1949-53
Chevrolet
PASSENGER CAR SHOP MANUAL

INCLUDES 1954 SUPPLEMENT

●

FOREWORD

This manual is designed to provide the service man with complete information on the construction, operation, maintenance and repair of various units of the 1949 to 1953 model Chevrolet passenger car.

Added to this manual and located after section 12 is the 1954 Supplement. This supplement covers changes for the 1954 product. Unless otherwise stated in the supplement, the information in this manual that applies to 1953 models will also apply to the 1954 models.

An effort has been made to produce a manual that will not only serve as a ready reference book for the experienced service man but also cover step-by-step procedure for the guidance of the less experienced man.

The Section Index on the title page enables the user to quickly locate any desired section. At the beginning of each section is a Table of Contents followed by an index listing the page on which each main subject begins. In those sections that cover more than one major subject, the Table of Contents gives the page number on which the coverage of the subject begins, and the detailed index of that subject appears on this page. This arrangement, we believe, will make it easy for the service man to locate the desired information.

Provision is made to enter references to any supplementary information received by the dealer in the form of *Service News* and *Service Bulletins.*

The Special Service Tools shown in this manual, or their equivalent, are necessary for the efficient servicing of Chevrolet passenger cars. All tools listed are available through Kent-Moore Organization, Inc., General Motors Building, Detroit 2, Michigan.

This manual should be kept in a handy place for ready reference. If properly used, it will enable the mechanic to better serve the owners of Chevrolet passenger cars and thereby build or maintain a reputation for reliable service.

All information, illustrations and specifications contained in this literature are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

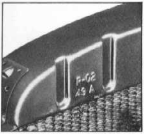
CHEVROLET MOTOR DIVISION
General Motors Corporation
DETROIT, MICHIGAN

UNIT SERIAL NUMBER LOCATIONS

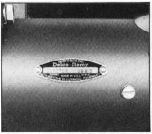
For the convenience of servicemen when writing up certain business papers such as Application for Policy Adjustment, Product Information Reports, or reporting product failures in any way, we are showing below the location of the various unit numbers. These unit numbers and their prefixes are necessary on these papers for various reasons—such as accounting, follow-up on production, etc.

The prefixes on certain units identify the plant in which the unit was manufactured, and thereby permits proper follow-up of the plant involved to get corrections made when necessary.

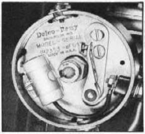
Always include the prefix in the serial number.



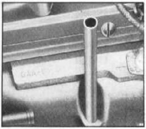
Radiator code and number located on the left side of vehicle on the rear of the top tank (fig. 1).



Generator serial and model number are located on a metal plate staked on the generator body just forward of armature terminal (fig. 2).

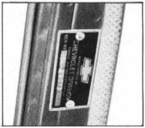


Ignition distributor serial and model number are located on the distributor breaker plate which is under distributor cap (fig. 3).

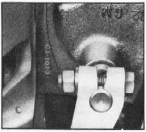


Engine serial number located on right side of engine on a boss just to the rear of the ignition distributor (fig. 4).

Starting motor serial and model number are located on starting motor body just below solenoid (fig. 5).



Vehicle serial number located on left front body pillar approximately 10" above belt (fig. 6).



Transmission serial number is stamped on case at front left side (fig. 7).

Rear axle serial number is stamped on the front of the differential carrier right side of vehicle (fig. 8).

Body Style Number, Trim Number and Paint Number located on top of cowl on right side (fig. 9).

SECTION 0

GENERAL LUBRICATION

CONTENTS OF THIS SECTION

LUBRICATION INDEX

GENERAL LUBRICATION

The selection of the proper lubricant and its correct application at regular intervals does much to increase the life and operation of all moving parts of the vehicle. Consequently, it is important that the correct grade of oil or grease, as noted in the following pages, be used.

ENGINE LUBRICATION

Proper selection of the oil to be used will add much to the performance, reliability, economy and long life of the engine.

It is imperative that the recommended light oils be used in the engine during the break-in period. Light oils assure a better breaking in of the engine as they assure ease of starting, prompt flow of a sufficient quantity of oil to the bearings, less friction between moving parts, less wear of moving parts, etc.

OIL GAUGE

When starting a cold engine, it will be noted that the oil gauge on the instrument panel registers a high oil pressure. As the engine warms up, the pressure will drop until it reaches a point where changes to higher speeds will raise the pressure very little, if at all.

If the oil pressure registers abnormally high after the engine is thoroughly warmed up, an inspection should be made to ascertain if the oil lines and passages are plugged up.

LUBRICATION FIRST 500 MILES

The engine crankcase of all new cars is filled with a light body "breaking-in" oil at the factory and it is recommended that this oil be used for the first 500 miles.

At the end of the first 500 miles, the crankcase should be drained—when hot—and refilled to the proper level with the recommended oil.

LUBRICATION AFTER 500 MILES

After the first 500 miles the crankcase oil should be selected to give the best performance under the climatic and driving conditions in the territory in which the vehicle is driven.

FALL-WINTER-SPRING-SUMMER

During the colder months of the year, an oil which will permit easy starting at the lowest atmospheric temperature likely to be encountered, should be used.

When the crankcase is drained and refilled, the crankcase oil should be selected, not on the basis of the existing temperature at the time of the change, but on the lowest temperature anticipated for the period during which the oil is to be used.

Unless the crankcase oil is selected on the basis of viscosity or fluidity at the anticipated temperature, difficulty in starting will be experienced at each sudden drop in temperature.

The viscosity grade of crankcase oil will, therefore, depend upon the climatic conditions under which the vehicle will operate. The grades best suited for use in an engine at the various temperatures are shown in the following table.

If you anticipate that the lowest atmospheric temperature will be:	Use the grade indicated:
Not lower than 32°F. above zero	S.A.E. 20W or S.A.E. 20
Not lower than 10°F. above zero	S.A.E. 20W
Not lower than 10°F. below zero	S.A.E. 10W
Below 10°F. below zero	S.A.E. 5-W (see note)

NOTE: S.A.E. 5W oils are particularly advantageous during low temperatures because of their easy starting and quick flow characteristics. The easy starting characteristics of these oils greatly reduce the drain on the battery in cold weather.

The S.A.E. 5W oils designated "For Service MS" are similar in viscosity, or "Body," at engine operating temperatures to high quality S.A.E. 10W oils and give equivalent lubrication protection and oil economy. These oils are intended for use under all operating conditions and under all atmospheric temperatures that may be encountered when below zero temperatures may be expected—they may be retained in the crankcase during the warmer days that occur during the winter season.

Figure 1 shows the data in the above table as it would appear on a thermometer—the lowest temperature at which the indicated grades of oil will permit easy starting.

NOTE: When in doubt use the lighter grade of oil. The use of S.A.E. 20W is recommended rather than S.A.E. 20 if freezing temperatures are anticipated.

The use of S.A.E. 20W or S.A.E. 20 during the summer months will permit better all around performance of the engine than will the heavier body oils, with no appreciable increase in oil consumption.

MAINTAINING OIL LEVEL

The oil gauge rod (fig. 2) is marked "Full" and "Add Oil." These notations have broad arrows pointing to the level lines. The oil level should be maintained between the two lines, neither going above the "Full" line nor under the "Add Oil" line.

Check the oil level frequently and add oil when necessary. Always be sure the crankcase is full before starting on a long drive.

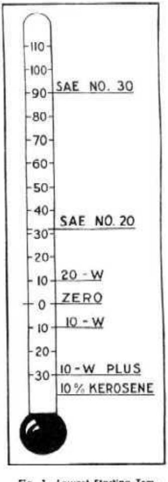


Fig. 1—Lowest Starting Temperature for Oils Indicated

NOTE: It is advisable, when taking a long trip, to recheck the oil level after the first 100 miles of the trip. This is a precautionary measure, due to the possibility of crankcase dilution which would give a false oil level reading. The diluents which are usually the result of incomplete engine warm-up (traveling short distances) are driven out of the crankcase with high speed driving or sustained normal engine operating temperatures.

WHEN TO CHANGE CRANKCASE OIL

Oils have been greatly improved, driving conditions have changed and improvements in engines, such as the crankcase ventilating system, have greatly lengthened the life of good lubricating oils. However, to insure continuation of best performance, low maintenance cost and long engine life, it is necessary to change the crankcase oil whenever it becomes contaminated with harmful foreign materials. Under normal driving conditions draining the crankcase and refilling with fresh oil every 2000 to 3000 miles is recommended.

Under the driving conditions described in the following paragraphs, it may become necessary to drain the crankcase oil more frequently.

Frequent long runs at high speed, with the resultant high engine operating temperatures, may oxidize the oil and may result in the formation of sludge and varnish. While no definite drain periods can be recommended under these conditions, they should be more frequent than under normal driving conditions.

Driving over dusty roads or through dust storms introduces abrasive material into the engine. Carburetor air cleaners decrease the amount of dust that may enter the crankcase. The frequency of draining depends on severity of dust conditions and no definite draining periods can be recommended, but should be more frequent than under normal driving conditions.

Fig. 7—Oil Gauge Rod

Short runs in cold weather, such as city driving and excessive idling, does not permit thorough warming up of the engine and water may accumulate in the crankcase from condensation of moisture produced by the burning of the fuel. Water in the crankcase may freeze and interfere with proper oil circulation. It also promotes rusting and may cause clogging of oil screens and passages. Under normal driving conditions this water is removed in the form of vapor by the crankcase ventilator. However, if water accumulates, it should be removed by draining the crankcase as frequently as may be required.

It is always advisable to drain the crankcase only after the engine has become thoroughly warmed up or reached normal operating temperature. The benefit of draining is, to a large extent, lost if the crankcase is drained when the engine is cold, as some of the suspended foreign material will cling to the sides of the oil pan and will not drain out readily with the cold, slower moving oil. Flushing the crankcase with oils or solutions other than a good grade of S.A.E. 10W engine oil is not recommended.

CRANKCASE DILUTION

Probably the most serious phase of engine oil deterioration is that of crankcase dilution which is the thinning of the oil by fuel vapor leaking by pistons and rings and mixing with the oil.

Leakage of fuel, or fuel vapors, into the oil pan mostly occurs during the "warming up" period when the fuel is not thoroughly vaporized and burned.

AUTOMATIC CONTROL DEVICES TO MINIMIZE CRANKCASE DILUTION

The Chevrolet engine is equipped with automatic devices which aid greatly in minimizing the danger of crankcase dilution.

Rapid warming up of the engine is aided by the thermostatic water temperature control which automatically prevents circulation of water in the cooling system until it reaches a pre-determined temperature.

Thermostatic heat control on the exhaust manifold during the warming up period, automatically directs the hot exhaust gases against the center of the intake manifold, greatly aiding in proper vaporization of the fuel.

Sparing use of the choke reduces danger of raw or unvaporized fuel entering the combustion chamber and leaking into the oil reservoir.

An efficient crankcase ventilating system drives off fuel vapors and aids in the evaporation of the raw fuel and water which may find its way into the oil reservoir.

CONTROL BY CAR OWNERS UNDER ABNORMAL CONDITIONS

Ordinarily the above automatic control devices will minimize or eliminate the danger of crankcase dilution. However, there are abnormal conditions of service when the car owner must aid in the control of crankcase dilution.

Short runs in cold weather, such as city driving and excessive idling do not permit the thorough warming up of the engine nor the efficient operation of automatic control devices. It is recommended that the oil be changed more often when the car is subjected to this type of operation.

Poor mechanical condition of the engine, such as scored cylinders, poor ring fit, sloppy or loose pistons, faulty valves and poor ignition will increase crankcase dilution.

Poor fuels which contain portions hard to ignite and slow to burn will increase crankcase dilution. Use a good fuel.

WATER IN CRANKCASE

Serious lubrication troubles may result in cold weather by an accumulation of water in the oil pan. This condition is, as a rule, little understood by the car owner. To demonstrate the chief cause of water in the oil pan, hold a piece of cold metal near the end of the exhaust pipe of the engine and note the rapid condensation and collection of drops of water on it. The exhaust gases are charged with water vapor and the moment these gases strike a cold surface, they will condense, forming drops of water.

A slight amount of these gases pass the pistons and rings, even under the most favorable conditions, and cause the formation of water in the oil pan, in a greater or lesser degree, until the engine becomes thoroughly warm, then the crankcase will no longer act as a condenser and all of these gases will pass out through the crankcase ventilator system.

Short runs in cold weather, such as city driving, will aggravate this water forming condition.

CORROSION

Practically all present day engine fuels contain a small amount of sulphur which, in its natural form, is harmless. This sulphur, however, when it burns, forms a gas, a small portion of which is likely to leak past pistons and rings and reacting with water when present in the oil pan forms a very corrosive acid. The more sulphur in the fuel the greater the danger from this type of corrosion. This is a condition which cannot be wholly corrected, but it may be reduced to a minimum by proper care of the engine.

As long as the gases and internal walls of the crankcase are hot enough to keep water vapor from condensing, no harm will result. However, when the engine is run in low temperatures, moisture will collect and unite with the gases formed by combustion resulting in an acid formation. The acid thus formed is likely to cause serious etching or pitting which will manifest itself in excessively rapid wear on piston pins, camshaft bearings and other moving parts of the engine, oftentimes causing the owner to blame the car manufacturer or the lubricating oil when in reality the trouble may be traced back to the character of fuel used, or a condition of the engine such as excessive blowby or improper carburetor adjustment.

TYPES OF OILS

For maximum protection of Chevrolet engines under all general driving conditions, the oils designated for "Service MS" or "Service MS-DG" are recommended. Oils designated "Service DS" are not generally required for automobile engines, however, such oils may be used to advantage under severe stop-and-start service during cold winter months. The following chart shows the various oil classifications and their previous designations:

Previous Oil Designation	Type of Service Operating Condition	New Classification
Regular	Light and Favorable (Gasoline Engines)	Service ML
Premium	Moderate (Gasoline Engines)	Service MM
Heavy Duty	Moderate to Severe (Gasoline Engines)	Service MM or MS
	Severe (Gasoline Engines) Light and Favorable (Diesel)	Service MS or DG
	Severe (Diesel)	Service DS

S.A.E. VISCOSITY NUMBERS

The viscosity of a lubricant is simply a measure of its body or fluidity. The oils with the lower S.A.E. numbers are lighter and flow more readily than do oils with the higher numbers.

The S.A.E. numbers constitute a classification of lubricants in terms of viscosity or fluidity, but with no reference to any other characteristic or property.

These S.A.E. numbers have been adopted by practically all oil companies and no difficulty should be experienced in obtaining the proper grade of lubricant to meet seasonal requirements.

VISCOSITY GRADES OF OIL

The S.A.E. Viscosity Numbers constitute a classification for crankcase lubricating oils in terms of viscosity only. Viscosity numbers without an additional symbol are based on the viscosity at 210°F. Viscosity numbers with the additional "W" are based on the viscosity at 0°F. The viscosity of oils included in this classification for use in crankcases shall not be less than 39 SUS at 210°F. Other factors of oil character or quality are not considered.

S.A.E. Viscosity Number	Viscosity Range, Saybolt Univ. Sec.			
	At 0°F		At 210°F	
	Minimum	Maximum	Min.	Max.
5W	—	4000	—	—
10W	6000 (Note A)	Less than 12000	—	—
20W	12000 (Note B)	Less than 48000	—	—
20	—	—	45	Less than 58
30	—	—	58	Less than 70
40	—	—	70	Less than 85
50	—	—	85	Less than 110

Note A: Minimum Viscosity at 0°F. can be waived provided viscosity at 210°F. is not below 40 Saybolt Seconds Universal.

Note B: Minimum Viscosity at 0°F. can be waived provided viscosity at 210°F. is not below 45 Saybolt Seconds Universal.

WATER PUMP

The water pump is of the ball bearing type, lubricated at the time of manufacture and is permanently sealed. This type pump requires no further or additional lubrication.

CARBURETOR ACCELERATING PUMP

1949 Models

Every 5000 miles, remove the dust cover and saturate the felt ring on the carburetor pump lever shaft with light oil or engine oil.

GENERATOR

Every 1000 miles put a few drops of a light oil, or engine oil, in the 2 oil cups. Do not "over-oil" as excessive oil will flow into the commutator causing it to become "gummed up" or sticky.

STARTING MOTOR

Starting motor end frames are equipped with oil-less bearings which do not require lubrication.

STARTER SOLENOID

A few drops of engine oil should be used on the pivots of the starter shift lever mechanism. Do not oil solenoid plunger.

DISTRIBUTOR

Lubricant cup located on side of housing is filled with chassis lubricant. Turn cup down one turn every 1,000 miles. Distributor cap (1950-52 models) should be removed every 5,000 miles, then remove rotor and place a few drops of S.A.E. 10 engine oil on felt wicking in top of cam. Apply a small amount of petroleum jelly on distributor cam surface by holding a clean cloth which has been soaked in jelly against it while cranking starter.

POWERGLIDE TRANSMISSION

Check oil level with engine idling, parking brake set, transmission warm and control lever in Neutral (N) position. Add only "Automatic Transmission Fluid Type "A," bearing an AQ-ATF number when level reaches "add 1 qt." mark on oil level rod. Do not allow dirt to enter filler tube.

Drain and refill the Powerglide transmission every 25,000 miles. Before draining, warm transmission up to operating temperature. Complete draining is accomplished as follows:

1. Remove transmission case drain plug – this draws oil from transmission case.
2. After transmission is completely drained, install transmission case plug.
3. Remove dip stick and refill transmission with five (5) quarts of Automatic Transmission Fluid "Type A."
4. Start engine, and allow to idle for a few minutes in Neutral position and then check oil level. If necessary add oil to bring up to full mark on dip stick.

REAR AXLE AND STANDARD TRANSMISSION

The passenger car hypoid rear axle operates under the most severe lubrication conditions at high speed and requires a hypoid lubricant which will meet this condition.

Recommended Lubricants

Rear Axle – S.A.E. 90 "Multi-Purpose" gear lubricant.

Transmissions–S.A.E. 90 Transmission or Mineral Oil gear lubricant.
S.A.E. 90 "Multi-Purpose" gear lubricant.

CAUTION: Straight Mineral Oil gear lubricants must not be used in Hypoid rear axles.

The S.A.E. 90 viscosity grade is recommended for year round use. However, when extremely low temperatures are encountered for protracted periods during the winter months, the S.A.E. 80 viscosity grade may be used.

"Multi-Purpose" Gear Lubricants

Gear lubricants that will satisfactorily lubricate hypoid rear axles have been developed and are commonly referred to as "Multi-Purpose" gear lubricants.

These lubricants can also be satisfactorily used in transmissions, steering gears, and universal joints requiring a fluid lubricant.

"Multi-Purpose" gear lubricants must be carefully compounded and of the latest non-corrosive type and of proven quality. The lubricant manufacturer must be responsible for the satisfactory performance of his product. His reputation is the best indication of quality.

Lubricant Additions

The lubricant level in the axle and transmission housings should be checked periodically.

It is recommended that any additions required to bring up the lubricant level be made using the same type lubricant already in the housing.

When checking lubricant level in transmission or rear axle the unit being checked should be at operating temperature. With unit at operating temperature the lubricant should be level with bottom of the filler plug hole. If the lubricant level is checked with the unit cold the lubricant level should be ½ inch below the filler plug hole.

Lubricant Changes

While seasonal changes of the lubricant are not required, it is recommended that the housing be drained and refilled with the recommended lubricant at least twice a year, or every 6,000 to 10,000 miles.

It may be necessary and desirable to drain rear axles and transmissions in vehicles subject to severe service more frequently than recommended above. In any event use a light flushing oil to flush out the housings when draining.

CAUTION: Do not use water, steam, kerosene, gasoline or alcohol to flush units.

UNIVERSAL JOINT

Universal joints are of the enclosed type which are bushing equipped and receive lubrication from the transmission. Additional lubrication is not necessary. The universal joint housing should be filled through the speedometer driven gear hole for initial lubrication after a repair operation.

CAUTION: Under no circumstances should any of the soap type lubricants such as chassis lubricant, fibrous universal joint lubricants, etc., be used in lubricating the enclosed bushing type universal.

FRONT WHEEL BEARINGS

It is necessary to remove the wheel and hub assembly to lubricate the bearings. The bearing assemblies should be cleaned before repacking with lubricant. Do not pack the hub between the inner and outer bearing assemblies or the hub caps, as this excessive lubrication results in the lubricant working out into the brake drums and linings.

Front wheels of all passenger car models are equipped with ball bearings and should be packed with a high melting point front wheel bearing lubricant.

The proper adjustment of front wheel bearings is one of the important service operations that has a definite bearing on safety. A car with improperly adjusted front wheel bearings lacks steering stability, has a tendency to wander or shimmy and also increases tire wear. In an effort to provide for more accurate adjustments the spindles are drilled both vertically and horizontally and the adjusting nuts are slotted on all six sides. For adjustment procedure, see "Front Wheel Bearings–Adjust" in Section 3.

REAR WHEEL BEARINGS

The rear wheel bearings receive their lubrication from the rear axle. When installing bearings which have been cleaned repack with smooth type grease.

SPRING SHACKLES

The spring shackles used at the rear end of the rear chassis springs are the rubber bushed type.

Rubber bushings are also used at the front of each rear spring and at the spring seats. These bushings must not be lubricated or sprayed with oil.

BRAKE AND CLUTCH PEDAL

These pedals, lubricated at the time of assembly, should not require further lubrication. However, should pedal operation become "sticky," remove the plug, insert lubrication fitting and fill the reservoir with chassis lubricant. Remove lubrication fitting and replace plug.

CAUTION: Be very careful not to get any lubricant on the nearby rubber parts.

STEERING GEAR

The steering gear is filled at the factory with a special all-season gear lubricant. Seasonal change of this lubricant is unnecessary and the housing should not be drained. Whenever required, additions should be made using a lubricant which, at low temperatures, is fluid and will not "channel" or cause "hard steering" and which will provide satisfactory lubrication under extreme summer conditions. Steering gear lubricants are marketed by many oil companies and either "Multi-Purpose" or "Universal" gear lubricants are satisfactory to use.

The pipe plug is installed in its particular location in the steering gear housing to prevent overlubrication, generally occasioned by the use of a pressure gun. Overlubrication of this unit might result in forcing lubricant up the steering gear tube to the horn button and steering wheel.

On 1953 models equipped with power steering gear, check level in gear box by removing combination vent and filler plug. Use same gear lube as specified for standard steering gear and bring to level of plug hole. Check fluid in pump reservoir. Add Automatic Transmission Fluid bearing an AQ-ATF number to bring level to full mark on reservoir tank.

GEARSHIFT CONTROL HOUSING

This mechanism, is lubricated at the factory and should require no further lubricant. If shifting effort becomes "sticky", remove cap from gearshift control box and fill box with a soft smooth grease.

SHOCK ABSORBER

The shock absorbers used, front and rear, on all passenger cars are permanently sealed and require no maintenance other than replacement if necessary.

CHASSIS LUBRICATION

For chassis lubrication, consult the lubrication chart. Figure 3 shows the points to be lubricated and how often the lubricant should be applied.

The term "chassis lubricant" as used in this manual, describes a semi-fluid lubricant designed for application by commercial pressure gun equipment. It is composed of mineral oil (300 to 500 seconds Saybolt Universal viscosity at 100°F) combined with approximately 8% soap, or soaps which are insoluble in water.

BODY LUBRICATION

Many of the annoying squeaks and noises that occur in closed bodies are due to neglecting a very important maintenance service which all bodies should receive regularly.

The movable mechanical parts of the body are lubricated at the factory for easy operation and to eliminate squeaks caused by frictional contact. This lubrication should be maintained and replenished at periodic intervals.

Most body lubrication points do not carry heavy loads like the chassis, and for this reason many of the points do not require as heavy nor as frequent lubrication as the chassis points.

For body lubrication, a specific kind of lubricant, the one best suited for individual points, should be used. Knowing what to use and where to use it, together with a little care and cleanliness, will bring many returns in the satisfaction and pleasure of driving a car properly serviced.

For exposed surfaces, such as door checks, door lock bolts, lock striker plates, dovetail bumper wedges, etc., apply a thin film of light engine oil.

Where oil holes are provided in body parts a dripless oil can be safely used, but any lubricant should be used sparingly, and after application all excess should be carefully wiped off.

The seat adjusters and seat track, ordinarily overlooked, should be lubricated with cup grease, graphite grease, or dripless oil—used sparingly.

There are other points on bodies which may occasionally require lubrication and which are difficult to service. Window regulators and controls are confined in the space between the upholstery and the outside door panel and, while it is possible in some cases to apply oil by drops to a long wire leading to the operating mechanism, it is not a practical procedure, as extreme care must be taken to keep the oil from contacting the trim on the inside of the door. Easy access to the working parts may be made by removing the trim. Door and trunk lid weatherstrips and hood rubber bumpers should be lightly coated with a rubber lubricant such as Ru-Glyde.

Overlubrication

Excessive lubrication of body parts usually causes more complaints than lack of lubrication. If a soft, dark grease is applied to a door lock bolt or a dovetail wedgeplate on the exposed face of the door, a slight brush across this soft grease may ruin a gown and spoil the entire evening for the owner and others. Too much lubrication applied to exposed parts serves no good purpose. It is not only a waste of material but is a contribution to serious complaints.

Lubricate only where squeaks develop, or where conditions indicate that the addition of lubricant is desirable for easier operation of individual units or points.

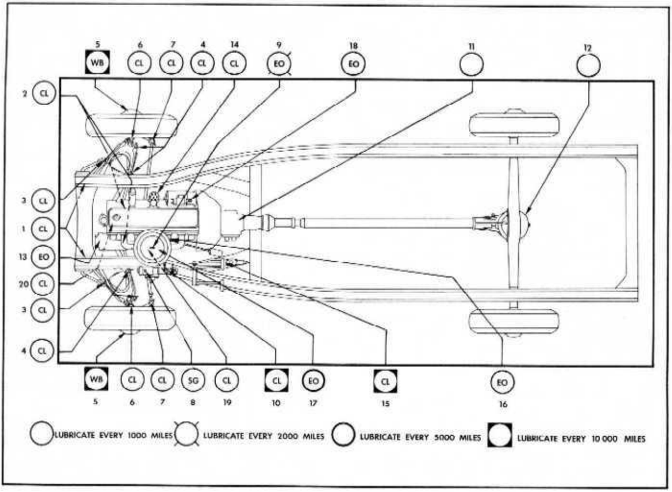


Fig. 3—Lubrication Chart

POINTS OF LUBRICATION

1. Lower Control Arm (Front—1 each side) .... 1000 miles
2. Lower Control Arm (Rear—2 each side) .... 1,000 miles
3. Upper Control Arm (Front—1 each side) .... 1,000 miles
4. Upper Control Arm (Rear—2 each side) .... 1,000 miles
5. Front Wheel Bearings..........10,000 miles
6. Kingpin (2 each side).......... 1,000 miles
7. Tie Rod (2 each side).......... 1,000 miles
8. Steering Gear .... 1,000 miles
9. Air Cleaner .... 2,000 miles
10. Steering Column Gearshift Control ....10,000 miles
11. Transmission ....See Page 0-5
12. Rear Axle ....See Page 0-5
13. Generator (2 oil cups)......... 1,000 miles
14. Distributor (1 cup)............ 1,000 miles
15. Clutch and Brake Pedal Shaft..10,000 miles
16. Throttle Bell Crank .... 1,000 miles
17. Carburetor Accelerator Pump Shaft (1949 Models) .... 5,000 miles
18. Solenoid Linkage .... 1,000 miles
19. Steering Connecting Rod (1 each end) .... 1,000 miles
20. Steering Idler and Third Arm (2 places) .... 1,000 miles

LUBRICANT KEY

CL Chassis Lubricant

EO Light Engine Oil

WB Wheel Bearing Lubricant

SG Steering Gear Lubricant

SECTION 1

BODY

CONTENTS OF THIS SECTION

INDEX

GENERAL DESCRIPTION

The body front end assembly consists primarily of a cowl and dash assembly, right and left front body hinge pillar facing assembly, right and left front end side rail assembly, windshield inner frame upper, windshield inner frame division reinforcement, right and left dash to chassis frame brace assembly and an instrument panel assembly.

The upper pillar portion of the front end is formed by a front end side rail assembly and windshield inner side frame reinforcement. The lower pillar portion is formed by a "U" shaped front body hinge pillar facing and pillar reinforcement which are welded to the cowl side panel and the lower end of the front end side rail assembly.

The upper end of the cowl side panel is lapped under and spot welded to the cowl upper panel. In addition, it is also flanged over and spot welded to the dash panel. The front body hinge pillar portion of the panel is flanged over and spot welded to a "U" shaped front body hinge pillar facing and its reinforcement which, together with reinforced supports, provides a mounting for the front doors.

Instrument panels are integral with the front end assembly and are spot welded to the front body hinge pillar facing and the front end side rail assembly. Along the lower windshield opening the instrument panel is also welded to the upper cowl panel. forming a pinch-weld flange over which the windshield rubber channel is seated.

The roof panel is a one-piece steel stamping that covers the complete roof section. It is stamped so as to include the upper portion of the windshield opening, the complete back window opening, and also the upper portion of the rear compartment opening.

The rear quarter side outer panel is stamped so as to include the rear fender and a wheelhouse sub-assembly panel is welded to the inside of this quarter panel. Access holes and plates are provided for accessibility for repairs.

The rear body lock pillar section of the rear quarter panel on sedans is formed by a sedan rear body lock pillar outer panel. This metal panel which is welded to the wheelhouse and to the flanges of the rear quarter side outer panel acts as a nosing for the rear fender portion of the outer quarter panel.

The rear compartment or trunk opening is formed by welding at the junction of the roof panel, the rear quarter side outer panel, rear quarter side outer panel extension and the rear end panel.

The rear compartment or trunk lid consists of an inner and outer panel which are spot welded together along their flanged edges to form a complete unit. The lid is hinged at the top to the compartment opening with spring loaded box type hinges and is locked at the bottom to the rear end panel by a clutch type lock mechanism. For sealing purposes, the upper section of the compartment rubber weatherstrip is installed in the gutter of the opening, the sides and bottom section of the weatherstrip are cemented to the flanges of the lid.

The tire well is spot welded into the floor for carrying the spare tire in a vertical position. The rear floor area is reinforced underneath by longitudinal rear compartment pan metal reinforcement, upper and lower. In addition, the extreme rear end is reinforced by a heavy gauge rear cross bar which is spot welded to the underside of the floor.

Doors consist of inner and outer panels which are spot welded together along their flanged edges. The inner panels are deep drawn to conform with the body styling and are provided with loading holes for the installation of hardware and to provide accessibility for repairs.

SERVICE OPERATIONS

DOORS

WINDOW GARNISH MOLDING

1. Remove inside safety locking rod knob.
2. On 1949-52 rear doors only, remove the wind deflector and grommets. The wind deflector is held to the ventilator division channel by two cross-head screws.
3. Remove garnish molding screws. Remove molding by moving it out of position at the top and then lift upward to free it from the retaining clips at the bottom.
4. To install, reverse this procedure.

INSIDE HANDLES

1. Depress trim pad and insert special pliers KMO-601 or other suitable tool between base of handle and bearing plate to grip handle retaining spring clip.
2. Carefully extract the retaining spring, then remove handle. The bearing plate may also be removed if required.
3. To replace, reverse this procedure. Before installation, note the angle of the handle by observing the handle position on the opposite door with windows closed.

ARM REST

Doors

1. Remove the two screws holding arm rest frame assembly to the door inner panel and remove arm rest.
2. To install, reverse this procedure and adjust as necessary. Slotted holes in the retainer permit a fore and aft adjustment.

Rear Quarter

1. Remove finishing cover, lower half of arm rest, by removing three small cross-head screws holding this part to the arm rest frame.
2. Remove the two screws holding arm rest frame assembly to the rear quarter inner panel and remove arm rest.
3. To install, reverse this procedure and adjust as necessary. Slotted holes in the retainer permits a fore and aft adjustment.

TRIM PAD

1. Remove door window garnish molding.
2. Remove door inside handles and arm rest.
3. Remove the trim pad anchor screws.
4. With a flat tool, pry both sides of trim pad loose.
5. Lift trim pad from lower retaining channel.
6. To install, reverse this procedure.

NOTE: In cases where nails break or pull loose during removal they should be replaced with door trim pad replacement clips, Part Number 4081772.

OUTSIDE HANDLE

Removal

1. Release the door rubber weatherstrip at the lock pillar face to expose the flat spring handle retainer.

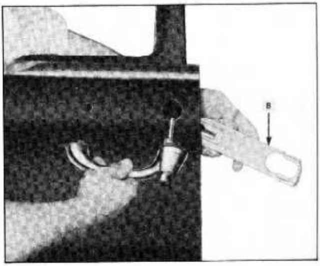


Fig. 1—Removing Outside Handle

2. Pull retainer "B" out until handle can be removed (fig. 1).

Installation

1. Cock lock bolt by pushing to "up" position.
2. With push button depressed, install handle. When in correct position, the lock bolt will snap down.
3. Install retainer to position.

4. Re-cement door weatherstrip using 3-M Synthetic Rubber Adhesive.

OUTSIDE HANDLE SAFETY LOCK

1. Remove door outside handle.
2. Remove retainer snap ring.
3. Remove stop washer, spring and detent washer, noting relative position of the two washers.
4. Remove lock cylinder, lock cylinder housing and push button shaft assembly. This unit slips out of the door handle casting.
5. Remove handle sealing ring.
6. Remove push button cap by bending up small ears of cap to disengage from lock cylinder housing.
7. Remove retainer holding lock cylinder and push button shaft to housing. A new retainer will be required at re-assembly.
8. Remove door lock cylinder and push button shaft from housing.
9. Figure 2 shows lock parts layout.
10. To re-assemble, reverse this procedure.

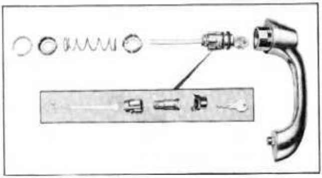


Fig. 2—Layout of Lock Parts

GLASS RUN CHANNEL

1. Lower the glass and remove garnish molding, inside handles, arm rest and door trim pad.
2. Remove door loading hole cover. On front doors remove cover nearest door pillar portion of glass run channel.
3. Through loading hole, loosen stud holding bottom of glass run channel to door pillar.
4. Pry the glass run channel to release clips from pinch weld at the door header and pillar sides. Then, remove glass run channel by carefully pulling up through door window opening and extracting from attaching points at lower end of channel and at spring clip retainer on door pillar just below window opening.

   CAUTION: Use extreme care not to dent stainless steel bead molding on channel.

5. To install, reverse this procedure. Make sure when inserting channel in position that the spring clip on the channel engages its retainer on the door pillar just below the window opening. Seal loading hole cover during installation.

VENTILATOR DIVISION CHANNEL (1949-51)

1. Lower the door window and remove garnish molding, inside handles, arm rest and door trim pad.
2. Remove screw "A" (fig. 3) holding division channel to the ventilator at its upper end.
3. Remove two screws "B" holding channel mounting bracket to upper flanged surface of door inner panel at lower window opening.
4. Remove the lower nut, washers and adjusting screw "C".

   NOTE: Before removal, the length of the screw projecting out through the hole should be noted.

5. With the door ventilator open, swing division channel out of position, pull up, and remove through the window opening of the door.
6. To install, reverse this procedure.

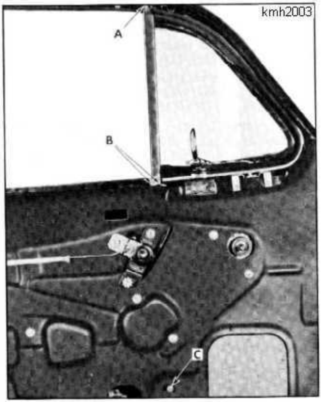


Fig. 3—Division Channel Attachment

Adjustment

1. To adjust the lower end of channel forward or backward, loosen nut "C" (fig. 3) and move stud in slotted hole in inner panel the desired amount.

NOTE: A total fore and aft adjustment of ⅝" is provided at this point.

2. Tighten nut "C".
3. To move the lower end of the channel in or out, adjust the internal stud nut on the inside of the inner panel. This nut is accessible after removing the loading hole cover.

DOOR VENTILATOR ASSEMBLY–1953 Conv. and Spt. Cpe.

1. Remove door inside hardware and trim pad.
2. Carefully cut the ventilator and door weatherstrip indicated at "A" (fig. 4).
3. Loosen the nut "B" and remove bolt "C".
4. Remove two bolts "D".
5. Remove ventilator lower pivot shaft retaining bolt "E".

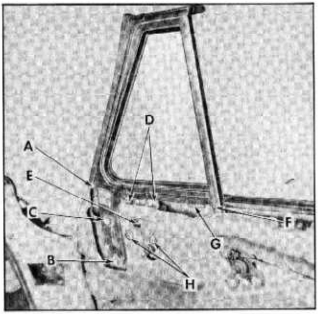


Fig. 4—Convertible Ventilator Assembly

6. Remove screw "F" from ventilator rear attaching bracket.
7. Remove screw "G" holding ventilator division channel to door panel flange.
8. Loosen regulator to inner panel attaching screws "H".
9. Remove ventilation division channel lower adjusting stud at the door inner panel.
10. Loosen weatherstrip seal and remove ventilator assembly.
11. To install, reverse this procedure. Cement ends of the weatherstrip indicated at "A" together and the outer front portion of the ventilator weatherstrip to the belt molding, with 3-M Weatherstrip Adhesive or its equivalent.

Adjustments

Fore and Aft–Up and Down

1. Loosen nut "B" and bolt "C" (fig. 4).
2. Loosen two bolts "H".
3. Remove screws "G" and "F" from division channel and rear bracket.
4. Loosen division channel lower adjusting nut.
5. Adjust ventilator assembly to desired position and retighten bolts and screws.

NOTE: After adjustment it may be necessary to drill new screw holes at "G" and "F". Set screw located at "E" controls the friction clamp on the regulator mechanism.

In and Out

1. Same as steps 1 through 4 indicated above.
2. Adjust "in or out" at the lower adjusting stud "B" and the division channel adjusting stud. In cases where seal of the ventilator weatherstrip has been broken it must be resealed using 3-M Weatherstrip Adhesive or its equivalent.

WINDOW REGULATOR

1. Lower the door window and remove garnish molding, inside handles, arm rest and door trim pad.
2. Remove the loading hole covers.
3. Through the loading holes in the door inner panel remove the four window assembly to

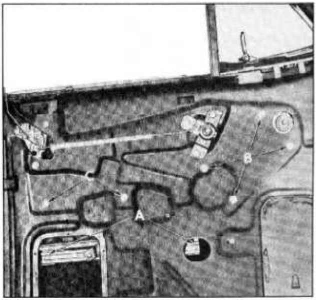


Fig. 5—Window Regulator Mechanism Attachments

sash channel cam screws "A" (fig. 5) so as to disengage the window lower sash channel cam from the regulator mechanism.

4. Remove the four screws "B" holding window

regulator and two screws "C" holding stationary cam to inner panel.

5. Remove regulator and cam assembly through the loading holes.
6. To install, reverse this procedure. Seal loading hole covers during installation.

LOCK REMOTE CONTROL

1. Remove garnish molding, inside handles, arm rest and door trim pad.

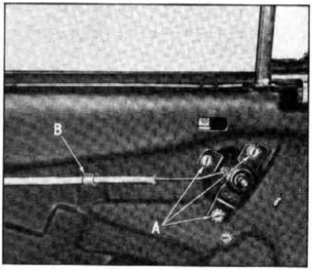


Fig. 6—Remote Control Attachment

2. Remove the three remote control assembly attaching screws "A" (fig. 6) from door inner panel.
3. Disengage remote control assembly connecting rod from clip "B" on door inner panel and retaining clip at rod attachment to remote control.
4. Rotate remote control assembly to disengage from remote control connecting rod.

NOTE: Remote control assembly spindle rotates counterclockwise on right hand doors and clockwise on left hand doors.

5. To install, reverse this procedure.

Adjustment

1. Place door lock remote control button in the locked position.
2. Loosen remote control to door inner panel screws.
3. Rotate remote control mechanism to remove all play in the linkage and then tighten attaching screws.

LOCK ASSEMBLY

1. With lock bolt in "down" position, remove door outside handle.
2. Remove garnish molding, inside handles, arm rest and door trim pad.
3. Remove loading hole cover from door inner panel.
4. Disconnect the door lock rod remote control connecting rod from lock by removing the remote control mechanism.
5. Remove inside locking rod. On rear doors, remove the single bolt and washer holding the inside lock rod lever to the door inner panel.
6. On front doors only, remove the glass run channel retaining stud on the inner lower surface of door lock pillar facing.
7. Remove the two door lock screws and washers from the inner panel facing.
8. Remove the three door lock screws and washers from the door lock pillar facing.
9. Remove door lock by rotating out of position and extracting the lock down and out through the loading hole. On front doors, lock must be dropped straight down to clear end of glass run channel.
10. To install, reverse this procedure, first checking to see that lock bolt is in "down" position. On front doors the "U" shaped retainer on the lock housing must be threaded behind the lower end of the glass run channel during installation. This can be accomplished by pulling the lower end of the glass run channel out slightly. Seal loading hole cover during installation.

CAUTION: It is possible to seriously damage the door lock if the door is slammed shut after the lock bolt has been accidentally or intentionally pushed in the "up" position.

DOOR LOCK STRIKER

1. With a pencil scribe the position of the striker on the center or rear body pillar.
2. Remove the two attaching screws holding striker to pillar and lift out of position.
3. To install, place striker in position within the location designated by the pencil marks. Hold firmly and re-install attaching screws.

NOTE: It is imperative that the door lock striker be installed in a level position so that it is in proper alignment with the lock bolt on the lock.

Adjustment

Adjustment of the door lock striker plate is provided by means of floating anchor plates in retaining cages behind the body lock pillar and center pillar facings. Serrations on the striker plates and anchor plates (fig. 7) provide ample retention to hold the striker plates in the desired position.

To adjust the striker plate, the attaching screws should be loosened sufficiently to allow the striker plate to be moved by hand to the desired location. Scribing the position of the striker plate on the pillar with a pencil prior to loosening the attaching screws will clearly indicate the amount the striker plate has been moved. Hammering or blocking the striker plate should never be attempted as damage to the serrations may result causing loss of proper tension. Hammering or blocking of the striker plate may also result in closing of the lock bolt groove which will seriously affect the operation due to a binding condition which develops on the lock bolt roller.

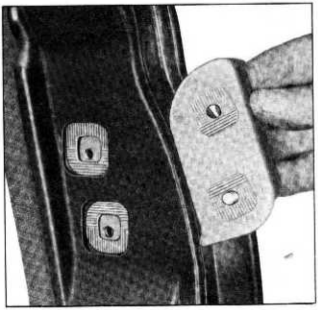


Fig. 7—Striker and Anchor Plates

VENTILATOR ASSEMBLY (1949-52)

1. Remove the door window garnish molding, inside handles, arm rest and trim pad.
2. On front doors, remove the single screw holding top end of door division channel to ventilator frame.
3. On rear doors, remove the door ventilator division channel. Also on rear doors that have stationary ventilator windows break seal and remove ventilator glass and rubber glass channel as an assembly.
4. Remove retainer screws holding ventilator frame to the door header.
5. Remove ventilator lower mounting bracket screws at lower window opening.
6. Remove ventilator assembly.
7. To install, reverse this procedure.
8. Check alignment and re-seal using 3-M Auto Body Sealer.

Adjustment

The spring tension of the ventilator lower pivot can be adjusted by means of a castle nut which holds the pivot spring under compression at the bottom of the ventilator assembly.

VENTILATOR ASSEMBLY (1952-53)

Front door ventilators on 1953 bodies are operated by a regulator type of mechanism. The ventilator division channel is also an integral part of the ventilator frame. Front door ventilators on 1952 bodies are the friction type with an integral division channel.

Removal and Installation

1. Remove the door trim pad and loading hole cover "A" (fig. 8).
2. Remove screws attaching ventilator frame and ventilator regulator to window opening at "B".
3. On 1953 bodies remove the ventilator pivot attaching bolt "C" and loosen the regulator attaching bolts "D".

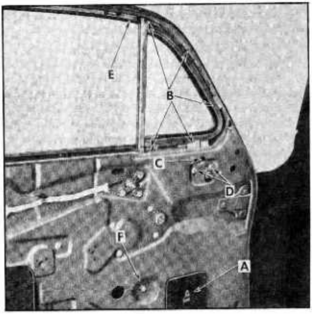


Fig. 8—Ventilator Assembly

4. Lower the window and at "E" detach clips and lower the glass run channel out of position.
5. Remove division channel lower stud nut "F".
6. Remove ventilator assembly.
7. To install, reverse the removal procedure making sure stud and nut located at "F" and the loading hole cover "A" are sealed as specified in sealing procedure for door inner panels.

Adjustment

To adjust the lower end of ventilator division channel "forward or backward", loosen the stud lock nut "F" and move stud the desired amount. To move lower end of division channel "in or out" loosen stud lock nut and turn stud in or out to the desired adjustment, then tighten stud nut.

VENTILATOR GLASS

1. Remove ventilator assembly.
2. Using an oil can or similar means, squirt gasoline on the glass filler all around the glass channel or frame to soften the old seal. When seal has softened, remove the glass from the channel.
3. Thoroughly clean the inside of the glass channel with sandpaper, removing all rust, etc.
4. Using new glass channel filler, cut the piece to be installed two inches longer than necessary for the channel. Place this piece of filler, with the soapstoned side of filler away from the glass, evenly over the edge of the glass which will fit into the channel. The extra filler extending beyond the rear edge of the glass should be pinched together to hold it in place during glass installation.

   NOTE: One side of this filler (the outside of the roll) is soapstoned. This is the side which goes into the metal channel. This glass channel filler is serviced in two thicknesses, .032" and .047", to permit selection of the proper thickness so the glass may be installed without the use of special tools.

5. Brush the inside of the metal glass channel freely with ordinary S.A.E. 10 engine oil. This will enable the glass and filler to slide freely into the channel.

6. Push the glass with the filler around it into the channel until it is firmly seated. After the glass is firmly in place, the oil softens the filler causing it to swell, thereby making a perfect watertight seal.
7. Trim off the excess filler material around the channel and at the ends of the channel.
8. It takes 24 hours for the oil to fully affect the filler. Therefore, water leak tests should not be made before this period has elapsed.

VENTILATOR REGULATOR—1953

1. Remove the door trim pad.
2. Remove the front loading hole cover from door inner panel.
3. Disconnect the ventilator lower pivot shaft from regulator mechanism by removing cap screw at "A" (fig. 9).

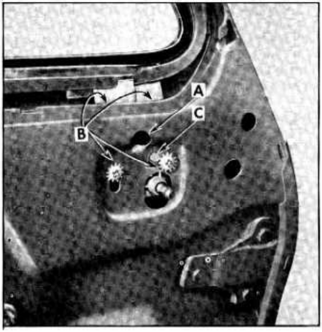


Fig. 9—Ventilator Regulator

4. Remove the four (4) screws, indicated at "B". Remove regulator mechanism through loading hole.
5. To install, reverse the removal operations. Apply a ribbon of 3-M Caulking Compound along the upper and side edges of the ventilator regulator where it contacts the door inner panel.

   NOTE: Ventilator tension is increased or decreased by adjusting screw "C".

CHECK LINK

Link Assembly

1. Remove cowl trim pad (for 1949-52 model front doors only) or center pillar trim (for all model rear doors).
2. Remove screw holding link to cowl or center pillar.
3. Remove link.
4. To install, reverse this procedure.

Support Assembly

1. Remove window garnish molding, inside handles, arm rest and door trim pad on all models except 1953 front doors.
2. Remove loading hole cover nearest door hinge pillar.
3. Remove screws from door hinge pillar facing marking position of screws in slotted holes.
4. Remove support assembly through loading hole.
5. To install, reverse this procedure.

NOTE: Check link support, Part No. 4561013 is used interchangeably on both right and left sides. Check part to make sure pin that holds roller is staked. If pin is not staked, make sure that pin is installed so that head will be up when installed in the door hinge pillar.

Adjustment

Loosen support assembly on door and move assembly in or out to decrease or increase respectively the hold open force. Then, tighten screws securely to hold check link support in new position.

FRONT DOOR AND/OR HINGES (1949-52)

Removal

1. Remove screws holding hinge cover plates to door hinge pillar.
2. Pry out the rosebud fastener "A" (fig. 10).
3. With the door open, remove the screws "B" that attach the small retaining plate to the body.
4. Raise the car and remove the horizontal metal baffle that extends from the front fender to the frame. This is necessary to gain access to the body hinge pillar portion of the sealing strip.

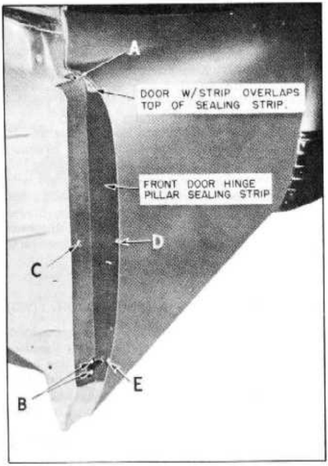


Fig. 10—Hinge Pillar Sealing Strip

5. Pry out the rosebud fastener "C".
6. Using a putty knife, pry the cemented edge of the sealing strip loose from the cowl side panel.
7. Scribe the position of the door hinge straps on the door pillar.
8. With a helper holding the door, remove the three bolts from the door half of each hinge strap and remove the door.

   NOTE: By using care, the door can be removed from the body without removing the check link. Rotate the door toward the closed position until the curved end of the check link strap disengages the check link support.

9. To remove the hinge from the body pillar, remove the body hinge cover plates, scribe position of each hinge, remove three bolts from body half of each hinge strap and remove hinges.
10. Loosen the portion of the rubber door weatherstrip that laps over the top of the sealing strip.
11. Pry out rosebud fastener "D".
12. Pry off clip "E" from the fastener stud at the lower end of the door hinge pillar. This stud and fastener locate and maintain the position of the sealing strip in relation to the door bottom weatherstrip.
13. Using a putty knife, remove the sealing strip from the door hinge pillar.
14. Clean the surfaces of both the body hinge pillar and the door hinge pillar.

Installation

1. Install the upper and lower hinges and cover plates to the body pillar aligning with scribe marks made at time of removal.
2. Cement a new sealing strip to the door hinge pillar using 3-M Weatherstrip Adhesive. Position the sealing strip by aligning the hole in the sealing strip with the fastener stud "E" (fig. 10) and aligning the corresponding holes in the sealing strip and door pillar fastener "D". The sealing strip is cemented over the door bottom weatherstrip.
3. Install the clip "E" and the rosebud fastener "D".
4. Use 3-M Weatherstrip Adhesive to cement the door upper weatherstrip back in position. The lower portion of this weatherstrip laps over the door sealing strip.
5. Replace door assembly on the body, using care when engaging the check link strap to the support assembly, and realign using the scribe marks made when the door was removed.

6. Raise the car and cement the sealing strip to the cowl side panel using 3-M Weatherstrip Adhesive.
7. Install the rosebud fastener "C."
8. Reinstall the horizontal baffle between the fender and frame.
9. Lower the car and install the rosebud fastener "A". Then, position the retaining plate and install its attaching screws "B".
10. Replace hinge cover plates to door hinge pillar.

FRONT DOOR AND/OR HINGES (1953)

Front door hinges on 1953 passenger car bodies are of the swing out box type designed with an integral leaf type door check and hold-open. The pivot center of this hinge allows the door to swing outward away from the body. An effective but less complex door weatherseal construction is utilized with this type hinge.

Door and Hinge—Removal

1. Apply masking tape along door edge at hinge pillar.
2. Open door and scribe locations of hinge boxes on front body hinge pillar.
3. Support door and remove attaching screws and bolts from face of hinge box and from interior of hinge box.
4. Remove door and attached hinges from body.

Door from Hinge Strap—Removal

1. Remove door trim and hardware.
2. Scribe location of hinge straps on door inner panel.
3. With the door supported, remove upper hinge cover plate.
4. Remove hinge to door attaching bolts and carefully slide door from hinge straps.

Installation

1. Coat all attaching surfaces with 3-M Autobody Sealer or its equivalent.
2. Position hinges within scribe marks and reinstall bolts.
3. Then reverse removal procedure.

   NOTE: The leaf door hold-open must be lubricated periodically.

4. Adjust as necessary.

REAR DOOR AND/OR HINGES—1949-53

Removal

1. Remove upper and lower hinge cover plates at the body hinge pillar by removing their retaining screws.
2. Scribe hinge locations with a scribe or pencil.
3. With a helper holding the door, remove upper and lower hinge bolts at body hinge pillar.
4. Swing the door toward the closed position to disengage the curved end of the link from the support assembly, then remove the door.
5. To remove hinges from door, remove screws holding metal weatherstrip to door pillar. Then carefully break seal between weatherstrip and door pillar with a putty knife. This will allow metal weatherstrip retainer to be moved away from door for hinge cover removal.
6. Remove upper and lower hinge cover plate screws and cover plates from door pillar.
7. Remove upper and lower hinge bolts from door and remove hinges.
8. Clean surface of door pillar along area that weatherstrip is held in position.

Installation

1. If hinges were removed from door, install them to the door pillar prior to assembling door to center pillar, aligning with scribe marks made at disassembly.

   NOTE: Lay a bead of 3-M Auto Body sealer on surface of door pillar and hinge leaf before installing hinge on door. When hinge is installed apply a bead of sealer to top and bottom of hinge leaf. Be careful of trimmed parts adjacent to hinge area.

2. Replace hinge cover plates to door pillar. Then apply 3-M weatherstrip cement to door facing where weatherstrip is fastened. Place weatherstrip and metal retainer in position and secure with retaining screws.
3. Place bead of 3-M Auto Body Sealer on surface of pillar and hinge leaf and assemble door to center pillar by inserting check link and installing hinge bolts. Align hinges with scribe marks made at disassembly and tighten bolts securely.
4. Place a bead of sealer at top and bottom of hinge leaf and along entire length of area covered by the hinge cover plates.
5. Install hinge cover plates to center pillar.

REAR DOOR GLASS RUN CHANNEL (1953)

Rear doors have a two section channel consisting of a short section extending from the door lower hinge pillar up to the door belt line and a long section extending from the top of the short section around the window opening and down the door lock pillar. The short section is retained at the top by a sliding clip.

1. Remove door trim pad and loading hole cover.
2. Through loading hole, loosen nut indicated at

"A" retaining short glass run channel section to door hinge pillar (fig. 11).

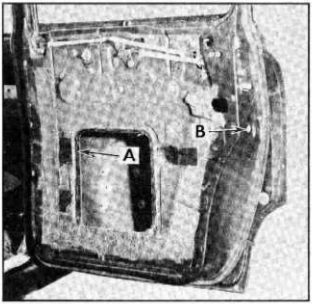


Fig. 11—Rear Door Glass Run Channel

3. Remove screw "B" from opposite end of run channel.
4. Lower door glass and carefully pry channel outward to release rosebud fasteners from door channel indicated at "C".
5. Remove channel through window opening.
6. To install reverse this procedure.

Adjustment

The lower ends of the glass run channel may be adjusted in or out at the two attaching points "A" and "B".

SEALING OPERATIONS ON DOOR INNER PANELS

The following sealing operations should be performed on either the front or rear door inner panels, if the seals are disturbed in the process of repair operations, etc.

NOTE: In addition to the sealers outline below any comparable sealer may be used.

1. Apply a ribbon of 3-M Autobody Sealer across the top and down the side flanges of each loading hole opening.
2. Apply a ribbon of 3-M Autobody Sealer to the lower side flange of each loading hole cover before it is installed. This seal to extend approximately three inches upward from the bottom.
3. After loading hole covers are installed, seal the lower offset corners with 3-M Autobody Sealer.
4. Apply body tape to all inner panel openings.
5. Apply 3-M Caulking Compound to the center division adjusting stud and opening.
6. Apply 3-M Weatherstrip Adhesive to the exposed surface of the regulator spindle hole sealing washer.
7. Rear doors, seal with 3-M Caulking Compound inner panel cam and arm rest front attaching holes.
8. Rear doors, apply a bead of 3-M Weatherstrip Adhesive along the joint of the rear door inner panel extending from edge of lower hinge to edge of upper hinge.

WINDOW GLASS

Removal and installation of the door glass on all models is similar. On convertibles and sport coupes it is not necessary to remove the ventilator, but it is necessary to move the glass stops inward and to remove the roller guides.

1. Lower window and remove window garnish molding.
2. Remove inside handles, arm rest and door trim pad. kmh2003
3. Remove loading hole covers.
4. Remove ventilator division channel or ventilator assembly.
5. Remove the window garnish molding retaining clips.

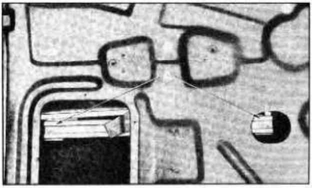


Fig. 12—Sash Channel to Cam Attaching Screws

6. Remove the two screws "A" (fig. 12) from each end of the sash channel to disengage the sash channel from the cam.

NOTE: These screws are accessible through the loading holes in the door inner panel with the window in its lowered position.

7. Carefully raise the glass to an almost closed position and tilt inward, using care to work out one of the lower corners at a time so as not to cause damage.
8. Squirt gasoline on the glass filler along the lower channel to soften the seal. When the

seal has softened, remove the glass from the channel.

9. Thoroughly clean the inside of the lower sash channel with sandpaper, removing all rust, etc.
10. Using new glass channel filler, cut the piece to be installed two inches longer than the lower edge of the door glass. Place this piece of filler, soapstoned side of filler away from glass, evenly along the edge of the glass which will fit in the channel. The extra filler extending beyond the edges of glass should be pinched together to hold the filler in place during glass installation.
11. Brush the inside of the metal channel freely with S.A.E. 10 engine oil. Push the glass, with the filler, into the channel until it is firmly seated.
12. After the glass is firmly in place, the oil softens the filler causing it to swell, thereby making a perfect watertight seal. Trim off the excess filler material along the channel and at the ends.
13. Install window glass assembly carefully, engage sash channel with cam and install two screws "A" (fig. 12) at each end of sash channel.
14. Replace ventilator division channel, garnish molding clips and loading hole covers.
15. Replace door trim pad, arm rest, inside handles and window garnish molding.

Adjustment

Sedans and Coupes

1. The travel of the door glass can be changed by adjusting the lower section of the ventilator division channel in or out or forward or backward.
2. The lower section of the glass run channel on the door lock pillar can be adjusted in or out. The rear attaching screw hole of the stationary cam is slotted vertically. By loosening this screw alignment of the "up" and "down" travel of the window glass in relation to the ventilator division and glass run channels can be made to throw glass travel forward or to the rear.

Sport Coupes and Convertibles

1. Remove door hardware and trim pad.
2. Loosen two glass run adjusting screws on door lock pillar and move channel in desired direction.
3. Make corresponding adjustment at ventilator division channel stud.
4. If necessary realign ventilator assembly and rear quarter window.

NOTE: Up adjustment is made at the window stops located at the top of the door inner panel.

BODY GLASS

WINDSHIELD GLASS AND REVEAL MOLDINGS (TWO-PIECE)—1949-52

The procedure in the removal and installation of the windshield glass and its component parts is accomplished from the outside of the body. The operations given apply to only half the windshield assembly and may be applied to either the right or left side or the complete windshield assembly if necessary.

Before windshield removal, protect the paint finish by masking around the windshield opening. Also, lay a suitable covering across the hood and front fender on the side the windshield is being replaced.

Removal

1. Inside the car, remove the rear view mirror and center division molding. Also, remove windshield garnish molding, including spacers, on the side windshield is to be replaced.

   NOTE: Screws at bottom, top and side differ in length.

2. Underneath the instrument panel, directly below the position of the lower reveal molding on the outside of the cowl, remove the retaining screws and cup washers which hold this reveal molding to the top of the cowl.
3. On the outside of the car, remove windshield wiper arm and blade.
4. Remove center division reveal molding and lower escutcheon.

   NOTE: Barrel nuts and retaining screws are used to hold outer reveal and inner garnish moldings to center division.

5. Loosen or remove lower reveal molding retainer at center division by loosening its single screw.
6. Remove lower reveal molding outer retaining screw on front body pillar.
7. Remove lower reveal molding by raising molding to clear wiper transmission shaft and sliding it off the center retainer.
8. Remove lower outer corner reveal molding by unscrewing the single retaining screw.
9. With the palm of the hand against the inside surface of the glass (fig. 13), carefully force the assembly outward until the lip of the rubber channel has been removed from the pinch-weld flanges of the opening. The glass, rubber channel and upper reveal molding are removed as a unit.

   NOTE: Hand pressure should be applied alternately at the upper and lower corners until separation begins.

Fig. 13—Removing Windshield Glass

10. With the windshield out of position, curl back the lip of the rubber glass channel and remove the upper reveal molding (fig. 14).

    NOTE: The windshield upper reveal molding is retained by a molded groove in the windshield rubber channel. Due to its retaining flange this molding cannot be removed from the groove in the rubber channel until the windshield is almost completely removed from the body opening.

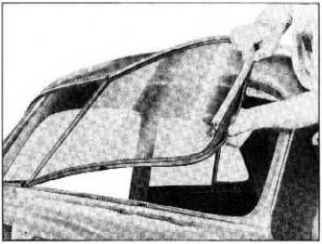


Fig. 14—Removing Upper Reveal Molding

11. Loosen the seal of weatherstrip cement between the glass and rubber channel. Disengage the rubber weatherstrip from the glass and lift glass out of body opening (fig. 15).

Installation

Before new glass installation, inspect the contour of the pinch-weld flange for any irregularities and correct. New glass can be used as a template. Using a scraper and oleum spirits, remove all old cement and dry thoroughly. Also, clean rubber

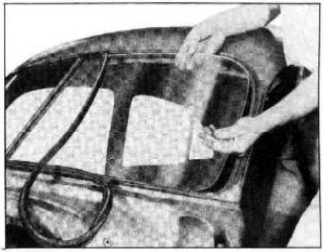


Fig. 15—Disengaging Glass from Weatherstrip

glass channel. Do not use gasoline or similar product to clean the rubber channel.

1. Before installation, apply 3-M Autobody Sealer to the flanges of the windshield opening as indicated in Figure 16.

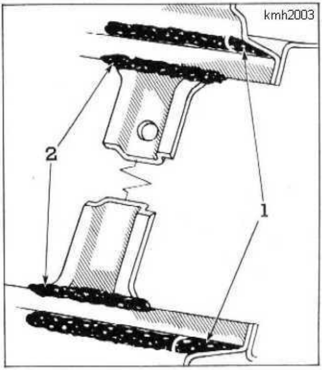


Fig. 16—Applying 3-M Autobody Sealer to Windshield Opening

a. Apply a 3/16" to 1/4" continuous bead of sealer along the outside rabbet of the opening just below the pinch-weld as indicated at (1).
b. Apply a 3/16" to 1/4" bead of sealer across the windshield center bar at top and bottom as indicated at (2).

2. Insert a strong cord into the pinch-weld cavity of the windshield rubber channel.
3. Install windshield glass into rubber channel. Work channel over edge of glass all around except at the center division edge.
4. To facilitate easy installation, use a mild soap and water solution and apply this solution into the upper reveal molding groove in the rubber channel and also into the center division glass cavity of the rubber channel.
5. Insert the inner end of the reveal molding into the groove in the glass rubber channel six inches from the center division. Then slide it towards the center division until the outer side section of the molding comes into alignment with the rubber channel. When in alignment, insert the top and side sections into the rubber channel and press firmly into place.
6. Lower the glass and its channel into the windshield body opening and move the glass so that its inner edge enters into the center division groove of the glass channel.
7. With a helper, position and hold the glass and its channel firmly in the windshield body opening. Then, use the string previously placed in the pinch-weld cavity of the rubber channel to pull the inner lip of the channel over the pinch-weld (fig. 17).

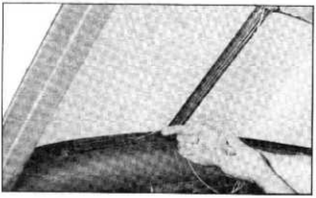


Fig. 17—Raising Inner Lip of Channel Over Pinch-Weld

8. After the assembly is in position and before the moldings are installed, seal as indicated (fig. 18) using 3-M Weatherstrip Adhesive in a sealing gun.
   a. Seal between outer lip of rubber and glass as indicated at (3), completely around opening.
   b. Before garnish molding is installed, seal under inner pinch-weld lip of rubber channel as indicated at (4).
9. To complete sealing, seal all outside reveal molding attaching screw holes with 3-M Autobody Sealer.

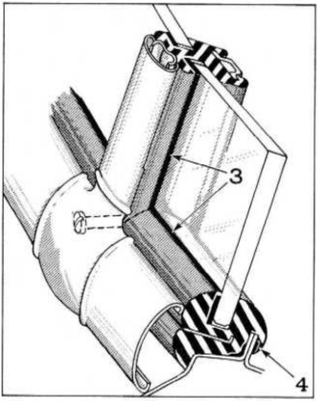


Fig. 18—Sealing after Glass and Channel are in Position

10. Replace garnish moldings, outside lower reveal molding, center division reveal molding and escutcheon, and wiper arms and blades.

WINDSHIELD ASSEMBLY (1953)

All 1953 Chevrolet body styles utilize a large one piece windshield. The removal and installation procedure is basically the same for all body styles, with the exception of the molding removal.

Before windshield removal, protect the paint finish by masking around the windshield opening. Also, place a suitable covering across the hood and fenders.

Removal

1. Remove windshield wiper blade and arm assemblies and wiper transmissions. Lower top on Convertibles.
2. Remove windshield garnish moldings, escutcheon and rear view mirror. On convertibles remove screw retaining side reveal molding to upper windshield pillar.
3. On Sport Coupes, remove rain deflector and single screw from each windshield side reveal molding.

4. Remove instrument panel compartment box to gain access to belt molding attaching nuts.
5. On closed body styles loosen two belt molding attaching nuts nearest front body hinge pillar. On Sport Coupes and Convertibles it is necessary to remove the entire belt molding.
6. Loosen hinge pillar trim on Sport Coupes and Convertibles to gain access to windshield rubber channel.
7. Inside the body loosen the inside lip of the windshield rubber channel, at the windshield pinch-weld, with a putty knife.
8. Starting at the inside upper corner of the glass, carefully force the glass assembly outward with the palm of the hand. Repeat this operation until the lip of the rubber channel clears the upper pinch-weld flange.
9. Carefully work the windshield assembly outward and upward to disengage the rubber channel lip from the lower pinch-weld flange. On Bel-Air and 210 series bodies, disengage the flange of each corner reveal molding "A" from the belt molding (fig. 19).

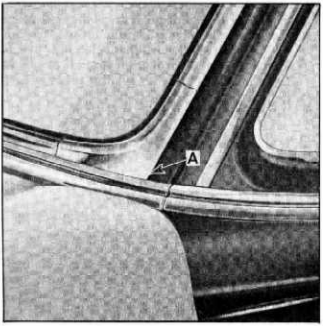


Fig. 19—Corner Reveal Molding Disengagement

10. With a helper carefully lift the entire windshield assembly from the opening and place it on a covered bench.
11. Remove the reveal moldings and rubber channel from the windshield glass.

Installation

Before installing new glass, inspect the contour of the pinch-weld flange for any irregularities and correct. New glass may be used as a template for this check.

1. Clean, all old sealer from the windshield opening and rubber channel with a putty knife and rags. Do not use gasoline, oleum spirits or other solvents to clean sealer from rubber channel as the channel will be damaged.
2. Install rubber channel around windshield glass.
3. Insert attaching flanges of reveal moldings into reveal molding groove of rubber channel.

NOTE: Windshield glass is installed with manufacturers trade mark at the lower corner.

4. Insert a strong cord into the pinch-weld flange cavity of the rubber channel, tie cord ends at bottom center of assembly and tape ends to windshield glass (fig. 20).
5. With a sealing gun, apply a continous heavy ribbon of 3-M Autobody Sealer, or its equivalent to the base of rubber channel.

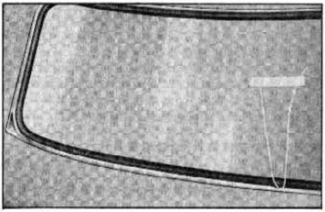


Fig. 20—Cord in Pinch-Weld Cavity

6. Apply a heavy ribbon of sealer at the pinch-weld flange along each side of the windshield opening and extending out six inches from each corner.
7. With the aid of a helper, place the windshield assembly into the body windshield opening. On Convertibles and Sport Coupes position windshield assembly slightly off center in opening so as to engage the flange of the side reveal molding with the windshield pillar. While pressing firmly from the outside, have helper on the inside slowly pull the cord along the bottom only so as to seat the lip of the rubber channel over the pinch-weld. Pull cord only as far as the lower corners of the opening.

8. On Bel Air and 210 Series bodies from the outside of the windshield, apply pressure downward at each lower left and right corner so as to seat the lower flange of the corner reveal moldings underneath the belt molding.
9. Continue pulling the cord up each side and

across top of the windshield until the lip of the rubber channel is seated over the pinch-weld completely around the opening. On Convertibles and Sport Coupes engage flange of side reveal molding with windshield pillar with the aid of a putty knife.

10. With windshield in position, retighten belt molding attaching nuts underneath the instrument panel, then reinstall the glove box to its original position.
11. Sport Coupes, apply a ribbon of 3-M Autobody Sealer, or its equivalent, to the attaching flange of the rain deflector; this sealer should partially cover the attaching screw holes. Then install rain deflector to body.
12. On Convertibles and Sport Coupes, seal around belt molding attaching holes with 3-M Autobody sealer or its equivalent. Install belt molding.
13. Reseal windshield wiper transmissions with 3-M Weatherstrip Adhesive or its equivalent and install wiper transmissions.
14. Install windshield garnish moldings, escutcheon and rear view mirror.
15. Seal lip of rubber channel to windshield with 3-M Weatherstrip Adhesive or its equivalent.
16. Clean up glass, remove protective coverings and replace wiper blade and arm assemblies.

REAR QUARTER WINDOW

Regulator Type—1949-53

1. Remove the quarter window garnish molding.
2. Raise window, turn down trim pad, remove tape over cut-outs in inner quarter panel. Through these cut-outs, remove the four screws from the regulator cam.
3. Lower glass assembly as far as it will go. Then, disengage mechanism and lift up glass. Tilt toward inside of body to free it from its channel and remove.
4. Removal of glass from sash channel may be accomplished in the same manner as the door glass.
5. To install, reverse the above procedure.

Sliding Type—1949-53

1. Remove rear quarter window garnish molding.
2. Remove the three screws and washers holding the window and its mechanism to top edges of lower window opening.
3. Carefully remove glass and operating mechanism.
4. Removal of glass from channel may be accomplished in the same manner as the door glass.
5. To replace, reverse this procedure. Make sure window is closed before tightening screws.
6. Adjustment is provided by slotted attaching screw holes which provide "in" and "out" adjustment of the glass and operating mechanism.

Stationary Type—1949-53

1. Remove rear quarter garnish molding.
2. From inside the body, remove stationary glass and channel assembly by freeing channel from its sealer on the wall of the rabbet around the window opening.
3. Remove glass from rubber channel.
4. Clean any dirt and old sealer from the wall of the rabbet around the stationary window opening.
5. To replace, install glass in rubber channel.
6. Place strong string in rabbet cavity of glass rubber channel adjacent to outer lip of channel. String must extend completely around channel.
7. Apply 3-M Weatherstrip Adhesive on wall of rabbet completely around channel.
8. Install window and channel assembly to opening from inside of body, making sure free ends of string are accessible on outside of body.
9. Holding one end of string stationary, grasp the other end and pull in a plane parallel to the glass, the string should always be perpendicular to the rubber channel. Apply moderate hand pressure around the glass from inside of body to set the rubber channel home around opening.
10. Install garnish molding.

All Convertible and 1950-52 Bel Air and 1953 Sport Coupe

1. Convertible—Lower the top.
2. Remove rear seat assembly.
3. Remove rear quarter trim and hardware.
4. Sport Coupe—Remove molding support.
5. Remove quarter glass hinge pivot bolt.
6. Move glass into half-up position and disengage hinge arm from female hinge. Remove cam channel from regulator arm and remove quarter glass from body.
7. To install, reverse this procedure.

Adjustments

Sport Coupe

Up and Down, Fore and Aft Adjustment

1. "Up and down" and "fore and aft" adjustments of the window glass are made by loosening the pivot bolt "C" and the adjusting stud nuts "A" then shifting window glass assembly to the desired position (fig. 21).
2. Stop "D" is attached at the lower end of the glass guide for adjusting the downward travel of quarter glass. For this adjustment, it is

necessary to remove the loading hole cover. The "up" limit of travel of the window is controlled by loosening the nut and raising or lowering stop "E".

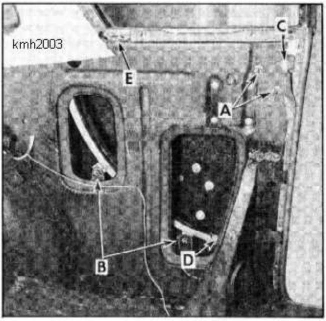


Fig. 21—Sport Coupe Rear Quarter Window Adjustment

In and Out

1. The "in and out" adjustments of the quarter window is made by loosening the stud nuts "A" and turning the studs. Turning the studs "in" moves the top of the glass "in". Turning the studs "out" moves the top of the glass out (fig. 21).
2. The window guide may also be adjusted "in or out" by two studs "B".

Convertible

Up and Down, Fore and Aft

1. Same as adjustment on Sport Coupe.
2. "Up" travel is also controlled by stop "A". Loosen bolts and position stop at desired location, retighten bolts (fig. 22).

In and Out

1. Same as adjustment on Sport Coupe.
2. The quarter window guide channel is adjusted in or out by loosening the bolt "B" on body lock pillar face and nut "C" at the adjusting stud on inner panel. Move guide to desired position then retighten nut and bolt (fig. 22).

BACK WINDOW—(1949-53)

The removal of all back window glass is basically the same as the windshield glass removal. This operation outlines the back window glass

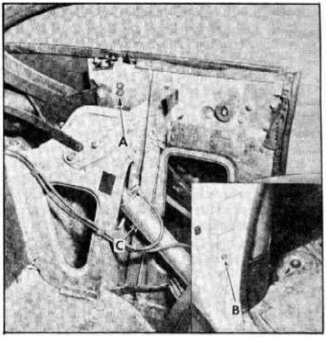


Fig. 22—Convertible Rear Quarter Window Adjustment

removal on 1949-53 bodies. The Styleline (notchback) body styles have the following exceptions. The rear quarter belt molding right and left, the belt molding "snap-on" retainer below the back window opening, and the corner reveal moldings at each lower corner of the back window opening must be removed before proceeding with the steps as outlined in this operation. On the Styleline models, the rear quarter belt molding is attached with "snap-on" retainers and also nut and bolt assemblies which are accessible through the upper rear compartment opening. All other exceptions are noted.

Removal

1. Remove back window garnish molding. On 1953 bodies, turn back the lip of the rubber channel, inside at each upper corner and remove the upper corner reveal molding nuts. Then remove the molding from the outside of the body. With a flat-bladed tool, loosen the rubber channel from its cemented base at pinch-weld flange around interior of back window opening.
2. Apply moderate hand pressure across the top of glass from inside the body and carefully force the glass and its channel at one side to release from the pinch-weld.
3. On the outside of the body, remove the glass and rubber channel assembly from the opening.

   NOTE: The glass remains in the channel during removal.

4. Remove the reveal molding by first curling

the rubber channel off the side of the molding, then sliding the molding out of the rubber channel. The escutcheons at the center of the back window opening will slide off the molding during its removal.

5. Remove glass from rubber channel.

Installation

Before new glass installation, inspect the contour of the pinch-weld flange for any irregularities and correct. A new rear window glass can be used as a template. Using a scraper and oleum spirits, remove all the old cement from pinch-weld flange and dry thoroughly. Also clean rubber glass channel.

CAUTION: Do not use gasoline or similar product to remove sealer from rubber channel.

1. Apply 3-M Autobody Sealer around outside base of pinch-weld continuously around back window opening as shown at "A" (fig. 23).

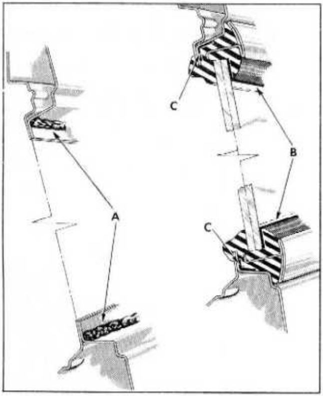


Fig. 23—Sealing Back Window

2. Install glass in rubber channel and with liquid hand soap, lubricate reveal molding cavity of rubber channel and install reveal moldings to channel.
3. Insert a strong cord into rubber pinch-weld cavity at "C". Allow a loop to extend out of the channel at one side while the two ends of the string extend out of the channel at the opposite side. Be sure the strings at the base of the loop overlap within the pinch-weld cavity.
4. Using a mild soap solution and cloth, lubricate rubber channel inside lip.
5. Install the glass and rubber channel into the window opening with string accessible from inside body. With either a helper or masking tape holding the back window assembly firmly to the opening, use the string from inside the body to pull the inner lip of rubber channel over the pinch-weld (fig. 24).
6. On 1953 bodies, apply 3-M Autobody Sealer to the upper corner molding bolt holes in rubber channel also apply sealer to the base of the attaching stud.
7. Reinstall garnish molding and from the outside of the body, seal the lip of the rubber channel to the glass with 3-M Weatherstrip Adhesive.

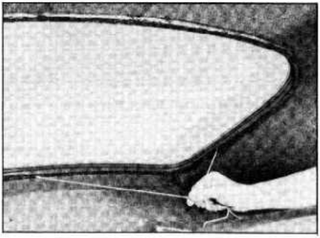


Fig. 24—Pull Inner Lip of Channel Over Pinch-Weld

MOLDINGS

Reveal and belt moldings around the window openings are installed with clips while the belt or lower moldings across the doors and rear quarters are installed with bolts, nuts and washers. The upper portion of the molding around the window opening is called a "reveal molding." The molding along the lower sill of the window opening is a "belt molding." The molding across the lower door panel is referred to as a "door outer panel lower molding."

DOOR REVEAL AND BELT MOLDING—1949-52

Removal

1. Protect the finish on each side of the molding with masking tape.
2. Remove upper reveal molding and lower belt molding by either releasing the molding clip tabs on the inside of the door flange

underneath the weatherstrip or by carefully prying the molding from the outside of the door with a suitable flat-bladed tool.

Installation

1. Install molding clips in their original position in clip opening in door panel. If clips are bent or damaged, use new clips.

   NOTE: Some molding installations may be made by placing the clips in the molding first, then spacing each clip to correspond with the clip opening in the door panel.

2. After clip installation, seal each clip and clip opening in door panel with a liberal amount of 3-M Auto Body Sealer.
3. Place molding in position over clips, center and align it properly, then snap in place.

DOOR OUTER PANEL LOWER MOLDING—1949-52

Removal

1. Remove window garnish molding, inside handles, arm rest and trim pad.
2. Remove loading hole covers on door inner panel.
3. Remove nuts and washers on inner surface of door outer panel from molding retaining clips.
4. Carefully remove molding from outer panel. The retaining clips are held in the molding and are removed with it.

Installation

1. Apply a coating of 3-M Auto Body Sealer around each bolt opening in door panel.
2. Equally space each clip and bolt in the molding to correspond with the bolt holes in the door panel.
3. Place molding in position and align end of molding with the edge of the door. Then on the inside of the door, install washers and nuts and tighten securely.
4. Replace loading hole covers, resealing at assembly.
5. Replace trim pad, inside door handles, arm rest and garnish molding.

CENTER PILLAR UPPER MOLDING—1949-53

1. Loosen center pillar trim and windhose foundation at upper end.
2. Remove center pillar reveal molding assembly by removing the attaching nut and washer on the center pillar inner panel.
3. To install, reverse this procedure, sealing attaching hole with 3-M Auto Body Sealer prior to positioning molding.

BELT MOLDING—1953

1. ALL STYLES EXCEPT TWO DOOR COUPE: Remove the rear seat cushion and seat back.
2. FOUR DOOR "BEL AIR": On the inside of the body remove rear quarter belt finishing molding by removing one (1) screw and sliding molding forward to disengage from retaining clip.
3. ALL STYLES EXCEPT TWO DOOR COUPE: Inside the car, loosen the headlining or the quarter trim panel along the rear quarter area, which ever is applicable and remove the belt molding retaining nuts and washers.
4. ALL STYLES: Underneath the upper section of the compartment opening, remove all belt molding retaining nuts, cup washers and rubber washers. At this stage the belt molding on 4-door styles can be removed.
5. TWO DOOR STYLES ONLY: From outside the body, carefully detach front portion of molding from the snap-on retainers along each rear quarter outer panel and remove molding.
6. To install, reverse the above procedure.

UPPER SIDE OUTER PANEL MOLDING—1953 BEL AIR 4 DOOR SEDAN

NOTE: The molding referred to in this procedure, is the triangular shaped molding.

1. Remove rear cushion and seat back. Also loosen and turn back headlining at the rear quarter area.
2. Remove the rear quarter belt molding.
3. Through the cut-out in the inner upper quarter construction remove the molding retaining nut.
4. On the outside of the body, remove retaining screws securing lower flange of molding to the belt area of the quarter panel.
5. Slide molding forward to disengage it from clip. Remove upper Rear Quarter Side Outer Panel Molding from body.
6. To install, reverse this procedure.

REVEAL MOLDING—1953 TWO-TEN 4 DOOR SEDAN

1. Remove rear seat and seat back.
2. Loosen headlining at the rear quarter area so as to gain access to the nut retaining molding. Remove nut and washer. Also loosen front portion of belt molding.
3. On the outside of car, with a suitable tool carefully pry the molding so as to free the molding clip from the clip hole in quarter panel. Carefully disengage lower flange of

molding from beneath belt molding and remove.

4. To install, reseal clip hole and attaching bolt hole and reverse the above procedure.

BACK WINDOW SIDE REVEAL MOLDING—1953 BEL-AIR 2 AND 4-DOOR SEDANS

1. Remove the rear quarter belt molding.
2. On 4 door sedans remove the upper rear quarter side outer panel molding. On 2-door sedans, remove the rear quarter header moldings.
3. Inside the car remove the back glass garnish molding and near the upper right and left corner turn back the lip of rubber channel and remove the nut and washer retaining upper end of side reveal molding.
4. Outside the car remove the sheet metal screws retaining molding to the outer quarter panel. Remove molding.
5. To install, reverse this procedure and seal as specified.

DOOR FENDER SHIELD—1949-53

1. Remove garnish molding, inside handles, arm rest and trim pad.
2. Remove rear door loading hole cover.
3. Through the loading hole, remove fender shield retaining nuts and washers from inside face of door outer panel. On 1953 styles also remove rivet at lower corner.
4. Remove the fender shield assembly.
5. To replace, reverse this procedure.

REAR QUARTER FENDER SHIELD—1949-53

1. Remove rear quarter trim.
2. Remove loading hole cover and through loading hole, remove nuts and washers retaining fender shield to nose portion of fender.
3. From outside of body, remove the two retaining screws at the bottom of fender shield and remove shield. On 1953 styles remove one screw from lower face on shield and a retaining nut from lower flange of fender.
4. To install, reverse this procedure.

SEATS

FRONT SEAT ASSEMBLY—REMOVAL—1949-52

1. Loosen set screw and remove seat adjuster control knob from left side of seat.
2. Remove seat side panels on 4-door models by removing two screws on front curved end of side panel and upper and lower outer retaining screws at rear of side panel. On 2-door models remove two screws on front curved end of side panel, then tilt seat back assembly forward to expose side panel rear attaching screw and remove screw.
3. Remove seat adjuster bolts attaching each seat adjuster support to the floor pan (fig. 25).

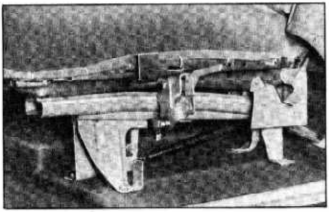


Fig. 25—Seat Adjuster Attachment

4. Remove the front seat assembly from the body with seat adjuster assembly attached.
5. To install, reverse this procedure.

FRONT SEAT ASSEMBLY—REMOVAL—1953

1. With seat in a full forward position turn back floor carpet to expose the rear seat adjuster to floor pan bolts.
2. Remove two (2) rear seat adjuster bolts from each side of seat.
3. With a helper, pull seat assembly rearward to disengage the front adjuster legs from brackets.
4. Remove seat assembly from the body.
5. To install the front seat assembly, reverse the above procedure.

TILTING SEAT BACK—1953

Lower Side Panel—Removal

1. Loose seat adjuster knob set screw and remove knob.
2. Remove two (2) screws from front of lower side panel.
3. Tilt seat back forward and remove screw and rubber bumper and the screw at inner rear of panel.
4. Pull side trim panel outward at the front to clear brackets and remove.
5. To install, reverse this procedure.

Upper Side Panel

1. Remove screws. Upper and lower screws at rear.

2. Rotate panel out of position and remove.
3. To install, reverse this procedure.

Seat Back

1. Remove lower side panel.
2. Remove the center hinge post cover plate.
3. Remove cotter pin and washer from outside hinge pin.
4. Tilt opposite seat back forward.
5. Pull the seat back being removed toward outside of car disengaging outside support arm from the hinge pin.
6. Rotate the seat back forward to disengage hooked end of center hinge pin from its retainer and remove seat back.
7. To install, reverse this procedure.

NOTE: At the center hinge attachment a fiber washer is installed on the hinge pin next to the cushion trim.

FRONT SEAT ADJUSTER—1949-53

1. Remove the front seat assembly from body.
2. Remove the seat lower side panels.
3. Detach locking rod from clip.
4. Remove seat adjuster to seat frame bolt. Move sliding mechanism rearward and remove attaching bolt. Move sliding mechanism forward and remove attaching bolt.
5. With seat adjuster detached, the locking rod can be disengaged and the adjusters removed. To install, reverse this procedure.

ROBE CORD—1949-52

1. Grasp cord, push in on one end, turn slightly to disengage hook and remove. Repeat for other end.
2. To remove escutcheon plate, remove single screw holding escutcheon to seat back.
3. To install, first replace escutcheon plate if removed. Hold cord so hook end is in horizontal position with end of hook toward outside of body. Insert hook through escutcheon plate and push on cord until it snaps into place.

ROBE CORD—1953

1. Remove robe cord escutcheon attaching screw at each end of cord and remove cord.
2. To install, reverse removal operation.

NOTE: On some early production 4-door sedan front seats a "spring loaded" robe cord is used. The right end of the cord is removed and installed as explained above. The left end however, is removed and installed the same as on 1949-52 models.

SEDAN SEAT BACK—1949-52

On sedans the front seat back may be removed within the car without disturbing the seat cushion proper, or it may be removed after the entire seat assembly has been removed from the car.

1. Remove back trim panel attaching screws and washers at lower outside corners of panel.
2. Remove back trim panel by disengaging the slide on clips retaining the panel to the upper seat back frame.
3. Remove four bolts at each side retaining seat back to the bottom of cushion frame. Also remove seat adjuster track cover screw.
4. Lift seat back assembly upward from seat sockets and remove.
5. To install, reverse this procedure.

FRONT SEAT BACK—1953 Solid Type

Removal and Installation

1. Remove the front seat side panels.
2. Remove four (4) bolts at each lower corner of seat back. kmh2003
3. Remove seat back by lifting up so that seat back becomes disengaged from the cushion frame.
4. To install, reverse this procedure.

NOTE: It is not necessary to take the seat out of the body to remove the seat back.

Front Seat Side Panels—Removal

1. Loosen adjuster knob set screw and remove knob.
2. Remove two (2) screws at front of panel.
3. Remove screw at lower rear inside of panel.
4. Remove screw at top rear of panel.
5. Pull panel outward at front to clear brackets and remove.
6. To install, reverse this procedure.

REAR SEAT BACK

The manner of retaining the top of the seat back has been accomplished by three different methods since the beginning of the 1951 production year. Service men are cautioned to ascertain the method of attachment before attempting seat back removal to prevent damage to the headlining due to improper disassembly.

The first type was retained at the top by a retainer at the top into which the flange at top of seat back was positioned. The second type was retained at the top by three screws which were installed through the flange of the rear compartment shelf into three metal retainers in the seat back assembly across the top. The third type is retained at the top by clinching three retainers located on the front flange of the package shelf over the top spring border wire.

1. Lift up and remove rear seat cushion.
2. From inside body at bottom of seat back, straighten out the metal retaining tabs.
3. Obtain two pieces of cardboard and trim one side of each piece with scrap trim material. Insert one piece of cardboard in between each end of the rear seat molding and the headlining, with the trimmed side of the cardboard against the headlining to prevent the rear seat back molding from damaging the headlining during removal of the rear seat back.
4. (First Type) Pull out the seat back at the bottom and carefully lift up to free from retainer at the top.
   (Second Type) Open the rear compartment and remove the three retaining screws at the top. Then from inside body pull seat back out at the bottom and carefully remove.
   (Third Type) In the trunk compartment, remove the rear seat back trim panel and insert a large screwdriver in between the top spring border wire and the flange of the package shelf at each upper spring retaining clip and carefully pry the spring forward to unclinch each clip. Then from inside body pull out seat back at bottom and carefully raise rear seat back upward approximately 1" and forward to disengage the upper border wire from the upper retaining clips and remove seat back.
5. To install reverse this procedure installing three retaining screws on second type and reclinching upper spring retaining clips on third type.
6. Clinch lower spring retainer tabs over border wire and reinstall rear seat cushion.

REAR QUARTER TRIM PANEL

2-DOOR—Replace

1. Remove rear quarter window garnish molding.
2. Remove rear seat cushion and seat back.
3. Remove rear quarter arm rest.
4. Remove window regulator handle.
5. Using a suitable flat tool, pry loose the front edge of the trim assembly "A" (fig. 26) where it is secured to the tacking strip by retainer nails.
6. Loosen cemented portions of panel along floor and wheelhouse areas.
7. Loosen nails retaining panel along bottom edge of rear quarter inner panel.
8. Pry loose the single drive nail "B" at top rear corner of panel.
9. Loosen lower edge of rear body lock pillar trim and pry loose the quarter trim panel single nail at the top front corner. Remove panel.
10. To install, reverse this procedure and re-cement the panel where necessary.

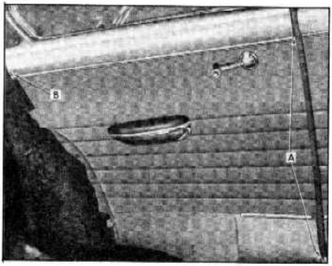


Fig. 26—Rear Quarter Trim Panel Attachment

CONVERTIBLE AND SPORT COUPE—1953

Replace

1. Remove rear seat assembly.
2. Remove screws retaining rear quarter arm rest assembly (fig. 27).

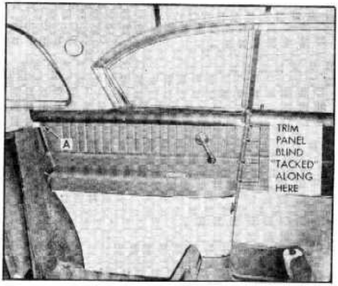


Fig. 27—Sport Coupe Rear Quarter Trim

3. Disconnect wiring from light switch and remove arm rest assembly.
4. Remove rear quarter finishing molding and regulator handle.

5. On the Sport Coupe style, remove drive nail "A".
6. Swing panel out to expose blind tacks. Remove tacks and trim panel.
7. To install, reverse procedure.

HEADLINING

Preparatory to headlining removal, the following parts must be removed. Clean hands are essential when working on the interior trim parts of the body.

a. Garnish moldings around windshield, rear quarter and back windows.
b. Sunshades and brackets.
c. Dome lamp assembly.
d. Rear seat cushion and rear seat back.
e. Rear seat back package shelf trim (imitation leather). This trim is cemented to the metal and may be removed by first loosening front flap, unbending tabs under flap, and freeing remainder of trim panel from cement.

1. Remove tacks from headlining at upper outside corners of windshield, around quarter window opening (2-door styles), and from sides of seat back compartment shelf.
2. Loosen trim around windshield and back window openings and on quarter panels above wheelhouse on applicable styles. Inasmuch as the trim is retained at these locations by pointed metal tabs (fig. 28), proceed slowly to avoid damaging material.

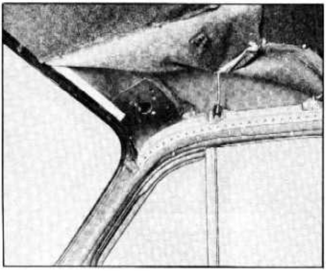


Fig. 28—Removing Headlining

3. Starting at the front corners, disengage the headlining from its retainers along both side roof rails. By loosening the retainer screws along the side roof rail progressively, as headlining is loosened, it is easier to disengage the headlining from the retainer.
4. On the right roof rail, remove screws holding ends of headlining supp rt wires to side roof rail (fig. 29).

NOTE: Headlining support or listing wires are inserted through headlining listings on the upper side of the headlining so as to form the headlining to the contour of the roof. The left end of each support wire is formed with an offset which is inserted through a rubber grommet insulated hole in the left side roof rail.

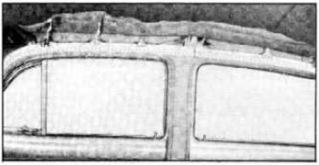


Fig. 29—Attachment of Headlining Support Wires to Side Roof Rail

5. Starting at the front and proceeding toward the rear, disconnect headlining support wires from their attachment on the left side roof rail. At the roof bow, bend down the metal tabs and remove the headlining from its attachment at the bow. Proceed to the rear and remove headlining.

Installation

1. Install the ends of the headlining support wires to their attachment on the side roof rail.

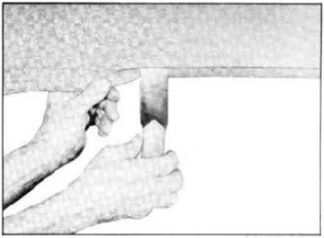


Fig. 30—Installing Headlining under Retainer

2. Install headlining listing wire to its attachment of the single roof bow.

3. Secure headlining to tabs at back window opening.
4. Depending on the body style, secure headlining at the quarter window area with tacks and to the lower quarter panel over the tabs at this area. Tack along sides of package shelf.
5. At the windshield opening, center and stretch headlining forward and tack at upper outer corners. Then, attach headlining to metal tabs over the opening.
6. Install headlining under retainers at side roof rails, using a headlining inserting tool (fig. 30). Make sure retainers are tight before beginning installation.
7. Install dome lamp, seat back package shelf trim panel, garnish moldings, sunshades, and rear seat back and cushion.

INSTRUMENT PANEL

COMPARTMENT DOOR

1. Remove two screws from each side which retain curved hinged arms to inner face of door and remove door.
2. To install, reverse this procedure.

Adjustment

1. At top of door opening, loosen the two screws of the striker plate for in and out adjustment.
2. At the hinge arm attaching points on door inner surface, loosen the two screws at each side for up and down adjustment.

COMPARTMENT BOX

1. Open the instrument panel compartment door and remove the screws holding box to instrument panel flange at top and bottom and on each side. During screw removal, note two different type screws removed.

   NOTE: The striker plate at the top of the opening need not be removed in this operation.

2. To install, reverse this procedure.

COMPARTMENT DOOR LOCK

1. The lock is released by removing one screw and washer on the lock retainer cap.
2. To install, reverse this procedure.

WINDSHIELD WIPERS

MOTOR—REPLACE—1949-52

1. Disconnect vacuum line from motor under dash.
2. Remove link retainer and spring assembly attaching wiper arms to motor.
3. Remove motor attaching screws, drop motor down and disconnect wiper control assembly cable.
4. To replace motor assembly, attach control cable to motor before attaching motor to mounting bracket. Install mounting screws loosely.
5. Attach wiper arms to motor and connect vacuum line to motor and adjust as outlined under "Adjustment."

TRANSMISSION—REPLACE—1949-52

1. Disconnect link at motor under dash.
2. Remove glove compartment for right transmission removal.
3. Disconnect windshield wiper hose at transmission indicated at "C" (fig. 31).
4. Remove transmission bolt "D" also retainer "B". Break seal and remove transmission through opening in top of cowl.
5. To install, reverse this procedure. Apply 3-M Synthetic Rubber Adhesive to both sides of gasket "A" and to metal surfaces of transmission and cowl.
6. Adjust link as outlined under "Adjustment."

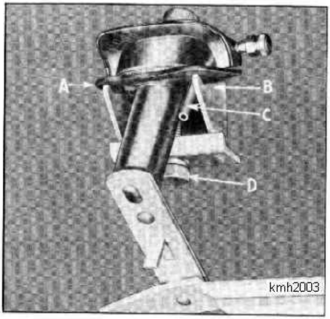


Fig. 31—Windshield Wiper Transmission

Adjustment—1949-52

1. With mounting screws loose, and motor operating arm vertical, shift the motor so both wiper arm operating levers are vertical. Tighten the motor mounting screws.
2. When the operating levers are vertical, the wiper blades should also be vertical. If not,

shift the position of the blade arms on their serrated shafts as required.

3. If further adjustment of the sweep of the blades is desired, wet the windshield and turn wiper on to run about half speed, and note the sweep of the arm. Then remove one or both wiper arms and change to whatever position may be necessary on the shaft to provide the desired sweep.

WIPER TRANSMISSIONS AND CABLES—1953

1. Remove the wiper blades and arms.
2. Remove the wiper transmission spanner nut with Tool J-5449 from each transmission.

   NOTE: The other end of Tool J-5449 is used to remove the control knob spanner nut.

3. Inside the body, underneath the instrument panel, carefully pull each transmission downward so that it slips through the escutcheon on top of the cowl. Disengage the wiper cables from the motor auxiliary drive or drum drive and remove assembly. To gain access to the transmission underneath the right side of the cowl, remove the instrument panel compartment box.
4. On top of the cowl, lift up and remove each wiper transmission escutcheon, including wiper transmission gasket.
5. To install, reverse this procedure. Clean old sealer from escutcheon, gasket and transmission opening in cowl and reseal with 3-M Autobody Sealer or its equivalent.

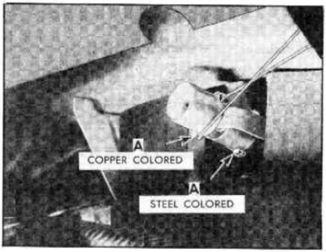


Fig. 32—Right Transmission Attachment

6. Connect wiper cables to motor drive. On the first type transmissions, the cables running to the left transmission run parallel, the cables to the right transmission are crossed.

   On the second type, transmission having a drum auxiliary drive, rotate the drive counterclockwise and attach right transmission cables—copper end to copper drum and steel colored to steel drum as shown at "A" in figure 32. Then rotate drum auxiliary drive clockwise and attach left transmission cables to their respective drums as shown at "B" in figure 33. Adjust cable tension.

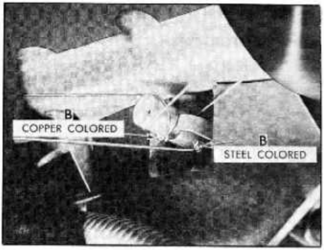


Fig. 33—Left Transmission Attachment

NOTE: First and second type wiper auxiliary drives and transmission assemblies are not interchangeable.

Adjustment

The movement of the wiper blades is controlled by the tension of the wiper cables. To adjust this tension, when wiper blade action is slow:

1. On the first type move the wiper arms by hand, midway in their travel arc. With the arms in this position the motor auxiliary drive lever should be in a vertical position (Auxiliary drive should remain in this position during all steps of the adjustment).

   NOTE: This positioning operation is only necessary on arm drives, wiper motors equipped with spiral drum drive may be adjusted in any position.

2. Remove arms and blades.
3. Loosen screw in end of transmission shaft approximately ¾ turn. Tap screw lightly to insure full tension.
4. From under cowl, take cables between thumb and forefinger and increase finger pressure until one notch movement of transmission serrations can be felt or heard. While holding cables in this position **retighten the tension screw**. This is a two-man operation.

NOTE: Serration contact is lost if tension screw is loosened excessively.

5. Repeat steps 2, 3 and 4 on opposite wiper transmission.
6. Recheck operation of wiper blades on a wet windshield, if action is still slow increase slack in cables by an additional notch movement of the transmission serrations.
   Should excessive wiper blade slap be the complaint, it can be corrected by increasing the tension of the wiper cables.

WIPER MOTOR—1953

1. Disconnect and remove control cable and vacuum line from wiper motor.
2. Remove two screws attaching wiper motor legs to auxiliary drive and remove motor.
3. To install, reverse this procedure.

NOTE: First and second type motors are interchangeable.

AUXILIARY DRIVE—1953

1. Disconnect transmission cables from auxiliary drive.
2. Remove control cable and vacuum line from wiper motor.
3. Remove two bolts from auxiliary drive and remove auxiliary drive and motor.
4. To install, reverse this procedure after cleaning and resealing wiper motor gasket with 3-M Autobody Sealer or its equivalent.

NOTE: Right transmission cables must be "crossed" before connecting to the auxiliary drive on first type only.

GASOLINE FILLER DOOR

1. Remove rear compartment left side trim opposite filler door. Clean sealer from around door retaining nuts and reinforcement.
2. With the filler door in a raised position, remove the two upper door retaining screws and washers. The loose reinforcement and retaining nuts may be removed from the rear compartment interior left side.
3. Remove the door and silencer.
4. To install, reverse this procedure and place 3-M Auto Body Sealer around door retainer nuts.
5. The filler door is adjustable vertically and horizontally by means of elongated screw holes.

REAR COMPARTMENT

LID

1. Scribe position of hinge straps.
2. Remove retaining bolts from the hinges, two on each hinge, and remove lid. Use care to prevent dropping or damage to body finish.

NOTE: Although it is possible to remove the lid by drawing out the lid hinge pins the operation described is much simpler.

3. To replace, with the aid of a helper, carefully position lid over hinge straps within the scribe marks. Install hinge bolts through hinge straps to floating anchor plates at attaching points, do not tighten. Close lid and check alignment of lid in opening.

NOTE: To help retain correct alignment of the rear deck lid in its opening in the body and thus improve weather sealing, a guide pin which is adjustable is installed at the bottom of the lid inner panel on the right side of the lock. When the deck lid is lowered, the pin enters a hole in a small plate attached to the body that guides the lid into the same position each time it is closed.

4. To adjust, move lid either up or down or sideways the desired amount and then tighten the bolts.

NOTE: Floating anchor plates on the lid inner panel permit this adjustment. The lid lock striker at the bottom of lid opening and the side bumpers are also adjustable.

LID HINGE

1. Support lid on the side from which hinge is to be removed and scribe hinge location on lid inner panel.
2. Remove hinge bolts from lid attaching points.
3. Bend up retaining tabs and remove the two hinge pins from the supports.
4. Remove the hinge.
5. To install, position hinge and install hinge pin at front of hinge box.
6. Install hold open pin at rear of hinge box.
7. Bend down retaining tabs.
8. Install lid hinge bolts, check alignment and adjust as necessary.

LID LOCK STRIKER REMOVAL

The lid lock striker is mounted to a striker anchor plate at the bottom of the rear compartment lower opening and is retained by two screws. The bevelled surface anchor plate allows the striker, through slotted holes at the attaching points, to be adjusted up and down. At the same time, a slight corresponding rearward and forward adjustment is available. In extreme adjustment cases, an emergency spacer is available to obtain proper engagement of lock and striker.

LID LOCK ADJUSTMENT

Improperly adjusted rear compartment lid locks and striker plates result in improper operation of the lid lock. Checking engagement of lock bolt and striker and the following adjustments should be made where necessary:

Checking Engagement

1. Insert modeling clay at the bottom of the bolt slot and close lid with moderate force (fig. 34).
2. Open lid and check the engagement of lock bolt with striker as indicated by the compression of the modeling clay. With a rule, measure the distance between the base of the "U" in the modeling clay to the base of the "U" in the lock bolt. This dimension should be ⅛" to 5/32".

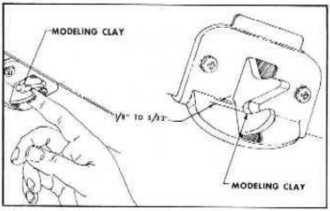


Fig. 34—Lid Lock Engagement

3. Adjust striker as required, if necessary, use a spacer which is available for extreme cases of compartment lid lock striker misalignment. Tighten all attaching screws.

Adjustment

1. With the deck lid open, snap the catch to its normal locked position. If the catch does not go over-center far enough, it can be forced to the unlocked position with the hands. In this case the lock should be loosened and a 1/16" shim placed between the rear compartment inner panel and the lock.
2. When the key will operate the lid handle pawl but the pawl does not trip the lock to the unlocked position, loosen the handle assembly nut and move end of handle shaft down.
3. When the lock handle pawl prevents the lock from tripping to the locked position, loosen the handle assembly nut and move end of handle shaft up.
4. When pawl in lock handle cylinder jams and cannot be moved by the key far enough to trip the lock to the open position, remove handle assembly, disassemble handle lock cyl-cylinder and check tip of the steel insert. If tip of steel insert is damaged it should be replaced.
5. Adjust rubber bumpers on each side of lid opening.

WATER LEAKS

Checking for water leaks and then applying the right correction are two operations that often require considerable skill or ingenuity on the part of the service man. Water which shows up at a certain place in the body may actually be entering at a point other than where the water is found. In locating and correcting a water leak, it is only by a thorough knowledge of body construction, the use of proper sealing compounds, and the knack of locating points at which a potential leak may occur, that enables the service man to make a successful correction.

Test the windshield or rear window for leakage by spraying water under medium pressure against the face of the glass. Direct a heavy stream along weatherstrip while an assistant inside the body (with garnish molding removed) marks points of leakage, paying particular attention to whether leakage occurs between the glass and weatherstrip or between weatherstrip and body window opening pinch-weld.

After location of leak has been determined, apply 3-M Weatherstrip Adhesive using cement gun B-182-A between lip of rubber weatherstrip and glass and before replacing garnish molding between pinch-weld lip of rubber weatherstrip and body. Allow adhesive to set and then retest with a water spray.

If water leaks occur around door opening check to make sure door seats on rubber weatherstrip. If door does not rest firmly against weatherstrip, door alignment should be checked and corrected.

DOOR ADJUSTMENTS

1949-52

There is perhaps no other part of a body structure subject to more actual use than are the doors of an automobile body. When one considers the number of times the doors are opened and closed, sometimes with force, the weight of the doors themselves on the hinges and dovetail assemblies, the continual use of door handles and regulator handles with the operation of windows up and down, it is only reasonable to suppose that doors and their mechanical parts certainly need maintenance from time to time. This is particularly true of front doors. Except in cases where the body has been overturned or otherwise damaged by accident, the doors may ordinarily be fitted to the body door openings by the simple method of adjusting hinges and the door lock striker plate. Before adjusting hinges, however, a careful analysis of the door condition as well as the corrective methods to be used should be studied out beforehand.

CHECKING FOR DOOR MISALIGNMENT

Remove the door lock striker from the body pillar to allow the door to hang free on its hinges. Then check the spacing at the sides and top of door for misalignment. The belt molding on the doors and adjacent body panels (fig. 35) should be in continuous horizontal alignment.

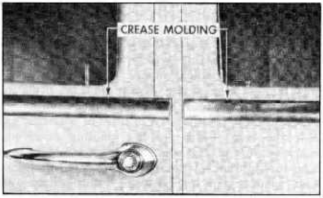


Fig. 35—Check Molding for Door Alignment

ADJUSTABLE DOOR HINGES

A butt type door hinge is used on the front doors with "in and out" adjustment provided on the door pillar while "up and down" and "fore and aft" adjustments are provided through oversize attaching bolt holes on the front body hinge pillar (fig. 36).

A butt type hinge is also used on the rear doors of all sedan bodies. An "up and down" adjustment is provided on the door pillar, while an "in and out" adjustment is made on the center pillar (fig. 37). Shimming of hinges may also be done to provide necessary adjustments.

TYPICAL DOOR ADJUSTMENTS

The following door misalignment illustrations are exaggerated to show possible conditions. After months of service, most cases of apparent door misalignment can be taken care of by simply tightening the hinge screws.

NOTE: On 1949-52 models, prior to making any door adjustment at the hinge

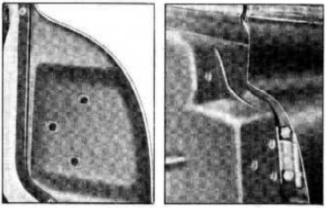


Fig. 36—Front Door Adjustments

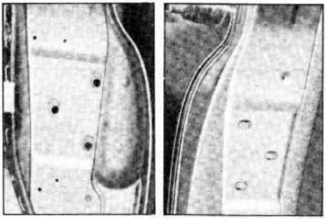


Fig. 37—Rear Door Adjustments

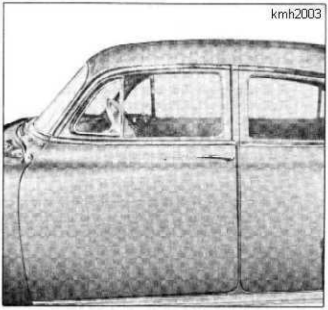


Fig. 38—Door Too High at Lock Pillar

attaching bolts on the front body pillar, it will be necessary to remove the baffle plate under the fender, then from below, loosen the sealing strip from the front body pillar. After door adjustment has been made the sealing strip should be recemented to the front body pillar with 3-M Weatherstrip Adhesive.

Figure 38 shows a condition where the front door is too high at the lock pillar side. The vertical spacing is too wide at the top and too close at the bottom. To correct, use one of the following:

1. Remove upper hinge on door pillar face and place a thin waterproof cardboard shim behind the complete hinge strap. Then, tighten hinge in place.
2. Remove door and at the body pillar, adjust upper hinge "aft" and/or lower hinge "forward" the desired amount.
3. To correct on rear doors, remove the upper hinge strap at center pillar and place a thin waterproof cardboard shim behind the complete hinge strap and tighten in place.
4. Replace and adjust door lock striker.

Figure 39 shows a condition where the front door is too low at the lock pillar side. The vertical spacing is too close at the top and too wide at the bottom.

1. To correct on front doors, adjust at body pillar. Move the lower hinge "aft" and/or the upper hinge "forward." Also, a thin waterproof cardboard shim may be placed under the door pillar lower hinge strap or a combination of such adjustments used.
2. On rear doors, remove the lower hinge strap from the body hinge pillar and place a thin waterproof cardboard shim behind the complete strap and tighten in place.
3. Replace and adjust door lock striker.

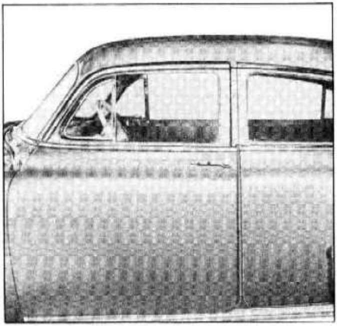


Fig. 39—Door Too Low at Lock Pillar

Figure 40 shows a condition at the lock pillar side of door where the vertical spacing, top and bottom, is excessive. The spacing at the hinge pillar side of the door is too close.

1. To correct on front doors, adjust upper and lower hinges "aft" at body pillar. Additional correction may be obtained by placing full waterproof cardboard shims under the upper and lower hinge straps on the door pillar.
2. To correct on rear doors, remove each hinge strap (one at a time) at center body pillar and place a waterproof cardboard shim be-

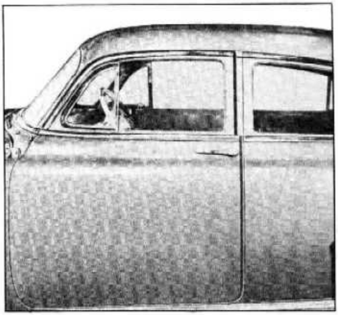


Fig. 40—Door Too Far Forward

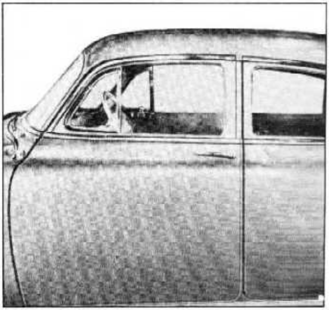


Fig. 41—Door Too Far to the Rear

hind each complete hinge strap sufficient to move the door rearward the desired amount, then tighten screws.

3. Replace and adjust door lock striker.

Figure 41 shows a condition at the hinge pillar side of the door where spacing is excessive. The spacing at the lock pillar side of the door is too close.

1. To correct on front doors, adjust both hinges "forward" at body pillar. A narrow waterproof shim placed behind the inner edge of each hinge strap on the door pillar will tilt the hinge and also move the door forward in the opening. This shimming adjustment, which is limited, can also be used on rear doors at the center pillar hinge attaching points.
2. Replace and adjust door lock striker.

Figure 42 shows a condition at center pillar where door stands out from the body too far.

1. To correct on front doors where door stands out from body or is in too far, loosen screws at hinge attaching points on door pillar and move door "in" or "out" to align with adjacent body panels.
2. To correct on rear doors, loosen screws at hinge attaching points on center pillar and move door "in" or "out" to align with adjacent body panels.
3. If the door is mounted uniformly too high or too low, adjust vertically at each hinge attaching point at body pillar (front doors) and door pillar (rear doors).
4. Replace and adjust door lock striker.

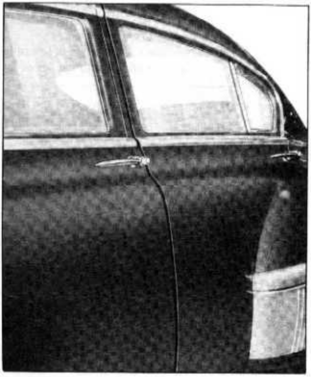


Fig. 42—Door Too Far "Out" at Pillar

DOOR ADJUSTMENTS—1953

Adjustment of the doors is provided by means of slotted and oversize hinge bolt attaching holes or adjustable clinch nuts located in the door and adjacent hinge pillars. The rear door adjustments are the same as for 1949-52 models. The swing-out box type hinges used on the front doors have an "up and down" and "in and out" adjustment at the front body hinge pillar. The "fore and aft" adjustment together with an additional "up and down" adjustment is provided at the hinge strap to the door inner panel attachment.

> **NOTE: Should an "up and down" adjustment be made on a door it is necessary to make a compensating adjustment at the door lock striker.**

When the spacing between door and body center pillar is excessive from top to bottom, make the following correction.

Remove door trim pad, loosen all hinge to door inner panel retaining bolts and shift door toward center pillar (rearward), retighten attaching bolts.

Excessive spacing between door and body center pillar from top to bottom, may be corrected in the following manner.

Remove door trim pad, loosen all hinge to door inner panel retaining bolts and shift door toward the body hinge pillar (forward), retighten attaching bolts.

Excessive spacing at top of door between door lock pillar and center pillar and spacing too narrow at bottom of door between door lock pillar and center pillar, is corrected in the following manner.

Remove door trim pad and barely loosen hinge attaching bolts at door, pivot door downward the desired amount and retighten bolts.

If spacing is excessive at bottom of door between door lock pillar and center pillar and spacing is too narrow at top of door between door lock pillar and center pillar, make this correction.

Remove door trim pad and barely loosen hinge attaching bolts at door, pivot door upward the desired amount and retighten attaching bolts.

When the door is either "in" or "out" too far at hinge pillar side correct as follows.

Loosen all hinge attaching bolts and screws on body pillar and shift the door in or out the desired amount, retighten screws and bolts. An additional outward adjustment may be made by shimming back of the hinge attachment on the door inner panel.

Should the door be uniformly too high or low, alignment is obtained as follows.

Loosen all hinge attaching bolts and screws on body pillar and shift door either up or down the desired amount. An additional adjustment can be made by loosening bolts at hinge to door inner panel and shifting door up or down.

FREE-WHEELING ADJUSTMENT–REAR DOOR LOCKS

1949-52 Models

Free-wheeling rear door locks are safety locks designed so that a small free-wheeling linkage in the lock mechanism may be adjusted to allow the door inside remote control handle to be moved backward and forward (free-wheel) without unlocking the door. The free-wheeling feature consists of a tie bar and a free-wheeling trip lever which are incorporated into the lock. The trip lever can be shifted to put the lock either in free-wheeling position or in normal operating position. Access to this shifting free-wheeling trip lever is gained through the lock bolt slot with the bolt in the normal unlocked position at the bottom of the slot.

To adapt the door lock to "free-wheeling" it is necessary to insert an adjusting tool through the lock bolt slot in door pillar facing, engage the control lever, and trip the lever away from the door facing (fig. 43). When the control lever is in this position and the door lock button "down" (door locked), the inside remote control handle will "free wheel". If the lock button is "up" (door unlocked), the inside remote control handle will not "free wheel" but will operate the door lock.

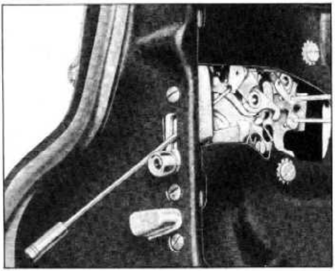


Fig. 43—Adapting Lock to "Free-Wheeling"

To remove the lock from "free-wheeling" operation, insert an adjusting tool through the lock bolt slot in door pillar facing, engage the control lever, and pull the lever toward the pillar facing (fig. 44).

To trip the "free-wheeling" control lever use a piece of wire approximately 6 or 7 inches in length with a hook of approximately ¼-⅜ inch on one end. The control lever is approximately on a level with the lock attaching screw located above the bolt slot, and either 1¾ or 2¾ inches forward of the pillar facing, depending on whether or not the lock is in "free-wheeling". This operation is accomplished chiefly by "feel" and to trip the control lever requires a very small amount of "push" or "pull" on the adjusting tool. Bear this fact in mind, for it may be used as a guard against pulling off the tie bar return spring (fig. 45).

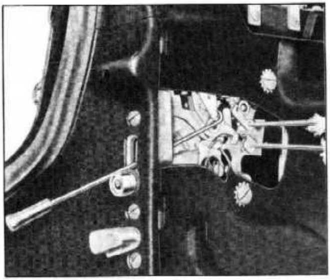


Fig. 44—Removing Lock from "Free-Wheeling"

Fig. 45—Door Lock Assembly

In a few instances it may be found that when the control lever is in "free-wheeling", the inside remote control handle will not operate the door lock regardless of the position of the door lock button. This condition results from too much end play in the remote control linkage and is caused by improper adjustment of the door lock remote control mechanism. To correct: Remove the door trim pad, loosen the (3) attaching screws "A" (fig. 5) holding the regulator to the door inner panel and rotate the remote control mechanism to remove all play in the linkage and thus provide full effective travel for the remote control handle.

1953 Models

Since the 1953 model rear doors do not have ventilator assemblies, the free-wheeling linkage in the door lock can be adjusted through the door window opening as follows:

1. To adjust the free wheeling link on 1953 Chevrolet four-door styles, lower the rear door glass and insert a screw driver or suitable tool through the opening (fig. 46). The free wheeling link may then be adjusted as follows:

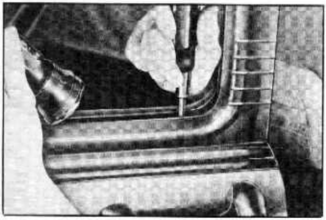


Fig. 46—1953 Free-Wheeling Adaption

2. To place lock in free-wheeling, trip link in the direction indicated by the arrow (fig. 47).
3. To place lock in conventional operating position, trip link in the direction indicated by the arrow (fig. 48).

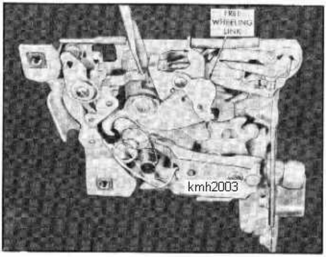


Fig. 47—Lock to "Free-Wheeling"

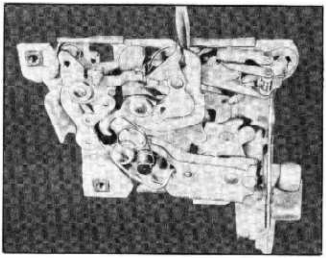


Fig. 48—Lock to Conventional Operation

CONVERTIBLE AND SPORT COUPE ADJUSTMENTS

CONVERTIBLE TOP

The adjustment of the Convertible Top must be planned by determining whether one or several adjustments are necessary to obtain the desired results.

Front Roof Rail Corner Brace

Should the top be too far forward or not forward far enough at the windshield header, it may be adjusted as follows.

1. Raise top slightly to clear windshield header dowels.
2. Loosen two corner brace attaching bolts "A" and "B" (fig. 49).

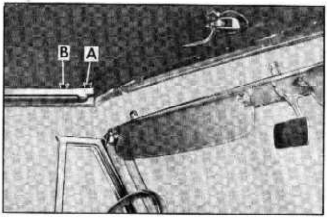


Fig. 49—Corner Brace Adjustment

3. Slotted holes in corner brace allow a forward or rearward movement of the top front roof rail.

If the top front roof rail is too high with the top in the raised position and results in difficult locking action or an inadequate weatherseal at the windshield header, adjust as follows:

1. Remove corner brace attaching bolts "A" and "B".
2. Place a shim between the side roof rail and corner brace at bolt "B" location. Reinstall bolts and check.

Control Link Adjusting Plate (1953 Convertibles)

If the side roof rail is too high or too low in relation to top of door or quarter window it may be adjusted as follows:

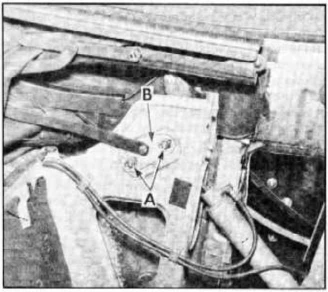


Fig. 50—Control Link Adjusting Plate

1. Lower top approximately halfway.
2. Loosen two attaching nuts "A" and without changing the fore and aft location of the plate "B," shift the plate up to lower the side roof rail or down to raise the side roof rail (fig. 50).

If the top in the folded position is not down far enough in the top well, the linkage is not resting on bumper and may be adjusted as follows:

1. Loosen two attaching nuts "A" and without changing the up and down location of the plate "B" shift the plate to the rear, retighten nuts.

NOTE: Adjustment made at the control link adjusting plate should be made in a straight line with no rotational movement of plate.

Hinge Support (1953 Convertibles)

The following adjustments may be made on the side roof rail if it is too high or too low at the rear quarter window area.

1. Loosen four bolts "A" securing the hinge support (fig. 51).
2. Move hinge support in desired direction and retighten bolts. Check rail alignment.

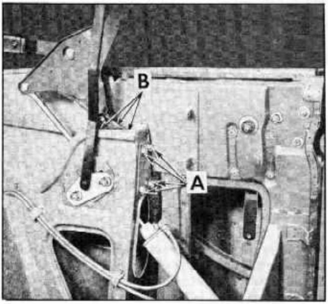


Fig. 51—1953 Folding Top Hinge Adjustments

Female Hinge (1953 Convertible)

Where there is too much or too little space between top and rear quarter window, or the top is over too far to the side at the front roof rail, adjust as follows:

1. Loosen three bolts "B" located down in quarter (fig. 51).
2. Shift hinge in desired direction and retighten bolts.
3. A slight rotational movement is provided at this point to give a lateral correction at the front roof rail.

Windshield Header Dowels

If a hard locking top or poor fit of top at windshield header is encountered, adjust as follows.

1. Loosen set screw "A" in header dowel and turn dowel up or down to desired position. Retighten set screw and check operation (fig. 52).

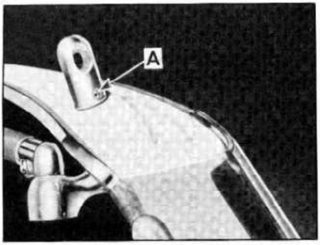


Fig. 52—Windshield Header Dowel Adjustment

Control Link Adjusting Plate (1949-52 Convertibles)

When the side roof rail is too high or too low in relation to top of the door or quarter windows adjust as follows.

1. Lower the top halfway.
2. Loosen three bolts "A" and shift the plate "B" downward or upward. A downward movement will raise the side roof rail and an upward movement will lower it (fig. 53).

If the top is not down far enough in the top compartment well to touch the bumpers "C" when in a folded position it can be adjusted as follows:

1. With the top in a folded position loosen three bolts "A" and shift the plate directly rearward. Do not change the horizontal position of the plate.

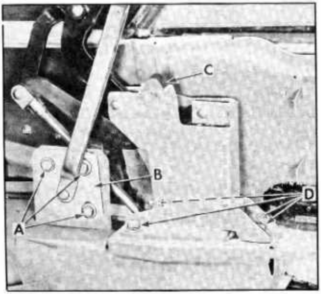


Fig. 53—1949-52 Hinge Fulcrum and Control Link Plate

Top at Hinge Fulcrum (1949-52 Convertibles)

If the spacing is too great or too little at the rear quarter windows or the top is over too far to the side at the front roof rail, adjust as follows.

1. With the top raised half-way loosen bolts "D", this allows a forward or rearward movement of the hinge fulcrum and permits the desired adjustment (fig. 53).
2. A slight rotational movement at the hinge fulcrum permits a lateral movement of the front roof rail.

Side Roof Rail Weatherstrip

An adjustable three sectioned side roof rail weatherstrip is used on convertibles. The weatherstrips are secured to their retainers with screws, the retainers are attached to the side roof rails with screws and nuts. The front weatherstrip section located over the door, also has a metal insert molded into the weatherstrip which is attached to the front roof rail corner with screws.

If the weatherstrip is in or out too far for proper contact with the door ventilator, door window or rear quarter window, adjust as follows.

1. Remove screws from groove of weatherstrip and remove weatherstrip.
2. Loosen the screws securing the weatherstrip retainer to the side roof rail. The screw attaching nuts are loosened along the top of the side roof rail.

Shift weatherstrip retainer "in" or "out" as required, then tighten screws.

NOTE: The attaching screw holes in the retainer may be elongated if necessary to secure additional adjustment in extreme cases.

If the weatherstrip is too high not permitting contact with the door ventilator, door glass or rear quarter window, adjust as follows.

1. Remove weatherstrip from its retainer.
2. Loosen the screws and/or nuts securing weatherstrip retainer to side roof rail.
3. Insert waterproof shims between weatherstrip retainer and side roof rail, then tighten screws.
4. Apply 3-M Caulking Compound or its equivalent along the base of the side roof rail weatherstrip retainer, where retainer and side roof rail are joined.
5. Install weatherstrip in retainer and check alignment.

SPORT COUPE
Side Roof Rail Mechanical Sealing Strip—Removal

1. Remove two screws and front corner outer sealing strip.
2. Remove remaining attaching screws and mechanical sealing strip from side roof rail.

Installation

1. Clean old sealer from side roof rail and from rubber gasket.
2. Tape "flipper" of mechanical sealing strip in a closed position and apply 3-M Weatherstrip Adhesive or its equivalent to the cementing surface of the sealing strip.
3. Apply adhesive to underside of rubber gasket.

NOTE: The hinge of the mechanical sealing strip and the lip of the rubber gasket should be free of adhesive.

4. Position rubber gasket on mechanical sealing strip and place a ribbon of 3-M Caulking Compound along the outer edge of the rubber gasket.
5. Install sealing strip to side roof rail. Also install front corner outer sealing strip.

Adjustment

The attaching screw holes of the sealing strip are slotted to allow an in or out adjustment of the sealing strip.

If the flipper has a tendency to bind or be slow operating, loosen the attaching screws one at a time until the screw causing the bind is located and the flipper snaps open. Place a slotted shim between the roof rail and the rubber gasket, around the shank of the attaching screw. Retighten screws and check operation of the sealing strip.

HYDRO-LECTRIC SYSTEM

1949-50 MODELS

Two different motor and pump units were used on 1949-50 Convertibles. These units, the Dura and the Moraine, are similar in outward appearance but differ in the design of the pump. They are incorporated into a vented hydraulic system and operate at maximum fluid pressures of 250 to 260 psi. These units are readily identified by the nameplate on side of motor.

CHECKING FLUID LEVEL

1. Move spring wire bail out of position and lower reservoir.
2. Check fluid level and if necessary add Delco Super No. 11 Brake fluid.
3. Replace reservoir.

REMOVING FLUID FROM COMPLETE SYSTEM

1. Disconnect positive cable from battery.
2. Remove and drain reservoir. Place a container under the pump to catch the hydraulic fluid and manually operate the top up and down, in conjunction with the top operating valve, to drain fluid from lift cylinders and lines.

REPLACING FLUID IN SYSTEM

Hydraulic fluid must be changed once a year, preferably in the fall where the pump reservoir is vented to the atmosphere. Do not overfill reservoir.

1. Fill reservoir to specified fluid level with recommended fluid and install on pump.
2. Operate top control valve, moving top through its up and down cycle.
3. Remove and refill reservoir and repeat operation of the top. This is necessary to completely refill lift cylinders.
4. Repeat this operation until Hydro-Lectric hydraulic system is refilled. Continue up and down top travel cycle several times to eliminate air trap in line and recheck fluid level.

FOLDING TOP OPERATING VALVE—Replace

1. Disconnect positive battery cable.
2. Disconnect control rod "A" by loosening set screw at operating valve under the hood on the left hand side of the cowl (fig. 54).
3. Disconnect two wires from control valve.
4. Disconnect and cap four hydraulic lines "B" at valve.

NOTE: Keep cloth handy to absorb hydraulic fluid dripping from lines.

5. Remove three screws retaining valve to support and remove valve.
6. To install, reverse this procedur.. Seal coupling threads with 3M Hydraulic Tubing Sealer or its equivalent.

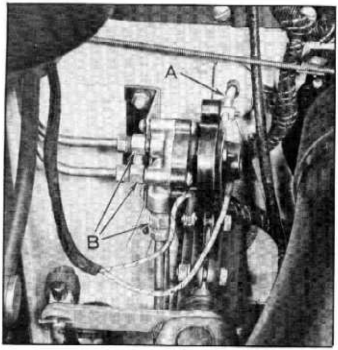


Fig. 54—Top Operating Valve

FOLDING TOP CONTROL ROD—Adjust

The folding top control rod is adjusted to permit at least 1/8" over-travel in either direction to insure the electrical switch will make positive contact.

1. Loosen set screw retaining control rod at operating valve.
2. Position the control rod so there is 1" minimum to 1 3/32" maximum between the ferrule on the control rod support at the instrument panel and the forward end of the control rod knob.
3. Tighten control rod set screw at valve.
4. This adjustment gives the 1/8" over-travel.
5. If the control rod is not long enough for this adjustment, remove control rod from its support assembly by removing the retaining nut at the rod support bracket.
6. Loosen the stop nut and with the rod secured in a vise, lengthen the rod the desired amount by unscrewing the control knob assembly.
7. Replace control rod and complete adjustment.

TESTING PROCEDURE

The following procedure may be used for testing and checking the operation of the hydraulic and electrical circuits of the 1949-50 Hydro-Lectric System.

Pump Pressure

Faulty, erratic operation of the Hydro-Lectric System may be due to lack of hydraulic fluid in the pump reservoir. For efficient operation, fluid level should be checked and additional fluid added as indicated by the fluid level mark on the side of the reservoir. Foreign matter obstructing the pressure relief valve or internal gears of the pump may also cause low pressure resulting in slow operation of the various power units. Figure 55 shows the method of testing the fluid pressure with a pressure gauge connected to the pressure port of the pump.

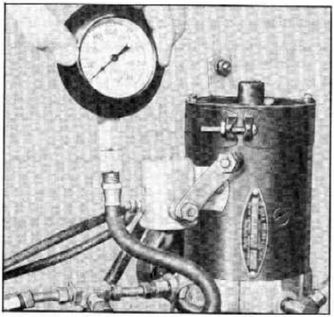


Fig. 55—Pump Pressure Check

1. Connect the pressure gauge to one of the pressure ports of the operating valve. If the top is up use pressure port "A" and if the top is down use pressure port "B" (fig. 56). With the top up and the pressure gauge installed to pressure port "A", push the control knob in. Hold the control in this position for a few seconds and note the pressure reading which should be 250-260 psi. If pressure readings are below the specified readings and the pump pressure is normal the trouble lies either in the valve itself or the hydraulic lines leading to the valve. Disassemble and check for obstructions within the valve body, also check hydraulic lines for kinks or passage obstructions.
2. After checking pressures at pump and control valve, install pressure gauge to either port of the lift cylinder. Operate the control valve and after top has completed its travel cycle note the pressure reading. If pressure readings are below specified pressures, inspect hydraulic tubing, power cylinder connecting tees and the lift cylinder for obstructions, leaks, etc. In the event the lift cylinder is at fault replace the lift unit.

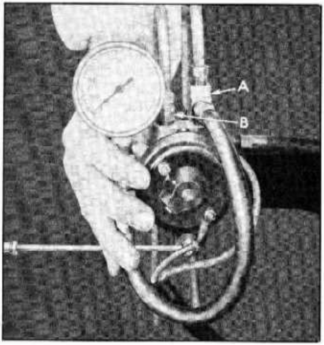


Fig. 56—Pressure Check at Valve

Electrical Circuit

1. Check the battery.
2. Visually inspect wiring for loose connections, corrosion of switch contact or terminal, shorts or broken wires.
3. Check operation of motor solenoid by connecting one end of a heavy jumper wire to the battery wire terminal of the solenoid and the other end to the solenoid switch wire terminal. If the solenoid is operating satisfactorily a click will be heard and the motor will operate. If the click is not heard the solenoid should be replaced.
4. Use a Voltmeter to test the electrical circuit through the folding top control valve.
   a. Connect the positive lead of the tester to the feed wire terminal of the valve and ground the negative lead. The voltage should approximate the battery voltage within .2 of a volt. If voltage reading is lower check for short, break, etc.
   b. Then connect the positive lead of the Voltmeter to the other terminal of the valve and ground the negative lead. The voltage drop should not exceed .2 of a volt when the valve control rod is operated.
   c. If there is no voltage registered, check control rod over-travel adjustment. If there is an excessive voltage drop check the electrical contacts of control valve for corrosion.

SERVICE OPERATIONS

MORAINE PUMP

Disassembly and Inspection

1. Disconnect positive terminal of battery and inspect pressure relief valve by removing plug, stop washers, and compression spring (fig. 57). Pressure adjustments may be made at the valve by adding washers to increase pressure or removing washers to reduce pressure.

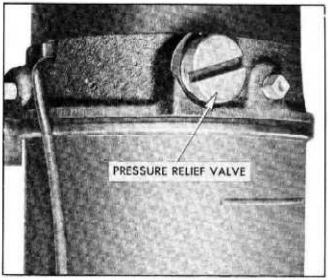


Fig. 57—Moraine Pressure Relief Valve

2. Remove motor and pump assembly from its mounting under hood of car after first removing the pump reservoir and wire bail. Check the reservoir gasket. Lay motor and pump assembly on a bench and remove the pump cover assembly attaching screws and washers. Remove and inspect cover assembly for clogging and wear.
3. With a small screwdriver or similar tool, carefully and uniformly pry up the outer rotor of the pump. The inner rotor may then be lifted off the pump motor shaft. Inspect these parts for wear as well as for presence of dirt or foreign matter, either on rotor parts or on the exposed face of the pump body assembly.
4. Check the ball and valve seat in pump assembly. The ball and valve assembly may be removed by first removing pressure relief plug, stop washers and spring, then inserting a hook type tool or stiff hooked wire into the pressure relief port and pulling out valve. Then tip the motor and pump over allowing the ball to drop out. If the valve is seated too snugly in position, it may be removed by inserting the tool into the small

hole at bottom of rotor gear well and pushing out.

5. To remove the pump body assembly from the motor, first place scribe marks across junction of motor housing and pump body assembly, then loosen the two long bolts from the motor end of the unit and remove pump body assembly. Check motor shaft seal and filter vent. This pump body assembly, less the cover, is serviced as a unit.
6. To reassemble the Moraine pump, reverse the above procedure.

NOTE: Two types of rotor assemblies were used in 1949. Each type required a different pump body and were not interchangeable. Identification of rotor type is made by part number stamped on identification plates on motor housing.

DURA PUMP

Disassembly and Inspection

1. With a pressure gauge, as illustrated in figure 55, check the pump fluid pressure according to pressure specifications as outlined. Remove the pressure relief plug, washers and compression spring (fig. 58). Inspect this assembly for possible obstruction or damage to spring. Check the adjustment of pressure to within operating range, by varying the number of washers on the plug. Adding washers decreases the pressure, removing washers increases the pressure.

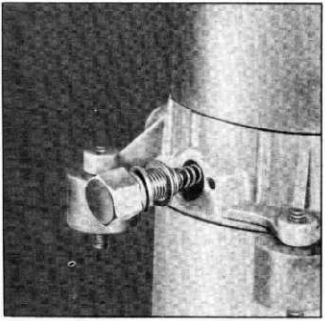


Fig. 58—Dura Pressure Relief Valve

2. Disconnect positive terminal of battery and remove the spring wire bail and pump reservoir containing fluid. Remove motor and pump assembly from its attachment on outer dash panel. Check the reservoir gasket. With motor and pump assembly placed on a bench, remove the screws holding diffuser and retainer to bottom of intake and discharge tubes. Clean these parts. Next, remove the rotor pump bottom plate (rotor cavity plate).
3. Remove and check the rubber sealing ring. Then remove each of the parts in the rotor cavity as follows: Rotor plate spider spring, rotor plate, inner rotor and outer rotor. Inspect for wear of parts and presence of dirt or foreign material.

4. Remove the port plate from bottom of rotor cavity and inspect. If port plate "tab" has been damaged or sheared off, replace with a new steel port plate. When replacing, make sure tab on port plate enters the notch at bottom of rotor cavity.

CAUTION: If tab has sheared off the original port plate, check the rotor cavity thoroughly. This small piece of metal may be lodged in the pressure outlets and if not removed will cause further operating irregularities.

5. Be sure and clean rotor cavity thoroughly. Inspect the pressure relief valve previously explained by removing the plug, washers, and compression spring. With a hooked wire, poke out the valve through opening in bottom of cavity. Clean out any dirt or foreign matter from valve and valve seat. Note the location of the notch at the bottom of the cavity for positioning the tab on the port plate.
6. To remove the pump housing assembly from the motor unit, remove the four screws and washers on pumps equipped with Autolite motors, or the two long bolts from the end of motor unit on pumps equipped with Delco motors. To facilitate reassembly, scribe the relative positions of pump and motor housings before removal.

Hydraulic Motor

In cases where the cause of failure or faulty operation of the Hydro-Lectric System appears to be in the electrical portion of this system, a routine check of the circuit should be made. If as a result of this check, the cause is traced to the hydraulic motor unit, a complete testing of the motor parts should be undertaken. However, before proceeding with such testing, make sure all contacts at ends of both ground and solenoid switch connector straps are tight and free of corrosion.

NOTE: A quick check to determine if the cause lies within the motor (assuming battery and battery connections have been checked) is to place a jumper wire between the battery terminal of the motor solenoid switch and the terminal where the solenoid switch connector strap is attached to the motor housing. If the motor does not start, the trouble lies within the motor, and this unit should then be disassembled and tested as outlined in "Starting Motor Tests" in this manual.

1951-53 MODELS

A "sealed-in" Hydro-Lectric system is used to operate the folding top of the 1951-53 Convertible. The pump is not vented to the atmosphere, as a result, periodic hydraulic fluid replacement in the system is unnecessary. This system is self-air bleeding, should air become trapped in the lines, a few cycles of top operation will expel the trapped air into the reservoir.

The reversible motor used with this system requires 95 ampere when operating the pump to develop a fluid pressure of 230 psi. The wiring harness used in the electrical circuit of the system consists of heavy No. 8 stranded wire, due to the large electrical load that the harness must carry when the system is in operation. It is imperative when conducting electrical checks or replacing sections of the harness that No. 8 wire is used.

The pump employed by this system is a spur gear type and the pressure developed by the pump is proportional to the speed of the motor therefore no pressure relief valve is used. The pump should deliver a maximum fluid pressure of 220 to 260 psi and should be capable of raising or lowering the top through a complete up or down cycle in 15 seconds at a maximum fluid pressure not exceeding 250 psi.

Motor and Pump Assembly

The Hydro-Lectric motor and pump assembly consists of an electric motor, a spur gear pump and a fluid reservoir assembled vertically into a single unit. The fluid reservoir is located at the top of the assembly, which is mounted with rubber attaching grommets on the rear compartment lower division panel under the folding top compartment. The entire unit is sealed and is not vented to the atmosphere.

An exploded view of the motor and pump assembly is shown (fig. 59). The component parts of the assembly may be identified as follows:

A. RESERVOIR RETAINING NUTS
B. PUMP TUBE "O" RINGS
C. RESERVOIR AND FASTENER GROMMETS

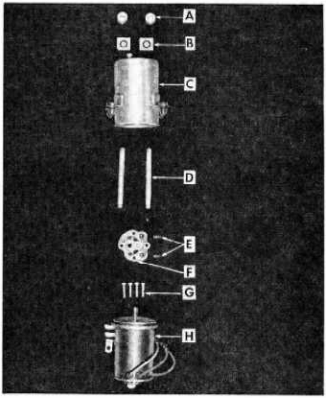


Fig. 59—Exploded View of 1951-53 Motor and Pump

D. PUMP TUBES
E. VALVE BALL CHECK SPRINGS
F. SPUR GEAR PUMP UNIT
G. PUMP ATTACHING SCREWS
H. MOTOR UNIT AND END PLATE

Hydraulic Pump

A spur gear pump is used in conjunction with the reversible type motor. This pump employes

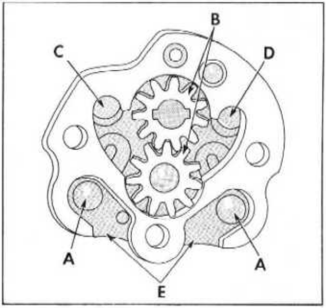


Fig. 60—Spur Gear Hydraulic Pump

only four moving parts, two spur gears and two ball-spring valves. The fluid pressure developed by this pump is proportional to the speed of the motor. A low battery will therefore result in a "sluggish" acting pump. Figure 60 shows the component parts of the pump assembly, as viewed from the motor attaching side. These parts may be identified as follows:

A. BALL AND SPRING VALVE
B. SPUR GEARS
C. PORT (LOWER CYLINDER END)
D. PORT (UPPER CYLINDER END)
E. PUMP OPENINGS TO RESERVOIR

Folding Top Control Switch

The operation of the convertible top is controlled by a self-centering control switch. The switch is mounted at the bottom of the instrument panel and is connected to the motor and pump assembly with two electrical leads. By pushing the control switch knob forward, the current passes from the battery, through the top control switch, and out through the green lead to the motor. The motor and pump then operate to raise the top. By pulling the control switch knob rearward, the current passes from the battery, through the switch, and out via the red lead to the motor. This causes the motor and pump to operate in the opposite direction and lower the top.

SERVICE OPERATIONS

Folding Top Lift Cylinder (1949-1953)

Removal and Installation

NOTE: The top should be in the raised or full "up" position during this operation.

1. Disconnect the positive battery cable.
2. Remove rear seat cushion and seat back.
3. Remove rear quarter side trim panel.
4. Remove nut and bolt connecting lift cylinder piston rod to top linkage.
5. Push the piston assembly down the bottom of the cylinder.
6. Vent hydraulic system at reservoir on 1951-53 models.
7. Disconnect hydraulic tubing from top and bottom of folding top lift cylinder and cap ends of hydraulic lines to prevent dripping of fluid.
8. Remove the cotter pin and the clevis pin securing lift cylinder to floor pan, then remove cylinder.
9. To install, reverse the above procedure. Apply a suitable hydraulic thread sealer to the threads of all male fittings. Connect battery cable or switch wire and check operation of top. Inspect all tubing connections for leaks and check the hydraulic fluid level.

Motor and Pump Assembly

Removal and Installation

1. Raise the folding top to the full "up" position.
2. Remove cover plate from right side of folding top compartment bottom panel (fig. 61).
3. Remove rear seat cushion and back, and fold back the insulating pad on right side of body.
4. Disconnect the positive battery cable.
5. Remove reservoir filler cap to vent hydraulic system.

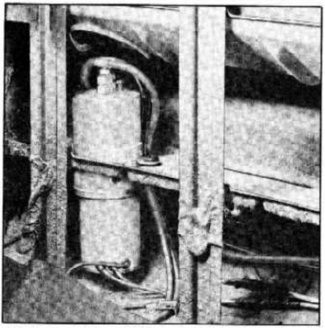


Fig. 61—Hydraulic Motor and Pump Installation

NOTE: Venting of the reservoir is necessary in this "sealed-in" system to equalize the pressure in the reservoir to that of the atmosphere and avoid the possibility of hydraulic fluid being forced under pressure from the disconnected lines.

6. Disconnect hydraulic lines from top of pump reservoir and cap open fittings to prevent dripping of hydraulic fluid. Keep a cloth handy to absorb any leakage of fluid.
7. Disconnect the red and green motor lead wires and the black ground wire.
8. Loosen the four rubber grommets, from rear compartment lower division panel, then lift motor and pump assembly and remove through folding top compartment opening.
9. To install, reverse the above procedure.

Apply 3-M hydraulic line sealer or a suitable hydraulic pipe sealer to the threads of all male fittings.

10. To refill the hydraulic system, fill the reservoir to the prescribed level with hydraulic fluid, Delco Super No. 11 and operate the top through several cycles, check the reservoir and add fluid, repeat this operation as often as necessary. One filling of the reservoir may not be sufficient, as the fluid capacity of the two top lift cylinders is almost double that of the reservoir.

TESTING PROCEDURE

Pump Pressure

The following information on testing the hydraulic units may be employed to locate any trouble in this portion of the Hydro-Lectric System.

NOTE: When testing fluid pressure with a hydraulic pressure gauge on the 1951-53 "Sealed-in" hydraulic system, it is necessary to have a ¼" connector fitting on the gauge to hook up to the hydraulic lines. If using a gauge equipped with ⁵⁄₁₆" fittings of the type used for testing 1950 or earlier convertible models, an adapter will have to be used.

1. With the top in a raised position, remove the inspection cover plate from folding top compartment, then remove filler plug which vents the system. Check fluid level in reservoir, which should be within two inches of the top of the reservoir. Fill if necessary with Delco Super No. 11 hydraulic fluid and replace filler plug.

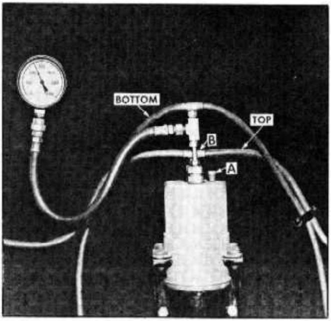


Fig. 62—Checking Pump Fluid Pressure

2. Remove rear seat cushions and quarter side trim. Operate the top, observing the operation of the lift cylinders. If the top movement appears sluggish or is binding, then one of the lift cylinders is inoperative or is operating too slowly. The condition could be the result of a defective cylinder or clogged hydraulic line. Inspect the hydraulic tubing and couplings for obstructions. Binding may also be the result of mechanical fault.

3. To check fluid pressure in hydraulic lines with the top in a raised position install pressure gauge at "A" (fig. 62). Where operation of the top through the down cycle is to be checked, lower the top and install gauge at "B."

   Operate the top switch and the pressure should read 220 to 260 psi. If pressure indicated is below this prescribed maximum range, either the pump is not delivering required pressure or there is fluid leakage past the piston in one or both cylinders.

   NOTE: Check the fluid pressure delivered by the pump after the top movement is completed.

4. To check the fluid pressure delivered by the pump, install pressure gauge (fig. 63) in hydraulic lines leading to the bottom of lift cylinders. Pinch or "kink" hydraulic tubing "A" and "B" to completely shut off fluid flow to the bottom of each of the folding top lift cylinders, then push switch knob forward and hold a few seconds. The pressure should read 220 to 260 psi. The fluid pressure to the top of lift cylinders is checked by installing pressure gauge in hydraulic lines leading to top of lift cylinders, pulling switch knob rearward and pinching or "kinking" hydraulic lines "C" and "D". If pressure reads below the prescribed on either check, then the trouble lies within the pump unit which must be repaired or replaced. If however the pump pressure reads within the prescribed maximum range, then fluid must be leaking past the pistons in one or both lift cylinders and the following check should be made.

5. With the top in a raised position and pressure gauge installed in lines leading to the bottom of the lift cylinders, test for leakage past the piston in cylinder No. 2 by pinching lines "A" and "C" so as to shut off fluid flow to cylinder No. 1 (fig. 63). Push control switch knob forward and hold a few seconds, if the pressure gauge reads 220 to 260 psi, then cylinder No. 2 is not defective. However, if the pressure reads below the prescribed range, then the fluid is leaking

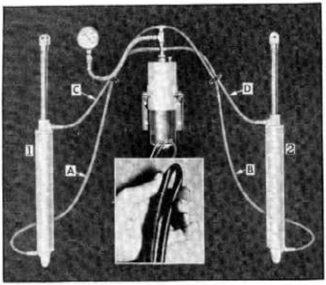


Fig. 63—Fluid Pressure Checking Points

past the piston in cylinder No. 2 and the cylinder must be replaced. To test cylinder No. 1, repeat this procedure and pinch off lines "B" and "D." With the top in a fully lowered position and the pressure gauge installed in lines leading to the top of the lift cylinder, pull control switch knob rearward and repeat the procedure.

Electrical Circuit

1. Check the battery according to the recommended service procedure. A partially discharged battery will result in a sluggish operating (low r.p.m.) Hydro-Lectric pump.
2. Ground one lead of a light tester and check switch battery terminals. The two terminals are connected by a metal strip and the hot battery lead is connected to one of the terminals. If the test light does not light up on contact, trouble is in the hot battery lead and the switch to battery lead should be repaired or replaced.
3. Disconnect switch to motor wires from terminals and with one lead of tester grounded, check switch operation by moving switch control either in or out and testing the respective motor wire terminal. If test light fails to light, repair or replace switch.
4. Checking Switch to Motor Lead Wires. Disconnect the green and red switch to motor lead wires at motor, ground one tester wire. Push top switch control knob forward and apply tester to the end connector of the green (up cycle) lead wire. Pull control knob rearward and apply tester to end of red (down cycle) lead wire. If tester fails to light in either case, the trouble is in the lead wire or wires from the switch and repairs should be made to this part of the circuit.
5. Checking Motor Unit. If, after the above test the lead wires from the operating switch to the motor indicate a flow of current according to the light tester, and the motor unit still does not operate when the switch is moved for "up or down" operation, a final check of the motor unit itself should be made. First check the motor ground strap for proper connection to the body, then use a No. 8 stranded "jumper" wire to test as follows. Connect one end of "jumper" to battery positive pole and connect the opposite end to the motor green wire terminal. The motor should operate to raise the top. Then move "jumper" wire over to motor red wire terminal, which should operate motor to lower top. If the motor fails to operate on either or both electrical checks, the motor should be repaired or replaced. If the motor operates with the "jumper" wire but does not operate when connected to the switch to motor leads, even after current flow through these leads has been indicated, the trouble may be caused by reduced current flow, resulting from damaged lead wires somewhere between the motor and the battery terminals. Reconnect red and green switch lead wires to motor after completing check.

CARE OF TRIM

This section contains general directions for the proper care of the interior trim of the car and the convertible top.

Two types of cloth material are or have been used in the Chevrolet; Broadcloths and Pile fabrics. They are distinguished in part by flat woven yarns as in the broadcloths and pile surfaces upright fibers densely woven at right angles to the base of the fabric.

General Instructions

Dirt and dust particles should be removed every few weeks, or more often if car upholstery is subject to constant hard driving. This can be done with a whisk broom, carpet beater or vacuum cleaner.

It is essential that stains be removed from upholstery as soon as possible. If they are allowed to remain on the fabric for some time, they often become oxidized and removal is difficult, if not impossible.

There are two basic types of popular cleaners available to car owners: (1) Volatile Cleaners, colorless liquids, generally having carbon-tetrachloride or naphtha as a base. (2) Alkaline Cleaners which have a soap base.

The Volatile Cleaners are recommended since they have great solvent powers for grease, oil and road grime. Alkaline Cleaners generally emulsify stains satisfactorily but at possible risk to the removal of the color of finish of the fabric.

Cleaning Pile Fabric

Soap and water may be used in cleaning pile fabrics, providing the instructions which follow are adhered to closely. A neutral non-alkaline soap should be used with lukewarm water. The suds should be frothy, not watery. They should be applied in moderate quantities with a damp cloth, sponge, or soft brush. Rub with the pile, not against it. Soapsuds should be removed with a clean, damp cloth or sponge. Then wipe the surface several times with a dry cloth. While still damp, brush lightly with a whisk broom or brush of medium stiffness. Permit air to circulate freely over the wet upholstery. When dry, brush again, against the pile.

The surface of pile fabrics can also be freshened by steaming. Spread a damp cloth over the surface and touch a hot flatiron to it lightly. While still damp, the upholstery should be brushed lightly with a whisk broom or brush of medium stiffness. When thoroughly dry, the material should again be brushed. Brush against the pile.

Cleaning Broadcloths

Soap and water, regardless of the basic type of soap, is not recommended for cleaning flat cloths, particularly broadcloths.

1. Carefully brush all loose particles of dirt and soil.
2. Immerse small cloth in volatile type cleaning solution, wring out thoroughly, open cloth and allow medium evaporation.
3. Place cloth on soiled spot, do not rub, apply slight tapping pressure, several times. This will pick up particles which are too embedded to be removed in the brushing operation. This operation should be repeated several times—in each instance using a clean area of the cloth.
4. Immerse a new cloth in cleaner, wring out thoroughly, open and allow to evaporate until barely damp. Apply increased pressure and rub soiled area in a backward and forward motion. The cleaning cloth should be reversed several times in this operation.
5. Immerse third cloth, wring out, allow evaporation and apply to both the soiled and the area surrounding same, using a light, brisk motion.
6. Repeat brushing operation.
7. If a cleaning ring should form, the entire area of the assembly which is being cleaned should be thoroughly brushed and gone over lightly with the solvent.

Safety Precautions for Cleaning Fabrics

1. Do not use as a cleaning solvent any gasoline which is colored or which contains tetraethyl lead.
2. Do not use any of the following bleaches or reducing agents, as their use tends to weaken the fabric and change or bleach the color of the goods: Chloride of lime, Javelle water, Hydrogen peroxide, Sodium Hydrosulphite, Potassium permanganate, Chlorine or chlorine water, Sulphurous acid (sulphur dioxide), Sodium thiosulphate (Photographers' hypo).

3. Carbon tetrachloride is non-inflammable. Most other types of cleaning solvents are inflammable; and every precaution and care must be exercised in handling them.
4. Do not permit cleaning solvents to come in contact with the skin on the upper arms or the body. Such contacts sometimes produce local irritation, which is unpleasant, if not serious.
5. Do not breathe the fumes of cleaning solvents, since they are usually toxic in large quantities.
6. Keep oxalic acid out of reach of children and away from the mouth. It is a deadly poison.
7. There are on the market a great number of inexpensive, slow-drying cleaners of the clear type which are not recommended. Care should be taken, in the selection of a cleaner for the upholstery in your car, to select a product of proven reputation and quality.
8. Do not use too much cleaning fluid; some interior trim assemblies are padded with rubber, and volatile cleaners are generally solvents for rubber. The application of too much cleaner may destroy these rubber pads or cause the rubber itself to penetrate the upholstery fabric and soil it.

Cleaning Genuine Leathers and Imitation Leather

Care of genuine leather and imitation leather is a relatively simple but important matter. If dirt accumulates on the surface, this generates into a hard grit which under pressure will cut the finish and cause the leather to crock or bleed color. The surface should be gone over occasionally with a dry cloth and if dirt should accumulate, the following cleaning instructions should be used:

1. Lukewarm water and a neutral soap should be used and a thick suds worked up on a piece of cheesecloth and applied to the surface.
2. The operation should be repeated, using only a damp cloth and no soap.
3. The leather should then be wiped dry with a soft cloth.

Polishes and cleaners used for body finishes, volatile and other clear cleaners, naphtha, furniture polishes, oils, varnishes or household cleansing and bleaching agents should never be used.

Cleaning Convertible Top Materials

The top materials are easily cleaned and kept attractive if the proper methods of cleaning and care, are exercised. Generally, soilage can be removed with art gum or crude rubber. If dirt is embedded in the fabric, the top should be thoroughly brushed with a whisk broom. In this brushing a minimum of pressure should be applied to those areas of the assembly which cover the metal bows of the top structure, since heavy abrasion will disturb the surface of the material appreciably, causing an unsightly appearance. After brushing, the top should be washed thoroughly with a neutral soap suds and lukewarm water. A cloth or brush with soft bristles should be used. Generous quantities of clear water should then be applied over the surface to remove any soap which might remain. Volatile and other clear cleaners, naphtha, gasoline or household cleaning and bleaching agents should never be used.

After cleaning, always be sure that the top is thoroughly dry before folding it down. Folding the top while still wet or damp may cause mildew and unsightly wrinkles.

This precaution should also be taken by the owner in service. After rainfall, the top should be allowed to dry out thoroughly before being collapsed because, in addition to causing mildew and wrinkles, the top material will possibly shrink, after such abuse, to a degree that it may be impossible to return the top structure to its normal upright position.

Cleaning Carpet Floor Coverings

To clean carpet floor coverings, they should first be brushed thoroughly. If soil remains, a volatile type cleaner is recommended. The cleaning operation should be repeated for heavily embedded stains.

Extreme care should be taken by the owner to make certain that the carpets are not "soaked" with the cleaner. This may cause deterioration of the rubber compound backing construction of some carpets.

Neutral soap and water may also be used, at risk of color removal, but the owner is cautioned to make certain that the carpets are thoroughly dry before closing all window and door openings to prevent possible mildew of the carpet.

Cleaning Convertible Plastic Back Window

1. To remove road dust use a soft cloth moistened with water and wipe crosswise of the window to remove superficial dust.

   NOTE: Do not use a dry cloth or paper cleaning tissue.

2. To clean the back window use cold or warm water and a mild neutral soap suds. After washing, rinse with clear water and wipe with a damp cloth.

   CAUTION: Never use cleaners of alcoholic or chemical content as they may have a deteriorating affect on the plastic or may spot the Duco finish below the window.

3. Do not use a scraper to remove frost, ice or snow from the plastic back window. Warm water may be used in an emergency.

KEYS AND LOCKS

Lock cylinders are furnished for service uncoded, this necessitates the coding of all replacement lock cylinders.

The side bar type lock (fig. 64) is used for the ignition, door and trunk lid on passenger cars and for ignition and door locks of trucks. Glove compartment locks are wafer tumbler single bitted type having 4 tumblers on passenger and 5 tumblers on truck. These locks are all coded the same allowing for usage of only one key for all locks on the vehicle. To protect owners, automobile lock manufacturers stamp the lock number on the lock core, shaft, etc. where they will not show until the lock is removed. The location of lock code numbers on the various type locks is shown in Figure 65.

Service personnel may be required to cut new keys by code or key number when the owner is not always in possession of the key number or he may be required to cut a new key to fit the lock when an owner has lost his key and has no record of the key number. Simply by removing the door lock, the key number may be obtained from the lock core, shaft, etc. which will be the same on all of the other locks.

In addition, when a lock cylinder requires re-

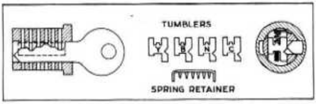


Fig. 64—Slide Bar Lock

placement the lock code number may be obtained either from the key, if available, or from the old lock cylinder which is being replaced.

Once the code number of the lock is obtained, look up this number in a key cutting code book.

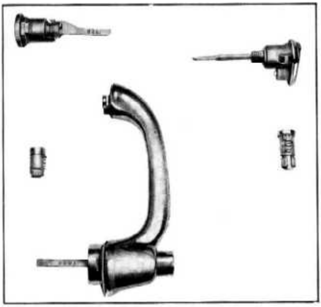


Fig. 65—Locations of Lock Code Numbers

There are two types of code booklets in general use, one which lists the cutting code by letter C, N, B and Y. Numbers or letters are always recorded from the head of the key to the end.

Numbers may be transposed to letters to numbers as follows:

Code Book-Numbers	Code Book-Letters
1	C
2	N
3	B
4	Y

All side bar locks furnished to the field by the Parts Department are uncoded, that is, they are furnished without tumblers, springs or spring retainers; these parts are serviced separately. The tumblers come in four different depths indicated by colors "C" for copper, "N" for nickel, "B" for black and "Y" for yellow.

The side bar locks as used on Chevrolets have six tumbler positions, and in looking up the cutting code, the following may be used as an example. After key code number is determined, either from key or from number stamped on lock cylinder refer to your code book and record the key cutting information as follows:

Key of lock code Number	Key cutting code Numerical	Key cutting code Alphabetical
8109	2-3-2-1-2-4	N-B-N-C-N-Y
Cutting or Tumbler position from head of lock.	1-2-3-4-5-6	1-2-3-4-5-6

The numbers or letters (depending on code book) which are written above the cutting or tumbler position indicate the different color tumblers which are to be dropped into each tumbler slot of the lock: "C"—copper, "N"—nickel, "B"—black, "Y"—yellow.

> ***NOTE:** If code book used lists the key cutting code numerically, the numbers must be transposed to letters as previously stated in order to select proper colored tumblers for installation into the lock.*

In cases where a code book is not available, the diagram as shown in figure 66 may be used to determine the tumblers required to assemble an uncoded lock cylinder.

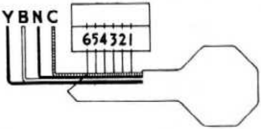


Fig. 66—Tumbler Requirement Diagram

1. Lay the key on the diagram (fig. 66) with the bottom of the key flush with the edge of the drawing, head and point carefully lined up.
2. Read the code in letters C-N-B-Y from the head of key to the end from positions 1 to 6 inclusive. As each depth is determined write that letter in the blank space provided above the position numbers (1-2-3-4-5-6).
3. With the key properly lined up on the diagram, all cuts that show in the first section are to be marked "C".
4. Cuts that fall in the first black section, mark "N".
5. Cuts that fall in the white section, mark "B".
6. Cuts that fall in the second black section, mark "Y".

After the letter (C-N-B-Y) have been determined and written above the cutting positions the lock cylinder should be assembled as follows.

Lock Cylinder Assembly

1. Hold cylinder with head of cylinder away and starting at the head of the cylinder, insert the tumblers in their proper slots in the order called for by the code, ribbed side toward you and long point down (fig. 67).

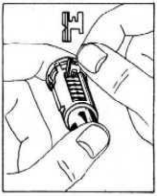


Fig. 67—Inserting Tumblers

2. After all tumblers are in place, check for correctness with the code. Then, press tumblers down with one finger (fig. 68).

Fig. 68—Checking with Code

3. Insert one tumbler spring in the space provided above each tumbler (fig. 69).

CAUTION: ***If the springs are tangled, do not pull them apart—unscrew them.***

4. Reverse the lock cylinders so that the head of the cylinder is now toward you. Insert the spring retainer so that one of its six prongs enters into each of the springs and the two large end prongs slide into the slots at either end of the cylinder (fig. 70). Press the retainer down with one finger.

Fig. 69—Inserting Tumbler Springs

5. To check, insert proper key and if tumblers are installed properly the side bar will be allowed to drop down. If bar does not drop down, remove the key, spring retainer, springs and tumblers and reassemble correctly.

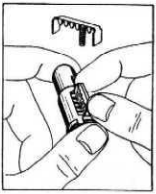


Fig. 70—Inserting Spring Retainer

NOTE: ***If the tumblers have not been assembled correctly and not according to the code, the tumblers can be removed from the cylinder by holding it with the tumbler slots down, pulling the side bar out with the fingers and jarring the cylinder to shake the tumblers out. This procedure is necessary because after the tumblers have been pressed down into the cylinder they are held in their slots by the cross bar.***

6. If after checking it is found that the lock is assembled properly, remove key and place cylinder in a vise using leather or wood on each side to prevent damage to the cylinder.

7. Stake the retainer securely in place by staking the cylinder metal over both edges of the retainer ends using a suitable staking tool at right angles to the top of the retainer and from the cast metal of the cylinder over the retainer at each corner.

SECTION 2

FRAME AND SHOCK ABSORBERS

CONTENTS OF THIS SECTION

FRAME

INDEX

GENERAL DESCRIPTION

The frame is the structural center of the vehicle for in addition to carrying load, it furnishes support for the body, transmission system and other units. The frame maintains correct relationship of all parts in order to secure their normal function and freedom from stress and strain and wear that

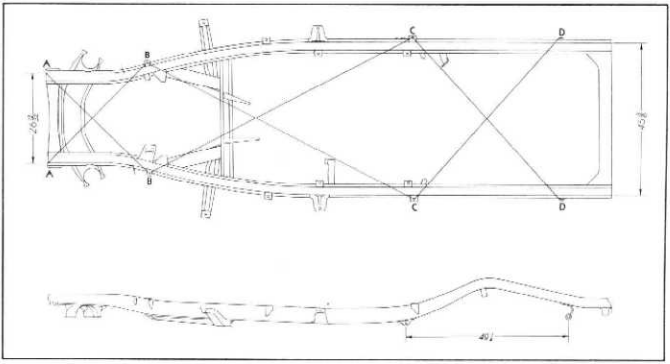


Fig. 1—Fleetline and Styleline Frame

may be caused by operation in a misaligned condition.

The frame for the Fleetline, and Styleline models (fig. 1) is of the box girder type. Every structural member is a box section, making the frame very stiff torsionally and laterally, with minimum weight. It is of extremely simple design, making all chassis units easily accessible for servicing.

The side members are of extremely rigid rectangular cross section, to which are attached the hangers and cross members. This provides a simple, sturdy and rigid construction, making the replacement of frame parts a comparatively easy job.

The front cross member is a large semi-tubular unit which is saddle mounted and bolted rigidly to the frame side members. The use of bolts in place of rivets facilitates overhaul as the complete front end assembly may be removed from the frame as a unit.

A pair of exceptionally sturdy box section braces are added to the frame, one at each side. These braces extend diagonally forward from the second cross member to the frame side members. They are instrumental in stiffening up the entire front end and also maintaining the longitudinal position of the side members relative to each other.

The radiator support cross member is of channel section and is an entirely separate support located just ahead of the front cross member. It is riveted to the inner flange of the frame side members and bolted at the outside flange to accommodate the mounting of the stabilizer bracket. This support member is also indirectly the support for the front end sheet metal which is secured to the radiator core support which in turn is bolted directly to the radiator support cross member. Figure 2 shows each member of the frame in cross-section.

The 1950-52 Bel Air models and the 1953

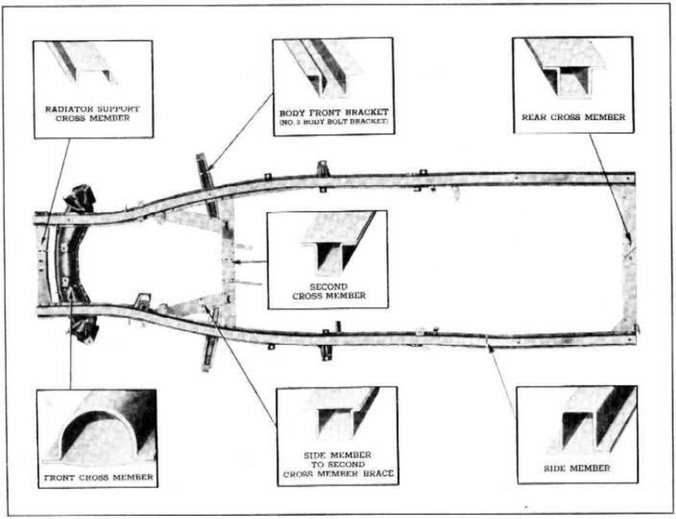


Fig. 2—Frame Cross Section

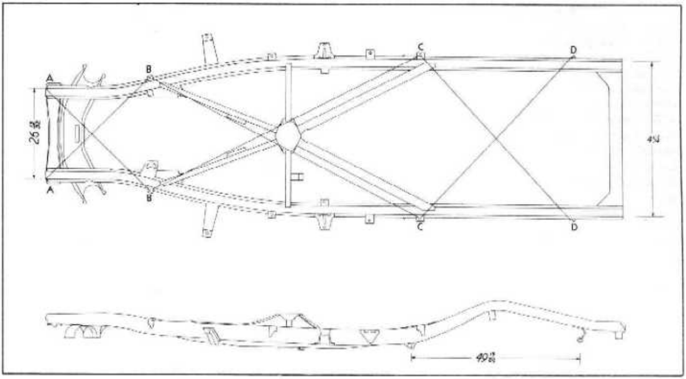


Fig. 3—Convertible Frame

Bel Air and Two Ten Sport Coupes have a box girder frame similar to that used on closed models, but with reinforced side rails. The reinforcements, $\frac{5}{16}$" thick and in three sections, extend almost the full length of each side rail. The reinforcements are inside and puddle welded to the top of the frame box section.

The frame assembly used on 1950-52 closed model passenger cars equipped with the Powerglide transmission is the same as the regular frame with the exception that the second cross member is mounted $2\frac{5}{8}$" farther toward the rear. This necessitates a change in second cross member and side member to second cross member braces. On the Convertible model, the same effect is accomplished by the use of a new transmission support cross member. On 1953 models equipped with Powerglide transmission, the second cross member or transmission support is bolted in place.

The Convertible body is a rather flexible structure as compared to a closed body and for this reason the Convertible frame (fig. 3) must be more rigidly constructed. The side members of this frame are basically the same as used on the closed body models but a simplified "VK" structure of I-beam section replaces the various cross members used on the regular passenger car frame. Each one of the four diagonal members of the "VK" section carries a body mounting bracket in addition to those located on the side members. The "VK" assembly is welded top and bottom as well as riveted to the frame side members at all six points of contact.

CHECKING FRAME ALIGNMENT

Vehicles which have been in a collision, upset or an accident of any nature which might result in "swayed" or "sprung" frame should always be checked for proper frame alignment in addition to steering geometry and wheel alignment.

When checking a frame for alignment in case of damage, the most efficient method is "X" checking with a tram from given points on each side member.

In figure 1 and 3 reference points are indicated "A", "B", "C", "D" on each frame side member.

Frame alignment checks on all models should be made with the tram points set at the center of each locating point indicated and the cross bar level to insure accuracy.

When "X" checking any section of the frame, the measurements should agree within $\frac{3}{16}$". If the measurements do not agree within the above limit, it means that corrections will have to be made between those measurement points that are not equal.

The minimum dimension between spring hangers, is shown in figures 1 and 3 and in addition the spread at the front and rear of the side members is also shown.

If a tram gauge is not available, the "plumb bob" method of checking may be used. To assure any degree of accuracy when using this method, the vehicle should be on a level floor when dimensions are checked.

By using this method, it is only necessary to have a piece of cord attached to an ordinary surveyor's plumb bob. When measuring the distance between two points, the free end of the cord should be placed on the reference point allowing the plumb bob to hang just off the floor. A check mark should be made on the floor just under the tip of the plumb bob. This operation should be repeated at all reference points. With these points located on the floor, they may easily be measured with a rule.

CROSS MEMBERS AND BRACKETS

All cross members and brackets that are damaged or broken may be replaced. Cut off all rivets holding part to be replaced by first drilling the heads and then cutting them off using a sharp cold chisel. Care should be exercised to prevent distorting rivet holes. In permanently attaching a new piece, it is recommended that hot rivets be used to secure in place.

SHOCK ABSORBERS

INDEX

GENERAL DESCRIPTION

Shock absorbers both front and rear on all passenger car models are non-adjustable direct acting bayonet type, consisting of three concentric tubes known as the pressure tube, reservoir tube and dust shield or outer tube. Front shock absorbers on 1952-53 models are not equipped with dust shields. These shock absorbers are permanently sealed and require no maintenance other than replacement if necessary.

Front shock absorbers are stem attached at the top directly to the top of the front spring housing and at the bottom are stem attached to a retainer bracket bolted to the lower control arm (fig. 4).

Rear shock absorbers are stem attached at the top to the body floor shock absorber reinforcement channel and at the bottom are eye attached to an anchor bolt in the rear spring "U" bolt and shock absorber anchor bolt plate (fig. 5).

OPERATION

On the compression stroke, the piston moves toward the lower end of the pressure tube forcing fluid through the holes in the piston. The pressure lifts the intake valve plate allowing fluid in lower chamber to pass into the upper chamber. Since the piston rod is also in the upper chamber, all of the fluid in the lower chamber cannot enter the upper chamber. The volume of fluid which cannot enter the upper chamber, because of the piston rod, is forced out of the lower chamber through the compression valve orifice and through open-

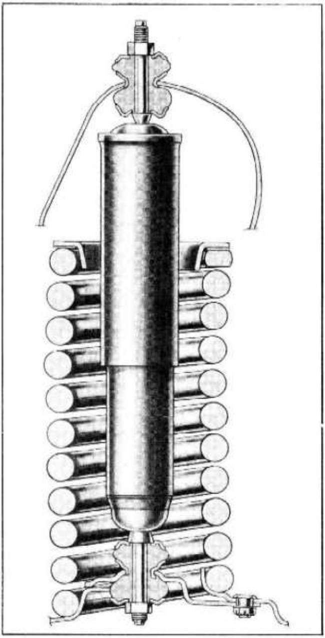


Fig. 4—Front Shock Absorber Mounting

ing into the surrounding reservoir. Thus the amount of compression control is governed only by the volume of fluid displaced by the piston rod. On fast or extreme movements when the fluid flow exceeds the capacity of the orifice, fluid then flows through the compression relief valve. The resistance to the vehicle spring travel is determined by the diameter of the orifice and the strength of the compression valve spring.

On the rebound stroke, when the car body moves away from the car springs, the resistance of the absorber is instantly effective. As the piston is pulled upward, fluid in the upper chamber is forced through slots in the intake valve plate and through holes in the piston building up pressure against the orifice plate. As the pressure increases, the piston spring is compressed and the orifice plate lifts off its seat, permitting fluid to pass into the lower chamber. Since the piston rod is moving out of the inner chamber or pressure tube, the space taken up by the piston rod is displaced by fluid drawn into the lower chamber from the surrounding reservoir through the intake valve. The valve plate lifts off its seat in this operation, allowing the fluid to fill the pressure tube.

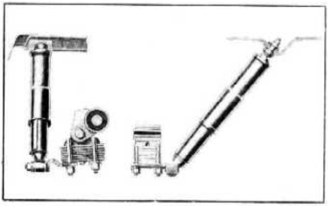


Fig. 5—Rear Shock Absorber Mounting

SERVICE OPERATIONS

Since both front and rear shock absorbers are permanently sealed, service operations are limited to replacements only. Shock absorbers may be replaced on the vehicle as follows:

FRONT SHOCK ABSORBERS

Removal

1. With a ¼" open end wrench, hold upper stem from turning and remove upper stem retaining nut, grommet retainer and grommet.
2. Remove nut and lockwasher from special bolt, retaining shock absorber lower mounting bracket to lower control arm, and pull shock absorber assembly and mounting bracket out bottom of spring housing (fig. 6).
3. Place mounting bracket in vise and remove

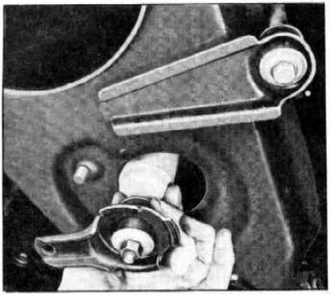


Fig. 6—Removing Front Shock Absorber

lower stem retaining nut, grommet retainer and grommet and remove shock absorber from mounting bracket.

4. Inspect rubber grommets for condition and if necessary replace with new grommets.

Installation

1. Install grommet retainer, upper grommet, retainer bracket assembly, lower grommet and grommet retainer on bottom stem of shock absorber and install grommet retainer nut and tighten until it bottoms on shoulder of stem. Then, tighten to 4-6 ft. lb. torque and stake in place.
2. Install grommet retainer and grommet on upper stem of shock absorber and install shock absorber up through lower control arm and spring housing.
3. Index upper stud through mounting hole in top of spring housing and index mounting hole in shock absorber retainer bracket over special bolt in lower control arm.
4. Install lockwasher and nut on special bolt and tighten nut securely.
5. Install grommet and grommet-retainer over upper stem of shock absorber.
6. Install retainer nut to upper shock absorber stem and, holding stem with ¼" wrench, tighten nut until it bottoms on shoulder of stem. Then tighten to 4-6 ft. lb. torque and stake in place.

REAR SHOCK ABSORBER

Since the upper stem of the rear shock absorber extends up through body floor, the upper retainer nut is reached through the trunk compartment.

Removal

1. Raise trunk lid, fold back rear compartment mat and holding upper stem from turning, remove upper shock absorber retainer nut, upper grommet retainer, grommet and lower grommet retainer from shock absorber upper stem.
2. Remove nut, lockwasher and flat washer from shock absorber anchor bolt on rear spring "U" bolt and shock absorber anchor bolt plate.
3. Pull or drive lower shock absorber eye from anchor bolt and drop down to disengage upper stem from body floor.
4. Inspect rubber grommets for condition and if necessary replace with new grommets.

Installation

1. Install rubber bushings in shock absorber eye and install grommet retainer, grommet and grommet retainer to shock absorber upper stem.
2. Install steel flat washer on shock absorber anchor bolt and then install shock absorber indexing upper stem through hole in body floor and then install lower shock absorber eye to anchor bolt.
3. Install steel flat washer, lockwasher and nut to anchor bolt and tighten securely.
4. Install grommet retainer, grommet and grommet retainer to upper stem protruding into trunk compartment.
5. Install retainer nut to upper stem and holding stem from turning, tighten nut until it bottoms on shoulder of stem. Then tighten to 4-6 ft. lb. torque and stake in place.

TROUBLES AND REMEDIES

Symptom and Probable Cause	Probable Remedy
Hard Riding	
a. Shock absorber broken.	a. Disconnect shock absorber and test action; replace inoperative shock.
b. Vehicle springs improperly lubricated.	b. Lubricate springs.
Vehicle Too Flexible	
a. Lack of fluid in shock absorber.	a. Replace shock absorber.
b. Dirt in relief valve.	b. Replace shock absorber.
c. Shock absorber broken.	c. Replace shock absorber.
Shock Absorber Noisy	
a. Insufficient fluid.	a. Replace shock absorber.
b. Dirt in relief valve.	b. Replace shock absorber.
c. Grommets at upper or lower stems not compressed sufficiently or nut on rear shock lower eye not tight.	c. Tighten retainer nuts as specified or tighten rear shock eye retainer bolt nut.
d. Shock absorber broken internally.	d. Replace shock absorber.
Leaks Fluid	
a. Sealing welds broken loose.	a. Replace shock absorber.
b. Packing gland worn.	b. Replace shock absorber.

SERVICE NEWS REFERENCE

Month	Page No.	Subject

SECTION 3

FRONT SUSPENSION

CONTENTS OF THIS SECTION

FRONT SUSPENSION

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INDEX

GENERAL DESCRIPTION

Front wheels on all passenger car models are independently sprung by the S.L.A. (short and long arms) method (fig. 1).

This design allows the wheel to move up or down independently in following irregularities of the road, resulting in a minimum of tire wear due to scrubbing of tires against road surface. Whether these irregularities be raised obstructions or chuck holes, the shock will not be transmitted to the car or passengers.

In this construction the entire assembly is attached to an unusually rugged frame cross member which is semi-tubular in design and is saddle mounted and bolted rigidly to the frame side members. This construction facilitates complete overhaul or replacement in that the complete assembly may be removed from the frame as a unit.

Chassis coil springs 14¼" long, positioned in spring seats, are used. The lower spring seat is formed in the lower control arm and the upper spring seat is welded into the upper section of the spring housing tower.

Direct acting permanently sealed bayonet type shock absorbers are located in the center of the spring and operate in a vertical plane. The top of the shock absorber is stem attached to the top of the spring housing and the bottom is stem attached to a removable plate attached to the lower control arm.

The upper control arm is pivoted at its inner end on threaded steel bushings which are threaded to the upper control arm shaft. The upper control arm shaft is in turn threaded at either end into the spring housing assembly and into a reinforcement at each side which is welded to the

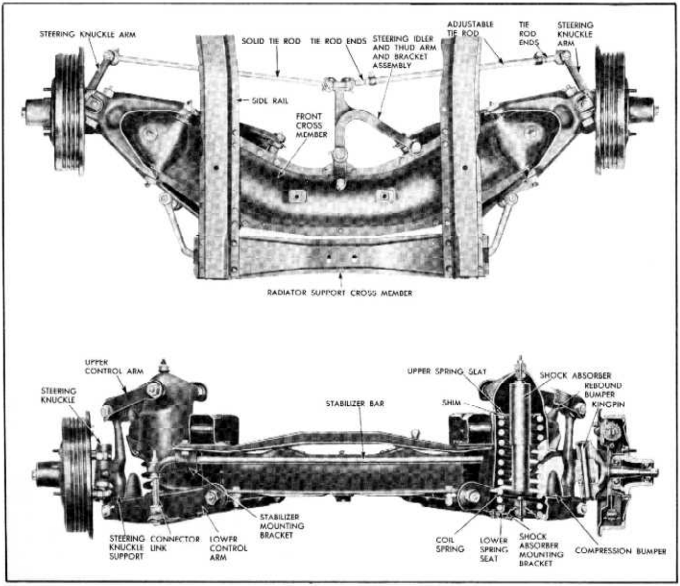

Fig. 1—Top and Front Views of Front Suspension

spring housing assembly at the hole location. Neoprene seals cover the inner end of each bushing and the threads on the shaft. These seals prevent dirt and water from entering the bearings, thereby prolonging their life.

The lower control arm carries threaded steel bushings which are threaded to a forged shaft attached to the underside of the frame front cross member by two brackets forged integral with the shaft. The steel bushings are threaded on the outer diameter of the shaft. On early 1949 models a lock nut is installed on outer diameter of bushings next to inner face of lower control arm which locks the bushing to the control arm. On late 1949 and 1950-53 models a reinforcement is welded to the inner face of the lower control arm at the bushing hole location eliminating use of lock nuts.

Neoprene seals cover the inner end of each bushing and the threads on the shaft. These seals prevent dirt and water from entering the bearings, thereby prolonging their life.

The steering knuckle support, which carries the steering knuckle and kingpin, is pivoted at its upper and lower ends to the upper and lower control arms. At the lower end a steel threaded type bushing is screwed into the steering knuckle support. A threaded bolt which passes through the lower control arm and threaded bushing completes the mounting.

To secure this bolt in place a lock nut is installed on the end and is tightened down against outer face of control arm. Neoprene seals installed between ends of bushing and control arm protect the bearings from road dirt and water. The upper end of the knuckle support is mounted to the upper control arm through threaded steel bushings and a threaded eccentric bolt which provides for caster and camber adjustments.

The steering knuckle is of the reverse Elliot type, pivoting on the kingpin through floating bushings which permits movement of the bushings on the kingpin as well as in the steering knuckle. A ball bearing located between lower face of steering knuckle support and steering knuckle absorbs thrust and allows for easy steering.

The brake flange is securely bolted to the steering knuckle and carries the brake shoes and wheel cylinders. The steering knuckle arms are also bolted to the steering knuckles.

Two tie rods are used which connect the steering knuckle arms directly to the steering idler and third arm and bracket assembly. The bracket of the steering idler and third arm assembly is in turn bolted directly to the front cross member being located on the center line of the vehicle. The right hand tie rod is solid while the left tie rod is adjustable to provide for toe-in adjustment.

The front wheel spindles which are forged integrally with the steering knuckles are tilted downward at their outer ends causing the front wheels to be farther apart at the top than they are at the bottom. This slight angular position of the front wheels is called camber.

The steering knuckle arms are installed on the knuckles at an angle, permitting the front wheels to toe-out when making turns. This is necessary so that when turning curves all wheels may travel in different arcs about a common center so as to avoid tire scuffing and wear.

Kingpin lock pins are stepped pins, inserted from the front of the steering knuckle support and held in place with a nut and lockwasher. This nut should be inspected at regular intervals and tightened when necessary.

Rubber bumpers for rebound and compression are mounted on the front spring housing and on the lower control arm. The lower (or compression) bumper which is mounted on the lower control arm engages a bumper pad which is part of the front cross member and the upper (or rebound) bumper which is mounted on the front spring housing engages against a bumper pad which is part of the upper control arm.

A front end stabilizer bar is used in connection with this suspension to provide steering stability and control of body roll. The stabilizer bar is attached to brackets at the outer ends of the radi-

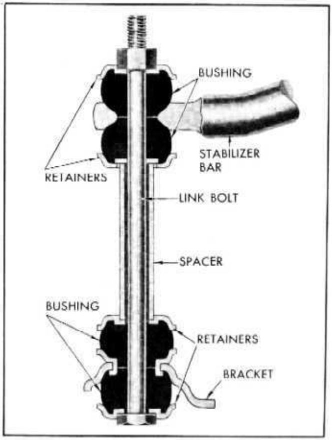

Fig. 2—Front Stabilizer Link Attachment

ator support cross member. These brackets are rubber bushed and are held in place by bolts which extend through the brackets, radiator support cross member and frame side member outer flange. Delco type connector links are used to connect the stabilizer bar to a bracket welded to the lower control arm (fig. 2). The linkage provides complete rubber insulation between the metal parts.

The ball and socket joints on the tie rod connections are of the self adjusting type, protected from dirt by a synthetic oil resisting rubber seal.

A short, tubular steering connecting rod, which is adjustable for length, is used and is attached to the ball connector of the steering idler and third arm assembly and to the steering pitman arm by means of the ball seat and spring type of construction.

MINOR SERVICE OPERATIONS

TIE ROD

There are two tie rods used on all model passenger cars. The right tie rod is a one piece non-adjustable rod designed with tie rod ends which are not removable. The left tie rod is of three piece construction, consisting of the tie rod and two tie rod end assemblies. The ends are threaded into the rod and locked with clamps. Right and left hand threads are provided to facilitate toe-in adjustment.

The tie rod ends used (fig. 3) are self adjusting for wear and require no attention in service other than periodic lubrication and occasional inspection to see that ball studs are tight. Replacement of tie rod ends of left tie rod or complete right hand tie rod assembly should be made when excessive up and down motion is evident or if any lost motion or end play at ball end of stud exists.

Removal

1. Bend tangs of ball stud nut lock plates away from nuts and remove ball stud nuts from ball studs.

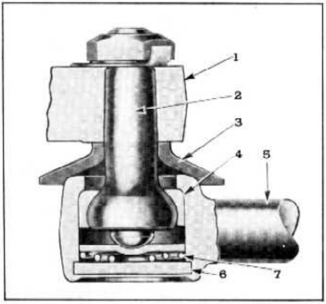

Fig. 3—Tie Rod End

1. Arm
2. Ball Stud
3. Seal
4. Ball Seat
5. Socket
6. Plug
7. Spring

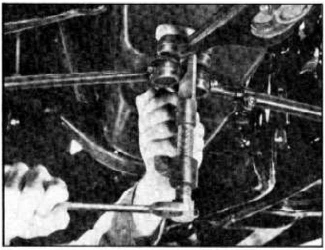

Fig. 4—Removing Inner Ball Studs

2. To remove outer ball stud, screw J-1273 remover over threaded end of stud to protect threads. Support steering arm and drive on remover with a hammer to loosen stud, then remove tie rod end from steering arm.
3. To remove inner ball studs from steering idler and third arm assembly, install tie rod ball stud remover J-2963 (fig. 4). Turning the screw on the tool will press the ball studs from idler and third arm assembly.
4. To remove tie rod ends from left tie rod, loosen clamp bolt and unscrew end assembly from tie rod.

Installation

1. If tie rod ends were removed, install ends on tie rod making sure both ends are threaded an equal distance into the tie rod and that both ends are in the same plane (fig. 5).
2. Make sure that threads on ball studs and in ball stud nuts are perfectly clean and smooth. Install neoprene seals on ball studs.

NOTE: If threads are not clean and smooth, ball studs may turn in tie rod ends when attempting to tighten nut.

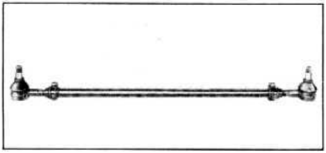

Fig. 5—Alignment of Tie Rod Ends

3. Install ball studs into steering arms at outer ends and to steering idler and third arm assembly at the center or inner ends.
4. Install new ball stud nut lock plates and ball stud nut and tighten securely. Bend tangs against nut to lock.
5. Adjust toe-in as described under "Front Wheel Alignment" and tighten tie rod end clamps to 8-12 ft. lbs. torque on left tie rod.

STEERING IDLER AND THIRD ARM AND BRACKET ASSEMBLY (fig. 6)

Removal

1. Raise front of vehicle and place on stand jacks.
2. Bend tangs of center tie rod end ball stud nut lock plate away from stud nuts and remove nuts from studs.
3. Install tool J-2963 and press ball studs from steering idler and third arm assembly.
4. Remove cotter pin and end plug from end of steering connecting rod and disengage rod from ball on steering idler and third arm assembly.

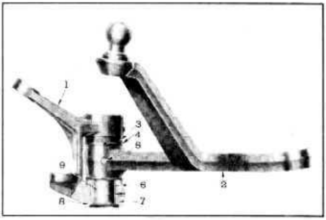

Fig. 6—Steering Idler and Third Arm and Bracket Assembly

1. Bracket
2. Idler and Third Arm
3. Seal
4. Seal Retainer
5. Lock Pin
6. Shim
7. Bushing
8. Plug
9. Pivot Shaft

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NOTE: Thread plug back into end of steering connecting rod to prevent losing ball seats, spring, etc., from end of connecting rod.

5. Remove three bolts which retain steering idler and third arm and bracket assembly to front cross member and remove assembly.

Disassembly

1. Support idler and third arm in vise, remove lubrication fittings and with a ⅛" punch drive out idler and third arm to pivot shaft lock pin.

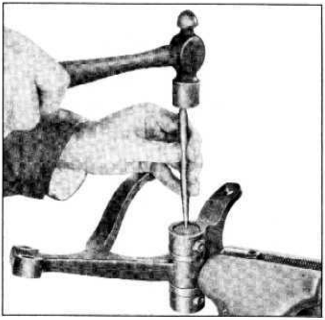

Fig. 7—Removing Pivot Shaft Plug

2. Remove pivot shaft plugs. This can be done with a sharp drift punch by driving through either plug and forcing the pivot shaft against the other plug to remove it (fig. 7). Shaft may then be removed and idler and third arm assembly and shim removed from bracket assembly.
3. Inspect bushings in bracket assembly and if worn excessively or damaged, drive out using K-318 steering knuckle bushing driver (fig. 8).

Assembly

When replacing the pivot pin bushings it is necessary to ream them to size as service bushings are not machined to finish dimensions. When replacing bushings, care should be taken to make sure the oil grooves in the bushings line up with the lubrication fitting holes in the bracket.

1. Press new bushings in the bracket using K-318 steering knuckle bushing driver.

Fig. 8—Removing Pivot Shaft Bushings

2. Ream bushings to .922"-.923" using J-3189 bushing reamer.

NOTE: Reamer must be long enough to pilot in one bushing while reaming the other to maintain alignment (fig. 9).

3. Inspect rubber dust seals, replace if necessary and place the idler and third arm with rubber dust seals in place in the bracket, install shim between lower face of idler and third arm assembly and bracket and install pivot pin.

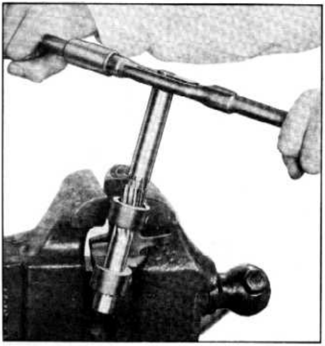

Fig. 9—Reaming Pivot Shaft Bushings

4. Check clearance between idler and third arm assembly and bracket with a feeler gauge (fig. 10). If this clearance exceeds .006" install shim, part No. 3687657, between bracket and lower face of idler and third arm assembly.

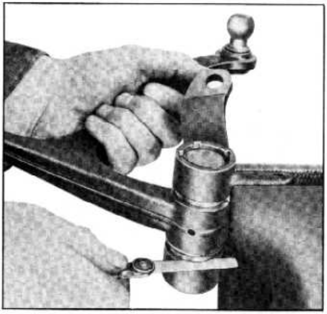

Fig. 10—Clearance Between Idler and Third Arm and Bracket

5. Align pin hole in idler and third arm assembly with pin hole in pivot shaft and install new groove lock pin.
6. Install pivot shaft plugs and stake plugs securely in four places.
7. Install lubrication fittings.

Installation

1. Place steering idler and third arm and bracket assembly in position on front suspension cross member and install two lower bolts and one upper bolt and turn all three bolts down finger tight.
2. Tighten the two lower bolts to 30 ft. lbs. minimum torque.
3. With the lower bolts tightened securely, remove the upper bolt and check space between front suspension cross member and bracket at upper mounting hole with a feeler gauge (fig. 11). Maximum allowable space at this point is .008". If space exceeds .008", add shims as necessary to bring space within allowable limit.

NOTE: A .010" shim is available for use at this point. This shim may be used singly or in any combination to bring space within .008" maximum limit.

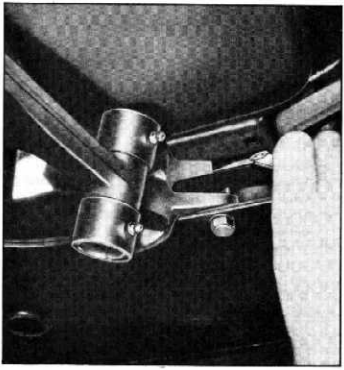

Fig. 11—Clearance Between Bracket and Front Cross Member

4. Install upper bolt and tighten securely. The specified torque for this bolt is 65 ft. lbs. but in most instances it is impossible to place a torque wrench on this bolt so that the bolt must be tightened to as near 65 ft. lbs. as possible.
5. Install ball studs of tie rod ends into steering idler and third arm, install new ball stud nut lock plates and ball stud nuts and tighten securely. Bend tangs of lock plate against nuts to lock.
6. Assemble rubber dust cover over ball on steering idler and third arm assembly making sure the short end is to the rear. Assemble steering connecting rod to ball on idler and third arm assembly.
7. Screw plug in tight until spring is compressed solid and back off one complete turn plus amount necessary to insert cotter pin.
8. Insert and clinch cotter pin.
9. Check steering to make sure wheels are in straight ahead position with steering gear on high point. If necessary, adjust length of steering connecting rod as outlined in Section 9, "Steering Connecting Rod—Adjust."
10. Lower vehicle to floor, lubricate and check toe-in. Adjust, if necessary, as outlined under "Front End Alignment—Toe-In Adjustment."

STABILIZER

A ride stabilizer is used on all passenger cars to provide steering stability and control of body roll. This bar is rubber mounted to brackets attached to the radiator support cross member as described in the general description.

Removal

1. Disconnect the stabilizer links by removing the nut from the top of the link bolt and pulling the bolt out from the lower bracket attached to the lower control arm.
2. Remove the bolts and nuts that attach the stabilizer brackets to the radiator support cross member and remove bar and brackets.

Installation

1. Place rubber bushings on stabilizer bar and install support brackets over bushings, then bolt brackets loosely to radiator support cross member.
2. The stabilizer link bolt, bushings and retainers may be assembled by placing one steel retainer and one rubber bushing on the link bolt and threading the bolt up through the bracket on the lower control arm.
3. Assemble rubber bushing, retainer, steel spacer, retainer and rubber bushing over bolt and thread bolt through eye on stabilizer bar.
4. Install rubber bushing and retainer over bolt and install nut tightening it to LIMIT of bolt threads.
5. With wheels of car on floor and supporting the car weight, bounce front end up and down several times to allow parts to seek proper relationship.
6. Tighten bracket mounting bolts securely.

HUB AND DRUM ASSEMBLY

Removal

1. Remove hub caps, loosen wheel to hub bolt nuts, raise vehicle from floor, place on stand jacks and remove wheels.
2. Remove hub grease cap, cotter pin, spindle nut, spindle washer and remove drum and hub assembly.

NOTE: In some cases it may be necessary to back off the brake adjustment because of scored drums or badly worn linings holding drum on.

3. Remove outer bearing from hub with fingers. The inner bearing will remain in the hub and may be removed by prying out the inner bearing felt seal assembly.
4. Wash all parts thoroughly in cleaning solvent.

Inspection

1. Check all bearings for cracked bearing cages or worn or pitted balls.
2. Check bearing race for cracks or evidence of scoring.

3. Check brake drum for out of round or scored condition.
4. Check bearing outer race for looseness in hub.

REPAIRS

Bearing Races—Replacement

1. Insert front wheel bearing cup remover K-224 through hub, indexing end of tool with notches in hub shoulder behind bearing cup.
2. Tap lightly on cup through each notch to remove cup from hub.
3. Install new bearing cup in hub using K463A bearing cup inserter (fig. 12).
4. Make sure that cup is not cocked and that it is fully seated against shoulder in hub.

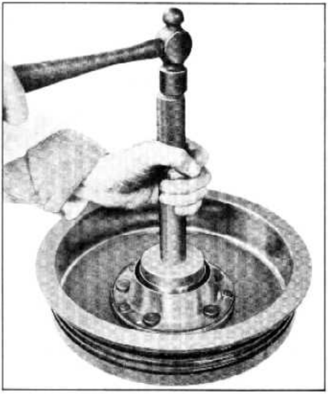

Fig. 12—Installing Bearing Cup

Brake Drum—Replacement

The brake drum is held to the hub by three rivets which must be removed to replace the brake drum.

1. Cut heads from three rivets which retain drum to hub. Drilling rolled end of rivet first will permit cutting them without distorting holes. A sharp cold chisel should be used in this operation and care exercised to avoid distorting rivet holes. Drive rivets from drum and hub using tapered punch and remove drum from hub bolts.
2. Remove brake drum gasket from hub and clean gasket surface on hub thoroughly.
3. Install new brake drum gasket and brake drum over hub bolts and insert three new rivets through rivet holes in oil deflector, hub, gasket and drum.
4. Support heads of rivets and peen ends securely.

Wheel Hub—Replacement

1. Remove inner and outer bearing cups.
2. Remove three rivets retaining brake drum to wheel hub and remove brake drum.
3. Drive hub bolts from hub and remove oil deflector.
4. When installing a new hub it is necessary to install new bolts, rivets and gaskets. The gasket between the hub flange and oil deflector must be covered with a heavy shellac or paint on both sides to prevent oil leaks.
5. Install gasket and oil deflector to hub flange and install new hub bolts.
6. The end of the shoulder on the hub bolts should be peened into the countersink around the bolt holes in the hub flange, using J-554 peening tool and anvil (fig. 13).

NOTE: Shoulder of bolts must be peened into hub countersink approximately $^{1}/_{16}$" before assembling drum.

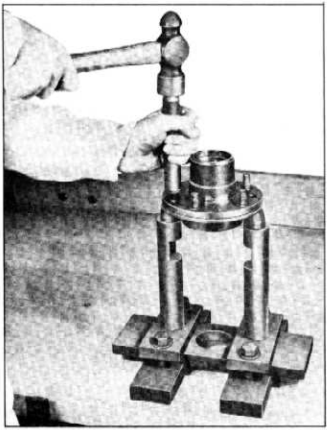

Fig. 13—Peening Front Hub Bolts

7. Install new brake drum gasket and brake drum over hub bolts.
8. Install three new rivets through rivet holes in oil deflector, hub flange and drum and supporting rivet heads peen ends securely.
9. Install inner and outer bearing cups into hub using K-463-A, Bearing Cup Inserter Set.

Installation

1. Hand pack both inner and outer bearings, using a short fibre "High Melting Point Lubricant".
2. Place inner bearing in hub, then install a new inner bearing felt seal assembly.
3. Using a piece of fine sandpaper, lightly sand the inside braking surface of brake drum to insure a clean surface and proper brake operation.
4. Carefully position hub on spindle making sure the inner oil deflector is in proper position between inner bearing and inner race and shoulder on spindle.
5. Install outer bearing, pressing it firmly into the hub by hand.
6. Install spindle washer and spindle nut. Draw spindle nut up snug and adjust bearings.

FRONT WHEEL BEARINGS—ADJUST

The proper adjustment of front wheel bearings is one of the important service operations that has a definite bearing on safety. A car with improperly adjusted front wheel bearings lacks steering stability, has a tendency to wander or shimmy and causes excessive tire wear. In an effort to provide for more accurate adjustments the spindles are drilled both vertically and horizontally and the adjusting nuts are slotted on all six sides.

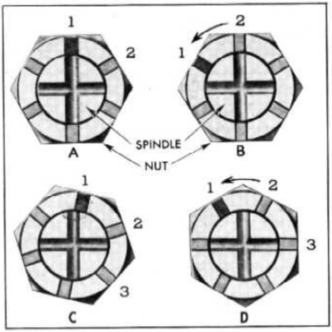

Fig. 14—Method of Adjusting Front Wheel Bearings

1. Tighten spindle nut to 33 foot pounds with a torque wrench.
2. Check the location of a slot in the nut with reference to a hole in the spindle. If a slot in the nut lines up with either the vertical or horizontal holes in the spindle (see A, Fig. 14), back off the nut (1/6 turn) until the next slot in the nut lines up with the same hole in the spindle and insert cotter pin (see B, Fig. 14).
3. If, when the spindle nut is tightened to 33 foot pounds, the slot in the nut has passed beyond the vertical or horizontal holes in the spindle (see C, Fig. 14), back off the nut a sufficient amount (less than 1/6 turn) to line up the second next slot in nut and the other hole in the spindle.
4. To illustrate this point the slots in the nut are indicated 1, 2 and 3 (see D, Fig. 14). If the slot marked 1 on the nut is slightly beyond the vertical hole in the spindle, the nut should be backed off until the slot marked 3 is in line with the horizontal hole in the spindle. It will be noted that the nut has been backed off slightly less than 1/6 turn.

NOTE: Front wheel bearings should never be set up on the loose side as such an adjustment does not bring the balls and races into proper contact.

5. Install hub grease cap and wheel. Lower vehicle to floor, retighten wheel hub bolt nuts and install hub caps.

RIDING HEIGHT AND COIL SPRING SAG

Where the car does not seem to be level and a check of the coil spring height is desired, position

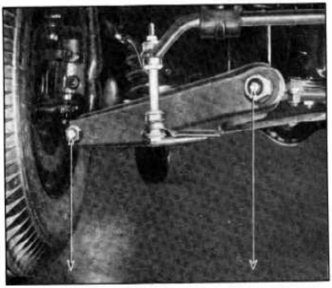

Fig. 15—Measuring Spring Height

the vehicle on a smooth level floor and rock it sidewise several times and allow to settle. This will remove any binding that might cause a dimensional difference.

Measure the distance from center of the lower control arm outer pivot pin to the floor and from center of lower control arm inner bushing to the floor (fig. 15). The difference between these two measurements should be $1\frac{5}{8}'' \pm \frac{1}{4}''$.

If the difference between the two measurements is less than the above limits a shim part No. 599810 which is $\frac{1}{16}''$ thick can be added to the top of the coil spring.

More than two shims should not be used because additional shims will cause the spring coils to bottom before the lower support arm movement is stopped by the rubber bumper.

If the addition of shims does not bring the spring height within the limits given above, it will be necessary to install a new front spring to make the correction.

Service replacement springs are checked to designed height before being shipped to parts warehouses and a shim, if necessary, is wired to the spring. Field replacement of springs should be made to include the shim that is attached to the spring. Should no shim be attached to the spring as received by dealers parts departments it indicates that spring is correct to design height and no shim is necessary.

MAJOR SERVICE OPERATIONS

FRONT SPRINGS

Removal

1. Disconnect the stabilizer link from the link bracket on the lower control arm.
2. Remove front shock absorber on the side spring is to be replaced as outlined under "Front Shock Absorber—Removal" in Section 2.
3. Raise the front end of car off the floor and place stand jacks beneath frame side rails. Lower car until weight is carried on stand jacks.
4. Place a hydraulic jack under the lower control arm inner shaft on side from which the spring is to be removed.
5. Remove nuts and lockwashers from the lower control arm shaft bracket bolts and drive out the bolts.
6. Lower the jack slowly to remove the spring pressure; then, remove the hydraulic jack. This allows the lower control arm to drop down, releasing the spring.

NOTE: If shim is used, make sure it is removed from upper spring seat.

Installation

1. Springs for service replacement are checked for design height and shims if necessary are wired to the spring.
2. Install flat end of spring up with shim, if furnished with spring, in place and then raise lower control arm making sure lower end of spring seats in recess in lower spring seat.
3. Place a hydraulic jack under lower control arm inner shaft.
4. Slowly raise arm with jack to compress the spring. Use a long drift punch through the lower control arm shaft bracket hole and hole in frame cross member to maintain alignment (fig. 16).

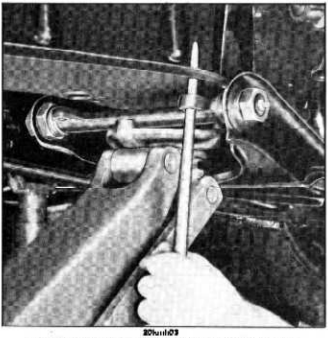

Fig. 16—Maintaining Alignment of Lower Control Arm Shaft Bracket

5. Install bolts through cross member and control arm shaft bracket bolt holes and install lockwashers and nuts and tighten securely.
6. Remove the hydraulic jack, then raise front end of car and remove stand jacks.
7. Lower car to floor and connect the stabilizer link to the bracket on the lower control arm.
8. Replace front shock absorber as outlined under "Front Shock Absorber—Installation" in Section 2.

LOWER CONTROL ARM, SHAFT OR BUSHINGS—EARLY 1949 MODELS

When replacing the lower control arm, lower control arm shaft or lower control arm shaft bushings, it is necessary to remove the control arm assembly from the vehicle and perform the work on the bench. This is necessary to insure the proper spacing of the lower control arm on the control arm shaft and for the proper tightening of the shaft bushing lock nuts.

Removal

1. Remove wheel and tire assembly on side of car from which control arm, control arm shaft or bushings are to be replaced.
2. Remove front spring as outlined under "Front Spring–Removal."
3. Remove tie rod end from steering arm as outlined under "Tie Rod–Removal".
4. Remove lower control arm pivot bolt nut and bolt and remove lower control arm assembly from beneath vehicle.

Disassembly

1. Place lower control arm shaft in a bench vise (fig. 17) and loosen lower control arm shaft bushing lock nuts.

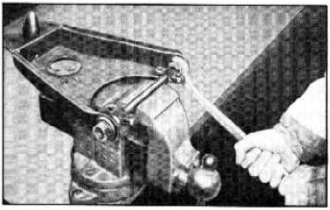

Fig. 17—Loosening Lower Control Arm Shaft Bushing Lock Nut

2. Remove lubrication fittings from bushings and remove bushings.
3. Remove control arm from control arm shaft and remove grease seals from ends of shaft.

Assembly

1. Place lower control arm shaft in a bench vise, install new seals over threaded ends and up onto shaft shoulders.
2. Install bushing lock nuts over threaded ends of shaft with chamfered side of nuts toward ends of shaft.
3. Install lower control arm to shaft and thread bushings onto ends of shaft and through lower control arm.
4. As bushings are threaded onto shaft and through control arm, thread lock nuts onto bushing.
5. Install lower control arm assembly gauge J-3184, indexing pin of tool with bolt hole in shaft and tighten bushing until lower control arm inner face contacts end of tool (fig. 18).

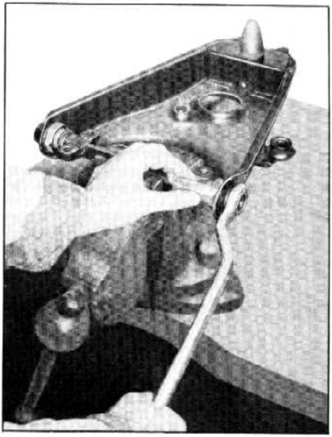

Fig. 18—Positioning Lower Control Arm on Shaft

6. Tighten lock nut securely; then, holding lock nut, tighten bushing to 150-200 ft. lbs. torque using J-1264 Torque Wrench (fig. 19).
7. Slip seals off of shaft shoulders and into their seats and install lubrication fittings into ends of bushings.

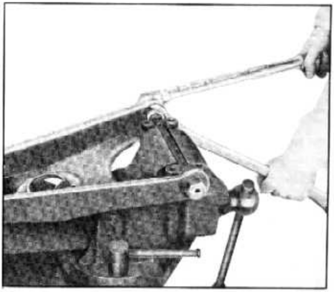

Fig. 19—Locking Control Arm in Position

Installation

1. Place new seals over exposed ends of bushing in knuckle support.
2. Start pivot bolt into lower control arm from rear to front. Hold knuckle support in the center of the yoke formed by the lower control arm and thread pivot bolt into bushing in the knuckle support being very careful to keep it centered in the yoke.
3. Continue to screw pivot bolt in until it contacts the front face of the control arm. If the threads on the bolt and in the control arm index properly, continue to screw bolt into control arm until its head seats firmly against the rear face of the lower control arm.
4. If the threads do not index properly, place a "C" clamp over ends of control arm and compress the ends slightly trying the threads as you proceed (fig. 20). It will be found that very little compression will allow the threads to index properly.
5. Tighten pivot bolt to 100-200 foot lbs., install lock nut and tighten nut to 90-120 foot lbs.

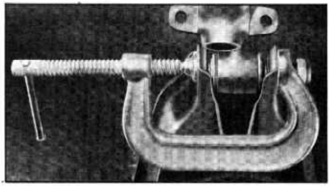

Fig. 20—Indexing Threads of Pivot and Lower Control Arm

6. With a hook made of stiff wire, slip seals off ends of knuckle support bushing and into their seats.
7. Install front springs as outlined under "Front Spring–Installation", operations 1-5.
8. Install tie rod to steering arm as outlined under "Tie Rod–Installation."
9. Install lubrication fittings and lubricate.
10. Install wheel and tire assembly, remove stand jacks from under side rails and lower car to floor.
11. Connect stabilizer link to bracket on lower control arm and replace shock absorber as outlined under "Front Shock Absorber–Installation" in Section 2.
12. Check and adjust front wheel alignment as outlined under "Front Wheel Alignment".

LATE 1949 AND 1950-53 MODELS

Replacement of lower control arm shaft or lower control arm shaft bushings may be accomplished without removal of lower control arm from vehicle.

Removal

1. Support inner end of control arm securely on jack and remove one bushing.
2. Ascertain that control arm shaft is centered in control arm bushing hole. Then, thread new bushing onto shaft and into control arm and tighten to 85-100 ft. lb. torque.
3. Remove other bushing and replace.

NOTE: When replacing both bushings replace one at a time to assure alignment of control arm and shaft.

4. When replacing control arm shaft, place shaft in control arm and position by scale measurement. Start bushings into control arm making sure threads index and enter arm properly. Tighten bushings to 85-100 ft. lb. torque.
5. Install both through cross member and control arm shift bracket holes, install lock washer and nuts and tighten securely.
6. For replacing lower control arm, follow procedure for removal and installation as outlined for 1949 models.

LOWER CONTROL ARM PIVOT BOLT AND BUSHING

Removal

1. Raise the car and place stand jack under the inner side of the lower spring seat.

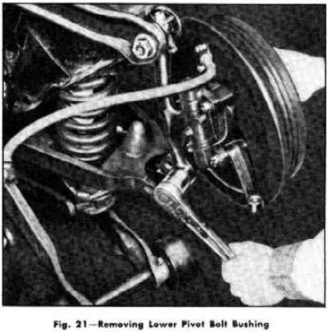

Fig. 21—Removing Lower Pivot Bolt Bushing

2. Remove the wheel and tire assembly.
3. Remove tie rod end as outlined under "Tie Rod—Removal".
4. Remove pivot bolt lock nut and then remove lubrication fitting from pivot bolt and remove bolt from lower control arm and knuckle support.
5. Turn wheel being worked on to the extreme outward position. This locks the knuckle support so that it cannot move outward at the bottom when removing the bushing.
6. Remove lower pivot bolt bushing from the knuckle support (fig. 21).

Installation

1. Install the lower pivot bolt bushing into knuckle support from rear to front and tighten it to 150-170 foot lbs. torque.
2. Install pivot bolt as outlined under "Lower Control Arm, Shaft or Bushings—Installation".

UPPER CONTROL ARM PIVOT PIN AND BUSHINGS

Removal

1. Raise the front end of car and place a stand jack under the spring seat, allowing jack to support vehicle.
2. Remove wheel and tire assembly and remove lubrication fitting from rear bushing.
3. Remove pivot pin front and rear threaded bushings from upper control arm. The upper control arm and pivot pin in cross section is shown in figure 22.
4. Remove seals from ends of pivot pin.
5. Remove clamp bolt from upper end of knuckle support and slide the upper pivot pin out of the knuckle support using a 1/4" Allen set screw wrench to assist removal.

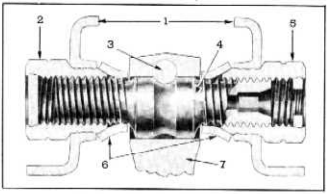

Fig. 22—Upper Control Arm Pivot Pin and Bushings

1. Upper Control Arm
2. Front Bushing
3. Clamp Bolt
4. Pivot Pin
5. Rear Bushing
6. Seal
7. Knuckle Support

Installation

1. Assemble upper pivot pin through control arm and into knuckle support with Allen wrench hole in pin to the rear of car. Center pivot pin in knuckle support and install lock bolt, lockwasher and nut and tighten to 30-35 foot lbs. Place new seals over ends of pivot pin.
2. Start front bushing onto pivot pin and then, keeping knuckle support centered (fig. 23) carefully index bushing threads into control arm.

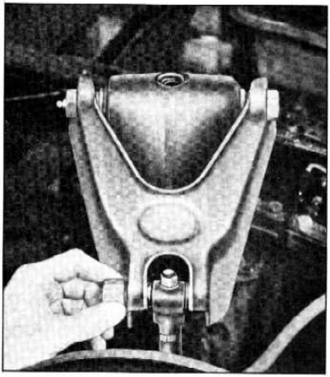

Fig. 23—Centering Knuckle Support

3. Start rear bushing onto pivot pin and then carefully index bushing threads into control arm.
4. Thread bushings into control arm until heads seat and then tighten to 30-40 foot lbs. torque.
5. Install wheel and tire assembly, raise vehicle to remove stand jack and lower vehicle to floor.
6. Install lubrication fittings and lubricate.
7. Check and adjust caster and camber as outlined under "Front Wheel Alignment".

UPPER CONTROL ARM, SHAFT OR BUSHINGS

The upper control arm as furnished for service use has threads cut in bushing holes that are slightly undersize to assure a snug bushing fit. These threaded holes also establish a lead for the bushings when a new arm is installed.

When installing an arm in service, the arm should be placed in position on the control arm shaft by scale measurement and the bushings started making sure that the threads index and enter the arm properly. Since there will be no control of thread start positions, the arm may be out of position by ½ thread pitch or $\frac{3}{64}''$. The off position of the shaft thread may be compensated by positioning of the pivot pin thread although there will always remain the possibility of the assembly being ½ thread pitch out of position. This may be corrected by means of a caster adjustment.

After completion of assembly, the bushings should be finally tightened to 30-40 foot lbs. torque. The arm should be assembled at the shaft end first, the lubricators assembled in the bushings, and moved up and down through the full range of normal movement with rubber bumper removed to insure that there is no interference between shaft and bushings.

Service replacement shafts are oversize on the thread diameters which thread into the spring housing. The large end of the shaft is installed to the front of the housing which allows the small end or rear of shaft which carries an identification indentation to slide through the front hole in spring housing.

Removal

1. Raise front of car and place a stand jack under the outer end of the lower control arm allowing jack to support vehicle.
2. Remove wheel and tire assembly and remove lubrication fittings from bushings.
3. Remove front and rear bushings from upper control arm outer pivot and remove seals from ends of pin.

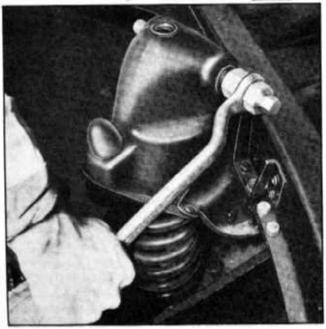

Fig. 24—Removing Upper Control Arm Shaft

4. Remove pivot pin clamp bolt from knuckle support and slide the pivot pin out of the knuckle support using a ¼" Allen set screw wrench to assist removal.
5. Swing knuckle support and hub and drum assembly away from upper control arm.
6. Remove upper control arm shaft front and rear bushings and remove control arm from control arm shaft.

NOTE: On left side of vehicle it will be necessary to remove the sheet metal splash guard over the steering gear housing to get to the rear bushing.

7. Remove seals from ends of upper control arm shaft and using Upper Control Arm Shaft Remover and Replacer J-2958 (fig. 24) remove upper control arm shaft from spring housing from rear to front.

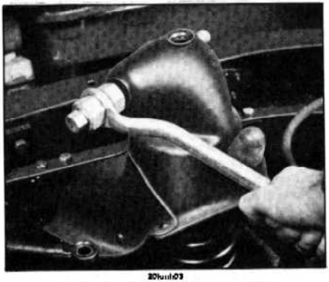

Fig. 25—Installing Upper Control Arm Shaft

Installation

1. Lubricate threads of shaft when they enter spring housing to prevent tearing threads during installation.
2. Install new upper control arm shaft into spring housing from front to rear using Upper Control Arm Shaft Remover and Replacer J-2958 (fig. 25). Drive shaft into housing until end projects out back of spring housing 1⅛" (fig. 26). Remove tool.

CAUTION: Rear end or smaller threaded end of shaft which carries an identification indentation has tapered threads and extreme care must be exercised when installing shaft so that it is not driven in too far since backing it off will leave it loose in the spring housing.

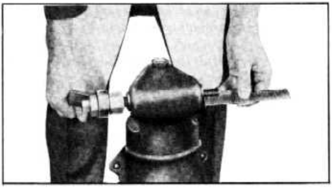

Fig. 26—Locating Shaft in Spring Housing

3. Install new seals over ends of control arm shaft and install control arm on shaft.
4. Start both front and rear bushings onto shaft, position arm by scale measurement and start bushings into arm making sure threads index properly.
5. Tighten bushings until they seat and then tighten to 30-40 foot lbs. torque.
6. Install lubrication fittings, lubricate and check operation of arm. Arm should fall of its own weight.
7. Install sheet metal splash guard over steering gear housing.
8. Install pivot pin and bushings as outlined under "Upper Control Arm Pivot Pin and Bushings–Installation."

KINGPIN BUSHINGS

Removal

1. Place a jack under the spring seat, raise the vehicle off the floor and remove the wheel and tire assembly.
2. Remove the kingpin lock pin, then remove the upper kingpin bearing plug cover and the upper and lower lock rings.
3. Remove lubrication fittings.
4. Remove the kingpin bearing plugs. This can be done with a sharp drift punch by driving through the lower plug and forcing the kingpin upward until the upper plug is removed (fig. 27). The kingpin may then be removed by driving it out the bottom using a soft steel drift.
5. Remove steering knuckle and thrust bearing from the knuckle support and remove the floating bushings from the knuckle.

CAUTION: Extreme care must be exercised to prevent damage to hydraulic brake hose during this operation.

Installation

When replacing the kingpin floating bushings it is not necessary to ream them to size as service bushings are machined to finish dimensions. However, when replacing floating bushings, care should be taken to make sure the oil grooves in the bushings line up with the lubrication fitting hole in the steering knuckle. These bushings should be free both on the kingpin and in the steering knuckle.

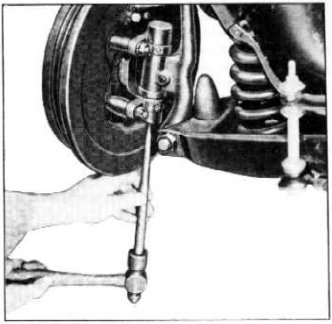

Fig. 27—Removing Kingpin Upper Bearing Plug

1. Install new bushings in the steering knuckle and place the knuckle on the knuckle support. Then install the thrust bearing between the lower yoke of the steering knuckle and knuckle support making sure that the shield on the bearing is toward the top.
2. Install the kingpin from the bottom, making sure to line up the lock pin slot with the lock pin hole in the knuckle support.

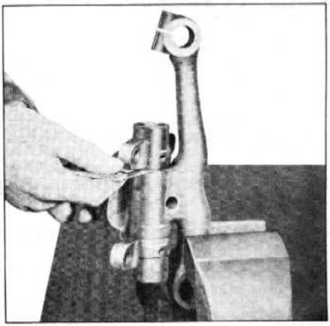

Fig. 28—Clearance Between Steering Knuckle and Support

3. After the kingpin is installed, check the clearance between the steering knuckle and knuckle support with a feeler gauge (fig. 28). If this clearance is more than .006", install a steel shim between the steering knuckle and top of the steering knuckle support.

   NOTE: To prevent damaging the steel shim when installing kingpin, a pilot approximately 1 ½" long can be made from an old kingpin. Use of this pilot will keep steel shim aligned and prevent damage to it during kingpin installation.

4. Install the kingpin lock pin, bearing plugs, lock rings and then install upper kingpin bearing plug cover.
5. Install lubrication fittings and lubricate.
6. Install front wheel and tire assembly and lower vehicle to floor.
7. Check and adjust front wheel toe-in as outlined under "Front End Alignment—Toe-In Adjustment."

FRONT END ALIGNMENT

Front end alignment is the mechanics of adjusting all the inter-related factors and correct alignment must be maintained in order to assure ease of steering and satisfactory tire life.

There are five factors of wheel alignment all inter-related but each having a specific purpose. These factors control the front wheels and steering under varying conditions and should one of the factors get out of position proper relationship is destroyed. These factors, kingpin inclination, caster, camber, toe-in and steering geometry should be checked at regular intervals, particularly if the front suspension unit has been subjected to heavy impacts.

When checking wheel alignment, it is important that wheel bearings and knuckle bearings be in proper adjustment. Loose bearings will affect instrument readings when checking camber, kingpin inclination and toe-in.

KINGPIN INCLINATION—is the amount in degrees that the tops of the kingpins are inclined toward the center of the vehicle which contributes to steering stability.

CASTER—is the amount in degrees of the backward tilt from the vertical of the knuckle support and kingpin which also contributes to steering stability.

CAMBER—is the amount in degrees that the front wheels are tilted outward at the top from a vertical position.

When a wheel is tilted too far out at the top, hard steering or wander will be experienced and tires will show excessive wear on outside shoulders.

Reverse camber or a wheel that is tilted too far in at the top will result in excessive tire wear on the inner shoulders.

Unequal camber may result in unstable steering, wandering or unequal tire wear.

TOE-IN—is the amount in fractions of an inch that the wheels are closer together in front than at the rear. The purpose of toe-in is to insure parallel rolling of the front wheels, to stabilize steering and prevent side slipping and excessive wear of tires. A slight amount of positive toe-in is desirable to offset the small deflections due to rolling resistance and brake application which tends to turn the wheels outward.

STEERING GEOMETRY—is the mechanics of keeping the front wheels in proper relative alignment as the wheels are turned right or left. It is sometimes called error of steering angularity. The governing factors in steering geometry are the length and angularity of the steering arms and linkage.

The front wheels when the vehicle is making a turn are not on the same radius line drawn from the center around which the vehicle is turning. Because of this, it is necessary for the front wheels to assume a toed-out position when rounding curves. This position is governed by the angle of the steering arms.

The wheel of any vehicle, if properly set on the curves, will be at a right angle to the radius line from the center or point around which the vehicle is turning.

SERVICE OPERATIONS

There are several different types of front end alignment machines all of which outline proper procedure for checking factors of proper wheel alignment. The instructions furnished by each manufacturer for the operation of his particular machine should be followed. Regardless of type of equipment used, all checks must be made with the vehicle level and with the weight of the vehicle on the wheels.

Steering complaints are not always the result of improper front wheel alignment, therefore, it is recommended that the following factors be checked and corrected prior to placing the vehicle on the front end machine.

1. Loose or improperly adjusted steering gear.
2. Steering gear housing loose at frame.
3. Play or excessive wear in kingpins or bushings.
4. Loose tie rod or steering connections.
5. Improper front spring heights.
6. Underinflated tires.
7. Unbalanced or improperly mounted tires.
8. Motor mountings improperly adjusted or broken.
9. Brakes dragging.
10. Wheel bearings improperly adjusted.
11. Shock absorbers not operating properly.

CASTER AND CAMBER—Adjust

The caster and camber adjustments are both performed by turning the upper control arm pivot pin with an allen wrench placed in allen

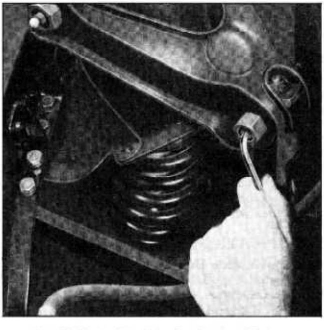

Fig. 29—Turning Pivot Pin to Set Caster and Camber

wrench hole in rear end of pivot pin after lubrication fitting is removed from rear bushing. This pivot pin is threaded into the front and rear bushings in the control arm and the steering knuckle support is held centrally located on the pivot pin, which is $\frac{3}{32}''$ eccentric, by a clamp bolt which indexes with a groove in the pivot pin. With this construction, change in caster is slight for a full range of camber adjustment.

Procedure for adjustment is to turn pivot pin (fig. 29) until the travel of pin threads in bushings gives an exact caster setting, then turn pivot pin less than ½ turn in direction required for camber adjustment. The direction depends upon the position of the eccentric. The maximum amount of thread travel during camber adjustment is about ¼ of the available caster adjustment so that caster and camber can be brought within limits on the first trial.

Caster should be ½° plus or minus ½° and camber should be ½° plus or minus ½°.

KINGPIN INCLINATION

From the definitions of "KINGPIN INCLINATION" and "CAMBER", one being the inward tilt of the kingpins and the other the outward tilt of the wheels, it is evident that one cannot be corrected without changing the other. For this reason these two factors of front wheel alignment must be considered together. The correct kingpin inclination should be 4° plus or minus ½°.

If a check shows that the camber is incorrect and the kingpin inclination is correct it indicates that the steering knuckle is bent and must be replaced. If the kingpin inclination is incorrect the knuckle support must be replaced. If a new knuckle support is installed it is necessary to re-adjust both caster and camber.

TOE-IN—Adjust

Toe-in which should be 0—⅛" on 1949-52 cars and ¼" plus or minus $\frac{1}{16}''$ on 1953 cars can be adjusted by loosening the clamp bolts at each end of the left hand tie rod and turning the left hand tie rod to increase or decrease its length as necessary, until proper toe-in is secured.

Before locking the clamp bolts, make sure that the tie rod ends are in alignment (fig. 5) with their ball studs. If the tie rod is not in alignment with the studs, binding will result. Lock the clamp bolts at each end of the tie rod by tightening the clamp bolt nuts to 8-12 foot lbs.

Check wheels for straight ahead position with steering gear on high point. If wheels are not straight ahead with gear on high point, adjust steering connecting rod as outlined in Section 9, "Steering Connecting Rod—Adjust."

STEERING GEOMETRY

Steering geometry or toe-out on turns is controlled by the angle of the steering arms. If, when checking, toe-out does not fall within the limits given in the specifications, it will be necessary to replace the steering arm on the wheel side that does not come within limits.

TROUBLES AND REMEDIES

FRONT AXLE AND WHEEL ALIGNMENT

Symptom and Probable Cause	Probable Remedy
Hard Steering	
a. Lack of lubrication	a. Lubricate chassis and steering gear
b. Tight kingpin bushings	b. If not corrected by lubrication, replace bushings
c. Underinflated tires	c. Inflate tires to recommended pressure
d. Improper toe-in	d. Adjust toe-in
e. Improper steering gear adjustment	e. Adjust steering gear
f. Tie rod ends out of alignment	f. Align tie rod ends with ball studs
Front Wheel Shimmy	
a. Underinflated tires	a. Inflate tires to recommended pressure
b. Broken or loose wheel bearings	b. Replace or adjust wheel bearings
c. Improper toe-in	c. Adjust toe-in
d. Worn kingpin bushings	d. Replace worn parts
e. Improper caster	e. Adjust caster
f. Unbalanced wheels	f. Balance wheel and tire assemblies
g. Steering gear loose	g. Adjust steering gear
h. Tie rod ball studs loose	h. Replace worn ball studs
Road Wander	
a. Underinflated tires	a. Inflate tires to recommended pressure
b. Lack of lubrication	b. Lubricate chassis and steering gear
c. Tight steering gear	c. Adjust steering gear
d. Improper toe-in	d. Adjust toe-in
e. Improper caster and camber	e. Adjust caster and camber
f. Worn tie rod ends	f. Replace tie rod ends
Wheel Tramp	
a. Wheel assembly out of balance	a. Clean wheel and balance assembly
b. Blister or bump on tire	b. Replace or repair tire
c. Improper shock absorber action	c. Replace shock absorber
Excessive or Uneven Tire Wear	
a. Underinflated tires	a. Inflate tires to recommended pressure
b. Improper camber	b. Adjust camber
c. Improper caster	c. Adjust caster
d. Improper toe-in	d. Adjust toe-in
e. Wheels out of balance	e. Balance wheels

FRONT SUSPENSION SPECIFICATIONS

Caster Degrees	$\frac{1}{2}° \pm \frac{1}{2}°$
Camber—Degrees	$\frac{1}{2}° \pm \frac{1}{2}°$
Kingpin Inclination—Degrees	$4° \pm \frac{1}{2}°$
Toe-In—Inches 1949-52	$\frac{1}{8}''$
Toe-In—Inches 1953	$\frac{1}{4}'' \pm \frac{1}{16}''$
Steering Geometry (Toe-Out on Turns)	
Outside Wheel—Degrees	20°
Inside Wheel—Degrees	$24° \pm 2°$
Riding Height—Front Springs: Measure from center of lower control arm outer pivot bolt to floor and center of lower control arm inner front bushing to floor. Difference should be—	$1\frac{5}{8}'' \pm \frac{1}{4}''$
Steering Knuckle Bushing Diameter	.867"—.868"
Kingpin Diameter	.866"
Steering Idler and Third Arm Shaft Bushing Diameter	.922"—.923"
Steering Idler and Third Arm Pin Diameter	.921"
Clearance between Steering Idler and Third Arm Assembly and Bracket	.006" maximum
Clearance between Steering Knuckle and Knuckle Support	.006" maximum
Clearance between Steering Idler and Third Arm Bracket and Front Cross Member at Upper Mounting Hole	.008" maximum

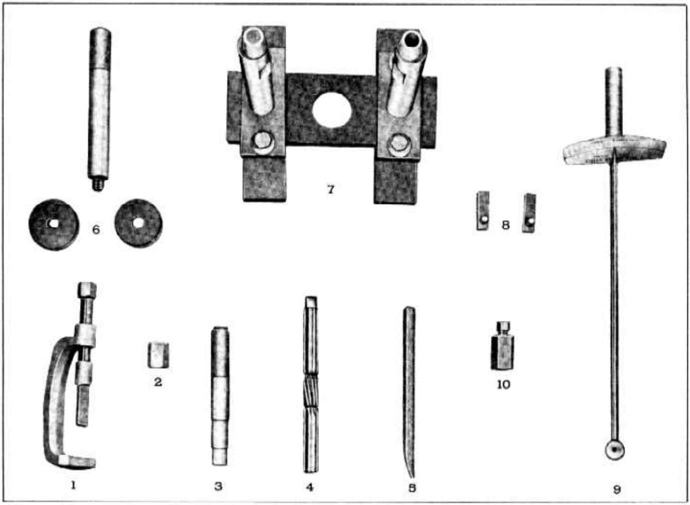

Fig. 30—Front Suspension Special Tools

1. Tie Rod Ball Stud Remover—J-2963
2. Outer Ball Stud Remover—J-1273
3. Steering Knuckle Bushing Driver—K-318
4. Steering Idler Bracket Bushing Reamer—J-3189
5. Wheel Bearing Cup Remover—K-224
6. Wheel Bearing Cup Inserter—K-463-A
7. Hub Bolt Peening Tool and Anvil—J-554
8. Lower Control Arm Assembly Gauge—J-3184
9. Torque Wrench—J-1264
10. Upper Control Arm Shaft Remover and Replacer—J-2958

TORQUE SPECIFICATIONS

Tie Rod Clamp Bolt Nut	8-12 Ft. Lbs.
Steering Idler Bracket to Cross Member Lower Bolts	30 Ft. Lbs. Min.
Steering Idler Bracket to Cross Member Upper Bolt	65 Ft. Lbs. Min.
Spindle Nut...See Front Wheel Bearings—Adjust	
Lower Control Arm Shaft Bushing Lock Nut (Early 1949 Models)	150-200 Ft. Lbs.
Lower Control Arm Pivot Bolt	100-200 Ft. Lbs.
Lower Control Arm Pivot Bolt Lock Nut	90-120 Ft. Lbs.
Lower Control Arm Pivot Bolt Bushing	150-170 Ft. Lbs.
Upper Control Arm Pivot Pin Lock Bolt Nut	30- 35 Ft. Lbs.
Upper Control Arm Pivot Pin Bushings	30-40 Ft. Lbs.
Upper Control Arm Shaft Bushings	30-40 Ft. Lbs.

SERVICE NEWS REFERENCE

Month	Page No.	Subject

SECTION 4

REAR AXLE AND SUSPENSION

CONTENTS OF THIS SECTION

REAR AXLE

INDEX

GENERAL DESCRIPTION

The rear axle used on all passenger car models is of the semi-floating type with Hypoid gears mounted in a pressed steel banjo type housing. Typical construction features are shown in fig. 1. An oil retainer mounted in the carrier ahead of the pinion Hyatt roller bearing retards the return flow of lubricant to the carrier, thus assuring a continual bath of oil.

The drive pinion is overhung, the rear bearing is a Hyatt roller and the front bearing is a double row ball bearing. There are two differential pinion gears and two differential side gears. Barrel roller bearings are used in mounting the differential case. Both the pinion bearings and the differential bearings are preloaded in manufacture.

Wheel and axle shaft mountings are of the semi-floating design. Permanently lubricated and sealed Hyatt roller bearings are used at the rear wheels and the axle shaft oil seals are located at the outer ends of the axle tubes.

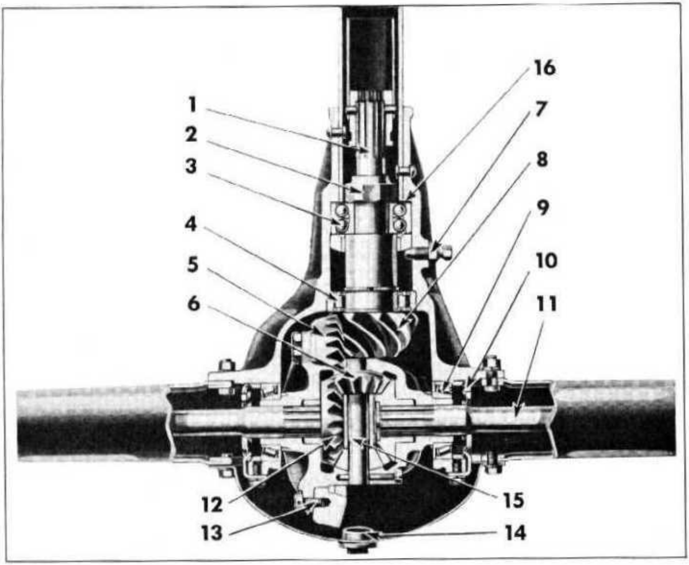

Fig. 1—Rear Axle Assembly

1. Pinion Shaft
2. Pinion Bearing Retaining Nut
3. Front Pinion Bearing
4. Rear Pinion Bearing
5. Ring Gear
6. Differential Pinion Gear
7. Front Pinion Bearing Retainer Screw
8. Drive Pinion
9. Differential Side Bearing
10. Differential Side Bearing Adjusting Nut
11. Axle Shaft
12. Differential Side Gear
13. Ring Gear Capscrew
14. Filler Plug
15. Differential Pinion Gear Shaft
16. Shims

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MINOR SERVICE OPERATIONS

AXLE SHAFT OR DRUM

Removal

1. Remove wheel.
2. Remove two stamped brake drum retaining nuts (zipon type) from the two hub bolts (fig. 2).
3. Remove brake drum from axle shaft.
4. Install wheel cylinder clamp, KMO-145, on brake wheel cylinder.
5. Drain lubricant from differential and remove housing cover.
6. Remove the differential pinion shaft lock screw, the differential pinion shaft, axle shaft spacer and differential pinions (fig. 3).
7. Push axle shafts in toward the center of the axle and remove "C" washers from inner ends of the axle shafts.
8. Remove shafts from axle housing.

Replacement

1. Install gasket to hub aligning the center hole of the three holes closest together with the notch in the hub.

NOTE: Apply heavy shellac or paint to both sides of gasket and oil deflector.

2. Install oil deflector over gasket aligning oil pocket with notch in the hub.

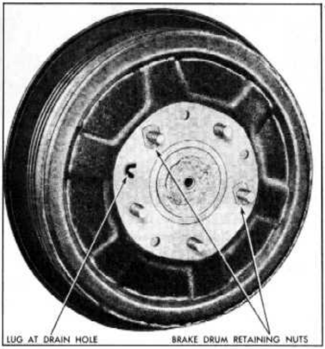

Fig. 2—Rear Brake Drum Retaining Nuts

Fig. 3—Removing Axle Shaft Spacer

3. Insert six special bolts and force heads down to the deflector.
4. Peen end of shoulder on bolts into countersink around bolt holes in the flange, using anvil and hub bolt peening tool J-554 (fig. 4).

   CAUTION: This peening operation is very important from a safety standpoint.

5. Inspect leather oil seal on inside of axle housing for excessive wear, damage or misplacement.

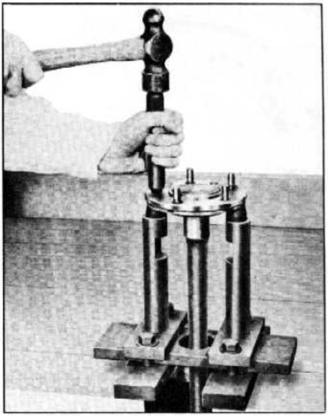

Fig. 4—Peening Flange Bolts

6. Slide axle shaft into place.

   CAUTION: Exercise care that splines on end of shaft do not cut leather oil seal and that they engage with splines of differential side gears.

7. Replace "C" washers on inner ends of shaft.
8. Pry shafts apart so that "C" washers are seated in counterbore in differential side gears, and install differential pinions.

   CAUTION: Exercise care to avoid scratching or damaging inner ends of shaft.

9. Select axle shaft spacer to give free fit to .014" maximum clearance between ends of axle shaft and the spacer (fig. 5).

   NOTE: There are four sizes of axle shaft spacers available as follows:

   Narrow ....1.011"- 1.013" wide across ground surfaces

   Medium ....1.018"- 1.021" wide across ground surfaces

   1.028"- 1.031" wide across ground surfaces

   Wide ....1.033"- 1.035" wide across ground surfaces

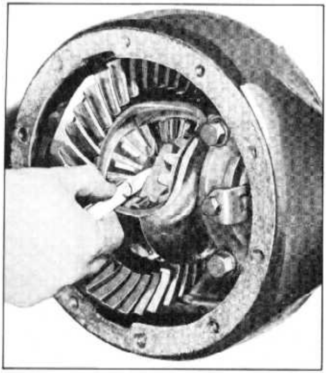

Fig. 5—Clearance Between Axle Shaft and Spacer

10. Install spacer in place and assemble pinion shaft, locking in place with special screw using lockwasher under head.
11. Replace axle housing cover using new gasket and refill differential.
12. Remove wheel cylinder clamp.
13. Replace brake drum and two brake drum retaining nuts.

    CAUTION: Make sure lug in web section of drum is aligned and extends into drain hole in axle shaft flange.

14. Replace wheel.

AXLE SHAFT—BEARING OR OIL SEAL

Removal

1. Remove wheel and axle shafts (see axle shaft—removal).
2. Insert special bearing puller J-1436 and remove bearing, bearing retainer and oil seal (fig. 6).
3. Inspect bore and dress out the old seal stake points to prevent damage to the new seal when installed.

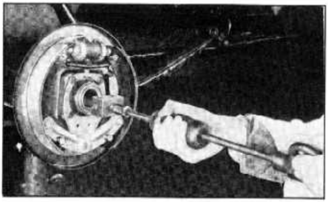

Fig. 6—Axle Shaft Bearing Puller

Replacement

1. Using bearing and retainer replacer K-427 (fig. 7) place oil seal, bearing and inside bearing retainer on tool in that order.
2. Place a light coat of Permatex on the O.D. of oil seal to assure proper sealing of oil seal in housing bore.

    CAUTION: Be careful that no sealing material gets on the leather lip of oil seal.

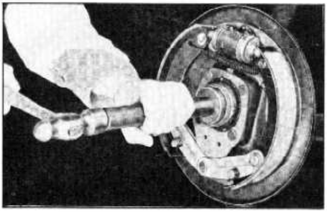

Fig. 7—Axle Shaft Bearing and Oil Seal Replacer

3. Start the bearing into the axle housing and tap tool with hammer to seat parts.
4. Remove special tool and stake oil seal in place with a prick punch.
5. Assemble axle shafts (see axle shaft-replacement).

MAJOR SERVICE OPERATIONS

REAR AXLE ASSEMBLY

Removal

1. Raise vehicle from floor.
2. Remove rear wheels and brake drums.
3. Install wheel cylinder clamps KMO-145 on brake wheel cylinders.
4. Disconnect hand brake cables from cross shaft lever.
5. Remove brake cables from cable clamp on frame side member.
6. Disconnect hydraulic brake line connection at rear axle housing.

7. Disconnect shock absorber from rear spring "U" bolt and shock absorber anchor bolt plate.
8. Remove spring "U" bolts and plate.
9. Disconnect spring shackles and drop springs.
10. Slide axle back to disconnect torque tube at front end, and remove from vehicle.
11. Place axle assembly in axle stand.

REAR AXLE AND DIFFERENTIAL CARRIER

Disassembly

1. Drain lubricant and remove housing cover.
2. Remove axle shafts and differential gears (see axle shaft removal).
3. Remove third member by removing nuts holding it to the front of the axle housing.
4. Remove the adjusting nut locks and four differential carrier cap screws.
5. Remove bearing caps and adjusting nuts and remove differential assembly.
6. Remove three tapered bearing retaining screws and tap splined end of propeller shaft allowing pinion shaft to slide out.
7. Remove shims from inside of propeller shaft housing making note of number and total thickness of shims removed.
8. Clean all parts in cleaning solvent.

Inspection

1. Check clearance between propeller shaft and its bushing.

NOTE: If this clearance exceeds .010" the bushings and oil seal should be replaced.

REPAIRS

Propeller Shaft Bushing and Oil Seal—

The torque tube front and rear bushings on late 1950 and all 1951-53 model passenger cars are a press fit in the torque tube, eliminating the dowel pin locking method used on 1949 and early 1950 models. This press fit eliminates any tendency for lubricant leakage at the dowel pins.

These bushings should be installed in late 1950 and all 1951-53 passenger car models using torque tube bushing driver J-4259 for the rear bushing and driver J-4290 for the front bushing. These drivers must be used to properly position the bushings in the torque tube.

When installing the new bushings in an old torque tube, however, it is imperative that the bushings be a tight fit in the tube. If there is any doubt, the bushings must be drilled for dowel pins following the instructions as given under, "Propeller Shaft Bushings and Oil Seal".—Replacement (Dowel Type).

It should also be noted that rear bushing driver tool J-4259 includes a steel washer. This steel washer is used with the tool only when installing the rear bushing on ½ ton trucks to allow for proper positioning.

The 1949-1950 oil seal in back of the rear bushing assembly is the same as previously used on all models except those equipped with the Powerglide Automatic Transmission.

On the 1950 rear axles used with the Powerglide Automatic Transmission and in all 1951-1953 models, a seal is used which is encased in rubber to prevent oil leakage around the O.D. of the seal retainer.

Replacement—Dowel Type—1949

1. Drill out dowel pins retaining bushings (fig. 8).
2. Drive out both bushings and oil seal from pinion end of housing.
3. Start a new oil seal into the housing with free side of the leather toward the front.
4. Install new rear bushing and drive both bushing and oil seal firmly against their seat, using bushing driver J-968.
5. Drill dowel hole in bushing being careful to control depth.

CAUTION: Do not drill completely through bushing.

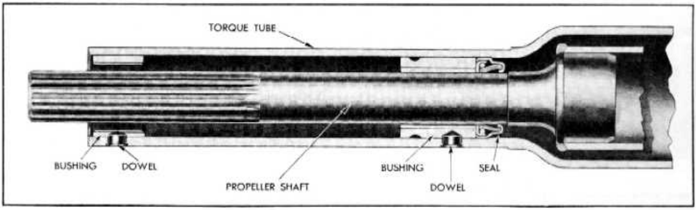

Fig. 8—Propeller Shaft Bushings and Oil Seal

6. Coat dowel with sealer to prevent leakage, install and peen dowel in place.
7. Install front bushing using bushing driver J-968.
8. Drill dowel hole in bushing.

   CAUTION: *Extreme care must be used not to break through the wall of the bushing.*

9. Install and peen dowel in place.

   NOTE: To prevent distortion of these bushings when peening the dowels an arbor or universal joint yoke should be inserted to support the bushing.

10. Dress off with file any burrs set up during peening operation.

Replacement—Press Fit Type—1950-53

To remove propeller shaft bushings and oil seal on these models, it is necessary to pull both bushings and the oil seal from the housing using special puller J-4258.

1. Remove rear axle assembly from vehicle and remove differential assembly and propeller shaft and pinion from carrier.
2. Insert shaft with flanged end, which is part of J-4258, from pinion end of housing and position firmly against the oil seal.
3. Assemble puller flange on front of torque tube, then thread thrust bearing and nut on shaft. Turn nut to pull both bushings and oil seal from the torque tube (fig. 9).
4. Place a new oil seal on driver J-968 so that the free side of the leather is toward the head of the driver. Place the driver and seal into the housing and drive the seal against its seat.

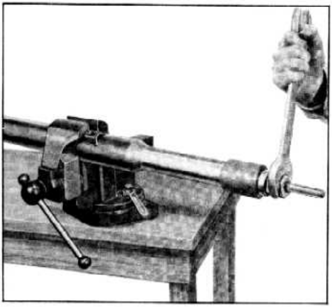

Fig. 9—Removing Torque Tube Bushing

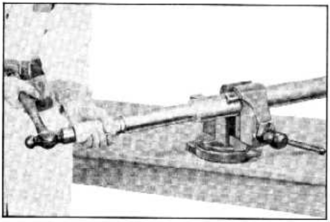

Fig. 10—Installing Torque Tube Front Bushing

5. Install new rear bushing using bushing driver J-4259. Drive the bushing in until the stop on the driver is against end of torque tube (fig. 10).

   NOTE: The small steel spacer, which is part of bushing driver J-4259, should not be used when installing rear bushings in passenger cars.

6. Install new front bushing using driver J-4290. Drive the bushing in until stop on driver is against end of torque tube.

PROPELLER SHAFT AND PINION ASSY. 1949-50 Models

Disassembly

1. Drill end of rivet to clear countersink into which it is upset being careful to center the rivet with center punch.
2. Drive out rivet.
3. Loosen pinion bearing lock nut and separate pinion from propeller shaft.
4. Remove pinion bearing lock nut and press bearing from pinion shaft using pinion bearing remover, J-996.
5. Remove bearing lock sleeve and rear bearing lock ring.
6. Remove rear bearing from pinion shaft.

Inspection

1. Wash all parts in cleaning solvent.
2. Inspect splines for excessive wear or looseness.
3. Inspect shaft at propeller shaft bushing location for scoring or excessive wear.
4. After cleaning and oiling bearings, check for roughness by slowly turning the outer race by hand.

   NOTE: Bearings should be cleaned in cleaning solvent and blown out with compressed air.

CAUTION: Do not spin bearings with compressed air, as this will cause damage to races and balls.

5. Inspect double row front pinion bearing for end play.

   NOTE: Any end play in this bearing will allow the pinion to float in and out changing pinion depth in ring gear.
6. Inspect pinion for cracked, chipped or scored teeth.

Assembly

1. Install rear pinion bearing on pinion shaft and lock in place with lock ring.
2. Coat beveled surface of pinion bearing lock sleeve with rear axle lubricant and install on shaft with beveled edge toward the pinion.
3. Press front (double ball) bearing on shaft and install bearing lock nut.

   NOTE: When assembling either of the "W" type pinion bearings, Part No. 954533, New Departure ND5306 or ND5306-W, on the pinion shaft, the bearing should be assembled with the loading slot toward the pinion. This places the thrust occurring during drive on the side of the double row bearing that does not contain the loading slot. Favoring of the bearing in this manner provides for better over-all bearing performance and greater life.

   The older type bearing, Part No. 954395, should be installed with the loading slot away from pinion as the contours of the inner and outer races are in a position reversed to the new type bearing.

4. Install splined end of pinion shaft into coupling on end of propeller shaft aligning rivet holes.
5. Install new rivets and rivet both ends.
6. Tighten bearing lock nut to 200-240 ft. lbs. and lock in milled slot in pinion shaft.

1951-53 Models

The propeller shaft ends are designed so that balancing weights can be welded on. Propeller shaft and pinion shaft assembly are balanced together instead of balancing the propeller shaft before assembly to pinion as in the 1949-50 models.

The splines on the hypoid drive pinion have been designed to provide a 2,000 to 10,000 pound press fit into the propeller shaft coupling. Because of this press fit, a propeller shaft and pinion assembly tool, J-4548, must be used to remove and replace the pinion assembly.

NOTE: 1953 Drive pinion fit into the propeller shaft coupling is a metal to metal fit with a coil spring adding fore and aft tension.

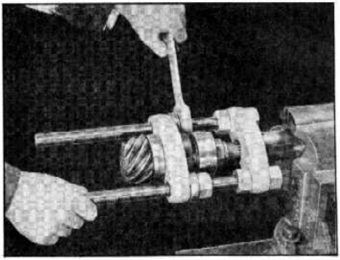

Fig. 11—Removing Pinion from Propeller Shaft Coupling

Disassembly

1. Center punch the riveted end of coupling pin, then drill end of rivet to clear countersink into which it is upset.
2. Drive out coupling pin.
3. Install J-4548, propeller shaft and pinion assembly and replacer (fig. 11). Separate pinion assembly from propeller shaft.

   NOTE: The nuts on the remover and replacer screws should be turned evenly to prevent binding.

4. For disassembly and inspection of the pinion shaft, refer to procedure as outlined for 1949-50 models.

Assembly

1. Align coupling pin holes in pinion shaft with those in the propeller shaft coupling and start end of pinion into coupling.

   NOTE: On 1953 models install coil spring in coupling before starting end of pinion into coupling.

2. Install tool J-4548 (fig. 12). Turn nuts on the remover and replacer screws and press the pinion into the coupling until the pin holes in the pinion and coupling are aligned.

   NOTE: The end plate of tool J-4548 has a small reversible adapter which is used to hold the pinion centered. By reversing this adapter, the tool may be used with pinions which have the ends either centered or counterbored.

3. Install new coupling pin and rivet over both ends.

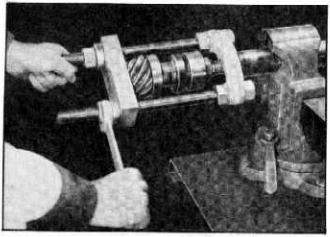

Fig. 12—Pressing Pinion into Propeller Shaft Coupling

DIFFERENTIAL ASSEMBLY

Inspection

1. Inspect differential side gears for scored hubs or thrust surfaces.
2. Inspect internal splines of side gears and check fit on axle shafts.
3. Inspect thrust surfaces on differential pinion gears and check their fit on pinion shaft.
4. Inspect differential side gear and pinion gear thrust faces in the differential case.
5. Using a torque wrench check ring gear bolts for tightness (should be 40-60 ft. lbs.).
6. Clean differential side bearings, oil and check for roughness by rotating slowly by hand.

REPAIRS

Differential Bearing Replacement

1. Install differential bearing puller TR-278-R making sure puller legs are fitted securely in notches in case and retaining yoke tight.
2. Tighten puller screw and remove bearing (fig. 13).
3. Replace bearing by placing on hub with the thick side of inner race toward case.
4. Drive bearing in place with differential side bearing replacer J-994 (fig. 14).

Ring Gear Replacement

1. Remove ring gear bolts and lockwashers.
2. With soft hammer tap ring gear off the case.
3. Install guide pins made from ⅜"-24 x 1½" long capscrews with heads cut off and ends slotted (fig. 15) to new ring gear.

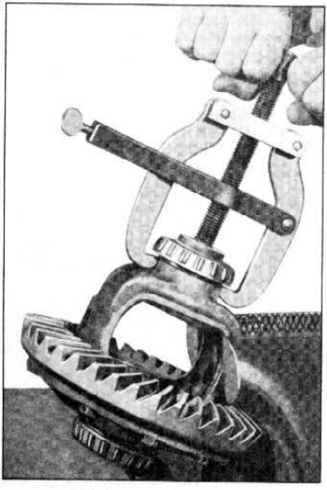

Fig. 13—Removing Differential Bearing

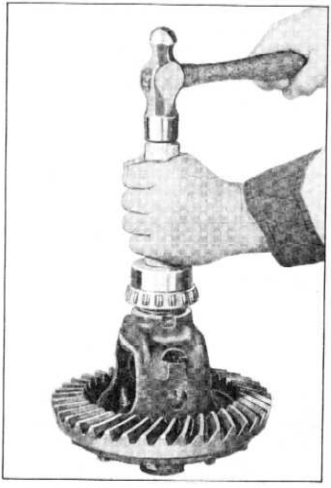

Fig. 14—Replacing Differential Bearing

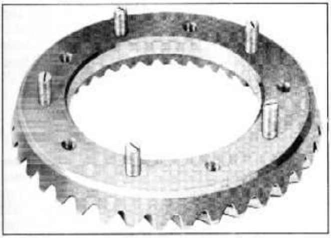

Fig. 15—Use of Guide Pins in Ring Gear

4. Make sure back face of ring gear and face of case are free of dirt and burrs and slip gear over pilot diameter of the case.
5. Install every other ring gear bolt and lock-washer, then draw them up evenly and snugly so that ring gear face is flush with face of case.
6. Remove guide pins and install remaining bolts.

NOTE: All bolts should be tightened to 40-60 ft. lbs.

7. Install differential carrier into axle housing and check runout of rear face of ring gear. This runout not to exceed .0035″.

DIFFERENTIAL CARRIER

Assembly—1949 and Early 1951

1. If original ring gear and pinion are to be used, replace same thickness of shims in propeller shaft housing counterbore that were removed.

NOTE: As a means of adjusting pinion depth, shims are available in thicknesses of .012″, .015″, .018″ and .021″. By combining two shims a total shim thickness of .024″ to .042″ may be secured.

2. If new ring gear and pinion are used one .015″ and one .018″ shim should be used as a standard starting point.

CAUTION: Make sure shims, when installed, are flat in the counterbore and not cocked.

3. Install propeller shaft and pinion assembly, driving it down until bearings are seated in the housing using spacer tool J-4050 to provide proper pinion to bearing clearance (fig. 16).
4. Check through the bearing lock screw holes to make sure lock sleeve is in position against back of front pinion bearing.
5. Install three tapered lock screws and draw them down evenly and tightly, then tighten lock screw nuts.
6. Install differential assembly in the carrier and install adjusting nuts.

CAUTION: Carefully slide adjusting nuts alongside the bearing so that threads on nuts fit into threads in carrier.

7. Install bearing caps aligning marks on cap with marks on carrier.
8. Install and tighten cap screws until lock-washers just flatten out.

Assembly—1951-53 Models

The depth of the bore in the differential carrier against which the pinion double row bearing seats has been reduced .015″ on all passenger car models. This necessitates a change in the shim set-up for adjusting pinion depth in the ring gear. Although the same number and thickness shims are available (namely .012″, .015″, .018″, and .021″) only one shim is used between the double row bearing and the bottom of the bore in the carrier instead of the two shims which were formerly used.

When installing a new ring gear and pinion in an axle equipped with the new differential carrier and torque tube assembly, one .018″ shim should be used as a starting point. Checking the tooth pattern according to instructions under, "Adjusting Ring Gear and Pinion," will establish any changes in the shimming that may be necessary to procure proper pinion depth adjustment.

These differential carrier and torque tube assemblies started in production on 5/29/51 at the

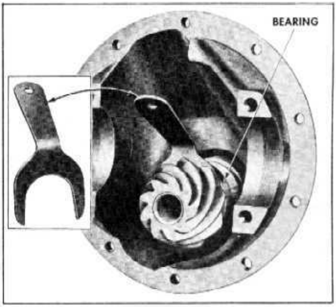

Fig. 16—Checking Pinion to Bearing Clearance

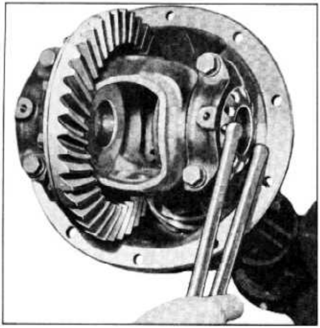

Fig. 17—Adjusting Ring Gear and Pinion

Detroit plant, and 4/26/51 at the Tonawanda plant and may be identified as follows:

	Detroit Plant	Tonawanda Plant
Regular Passenger	JA 529	JB 426
Powerglide Passenger.....	JJ 529	JK 426

The number following the prefix is the calendar month and the number or numbers following the month designation will be the day of the month. Example: JA 529—the prefix JA identifies the Detroit plant, the numeral 5 identifies the month as May, and 29 the twenty-ninth day of that month.

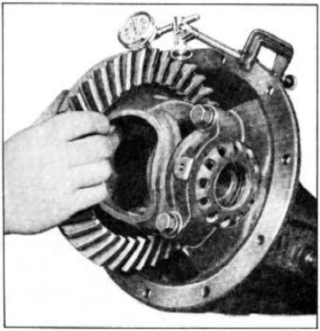

Fig. 18—Checking Ring Gear and Pinion Backlash

Service stock of these differential carrier and torque tube assemblies are identified by a band of yellow paint around the torque tube. Mechanics should remember that only one shim is to be used when assembling the pinion and propeller shaft in a differential carrier assembly identified by a band of yellow paint.

Adjustment

1. Loosen right hand adjusting nut and tighten left hand adjusting nut using differential adjusting wrench J-972 while turning ring gear. Continue tightening left hand nut until all lash is removed, then back off the left hand nut one notch to a locking position.
2. Tighten right hand nut to force left bearing firmly into contact with left adjusting nut. Then loosen the right nut and again tighten snugly against the bearing.

   NOTE: This position may be easily determined as the nut comes to a definite stop.

3. Tighten right hand nut a minimum of one additional notch to maximum of two notches further to a locking position (fig. 17). This operation preloads the differential bearings.
4. Mount a dial indicator on the carrier and check the back lash (fig. 18), between the ring gear and pinion. The back lash should be from .005"-.008".

   NOTE: If back lash is more than .008" loosen right hand adjusting nut one notch and tighten left hand adjusting nut one notch. If back lash is less than .005" loosen left hand adjusting nut one notch and tighten right hand adjusting nut one notch.

5. Tighten bearing cap bolts to 65-80 ft. lbs. Recheck back lash and install both adjusting nut locks.

REAR AXLE—

Assembly

1. Clean out axle housing and cover and place new gasket over carrier mounting bolts.
2. Assemble differential carrier assembly to axle housing, install lockwashers and nuts and tighten securely.
3. Lubricate hubs of differential side gears with hypoid lubricant and install them into differential case.
4. Install axle shafts, making sure the longer shaft is used on the right hand side and install "C" shaped axle shaft locks.
5. Spread shafts to make sure that the shafts, locks and differential side gears are in positive contact.

6. Roll the two differential pinions into position and install axle shaft spacer, pinion gear shaft and pinion gear shaft lock screw.

NOTE: Check clearance between end of axle shaft and spacer. This should be from free fit to .014" (fig. 5).

7. Install the axle housing cover using a new gasket and refill differential with 3½ pints of S.A.E. 90 "Multi-Purpose" gear lubricant.

Replacement

1. Adjust universal ball joint as outlined in Transmission Section.
2. Slide axle assembly under vehicle and start propeller shaft into universal joint splines.
3. Raise axle assembly and replace rear spring shackles.
4. Fill retainer housing through speedometer driven gear hole with ½ pint of lubricant to provide initial lubrication for universal joint and propeller shaft bushings. Install speedometer driven gear and connect cable.
5. Replace rear spring "U" bolt and shock absorber anchor bolt plate, install "U" bolts and tighten securely.
6. Replace shock absorber eye to bolt on anchor plate.
7. Connect hydraulic brake line to connector at rear axle housing.
8. Remove wheel cylinder clamps and install brake drums and rear wheels.
9. Connect hand brake cables to cross-shaft lever and to bracket on frame side member and adjust. See Brake Section.
10. Lower vehicle to floor.
11. Bleed brake lines at all four wheels. See Brake Section.

ADJUSTING RING GEAR AND PINION

Proper ring gear and pinion adjustment is important if the rear axle assembly is to provide quiet and trouble-free operation. The following procedure is recommended for checking gear tooth bearing, either before disassembly to determine whether improper adjustment is the cause of noisy operation, or following the installation of a new gear set.

Complaints of rear axle noise, which can nearly always be contributed to improper adjustment, can be placed in three general classifications:

1. DRIVE NOISE is most pronounced on constant acceleration through the speed range of 15 to 45 M.P.H.
2. COAST NOISE is most pronounced when the car is allowed to coast through the speed range from 45 to 15 M.P.H. with the clutch engaged and throttle closed.
3. FLOAT NOISE is most pronounced while holding the car speed constant at intervals between 15 and 45 M.P.H.

Drive, coast and float noises will be very rough and irregular if the differential or pinion shaft bearings are rough, worn or loose.

Service personnel should refer to Figure 19 to familiarize themselves with the terms used in referring to the different parts of the gear tooth. The large end of the tooth is called the "heel" and the small end the "toe." Also, the top of the tooth, which is the part above the pitch line, is called the "face," while the part below the pitch line is called the "flank." The space between the meshed teeth is referred to as "backlash."

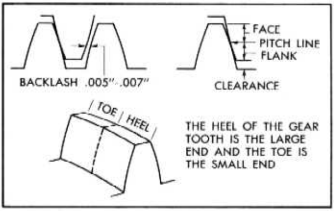

Fig. 19—Gear Tooth Terms

1. Raise rear of car and place on stand jacks, then, drain and flush rear axle housing and leave housing cover off.
2. Wipe ring gear and pinion dry with a clean cloth. Paint ring gear teeth lightly and evenly with red lead of suitable consistency.
3. Apply parking brake to provide a heavy drag at the rear wheels.
4. Run engine slowly with transmission in first gear and then in reverse for a few seconds.
5. Stop the engine and compare the marks produced on the gear teeth with the marks shown in Figure 20. Tooth pattern "A" provides the ideal bearing for quietness and long life.
6. If the pattern shows a toe contact "B", it indicates not enough backlash. To correct, move the ring gear away from the pinion by loosening left-hand differential adjusting nut and tightening right-hand adjusting nut.

NOTE: Make adjustment one notch at a time, repeat check with red lead and continue adjustment until tooth contact appears as in "A".

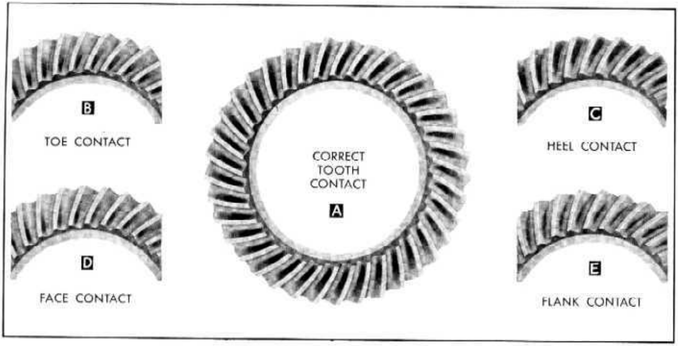

Fig. 20—Gear Tooth Patterns

7. If the pattern shows a heel contact "C," it indicates too much backlash. Make correction as in step No. 6, however, loosen right hand differential adjusting nut and tighten left hand adjusing nut to move ring gear toward pinion.

8. If the pattern shows a high face contact "D," it indicates that the pinion is too far out, that is too far toward the front of the car. To correct, remove the differential carrier assembly and place in a vise or on a bench. Remove differential bearing caps and remove differential assembly. Remove three tapered bearing retainer screws and tap splined end of propeller shaft allowing pinion shaft to slide out. Be careful in removing the shaft that the metal shims between ball bearing and carrier are not lost. Use a pair of micrometers to determine shim thickness.

   NOTE: Late model 1951 and all 1952-53 models have a shallower bore into which the pinion double row bearing seats. These models, therefore, use only one shim between the bearing and the bottom of the bore in the carrier whereas the 1949-50 and early 1951 models used two shims.

   Then, use a new combination of shims to provide .006" increase in shim pack thickness. Reassemble and repeat check with red lead and continue adjustment until tooth contact appears as in "A".

   NOTE: As a means of adjusting pinion depth, shims are available in thicknesses of .012", .015", .018" and .021". By combining two shims, a total shim thickness of .024" to .042" may be obtained.

9. If the pattern shows a flank contact "E," it indicates that the pinion is in too far. To correct, proceed as outlined in step No. 8 and select a new shim combination to provide .006" reduction in shim pack thickness. Reassemble and repeat check with red lead and continue adjustment until tooth contact appears as in "A".

10. In making pinion adjustments, be sure backlash is correct before retesting with red lead for tooth pattern. Moving the pinion in reduces backlash and moving it out increases it.

11. When proper tooth contact is obtained, wipe red lead from gears and carrier with cloth moistened with clean gasoline or kerosene. Wipe out housing with clean cloth.

12. Pour a liberal quantity of rear axle lubricant on gears and bearings and turn rear wheels to work lubricant into all surfaces.

13. Install housing cover using a new gasket, coating bolt threads with Permatex to avoid oil leaks.

14. Remove car from stand jacks and fill differential carrier with 3½ pints of S.A.E. 90 "Multi-Purpose" gear lubricant.

TROUBLES AND REMEDIES

REAR AXLE

Symptom and Probable Cause	Probable Remedy
Excessive Backlash	
a. Loose wheel bolts.	a. Tighten nuts securely. Make sure the tapered end of nut is toward wheel.
b. Worn universal joint.	b. Replace or overhaul joint.
c. Loose propeller shaft to pinion splines.	c. Replace worn parts.
d. Loose ring gear and pinion adjustment.	d. Adjust ring gear and pinion.
e. Worn differential gears or case.	e. Replace worn parts.
f. Worn axle shaft or differential side gear splines.	f. Replace worn parts.
Klunking Noise in Axle or Vehicle Weight Shifts From Side to Side	
a. Excessive end play in axle shafts.	a. Install thicker axle shaft spacer.
Axle Noisy on Drive	
a. Ring gear and pinion adjustment too tight.	a. Readjust ring gear and pinion.
b. Pinion bearings rough.	b. Replace bearing and readjust ring gear and pinion.
Axle Noisy on Coast	
a. Ring gear and pinion adjustment too loose.	a. Readjust ring gear and pinion.
b. Pinion bearings rough.	b. Replace bearing and readjust ring gear and pinion.
c. Excessive end play in pinion.	c. Tighten pinion bearing retaining screws or replace bearing.
d. End play in double row bearing.	d. Replace pinion bearing.
Axle Noisy on Both Drive and Coast	
a. Pinion bearings rough.	a. Replace bearings and adjust ring gear and pinion.
b. Loose or damaged differential side bearings.	b. Replace or adjust differential side bearings.
c. Damaged axle shaft bearing.	c. Replace bearing.
d. Worn universal joint or propeller shaft bushing.	d. Replace worn parts.
e. Badly worn ring gear or pinion teeth.	e. Replace ring gear and pinion.
f. Loose or worn wheel bearings.	f. Replace bearings.

REAR AXLE SPECIFICATIONS

Item		
Type	Semi-Floating	
Gears	Hypoid	
Ratio		
Conventional 1949-52	4.11:1	
Conventional 1953	3.70:1	
Powerglide 1950-53	3.55:1	
Backlash	.005"-.008"	
PINION		
Mounting	Overhung	
Adjustment	Shim and Tapered Collar	
Thrust	Against Front Bearing	
PINION BEARINGS		
Part No. Front	N.D. 954780	
and Type Rear	Hy. 125630	
DIFFERENTIAL TYPE	Two Pinion	
Part No. and Type	Hy. 127861	
AXLE SHAFT		
Type	Wheel Drive Flange Integral with Shaft	
Minimum Diam.	63/64"	
AXLE SHAFT BEARINGS		
Part No. and Type	Hy. 111119	
DRIVE TORQUE	Torque Tube	
Lubricant Capacity	3½ Pints	

PROPELLER SHAFT AND UNIVERSAL JOINTS

INDEX

GENERAL DESCRIPTION

A tubular type propeller shaft is used on all passenger cars. Universal joints are of the bushing type.

The torque tube drive is equipped with a universal ball and slip joint located at the transmission end of the shaft.

A slip joint which compensates for variations in distance between rear axle and transmission and also facilitates transmission or power plant removal is located at forward end of propeller shaft.

The rear end of the splined opening of the slip joint is sealed by means of a cork packing contained in a retainer cap which screws on the end of the yoke (fig. 21).

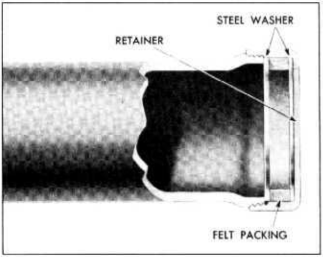

Fig. 21—Slip Joint Packing

SERVICE OPERATIONS

PROPELLER SHAFT

Service operations on the passenger car propeller shafts are covered in the Rear Axle Section.

UNIVERSAL JOINT

The universal joint is a fully enclosed unit which is equipped with bushings in the trunnions. Figure 22 shows construction details.

Disassembly

1. Unhook hand brake pull back spring, disconnect pull cable clevis from idler lever and remove idler lever.
2. Remove cap screws which retain ball retainer collar to transmission rear bearing support and slide collar and ball back on propeller shaft housing.
3. Remove cap screws which fasten front trunnion bearings to the front yoke.
4. Place jack under propeller shaft, remove the two front yoke trunnion bearings and split the joint.

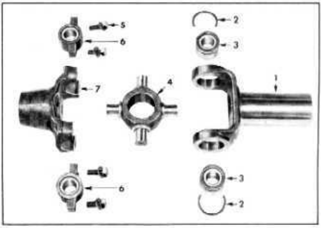

Fig. 22—Exploded View—Universal Joint

1. Front Yoke
2. Trunnion Lock Ring
3. Trunnion Bearing and Bushing
4. Trunnion
5. Capscrew
6. Rear Trunnion Bearing and Bushing
7. Rear Yoke

5. Lower propeller shaft and remove the rear yoke and trunnion from the propeller shaft splines.

6. Remove front yoke by removing bolt and lockwasher from end of transmission main shaft.

Inspection

1. Wash all parts in cleaning solvent.
2. Inspect yokes for excessive spline wear or damage.
3. Inspect trunnion yoke for scoring or excessive wear.
4. Inspect bushing for scoring or excessive wear.

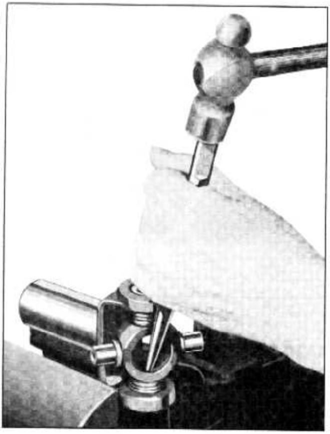

Fig. 23—Disassembly of Universal Joint

Repairs

1. Remove lock rings from trunnion bearings.
2. With yoke supported in a bench vise, drive on the center of the trunnion with a drift punch to remove rear trunnion bearings (fig. 23).
3. Press new rear trunnion bearings into yoke and over hubs of trunnion just far enough to install lock rings.
4. Install lock rings and while holding yoke in one hand, tap ends of trunnions with a hammer to firmly seat bushings against lock rings.

NOTE: Use new lock rings in reassembly.

5. Adjust Universal Ball Joint as outlined in Transmission Section.

Assembly

1. Install front yoke on transmission main shaft and lock in position with lockwasher and nut.
2. Slide rear yoke and trunnion on propeller shaft and raise front end of propeller shaft.
3. Install new front trunnion bearings to the trunnion, fasten front trunnion bearings to front yoke and tighten cap screws to 25-30 ft. lbs. torque.

NOTE: Use new lock plates under cap screws and bend tangs up to lock cap screws after assembly.

4. Slide collar and ball retainer forward on propeller shaft housing and install retaining collar cap screws and tighten to 8-12 ft. lbs. torque.
5. Remove speedometer driven gear and fill housing with ½ pint transmission lubricant.
6. Install hand brake idler lever, pull back spring and connect pull cable clevis to idler lever.

TROUBLES AND REMEDIES

PROPELLER SHAFT AND UNIVERSAL JOINTS

Symptom and Probable Cause	Probable Remedy
Excessive Vibration	
a. Worn universal joint.	a. Replace worn parts.
b. Bent propeller shaft.	b. Replace bent shaft.
c. Propeller shaft bushings or universal joint yoke bushings worn.	c. Replace worn parts.
Excessive Backlash	
a. Worn universal joints.	a. Replace worn parts.
b. Worn drive shaft or joint splines.	b. Replace worn parts.

REAR SPRING AND SHACKLES

INDEX

GENERAL DESCRIPTION

The rear springs used on all passenger car models are of the semi-elliptic type and are designed to provide adequate load carrying capacity and a spring rate which is proportional to that of the front spring to give the smoothest ride possible.

The front ends of the rear springs are mounted in rubber bushings (fig. 24).

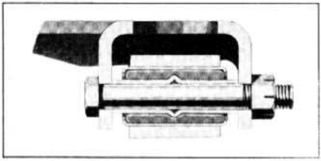

Fig. 24—Rear Spring Front Hanger

These bushings consist of an internal steel tube, a tubular outer retainer, and a rubber bushing securely held between these two steel members.

Rubber bushings require no lubrication and no attention other than to keep the bolt drawn up to 60-90 ft. lbs. torque to compress inner sleeve between ears of front hanger.

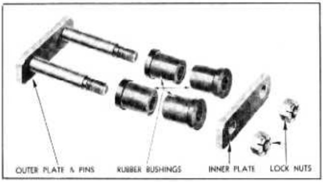

Fig. 25—Layout of Rubber Bushed Spring Shackle

The spring shackles used at the rear end of the rear chassis springs are rubber bushed type.

These rubber bushed type shackles consist of the outer shackle plate with both pins serrated through the plate and riveted in place, two natural rubber bushings (each in two halves), the inner shackle plate, and the two special lock nuts (fig. 25).

The rubber bushings, fitting in each spring and hanger eye, are in two halves having a shoulder

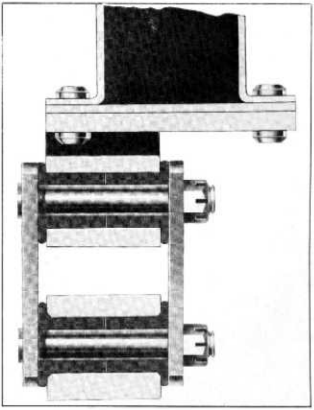

Fig. 26—Rubber Bushed Spring Shackle

at the outer end of each. When installed, and prior to tightening the lock nuts, the bushings are ¼" longer than the space between the two shackle plates when tightened in place. Tightening the lock nuts until the inner plate bottoms on the pin shoulders, forces this excess rubber into the eye and around the pins, resulting in a tightly locked joint. The castellated sections of the special lock nuts tighten firmly against the pin threads when the nuts are pulled up tight.

All shackle movement in relation to the spring and hanger eyes is taken by the flexibility of the rubber bushings since the pins are solidly locked to the bushings and the bushings cannot turn in the eyes (fig. 26).

SERVICE OPERATIONS

REAR SPRING

Rear springs used on all vehicles are of the single stage type shackled at the rear by a rubber bushed type shackle and pivoted at the front in a rubber bushing.

Removal

1. Raise vehicle with chain hoist enough to relieve spring tension.
2. Disconnect shock absorber eye from rear shock absorber anchor bolt.
3. Remove spring "U" bolts and spring "U" bolt and shock absorber anchor plate.
4. Remove two shackle plate lock nuts, inner shackle plate, and outer shackle plate with pins and lower rear end of spring to the floor.
5. Remove rear spring front hanger bolt nut and lockwasher and remove bolt.

Inspection

1. Inspect rubber bushing in rear spring front eye for excessive wear or damage.
2. Check rubber bushings of rear shackle for damage.
3. Check spring center bolt for tightness.

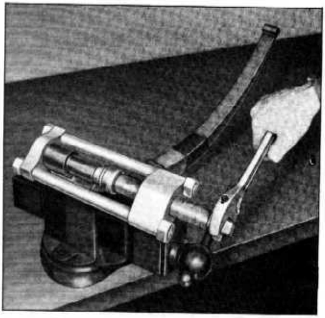

Fig. 27—Removing Rear Spring Front Bushing

REPAIRS

Front Bushing—Replacement

1. Place spring assembly in bench vise.
2. Install rear spring front bushing remover and installer J-136A in position (fig. 27) with adapter plug inside the bushing and pressure plate behind the spring eye.
3. Turn center screw clockwise to remove the bushing.
4. Place new bushing over adapter plug and with bushing lined up with spring eye, turn center screw clockwise to force bushing into position.

Spring Leaf—Replacement

1. Place spring in a bench vise and remove spring cover and clips.

NOTE: Spring clips will have to be bent open.

2. File peened end of center bolt and remove center bolt nut.
3. Open vise slowly and carefully to let spring assembly expand. Wire brush and clean spring leaves.
4. Replace broken spring leaf.
5. Align center holes in spring by means of a long drift and compress leaves in vise.
6. Remove drift from center hole and install new center bolt.
7. Install nut on center bolt and tighten securely and peen end of bolt to keep nut from loosening.
8. Align springs by tapping with a hammer and bend spring clips back in position.

NOTE: Spring clips should be bent sufficiently to maintain alignment, but not tight enough to bind spring action.

9. Install spring covers.

Installation

1. Assemble front end of spring to spring hanger and install eye bolt.
2. Install eye bolt lockwasher and nut, but do not tighten.

3. Raise spring assembly and locate center bolt in locator hole of spring seat.
4. Install spring "U" bolt and shock absorber anchor plate and "U" bolts.
5. Install "U" bolt self-locking nuts, and tighten to 75-90 ft. lbs.
6. Connect shock absorber eye to bolt on anchor plate, install flat washer, lockwasher and retainer nut and tighten securely.
7. Install rear spring shackle as outlined under "Rear Shackle or Bushing–Replace."
8. Tighten rear spring front eye bolt and nut to 60-90 foot lbs. torque with weight of car on wheels.

REAR SHACKLE OR BUSHINGS–REPLACE

1. Raise car enough to relieve the load and remove two lock nuts and inner shackle plate.
2. Remove outer shackle plate with pins from spring and hanger eyes.
3. To install, raise car as necessary to provide the proper distance between spring hanger and spring eye to install the shackle.
4. Wipe the bushing holes in the spring hanger and spring eye, both shackle plates and pins and the inside and outside of both bushings, free of all dirt and grease.
5. Install one bushing in the hanger and spring eye (two halves to each bushing) with the bushing shoulder or collar to the outside of each hole.
6. Insert the shackle pins through the bushings (plate with pins attached) with the attached plate toward the outside of the car. Threaded ends of pins toward the center of the car.
7. Install the inner shackle plate and tighten the lock nuts about half-way onto the pins.
8. Lower the car and allow to stand normally with the weight on the wheels–no passengers or weight in the car.
9. Bounce the back end of the car up and down several times to center and seat the rubber bushings. Then, when the car comes to rest normally, tighten both lock nuts until the inner shackle plate "bottoms" on the shoulders of the pins. Finish tightening to 25-30 ft. lbs. torque. This type shackle requires no lubrication at any time and during lubrication periods, care should be exercised to prevent the spraying of lubricant of any kind on these shackles. This also applies to the spring seats and rear spring front eye attachment since these points are also rubber insulated.

REAR SPRING SEAT

Rear springs on all vehicles are completely insulated from the axle by means of a rubber core. At each side, a bracket is welded on the front side of the axle housing (fig. 28). An eye bolt

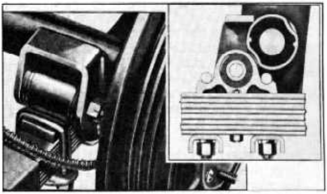

Fig. 28—Rear Spring Seat

passes through this bracket and the spring seat in a manner similar to the way the front end of the rear spring is mounted. A steel spacer sleeve is used to prevent collapsing the walls of the axle bracket when the eye bolt and nut are pulled down tight. Between the spacer sleeve and the spring sleeve is a rubber bushing. Rubber washers at each end complete the installation.

The mounting effectively dampens out objectionable road noise at its source and in doing so prevents it from telegraphing through the frame and springs into the body.

Adjust this type seat as follows:

1. Weight of vehicle must be on the wheels.
2. Loosen hanger eye bolt nut and bounce vehicle up and down several times. This sets the rubber bushings in their normal position.
3. Tighten eye bolt nut securely and install cotter pin.

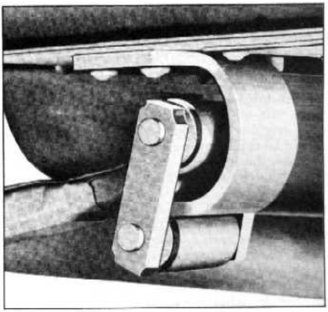

Fig. 29—Rear Spring Rear Hanger

REAR SPRING HANGER

The "U" shaped rear spring hanger is attached to the underside of the frame by four rivets (fig. 29).

When replacing this spring hanger, the following procedure should be followed:

Removal

1. Raise the car with a chain hoist and disconnect the spring from the hanger and spring seat.
2. Drill a $\frac{3}{16}''$ hole through the four rivets which attach the hanger to the frame. Enlarge this hole with a $\frac{5}{16}''$ drill for depth of the rivet head only. Cut off the remainder of the rivet head with a sharp cold chisel.
3. Remove the hanger, then cut off the rivets flush with the underside of the frame side rail.

CAUTION: Do not attempt to drive out the rivets without cutting them off or the hole in the bottom plate of the side rail may be distorted.

4. Drive out the remaining portion of the rivet.

Installation

There are right and left hangers which may be identified as follows: The spring eye portion of the hanger is closer to one side than the other.

The hanger must be assembled to the side rail with the side containing the spring eye toward the outside. Bolt the hanger to the side rail using the following parts:

Part No. 369627
4 Special Heat-Treated Bolts $\frac{5}{16}''$-18 x $1\frac{1}{8}''$
Part No. 121367
4 Lockwashers $\frac{5}{16}''$
Part No. 120376
4 Hex Nuts $\frac{5}{16}''$-18.

After the bolts are drawn up tight, peen over the ends to prevent the nuts loosening up.

SPRING LUBRICATION

When lubricating springs having metal covers, use a soft, smooth cup grease to which 8% to 10% graphite has been added. This compound should be applied in such a way that it is forced between the leaves of the springs and not between the canvas liners and the spring covers. This can be done with the use of a spring lubricating clamp J-595, as follows:

1. Jack up the frame to remove the load and allow the spring leaves to separate.
2. If the spring cover has no hole, drill a $\frac{3}{16}''$ hole in the center of the bottom, one-third of the way from the spring eye.
3. Set the adjustment screw of the lubricating clamp (fig. 30) until the width of the clamp is a little more than the spring thickness.
4. Push the threaded end of the plunger into the drilled hole, forcing the canvas against the plate.
5. Screw the plunger several times to the right to thread the end through the canvas (fig. 31).
6. Screw the sleeve against the bottom of the spring cover. Never use pliers.
7. Attach the grease gun hose to the fitting and apply pressure slowly.
8. Separate the main and second spring leaves with a screwdriver so the lubricant can go between.

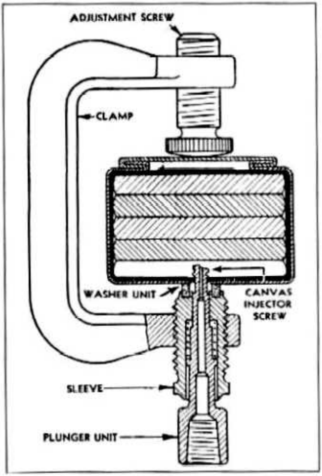

Fig. 30—Spring Lubricating Clamp

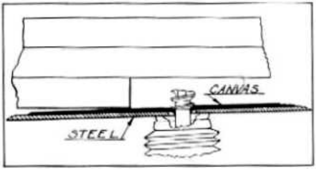

Fig. 31—Position of Plunger for Lubricating Spring

9. Remove the screwdriver and attach a "C" clamp at the end of the spring cover. Continuing to apply pressure will force the lubricant toward the opposite end.

TORQUE SPECIFICATIONS

Ring Gear Bolts	40- 60 Ft. Lbs.
Differential Side Bearing Cap Bolts	65- 80 Ft. Lbs.
Tapered Bearing Retainer Screw	26- 30 Ft. Lbs.
Pinion Shaft Bearing Nut	200-240 Ft. Lbs.
Spring "U" Bolt Nuts	75- 90 Ft. Lbs.
Spring Front Eye Bolt	60- 90 Ft. Lbs.
Spring Rear Shackle Bolt Nuts	25- 30 Ft. Lbs.
Universal Joint Yoke Attaching Bolt	25- 30 Ft. Lbs.
Universal Joint Yoke Ball Retainer Bolts	8- 12 Ft. Lbs.

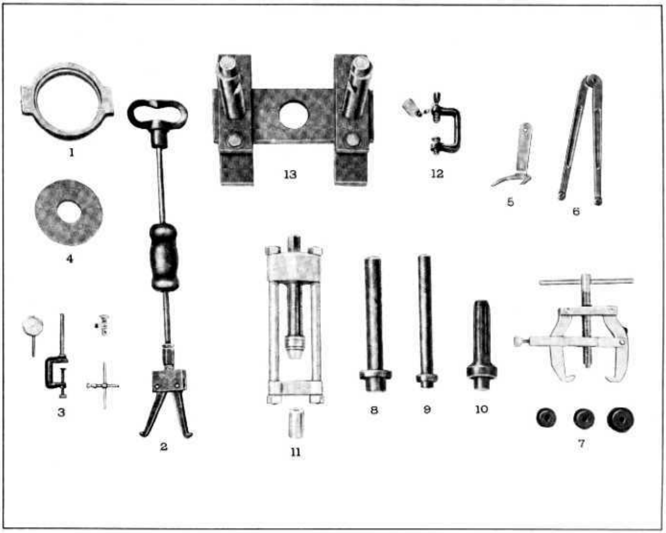

Fig. 32—Rear Axle, Propeller Shaft and Rear Spring Tools

1. Plate Holder—T 20-22-R-3
2. Rear Axle Shaft Bearing and Oil Seal Remover—J-1436
3. Dial Indicator and Attachments—KMO-30
4. Pinion Outer Bearing Remover—J-996
5. Pinion Shaft Rear Bearing Spacer—J-4050
6. Differential Adjusting Wrench—J-972
7. Differential Side Bearing Puller Set—TR-278-R
8. Differential Side Bearing Replacer—J-994
9. Propeller Shaft Bushing Replacer—J-968
10. Axle Shaft Bearing and Oil Seal Replacer K427 and Handle—J-872-5
11. Rear Spring Front Bushing Remover and Installer—J-136-A
12. Spring Lubricating Clamp—J-595
13. Hub Bolt Peening Tool and Anvil—J-554

REAR SPRING SPECIFICATIONS

	All Models except Station Wagon and Sedan Delivery	Station Wagon and Sedan Delivery
Length	49-1/8"	49-1/8"
Leaf Width	1-3/4"	1-3/4"
Stage	Single	Single
No. Leaves	7	8
No. Spring Clips	2	2
Shackle Type	Rubber Bushed	Rubber Bushed
Seat Type	Rubber Bushed	Rubber Bushed

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SECTION 5

BRAKES

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BRAKE

INDEX

GENERAL DESCRIPTION

1949-50 MODELS

The brakes used on all passenger car models are a self-energizing type which combine hydraulically-operated service brakes with mechanically-operated parking brakes. Figure 1 shows a typical brake construction.

Operation of the hydraulic system is dependent upon the proper functioning of main and wheel cylinders. The main cylinder (fig. 2) consists of a piston which receives mechanical pressure from the push rod and exerts pressure on the fluid in the lines, building up the hydraulic pressure, which moves the wheel cylinder pistons. The primary cup is held against the piston by the piston return spring which also retains the return valve against its seat. The spring maintains a slight pressure in the lines and in the wheel cylinders to prevent the possible entrance of air into the system. The secondary cup, which is secured to the opposite end of the piston, prevents the leakage of fluid into the rubber boot. The holes in the piston head are for the purpose of allowing the fluid to flow from the annular space around the piston into the space between the primary cup and the check valve, keeping sufficient fluid in

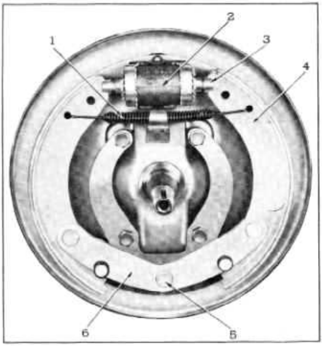

Fig. 1—Front Brake Mechanism

1. Retracting Spring
2. Wheel Cylinder
3. Adjusting Screw
4. Brake Shoe
5. Anchor Pin
6. Articulating Link

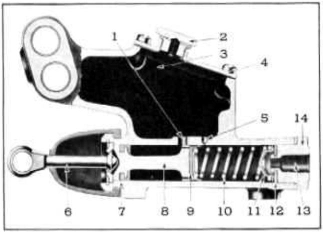

Fig. 2—Main Cylinder Cross Section

1. Inlet
2. Filler Plug
3. Reservoir
4. Cover
5. Compensating Port
6. Push Rod
7. Piston Cup—Secondary
8. Piston
9. Piston Cup—Primary
10. Spring
11. Valve
12. Valve Seat
13. Outlet
14. End Plug

the lines at all times. The holes in the valve cage allow the fluid to flow through the cage and around the lip of the rubber valve cup and out into the lines during the brake application. When the brake is released, the lip of the rubber valve cup seals the holes in the valve cage and the valve is forced off its seat, permitting the fluid to return to the main cylinder.

The push rod assembly is held in the opposite end of the housing by means of a snap ring. A rubber boot that fits around the push rod and over the end of the housing prevents dirt or any other foreign matter from entering the main cylinder.

The wheel cylinder (fig. 3) is a double piston cylinder permitting the even distribution of pres-

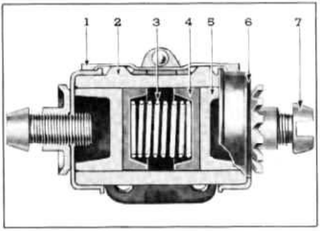

Fig. 3—Wheel Cylinder Cross Section

1. Lock Spring
2. Housing
3. Spring
4. Piston Cup
5. Piston
6. Cover
7. Adjusting Screw

sure to each brake shoe. The rubber piston cups maintain pressure on the pistons and prevent leakage of fluid past the pistons. The adjusting covers serve two purposes; first, to cover the ends of the cylinder and prevent the entrance of dirt and foreign matter into the cylinder; and second, to allow a means of adjusting the brake shoes to proper drum clearance, being threaded to receive the slotted adjustment screws which fit the webs of the brake shoes.

In operation, pressure is applied to the brake pedal and transmitted to the push rod and the piston in the main cylinder. This pressure on the piston causes the primary cup to close the compensating port and fluid is forced through the holes in the valve cage, around the lip of the rubber valve cap, into the pipe lines and into the wheel cylinders. This fluid pressure forces the pistons in the wheel cylinders outward, expanding the brake shoes against the drums. As the pedal is depressed further, higher pressure is built up within the hydraulic system, causing the brake shoes to exert greater pressure against the brake drums.

As the pedal is released, the hydraulic pressure is relieved and the brake shoe retracting springs draw the shoes together, pressing the wheel cylinder pistons inward and forcing the fluid out of the wheel cylinders back into the lines toward the main cylinder. The piston return spring in the main cylinder returns the piston to the pedal stop faster than the brake fluid is forced back into the lines, creating a partial vacuum in that part of the cylinder ahead of the piston. This vacuum causes a small amount of fluid to flow through the holes in the piston head, past the lip of the primary cup and into the forward part of the cylinder. This action keeps the cylinder full of fluid at all times, ready for the next brake application. As fluid is drawn from the space behind the piston head, it is replenished from the reservoir through the inlet or breather port. When the piston is in a fully released position, the primary cup clears the compensator port, allowing excess fluid to flow from the cylinder into the reservoir as the brake shoe retracting springs force the fluid out of the wheel cylinders.

The passenger car parking brake lever is located under the dash to the right of the steering column and is connected to the idler lever with rod-type linkage. The idler lever is mounted in two brackets riveted to the center of the second cross member. Two one-piece cables are pivoted at the center of the idler lever and are attached to the rear brakes.

The pull rod from the control lever is yoked at one end of the idler lever and provides proper pull for emergency brake application (fig. 4).

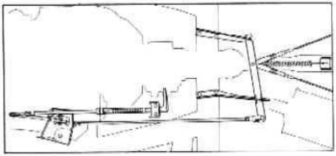

Fig. 4—Emergency Brake Linkage

1951-53 MODELS

The brakes used on both front and rear of all 1951-53 models are the Duo-Servo single anchor type which utilize the momentum of the vehicle to assist in the brake application. This self-energizing or self-actuating force is applied to both brake shoes at each wheel in both forward or reverse motion.

Each brake (fig. 5) has one wheel cylinder located near the top of the brake flange plate just below the anchor pin. Each wheel has two shoes with a pull back spring installed between each shoe and the anchor pin to hold the upper ends of the shoes against the anchor pin when the brakes are released. The lower ends of the shoes are connected by a link and a helical spring. The link is made up of an adjusting screw, riding in a socket at one end, and threaded into a pivot nut at the other. The outer ends of the socket and pivot nut are notched to fit the webs of the brake shoes, providing freedom of motion between the link and the shoes. The spring is stretched from one shoe web to the other, crossing over the notched head of the adjusting screw. It bears against one of the notches in the head, and thus acts as a lock for the adjusting screw. Bonded brake linings are used and brake drums are 11" in diameter. The front brakes are 2" wide while the rear are 1¾".

In each brake assembly, the linings for the front and rear shoes differ in length with the secondary facing being 2½" longer than the primary, because in operation, a greater force is applied to the secondary facing than to the primary.

The brake flange plate has six bearing surfaces, three for each shoe, against which the inner surfaces of the shoes bear to maintain alignment. Slightly below the center of each shoe web is a hole through which a hold down pin is inserted. A spring, fitted over the outer end of the pin, holds the shoe against the bearing surfaces. At the top of the brake where the shoes butt against the anchor pin, a guide plate separates the pull back springs from the shoe webs, and assists in keeping the shoes properly aligned. The brake mechanism is effectively sealed against the entrance of dirt or mud by the joint between the brake flange plate and the drum. The outside edge of the flange plate fits over the edge of the drum which has an annular groove located be-

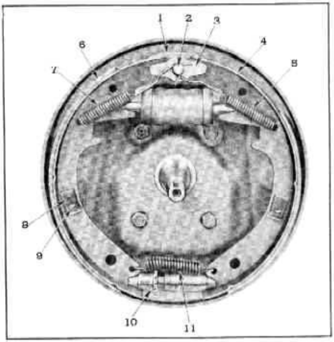

Fig. 5—Duo-Servo Brake

1. Backing Plate
2. Anchor Pin
3. Guide Plate
4. Primary Shoe
5. Pull Back Spring
6. Secondary Shoe
7. Pull Back Spring
8. Hold Down Spring
9. Hold Down Pin
10. Adjusting Screw
11. Adjusting Screw Spring

tween two flanges. The outer flange is of a larger diameter than the inner one, so that dirt and moisture which collect in the groove are thrown off the larger flange by the centrifugal force of the rotating drum, thus keeping foreign matter away from the drum-to-flange plate joint.

When the brakes are applied, the pistons in the wheel cylinder, acting on the brake shoes through the connecting links, force the shoes against the drum. Since the shoes float free in the brake, the force of friction between the shoes and the rotating drum turns the entire assembly in the direction of the wheel rotation. The front or primary shoe moves downward, and the back or secondary shoe is carried upward until its upper end butts against the anchor pin. The friction between the moving drum and the stationary shoes now tends to roll both shoes toward the drum with increased pressure. The secondary shoe pivots on the anchor pin at the top, and the primary shoe tends to turn about the adjusting link at the bottom which is held stationary by the secondary shoe. This self-energizing effect, greatly increases the pressure of the shoes against the drum and reduces the physical force required on the brake pedal.

Inasmuch as the brake shoes are freely connected at the bottom by the adjusting link, the self-energizing or friction force which is applied to the primary shoe by the brake drum is transmitted to the secondary shoe through the link. The effectiveness of the secondary shoe is nearly doubled, because the total force applying this shoe becomes the sum of the force which is received from the primary shoe and the self-energizing effect that is derived from the rotating drum.

When backing the car, the brake action is reversed. The rear shoe becomes the primary shoe and the front shoe becomes the secondary, butting up against the anchor pin during braking and being forced against the drum with great pressure.

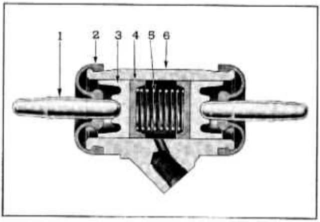

Fig. 6—Wheel Cylinder

1. Connecting Link
2. Rubber Boot
3. Piston
4. Piston Cup
5. Spring
6. Housing

Wheel cylinders (fig. 6) are the double piston type permitting even distribution of pressure to each brake shoe. To keep out dust and moisture and to prevent gumming of the brake fluid, both ends of each wheel cylinder are sealed with a rubber boot. The wheel cylinders have no external adjustments.

To facilitate assembly and avert possible binding of the parking brake control rod in the housing, greater clearance than in 1949-50 models is provided between the two parts by increasing the housing diameter between the points of attachment to instrument panel and dash.

Replacing the check nuts on either side of the dash panel, the parking control rod housing on these models is threaded into a small bracket which is bolted to the passenger side of the dash panel.

Other changes in the mechanical linkage for the parking brakes are minor and simply adapt it to the Duo-Servo type brake mechanism.

MINOR SERVICE OPERATIONS

In any service operation it is extremely important that absolute cleanliness be observed. Any foreign matter in the system will tend to clog the lines, ruin the rubber cups of the main and wheel cylinders and cause inefficient operation or even failure of the braking system. Dirt or grease on a brake lining will cause that brake to grab first on brake application and fade out on heavy brake application.

HYDRAULIC BRAKE FLUID

Only G. M. Hydraulic Brake Fluid Super No. 9 should be used when bleeding brakes. This brake fluid is satisfactory for any atmospheric temperature hot or cold and has all the qualities necessary for satisfactory operation, such as a high boiling point to prevent evaporation and tendency to vapor lock and remains fluid at low temperatures.

In the event that improper fluid has entered the system, it will be necessary to—

1. Drain the entire system.
2. Thoroughly and vigorously flush the system with clean alcohol, 188 proof, or a hydraulic brake system cleaning fluid such as "Declene."
3. Replace all rubber parts of the system, including brake hoses.

4. Refill the system with G. M. Hydraulic Brake Fluid Super No. 9.

BLEEDING HYDRAULIC SYSTEM

The hydraulic brake system must be bled whenever a pipe line has been disconnected, when a leak has allowed air to enter the system or at any time the system has been opened. The system must be absolutely free from air at all times.

Bleeding should be done on the longest line first and the proper sequence to follow is left rear, right rear, right front and left front.

Bleeding of brake lines may be accomplished by one of two methods: Pressure or Manual.

Pressure Bleeding

1. Clean all dirt from top of main cylinder and remove filler plug.
2. Connect hose from bleeder tank to main cylinder filler plug opening and open valves at both ends of hose.

NOTE: Make sure fluid in tank is up to petcock above outlet and that tank is charged with 10 to 20 pounds air pressure.

3. Remove bleeder valve screw and screw bleeder hose into bleeder valve, placing other end of hose in a container having sufficient fluid to cover end of hose (fig. 7).
4. Open bleeder valve by turning ¾ turn in a counterclockwise direction and watch flow of fluid at end of bleeder hose.
5. Close bleeder valve tightly as soon as bubbles stop and fluid flows in a solid stream.
6. Remove bleeder hose and install bleeder valve screw in bleeder valve.
7. Repeat above operations at each wheel.

Manual Bleeding

1. Clean all dirt from top of main cylinder and remove filler plug.
2. Install adapter and automatic filler J-713 (fig. 8).
3. Remove bleeder valve screw and screw bleeder hose into bleeder valve, placing other end of hose in a container having sufficient fluid to cover end of hose (fig. 8).
4. Open bleeder valve by turning ¾ turn in a counterclockwise direction.
5. Depress foot pedal by hand, allowing it to return slowly. Continue this pumping action to force fluid through the lines and out at the bleeder drain, carrying with it any air in the system.
6. Close bleeder valve tightly as soon as bubbles stop and fluid flows in a solid stream.
7. Remove bleeder hose and install bleeder valve screw in bleeder valve.
8. Repeat above operations at each wheel.

TOE BOARD CLEARANCE

Toe board clearance very seldom needs adjustment. The main cylinder push rod has a definite stop which is permanent and not adjustable. This stop is used in conjunction with an eccentric

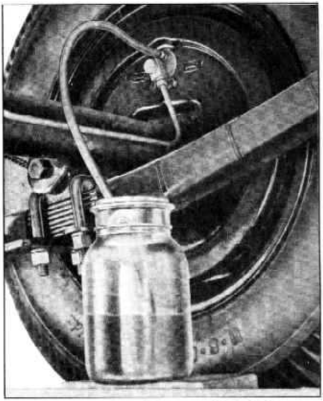

Fig. 7—Bleeding Brake System at Wheel Cylinder

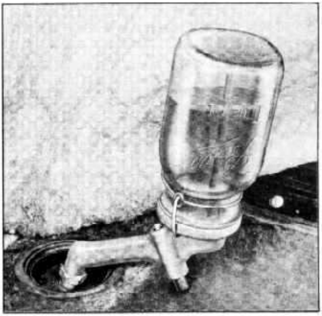

Fig. 8—Filling Main Cylinder Reservoir

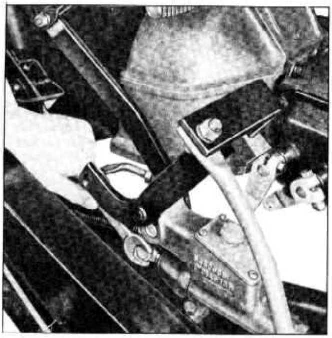

Fig. 9—Adjusting Toe Board Clearance

bolt attachment between the brake pedal and the push rod and toe board clearance adjustment is made with this eccentric bolt (fig. 9). Before adjusting toe board clearance, make sure brake pedal returns to the fully released position freely, with no binding, and that the pedal retracting spring has not lost its tension.

1. Brake pedal should be adjusted to give 7/16" clearance between top of brake pedal arm and the underside of the brake pedal toe pan depression (fig. 10).
2. Loosen check nut on the eccentric bolt.
3. Turn eccentric bolt in proper direction to secure 7/16" clearance at toe board.

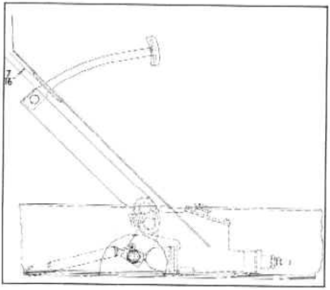

Fig. 10—Toe Board Clearance

NOTE: If 7/16" clearance cannot be obtained by normal adjustment of bolt, place shims under front or rear main cylinder mounting bolts as required.

4. Tighten check nut on eccentric bolt to 20-25 ft. lbs. torque.

HYDRAULIC BRAKE TUBING

Hydraulic brake tubing used on all models is a double layer annealed steel, copper coated and tin plated tubing which resists corrosion and also stands up under the high pressures which are developed when applying the brakes. All 1949-50 models use 1/4" tubing and 1951-53 models use 3/16" tubing. In making up hydraulic brake pipes, it is important that the proper size flaring tool, be used to flare the ends of the tubing for the compression couplings. Unless the tubing is properly flared, the couplings will leak and the brakes will become ineffective.

CAUTION: When necessary to replace brake tubing, always use special metal tubing which is especially designed to withstand high pressure and resist corrosion. For this reason, ordinary copper tubing is not satisfactory and should not be used.

This safety steel tubing must be double-lap flared at the ends in order to produce a strong leak-proof joint.

The brake tube flaring tool J-2185 (fig. 11) is used to form the double-lap flare.

Figure 12 shows two pieces of tubing—one with a single-lap flare "A" and the other with a double-lap flare "B". It will be noted that the single-lap flare split the tubing while the one shown in "B" has a heavy, well-formed joint.

The following procedure should be followed in making up hydraulic brake pipes:

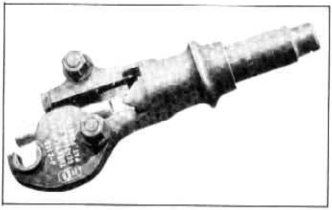

Fig. 11—Hydraulic Brake Tube Flaring Tool

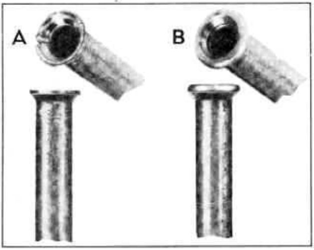

Fig. 12—Single and Double Lap Flare

Double Lap Flaring

1. Clamp the tubing in the proper size die blocks with the flat ends of the blocks toward the end of the tubing to be cut off. Cut the end of the tubing flush and square. Using a mill file, dress tubing and square ends.
2. Remove the tubing from the die blocks, and using tool J-2185-24, deburr the inside and outside edges.
3. Install compression couplings on tubing and dip end of tubing to be flared in hydraulic fluid. This lubrication results in better formation of the flare.
4. Place one-half of the die blocks in the tool body with the counterbored ends toward the ram guide. Now lay the tubing in the block with approximately ½" protruding beyond the end. Fit the other half of the block into the tool body, close the latch plate and tighten the nuts "finger-tight".
5. Select the correct size upset flare punch. One end of this punch is counterbored or hollowed out to gauge the amount of tubing necessary to form a double lap flare. Slip the punch into the tool body with the gauge end toward the die blocks. Install the ram; then tap lightly until the punch meets the die blocks and they are forced securely against the stop plate (fig. 13).

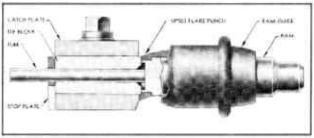

Fig. 13—Flaring Operation—Positioning Tubing

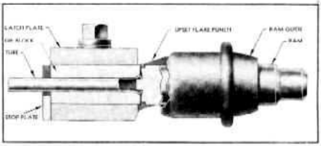

Fig. 14—Flaring Operation—First Flare

6. Using Wrench J-2185-22, draw the latch plate nuts down tight to prevent the tube from slipping. Tightening the nuts alternately (beginning with the nut on the closed side) will prevent distortion of the plate. Remove the punch and the ram. Now reverse the punch and put it back into the tool body. Install the ram and tap it lightly until the face of the upset flare punch contacts the face of the die blocks (fig. 14). This completes the first operation. Remove the ram and the punch.
7. To complete the flare, insert the finish flare punch and the ram into the tool body. Tap the ram until a good seat is formed (fig. 15).

NOTE: The seat should be inspected at intervals during the finishing operation to avoid over-seating.

HYDRAULIC BRAKE ADJUSTMENT

1949-50 MODELS

All hydraulic brakes can be adjusted without removal of the wheels as all brake flange plates have openings with removable spring snap covers. As brakes are self-energizing through energizing links, only one service adjustment at the wheel cylinders is needed which simplifies brake adjustment.

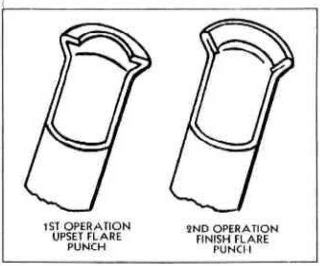

Fig. 15—Flaring Operation—First and Second Flare

1. Jack up wheel and remove adjusting hole covers from flange plate.
2. Through hole in flange plate, insert screwdriver or similar tool and engage it in teeth of adjusting wheel on wheel cylinder.
3. Turn adjusting wheel in clockwise direction, looking toward center of brake from end of cylinder being adjusted, until shoe drags slightly.

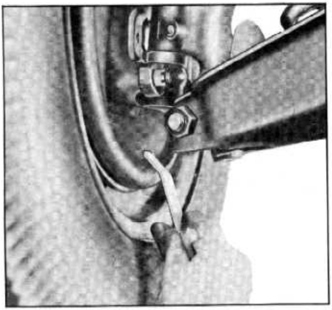

Fig. 16—Adjusting Brakes

4. Turn adjusting wheel back four notches to insure running clearance.
5. Repeat this operation on each shoe in each brake and replace hole covers.

1951-53 MODELS

Hydraulic brake adjustment is confined to a single operation on each brake assembly, very similar to that for previous Chevrolet brakes. A spring snap cover plate is pried from the back of the flange plate, exposing a hole through which the J-4707 brake adjusting tool is inserted to turn the single adjusting screw.

Adjustment Front or Rear—Minor

1. Jack all wheels clear of floor.
2. Loosen the check nuts at the forward ends of the parking brake cables sufficiently to remove all tension from the brake cables.

   NOTE: If cables have been adjusted too short, the rear brake shoes will be forced away from the anchor pins in brake release position, making correct shoe adjustment impossible.

3. Remove adjusting hole cover from brake flange plate. Expand brake shoes by turning adjusting screw with tool J-4707 until a light uniform drag is felt on the brake drum (fig. 16).

   NOTE: Moving the outer end of tool toward center of wheel, expands the shoes.

4. Turn adjusting screw back, to contract brake shoes, 14 notches of star wheel so as to insure running clearance. On 1953 brakes, turn adjusting star wheel back 7 notches to insure running clearance, after light uniform drag is felt.
5. Repeat the above operations 3 and 4 at each wheel and replace hole covers.
6. After the hydraulic brakes are adjusted, adjust the parking brakes as outlined under, "Parking Brake Adjustment (1951-53 models)".
7. Lower car to floor and test brakes.

Adjustment Front or Rear—Major

The major brake adjustment is intended for use when braking action is unequal, severe or otherwise unsatisfactory. This major adjustment must also be performed after new brake shoes have been installed or when the car has been driven sufficient mileage to warrant thorough inspection and cleaning of the brake assemblies and drums.

1. Raise vehicle and place on stand jacks.
2. Check fluid in master cylinder reservoir and add fluid if necessary.
3. Check brake pedal for free action, proper return to stop and proper clearance at toeboard.
4. Check for proper release of master cylinder or leakage within cylinder by action of brake pedal. If improper release or leakage is found, overhaul master cylinder.
5. Inspect all brake hoses, pipes and connections for evidence of fluid leakage. Tighten any leaking connection, apply heavy pressure to brake pedal to build up pressure in system and recheck connections.
6. Remove all wheels, rear brake drums and front hub and drum assemblies.

   NOTE: Since stops are located on brake backing plates to prevent pistons from leaving wheel cylinders, it is not necessary to install wheel cylinder clamps when drums are removed; however, brake pedal must not be depressed while drums are removed.

7. Clean all dirt out of brake drums being careful not to get dirt in front wheel bearings. Inspect drums and replace or recondition if required.

8. Inspect front wheel bearings and oil seal and, if damaged, replace.
9. Blow all dirt from brake assemblies. Inspect brake linings for excessive wear, oil soaking and embedded foreign particles. If linings are worn excessively or are oil soaked, replace shoes.
10. Carefully pull lower edges of wheel cylinder boots away from cylinders and note whether interior is wet excessively with brake fluid. Excessive fluid at this point indicates leakage past the piston cup, requiring overhaul of wheel cylinder.

    NOTE: A slight amount of fluid is nearly always present and acts as lubricant for the piston.

11. Inspect rear brake flange plates for oil leaks past axle shaft oil seal. If leakage is evident, replace seal.
12. Tighten brake flange plate attaching bolts.
13. Loosen the check nuts at the forward ends of the parking brake cables sufficiently to remove all tension from the brake cables.
14. If shoes are not removed for additional work, pry shoes away from brake flange plates and clean all rust and dirt from contact surfaces on shoes and flange plates, using fine emery cloth. Lubricate contact surfaces sparingly with Bendix or Delco brake lubricant or Lubriplate. On rear brakes, sparingly apply the same lubricant to parking brake strut and flange plate boss under the brake cable.
15. Lubricate front wheel bearings, install hub and drum assemblies, adjust wheel bearings and install front wheel and tire assemblies.
16. Install rear brake drums and drum retaining (stamped) nuts and install wheel and tire assemblies. Remove adjusting hole covers from all brake flange plates.
17. Loosen anchor pin nut just enough so that pin can shift in slotted hole in flange plate.

    NOTE: If nut is loosened too much, the anchor pin will tilt due to pull of brake shoe pull back springs.

18. Using tool J-4707, turn brake adjusting screw to expand brake shoes until a heavy drag is felt on drum.
19. Tap anchor pin and brake flange plate to allow shoes to center in drum. If drag on drum decreases, tighten adjusting screw a few more notches and again tap anchor pin and flange plate. Repeat this operation until heavy drag remains constant. Then tighten anchor nut to 60-80 ft. lbs. torque.
20. Back off adjusting screw 14 notches on 1951-52 models and 7 notches in 1953 models and check wheel for freedom from drag, if drag is experienced, repeat operation No. 19. Replace adjusting hole covers.
21. Adjust parking brakes.
22. Lower car to floor and test brakes.

PARKING BRAKE ADJUSTMENT

1949-50 MODELS

The parking brake adjustment should be checked each time the hydraulic service brakes are adjusted.

When making a parking brake adjustment, the service brakes must be properly adjusted first as a base for the parking brake adjustment.

1. Set the emergency brake lever in the fully released position.
2. Loosen the check nuts at the cable ends.
3. Pull cables out of conduit by hand until a positive stop is felt. While holding cable in this position, adjust forward check nut against clevis plate. Then tighten rear check nut securely.
4. Inspect brakes for freedom from shoe drag and for equal braking.
5. If further adjustment is necessary to eliminate either shoe drag or unequal braking repeat operations above.

    NOTE: Never attempt to eliminate either shoe drag or unequal braking by using the wheel cylinder adjustment. Hand brake adjustment must be done at check nuts and clevis attaching points.

1951-53 MODELS

The parking brake must be adjusted each time the hydraulic service brakes are adjusted. When making a parking brake adjustment, the service brake must be properly adjusted first as a base for the parking brake adjustment.

1. Jack up both rear wheels.
2. Pull out hand brake handle for 7 clicks of pawls (not 7 notches).
3. Loosen check nuts at cable ends. Turn the forward check nuts against the clevis plates to draw up each brake cable until a moderate drag is felt when rotating drum.
4. Tighten check nuts securely.
5. Set parking brake lever back to 2 clicks from full release position, at which point no brake shoe drag should be felt.

HAND BRAKE LEVER ALIGNMENT

If complete release of the hand brake lever is not obtained, unless the lever is forcibly returned to its released position, it indicates misalignment of the bell crank with the hand brake lever or a bind in the hand brake lever itself.

The following procedure of adjustment should be followed whenever sticky operation on all models or bind on 1949-50 models in the hand brake mechanism is encountered.

1. With the hand brake tightly engaged, check the bell crank for alignment with the hand brake lever rod. If an out of line condition exists, bend the bell crank as necessary to obtain alignment.
2. On 1949-50 models check hand brake lever assembly for free operation. If operation is sticky or a bind is experienced, correct as follows:

a. Loosen lower adjusting nut at engine sid of dash panel.
b. Run inner nut at driver side of dash panel down or up on the housing as necessary until the nut is snug against the dash panel.
c. Retighten the lower nut on the engine side of the dash panel. This will align the hand brake lever assembly and eliminate any bind within the assembly.
d. After the above adjustments have been made, check the operation of the hand brake to see that it works free and returns to the fully released position merely by tripping the lever.

MAJOR SERVICE OPERATIONS

In all cases of brake complaints denoting actual brake lining or shoe failure, the brake drums should be removed and before disassembly of the shoes from the flange plate, all linings should be inspected for wear, improper alignment causing uneven wear and oil and grease on the linings. If any of these conditions exist, it will be necessary to replace the shoes. If, in checking the linings, it is noticed that they have the appearance of being glazed, this is a normal condition with the hard type lining used. Do not use a wire brush or an abrasive on the lining to destroy this glazed surface as it is essential for proper operation.

On 1949-50 models satisfactory performance can be obtained by replacing only the forward shoes when the reverse shoe linings do not show excessive wear. Tests have shown that in most cases, the reverse shoe lining will outlast two sets of forward shoe linings. This is true of both front and rear wheel brakes.

Shoes should be replaced in sets—that is, both forward shoes on the front wheels or both forward and reverse shoes on the front wheels. The same is true on the rear wheels.

On 1951-53 models, when brake lining replacement is necessary, all shoes and linings should be replaced. In no case should a single lining and shoe be replaced; however, in exceptional cases, it may be satisfactory to replace the shoes and linings on both front wheels or both rear wheels.

BRAKE SHOE REPLACEMENT—1949-50 MODELS
REMOVAL

Front

1. Raise vehicle and place on stand jacks.
2. Remove wheels, back off brake adjustment and remove drums.

NOTE: Front brake drums are non-demountable and are removed with front wheel hubs and bearings.

3. Install wheel cylinder clamps KMO-145, (fig. 17), to keep wheel cylinder pistons in place and to prevent leakage of fluid while replacing shoes.
4. Remove brake shoe retracting spring with brake spring pliers KMO-142 (fig. 18).
5. Remove brake shoe anchor pin lock and pin and remove shoes.

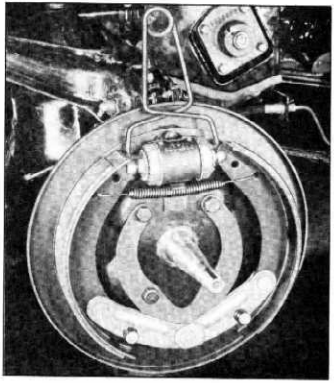

Fig. 17—Brake Wheel Cylinder Clamp

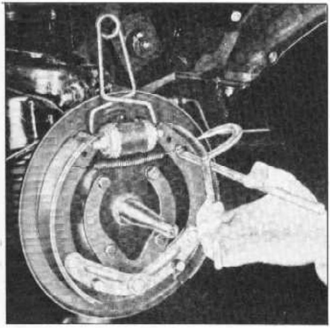

Fig. 18—Removing Brake Shoe Retracting Spring

6. Disassemble articulating links from shoes by removing friction spring locks, pins and springs.

Rear

1. Raise vehicle and place on stand jacks.
2. Remove wheels, back off brake adjustment and remove drums.

   NOTE: Rear brake drums may be removed by removing two stamped brake drum retaining nuts (Zipon-type).

3. Install wheel cylinder clamps, KMO-145, to keep wheel cylinder pistons in place and to prevent leakage of fluid while replacing shoes.
4. Remove brake shoe retracting spring with brake spring pliers, KMO-142.
5. Remove brake shoe anchor pin lock and pin.
6. Unhook toggle lever from parking brake cable and remove brake shoes.
7. Remove toggle lever eccentric bolt and nut from brake shoe and remove toggle lever from shoe; also, remove parking brake extension link.
8. Disassemble articulating links from shoes by removing friction spring locks, pins and springs.

Relining

Brake linings on the brake shoe assemblies are bonded to the shoe which greatly increases the useful lining life. In the interest of safety, bonded brake shoes will be serviced to the field as an assembly only. When the brake shoe lining becomes worn to a point where replacement is necessary, it is recommended that factory bonded shoes be used for replacement.

INSTALLATION

Front

1. Assemble articulating links, pins, friction springs and locks to new brake shoes.

   NOTE: To facilitate installation of link pin lock install shoe in vise and compress spring with screwdriver (fig. 19).

2. Attach new brake shoe assemblies to the anchor plate with anchor pin and anchor pin lock.
3. Engage ends of shoes in the slots in ends of wheel cylinder adjusting screws.
4. Install brake shoe retracting spring, using brake spring pliers KMO-142.

   NOTE: Place metal strip between point of pliers and shoe lining.

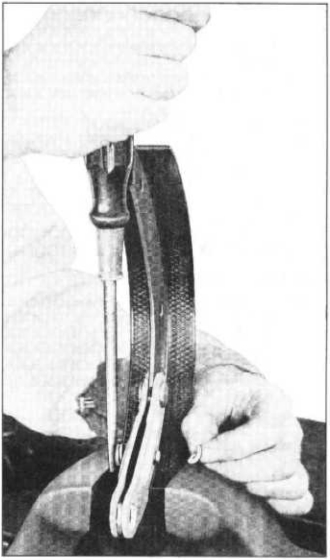

Fig. 19—Installing Articulating Link Pin Retainer

5. Remove wheel cylinder clamp KMO-145.
6. Install hub and drum assembly and adjust wheel bearings as outlined in Section 3.
7. Install wheels.
8. Depress foot pedal several times to align the brake shoe articulating links. Adjust brakes and bleed lines as outlined in this section.
9. Lower vehicle to floor.

Rear

1. Assemble articulating links, pins, friction springs, locks and emergency brake extension link to new shoes.
2. Assemble toggle lever to new shoe, making sure that the high side of the eccentric attaching bolt is toward the brake shoe facing.

   NOTE: A flat has been ground on the bolt head to indicate the high side of the eccentric.

3. Lubricate parking brake cables.
4. Assemble shoes to anchor plate with anchor pin and anchor pin lock.
5. Hook toggle lever to parking brake cable.
6. Place spring on parking brake extension link and line up slot of the link so it will straddle the toggle lever.
7. Engage ends of shoes in the slots in ends of wheel cylinder adjusting screws and install brake shoe retracting spring.
8. Remove wheel cylinder clamp.
9. Replace brake drum, making sure tang in drum is aligned with drain hole in axle flange and install brake drum retaining nuts.
10. Depress foot pedal firmly several times to align brake shoe articulating links; adjust brakes and bleed lines.
11. Adjust parking brake toggle lever, and parking brakes. See instructions in this section.

PARKING BRAKE TOGGLE LEVER

Whenever new rear brake shoes are installed, it is necessary to adjust the toggle lever with the parking brake extension link, by means of the eccentric bolt. This can only be done correctly AFTER the hydraulic service brake adjustment has been made and the brake shoes are in a fully released position.

Adjustment

1. Remove brake drum and loosen eccentric bolt lock nut.
2. Hold the toggle lever against the shoe and turn the eccentric bolt until there is only a slight clearance between the lever and the bottom of the slot in the parking brake extension link (fig. 20).
3. Tighten the eccentric bolt lock nut and again check for clearance.

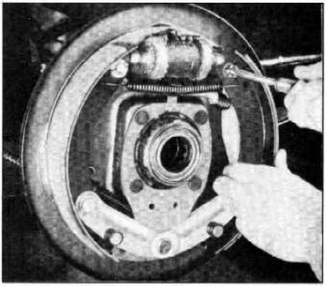

Fig. 20—Adjusting Rear Brake Toggle

4. Replace brake drum and adjust parking brake.
5. Install wheel assembly and lower vehicle to the floor.

BRAKE SHOE REPLACEMENT 1951-53 MODELS

Removal

1. Raise vehicle and place on stand jacks.
2. Loosen check nuts at forward ends of parking brake cables sufficiently to remove all tension from brake cables.
3. Remove rear brake drums and front hub and drum assemblies.

   NOTE: Since stops are located on brake backing plates to prevent pistons from leaving wheel cylinders, it is not necessary to install wheel cylinder clamps when drums are removed; however, brake pedal must not be depressed while drums are removed.

4. Unhook brake shoe pull back springs from anchor pin using brake spring remover and replacer, KMO 526 (fig. 21).
5. Remove brake shoe hold down pins and springs using tool J-4712 (fig. 22).
6. Spread shoes to clear wheel cylinder connecting links and remove shoes from backing plate (fig. 23).
7. Separate the brake shoes by removing adjusting screw and spring.
8. Remove parking brake lever from secondary brake shoe (rear only).
9. Clean all dirt out of brake drum using care to avoid getting dirt into front wheel bear-

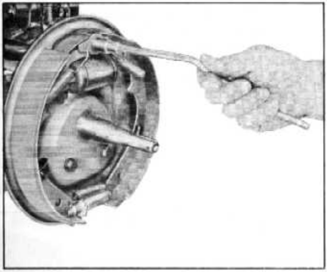

Fig. 21—Unhook Pull Back Spring

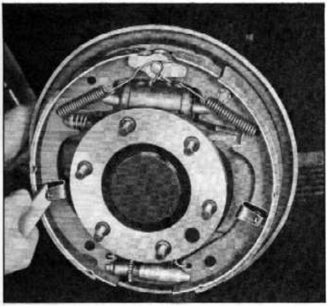

Fig. 22—Remove Holddown Pins and Springs

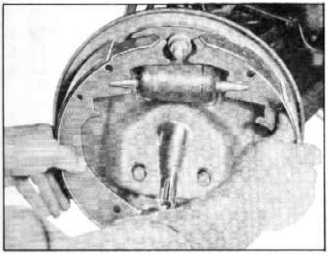

Fig. 23—Spread Shoes to Remove

ings. Inspect drums for roughness scoring or out-of-round. Replace or recondition drums as necessary.

10. Inspect wheel bearings and oil seal and replace any necessary parts.
11. Carefully pull lower edges of wheel cylinder boots away from cylinders and note whether interior is wet with brake fluid. Excessive fluid at this point indicates leakage past piston cups requiring overhaul of wheel cylinder.

NOTE: A slight amount of fluid is nearly always present and acts as lubricant for the piston.

12. If working at rear wheels, inspect backing plate for oil leakage past axle shaft oil seals. Install new seals if necessary.
13. Check all brake flange plate attaching bolts to make sure they are tight. Clean all rust and dirt from shoe contact faces on flange plate, using fine emery cloth.

Installation

1. Inspect new linings and make sure there are no nicks or burrs or bonding material on shoe edge where contact is made with brake flange plate or on any of the contact surfaces.

NOTE: Keep hands clean while handling brake shoes. Do not permit oil or grease to come in contact with linings.

2. If working on rear brakes, lubricate parking brake cables.
3. On rear brakes only, lubricate fulcrum end of parking brake lever and the bolt with Bendix or Delco brake lube or Lubriplate, then attach lever to secondary shoe with bolt, spring washer, lockwasher, and nut. Make sure that lever moves freely.
4. Lubricate threads and socket end of adjusting screw with Bendix or Delco brake lube or Lubriplate.
5. Connect brake shoes together with adjusting screw spring then place adjusting screw, socket and nut in position.

CAUTION: The socket and adjusting screw must be adjacent to the primary shoe (front) on the brakes on the left side and adjacent to the secondary shoe (rear) on the brakes on the right side.

6. Attach brake shoes to brake flange plates with the hold down pins and springs using tool J-4712; at the same time engage shoes with wheel cylinder connecting links. The primary shoe (short lining) goes forward.

7. On rear brakes, connect cable to parking brake lever and install strut between lever and primary shoe as installation is made.

NOTE: Strut anti-rattle spring must be installed with the spring loop to the rear and with loop inside shoe on the left side and outside shoe on the right side.

8. If old brake pull back springs are nicked, distorted, or if strength is doubtful, install new springs. Install guide plate over anchor, hook springs in shoes and using brake spring remover and replacer KMO 526, install spring connected to primary shoe over anchor (fig. 24), and then spring connected to secondary shoe over anchor.
9. Pry shoes away from backing plate and lubricate shoe contact surfaces with a thin coating of Bendix or Delco brake lube or Lubriplate. On rear wheels, sparingly apply this same lubricant where brake cable contacts brake flange plate.

CAUTION: Be careful to keep lubricant off facings.

10. Install brake drums. If working on front

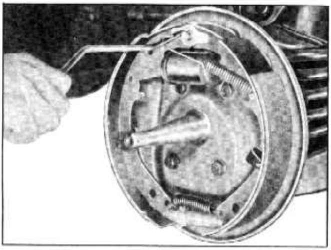

Fig. 24—Install Pull Back Spring

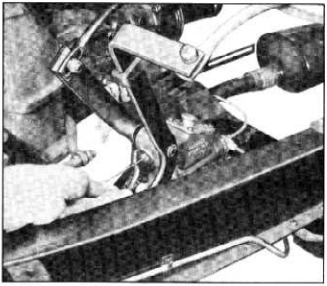

Fig. 25—Removing Lock Pin

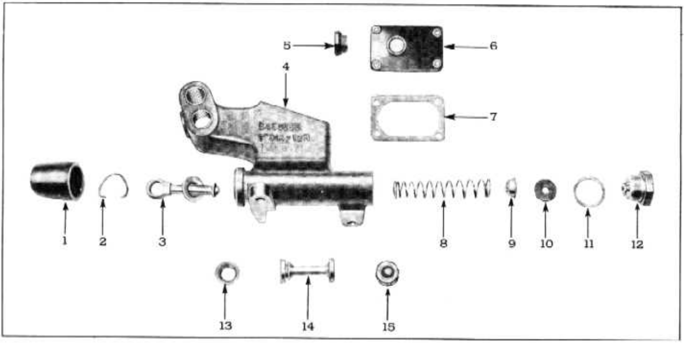

Fig. 26—Main Cylinder Parts Layout

1. Rubber Boot
2. Lock Ring
3. Push Rod Assembly
4. Body
5. Filler Plug
6. Cover
7. Cover Gasket
8. Spring
9. Valve Assembly
10. Valve Seat
11. End Plug Gasket
12. End Plug
13. Secondary Cup
14. Piston
15. Primary Cup

brakes, lubricate and adjust wheel bearings and install front and rear wheel and tire assemblies. Remove adjusting hole covers from backing plates.

11. Centralize brake shoes and set anchor pin, then adjust all brakes and brake cables as outlined under, "Minor Service Operations, Adjustment—Major".

MAIN CYLINDER

Removal

1. Disconnect hydraulic line from end of cylinder.
2. Remove eccentric bolt from brake pedal extension and main cylinder push rod. Remove clutch link from clutch pedal extension.
3. Remove plug from forward end of main cylinder, insert a stiff wire into shaft lock pin and remove lock pin (fig. 25).
4. Remove clutch and brake pedal extension pivot shafts from the main cylinder body.
5. Remove master cylinder to frame mounting bolts and remove unit from vehicle.

Disassembly—Figure 26 shows construction details

1. Remove the end plug and valve seat washer.
2. Remove the valve seat washer from the button on the end plug (fig. 27).

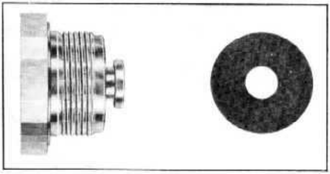

Fig. 27—Valve Seat and End Plug Relation

3. Remove the valve assembly and spring.
4. Remove the main cylinder boot.
5. Remove the pedal stop snap ring with a screw driver and remove the pedal stop and push rod assembly.
6. Remove the piston with the secondary cup.
7. Remove the primary cup.
8. Remove filler plug.

Inspection

1. Wash all parts in clean alcohol. Make sure that compensating port in main cylinder body and bleeder holes in piston are clean and open.

NOTE: Before washing parts, hands must be clean. Do not wash hands in gasoline or oil before cleaning parts. Use soap and water to clean hands.

2. Inspect cylinder bore to make sure it is smooth.
3. Inspect primary and secondary cups, valve and valve seat for damage or swelling. Swelling of rubber parts is due to the use of improper brake fluid or washing parts in gasoline or kerosene.

NOTE: The primary cup has a brass support ring vulcanized in its base to prevent it from imbedding in the bleeder holes during braking action.

4. Check piston fit in cylinder bore (fig. 28). The clearance between piston and wall of the cylinder should be from .001"-.005".

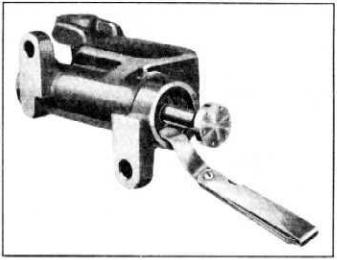

Fig. 28—Checking Main Cylinder Piston Fit

5. Check clearance between the edge of the primary cup and the center of the compensating port, (fig. 29). To check this clearance, proceed as follows:

   a. Install pedal stop and push rod assembly and lock in place with snap ring.

   b. Assemble secondary cup on piston and install assembly in body. Place primary cup in the body with the flat side of the cup against the piston.

   c. Push the piston cup against the pedal stop and check clearance between edge of primary cup and center of the compensating port. This clearance should be a minimum of .035". If clearance is less than .035", the primary cup must be replaced.

NOTE: This check is made easiest by using a wire inserted through the

reservoir of the body and extending into the piston chamber (fig. 29).

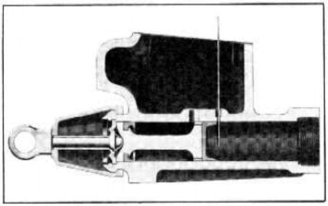

Fig. 29—Checking Compensating Port Clearance

6. After clearance is checked, again completely disassemble main cylinder.

Assembly

Whenever a hydraulic brake main cylinder is overhauled, care must be taken to reassemble the valve and seat correctly. Improper assembly of the check valve seat rubber washer will result in its distortion. When the check valve seat is distorted, there will be no check valve seal and there will be a loss of brake pedal travel, also, the pedal will have to be depressed or pumped one or more times before actual car braking occurs.

1. Dip a new check valve seat washer in genuine hydraulic brake fluid and assemble over the button on the end of the end plug.
2. Assemble a new gasket over the end plug and screw the plug, valve seat washer and gasket into the main cylinder body and tighten securely.
3. Inspect valve seat washer through push rod end of the body to make sure the washer is properly seated.
4. Dip the rubber cups and valve in hydraulic brake fluid.
5. Install valve assembly from push rod end of main cylinder.
6. Install piston spring.
7. Place the primary cup in the body with the cupped side against the spring.
8. Assemble secondary cup to the piston and install assembly in the body so that the bleeder hole end of the piston will be against the flat side of the primary cup.
9. Install the pedal stop and push rod assembly and lock in place with a snap ring.
10. Install the rubber push rod boot, making sure this seal is tight on the body. This seal must be tight to keep water and other foreign matter from entering the main cylinder through the pedal stop.

Installation

1. Replace unit in vehicle and tighten attaching bolts securely.
2. Replace clutch pedal extension pivot shaft in upper hole on left hand side of main cylinder body and brake pedal extension pivot shaft in lower right hand hole.
3. Insert shaft lock pin and replace retaining plug.
4. Connect clutch link to clutch pedal extension and piston push rod to pedal extension with eccentric bolt and adjust to give proper toe board clearance, as outlined under "Minor Service Operations."
5. Connect hydraulic brake line to cylinder.
6. Refill main cylinder and bleed all brake lines as outlined in this section.

WHEEL CYLINDER—1949-50 MODELS

Removal

1. Raise vehicle and place on stand jack.
2. Remove wheels. Back off brake adjustment and remove drums.

NOTE: Front drums are non-demountable and are removed with front wheel hubs. Rear brake drums may be removed by removing retaining nuts.

3. Disconnect brake system wheel cylinder pipe or hose from fitting at flange plate.
4. Disconnect brake shoe retracting spring from brake shoes.
5. Remove two capscrews which hold wheel cylinder to brake flange plate and remove wheel cylinder.

Disassembly—Figure 30 shows construction details

1. Remove the cylinder adjusting covers.
2. Remove the pistons, rubber cups and spring.
3. Wash all parts in clean alcohol.

NOTE: Before washing parts, hands must be clean. Do not wash hands in gasoline or oil before cleaning parts. Use soap and water to clean hands.

Inspection

1. Inspect cylinder bore, making sure that it is smooth. A scored or damaged cylinder must be replaced.
2. Check rubber cups for damage or swelling due to improper brake fluid. Replace the cups when necessary. Improper brake fluid will cause the cups to swell as much as 40 per cent.

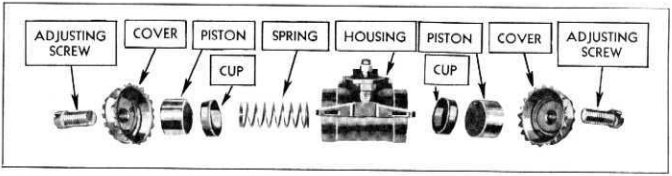

Fig. 30—Wheel Cylinder Parts Layout

3. Check fit of the piston in the cylinder bore, using a feeler gauge (fig. 31). This clearance should be from .002"-.004".

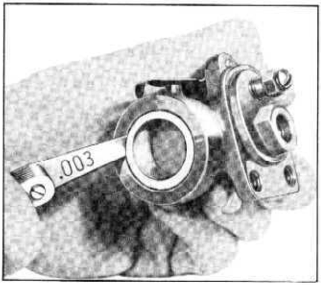

Fig. 31—Checking Wheel Cylinder Piston Fit

Assembly

1. Dip pistons and rubber cups in hydraulic brake fluid.
2. Place the spring in the center of the housing.
3. Install rubber cups at each end of spring with cupped side toward spring.
4. Install pistons with flat side of pistons against flat side of rubber cups.
5. Replace adjusting covers with adjusting screws in place.

Installation

1. Mount wheel cylinder to brake flange plate and install two capscrews and tighten securely.
2. Replace brake shoe retracting spring.
3. Connect wheel cylinder pipe or hose.
4. Install rear brake drums and install the retaining nuts.
5. Install front hub and drum and adjust bearings as outlined in Section 3.
6. Bleed all brake lines.

WHEEL CYLINDER—1951-1953 MODELS

The brake wheel cylinders for 1951-1953 passenger cars are equipped with a rubber boot at each end of the wheel cylinder. This boot replaces the metal end covers used on 1949-1950 models and there is no provision for adjusting brake shoe clearance at the wheel cylinder.

The service procedure for the wheel cylinders remain the same as that outlined for the 1949-1950 models except that the brake spring remover and replacer tool, KMO 526, should be used to remove and replace the brake shoe pull back springs.

BRAKE DRUMS

Front brake drums are the non-demountable type, that is, they cannot be removed without removing the hub. Whenever this type drum is removed, wheel bearings must be adjusted as outlined in Section 3. Rear brake drums are demountable, that is, they may be removed without removing the axle shaft.

Removal

1. Jack up front end of vehicle and remove wheel.
2. Remove hub and brake drum assembly.
3. Remove brake drum from hub, as outlined in Section 3.
4. Jack up rear end of vehicle and remove wheel.
5. Remove two stamped brake drum retaining nuts and remove brake drum from flange of axle shaft.

Inspecting and Reconditioning

Whenever brake drums are removed they should be thoroughly cleaned and inspected for cracks, scores, deep grooves, and out-of-round. Any of these conditions must be corrected since they can impair the efficiency of brake operation and also can cause premature failure of other parts.

Smooth up any slight scores by polishing with fine emery cloth. Heavy or extensive scoring will cause excessive brake lining wear and it will probably be necessary to rebore in order to true up the braking surface.

An out-of-round drum makes accurate brake shoe adjustment impossible and is likely to cause excessive wear of other parts of brake mechanism due to its eccentric action.

A drum that is more than .010" out-of-round on the diameter is unfit for service and should be rebored. Out-of-round, as well as taper and wear can be accurately measured with an inside micrometer fitted with proper extension rods.

If drum is to be rebored for use with standard size brake facings which are worn very little, only enough metal should be removed to obtain a true smooth braking surface.

If drum has to be rebored more than .010" over the standard diameter, it should be rebored to .060" oversize and the brake facing should be replaced with .030" oversize facings.

A brake drum must not be rebored more than .060" over the maximum standard diameter, since removal of more metal will effect dissipation of heat and may cause distortion of drum. Chevrolet brake facing is not furnished larger than .030" oversize and this will not work efficiently in drums bored more than .060" oversize.

Brake drums may be refinished either by turning or grinding. Best brake performance is obtained by turning drums with a very fine feed. To insure maximum lining life, the refinished braking surface must be smooth and free from chatter or tool marks, and run-out must not exceed .005" total indicator reading.

Cleaning

New brake drums in parts stock are given a light coating of rust proofing oil to prevent the formation of rust on the critical braking surfaces during the time that the drums are in storage.

This rust proofing oil must be carefully removed before the drum is placed in service to prevent any of this oil from getting on the brake shoe facings, which might cause an extreme brake grab condition.

It is recommended that naphtha or carbon tetrachloride be used to clean the oil from the braking surface of the new brake drums before they are placed in service to insure the cleanest possible surface.

Gasoline or kerosene should not be used as there is danger that a portion of the diluted oily substance may be left on the braking surface that may later cause difficulty.

Installation

1. Make sure mating surfaces of hub, drum and oil deflector are clean and smooth and assemble front drum as outlined in Section 3.
2. On front, install drum and hub assembly to wheel spindle and adjust bearings as outlined in Section 3.
3. On rear, assemble drum over axle shaft studs and install retaining nuts.
4. Replace wheel assembly, adjust brakes and lower vehicle to floor.

BRAKE SPECIFICATIONS

Model	Brake Size	Lining		Clearance		Wheel Cyl.	Main Cyl.
		Thickness	Width	Main Cyl. Piston	Wheel Cyl. Piston	Size	Size
All Passenger Front Rear	 11 11	 .187-.194 .187-.194	 1¾" 1¾"	.001" to .005"	.002" to .004"	 1 5/16" 1⅛"	1"
1951-52 Passenger Front Rear	SAME	SAME	2" 1¾"	SAME	SAME	1⅛" 1"	SAME
1953-Passenger	SAME	SAME	SAME	SAME	SAME	SAME	⅞"

TROUBLES AND REMEDIES
BRAKE SYSTEM

Symptom and Probable Cause	Probable Remedy
Pedal Spongy	
a. Air in brake lines.	a. Bleed brakes.
All Brakes Drag	
a. Mineral oil in system.	a. Flush entire brake system and replace all rubber parts.
b. Improper pedal toe board clearance.	b. Adjust pedal toe board clearance.
c. Compensating port in main cylinder restricted.	c. Overhaul main cylinder.
One Brake Drags	
a. Loose or damaged wheel bearings.	a. Adjust or replace wheel bearings.
b. Weak, broken or unhooked brake retractor spring.	b. Replace retractor spring.
c. Brake shoes adjusted too close to brake drum.	c. Correctly adjust brakes.
Excessive Pedal Travel	
a. Normal lining wear or improper shoe adjustment.	a. Adjust brakes.
b. Fluid low in main cylinder.	b. Fill main cylinder and bleed brakes.
Brake Pedal Applies Brakes but Pedal Gradually Goes to Floor Board	
a. External leaks.	a. Check main cylinder, lines and wheel cylinder for leaks and make necessary repairs.
b. Main cylinder leaks past primary cup.	b. Overhaul main cylinder.
Brakes Uneven	
a. Grease on linings.	a. Clean brake mechanism; replace lining and correct cause of grease getting on lining.
b. Tires improperly inflated.	b. Inflate tires to correct pressure.
c. Spring center bolt sheared and spring shifted on axle.	c. Replace center bolt and tighten "U" bolts securely.
Excessive Pedal Pressure Required, Poor Brakes	
a. Grease, mud or water on linings.	a. Remove drums—clean and dry linings or replace.
b. Full area of linings not contacting drums.	b. Free up shoe linkage, sand linings or replace shoes.
c. Scored brake drums.	c. Turn drums and install new linings.

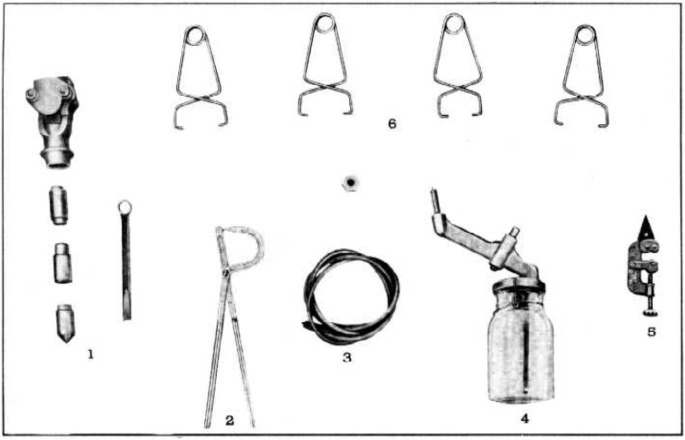

Fig. 32—Brake Special Tools

1. Tube Flaring Tool—J-2185
2. Brake Spring Pliers—KMO-142
3. Brake Bleeder Tube—J-747
4. Main Cylinder Filler—J-713
5. Tube Cutter—KMO-3A
6. Wheel Cylinder Clamps—KMO145

SERVICE NEWS REFERENCE

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SECTION 6

ENGINE ASSEMBLY

CONTENTS OF THIS SECTION

ENGINE

INDEX

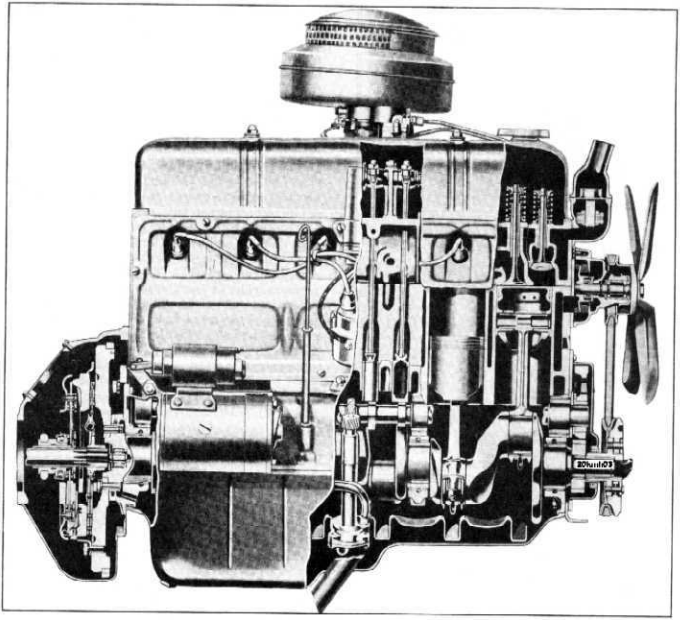

Fig. 1—216 Engine—Cross Section

GENERAL DESCRIPTION

The engine (fig. 1) which is typical of those used on all passenger car models is a six cylinder valve-in-head type. This engine which is used on all models except 1950-53 models equipped with Powerglide transmission and 1953 conventional models has a displacement of 216.5 cubic inches using a 3½" bore and 3¾" stroke.

The engine used on all 1950-53 models which are equipped with the Powerglide transmission and the standard engine used on 1953 vehicles has a displacement of 235.5 cubic inches using a $3\frac{9}{16}$" bore and a $3\frac{15}{16}$" stroke. This engine incorporates all of the design fundamentals of the regular 216 engine but includes, in addition, hydraulic valve lifters for quiet operation in addition to numerous other design improvements. The 1953 Powerglide engine incorporates full pressure lubrication (fig. 2).

The cylinder head assembly as installed on either engine includes the valve guides, valves, valve springs, rocker arm and shaft assemblies, spark plugs, temperature indicator fitting, water outlet, exhaust and intake manifolds and other assembling parts. The carburetor and air cleaner assembly bolts to the top of the manifold and the rocker arm cover attaches to the top of the head to enclose the valve mechanism.

The cylinder block and crankcase assembly is the major section of the engine as it is fitted with the camshaft, crankshaft, timing gear plate, tim-

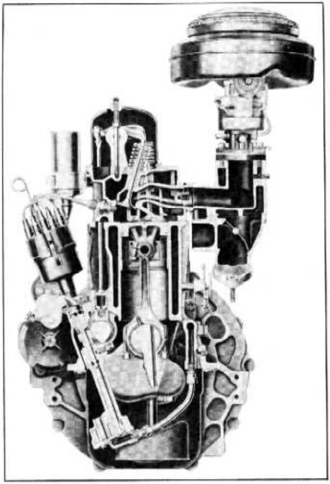

Fig. 2—1953 Powerglide Engine

ing gears, pistons, piston rings, piston pins, connecting rods and miscellaneous parts.

In addition to the above parts which are part of a cylinder block assembly, the following units are attached to this assembly when in the vehicle—water pump, oil pump, distributor, starter, generator, flywheel, clutch, clutch housing, harmonic balancer, fuel pump and other miscellaneous parts.

The oil pan used with all models except the 1953 Powerglide engine is fitted with oil troughs and oil pipes for connecting rod bearing lubrication.

A "V" type fan belt operating from a combined harmonic balancer and pulley on the front of the crankshaft drives the generator, water pump and fan.

The distributor, mounted on the right side of the engine, is gear driven from the camshaft. The oil pump connects to the lower end of the distributor shaft and is driven at distributor speed. The fuel pump mounts on the right side of the engine and is operated by a special cam on the camshaft.

Pistons are cast iron on all models except the 235 cubic inch engine used with the 1953 Powerglide transmission, cam ground to provide, slightly greater diameter at right angles to the piston pin. Pistons have three piston ring grooves above the piston pin bosses and the cast iron piston pin bosses have bronze bushings installed. Pistons used on the 1953 Powerglide engine are aluminum.

One oil control ring and two compression rings are used on each piston. The oil control ring is used in the bottom groove where the piston is drilled to permit the oil wiped by the ring to return to the oil pan. The face of the compression rings, both on the 216 engine and the second on all 235 engines except in the 1953 Powerglide engine, are tapered .001" to provide the means of quick seating of the rings.

In the 235 cubic inch engine used in 1950-52 models equipped with Powerglide transmission and the standard 1953, 235 engine, the top compression ring of each piston is a deep section twist type $\frac{3}{32}$" wide while the second compression ring is the taper face type. Both compression rings used on the 1953 Powerglide engine are the deep section twist type.

Camshaft bearings are steel backed and babbitt lined providing uniform expansion and long life. The bearings are installed in the cylinder block and finish bored for perfect alignment.

Main bearings are precision interchangeable, thin-wall babbitt type with dual advantages of longer life and simplified installation.

The precision interchangeability feature of the bearings facilitate engine repair as well as engine assembly because the bearings are accurately machined to tolerances of .0003" and are ready for installation.

The crankshaft has four unusually large bearing journals and is heavily counterbalanced which contributes to Chevrolet's smooth engine performance.

In the 235 cubic inch engine used in 1950-52 models equipped with Powerglide, the crankshaft is identical with that used in the regular 216 cubic inch engine except for its longer stroke and for revision in the counterweights. The revisions in the counterweights and adjustments in the tuning of the harmonic balancer compensate for the longer stroke to provide dynamic dampening in the crankshaft. The bearings used with the crankshaft are the same as those of the regular engine because they are fully capable of withstanding the heavier bearing loads of this special high output engine. Bearings and crankshafts used on the 1953 Standard and Powerglide engines differ from each other and from the 1950-52 Powerglide engine.

The four bearing camshaft is designed to provide accurate, quiet valve action and hold the valves open long enough to provide complete discharge of the exhaust gases and allow a full charge of fuel mixture. The cams have a wear resisting treatment, which combined with off-center lifters, provide unusually long life and quiet operation.

Connecting rods are of drop forged steel "I" beam construction for rigidity. The upper end is fitted with a clamp bolt for securely attaching the rod to the piston pin. The bearings of all engines except the 1953 Powerglide engine are spun in and are of the thin wall babbitt type. The spun bearing rod and cap assembly is clamped to a special face plate that revolves at a high rate of speed while the molten bearing metal is being cast into the rod. The centrifugal force causes the metal to adhere to the rod and become an integral part of the rod assembly. The bearings are then precision bored for journal fit and alignment. The 1953 Powerglide engine has precision interchangeable insert type connecting rod bearings.

On all Standard transmission engines a heavy cast iron flywheel bolts to the flange at the rear end of the crankshaft and a steel ring gear is shrunk on the outer diameter of the flywheel; On all automatic transmission engines the flywheel is a reinforced steel stamping with the ring gear welded to the flywheel, the starting motor drive pinion engages this ring gear when cranking the engine. Flywheel and crankshaft are accurately balanced to prevent engine vibration and the rear flywheel face is accurately machined for clutch mounting.

The front end of the crankshaft is fitted with a harmonic balancer. This balancer consists of a hub attached to the crankshaft and a small flywheel connected to the hub by two rubber annular rings. This rubber mounted flywheel tends to resist quick increases in crankshaft speed caused by the power impulses, and thereby dampen out or absorbs crankshaft vibration.

The cylinder head is constructed as to size and shape of the combustion chambers, location and size of the valves, shape and size of the intake and exhaust ports, location of spark plugs, size and shape of the water passages and the nozzle circulation of water around the exhaust seats on 216 engines (fig. 3) to provide for economy, performance and efficiency of operation.

The cylinder head on the 235 cubic inch Powerglide engine used on 1950-52 models is larger than that of the regular 216 engine and somewhat different in design. Its combustion chambers provide for the 6.7 to 1 compression ratio and for different valve positions. Additional revisions in the cylinder head passages, valves, etc. give a compression ratio of 7.1:1 on the Standard 1953, 235 engine and a 7.5:1 on the 1953 Powerglide engine. The inlet and exhaust valve ports and passages are larger permitting freer intake of fuel mixture and expulsion of exhaust gases. Likewise, its water passages are larger, providing more coolant capacity and eliminating the need for nozzle jets. In addition it is shaped to enclose the upper ends of the push rods so a shorter push rod cover, that covers just the openings in the cylinder case and is fastened to the case alone, may be used. This permits removal of the cylinder head without the need to remove the push rod cover. Furthermore, because the cover terminates below the spark plugs, they do not extend through the cover, eliminating any necessity for oil seals around them.

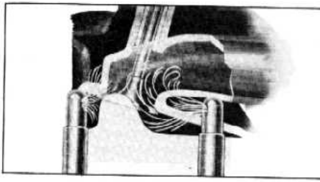

Fig. 3—Cylinder Head Water Nozzles

Except for the four corner bolts, all the bolts that hold the cylinder head to the cylinder case are shorter, making them more rigid. Because these bolts are located in different positions and because of the larger cylinder bores, a special gasket is used to seal the head to the case which is not interchangeable with those used previously. 1953 cylinder heads on both passenger engines have three additional head bolts.

Exhaust valves in the 1950-53 models are $1/32''$ in diameter and approximately $1/16''$ longer than those used in 1949 models. These exhaust valves are interchangeable with those in the 235 cubic inch engine furnished with the Powerglide transmission. In addition the face angle on the exhaust valves is changed from 30 to 45 degrees to increase their strength and the throat passage diameter is increased by $3/64''$. The metal added to the valve heads and seats by these changes, combined with the steeper seat angle, results in stronger, more durable exhaust valves which offer less resistance to expulsion of gases from the combustion chambers.

The intake valves, on the 1950-53, 235 cubic inches engine only, have been increased $3/32''$ in length and the O.D. of the valve head is increased $5/16''$.

The intake manifold used on all 216 engines is a "D" shape cross section which results in good atomizing and even distribution of the fuel mixture to each of the six cylinders.

The inlet manifold used on 1950-53 models with the 235 cubic inch engine, has a larger round cross section and is mounted parallel to the ground, so there is no tendency for fuel to collect at one end and no cylinder is starved while others are fed an excess of fuel.

The exhaust manifold is designed to reduce back pressure to a minimum. Located on the inside of the exhaust manifold is the thermostatically operated heat control valve.

This valve in the exhaust manifold directs the hot exhaust gases against the center of the intake manifold when the engine is cold as shown at the left of Figure 4, As the engine warms up, the thermostatic spring closes the valve and directs the exhaust gases away from the intake manifold as shown at the right of Figure 4. This thermostatic control results in the proper temperature of the incoming gases under all operating conditions.

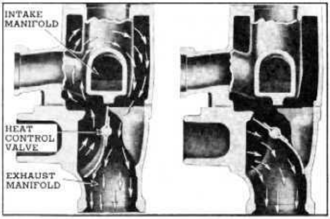

Fig. 4—Manifold Heat Riser and Heat Control Valve

The tension of the thermostatic spring is very important. When too tight, the heat will not be turned off the intake heat riser as the engine warms up, with the result that the incoming gases will be expanded several times greater than normal and it will be impossible to get a normal fuel charge into the cylinders. This condition will reduce power and maximum speed and cause detonation as well as sticking valves. Therefore, it is important that the thermostatic spring be wound up just enough to slip its outer end over the anchor pin (fig. 5) in the manifold and no more. This is approximately ½ turn of the spring from its position when unhooked.

Sometimes the heat control valve shaft becomes frozen in the manifold; when this condition occurs the valve may stick in either the "heat on" or "heat off" position.

If it sticks in the "heat on" position, it will result in poor engine performance, overheating and detonation. On the other hand, if it should stick in the "heat off" position the heat will be turned off the intake heat riser at all times and result in poor performance, particularly while the engine is warming up and driving at lower speeds.

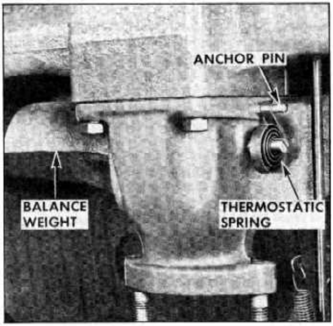

Fig. 5—Manifold Heat Valve Thermostatic Spring

On all engine tune-up jobs and also on complaints of poor performance, overheating and detonation the operation and adjustment of the manifold heat control valve should be closely checked and any necessary corrections made.

The exhaust manifold, used on the 1950-53 models with the 235 cubic inch engine, is similar but not interchangeable with those used on the regular 216 cubic inch engine for it has larger dimensions for attachment to the cylinder head and for attachment of the exhaust pipe.

The 235 cubic inch engine, used in 1950-53 models equipped with Powerglide transmission, have hydraulic valve lifters that provide a means of automatically maintaining zero valve lash or tappet clearance at all times. Any lash, which would tend to result in the system is instantly taken up by hydraulic action. The hydraulic lifters eliminate periodic valve adjustments, eliminate valve tappet clearance and noise.

A direct oil feed is maintained to the lifters at all times through a $\frac{9}{16}''$ oil gallery which runs the full length of the engine. This gallery goes through the center of each valve tappet bore and intersects an oil passage drilled in the block from the rear camshaft bearing.

Operation

Whenever lash tends to be present, the plunger spring expands pushing the plunger until solid contact is made with the push rod and linkage. This creates a difference in oil pressure on either side of the ball check valve, the lower pressure being below the plunger. The higher pressure above, then forces the oil to flow to the chamber below the plunger until the pressure is equalized.

When the lifter is raised by the cam, the increased oil pressure below the plunger forces the ball check valve against its seat and the oil then becomes a solid connecting link.

There is a certain amount of oil leakage between the plunger and lifter body while the engine valve is open and pressure is thus applied to the lifter. A small amount of "leakdown" is desirable for it eliminates the possibility of a "negative valve lash clearance" condition.

NOTE: After the engine has been standing for a considerable length of time, a certain amount of valve lifter noise will occur when the engine is first started due to "leakdown" on those lifters which were holding valves open against spring pressure at the time the engine was stopped. Oil pressure will refill these lifters after a few seconds of engine operation, at which time the noise will disappear.

Engine lubrication is supplied by a positive driven gear pump equipped with a spring loaded by-pass valve to control the maximum pressure at high speeds and when the engine oil is cold and sluggish during cold weather starting.

The oiling system on all engines except the 1953 Powerglide engine provides positive pressure lubrication to the main bearings and camshaft bearings. The connecting rod bearings are lubricated at low speeds by means of dippers on the rod bearing caps which dip into oil filled troughs in the oil pan. At high speeds lubrication is amply maintained by oil nozzles, which direct a stream of oil that is intercepted by the dippers, thereby, forcing oil into the bearings under high pressure. Cylinder walls and pistons are lubricated by the oil spray thrown off by the connecting rods. Lubrication of the valve mechanism is accomplished by oil being pumped to the hollow rocker arm shafts.

Improved lubrication control of the inlet and exhaust valve stems is provided by a new design oil seal. A synthetic rubber seal is assembled between the valve stem and the valve spring cap. An extra groove is provided on the valve stem to accommodate this rubber seal and the valve spring cap neck and valve stems are longer. Both seal and cap are interchangeable between intake and exhaust valves and the valve spring cap is identified by an annular groove $\frac{1}{16}''$ deep in the top of the cap in addition to its longer neck. Valve stem tips are hardened to prevent wear from contact with the rocker arms.

Full pressure lubrication to the main and camshaft bearings is provided by oil flowing from the pan through the pump screen and oil pump to a block fitting and thence to the oil manifold, from the manifold through drilled passages in the bearing support webs in the cylinder block to the four main bearings. The oil then passes through grooves in the bearings to the drilled passages in the other side of the cylinder block webs to the camshaft bearings. In this manner full pressure feed lubrication is supplied to all main and camshaft bearings.

Lubrication for the timing gears is supplied by conducting the oil from the front camshaft bearing through a milled slot in the rear surface of the engine front plate, to a nozzle extending out from the front and so aimed that the oil stream effectively lubricates the timing gears.

Oil for the connecting rod bearings passes from the oil pump to the oil manifold, through a drilled passage in the cylinder block to the oil distributor. As the oil pressure builds up, the oil distributor valve opens and releases the oil into a drilled passage in the block; this passage connects with the short pipe fitting into the main supply pipe in the oil pan. From the main supply pipe the oil passes to the oil distributor pipe in the oil pan where it is distributed to the six oil nozzles.

As the engine speed is increased and the oil pressure is built up, the nozzle oil streams rise and are caught by the dippers, forcing oil into the connecting rod bearings under high pressure (fig. 6).

Oil for lubrication of the valve mechanism is tapped from a small diameter by-pass at the oil distributor valve and carried by a pipe, passing through the water jacket, to a fitting between the two hollow rocker arm shafts, then distributed to all rocker arm bearings. A bleeder hole in each rocker arm supplies oil for lubrication of the valve stems and push rod sockets.

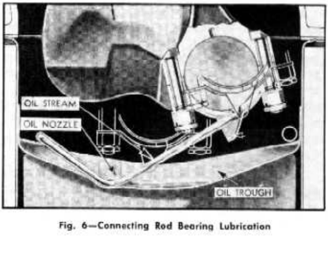

Fig. 6—Connecting Rod Bearing Lubrication

The lubrication system of the 1950-52, 235 cubic inch engine used with Powerglide is the same as that of the regular engine except for the hydraulic valve lifter and valve rocker arm bearing lubrication.

As in the regular engine, oil for each of the four camshaft bearings is supplied from an oil gallery on the left side of the engine through a drilled passage. Each passage extends from the gallery to the groove of the adjacent main bearing and from there to the groove in the camshaft bearing. The drilled passage for the rear camshaft bearing is continued upward to intersect a second oil gallery, on the right side of the engine, that extends through each of the hydraulic valve lifter bores.

This same drilled passage serves also in supplying oil to the valve rocker arm bearings. Instead of starting at a metered hole in the oil distributor valve, the tubing that carries oil to the valve rocker shaft is connected to the end of this passage and extended upward, through the push rod compartment. Its upper end, as in the regular engine, is joined to the middle of the hollow rocker arm shaft, through which oil is directed to the valve rocker arm bearings. Because the spring force of the hydraulic valve lifters places a continuous load on these bearings, a flat is machined on the bottom of the hollow shaft to supply them with more oil than in the regular engine.

A full pressure lubrication system is used on the 1953, 235 Powerglide engine. A gear driven oil pump maintains 45 pounds pressure lubrication; it is equipped with a spring loaded by-pass valve to control maximum pressure at high speeds and when engine oil is cold and sluggish during cold weather starting.

The engine pressure oil system is designed to provide positive lubrication of all moving parts. Full pressure lubrication to the main and camshaft bearings is provided by oil flow from the pan through the pump screen and oil pump to a block fitting and then to the oil manifold. From the oil manifold the oil passes through drilled passages in the main bearing support webs of the cylinder block to the four main bearings. The oil then passes through grooves in the bearings to passages drilled in the other side of the cylinder block webs and on to the camshaft bearings. The crankshaft also contains drilled oil passages connecting the main bearing journals with the crankpins which provide lubrication for the connecting rod bearings.

A direct oil feed is maintained to the valve lifters at all times. An oil gallery $\frac{9}{16}$" in diameter extends the full length of the engine. This gallery goes through the center of the tappet holes and intersects the oil passage drilled in the block from the rear camshaft bearing to the valve rocker shaft lubrication pipe.

Timing gear lubrication is supplied by conducting oil through a milled slot in the rear surface of the engine front plate from the front camshaft bearing to a nozzle extending out from the front and so aimed that an oil stream effectively lubricates the timing gears.

Pistons and cylinder walls are lubricated by the oil spray thrown out through spurt holes in the connecting rod and bearing. Piston pin lubrication is maintained through two drilled passages in the top surface of the recessed piston pin bosses.

Lubrication of the valve mechanism is supplied by a drilled passage from the rear camshaft bearing to a pipe located under the push rod cover to a fitting at the top of the cylinder block. The oil then flows through a passage drilled in the cylinder block and head to the valve mechanism oil connector pipe.

MINOR SERVICE OPERATIONS

VALVE TIMING

Valve timing diagram (fig. 7) is applicable to all 1949-52 passenger car models having 216 engine. Note that the intake valve starts to open one degree after upper dead center and remains open for 218 degrees, closing 39 degrees past lower dead center.

The exhaust valve starts to open 42 degrees before lower dead center and remains open for 231 degrees, closing 9 degrees past upper dead center.

Both the exhaust and intake valves must open and close at the correct time in relation to piston position or lack of power or overheating will result. To check the valve timing, use the number one cylinder exhaust valve.

1. Remove rocker arm cover.
2. With number one cylinder exhaust valve closed, tighten adjusting screw to remove all lash.
3. Crank the engine until the number one cylinder exhaust valve opens and just starts to close.
4. Continue to crank the engine until the triangular mark on the flywheel lines up with the pointer on the flywheel housing.
5. Mount a dial gauge on the rocker shaft support with the spindle of the indicator on top of the number one cylinder exhaust valve adjusting screw.

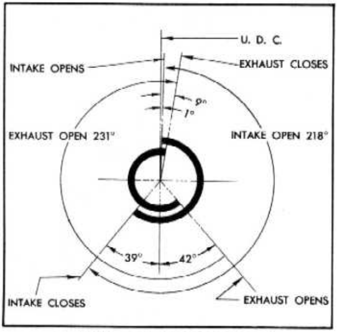

Fig. 7—Valve Timing Diagram (216 Engine)

6. Set the indicator at .044" (fig. 8).
7. Continue to crank the engine until the indicator hand just stops moving. At this point the indicator should read zero plus or minus .004".
8. If indicator is greater or less than .004" it indicates excessive timing gear wear or improperly installed timing gears. Refer to timing gear installation under "Major Service Operation."

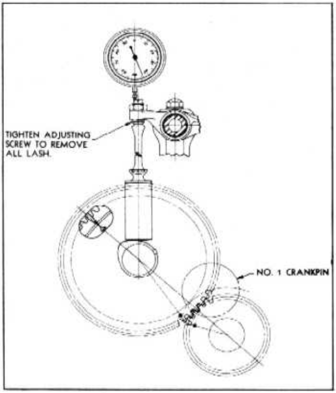

Fig. 8—Checking Valve Timing

The inlet and exhaust valve cams on the camshaft of all 1950-52 models having 235 cubic inch engine have an identical contour that was developed especially for use with the hydraulic valve lifters. The 1953 camshaft differs from the 1950-52 camshaft only in respect to the oil groove in the rear bearing journal.

Included on each cam is a quieting ramp which is slower and smoother than that of similar ramps in the 216 cubic inch engine. Hydraulic valve lifters, like conventional tappets, need this cam shape in order to start the valve trains in motion smoothly. No special ramp, however, is required to absorb valve lash clearance, as in the 216 cubic inch engine.

The theoretical valve timing is different as both inlet and exhaust valves open earlier and stay open longer (fig. 9).

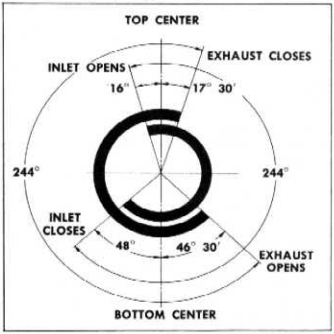

Fig. 9—Valve Timing Diagram (235 Engine)

To check an engine equipped with hydraulic valve lifters for valve timing, the hydraulic lifter and the push rod for the number one (1) cylinder exhaust valve must first be replaced by a non-hydraulic tappet assembly and push rod, the same as those used in the regular 235 cubic inch engine. The procedure for checking and dimensions specified are the same as outlined for the 216 cubic inch engine.

The camshaft driven gear is the same as that used in the regular 216 cubic inch engine, that is, bakelite and fabric composition with steel hub.

VALVE ADJUSTMENT

On all 1949-52 models having 216 cubic inch engines and Standard 1953 235 engines before adjusting the valve stem to rocker arm clearance, it is extremely important that the engine be thoroughly warmed up to normalize the expansion of all parts. This is very important because during the warm-up period, the valve clearances will change considerably. To adjust the valves during or before this warm-up period will produce clearances which will be far from correct after the engine reaches normal operating temperature.

Tests have shown that valve clearances will vary as much as .005" from a cold check through the normalizing range; consequently the engine should be run approximately 30 minutes to properly normalize all parts.

Covering the radiator will not materially hasten this normalizing process because even with the water temperature quickly raised to 185° it does not change the rate at which the oil temperature increases or the engine parts become normalized.

The actual temperature of the oil is not as important as stabilizing the oil temperature. The expansion or contraction of the valves, rocker arm supports, push rods, cylinder head and cylinder block are relative to this oil temperature. Therefore, only after the oil temperature is stabilized, do these parts stop expanding and valve clearance changes cease to take place.

1. Remove rocker arm cover attaching nuts and cover.
2. Run engine at fast idle (approximately 600 RPM) and check oil temperature with a thermometer at the overflow pipe on the valve rocker shaft connector.

   NOTE: When oil temperature remains constant for five minutes, engine is normalized and ready for valve adjustment.

3. Tighten all manifold bolts, valve rocker arm stud nuts and cylinder head bolts.
4. Lubricate valve stems with engine oil to insure free movement of valves in their guides.
5. Adjust valve clearance hot as follows:

	1949-52	1953
Intake	.006" to .008"	.006"
Exhaust	.013" to .015"	.016"

6. Install rocker arm cover using a new gasket, tighten nuts to 5 ft. lb. torque maximum and check for oil leaks.

Hydraulic Valve Lifters

The hydraulic valve lifters used in 1950-53 models having the 235 cubic inch Powerglide engine very seldom require attention. The lifters are extremely simple in design, readjustments are not necessary, and servicing of the lifters require only that care and cleanliness be exercised in the handling of parts.

The easiest method for locating a noisy valve lifter is by use of a piece of garden hose approximately four feet in length. Place one end of the hose near the end of each intake and exhaust valve with the other end of the hose to the ear.

In this manner, the sound is localized making it easy to determine which lifter is at fault.

Another method is to place a finger on the face of the valve spring retainer. If the lifter is not functioning properly, a distinct shock will be felt when the valve returns to its seat.

The general types of valve lifter noise are as follows:

1. Hard Rapping Noise—Usually caused by the plunger becoming tight in the bore of the lifter body to such an extent that the return spring can no longer push the plunger back up to working position. Probable causes are:
   a. Excessive varnish or carbon deposit causing abnormal stickiness.
   b. Galling or "pick-up" between plunger and bore of lifter body, usually caused by an abrasive piece of dirt or metal wedging between plunger and lifter body.
2. Moderate Rapping Noise—Probable causes are:
   a. Excessively high leakdown rate or leaky check valve seat.
   b. A clogged air vent in push rod seat (1950-52 lifters).
3. General Noise throughout the Train—This will, in almost all cases, be a definite indication of insufficient oil supply.
4. Intermittent Clicking—Probable causes are:
   a. A microscopic piece of dirt momentarily caught between ball seat and check valve ball.
   b. In rare cases, the ball itself may be out-of-round or have a flat spot. 20hull03

In most cases where noise exists in one or more lifters, all lifter units should be removed, cleaned in a solvent, reassembled, and reinstalled in the engine. If dirt, varnish, carbon, etc. is shown to exist in one unit, it more than likely exists in all the units, thus it would only be a matter of time before all the lifters caused trouble.

In instances where parts are damaged, particularly the plunger or lifter body, the complete lifter unit should be replaced. However, in rare or emergency cases an Arkansas hard stone may be used to remove metal scratches or humps; and if after correcting, the plunger will operate freely in the lifter body, the parts may be thoroughly cleaned and the unit reassembled and reintalled.

A few precautions to follow when servicing the valve lifters are:

1. Plungers are not interchangeable, they are a selective fit at the factory. Should a plunger or lifter body become damaged, it is necessary to replace the whole unit.

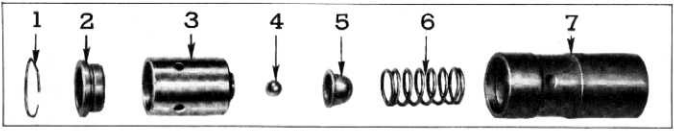

Fig. 10—Valve Lifter—Exploded View

1. Plunger Retainer
2. Push Rod Seat
3. Plunger
4. Ball
5. Ball Retainer
6. Spring
7. Body

2. The plunger must be free in the lifter body. A simple test for this is to be sure the plunger will drop of its own weight in the body.
3. There must be no excessive leakdown and there must be no ball check valve leakage.

Removal

1. Remove rocker arm cover attaching nuts and remove cover and gasket.
2. Disconnect spark plug wires and disconnect high tension wire from coil.
3. Remove push rod cover attaching screws and remove cover and gasket.
4. Disconnect rocker arm oil line.
5. Remove bolts and nuts which retain valve rocker arm assembly to cylinder head and remove rocker arm assembly.
6. Remove the twelve push rods and twelve valve lifters.

NOTE: Valve lifters and push rods should be placed in a rack in their proper sequence so they can be reinstalled in their same positions in the cylinder block.

Disassembly and Assembly

1. Hold plunger down with a push rod and using a small screwdriver or pointed awl, remove plunger retainer.
2. Remove push rod seat, plunger, ball check valve, ball retainer and spring. Figure 10 shows layout of parts.
3. Thoroughly clean all parts in cleaning solvent, then inspect them carefully. If any parts are damaged, the entire lifter assembly should be replaced.
4. To reassemble, invert the plunger and set the ball into hole in plunger and place the ball check valve retainer over the ball and on the plunger.
5. Place check valve retainer spring over retainer.
6. Assemble valve lifter body over the complete assembly being careful to line up the feed holes in the lifter body and plunger.
7. Turn assembly over and fill with SAE 10 oil, then insert end of tool J-4274 through ball seat hole in bottom of plunger and press down solid, at which point holes in lifter body and plunger will be aligned.
8. Insert pin which is part of J-4274 through both holes to hold plunger down against spring tension. Remove tool from top of lifter (fig. 11).
9. Fill assembly with SAE 10 oil, install push rod seat and spring retainer.
10. Press down on push rod seat and remove pin. The hydraulic lifter is now completely assembled, loaded with oil and ready for installation in the engine.

Installation

1. Install valve lifters in cylinder block.
2. Install push rods and valve rocker arm assembly, connect rocker arm and shaft oil line, and install push rod cover and gasket.
3. Replace high tension wire to coil and connect spark plug wires.

Adjustment

Any time the rocker arm assemblies or valve lifters are removed from the engine it is neces-

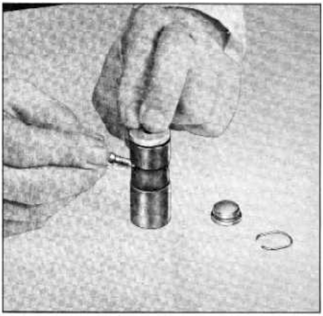

Fig. 11—Valve Lifter Assembly Tool

sary to make an initial adjustment for each valve lifter. This adjustment must be made when the lifter is on the base circle of the cam according to the following procedure.

1. Remove distributor cap, then crank engine until distributor rotor points to number one (1) cylinder position with the breaker points open. In this position the piston in number one cylinder is at top center on compression stroke with both lifters on the base circle of the cam and both valves can then be adjusted.
2. Turn adjusting screw down until all lash is removed from lifter to valve. This can be determined by checking push rod side play at adjusting screw end while turning the adjusting screw. At the point where no side play of push rod can be felt, continue turning adjusting screw down 1½ turns and tighten lock nut securely. This places the lifter plunger in center of its travel and no further adjustment is required.
3. Crank engine until the distributor is pointing to number five (5) cylinder position. Then adjust both valves for number five (5) cylinder in the manner described above.
4. The other valves may be adjusted by setting the engine with the distributor as described above. It should be noted that we are following the firing order of the engine which is 1, 5, 3, 6, 2, 4; therefore, both intake and exhaust valves for each cylinder should be adjusted in this order.

CYLINDER HEAD AND VALVE CONDITIONING

The condition of the cylinder head and valve mechanism, more than anything else, determines the power, performance and economy of a valve-in-head engine. Extreme care should be exercised when conditioning the cylinder head and valves to maintain correct valve stem to guide clearance, correctly ground valves, valve seats of correct width and correct valve adjustment.

Removal and Disassembly

1. Drain radiator, raise hood, loosen air cleaner clamp and remove air cleaner. Disconnect throttle and choke wires from carburetor if engine is so equipped.
2. Remove cotter pin at lower end of throttle rod and disconnect rod from bell crank and disconnect throttle return spring.
3. Disconnect gas and vacuum lines from carburetor.
4. Remove gas and vacuum line retaining clip from water outlet.
5. Remove capscrews and clamps that attach manifold assembly to cylinder head and pull manifold assembly off the manifold studs. Remove intake manifold pilot sleeves.
6. Disconnect radiator hose from water outlet, remove outlet to cylinder head bolts and remove outlet and thermostat. Remove battery ground strap to cylinder head bolt.
7. Remove rocker arm cover attaching nuts and remove cover and gasket.
8. Disconnect wires and remove all spark plugs.
9. Remove high tension wire from coil, remove coil attaching screws and lay coil down out of the way.
10. Remove push rod cover attaching screws and remove cover and gasket.
11. On 1949-52 engines, disconnect rocker arm oil line from rocker arm connector.
12. Remove temperature indicator element from cylinder head.
13. Remove four bolts and two nuts which retain rocker arm assembly to cylinder head and remove rocker arm assembly.
14. Remove twelve push rods and twelve valve lifters.

NOTE: Valve lifters and push rods should be placed in a rack in their proper sequence so they may be reinstalled in the same positions in the cylinder block at assembly.

15. Remove the cylinder head bolts, cylinder head and gasket.
16. Place cylinder head assembly on its side on a bench then, using Valve Lifter tool KMO-642, compress valve spring and remove valve lock, seal, spring cup and spring. Repeat this operation on each valve (fig. 12).

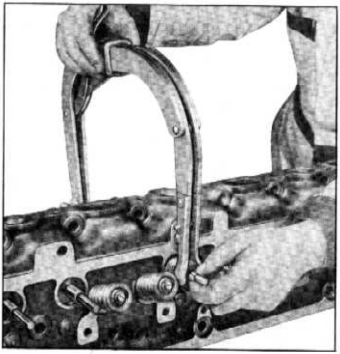

Fig. 12—Valve Lifter Tool

17. Remove valves from cylinder head and keep them in their proper sequence for inspection and assembly.

Cleaning

1. Clean all carbon from combustion chambers and valve ports using carbon removing brush KMO-7004.
2. Thoroughly clean the valve guides, using valve guide cleaner KMO-122.
3. Clean all carbon from push rods and valve lifters, disassemble, clean and reassemble hydraulic valve lifters on models where used.
4. Clean valve stems and heads on a buffing wheel.
5. Clean carbon deposits from pistons and cylinders.
6. Wash all parts in cleaning solvent and dry them thoroughly.

Inspection

1. Inspect the cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks to the water chamber.
2. Inspect the valves for burned heads, cracked faces or damaged stems.
3. Check fit of valve stems in their respective guides.

   NOTE: Excessive valve to guide clearance will cause lack of power, rough idling and noisy valves. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engine smoothness of operation. Intake valve stem to guide clearance should be .001" to .003" while exhaust stem clearance should be .002" to .004". By trying new valves in the old guides it can be determined whether the valves or guides or both should be replaced.

4. Check valve spring tension with KMO-607 spring tester (fig. 13).

   NOTE: Spring should be compressed to 1½" at which height it should check from 120 to 140 pounds on all engines except the Powerglide engine which should be 155 to 165 pounds. Weak springs affect power and economy and should be replaced if not within the above limits.

5. Check valve lifters for free fit in block. The end that contacts the camshaft should be smooth. If this surface is worn or rough the lifter should be replaced.
6. Check push rods for bent condition.

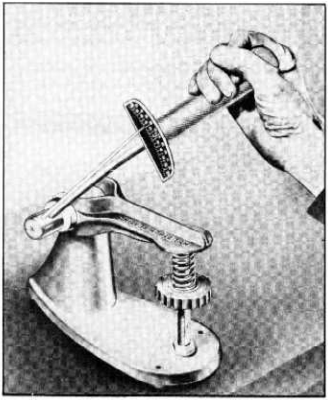

Fig. 13—Checking Valve Spring Tension

REPAIRS

Replace Valve Guides

1. Place the cylinder head on the table of an arbor press and press the old valve guides out using remover J-267 (fig. 14).
2. Press new precision exhaust (short) guides into the cylinder head using replacer J-1090.
3. Press new precision intake (long) guides into the cylinder head using replacer J-1089.

   NOTE: Replacer tools J-1089 and J-1090 have stop collars for proper positioning of the guides.

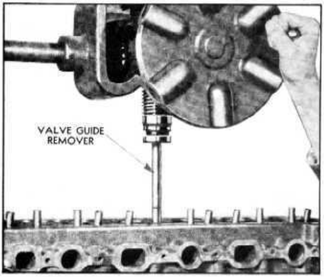

Fig. 14—Removing Valve Guides

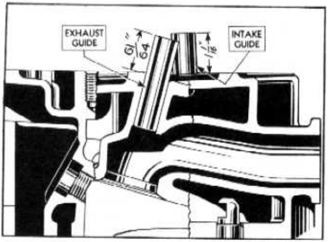

Fig. 15—Valve Guides (216 Engine)

4. The exhaust guides are installed in the head so they will extend $^{61}/_{64}''$ above the head and the intake guides extend $1^{1}/_{16}''$ above the head (fig. 15).
5. Finish ream all guides with a .343″ hand reamer.

Replace Valve Guides—1950-53 Models with 235 Engine

Removal of valve guides from the head of the 235 engine may be accomplished in the same manner as for the 216 engine. In replacement of guides, however, positioning dimensions differ because of the increased height of the 235 engine head and the increased length of both the inlet and exhaust valves. Replacer tools J-1089 and J-1090 may still be used but final positioning must be $^{55}/_{64}''$ for the exhaust valve guides and 1″ for the intake valve guides.

Reseating Valve Seats

Reconditioning the valve seats is very important, because the seating of the valves must be perfect for the engine to deliver the power and performance built into it.

Another important factor is the cooling of the valve heads. Good contact between each valve and its seat in the head is imperative to insure that the heat in the valve head will be properly carried away.

Several different types of equipment are available for reseating valve seats; the recommendations of the manufacturer of the equipment being used should be carefully followed to attain proper results.

Valve reseater set KMO-105-B and J-4387 contains all necessary valve seat reconditioning equipment necessary for proper renewing of valve seats. Regardless of what type of equipment is used, however, it is essential that valve guides are free from carbon or dirt to insure proper centering of pilot in the guide.

1. Install proper expanding pilot in the valve guide and expand pilot by tightening nut.
2. Place roughing or forming cutter over pilot and just clean up the valve seat. Use a 31° cutter for both intake and exhaust on all 1949 engines; all 1950-53 engines take a 31° cutter for intake and a 46° cutter for exhaust valve seats.
3. Remove roughing or forming cutter from pilot, install finishing cutter on pilot and cut just enough metal from the seat to provide a smooth finish.
4. Narrow down the valve seats to the proper width of $^{3}/_{64}''$ to $^{1}/_{16}''$ for the intake and $^{1}/_{16}''$ to $^{3}/_{32}''$ for the exhaust.

NOTE: This operation is done by machining both port and top of valve seat.

5. A form cutter must be used to thin down the intake seats from the top. This cutter also machines the edge of the valve recess in the head smoothing this passage for the free flow of incoming gases.
6. Remove expanding pilot and clean head carefully to remove all chips from above operations.

NOTE: Valve seats should be concentric to within .002″ total indicator reading (fig. 16).

Refacing Valves

Valves that are pitted can be refaced to the proper angle, insuring correct relation between the head and stem on a valve refacing machine. Valve stems which show excessive wear, or valves

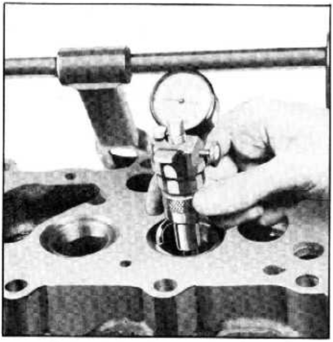

Fig. 16—Checking Valve Seats for Concentricity

that are warped excessively should be replaced. When a valve head which is warped excessively is refaced,a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less than 1/32" thick after grinding, replace the valve.

1. If necessary, dress the valve refacing machine grinding wheel to make sure it is smooth and true. Set the chuck at the 30° mark for grinding 30° valve seats for both intake and exhaust valves of 1949 models and intake valves only of 1950-53 models. Set chuck at 45° mark for grinding 45° seats on exhaust valves of all 1950-53 models (fig. 17).
2. Clamp the valve stem in the chuck of the machine.
3. Start the grinder and move the valve head out in line with the grinder wheel by moving the lever to the left.
4. Turn the feed screw until the valve head just contacts wheel. Move valve back and forth across the wheel and regulate the feed screw to provide light valve contact.
5. Continue grinding until the valve face is true and smooth all around valve. If this makes the valve head thin the valve must be replaced as the valve will overheat and burn.
6. Remove valve from chuck and place stem in "V" block. Feed valve squarely against grinding wheel to grind any pit from rocker arm end of stem.

NOTE: Only the extreme end of the valve stem is hardened to resist wear. Do not grind end of stem excessively.

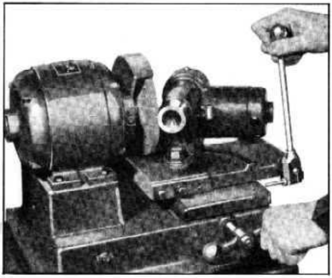

Fig. 17—Valve Refacing Machine

7. Make pencil marks about 1/4" apart across the valve face, place the valve in cylinder head and give the valve 1/2 turn in each direction while exerting firm pressure on face of valve.
8. Remove valve and check face carefully. If all pencil marks have not been removed at the point of contact with the valve seat, it will be necessary to repeat the refacing operation and again recheck for proper seating.
9. Grind and check the remaining valves in the same manner.

Rocker Arms and Shafts

Sludge and gum formation in the rocker arm shafts and rocker arms will restrict the normal flow of oil to the rocker arms and valves. Each time the rocker arm and shaft assemblies are removed they should be disassembled and thoroughly cleaned.

1. Remove the support bolts, hairpin locks, springs, rocker arms and supports.
2. Clean all sludge or gum formation from the inside and outside of the shafts and from valve rocker shaft tube.
3. Clean oil holes and passages in the shafts and rocker arms.
4. Clean the rocker arm shaft oil connector assembly.
5. Inspect the shafts for wear. Check the fit of rocker arms on the shafts and check the valve end of rocker arms for excessive wear. Replace all worn parts.
6. There are three each of four different type rocker arms used—right and left hand exhaust and right and left hand intake. They must be installed on the shafts in correct position. For identification each type rocker arm carries a different number stamped on the side (fig. 18).

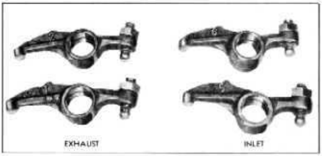

Fig. 18—Valve Rocker Arm Identification

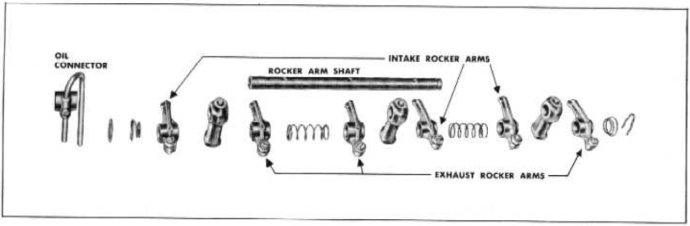

Fig. 19—Layout Rocker Arm and Shaft Parts

7. The proper location of the rocker arms according to number are as follows:

216 ENGINE—1949-52 MODELS

No. on Rocker Arm	Type Rocker Arm	For Cylinder No.	Part Number
1	L.H. Exhaust	1-3-5 Exhaust	839459
2	R.H. Exhaust	2-4-6 Exhaust	839460
5	L.H. Intake	2-4-6 Intake	839463
6	R.H. Intake	1-3-5 Intake	839464

235 ENGINE—1950-53 MODELS

No. on Rocker Arm	Type Rocker Arm	For Cylinder No.	Part Number
9	L.H. Exhaust	1-3-5 Exhaust	3835547
0	R.H. Exhaust	2-4-6 Exhaust	3835548
3	L.H. Intake	2-4-6 Intake	3835551
4	R.H. Intake	1-3-5 Intake	3835552

8. One end of each rocker arm shaft is plugged; the open end of each shaft must be toward the center.

9. Install the rocker arms, springs, supports, support bolts and locks in their correct position by referring to the above chart and Figure 19.

CYLINDER HEAD Assembly

1. Clean valves, valve seats, valve guides and cylinder head thoroughly.

2. Starting with No. 1 cylinder, place the exhaust valve in the port and place the valve spring and cap in position. Then using valve KMO-642, compress the spring and install the oil seal and valve keys (fig. 20). See that the seal is flat and not twisted in the valve stem groove and that the keys seat properly in the valve stem groove.

NOTE: Place valve springs in position with the closed coil end toward the cylinder head.

3. Assemble the remaining valves, valve springs, spring caps, oil seals and valve keys in the cylinder head using tool, KMO-642.

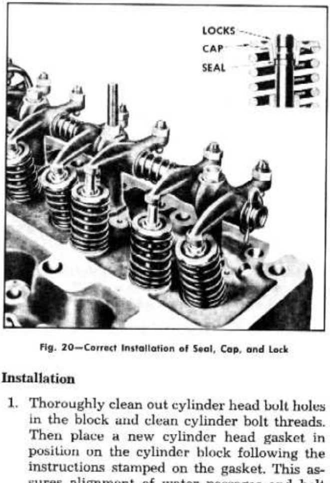

Fig. 20—Correct Installation of Seal, Cap, and Lock

Installation

1. Thoroughly clean out cylinder head bolt holes in the block and clean cylinder bolt threads. Then place a new cylinder head gasket in position on the cylinder block following the instructions stamped on the gasket. This assures alignment of water passages and bolt holes in the block and head with openings in the gasket.

2. Place two cylinder head guide pins through the gasket and screw them into the cylinder block front and rear holes on the manifold side to hold the gasket in position and guide the cylinder head into place.

3. Place the cylinder head in position over the

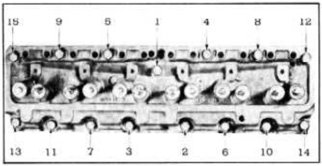

Fig. 21—Cylinder Head Bolt Tightening Diagram (1949-52)

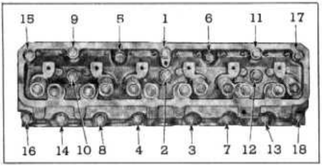

Fig. 22—Cylinder Head Bolt Tightening Diagram (1953)

guide pins. On 1949-52 models pilot the rocker arm feed pipe up through hole in head and lower the head into position.

4. Oil threads of cylinder head bolts and install bolts finger tight. Remove guide pins and install two remaining bolts.
5. Tighten the cylinder head bolts a little at a time in the order shown (fig. 21-22). The final tightening should be 70-80 foot pounds on 216 engines and 90-95 foot pounds on 235 engines.
6. Install 12 valve lifters in right side of block and drop the 12 valve push rods down through the openings in the cylinder head and seat them in the lifters.
7. Install and tighten two rocker arm shaft studs in the cylinder head.
8. Place the oil connector over open ends of the two rocker shaft assemblies and place this assembly on the cylinder head so that the studs will enter the center support on each shaft. On 1953 engines, align oil connector tube with supply passage in cylinder head.
9. Install bolts and stud nuts which retain rocker arm assembly to cylinder head and tighten evenly to 25-30 foot pounds torque.
10. On 1949-52 engines connect rocker arm oil line to oil connector and tighten securely. Figure 23 shows rocker arm and shaft assemblies correctly installed on head.
11. Install temperature indicator fitting and tighten securely.
12. Install thermostat and thermostat housing using new gaskets and connect radiator hose. Install battery ground strap.
13. Install push rod cover using a new gasket. On 216 engines make sure the cork seals are properly positioned around the spark plug openings. Place coil in position and install attaching screws. Tighten push rod cover screws to 6-7½ ft. lbs. and coil bolts to 5-8 ft. lbs. torque.
14. Clean all spark plugs with abrasive type cleaner, inspect for damage and set gap at .035" using a round feeler gauge.
15. Place new gaskets on plugs and install. Tighten to 20-25 foot pounds tension. If torque wrench is not available, tighten finger tight and ½ turn more using new gaskets.

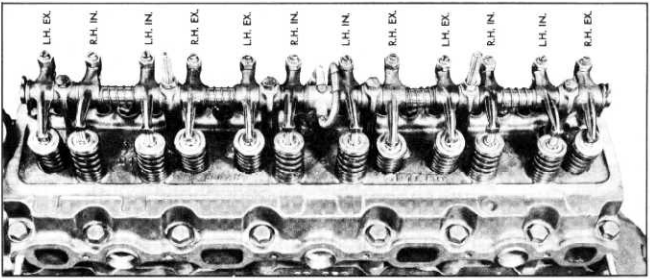

Fig. 23—Valve Rocker Arms Correctly Assembled

16. Connect spark plug wires to their respective terminals and the high tension wire to the coil.
17. Clean gasket flanges on cylinder head and manifold, install new gaskets, intake manifold pilot sleeves and install the four capscrews with clamps loosely to hold the gaskets in place. Position the manifold and slide it into place over the studs and pilot sleeves making sure that it seats against the gaskets.
18. Install capscrews and nuts, turn the clamps into position against the manifold and tighten clamp bolts to 15-20 foot pounds tension and on 1949-52 engines tighten stud nuts to 25-30 foot pounds tension.
19. Connect throttle and choke wires on models so equipped, connect lower end of throttle rod and install a new cotter pin. Replace throttle return spring.
20. Connect gas and vacuum lines to carburetor.
21. Attach gas and vacuum line retaining clip to water outlet.
22. Fill cooling system and check for water leaks.
23. Clean air cleaner and install.
24. On all models not equipped with hydraulic lifters roughly set all valve clearances to make sure that all valves have clearance. Normalize engine and adjust valves as instructed under "Valve Adjustment" in this section.
25. On 1950-53 models having hydraulic lifters adjust lifters as outlined under "Hydraulic Valve Lifter–Adjustment."

ENGINE MOUNTINGS

1949-51 Models

The engine is rubber mounted in three places. The front engine mount is through the engine front mounting plate and rubber insulator mounts to the frame front cross member. Two side support cushions are used to dampen the torque reaction of the engine at low car speeds. These cushions are located at the rear of the engine and are mounted between brackets bolted to the clutch housing and brackets riveted to the frame side rails. The side rail brackets are serrated on the support mounting face and the side mounts are also serrated. The frame brackets have an elongated bolt hole for up and down adjustment.

To complete the engine mounting a one piece vulcanized rubber cushion assembly is bolted directly to the transmission and cross member and all fore and aft movement of the engine is taken up in this assembly which provides positive control of engine movement.

Mounting bracket bolts at clutch housing and at transmission and cross member should be inspected at regular intervals to be sure that they are tight.

The front supports should be kept clean and free of oil to prevent deterioration of rubber portion of support. Engine oil leaks, if any, should be eliminated prior to installation of a new support.

Engine Front Mounts–Replace

1. Remove engine front mounting plate to engine front mount bolts.
2. Remove front cross member to engine front mount bolts.
3. Raise front end of engine sufficiently to slide front mounts from between front cross member and engine front mounting plate.
4. Make sure front support mounting surfaces are clean and free of oil and install new front mounts. Install front cross member to engine front mount lockwashers and bolts, and tighten securely.
5. Lower engine onto front mounts, install mounting plate and mount lockwashers and bolts, and tighten securely.

Engine Side Supports–Replace

1. Remove nuts and lockwashers from bolts which attach side supports to clutch housing brackets and to frame side member brackets.
2. Remove bolts and remove side supports.
3. Place new side support in position and install bolt through clutch housing bracket and support. Install lockwasher and nut and tighten securely.
4. Install bolt through frame bracket and support, install lockwasher and nut and tighten securely.

NOTE: Frame bracket face is serrated and bolt hole is elongated. Support should be installed with serrated face toward frame bracket. Serrations and elongated bolt hole allow for proper positioning of support without shimming.

Transmission Support–Replace

1. Bend tangs of lock plate away from bolt heads and remove bolts attaching support to transmission and to transmission support cross member.
2. Raise rear of engine sufficiently to slide rear support from between transmission and cross member.
3. Bolt new support assembly to transmission

support cross member using new bolt lock plate.

4. Lower engine and transmission assembly on to transmission support.
5. Bolt transmission support assembly to transmission using new bolt lock plate.

NOTE: Two transmission attaching bolt holes are slotted to provide alignment between transmission and the support.

6. Bend tangs of lock plate against heads of bolts to lock.

1952-53 Models

The engine mounting used on all 1952-53 models is a three-point system with two front mountings and one rear mounting. The rear mounting is located at the extreme rear of the transmission. The front mountings are located high alongside the engine, one on each side, instead of low and at the extreme front of the engine as on 1949-51 models. For this reason, they are described as high side front engine mountings. In effect, the engine is suspended from the mountings instead of resting on top of them. This is a more stable condition since the engine weight below the mountings opposes displacement of the engine from its normal attitude.

The front mountings and the rear mounting are located on a plane through the principal axis of the engine. Thus the mountings are closer to the center of rotation of the mass of the engine, so that they have less engine vibrational movement to absorb.

The engine front mountings are several inches rearward of the locations of the 1949-51 front mountings, and the rear mounting also is farther back than before. These mounting locations have resulted in a redistribution of the weights supported by the mountings so that the front mountings carry more weight than before and the rear mounting carries less. The reduction in load on the rear mounting is particularly advantageous in Powerglide models, providing a marked increase in the life of the mounting.

Each front mounting consists of a bracket attached to the engine, with another bracket bolted to the frame, the two brackets being connected by a vertical bolt through two rubber biscuits. The two biscuits are positioned one above the other, with the top flange of the frame bracket passing between them. This construction provides both compression and rebound control, with improved lateral control. Both rubber biscuits are held in compression. The amount of compression preloading is determined accurately by a tubular spacer around the bolt. The bolt is pulled up tight against the spacer, compressing the two biscuits a predetermined amount. In addition, the rubber parts are always loaded in compression regardless of the direction of the load on the mounting which greatly increases the life of the rubber parts. The biscuits are molded of a special rubber compound having excellent damping characteristics, and the bolt hole in each of the rubber biscuits is enlarged to permit the desired amount of lateral freedom.

Since the front mountings act as torque reaction dampers, the dampers used on 1949-51 models which are located on each side of the clutch housing are eliminated.

In the 1952-53 rear mounting which is located directly on the engine support cross member the rubber member, reinforced internally with steel, is compressed within a sheet metal case that is bolted to the cross member. Two bolts pass up through the rubber mounting into bosses provided on each side of the transmission rear bearing support. Thus, regardless of the type of movement the mounting absorbs, the rubber takes the load in compression, which increases its durability.

Front Mounting Replacement—1952-53 Models

In the event of mounting rubber biscuit replacement, they should be replaced in pairs.

1. Remove side mount through bolts.
2. With a jack raise front of engine approximately ½ inch or until rubber biscuits are free.
3. Remove rubber biscuits from each side.
4. Install new rubber biscuits and carefully lower engine until full weight rests on biscuits.
5. Install right biscuit through bolt, raising and aligning engine as necessary; then install left side through bolt. Tighten both through bolt nuts to 25-35 ft. lb. torque and install cotter pin.

Rear Mounting Replacement

1. Remove rear mount through bolts.
2. Remove four bolts attaching transmission support to engine support cross member.
3. Raise rear of engine sufficiently to slide rear engine mounts from between transmission and cross member.
4. Align new rear engine mounting on engine support cross member and install four bolts.
5. Install two through bolts to transmission rear bearing support and torque all bolts to 25-35 ft. lb.

Engine Mounting Adjustment

In all cases of engine replacement or removal or in the event the side mounts are being replaced, the following adjustment procedure should be followed:

1. Assemble mounting with through bolts loose to engine crankcase and tighten side mount to crankcase bolts securely.
2. Using same number of shims between mounting and right side rail or if shims were loose use one shim part number 3701154 and install side mount to frame side rail bolts, lockwashers and nuts and tighten securely.
3. Install, if removed, transmission support to cross member bolts and tighten securely.
4. On right side, make sure bolt is free and does not bind, then, tighten mounting through bolt nut to 25-35 ft. lb. torque and install cotter pin.
5. Allow engine weight to rest on side mount rubber biscuits, remove nut and steel washer from left through bolt and check to make sure there is lateral clearance around bolt. Shim between frame rail and support arm as necessary to get this clearance.
6. If bolt has lateral clearance, replace steel washer and nut, tighten to 25-35 ft. lb. torque and install cotter pin.

OIL PUMP

Oil pump (fig. 24) consists of two gears and a pressure relief valve enclosed in a two-piece housing and driven from the distributor drive shaft which in turn is driven by a helix gear on the camshaft. Pump inlet is fitted with a fine mesh screen to prevent entry of small particles of sludge, etc., into the oil lines.

Fig. 24—Layout of Oil Pump Parts

1. Oil Pump Body
2. Drive Gear and Shaft
3. Idler Gear
4. Cover Gasket
5. Cover

Inasmuch as the oil pump is serviced on an exchange basis no repair operations other than disassembly and inspection operations are covered in this manual.

Removal and Disassembly

1. Remove bolts and lockwashers attaching steering idler and third arm and bracket assembly to frame front cross member and let assembly drop down.

   NOTE: Carefully note number of shims used between upper mounting bolt and cross member, so that same number may be installed when replacing assembly.

2. Drain oil and remove flywheel housing underpan, flywheel underpan extension and oil pan.
3. Disconnect oil pump to block oil line at the block and disconnect oil line from pump to screen at pump.
4. Remove oil pump retaining sleeve lock screw and remove oil pump and pump to block oil line.
5. Remove oil line from pump and remove pump cover attaching screws, cover, gasket, idler gear and drive gear and shaft.
6. Remove oil pump inlet screen.
7. Wash all parts in cleaning solvent and dry by using compressed air, if available.

Inspection

Should any of the following conditions be found during inspection operations it is advisable to replace pump assembly.

1. Inspect pump body for cracks or excessive wear.
2. Inspect oil pump gears for excessive wear or damage.
3. Check shaft for looseness in the housing.
4. Check inside of cover for wear that would permit oil to leak past the ends of gear.

Assembly

1. Place drive gear and shaft in pump body.
2. Install idler gear so that chamfered end of gear will be away from the cover.
3. Install a new GENUINE Chevrolet gasket to assure correct end clearance of the gears.
4. Install cover and attaching screws. Tighten

screws securely and check to see that shaft turns freely.

5. Install oil line to pump body loosely.
6. Place oil pump in block fitting aligning oil lines and making sure drive slot aligns properly with tang on distributor shaft, and install oil pump retaining sleeve lock screw and tighten it securely.

   NOTE: Make sure that tapered end of lock screw draws down into hole in oil pump body. Tighten lock nut securely.

7. Tighten oil pump to block oil line and pump to screen oil line connector nuts securely and replace oil pump screen.

   CAUTION: Make sure oil lines fit properly to eliminate possibility of shaft seizure when tightened.

8. Install oil pan using a new oil pan gasket. Tighten oil pan flange bolts to 6-7½ ft. lbs. and oil pan corner bolts to 12½ to 15 ft. lbs. torque and refill with oil. Install flywheel underpan extension and flywheel housing underpan.
9. Install steering idler and third arm and bracket assembly as outlined in Section 3.

PRESSURE STREAM AND SPLASH SYSTEM CONNECTING ROD BEARING LUBRICATION

All 1949-52 and 1953 Standard 235 Engines

Proper lubrication of the connecting rod bearings depends upon accurate adjustment of connecting rod dippers, depth of oil pan troughs and aiming nozzles in the oil pan.

The oil pans on both engine are the same; however, there is a difference in the length of the engine stroke. When checking oil pan troughs and dipper heights, use the gauges as listed below:

Tool No.	Engine Displacement	Model
J-969-2A	216.5 cubic inch	All 1949-52
J-1514	235.5 cubic inch	All 1950-52 1953 Standard

These gauges have "Go" and "No Go" limits for the dipper height incorporated in them.

Checking Dipper Height

1. With oil pan removed, turn crankshaft until connecting rod is at bottom dead center.
2. With the oil pan gasket removed, place the two side pins of the gauge on the pan rail adjacent to the connecting rod dipper being checked.
3. Slide the gauge over the dipper being checked (fig. 25). If the dipper is properly adjusted, the low (or "Go") step of the gauge will pass over the dipper, but the high (or "No Go") step will not pass over it.

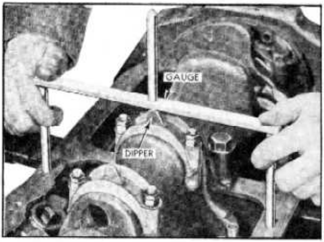

Fig. 25—Checking Connecting Rod Dipper Height

4. If the low (or "Go") step of the gauge will not pass over the dipper it may be lowered by a light tap with a hammer.
5. If the high (or "No Go") step passes over the dipper, a new dipper should be installed.

Each connecting rod dipper should be checked in this manner.

Checking Oil Pan Troughs

1. With the oil pan gasket removed, place the gauge on the side rails with the center pin extending into the oil pan.

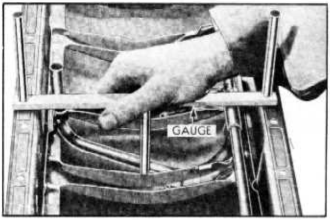

Fig. 26—Checking Oil Trough Depth

2. Slide the gauge so that the pin passes over the edge of the trough at its center (fig. 26).
3. Check clearance between end of pin on gauge and edge of oil trough. This should not exceed .015" if the trough is in proper adjustment.
4. If the gauge does not pass over the trough, it

may be corrected by carefully grinding the edge of the trough.

5. If there is more than .015" clearance between end of gauge and edge of oil trough, check for loose spot welds where trough is welded to the oil pan. A loose trough should either be rewelded or the oil pan replaced.

Checking Oil Pan Nozzles

1. Install oil pan target gauge J-969-1 on the oil pan with the target plate on the side of the pan opposite the oil nozzles; locate the dowels of the gauge in the screw holes in the oil pan rail.
2. Insert water nozzle J-793-3 in the main oil pipe.
3. Tip the oil pan about 45 degrees to prevent the water from covering the ends of the nozzles.
4. Open the water nozzle just enough to straighten the water streams at the ends of the nozzles. If the oil nozzles are properly adjusted, the water stream will pass through the centers of the target holes. Correct and incorrect aiming of the nozzles is shown in Figure 27.

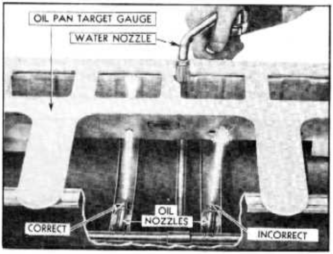

Fig. 27—Checking Aim of Oil Nozzles

5. The aiming of the oil nozzles may be adjusted by using the oil nozzle wrench J-793-5 (fig. 28). Continue adjusting and checking the oil nozzles until each water stream passes through the center of its target hole.

MAIN BEARINGS—ADJUST

In making shim adjustments to take up excessive clearances, all shims may be removed if necessary to obtain the proper running clearances, providing there is no excessive fatigue, distress, abrasion, erosion, nicks or damage

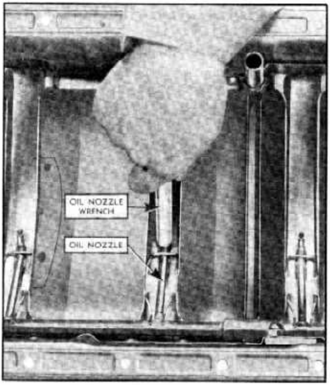

Fig. 28—Adjusting Aim of Oil Nozzles

from handling, excessive scratches, etc., in the bearings or crankshaft journals.

In general, the lower half of the bearing shows a greater wear and the most distress from fatigue. If upon inspection the lower half is suitable for use, it can safely be assumed that the upper half is also satisfactory. If the lower half is fatigue cracked to the point of near failure, both upper and lower halves should be replaced. Never should one-half be replaced without replacing the other half.

If the running clearance of a bearing is still too great with all of the shims removed, it will be necessary to install both upper and lower bearing halves. Should this become necessary the crankshaft journal should be checked with a micrometer for out-of-round, taper or undersize. Experience has shown that clearance increase from wear in main bearings is not only due to bearing wear, but is also due in part to crankshaft journal wear.

If the journal exceeds .001" out-of-round or taper, the crankshaft should be replaced or reconditioned to an undersize figure that will enable the installation of undersize precision type bearings.

AMMETER METHOD

Adjustment of main bearings with the engine in the vehicle, is extremely difficult due to the mechanic's inability to find adequate means of turning the engine over by hand so as to get a definite feel of bearing drag during adjustment.

In view of this fact and also in an effort to eliminate the human element involved in this type of adjustment, the following method of main bearing adjustment is recommended to eliminate all of these factors and at the same time provide a quick and accurate method of adjustment.

This procedure, using an ammeter, is accurate and eliminates all the human element factor and will provide for an accurate and uniform adjustment of all bearings at all times.

In preparing a unit for adjustment by this method it is imperative that the battery be in good condition and each cell should show a minimum hydrometer reading of 1.260. Hydrometer readings below this figure will permit discrepancies of ammeter readings.

After determining that battery gravity reading is within proper working limit (minimum 1.260) proceed with the bearing adjustment as follows:

1. Remove spark plugs and disconnect positive cable from battery. Drain oil from oil pan and remove pan.
2. With control handle on Battery Capacity Tester in the "Off" position, connect positive ammeter lead to the positive terminal of battery and negative ammeter lead to the positive battery cable previously disconnected from battery terminal.

   CAUTION: Wrap negative ammeter lead and positive battery cable where connected together to prevent shorting.

3. Attach remote control switch to starter and then turn control handle of Battery Capacity Tester to starter position and check stabilized cranking load. Record this reading as it will be the base for the bearing adjustment (fig. 29).

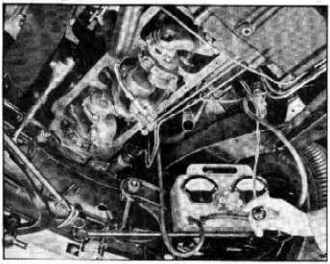

Fig. 29—Main Bearing Adjustment—Ammeter

4. Remove bearing cap and remove one shim from bearing, replace cap and torque bolts to 100-110 ft. lb. and then recheck cranking load. If cranking load is the same as the initial check, remove another shim and recheck. When cranking load increases replace one .002" shim to bring cranking load back down to original reading.
5. Repeat this procedure on remaining bearings. When using the above procedure it is not necessary to loosen the bearing cap bolts after the bearing has been adjusted before proceeding with the adjustment of the next bearing; this saves time in the complete main bearing adjustment.

   NOTE: It must be remembered that the base amperage demand (load) must be established for the engine being worked on, because there will be differences in engines, starting motors and batteries which will affect the initial base reading of the ammeter. However, once the base reading has been established the procedure for adjustment is the same; namely, remove shims until the ammeter reading increases, then replace one .002" shim.

By following the foregoing procedure the serviceman can be sure the main bearings will be properly adjusted—neither too tight or too loose.

OIL SEAL—REAR BEARING CAP—REPLACE

Sealing at the crankshaft rear bearing is made very effective due to machining the rear bearing cap and cylinder block to receive a wick type seal (fig. 30).

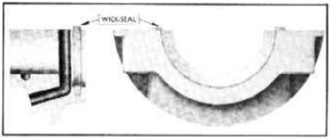

Fig. 30—Rear Main Bearing Oil Seal

To install a new wick seal in the rear main bearing cap proceed as outlined below.

1. Remove rear bearing cap.
2. Remove old seal from groove and make sure groove is clean.
3. Insert new seal in groove with the fingers.
4. Using a rounded tool, roll the seal into the groove.

   NOTE: When rolling the seal start at one end and roll it to the center of the

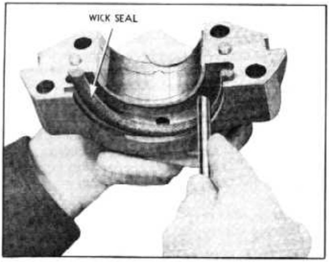

Fig. 31—Rolling Rear Bearing Cap Oil Seal Into Groove

groove. Then starting from the other end, again roll toward the center (fig. 31).

5. Cut the small portion of the seal that protrudes from the groove flush with the surface of the bearing cap.

   NOTE: To prevent possibility of pulling seal out of groove a round block of wood the same diameter as the crankshaft flange may be used to hold packing firmly in place while the ends are being cut off.

6. If it should be necessary to replace the upper half of the seal it will be necessary to remove the engine from the chassis and remove the crankshaft as outlined under "Major Service Operations" in this section.
7. Replace cap and adjust bearing.

HARMONIC BALANCER AND TIMING GEAR COVER

Removal

1. Drain radiator and disconnect upper and lower radiator hoses.
2. Remove radiator core to radiator core support bolts and remove radiator core. Lay horns back out of the way.
3. Remove bumper face bar.
4. Disconnect parking lamps at junction block.
5. Remove screws retaining lower catch plate assembly to upper grille bar and grille support and remove catch plate.
6. Remove front fender to grille screws and front fender to bumper filler panel screws.
7. Remove front fender skirt to bumper filler panel screws.
8. Remove air duct baffle to bumper filler panel screws.
9. Remove radiator grille and filler panel baffle as an assembly.
10. Remove fan belt.
11. Remove engine front mounting bolts or side mount bolts.
12. Place jack under front of engine and raise engine approximately ½ inch.

    NOTE: This is necessary to allow harmonic balancer puller head to clear the radiator support cross member.

13. Install harmonic balancer puller J-1287 to harmonic balancer and turn puller screw to remove balancer and pulley assembly (fig. 32).

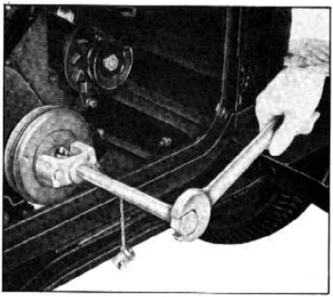

Fig. 32—Removing Harmonic Balancer

14. Lower engine to normal position.
15. Remove bolts attaching steering idler and third arm and bracket assembly to frame cross member and drop down.

    NOTE: Carefully note number of shims used between bracket and cross member to facilitate reassembly.

16. Drain oil from oil pan and remove pan.
17. Remove timing gear cover attaching screws and two bolts that are installed from the back through the front main bearing cap and remove cover and gasket.

REPAIRS

Timing Gear Cover Oil Seal—Replace

1. Pry old seal out of cover from the front with a large screwdriver.

2. Install new seal so that open end of the leather is toward the inside of cover and drive it into position with oil seal driver J-995 (fig. 33).

Installation

1. Make certain that cover mounting face and cylinder block front end plate face are clean.
2. Install timing gear cover centering gauge J-966 over end of crankshaft.

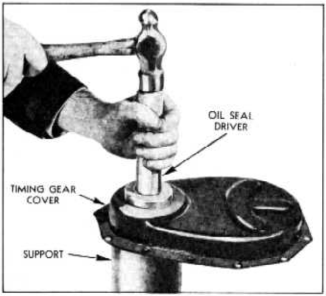

Fig. 33—Installing Timing Gear Cover Oil Seal

3. Coat the leather oil seal with light grease and using a new cover gasket install cover and gasket over centering gauge (fig. 34).

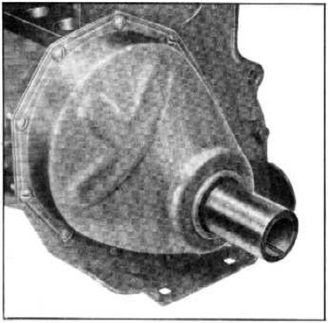

Fig. 34—Timing Gear Cover Installation

4. Install cover screws and two bolts through bearing cap and tighten to 6-7½ foot pounds torque. Remove centering gauge.

   NOTE: It is important that the centering gauge be used to align the timing gear cover so that the harmonic balancer installation will not damage the seal and to provide uniform seal tension on the hub of the balancer.

5. Install new oil pan gaskets and end corks. Carefully place the oil pan in position and tighten pan bolts securely.

   NOTE: Tighten oil pan corner bolts to 12½-15 foot pounds. Tighten flange bolts to 6-7½ foot pounds.

6. Install steering idler and third arm and bracket assembly as outlined in Section 3.
7. Raise engine approximately ½ inch.
8. Remove puller screw from harmonic balancer.
9. Place driver adapter of puller J-1287 in starting crank jaws of balancer. Install puller body to balancer and tighten attaching screws securely.
10. Position balancer on crankshaft so that keyway aligns with key in crankshaft and drive balancer onto shaft until it bottoms against crankshaft gear using puller screw as a driver.
11. Remove puller screw and remove puller body attaching bolts and puller body from balancer.
12. On 1949-51 models, lower engine, aligning front mounting bolts with bolt holes in frame cross member, install bolts and tighten securely.

    On all 1952-53 models, carefully lower engine on side mounts, install bolts making sure bolts have lateral clearance in upper mounting bracket hole. Install flat steel washer and nut. Tighten nut securely and install cotter pin.
13. With the wide fan belt used prior to 1953, replace and adjust to give ¾" deflection midway between pulleys. The narrow belt used on 1953 models should be adjusted to give 7/16"-½" deflection at this point (fig. 35).
14. Replace radiator core, horns, attaching bolts and tighten securely.
15. Replace upper and lower radiator hoses and refill cooling system.
16. Install radiator grille and bumper filler panel baffle. Install all screws and tighten securely.
17. Connect parking lamps and replace lower catch plate but do not tighten catch plate screws.

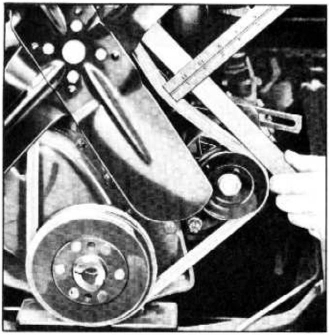

Fig. 35— Fan Belt Adjustment

18. Lower hood and align lower catch plate with hood lock bolt. Raise hood and tighten catch plate screws securely.
19. Replace bumper face bar.

CRANKCASE VENTILATION

Positive crankcase ventilating units may be used on all 1949-1953 models. Installation of this unit will serve:

1. To prevent entrance of dust or dirt into the crankcase on vehicles that are operated in dusty areas. Dust and dirt in the crankcase and oiling system will result in rapid wear of main and connecting rod bearings, piston rings, cylinder walls and other moving parts.

   NOTE: An oil bath air cleaner should also be used in dusty areas.

2. To provide adequately controlled crankcase ventilation on vehicles used continuously in slow speed, door to door delivery and similar type operations by effectively removing harmful vapors which contaminate the oil, also to prevent corrosion and sludge formation in the crankcase.

   NOTE: A 181° temperature thermostat should be used during cold weather operations as a further aid in preventing oil contamination sludge and corrosion. Permanent anti-freeze must be used when this thermostat is installed.

Operation

Positive crankcase ventilation is accomplished by utilizing the vacuum created in the intake manifold and the system features controlled circulation of clean air through the crankcase and valve chamber at all engine speeds and loads. Clean air is drawn into the engine from the carburetor air cleaner through a ventilation valve which regulates the amount of ventilation to meet changing operating conditions. To assure proper operation of positive crankcase ventilation system it is important that the crankcase oil level be correctly maintained and not over filled.

When the positive crankcase ventilation system is installed on a Chevrolet engine an extra quantity of air is permitted to enter the intake manifold below the carburetor. This may in some instances result in a leaner air-fuel ratio in the engine than is desirable.

On 1949 models equipped with Carter carburetors it is recommended that the one step rich metering rod be installed, to enrich the mixture.

On 1950-53 models equipped with either GM Model "B" or "BC" Carburetor, no change in carburetion should be made unless definite evidence of lean mixture is experienced. If this condition is experienced, one step rich main metering jet may be used in the carburetor.

Maintenance

The positive crankcase ventilation system will operate effectively as long as normal maintenance is applied. Due to the nature of the materials carried by the ventilating system, the valve and pipe are subject to fouling with sludge and carbon formation.

At regular intervals of 10,000 miles or less, depending on operating conditions, the metering valve, the pipe running from the valve to the intake manifold and manifold fitting should be removed from the engine, disassembled and cleaned thoroughly.

NOTE: Under cold weather operating conditions, when vehicles are operated at slow speeds with low engine temperatures, more rapid accumulations of harmful fumes may be present in the engine. Under these conditions of operation the valve and tube must be cleaned more frequently than specified above. However, no specific mileage recommendation can be made under these conditions. Frequency of cleaning must be dictated by experience.

Disassemble the valve (fig. 36) and clean the valve parts with any good solvent cleaner and blow dry with compressed air. The jiggle pin, which floats in the center orifice of the valve, may be snapped out of position by pressing on the end of the pin so that the center orifice of the valve

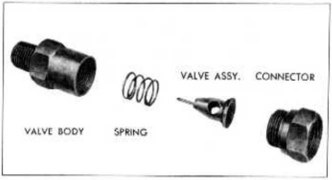

Fig. 36—Positive Crankcase Ventilation Valve

may be cleaned. The pin may then be snapped back into position.

When reassembling the valve parts, be sure to attach the spring on the valve by pushing the end coil over the tapered end of the valve, over the ridge and into the groove machined just under the head of the valve. This is very important. Unless the spring is properly assembled, the valve will not contact the valve seat squarely and will not close properly, consequently, the engine will not idle properly due to the entrance of too much air into the intake manifold. If the spring has been stretched the same trouble may occur.

If improper action of the spring is suspected due to spring being distorted, bent or etched from corrosive action, the valve assembly should be replaced. Clean the steel ventilator connection tube and intake manifold connector with solvent and blow dry with compressed air.

Remove oil filler tube and inspect for sludge accumulation, if necessary burn clean, make sure all holes in baffle inside of oil filler tube are open. Inspect oil filler cap and gasket for sealing, if necessary replace gasket as ventilating system efficiency depends on a sealed cap at this point.

Inspect for and correct any air leaks at valve rocker cover gasket, valve side cover gasket and ventilator connecting tube and fitting to prevent entrance of air.

ENGINE TUNE-UP

One of the most important duties to perform on modern high compression engines is proper engine tune-up. This operation more than any other determines whether or not the vehicle will produce the maximum amount of economy. Only by performing these operations and staying within limits, clearances and specifications is it possible to obtain the performance and economy built into the Chevrolet engine.

Compression

Before making any checks on an engine it should be run for several minutes and allowed to warm up. Lubricate the valve mechanism. The compression of each cylinder should be checked first because AN ENGINE WITH UNEVEN COMPRESSION CANNOT BE TUNED SUCCESSFULLY.

1. Turn the ignition off and pull the hand throttle control out to open position or block the throttle in an open position.
2. Remove all spark plugs from engine.
3. Insert compression gauge in a spark plug hole and hold it tightly in position. Crank the engine with the starting motor until gauge reaches its highest reading, which requires only a few turns of the engine.
4. Repeat this test on all cylinders and make a note of the compression reading on each cylinder.
5. Compression on all cylinders should be 110 pounds or better on all 1949-52 engines and 130 pounds or better with the engine hot on all 1953 engines. All cylinders should read alike within 5 to 10 pounds for satisfactory engine performance.

Should a low compression reading be obtained on two adjacent cylinders, it indicates the possibility of a leak from one cylinder to the other, usually caused by a leak at the cylinder head gasket.

If the compression readings are low, or vary widely, the cause of the trouble may be determined by injecting a liberal supply of engine oil on top of the pistons of the low reading cylinders.

Crank the engine over several times, and then take a second compression test. If there is practically no difference in the readings when compared with the first test, it indicates sticky or poorly seating valves. However, if the compression on the low reading cylinders is higher and about uniform with the other cylinders it indicates compression loss past the pistons and rings.

The cause of low or uneven compression must be corrected before proceeding with an engine tune-up job.

Spark Plugs

Clean the spark plugs thoroughly, using an abrasive type cleaner. If the porcelains are badly glazed or blistered, the spark plugs should be replaced. All spark plugs must be of the same make and number or heat range. 1949-52 engines are equipped with AC 46-5 spark plugs and 1953 engines use a "colder" spark plug, AC 44-5.

Adjust the spark plug gaps to .035" using a round feeler gauge.

CAUTION: In adjusting the spark plug gap never bend the center electrode which extends through the porcelain center.

Always make adjustment by bending the side electrode. Install the spark plugs in the engine using new gaskets whenever necessary and tighten to 20 to 25 foot pounds tension. If torque wrench is not available, tighten finger tight and ½ turn more using new gaskets.

Plugs are of 14-millimeter size and care must be exercised when installing or the setting of the gap may be upset.

Battery Test

Connect the positive terminal of a voltmeter to the starting switch terminal and the negative terminal of the voltmeter to a good ground.

Close the starting motor switch and crank the engine for 15 seconds. If the starting motor cranks the engine at a good rate of speed during this period with the voltmeter reading 5 volts or better, it indicates a satisfactory starting circuit, which includes the condition of the battery terminals and cables. However, if the cranking speed is slow, or the voltmeter reading is under 5 volts, the starting motor, battery and battery terminals should be checked individually to locate the source of the trouble.

Ignition Distributor

1. Remove the spark plug wires from the distributor cap and examine the terminals for corrosion. The wires should be checked for damaged insulation and oil soaked condition.
2. Remove the distributor cap. Check the cap and distributor rotor for cracks or burned or pitted contacts.
3. Check the distributor automatic advance mechanism by turning the distributor cam in a clockwise direction as far as possible, then release the cam and see if the springs return it to its retarded position. If the cam does not return readily, the distributor must be disassembled and the cause of the trouble corrected. See Section 12 for "Distributor Repair."
4. Examine the distributor points. Dirty points should be cleaned, and pitted or worn points should be replaced. Check the points for alignment and align them if necessary.
5. Crank the engine until the distributor point cam follower rests on the peak of the cam. Adjust the point gap (fig. 37) using a feeler gauge. This operation must be performed very accurately because it affects the point dwell or length of time the points remain closed in operation and, in turn, ignition coil performance.

   NOTE: The standard point setting on 1949-52 distributors, is .018" When new points are installed, adjust points to .022" because the cam follower will wear down slightly while seating to the cam. The standard point setting on 1953 engines is .019" for new points and .015" for used points.

6. Crank the engine until the cam follower is located between the cams. Hook the end of a distributor point scale over the movable point and pull steadily on the spring scale until the points just start to open. At this point the reading on the scale should be between 17 and 21 ounces for 1949-52 distributors and 19 to 23 ounces for 1953 distributors.

Fig. 37—Adjusting Distributor Points

7. Check to see that the vacuum spark control operates freely by turning the distributor body counterclockwise and see that the spring returns it to the retarded position. Any stiffness in the operation of the vacuum spark control will affect the ignition timing.
8. Install the rotor and distributor cap to the distributor body and spark plug wires to cap. Make sure that the terminal of the primary wire at the ignition coil and distributor are clean and tight.

Coil and Condenser

The ignition coil and condenser should be checked following the instructions given by the manufacturer of the test equipment being used.

Ignition Timing

1. Set the octane selector at "0" on the scale (fig. 38) and attach a Neon Timing Light to the No. 1 spark plug and a good ground. Start the engine and run it at idling speed with light aimed at flywheel housing opening.
2. Loosen distributor clamp and rotate distributor body clockwise or counterclockwise until the steel ball in the flywheel lines up with the pointer on the flywheel housing.
3. Tighten distributor clamp screw and remove timing light.

NOTE: 1953 engine ignition timing is 2° after top center and 1949-52 engines are timed 5° before top center.

Fuel Pump

1. Remove pump filter bowl and screen and wash them thoroughly in cleaning solvent.

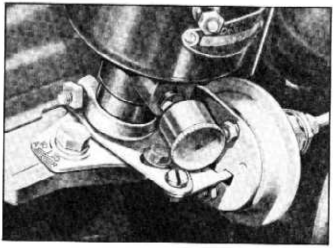

Fig. 38—Octane Selector

2. Reassemble bowl and screen making sure that the cork gasket is in good condition and properly seated.
3. Tighten all fuel pump connections.

Air Cleaner

1. Remove cover wing nut, cover and filter element.
2. Wash filter element thoroughly in cleaning solvent.
3. Let element dry and dip in clean engine oil and allow excess oil to drain.
4. Install element and cover and secure with wing nut.

NOTE: If oil bath air cleaner is used, see instructions under "Fuel Section."

Positive Crankcase Ventilation

On those models that are equipped with positive crankcase ventilation, perform maintenance operations as outlined under "Positive Crankcase Ventilation—Maintenance."

Carburetor

1. Remove carburetor from engine, disassemble, inspect and reassemble as outlined in "Fuel Section."
2. Reassemble carburetor and air cleaner to the engine. Tighten carburetor stud nuts to 10-15 ft. lb. torque.

Manifold Heat Valve

1. Unhook the thermostat spring from its anchor pin and check the adjustment.
2. Proper adjustment and hook up requires only ½ turn of the spring from its unhooked position to slip it over the anchor pin.

NOTE: Should this spring be distorted in any way it should be replaced.

3. Check valve shaft to make sure it is free in the manifold. If shaft is sticking, free it up with kerosene containing a small amount of baking soda.

Valve Adjustment

All Engines Except Powerglide

1. Start the engine and while it is warming up, tighten cylinder head bolts, rocker shaft support bolts and nuts and the manifold bolts and nuts.

NOTE: Cylinder head bolts should be tightened to 70-80 foot pounds on 216 engines and 90-95 foot pounds on 235 engines and rocker shaft support bolts to 25-30 foot pounds.

2. Normalize the engine and adjust the valves according to procedure in this section under "Valve Adjustment."

Idling Adjustment (Carter Carburetor)

1949 Models

1. Warm up engine to normal operating temperature.
2. Attach vacuum gauge to intake manifold fitting.
3. Set idling speed to approximately 450-500 RPM by adjusting stop screw on carburetor throttle lever.

4. Turn idling screw gradually to right or left to give highest reading on vacuum gauge. This reading should range between 17 and 21 inches.
5. If engine idles too fast after this adjustment, readjust throttle stop screw until correct idling speed is obtained.

Idle Mixture Adjustment (Rochester Carburetor) 1950-53 Models

1. Screw idle adjusting screw all the way in.

   CAUTION: ***To prevent scoring or grooving the needle on the adjusting screw, do not turn it in too tight.***

2. Back off the idle adjusting screw 1½ to 2½ turns.
3. Allow engine to idle.
4. Turn screw either way from this position until best idle point is reached.

Idle Speed Adjustment

1. Make sure that the accelerator and throttle linkage is free so that throttle stop screw is against the stop.
2. Turn screw in or out to obtain an idling speed of 450 to 500 revolutions per minute for the 216 and 1953 standard 235 engines and 425 to 450 revolutions per minute for the Powerglide engine with the transmission in drive range.
3. Recheck idle mixture adjustment so that the idle speed adjustments, in combination with each other, produce a smooth idle at the required RPM's.

Cooling System

1. Tighten all cooling system hose connections and check for indications of leakage.
2. Check fan belt for proper tension and adjust if necessary. See "Cooling System" for Fan Belt Adjustment.

   NOTE: With correct adjustment, a light pressure on the belt at a point midway between the pulleys should cause ¾" maximum deflection with the wide belt used prior to 1953 and a ½" maximum deflection with the narrow belt used on 1953 models.

Current and Voltage Regulator

Check the adjustment of the current and voltage regulator as outlined in Section 12 of this manual.

Road Test

After completion of the above operations, the vehicle should be road tested for performance. During this test the octane selector should be adjusted for the grade of gasoline being used. For peak performance and maximum gasoline economy, the octane selector should be set so the engine will produce a slight "ping" on acceleration to wide open throttle.

MAJOR SERVICE OPERATIONS

ENGINE

Removal

1. Drain radiator and cylinder block and remove hose connections.
2. Drain oil pan and transmission. Where Powerglide transmission is used, also drain sump.
3. Disconnect hood springs and hinges and remove hood.
4. Disconnect battery ground strap from cylinder head, disconnect live battery cable from battery and remove battery.
5. Remove the radiator core from the radiator core support.
6. Disconnect wiring harness from right junction block and pull harness through header bar.
7. Remove radiator core support and header bar.
8. Remove battery cable and ammeter wire from large terminal on solenoid and starter wire from small terminal and disconnect wire to coil.
9. Disconnect gasoline line from fuel pump.
10. Remove the generator and field wires from the generator.
11. Remove air cleaner and disconnect choke and throttle control cables from carburetor on 1949 models and choke cable on 1950-52 models except 1952-53 models with automatic choke carburetor.
12. Disconnect line to oil pressure gauge and remove temperature element from the cylinder head.
13. Disconnect windshield wiper vacuum line, and on 1950-53 models using Powerglide, remove transmission vacuum line.
14. Remove exhaust pipe from manifold.
15. Disconnect accelerator pedal from accelerator rod, and remove bell crank from under side of the toe kick pan on 1953 models.

16. On all models having 3-speed transmission, disconnect transmission control rods from shifter levers at transmission side cover. On models with Powerglide transmission, disconnect transmission control rod from transmission control rod bell crank.
17. Disconnect speedometer cable from transmission and on models with 3-speed transmission, disconnect clutch link to clutch pedal arm.
18. Remove clevis pin and separate split link on end of hand brake lever rod from bell crank. Then push hand brake lever rod into driver's compartment.
19. Disconnect parking brake rod from idler lever and drop idler lever, cables and spring.
20. Remove bolts from universal bell retainer and slide collar and ball back on propeller shaft housing.
21. Place jack under propeller shaft, and remove cap screws which fasten front trunnion bearings to the front yoke, remove bearings and split the joint and lower front end of propeller shaft.
22. Remove rocker arm cover, disconnect oil line from rocker arm connector, remove rocker arm attaching bolts and stud nuts and remove rocker arm, shaft assembly and push rods.
23. On models with 3-speed transmission, remove the fourth cylinder head bolt from the rear on the left side and the third bolt from the rear on the right side. On models with Powerglide transmission, remove the second cylinder head bolt from the rear on the left side and the fourth bolt from the rear on the right side. Then, using lift kit J-4536, install the proper lifting tool (fig. 39) and raise engine slightly.
24. On 1949-51 models, remove bolts attaching engine side support cushions, front engine mounting bolts and rear transmission support to frame cross member bolts.

    On 1952-53 models, loosen engine side mount through bolts, and remove side mount to frame bolts. Remove rear transmission support to frame cross member bolts.

    NOTE: Make a note of the number of shims used, if any, between mounting bracket and frame side member so that same number may be replaced when installing engine.

25. On 1950-53 models that are equipped with Powerglide transmission, clean dirt around filler tube and dip stick and transmission side cover and remove bolt which holds filler tube in position. Remove filler tube and dip stick.

    NOTE: Use masking tape or a rubber stopper to cover filler tube hole in side cover.

26. Raise the engine and transmission assembly from the chassis as a unit.
27. Remove crankcase ventilator pipe and on 1952-3 models, remove side mount to crankcase bolts and remove mounts.
28. Remove starting motor, generator and fan belt.

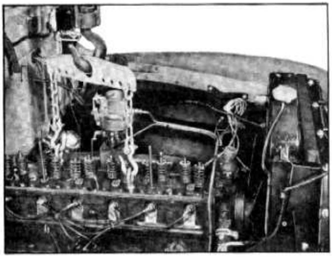

Fig. 39—Installation of Engine Lifting Attachment

Disassembly

1. Mount engine in an engine stand and clamp it securely so that the engine can be turned over when necessary and remove the lifting attachment.
2. On all 1949-52 models equipped with a 3-speed transmission, proceed as follows:
    a. Remove flywheel underpan extension and bolts attaching transmission to clutch housing. Remove transmission.

    NOTE: Support the transmission as the last mounting bolt is removed and as it is being pulled away from the engine to prevent damage to clutch disc.

    b. Remove clutch release link from clutch fork.
    c. Remove throwout bearing from clutch fork and remove fork by forcing it away from ball mounting with a large screwdriver.
    d. Install clutch pilot K-411 to support clutch during disassembly. Loosen clutch to flywheel bolts a turn at a time (to prevent distortion of clutch cover) until the diaphragm spring pressure is released. Remove all bolts, pilot tool, cover assembly and disc.
    e. Remove the flywheel and clutch housing.

3. On all 1950-53 models equipped with a Powerglide transmission, proceed as follows:
   a. Remove two upper transmission to converter housing bolts, install lift sling J-4262 and attach chain hoist to lift sling.
   b. Remove spark plugs and wires, and remove flywheel cover and flywheel underpan extension.
   c. Using tool J-4281 to turn engine over, remove six flywheel to converter bolts working through bolt access hole on left side of flywheel housing adjacent to cylinder block drain cock.

   NOTE: Do not remove converter cover bolts which extend through holes in flywheel.

   d. Remove converter housing to flywheel housing bolts and separate transmission assembly from engine. On 1953 Powerglide transmissions install converter assembly holding tool J-5384.
4. Remove spark plug wires and spark plugs from those models where 3-speed transmission is used.
5. Remove coil and octane selector retaining screw and disconnect vacuum line from vacuum spark control. Lift the distributor up out of engine.
6. Disconnect gas line from fuel pump, remove fuel pump mounting bolts and fuel pump.
7. Disconnect fuel and vacuum lines from clip at water outlet and from carburetor and remove lines.
8. Remove push rod cover and oil gauge rod.
9. Remove two bolts attaching water outlet to thermostat housing and remove water outlet and thermostat. On Powerglide models remove oil cooler and oil cooler lines.
10. Remove two bolts attaching thermostat housing to cylinder head and remove housing.
11. Remove water pump retaining bolts and remove generator brace and pump.
12. Attach harmonic balancer puller J-1287 to balancer and turn puller screw to remove balancer and pulley assembly (fig. 40).
13. Disconnect throttle rod from carburetor and accelerator control lever and remove throttle rod.
14. Remove accelerator control lever stud and accelerator control lever from cylinder block.
15. Remove carburetor attaching nuts and carburetor.
16. Remove nuts and/or capscrews attaching manifold to cylinder head and remove manifold assembly and gaskets.

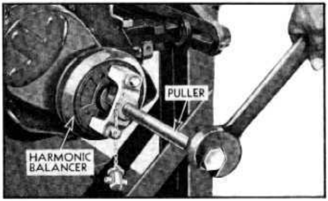

Fig. 40—Harmonic Balancer Puller and Driver

17. On 1949-52 models and 1953 standard 235 engines, remove screws attaching oil distributor to block and remove cover, gasket, plate with valve and gasket.
18. On 1950-53 models with 235 cubic inch engine, disconnect rocker arm shaft oil line at cylinder block and remove oil line.
19. Remove valve lifters.
20. Remove the cylinder head attaching bolts, cylinder head and gasket.
21. Using valve lifter KMO-642, compress the valve springs and remove valve keys, spring caps, oil seals, springs and valves.
22. Turn the block assembly over in the engine stand and remove oil pan attaching screws, oil pan and gasket.
23. Remove the timing gear cover attaching screws and the two bolts that are installed from the back through the front main bearing cap and remove cover and gasket.
24. Pull the crankshaft gear with gear puller T126-R by attaching it to the gear and turning the puller handle (fig. 41).
25. Remove the two camshaft thrust plate screws by working through the two holes in the camshaft gear.
26. Remove the camshaft and gear assembly by pulling it out through the front of the block

    NOTE: Support shaft carefully when removing so as not to damage camshaft bearings.

27. Remove the engine front mounting plate attaching screws and remove plate and gasket.
28. Disconnect oil pump to block and oil pump to screen oil lines from pump and block fitting and remove oil line.
29. Remove oil pump retaining screw and remove oil pump.
30. Remove oil screen and body assembly.
31. Remove oil pump cover attaching screws,

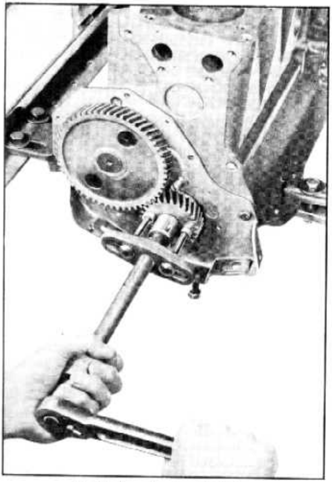

Fig. 41—Removing Crankshaft Gear

cover, gasket, idler gear and drive gear and shaft.

32. Check the connecting rods and pistons for cylinder number identification and, if necessary, mark them.

33. Remove connecting rod pal nuts, nuts, oil dippers (on those models so equipped) and rod caps. Push the rods away from the crankshaft and install caps and nuts loosely to their respective rods.

34. Push piston and rod assemblies away from crankshaft and out of the cylinders. If piston rings strike ridge at top of cylinder, remove ridge to prevent damaging piston ring lands.

NOTE: It will be necessary to turn the crankshaft slightly to disconnect some of the rods and to push them out of the cylinder.

35. Remove piston rings by expanding them and sliding them off the ends of the pistons.

NOTE: 1953 Powerglide engines are equipped with oil ring expanders.

36. Clamp the piston in a piston vise J-1218 (fig. 42), remove the connecting rod to piston pin clamp bolt and push the piston pin out (all pistons).

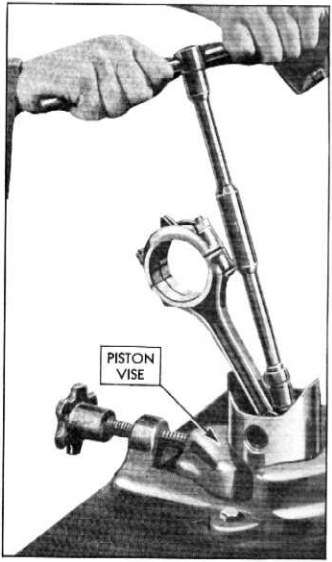

Fig. 42—Piston in Piston Vise

37. Remove main bearing cap bolts and remove the bearing caps and shims.

38. Lift the crankshaft out of the block and place it where it will not get damaged.

39. Lift bearing shells from block.

Cleaning and Inspection

1. Wash all parts thoroughly in cleaning solvent.

2. Remove main oil gallery plugs located one at left front and one at left rear face of cylinder block on all 1949-52 models with a 216 cubic inch engine. All 1950-53 Powerglide models with a 235 cubic inch engine have, in addition to this main gallery, another oil gallery on the right side of the engine for distribution

of oil to the hydraulic valve lifter. Remove all four plugs on these models. These oil passages should be thoroughly cleaned either by using compressed air or a wire brush. Plugs may easily be removed with a sharp punch or they may be drilled and pried out.

3. Clean all oil passages in the cylinder block by blowing them out with compressed air. It is good practice to blow them out separately. This can be done by plugging the holes in three of the bearings and placing the nozzle of the air gun in the oil inlet of the cylinder bearing oil passages. Continue this until all passages are clean. Blow through the passages to the camshaft bearings and passage to valve lifter oil gallery on Powerglide engines.
4. Blow out the rocker arm shaft oil line. Blow out the pipes in the oil pan.
5. Clean carbon from piston heads, ring grooves and inside of piston head. Clean carbon from cylinder head combustion chambers and valve ports with carbon removing brush KMO-7004. Clean valve guides with valve guide cleaner KMO-122. Clean valve stems and heads on a buffing wheel.
6. Check the cylinder block for cracks in the cylinder walls, water jacket and main bearing webs.
7. Check the cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator (fig. 43). Set the gauge so that the thrust pin must be forced in about ¼" to enter gauge in cylinder bore. Center gauge in cylinder and turn dial to "0". Carefully work gauge up and down cylinder to determine taper and turn it to different points around cylinder wall to determine the out-of-round condition.

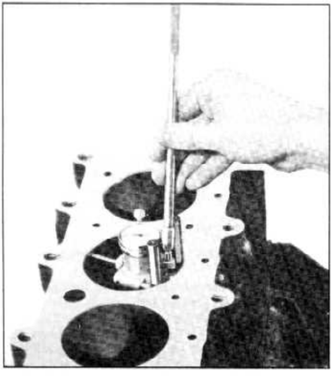

Fig. 43—Checking Cylinder Bore with Dial Gauge

8. Set the indicator to the standard cylinder size using a pair of micrometers. Then, by checking the cylinders, the oversize pistons required and the amount necessary to be removed from the cylinders can be determined.
9. Inspect the main bearings for wear or damage that would make replacement necessary.
10. Inspect camshaft bearings for wear or damage that would make replacement necessary.

NOTE: Camshaft bearings should not be removed from the case unless new bearings are to be installed.

11. Inspect the camshaft for damaged cams or bearing journals. If the journals are out-of-round more than .001" the shaft should be replaced. Check the fit of the camshaft in the bearings.
12. Inspect the crankshaft journals and crank pins for roughness and scores. Check them with a micrometer for out-of-round or taper. If out-of-round more than .001" or tapered, the shaft should be replaced or reconditioned.
13. Inspect the connecting rod bearings for damage that would make replacement necessary.
14. Determine whether or not pistons are to be replaced. New piston assemblies and rings are required when the cylinders are to be honed or rebored. If the pistons are to be used again, check the piston pin fit.
15. Inspect the timing gears for excessive tooth wear and for loose hub in camshaft gear. Inspect the camshaft thrust plate for excessive wear.
16. Check the cylinder head for being warped, for having clogged water passages, cracked valve seats or worn valve guides.
17. Inspect the manifolds for excessive carbon in the ports. Check the operation of the heat control valve and make sure that the gasket between the manifolds is in good condition.
18. Inspect the oil pump gears for wear, check the shaft for looseness in the housing and the inside of cover for wear that would permit oil to leak past end of gears.
19. Instructions for inspection and repair of the fuel pump, carburetor, air cleaner, generator, starting motor, distributor, clutch and water pump will be found in their respective sections of this manual.

REPAIRS

Some of the following repair operations may not be required on all engine overhauls, depending upon the result of the inspections made. In making some of the repairs, certain engine assembling operations must be performed; therefore, the assembling operations will start with the engine partly assembled as covered under repair operations.

Cylinder Conditioning

If the cylinder block inspection indicated that the block was suitable for continued use except for out-of-round or tapered cylinders, they can be conditioned by honing or boring and honing.

High limit standard size pistons are available for service use so that proper clearances can be obtained for slightly worn cylinder bores and blocks requiring only light honing to clean up the bores. The 1953 Powerglide engine has four standard size pistons available for service under two part numbers. These aluminum pistons are selected by weight and size and are unitized in groups of six for service usage. Cast iron pistons used on 1949-52, 216 engines and 1950-53, 235 standard engines are serviced in .010", .020", 030" and .040" oversizes. Aluminum piston for 1953 Powerglide engines are serviced in .020", .030" and .040" oversizes. If the cylinders were found to have less than .005" taper or wear they can be conditioned with a hone and fitted with the high limit standard size pistons. If more than .005" taper or wear they should be bored and honed to the smallest oversize that will permit complete resurfacing of all cylinders. The use of a dial gauge set up with a pair of micrometers to the standard cylinder bore size as outlined under "Cleaning and Inspection," will aid in determining the size pistons for which the cylinders must be bored.

Cylinder Boring

1. Before using any type boring bar, the top of the cylinder block should be filed off to remove any dirt or burrs. This is very important, otherwise the boring bar may be tilted which would result in the rebored cylinder wall not being at right angles to the crankshaft.
2. In Chevrolet engines, the piston to be fitted should be checked with a micrometer, measuring just below the lower ring groove and at right angles to the piston pin. The cylinder should be bored to the same diameter as the piston.
3. If a micrometer is not available to measure the piston, the cylinder should be bored .002" less than the overize piston to be fitted. For example, when fitting a .020" oversize piston, the cylinder should be bored .018" oversize.
4. The instructions furnished by the manufacturer of the equipment being used should be very carefully followed.

Cylinder Honing and Piston Fitting

1. When the cylinders are to be honed only for high limit standard size pistons or for final finishing after they have been rebored to within .002" of the desired size, they should be finish honed and polished with a hone similar to the one shown in Figure 44. This is an expanding type hone with the blades or stones expanding when the nut on top of the hone is turned. Rough stones may be used at first and fine stones for the polishing operation.

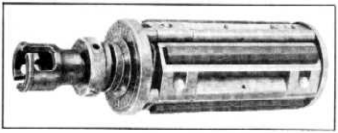

Fig. 44—Cylinder Hone

2. Place the hone into a cylinder bore and expand the stones until the hone can just be turned by hand. Connect a ¾" electric drill to the hone and drive hone at drill speed while slowly moving hone up and down entire length of cylinder until hone begins to run free. During this operation a liberal amount of kerosene should be used as a cutting fluid to keep the stones of the hone clean.
3. Expand the stones out against the cylinder bore and repeat the honing operation until the desired bore diameter is obtained.
4. Occasionally during the honing operation the cylinder bore should be thoroughly cleaned and the piston selected for the individual cylinder checked for correct fit.
5. On 1949-52 engines and 1953 standard engines correct piston fit is determined by placing a long, ½" wide feeler along the side of the piston 90° around the piston from the piston pin (fig. 45) and inserting the piston and feeler into the cylinder bore. The piston should push through the cylinder with light pressure when a .002" feeler is used and should lock with a .003" feeler.

   On 1953 Powerglide engines check fit of the aluminum pistons in the following manner:

   a. Invert the piston, skirt end up, and place

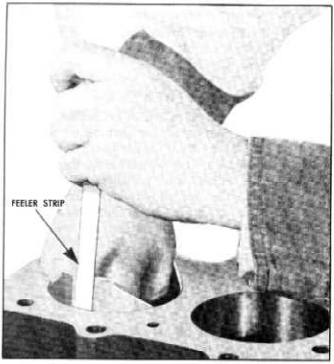

Fig. 45—Fitting Cast Iron Pistons

a .0015" by ½" wide feeler ribbon, part of piston fitting gauge and scale tool, J-5513 on the side of the piston 90° from the piston pin holes.

b. Insert the feeler ribbon and inverted piston into the cyinder bore so that the center of the piston pin is flush with the top surface of the cylinder block. Keep the feeler ribbon straight up and down and keep the piston pin parallel with the crankshaft axis.

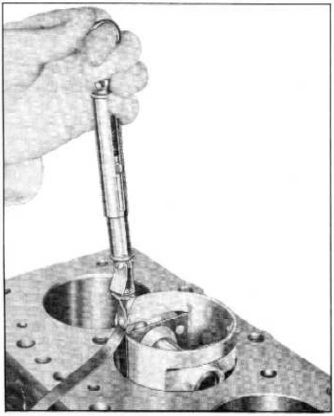

Fig. 46—Fitting Aluminum Pistons

c. Pull the feeler gauge straight up and out, noting at the same time the scale reading which should be between 7 and 18 pounds (fig. 46).

d. If the scale reading is greater than the maximum allowable pull, try another piston or lightly hone the cylinder bore to obtain the proper fit.

e. Should the scale reading be less than the minimum allowable pull, try another piston, or if standard size, try a standard high limit piston. If proper fit cannot be obtained, it will be necessary to rebore the cylinder to the next oversized piston.

f. Mark each piston after fitting to correspond with the cylinder to which it has been fitted. This will assure proper installation.

6. Permanently mark the piston for the cylinder to which it has been fitted and proceed to hone cylinders and fit the remaining pistons.

CAUTION: *Handle the pistons with care and do not attempt to force them through the cylinder until the cylinder has been bored to correct size as this type piston can be distorted through careless handling.*

7. Clean the cylinder bores and block to remove all cuttings.

Piston Pin Fitting

All new Chevrolet pistons are serviced with properly fitted piston pins and bushings; therefore, pin fitting is unnecessary when new pistons are installed. Where cylinder condition and piston fit justify the use of old pistons, it may be desirable to install new piston pins which are available for 1949-52 engines and the 1953 standard engine in .0015", .003", .005" and .010" oversizes. New piston pins are available for 1953 Powerglide engines in .0015", .003" and .005" oversizes. Correct alignment of the bushing bores is essential; therefore, the following procedure should be carefully followed.

NOTE: 1953 Powerglide aluminum pistons are not equipped with piston pin bushings. The piston pin bore is reamed to size.

1. Place the piston pin bushing reaming fixture J-965 in a bench vise.
2. Adjust the expansion reamer for a light cut.
3. Insert the reamer in the piston bushings and start the reamer pilot into the guide in the fixture.
4. Hold the piston in the V-block of the fixture with one hand and turn the reamer handle with the other hand until the reamer has passed through both bushings (fig. 47).

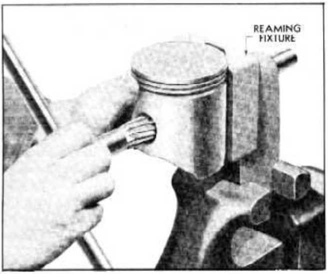

Fig. 47—Reaming Piston Pin Bushings

5. Expand the reamer by easy stages and repeat the reaming operation until the piston pin is fitted. The proper fit of the piston pin in a cast iron piston is a "thumb push" fit as shown in Figure 48.

Fig. 48—Fitting Piston Pin—Cast Iron Piston

Piston pins are fitted to aluminum pistons used in the 1953 Powerglide engine in the following manner:

1. Stabilize the temperature of the piston and piston pin by immersion in oil at 70° F.
2. Wipe the piston and pin dry, and lightly coat the pin with an oil film.
3. Place one end of the pin in either boss.
4. The fit must be such that the pin will hold its own weight in either boss and yet permit movement under thumb pressure in its final position.
5. If pin is too tight, lightly hone pin hole.
6. If pin is too loose, hone to next oversize pin. After fitting the first piston pin, the other bushings may be reamed quickly by reducing the diameter of the reamer approximately .0005" (half a thousandth) by backing off the expansion screw. This permits quick roughing out of all bushings leaving about half a thousandth for the finish cut.
7. It is good practice to check the diameter of all piston pins with a micrometer. In case there should be a slight variation in diameter, consideration must be taken when adjusting the reamer for the finish cut.
8. The purpose of the piston pin reaming fixture is to make sure that the piston pin bushings will be reamed at right angles to the skirt of the piston, assuring proper alignment of the piston in the cylinder.

CAMSHAFT

The camshaft bearing journal sizes are as follows: front, 2.0282"-2.0292"; front intermediate, 1.9657"-1.9667"; rear intermediate, 1.9032"-1.9042"; rear, 1.8407"-1.8417".

These dimensions should be checked with a micrometer for an out-of-round condition. If the journals exceed .001" out-of-round, the camshaft should be replaced.

The camshaft should also be checked for alignment. The best method is by use of "V" blocks and a dial indicator (fig. 49). The dial indicator will indicate the exact amount the camshaft is out of true. If it is out more than .002" dial indicator reading, the camshaft should be straight-

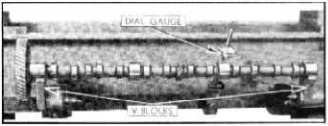

Fig. 49—Checking Camshaft Alignment

ened. When checking, the high reading of the dial indicator indicates the high point of the shaft. This point should be chalk marked to tell exactly where to apply pressure when straightening.

NOTE: During the straightening operation, care should be taken to protect the bearing journals and prevent damage of their surfaces.

After the camshaft has been straightened, it should be rechecked to be sure it is within .002" dial indicator reading for alignment.

BEARINGS

All four of the steel backed, babbitt lined camshaft bearings are pressed into the crankcase and staked in place to prevent rotation or endwise movement in the bores. The camshaft bearings are lubricated through holes that line up with oil passages leading from the main bearings.

Replacement of these bearings is seldom necessary; however, if the inspection previously made indicates that replacement is necessary the camshaft bearing removing and replacing tools shown in Figure 50 must be used. These tools are not considered essential as far as dealer operation is concerned and when this job is necessary they may be obtained from the Chevrolet Zone Offices.

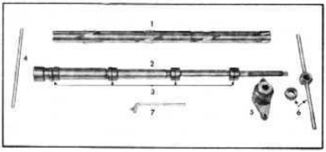

Fig. 50—Camshaft Bearing Removing and Replacing Tools

1. Reamer
2. Removing and Replacing Bar
3. Removing and Replacing Slee
4. Extension Handle
5. Bracket
6. Handle and Thrust Bearing
7. Staking Tool

Removal

1. With camshaft removed, drive out expansion plug from cylinder block at the rear of the rear camshaft bearing, by driving it out from the inside.
2. Assemble the camshaft bearing remover bracket loosely to the rear of the cylinder block.
3. Start the bearing puller bar through the front bearing and install the puller sleeve for each bearing over the bar before it passes through that particular bearing. Then pass the bar through the hole in the bracket. Tighten the bolts that hold the bracket to the cylinder block. Then install the thrust bearing and puller handle on the end of the bar.
4. Turning the puller handle clockwise will now remove all four bearings at one time. An extension handle is provided to aid in starting bearings that may have corroded in the block.

Replacement

1. To make sure that the oil holes in the camshaft bearing bores will line up with the oil holes in the camshaft bearings after the bearings have been installed, mark the position of the oil hole in the bore on the front face of each bearing bore.
2. Place puller sleeve and new front camshaft bearing over the puller bar and start the bar through the front bearing bore. Place the puller sleeve with a new bearing over the bar before passing the bar through the other bearing bores in the cylinder block. Pass the end of the bar through the puller bracket, install the thrust bearing and turning handle.
3. Line up the oil holes in each bearing with the oil hole location marks previously made. All four bearings can now be pulled into place at the same time.
4. Remove the puller bar and bracket and stake each bearing into the hole provided in the bore for that purpose.

Reaming

The special camshaft bearing line reamer has all four cutters mounted on one bar so that all bearings will be in perfect alignment after the reaming operation.

1. Pass the reamer through the first, second and third bearings. Turn the cylinder block to a vertical position so the reamer will feed through the bearings by its own weight. Then start the reamer cutter into all four bearings and turn the reamer slowly until the cutters have passed through the bearings. While the bearings are being reamed, a liberal amount of kerosene should be used to wash out all metal cuttings.
2. Remove the reamer by pulling it back through the bearings, at the same time turning the reamer slowly in the same direction as when reaming the bearings.
3. Blow all cuttings from the bearings with compressed air and wash cylinder block out thoroughly with cleaning solvent. Blow out all oil passages. Install the camshaft and check all bearing clearances with a narrow feeler gauge. The proper clearance is from .002" to .004". Install a new camshaft end

plug in the back end of the cylinder block at the rear camshaft bearing.

NOTE: Camshaft end plug must be assembled flush to 1/32" deep from clutch housing face of case.

OIL SEAL—REAR BEARING—UPPER

The upper half of the rear bearing cap oil seal, located in the cylinder block, can only be replaced with the crankshaft removed from the block.

See "Oil Seal—Rear Bearing Cap" under "Minor Service Operations" for replacing oil seal in bearing cap.

1. Remove old wick seal from groove in block and make sure groove is thoroughly cleaned.
2. Install new wick seal in groove with the fingers.
3. Use a rounded tool and roll the seal into the groove starting at one end and roll it to the center. Then starting from the other end again roll to the center.
4. Cut the small portion of the seal that protrudes from the groove off flush with surface of the bearing.

NOTE: A round block of wood the same diameter as the crankshaft flange should be used to hold the packing firmly in position in the groove while the ends are being cut off.

CRANKSHAFT

The crankshaft main bearing journal and connecting rod journal sizes are as follows: front, 2.6835"-2.6845"; front intermediate, 2.7145"-2.7155"; rear intermediate, 2.7455"-2.7465"; rear, 2.7765"-2.7775"; connecting rod journal, 2.311"-2.312"

These dimensions should be checked with a micrometer for out-of-round taper or undersize. If the journals exceed .001" out-of-round or taper the crankshaft should be replaced or reconditioned to an undersize figure that will enable the installation of undersize precision type bearings.

The crankshaft should also be checked for runout. To perform this operation, support the crankshaft at the front and rear main bearing journals in "V" blocks and indicate the runout of both the rear intermediate and front intermediate journals, using a dial indicator. The runout limit of each of these journals is .002". If the runout exceeds .002" the crankshaft must be straightened.

MAIN BEARINGS

Precision type main bearings used as service replacement are of high quality with close tolerances of fit and will not require line reaming on installations. The close dimensional tolerances assure an equalized bearing surface at all points on the crankshaft when replaced in sets.

Bearings are available in standard sizes and undersizes of .002", .010", .020" and .030".

1. Remove old bearing shells if not already removed from cylinder block and caps.
2. Install the new bearing shells in the cylinder block and caps.

NOTE: Main bearing shells with oil holes are the upper halves of the bearing shells and are inserted between the crankshaft and cylinder block.

3. Lubricate all four bearings and carefully place the crankshaft in the bearings.
4. Check the end play by forcing the crankshaft to its extreme rear position, check at the rear side of the rear intermediate bearing with a feeler gauge (fig. 51). This clearance should be from .003" to .009".

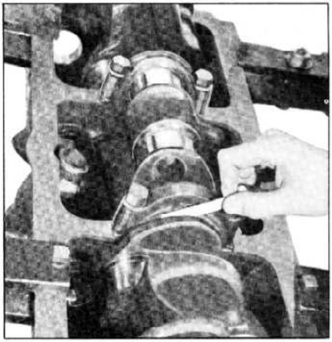

Fig. 51—Checking Crankshaft End Play

5. Place three .002" shims on each side of each bearing and install the caps.

NOTE: The intermediate bearing caps are marked "F" and "R" for identification purposes. The front intermediate bearing cap is installed with the "F" mark to the front of the engine and the rear intermediate bearing cap is installed with the "R" mark to the rear of the engine.

ADJUST MAIN BEARINGS

(Plastigage Method)

Plastigage consists of a wax-like plastic material which will compress evenly between the bearing and journal surfaces without damaging either surface. To obtain the most accurate results with Plastigage, certain precautions should be observed. If the engine is out of the chassis and upside down, the crankshaft will rest on the upper bearings and it can be assumed that the total clearance can be measured between the cap bearing and journal.

NOTE: To assure the proper seating of the crankshaft, remove rear main bearing oil seal. In addition, preparatory to checking fit of bearings the surface of the crankshaft journal and bearing should be wiped clean of oil. If the Plastigage check is to be made on engine in the chassis, the crankshaft must be supported by a jack or blocks, up against the upper bearings.

1. Starting with the rear main bearing, remove bearing cap and wipe oil from journal and bearing cap.

   NOTE: The other bearings must be left at their specified torque.

2. Place a piece of Plastigage the full width of the bearing (parallel to the crankshaft) on the journal (fig. 52).

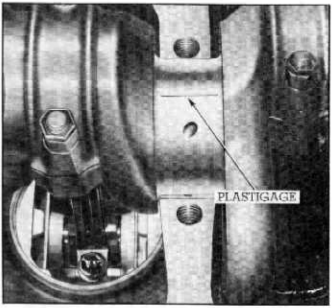

Fig. 52—Plastigage on Journal

3. Install the bearing cap and shims removed and evenly tighten the retaining bolts to 100-110 ft. lb. torque.

   CAUTION: Do not rotate the crankshaft while the Plastigage is between the bearing and journal.

4. Remove bearing cap, the flattened Plastigage will be found adhering to either the bearing shell or journal. On the edge of Plastigage packing envelope there is a graduated scale which is correlated in thousandths of an inch.
5. Without removing the Plastigage, check its compressed width (at the widest point) with the graduations on the Plastigage envelope (fig. 53).

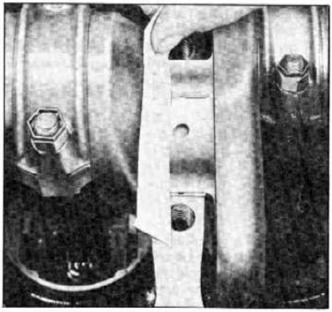

Fig. 53—Measuring Plastigage

NOTE: Normally, main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal be sure to fit to the maximum diameter of the journal. If the bearing is fitted to the minimum diameter of the journal and the journal is out-of-round .001" or more, interference between the bearing and journal will result in rapid bearing failure. If the flattened Plastigage tapers toward the middle or ends, there is a difference in clearance indicating a taper, low spot or other irregularity of the bearing or journal. Be sure to check the journal with a micrometer if the flattened Plastigage indicates more than .001" difference.

6. If the bearing clearance is not over .0045" or less than .0005" the bearing insert is satisfactory. If the clearance is not within these limits try selective fitting bearing by removing or inserting shims.

   NOTE: When adjusting main bearings it is a good practice to remove the shims

evenly, however, should it be necessary to use an uneven number of shims, the greater number of shims should be on the same side of all bearings.

7. If removal of shims does not bring the clearance below .0045" it will be necessary to regrind the crankshaft journal for use with the next undersize bearing.

   NOTE: Bearings are available in standard sizes and .002", .010", and .020" and .030" undersize.

8. New bearing shell clearance should be .003" maximum and .0005" minimum.
9. After adjusting rear main to specifications proceed to next bearing. After all bearings have been adjusted, check to see that there is no excessive drag on the crankshaft.
10. Install new rear bearing oil seal.
11. Install front end plate and gasket and crankshaft gear.

ASSEMBLY—CYLINDER BLOCK

Timing Gear Oil Nozzle

Two types of timing gear oil nozzles are used on the cylinder block front end plate. One type is of tubular construction which is pressed and flared in place. The other is a screw-cap type.

Examine the oil nozzle and in the event it is damaged, if it is the pressed and flared type, the front end plate assembly must be replaced as it is not practical to replace the nozzle only, without the use of special equipment. The screw-cap type can be replaced with a new screw-cap.

Cylinder Block Front End Plate

1. Install new oil gallery plugs at front and rear face of block making sure they seat properly.
2. Install new front end plate gasket and end plate, and hold in position with three screws and two hex head bolts. Tighten screws to 15-20 foot pounds and stake securely at bottom of slot.

   NOTE: Make sure the gasket surfaces on block and on end plate are thoroughly cleaned.

3. Place two camshaft thrust plate gaskets and a new thrust plate over camshaft hole in end plate.
4. Lay a straight edge against the thrust plate and over to the gear shoulder on the crankshaft. Check to see whether their two surfaces are flush (fig. 54).
5. If scale strikes the shoulder on the crankshaft, add another gasket beneath the thrust plate.
6. When number of thrust plate gaskets necessary to obtain this proper alignment is determined, note the number so that when camshaft is installed the proper number of gaskets will be used between the thrust plate and the front end plate.

Crankshaft Gear—Install

1. Place the two woodruff keys in their respective keyways in the crankshaft.
2. Place the crankshaft gear on the end of crankshaft with keyway in line with key.
3. Drive the gear onto the shaft, using a suitable driver until gear bottoms against shoulder on shaft.

Fig. 54—Checking Timing Gear Alignment

Camshaft, Camshaft Gear and Thrust Plate

1. If the inspection indicated that the camshaft, gear and thrust plate were in good condition, the camshaft end play should be checked (fig. 55). If this clearance is over .003" the gear should be pressed onto the shaft until the thrust plate will turn free, but does not have over .003" clearance.

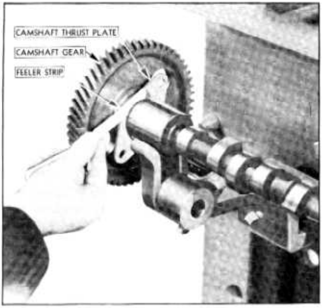

Fig. 55—Checking Camshaft End Play

2. If the inspection indicated that the shaft, gear or plate should be replaced, the gear must be removed from the shaft. This operation requires the use of camshaft gear remover J-971.

3. Place the camshaft through the gear remover, place end of remover on table of a press and press shaft out of gear (fig. 56).

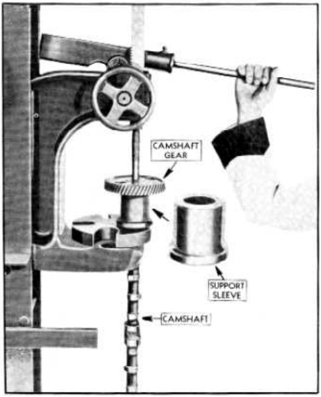

Fig. 56—Removing Camshaft Gear

CAUTION: Thrust plate must be so positioned that woodruff key in shaft does not damage it when shaft is pressed out of gear.

4. To assemble camshaft gear and thrust plate to shaft, firmly support shaft at back of the front journal in an arbor press. Place thrust plate over end of shaft, make sure woodruff key is seated in shaft keyway, install camshaft gear and press into position.

NOTE: Press on the steel hub of the gear or the gear will be seriously damaged.

5. As the gear is being pressed onto the shaft, check space between thust plate and shoulder of shaft. The plate must turn freely, but not have over .003" clearance.

6. Place the thrust plate gaskets, proper quantity previously determined, over camshaft and install camshaft assembly being careful not to damage bearings or cams.

7. Turn crankshaft and camshaft so that the valve timing marks on the gear teeth will line up and push camshaft into position. Install camshaft thrust plate to block screws and tighten them securely.

8. Check camshaft and crankshaft gear runout with a dial indicator (fig. 57). The camshaft gear runout should not exceed .004" and the crankshaft gear runout should not exceed .003".

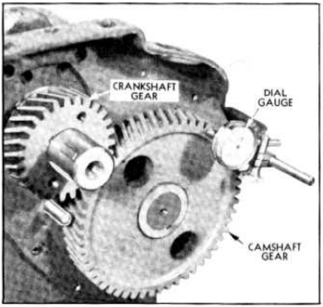

Fig. 57—Checking Runout of Timing Gears

9. If gear runout is excessive, the gear will have to be removed and any burrs cleaned from the shaft or the gear replaced.

10. Check the backlash between the timing gear

teeth with a narrow feeler gauge (fig. 58). The backlash should not be less than .003" nor more than .004".

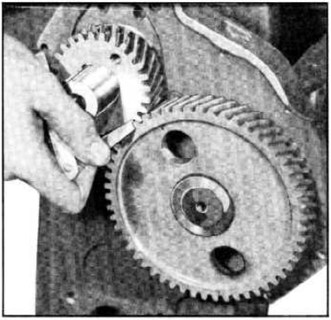

Fig. 58—Checking Timing Gear Backlash

Timing Gear Cover

1. A spring loaded leather oil seal is pressed into the crankshaft opening of the timing gear cover to prevent oil leakage around the hub of the harmonic balancer.
2. If this seal shows signs of wear or damage, it should be replaced by prying it out of the cover from the front with a large screwdriver.
3. Install new seal so that open end of the leather is toward the inside of the cover and drive in place with oil seal driver J-995 (fig. 33).
4. Make certain that cover mounting face and cylinder block front end plate face are clean.
5. Install timing gear cover centering gauge J-966 over end of crankshaft.
6. Coat the leather oil seal with light grease and using a new cover gasket install cover and gasket over centering gauge.
7. Install cover screws and two bolts through bearing cap and tighten to 6-7½ foot pounds torque using a torque wrench. Remove centering gauge.

NOTE: It is important that the centering gauge be used to align the timing gear cover so that the harmonic balancer installation will not damage the seal and to provide uniform seal tension on the hub of the balancer.

Harmonic Balancer Installation

1. Remove puller screw from harmonic balancer.
2. Place driver adapter of puller J-1287 in starting crank jaws of balancer. Install puller body to balancer and tighten attaching screws securely.
3. Line up keyway in balancer with key on crankshaft and drive balancer onto shaft until it bottoms against crankshaft gear using puller screw as a driver.

Clutch Housing—Install

1949-53 Models with Standard Transmissions

1. Install clutch housing and attaching bolts and tighten to 45-55 foot pounds with a torque wrench.
2. Install indicator extension in a crankshaft stud hole, attach indicator to extension and check pilot hole runout (fig. 59). This runout should not exceed .008".

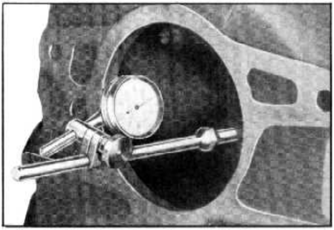

Fig. 59—Checking Runout of Transmission Pilot Hole

3. Should runout exceed .008" the clutch housing should be aligned as outlined for flywheel housing, 1950-53 Powerglide models.
4. Remove indicator and indicator extension.

FLYWHEEL HOUSING — 1950-53 POWERGLIDE MODELS

The flywheel housing used on 1950-53 Powerglide models with the 235 engine differs from the regular production 216 clutch housing in both design and tolerances. Parallelism of the face must be within .007" and total bore runout must not exceed .005". Special oversize dowel pins are to be used to obtain proper bore runout with respect to the crankshaft bearings.

Procedure for installing this flywheel housing on the 235 engine, checking alignment correction, is as follows. In addition, this method of alignment correction may be applied to correct bore misalignment, where found, of the clutch housing on the 216 engine.

1. Remove old flywheel housing from cylinder block.
2. Carefully clean mating surfaces of block and new housing of dirt, burrs, nicks, etc.
3. Install new flywheel housing to block, install attaching bolts and tighten evenly to 45-55 ft. lbs. torque.

ALIGNMENT CHECK

1. Install indicator post J-2494 in one of the crankshaft flange stud holes. Attach swivel J-4656-1, swivel sleeve J-4656-3 to indicator post.

   NOTE: Swivel, swivel sleeve and indicator extension rod are part of swivel set J-4656 designed for this alignment check.

2. Install indicator KMO 30-B to indicator extension rod and set indicator to read zero at the six o'clock position on the flywheel housing face.
3. Indicate face of housing and take readings at the 9, 12 and 3 o'clock positions. The runout limit is .007" (fig. 60).

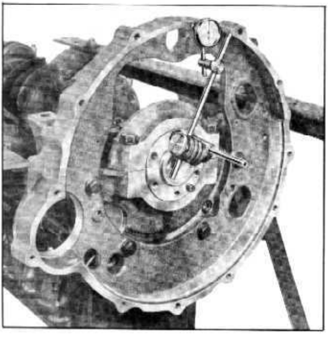

Fig. 60—Checking Face Parallelism

NOTE: Care should be exercised so that the indicator button is not on the edge of a bolt hole when the readings are taken.

4. Reset the indicator to read zero at the six o'clock position on the machined inside diameter of the flywheel housing bore, being careful that the indicator button is centered on the narrow machined flange and does not touch flange step.
5. Take readings at the 9, 12, and 3 o'clock positions, carefully lifting indicator button over each cutaway section of flange. The runout should not exceed .005" (fig. 61).

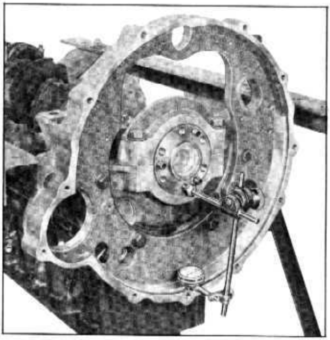

Fig. 61—Checking Bore Runout

ALIGNMENT CORRECTION

NOTE: When applying this alignment correction to clutch housing of the 216 engine, face parallelism should be disregarded as this alignment check must be made with the transmission case assembled to housing and with weight of engine resting on the transmission mounting in the normal manner. This alignment correction is covered in the transmission section.

1. If bore runout is in excess of .005" or if housing face parallelism exceeds .007", remove indicator and the flywheel housing from the engine block.
2. Remove the lower left hand dowel by driving it out, using a drift punch through hole in cylinder block flange.
3. Center punch the other two dowels and then drill through the dowels using a 7/32" drill.
4. Run a 1/4"-28 tap through drilled holes in dowels.
5. Install a 1/4"-28x2" capscrew into each dowel.

Tightening capscrew will push dowels out of block.

6. Clean mating faces of flywheel housing and engine block and make certain there are no burrs or metal extrusion around dowel or bolt holes.
7. Install flywheel housing and tighten attaching bolts evenly to 45-55 ft. lb. torque.
8. Mount indicator on indicator post and indicate flywheel housing face. Set indicator at zero at the six o'clock position and carefully check indicator readings at the 9, 12 and 3 o'clock positions. The runout limit is .007".

NOTE: Care should be exercised so that the indicator button is not on the edge of a bolt hole when the readings are taken.

9. If the face runout exceeds .007", shim as necessary, using main bearing shim No. 3847687 between the housing and block at the attaching bolt locations.
10. After the housing face has been brought within the .007" limit with bolts tightened to 45-55 ft. lb. torque, reset indicator to read zero at the six o'clock position on the machined inside diameter of the flywheel housing bore.

NOTE: Be careful that the indicator button is centered on the narrow machined flange and does not touch flange step.

11. Check indicator readings at the 9, 12 and 3 o'clock positions, carefully lifting indicator button over each cutaway section of flange. The runout should not exceed .005".
12. If the readings exceed the .005" runout limits, loosen bolts slightly and tap housing with a soft hammer in required direction until runout is within limits. Tighten attaching bolts evenly to 45-55 ft. lb. torque and recheck.
13. With flywheel housing in proper alignment, carefully drill through both dowel holes in housing and into block using a $^{13}\!/_{32}$" drill.

CAUTION: When drilling into lower right blind hole in block, be careful not to drill through.

14. Carefully ream holes using J-4628 reamer ($^{27}\!/_{64}$").
15. Blow out holes and then install special oversize dowels. Part No. 3696828.
16. Recheck flywheel housing bore and the face to make sure they still are within proper limits.

Flywheel Installation

1. Clean the mating flanges of flywheel and crankshaft carefully and make sure there are no burrs on either mounting face.
2. Place the flywheel in the clutch housing and position it so that the three evenly spaced dowels in crankshaft flange will enter the holes in the flywheel.
3. Install the six bolts using new lock plates under each pair of bolts.
4. Tighten bolts to 50-65 foot pounds with a torque wrench.
5. On all models except 1950-53 Powerglide models, mount a dial indicator on the clutch housing so that the button of the indicator will contact the machined surface of flywheel (fig. 62), and check the flywheel runout.

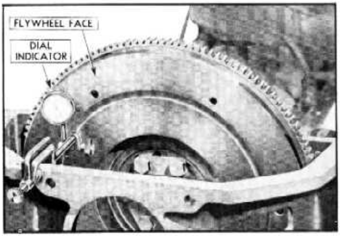

Fig. 62—Checking Flywheel Runout

6. Runout should not exceed .008". If excessive, remove flywheel and recheck for burrs or replace flywheel.
7. Securely lock the mounting bolts by bending the lock plates up against the bolt heads.

CONNECTING ROD ALIGNMENT

Correct alignment of the connecting rods is important. Whether new rods are being used or the old ones reinstalled they must be checked for alignment.

1. Place the piston pin in the eye of the connecting rod and tighten the clamp bolt.
2. Place the connecting rod on the arbor of the aligning fixture J-874-C, and tighten the connecting rod bolts.
3. Place the "V" block on the piston pin and move the rod and arbor toward the face plate until the pins on the "V" block just

engage the face plate (fig. 63). If all pins touch the face plate the rod is in alignment.

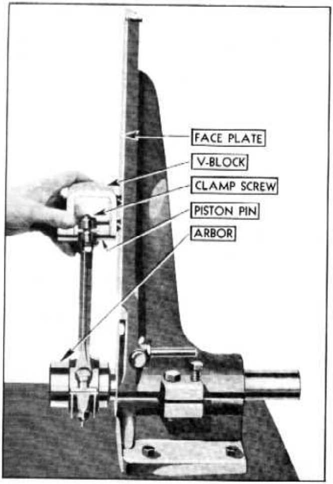

Fig. 63—Connecting Rod Alignment Fixture

4. If either the top or the bottom two pins touch the face plate, but the other two do not, the rod is bent.

5. If only the two pins on the front or the two on the back side of the "V" block touch the face plate, the rod is twisted.

6. The fixture is sufficiently strong to hold the connecting rod for straightening. Place a bending bar on the rod and twist or bend the rod as required and recheck. Continue this operation until all pins just touch the face plate.

7. Place the "V" block on the piston pin so that the "V" block rests against the outside edge of the connecting rod and move the rod and "V" block toward the face plate until all four pins touch.

8. Place the index on the bottom of the fixture so that it touches the large end of the connecting rod bearing. Remove the rod from the arbor and turn it around.

9. Assemble it again to the arbor and place the "V" block on the piston pin in the same place as when checking the other side. Move rod and "V" block toward the face plate until either the index touches the bearing or the pins touch the face plate.

10. If the index does not touch the rod bearing with the four pins touching the face plate, check the distance between the rod bearing and the index with a feeler gauge. If this distance is greater than .025" the rod should be straightened until pins touch the face plate and the index touches the rod bearing within .025".

11. If the index touches the rod bearing and the four pins do not touch the face plate, the distance between the pins and the face plate should also be checked with a feeler gauge. If this distance is more than .025" the rod should be straightened until the pins on the "V" block touch the plate and the index touches the rod bearing within .025".

Assemble Connecting Rod to Piston

1. Place the piston in piston vise J-1218. Assemble the rod to the piston and install the piston pin. Before tightening the clamp screw, center the piston pin in the piston and the connecting rod in the center of the two piston pin bosses. Figure 64 shows component parts of the 1953 Powerglide piston assembly.

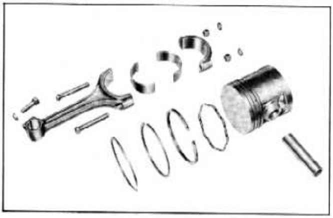

Fig. 64—1953 Powerglide Piston Assembly

2. Tighten the clamp screw to 25-35 ft. lbs. torque and move piston on pin from side to side, checking to see that the connecting rod is centered on the piston pin.

3. Assemble remaining rods to pistons.

NOTE: The connecting rod should never be clamped in a bench vise when installing the piston on it as tightening the clamp screw will likely twist the rod.

Check Rod and Piston Alignment

1. Assemble the piston and connecting rod assembly to the alignment fixture (fig. 65) and check with the "V" block resting against the piston skirt to see that the rod and piston are in alignment. Both pins on the "V" block should rest against the face of the plate on the fixture. The piston should be in the same alignment as the connecting rod when this check is made.
2. A quick check of a piston and connecting rod assembly for both cock and twist can be made without disassembling the rod from the piston. This method saves considerable time on any repair operation that does not normally require the removal of the rod from the piston.
3. To make this check, the connecting rod and piston assembly is mounted on the alignment fixture and the piston is set in line with the connecting rod. Then place the "V" block on the piston skirt. If both pins on the block contact the face plate, the rod is not cocked (fig. 65).
4. Then, with the "V" block on the piston skirt and the pins against the face plate, tip the piston first in one direction and then in the other (fig. 66). If the pins on the block remain against the face plate, there is no twist in the connecting rod.

Fig. 65—Checking Piston and Connecting Rod Assembly

Fig. 66—Checking Piston and Connecting Rod Assembly for Twisted Connecting Rod

5. If one pin leaves the face plate while the piston is being tipped in one direction and the other pin leaves the face plate while the piston is being tipped in the other direction, the connecting rod is twisted and should be straightened until both pins follow the face plate.

Piston Ring Fitting

The face of the compression rings on all 216 engines and the second ring on 1950-52 Powerglide engines and 1953 standard engines, are tapered one thousandth of an inch, being wider at the bottom. With this design the lower edge of the ring tends to scrape the excess oil from the cylinder wall and acts as an oil control ring until the regular oil control ring is seated (broken-in) in the cylinder. The top compression ring of 1950-52 Powerglide models and the standard 1953 along with all compression rings on the 1953 Powerglide engine are deep section twist type rings which assume a twisted or cocked position when installed and they retain this position for life. All compression rings are marked with the word "TOP" cast on the upper side of the ring. When installing compression rings, make sure the side marked "TOP" is toward the top of the piston.

Chevrolet piston rings are furnished in standard sizes as well as .005", .020", .030" and .040" oversizes.

1. Select rings comparable in size to the pistons being used.
2. Slip the ring in the cylinder bore; then, using the head of a piston, press the ring down into the cylinder bore about two inches.

NOTE: Using a piston in this way will place the ring square with the cylinder walls.

3. Check the space or gap between the ends of the ring with a feeler gauge. This gap should be from .005" to .015" on taper face rings and .007"-.017" on twist type rings.
4. If the gap between the ends of the ring is less than .005" for taper face or .007" for twist type rings, remove the ring and try another for fit, or the gap in the tight fitting ring may be enlarged as follows.
5. Remove the ring from the cylinder. Clamp a fine cut file in a vise. Grasping each end of the ring firmly between the thumb and fingers, work the two ends of the ring across the surfaces of the file, pressing the ring together at the gap lightly until the proper gap is obtained. Be careful not to distort the ring during this operation or it may bind in the ring groove of the piston. Fit each ring separately to the cylinder in which it is going to be used.
6. New pistons, rings and cylinder bores wear considerably during seating and gaps widen quickly; however, engine operation will not become seriously affected if ring gaps do not become greater than $\frac{1}{32}$".
7. Carefully remove all particles of carbon from the ring grooves in the piston and inspect the grooves carefully for burrs or nicks that might cause the rings to hang up.
8. Slip the outer surface of the ring into the piston ring groove and roll the ring entirely around the groove to make sure that the ring is free and does not bind in the groove at any point (fig. 67). If binding occurs the cause should be determined and removed by carefully dressing with a fine cut file. However, if the binding is caused by a distorted ring, install a new ring.

Fig. 67—Rolling Piston Ring in Ring Groove

9. Proper clearance of the piston ring in its piston ring groove is very important in maintaining engine performance and in preventing excessive oil consumption. Therefore, when fitting new rings, the following clearances between the top and bottom surfaces of the ring grooves should be provided.
10. The two compression rings on all 1949-52 models with the 216 engine, and the second compression ring on 1950-52 Powerglide engines and the standard 1953 engine should be fitted so that a .0015" feeler gauge will be free, but a .003" feeler will cause a rather heavy drag. The top compression ring on 1950-52 Powerglide engines, standard 1953 engines and all compression rings on 1953 Powerglide engines being of the twist type will not have any side clearance when installed in piston ring grooves.
11. At the bottom of oil control groove, a .002" feeler should be free, but a .0035" feeler should produce a heavy drag (fig. 68).

Fig. 68—Checking Piston Ring Clearance in Ring Groove

12. Assemble the rings to the pistons as they are fitted and make a final test of the ring fit in the grooves by repeating the fitting procedure given above.

NOTE: It is important that each ring be fitted to its individual cylinder for proper gap spacing and to its individual piston and groove for proper groove clearance.

Assemble Pistons And Connecting Rods To Engine

When the rods are being reassembled, they should be installed in the same cylinder from which they were removed and with the stamped number on the camshaft side.

The condition of the crank pins on the crankshaft should be checked when installing new rods. Damaged crank pins can only be corrected by the installation of a new crankshaft, as it is impossible to insure connecting rod bearing life on a damaged crank pin.

1. Position piston rings in piston ring grooves so that gaps will be spaced 120° apart.

   CAUTION: Never install pistons with piston ring gaps in line as gaps in this position will allow gases to leak by at this point.

2. Lubricate pistons and cylinder bores, remove bearing caps and install piston and rod assemblies using piston inserter KMO-357 (fig. 69).

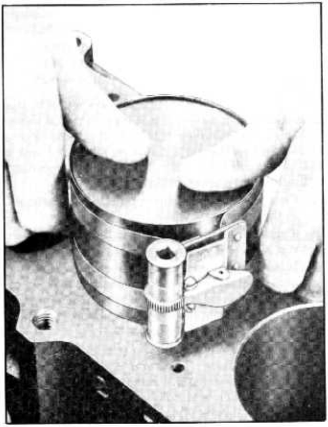

Fig. 69—Installing Piston in Cylinder Bore

NOTE: Piston and rods must be installed with the piston pin clamp on the camshaft side.

3. Lubricate crank pin and pull connecting rod down onto it, making sure the numbered side of the rod is toward the camshaft.
4. On 1949-52 engines and standard 1953 engines install three .002" shims on each connecting rod bolt, 1953 Powerglide engines are equipped with precision interchangeable insert bearings and do not require shims. Install the bearing cap with the numbered side toward the camshaft. On 1949-52 engines and standard 1953 engines install the connecting rod oil dipper with its open side toward the camshaft. Assemble and tighten the bearing cap nuts to 40-50 foot pounds of torque.
5. Install "pal" locking nuts with open side of nut toward end of bolt. Turn "pal" nut up finger tight and then ½ turn more.
6. Install remaining piston and connecting rod assemblies as described above.
7. Adjust connecting rod bearings.

CONNECTING ROD BEARING ADJUSTMENT (Plastigage Method)

Connecting rod bearing inserts for 1953 Powerglide engines are available in standard sizes and undersizes of .001", .002", .010" and .020". These bearings are not shimmed and when clearances become excessive the next undersize bearing insert should be used. DO NOT FILE ROD OR ROD CAPS.

Any adjustment necessary on the spun type connecting rod bearings, used on all 1949-52 engines and 1953 standard engines is provided by the connecting rod bearing shims.

1. Remove the connecting rod bearing cap.
2. Wipe bearing insert shell or spun type bearings, and crankpin clean of oil.
3. Place a piece of Plastigage the full width of the bearing or crankpin (parallel to the crankshaft) (fig. 70).

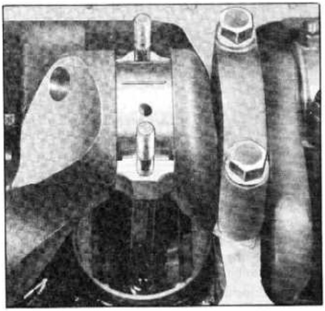

Fig. 70—Plastigage on Crankpin

4. Reinstall the bearing cap and evenly tighten the retaining bolts to 35-45 ft. lbs. torque.

   CAUTION: Do not turn crankshaft with the Plastigage installed.

5. Remove the bearing cap and without removing the Plastigage, check its width at the widest point with the Plastigage scale (fig. 71).

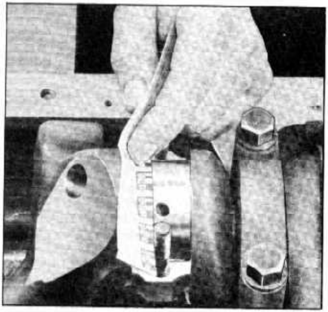

Fig. 71—Measuring Compressed Plastigage

NOTE: If the crankpin is out-of-round be sure to fit the bearing to the maximum diameter of the crankpin. If the flattened plastic is not uniform from end to end in its width, the crankpin or bearing is tapered, has a low spot or some other irregularity. Check the crankpin with a micrometer for taper if the flattened Plastigage indicates more than a .001" difference.

6. If the reading is not over .0045" or not less than .001" the fit is satisfactory. If however, the clearances are not within these limits, on bearing insert shell type, replace the bearing with the proper undersize bearing. Where the spun type bearing is being checked, remove or add shims to bring clearances within limits.

   NOTE: The insert bearing shells are not adjustable and no attempt should be made to adjust by filing the bearing caps.

7. New bearing shell inserts or spun type bearing clearance should be .003" maximum and .001" minimum.
8. Rotate the crankshaft after bearing adjustment to be sure the bearings are not too tight.
9. Check connecting rod clearance between upper half of connecting rod and side of crank pin. See engine specifications for clearance.

Connecting Rod Dippers, Oil Troughs and Nozzles All 1949-52 and Standard 1953 Engines

Checking and adjusting connecting rod dippers, oil troughs and oil nozzles must be performed according to instructions given under "Minor Service Operations."

Oil Pump Assembly

If the inspection indicated excessive oil pump wear, it is advisable to replace the entire oil pump. If the old pump is to be used, it should be assembled as follows.

1. Place the drive gear and shaft in the pump body and install the idler gear so that the chamfered side of gear will be away from the cover.
2. Install a new GENUINE Chevrolet gasket to assure correct end clearance of the gears.
3. Install the cover and attaching screws. Tighten screws securely and check to see that shaft turns freely.

Cylinder Head

Condition the cylinder head and valves according to procedure given under "Minor Service Operations."

Oil Distributor to Rocker Shaft Pipe 1949-52 Models with 216 Engine

The pipe leading from the oil distributor to the rocker arm shaft passes directly through the water jacket of the cylinder block. If this pipe is removed for any reason, it must be discarded and a new pipe and nipple assembly installed according to the following instructions.

1. Coat the threads of the nipple that is fastened to the pipe with white lead.
2. Thread the pipe through the block from push rod side and screw nipple securely in block.
3. Install nipple and sleeve nut at lower end of pipe, on left side of block, coating threads of nipple with white lead and tighten securely.
4. Make a bend in lower end of pipe and connect to fitting at oil distributor location.
5. Bend pipe on right side of block to provide clearance when push rod cover is installed and so pipe extends straight up in position so that cylinder head may be installed over it.

On all 1950-53 models having the 235 engine, the rocker shaft oil line pipe extends forward in the push rod compartment from a fitting in the tappet ledge just above the rear camshaft bearing to the center and then upward to a fitting. To replace this pipe, cut a new pipe to proper length, install new nipples at each end, and install pipe to cylinder block fitting. Then bend pipe to proper contour so that clearance is provided for the push rods and push rod cover and so that the end of the pipe extends straight up for cylinder head installation.

ENGINE ASSEMBLY

1. Place the oil pump in position in the block fitting. Install the oil pump retaining screw and tighten it securely, being sure that the tapered end of screw draws down into the hole in pump body. Tighten lock nut securely.
2. Install the oil pump to block oil line and tighten the connector nuts securely. Install oil screen and body assembly and the oil pipe between screen and pump.
3. Check to see that the crankcase ventilator baffle (attached to inside of block at crankcase ventilator hole) is not damaged and is securely bolted in place. Turn the crankshaft to see that the camshaft lobes clear the baffle.
4. Check to see that all connecting rod bolt nuts and main bearing cap bolts are properly tightened and locked. Check to see that the crankcase is clean.
5. Install new oil pan gaskets and end corks. Carefully place the oil pan in position and tighten pan bolts securely.

   NOTE: Tighten oil pan corner bolts to 12½ to 15 foot pounds. Tighten oil pan flange bolts to 6 to 7½ foot pounds.

6. On all 1949-53 models having the 3-speed transmission:
   a. Lubricate the clutch pilot bearing with a small amount of high melting point grease. Place the clutch disc and clutch cover assembly in position and install the pilot tool K-411.
   b. Turn the clutch cover until the "X" on the cover lines up with the "X" on the flywheel (fig. 72). Install the attaching bolts loosely and then tighten them a turn at a time to take up the spring pressure evenly and prevent clutch distortion. Tighten bolts to 25-30 foot pounds torque with a torque wrench and then remove pilot tool.
   c. Pack the clutch fork ball seat with a small amount of high melting point grease and snap the fork onto the ball with the end extending through opening in clutch housing.
7. Turn engine assembly over in engine stand.
8. Place a new cylinder head gasket on the block following the installation instructions stamped on gasket. This assures alignment of water passage and bolt holes in head and block. Install two guide pins to position gasket and pilot cylinder head.
9. Carefully place cylinder head in position over guide pins, pilot the rocker arm oil tube through opening in head and lower the head into position. Remove guide pins and install all cylinder head bolts and tighten them finger tight.

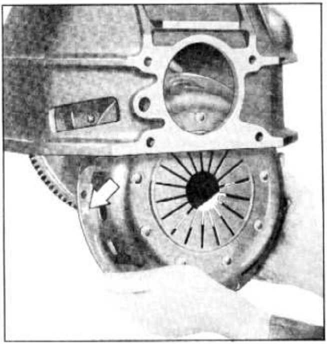

Fig. 72—Installing Clutch Assembly

10. Tighten the cylinder head bolts a little at a time in the order shown in Figure 21 or 22. The final tightening should be 70-80 foot pounds on 216 engines and 90-95 foot pounds on 235 engines.
11. Install the twelve valve lifters in right side of block, and on 1950-53 models with 235 engines install rocker arm shaft oil line making connection at cylinder block.
12. Install push rod cover using a new gasket and tighten attaching screws evenly to 6-7½ foot pounds tension.
13. Install new manifold to cylinder head gaskets, intake manifold sleeves, manifold assembly and attaching parts. Tighten clamp bolts to 15-20 foot pounds tension and stud nuts when used to 25-30 foot pounds tension. Check manifold heat control valve as instructed under "Engine Tune-Up."
14. On all 1949-52 engines and 1953 standard engines place a new oil distributor to block gasket No. 1 (fig. 73) in position on the left side

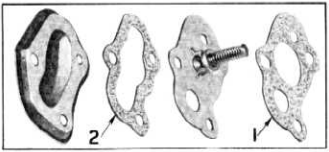

Fig. 73—Oil Distributor Cover and Gaskets

of block. Place the oil distributor, distributor cover gasket No. 2 and cover in position and install the retaining screws. Tighten to 6-7½ foot pounds tension.

CAUTION: The gasket marked "1" (fig. 73) must be placed between oil distributor and engine block, and the one marked "2" must be placed between distributor and cover.

15. Install water pump using a new gasket and tighten attaching bolts to 25-30 foot pounds tension. Install thermostat housing, place thermostat in housing, install new water outlet gasket and water outlet, and install attaching bolts. Tighten bolts securely.
16. On 1953 models install bell crank to underside of toe kick pan, then on all models install carburetor and tighten nuts securely. Place throttle rod in position and connect it to the bell crank and throttle shaft arm. Install throttle return spring.
17. Install crankcase ventilator tube. Connect tube brace to oil pan flange on 1949-51 models and to the side of crankcase on 1952-3 models. Install oil gauge rod.
18. Install the fuel pump using a new gasket and tighten attaching bolts to 15-20 foot pounds tension. Place the fuel pump to carburetor gas line and the vacuum spark control line in position and connect them to carburetor and clip at water outlet. Connect the gas line to the fuel pump.
19. Install ignition distributor following instructions in Section 12 of this manual and connect vacuum line to distributor spark control.
20. On all 1949-53 models having the 3-speed transmission.
    a. Lubricate the recess on the inside of clutch throwout bearing collar and coat the throwout fork grooves with a small amount of high melting point grease and place bearing assembly in position on the throwout fork.
    b. Carefully clean the mating faces on clutch housing and transmission case. Pilot the clutch shaft of transmission through the throwout bearing and into clutch disc and pilot bearing. Work the transmission up against the clutch housing until bearing retainer pilots into pilot hole in clutch housing. Install and tighten securely the transmission mounting bolts.

       NOTE: Properly support the transmission as it is being installed or the clutch disc may be damaged.

    c. Remove universal joint ball from torque tube and adjust as outlined in "Transmission Section."
    d. After adjustment is made replace universal joint ball on torque tube noting number of shims used in adjustment.
    e. Install the clutch housing underpan and retaining bolts.
21. On all 1950-53 models having the 235 engine and the Powerglide Transmission, assemble transmission to engine as follows:
    a. Lubricate the flywheel pilot with Lubri-Plate.
    b. Raise transmission until converter housing is in approximate position.

       CAUTION: Extreme care must be taken when bringing transmission into position that flywheel pilot is not bumped in any way.

    c. Turn the torque converter until the "X" mark on the turbine cover is lined up with the "X" mark on the flywheel to the nearest attaching bolt hole.

       NOTE: These marks must be aligned to maintain balance and the marks will not be visible after the assembly has been completed.

    d. Align one of the bolt holes in flywheel with the flywheel housing opening. Then, on 1953 models remove converter assembly tool J-5384 and with one $\frac{5}{16}$" x 24 guide pin installed in converter cover, carefully enter guide pin in flywheel hole that is aligned with housing opening. At the same time, raise or lower transmission to align flywheel pilot.

       NOTE: Do not attempt to force transmission, when flywheel pilot is properly aligned it will enter flywheel easily and housings will come together.

    e. Install converter housing to flywheel housing bolts, remove lift sling J-4262 and replace two transmission housing to converter housing bolts.
    f. Remove guide pin and install six flywheel to turbine bolts, rotating flywheel as necessary with flywheel indexing tool J-4281.
    g. Remove universal ball from torque tube and adjust as outlined in "Transmission Section." After adjustment is made, replace universal joint ball on torque tube noting number of shims used in adjustment.
    h. Install flywheel cover and flywheel underpan extension.
22. On models with 3-speed transmission, remove the fourth cylinder head bolt from the rear on the left side and the third bolt from rear on the right side. On models with Powerglide transmission, remove the fourth cylinder head bolt from the rear on the right side and

10. Replace hand brake idler lever with cables attached and replace pull back spring. Connect parking brake rod to idler lever. Push hand brake lever rod down into engine compartment and attach split link to bellcrank.
11. On all 1949-53 models having a 3-speed transmission:
    a. Remove speedometer driven gear and lubricate universal by filling housing with ½ pt. of SAE 90 transmission lubricant. Replace speedometer driven gear.
    b. Connect clutch pedal adjusting link to clutch fork and adjust to give ¾" to 1" free pedal travel.
    c. Connect speedometer cable to speedometer driven gear.
    d. Connect transmission control rods to shifter levers on transmission side cover. Adjust control rods as outlined in "Transmission Section."
    e. Fill transmission with one pint of SAE 90 transmission lubricant
12. On all 1950-53 models having a Powerglide transmission:
    a. Connect speedometer cable to speedometer driven gear.
    b. Connect transmission control rod to transmission control rod bell crank and adjust rod as outlined in "Transmission Section."
    c. Install transmission filler tube and dip stick.
    d. Connect transmission vacuum line.
13. Replace exhaust pipe to manifold and tighten attaching bolts securely.
14. Connect vacuum lines.
15. Connect line to oil pressure gauge and install temperature element in cylinder head.
16. Connect choke and throttle control cables to carburetor on 1949 models and choke cable on 1950-52 models except 1952 models with automatic choke carburetor. Install air cleaner.
17. Attach generator and field wires to generator.
18. Attach gasoline line to fuel pump.
19. Mount coil in position with two coil mounting bolts, tighten bolts to 5-8 ft. lb. torque.
20. Install battery and connect battery cables.
21. Attach battery cable and ammeter wire to large terminal on solenoid and starter switch wire to small terminal and connect coil wire to coil.
22. Install radiator core support and feed wire harness through radiator header bar.
23. Install radiator assembly to radiator support, and oil cooler and lines on all 1950-53 Powerglide models, and connect radiator hoses.
24. Refill radiator and crankcase.
25. On all 1949-52 models with 216 engine and on Standard 1953 models, start engine and allow to run until properly normalized and adjust valves as outlined under "Valve Adjustment."
26. On all 1950-53 models with the 235 engine and Powerglide transmission, use oil filler tube and funnel J-4264 and fill transmission as follows:
    a. Fill transmission with five quarts of Automatic Transmission Fluid, "Type A".
    b. Start engine and let idle with transmission selector lever in "N" position. Check oil level and if necessary add oil to bring fluid level to "Full" mark on the dip stick. Do not overfill.
27. On Powerglide equipped cars, place selector lever in reverse and check linkage adjustment as outlined in the "Transmission Section."
28. Replace hood assembly and connect hood hinges.

TROUBLES AND REMEDIES

ENGINE

Symptom and Probable Cause	Probable Remedy
LACK OF POWER	
1. Poor Compression	
a. Incorrect valve lash	a. Adjust valve lash according to instructions
b. Leaky valves	b. Remove cylinder head and grind valves
c. Valve stems or lifters sticking	c. Free up or replace
d. Valve springs weak or broken	d. Replace springs
e. Valve timing incorrect	e. Retime valves
f. Leaking cylinder head gasket	f. Replace gaskets
g. Piston rings broken	g. Replace rings
h. Poor fits between pistons, rings and cylinders	h. Overhaul engine

Symptom and Probable Cause	Probable Remedy
2. Ignition System Improperly Adjusted	
a. Ignition not properly timed	a. Set ignition according to instructions
b. Octane selector not adjusted for grade of fuel being used	b. Set octane selector. See "Engine Tune-Up"
c. Spark plugs faulty	c. Replace or clean, adjust and test spark plugs
d. Distributor points not set	d. Set distributor points and time engine
3. Lack of Fuel	
a. Dirt or water in carburetor	a. Clean carburetor
b. Gas lines partly plugged	b. Clean gas lines
c. Dirt in gas tank	c. Clean gas tank
d. Air leaks in gas line	d. Tighten and check gas lines
e. Fuel pump not functioning properly	e. Replace or repair fuel pump
4. Carburetor Air Inlet Restricted	
a. Air cleaner dirty	a. Clean air cleaner
b. Carburetor choke partly closed	b. Adjust or replace choke mechanism
5. Overheating	
a. Lack of water	a. Refill system
b. Fan belt loose	b. Adjust or replace
c. Fan belt worn or oil soaked	c. Replace belt
d. Thermostat sticking closed	d. Replace thermostat
e. Water pump inoperative	e. Replace water pump
f. Cooling system clogged	f. Clean and reverse flush
g. Incorrect ignition or valve timing	g. Retime engine
h. Brakes dragging	h. Adjust brakes
i. Improper grade and viscosity oil being used	i. Change to correct oil
j. Fuel mixture too lean	j. Overhaul or adjust carburetor
k. Restricted air cleaner	k. Clean air cleaner
l. Valves improperly adjusted	l. Adjust valves
m. Defective ignition system	m. See "Engine Tune-Up"
n. Exhaust system partly restricted	n. Clean or replace
6. Overcooling	
a. Thermostat holding open	a. Replace thermostat
EXCESSIVE OIL CONSUMPTION	
1. Leaking Oil	
a. Oil pan drain plug loose	a. Tighten drain plug
b. Oil pan retainer bolts loose	b. Tighten oil pan bolts
c. Oil pan gaskets damaged	c. Replace pan gaskets
d. Timing gear cover loose or gasket damaged	d. Tighten cover bolts or replace gasket
e. Oil return from timing gear case to block restricted, causing leak at crankshaft fan pulley hub	e. Remove oil pan and clean oil return passages
f. Push rod or rocker arm cover gaskets damaged or covers loose	f. Tighten covers or replace gaskets
g. Fuel pump loose or gasket damaged	g. Tighten fuel pump or replace gasket
h. Rear main bearing leaking oil into clutch housing	h. Adjust or replace main bearing or main bearing oil seal
2. Burning Oil	
a. Broken piston rings	a. Replace rings
b. Rings not correctly seated to cylinder walls	b. Give sufficient time for rings to seat. Replace if necessary.
c. Piston rings worn excessively or stuck in ring grooves	c. Replace rings

Symptom and Probable Cause	Probable Remedy
d. Piston ring oil return holes clogged with carbon	d. Replace rings
e. Excessive clearance between piston and cylinder wall due to wear or improper fitting	e. Fit new pistons
f. Cylinder walls scored, tapered or out-of-round	f. Recondition cylinders and fit new pistons
g. Valve stem oil seals broken or missing	g. Install new valve stem oil seals
HARD STARTING	
1. Slow Cranking	
a. Heavy engine oil	a. Change to lighter oil
b. Partially discharged battery	b. Charge battery
c. Faulty or undercapacity battery	c. Replace battery
d. Poor battery connections	d. Clean and tighten or replace connections
e. Faulty starter switch	e. Replace switch
f. Faulty starting motor or drive	f. Overhaul starting motor
2. Ignition Trouble	
a. Distributor points burned or corroded	a. Clean or replace points
b. Points improperly adjusted	b. Adjust points to .018" or .016".
c. Spark plugs improperly gapped	c. Set plug gap at .035"
d. Spark plug wires loose and corroded in distributor cap	d. Clean wire and cap terminals
e. Loose connections in primary circuit	e. Tighten all connections in primary circuit
f. Series resistance in condenser circuit.	f. Clean all connections in condenser circuit
g. Low capacity condenser	g. Install proper condenser
3. Engine Condition	
a. Valves holding open	a. Adjust valves. See "Poor Compression"
b. Valves burned	b. Grind valves
c. Leaking manifold gasket	c. Tighten manifold bolts or replace gasket
d. Loose carburetor mounting	d. Tighten carburetor
e. Faulty pistons, rings or cylinders	e. See "Poor Compression"
4. Carburetion	
a. Choke not operating properly	a. Adjust or repair choke mechanism
b. Throttle not set properly	b. Set throttle
c. Carburetor dirty and passages restricted	c. Overhaul carburetor
POPPING, SPITTING AND DETONATION	
1. Overheated Intake Manifold	
a. Manifold heat control spring not properly installed	a. Adjust according to instructions under "Engine Tune-Up"
b. Manifold heat control valve sticking	b. Free up heat control valve
2. Ignition Trouble	
a. Loose wiring connections	a. Tighten all wire connections
b. Faulty wiring	b. Replace faulty wiring
c. Faulty spark plugs	c. Clean or replace and adjust plugs
3. Carburetion	
a. Lean combustion mixture	a. Clean and adjust carburetor
b. Dirt in carburetor	b. Clean carburetor
c. Restricted gas supply to carburetor	c. Clean gas lines and check for restrictions
d. Leaking carburetor or intake manifold gaskets	d. Tighten carburetor to manifold and manifold to head bolts or replace gaskets
e. Carburetor metering rod hole cover not in place	e. Replace metering rod hole cover

Symptom and Probable Cause	Probable Remedy
4. Valves	
a. Valves adjusted too tight	**a.** Adjust valve lash
b. Valves sticking	**b.** Lubricate and free up. Grind valves if necessary
c. Exhaust valves thin and heads overheating	**c.** Replace valves
d. Weak valve springs	**d.** Replace valve springs
e. Valves timed early	**e.** Retime. See "Timing Gear Installation"
5. Cylinder Head	
a. Excessive carbon deposits in combustion chamber	**a.** Remove head and clean carbon
b. Cylinder head water passages partly clogged causing hot spot in combustion chamber	**b.** Remove cylinder head and clean water passages
c. Partly restricted exhaust ports in cylinder head	**c.** Remove cylinder head and clean exhaust ports
d. Cylinder head gasket blown between cylinders	**d.** Replace cylinder head gasket
6. Spark Plugs	
a. Spark plugs glazed	**a.** Clean or replace spark plugs
b. Wrong heat range plug being used	**b.** Change to correct spark plugs
7. Exhaust System	
a. Exhaust manifold or muffler restricted causing back pressure	**a.** Clean or replace manifold and muffler

ROUGH ENGINE IDLE

Symptom and Probable Cause	Probable Remedy
1. Carburetor	
a. Improper idling adjustment	**a.** Adjust according to instructions
b. Carburetor needle valve not seating	**b.** Clean or replace
2. Air Leaks	
a. Carburetor to manifold gasket leaks	**a.** Tighten carburetor to manifold bolts or replace gasket
b. Manifold to head gasket leaks	**b.** Tighten manifold to head bolts or replace gaskets
c. Air leaks in windshield wiper vacuum line	**c.** Check for leaks and repair
3. Valves	
a. Improper lash adjustment	**a.** Check and adjust valves
b. Valves not seating properly	**b.** Grind valves
c. Valves loose in guides	**c.** Condition valves
4. Cylinder Head	
a. Cracks in exhaust ports	**a.** Replace cylinder head
b. Head gasket leaks	**b.** Replace cylinder head gasket

ENGINE MISSES ON ACCELERATION

Symptom and Probable Cause	Probable Remedy
1. Carburetion	
a. Accelerating pump jet plugged or pump sticking or not working	**a.** Overhaul carburetor
b. Lean fuel mixture	**b.** Overhaul carburetor
2. Ignition Trouble	
a. Faulty spark plugs	**a.** Clean, adjust or replace plugs
b. Faulty ignition wiring	**b.** Replace faulty wiring
c. Improperly adjusted or faulty distributor points	**c.** Adjust or replace distributor points
d. Weak coil	**d.** Replace coil

Symptom and Probable Cause	Probable Remedy
3. Engine	
a. Burned or improperly adjusted valves	a. Adjust, replace or grind valves
b. Leaky manifold gaskets	b. Tighten manifold or replace gaskets
c. Poor compression due to cylinder, piston or ring condition	c. Overhaul engine
d. Leaking cylinder head gasket	d. Replace gasket
ENGINE NOISE	
1. Crankshaft Bearings Loose	
a. Bearings improperly fitted	a. Readjust main bearings
b. Crankshaft journals out-of-round	b. Replace or recondition crankshaft
c. Crankshaft journals rough	c. Replace or recondition crankshaft
d. Oil passages in block restricted	d. Clean passages
e. Insufficient oil	e. Adjust or replace bearings. Replenish oil
f. Improper grade and viscosity oil being used	f. Adjust bearings and change to correct oil
g. Oil pump failure	g. Replace oil pump, adjust or replace bearings and other damaged parts
h. Contaminated oil	h. Wash motor thoroughly. Adjust or replace bearings and other damaged parts
2. Connecting Rod Bearings Loose	
a. Improperly adjusted bearings	a. Adjust bearings
b. Crankpins rough	b. Polish or replace shaft. Adjust or replace rods
c. Insufficient oil	c. Adjust or replace rods and replenish oil
d. Oil pump failure	d. Replace oil pump. Replace or adjust rod bearings
e. Connecting rod dipper broken or damaged	e. Adjust or replace rod and dipper
f. Oil troughs or lines not adjusted properly or restricted	f. Clean, adjust or replace oil troughs and lines
g. Improper grade and viscosity of oil used	g. Adjust or replace rod bearings and change to proper oil
3. Pistons or Pins Loose	
a. Excessive cylinder wear	a. Hone cylinders and fit new pistons and rings. Make sure all abrasive that would cause cylinder wear is removed
b. Improperly fitted pistons or pins	b. Replace pistons or pins
c. Contaminated oil	c. Make necessary replacements, flush oiling system and use new oil
d. Faulty fuel or ignition system causing unburned fuel to flush oil from cylinder walls	d. Make necessary repairs to fuel or ignition system, replace worn parts and change oil
e. Piston pin or bushing wear	e. Ream bushings and install oversize piston pins
4. Engine Noise—General	
a. Bent connecting rod	a. Replace rod
b. Excessive end play in camshaft	b. Replace camshaft thrust plate, or correct end play by pressing gear on further
c. Excessive crankshaft end play	c. Replace main bearings
d. Broken piston ring	d. Replace broken ring and check condition of cylinder wall
e. Loose timing gears	e. Replace timing gears
f. Dry push rod sockets	f. Polish and lubricate push rod sockets
g. Bent oil gauge rod	g. Replace oil gauge rod
h. Improperly adjusted valve lash	h. Adjust valve lash
i. Sticking valves	i. Free or grind valves

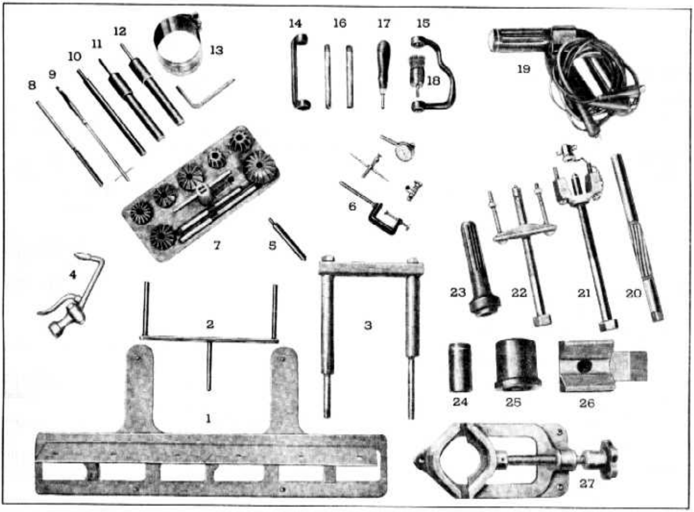

Fig. 75—Engine Special Tools

1. Oil Pan Target Gauge J-969-1
2. Oil Pan Trough Depth and Dipper Gauge J-969-2A
3. Engine Lifting Attachment J-2967
4. Water Faucet Assembly J-793-3
5. Nozzle Adjusting and Aligning Tool J-793-5
6. Dial Indicator and Attachments KMO-30
7. Valve Reseater Set KMO-105B
8. Valve Guide Reamer (finishing) .343"
9. Valve Guide Cleaner KMO-122
10. Valve Guide Remover J-267
11. Valve Guide Replacer (intake) J-1089
12. Valve Guide Replacer (exhaust) J-1090
13. Piston Inserter KMO-357
14. Cylinder Head Wrench Attachment (close sweep) KMO-187-1
15. Cylinder Head Wrench Attachment (wide sweep) KMO-187-10
16. Cylinder Head Guide Pins N-344
17. Distributor Cap Terminal Cleaner KMO-230
18. Carbon Cleaning Brush KMO-7004
19. Power Timing Light KMO-318
20. Piston Pin Bushing Expansion Reamer .865"
21. Harmonic Balancer Puller and Driver J-1287
22. Crankshaft Gear Puller T-126-R
23. Timing Gear Cover Oil Seal Driver J-995
24. Timing Gear Cover Centering Gauge J-966
25. Camshaft Gear Remover J-971
26. Piston Reamer Fixture J-965
27. Piston Vise J-1218

ENGINE SPECIFICATIONS

Type ..... Valve-in-head

Number of Cylinders 6

Bore

216.5 Engine ..... 3½"
235.5 Engine ..... 3⁹⁄₁₆"

Stroke

216.5 Engine ..... 3¾"
235.5 Engine ..... 3¹⁵⁄₁₆"

Piston Displacement

49-52 Std. Engine ..... 216.5 cu. in.
50-53 Powerglide and
53 Std. Engine ..... 235.5 cu. in.

Compression Ratio

49-52 216.5 Engine 6.6:1
50-52 235.5 Powerglide Engine 6.7:1
53 235.5 Std. Engine 7.1:1
53 235.5 Powerglide Engine 7.5:1

Horsepower (S.A.E.)

All 216.5 Engines 29.4
All 235.5 Engines 30.4

Firing Order 1-5-3-6-2-4

Cylinder Block Bore Size

All 216.5 Engines ..... 3.4995"-3.5015"
All 235.5 Engines ..... 3.5620"-3.5640"

Crankshaft

Number of Bearings 4
Bearing Journal Diameter
Front ..... 2.6835"-2.6845"
Front-Intermediate ..... 2.7145"-2.7155"
Rear-Intermediate ..... 2.7455"-2.7465"
Rear ..... 2.7765"-2.7775"
Thrust Taken ..... Rear Intermediate
End Clearance ..... .003"-.009"
Connecting Rod Journal
Diameter ..... 2.311"-2.312"
Journal Out of Round ..... .001" Max.
Runout at Intermediate
Journal ..... .002" Max.
Crankshaft Main Bearing Clearance
New ..... .001"-.003"
Used ..... .001"-.0045"
Undersize Bearings
Available ..... .002"-.010"-.020"-.030"

Connecting Rod

Center to Center Length ..... 6.8125"
Upper Bearing ..... Locked on Pin
Lower Bearing
All engines except '53
Powerglide ..... Centrifugally Cast (Babbitt)
53 Powerglide
Engine ..... Precision Interchangeable Insert (Steel Backed, Babbitt)
Bearing Bore Diameter
All engines except
53 Powerglide Engine ... 2.3135"-2.3140"
53 Powerglide Engine ..... 2.3127"-2.3138"
Lower Bearing Clearance
New ..... .001"-.003"
Used ..... .001"-.0045"
Side Clearance Rod to Crankpin
checked at upper half of bearing
All Engines except
53 Powerglide ..... .004"-.012"
53 Powerglide Engine ..... .005"-.012"
Clearance Rod to Piston
Pin Boss ..... .015" Min.

Piston

Diameter Clearance at Skirt
Cast Iron ..... Hold on .003" Feeler
Aluminum
(53 Powerglide) ..7 lb. to 18 lb. pull with .0015" Feeler
Oversize Pistons
216.5 Engine ..... .001"-.020"-.030"-.040"
235.5 Engine (Except '53
Powerglide) .001"-.010"-.020"-.030"-.040"
53 Powerglide .... .001"-.020"-.030"-.040"

Piston Pin

Diameter
1949-53 (Except 53 Powerglide) .8645"-.8650"
1953 Powerglide ..... .8660"-.8665"
Oversize
1949-53 (Except
53 Powerglide) .. .0015"-.003"-.005"-.010"
1953 Powerglide ..... .0015"-.003"-.005"
Piston Pin Fit ..... Thumb Push Fit

Compression Ring

Quantity 2
Type
1949-52 (216.5 Engine) .... Both Taper-Face
1950-53 (235.5 Engine Except
53 Powerglide) ..... Upper—Twist-Type
Lower—Taper-Face
1953 Powerglide ..... Both Twist-Type
Width
Twist-type ..... .093"-.0935"
Taper-face ..... .1235"-.1240"
Gap
Twist-type ..... .007"-.017"
Taper-face ..... .005"-.015"
Ring Groove Clearance (Taper
Face Only) ..... .0015"-.003"

Oil Ring

Quantity 1

Type
- All Except 1953 Powerglide ..... Wide Slot
- 1953 Powerglide .. Wide Slot with Expander

Width ..... .1860"-.1865"
Gap ..... .005"-.015"
Ring and Groove Clearance ..... .002"-.0035"
Ring Gap Spacing ..... 120°

Camshaft

Number of Bearings 4
Bearing Journal Diameter
- Front ..... 2.0282"-2.0292"
- Front-Intermediate ..... 1.9657"-1.9667"
- Rear-Intermediate ..... 1.9032"-1.9042"
- Rear ..... 1.8407"-1.8417"

Runout at Intermediate Bearing ..... .002"
Thrust Taken ..... By Thrust Plate
Camshaft End Clearance ..... .001"-.005"
Camshaft Bearing
- Type ..... Steel Backed Babbitt Lined
- Front ..... 2.0307"-2.0317"
- Front-Intermediate ..... 1.9682"-1.9692"
- Rear-Intermediate ..... 1.9057"-1.9067"
- Rear ..... 1.8432"-1.8442"

Bearing Clearance ..... .002"-.004"
Camshaft End Plug
- Assembly in Crankcase .. Flush to $\frac{1}{32}$" Deep

Intake Valve

Lash–Hot ..... .006"-.008"
Seat Angle ..... 30°
Diameter–Head
- 1949-52 216.5 Engine ..... $1\frac{11}{64}$"
- 1950-52 235.5 Engine ..... $1\frac{15}{16}$"
- 1953 All 235.5. Engines ..... $1\frac{7}{8}$"

Length–Overall
- 1949-52 216.5 Engine ..... 6.260"-6.290"
- 1950-53 All 235.5 Engines ..... 6.364"-6.394"

Diameter–Stem ..... .3410"-.3417"
Guide Ream ..... .3427"-.3437"
Stem to Guide Clearance ..... .001"-.003"
Intake Opens
- 1949-53 All Except 1953 Powerglide ..... 1° A.U.D.C.
- 1953 Powerglide ..... 16° B.U.D.C.

Intake Closes
- 1949-53 All Except 1953 Powerglide ..... 39° A.L.D.C.
- 1953 Powerglide ..... 48° A.L.D.C.

Intake Period
- 1949-53 All Except 1953 Powerglide ..... 218°
- 1953 Powerglide ..... 244°

Width of Seat (in head) ..... $\frac{3}{64}$"-$\frac{1}{16}$"

Exhaust Valve

Lash–Hot ..... .013"-.015"
Seat Angle
- 1949 Engine ..... 30°
- 1950-53 Engines ..... 45°

Diameter–Head
- 1949 Engines ..... $1\frac{15}{32}$"
- 1950-53 Engines ..... $1\frac{1}{2}$"

Length–Overall
- 1949 Engine (216.5) ..... 4.839"-4.869"
- 1950 Engine (216.5) ..... 4.917"-4.947"
- 1950 235.5 Engine and All 1951-53 Engine ..... 4.902"-4.932"

Diameter–Stem ..... .3400"-.3407"
Guide Ream ..... .3427"-.3437"
Stem to Guide Clearance ..... .002"-.004"
Exhaust Opens
- 1949-53 All Except 1953 Powerglide ..... 42° B.L.D.C.
- 1953 Powerglide ..... 46°30′ B.L.D.C.

Exhaust Closes
- 1949-53 All Except 1953 Powerglide ..... 9° A.U.D.C.
- 1953 Powerglide ..... 17°30′A.U.D.C.

Exhaust Period
- 1949-53 All Except 1953 Powerglide ... 231°
- 1953 Powerglide ..... 244°

Width of Seat (in head) ..... $\frac{1}{16}$"-$\frac{3}{32}$"

Valve Guide

Extend above head	Intake	Exhaust
1949-52 216.5 Engines	$1\frac{1}{16}$"	$\frac{61}{64}$"
1950-53 235.5 Engines	1"	$\frac{55}{64}$"

Valve Lifter

Diameter ..... .989"-.990"
Clearance Block to Lifter ..... Selective fit

Valve Spring

Free Length
- 216.5 Engine ..... $2\frac{1}{8}$"
- 235.5 Engine ..... $2\frac{5}{32}$"

Lbs, Pressure at $1\frac{1}{2}$"
- 216.5 Engine ..... 124-140 lbs.

Lbs, Pressure at $1\frac{1}{2}$"
- 235.5 Engine ..... 155-165 lbs.

Valve Rocker Shaft

Rocker Shaft Diameter ..... .7910"-.7917"
Rocker Arm Bore ..... .7922"-.7935"

Timing Gear

Back Lash ..... .003"-.005"

Crankshaft Gear

Material ..... Steel
Teeth 27
Runout ..... .003"

Camshaft Gear

Material... Steel Hub with Bakelite and Fabric
Teeth 54
Runout ..... .004"

Oil Pump

Type and Drive... Gear Pump Driven by Tang on Distributor

Lbs, Pressure
All engines except 1953
Powerglide .... 14 lbs. at 2000 RPM
1953 Powerglide .... 45 lbs.

Spark Plugs

Make, Model, Size
1949-52 Engines .... AC 46-5-14MM
1953 Engines .... AC 44-5-14MM
Spark Plug Gap
AC 46-5 .... .035"
AC 44-5 .... .033"-.038"

Distributor

Point Gap
1949-52 Engines .... New, .018"-.024"
Used, .015"-.022"
1953 Engines .... New, .016"-.021"
Used, .0125"-.0175"
Point Spring Tension
1949-52 Engines .... 17-21 ounces
1953 Engines .... 19-23 ounces

Idling Speed

1949-53 Std. Transmission .... 475 RPM
1950-53 Powerglide
Transmission ...... 425 RPM in "D" Range

Vacuum Reading at
Idling Speed .... 17-21 inches

Fan Belt Adjustment

Deflection Midway Between Pulleys
Wide Belt, 1949-52 .... 3/4"
Narrow Belt, 1953 .... 7/16"-1/2"

Clutch Housing Pilot Hole

Runout .... .008" Max.

Flywheel

Runout .... .008" Max.

Flywheel Housing 1950-53 Powerglide

Parallelism of Face .... .007"
Bore Runout .... .005" Max.

TORQUE WRENCH SPECIFICATIONS

ENGINE BOLTS AND NUTS

Cylinder Head Bolts 216.5 Engine .. 70-80 ft. lbs.
Cylinder Head Bolts 235.5 Engine .. 90-100 ft. lbs.
Valve Rocker Shaft Support
Bolts .... 25-30 ft. lbs.
Manifold Clamp Bolts .... 15-20 ft. lbs.
Manifold Stud Nuts (if used) ...... 25-30 ft. lbs.
Connecting Rod Pinch Bolt......... 25-35 ft. lbs.
Connecting Rod Nuts .... 35-45 ft. lbs.
Main Bearing Cap Bolts
(with oiled threads) .... 100-110 ft. lbs.
Crankcase Front End Plate
Screws .... 15-20 ft. lbs.

Timing Gear Cover Screws .... 6-7½ ft. lbs.
Clutch Housing Attaching Bolts .... 45-55 ft. lbs.
Flywheel Mounting Bolts .... 50-65 ft. lbs.
Oil Pan Flange Bolts .... 6-7½ ft. lbs.
Oil Pan Corner Bolts .... 12½-15 ft. lbs.
Clutch Cover to Flywheel Bolts ..... 25-30 ft. lbs.
Push Rod Cover Screws .... 6-7½ ft. lbs.
Oil Distributor Cover Screws ...... 6-7½ ft. lbs.
Water Pump Attaching Bolts ...... 25-30 ft. lbs.
Fuel Pump Attaching Bolts .... 15-20 ft. lbs.
Spark Plugs .... 20-25 ft. lbs.
Coil Attaching Bolts .... 5-8 ft. lbs.

FUEL SYSTEM

INDEX

CARTER CARBURETOR—1949

GENERAL DESCRIPTION

The carburetor used on all 1949 models is a Carter 684S downdraft type. Downdraft indicates that the carburetor is mounted above rather than below the intake manifold and the fuel travel is downward. With this type carburetor, gravity aids the engine vacuum in delivering a fuel mixture to the combustion chamber.

The downdraft carburetor embodies a principle which employs three venturis, one located above and two below the level of the gasoline in the float chamber. This triple venturi has the effect of increasing the suction on the first or primary venturi, causing the nozzle to start delivering gasoline at a very low air speed. The nozzle enters the primary venturi at an angle, discharging upward against the air stream. This angle provides an even flow of correctly proportioned and finely atomized fuel.

The gasoline thus atomized in the primary venturi is kept centrally located in the air stream by the surrounding blanket of air passing into the second venturi and this process is repeated by the air in the main venturi. By this means the fuel mixture is carried to the cylinders in a more perfectly atomized condition. This insulated atomization results in increased smoothness of operation at both low and high speeds.

The fuel mixture quality is controlled by a metering rod operating in the metering rod jet, and operated by the throttle lever. There are two steps of different diameters on this metering rod. The larger diameter, or economy step, is tapered and controls the gasoline flow to about seven-eighths throttle, at which time the smaller diameter, or power step, becomes effective, giving full power for either high speed or hard low speed pulling. By this means both maximum power and greater economy are available without changing the carburetor adjustment. Figure 76 shows a diagramatic view of the downdraft carburetor with

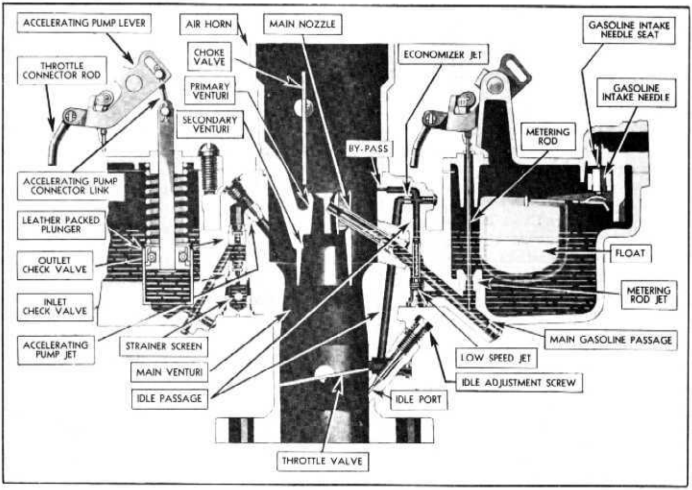

Fig. 76—Diagramatic View of Carter Downdraft Carburetor

details of various passages, jets, etc. identified.

The air pressure in the carburetor float chamber is balanced with the pressure inside of the air horn by a system of passages in the carburetor. The air intake for the balance passage consists of a brass tube pressed into the wall of the air horn and extending to the center of the air horn. This tube connects with a passage in the side of the air horn (fig. 77). With this balanced pressure, the proportions of air and gasoline in the mixture delivered to the engine remain substantially the same at all times, even when the air cleaner is restricted by dirt.

The choke consists of a one-piece choke valve, fastened by means of two screws to the choke shaft which is offset to one side of the carburetor air horn. The valve is machined with an angle on

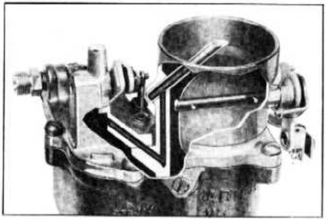

Fig. 77—Carburetor Balance Passages

each end to permit solid seating against the wall of the air horn. Due to the choke valve seating against the walls of the air horn, it cannot be damaged by backfire.

The inner choke lever is mounted on a boss on the air horn and is retained by a snap ring fitted into a groove in the boss.

The inner choke lever also incorporates a pin which engages a slot in the fast idle link (fig. 78). This link is attached and pivots at its lower end, on the throttle valve shaft. The throttle stop screw bears against the edge of this link.

The outer choke lever is attached to the choke valve shaft and a light coil spring is used to connect the inner lever to the outer lever. In this way the outer choke lever and valve are operated by the inner choke lever through the spring. When the choke button on the instrument panel is pulled out, it causes the inner choke lever to rotate around the boss on which it is mounted. The light coil spring which is attached to it causes the outer choke lever to rotate which rotates the choke valve shaft and closes the choke valve. The pin in the inner choke lever which is engaged in

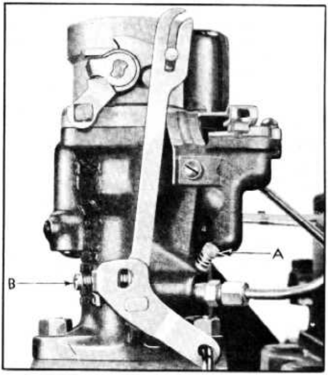

Fig. 78—Fast Idle Link

the slot in the fast idle link causes the link to move. This movement is such that it causes an opening of the throttle through the throttle stop screw which bears against this link. This provides for a compensation in throttle opening with choke valve operation which will prevent unnecessary flooding.

The accelerating pump consists of a cylinder with a plunger which is below the fluid level at all times and two check valves, one on the inlet and one on the outlet side. The accelerating pump plunger spring located on top of the plunger allows for a positive non-variable pressure available at all times. The accelerating pump plunger including the shaft, guide and leather is made as an assembly. The shaft is rectangular and bears in the bowl cover.

Gasoline enters the low speed jet through a $\frac{3}{64}$" hole drilled through the jet at the recess between the threaded section and the base of the jet, which coincides with the low speed well in the carburetor body (fig. 76). The metering hole is drilled vertically and is .035" in diameter. This design prevents the possibility of the engine stalling due to gasoline surging away from this jet when the brakes are applied suddenly.

The main nozzle is of two-piece construction with the inner nozzle pressed into the outer nozzle, thereby maintaining the proper relationship between the openings in the walls of the two nozzles. The nozzle assembly is held in place by a brass plug having a .130"-.150" hole drilled through its center.

The throttle shaft end of the throttle connector rod fits through the throttle lever and is retained by a hairpin lock at this point. The pump arm end of the rod is flattened and has a small groove machined into it to receive a lock. When the connector rod is assembled to the pump arm a small coil spring fits over the rod and is held in place by a stamped lock. This method of attachment provides a minimum of friction while still providing an anti-rattling device.

OPERATION

ACCELERATING PUMP

The upward movement of the pump plunger, when the throttle is closed compresses the plunger spring and draws a small quantity of gasoline into the bottom of the pump cylinder. The slightest opening of the throttle allows a downward movement of the pump plunger which is under spring pressure and causes an immediate discharge through the pump jet into the main venturi (fig. 79).

STARTING

With the choke valve in the closed position, as when starting a cold engine, the fast idle link is rotated and opens the throttle valve a maximum of approximately 12° on full choke. Suction from the down stroke of the engine piston then draws a small amount of air past the choke valve (fig. 80), which is then mixed with gasoline drawn from the main nozzle and forms a rich mixture for easy starting. When the engine starts, the incoming rush of air overcomes the choke shaft spring tension and opens the choke valve just the right amount to maintain a running mixture.

Fig. 79—Carburetor Accelerator Pump Operation

Fig. 80—Carburetor Operation When Starting Engine

IDLING

At idling speed the throttle is almost completely closed. The suction from the down stroke of the engine piston is concentrated on the idling port below the throttle valve. This suction is applied to the low speed passage in the carburetor body and results in air being drawn in through the by-pass hole in the carburetor body. The air is then swept over the top of the low speed jet, causing gasoline to be lifted from the jet. The gasoline and air mixture then passes through the economizer and down the idle passage to the idling ports where it mixes with air passing the throttle and is discharged into the throat of the carburetor (fig. 81). It is then carried on through the manifold to the cylinders.

As the throttle valve is opened the idling port above the throttle valve is uncovered and further increases the suction on the idling system permitting it to furnish the necessary fuel mixture for the increase in engine speed.

LOW SPEED

At low speed the throttle is partly open and

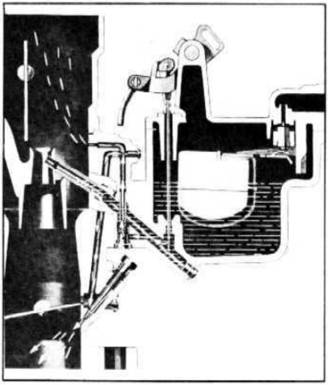

Fig. 81—Carburetor Operation During Idling

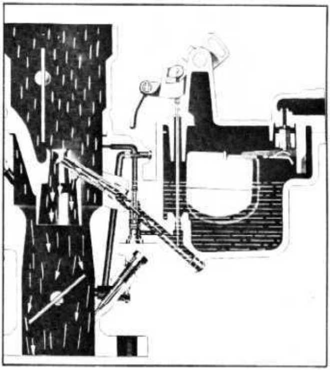

Fig. 82—Carburetor Low Speed Operation

suction from the down stroke of the engine piston draws air in through the air horn. The air in passing through the main venturi increases in velocity with the result that the suction is increased over the secondary venturi. The increased air speed through the secondary venturi in turn steps up the suction on the primary venturi and thereby increases the air speed through the primary venturi. The air, passing through the primary venturi, draws gasoline from the main nozzle (fig. 82) where it is mixed with the air passing through the primary, secondary, and main venturi forming a finely atomized mixture which then passes on into the manifold and cylinders.

HIGH SPEED

The carburetor operation at higher speeds is similar to the low speed operation with the exception of raising the metering rod in the metering rod jet. This serves the same purpose as increasing the size of the jet and thereby furnishes the additional gasoline required for higher speeds and wide open throttle power operation.

MINOR SERVICE OPERATIONS

All carburetors are carefully tested and adjusted to the engine requirements before leaving the factory. Too often in servicing operations, adjustments are made on the carburetor, when in reality something else is causing uneven running or the engine has not thoroughly warmed up.

Before making any carburetor adjustments make sure that the carburetor to manifold and manifold to cylinder head bolts are tight, thus preventing air leaks and have the engine thoroughly warmed up to operating temperature.

There are four adjustments that can be made on the carburetor to improve performance when necessary; idling mixture and idling speed adjustments which should be made together and which are external adjustments, and float level and metering rod adjustments which are internal.

IDLING MIXTURE ADJUSTMENT

1. Screw idle adjusting screw "A" (fig. 83) all the way in.
2. Back off idle adjusting screw "A" 1¾ turns.
3. Allow engine to idle.
4. Turn screw either way from this position until best idle point is reached.

NOTE: If it is necessary to turn adjusting screw more than ½ turn in either direction to get a satisfactory idle, internal trouble is indicated.

IDLING SPEED ADJUSTMENT

1. Make sure hand throttle and hand choke on instrument panel are closed.

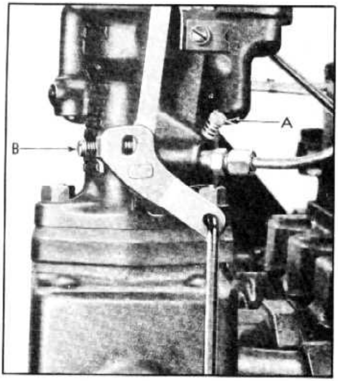

Fig. 83—Carburetor Idle Adjustment

2. Adjust throttle lever stop screw "B" (fig. 83) so engine runs at approximately 450 to 500 revolutions per minute.
3. If engine runs too fast, back screw out. If engine runs too slow, turn screw in until proper speed is obtained.
4. Recheck idle mixture adjustment as indicated in number 4 above.

FLOAT LEVEL ADJUSTMENT

1. Remove carburetor air cleaner from air horn.
2. Remove dust cover from carburetor bowl.
3. With throttle valve in open position, remove stamped retainer from pump arm end of the throttle connector rod by pushing in on the retainer and turning it 90 degrees. Remove anti-rattle spring.
4. Disconnect metering rod spring and remove metering rod and metering rod disc, being careful not to bend the rod.
5. Remove hairpin lock from pump connector link and remove pump connector link.
6. Remove four bowl cover screws and remove bowl cover and float assembly.
7. Remove bowl cover gasket.
8. With bowl cover upside down measure the distance from the top of the float to the machined under surface of the bowl cover (fig. 84).

   NOTE: This distance should be ½" and can be accurately checked with J-818-1 Float Level Gauge.

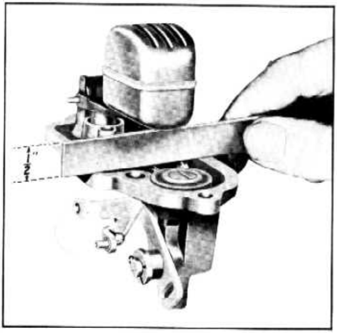

Fig. 84—Checking Carburetor Float Level

9. If float level must be reset, bend lip contacting intake needle up to lower the float and down to raise it.

   NOTE: Do not make this adjustment by pressing on the float. Bend the lip that contacts the needle.

10. Turn cover right side up and check the low position of the float by measuring from the under side of the cover to the top of the float at the outer end. This distance should be 1".

    NOTE: If adjustment is necessary, bend the two stops on the float with a small pair of pliers.

11. Replace bowl cover using a new gasket.
12. Connect carburetor pump lever to pump plunger by installing pump connector link and hairpin lock.
13. Replace metering rod disc and metering rod and connect metering rod spring.
14. Attach throttle connecting rod to pump lever and secure with anti-rattle spring and stamped retainer.
15. Replace carburetor bowl dust cover.
16. Install carburetor air cleaner on air horn.

METERING ROD

The metering rod controls the amount of gasoline that passes through the jet and may be changed to meet various climatic, gasoline or driving conditions.

There are three metering rods available which are marked as follows:

Standard	67-46
1 Step Lean	68-49
1 Step Rich	66-42

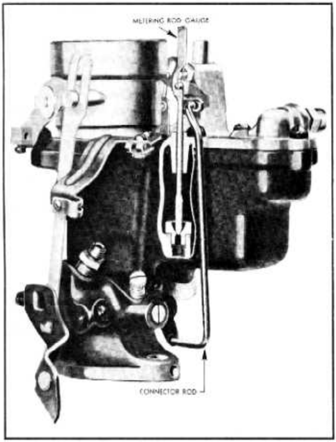

Fig. 85—Checking Throttle Connecting Rod with Metering Rod Gauge

Whenever a new metering rod is to be installed or after the old metering rod has been removed, a metering rod gauge T-109-25 should be used to assure that the position of the throttle valve and the metering rod are in correct relation with each other.

The following procedure should be followed to synchronize the metering rod with the throttle valve.

1. Remove carburetor air cleaner.
2. Remove dust cover from carburetor bowl.
3. Disconnect metering rod spring and remove metering rod.
4. Disconnect connector rod from throttle lever.
5. Make sure choke valve is fully open and back off throttle stop screw until throttle valve is closed tightly.
6. Install metering rod gauge T-109-25 by threading it through the bowl cover.

NOTE: Make sure gauge seats in metering rod jet (fig. 85).

7. Press down on the pump arm until the pivot pin rests firmly on top of the gauge (fig. 85).
8. With pump arm in this position and the throttle valve fully closed, bend throttle connector rod at the throttle valve end so that connector rod will enter hole in throttle valve lever freely. Install hairpin lock.
9. Remove metering rod gauge, install metering disc and rod and connect metering rod spring.
10. Turn throttle stop screw in until throttle just starts to open.
11. Replace carburetor bowl dust cover.
12. Replace carburetor air cleaner.
13. Adjust idling speed and idling mixture.

MAJOR SERVICE OPERATIONS

The perfect carburetor delivers the proper gasoline and air ratios for all speeds of the particular motor for which it was designed. By completely overhauling at regular intervals, which will allow cleaning and replacing of all worn parts, the carburetor can be returned to its original condition and it will then deliver the proper ratios as it did when new.

Removal

1. Loosen air cleaner clamp bolt and remove air cleaner.
2. Disconnect fuel and vacuum lines from carburetor.
3. Release the choke and throttle cable clamps and lock screws and remove cables from carburetor.
4. Disconnect throttle rod from throttle shaft lever.
5. Remove the two carburetor flange to manifold stud nuts and lift carburetor off.

Disassembly

1. Remove dust cover from carburetor bowl.
2. With the throttle valve in the open position, remove stamped retainer and anti-rattle spring from pump arm end of throttle connector rod and hairpin lock from throttle lever end and remove connector rod.
3. Disconnect metering rod spring and remove metering rod and disc being careful not to bend rod.
4. Remove hairpin lock from pump connector link and remove pump connector link.
5. Remove four bowl cover screws and remove bowl cover and float assembly.
6. Remove float pivot and remove float and needle valve from cover.
7. Using tool J-816-4 remove needle valve seat from cover.
8. Remove accelerating pump plunger spring, pump plunger and metering rod jet from carburetor float bowl.

NOTE: Use tool J-816-4 to remove metering rod jet.

9. Loosen three screws attaching air horn to carburetor body.
10. Remove main nozzle passage plug using tool J-816-7.
11. Remove main nozzle screw plug using tool J-816-2.
12. With a screwdriver, reach down through the air horn and press on the "D" section of the main nozzle to remove nozzle from primary venturi.

NOTE: Do not press on end of the main nozzle.

13. Remove air horn screws and air horn.
14. Remove low speed jet using tool J-816-2.
15. Remove passage plug and screen for accelerating pump check valves using tool J-816-4.
16. Remove inlet and outlet check valves using tool J-816-2.
17. Remove passage plug for accelerating pump jet using tool J-816-2.
18. Remove accelerating pump jet using tool J-816-1.
19. Remove idle adjusting screw and idle port passage plug using tool J-816-7.
20. It will not be necessary to remove the choke or throttle valves unless the following inspections indicate that they require replacement.

Inspection

1. Wash all parts thoroughly in cleaning solvent.
2. Check the idle ports and first by-pass for carbon deposits.
3. Blow out all drilled passages with compressed air in the opposite direction to that of normal flow of air or gasoline.
4. Inspect the main nozzle for burrs at the venturi end.
5. Blow out the low speed jet and make sure the metering hole in jet is clean.
6. Check operation of inlet and outlet check valves.
7. Inspect accelerating pump jet to make sure it is clean.
8. Inspect accelerating pump plunger. If the leather or its expanding spring are damaged in any way the plunger assembly should be replaced.
9. Inspect the metering rod and metering rod jet for wear or damage and make sure correct metering rod is being used.
10. Check float for dents and wear on lip and float pin. Check bowl cover for warpage and wear in countershaft hole. If needle shows groove on seating surface replace both needle and seat.
11. Check throttle shaft arm for looseness on the shaft and for excessive wear at throttle rod connection.
12. Check throttle shaft for excessive looseness in the carburetor body.
13. Inspect throttle arm for wear.
14. Make sure choke valve opens and closes freely. Hold lever in closed position and push valve open to see that choke spring has normal tension.
15. Replace all worn or damaged parts. If throttle or choke valve parts require replacement they may be replaced according to the following procedure.

REPAIRS

Throttle Valve

1. File off upset ends of throttle valve to shaft screws, remove screws and throttle valve.
2. Loosen throttle arm lock screw and remove arm from shaft.
3. Remove shaft and lever assembly. Replace damaged parts.
4. Install throttle shaft and lever assembly.
5. Place throttle arm on end of shaft and tighten lock screw.
6. Place throttle valve on shaft with the letter "C" stamped on valve toward the idle port (fig. 86). Install new valve to shaft screws, tighten securely and upset ends so they will not loosen.

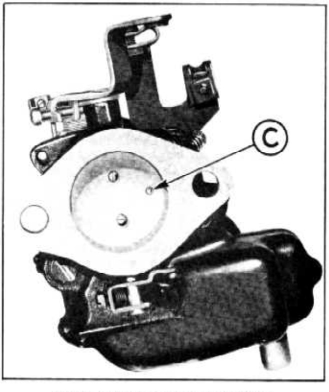

Fig. 86—Correct Assembly of Throttle Valve

Choke Valve

1. File off upset ends of choke valve to shaft screws, remove screws and choke valve.
2. Disconnect choke spring from outer choke lever and remove shaft assembly.
3. Remove snap ring holding inner choke lever on boss of air horn and remove lever and spring disengaging lever pin from fast idle link. Replace all damaged or worn parts.
4. Place spring and inner choke lever on air horn boss engaging lever pin in slot in fast idle link and install snap ring.
5. Install choke shaft assembly and hook choke spring to outer choke lever.
6. Place choke valve in position with letter "C" on valve toward the top.
7. Install new valve to shaft screws, tighten securely and upset ends so they will not loosen.

ASSEMBLY

1. Install air horn to carburetor body making sure the small gasket is in place at the balance passage and that the control clip assembly is on the screw above the idling adjusting screw.
2. Assemble copper gasket (4) on main nozzle (5) (fig. 87). Hold carburetor with air horn down, line up "D" section on end of nozzle with "D" opening in primary venturi and drop nozzle into the opening.

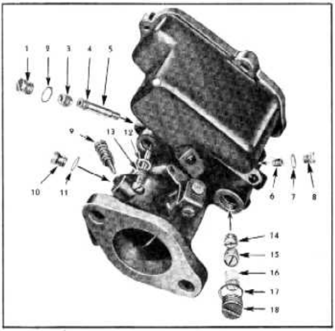

Fig. 87—Carter Downdraft Carburetor Jets and Plugs

1. Passage Plug
2. Passage Plug Gasket
3. Nozzle Screw
4. Main Nozzle Gasket
5. Main Nozzle
6. Pump Jet
7. Passage Plug Gasket
8. Passage Plug
9. Idle Adjusting Screw and Tension Spring
10. Passage Plug
11. Passage Plug Gasket
12. Low Speed Jet Gasket
13. Low Speed Jet
14. Pump Outlet Check Valve
15. Pump Inlet Check Valve
16. Pump Strainer Screen
17. Passage Plug Gasket
18. Pump Screen Retainer and Passage Plug

3. Install nozzle screw plug (3) and tighten it securely. Tighten the three air horn screws and then install main nozzle passage plug (1) using a new copper gasket (2) and tighten securely.
4. Install the low speed jet (13) and gasket (12) in carburetor body and tighten securely. Remove jet and check bearing at end. If there is a complete bearing around the end of the jet as indicated in Figure 88 reinstall jet. If bearing is not complete, install a new jet.

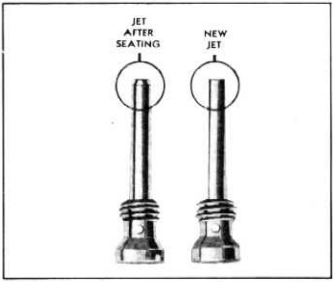

Fig. 88—Checking Seat on Low Speed Jet

5. Install the inlet (14) and outlet (15) check valves, tightening securely.
6. Install strainer screen (16) passage plug (18) and gasket (17) and tighten plug securely.
7. Install accelerating pump jet (6), plug (8) and gasket (7), tightening both jet and plug securely.
8. Install the metering rod jet and gasket and tighten securely.
9. Place the accelerating pump plunger in the pump cylinder using sleeve J-507.
10. Slip the accelerating pump plunger spring over the pump plunger.
11. Install the float needle valve, seat and washer in the bowl cover, tightening seat securely.
12. Install float and float lever pin.
13. With the cover turned upside down and gasket removed check float lever and adjust if necessary as outlined under "Float Level Adjustment."
14. Install a new bowl gasket and install cover to bowl and tighten securely.
15. Connect carburetor pump lever to pump plunger with pump connector link and hair-pin lock.

16. Assemble throttle connector rod to the pump arm and install anti-rattle spring and retainer to rod end.
17. With choke valve fully open, back off throttle stop screw until throttle valve closes tightly.
18. Install metering rod gauge T109-25 and synchronize metering rod with throttle lever as outlined under "Metering Rod."
19. Remove metering rod gauge and install proper metering rod with disc dropping it into position and hook eye over pivot pin. Hook metering rod spring to metering rod.
20. Turn throttle stop screw in with choke valve open until throttle starts to open and then ¾ turn more.
21. Install the idling adjusting screw and spring (9) (fig. 87). Turn screw in until it seats and then back off 1¾ turns.
22. Install idle port passage plug (10) and gasket (11) and tighten securely.
23. Lubricate pump arm felt wick with a few drops of engine oil and install dust cover and attaching screw.

INSTALLATION

1. Place carburetor in position on manifold studs and install retaining nuts. Tighten evenly and securely.
2. Connect fuel and vacuum lines to carburetor.
3. Push choke and throttle button in against instrument panel.
4. Install carburetor throttle rod to throttle lever.
5. Push hand throttle wire and conduit through clamp on carburetor and hole in end of throttle lever rod.
6. Tighten clamp and install wire guide leaving about ⅛ inch between guide and throttle lever rod with throttle valve closed.
7. Push choke wire and conduit through clamp on carburetor and enter wire in connector on choke lever.
8. Tighten clamp and wire retaining screw in connector.
9. Check choke and throttle operation by pulling choke and throttle button on dash all the way out. Throttle valve should be fully open and choke valve fully closed.
10. Push buttons all the way in. Throttle valve should be fully closed to stop screw and choke valve should be fully open.
11. Install air cleaner.
12. Start engine and after it has warmed to operating temperature make necessary idle mixture and idle speed adjustment as outlined under "Idle Mixture" and "Idle Speed Adjustment."

GENERAL DESCRIPTION

ROCHESTER CARBURETOR—1950-51 MODELS

The carburetor used on all 1950-51 models is a Rochester Model "B" downdraft carburetor (fig. 89).

This carburetor presents several distinct features of importance to the car owner and the mechanic. Foremost among these features are:

(a) Concentric fuel bowl–Regardless of any shift of fuel level in the bowl, the main metering jet is at all times immersed in fuel.

(b) Centrally located main discharge nozzle–A shift in fuel level has little or no effect on the rate of discharge from the nozzle.

(c) The main well and support assembly, which contains the main metering jet and the power valve, is attached to the cover and suspended in the float bowl which provides ease in servicing.

(d) A fast idle mechanism, which is in linkage with the choke lever, is an aid to faster, more efficient cold weather starting and helps to prevent over-choking.

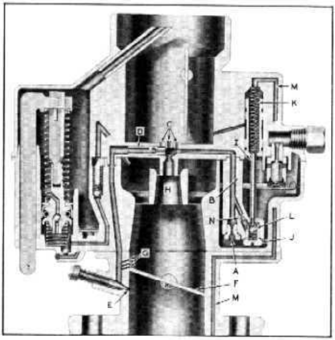

Fig. 89—Rochester Carburetor Cross Section

Although functionally the same, there are two model "B" carburetors used on passenger car models; one is for the 216 cubic inch engine, and the other for the 235 cubic inch engine. The main differences between the two carburetors are the size of the carburetor throat diameter and the size of orifices in some of the carburetor jets.

	Size of I.D. of Main Venturi	Size of Throttle Bore
216 Cu. In. Engine...	1.218″	1½″
235 Cu. In. Engine...	1.343″	1$\frac{9}{16}$″

A Throttle Return Check is used in conjunction with the carburetor assembly used on the 1950-52, 235 cubic inch passenger car engine. This unit (fig. 90) is designed to retard throttle closing, gradually slowing the engine down from a fast idle to the normal idle speed when the throttle is closed.

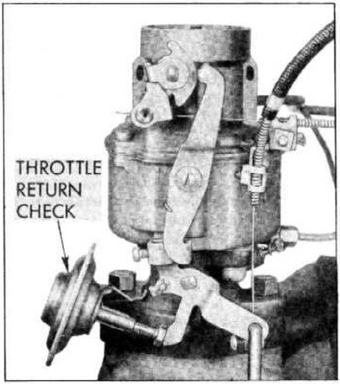

Fig. 90—Throttle Return Check

OPERATION

Idle System

At idle speed, the throttle is almost completely closed. The idle fuel first passes from the bowl through the calibrated main metering jet "A" (fig. 89) in the bottom of the main well support assembly "B".

The fuel is then drawn up the main well by manifold vacuum (suction) to the crossbar of the air horn. Air joins the solid fuel through the three calibrated air bleeds "C" in the center of the crossbar. The fuel/air mixture is then calibrated by the idle tube "D" and passes down the passage in the float bowl to the throttle body.

The idle fuel is then metered to the engine by the idle adjusting needle hole "E" which is below the throttle valve "F". As the throttle valve is opened the secondary idle holes "G" are exposed in turn to manifold vacuum and deliver additional fuel to meet the increased engine demand.

NOTE: Late 1951 models having 235 engines and Powerglide transmissions have a revised idle system. See "General Description—1952-53 Models."

Part Throttle System

As the throttle valve "F" is opened to a greater degree; additional suction is applied to the main discharge nozzle "H" in the crossbar. As a consequence the fuel begins to pass from the main nozzle rather than through the idle system.

The calibration of the main metering jet "A" and the air bleeds "C" in the crossbar controls and maintains the economical fuel/air ratios throughout the 25-70 mph driving range.

Power System

To provide for additional fuel for sustained high speed operation or increased road load power, the vacuum operated power system delivers such fuel readily and economically.

A direct manifold vacuum passage "M" within the carburetor which connects to the engine intake manifold, operates this system. At any manifold vacuum above 5″ of mercury, the power actuating piston "I" is held by suction in the "Up" position against the compression of the power spring "K". Consequently, no fuel passes through the ball type power valve "J". With any decrease in vacuum below 5″ mercury, the calibrated power spring "K" immediately forces the power piston down, which unseats the spring loaded ball "L" in the power valve "J". Fuel then passes readily around the ball into the base of the main well support assembly. The calibrated power restriction "N" meters the fuel prior to joining the fuel from the main metering jet, "A" and is delivered to the engine. Coversely as the manifold vacuum rises above 5″ mercury, the power piston is drawn immediately to the "Up" position and the engine returns to the economical part throttle mixtures of the carburetor.

There is no adjustment required for either the part throttle or power systems.

Float System

The Model "B" carburetor is completely balanced (fig. 91). The balance tube connects the carburetor air intake and the float bowl, thereby

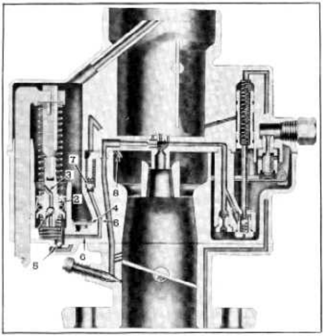

Fig. 91—Carburetor Pump System

equalizing air pressures. In this manner, any accumulation of dirt in the air cleaner is compensated for and prevents any erratic richer mixtures.

To aid in maintaining the correct fuel level under all conditions the carburetor employs twin floats. It is of utmost importance that the floats be adjusted carefully and accurately.

Pump System

To provide for smooth, quick acceleration, a double spring pump plunger is used in the Model "B" carburetor. The rates of compression of the top spring versus the bottom spring is calibrated to insure a smooth, sustained charge of fuel for acceleration.

To exclude dirt, all fuel for the pump system first passes through the pump screen "4" (fig. 91) in the bottom of the float bowl. It is then drawn past the ball check "5," into the pump well on the intake stroke of the plunger "2." Upon acceleration, force of the pump plunger seats the ball check "5" and forces the fuel up passage "6." The pressure of the fuel lifts the pump outlet ball check "7" from its seat overcoming the check ball spring pressure. The fuel is then sprayed on the bottom edge of the venturi by the pump jet "8" and delivered to the engine. No targeting of the pump jet is required.

For greater driving ease, the plunger head is designed to eliminate fuel porcolation in the pump system. This has been accomplished by designing a by-pass around a ball check "1" in the plunger head "2." When the engine is not operating, any build up of fuel vapors in the pump will by-pass this ball allowing the hot fuel and vapors to circulate up the passage "3" in the plunger head and return to the float bowl. Otherwise, any vapor pressure built up would evacuate the fuel in the pump system into the engine manifold, causing poor initial acceleration due to lack of fuel in the pump system when engine is hot.

NOTE: Late 1951 models having 235 engines and Powerglide transmissions have a revised pump system. See "General Description—1952-53 Models."

MINOR SERVICE OPERATIONS

All carburetors are carefully calibrated to the engine requirements and then are tested and adjusted before leaving the factory. Too often, in servicing operations, adjustments are made on the carburetor, when in reality something else is causing uneven running or the engine has not thoroughly warmed up.

Before making any carburetor adjustments, make sure that the carburetor to manifold and manifold to cylinder head bolts are tight, thus preventing air leaks. Of equal importance is to have the engine thoroughly warmed up to operating temperature. On the G.M. Model "B" carburetor, there are only two external adjustments and one internal adjustment. The idle mixture and idle speed adjustments are external adjustments and should be made together. The only internal adjustment is the float level adjustment.

The adjustment of the throttle return check on models so equipped, should only be made after the idle speed and idle mixture are properly adjusted.

IDLE MIXTURE ADJUSTMENT

1. With engine at operating temperature, screw idle adjusting screw "A" (fig. 92) all the way in.

CAUTION: To prevent scoring or grooving the needle on the adjusting screw, do not turn it in too tight.

2. Back off the idle adjusting screw "A" 1 to 2½ turns.
3. Start engine and allow to idle.
4. Turn screw either way from this position until best idle point is reached.

NOTE: On passenger cars equipped with Powerglide 235 engines, set parking

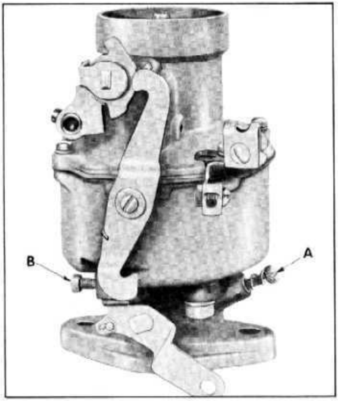

Fig. 92—Idle and Mixture Adjustment

brake tight and move transmission selector lever to "D" range while making this adjustment.

IDLE SPEED ADJUSTMENT

1. Make sure hand throttle and hand choke buttons on instrument panel are pushed in all the way and that the accelerator and throttle linkage is free so that throttle stop screw "B" is against the stop. (1951 models are not equipped with hand throttle.)
2. Connect a tachometer to the engine and with engine at operating temperature, turn screw "B" in or out to obtain an idling speed of 450 to 500 revolutions per minute on all models except passenger cars equipped with Powerglide 235 engine.
3. Recheck idle mixture adjustment so that the idle mixture and idle speed adjustments, in combination with each other, produce a smooth idle at the required RPM.
4. On passenger cars equipped with Powerglide 235 engine, place selector lever in "N" range and turn screw "B" in or out to obtain an idling speed of 500 RPM.
5. Set the parking brake tight and move selector lever to "D" range. Readjust the idle mixture screw for smooth engine performance at idle. This setting will give approximately 440 RPM.

NOTE: Snap accelerator pedal several times when changing any of these adjustments to remove any lag from carburetor and linkage. On passenger cars with Powerglide 235 engines shift transmission to "N" before snapping accelerator pedal.

FLOAT LEVEL ADJUSTMENT

1. Remove carburetor air cleaner from cover assembly.
2. Release the choke and throttle cable clamps (1950) or choke only (1951) and remove cables or cable from carburetor.
3. Disconnect fuel line at carburetor cover fitting.
4. Remove cover attaching screws and choke bracket with wires attached.
5. While holding throttle kick lever, lift cover straight up to prevent damage to floats.
6. With cover fully assembled and cover gasket in position, place assembly upended on a flat surface.
7. Place fuel float gauge, part No. 3696192, into position (fig. 93) with tang at center of gauge located in the main discharge nozzle of the cover.

   NOTE: Float level gauge, part No. 3696192, is available through the Parts Department.

8. Bend float arms vertically so that each float just touches top portion of gauge.

Fig. 93—Float Adjustment Check

NOTE: If both floats are level, the tab may be bent to raise or lower floats.

9. Carefully bend float arms horizontally so that each float is centered in the gauge. Tilt assembly 90° each side and check that floats do not touch gauge (fig. 94). This insures that floats will not rub inner or outer sides of float bowl. Recheck level adjustment.

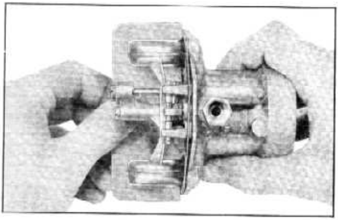

Fig. 94—Float Center Check

FLOAT DROP ADJUSTMENT

To insure sufficient entry of fuel under high speed operation, it is necessary to check and adjust the float drop.

With the cover assembly held right side up and floats suspended freely, carefully bend the float tang at rear of float assembly so that the bottom of the float is 1¾" below the gasket surface (fig. 95).

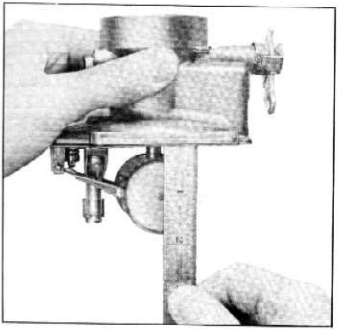

Fig. 95—Float Drop Adjustment

COVER ASSEMBLY INSTALLATION

1. Rotate throttle kick lever clockwise against tension of spring to a vertical position and carefully place cover assembly on bowl (fig. 96).

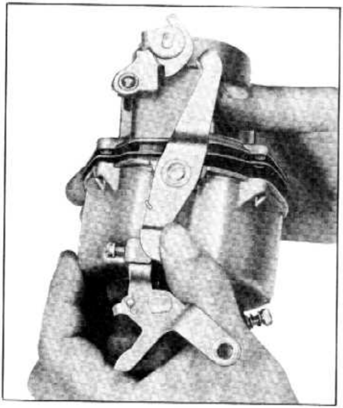

Fig. 96—Assemble Cover to Bowl

2. Install four attaching screws and choke bracket and tighten screws securely.
3. Connect fuel line to carburetor cover fitting.
4. Enter choke wire into connector on choke lever, check to see that choke button is pushed in against instrument panel and choke valve is fully opened. Then tighten choke wire retaining screw in connector. On 1950 models, check to see that throttle button is pushed in against instrument panel and throttle valve is fully closed. Then connect throttle wire.
5. Replace carburetor air cleaner and check and adjust idle speed and idle mixture, if necessary.

NOTE: On passenger cars Powerglide (235 engine) equipped with throttle return check, adjust check in accordance with instructions under "Throttle Return Check."

THROTTLE RETURN CHECK INSTALLATION AND/OR ADJUSTMENT

The throttle return check should be installed on carburetors used on late 1950 and 1951-2, 235 Powerglide passenger car engines. It may be installed on carburetors used on early 1950, 235 Powerglide passenger car engines, when a new throttle body assembly, part No. 7003235, equipped with a contact arm on the throttle lever, is also installed. Throttle return check is not used on 1953 Powerglide 235 engines.

To install throttle return check, proceed as follows:

1. Install carburetor and throttle return check assembly on engine manifold as shown in Figure 90.
2. Connect the carburetor controls, gasoline and vacuum spark control pipes.
3. Be sure that accelerator pull back spring, part No. 3695705, is used. Early 1950 production models used pull back spring, part No. 3685718. Figure 97 shows how the springs may be identified.

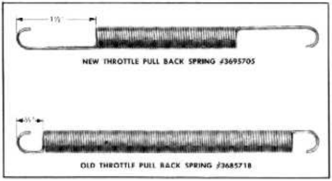

Fig. 97—Throttle Pull Back Springs

4. Check the alignment of the throttle return check adjusting screw with the contact arm on the throttle lever. It may be necessary to bend the throttle return check bracket or throttle lever contact arm to center the adjusting screw on the radius of the contact arm.
5. Connect a tachometer to the engine. Place the transmission control in "Park" position. Start the engine and run it at a fast idle to warm up.
6. Carburetor adjustments should not be made until engine is at operating temperature. While warming up, tighten manifold bolts and clamp nuts.
7. With selector lever in "N" (neutral), turn idle speed adjusting screw to obtain an idling speed of 500 RPM.
8. Set the parking brake tight and move selector lever to "D" (drive) range. Adjust the idle mixture screw to provide smooth engine performance at idle. This setting will result in an idle of approximately 440 RPM.

NOTE: Snap accelerator pedal several times when changing any of these adjustments to remove any lag from carburetor and linkage. Move selector lever to "N" (Neutral) range before snapping accelerator pedal.

9. Remove air cleaner and insert a .090" feeler gauge (fig. 98) between carburetor choke lever cam and the fast idle lever. Check return check screw to ascertain that screw does not project more than ⅜" to ½" measured from underside of screw head to shoulder of shaft.

   Center check screw head with throttle lever contact arm, bending return check bracket or throttle lever as necessary to obtain screw contact with throttle lever with initial ⅜" to ½" adjustment.

   While holding throttle return check shaft to keep it from turning, which would damage the diaphragm, turn adjusting screw until it just touches throttle lever contact arm using a piece of thin paper as a feeler.

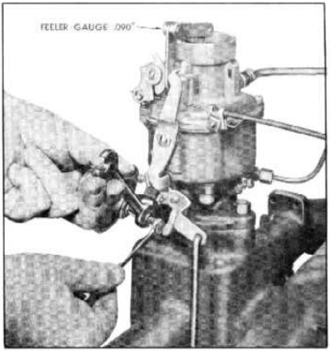

Fig. 98—Throttle Return Check Adjustment

10. Install air cleaner.
11. To shop test adjustment of throttle return check, with parking brake set and selector in "D" range, quickly accelerate engine to stall speed and then release accelerator pedal quickly. If the engine stalls, turn the return check adjusting screw out ½ turn at a time until engine does not stall. The maximum amount screw can be turned out without disengaging from the nylon lock is 1½ turns from initial adjustment.

MAJOR SERVICE OPERATIONS

The perfect carburetor delivers the proper gasoline and air ratios for all speeds of the particular engine for which it was designed. This efficient carburetion can be maintained by completely disassembling the carburetor at regular intervals. This will allow cleaning of all parts, passages and discharge holes which require extreme care in cleaning. Use only carburetor solvent and compressed air to clean passages and passage discharge holes. Never use wire or other pointed instrument to clean as calibration of carburetor will be affected.

REMOVAL

1. Loosen air cleaner clamp and remove air cleaner.
2. Disconnect fuel and vacuum lines from carburetor.
3. Release the choke and throttle cable clamps (1950) or choke only (1951) and remove cables or cable from carburetor.
4. Disconnect throttle rod from throttle shaft lever.
5. Remove the two carburetor flange to manifold stud nuts, remove the throttle return check if one is installed, and lift carburetor assembly from the vehicle.

DISASSEMBLY

1. Remove cover attaching screws and choke bracket.
2. Lift cover straight up to prevent damage to floats. Hold throttle kick lever while lifting cover.
3. Place cover up-ended on flat surface and remove float hinge pin and floats.
4. Remove float needle and using a screwdriver of proper width, remove float needle seat and fibre gasket.
5. Remove main metering jet and power valve assembly from main well support.

   NOTE: Use care when removing power valve not to lose small spring and ball.

6. Remove main well support attaching screw and lift support straight up to remove.

   NOTE: The GM Model "B" Carburetor used on late 1951 model passenger car with Powerglide 235 engine, has a main well tube pressed into the cover and extending from the cover surface 1⅛" down into the main well support. The cover will be serviced as an assembly with the main well support and cover gasket. When the main well support is being removed, extreme care must be taken to prevent damage to the main well tube.

7. Remove the cover gasket and lift power piston and spring from cover.
8. Remove throttle kick lever and spring by removing retaining screw and washer.
9. Holding pump plunger all the way down, remove hairpin retainers from pump link and remove pump link from throttle lever and pump plunger. Pump plunger may be lifted from bowl.
10. Lift pump spring from well and remove ball check from bottom of well.
11. With small screwdriver, rotate pump discharge guide until it can be removed. Pump discharge spring and ball check will fall from bowl when turned upside down.
12. Remove pump screen retainer and pump screen from bowl.
13. With bowl upside down remove throttle body attaching screws and remove throttle body assembly.
14. Remove idle adjusting needle and spring from throttle body.
15. Figure 99 illustrates carburetor completely disassembled.

INSPECTION

1. Wash all parts thoroughly in carburetor solvent and dry with compressed air.
2. Check all ports and passages for carbon deposits.
3. Blow out all drilled passages with compressed air and check with flashlight to make sure they are clean.

   NOTE: Do not, under any circumstances, use wire or other pointed instrument to clean drilled passages or calibrated holes in carburetor. Holes and passages are carefully calibrated and use of wire or other cleaning instrument will destroy calibration of carburetor.

4. Inspect pump plunger. If the leather or its expanding spring are damaged in any way, the plunger assembly should be replaced.
5. Check floats for dents and wear on tang and hinge pin. Also check cover for wear in hinge pin holes.
6. Check float needle and seat. If wear is noted on float needle, install new float needle assem-

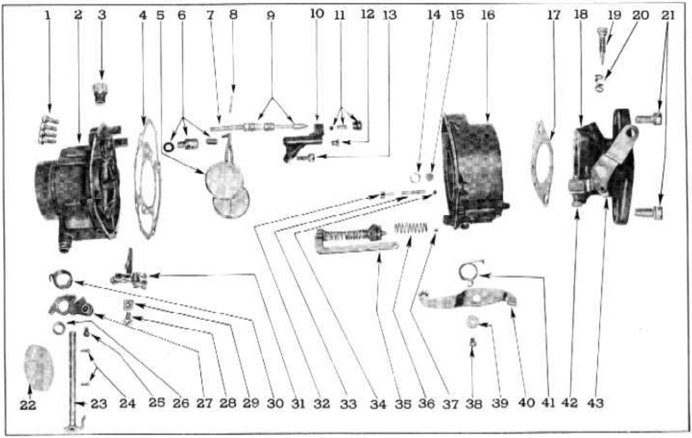

Fig. 99—Carburetor Layout

1. Screw—Cover Attaching
2. Cover
3. Fuel Inlet Fitting
4. Gasket—Cover
5. Float
6. Float Needle, Seat, Gasket Assy.
7. Power Spring
8. Float Hinge Pin
9. Power Piston
10. Main Well Support
11. Power Valve Assembly
12. Main Metering Jet
13. Screw—Attaching
14. Retainer—Pump Screen
15. Pump Screen
16. Float Bowl
17. Gasket—Throttle Body
18. Throttle Body Assembly
19. Idle Adjusting Needle
20. Spring—Idle Needle
21. Screw—Throttle Body
22. Choke Valve
23. Choke Shaft
24. Screw—Choke Valve
25. Screw—Choke Lever
26. Retainer—Choke Lever
27. Choke Lever
28. Screw—Bracket
29. Nut—Bracket
30. Spring—Choke Shaft
31. Choke Bracket
32. Guide—Pump Discharge
33. Spring—Pump Discharge
34. Ball—Pump Discharge—$\frac{3}{16}$ Steel
35. Pump Plunger Assy.
36. Spring—Pump Return
37. Ball—Pump Check—$\frac{5}{32}$ Aluminum
38. Screw—Throttle Kicker
39. Washer—Throttle Kicker
40. Throttle Kicker
41. Spring—Throttle Kicker
42. Screw—Throttle Valve
43. Throttle Shaft

bly consisting of matched and tested needle and seat fibre washer.

7. Check power piston for burrs or other damage. Piston must move freely in cover bore.
8. Check pump screen—make sure it is clean.
9. Check throttle arm for looseness on the shaft and for excessive wear at throttle rod connection.
10. Check throttle shaft for excessive looseness in throttle body.

NOTE: Any damage or excessive wear in throttle arm or shaft necessitates replacement of the throttle body assembly. This is due to the close tolerance of throttle valve fit required and the fact that the idle discharge and spark advance holes are drilled in relation to a proper fitting valve.

11. Make sure choke valve opens and closes freely. Hold lever in closed position and push valve open to see that choke spring has normal tension.

REPAIRS

Choke Valve Removal

1. Remove choke valve screws and choke valve.
2. Disconnect choke spring from outer choke lever and shaft assembly and remove choke shaft assembly.
3. Remove choke swivel retaining ring which retains swivel on boss of cover and remove swivel and spring.

Installation

1. Place choke spring on cover boss with extended hook end against cover.

2. Place choke swivel assembly on boss with lug and screw on the inside. Lock retaining ring into groove.
3. Slip choke shaft into cover. Center choke valve and tighten screws. The letters "RP" or "C" must face outward with choke valve closed (fig. 100).

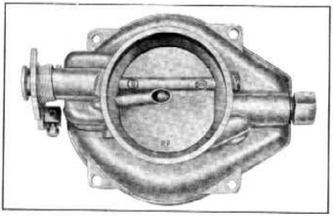

Fig. 100—Choke Valve Installation

4. Turn choke spring clockwise until outside hooked end engages slot in bottom of choke swivel assembly. With small piece of wire, wind inside end of choke spring approximately ½ turn and hook over end of choke shaft assembly. Ascertain that choke assembly has free movement.

Assembly

1. Install idle needle and spring finger tight in throttle body. As a temporary idle adjustment, back needle out 1½ turns.
2. Using a new throttle body gasket, attach bowl to throttle body. Tighten screws evenly and securely.
3. Place clean pump screen in bottom of bowl and lock retainer into position.
4. Drop small aluminum ball in pump well.

NOTE: After installing ball ascertain that ball lifts freely from its seat.

5. Place pump return spring into pump well and center it by depressing with finger.
6. Install pump plunger and connect pump link to throttle lever and pump rod. Install hairpin retainers at both upper and lower ends.
7. Drop large steel ball into pump discharge cavity of bowl and place spring on top of ball.
8. Index end of pump discharge guide into spring and press down until guide is flush with bowl surface.
9. Place throttle kick lever spring on bowl boss with smaller hooked end against bowl. Rotate clockwise until small end engages lower boss.
10. Attach throttle kick lever with screw and washer. Flat portion of lever must be against idle screw.
11. Install float needle seat using new fibre washer and install float needle.
12. Place new cover gasket on cover.
13. Place power piston spring and power piston in air horn cavity and attach main well support to air horn.
14. Install main metering jet and tighten securely.
15. Hold power piston stem down and install power ball, spring and plug and tighten securely.
16. Attach float with hinge pin.

NOTE: Float tang must face air horn.

17. Adjust float setting as outlined under "Minor Service Operations, Float Level Adjustment."
18. Rotate throttle kick lever clockwise until extended hooked end of spring engages lower half of lever. Turn lever to vertical position against tension of spring. Cam portion of lever will now be in position to engage cam portion of choke swivel.
19. Holding throttle kick lever as described, place cover assembly on bowl (fig. 96). Install attaching screws and choke bracket and tighten screws securely.

Installation

1. Place carburetor in position on manifold studs, position throttle return check if one is to be installed, and install retaining nuts. Tighten evenly and securely.
2. Connect fuel and vacuum lines to carburetor.
3. Connect throttle rod to throttle shaft lever.
4. On 1950 models only, push hand throttle wire and conduit through bracket on carburetor and guide wire through hole in end of throttle lever rod. Make sure throttle button is pushed in against dash and then install wire guide on end of throttle wire leaving about ⅛" between guide and throttle lever rod with throttle valve closed.
5. On 1950 and 1951 models, push choke wire and conduit through bracket on carburetor and enter wire in connector on choke lever. Make sure choke button is pushed in against dash. Then tighten bracket clamp and wire retaining screw in connector.
6. Check choke and throttle operation on 1950 models and choke operation only on 1951 models by pulling buttons on dash all the

way out. Throttle valve should be fully opened and choke valve fully closed. Push buttons all the way in. Throttle valve should be fully closed to stop screw and choke valve should be fully opened.

7. Install air cleaner, start engine and warm to operating temperature. Make necessary idle mixture and idle speed adjustments as outlined under "Minor Service Adjustments."
8. On carburetors equipped with a throttle return check, adjust as outlined under "Minor Service Operations."

ROCHESTER CARBURETOR—1952-3 MODELS

GENERAL DESCRIPTION

MANUAL CHOKE

All 1952 models that have the regular 216 engine are equipped with a Rochester Model "B" carburetor that is functionally the same as far as operating and servicing operations as the carburetor used on the 1950-51 models. However, this carburetor has a float bowl and cover of heavier construction with heavier cover screws and in addition has a revised idle system and accelerating pump system. This revised type system was incorporated in late 1951 models having the 235 engine and Powerglide transmission.

In the revised idle system, only two calibrated holes are drilled through the cross bar of the air horn (fig. 101). Two additional cored and drilled passages have been added to the air horn which connect to the present idle passage at one end and vents into the float chamber at the other end. This construction tends to relieve more rapidly any build up of gasoline vapor in the cross bar and idle passages after a hot engine is shut off.

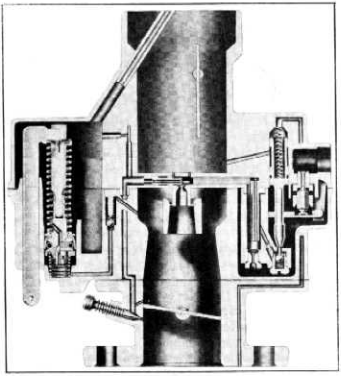

Fig. 101—Carburetor Revised Idle System

In addition, the venting into the float bowl allows for better atomization of fuel at idle.

The pump system is revised in that the passage up into the cover and the pump jet, as used in the 1950-51 model carburetor, is discontinued. The revised construction consists simply of a metered hole drilled directly between the pump discharge passage and the main venturi section of the carburetor. This construction places the jet just slightly above the fuel level in the float chamber and eliminates any lag of fuel injection during quick acceleration.

Service operations remain the same as those outlined for the carburetor used on the 1950-51 models. However, due to the change in the idle system and accelerating pump system a new carburetor bowl to cover gasket, Part Number 7003819, which is part of gasket kit, Part Number 7004335, must be used. For identification, the last four digits of gasket part number are stamped on the gasket.

AUTOMATIC CHOKE

The carburetor (fig. 102) used on 1952 models with 235 engine equipped with the Powerglide transmission and on all 1953 models is a Rochester Model "BC" with an automatic choke mechanism. This carburetor in addition to the automatic choke incorporates other changes; relocated accelerator pump jet outlet, revised idle system, heavier flange on the cover and float bowl castings, and larger diameter cover screws.

OPERATION

Operation of the "BC" carburetor is basically the same as the regular "B" carburetor with the exception of the choke system which is designed to insure proper starting and driving during cold weather operation. This choke system is comprised of a thermostatic coil, choke piston, choke valve and fast idle cam and linkage. It is controlled by a combination of intake manifold vacuum, the offset choke valve, atmospheric temperature and exhaust manifold heat.

The thermostatic coil which is linked to the choke valve shaft, holds the choke valve closed

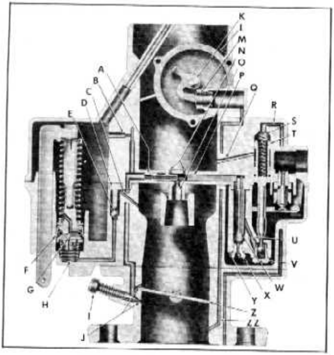

Fig. 102—Carburetor Cross Section

A. Idle Restriction
B. Idle Air Bleed
C. Pump Jet
D. Pump Discharge Guide
E. Pump Discharge Ball
F. Pump Plunger
G. Pump By-Pass Ball Check
H. Pump Return Spring
I. Idle Adjusting Needle
J. Idle Discharge Holes
K. Choke Shaft
L. Choke Housing
M. Choke Piston
N. Air Bleeds
O. Main Discharge Nozzle
P. Cross Bar
Q. Relief Passage
R. Vacuum Passage
S. Power Spring
T. Power Piston
U. Calibrated Power Restriction
V. Power Valve
W. Main Well Tube
X. Main Metering Jet
Y. Main Well Support
Z. Throttle Valve
ZZ. Vacuum Passage

when the engine is cold. As the engine is started, air velocity against the offset choke valve causes the valve to open slightly against the torque of the thermostatic coil. In addition, as the engine starts, intake manifold vacuum is applied to the choke piston, which also tends to pull the choke valve open.

As a consequence, the choke valve assumes a position where the torque of the thermostatic coil is balanced against the vacuum pull upon the choke piston and air velocity against the offset choke valve, thereby causing a regulated air flow into the carburetor which provides a proper mixture during the warm-up period.

During warm-up, the choke piston serves to modify the choking action to compensate for varying engine loads or acceleration. Any acceleration or increased road load decreases the vacuum exerted on the choke piston. This allows the thermostatic coil torque to momentarily increase choke valve closure to provide the engine with sufficiently richer mixture for acceleration.

As the engine warms up, hot air from the exhaust manifold "stove" is drawn into the thermostatic coil cover by the vacuum behind the choke piston. This hot air causes a rise in temperature which causes the coil to slowly relax its tension Thus the choke valve is allowed to move gradually to the full open position.

To prevent stalling during the warm-up period, it is necessary to run the engine at an idle speed slightly higher than that for a warm engine. This is accomplished by the fast idle cam (fig. 103) which is linked to the choke valve shaft and holds the throttle valve open sufficiently during the warm-up period to give the increased idle RPM until such time as the choke valve moves to the full open position. While the automatic choke is in operation, the driver may wish to advance the throttle to the full wide open position. Since this would decrease vacuum pull on the choke piston, thereby closing the choke valve, it is necessary to provide increased carburetor air flow by opening the choke valve mechanically. To accomplish this, a tang on the throttle lever is made to contact the fast idle cam linkage at wide open throttle position so as to partially open the choke valve. This will also relieve excess choking on starting by allowing more air to enter the carburetor when the engine is cranked with the accelerator held fully depressed.

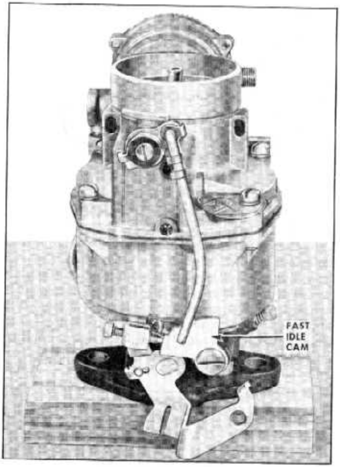

Fig. 103—Fast Idle Cam

MINOR SERVICE OPERATIONS

Because of the simple construction of the "BC" carburetor, it is possible to make all carburetor adjustments without removing the carburetor from the car.

Idle Speed Adjustment

1. With the engine at operating temperature make sure choke is entirely off and linkage is free. Also make sure throttle linkage is free so that throttle stop screw "A" is against the low step on the fast idle cam (fig. 104).

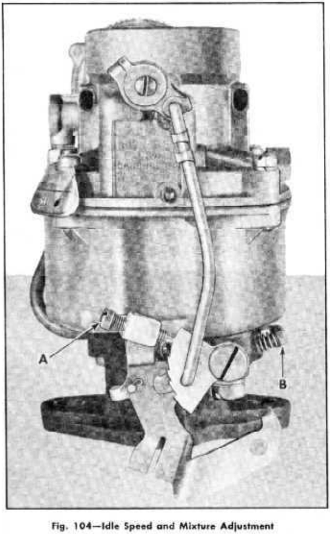

Fig. 104—Idle Speed and Mixture Adjustment

2. Set parking brake tight, place selector lever in "N" (neutral) range and then, turn screw in or out to obtain an idling speed of 500 revolutions per minute.

Idle Mixture Adjustment

The idle mixture adjustment should be made to give a smooth idle at the specified idle speed. Missing is an indication of too lean an idle mixture, while "rolling" or "loping" indicates too rich a mixture.

1. With the engine at operating temperature, screw idle adjusting screw "B" in until it seats lightly (fig. 104).

   CAUTION: Turning adjusting screw in too tight may cause scoring or grooving of the needle.

2. Back off idle adjusting screw 2½ turns.
3. Start engine and allow to idle (engine at operating temperature).
4. Set parking brake tight and with transmission selector lever in "D" (drive) range, turn screw either way from this position until best idle point is reached.

   NOTE: This setting will give approximately 440 RPM.

Automatic Choke Adjustment

Normal setting of the choke is such that the scribed index mark on the cover is in line with the long cast mark on the choke housing casting. If it is believed that the indexing is wrong, it may be checked as follows:

1. Remove air cleaner.
2. If engine is hot, remove carburetor from engine and allow to cool uniformly. Removal of the choke cover assembly will accelerate cooling. Carburetor must be normalized to room temperature before attempting to check choke operation. If car has stood for a few hours at room temperature, removal of the carburetor is not necessary.
3. Check choke valve and shaft for free operation.
4. Check room temperature.
5. Reinstall choke cover assembly rotating clockwise so the thermostat spring hooks behind choke lever. Set cover index mark to long index mark of choke housing if room temperature is 85°; set one (1) mark leaner for each 5° that temperature is below 85°; or one (1) mark richer for each 5° that temperature is above 85°. Choke valve should close when air horn is vibrated or rapped lightly.

   NOTE: Carburetor must be upright on flange and throttle adjusting screw must not touch fast idle cam during above check.

6. If original setting was correct, reset cover index mark to long index mark on choke housing and tighten three cover screws. If

above check indicates need for changing original cover setting, make necessary correction and tighten three cover screws.

Fast Idle Adjustment

No adjustment of the fast idle speed is provided since the steps on the fast idle cam are correctly proportioned to give the correct speed steps above normal idle speed. It is necessary, however, to have the correct relationship between the fast idle cam position and the choke valve position. To check and adjust this setting, proceed as follows:

1. Place end of idle adjusting screw on the next to highest step of the fast idle cam. Using gauge J-5120, see if small end of gauge (.073") just slides easily between lower edge of choke valve and bore of carburetor (fig. 105).

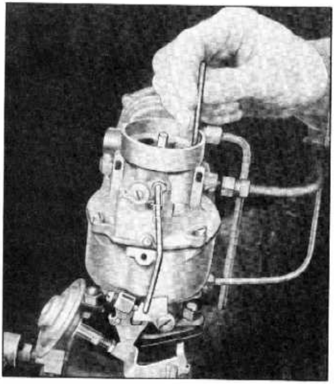

Fig. 105—Checking Choke Valve

2. If necessary, bend choke rod using tool J-4552, until required clearance as measured in step 1 is obtained (fig. 106).

Unloader Adjustment

Check and make any necessary correction of the unloader adjustment as follows:

1. Place throttle in wide open position.
2. Using gauge J-5120, see if large end of gauge (.166") just slides freely between lower edge of choke valve and bore of carburetor (fig. 107).

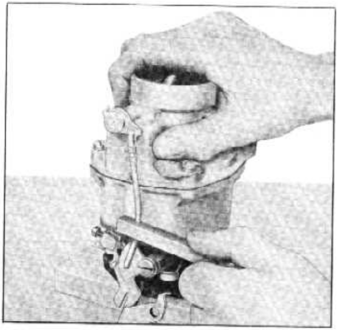

Fig. 106—Adjusting Choke Rod

3. If necessary, bend tang of throttle lever with tool J-4552 to obtain necessary clearance (fig. 108).

Throttle Return Check Adjustment

1. Check alignment of the throttle return check adjusting screw with the contact arm on the throttle lever. It may be necessary to bend

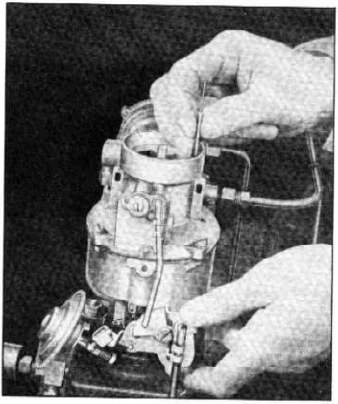

Fig. 107—Unloader Adjustment

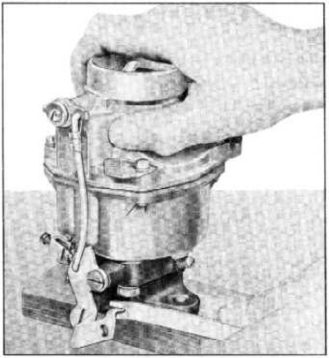

Fig. 108—Bend Throttle Lever Tang

the throttle return check bracket or throttle lever contact arm to center the adjusting screw on the radius of the contact arm.

2. Connect a tachometer to the engine. Place the transmission control in the "Park" position, start the engine and run at a fast idle to warm up engine.
3. With parking brake set tight, place selector lever in "D" range and adjust the throttle stop screw and idle adjusting screw in combination with each other to secure a smooth idle at 440 revolutions per minute. This adjustment should be made with the choke valve in the wide open position and with the throttle stop screw resting on the low step of the fast idle cam.
4. Shut off engine. With the choke valve in the closed position, position the throttle stop screw so that it rests on the highest step of the fast idle cam.
5. Using a 9/32" wrench on the flat sections of throttle return check shaft, hold the shaft from turning and with a 3/8" wrench, turn the adjusting screw until it just contacts the throttle lever contact arm (fig. 109).

NOTE: If screw protrudes more than ½" from shaft when head of screw just touches throttle lever contact arm, reposition throttle check on manifold stud.

6. Install air cleaner, start engine and recheck idling adjustment.

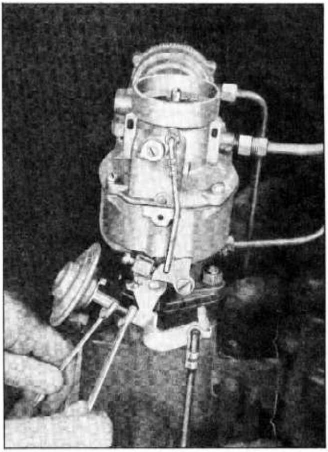

Fig. 109—Throttle Return Check Adjustment

NOTE: The throttle return check is not necessary on 1953 Powerglide Engines.

REPAIRS

Choke Disassembly

1. Remove air cleaner and loosen the ½" brass connector nut on the choke heat tube.
2. Remove three choke cover attaching screws and retainers; then, remove choke cover and thermostatic coil assembly from choke housing.
3. Remove choke cover gasket and baffle plate.
4. Remove retainers from each end of choke rod and remove rod.
5. Remove retaining screw at end of choke shaft and carefully pry off choke trip lever, spacing washer and choke lever and collar assembly.
6. Remove two choke valve screws and then remove choke valve.
7. Rotate choke shaft clockwise to free choke piston from housing and then remove piston and choke shaft from carburetor.
8. Remove choke piston pin and piston from choke shaft.

9. Remove two choke housing attaching screws and remove choke housing and gasket from cover.

Choke Assembly

1. Place new hex fitting packing on choke heat tube. Then, place new gasket in position and attach choke housing to cover. Tighten screws securely.
2. Tighten hex fitting on choke housing. Fitting must be tight to prevent loss of vacuum.
3. Inspect choke shaft assembly and piston for evidence of varnish or carbon deposit, clean when necessary. Then assemble choke piston to shaft with pin and install into choke housing. Index piston with piston bore and rotate choke shaft counterclockwise to enter piston into bore.
4. Install choke valve to choke shaft with letters "RP" facing upward. Center choke valve before tightening screws.
5. Place baffle plate and choke housing gasket into position and install choke cover and thermostatic coil assembly. Rotate cover clockwise until index mark on cover is aligned with long cast mark on the choke housing casting. Install three retainers and screws to choke housing and tighten securely.

NOTE: Choke valve should be lightly closed at room temperature (75° F) when index mark on cover and housing are aligned.

6. Place choke lever and collar assembly on end of choke shaft with tang facing choke housing. Install spacing washer and choke trip lever so that tang of trip lever rests on top of tang on choke lever and collar assembly with choke valve closed.
7. Install choke rod and retainer to choke lever and collar assembly and to fast idle cam. The hair pin end of rod must connect to fast idle cam.

NOTE: Check choke valve for free movement.

Automatic Choke Stove

Installation

When the "BC" carburetor is installed on past model cars or should the stove be removed for any reason the following procedure of installation should be followed to assure proper alignment of stove unit.

1. Assemble carburetor to engine manifold, connect carburetor controls, gasoline and vacuum spark control lines.
2. Mount manifold stove assembly on exhaust manifold between No. 1 and No. 2 exhaust ports so that hot air tube connection is offset slightly toward front of engine. Do not tighten retainer screw securely until tube installation is made.
3. Place tapered end of hot air tube into manifold stove connection. Then, by adjusting position of manifold stove on the exhaust manifold, assemble the tube fitting to the carburetor choke housing connection finger tight.
4. After this assembly has been made, tighten the stove retainer screw and the tube fitting securely.

NOTE: If heater is being installed on a replacement manifold, remove paint from manifold at heater location before installation.

OVERHAUL

Carburetor removal, disassembly, assembly and installation may be performed as outlined for carburetor used on 1950-51 models. Due to revised idle system, accelerator pump system and automatic choke, carburetor bowl to cover gasket, Part No. 7004480 which is part of gasket kit, Part No. 7004595, must be used. For identification, the last four digits of the gasket part number are stamped on the gasket.

FUEL PUMP

GENERAL DESCRIPTION

The diaphragm type fuel pump (fig. 110) used on all passenger car models mounts on the right side of the crankcase near the front of the engine. It is operated by a rocker arm that reaches through the side of the crankcase and rides on a special cam on the engine camshaft.

The fuel pump consists of a body, rocker arm and link assembly, diaphragm, diaphragm spring, oil seal, seal spring, cover, inlet and outlet valves, strainer, bowl and bowl retainer. The diaphragm consists of several layers of specially treated cloth, which are not affected by gasoline or benzol, held together by two metal discs and a push rod and is held down on the pump body by the seal spring.

The glass bowl must seal fuel and air tight to provide the vacuum necessary to draw fuel from the fuel tank. The bowl provides an area for sedi-

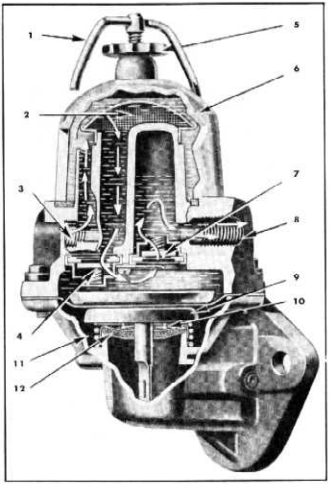

Fig. 110—Fuel Pump

1. Bowl Retainer
2. Filter Screen
3. Inlet
4. Inlet Valve
5. Bowl Retainer Nut
6. Sediment Bowl
7. Outlet Valve
8. Outlet
9. Diaphragm
10. Oil Seal Spring
11. Diaphragm Spring
12. Oil Seal

ment and water to settle before the fuel is filtered through the fine screen at the top and taken into the pump. A large surge chamber in the outlet side of the pump provides an air space to cushion the discharge impulses of the pump. The inlet and outlet valve assemblies are interchangeable.

OPERATION

In operation the diaphragm is pulled down against the tension of the diaphragm spring by the action of the cam and rocker arm. This causes a partial vacuum in the pump chamber which opens the inlet valve and applies this vacuum to the bowl chamber and inlet line from the fuel tank. Further movement of the camshaft releases the rocker arm and the diaphragm spring pushes the diaphragm up, the intake valve closes and the outlet valve is forced open permitting the fuel to be forced into the outlet line and up to the carburetor. Each revolution of the camshaft repeats this operation bringing additional fuel in through the inlet, up into the bowl, through the filter screen, through the inlet and outlet valves and up to the carburetor.

When the fuel in the carburetor bowl raises the float to where it closes the needle valve, the fuel pump diaphragm spring is not strong enough to force the needle valve off its seat; therefore, the diaphragm stays near the bottom of the stroke. The fuel pump rocker arm idles on the cam and only moves the diaphragm a few thousandths of an inch to replace the fuel that entered the carburetor between fuel pump strokes. A constant pressure, equal to the tension of the diaphragm spring, is maintained on the fuel in the line to the carburetor.

MINOR SERVICE OPERATIONS

The fuel pump should be checked regularly to make sure that the mounting bolts, cover to body bolts, bowl retaining nut and inlet and outlet connections are tight. The sediment bowl should be checked and cleaned regularly.

The glass bowl permits visual inspection to determine the amount of sediment or water in the fuel pump. When sediment or water is visible proceed as follows.

1. Loosen the bowl retaining nut, remove bowl and screen and clean.
2. Remove gasket and clean all dirt and water from the top of fuel pump.
3. Install a new gasket and the bowl.
4. Tighten retaining nut to create a little tension and turn bowl slightly to make sure it seats. Tighten retaining nut securely.
5. Start engine and check to see that fuel pump fills with fuel and that there is no indication of leaks.

MAJOR SERVICE OPERATIONS

Removal and Disassembly

1. Disconnect fuel inlet and outlet lines from the fuel pump.
2. Remove the two attaching screws and remove pump and gasket.
3. Loosen bowl retaining nut and remove bowl and filter bowl screen.
4. Remove top cover screws and top cover assembly.
5. Raise edge of diaphragm and with a thin bladed screwdriver lift the spring and oil seal over edge of boss in the fuel pump body.

6. Unhook diaphragm from the link by pressing down and away from the rocker arm side.
7. Remove oil seal and retainer from diaphragm.
8. Remove valve assembly retainer screws and remove valve retainer.
9. Remove valve assemblies and gaskets, noting that the inlet valve is assembled in the cover so that the valve opens downward, the valve spring being visible at the bottom of the valve cage. The outlet valve is assembled in the cover so this valve opens upward, the valve spring not being visible when the valve is assembled in the cover in this position.

Inspection

1. Wash all parts thoroughly in cleaning solvent.
2. Inspect the rocker arm and link for excessive wear and for loose hinge pin.
3. Inspect body and cover for cracks or damaged flanges.
4. Inspect diaphragm for cracks or wear that would cause leaks.
5. Inspect oil seal and retainer for damage.
6. Make sure the valves are clean and that they seat properly under normal spring tension.
7. Check the bowl for chips around the rim that would make a good seal difficult.
8. Inspect the filter screen for rust or restriction.

Assembly

1. Install the oil seal to the diaphragm push rod in the following manner. Assemble oil seal spring, upper retainer, two leather seals and lower retainer with convex side out. This is extremely important in order to seal the fuel pump from any oil that might come up from the crankcase.
2. Raise the fuel pump link with a screwdriver (fig. 111), install the diaphragm spring and hook the diaphragm pull rod over the end of the link.
3. Install valve assemblies and paper gaskets making sure to install the inlet valve with the spring down and the outlet valve with the spring up.

   NOTE: The inlet valve is assembled in the cover next to the tapped passage marked "INT."

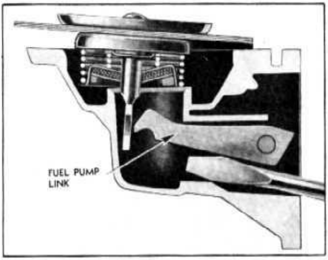

Fig. 111—Method of Assembling Fuel Pump Diaphragm to Link

4. Install the valve retainer with the convex side and secure in place with two retainer screws.
5. Assemble the top cover assembly to the fuel pump body and tighten the cover screws alternately and securely.
6. Assemble the filter screen on the cover and assemble the glass filter bowl to the cover making sure the cork gasket is in good condition and that the bowl nut is tight to prevent air leaks.
7. Test fuel pump operation by connecting a piece of gas line to the pump inlet, dipping end of line in container of gas and pumping rocker arm a few strokes.
8. Place a new gasket between pump and engine and install the attaching screws, tighten to 15-20 ft. lbs torque, connect fuel lines to pump, start engine and check pump operation.

FUEL AND VACUUM PUMP

GENERAL DESCRIPTION

The AC combination fuel and vacuum pump may be used as optional equipment on all passenger car models. This pump assembly, which is mounted on the right side of the engine crankcase at the front, is operated by an eccentric on the engine camshaft which actuates the pump rocker arm. The single rocker arm actuates both the fuel and vacuum section of the pump through separate links which permits each section to function independently of the other section (fig. 112).

The fuel and vacuum sections form two separate, independently operating diaphragm type pumps. They are combined in one assembly for compactness and to permit operation from one eccentric on the camshaft.

A fuel filter, consisting of a bowl and fine mesh screen is incorporated in the fuel section of the pump. Fuel from the gasoline tank enters the bowl then flows through the screen into the fuel pump. The bowl provides a settling chamber for water and dirt which cannot pass the screen. The bowl and screen should be cleaned periodically.

OPERATION

Fuel Pump

Downward movement of the pump diaphragm, or the suction stroke, is caused by the rotation of an eccentric on the camshaft actuating the pump rocker arm. Through a connecting link the diaphragm is moved downward against the pressure of the diaphragm spring, producing a vacuum in the fuel chamber. Atmospheric pressure then pushes fuel from the tank, through the fuel line, bowl, strainer and into the fuel chamber above the diaphragm.

On the return stroke of the rocker arm, the diaphragm spring forces the diaphragm up, the inlet valve closes, and the outlet valve is forced open, allowing fuel to flow through the outlet to the carburetor.

The link is hinged to the rocker arm so that the link and the connected diaphragm can be moved down, but not up, by the rocker arm. The link and the diaphragm are moved upward only by the diaphragm spring. The pump, therefore, delivers fuel to the carburetor only when the fuel pressure in outlet line is less than the pressure maintained by the diaphragm spring. This condition arises when the float needle valve is not seated and the fuel passage from the pump into the carburetor float chamber is open. When the needle valve in the carburetor float chamber is closed and held in place by the pressure of the float, the pump builds up pressure until it overcomes the resistance of the diaphragm spring. The pressure moves the diaphragm and link down until the rocker arm barely contacts the link and results in almost complete stoppage of diaphragm movement until more fuel is needed. The only function of the rocker arm spring is to make the rocker arm follow the camshaft eccentric.

The inbuilt airdome provides a pocket in which fuel under pressure can compress a certain volume of air. When the pressure is relieved (pump on vacuum stroke) the pocket of compressed air pushes the fuel on to its destination. The airdome minimizes flow variations experienced with two-cycle pump stroke and gives increased fuel flow characteristics.

Fuel Pump Vacuum Section

The vacuum suction acts as a booster to the intake manifold suction thus providing uniform operation of the windshield wiper at all engine speed and loads. Both sections of the combination pump are actuated by a siugle rocker arm. Rocker arm movement, through the link and pull rod, pushes the diaphragm into the air chamber against spring pressure. Pressure created by the diaphragm movement expels air through the outlet port and into the manifold. The return stroke (low point of cam) releases the compressed diaphragm spring, creating a vacuum and pulling air through the inlet valve from the windshield wiper.

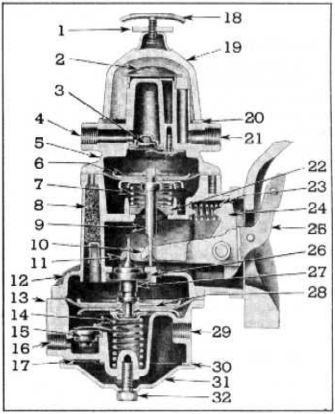

Fig. 112—Fuel and Vacuum Pump

1. Bowl Retainer Nut
2. Fuel Filter Screen
3. Outlet Valve
4. Outlet Port
5. Fuel Pump Cover
6. Fuel Pump Diaphragm
7. Diaphragm Spring
8. Air Filter
9. Pull Rod
10. Fuel Link
11. Vacuum Link
12. Pump Body
13. Vacuum Cover
14. Diaphragm Spring
15. Outlet Valve
16. Outlet Port
17. Screen
18. Bail Assembly
19. Sediment Bowl
20. Bowl Gasket
21. Inlet Port
22. Oil Seal
23. Rocker Arm Spring
24. Link Spacer
25. Rocker Arm
26. Oil Seal
27. Pull Rod
28. Vacuum Diaphragm
29. Inlet Port
30. Cover Plate Gasket
31. Cover Plate
32. Capscrew Gasket

When manifold vacuum is greater than that created by the pump, the stronger manifold vacuum pulls the diaphragm into the air chamber against spring pressure thus moving the links out of engagement with the rocker arm. Under this condition the rocker arm continues to move with the cam, but produces only a fluttering effect on the diaphragm. The windshield wiper then operates on manifold vacuum without assistance from the pump. When intake manifold vacuum is low, as on acceleration or at high speed, the vacuum created by the pump will assure adequate operation of the wiper.

MINOR SERVICE OPERATIONS

MAINTENANCE

Sediment and water sometimes become trapped within the fuel pump filtering bowl, causing difficult engine operation. Difficulty because of moisture is more likely to occur at low winter temperatures. To avoid this trouble, remove and clean the filter bowl and screen at least twice a year, preferably in the spring and fall. The fuel pump must also be checked regularly to make sure that the mounting bolts, cover to body screws, bowl retaining nut and fuel line connections are tight.

Locating Pump Trouble

Always check while the pump is installed on the engine. Do not take it off to check it.

1. Be sure there is gas in the tank.
2. Disconnect pump to carburetor line at the carburetor. Use a fuel analyzer gauge to check for idle pressure of 3 to 4 pounds. Minimum bleed (capacity) at idle, is one pint of fuel in one minute. If pump is not up to the foregoing specification, first check items "a" thru "f" below. If pump does not then meet specifications, it should be removed for overhaul or replacement.

   If fuel pump analyzer gauge is not available, a simple test can be made by disconnecting pump to carburetor line at the carburetor. With the ignition switch off, use the starting motor to turn the engine over a few times. If gas spurts from the pump (or open end of the line), the pump, gas line and tank are O.K., and trouble is in the carburetor, ignition or engine. If no gas flows, or if only a little gas flows, do the following:

   a. Fuel bowl gasket worn or damaged. REPLACE GASKET.
   b. Fuel bowl screen or strainer clogged or corroded. CLEAN THE SCREEN OR REPLACE.
   c. Fuel line connections loose or cracked. TIGHTEN OR REPLACE FUEL LINE FITTINGS.
   d. Fuel line clogged. BLOW OUT WITH COMPRESSED AIR.
   e. Diaphragm flange screws loose. TIGHTEN FLANGE SCREWS.
   f. Flexible inlet line broken or porous. REPLACE FLEXIBLE LINE.
3. If correction of any or all the above items does not place the pump in operating condition, it should be removed for replacement or overhaul.

Locating Vacuum Section Trouble

1. Disconnect outlet (manifold) line from pump.
2. Open vacuum valve to windshield wiper and operate engine from idle, through slow acceleration to about 40 MPH.
3. The wiper should start operating on only pump vacuum at about 15 MPH engine speed and reach full speed at about 40 MPH and thus indicating that the vacuum section is operating correctly.
4. If the wiper does not operate, then also detach windshield wiper line at pump and join it to the already detached outlet line with a piece of rubber hose.
5. SLOWLY operate engine from idle to about 25 MPH. The wiper should run at full speed, operating on the engine vacuum only. If it does not, it can be assumed that the wiper motor or tubing is defective.
6. The pump vacuum section is inoperative if the windshield wiper operates on engine vacuum, but not on pump vacuum.
7. The pump vacuum section, when disconnected from intake manifold, should produce 8-10 inches of vacuum at about 25 MPH engine speed.

DISASSEMBLY

NOTE: Before proceeding with the following operation, wash the outside of the unit with cleaning solvent and blow off with compressed air to remove loose grit and grease.

1. Mark edges of fuel and vacuum cover and body diaphragm flanges with a file. The parts may then be reassembled in the same relative position. Note that the fuel diaphragm flange is symmetrical, and the vacuum diaphragm flange has bulges where the screw holes occur.
2. Remove fuel cover screws and lockwashers. Separate cover from body by jarring cover loose with a screwdriver handle.
3. Remove fuel valve and cage retainer screw and lift out retainer, two valve and cage assemblies and two gaskets.
4. Loosen bail thumb nut, swing bail to the side and remove from cover. Remove bowl, screen and bowl gasket.
5. Remove only two cover screws from opposite sides of the vacuum cover, and substitute for them two No. 10-32-1½ inch fillister head screws. Turn the two long screws all the way down, and then remove the balance of the regular cover screws. Alternately back off the two long screws, a few turns at a time, until the force of the heavy vacuum diaphragm spring is no longer effective. Rap the cover with a screwdriver handle if the

flanges stick together. Remove the two long screws, the cover assembly and diaphragm spring.

6. Remove vacuum valve and cage retainer screw and lift out retainer, two valve and cage assemblies and two gaskets.
7. Remove vacuum cover plate screw and gasket. Lift off the cover plate, cover gasket, screen retainer, and screen.
8. File riveted end of rocker arm pin flush with steel washer, or cut off end with 3/8" drill. Drive out rocker arm pin with a drift punch and hammer. Wiggle rocker arm until links unhook from both diaphragms. Then remove rocker arm spring, rocker arm, and link assembly.
9. Remove bushing from rocker arm to disassemble rocker arm, two vacuum links, one fuel link, link spacer, and link washers (there may be one or two link washers).
10. Lift vacuum diaphragm straight out of body to avoid damage to staked-in oil seal.
11. Remove fuel diaphragm by pulling straight out to avoid damage to oil seal. Lift diaphragm spring and spring retainer from pump body.

Inspection

1. Blow out all passages with compressed air.
2. Check parts of fuel pump as follows:
   a. Top cover and pump body—Make visual check for cracks and breakage. Inspect for diaphragm flange warpage by testing on a smooth flat surface. Examine all threaded holes for stripped or crossed threads. Broken, damaged, or severely warped castings must be replaced.
   b. Valves, valve and cage assemblies—Replace. Extent of wear cannot be determined visually.
   c. Screen—Inspect for damage to edges and wire spacing. Replace if damaged or corroded.
   d. Rocker Arm—Inspect for wear or scores at camshaft pad, at point of contact with link and pull rod.
   e. Rocker Arm Pin and Washer—Replace.
   f. Link—Replace link because amount of wear cannot be determined visually.
   g. Rocker Arm Spring—Replace. Spring may be weak from distortion or corrosion.
   h. Diaphragm Spring—Replace. Spring may be weak from distortion or corrosion.
   i. Diaphragm—Always replace.
   j. Gaskets—Always replace gaskets to assure tight seals.

Assembly

NOTE: Soak new diaphragm assembly in clean kerosene while performing the following steps. Fuel oil or gasoline may be used.

1. Assemble link spacer (spacer also retains rocker arm spring) over fuel link. Place one vacuum link on each side of the fuel link. The hook ends of the vacuum links should come together so that they surround the fuel link. All link hooks should point in the same direction. Place assembly of links and spacer between lobes of rocker arm with one spacer washer on the outer side of each vacuum link. Slide rocker arm bushing through holes in rocker arm, spacer washers, and links.
2. Stand the pump body on the bench, fuel flange down. Set rocker arm spring in position with one end over cone cast into the body. Slide rocker arm and link assembly into body. Outer end of rocker arm spring slips over projection on link spacer, and the open end of all link hooks must point toward vacuum flange. Temporarily retain rocker arm and link assembly with small end of tool PT-6.
3. Turn the pump body over so the fuel diaphragm flange is up. Set the diaphragm spring on the staked-in oil seal, and the retainer on top of the spring. Push diaphragm pull rod through retainer, spring and oil seal. Flat of pull rod must be at right angles to link. Hook diaphragm pull rod to fuel link.

NOTE: Fuel link is the short, center link.

4. Drive tool PT-6 out with permanent rocker arm pin. Place washer over small end of pin and spread pin end.
5. Place valve and cage gaskets in recesses provided in fuel cover. Place valve and cages on top of gaskets. Inlet valve must have 3-legged spider facing out of cover, and outlet valve must have 3-legged spider facing into cover. Secure valve assemblies with retainer and screw.
6. Install fuel screen, bowl gasket and bowl. Retain bowl with bail assembly, turning thumb nut only finger tight.
7. Push on rocker arm until diaphragm is flat across body flange and install fuel cover on body, making sure that file marks on cover and body line up. While holding diaphragm flat, install cover screws and lockwashers loosely until screws just engage lockwashers. Pump the rocker arm three or four full strokes and tighten cover screws securely.
8. Diaphragm must be flexed by several full strokes of rocker arm before tightening cover screws, or pump will deliver too much pressure.

9. Place valve and cage gaskets in recesses provided in vacuum cover. Place valve and cages on top of gaskets. Inlet valve must have 3-legged spider facing out of cover, and outlet valve must have 3-legged spider facing into cover. Secure valve assemblies with retainer and screw.

10. Turn vacuum cover over, and install screen, one screen retainer, and gasket. Position cover plate and retain with cover screws and gasket.

11. Clamp pump body in vise by one of mounting flange ears. Insert vacuum diaphragm pull rod straight through oil seal.

    CAUTION: Do not tilt diaphragm pull rod excessively as this may damage the oil seal. Push rocker arm toward pump to raise vacuum links and hook them to link slot in pull rod.

12. The vacuum diaphragm must be held level with body flange during the following operations. The diaphragm is held level by inserting a $\frac{3}{32}$ inch piece of metal between rocker arm stop and body. This spacer can be made from a piece of steel, $\frac{3}{16}$ inch x $\frac{3}{32}$ inch x 8 inches. Bend one end to form a right angle hook, $\frac{3}{8}$ inch from bend to end. This tool is also available from your AC jobber as Type PT-8.

13. Place vacuum spring over location on upper diaphragm protector. Place vacuum cover over spring, and align the file marks.

14. Insert two No. 10-32 x $1\frac{1}{2}$ inch screws in two opposite holes in cover flange. Turn these long screws down, alternating a few turns on each. Insert regular screws with lockwashers, and tighten until screws just engage lockwashers. Replace two long screws with regular screws and lockwashers.

15. Remove $\frac{3}{32}$ inch spacer from rocker arm position. This allows the heavy vacuum spring to push diaphragm into a flexed position. Tighten all cover screws securely.

16. Combination fuel and vacuum pump cannot be bench tested because of the heavy vacuum section spring. The only adequate test for this type pump is with a low-pressure gauge when the pump is mounted on the engine.

AIR CLEANER

Air cleaners on all models operate primarily to remove dust and dirt from the air that is taken into the carburetor and engine. All air cleaners used incorporate flame arresters.

The standard cleaner has an element (fig. 113) consisting of a metallic gauze filter that is saturated in heavy oil. As air filters through this element, dirt and dust are deposited on the oily surfaces of the gauze. This gauze also quenches any flame that may be caused by engine backfire through the carburetor.

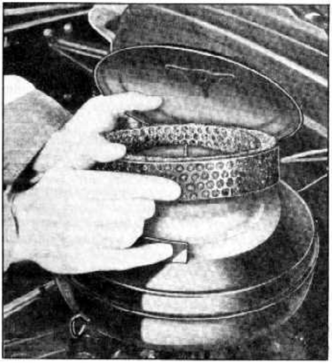

Fig. 113—Standard Air Cleaner

An oil bath type cleaner is also available as optional equipment when vehicles are to be used in unusually dusty areas. This cleaner (fig. 114) is interchangeable with the standard air cleaner and will not affect power or economy in any way. Air entering this cleaner must go directly down in a narrow space around the cleaner to the oil level in the cleaner body. The air must then turn and go up through the metallic gauze through a long silencer chamber and then down into the carburetor. As the direction of air flow is reversed, heavy particles in the air are thrown into the oil in the cleaner body, greatly reducing the amount of dirt to be deposited in the metallic gauze.

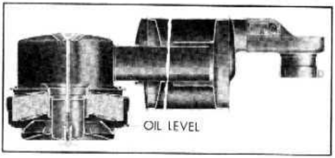

Fig. 114—Oil Bath Air Cleaner

SERVICE OPERATIONS

OIL BATH AIR CLEANER

1. Loosen cleaner body unit wing nut and lower body unit with filter away from cleaner assembly.

   NOTE: Do not pry the filter element loose if it sticks. It must be removed by hand, otherwise damage to the filter element flange may result. This flange must lie flat against the body to insure a tight seat at this point to prevent air leaks when assembled.

2. Empty oil out of cleaner and clean out all oil and accumulated dirt.
3. Wash body with cleaning solvent and wipe dry.
4. Wash filter element by slushing up and down in cleaning solvent.
5. Dry filter unit with an air hose or let stand until dry.
6. Fill body of cleaner with one pint of SAE 50 engine oil in summer and lighter in winter.
7. Assemble filter element to body of cleaner, being sure that the flange rests against the top flange of the body.
8. Install body to cleaner assembly making sure gasket is clean and in good condition over its entire surface so a tight seat is obtained and tighten wing nut.

TROUBLES AND REMEDIES

FUEL SYSTEM

Symptom and Probable Cause	Probable Remedy
Excessive Fuel Consumption	
a. Improper adjustment	a. Adjust idling and mixture screws
b. Improper float level adjustment	b. Check and adjust float level
c. Metering rod not synchronized with throttle	c. Check and synchronize metering rod
d. Metering rod disc missing	d. Install new disc
e. Metering rod spring disconnected from metering rod	e. Connect spring
f. Dirty air cleaner	f. Clean air cleaner
g. Fuel leaks	g. Check carburetor, fuel pump, fuel tank and all lines and connections for leaks
h. Sticking controls	h. Check choke and throttle valve and manifold spring for proper operation
i. Improper engine temperature	i. Refer to Cooling Section
j. Dragging brakes	j. Refer to Brake Section
k. Engine improperly tuned	k. Tune engine—See Engine Section
l. Tires underinflated	l. Inflate to recommended pressure
Fast Idling	
a. Improper adjustment	a. Adjust idling and throttle stop screws
b. Controls sticking	b. Free up controls and lubricate linkage
Engine Dies (Will Not Idle)	
a. Low speed jet or idle passages plugged	a. Disassemble and clean carburetor
Engine Misses on Acceleration	
a. Accelerating pump jet plugged	a. Disassemble and clean carburetor
b. Accelerating pump check valves sticking or leaking	b. Disassemble and clean carburetor
c. Improper spark plug adjustment	c. Adjust spark plugs—See Engine Section
d. Improper tappet adjustment	d. Adjust tappets—See Engine Section
e. Sticking or burned valves	e. Free up sticking valves or replace burned valves

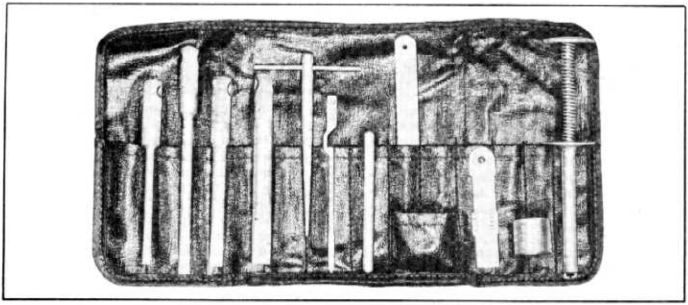

Fig. 115—Carter Carburetor Special Tools

KMO-268	Carburetor Tool Set	J 816 4	Jet Wrench 7/16"	J-818-1	Float Level Gauge ½"
	Set consists of the following:	J-816-2	Jet Wrench ¼"	J-818-13	Float Level Gauge (C.O.E.)
J-816-1	Jet Wrench 3/16"	J-508	Nozzle Puller and Handle	J-507	Loading Cylinder ¾"
J-816-7	Jet Wrench 5/16"	J-509	Metering Rod Gauge	KMO-65-4	Butterfly Valve Screw Holder
		J-816-5	Jet Wrench Handle		

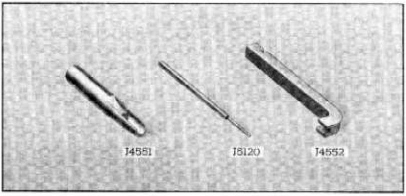

Fig. 116—Rochester Carburetor Tools—Kit J-5127

FUEL SYSTEM SPECIFICATIONS

Air Cleaner

Make .... A.C. No. 1544448
Type .... Standard

Carburetor

1949 Models
Type .... Downdraft
Make and Model .... Carter 684S-W-1
1950-52 Models except 1952 with Powerglide
Type .... Downdraft
Make and Model .... Rochester "B"
1952-53 Models with Powerglide
1953 Standard Transmission Models
Type ....Downdraft with Automatic Choke
Make and Model .... Rochester "BC"

Fuel Pump

1949-51 Models
Make and Model ................A.C.–AF
Pressure ....3-4 P.S.I.
1952-3 Models
Make and Model ................A.C.–AF
Pressure ....3½-4½ lbs.

Fuel and Vacuum Pump

1949-53 Models
Make and Model ................A.C.–BW
Pressure ....3½-4½ P.S.I.

COOLING SYSTEM

INDEX

GENERAL DESCRIPTION

The cooling system of all passenger car models is designed with two purposes in mind; first, to carry off a certain amount of the heat created in the engine so it will not operate at too high a temperature; and second, to maintain the engine heat at the temperature which will produce the most efficient and economical operation of the engine. Fig. 117 shows a cross section view of the cooling system. The radiator on all model cars is of ribbed cellular construction. The water passages are wide and straight with smooth interior, permitting maximum cooling liquid flow and efficient cleaning of the radiator. A water by-pass is included in the cooling system of all 1953 models. This provides some circulation of coolant even though the thermostat is closed and results in a faster engine warm-up and more uniform coolant temperature throughout the engine.

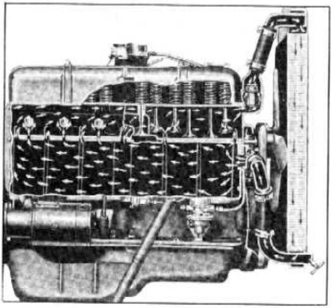

Fig. 117—Cross Section of Cooling System

All 1950-51 models having 235 engines and Powerglide transmissions and all 1952 and 1953 models are equipped with a pressure type radiator cap which seals the cooling system.

The pressure type radiator cap used is designed to hold a pressure up to approximately four pounds per square inch above atmospheric pressure. Above four pounds, the pressure is relieved by a valve within the cap that opens to radiator overflow. As the pressure is reduced to atmospheric upon cooling, a "reverse" valve in the cap allows air to re-enter the radiator, preventing the formation of a vacuum in the cooling system (fig. 118).

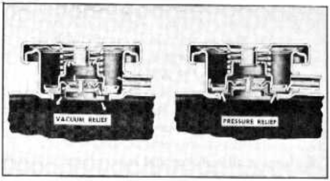

Fig. 118—Pressure Radiator Cap

The pressure type radiator cap helps to prevent coolant loss from boiling, for by raising the pressure on the coolant above atmospheric, the coolant will not boil until a higher temperature is reached. This increases the margin of safety between the coolant operating temperature and the boiling point, and is advantageous in that it permits the engine to operate at higher temperature without having the coolant overflowing. Thus, passenger cars may operate at slightly higher engine temperatures, and may do so with a minimum of coolant loss from overflowing.

The water pump driven by a belt circulates the coolant from the radiator through the engine water passages and back to the radiator where it is cooled by the action of the fan.

The thermostat, mounted in the cylinder head water outlet, restricts the flow of water to the radiator until a predetermined temperature is reached, thus minimizing the length of time required to reach efficient operating temperature.

Since the action of the cooling system controls the operating temperature of the engine it is essential that systematic inspection of units in the system be made periodically to maintain the efficiency of the system.

MINOR SERVICE OPERATIONS

ANTI-FREEZE

In selecting an anti-freeze solution for winter operation, the local conditions and the type of service must be considered. In any event it is very essential to make certain checks and do certain things to at least insure the anti-freeze remaining in the cooling system. To be certain that the solution will not leak out and be lost entirely, resulting in little or no protection against freezing, or seep into the working parts of the engine, the following procedure should be followed in conditioning the system.

1. Drain the entire cooling system including the cylinder block.
   NOTE: If considerable rust, scale, oil or grease is present in the water drained out it is advisable to flush and clean the system.
2. Tighten all cylinder head bolts in sequence as shown in Figures 21 and 22 of Engine Section.
3. Check the water pump for leaks, excessive end play or looseness of the shaft in the pump.

   NOTE: Should the water pump leak or indicate that leakage would occur with anti-freeze in the system, it should be replaced.
4. Inspect fan belt. Replace if badly worn. Adjust belt to proper tension. See Fan Belt adjustment in this section (fig. 119).
5. Inspect all radiator and heater hoses. If hoses are collapsed, cracked or in any way indicate a rotted condition on the inside, replacement should be made. Carefully check and tighten all hose clamps.
6. Check the thermostat. Make sure it does not stick open or closed.

   NOTE: Standard production thermostats are rated at 143° on all 1949-50 models and 151° on all 1951-53 models. A 181° thermostat should be installed when permanent anti-freeze is used.
7. Fill the cooling system with the proper quantity of anti-freeze and water according to instructions of manufacturer of anti-freeze.

   NOTE: Be sure to allow for additional amount of anti-freeze solution when car is equipped with a hot water heater.
8. Warm up engine and recheck radiator, water pump and all hose connections for leaks with ENGINE HOT.
9. Check and adjust valves when necessary. See Engine Section.

   NOTE: Tightening of cylinder head bolts will affect valve clearance adjustment.

FAN BELT ADJUSTMENT

1. Loosen bolt at generator slotted bracket.
2. Pull generator away from engine until desired belt tension is obtained.

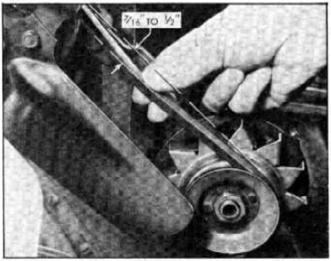

Fig. 119—Fan Belt Adjustment

NOTE: With correct adjustment, a light pressure on the belt at a point midway between pulleys should cause 3/4" deflection on 1949-52 models with the wide belt and a 7/16"-1/2" deflection of the narrow belt used on 1953 models. (fig. 119).

3. Tighten all generator bolts securely.

THERMOSTAT

The thermostat consists of a restriction valve actuated by a thermostatic element. This unit is mounted in the housing at the cylinder head water outlet above the water pump.

Thermostats are designed to open and close at predetermined temperatures and if not operating properly should be removed and tested.

1. Remove radiator to water outlet hose and remove gas line clip from water outlet.
2. Remove water outlet to thermostat housing bolts and remove ,water outlet, gasket and thermostat.
3. Inspect thermostat bellows and valve to make sure they are in good condition.
4. Place thermostat in hot water 25° above the temperature stamped on the thermostat valve.
5. Submerge the bellows completely and agitate the water thoroughly. Under this condition the valve should open fully.
6. Remove the thermostat and place in water 10° below temperature indicated on the valve.
7. With bellows completely submerged and water agitated thoroughly, the valve should close completely.
8. If thermostat checks satisfactorily, replace using a new housing gasket.

CLEANING AND REVERSE FLUSHING

Unless water in the cooling system is treated with a corrosion preventive, rust and scale may eventually clog water passages in the radiator and water jackets. This rust accumulation (fig. 120) will result in inefficient operation of the cooling system vitally affecting engine performance and economy of operation.

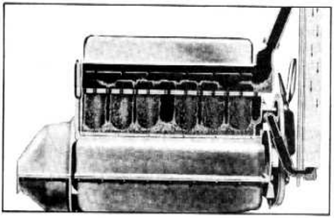

Fig. 120—Rust Accumulation in Water Passages

Two common causes of corrosion are: (1) air suction—air may be drawn into the system due to low liquid level in the radiator, leaky water pump or loose hose connections; (2) exhaust gas leakage—exhaust gas may be blown into the cooling system past the cylinder head gasket or through cracks in the cylinder head and block.

Periodic service must be performed to the engine cooling system to keep it in efficient operating condition. These services should include a complete cleaning and reverse flushing as well as a reconditioning service as explained under "Anti-Freeze."

CLEANING

A good cleaning solution should be used to loosen the rust and scale before reverse flushing the cooling system. There are a number of cleaning solutions available and the manufacturer's instructions with the particular cleaner being used should always be followed.

An excellent preparation to use for this purpose is G. M. Cooling System Cleaner. The following directions for cleaning the system applies only when this type cleaner is used.

1. Drain the cooling system including the cylinder block and then close both drain cocks.
2. Remove thermostat and replace thermostat housing.
3. Add the liquid portion (No. 1) of the cooling system cleaner.
4. Fill the cooling system with water to a level of about 3 inches below the top of the overflow pipe.
5. Cover the radiator and run the engine at moderate speed until the heat indicator reaches 180 degrees.
6. Remove cover from radiator and continue to run the engine for 20 minutes. AVOID BOILING.
7. While the engine is still running add the powder portion (No. 2) of the cooling system cleaner and continue to run the engine for 10 minutes.
8. At the end of this time, stop the engine, wait a few minutes and then open the drain cocks and lower hose connection.

CAUTION: Be careful not to scald your hands.

REVERSE FLUSHING

Reverse flushing should always be accomplished after the system is thoroughly cleaned as outlined above. Flushing is accomplished through the system in a direction opposite to the normal flow. This action causes the water to get behind the corrosion deposits and force them out.

Radiator

1. Remove the upper and lower radiator hoses.

2. Attach a lead-away hose at the top of the radiator.
3. Attach a new piece of hose to the radiator outlet connection and insert the flushing gun in this hose.

NOTE: On 1950-53 Powerglide models it is necessary to disconnect oil lines from cooler and remove cooler.

4. Connect the water hose of the flushing gun to a water outlet and the air hose to an air line.
5. Turn on the water and when the radiator is full, turn on the air in short blasts, allowing the radiator to fill between blasts of air (fig. 121).

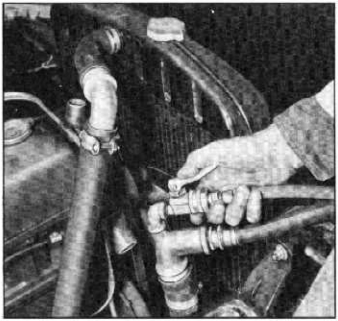

Fig. 121—Reverse Flushing Radiator

CAUTION. Apply air gradually as a clogged radiator will stand only a limited pressure.

6. Continue this flushing until the water from the lead-away hose runs clear.

Cylinder Block and Cylinder Head

1. With thermostat removed attach a lead-away hose to the water pump inlet and a length of new hose to the water outlet connection at the top of the engine.
2. Insert the flushing gun in the new hose.
3. Turn on the water and when the engine water jacket is full turn on the air in short blasts (fig. 122).
4. Continue this flushing until the water from the lead-away hose runs clear.

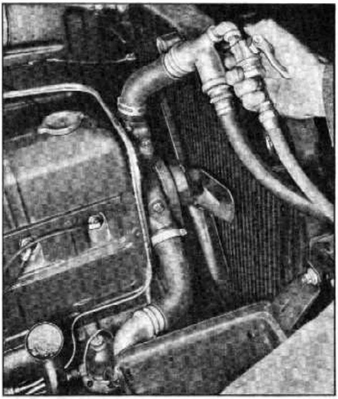

Fig. 122—Reverse Flushing Block and Head

Hot Water Heater

1. Remove water outlet hose from heater core pipe.
2. Remove inlet hose from engine connection.
3. Insert flushing gun and flush heater core. Care must be taken when applying air pressure to prevent damage to the core.

After cooling system has been cleaned and reverse flushed the system should be thoroughly reconditioned. Procedure for reconditioning as outlined under "Anti-Freeze" in this section should be followed.

Dirt and bugs may be cleaned out of the radiator air passages by blowing out with air pressure from the back of the core.

WATER PUMP AND FAN

The water pump (fig. 123) is the ball bearing type and requires no care other than to make certain the air vent at the top of the housing and the drain holes in the bottom do not become plugged with dirt or grease.

The shaft and the double row ball bearings are integral. The bearing is packed with a special high melting point grease at the time of manufacture and requires no further lubrication.

The ends of the bearing are sealed to retain the lubricant and prevent dust and dirt from entering.

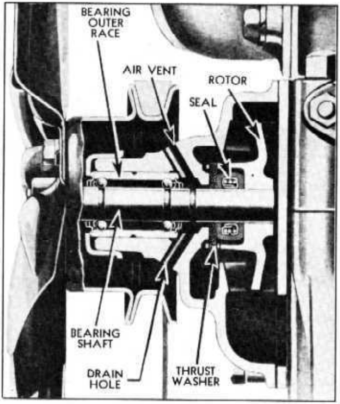

Fig. 123—Cross Section of Ball Bearing Water Pump

The shaft and bearing are retained in the housing by a metal cap which is a press fit on the housing. The thrust washer has two lugs which fit into two slots in the end of the rotor. One side of the thrust washer bears against the ground thrust surface of the pump housing and the other against the seal. The rubber seal bears against the machined surface on the inside of the rotor and also against the thrust washer. A coil spring mounted inside, and an integral part of the seal, maintains a constant pressure against the thrust washer and rotor, assuring a positive seat. An air vent in the top of the housing and drain holes in the bottom prevent any water seepage past the thrust washer from entering the bearing.

All fans are of the four blade type with blades spaced so as to dampen out vibrations and of a size to provide adequate cooling.

The fan blades are bolted directly to the water pump pulley which is driven by the crankshaft pulley by means of a "V" type endless fan belt.

NOTE: Water pumps used on 1953 models have by-pass feature otherwise they are same as 1949-52 water pumps.

MAJOR SERVICE OPERATIONS

WATER PUMP SEAL AND/OR THRUST WASHER

To facilitate repair, tool J-1226 has been developed for use in removing the water pump pulley. Repairs to replace the water pump seal and/or thrust washer should be performed in the following manner using repair kit No. 3690932.

Disassembly

1. Place pump assembly in vise and remove pump plate attaching screws. Remove pump from vise and remove plate and plate gasket.
2. Assemble water pump pulley puller J-1226 to pulley.

   CAUTION: Make sure tool is installed with puller plate square with pulley face.

3. Place puller plate in vise (fig. 124) and tighten puller screw to remove pulley. Remove tool from pulley.
4. Place pump body in vise and with a long drift punch, remove bearing retainer from pump body.
5. Support pump on milled shoulder of body in a hand arbor press or on press plate J-1453 in arbor press and press shaft and bearing assembly out of pump body and rotor (fig. 125).

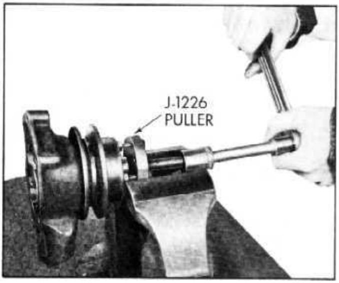

Fig. 124—Removing Water Pump Pulley

6. Remove thrust washer and seal assembly from rotor and discard.

Inspection

1. Wash all parts except pump shaft bearing in cleaning solvent.

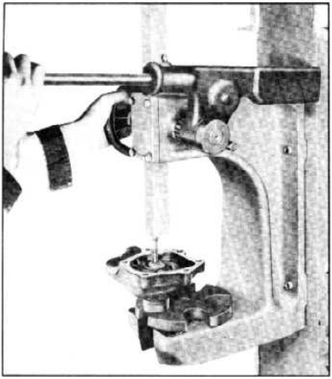

Fig. 125—Removing Shaft and Bearing Assembly

NOTE: Pump shaft bearing is a permanently sealed and lubricated bearing and should not be washed in cleaning solvent.

2. Inspect shaft and bearing assembly for roughness or excessive end play. Remove any rust or scale from shaft with fine emery cloth. The bearing should be wrapped in cloth while this operation is performed to prevent emery dust from entering bearing.
3. Inspect seat for thrust washer in pump body for pit marks or scoring. If seat for thrust washer is scored or pitted the water pump should be replaced.

Assembly

1. Install pump shaft and bearing assembly into pump body bearing bore applying pressure to outer race until it bottoms.
2. Press shaft and bearing retainer onto pump body using a short piece of 1½" I.D. pipe or pilot of J-2671 transmission third speed bushing installer (fig. 126).
3. Coat end of the rubber seal opposite to the end having the three projections with sealer, then place seal into rotor bore with the sealer coated end down.
4. Coat both sides of thrust washer with a small amount of water pump grease and install washer on top of seal assembly so that two lugs index with slots in the rotor.

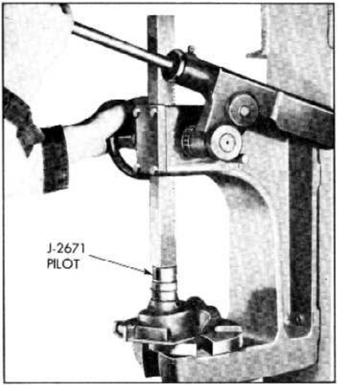

Fig. 126— Installing Shaft and Bearing Retainer

5. Lay the rotor and seal assembly on a flat surface on an arbor press and carefully press the shaft and housing assembly into the rotor (fig. 127).
6. Check clearance between face of rotor and pump body (fig. 128). This clearance should be .010" to .035".

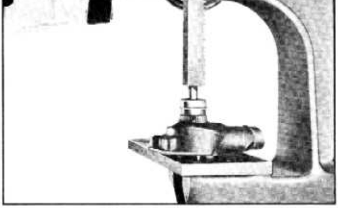

Fig. 127—Installing Shaft and Housing into Rotor

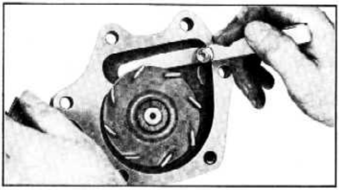

Fig. 128—Checking Clearance Between Face of Rotor and Pump Body

7. Place pump in arbor press with end of pump shaft supported on a small flat plate and press pump pulley onto shaft (fig. 129) until pulley is flush with end of shaft.
8. Install pump plate to pump body using a new gasket, install screws, tighten securely and stake in place.

RADIATOR REPLACEMENT

1. Remove drain plug and drain radiator.
2. Raise hood and block in open position.
3. Remove radiator to water outlet hose.
4. Remove radiator to inlet pipe hose.
5. Remove radiator to radiator support bolts, lay horns back out of way, and lift radiator core straight up to remove.

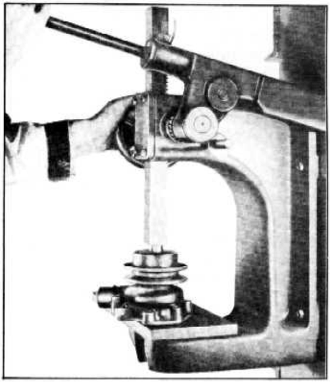

Fig. 129—Installing Pump Pulley

6. Slide radiator core into position with radiator flange in back of radiator support front flange and install support bolts and horns.
7. Install radiator hoses and replace radiator drain plug.
8. Fill cooling system and check for leaks and lower hood.

TROUBLES AND REMEDIES

COOLING SYSTEM

Symptom and Probable Cause	Probable Remedy
Overheating	
a. Lack of coolant	a. Refill system and check for leaks
b. Fan belt loose	b. Adjust
c. Fan belt oil soaked	c. Replace fan belt
d. Thermostat sticks closed	d. Replace thermostat
e. Water pump inoperative	e. Replace water pump
f. Cooling system clogged	f. Clean entire system and reverse flush
g. Incorrect ignition timing	g. Retime engine
h. Brakes dragging	h. Adjust brakes
i. Manifold heat valve thermostatic spring damaged	i. Replace spring
j. Manifold heat valve stuck due to seized shaft	j. Free manifold heat valve shaft
Overcooling	
a. Thermostat remains open	a. Replace thermostat
b. Extremely cold climate	b. Cover part of radiator area

Symptom and Probable Cause	Probable Remedy
Loss of Coolant	
a. Leaking radiator	a. Replace or repair
b. Loose or damaged hose connection	b. Tighten or replace hose connections
c. Leaking water pump	c. Replace water pump
d. Loose or damaged heater hose	d. Tighten or replace hose
e. Leaking heater unit	e. Replace or repair heater core
f. Leak at cylinder head gasket	f. Replace gasket and tighten bolts securely and evenly
g. Cracked cylinder head	g. Replace cylinder head
h. Cracked cylinder or block expansion plug loose	h. Make necessary repairs or replacements
i. Engine operating at too high temperature	i. See overheating causes
Circulation System Noisy	
a. Pump bearings rough	a. Replace pump
b. Fan blades loose or bent	b. Tighten or replace fan blades
c. Fan belt noisy in pulley	c. Dress belt with belt dressing or soap and adjust
d. Fan belt inner plies loose	d. Replace fan belt

COOLING SYSTEM SPECIFICATIONS

Cooling Capacity (Quarts) 1949-52.......... 15

Cooling Capacity (Quarts) 1953 16

Water Pump

Type and drive	Centrifugal by fan belt
Location	Front of cylinder block
Capacity	47 gal. per minute at 4000 engine RPM
Impeller location	Pump body
Bearings	Permanently sealed and lubricated ball
Seal	Molded rubber automatically adjusted by spring tension

Fan

Diameter .... 15¾″
Number of blades 4

Fan Belt

Deflection 1949-52 .... ¾″
Deflection 1953 ....7/16″-½″
Adjustment .... By moving generator

Thermostat	Stamped 151	Stamped 143	Stamped 181
Starts to open at	148°-156°	140°-147°	175°-184°
Fully opened	176°	170°	204°
Location	In cylinder head outlet		

Radiator Core

Make and type.....Harrison, ribbed cellular
Frontal area ....408 sq. inches

CLUTCH

INDEX

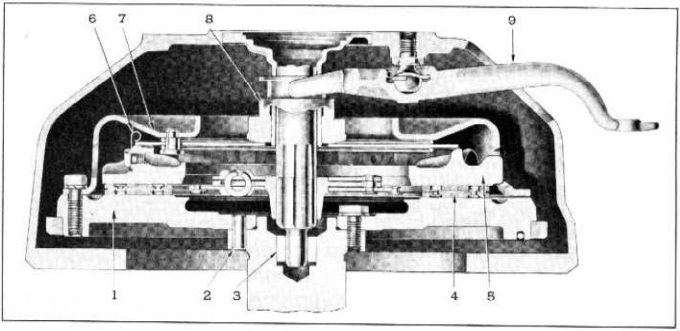

Fig. 130—Clutch Cross Section

1. Flywheel
2. Dowel
3. Bushing
4. Driven Disc
5. Pressure Plate
6. Spring
7. Cover
8. Throwout Bearing
9. Fork

GENERAL DESCRIPTION

The clutch used on all models, except those equipped with Powerglide transmission, is a single plate dry disc type consisting of two basic assemblies, the driven disc and facing assembly and the cover, pressure plate and diaphragm spring assembly. See Figure 130 for layout of clutch parts.

The entire clutch assembly is mounted on a splined transmission clutch gear and bolted to the flywheel through the clutch cover. The driven disc assembly, which includes a hub and torsional springs, has conventional clutch facing riveted on both sides of the disc.

The pressure plate and diaphragm spring are assembled in the clutch cover and mounted to the flywheel over the driven disc assembly. The diaphragm spring is dished to maintain a constant pressure on the pressure plate which in turn holds the driven disc in contact with the flywheel face. This spring has eighteen tapered fingers pointing inwards and is made from very high quality steel, carefully heat treated and shot blasted to secure long life. The action of this diaphragm spring can be compared to the flexing action of the bottom of an ordinary oil can. By depressing the clutch pedal, the throwout bearing is forced against the diaphragm spring fingers causing the diaphragm spring to pivot on pivot rings (fig. 131).

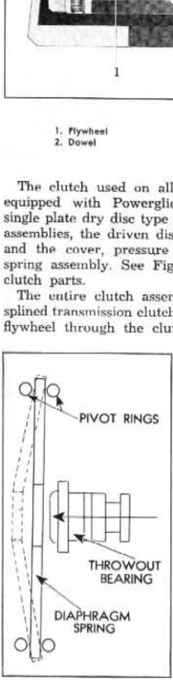

Fig. 131—Action of Diaphragm

An oil impregnated type pilot bearing is installed in the end of the crankshaft and serves as a pilot for the transmission clutch gear. The release bearing which is a part of the clutch release collar and bearing assembly is a sealed ball type. The release fork is ball stud mounted in the clutch housing, the inner end of the fork engaging the grooves in the release collar for actuating the collar and bearing.

OPERATION

The clutch is always engaged unless purposely disengaged by the driver by depressing the foot pedal. In the engaged position, the diaphragm spring fingers are flat and the entire rim of the spring exerts pressure against the pressure plate (fig. 132).

When the clutch pedal is depressed, pressure of the throwout bearing on the inner ends of the diaphragm fingers causes a diaphragm action and the outer ends of the fingers, near the rim, pivot on the inner pivot ring. This action causes the rim of the diaphragm spring and the pressure

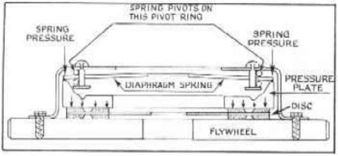

Fig. 132—Engaged Position of Diaphragm Spring

plate to move away from the clutch disc disengaging the clutch (fig. 133). When the clutch pedal is released and the throwout bearing no longer contacts the fingers, the spring in the diaphragm causes the fingers to pivot about the rear pivot ring and the rim to bear against the pressure plate.

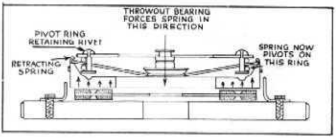

Fig. 133—Disengaged Position of Diaphragm Spring

MINOR SERVICE OPERATIONS

The dry disc type clutch requires very little care during its life. Only one simple adjustment is necessary to maintain clutch efficiency and assures long life. This adjustment is for the amount of free clutch pedal travel before the throwout bearing contacts the clutch fingers (fig. 134). As

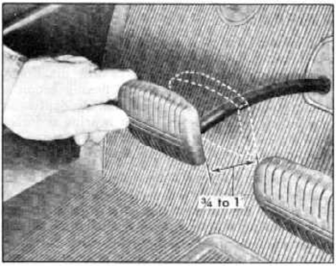

Fig. 134—Clutch Pedal Free Travel

clutch facings wear, the amount of free pedal travel is reduced and in time this will result in the clutch pedal being held tight against the pedal stop or toe board resulting in clutch slippage. Therefore, it is necessary to adjust pedal at periodic intervals to provide sufficient free pedal travel ¾"-1" to permit full engagement of the clutch.

ADJUSTMENT—FREE PEDAL TRAVEL

1. Loosen check nut "A" (fig. 135).
2. Turn adjusting nut "B" until free pedal travel is ¾" to 1".

   NOTE: Check this free travel with one finger on the pedal and not with the foot as the adjustment is sensitive.

3. Tighten check nut "A".

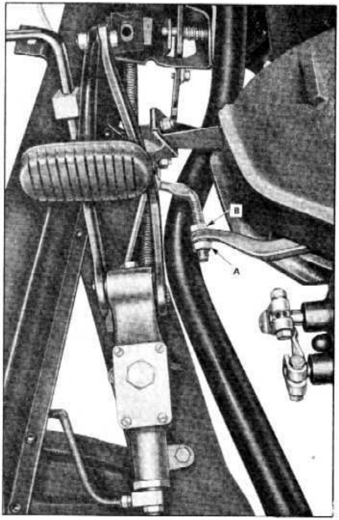

Fig. 135—Clutch Pedal Free Travel Adjustment

CLUTCH RETRACTING SPRINGS

A rattle in the clutch assembly at idling speeds with the clutch released may be caused by insufficient tension on the pressure plate retracting springs. This noise can easily be remedied by replacing the springs, as follows:

1. Remove the clutch housing underpan.
2. Hand crank the engine until one retracting spring attaching bolt is at the bottom. Remove the bolt and retracting spring and install a new spring.
3. Replace the other retracting springs in the same manner.
4. Replace clutch housing underpan.

If replacing the retracting springs does not correct the rattle condition, the clearance between the drive lugs on the pressure plate and the slots in the cover should be checked. If this clearance exceeds .008", the pressure plate and/or cover assembly should be replaced to obtain proper clearance.

MAJOR SERVICE OPERATIONS

There are many things which affect good clutch operation. Therefore, it is necessary, before performing any major clutch operations, to make certain preliminary inspections to determine whether or not the trouble is actually in the clutch.

1. Check the clutch pedal to make sure that the pedal has ¾" to 1" free travel before the clutch starts to disengage.
2. Check the clutch pedal bushing for wear and for sticking on the shaft or loose mountings.
3. Lubricate the pedal linkage.
4. Tighten all front and rear engine mounting bolts. Should the mountings be oil soaked, it will be necessary to replace them.
5. Check rear spring shackle bushing and pins.

Removal

1. Remove transmission as outlined in Transmission Section 7.
2. Remove clutch throwout bearing from the fork.
3. Remove lock nut from adjusting link and remove clutch fork by pressing it away from its ball mounting with a screwdriver, until the fork snaps loose from the ball.

   NOTE: The retainer may be removed from the fork by prying out with a small screwdriver.

4. Install clutch pilot tool K-411 to support the clutch assembly during removal.
5. Loosen the six clutch attaching bolts one turn at a time to prevent distortion of clutch cover until diaphragm spring is released.
6. Remove clutch pilot tool and remove clutch assembly from vehicle.

Disassembly

1. Remove the three clutch pressure plate retracting springs (fig. 136) and remove pressure plate from clutch cover.

   NOTE: When disassembling, note position of "O" marks on pressure plate and cover. These marks must be aligned in assembly to maintain balance.

2. The clutch diaphragm spring and two pivot rings are riveted to the clutch cover (fig. 132).

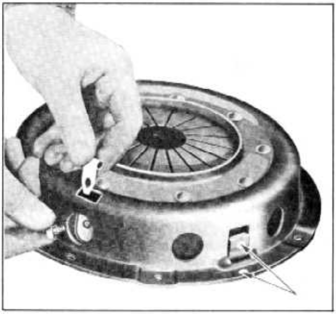

Fig. 136—Removing or Replacing Pressure Plate Retracting Springs

Spring, ring and cover should be inspected for excessive wear or damage and if there is a defect, it is necessary to replace the complete cover assembly.

Inspection

1. Wash all parts, except throwout bearing in cleaning solvent.

   NOTE: The throwout bearing is permanently packed with lubricant and should not be soaked in cleaning solvent as this may dissolve the lubricant.

2. Inspect pressure plate and flywheel for scores on the contact surfaces.
3. Check pressure plate drive lugs for burrs. These lugs must move freely in the cover.
4. Check clearance between lugs and cover. This clearance should be .002"-.008".

5. Check throwout bearing for roughness and free fit on the sleeve of the transmission clutch gear bearing retainer.
6. Check runout of transmission pilot hole in clutch housing by removing flywheel stud and installing an indicator (fig. 59). The runout should be within .008" indicator reading.
7. Check fit of ball in clutch fork (fig. 137). This fit should be snug without end play.

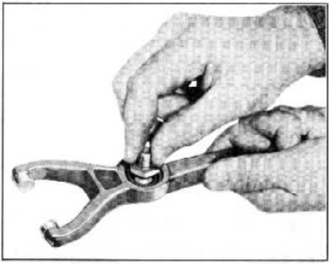

Fig. 137—Checking Free Fit of Fork Ball in Clutch

8. Inspect clutch disc for worn, loose or oil soaked facings, broken springs, loose rivets or riding.
9. Examine splines in hub and make sure they slide freely on splines of transmission clutch shaft. If splines are worn, the clutch should be replaced.

REPAIRS

Pilot Bearing

The clutch pilot bearing is an oil impregnated type bearing pressed into the crankshaft. This bearing requires attention only when the clutch is removed from the vehicle, at which time it should be cleaned and inspected for excessive wear or damage and should be replaced if necessary. To remove, install pilot bearing puller J-1448 and remove bearing from crankshaft (fig. 138). In replacing this bearing, use clutch pilot bearing driver J-1522. Place bearing on pilot of tool with radius in bore of bearing next to shoulder of tool and drive into crankshaft.

ASSEMBLY

1. Install the pressure plate in the cover assembly lining up the "O" mark on pressure plate driving lug with "O" mark on flange of cover (fig. 136).

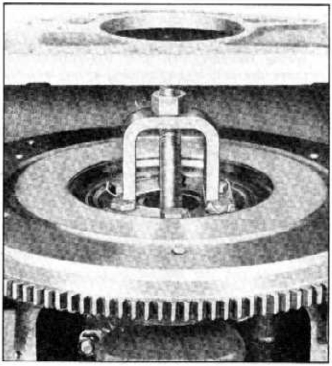

Fig. 138—Clutch Pilot Bearing Remover

2. Install the three pressure plate retracting springs (fig. 136). The clutch is now ready to be installed.
3. Crank the engine until "X" mark on flywheel is at the bottom.
4. Install clutch disc, pressure plate and cover assembly and support them with clutch pilot tool K-411.
5. Turn clutch assembly until "X" mark on clutch cover flange lines up with "X" mark on flywheel (fig. 72).
6. Install attaching bolts and tighten each one a turn at a time to prevent distorting the cover as the spring pressure is taken up.
7. Remove clutch pilot K-411.
8. Pack clutch fork ball seat with a small amount of high melting point grease and install a new retainer in the groove of the clutch fork if the old retainer is worn or damaged.

NOTE: Install retainer with high side up, away from bottom of the ball socket and with open end of retainer on the horizontal.

9. Replace clutch fork to the clutch fork ball in clutch housing by snapping it onto the ball.
10. Lubricate the recess on the inside of the throwout bearing collar and coat the throwout fork groove with a small amount of high melting point grease (fig. 139).

CAUTION: Be careful not to use too much lubricant.

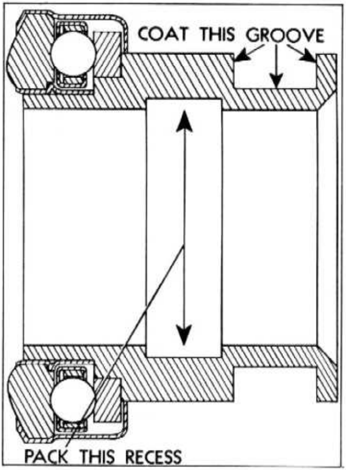

Fig. 139—Lubrication Points on Clutch Throwout Bearing

11. Install throwout bearing assembly to the throwout fork.
12. Assemble transmission as outlined in Transmission Section.

CLUTCH AND BRAKE PEDAL

The pedals and brake main cylinder unit are mounted on the box section second cross member brace to the left side rail.

Each pedal has its own individual shaft riveted to it and each shaft pivots in a bushing in the brake main cylinder housing. The main cylinder housing is equipped with a removable plug in a centrally located hole for lubricating the brake and clutch pedal shafts at the same time (fig. 140).

Each shaft has a groove machined in it to lock the pedals in position. A key, which is retained by a tapered plug fits into the shaft grooves.

Disassembly

1. Remove clutch pedal connecting link from clutch pedal and remove bolt connecting brake pedal to main cylinder push rod.
2. Disconnect upper from lower clutch and brake pedals.

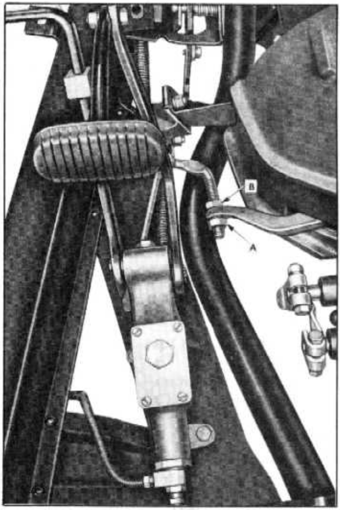

Fig. 140—Brake and Clutch Pedal Mounting

3. Remove pipe plug.
4. Remove plug from forward end of main cylinder, insert a stiff wire into the shaft lock key and remove key (fig. 141).
5. Remove pedals from main cylinder housing.

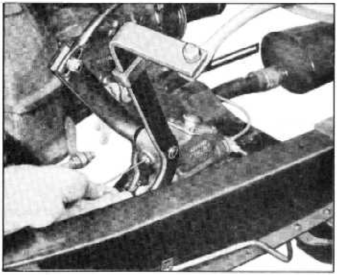

Fig. 141—Removing Clutch and Brake Pedal Key

Assembly

1. Install pedal shafts into main cylinder housing.
2. Line up key grooves in shaft and install shaft lock key.
3. Lubricate and install plug and tighten securely.

   NOTE: Care should be used not to over-lubricate the pedal shaft because excess grease will drip down on the rubber boot on the front of the brake main cylinder and damage the boot.

4. Connect upper brake and clutch pedals to lower pedals.
5. Connect clutch pedal link and adjust clutch free pedal travel. Install bolt connecting brake pedal to main cylinder push rod and check and adjust toe board clearance.

TROUBLES AND REMEDIES

CLUTCH

Symptom and Probable Cause	Probable Remedy
Slipping	
a. Improper adjustment	a. Adjust pedal travel
b. Oil soaked	b. Install new disc
c. Sticking pressure plate	c. Check fit of drive lugs on pressure plate in slots of cover. If necessary, replace pressure plate or cover
d. Worn splines on clutch gear	d. Replace transmission clutch gear
e. Lining torn loose from disc	e. Install new disc
Grabbing	
a. Oil on lining	a. Install new disc
b. Worn splines on clutch gear	b. Replace transmission clutch gear
c. Sticking pressure plate	c. Check fit of drive lugs in cover
d. Worn shackles	d. Replace shackle bushings and pins
e. Loose engine mountings	e. Tighten or replace mountings
Rattling	
a. Weak retracting springs	a. Replace springs
b. Excessive clearance at driving lugs	b. Replace pressure plate or cover
c. Throw out fork loose on ball studs	c. Check ball stud and retaining spring and replace if necessary

CLUTCH SPECIFICATIONS

Type .... Single Plate Dry Disc

Disc Diameter .... 9⅛″

Clutch Pressure Spring
Type .... Diaphragm
Diameter .... 9″

Clutch Release Bearing
Type .... Sealed
Make .... New Departure

Clutch Pilot Bearing
Type .... Oil Impregnated Bushing

Clearance Between—
Pressure Plate Drive
Lugs and Cover .... .002″-.008″

Transmission Pilot Hole
Runout not to exceed .... .008″

Clutch Pedal
Free Pedal Travel .... ¾″ to 1″

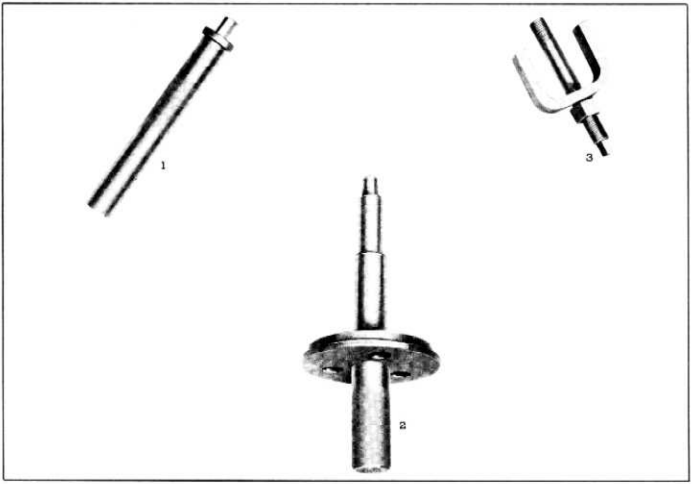

Fig. 142—Clutch Special Tools

1. Clutch Pilot Bearing Driver—J-1522
2. Clutch Pilot Tool—K-411
3. Clutch Pilot Bearing Puller—J-1448

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SECTION 7

TRANSMISSION

CONTENTS OF THIS SECTION

3-SPEED TRANSMISSION

INDEX

GENERAL DESCRIPTION

A three-speed synchromesh transmission (fig. 1) is used as standard equipment on all passenger cars. This transmission incorporates all helical gears which are machined from drop forged steel gear blanks, heat treated for strength and long life. The shafts are machined from high grade steel, heat treated and ground to close limits.

The rear end of the clutch gear is supported by a heavy duty ball bearing at the front end of the transmission case and is piloted at its front end in an oil impregnated bushing mounted in the engine crankshaft. On 1949-52 models the front end of the mainshaft is piloted in roller bearings set into the hollow end of the clutch gear and the

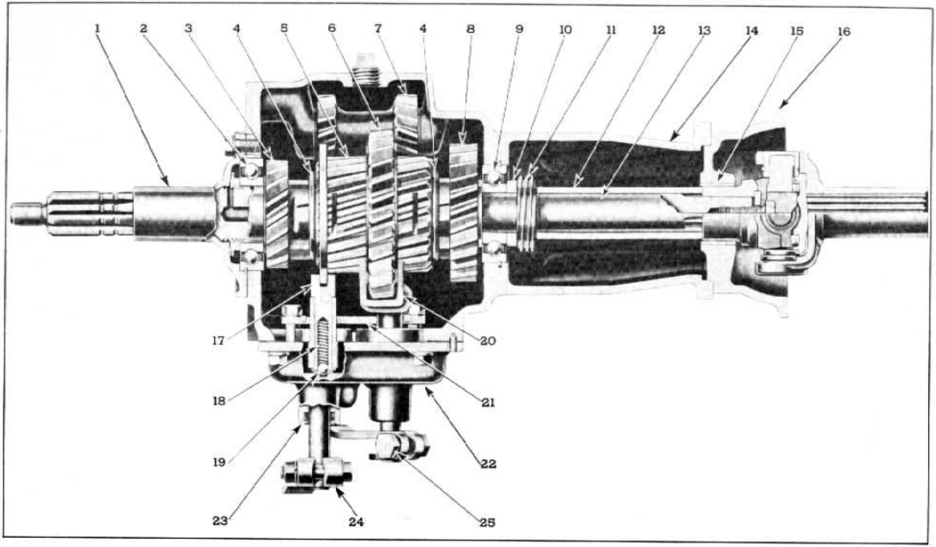

Fig. 1—Transmission Cross Section

1. Clutch Gear Bearing Retainer
2. Clutch Gear Bearing
3. Clutch Gear
4. Synchronizer Ring
5. Synchronizer Drum
6. First and Reverse Sliding Gear
7. Reverse Idler Gear
8. Second Speed Gear
9. Mainshaft Rear Bearing
10. Speedometer Drive Gear Spacer
11. Speedometer Drive Gear
12. Universal Joint Spacer
13. Mainshaft
14. Transmission Case
15. Rear Bearing Support Bushing
16. Rear Bearing Support
17. Second and Third Shifter Fork
18. Detent Spring
19. Detent Ball
20. First and Reverse Shifter Fork
21. Interlock Retainer
22. Side Cover
23. Seal
24. Second and Third Shifter Lever
25. First and Reverse Shifter Lever

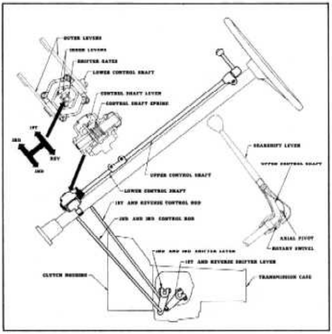

Fig. 2—Gearshift Linkage

rear end is carried by a ball bearing mounted in the rear of the transmission case. On 1953 models, the clutch gear roller pilot bearing is retained at the shaft end and an additional 24 roller bearings is located closer to the mainshaft clutch spine. To accommodate this additional bearing the clutch gear and mainshaft have been changed.

The countergear and reverse idler gear are carried on bronze bushings while thrust is taken on thrust washers located between ends of gears and front and rear of the case.

The transmission case is accurately machined to assure proper alignment of the gears and their shafts. To further steady and align the rear end of mainshaft and front universal joint a rear bearing support which pilots and bolts to the rear transmission case flange is used. This bearing support also makes up the front half of the universal ball joint.

Gearshifting is manual through steering column gearshift mechanism (fig. 2) to the transmission cover located on the side of the transmission. Shifting is accomplished by two rotating cranks which directly engage the gears to be shifted, thus affording a highly efficient mechanical action. The shifter gate for selection between first and reverse and second and high is contained in the shifter housing mounted on the lower portion of the steering column mast jacket. Two shifter control rods connect the shifter lever on the transmission to the outer shifter levers on this housing.

The gearshift lower control shaft has a short lever or lug which engages one of the levers in the shifter housing. Rotating motion created by moving the gearshift lever is transmitted to the levers on the shifter housing and thence to the shifter levers on the transmission cover, thus shifting into the selected gear.

MINOR SERVICE OPERATIONS

STEERING COLUMN GEARSHIFT LINKAGE—ADJUST

In cases where insufficient clearance is encountered between the gearshift lever and the steering wheel or when the gearshift linkage has been disconnected or removed for steering gear overhaul, proper adjustment sequence is important.

1. Check clearance between gearshift lever and gearshift control upper support (fig. 3).
2. This clearance checked from the lower edge of the gear shift lever to the top of the upper support should be $\frac{3}{32}''$ to $\frac{1}{8}''$.
3. To correct this clearance remove upper bolt from upper and lower control shaft clamp and remove two screws holding upper support to steering gear housing and remove upper control shaft assembly.
4. Screw upper support up or down to get necessary clearance and replace upper control shaft tightening clamp bolt and replacing upper support screws.
5. Check clearance between gearshift lever and lower edge of steering wheel rim (fig. 4). This clearance should be $2\frac{3}{4}'' + \frac{1}{4}''$.
6. To correct this clearance loosen two gearshift control shaft and housing assembly clamp

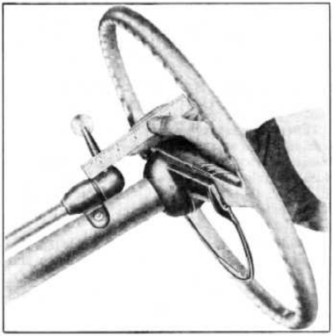

Fig. 3—Checking Gearshift Lever to Upper Support Clearance

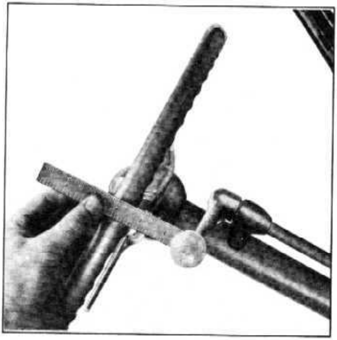

Fig. 4—Checking Gearshift Lever to Steering Wheel Clearance

bolts and move housing assembly with upper and lower control shafts and gearshift lever up or down to obtain necessary clearance.

7. With proper clearance obtained tighten housing assembly clamp bolts.
8. With transmission in neutral, gearshift lever should be horizontal. To move gearshift lever to horizontal position, loosen second and third speed control rod clamp and adjust to bring gearshift lever into a horizontal plane. Tighten clamp.
9. Remove housing cover and check to make sure that shifter gates in inner levers are aligned. If alignment is off, loosen first and reverse speed control rod clamp and adjust until shifter gates are aligned. Tighten clamp.

REAR BEARING SUPPORT AND/OR SPEEDOMETER DRIVE GEAR—REPLACE

The transmission bearing support (fig. 1) is serviced as an assembly in order to assure proper transmission alignment. Should the bushing in this assembly become worn it will be necessary to replace the assembly. Also, if replacement of speedometer drive gear is required, the bearing support must be removed.

1. Unhook hand brake pull back spring, disconnect pull cable clevis from idler lever and remove idler lever.
2. On 1949-52 models, remove floor mat and transmission hole cover.
3. Remove caperews holding universal joint collar to rear bearing support, slide universal ball and collar back on propeller shaft housing.
4. Place jack under propeller shaft, remove capscrews which retain front trunnion bearings to front yoke, split joint and lower front end of propeller shaft.
5. Remove retainer bolt, lockwasher and universal joint yoke washer and slide front universal joint yoke off end of mainshaft and out of rear bearing support bushing.
6. Remove bolts that retain bearing support to transmission housing and remove bearing support.
7. Remove universal joint spacer, disconnect speedometer cable and remove speedometer driven gear. Then remove speedometer drive gear and speedometer drive gear spacer from mainshaft.
8. Inspect speedometer drive gear spacer, universal joint spacer and speedometer drive gear and replace any worn or damaged parts.
9. Install speedometer drive gear spacer, speedometer drive gear and universal joint spacer on mainshaft.
10. Install new rear bearing support and gasket to transmission housing, install bolts and tighten securely.

    NOTE: Rear bearing support should be a hand push fit to a maximum of .0015" loose when assembled to case counterbore.

11. Adjust universal ball joint as outlined under "Major Service Operations."
12. Install front universal joint yoke on mainshaft and install universal joint yoke washer, lockwasher and retainer bolt to end of mainshaft and tighten bolt to 25-30 foot pounds.
13. Raise propeller shaft and connect trunnion bearings to front yoke, tighten capscrews securely and bend tangs on lock plate.
14. Slide universal ball and collar forward on propeller shaft and install capscrews holding collar to rear bearing support.
15. Add ½ pint transmission lubricant through speedometer hole. Then, install speedometer driven gear, connect speedometer cable and on 1949-52 models replace transmission hole cover and floor mat.
16. Install hand brake idler lever; connect pull back spring and replace pull cable clevis to idler lever.

TRANSMISSION SIDE COVER ASSEMBLY

On any replacement of parts in the side cover assembly it is necessary to remove cover from tranmission case.

1. Drain transmission and disconnect shifter rods from shifter levers on transmission.
2. On 1949-52 models remove floor mat and transmission hole cover.
3. To replace shifter shaft and fork assembly, shaft seals, interlock, poppets or springs, remove cover assembly from transmission case.
4. Remove nuts and locks from interlock retainer studs and remove shifter interlock retainer. This will allow removal of shifter shaft and fork assembly, shaft seals, poppets and springs or interlock from cover.
5. Replace necessary parts, install shifter interlock retainer over studs and install locks and nuts. Tighten nuts securely and lock in position.
6. With transmission gears in neutral and shifter forks in neutral position install cover to transmission using a new gasket and tighten retaining capscrews to 15-18 ft. lbs. torque.

   NOTE: Hump on first and reverse shifter fork (fig. 5) must be toward rear of transmission.

7. Attach shifter rods to shifter levers on transmission.
8. On 1949-52 models, replace transmission hole cover and floor mat and on all models, refill transmission with 1½ pints transmission lubricant.

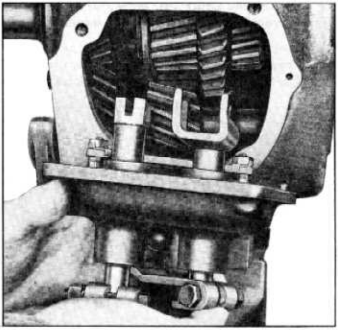

Fig. 5—Cover Assembly Installation

MAJOR SERVICE OPERATIONS

TRANSMISSION

Removal

1. On 1949-52 models, remove floor mat and transmission cover from body floor.
2. Disconnect speedometer cable from speedometer driven gear on transmission housing and remove speedometer driven gear.
3. Disconnect first and reverse and second and third control rods from shifter levers at transmission side cover.
4. Drain lubricant from transmission.
5. Unhook hand brake pull back spring, disconnect pull cable clevis from idler lever and remove idler lever.
6. Remove capscrews holding universal joint collar to rear bearing support; slide universal ball and collar back on propeller shaft housing.
7. Place jack under propeller shaft, remove capscrews which retain front trunnion bearings to front yoke, split joint and lower front end of propeller shaft.
8. Remove bolts holding rear transmission support to frame cross member.
9. Block up rear of engine to support after transmission is removed.
10. Remove two top transmission to clutch housing capscrews.
11. Support the transmission, remove flywheel underpan and remove the two lower transmission to clutch housing capscrews.
12. Slide the transmission straight back until the clutch gear shaft is free of the splines in the clutch disc.
13. Remove the transmission through opening in body floor on 1949-52 models and on 1953 models rotate transmission as necessary and remove from under the body.
14. Removal from convertible models is accomplished in the same manner with the exception that the transmission support must be removed completely and transmission rotated as necessary to provide clearance

Disassembly

1. Remove the capscrews from the transmission cover and remove the cover and gasket.

   NOTE: Under ordinary circumstances it is not necessary to disassemble the cover assembly. Servicing of cover is covered under "Minor Service Operations."

2. Place the transmission in two gears at once to lock the mainshaft, and remove the universal joint yoke retaining capscrew, lock-

washer and universal joint yoke washer. Slide the yoke off the mainshaft and remove the universal joint spacer.

CAUTION: Care should be used when shifting the gears into second or third to prevent damage to the wedge angles.

3. Remove the four clutch gear bearing retainer screws and shakeproof washers and remove the retainer. Note the screw holes in the retainer are unevenly spaced so that the retainer may only be assembled to the case in one position, matching up the oil return slot with the hole in the case.

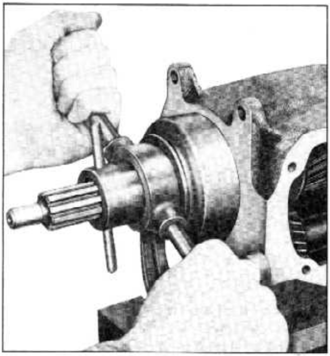

Fig. 6—Removing Clutch Gear and Bearing

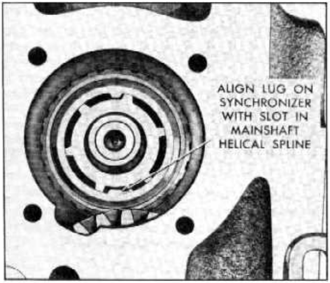

Fig. 7—Synchronizer Alignment

4. Install the special clutch gear and bearing puller J-937 by screwing the threaded sleeve (left-handed thread) onto the clutch gear shaft. Turning the puller handle will remove the gear and bearing without damage to mainshaft pilot bearings (fig. 6).
5. On 1949-52 models, remove the 14 roller bearings from inside the clutch gear. On 1953 models remove 24 roller rear pilot bearings, 2 spacers and 14 roller front bearings.
6. Turn the yoke of the mainshaft removing and replacing tool J-938, down on the threads, and screw adapter J-938-7 onto puller shaft, then install the puller shaft into the rear threaded end of the mainshaft. Bolt the yoke of the tool to the rear flange of the rear bearing support.

   IMPORTANT: Turn the front synchronizer ring so that the lugs line up with the slots in the main shaft helical spline (fig. 7).

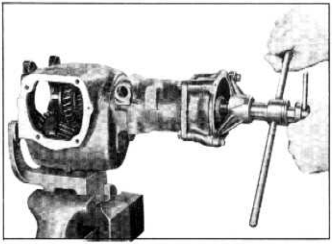

Fig. 8—Removing Mainshaft

7. While holding puller shaft handle, turn the puller handle clockwise to force the mainshaft out of the rear bearing (fig. 8). Disassemble the puller from mainshaft and the rear bearing support and remove the mainshaft from transmission through the front of the case.
8. Shift the second speed gear into the clutch sleeve. Remove the clutch sleeve assembly, first and reverse sliding gear and second speed gear from the case as a unit. Remove the second speed gear thrustwasher from the case.
9. Remove rear bearing support assembly retainer bolts and washers and remove bearing support assembly.
10. Remove speedometer drive gear and speedometer drive gear spacer from transmission case extension.

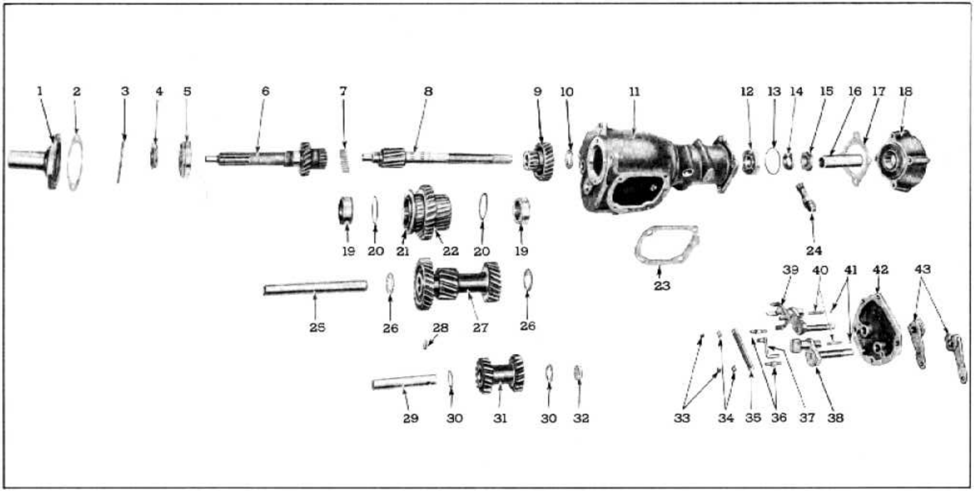

Fig. 9—Layout of Transmission Parts

1. Clutch Gear Bearing Retainer
2. Clutch Gear Bearing Retainer Gasket
3. Clutch Gear Bearing Snap Ring
4. Clutch Gear Bearing Nut and Oil Slinger
5. Clutch Gear Bearing
6. Clutch Gear
7. Main Shaft Pilot Needle Bearings
8. Main Shaft
9. Second Speed Gear
10. Second Speed Gear Thrust Washer
11. Transmission Case
12. Main Shaft Rear Bearing
13. Main Shaft Rear Bearing Snap Ring
14. Speedometer Drive Gear Spacer
15. Speedometer Drive Gear
16. Universal Joint Spacer
17. Rear Bearing Support Gasket
18. Rear Bearing Support
19. Synchronizer Ring
20. Synchronizer Ring Snap Ring
21. Synchronizer Drum
22. First and Reverse Gear
23. Transmission Cover Gasket
24. Speedometer Driven Gear
25. Countershaft
26. Counter Gear Thrust Washer
27. Counter Gear Assembly
28. Reverse Idler Shaft Lock Pin
29. Reverse Idler Shaft
30. Reverse Idler Gear Thrust Washer
31. Reverse Idler Gear
32. Expansion Plug
33. Shifter Interlock Retainer Stud Nut
34. Shifter Interlock Retainer Stud Nut Lock
35. Shifter Interlock Retainer
36. Shifter Interlock Retainer Stud
37. Shifter Interlock Shaft
38. Second and Third Shifter Fork
39. First and Reverse Shifter Fork
40. Shifter Fork Detent Spring
41. Shifter Fork Detent Ball
42. Transmission Cover
43. Shifter Shaft Lever

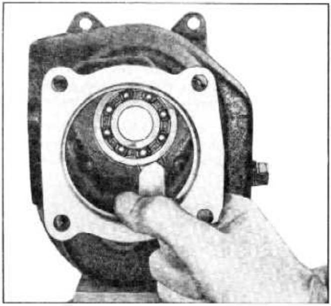

Fig. 10—Removing Rear Bearing

11. Expand the rear bearing lock ring into the case with the special expanding tool J-3185 (fig. 10). This raises the lock ring from the groove in the bearing and the bearing may be removed by lightly tapping the outer race toward the inside of the case. It is necessary to remove the rear bearing before attempting to remove the countergear.
12. Remove the countershaft by driving it from the rear to the front of the case, using a soft steel drift. Remove the countergear, and the front and rear thrustwashers.

    NOTE: It is necessary to remove the countergear before removing the idler shaft, otherwise the idler shaft will strike the countergear.

13. Drive out the reverse idler shaft expanding plugs from inside of the case. A hook-nosed punch or drift will be found most suitable for this job.
14. Drive the idler shaft lock pin into the shaft. This pin is shorter in length than the diameter of the shaft so that the shaft may be slipped out when the pin is driven in. Do not turn the shaft while removing as the lock pin may drop down between the idler gear bushings.
15. Remove reverse idler gear and thrustwashers. Layout of the three-speed transmission parts is shown in Figure 9.

CLEANING AND INSPECTION

Bearings

1. Wash the bearings thoroughly in a cleaning solvent.
2. Blow out the bearings with compressed air.

   CAUTION: Do not allow the bearings to spin, but turn them slowly by hand. Spinning bearings will damage the race and balls.

3. After making sure the bearings are clean, lubricate them with light engine oil and check them for roughness. Roughness may be determined by slowly turning the outer race by hand.

Transmission Case

Wash the transmission case inside and outside with a cleaning solvent and inspect for cracks. Inspect the front face which fits against clutch housing for burrs and if any are present, dress them off with a fine cut mill file.

Gears

1. Inspect all gears and, if necessary, replace any that are worn or damaged.
2. Check the first and reverse sliding gear to make sure it slides freely on clutch sleeve.
3. Check the clutch sleeve to see that it slides freely on mainshaft.

REPAIRS

Clutch Gear Bearing—Removal

1. Place the clutch gear in a vise and remove the bearing retainer nut using the special wrench J-933 (fig. 11). The retaining nut is machined with a left hand thread and is locked in place on the clutch gear shaft by being staked into a hole provided for that purpose.

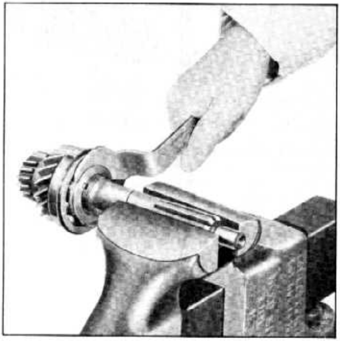

Fig. 11—Removing Bearing Retainer Nut and Oil Slinger

2. To remove the clutch gear bearing place the

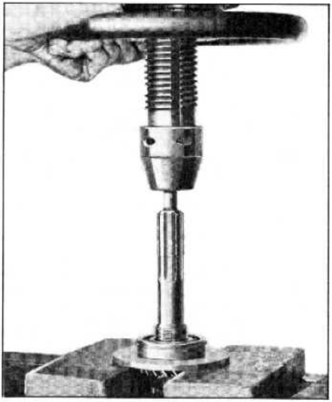

Fig. 12—Removing Clutch Gear Bearing

special press plate J-936 over the gear and against the bearing. Using an arbor press, press the shaft out of the bearing (fig. 12).

CAUTION: Do not attempt to drive the shaft out of the bearing or the bearing will be seriously damaged.

Clutch Gear Bearing—Replace

1. Using an arbor press, press the clutch gear bearing onto the clutch gear with the locating ring toward the front of the gearshaft so that the bearing will enter the case to the maximum possible depth.
2. Install the clutch bearing retaining nut on the clutch gear shaft and draw it up tight, using special wrench J-933.
3. Lock the retaining nut in place by staking it into the hole with a center punch. Care must be used not to damage the threads on the shaft.

Clutch Sleeve—Disassembly

1. Remove the second speed gear.
2. Remove the first and reverse sliding gear.
3. Turn the synchronizing ring in the clutch sleeve until the ends of the synchronizing ring retainer can be seen through the slot in the clutch sleeve.
4. Using special pliers J-932 expand the retainer into the counterbore in clutch sleeve; this raises the retainer from the grooves in

Fig. 13—Removing Synchronizer Ring

the ring and ring may be easily slipped out (fig. 13).

5. Check the synchronizing cones for wear or for being loose in the clutch sleeve. If cones are damaged in any way, it will be necessary to replace the clutch sleeve assembly and both synchronizing rings.

Synchronizer Rings

1. Inspect the synchronizer rings for smoothness.
2. Place the synchronizer rings in the synchronizing cones and check with thumbs to see that rings do not rock. Excessive rocking indicates a poor fit between the rings and cone, which will not permit proper synchronizing of gears during shifting.

Synchronizer Energizing Springs

1. It will be noticed upon examining these springs that one of the ends is slightly offset. Each spring must be assembled in its groove in the clutch gear and the second speed gear with the offset or locking end between the third and fourth teeth of either of the two banks of teeth on these gears, thus keeping the spring from turning in its groove (fig. 14).
2. Under normal operation it should never be necessary to replace the energizing springs; however, should an energizing spring be removed for any reason, a new spring should be installed. The spring may be removed by

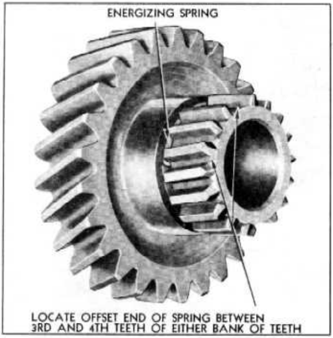

Fig. 14—Correct Position of Energizing Spring

slipping a thin blade under the spring and raising it over the clutch teeth on gear, and slipping it off over the teeth.

CAUTION: *In replacing either energizing spring be very careful not to distort the new spring when expanding it over the clutch teeth.*

Bushings

1. The bushings used in the countergear and the idler gear are pressed into the gear, then peened into holes in the bores to lock them into place, and are accurately bored with special diamond boring tools. This insures the positive alignment of the bushings and their shafts, as well as proper meshing of the gears. Because of the high degree of accuracy to which these parts are machined, the bushings are not serviced separately.
2. Check bushings for excessive wear by using a narrow feeler gauge between the shaft and the bushing. The proper clearance is from .002" to .004".

HIGH GEAR DISENGAGEMENT

High gear disengagement in three-speed transmissions, occurring at speeds around 50 MPH and up, may be due to insufficient tension on the shifter fork detent ball, excessive looseness in the gear shift control lever, or misalignment between the transmission and engine.

A. When high gear disengagement is experienced infrequently and appears to be due to:

1. Insufficient tension on the shifter fork detent ball, install a new detent spring, Part No. 591796, which has 13 lbs. tension. This heavier spring was started in production in late 1949 cars and is also used in all 1950-53 model passenger cars.

   When installing the new detent spring on early 1949 model passenger cars, also check for excessive end play in the shifter fork shafts which may be due to a bent shifter fork interlock retainer. Where the interlock retainer is bent, this will decrease the spring tension on the detent ball. When this condition is found, straighten or replace the retainer as necessary.
2. Where excessive movement is experienced in the gearshift control lever on early 1949 passenger cars, especially on choppy roads, install the new type gearshift lever control spring, Part No. 3692295, which has a small hook on one end to hook around the small lever welded to the gearshift lower control shaft. On the other end it has a long extension which presses against the bottom of the housing. This spring has been used as standard on all late 1949 and all 1950-53 passenger cars.

B. When high gear disengagement is persistent at 50 MPH and up, check and correct as outlined above where necessary, and in addition, the following procedure should be used to correct the alignment of the engine crankshaft pilot, clutch housing bore and the transmission assembly.

Special Tool

A special tool on which is mounted a dial indicator is necessary to check the transmission rear bore alignment. This tool may be made from a new or good used main drive gear (clutch gear) which has a good bearing surface on the crankshaft pilot and front main bearing.

The clutch hub splines on the main drive gear should be ground off so that the shaft may be rotated in a clutch disc hub with out interference when assembled in the car. Weld a piece of ¼" rod 8" long in the mainshaft pilot bore. Assemble a good main drive gear bearing on the shaft and secure it with a regular main drive gear bearing nut.

It is recommended that the Starrett "Last Word" #711F dial indicator be used with this tool. This is especially desirable as the dial of the indicator can be read direct.

NOTE: This indicator is available from Kent-Moore Organization, Detroit, Michigan, under their number J-4455.

Procedure

1. Remove the transmission from the car and completely disassemble as outlined under "Transmission, Removal and Disassembly."

   NOTE: In any case where the main drive gear pilot or bearing is excessively loose or worn, the crankshaft clutch pilot bearing should be replaced before dial indicating the transmission rear bearing bore.

2. Carefully install the special tool with the dial indicator into the transmission case with the face of the indicator and the tracing finger to the rear of the transmission. Secure in place with a main drive gear bearing retainer.
3. Carefully rotate the gear and make final adjustment of the indicator with the tracing finger of the indicator pointing to the rear and in the center of the rear bearing bore.
4. Assemble the transmission case to the clutch housing and tighten the four transmission mounting bolts securely.

   NOTE: Be sure to clean off any paint or other foreign material on the mating faces of the clutch housing and transmission as any foreign material on these faces will change alignment; also, check carefully for dings or burrs on these mating surfaces and remove carefully as necessary.

5. Remove the jack or other support from under the engine and let the weight of the engine rest on the transmission mounting in the normal position.
6. Dial indicate the transmission rear bearing bore and record the indicator readings in the 12, 3, 6 and 9 o'clock positions, with the weight on the transmission mounting as outlined above.

   NOTE: It is best to start the readings at the 6 o'clock position with the indicator set at "0" in this position and then record the 9, 12 and 3 o'clock readings in rotation.

7. Install temporary slotted shims between the transmission case and the clutch housing in the quantities and at the bolt locations as necessary to bring misalignment at the transmission rear bearing bore to a maximum of .003" indicator reading in either the vertical or horizontal plane.

   NOTE: Installation of a .002" shim between the transmission case and the clutch housing at two bolt locations opposite to the high indicator reading will change the transmission rear bore reading approximately .005".

8. After the position and quantity of shims has been determined and recorded, transmission case may be removed.

   NOTE: The clutch housing should then be stamped, showing the position where shims are to be installed and the thickness of shims at each location.

9. Inspect the clutching teeth of the main drive gear. Inspect the second and third speed clutch gear, internal clutching teeth on the high gear (forward end). If the teeth of either gear are worn or tapered due to long continued previous disengagement, the gears should be replaced. Reassemble transmission.
10. Install the transmission assembly to the clutch housing, using the correct number of shims at the proper locations as previously determined. Shims are available by unit part number 3694977 each unit consisting of the following shims:

4—.002" shims	Identification—two corners cut off
2—.005" shims	Identification—one corner cut off
1—.010" shims	Identification—all corners square

   NOTE: These special shims have a tab on one end for ease of installation. Do not slot the shims for the permanent installation. 20hmi03

Identification

All assemblies that have been dial indicated at the plants will be marked. A numeral, which will be visible when the transmission is installed, will be stamped at the bolt locations to show the thickness of shims necessary at each particular bolt location. In cases when no shimming is necessary, there will be a letter "K" stamped at the lower right corner.

Where it is necessary to re-shim a transmission to correct disengagement, the original marking should be stamped out and new markings placed on the clutch housing to prevent possible future confusion.

TRANSMISSION—ASSEMBLY

Reverse Idler Gear

1. Lubricate the reverse idler thrustwashers and install the gear and thrustwashers in the transmission case with the gear having the chamfered teeth to the rear of the case.
2. Install the idler shaft, making sure that the lock pin hole in the shaft lines up with the hole in the case at the same angle (fig. 15).
3. Use a new idler shaft lock pin, coat the pin

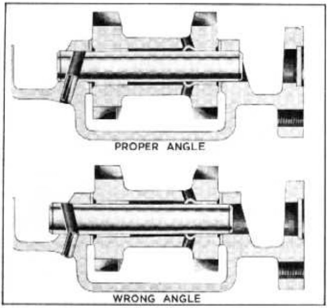

Fig. 15—Reverse Idler Shaft and Lock Pin

with Permatex, and drive it in approximately $\frac{1}{16}''$ beyond flush with case, and peen the hole slightly. This lock pin must be a tight fit in the case to prevent oil leaks.

4. Install the idler shaft expansion plugs in the case. New plugs should always be used whenever possible.

Countergear

1. Install the countergear in the case; lubricate the forward thrustwasher, and install it between the countergear and case.
2. Feed the assembly tool J-1617 (fig. 16) in from the front, tapered end first, picking up the forward thrustwasher and the countergear.

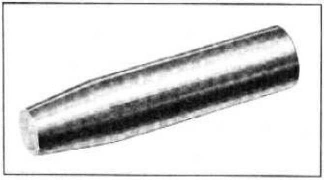

Fig. 16—Countershaft Assembly Tool

3. Lubricate the countershaft and install it in from the front, pushing the assembly tool ahead of it (fig. 17).
4. Lubricate the rear thrustwasher and slip it between the countergear and case, picking it up with the assembly tool as it is pushed through by the shaft.
5. The flat on the forward end of the shaft engages the clutch housing when transmission is installed in chassis and keeps the countershaft from turning. This flat must be horizontal and at the top, or the transmission cannot be assembled to clutch housing.

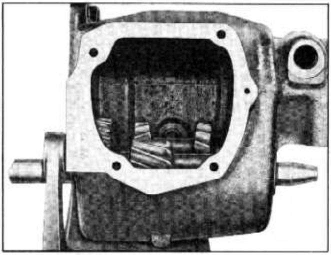

Fig. 17—Assembly of Countershaft

Rear Bearing

1. Install the rear bearing lock ring in the case. Start the bearing in from the inside of case making sure the wide side is to the front of case and use the lock ring expanding tool, J-3185, to expand the ring in the case.
2. Use a soft steel drift, tap the bearing on the outer race until it passes inside lock ring; then remove the lock ring expanding tool and continue to tap the bearing until the lock ring seats in the groove in the bearing.

Synchronizing Clutch Sleeve

1. Install the synchronizer rings and retainers in the counterbores in the ends of the clutch sleeve.

   NOTE: Make sure retainers seat in groove all the way around the rings.

2. Install the first and reverse sliding gear on the second and third speed clutch. Mesh the clutch teeth of the second speed gear with the internal splines of the second and third speed clutch.
3. Coat the grooved side of the thrustwasher with grease and place the washer on the back face of the second speed gear.
4. Install the second and third speed clutch assembly in the transmission case. Insert finger through the rear bearing to line up the thrustwasher and second speed gear with the bearing.

Mainshaft, Rear Bearing Support and Universal Joint

1. For initial lubricant, place transmission lubricant on second speed bearing area of the mainshaft. When installing the mainshaft the lugs on the front synchronizer must slide through the slots in the mainshaft spline. Push the shaft into the clutch sleeve as far as possible by hand, picking up the second speed gear and thrustwasher.
2. Install speedometer drive gear spacer and speedometer drive gear over rear end of mainshaft.
3. Install rear bearing support assembly and gasket to transmission, install retaining bolts and lockwashers and tighten securely. Coat inside of bushing with transmission lubricant.

NOTE: Rear bearing support assembly should be a hand push fit to .0015" maximum loose when assembled into case.

4. Turn the yoke of the mainshaft removing and replacing tool, J-938, down on the threads and screw adapter J-938-7 onto puller shaft, then install the tool shaft into the threaded end of the mainshaft. Bolt the yoke of the tool to the rear flange of the transmission rear bearing support.
5. Turn the tool handle counterclockwise until the mainshaft is seated in the rear bearing. The proper seating of the shoulder on the shaft against the second speed thrustwasher may be determined by checking the end play of the second speed gear. This clearance should be approximately .010". Remove tool from rear flange of rear bearing support.

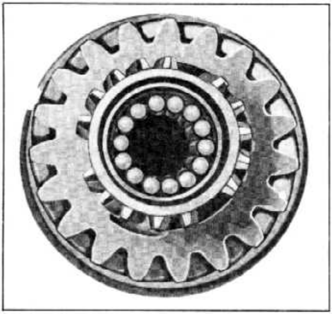

Fig. 18—Mainshaft Pilot Roller Bearings in Clutch Gear

6. Place some cup grease in the mainshaft pilot hole in the clutch gear and install the 14 roller bearings on 1949-52 models (fig. 18). On 1953 models install 14 roller front pilot bearings, 2 spacers and 24 roller rear pilot bearings. After being assembled in the pilot hole, these bearings will lock themselves in place and cannot fall out. Install the clutch gear in the transmission case.
7. Using a soft steel drift, tap the clutch gear bearing on the outer race until the bearing locating ring seats against the case, being careful to drive the assembly straight to prevent damage to the mainshaft pilot and pilot bearings.

CAUTION: During this operation make sure that the synchronizer ring lugs line up with the slots between the clutch teeth on the clutch gear.

8. Install the clutch gear bearing retainer and gasket making sure that the oil slot in the retainer lines up with the oil slot in the front face of the transmission case. Do not allow the gasket to protrude beyond the edge of the retainer.
9. Install the retainer screws and lockwashers Tighten the retaining capscrews to 10-12 foot pounds.
10. Install universal joint spacer on rear end on mainshaft, then, slide front yoke of universal joint on mainshaft, install yoke washer, lockwasher and capscrew and tighten to 25-30 foot pounds.
11. Install speedometer driven gear in transmission housing and tighten securely.

Side Cover Assembly

1. With transmission gears in neutral and shifter forks in neutral position, install cover to transmission using a new gasket.

NOTE: Hump on first and reverse shifter fork (fig. 5) must be toward rear of transmission.

2. Carefully note that locating pin hole in cover flange is indexed with locating pin in case and install retaining capscrews and tighten to 15-18 ft. lbs. torque.

UNIVERSAL JOINT BALL ADJUSTMENT

Due to construction of the universal ball joint it is important that proper adjustment be made at this point.

This type joint, if improperly adjusted, may result in oil leakage if too loose or a complaint of transmission noise if too tight. Therefore, whenever this joint is broken its adjustment must be checked when reassembling.

1. Remove universal joint ball, collar and retainer from torque tube.

2. Wash the ball thoroughly in cleaning solvent, then inspect it for roughness; if rough, smooth up with fine emery paper.
3. Using 4 new torque ball retainer shims as a starting point, assemble universal joint ball, collar and retainer to back of transmission and secure assembly to transmission case with attaching capscrews.

NOTE: Do not install ball joint collar oil seal (cork) at this time.

4. With capscrews tightened to the proper torque place both hands on torque ball at the packing retainer (fig. 19). If torque ball can be moved and is a snug fit the torque ball is properly adjusted.

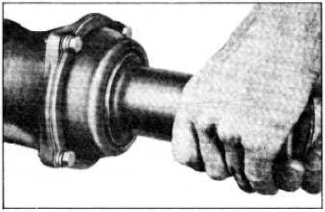

Fig. 19—Checking Ball Adjustment

NOTE: If the ball joint cannot be moved by hand or is too loose, remove the 4 capscrews from universal joint ball retainer and remove shims to tighten or add shims to loosen until the proper adjustment is secured.

5. Remove universal joint ball, collar and retainer and noting number of shims used for later assembly, replace joint ball, collar and retainer on torque tube splines.

INSTALLATION

1. Install transmission through opening in body floor on 1949-52 models and from underneath on 1953 models.
2. Install guide pin in upper right transmission to clutch housing bolt hole for alignment and place transmission on guide pin and rotate transmission as necessary, then start mainshaft into clutch disc. Slide transmission forward making sure the step at end of countershaft is flush with the face of the transmission and engages properly with the clutch housing. This keeps the shaft from turning as well as helps align transmission properly.
3. Install the two lower transmission mounting bolts and lockwashers and tighten securely. Remove guide pin and install upper mounting bolts and lockwashers and tighten securely.
4. Install flywheel underpan.
5. Replace bolts attaching rear transmission support to cross member and tighten securely.
6. Remove supporting block from rear of engine.
7. Raise propeller shaft, place proper number of torque ball retainer shims over rear yoke, and install new collar oil seal. Align yokes and install capscrews and lock plates which retain front trunnion bearings to front yoke and tighten securely. Bend tangs on lock plate to lock bolts.
8. Slide universal ball, collar and retainer into place and install retaining capscrews. Tighten first bolt finger tight, then tighten diagonally opposite bolt to 8-12 ft. lbs. Retighten first bolt to 8-12 ft. lbs. and proceed to tighten other two bolts to proper torque.
9. Replace idler lever, connect pull cable clevis and pull back spring to idler lever.
10. Connect first and reverse and second and third control rods to shifter levers at side cover.
11. Check and adjust linkage as necessary as outlined under "Minor Service Operations."
12. Remove speedometer driven gear and add ½ pint transmission lubricant to housing. Replace speedometer driven gear.
13. Connect speedometer cable to driven gear and tighten securely.
14. On 1949-52 models, replace transmission cover to body floor and replace floor mat.
15. Fill transmission with 1 pint of transmission lubricant.

TROUBLES AND REMEDIES

SYNCHRO-MESH TRANSMISSION

Symptom and Probable Cause	Probable Remedy
Slips Out of High Gear	
a. Transmission loose on clutch housing.	a. Tighten mounting bolts.
b. Dirt between transmission case and clutch housing.	b. Clean mating surfaces.
c. Misalignment of transmission.	c. Shim between transmission case and clutch housing.

Symptom and Probable Cause	Probable Remedy
d. Clutch gear bearing retainer broken or loose.	d. Tighten or replace clutch gear bearing retainer.
e. Damaged mainshaft pilot bearing.	e. Replace pilot bearing.
f. Shifter lock spring weak.	f. Replace spring.
g. Clutch gear or second and third speed clutch improperly mated.	g. Replace clutch gear and second and third speed clutch.
Slips Out of Low and/or Reverse	
a. Worn first and reverse sliding gear.	a. Replace worn gear.
b. Worn counter gear bushings.	b. Replace counter gear.
c. Worn reverse idler gear.	c. Replace idler gear.
d. Shifter lock spring weak or broken.	d. Replace spring.
e. Improperly adjusted linkage.	e. Adjust linkage.
Noisy in All Gears	
a. Insufficient lubricant.	a. Fill to correct level.
b. Worn counter gear bushings.	b. Replace counter gear.
c. Worn or damaged clutch gear and countershaft drive gear.	c. Replace worn or damaged gears.
d. Damaged clutch gear or mainshaft ball bearings.	d. Replace damaged bearings.
e. Damaged speedometer gears.	e. Replace damaged gears.
Noisy in High Gear	
a. Damaged clutch gear bearing.	a. Replace damaged bearing.
b. Damaged mainshaft bearing.	b. Replace damaged bearing.
c. Damaged speedometer gears.	c. Replace speedometer gears.
Noisy in Neutral with Engine Running	
a. Damaged clutch gear bearing.	a. Replace damaged bearing.
b. Damaged mainshaft pilot bearing.	b. Replace damaged bearing.
Noisy in All Reduction Gears	
a. Insufficient lubricant.	a. Fill to correct level.
b. Worn or damaged clutch gear or counter drive gear.	b. Replace faulty or damaged gears.
Noisy in Second Only	
a. Damaged or worn second speed constant mesh gears.	a. Replace damaged gears.
b. Worn or shifted countergear rear bushing.	b. Replace countergear assembly.
Noisy in Low and Reverse Only	
a. Worn or damaged first and reverse sliding gear.	a. Replace worn gear.
b. Damaged or worn low and reverse countergear	b. Replace countergear assembly.
Noisy in Reverse Only	
a. Worn or damaged reverse idler.	a. Replace reverse idler.
b. Worn reverse idler bushings.	b. Replace reverse idler.
c. Damaged or worn reverse countergear.	c. Replace countergear assembly.

Symptom and Probable Cause	Probable Remedy
Excessive Backlash in Second Only	
a. Second speed gear thrustwasher worn.	a. Replace thrustwasher.
b. Mainshaft rear bearing not properly installed in case.	b. Replace bearing, lock or case as necessary.
c. Universal joint retaining bolt loose.	c. Tighten bolt.
d. Worn countergear rear bushing.	d. Replace countergear assembly.
Excessive Backlash in All Reduction Gears	
a. Worn countergear bushings.	a. Replace countergear.
b. Excessive end play in countergear.	b. Replace countergear thrustwashers.
Leaks Lubricant	
a. Excessive amount of lubricant in transmission.	a. Drain to correct level.
b. Loose or broken clutch gear bearing retainer.	b. Tighten or replace retainer.
c. Clutch gear bearing retainer gasket damaged.	c. Replace gasket.
d. Cover loose or gasket damaged.	d. Tighten cover or replace gasket.
e. Operating shaft seal leaks.	e. Replace operating shaft seal.
f. Idler shaft expansion plugs loose.	f. Replace expansion plugs.
g. Countershaft loose in case.	g. Replace case.

TORQUE SPECIFICATIONS

Type

Selective Synchromesh

Speeds

Three forward—one reverse

Location

In unit with engine

Gears—Type

All helical

Bearings

Clutch Gear .... N.D. 954388

1949-52 Mainshaft
Pilot .... 14 Rollers—3/16" dia. x 33/64"

1953 Mainshaft
Front Pilot...... 14 Rollers—3/16" dia. x 33/64"
Rear Pilot........ 24 Rollers—1/8" dia. x 1/2"

Mainshaft Rear .... N.D. 954168

Mainshaft Rear Bearing Support ..... Bronze
Reverse Idler Bushing (front and rear) Bronze
Countershaft Bushing (front and rear) Bronze

Gear Ratio

First .... 2.94 to 1
Second .... 1.68 to 1
Third .... 1.00 to 1
Reverse .... 2.94 to 1

Service Data

Countergear and Reverse Idler Gear
Bushing Clearance .... .002"–.004"

Second Speed Gear Endplay ... Approx. .010"

Rear Bearing Support Assembly
fit in case. Hand push to max. of .0015" loose

Clearance between lower edge of gear-shift lever to top of upper support 3/32" to 1/8"

Clearance between gearshift lever and steering wheel rim .... 2¾" ± ¼"

TRANSMISSION SPECIFICATIONS

Universal Joint Yoke Attaching
Bolt .... 25-30 ft. lbs.

Universal Joint Yoke Ball Retainer
Bolts .... 8-12 ft. lbs.

Clutch Gear Bearing Retainer
Cap Screws .... 10-12 ft. lbs.

Side Cover Retaining Cap Screws .. 15-18 ft. lbs.

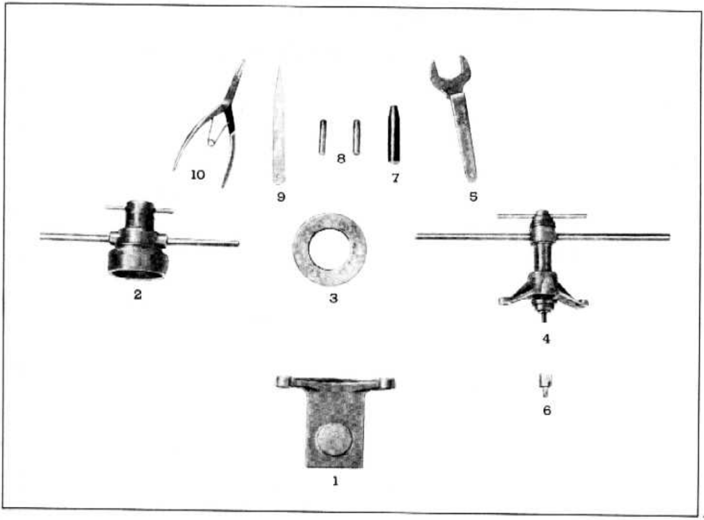

Fig. 20—Transmission Special Tools

1. Transmission Assembly Holding Stand—J-934
2. Clutch Gear and Bearing Puller—J-937
3. Clutch Gear Bearing Remover—J-936
4. Mainshaft Remover and Replacer—J-938
5. Clutch Gear Bearing Retainer Wrench—J-933
6. Mainshaft Remover and Replacer Adapter—J-938-7
7. Countershaft Assembly Tool—J-1617
8. Transmission Guide Pins—J-1126
9. Rear Bearing Snap Ring Remover and Replacer—J-3185
10. Synchronizer Ring Retainer Remover and Replacer—J-932

POWERGLIDE
1950-1952 TRANSMISSION

INDEX

DRIVING INSTRUCTIONS

Control of the Powerglide transmission is obtained by positioning a shift control lever mounted at the top of the steering column.

The control lever can be positioned in the following five positions:

Parking
Neutral
Drive
Low
Reverse

To make it easy for the driver to find the location of the range desired, the shift control quadrant is marked with the letters, "Park", "N", "D", "L", and "R". To shift into parking, or reverse range, it is necessary to raise the shift control lever against a light spring pressure.

PARKING

When placed in the parking position, the shift control lever engages a parking lever pawl which locks the transmission planet carrier to the transmission case. This parking lock must never be applied when the car is in motion.

NEUTRAL

The neutral position is to be used when the car is standing still with the engine running, or when towing the car. It permits accelerating the engine with no car movement.

DRIVE

Drive range is used for all normal forward driving conditions.

LOW

Low range is used only when the "going" is particularly tough, such as in deep snow or sand or on long steep grades. Low range can also be used to obtain additional engine braking when descending steep hills.

The shift from "low" to "drive" range or vice versa may be made while the car is in forward motion, but not in excess of 40 mph.

REVERSE

The reverse range is used to move the car in a reverse direction.

STARTING THE ENGINE

The starter on cars equipped with the Powerglide transmission is so wired that the engine will not start unless the shift control lever is in either "park" or "neutral" position.

PUSHING OR TOWING CAR TO START ENGINE

If it ever becomes necessary to push a car equipped with a Powerglide transmission, the control lever should be left in the "N" position until the car has reached a speed of approximately 15 mph. At this speed the turbine is spinning fast enough to turn the primary pump and the rear oil pump has developed sufficient pressure to engage the low band or drive clutch.

Then place the control lever in the "L" position to crank the engine. If the road is wet or icy resulting in poor traction, it may be necessary to push the car until a speed of approximately 20 mph is reached. Then place the control lever in the "D" range. After the engine starts, return the control lever to the "N" position for warm up.

> ***CAUTION: It is recommended that the car be pushed rather than to be towed, because when the engine starts with the transmission in either the "L" or "D" range, it is apt to accelerate into the rear end of the towing vehicle.***

TOWING A DISABLED CAR

A car equipped with Powerglide transmission must not be towed on its rear wheels except in Neutral (N) and should not be towed in excess of 45 M.P.H. If it is towed with the transmission in any of the driving ranges unnecessary damage to the transmission may result because the rear pump would be in operation.

If the car has been damaged in a collision to the extent that the control lever on the steering column cannot be positioned in Neutral (N), it will be necessary to disconnect the long control rod at the idler lever and place the transmission in Neutral (N) as follows:

1. Remove the cotter pin from the long control rod and disconnect it from the idler lever on the left side of transmission case.
2. Push the idler lever toward the rear of the car as far as it will go; this places the transmission in Reverse position. Then move the idler lever toward the front from this position to the third detent which is Neutral (N) position.

If for any reason the transmission is locked up the car must not be towed on its rear wheels or serious damage to the transmission will result.

MAINTENANCE

OIL REQUIREMENTS

The Powerglide transmission requires an oil known as Automatic Transmission Fluid, "Type A" bearing a "AQ-ATF" number. This oil is available through Chevrolet dealers and oil company filling stations in sealed containers.

OIL LEVEL

The transmission oil level should be checked every 1000 miles. Oil should be added only when the level gets down to the "Add 1 Quart" mark on the dip stick. The oil level dip stick is located in the engine compartment on the right side just opposite the starter (fig. 21). In order to check oil level accurately, the engine should be idled with the transmission warm and the control lever in neutral (N) position.

It is important that the oil level be maintained between the Full and Add 1 Quart marks on the transmission oil level gauge. DO NOT OVERFILL, for when the oil level is at the full mark on the dipstick, it is just slightly below the planetary gear unit. If additional oil is added, bringing the oil level above the full mark, the planetary unit will run in the oil, foaming and aerating the oil. This aerated oil carried through the various oil pressure passages (low servo, reverse servo, clutch apply, converter, etc.) may cause malfunction of the transmission assembly, resulting in cavitation noise in the converter and improper application of bands or clutches.

If the transmission is found consistently low on oil, a thorough inspection should be made to find and correct all external oil leaks. The mating surfaces of the servo case, modulator housing, modu-

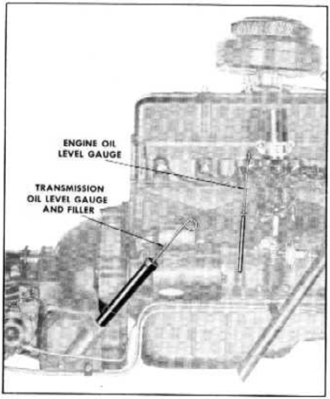

Fig. 21—Location of Dip Sticks

lator cover, universal joint ball collar, transmission case, converter housing, and side covers should be carefully examined for signs of leakage. All test plugs should be checked to make sure that they are tight and that no leakage is taking place at these points.

If no external leaks are apparent, the vacuum line from the vacuum modulator to the intake manifold should be disconnected from the modulator cover. Transmission lubricant in this line indicates that the modulator diaphragm is fractured or torn and that it should be replaced.

Check the rear axle lubricant level. If the rear axle is overfilled, the propeller shaft seal at the universal joint should be inspected and replaced if necessary.

CAUTION: Do not re-use axle lubricant that has been diluted with Automatic Transmission Fluid.

DRAINING AND REFILLING

Every 25,000 miles the transmission should be drained and refilled. The transmission should be warmed up before draining. Draining is accomplished as follows:

1. Remove transmission case drain plug. This drains oil from transmission case.

   CAUTION: Do not start engine while draining assembly.

2. After transmission is completely drained, install transmission case plug.
3. Remove dip stick and refill transmission with 5 quarts of Automatic Transmission Fluid, "Type A" using oil filler tube and funnel, J-4264 (fig. 22).

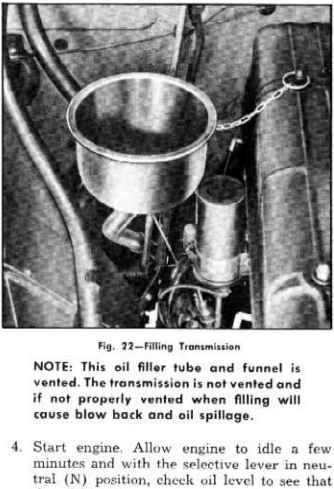

Fig. 22—Filling Transmission

NOTE: This oil filler tube and funnel is vented. The transmission is not vented and if not properly vented when filling will cause blow back and oil spillage.

4. Start engine. Allow engine to idle a few minutes and with the selective lever in neutral (N) position, check oil level to see that the oil level is up to the full mark on the dip stick. Add oil as required but DO NOT OVERFILL.

SERVICE ADJUSTMENTS

The Powerglide transmission requires only two service adjustments; a simple and positive linkage adjustment and a neutral safety switch adjustment.

Linkage Adjustment

1. Check clearance between control lever and upper support cover which should be $\frac{3}{32}''$ to $\frac{1}{8}''$ (fig. 23).
2. To correct this clearance, remove screws holding upper support to mast jacket and screw upper support up or down to gain necessary clearance. Replace upper support screws.
3. Place selector lever in reverse and check clearance between control lever and steering wheel rim which should be $1\frac{1}{2}'' \pm \frac{5}{16}''$ (fig.

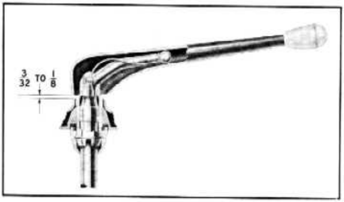

Fig. 23—Steering Column Upper Support to Control Lever Clearance

24). To adjust, loosen lower support clamp bolts and move up or down as necessary.

4. With selector lever in reverse, check clearance between the reverse stop on the control shaft lower support and lower lever (fig. 25). The clearance should be .090".
5. To adjust, loosen transmission control rod swivel, make sure transmission manual valve lever is raised to top detent position and selector lever is in (R) position. Move selector lever as necessary to obtain .090" clearance and retighten swivel.

Neutral Safety Switch

All cars equipped with Powerglide transmission are provided with a neutral safety switch which prevents operation of the starting motor except when the transmission is in the neutral (N) or (Park) positions. This switch is a safety feature installed for the purpose of preventing car motion when starting the engine. It is important, therefore, that this switch be maintained in proper adjustment.

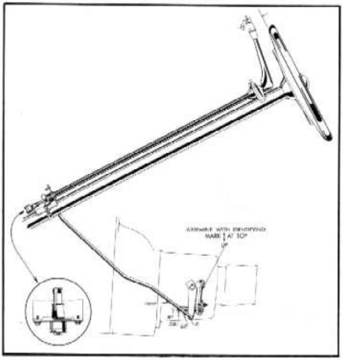

Fig. 24—Control Lever to Steering Wheel Clearance

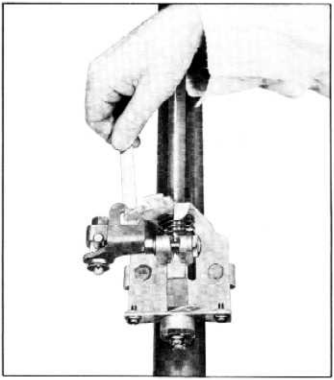

Fig. 25—Reverse Stop to Lower Lever Clearance

Adjustment

1. Loosen two switch assembly mounting screws.
2. Place selector lever in neutral and with clip over flats on end of shifter shaft, insert pin into switch mounting bracket and locating plate (fig. 26).
3. Tighten screws to secure switch in this position and remove locating pin.

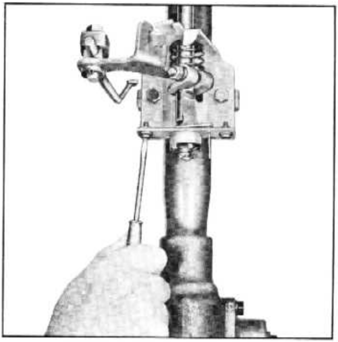

Fig. 26—Adjusting Safety Switch

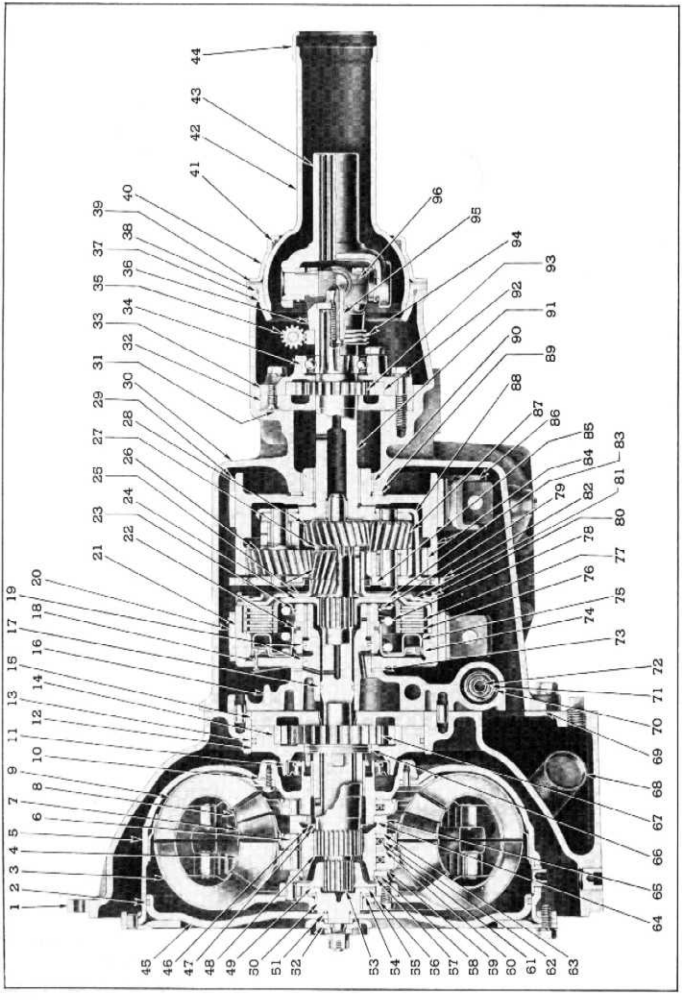

Fig. 27—Transmission Cross Section

Fig. 27—Transmission Cross Section

1. Transmission Housing
2. Converter Cover "O" Ring Seal
3. Turbine
4. Secondary Stator
5. Converter Housing
6. Over-Run Cam Roller
7. Primary Stator
8. Secondary Pump
9. Primary Pump
10. Primary Pump "O" Ring Seal
11. Front Oil Pump Body Oil Seal
12. Front Oil Pump Body
13. Front Oil Pump Body "O" Ring Seal
14. Front Oil Pump Driven Gear
15. Stator Race
16. Transmission Valve Body
17. Input Shaft Oil Seal Ring
18. Clutch Valve
19. Clutch Drum Oil Seal Rings
20. Low Brake Band
21. Clutch Drum
22. Clutch Piston Inner Ring Seal
23. Clutch Spring Snap Ring
24. Clutch Hub
25. Low Sun Gear and Clutch Flange Assembly
26. Planet Short Pinion
27. Low Sun Gear Thrust Washer
28. Reverse Sun Gear
29. Reverse Brake Band
30. Transmission Case
31. Rear Oil Pump Gasket
32. Rear Oil Pump Cover
33. Rear Oil Pump Body
34. Ball Bearing Assembly
35. Speedometer Driven Gear
36. Universal Joint Front Yoke
37. Ball Joint Seat
38. Ball Joint Seat "O" Ring Seal
39. Universal Joint Housing Shims
40. Universal Joint Ball Collar
41. Ball Joint Collar Oil Seal
42. Universal Joint Ball
43. Universal Joint Rear Yoke
44. Universal Joint Ball Packing Retainer
45. Converter Cover
46. Converter Retaining Washer
47. Converter Retaining Ring
48. Stator Support
49. Input Shaft Drive Flange
50. Turbine Bolt
51. Turbine Bolt "O" Ring Seal
52. Special Lockwasher
53. Input Shaft
54. Turbine Front Thrust Washer
55. Turbine Rear Thrust Washer
56. Turbine Hub Bolt Lock
57. Stator Race Thrust Snap Ring
58. Stator Race Thrust Washer
59. Over-Run Cam Roller and Spring Retainer
60. Over-Run Cam Thrust Washer
61. Over-Run Cam Roller Spring
62. Over-Run Cam Roller Guide
63. Stator Race
64. Secondary Pump Thrust Ring
65. Secondary Pump Thrust Washer
66. Front Oil Pump Seal Ring
67. Front Oil Pump Drive Gear
68. Oil Pump Suction Pipe and Screen
69. Valve Body Gasket
70. Accumulator Piston Outer Spring
71. Accumulator Piston Inner Spring
72. Accumulator Piston Stop
73. Clutch Drum Thrust Washer
74. Clutch Piston Outer Ring Seal
75. Clutch Piston
76. Clutch Drive Plates
77. Clutch Driven Plates
78. Clutch Spring
79. Clutch Spring Seat
80. Clutch Flange Retainer Ring
81. Clutch Flange Retainer
82. Parking Lock Gear
83. Clutch Hub Thrust Washer
84. Reverse Drum and Ring Gear
85. Planet Pinion Shaft Lock Plate
86. Reverse Brake Band Strut
87. Planet Long Pinion
88. Planet Carrier
89. Reverse Drum Thrust Washer
90. Transmission Case Rear Bushing
91. Planet Output Shaft
92. Rear Oil Pump Driven Gear
93. Rear Oil Pump Drive Gear
94. Speedometer Drive Gear
95. Special Bolt
96. Universal Joint Front Yoke Trunnion Bearing

GENERAL DESCRIPTION

The ideal transmission is one which will automatically provide the suitable speed or power ratio between the engine and the driving members to meet all driving conditions without any thought on the part of the operator.

Chevrolet's Powerglide Transmission (fig. 27) meets these ideal qualifications because it offers torque multiplication and automatically provides a smooth flexible ride comparable to the result that would be achieved if infinitely minute progressive gearshifts were manually possible.

The Powerglide Transmission is made up of the following components:

1. Torque Converter
2. Planetary Unit and Clutch
3. Oil Pumps
4. Hydraulic Controls

The transmission will be described in three phases:

1. Torque Converter
2. Planetary Unit and Clutch
3. Hydraulic Controls

TORQUE CONVERTER

One of the features of the Powerglide transmission is its ability to provide a smooth application of power from the engine to the rear wheels with a total absence of gear reduction. The engine's power is its ability to provide sufficient torque to the rear wheels to maintain certain car speeds. This torque is received from a rotating crankshaft and once a car is rolling on level ground the engine develops enough torque to keep it moving (fig. 28). But, on a hill or in starting, the driving wheels need more torque and we must have some means of multipling or converting this torque. This increase and multiplication of engine torque may be accomplished by shifting a gear transmission

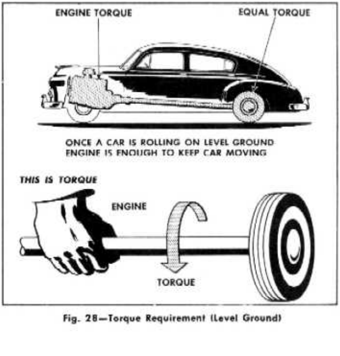

Fig. 28—Torque Requirement (Level Ground)

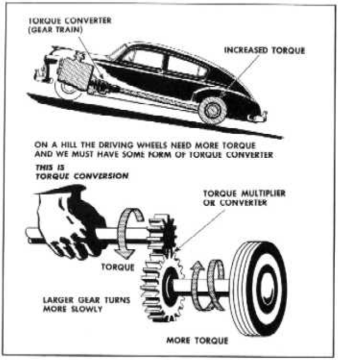

Fig. 29—Torque Requirement (Incline)

either manually or mechanically into a lower gea (fig. 29).

Chevrolets equipped with the Powerglide transmission do not have a conventional clutch or transmission between the engine and rear wheels. In place of the foot operated clutch and multi-speed transmission is a hydraulic unit that is a combination of a fluid coupling and a torque converter which provides hydraulic torque conversion.

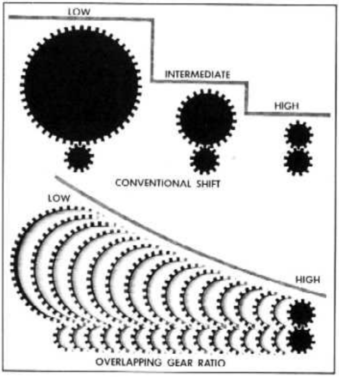

Fig. 30—Torque Graduations

Hydraulic torque conversion means using a fluid to provide the proper ratio of speed and torque. Torque conversion provides an infinite number of gear ratios instead of the conventional three, because the graduations in torque at the rear wheels are infinite (fig. 30).

FLUID COUPLING

To thoroughly understand the torque converter let us first examine the hydraulic fluid coupling which is simply a substitute for the friction clutch. The fluid coupling is more efficient at high speeds than at low speeds and is practically non-effective at idle speeds but necessitates attachment to a series of gear ratios to provide the necessary torque for starting and on heavy pulls. The torque converter, on the other hand, provides sufficient starting and pulling power without attachment to a series of gear reductions by combining the fluid coupling and torque converter into one unit.

A very simple fluid coupling can be illustrated with two common electric fans. If the fans are set a few inches apart, facing each other, and one fan is turned on it will make the blades of the other fan rotate (fig. 31). In this case the air is the fluid and the air stream created by the fan that is in operation forces the other fan to rotate. This is the basic principle of the fluid coupling.

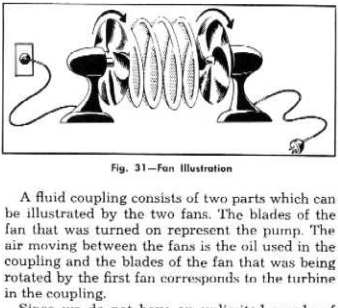

Fig. 31—Fan Illustration

A fluid coupling consists of two parts which can be illustrated by the two fans. The blades of the fan that was turned on represent the pump. The air moving between the fans is the oil used in the coupling and the blades of the fan that was being rotated by the first fan corresponds to the turbine in the coupling.

Since we do not have an unlimited supply of oil as we did air it is necessary to enclose these parts of the coupling in a housing so that the same oil may be used over and over again. The housing is in the shape of a doughnut and is hollowed out inside. We then split the doughnut in half (fig. 32). One half will be used as a pump and the other half for the turbine. The purpose of the pump, which is driven by the engine, is to pump oil cen-

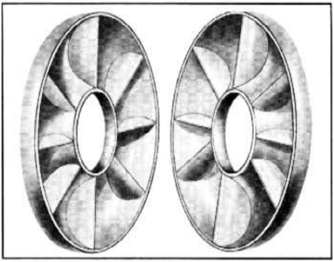

Fig. 32—Coupling (Doughnut Shaped with Vanes)

trifugally into the turbine which drives the rear wheels of the car. Vanes which serve the same purpose as the blades in the two fans are used in the pump and turbine to make them operate. These vanes move the oil from the pump to the turbine making the turbine move.

Pump and turbine are assembled as close together as possible without touching one another then filled with oil resulting in a simple fluid coupling.

Now that we know what the parts of a fluid coupling are, let's see what happens inside the coupling when starting the car, pulling or accelerating under a heavy load.

When the engine is started it drives the pump. The instant the pump begins to rotate the oil spins around with it. The movement of the oil spinning around and around with the pump is called rotary flow. As a result of this rotary flow a centrifugal force is set up in the oil. Inasmuch as the pump

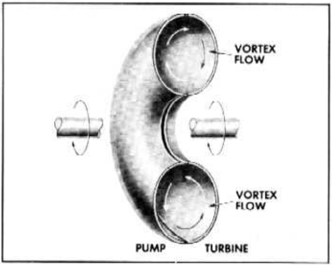

Fig. 33—Vortex and Rotary Flow

and turbine sections are curved like a doughnut, this shape, together with the vanes, imparts a second path of travel for the oil which is crosswise to the rotary path of travel. This crosswise movement of the oil is called vortex flow. The two paths of the oil, rotary and vortex, are shown in Figure 33.

This flow pattern can readily be understood if a coil spring is used as an example. If a drop of oil is placed on the coil it will travel from one end of the spring to the other—from A to B taking a spiral course along the path of the spring coils (fig. 34).

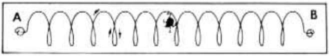

Fig. 34—Coil Spring (Vortex)

Now, if the spring is bent into a circle so that both ends are joined together, we have a perfect example of how the oil travels in vortex flow and rotary flow in the coupling at the same time (fig. 35).

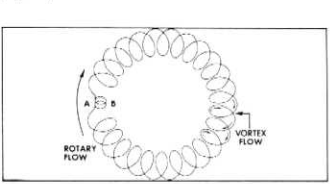

Fig. 35—Coil Spring (Vortex and Rotary)

Rapid vortex flow is the result of high forces in the oil of the pump acting against low forces in the oil of the turbine. Vortex flow is maintained only when there is a marked difference in rpm between the pump driven by the engine and the turbine which drives the rear wheels. This condition exists when starting the car or under heavy load.

To smooth out this vortex flow, which if unguided becomes turbulent causing loss of efficiency, a split guide ring is built into each half of our doughnut which results in a smooth uniform oil flow from the pump through the turbine (fig. 36).

The blades on the pump and turbine act much like buckets, the blades in the pump cause the oil to be thrown across to the turbine. This is vortex flow and the energy that is imparted to the oil by the pump is transformed into mechanical energy as it hits the turbine blades causing the turbine to turn under the impact.

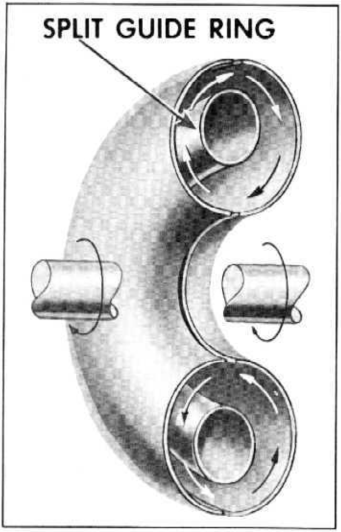

Fig. 36—Fluid Coupling with Split Guide Ring

Now, after we reach normal driving speeds or without heavy loads, the oil inside the fluid coupling follows the rotary flow almost entirely although there is some vortex flow under all driving conditions. Referring then again to our coil spring example, the oil flows along a path like a spring that has been stretched out so that the coils are far apart (fig. 37).

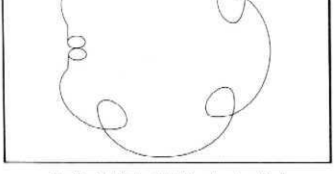

Fig. 37—Coil Spring (Fluid Coupling Condition)

CHEVROLET CONVERTER

As mentioned before the Chevrolet Converter combines the principles of a simple fluid coupling with a hydraulic torque converter. The fluid coupling we have already explained. Now, using its principle in combination with the principle of the hydraulic torque converter, Chevrolet cars can be driven from a standing start to top road speeds with smooth acceleration throughout the entire speed range without the use of gears and without shifting from one speed ratio to another, either by hand or through some automatic control.

The only gears built into the Chevrolet Powerglide transmission are the reverse gear and an emergency low gear. The emergency low gear is never used for normal driving. All that is necessary is to set the control lever in the "Drive" range, step on the accelerator and "move away".

Let's look at the basic difference between Chevrolet's torque converter and a simple fluid coupling. First, the fluid coupling does not gear down, it does not provide torque multiplication. The fluid coupling has to be attached to a gear train to provide additional twisting effort at the rear wheels when starting or heavy pulling is required.

In the torque converter used by Chevrolet, directional control of the oil flow is provided as it leaves the turbine and enters the pump which results in low gear acceleration while in the "driving range."

The torque converter gets its name from the fact that it can multiply torque, or twisting effort of the engine. The torque converter used in the Chevrolet Powerglide transmission produces almost as much torque multiplication as is obtained by putting the conventional transmission in low gear—but—there are no gears required for starting, pulling, acceleration or any normal driving condition. The torque converter handles all these conditions by itself.

Now let's see how this is done—in the fluid coupling the vanes in the pump and turbine may be straight whereas in the torque converter these vanes are curved so as to get the greatest amount of power out of the pump and turbine. The pump blades are curved in a backward direction from the direction of rotation which gives added acceleration to the oil as it leaves the pump rim. The vanes in the turbine are also curved so as to absorb as much of the energy as possible from the oil as it passes through the turbine (fig. 38). To be able to do this the vanes are curved in such a manner that causes the oil to be discharged from the center of the turbine in a backward direction opposite to rotation of the turbine. As the oil leaves the turbine blades at the center it still has a lot of kinetic energy left and due to the curvature of the turbine blades it proceeds to exert this energy against the blades of the pump. Some means must be had for getting this oil to help the pump instead of hinder it as this would tend to slow down the pump, requiring extra power to drive it.

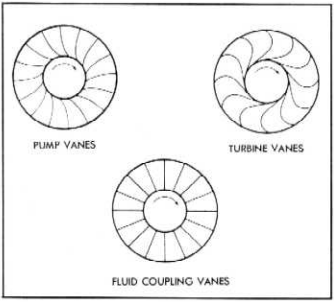

Fig. 38—Vane Comparison

We must have some means of giving directional control to the oil as it leaves the turbine and enters the pump. This is accomplished by interposing stators between the pump and turbine with vanes so curved that they will change the direction of the oil discharged from the turbine and cause it to flow in the same direction as the rotation of the pump (fig. 39). Now, instead of the oil bucking the pump and interfering with it, the unexpended energy in the oil is actually helping the pump do its job. The stator then becomes a reactionary member assisting the function of the pump giving torque conversion. Through this assistance it takes less engine power to drive the pump, the engine is able to deliver more power to the turbine and torque multiplication of 2.2 to 1 can be obtained as power to drive the rear wheels.

Now, as the rotational speed of the turbine increases, the rotary flow of the oil increases, the vortex flow decreases and the stator blades start to get in the way. This condition would result in power loss and excessive heat of the oil. Therefore, the stators are mounted on free wheeling clutches which lock them in a direction opposite to that of the pump and turbine rotation. As the vortex flow decreases, the stators free wheel and are carried along with the rotating oil mass.

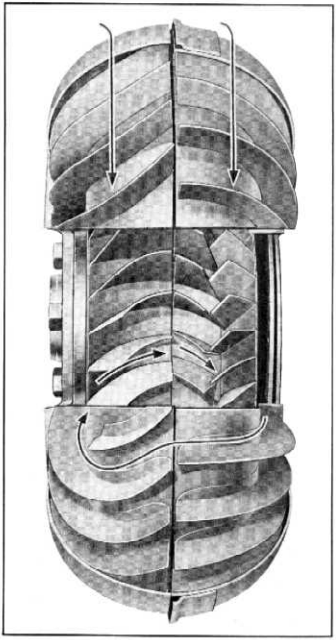

Fig. 39—Oil Flow Through Stator

TECHNICAL DESCRIPTION

Up to now the description of the Torque Converter has been very elementary and confined primarily to theory. For simplicity of explanation, the input shaft was shown driving the pump from its hub, and the pump was shown in front of the turbine. The true design of the Chevrolet Torque Converter is as shown in Figure 40.

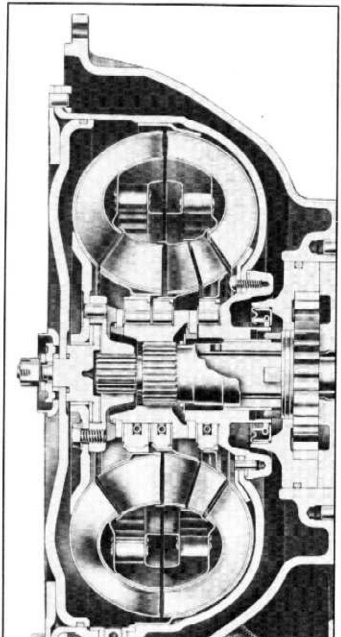

Fig. 40—Chevrolet Torque Converter

The pump is driven by its rim and is placed behind the turbine in order to allow for a satisfactory installation of the main shaft and output shaft.

THE PUMP

It is essential that the converter be designed to suit the characteristics of the engine driving it, and in Chevrolet, the Powerglide Transmission has been designed to take full advantage of the engine torque and horsepower.

The pump is designed to operate in two phases, the primary pump phase and the secondary pump phase.

The primary pump is bolted to the flywheel and always turns at crankshaft speed.

The smaller secondary pump is mounted on a free wheeling clutch on the hub of the primary pump (fig. 41) and turns at the same speed or can overrun at higher speeds than the primary pump under certain operating conditions.

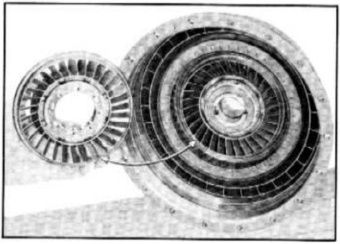

Fig. 41—Mounting of Secondary Pump

OPERATING CONDITIONS

First Phase

When starting the car or when under heavy loads, the primary pump is absorbing the full power of the engine and the secondary pump is overrunning because the rapid vortex flow through the converter discharges the oil from the turbine through the stators with such velocity that it is actually traveling at a higher speed than the secondary pump wheel. The high velocity of the oil makes it strike the back side of the vanes in the secondary pump. This reaction between the oil and pump would cause a turbulence and drop in pump efficiency if not corrected. The correction is to allow the lower portion of the pump vanes to move with the oil without causing a reaction force in the oil. This is accomplished by allowing the secondary pump to overrun the primary pump. The overrunning secondary pump, in effect, gets out of the way and allows the oil from the stators to enter the primary pump in the most

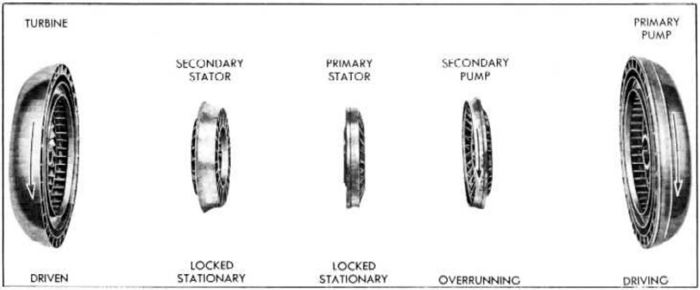

Fig. 42—Pump Operation (First Phase)

advantageous direction for the primary pump to pick it up (fig. 42).

Second Phase

When operating at steady driving and high speeds, the vortex flow is at a minimum and oil no longer impinges on the back of the secondary pump vanes. The converter is acting more like a fluid coupling, and the discharge of oil from the turbine is at a greatly reduced velocity.

At this time added pump capacity is required to maintain maximum efficiency. This is obtained when the secondary pump stops overrunning and turns as a unit with the primary pump. Again, the oil is channeled into the pumps in the most advantageous direction (fig. 43).

The transfer between the first and second stage in the pump does not take place at any set speed but is smooth and gradual, dependent on the load, or the power conditions required.

STATORS

There are two stators mounted on free wheeling clutches on a fixed stator hub attached to the stator support. The stators are designed to operate in three phases.

OPERATING CONDITIONS

First Phase

When starting the car or when under heavy loads or on acceleration, the greatest amount of torque multiplication is required, and the stators must absorb large reaction forces in order to exert directional control of the oil flow from the turbine to the pump. In order to absorb reaction, the stators are held stationary by the locking action

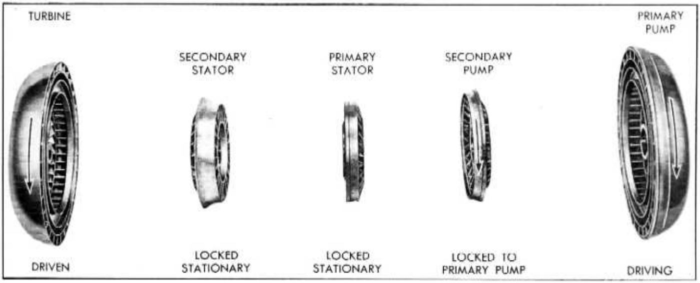

Fig. 43—Pump Operation (Second Phase)

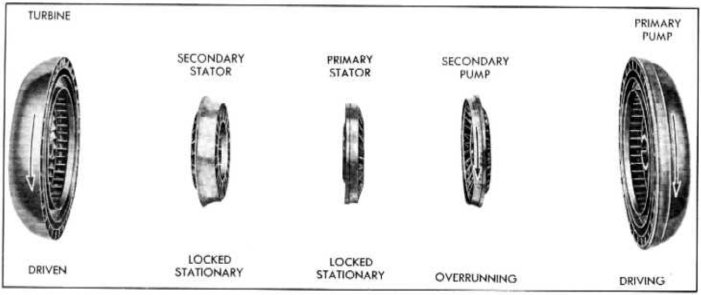

Fig. 44—Stator Operation (First Phase)

of the free wheeling clutches to the stator hub which is splined to the stator support held solidly in the transmission case. Both stators remain stationary so long as rapid vortex flow exists and high torque multiplication is required (fig. 44).

Second Phase

Under medium loads and light acceleration the turbine picks up rotary speed and approaches the speed of the pump and the vortex oil flow gradually decreases. As the vortex flow decreases, the reaction force on the stators becomes less and less, and as the reaction force decreases a point is reached where the secondary stator no longer carries any load.

The reaction forces which held the secondary stator in a locked, stationary position, now no longer exist and the stator is being carried along with the rotating oil mass and free wheels (fig. 45).

Third Phase

Under light loads and steady driving, the change taking place in the second phase continues as the requirements for torque multiplication diminish. When there are no requirements for torque multiplication, the turbine has reached approximately the same speed as the pump and vortex flow is reduced to a minimum, with no reaction force against the stators.

The oil mass in the converter is now in highly rotary motion, no force is holding either stator stationary. Both stators free wheel and rotate with the oil.

The converter now functions as a fluid coupling (fig. 46).

The second and third phases of stator operation are designed to take full advantage of the power in the engine, and at the same time furnish a smooth, gradual changeover from torque con-

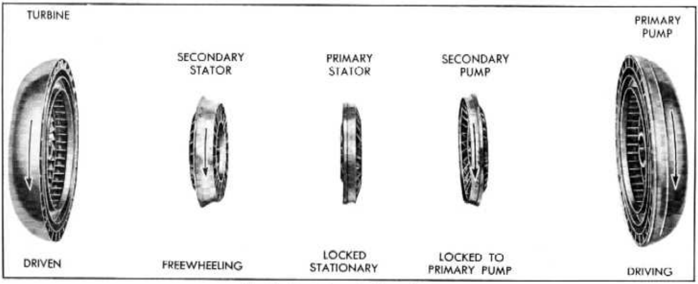

Fig. 45—Stator Operation (Second Phase)

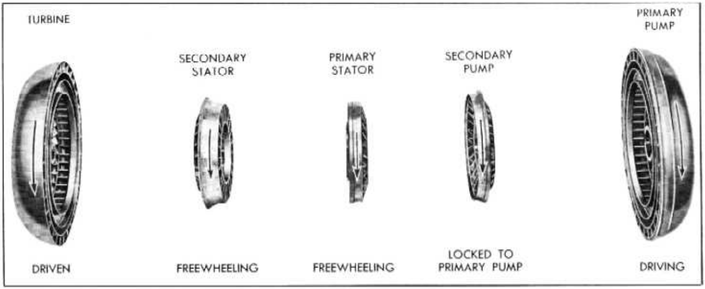

Fig. 46—Stator Operation (Third Phase)

verter requirement to an efficient fluid coupling.

The stators are designed to free wheel so they will not impose a static interference with the oil flow when the unit functions as a fluid coupling.

Inside of the torus section, which usually carries a "dead slug" of oil in ordinary fluid couplings or torque converters of the oval type, is incorporated an auxiliary fluid coupling. This auxiliary fluid coupling is designed to be very effective in the overrun direction and only slightly effective in forward direction. This member consists simply of crescent shaped paddles or vanes which tend to hook into the oil in overrun and slip through it in the opposite direction of relative rotation of the pump and turbine. It gives an effective drive for starting the engine by pushing the car and also improves overrun braking when the car coasts against the engine and interferes only slightly with the relative rotating speeds of the pump and turbine during torque multiplication.

PLANETARY UNIT AND CLUTCH

The planetary unit and clutch of the Chevrolet Powerglide Transmission (fig. 47) is a complete unit within itself containing a hydraulic clutch assembly and a planetary gear set to furnish drive, reverse, an emergency low and neutral.

The hydraulic clutch assembly is built up into a clutch drum, which includes a clutch piston, clutch spring and piston seals; nine clutch plates, five of these plates are steel externally splined to the clutch flange while four plates are steel, faced on both sides with a moulded metallic material. These four plates are internally splined to the clutch hub which in turn is splined to the input shaft. These parts are retained inside the drum by a clutch flange, flange retainer and retainer ring. The clutch flange is splined to a low sun gear.

When oil pressure is applied to the clutch piston, the clutch plates are pressed together, which

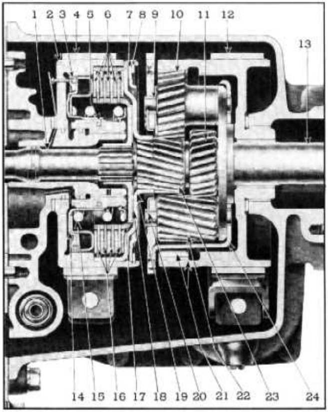

Fig. 47—Planetary Cross Section

1. Input Shaft
2. Clutch Drum
3. Clutch Piston Outer Ring Seal
4. Low Brake Band
5. Clutch Piston Inner Ring Seal
6. Clutch Driven Plates
7. Clutch Flange Retainer
8. Clutch Flange Retainer Ring
9. Planet Pinion Pin
10. Planet Short Pinion
11. Reverse Sun Gear
12. Reverse Brake Band
13. Output Shaft
14. Clutch Piston
15. Clutch Spring
16. Clutch Drive Plates
17. Clutch Hub
18. Clutch Hub Thrust Washer
19. Clutch Flange
20. Planet Pinion Shaft Lock Plate
21. Reverse Drum and Ring Gear
22. Planet Long Pinion
23. Low Sun Gear
24. Planet Carrier

connects the clutch drum to the clutch hub and the input shaft. This engagement of the clutch causes the low sun gear to rotate with the input shaft.

When oil pressure to the clutch is released, the clutch spring returns the piston to free the clutch plates. This disengages the clutch.

The outer diameter of the clutch drum is used for emergency low range band application. Application of the low band holds the low sun gear stationary.

The planetary unit consists of the reverse sun gear, low sun gear, short and long pinions, a reverse ring gear and drum and a planet carrier.

The use of planetary gears have several advantages; they are compact and sturdy, have a common axis and are always completely in mesh.

They are compact and sturdy because the load is distributed over several gears instead of only two as in a conventional transmission. This means that although the planetary gears may be smaller, thus occupying less space, they are capable of transmitting more power because there are more of them and because there is more tooth area in contact to transmit power.

Planetary gears having a common axis, eliminate the need for idler gears and extra shafts.

Inasmuch as planetary gears are always in mesh, they eliminate the danger of tooth damage which is always a possibility when gears are shifted for meshing.

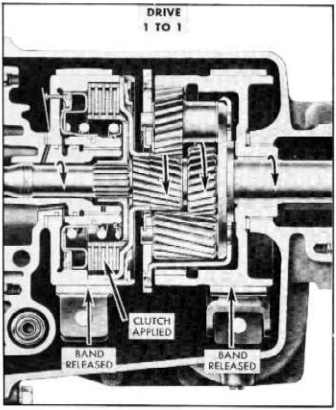

Fig. 48—Power Flow—Drive

In the planet carrier assembly, there are two sun gears, the reverse sun gear and the low sun gear. The reverse sun gear is splined to, and always turns with the input shaft. The low sun gear may revolve freely until the low band or the clutch is applied.

The reverse sun gear is in mesh with three long pinions and the long pinions are in mesh with three short pinions. These short pinions are in mesh with both the low sun gear and the reverse ring gear.

Both the long pinions and the short pinions are mounted on and revolve about planet pinion pins which are solidly fastened to the planet carrier which is part of the output shaft.

The reverse sun gear and the short pinions always rotate in the same direction. Band or clutch application, however, determines whether the output shaft rotates in a forward or reverse direction.

OPERATION

Drive Range

In drive range, the input shaft and the output shaft must turn at the same speed and in the same direction. To obtain direct drive the planetary system is locked up and revolves as a unit (fig. 48).

With the selector lever in the drive range the clutch is applied. This ties the clutch hub, which is splined to the input shaft, to the clutch flange through the medium of the clutch plates. The clutch flange is splined to the low sun gear. The low sun gear is meshed to the short pinions, the short pinions are meshed with the long pinions and the long pinions are meshed with the reverse sun gear which is splined to the input shaft. Drive then is through the input shaft to the reverse sun gear to the long pinions, to the short pinions to the low speed sun gear. Since the low speed sun gear is locked to the input shaft through the clutch flange, clutch plates and clutch hub, the entire unit will revolve as a mass giving direct drive.

Low

In low, the planet carrier must turn in the same direction as the input shaft but at a reduced speed (fig. 49).

With the selector lever in the low range position, the clutch is released and the brake band is applied to the outside diameter of the clutch drum. With the brake band applied, the clutch drum is held stationary which in turn holds the clutch flange stationary. The clutch flange which is splined to the low sun gear holds the sun gear stationary. Drive then is through the input shaft, to the reverse sun gear to the long pinions to the short pinions which are in mesh with the low sun gear. Since the low sun gear is held stationary with the brake band applied, the short pinions will walk around the low sun gear and as they walk around the sun gear they carry the output shaft to which they are attached with them at a reduction of 1.82 to 1.

Reverse

In reverse it is necessary to turn the planet carrier which is part of the output shaft in a direction opposite to that of the input shaft (fig. 50).

With the selector lever in the reverse position, the clutch and low band are released and the reverse band is applied to the reverse drum. With the band applied to the drum the reverse internal gear which is part of the drum is held stationary. Drive then is through the input shaft, to the reverse sun gear to the long pinions to the short pinions. Since the short pinions are meshed with the reverse internal gear which is held stationary when the band is applied, the short pinions will walk around inside the internal gear in a reverse direction carrying the output shaft to which they are attached with them at a reduction of 1.82 to 1.

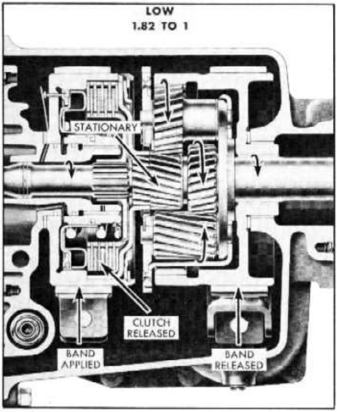

Fig. 49—Power Flow—Low

Neutral

In neutral the output shaft remains stationary.

With the selector lever in the neutral position, the clutch and low and reverse bands are released, consequently there is no reaction member to provide positive drive. All gears are free to spin around their own axis and no motion is imparted to the planet carrier in any direction.

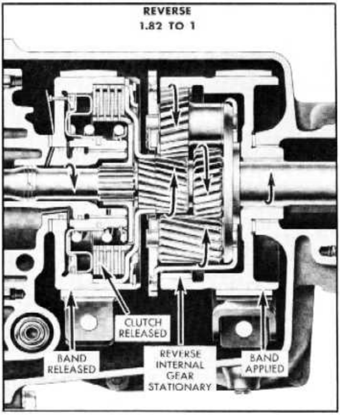

Fig. 50—Power Flow—Reverse

THE HYDRAULIC CONTROLS

OIL SUPPLY

Ten quarts of Automatic Transmission Fluid "Type A" are carried in the oil sump and converter to operate the transmission and its hydraulic controls.

OIL PUMPS

Two oil circulating pumps of the internal external gear type are incorporated in the transmission design. The front transmission pump has the greater capacity and is driven by the engine. The rear transmission pump has less capacity and is driven by the rear axle through the output shaft.

The requirements of the front pump are greater because when starting the car and when operating at low road speed or in reverse, the pump must be of adequate size to immediately furnish all the oil needed at required pressures.

The rear pump can be smaller because its output is not fully used until the car has reached a speed of approximately 15 mph, road load in

Drive range. The capacity of the smaller pump is sufficient at this time, due to its rpm, to furnish all the oil needed at the required pressures to operate the transmission.

The rear pump is required to operate the drive clutch or low range band when pushing or towing the car to start the engine.

A pressure regulator and check valve control the output of the pumps. At times either one or both pumps are used to supply the requirements of the transmission.

CONTROL

Range selection within the transmission is accomplished by means of a control lever under the steering wheel connected to a manual valve inside the valve body in the transmission.

Manual Valve

The manual valve is used to line up passages that feed oil to the drive clutch, the reverse and low bands as desired, or to exhaust for neutral or park. Figure 51 identifies oil passages of valve body.

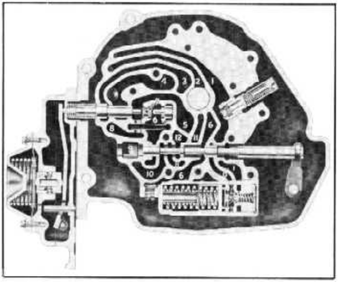

Fig. 51—Valve Body—Cross Section

1. Hydraulic Modulator
2. Lubrication or Converter Out
3. Release Side of Low Servo
4. Suction
5. Front Pump Pressure
6. Line Pressure
7. Converter In-Feed
8. Rear Pump Pressure
9. Reverse
10. Low Apply
11. High Clutch In-Feed
12. Exhaust
13. Accumulator Feed

Pressure Regulator Valve

The regulator valve is operated by oil pressure acting against calibrated spring pressure.

The pressure regulator valve has three functions as follows:

1. It controls the oil pressure necessary to operate all hydraulic units of the transmission.
2. It controls the maximum pressure of the front and rear pumps.
3. It keeps the correct amount of oil in the converter when the engine is running and prevents oil draining out of the converter when the engine is not running.

The pressure regulator valve operates in the following manner:

When the engine is not running, the position of the pressure regulator valve is as shown in Figure 52).

When the engine is started, the front pump starts pumping oil to the manual control valve and the pressure regulator valve. The oil, under pressure, enters the pressure regulator valve in the area between the second and third land on the valve.

The valve body has a small orifice through which oil flows into a dash pot beneath the first land of the valve. As pressure begins to build up behind the first land, the valve starts moving against the springs as shown in Figure 53 and opens the converter feed line.

When the oil pressure behind the first land reaches approximately 80 psi, the valve has been moved far enough against the springs to open a channel permitting excess oil to return to the pump suction line. The regulator valve moves back and forth to control the pressure of the oil pumps for whatever the load requirement.

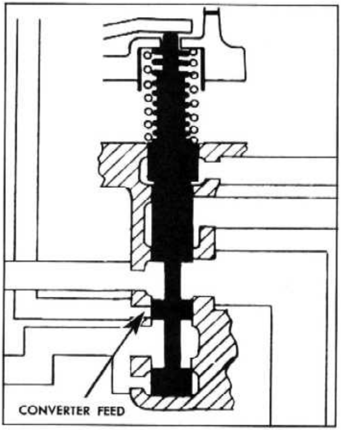

Fig. 52—Pressure Regulator Valve—Engine Not Running

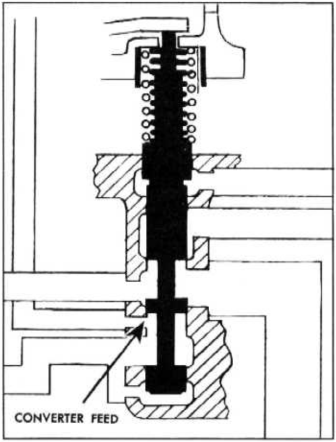

Fig. 53 Pressure Regulator Valve—Engine Running

Modulator

The vacuum modulator is attached to the transmission and connected through tubing to the manifold of the engine resulting in its being sensitive to engine vacuum. Spring pressure is applied to the top of a diaphragm which bears against a hydraulic plunger and body which in turn bears against the transmission modulator control lever. This control lever rests against the end of the pressure regulator valve and assists the pressure regulator springs in regulating pressures within the transmission as a result of load requirements which affect engine vacuum.

When requirements are light a strong vacuum is imposed which lifts the diaphragm, compressing the diaphragm spring and relieving pressure on the end of the regulator valve allowing it to regulate within range of the regulator springs. As load requirements are increased and vacuum decreases, the diaphragm is depressed by the diaphragm spring which applies pressure to the pressure regulator valve through the modulator control lever. The pressures within the system therefore increase to balance this additional pressure by the modulator. Now, when shifting into low or reverse, additional pressure is required to hold the bands. To obtain this pressure for the low or reverse band, oil is channeled by the manual valve through the accumulator to the hydraulic modulator. This oil expands the hydraulic plunger and body, which in turn applies pressure through the modulator control lever to the end of the pressure regulator valve. The additional pressure on the regulator valve causes it to regulate at higher pressure, thus, pressure is built up within the system for additional band holding power.

Accumulator

The accumulator which functions in low and reverse is simply a surge chamber to cushion the band application when shifting from drive to low with the car in operation or when shifting into either low or reverse with the car standing still.

OPERATION

Drive Range

Starting and Low Speed

When starting and at low speed, the front transmission pump is operating to supply the entire hydraulic system with oil. Under these conditions the controls operate as shown in Figure 54.

The oil flows from the front transmission pump to the pressure regulator valve and then to the manual valve. The pressure regulator valve maintains the oil pressure at 45 psi minimum and from a port in the manual valve the oil is directed to the back of the clutch piston through an orifice hole which allows for a smooth clutch engagement. A connecting passage also directs oil to the release side of the low servo piston. Another port at the manual valve also directs oil to the apply side of the low servo piston which balances this piston causing it to be held in its release position by the servo spring.

In drive range, a passage is opened through the manual valve to the top land on the regulator valve. This increases the regulated area on the regulator valve, thereby making provision for proper oil pressure regulation throughout the entire speed range of the car.

Above 15 MPH—Road Load

Before the rear pump can take over it must build up sufficient pressure to overcome the front pump pressure and open the pump check valve. This permits the front pump to idle and discharge into the suction line while the rear pump supplies the requirements of the transmission.

Above approximately 15 mph, road load, the rear transmission pump is supplying oil and the controls operate as shown in Figure 55.

The oil from the rear pump enters the pressure regulator valve between the first and second lands, also going through the orifice passage in the body to get under the valve for pressure regulation. As the pressure increases the second land regulates the pump pressure by dumping excess pressure into the suction line. From the pressure regulator valve the rear pump pressure is directed to the manual valve and to the clutch and low servo through the same passages as at lower speeds.

In order to prevent the working pump bleeding into the idling pump a check valve, common to both pumps, is used. When starting, the check valve is closed to the rear pump pressure line (fig. 54) and at speeds above 15 mph, road load, the check valve is closed to the front pump pressure line (fig. 55).

Action of Check Valve

In Figure 54 the check valve in starting or at low speeds is closed to the rear pump pressure line as the rear pump has not attained sufficient volume and pressure to be effective. The higher pressure from the front pump holds the valve closed. This prevents the oil from the front pump bleeding off through the rear pump. In Figure 55 when the car is being driven above approximately 15 mph, road load, the rear pump is being rotated fast enough to create sufficient pressure to operate the transmission. At this time the rear pump has overcome the front pump pressure, has opened the rear pump pressure line check valve and closed the valve to the front pump pressure line and is feeding oil to the pressure regulator valve. As the oil from the rear pump enters the regulator it forces the valve further against the regulator spring. This movement opens the front pump regulating port, bleeds the front pump to the suction line and drops its oil pressure. The front pump is now idling and requires practically no power to drive it. The use of the smaller rear pump at higher speeds conserves horsepower.

Low Range

As in the drive range the front pump supplies the oil pressure requirements of the transmission up to approximately 20 mph, road load, by which time the rear pump has built up sufficient pressure to overcome the front pump pressure which then idles and discharges into the suction line.

In the following description we will concede that the car has speed in excess of 20 mph, road load, at which time the rear pump is in operation and the front pump is discharging into the suction line. The controls operate as shown in Figure 56.

Oil flows from the rear pump to the pump check valve closing off the front pump pressure line and then to the pressure regulator valve. From the pressure regulator valve the oil is directed to the manual valve which is so positioned to route this oil to the apply side of the low servo piston. Oil from the pump is also routed through another port of the manual valve to the accumulator and from the accumulator to the hydraulic modulator assembly. The oil pressure expands the hydraulic plunger and body thus increasing the pressure exerted against the modulator control lever. This increased pressure causes the pressure regulator valve to regulate at a higher pressure, regardless of throttle and vacuum conditions, which firmly holds the low servo band applied. Oil passing into the accumulator, which acts as a surge chamber, retards the flow of oil to the modulator and subsequent build up of pressure, enough to allow a gradual band application.

Shifting from Low to Drive

When the control lever is moved from low to direct drive, the manual valve shuts off the flow of oil to the accumulator and the oil in the line to the accumulator and modulator is opened to sump with discharge of oil in the accumulator being abetted by the spring loaded piston. At the same time that the passage to the accumulator is closed, a passage to the clutch apply is opened resulting in clutch application. This same oil that applies the clutch is also routed to the release side of the low servo piston which balances the pressure on the apply side and the servo spring then holds the low band in the released position. A momentary delay in the release of the low band is experienced as result of oil going first to clutch and then to the release side of the low servo piston. This momentary delay in release of the low band while the direct drive clutch is engaging permits smooth transfer of power from low to drive without allowing the engine to run away. Maximum smoothness is obtained when the shift is made under power.

Never shift from low to drive above 40 mph as frequent shifting at high speed produces excessive wear in the operating parts.

Reverse

In reverse, the front transmission pump supplies the hydraulic system with oil. The controls operate as shown in Figure 57.

Oil flows from the front pump to the pressure regulator valve and then to the pump check valve closing the rear pump pressure line so that the front pump pressure does not exhaust through the rear pump. The manual valve is so positioned as to direct oil to the rear servo to apply the band, and at the same time, oil is directed through the accumulator to the hydraulic modulator to exert pressure through the modulator control lever to the pressure regulator valve. The regulator valve regulates at a higher pressure to firmly hold the reverse band applied regardless of throttle and vacuum conditions.

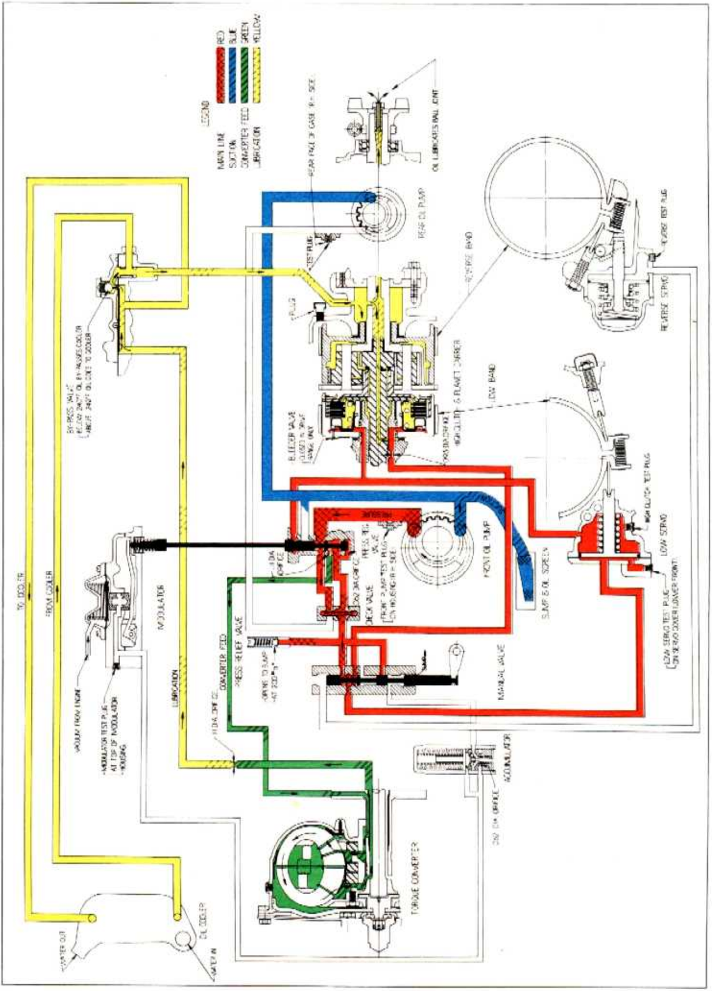

Fig. 54—Oil Circuits—Drive—Low Speed

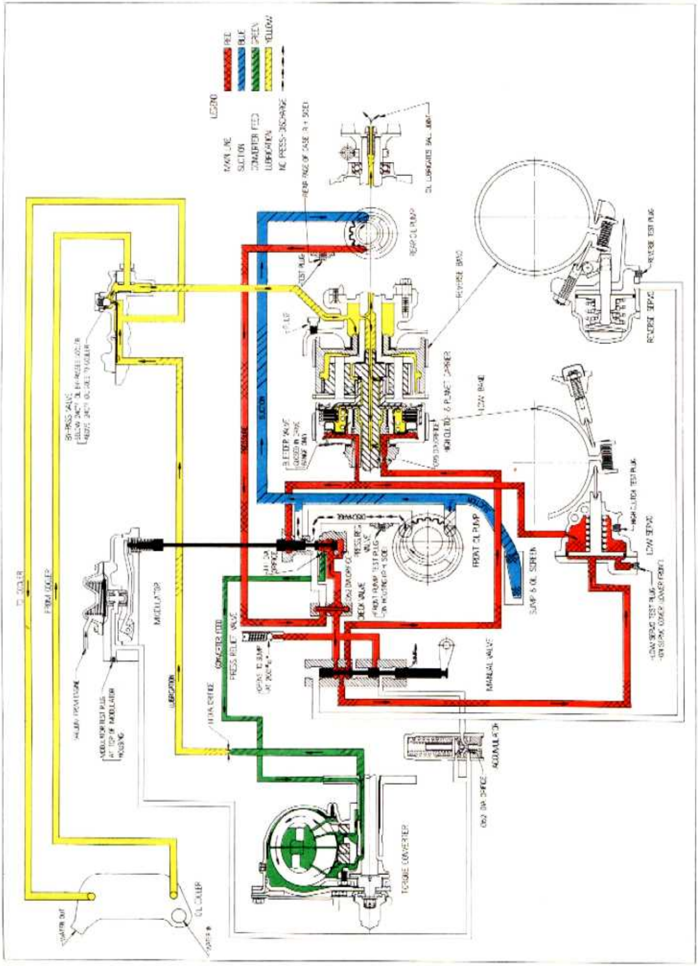

Fig. 55—Oil Circuits—Drive

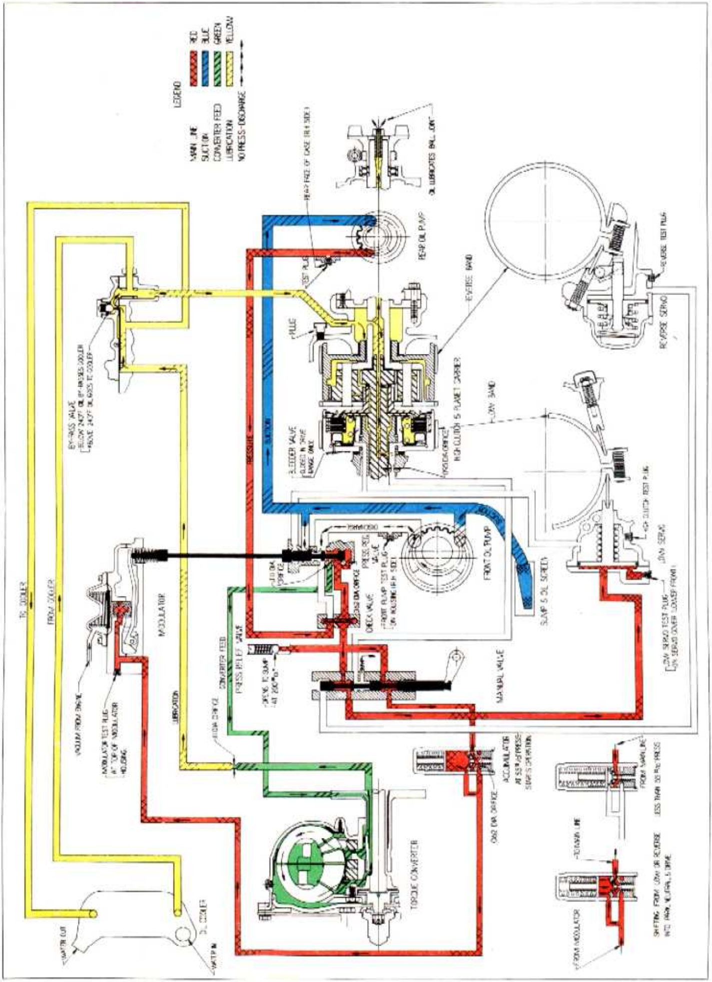

Fig. 56—Oil Circuits—Low

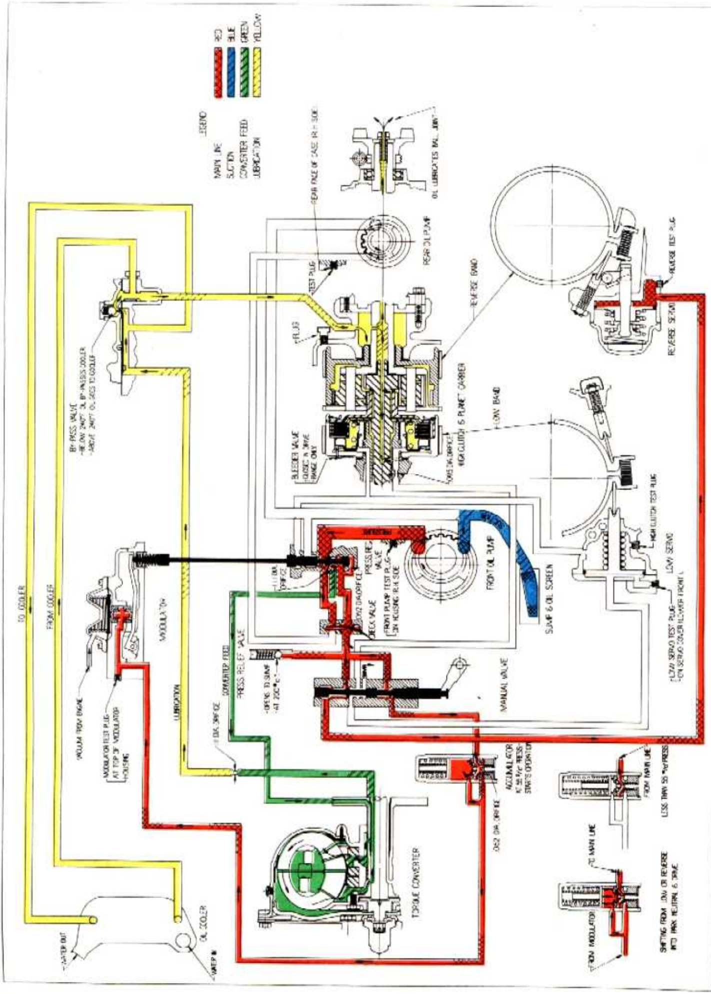

Fig. 57—Oil Circuits—Reverse

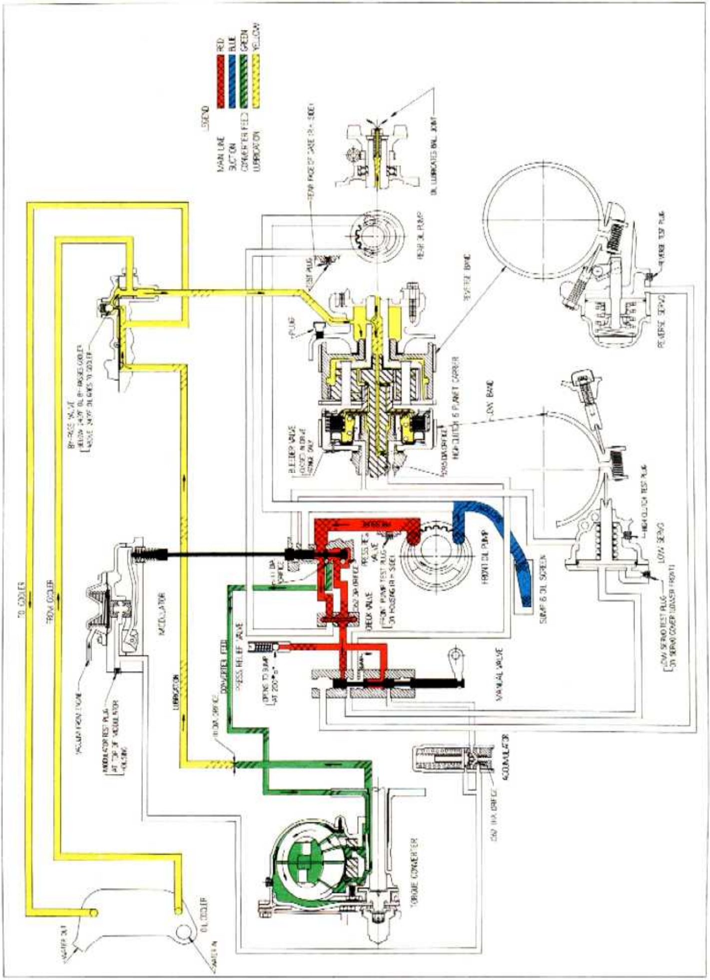

Fig. 58—Oil Circuits—Neutral

Neutral

In neutral the manual valve is positioned as shown in Figure 58. Oil is blocked from entering the pressure lines to either the servo pistons or the clutch leaving the bands and clutch released and the transmission in neutral. Oil to the pressure regulator valve, however, allows opening of the converter feed line and lubrication system.

Drive Clutch Relief Valve

In reverse and neutral, the low range clutch drum and direct drive clutch piston revolve at high speeds. This high speed rotation creates sufficient centrifugal force in the oil remaining in the clutch apply chamber to partially engage the clutch. To prevent this, in units built prior to Powerglide transmission No. JT-232315-D-23-D, a clutch relief valve is riveted to the clutch drum and is held in the open position by a pin depressed by the clutch piston when it is in the released position. This allows the oil trapped in the piston apply chamber to discharge into the transmission case, thereby, eliminating the possibility of partial application of the clutch.

In units built after Powerglide transmission Number JT-232315-D-32-D, the clutch relief valve is a steel ball. It is located in a hole drilled in the front side of the piston, the hole being slightly larger than the ball. It is retained there by staking. The rear end of the hole provides a seat and an orifice leading to the rear of the piston (fig. 59). When the clutch is in the released position, the centrifugal forces of the rotating clutch assembly, moves the ball off of its seat and allows any oil trapped in the piston apply chamber to discharge

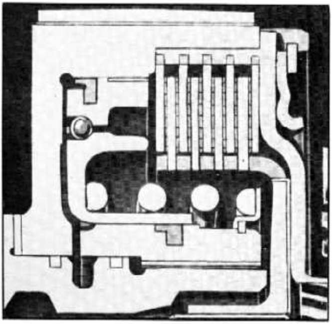

Fig. 59—Drive Clutch Relief Valve

through the orifice to the rear of the piston. This eliminates the possibility of partial application of the clutch.

In addition to the clutch relief valve, the clutch pressure line, by the position of the manual valve, is vented to the sump and the clutch sucks air instead of oil.

When pressure is again directed to the clutch to engage it, the early type clutch relief valve is closed by its own spring action as the clutch piston moves away from the operating pin. The late type clutch relief valve is closed by the oil pressure forcing the ball against its seat, blocking off the orifice.

Converter Feed and Oil Cooler

Oil from the pressure regulator is fed to the converter through a restricted metering orifice. This oil is directed through the stator support, a passage being provided between stator support and stator support sleeve, and is delivered into the converter between the primary stator and the secondary pump. Oil leaves the converter between the secondary stator and the turbine and flows inside the stator support to the case where it enters a passage leading to another restricted metering orifice and thence into the lubrication line and cooler.

Lubrication System

Oil leaving the converter goes through a restricted metering orifice and thence to the lubrication by-pass valve. When oil temperatures are below 240°F, a bi-metal strip opens the by pass valve allowing oil to go directly into the lubrication system. When oil temperatures are above 240°F, the bi-metal strip allows the by-pass valve to close. With the by-pass valve closed, oil is circulated through the oil cooler to cool the oil to a satisfactory operating temperature. The cooled oil then returns to the transmission and into the lubrication system. The oil cooler is a water cooled heat exchanger with water being supplied by the engine cooling system which in turn is cooled by the radiator.

Oil is continually being fed to the lubrication system by the converter and is directed through lubrication passages to the low range drum bushing and clutch plates, to the rear transmission case bushing, planetary gears and carrier and to the universal ball joint and transmission rear bearing and the pilot bearing on the input shaft. The free wheel clutches on the stators and the secondary pump and turbine bushing are lubricated by immersion in oil in the converter.

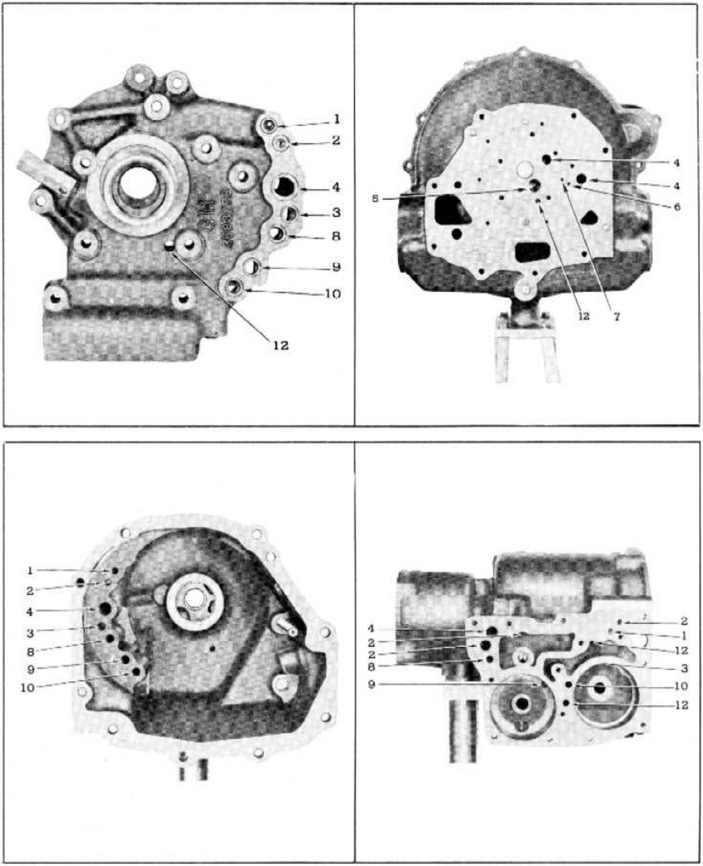

Fig. 60—Composite Layout—Oil Hole Identification

1. Hydraulic Modulator
2. Lubrication or Converter Out
3. Release Side of Low Servo
4. Suction
5. Front Pump Pressure
6. Line Pressure
7. Converter In-Feed
8. Rear Pump Pressure
9. Reverse
10. Low Apply
11. High Clutch In-Feed
12. Exhaust
13. Accumulator Feed

MAJOR SERVICE OPERATIONS

REMOVAL

1. Raise car and place on stand jacks.
2. Remove floor mat and transmission hole cover.
3. Remove toe pan plate.
4. Remove three top turbine housing attaching bolts through toe pan hole.
5. Disconnect speedometer cable from driven gear.
6. Disconnect emergency brake rod from cross shaft and drop cross shaft, cables and spring.
7. Remove capscrews holding universal joint collar to rear of transmission case, slide universal ball and collar back on propeller shaft housing.
8. Place jack under propeller shaft, remove capscrews which retain front trunnion bearings to front yoke, split the joint and lower front end of propeller shaft.
9. Remove two upper transmission to converter housing bolts and install lift sling J-4262.
10. Place lifting device J-4279 in position over transmission and attach lift cable to sling.
11. Attach lift chain to two top transmission universal joint collar attaching holes.
12. Remove transmission and turbine drain plugs and drain transmission and turbine.
13. Disconnect transmission oil cooler lines and vacuum line from transmission.
14. Remove two lower turbine housing attaching bolts and flywheel cover and flywheel underpan extension.
15. Remove spark plugs.
16. Disconnect exhaust pipe from manifold and disconnect muffler support. Tie exhaust pipe and muffler to left frame side member.

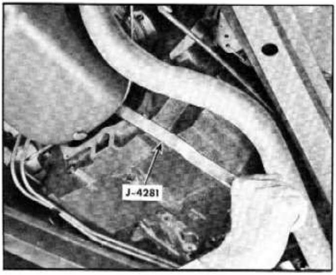

Fig. 61—Engine Indexing Tool

17. Disconnect transmission short shift rod from parking lock lever and long shift rod from bell crank. Tie long shift rod up out of way.
18. Remove bell crank lever and stud from transmission case.
19. Using tool J-4281 to turn engine over (fig. 61) remove six flywheel to converter bolts working through opening in housing on left side of engine (fig. 62).

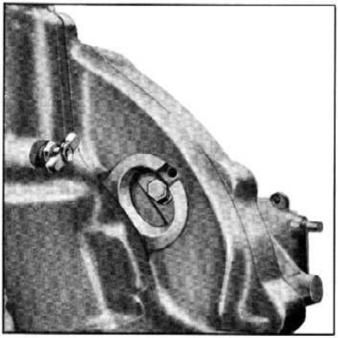

Fig. 62—Bolt Access Hole in Bell Housing

20. Clean dirt from around filler tube and dip stick and transmission side cover and remove turbine housing bolt which holds filler tube in position and remove filler tube and dip stick.

NOTE: Use masking tape or a rubber stopper to cover filler tube hole in side cover.

21. Place hydraulic jack under engine oil pan.
22. Remove transmission to transmission rear support bolts, and remove transmission support.
23. Remove remaining turbine housing retaining bolts on each side, lifting or lowering engine and transmission to gain necessary clearance to bolts.
24. Move transmission assembly back to clear flywheel pilot from flywheel.

NOTE: Extreme care must be exercised to prevent damage to flywheel pilot.

25. Lower transmission assembly a little, then lift up on back end of transmission as far as

it will come, hook chain in notch in back of hoist (fig. 63).

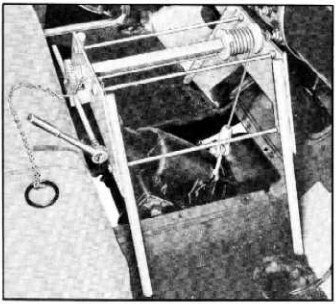

Fig. 63—Removing Transmission

26. Use a pry bar between the transmission and floor opening on the right side to clear the servo cover bolts.
27. Lower the transmission a little more and again pull up on back end of transmission as far as possible. Then use pry bar between transmission and floor opening until the lubrication bypass valve plug clears the opening.
28. Lower transmission on to a dolly or creeper being careful the transmission does not strike against flywheel.

DISASSEMBLY

1. Place transmission in assembly fixture J-3361 (fig. 64).

   NOTE: Cleanliness is an important factor in the overhaul of the transmission. Before attempting any disassembly operation, the exterior of the case should be thoroughly cleaned to prevent possibility of any dirt getting into the transmission. During disassembly all parts should be thoroughly cleaned with cleaning solvent and all parts air dried. Wiping cloths or rags should not be used to dry parts as lint may be deposited on the parts which will cause later trouble.

2. Remove right side cover and remove oil sump suction screen.
3. Install turbine locking strap to turbine, attaching by means of bolt to one of the flywheel attaching holes. This is necessary to hold unit stationary while loosening turbine cover retaining bolts.

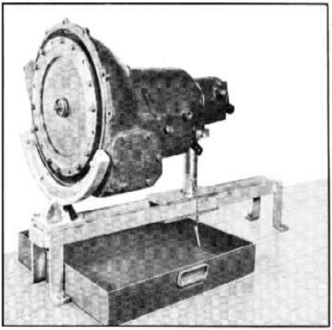

Fig. 64—Transmission in Assembly Fixture

4. After all retaining bolts have been removed, screw three 10-32x2" "T" screws, into three tapped holes in turbine cover to loosen cover and remove cover and turbine assembly (fig. 65).

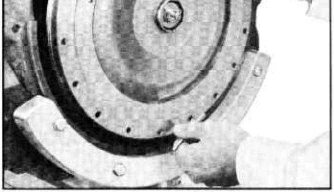

Fig. 65—Removing Turbine and Cover Assembly

5. Remove the primary and secondary stator as a unit (fig. 66) and test rollers for slippage, rotating by hand. The overrunning clutch mechanism should allow rotation in one direction only.

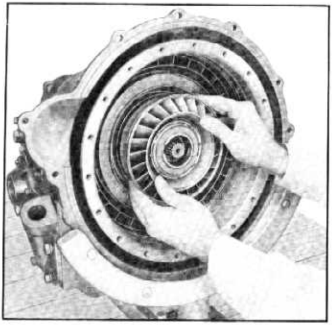

Fig. 66—Removing Stator Assembly

6. Check the secondary pump free wheeling clutch as in No. 5.
7. Remove the converter retaining ring and washer (fig. 67).
8. Slide the primary pump from the stator support and remove. Examine the pump hub for possible damage to the bearing surface.
9. Remove the modulator assembly bolts and remove modulator assembly.

   CAUTION: When removing modulator cover be careful that hydraulic plunger and body does not fall out and become damaged.

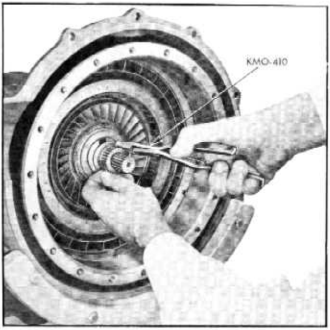

Fig. 67—Removing Converter Retaining Ring and Washer

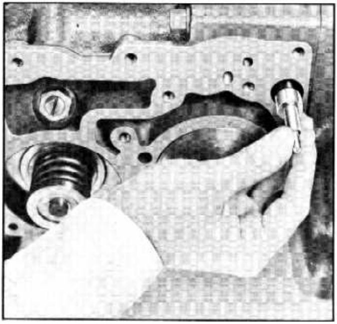

Fig. 68—Removing Pressure Regulator Valve

10. Remove the servo cover bolts and remove servo cover assembly and gasket.

    CAUTION: Reverse servo spring and pressure regulator springs exert pressure against this cover. Care should be taken when cover is removed to maintain pressure against this cover to eliminate possible cover breakage.

11. Remove reverse servo spring and pressure regulator springs and remove pressure regulator valve (fig. 68).

    CAUTION: Handle this valve carefully and lay aside so as to prevent damage.

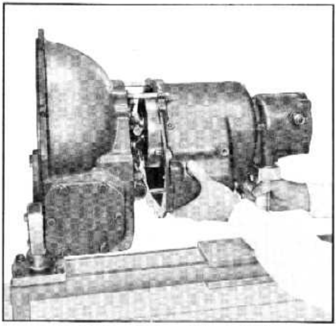

Fig. 69—Separating Transmission and Turbine

12. Loosen low band adjusting screw lock nut and tighten low band adjusting screw to hold clutch assembly in place.
13. Remove transmission to turbine housing bolts and carefully separate transmission from turbine housing (fig. 69).

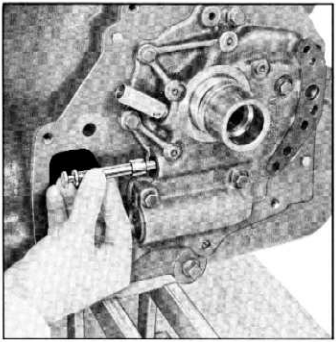

Fig. 70—Removing Manual Valve

14. Remove manual valve from valve body (fig. 70) and manual valve lever from turbine housing and also remove bronze thrust washer from valve body delivery sleeve. Then remove all bolts attaching valve body

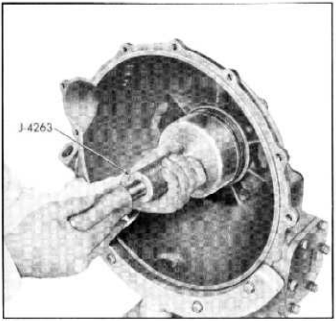

Fig. 71—Removing Front Oil Pump

to turbine housing and pump to valve body and remove body and gasket.

CAUTION: Carefully protect valve body to prevent damage.

15. Install front pump driver tool, J-4263, and remove pump assembly from turbine housing (fig. 71).
16. Loosen low servo adjusting screw and remove transmission input shaft and clutch assembly from transmission.
17. Back off adjusting screw and remove low servo brake band and strut assembly and remove low servo piston and release spring.
18. Remove retainer bolt, lockwasher and universal joint yoke washer and slide universal joint front yoke off end of shaft.
19. Install mainshaft removing and replacing tool, J-938, to planet carrier output shaft and to rear face of transmission case as shown in Figure 72 (Tool J-938 was originally de-

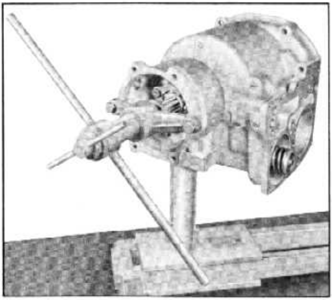

Fig. 72—Removing Planet Carrier Assembly

signed for the 3 speed Synchromesh transmission, but should be reworked so that it may also be used on the Powerglide transmission. (See September, 1950, Service News.)

20. Turn puller handle clockwise to force the planet output shaft out of rear bearing. Disconnect tool J-938 from output shaft and rear face of transmission and remove planet carrier assembly through front of case.
21. Remove reverse brake drum.
22. Loosen reverse servo lock nut, back off adjusting screw, and remove reverse servo brake band assembly and reverse servo piston.

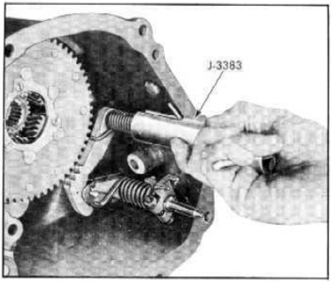

Fig. 73—Removing Parking Lock Pawl Spring

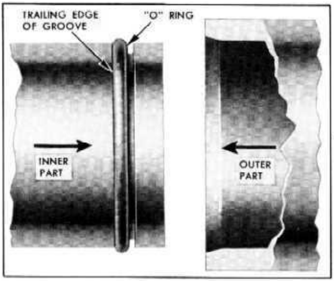

Fig. 74—Installing "O" Ring Seals

23. Remove rear pump attaching screws and remove rear pump assembly and gasket.
24. Using tool J-3383, engage parking lock pawl spring and rotate spring to unhook end from case (fig. 73). Remove spring and parking lock pawl.
25. Remove transmission parking lock lever and steel washer and then remove parking lock lever shaft and apply spring assembly from case.

NOTE: On late model transmissions the spring has been eliminated from the parking lock lever shaft. The newly designed part, Part No. 3697552, is available as a service replacement part for all past models 1950-52 inclusive.

"O" RING SEALS

"O" ring seals are used at five locations to provide positive sealing of oil pressures within the transmission. It is imperative that these "O" ring seals be replaced during an overhaul or whenever an "O" ring seal is removed.

Whenever new "O" ring seals are installed, the following procedure should be followed to insure proper installation.

1. Parts to be assembled should be thoroughly cleaned of metal chips, dirt or foreign material. Sharp edges must be slightly broken and all burrs removed.
2. Before placing "O" ring in groove, make sure ring is free from twists. This can be done by placing ring on a flat table. Table surface should be clean so it will not deposit any dirt or grit on the ring.
3. When handling the ring during installation, be careful not to twist the ring. Place one side of the ring in the groove and then pull the opposite side straight back, being careful not to twist the ring, and place it in the groove.
4. Before the outer part is placed over the inner part and "O" ring seal, the "O" ring should be in full contact with the side of the groove which is last to enter the outer part (fig. 74). This position may be obtained by inserting a smooth-edged flat tool between the "O" ring and leading edge of the groove and running the tool circumferentially around the groove.

CAUTION: In working the "O" ring against the trailing edge of the groove, do not use a screwdriver or any sharp tool which might cut or abrade the surface of the "O" ring.

5. When assembling the two parts avoid using a twisting motion.
6. Before assembling, the two parts and the "O" ring seal should be well lubricated using Automatic Transmission Fluid, "Type A."

OVERHAULING UNIT ASSEMBLIES

PRIMARY PUMP

Disassembly

1. Remove the stator race thrust snap ring and thrust washer (fig. 75).
2. Rotate secondary pump in clockwise direction and withdraw from the primary pump.
3. Remove the overrun cam roller and spring retainer and remove cam rollers, spring retainers, springs and overrun cam thrust washer.

4. Figure 76 shows layout of pump parts.

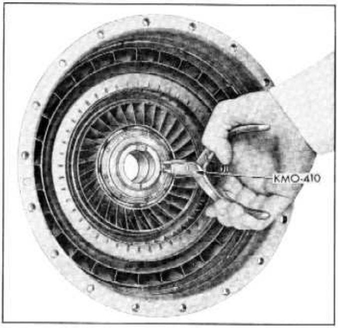

Fig. 75—Removing Stator Race Thrust Snap Ring

Inspection

1. Wash all parts in cleaning solvent (air dry).

   CAUTION: Do not use rags to dry parts.

2. Inspect cam rollers for scoring or galling.
3. Inspect cam roller springs for distortion and spring retainers for excessive wear or damage.
4. Inspect inner and outer primary pump hubs for galling or scoring and inspect pump bushing for excessive wear.
5. Check primary and secondary pump vanes for looseness or damage.

Repairs

Primary Pump "O" Ring Seal Replacement

The primary pump "O" ring seal is one of (3) "O" ring seals in the transmission converter section which act to seal the oil in the converter and prevent leakage of converter oil out into the transmission housing. In case of oil leakage at the rear of the converter section between the primary

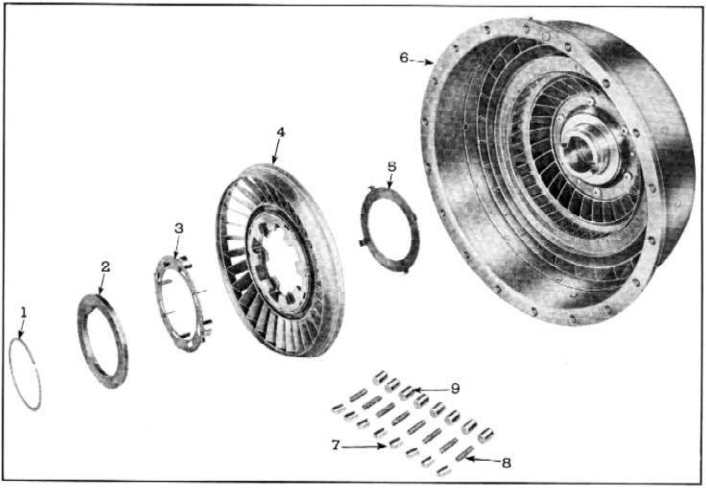

Fig. 76—Layout of Primary and Secondary Pump

1. Secondary Pump Thrust Ring
2. Secondary Pump Thrust Washer
3. Over-Run Cam Roller and Spring Retainer
4. Secondary Pump
5. Over-Run Cam Thrust Washer
6. Primary Pump and Hub Assembly
7. Over-Run Cam Roller Guides
8. Over-Run Cam Roller Springs
9. Over-Run Cam Rollers

pump and primary pump hub, it will be necessray to replace the primary pump "O" ring seal. Care must be taken in this operation as the primary pump and hub assembly is a balanced assembly, and when taken apart, must be reassembled so the parts maintain their same relative positions.

1. With a small center punch, mark both the primary pump hub and the primary pump (fig. 77). This is so the parts may be reassembled in the same relative positions, thus maintaining the balance of the assembly.
2. Remove the (6) screws attaching the pump hub to the primary pump.
3. Support the primary pump on two wood blocks and using a 1/8" pin punch, punch on the top of the (3) dowels to remove the hub from the assembly. The (3) dowels are swaged or peened over at the time of assembly.
4. Remove the primary pump "O" ring seal from the hub.
5. Using a small burring tool, clean up the top of the (6) screw holes so that they are free of any burrs that could lodge between the hub and the primary pump. Then use an Arkansas hard stone and thoroughly remove any chips or burrs from the mating surfaces of the primary pump hub and the primary pump. Remove any burrs from the ends of the (3) dowels.
6. Wash all parts in cleaning solvent (air dry).
7. Inspect pump hub and primary pump for galling or scoring and inspect pump bushing for excessive wear. Check the fit of the pump hub into the primary pump.

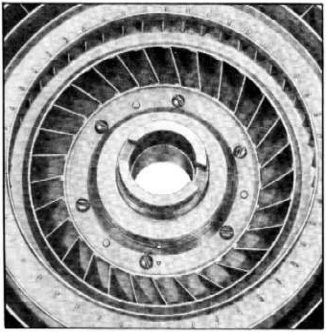

Fig. 77—Mark Primary Pump Hub and Primary Pump

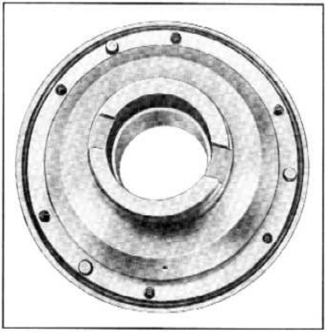

Fig. 78—Install "O" Ring Seal in Pump Hub

8. Check "O" ring groove in hub and make sure groove is free from chips, dirt or nicks.
9. Install new "O" ring seal in groove of pump hub (fig. 78).

NOTE: Select an "O" ring seal that will remain in the groove. Because of slight variations in the "O" rings, some may have a tendency to roll out of the groove.

10. Insure that there are no burrs, dirt, etc., on either mating surface. Place pump hub on bed of arbor press. Position primary pump on hub making sure to match the center punch marks that were made at the time of disassembly. Using a piece of thin wall pipe, approximately 4" long and square at both ends, having an

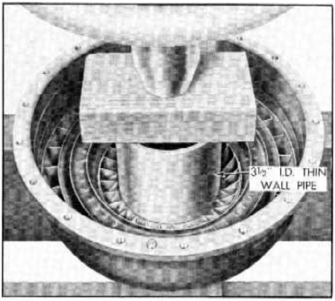

Fig. 79—Installing Primary Pump Hub

I.D. of 3½", carefully press the primary pump over the hub by applying the pipe against the pump hub face (fig. 79).

11. Install the (6) screws with lockwashers and draw up evenly to 4½ ft. lbs. torque.
12. Using a small punch, peen dowel holes around the ends of the (3) dowels to prevent any possibility of a dowel working into the converter.
13. Install primary pump assembly in position on stator support aligning front pump drive gear tangs with drive slots in pump hub. Face of pump must be flush with face of bell housing.
14. Mount a dial indicator on the transmission mounting fixture so that the button of the indicator will contact the forward face of the primary pump (fig. 80).

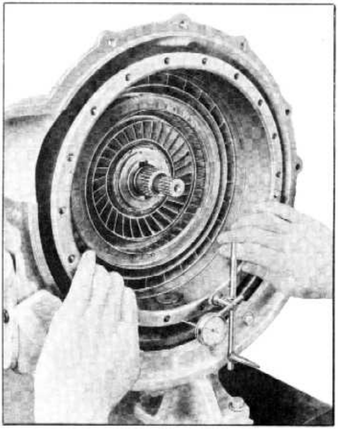

Fig. 80—Check Runout of Primary Pump

15. Check the runout of the primary pump. This runout should not exceed .010". If excessive, there are likely burrs or dirt still remaining between the mating faces of the pump hub and primary pump or the pump "O" ring seal may be out of the groove.

Assembly

1. Assemble overrun cam roller and spring retainer so that prongs on the retainer are to the rear.
2. Assemble cam rollers, spring retainers and springs in cam pockets.

   NOTE: Spring retainers are curved and this curvature should fit the curvature of the unit (fig. 81).

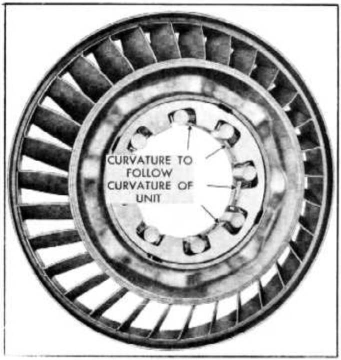

Fig. 81—Curvature of Spring Retainers

3. After all cam rollers, springs, and retainers are installed, install overrun cam thrust washer holding retainer on opposite side so that it is not pushed out of position.
4. Using loading tool No. J-3362, install secondary pump to primary pump hub (fig. 82),

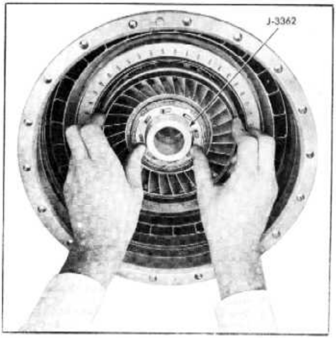

Fig. 82—Installing Secondary Pump to Primary Pump Hub

and rotate secondary pump making sure that pump rotates freely in a clockwise direction and locks when rotated in a counterclockwise direction.

5. Remove loading tool and install stator race thrust washer and snap ring.

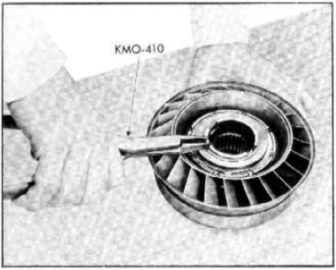

Fig. 83—Removing Stator Race Thrust Snap Ring

STATORS

Disassembly

1. Remove stator race thrust snap ring and thrust washer (fig. 83).
2. Rotate secondary stator clockwise and remove from stator race. Then carefully rotate stator race and remove from primary stator.

   CAUTION: Exercise care when separating parts so that cam rollers and springs may not become lost.

3. Remove cam roller and spring retainer from secondary and primary stator and remove cam rollers, springs and spring retainers.

   NOTE: Cam thrust washers, springs and spring retainers only are interchangeable.

4. Figure 84 shows layout of stator parts.

Inspection

1. Wash all parts in cleaning solvent (air dry).

   CAUTION: Do not use rags to dry parts.

2. Inspect cam rollers for scoring or galling.
3. Inspect cam roller springs for distortion and spring retainers for excessive wear or damage.

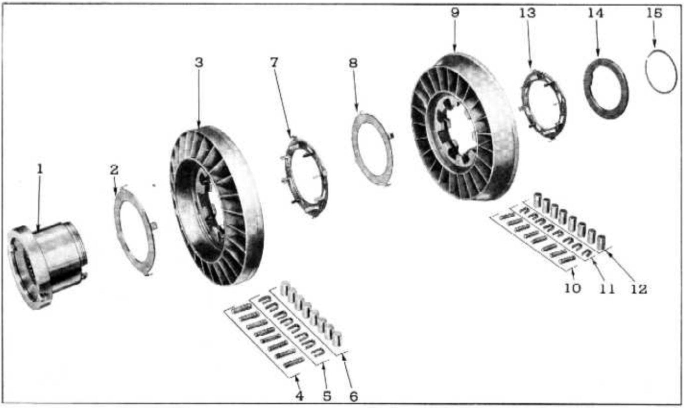

Fig. 84—Layout of Stator Parts

1. Stator Race
2. Over-Run Cam Thrust Washer
3. Primary Stator
4. Over-Run Cam Springs
5. Over-Run Cam Guides
6. Over-Run Cam Rollers
7. Over-Run Cam Retainer
8. Over-Run Cam Thrust Washer
9. Secondary Stator
10. Over-Run Cam Springs
11. Over-Run Cam Guides
12. Over-Run Cam Rollers
13. Over-Run Cam Retainer
14. Stator Race Thrust Washer
15. Stator Race Thrust Snap Ring

4. Inspect stator hub for galling or scoring.
5. Inspect stator vanes for looseness or damage.

Assembly

1. Install cam roller and spring retainer to secondary stator.

   NOTE: Secondary stator roller and spring retainer has long tabs to accommodate long rollers.

2. Install cam rollers, springs and spring retainers.

   NOTE: In assembly of spring retainers curvnture of retainers must follow curvature of hub.

3. Install overrun cam thrust washer being careful not to dislodge cam rollers, springs or retainers.
4. Install cam roller and spring retainer to primary stator.
5. Install cam rollers, springs and spring retainers.

   NOTE: In assembly of spring retainers curvature of retainers must follow curvature of hub.

6. Install overrun cam thrust washer being careful not to dislodge cam rollers, springs or retainers.
7. Carefully install stator loading tool J-3362 on stator race and install primary stator over tool and onto stator race with thrust washer down.

   NOTE: Carefully rotate stator in free wheel direction (clockwise) to eliminate possibility of pushing cam rollers out of position.

8. Carefully rotate secondary stator over loading tool with thrust washer down and onto stator race being careful not to dislodge cam rollers (fig. 85).
9. Install bronze thrust washer and snap ring.
10. Check operation of stators. Stators should

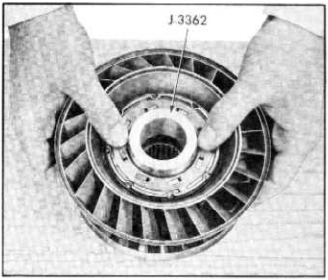

Fig. 85—Use of Loading Tool to Assemble Stators

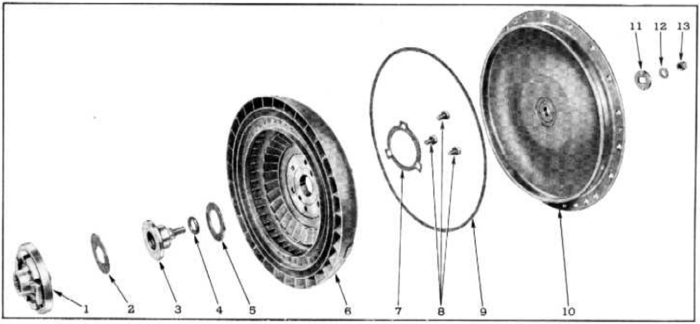

Fig. 86—Layout of Turbine Parts to Transmission KT-22574A-15-D

1. Input Shaft Drive Flange
2. Turbine Rear Thrust Washer
3. Turbine Bolt
4. Turbine Bolt "O" Ring Seal
5. Turbine Front Thrust Washer
6. Turbine
7. Turbine Hub Bolt Lock
8. Turbine Hub Bolts
9. Cover "O" Ring Seal
10. Cover
11. Special Lockwasher
12. Washer
13. Nut

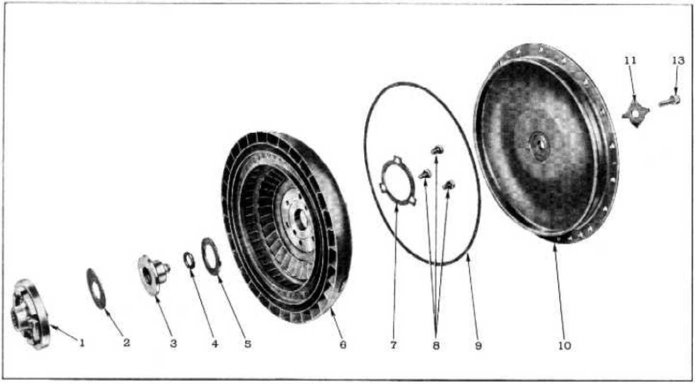

Fig. 87—Layout of Turbine Parts after Transmission KT-22574A-15-D

1. Input Shaft Drive Flange
2. Turbine Rear Thrust Washer
3. Turbine Nut
4. Turbine Nut "O" Ring Seal
5. Turbine Front Thrust Washer
6. Turbine
7. Turbine Hub Bolt Lock
8. Turbine Hub Bolts
9. Cover "O" Ring Seal
10. Cover
11. Cover Center Bolt Lock
12. Cover Center Bolt

free wheel in clockwise direction and lock to stator race in other direction when viewed from front.

TURBINE

Disassembly

1. Remove "O" ring from converter cover.
2. On units built prior to Powerglide transmission Number KT-22574A-15-D, remove the turbine bolt cotter key, nut, flat washer and slotted washer. On units built after Powerglide transmission Number KT-22574A-15-D, bend down the ears of special lock, remove the flanged nut center bolt, special lock and slotted washer.
3. Lift turbine cover from turbine bolt or flanged nut.
4. Bend down ears of lock plate and remove the three turbine drive flange to turbine capscrews.
5. Remove turbine drive flange and bolt, or flanged nut, from turbine.
6. Remove turbine bolt or flanged nut, and thick and thin thrust washers from flange.
7. Remove "O" ring from turbine bolt or flanged nut.
8. Figure 86 shows layout of turbine parts of units built prior to Powerglide transmission Number KT-22574A-15-D. Figure 87 shows layout of turbine parts of units built after Powerglide transmission Number KT-22574A-15-D.

Inspection

1. Clean all parts in solvent (air dry).

   CAUTION: Do not use rags to dry parts.

2. Inspect turbine bolt or flanged nut, drive flange and thrust washers for excessive wear or scoring.
3. Inspect turbine blades for looseness or damage.

Repairs

Turbine Bushing Replacement

A precision type turbine bushing, part number 3689929, should be used for field service replacement This bushing is of high quality with close tolerances of fit and will not require reaming after installation.

Should the turbine bushing during an overhaul inspection show evidence of excessive wear, it may be replaced easily and accurately using the following procedure.

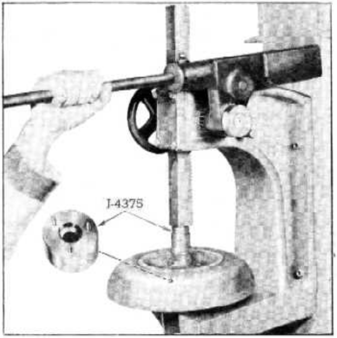

Fig. 88—Pressing Turbine Bushing into Turbine

1. Using large end of turbine bushing remover and replacer set, J-4375, press old bushing from turbine.
2. Place new bushing on small end of driver and press bushing into position (fig. 88).
3. Assemble turbine bolt and drive flange to turbine as outlined under "Turbine Assembly."
4. Check end play of turbine bolt (fig. 89). This endplay should be from .002" to .016".

NOTE: Two shims are available to be installed between the turbine and the input shaft drive flange to obtain this running clearance. The two shims are available under part number 3691922 (.014") or part number 3691923 (.019") and may be used singly or in combination, as required. Transmissions built after serial number HT-19226-B24 do not use shims, however, the endplay limits of .002" to .016" apply.

Fig. 89—Check End Play of Turbine Bolt

Assembly

1. Install new "O" ring on turbine or flanged nut.
2. Install thick thrust washer to turbine, indexing lugs with locating holes in turbine.
3. Install turbine bolt or flanged nut.
4. Install thin washer to drive flange and install drive flange over bolt or flanged nut, indexing three dowels with locating holes in turbine.
5. Install lock plate and three input shaft drive flange to turbine capscrews, tighten to 12½-15 ft. lbs. and lock.
6. Install turbine cover over turbine bolt or flanged nut.
7. Install slotted washer over turbine bolt or flanged nut, indexing pimples with locating holes in pilot. On units built prior to Powerglide transmission KT-22574A-15-D, install flat washer and nut. Tighten to 12½ to 15 ft. lbs. minimum. If hole in bolt lines up with slot in nut insert cotter key. If not, tighten nut until cotter key can be inserted. Do not back off nut to insert cotter key. On units built after Powerglide transmission KT-22574A-15-D, install special lock and center bolt. Tighten center bolt 12½ to 15 ft. lbs. and bend up ears of special lock.
8. Install new "O" ring on converter cover.

CLUTCH

Disassembly

1. Remove clutch flange retainer ring and clutch flange retainer.
2. Remove low sun gear and clutch flange assembly from clutch drum.
3. Remove clutch hub thrust washer, hub and clutch plates from clutch drum.
4. Place clutch drum in bench press and install piston spring compression tool to compress clutch release spring (fig. 90). On units built prior to Powerglide transmission JT-232315-D-23-D tool J-3364 is used. Tool J-5133 is used on units built after that number.

NOTE: When handling clutch drum, precaution should be taken to prevent dam-

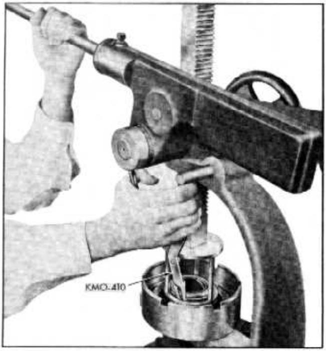

Fig. 90—Remove Clutch Spring Snap Ring

age to clutch pressure relief valve, in instances where it is located on the front face of the clutch drum.

5. Remove clutch spring snap ring using snap ring pliers KMO-410. Release pressure slowly and remove clutch spring seat and clutch spring.
6. Forcibly rap the clutch drum, face down, on a wood surface to remove the clutch piston.
7. Remove piston outer ring seal from clutch piston.
8. Remove piston inner ring seal from hub of clutch drum.
9. Figure 91 shows layout of clutch drum assembly.

Inspection

1. Wash all parts in cleaning solvent (air dry).

   CAUTION: Do not use rags to dry parts.

2. Inspect drum brake band surface for excessive scoring or burning. Also check drum bushing for scoring.
3. On the early type units make sure that valve is not bent or damaged in any way and that it is free in its operation. On the late type units, the relief valve is a steel ball that is staked in a hole, slightly larger than the ball, in the front face of the piston. Make sure that it is free to move in the hole and that the orifice leading to the rear of the piston is open.
4. Check fit of clutch flange in drum slots. There should be no appreciable radial play between these two parts. Also check low sun gear for nicks or burrs.
5. Check clutch plates for burning or metal pick up. Also check to see that composition plates are a free fit over clutch hub and that steel plates are a free fit in clutch flange.

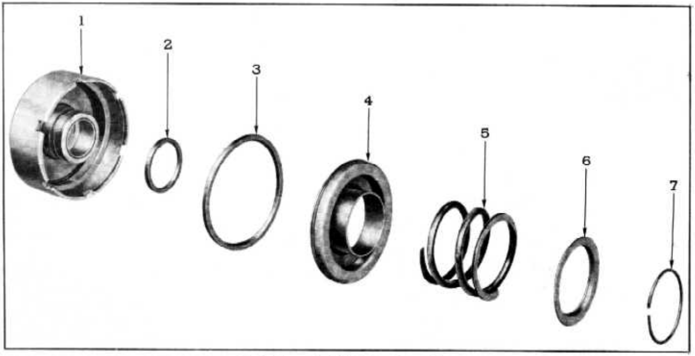

Fig. 91—Layout of Clutch Drum Assembly

1. Clutch Drum
2. Clutch Piston Inner Ring Seal
3. Clutch Piston Outer Ring Seal
4. Clutch Piston
5. Clutch Spring
6. Clutch Spring Seat
7. Clutch Spring Snap Ring

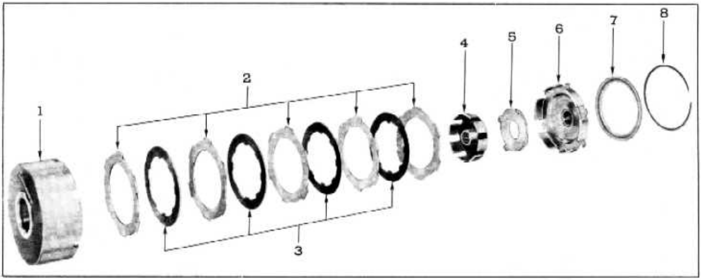

Fig. 92—Layout of Clutch Assembly

1. Clutch Drum Assembly
2. Clutch Driven Plate
3. Clutch Drive Plate
4. Clutch Hub
5. Clutch Hub Thrust Washer
6. Low Sun Gear and Clutch Flange Assembly
7. Clutch Flange Retainer
8. Clutch Flange Retainer Ring

6. Figure 92 shows layout of complete clutch assembly.

Repairs

Clutch Relief Valve—Replacement

When it is necessary to replace the relief valve in the early type transmissions proceed as follows:

1. With a sharp chisel cut heads from relief valve spring retainer rivets.
2. With a small punch drive rivets out of drum and remove valve spring and valve.
3. Install new relief valve, valve spring and two new rivets.
4. Carefully support drum and peen over ends of rivets securely.

Should it be necessary to replace the steel ball, that acts as a relief valve, in the clutch piston of late type transmissions proceed as follows:

1. Carefully inspect the ball retaining hole in the clutch piston, making sure that it is free of all burrs and nicks and that the steel ball seats perfectly on its seat.
2. Place the steel ball in the retaining hole and carefully stake around the edge of the hole to make sure that it does not fall out.

CAUTION: Make sure that the ball is free to move after staking.

Assembly

1. Install new piston outer ring seal on clutch piston being careful not to stretch seal. Lip of seal should be installed so that it is toward oil pressure side of piston.
2. Install new piston inner ring seal on inner hub of clutch drum with lip of seal toward bottom of piston pocket.
3. Place small amount of transmission oil on inner diameter of clutch drum and onto seals. Then carefully install piston into clutch drum using a piece of feeler stock to insure seating of outer ring seal in clutch drum (fig. 93).
4. Install clutch spring and clutch spring seat. Place unit in press and compress spring, using tool J-3364 on the early type units and tool J-5133 on the late type units. Install snap ring.

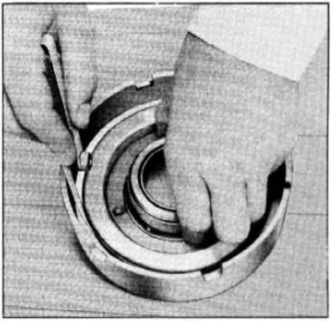

Fig. 93—Checking Seating of Clutch Piston Outer Seal

CAUTION: When compressing spring be careful spring seat does not hang up in snap ring groove which will cause damage to groove.

5. Place the four equally spaced tabs on clutch hub thrust washer into slots in clutch hub. Then place clutch hub with thrust washer on clutch flange with open side of clutch hub up and install five steel and four composition plates alternately (fig. 94).

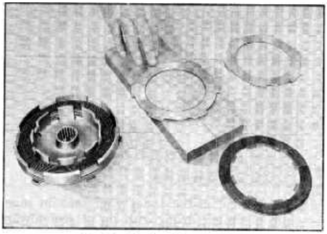

Fig. 94—Checking Plates for Dish

NOTE: When installing plates start with a steel plate. Steel plates are dished and must all be installed with the dished side toward the low sun gear and clutch flange assembly.

6. Assemble clutch drum over clutch flange, invert, and install clutch flange retainer and clutch flange retainer ring.
7. Check end play with feeler gauge between clutch flange drive lug and drive slot in drum (fig. 95). Maximum allowable end play is .013".

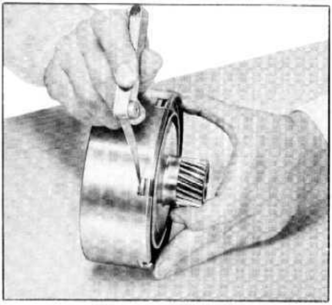

Fig. 95—Checking End Play of Clutch Flange

NOTE: Retainer rings are available in three thicknesses, .055"-.064"-.073" to control end play of sun gear and clutch flange assembly in clutch drum.

MODULATOR

Disassembly

1. Remove hydraulic plunger and body and carefully lay aside to prevent damage.

NOTE: Hydraulic plunger and body consists of internal plunger and external body (fig. 96) and care must be taken not to drop internal plunger from outer body.

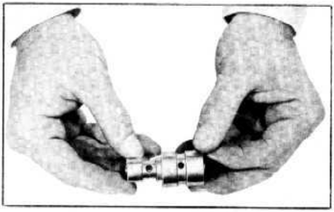

Fig. 96—Hydraulic Plunger and Body

2. Remove modulator outer cover attaching screws holding cover down against diaphragm spring pressure.
3. Remove diaphragm spring and diaphragm.
4. Wash all parts in cleaning solvent and blow out all oil passages.

CAUTION: Do not use rags to dry parts.

Inspection

1. Check diaphragm spring for distortion or loss of tension.
2. Check diaphragm for wear or cracks that would cause leaks.
3. Inspect modulator outer cover for cracks.
4. Inspect hydraulic plunger and body for nicks and make sure body operates freely in modulator bore and plunger operates freely in body.

Assembly

1. Place assembly tool J-4261 in hydraulic plunger and body bore of modulator, place diaphragm in position and place diaphragm spring on diaphragm.

2. Install two 10-24x3" guide pins and install modulator cover (fig. 97). Install attaching screws and tighten securely.
3. Install hydraulic plunger and body with plunger up or so plunger will engage the modulator lever when assembly is completed.

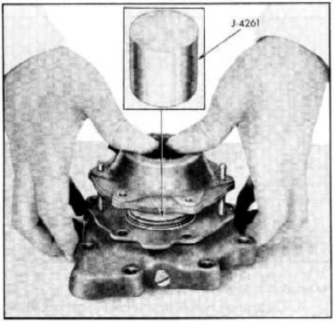

Fig. 97—Installing Modulator Cover

SERVO COVER

Disassembly

1. Remove bi-metal strip retaining screw, bi-metal strip and retainer from cover (fig. 98).
2. Remove lubrication by-pass ball plug, and copper gasket. Remove by-pass ball spring and ball from cover.
3. Wash all parts in cleaning solvent and blow out all oil passages.

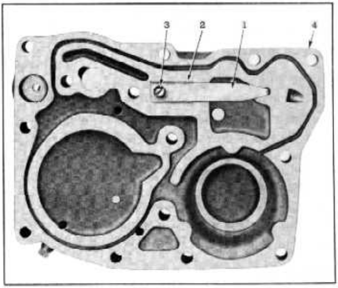

Fig. 98—Lubrication Thermostatic Valve

1. Bi-metal Strip
2. Bi-metal Strip Retainer
3. Screw
4. Servo Cover

CAUTION: Do not use rags to dry parts.

Inspection

1. Inspect cover for nicks or cracks which would result in oil leaks.
2. Inspect by-pass ball spring for distortion.
3. Inspect modulator control lever for free operation.

NOTE: It is important that this lever does not bind on guide pin.

Assembly

1. Install lubrication by-pass ball into servo cover.
2. Install lubrication by-pass ball spring.
3. Using new plug gasket, install plug and tighten to 17-20 ft. lbs.

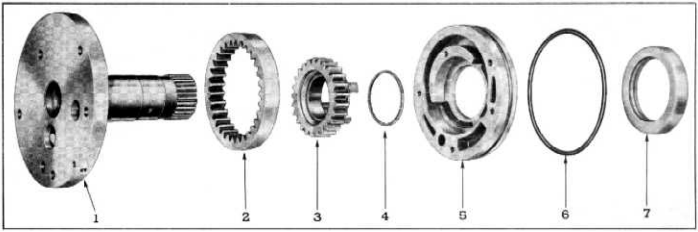

Fig. 99—Layout of Front Pump

1. Stator Support
2. Driven Gear
3. Drive Gear
4. Seal Ring
5. Pump Body
6. "O" Ring Seal
7. Oil Seal

4. Install bi-metal strip retainer, bi-metal strip and strip retaining screw and tighten securely.

FRONT PUMP

Disassembly

1. Remove stator support from pump body.
2. Remove pump gears from pump body.

   CAUTION: Care must be taken when removing and handling gears not to drop or nick gears as these gears are not heat treated.

3. Remove front oil pump seal ring.
4. Remove "O" ring from pump body.
5. Figure 80 shows layout of pump parts.

Inspection

1. Wash all parts in cleaning solvent and blow out all oil passages.

   CAUTION: Do not use rags to dry parts.

2. Inspect pump gears for nicks or damage.
3. Inspect drive gear oil ring and oil ring groove making sure ring is free of burrs and is free in ring groove. Also install ring in pump body bore and make sure hooked ring ends have clearance.
4. Inspect stator support pump face for nicks or scoring.
5. Inspect pump body for nicks or scoring.
6. Inspect pump body oil seal for excessive wear or damage or evidence of leakage.

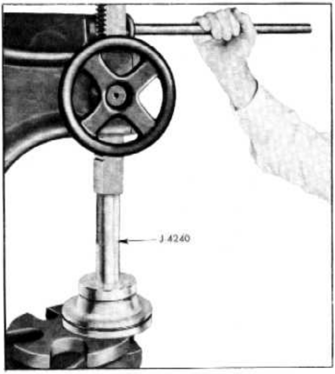

Fig. 100—Installing Pump Body Oil Seal

7. If oil seal is damaged or is leaking, pry out and install new seal using seal driver J-4240 (fig. 100).
8. With parts clean and dry, install pump gears and check:

   a. Clearance between OD of gear and body should be .0025"-.0055" (fig. 101).

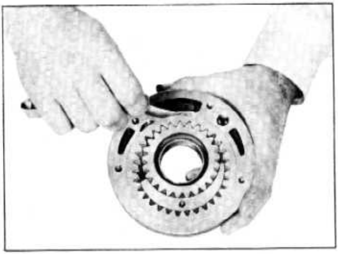

Fig. 101—Clearance—O.D. Gear and Body

   b. Clearance between internal gear and crescent should be .003"-.009" (fig. 102).

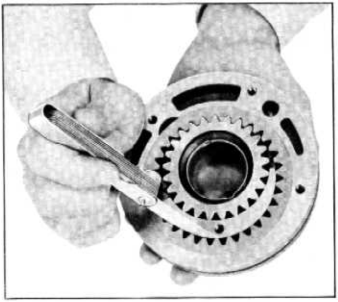

Fig. 102—Clearance Crescent to Internal Gear

   c. With scale and feeler gauge check gear end clearance. This clearance should be .0005" to .0015" (fig. 103).

Assembly

1. Install new "O" ring in pump body.
2. Remove gears from pump body, install oil pump seal ring, oil gears generously with

automatic transmission oil before assembly into pump body.

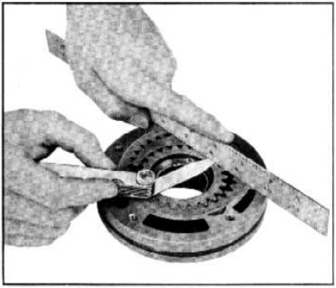

Fig. 103—Gear End Clearance

NOTE: Drive lugs on drive gear protrude through oil seal.

3. Assemble stator support through drive gear aligning attaching holes.

REAR PUMP

Disassembly

1. Remove two flat slotted head screws and remove pump body plate.
2. Remove pump gears, wash all parts in cleaning solvent and blow out all oil delivery holes.

CAUTION: Do not use rags to dry parts.

3. Figure 104 shows layout of pump parts.

Inspection

1. Inspect rear bearing for roughness by rotating by hand.
2. If bearing is rough remove the three retaining capscrews, lockwashers and lock plate. Drive out old bearing.

NOTE: The rear oil pump bearing lock plate was not incorporated in the early 1950 Powerglide transmissions. It should be installed in these transmissions when this section is disassembled.

3. Press new bearing into place and install the lock plate, lockwasher and retaining capscrews.
4. With parts clean and dry install pump gears and check.
   a. Clearance between OD of gear and body should be .003″-.007″.
   b. Clearance between internal gear and crescent should be .002″-.009″.
   c. With scale and feeler gauge check gear end clearance. This clearance should be .0005″-.0015″ (fig. 103).

Assembly

1. Remove gears from pump body and oil generously with automatic transmission oil.
2. Assemble gears to body.
3. Install pump body plate and secure with two flat slotted head screws.

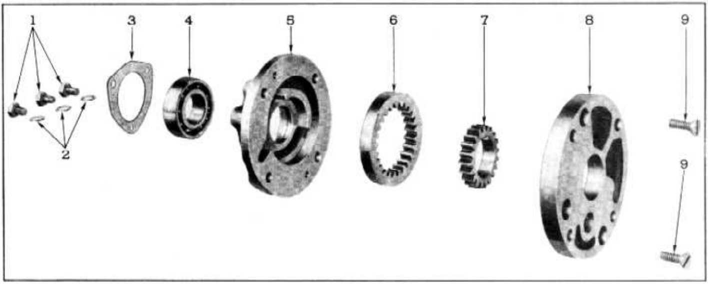

Fig. 104—Layout Rear Pump

1. Bearing Retaining Bolts
2. Bearing Retaining Bolt Lockwashers
3. Bearing Lock Plate
4. Ball Bearing Assembly
5. Body
6. Driven Gear
7. Drive Gear
8. Cover
9. Cover Retaining Screws

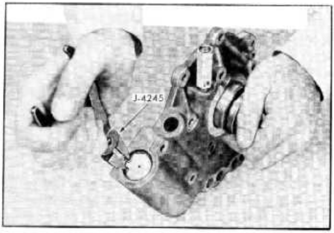

Fig. 105—Removing Accumulator Special Snap Ring

VALVE BODY

Disassembly

1. Using pliers J-4245 remove accumulator special snap ring (fig. 105).
2. Remove accumulator valve spring washer, valve spring and accumulator valve.
3. Remove accumulator valve body assembly and accumulator piston from piston bore.
4. Remove accumulator inner and outer springs and accumulator piston stop from piston bore.
5. Remove two clutch drum oil seal rings.
6. Remove pressure relief valve assembly or dryseal pipe plug.

NOTE: Late in the 1951 production, the pressure relief valve was replaced with a dryseal pipe plug.

7. Figure 106 shows layout of valve body parts.

Inspection

1. Wash all parts in cleaning solvent, air dry and blow out all oil passages.

CAUTION: Do not use rags to dry parts.

2. Inspect accumulator valve body assembly for scoring and make sure small fibre valve operates freely.
3. Check accumulator body in valve body bore to see that it operates freely.
4. Check accumulator piston for scoring and see that it operates freely in valve body bore.
5. Check accumulator valve for scoring and see that it operates freely in accumulator body bore.
6. Check springs for distortion.
7. Check oil seal rings for nicks or burrs and make sure they are free in ring grooves. Also install rings in clutch drum bore and make sure hooked ring ends have clearance.

Assembly

1. Install accumulator piston inner and outer springs and piston stop in valve body bore.
2. Install accumulator piston making sure that it seats over inner and outer accumulator springs.
3. Install accumulator valve body assembly into valve body bore.

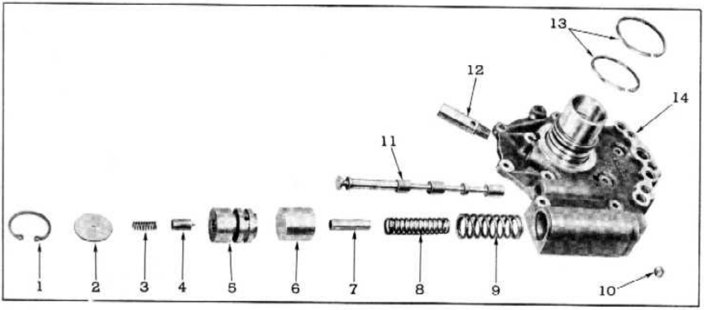

Fig. 106—Layout of Valve Body

1. Snap Ring
2. Accumulator Valve Spring Washer
3. Accumulator Valve Spring
4. Accumulator Valve
5. Accumulator Valve Body Assembly
6. Accumulator Piston
7. Accumulator Piston Stop
8. Accumulator Piston Inner Spring
9. Accumulator Piston Outer Spring
10. Plug
11. Transmission Manual Valve
12. Pressure Relief Valve
13. Clutch Drum Oil Seal Rings
14. Transmission Valve Body

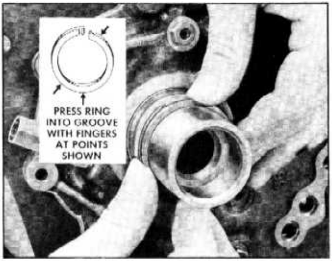

Fig. 107—Installing Oil Seal Rings

4. Install accumulator valve into accumulator valve body bore and install accumulator valve spring.
5. Install accumulator valve spring washer, compress spring and install special snap ring making sure it seats in snap ring groove.
6. Install pressure relief valve assembly or dry-seal pipe plug.
7. Install two clutch drum oil seal rings (fig. 107).

NOTE: Four interlocking type cast iron rings are used in the transmission. These are easily removed from or installed in their grooves by applying pressure to the ring, with index fingers and thumb at the

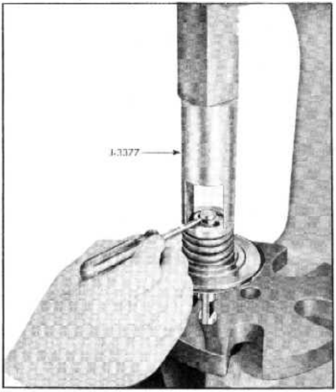

Fig. 108—Removing Piston Retainer Keys

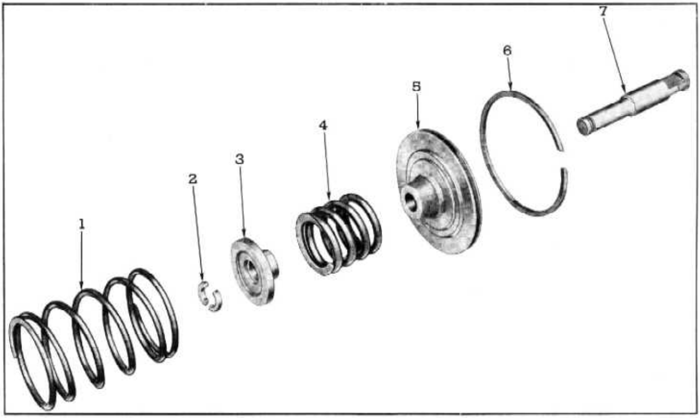

Fig. 109—Layout Reverse Servo Piston

1. Return Spring
2. Apply Spring Retainer Keys
3. Apply Spring Retainer
4. Apply Spring
5. Piston
6. Piston Ring
7. Piston Rod

proper points. Sidewise movement of the ring is restricted, therefore, one end must be compressed into the ring groove while the other end is pushed out away from the groove to lock or unlock the ring. These rings are used on the input shaft, the front oil pump drive gear and neck of the valve body.

REVERSE SERVO AND LOW SERVO PISTONS

1. Place reverse servo piston in bench press and with tool J-3377 compress piston spring and remove piston spring retainer key and retainer (fig. 108) and remove piston from piston shaft.
2. Figure 109 shows layout of reverse servo piston assembly parts.
3. Install piston on shaft and install servo piston apply spring.
4. Install spring retainer over spring and shaft and compress spring with tool J-3377 and install retainer key.
5. Remove piston ring from reverse servo piston and low servo piston and install in piston bore. Check ring gap which should be .005"-.010" (fig. 110).
6. Install rings to reverse and low servo pistons.

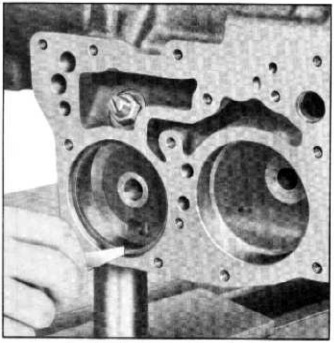

Fig. 110—Checking Servo Piston Ring Gap

PLANET ASSEMBLY AND INPUT SHAFT

Inspection

1. Wash planet carrier and input shaft in cleaning solvent, blow out all oil passages and air dry.

CAUTION: Do not use rags to dry parts.

2. Inspect reverse brake drum O.D. for scoring or burning. Also check internal gear for tooth damage and inspect drum hub bushing for scoring or damage.
3. Inspect planet pinions for nicks or other tooth damage.
4. Check end clearance of planet gears. This clearance should be .006"-.030" (fig. 111).

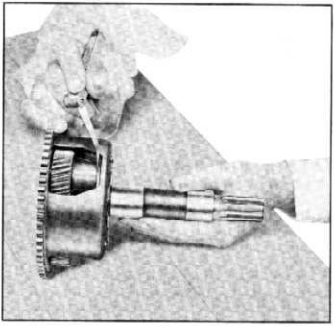

Fig. 111—Checking Planet Gear End Clearance

5. Check reverse sun gear for tooth damage, also check reverse sun gear rear thrust washer for damage.
6. Inspect output shaft bearing surface for nicks or scoring and inspect input pilot bushing.
7. Inspect input shaft splines for nicks or damage and check fit in clutch hub and reverse sun gear. Also check fit of spline in turbine hub.
8. Check oil seal ring for damage, ring must be free in input shaft ring groove. Remove ring and insert in valve body bore and check to see that hooked ring ends have clearance. Replace ring on shaft.

Repairs

Planet Carrier Assembly—Overhaul

If during inspection, the planet pinions, pinion needle bearings, pinion thrust washers, reverse sun gear, and/or reverse sun gear thrust washer should show evidence of excessive wear or damage, they should be replaced using the following procedure.

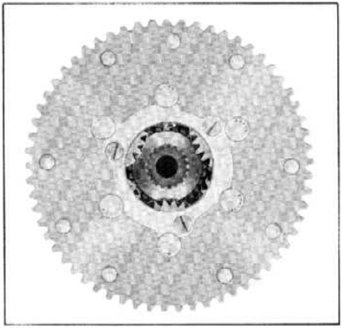

Fig. 112—Mark Each Pinion Shaft

1. Place the planet carrier assembly in a fixture or vise so that the front (parking lock gear end) of the assembly faces up.
2. Using prick punches or other similar means, mark each pinion shaft and also the planet carrier assembly (fig. 112), so that when reassembling, each pinion shaft will be reinstated in the same location from which it was removed.

NOTE: Each shaft is selectively fitted to the planet carrier assembly and it is imperative that if the shafts are removed, they be reinstalled in the same location.

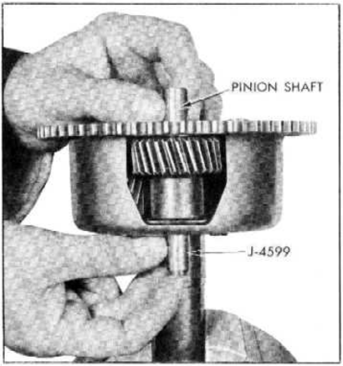

Fig. 113—Removing Planet Pinion

3. Remove the pinion shaft lock plate screws and rotate the lock plate counterclockwise sufficiently to remove.
4. Starting with a short planet pinion, and using a soft steel drift, drive on the lower end of the pinion shaft until the pinion shaft is raised above the press fit area of the output shaft flange. Feed tool J-4599 into the short planet pinion from the lower end (fig. 113), pushing the planet pinion shaft ahead of it until the tool is centered in the pinion and the pinion shaft is removed from the assembly.

NOTE Planet pinion remover and replacer tool, J-4599, comes in two pieces, both alike. Only one is used when removing the planet pinion; two, however, must be used when reassembling.

5. Remove the short planet pinion from the assembly.
6. Remove tool J-4599, needle bearings and needle bearing spacer from short planet pinion.

CAUTION: Use care so as not to lose any of the planet pinion needle bearings.

7. By following the procedure as outlined in steps 4, 5, and 6, remove the adjacent long planet pinion that was paired by thrust washers to the short planet pinion now removed.
8. Remove the upper and lower thrust washers.
9. Remove and disassemble the remaining planet pinions, in pairs, by first removing a short planet pinion and then the adjacent long planet pinion.
10. Remove reverse sun gear and reverse sun gear thrust washer.
11. Wash all parts in cleaning solvent and air dry.
12. Recheck the planet pinion gears and reverse sun gear for nicks or other tooth damage, also check the planet pinion thrust washers and reverse sun gear thrust washer. Replace worn or damaged parts.
13. Inspect the planet pinion needle bearings closely and if excessive wear shows, all the needle bearings must be replaced.
14. Using tool J-4599, assemble needle bearing spacer and needle bearings (20 in each end) in one of the long planet pinions (fig. 114). Use cup grease to aid in assembling and holding the needle bearings in position.
15. Position the long planet pinion with tool J-4599 centered in the pinion assembly and with thrust washers at each end, in the planet carrier.

NOTE: The long planet pinions are located opposite the closed portions of the carrier, while the short planet pinions are located at the openings.

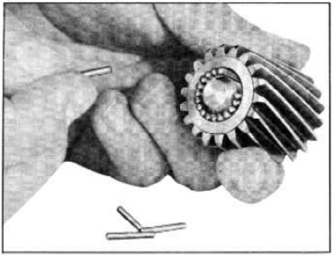

Fig. 114—Assembling Needle Bearings to Pinion

16. Feed the second tool J-4599 in from the top, picking up the upper thrust washer and the planet pinion and pushing the already installed tool J-4599 out the lower end (fig. 115). As the first tool is pushed down, insure that it picks up the lower thrust washer.
17. Select the proper pinion shaft, as marked in step 2, lubricate the shaft and install it from the top, pushing the assembling tools ahead of it.
18. Turn the pinion shaft so that the slot or groove at the upper end faces the center of the assembly.
19. With a brass or soft steel drift, drive the pinion shaft in until the lower end is flush with the lower face of the planet carrier.
20. Following the same general procedure as outlined in steps 14 through 19, assemble and install a short planet pinion in the planet carrier adjacent to the long planet pinion now installed.

NOTE: The thrust washers already installed with the long planet pinion also suffice for this short planet pinion as the two pinions are paired together on one set of thrust washers.

21. Install the reverse sun gear thrust washer and install the reverse sun gear.
22. Assemble and install the remaining planet pinions, in pairs, by first installing the long planet pinion and then the adjacent short planet pinion.
23. Check end clearance of planet gears. This clearance should be .006"-.030" (fig. 111).
24. Place the pinion shaft lock plate in position, then with the extended portions of the lock plate aligned with slots in the planet pinion shafts, rotate the lock plate clockwise until the three attaching screw holes are accessible.
25. Install the pinion shaft lock plate attaching screws and tighten to 2½-3 ft. lbs.

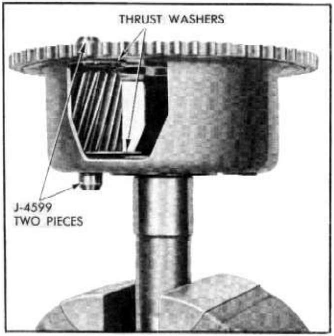

Fig. 115—Installing Planet Pinion

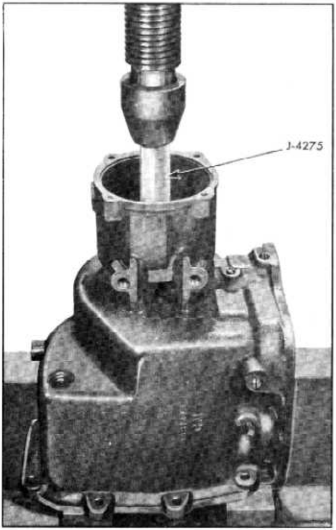

Fig. 116—Removing Transmission Rear Bearing

TRANSMISSION CASE

Inspection

1. Wash case thoroughly with cleaning solvent, air dry and blow out all oil passages.

   CAUTION: Do not use rags to dry parts.

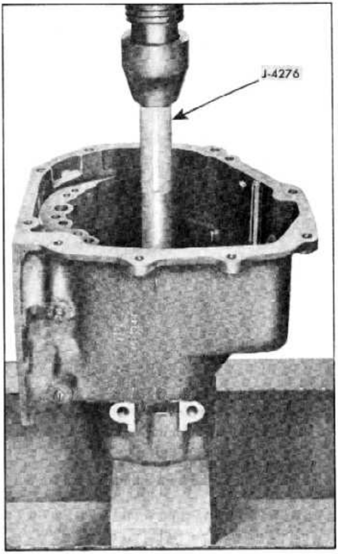

Fig. 117—Installing Transmission Rear Bearing

2. Inspect case for cracks which may contribute to leakage.
3. Inspect case rear bushing for damage or excessive wear.

   NOTE: This is a precision bushing and if damaged or worn excessively may be replaced.

Repairs

Rear Bushing Replacement

Transmission case rear bushing is a precision bushing which requires no reaming or finishing after assembly.

1. Place transmission case in an arbor press with rear end up.
2. Install bushing remover tool J-4275 and press old bushing from case (fig. 116).
3. To install new bushing install rear oil pump assembly so that rear bearing may be used as a pilot when installing new bushing into case.

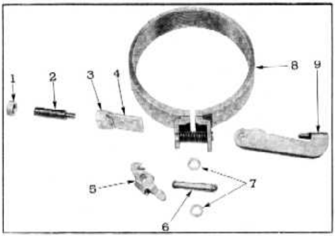

Fig. 118—Layout—Reverse Brake Band

1. Anchor Adjusting Screw Lock Nut
2. Anchor Adusting Screw
3. Anchor
4. Strut
5. Lever
6. Link Pin
7. Pin Locks
8. Brake Band
9. Link

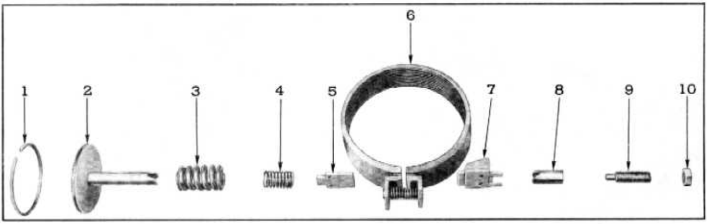

Fig. 119—Layout—Low Brake Band

1. Piston Ring
2. Piston
3. Piston Return Spring
4. Strut Guide Spring
5. Strut
6. Brake Band
7. Strut
8. Anchor
9. Anchor Adjusting Screw
10. Adjusting Screw Lock Nut

4. Place transmission case in an arbor press with front end up.
5. Place new bushing on bushing installer J-4276 with the square end of bushing against shoulder of installer. Insert in case entering pilot of tool into rear bearing and press bushing into place (fig. 117).

BRAKE BANDS

Brake bands used in the Powerglide transmission have bonded linings which due to the transmission characteristics and band usage should require very little attention. However, whenever a transmission is disassembled the bands should be cleaned in cleaning solvent, air dried and inspected.

1. Check linings for evidence of scoring or burning.
2. Check bands and linings for cracks.
3. Check all band linkage for excessive wear.
4. Figures 118 and 119 show layout of brake band parts.

ASSEMBLY

CONVERTER

1. After thoroughly cleaning suction screen, install in oil sump making sure sealing ring is in position.
2. Place two ¼-20 x 3½" guide pins in valve body attaching holes in converter housing.
3. Install new valve body gasket to turbine housing.
4. Install valve body over guide pins and install attaching bolts tightening to ten ft. lbs. torque (fig. 120) with the exception of the bolt over the pressure regulator valve. This bolt should be torqued to eight ft. lbs.

   NOTE: Tighten bolts in a criss cross manner and after bolts are installed check to make sure manual valve and pressure regulator valve operate freely.

5. Align the holes in the stator support assembly with the holes in the front oil pump body and install two ¼-20 x 3½" guide pins in front pump (fig. 121). Install pump to turbine housing using pump driver J-4263.

   NOTE: When installing pump, line up suction and delivery holes on left side of pump.

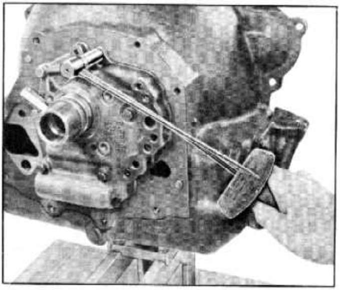

Fig. 120—Tightening Valve Body Attaching Bolts

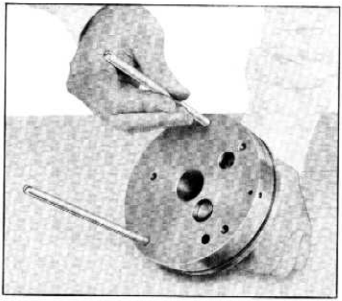

Fig. 121—Guide Pins in Front Pump

6. Install five self locking bolts through valve body and into pump. Tighten bolts directly above and directly below regulator valve to eight ft. lbs. and remaining bolts to ten ft. lbs. (fig. 122).

   CAUTION: After tightening two bolts across pressure regulator valve bore, check valve to make sure it operates freely.

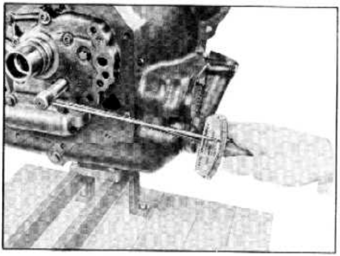

Fig. 122—Tightening Pump to Valve Body Bolts

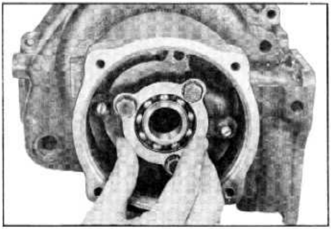

Fig. 123—Installing Rear Pump

7. Check and make sure front pump operates freely.

TRANSMISSION UNIT

1. Install two 5/16-18 x 3″ guide pins in rear pump attaching holes. Install new gasket and pump (fig. 123), aligning suction and delivery holes. Install bolts and tighten to 12½ 15 ft.-lbs.
2. Install reverse servo piston using ring compressor J-3365 (fig. 124). Notch on shaft should be positioned toward front of transmission case.
3. Install reverse brake band and strut assembly with thin end of band away from piston and thread adjusting screw in until it indexes with hole in anchor.
4. Install bronze thrust washer on hub of reverse drum and install drum into case and brake band.
5. Rotate rear pump drive gear lug to top of pump, then install planet carrier assembly in drum aligning slot on carrier shaft with lug of pump drive gear. Check amount end of shaft protrudes out of bearing (fig. 125). This should be a minimum of ⅞″ and indicates proper seating of pump gear drive lug in carrier shaft slot.

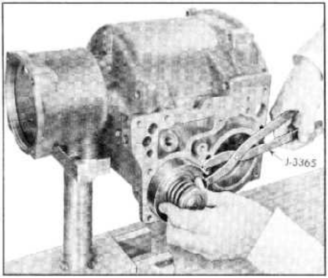

Fig. 124—Installing Reverse Servo Piston

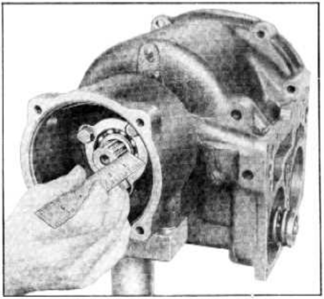

Fig. 125—Checking Seating of Output Shaft

6. Install shaft of tool J-938 into threaded end of planet carrier output shaft and bolt yoke of tool to rear face of transmission case. Turn tool handle counterclockwise until the output shaft is seated in the rear bearing. Disconnect tool J-938 from output shaft and transmission case.
7. Install universal joint front yoke, universal joint washer, lockwasher and bolt and tighten to 25-30 ft. lbs.
8. Hold the reverse servo return spring in one hand and with the other slowly tighten the reverse servo adjusting screw with tool J-4277 until endplay, as felt by push-pull on piston assembly, is just taken up (fig. 126). Then back off adjusting screw ⅛ to ¼ turn and tighten nut securely. This is a sensitive adjustment and must be done carefully. When end play movement of the piston is

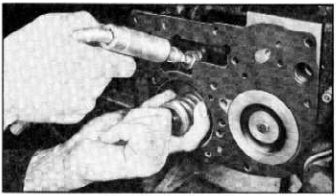

Fig. 126—Adjusting Reverse Servo

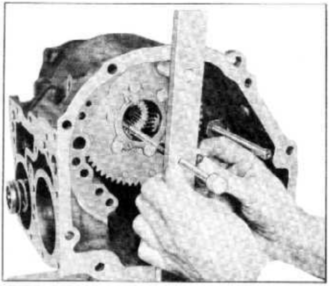

Fig. 127—Measuring Sun Gear Depth

just taken up, and before backing off adjusting screw, the band must be free on the drum so that the drum can be easily rotated by hand.

9. To determine the thickness of the low sun gear to reverse sun gear thrust washer proceed as follows:
   a. Install bronze thrust washer and clutch assembly on oil delivery sleeve.
   b. To measure distance from case flange to reverse sun gear, loosen set screw of tool J-4260 and place bar of tool against case flange with stem of tool against face of reverse sun gear. While holding tool in this position, tighten thumb screw (fig. 127).
   c. There are three hardened and ground steel washers furnished with this tool which are .095", .120" and .145" thick. These washers are the same thickness as bronze thrust

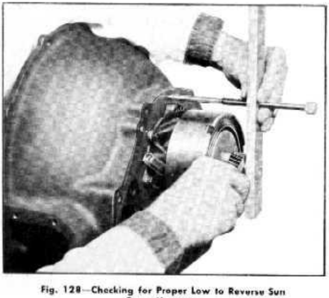

Fig. 128—Checking for Proper Low to Reverse Sun Gear Clearance

washers available under the following part numbers for service use in transmission assembly.

Part No.	3694467	.095"
	3694468	.120"
	3694469	.145"

   d. Select the .120" steel washer furnished with the tool and place it over the pilot of tool. Insert pilot into bore of low sun gear and while holding tool securely, check clearance between end of low sun gear and steel washer with feeler gauge (fig. 128). This clearance should be .007"-.035".
   e. If clearance is not within the above limits, remove tool and then recheck using either the .095" or .145" steel washer furnished with the tool until the proper clearance is obtained.
   f. When proper clearance is obtained, the thickness of steel washer used is the thickness of the bronze thrust washer required for transmission assembly.

10. After above checks are completed remove clutch assembly and thrust washer from oil delivery sleeve.

11. Install parking lock lever shaft and apply spring assembly in case. Install small lip seal over end of parking lock lever shaft and into counter bore of case with lip of seal toward inside of case.

12. Install flat washer and parking lock lever on end of parking lock lever shaft pushing lever onto shaft to obtain .000" to .010" clearance between lever and washer (fig. 129). Then tighten clamp screw to 8-12 ft. lbs.

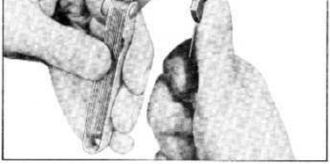

Fig. 129—Checking Clearance Between Parking Lock Lever and Steel Washer

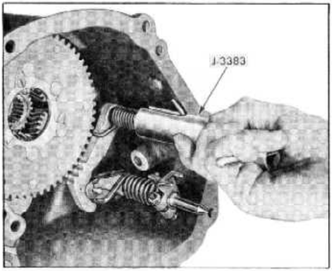

Fig. 130—Installing Parking Pawl Spring

13. Install parking lock pawl over pawl support rod and install parking pawl spring.
14. Wind up pawl spring using tool J-3383 so that spring catches on inside of case (fig. 130).
15. Install input shaft to clutch unit. Install thrust washer previously selected on reverse sun gear splines of input shaft.

    NOTE: It is important that the flat side of the thrust washer be installed toward the reverse sun gear.

16. Install unit assembly into case indexing input shaft pilot with pilot in output shaft and low sun gear with short pinions in planet carrier (fig. 131).
17. Install low servo piston release spring on servo piston shaft and install piston and spring into case using piston ring compressor J-3365.

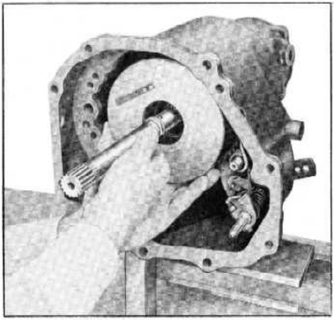

Fig. 131—Installing Unit Assembly Into Case

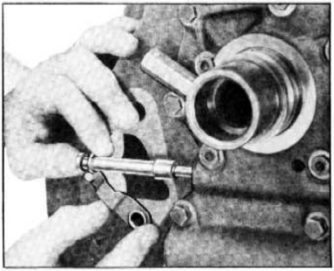

Fig. 132—Indexing Manual Valve with Lever

18. Install low brake band over clutch drum with thin end of band toward piston.
19. Place strut guide spring over piston and anchor strut in piston slot with other end of anchor strut engaging brake band.
20. Place brake band strut assembly in brake band groove, then engage slotted end of anchor over strut and locate over adjusting screw.
21. Install speedometer driven gear and tighten to 45-50 ft. lbs.

TRANSMISSION TO TURBINE HOUSING ASSEMBLY

1. Install manual valve in valve body and manual valve inner lever in turbine housing. Index lever pin with pick up slot in valve (fig. 132).
2. Set manual valve so end of valve protrudes 1½" from face of valve body (fig. 133). This places valve in reverse position.

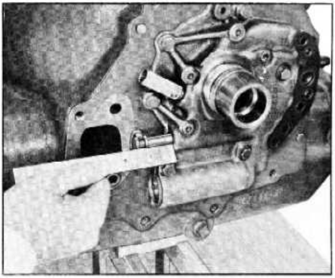

Fig. 133—Setting Manual Valve in Reverse Position

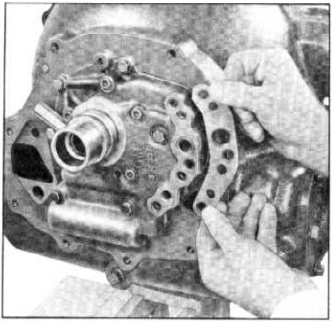

Fig. 134—Installing Valve Body to Case Gasket

3. Install new valve body to case gasket (fig. 134).
4. Raise transmission manual valve lever to top detent position which is reverse. This aligns reaction lever so that it will index with manual valve inner lever.
5. Place clutch drum thrust washer over oil delivery sleeve.
6. Install two 3/8"-16 x 3¾" guide pins in turbine housing, then push case and turbine housing together checking to see that reaction lever indexes properly with manual valve inner lever. Then install case to housing bolts and tighten to 25-30 ft. lbs.

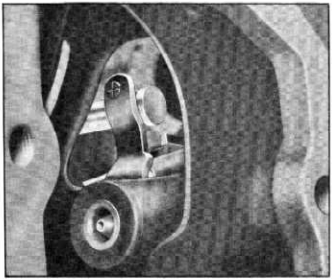

Fig. 135—Indexing Manual Valve Inner Lever and Reaction Lever

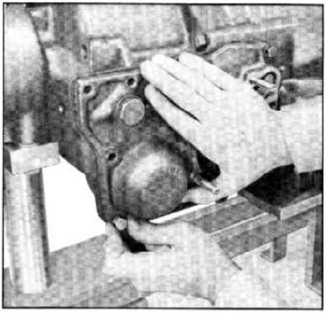

Fig. 136—Installing Servo Cover

NOTE: Remove left hand sump cover to observe mating of manual valve inner lever and reaction lever (fig. 135).

7. Install two 5/16"-18 x 3" guide pins as guides for servo cover and install new servo cover gasket.
8. Install pressure regulator valve and inner and outer valve springs. Install reverse servo return spring.
9. Install servo cover applying pressure to cover to compress springs and secure with servo cover bolts (fig. 136). Tighten to 12½"-15 ft. lbs.

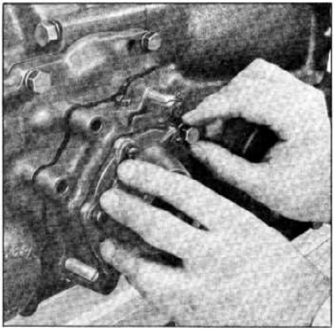

Fig. 137—Installing Modulator

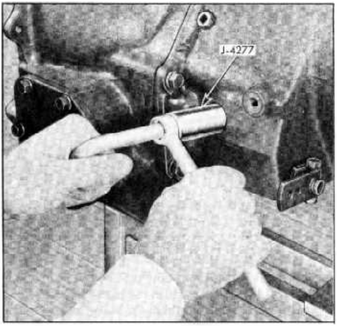

Fig. 138—Adjusting Low Servo

NOTE: Be sure pressure regulator springs and reverse servo spring seat properly in seat pockets of servo cover.

10. Install new modulator cover gasket and modulator cover (fig. 137) and tighten attaching bolts to 12½-15 ft. lbs.
11. Tighten low servo adjusting screw, using tool J-4277, down tight and back off three complete turns and tighten lock nut (fig. 138). Replace adjusting screw cap.
12. Assemble primary pump aligning front pump drive gear tangs with drive slots in pump hub (fig. 139). Face of pump must be flush with face of bell housing.
13. Install converter retaining washer and snap ring (fig. 140).

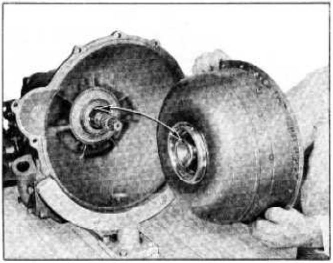

Fig. 139—Aligning Primary Pump with Front Pump Drive Lugs

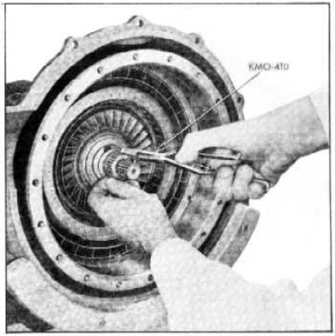

Fig. 140—Installing Converter Retaining Snap Ring

14. Install stator assembly to stator support (fig. 141).

NOTE: Small or primary stator is installed to the rear.

15. Install two $\frac{5}{16}$"-24 x 1½" guide pins in primary pump bolt holes, align dowel pin hole of turbine cover and dowel pin in primary pump and install turbine cover assembly. Remove guide pins and secure with twelve cap screws (fig. 142). Tighten to 15-20 ft. lbs.

NOTE: Install one bolt on each side of dowel pin, skip one hole and then install two bolts alternately around assembly.

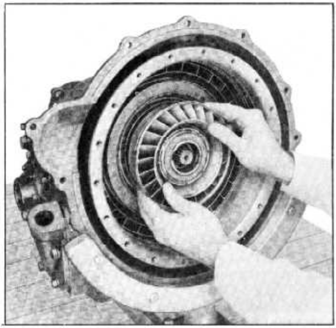

Fig. 141—Installing Stator Assembly

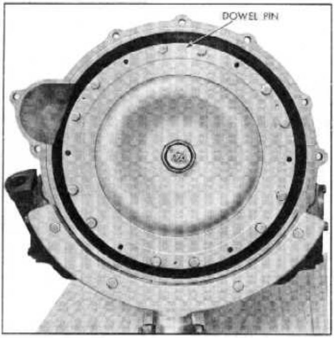

Fig. 142—Positioning of Turbine Cap Screws

16. Install right hand sump cover and new gasket. Secure with cap screws tightening securely.
17. Install "O" ring seal on universal joint ball seat.
18. Install universal joint ball seat and, using four new universal ball shims, install ball and collar and tighten attaching bolts to 8-12 ft. lbs. If ball cannot be moved by hand (fig. 143), add a shim until a smooth firm adjustment is obtained. If ball moves freely by hand, remove shims until proper adjustment is obtained.

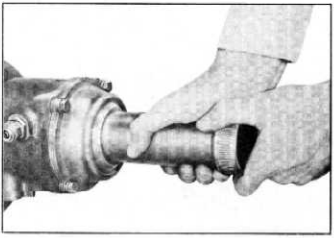

Fig. 143—Adjusting Ball Joint

NOTE: Ball joint collar oil seal (cork) should not be installed when making this adjustment.

19. After number of shims for proper adjustment have been determined, remove universal joint ball and collar and seat. Note number of shims used for later assembly and replace universal ball, collar oil seal and collar on end of propeller shaft.

POWERGLIDE BENCH TEST

A simple test has been devised whereby Powerglide transmissions which have been repaired, may be bench checked under pressure before being reinstalled in the vehicle. This check is particularly helpful in instances where oil leakage or insufficient oil pressures made the original repairs necessary.

By revolving the primary pump (fig. 144) pressures are built up within the transmission similar to those experienced under actual operating conditions. This enables the mechanic to check the oil pressures in the various ranges and also to determine whether or not any leakage is taking place in the converter section, at the servo cover, side covers, etc.

Equipment needed for this test includes a ½ or ⅜ inch power drill that will turn approximately 300 RPM or more, and J-4920, transmission torque converter cover turning tool. To adapt the drill to the tool, a ¾ inch socket is used along with an extension that is altered to fit the drill chuck.

After the transmission is completely assembled and while still in the bench assembly fixture, proceed as follows:

1. Replace the specially drilled universal joint yoke attaching bolt with a standard bolt.

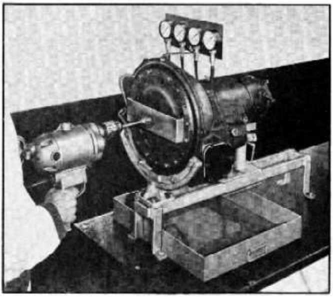

Fig. 144—Revolving Primary Pump

2. Remove the oil cooler line fittings from rear of transmission case and install pipe plugs.
3. Connect the four pressure gauges to the following test points:
   a. Front pump (on right side of converter housing above the side cover).
   b. Low servo apply.
   c. High clutch (release side of low servo).
   d. Reverse servo.
4. Assemble J-4920, transmission torque converter cover turning tool, to converter as shown in Figure 144.
5. Fill the transmision with 8 quarts of Automatic Transmission Fluid, Type "A".

   NOTE: While adding the last 5 quarts use the power drill to revolve the primary pump to work the oil into the converter and passages.

6. Revolve the primary pump and note the fluid pressures in Neutral, Drive, Low and Reverse. They should read as follows:

Neutral	150-160 psi	Low	125-150 psi
Drive	80-100 psi	Reverse	125-150 psi

   NOTE: The pressures in Neutral and Drive are high because no engine vacuum is being imposed on the vacuum modulator.

7. Check for oil in converter housing which would indicate leakage at primary pump hub "O" ring seal, front pump oil seal, front pump "O" ring seal, or possible sand hole in converter housing. Check for leakage at converter cover or turbine bolt "O" ring seals.
8. Check servo cover and housing side covers for evidence of leakage, also the opening in the modulator cover to which the engine vacuum line is attached.
9. Drain the transmission and remove tool J-4920 and the pressure gauges. Reinstall pipe plugs at the test points.
10. Remove standard bolt and reinstall special bolt in universal joint yoke.
11. Remove the pipe plugs and reinstall oil cooler line fittings to rear of transmission case.

INSTALLATION

1. Remove transmission from assembly fixture, place on dolly or creeper and roll into position under car.
2. Attach lift sling to transmission and transmission hoist cable to lift sling.
3. Lubricate flywheel pilot with Lubri-Plate.
4. Raise transmission at the same time lifting up on rear end (fig. 145). Move up through opening using pry bar as necessary to gain clearance at servo cover.
5. Continue to raise transmission until turbine housing is in approximate position.

   CAUTION: Extreme care must be taken when raising transmission into position that flywheel pilot is not bumped or damaged in any way.

6. Turn the torque convertor until the "X" mark on the turbine cover is lined up with the "X" mark on the flywheel to the nearest attaching bolt hole.

   NOTE: These marks must be aligned to maintain balance, and the marks will not be visible after the assembly has been completed.

7. With bolt hole in flywheel aligned with bell housing opening and with one $\frac{5}{16}$"-24 guide pin installed in converter cover, carefully enter guide pin in flywheel hole at the same time raise or lower transmission as required to align flywheel pilot.

   NOTE: Transmission must not be forced forward but should be guided by hand until flywheel pilot enters flywheel and housings come together.

8. Install transmission housing to bell housing bolts.
9. Remove guide pin and install six flywheel to turbine bolts rotating flywheel as necessary with flywheel indexing tool, J-4281. Tighten bolts diagonally opposite in sequence.
10. Install filler tube and dip stick.
11. Remove hydraulic jack from beneath engine oil pan and make sure transmission drain plug and converter drain plug are tight.
12. Install bell crank lever and stud to transmission case.
13. Connect short shift rod to parking lock lever

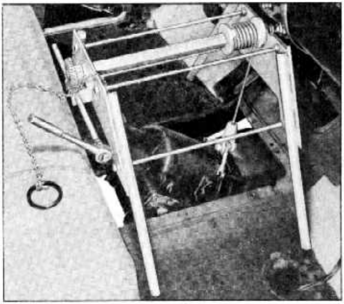

Fig. 145—Installing Transmission

making sure identification arrow points up (fig. 24), and connect long shift rod to bell crank.

14. Connect exhaust pipe to manifold and connect muffler support.
15. Replace spark plugs.
16. Replace oil cooler and vacuum lines to transmission, replace flywheel underpan extension and replace rear transmission support.
17. Remove transmission lifting device.
18. Install new "O" ring seal on universal ball seat and insert in rear of transmission case. Connect universal joint and using shims determined during transmission assembly, slide universal ball and collar forward on propeller shaft and fasten securely. Tighten first bolt finger tight, then tighten diagonally opposite bolt to 8-12 ft. lbs. Retighten first bolt to 8-12 ft. lbs. and proceed to tighten other two bolts to proper torque.
19. Replace parking brake cross shaft, cables and spring and connect emergency brake rod to cross shaft.
20. Connect speedometer cable to driven gear.
21. Install top turbine housing attaching bolts, replace toe pan plate, transmission hole cover and floor mat.
22. Remove car from stand jacks.
23. Using oil filler tube and funnel, J-4264, place three quarts of Automatic Transmission Fluid "Type A" in transmission. Start engine and then complete filling with seven quarts "Type A" Fluid.
24. Idle engine with selector lever in "N" position and check oil level. If necessary add oil to bring to "Full" mark on dip stick. DO NOT OVERFILL.
25. Place selector lever in reverse and check linkage adjustment as outlined under "Service Adjustment." Adjust as necessary.
26. Road test for performance in all selector lever positions.

POWERGLIDE DIAGNOSIS

Proper operation of the Powerglide transmission may be affected by a number of factors, all of which must be considered when trouble in the unit is diagnosed.

Proper trouble diagnosis can only be accomplished when performed in a thorough step by step procedure. The following procedure has been devised and tested and is recommended for all trouble diagnosis complaints and if the service man will follow this checking procedure, accurate and dependable diagnosis may be accomplished. This will result in a savings of time, not only to the service man, but to the customer as well.

SELECTOR LINKAGE

1. Place selector lever in reverse and check clearance between selector lever and steering wheel rim which should be 1½" plus or minus ⁵⁄₁₆". To adjust, loosen lower support clamp bolts and move up or down as necessary. Tighten clamp bolts evenly.

   NOTE: Make sure dowel in support is located in slot in mast jacket.

2. With selector lever in reverse, check clearance between the reverse stop on control shaft lower support and lower lever (fig. 146). This clearance should be .090".
3. To adjust, loosen transmission control rod swivel, make sure transmission manual valve is raised to top detent position and selector lever is in "R" (Reverse) position. Move selector lever as necessary to obtain .090" clearance and retighten swivel.
4. Check proper installation of short connector rod (bell crank to parking lock lever), arrow must point up.

WARMING UP TRANSMISSION

Before attempting to check and/or correct any complaints on the Powerglide transmission, it is absolutely essential that the oil level be checked and corrected if necessary. An oil level which is either too high or too low can be the cause of a number of abnormal conditions from excessive noise to slippage in all ranges.

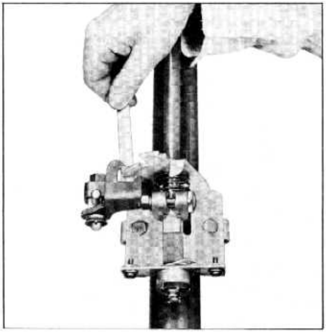

Fig. 146—Reverse Stop to Lower Lever Clearance

It must be remembered that cold oil will slow up the action of the hydraulic controls in the transmission. For this reason a trouble or oil leak diagnosis should not be attempted until the transmission has been warmed up by either of the following procedures:

Road Warm Up

Drive the car approximately 5 miles with frequent starts and stops.

Shop Warm Up

1. Connect tachometer to engine.
2. Set parking brake tight and start engine.
3. Place selector lever in "D" (drive) range.
4. Set hand throttle (1950 Models) or carburetor idle speed adjusting screw (1951-52 Models) to run engine at approximately 750 RPM and operate transmission in this manner for 15 minutes. At the end of 15 minutes of operation, transmission will be sufficiently warmed up for diagnosis purposes.

NOTE: On 1951-52 models, readjust the idle speed to 430-450 R.P.M.

After the transmission has been warmed up, check the fluid level with the engine idling, parking brake set and control level in "N" (neutral). If the fluid level is low, add fluid to bring level up to the full mark on gauge rod.

CAUTION: If fluid level is too high, fluid may be aerated by the planet carrier. Aerated fluid will cause turbulence in the converter which will result in lost power, lower stall speed and lower pressures in control circuits. Lower fluid level to full mark, then drive car five miles to work air bubbles out of fluid.

STALL TESTS

Check the coolant level in the radiator as a safety precaution, as heat is rapidly built up during the diagnosis operation.

With the tachometer connected to the engine and the service brakes securely locked, open throttle wide, with transmission in Drive, in Low and in Reverse. Note the maximum speed attained in each range and record on Diagnosis Guide.

CAUTION: Because of the rapid temperature rise of fluid, the stall condition should never be maintained for more than ten seconds at one time. About two minutes should be allowed between tests to prevent overheating. Stall speed should be almost identical in all ranges and between 1560 and 1610 R.P.M. If so, there is no slippage, however, other causes of faulty operation may exist which can only be revealed by further checking.

If the engine fails to attain minimum stall speed by several hundred R.P.M., it is likely the secondary pump is frozen on its hub or the stators are not locking up on the stator hub.

If the stall speed varies much between ranges or exceeds the maximum in all ranges, there is slippage which may be due to insufficient oil pressure or to a mechanical fault of clutch or band.

PRESSURE TESTS

Pressure tests will reveal the cause of slippage as well as several other causes of improper operation.

1. Support the rear axle on stand jacks so the rear wheels can be driven.
2. Connect pressure gauges (fig. 147) to the following test points:
    a. Low Servo Apply.
    b. High Clutch (Release side of low servo).
    c. Reverse Servo.
    d. Rear Pump Pressure.

Drive Range

1. Adjust the engine idling speed to 430-450 R.P.M.
2. Place the selector lever in "D" (drive) range, check the idling pressure and record it on the

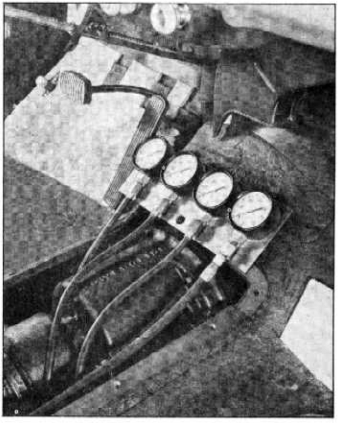

Fig. 147—Connecting Pressure Gauges

Diagnosis Guide. Idling pressure should be from 40 to 45 pounds.

3. Increase speed to approximately 30 miles per hour and note fluid pressure; then load the engine several times by partially applying the brakes while maintaining 30 M.P.H. speed. If the vacuum modulator is operating properly, pressure will rise each time. If the vacuum modulator is not operating correctly, check the vacuum lines for leaks. If no vacuum leaks are found, the trouble is in the vacuum modulator.

   NOTE: While making the above tests, check the pressures on the gauges connected to low servo apply and high clutch test points. The readings should be approximately the same with the selector lever in "D" range.

4. Apply service brake and accelerate engine to normal stall speed (1560-1610 R.P.M.). Check the pressure reading and record on Diagnosis Guide. Pressure should be 75 to 100 pounds. If the pressure is within limits but the engine speed exceeds the maximum stall speed, the high clutch is slipping.

   If the pressure is below 75 pounds with the engine at full throttle and the brakes locked, the following items will require checking:

   a. Partially plugged oil suction screen.
   b. Air leak in oil suction line.
   c. Pressure regulator valve stuck.
   d. Clutch piston seals leaking.
   e. Clutch drum oil seal rings leaking.
   f. Leak at valve body to case gasket.
   g. Leak between valve body and housing.
   h. Front pump clearances.

Low Range

1. Place the selector lever in "L" (low) range.
2. With the engine running at idling speed, check the pressure and record on Diagnosis Guide. The pressure should be from 125 to 150 pounds.
3. Apply service brakes and accelerate engine to normal stall speed (1560 to 16-0 R.P.M.), check the pressure and record on Diagnosis Guide. The pressure reading should be from 160 to 200 pounds.
4. If the pressure is within the above limits but the engine exceeds normal stall speed, adjust the low band by turning the adjusting screw in all the way and backing off three turns.
5. If the pressure is below the low limit, the trouble may be in the accumulator or hydraulic modulator. Move the pressure gauge attached to the high clutch test point to the hydraulic modulator test point.
6. Repeat the low range idle test. If the pressure is zero or very low on the gauge attached to hydraulic modulator, the trouble is in the accumulator.
7. If the pressure is the same but below 125 pounds on the gauges attached to the low servo apply and the hydraulic modulator, the following items will require checking.

   a. Partially plugged oil suction screen.
   b. Broken or damaged ring in low servo.
   c. Pressure regulator valve stuck.
   d. Leak at valve body to case gasket.
   e. Leak between valve body and housing.
   f. Leak at servo cover.
   g. Front pump clearances.
   h. Modulator control lever or piston stuck.
   i. Leak between modulator and servo cover.

Reverse

1. Place the selector lever in "R" (reverse) position.
2. With the engine running at idling speed, check the pressure on the gauge attached to the reverse servo test point and record the reading on the Diagnosis Guide. The pressure reading should be 125 to 150 pounds.
3. Apply service brakes and accelerate engine to stall speed (1560-1610 R.P.M.), check pressure reading and record it on Diagnosis Guide. At this speed pressure should be from 160 to 200 pounds.
4. If the pressure is within the above limits but the engine exceeds normal stall speed, the reverse band requires adjustment. It is necessary to remove the transmission to make this adjustment or correct any damage to the linkage.
5. If pressure is below the above limits the following items should be checked:

   a. Partially plugged oil suction screen.
   b. Broken or damaged reverse servo piston ring.
   c. Pressure regulator valve stuck.
   d. Leak at valve body to case gasket.
   e. Leak between valve body and housing.
   f. Front pump clearances.
   g. Modulator control lever or piston stuck.
   h. Leak between modulator and servo cover.

Rear Pump

1. Place the selector lever in "D" (drive) range and release the parking brake.
2. Accelerate the engine until the speedometer registers 30 miles per hour.
3. Check the pressure at this speed and record it on the Diagnosis Guide. The pressure at this speed should be 50 to 75 pounds.

4. Move the selector lever to "L" (low) range and check the pressure which should be 140 to 180 pounds.
5. If the pressure is less than the above limits, the following items should be checked:
   a. Leak at servo cover.
   b. Leak at valve body to case gasket.
   c. Leak between valve body and housing.
   d. Rear pump clearances.

OIL LEAKS

If a customer complains of high oil consumption or oil leakage, the following points should be checked:

a. Transmission housing side covers.
b. Servo cover and transmission case.
c. Transmission housing and transmission case.
d. Universal ball.
e. Front of flywheel housing.
f. Rear axle lubricant level for propeller shaft oil seal.
g. Modulator vacuum line.
h. Oil cooler pipe connections.
i. Drain back hole from "U" joint to case not drilled.
j. Faulty modulator diaphragm will permit engine vacuum to pull oil out of transmission.

If oil leakage shows at front of flywheel housing, remove plug from bottom of transmission housing. Should an accumulation of oil be found in the housing, an oil leak is indicated and the following points should be checked:

a. "O" ring seal between primary pump and primary pump hub.
b. Front pump oil seal.
c. Front pump "O" ring seal.
d. Oil drain in front pump plugged.
e. Converter cover "O" ring seal.
f. Turbine bolt "O" ring seal.
g. Sand hole in transmission housing allowing leakage between oil sump and converter cavity.

DIAGNOSIS OF UNUSUAL CONDITIONS

OIL BEING FORCED OUT OF FILLER TUBE

a. Oil level too high, aeration and foaming caused by planet carrier running in oil.
b. Split in suction pipe permitting aeration of oil.
c. Damaged suction pipe seal permitting aeration of oil.
d. Ears on suction pipe retainer bent, thereby preventing proper compression of the suction pipe seal, permitting aeration of oil.
e. Bore for suction pipe in housing too deep, thereby preventing proper compression of suction pipe seal, permitting aeration of oil.
f. Sand hole in suction bore in transmission housing or case, permitting aeration of oil.
g. Sand hole in suction cavity in valve body permitting aeration of oil.

DIFFICULTY IN SHIFTING FROM DRIVE TO LOW AND FROM LOW TO DRIVE

This trouble can be caused by an improperly drilled high clutch feed orifice in the valve body. Oil restriction at this orifice would result in slow application of the clutch with the selector in Drive range. When shifting from Drive to Low the oil return to the sump from the clutch and release side of the low servo would be slow due to the restricted orifice.

The above condition can be easily diagnosed by connecting pressure gauges to the low servo apply and the high clutch (release side of low servo) test points.

a. Move the selector lever from Neutral to Drive with the engine running at idle speed, and watch the action on the two gauges.

   If the pressure builds up much more rapidly on the gauge connected to the low servo apply than on the gauge connected to the high clutch, restriction in the passage is indicated, which more than likely is due to an undersized orifice.

b. Move selector from Drive to Low and watch the action on the pressure gauge connected to the high clutch.

   If the pressure drops rather slowly, the oil is being restricted in draining from the clutch and release side of low servo. This results in clutch drag and slow low band application.

SLIPPING AND CHATTER IN LOW RANGE

This condition may be caused by poor ring fit or broken ring on the low servo piston. This allows oil to leak into the clutch apply circuit in greater volume than the high clutch orifice can handle, resulting in sufficient pressure being built up to partially apply the clutch at the same time that the low band is being applied.

The above condition can be easily diagnosed by connecting pressure gauges to the low servo apply and the high clutch (release side of low servo) test points.

With the selector lever in low range and the brakes set, accelerate engine to stall speed and check the pressure on both gauges. If everything is normal the gauge connected to low servo apply should register from 160 to 200 pounds and the gauge connected to high clutch should register zero.

However, if the gauge connected to the high clutch registers pressure, oil is leaking into the clutch apply the circuit.

HIGH CLUTCH FAILURES (Burned Plates)

In case of high clutch failures the transmission should be checked very closely both before and after disassembly.

With pressure gauges connected to low servo apply, high clutch and reverse servo test points, check the following:

a. With selector lever in Drive, check for slow build up of pressure on gauge connected to high clutch. Slow build up of pressure would indicate restriction in high clutch apply orifice which would result in clutch slippage.

b. With selector lever in Low, check for pressure on gauge connected to high clutch, if any pressure is shown, leakage past the low servo piston ring is indicated which would result in partial application of the clutch.

c. With selector lever in Reverse, check for pressure on gauge connected to high clutch. If any pressure is shown, leakage is indicated between the converter out and low servo release channels in the valve body or a damaged housing to valve body gasket.

When the transmission is in reverse the clutch plates are rotating in opposite directions, the drive plates are revolving at 2.43 times the driven plates. So being the case, a very slight clutch drag would soon burn out the clutch.

NOTE: The valve body should be carefully checked for porosity or sand holes or a damaged gasket between transmission housing and valve body.

UNABLE TO SHIFT INTO REVERSE WITH ENGINE RUNNING

The transmission cannot be shifted into reverse with the engine running but can be shifted into reverse with the engine shut off. This condition is usually caused by the accumulator snap ring being out of place allowing the accumulator valve and the valve body to be forced against the clamp nut on the parking lock lever shaft and apply spring assembly by the hydraulic pressure, thereby blocking the shift into reverse.

The shift can be made into low because the clamp nut is not aligned with the accumulator valve and valve body when shifting into low range.

POWERGLIDE
1953 TRANSMISSION

FOREWORD

This section includes only the differences found in this transmission over the 1950-52 transmission. Operations where not included in this section should be performed as indicated in the first section of this manual.

INDEX

DRIVING INSTRUCTIONS

Control of the new Powerglide transmission is the same as in the past with the exception that a slight lift of the control lever is now necessary to go from the "D" to "L" position. In addition the "D" range is now the automatic range in which the vehicle starts in low range and upshifts automatically, depending on the extent to which the accelerator is depressed.

PUSHING OR TOWING CAR TO START ENGINE

If it ever becomes necessary to push a car equipped with a Powerglide transmission, the control lever should be left in the "N" position until the car has reached a speed of approximately 16 mph. At this speed the turbine is spinning fast enough to turn the primary pump and the rear oil pump has developed sufficient pressure to engage the low band.

Then place the control lever in the "L" position to crank the engine. If the road is wet or icy resulting in poor traction, it may be necessary to push the car until a speed of approximately 20 mph is reached. Then place the control lever in the "L" range. After the engine starts, return the control lever to the "N" position for warm up.

> ***CAUTION: It is recommended that the car be pushed rather than to be towed, because when the engine starts, it is apt to accelerate into the rear end of the towing vehicle.***

MAINTENANCE

Capacity of the new transmission has been increased to 11 qts. on an overhaul or 5 qts. on a refill as outlined in 1950-52 section.

SERVICE ADJUSTMENTS

Service adjustments remain the same for linkage and safety switch. With the addition of the low drive valve body in the transmission an additional throttle valve linkage adjustment is required to maintain correct relationship between the accelerator pedal, carburetor and the throttle valve in the low drive valve body. The transmission throttle valve is connected through linkage to the carburetor and the accelerator pedal. Throttle valve pressure is, therefore, variable and dependent on carburetor and throttle pedal opening. Adjustment of throttle linkage is important to maintain correct pressure relationship in the transmission which controls the transmission shift range. Adjustment of the throttle valve linkage should be accomplished as follows:

1. With transmission control lever in "D" range and hand brake set, adjust engine idle to 425 RPM with engine at normal operating temperature and transmission warm.

   NOTE: Automatic choke must be entirely off and throttle stop screw against low step on fast idle cam.

2. Disconnect rod "A" (fig. 148) from throttle lever "D".
3. Remove lower right side cover bolt and with clamp "C" held back lightly against stop in transmission measure distance between hole in side cover and hole in throttle lever with throttle lever positioning gauge J-5391 (fig. 149). If pins of gauge will enter holes adjustment of lever "D" is correct. If not, loosen

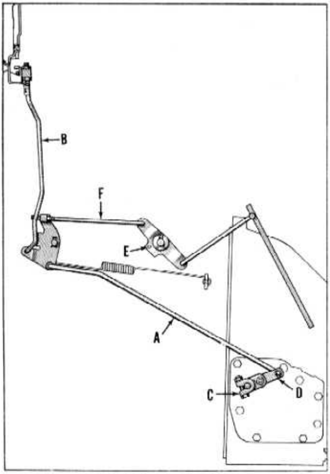

Fig. 148—Throttle Valve Linkage

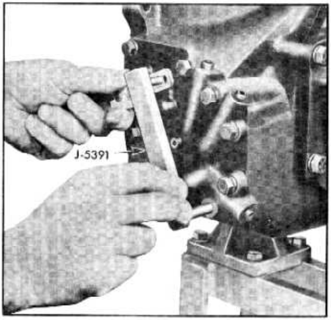

Fig. 149—Use of Outer Throttle Valve Lever Gauge

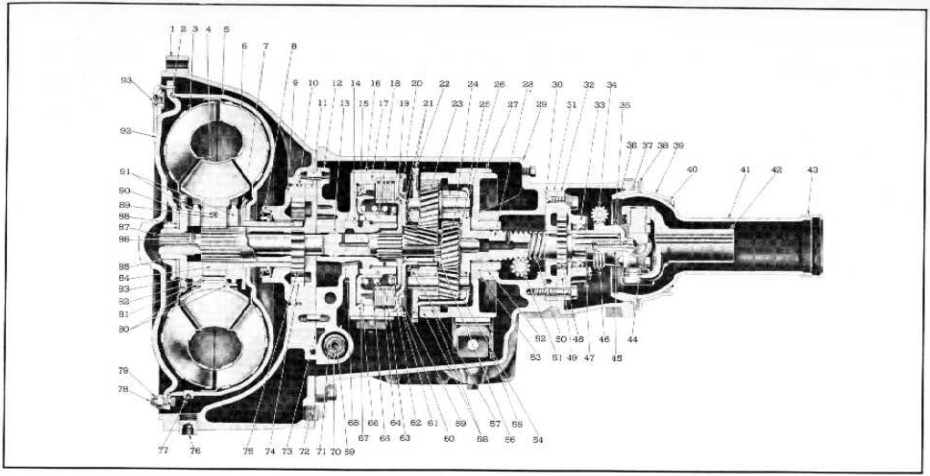

Fig. 150—Transmission Cross Section

1. Transmission Housing
2. Converter Cover "O" Ring Seal
3. Turbine Assembly
4. Stator Assembly
5. Converter Housing & Pump Assembly
6. Converter Pump
7. Converter Pump Thrust Washer
8. Front Oil Pump Body Oil Seal
9. Front Oil Pump Body
10. Front Oil Pump Body "O" Ring Seal
11. Stator Support
12. Transmission Valve Body
13. Input Shaft Oil Seal Ring
14. Clutch Drum Oil Seal Rings
15. Clutch Relief Valve Ball
16. Low Brake Band
17. Clutch Drum
18. Clutch Piston Inner Seal
19. Clutch Hub
20. Clutch Hub Thrust Washer
21. Low Sun Gear & Clutch Flange Assembly
22. Parking Lock Gear
23. Planet Short Pinion
24. Planet Reverse Sun Gear
25. Planet Reverse Sun Gear Thrust Washer
26. Planet Carrier
27. Reverse Brake Band
28. Output Shaft
29. Transmission Case
30. Rear Oil Pump Gasket
31. Rear Oil Pump Cover
32. Rear Oil Pump Body
33. Transmission Rear Bearing Assembly
34. Speedometer Driven Gear
35. Universal Joint Front Yoke
36. Universal Joint Ball Seat
37. Ball Seat "O" Ring Seal
38. Joint Ball Collar Shims
39. Universal Joint Ball Collar
40. Ball Collar Oil Seal
41. Universal Joint Ball
42. Universal Joint Rear Yoke
43. Ball Packing Retainer
44. Universal Joint Front Yoke Trunnion Bearing
45. Special Universal Joint Bolt
46. Speedometer Drive Gear
47. Transmission Rear Bearing Lock Plate
48. Rear Oil Pump Drive Gear
49. Rear Oil Pump Driven Gear
50. Governor Drive Gear
51. Governor Driven Gear
52. Transmission Case Bushing
53. Reverse Drum Thrust Washer
54. Planet Long Pinion
55. Reverse Band Lever & Link Assembly
56. Low Sun Gear Thrust Washer
57. Planet Pinion Shaft Lock Plate
58. Reverse Drum & Ring Gear
59. Clutch Flange Retainer
60. Clutch Flange Retainer Ring
61. Clutch Spring Seat
62. Clutch Spring Snap Ring
63. Clutch Spring
64. Clutch Drive Plates
65. Clutch Driven Plates
66. Clutch Piston
67. Clutch Piston Outer Seal
68. Clutch Drum Thrust Washer
69. Accumulator Piston Stop
70. Accumulator Piston Inner Spring
71. Accumulator Piston Outer Spring
72. Transmission Housing Drain Plug
73. Transmission Case Gasket
74. Front Oil Pump Driven Gear
75. Front Oil Pump Drive Gear
76. Transmission Housing Converter Drain Plug
77. Converter Housing Drain Plug
78. Converter Pump Housing Bolt
79. Converter Pump Housing Nut
80. Over-run Cam Retaining Rings
81. Over-run Cam Thrust Washer
82. Over-run Cam Roller & Spring Retainer
83. Over-run Cam Roller
84. Stator Race
85. Converter Cover Hub Bushing
86. Input Shaft Stop Ring
87. Input Shaft
88. Turbine Thrust Washer
89. Over-run Cam Roller Guide
90. Over-run Cam Roller Spring
91. Stator Thrust Washers
92. Converter Cover Assembly
93. Flywheel to Transmission Anchor Nut

lever to clamp attaching bolt and adjust accordingly.

NOTE: When making adjustment clamp "C" must be held back against stop.

4. Connect rod "A" to lever "D".
5. With idle set as outlined in step 1 and rod "A" (fig. 148) forced back lightly against stop in transmission (closed throttle), adjust rod "B" for length required for free entry of swivel pin in throttle lever. Then, shorten by making three full turns of upper check nut. Tighten lower check nut securely while holding swivel from turning.
6. Install $\frac{3}{16}''$ diameter pin through bell crank and bracket at "E".
7. With rod "B" against idle stop in carburetor, adjust rod "F" for length required for free entry of swivel into bell crank. Hold swivel from turning and lock check nut securely.
8. Remove $\frac{3}{16}''$ gauge pin.

GENERAL DESCRIPTION

The ideal transmission is one which will automatically provide the suitable speed or power ratio between the engine and the driving members to meet all driving conditions without any thought on the part of the operator.

Chevrolet's Powerglide transmission (fig. 150) meets these ideal qualifications because it offers torque multiplication and an automatic shift range which automatically provides shifts from low to drive and drive to low to meet variable road and traffic conditions.

The transmission will be described in four phases:

1. Torque Converter
2. Planetary Unit and Clutch
3. Hydraulic System
4. Hydraulic Operation

TORQUE CONVERTER

One of the features of the Powerglide transmission is its ability to provide a smooth application of power from the engine to the rear wheels. The engine's power is its ability to provide sufficient torque (twisting power) to the rear wheels to maintain certain car speeds. Torque is received from a rotating crankshaft and once a car is rolling on level ground the engine develops enough torque to keep it moving (fig. 151) but on a hill or in starting, the driving wheels need more torque and there must be some means of multiplying or converting this torque.

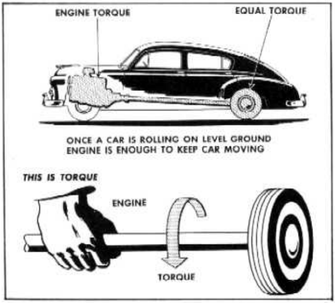

Fig. 151—Torque Requirement (Level Ground)

This increase and multiplication of engine torque may be accomplished by a gear transmission or through the use of a hydraulic unit which provides hydraulic torque conversion.

Hydraulic torque conversion means multiplying engine torque by changing fluid velocity into power. Torque conversion, therefore, provides an infinite number of gear ratios because the graduations in torque at the rear wheels are infinite (fig. 152).

Chevrolet's torque converter is a fluid driven unit having three elements, a pump mounted in a housing driven by its rim which is bolted to the flywheel, a turbine driven by the pump and attached through a hub to the transmission mainshaft, and a stator mounted on an overrunning clutch on a stator support (fig. 153). These parts are enclosed in a fluid filled housing which is part of the pump.

The pump, or driving member is designed with 31 curved blades placed radially on the inside of a housing which is driven by the engine. An inner

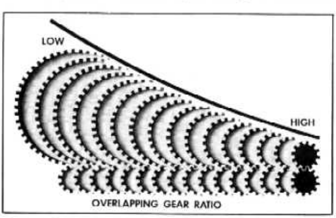

Fig. 152—Torque Graduations

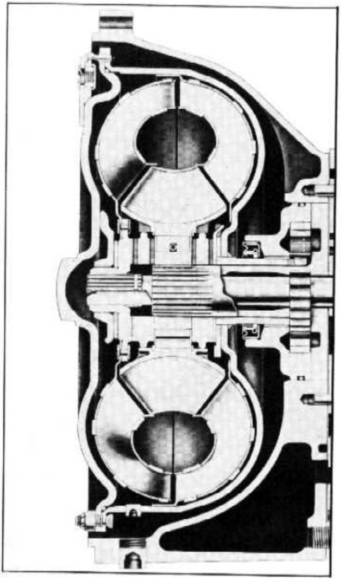

Fig. 153—Torque Converter—Cross Section

ring locks the blades in place and forms the fluid passages. As the pump rotates, fluid is thrown through the curved fluid passages in the turbine.

The turbine is the driven or output member of the converter and is spline mounted through its hub to the transmission mainshaft. Its design is similar to that of the pump except that it has 33 blades curved opposite to the pump blades. Fluid thrown from the pump blades hits the turbine blades and causes the turbine to rotate which in turn rotates the transmission mainshaft.

The stator is mounted through a free wheeling clutch to a stator hub which is splined to the stator support held solidly in the transmission case. The stator then is a reactionary member and provides directional control of the oil as it leaves the turbine.

Operation

In the torque converter the vanes are curved so as to get the desired amount of power from the pump and turbine. The pump blades are curved in a backward direction from the direction of rotation which gives added acceleration to the oil as it leaves the pump rim. The vanes in the turbine are also curved to absorb the required amount of energy from the oil as it passes through the turbine (fig. 154). To be able to do this the vanes are curved in a manner that causes the oil to be discharged from the center of the turbine in a direction opposite to rotation of the turbine. As the oil leaves the turbine blades at the center it still has a lot of kinetic energy left and due to the curvature of the turbine blades, it proceeds to exert this energy against the blades of the pump. Some means must be had for getting this oil to help the pump instead of hinder it as this would tend to slow down the pump, requiring extra power to drive it.

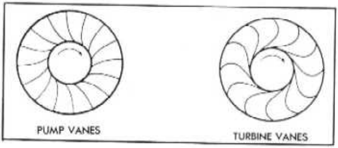

Fig. 154—Vane Comparison

We must have some means of giving directional control to the oil as it leaves the turbine and enters the pump. This is accomplished by interposing a stator between the pump and turbine with vanes so curved that they will change the direction of the oil discharged from the turbine and cause it to flow in the same direction as the rotation of the pump (fig. 155). Now, instead of the oil bucking the pump and interfering with it, the unexpended energy in the oil is actually helping the pump do its job. The stator then becomes a reactionary member assisting the function of the pump giving torque conversion. Through this assistance, it takes less engine power to drive the pump, the engine is able to deliver more power to the turbine and torque multiplication of 2.2 to 1 can be obtained as power to drive the rear wheels.

Now, as the rotational speed of the turbine increases, the rotational flow of the oil increases, and the stator blades start to get in the way. This condition would cause turbulance resulting in increased friction and power loss. Therefore, the stator is mounted on a free wheeling clutch which locks in a direction opposite to that of the pump and turbine rotation. As the turbine speed approaches pump speed the stator free wheels and is carried along with the rotating oil mass.

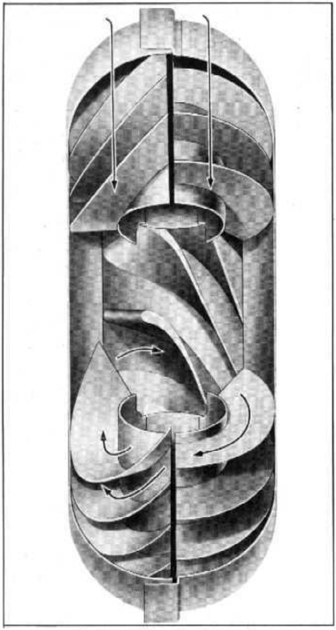

Fig. 155—Oil Flow Through Converter

PLANETARY UNIT AND CLUTCH

The transmission (fig. 156) is basically the same in construction and operation as in the past. The clutch piston, however, has been reduced ¼″ in diameter to provide for a smoother downshift. The steel driven plates are now waved and the drive plates have a combination facing of paper and cork.

To provide for the automatic shift a low-drive valve body has been incorporated in the transmission. This automatic shifting mechanism causes the transmission, when the selector lever is in the "D" position, to always start in low range and subsequently to shift into high. This automatic shifting mechanism is sensitive to car speed and throttle position and the vehicle starts in low and shifts into high after reaching a certain speed determined by the throttle opening. If the throttle is opened wider the transmission will not shift into high until the vehicle reaches a higher speed. With the throttle closed, the upshift will occur at approximately 10 mph, with the throttle depressed almost to the floor (detent touch position) the upshift will occur at approximately 29 mph and if the accelerator is depressed to the floor (through the detent), the vehicle will reach a speed of approximately 42 mph before upshifting.

If the accelerator pedal is pressed to the floor while cruising at a speed of 37 mph or less, the transmission will downshift from high to low, providing additional torque for rapid acceleration. As soon as the speed reaches approximately 42 mph it will upshift again. Downshifts will occur without pressing the accelerator to the floor upon deceleration. When slowing down with the throttle closed the transmission will downshift into low at approximately 9 mph and if the throttle

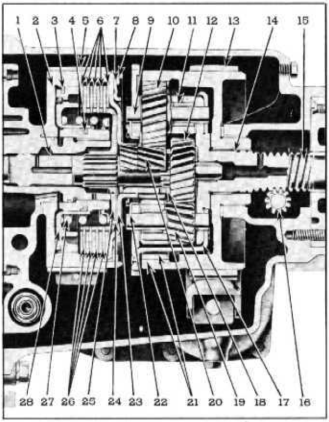

Fig. 156—Planetary Cross Section

1. Input Shaft
2. Clutch Drum
3. Clutch Piston Outer Ring Seal
4. Clutch Piston Inner Ring Seal
5. Low Brake Band
6. Clutch Driven Plates
7. Clutch Flange Retainer
8. Clutch Flange Retainer Ring
9. Planet Pinion Pin
10. Planet Short Pinion
11. Planet Pinion Needle Bearings
12. Reverse Sun Gear
13. Reverse Brake Band
14. Output Shaft
15. Governor Drive Gear
16. Governor Driven Gear
17. Planet Carrier
18. Low Sun Gear Thrust Washer
19. Planet Long Pinion
20. Low Sun Gear
21. Reverse Drum and Ring Gear
22. Planet Pinion Shaft Lock Plate
23. Clutch Flange
24. Clutch Hub Thrust Washer
25. Clutch Hub
26. Clutch Drive Plates
27. Clutch Spring
28. Clutch Piston

is depressed almost to the floor (detent touch) at any speed under 16½ mph the transmission will downshift.

AUTOMATIC DRIVE

When the selector lever is placed in the automatic drive "D" range which is the normal driving range and the accelerator is depressed, the car starts forward and the transmission is in the low range. The clutch is released and the brake band applied to the outside diameter of the clutch drum. With the brake band applied, the clutch drum is held stationary which in turn holds the clutch flange stationary. The clutch flange which is splined to the low sun gear holds the sun gear stationary. Drive then is through the input shaft, to the reverse sun gear to the long pinions to the short pinions which are in mesh with the low sun gear. Since the low sun gear is held stationary with the brake band applied, the short pinions will walk around the low sun gear and as they walk around the sun gear they carry the output shaft to which they are attached with them at a reduction of 1.82 to 1.

The transmission will automatically shift to the high range at approximately 12 to 42 mph depending to what extent the accelerator pedal is depressed. When this shift occurs, the brake band is released and the clutch is applied which locks the planatary system causing it to rotate as a unit. With the clutch applied, the clutch hub which is splined to the input shaft is tied to the clutch flange through the medium of the clutch plates. The clutch flange is splined to the low sun gear. The low sun gear is meshed to the short pinions, the short pinions are meshed with the long pinions and the long pinions are meshed with the reverse sun gear which is splined to the input shaft. Drive then is through the input shaft to the reverse sun gear to the long pinions, to the short pinions to the low speed sun gear. Since the low speed sun gear is locked to the input shaft through the clutch flange, clutch plates and clutch hub, the entire unit will revolve as a mass giving high range.

Emergency low, reverse and neutral operation remain the same as before.

THE HYDRAULIC SYSTEM

Oil Supply

Eleven quarts of Automatic Transmission Fluid "Type A" are carried in the oil sump and converter to operate the transmission and its hydraulic controls.

Oil Pumps

Two oil circulating pumps of the internal external gear type are incorporated in the transmission design. The transmission front pump has the greater capacity and is driven by the engine. The transmission rear pump has less capacity and is driven by the output shaft.

The requirements of the front pump are greater because when starting the car and when operating at low road speed or in reverse, the pump must be of adequate size to immediately furnish all the oil needed at required pressures.

The rear pump can be smaller because its output is not fully used until the car has reached a speed of approximately 15 mph, road load in Drive range. The capacity of the smaller pump is sufficient at this time, due to its rpm, to furnish all the oil needed at required pressures.

The rear pump is required to operate the low range band when pushing or towing the car to start the engine.

A pressure regulator valve controls the output of the pumps. At times either one or both pumps are used to supply the requirements of the transmission.

Controls

Range selection within the transmission is accomplished by means of a control lever under the steering wheel connected to a manual valve inside the valve body in the transmission.

Main Valve Body

The main valve body has been changed on the 1953 Powerglide to include additional valves and feed lines required in the 1953 Powerglide unit. The manual selector valve and pressure regulator valve, which are still retained in this body, have been redesigned. In addition a high clutch–low servo valve, converter pressure regulator valve and a governor pressure cut-off valve has been added to the main valve body. The pressure relief valve incorporated in 1950-52 valve bodies has been eliminated.

Early in 1953 Powerglide transmission production a change was made with transmission serial number, LT 2151-M27D, in the valve body and the pressure regulator valve. Another change was also made with transmission number LT 41170B-12D, in the converter pressure regulator valve and the converter pressure regulator valve spring. Figure 157 identifies oil passages of the valve body.

Pressure Regulator Valve

The pressure regulator valve is operated by oil pressure acting against calibrated spring pressure and has the following functions:

1. It regulates the pressure of the front and rear pumps.
2. It keeps a constant supply of oil to the converter when the engine is running and prevents oil draining out of the converter when the engine is not running.

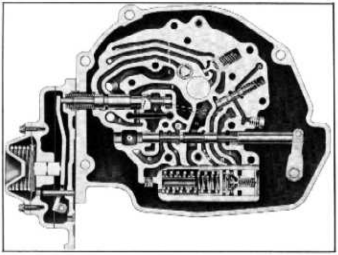

Fig. 157—Valve Body—Cross Section

1. Hydraulic Modulator
2. Lubrication or Converter Out
3. Release Side of Low Servo
4. Suction
5. Front Pump Pressure
6. Line Pressure
7. Feed Hole to Converter
8. Rear Pump Pressure
9. Reverse
10. Apply Side of Low Servo
11. High Clutch Feed
12. Exhaust Low and High
13. Accumulator Feed
14. Low Drive Valve Body Supply
15. Governor Pressure

The pressure regulator valve operates in the following manner:

When the engine is not running, the position of the pressure regulator valve is as shown in Figure 158. When the engine is started, the front pump starts pumping oil to the manual control valve and the pressure regulator valve. The oil, under pressure, enters the pressure regulator valve in the area between the second and third land on the valve through the check valve and then back to the pressure regulator valve between the first and second lands on the valve. Due to differences in diameters of the first and second lands on the valve a pressure differential is built up which causes the valve to move overcoming the pressure regulator valve springs. As the valve moves, the second land uncovers the converter feed line orifice (fig. 159). As pressure differential continues to build up the valve moves far enough to allow the valve to regulate front pump pressure by dumping into the suction line at the valve third land. The regulator valve will continue to move back and forth regulating the pressure of the oil pump.

A new pressure regulator valve with an internal plunger (2nd type) entered production with transmission number LT 2151 M-27D, differs in operation from the first type. This new pressure regulator valve has a small orifice through which oil, under main line pressure, flows into a chamber inside the valve and above the plunger. As pressure increases the plunger and pressure regulator tend to expand or separate and this force, aided by the force due to the differences in the diameters of the first and second lands of the valve, moves the valve spring as shown in figure 160. The pressure regulator moves to open the converter feed and continues to move

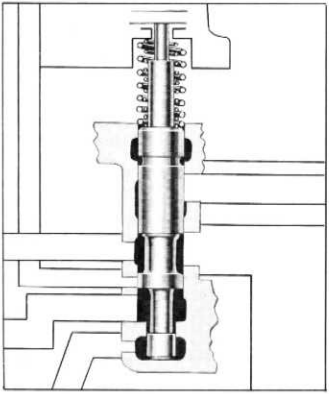

Fig. 158—Pressure Regulator Valve—Engine Not Running

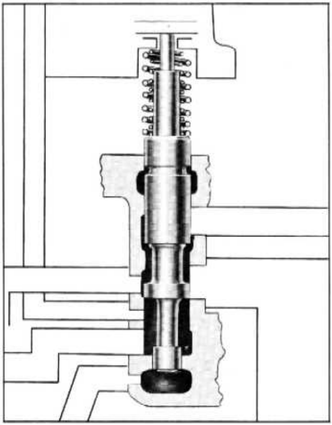

Fig. 159—Pressure Regulator Valve—Engine Running

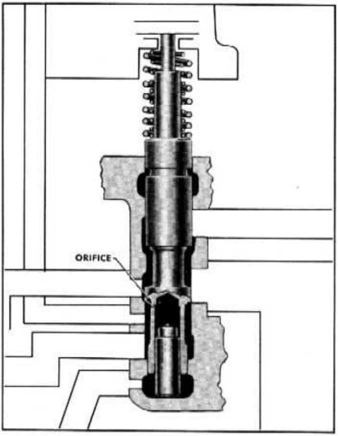

Fig. 160—Second Type Pressure Regulator Valve

back and forth to regulate front or rear pump pressure as the case may be. The internal plunger remains in the position shown in figure 160.

In automatic drive range, as governor oil pressure increases, it will aid in regulating main line pressure due to the governor oil pressure acting on the lower outer surface of the pressure regulator valve, tending to move the regulator valve against the regulator valve springs. Since governor pressure is never greater than mainline pressure the plunger in the regulator valve remains in the position shown in figure 160. The first and second type pressure regulator valves are not interchangeable.

Converter Pressure Regulator Valve (fig. 157)

When the engine is started oil is directed to the converter through an orifice uncovered by the pressure regulator valve. Oil circulates through the converter and is returned to lubrication through an orifice restricted by a converter pressure regulator valve. This valve is designed to prevent excessive pressure build up in the converter and opens at 43 to 58 pounds per square inch of pressure. When pressure in the converter builds up to this extent, the valve opens and increases the orifice area into the lubrication line thus maintaining a controlled pressure within the converter.

A second type converter pressure regulator valve was incorporated in the valve body with Powerglide transmission number LT 41170-B-12D. The previous valve provides a restricted opening from 0 psi to a full opening at converter pressure of 43-58 psi. The second type valve is similar in operation except that it seals oil in the converted up to a pressure of approximately 10 psi at which time it opens slightly to provide a restricted opening. The full open pressure remains the same at 43-58 psi. The diameter of the restricted opening is .010" smaller in the new valve body. The first and second type converter pressure regulator valves are interchangeable.

Pressure Regulator Governor Valve (fig. 157)

To assist regulation when in "D" range, variable governor pressure is directed to the end of the main pressure regulator valve through a pressure regulator governor valve. This additional pressure assists in keeping line pressure at a minimum in "D" range where extreme pressures are not required. When in "L" (emergency low) or "R" (reverse), line pressure is applied against the opposite end of the pressure regulator governor valve which shuts off the governor pressure passage to the main regulator valve allowing a greater pressure to build up in the system before regulation by the main regulator valve.

Modulator (fig. 157)

The vacuum modulator is attached to the transmission and connected through tubing to the manifold of the engine resulting in its being sensitive to engine vacuum. Spring pressure is applied to the top of a diaphragm which bears against a two piece (inner and outer) hydraulic plunger which in turn bears against the transmission modulator control. The control lever rests against the end of the pressure regulator valve and assists the pressure regulator springs in regulating pressures within the transmission as a result of load requirements which affect engine vacuum.

When requirements are light a strong vacuum is imposed which lifts the diaphragm, compressing the diaphragm spring and relieving pressure on the end of the regulator valve allowing it to regulate within range of the regulator springs. As load requirements are increased and vacuum decreases, the diaphragm is depressed by the diaphragm spring which applies pressure to the pressure regulator valve through the modulator control lever. The pressures within the system therefore increase to balance this additional pressure by the modulator. When the transmission is in low or reverse, additional pressure is required to hold the bands. To obtain this pressure for the low or reverse band, oil is chan-

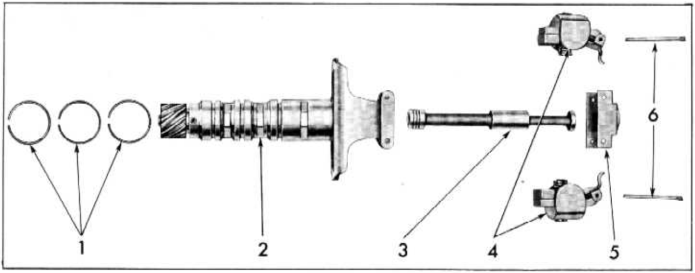

Fig. 161—Governor

1. Sleeve Oil Seal Rings
2. Sleeve
3. Valve
4. Weight Assemblies
5. Thrust Cap
6. Weight Pins

neled by the manual valve through the accumulator to the hydraulic modulator. This oil, admitted between the inner and outer plunger separates the two plungers, which in turn apply pressure through the modulator control lever to the end of the pressure regulator valve. The additional pressure on the regulator valve causes it to regulate at higher pressure, thus, pressure is built up within the system for additional band holding power.

Accumulator (fig. 157)

The accumulator which functions in low and reverse is simply a surge chamber to cushion the band application when shifting from automatic drive to emergency low with the car in operation or when shifting into either emergency low or reverse with the car standing still.

High Clutch Low Servo Valve (fig. 157)

To further assist in cushioning the automatic downshift from high to low range, a high clutch low servo valve is incorporated in the release side of the low servo circuit. This is a spring loaded valve with an orifice to retard servo release from 0 to 65 psi. Low servo apply pressure when it exceeds the 65 psi will cause the valve to unload by overcoming orifice spring load. This valve, therefore, allows for a soft initial band application at the time of down shifting.

Governor

The governor (fig. 161) which is driven by the output shaft of the transmission whenever the car is moving causes the transmission, when the selector lever is in automatic drive "D" range to be speed-conscious; i.e. it initiates the shift from low to high.

The governor consists of a single plunger type valve and two sets of governor weights acting upon this valve. This construction actually provides a rotating pressure regulator. Two weights, producing a two stage pressure curve, are used to provide a pressure range, which will produce shifts at the desired speeds. The effect of centrifugal force on the combined weights affects the governor pressure at the lower speeds. When the large outer weights hit their stops only the smaller inner weights in combination with their springs determine pressure at the higher speeds. Oil under pressure is delivered from the transmission rear oil pump directly to the governor where it is regulated and directed to the shifter valve in the throttle valve body and to the pressure regulator governor valve to regulate main line pressure affecting the automatic shift.

Action of Check Valve (fig. 157)

The check valve in starting is closed to the rear pump pressure line as the rear pump does not attain sufficient volume and pressure to be effective. The higher pressure from the front pump holds the valve closed and prevents the oil from the front pump bleeding off through the rear pump. When the car speed is above approximately 15 mph road load, the rear pump rotates fast enough to create sufficient pressure to operate the transmission. At this time the rear pump overcomes the front pump pressure, opens the check valve to rear pump pressure and closes the valve to the front pump pressure line. The rear pump then supplies oil to the main pressure regulator governor valve to the main pressure regulator valve which in combination with pressure differential between the 1st and 2nd lands of the main pressure regulator valve forces

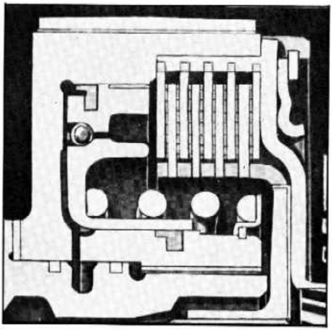

Fig. 162—Drive Clutch Relief Valve

the valve further against the regulator spring. Its effect, however, is dependent on engine vacuum. This movement opens the front pump regulating port, bleeds the front pump to the suction line and drops its oil pressure. The front pump is now idling and requires practically no power to drive it. The use of the smaller rear pump at higher speed conserves horsepower.

Drive Clutch Relief Valve

In reverse and neutral, the low range drum and direct drive clutch piston revolve at high speeds. This speed rotation could create sufficient centrifugal force in the oil remaining in the clutch apply chamber to partially engage the clutch. However, to prevent this, there is a clutch relief valve that is part of the piston assembly (fig. 162). This relief valve is a steel ball which is retained by staking in a hole, slightly larger than the ball, drilled from the front side of the piston. The rear end of the hole provides a seat and orifice leading to the rear of the piston.

In the clutch apply position, oil pressure holds the ball on its seat blocking off the orifice. When the clutch is in the released position, the centrifugal force of the rotating clutch assembly forces the ball off its seat allowing any oil that may be trapped between the piston and drum to be discharged through the orifice to the rear of the piston.

HYDRAULIC OPERATION

Automatic Drive Range

When starting with the selector lever in "D" (fig. 163) range, pump pressure is directed to the manual valve which is so positioned to open pressure passages to the apply side of the low servo and to the low drive valve body. With pressure applied to the low servo the vehicle starts out in low range. As the vehicle starts to move the rear pump begins to operate as does the governor since each is driven by the output shaft. Depressing the accelerator pedal allows throttle valve pressure to get behind the shifter valve in the low drive valve body. This pressure plus spring pressure holds the shifter valve closed, until sufficient pressure is built up by the governor at which time the shifter valve moves opening a passage to the clutch assembly to main line pressure. Main line pressure is also directed to the release side of the low servo piston which balances the piston and permits the low servo spring to release the brake band and places the transmission in high range.

Now let's look at the forces which make this automatic shift possible and how it is accomplished.

The governor driven off the output shaft of the transmission at a speed proportional to car speed supplies hydraulic pressure to the shifter mechanism. Part of the output from the rear oil pump flows through the governor, and the pressure of this oil balances the force of the centrifugal weights. The faster the governor spins, the greater is the pressure required to hold the governor valve in equilibrium. Therefore, as car speed increases, the hydraulic pressure from the governor to the shifter mechanism also increases until it reaches main line pressure.

The shifter mechanism includes a throttle valve, throttle valve spring regulator, regulator valve and shifter valve. The shifter valve controls the flow of oil to or from the high clutch. The position of the shifter valve is controlled by two opposing forces, one the hydraulic pressure from the governor and the other throttle valve pressure. The throttle valve pressure which controls the shifter valve is regulated by the throttle valve. Main line oil flows through the throttle valve and imposes pressure on the inner face of the throttle valve to oppose the force of the valve spring. The spring force is affected by engine throttle position through linkage to a lever that presses on the throttle valve spring regulator. As the throttle is opened, the pressure required to oppose the spring force increases, and therefore the pressure of the oil flowing from the throttle valve increases. The oil from the throttle valve flows to the regulator valve, where the pressure is imposed on the large end of the shifter valve, opposing the force of the governor pressure. The position of the shifter valve is controlled by these opposing pressures. The shifter valve has three machined cylindrical surfaces, a

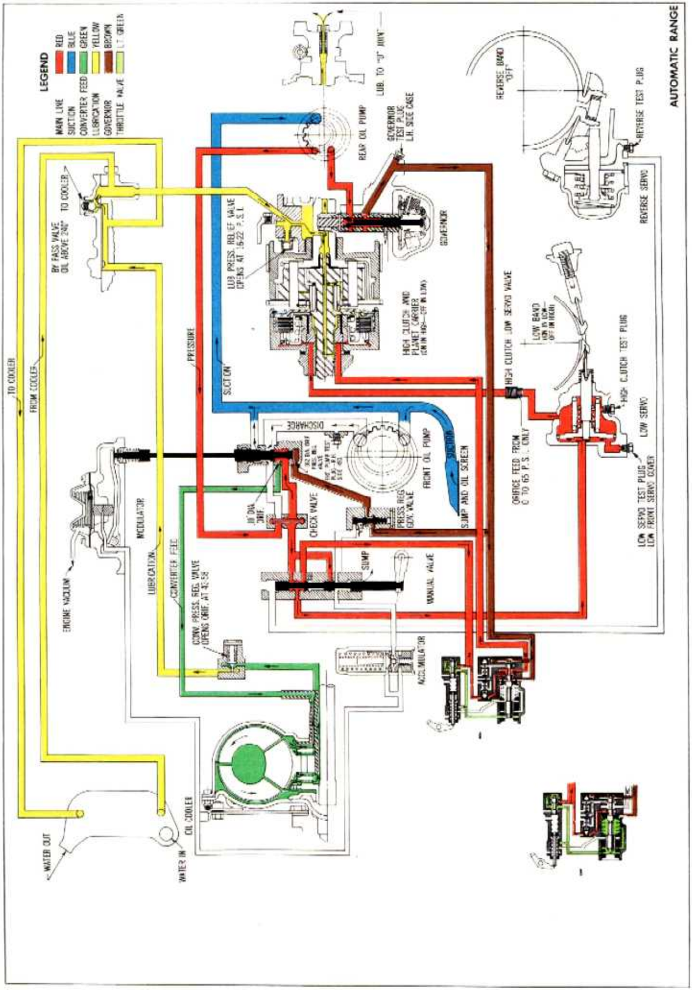

Fig. 163—Oil Circuits—Automatic Drive

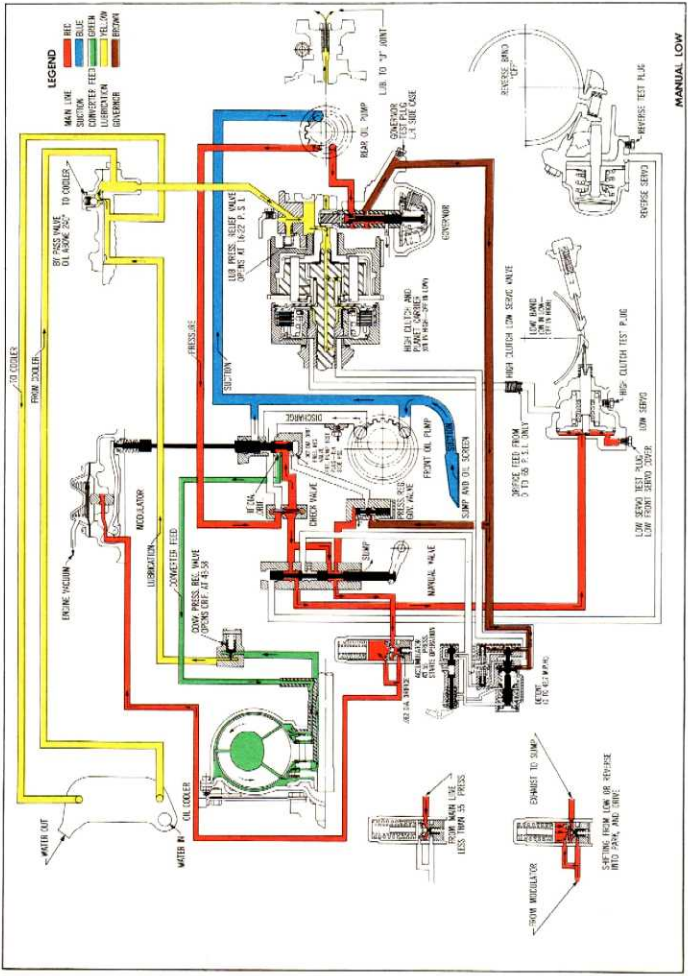

Fig. 164—Oil Circuits—Manual Low

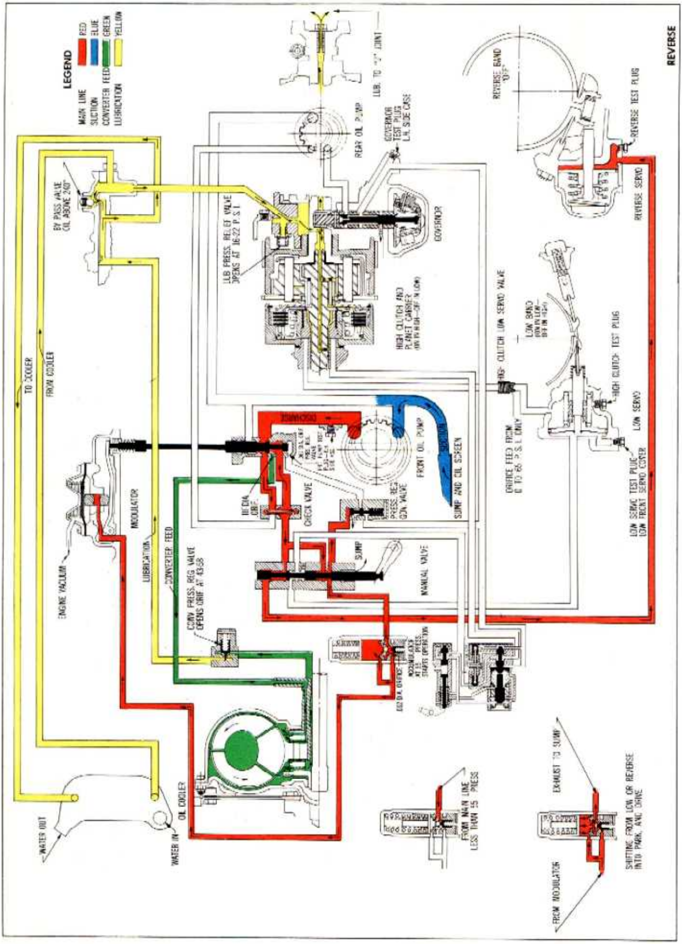

Fig. 165—Oil Circuits—Reverse

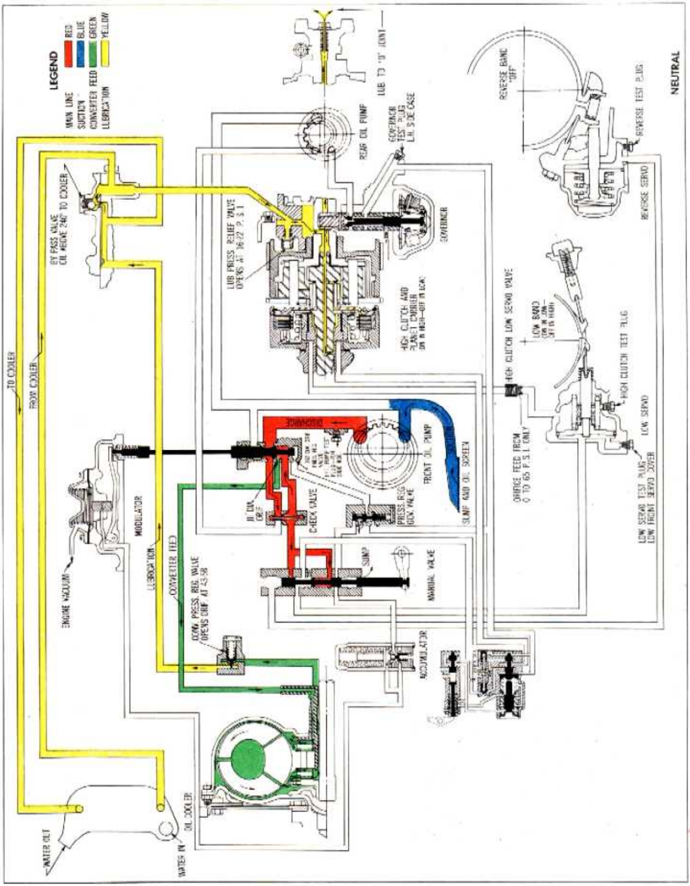

Fig. 166—Oil Circuits—Neutral

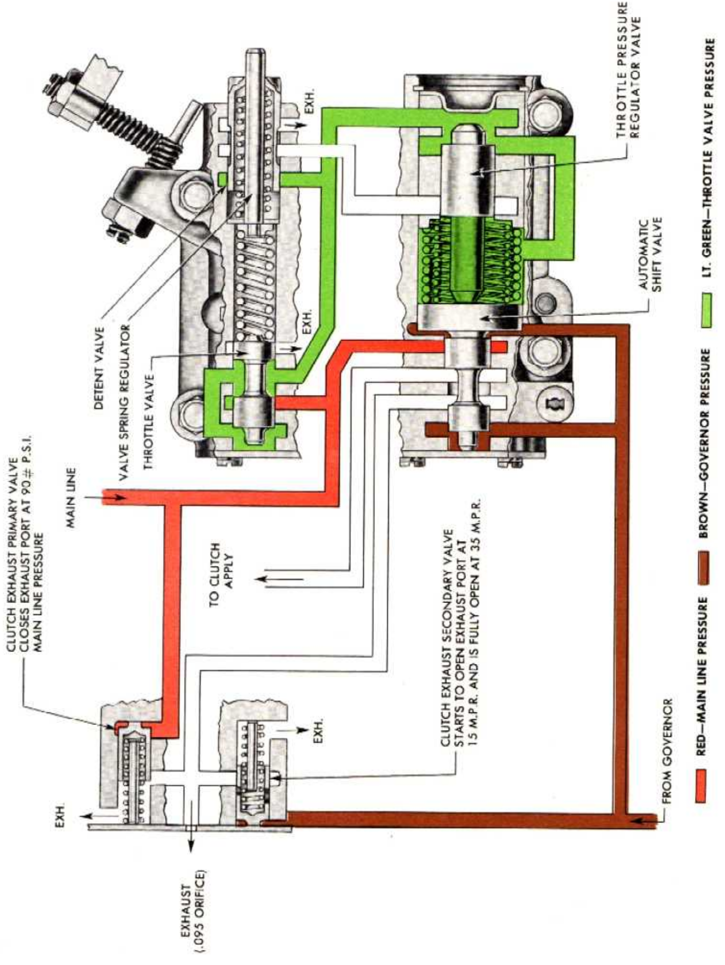

Fig. 167—Oil Circuits—Low Drive Valve Body

large diameter on the throttle valve pressure side and two smaller diameters at the opposite end. These two smaller diameter surfaces, or lands, and the space between them perform the valve function, opening or closing off passages according to the position of the valve.

When the governor pressure is great enough, it moves the shifter valve to open the high clutch line to main line, thereby putting pressure on the clutch and releasing the low band. When a reduction in speed causes the governor pressure to drop off sufficiently the pressure opposing the governor pressure moves the shifter valve to close off the main line pressure and open the high clutch line to an exhaust port, thereby relieving the pressure on the clutch so that the clutch is disengaged and the low band is applied. Band application is delayed slightly in that oil on the release side of the low servo piston must be exhausted through the high clutch low servo valve which cushions the band application. Downshifting also may be caused by opening the throttle sufficiently. In this case, the increased throttle valve spring force results in higher pressure from the throttle valve and a consequent greater force on the plunger to overcome the governor pressure. Above about 37 mph, the governor pressure has increased to a point at which it cannot be overcome even with the accelerator pedal pressed to the floor.

The shifter valve is designed so that it will not "hunt," that is, move back and forth, when the transmission is at a shifting point. For example, when the governor pressure is great enough to cause a shift from low to high, the valve will begin to move as soon as there is a slight advantage in governor pressure force. But, as soon as the valve has started to feed main line pressure to the high clutch, there is an additional force tending to move the valve to its new position. This is accomplished by having different diameters for the two lands of the valve. The end against which the governor pressure is imposed is smaller than the end adjacent to the plunger. The governor pressure is imposed on the small end of the valve and on the back side of the large end of the valve. The valve begins to move as soon as the force of the governor pressure times the area against which it presses is greater than the spring force and throttle valve pressure on the oposite side of the large end of the valve. However, as soon as the valve has moved to its new position, there is hydraulic fluid under pressure between the two small land diameters. This is the main line pressure that is being fed to the clutch. As the valve moves it also moves the throttle valve regulator valve against its stop which cuts off T. V. pressures to the large end of shifter valve. Throttle valve pressure will have to increase substantially before the valve will be able to move against governor pressure. This is the feature that prevents hunting between low and drive. The mainline pressure between the small lands on the shifter valve adds a small net force due to difference in land diameter to the effect of the governor pressure and helps hold the valve in its new position. Moving the valve under the influence of governor pressure and then having an additional differential holding pressure come into effect provides a snap action in movement of the valve.

The same effect is produced in moving the shifter valve from the high to the low position. In this case, it is necessary for either spring pressure or spring and throttle valve pressure on the regulator valve to be great enough to overcome the effect of the governor pressure as well as the added differential force of the pressure between the small lands of the shifter valve. Of course, as soon as the valve moves, the high clutch line is dumped into the sump and the pressure between the ends of the small lands of the valve is dissipated. This has the effect of a sudden increase in the net force tending to hold the valve in its new position, thereby providing a snap action.

Dumping of the high clutch is controlled by two valves, the primary and secondary exhaust valves (fig. 167). The primary valve is sensitive to mainline pressure and therefore is affected by engine load conditions. The secondary valve is sensitive to governor pressure and therefore is affected by vehicle speed. Under load conditions which provide mainline pressures greater than 90 psi the primary valve overcomes its spring and forces the high clutch to exhaust through a .090" orifice. At closed throttle, low speed downshifts, the mainline pressure will be less than 90 psi and the valve spring will open the valve allowing unrestricted exhaust for the high clutch. Part throttle downshifts which occur at 20-30 MPH, line pressure closes the free exhaust and the secondary valve provides a variable rate of exhaust by means of three holes in its perimeter. These exhaust holes are calibrated for size and location in such a way that as higher speed downshifts are made more exhaust area is provided. The alignment of these exhaust holes with the high clutch exhaust is maintained by governor pressure imposed on end of the secondary exhaust valve. By providing greater exhaust area at higher speeds, faster release of the clutch is obtained. This faster release prevents simultaneous engagement of the low band and clutch which would occur if the rate of clutch release was too slow. Simultaneous engagement would provide rough shifts which would be detrimental to transmission life. The secondary valve exhaust passage will vary from completely closed at low speed 15 MPH, low governor pressure, to the largest of the calibrated exhaust holes at high governor pressure 35 MPH. Close throttle, low speed downshifts which occur at pressure less than 90 psi line pressure are improved by fast disengagement of the clutch which permitted by full exhaust area at less than 90 psi.

The main function of the primary valve is to close off free exhaust during downshifts which occur under load and speed conditions which are so severe that the converter alone cannot absorb the shock and require precise timing between the disengagement of the low band and engagement of the high clutch. Downshifts made at 30-40 MPH require rapid disengagements of the high clutch and under these conditions the secondary valve has overcome its spring permitting the free exhaust desired.

When the throttle is not yet wide open, and the accelerator pedal is not quite to the floor, there is a definite resistance to further movement of the accelerator pedal, this resistance being furnished by a detent spring. The detent spring is a helical spring in the shifter valve body. Further movement of the accelerator pedal against the resistance of the detent spring moves a detent valve and directs throttle valve pressure to the large diameter plunger. This pressure imposed on the plunger will move the shifter valve to cause a down shift, provided the vehicle speed is no greater than 37 mph. For example, with the accelerator pedal pressed to the floor, the transmission will downshift at a speed of 37 mph or less, but it will not upshift again until the vehicle speed reached 42 mph. The reason for this is that in high the governor pressure has the help of the hydraulic force differential between the ends of the shifter valve in keeping the valve in the high position, and therefore, the vehicle speed must decrease to 37 mph before the governor pressure is low enough to allow a shift. On the other hand, with the transmission in low, the governor pressure no longer has the help of the differential hydraulic force in the valve, and therefore it is necessary for the vehicle speed to reach 42 mph before the governor pressure is great enough to move the shifter valve into high position.

To provide smooth shifting, it is desirable that the main line pressure be sensitive to engine load and road speed. To accomplish this, governor pressure is imposed on the inner end of the transmission main pressure regulating valve in "D" range only. As vehicle speed increases, governor pressure increases and causes movement of the transmission pressure regulating valve to provide a lower pressure regulation. Since higher pressure is required in low and reverse, as soon as the transmission is shifted to one of these positions, the control valve shuts off the governor pressure from the regulator valve, thus allowing the pressure to rise.

Emergency Low Range

As in the drive range the front pump supplies the oil pressure requirements of the transmission up to approximately 20 mph, road load, by which time the rear pump has built up sufficient pressure to overcome the front pump pressure which then idles and discharges into the suction line.

In the following description we will concede that the car has speed in excess of 20 mph, road load, at which time the rear pump is in operation and the front pump is discharging into the suction line. The controls operate as shown in Figure 164.

Oil flows from the rear pump to the pump check valve closing off the front pump pressure line and then to the pressure regulator valve and to the manual valve. The manual valve is so positioned to route this oil to the apply side of the low servo piston. Oil from the pump is also routed through another port of the manual valve to the accumulator and to the pressure regulator governor valve causing this valve to move to close off governor pressure to the regulator valve. From the accumulator, oil is directed to the hydraulic modulator assembly forcing the inner and outer plungers apart thereby increasing the pressure exerted against the modulator control lever. This increased pressure plus closing of governor pressure passage to the pressure regulator causes the pressure regulator valve to regulate at a higher pressure, regardless of throttle and vaccum conditions, which firmly holds the low servo band applied. Oil passing into the accumulator, which acts as a surge chamber, retards the flow of oil to the modulator and subsequent build up of pressure, enough to allow a gradual band application.

Reverse

In reverse, the front transmission pump supplies the hydraulic system with oil. The controls operates as shown in Figure 165.

Oil flows from the front pump to the pressure regulator valve and then to the pump check valve closing the rear pump pressure line so that the front pump pressure does not exhaust through the rear pump. The manual valve is so positioned as to direct oil to the rear servo to apply the band, and at the same time, oil is directed through the accumulator to the hydraulic modulator to exert pressure through the modulator control lever to the pressure regulator valve. The regulator valve regulates at a higher pressure to firmly hold the reverse band applied regardless of throttle and vacuum conditions.

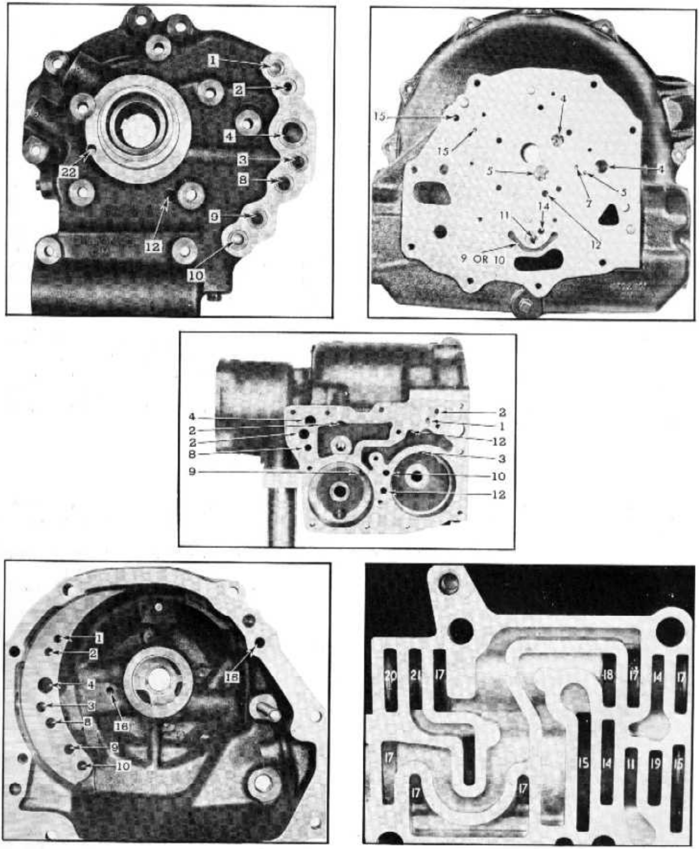

Fig. 168—Composite Layout—Oil Hole Identification

1. Hydraulic Modulator
2. Lubrication or Converter Out
3. Release Side of Low Servo
4. Suction
5. Front Pump Pressure
6. Line Pressure
7. Feed Hole to Converter
8. Rear Pump Pressure
9. Reverse
10. Apply Side of Rear Servo
11. High Clutch Feed
12. Exhaust—Low and High
13. Accumulator Feed
14. Low Drive Valve Body Supply
15. Governor Pressure
16. Lubrication Check Valve
17. Throttle Valve Pressure
18. Throttle Valve Pressure Exhaust
19. High Clutch Exhaust
20. Detent Valve Exhaust
21. Detent Feed Line
22. Governor Pressure Regulator Valve Exhaust

Neutral.

In neutral the manual valve is positioned as shown in Figure 166. Oil is blocked from entering the pressure lines to either the servo pistons or the clutch, leaving the bands and clutch released and the transmission in neutral. Oil to the pressure regulator valve, however, allows opening of the converter feed line and lubrication system.

Converter Feed and Oil Cooler

Oil from the pressure regulator is fed to the converter through a metering orifice. This oil is directed through the clearance passage between the stator support and the pump hub, and is delivered into the converter between the stator and the pump. Oil leaves the converter between the stator and the turbine and flows inside the stator support to the valve body where it enters a passage leading to the converter pressure regulating valve and thence into the lubrication line and cooler.

Lubrication System

Oil leaving the converter goes through the converter pressure regulator valve to the lubrication line and thence to the lubricating by-pass valve. When oil temperatures are below 240°F, a bi-metal strip opens the by-pass valve allowing oil to go directly into the lubrication system. When oil temperatures are above 240°F the bi-metal strip allows the by-pass valve to close. With the by-pass valve closed oil is circulated through the oil cooler to cool the oil to a satisfactory operating temperature. The cooled oil then returns to the transmission and into the lubrication system. The oil cooler is a water cooled heat exchanger with water being supplied by the engine cooling system.

Oil is continually being fed to the lubrication system by the converter and is directed through lubrication passages to the low range drum bushing and clutch plates, to the rear transmission case bushing, planetary gears and carrier and to the universal ball joint and transmission rear bearing and the pilot bearing on the input shaft. A lubrication pressure relief valve which opens when pressure exceeds 16 to 22 psi prevents a build up of back pressure in the converter. Both the free wheel clutch on the stator and the turbine bushing are lubricated by immersion in oil in the converter.

MAJOR SERVICE OPERATIONS

Removal

The removal of the early 1953 Powerglide transmission assembly from the vehicle remains the same with two exceptions, one is that the throttle valve control rod must be disconnected from the throttle valve control outer lever assembly. The other is that the converter assembly is no longer secured to the stator support with a retaining ring. Therefore, a converter assembly holding tool, J-5384, has been developed to eliminate the possibility of this assembly falling out. It is installed on the converter housing (fig. 169) and holds the converter assembly in place during the removal of the transmission from the vehicle. In addition the transmission support cross-member was made removable to facilitate removal.

Early in 1953 production the transmission hole cover was eliminated from the body. As a result of these changes the Powerglide transmission must be removed as follows:

1. Jack up car and install stands front and rear.
2. Remove the two transmission support assembly to transmission attaching bolts and install support bar or cradle to support engine and raise approximately one-half inch.
3. Remove hand brake pull rod, cross shaft and break the universal joint.
4. On convertible models,
   a. Disconnect gear shift control long rod, throttle valve control rod, speedometer cable and modulator pipe from transmission.
   b. Remove transmission support assembly cross member and support retainer.
   c. Raise engine as high as possible, lower

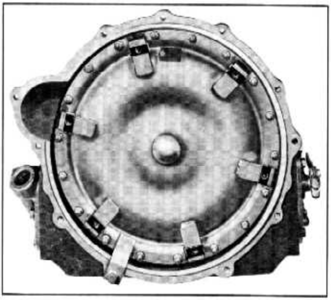

Fig. 169—Converter Assembly Holding Tool

torque tube as far as possible, remove rear half of universal joint, then lower transmission approximately two inches.
d. Disconnect oil cooler pipes from transmission through access provided in floor pan.

5. On all other models,
   a. Loosen exhaust pipe at manifold.
   b. On early 1953 models, remove brake main cylinder pipe from clip in second cross member grasp pipe at this point and spring back approximately four inches. On later models pipe is redesigned and this is not necessary.
   c. Disconnect and remove second cross member, slide out to the right side.
   d. Disconnect modulator pipe and transmission control long rod, throttle valve control rod and speedometer cable.
   e. Lower engine and transmission approximately one and one half inches.
   f. Disconnect oil cooler lines from transmission and disconnect lines from clips and move ends out to right side.
6. Raise the torque tube as high as underbody will permit.
7. Remove converter attaching bolts.
8. Remove all transmission attaching bolts except three top ones.
9. Position hydraulic jack to which tool No. J-5214 and J-5526 bracket have been mounted. Raise jack and fasten transmission handling equipment to transmission.
10. Remove three top transmission attaching bolts through toe pan inspection cover.
11. Move transmission to rear slightly and install converter holding tool J-5384.
12. Lower transmission on jack and remove from under car.

Disassembly

1. Place transmission in assembly fixture J-3361.

   NOTE: Cleanliness is an important factor in the overhaul of the transmission. Before attempting any disassembly operation, the exterior of the case should be thoroughly cleaned to prevent possibility of any dirt getting into the transmission. During disassembly all parts should be thoroughly cleaned with cleaning solvent and all parts air dried. Wiping cloths or rags should not be used to dry parts as lint may be deposited on the parts which will cause later trouble.
2. Remove converter assembly holding tool, J-5384, and converter assembly.
3. Remove right side cover and gasket. Remove oil pump suction screen.

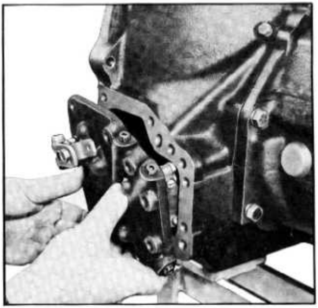

Fig. 170—Removing Low and Drive Valve Body

4. Remove transmission low and drive valve body assembly (fig. 170). Remove gasket.

   NOTE: The throttle valve control outer lever assembly should not be removed at this time as it retains the throttle valve inner lever assembly to cover.
5. Remove modulator assembly bolts and lockwashers and remove modulator assembly and gasket.

   CAUTION: When removing modulator housing be careful hydraulic modulator pistons do not fall out and become damaged.
6. Remove the servo cover bolts and lockwashers, and remove servo cover assembly and gasket.

   CAUTION: Reverse servo spring, pressure regulator valve springs and low servo piston return spring exert pressure against this cover; therefore, care should be taken when this cover is removed to maintain a pressure against it to eliminate the possibility of cover breakage.
7. Remove reverse servo spring and pressure regulator valve springs and remove pressure regulator valve.

   CAUTION: Handle this valve carefully and lay aside so as to prevent damage. Do not drop plunger when removing second type pressure regulator valve.
8. Remove low band adjusting screw cover, loosen low band adjusting screw lock nut using tool, J-4277, and tighten low band adjusting screw to hold clutch assembly in place.

22. Turn puller handle clockwise to force the planet output shaft out of rear bearing. Disconnect tool J-938 from output shaft and rear face of transmission and remove planet carrier assembly through front of case.
23. Remove reverse brake drum.
24. Using tool, J-4277, loosen reverse servo adjusting screw lock nut, back off adjusting screw and remove reverse brake band assembly and reverse servo piston.
25. Remove the rear pump attaching bolts and lock washers and remove rear pump assembly and gasket.
26. Remove the lubrication pressure relief valve from the transmission case (fig. 173).

"O" Ring Seals

"O" ring seals in the transmission are used to provide positive sealing of oil pressures within the transmission. It is imperative that these "O" ring seals be replaced during an overhaul or whenever an "O" ring seal is removed.

Whenever new "O" ring seals are installed, the following procedure should be followed to insure proper installation.

1. Parts to be assembled should be thoroughly cleaned of metal chips, dirt or foreign material. Sharp edges must be slightly broken and all burrs removed.
2. Before placing "O" ring in groove, make sure ring is free from twists. This can be done by placing ring on a flat table. Table surface should be clean so it will not deposit any dirt or grit on the ring.
3. When handling the ring during installation, be careful not to twist the ring. Place one side of the ring in the groove and then pull the opposite side straight back, being careful not to twist the ring, and place it in the groove.
4. Before the outer part is placed over the inner part and "O" ring seal, the "O" ring should be in full contact with the side of the groove which is last to enter the outer part. This position may be obtained by inserting a smooth-edged flat tool between the "O" ring and leading edge of the groove and running the tool circumferentially around the groove.

CAUTION: In working the "O" ring against the trailing edge of the groove, do not use a screwdriver or any sharp tool which might cut or abrade the surface of the "O" ring.

5. When assembling the two parts avoid using a twisting motion.
6. Before assembling, the two parts and the "O" ring seal should be well lubricated using Automatic Transmission Fluid, "Type A."

OVERHAULING UNIT ASSEMBLIES

CONVERTER

Disassembly

1. Place converter assembly on bench and remove converter cover attaching lock nuts and bolts. With a small punch drive two split dowel pins out of converter cover.
2. Remove converter cover, turbine assembly, stator assembly, stator thrust washers and converter pump thrust washer.
3. Remove the thrust washer from the hub of the turbine.
4. Remove "O" ring seal from converter cover.
5. Figure 174 shows layout of converter parts.
6. Remove stator race from the stator assembly.
7. Remove the snap ring and over-run cam retaining thrust washer.

CAUTION: Exercise care when separating the parts so that the cam rollers, springs and guides do not become lost.

8. Remove cam rollers, springs and guides.
9. Remove snap ring and the over-run cam roller and spring retainer.

CAUTION: Exercise care that the over-run cam does not become disengaged from the stator hub and become damaged.

10. Figure 175 shows layout of stator parts.

Inspection

1. Wash all parts in cleaning solvent (air dry).

CAUTION: Do not use rags to dry parts.

2. Inspect converter pump hub inner and outer surfaces for galling or scoring.
3. Inspect converter pump thrust washer for galling or scoring.
4. Check converter pump vanes for looseness or damage.
5. Inspect turbine hub and turbine thrust washer for galling or scoring.
6. Check turbine vanes for looseness or damage.
7. Inspect converter cover bushing for galling, scoring or excessive wear.
8. Inspect stator race and cam rollers for galling or scoring.
9. Inspect cam springs for distortion and spring guides for excessive wear or damage.

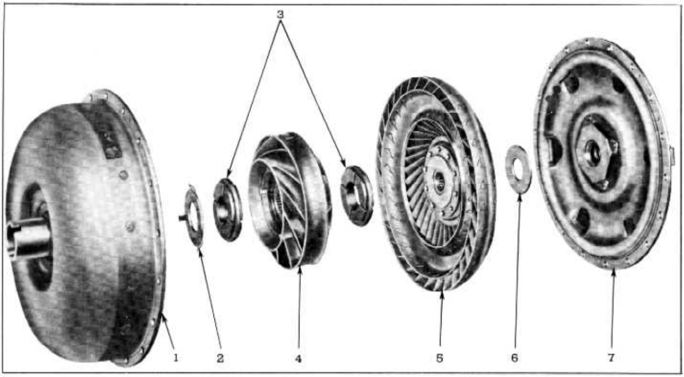

Fig. 174—Layout of Converter Parts

1. Converter Housing & Pump Assembly
2. Converter Pump Thrust Washer
3. Stator Thrust Washers
4. Stator Assembly
5. Turbine Assembly
6. Turbine Thrust Washer
7. Converter Cover Assembly

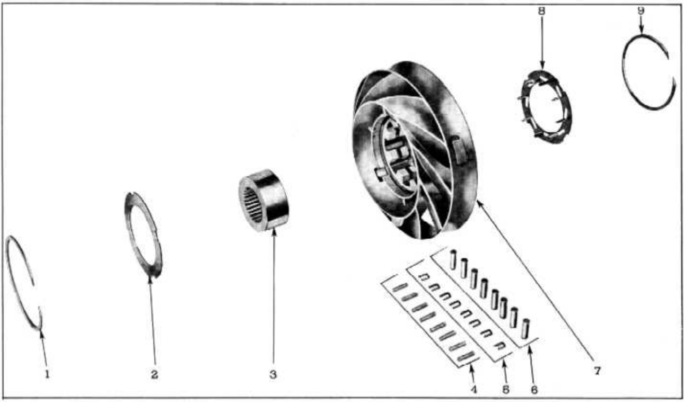

Fig. 175—Layout of Stator Parts

1. Over-Run Cam Retaining Ring
2. Over-Run Cam Thrust Washer
3. Stator Race
4. Over-Run Cam Springs
5. Over-Run Cam Roller Guides
6. Over-Run Cam Roller
7. Stator
8. Over-Run Cam Roller and Spring Retainer
9. Over-Run Cam Retaining Ring

10. Inspect over-run cam thrust washer and over-run cam roller and spring retainer for excessive wear or damage.
11. Inspect stator thrust washers for galling, scoring or excessive wear.
12. Inspect stator vanes for looseness or damage.

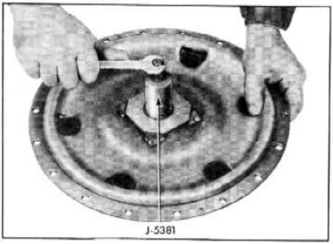

Fig. 176—Removing Converter Cover Bushing

REPAIRS

CONVERTER COVER BUSHING REPLACEMENT

A precision type converter cover bushing, part number 3702078, should be used for field service

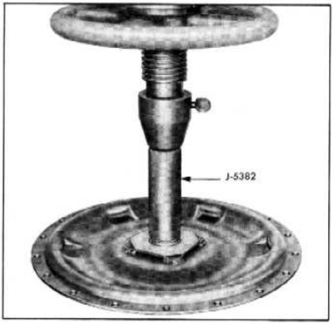

Fig. 177—Replacing Converter Cover Bushing

replacement. This bushing is of high quality with close tolerances of fit and will not require reaming after installation.

Should the converter cover bushing, during an overhaul inspection, show evidence of being galled, scored or excessively worn, it may be replaced easily and accurately using the following procedures:

1. Insert converter cover bushing remover, tool J-5381, in bore of bushing and turn puller screw clockwise (fig. 176).
2. Place new bushing on pilot end of converter cover bushing replacer, tool J-5382, and press bushing into position (fig. 177).

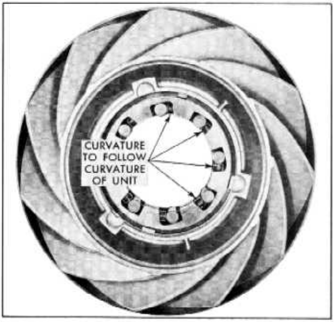

Fig. 178—Curvature of Spring Retainers

Assembly

1. Assemble over-run cam roller and spring retainer to stator so that the prongs of the retainer are pointed toward the rear of the stator. Install retaining snap ring, making sure it is properly seated in groove.

   NOTE: The front of the stator can be identified by the vanes. The vanes are thicker at the front than they are at the rear. The letters "Front" are also cast in the stator for ready identification.

2. Assemble cam rollers, springs and guides in cam pockets.

   NOTE: Spring guides are curved and this curvature should fit the curvature of the unit (fig. 178).

3. Install over-run cam thrust washer and retaining snap ring. Be sure that snap ring is properly seated in groove.
4. Coat stator race and loading tool, J-5930, with a light film of oil; then place stator race on pilot end of loading tool and carefully rotate stator over tapered end of loading tool and stator race (fig. 179). Be careful not to dislodge rollers.

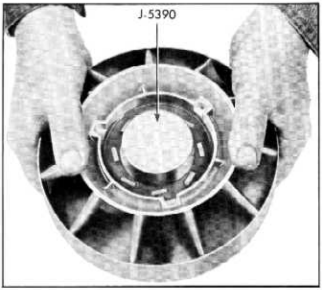

Fig. 179—Use of Loading Tool to Assemble Stator

NOTE: Carefully rotate stator in free wheel direction (clockwise) to eliminate the possibility of dislocating cam rollers.

5. Check operation of stator. Stator should free wheel in clockwise direction when viewed from the front.
6. Place converter pump on bench.
7. Install thrust washer to converter pump hub. Be sure that the tabs are engaged in the notches of the hub flange.
8. Assemble both thrust washers to stator and install to converter pump as an assembly.

   CAUTION: Be sure that the cut-outs in the over-run cam roller and spring retainer are facing upward. In other words, toward the turbine.

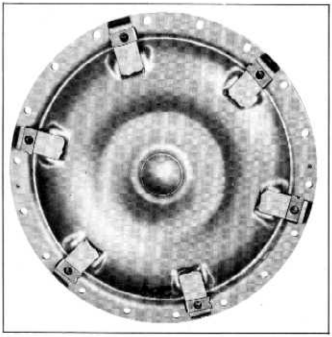

Fig. 180—Installing Converter Cover to Pump

9. Install thrust washer on turbine hub and assemble turbine assembly to converter pump.
10. Install new "O" ring seal on converter cover.
11. Align dowel pin holes in the converter cover and the dowel pins in the converter pump and install converter cover assembly (fig. 180).
12. Install converter pump to converter cover attaching bolts and lock nuts and tighten to 15-20 ft. lbs.

CLUTCH

Disassembly

1. Remove clutch flange retainer ring and clutch flange retainer.
2. Remove low sun gear and clutch flange assembly from clutch drum.
3. Remove clutch hub thrust washer, hub and clutch plates from clutch drum.
4. Place clutch drum in bench press and install piston spring compression tool, J-5133, to compress clutch release spring.
5. Remove clutch spring snap ring using snap ring pliers KMO-410. Release pressure slowly and remove clutch spring seat and clutch spring.
6. Forcibly rap the clutch drum, face down, on a wood surface to remove the clutch piston.
7. Remove piston outer ring seal from clutch piston.
8. Remove piston inner ring seal from hub of clutch drum.
9. Figure 181 shows layout of clutch drum assembly.

Inspection

1. Wash all parts in cleaning solvent (air dry).

   CAUTION: Do not use rags to dry parts.
2. Inspect drum brake band surface for excessive scoring or burning. Also, check drum bushing for scoring.
3. Check the steel ball in the clutch piston that acts as a relief valve. Be sure that it is free to move in the hole and that the orifice leading to the rear of the piston is open.

   NOTE: Clutch piston is ¼" smaller in diameter than piston in past models and is, therefore, not interchangeable.
4. Check fit of clutch flange in drum slots. There should be no appreciable radial play between these two parts. Also check low sun gear for nicks or burrs.

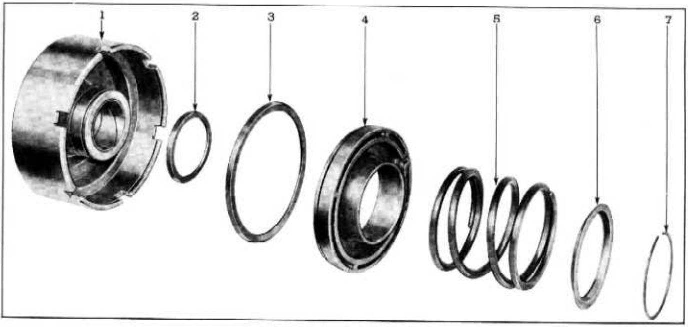

Fig. 181—Layout of Clutch Drum

1. Clutch Drum
2. Clutch Piston Inner Ring Seal
3. Clutch Piston Outer Ring Seal
4. Clutch Piston
5. Clutch Spring
6. Clutch Spring Seat
7. Clutch Spring Snap Ring

5. Check clutch plates for burning or metal pick up. Also check to see that composition plates are a free fit over clutch hub and that steel plates are a free fit in clutch flange.

   NOTE: Steel plates are waved plates and are not interchangeable with dished plates used in past models.

6. Figure 182 shows layout of complete clutch assembly.

REPAIRS

Clutch Relief Valve – Replacement

1. Carefully inspect the ball retaining hole in the clutch piston. Be sure that it is free of all burrs and nicks and that the steel ball seats perfectly on its seat.
2. Place steel ball in the retaining hole and carefully stake around edge of the hole to make sure that it will not come out.

   CAUTION: Be sure that the ball is free to move after staking.

Assembly

1. Install new piston outer ring seal on clutch piston being careful not to stretch seal. Lip of seal should be installed so that it is toward oil pressure side of piston.
2. Install new piston inner ring seal on inner hub of clutch drum with lip of seal toward bottom of piston pocket.
3. Place small amount of transmission oil on inner diameter of clutch drum and onto seals. Then carefully install piston into clutch drum

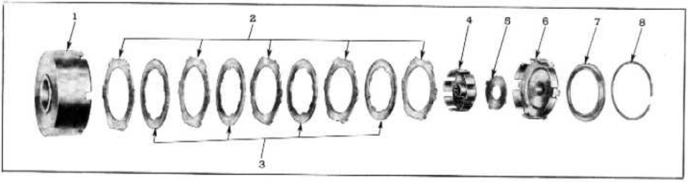

Fig. 182—Layout of Clutch Assembly

1. Clutch Drum Assembly
2. Clutch Driven Plate
3. Clutch Drive Plate
4. Clutch Hub
5. Clutch Hub Thrust Washer
6. Low Sun Gear and Clutch Flange Assembly
7. Clutch Flange Retainer
8. Clutch Flange Retainer Ring

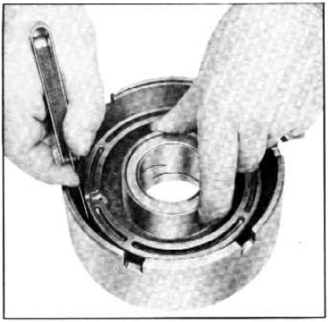

Fig. 183—Checking Seating of Clutch Piston Outer Seal

using a piece of feeler stock to insure seating of outer ring seal in clutch drum (fig. 183).

4. Install clutch spring and clutch spring seat. Place unit in press and using tool, J-5133, compress spring and install snap ring.

   CAUTION: When compressing spring be careful spring seat does not hang up in snap ring groove which will cause damage to spring seat and groove.

5. Place the four equally spaced tabs on clutch hub thrust washer into slots in clutch hub. Then place clutch hub with thrust washer on clutch flange with open side of clutch hub up and install five steel and four composition plates alternately.

   NOTE: When installing plates start with a steel plate. The steel plates are waved instead of being dished, therefore, they may be installed with either side toward the low sun gear and clutch flange assembly.

6. Assemble clutch drum over clutch flange, invert, and install clutch flange retainer and clutch flange retainer ring.

7. Check end play with feeler gauge between clutch flange drive lug and drive slot in drum. Maximum allowable end play is .013".

   NOTE: Retainer rings are available in three thicknesses, .055"-.064"—.073" to control end play of sun gear and clutch flange assembly in clutch drum.

MODULATOR

Disassembly

1. Remove hydraulic pistons and carefully lay aside to prevent damage.
2. Remove modulator outer cover attaching screws holding cover down against diaphragm spring pressure.
3. Remove diaphragm spring and diaphragm.
4. Wash all parts in cleaning solvent and blow out all oil passages.

   CAUTION: Do not use rags to dry parts.

Inspection

1. Check diaphragm spring for distortion or loss of tension.
2. Check diaphragm for wear or cracks that would cause leaks.
3. Inspect modulator outer cover for cracks.
4. Inspect hydraulic pistons for nicks and make sure they operate freely in modulator bore.

Assembly

1. Place assembly tool, J-5389, in hydraulic bore of modulator, place diaphragm in position and place diaphragm spring on diaphragm.
2. Install two 10-24x3" guide pins (part of Pilot Stud Set J-3387) and install modulator cover. Install attaching screws and tighten securely.
3. Install hydraulic pistons with crown toward modulator lever and modulator diaphragm.

SERVO COVER

Disassembly, inspection and assembly remains the same as in the past.

FRONT PUMP

Disassembly

1. Remove stator support from pump body.
2. Remove pump gears from pump body.

   CAUTION: Care must be taken when removing and handling gears not to drop or nick gears as these gears are not heat treated.

3. Remove "O" ring from pump body.
4. Figure 184 shows layout of front pump parts.

Inspection

1. Wash all parts in cleaning solvent and blow out all oil passages.

   CAUTION: Do not use rags to dry parts.

2. Inspect pump gears for nicks or damage.

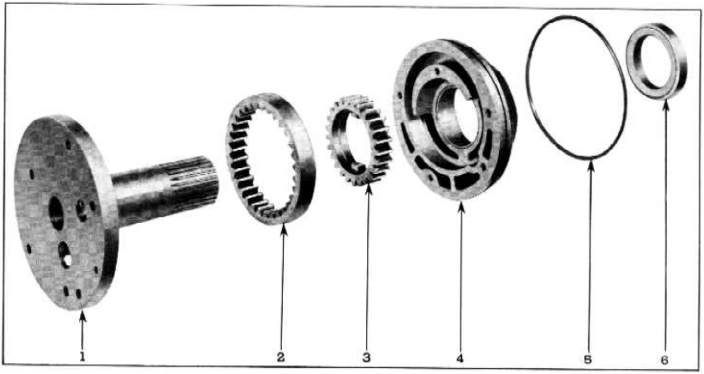

Fig. 184—Layout of Front Pump

1. Stator Support
2. Driven Gear
3. Drive Gear
4. Pump Body
5. "O" Ring Seal
6. Oil Seal

3. Inspect stator support pump face for nicks or being scored.
4. Inspect pump body for nicks or being scored.

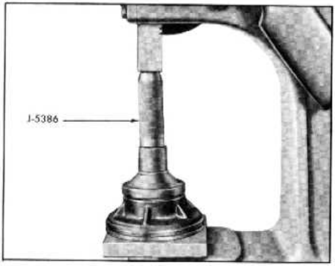

Fig. 185—Installing Pump Body Oil Seal

5. Inspect pump body oil seal for excessive wear or damage or evidence of leakage.
6. If oil seal is damaged or is leaking, pry out and install new seal using seal driver, J-5386 (fig. 185).
7. Inspect pump body bushing for galling or scoring. Check clearance between pump body bushing and coverter pump hub (fig. 186). Maximum clearance .007".
8. With parts clean and dry, install pump gears and check:
   a. Clearance between OD of gear and body should be .0025"-.0055".
   b. Clearance between internal gear and crescent should be .003"-.009".
   c. With scale and feeler gauge check gear end clearance. This clearance should be .0005" to .0015".

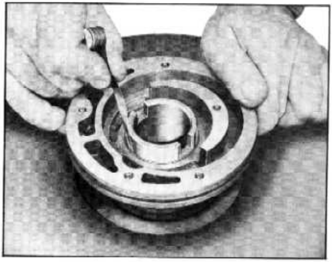

Fig. 186—Clearance Pump Body Bushing to Converter Pump Hub

Assembly

1. Install new "O" ring seal in pump body.
2. Remove gears from pump body, oil generously with automatic transmission oil and install in pump body.
3. Assemble stator support through drive gear aligning attaching holes.

REAR PUMP

Disassembly

1. Remove two flat slotted head screws and remove pump body plate.
2. Remove pump gears, wash all parts in cleaning solvent, blow out all oil delivery holes and inspect all parts for visible damage.
3. Install gears and check clearances. These should be the same as in the front pump.

Assembly

1. Remove gears from pump body and oil generously with automatic transmission oil.
2. Assemble gears to body.
3. Install pump body plate and secure with two slotted head screws. Tighten to 3½-5 ft. lbs.

VALVE BODY

Disassembly

1. Using pliers, J-4245, remove accumulator special snap ring.
2. Remove accumulator valve spring washer, valve spring and accumulator valve.
3. Remove accumulator valve body assembly and accumulator piston from piston bore.
4. Remove accumulator inner and outer springs and accumulator piston stop from piston bore.
5. Remove the clutch low servo valve assembly from valve body.
6. Place valve body assembly, face down, on two wood blocks of equal thickness and with a small pin punch drive the pressure regulator governor valve retaining pin from the valve body.

   CAUTION: Valve body should be so positioned on the blocks as not to obstruct removal of the pin.

7. Remove pressure regulator governor valve spring and valve from valve bore.

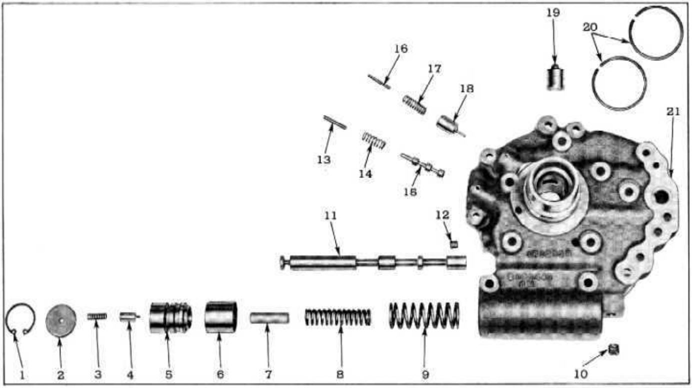

Fig. 187—Layout of Valve Body

1. Snap Ring
2. Accumulator Valve Spring Washer
3. Accumulator Valve Spring
4. Accumulator Valve
5. Accumulator Valve Body Assembly
6. Accumulator Piston
7. Accumulator Piston Stop
8. Accumulator Piston Inner Spring
9. Accumulator Piston Outer Spring
10. Plug
11. Transmission Manual Valve
12. Plug
13. Pressure Regulator Governor Valve Spring Stop Pin
14. Pressure Regulator Governor Spring
15. Pressure Regulator Governor Valve
16. Converter Pressure Regulator Valve Spring Stop Pin
17. Converter Pressure Regulator Valve Spring
18. Converter Pressure Regulator Valve
19. Clutch Low Servo Valve Assembly
20. Clutch Drum Oil Seal Rings
21. Transmission Valve Body

8. Using a small pin punch drive the converter pressure regulator valve retaining pin from valve body, remove the converter pressure regulator valve spring and valve from the valve bore.
9. Remove the two clutch drum oil seal rings.
10. Figure 187 shows layout of valve body parts.

Inspection

1. Wash all parts in cleaning solvent, air dry and blow out all oil passages.

   CAUTION: Do not use rags to dry parts.

2. Inspect accumulator valve body assembly for scoring and make sure small fibre valve operates freely.
3. Check accumulator body in valve body bore to see that it operates freely.
4. Check accumulator piston for scoring and see that it operates freely in valve body bore.
5. Check accumulator valve for scoring and see that it operates freely in accumulator body bore.
6. Check springs for distortion.
7. Inspect clutch low servo valve assembly and make sure that bakelite valve operates freely.
8. Inspect converter pressure regulator valve spring for distortion or damage.
9. Inspect converter pressure regulator valve for galling or scoring.
10. Check converter pressure regulator valve and make sure that it operates freely in valve bore.
11. Inspect the pressure regulator governor valve spring for distortion or damage.
12. Inspect the pressure regulator governor valve for galling or scoring.
13. Check pressure regulator governor valve and make sure that it operates freely in valve bore.
14. Check oil seal rings for nicks or burrs and make sure that they are free in ring grooves. Also install rings in clutch drum bore and make sure hooked ring ends have clearance.

Assembly

1. Install accumulator piston inner and outer springs, and piston stop in accumulator piston. Then install accumulator piston assembly in valve body bore.
2. Install accumulator valve and spring in accumulator valve body assembly.
3. Install accumulator valve body assembly into valve body bore.
4. Install accumulator valve spring washer, compress and install special snap ring, making sure it is properly seated in ring groove.
5. Install clutch low servo valve assembly.
6. Place valve body, face down, on wood blocks.
7. Assemble spring to converter pressure regulator valve and install assembly in valve bore. Install retaining pin.

   CAUTION: Do not confuse the converter pressure regulator valve spring with the pressure regulator governor valve spring. The converter pressure regulator valve spring is the longer of the two and is made of heavier spring wire.

8. Assemble spring to pressure regulator governor valve and install assembly in valve bore. Install retaining pin.
9. Install two clutch drum oil seal rings.

   NOTE: Six interlocking type cast iron rings are used in the transmission. These are easily removed from, or installed in, their grooves by applying pressure to the ring, with the index fingers and thumb at the proper points. Sidewise movement of the ring is restricted, therefore, one end must be compressed into the ring groove while the other end is pushed out away from the groove to lock or unlock the ring. These rings are used on the input shaft, oil delivery sleeve of the valve body and on the governor sleeve.

LOW AND DRIVE VALVE BODY ASSEMBLY

Should this assembly fail to function properly and it is necessary to disassemble it to locate the cause of the trouble, do not disturb or tamper with the throttle valve adjustment, which has two settings. This adjustment is pre-set to 62 psi plus/minus 1 psi at the factory and should not be disturbed unless it is necessary to install new parts that would affect this adjustment. It may be that foreign material is responsible for the trouble and that a thorough cleaning would restore it to normal operation.

Disassembly

1. Remove the low and drive valve body to side cover attaching bolts and lockwashers.
2. Hold the low and drive valve body in one hand and with a soft faced hammer tap on the inner side of the side cover until it is free of the locating pins.

   CAUTION: Exert pressure on the detent valve when separating valve body from the cover to prevent the loss or damage of parts from falling. A clip can easily be

made that retains the detent valve in its bore during disassembly and assembly to cover.

3. Remove the detent valve, spring, spring seat and the throttle valve spring regulator assembly.

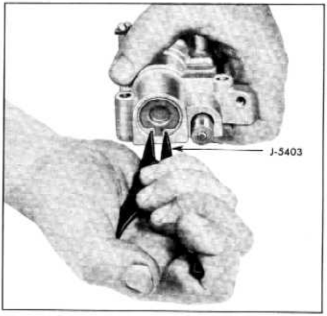

Fig. 188—Removing Low and Drive Valve Body Snap Ring

4. Remove throttle valve spring and throttle valve.
5. Using special snap ring pliers, J-5403, remove low and drive regulator valve cap retainer (fig. 188). Then remove low and drive regulator valve cap, sleeve and valve as an assembly, low and drive valve inner and outer springs, and low and drive valve.
6. Remove clutch exhaust cover plate to valve body slotted head attaching screws and remove clutch exhaust cover plate.
7. Remove the low and drive body end plate slotted head attaching screws and lockwashers and remove low and drive body end plate.

CAUTION: Exert pressure on low and drive body end plate while removing attaching screws to prevent the loss of parts.

8. Remove the clutch exhaust secondary control valve, spring and stop.
9. Remove the clutch exhaust primary control valve spring, stop and valve.
10. Remove throttle valve control outer lever assembly. Remove throttle valve lever shaft shield and throttle valve inner lever assembly. Then remove throttle valve lever shaft seal.
11. Figure 189 shows layout of low and drive valve body parts.

Inspection

1. Wash all parts in cleaning solvent, blow out all passages and air dry.

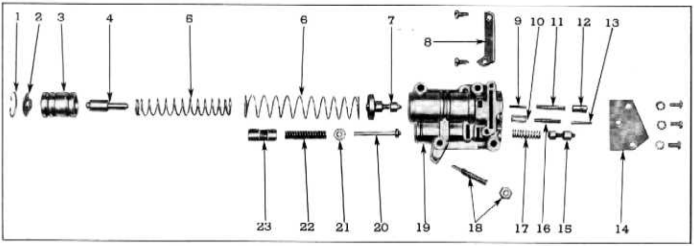

Fig. 189—Layout of Low and Drive Valve Body

1. Low and Drive Regulator Valve Cap Retainer Ring
2. Low and Drive Regulator Valve Cap
3. Low and Drive Regulator Valve Sleeve
4. Low and Drive Regulator Valve
5. Low and Drive Valve Inner Spring
6. Low and Drive Valve Outer Spring
7. Low and Drive Valve
8. Clutch Exhaust Cover Plate
9. Clutch Exhaust Secondary Control Valve Stop
10. Clutch Exhaust Primary Control Valve
11. Clutch Exhaust Secondary Control Valve Spring
12. Clutch Exhaust Secondary Control Valve
13. Clutch Exhaust Primary Control Valve Stop
14. Low and Drive Valve Body End Plate
15. Throttle Valve
16. Clutch Exhaust Primary Control Valve Spring
17. Throttle Valve Spring
18. Throttle Valve Inner Lever Adjusting Screw and Lock Nut
19. Low and Drive Valve Body
20. Throttle Valve Spring Regulator Assembly
21. Detent Valve Spring Seeat
22. Detent Valve Spring
23. Detent Valve

2. Inspect detent valve, detent valve spring seat, throttle valve spring regulator assembly and throttle valve for nicks, burrs, scoring or galling.
3. Check detent valve and throttle valve for free operation in their respective bores.
4. Check throttle valve spring regulator assembly for free operation in opening of detent valve.
5. Inspect detent valve spring and throttle valve spring for distortion or damage.
6. Inspect low and drive regulator valve sleeve and valve for nicks, burrs, scoring or galling.
7. Check low and drive regulator valve for free operation in valve sleeve.
8. Check low and drive regulator valve sleeve and low and drive valve for free operation in their respective bores.
9. Inspect low and drive valve inner and outer springs for distortion or damage.
10. Inspect clutch exhaust primary and secondary control valves for nicks, burrs, scoring and galling.
11. Check clutch exhaust primary and secondary control valves for free operation in their respective bores.
12. Inspect clutch exhaust primary and secondary control valve springs for distortion or damage.
13. Inspect throttle valve inner lever assembly shaft for scoring or galling and the lever for being tight on the shaft.
14. Check throttle valve inner lever assembly shaft for free operation in its bore in the side cover.
15. Inspect detent valve stop in side cover for distortion or damage. Replace with new stop if necessary.
16. Inspect locating pins in valve body and side cover for distortion or damage. Replace with new pins if necessary.

    NOTE: One locating pin should be in valve body and the other in the side cover. This is for assembly purposes.

17. Inspect mating surfaces of valve body and side cover. Be sure that they are free of nicks and burrs.

Assembly

1. Install the low and drive valve in valve body bore.

    CAUTION: The low and drive valve must be guided into its bore in the valve body to prevent damage to the bore. This can be accomplished with a piece of brake tubing. Insert it into the valve shank bore, in the rear of the valve body, engaging the tit on the end of the shank in the opening in the tubing. Then slowly move the valve into its proper position.

2. Install the low and drive regulator inner and outer springs in valve body bore.
3. Assemble low and drive regulator valve and cap to low and drive regulator valve sleeve. Then install as an assembly in valve body bore. Be sure inner spring is properly seated on seat of low and drive regulator sleeve.
4. Compress low and drive regulator valve assembly into valve body bore and install retainer, using special snap ring pliers, J-5403. Be sure retainer is properly seated in its groove in the valve body bore.
5. Install the clutch exhaust primary control valve in valve body bore. Then install the spring and stop in clutch exhaust primary control valve.

    CAUTION: Do not confuse clutch exhaust primary control valve stop and spring with the clutch exhaust secondary control valve stop and spring. The clutch exhaust primary control valve stop is the longer of the two stops and the clutch exhaust primary control valve spring is the shorter of the two springs.

6. Assemble clutch exhaust secondary control valve spring and stop to piston. Then install this assembly in valve body bore.
7. Install throttle valve spring and valve in valve body bore.
8. Place low and drive body end plate in position on valve body and install attaching screws and lock washers. Tighten to 1½-2½ ft. lbs.

    CAUTION: Exert pressure on low and drive body end plate while installing attaching screws to hold parts in position.

9. Install the clutch exhaust cover plate and attaching screws. Tighten to 2½-3½ ft. lbs.
10. Install the throttle valve spring regulator assembly in valve body bore. Be sure that it is seated on the throttle valve spring.
11. Install the detent valve spring seat in the valve body bore, threading the pin of the throttle valve spring regulator assembly through the opening in the detent valve spring seat.
12. Install the detent valve spring and detent valve in valve body bore, threading the pin of the throttle valve spring regulator assembly through the opening in the detent valve.

13. Place the side cover in a vise, face up. Align locating pin hole in low and drive valve body assembly and locating pin in side cover. Exert pressure on the valve body to keep the locating pin in the locating hole, at the same time compress the detent valve into the valve body bore. Rotate valve body counter clockwise until the locating pin in the valve body enters the locating hole in the side cover.

NOTE: Be sure that the face of the detent valve is resting against the detent valve stop pin in the side cover.

14. Install low and drive body attaching bolts and lock washers. Tighten from 3½ to 5 ft. lbs.
15. Install throttle valve inner lever assembly to side cover. Install new seal over shaft and into counterbore in cover. Then install shield.
16. Install throttle valve control outer lever assembly on inner lever shaft.
17. From the underside install outer lever attaching bolt. Install lockwasher and nut. Tighten securely.

THROTTLE VALVE INNER LEVER

Adjustment

If during disassembly it is found necessary to install new throttle valve parts, the throttle valve should be readjusted. It has two settings and the procedure is as follows:

1. Rotate the throttle valve inner lever until it just contacts the face of the detent valve. Hold the lever in this position and turn adjusting screw "A" until it just contacts the flat surface of the step in the lever (fig. 190). Back off one (1) complete turn and lock in this position by tightening adjusting screw lock nut securely.

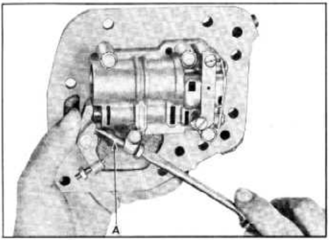

Fig. 190—Setting (1) of Throttle Valve Inner Lever Adjustment

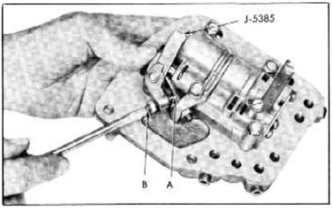

Fig. 191—Setting (2) of Throttle Valve Inner Lever Adjustment

2. Place throttle valve inner lever positioning gauge, J-5385, between the face of the detent valve and throttle valve inner lever. Hold in this position and turn adjusting screw "B" until it contacts threaded body of adjusting screw "A" (fig. 191). Tighten adjusting screw lock nut securely.

TRANSMISSION GOVERNOR ASSEMBLY

All of the components of the governor assembly, with the exception of the oil seal rings on the governor sleeve, are of a select fit and each assembly is calibrated. Therefore, the only parts serviced for replacement are the governor assembly and governor sleeve oil seal rings.

Disassembly, however, may be necessary due to foreign material causing improper operation. In cases of this kind the following procedure is recommended:

Disassembly

1. Cut off one end of each of the governor weight pins and remove pins, governor thrust cap, governor weight assemblies and governor valve from governor sleeve.

NOTE: The diameter of the governor weight pins should be measured with a micrometer upon their removal as the same gauge piano wire should be used when reassembling the governor, otherwise the calibration of the assembly will be upset.

2. Remove the oil seal rings from the governor sleeve.
3. Figure 192 shows a layout of the governor assembly parts.

Inspection

1. Wash all parts in cleaning solvent, air dry and blow out all passages.

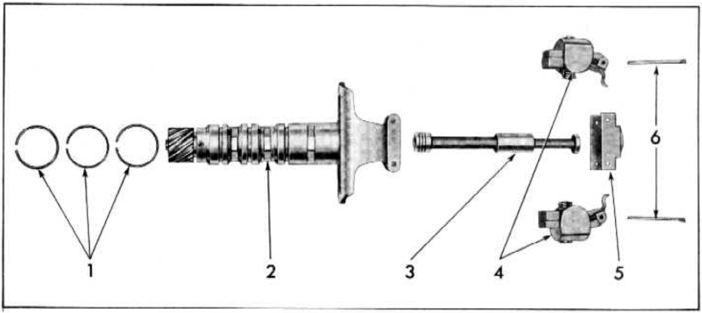

Fig. 192—Layout of Governor Assembly

1. Sleeve Oil Seal Rings
2. Sleeve
3. Valve
4. Weight Assemblies
5. Thrust Cap
6. Weight Pins

2. Inspect governor sleeve for nicks, burrs, scoring or galling.
3. Check governor sleeve for free operation in bore of transmission case.
4. Inspect governor valve for nicks, burrs, scoring or galling.
5. Check governor valve for free operation in bore of governor sleeve.
6. Inspect governor driven gear for nicks, burrs or damage.
7. Check governor driven gear for looseness on governor sleeve.
8. Inspect the governor weight springs for distortion or damage. Do not disassemble weights.
9. Check the governor weights for free operation in their retainers.
10. Inspect governor sleeve oil seal rings for damage. Then insert rings in the governor assembly bore in the transmission case and check to see that the hooked ends have clearance.

REPAIRS

Governor Drive Gear

To facilitate governor repair in the field a governor drive gear and pin unit, Part No. 3705357, is available for service use. This unit package contains a brass drive gear, two governor weight retaining pins and a governor gear retainer split pin. Field replacement of this governor gear must be accomplished with care and in the following manner.

Removal

1. Carefully grind off ends of governor weight retainer pins and remove weights and governor valve.

   NOTE: Carefully protect valve to prevent damage. Governor weights are interchangeable from side to side and need not be identified.

2. Drive out governor gear retainer split pin using a small punch.

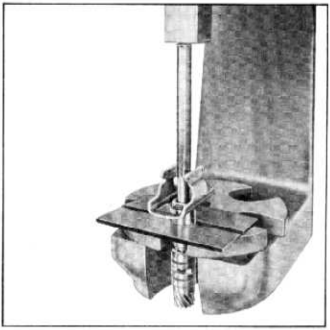

Fig. 193—Pressing Gear Out of Sleeve

3. Support governor on $\frac{3}{16}''$ plates installed in exhaust slots of governor sleeve, place in arbor press and with a long punch press gear out of sleeve (fig. 193).
4. Carefully clean governor sleeve of chips that may have been retained by original gear installation.
5. Support governor on $\frac{3}{16}''$ plates installed in exhaust slots of sleeve, position new gear in sleeve and with a suitable socket press gear into sleeve until nearly seated. Then, carefully remove any chips that may have shaved off gear hub and then press gear in until it bottoms on shoulder (fig. 194).

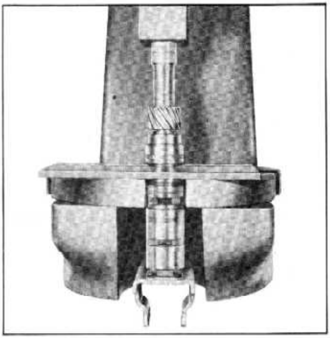

Fig. 194—Pressing Gear Into Sleeve

NOTE: It is essential that a socket be used to prevent damage to thrust button on end of gear.

6. A new pin hole must be drilled through sleeve and gear. Locate hole position 90° from existing hole, center punch and then while supporting governor in press drill new hole through sleeve and gear using a No. 24 (.152") drill (fig. 195).

NOTE: Hole must be drilled carefully to maintain squareness to governor sleeve.

7. Install split pin retainer.
8. Wash governor assembly thoroughly to remove any chips that may have collected.
9. Install governor valve and make sure it operates freely.
10. Install governor weight and retainer pins. Then crimp end of pins to secure in place.

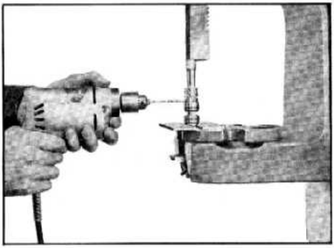

Fig. 195—Drilling New Pin Hole

Assembly

1. Install the oil seal rings on the governor sleeve. Be sure that the ends of the rings are hooked together and that the rings are free in the grooves.
2. Install the governor valve in the bore of governor sleeve.
3. Align the governor weight pin holes in the governor thrust cap, governor weight assemblies and governor sleeve and install new pins. Crimp both ends of both pins to prevent them from becoming dislocated.
4. Check governor weight assemblies for free operation on pins.

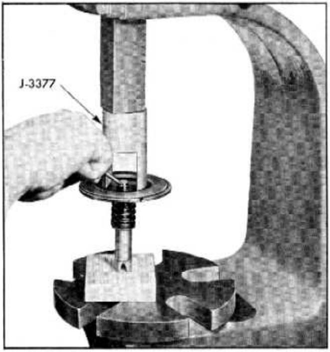

Fig. 196—Removing Low Servo Piston Rod Retainer

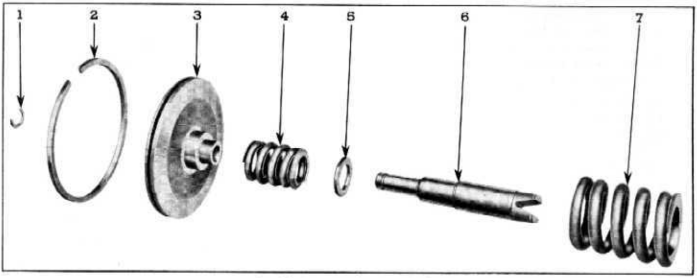

Fig. 197—Layout of Low Servo Piston

1. Piston Rod Retainer
2. Piston Ring
3. Piston
4. Apply Spring
5. Apply Spring Seat
6. Piston Rod
7. Return Spring

REVERSE SERVO AND LOW SERVO PISTONS

Disassembly, inspection and assembly of rear servo piston assembly remains the same. A change, however, has been made in the low servo piston assembly and the procedure for disassembling and assembling is as follows:

1. Place low servo piston in a bench press. Support the notched end of piston rod on a wood block. With tool, J-3377, compress piston spring and remove rod retainer (fig. 196).

   CAUTION: This spring is under 150 lbs. pressure.

2. Remove piston, spring and washer from piston rod.
3. Remove piston ring from piston and install in low piston bore. Check ring gap which should be .005"-.010".
4. Figure 197 shows layout of low servo piston assembly.
5. Assemble piston ring to piston. Then assemble washer, spring and piston to piston rod. Place assembly in bench press and, using tool J-3377, compress spring and install rod retainer, making sure it is properly seated in groove of piston rod.

PLANET ASSEMBLY AND INPUT SHAFT

Disassembly, inspection and assembly of the planet carrier and input shaft remains the same with one exception. The input shaft has a special snap ring that serves as a stop to insure against the input shaft floating forward (fig. 198).

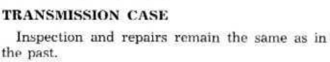

Fig. 198—Input Shaft

1. Upon inspection, if this special ring shows signs of damage or excessive wear, replace it using snap ring pliers KMO-410.

TRANSMISSION CASE

Inspection and repairs remain the same as in the past.

BRAKE BANDS

Inspection remains the same as in the past.

ASSEMBLY

CONVERTER

1. After thoroughly cleaning suction screen, install in oil sump making sure sealing ring is in position.
2. Place two ¼-20 x 3½" guide pins (part of Pilot Stud Set J-3387) in valve body attaching holes in converter housing.
3. Install new valve body gasket to converter housing.
4. Install valve body over guide pins and install attaching bolts tightening to 7½-10 ft. lbs. (fig. 199).

   NOTE: Lower left bolt over accumulator bore is a self locking bolt. Care must be

observed to install this bolt in this position. Tighten all bolts in a criss cross manner and after bolts are installed check to make sure manual and pressure regulator valves operate freely.

5. Align the holes in the stator support assembly with the holes in the front oil pump body and install two 1/4-20 x 3½" guide pins (part of Pilot Stud Set J-3387) in front pump. Install pump to converter housing using pump driver J-4263-5.

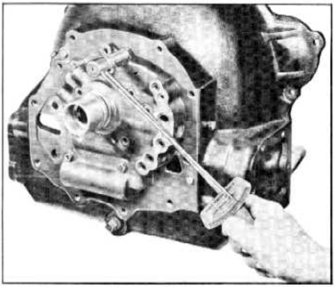

Fig. 199—Tightening Valve Body Attaching Bolts

NOTE: When installing pump, line up suction and delivery holes on left side of pump.

6. Install five self locking bolts through valve body and into pump. Tighten bolts to 7½-10 ft. lbs.

   CAUTION: After tightening across pressure regulator valve bore, check valve to make sure it operates freely.

7. Check and make sure front pump operates freely.
8. Install two 5/16-18 x 3" guide pins (part of Pilot Stud Set J-3387) in converter housing as guides for low and drive valve body assembly and install new gasket.
9. Install low and drive valve body assembly over guide pins and install attaching bolts and lock washers. Tighten to 12½-15 ft. lbs.

TRANSMISSION UNIT

1. Install two 5/16-18 x 3" guide pins in rear pump attaching holes. Install new gasket and pump, aligning suction and delivery holes. Install bolts and tighten to 12½-15 ft. lbs.
2. Check lubrication pressure relief valve, making sure that its openings are free of obstructions and that the valve disc and spring operate freely.
3. Install lubrication pressure relief valve in the rear of transmission case. Tighten securely.
4. Install reverse servo piston using ring compressor, J-3365. Notch on shaft should be positioned toward front of transmission case.
5. Install reverse brake band and strut assembly with thin end of band away from piston and thread adjusting screw in until it indexes with hole in anchor.
6. Install bronze thrust washer on hub of reverse drum and install drum into case and brake band.
7. Rotate rear pump drive gear lug to top of pump, then install planet carrier assembly in drum aligning slot on carrier shaft with lug of pump drive gear. Check amount end of shaft protrudes out of bearing. This should be a minimum of 7/8" and indicates proper seating of pump gear drive lug in carrier shaft slot.
8. Install shaft of tool, J-938, into threaded end of planet carrier output shaft and bolt yoke of tool to rear face of transmission case. Turn tool handle counterclockwise until the output shaft is seated in the rear bearing. Disconnect tool J-938 from output shaft and transmission case.
9. Install universal joint front yoke, universal joint washer, lock washer and bolt and tighten to 25-30 ft. lbs.
10. Tighten reverse servo adjusting screw using tool J-4277. Use one hand to turn down adjusting screw, check end play in linkage by grasping reverse servo return spring with other hand. Continue turning down adjusting screw slowly until end play, as felt by push-pull on piston assembly is taken up. Then back off adjusting screw 1/8 to 1/4 turn and tighten lock nut securely.

    CAUTION: This is a sensitive adjustment and must be done carefully. When end play movement of the piston is just taken up, and before backing off adjusting screw, the band must be free on the drum so that the drum can be easily rotated by hand.

11. The determining of the thickness of the low sun gear to reverse sun gear thrust washer remains the same as in the past.
12. Install parking lock lever shaft assembly in case. Install small lip seal over end of park-

ing lock lever shaft and into counter bore of case with lip seal toward inside of case.

13. Install flat washer and parking lock lever on end of parking lock lever shaft pushing lever onto shaft to obtain .000" to .010" clearance between lever and washer. Then tighten clamp screw to 8-12 ft. lbs.
14. Install parking lock pawl over pawl support rod and install parking lock pawl spring.
15. Wind up pawl spring using tool, J-3383, so that spring catches on inside of case (fig. 200).

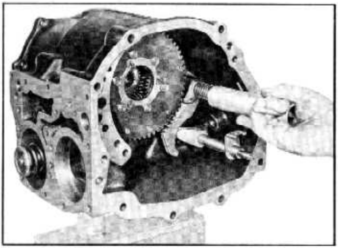

Fig. 200—Installing Parking Pawl Spring

16. Install input shaft to clutch unit. Install thrust washer previously selected on reverse sun gear splines of input shaft.

NOTE: It is important that the flat side of the thrust washer be installed toward the reverse sun gear.

17. Install unit assembly into case indexing input shaft pilot with pilot in output shaft and low sun gear with short pinions in planet carrier.
18. Install low servo piston release spring on servo piston rod and install piston and spring into case using piston ring compressor, J-3365.
19. Install low brake band over brake drum.
20. Place apply strut guide spring over piston shaft and apply strut in piston shaft slot with other end of apply strut engaging brake band.
21. Place brake band anchor strut assembly in brake band groove, then engage slotted end of anchor over strut, locating other end of anchor over adjusting screw.

NOTE: 1953 model struts are not interchangeable with past models.

22. Figure 201 shows layout low brake band assembly.
23. Install governor assembly in the bore in the transmission case, allowing it to rotate in a counterclockwise direction, as the driven gear of the governor meshes with the drive gear of the output shaft.

CAUTION: Installation should be done carefully so as not to damage gear teeth.

24. Install two $\frac{5}{16}$-18 x 3" guide pins (part of Pilot Stud Set J-3387) as guides for governor cover and install new gasket.
25. Install governor cover over guide pins and install attaching bolts and lock washers. Tighten to 6½-8½ ft. lbs.
26. Install speedometer driven gear and tighten to 45-50 ft. lbs.

TRANSMISSION TO CONVERTER HOUSING ASSEMBLY

1. Install manual valve in valve body and manual valve inner lever in converter housing. Index lever pin with pick up slot in valve.

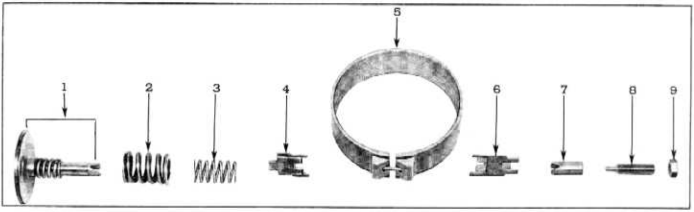

Fig. 201—Layout of Low Brake Band

1. Piston Assembly
2. Piston Return Spring
3. Strut Guide Spring
4. Apply Strut Assembly
5. Brake Band Assembly
6. Anchor Strut Assembly
7. Anchor
8. Anchor Adjusting Screw
9. Adjusting Screw Lock Nut

2. Set manual valve so end of valve protrudes 1½" from face of valve body. This places valve in reverse position.
3. Install new valve body to case gasket.
4. Raise transmission manual valve lever to top detent position which is reverse. This aligns reaction lever so that it will index with manual valve inner lever.
5. Place clutch drum thrust washer over oil delivery sleeve.
6. Install two ⅜-16 x 3¾" guide pins (part of Pilot Stud Set J-3387) in converter housing, then push case and converter housing together checking to see that reaction lever indexes properly with manual valve inner lever. Then install case to housing bolts and lockwashers and tighten to 25-30 ft. lbs.
7. From front of converter housing, install special self locking bolt. Tighten to 25-30 ft. lbs.
8. Install two $\frac{5}{16}$"-18 x 3" guide pins (part of Pilot Stud Set J-3387) as guides for servo cover and install new servo cover gasket.
9. Install pressure regulator valve and inner and outer valve springs. Install reverse servo return spring.

   NOTE: Two piece pressure regulator valve is assembled with the small end of the plunger toward the bottom of the bore in the valve.

10. Install servo cover applying pressure to cover to compress springs and secure with servo cover bolts. Tighten to 12½-15 ft. lbs.

    NOTE: Be sure pressure regulator springs and reverse servo spring seat properly in seat pockets of servo cover.

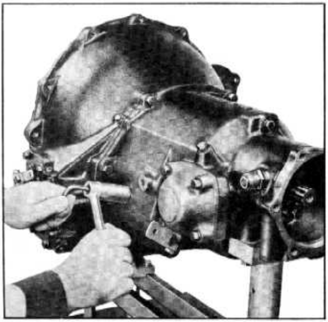

Fig. 202—Adjusting Low Servo

11. Install new modulator cover gasket and modulator cover and tighten attaching bolts to 12½-15 ft. lbs.
12. Tighten low servo adjusting screw, using tool, J-4277, down solid and back off four complete turns and tighten lock nut securely (fig. 202). Replace adjusting screw cap.
13. Install converter assembly in converter housing aligning front pump drive gear lugs with drive slots in converter pump hub.

    CAUTION: After converter is installed, check to insure engagement of converter pump hub drive slots in lugs of front pump drive gear. This dimension should with 9/16" or less (fig. 203).

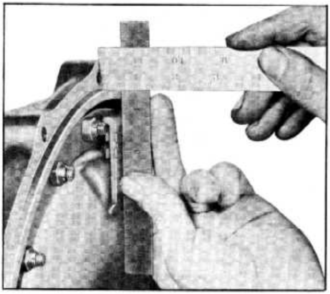

Fig. 203—Checking Engagement of Converter Pump Hub with Front Pump Drive Gear

14. Install converter holding tool, J-5384, to converter housing (fig. 204).
15. After transmission is assembled, remove the extreme lower rear low and drive valve body cover bolt and lock washer.
16. Rotate the throttle valve control outer lever assembly clockwise to the closed throttle position (to a definite stop). Hold in this position and, using throttle valve outer lever positioning gauge, J-5391, measure the distance between the open hole in the drive valve body cover and the hole in the outer lever (fig. 205). If the large pin of this gauge will go in the open hole in the cover and the small pin in the hole in the lever the adjustment is correct. If not, loosen lever to clamp attaching bolt and adjust accordingly.

    CAUTION: If an adjustment is necessary be sure that it is made with the lever in the closed throttle position.

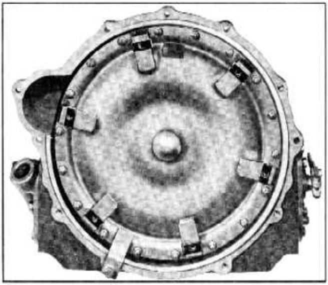

Fig. 204—Converter Assembly Holding Tool

17. Reinstall the extreme lower rear valve body cover attaching bolt and lock washer and tighten to 12½-15 ft. lbs.

18. Install "O" ring seal on universal joint ball seat.

19. Install universal joint ball seat and, using four new universal ball shims, install ball and collar and tighten attaching bolts to 8-12 ft. lbs. If ball cannot be moved by hand, add a shim until a smooth firm adjustment is obtained. If ball moves freely by hand, remove shims until proper adjustment is obtained.

    NOTE: Ball joint collar oil seal (cork) should not be installed when making this adjustment.

20. After number of shims for proper adjustment have been determined, remove universal joint ball and collar and seat. Note number of shims used for later assembly and replace universal ball, collar oil seal and collar on end of propeller shaft.

INSTALLATION

The installation of the Powerglide transmission assembly in the vehicle remains the same with a few exceptions and they are as follows:

1. Just before aligning the "X" mark on the converter cover with the "X" on the flywheel remove the converter assembly holding tool, J-5384, from the converter housing.

   CAUTION: After removing converter holding tool care must be observed so that the converter does not move forward causing disengagement of the pump hub drive slots from the lugs of the front pump drive gear.

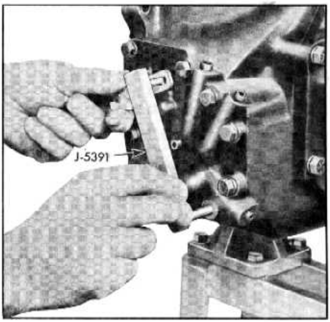

Fig. 205—Adjusting Throttle Valve Linkage and Outer Lever

2. Connect the throttle valve control rod to outer lever assembly. Install spring washer, washer and cotter pin.

3. Using oil filler tube and funnel, J-4264, place three quarts of Automatic Transmission Fluid "Type A" in transmission. Start engine and then complete filling with eight quarts "Type A" Fluid.

SHIFT PATTERNS AND PRESSURES

The following data on shift patterns and representative pressures is presented to give service personnel information to assist in diagnosing Powerglide operation. The figures may vary considerably due to variations in gauges, speedometers and oil temperature as well as variations in individual transmissions.

SHIFT PATTERNS

Upshift-Drive Range (Automatic)

Throttle Position	Range
Light throttle	10-20 MPH
To Detent	23-33 MPH
Thru Detent	*37-44 MPH

Downshift-Drive Range (Automatic)

Throttle Position	Range
Light throttle	8-10 MPH
To Detent	13-16.5 MPH
Thru Detent	*32-37 MPH

*This may be somewhat higher on early production units.

REPRESENTATIVE PRESSURES

NOTE: All pressures may vary approximately 5% (higher or lower) from the mean pressures shown. Locations of pressure check plugs are shown in Figures 206 and 207.

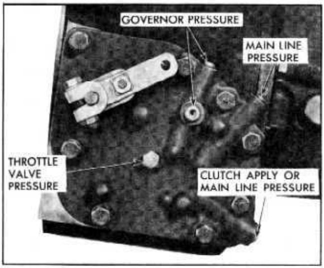

Fig. 206—Check Points

Low (Manual)

Idle 450 RPM 140# Front Pump (Main Line Pressures, fig. 206)

30 MPH

Location	Part Throttle Road Load	Full Throttle Thru Detent
Low Apply (fig. 207)	160#	190#
Governor (fig. 206)**	60#	60#

Drive (Automatic)

Transmission in Low Range			Transmission in High Range	
Light Throttle 10 MPH	Thru Detent 30 MPH	Location	Light Throttle 30 MPH	To Detent 40 MPH
70#	115#	Low Apply (fig. 207)	55#	120#
0	0	Clutch Apply (fig. 207)	55#	120#
10#	60#	Governor** (fig. 206)	68#	75#
—	45#	Throttle Valve (fig. 206)	45#	58#

**When governor pressure only is being checked, the vacuum line to the modulator must be disconnected to get a proper reading.

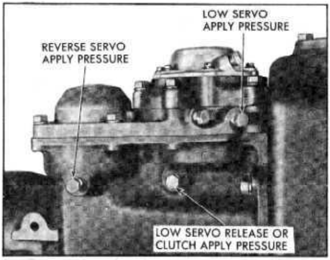

Fig. 207—Check Points

1950-52 POWERGLIDE TORQUE SPECIFICATIONS

Converter Cover Assy. to Primary Pump .... 15-20 ft. lbs.

Turbine Assy. to Converter Cover Assy. .... 12½ ft. lbs. min.

Drive Flange to Turbine Assembly .... 12½-15 ft. lbs.

Transmission Case to Housing ...... 25-30 ft. lbs.

Modulator Housing and Cover Assy. to Case .... 12½-15 ft. lbs.

Servo Cover to Case .... 12½-15 ft. lbs.

Valve Body Bolts:
2 Bolts Across Regulator Valve ... 8 ft. lbs.
All Others .... 10 ft. lbs.

Primary Pump to Hub .... 4½ ft. lbs.

Rear Pump Assy. to Case .... 12½-15 ft. lbs.

Universal Joint Assy. to Planet Carrier .... 25-30 ft. lbs.

Ball Joint Collar to Case .... 8-12 ft. lbs.

Speedometer Driven Gear Fitting .... 45-50 ft. lbs.

Brake Band Adjusting Screw Lock Nut .... 20-25 ft. lbs.

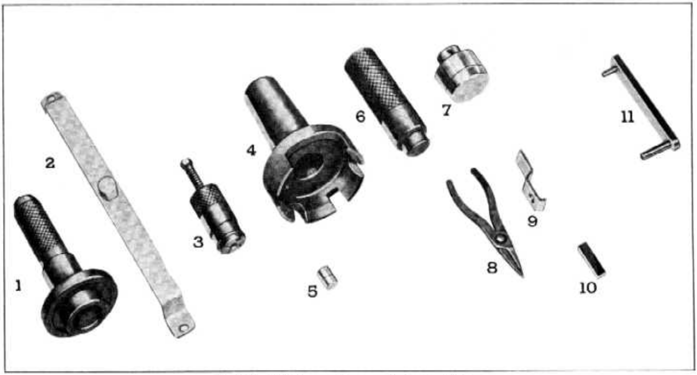

Fig. 208—1953 Powerglide Transmission Special Tools

1. Front Pump Seal Driver—J-5386
2. Torque Converter Turning Tool—J-5388
3. Converter Cover Bushing Remover—J-5381
4. Front Pump Driver Body (Use with J-4263 Pilot)—J-4263-5
5. Modulator Assembly Tool—J-5389
6. Converter Cover Bushing Replacer—J-5382
7. Stator Race Installing Tool—J-5390
8. Low and Drive Valve Body Snap Ring Pliers—J-5403
9. Converter Assembly Tool—J-5384
10. Inner Lever Positioning Gauge—J-5385
11. Outer Lever Positioning Gauge—J-5391

1953 POWERGLIDE TORQUE SPECIFICATIONS

Converter Cover Assy to Converter Pump	15-20 ft. lbs.
Transmission Case to Housing	25-30 ft. lbs.
Low and Drive Valve Body to Cover	3½-5 ft. lbs.
Low and Drive Body Assy. to Housing	12½-15 ft. lbs.
Modulator Housing and Cover Assy. to Case	12½-15 ft. lbs.
Servo Cover to Case	12½-15 ft. lbs.
Governor Cover to Case	6½-8½ ft. lbs.
Valve Body Bolts	7½-10 ft. lbs.
Rear Pump Assy. to Case	12½-15 ft. lbs.
Universal Joint Assy. to Planet Carrier	25-30 ft. lbs.
Ball Joint Collar to Case	8-12 ft. lbs.
Speedometer Driven Gear Fitting	45-50 ft. lbs.
Brake Band Adjusting Screw Lock Nut	20-25 ft. lbs.

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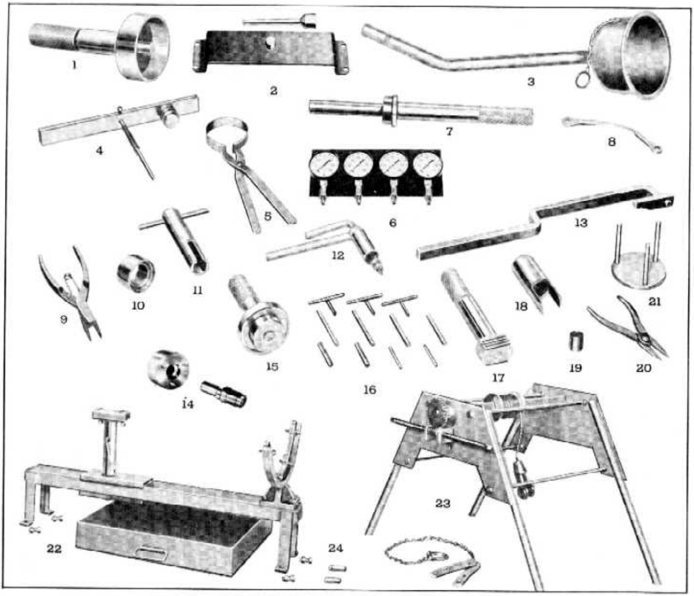

Fig. 209—1950-52 Powerglide Transmission Special Tools

1. Front Pump Driver—J-4263
2. Torque Converter Turning Tool—J-4920
3. Oil Filler Tube and Funnel —J-4264
4. Transmission End Clearance Gauge—J-4260
5. Servo Ring Compressor—J-3365
6. Transmission Pressure Gauges—J-4872
7. Transmission Rear Bearing Installer—J-4276
8. Transmission Sling—J-4262
9. Snap Ring Pliers—KMO-410
10. Stator Race Installing Tool—J-3362
11. Parking Lock Pawl Spring Remover and Replacer—J-3383
12. Band Adjusting Wrench—J-4277
13. Flywheel Indexing Tool—J-4281
14. Turbine Bushing Remover and Replacer—J-4375
15. Front Pump Oil Seal Driver —J-4240
16. Pilot Stud Set—J-3387
17. Transmission Rear Bearing Remover—J-4275
18. Reverse Servo Piston Apply Spring Compressor—J-3377
19. Modulator Assembly Tool—J-4261
20. Accumulator Retaining Snap Ring Pliers—J-4245
21. Clutch Spring Compressor—J-3364—J-5133
22. Transmission Assembly Fixture—J-3361
23. Transmission Hoist—J-4279
24. Planet Pinion Pin Assembly Tool Set—J-4599

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SECTION 8

FUEL AND EXHAUST

CONTENTS OF THIS SECTION

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FUEL SYSTEM

GENERAL DESCRIPTION

The fuel tank on passenger car models, having a 16 gallon capacity, is mounted on the left side of the car. The tank assembly consists of two shallow pans, each with a wide flange, which are set face to face and seam welded at the flanges around the entire tank to assure leakproof construction. Exceptional stiffness is secured by the combination of the welded flanges and depressed ribs in each of the pans.

The outlet or suction pipe and that portion of the pipe connecting to the pipe flange has a downward slant toward the tank bottom to eliminate the possibility of water or moisture accumulating at this point, and to prevent starvation as the tank becomes nearly empty. Upper and lower filler necks are so treated that rust will not get into the fuel supply.

The filler neck is combined with a vent tube which extends from the top of the tank to the top of the filler neck. The filler neck is accessible through the left rear fender and is covered with a vented and easily applied cap. The vented cover is covered by a spring loaded lid in the left rear fender. A vent pipe is provided inside the filler tube which makes it easier to fill the fuel tank.

The tank is supported by two straps attached to the body and is fitted with a tank gauge unit and a direct acting float, the movement of which is transferred to the tank unit rheostat contact by a link arm.

Considerable attention has been given to locating the gasoline feed lines so as to reduce vapor lock to a minimum. The main feed line is located on the inside of the right frame side rail—opposite side to the exhaust system—passes up the fuel pump side of the engine and is held in a retainer at the thermostat housing and carries back from that point to the carburetor.

In this way the lines are exposed to outside air currents along the car frame and through the radiator grilles.

> ***CAUTION: Always drain gasoline from complete fuel system including carburetor, fuel pump, all fuel lines and fuel tank if car is to be stored for any appreciable length of time. This precaution will prevent gum formations and resultant improper engine performance.***

FUEL TANK—REPLACE

1. Drain tank.
2. Disconnect filler neck and vent pipe hose connections at lower clamp.
3. Disconnect gasoline line from tank.
4. Loosen tank support straps enough to disconnect gauge wire on float unit.
5. Remove tank support straps and lower tank to floor.
6. Installation is performed by reversing the above operations.

EXHAUST SYSTEM

GENERAL DESCRIPTION

The exhaust system used on all passenger car models includes an exhaust pipe and muffler assembly and a tail pipe that extends back to a point where gases are discharged below the rear bumper on the left hand side.

The muffler is oval in shape to provide for additional road clearance. It is of integral construction having four sound arresting chambers (fig. 1)

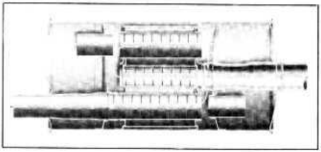

Fig. 1—Muffler Cross Section

and employs the reverse flow and diffusion principle. Incorporated at each end of the muffler is a resonance chamber, each chamber being connected to the main section of the muffler by a resonator tube. These resonance chambers eliminate period noises that usually occur in exhaust on coasting.

All external parts of the muffler are electric arc welded while all internal parts are spot welded in position. This type construction makes failure or rattling practically impossible.

When installing an exhaust and muffler assembly or a tail pipe, care should be taken to have these parts in the proper relation with each other. Incorrect alignment of the exhaust system is frequently the cause of annoying rattles due to incorrect clearances. Unusual noises, hard to locate, are sometimes due to a change or obstruction to normal flow of gases through improper mountings.

The center mounting directly back of the muffler (fig. 2) is a vulcanized shear type rubber cushion design. This holds to a minimum the transfer of any exhaust vibrations to the frame and body.

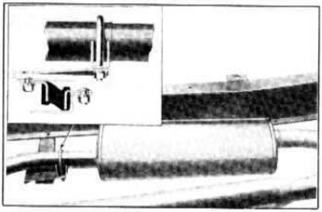

Fig. 2—Muffler Mounting

The rubber cushion is mounted to the muffler outlet pipe and the support is on a frame bracket. The muffler end of the tail pipe slides over the outlet pipe of the muffler and is held in place by a clamp. The back end of this tail pipe is clamped in a tail pipe support bracket. This bracket is attached through a rubber grommet located between it and a separate bracket riveted to the rear cross member. The rubber grommet is held in controlled suspension by a spacer, insuring proper tension on this mounting at all times.

There are two points to consider when installing an exhaust and muffler assembly or a tail pipe.

1. There should be ⅝" clearance between the underside of the floor pan and the tail pipe at the kick up.
2. The tail pipe support must be in a vertical position. If it is at an angle the tail pipe is apt to strike the bumper.

To replace a muffler assembly, cut exhaust pipe as close to muffler inlet as possible which will allow new muffler to be slipped over end of exhaust pipe.

If exhaust pipe has to be replaced it will be necessary to replace both the exhaust pipe and muffler with service replacement parts.

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SECTION 9

STEERING GEAR ASSEMBLY

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GENERAL DESCRIPTION

The steering gear (fig. 1) used on all passenger car models is of the roller sector type with an hour glass worm. The sector roller rotates on a double row of ball bearings. The gear ratio is 17.4 to 1 on 1949 and early 1950 models.

A steering gear assembly having a gear ratio of 19.4 to 1 in place of 17.4 to 1 went into production as a mid-season change in 1950 and is also used in all 1951-53 models. This assembly reduces steering effort, especially at low speed cornering and when parking.

The assembly, which may be interchanged with the old assemblies on 1949 and early 1950 models, may be identified by an embossed letter "X" which is ½" wide and is located on top of the steering gear housing near the mast jacket.

Component parts of the assembly are not interchangeable with parts in the old assemblies.

The principal working parts of the gear are the steering worm, sector roller and sector shaft. Each one of these parts is of heat treated alloy steel. The hour glass worm is pressed onto the

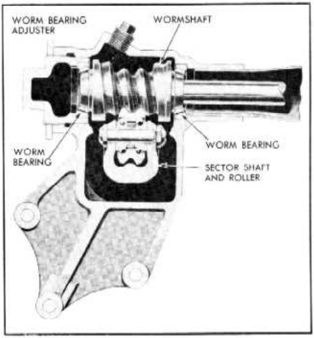

Fig. 1—Steering Gear Cross Section

steering mainshaft and is mounted between two roller bearings, the lower one of which is adjustable toward the upper for taking out end play in the worm shaft.

The sector roller is mounted on a double row ball bearing which in turn is supported on a through bolt that retains the assembly to the sector shaft. The sector roller, therefore, is free to rotate and thus provides a rotating engagement of the roller with the hour glass worm. The sector shaft is supported in an anti-friction bushing at one end and in the sector shaft cover at the other end on 1949-52 models. On 1953 models, needle bearings are used at both ends of the sector shaft. A grease seal is provided near the outer end of the sector shaft. The sector roller gear is not an ordinary spur gear, but is produced by a special process to provide true gear action between the hour glass worm and sector. With this construction, the adjustment for backlash between the worm and sector is very simple; all that is required is to shift the sector shaft slightly along its own axis by means of a convenient thrust screw, known as a lash adjuster.

The worm teeth are purposely cut in such a way that, when the sector is adjusted to take out all backlash at the center of travel or straight ahead position, there will be a slight backlash at each end of travel, thus snugness of the sector in the worm teeth in a straight-ahead position can be obtained without sacrifice of perfect freedom at extreme positions right or left of the front wheels.

The horn wire is soldered to a contact ring pressed into the mast jacket and insulated from the worm shaft (fig. 2). A spring loaded contact

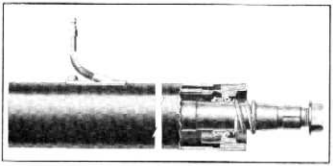

Fig. 2—Mast Jacket Bearing

horn button or a horn ring contact is in the steering wheel and when depressed the horn button or horn ring contact engages the contact ring. The wire from the horn is attached to a connector terminal at the mast jacket cover plate.

MINOR SERVICE OPERATIONS

ADJUSTMENTS

Correct adjustment of the steering gear is very important. While there are but two adjustments to be made, the following procedure must be followed step-by-step in the order given.

1. Disconnect the steering connecting rod from the pitman arm, taking care to note relative positions of steering connecting rod parts before disturbing them.
2. Remove sheet metal splash guard covering steering gear housing.
3. Loosen the lock nut "B" (fig. 3) and turn the lash adjuster "A" a few turns in a counterclockwise direction. This removes from the worm bearings the load imposed by close meshing of worm and sector teeth. Turn steering wheel gently in one direction until stopped by gear, then back away about one turn.

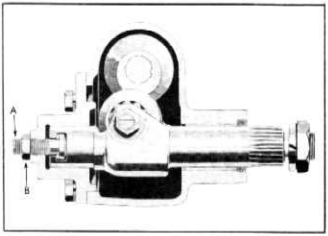

Fig. 3—Sector Adjustment Points

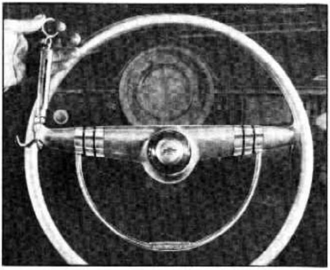

Fig. 4—Checking Load on Steering Gear

CAUTION: Do not turn steering wheel hard against stops when steering connecting rod is disconnected as damage to sector roller may result.

4. Using J-544-A Steering Gear Checking Scale, measure the pull at the rim of the wheel which is required to keep the wheel in motion. This should be between ⅜ and ⅝ pounds (fig. 4).

   If the pull necessary to move the wheel does not lie between these limits, adjustment of worm bearings is necessary.

   NOTE: When making this check, it is important that the line of the scale be kept tangent to the rim of the wheel.

5. To adjust the worm bearing, loosen lock nut "C" (fig. 5) and turn worm bearing adjusting cup "D" until there is no perceptible end play in worm. Check pull at wheel rim as

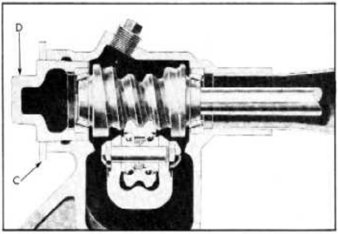

Fig. 5—Worm Bearing Adjustment Point

outlined above, readjusting if necessary, to obtain proper pull. Tighten lock nut "C" and recheck pull as it must lie between the limits specified after the lock nut is tightened. If the gear feels "lumpy" after adjustment of worm bearings, there is probably damage in the bearings due to severe impact or to improper adjustment and the assembly must be disassembled for replacement of damaged parts. Instructions for disassembly follow under the heading, "Repair Operations."

6. After proper adjustment of worm is obtained, and all mounting bolts tightened to 27-40 ft. lbs. torque, adjust lash adjuster "A" (fig. 3). First turn the steering wheel gently from one stop all the way to the other, carefully counting the total number of turns. Then turn wheel back exactly halfway, to center position. Remove the steering wheel ornamental cap or horn button and note position

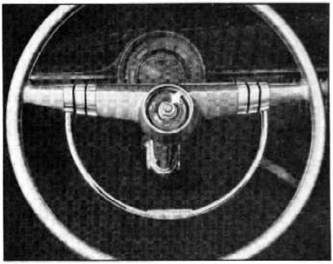

Fig. 6—Steering Gear Highpoint Mark

of mark on end of worm shaft. This mark (fig. 6) should be at the top of the shaft. Mark wheel at top or bottom center with a piece of tape. Turn lash adjuster "A" (fig. 3) clockwise to take out all lash in gear teeth, and tighten lock nut "B" to 10-15 ft. lbs. torque. Turn steering wheel off the high spot, then check pull at wheel rim with checking scale as before, taking the highest reading of checking scale as the wheel is turned through center position. This should be between ⅞ and 1⅞ pounds. If the reading is not within the above limits, turn the wheel a half turn off the high spot and either tighten or loosen the adjuster as necessary. Then recheck the adjustment by again pulling through the high spot with the checking scale.

   CAUTION: The final adjustment must be between ⅞ and 1⅞ pounds.

7. Reassemble steering connecting rod to pitman arm and adjust as outlined under Steering Connecting Rod—Adjust.

8. Replace sheet metal splash guard covering steering gear housing.

STEERING CONNECTING ROD—ADJUST

The steering connecting rod is adjustable for length to enable maintaining high point of steering gear adjustment with front wheels in the straight ahead position. Figure 7 shows details of connecting rod. Before making this adjustment, however, it is important that the ball and socket ends be adjusted properly to the pitman arm ball stud and the steering idler and third arm ball stud.

1. Remove cotter pins from ends of sockets and using a drag link bit in screw plug slot,

tighten plugs snugly to remove all end play of ball.

2. Back off screw plugs one complete turn plus amount necessary to insert cotter pin and lock adjustment.
3. Set front wheels in straight ahead position. This can be checked by measuring distance between lubrication fitting on lower control arm shaft and wheel felloe on each side.

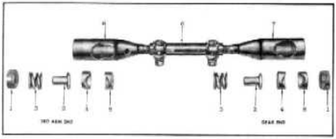

Fig. 7—Steering Connecting Rod Assembly Layout

1. Screw Plug
2. Safety Plug
3. Spring
4. Ball Seat
5. Ball Seat
6. Front Rod
7. Rear Rod
8. Adjusting Sleeve

4. With front wheels set straight ahead, remove ornamental cap or horn button and check position of mark on end of wormshaft designating steering gear high point.

NOTE: Steering gear high point is designated by a mark on end of worm shaft. This mark should be at the top of the shaft (fig. 6).

5. If gear has been moved off high point when setting wheels in straight ahead position, loosen steering connecting rod adjuster clamps and adjust by rotating as necessary to bring gear back on high point.
6. Tighten steering connecting rod adjuster clamp bolts to 8-12 ft. lbs. torque.

STEERING COLUMN GEARSHIFT LINKAGE—ADJUST

In cases where insufficient clearance is encountered between the gearshift lever and the steering wheel or whenever the gearshift linkage has been removed or disconnected, as on a steering gear overhaul, proper adjustment sequence is important. Adjustment should be made as outlined in Section 7.

MAST JACKET UPPER BEARING—REPLACEMENT

1. Remove horn button or ornamental cap and remove wheel retaining nut and washer.
2. On models equipped with horn blowing ring, remove screws holding pivot ring and remove pivot ring, lock ring and horn blowing spring washer.
3. Install steering wheel puller J-2927 and remove steering wheel.
4. Disconnect horn wire at connector and remove horn cable jacket clamp from mast jacket. Attach a piece of tie wire to the end of horn wire which enters the mast jacket.
5. Screw bearing puller J-2565 into top of bearing. Tightening the center screw in the puller removes the bearing from the mast jacket (fig. 8).

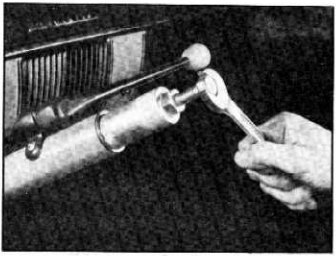

Fig. 8—Removing Mast Jacket Upper Bearing

6. Transfer tie wire to end of wire attached to new bearing assembly. Start bearing into mast jacket and drive it into place with special driver J-2565 (fig. 9).

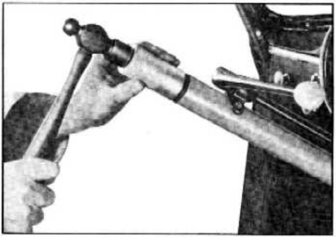

Fig. 9—Replacing Mast Jacket Upper Bearing

7. Pull wire through opening in mast jacket and install the horn cable jacket clamp.
8. Install the steering shaft upper bearing spring seat (with flared end up) and spring.

9. On models with horn blowing ring, install horn button contact and spring assembly in opening provided in steering wheel hub, install horn blowing spring washer, pivot ring and lock ring and tighten pivot ring screws to secure proper horn contact adjustment.
10. Install steering wheel, washer and nut, and tighten to 25-30 ft. lbs. torque.
11. Install horn button or ornamental cap, connect horn wire at mast jacket and test operation of horn.

MAJOR SERVICE OPERATIONS

Removal

1. Remove the horn button or ornamental cap and remove the steering wheel retaining nut and washer.
2. On models equipped with horn blowing ring, remove screws holding pivot ring and remove pivot ring, lock ring and horn blowing spring washer.
3. Using steering wheel puller J-2927, thread the puller anchor screws into the threaded holes provided in the steering wheel hub. Turn the center screw down tight against the centering adapter and then strike the puller screw head a light solid blow which will jar the steering wheel loose.
4. Remove upper control shaft clamp bolt from shaft connector.
5. Remove steering mast jacket toe board grommet and seal from toe board.
6. Remove nuts and lockwashers from the instrument panel to mast jacket clamp and remove clamp.
7. Remove the two clutch head screws that attach the gearshift control upper support to the mast jacket. The upper control shaft and upper support may now be pulled up out of engagement from shaft connector and removed.
8. Remove clamp bolt nuts and clamp retaining the shifter housing to the mast jacket and rotate shifter housing with lower control shaft and control rods attached away from mast jacket.
9. Remove sheet metal splash guard covering steering gear housing and remove nuts, lockwashers and bolts attaching steering gear housing to frame side rail.
10. Remove sheet metal screws attaching air duct to left fender skirt and remove duct.
11. Rotate gear assembly to clear fender skirt and then raise steering gear assembly bringing it up and forward to remove from engine compartment.

Disassembly

As with any steering gear assembly, the steering gear parts must be kept free of dirt. Clean paper or rags should be spread on the bench before starting disassembly of the steering gear.

1. Place assembly in bench vise, remove nut and lockwasher from end of sector shaft and remove pitman arm using pitman arm puller J-1025.
2. Loosen the lock nut "B" on the end of the sector shaft (fig. 3), then turn the lash adjuster "A" a few turns counterclockwise. This will remove the load from the bearings caused by the close meshing of the worm and sector teeth.
3. Loosen the lock nut "C" (fig. 5) on the worm bearing adjuster cup and turn the adjuster cup "D" counterclockwise a few turns.
4. Place a pan under the assembly to catch the lubricant and remove the bolts attaching the side cover to the housing.
5. Pull the side cover with the sector and shaft from the housing.

   NOTE: If sector does not clear the opening in the housing easily, turn the worm shaft by hand until the sector will pass through the opening in the housing.

6. Remove the worm bearing adjuster cup and lower worm bearing.
7. Draw the worm and shaft assembly from the housing. Lay this assembly flat on the bench so that the worm will not become damaged.
8. Remove the lock nut from the lash adjuster and screw the lash adjuster through the side cover. Slide the lash adjuster out of slot in the end of the sector shaft.

Inspection

With the steering gear completely disassembled (fig. 10) wash all parts in cleaning solvent. Dry them thoroughly with clean rags.

1. With a magnifying glass inspect the roller bearings, cups, worm and the sector roller.
2. Check sector roller for any tightness or roughness of bearings.
3. Inspect the sector shaft for wear and on 1949-52 models check the fit of the shaft in the housing bushing. On 1953 models, inspect needle bearings.
4. On 1949-52 models, inspect the fit of the sector shaft in the side cover. If this area in the

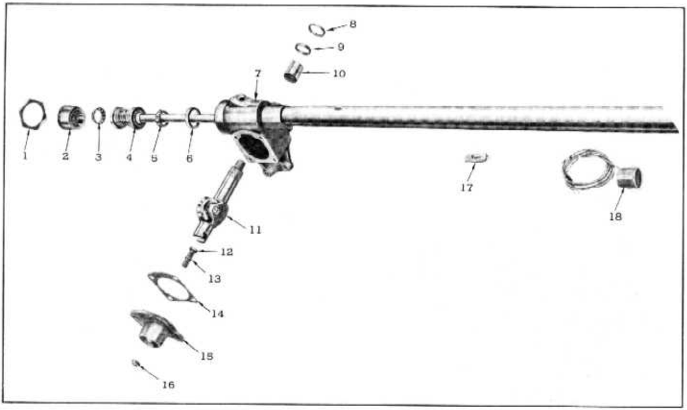

Fig. 10—Layout of Steering Gear Parts (1949-52)

1. Worm Bearing Adjuster Lock Nut
2. Worm Bearing Adjuster Cup
3. Lower Worm Shaft Roller Bearing
4. Worm Shaft Assembly
5. Upper Worm Shaft Roller Bearing
6. Upper Worm Shaft Roller Bearing Race
7. Housing and Mast Jacket Assembly
8. Sector Shaft Packing Retainer
9. Sector Shaft Packing
10. Sector Shaft Bushing
11. Sector Shaft and Roller Assembly
12. Lash Adjuster
13. Lash Adjuster Shim
14. Housing Side Cover Gasket
15. Housing Side Cover
16. Check Nut
17. Horn Wire Retainer
18. Mast Jacket Bearing Assembly

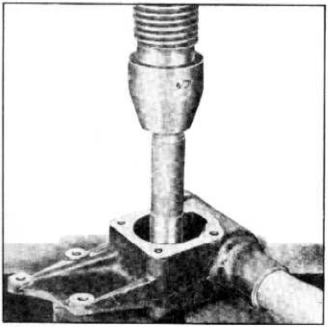

Fig. 11—Replacing Sector Shaft Bushing

cover or the shaft is worn a new side cover and shaft should be installed.

NOTE: Any parts that show signs of wear or damage should be replaced.

REPAIRS

Sector Shaft Bushing and/or Packing Replacement—1949-52 Models

1. Support steering gear housing in an arbor press and press sector shaft bushing packing and packing retainer from housing using J-1614 sector shaft bushing driver (fig. 11).
2. Press new bushing into position using sector shaft bushing driver J-1614.

   NOTE: Bushings are diamond bored to size and require no further reaming.

3. Press new packing and retainer into housing.

Sector Shaft Needle Bearing and/or Packing Replacement—1953 Models

1. Support steering gear housing in an arbor press and press sector shaft needle bearing packing and packing retainer from housing using J-5408 sector shaft bearing driver.
2. Press new needle bearing into position using sector shaft bearing driver J-5408.
3. Press new packing and retainer into housing.

Housing Side Cover Bearing—1953 Models

1. Place side cover in vise and install housing

side cover bearing remover adapter J-5409 and bearing remover J-5190.

2. Tighten screw in remover J-5190 and remove bearing.
3. Install new bearing to position in side cover with bearing driver J-5408.

Sector Shaft Packing Replacement

1. Pry packing retainer out of housing and remove packing.
2. Soak the new packing in engine oil to lubricate it; then, install it in a new packing retainer.
3. Press packing retainer and packing into housing.

Mainshaft Bearing Cups—Replacement

1. Support steering gear housing or worm bearing adjuster in a bench vise and install Mainshaft Bearing Cup Remover J-3183 making sure flange locates behind bearing cup.
2. Tighten split sleeve expander bolt to anchor flange behind bearing cup; then, tighten puller nut (fig. 12) to remove cup.

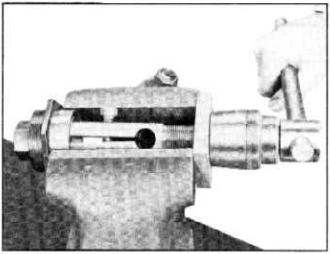

Fig. 12—Removing Mainshaft Bearing Cup

3. Install new bearing cup on Bearing Cup Replacer J-3182 and drive cup into housing or worm bearing adjuster (fig. 13).

NOTE: Exercise care when installing cups that they are not cocked.

Assembly

1. Place the upper roller bearing over the worm shaft. Making sure the end of the horn wire is through its opening in the housing, thread the worm shaft into the housing. Install the lower roller bearing and assemble the worm bearing adjuster cup to the housing.
2. Assemble the lash adjuster with shim in the slot in the end of sector shaft. Check the end clearance which should not be greater than

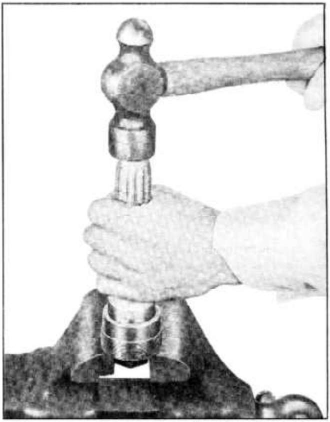

Fig. 13—Installing Mainshaft Bearing Cup

.002″ (fig. 14). For the purpose of adjusting this end clearance, a steering gear lash adjuster shim unit Part Number 605142 is available. It contains four shims—.063″, .065″, .067″ and .069″ thick.

3. After the lash adjuster end clearance has been adjusted start the sector shaft pilot into the side cover. Then, using a screwdriver through the hole in the cover, turn the lash adjuster in a counterclockwise direction to pull the sector shaft pilot into the side cover as far as it will go.
4. Place a new gasket on side cover; then push

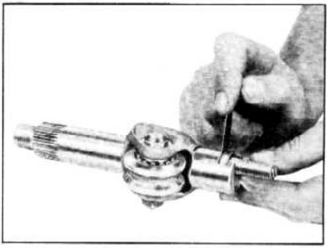

Fig. 14—Checking Sector Shaft Lash Adjuster End Clearance

the side cover assembly including sector shaft into place. After making sure there is some lash between the worm and sector roller, assemble and tighten the side cover bolts.

Adjustment—On Bench

1. Tighten the worm bearing adjuster cup until all worm shaft end play has been removed. Then tighten the lock nut.
2. Install the steering wheel on the worm shaft temporarily. Carefully turn the steering wheel all the way in one direction and then turn back about one turn.
3. Using a J-544-A steering gear checking scale, at right angles to one spoke at wheel rim, measure the pull required to keep the wheel in motion. This should be between 3/8 and 5/8 pounds. If necessary, adjust the worm adjuster cup until a proper pull is obtained.
4. Turn the steering wheel from one stop all the way to the other, counting the number of turns. Then turn the wheel back exactly half the number of turns to the center or high point position. High point of gear is indicated by mark on end of worm shaft. This mark (fig. 6) should be at the top of the shaft. Mark the wheel at the top or bottom with a piece of tape.
5. Turn sector lash adjuster clockwise to take out all lash in gear teeth, and tighten lock nut to 10-15 ft. lbs. torque.
6. Turn steering wheel off the high spot, then check pull at wheel rim with checking scale as before, taking the highest reading of checking scale as the wheel is turned through center position. This should be between 7/8 and 1 7/8 pounds.
7. If the reading is not within the above limits, turn the wheel a half turn off the high spot and either tighten or loosen the adjuster as necessary. Then recheck the adjustment by again pulling through the high spot with the checking scale.

   CAUTION: The final adjustment must be between 7/8 and 1 7/8 pounds.

8. Fill the assembly with steering gear lubricant to the level of the filler plug hole and replace filler plug.
9. Install pitman arm, lockwasher and nut and tighten to 90-100 ft. lbs. torque.

Installation

1. Start end of mast jacket through hole in toe pan, lower gear assembly into engine compartment and place in position on frame side rail.
2. Install mast jacket toe board grommet and seal to toe board.

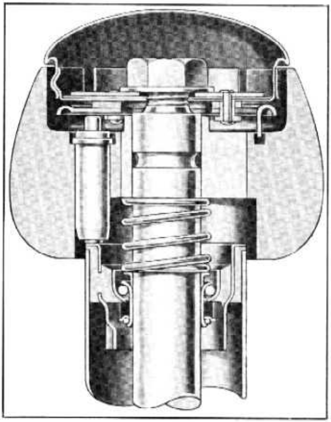

Fig. 15—Standard Wheel

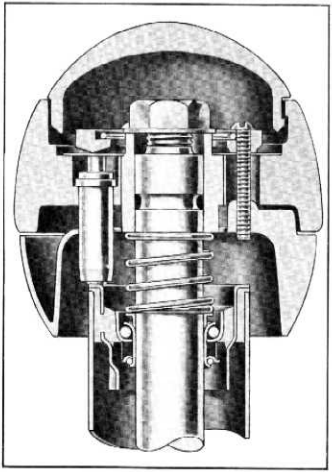

Fig. 16—Deluxe Wheel

3. Install bolts, lockwashers and nuts retaining housing to side rail but do not tighten.
4. Install mast jacket to instrument panel clamp and install bolts and tighten securely. Then tighten housing to frame side rail bolts to 27 to 40 ft. lbs. torque.
5. Rotate shifter housing with lower control shaft and control rods attached to mast jacket, indexing dowel in housing body with dowel hole in mast jacket. Install retaining clamp lockwasher and nuts, and tighten securely.
6. Install upper control shaft and shifter lever assembly to mast jacket indexing end of shaft with control shaft connector and install upper clamp bolt and nut. Tighten nut securely.
7. Install two clutch head screws attaching gearshift control upper support to the mast jacket.
8. With steering gear on high point, install steering wheel, with spokes horizontal, washer and nut, and tighten to 25-30 ft. lbs. torque. Install horn blowing spring washer, pivot ring and lock ring and install pivot ring screws and tighten to secure proper horn contact adjustment.
9. Install horn button or ornamental cap. Figure 15 and 16 illustrate steering wheel in cross section.
10. Replace sheet metal splash guard covering steering gear housing.
11. Replace air duct to left fender skirt.
12. Adjust steering column gearshift controls as outlined in Section 7 and steering connecting rod as outlined in this section under "Minor Service Operations."

TROUBLES AND REMEDIES

STEERING GEAR

Symptom and Probable Cause	Probable Remedy
Hard Steering	
a. Lack of lubrication.	a. Lubricate steering gear, tie rod ends, steering connecting rod ball joints and idler arm pivot pin.
b. Steering connecting rod ends too tight.	b. Readjust steering connecting rod ends.
c. Underinflated tires.	c. Inflate tires to recommended pressure.
d. Improper adjustment.	d. Adjust according to instructions.
Loose Steering	
a. Improper adjustments.	a. Adjust according to instructions.
b. Loose ball joints.	b. Adjust ball joints.
c. Worn steering knuckle bushings.	c. Replace steering knuckle bushings.
d. Worn sector shaft bushing.	d. Replace bushing.

STEERING GEAR SPECIFICATIONS

Gear Ratio............................17.4 to 1
Gear Ratio Late 1950 and 1951-53 ....19.4 to 1
Type—
Semi-Reversible Hour Glass Worm and Ball Bearing Roller Sector

End Clearance Lash Adjuster to Sector Slot .... .002" Max.
Worm Bearing Adjustment—
3/8 to 5/8 pounds to keep wheel in motion
Lash Adjustment or High Point. 7/8 to 1 7/8 pounds

TORQUE SPECIFICATIONS

Steering Gear to Frame Bolt Nuts . .27-40 ft. lbs.
Pitman Arm Nut ....90-100 ft. lbs.
Steering Wheel Nut ....25-30 ft. lbs.
Lash Adjuster Lock Nut ....10-15 ft. lbs.

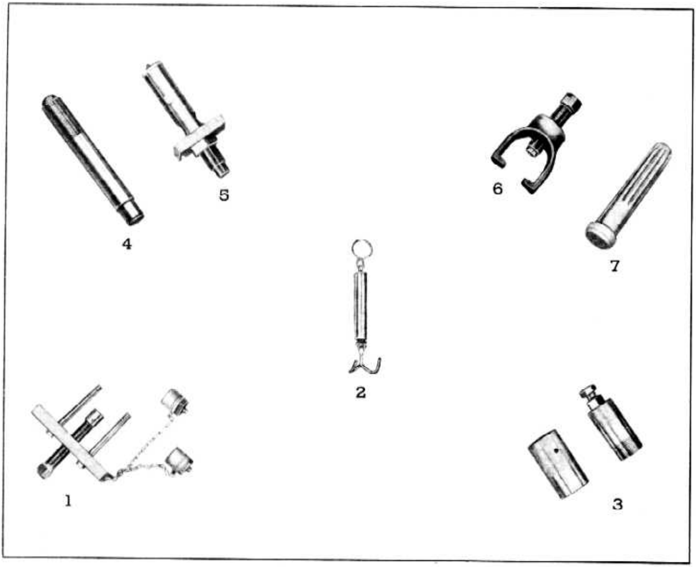

Fig. 17—Steering Gear Special Tools

1. Steering Wheel Puller—J-2927
2. Steering Gear Checking Scale—J-544-A
3. Mast Jacket Bearing Remover and Replacer—J-2565
4. Sector Shaft Bushing Driver—J-1614
5. Mainshaft Bearing Cup Remover—J-3183
6. Pitman Arm Puller—J-1025
7. Mainshaft Bearing Cup Replacer—J-3182

POWER STEERING GEAR

INDEX

GENERAL DESCRIPTION

Chevrolet Power Steering, available as optional equipment on all passenger cars, consists of a recirculating ball type steering gear to which a hydraulic power mechanism has been added. The hydraulic mechanism furnishes additional power to ASSIST the manual operation so that the turning effort at the steering wheel is greatly reduced.

The power steering gear is designed to reduce steering effort but not to remove the so called "feel" of steering. With Chevrolet Power Steering, the hydraulic assistance is zero up to a pull of about 3 pounds on the rim of the steering wheel and the steering of the car is entirely normal. At this 3 pound load, the hydraulic system starts to assist the driver's effort and from 3 to 7 pounds pull, the input effort is proportional to the force necessary to turn the front wheels. The 7 pound load is sufficient to turn the front wheels with the car standing still which means the hydraulic system is doing about 80% of the work of steering.

In addition to assisting the driver in steering the car, Power Steering greatly reduces the effort required in parking. Then too, the oil filled hydraulic cylinder absorbs road shocks when driving over rough roads, railroad tracks, etc. This permits the wheel in the driver's hand to remain steady, reduces driver "fatigue" and permits many miles of driving without tiring.

RECIRCULATING BALL

The steering gear used with Power Steering is of the recirculating ball type. The gear ratio is 21.3 to 1.

The principal working arrangement of the recirculating ball type steering gear consists of a "ball nut" connected to the steering worm and in mesh with the sector gear. Precision finished helical grooves inside the ball nut match helical grooves in the worm, and it is in these grooves that ball bearings roll around as the steering wheel is turned. There are two complete ball circuits within the ball nut with 30 balls to each circuit. To keep the balls from running out of the end of either circuit, the nut is equipped with two tubular ball guides, each of which deflects the balls away from their helical path at one end of their travel, guides them diagonally across the back of the nut, and returns them to their helical path between the ball nut and the worm at the other end of their travel.

The balls within the helical path constitute a thread between the worm and ball nut, so that when the worm is turned, the nut moves along the worm as with the ordinary screw thread. At the same time, the balls roll freely between the worm and the ball nut, circulating within their closed circuits so that screw motion is obtained with rolling contact between the parts.

The teeth in that portion of the ball nut that faces the sector and the sector gear teeth, are cut so as to provide true gear action between the sector and ball nut when the ball nut is located at a slight angle. This type of construction provides a means for backlash adjustment between the ball nut and the sector in that all that is required is to shift the sector shaft slightly along its own axis. This is accomplished by means of a convenient thrust screw, known as a lash adjuster.

The sector teeth are also cut so that when the sector is adjusted to take out all backlash at the center of travel or straight ahead position, there will be slight backlash at each end of travel, thus snugness of the sector in a straight ahead position can be obtained without sacrifice of perfect freedom at extreme positions, right or left, of the front wheels.

The sector shaft is straddle mounted in anti-friction bushings and a grease seal is provided at the outer end of the shaft.

The worm is integrally welded to the mainshaft and is mounted on two roller bearing.

HYDRAULIC STEERING MECHANISM

The hydraulic power steering mechanism consists of an engine driven oil pump capable of delivering oil at a pressure of 750 to 900 pounds per square inch, an oil reservoir, a double-acting hydraulic power cylinder, and a control valve (fig. 18).

The hydraulic cylinder assembly is mounted on the steering gear housing and is linked to the pitman shaft gear through a power rack attached to the end of the piston rod (fig. 19). The power rack is guided by a shim adjusted plate bolted to the housing cover.

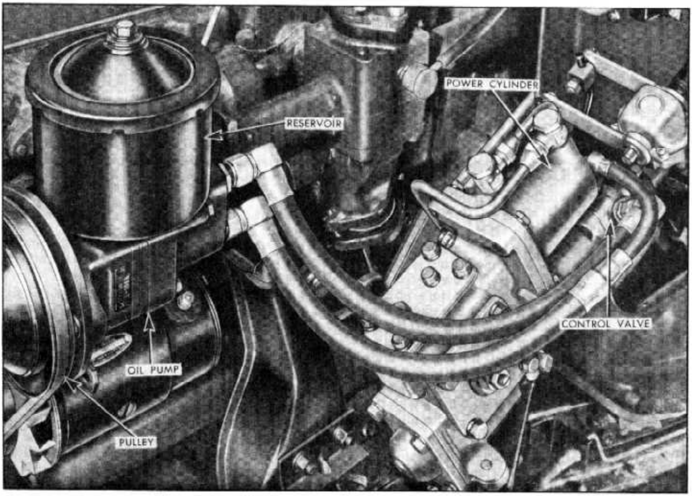

Fig. 18—Power Steering and Pump Installation on Car

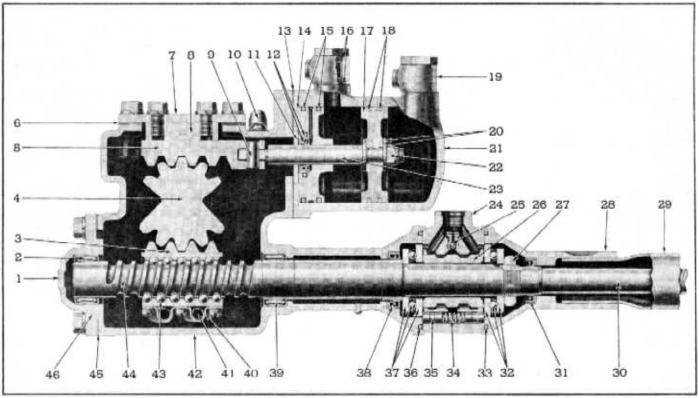

Fig. 19—Power Steering Cross-Section

1. Housing End Cover
2. End Cover Worm Bearing
3. Ball Nut
4. Pitman Shaft with Sector Gears
5. Power Rack
6. Power Rack Cover Shims
7. Power Rack Cover
8. Power Rack Guide
9. Coupling Pin
10. Filler Plug and Vent
11. Rack Stop Plate
12. Adapter Push Rod Seal and "O" Ring Seal
13. Power Cylinder Gasket
14. Power Cylinder Adapter
15. Adapter "O" Ring Seal
16. Elbow Fitting "O" Ring Seals
17. Power Cylinder Piston
18. Piston Rings
19. Elbow Fitting
20. Piston Rod Thrust Washer
21. Power Cylinder
22. Piston Rod Lock Nut
23. Piston Rod
24. Valve Body
25. Check Valve
26. Valve Spool
27. Worm Thrust Bearing Nut
28. Valve Cover
29. Mast Jacket
30. Steering Mainshaft
31. Valve Cover Seal
32. Worm Thrust Bearing (Upper)
33. Valve "O" Ring Seal
34. Centering Spring
35. Centering Plungers
36. Valve "O" Ring Seal
37. Worm Thrust Bearing (Lower)
38. Housing Worm Seal
39. Housing Worm Bearing
40. Ball Return Guide Clamp
41. Ball Return Guide
42. Steering Gear Housing
43. Ball
44. Steering Worm
45. End Cover Gasket
46. End Cover

The hydraulic control valve is mounted on the steering gear housing and is concentric with the steering mainshaft. This valve consists of a spool having two annular grooves which connect three annular passages inside the valve body (fig. 19). The valve spool is centered and restrained from linear motion on the shaft by five sets of plungers which bear against the cover on one end and the housing on the other end. The plungers also bear at the ends against thrust bearings which are attached to the steering shaft above and below the spool. The plungers are held against these parts by the action of five springs. It is, therefore, necessary to overcome the preload of the five springs before the valve spool can be moved up or down. When there is sufficient resistance to rotation of the pitman shaft developed at the road wheels, continued turning of the steering wheel will result in an axial movement of the worm and shaft, thus overcoming the preload of the springs. This axial movement is due to the lead on the steering worm and the direction of movement is dependent upon the direction of rotation of the steering wheel.

The ball thrust bearings located above and below the valve spool limit the movement of the valve spool and absorb the thrust loads developed when the steering shaft is turned against resistance.

A by-pass valve is built into the control valve body and is used merely to insure easy steering in the event of pump failure. Should the pump fail to operate, this by-pass valve would open and allow the oil to by-pass the pump and reservoir. Thus, in the event of such failure, steering would be entirely mechanical.

HYDRAULIC PUMP AND RESERVOIR

The oil pump, a Vickers vane type pump, is mounted on the engine in position to be driven by a belt from the crankshaft balancer.

The Vickers pump houses a slotted driving hub or rotor in which twelve vanes slide radially outward to contact the hardened and ground inside surface of a cam ring. As the shaft and rotor rotate, centrifugal force and fluid pressure against the inner ends causes the vanes to follow the cam contour of the ring. The contour of the ring is so shaped that two opposing pumping chambers are formed. In each pumping chamber, the increasing and decreasing pockets formed between the rotor, vanes, and ring propel the oil from the entrance to the exit ports of pump.

The pump contains a combination overload relief valve, which is set to open at 750 psi to 900 psi, and a flow control valve which recirculates oil within the pump as required to regulate the output volume between .9 gal. per minute at idling speed to 1.8 gal. per minute at approximately 2000 RPM.

The reservoir is mounted on the pump and provides a reserve supply of oil to assure complete filling of the hydraulic system. An air chamber in the upper part of the reservoir and a vented cover attachment provide for the escape of any air that may be introduced into the system.

OPERATION OF HYDRAULIC BOOSTER SYSTEM

Figure 20 shows an outline drawing of the hydraulic booster system added to a recirculating ball steering gear. It can be seen that movement of the piston rod will rotate the pitman shaft through the power rack and the power sector which is integral with the pitman shaft. The pitman shaft, in turn, has fixed to it the pitman arm which is the link connecting to the steering linkage that actually turns the front wheels.

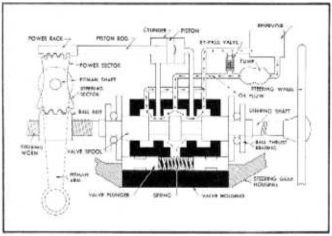

Fig. 20—Hydraulic Circuit—Neutral

In the position shown in Figure 20, it is apparent that oil from the pump can circulate freely through the oil lines to the valve housing, through the grooves in the housing and spool, and back through the return line to the reservoir. At the same time, the piston, through action of the power rack and piston rod, can be moved back and forth freely with no change in the system except to move oil through the connecting line from one end of the cylinder to the other. Except for restrictions in lines and passages, there is no resistance to the flow of oil and oil circulates at practically zero pressure. With the valve in the position shown, the pump has no influence on the cylinder.

As long as the load required on the steering wheel remains less than 3 pounds, the valve spool will remain in this neutral position. The 5 plunger springs are compressed or preloaded to a total load of about 300 pounds, and as a result, there can be no valve operation unless the load tending to move the valve exceeds this amount. The ball bearing screw and ball-nut is, in effect, a very efficient jack and it takes only about 3 pounds pull at the rim of the steering wheel to develop the 300 pound load. Up to such a load there is no hydraulic boost and the car steers normally.

If the steering wheel were to be turned to the left, for example, under such steering conditions that would require a load exceeding 3 pounds, then the ball bearing screw and nut would force the whole steering shaft, including the valve spool, to the right. This would place the valve parts in the position shown in Figure 21.

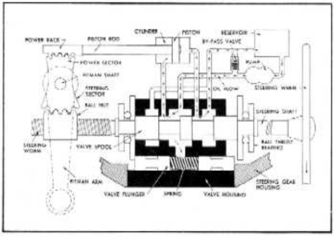

Fig. 21—Hydraulic Circuit—Start of Left Turn

When the valve spool moves to the right as shown in Figure 21, this closes some of the passages within the valve housing and oil from the pump is directed to the left-hand end of the cylinder thus forcing the piston, and piston rod and power rack, to the right. At the same time, the oil from the right-hand end of the cylinder is allowed to return to the reservoir. As this high pressure oil forces the piston to the right, the power rack rotates the power sector, pitman shaft and pitman arm clockwise.

If the valve spool were to be moved to the left, the conditions would be reversed and the piston, piston rod and power rack would move to the left.

This would rotate the power sector, pitman shaft and pitman arm counterclockwise.

In the position shown in Figure 21, the valve is fully closed, but the slightest movement of the valve from what might be called the neutral position in Figure 20 toward the fully closed position in Figure 21, will upset the hydraulic balance of the system and will cause some oil to flow to the left-hand end of the cylinder. With any given pump and cylinder, therefore, the speed of travel, force exerted by, and direction of travel of the piston rod are subject to complete control by simply moving the valve spool varying amounts and directions.

At the same time that high oil pressure was assisting the turn to the left for the condition shown in Figure 21, the high oil pressure was also acting on the inner surfaces of the plungers tending to move the steering shaft and valve spool back to the central or neutral position. This oil pressure is in addition to the pressure of the five plunger springs which also act to move the valve spool back to the neutral position. As the load required for turning decreases, the valve spool moves toward the neutral position. When the load required decreases to 3 pounds or less, then conditions would be as shown in Figure 22 where the pitman arm has been moved clockwise, but where the valve is back to a central or neutral position.

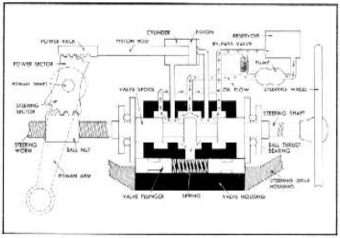

Fig. 22—Hydraulic Circuit—Left Turn—Minimum Load

The gear as described and pictured, has been diagrammatic and the valve movements and proportions have been greatly exaggerated. In the actual steering gear, the total valve movement is approximately .060".

HYDRAULIC STEERING MAINTENANCE

Hydraulic steering maintenance can be covered in three categories that generally will include any complaint on the operation of the unit. These three categories, Leaks, Noise and Hard Steering, if properly handled will correct the majority of complaints that may be encountered regarding this units operation.

Cleanliness is a highly important factor in the service of the power steering unit. If dirt enters the hydraulic system it will cause noise, leaks, or improper operation. A good example of the improper operation due to dirt, would be sticky plungers. So, when working on a power steering unit be sure to completely clean the outside before disassembly. Be sure the bench is free of dirt, then lay the parts on clean paper. Careful thought to cleanliness while disassembling and reassembling the power steering unit will prevent having a dissatisfied owner and a job that must be done over.

Leaks

If the complaint is oil loss in the power steering unit, the following steps should be performed. First, wipe the complete unit dry. This includes the pump, hoses, gear housing, power cylinder, and control valve assemblies. Then fill the reservoir, start the engine, operate the steering unit, and observe where the leak occurs. The position of the leak will then give an indication of the cause.

If the valve cover seal is faulty there will be leakage at the horn wire location on mast jacket. If the "O" ring seals, (between the housing and the valve body or between the cover and the valve body), are leaking, the evidence will appear at the joint of these parts.

Another possible place for leakage would be at the pump, involving either the reservoir to pump body gasket or the pump drive shaft oil seal. In the case of pump leakage the repair is fairly simple requiring very little time to replace either the seal or the gasket. On the other hand leaks in the steering unit require, in every case, removal of the unit from the car and replacement of the offending seal.

One of the major causes of leaks in any unit is improperly installed seals. In this category, if a worm bearing seal were cocked in installation the seal could not do its job. These worm bearing seals are rubber coated so special care must be taken to clean the bore and install the seal so that this covering will not be damaged. These seals could also be damaged if not protected from the threads on the worm shaft. However, damage to seals can also come from other conditions. If the "O" ring seal grooves in either the valve cover housing or the steering gear housing have sharp edges, then cutting of the "O" ring seals will occur with the possibility of a resulting leak. As a correction, sharp edges should be removed with a fine stone and new seals installed.

Noise

When the complaint is excessive noise it is sometimes hard to isolate the sound. So here is a quick check to determine whether or not the steering unit is at fault. Simply disconnect the pump drive belt and operate the car. If the noise is no longer present then make the power steering unit your next check. Another good thing to remember is never diagnose a power steering complaint without first checking fluid level and drive belt tension. Either may cause noises and malfunctions which could conceivably be blamed on the steering unit. When checking fluid level, be sure bubbles are not present in the fluid. If bubbles are found, the bleeding procedure outlined on page 9-17 should be performed.

Another cause of noise in the pump can be a sticky relief valve which will produce a buzzing sound. This can be determined by checking for excessive pump pressure with oil pressure gauge, Tool J-5176.

Obstructions in the hydraulic system will also cause a noise. For instance, a slight burr on the edge of one of the valve spool lands or a hose restriction will cause a noise on turns. Removal of the burr with a fine stone or replacement of the hose will be necessary for correction.

If belt noise, possibly accompanied by a knock or steering wheel oscillation, is present on extreme turns, it's a good bet that improper pump belt tension is the cause.

Hard Steering

Plungers, sticking as a result of dirt in the system, have been found to be a cause of hard steering as greater effort is required to reposition the spool and bring the power steering into operation. The repair will be a complete cleaning of the hydraulic system. A pump relief valve stuck in the open position or an improperly shimmed relief valve can be the cause of hard steering as there will be zero pump pressure. This can easily be checked by using oil pressure gauge J-5176.

The easiest one of all to fix is the one where the high spot adjustment is too tight, causing a bind in the gear operation. This condition will also be present if the power rack adjustment is too tight. Proper adjustment is the answer to this problem.

MINOR SERVICE OPERATIONS

STEERING GEAR ADJUSTMENTS

The power steering gear has three adjustments: The Thrust Bearing Adjustment, Over-Center Adjustment, and Power Rack Adjustment.

The Thrust Bearing Adjustment is performed only when the unit has been removed from the car for overhaul. The procedure for making this adjustment is outlined in step 9 under Assembly of Power Steering Gear.

To perform the Over-Center Adjustment and Power Rack Adjustment, proceed as follows:

1. Disconnect steering connecting rod from pitman arm, taking care to note relative positions of steering connecting rod parts before disturbing them.
2. Loosen the four corner power rack cover mounting bolts. This removes the pre-load imposed by the power rack guide on power rack and sector gear.
3. Loosen the lash adjuster lock nut and turn the lash adjuster a few times in a counterclockwise direction. This removes the over-center load imposed by close meshing of worm and sector teeth.
4. Turn steering wheel gently through the full range (5½ turns) to check for free action, then turn wheel back to midway position (2¾ turns) to center ball-nut on central "high point" of sector gear teeth.
5. Remove the steering wheel ornamental cap or horn button and check position of mark on end of wormshaft. This mark should be at the top of the shaft.
6. Turn lash adjuster clockwise to take out all lash in gear teeth. Tighten lock nut.
7. Turn steering wheel off the high spot, then check pull at wheel rim with checking scale, J-544-A, taking the highest reading on checking scale as the wheel is turned through the center position. This is the Over-Center Adjustment and should be between 1⅛ and 1½ pounds.

   NOTE: If the reading is not within limits, turn the wheel off the high spot and either tighten or loosen the adjuster as necessary. Then recheck the adjustment by again pulling through the high spot. The final Over-Center Adjustment must be between 1⅛ and 1½ pounds.

8. Tighten power rack cover bolts evenly.
9. Check pull at the steering wheel rim with checking scale, J-544-A, taking the highest reading on checking scale as the wheel is turned through the center position.
10. If the pull over the high point remains the same as the final Over-Center Adjustment (1⅛ to 1½ pounds), one .003" shim should be

removed. The guide cover should be reinstalled and the pull again checked. If necessary, continue to remove .003" shims, one at a time or a combination that will equal .003", until the pull required to pull through the center position increases over the final Over-Center Adjustment. At the time of increase, if the pull increases more than 1/8 pound, add one .003" shim.

NOTE: To obtain this adjustment, guide rack cover shims are furnished in thicknesses of .003", .005" and .010".

11. If when the power rack is first tightened down, the pull through the center position increased over the final adjustment for Over-Center, then shims of .003" thickness should be added, one at a time, until the pull required is decreased to within 1/8 pound of the Over-Center Adjustment.
12. Total Over-Center Load after all adjustments must not exceed 1⅝ pounds.
13. Reassemble steering connecting rod to pitman arm and adjust as outlined under "Steering Connecting Rod-Adjust."

CHECKING AND BLEEDING HYDRAULIC SYSTEM

Fluid Level

1. With engine shut off, remove tank cover hold-down bolt and remove cover and gasket.
2. Level of fluid should be 1" below top edge, at oil level mark as indicated on outside of tank (fig. 23).
3. Fill to level with Automatic Transmission Fluid, "Type A" bearing an "AQ-ATF" number. This is the same oil as available for Powerglide Transmissions and is available through Chevrolet Dealer and oil company filling stations.

   NOTE: The total fluid capacity of the Power Steering Unit is approximately 1.6 quarts.

4. Install gasket, cover and hold-down bolt.

Bleeding Hydraulic System

If there is air in the hydraulic circuit, the following procedure should be used to bleed the hydraulic circuit.

1. Fill oil reservoir to proper level and let oil remain undisturbed for about two minutes.
2. Raise front end of vehicle so that wheels are off the ground.
3. Start the engine and run at idle for two minutes. Recheck fluid level and hoses and connections for leaks.
4. Increase engine speed to approximately 1500 RPM and continue running at this speed until air bubbles cease to appear. Turn the wheels (off ground) right and left, lightly contacting the stops.
5. Lower the car and turn wheels on the ground. Recheck for leaks.
6. Check oil level and refill as required.

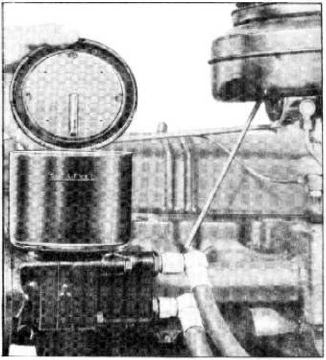

Fig. 23—Oil Level

PUMP BELT TENSION

1. Loosen inner bracket to pump mounting bolt at slotted hole in bracket.
2. Loosen outer bracket to pump fixed mounting bolt.
3. Attach a torque wrench to Belt Tension Adjusting Tool, J-5470, and insert tool between pulley and pump with inner end of tool resting under pulley hub and notch in tool over the head of the outer fixed mounting bolt (fig. 24).
4. Pull outward on torque wrench until a torque of 14 ft. lbs. is attained.
5. Tighten mounting bolt at slotted hole, remove tool J-5470 and torque wrench, then tighten fixed mounting bolt.

CHECKING PUMP PRESSURE

1. Disconnect hose at lower pump union.
2. Install Checking Gauge, Tool J-5176 (with gauge valve closed) on pump union.

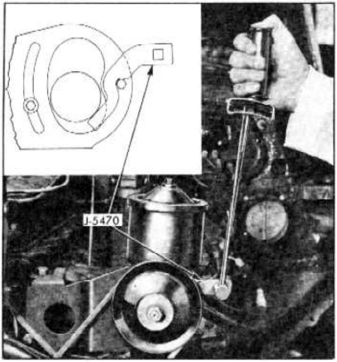

Fig. 24—Adjusting Pump Belt Tension

3. Connect hose to fitting on valve side of gauge.
4. Open gauge valve and run engine at idle.
5. Turn wheels (on ground) against stops. Pressure should not be less than 750 psi.
6. If pressure is less than 750 psi, slowly close gauge valve, observing gauge for pressure increase. Pressure will increase as valve is closed, if pump is good.

   CAUTION: Do not leave valve closed for more than 15 seconds.

7. Check pressure reading on gauge. If pressure increases to 750 psi when valve is closed, the trouble is in the gear.
8. If pressure does not increase when valve is closed, difficulty is in the pump.
9. If the pressure with the valve closed is greater than system pressure, but less than 750 psi, both units require attention.
10. Shut engine off, remove gauge and valve, and reconnect hose to pump.

STEERING CONNECTING ROD—ADJUST

The steering connecting rod is adjustable for length to enable maintaining high point of steering gear adjustment with front wheels in the straight ahead position. Before making this adjustment, however, it is important that the ball and socket ends be adjusted properly to the pitman arm ball stud and the steering idler and third arm ball stud.

1. Remove cotter pins from ends of sockets and using a drag link bit in screw plug slot, tighten plugs snugly to remove all end play of ball.
2. Back off screw plugs one complete turn plus amount necessary to insert cotter pin and lock adjustment.
3. Set front wheels in straight ahead position. This can be checked by measuring distance between lubrication fitting on lower control arm shaft and wheel fellow on each side.
4. With front wheels set straight ahead, remove ornamental cap or horn button and check position of mark on end of wormshaft designating steering gear high point.

   NOTE: Steering gear high point is designated by a mark on end of wormshaft. This mark should be at the top of the shaft.

5. If gear has been moved off high point when setting wheels in straight ahead position, loosen steering connecting rod adjuster clamps and adjust by rotating as necessary to bring gear back on high point.
6. Tighten steering connecting rod adjuster clamp bolts to 8-12 ft. lbs. torque.

MAST JACKET UPPER BEARING REPLACEMENT

1. Remove horn button or ornamental cap and remove wheel retaining nut and washer.
2. Install steering wheel puller, J-2927-A, and remove steering wheel.
3. Disconnect horn wire at connector and remove horn cable jacket clamp from mast jacket. Attach a piece of tie wire to the end of horn wire which enters the mast jacket.
4. Bend up the brass upper flange of bearing assembly and then pry on the rubber to work the bearing up and out of the mast jacket.
5. Transfer tie wire to end of wire attached to new bearing assembly. Apply a rubber lubricant, such as Ru-Glyde, to outer bearing surface, start bearing into mast jacket and drive it into place with special driver, J-2565.
6. Pull wire through opening in mast jacket and install the horn cable jacket clamp.
7. Install steering wheel, washer and nut, and tighten to 35-40 ft. lbs. torque.
8. Install horn button or ornamental cap, connect horn wire at mast jacket and test operation of horn.

MAJOR SERVICE OPERATIONS

RESERVOIR AND PUMP ASSEMBLY

Removal

1. Remove oil from reservoir with a suction gun.
2. Disconnect hoses at unions on pump. When hoses are disconnected, secure ends of hoses in a raised position to prevent drainage of oil.
3. Install caps at pump unions to prevent drainage of oil from pump.
4. Remove drive pulley attaching nut.
5. Loosen two bracket to pump mounting bolts.
6. Remove pump belt.
7. Slide pulley from pump drive shaft.
8. Remove two bracket to pump mounting bolts and remove reservoir and pump assembly.

Disassembly

1. Remove the reservoir cover bolt and washers and remove reservoir cover with gasket.
2. Remove four reservoir to pump mounting screws and remove reservoir with cork gaskets and spacers from pump assembly. Figure 25 shows the pump assembly.
3. Remove four pump cover to body attaching bolts and remove cover assembly and control valve assembly and spring. Remove cover "O" ring seal and discard.

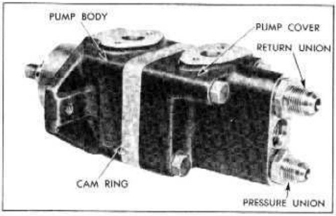

Fig. 25—Pump Assembly

4. Remove pressure and return line unions with "O" rings from pump cover and discard "O" rings.
5. Push the spring retainer plug, located between the pressure and return line unions in the cover, inward to remove. Remove and discard "O" ring seal. Remove plug snap ring.
6. To disassemble the control valve assembly, remove end screw with spacers, relief ball, relief spring guide and relief spring. Figure 26 shows the cover and control valve parts.

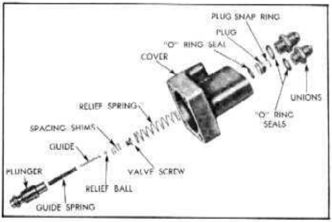

Fig. 26—Pump Cover and Control Valve

7. Lift pressure plate off dowel pins which extend through pump ring.
8. Remove pump ring from dowel pins located in pump body.
9. Remove rotor with vanes from pump shaft.
10. Remove and discard "O" ring from groove in pump body.
11. Remove dowel pins from pump body.
12. Using snap ring pliers, J-4245, remove drive shaft bearing retainer snap ring from front face of pump body. These are the same snap ring pliers as used for the Powerglide accumulator piston snap ring.
13. Remove drive shaft and drive shaft outer bearing assembly from pump body.
14. Using a punch, tap drive shaft seal and drive shaft inner bearing from pump body. The drive shaft seal must be removed first for inner bearing cannot be removed from body until seal is removed.

    CAUTION: Use care when handling the pump body especially when removing the seal and bearing so as not to score or mar the finished surface which mates with the cam ring when pump is assembled.

15. Remove woodruff key from slot in shaft.
16. Press sealed outer bearing off drive shaft over threaded end of shaft. Figure 27 shows the pump body and drive shaft parts.

Cleaning and Inspection

1. Wash all parts, except the sealed outer bearing, in cleaning solvent and wipe dry with clean lint-free cloth. Wipe off the bearing;

solvent may dilute the lubricant in the sealed bearing.

2. Inspect the drive shaft for wear and check both ball bearings for roughness or noisy operation.
3. Check fit of vanes in slot in rotor, vanes must slide freely but snugly in slots. Tightness may be relieved by thorough cleaning or removal of irregularities.
4. Inspect all ground surfaces of the ring for roughness or irregular wear. Slight irregularities may be removed with an Arkansas hard stone. Replace the cam ring if inside cam surface is scored or worn.
5. Inspect flat faces of pressure plate and body. These faces may be repaired by lapping until smooth and flat, after which all lapping compound must be thoroughly washed away.

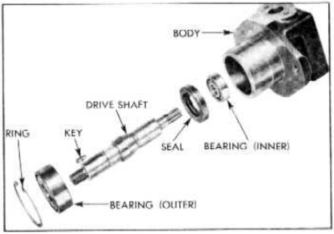

Fig. 27—Pump Body and Drive Shaft

6. Inspect cylindrical surface of control valve and check fit of control valve in pump cover. Slight irregularities may be corrected by polishing.

Assembly

Make sure all parts are absolutely clean, then lubricate parts with clean engine oil before assembly.

1. Place small inner bearing in position in pump body with stamped face down, then lightly tap it into position, making sure it is firmly seated.
2. Install the shaft seal with the two small $\frac{1}{16}''$ oil holes in face of seal up or toward the outer bearing when it is installed. Use a tube or socket of $1\frac{5}{8}''$ O. D. to apply pressure against the seal during installation.
3. Press large sealed bearing over threaded end of drive shaft with stamped face toward threaded end (fig. 28).
4. Install woodruff key in slot in shaft.
5. Install drive shaft and outer bearing assembly into pump body, pressing it lightly into place.
6. Using snap ring pliers, J-4245, install retaining snap ring with chamfered side up.

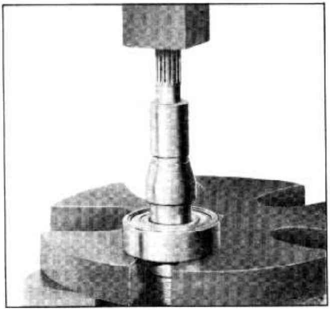

Fig. 28—Press Outer Bearing on Shaft

7. Install dowel pins in holes in body.
8. Install rotor, with vanes, on pump body over splined end of drive shaft.

NOTE: The curved edges of the vanes are toward the outside of the rotor.

9. Install pump body "O" ring seal and cam ring over dowel pins and rotor vanes (fig. 29).

NOTE: Be sure arrows on outer edges of cam ring point in the direction of pump rotation.

10. Install pressure plate over dowel pins which extend through ring.

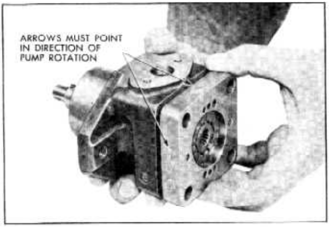

Fig. 29—Cam Ring Directional Arrows

11. Install pressure and return line unions, with new "O" ring seals, in pump cover.
12. Place a new "O" ring seal on spring retainer plug and apply Lubriplate or equivalent to "O" ring and in snap ring groove. Assemble plug from outer end until end of plug is just past snap ring groove. Install snap ring.
13. Assemble control valve asembly by installing the relief spring, spring guide, relief ball, and end screw with all original spacing shims into valve plunger. Tighten end screw securely.
14. Place a new pump cover "O" ring seal over pressure plate and on cam ring.
15. Install flow control valve spring in cover, install flow control valve and place pump cover assembly over pressure plate and against cam ring.
16. Install and securely tighten four cover to body attaching bolts.
17. When pump assembly is completed, rotate pump shaft to make sure of free movement, then cap union connections to exclude dirt until pump is installed.
18. Install new cork gaskets and spacers on pump body and pump cover reservoir mounting flanges.
19. Install reservoir on pump assembly and install four screws and lockwashers.
20. Install reservoir cover with new gasket, mounting bolt, spacer washer and lockwasher.
21. If any relief valve parts were replaced, test pump for valve operation after installation on car, as follows:
    a. Test pump pressure with Gauge, J-5176, as described under "Minor Service Operations."
    b. Relief valve should start to open, indicated by slight bussing noise in pump, at 750 psi or slightly higher. With engine speeded above idle, maximum pump pressure should not exceed 900 psi.
    c. Change the number of relief valve shims as required to obtain operation specified above.

Installation

1. Position reservoir and tank assembly on mounting bracket and install, but do not tighten bracket to pump mounting bolts.
2. Slide pulley onto pump shaft aligning slot in pulley with woodruff key in pump shaft.
3. Install drive pulley attaching nut finger tight against pulley.
4. Install pump belt over pulley.
5. Adjust the belt tension as follows:
    a. Loosen inner bracket to pump mounting screw at slotted hole in bracket.
    b. Loosen outer bracket to pump fixed mounting bolt.
    c. Attach a torque wrench to Belt Tension Adjusting Tool, J-5470, and insert tool between pulley and pump with inner end of tool resting under pulley hub, and notch in tool over the head of the outer fixed mounting bolt. (Fig. 24).
    d. Pull outward on torque wrench until a torque of 14 ft. lbs. is obtained.
    e. Tighten mounting bolt at slotted hole, remove tool J-5470 and torque wrench, then tighten fixed mounting bolt.
6. Tighten pulley nut to 35 to 45 ft. lbs. torque.
7. Remove caps at pump unions and connect and tighten hose fittings.
8. Fill and bleed the hydraulic system as outlined under "Minor Service Operations".
9. If any relief valve parts were replaced, test pump for valve operation, as explained in, Assembly, Step No. 21.

POWER STEERING GEAR

Removal

1. Remove the horn button or ornamental cap and remove the steering wheel retaining nut.
2. Install Steering Wheel Puller, J-2927-A, and remove steering wheel.
3. Remove upper control shaft clamp bolt from shaft connector.
4. Disconnect horn and directional signal wires at connectors under the instrument panel near where the horn wire comes from the mast jacket.
5. Remove steering mast jacket toe board grommet and seal from toe board. Remove directional signal housing and switch assembly.
6. Remove nuts and lockwashers from instrument panel to mast jacket clamp and remove clamp.
7. Remove the two clutch head screws that attach the gearshift control upper support to mast jacket. The upper control shaft and upper support may now be pulled up and out of engagement from shaft connector.
8. Remove clamp bolt nuts and clamp retaining the shifter housing to the mast jacket, then rotate shifter housing with lower control shaft

and control rods attached away from mast jacket.

9. Disconnect steering connecting rod at pitman arm, taking care to note relative position of steering connecting rod parts before disturbing them.
10. Disconnect steering pump to valve body hoses at valve body unit. Secure the ends of the hoses in a raised position to prevent drainage of oil.
11. Remove nuts, lockwashers and bolts attaching steering gear housing to steering support bracket.
12. Remove the left air duct.
13. Rotate gear assembly to clear fender skirt and then raise steering gear assembly bringing it up and forward to remove from engine compartment.

Disassembly

Clean the exterior of the gear assembly thoroughly, then proceed as follows:

1. Remove the two valve to power cylinder pipes. Unless the "O" ring seals are to be replaced, do not loosen the elbow fittings or the pressure or return line unions (fig. 30).
2. Remove small by-pass line between power cylinder and gear housing.

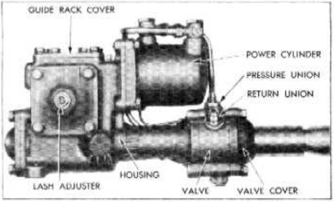

Fig. 30—Power Steering Assembly

3. Mark the cover, valve body and gear housing to insure proper positioning of the parts on reassembly (fig. 31). A double mark at the upper or cover end of the valve body will aid in the reassembly.
4. Remove three valve cover to gear housing mounting bolts and slide valve cover with steering mast jacket up and off of the steering mainshaft. Remove and discard the valve cover "O" ring seal.
5. Remove thrust bearing nut and special tanged washer.

NOTE: If staked type nut is being removed, it may be threaded off shaft in the normal manner. However, be sure to remove all chips sheared off the nut in the shaft keyway and be careful that no chips get into the thrust bearing or valve body.

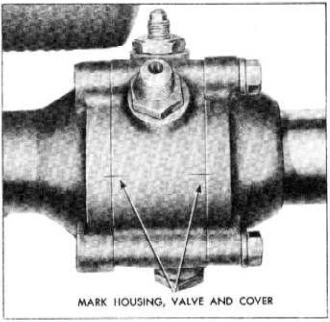

Fig. 31—Mark Housing, Valve and Cover

6. Slide valve body and valve spool as an assembly off the mainshaft.

CAUTION: Use care to keep the spool, plungers and plunger springs from falling out.

7. Remove and discard "O" ring seal from gear housing upper flange.
8. Remove the lower thrust bearing assembly.
9. Remove the four corner bolts only from the power rack guide cover and remove power rack guide cover with guide and spacing shims.

CAUTION: Do not remove the center bolts as these retain the power rack guide.

10. Remove pitman sector shaft adjusting screw lock nut and remove side cover bolts. Turn adjuster screw down through cover to remove side cover from housing. Remove cover and gasket.
11. Pull pitman shaft from housing.
12. Remove the power cylinder to gear housing bolts and remove cylinder and gasket,

guiding power rack through hole in housing (fig. 32).

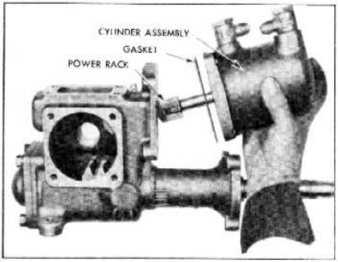

Fig. 32—Removing Power Cylinder Rack

13. Remove four lower end cover attaching bolts and remove cover and gasket.
14. Carefully slide mainshaft and ball nut assembly out of gear housing.

REPAIRS

Valve Body

The valve spool and plungers are a very close fit in the valve body and must be removed and replaced carefully;—avoid jamming.

1. Remove spool, plungers and plunger springs.
2. Remove the return line union and remove the check valve. Discard union "O" ring seal. Figure 33 shows the valve parts.

Inspection

Test the check valve by blowing through both ends. Ball should seat when blowing through inner end, and allow air to pass when blowing through slotted end.

The control valve body and spool are a selective fit and are serviced as a unit. The plungers, springs and check valve are serviced separately.

Replace the damaged parts and make certain that they are oiled so plungers and spool will slide freely in valve body.

Assembly

1. Install the check valve in valve body.
2. Place a new "O" ring seal on the return line union and install the union and securely tighten.
3. Place the valve spool in the valve body so end of spool with shallow counterbore will be away from the steering wheel and away from the double mark on the valve body.
4. Install plunger springs and plungers in valve body with drill spot end of plungers in against the springs.

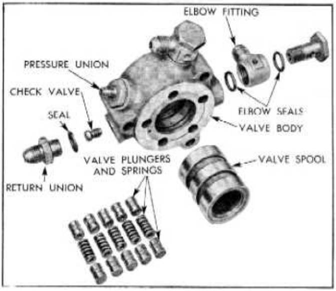

Fig. 33—Valve Parts

Piston, Piston Rod, Adapter, Power Rack and Cylinder

1. Remove gasket and place power rack in a vise with jaws against sides of rack (fig. 34). Tap the cylinder off adapter and piston assembly.
2. With power rack still in vise, remove piston rod retaining nut, thrust washer, piston with rings, thrust washer, and adapter assembly.
3. Remove two piston rings from piston assembly.
4. Remove large "O" ring seals from adapter assembly and discard.
5. Remove the stop plate from adapter assembly.

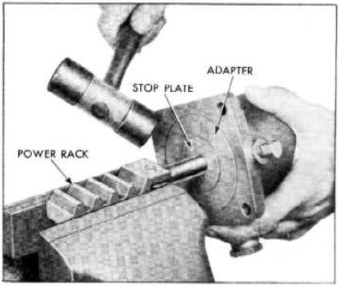

Fig. 34—Removing Cylinder from Piston

Inspection

Inspect seal in power cylinder adapter. If seal is worn or damaged, it may be replaced. Pry the worn or damaged seal out of the adapter, then remove and discard the "O" ring seal. Place a new "O" ring seal in groove and then use a tube or socket of 1⅛" O.D. to press the new seal assembly, with the lip and spring side down, into the adapter until it is firmly seated.

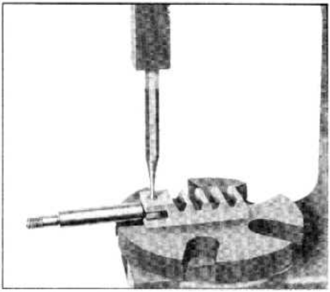

Fig. 35—Removing Power Rack Pin

Inspect piston rod, teeth and guide bearing surface of power rack. If necessary to replace piston rod or rack, remove coupling pin (fig. 35). Connect the new parts by reinstalling coupling pin. Stake the rack at three places on each side to retain the pin, then file down burrs raised by staking.

Inspect power cylinder bore for scores or other damage.

Assembly

1. Install new "O" ring seals on adapter.
2. Slide stop plate over piston rod.
3. Install special assembly tool, J-5193 (fig. 36),

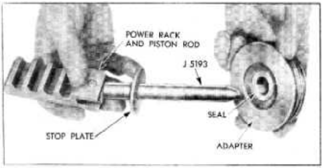

Fig. 36—Installing Adapter on Piston Rod

over threaded end of piston rod. Slide adapter over piston rod. Then remove assembly tool J-5193.

4. Install piston rings on piston.
5. Install thrust washer, piston assembly, thrust washer and nut on piston rod. Tighten nut securely.
6. Install piston and adapter assembly into cylinder using Ring Compressor, J-5186-A, to compress the piston rings (fig. 37). It may be necessary to tap adapter with a soft mallet until its flange is flush with cylinder face.

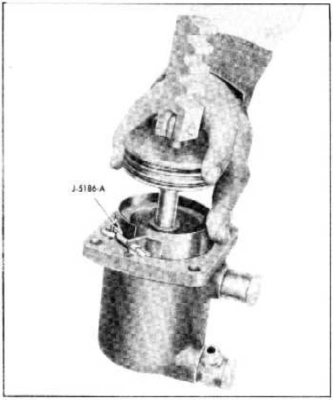

Fig. 37—Installing Piston in Cylinder

Pitman Shaft Bushing and/or Packing

1. To replace both the bushing and packing proceed as follows:
   a. Support steering gear housing in an arbor press and press sector shaft bushing, packing and packing retainer from housing using J-1614, Pitman Shaft Bushing Driver.
   b. Press new bushing into position using bushing driver J-1614.

   NOTE: Bushings are diamond bored to size and require no further reaming.

   c. Soak new packing in engine oil, install it in a new packing retainer and press new packing and retainer into housing.

2. To replace only the sector shaft packing proceed as follows:
   a. Pry packing retainer out of housing and remove packing.
   b. Soak new packing in engine oil, install it in a new packing retainer and press new packing and retainer into housing.

Side Cover Bushing

Inspect the fit of the sector shaft in the side cover. If the side cover bushing is worn or damaged, a new side cover should be installed.

End Cover Bearing

1. If the roller bearing in the housing end cover requires replacement, insert remover tool, J-5190 (with the screw backed out sufficiently for the plates to be in flush with the tool body), into bearing and turn the screw (fig. 38). This will expand the plates under the bearing and will then force tool and bearing out.

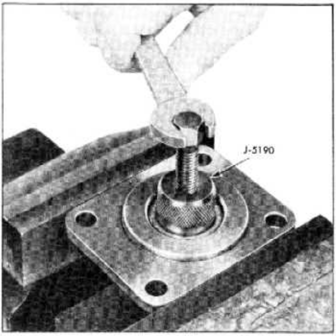

Fig. 38—Removing Bearing from End Cover

2. Press new roller bearing into end cover using installer, J-5191 (fig. 39). This tool has a shoulder to locate bearing at proper depth in cover.

Housing Upper Seal and Roller Bearing

1. Remove housing upper seal by carefully tapping an "off-set" screwdriver between seal and shoulder in housing, then pry lightly around seal to remove.
2. The roller bearing is removed with a punch and should not be removed unless replacement is necessary, as removal will damage the bearing.

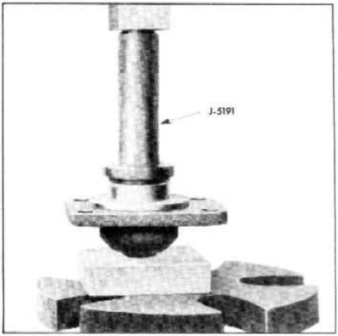

Fig. 39—Installing End Cover Bearing

3. If the bearing is removed, use "Bearing" end of tool J-5189 to install new bearing against the shoulder in housing (fig. 40).

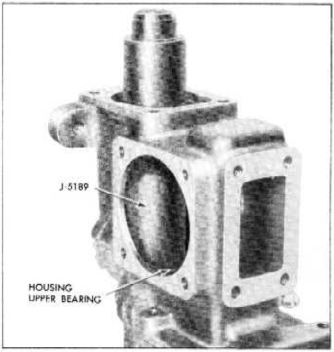

Fig. 40—Installing Housing Roller Bearing

4. Use "Seal" end of tool J-5189 to press new seal down to shoulder in housing (fig. 41). The lip and spring of seal are up toward shoulder of tool.

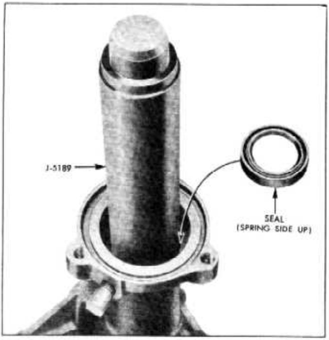

Fig. 41—Installing Housing Seal

Valve Cover Seal

1. Remove valve cover seal by carefully tapping an "off-set" screwdriver between seal and shoulder in cover, then pry lightly around seal to remove.
2. Use installer tool, J-5188, to install new seal (fig. 42). The lip and spring side of seal go toward shoulder of tool.

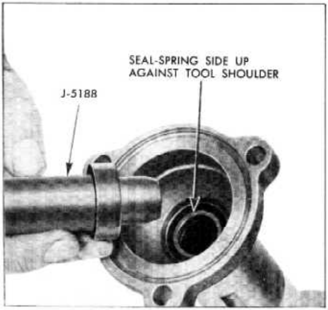

Fig. 42—Installing Valve Cover Seal

Mainshaft and Ball-Nut

As a rule, disassembly of the ball bearing nut should not be necessary. However, if there is an indication of binding or tightness, the unit should be disassembled, cleaned and inspected.

CAUTION: Never allow the ball nut to rotate of its own weight until it strikes either end of the worm. Allowing it to do so will damage the ball guides.

1. Remove the screws and clamp retaining the ball guides in the nut. Lift out the two ball guides.
2. Turn the nut upside down and rotate the worm and mainshaft back and forth until all the balls have dropped out of the nut and into a clean pan.
3. With the balls removed the nut can be slipped off the worm.

Inspection

Wash all parts in cleaning solvent and dry with clean, lint-free cloths. Lubricate parts with clean engine oil for assembly.

Inspect worm and ball nut grooves and all balls for signs of indentations. Also look for signs of chipping or breakdown of any surface.

Inspect each half of each ball guide carefully, particularly the ends where the balls enter and leave the guides. Any damaged guides should be replaced.

NOTE: All damaged parts must be replaced with genuine parts only. In the case of the balls, this is essential because they are made to special specification. Non-genuine balls, even of the highest quality will not give satisfactory service.

Assembly

1. Place the mainshaft flat on the bench and slip the nut over the worm with the ball guide holes up and the shallow end of the rack teeth to the left from the steering wheel position. Align the grooves in the worm and nut by sighting through the ball guide holes.
2. Count 30 balls into a suitable container. This is the number of balls for one circuit. Drop the counted balls from the container into one of the guide holes while turning the worm gradually away from that hole. Continue until the ball circuit is full from the bottom of one guide hole to the bottom of the other.

NOTE: In cases where the balls are stopped by the end of the worm, hold down those balls already dropped into the nut with the blunt end of a clean rod

or punch (fig. 43) and turn the worm in the reverse direction a few turns. The filling of the circuit can then be continued. It may be necessary to work the worm back and forth, holding the balls down first in one hole then the other, to close up the spaces between the balls and fill the circuit completely and solidly.

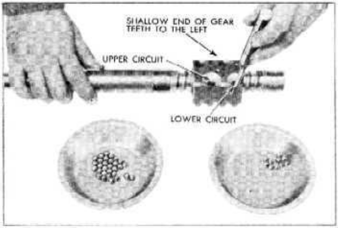

Fig. 43—Filling Ball Circuits in Nut

3. Lay one-half of ball guide, groove up, on the bench and place the remaining balls from the count container in one-half of the ball guide (fig. 44). The number of balls remaining should just fill the guide.

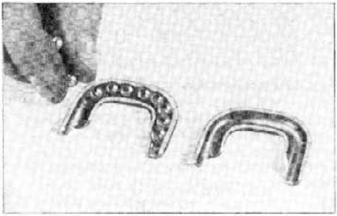

Fig. 44—Filling Ball Guides

4. Close this half of guide with the other half. Hold the two halves together and plug each open end with vaseline so balls will not drop out while installing guide.
5. Push the guide into the guide holes of the nut (fig. 45). This completes one circuit of balls. If guide does not push all the way down easily, tap it lightly into place with a soft mallet.
6. Fill the second ball circuit in the same manner as described.
7. Assemble the ball guide clamp to the nut, being sure to use lockwashers under the

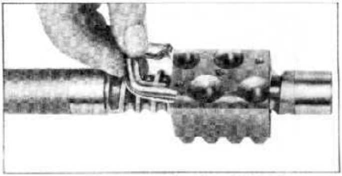

Fig. 45—Removing and Replacing Ball Guides

clamp screws, then tighten the screws securely.

Check the assembly by rotating the nut on the worm to see that it moves freely. If there is any "stickiness" in the motion of the nut, some slight damage to the ends of the ball guides may have been overlooked.

Assembly

Be sure all parts are absolutely clean and lubricated with clean engine oil before assembly.

1. Slide steering mainshaft and ball nut assembly up into housing.

   CAUTION: Guide upper end of mainshaft carefully through seal at top of housing to prevent damage to edges of seal.

2. Install lower end cover with gasket, tightening in place with four bolts and lockwashers.
3. Install lower thrust bearing assembly with large race outward.
4. Place a new "O" ring seal in groove in housing flange.
5. Carefully slide valve body assembly over mainshaft and up against thrust bearing. Move valve body around to make sure thrust bear-

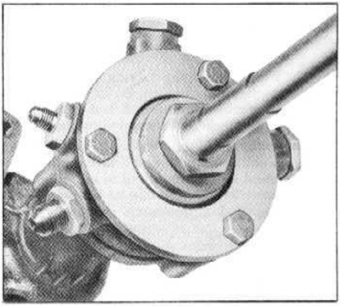

Fig. 46—Installing Valve Body Adapter

ing balls are seated in races. Align marks made in step No. 3 of disassembly to insure proper positioning of valve body. The marks should also insure that proper end of the valve body is toward upper end of steering mainshaft. Also, check that counterbored end of spool is toward bottom end of mainshaft.

6. Place valve cover adapter, J-5182 over valve body, install valve body to housing bolts and tighten bolts evenly and securely (fig. 46).
7. Install upper thrust bearing assembly with large race toward valve spool.
8. Place new stake type nut on shaft, do not use tanged washer.

NOTE: Nut must spin on threads freely with no binding (fig. 47).

9. Adjust the thrust bearing as follows:
   a. Place a steering wheel on end of mainshaft and turn steering wheel to the right or clockwise until plunger springs are compressed.

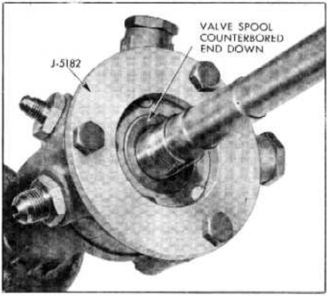

Fig. 47—Adjusting Thrust Bearing

   b. While holding the steering wheel to the extreme right, tighten thrust bearing lock nut firmly to remove all end play of valve spool. Back off nut and retighten lightly.
   c. Using, J-544-A, Steering Gear Checking Scale, measure the pull at the rim of the wheel which is required to keep the wheel in motion. This should be between ¼ and ½ pound. If necessary, readjust lock nut to obtain this adjustment.

NOTE: This adjustment seats the thrust bearings against the centering plungers, removes all end play between bearing races and spool, and places a slight preload on the thrust bearings.

   d. Stake the nut securely into the keyway with a round drift punch.

10. Remove steering wheel and valve cover adapter, J-5182.
11. Place a new "O" ring seal in groove in valve cover flange. Then install valve cover and steering mast jacket, aligning marks on steering gear housing, valve body, and valve cover. Install and tighten attaching bolts evenly. Torque bolts to 15-20 ft. lbs.

NOTE: This torque is important for the bolts must be tightened firmly, but if tightened too tight, the valve body distorts and causes the spool to stick.

12. Place cylinder to housing gasket over the power rack and then guide power rack through opening in gear housing with teeth on rack pointing toward center of housing.
13. Install cylinder to housing mounting bolts and tighten securely.
14. Install by-pass pipe at cylinder and gear housing flanges, and if removed, the elbow fittings and unions, being sure to use new "O" ring seals (two at each elbow fitting, one at each union.) Install cylinder to valve body pipes.
15. Assemble the lash adjuster with shim in the slot in the end of the sector shaft. Check the end clearance which should not be greater than .002". For the purpose of adjusting this end clearance, a steering gear lash adjuster shim unit is available.
16. Install pitman shaft into housing as follows:
    a. Place steering wheel on end of mainshaft and turn wheel right or left until center groove of ball nut is in line with center of pitman shaft bushing (fig. 48).

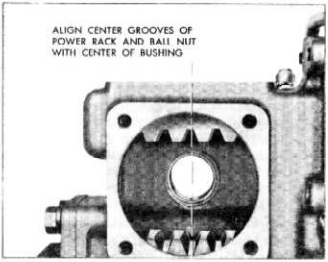

Fig. 48—Positioning Ball Nut and Power Rack

b. Position power rack so that center groove (third groove from piston end) is in line with center of pitman shaft bushing (fig. 48).

c. Install pitman shaft so that center tooth in each set of sector gear teeth meshes with the center grooves of ball nut and power rack (fig. 49).

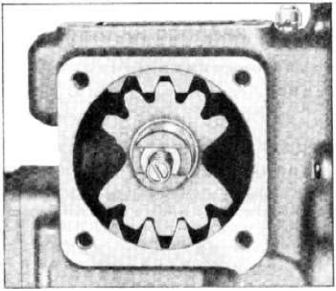

Fig. 49—Installing Pitman Shaft

17. Place a new gasket on side cover, then while using a screwdriver through hole in side cover, turn the pitman shaft lash adjuster screw in a counterclockwise direction to pull the side cover in against the housing. Install and tighten the side cover bolts.

18. Oil the face of power rack and guide, then position the power rack cover and guide assembly, with the same number of spacing shims as were removed, on housing. Install but DO NOT TIGHTEN the four corner bolts. These bolts must be left loose until the Over-Center (High Point) Adjustment has been checked and adjusted.

ADJUSTMENTS

Over-Center Adjustment

1. Turn steering wheel slowly through the full range (5½ turns) to check for free action, then turn wheel back to midway position (2¾ turns) to center ball nut on central "high-point" of sector gear teeth.
2. Turn sector lash adjuster clockwise to take out all lash in gear teeth. Tighten lock nut.
3. Turn steering wheel off the high spot, then check pull at wheel rim with checking scale, J-544-A, taking the highest reading on checking scale as the wheel is turned through the center position. This should be between 1⅛ and 1½ pounds.

NOTE: If the reading is not within limits, turn the wheel off the high spot and either tighten or loosen the adjuster as necessary. Then recheck the adjustment by again pulling through the high spot. The final adjustment must be between 1⅛ and 1½ pounds.

Power Rack Adjustment

1. Tighten power rack guide cover bolts evenly.
2. Check pull at the steering wheel rim with checking scale, J-544-A, taking the highest reading on checking scale as the wheel is turned through the center position.
3. If the pull over the high point remains the same as the final Over-Center Adjustment (1⅛ to 1½ pounds), one .003" shim should be removed. The guide cover should be reinstalled and the pull again checked. If necessary, continue to remove .003" shims, one at a time or a combination that will equal .003", until the pull required to pull through the center position increases over the final Over-Center Adjustment. At the time of increase, if the pull increases more than ⅛ pound, add one .003" shim.

NOTE: To obtain this adjustment, guide rack cover shims are furnished in thicknesses of .003", .005" and .010".

4. If, when the power rack cover is first tightened down, the pull through the center position increased over the final adjustment for Over-Center, then shims of .003" thickness should be added, one at a time, until the pull required is decreased to within ⅛ pound of the Over-Center Adjustment.
5. Total Over-Center Load after all adjustments must not exceed 1⅝ pounds.

INSTALLATION

1. Start end of mast jacket through hole in toe board, lower gear assembly into engine compartment and place in position on steering support bracket.
2. Install mast jacket toe board grommet and seal to toe board.
3. Install bolts, lockwashers and nuts retaining housing to support bracket, but do not tighten.
4. Install mast jacket to instrument panel clamp and install bolts and tighten securely. Then tighten housing to steering support bracket bolts to 27-40 ft. lbs. torque.

5. Connect the valve body to pump hoses to valve body unit.

6. Rotate shifter housing, with lower control shaft and control rods attached to mast jacket, indexing dowel in housing body with dowel hole in mast jacket. Install retaining clamp, lockwasher and nuts and tighten securely.

7. Install upper control shaft and shifter lever assembly to mast jacket, indexing end of shaft with control shaft connector and install upper clamp bolt and nut. Tighten nut securely.

8. Install two clutch head screws attaching shift control upper support to mast jacket.

9. Connect horn wire at connector under instrument panel.

10. With steering gear on high point, install steering wheel with spokes horizontal, washer and nut, and tighten to 35-40 ft. lbs. torque.

11. Reassemble steering connecting rod to pitman arm and adjust as outlined under "Steering connecting rod-Adjust."

12. Replace left air duct.

13. Adjust steering column shift controls as outlined under "Steering Column Gearshift Linkage-Adjust" on page 9-4.

14. Bleed steering hydraulic system as outlined in "Minor Service Operations."

TROUBLE DIAGNOSIS

This section will cover only those causes of trouble which may be due to the hydraulic power steering mechanism. Before assuming that the hydraulic power mechanism is at fault, make sure the mechanical components are in good condition. The mechanical items include: front wheel alignment, tire condition and pressure, wheel bearing adjustment, lubrication and adjustment of steering linkage, and proper alignment of steering gear in mounting to eliminate bindings.

1. HARD STEERING

To determine whether hard steering actually exists, place car on a clean dry floor, apply brakes, and with engine idling, turn wheel to the extreme right and left and hold against the stop (centering springs compressed) momentarily in each direction several times. This will bring the oil temperature to approximately 170° F. which is operating temperature. Apply Steering Wheel Checking Scale, J-5178 (15 lbs.) to a spoke at rim of steering wheel and check the pull required to turn the wheel steadily with gauge held at 90 degrees to the spoke. If the pull required to turn the wheel exceeds 10 pounds, check the following causes.

Possible Causes

a. Pump drive belt loose
b. Low oil level in reservoir
c. Air in hydraulic system
d. Insufficient oil pressure
e. Steering adjustment tight

2. EXCESSIVE PLAY OR LOOSENESS IN STEERING MECHANISM

Possible Causes

a. Excessive lash between pitman shaft sectors and ball nut or power rack.
b. Loose worm thrust bearing adjustment.

3. LOW OIL PRESSURE

If it is believed oil pressure is low, the pressure should be checked as outlined in "Minor Service Operations" using pressure gauge, J-5176.

Possible Causes

a. Pump drive belt loose
b. Low oil level in reservoir
c. Pump mechanical difficulty—possibly caused by:
   (1) Relief valve: improper adjustment, weak relief valve spring or relief valve stuck open.
   (2) Control valve stuck or broken flow control spring.
   (3) Worn rotor parts.
d. Pressure loss in steering control valve, possibly caused by sticking valve spool or discharge valve stuck open.
e. Pressure loss in power cylinder, possibly caused by leaking adapter "O" ring seal.
f. External or internal oil leaks.

4. POOR CENTERING OR RECOVERY ON TURNS

Possible Causes

a. Valve spool sticking in valve housing.
b. Faulty valve centering plungers and/or springs.
c. Binding of steering shaft.
d. Loose worm thrust bearing adjustment.

5. OIL PUMP NOISY

Possible Causes

a. Improper oil level
b. Air in system

c. Reservoir air vent plugged

d. Sludge or dirt in pump

e. Pump bearings, shaft, vanes or other rotating parts worn or damaged. Sticking pump vanes also a possibility.

6. STEERING GEAR NOISY

A very slight rattle may occur on turns because of the lash off the "high-point." This is normal and lash must not be reduced below specified limits to eliminate the slight rattle.

Possible Causes

a. Excessive lash between pitman shaft sectors and ball nut or power rack, possibly caused by improper over-center adjustment and/or power rack adjustment.

b. Loose thrust bearing adjustment.

7. OIL LEAKS

External–Possible Causes

a. Loose connections or faulty "O" rings at hose unions or oil pipe elbows.

b. Loose connection or faulty "O" rings between valve cover, valve body and steerring gear housing.

c. Hose leaks.

Internal–Possible Causes

a. Leaking upper housing or valve cover seals.

b. Cylinder adapter seal leaking.

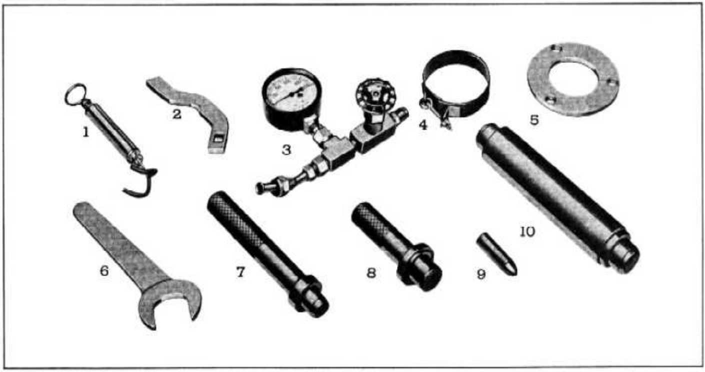

Fig. 50—Power Steering Tools

1. Steering Wheel Tension Gauge—J-5178
2. Pump Belt Tightener—J-5470
3. Pressure Checking Gauge—J-5176
4. Piston Ring Compressor—J-5186-A
5. Worm Bearing Retaining Collar—J-5182
6. Worm Bearing Nut Adjusting Wrench—J-5259
7. Valve Cover Seal Installer—J-5188
8. End Cover Bearing Installer—J-5191
9. Piston Rod Inserter—J-5193
10. Upper Housing Seal and Bearing Installer—J-5189

SERVICE NEWS REFERENCE

Month	Page No.	Subject

SECTION 10

WHEELS AND TIRES

CONTENTS OF THIS SECTION

INDEX

GENERAL DESCRIPTION

Steel disc wheels, slotted just inside the rims, are used on all passenger car models. Snap-on type hub caps are used to conceal the nuts and studs by means of which the road wheels are mounted on the hubs.

The wheels on all models are 15 inches in diameter, with 5" rims. All models, except convertible models with Powerglide, eight passenger Station Wagon and Sedan Delivery, take 4-ply rating 6.70-15 tires.

Convertible with Powerglide transmission have 4-ply rating 7.10-15 tires while the eight passenger Station Wagon and Sedan Delivery have 6-ply rating 6.70-15 tires.

The spare tire is mounted vertically on the right hand side of the trunk compartment on all models except the Station Wagon and Sedan Delivery, in which it lies in a covered well in the rear body floor. A sturdy bumper type jack with exceptional wide base is carried in the trunk compartment. The jack handle also serves as a wheel wrench.

SERVICE INFORMATION

TESTING TIRE PRESSURES

The correct tire pressure for all models, except the eight passenger Station Wagon and Sedan Delivery, is 24 pounds front and rear. Correct pressure on the eight passenger Station Wagon and Sedan Delivery is 30 pounds front and rear. Frequent checking is essential with low pressure tires as variations of only a few pounds make an appreciable difference in riding qualities, handling ease and tire wear. It should also be general practice to check tire pressures each time a car is brought in for service, not only as a convenience to the owner, but also to reduce the possibility of owner complaint of riding, steering or tire wear due solely to improper tire inflation. Checking inflation pressures should be a part of every lubrication job.

Tire pressures should always be checked when the tires are cold, preferably in the morning or after standing in a cool place, and never after a fast run. Heat developed on fast runs or from hot pavements increases the pressures which decreases again when the tires cool.

The recommended pressure is a minimum pressure when the tire is cold and includes all necessary allowances for pressure increases due to fast runs or hot weather.

When checking tires, servicemen should be careful to reinstall valve stem caps. These caps provide an essential function in keeping dirt out of the valve and in reducing the possibility of slow leaks through the valve.

CHANGING ROAD WHEELS

To change the road wheels using the jack that comes with the car, observe the following procedure.

1. Set hand brake and remove wheel shields.
2. Remove hub cap and break wheel mounting nuts loose.
3. Place jack directly under bumper just outside bumper guard and raise car until wheel clears ground.
4. Remove wheel mounting nuts and remove wheel from hub or drum.
5. To replace road wheel reverse the above instructions.

INTERCHANGING TIRES

Normal tire wear is uneven between the front and rear wheels because of the difference in the functions of the front and rear tires. To minimize tire wear and tire noise due to wear, it is recommended that tires be interchanged both as to front or rear use and as to change of direction at intervals of from 4,000 to 5,000 miles.

In addition, utilizing the spare tire in rotation with the other four tires gives 20% more total car mileage before replacement tires must be purchased.

The recommended plan for interchanging tires is based on the following steps.

Move the left front wheel to left rear, left rear to right front, right front to spare, spare to right rear and right rear to left front.

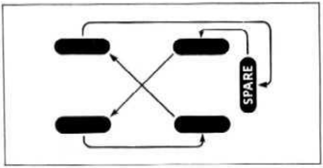

Fig. 1—Tire Rotation Plan

In detail, the plan provides the changes as shown in Figure 1 each time the tires are interchanged.

CLEANING WHITE SIDEWALL TIRES

A great deal of ordinary road dirt which collects on white sidewall tires may be sponged off with clear water or a mild soap solution.

Chevrolet White Sidewall Tire Cleaner, however, is a quicker and more effective cleaner for removing dirt and stains from white sidewall tires and in many cases it will remove stains and discoloration that the simpler method of soap and water will not remove.

Under no circumstances should gasoline, kerosene or any cleaning fluid containing a solvent derived from oil be used to clean white sidewall tires. Oil in any form is detrimental to rubber and a cleaner with an oil base will discolor or injure white sidewall tires.

CORRECTION OF IRREGULAR TIRE WEAR

Heel and Toe Wear—This is a saw-toothed effect where one end of each tread block is worn more than the other.

The end that wears is the one that first grips the road when the brakes are applied.

Heel and toe wear is less noticeable on rear tires than on front tires, because the propelling action of the rear wheels creates a force which tends to wear the opposite end of the tread blocks. The two forces, propelling and braking, make for more even wear of the rear tires, whereas only the braking forces act on the front wheels, and the saw-tooth effect is more noticeable.

A certain amount of heel and toe wear is normal. Excessive wear is usually due to high speed driving and excessive use of brakes. The best remedy, in addition to cautioning the owner on his driving habits, is to interchange tires regularly.

Side Wear—This may be caused by incorrect wheel camber, underinflation, high cambered roads or by taking corners at too high a rate of speed.

The first two causes are the most common. Camber wear can be readily identified because it occurs only on one side of the treads, whereas underinflation causes wear on both sides. Camber wear requires correction of the camber first and then interchanging tires.

There is, of course, no correction for high cambered roads. Cornering wear is discussed further on.

Misalignment Wear—This is wear due to excessive toe-in or toe-out. In either case, tires will revolve with a side motion and scrape the tread rubber off. If misalignment is severe, the rubber will be scraped off of both tires; if slight, only one will be affected.

The scraping action against the face of the tire causes a small feather edge of rubber to appear on one side of the tread and this feather edge is certain indication of misalignment. The remedy is readjusting toe-in within 0 to 1/8 inch, on 1949-52 models and $1/4 \pm 1/16$ inch on 1953 models, or rechecking the entire front end alignment if necessary.

Uneven Wear—Uneven or spotty wear is due to such irregularities as unequal caster or camber, bent front suspension parts, out-of-balance wheels, brake drums out-of-round, brakes out-of-adjustment or other mechanical conditions. The remedy in each case consists of locating the mechanical defect and correcting it.

Cornering Wear—Since the introduction of independently sprung front wheels, improvements in spring suspension have enabled drivers to negotiate curves at higher rates of speed with the same feeling of security that they had with the older cars at lower speeds. Consequently, curves are being taken at higher speeds with the result that a comparative new type of tire wear called "Cornering Wear," frequently appears.

When a car makes an extremely fast turn, the weight is shifted from an even loading on all four wheels to an abnormal load on the tires on the outside of the curve and a very light load on the inside tires, due to centrifugal force. This unequal loading may have two unfavorable results.

First, the rear tire on the inside of the curve may be relieved of so much load that it is no longer geared to the road and it slips, grinding off the tread on the inside half of the tire at an excessive rate. This type of tire shows much the same appearance of tread wear as tire wear caused by negative camber.

Second, the transfer of weight may also overload the outside tires so much that they are laterally distorted resulting in excessive wear on the outside half of the tire, producing a type of wear like that caused by excessive positive camber.

Cornering wear can be most easily distinguished from abnormal camber wear by the rounding of the outside shoulder or edge of the tire and by the roughening of the tread surface which denotes abrasion.

Cornering wear often produces a fin or raised portion along the inside edge of each row in the tread pattern. In some cases this fin is almost as pronounced as a toe-in fin, and in others, it tapers into a row of tread blocks to such an extent that the tire has a definite step wear appearance.

The only remedy for cornering wear is proper instruction of owners. They should be shown that rubber is being ground off of their tires and they should be instructed to drive a little more slowly on curves and turns. Also, the tires should be interchanged at regular intervals.

DISMOUNTING AND MOUNTING TIRES

The rims used on all passenger cars are of the familiar drop center design. Dismounting tires presents no problems if the correct procedures are used and the following precautions observed.

1. Deflate the tube completely by removing the valve core before attempting to dismount the tire.
2. The toe of each tire bead has a soft rubber tip which protects the tube from chafing. Be very careful not to damage this tip.
3. Be careful not to pinch the tube when using the tire irons.
4. If prying the bead over the flange seems to require excess force, the bead on the opposite side of the rim is not far enough down in the well.
5. Do not attempt to remove or apply both beads at the same time.

When mounting a tire on a rim:

1. Coat the inside and outside of the bead with a vegetable oil soap solution. This will make the work much easier. Do not use oil or grease.
2. When inserting the tube in the tire, make certain that the valve stem is in line with the balancing mark plus or minus two inches on the outside of the casing, otherwise the tire and tube will be unbalanced.
3. After the tire and tube are on the rim, they must be centered in the wheel. Inflate the tire slowly to bring the beads up on the bead seat. The centering rib above the tire bead must show uniformly above the rim flange; then, deflate tube completely and reinflate to recommended pressure.

NOTE: Never attempt to inflate a completely deflated tire on a car without first jacking the tire clear of the ground.

BALANCING WHEELS AND TIRES

A wheel and tire assembly may lose its original balance due to irregular tire wear, tube or tire repair or some type of misalignment. Consequently, if front end instability develops, the tire and wheel assembly should be checked for static and in severe cases dynamic balance. The assembly should also be checked for balance whenever any original tire is replaced and especially in cases where nonstandard tire equipment, such as a puncture proof tube or extra ply casing, is used.

Static Balance (still balance) is the equal distribution of weight of the wheel and tire assembly about the axis of rotation so that the assembly has no tendency to rotate by itself. Static unbalance causes the pounding action of the front wheels that is called "tramp."

To correct static unbalance:

1. Remove wheel and hub from spindle as a unit.
2. Clean all grease from wheel bearings and races.
3. Clamp a clean spindle in a bench vise, or if the spindle on the car must be used, clean it carefully.
4. Mount the wheel on the spindle and adjust the bearings loosely so that the wheel is just held in position and is practically frictionless.
5. Make sure that the tire is inflated to the correct pressure.
6. Start the wheel in motion and allow it to stop by itself. When it stops, the heavy side will be at the bottom.
7. Mark the heaviest point and also the uppermost or lightest point.
8. Install two balancing weights on the rim opposite each other and 180° away from the heavy point.
9. Move these weights equally in opposite direction toward the heavy side until the wheel is in balance.
10. Repack wheel bearings, reinstall and adjust bearings as explained in Section 3, "Front Wheel Bearings—Adjust."

Dynamic Balance (running balance) requires not only that the wheel be in static balance, but also that it runs smoothly at all speeds on an axis which runs through the center line of the wheel and tire and is perpendicular to the axis of rotation. Dynamic unbalance sets up forces which cause the wheels to wobble or "shimmy."

The quickest and best methods of testing and correcting dynamic unbalance are by the use of dynamic wheel balancers which are available commercially. These commercial balancers include all necessary instructions on where and how the balancing weights should be placed. The following information, however, will help in the correction of dynamic balance.

When a wheel that is statically unbalanced is dynamically in balance, the dynamic balance can be retained while correcting the static balance by installing the corrective weights so that half of the weight required is placed on the inner edge of the rim and the other half on the outer edge of the rim.

Dynamic unbalance can be corrected without destroying static balance by installing weights so half of weight required for dynamic balance is placed on the rim opposite the heavy point, while the other half is placed 180° away and on the opposite side of the rim.

WHEEL RUN-OUT AND ECCENTRICITY

The wheels should not run out (wobble) more than $\frac{1}{16}''$ as measured on the side of the rim at the base of the tire. Excessive run-out is the result of a bent wheel, an improperly mounted wheel, worn knuckle bearings or steering connections. These parts should be checked for correct adjustment, proper alignment and wear whenever excessive run-out is encountered.

The wheels should also run concentric with the steering knuckle spindle within $\frac{1}{16}$ inch as measured on the tire bead seat of the rim with the tire removed.

Wheel run-out, eccentricity and balance are closely associated with steering and front wheel alignment. Further information on these subjects will be found under "Front Suspension."

TESTING FOR TIRE NOISE

Noise caused by the normal action of tire treads on various road surfaces is often confused with rear axle gears or other noises in the car.

The determination of whether tires are causing the noise complained of is relatively simple. The car should be driven at various speeds and note taken of part throttle, sudden acceleration and deceleration as axle and exhaust noises show definite variations under these conditions, while tire noise will remain constant. Tire noise is, however, most pronounced at speeds of approximately twenty or thirty miles per hour.

The tires may be further checked by driving the car over smooth pavement with the tires at normal pressure and again over the same stretch of pavement when the tires have been inflated to fifty pounds pressure. This high inflation pressure should immediately be reduced to normal after test. If the noise for which the test is being made is caused by tires, it will noticeably decrease when the tire pressure is increased, whereas axle noise should show no change in volume.

If, on inspection, the tires on the front wheels are found to be creating most of the noise, the alignment of the front wheels should be checked, as excessive tire noise usually results from low tire pressure, incorrect alignment or from uneven tire wear.

TROUBLES AND REMEDIES

WHEELS AND TIRES

Symptom and Probable Cause	Probable Remedy
Front Wheel Shimmy	
a. Loose wheel lugs.	a. Tighten lugs.
b. Loose or broken wheel bearing.	b. Tighten or replace bearing and adjust according to instructions.
c. Bent wheel.	c. Replace or straighten wheel.
d. Improper alignment.	d. Front end alignment as per specifications.
e.. Wheel out-of-balance.	e. Balance wheel.
f. Loose tie rod ends.	f. Replace tie rod ends.
Hard Steering	
a. Low air pressure in tires.	a. Inflate tires to recommended pressure.
b. Lack of Lubrication.	b. Lubricate according to instructions.
c. Improper wheel alignment.	c. Front alignment correction.
d. Sagging front or rear spring.	d. Replace springs as required.
e. Bent wheel or spindle.	e. Straighten or replace wheel or replace spindle.
f. Broken wheel bearings.	f. Replace necessary bearings.
Improper Tire Wear	
a. Improper air pressures.	a. Inflate tires to recommended pressure.
b. Not rotating tires as required.	b. Rotate tires according to instructions.
c. Improper acting brakes.	c. Correct brakes as required.
d. Improper camber.	d. Align front end as per specifications.
e. High speed driving on turns.	e. Take turns more slowly.
f. Rapid stopping.	f. Apply brakes slowly on approaching stop.
Noise in Front or Rear Wheels	
a. Loose wheel lugs.	a. Tighten wheel lugs.
b. Broken or loose brake shoe return spring retainers.	b. Replace return spring retainers.
c. Broken or rough wheel bearings.	c. Replace bearings according to instructions.
d. Scored drums.	d. Replace brake lining and remachine drums.
e. Lack of lubrication.	e. Lubricate as per instructions.

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SECTION 11

CHASSIS SHEET METAL

CONTENTS OF THIS SECTION

HOOD ASSEMBLY

INDEX

GENERAL DESCRIPTION

The hood is an alligator jaw type, opening at the front and operated by a counter-balancing device comprised of a spring loaded hinge on each side of the cowl. The over center type, spring loaded hinge tends to hold the hood down when it is in the locked position, but when raised, holds the hood up for easy access to the engine compartment (fig. 1).

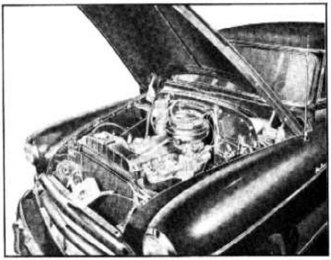

Fig. 1—Engine Compartment

The hood is of a two panel construction, riveted together at the center with a moulding and ornament covering the joint. A sturdy, rigid hood brace is provided at the rear and allows for a solid hinge attachment.

On 1949 models a hood control knob is located just below the left end of the instrument panel and is attached to a cable that passes through a conduit to a spring loaded locking latch in the hood lock plate (fig. 2). The hood lock is released by pulling out on the control knob. To raise the hood above the safety catch position insert the fingers under the front of the hood opening and press in on the safety catch lever (fig. 3). The hood can then be raised to the fully open position.

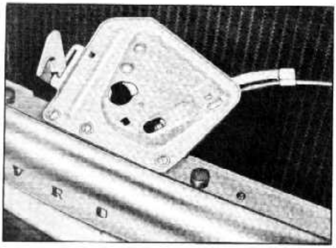

Fig. 2—Hood Lock Plate

On 1950 models, the hood lock is released by reaching under the top grille bar, to the right of the center of the hood, and lifting up on the release lever. The safety catch can then be released by reaching in under the nose of hood to the left of center and pressing safety catch lever toward rear of car.

On 1951-53 models, the hood lock release lever is located under the top grille bar, slightly to the left of the center of the hood. Lifting the lever slightly will release the hood lock and when raised further, it releases the safety catch.

Hood hinges are comprised of a heavy steel plate with two hinge support arms securely pinned by heavy rivets to bosses in the plate. Heavy bracing welded to the hood side panel provides the rigid mounting point for the hood ends of the hinge arms attached by shoulder bolts to the side panel.

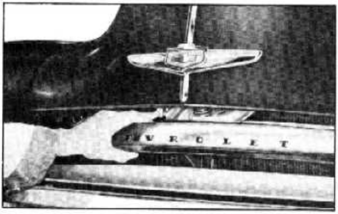

Fig. 3—Hood Safety Catch Release

Each hinge plate is rigidly attached to the cowl by four bolts. Two bolts extend through the cowl from the inside and thread into square nuts permanently staked in place on the outside of the hinge plate. The front bolts extend from the outside, through the plate and cowl and are threaded into square nuts permanently staked in place on the inside of the cowl.

The holes through the cowl and hinge plate are elongated horizontally, as well as being considerably wider than the bolt diameter to provide for shifting the hinge plate in any direction necessary for proper hood alignment.

The radiator upper baffle is an integral part of the forward part of the hood providing for an improved service condition since the baffle moves up with the hood, leaving a space between the radiator core and the radiator grille. This space provides accessibility for servicing horn, parking lamps, electrical connections, cleaning front of radiator core and, in case of damage, repair of the grille parts.

MINOR SERVICE OPERATIONS

CENTER MOLDING

Replacement

1. Open hood and remove front name plate.
2. Remove hood ornament.
3. Working from under hood bend the metal tangs in a straight vertical position and remove the moldings.
4. Position new tangs in new moldings at approximate locations of tangs in old moldings.
5. Place moldings in position making sure the tangs are through hood and are accessible and the molding is centered properly and flush.
6. Working from underside twist the tangs to a locked position.
7. Install hood emblem and hood ornament.
8. Close hood.

UPPER CATCH PLATE BOLT

Replacement

1. Open hood and loosen lock nut on catch bolt and remove nut.
2. Remove catch bolt, spring and spring retainer from upper catch plate.
3. Place spring retainer and spring over catch bolt and install in upper catch plate.
4. Install lock nut leaving loose and adjust hood lock as outlined under "Adjustment."
5. Holding catch bolt, tighten lock nut and close hood.

Adjustment

1. The closing or locking tension of the lock bolt in the lock plate may be adjusted by loosening the lock nut on the bolt and turning the bolt in the retaining plate (fig. 4) clockwise

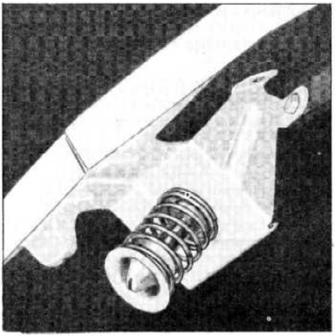

Fig. 4—Hood Lock Bolt

to increase the tension or counterclockwise to reduce it.

NOTE: This adjustment also changes the spacing between the underside of the hood and top of grille. Proper spacing at this point is $\frac{1}{16}$".

2. Lock the lock nut and close hood.

UPPER RADIATOR BAFFLE

Replacement

1. Open hood and remove two nuts and bolts attaching upper radiator baffle to upper catch plate.
2. Remove two bolts attaching upper radiator baffle to bottom flange of hood on each side.
3. Remove two rivets attaching upper radiator baffle to side of flange on each side.
4. Position baffle in hood and install bolts and nuts to bottom flange of hood each side.
5. Install bolts and nuts attaching upper catch plate to upper radiator baffle.
6. Install 2 rivets to side flange each side.

UPPER CATCH PLATE

Replacement

1. Open hood and remove upper radiator baffle as described above.
2. Remove the hood emblem.
3. Remove rivets attaching upper catch plate to the hood.
4. Assemble the upper baffle to upper catch plate with bolts, nuts and lockwashers.

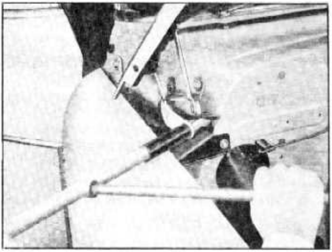

Fig. 5—Removing Hood Spring

5. Position assembly in hood and install bolts attaching upper radiator baffle to hood.
6. Install rivets each side attaching upper radiator baffle to hood and rivets attaching upper lock plate to the hood.
7. Install the hood emblem.
8. Adjust hood lock and close hood.

HOOD HINGE

Removal

1. On 1949-52 Models, open hood and prop in upright position. Place cloth between rear edge of hood and cowl and fender to prevent damage to finish when hinge is removed.
2. Using J-3181, Hood Spring Remover and Replacer, remove spring (fig. 5).

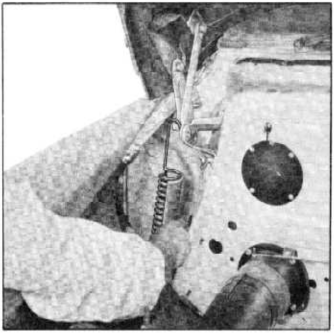

Fig. 6—Removing Hood Spring

3. On 1953 models, use J-5544, Hood Spring Remover and Replacer as follows:
   a. Open hood only far enough to obtain clearance so tool J-5544 may be placed around hood spring.
   b. Then fully open hood and remove tool and spring (fig. 6).

   CAUTION: Tool J-5544 is supplied in a set of two, do not remove spring from tool.

   c. After removing hood springs, prop hood in full open position.

   NOTE: Tool J-5544 may also be used to remove and replace hood springs on 1949-52 models.

4. Remove the hex head shoulder bolts attaching hood hinge support arms to hood.

   CAUTION: When bolts are removed from support arms the hood, if not held, will fall down and damage hood as well as fender tops. Care must be used at all times.

5. From inside of cowl remove the hinge to cowl bolts. From outside at cowl hood hinge remove hex head bolts and washers attaching hood hinge to cowl and remove hinge.

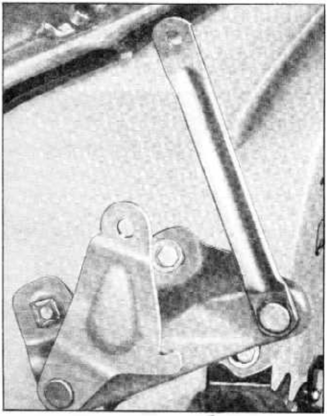

Fig. 7—Hood Hinge to Cowl

NOTE: The reason for working from inside to outside at this point is to prevent hinge from falling and causing damage.

Installation

1. Place hood hinge in position on cowl (fig. 7), align all bolt holes and start the hex head bolts and washers attaching hood hinge to cowl.
2. From inside of cowl start cowl to hinge bolts.
3. Place hood in position, prop in full open position and install the bolts attaching hood hinge support arms to hood. Tighten securely.
4. Close hood to locked position. See that hood rests flat on cowl and is in alignment. Tighten two inside cowl to hinge bolts securely.
5. Open hood and tighten hinge to cowl bolts.
6. On 1949-52 Models, replace spring using J-3181 Hood Spring Remover and Replacer.
7. On 1953 models, with hood in full open position, attach spring and tool J-5544, then partially close hood allowing enough clearance to insert arm between hood and fender and remove tool J-5544 from spring.

LOWER CATCH PLATE

Replacement

1. Open hood.
2. On 1949 models, remove clamp from end of hood control cable and remove bolt and nut attaching cable bracket to lower catch plate.
3. Remove bolt and nut attaching lower catch plate to grille bar center spacer.
4. Remove 3 slot head bolts and nuts attaching lower catch plate to radiator grille assembly and remove from vehicle.
5. Position lower catch plate and insert 4 slotted head bolts, start but do not tighten nuts.
6. On 1949 models, replace conduit bracket. Replace cable through trip lever and insert through end clamp. Adjust clamp so that with the hood control knob "in" the hood catch is engaged but when knob is pulled the catch begins to release.
7. Adjust lower catch plate as described below and tighten all bolts securely.

Adjustment

1. Open hood and loosen the bolts attaching lower catch plate to grille and grille bar center spacer.
2. Lower hood carefully and center lock bolt in the catch plate.
3. Raise the hood and tighten the bolts securely.
4. Adjust hood lock bolt as per instructions under "Upper Catch Plate Bolt—Adjustment".

MAJOR SERVICE OPERATIONS

HOOD ASSEMBLY

Removal

1. Lay a fender cover along top ot cowl and fender to prevent hood from scratching cowl or fenders.
2. Open hood and prop in full open position.
3. Using either J-3181 or J-5544 Hood Spring Remover and Replacer Tools, remove hood springs (fig. 5 or 6).
4. Remove bolts attaching hood hinge support arms to hood on each side.

   CAUTION: When bolts are removed from support arms the hood, if not held, will fall down and damage hood as well as fender tops. Care must be used at all times.

5. Remove hood from vehicle.

Installation

1. Lay a fender cover along top of cowl and fender to prevent hood from scratching cowl top or fenders.
2. Place the hood in position and prop in full open position.
3. Connect the hood hinge support arms with bolts each side and tighten securely.
4. Using either J-3181 or J-5544 Hood Spring Remover and Replacer Tools, replace hood hinge spring.
5. Remove the fender cover from the cowl and fenders and close hood. Check hood fit and, if necessary, loosen hinge to cowl bolts to adjust hood alignment. Adjust upper catch plate as instructed under "Upper Catch Plate Bolt Adjustment" in this section.

HOOD HALF

Removal

1. Remove hood as instructed in Hood Assembly–Removal.
2. Stand hood in upright position on fender cover on floor.
3. Remove hood emblem and hood ornament.
4. Remove the upper radiator baffle and upper hood catch plate.
5. Remove hood rear reinforcement tie plate from the side to be removed.
6. Remove hood molding.
7. Lay hood down on fender cover to prevent it from being scratched and using a sharp chisel cut the rivet heads attaching the hood halves together.

   NOTE: After rivets have been cut it is sometimes necessary to use a small drift or punch to remove rivets.

8. Remove hood bumpers from panel that is to be replaced.

Installation

1. Align the two hood halves and install the rear reinforcement tie plate and tighten securely.
2. Install upper radiator baffle to be used as a brace while riveting hood halves together and secure in place with bolts.

   CAUTION: Before riveting hood halves together check outside top of hood and make sure it is a flush fit so hood center moulding will lay flat on hood top.

3. Stand hood in a vertical position and start riveting from bottom to top. Replace all rivets possible, then remove upper radiator baffle and replace remaining rivets.
4. Install hood center moldings.
5. Install upper catch plate and upper radiator baffle.
6. Install hood ornament and hood emblem.
7. Install hood rubber bumpers.
8. Lay fender cover along cowl top and fenders and install hood.
9. Check hood fit and alignment and adjust as necessary.

RADIATOR GRILLE AND BAFFLES

INDEX

GENERAL DESCRIPTION

The radiator grille consists of a radiator grille header bar bordering the hood opening, a radiator grille center bar spanning the width across the front fenders, a radiator grille lower bar dividing the junction of the grille with the front bumper filler panel baffle and 1949 models a series of seven vertical moldings. 1952 models have five vertical moldings and 1953 models three vertical moldings which are bolted to the center horizontal bar. All bars and moldings are durable steel stampings finished in bright chromium and securely fastened to the radiator grille assembly.

The radiator grille assembly consists of a series of sheet metal stampings welded together to form a rigid structural mounting for the chromium finished pieces and parking lamps. This construction results in a noise free and rigid assembly that is securely bolted to the forward edge and surface of the front fenders.

The parking lamp assembly on 1949-50 models is a round chromium plated unit held in position on the right and left between the upper and center grille bars with two nuts. Parking lights on all 1951-52 models are housed within the semi-circular sides of the radiator grille. 1953 parking lights located in the same area are circular in design. The parking lamp bulb snaps into the back plate and may be replaced without removing the parking lamp assembly from the vehicle. The rest of the parking lamp assembly is serviced as a unit.

The radiator grille to front bumper filler panel baffle is of one piece construction extending from the front bumper face bar to the radiator core. This produces a simple structure readily removable for service purposes.

RADIATOR GRILLE TO FRONT BUMPER FILLER PANEL BAFFLE

Removal

1. Remove bumper face bar.
2. Remove sheet metal screws attaching filler panel baffle to fender air duct baffle and front fender skirt each side.
3. Remove sheet metal screws attaching filler panel baffle to grille bar center spacer.
4. Remove nuts and lockwashers from special bolts attaching filler panel baffle to grille lower bar.
5. Lower filler panel baffle enough to slide off special bolts and remove from vehicle.

Installation

1. If filler panel baffle is replaced with new baffle, remove the two rubber bumpers at front edge and install on new baffle.
2. Slide baffle over special bolts in grille and tighten nuts and lockwashers.
3. Replace screws attaching baffle to grille bar center spacer.
4. Attach baffle to fender, air duct baffle and front fender skirt with sheet metal screws.
5. Replace bumper face bar.

RADIATOR GRILLE

Removal

1. Open hood, disconnect the parking lights at the junction block on each side and remove horns on 1953 models.
2. Remove lower catch plate and lay back out of the way.
3. Remove fender to grille screws and fender to front skirt to grille screws.
4. Remove nuts and lockwashers from special bolts attaching grille to filler panel baffle on each side.
5. Remove screws attaching grille bar center spacer to filler panel baffle.
6. Remove the grille assembly from the vehicle.

Disassembly

On 1949 models, if the vertical moldings are to be replaced only the lower bar need be removed. On 1952-3 models, vertical moldings may be removed without any disassembly of grille. To replace the center bar the parking lamps and the header bar must be removed.

1. Remove the parking lamp from each side by removing the retaining nuts.
2. Remove the rivets holding the grille bar center spacer to the grille assembly.
3. Remove the screw from each side attaching the header bar to the center bar.
4. Remove rivets, each side, attaching the header bar to the grille bar outer spacers.
5. Remove rivets attaching center bar to the grille assembly and lift the center bar off.
6. Remove rivets attaching the lower bar to the grille assembly.
7. Slip vertical moldings down and off grille assembly.
8. If header bar is to be replaced remove rubber bumpers.

Assembly

1. On 1949 models slip on vertical moldings from the bottom until they hit a definite stop. Be sure that they are straight. The center, or number 1 molding, may be identified by noticing that there are no notches and only one end has chamfered corners. The chamfered corners are to be at the top when assembled.

   The next two moldings on each side or the number 2 moldings are identified by being notched in the center. The moldings are assembled to the grille assembly with this notch toward the outside.

   The end moldings or number 3 and 4 are identified by having the notch off center. When assembled, this notch is to be in the up position and toward the outside of the car. The outer edge of the end moldings clip around the outside of the grille assembly.
2. Assemble the lower bar to the grille assembly using three bolts to hold in place temporarily.
3. Position center bar on grille assembly and hold in place with bolts through the outer ends.
4. On 1951-2 models assemble outer moldings to lower and center grille moldings.
5. Place header bar in position and secure to the center bar at the outer ends with screws.
6. Replace the grille bar center spacer and temporarily bolt to the grille assembly.
7. Replace all rivets and rivet. Then remove the temporary bolts and rivet at these locations.
8. Replace the parking lamps and assemble to the grille assembly with two nuts on each side.
9. Replace the four rubber bumpers on the header bar. The two thick ones are closest to the center of the vehicle.

Assembly—1953 Models

1. Install outer end moldings to lower radiator grille molding.
2. Place four inserts in parking lamp housing and install housing to outer end moldings.
3. Install center horizontal grille molding with vertical moldings attached to parking lamp housing.
4. Install parking lamp upper brackets between outer end moldings and upper grille molding and rivet or bolt in place.
5. Attach parking lamp bracket to lamp housing.
6. Install air duct baffle to upper and lower defectors.

Installation

1. Raise hood and replace grille in position in the vehicle.
2. Replace sheet metal screws connecting grille to front fenders and front fender skirts.
3. Replace lockwashers and nuts on special grille to filler panel baffle bolts and tighten securely.
4. Secure air duct baffle to attaching brackets on models so equipped.
5. Replace sheet metal screws attaching filler panel baffle to grille bar center spacer.
6. Replace lower catch plate.
7. Connect parking lights and install horns.
8. Adjust locking plate as described under "Lower Catch Plate—Adjustment."

FRONT END SHEET METAL

INDEX

GENERAL DESCRIPTION

The front end sheet metal consists of front fenders, hood, radiator grille, and the necessary skirts and baffles. The front end sheet metal assembly and radiator is anchored on the radiator support frame cross member in a stabilized mounting. Unitizing of front fenders, radiator and sheet metal in a framework of panels from the cowl to the single stabilized mounting point on this cross support prevents frame movements from being imparted to the sheet metal, thereby prolonging life of the sheet metal and the radiator core. A minimum wheel shock is transmitted to these parts due to the stabilized unit mounting on the special frame cross member.

The front fenders are of one piece, deep drawn, heavy gauge steel construction strongly supported and braced to the radiator support at the front and cowl at the rear. Adjustment is provided so that sheet metal assembly and hood assembly can be located in good conformance with the body surfaces.

FRONT END SHEET METAL ASSEMBLY

Removal

NOTE: Certain locations have shims specified as required for adjusting purposes, therefore, shims should be replaced as removed at these locations at installation.

1. Drain radiator. Remove hood as outlined under "Hood Assembly Removal."
2. Remove nuts and washers from sill moulding bolts at the fender and remove mouldings from clips on body.
3. Remove battery cables from battery. Remove battery and remove positive cable from right fender skirt.
4. Remove wiring harness from junction blocks, pull harness out of radiator support tie bar and front skirt hole. On 1949 models, remove horn relay and voltage regulator. Remove wiring harness from clips on left fender skirt.
5. On 1949 models, remove hood lock control cable from clips on left fender skirt and remove clamp from front end of hood lock control cable. Loosen nut and bolt attachment of cable bracket to lower hood lock plate. Pull out hood lock control cable from lower hood lock plate and fender front skirt.
6. Turn rubber connectors back over air ducts.
7. Remove upper and lower radiator hoses and oil cooler from Powerglide models.
8. Remove steering gear housing shield, on models so equipped.
9. Remove fender skirt to dash leg nuts, washers, and bolts each side.
10. Remove rear baffle to cowl bolt each side.
11. Remove rear baffle extension each side.
12. Remove fender to frame side member brace each side, except on 1953 convertibles.
13. Remove fender to lower baffle screws each side.
14. Remove nuts, lockplate, spacer and rubber cushion connecting the radiator support to radiator support cross member. Remove bolts from air duct baffles on 1953 models.

    NOTE: These bolts cannot be pushed through or removed without removing lock plate and radiator core and bending up retaining tabs on bolt lock plate in radiator support.

15. Remove horns from 1953 models.
16. Remove fender to cowl brace bolts at fender each side.
17. Remove fender to cowl side bolts each side.
18. Lift up at rear (using care not to mar doors) until the radiator support bolts clear radiator support cross member, and the filler panel

can slip from under top edge of front bumper face bar, then pull straight forward.

Installation

1. Tape rubber cushion and shims in place on radiator support over the radiator support to radiator support cross member bolts. Lift rear end of assembly (using care not to mar doors), position front end under top edge of bumper face bar, and lower rear end into position making sure that radiator support bolts are through the holes in radiator support cross member.
2. Replace two fender to cowl side bolts each side.
3. Replace fender to cowl brace bolts at fender each side.
4. Replace fender skirt to dash leg bolts, lockwashers and nuts.
5. Replace rear baffle to cowl bolt each side.
6. Replace fender to side member brace each side. (No brace on 1953 convertibles).
7. Replace fender to lower baffle screws each side.
8. Replace rear baffle extension each side.
9. Replace steering gear housing shield on those models so equipped.
10. Replace rubber cushion, spacer, lock plate and nuts to radiator support to radiator support cross member bolts, tighten nuts and lock plate.
11. Replace upper and lower radiator hoses and oil cooler on Powerglide models.
12. Turn rubber connectors over air ducts.
13. On 1949 models, replace hood lock control cable into clips on left fender skirt, through front skirt into lower hood lock plate and replace clamp at front end of cable.
14. Replace air duct baffle bolts.
15. Replace horn relay, voltage regulator on 1949 models and wiring harness and connect to junction blocks.
16. Replace horns on 1953 models.
17. Replace battery and battery cables.
18. Replace body sill mouldings.
19. Replace hood as instructed in "Hood Assembly Installation", and refill radiator.

FENDER AND SKIRT ASSEMBLY

Removal

> **NOTE: Certain locations have shims specified as required for adjusting purposes, therefore shims should be replaced as removed at these locations at installation.**

1. Remove nuts and washers from sill molding bolts, at the fender and remove molding from clips on body.
2. If left assembly is to be removed, disconnect at least one battery cable from battery. Disconnect parking lights and horns from junction block. Disconnect wiring harness from junction blocks, and pull harness out of radiator support tie bar and front skirt hole. Remove harness from clips on rear skirt and lay out of way, after removing horn relay and on 1949 models, the voltage regulator. On 1949 models, remove clamp from front of hood lock control cable. Loosen nut and bolt attachment of cable bracket to lower hood lock plate and pull out hood lock control cable from lower hood lock plate and fender front skirt after removing cable from clips on fender rear skirt. Lay cable out of way.
3. If right assembly is to be removed: Remove battery cables from battery and remove battery. Disconnect parking light and horn from junction block. Disconnect wiring harness from junction block. Remove positive battery cable from fender rear skirt.
4. Turn back rubber connector over air ducts.
5. Remove fender skirt to dash leg nuts, lock washers and bolts.
6. Remove fender to frame side member brace screws from fender and rear baffle.
7. Remove rear baffle to baffle extension screws.
8. Remove rear baffle to cowl bolt.
9. If left assembly is to be removed, remove steering gear housing shield.
10. Remove fender to lower baffle screws.
11. Remove air duct baffle to filler panel screws.
12. Remove front skirt to radiator support bolts.
13. Remove horn and horn bracket assembly.
14. Remove fender to grille sheet metal screws.
15. Remove fender to filler panel screws.
16. Remove fender front skirt to filler panel screws.
17. Remove fender to cowl brace bolts at the fender.
18. Remove fender to cowl side bolts.
19. Remove fender to radiator support brace bolts at the radiator support.

> **NOTE: If any shims are removed in items 17-18-19, they should be replaced as removed to maintain adjustment.**

20. Place cloth over rear outer portion of grille and filler panel, also over fender at rear outer corner of hood, to prevent damage to fender. Use care to prevent marring of door when removing assembly.

21. Pull hood down from open position, enough to allow maximum clearance between fender and rear outer corner of hood. Pull grille and filler panel forward far enough to allow removal of front fender. Remove assembly from vehicle by lifting over the spring housing.

Installation:

1. Place cloth over rear outer portion of grille and filler panel, also over fender at rear outer corner of hood, to prevent damage to fender. Use care to prevent marring of door when installing assembly. Pull grille and filler panel forward far enough to allow installation of assembly. Lift assembly over spring housing, position front end, then slide rear into position.
2. Replace fender to radiator support brace bolts at radiator support.
3. Replace fender cowl side bolts.
4. Replace fender to cowl brace bolts at fender.
5. Replace fender skirt to radiator support bolts.
6. Replace air duct baffle to filler panel screws.
7. Replace horn and horn bracket assembly.
8. Replace fender front skirt to filler panel screws.
9. Replace fender to filler panel screws.
10. Replace fender to grille screws.
11. Replace fender to lower baffle screws.
12. If left hand fender was removed replace steering gear housing shield.
13. Replace rear baffle to cowl bolt.
14. Replace rear baffle to baffle extension screws.
15. Replace fender to frame side member brace screws, to fender and rear baffle.
16. Replace fender skirt to dash leg nuts, lock washers and bolts.
17. Turn rubber connectors over air ducts.
18. If right assembly was removed: Replace positive battery cable to fender rear skirt. Connect wiring harness, parking light, and horn wires to junction block. Replace battery and connect battery cables to battery.
19. If left assembly was removed: On 1949 models replace hood lock control cable in clips on fender rear skirt, through grommet in fender front skirt, into hood catch lower plate, and replace clamp at front end of cable. Replace horn relay and on 1949 models, the voltage regulator. Replace wiring harness on clips on fender rear skirt, through grommet in front skirt, through radiator support tie bar and connect to junction blocks. Connect parking lights and horns to junction blocks. Connect battery cable to battery.
20. Replace body sill molding.

FRONT FENDER

Removal

NOTE: Certain locations have shims specified as required for adjusting purposes, therefore, shims should be replaced as removed at these locations at installation.

1. Remove nuts and washers from sill molding bolts at front fender. Remove molding from clips on body.
2. Disconnect headlight at junction block and headlight ground from fender front skirt.
3. Remove fender to grille screws.
4. Remove fender to filler panel screws.
5. Remove fender front skirt to filler panel screws.
6. Remove air duct baffle to filler panel screws.
7. Remove fender to frame side member brace screw.
8. Remove fender to lower baffle screws.
9. Remove fender to front and rear skirt bolt and screws.
10. Remove fender to cowl side bolts.
11. Remove fender to radiator support brace bolts at the fender.
12. Remove fender to cowl brace bolt at fender.

NOTE: Place cloth over rear outer portion of grille and filler panel, also over fender at rear outer corner of hood, to prevent damage to fender. Use care when removing fender not to mar door.

13. Pull hood down from open position enough to allow maximum clearance between fender and rear outer corner of hood. Pull grille and filler panel forward far enough to allow removal of fender. Pull fender up at rear and slip fender flange from under bottom of fender front skirt at front, then lift fender up and out.

Installation

1. Place cloth over rear outer portion of grille and filler panel, also over fender at rear outer corner of hood, to prevent damage to fender. Use care when installing fender not to mar door. Pull hood down from open position enough to allow maximum clearance between fender and rear outer corner of hood. Pull grille and filler panel forward far enough to allow fender to slip into position at front, then install rear end into position.
2. Replace fender to radiator support brace bolts.

SERVICE NEWS REFERENCE

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SECTION 12

ELECTRICAL SYSTEM

CONTENTS OF THIS SECTION

ELECTRICAL SYSTEM

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WIRING

Two separate wiring harnesses, body wiring harness and chassis wiring harness, are provided in all passenger car models. A junction block, located on the lower flange of the instrument panel on 1949-50 models provides a convenient division point for these harnesses and an extra terminal is provided on this junction block for convenient connection of electrical accessories. All connections on 1951-53 models are made directly to the switches or gauges mounted on the instrument panel. Accessories connections, on 1951-53 models, are made to an accessory junction block.

To facilitate servicing of the electrical system an access door is provided in the dash. This door makes it much easier to reach the wiring behind the instrument panel as well as the instruments themselves.

The wiring diagrams (figs. 1-5) show all electrical units and circuits, positions of electrical units which are shown diagrammatically and the wiring harness loom which is indicated by the cross-hatched sections. Figures 6-9 shows additional wiring for top operation on Convertible.

The insulation of each wire is distinctively patterned and colored to assist in tracing circuits and making correct connections. Plastic insulation on the wires of the wiring harness was started on 1953 models in May and June of 1953. Both color codes, braided and plastic, are shown on the 1953 diagram.

In the wiring harness leading from the junction block to the lighting switch, protection is provided by a 30-ampere thermal circuit breaker located in the lighting switch. This circuit breaker is a bi-metal thermostatic element which, when overheated by a current flow of more than 30 amperes, opens all circuits leading out of the switch. When the bi-metal element has cooled sufficiently, electrical contact is restored. Thus the current to the lights is rapidly interrupted and restored until the short is located and corrected. Protection against destruction of the wiring is thereby provided and possible rapid discharge of the battery averted. A further advantage is evident should a short circuit occur in the lighting system at night. The intermittent operation of the lights makes it possible to drive the vehicle until a service garage is reached.

If a repair operation should require removal of the body from the chassis on 1949 models, it is unnecessary to disturb any of the internal wiring in the body or to disconnect any of the chassis wiring at the lamps. Instead, simple disconnections may be made at the junction block and at a few convenient locations so that the body is electrically free from the chassis, eliminating the necessity for loosening clips or removing a series of wires.

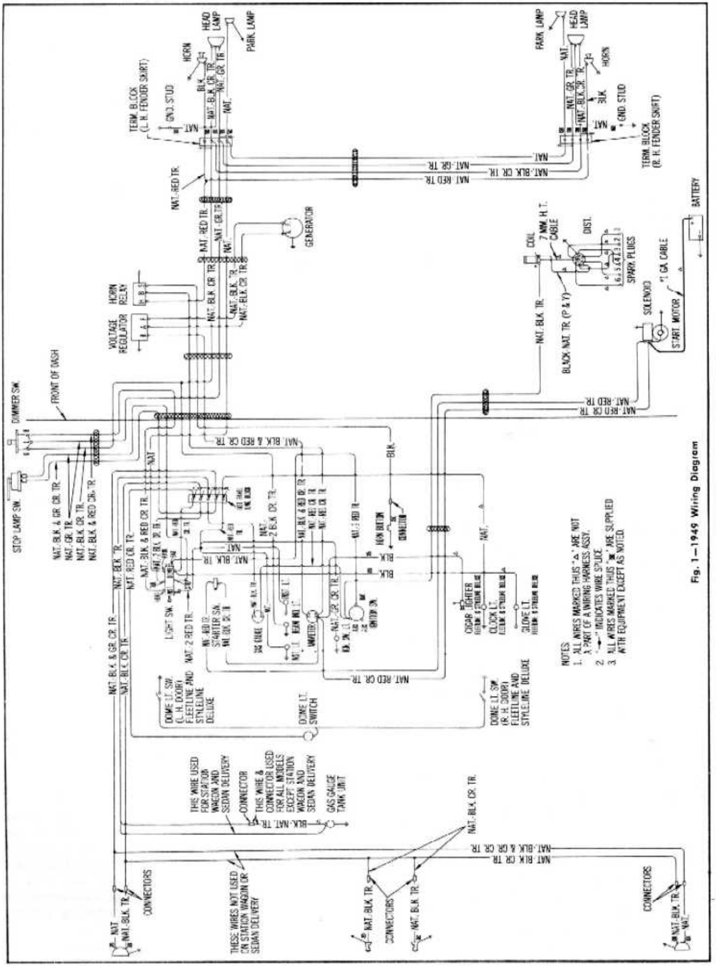

Fig. 1—1949 Wiring Diagram

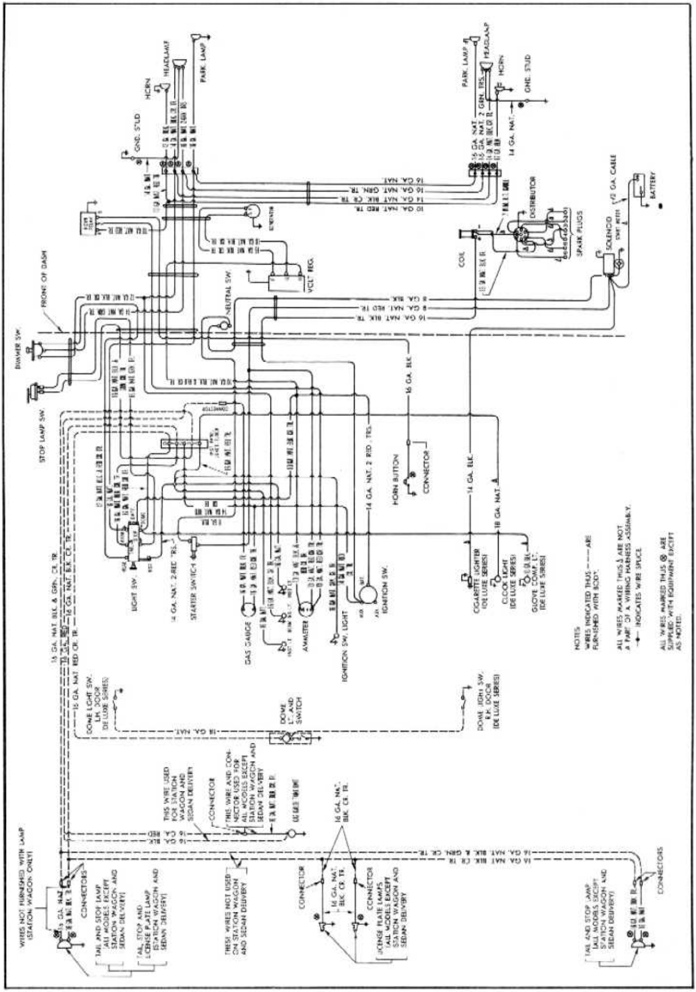

Fig. 2—1950 Passenger Car Wiring Diagram

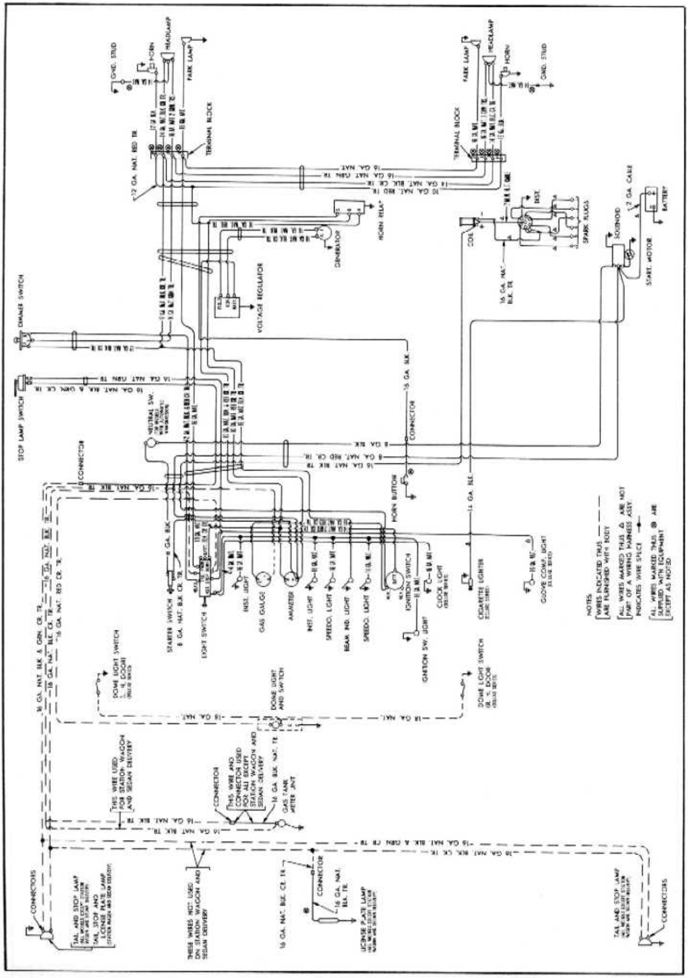

Fig. 3—1951 Passenger Car Wiring Diagram

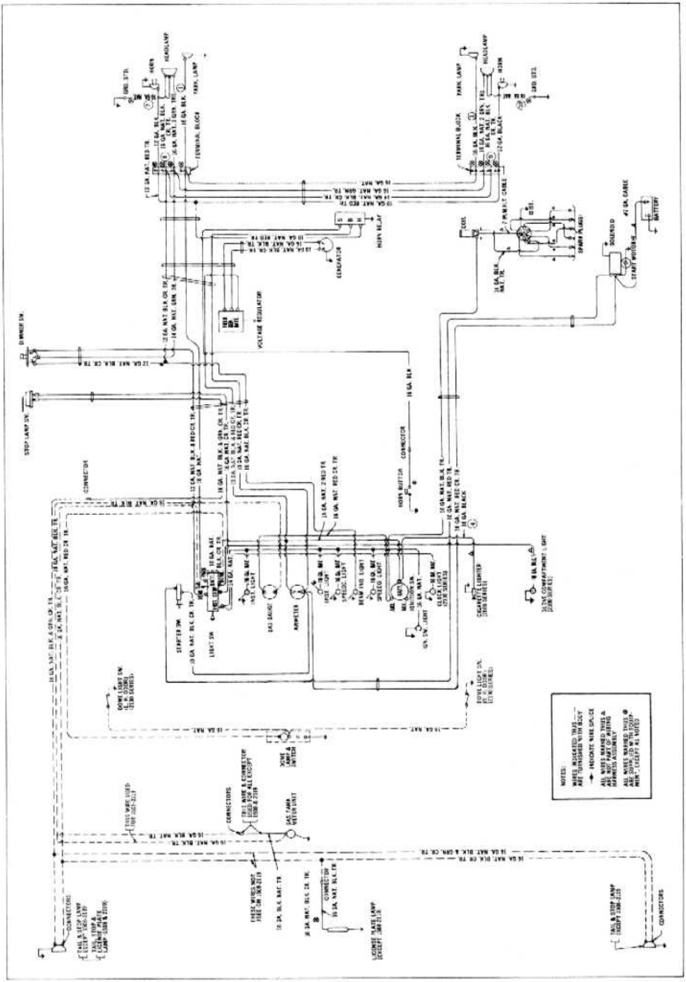

Fig. 4—1952 Passenger Car Wiring Diagram

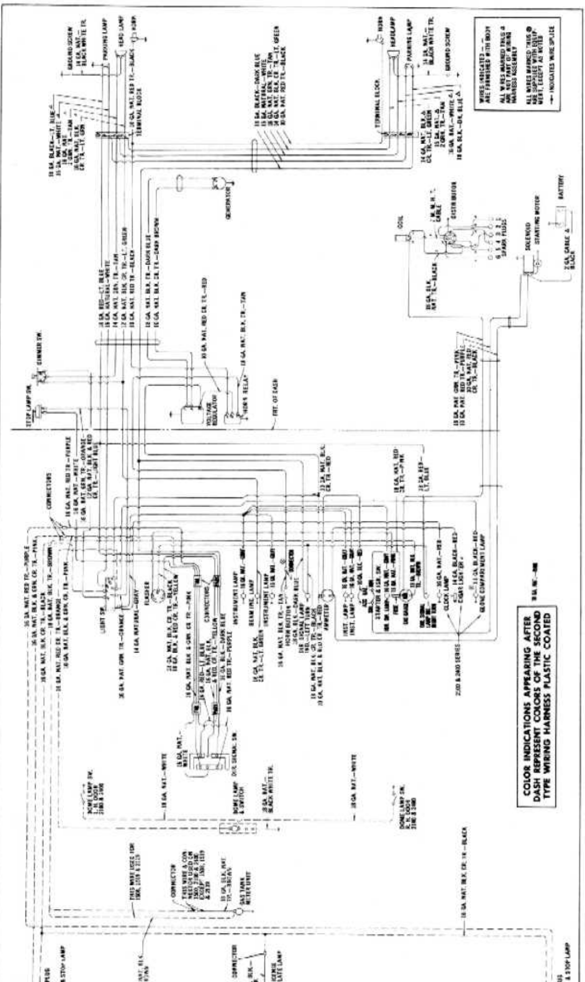

Fig. 5—1953 Passenger Car Wiring Diagram

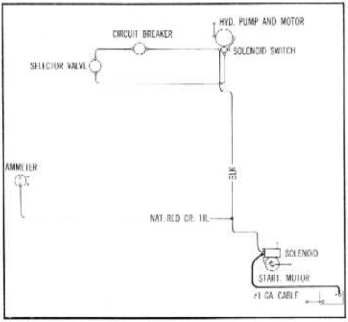

Fig. 6—1949 Additional Wiring (Convertible)

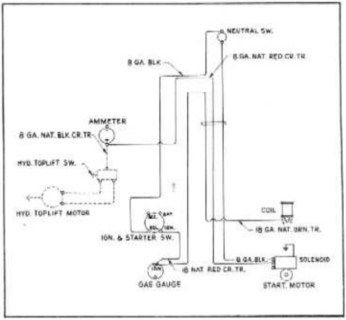

Fig. 8—1951-52 Additional Wiring (Convertible)

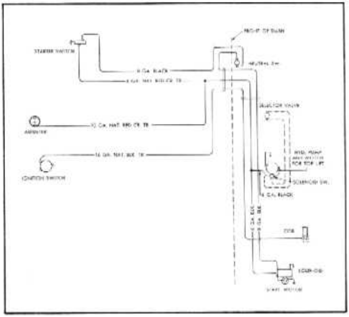

Fig. 7—1950 Additional Wiring (Convertible)

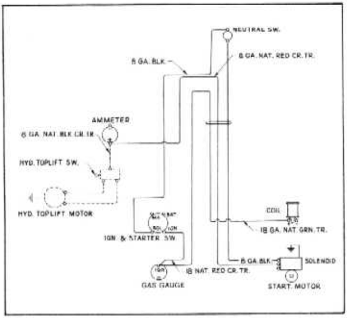

Fig. 9—1953 Additional Wiring (Convertible)

BATTERY

The battery, popularly referred to as "storage battery" is in reality an electro-chemical apparatus so constructed to change the energy put into it by the generator to chemical energy or "charged." This chemical energy can then be converted into electrical energy by making a continuous uninterrupted circuit between the positive and negative terminals of the battery, through the wiring system and electrical circuits of the vehicle.

The battery consists of three acid proof compartments or cells. Within each cell are two elements, one positive and one negative. Each element consists of a number of plates called "grids," the openings of which are filled with a lead paste. Each group of plates is connected together and the positive are separated from the negative by porous separators between each plate.

The liquid in which these plates are immersed is called electrolyte (suphuric acid and water). When the battery is receiving electrical energy from the generator, acid is driven from the composition of the plates and causes the battery to be in a state of charge. When current is drawn from the battery the acid combines with the lead paste of the plates forming a chemical compound.

As the sulphuric acid reacts to combine with the lead paste the electrolyte solution becomes practically all distilled water and when this condition exists the battery is said to be in a state of discharge.

The efficiency of a battery, therefore, is in direct proportion to its state of charge. To obtain the maximum efficiency, whatever amount of current is withdrawn from or generated by the battery must be compensated for by running the generator long enough to restore the batterv to the condition known as "charged."

The generator is designed to restore battery energy consumed in starting and then to assume the burden of supplying complete electrical load. If the generator fails in its duty and the battery becomes run down or in a state of discharge, charging from an outside source is necessary.

CHARGING

Charging a battery by causing an electric current to flow through it, sets up an electrochemical action between the positive and negative plates in the presence of the electrolyte. This reaction results in a condition called "gassing." The cover on each cell has a vent or opening so that the gas produced may be vented to atmosphere. The filler caps should be removed when charging. An open flame should never be placed near a charging battery as the discharging gas is explosive.

To check the battery for its state of charge a hydrometer should be used (fig. 10). A fully charged battery should have a specific gravity of 1.275 to 1.300 while a fully discharged battery will have a specific gravity of approximately 1.150.

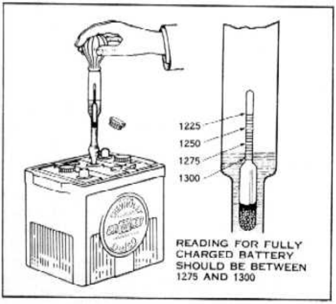

Fig. 10—Testing Specific Gravity of Battery

BATTERY CAPACITY TEST

A 6 volt battery that will maintain a 4.8 or better voltage during a battery capacity test should be considered a good battery. To make the battery capacity test, proceed as follows:

1. Connect positive ammeter lead of Volts Ampere Tester to positive post of battery (fig. 11).

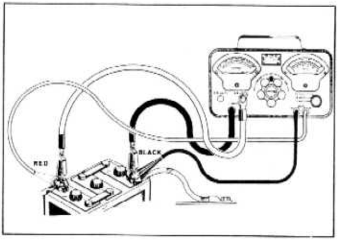

Fig. 11—Battery Capacity Test

2. Turn control knob of battery starter tester to off position.
3. Turn voltmeter switch to 15 volt position.
4. Connect negative ammeter lead to battery negative post.
5. Connect positive and negative voltmeter leads to positive and negative battery posts respectively.

   NOTE: The attachments must be made to battery post and not the ammeter clips.

6. Turn battery-starter control knob to battery position until test ammeter reads 300 amperes (ampere hour rating of battery times three).

   CAUTION: Do not turn battery-starter control knob to starter position with ammeter connected across the battery as this will cause a direct short.

7. With ammeter reading 300 amperes for fifteen seconds then take voltage reading which should be 4.8 volts or better.
8. If voltage is less than 4.8 volts, proceed with Three Minute Battery Test.

THREE MINUTE BATTERY TEST

In addition to the hydrometer test and battery capacity test, an accurate test using a Voltmeter and a fast charger will quickly establish in three to four minutes whether a battery is good or bad

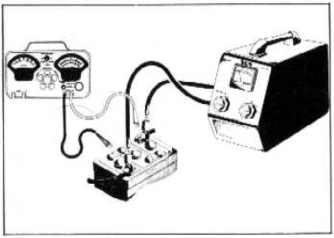

Fig. 12—Three Minute Battery Test

even when the battery is in a discharged condition.

This procedure determines the condition of charged or discharged batteries by following the principles that:

a. A charged battery may be tested by taking current out of it.

b. A discharged battery may be tested by passing current through it.

This test should not be used if the battery temperature is below 60° F. Figure 12 shows test hookup for three minute test.

FILLING

Batteries should be filled with sufficient quantity of distilled water to bring the electrolyte up

Make a visual inspection and add water if below the plates. If it was not necessary to add water, test specific gravity.

Make the Battery Capacity Test, noting the voltage under a discharged load of 3 times the Ampere Hour Rating.*

IF VOLTAGE IS BELOW 4.8 VOLTS:

Fast charge the battery at 75 amperes for 3 minutes. Then, with fast charger still operating, test individual cell voltage of battery.

IF CELL VOLTAGES ARE EVEN WITHIN .1 VOLT:

Test total battery voltage with charger still operating on fast charge.

IF CELL VOLTAGES ARE UNEVEN BY MORE THAN .1 VOLT:

Replace the battery.

IF TOTAL VOLTAGE IS OVER 7.75 VOLTS:

Battery is unsatisfactory and is probably sulphated. Battery may be serviceable after continued slow charge, then test capacity. If above 4.8 volts, place back in service. If below 4.8 volts, replace the battery.

IF TOTAL VOLTAGE IS UNDER 7.75 VOLTS:

Test specific gravity. Battery can be fast-charged up to the times shown in the accompanying chart. Always follow the fast charge with sufficient slow charging to bring battery to full charge.

IF VOLTAGE IS 4.8 VOLTS OR MORE:

Battery has good output capacity and will readily accept a normal change.

If the specific gravity is 1.250 or more, no service is required.**

If the specific gravity is below 1.250 check the charging circuit to determine the cause, and correct as needed.

a. Slow charge to full charge for city driving.

b. Highway driving with good charging system should return battery to full charge.

Specific Gravity	Fast Charge Up to
1.150 or less	1 hour
1.150 to 1.175	¾ hou
1.175 to 1.200	½ hour
1.200 to 1.225	¼ hour
Above 1.225	Slow charge only.

***NOTE:** Delco batteries, used in Chevrolet, are rated at 100 amp. hr.

****CAUTION:** If a battery is up and passes the capacity test with a voltage of 4.8 volts or more, do not follow through with the additional tests recommended for discharged batteries. A charged battery will not accept 75 amperes without an excessively high voltage.

to the top of the split ring in each cell.

NEW VEHICLES IN STOCK

1. Check battery electrolyte on each new car received; add sufficient distilled water to bring the electrolyte up to not more than ¼" above the top of plates in each cell.
2. Check electrolyte and add distilled water as necessary at weekly or semi-monthly intervals, depending upon the weather; warm weather causes greater water loss.
3. If the specific gravity of the battery is below 1.225, remove it and place on the charging line. Charge the battery until the specific gravity reaches 1.275 to 1.300.

Before a new car is delivered to a customer, make sure the specific gravity of the battery electrolyte measures at least 1.260 – preferably higher. Under no circumstances should acid be added to a new battery to increase the specific gravity of the electrolyte.

NEW BATTERIES IN PARTS STOCK

1. Batteries in stock should be checked for solution level and specific gravity in accordance with the procedure listed above.
2. Batteries on display should be rotated periodically with those in stock to avoid possibility of old batteries remaining in stock.

GENERATING SYSTEM

INDEX

DESCRIPTION

The generating system consists of a belt driven generator mounted on the left side of engine, the voltage and current regulator mounted on the left fender skirt on 1949 models and on the instrument access panel of 1950-53 models and the necessary wiring to properly connect the two units and the battery. The purpose of this system is to convert just enough mechanical energy from the engine into electrical energy to supply all electrically operated accessories and keep the battery fully charged.

The generator is a two-brush shunt wound unit controlled by a combined voltage and current regulator. The combined voltage and current regulator keeps the voltage and amperage within safe operating limits under the most adverse conditions and increases or decreases the amperage output to meet the varying requirements of the battery and electrical accessories.

The voltage and current regulator assembly actually consists of three units—the voltage regulator, the current regulator and the circuit breaker (fig. 13).

The voltage regulator controls the maximum voltage of the generator and keeps it from exceeding a predetermined value fixed by the regulator setting. This prevents excessive voltage at the lamp bulbs, ignition points, radio and prevents overcharging battery thereby prolonging their life. The actual charging rate to the battery at a given generator voltage depends upon the state of charge (counter voltage) of the battery.

The current regulator controls the maximum amperage output of the generator, thereby preventing damage to the generator due to overload.

The circuit breaker (cut-out relay) unit of the regulator is an automatic switch in the charging circuit between the generator and the battery. When the generator voltage exceeds the voltage for which the circuit breaker is set (slightly above battery voltage) the circuit breaker points close and the generator begins to supply electrical energy to operate electrical units and charge the battery. When the generator voltage drops below that of the battery the current starts to flow from the battery to the generator which opens the circuit breaker points and breaks the circuit.

CONSTRUCTION

GENERATOR

The generator housing (field frame) has the two pole shoes attached to it 180° apart. The field coils are around the pole shoes. The armature is centered between the pole shoes and is held in place by bearings in the frames (end plates); the end plates have openings for circulation of air for cooling. Air is circulated through the generator by the combined pulley and fan that are mounted on the front end of armature shaft. The commutator end frame (end plate) is fitted with the brush holders that hold the brushes in correct position under spring tension against the armature commutator. One brush is grounded to the frame while the other is insulated from the frame.

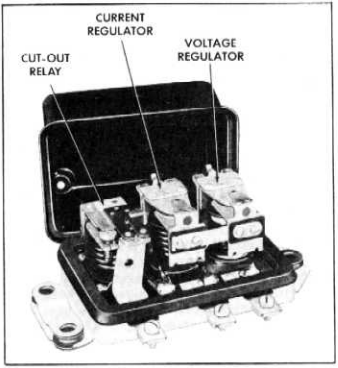

Fig. 13—Current and Voltage Regulator

The insulated (positive brush) is connected to the positive "A" terminal of the generator and to one terminal of the field coils. The other end of the field coils is connected to the insulated field "F" terminal of the generator.

CIRCUIT BREAKER (CUTOUT RELAY)

The cutout relay (fig. 14) has two windings assembled on one core, a series winding of a few turns of heavy wire (solid line) and a shunt winding of many turns of fine wire (dashed line). The shunt winding is shunted across the generator so that the generator voltage is impressed upon it at all times. The series winding is connected in series with the charging circuit so that the generator output passes through it.

The relay core and windings are assembled into a frame. A flat steel armature is attached to the frame by a flexible hinge so that it is centered just above the end of the core. The armature has two contact points which are located just above a similar number of stationary contact points. When the generator is not operating, the armature contact points are held away from the stationary points by the tension of a flat spring riveted on the side of the armature.

VOLTAGE REGULATOR

The voltage regulator (fig. 14) has two windings assembled on a single core, a shunt winding consisting of many turns of fine wire (dashed line) which is shunted across the generator; and a series winding of a few turns of relatively heavy wire (solid line) which is connected in series with the generator field circuit when the regulator contact points are closed.

The windings and core are assembled into a frame. A flat steel armature is attached to the frame by a flexible hinge so that it is just above the end of the core. The armature contains a contact point which is just beneath a stationary contact point. When the voltage regulator is not operating, the tension of a spiral spring holds the armature away from the core so that the points

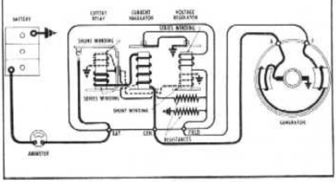

Fig. 14—Circuit Diagram

are in contact and the generator field circuit is completed to ground through them.

CURRENT REGULATOR

The current regulator (fig. 14) has a series winding of a few turns of heavy wire (solid line) which carries all generator output. The winding core is assembled into a frame. A flat steel armature is attached to the frame by a flexible hinge so that it is just above the core. The armature has a contact point which is just below a stationary contact point. When the current regulator is not operating, the tension of a spiral spring holds the armature away from the core so that the points are in contact. In this position, the generator field circuit is completed to ground through the current regulator contact points in series with the voltage regulator contact points.

OPERATION

In order for the generating system to operate the positive wire from the generator must be connected to the generator (GEN) terminal of the regulator, the field terminal of the generator connected to the field (F) terminal of the regulator and the wire from the battery through the ammeter to the battery (BAT) terminal of the regulator.

CIRCUIT BREAKER (CUTOUT RELAY)

When the generator voltage builds up to a value great enough to charge the battery, the magnetism induced by the current flowing through the shunt winding is sufficient to overcome the armature spring tension and pull the armature toward the core so that the contact points close. This completes the circuit between the generator and battery. The current which flows from the generator to the battery passes through the series winding in the proper direction to add to the magnetism holding the armature down and the points closed.

When the generator slows down or stops, current begins to flow from the battery to the generator. This reverses the direction that the current flows through the series winding, thus causing a reversal of the series winding magnetic field. The magnetic field of the shunt winding does not reverse. Therefore, instead of helping each other, the two windings now magnetically oppose each other so that the resultant magnetic field becomes insufficient to hold the armature down. The flat spring pulls the armature away from the core so that the points separate; this opens the circuit between the generator and battery.

VOLTAGE REGULATOR

When the generator voltage reaches the value for which the voltage regulator is adjusted, the magnetic field produced by the two winding (shunt and series) overcomes the armature spring tension and pulls the armature down so that the contact points separate. This inserts resistance into the generator field circuit so that the generator field current and voltage are reduced. Reduction of the generator voltage reduces the magnetic field of the regulator shunt winding. Also, opening the regulator points opens the regulator series winding circuit so that its magnetic field collapses completely. This results in the magnetic field reducing sufficiently to allow the spiral spring to pull the armature away from the core so that the contact points again close. This directly grounds the generator field circuit so that the generator voltage and output increase. The above cycle of action again takes place and the cycle continues at a rate of 150 to 250 times a second, regulating the voltage to a constant value. By thus maintaining a constant voltage, the generator supplies varying amounts of current to meet the varying states of battery charge and electrical load.

Temperature Compensation

The voltage regulator is compensated for temperature by means of a bi-metal thermostatic hinge on the armature. This causes the regulator to regulate for a higher voltage when cold which partly compensates for the fact that a higher voltage is required to charge a cold battery.

CURRENT REGULATOR

When the load demands are heavy, as for example when electrical devices are turned on and the battery is in a discharged condition, the voltage may not increase to a value sufficient to cause the voltage regulator to operate. Consequently, generator output will continue to increase until the generator reaches its rated maximum output. This is the current value for which the current regulator is set. Therefore, when the generator reaches its rated output, this output flowing through the current regulator winding, creates sufficient magnetism to pull the current regulator armature down and open the contact points. With the points open, resistance is inserted into the generator field circuit so that the generator output is reduced.

As soon as the generator output starts to fall off, the magnetic field of the current regulator winding is reduced, the spiral spring tension pulls the armature up, the contact points close thereby removing the resistance from the field circuit. Output increases and the above cycle is repeated. The cycle continues to take place while the current regulator is in operation 150 to 250 times a second, preventing the generator from exceeding its rated maximum.

When the electrical load is reduced, electrical devices turned off or battery comes up to charge, then the voltage increases so that the voltage regulator begins to operate and tapers the generator output down. This prevents the current regulator from operating. Either the voltage regulator or the current regulator controls the generator at any one time—the two never operate at the same time.

RESISTANCES

The current and voltage regulator circuits use a common resistance (fig. 14) which is inserted in the field circuit when either the current or voltage regulator operates. A second resistance (fig. 14) is connected between the regulator field terminal and the relay frame, which places it in parallel with the generator field coils. The sudden reduction in field current occurring when either the current or voltage regulator contact points open, is accompanied by a surge of induced voltage in the field coils as the strength of the magnetic field changes. These surges are partially dissipated by the two resistances, thus preventing excessive arcing at the contact points.

REGULATOR POLARITY

Some regulators are designed for use with negative grounded batteries while others are designed for use with positive grounded batteries. Using the wrong polarity regulator on an installation will cause the regulator contact points to pit badly and give very short life. As a safeguard against installation of the wrong polarity regulator, regulators designed for positive grounded systems have copper plated current and voltage regulator armatures while regulators for negative grounded systems have cadmium plated armatures.

QUICK CHECKS OF GENERATING SYSTEM

The following checks must be made to determine whether or not the units are operating normally. If not, the checks will indicate whether the generator or regulator is at fault so that proper corrective steps may be taken.

1. **A Fully Charged Battery and a Low Charging Rate** indicates normal voltage regulator operation. To check the current regulator remove the battery wire from the battery (BAT) terminal of the regulator. Connect the positive lead of an ammeter to the battery terminal of the regulator and the negative lead to the battery wire. With the ignition switch in the "Off" position, press on the starting button and crank the engine for about fifteen seconds. Then start the engine and, with it running at medium speed, turn on lights, radio and other electrical accessories and note quickly the generator output, which should be the value for which the current regulator is set. See specifications in this section. Now turn off the lights, radio and other accessories and allow the engine to continue running. As soon as the generator has replaced in the battery the current used in cranking, the voltage regulator, if operating properly, will taper the output down to a few amperes.
2. **A Fully Charged Battery and a High Charging Rate.**
   (a) With ammeter hooked up as in previous check, start engine and run it at medium speed. Disconnect the field wire from the field circuit and the output should immediately drop to zero. If it does not, the generator field circuit is grounded either inside the generator or in the wiring harness. If the output drops off to "zero" with the field lead disconnected, the trouble has been isolated in the regulator. Reconnect the field lead on the field terminal of the regulator.
   (b) Remove the regulator cover and depress the voltage regulator armature manually to open the points. If the output now drops off, the voltage regulator unit has been failing to reduce the output as the battery came up to charge and voltage regulator adjustment is indicated.
   (Instructions for adjusting the regulator are covered under the heading "Checks and Adjustments.")
   (c) If separating the voltage regulator contact points does not cause the output to drop off, the field circuit within the regulator is shorted and the regulator should be replaced.
3. **With a Low Battery and a Low or No Charging Rate** check the entire charging connections, corroded battery terminals, loose or corroded ground strap, and frayed or damaged wires. The high resistance resulting from these conditions will prevent normal charge from reaching the battery. If the entire charging circuit is in good condition, then either the regulator or generator is at fault.
   (a) With a jumper wire, ground the field terminal of the regulator to the engine block or other good ground. This completes the generator field circuit without its having to pass through the regulator. Increase the generator speed to determine which unit needs attention. Use care to avoid excessive speed since under these conditions the generator may produce a dangerously high output.
   (b) If the output increases, the regulator needs attention. Check for dirty or oxidized contact points or a low voltage setting.

(c) If the generator output remains at a few amperes with the field terminal grounded, the generator is at fault and should be checked further.

(d) If the generator does not show any output at all, either with or without the field terminal grounded, very quickly disconnect the generator lead from the generator (GEN) terminal of the regulator and strike it against a convenient ground with the generator operating at a medium speed. If a spark does not occur, the trouble has now been definitely isolated in the generator and it should be removed and repaired.

If a spark does occur, likely the generator can build up but the circuit breaker is not operating to permit the current to flow to the battery due to burnt points, points not closing, open voltage winding in circuit breaker, grounded circuit breaker, or too high closing voltage setting.

CAUTION: Do not operate the generator with the generator lead disconnected for any length of time since this is open circuit operation and the units will be damaged. A burned regulator resistance unit, regulator winding, or fused contacts can result only from an open circuit operation of extreme resistance in the charging circuit. With these conditions check wiring before reinstalling regulator.

REGULATOR MAINTENANCE

GENERAL INSTRUCTIONS

1. Mechanical checks and adjustments (air gaps, point opening) must be made with the battery disconnected and the regulator preferably off the vehicle.

   CAUTION: The cutout relay contact points must never be closed by hand with the battery connected to the regulator. This would cause a high current to flow through the units which would seriously damage them.

2. Electrical checks and adjustments may be made either on or off the vehicle.
3. The regulator must always be operated with the type generator for which it is designed.
4. The regulator must be mounted in the operating position when electrical settings are checked and adjusted and it must be at operating temperature.
5. If regulator is replaced or if adjustment was made on bench or if new or rebuilt generator is installed, the generator should be repolarized after leads are connected but before engine is started.

CHECKS AND ADJUSTMENTS

When checking and adjusting current and voltage regulator units it is essential that reliable instruments be used. A volts ampere tester with a fixed ¾ resistor and a variable resistor in series with the ammeter is required for checking and adjusting voltage regulators.

Before making any checks or adjustments the regulator must be at operating temperature. Operating temperature shall be assumed to exist after not less than 15 minutes of continuous operation with a charging rate of 8-10 amperes.

CIRCUIT BREAKER (CUT-OUT RELAY)

The cutout relay requires three checks and adjustments; air gap, point opening and closing voltage. All mechanical adjustments should be made with the battery wire disconnected from the regulator terminal to prevent accidental short circuits.

Closing Voltage

1. Turn control knob of tester to the direct position and then disconnect battery wire from the battery terminal (BAT) of the regulator.
2. Connect positive lead of voltmeter to generator terminal of regulator and negative lead to ground.
3. Connect positive lead of ammeter to battery terminal of regulator and negative lead to the battery wire (fig. 15).
4. Turn voltmeter selector switch to the eight volt position.

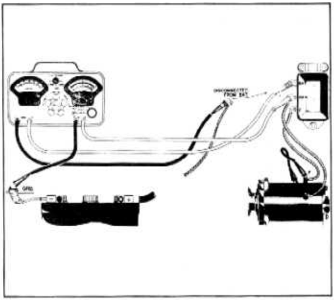

Fig. 15—Volt-Ammeter Connection for Checking Circuit Breaker

5. Slowly increase engine speed and note voltage at which circuit breaker points close.

   NOTE: Closing voltage should be from 5.9 to 6.8 volts. Preferred 6.4 volts.

6. When necessary to make a correction, adjust closing voltage by turning adjusting screw (fig. 16) until the preferred setting of 6.4 volts is obtained. Turn screw clockwise to increase spring tension and closing voltage and counterclockwise to decrease spring tension and closing voltage.

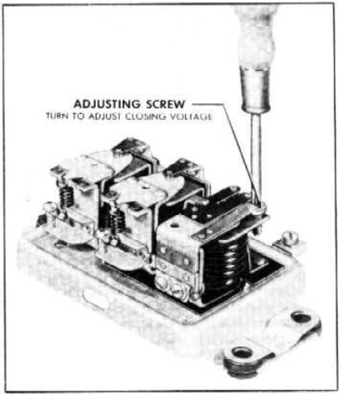

Fig. 16—Closing Voltage Adjusting Screw

7. With closing voltage adjusted increase engine speed to close points, then slowly decrease engine speed and note discharge current necessary to open circuit breaker points.

   NOTE: This current should be 0 to 4 amperes. If the reverse (discharge) current necessary to open the points is not within the 0 to 4 ampere limit, the air gap and point opening should be checked and adjusted.

Air Gap

1. Place finger on armature directly above core and move armature down until points just close.
2. Measure the air gap between the armature and center of core (fig. 17). This gap should be .020".
3. If both sets of points do not close simultaneously, bend spring fingers so they do.

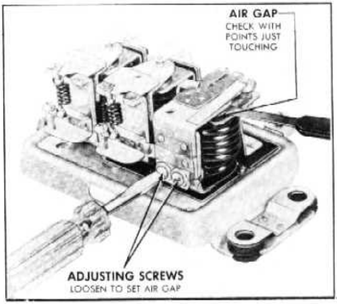

Fig. 17—Air Gap Adjusting Screws

4. To adjust air gap, loosen two screws at the back of relay (fig. 17) and raise or lower the armature as required. Tighten screws securely after adjustment.

Point Opening

1. Check point opening. This opening should be .020" and may be adjusted by bending the upper armature stop (fig. 18).

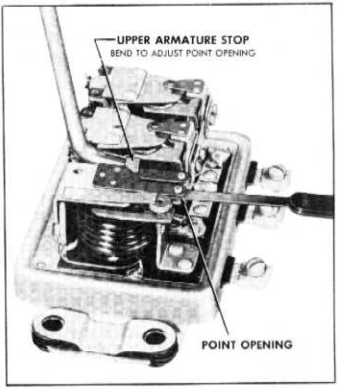

Fig. 18—Adjusting Point Opening

After making air gap or point opening adjustments, recheck closing voltage and opening amperage and make any necessary readjustments.

VOLTAGE REGULATOR

Two checks and adjustments are required on the voltage regulator; air gap and voltage setting.

To check and adjust the voltage setting, connect the volt ampere tester to the regulator as follows:

1. Turn the fixed load switch of tester to ¾ ohm position and lock tester control knob in fixed load position.
2. Remove the battery wire from the battery terminal of the regulator and connect the positive lead of the ammeter to the battery terminal and the negative lead to ground.
3. Connect the positive lead of the voltmeter to the battery terminal of the regulator and the negative lead to a good ground (fig. 19).

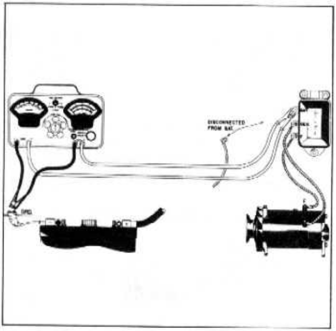

Fig. 19—Volt-Ammeter Connections for Checking Voltage Regulator

4. Turn voltmeter selector switch to eight volt position and check calibration of voltmeter.
5. Start the engine and cycle the regulator by reducing engine speed until cutout relay points are open, then slowly increase speed to 1500 engine rpm.
6. Operate the generator at this speed for at least 15 minutes to bring the regulator up to operating temperature.
7. Retard the generator speed until the circuit breaker points open, then bring generator back to speed and note voltage setting, which should be from 7.0 to 7.7 volts. Preferred 7.4 volts.

NOTE: When checking voltage regulator setting the regulator cover must be in place.

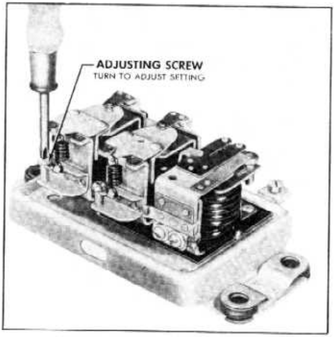

Fig. 20—Voltage Regulator Adjusting Screw

8. To adjust voltage setting, remove regulator cover and turn adjusting screw (fig. 20) clockwise to increase voltage setting or counterclockwise to decrease voltage setting.

   CAUTION: If adjusting screw is turned down (clockwise) beyond the normal range required for adjustment, the spring support may be bent beyond its elastic limit and fail to return when pressure is relieved. In such a case, turn the screw counterclockwise until sufficient clearance develops between the screw head and the spring support, then bend spring support up carefully with small pliers until contact is made with the screw head. The final setting of the unit should always be approached by increasing the spring tension, never by reducing it. In other words, if the setting is found to be too high, the unit should be adjusted below the required value and then raised to the exact setting by increasing the spring tension.

9. After each adjustment and before taking voltage reading, replace regulator cover, reduce the engine speed until the relay points open and then slowly increase the engine speed again.

Air Gap

1. Place fingers on armature directly above core and move armature down to the core and release it until the contact points just touch.
2. Measure the air gap between the armature and the center of core (fig. 21). This gap should be .075"-.085".

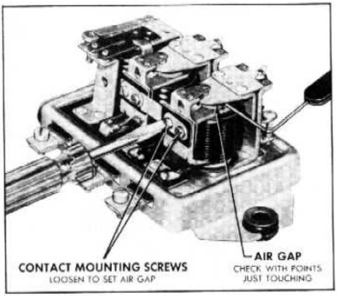

Fig. 21—Checking and Adjusting Air Gap

3. To adjust air gap, loosen the contact mounting screws and raise or lower the contact bracket as required.
4. Tighten contact mounting screws securely making sure points are lined up.
5. After making air gap adjustment, recheck voltage setting and make any necessary readjustments.

CURRENT REGULATOR

Two checks and adjustments are required on the current regulator; air gap and current setting. The air gap on the current regulator is checked and adjusted in exactly the same manner as for the voltage regulator already described.

Current Setting

Engine should be run at medium speed at least 15 minutes before making checks or adjustment on the regulator.

1. Remove battery wire from battery terminal of the regulator and connect positive lead of tester ammeter to battery terminal of regulator (fig. 22).
2. Ground negative lead of tester ammeter.
3. Place fixed load switch of tester in ¾ ohm position.
4. Set engine speed at approximately 1500 RPM.
5. Turn control knob tester to variable position and adjust control knob to obtain highest possible reading on tester ammeter.
6. The ammeter highest reading indicates the setting of the current regulator. (See specifications in this section for correct current regulator setting).
7. To adjust the current setting, turn adjusting screw clockwise to increase current setting or counterclockwise to decrease the setting. See caution note under voltage setting of voltage regulator.

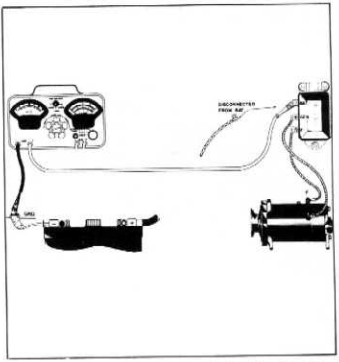

Fig. 22—Volt-Ammeter Connections for Checking Curent Regulator

BATTERY CHARGING RATE

The shunt wound generator controlled by current and voltage regulation is an ideal generating unit since it has the capacity to supply the necessary current for lights and accessories in addition to charging the battery. The maximum charging rate is available from approximately 25 m.p.h. to maximum speed.

At normal operating speed the battery charging rate is controlled by the regulator voltage setting, the counter voltage (state of charge) of the battery and resistance in the charging circuit. Figure 14 gives the battery charging curves up to 20 amperes and the generator voltage necessary with different specific gravity readings (state of charge) of the battery.

It will be noted by referring to Figure 23 that when the battery is in a discharged condition, 1.160 specific gravity, that slightly more than 7 volts generator pressure will produce 20 amperes charging rate. It will also be noted that it would take 7.8 volts generator pressure to produce 20 amperes at 1.250 specific gravity and over 8.3 volts to produce 20 amperes charging rate with the battery specific gravity at 1.280.

We have already stated that the voltage control unit should be set to control the generator voltage at between 7.0 and 7.7 volts. Assuming that it is set at 7.3 volts we will be unable to produce the battery charging rate shown by the curves above

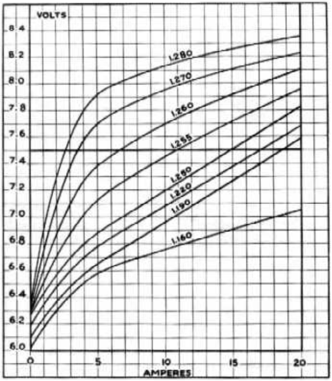

Fig. 23—Battery Charging Curve

the heavy line at 7.3 volts on Figure 23; therefore, if the battery is fully charged 1.280 we will have a maximum battery charging rate of 2 amperes. If the battery specific gravity is 1.250 the maximum charging rate will be 12 amperes. As the battery specific gravity rises the charging rate tapers off. This is known as the "Constant Potential System" and is considered the ideal way of charging a battery.

When lights or electrical accessories are turned on, the electrical energy to operate them is taken from the charging circuit and the generator output will increase to supply these accessories and still maintain about the same charging rate to the battery. This is true providing the accessory load plus the charging rate as required by the state of charge of the battery does not exceed 32 to 40 amperes in which case the current regulator will hold the total output at 32 to 40 amperes.

REPAIRS

Cleaning Regulator Contact Points

Cleaning the contact points of the current and voltage regulator properly is one of the most important operations the service man will be called on to perform. Dirty or oxidized contact points arc and burn, cause reduced generator output, and run down batteries. If the points are properly cleaned the regulator will be restored to normal operation. If improperly cleaned, improvement in performance will be small and only temporary.

1. Loosen the upper contact bracket mounting screws, so that the bracket may be tilted to one side (fig. 24).

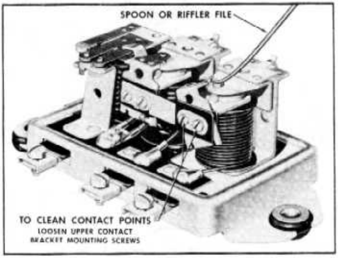

Fig. 24—Cleaning Contact Points

NOTE: Never use sandpaper or emery cloth to clean the contact points because particles of embedded grit in the regulator points will cause them to corrode.

2. Use a thin, fine-cut ignition point file and file each point separately.

NOTE: Do not use the file excessively on the rounded (smaller) point.

3. If a cavity is found in the flat point, clean it out with a spoon or riffler file (fig. 25).
4. Make sure the cavity is actually cleaned out, so good clean contact is made between the points.
5. Rotate upper contact bracket into position, tighten mounting screws and adjust the air gap.

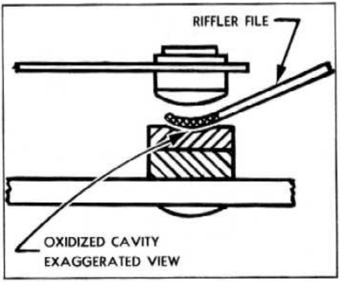

Fig. 25—Use of Riffler File

Replacing Contact Support Brackets

Voltage or current regulator contact support brackets can be replaced by carefully noting the relationship of the parts as they are removed. Note particularly that the connector strap is insulated from the voltage regulator contact mounting screws while it is connected to the current regulator contact mounting screws. New bushings should always be used when installing a contact support bracket since the old bushings may be distorted or damaged.

Installing New Springs

If it becomes necessary to replace the spring on either the current or voltage regulator unit, the new spring should first be hooked on the lower spring support and then stretched up until it can be hooked at the upper end. Stretch the spring only by means of a screwdriver blade inserted between the turns—do not pry the spring into place as this is likely to bend the spring supports.

Repolarizing Generators

If the polarity of the generator is reversed, the circuit breaker contact points will vibrate and burn. To make sure the generator has the correct polarity after connecting it with the regulator, momentarily connect a jumper lead between the generator (GEN) terminal and the battery (BAT) terminal of the regular before starting the engine. The momentary surge of battery current to the generator will correctly polarize the generator.

The installation of radio by-pass condensers of too high capacity on the field terminal of the regulator or generator will cause the current and voltage regulator contact points to oxidize. Oxidized points cause a high resistance and may result in a low charging rate and a discharged battery. **Do not connect radio by-pass condensers to the field terminal of the regulator or generator.**

If a condenser has been installed to the field terminal, disconnect condenser and clean the contact points of both the current and voltage regulator as explained under the heading "Cleaning Contact Points."

Regulator Replacement

1. Disconnect the battery wire from the battery terminal of the regulator and the generator to regulator wires from the generator and field terminals of the regulator.
2. Remove the screws attaching the regulator and remove regulator.
3. Make sure the attaching area is clean so that the new regulator will ground properly. Place the regulator in position and install the attaching screws.
4. Connect the wire leading from the field terminal of the generator to the field (F) terminal of the regulator. This is the natural wire with the single black tracer.
5. Connect the positive wire from the generator to the generator (GEN) terminal of the regulator. This is the natural wire with the black cross tracer.
6. Connect the battery wire from the ammeter to the battery (BAT) terminal of the regulator.
7. Start engine and check regulator operation. If necessary adjust regulator as outlined under "Checks and Adjustments."

GENERATOR OVERHAUL

Removal

Various generators have been used in Chevrolet passenger cars since 1951 due to government material restrictions and the ever increasing need for higher output generators. The following information on generators and voltage regulators is presented to assist in servicing these parts.

Regulator Settings

REGULATOR NUMBER		VOLTAGE REG. SET.	PRE-FERRED	CURRENT REG. SET.	PRE-FERRED	CUT OUT RELAY	PRE-FERRED
	1118725	7.0—7.7	7.4	45—51	47	5.9—6.7	6.4
	1118301	7.0—7.7	7.4	32—40	36	5.9—6.7	6.4
	1118720	7.0—7.7	7.4	34—42	38	5.9—6.7	6.4
PRODUCTION OPTIONS	1118725	7.0—7.7	7.4	45—51	47	5.9—6.7	6.4
PRODUCTION OPTIONS	1118390	6.8—7.4	7.2	53—57	55	5.9—6.7	6.4
PRODUCTION OPTIONS	1118722	6.8—7.5	7.2	48—52	50	5.9—6.7	6.4
PRODUCTION OPTIONS	1118721	6.8—7.5	7.2	40—46	42	5.9—6.7	6.4
PRODUCTION OPTIONS	1118359	7.0—7.7	7.4	58—63	60	3.6—4.6	4.0
PRODUCTION OPTIONS	1118742	7.0—7.7	7.4	78—83	80	3.6—4.6	4.0

Generator and Regulator Usage

GENERATOR NO.		YEAR	CAPACITY	GEN. ARM. PART NO.	NO. TURNS	REG. USED
Production Part......1102749 Service Part..........1102719		Late 51	35 Amp	*1879002 or *1921235	3½ or 4	**1118301
Production Part......1102749 Service Part..........1102719		Early 52	37 Amp	*1921235	3½	1118720
Service Part..........1100013		52	37 Amp	*1921351	3½	1118720
Service Part..........1100018		53	45 Amp		3½	1118725
			*Generator armature part number stamped on one of the armature core segments			
PRODUCTION OPTIONS	1102786		45 Amp			1118725
	1106757		55 Amp			1118390
	1105001		50 Amp			1118722
	1105002		40 Amp			1118721
	1117061		60 Amp			1118359
	1117061		80 Amp			1118742
			**Regulator 1118301 can be used with the 1940-1952 generators which have 3½ or 4 turn armatures. Regulator 1118720 cannot be used with the 1951 generator having a 4 turn armature and is not serviced.			

1. Disconnect the field and positive wires from the generator.

   NOTE: Field and positive post on generators 1100013 and 1100018 are reversed from previous models.

2. Remove the generator brace nut, fan belt and bracket bolts.
3. Remove the generator from the engine.

Brush Replacement—Late 1952—all 1953 models.

If brushes are worn to half their original length they should be replaced.

1. Place generator in a bench vise.
2. Remove the two through bolts and the commutator end frame assembly.
3. Remove the armature and drive end assembly as a unit from the generator.
4. Remove the brush lead wire screws.
5. Install new brushes and reassemble the generator to engine.

   NOTE: If tests are required immediately after the installation of new brushes, the brushes should be seated to the commutator by using a soft abrasive on the commutator "road" for a few seconds then blow all dust from the generator. This will insure accurate readings. If immediate tests are not required, allow the brushes to seat themselves. This will take about 10 hours of operation.

Disassembly

1. Place the generator in a bench vise, use the vise as a holding fixture only, being careful not to pinch the generator frame.
2. Remove the generator pulley and key.
3. On 1949-early 1952 models remove the commutator cover band, brush lead machine screws, through bolts and commutator end frame assembly from the generator.
4. On late 1952 and all 1953 models remove two through bolts and commutator end frame.

   NOTE: Late 1952 and all 1953 models do not have commutator band covers.

5. Remove the drive end frame and armature assembly.
6. Remove the drive end bearing retainer plate screws, drive end bearing outside spacer collar and end frame from the armature shaft.

   NOTE: The drive end bearing retainer gasket, retainer and spacer washer should then be removed from the end of the armature shaft.

7. Remove the drive end bearing inside spacer washers and felt washer.

With the generator completely disassembled (fig. 26) wash all parts in cleaning solvent.

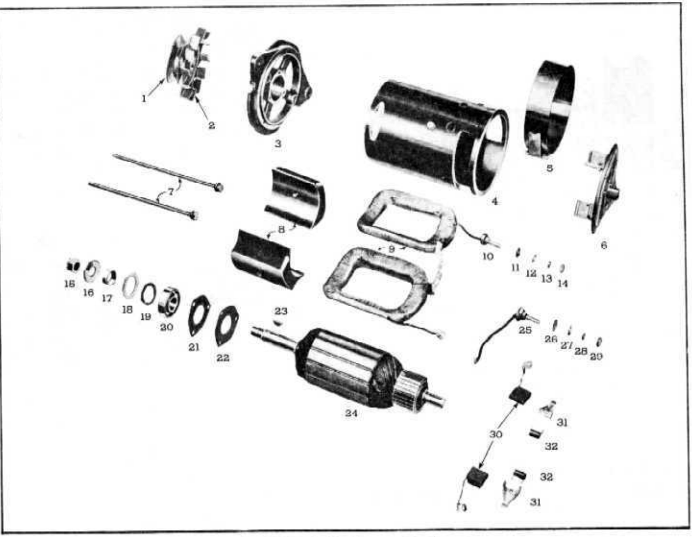

Fig. 26—1949-Early 1952 Generator Parts Layout

1. Pulley
2. Fan (part of pulley)
3. Frame, Drive End
4. Field Frame
5. Band
6. Frame with Pins, Commutator End
7. Through Bolts
8. Pole Shoes
9. Field Coils
10. Stud
11. Insulation Washer
12. Flat Washer
13. Lockwasher
14. Nut
15. Nut
16. Washer
17. Spacer Collar
18. Retainer
19. Felt Washer
20. Bearing
21. Retainer Plate Gasket
22. Retainer Plate
23. Key
24. Armature
25. Terminal Stud and Lead
26. Insulation Washer
27. Flat Washer
28. Lockwasher
29. Nut
30. Brushes
31. Brush Arm
32. Brush Spring

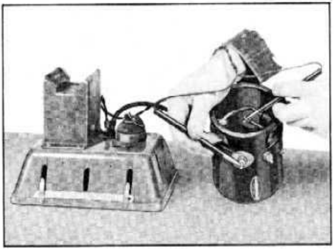

Fig. 27—Field Coil Test for Continuous Circuit

TESTING GENERATOR PARTS

Field Coil Test For Continuous Circuit

Burned bars with other bars fairly clean, indicate open circuited coils.

> ***CAUTION: Commutator bars on 3½ turn armatures (late 1952 and all 1953 generators) tend to blacken unevenly after short usage. This not not affect the performance and should not be confused with burned bars.***

1. Place the test prod leads on the field coil terminals (fig. 27).
2. If the test lamp lights, the circuit is not open.
3. If the test lamp does not light, move the test prod from the positive terminal to the positive brush lead screw.

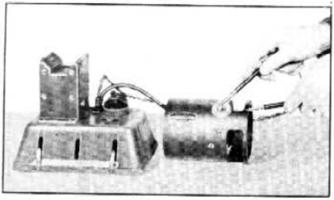

Fig. 28—Field Coil Test for Ground

4. If the test lamp still does not light the field coils are open circuited and should be replaced.
5. If the test lamp lights, the brush lead to the generator positive terminal is open circuited.

Field Coil Test For Ground

1. Place test prod leads, one to the ground and the other to field coil terminal (fig. 28).
2. If the test lamp lights, field coils are grounded and should be replaced.
3. If the test lamp does not light, field coils are not grounded.

Field Coil Balancing Test

1. Slide the insulation off the soldered connection between the two field coils.

NOTE: This test is made with a battery, an ammeter and two leads.

2. Place one test lead on the soldered connection and the other one on end of the field coil (fig. 29).

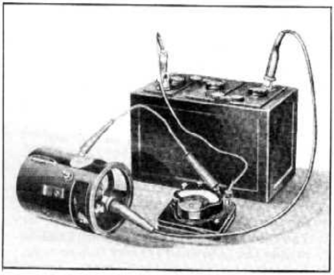

Fig. 29—Field Coil Balancing Test

3. Take a reading on the ammeter.
4. Remove the lead from the end of the field coil and place it on the end of the other field coil and take a reading.
5. If one field draws more current than the other, there is an internal short in the field coil and the coil that draws the most current should be replaced.

Generator Positive Terminal Test For Ground

1. Place one test prod on the terminal and the other on the generator frame (fig. 30).

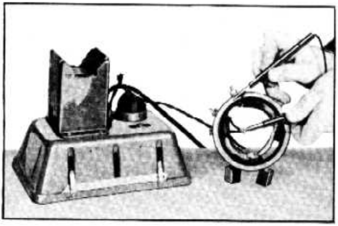

Fig. 30—Positive Terminal Test for Ground

2. If the test lamp lights, the terminal insulation is broken down and should be replaced.
3. If the lamp does not light, the insulation is satisfactory.

Main Brush Test For Ground

1. Place test prod leads, one on the positive brush and the other on the end frame (fig. 31).
2. If the test lamp lights, the positive brush holder is grounded and it should be replaced.
3. If the test lamp does not light, the brush holder is not grounded.

Brush Holder Spring Tension

Check to see that the brush holder springs have enough tension to hold the brushes snugly against the commutator. Proper spring tension is from 17 to 21 ounces for 1949-early 1952 generators and 24 to 32 ounces for late 1952 and all 1953 generators. Check brushes for wear and condition. Replace if necessary.

Front Bushing Fit

Check the fit of the armature shaft in the front bushing and if this bushing is worn, replace it with a new one on 1949-early 1952 generators.

On late 1952 and all 1953 generators it is necessary to replace the frame.

Armature Test For Ground

1. Place the test prod leads, one to the arma-

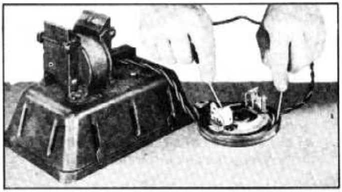

Fig. 31—Positive Brush Holder Test for Ground

ture core and the other to the commutator bars (fig. 32).

2. If the test lamp lights, the armature is grounded and should be replaced.
3. If the test lamp does not light, the armature is not grounded.

Armature Test For Short

1. Place the armature on the growler, and with a hack saw blade over the armature core, rotate the armature and test (fig. 33).
2. If the saw blade does not vibrate, the armature is not short circuited.

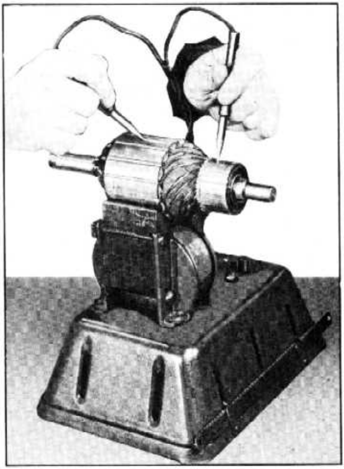

Fig. 32—Armature Test for Ground

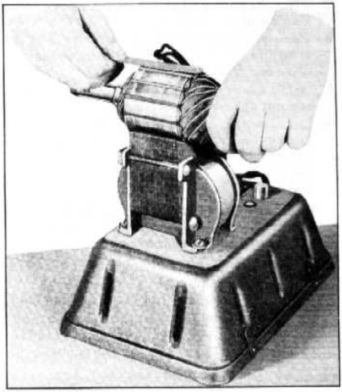

Fig. 33—Armature Test for Short

3. If the saw blade vibrates, the armature is short circuited.
4. To determine whether the armature or the commutator is shorted, clean out between the commutator bars and recheck the armature.
5. If the saw blade still vibrates, the armature is short circuited and should be replaced.

Armature to Commutator Leads

Check to see that armature to commutator leads are properly soldered. If it is necessary to solder wiring or connections, use rosin flux for making these solder connections. Never use an acid flux on electrical connections.

Commutator

Check the commutator for roughness, and if rough, turn down on a lathe until it is thoroughly cleaned up, after which sand off with 00 sandpaper. Undercut the mica approximately 1/32" and check the armature on the growler.

ASSEMBLY

After all parts have been thoroughly tested and inspected and worn or damaged parts replaced, the generator should be reassembled.

1. Place felt retainer washer in drive end frame, positioning tab in oil slot with the depressed or grooved side up. Pack bearing with grease, place felt washer on bearing and install bearing with felt washer down.

2. Place the plate gasket and retainer plate over bearing and install screws.
3. Place steel spacer washer on drive end of armature shaft and install armature shaft in drive end frame.
4. Install spacer collar, key, pulley, lock washer and nut on armature drive shaft.
5. Install new brushes in brush holders and push brushes back against spring tension. Assemble armature and drive end frame to field frame, release brushes so they will contact commutator.

NOTE: If brush holders are damaged they can be replaced by special service units which are attached with screws and nuts.

6. Install commutator end frame and the two long through bolts and tighten securely.
7. Motor the generator (fig. 34) by grounding the field terminal to generator frame, connect the generator positive terminal to positive terminal of battery with a good ammeter in the circuit, then connect the battery negative lead to generator frame. The generator should run as a motor and draw from 4 to 6 amperes.

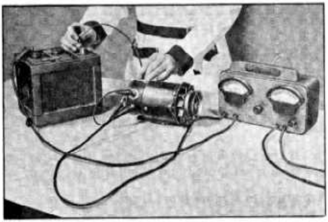

Fig. 34—Motor the Generator

CAUTION: When performing this test make sure the positive post of battery is connected to positive terminal of generator, otherwise the residual magnetism of the generator will be reversed, thereby reversing the polarity of the generator.

INSTALLATION

1. Place generator in position, install the generator to bracket bolts, tighten snugly and install cotter pins. Place the fan belt in position on pulley, install generator brace bolt, adjust fan belt by forcing generator away from engine until the belt has ¾" deflection midway between generator and fan, tighten generator brace bolt.
2. Connect the wire with single black tracer leading from field terminal of regulator to field terminal (closest to engine block) of generator. Connect the wire with black cross tracer to positive terminal of generator.

NOTE: It is good practice, after installing a new or rebuilt generator on a vehicle, to connect a jumper lead momentarily between the Armature and Battery terminals of the relay or regulator after all leads have been reconnected but before the engine is started. This allows a momentary surge of current to flow through the generator which correctly polarizes it.

3. Check the voltage setting and generator output (amperage) as described under "Care and Adjustment."

STARTING SYSTEM

INDEX

DESCRIPTION AND OPERATION

The starting system has only one function to perform—to crank the engine. In the starting system, there are three units: the battery, the start-in solenoid and the starting motor (fig. 35).

The battery supplies the energy, the solenoid completes the circuit, allowing this energy to flow to the starting motor. The motor then delivers mechanical energy and does the actual work of cranking the engine. The starting equipment is used for a short time only and then

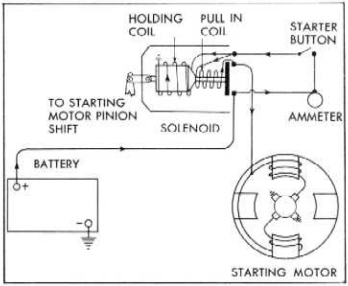

Fig. 35—Starting Motor Circuit

remains idle until it is again needed to start the engine. The battery, however, performs other functions.

It should be noted that the starting motor draws a large amount of current for a short period of time, whereas the generator replaces this current by charging the battery at a lower rate for a much longer period of time.

The starting motor is designed to incorporate a solenoid drive mechanism which assures positive engagement of the starting motor pinion with the flywheel until the engine is started (fig. 36).

In this design, the starter pinion in conjunction with an over-running clutch (or roller clutch), a compression spring and pulley-like sheave are mounted as an assembly on the splined part of the armature shaft. The sheave and spring are mounted to rotate freely on the outer diameter of the tube portion of the assembly (fig. 36).

A multiple spring and roller over-running mechanism (fig. 37), similar to that of a bicycle coaster brake, is located between the outer part of the clutch which is attached to the pinion and the inner part splined to the armature shaft.

A shift lever bolted at its fulcrum to the starting motor housing has a yoke at its lower end which straddles the sheave, integral bosses on its inner sides engage the sheave grooves. Its upper end connects to the solenoid plunger link.

The function of the solenoid switch is to magnetically shift the starter pinion into mesh with the flywheel ring gear and close the starting motor switch contacts. To accomplish this action, a shift plunger linked to the shift lever (fig. 38) is drawn into the solenoid when the solenoid windings are energized. There are two windings in the solenoid, a pull-in winding which is shorted out as the starting motor switch contacts close and a hold-in winding which holds the plunger in the solenoid as long as the starting motor control circuit is not broken.

The solenoid is controlled by a dash switch in the battery circuit.

Inside the solenoid is a heavy plunger which is connected by linkage to the pinion shaft lever. When the solenoid remote control switch is closed, the plunger pulls the pinion into mesh with the flywheel teeth. The plunger movement continued, closes the switch contacts; thus permitting the starting motor to crank the engine.

When the remote control switch is closed, the

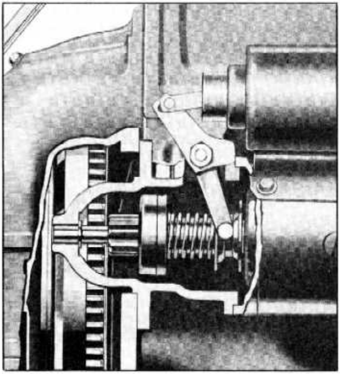

Fig. 36—Cut-Away View of Starting Motor Drive

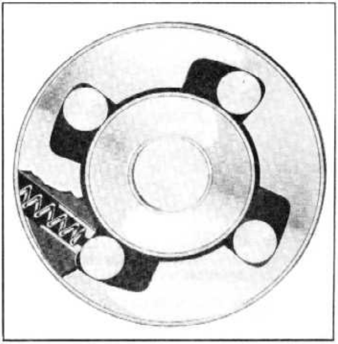

Fig. 37—Starter Drive Over-Running Clutch

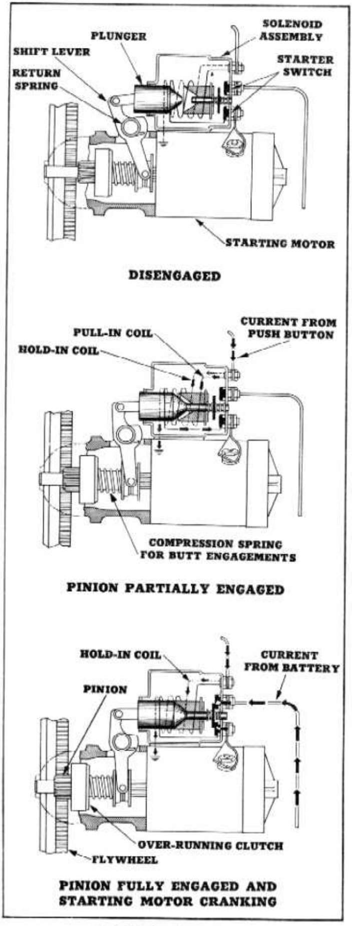

Fig. 38—Solenoid Operation

battery energizes both the "pull-in" and "hold-in" coils. The "pull-in" coil draws a comparatively heavy current for a short interval. This is needed to engage the pinion. The "hold-in" coil also aids the "pull-in" coil. As soon as the solenoid switch is closed (and the pinion shifted), the "pull-in" coil is short circuited by the contacts in the starting motor circuit so that only the "hold-in" coil draws current.

SOLENOID

Replacement

1. Disconnect the battery ground strap from battery negative post.
2. Disconnect solenoid plunger from starter shifter lever.
3. Disconnect the positive cable, ammeter wire; starter switch wire and connector strap from solenoid, remove solenoid to starter bolts and remove solenoid assembly.
4. Place new solenoid in position on the starter and install the attaching bolts.
5. Connect solenoid plunger to starter shifter lever and adjust as instructed under Solenoid Adjustment.
6. Connect the positive cable, ammeter wire, starter switch wire and connector strap to starter solenoid and tighten nuts securely.
7. Place ground strap on negative battery post and tighten securely. Check starter operation.

Solenoid Adjustment

1. Connect the battery ground strap to the battery negative post.
2. Connect positive battery cable or jumper lead from the positive battery post to the starter button switch terminal (small) on the solenoid. **Make no other connections.**
3. Push in the solenoid plunger by hand. The plunger will remain in as long as the battery is connected in this manner.
4. Remove flywheel underpan.
5. Check for $\frac{3}{16}''$ clearance between starter

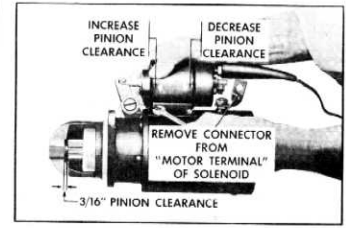

Fig. 39—Adjustment of Solenoid for Pinion Clearance

pinion and starter housing (fig. 39) with a piece of $\frac{3}{16}''$ stock.

6. Adjust this clearance by loosening the solenoid to starter housing attaching bolts and moving the solenoid backward or forward on the starter housing. When the proper adjustment is obtained, tighten solenoid attaching bolts (fig. 39).
7. Replace flywheel underpan.
8. Remove the jumper lead from starter switch terminal and connect ammeter wire, starter switch wire and connector strap to starter solenoid and tighten nuts securely.

Solenoid Contacts—Replace

1. Remove solenoid from starting motor and remove solenoid plunger from solenoid body.
2. Remove cover retaining screw and remove cover.
3. Remove nuts, lockwashers, flat washers and insulating washers from terminal studs.
4. Remove nut, lockwasher, flat washer and two insulating washers from starter switch lead stud.
5. Remove two terminal stud support plate to solenoid housing screws and remove support plate, insulating plate, one terminal stud and starter switch lead stud.
6. Remove outer spring retainer and spring from solenoid plunger contact ring.
7. Compress solenoid plunger contact ring spring, remove retainer and insulating washer and contact ring from plunger and remove plunger from solenoid body.
8. Unsolder remaining terminal stud from solenoid coil lead.
9. Place new contact ring and insulating washer on plunger, compress spring and install retainer with open side of retainer up.

   NOTE: Make sure three lugs on bottom of contact ring index with slots in lower insulating washer.

10. Install solenoid plunger assembly into solenoid body and carefully solder new terminal stud to solenoid lead.
11. Place solenoid plunger spring and outer spring retainer in position over end of solenoid plunger.
12. Place terminal support insulator plate and terminal support plate over terminal stud soldered to solenoid lead. Make sure lugs in terminal support plate fit into holes in insulator.
13. Place starter switch lead stud up through terminal insulator plate and terminal support being careful to index lugs on stud with slots in insulator plate. Snap stud into place.
14. Insert other terminal stud up through support insulator plate and terminal support; then install terminal support plate to solenoid housing screws and lockwashers and tighten securely.
15. Install two insulating washers, flat washers, lockwasher, and nut to starter switch lead stud and tighten securely.
16. Install insulating washer, flat washer, lockwasher and nut on terminal studs and tighten securely.
17. Install cover and cover attaching screw and tighten securely.
18. Test solenoid for proper operation and install to starting motor. Adjust as outlined under "Solenoid Adjustment."

STARTING MOTOR

Before removing a starting motor from an engine, certain tests should be made to be sure that the starting motor is in need of repair.

1. Check the battery. If the specific gravity is below 1.175, the battery is discharged and should be recharged.
2. Check the battery ground connection to the cylinder head and clean and tighten if necessary.
3. Check the battery terminals. Dirty terminals result in poor connection between the battery and the electrical units. They should be cleaned regularly and the battery washed off with a solution of bicarbonate of soda and water.
4. Remove the starting motor solenoid and check the contacts to be sure that they are clean and not burned or corroded and that solenoid operates properly.

If, after making the foregoing inspections the starting motor still does not function, it should be removed and disassembled.

Removal

1. Disconnect battery ground strap from negative battery post.
2. Disconnect battery positive cable, starter switch wire and ammeter lead from starter solenoid.
3. Remove the two starter drive housing to clutch housing bolts, pull starter assembly forward to clear the clutch housing and remove starter.

Disassembly

1. Remove starter to solenoid strap, remove solenoid to starter bolts, disconnect solenoid plunger from starter shift lever and remove solenoid.
2. Remove commutator cover band, through bolts and rear housing.
3. Remove the field coil to brush lead machine screws and the commutator end frame as-

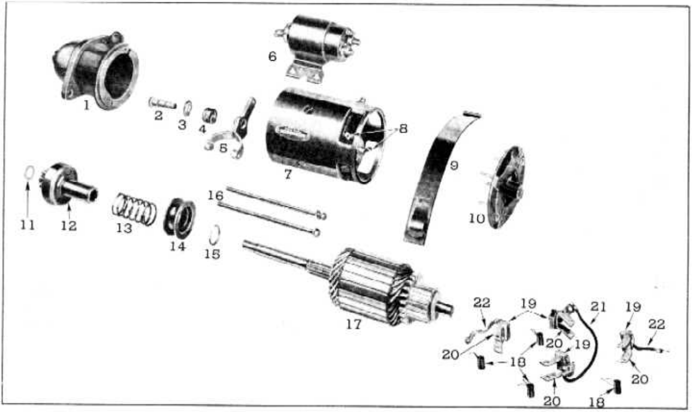

Fig. 40—Starting Motor Parts Layout

1. Drive Housing
2. Shifting Lever Pivot Bolt
3. Shifting Lever Return Spring Retainer
4. Shifting Lever Return Spring
5. Shifting Lever
6. Solenoid Assembly
7. Field Frame
8. Field Coils
9. Commutator Cover Band
10. Brush Holder Frame with Pins
11. End Spacer
12. Starter Drive Shaft and Pinion
13. Spring
14. Sheave
15. Snap Ring
16. Through Bolts
17. Armature
18. Brush Springs
19. Brushes
20. Brush Holders
21. Brush Field Lead
22. Brush Ground Lead

sembly. Remove armature assembly.

4. Remove the shift lever to drive housing bolt and remove the shift lever. Remove drive mechanism.

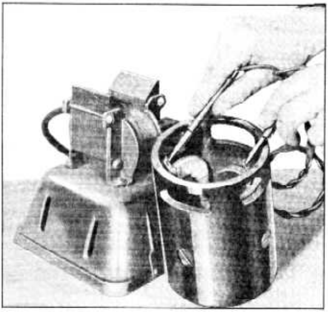

Fig. 41—Field Coil Test for Continuous Circuit

5. With starter completely disassembled, EXCEPT FOR STARTER DRIVE OVERRUNNING CLUTCH, wash all parts in cleaning solvent.

The illustration (fig. 40) shows an exploded view of the starter parts.

TESTS

Field Coil Circuit Test

1. Place the test prods on the field coil leads (fig. 41).
2. If test lamp lights the field coils are OK as far as continuous circuit.
3. If test lamp does not light there is an open circuit and replacement or repairs must be made.

Field Coil Ground Test

1. Place one test prod on frame and the other on field coil lead (fig. 42).
2. If test lamp does not light the coils are not grounded.
3. If test lamp lights one or both field coils are grounded.

NOTE: If test lamp lights, break solder connection between the two coils and

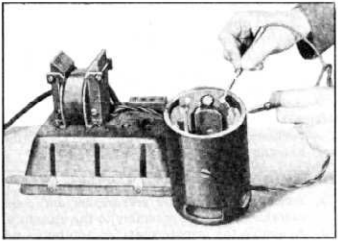

Fig. 42—Field Coil Test for Ground

test each one separately. Replace the grounded coil.

4. Inspect the field coil connections to solenoid terminal for good connections and proper insulation.

Armature Test

1. Place one test prod on the armature and the other on the commutator (fig. 43).

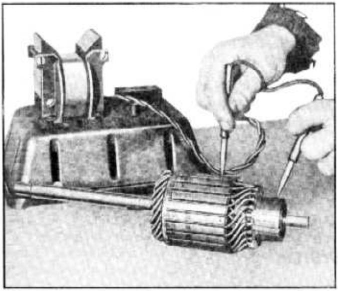

Fig. 43—Armature Test for Ground

2. If the test lamp lights, the armature is grounded and should be replaced.
3. Place the armature on the growler, and with a saw blade over the armature core, rotate the armature and test (fig. 44).
4. If the saw blade does not vibrate, the armature is not shorted.
5. If the saw blade vibrates, the armature is short circuited and should be replaced.

Commutator

Inspect the commutator for roughness. If it is rough, turn down on a lathe until it is thoroughly

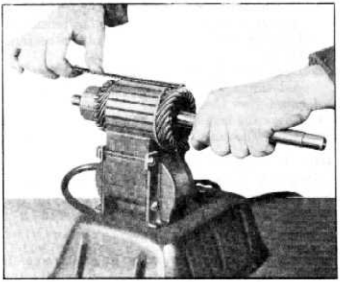

Fig. 44—Armature Test for Short

cleaned up, then sand off the commutator with 00 sandpaper.

Insulated Brush Holder Test

1. Place one test prod lead to the cover and the other on the brush holder (fig. 45).

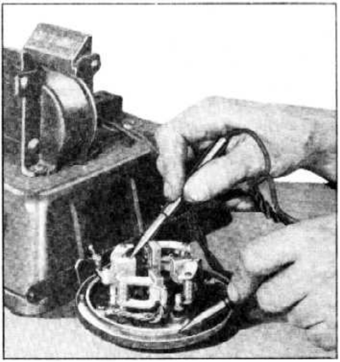

Fig. 45—Insulated Brush Holder Test for Ground

2. If the test lamp lights, brush holder is grounded and should be replaced.
3. If the test lamp does not light, the brush holder is not grounded.

Brushes and Leads

1. Check the condition of the brushes and if they are pitted or worn, they should be replaced.

2. Check the tension of the brush holder springs; they should have enough tension to hold the brushes snugly against the commutator.
3. Disconnect the brush ground leads from the end frame and clean all terminals and replace.
4. Check the insulation of the brush to field coil leads. The insulation should not be broken.

Drive Housing Bushing

Check the condition of the drive housing bushing. The armature shaft should fit snugly in this bushing; if it is worn it should be replaced.

Commutator End Frame Bushing

Check condition of bushing in end frame. If this bushing is damaged or worn excessively, the commutator end frame assembly must be replaced.

Starter Drive

1. Check the over-running clutch for free reverse action and looseness.
2. Check the spring for normal tension and the sheave for wear.
3. Inspect the gear for wear or damage; replace the assembly if damaged.
4. If necessary the spring or sheave can be replaced by forcing the sheave toward the clutch and removing lock ring from end of tube (fig. 46).

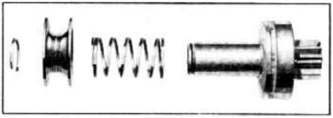

Fig. 46—Starting Motor Drive Mechanism

5. Thread the shift lever through the slot in the drive housing, while at the same time engaging the bosses on the inner end of the lever in the sheave grooves on the drive mechanism, then slide the lever and the drive into the housing together.
6. Assemble the pivot bolt through the spring retainer, spring and shift lever to the housing.

ASSEMBLY

1. Assemble commutator end washer and commutator end frame assembly to the armature.
2. Assemble the armature and commutator end frame assembly to the starting motor housing.
3. Thread the armature shaft through the drive mechanism, making sure to install the thrust washer between the drive and the drive housing bushing.
4. Install the through bolts and tighten them securely.
5. Assemble the field coil to brush lead machine screws.
6. Connect the starting motor to a battery and operate for running test.
7. Assemble commutator cover band.
8. Install the starting solenoid to the motor and connect the solenoid plunger to shifter lever.
9. Adjust as instructed under "Solenoid Adjustment."

INSTALLATION

1. Place starter in position, install and tighten the attaching bolts.
2. Connect battery positive cable, starter switch wire and ammeter wire to starter solenoid terminals.
3. Connect battery ground strap to battery negative post.

IGNITION SYSTEM

INDEX

GENERAL DESCRIPTION

The ignition system consists of the ignition switch, coil, distributor, spark plugs, vacuum spark control, the necessary wiring and connections to properly connect the various units as well as the battery and ammeter which are covered elsewhere in this section. Figure 47 shows a diagrammatic view of the ignition system.

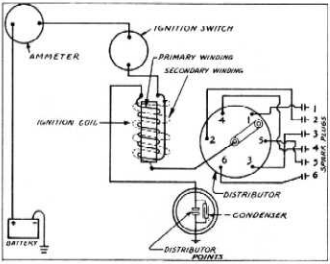

Fig. 47—Ignition System

The ignition switch located in the low tension circuit between the battery and coil is used to make or break the ignition circuit when starting or stopping the engine. This switch is of a three position design. There are two "OFF" positions, one to the right and one to the left of the "ON" (vertical) position.

The key can be removed with the switch in any of the three positions. When the ignition is turned "OFF" by turning the switch clockwise and key is removed the ignition can be turned "ON" or "OFF" without use of the key. When the ignition is turned "OFF" by turning the switch counterclockwise and removing the key the ignition is locked "OFF."

The ignition coil transforms the battery current to high-tension current which will jump the gap at the spark plugs.

The distributor is mounted on the right side of engine. It incorporates the distributor points which open and close to make and break the primary circuit, the condenser which prevents arcing at the points and aids in breaking down the magnetic field in the coil, the mechanical spark advance mechanism which advances and retards the spark with changes in engine speed, the distributor cap which has the terminals for high tension current distribution to the spark plugs and the rotor which distributes the high tension current to the terminals in the cap.

The distributors used on the 1950-52 216 and the 235 cubic inch engines are not interchangeable because of difference in the centrifugal advance mechanisms. For the 1950-52 235 engine, the mechanism has been altered to decrease the spark advance from 36° at 3450 rpm to 31° at 3700 rpm. 1953 distributors for the 235 standard engine and 235 Powerglide engine also differ due to the centrifugal advance, which is 34° at 3600 rpm for the standard 235 engine and 26° at 3500 rpm for the Powerglide engine.

For 1951-52 models, the attachment of the primary terminal of the distributor has been revised to facilitate assembly and minimize misalignment of the breaker points.

The spark plugs, one of which is properly positioned in each combustion chamber, are 14 millimeter plugs and provide for the spark which ignites the combustion mixture. This small plug warms up quickly; however, it dissipates the heat rapidly; therefore, operates at a lower temperature.

The vacuum spark control is attached to the distributor bracket and connects to the distributor. The diaphragm chamber is connected to the carburetor so that engine vacuum can advance the spark and so that it will retard when engine vacuum decreases on acceleration.

The coil consists of a soft laminated core over which is placed the high tension (secondary) winding and the low tension (primary) winding. This assembly is carefully insulated and placed in a metal container, the necessary connections are made, the assembly is then filled with transformer oil and hermetically sealed to prevent the entrance of moisture. A large insulator is used at the secondary terminal to provide effective insulation.

The distributor housing is designed to pilot down into the right side of cylinder block which supports the distributor and provides a bearing for the distributor shaft. A drive gear is located near the lower end of shaft and meshes with a gear on the engine camshaft to drive the distributor shaft at camshaft speed. A plate fitted with pivot pins for the governor weights is attached near the top of the shaft. The weights are placed on the pivots, the cam assembly is placed over the top of shaft and the springs are installed. The weight cover and stop assembly is placed over the governor and adjusted to obtain the desired maximum governor spark advance. Figure 48 shows construction details.

The breaker plate which is internally grounded sets directly above the governor mechanism and is attached to the distributor housing. One distributor point and support sets over the pivot

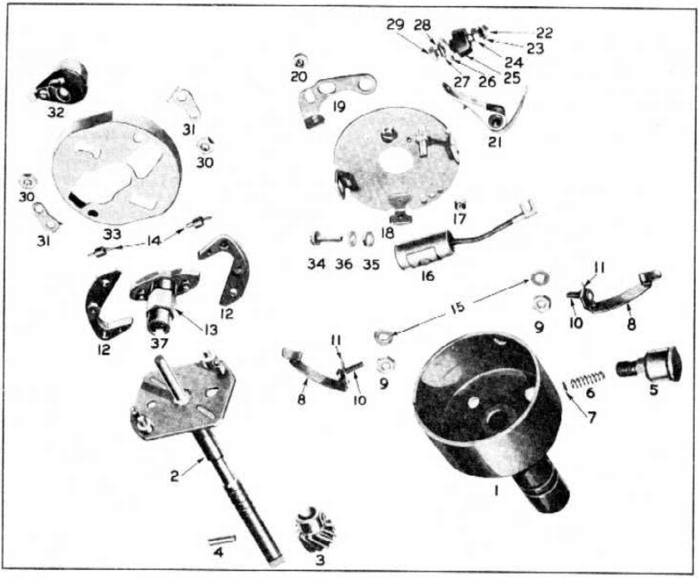

Fig. 48—Layout of Distributor Parts

1. Housing
2. Mainshaft and Weight Plate
3. Gear
4. Gear Pin
5. Grease Cup
6. Plug Spring
7. Bakelite Plug
8. Cap Springs
9. Retaining Nuts
10. Retaining Screws
11. Cap Spring Supports
12. Governor Weights
13. Cam Assembly
14. Weight Springs
15. Flat Washers
16. Condenser
17. Condenser Attaching Screw
18. Breaker Plate
19. Contact Point and Support
20. Contact Adjusting Screw
21. Breaker Arm
22. Terminal Stud Plain Nut (Inside)
23. Terminal Stud Plain Washer (Inside)
24. Terminal Stud
25. Terminal Stud Insulating Bushing (Inside)
26. Terminal Stud Insulating Washer (Outside)
27. Terminal Stud Plain Washer (Outside)
28. Terminal Stud Lockwasher (Outside)
29. Terminal Stud Nut
30. Weight Plate Nuts
31. Weight Plate Nut Lockwasher
32. Rotor
33. Weight Cover and Stop Plate
34. Attaching Screw
35. Nut
36. Lockwasher
37. Shaft Felt Wick (in Cam)

pin on the breaker plate and is held in place by a lock screw. The location of this point can be moved for point gap adjustment by loosening the lock screw and turning the eccentric adjusting screw as desired. The other point and arm assembly is fitted with an insulating bushing which pilots over the pivot pin. The breaker arm is fitted with a fibre block which extends out toward the cam; as the cam turns the lobes contact the fibre block and cause the points to open (fig. 49).

The condenser is attached to the breaker plate and the lead is connected to the insulated terminal at the point where the breaker arm connects. This places the condenser across the breaker points. The rotor attaches to the top of the cam and turns at camshaft speed. The distributor cap sets on the top of housing with a positioning lug engaging a groove in the housing. Clamps hold the cap in position. The center terminal of the cap engages the spring contact of the rotor to trans-

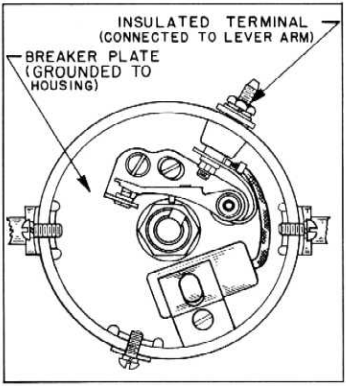

Fig. 49—Distributor Connections

setting, 1949 through 1952 on the 216 and 235 engines 5° before top center and on all 1953 passenger engines 2° after top center.

As the engine speed increases the governor weights in the distributor start to swing outward advancing the spark. This continues until the engine reaches a speed and maximum advance as indicated on the chart below. As engine speed decreases the springs pull the weights inward, retarding the spark and providing governor advance in direct relation to engine speed.

The vacuum spark advance operates entirely independent of the governor advance. As the carburetor throttle is opened slightly from the idling position, manifold vacuum is applied to the vacuum spark control passage in the carburetor which causes the vacuum spark control diaphragm to compress the spring and advance the spark. This advances the spark a maximum of 20° on 1949-52 models and 15° on 1953 models but only with comparatively high manifold vacuum. Each time the throttle is opened wider for acceleration the manifold vacuum decreases retard-

	ENGINE	ADVANCE BEGINS	YEAR	FULL ADVANCE
VACUUM CONTROL	235	4″ to 6″ Hg.	1953	13° to 17° at 11.0″ to 13.0″ Hg
VACUUM CONTROL	216 & 235	7″ to 8.5″ Hg.	1950-1-2	18° to 22° at 16.5″ to 18.5″ Hg
VACUUM CONTROL	216	7″ Hg Min.	1946-49	20° at 12″ Hg Min.
CENTRIFUGAL CONTROL	216	550 to 775 RPM	1946-52	32.5° to 39.5° at 3450 RPM and up
CENTRIFUGAL CONTROL	235	450 to 750 RPM	1950-1-2	29° to 33° at 3700 RPM and up
CENTRIFUGAL CONTROL	Std. 235	450 to 750 RPM	1953	32° to 36° at 3600 RPM and up
CENTRIFUGAL CONTROL	Powerglide 235	450 to 750 RPM	1953	24° to 28° at 3500 RPM and up

mit high tension current from the coil to the rotor; as the rotor turns the current can be transmitted to the different spark plug wire terminals.

AUTOMATIC SPARK CONTROL

To get the best performance and economy from an engine at all speeds and under all load conditions it is necessary to change the ignition timing with variations in speed and load conditions. This is done automatically by two methods.

When the engine is idling below 600 R.P.M. the spark will occur according to the timing

ing the spark to prevent excessive detonation. At high vehicle speed with nearly wide open throttle the vacuum is low; therefore, the vacuum spark advance is not in operation. However, under this condition maximum governor advance is in use.

CARE AND ADJUSTMENT

Normal care consists of maintaining tight, corrosion free connections in the entire circuit, making sure the wires are properly insulated and protected against possible shorts, keeping the vacuum spark control line connections tight, keeping excessive grease and oil from the distributor, coil, spark plugs and wires. Place a drop or two of oil on the felt wick in the distributor cam (on 1949-52 models only), tighten the grease cup a turn every 1000 miles and keep the points clean and properly adjusted.

REPAIRS

Ignition Switch Replacement

1. Raise hood and disconnect positive battery cable from battery.
2. Remove lock cylinder.

   NOTE: To remove lock cylinder, position switch in "off unlock" position and insert wire in small hole in cylinder face. Push in on wire to depress plunger and continue to turn key clockwise until lock cylinder can be removed. 20wuh01

3. Disconnect wires from ignition switch.

   NOTE: Identify wires as removed for easy installation. 20wuh01

4. Loosen two screws retaining switch to ignition lock light plate—rotate counterclockwise and remove.
5. Install new switch and tighten retaining screws securely.
6. Connect wires to switch.
7. Replace lock cylinder.
8. Replace battery cable to battery and lower hood.

Ignition Coil Replacement

1. Disconnect ignition switch and distributor leads from terminals on coil and pull the high tension wire from terminal at bottom of coil. Remove coil to cylinder head attaching bolts.
2. Place new coil in position and install attaching bolts.
3. Place high tension lead securely in terminal at bottom of coil, and connect ignition primary lead and distributor lead to terminals on coil. Start engine to test coil operation.

Distributor Point Replacement

1. Remove wires from numbers 1, 2 and 3 spark plugs, release the distributor cap clamps, remove cap and pull it back out of the way.
2. Remove rotor.
3. Loosen the insulated terminal inside nut, unhook the breaker arm spring from terminal and remove arm assembly.
4. Remove the contact point support lock screw and remove contact point and support assembly.
5. Carefully wipe the protective film of oil from the contact points of the new set.
6. Place the contact point and support assembly in position over the pivot pin and adjusting screw and install the lock screw loosely.
7. Place the breaker arm over pivot pin and hook the arm spring over the terminal stud. Tighten terminal stud nut securely.
8. Crank the engine until the distributor point cam follower is on the extreme peak of a lobe on the cam which will provide maximum breaker point opening. Turn the eccentric adjusting screw (fig. 50) to right or left to obtain the correct point opening.

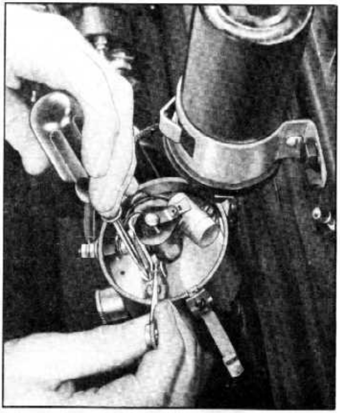

Fig. 50—Adjusting Distributor Points

   NOTE: The standard point setting for 1949-52 models is .018". When new points are installed adjust points to .022" to .024" as the rubbing block will wear down slightly while seating to the cam. The 1953 distributor point settings are .019" for new and .016" for used.

9. Tighten the point support lock screw and recheck point opening. Install rotor.
10. Place cap in position and hook the clamps. Install Number 1, 2 and 3 spark plug wires.
11. Check and set ignition timing with a timing light (See Engine Tune-Up, Section 6).

Distributor Condenser Replacement

1. Remove the distributor cap and lift off the rotor.

2. Loosen the terminal inside nut and remove condenser lead from terminal.
3. Remove the screw that attaches condenser tab to distributor plate and remove condenser.
4. Place the new condenser in position and install the condenser tab to breaker plate screw.
5. Place the condenser lead in position on the terminal and tighten the nut securely.
6. Install rotor and distributor cap.

Spark Plug Wires and/or Distributor Cap Replacement

1. Disconnect all wires from the spark plugs and the high tension wire from bottom of coil.
2. Remove distributor cap and remove all wires from cap.
3. Inspect the wires for damaged insulation and loose or damaged terminals.
4. Inspect the cap for cracks and damaged terminals. If the cap is suitable for additional service clean the contacts on the inside of cap and the terminals on the top of cap.
5. Replace all damaged parts.
6. If new wires are being installed or the old wires were removed from the old rubber support, place one long and two short wires through each of the supports.
7. Place the rubber nipples on the distributor end of all wires.
8. Attach the two sets of wires to the spark plugs with the two long wires attached to Numbers 1 and 6 plugs.
9. Place the coil to distributor wire securely in the terminal of coil and the center terminal of distributor.
10. Install the cap and hook the retainers.
11. Place the long wire attached to Number 1 spark plug securely in the cap terminal farthest from engine block and install the remaining wires in a clockwise direction from Number 1 according to the firing order of 1-5-3-6-2-4.
12. Start engine and test operation.

DISTRIBUTOR OVERHAUL

Removal

1. Disconnect the coil to distributor wire from terminal on distributor.
2. Remove distributor cap and hand crank the engine until the rotor points directly away from engine (at 90° to block); scratch a mark on outside of distributor in line with rotor.
3. Loosen the distributor clamp screw and work the distributor up out of cylinder block.

Disassembly

1. Remove rotor, loosen insulated terminal inside nut and remove breaker arm.
2. Remove contact point support lock screw and remove contact point and support.
3. Remove attaching screw and remove condenser.
4. Remove insulated terminal stud assembly.
5. Remove breaker plate to distributor screws, nuts and cap clamps.
6. Lift out the breaker plate.
7. Remove the lubrication cup, spring and bakelite shaft contact plug.
8. Drive out the distributor gear to shaft pin, remove gear from shaft and shaft with advance mechanism from body.
9. Remove the governor weight springs, release the lock plate tangs, remove the nuts and governor weight cover and stop plate.
10. Remove the cam and governor weights.

Cleaning and Inspection

1. Wash all parts in cleaning solvent.
2. Inspect the shaft for wear, and check its fit in the bearings in the distributor body. If the shaft or bearings are worn, the shaft and distributor body should be replaced.
3. Mount the shaft in "V" blocks and check the shaft alignment with a dial gauge. The runout should not exceed .002".
4. Inspect the governor weights for wear or burrs and free fit on their pins.
5. Inspect the cam for wear or roughness. Then check its fit on the end of the shaft. It should be absolutely free, without any looseness.
6. Inspect the condition of the distributor points—dirty points should be cleaned and badly pitted points should be replaced.
7. Test the condenser for series resistance, microfarad capacity (.18 to .23) and insulation breakdown, following the instructions given by the manufacturer of the test equipment used.
8. Inspect the distributor cap and spark plug wires for damage. See "Spark Plug Wires and/or Distributor Cap Replacement" if replacement is necessary.

Assembly

1. Assemble the governor weights over their pivot pins. Lubricate the top end of the shaft with light engine oil and install the cam.
2. Install the weight cover and stop plate, the lock plates and nuts. Tighten nuts securely and lock them by bending up the lock plate tangs. Install the two weight springs.
3. Lubricate the shaft and install it in the distributor housing.
4. Install the drive gear and retainer pin. Check to see that the shaft turns freely.
5. Place the breaker plate in the distributor body.

6. Place nuts in the lugs of the breaker plate, place the distributor cap springs and screws in position and tighten them into nuts.
7. Install the insulated primary terminal insulating bushing, terminal, insulation washer, flat washer, lockwasher and nut.
8. Clean the condenser mounting tab, place the condenser in position and install the attaching screw. Connect the lead to the insulated terminal.
9. Clean all oil carefully from contact points, place the contact point and support assembly in position over the pivot pin and install the lock screw securely.
10. Place the breaker arm over the pivot pin and hook the arm spring over the terminal stud. Tighten terminal stud nut securely.
11. Turn the distributor shaft until the breaker arm rubbing block is on the extreme top of a lobe of the cam which will provide maximum breaker point opening.
12. Turn the eccentric adjusting screw (fig. 50) to the right or left to obtain .018"-.022" point opening (.022" to .024" if new points are being used) on 1949-52 models and .019" for new points and .016" for used points on 1953 models.
13. Tighten point support lock screw and recheck point opening.
14. Install the bakelite shaft contact plug, spring and grease cup properly filled with chassis lubricant and install rotor on top of cam.

Installation

1. Turn the rotor about ¼" in a clockwise direction past the mark previously placed on distributor housing.
2. Start the distributor down into block with the mark previously placed on distributor housing at 90° to engine block and then push distributor down into position.

   NOTE: It may be necessary to move rotor slightly to start gear into mesh with camshaft gear, but rotor should line up with the mark when distributor is down in place.

3. Tighten the distributor clamp enough to hold the distributor in place and connect coil to distributor wire to distributor terminal.
4. Time the ignition according to instructions under "Engine Tune-Up," Section 6.

Distributor Installation

(When engine has been turned or if distributor was not properly marked when removed)

1. Remove valve rocker arm cover.
2. Crank the engine until Number 1 intake valve (second valve from front of head) closes and continue to crank it slowly about ⅓ turn until Number 1 piston is at top of cylinder.

   NOTE: This can be determined by watching at the timing indicator opening on clutch housing, above starter mounting, until U/C marking on flywheel lines up with pointer.

3. Start the distributor down into right side of engine block with the distributor cap spring clips parallel with engine block, turn rotor slightly clockwise from 90° to engine block and push distributor down into position.

   NOTE: In some cases it may be necessary to remove distributor and turn oil pump shaft with a long screwdriver so that the slot in oil pump shaft will line up with tang on distributor shaft.

4. Turn distributor body slightly until points are just slightly open and tighten distributor clamp screw.
5. Place distributor cap in position and check to see that rotor lines up with terminal for Number 1 spark plug.
6. Install distributor cap, check all high tension wire connections and connect spark plug wires if they have been disconnected or removed.
7. Connect the coil to distributor wire.
8. Start engine and set timing according to instructions under "Engine Tune-Up," Section 6.

SPARK PLUG SERVICE

1. Disconnect the spark plug wires from plugs and carefully remove the spark plugs.
2. Inspect the plugs for cracked porcelain both above and below the shell. If porcelain is cracked the plug or plugs must be replaced. It is advisable to replace the plugs in sets. If only part of the set is to be replaced, be sure to use plugs of the same make and heat range.
3. Inspect the electrodes for excessive wear or damage, inspect the insulators for heavy blisters near the inner ends. If the electrodes are badly worn or damaged or if the porcelains are badly blistered the plugs should be replaced.
4. If the spark plugs are to be kept in service they should be thoroughly cleaned with an abrasive, air-blast type cleaner to remove the oxide from the insulator. This oxide coating will probably be in powder form if the plug has had but 3000 or 4000 miles of service since cleaning; however, it eventually melts and forms a glazed surface which is very

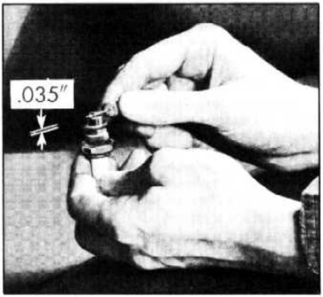

Fig. 51—Setting Spark Plug Gap

difficult to remove even with a sand-blast cleaner. This fused oxide coating is very deceiving; after cleaning the plug it will look clean, but there will still be an invisible layer of the glazed oxide which may cause a miss at high speeds. Plugs in this condition should be thoroughly recleaned to remove this coating.

5. After cleaning the plugs inspect them again for damage that was not visible before cleaning. Set the electrode gaps to .035" using a round feeler gauge (fig. 51).

   NOTE: Never bend the center electrode as this will probably crack the porcelain insulator. Make all adjustments with the side electrode.

6. Place new gaskets on the spark plugs if they are available and tighten the plugs into the head with a torque wrench to 20 to 25 foot pounds tension.
7. If a torque wrench is not available, tighten the plugs "finger tight" plus ½ turn more.
8. Connect the wires to their respective spark plugs according to the firing order of 1-5-3-6-2-4.

INSTRUMENTS AND GAUGES

INDEX

DESCRIPTION AND OPERATION

The ammeter, fuel gauge, temperature indicator, oil pressure gauge and speedometer come under the classification of instruments and gauges.

AMMETER

The ammeter is a current operated electromagnetic instrument to measure the approximate flow of current in the circuit. It is placed in the main circuit between the battery and the generator. The flow of current from the generator to battery or from battery to most electrical equipment is indicated by this instrument. Exceptions to this rule include the starting motor, horns, cigarette lighter and some electrical accessories that might be attached to the battery side of ammeter.

FUEL GAUGE

The fuel gauge consists of a dash or indicating unit and a tank unit plus the necessary wiring (fig. 52). The circuit is connected to the dead side of the ignition switch; therefore, it registers only when the ignition switch is "on." The dash unit operates on the electro-magnetic principle counteracted by a counterweight on the indicator hand. When the current is "off" counterweight returns the hand to the "empty" position. When the switch is "on," current flows from the ignition switch to the fuel gauge dash unit small terminal, through the choke or limiting coil to the common connection between the two coils. From this point current can travel through the operating coil of

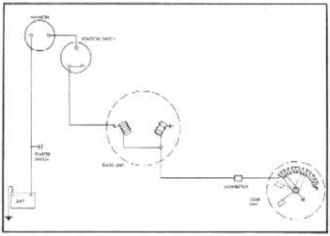

Fig. 52—Gasoline Gauge Circuit

the dash unit to ground and also over the wire to the tank unit and through this unit to ground. When this tank is empty the float will be near the bottom of tank and the contact finger cuts out the resistance of the tank unit so that most of the current passes to the tank unit and directly to ground and very little current passes through the dash unit operating coil; therefore, the gauge shows empty. As more fuel is placed in the tank the float is raised causing the contact finger of tank unit to move across the resistance unit inserting more coils of resistance in the tank circuit (fig. 44). This additional resistance forces more current through the dash unit operating coil which moves the indicating hand over toward the "full" side of scale.

TEMPERATURE INDICATOR

The temperature indicator consists of an indicating unit on the dash, an ether filled bulb in the cylinder head and a small tube forming an air tight connection between the two units. As the water in the cylinder head warms up, the ether expands causing the hand on the dash unit to move toward the right indicating the water temperature.

OIL PRESSURE GAUGE

The oil pressure gauge mounts in the instrument cluster and is connected to the engine pressure oil system by a small pipe. The oil pressure created by the oil pump causes the gauge hand to move to the right recording the pressure.

SPEEDOMETER

The speedometer, mounted centrally in the instrument group, is driven by a cable and gears from the transmission mainshaft. This unit incorporates two devices—the speedometer to indicate rate of speed and the odometer to record the distance traveled.

SERVICE OPERATIONS

The ammeter and oil gauge are mounted to a plate which attaches to the instrument cluster case with three screws. Similarly the gasoline gauge and the temperature gauge are mounted to a plate which also attaches to the instrument cluster case. The entire case is enclosed by a bezel and glass and fastened to the dash panel with four attaching bolts and nuts. To replace any of the gauges a large inspection hole is provided in the dash fire wall. This hole is covered by a removable plate to allow access to the instrument panel cluster through the engine compartment. The following procedure covers removal of any of the above instruments from the cluster.

1. Raise hood and remove hole cover from engine side of dash panel.
2. Disconnect positive battery terminal from battery.
3. If oil gauge or ammeter is to be replaced, disconnect oil pressure line from oil pressure gauge and wires from ammeter.

NOTE: Identify wires removed from ammeter for easy installation.

4. Remove three screws attaching instrument mounting plate to cluster and remove gauges and plate.
5. Remove instrument to be replaced from mounting plate.
6. Install new instrument to mounting plate, install instruments and mounting plate to cluster and connect wires to ammeter and oil pressure line to oil gauge.
7. If gas gauge or temperature gauge are to be removed, disconnect wires from gas gauge and identify wires.
8. Remove three screws attaching instrument mounting plate to cluster and remove gauges and plate.

CAUTION: If temperature gauge is not going to be replaced, exercise care that heat indicator line is not damaged.

9. Remove instrument to be replaced from mounting plate.
10. Install new instrument to mounting plate, install instruments and mounting plate to cluster and connect wires to gas gauge.

CAUTION: If hotwire touches the tank unit terminal on gas gauge, the tank unit will be damaged.

11. Replace hole cover to engine side of dash panel.

12. Connect positive battery terminal to battery, check instrument operation and close hood.

INSTRUMENTS AND GAUGES

On 1951 models, the face of the instrument panel contains two round instrument clusters instead of the single cluster as used in 1949-50. The left hand cluster encloses the temperature and fuel gauges, the ammeter and oil pressure gauge. The speedometer and odometer occupy the unit on the right, and the headlight beam indicator is located near the top of this unit.

To replace any of the gauges it is necessary to remove the cluster assembly from the vehicle, disassemble, replace the defective gauge or gauges, and reinstall the cluster in the vehicle. This may be accomplished as follows:

1. Raise hood and remove dash panel access plate.
2. Disconnect positive battery terminal from battery.
3. Disconnect oil pressure line from oil pressure gauge and disconnect wires from ammeter and gas gauge. Identify wires for ease in connecting.
4. Drain radiator and remove temperature indicator element from cylinder head.
5. Remove nuts and lockwashers attaching instrument cluster to instrument panel and remove the instrument cluster from the vehicle.

   CAUTION: Exercise care that the heat indicator line is not damaged.

6. Un-crimp the bezel ring from the instrument case sufficiently to remove.
7. Remove the instrument face assembly by removing the screw through the back of the instrument case.
8. Remove and replace the defective gauge or gauges by removing the screws or nuts holding each gauge to the instrument case.
9. Assemble the instrument face assembly to the case and reassemble the bezel ring, with gaskets 180° apart and with glass, to the case. Re-crimp the bezel ring so that there is no loose play between bezel ring and case.
10. Attach the instrument cluster to the instrument panel, using care not to damage the heat indicator line.
11. Install the temperature indicator element in the cylinder head.
12. Reconnect the oil pressure line and reconnect the wires to ammeter and gas gauge.
13. Connect positive battery terminal to battery, refill the cooling system, and check instrument operation.
14. Replace the dash panel access plate and close the hood.

AMMETER

The ammeter requires very little service other than keeping the terminal nuts clean and tight.

FUEL GAUGE

The most common cause of fuel gauge trouble is high resistance in the circuit. Make sure all connections are tight and free from dirt, paint or corrosion.

Since the fuel gauge consists of two remotely located units and the connecting wires, it is sometimes difficult to determine which unit is at fault. A gas gauge tester No. KMO-204 (fig. 53) is available for testing the units. If a unit is proved to be faulty it should be replaced.

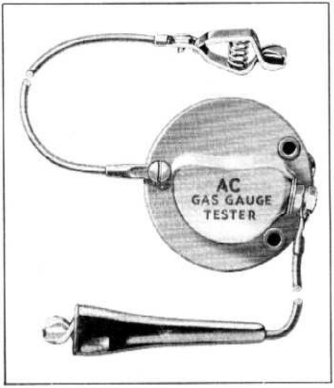

Fig. 53—Gasoline Gauge Tester

If KMO-204 gas gauge tester is not available a tester may readily be made by obtaining a tank unit from parts stock. Attach a spring terminal clip to a 5-foot piece of insulated colored wire and connect the other end of this wire to the binding part of the tank unit. Next, attach two spring terminal clips to a similar piece of black insulated wire and the tester is ready for use.

TESTING

A-1. With ignition switch "OFF," disconnect tank wire from back of dash units. (This is the larger terminal.)

2. Attach the colored wire of the tester to this terminal and black wire to a good ground.
3. Turn ignition switch "ON"—move tester arm up and down, dash unit should register

"FULL" and "EMPTY" if it is OK. If so, turn ignition switch "OFF" and reconnect tank wire.

4. If dash unit does not register at all on above test—before replacing it, make certain that it is getting current from the ignition switch. This can be quickly tested by connecting a 6-volt lamp from ignition terminal (left hand terminal on back of dash unit) to ground.

B— If dash unit is OK, next check the wiring between dash and tank units as follows:

1. Disconnect tank unit wire near the gas tank at the bayonet connection or terminal junction block.
2. Attach the colored wire of the tester to the connection running to the dash and the black wire to ground.
3. If on this test dash unit reads "EMPTY" at all times or the reading is noticeably lower than during the check at the dash unit, look for shorts or leaks in the wiring between dash and tank. Leaks are most likely to occur at terminal junctions. If dash unit reads above "FULL" at all times or if it reads higher at "EMPTY" and "FULL" than readings obtained when checking at the dash, look for poor connection or break in the wiring. Be sure contacts in bayonet connectors are clean.

C-1. If dash unit and wiring check OK, drop tank and remove tank unit. Clean away all dirt that has collected around tank unit terminal as road dirt, particularly calcium chloride, causes an electrical leak that will cause an error in reading.

2. After cleaning thoroughly, connect tank unit to the wire leading to dash, grounding the tank unit with a short piece of wire from the outer edge to any part of the car. Turn ignition switch "ON" and move the float arm up and down. If this unit is OK, the dash unit will give corresponding "EMPTY" and "FULL" readings.
3. If tank unit is OK, reinstall in the tank—if not, replace with a new tank unit but first repeat above test before installing in the tank.

NOTE: Always check tank units for freedom of movement of the float arm by raising it to various positions and observing that it will fall to "EMPTY" position in every instance.

TANK UNIT REPLACEMENT

1. Disconnect tank unit wiring at bayonet connection and disconnect fuel line from tank. Drain fuel from tank until the tank can be conveniently handled. Release tank support straps and remove tank.
2. Remove tank gauge unit attaching screws and gauge unit. Make necessary tests as explained under "Testing Fuel Gauge."
3. Thoroughly clean the flanges of the new gauge, place a new gasket on tank and securely attach gauge to tank. Attach wire to terminal.
4. Place tank in position and tighten tank support straps. Connect fuel line to tank and fuel gauge wire to bayonet connector. Place any fuel removed back in tank.

TEMPERATURE INDICATOR

The temperature indicator requires very little attention other than avoiding damage to the line between the indicator and the bulb. If this unit fails to register at all, look for leaks or restricted line. If the hand stays in the "hot" range it likely was caused by an overheated engine. The only remedy is replacement of the entire unit.

Replacement

1. Drain the cooling system until the coolant level is below the top of cylinder head. Remove fitting nut from left rear corner of cylinder head and remove indicator bulb.
2. Remove grommet from cowl so that bulb can be pulled through. Remove dash unit as outlined under "Service Operations."
3. Work bulb of new unit through opening in dash being careful not to bend pipe excessively. Connect indicator securely to instrument panel and work the surplus pipe through dash. Install grommet, make necessary coil or long bends in pipe to take up slack, place bulb in fitting on cylinder head and tighten securely. Refill cooling system.

OIL PRESSURE GAUGE

The oil pressure gauge requires very little attention. If the control line should become restricted it should be blown out or replaced.

SPEEDOMETER SERVICE

The speedometer head requires comparatively little service, and as special equipment is required to render this service, most automobile dealers send the speedometer to an authorized AC speedometer service station.

Cable Replacement or Lubrication

1. Disconnect the speedometer cable from the speedometer head and fitting at the transmission. Remove the old cable by pulling it out from speedometer end of conduit.

NOTE: If old cable is broken it may be necessary to remove lower piece from transmission end of conduit.

2. Lubricate the lower ¾ of cable with AC speedometer cable lubricant and push the cable into conduit. Connect lower end to fitting on transmission and upper end to speedometer head. Road test vehicle for speedometer operation.

Head Replacement—1949-50 Models

1. Raise hood and remove hole cover from engine side of dash panel.
2. Disconnect speedometer cable from head.
3. Remove three screws which retain speedometer head plate and head assembly to cluster housing and remove head plate and head assembly.
4. Remove 2 screws, 4 flat washers, rubber pad, 2 rubber grommets and 2 grommet retainers connecting speedometer head plate to speedometer head, and remove speedometer head.
5. Install speedometer head in head plate. Push two rubber grommets through from the outside, position grommet retainers, and place 2 flat washers between speedometer head and head plate. Install rubber pad at center between head and plate where speedometer cable attaches. Install 2 screws and tighten.
6. Position speedometer head and plate assembly on cluster housing, install 3 screws and tighten.
7. Connect speedometer cable to head.
8. Replace hole cover to engine side of dash panel and close hood.

Speedometer Service—1951-53 Models

As a precaution disconnect battery positive cable. The speedometer mechanism, in order to be serviced, should be removed as follows:

1. Raise the hood and remove the dash panel access plate.
2. Disconnect the speedometer cable from the speedometer mechanism.
3. Remove nuts and lockwashers attaching speedometer assembly to instrument panel and remove the assembly from the vehicle.
4. Un-crimp the bezel ring from the case sufficiently to remove.
5. Remove the screws holding the speedometer mechanism to the case and remove the mechanism.
6. Install a new speedometer mechanism and reassemble the bezel ring, with gaskets 180° apart and with glass, to the case. Re-crimp the bezel ring so that there is no loose play between bezel ring and case.
7. Attach the speedometer assembly to the instrument panel, connect the speedometer cable, reinstall the dash panel access plate, and lower the hood.

HORNS

Dual, matched horns (fig. 54) are used on all passenger car models and are mounted on brackets between radiator core and grille. The horn relay is mounted on the left front fender skirt on 1949-50 models and on left front fender baffle on 1951-53 models.

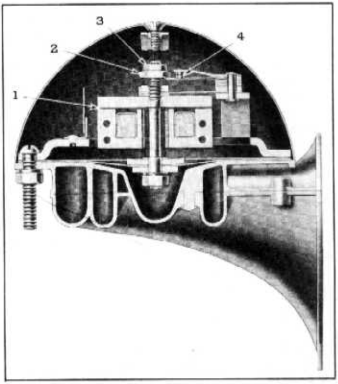

Fig. 54—Horn Cross Section

Horns operate on a magnetic principle to produce a warning signal. Current from the battery flows through windings within the horn body when the circuit is completed at the horn button.

The following conditions affect performance of the horns and should be checked before attempting to make any adjustments.

1. If horns produce a weak signal, voltage at horn should be checked. Connect a voltmeter across the horn terminals. This voltage reading should not be less than 5.25 volts. A lower reading would indicate either a low battery or a high resistance in the horn circuit. Check condition of battery as explained under "BATTERY" in this section.
2. Loose or corroded connections in horn circuit should be corrected. Check for defective wiring by connecting separate test leads from horn to battery.
3. A loose or poor contact at horn button switch may cause horn to operate intermittently.

Shunt around horn button to determine whether there is poor contact at push button. Whenever wiring is replaced in horn circuit, use wire of same size as removed.

4. Horns usually have a rasping sound when vital parts are broken or loose. A loose backshell may affect tone. Tighten all collar screws, mounting nuts and studs, and replace all damaged parts.
5. The horn will not function properly if field windings within horn are open circuited, short circuited or grounded. Connect an ammeter into horn circuit at horn terminal. If there is not indication of current flowing when contact points are closed, windings are open circuited. The ammeter will indicate an excessive flow of current if windings are short circuited or grounded.
6. Excessive arcing at contact points (4) may be caused by improper current adjustment. An open circuit in condenser will cause excessive arcing at points, and in some cases contacts will be fused together.

Adjustment

If tone is not satisfactory after checking and correcting the preceding conditions, adjust horn in the following manner:

1. Remove backshell from horn.
2. Connect ammeter in circuit at horn and adjust current flow to 17-19 amps. for high note and 19-21 amps. for low note, by varying position of adjusting nut (fig. 54).
3. Loosen adjusting locknut (3) and turn adjusting nut (2) left to decrease current or right to increase current.
4. Too much current will cause horn to have a sputtering sound. This adjustment is very sensitive and nut should be moved $\frac{1}{10}$ turn at a time and locked in position each time before trying.
5. Correct air gap between armature and core (1) is important for proper tone. This gap measured with a feeler should be .044"-.049" and must be uniform across the entire surface of the armature. Adjustments may be made by use of the air gap adjusting nuts.

Replacement

1. Raise hood and disconnect wires to horn.
2. Remove nuts and lockwashers retaining horn to mounting bracket and remove horn.
3. Install new horn and fasten securely to mounting bracket.
4. Replace wires to horn connections and test for operation. Adjust if necessary and lower hood.

HORN RELAY

The horn relay is a magnetically operated switch, remotely controlled by the horn push button switch. This relay completes the circuit directly to the horn through the relay contacts.

When the horn button completes the circuit, a small amount of current flows from the battery through the relay windings. The armature is attracted to the magnetic field, causing the contact points to close. Current from the battery then flows directly across the contact points in the relay to the horn. The relay is used to provide a higher voltage to the horn by avoiding a voltage drop in the long circuit to the horn button.

LIGHTING SYSTEM

INDEX

DESCRIPTION AND OPERATION

The lighting and wiring units include the lighting switch, stop light switch, dimmer switch, dome light switch, head and parking lights, tail and stop lights, instrument lights, the wiring harness and other wiring except that covered under other circuits.

The lighting switch incorporates a 30 ampere thermal circuit breaker to protect the entire lighting system. All lights on the vehicle are protected by this circuit breaker and if an overload or short circuit occurs, causing a current flow of more than 30 amperes, the points of this current limit relay will open and close as they warm and cool. Thus, the current to the lights is rapidly interrupted and restored until the short is located and corrected. Protection against destruction of the wiring is thereby provided and possible rapid discharge of the battery averted. A further advantage may be realized should a short circuit occur in the lighting system at night. The intermittent operation of the lights makes it possible to drive the vehicle until a service garage is reached.

When the switch control button is pulled out to the first position, an internal circuit is established to the switch terminals for the parking lamps, instrument lights, and tail lamps. When the switch is pulled out to the last position, an internal circuit is established to the switch terminals for the headlamps, instrument lights and tail lamps. The current for the instrument lights passes through a rheostat which is regulated by the light switch knob. By turning the switch knob the instrument lights can be dimmed or turned completely off.

The mechanically operated stop light switch is attached to the underside of the toe pan to the right of the brake pedals (fig. 55). The actuating

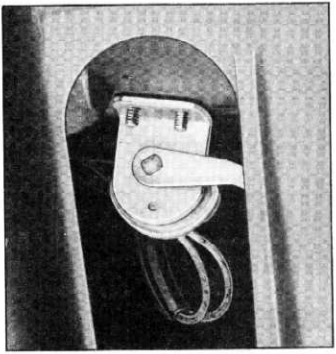

Fig. 55—Stop Light Switch Mounting

lever or arm of the switch extends out to the left between the brake pedal and toe pan. When the brake pedal is released, it holds the switch arm in the "off" position but when the brake pedal is pushed down, a spring within the switch causes the switch arm to follow the pedal, closing the circuit within the switch and lighting the stop lights.

The dimmer switch is located on the toe pan to the left of the clutch pedal. When the headlights are on, this switch is used to change the lights from high to low beam or from low beam to high beam. Each time the switch button is depressed and released the lights are switched from one beam to another.

The dome lamp switch is located on the dome lamp on all models except Convertible and Sport Coupe models (Bel-Air). Location on these models is on the front of the lower left rear quarter trim panel. In addition, an automatic dome light switch which is used on all Fleetline and Styleline Deluxe models is located in both the left and right front door pillars and is operated by opening either front door.

All models are equipped with "Sealed Beam" headlight units in which the light source, the reflector, lens and gasket are all assembled in a securely sealed unit. Figure 56 shows the component parts of the light. This sealed construction prevents tarnished reflectors and keeps dirt and moisture from the reflector and inside of the lens. This assures maximum lighting efficiency throughout the life of the unit.

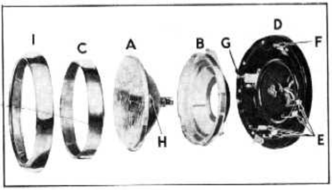

Fig. 56—Sealed Beam Headlamp Parts

A. Sealed Beam Unit
B. Sub-Body
C. Retainer Ring
D. Lamp Housing
E. Coil Springs
F. Vertical Adjustment Screw
G. Horizontal Adjustment Screw
H. Locating Lug
I. Headlamp Rim

The "Sealed Beam" units have two separate filaments located in the unit in positions to produce an upper (country) light beam and a lower (traffic) light beam. The upper beam is designed to illuminate the road evenly for considerable distance ahead of the vehicle and should only be used on the open highway when no other vehicles are approaching. The lower beam is adjusted to illuminate the right side of the road a reasonable distance ahead but to prevent glare in the eyes of oncoming drivers.

When the upper beams are in use a red pilot light will be seen through a small opening at the top of the speedometer dial. The dimmer switch is used to switch from one beam to the other.

Parking lamps are mounted between the header bar and the center bar at their outer ends. A three candlepower bulb is used in each parking lamp.

All models use combination stop and and tail lamps. Double filament bulbs are used having 21 candlepower for the stop light and 3 candlepower for the taillight. The stop light is controlled by the stop light switch, actuated by the brake pedal, independent of the other light circuit while the tail light is turned on by the lighting switch.

The rear license plate is mounted below the rear deck lid opening at the center of the car and is illuminated by a three candlepower lamp at each side.

The instruments are indirectly illuminated by two small bulbs back of the instrument panel. Each individual light socket is fitted with a spring clip so that it can be pushed into an opening in the instrument carrier and will be held in place by the clip. These lights are turned on by the regular light switch and can be dimmed by the light switch rheostat.

CARE AND ADJUSTMENT

In general, care of the lighting units and wiring system consists of an occasional check to see that all wiring connections are tight, that the lighting units are tightly mounted to provide a good ground and that the wiring is not pinched or worn to a point that a short circuit might result. All lights should be checked regularly to see that they light correctly and do not flicker.

HEADLAMP BEAM ADJUSTMENT

To obtain the maximum results in road illumination and the safety that has been built into the headlighting equipment, the headlamps must be properly aimed. Before adjusting aim of headlamps, bounce car up and down several times and allow to settle.

1. Make a headlamp aiming screen (fig. 57). A vertical line must be drawn to represent the center of the chart and will be used in positioning the screen. Measure the distance between the headlamp centers, space sliders or vertical lines "B" and "C" at this distance.
2. Place the car on a level floor 25′ from a wall or object that will act as a support for the screen. Sight from the center of rear window past the windshield division channel on each side and place the screen center line midway between these two points.
3. Raise or lower the screen until the horizontal line "A" is 3″ below the center of headlamps.

NOTE: If State Laws require a loading allowance when adjusting headlamps, place the line as much below the headlamp center as the particular State requires.

4. Turn on the headlights and place the dimmer switch in the position to produce the upper (bright) beam. Remove the headlamp rims and cover one headlamp.
5. Check the position of the light beam on the

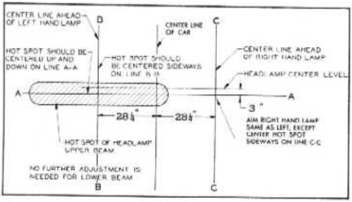

Fig. 57—Headlamp Aiming Screen

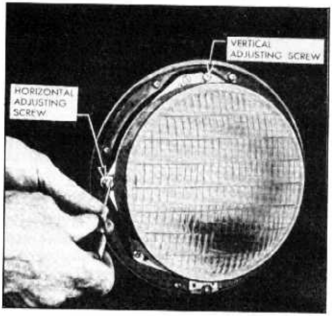

Fig. 58—Headlamp Adjusting Screws

screen. If the hot spot of the light beam does not center on intersection of line "A" and the vertical line directly in front of the light (fig. 57), adjustment is necessary.

6. Turning the vertical adjusting screw "In" or "Out" will raise or lower the light beam as desired. Turning the horizontal adjusting screw (fig. 58) "In" or "Out" will center the beam on the vertical line "B" or "C".
7. Install headlamp rim and adjust the opposite light in the same manner. Figure 59 illustrates a headlamp correctly aimed. It is not necessary to adjust the headlamp for the lower beam.

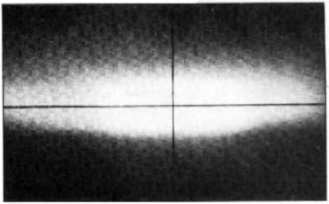

Fig. 59—Properly Aimed Headlamp Beam

SERVICE OPERATIONS

SEALED BEAM UNIT REPLACEMENT

1. Loosen clamp screw and remove headlamp door rim by pulling it out at the bottom and unhooking the top (fig. 60).

Fig. 60—Removing Headlamp Rim

2. Remove the three screws attaching retaining ring (fig. 61). DO NOT DISTURB THE AIMING SCREWS.
3. Rotate retainer ring counterclockwise and remove ring. Pull sealed beam unit forward and disconnect connector plug from unit.
4. Connect plug to new sealed beam unit, place unit in position and install retaining ring. Tighten retaining screws securely.
5. Hook the headlamp rim at the top and pull it down into place. Install and tighten the clamp screw.

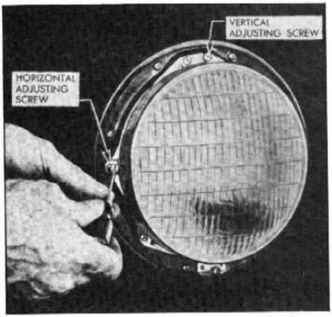

Fig. 61—Removing Sealed Beam Retaining Ring Screws

SEALED BEAM HEADLAMP OVERHAUL

1. Remove rim, retaining ring and sealed beam unit as instructed above.
2. Remove the vertical and horizontal adjusting screws and unhook the four coil springs attaching the sub-body. Remove sub-body assembly.
3. Remove the screws attaching the lamp housing to fender and remove lamp housing.
4. Disconnect the light socket wires from the junction block and ground. Work wire through grommet and remove socket and wire assembly. Replace all damaged parts.
5. Work the light socket wires through grommet and connect them to their respective terminals.
6. Place lamp housing in position and install the attaching screw. Place sub-body in position and hook up the springs. Install the two

adjusting screws and tighten to approximately their original adjustment.

7. Connect sealed beam unit to lamp socket and install sealed beam unit, retaining ring and attaching screws.
8. Focus the headlamp beam according to instructions under "Headlamp Beam Adjustment."

LIGHTING SWITCH REPLACEMENT

1. Disconnect all wires from the lighting switch and either tag them for correct installation or make sure you can properly connect them by reference to Figure 62.

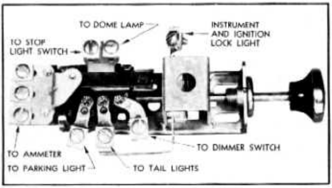

Fig. 62—Light Switch Wiring Identification

2. Depress the switch shaft retainer (fig. 63), and remove the knob and shaft.

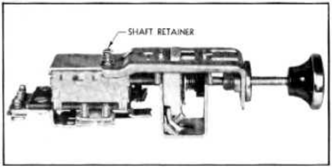

Fig. 63—Light Switch Shaft Retainer

3. Remove the switch retaining nut and the switch assembly.
4. Place the new switch in position and install the retaining nut.
5. Push the switch knob and shaft assembly into position so that the retainer seats in the groove.
6. Connect all wires to the lighting switch terminals according to the notations made when disconnecting or according to connections shown in Figure 62.
7. Check operation of all lights.

STOPLIGHT SWITCH REPLACEMENT

1. Disconnect the wires from the two terminals at top of switch.
2. Remove screws attaching switch to underside of toe pan and remove switch.
3. Place new switch in position and install the attaching screws.
4. Connect the wires to switch terminals and test stoplight operation.

DIMMER SWITCH REPLACEMENT

1. Disconnect the three wires from the switch noting the wire removed from each terminal.
2. Remove the bolts that attach the switch to toe pan and remove switch.
3. Place new switch in position and install the attaching bolts securely.
4. Connect the wires to their respective switch terminals and test the switch operation.

PARKING LIGHT SERVICE

1. Raise hood and remove bulb and socket from lamp body.
2. Remove bulb from socket.
3. To remove parking light body, remove the nuts attaching body to grille and disconnect wire from junction block.
4. Place lamp body in position and install attaching nuts. Run the wire up and connect to junction block.
5. Install bulb in socket and replace bulb and socket into lamp body. Test light operation.

TAIL AND STOPLIGHT SERVICE

The tail and stop lamp bulbs may be changed by removing the lamp door attaching screws and lamp door.

To remove body assembly, remove lamp door and remove two body attaching screws, disconnect wires inside trunk and remove lamp body.

TROUBLES AND REMEDIES

ELECTRICAL

BATTERY AND STARTING SYSTEM

Symptom and Probable Cause	Probable Remedy
Slow Engine Cranking Speed	
Partially discharged battery	Charge or change battery and determine cause of battery condition
Low capacity battery	Cycle battery to improve capacity or replace it
Faulty battery cell	Replace battery
Loose or corroded terminals	Clean and tighten terminal
Under capacity cables	Replace battery cables
Burned starter solenoid switch contacts	Replace solenoid
Internal starting motor trouble	Overhaul starting motor
Heavy oil or other engine trouble causing undue load	Make necessary repairs to engine
Starter Engages but Will Not Crank Engine	
Partially discharged battery	Charge or change battery
Faulty battery cells	Replace battery
Bent armature shaft or damaged drive mechanism	Overhaul starter
Faulty armature or fields	Overhaul starter
Starter Will Not Run	
Battery fully discharged	Replace or charge battery
Disconnected battery cables	Replace faulty cables
Shorted or open starter circuit	Make necessary repairs

GENERATING SYSTEM

Symptom and Probable Cause	Probable Remedy
Low Charging Rate	
Fully charged battery and low charging rate	This is a normal condition with a fully charged battery
Fan belt slipping	Replace or adjust belt
Generator commutator dirty	Clean commutator
High resistance in charging circuit	Check charging circuit progressively and make necessary repairs to remove high resistance
Too low voltage setting of voltage regulator unit	Adjust voltage regulator
Oxidized voltage regulator points	Clean and adjust points
Partially shorted field coils	Overhaul generator
High Charging Rate With Fully Charged Battery	
Voltage regulator setting too high	Adjust voltage regulator
Voltage regulator points stuck	Clean and adjust points and readjust regulator
Regulator unit improperly grounded	Remove regulator and clean connections. Readjust regulator
Generator field circuit to regulator short circuited	Test to locate short circuit and make necessary repairs
Shunt field circuit short circuited within regulator	Replace regulator
Low Battery and No Charging Rate	
Fan belt broken or loose	Replace or tighten fan belt
Charging circuit open between regulator and battery	Locate open circuit and make necessary repairs
Cut-out voltage winding open circuited	Replace regulator unit
Corroded points in current and voltage regulator	Clean points and readjust regulator
Open circuit between generator and regulator	Locate open circuit and make necessary repairs to wiring
Internal trouble in generator	Overhaul generator

Symptom and Probable Cause	Probable Remedy
IGNITION SYSTEM	
Engine Will Not Start	
(See Starting and Fuel System Troubles)	
Ignition switch not turned on	Turn switch on
Weak battery	Charge battery
Excessive moisture on high tension wiring or spark plugs	Dry parts, coat with PIB
Cracked distributor cap	Replace cap
Faulty coil or condenser	Replace faulty unit
Coil to distributor high tension wire not in place	Properly install wire
Loose connections or broken wire in low tension circuit	Tighten or replace wires
Improperly adjusted or faulty distributor points	Clean and adjust or replace points
Hard Starting	
(See Starting and Fuel System Troubles)	
Faulty or improperly set spark plugs	Clean and adjust or replace spark plugs
Improperly adjusted or faulty distributor points	Clean or replace and adjust points
Loose connections in primary circuit	Tighten loose connections
Worn or oil soaked high tension wires	Replace high tension wires
Low capacity condenser	Replace condenser
Low capacity coil	Replace coil
Faulty distributor cap or rotor	Replace faulty part
Engine Misfires	
Dirty or worn spark plugs	Clean or replace plugs
Damaged insulation on high tension wires or wires disconnected	Connect or replace wires
Distributor cap cracked	Replace cap
Poor cylinder compression	See Engine Troubles
Improper distributor point adjustment	Adjust distributor points
HEADLAMP AND CIRCUIT	
Headlights Dim (engine idling or shut off)	
Partly discharged battery	Charge battery
Defective cells in battery	Replace battery
High resistance in light circuit	Check headlight circuit including ground connection. Make necessary repairs
Faulty bulbs	Replace bulbs or sealed beam units
Headlights Dim (engine running above idle)	
High resistance in lighting circuit	Check lighting circuit including ground connection. Make necessary repairs
Faulty bulbs or reflectors	Replace bulbs or reflectors
Faulty voltage control unit	Test voltage control and generator. Make necessary repairs
Lights Flicker	
Loose connections or damaged wires in lighting circuit	Tighten connections and check for damaged wiring
Light wiring insulation damaged producing momentary short	Check light wiring and replace or tape damaged wires
Lights Burn Out Frequently	
High voltage regulator setting	Adjust voltage regulator
Loose connections in lighting circuit	Check circuit for loose connections

Symptom and Probable Cause	Probable Remedy
Lights Will Not Light	
Discharged battery	Recharge battery and correct cause
Loose connections in lighting circuit	Tighten connections
Burned out bulbs	Replace bulbs or sealed beam unit
Open or corroded contacts in lighting switch	Replace lighting switch
Open or corroded contacts in dimmer switch	Replace dimmer switch
Thermal Circuit Breaker Causing Current Interruption	
Short in wiring	Check wiring of circuits in use for short circuits and make necessary repairs
Short within some light or instrument in use	Check lights or instruments for short

GASOLINE GAUGE

Symptom and Probable Cause	Probable Remedy
Gauge Shows Empty at All Times	
Tank unit shorted	Replace unit
Wire from dash unit to tank unit shorted	Replace wire or repair short
Float stuck in empty position	Replace tank unit
Dash unit improperly grounded on instrument panel	Properly ground dash unit
Gauge Shows Full at All Times	
Tank unit burned out	Replace tank unit
Wire between units disconnected or broken	Connect or replace wire
High resistance in wire between units	Clean bayonet connection and terminals
Float stuck in full position	Replace tank unit
Gauge Does Not Register Accurately (within normal limits)	
Bent hand on dash unit	Replace unit or straighten hand
High resistance in circuit	Check and correct circuit
Partial short in circuit	Correct cause of short
Loose electrical connections	Tighten connections at dash unit, tank unit and bayonet connector

STOPLIGHT AND CIRCUIT

Symptom and Probable Cause	Probable Remedy
Will Not Light	
Switch faulty or arm bent	Replace switch
Wires broken, disconnected or loose	Make necessary repairs
Bulb burned out	Replace bulb
Loose connection or poorly grounded lamp body	Tighten loose connections or properly ground lamp body

HORNS

Symptom and Probable Cause	Probable Remedy
Will Not Blow	
Loose connections or broken wire	Tighten loose connection or replace broken wire
Horn button not making contact	Adjust horn button contact
Horn improperly adjusted or faulty	Adjust or replace horn
Relay not operating	Replace relay
Horn Tone Poor	
Horn improperly adjusted	Adjust horn

SPECIFICATIONS

Battery	
Make	Delco-Remy
Plates per cell	15
Ampere hour capacity (at 20 hour rate)	100
Voltage	6
Specific gravity (fully charged)	1.275 to 1.300
Specific gravity (fully discharged)	1.150
Starting Motor	
Make	Delco-Remy
Brush spring tension	24 to 28 ounces
Generator	
Make	Delco-Remy
Brush spring tension	24 to 32 ounces
Regulator	
Make	Delco-Remy
Voltage regulator armature air gap	.075" to .085"
Voltage regulator voltage setting	7.0 to 7.7 volts (7.4 volts preferred)
Current regulator amperage setting—1949	36 amps. preferred
Current regulator amperage setting—1950-51	35 amps. preferred
Current regulator amperage setting—1952	37 amps. preferred
Current regulator amperage setting—1953	47 amps. preferred
Current regulator armature air gap	.075"
Cut-out relay points closed (hot)	5.9 to 6.8 volts (6.4 volts preferred)
Cut-out relay points open (reverse flow)	0-4 amperes
Cut-out relay armature air gap	.020"
Cut-out relay point opening	.020"
Distributor	
Make	Delco-Remy
Type of advance	Centrifugal
Firing order	1-5-3-6-2-4
Breaker point gap	New .022"-.024" Old .018"-.022"
Breaker arm spring tension—1949-52	17-21 oz.
Breaker arm spring tension—1953	19-23 oz.
Ignition timing—1949-52	5° B.U.D.C.
Ignition timing—1953	2° A.U.D.C.
Condenser capacity	.2 Microfarad
Spark Plugs	
Make	AC
Type—1949-52	46-5
Type—1953	44-5
Size	14 MM
Plug Gap	.035"
Ignition Coil	
Make	Delco-Remy

Lamp Bulb Data

Location	Candlepower	Number
Headlamp	45-35 Watts	Sealed Beam
Parking Lamp with Directional Signal	3-21	1154
Parking Lamp	3	63
Tail and Stop Lamp	3-21	1154
Tail Lamp with Directional Signal	3-21	1154
Tail Lamp	3	63
Stop Lamp	21	1129
License Plate Lamp	3	63

Location	Candlepower	Number
Ignition Lock Lamp	1	51
Headlamp Beam Indicator	1	51
Directional Signal Tell-Tale	1	51
Instrument Cluster	2	55
Speedometer	2	55
Clock	3	63
Glove Compartment	2	55
Dome Lamp (except Convertible)	15	88
Dome Lamp (Convertible)	2	55
Radio Dial Light	2	55
Courtesy Light	6	82

AUTRONIC EYE

INDEX

GENERAL DESCRIPTION

The Autronic Eye is an automatic electronic device that selects the proper headlight beam of the car on which it is installed in response to light from an approaching car. This device, which is available as an accessory on all 1953 model passenger cars, contributes to safety, comfort and convenience of night driving by accomplishing the following three functions without the possibility of human error.

1. It automatically shifts the headlamps from upper to lower beam whenever an oncoming car approaches.
2. It holds the lower beam on until the initial car and all other cars behind it have passed, even though the lights of the oncoming cars are dimmed immediately.
3. It automatically returns the headlamps to the upper beam as soon as all oncoming traffic has passed.

The Autronic Eye consists of four individual units (fig. 64).

1. Phototube Unit
2. Amplifier Unit
3. Power Relay
4. Auxiliary Foot Switch

PHOTOTUBE UNIT

The Phototube Unit, mounted on the top left side of the instrument panel, is an optical device which receives power from the Amplifier Unit by electrical cable. The lens of the Phototube Unit picks up light from an approaching car and focuses it through a filter and mask to the phototube. The phototube converts the light into an electrical signal which is conducted, by a cable, to the Amplifier Unit.

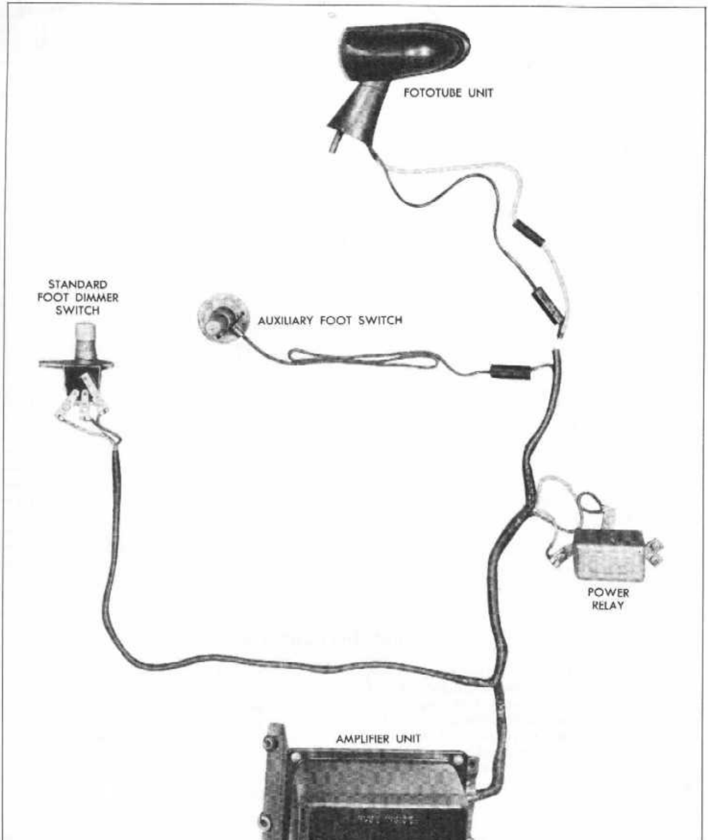

Fig. 64—Four Autronic Eye Units

AMPLIFIER UNIT

The Amplifier Unit is mounted under the hood on the left front fender skirt. It supplies voltage to both the Phototube Unit and the Power Relay. The Amplifier Unit operates the Power Relay in response to a signal from the Phototube Unit.

POWER RELAY

The Power Relay is mounted under the hood near the Amplifier Unit. It is a heavy duty relay equipped with special alloy contacts. Upon receipt of a signal from the Phototube Unit through the Amplifier Unit, the Power Relay switches the headlamps between the upper and lower beams.

AUXILIARY FOOT SWITCH

The Auxiliary Foot Switch is mounted on the toe board just above the Standard Foot Dimmer Switch. It is a spring loaded plunger type switch which, when pressed down and held, provides an upper beam regardless of light on the Phototube Unit.

OPERATION

The Autronic Eye provides complete automatic switching of the headlamp beams on the car to which it is installed when the Standard Foot Dimmer Switch is in the upper beam "Automatic" position. The other position of the Standard Foot Dimmer Switch provides the lower beam.

The Autronic Eye is disconnected from its vehicle headlamps in the lower beam position of the Standard Foot Dimmer Switch, however, the Autronic Eye is not turned off. It continues to function as long as the headlamps are turned on, and is ready at all times to provide automatic control whenever the Standard Foot Dimmer Switch is returned to the upper beam position.

The Auxiliary Foot Switch functions only in the upper beam position of the Standard Foot Dimmer Switch. When pressed down and held, it provides the upper beam regardless of light on the Phototube Unit. This arrangement permits signaling if desired and provides a simple test for the upper beam position of the Standard Foot Dimmer Switch.

With the Standard Foot Dimmer Switch in the upper beam position, the following operation would be considered normal. When a car approaches, the light from its headlamps strikes the Phototube Unit which causes the Autronic Eye to switch headlamps from the upper to the lower beam. At this time, if the lights of the approaching car were on the upper beam, the driver would normally switch to the lower beam; thus greatly reducing the amount of light falling on the Phototube Unit.

The Autronic Eye is designed to maintain its vehicle headlamps on a lower beam even with this reduction in light. When light is removed from the Phototube Unit, the Autronic Eye returns its vehicle headlamps to the upper beam.

If the approaching vehicle fails to switch to its lower beam, the Auxiliary Foot Switch may be operated to provide an upper beam for signaling purposes. Street lights and extraneous lights encountered in the city are sufficient to cause the Autronic Eye to maintain the vehicle headlamps on the lower beam.

At times it may be desirable to operate the Standard Foot Dimmer Switch to the "Lower Beam" position, when following a vehicle, to avoid glaring its driver through the rear window.

SERVICE INFORMATION

INSTALLATION

To assure complete owner satisfaction, Servicemen should familiarize themselves with the installation procedure, in order that the field installation will conform to the high standards of accuracy built into this unit.

Install the component parts of the Autronic Eye by performing the operations as outlined in the instruction sheet which is enclosed with each Autronic Eye package. Servicemen should pay particular attention to the items outlined below:

CAUTION: Disconnect the battery ground cable before making the installation of this accessory. The Phototube Unit operates on 1000 VOLTS.

1. Positioning Template on Instrument Panel. Carefully position template on instrument panel, with wide folded edge of template located along recess in panel, and tape in position. If holes are not properly positioned it will affect both the vertical and axial focusing of the Phototube Unit.

2. Checking the Alignment of the Phototube Unit with the Centerline of the Car.
   a. Make an aiming screen (fig. 65) or utilize a headlamp aiming screen, if available.
   b. Place two vertical lines on the aiming screen, one a centerline and another line 23½ inches to the left of the centerline.

   NOTE: If using a headlamp aiming screen, it will only be necessary to place the second line on the screen.

   c. Place the car on a level floor at a distance of 20 feet from a wall or object that will act as a support for the screen.

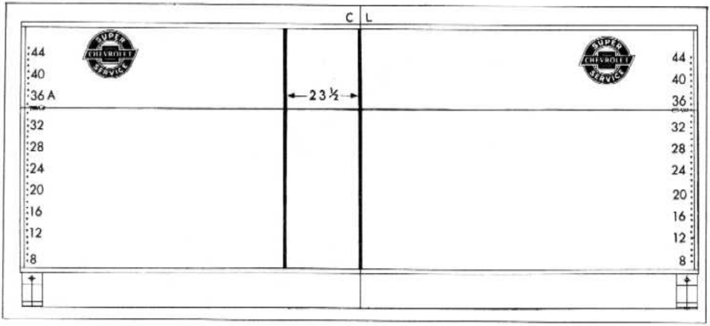

Fig. 65—Headlamp Aiming Screen

d. Sight from the center of the rear window over the center of the hood and place the centerline of the screen at this point.

e. Sight over the raised ridge on the cover of the Phototube Unit. This ridge above the centerline of the Phototube Unit should line up with the left line on the screen within 4 inches to left or right.

If the Phototube Unit does not line up within these limits, the mounting holes should be elongated as necessary to properly position the unit.

TESTING AND ADJUSTMENT AFTER INSTALLATION

After the four units have been installed as specified in the instruction sheet, the following tests and adjustments should be made to be sure the Autronic Eye is operating properly.

NOTE: Servicemen must use the Autronic Eye Tester J. 5297, available from the Kent Moore Organization. This tester consists of a leveling device, sensitivity meter, intensity rheostat, a special 1/16" screwdriver and an Allen wrench for making adjustments, all enclosed in a compact portable steel carrying case.

1. Leveling the Phototube Unit.

   Place the car on a level floor, or preferably, on a wheel aligning machine and level the Phototube Unit as outlined under "Phototube Unit Aiming Procedure."

   NOTE: Floor must be level within ¼" fore and aft of car.

2. Checking "Dim" and "Hold" Sensitivity.

   Using the Autronic Eye Tester, check both the "Dim" and "Hold" sensitivity of the Autronic Eye and adjust as necessary. Refer to "Sensitivity Adjustments" for proper testing procedure. Two scales are provided on the Tester Meter for checking the "Dim" and "Hold" sensitivity of the Autronic Eye. Readings are taken from the lower scale when the Autronic Eye being tested is installed on a car equipped with clear windshield glass and the upper scale is used when checking the Autronic Eye installed on a car equipped with a tinted windshield glass.

   The Phototube Unit in the field installation package is finished in one color only, granite gray, and must be repainted to match the instrument panel on which it is installed.

PHOTOTUBE UNIT AIMING PROCEDURE

NOTE: Due to normal settling of front and rear springs, it is recommended that the aiming procedure outlined below should be rechecked on new cars at the 1,000 mile inspection.

1. The Phototube Unit aiming procedure should be done with car unloaded, trunk empty except for spare tire, gas tank at least half full and with tires at correct pressure.
2. Locate car on a level floor (level within ¼" fore and aft of car).
3. Rock car to equalize springs.
4. Adjust dial on aiming device to the number stamped below the serial number on the

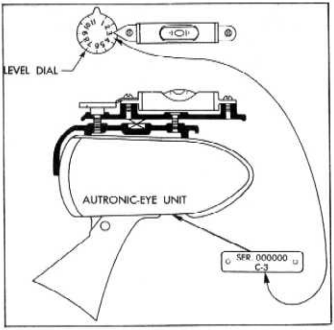

Fig. 66—Serial Number Plate and Aiming Device

serial plate which is mounted on the bottom of Phototube Unit (fig. 66).

5. Carefully center aiming device by placing the slotted legs on raised ridge on top of Phototube Unit and the tongue of the aiming device contacting the lens.

6. If the bubble does not indicate level, adjust Phototube Unit aiming screw with the Allen wrench furnished with the Tester until the bubble is centered in the level (fig. 67).

NOTE: It is very important that the Phototube Unit be aimed, or leveled, accurately. If it is aimed too low, back reflections from the headlamps of the car on which the Autronic Eye is installed will hold the lamps on the lower beam. Also, the unit must be aimed as low as possible to provide the maximum tolerance for car loading.

SENSITIVITY ADJUSTMENTS

Separate sensitivity adjustments are provided for adjusting "Dim" and "Hold" sensitivity. These adjustments are made using the Kent Moore Autronic Eye Tester J-5297.

Before using the Autronic Eye Tester for the many sensitivity adjustments, check the batteries by rotating the intensity rheostat switch clockwise. If the batteries are good, the dial will indicate batteries O.K. In the event this reading cannot be obtained, remove the four 1½ volt flashlight cells by taking off the plate at the back of the Tester and replace with four new cells. Due to possible battery leakage it is recommended that the metal case type of battery be used.

"DIM" SENSITIVITY ADJUSTMENT

CAUTION: The Autronic Eye develops 1000 volts—headlamps must be turned off before removing cover from Phototube Unit.

1. Remove 2 oval head screws from bottom of the Phototube Unit.
2. Lift off cover, remove outer lens (do not remove amber filter) and replace lens with Test Lamp (fig. 68).

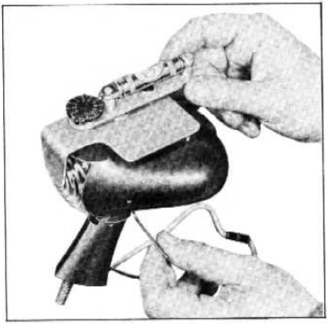

Fig. 67—Adjustment of Phototube Unit

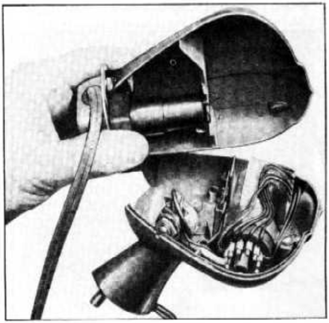

Fig. 68—Installing Test Lamp

3. Replace cover and screws.
4. Turn headlamps ON and wait at least four minutes for amplifier to stabilize. Set Standard Foot Dimmer Switch to upper beam position.
5. Turn zero corrector on face of meter until meter pointer is on zero set line (fig. 69).
6. If windshield is tinted, use upper portion of scale on dial. If windshield is clear, use lower portion.
7. Check car battery voltage. If less than 6 volts, operate engine at fast idle when making sensitivity adjustments.

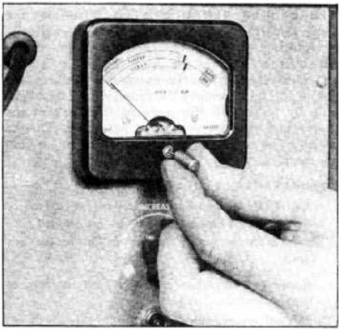

Fig. 69—Checking Needle Zero Line

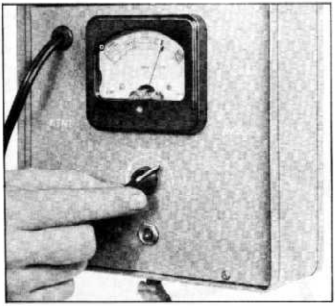

Fig. 70—Dim Sensitivity Adjustment—Rotating Meter Knob

8. Snap meter switch on test panel to "DIM" position. Turn meter control knob clockwise to set test panel in operation (fig. 70).
9. Advance needle up dial by turning meter control knob clockwise and note point on dial scale where headlamps switch to the lower beam. If Phototube Unit is adjusted correctly, the headlamps should switch to lower beam when the meter needle is on the "DIM" line of the dial. If not, proceed as follows:
10. Rotate Phototube Unit Sensitivity Control counterclockwise to end of adjustment using a special $1/16$" screwdriver provided in Tester (fig. 71).
11. Turn meter control knob counterclockwise until headlamps switch to the upper beam, and then turn meter control knob clockwise until meter needle is on the "DIM" line of the dial.
12. Carefully and slowly turn Phototube Unit Sensitivity Control clockwise just to the point where the headlamps switch to the lower beam—do NOT go beyond this setting.
13. Recheck this setting by turning meter control knob counterclockwise until headlamps switch to the upper beam and then turn meter control knob clockwise slowly just to the point where the headlamps switch to the lower beam. If "DIM" sensitivity has been adjusted correctly the meter pointer should fall within the "DIM" sensitivity adjustment line. If not, repeat steps 5 through 13.

"HOLD" SENSITIVITY ADJUSTMENT ON CAR

"HOLD" Sensitivity Adjustment may be made by adjusting the potentiometer on the bottom (outside) of the Amplifier Unit. This adjustment

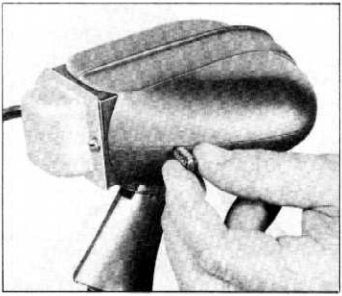

Fig. 71—Adjusting Phototube Unit Sensitivity Control

should not be made until "DIM" sensitivity is adjusted correctly and "HOLD" sensitivity adjustment checked to see if the meter pointer falls within "HOLD" sensitivity adjustment bar.

Checking "Hold" Sensitivity Adjustment

1. With "DIM" sensitivity correctly adjusted, snap meter switch to "DIM" position.
2. Turn meter control knob clockwise to obtain the lower beam.
3. Snap meter switch to "HOLD" position.
4. Turn meter control knob counterclockwise (fig. 72) carefully and slowly just to the point where the headlamps switch to the upper beam. The meter pointer should fall within the "HOLD" sensitivity adjustment bar on meter scale.

   NOTE: Be sure to use correct "HOLD" scale for clear or tinted windshields.

Adjust Amplifier for "Hold" Sensitivity

1. Turn off headlamps.
2. Remove amplifier mounting screws.
3. Turn amplifier over and attach a jumper wire between case of amplifier and ground on car.
4. Turn the "HOLD" control on the bottom (outside) of the Amplifier Unit clockwise to end of adjustment (fig. 73).
5. Turn on headlamps and wait four minutes to allow amplifier to stabilize.
6. Snap meter switch to "DIM" position and rotate meter control knob clockwise to switch headlamps to lower beam; then snap meter switch to "HOLD" position.

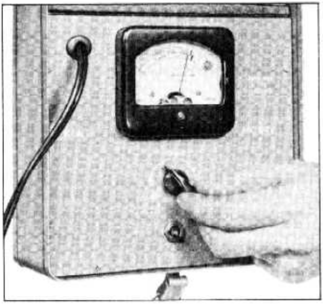

Fig. 72—Hold Sensitivity Adjustment—Rotating Meter Knob

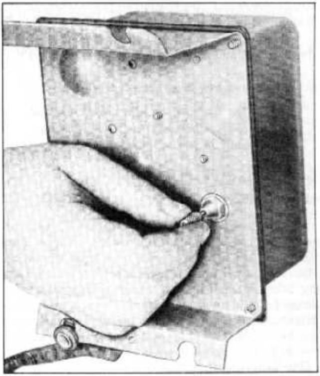

Fig. 73—Adjusting Hold on Bottom of Amplifier Unit

7. Adjust meter control knob until pointer is in center of the "HOLD" sensitivity adjustment bar on meter scale.

   NOTE: Be sure to use correct "HOLD" scale for clear or tinted windshields.

8. Turn "HOLD" control on amplifier counterclockwise slowly just to the point where the headlamps switch to the upper beam. If the headlamps do not switch to upper beam when the "HOLD" control is turned completely counterclockwise, rotate meter control knob counterclockwise until headlamps switch to upper beam. If the meter pointer is within the "HOLD" sensitivity adjustment bar, the amplifier unit is within tolerance.
9. Again check "HOLD" sensitivity adjustment by snapping meter switch to "DIM" position and rotating meter control knob clockwise to switch headlamps to lower beam.
10. Then snap switch to "HOLD" position.
11. Turn meter control knob counterclockwise carefully and slowly just to the point where the headlamps switch to upper beam. The meter pointer should fall within the "HOLD" sensitivity adjustment bar on meter scale, if adjustment was made correctly.

    NOTE: Be sure to use correct "HOLD" scale for clear or tinted windshields.

12. Turn off headlamps and reinstall amplifier.

13. Remove 2 oval head screws from bottom of Phototube Unit.
14. Lift off cover, remove test lamp and replace lens.
15. Replace cover and screws.

CAUTION: Be sure to turn meter control knob counterclockwise to "OFF" position after using to prolong battery life.

PRELIMINARY CHECKS BEFORE ADJUSTMENT

The Autronic Eye properly installed and adjusted should hold its adjustment over a long period of time. There may be occasions, of course, when adjustment of the device is questioned. Like any other electrical unit, loose or incorrect wire connections, defective fuse, or even a misunderstanding of the operation of the device, may lead one to believe that an adjustment is necessary. The following troubles may be reported:

Headlamps switch to the lower beam when an approaching car is too far away.

Headlamps switch to the lower beam when approaching car is too close or will not switch to the lower beam at all.

Headlamps will not return to the upper beam when no car or other lights are ahead.

Headlamps, after being depressed by beam of an approaching car, return to upper beam when approaching car switches to lower beam.

Headlamps switch back and forth rapidly between upper and lower beams.

While the above complaints may be corrected by simple aiming and sensitivity adjustments in most cases, a few preliminary tests should be made to indicate if the difficulty is more serious than can be corrected by simple adjustment. Check as described below:

1. With the car in a lighted area, pull light switch knob to full "On" position. Regardless of the position of the Standard Foot Dimmer Switch, the lights should remain on the lower beam.

2. Depress the Auxiliary Foot Switch. The lights should change to the upper beam, if the Standard Foot Dimmer Switch is in the upper beam position. If not, trip the Standard Foot Dimmer Switch and again depress the Auxiliary Foot Switch. The lights should now change to the upper beam and return to the lower beam when the Auxiliary Foot Switch is released.

   If lights do not operate as described in steps 1 and 2, refer to Minor Service Corrections and Trouble Diagnosis.

3. Cover the Phototube Unit lens with a heavy black cloth. The headlamps should switch to the upper beam and back to the lower beam when the cloth is removed, providing the Standard Foot Dimmer Switch is in the upper beam position. If beam does not raise and lower as explained above, refer to Minor Service Corrections and Trouble Diagnosis.

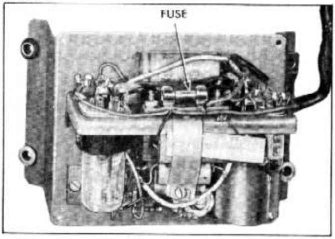

Fig. 74—Amplifier with Cover Off—Showing Fuse

NOTE: If the headlamps operate as outlined in the above tests, the unit should operate correctly with the proper aiming and sensitivity adjustment. If the Autronic Eye cannot be serviced immediately, the lights can be quickly converted to standard foot dimmer switch operation, in most cases, by removing the 14 ampere fuse under the amplifier cover (fig. 74).

MINOR SERVICE CORRECTIONS (ON CAR)

CAUTION: Headlamps should be turned "off" before any connections are tightened, made, or broken. The battery ground strap should be disconnected before removing or tightening any one of the Units. The Autronic Eye develops 1000 volts.

1. Check to see that all external connections are tight and properly made. Be sure to inspect plug-in connections of Phototube Unit under the instrument panel.
2. Turn on headlamps and feel the amplifier for vibrator buzz. If vibrator does not buzz:
   a. Turn off headlamps and inspect 14 amp fuse by removing amplifier cover. DO NOT USE HIGHER THAN A 14 AMP FUSE FOR REPLACEMENT.
   b. Be sure vibrator is firmly seated in socket.
   c. Replace vibrator with new 4 volt vibrator, providing steps "a" and "b" above did

not correct the trouble. DO NOT USE STANDARD RADIO 6 VOLT TYPE VIBRATOR.

2. Inspect tube filaments for glowing, except the amperite (large tube) and phototube. Check or replace one tube at a time in amplifier unit with known good tube. If tube is replaced, dimming sensitivity must be rechecked.

TROUBLE DIAGNOSIS (UNITS ON CAR)

With the Autronic Eye units on the car, trouble may be isolated to any individual unit of the Autronic Eye system with the exception of the Amplifier Unit and the Phototube Unit. Some minor repairs may be made to the Amplifier Unit as outlined under "Minor Service Corrections," but electronic testing equipment is required to definitely isolate other troubles in either the Amplifier Unit or Phototube Unit.

The following series of tests should be made with the units on the car before condemning either the Amplifier Unit or the Phototube Unit:

1. Clean and tighten terminal connections to all units. Visually inspect the wiring harness for open or shorted circuits. It is important that each unit is properly grounded.
2. Remove the fuse from the Amplifier Unit. The headlamps should switch between the upper and lower beams by operating the standard foot dimmer switch. If not the trouble may be traced to one or more of the locations listed below:
   a. Power Relay or Terminal Connections
   b. Standard Car Wiring Harness and/or Headlamps
   c. Standard Foot Dimmer Switch or Terminal Connections
   d. Amplifier Unit Harness from Standard Foot Dimmer Switch to Power Relay
3. Test the Power Relay in the following manner:
   a. Disconnect the natural color wire from the "C" terminal of the power relay.
   b. Disconnect the following wires from the "BAT" terminal of the power relay.
      (1) Natural with Red cross tracer.
      (2) Red with natural tracer.
      (3) Natural with black and red cross tracer.
   c. Disconnect the natural with black cross tracer wire from the upper beam (UB) terminal of the power relay.
   d. Disconnect the natural with green tracer wire from the lower beam (LB) terminal of the power relay.
   e. Attach a test wire from the positive post of the battery to the battery (BAT) terminal of the power relay.
   f. Connect a test light to a good ground connection.
   g. Connect the lead wire of the test light to the upper beam (UB) terminal of the power relay. The test light should be on.
   h. With the battery lead and the test light connected as in steps "e" through "g" above, attach a second test wire from the positive post of the battery to the "C" terminal of the power relay. The relay should operate audibly and the test light should go out.
   i. Move the test light lead to the lower beam (LB) terminal of the power relay. The test light should light.

   If any of the above tests fail, the power relay is defective and must be replaced. If all tests check O.K., remove the test wires and the test light and reconnect wiring to the power relay in accordance with the wiring diagram (fig. 75).
4. The standard car wiring harness and headlamps may be tested by repeating the tests of the power relay as indicated in step 3 above with the following exceptions:
   a. Do not disconnect the natural with green tracer wire from the lower beam (LB) terminal of the power relay.
   b. Do not disconnect the natural with black cross tracer wire from the upper beam (UB) terminal of the power relay.
   c. The test light will not be needed in this test.
   d. The headlamps should be on the upper beam with one test lead connected from the positive post of the battery to the battery (BAT) terminal of the relay.
   e. Attaching the second test wire from the positive post of the battery to the "C" terminal of the power relay should cause the relay to operate and the headlamps should switch to the lower beam.

   If any of the above tests fail, the trouble is isolated to the standard car wiring harness and/or headlamps. If all tests check O.K., remove the test wires and reconnect wiring to the power relay in accordance with the wiring diagram (fig. 75).
5. Test the standard foot dimmer switch in the following manner:
   a. Disconnect the natural color wire from the battery (BAT) terminal of the standard foot dimmer switch.

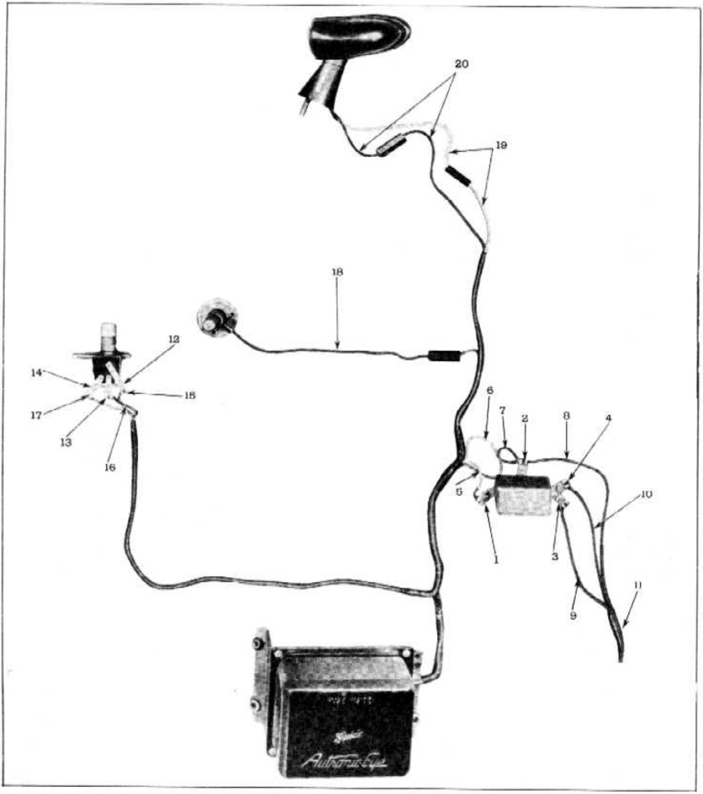

Fig. 75—Wiring Diagram

1. "C" Terminal—Power Relay
2. Battery Terminal—Power Relay
3. Upper Beam (UB)—Power Relay
4. Lower Beam (LB)—Power Relay
5. Natural Wire
6. Natural with Red Cross Tracer Wire
7. Red with Natural Tracer Wire
8. Natural with Black and Red Cross Tracer Wire
9. Natural with Black Cross Tracer Wire
10. Natural with Green Tracer Wire
11. Standard Foot Dimmer Switch Branch from Main Wiring Harness
12. Battery Terminal—Standard Foot Dimmer Switch
13. Lower Beam—Standard Foot Dimmer Switch
14. Upper Beam—Standard Foot Dimmer Switch
15. Natural Wire—S.F.D.S.
16. Natural with Red Cross Tracer—S.F.D.S.
17. Natural with Black Cross Tracer—S.F.D.S.
18. Red Plastic Covered Wire—Aux. Foot Switch
19. White Plastic Covered Wire
20. Black Plastic Covered Wire

b. Disconnect the natural with red cross tracer wire from the lower beam terminal of the standard foot dimmer switch.

c. Disconnect the natural with black cross tracer wire from the upper beam terminal of the standard foot dimmer switch.

d. Connect a test wire from the positive post of the battery to the battery (BAT) terminal of the standard foot dimmer switch.

e. Connect a test light to a good ground connection.

f. Attach the lead wire of the test light to the lower beam terminal of the standard foot dimmer switch. The test light should light, depending, however, upon the location of the standard foot dimmer switch contacts. If the light does not light, switch the standard foot dimmer switch and then the light should light.

g. Transfer the test light lead to the upper beam terminal of the standard foot dimmer switch. The test light should now be out. Switching the standard foot dimmer switch should cause the test light to go on.

If any of the above tests fail, the standard foot dimmer switch is defective and should be replaced. If all tests check O.K., remove the test wire and test light and replace the wiring to the standard foot dimmer switch in accordance with the wiring diagram (fig. 75).

6. The amplifier unit harness from the standard foot dimmer switch to the power relay should be inspected visually as outlined under step 1 above. Do not attempt to test the wiring by use of a test light since high voltage electronic circuits in the amplifier unit are incorporated in this harness.

7. The auxiliary foot switch may be tested in the following manner:

   a. Disconnect the auxiliary foot switch to amplifier unit lead wire (red plastic covered wire) at the connector.

   b. Attach the auxiliary foot switch lead wire to a test light which is connected to the positive post of the battery.

   c. Depress the auxiliary foot switch. The test light should light with this switch depressed. If not, either the contacts of the auxiliary foot switch are defective or the ground connections are poor from the auxiliary foot switch to the toe panel of the car.

   d. Attach a jumper wire from the body of the auxiliary foot switch to a good ground connection. Again depress the auxiliary foot switch. If the test light still fails to light, the auxiliary foot switch is defective and must be replaced.

If all of the foreging test (steps 2 through 7) check O.K. and the Autronic Eye still fails to function, the trouble is definitely located in either the Amplifier Unit or the Phototube Unit. Remove BOTH UNITS from the car for further service by an authorized representative of United Motors Services.

When service and repairs are needed on Tester unit send unit to Kent-Moore Organization, 1501 S. Jackson Street, Jackson, Michigan.

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1954 SUPPLEMENT

to the

1949-53

Chevrolet

PASSENGER CAR SHOP MANUAL

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FOREWORD

This supplement has been prepared for use with the 1949-53 Passenger Shop Manual and covers changes for the 1954 product along with recent changes that affect the servicing of models prior to 1954.

Unless otherwise stated within the Supplement, the information in the 1949-53 Passenger Shop Manual that applies to 1953 models, will also apply to 1954 models.

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CHEVROLET MOTOR DIVISION

GENERAL MOTORS CORPORATION

DETROIT, MICHIGAN

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SECTION 1

BODY

The Chevrolet passenger cars for 1954 all feature improvements in styling and performance, while retaining the same basic car lines of previous year models. Designations for the three series introduced during the 1953 model years, together with the identifying body moldings in each series, have been carried over and a wide variety of the models have been continued. Notable changes include the adding of an eight-passenger Station Wagon to the Bel Air Series, the discontinuing of the Convertible, Sport Coupe, and eight-passenger Station Wagon, from the Series 2100, and the elimination of the Club Coupe from Series 1500. The Business Coupe in the 1500 Series has been replaced by a Utility Sedan Model 1512 which has almost three additional cubic feet of load space more than the former business coupe.

SECTION 3

FRONT SUSPENSION

TOE-IN SPECIFICATIONS

The front suspension and steering system on the 1954 passenger car have been modified to improve handling characteristics under variations in load. These modifications necessitate a change in toe-in specifications. The new toe-in setting is ⅛" plus or minus $\frac{1}{16}$". The methods used to check toe-in vary with each type of equipment utilized. Manufacturers procedures should be followed. The toe-in may be adjusted by loosening the clamp bolts at each end of the left hand tie rod and turning the rod to increase or decrease its length. Increasing the tie rod length increases the toe-in; decreasing the length reduces the amount of toe-in. It is important that the tie rod ends be in alignment with their ball studs when the clamp bolts are tightened, or binding will result. After adjusting toe-in, check the relationship of the steering wheel to the front wheels. With the wheels in the straight ahead position, the steering wheel cross-bar should be horizontal. If it is not, check the relationship of the cross-bar to the high point mark on the end of the steering mainshaft. They should be at right angles to one another. With the proper relationship of cross-bar to high point mark, the cross-bar may be leveled by adjusting the length of the steering connecting rod, in a manner similar to the procedure for adjusting toe-in.

SECTION 5

POWER BRAKES

GENERAL DESCRIPTION

The power brake is a unit incorporating a hydraulic cylinder and reservoir, a vacuum power cylinder and a control valve assembly which utilizes engine intake manifold vacuum and atmospheric pressure for its operation (fig. 1). The power brake unit is mounted to the engine side of the firewall and is connected to a vacuum reserve tank which is mounted to the back of the left front wheel splash pan.

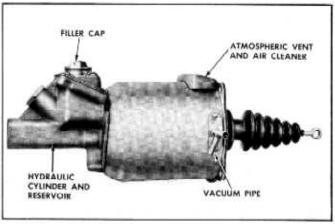

Fig. 1

Basically, the power brake utilizes the engine vacuum to remove air from one side of a piston in a closed cylinder, while the other side of the piston is open to the atmosphere. The differential in pressures on each side of the piston moves the piston in the direction of the low pressure or vacuum side. The piston is in contact with a displacement plunger which builds up a hydraulic pressure in the hydraulic cylinder which in turn transmits this pressure to the brake shoes through the hydraulic lines.

All energy for the brake actuation is not supplied by the air pressure differential. A proportion of the effort, which varies with the severity of the brake application must be supplied by the driver. Control or diversion of the effort between manual and power braking is provided by a sliding vacuum control valve.

The power brake provides approximately a 50% reduction of pedal travel when compared to the conventional braking system. This reduced pedal travel brings the height of the pedal down to approximately that of the accelerator pedal and permits a brake application by shifting the toe from accelerator to the brake pedal without lifting the heel from the floor.

In addition, the power brake unit is so constructed that in the event of engine failure and consequent loss of vacuum the brakes will function satisfactorily, although greater effort is required. The vacuum reserve tank maintains a vacuum which will allow at least one brake application after the engine has stopped. The vacuum line from the intake manifold also has a vacuum check valve which retains vacuum in the brake system during acceleration, hill climbing or

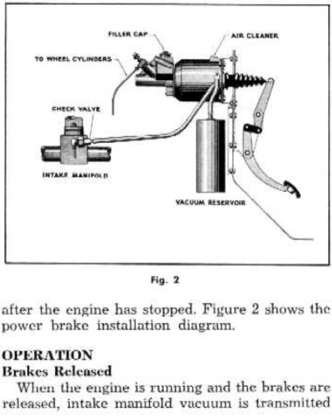

Fig. 2

after the engine has stopped. Figure 2 shows the power brake installation diagram.

OPERATION

Brakes Released

When the engine is running and the brakes are released, intake manifold vacuum is transmitted

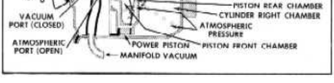

Fig. 3

through the vacuum check valve (fig. 2) to the inlet tube and vacuum reservoir. From the inlet tube the vacuum is directed to the power piston where it is blocked by an annular land on the sliding valve (fig. 3). Atmosphere is admitted to the cylinder left chamber through the air cleaner port then through a notch in the power piston stop to the interior of the sliding valve. Atmosphere is free to travel from the sliding valve through the atmosphere port into the piston front chamber, from the piston chamber the atmosphere passes through a slot passage to the cylinder right chamber. Atmosphere is also transmitted from the left cylinder chamber through a passage to the piston rear chamber then through a pin hole in the diaphragm plate to the diaphragm chamber.

Since atmosphere exists on both sides of the power piston and across the diaphragm assembly the piston is in balance and is held in the released position by the piston return spring. The sliding valve is held by the valve return spring so as to block the vacuum port with the land.

With the power piston and sliding valve in the released position, the various components of the hydraulic cylinder are also in the released position. The compensating valve is tilted by the ring on the end of the hydraulic plunger permitting fluid flow between the reservoir and the hydraulic cylinder. This arrangement compensates for any expansion, contraction or leakage of fluid in the system. Hydraulic fluid in the lines to the wheel cylinders is trapped by the residual check valve which maintains a residual pressure in the lines as in a conventional braking system.

Application

When the brake pedal is depressed the push rod moves to the right within the sleeve of the power piston closing off the atmosphere port and opening the vacuum port (fig. 4). This action allows the atmosphere to be removed from piston front chamber and the cylinder right chamber. This evacuation of atmosphere causes a pressure differential across the power piston and diaphragm resulting in the piston moving to the right or toward the low pressure or vacuum side. The movement of the piston compresses the large piston return spring and forces the hydraulic plunger into hydraulic cylinder.

The pressure differential across the reaction diaphragm assembly causes a reactionary force to act to the left or against the sliding valve and push rod. This force tends to move the valve land back over the vacuum slot, thus closing off vacuum from the chambers and reopening the chambers to atmosphere. The reactionary force also increases in direct proportion to the pressure differential across the power piston. This force together with the movement of the hydraulic plunger into the hydraulic cylinder, gives the driver complete feel of the brakes.

The initial movement of the hydraulic plunger into the hydraulic cylinder moves the plunger ring away from the compensating valve stem allowing the valve to close the compensating port. Hydraulic fluid is thereby trapped in the cylinder. The force exerted on the push rod plus the force resulting from the piston movement combines to force the hydraulic plunger into the hydraulic cylinder. The hydraulic fluid displaced by the plunger is forced past the residual check valve and creates a pressure in the lines to the wheel cylinders.

Holding

The driver stops increasing the brake pedal force when sufficient braking force has been obtained and the sliding valve stops moving to the right. Although the sliding valve stops, the piston continues to move to the right, due to the pressure differential, until the valve land covers the vacuum port (fig. 5). Vacuum is trapped in the piston chamber and in the cylinder right chamber and the brakes are in an applied hold position. No further action takes place until the brake

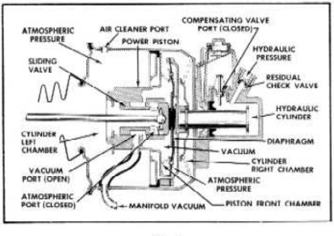

Fig. 4

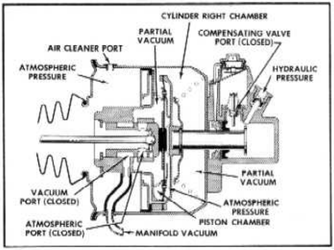

Fig. 5

pedal pressure against the valve is either increased or decreased.

Releasing

When foot pressure is released from the brake pedal, the valve return spring moves the sliding valve to the left closing off the vacuum slot. At the same time the piston chamber and cylinder right chamber are opened to atmosphere. With atmospheric pressure on both sides of power piston, the piston, sliding valve and push rod are returned to the left by the piston return spring. Hydraulic fluid which had been displaced into the brake lines to wheel cylinders is returned to the master cylinder through the residual check valve. When the hydraulic plunger reaches the fully released position the plunger ring unseats the compensating port valve allowing any fluid loss in the system to be compensated.

SERVICE OPERATIONS

Removal

1. On the engine side of the dash panel, remove vacuum lines from vacuum inlet tube on cylinder.
2. Remove hydraulic line from hydraulic cylinder and cap line. Disconnect stop light switch wires.
3. Inside body, remove bolt from push rod and disengage push rod from pedal mechanism.
4. Remove four bolts retaining power brake unit to mounting bracket and remove power brake unit from vehicle.

Replacement

1. Insert push rod through dash panel into body then attach brake unit to mounting bracket on dash with four bolts.
2. Connect vacuum line from intake manifold check valve and line from vacuum reserve tank to inlet tube on vacuum cylinder.
3. Attach brake hydraulic line and stop light switch wires.
4. Inside body, connect push rod to brake pedal mechanism with shoulder bolt.
5. Inspect pedal pivots for misalignment and binding. Lubricate pedal pivots if necessary

PREVENTIVE MAINTENANCE

Brake System Inspections

1. Check the vacuum lines and connections at the engine intake manifold, and check valve for possible vacuum loss.
2. Inspect the hydraulic lines and connections at the wheel cylinders for possible hydraulic leaks.
3. Check brakes for scored drums, grease or brake fluid on linings, worn or glazed linings and make necessary brake adjustments.

Power Brake Unit Inspections

1. Check the vacuum lines and connections at the vacuum inlet tube assembly, check vacuum attachment at vacuum reservoir.
2. Inspect the hydraulic line and connection attached to the power brake hydraulic cylinder output port for hydraulic leaks.
3. Check the brake fluid level in the hydraulic reservoir. The reservoir should be filled to within ½" of the top of the filler cap opening. Inspect the reservoir cover for fluid leaks at gasket.
4. Check air cleaner on brake cylinder and replace hair filter if necessary.
5. Inspect the air cleaner and vacuum inlet tube assembly for loose screws. Check for loose unit mounting bolts.
6. Check brake pedal pivot for binding and misalignment between pedal and push rod.

System Tests

Road test brakes by making a brake application at approximately 20 MPH to determine if braking is even and quick. If pedal has a spongy feel when applying the brakes, air is present in the hydraulic system. Bleed brake system as described in the Brake Section of the 1953 Passenger Shop Manual.

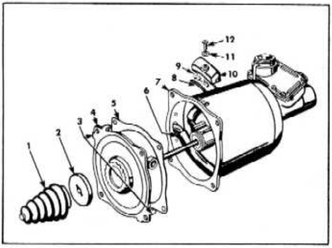

Fig. 6

With the engine stopped and the transmission in neutral apply the brake several times to destroy all vacuum in the system. Then depress the brake pedal and while holding the brake pedal down, start the engine. If the vacuum system is operating, pedal will tend to fall away under foot pressure and less pressure is required to hold pedal in the applied position. If no action is felt, vacuum system is not functioning.

Stop engine and again destroy all vacuum in the system. Then, depress the brake pedal and hold foot pressure on pedal. If pedal gradually falls away from foot pressure, the hydraulic system is leaking.

If the brake pedal travels to within one inch of the toe board, brake shoes require adjustment or relining.

Bleeding Instructions

The power brake system may be bled either manually or with a pressure bleeder as outlined in the brake section of the shop manual. Use only Delco Super No. 11 or its equivalent.

Lubrication

The power brake system is lubricated at the time of assembly and needs no further lubrication.

DISASSEMBLY

1. Remove unit from vehicle and clean all dirt from outside of the power brake unit, use care to prevent cleaning fluid from entering the unit.
2. Scratch alignment marks between the cylinder shell and shell end plate, between the cylinder shell and hydraulic cylinder casting and between the hydraulic cylinder reservoir casting and cover.
3. Release lip of rod guard from the cylinder shell end plate and slip guard (1) and felt washer (2) from push rod as shown in figure 6.
4. Straighten retaining tabs on end plate (3) and remove end plate (4) and gasket (5) from vacuum cylinder (7). Remove vacuum hose (6) from tube assembly.
5. Remove screw (12) and gasket (11), air cleaner shell (10), hair (9) and shell gaskets (8) from outside of vacuum cylinder shell.
6. Remove screws (5), fitting (6) and gasket (7) from vacuum cylinder (1) as shown in figure

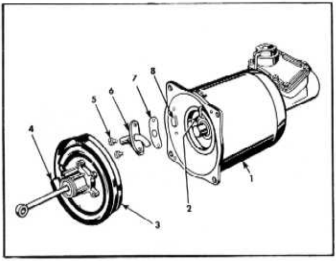

Fig. 7

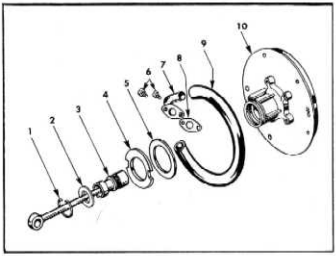

Fig. 8

7. Then pull piston assembly (3) from the bore of the cylinder shell.

7. Remove the snap ring (1) retaining the valve in the valve sleeve with needle nose pliers or a screwdriver (fig. 8). Remove stop washer (2) and push rod sliding valve assembly (3) from piston assembly (10).

CAUTION: Exercise caution in removing the sliding valve, protecting the machined surfaces of the valve and the valve sleeve in the piston assembly from damage.

8. Remove the vacuum hose (9), screws (6), tube (7) and gasket (8) from the piston assembly (10).
9. Remove the rubber stop washer (4) and steel backup washer (5) from the recess on the hub of piston plate.

NOTE: The rubber stop washer will have to be replaced when the piston is re-assembled.

10. Push return spring retainer (2) into the cyl-

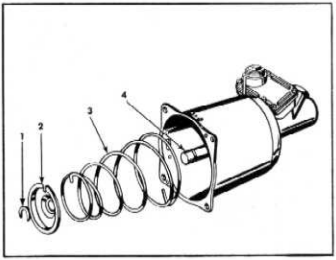

Fig. 9

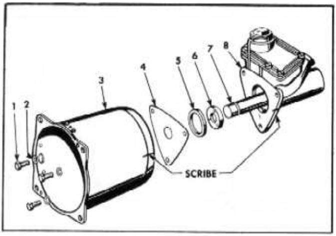

Fig. 10

inder bore and disengage "C" washer (1) from groove in end of the hydraulic plunger (4). Then remove retainer and return spring from bore of shell (fig. 9).

11. Remove three shell to hydraulic cylinder mounting bolts (1) and lockwashers (2) illustrated in figure 10. Separate shell (3), gasket (4) and seal (5) from the hydraulic cylinder (8).
12. Push hydraulic plunger (7) into the hydraulic cylinder, then pull plunger out to remove seal (6) from recess in hydraulic cylinder (8).
13. Remove the filler cap (2) and gasket from the hydraulic fluid reservoir (fig. 11). Drain any excess hydraulic fluid from reservoir.
14. Remove cover retaining screws (1), cover (3) and gasket (4) from hydraulic cylinder reservoir.
15. Use a thin wall 1⅛" socket to unscrew the compensating valve and port (5) from the bottom of the reservoir.
16. Use inside snap ring pliers J-5403 and disengage snap ring (7) from recess in hydraulic cylinder casting.

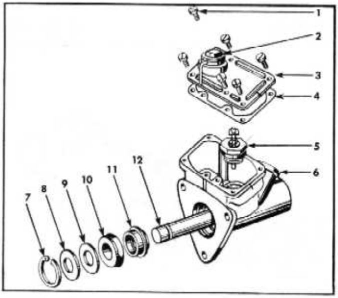

Fig. 11

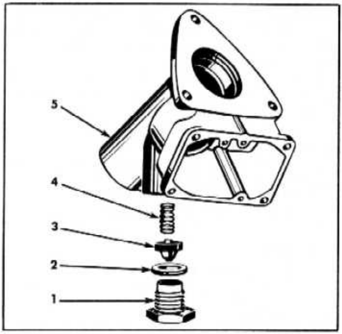

Fig. 12

17. Remove hydraulic plunger (12) together with washers and hydraulic cup from bore of hydraulic cylinder. Then remove the steel washer (8), washer (9), hydraulic cup (10) and cup retainer (11) from the hydraulic plunger (12).

CAUTION: Protect the surfaces of the hydraulic plunger from damage

18. Unscrew the hydraulic fitting (1) from hydraulic cylinder and remove rubber seal (2). Lift residual check valve (3) and spring (4) from bore (fig. 12).
19. Remove rubber seal (4) from compensator port fitting (3), open spring retaining washer (1) and remove washer and spring (2) from stem of valve (fig. 13).

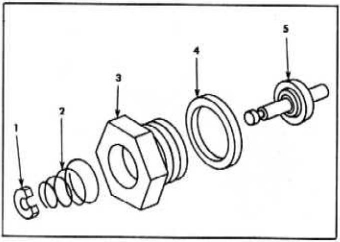

Fig. 13

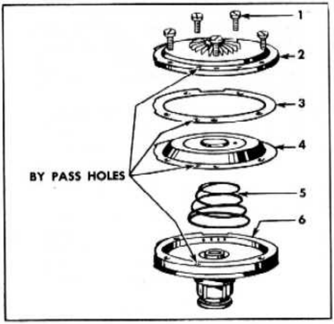

Fig. 14

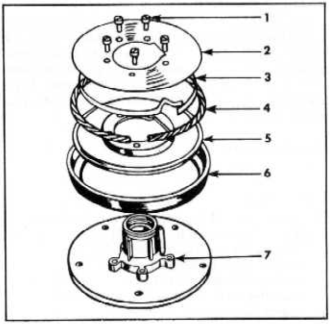

Fig. 15

20. Place the piston assembly hub down on a bench and scratch alignment marks between the front and rear piston plates. Unscrew piston plate retaining screws (1) and separate plate (2), gasket (3), diaphragm assembly (4) and reaction spring (5) from piston (fig. 14).

    NOTE: By-pass holes allow atmosphere to be present back of the diaphragm at all times.

21. Place the piston assembly on a bench, hub side up, and remove retainer plate screws (1). Then remove retainer plate (2), packing ring (3), wicking (4), packing plate (5) and packing (6) from the piston plate (7) as shown in figure 15.

CLEANING

Wash all parts in alcohol and air dry. Blow dirt and cleaning fluid from all internal passages. If the inside of the vacuum cylinder shell is corroded or rusted, clean with crocus cloth or fine emery cloth, then finish cleaning with alcohol. After cleaning, it is important that all parts are placed on clean paper or cloth to prevent the possibility of dirt being assembled into the unit.

INSPECTION

In addition to the parts contained in the repair kit, the following inspection operations should be made and damaged parts replaced if necessary.

Vacuum Cylinder Shell

Inspect shell for scoring, pitting, dents or nicks or damaged threads.

Hydraulic Cylinder Casting

Check the bore down one inch from the open end. This portion of the bore must be free from scores, deep scratches and corrosion to permit proper sealing of the hydraulic cup. Gasket surfaces at the reservoir cover, compensating port and outlet fittings, must be free from scoring, pitting, dents and nicks. In addition, check casting for cracks and damaged threads.

Compensator Port Fitting

The surface at the end of bore, inside threaded portion must be free of scoring or corrosion to insure proper sealing of the rubber poppet on the compensating valve.

Vacuum Inlet Tube

Make sure the braze is secure and the tube plate is not distorted.

Piston Plates and Valve Sleeve

Examine the plates for cracks and damaged threads. Make sure valve sleeve is securely pressed into plate. The assembly must be replaced if the bore of the sleeve has scores, deep scratches or corrosion. Do not attempt to refinish the sleeve bore as excessive clearance between the valve and sleeve will cause a serious vacuum leak.

Hydraulic Plunger

Inspect plunger for scoring, pitting or dents. No attempt should be made to refinish the plunger, as an undersize plunger may result in a serious hydraulic leak.

Sliding Valve and Push Rod Assembly

Rod must pivot freely in sliding valve but without noticeable end play. Inspect sliding valve for scoring, pitting, or dents on the outside diameter polished surfaces. Do not attempt to refinish outside diameter of sliding valve as excessive clearance between valve and sleeve will cause serious vacuum leakage.

Shell End Plate

Examine end plate for distortion.

ASSEMBLY

1. Place new rubber seal (4) over threaded portion of compensator port fitting (3). Insert stem of new compensator valve (5) through center of threaded end of fitting and place a new valve spring (2) large coil end of spring into hex end of fitting. Depress spring and insert new spring retainer (1) in groove of stem and with needle nose pliers, crimp retainer in place (fig. 13).
2. Place hydraulic cylinder in a holding device so the outlet fitting port is in a vertical position (fig. 12). Place a new rubber seal (2) over threaded end of port fitting (1).
3. Insert and center valve (3) and spring (4) in fitting (1) and screw assembly into port. Tighten fitting to 50 lb.ft. torque.
4. Dip new hydraulic cup (10) in brake fluid and place large side of cup retainer (11) to lip side of cup (fig. 16).
5. Place hydraulic plunger seal installer J-5404 over end of plunger, then coat plunger with brake fluid and slip cup and retainer on plunger with lip of cup toward plunger ring.
6. Remove tool J-5405 and place washer (9) and steel washer (8) on plunger and insert plunger assembly, ring first into cylinder bore.

CAUTION: Exercise care when installing plunger to cylinder bore to prevent cutting the cup lip. It is necessary to use a small screwdriver or some similar tool to start lip into the bore.

7. Press assembled parts into cylinder bore and insert snap ring (7) using snap pliers J-5403. Make sure snap ring is engaged in recess.
8. Press hydraulic plunger all the way into cylinder bore then install compensator valve assembly (5) and torque to 15 lb.ft.

NOTE: Pressing hydraulic plunger into the bore insures the proper location of the compensator valve lower stem in relation to the plunger ring. Pulling the plunger out should tilt the compensator valve.

9. Place reservoir cover gasket (4) and reservoir cover (3) on top of reservoir. Check previously marked alignment marks for proper installation of cover and install retainer screws. Tighten cover down evenly.

NOTE: Align cover gasket carefully so as to provide a seal for the by-pass tube.

10. Replace filler cap gasket and filler cap (2).
11. Place assembly tool J-5405 (9) over end of plunger (7). (See inset in figure 17.) Then assemble seal (6) over tool J-5405 onto the plunger with lip of seal toward hydraulic cylinder. Push seal into recess in hydraulic cylinder and remove special tool.
12. Insert new rubber seal ring (5) into recess in hydraulic cylinder (8) and with a new gasket (4) between vacuum cylinder shell (3) and hydraulic cylinder, align assembly scribe marks then install attaching bolts (1) and lockwashers (2). Torque attaching bolts to 5 lb.ft.

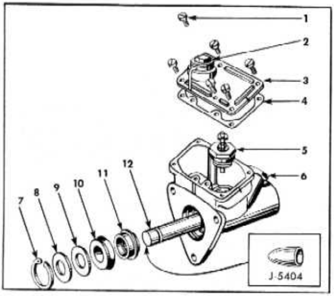

Fig. 16

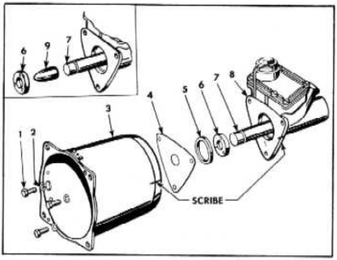

Fig. 17

NOTE: Two holes for air cleaner on vacuum cylinder should be at the top of the assembly.

13. Place return spring (3) over hydraulic plunger (4) with the hook at the large end of the spring in the space between the attaching bolt and a raised dimple at the end of the shell (fig. 9).

NOTE: This prevents the return spring from rotating in the vacuum cylinder shell.

14. Place spring retainer (2) with convex side of retainer in spring coil and spring hook engaged in slot of retainer. Compress spring until "C" washer (1) can be installed into groove at end of hydraulic plunger.
15. Place piston plate (6) on bench with collar down then insert guide pins J-5404 (7) in screw holes (fig. 18).
16. Center reaction spring (5) on plate with large coil against plate. Place a new diaphragm assembly (4) on top of reaction spring, centering small coil of spring in ring plate of the diaphragm assembly. On top of the diaphragm place a new gasket (3) and diaphragm cover (2).

NOTE: Check and align by-pass holes, screw holes and cut outs at outer diameter of plate, diaphragm and gasket.

17. Compress spring and with all holes aligned remove guide pins (7) one at a time and replace with screws (1). Look into valve sleeve and center diaphragm if necessary before tightening screws securely.
18. Place assembly tool J-5406 on bench and place piston sub assembly (7) inside of ring with sleeve up (fig. 19).
19. On top of plate (7) place new leather packing (6) with the lip up and insert retaining plate (5) inside of packing lip, align cut out and holes in plate with flat surface and screw holes in piston plate.
20. Cut a new wicking (4) to fit the inside diameter of packing lip. Dip wicking in hydraulic brake fluid and place inside of packing lip. Insert packing ring (3) so barbs point up and into the wicking. Compress loop end of ring and engage notch at loop end with hook near the other end.
21. Place retainer plate (2) over wicking and ring, align holes and cut out of plate and install and tighten securely retaining screws.

NOTE: Do not remove assembly tool J-5406 until ready to insert piston assembly into cylinder shell.

22. Clean surface of steel back-up washer (5) and place washer over hub end against shoulder of piston assembly (10) (fig. 8). Soften the coated side of new piston stop washer (4) with a few drops of gasoline and assemble washer, with inside diameter in groove of piston assembly hub and with coated side down against steel washer (5).
23. Make certain slide valve and screen (3) are clean and dry. Insert slide valve and push rod into valve sleeve in piston assembly. Install stop washer (2) and snap ring (1) into valve sleeve outer end, make certain snap ring is seated in ring groove.
24. Attach vacuum fitting (7) and gasket (8) with screws (6) to piston assembly, then assem-

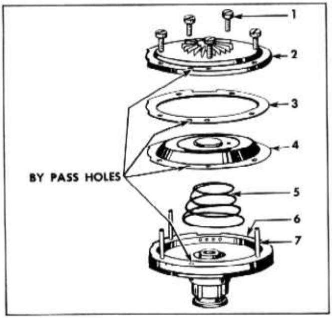

Fig. 18

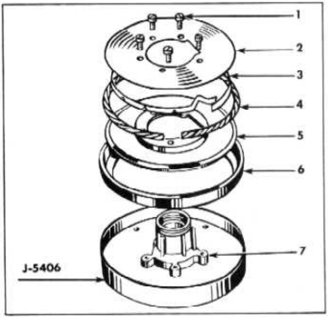

Fig. 19

ble vacuum hose (9) to the fitting.

25. Apply film of brake fluid to the inside of the cylinder shell (1) and to lip of packing (3). Remove assembly tool J-5406 from piston and insert piston in cylinder so that the vacuum hose end is slightly below the elongated hole (8) in figure 7.

26. Push the piston into the cylinder shell (1) until piston engages end of hydraulic plunger and small hook of return spring (2) is between two webs on the back side of the piston assembly.

27. Twist piston in the cylinder shell in both directions, then move piston through its full stroke several times to permit it to find its normal operating position.

28. Assemble new gasket (7), tube and plate assembly (6) with retaining screws (5) to the cylinder shell, then slide vacuum hose (4) approximately ⅝" on fitting (6).

29. Operate the piston through its full stroke several times to make certain vacuum hose does not rub the cylinder wall or piston. Should interference occur, remove and rotate the piston by putting the spring hook in another "web position." Repeat the piston stroke check for intereference.

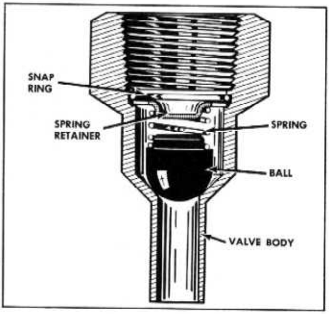

Fig. 20

30. Reassemble air cleaner (10), new clean hair (9) and gaskets (8) to cylinder shell (fig. 6). Place new end plate gasket (5) on end plate (4) and align holes in gasket, end plate and flange of cylinder shell (7). Attach end plate to cylinder shell by crimping tangs (3).

31. Assemble push rod felt (2) to the largest convolute of the rubber dust guard (1). Dip small end of dust guard in brake fluid and assemble over end of valve push rod. Attach large end of rubber dust guard over scallops on end plate into retaining groove.

32. Install power brake unit on vehicle.

VACUUM CHECK VALVE

To disassemble check valve, remove snap ring and lift out spring retainer, spring and ball (fig. 20).

Inspect the ball seat in valve body for scoring and rubber ball for wear. If the valve has been in service for a long period of time, the ball should be replaced.

To assemble the valve, engage the ball in the end coil of the spring and align the spring and ball with the retainer. Then insert the snap ring and be sure it is engaged in its groove in the valve body.

Coat the threads of the valve with pipe thread compound to prevent a vacuum leak before installing valve to manifold.

BRAKE DIAGNOSIS CHART

Brake trouble may be easily diagnosed if the complaint is understood. The trouble will always show up in one or more of the ways listed. Related parts of the power brake system should be checked before dismantling the Power Brake when a malfunctioning brake system is experienced.

1. Hard pedal feel may be caused by:
   - a. Glazed linings.
   - b. Grease or brake fluid on the linings.
   - c. Bound up brake pedal linkage.
   - d. Sticking vacuum check valve.
   - e. Collapsed vacuum hose.
   - f. Plugged vacuum fittings.
   - g. Leaking vacuum reserve tank.
   - h. Internal vacuum hose loose or restricted.
   - i. Jammed vacuum cylinder piston.
   - j. Vacuum leaks in unit caused by loose piston plate screws.
   - k. Faulty diaphragm rubber stop in reaction diaphragm.
   - l. Faulty vacuum cylinder piston seal.

2. Severe brakes may be caused by:
   - a. Grease or brake fluid on linings.
   - b. Scored drums.
   - c. Reaction diaphragm leakage.

d. Broken counter-reaction spring.
e. Restricted diaphragm passage.
f. Sticking vacuum valve action. (DO NOT OIL).

3. Pedal goes to floor may be caused by:
   a. Brakes need adjustment.
   b. Air in hydraulic system.
   c. Hydraulic leak or low fluid level.
   d. Compensating valve leak.
   e. Hydraulic piston seal leak.
   f. Compensating port or outlet fitting seal leak.

4. Slow release, or failure to release may be caused by:
   a. Brakes improperly adjusted.
   b. Bound up brake pedal linkage.
   c. Restricted air cleaner or passages.
   d. Excessive hydraulic seal friction.
   e. Compensator port plugged.
   f. Faulty residual check valve.
   g. Piston stroke interference.
   h. Sticky vacuum valve. (NO NOT OIL)
   i. Broken piston return spring.
   j. Dry vacuum piston leather packing.

SECTION 6

ENGINE

REGULAR PRODUCTION WITH 3-SPEED TRANSMISSION

The 235 cubic inch engine, (fig. 21) is continued for use with the 3-speed transmission, with design changes increasing power output, estimated at 115 gross horsepower at 3700 RPM, improved fuel economy and smoother, quieter operation. The gross torque remains at 200 ft.-lbs. at 2000 RPM. The compression ratio has been increased to 7.5:1, providing a higher maximum horsepower development and a greater efficiency from the fuel consumed. This higher compression ratio which was one of the features introduced for use with the Powerglide transmission in 1953 is now extended to the regular production engine. In addition the regular production engine incorporates full-pressure lubrication system, aluminum pistons, insert-type connecting rod bearings and more rigid crankshaft and connecting rods previously available only in the Powerglide option engine. The Sedan Delivery engine is now a 235.5 cubic inch engine and is the same as the regular production engine.

The drop forged camshaft has larger bearing journals, but the cams are the same as used on 1953 engines. The engine front plate and the camshaft thrust plate have a larger hole for passage of the new camshaft. A cast iron alloy camshaft will replace the forged camshaft in mid-1954 season, a cast iron distributor drive gear also will be introduced at the same time.

The cylinder blocks for all 235.5 cubic inch engines, both passenger car and trucks are basically the same in 1954 and have added reinforcements of the 1953 Powerglide engine. Cylinder head gaskets, new inlet valve guides, and new rocker shaft supports are also interchangeable on all 235.5 cubic inch engines in 1954.

Greater strength and rigidity is provided in the rocker shafts by reducing the diameter of the attachment holes at each end, (fig. 22). The shaft

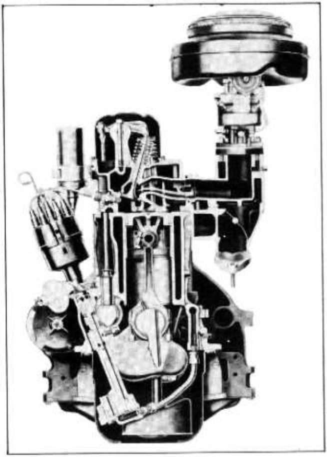

Fig. 21

supports also have a smaller diameter attaching hole for bolting to the cylinder head. The two through bolts used on previous models for the attachment of the valve rocker cover are no longer used. The attachment of the rocker cover is now accomplished by four bolts resulting in improved suppression of valve operating noise. In addition a better pressure distribution on the rocker cover gasket improves sealing against oil leakage.

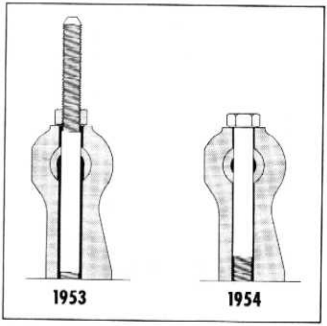

Fig. 22

A stiffer crankshaft gives smoother engine operation. This crankshaft is the same as used on the 1953 Powerglide engine and weighs approximately 78.5 pounds.

The pistons used in the new engine are the same light-weight expansion-controlled aluminum type used in the 1953 Powerglide engine. The cast iron alloy deep section twist type compression rings used on the Powerglide engine are used on this engine along with the wide slot expander type oil control ring. The 1954 piston differs from the 1953 Powerglide piston in that the piston pin is offset by $\frac{5}{64}$ inch. This feature reduces the possibility of piston slap, providing quieter engine operation under all loading conditions. As the piston passes top dead center, the piston skirt loading changes from one side to the other, due to reversal of connecting rod angularity, and moves the piston across the bore to take up any difference in piston skirt and cylinder bore diameters. In a center-pinned piston, this movement is substantially uniform along the whole length of the piston, with the result that a sharp blow is dealt the cylinder wall. With an offset-pinned piston, the open end of the piston moves into contact with the opposite side of the bore before the top end of the skirt. This action greatly reduces the force of the lateral movement of the piston in contacting the cylinder wall and minimizes the development of piston slap when the engine is cold or the pistons are worn.

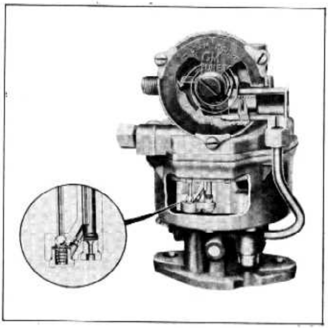

Fig. 23

A change has been made in the carburetor power jet valve, (fig. 23) to provide smoother acceleration with a more positive feel. The spring-loaded ball now seats within a counterbored recess which is slightly larger than the check ball. When the valve is depressed by the power piston rod as manifold vacuum decreases, a double step-up valving of the fuel into the power jet is provided. By this means the fuel-air ratio of the intake mixture maintains a better balance for optimum power attainment during changing loading conditions, and results in a smoother increase in engine power as speed increases. The accelerator linkage for 1954 incorporates a nylon sleeve on the accelerator lever rod and control lever rubber bushing to suppress engine vibrations from reacting on the accelerator pedal. The distributor drive gear is the steel type. The distributor advance curve is revised due to the requirements of the increase in engine compression ratio and now is the same as previously used in the 1953 Powerglide engine.

Clutch

The operation of the clutch is improved by a new clutch assembly that uses three pairs of equally spaced spring-steel straps for driving the pressure plate. These straps are riveted to the cover assembly and bolted to the pressure plate. In the previous design, the pressure plate had three lugs projecting from its outside circumference that fitted into pierced slots in the cover assembly. These rectangular slots permitted longitudinal movement of the pressure plate for releasing or applying pressure on the driven plate, and the drive was accomplished by pressure of the slot wall against one or more of the lugs. Clearance in the slot was necessary for pressure plate movement, and rattle could occur when this space was taken up as the clutch was engaged or the load on the power train was reversed during deceleration. Because the pressure plate was free to float a slight amount laterally, mass concentricity could not be accurately controlled and could cause eccentric loading and rotating unbalance of the drive train. Moreover, the friction between the lug and slot had to be overcome to release the clutch, which added resistance to actuation of the clutch operating mechanism. It also was possible for the pressure plate to tilt or hang up in the slots and not effect a full surface contact with the driven plate. All these problems are eliminated in the new design which permits a friction-free movement of the pressure plate and positive control of concentricity by the attachment of the straps. Since binding in the slots is eliminated, the pressure plate always makes a full pressure contact with the driven plate for transfer of the engine torque to the drive train.

The pull back springs for the pressure plate are reshaped and their attachment is relocated on the pressure plate. The flywheel friction ring has been enlarged to the 10-inch diameter of the new pressure plate. The driven plate remains at 9⅛ inch outside diameter and a 6⅛ inch inside diameter. However, the torque capacity rating has been increased to 220 foot pounds for use with the more powerful engine.

Radiator Pressure Cap

Improved engine cooling and a reduction in water evaporation has been provided by increasing the radiator pressure cap to seven pounds. This will increase the boiling point of the cooling water to approximately 235°F.

WITH POWERGLIDE TRANSMISSION

The basic 235 cubic inch engine, (fig. 24) used with the 1954 Powerglide transmission option incorporates various refinements to give increased performance at mid-speed range, improved traffic acceleration and hill climbing ability. Operating quietness has been increased by the addition of a revised valve rocker cover and by offset piston pins.

A new cast iron camshaft with larger bearing

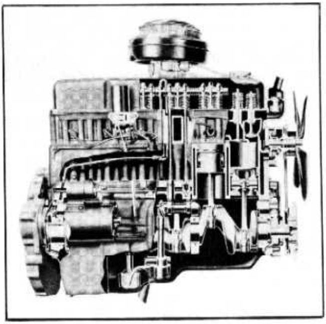

Fig. 24

journals replaces the forged steel used in 1953 giving more durable and quieter operation. This new camshaft has greater resistance to twisting during high speed operation and provides a better sliding characteristic across the hydraulic lifter face for reduced wear and freedom from galling. This camshaft is of a high lift design. The high lift cams permit a greater charge of the fuel and air mixture to enter cylinder and provides for a more rapid and complete expulsion of exhaust gases from the cylinders. Another advantage of the greater valve opening is that less inert gas is left in the cylinder to dilute the intake charge resulting in a richer combustion mixture at the time of ignition and greater power as it burns. This improved intake and exhaust cycle results in a greater power output with the same 7.5:1 compression as was used in 1953 Powerglide engines. This better engine breathing, or volumetric efficiency, becomes increasingly significant as the engine speed rises, with the result that the maximum power is increased from 115 horsepower @ 3600 RPM to an estimated 125 horsepower @ 4000 RPM.

With high lift cams the valve train movement is greater, in the same time interval, than with regular lift cams. The acceleration and deceleration of the components of the valve train is higher resulting in greater stresses in the operating mechanism. As a result, a new valve spring has been designed for use with the highlift cam. In addition, a shorter inlet valve guide is provided for the longer valve stem travel with the high lift cam.

The valve rocker arms have increased cross-section thickness to reduce flexibility with the greater loads imposed on them, while the rocker shafts are made more rigid by an increased wall thickness in their tubular structure resulting in more positive valve operation over the entire speed range. Valve operating push rods are of a larger diameter providing greater stiffness for the higher stresses developed in the new valve train action.

The hydraulic valve lifters are redesigned and made of different material for improved operation with high lift cams. The check valve has been redesigned to overcome unseating due to increased reciprocating speeds of operation. Alloy iron, which has higher wear resistance, is used to compensate for the greater loads and the higher speed of the larger cam lobe contour rubbing on the lifter face.

XCR steel, which has a higher alloy content, replaces silchrome steel for exhaust valves to provide greater hot strength and resistance to scaling and pitting. Exhaust valve durability is thereby increased and more reliable valve sealing obtained, thus extending the intervals between reconditioning and minimizing the furrowing damage to the valve seats due to exhaust gas leakage.

Besides the double step-up power jet valving in the new regular production engine carburetor, the automatic choke for this optional engine is redesigned for freedom from stalling on cold starts. The thermostat spring in the automatic choke is stiffer, and a larger diameter vacuum piston is used. Since the choke valve is mounted offset in the carburetor throat, the rush of air against its plate when the throttle is opened for acceleration tends to overcome the restraining force of the thermostat spring on the choke plate shaft. This reduces the degree of choking and may cause the engine to stall because of too lean a mixture. Such behavior could occur with the previous automatic choke design when heavy acceleration demands were made from a cold start condition. The new heavier thermostat spring exerts greater torsion on the choke valve shaft to resist premature choke opening. The larger diameter vacuum piston is used to counter-balance the stiffer thermostat spring and hold the choke valve open after the engine has reached operating temperature.

1954 VALVE LASH SPECIFICATIONS

The following valve lash specifications should be used when adjusting valve lash on the 1954 model Passenger Car.

Corvette (1953-54)

Intake .... .008"
Exhaust .... .020"

Passenger

Intake .... .006"
Exhaust .... .016"

1954 CHEVROLET PASSENGER ENGINES GENERAL SPECIFICATIONS

Passenger Car With Conventional Transmission		*Passenger Car With Powerglide Transmission*
Blue Flame—115	Engine Name	Blue Flame—125
Valve in head	Type of Engine	Valve in head
Full Pressure	Lubrication	Full Pressure
Six	Number of Cylinders	Six
3-9/16 x 3-15/16	Bore and Stroke	3-9/16 x 3-15/16
7.5:1	Compression Ratio	7.5:1
235.5 cu. in.	Displacement	235.5 cu. in.
Expansion Controlled	Piston Type	Expansion Controlled
Aluminum	Piston Material	Aluminum
5/64"	Piston Pin Offset	5/64"
Insert	Connecting Rod Bearing	Insert
Forged Steel	Camshaft	Cast Alloy Iron–Hi lift
Bakelite and Fabric Composition	Timing Gear	Bakelite and Fabric Composition
Mechanical Tappets	Tappets or Lifter	Hydraulic Lifters
Silichrome Steel	Exhaust Valves	XCR Steel
Open Type	Ventilation	Open Type
115 @ 3700 RPM	Gross Horsepower	125 @ 4000 RPM
200 @ 2000 RPM	Gross Torque	200 @ 2000 RPM
107 @ 3600 RPM	Net Horsepower	115 @ 3800 RPM
195 @ 2000 RPM	Net Torque	195 @ 2000 RPM
Strap—9-1/8"	Clutch Type and Size	-0-
220 ft. lb.	Torque Capacity	-0-
475 RPM	Engine Idling Speed	425 In Drive
AC 44-5	Spark Plugs	AC 44-5

CONNECTING ROD BOLT NUTS

Effective 2-15-54 with engine numbers F54-0310615, F54-0314001 and T54-0159939 pal nuts have been discontinued on connecting rod bolts. Torque remains at 35-45 ft. lbs. with oiled threads.

VALVE TIMING

The valve timing checking procedure as outlined in this manual is applicable to the 1954 models. However, the indicator settings and readings are changed because of the high lift cam usage. The following indicator settings and allowable variations apply to all 1954 models as indicated.

All passenger with standard transmission
Set indicator to .044"
Final reading zero ± .004"

All passenger with Powerglide transmission
Set indicator to .058"
Final reading zero ± .004"

All Corvette
Set indicator to .090"
Final reading zero ± .007"

SECTION 7

TRANSMISSION

POWERGLIDE TRANSMISSION

The Powerglide transmission continues from 1953 with no major design changes. However, its availability is now extended to include all the One-Fifty Series models. For the first time, Sedan Delivery and Business Coupe models can be supplied with this convenience feature, and a wide range of economy priced body types can be provided with the automatic transmission.

The 1954 Powerglide transmission, while not incorporating any major design changes, does have some refinements which will affect servicing of the transmission. In addition, these changes will be reflected in some service operations on the 1953 Powerglide transmission.

Stator Support and Thrust Washers

The 1954 Powerglide transmission assemblies have an improved stator rear thrust washer and primary pump washer design. The new stator rear thrust washer incorporates a rear face of three inch diameter and no oil grooves and a front face of the same diameter with two oil grooves. The new primary pump washer has three radial oil grooves on its face and is made optionally of steel backed bronze (Cleveite design) or Durex, which is the color of babbitt metal.

These improved washers are interchangeable with those used on late production 1953 transmissions and are available under the rear stator thrust and pump thrust washer unit No. 3709886.

On 1953 Powerglide transmissions prior to LT92034 C 20 D, a new stator support, Part No. 3703255 must be installed along with the improved thrust washers when replacement is necessary. It should be noted that the three inch diameter face of the stator rear thrust washer without oil grooves must be installed toward the rear of the transmission.

Low and Drive Valve Assembly

A change has been made for 1954 Powerglide transmissions in the low and drive valve assembly. The throttle valve inner lever has been revised to permit full carburetor travel at wide open throttle. The aforementioned revision necessitates a change in the service adjustment of the throttle valve linkage and throttle valve inner lever. This revised adjustment procedure follows.

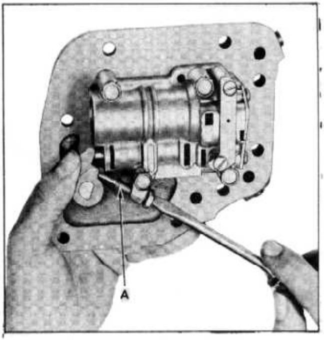

Fig. 25

ADJUSTMENTS

Throttle Valve Inner Lever

The throttle valve inner lever has only one setting on 1954 Powerglide transmission.

1. Rotate the throttle valve inner lever until it just contacts the face of the detent valve. Hold the lever in this position and turn adjusting screw "A" until it just contacts the flat surface of the step in the lever (fig. 25). Back off one complete turn and lock in this position by tightening adjusting screw lock nut securely.

Adjustment of Throttle Valve Linkage

1. Set transmission control lever in "D" range with the hand brake set and adjust engine idle to 425 RPM with the engine normalized and the transmission warm. Stop engine after it is normalized.

NOTE: Automatic choke must be entirely off and throttle stop screw against the low step on the fast idle cam.

2. Remove emergency brake rod from bell crank.
3. Disconnect rod "A" (fig. 26) from throttle lever "D".
4. Remove upper rear side cover bolt and rotate

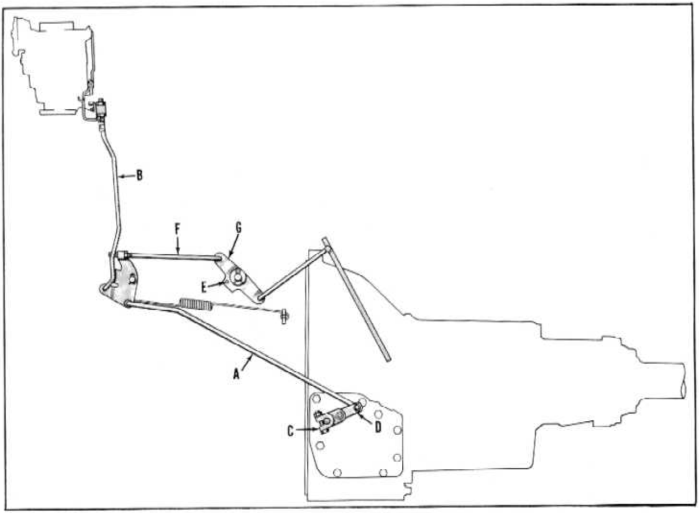

Fig. 26

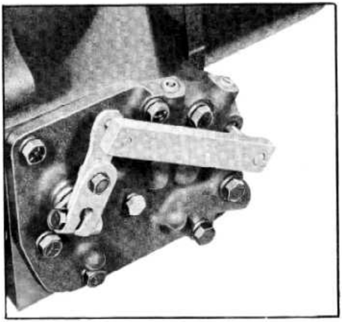

Fig. 27

clamp "C" counterclockwise to the full detent position. Measure the distance between the hole in the side cover and the hole in the throttle lever "D" with throttle valve outer lever positioning gauge J-5588 (fig. 27). If pins of gauge will enter holes, adjustment of lever "D" is correct. If not, loosen lever to clamp attaching bolt and adjust accordingly.

NOTE: When making adjustment, clamp "C" must be rotated counterclockwise to the full detent position.

5. Connect rod "A" to lever "D".
6. Rotate engine bell crank clockwise to set transmission lever "D" at full detent and adjust rod "B" to length required for free entry of the swivel pin into the throttle lever when the throttle lever is held at the wide open (upward position). Secure swivel pin to carburetor lever with clip.
7. Install $\frac{3}{16}''$ diameter gauge pin through bell crank "G" and bracket at "E."
8. With rod "B" against idle step in carburetor, adjust rod "F" for free entry of swivel pin into throttle valve control bell crank. Hold swivel from turning and lock check nut securely.
9. Remove $\frac{3}{16}''$ gauge pin.

Selector Linkage

1. Place selector lever in reverse and check clearance between selector lever and steering rim which should be $1\frac{11}{16}''$. To adjust, loosen lower support clamp bolts and move up or down as necessary. Tighten clamp bolts evenly.

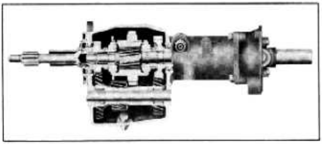

Fig. 28

2. With selector lever in reverse, check clearance between the reverse stop on control shaft lower support and lower lever. This clearance should be .090″.
3. To adjust, loosen transmission control rod swivel, make sure transmission manual lever is raised to top detent position and selector lever is in "R" (Reverse) position. Move selector lever as necessary to obtain .090″ clearance and retighten swivel.
4. On side of the transmission, check proper installation of short connector rod (bell crank to parking lock lever) arrow must point up.

3-SPEED TRANSMISSION

The new 3-speed transmission, (fig. 28) is improved for increased durability, and quieter operation, and has higher load carrying capacity.

All the design and manufacturing improvements incorporated in the mid and late season 1953 transmission have been continued. These changes include various reductions in gear tolerance, the addition of two teeth to inner diameter of the synchronizer ring to reduce the rotational movement and rattle of the synchronizing ring and the reduction of gear lash in the constant mesh gear. In addition, needle bearings for the countergear shaft, previously available only in heavy duty transmission for taxicab use, are now included as regular equipment. Gear hardening, for wear resistance, continues as in 1953 and, in addition, the gears are now shot-peened after hardening for improved resistance to fatigue when handling the greater power output of the new engine.

SECTION 9

POWER STEERING GEAR

LEAD OR WANDER

Complaints of Lead, right or left or Wander on cars equipped with the Power Steering Gear can generally be attributed to improper assembly of the valve body assembly or improper usage of "O" ring seals.

Trouble in the valve body assembly can be easily detected by indicating the end motion of steering shaft with respect to its housing while oscillating pitman arm between right and left turn positions. Measurements in excess of .002″ indicate that valve has excessive free movement in the valve body and can be allowing fluid to pass to power cylinder.

If indicator reading measures in excess of .002″ check valve spool for proper installation and check for proper "O" ring seal usage. Turn valve spool over and recheck. If endplay is still excessive replace valve body assembly.

SECTION 12

ELECTRICAL

ELECTRIC FRONT SEAT ADJUSTER AND FRONT WINDOW LIFTS

A new regulator production option for the 2100 and 2400 Series models consisting of an electric front seat adjuster and electric lifts for the front door windows is available in 1954. This conveni-

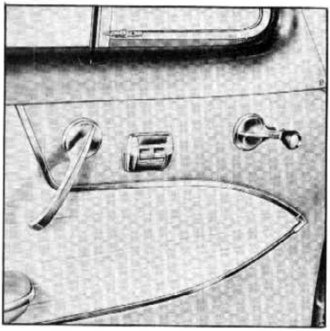

Fig. 29

ence package offers push button adjustment of the front seat and front door windows to any desired position. The window lift controls are located beneath each window with a master control switch (fig. 29) on the driver's door which provides a push button for each of the front door windows. The seat adjuster control (fig. 30) is located at the lower front side of the front seat left end panel and controls fore and aft movement of the seat assembly.

PASSENGER CAR VOLTAGE REGULATOR

All 1954 passenger cars are equipped with voltage regulators of improved design. This engineering change improves the load characteristics of the voltage regulation section of the regulator assembly, by stabilizing the voltage regulation under extremes of load and speed. The new regulator does not use an accelerator or second

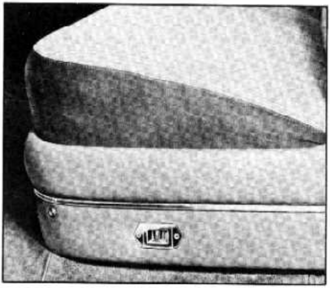

Fig. 30

winding on the voltage regulator unit. The use of the single shunt winding produces the improvement. The new circuit is shown in Figure 31.

This change necessitates a different procedure

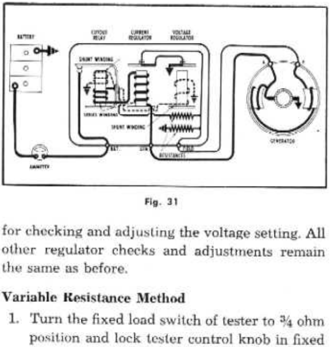

Fig. 31

for checking and adjusting the voltage setting. All other regulator checks and adjustments remain the same as before.

Variable Resistance Method

1. Turn the fixed load switch of tester to ¾ ohm position and lock tester control knob in fixed position.
2. Remove the battery wire from the battery terminal of the regulator and connect the positive lead of the ammeter to the battery

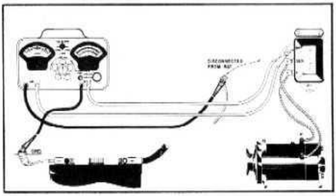

Fig. 32

terminal of the regulator and the negative lead to the battery wire.

3. Connect the positive lead of the voltmeter to the battery terminal of the regulator and the negative lead to a good ground (fig. 32).
4. Turn voltmeter selector switch to eight volt position and check calibration of voltmeter.
5. Start the engine and cycle the regulator by reducing engine speed until cutout relay points are open, then slowly increase speed to 1500 engine RPM.
6. Operate the generator at this speed for at least 15 minutes to bring the regulator up to operating temperature.

   NOTE: When checking voltage regulator setting the regulator cover must be in place.

7. Turn CONTROL KNOB of tester to VARIABLE position and adjust knob for a charging rate of 1 to 10 amperes.
8. Momentarily reduce engine speed until cutout relay opens, then again set engine speed at 1500 RPM. This cycles the regulator.
9. If the charging rate is still within 1 to 10 amperes, the voltmeter reading now indicates the setting of the Voltage Regulator.

   NOTE: If charging rate is not within 1-10 amperes after first cycling, readjust control knob, and recycle regulator before reading voltage regulator setting.

10. To adjust voltage setting, remove regulator cover and turn adjusting screw (fig. 33) clockwise to increase voltage setting or counter-clockwise to decrease voltage setting.

    CAUTION: If adjusting screw is turned down (clockwise) beyond the normal range required for adjustment, the spring support may be bent beyond its elastic limit and fail to return when pressure is relieved. In such a case, turn the screw counterclockwise until sufficient clearance develops between the screw head and the spring support, then bend spring support up carefully with small pliers until contact is made with the screw head. The final setting of the unit should always be approached by increasing the spring tension, never by reducing it. In other words, if the setting is found to be too high, the unit should be adjusted below the required value and then raised to the exact setting by increasing the spring tension.

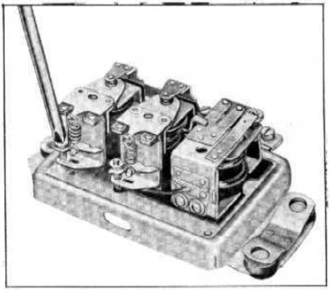

Fig. 33

The new regulator numbers and settings are listed in the following chart:

Regulator Setting

Regulator Number	Voltage Reg. Set.	Preferred	Current Reg. Set	Preferred	Cut Out Relay Set	Preferred
1118827	7.0-7.7	7.4	45-51	47	5.9-6.7	6.4
1118833	6.8-7.4	7.2	53-57	55	5.9-6.7	6.4
1118835	6.8-7.5	7.2	48-52	50	5.9-6.7	6.4
1118831	6.8-7.5	7.2	40-46	42	5.9-6.7	6.4
1118842	7.0-7.7	7.4	53-57	55	5.9-6.7	6.4

AC-DC GENERATING SYSTEM

The AC-DC generating system is designed for vehicles requiring extra heavy electrical loads. It develops maximum output at lower engine speeds than the conventional DC installation, and is supplied in 60 and 80-90 ampere ratings.

The system is made up of an alternator (AC generator), which produces three-phase AC; a rec-

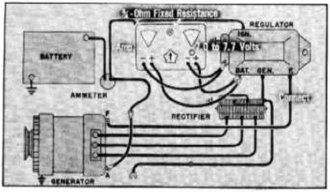

Fig. 34

tifier, which converts AC to DC; and a regulator (fig. 34).

One alternator unit is rated at 60 amperes and the other at 80-90 amperes. The alternator units and rectifier units are identical while the control unit, the regulator, used with the 60 amperes alternator has a current regulator and the regulator used with the 80-90 amperes alternator does not. The current output of the 80-90 amperes alternator is controlled entirely by loads imposed by the electrical system.

The charge of the 60 amperes alternator, 1117063, with regulator 1118359, at normal engine idle speed of 450-500 RPM approximates 35 to 47 amperes and reaches a full charge rate of 60 amperes at 12 MPH. The 80-90 amperes alternator, 1117063, with regulator 1118742, has the same charging rate curve as the 60 ampere alternator up to the point that the 60 ampere alternator is cut off by the current regulator. The maximum rated 80-90 amperes output is reached at 18 MPH.

While direct current generators and AC-DC alternators resemble each other in external appearance, the internal construction is quite different. In the alternator, the field and armature reverse places in respect to the DC generator construction. In the alternator, the field coils are a part of the moving member called a rotor and the heavy wire armature windings are in a circular stationary part called the stator.

Field current is supplied to the coils on the rotor through brushes on slip rings. Alternating current developed in the stator is taken off at three terminals on the field frame for the rectifier. This construction of the alternator eliminates the problem of carrying heavy current loads at the brushes and at the same time enables the rotor to withstand high speeds without damage.

To charge a storage battery it is necessary to use direct current, therefore the output of the alternator, which is alternating current, must be changed. This is accomplished through a separate device called a rectifier, 1913280. The dry plate, magnesium copper sulfide type rectifier, used on Chevrolet alternator installations, is so named because of the rectifying chemical used in its construction. The rectifier allows the alternator current to flow through it in only one direction; as a result, a pulsating direct current charges the battery. This rectifier is a three phase, full wave bridge type rectifier and as a result has a high efficiency and delivers a rectified voltage of a small ripple component of six times the fundamental frequency. The frequency in cycles per second of the alternator is .1 the alternator shaft RPM.

The third component of the Chevrolet alternator-generating system is the regulator. The regulator is a vibrating type adapted to the alternating current system. An extra terminal on the regulator is connected to the coil side of the ignition switch for the purpose of initially exciting the alternator field when the switch is closed to insure prompt build-up. The third component also determines the maximum rating of the system, regulator number 1118359 is used for the system with a maximum rating of 60 amperes and contains a current regulator (fig. 35). Regulator

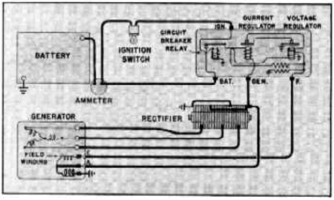

Fig. 35

number 1118742, used on the 80-90 amperes rated alternator, has no current regulator since current requirements are governed by the loads imposed on the electrical system (fig. 36). In addition, no reverse current windings are used in these regulators since the rectifier blocks reverse current to

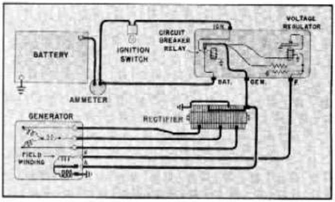

Fig. 36

the extent that no more than 5 amperes will flow through the alternator to ground.

Testing and adjusting the AC-DC generating system should be performed in the following manner:

1. Trouble Shooting.
2. Testing Generator and Rectifier
3. Testing and Adjusting Regulator

This procedure will give a systematic approach in locating trouble cause for correction.

TROUBLE SHOOTING

1. Check generator drive belt for slippage or wear and adjust for proper tension as required.
2. Inspect all wiring for loose connections or broken wires, damaged insulation or improperly connected wiring harness.
3. Inspect battery for cracks, dirt or corrosion.
4. Check battery capacity and specific gravity.

NOTE: The electrical tests that follow all depend on a good battery. If necessary, install a fully-charged battery for testing purposes.

Generating system failures generally fall into two groups.

1. Failures that cause a low charging rate or no charging rate.
2. Failures that cause a high charging rate.

Low or No Charging Rate

1. If the system is producing a low charging rate or produces no charging rate, the trouble could be caused by an improperly adjusted, worn, dirty or defective regulator; by a defective generator or rectifier or by defective connecting wiring.
2. To isolate a low or no charging rate trouble make a continuity check by first connecting a voltmeter (fig. 37).

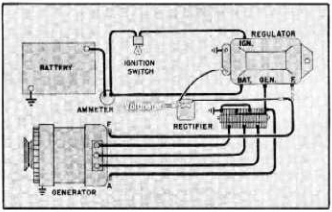

Fig. 37

3. With ignition switch turned on, check reading on voltmeter. A reading of battery voltage indicates that the circuit breaker relay is closing properly and that the field circuit is complete up to the regulator.
4. If the voltmeter reading is well below battery voltage it indicates high resistance in the field circuit and if no reading is obtained it indicates an open or grounded field circuit. To isolate this trouble continue the checks that follow.
5. With voltmeter connected (fig. 38) a reading

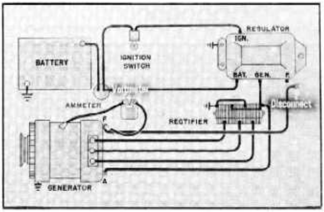

Fig. 38

of battery voltage will indicate a break or ground in the "F" wire between the generator and regulator.

6. With voltmeter connected to "A" terminal of generator (fig. 39) a reading of battery voltage

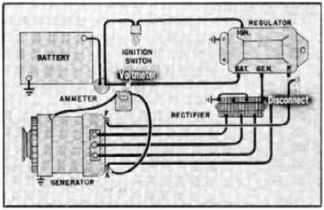

Fig. 39

age will indicate an open or grounded field circuit in the generator.

7. With voltmeter connected (fig. 40) check lead between regulator "GEN" terminal and the generator "A" terminal. A voltmeter reading of battery voltage will indicate a break or ground in this wire.
8. If the above tests do not isolate trouble, connect voltmeter (fig. 41) and again take a read-

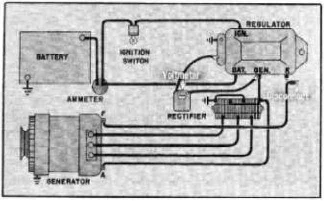

Fig. 40

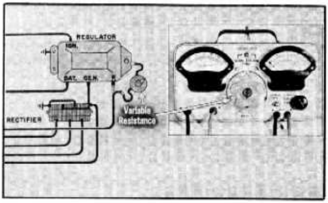

Fig. 42

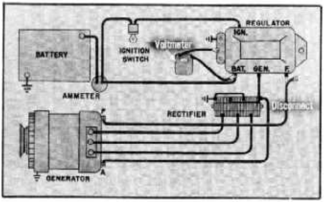

Fig. 41

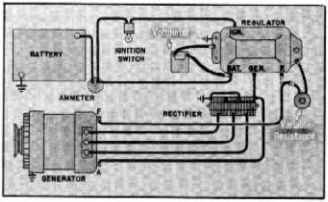

Fig. 43

ing. A reading of battery voltage will now indicate an open circuit or ground in the relay. A low reading indicates a failure in the wiring between the regulator and the battery.

If the above tests indicate the field is complete up to the regulator, a low charging rate could be caused by trouble in the generator, rectifier, or the current or voltage regulator. Test the DC voltage output of the generator and rectifier first as follows:

1. To prevent the voltage regulator from operating without damaging the rectifier with high voltage, ground the "F" wire through a variable resistance using the 7-ohm resistance setting in a volts-amperes tester (fig. 42).

   NOTE: Here we are substituting the variable resistance for the voltage regulator. This resistance prevents the alternator from building up a high voltage output which protects the rectifier which would break down if subjected to too much voltage.

2. Connect a voltmeter in parallel with the battery (fig. 43) and operate the engine at idle.

   Gradually cut out the resistance but DO NOT ALLOW VOLTAGE TO EXCEED 9 VOLTS.

   CAUTION: Do not operate engine above idle because voltage build-up might damage rectifier even with resistance in the field circuit.

3. Check voltmeter reading. If voltage is above battery voltage the alternator and rectifier are operating properly and the charging circuit is good. This indicates that any low charging rate trouble is in the regulator circuit.

   NOTE: As we have already checked the field circuit up to the regulator, the trouble would have to be in either the current or voltage regulator.

4. If the voltmeter reading is battery voltage or less, trouble is indicated in the AC side of the system—either in the generator, rectifier or wiring. Testing the generator and rectifier is covered later.

High Charging Rate

1. If the system is producing a high charging rate the trouble could be caused by either a grounded field circuit or an improperly adjusted or defective regulator.
2. Make continuity test for grounded field circuit as explained under LOW or NO

CHARGING RATE. Then, if field circuit is complete up to the regulator, test and adjust the regulator as explained later.

TESTING GENERATOR AND RECTIFIER

Before testing electrically, inspect the generator while not operating. Look for burned or worn slip rings and sticking or worn brushes. Correct as necessary.

Depending on available equipment, the generator and rectifier may be tested electrically with an alternator tester (fig. 44) or with a standard A-C voltmeter.

Fig. 44

1. Before connecting the alternator tester, turn the voltmeter selector switch to the 30-volt position. Connect the three test leads (fig. 45), start engine and adjust speed for a voltmeter reading of less than 15 volts.

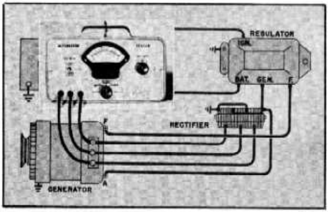

Fig. 45

2. Turn selector switch to the 15-volt position and readjust engine speed to give a voltmeter reading of 9 volts.
3. NO LOAD TEST
Rotate the phase selector switch to each position (fig. 46) and check the A-C voltmeter reading. Variation of more than one volt be-

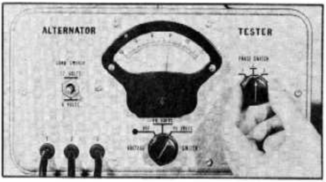

Fig. 46

tween phases indicates faulty stator windings or rectifier.

The No Load Test may also be made with a standard A-C voltmeter. For this purpose, connect the leads across each of the three pairs of terminals and compare the readings. The allowable variation is the same as with the alternator tester—one volt.

4. LOAD TEST
Hold the load selector switch in the 6-volt position (fig. 47) and again check the A-C voltmeter reading for each phase. Variation of more than .3 volts indicates faulty stator winding or rectifier.

NOTE: Since the standard A-C voltmeter has no internal load, this test can only be made with the alternator tester.

5. To test only the generator, disconnect all three A-C leads to the rectifier (fig. 48) and repeat the Load and No Load tests.

NOTE: It is only necessary to make this test when the test of the generator and rectifier together, step 3 and 4 above, indicates a failure.

6. If the generator checks out incorrectly, remove and overhaul the generator. If the generator checks out correctly, any failure in the A-C side of the generating system is in the rectifier or connecting wiring. If necessary, replace the rectifier.

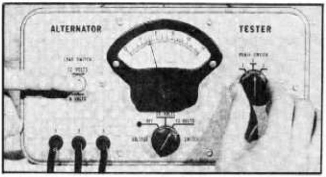

Fig. 47

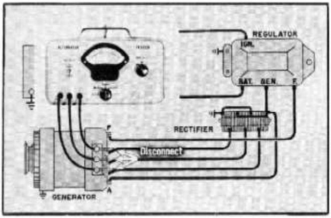

Fig. 48

TESTING AND ADJUSTING REGULATOR

If the above tests indicate trouble in the regulator three electrical tests and adjustments are necessary.

1. Closing Voltage of Circuit Breaker Relay
2. Voltage Regulator Setting
3. Current Regulator Setting (60 ampere unit only)

Before making any of the following tests, run the generator for 15 minutes at 8-10 amperes with the regulator cover on.

Closing Voltage of Circuit Breaker

1. To test the closing voltage of the relay, connect voltmeter, ammeter and variable resistance (fig. 49) Remove regulator cover and with ignition switch on, gradually cut out resistance and read voltage at the instant you see the relay close. This reading should be 3.6 to 4.6 volts.

NOTE: The volts-amperes tester has the ammeter and variable resistance wired in series and by connecting instrument as shown we can control the voltage to the relay coil and adjust to the exact voltage required to close the relay points.

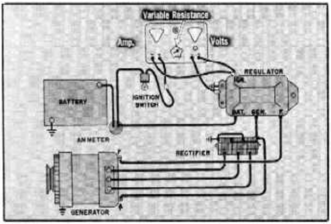

Fig. 49

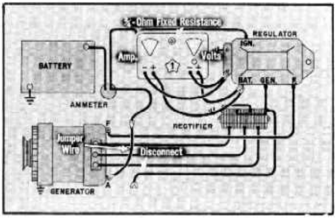

Fig. 50

2. To adjust closing voltage on the circuit breaker relay, turn the adjusting screw clockwise to decrease and counter-clockwise to increase.

Voltage Regulator Setting

1. Connect a volts-amperes tester (fig. 50) and turn fixed load switch to ¾ ohm position and lock tester control knob in fixed position.
2. Disconnect the "A" lead from the generator and disconnect the "BAT" wire from the regulator. Connect "BAT" wire to "A" terminal of generator with a jumper wire.
3. Disconnect "F" wire from regulator before starting engine (fig. 51). Start engine and operate at 1300 RPM. Momentarily touch "F" wire to its terminal. If output exceeds 9 volts, temporarily adjust the voltage regulator down to about 8 volts.
4. Connect "F" wire and run engine for 15 minutes with regulator cover on at 1300 RPM. Cycle regulator by starting and stopping engine. Then check voltage reading which should be 7.0 to 7.7 volts at 1300 RPM (fig. 52). If necessary, adjust the voltage regulator to 7.4 volts preferred.
5. To increase the voltage setting, turn the adjusting screw clockwise, being careful not to

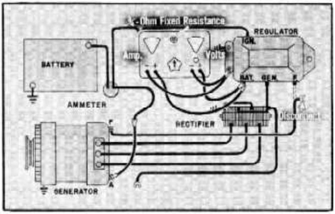

Fig. 51

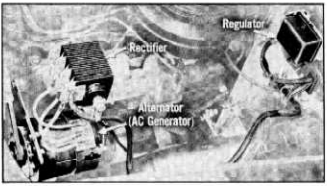

Fig. 52

bend the spring support. When adjusting, always start with a low-voltage setting and gradually increase spring tension until the desired setting is obtained.

6. After each voltage adjustment, replace the cover and cycle the regulator by stopping and starting the engine before taking a voltage reading.

Current Regulator

1. Before testing the current regulator setting, bring the regulator to operating temperature. To prevent the voltage regulator from operating, use a battery capacity tester as a load across the battery terminals.

   CAUTION: DO NOT use jumper wires across voltage-regulator contact points. Resulting high voltage will damage the rectifier.

   The current regulator tests are for the 60 ampere units only. It is not necessary to test the current output of 80-90 ampere units, which have no current regulating units.

2. To test current setting by the load method, operate the engine at 1500 RPM. With an ammeter connected (fig. 53), increase the load across the battery until the ammeter reading

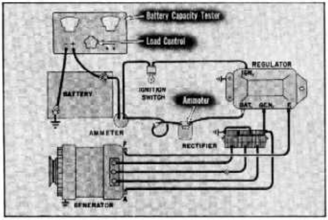

Fig. 53

stops rising, and check current setting. Adjust as necessary.

NOTE: The current reading must be taken from the ammeter that is inserted into the charging circuit—shown on (fig. 53) with a white label. The ammeter that's already in the vehicle, of course, is not calibrated for an accurate reading; and the ammeter in the battery capacity tester is not correctly connected to give a charging circuit reading.

3. Mechanical adjustments on the regulator are similar to those on a conventional unit. If necessary, clean the points and adjust to the following specifications:

	Air Gap	*Point Opening*
Circuit Breaker Relay	.013″	.027″
Voltage Regulator	.075″	
Current Regulator	.075″	

4. After adjustment, replace the regulator cover and gasket carefully. The gasket protects the regulator from possible damage by moisture, dust or oil vapors.

ALTERNATOR GENERATOR

Maintenance

At regular intervals the alternator should be disassembled for a thorough cleaning and inspection. This operation should be based on a time interval or mileage accumulation depending on the type of operation.

Kerosene or oleum spirits is suitable as a cleaner for all parts having insulation or insulating varnish or paint. The slip ring end and drive end bearing should be carefully inspected and replaced if worn. If generator is equipped with sealed bearings no additional lubrication is required. If generator is equipped with non-sealed bearings, repack with Delco-Remy Cam and Ball Bearing lubricant.

Inspect slip rings and true in a lathe if out of round or if the surface is not clean and smooth.

Disassembly

1. Remove castle nut, washer, fan belt pulley and woodruff key.
2. Remove four through bolts from slots in slip ring end frame.
3. Remove spacer and remove front end frame.
4. Remove spacer from rotor shaft.
5. Remove rear bearing cap and gasket from slip ring end frame.
6. Remove lock nut and washer retaining rotor shaft in slip ring end frame.

7. Remove rotor assembly from stator and slip ring end frame.
8. Remove rear bearing from rotor shaft.

NOTE: Take care to prevent damaging insulation between slip-rings when removing bearing.

9. Pull stator assembly from slip ring end frame.

Assembly

1. Place stator in position in slip ring end frame.

NOTE: Make sure stator is centered in end frame.

2. Install rear bearing to rotor shaft, then install rotor into stator and slip ring end frame. Carefully lift brushes over slip rings when installing rotor.
3. Install washer and lock nut to rotor shaft at slip ring end frame.
4. Install rear gasket and bearing retainer to slip ring end frame.
5. Install spacer (larger 1.0 diameter) to rotor shaft.
6. Carefully align front end frame on stator and install through bolts.

NOTE: Tighten through bolts in a diagonally opposite sequence to insure proper alignment. This will insure clearance of the rotor in the stator.

7. Install front spacer, woodruff key, pulley and lock nut to rotor shaft.

FRONT BEARING

Removal

1. Remove four nuts and screws from oil seal and bearing retainer.
2. Remove retainer, oil seal, gasket and ball bearing assembly.

Assembly

1. Install bearing to end frame with sealed side of bearing facing front of the frame.
2. Install gasket, oil seal and bolts.
3. Install retainer and tighten screws in retainer.
4. Install nuts to screws at bearing retainer.

GENERATOR—1954 PASSENGER

Current production 1500, 2100 and 2400 series vehicles are equipped with a low cut-in generator.

This generator will use the same pulley as previous production, 2.87 P.D. The regulators used with this generator must be set to 40 amperes.

Armature Commutator Bar to Bar Test on Growler

The 3½ turn armature used in the generator is actually an alternate-wound armature having alternate 3 and 4 turn windings in adjacent slots.

Alternate-wound armatures show a regular pattern of variation in readings when tested bar-to-bar on a growler. The pattern consists of two low readings, two high readings and so on around the commutator.

For example, a set of typical readings on a certain growler might be 42-42-45-45-42-42-45-45 etc. A damaged winding will cause a wide deviation from regular pattern which can be easily detected.

The regular variation in readings on the alternate-wound armature is normal for this design and does not indicate a defect.

Commutator bars on alternate-wound armatures tend to blacken unevenly after short usage. This condition is caused by small differences in voltage between unequal windings. It does not affect performance and does not indicate a defect. The condition will be noted only on new or newly cleaned commutators. After longer usage the bars will become uniformly dark in the normal manner.

The early production 1954 generator, rated at 45 amperes, was Part No. 1100018 and used regulator No. 1118827. The low-cut in generator, rated at 40 amperes, is Part No. 1100028 and uses regulator No. 1118843.

Generator Improvement—Metropolitan Winter Driving

The heavy electrical requirements of winter metropolitan driving may necessitate a service change on either the early or late 1954 model generators. The addition of a new service pulley, 2.55 P.D., and/or a 4 turn armature will increase the output at the low speeds encountered in metropolitan driving.

Part No. 5846798 pulley and Part No. 1921351 armature may be used for this purpose. With this armature, the regulator must be set to 37 amperes.

CAUTION: It is not advisable to install this armature or pulley in any units which will be driven for long periods at sustained high speeds.

The lowest vehicle speed for maximum output on the early production No. 1100018 generator is approximately 34.5 MPH. The addition of the 2.55" pulley changes this to approximately 30.5 MPH. On the late production generator, No. 1100028, the change is from 32 MPH to 28.5 MPH. The addition of the 4 turn armature will cause a similar decrease in maximum output speed. However, the 4 turn armature necessitates a regulator setting of 37 amperes which may offset the advantage of the lowered maximum output speed under some driving conditions.

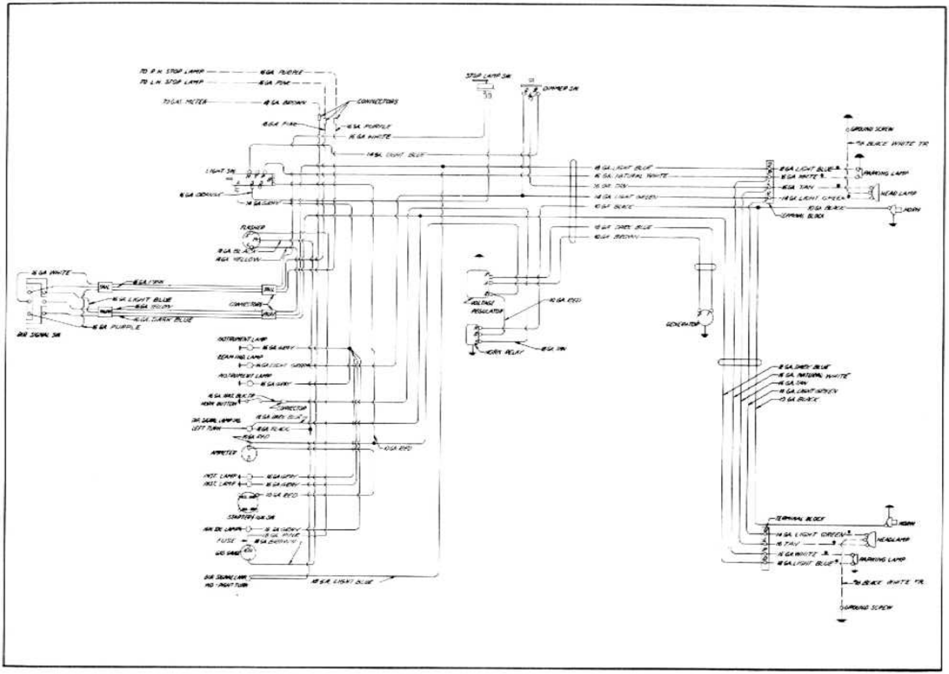

Fig. 54—1954 Passenger Wiring Diagram

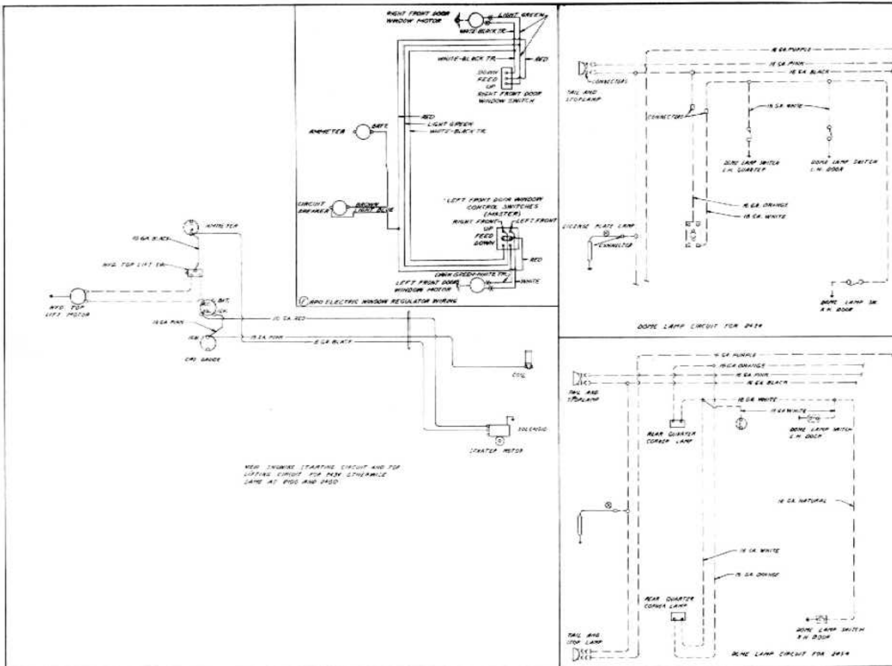

Fig. 55—1954 Passenger Wiring Diagram