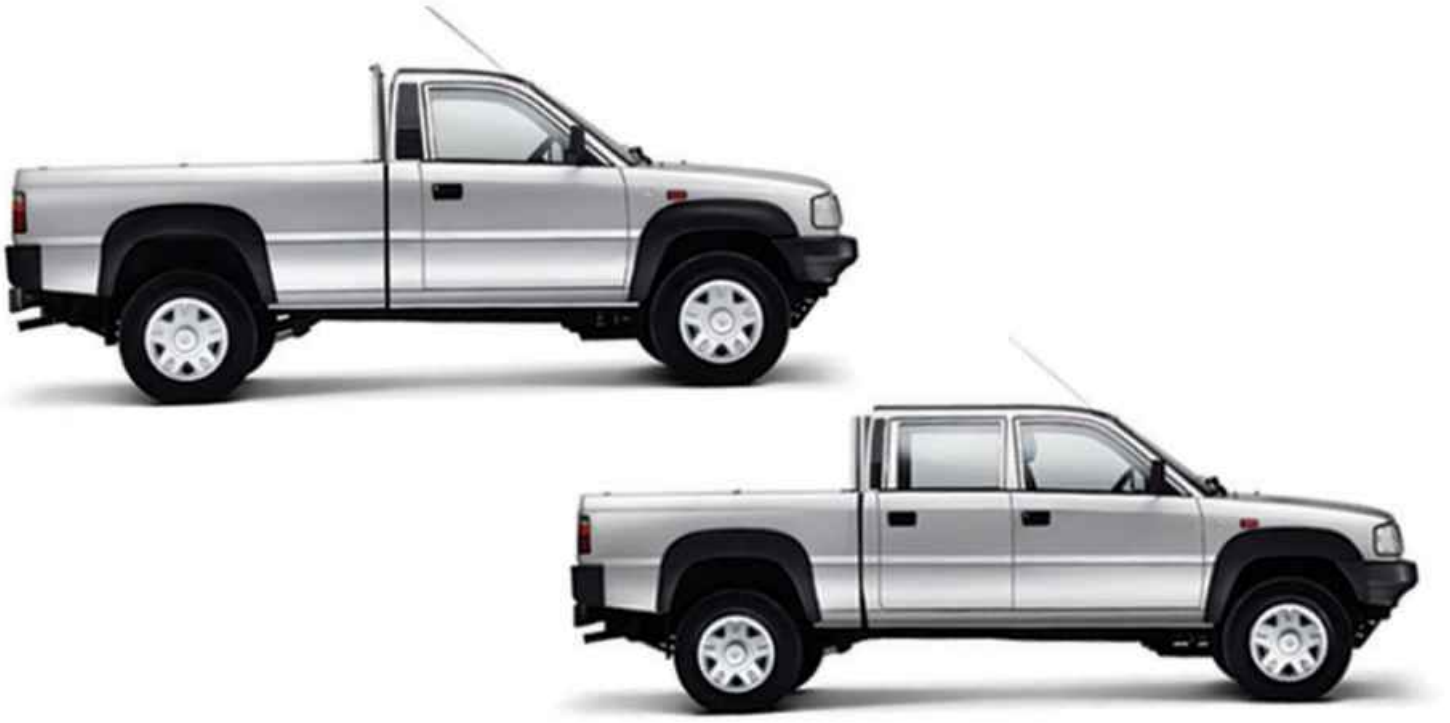
Group Index

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TATA TL



Workshop Manual

TATA MOTORS

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All specifications are given in C.G.S. System (Metric System) unless otherwise specified.

Created by :
Tata Motors Ltd.
CVBU - International Business Unit
Mumbai

Reproduction or translation of the whole or part of the workshop manual without our written approval is prohibited.

Subject to modification in Design, Specification and Equipment.

MAIN INTRODUCTION





This manual brings to you the technical know-how on maintenance & repairs of TATA Telcoline model. This manual is applicable for :

- LHD/RHD versions
- Single cab / Crew cab versions
- Euro II / Euro III versions
- 4x2 & 4x4 versions

Assuming that the workman is fully conversant with general automobile repair practices, repair procedures outlined in this manual emphasize special aspects of the product.

This manual is divided into 20 groups.

Information on technical specifications, tightening torque, special tools, disassembly/inspection/ assembly procedures with the help of special tools & trouble shooting procedure etc. wherever needed have been furnished in all groups.

Procedure for repair of proprietary aggregates as given by respective manufacturers also have been included to make this manual comprehensive.

Appropriate symbols have been provided at top corner of each page.

A section has been included at the end to give details of important product modifications introduced on facelift version.

All data contained in this manual is based on the latest product information available at the time of publication.

The contents are not binding on us, are subject to change without notice and are for illustrative purpose only.

For any further technical advice or clarifications please get in touch with :

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MAIN INTRODUCTION

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TRANSFER CASE
ACCELERATOR
SUSPENSION
FRONT AXLE 4X2
FRONT LIVE AXLE 4X4
REAR AXLE
WHEELS & TYRE
PROPELLER SHAFT
BRAKES
POWER STEERING
FUEL SYSTEM
EXHAUST SYSTEM
RADIATOR
ELECTRICALS
CAB/LOAD BODY
AIR CONDITIONING
PRODUCT IMPROVEMENTS

GENERAL

INTRODUCTION

This manual provides information on chassis and aggregate numbering system, location of aggregate numbers, broad technical specifications and filling capacities.

It also provides information on fuel, coolant and lubricants specified, tightening torque values and service schedule chart.

Lubrication and maintenance work needs to be carried out as given in service schedule chart.

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GOOD WORKSHOP PRACTICES & SAFETY PRECAUTIONS

Following are some safety precautions to be observed in the workshop.

- Always ensure that all the repair / maintenance work carried out should be as per the instructions provided in the workshop manual.
- Use protective clothing, apron, hand gloves, and safety shoes while working in the workshop. Do not wear watch, rings and belt while serving the vehicle.
- Keep your work area, equipment and tools clean at all times.
- Make sure you use the proper tool for the job and use it the rightway. The improper tool or its incorrect use can damage the part you are working on or cause injury or both.
- Never keep the tools on the floor/vehicle. The tools should be kept in the tool box after use.
- Cover fenders, seats, steering wheel and any other parts those are likely to get scratched/soiled before starting any service work (Fig. 1).
- While servicing the vehicle in engine running condition make sure that the gear shifting lever is in neutral position and parking brake is fully applied. Never run the engine without proper ventilation and adequate means of getting rid of exhaust gases.
- Prior to removing or disassembling parts, they must be inspected carefully to isolate the cause for which the service is called for (Fig. 2).
- All the reusable dismantled components must be kept in a clean enamel coated white tray sequentially in an orderly manner to facilitate their accurate and proper reinstallation (Fig. 3).
- Never reuse the parts like oil seals, gaskets, packing, O-rings, locking washers, split pins, self locking nuts and certain other parts.
- Plug the ports / openings of aggregates such as FIP / Injectors, Turbocharger, Intercooler, Radiator, Fuel high pressure lines, Air/vaccum/oil pipes, TMC, etc., whenever removed from vehicle.

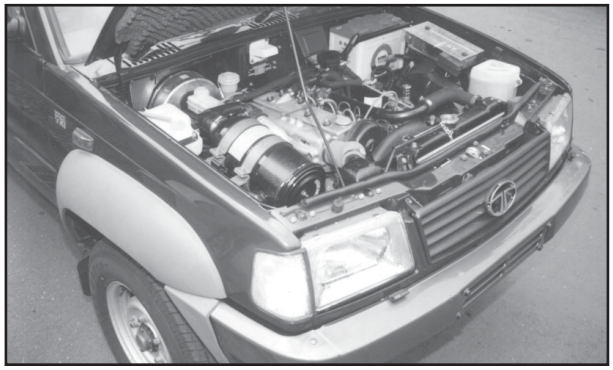


Fig. 1

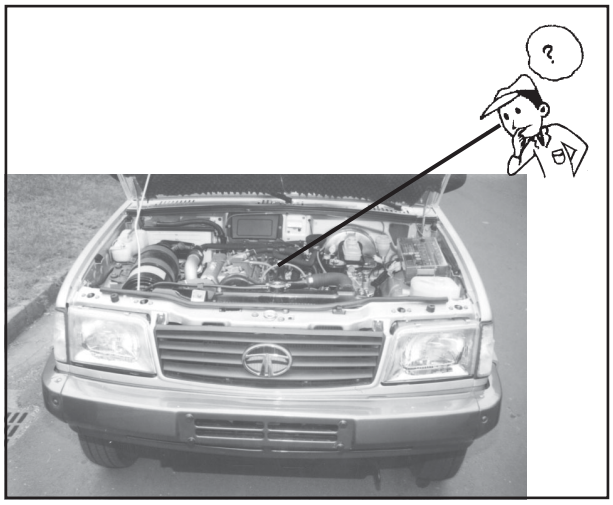


Fig. 2

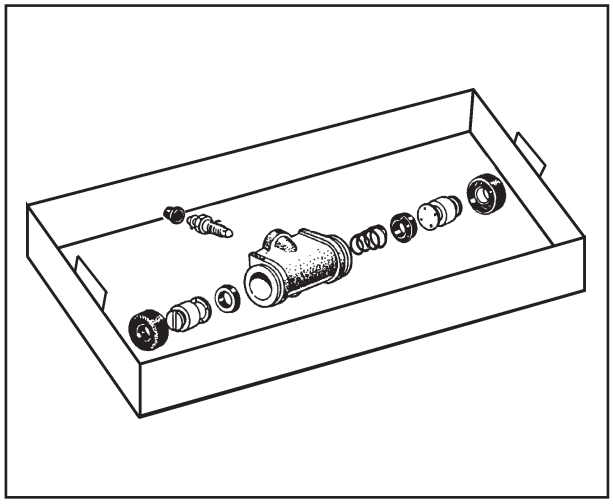


Fig. 3

- For correct reinstallation of EGR system hoses attach a tag describing the correct positions Fig. 4.
- Make sure only the branded lubricants, coolant, corrosion protection coatings and sealants are used.

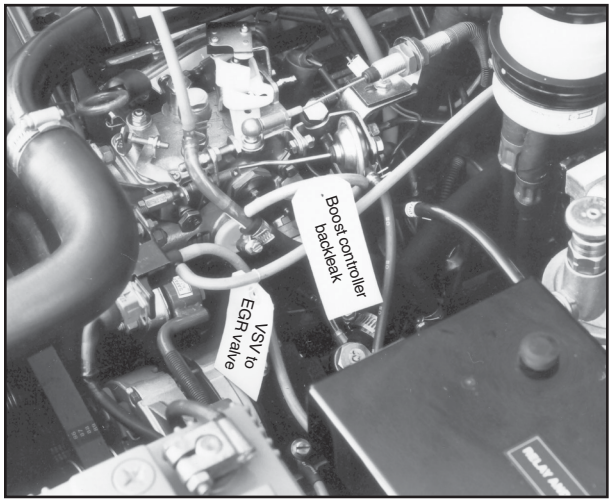
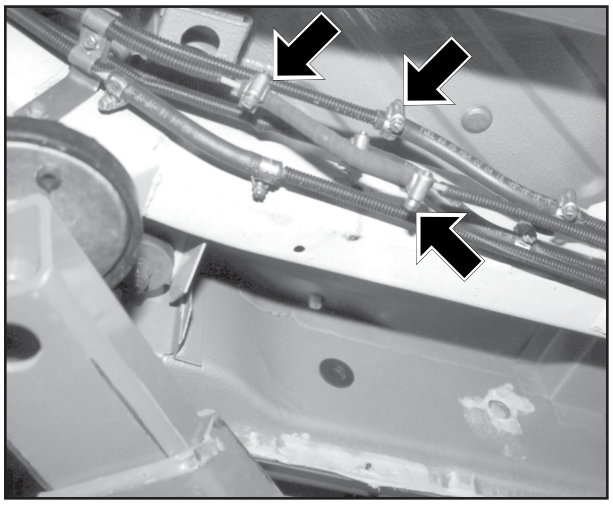


Fig. 4

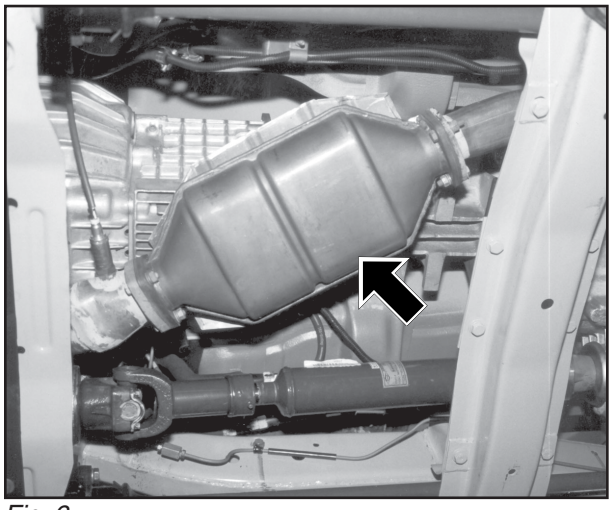
- Check all the lines for leaks related to the systems like fuel, oil, coolant, vacuum, exhaust and brakes after servicing Fig. 5.
- Do not disconnect the fuel line between the injector and the fuel pump without releasing the fuel pressure or fuel can be sprayed out under pressure.


Fig. 5

Precaution for Catalytic Converter Fig. 6.

Caution : If large amount of unburnt fuel goes into the converter, it may overheat and creat a fire hazard. To prevent this, observe the following precautions.

- Use only Low sulphur (<0.25%) Diesel.
- Engine compression checks should be carried out within the shortest possible time.
- Do not run the engine when the fuel tank is nearly empty to avoid engine misfire and damage to catalytic converter.


Fig. 6

Precaution for Electrical circuit service :

- Disconnect the negative cable of the battery while servicing the electrical parts that do not require battery power Fig. 7.
- While removing the battery first disconnect the negative cable and then the positive cable. While reinstalling the battery, first connect the positive cable and then negative cable.

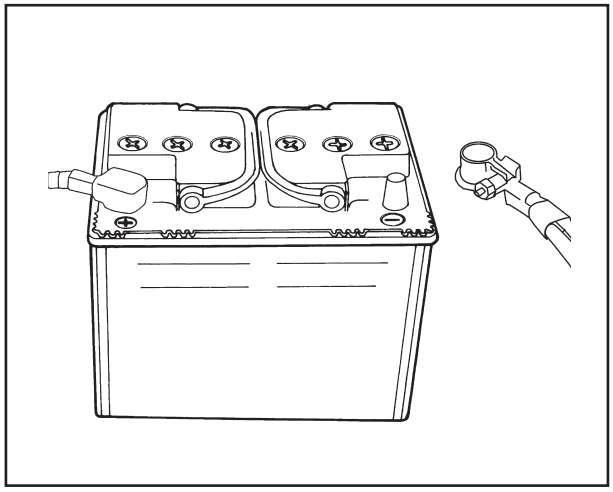


Fig. 7

- Be sure to turn the ignition switch off before disconnecting and connecting coupler to avoid electronic parts damage Fig. 8.
- Do not touch the electrical terminals of parts which use microcomputers (e.g. electronic control units like ECM etc.) to avoid damage to these parts from static electricity from your body Fig. 8.
- Always use the correct voltmeter, ohmmeter for taking measurement to avoid damage to the electronic control unit and sensors.
- Make sure to insert the probe from wire harness side of the connector for taking measurement.

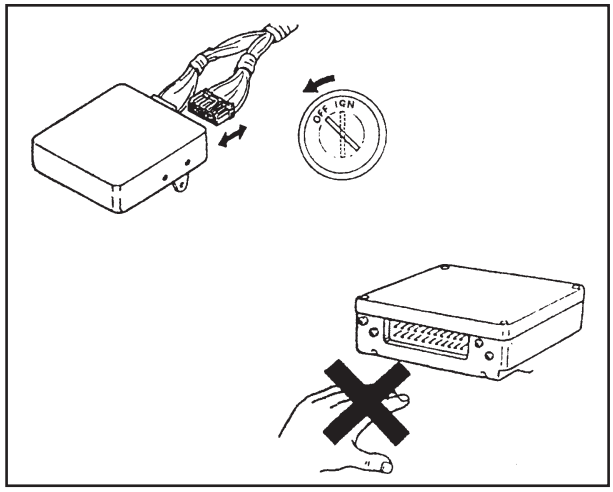


Fig. 8

- Make sure the connector halves are mating properly and terminals seating precisely in the connector body Fig. 9.

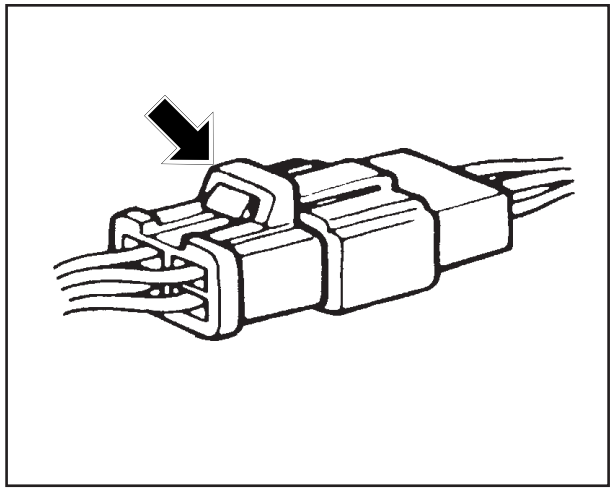


Fig. 9

1. CHASSIS TYPE DESIGNATION

TELCOLINE EURO - II

Chassis Type No.	Sales Designation Export	Description
374 021	207/28 Telcoline	Normal Control Chassis with Cab & Load Body, Pick-up Version, 483 DL TCIC Euro-II Engine with A.C. + Heating & Demisting, 2825mm W.B.
374 023	207/28 - 4x4 Telcoline-Tdi-4x4	Normal Control Chassis with Cab & Load Body, 4x4 Pick-up Version with 483 DL TCIC Euro-II Engine with Heating & Demisting, 2825mm W.B.
374 024	207/28 Telcoline -Tdi	Normal Control Chassis with Cab & Load Body, Pick-up Version with 483 DL TCIC Euro-II Engine with Heating & Demisting, 2825mm W.B.
374 026	207/31 Telcoline -Tdi	Normal Control Chassis with Cab & without Load Body with 483 DL TCIC Euro-II Engine with Heating & Demisting, 3150mm W.B.
374 027	207/28 Telcoline-Tdi-4x4	Normal Control Chassis with Cab & Load Body, 4x4 Pick-up Version with 483 DL TCIC Euro-II Engine with A.C. + Heating & Demisting, 2825mm W.B.
374 030	207/28 Telcoline-Tdi-4x4	Normal Control Chassis with Cab & without Load Body 4x4 Pick-up Version with 483 DL TCIC Euro-II Engine with A.C. + Heating & Demisting, 2825mm W.B.
374 054	207/31 Telcoline Crew Cab-Tdi	Normal Control Chassis with Crew Cab & Load Body, Pick-up Version, 483DL TCIC Euro-II Engine, A.C. + Heating & Demisting, 3150mm W.B.
374 057	207/31 Telcoline Crew Cab-Tdi 4x4	Normal Control Chassis with Crew Cab - 4 x 4 & Load Body, Pick-up Version, 483DL TCIC Euro-II Engine, A.C. + Heating & Demisting, 3150mm W.B.
374 067	207/31 Telcoline Crew cab	Normal Control Chassis with Crew Cab & Load Body, Pick-up Version, 483DL TCIC Euro-II Engine with Heating & Demisting, 3150mm W.B.
374 068	207/31 Telcoline Crew cab-Tdi-4x4	Normal Control Chassis with Crew Cab & Load Body, 4x4 Pick-up Version, 483DL TCIC Euro-II Engine with Heating & Demisting, 3150mm W.B.

TELCOLINE EURO - II

Chassis Type No.	Sales Designation Export	Description
374 084	207/31 Telcoline-Tdi-4x4	Normal Control Chassis with Cab - 4x4, Without Load Body, 483 DL TCIC Euro-II Engine with A.C. + Heating & Demisting, 3150mm W.B.
374 151	207/28 Telcoline-P	Normal Control Chassis with Cab & Load Body, Pick-up Version with 486 PL Euro-II Engine with Heating & Demisting, 2825mm W.B.
374 185	207/31 Telcoline Crew Cab-P	Normal Control Chassis with Crew Cab & Load Body, Pick-up Version with 486 PL Euro-II Engine with AC, Heating & Demisting, 3150mm W.B.
374 186	207/31 Telcoline Crew Cab-P 4x4	Normal Control Chassis with Crew Cab 4x4 & Load Body, Pick-up Version with 486 PL Euro-II Engine with AC, Heating & Demisting, 3150mm W.B.
374 250	207/28 Telcoline-P 4x4	Normal Control Chassis with Cab & Load Body 4x4 Pick-up Version with 483 PL Euro-II Engine with A.C. + Heating & Demisting, 2825mm W.B.

1. CHASSIS TYPE DESIGNATION

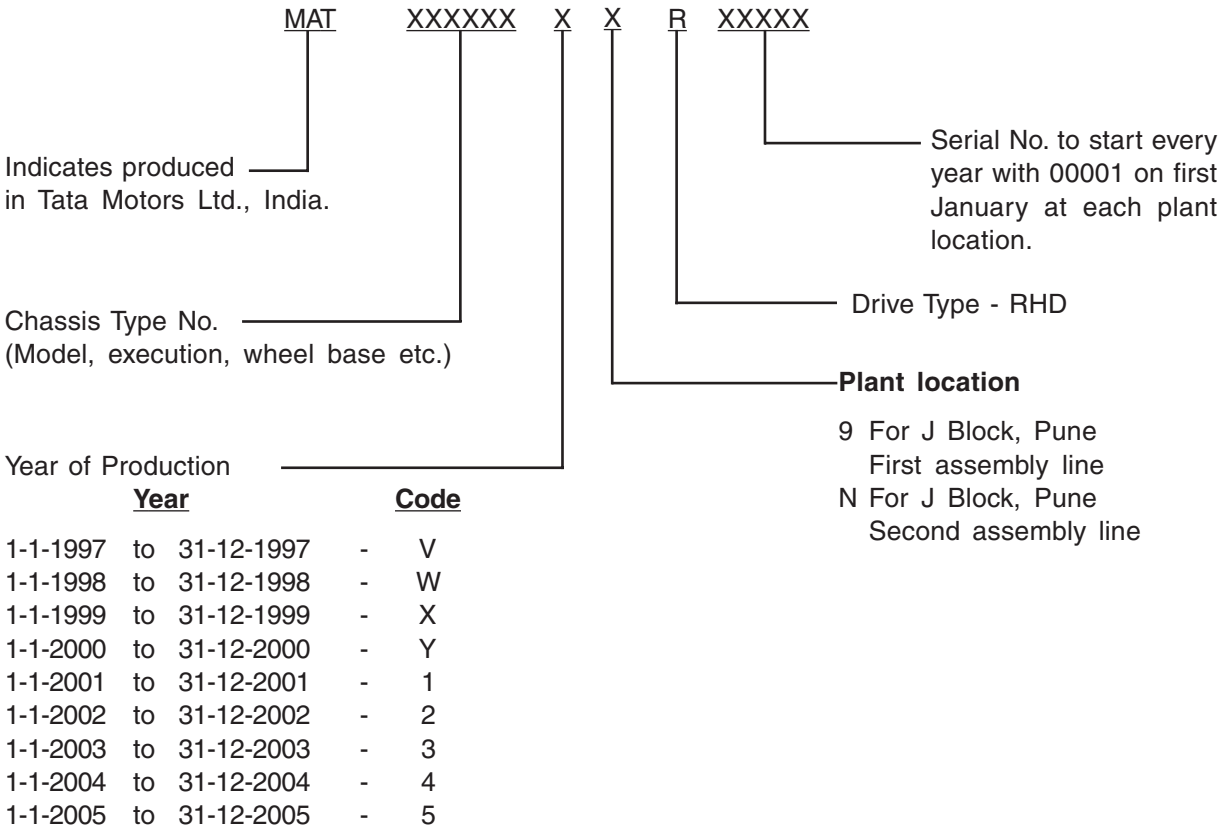
TELCOLINE EURO - III

Chassis Type No.	Sales Designation Export	Description
374 501	Telcoline Tdi	Normal control chassis with cab & load body, pick-up version, 483DL TCIC Euro-III Engine, Heating & Demisting 2825 mm W.B.
374 502	Telcoline Tdi	Normal control chassis with cab & without load body pick-up version, 483DL TCIC Euro-III Engine, Heating & Demisting, 3150mm W.B.
374 504	Telcoline Tdi	Normal control chassis with cab & load body, pick-up version, 483DL TCIC Euro-III Engine, A.C. + Heating & Demisting, 2825mm W.B.
374 531	Telcoline Tdi-4x4	Normal control chassis with cab & load body - 4x4, pick-up version, 483DL TCIC Euro-III Engine, Heating & Demisting, 2825mm W.B.
374 534	Telcoline Tdi-4x4	Normal control chassis with cab & with load body - 4x4, pick-up version, 483DL TCIC Euro-III Engine, A.C. + Heating & Demisting, 2825mm W.B.
374 551	Telcoline Crew cab Tdi	Normal control chassis with crew cab & load body, pick-up version, 483DL TCIC Euro-III Engine, Heating & Demisting, 3150mm W.B.
374 552	Telcoline Crew cab Tdi	Normal control chassis with crew cab & load body, pick-up version, 483DL TCIC Euro-III Engine, A.C. + Heating & Demisting, 3150mm W.B.
374 581	Telcoline Crew cab Tdi-4x4	Normal control chassis with crew cab, & load body - 4x4 pick-up version, 483DL TCIC Euro-III Engine, Heating & Demisting, 3150mm W.B.
374 582	Telcoline Crew cab Tdi-4x4	Normal control chassis with crew cab, & load body - 4x4, pick-up version, 483DL TCIC Euro-III Engine, A.C. + Heating & Demisting, 3150mm W.B.

2. CHASSIS NUMBERING SYSTEM

2A. EXPORT VEHICLES (RHD) :

Chassis number is punched at the front on LH long member in a single line without any gap. Chassis number consists of 17 digits as given below :

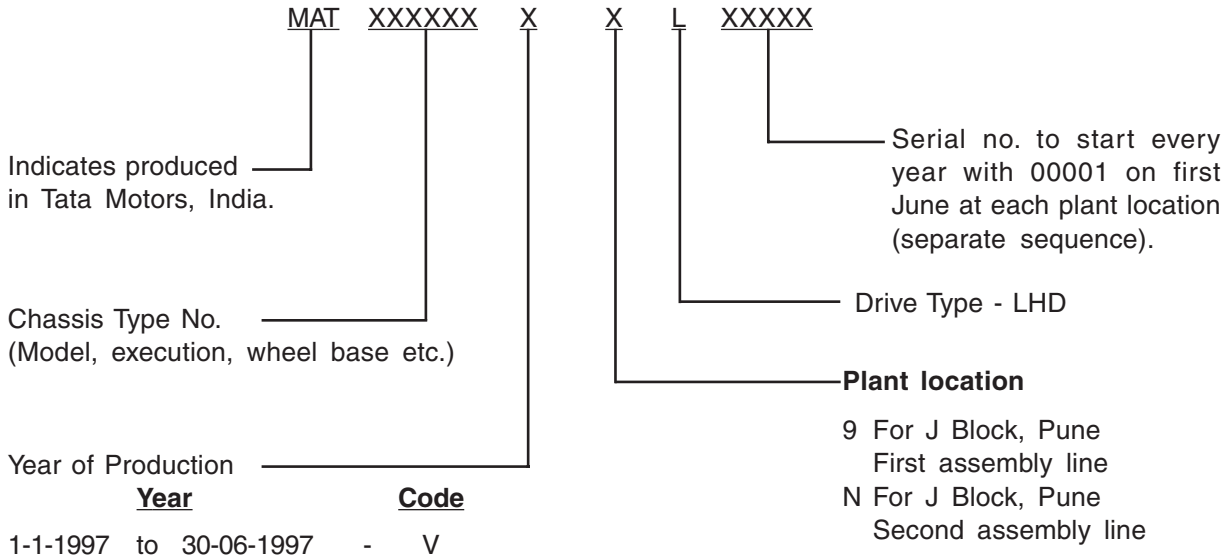


Year				Code
1-1-1997	to	31-12-1997	-	V
1-1-1998	to	31-12-1998	-	W
1-1-1999	to	31-12-1999	-	X
1-1-2000	to	31-12-2000	-	Y
1-1-2001	to	31-12-2001	-	1
1-1-2002	to	31-12-2002	-	2
1-1-2003	to	31-12-2003	-	3
1-1-2004	to	31-12-2004	-	4
1-1-2005	to	31-12-2005	-	5

Example : MAT374052V9R25340 indicates Telcoline crew cab normal control chassis with crew cab and load body, pickup version with 483 DL TCIC engine, heating & demisting 3150 mm W.B. produced between 1st January 1997 & 31st December 1997, in 'J' Block, Pune, Right hand drive vehicle for export and the serial number of vehicle is 25340.

2B. EXPORT VEHICLES (LHD) :

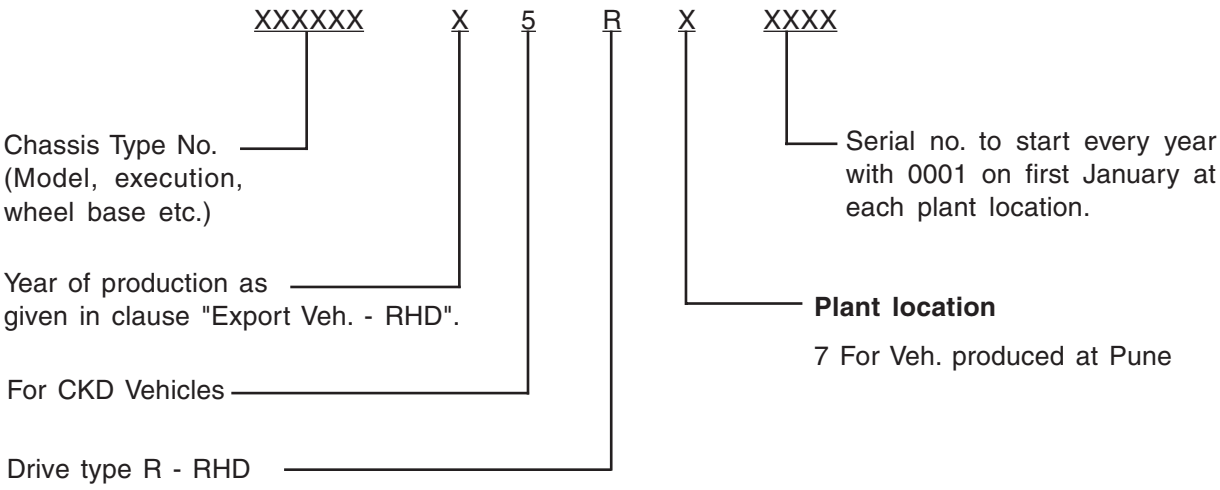
Chassis number is punched at the front on RH long member in a single line without any gap. Chassis number consists of 17 digits as given below :



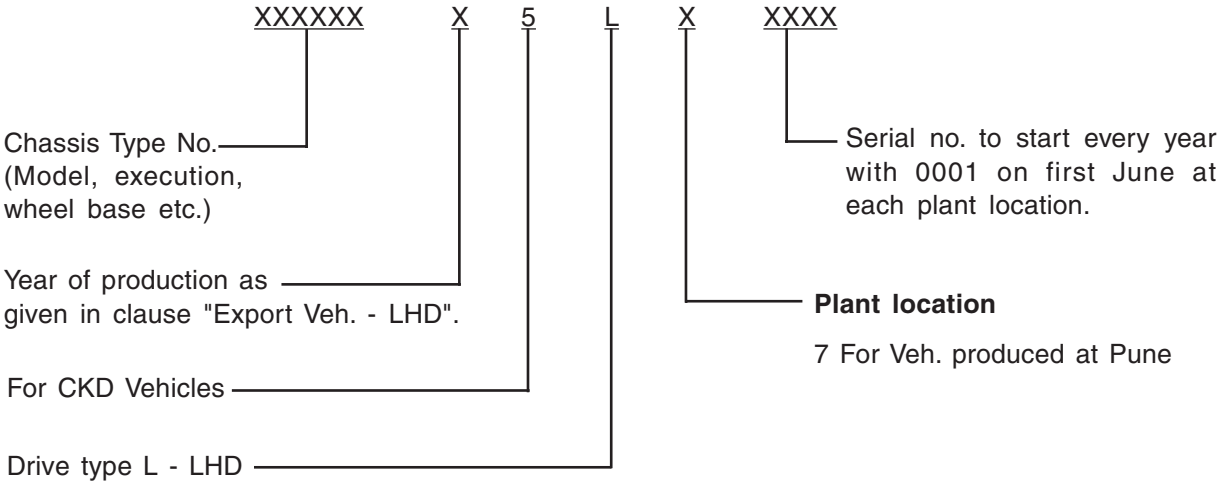
Year				Code
1-1-1997	to	30-06-1997	-	V
1-7-1997	to	30-06-1998	-	W
1-7-1998	to	30-06-1999	-	X
1-7-1999	to	30-06-2000	-	Y
1-7-2000	to	31-05-2001	-	1
1-6-2001	to	31-05-2002	-	2
1-6-2002	to	31-05-2003	-	3
1-6-2003	to	31-05-2004	-	4
1-6-2004	to	31-05-2005	-	5

Example : MAT374052W9L00750 indicates Tata Telcoline crew cab normal control chassis with crew cab and load body, pick-up version with 483 DL TCIC engine, heating & demisting 3150 mm, W.B. produced between 1st July, 1997 and 30th June, 1998 in 'J' Block, Pune, Left hand drive vehicle for export and the serial number of vehicle is 00750.

2C. CKD VEHICLES (RHD) :



2D. CKD VEHICLES (LHD) :



3. AGGREGATE NUMBERING SYSTEM AND LOCATION OF SERIAL NUMBER

3A. FRAME

1 The frame no. is punched on RH long member at rear end.

2 'L' is to be punched for LHD execution after 1st two barrels eg. B002L TQ 5 81650.

Frame is numbered in five barrels as below :

Example :	X	XXX	XX	X	XXXXX
	1	2	3	4	5

Barrel 1 : Basic model
T - 207 family

Barrel 2 : Variation in basic model and wheel base :

004 - 2825 mm W.B., Pickup, 4PL
005 - 2825 mm W.B., Pickup
006 - 2825 mm W.B., Pickup with crew cab
007 - 2825 mm W.B., Passenger version with crew cab
013 - 2825 mm W.B., Pick-up 4x4 version
050 - 3150 mm W.B., Pick-up version with Crew cab
051 - 3150 mm W.B., Tata Mobile pick-up version
063 - 3150 mm W.B., Pick-up with Crew cab, 4x4 version

Barrel 3 : Year of Production

SQ - 1997
RQ - 1998
QQ - 1999
ZZ - 2000
YZ - 2001
XZ - 2002
WZ - 2003
VZ - 2004
UZ - 2005

Barrel 4 : Plant Location

8 Pune - 'J' Block

Barrel 5 : Cumulative Serial No. of frame commencing from 00001 on 1st January, every year.

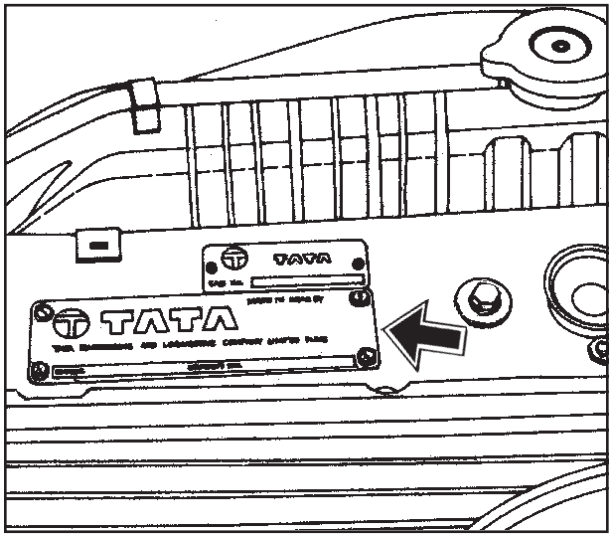


Fig. 1 - Location of chassis number plate on cab

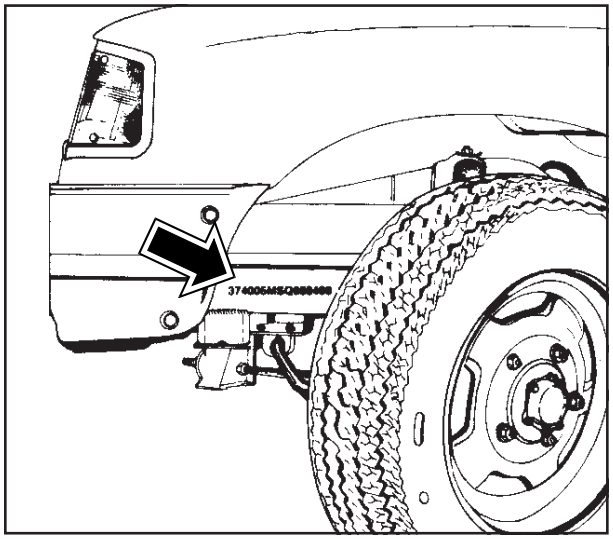


Fig. 2 - Chassis number plate on long member

3B. ENGINE

Engine is numbered in seven barrels each as below :

Example :

XXXXXXX	XX	X	X	XX	X	XXXXX
1	2	3	4	5	6	7

Barrel 1 : Indicates engine model ex. 483 DLTC

Barrel 2 : Indicates variation in basic model of engine ex.

55 - 483DL turbocharged, Inercooled diesel engine, 64kW @4300rpm, linered, meeting Euro-III emission norms with catalytic convertor & Exhaust Gas Recirculation (EGR)

Barrel 3 : Indicates 'L' for LHD application only.

Barrel 4 : Indicates month of Production :

Month	Code	Month	Code
January	A	July	G
February	B	August	H
March	C	Sept.	J
April	D	Oct.	K
May	E	Nov.	L
June	F	Dec.	M

Barrel 5 : Indicates Year of Production (Same as mentioned above for 'Frame'.

Barrel 6 : Indicates Plant Location
7 & 8 for 'D' block, Pune

Barrel 7 : Sr. No. starting from 00001 on 1st Jan. every year.

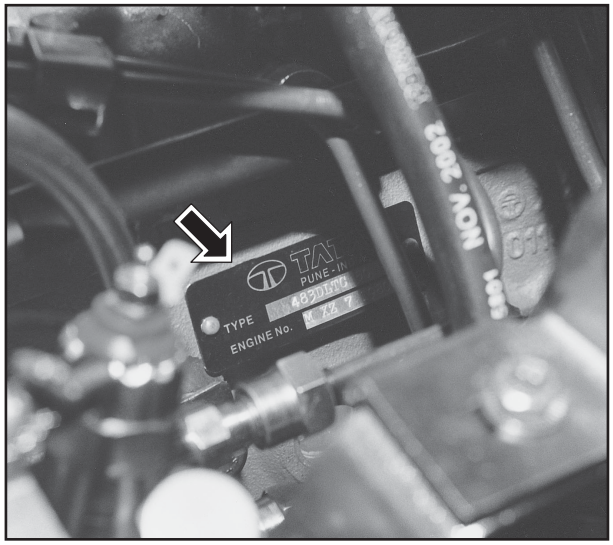


Fig. 3 - Location of engine number plate

3C. GEAR BOX

Gear box is numbered in five barrels each as below :

Example :	XXXX	XXX	XX	X	XXXXX
	1	2	3	4	5

Barrel 1 : Indicates the basic model numbered as follows :

2684 - G-76 Gearbox
2684 D - G-76 Gearbox with dual synchro cones

Barrel 2 : **First digit indicates types of gear arrangement and shift**

7 - For synchromesh - semi-remote
8 - For synchromesh - full-remote

Second digit Indicates vehicle type

1 - For normal control vehicle

Third digit indicates 1st gear ratio for G-76 gear box

0 - For first gear ratio 3.87 (std.)
1 - For first gear ratio 3.87 with modified 2nd gear ratio 2.36
2 - For first gear ratio 4.1

Barrel 3 : Indicates Year of Production (As explained in Frame Numbering System.)

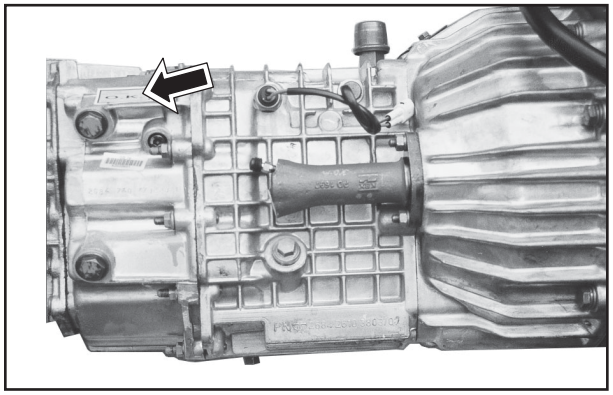


Fig. 4 - Gear box number location

Barrel 4 : Indicates Plant Location

Plant Location	Plant Code
'D' block, Pune	5 and 6

6 is to be used if serial no. reaches upto 99,999 under plant code 5 in the same year.

Barrel 5 : Indicates Cumulative Serial No. as per frame.

Note : *Gear box for LHD vehicle will have an additional letter 'L' punched after first two barrels.*

3D. TRANSFER CASE

Identification tag is attached to the transfer case at location shown in figure. Manufacturing details are stamped on tag. This information is necessary for ordering replacement spare parts.

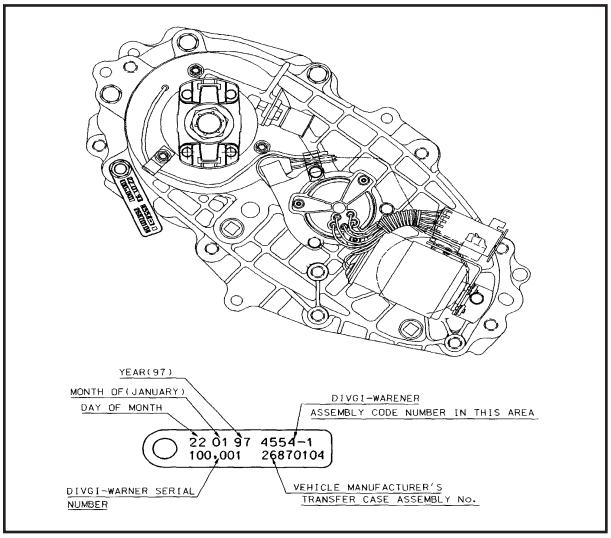


Fig. 5 - Transfer Case number location

3E. REAR AXLE (TATA MOTORS)

Rear axle is numbered in five barrels as below :

Example : XXX (1) XX(X) (2) XX (3) X (4) XXXXX (5)

Barrel 1 : Indicates the basic model numbered as follows :

371 - For 207 family vehicles

Barrel 2 : Indicates variation in basic model :

01 - For RAS 101 single tyre, salisbury type for pick-up with leaf spring suspension.

Barrel 4 : Indicates Plant Location

Plant Location	Plant Code
'D' Block	5
'H-4' Block	6
'H-6' Block	8

Barrel 3 & 5 : (As explained in Frame Numbering System.)

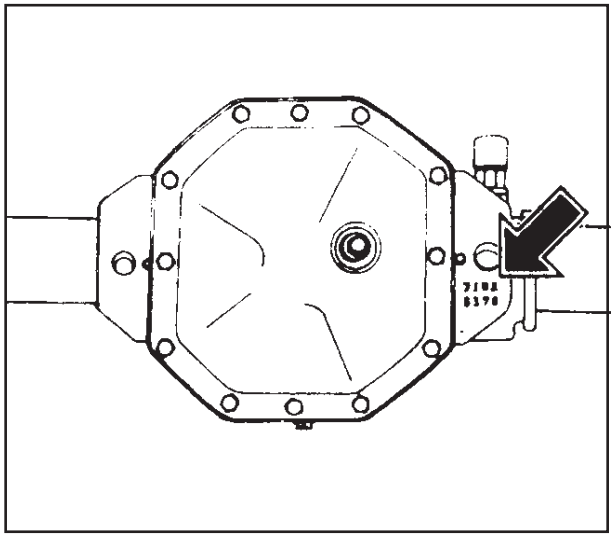


Fig. 6 - Number location on rear axle (Tata Motors)

3F. REAR AXLE (DANA SPICER)

Rear axle is numbered in three barrels as below :

Example : X (1) XXX (2) XXX (3)

Barrel 1 : Indicates the year of manufacture.

6 - Manufacturing year 1996

Barrel 2 : Represents the day of manufacturing year.

215 - 215th day of 1996

Barrel 3 : Represents the serial number of axle produced on the day.

034 - 34th axle produced on 215th day of 1996

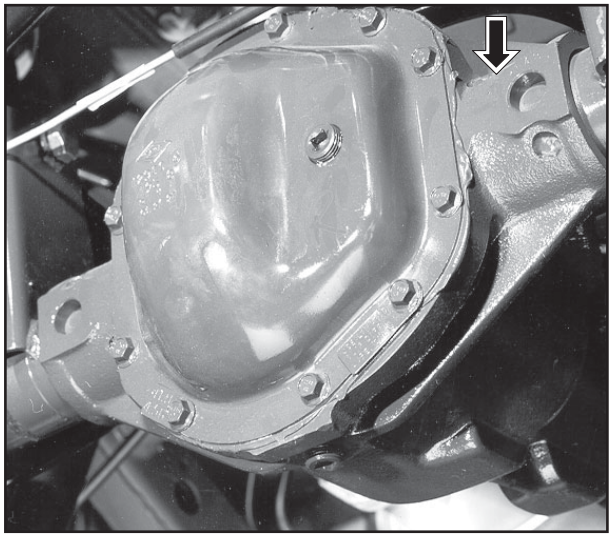


Fig. 7 - Dana Rear axle number location

3G. FRONT LIVE AXLE (DANA SPICER) :

Front live axle is numbered in three barrels as below :

Example : X (1) XXX (2) XXX (3)

Barrel 1 : Indicates the year of manufacture.

6 - Manufacturing year 1996

Barrel 2 : Represents the day of manufacturing year.

215 - 215th day of 1996

Barrel 3 : Represents the serial number of axle produced on the day.

034 - 34th axle produced on 215th day of 1996

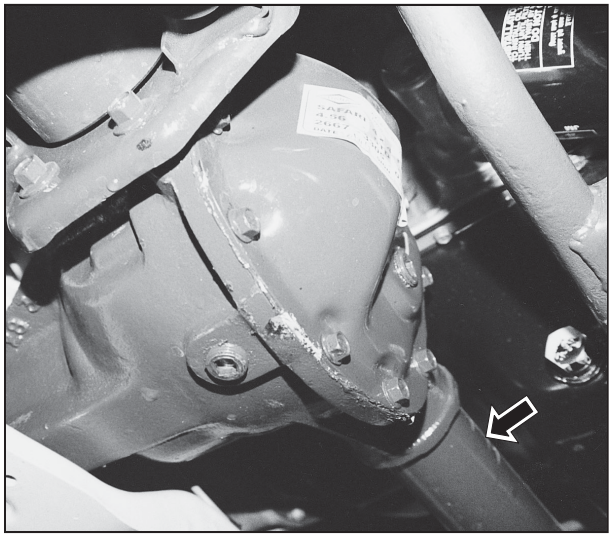


Fig. 8 - Live Front axle number location

3H. POWER STEERING GEAR BOX : (RANE)

Example : 1XX9999

1 - Stands for the type of gear and in this case the Type 54 gear

X - First X stands for year of manufacture. 1990 - A, 91 - B, 92 - C, 93 - D, 94 - E, 95 - F, 96 - G, 97 - H, 98 - J, 99 - K, 2000 - L, 01 - M, 02 - N, 03 - P, 04 - Q, 05 - R, 06- S, 07 - T, 08 - U, 09 - V

X - Second X stands for Month of manufacture - Jan - A, Feb - B, Mar - C, Apr - D, May - E, June - F, July - G, Aug - H, Sep - J, Oct - K, Nov - L, Dec - M.

9999 - Stands of the serial number of the gear during the financial year.

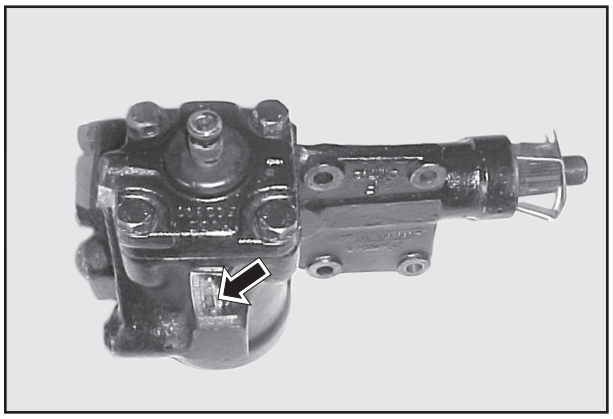


Fig. 9 - Number location on steering gear box (Rane)

3I. POWER STEERING GEAR BOX : (ZF)

It is numbered in five barrels as per example given below :

Example :	M033	955	805	1000	01/03
	1	2	3	4	5

Barrel 1 : Indicates the vehicle model

Telcoline / Multi Utility Vehicle

Barrel 2 : Indicates type of steering gear assembly.

Barrel 3 : Indicates design serial number of steering gear assembly.
805 for Telcoline facelift RHD
802 for Telcoline facelift LHD

Barrel 4 : Indicates gear box serial number produced in the year.

Barrel 3 : Indicates month & year of production.
01 - January
03 - Year 2003

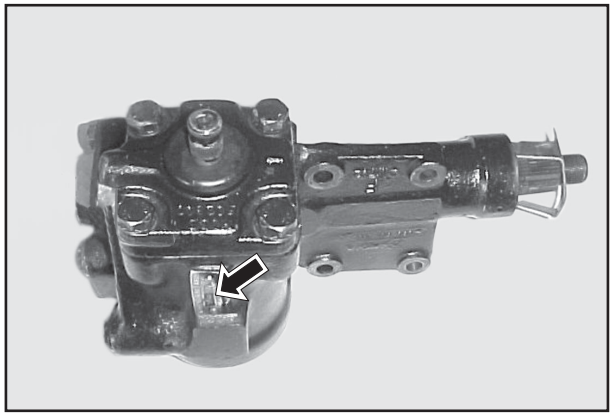


Fig. 9 - Number location on steering gear box (ZF)

3J. CABIN

Drivers cab is numbered in five barrels as below :

Example :	X(X)	XXX	XX	X	XXXXX
	1	2	3	4	5

Barrel 1 : Indicates the basic model of cab

NC - Crew cab, normal control
P - Tata mobile normal control

Barrel 2 : Indicates vehicle model of Cab

371 - For Telcoline model

Barrel 3 : 4 & 5 (As explained in Frame Numbering System.)

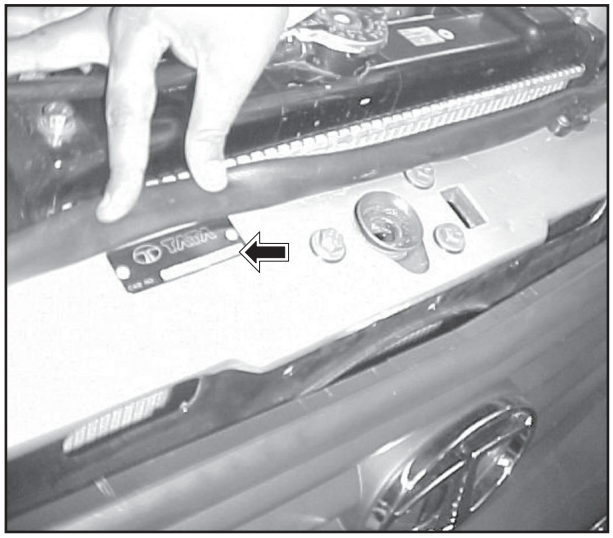


Fig. 11 - Number plate location on body

3K. CROWN WHEEL AND TAIL PINION SET (Tata Motors)

Crown wheel and Tail pinion set is numbered in five barrels each as below :

Example : XX (1) XXXXX(X) (2) XX (3) X (4) XXXXX (5)

Barrel 1 : Indicates type and form of gear teeth of crown wheel and tail pinion set

- RS - For Oerlikon type Spiral gear
- RH - For Oerlikon type Hypoid gear
- GS - For Gleason type Spiral gear
- GH - For Gleason type Hypoid gear

Barrel 2 : Indicates exact mounting distance in mm. of the pinion from the centreline of the crown wheel as found after lapping and to be maintained during assembly.

Barrel 3, 4 & 5 : (As explained in Frame Numbering System.)

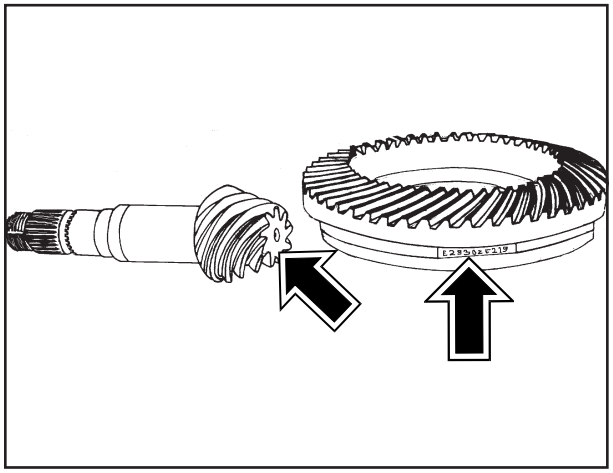


Fig. 8 - Number location on crown wheel and tail pinion set

TECHNICAL SPECIFICATIONS :

ENGINE

Model	:	TATA 483DL TC
Type	:	Water Cooled Indirect Injection Turbo Charged Intercooled Diesel Engine with Crank Case Breather & Oil Separator
No. Of Cylinders	:	4 Inline
Bore / Stroke	:	83 mm x 90 mm
Capacity	:	1948 cc
Max. Engine Output	:	64 kw (90 ps) at 4300 rpm
Max. Torque	:	190 Nm (19 kgm) at 2000-3000 rpm
Compression Ratio	:	21 : 1
Firing Order	:	1 - 3 - 4 - 2
Air Filter	:	Dry (Paper) Type
Oil Filter	:	Spin-on Full Flow Paper Type
Fuel Filter	:	Two Stage, Fine Filtration
Fuel Injection Pump	:	Rotary Type with Electric Stop Solenoid
Governor	:	Mechanical
Engine Oil Capacity	:	Max. 7.7 litres / Min. 5.7 litres
Weight Of Engine	:	220 kg (Dry)
Radiator Frontal Area	:	2340 sq. cm
Exhaust System	:	Exhaust gas recirculation (Euro III), catalytic convertor (Euro II & III)

CLUTCH

	:	Single Plate Dry Friction Diaphragm Type
Outside diameter of clutch lining.	:	228 mm
Friction Area	:	463 sq.cm (Approx.)

GEAR BOX

Model	:	G 76 - 5/3.87 with Overdrive (Inline shifting)
No. of gears	:	5 Forward 1 Reverse, Synchromesh on all gears
Gear Ratios	:	1st - 3.87 2nd - 2.22 3rd - 1.37 4th - 1.00 5th - 0.82 Rev - 3.42

TRANSFER CASE (For 4x4 version only)

	:	With Electrical Shift Arrangement Mounted on Gear Box with Electronic Controller Unit.
Drive Options	:	4x2 - Ratio 1:1 4x4 High - Ratio 1:1 4x4 Low - Ratio 1:2.48

REAR AXLE

4 x 2 (Non Facelift)	:	Single Reduction, Salisbury Type Rear Axle with Hypoid Gears, Semi-Floating Axle Shafts.
4 x 4 (Non Facelift)	:	As above but with limited Slip differential.
4x2 & 4x4 (Facelift)	:	Limited slip differential fitment 100%
Ratio	:	4.88 (44/9)

FRONT AXLE (For 4x2 version)

	:	Independently suspended.

FRONT AXLE (For 4x4 version)

		Independently Suspended with Automatic Hub Locks.
Ratio	:	4.88 (44/9)

POWER STEERING

Type	:	Hydraulic Power Assistance
Ratio	:	18.2 : 1 (RANE), 18.9 : 1 (ZF)
Steering Wheel	:	380 mm dia, 4 spoke
Steering column	:	Provided with tilt mechanism for height adjustment.

BRAKES

Service Brakes	:	Vacuum assisted independent hydraulic brakes on front and rear wheels through tandem master cylinder. Vacuum pump mounted on alternator
Front Brakes	:	271 dia Disc brake
Rear Brakes	:	282 dia Drum brake

Parking Brakes Mechanical	:	Cable operated linkages acting on rear wheels
LCRV	:	Provided for rear brakes

FRAME

	:	Ladder type cranked frame with boxed section long members & Welded Cross Members.
Depth	:	110 mm (max.)
Width	:	60 mm
Tow Hooks	:	At Front & Rear.

SUSPENSION

Front	:	Double Wishbone Type with Torsion Bar
Rear	:	Parabolic Leaf Springs
Shock Absorber	:	Hydraulic Double Acting Telescopic Type at Front and Rear
Antiroll Bar	:	At Front and rear

WHEELS AND TYRES

Tyres	:	205/80 R 16 (Tubeless radial) Rib pattern on 4x2 Block pattern on 4x4
Wheel Rims	:	5.5 J x 16 Steel Rims
Wheel Caps	:	Standard
No. of Wheels	:	Front-2 Rear-2 Spare-1

FUEL TANK

	:	Made out of steel sheets
Capacity	:	60 litres (Single Cab) 50 liters (Dual Cab)

CAB

Type		:	Normal Control All Steel Shell
Seats		:	With foam laminated fabric
Front Seat	Option I	:	Bucket Seats with front to rear adjustment, backrest adjustment, adjustable head rest & seat belts
	Option II	:	Bench seat with front to rear adjustment, seat belts & head rests (adjustable)
Rear Seat (for Dual Cab)		:	Non adjustable bench seat with seat belts, lap belt for middle occupant & with neck rests
Windshield		:	Laminated & Tinted with Darker built in Green Tint Band at Top
Door window glass		:	Tinted - AC with heating/ demisting Plain - Heating/demisting
Ventilation	Option I	:	Air Conditioning with Heating / Demisting
	Option II	:	Heating / Demisting
Mirrors		:	LH/RH Side External Rear View Mirrors adjustable from inside & Inner Antiglare Rear View Mirror
Rear glass		:	Plain fixed glass with electrical demisting.
Other Features		:	1. Soft Feel Dashboard / console 2. Moulded Roof Linings 3. Central Locking 4. Cab Guard on Load Body 5. Provision for fixing canopy on load body 6. Moulded Carpets 7. Sun Visors with Plastic Moulded Stem 8. Vanity mirror on sun visor (Co-driver side) 9. Magazine Pockets 10. Ash Tray & Cigarette Lighter

ELECTRICAL SYSTEM

System Voltage	:	12 Volts (-ve earth)
Alternator Capacity	:	65 Amps for heating/demisting 75 Amps for AC with heating/demisting
Battery	:	12 V, MF 70Z (75 Ah, 20 Hr rating)

Wind Screen Wiper & Washer	:	2 Speed with Intermittent Wiping, Spoiler on Driver Side Wiper blade, 2.5 lit. Windscreen Washer Water Reservoir
Steering Lock cum Ignition Switch	:	Standard Fitment
Instruments	:	a) Speedometer (km/hr) and Odometer (km) & Trip meter (km) b) Fuel Gauge with Low Fuel Indicator c) Water Temperature Gauge d) Engine RPM meter
Indicator Lamps	:	For Battery Charging, Low Oil Pressure, Rear fog lamp, Hand Brake + Brake Fluid Level, Direction Indicator, Main Beam, Glow Plug Timer & Hazard Warning. 4x4 High and 4x4 low indication. (for 4x4 version only), trailer attachment (optional)
Combi Switch	:	With Self Cancelling Turn Signals and Hazard Warning Switch
Tail Lamp	:	Four Function Tail Lamp & Separate Reflex Reflector at Rear.
Head Lamp	:	Semi-Sealed European Beam Asymmetrical Pattern with Halogen bulb. Built-in front Parking Light
Other Electrical Fitments	:	1. Rear Fog Lamp 2. Blinkers on Side Bonnet 3. Roof Lamp (2 nos. for dual cab) 4. Provision for Radio/Cassette Player/Speakers 5. Trip meter 6. Reading lamp 7. Chime unit / buzzer 8. Door Reflex Reflector Stickers 9. Rear Number Plate Lamps 10. Head lamp levelling device 11. Rear glass heating/ demisting 12. Provision for digital clock fitment
Optional fitments	:	1. Speedometer with miles/hr Primary & km/hr Secondary Scale & Odometer in miles 2. Immobilizer (anti theft device) 3. Provision for trailer attachment indication on dash board 4. Over speed warning device

PERFORMANCE

Parameter	4x2	4x4
Max. speed at rated GVW	123 kmph (76 mph)	123 kmph (76 mph)
Max gradeability at rated GVW	33%	72% (4x4 low)

SPECIFICATIONS OF HEATING, VENTILATION & AC SYSTEM :

PARAMETER	VALUE
COOLING CAPACITY	3080 ±310 kcal/hr at 280 ±28 m^3/hr
AIR FLOW AMOUNT	400 m^3/hr
RATED VOLTAGE	13.5 V
ELECTRIC CONSUMPTION	376 W
BLOWER MOTOR	216 ±21w
MAGNETIC CLUTCH	40 W
COND. FAN MOTOR	120 W
EVAPORATOR	311 x 185 x 85 mm
CONDENSER (SERPENTINE)	330 x 490 x 22 mm
COMPRESSOR TYPE	10 P13 (133.6 CC/rev.)
REFRIGERANT TYPE grams	R 134a QUANTITY - 670 ± 20
LUBRICATING OIL	DENSOIL - ND8 Quantity - 80 ± 20 c.c.

CHASIS DIMENSIONS / WEIGHTS / LOAD BODY DIMENSIONS

MAIN CHASSIS DIMENSIONS AS PER ISO:612 in mm (Nominal) (TOLERANCES AS PER INTER EUROPE STVZO)	4x2			4x4		
	Single Cab		Dual Cab	Single Cab		Dual Cab
	Withload body	Without load body	With load body	Withload body	Without load body	With load body
Wheel Base	2825	3150	3150	2825	2825	3150
Track front	1511	1511	1511	1511	1511	1511
Track Rear	1461	1461	1461	1461	1461	1461
Overall Length	4585	4955	4910	4585	4630	4910
Max. Width	1810	1810	1810	1810	1810	1810
Front Overhang	810	810	810	810	810	810
Rear Overhang	950	995	950	950	995	950
Overall height Unladen	1755	1755	1755	1755	1755	1755
Overall height Laden	1720	1720	1720	1720	1720	1720
Min. turning cicle dia	12600	15000	15000	12600	12600	15000
Min. turning circle clearance circle dia	13500	16100	16100	13500	13500	16100
Ground clearance (Laden)	200	200	200	200	200	200

WEIGHTS (kg) (TOLERANCE AS PER INTEREUROPE STVZO)	4x2			4x4		
	Single Cab		Dual Cab	Single Cab		Dual Cab
	Withload body	Without load body	With load body	Withload body	Without load body	With load body
Gross vehicle weight	2950	2950	2950	2950	2950	2950
Max. permissible FAW	1120	1120	1120	1250	1250	1250
Max. permissible RAW	1850	1850	1850	1750	1750	1750
Complete vehicle kerb weight as per ISO:1176 (with spare wheel & tools)	1640	1520	1700	1780	1630	1920
Gross combination weight with trailer	4950	4950	4950	4950	4950	4950
Max. Mass of Unbraked trailer	750	750	750	750	750	750

LOAD BODY DIMENSIONS	4x2		4x4	
	Single Cab	Dual Cab	Single Cab	Dual Cab
Type	Pick up type with all steel, Non-integral load body. 90 degree Hinged (wire ropes). Rear tail gate with latch and handle at centre. Provision for fixing canopy.			
Wheel Base (mm)	2825	3150	2825	3150
Net Inside loading space in metres (length x widhth x height)	1.88 x 1.41 x 0.4	1.5 x 1.41 x 0.4	1.88 x 1.41 x 0.4	1.5 x 1.41 x 0.4

FUEL, LUBRICANTS & COOLANT :

Fuel

High speed diesel conforming to IS 1460 or DIN 51601 or equivalent is recommended to be used as fuel.

At very low temperatures fluidity of diesel may become insufficient due to paraffin separation. It is therefore, necessary to mix supplementary fuel with summer or winter grade diesel. Supplementary fuel to be used is kerosene or aviation turbine fuel.

Ratios for mixing of supplementary fuel and diesel are shown in tables given below :

Ambient temperature upto ^{0}C	Percentage	
	Summer grade diesel	Supplementary fuel
Upto 0	100	0
0 to - 10	70	30
-10 to -15	50	50

Ambient temperature upto ^{0}C	Percentage	
	Winter grade diesel	Supplementary fuel
Upto -15	100	0
-15 to -20	70	30
-20 and Below	50	50

Care should be taken that diesel and supplementary fuel are thoroughly mixed before filling.

Recommended fuel specification for Euro II & Euro III engines :

Sl. No.	Parameter	Unit	Emission Norms	
			EURO III	EURO II
1.	Cetane number (Min)	CN	51	48
2.	Sulphur content	mg/kg	350	500
3.	Lubricity (HFRR)	microns	460	460

Lubricants

Recommended lubricants conform to the following specifications :

Engine oil

Use engine oil conforming to API CF4 + or equivalent specifications as given below :

Ambient temperature ^{0}C	Engine oil grade
-10 and Above	SAE 15W40
-20 to 0	SAE 10W30
-10 and Below	SAE 5W20

Rear axle oil and live front axle oil (DANA Spicer)

Use multigrade oil conforming to SAE 85W140 API GL5 specifications.

* Friction modifier 40819 (2-5%) to be added to oil for rear axle with limited slip differential.

Rear axle oil (Tata Motors)

Use multigrade oil conforming to SAE 85W140 grade and API GL5 specifications with 6.3% by weight A-99 additives.

Gear box oil

Use synthetic oil conforming to SAE 75W90 API GL4 specifications. If synthetic oil is not available SAE 80W90 API GL4 with 7% anglamol additives also can be used but with lesser drain period.

Transfer case oil

Use multigrade oil conforming to ATF to General Motors, Type A, Suffix A specifications.

Power Steering oil

Use power steering oil conforming to DEXRON-II D specifications OR multigrade oil conforming to ATF to GM Type A, Suffix A specifications.

Chassis & Wheel Bearing Grease (Spicer Axle)

Use SS 6805 bearing grease.

CV Joints for Front live axle (Spicer)

Use grease M-2001 (Lithium complex grease no. 2 of Castrol)

Brake and clutch fluid

Use brake & clutch fluid conforming to SAE J 1703, DOT 4.

Spicer propeller shaft (where applicable)

Lubricate slip joint with NLGI-2 grade grease

Please use only recommended grade of oils for trouble free performance.

Oil change periods recommended in maintenance schedule should be adhered to.

Use of reclaimed oil is not recommended.

Coolant

Use coolant as per class II, JIS K2234 with soft water as per ratio specified below.

Ambient Temperature	coolant/water ratio
Below - 18^{O}c	60:40
-18^{O}c and above	50:50

Windscreen Washer Antifrost

Make : Antifrost - K

Concentration (antifrost : water) : 1:5 for 0^{0}C
1:1 for - 10^{0}C
2:1 for - 16^{0}C
1:0 for -37^{0}C

Aggregates filling capacity :

1. Engine oil (Turbocharged engine) : 7.7 Ltr.
2. Gear box G 76 : 1.6 Ltr.
3. Rear axle (Tata Motors) : 1.9 Ltr.
4. Rear axle (spicer) : 2.2 Ltr.
5. Front live axle (spicer) : 1.2 Ltr.
6. Transfer case : 1.2 Ltr.
7. Power steering system - Rane : 1.4 Ltr.
   Power steering system - ZF : 1.6 Ltr.
8. Brake hydraulic system : 0.5 Ltr.
9. Clutch hydraulic system : 0.2 Ltr.
10. Grease : Front axle per hub (Tata Motors) : 100 gm.
    Rear axle per hub (Tata Motors) : 120 gm.
    Front live axle per hub (spicer) : 92 gm.
    Rear axle per hub (spicer) : 25 gm.
11. Cooling system (Approx) : 9.8 Ltr.

Recommended Tyre Pressure :

TYRE PRESSURE	Veh. Condition	Wheels	4 x 2		4 x 4	
			PSI	Bar	PSI	Bar
	Unladen	Front	26	1.8	26	1.8
		Rear	26	1.8	26	1.8
	Laden	Front	26	1.8	30	2.1
		Rear	50	3.4	45	3.1

FILLING CAPACITY AT A GLANCE

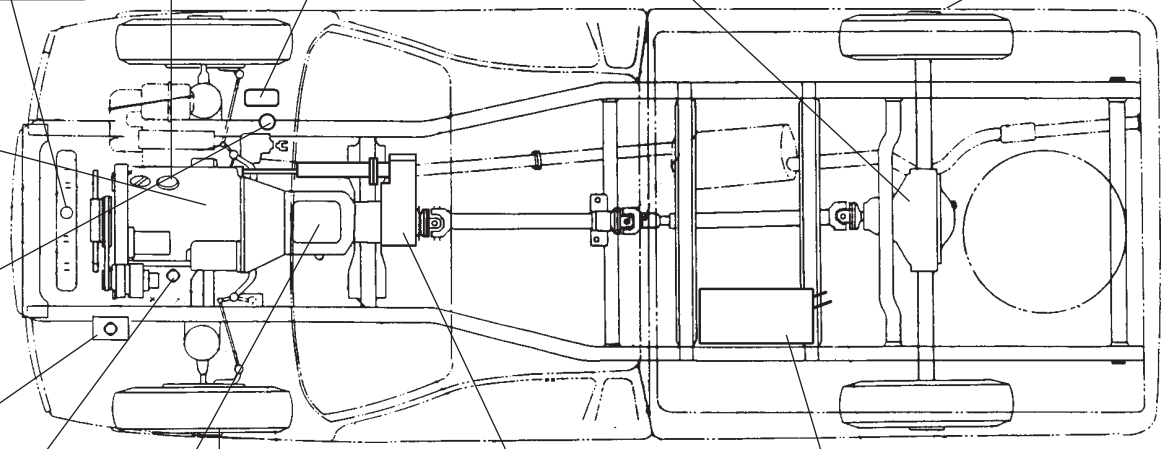
Engine oil upto Dipstick Max. mark - 7.7 Ltrs.
Min. mark - 5.7 Ltrs.

Rear axle Oil (Tata Motors) - 1.9 Ltrs
Rear axle Oil (Spicer) - 2.2 Ltrs

Brake Hydraulic System 0.5 Ltrs

Rear axle Grease / Hub (Tata Motors) - 120 gm
Rear axle Grease / Hub (Spicer) - 25 gm

Engine Coolant = Antifreeze agent + Soft Water = 9.8 Ltrs



Front live axle oil = 1.2 Ltr. (4x4 version)

Clutch Hydraulic System 0.2 Ltrs

Windshield Washer reservoir = 2.5 Ltr

Power Steering System -
RANE - 1.4 Ltrs
ZF - 1.6 Ltrs

Transfer Case - 1.2 Ltrs

Fuel Tank Capacity - Single Cab - 60 Ltrs
Dual Cab - 50 Ltrs

Gearbox - 1.6 Ltrs

Front axle Grease / Hub (Tata Motors) - 100 gm
Front axle Grease / Hub (Spicer) - 92 gm

TYRE PRESSURE	Veh. Condition	Wheels	4 x 2		4 x 4	
			PSI	Bar	PSI	Bar
	Unladen	Front	26	1.8	26	1.8
		Rear	26	1.8	26	1.8
	Laden	Front	26	1.8	30	2.1
		Rear	50	3.4	45	3.1

6. LUBRICATION & MAINTENANCE

A. LUBRICATION POINTS

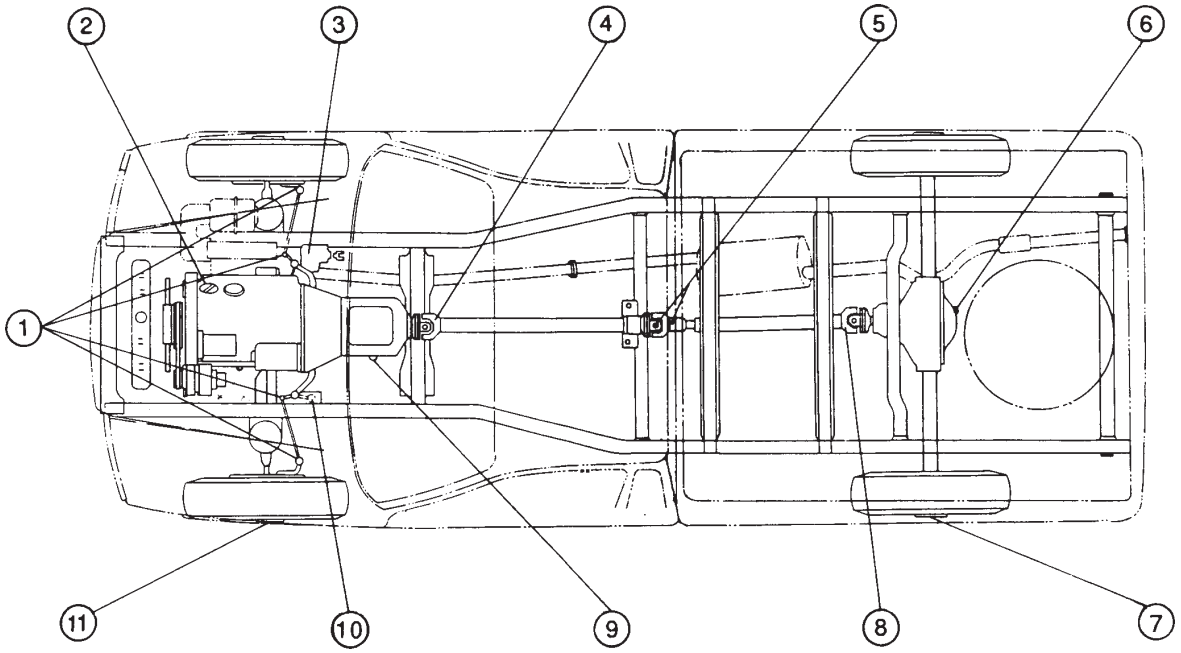
For 4x2 Vehicle

Lubrication points listed below and shown on next page require greasing or oil level check and top up.

Sr. No.	Description	No. of points
1.	Engine	Oil level
2.	Power steering tank	Oil level
3.	Propeller shaft-front	1 grease nipple
4.	Rear axle	Oil level
5.	Rear hub	Pack grease (for Tata Motors axle only)
6.	Gear box	Oil level
7.	Idler arm	1 grease nipple
8.	Front hub	Pack grease
9.	@ Centre link	2 nipples

@ Not applicable for facelift vehicles & 4x4 non facelift vehicles.

Note : Grease nipples must be carefully cleaned prior to greasing and the same applies to grease cups / screw plugs before they are unscrewed.



B. LUBRICATION POINTS

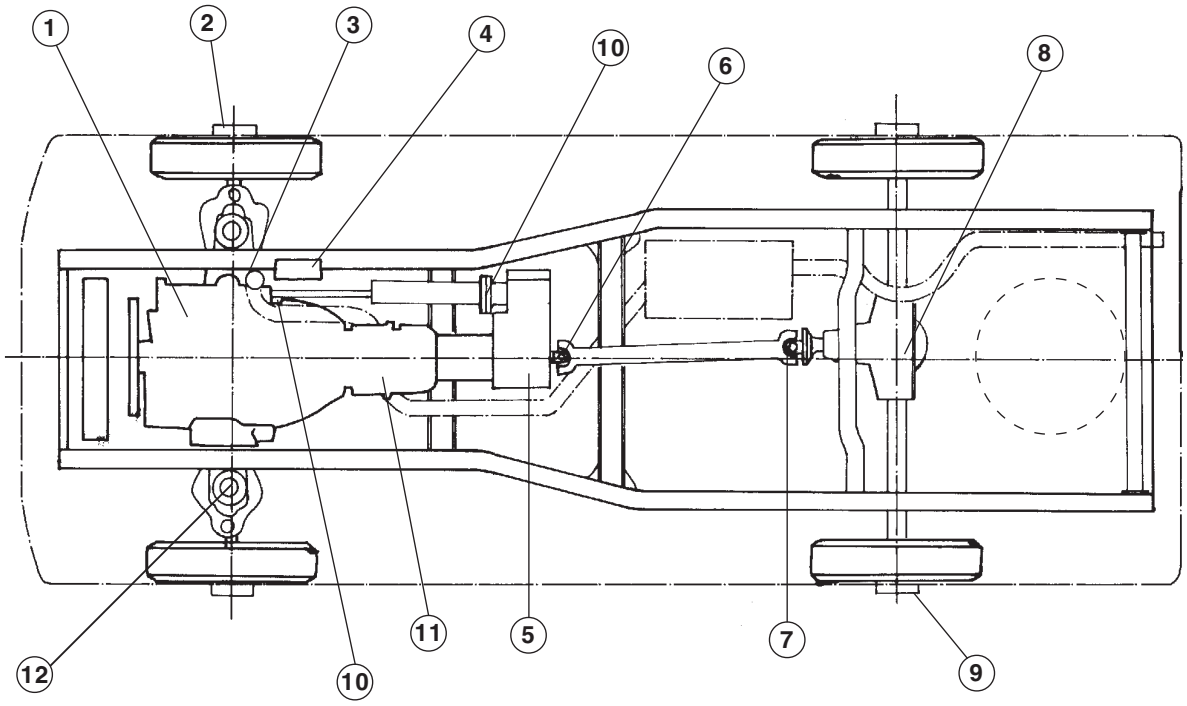
For 4x4 Vehicle

Lubrication points listed below and shown on next page require greasing or oil level check and top up.

Sr. No.	Description	No. of points
1.	Engine	Oil level
2.	Power steering tank	Oil level
3.	Propeller shaft-front	1 grease nipple
4.	Rear axle	Oil level
5.	Rear hub	Pack grease (for Tata Motors axle only)
6.	Gear box	Oil level
7.	Transfer case	Oil level
8.	Idler arm	1 grease nipple
9.	Front hub	Pack grease
10.	Front live axle	Oil level
11.	Propeller shaft - Front live axle	1 grease nipple
12.	@ Centre link	2 nipples

@ Not applicable for facelift vehicles & 4x4 non facelift vehicles.

Note : Grease nipples must be carefully cleaned prior to greasing and the same applies to grease cups / screw plugs before they are unscrewed.



6 C. TIGHTENING TORQUES

Sl. No.	Location	4x4 (in mkg)	4x2
1.	Front axle on frame	4 - 5	NA
2.	Torsion bar bracket	9	9
3.	Lower wishbone bush	14	14
4.	2nd cross member	9	NA
5.	Power Steering gear box mounting to frame	8	8
6.	Idler arm mounting to frame	8/5	8/5
7.	Front engine mounting pad to frame	4.5	4.5
8.	Centre link ball joint	7-9	7-9
9.	Front anti roll bar to frame	4.5	4.5
10.	Rear spring U bolt nut	8	8
11.	Rear spring U bolt lock nut	4	4
12.	Dana propeller shaft on axle	1.8 - 2.2	1.8 - 2.2
13.	Top wishbone ball joint to stub axle	13.5	13.5
14.	Stub axle ball joint to lower link	13.5	13.5
15.	Bottom ball joint to lower wish bone	9	9
16.	Brake calliper mounting to lower wish bone	7.6 - 8.8	7.6 - 8.8
17.	Steering damper	8 - 9	NA
18.	Rear shock absorber mounting to frame	6-7	6-7
19.	Front shock absorber	9	9
20.	Hub lock	5.5 - 6.5	NA
21.	Dana propeller shaft to front live axle	4	NA

Sl. No.	Location	in mkg
22.	Engine mounting front	7
23.	Engine mounting rear	4
24.	Center bearing mounting	8
25.	Wheel nuts	18 - 19.5
26.	Exhaust pipe joints catalytic convertor	2.5
27.	Dana propeller shaft to gear box	1.8 - 2.2
28.	Shackle mounting to frame	14
29.	Cab mounting	4.6 - 6
30.	Load body bolts	6 - 7
31.	Steering U/J cross	2.5
32.	Steering wheel nut	5
33.	Tie rod check nut	8
20.	Drain Plugs	
	a) Engine	4 - 6
	b) Gear Box	5
	c) Transfer case	2.8 - 4.2
	d) Front Axle (4x4) / Rear Axle (Spicer)	2 - 3.5
21.	Oil Level Plugs	
	a) Engine	Hand Tight
	b) Gear Box	2.5
	c) Transfer case	2.8 - 4.2
	d) Front Axle (4x4) / Rear Axle (Spicer)	2 - 3.5

6D. SERVICE SCHEDULE CHART

SR. No.	OPERATION	FREQUENCY x1000km / x1000 miles	DAILY	10 / 6	20 / 12	30 / 18	40 / 24	50 / 30	60 / 36	70 / 42	80 / 48	90 / 54	100 / 60
	GENERAL												
1.	Wash the vehicle	Periodically											
2.	Lubricate all grease nipples	10,000		●	●	●	●	●	●	●	●	●	●
3.	Tighten all fasteners: front grill, & fuel lines, engine, clutch hsg. radiator mtg., accelerator cable, radiator hose, prop. shaft centre brg. bracket/mounting bolts, U-bolts & nuts of springs, joints of pitman arm, idler arm, centre link, tie rods, upper ball joints of top wish bone, mtg's of lower arm & lower link, steering gear box and its mtg. bracket, vacuum & hydraulic line connections, head lamp mtg. wheel mtg. nuts, drivers cab seats mountings, axle shaft mtg., anti roll bar mtg., vacuum booster & tandem master cylinder mtg's, clutch master & slave cylinder mtg., rear anchor plate mtg., front disk brake mtg., fuel tank mtgs., front suspension top rubber mtg. nut.	10,000		●	●	●	●	●	●	●	●	●	●
	ENGINE												
3.	Check coolant level. Top up if necessary	Daily	●	●	●	●	●	●	●	●	●	●	●
4.	Change coolant in cooling system	50,000	or two years whichever is earlier										
5.	Check oil level in sump, Top up if necessary	Daily	●	●	●	●	●	●	●	●	●	●	●
6.	Change engine oil & oil filter cartridge	10,000		●	●	●	●	●	●	●	●	●	●
7.	Drain water from water drain plug in primary fuel filter	Periodically											
8.	Change fuel filter element (tank side)	10,000		●	●	●	●	●	●	●	●	●	●
9.	Change both fuel filter elements	20,000			●		●		●		●		●
10.	Clean air cleaner filter element, change if red band appears on service indicator even after cleaning		As and when red band appears										
11.	Tighten turbo charger mounting, inter cooler mounting fastners	10,000		●	●	●	●	●	●	●	●	●	●
12.	Tighten turbo charge hose connections/its mountings & inter cooler hose connection/its mountings	10,000		●	●	●	●	●	●	●	●	●	●
13.	Check inter cooler fins for dust accumulations and clean by compressed air	20,000			●		●		●		●		●
14.	Check end play of turbo charger shaft and radial clearance between turbine wheel and housing	70,000								●			
15.	Check timing belt, adjust tension if necessary, replace if defective	20,000			●		●		●		●		●
16.	Replace timing belt	1,00,000											●
17.	Check all drive belts, adjust tension if necessary, replace if defective.	10,000		●	●	●	●	●	●	●	●	●	●
18.	Replace all drive belts (other than timing belt)	40,000					●				●		
19.	Check injection nozzles for opening pressure & spray characteristics		Check if any problem is noticed										
	CLUTCH AND BRAKES												
20.	Check level of clutch & brake fluid in containers, top up if necessary	10,000		●	●	●	●	●	●	●	●	●	●
21.	Check service & parking brakes, adjust if necessary	10,000		●	●	●	●	●	●	●	●	●	●
22.	Check front brake pads & rear brake linings, Replace if necessary	20,000			●		●		●		●		●
23.	Overhaul the following brake components and change the brake fluid in the system 1) Tandem Master Cylinder, 2) Front Caliper, 3) Rear Wheel Cylinders, 4) Clutch Master Cylinder & Slave Cylinder	30,000				●			●			●	
	FOR CONVENTIONAL BOOSTER (YELLOW)												
24.	Overhaul Vacuum Booster & change the felt and Polyurethane filters along with rubber bellow	30,000				●			●			●	
	FOR ZERO DEAD STROKE BOOSTER (BLACK) (IF FITTED)												
25.	Check the performance by applying & releasing brakes when engine is running. The pedal should go down easily and return swiftly.	10,000		●	●	●	●	●	●	●	●	●	●
26.	Lubricate linkages and check for slackness at fork. Check the gaiter for proper fitment existence of damage and replace if necessary.	20,000			●		●		●		●		●
27.	Change filters and gaiter.	40,000					●				●		
28.	Overhaul the assembly using recommended repair kit. Replace valve body& rubber reaction disc if necessary.	80,000									●		
	GEAR BOX & TRANSFER CASE												
29.	Check oil level in gear box, Top up if necessary	10,000		●	●	●	●	●	●	●	●	●	●
30.	Change oil in gear box (also at 1st 10,000 km), if multigrade oil 80W 90 is used (non facelift)	40,000		●			●				●		
31.	Change oil in gear box (also at 1st 40,000 km), if synthetic oil 75W 90 is used (facelift) - dual cone gear box	80,000					●						
32.	Check oil level in transfer case (4 x 4 vehicle), top up if necessary	10,000		●	●	●	●	●	●	●	●	●	●
33.	Change oil in transfer case (4 x 4 vehicle)	40,000					●						●
34.	Clean breather on gear box	70,000								●			

6B. LUBRICATION AND MAINTENANCE SCHEDULE

SR. No.	OPERATION	FREQUENCY x1000km	FREQUENCY x1000 miles	DAILY	10	20	30	40	50	60	70	80	90	100
					6	12	18	24	30	36	42	48	54	60
	FRONT & REAR AXLES													
35.	Check oil level in rear axle, top up if necessary (Also front live axle 4x4 vehicle)	10,000			●	●	●	●	●	●	●	●	●	●
36.	Change oil in rear axle and front live axle (4x4 vehicle) (also at 1st 20,000 km)	40,000						●				●		
37.	Change grease in front & rear hubs & adjust bearing play (only for Tata Motors axle)	30,000					●			●			●	
38.	Change grease in front hubs & adjust bearing play (DANA Spicer)	40,000						●				●		
39.	Lubricate automatic hub lock parts (except drag sleeve assembly) by dipping in ATF oil	40,000						●				●		
	SUSPENSION & STEERING													
40.	Check play in ball joints at front suspension, top & bottom. Replace if necessary	20,000				●		●		●		●		●
41.	Check wheel alignment, chassis height & adjust if necessary	10,000			●	●	●	●	●	●	●	●	●	●
42.	Check & adjust steering wheel free play	30,000					●			●			●	
43.	Check oil level in power steering tank and top up if necessary	10,000			●	●	●	●	●	●	●	●	●	●
44.	Change oil & oil filter in power steering system	80,000										●		
45.	Check condition of rubber bushes in the following, replace if necessary, 1) Top Wish Bone													
	2) lower wishbone 3) Anti Roll Bars 4) all suspension bump stops	30,000					●			●			●	
46.	Check shock absorber & its bushes and steering damper bushes, replace if necessary	20,000				●		●		●		●		●
	ELECTRICALS													
48.	Check electrolyte level in battery, add distilled water if necessary	10,000			●	●	●	●	●	●	●	●	●	●
49.	Check Specific gravity of electrolyte and the charge of battery	30,000					●			●			●	
50.	Check headlamp focussing & functioning of other electrical equipments & adjust	10,000			●	●	●	●	●	●	●	●	●	●
51.	Check glow plugs for continuity/short circuit, replace if required	20,000				●		●		●		●		●
52.	Check water level in windscreen washer container & top up if necessary	Daily		●	●	●	●	●	●	●	●	●	●	●
	CAB													
53.	Apply grease on door latches, door lock striker, bonnet opening lever and lock plate	10,000			●	●	●	●	●	●	●	●	●	●
54.	Apply grease on tail gate hinges & door lock inner ratchet, Lubrication with oil can	30,000					●			●			●	
	WHEELS & TYRES													
55.	Tyre rotation & check tyre pressure	10,000			●	●	●	●	●	●	●	●	●	●
56.	Wheel balancing			When tyre is removed from wheel rim										
	AIR CONDITIONING SYSTEM (wherever fitted)													
	Check torque of bolts on brackets & AC compressor	10,000			●	●	●	●	●	●	●	●	●	●
57.	Check compressor belt, adjust tension, Replace if necessary (Replace at 40,000 km)	10,000			●	●	●	●	●	●	●	●	●	●
58.	Check bubbles in receiver drier for refrigerant level	10,000			●	●	●	●	●	●	●	●	●	●
59.	Check for leak of gas / oil from pipes, joints, compressor shaft seal & cylinder head	10,000			●	●	●	●	●	●	●	●	●	●
60.	Clean condensor with high pressure water	10,000			●	●	●	●	●	●	●	●	●	●
61.	Check fan speeds for proper air flow	10,000			●	●	●	●	●	●	●	●	●	●
62.	Check clutch operation	10,000			●	●	●	●	●	●	●	●	●	●
63.	Check system pressure with gauges. Recharge if necessary	10,000			●	●	●	●	●	●	●	●	●	●
64.	Clean evaporator from its face to remove dust, foreign objects etc.	20,000				●		●		●		●		●
	HEATING / DEMISTING SYSTEM (wherever fitted)													
65.	Check hose joits of heating system for leakage. Tighten if necessary	10,000			●	●	●	●	●	●	●	●	●	●
66.	Check hoses of heating system for cracks. Replace if required	10,000			●	●	●	●	●	●	●	●	●	●
67.	Check blower for proper functioning. Check fuse. Replace if found blown.	10,000			●	●	●	●	●	●	●	●	●	●

4 DLTC ENGINE

INTRODUCTION :

TATA 483 DL TC IC is a turbocharged engine with intercooler, and indirect fuel injection system. Aluminium cylinder head incorporates glow plugs, combustion chambers, and overhead camshaft. A rubberised timing belt drives overhead camshaft, water pump and rotary fuel injection pump from crankshaft. Element type heat exchanger is fitted on the right hand side of the engine and it can be easily removed for access to water jackets. Oil pump is chain driven from crankshaft and oil filter is spin-on-throw away type. An oil separator is provided in crank case ventilation system to separate gases and oil droplets.

Engine has a three point mounting with two mounting points in front of engine and one under the rear of gear box.

4 DLTC ENGINE

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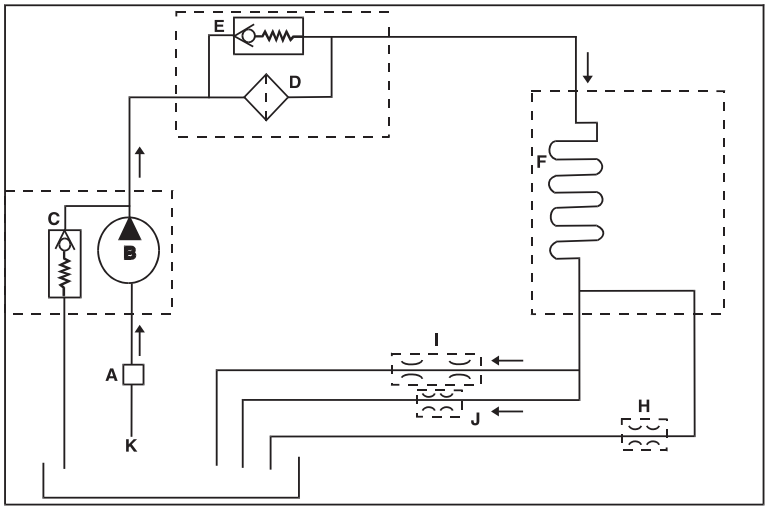
4 DLTC ENGINE

TECHNICAL SPECIFICATIONS

Engine model	:	4DL TCIC
Type	:	Water cooled, indirect injection, turbo charged, and intercooled diesel engine with Crankcase breather / oil separator & Exhaust gas recirculation system.
No. of cylinders	:	4 in line
Bore/stroke	:	83 mm x 90 mm.
Capacity	:	1948 CC
Max. Engine output	:	64kW (90 ps) at 4300 rpm
Max. Torque	:	190 Nm (19 kgm) at approx. 2000-3000 rpm
Compression ratio	:	21:1
Firing order	:	1-3-4-2
Air filter	:	Dry (paper) type
Oil filter	:	Spin-on full flow paper type
Fuel filter	:	Two stage, fine filtration
Fuel injection pump	:	Rotary type with electric stop solenoid
Governor	:	Mechanical
Engine oil capacity	:	Max. 7.7 liters
Weight of engine	:	220 kg (dry)
Radiator frontal area	:	2340 sq. cm.
Exhaust System	:	With Catalytic Convertor

SCHEMATIC CIRCUITS OF VARIOUS SYSTEMS ON 4 DLTC ENGINE

2a. Lubrication System



A. Strainer in sump
B. Oil pump
C. Oil pump relief valve
D. Full flow oil filter (paper type)
E. Filter bypass valve
F. Oil cooler
H. Turbocharger
I. Crankshaft Journals etc.
J. Piston cooling nozzles
K. Oil sump

Fig. 1

2b. Cooling System

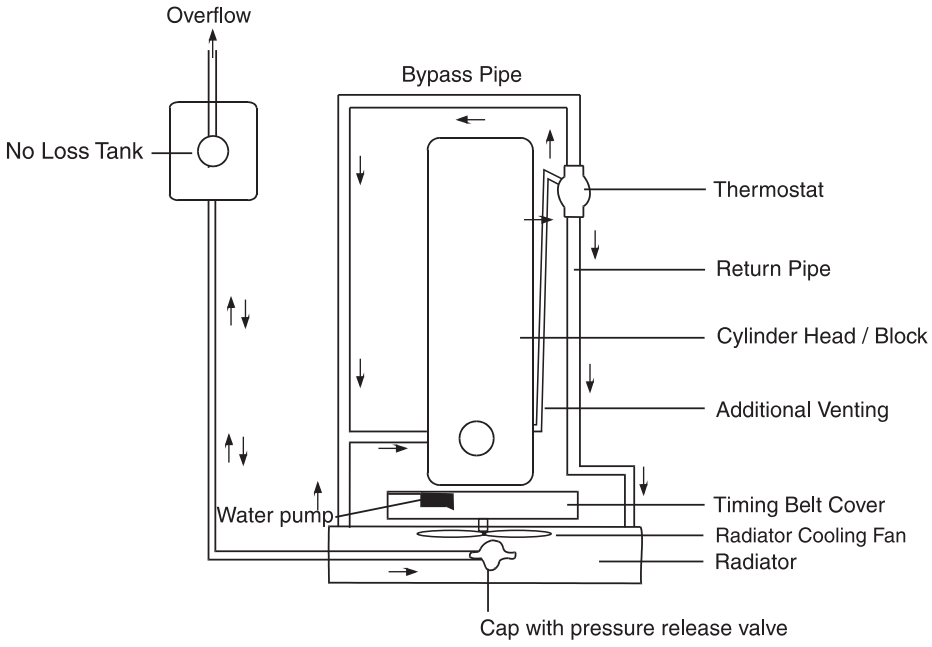


Fig. 2

2c. Fuel System (Lucas DPC for EURO II & EURO III)

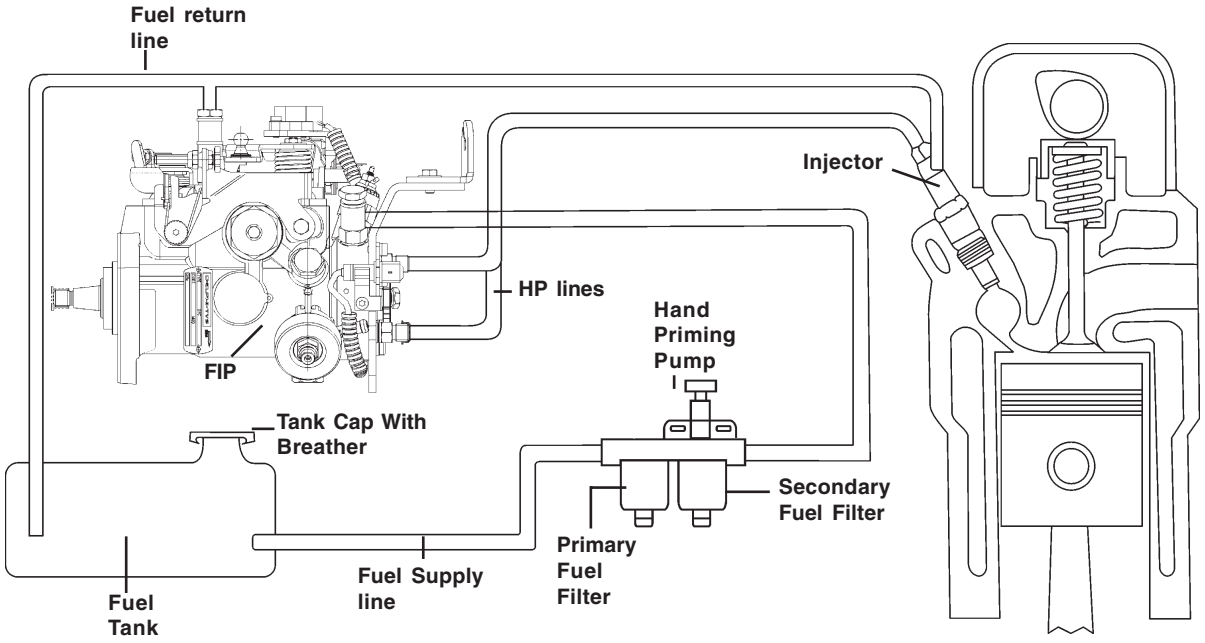


Fig. 3

2d. EGR SYSTEM ON EURO-III ENGINE

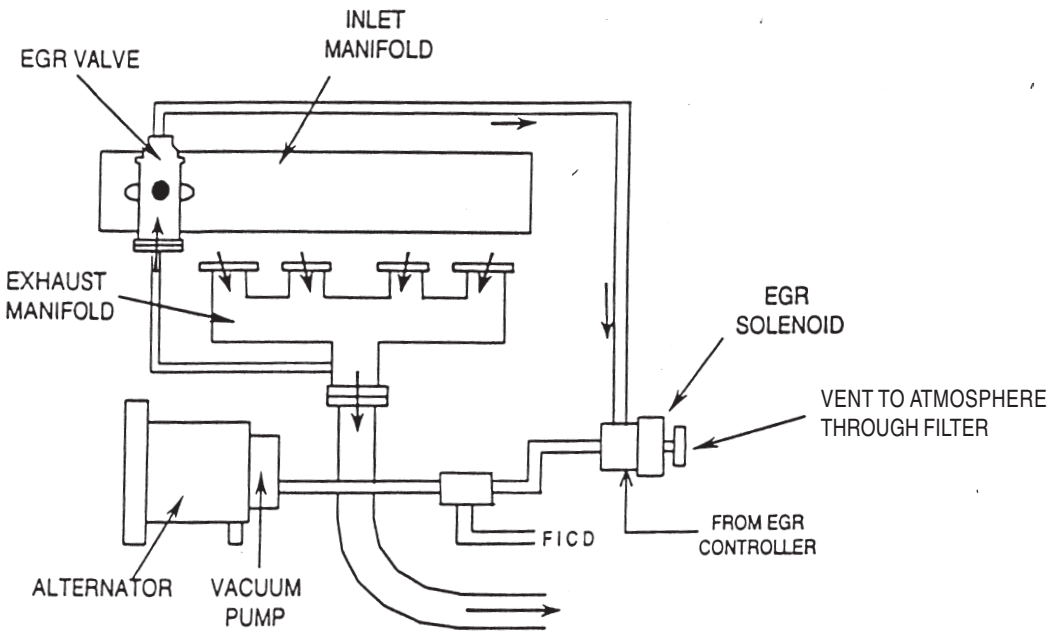
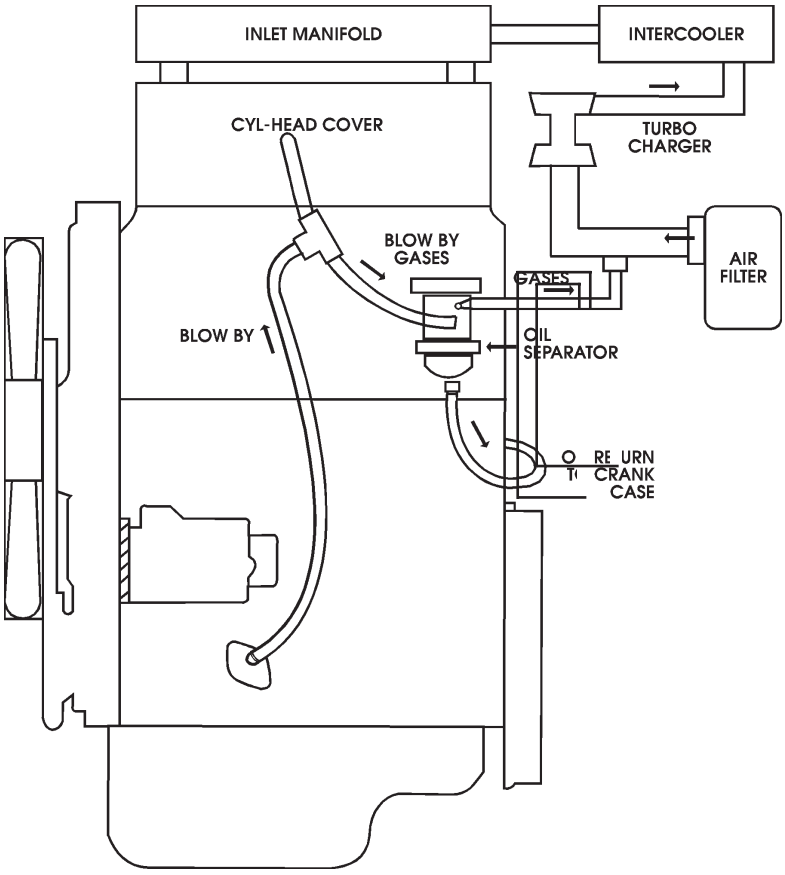


Fig. 4

2e. ENGINE BREATHING SYSTEM (SCHEMATIC LAYOUT)



Oil Separator for Air Breather :

A step towards developing environment friendly products, to eliminate the engine blow by being emitted to atmosphere, the engine breather / oil separator has been fitted.

The oil separator, separates oil from the blow by of the engine and sends it back to engine oil sump. The remaining air, carbon particles and other gases are sent to the inlet manifold.

There is also a spring loaded diaphragm valve provided on the oil separator outlet to the inlet manifold. This prevents the flow of excessive of blow-by from the oil separator to inlet manifold in case the air filter is choked and high suction starts acting on outlet port of oil separator.

No leakage past diaphragm or top cover of oil separator is permitted. Replace the assembly if there is any leakage.

Fig. 5

2f. OIL SEPARATOR (SECTIONAL VIEW)

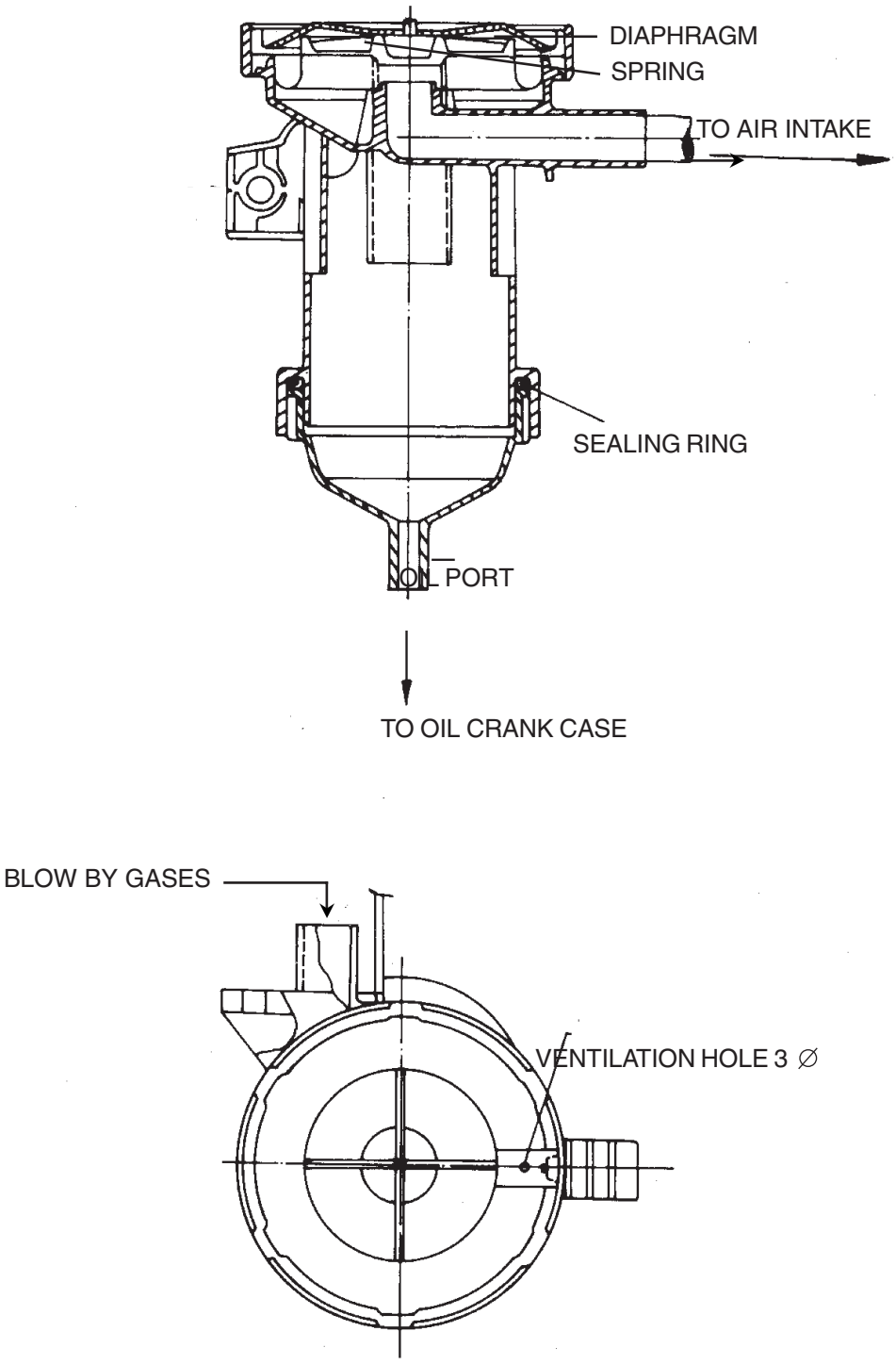


Fig. 6

SPECIAL TOOLS

Sr. No.	Description	Part Number
1.	Adaptor for checking engine compression.	2654 5890 01 01
2.	Fly wheel locking pin	2654 5890 03 09
3.	Spanner for crank shaft.	2654 5890 03 02
4.	Drift for crank shaft front oil seal.	2654 5890 03 03
5.	Drift for crank shaft rear oil seal.	2654 5890 03 04
6.	Puller for crank shaft gear and sprocket.	2654 5890 03 05
7.	Puller for crank shaft spigot bearing.	2654 5890 03 06
8.	Spanner for FIP and Cam shaft gear.	2654 5890 05 01
9.	Camshaft and FIP gear locking bolt.	2654 5890 05 02
10.	Drift for valve guide.	2654 5890 05 04
11.	Spacer for drift valve guide seal (Inlet)	2651 5890 06 02
12.	Spacer for drift valve guide seal (Exhaust)	2651 5890 06 03
13.	Support rail.	2654 5890 05 06
14.	Valve spring compressor.	2654 5890 05 07
15.	Drift for cam shaft oil seal.	2654 5890 05 08
16.	Assembly adaptor for FIP timing checking. (MICO)	2654 5890 05 09
17.	Timing rod (Lucas)	2654 5890 06 01
18.	Assembly bracket for FIP timing checking (Lucas)	2654 5890 06 02
19.	Assembly bracket for FIP timing checking (Lucas)	2654 5890 06 03
20.	Drive square for timing belt tensioner.	2654 5890 05 10
21.	Spanner for oil filter.	2654 5890 18 01
22.	Engine mounting bracket attachment (To be used with engine stand)	2654 5890 24 01
23.	Mandrel for clutch plate alignment.	2654 5890 25 01
24.	Puller for fan pulley.	312 589 03 33
25.	Socket for removal / installation of injectors.	312 589 00 09
26.	Engine mounting stand.	2573 5890 24 01
27.	Drift for removal of cylinder liners	2654 5890 01 03
28.	Drift for installation of cylinder liners	2654 5890 01 02

4. PRELIMINARY INSPECTION OF ENGINE

Before proceeding to carry out reconditioning of engine, it is desirable to have preliminary inspection to ascertain whether an engine reconditioning is necessary.

Common reasons for which engine is reconditioned are :

1. Loss of power
2. Excessive engine oil consumption.
3. Low engine oil pressure
4. Mechanical failures

1. LOSS OF POWER

Loss of power may be due to :

a. Clogged air cleaner / loss of charge air pressure / choked exhaust silencer
b. Clutch slippage
c. Brake binding
d. Defective fuel system
e. Loss of engine compression

a. CLOGGED AIR CLEANER / LOSS OF CHARGE AIR PRESSURE / CHOCKED EXHAUST SILENCER

Loss of power with unusual black smoke from engine exhaust indicates lack of air or low air charging pressure to engine cylinders. Loss of charge pressure can be due to leakage of charge air from outlet of turbocharger, worn out vanes of turbocharger compressor & leakage in inlet manifold etc.

Clean air cleaner. Check all joints for air leakage. If power loss with black smoke is still felt, check silencer for choking. Clean or replace silencer if necessary.

b. CLUTCH SLIPPAGE

Clutch slipping can be confirmed by any of the following two methods :

Drive vehicle in 1 st or 2nd gear at maximum speed corresponding to that gear. With accelerator pedal fully pressed, apply brake gradually with left foot. If engine stalls, it means that clutch does not slip.

Drive loaded vehicle in 3rd gear on level ground and let the speed drop down to approximately 15 kmph. Now press accelerator pedal fully. With slipping clutch, vehicle speed will not pick up and also clutch burning smell will be noticed. If this does not occur and vehicle picks up speed, it indicates that clutch does not slip.

c. BRAKE BINDING

During driving, apply brakes number of times and then shift gear to neutral position. Check brake drums/brake discs for overheating. If necessary, jack up axles and check wheels for free rotation.

Check Handbrake position (Released/applied)

D. FUEL SYSTEM

Check condition of fuel filter elements, fuel pump timing, injection nozzles and fuel injection pump for proper functioning.

E. CHECKING ENGINE COMPRESSION PRESSURE

- If loss of power is not on account of any reasons above, check engine compression as given below.
- Warm up engine preferably by road drive to get a temperature of about 85 to 95° C.

  Remove all injectors. Flame guard washers should be replaced while refitting the injectors.
- Fit adaptor 2654 5890 01 01 in place of one injector. Tighten pressure screw using spanner 312 589 00 09 to specified torque.
- Connect compression tester to adaptor and tighten vent knob.
- Crank engine. Pressure gauge needle will start rising. Continue cranking till gauge needle stops rising any further. Note down reading. Loosen vent knob to make sure tester needle returns to zero. Repeat this operation for remaining cylinders.
- Minimum compression pressure in each cylinder should be 19 bar. Variation in compression pressure between cylinders should not be more than 1.5 bar.
- Low compression pressure may be due to leakage past valves / piston rings /blown head gasket. Spray small quantity of clean engine oil in cylinder showing low pressure. If compression improves, wear in piston rings / cylinder bore is indicated. If it does not, leakage past valves is indicated. If compression pressure of adjacent cylinder is also on lower side, it may be due to blown cylinder head gasket.

2. EXCESSIVE ENGINE OIL CONSUMPTION

Check oil consumption as given below :

1. Make sure that there is no external leakage of the oil (i.e. from the camshaft oil seal, crankshaft oil seal, oil sump gasket, cylinder head cover gasket etc.
2. Ensure that oil separator condition is OK & no leakage in the circuit.
3. If no external leakage is found, determine oil consumption as given below.

Caution : Do not make a rough estimate of engine oil consumption by noting the kilometers covered by the vehicle at any random stage and finding oil consumed from the topped up position taking into consideration dipstick level and oil tank capacity.

Procedure :

1. Place the vehicle on the level ground.
2. Top up oil to max. level in dipstick.
3. Warm up the engine.
4. Take a clean vessel, place it below drain plug of sump.
5. Drain hot oil into the vessel. Drain it fully.
6. Screw in oil sump drain plug and tighten it.
7. Weigh the vessel along with oil. Let this weight be 'w1' gms.
8. Refill weighed oil into sump. Do not spill any oil. The vessel used for draining should not be used for any other purposes.
9. Load the vehicle approximately to rated GVW. Drive vehicle for at least 200 km under normal operating conditions. Let this drive distance be 'D' kms.
10. Immediately after the test drive, place the vehicle at the same spot.
11. Now place the same vessel below sump. Unscrew drain plug and drain oil into the vessel. Drain oil in sump fully.
12. Weigh the vessel along with oil. Let this weight be 'W2' gms.
13. Find out standard oil consumption as :

$$\text{Standard oil consumption 'C' (Litres/1000 km)} = \frac{\text{(W1-W2) (Wt. of oil consumed gms) x 1000}}{\text{Sp. wt. of oil (gm) x 'D' (drive dist. in km)}}$$

$$\text{'C'} = \frac{\text{(W1-W2)}}{\text{0.88 x D}} \text{ litres/1000 km}$$

If the oil consumption value is more than 0.8 Ltr./1000 kms. then engine needs further investigation.

Note : Oil consumption of engine depends on the oil conditions (e.g. viscosity/cleanliness/quality etc.) and the driving conditions. If the vehicle is driven in high speeds and / or with frequent accelerations for comparatively long time, then oil consumption may show variation over the specified values.

3. EXTREMELY LOW OIL PRESSURE

Check the following :

a. External leakages.
b. Oil level in sump.
c. Oil pressure indicator for proper functioning.
d. Functioning of pressure relief valve on oil pump.
e. Oil pump performance.
f. Clogged oil filter

Specified oil pressure at 4300 rpm & at 85^{0}C temperature

Engine	Minimum oil pressure at	
	Max Speed	Idle Speed
New	5.5 bar	1.4 bar
Old	4.0 bar	1.0 bar

If oil pressure is less than specified, it may be due to improper functioning of oil pump or defect in oil pump relief valve.

If low oil pressure is not on account of oil pump/oil pump relief valve, wear of journals / bearings is indicated for which overhaul of engine may be considered.

Oil pressure can be checked with a pressure gauge as given below :

- Remove the pipe union bolt on crank case, used to ount the oil line (crank case to vaccum pump)
- Put a suitable adaptor on crank case.
- Connect a pressure gauge on the adaptor with the help of metallic pressure line.
- Run the engine at idling / maximum speed at specified temeperature and measure oil pressure.

4. MECHANICAL FAILURES

Defective water pump or alternator can be a source of mechanical noise. Defect can be located by replacing alternator or water pump with new one.

Metallic knocking sound from engine may be due to faulty injection, excessive clearance in main and big end bearings, small end bush, tappets, piston slap, seizing of piston rings, scored cylinder bore or breakage of any moving parts. Noise due to defective fuel injection equipment can be eliminated by attending FIP/injectors. Cutting off high pressure line to individual injectors with engine running will pin point the cylinder with Diesel Knock. Overhauling of fuel system will set right this defect.

Noise also can be from turbocharger.

Dismantling of engine may be considered if still noise occur even after attending all above mentioned problems.

REMOVAL OF ENGINE FROM VEHICLE

Remove bonnet.

Disconnect electrical cable connections for :

- Battery
- Starter Motor
- Alternator
- Fuel injection pump solenoid switch
- FICD (Fast idling control device (if fitted)
- Oil pressure switch
- Glow plugs
- EGR System (if fitted)
- Water temperature transducer
- Reversing switch

Disconnect cables for :

- Accelerator
- Clutch
- Speedometer drive

Disconnect pipe lines from :

- Fuel filter to fuel injection pump
- Fuel injection pump to fuel tank
- Vacuum pump to vacuum booster
- Power steering pump

Disconnect exhaust pipe from exhaust manifold

Drain engine lubricating oil from oil sump

Drain coolant from cooling system.

Disconnect hoses from and to radiator, Intercooler

Disconnect pipe from radiator to auxiliary tank.
Disconnect A.C. pipe lines and hot water pipes connections (AC refrigerant should be drained from system as per local regulations).

Disconnect propeller shaft front end.

Remove following sub assemblies :

- Air filter, if necessary
- Starter motor
- Radiator with fan shroud
- Clutch slave cylinder
- Gear shift lever
- Gear box with clutch housing and transfer case (for procedure see gear box group)

Fix chain to front and rear engine lifting hooks and hold chain in position with crane.

Unscrew and remove engine mounting bolts.

Lift engine from vehicle with the help of crane.

Mount engine on work stand.

INSTALLATION OF ENGINE ON VEHICLE

- Check engine mounting pads for wear. Replace them if necessary.
- Install the engine in reverse sequence of removal.
- Tighten engine mounting bolts to specified torque.
- Connect all pipes, hoses and electrical connections.
- Fill specified quantity of oil in engine of recommended grade.
- Fill coolant in the cooling system through radiator.
- Crank the engine momentarily. Let oil and coolant circulate through the system.
- Confirm whether oil pressure indicator light is switching off when engine is started.
- Check for any leakage, rectify if necessary.
- Top up coolant upto FULL mark in auxiliary tank, if necessary.
- Check HVAC system for correct functioning.

ENGINE DISMANTLING PROCEDURE -
(engine mounted on work stand)

Loosen power steering pump mounting bolt.

Loosen hexagonal nut on belt tension adjuster. Refer figure 7.

Loosen lock nut.

Turn adjusting hex. nut till belt can be removed.

Remove alternator and power steering pump belt.

Loosen the hexagonal nut for belt tension adjuster for fan belt. Refer figure 8.

Loosen lock nut and then adjust hexagonal nut till fan belt can be removed.

Remove fan belt.

Unstake lock plates and remove fan along with hub. Refer figure 9.

Remove split pin and castle nut.

Remove fan pulley using puller 312 589 03 33. Refer figure 10.

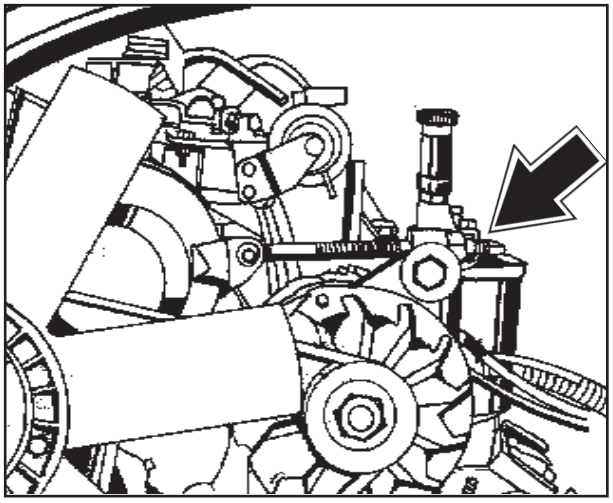


Fig. 8

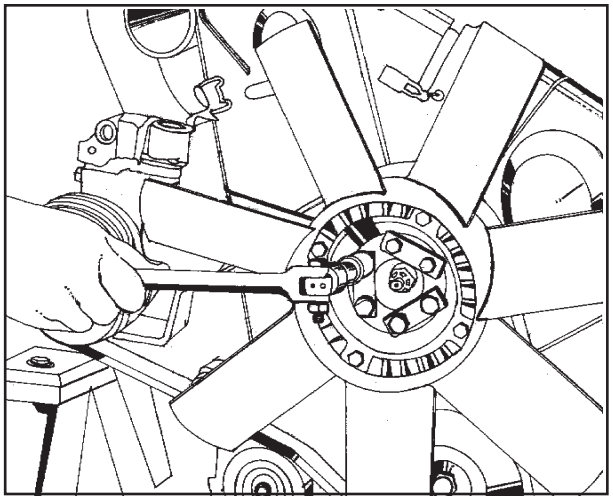


Fig. 9

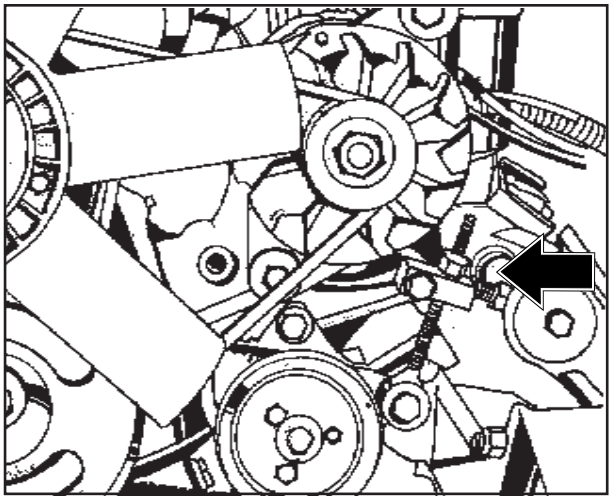


Fig. 7

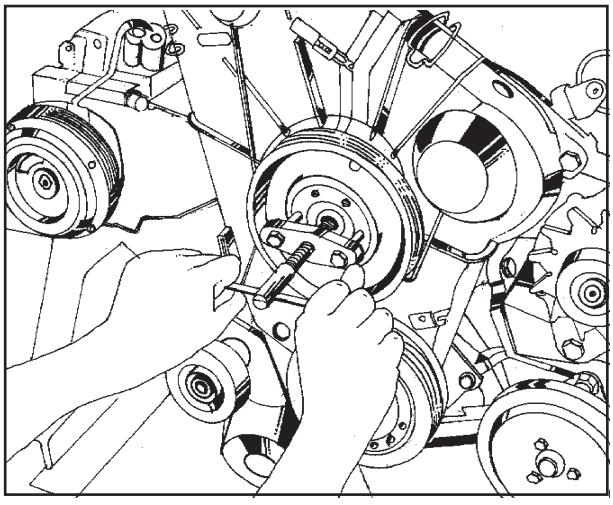


Fig. 10

Remove oil pipe from block to vacuum pump.

Remove alternator mounting bolt and alternator. Refer figure 11.

Remove power steering pump pulley by loosening three set screws.

Remove power steering pump. Refer figure 12.

Unscrew 4 set screws and remove A/C compressor assy. Refer figure 13. (if fitted)

Unlock toggle clamps. Remove clips holding front timing gear train covers. Refer figure 14.

Remove timing gear train covers.

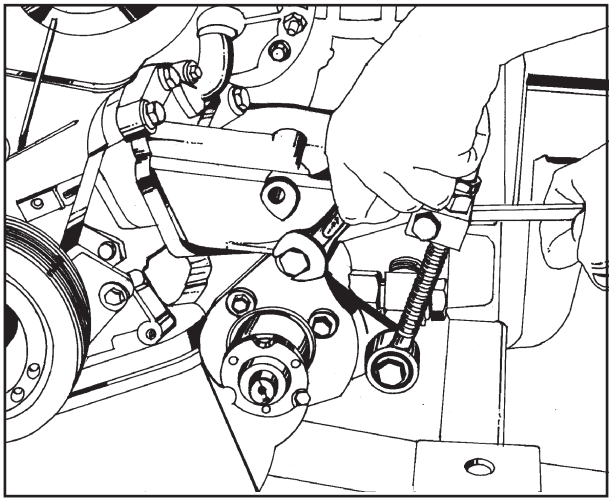


Fig. 12

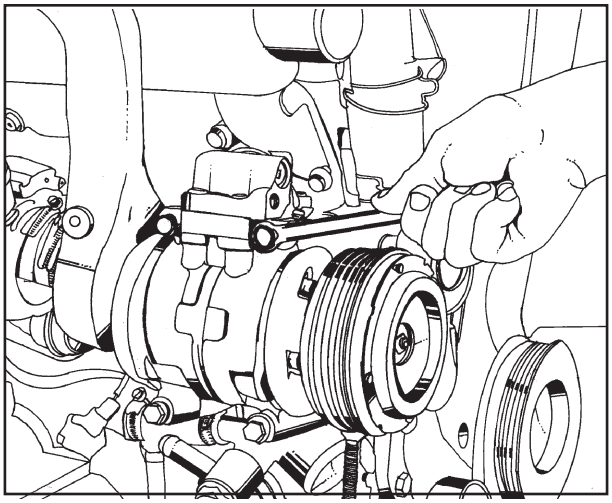


Fig. 13

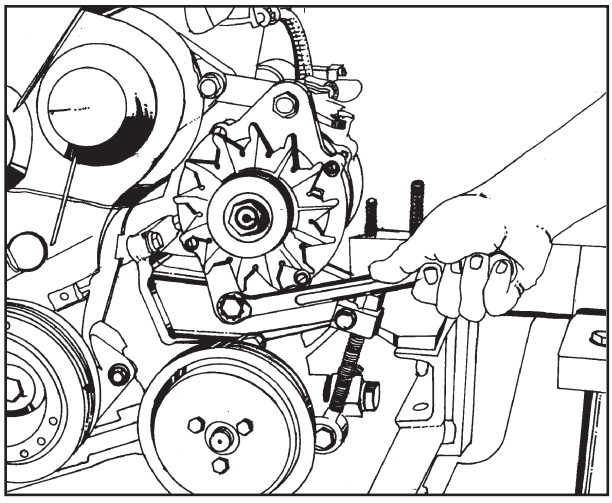


Fig. 11

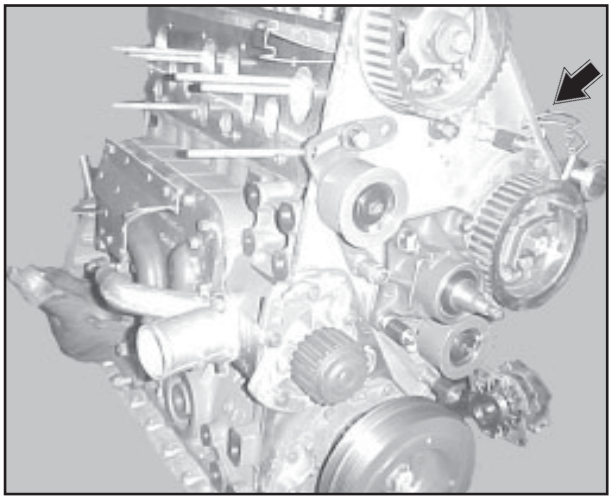


Fig. 14

Insert timing pin 2654 5890 03 09 in crankcase.

Rotate crankshaft with spanner 2654 5890 03 02, simultaneously pressing timing pin till it locks flywheel. Refer figure 15.

Lift timing pin slightly, rotate crankshaft further and try fitting timing pin again.

At this position it should be possible to lock camshaft gear with timing bolt 2654 5890 05 02. Refer figure 16. This will ensure compression TDC position of 1st piston. If not, turn crankshaft through one more turn.

Lock fuel injection pump gear with timing bolt, 2654 5890 05 02. Refer figure 17.

Loosen mounting bolt and nut of belt tensioner roller assembly. Refer figure 18.

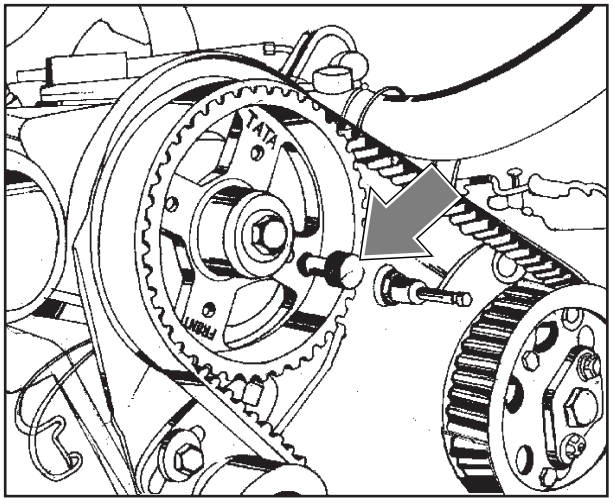


Fig. 16

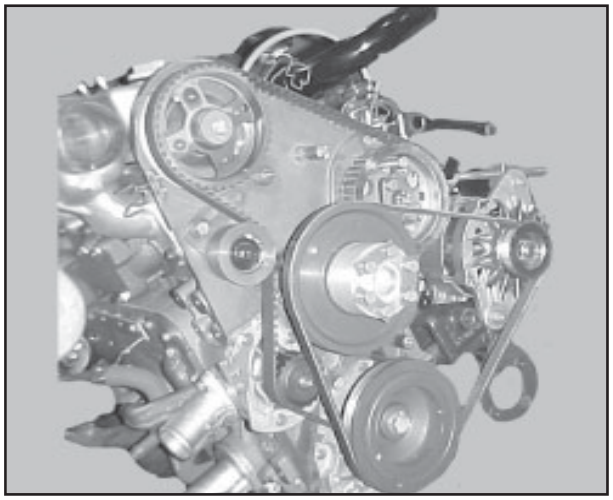


Fig. 17

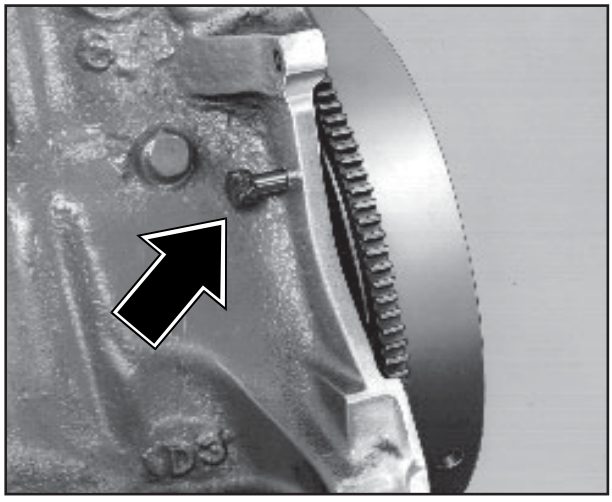


Fig. 15

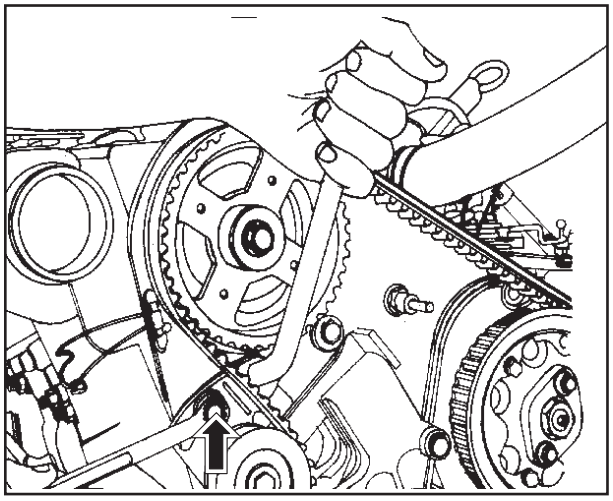


Fig. 18

Depress roller by using drive square pt. no. 2654 5890 05 10. Refer figure 19.

Remove timing belt.

Remove

- Overflow hose from 1st injector to fuel injection pump.
- Coolant pipe.
- High pressure injection pipe from injectors to fuel injection pump.
- Fuel pipe from fuel filter to fuel injection pump.
- Fuel return pipe from fuel injection pump to fuel tank.
- FICD unit.
- Oil separator and hoses.
- Thermostat assy. and Water Valve for cab heating (if fitted).

Disconnect engine stop solenoid and cold start unit electrical cable from fuel injection pump.

Hold fuel injection pump gear with spanner, 2654 5890 05 01 and unscrew mounting nut to remove fuel injection pump gear. Refer figure 20.

Remove timing bolts and FIP gear.

Remove woodruff key.

Remove fuel injection pump rear mounting bolt and taper nut, along with split sleeve.

Unscrew and remove fuel injection pump front mounting nuts.

Remove fuel injection pump.

Remove FIP mounting bracket.

Remove starter motor assembly. Refer figure 21.

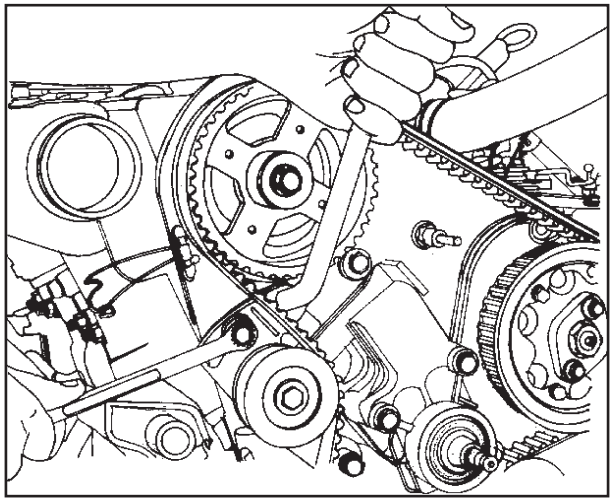


Fig. 19

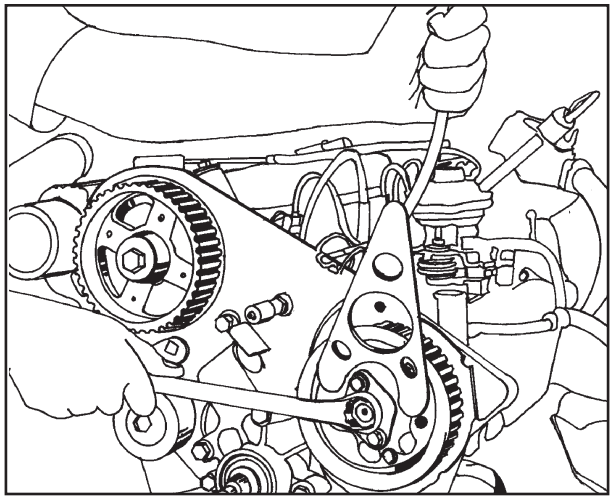


Fig. 20

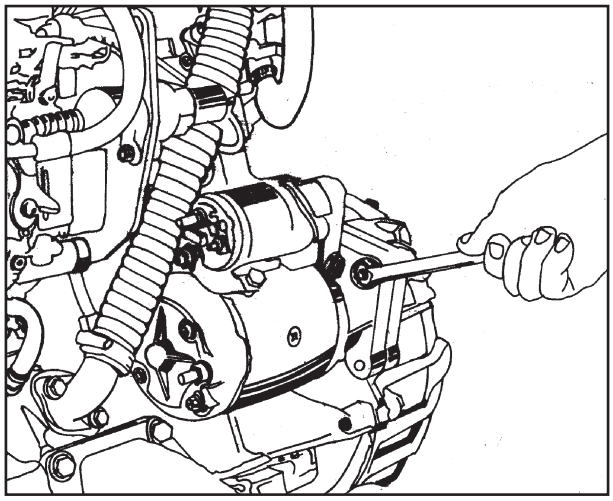


Fig. 21

Remove inlet pipes connected to turbocharger.

Remove oil inlet and oil outlet pipe connected to turbocharger. Refer figure 22.

Remove turbocharger shield.

Remove turbocharger exhaust elbow. Refer fig. 23.

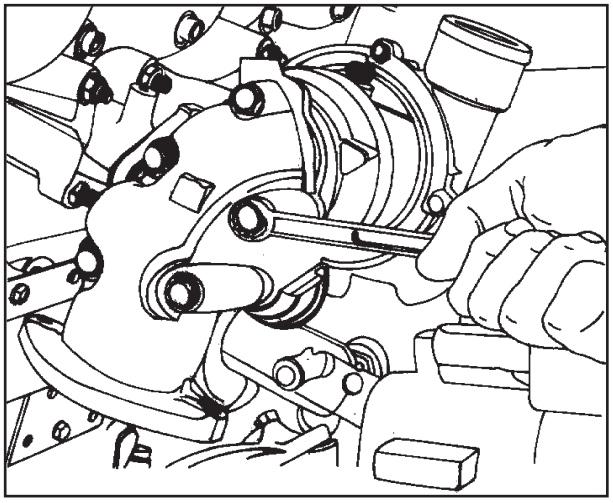


Fig. 23

Take out turbocharger assembly. Refer figure 24. Turbocharger should be stored with all openings covered suitably to prevent entry of foreign matter.

Take out exhaust manifold by loosening nuts. Refer figure 25.

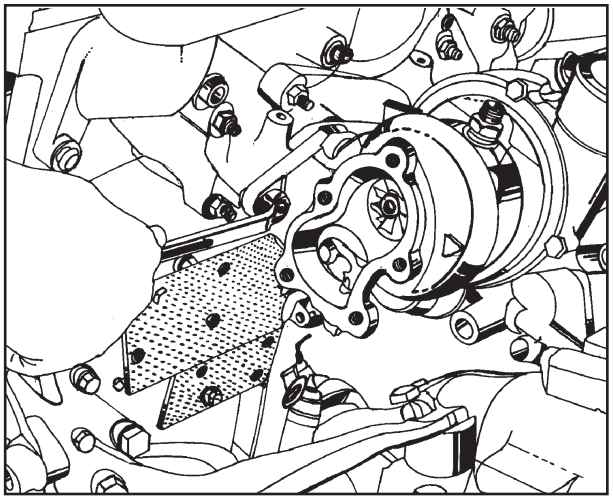


Fig. 24

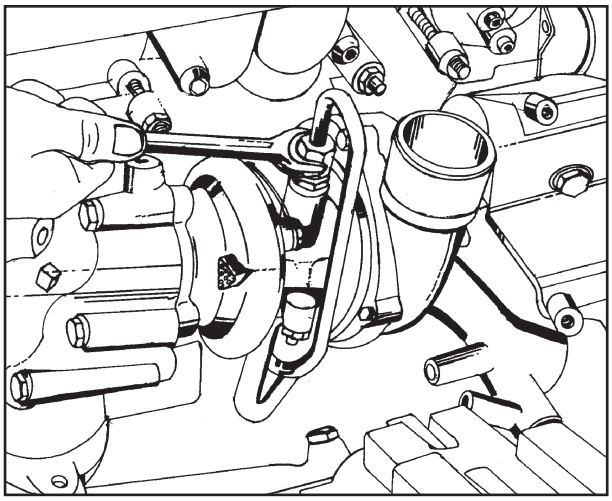


Fig. 22

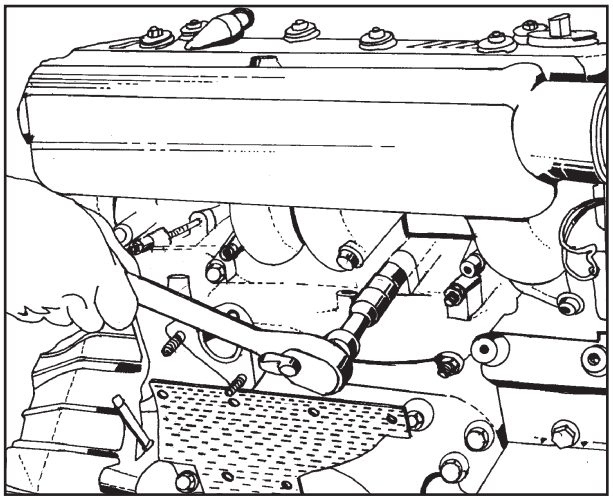


Fig. 25

Remove inlet manifold by loosening allen screw using allen key. Refer figure 26.

Using spanner, 2654 5890 05 01 lock camshaft gear. Refer figure 27.

Unscrew and remove camshaft gear mounting screw with spacer.

Remove camshaft gear and woodruff key.

Remove belt tensioner locking screw and timing gear train rear cover mounting screw at cylinder head. Refer figure 28.

Remove cylinder head cover. Refer figure 29.

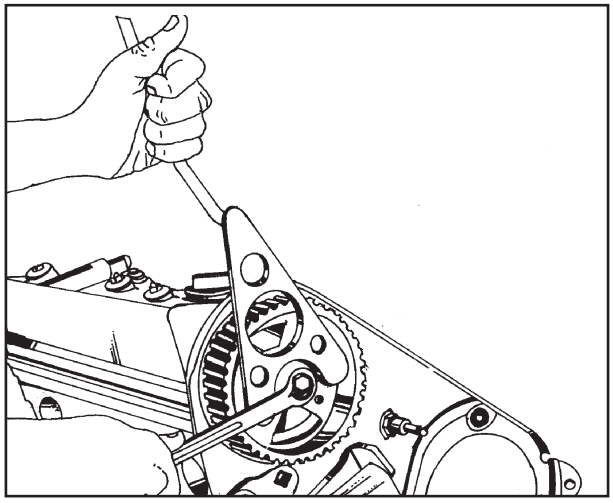


Fig. 27

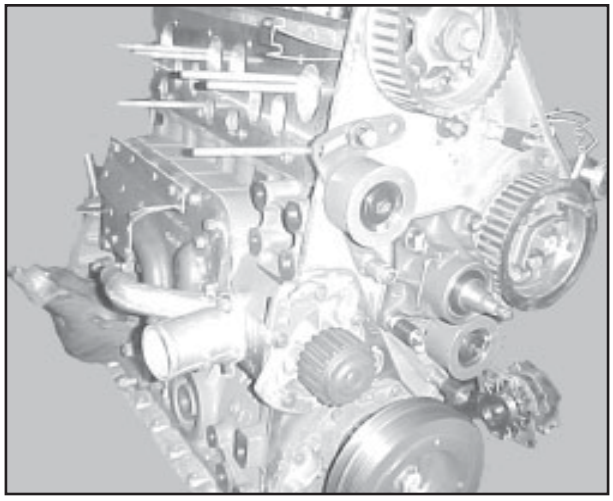


Fig. 28

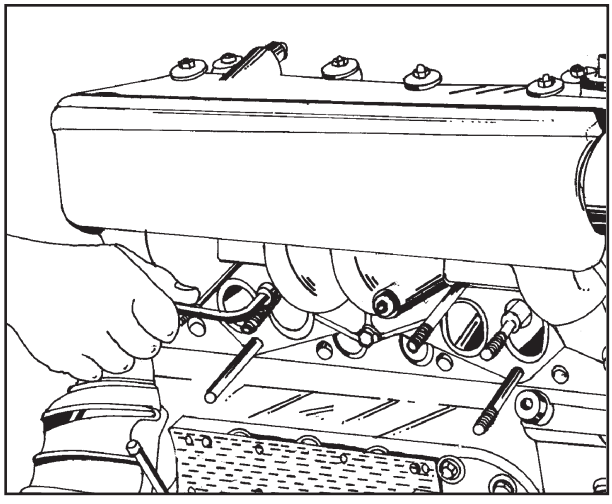


Fig. 26

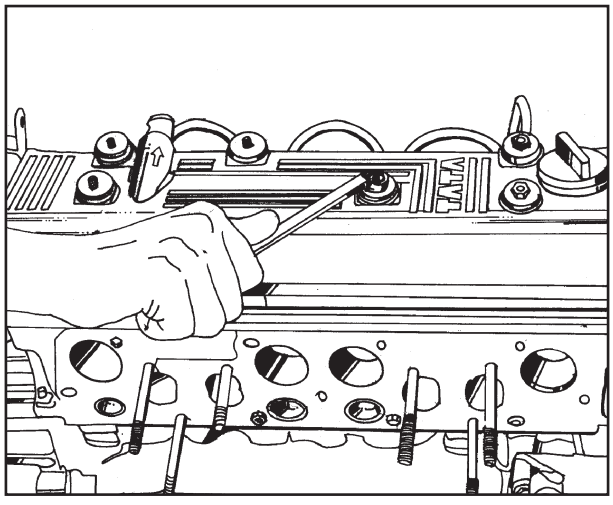


Fig. 29

Unscrew and remove cylinder head mounting bolts in reverse order of tightening. Refer figure 30.

Slightly lift cylinder head to clear locating hollow dowel in crankcase and remove it.

Uniformly and evenly unscrew clutch pressure plate mounting screws and remove clutch pressure plate and clutch disc.

Lock flywheel suitably and unscrew crankshaft pulley mounting bolt. Refer figure 31.

Remove crankshaft pulley.

Remove crankshaft gear using puller 2654 5890 03 05. Refer figure 32.

Remove

- Tensioner roller.
- Fan mounting bearing block. Refer figure 33.
- Idler roller.
- Timing gear train rear cover.

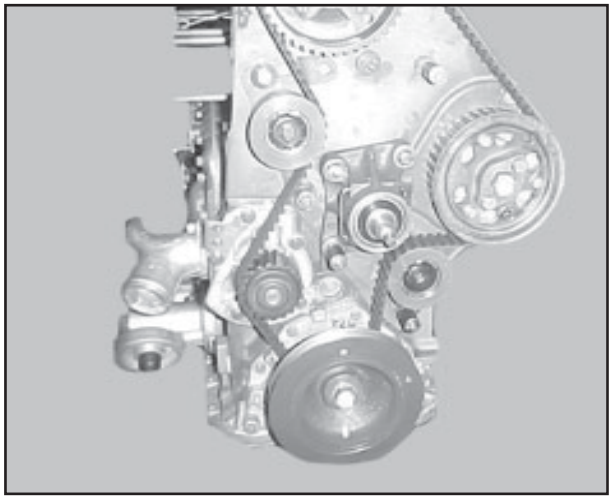


Fig. 31

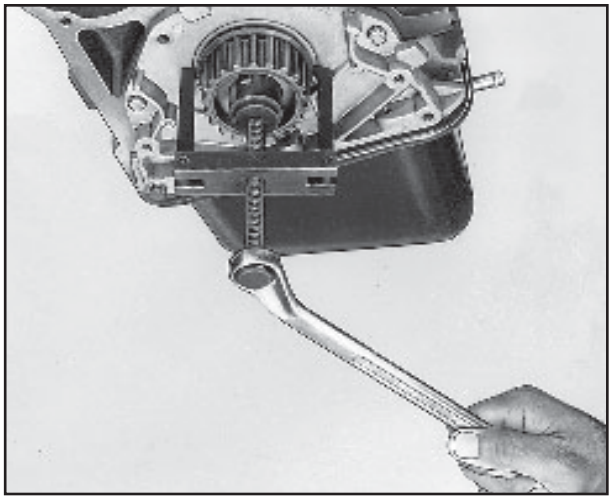


Fig. 32

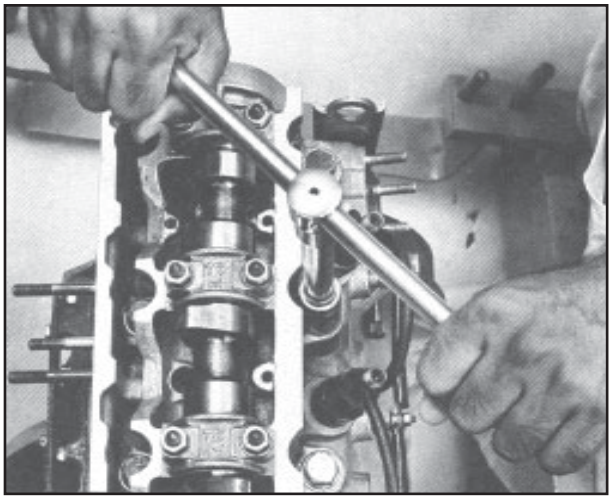


Fig. 30

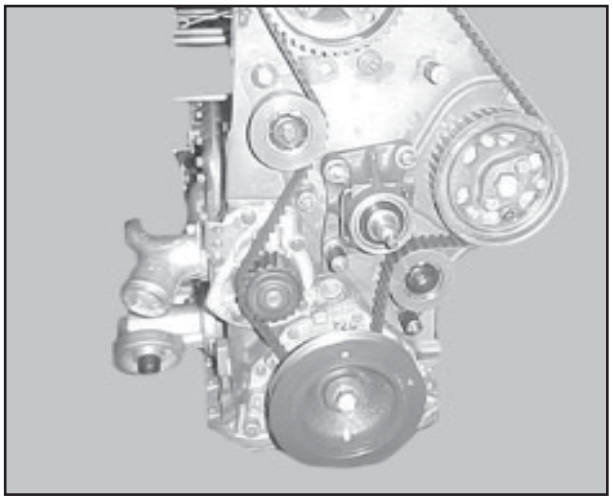


Fig. 33

Remove

- Oil filter and filter mounting adaptor. Refer figure 34.
- Oil cooler heat shield.
- Oil cooler.

Note : Do not loosen 4 screws in the centre.

- Water pump. Refer figure 35.
- A/C compressor mounting bracket. Refer figure 36.
- Water elbow.
- Power steering pump mounting bracket. Refer figure 37.

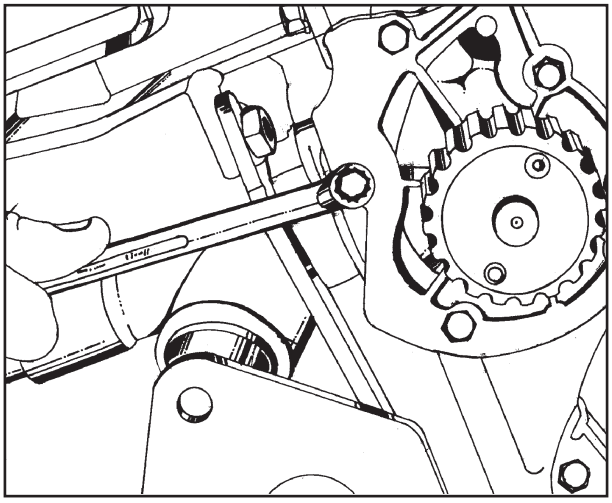


Fig. 35

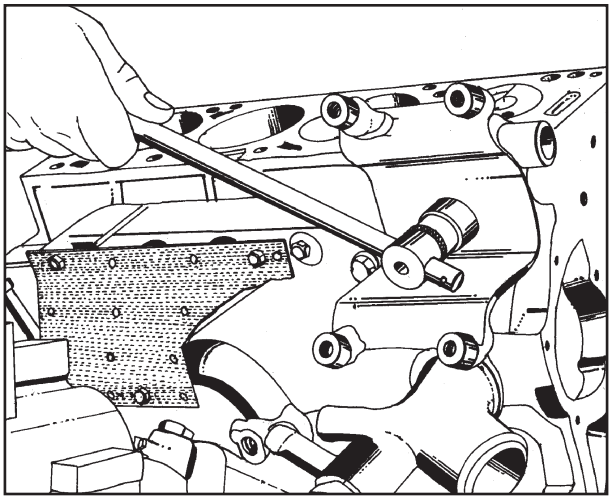


Fig. 36

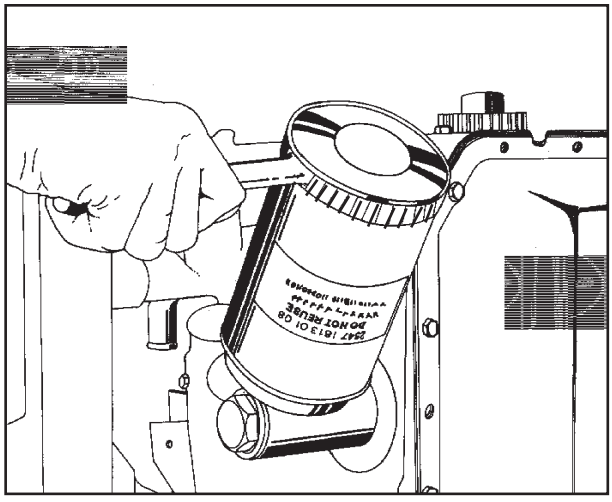


Fig. 34

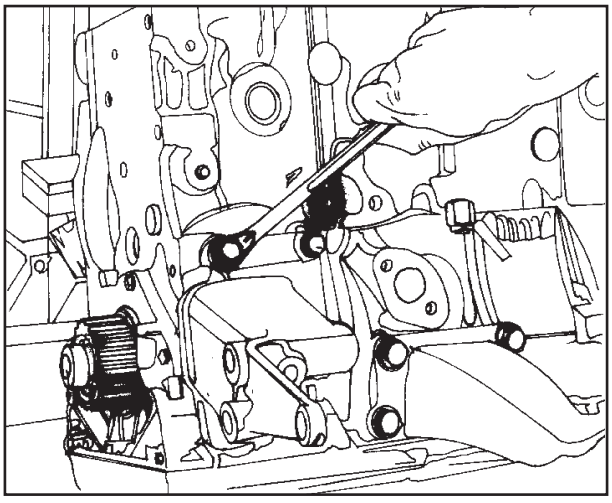


Fig. 37

Uniformly and evenly unscrew oil sump mounting screws and remove oil sump. Refer figure 38.

Unscrew and remove oil pump mounting bolts.

Tilt oil pump towards front end and remove chain from oil pump drive sprocket gear.

Remove oil pump. Refer figure 39, 40.

Remove ladder frame by removing setscrews. Refer figure 41.

Remove crank case front cover with crankshaft front oil seal. Remove oil seal. Refer figure 42.

Remove oil pump drive chain.

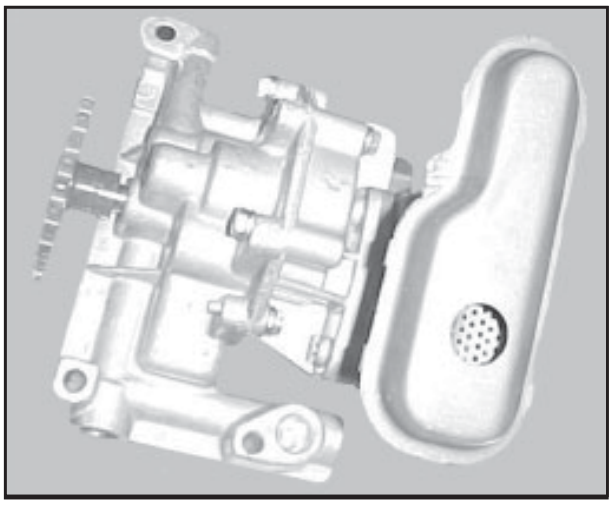


Fig. 40 *Oil Pump assembly*

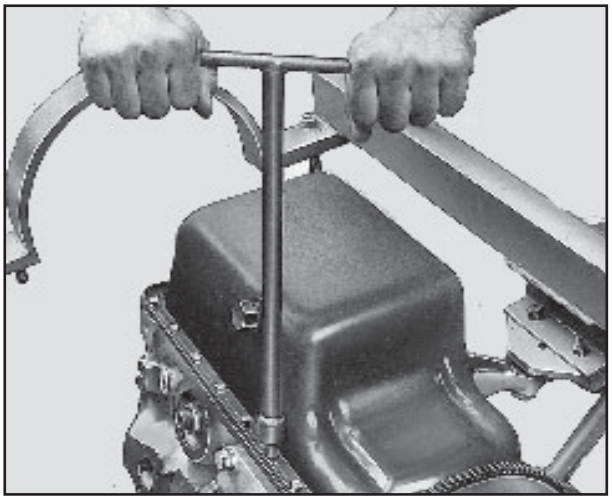


Fig. 38

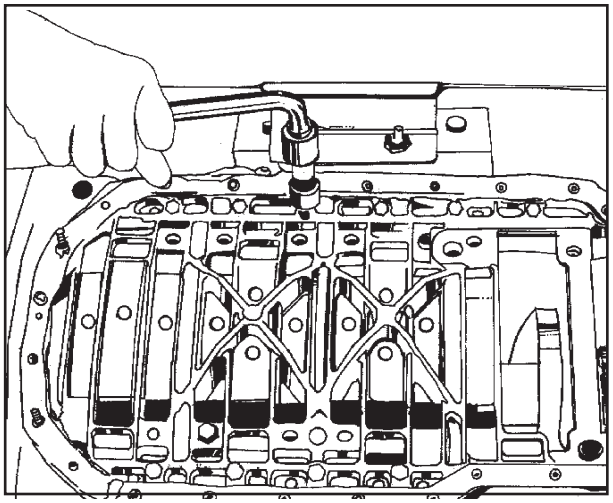


Fig. 41

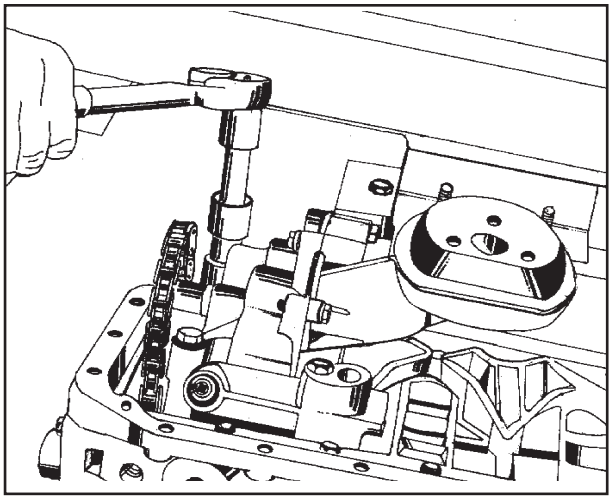


Fig. 39 *For 4 x 2 Vehicle*

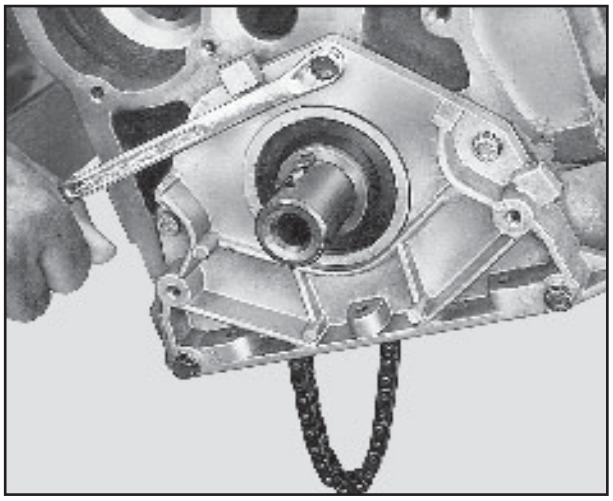


Fig. 42

Carefully remove combustion deposits on top end of cylinder bores, preferably by a broken piston ring or by ridge cutter.

Turn crankshaft and bring a pair of piston to BDC.

Unscrew the connecting rod bearing cap mounting nuts. Refer figure 43.

Remove connecting rod bearing caps with bearing shells.

Push these piston assemblies out of cylinders using wooden handle of mallet.

Remove connecting rod bearing shells and duly mark them with paint on their backs.

Assemble connecting rod bearing caps to their respective connecting rods.

Verify serial numbers on connecting rod bearing caps and connecting rods.

Remove remaining pair of piston in same manner.

Remove piston pin spring clips with suitable plier. Refer figure 44.

Remove piston pin from piston by pushing them out using soft drift. Refer figure 45.

Remove connecting rod.

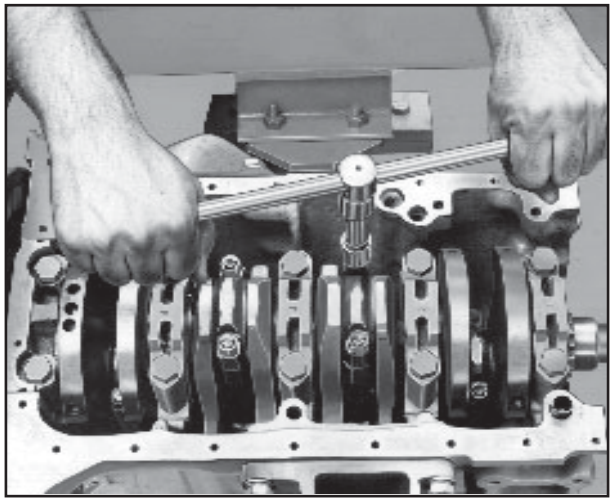


Fig. 43

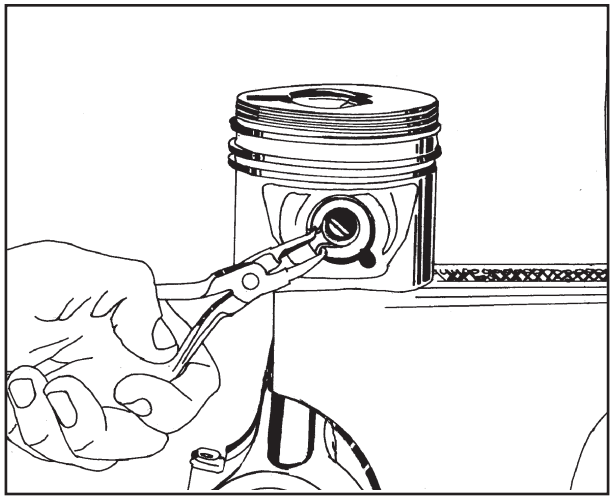


Fig. 44

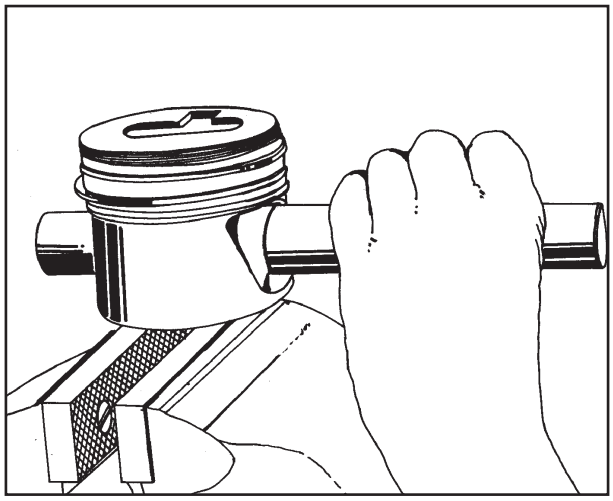


Fig. 45

KEEP PISTON AND PISTON PIN IN SETS.

Unstake lock plates for flywheel mounting screws.

Unscrew flywheel mounting screws.

Remove flywheel. Refer figure 46.

Unscrew and remove main bearing cap mounting bolts. Refer figure 47.

Remove main bearing caps with bearing shells.

Remove crank shaft with rear oil seal. Refer figure 48.

Remove crank shaft main bearing shells and thrust washers from crank case. Duly mark main bearing shells with paint on their backs.

Assemble main bearing caps to their respective positions in crank case.

Remove oil pump drive sprocket gear from crank shaft using puller, 2654 5890 03 05. Refer figure 49.

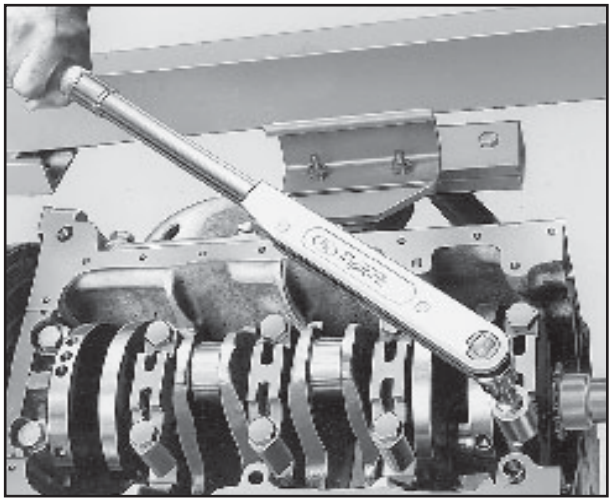


Fig. 47

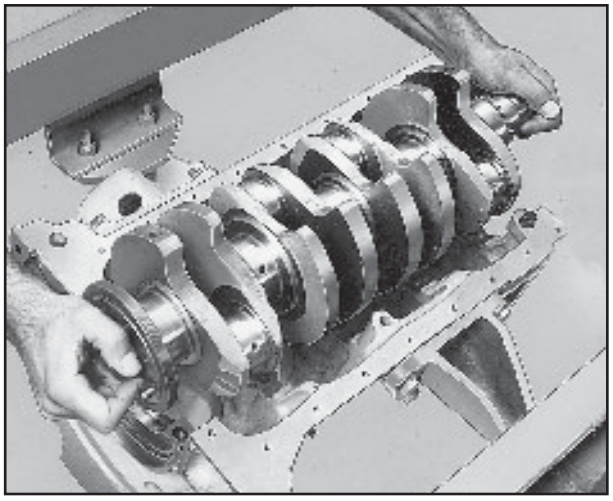


Fig. 48

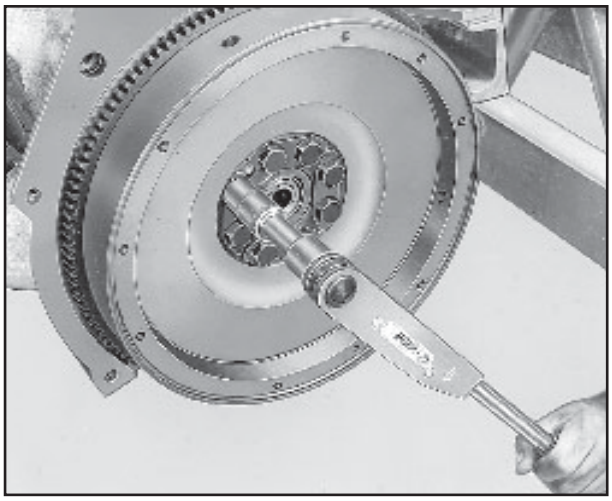


Fig. 46

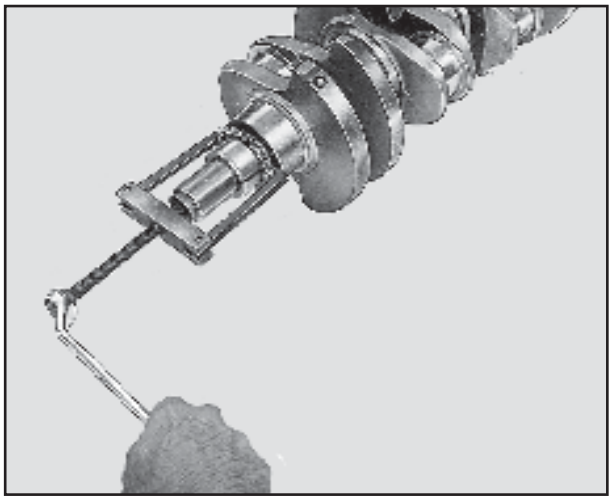


Fig. 49

Remove drive shaft spigot bearing from crank shaft using puller, 2654 5890 03 06. Refer figure 50.

Unscrew banjo bolt and remove assembly piston cooling nozzles from cylinder crank case.

CYLINDER HEAD DISMANTLING

Remove

- Glow plugs. Refer figure 51.
- Injector over flow hoses.
- Injectors with flame guard, flame guard washer and sealing washer. Refer figure 52.

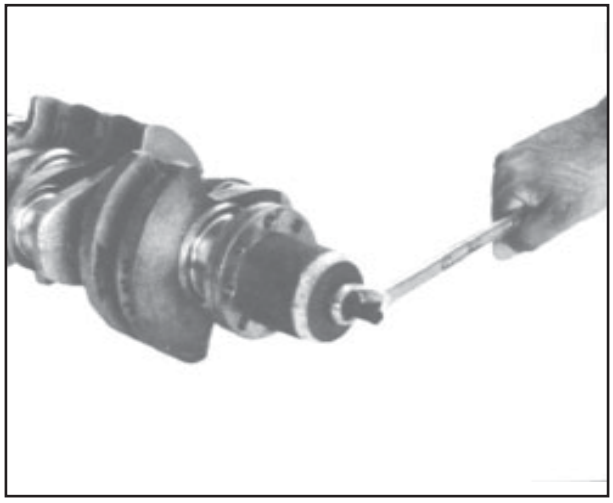


Fig. 50

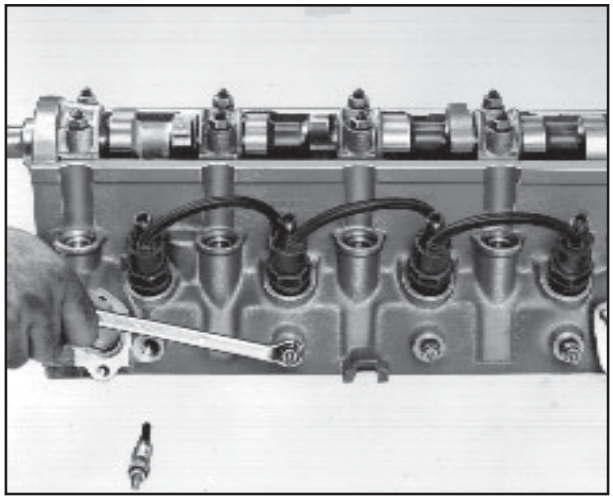


Fig. 51

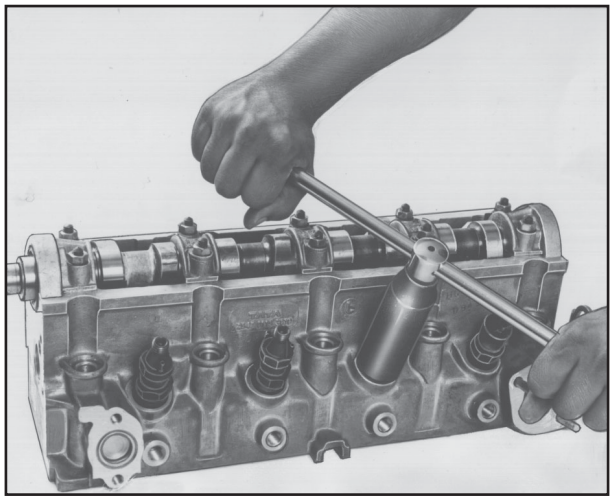


Fig. 52

Unscrew cam shaft bearing cap mounting nuts (first 5th and 1st caps, next 4th and 2nd caps, lastly 3rd cap.) Refer figure 53.

Remove cam shaft bearing caps.

Remove cam shaft with oil seal.

Remove tappets and shims and place them carefully in correct sequence. Refer figure 54.

Fit support rail, 2654 5890 05 06 to cylinder head. Refer figure 55.

With spring compressor, 2654 5890 05 07 compress valve springs and remove valve lock halves. Refer figure 56.

Remove valve lock retainers, valve springs, valve spring seats and valves. Place them in correct sequence.

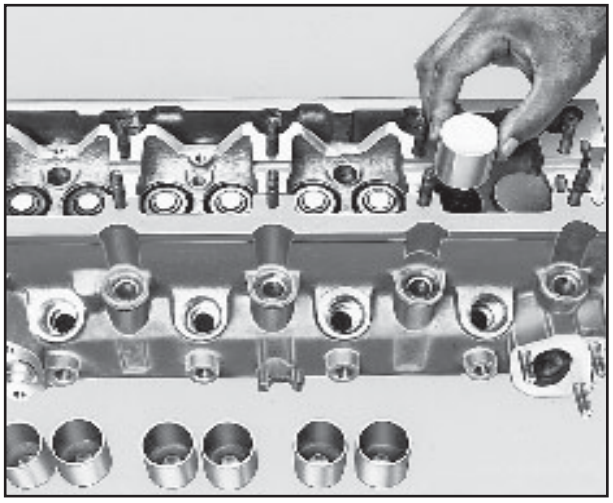


Fig. 54

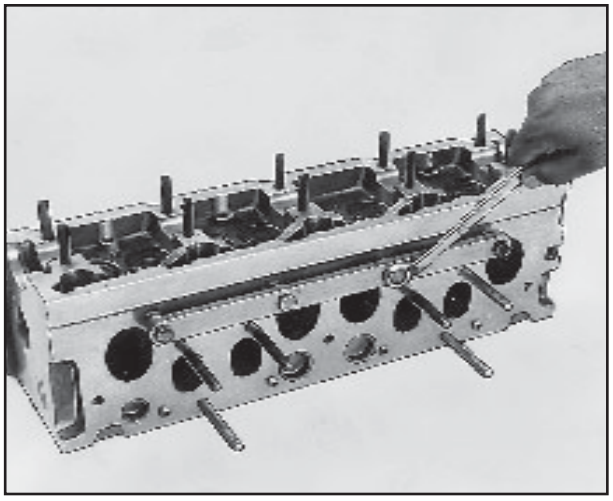


Fig. 55

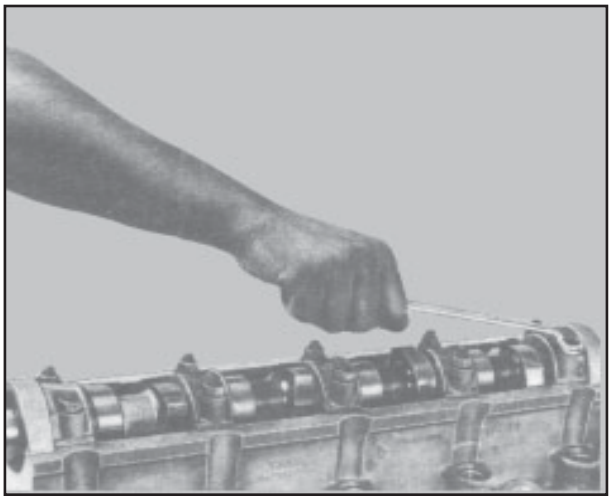


Fig. 53

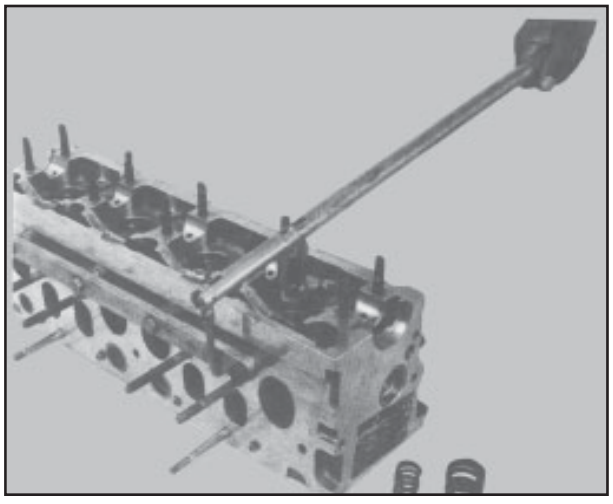


Fig. 56



TIGHTENING TORQUES

Description	Torque kgm.
Main bearing cap bolts M12x1.5	11
Connecting rod cap nut M9x1	5
Cylinder head screws M12x1.5 (as per the procedure prescribed).	
First stage	5.
Second stage	7.
Third stage	10.5
Screw plug for oil hole in cylinder head M 12x1.5	3
Injector to cylinder head	9
Cylinder head cover nuts M6	$0.8^{+0.2}$
Screw plug for oil hole near oil pump M 14x1.5	5
Oil sump screw M6.	0.8
Front lower cover to front cover M6	1
Sealing plug for oil gallery, front and rear M14x1.5	3.5
Screw plug for water hole in cylinder head M 8x1	2
Oil sump drain plug M16x1.5	5 ± 1
Assy. front cover to cylinder crankcase screw M6	1
Front lower cover to cylinder crankcase M6	1
Plug for TDC checking hole	3
Flywheel mounting screw M10x1	5
Crankshaft pulley to crankshaft bolt M14x1.5	$4 + 60^0$
Belt tensioner adjuster bolt M8	2
Timing belt idler and bearing housing to crankcase M8	2.3
Nut for drive belt tensioner	2
Camshaft gear to camshaft screw M10	4.5
Camshaft bearing cap mounting nuts M8	1.5
Assy. support to cylinder crankcase screw M8	2.3
FIP to support bracket nut M8	2.3
Flange to gear for locking screw M8	1.2
FIP gear to FIP shaft nut	5
Cap nuts on high pressure line	2
Air filter to air inlet elbow M8	2.5
Stay to air filter screw M6	0.6
Stay cylinder head screw M8	1

Description	Torque kgm.
M12 Screw/bolts used on fuel filter mounting bracket	8
Exhaust manifold on cylinder head nut M8	$2^{+0.3}$
Inlet manifold on cylinder head cap screw M8	2
Air inlet elbow to inlet manifold screw M8	2
Starter motor on flywheel housing M10	3
Alternator bracket to cylinder crankcase bolt M8	2.3
Alternator to bracket bolt M10	2
Clamp to support fip screw M8	2.5
Clamp to alternator screw M10	3
Glow plug to cylinder head	2.2
Glow plug connections	0.4
Oil pump on cylinder crankcase	1.5
Assy. strainer to assy. housing screw M6	1
Oil pressure switch on cylinder crankcase	3
Oil cooler boit M8	3.2
Assy. heat exchanger to oil cooler cover M8	$2^{-0.5}$
Sealing plug for water drain hole AM14 x 1.5	4
Piston cooling nozzie mounting screw	1
Fan mounting bolts M8	3.5
Water pump to cylinder crankcase screw M6	1
Thermostat housing to cylinder head nut M8	0.8
Thermostat cover to thermostat housing nut M6	0.8
Water inlet elbow to cylinder crankcase screw M8	1.5
For clamping assy. pipe line screw M8	2
Temperature transducer on thermostat housing	1.5
Engine support arms on cylinder crankcase M10	4
Lifting hook to cylinder head screw M8	2.5
A.C. compressor (SVL) to a/c compressor bracket (M8, 4 nos.)	2.4 to 3.6
A.C. compressor bracket to crankcase (M10, 4 nos.)	$6^{+0.5}$
A.C. compressor (subros) to A.C. compressor bracket. (M8, 4 nos.)	$3.2^{+0.3}$
Engine support front to front mounting pad bolt M12x1.5	7
Gear case cover to rear mounting pad nut M10	4
Clutch housing to cyl. block M10	4.6
Fan shroud to radiator screw M6	1
Radiator rnounting screw M8	2

REPAIR DATA

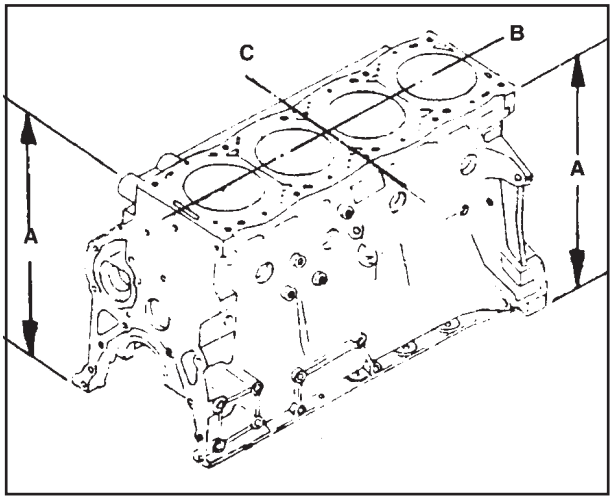


Fig. 57

CYLINDER BLOCK

Pressure test cylinder block for leakages of water at a temperature of and at a pressure of	70° to 80° C and 5 bar
Height of crank case (Dimension A)	303.9/304.1 mm
Crankshaft axis from crankcase top surface (above dimension with MB caps and front cover installed)	236.3/236.38 mm
Maximum permissible unevenness of crankcase mating surface with cylinder head	Length wise 'B' 0.030 mm Cross wise'C'0.015 mm
Maximum permissible out of parallelism between crankcase top and bottom machined surface	0.2 mm
Maximum permissible shift in perpendicularity of cylinder bore from crank shaft axis when checked at 200 mm from crank shaft center line	0.04 mm
Maximum permissible taper and ovality of cylinder bore	0.01 mm
- Liner inner dia	83 ± 0.005
- Cylinder block parent bore to be finished to size	86.00 to 86.02 mm
- Honing of cylinder bores -	Please refer separate section on liner

PISTON & PISTON BORE SIZES

Stage	Cylinder Bore dia mm	Piston stamped
Standard	83.00 83.01 83. 02	A B C
Standard I	83.03 83.04 83.05	A1 B1 C1

Piston to bore clearance 0.07 to 0.09 mm

PISTON RINGS

Type of ring	Ring thickness mm	Lateral clearance in piston groove mm	Butt clearance in cylinder bore mm
1st Compression	2.5	0.05/0.082	0.25/0.50
2nd Compression	1.970/1.990	0.04/0.08	0.3/0.5
3rd Oil control	2.975/2.990	0.03/0.065	0.1/0.3
Maximum permissible difference in weights of piston with pin and rings in one engine			1.5 gm

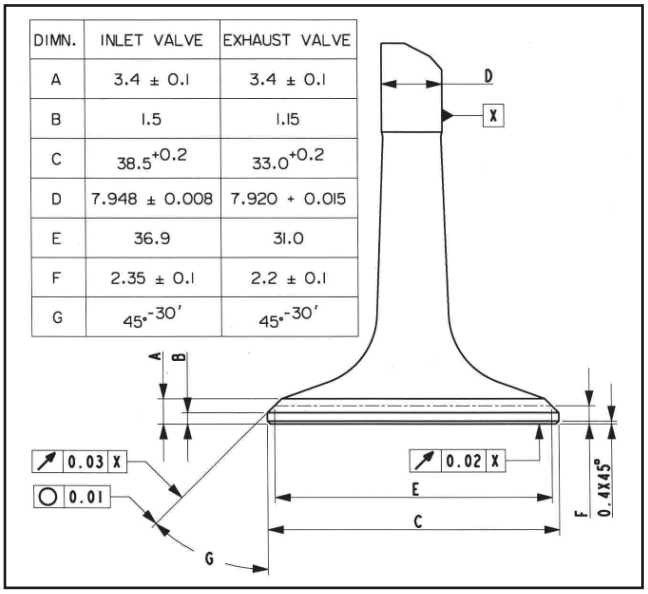


Fig. 58 Valve Dimension

VALVE / VALVE SEAT DIMENSIONS (in mm)

	INLET	EXHAUST
Maximum run out of valve face with respect to valve stem	0.2	0.2
Maximum run out of valve seat with respect to valve stem	0.03	0.03
Distance of valve head from cylinder head mating surface with crank case	0.7/0.95	0.7/0.95
Valve stem clearance	0.05 / 0.087	0.06 / 0.097
Permissible ovality of valve seat	0.01	0.01

PISTON PROJECTION	GASKET THICKNESS	IDENTI-FICATION
0.45 to 0.55 mm	1.5 mm	1Notch
0.56 to 0.65 mm	1.6 mm	2 Notches
0.66 to 0.75 mm	1.7 mm	3 Notches

Max. difference between piston projections of any two pistons in crank case should not exceed 0.12 mm.

MLS gasket (Multi layer steel) cylinder head gaskets are available in 1.5 mm / 1.6 mm thickness only.

In this case gasket thick can be identified by part no. punched on the gasket.

For 1.5 mm thick : 60-33155-40

For 1.6 mm thick : 60-33155-50

CYLINDER HEAD

Permissible unevenness of cylinder head mating surface	Length wise 0.03 mm Cross wise 0.015 mm

VALVE GUIDES

Stage	Valve guide bore in cylinder head mm	Valve guide out side diameter mm
Standard Standard 1	13.98/13.998 14.008/14.08	14.028/14.046 14.278/14.296

Valve guide inside diameter	7.98/7.995 mm
Valve guide installation height (from washer seat location for spring)	15.8/16.3 mm

VALVE SEAT

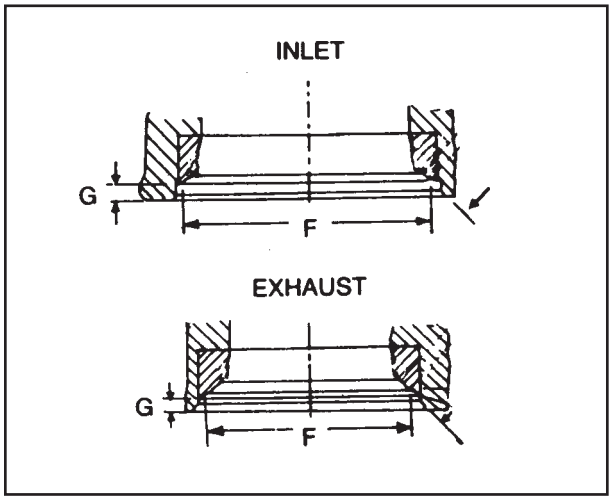


Fig. 59 Valve seat Dimension

VALVE SEAT DIMENSIONS

		INLET	EXHAUST
Valve seat angle (ø)		45^0 -15'	45^0 -15'
Valve seat dia in cylinder head 'F'	mm	36.9	31.0
Distance between cylinder head mating surface with crank case to valve seat in cylinder head 'G'	mm	1.85	1.95
Maximum run out of valve seat in cylinder head with respect to valve guide axis	mm	0.04	0.04

VALVE SEAT INSERTS

Valve seat insert & bore dia in cylinder head

Stage	Valve seat insert bore in cylinder head mm	Valve seat insert out side diameter mm
INLET		
Standard	39.9/39.925	40.08/40.105
Standard 1	40.2/40.225	40.38/40.405
EXHAUST		
Standard	33.95/33.975	34.08/34.105
Standard1	34.25/34.275	34.38/34.405

	Depth of bore in cylinder head for valve seat insert mm	Thickness of valve seat insert mm
INLET & EXHAUST	9.0/9.2	7.2/7.4

VALVE TIMING

Inlet opens	-	27^0 B.T.D.C.
Inlet closes	-	49^0 A.B.D.C.
Exhaust opens	-	72^0 B.B.D.C.
Exhaust closes	-	23^0 A.T.D.C.
Fuel injection	-	Refer the FIP timing setting procedure

TAPPET & TAPPET BORE DIMENSIONS

	Out side Diameter of tappet mm	Tappet bore in cylinder head mm
Standard	35.45/35.466	35.5/35.525
Standard I	35.65/35.666	35.7/35.725

Diametral clearance of tappets in cyl. head bores 0.034 to 0.075 mm

CRANKSHAFT

Stage	Crank case main bearing bore diameter with bearing shell mm	Crank shaft main bearing journal diameter mm
Standard	60.04/60.06	59.98/60.0
Standard1	59.94/59.96	59.88/59. 9
Repair 1	59.79/59.81	59.73/59.75
Repair 2	59.54/59.56	59.48/59.5

Stage	Connecting rod big end bore diameter with bearing shell mm	Crank pin journal diameter mm
Standard	50.02/50.04	49.98/49.995
Standard1	49.92/49.94	49.88/49.895
Repair 1	49.77/49.78	49.73/49.745
Repair 2	49.52/49.54	49.48/49.495

Stage	Width of 4th main bearing journal mm
Standard	27.0/27.052
Standard1	27.1/27.152
Repair 1	27.2/27.252

Width of 1st, 2nd, 3rd and 5th main bearing journals	27.0/27.2 mm
Width of crank pins	24.5/24.7 mm
Thickness of 4th main bearing thrust washers	2.72/2.67/2.62 2.57/2.52 mm
End play of crank shaft	0.07/0.252 mm
Fillet radius of crank pins	1.75/2.25 mm
Fillet radius of main journals	2.25/2.75 mm
Maximum permissible taper and ovality of main bearing journals	0.005 mm
Maximum permissible taper and ovality of crank pins	0.005 mm

Maximum permissible run out of 2nd, 3rd and 4th main bearing journals when supported at 1st and 5th main bearing journals	0.1 mm
Maximum permissible out of parallelism between crank pin and main bearing journal axis	0.01 mm
Pretension of main bearing shells	0.067/0.134 mm
Hardness of crank shaft main bearing and crank pin journals	53 to 59 HRC
Main bearing parent bore dia	63.72/63.739 mm
Maximum permissible taper of main bearing parent bore	0.01 mm
Maximum permissible ovality of main bearing parent bore	0.03 mm
Main bearing clearance	0.04 to 0.08 mm

CAMSHAFT

	Camshaft bearing journal bore diameter in cylinder head mm	Camshaft bearing journal diameter mm
Standard Standard1	28.0/28.021 27.9/27.921	27. 937/27.95 27.837/27.85

Bore dia in 1st & 5th cap for front & rear oil seals	50.0/50.025
Maximum permissible run out of cam shaft bearing journal	0.025 mm
Maximum permissible axial play of cam shaft in installed condition	0.08 - 0.15 mm
Camshaft bearing clearance	0.03 to 0.064 mm
Hardness of cam lobes	57 - 62 HRC

CONNECTING ROD (Dimensions)

Connecting rod small end

Stage	parent bore diameter mm	bush inside diameter mm
Standard Standard1	31.0/31.025 31.2/31.225	28.02/28.033

Maximum permissible taper and ovality of connecting rod small end parent bore	0.01 mm
Connecting rod small end bush inside diameter (to be finished after installation) (Piston pin oiled has thumb push fit in small end bush)	28.02/28.033 mm
Maximum permissible out of parallelism (bend) between connecting rod small end and big end parent bores	0.05 mm
Center to center distance between connecting rod small end and big end parent bores	145.0/145.040 mm
Maximum permissible twist of connecting rod measured at a distance of 50 mm from centre line of con-rod	0.05 mm
Connecting rod big end parent bore diameter	53.69/53.709 mm
Maximum permissible taper and ovality of connecting rod big end parent bore	0.01 mm

Maximum permissible taper and ovality of con. rod small end bush inside dia	0.005 mm
Pre-tension of connecting rod big end bearing shells	0.060/0.120 mm
Maximum permissible difference in weight of connecting rods in one engine	5.0 gm
Connecting rod big end axial play	0.1/0.4 mm
Connecting rod big end clearance	0.04 to 0.076mm
Small end clearance	0.007 to 0.025 mm

PRECOMBUSTION CHAMBER

Pre-combustion chamber collar out side diameter	32.043/32.073 mm
Pre-combustion chamber collar bore in cylinder head	32.0/31.975 mm
Height of pre-combustion chamber collar	4.02/4.03 mm
Height of pre-combustion chamber collar bore in cylinder head	4.0/4.02 mm
Projection of pre-combustion chamber above cylinder head mating surface with crank case	0 / 0.03 mm

INJECTION NOZZLE

Nozzle opening pressure (bar)

	LUCAS	MICO
New	143 to 152	135 to 140
Old	At least 140	At least 132

Maximum permissible variation in injection nozzle pressure
LUCAS - 140 - 150 bar & MICO - 132 - 143 bar

OIL PUMP (dimensions)

Maximum distance from drive gear face to sprocket face.	86.3 mm
Distance between drive gear and drive shaft end	0.1/0.2 mm
Axial play of assembly drive shaft	0.04/0.08 mm
Backlash between oil pump gears	0.15/0.25 mm
Bore diameter in oil pump housing for drive gear shaft	12.0/12.01 mm
Bore diameter of sprocket gear	11.95/11.96 mm
Bore diameter of drive gear	11.945/11.96 mm
Shaft diameter of drive gear	11.975/11.985 mm
Shaft diameter of driven gear	11.925/11.935 mm
Bore diameter for driver gear shaft in housing	11.9/11.91 mm

Oil Pump Pressure Relief Valve

- Opening Pressure	7 $\pm$ 0.5 bar

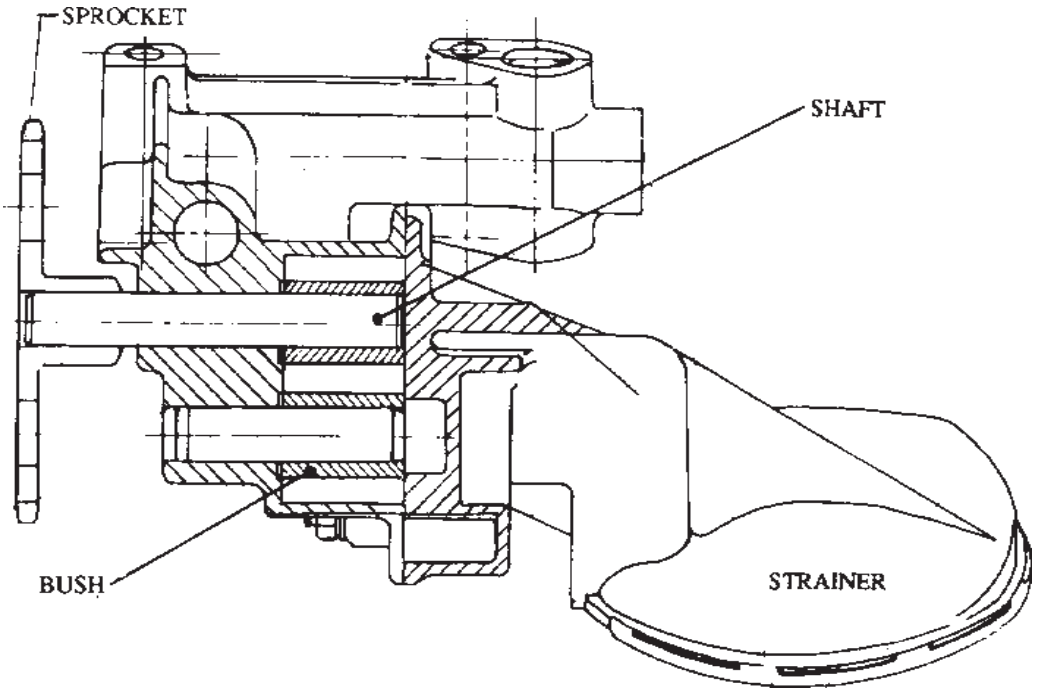


Fig. 60 oil pump assembly (For 4x2 vehicles)

PISTON COOLING NOZZLE

- Nozzle opening pressure	1.4/1.9 bar
- Jet height at pressure of 2.3/1.7 bar	144 mm
- Flow rate with SAE-30 oil at 40^{0}C and @ 3 bar	0.8/1.1 lpm

OIL PRESSURE SWITCH

NC contact opening pressure	0.6/0.9 bar

THERMOSTAT

- Start opening temperature	$83^{0} \pm 2^{0}$ C at 0.1 mm (For exports vehicle)
- Full open temperature	$95^{0} \pm 2^{0}$ C at 8.0 mm valve travel
- By pass port closed at or before	93^{0}C
- Leakage through main valve (including seepage hole) at room temperature and pressure of 1 kg/cm2	180 to 250 lpm (Max)
- Maximum leakage through bypass at full open temperature or main flow rate of 130 lpm	1.5 lpm

CYLINDER BLOCK

Check water jackets and oil passeges for leaks/cracks at air pressure of 5 bar under water.

Check block for cracks by pressure testing method. Refer Figure 61

Check crank case mating surface with cylinder head for unevenness with help of straight edge and feeler gauge. Refer Figures 62 & 63

If necessary grind this surfaces just to clear unevenness.

Ensure that the minimum height of crank case is not less than 303.9 mm. Cylinderblock needs to be replaced if height is less than this limit. Thoroughly clean main bearing caps and corresponding machined surfaces of crank case.

Install main bearing caps without bearing shells in their respective positions on crank case.

Ensure that serial numbers on crank case and main bearing caps are matching. Also caps are in serial order and notches for bearing shells are on same side.

Tighten main bearing cap mounting bolts to specified torque. Refer Figure 64

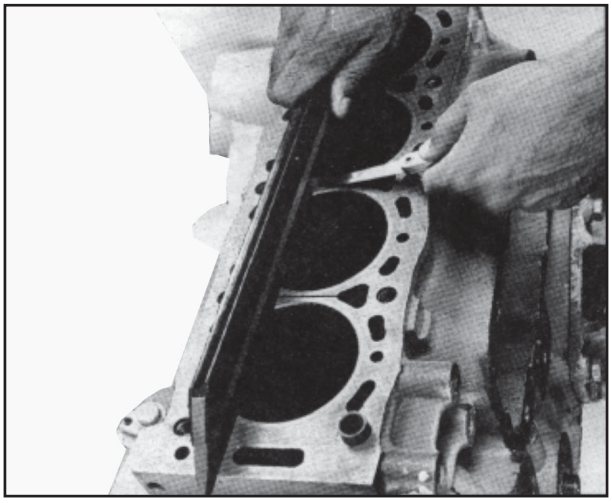


Fig. 62

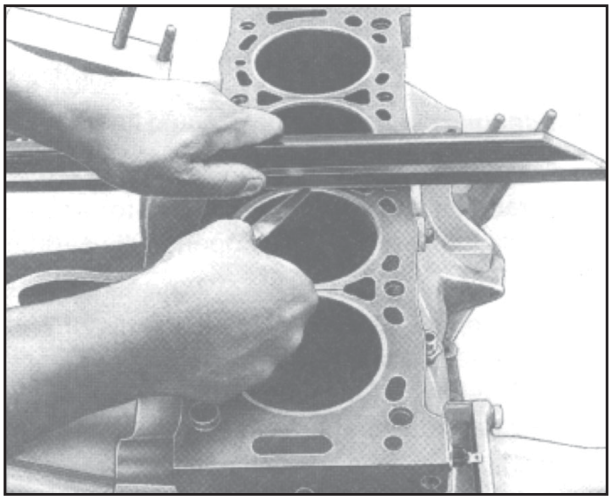


Fig. 63

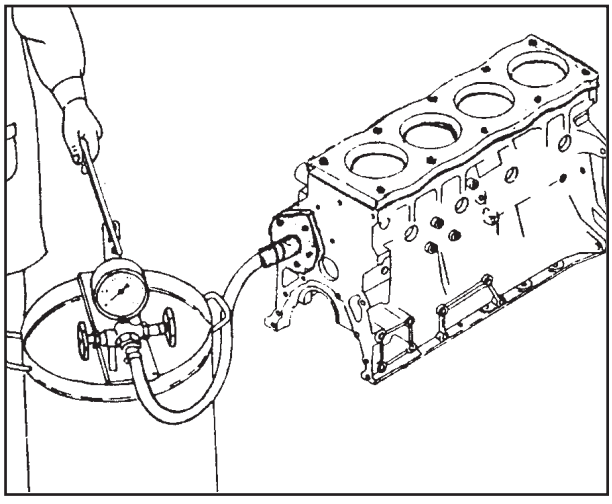


Fig. 61

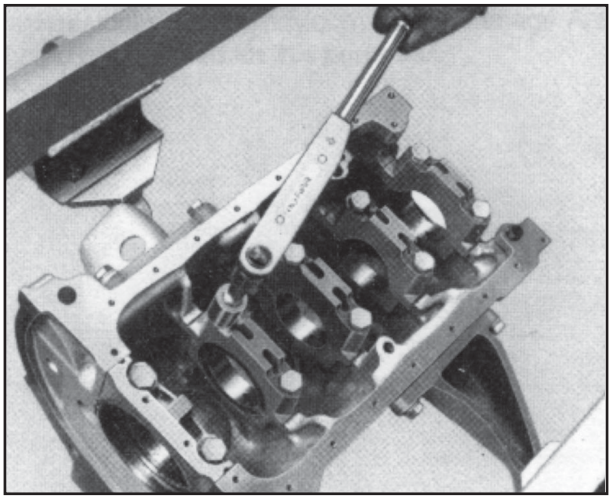


Fig. 64

Check crank case main bearing parent bore dimensions - Refer Figure 65

Since a slight clearance exists between main bearing cap dowel pins and corresponding dowel holes in crank case, it is possible that main bearing cap once removed may be installed off center, by which dimension of main bearing parent bore will be different in different directions. If there is a difference noticed in main bearing parent bore dimensions, main bearing cap can be centralized by lightly tapping it with mallet in required direction after loosening main bearing cap mounting bolts.

If main bearing parent bore is slightly more than maximum permissible limits, it is possible to reclaim crank case. Main bearing cap mating surface may be slightly faced after removing dowels. Parent bore should then be finished on a suitable line boring machine after fitting new dowels.

Install new pairs of main bearing shells according to main bearing journal diameter. Make sure that securing lugs of bearing shells are properly seated in grooves of crank case and main bearing caps.

Install main bearing caps with bearing shells in their respective positions on crank case.

Tighten main bearing cap mounting bolts to specified torque - Refer Figure 66

Measure main bearing bore dia. - Refer Figure 67

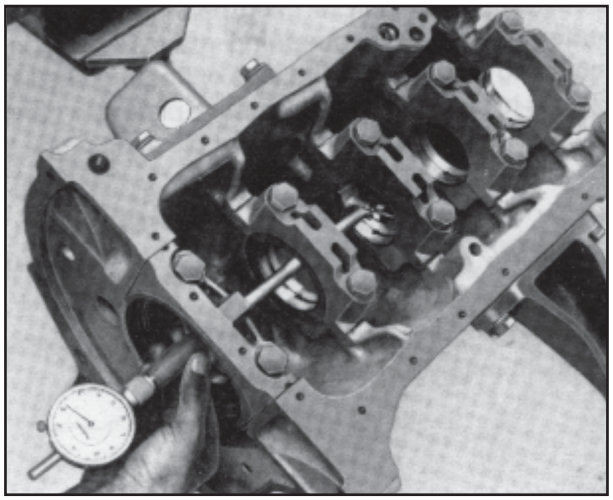


Fig. 65

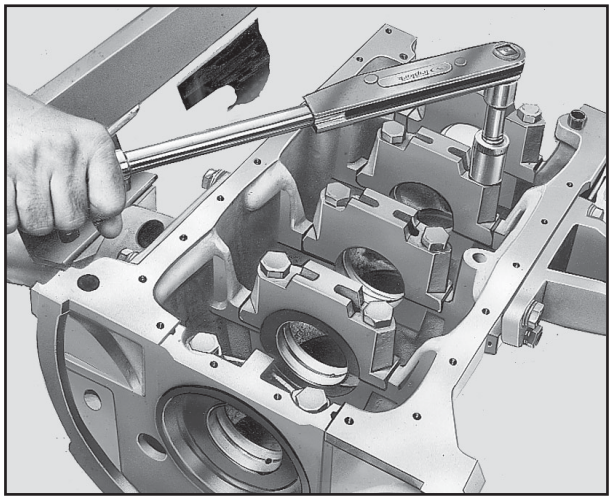


Fig. 66

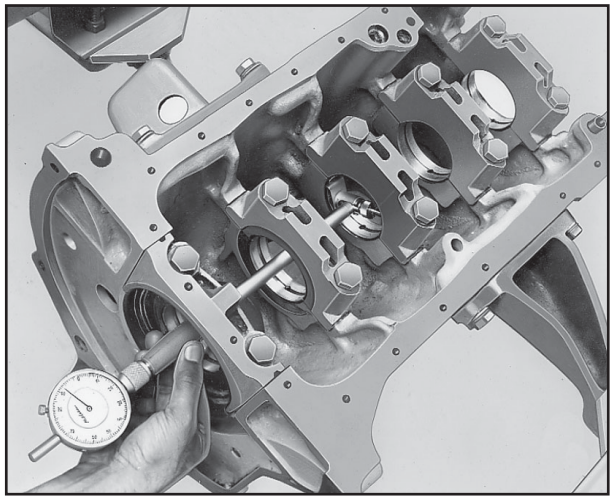


Fig. 67

Measure pre tension of main bearing shells with a feeler gauge after loosening corresponding main bearing cap bolts opposite side of bearing shell lug.

Main bearing shells are precision finished and should not be bored or scraped.

Select new pair of thrust washer according to crank shaft 4th main journal width.

CYLINDER BORES

Clean cylinder bores thoroughly.

Check cylinder liner dia., taper and ovality.

Refer Figures 68 & 69.

If taper and ovality is found to exceed specified limits or liner is excessively worn out/scored cylinder liners are to be replaced.

REMOVAL, INSTALLATION AND MACHINING OF CYLINDER LINERS

Cylinder block should be pressure tested for cracks and leakages as per procedure. Cylinder block with cracks should be discarded.

REMOVAL

1. Keep cylinder block upside down on hydraulic press such that bore from which liner is to be removed lies clear in machine table slot.
2. Ensure that the block is resting squarely on machine bed.
3. Press out liners individually using drift, 2654 5890 01 03 and a suitable distance piece between press ram and drift. Make sure that distance piece is also seating squarely between drift and ram.

INSTALLATION OF LINERS IN CYLINDER BLOCK

Thoroughly clean bores of cylinder block.

Thoroughly clean liners.

Place cylinder block on hydraulic press ensuring that oil sump mating face is resting evenly and squarely on bed.

Do not smear oil on liners.

Place liner with proper orientation (matching minimum / maximum ovality axis) in cylinder bore

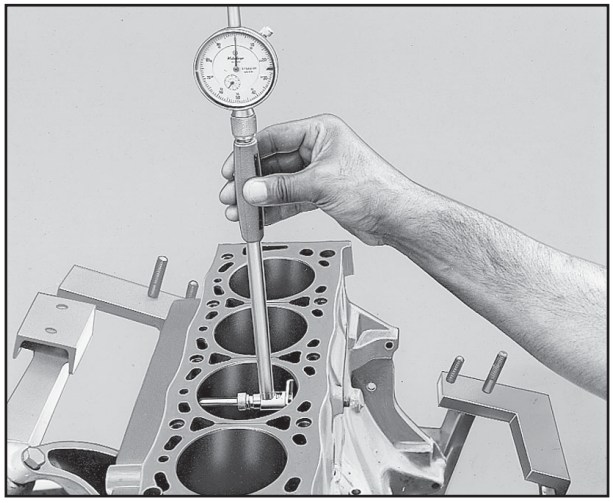


Fig. 68

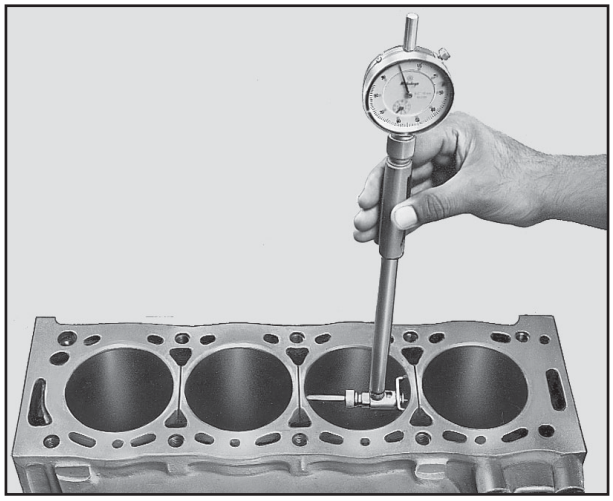


Fig. 69

and make it at right angles to cylinder block top surface in longitudinal and crosswise directions using precision tri-square.

Press liner using drift 2654 5890 01 02. Use a wooden spacer about 100 mm thick between press ram and drift. Pressing force should be within 4 to 6 tonnes.

Similarly, press all other liners.
Liners damaged during installation should be removed and replaced with new ones.

FINISHING OF CYLINDER BLOCK WITH LINER

Machine all bores to 82.915 to 82.945 mm diameter.

NOTE

It is very important that the axis of the bores are parallel to each other and are right angle to the axis of crankshaft. Permissible shift in perpendicularity of bore from crankshaft axis when checked at 200 mm from crankshaft centre line is 0.040 mm.

Therefore, we recommended use of pillar type boring and honing machines.

If portable boring bar is used, check and clean mating surface of boring bar and cylinder block and centralise boring bar as accurately as possible in bore.
Finish bores by honing to 83.00 ±0.005 mm diameter. Honing should be done in three stages as follows.

STAGE - I - ROUGH HONING

Use honing stone of grit 60. Honing speed should be approximately 100-120 rpm and approx. 50 double strokes per minute. Under these conditions leave about 0.02 mm material for second stage honing.

STAGE - II - BASE HONING

STICK SPECIFICATION - 39C8018 VKP TR 22 with pressure 3-4 kg/sq.cm. Honing speed should be approximately 50-60 rpm & 25 double strokes per minute. This operation should be completed in 15 double strokes.

STATE - III - PLATEAU HONING

STICK SPECIFICATION - 39C400 JVM1 TR 22 (GNO)

Honing speed should be approx. 50-60 rpm and 25 double strokes per minute. This operation should be completed in 5 to 8 double strokes with low pressure of 2.0 to 3.0 kg/sq.cm.

NOTE :- Adjust honing stick travel to ensure that stick projects by approx. 20 to 25 mm from top and bottom of bore during honing. Use plenty of kerosene during honing operation.

Clean cylinder block thoroughly and if engine assembly is not be taken up immediately, apply grease on machined surface of cylinder block.

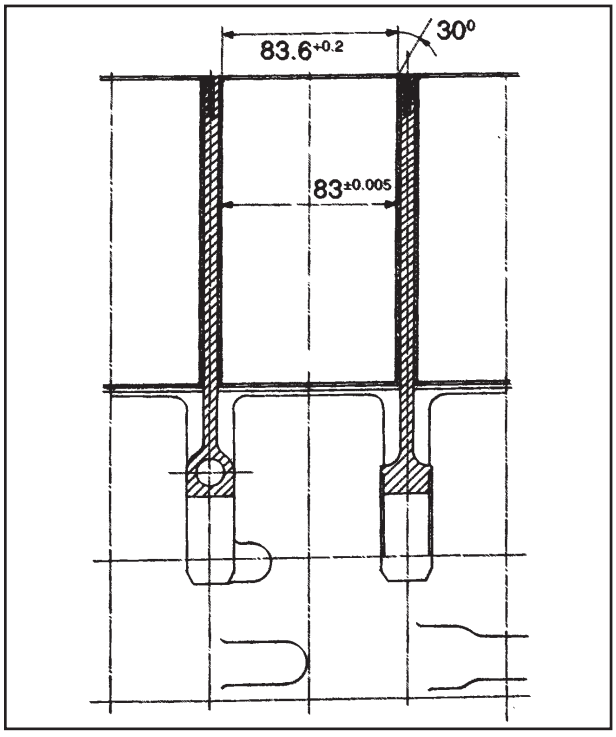


Fig. 70 - Cylinder block with liner

PISTONS AND PISTON RINGS

Please refer figures 71 & 74 for profiles of piston rings & piston. Remove piston rings from piston using ring expander.

Remove carbon deposits from piston. Clean piston and piston rings thoroughly.

Piston rings used :

Top - Moly coated

Middle - Taper faced

Bottom - Chrome plated conformable oil control ring

Identify all rings bore wise & tie them together. In case rings have to be re-used, they have to be installed in same pistons from which they were taken out.

Examine pistons for cracks, scoring, other damages, ring groove wear, piston pin bore wear, spring clip groove wear/damage etc.

Even if one piston has any of these defect, piston set has to be replaced as a whole.

Examine piston rings for scoring, lateral clearance in piston ring groove and butt clearance in cylinder bore. Refer Figures 72 & 73

Butt clearance of piston ring should be measured in unworn portion of cylinder bore.

Even in one piston ring has any of these defects, ring set has to be replaced as a whole.

Pistons have to matched as per size (Standard & Standard I) stamped on its head with respect to cylinder bore size.

Install piston rings in their respective positions using ring expander. Stagger piston rings gaps such that they are 120^0 apart.

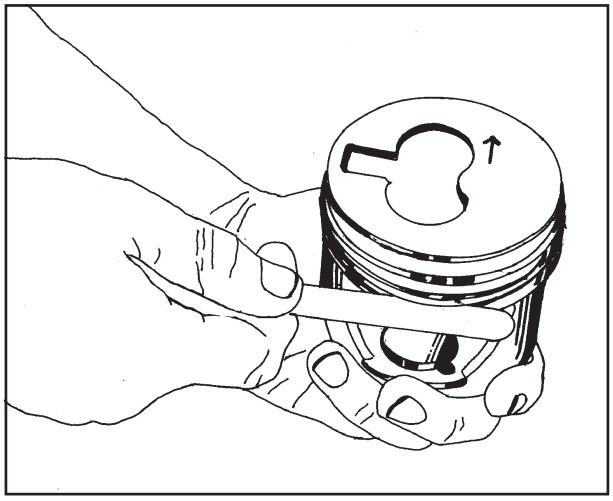


Fig. 72

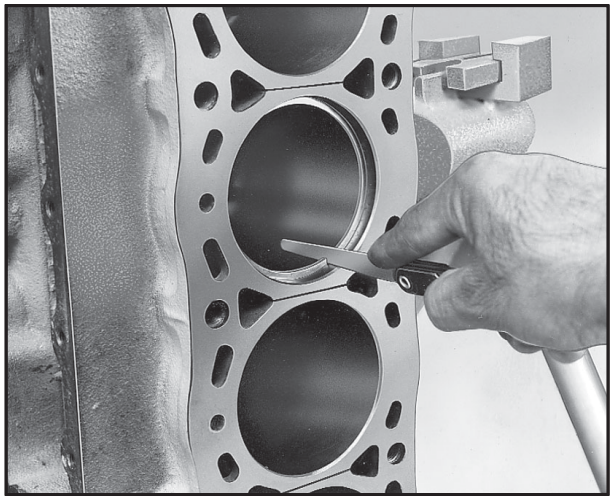


Fig. 73

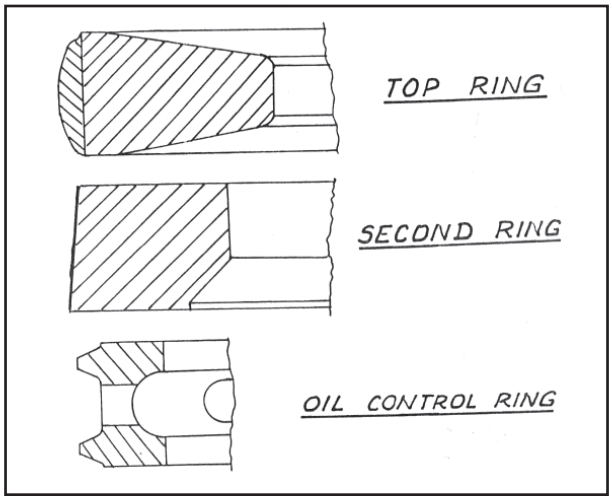


Fig. 71 - Piston ring profile

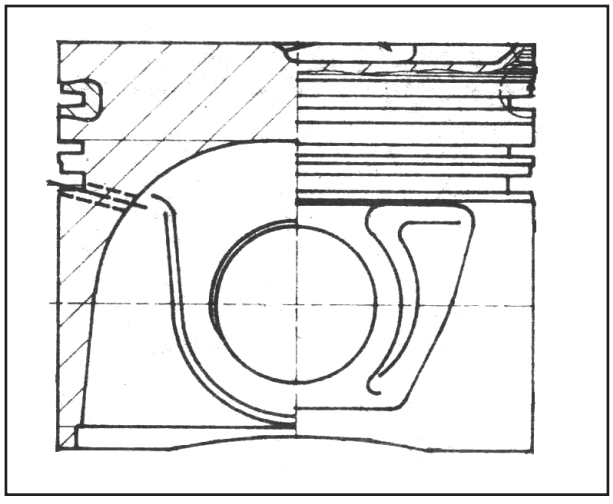


Fig. 74 - Piston profile

CYLINDER HEAD

Using a straight edge and feeler gauge, check cylinder head mating surface with crank case. Refer Figures. 75 & 76

If unevenness exceeds permissible limits, replace cylinder head.

Machining of cylinder head parting surface is not recommended.

If height of cylinder head is less than 139.9 mm it has to be discarded.

VALVES

Clean valves. Remove oil, carbon etc.

Valves with burnt heads, excessive scoring and wear on stem should be replaced.

Check valve head thickness. If it is less than specified limits replace valve. Valves have to be replaced as a set only.

Check valve seat run out with respect to valve stem.

Refer Figure 77 If it exceed specified limit replace valve. No attempt should be made to straighten bent valves. If valve is free from any other defects except worn out seat, then only it can be re-machined on valve grinding machine as follows:

- Clamp valve on grinding machine jaws as close as possible to valve head.
- Adjust grinding angle on graduated scale to achieve correct valve seat angle.
- Feed valve slowly towards grinding wheel until wheel just touches valve head.
- Grind at low feed until valve seat is just clean all around.

Note :

After grinding valve head thickness should not be less than specified values. Please refer page 32 for details.

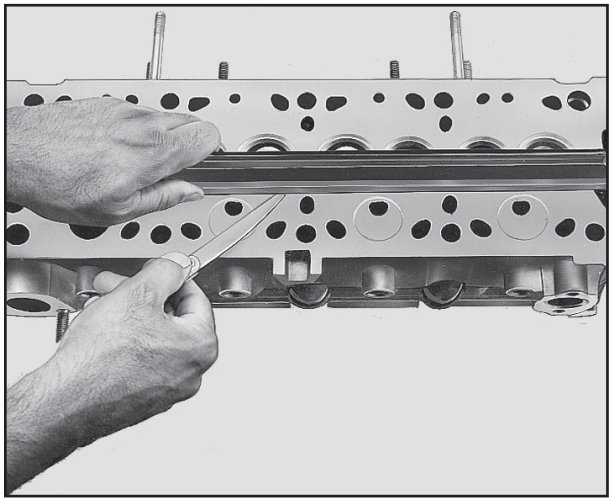


Fig. 75

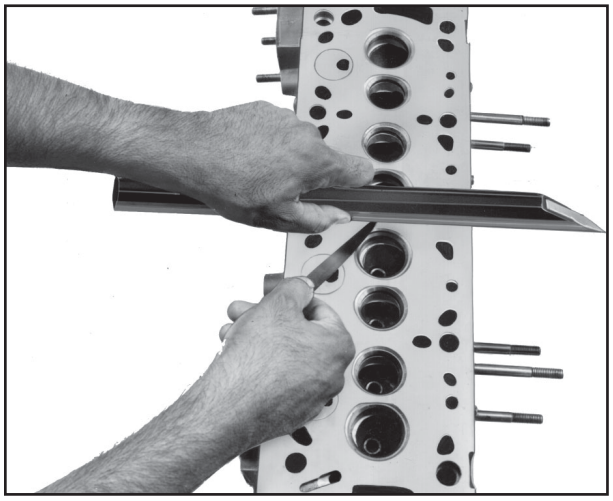


Fig. 76

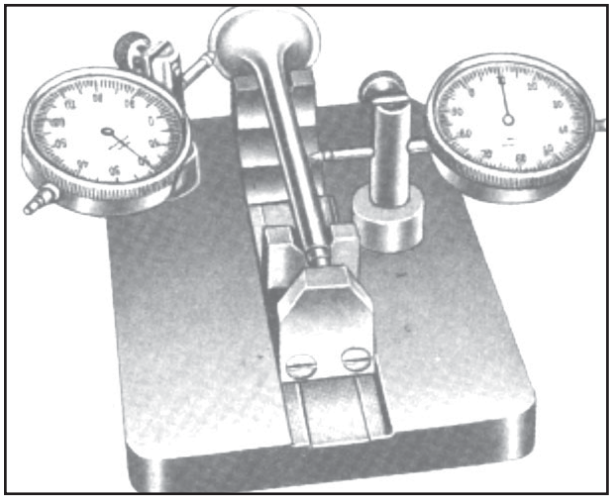


Fig. 77

VALVE GUIDES

In case of valve stem sticking in valve guide bore or excessive clearance between them, remove valve guide from cylinder head using drift 2654 5890 05 04. - Refer Figure 78

Remove valve guide seal. Check condition.

Check valve guide bore diameter in cylinder head. If necessary, ream valve guide bore to next over size.

Install matching size valve guide in cylinder head using drift, 2654 5890 05 04 and spacer, 2654 5890 05 05. Refer Figure 79.

It is desirable to ream (machine) ID of valve guides in installed condition (on cylinder head) to attain concentricity with tappet bore & to maintain their perpendicularity with cylinder head bottom face. Refer Figure 80.

Fit valve guide oil seals.

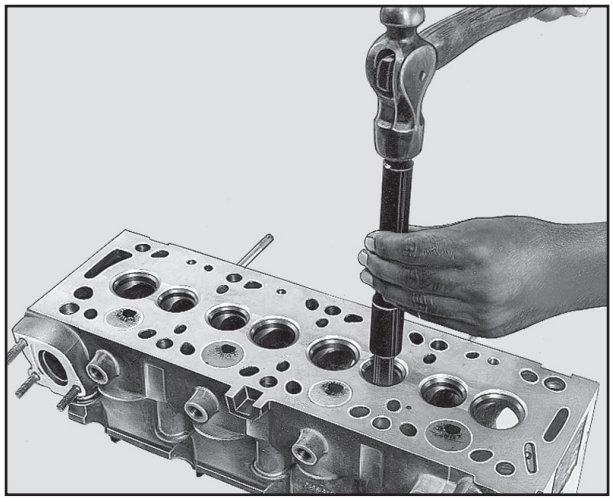


Fig. 78

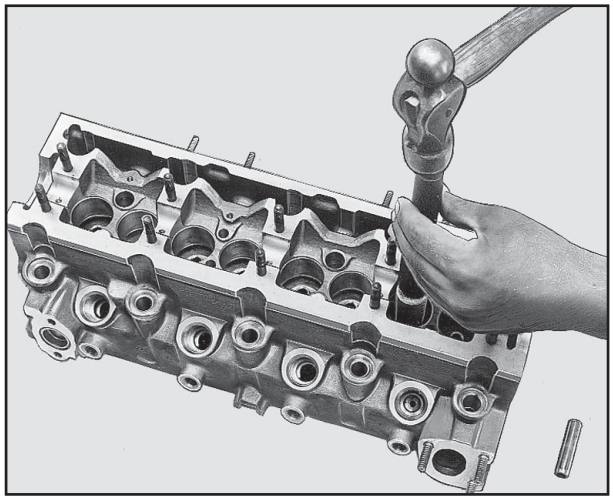


Fig. 79

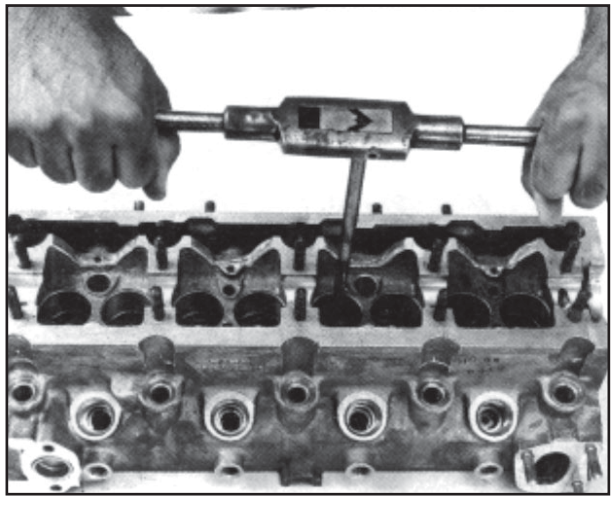


Fig. 80

VALVE SEATS OF VALVES

Check valve seat height with respect to cylinder head mating surface. Replace valve seat inserts if they are worn out beyond specified limit.

Cut exhaust and inlet valve seats with a 45^0 cutter. Refer Figures 81 & 82

Valve seat must be absolutely faultless and without any chatter marks.

If necessary lap valve seats and finish by using suitable hand grinder or by using lapping paste on valve itself.

Smear valve seat with carbon blue. Install valve in guide and turn it slowly under axial pressure.

Contact line on valve seat must be around entire circumference at equal width.

Distance between narrow diameter of valve face to contact line should be minimum 0.5 mm. - Refer Figure 83

Check for leakages through valve seat by pouring kerosene on valve head. Kerosene must not seep past valve seat.

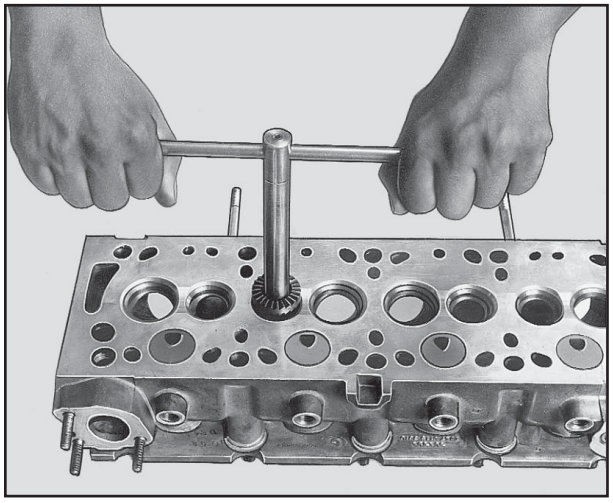


Fig. 81

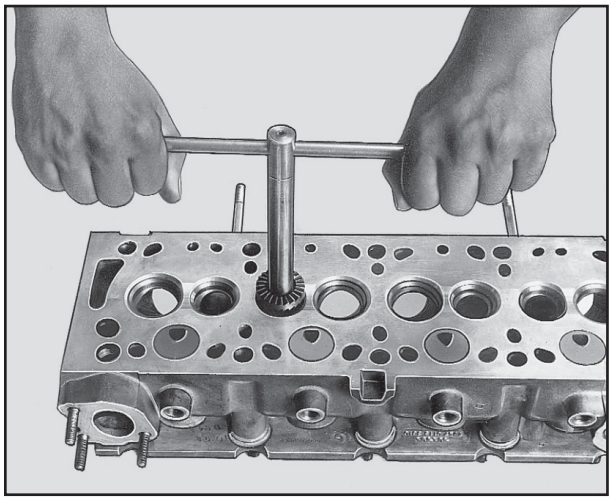


Fig. 82

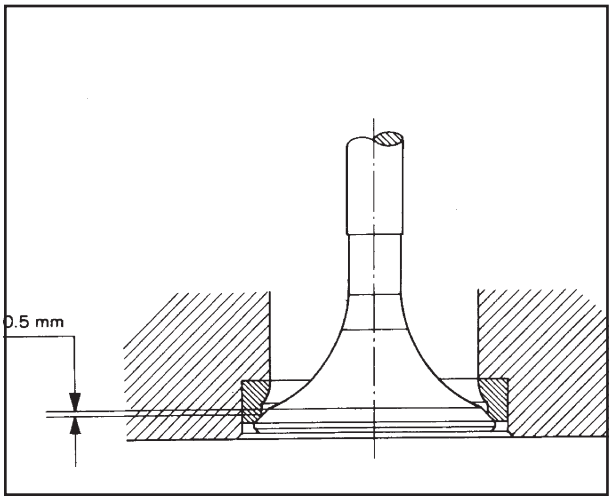


Fig. 83

VALVE SEAT INSERTS

For removing valve seat inserts from cylinder head use suitable boring machine. Bore old insert thin (about 0.5 mm thickness) and then pry it out.

Alternatively use a suitable turning tool to cut an annular groove into valve seat insert and then pull it out with a suitable puller. In order to avoid damage to cylinder head, place soft protective sheet metal under supports of puller.

Measure valve seat insert bore in cylinder head.

If boring and prying is done carefully without damaging valve seat insert bore, fitment of an over size valve seat insert will not be necessary.

Re-machined valve seat insert bore in cylinder head must be exactly at right angle to cylinder head mating surface with crank case. All specified dimensions should be strictly maintained to ensure proper interference of valve seat insert in its bore.

Clean valve seat insert and its bore in cylinder head thoroughly.

Just before installation.

- Place valve seat insert in a mixture of Methenol and dry ice for about 20-30 minutes to bring its temperature down.

– Heat cylinder head to approximately 80^{O}C in water bath.

  Install valve seat insert in cylinder head bore quickly by slight hammering. - Refer figures 84 & 85

Machine valve seat in cylinder head.

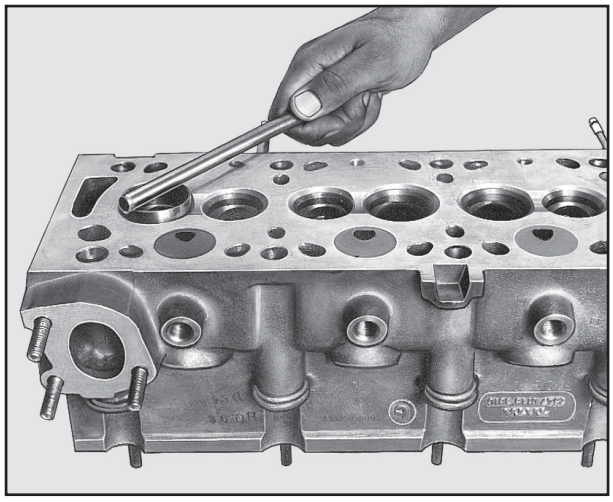


Fig. 84

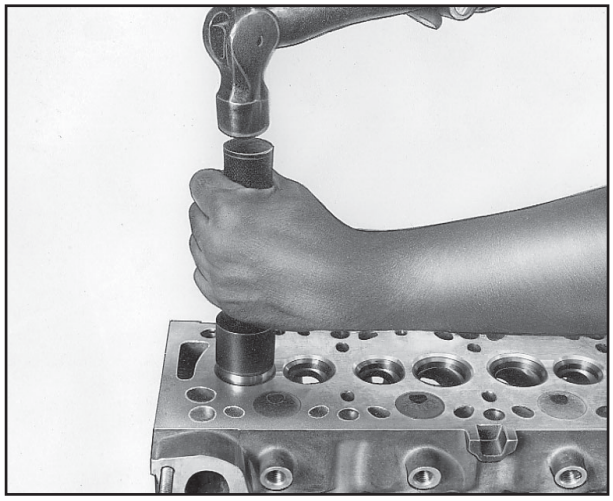


Fig. 85

CRANK SHAFT

Clean and carry out visual inspection of crank shaft for following.

Over heating of journals.

Scoring marks on journals.

Cracks, which should be checked on magnetic crack detector.

Check hardness of journals.

Check crank shaft run out by supporting it on V-block at 1st and 5th main bearing journals - Refer Figure 86

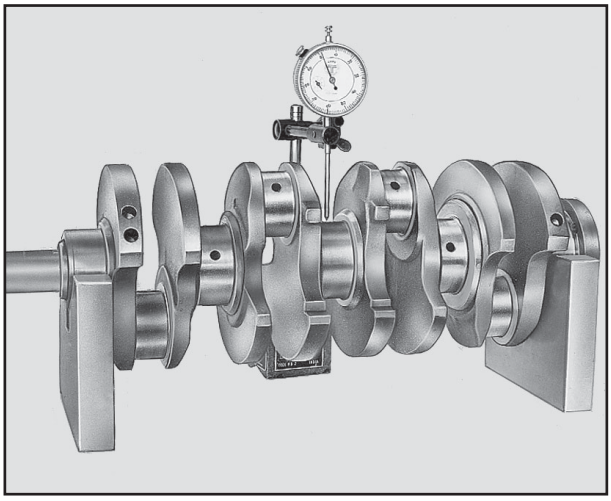


Fig. 86

If run out exceeds permissible limits, straighten crank shaft in cold condition on press carefully.

Similarly check lateral and radial run out of flywheel mounting flange.

Check crank shaft main bearing and crank pin journal dimensions.

If necessary, grind crank shaft main journals and crank pin journals to next repair size.

Maintain correct fillet radii for all journals and pins.

Care must be taken during grinding to ensure that width of journals is not increased.

Should it be necessary to grind sides of 4th main bearing journals, grind it to next over size.

Re-chamfer oil holes on journals to avoid scoring of new bearing shells.

Finish journals by lapping them with 320 grit lapping cloth of suitable width.

After grinding recheck main bearing and crank pin journal dimensions.

Also recheck run out of crank shaft.

We do not recommend balancing of crank shaft in field.

Thoroughly clean crank shaft with kerosene. Use wire brush for cleaning oil holes.

Apply grease to all machined surface, if crank shaft is to be stored. Crank shaft must always be stored in vertical position.

CAM SHAFT

Carry out visual inspection of cam shaft for:

- Over heating of journals.
- Scoring marks on journals and cam lobes
- Cracks, which should be checked on a magnetic crack detector.

Check hardness of cam shaft journals and cam lobes.

It should be 48-54 HRC.

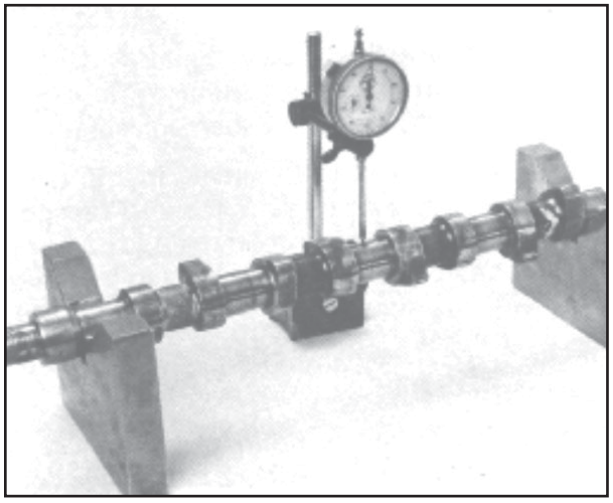


Fig. 87

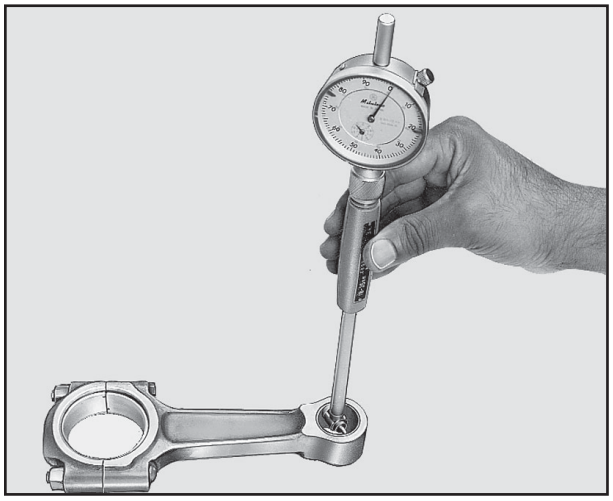


Fig. 88

Check cam shaft run out at 2nd, 3rd & 4th journal by supporting it on V-block at 1st and 5th journal. Refer Figure 87

CONNECTING RODS

Inspect connecting rod small end bush and if necessary remove it. Refer Figure 88

Check connecting rod small end parent bore dimension.

We do not recommend machining of con rod small end parent bore in field.

Ensure that connecting rod big end and small end axes are parallel to each other as specified.

Oil parent bore in connecting rod.

Install new bush in such a way that slit is positioned at approximately 45^0 from vertical axis.

Drill oil hole in new bush.

Finish connecting rod small end bush bore on a connecting rod boring machine. Alternately connecting rod small end bush may be reamed.

Install connecting rod bearing caps without bearing shells on connecting rod.

Tighten connecting rod bearing cap mounting nuts to specified torque. Refer Figure 89

Ensure that identification numbers for connecting rod and connecting rod bearing cap are matched and notches for bearing shells are on same side.

Check twist and bend of connecting rod by using new piston pin in connecting rod small end bush. Dimension between con rod big end & small end axes to be as specified. Refer Figures 90 & 91

Measure twist and bend of connecting rod with feeler gauge with respect to vertical face of connecting rod alignment gauge in vertical and horizontal plane at a distance of 50 mm from line joining centers of connecting rod small end and big end bosses.

If necessary, straighten connecting rod in cold condition. Since a slight clearance exists between connecting rod bolts and corresponding connecting rod bearing cap holes, it is possible that connecting rod bearing cap once removed may be installed off center. If there is a difference noticed in connecting rod big end parent bore dimension in different directions, bearing cap can be centralized by lightly tapping it with mallet in required direction after loosening cap mounting nuts.

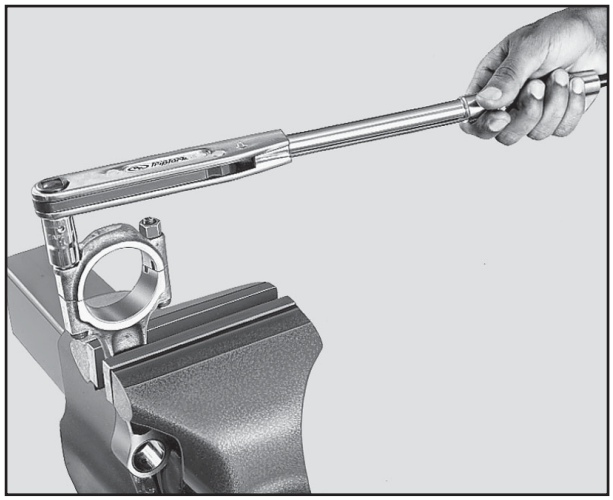


Fig. 89

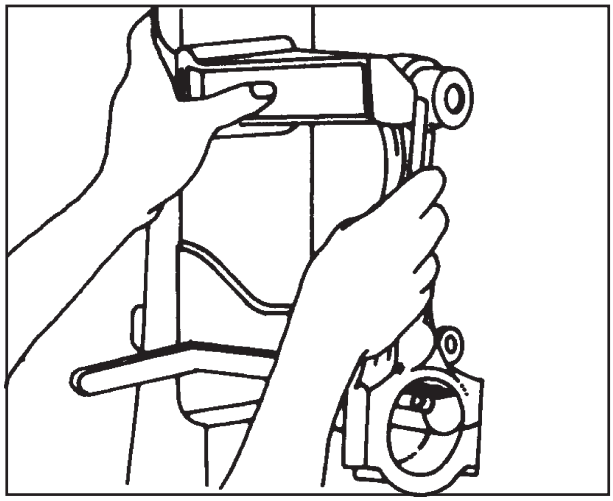


Fig. 90

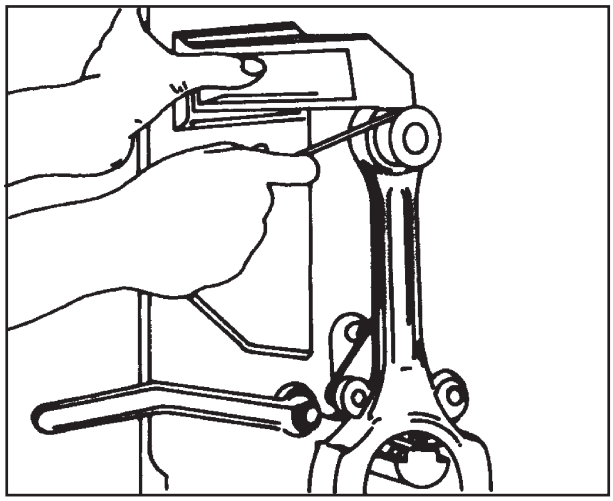


Fig. 91

Check big end parent bore dimension. Refer Figure 92

If big end parent bore is slightly more than maximum permissible limits, it is possible to reclaim connecting rod. Connecting rod bearing cap mating surface may be slightly faced.

Parent bore should then be finished on a connecting rod boring machine.

If one or more connecting rods are to be replaced, ensure that difference in weight are within permissible limits.

Install new pair of connecting rod bearing shell according to size of crank pin journal diameter, making sure that securing lugs of bearing shells are properly seated in grooves of connecting rod and cap . Refer Figure 93

Install bearing cap with shell on connecting rod.

Tighten cap mounting nuts to specified torque. Refer Figure 94.

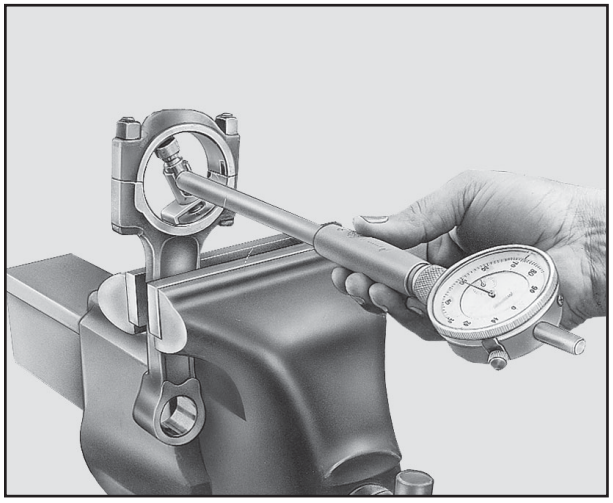


Fig. 92

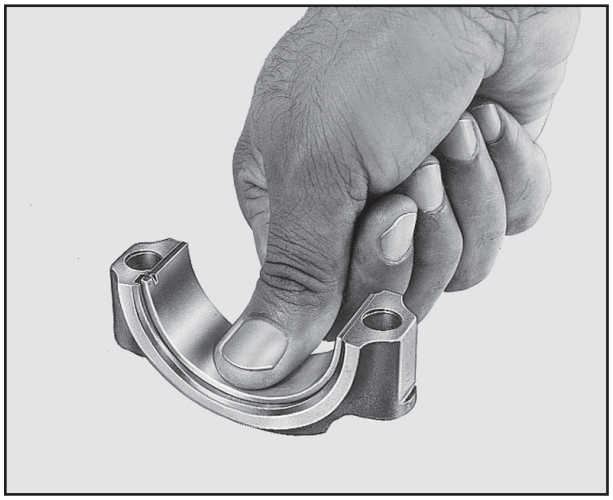


Fig. 93

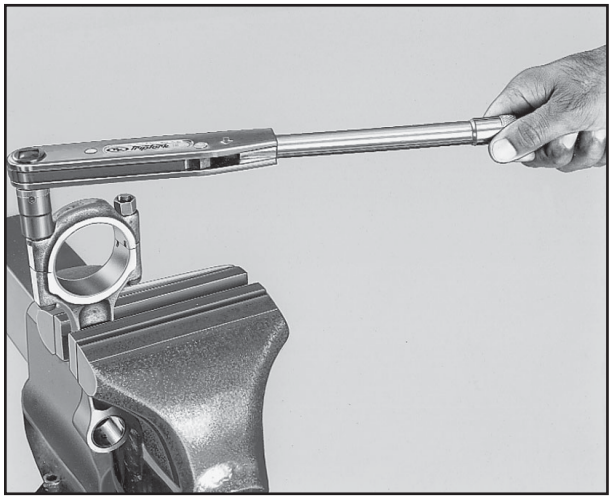


Fig. 94

Measure bearing dia. Refer Figure 95.

Measure pretension of bearing shell with feeler gauge after loosening bearing cap mounting nut on opposite side of bearing shell lug. Refer Figure 96

Bearing shell are precision finished and should not be bored or scraped.

INSPECTION OF INJECTION NOZZLE :

Checking nozzle opening pressure

- Connect injector assembly to nozzle tester.
- Slowly depress nozzle tester lever and read pressure gauge when nozzle starts opening.
- If opening pressure is not as per specified value, then adjust as required by selecting proper shims.

Check nozzle for leakage

- Slowly depress nozzle tester lever until pressure gauge shows 125 bar. The nozzle is leak proof, if no drop comes out of nozzle tip within 10 seconds.
- Rectify the leak by cleaning the nozzle elements.

Replace nozzle if necessary.

Checking nozzle spray

- Close shut-off valve.
- Depress nozzle tester lever 4 -5 times. The nozzle will then buzz very softly. The automization is satisfactory when an jet cone have uniform closed contour and is finely automized.

Inspection of glow plugs

- Check glow plugs for short circuits and or for burning. Replace them if necessary.

WATER PUMP

Check water pump for free rotation. Check water pump for flow rate at specified rpm. Check for water leakage through leakage hole. It indicates that water seal is damaged and leaking. Replace the water pump if necessary.

Dismantling and repairing of water pump is not recommended.

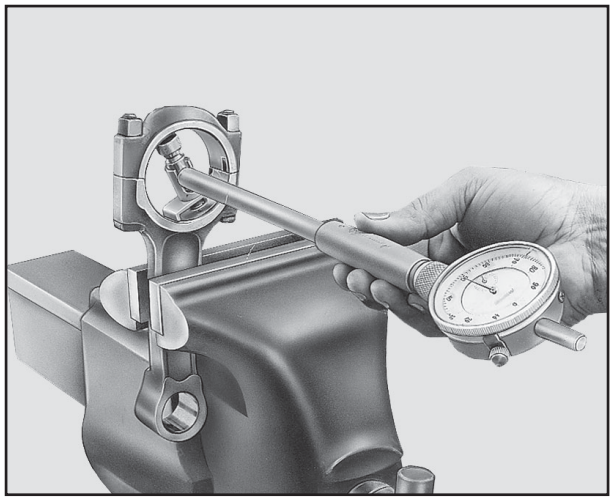


Fig. 95

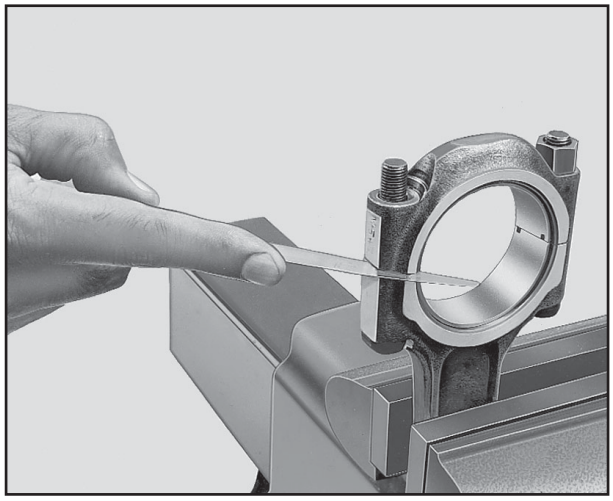


Fig. 96

Checking of thermostat element

1. Remove thermostat element from thermostat housing.
2. Mount thermostat element in suitable fixture and place the fixture in a vessel filled with water.
3. Fix dial gauge with its spindle on valve surface with a pretension @ 0.5 mm.

4. Heat the vessel and measure water temperature with thermometer.
5. Note down the temperature when dial gauge needles starts moving indicating valve opening.
6. Opening temperature and fully open temperature measured should be as mentioned in repair data.

If they do not meet specifications, replace thermostat element.

INSPECTION OF TIMING BELT

Check belt in detail. If following flaws are evident, replace belt with new one.

- Back surface glossy, non elastic and so hard that even if finger nail is forced into it, no mark is produced.
- Cracked back surface rubber
- Cracked or exfoliated canvas
- Cracked tooth bottom
- Side of belt cracked
- Side of belt badly worn
- Badly worn teeth
- Missing tooth

It is advisable to replace belt while reconditioning the engine.

NOTE:

Normal belt should have clear cut sides, as if cut with a sharp knife.

In initial stage of wear, load side tooth flank will look like fluffy canvas fiber, rubber gone and colour changed to white.

In last stage of wear, canvas on load side tooth flank will be totally worn out exposing rubber.

ASSEMBLY OF CYLINDER HEAD

Install valves in their respective positions.

Install spring seat, valve spring and valve retainers.

Fit support rail, 2654 5890 05 06 on cylinder head.

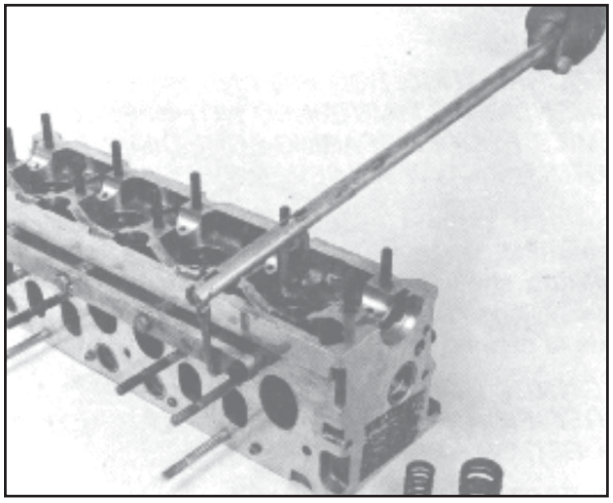


Fig. 97

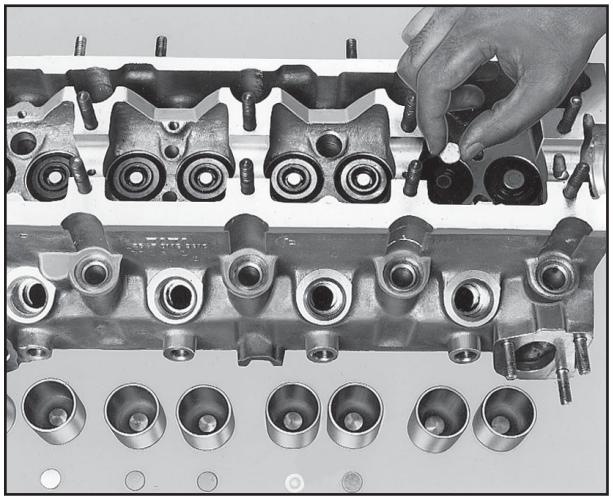


Fig. 98

With spring compressor, 2654 5890 05 07 compress valve spring and install valve lock halves. Refer Figure 97

In case of any replacement of tappet/valves or machining of valve seat use thinnest size of shims.

Install original or thinnest size shims in their respective positions. Refer Figure 98

Apply light coat of moly paste grease over shims.

Smear tappet outside diameter with engine oil.

Install tappets in their respective positions. Refer Figure 99

Smear Cam shaft journals and cam lobes with moly paste grease.

Install cam shaft with arrow mark pointing towards engine front. Refer Figure 100

Install cam shaft bearing caps in their respective positions with arrow mark pointing towards engine front.

Apply ANABOND 610 sealant on parting faces between 1st & 5th cap and cylinder head.

Tighten cam shaft bearing cap nuts with NEW **WASHERS** to specified torque (first 3rd cap, next 4th and 2nd caps, lastly 5th and 1st caps). Refer Figure 101

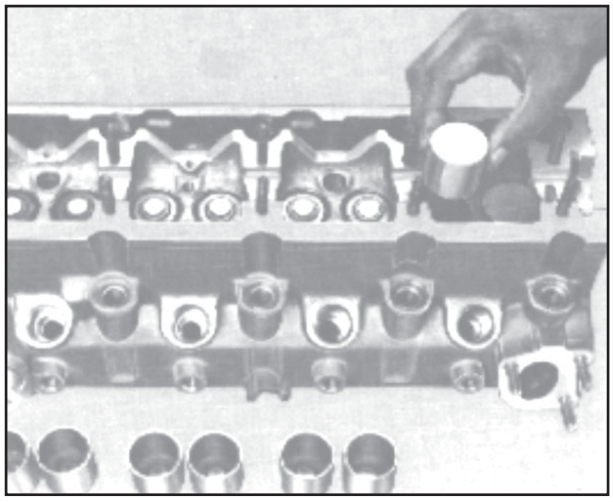


Fig. 99

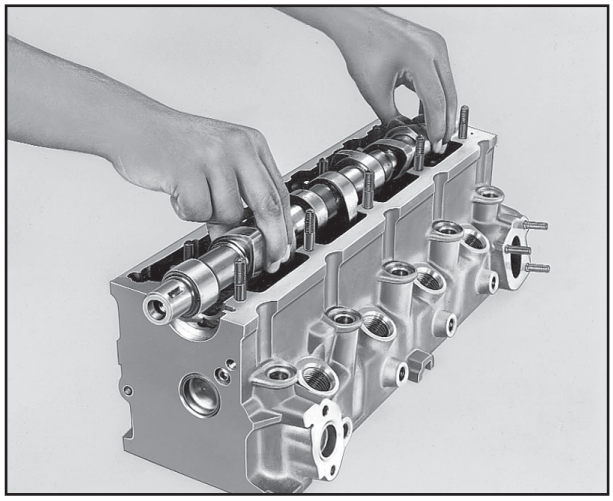


Fig. 100

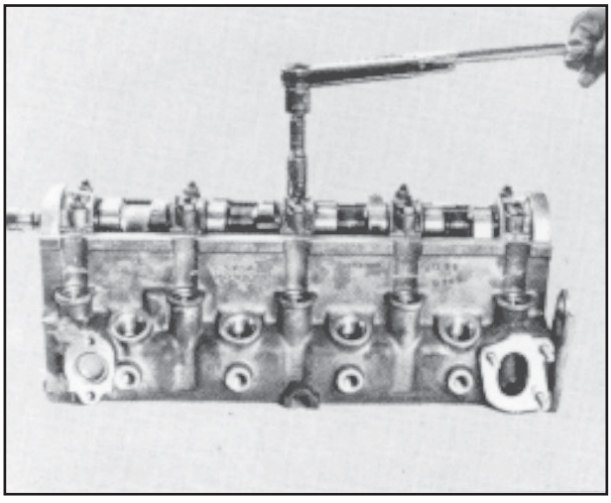


Fig. 101

Check cam shaft axial play. It should be within specified limits. Refer Figure 102

Check camshaft for rotation, the frictional torque should be between 1.8 to 2.2 mkg. Refer Figure 103

Install wood ruff key and cam shaft gear. Tighten cam shaft gear mounting screw along with spacer. Refer Figure 104

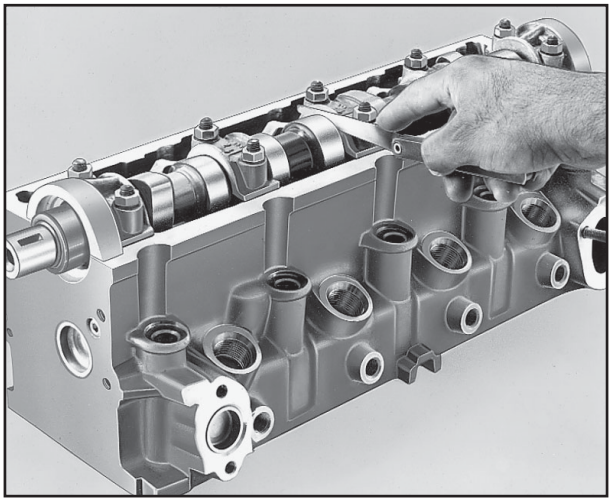


Fig. 102

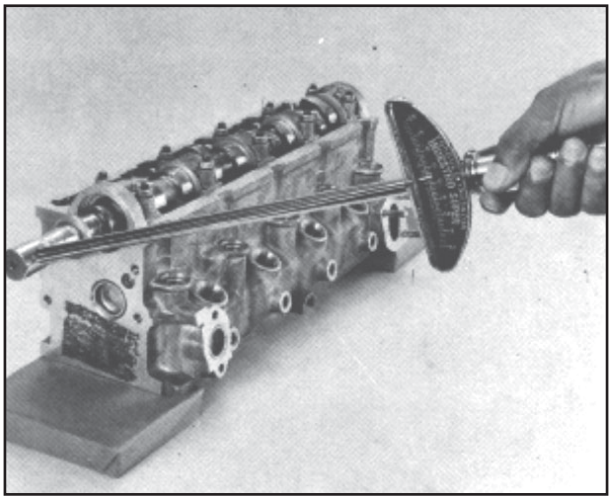


Fig. 103

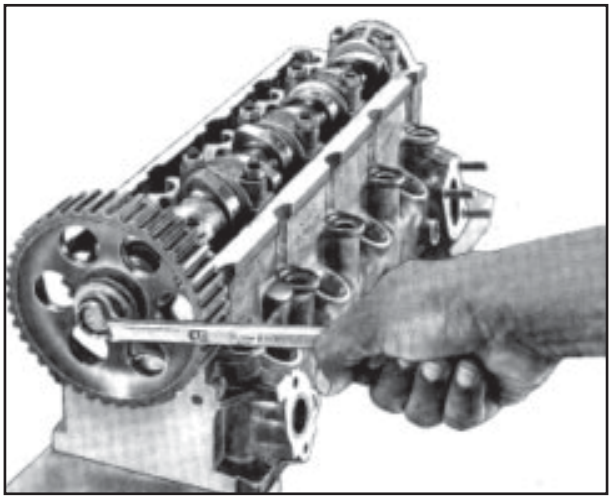


Fig. 104

VALVE CLEARANCE

Valve clearances should be checked only when engine is cold.

Turn cam shaft with spanner, 2654 5890 05 01 and check valve clearances. Refer Fig. 105

Adjust as given below:

Note respective valve clearances.

Calculate correct sizes of shims (Shims are available in thickness 2.4 to 3.55 mm in steps of 0.05 mm) to get specified valve clearances as shown in following table.

CALCULATION	INLET	EXHAUST
Specified	0.15 $\pm^{0.04}$	0.3 $\pm^{0.04}$
Measured	0.25	0.2
Difference	+ 0.1	- 0.1
Existing shim thickness	2.8	3.05
Shim thickness required	2.9	2.95

Smear moly paste on both sides of shims.

Install all eight correctly determined size shims in their respective positions.

Recheck valve clearance and if incorrect repeat above procedure.

Remove camshaft gear.

Fitment

Install cam shaft front and rear oil seals using adapter, 2654 5890 05 08. Refer Figure 106

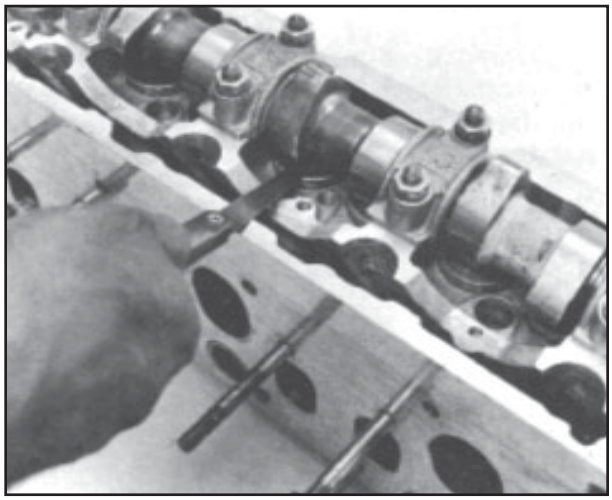


Fig. 105

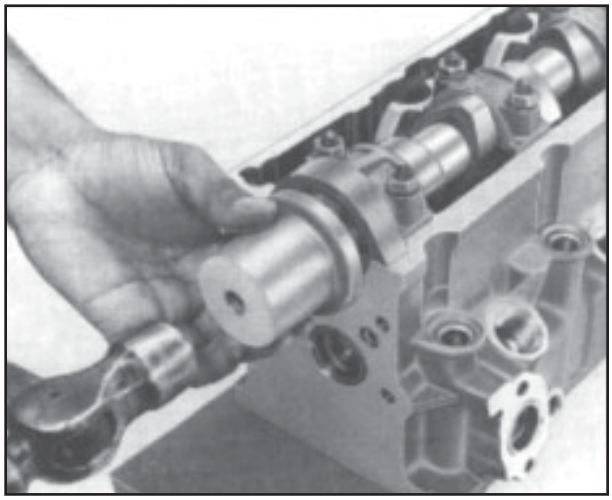


Fig. 106

Fit

Injectors with flame guard, new flame guard washer and sealing washer. Refer Figure 107 (Convex side of the flame guard washer should be up while installation)

Tighten injectors to specified torque using socket,

312 589 00 09. Refer Figure 108

Injector over flow hoses. Refer Figure 109

Glow Plugs.

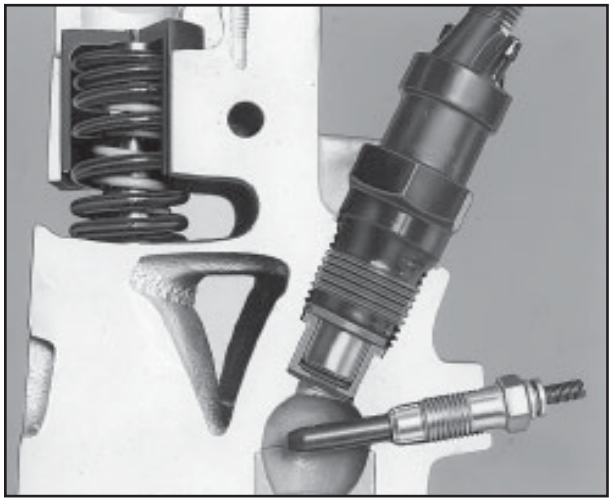


Fig. 107

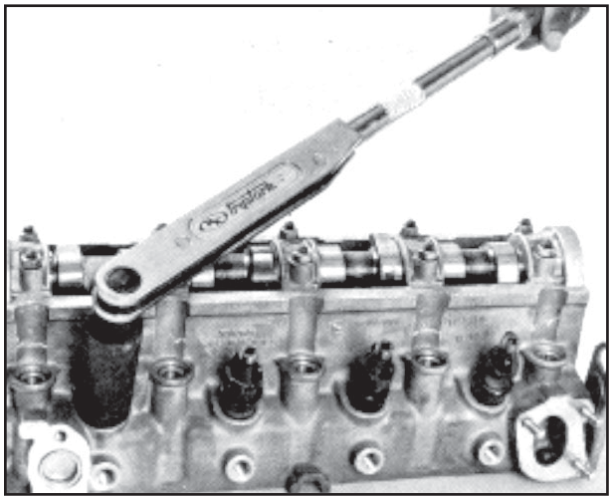


Fig. 108

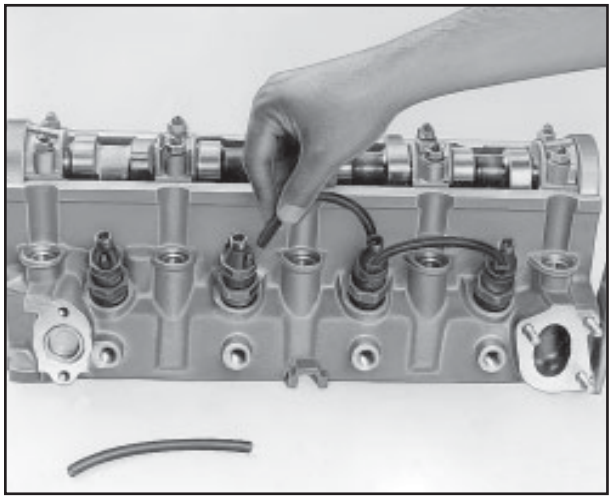


Fig. 109

ENGINE ASSEMBLY PROCEDURE

Fit piston Cooling nozzles.

Fit drive shaft spigot bearing and oil pump drive sprocket gear on crankshaft using suitable drift.

Install thrust washers in crankcase at their respective location on 4th Main bearing sides.

Apply light coat of engine oil to main bearing shells and main journals. Install main bearing shells on cylinder block.

Install crank shaft.

Install thrust washer on 4th main bearing cap sides.

Install 4th main bearing cap with shells and thrust washer in its position on crank case.

Install 1st, 2nd and 3rd main bearing caps with shells in their respective position on crank case.

Clean the grooves of 5th main bearing cap and make it free from oil and grease.

Apply a thin layer of maxifix adhesive-S758 (Dunlop make) in the groove and allow it to dry for 10 minutes.

Assemble both the side seals on 5th main bearing cap - Refer Figure 110 avoiding air bubbles and press firmly. Cut off the extra length of side seal keeping 2 mm projection above cap height.

Apply ANABOND 611 between mating faces of 5th main bearing cap and cylinder block.

Install 5th main bearing cap with shell and side seal in its position on crank case.

While installing ensure that

- Side seals are not getting cut or dislodged from its position on 5th main bearing cap.
- Thrust washers are not dislodged from their seat in crank case and 4th main bearing cap.
- Bearing shell lugs are on same side.

Tighten main bearing cap mounting bolts evenly and uniformly to specified torque. (First 3rd cap, next 4th and 2nd, lastly 5th and 1st) Refer Figure 111

Check that end float of crank shaft is within specified limits. Refer Figure 112

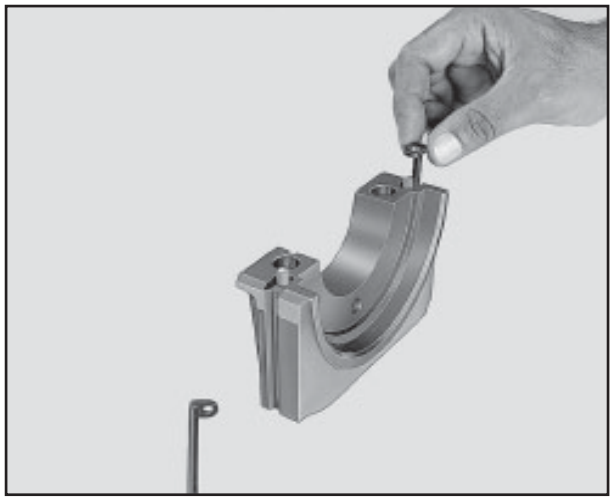


Fig. 110

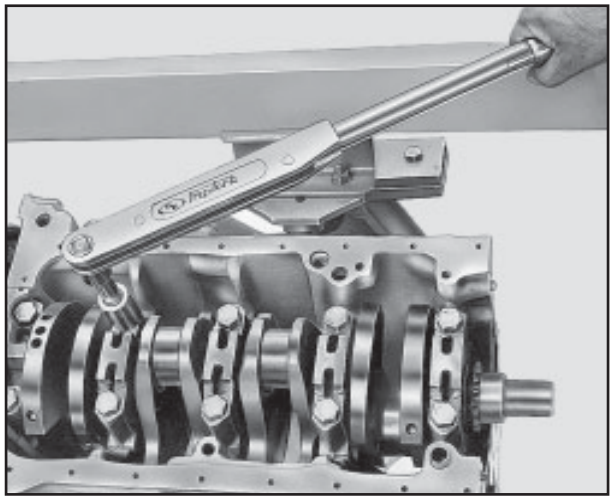


Fig. 111

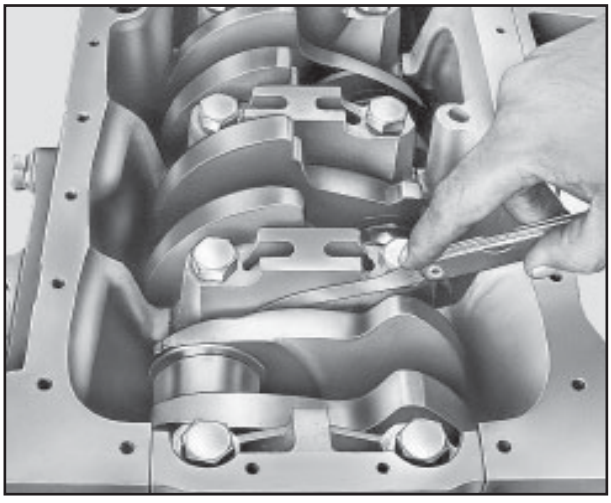


Fig. 112

Install rear oil seal using drift, 2654 5890 03 04. Refer Figure 113

Locate flywheel on crank shaft rear flange.

Install locking plates and screw-in flywheel mounting screws.

Tighten flywheel mounting screws to specified torque. Refer Fig. 114

Lock them by bending lock plates. Refer Fig. 115

Remove connecting rod bearing cap with shell.

Insert connecting rod in piston such that combustion cavity on piston and bearing shell lugs on connecting rod are on same side. Refer Figure 116

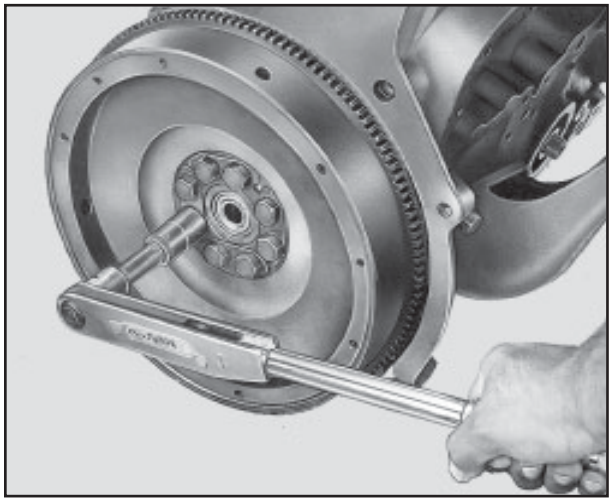


Fig. 114

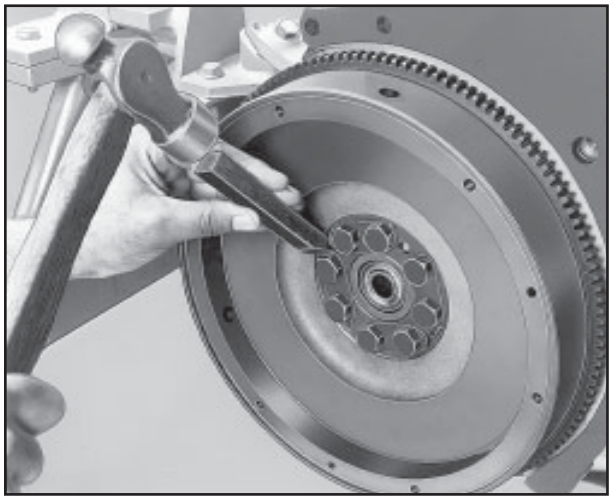


Fig. 115

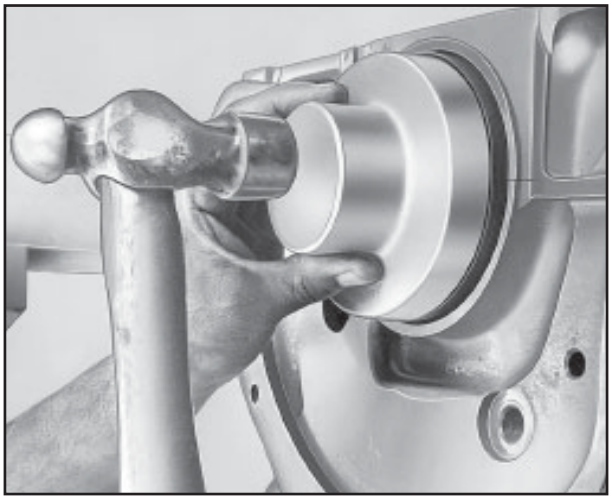


Fig. 113

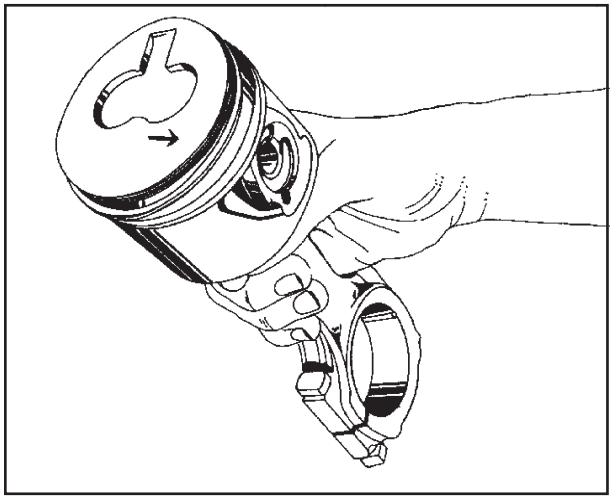


Fig. 116

Insert piston pin. Fit piston pin spring clip

Refer Figure 117

Top surface of all rings are identified on top surface by etching mark 'TOP'. Assemble rings with etching mark 'TOP' facing up.

Make sure that ring gap are 120 degrees apart to each other. Make sure that none of the ring gaps fall directly on piston pin axis.

Apply oil on piston, piston rings, cylinder bore and bearing shells.

Turn crank shaft and bring crank pin journal to top most position onto which connecting rod with piston is to be fitted.

Insert connecting rod with piston upto piston rings into cylinder bore with arrow on piston crown pointing towards front. Clamp piston ring compressor over piston rings such that piston with piston rings can slide inside it. Refer Figure 118

Push piston gradually inside cylinder bore using wooden handle or mallet till connecting rod locates on crank pin journal. Slowly rotate crank shaft, simultaneously pushing piston till crank pin journal reaches BDC position.

Install connecting rod bearing cap with bearing shell on connecting rod ensuring that bearing shell lugs are on same side.

Tighten connecting rod bearing cap mounting nuts to specified torque. Refer Figure 119

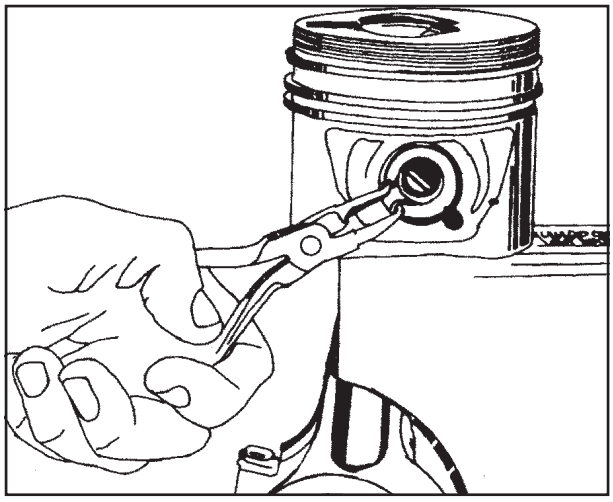


Fig. 117

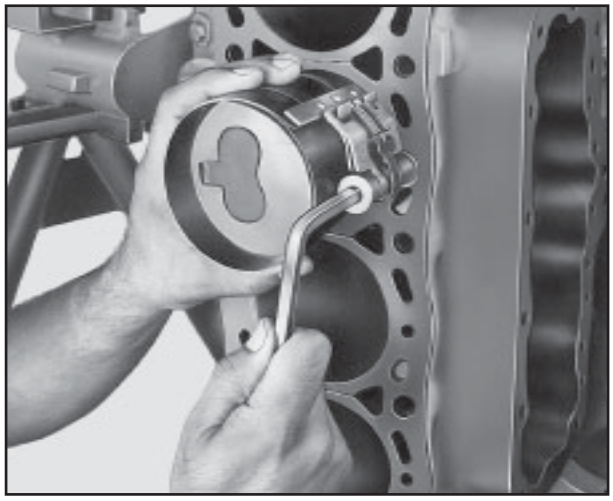


Fig. 118

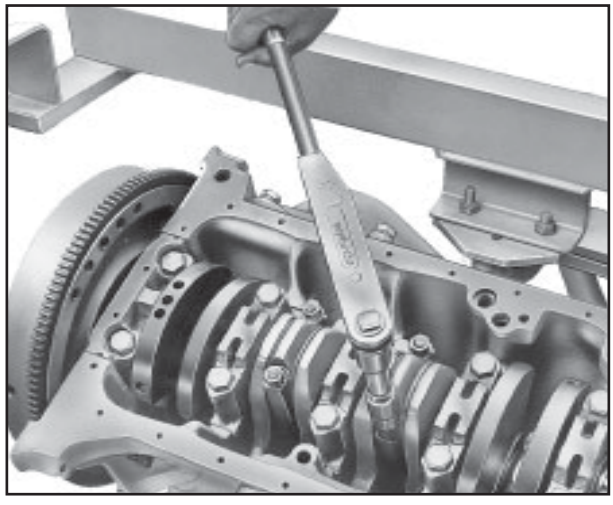


Fig.119

Assemble other connecting rods with piston in same manner.

Check end play of Con-rods. Refer Figure 120

* Apply liquid gasket ''Anaerobic liquid gasket TS 25408'' (Code No. 56506002520) uniformly between cylinder block and ladder frame mating surfaces.

Fit the ladder Frame.

Install oil pump drive chain over oil pump drive sprocket gear on Crankshaft.

Install crank shaft front oil seal using drift, 2654 5890 03 03. Refer Figure 122

Fit crank case front cover with new gasket. Tighten screw to specified torque . Refer Figure 123

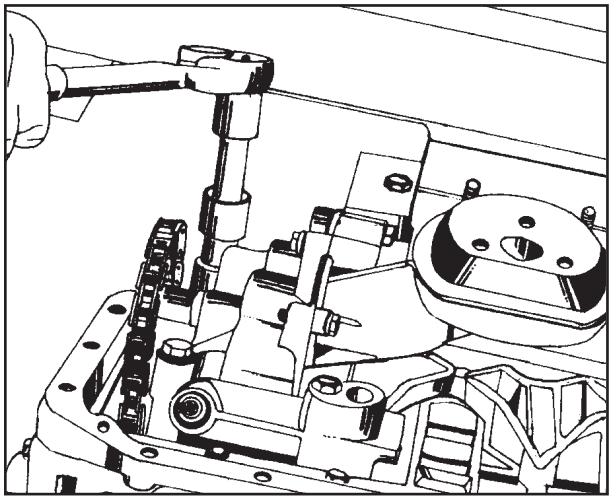


Fig. 121

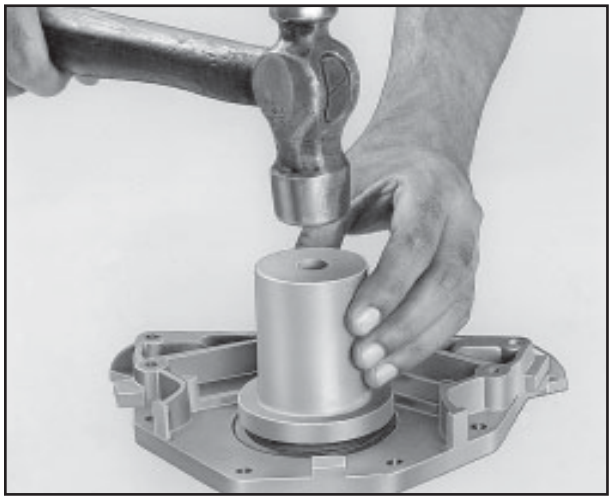


Fig. 122

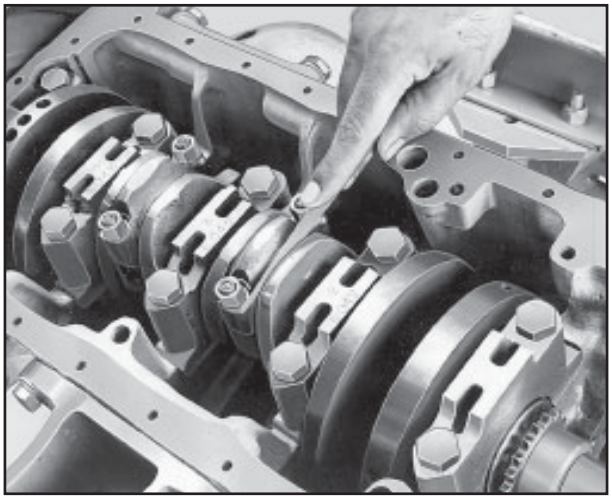


Fig. 120

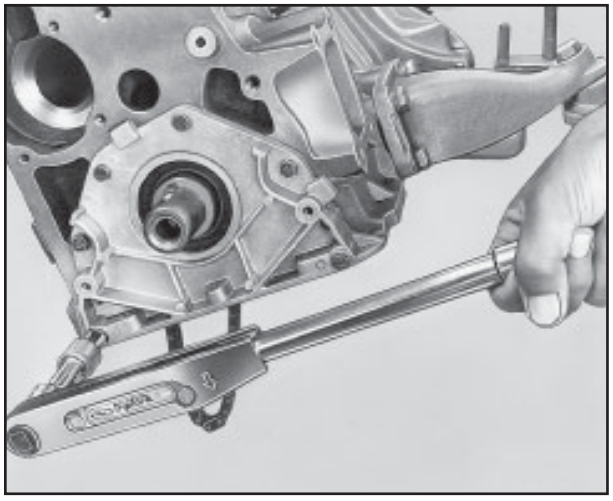


Fig. 123

Fit oil sump with new gasket. Tighten mounting screws to specified torque. Refer Figure 124

Install -

- Power steering pump mounting bracket.
- A/C Compressor mounting bracket. Refer Figure 125
- Water pump.
- Oil cooler assembly.
- Oil filter. Refer Figure 126

Install

- Timing gear train rear cover.
- Idler roller.
- Fan mounting bearing block.
- Tensioner roller.

Install both wood ruff keys in position. Slightly tap crankshaft gear and push it over crankshaft.

Install crankshaft pulley in position.

Lock fly wheel with timing pin, 2654 5890 03 09. Refer Figure 127

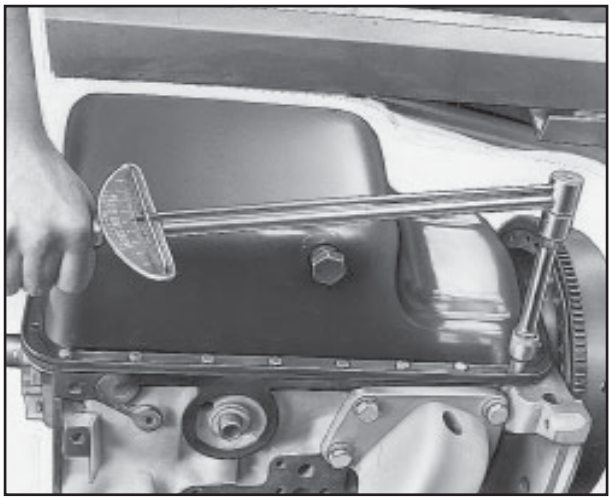


Fig. 124

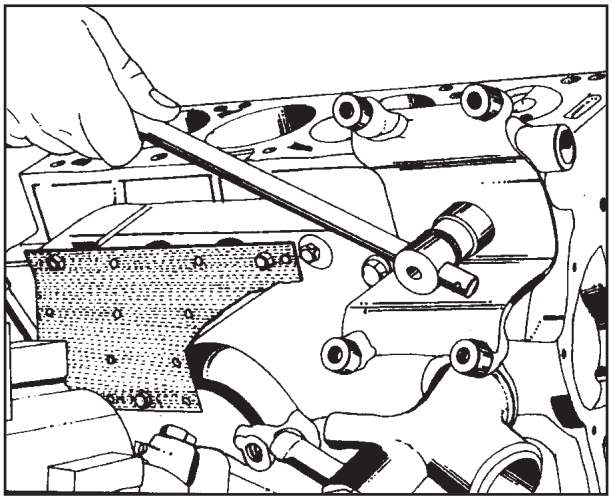


Fig. 125

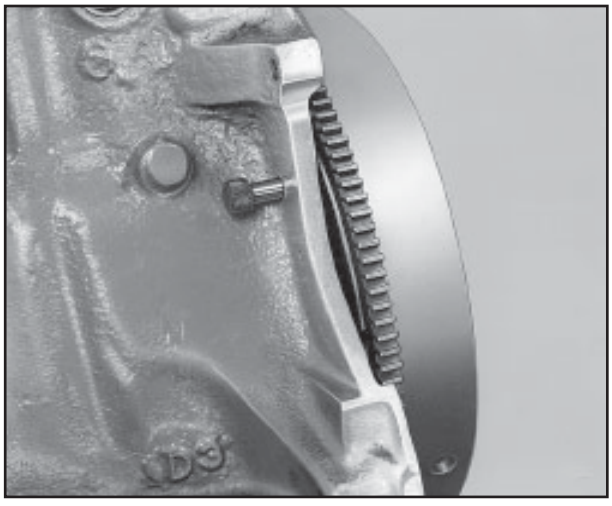


Fig. 127

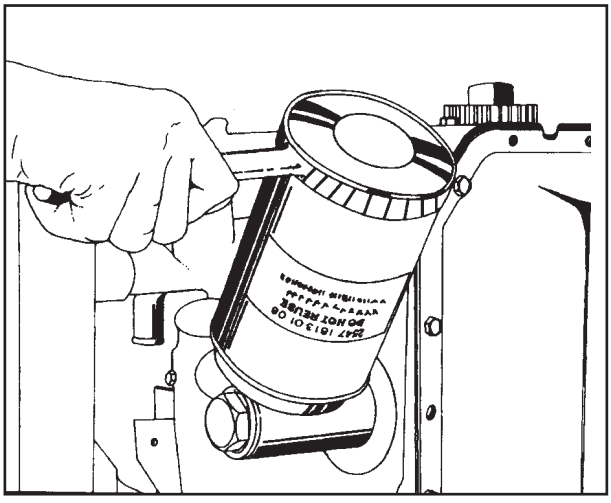


Fig. 126

Screw in crankshaft pulley mounting bolt with spacer and tighten it to specified torque. Refer Figure 128

Measure piston projection above crank case and select correct thickness of cylinder head gasket.

Refer repair data.

Rotate cam shaft and bring valves of 1st cylinder to compression TDC position. Refer Figure 129.

Procedure for selection of cylinder head gasket :

- Place adaptor with dial gauge on a surface block & set reading on dial gauge to zero.
- Rotate crank shaft to TDC and place the adaptor on cylinder no. 1 with adaptor touching crank case top face and dial gauge touching piston top (make sure that it is not touching the piston cavity). Take the reading of piston projection.
- Repeat the same procedure for cylinder no. 4 & take the reading.
- Rotate crank shaft by 180^{O} and repeat the above procedure for cylinder no. 2 & 3.
- Select head gasket based on highest reading obtained from all 4 piston projections. Gasket selection should be done as per procedure given in repair data.

Ensure that cylinder head locating hollow dowel is in position on crank case.

Ensure that timing pin. 2654 5890 03 09 is installed in position.

Install cylinder head and tighten cylinder head mounting screws to 5 mkg torque in the correct sequence i.e. from centre to outwards. Then retighten screws to 7 mkg torque in the same sequence.

Then tighten to 10.5 mkg torque. Refer Figure 130

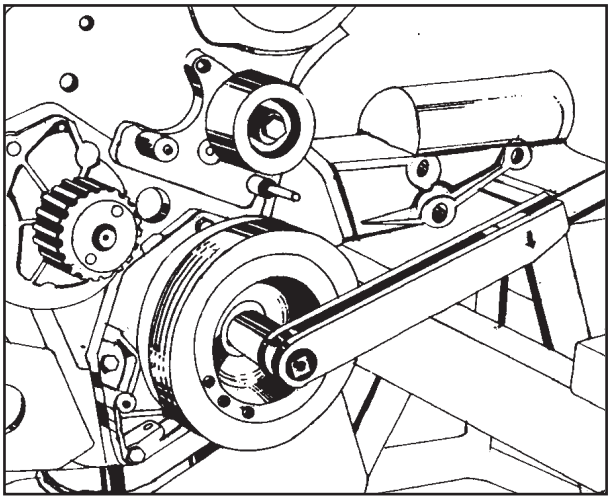


Fig. 128

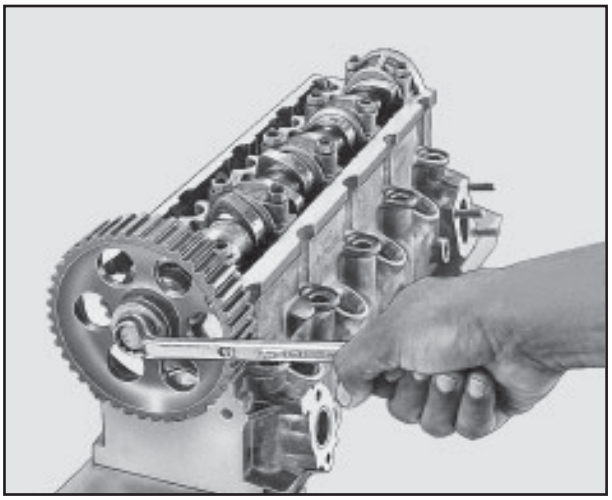


Fig. 129

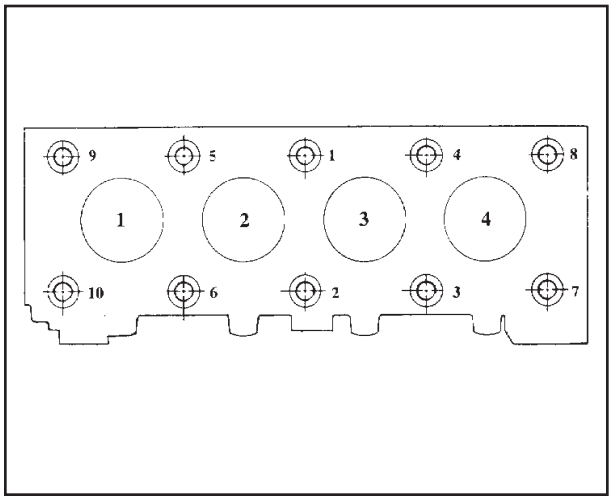


Fig. 130

Multi Layer Steel (MLS) Cylinder head gasket :

MLS gasket make Reinz, Germany has been introduced on 4 DLTC engines (Euro I, Euro II & Euro III) for robust sealing system.

Please refer figure no. 131a

Presently it is available in 1.5 mm thick & 1.6 mm thick.

Rivets (4 nos.) have been provided on gasket for proper location of gasket.

Cylinder block and cylinder head has been suitably modified for relieving of rivets at 4 locations.

In addition to this slit width in cylinder block has been changed to 1.6 mm -0.1 mm from 2.0 mm -0.2 mm

MLS gasket can not be fitted on old type cylinder block.

There is no change in cylinder head mounting bolt and tightening torque of head bolts.

Please ensure to use appropriate cylinder block, head gasket and cylinder head during repairs.

Fit belt tensioner locking screw and timing gear train rear cover mounting screw at cylinder head.

Install wood ruff key, cam shaft gear and spacer.

Tighten cam shaft gear mounting screw to specified torque. Use special tool 2654 5890 05 01. Refer Figure 131

Fit

- Inlet manifold. Refer Figure 132
- Exhaust manifold. Refer Figure 133

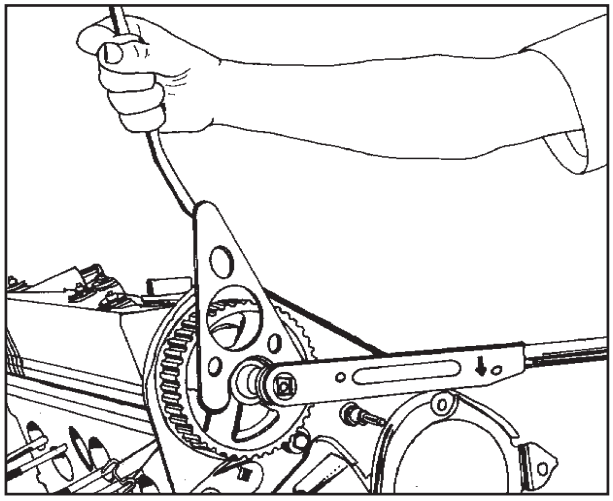


Fig. 131

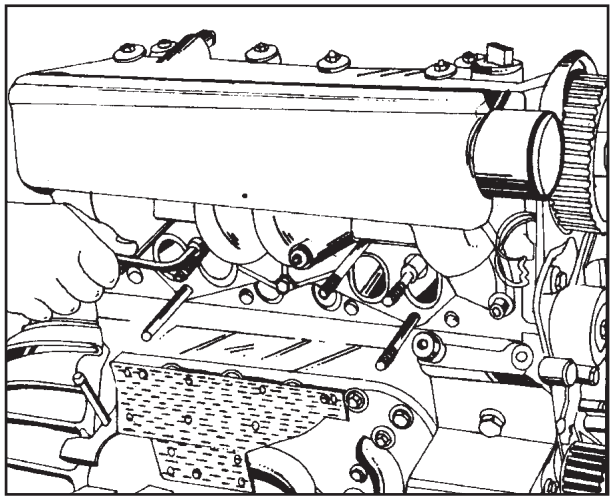


Fig. 132

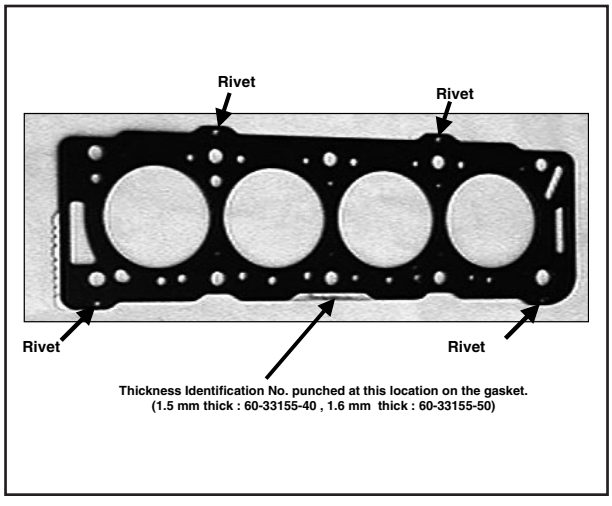


Fig. 131 a

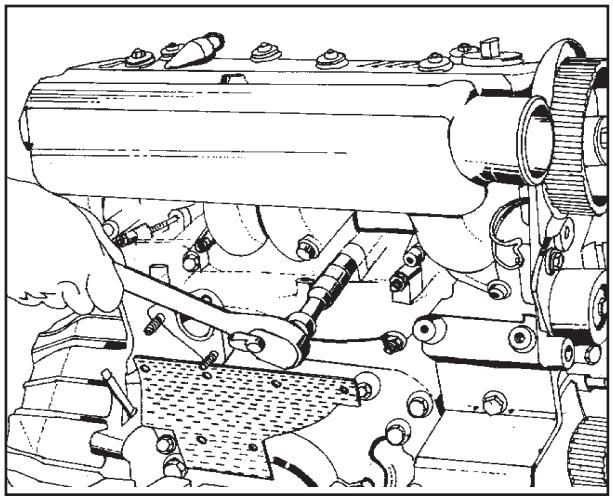


Fig. 133

Fit

- Turbocharger
- Turbocharger exhaust elbow / pipe
- Oil connection to turbocharger. Refer Figure 134
- Starter motor assembly. Refer Figure 135
- FIP mounting bracket
- FIP

Install wood ruff key in its position.

Install fuel injection pump gear.

Tighten fuel injection pump gear.

mounting nut to specified torque. Refer Figure 136

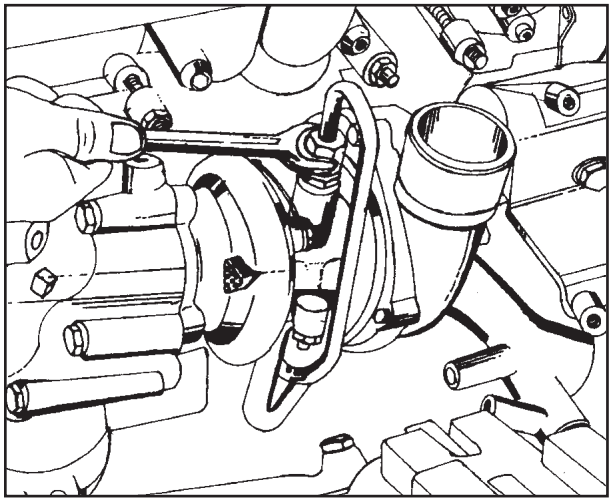


Fig. 134

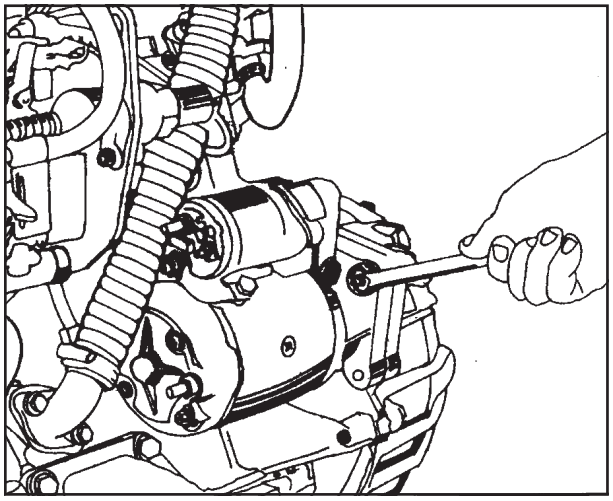


Fig. 135

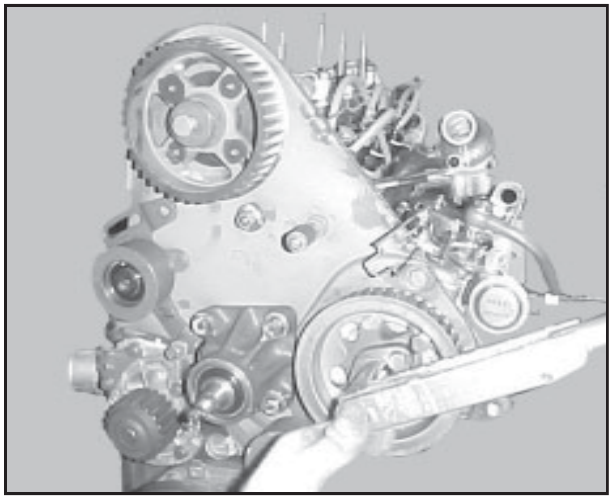


Fig. 136

Lock camshaft gear with timing bolt 2654 5890 05 02 Refer Figure 137

This will ensure compression T.D.C. position of 1st piston.

Lock FIP gear with timing bolt, 2654 5890 05 02 Refer Figure 138

Using drive square pt no. 2654 5890 0510 move tensioner roller and tighten tensioner locking bolt.

Install timing belt over crank shaft gear. Keep it stretched and slip over idler roller, fuel injection pump gear, camshaft gear tensioner roller and water pump gear.

Loosen tensioner locking bolt slightly and after roller exerts tension on timing belt, tighten it fully.

Refer Figure 139.

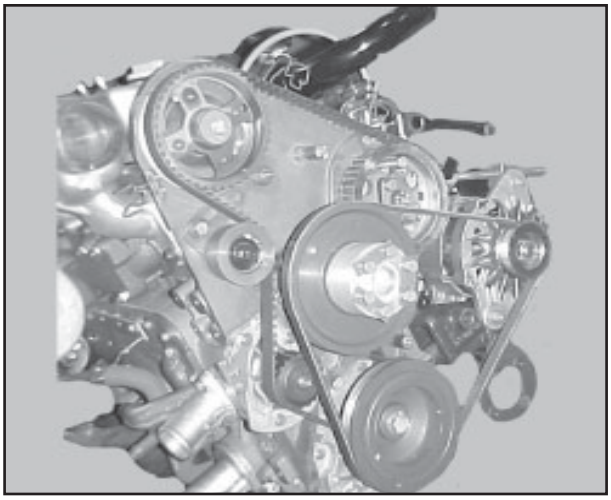


Fig. 137

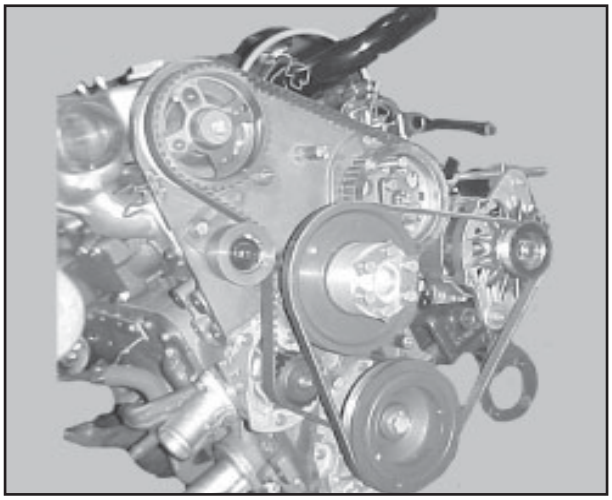


Fig. 138

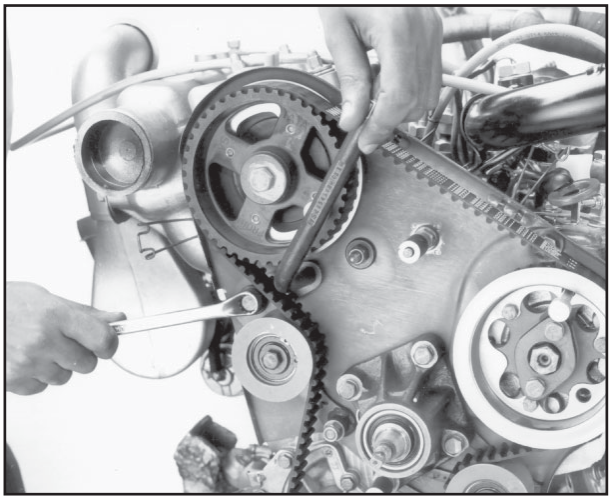


Fig. 139

Remove timing bolts and timing pin

Rotate crank shaft with spanner 2654 5890 03 02 by full two turns in direction of engine rotation.

Refer Figure 140

Try fitting timing bolts and timing pin in its position. If it is not possible to fit any one, repeat timing belt

installation procedure from beginning.

Ensure that timing bolts and timing pin are removed after timing belt fitment.

- FIP timing adjustment procedure is given separately. Connect engine stop solenoid and cold start advance unit electrical cable to fuel injection pump

Fit

- Cab heating valve unit (if fitted)
- Thermostat assy Refer Figure 141
- Oil separator and hoses
- FICD unit
- Fuel return pipe from FIP to fuel tank
- High pressure injection pipe from injectors to FIP
- Coolant pipe
- Over flow hose from 1st injector to fuel injection pump

Install all three (front left, front right and front lower) timing gear train covers.

Lock front timing cover with clip and toggle clamps. Refer Figure 142

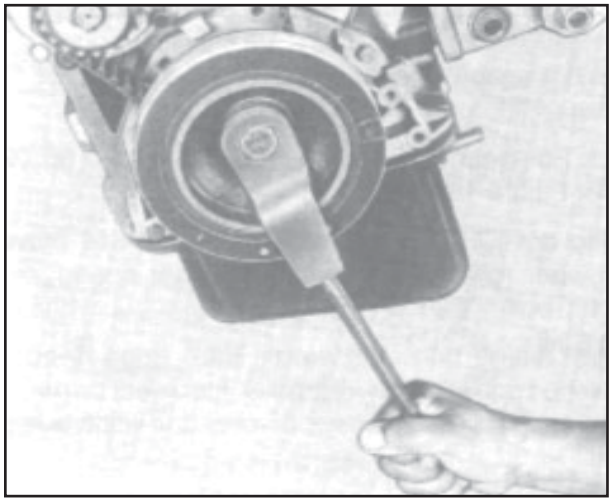


Fig. 140

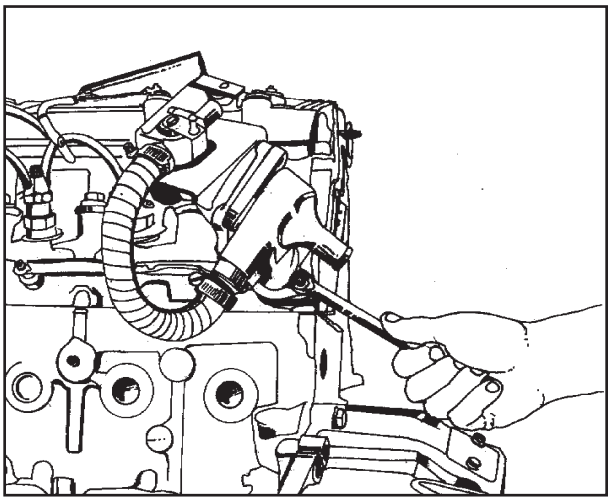


Fig. 141

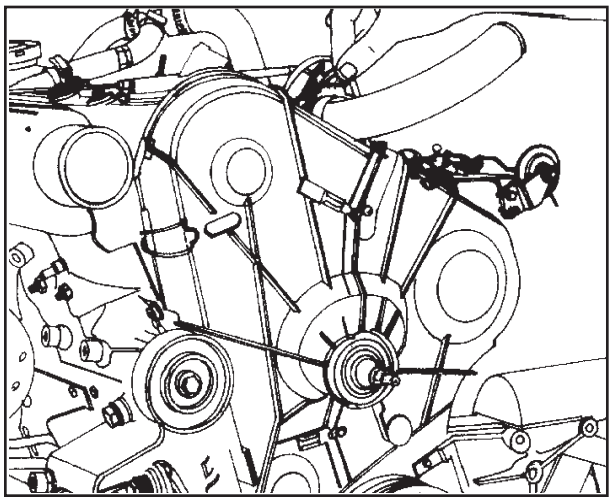


Fig. 142

Fit

- A.C. compressor assembly. Refer Figure 143
- Power steering pump. Refer Figure 144
- Alternator

Install fan pulley. Tighten castle nut and lock it with split pin.

Install fan along with hub. Tighten mounting screws to specified torque and lock them with lock plates. Refer Figure 145

Install fan belt.

Adjust fan belt tension.

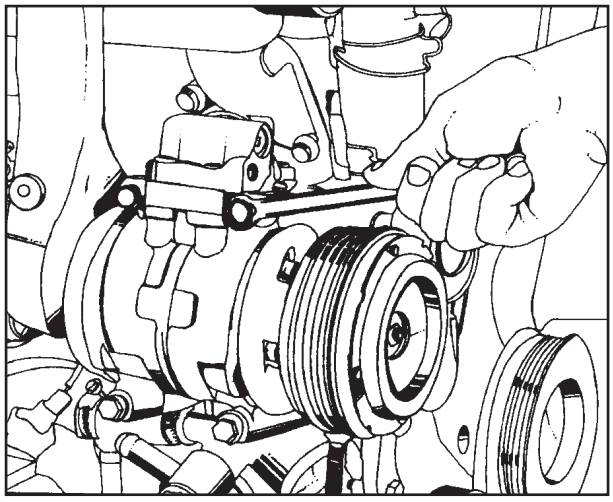


Fig. 143

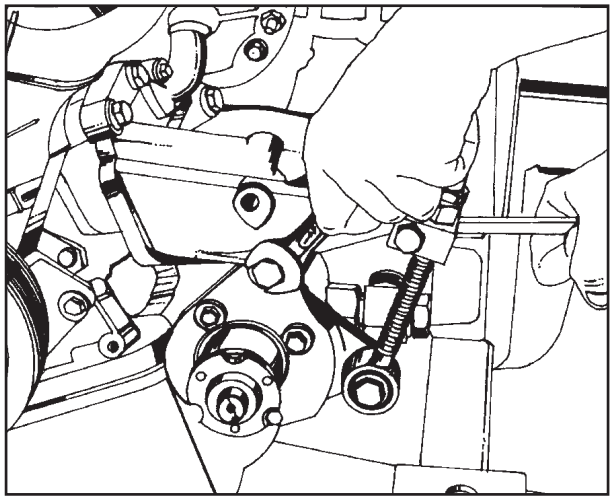


Fig. 144

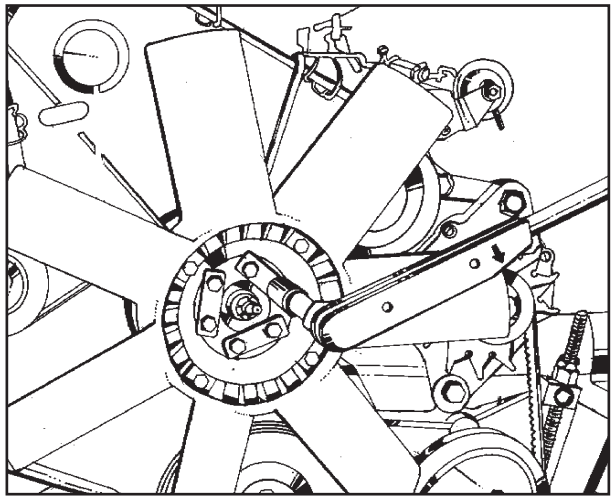


Fig. 145

F.I.P. TIMING SETTING PROCEDURE (MICO)

Ensure that timing pin is located in flywheel hole through cylinder block rear wall.

Disconnect high pressure injection pipes from injectors to fuel injection pump. Refer Figure 146

Slightly loosen fuel injection pump front mounting nuts and rear mounting taper nut.

Remove timing plug on fuel injection pump. Refer Figure 147

Fit timing adapter, 2654 5890 05 09 in place of timing plug. Refer Figure 148

Remove timing pin from flywheel.

Mount dial gauge in timing adapter with some preload. Refer Figure 149

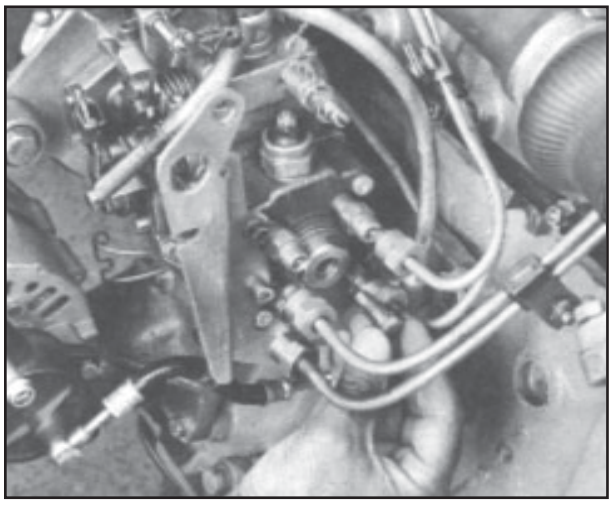


Fig. 147

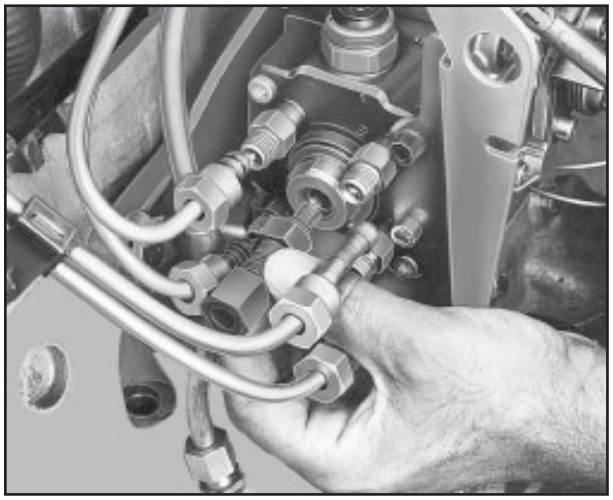


Fig. 148

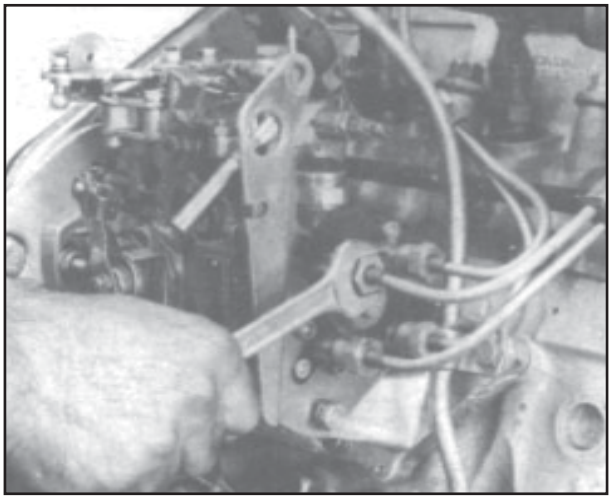


Fig. 146

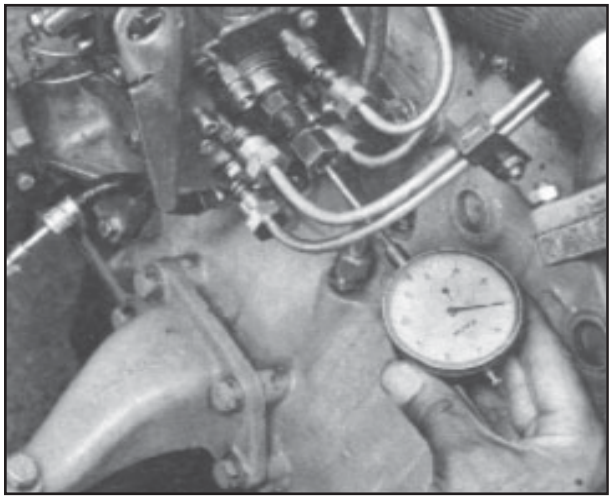


Fig. 149

Tighten adapter cap nut.

Rotate crankshaft in anti-clockwise direction by approximately 30 degrees.

Precisely locate bottom dead center of fuel injection pump plunger by slight rotation of crank shaft in either direction.

Set dial gauge reading to 0.

Rotate crank shaft clockwise to TDC position and insert the timing pin in flywheel. Refer Figure 150

Slowly rotate fuel injection pump till plunger lifts by values given below in dial gauge. Rotating fuel injection pump towards crank case increases plunger lift and vice versa. Refer Figure 151. For engines with MICO FIP.

Euro II engines 0.71 ± 0.02 mm

Euro I engines 0.83 ± 0.02 mm

Fully tighten fuel injection pump front mounting nuts, rear mounting bolt and taper nut in this position.

Remove timing pin from cylinder block.

Rechecking timing

Rotate crank shaft by two full rotations. Check injection pump plunger lift as specified above.

In this position it should be possible to insert timing pin in flywheel. If not, repeat fuel injection timing adjustment procedure.

Remove dial gauge and timing adapter, 2654 5890 05 09. Refer Figure 152

Fit back timing plug on fuel injection pump.

Connect high pressure injection pipes to fuel injection pump. Refer Figure 153

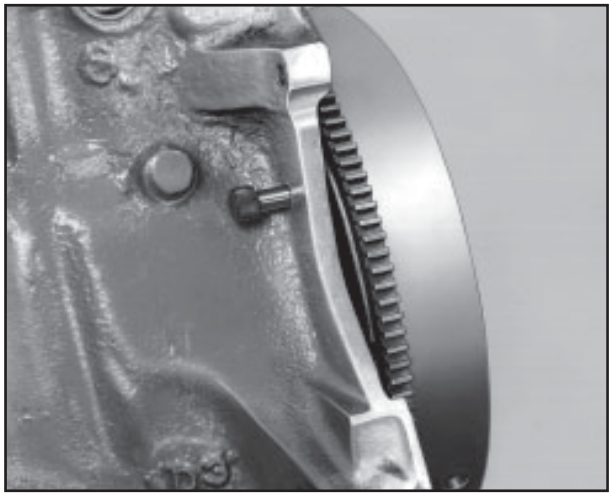


Fig. 150

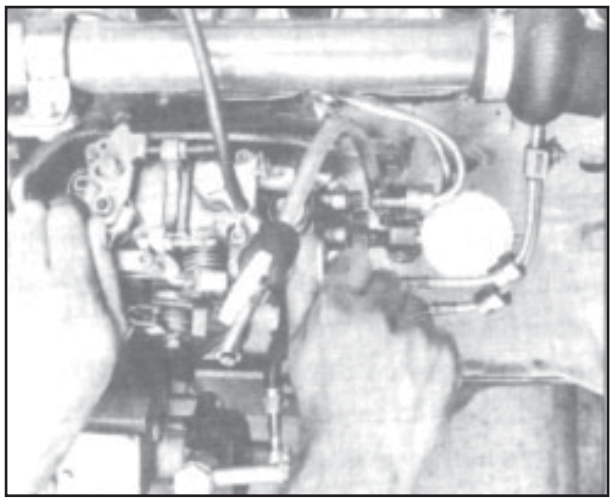


Fig. 151

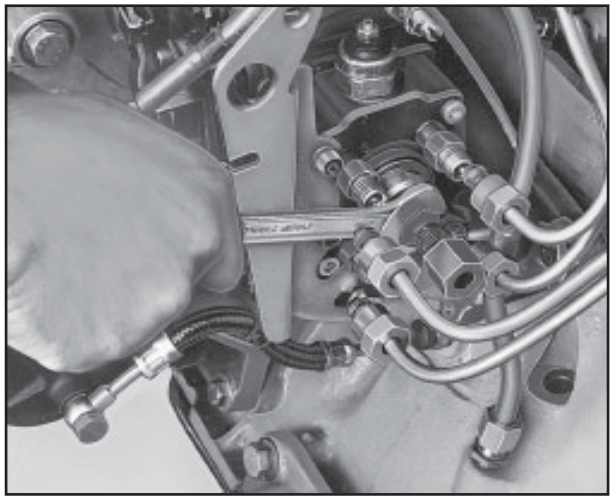


Fig. 152

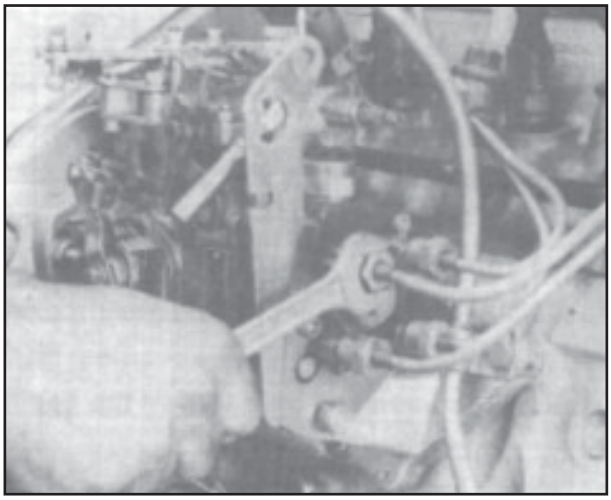


Fig. 153

ELECTRICALLY OPERATED AUTOMATIC KSB : (applicable for MICO FIP - Euro II)

FIP has got an automatic KSB (cold start accelerator) operated by a 12V power supply. Control device (1) Contains a wax module which is connected to KSB control lever (2) through a cable (3). When engine is running, control device draws current from battery through solenoid (4). Current drawn from battery is used to heat the wax module and the expanded wax releases KSB control lever (which is held against a torsion spring) towards the 'ZERO' position of injection advance unit plunger through the connecting cable (3). In this position, KSB control lever rests against a stop plate (5) fitted in pump housing.

When current supply is cut OFF to KSB unit, wax solidifies and control lever is pulled back to advanced position (max. 2.5 deg. cam angle). This ensures automatic timing advance during engine start. It is to be noted that during engine running, power supply to KSB control device is on.

Setting static timing on FIP fitted with KSB unit.

After fitting FIP loose on engine, 12V power supply to be connected to KSB control device to ensure that KSB control lever rests against stop plate. This takes 3 to 4 minutes after giving supply. This corresponds to fully retarded position of advance unit plunger.

At this position, specified lift of pumping plunger to be set atTDC of the engine and pump mountings to be tightened.

Temperature controlled idle speed increase (TLA) : (applicable for MICO FIP)

Above pump has also got the feature TLA. TLA is likewise actuated by control device (1). For this purpose, KSB control lever (2) is extended and a ball pin (6) is fitted. When engine is started in cold, this ball pin presses against the speed control lever and lifts it off the idle stop screw (7).

Idle speed is thus increased and engine warm up is improved. By the time engine is warm, KSB control lever is against KSB stop plate. Consequently, speed control lever also rests against idle stop screw ensuring normal idling.

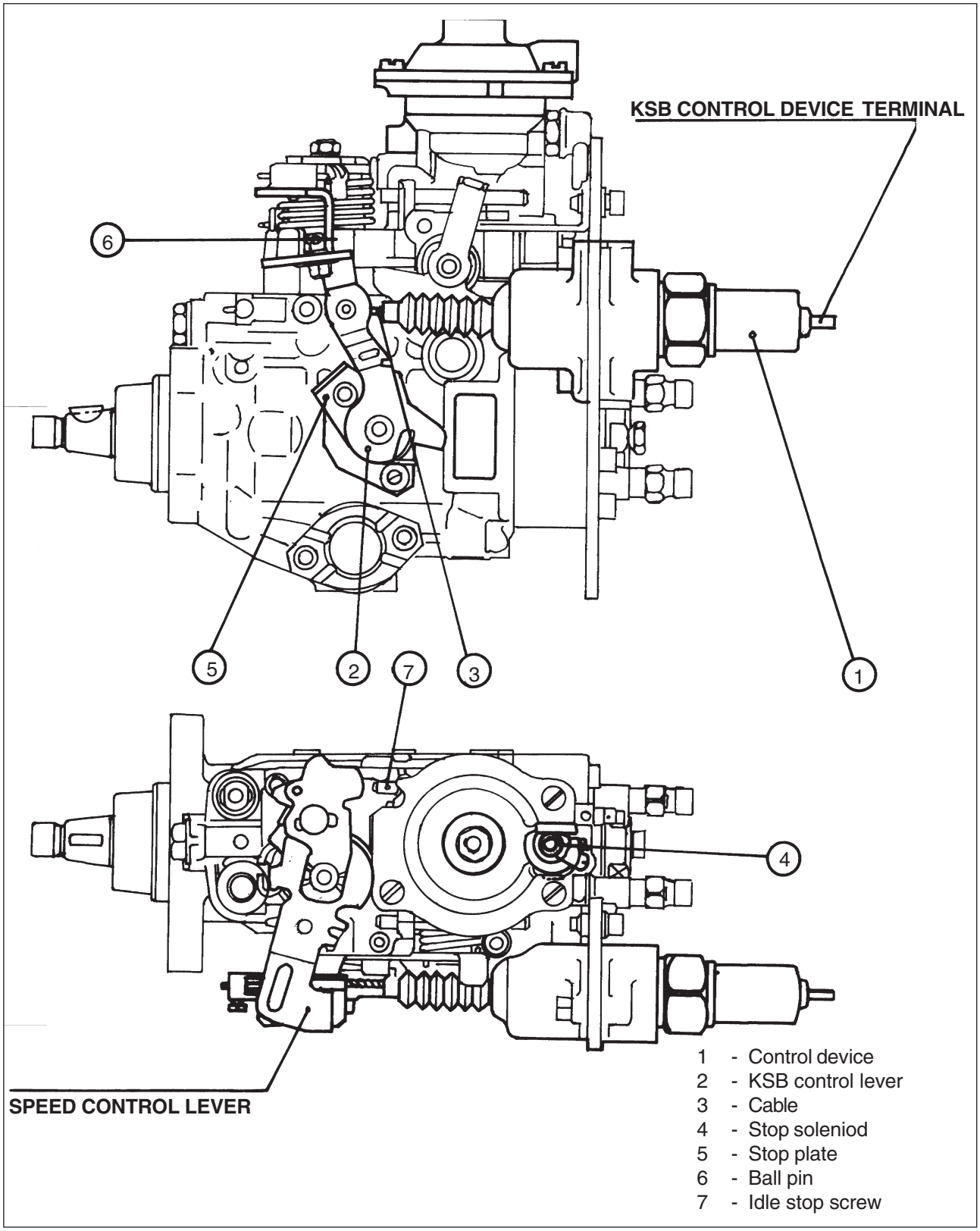

KSB CONTROL DEVICE TERMINAL
6
5
2
7
3
1
4
SPEED CONTROL LEVER
1 - Control device
2 - KSB control lever
3 - Cable
4 - Stop soleniod
5 - Stop plate
6 - Ball pin
7 - Idle stop screw

Fig. 154

LUCAS DPC FIP FOR EURO III ENGINES

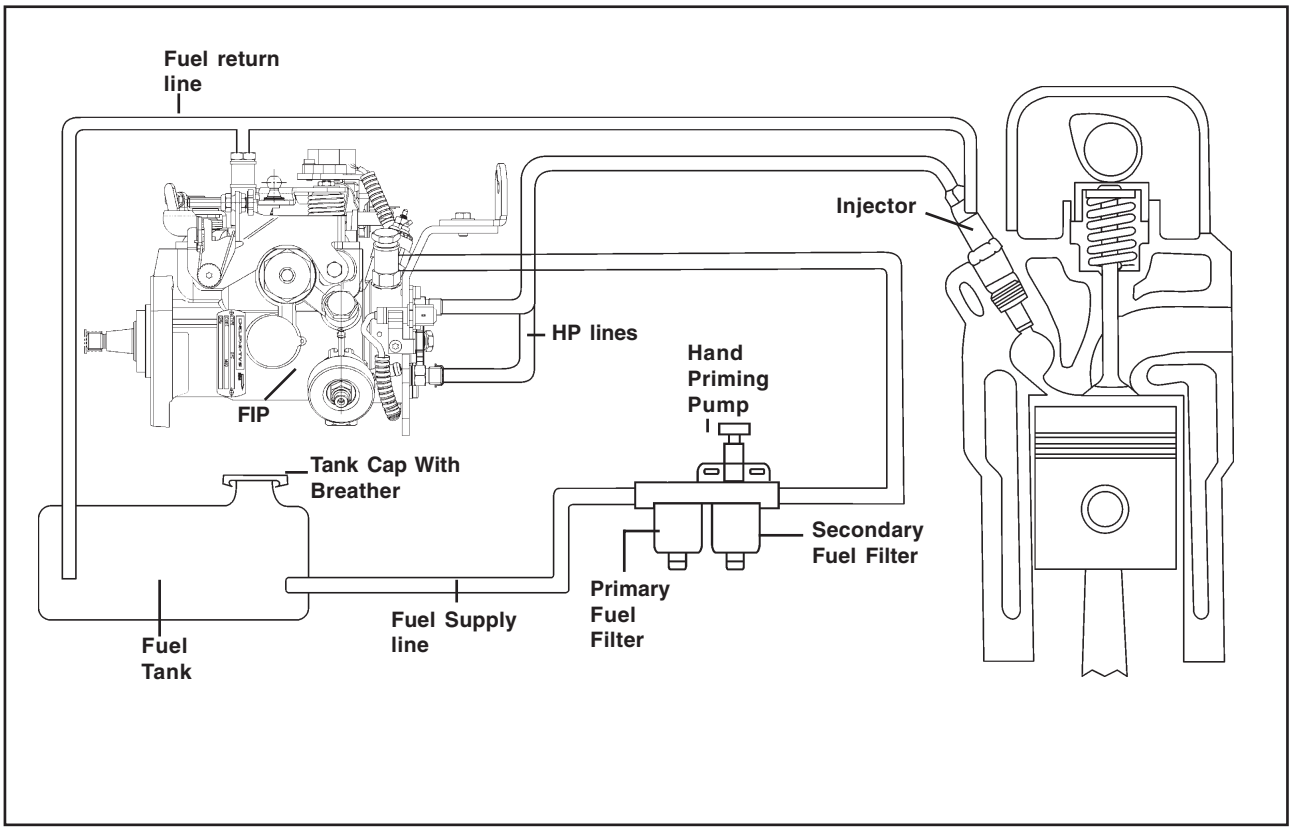


Fig. 155

Principles of DPC pump operation & Hydraulic Circuit with Boost Control

Fuel system consists of fuel tank, fuel filters, fuel injection pump and injectors.

Fuel is drawn into fuel injection pump by the transfer pump through filter assembly. A hand primer fitted between tank and filter facilitate in filling and venting operations.

Return line from FIP and injectors is connected to tank thus forming a closed loop system.

Transfer pump sucks fuel from tank, through filter assembly and increases the feed pressure and regulates it.

Fuel thus transfered and pressurised is metered by a metering valve and passes through electrical shut-off valve.

Metered fuel passes through various drillings of head & rotor between pumping plungers in rotor.

Pumping plungers when depressed by the action of the opposed cam lobes, rise the pressure to much greater level and the fuel at high pressure flows to the injectors.

LUCAS DPC FIP - HYDRAULIC CIRCUIT

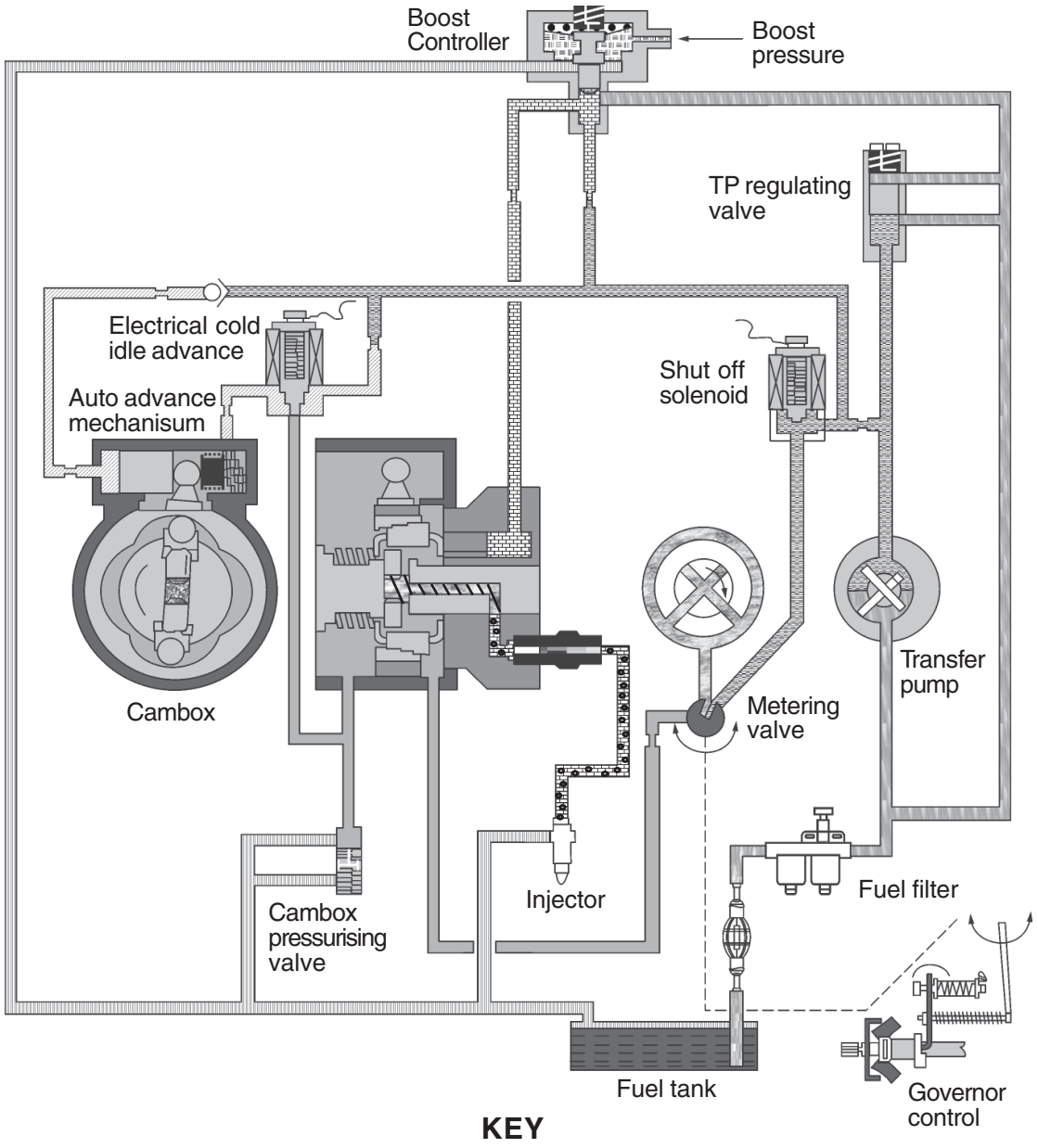


Fig. 156

LUCAS FIP - EURO III

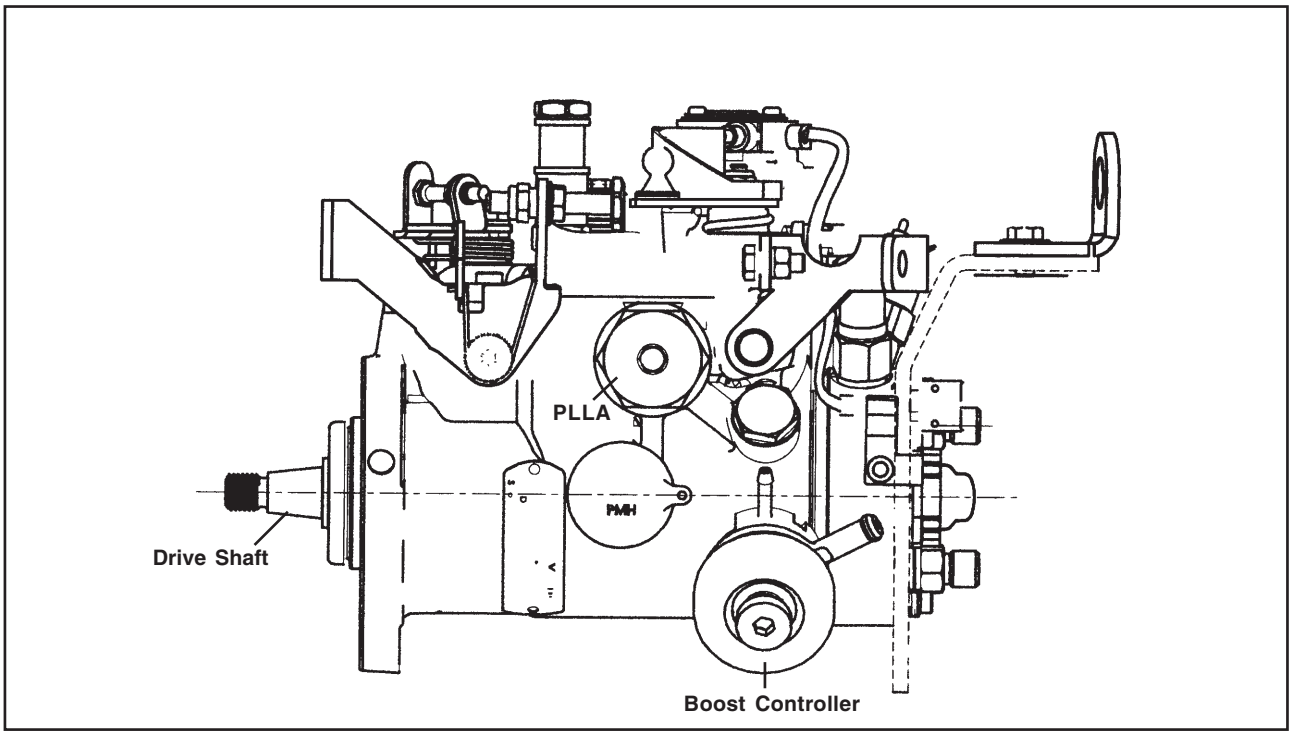


Fig. 157 Lucas - FIP (Euro III) side view

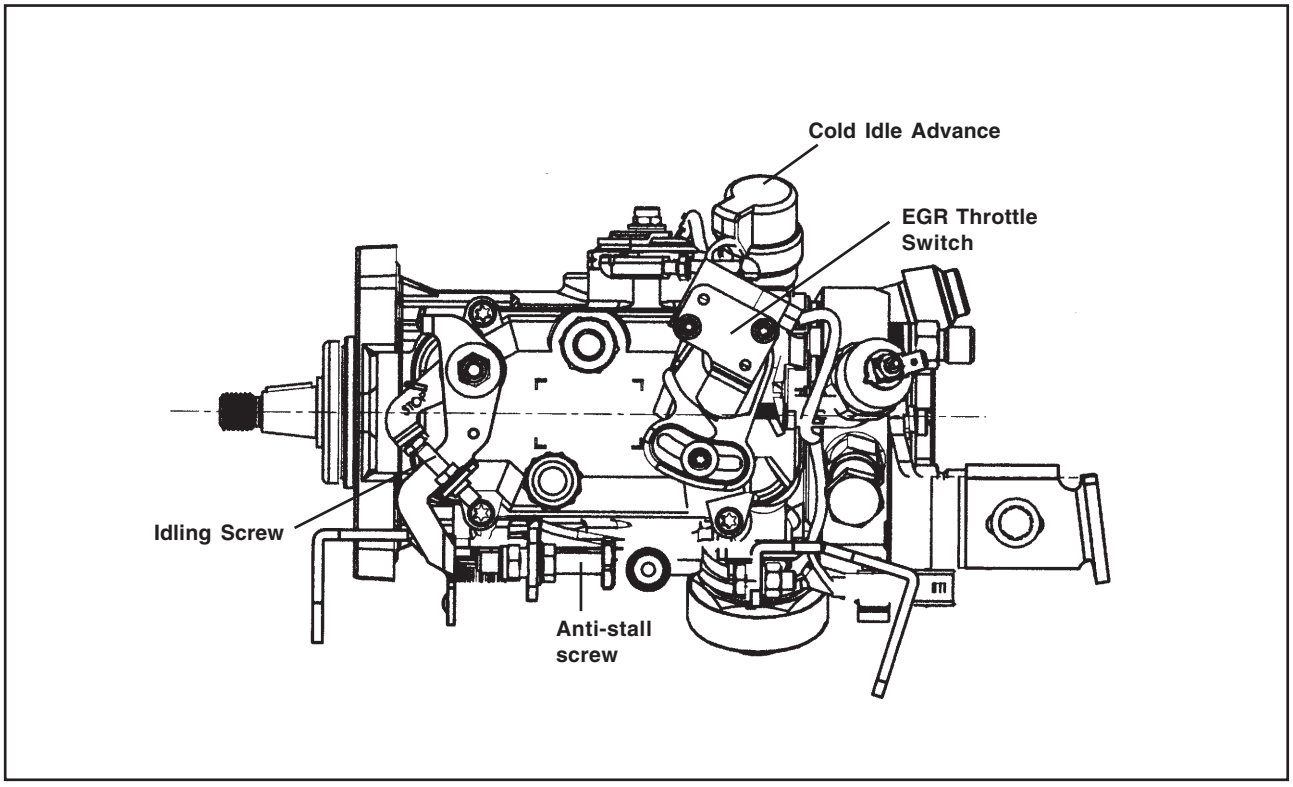


Fig. 158 Lucas FIP (Euro III) Top view

LUCAS DPC FIP - FEATURES

1. EXCESS FUEL SYSTEM

To assist engine starting, excess fuel system provides at very low pump speeds, fuel delivery that is greater than full load delivery.

The system is incorporated in delivery control mechanism, which by the action of a return spring allows distance between the pumping plungers to be increased to a level that is more than normal operating levels. This increased outward travel of plungers allow extra quantity of fuel to flow in during filling cycle. The same is pumped out during pumping stroke.

As the Engine speed increases, increase in transfer pressure automatically cuts-off excess fuel. The transfer pressure pushes delivery control system against the opposing return spring to retain it in normal operating position.

2. TWO SPEED GOVERNOR (MIN.-MAX.)

- Function of two speed governor is to control idling. Fast idling and maximum no-load speed of engine.
- Governor interferes only during idling and maximum no-load conditions, to determine the position of metering valve and thus control fuel delivery.

  - During intermediate phase, metering valve is directly linked to throttle lever (accelerator pedal), providing a direct control.

ADVANTAGES :

- Smooth response to alterations in throttle position.
- Improved driveability.

3. PROGRESSIVE LOW LOAD ADVANCE (PLLA)

Low Load Advance System overrides normal speed advance system. Under low load conditions, due to reduced fuel supply, there is a tendency for the timing to retard. Low load advance system compensates for this characteristic by slightly advancing injection at reduced fuel levels.

Type of low load advance system used is called progressive low load advance (PLLA) system.

Advantage of PLLA system is, that it progressively changes the advance to suit engine load conditions. Thus helps in achieving better emissions and also reduces transient noise.

4. SUPPORTED TOOTHED BELT TYPE DRIVE

- Assembly consists of drive shaft assembly supported by two bearings and in the pump housing the shaft is connected to the pump hydraulic head by an intermediate shaft.
- Bearing opposes the loading created by drive belt, thus maintaining alignment of drive shaft and hydraulic head.

ADVANTAGES :

- Smoother Running
- Pumping drive draws lesser power from engine
- Noise reduction

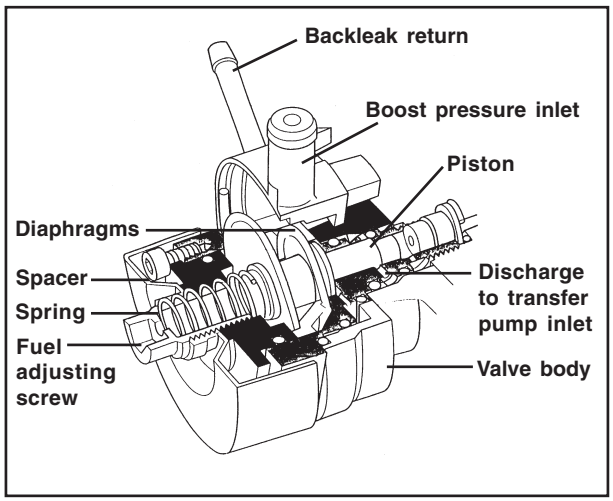


Fig. 159

5. BOOST CONTROLLER (Fig 155e)

Boost Controller is necessary on FIP fitted to turbo charged applications, in order to adjust maximum fuel delivery in accordance with variations in boost pressure from turbo charger.

Fuel adjustment plate and roller shoes on the pump are provided with ramps to allow for progressive change in fuel delivery as the assembly move axially on the rotor by the action of the actuating piston moving against a carriage return spring.

Boost controller consists of a piston valve moving within a valve body. The valve is linked to a pair of

diaphragms within boost controller. Boost pressure is piped and connected to the chamber formed between two diaphragms. Diaphragms sense variation in boost pressure and maintain the balance between fuel delivery and boost pressure, by continuously varying the pressure behind actuating pistons.

Operation :

At cranking speeds, assembly is held in Excess Fuel position (Full Boost) by a spring. As the engine picks up, transfer pressure builds up behind the actuating pistons and moves the assembly to minimum fuel position.

As boost pressure increases with the rise in engine speeds, the diaphragm responds and allows the pressure to leak acting behind actuating pistons. This allows the return spring to move the assembly axially towards increased fuel delivery position.

6. EGR THROTTLE SWITCH

EGR Throttle Switch fitted on throttle lever is used to sense the position of throttle lever. The output is given EGR controller.

7. COLD IDLE ADVANCE

Solenoid operated Cold Idle advance is driven by glow plug timer (GPT) and overrides normal advance control mechanism when engine is cold. This normally functions in conjunction with engine Pre / Post heat system and operates only when electrical input is supplied to it by GPT.

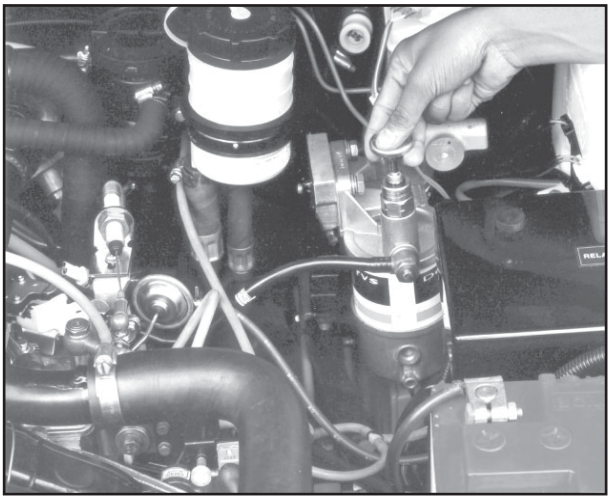


Fig. 160

AIR VENTING

DPC pumps are self venting pumps and therefore allows air entering into it, to go out through return line. However, it is recommended that whenever fuel lines are disconnected, system is to be primed in order to fill the system with fuel and remove air present in the system completely.

Procedure

- Energise Fuel Shut-Off Solenoid (Switch 'ON' ignition switch).
- Loosen following vent screws
  On the banjo bolt at filter outlet ①
  On the FIP timing chimney plug ②
  (See fig. 160)
- Loosen priming pump plunger ③ and actuate the pump until clear fuel comes out of vent screw ①
- Tighten vent screw ①
- Continue actuating priming pump plunger until clear fuel is seen coming out from vent screw ②
- Tighten vent screw ② and then priming pump plunger ③
  Loosen one of the HP connections at injector end. Crank engine for few seconds; and see that fuel flows out of injector line. Tighten HP connection.
  Start engine and see that there is no fuel leak from any points/connections.

IDLE SPEED SETTING

Procedure

1. Setting 'Idle' speed :

1.1 Set when the engine is hot.

1.2 Slacken lock nut ②, and turn the idling screw ① Fig. 161, to set idling speed as specified.

1.3 Tighten lock nut ② Fig. 161, and re-check idle speed.

2. Setting Fast Idle Control Device :

2.1 Fast Idle Speed as specified can be adjusted by setting the stroke length of Fast Idle Control Device.

2.2 Slacken lock nut ③, and adjust stroke length of FICD by turning adjuster ④ Fig.161

2.3 Hold adjuster and tighten lock nut.

2.4 Re-check the setting speed.

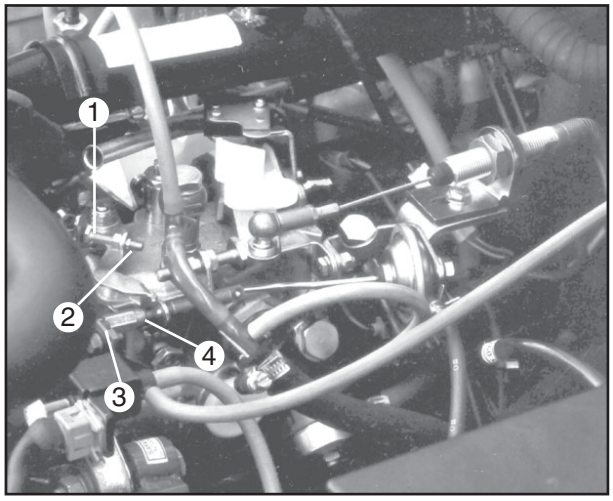


Fig. 161

Specified value

Idling speed : 850 to 900 rpm

Fast idle speed : 950 to 1000 rpm

ANTISTALL SETTING :

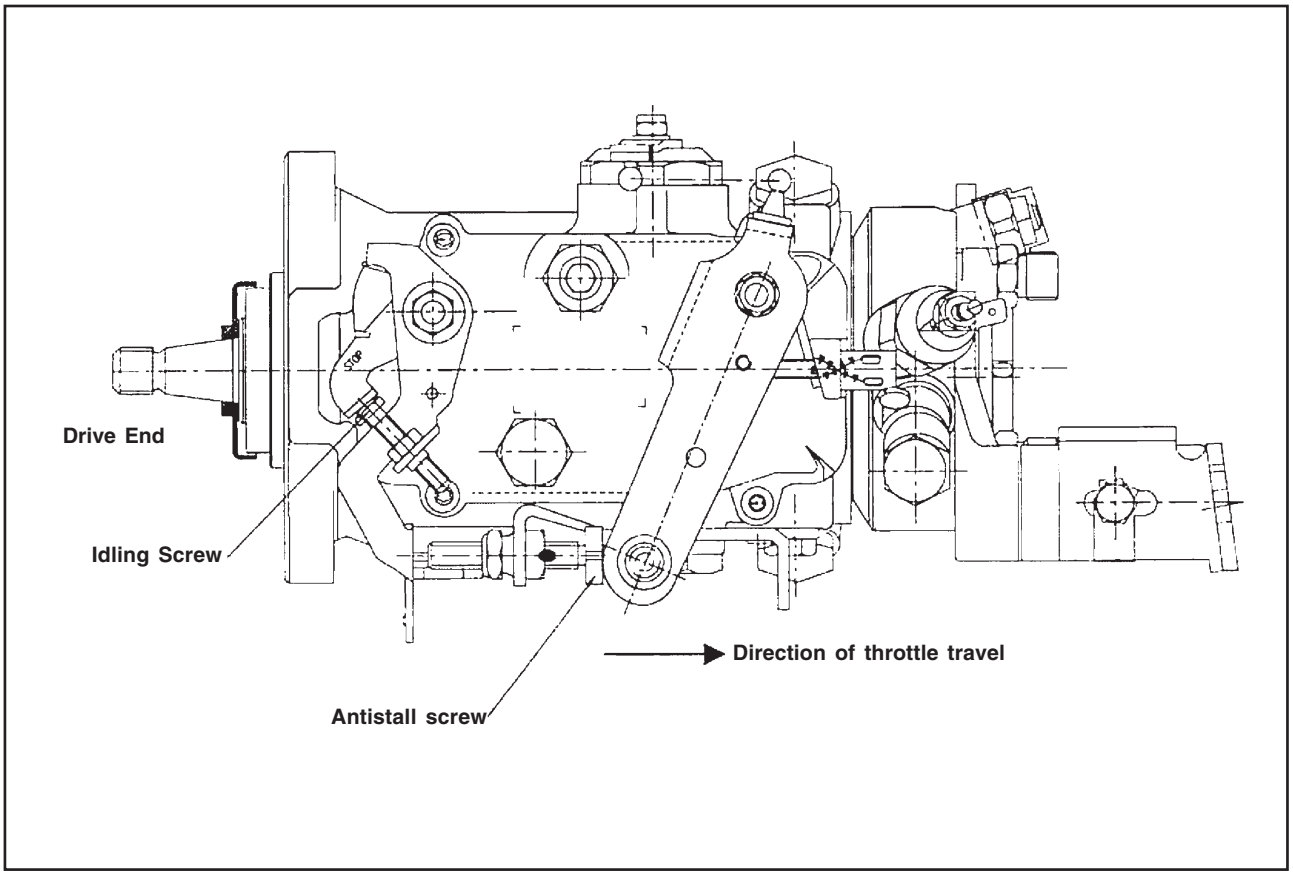


Fig. 162

Procedure

- This is set to prevent vehicle stalling when accelerator pedal is suddenly released from depressed position
- Setting is achieved by optimizing between dead travel and die-down time.
- **Verifying / Adjusting Antistall setting**

1 Warm the engine sufficiently to ensure that thermostat is open and engine is free to rotate.

2 Air-conditioning should be in off position. No other external loads (like power steering, alternator loads) should be imposed on engine.

3 Check idling speed. Adjust the same using idling screw to specified value, if required. (850-900 rpm).

4 Move throttle lever by approximately 2.0mm. Speed should increase from idle speed. If not adjust antistall in the direction of throttle travel as required.

5 Move throttle lever to near full throttle position and release. The die-down time should be maximum 4 seconds without any undershoot (speed reducing below idle speed and jerk / vibration observed). If it is more than 4 seconds move antistall screw in the direction of the drive end as required. If undershoot is observed move in the direction of throttle travel.

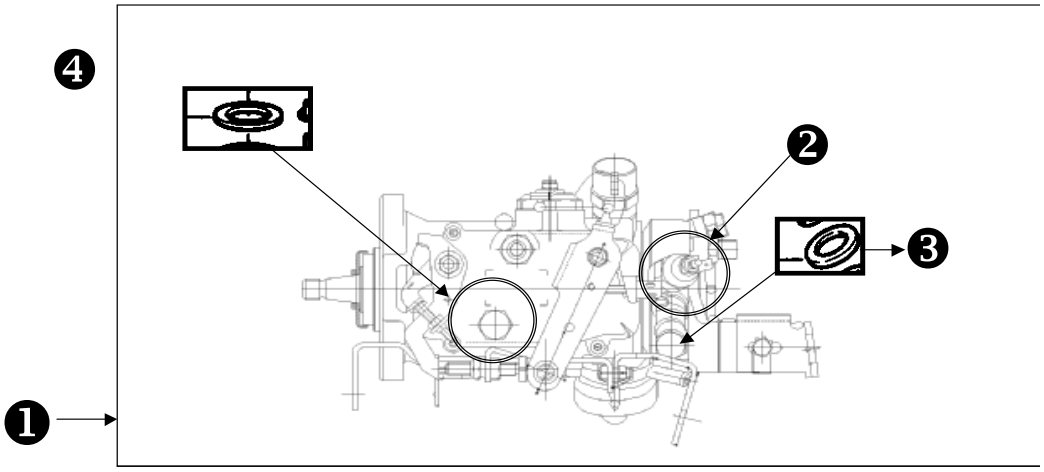
6 Verify and confirm that idle speed has not been disturbed. If idling found to be disturbed, repeat antistall setting procedure (steps 4 to 7).

- **Don'ts**

  Do not try to adjust / set idle speed with antistall screw.

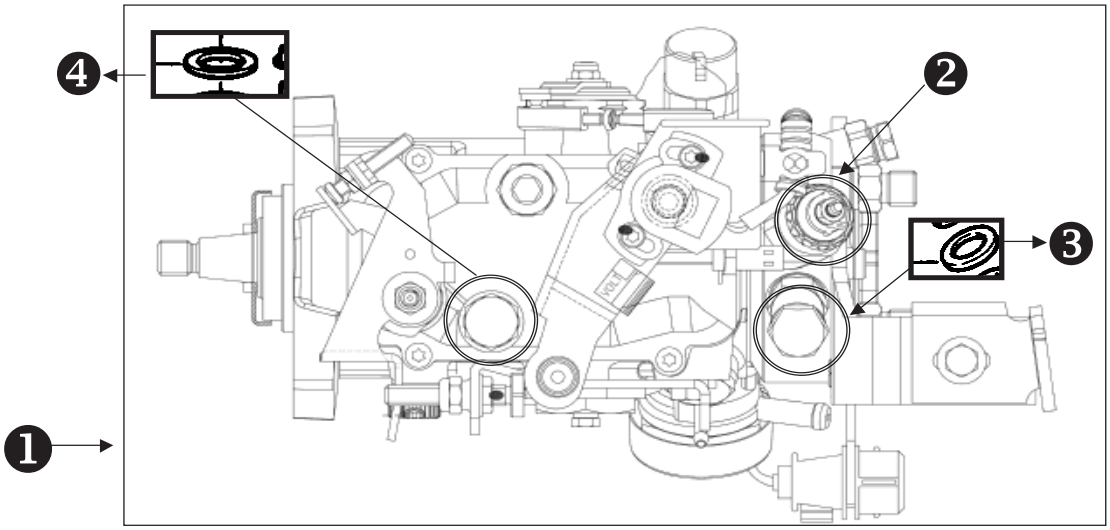
SERVICEABLE PART LIST FOR LUCAS DPC FUEL INJECTION PUMP

Lucas DPC FIP – 2547 0710 0137
(For Telco Line and Safari – Euro 2)



DTVS Part No	Description	Telco Part No	Iden. No
G8473B101B	Fuel Injection Pump	254707100137	❶
9108-073A	Solenoid assy	254707990147	❷
9103-287	Inlet copper washers	254707999901	❸
9007-392A	Back leak valve copper washers	254707999902	❹

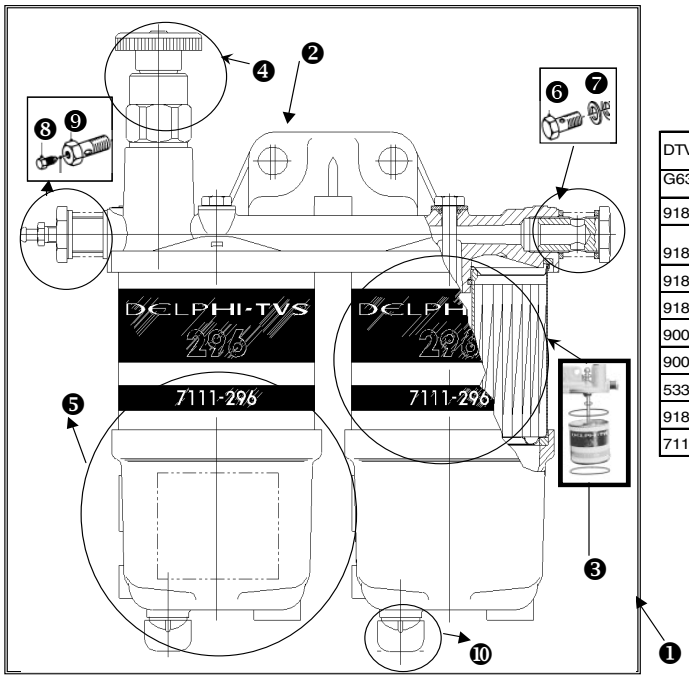
Lucas DPC FIP – 254707100138
(For Telco Line & Safari – Euro 3)



DTVS Part No	Description	Telco Part No	Iden. No
G8473B200A	Fuel Injection Pump	254707100138	❶
9108-073A	Solenoid assy	254707990147	❷
9103-287	Inlet copper washers	254707999901	❸
9007-392A	Back leak valve copper washers	254707999902	❹

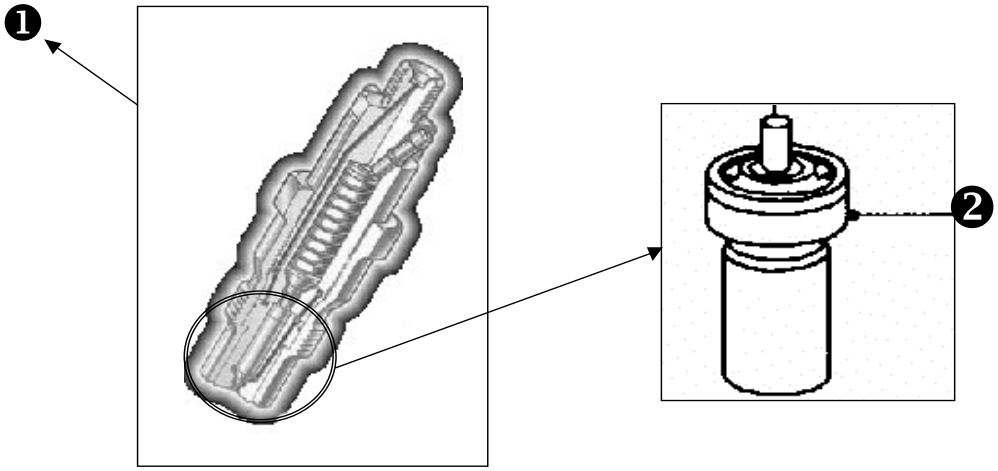
SERVICEABLE PART LIST FOR LUCAS DPC FILTER & INJECTOR

Delphi-TVS Filter Assembly – 254709110118
(For Telco Line and Safari Euro 2 & Euro 3)



DTVS Part No	Description	Telco Part No	Iden. No
G6300B040A	Filter assy	254709110118	❶
9183-012A	Filter head	254709999901	❷
9188-005	Filter element (7111-296)	254709999902	❸
9183-120	Hand primer	254709999903	❹
9188-004	Assy. Base filter	254709999904	❺
9007-864	Bolt banjo	254709999905	❻
9007-383A	Washer	254709999906	❼
5334-332C	Vent screw	254709999908	❽
9188-003	Assy. Bolt banjo	254709999907	❾
7111-740	Assy. Plug	254709999909	❿

Delphi-TVS Injector Assembly – 2547 0116 0111
(Telco Line and Safari – Euro 2 & Euro 3)



Delphi-TVS Part Number	Description	Telco Part Number	Identification Number
G02001G	Injector assy	'254701160111	❶
9008-088W	Assy Nozzle (R5643493)	254701999902	❷

FAULT DIAGNOSIS FUEL INJECTION SYSTEM

Overracing / Autoracing of engine / vehicle	Delayed response	Difficult Starting (Cold / Hot)	Irregular Idle and Fast Idle	Insufficient Maximum Speed	Erratic Running / Surging	Excessive Smoke	Excessive Noise	Lack of Power	Excessive Fuel Consumption	Stalling	Slow Engine Die-down	Engine cannot be Shut-off	Cause	Check
Symptom														
		●			●								1. Lack of Fuel	1 Fuel Level
		●											2. Manual stop control* faulty	2. In run position and linkage free
		●			●							●	3. Stop solenoid* faulty	3. Audible operation when switched. Check electrical supply.
												●	4. Stop solenoid* valve leaking	4. Engine stops when supply lead removed.
		●											5. Wrong starting procedure	5. Starting procedure correct. (Start advance and starting aid operation).
●		●	●	●	●			●		●			6. Air in fuel system	6. Fuel System is vented, all joints and unions airtight, no leakage at diaphragms
		●	●	●	●			●		●			7. Fuel inter restriction	7. Filter not choked and feed pipes clear
		●	●	●		●		●		●			8. Fuel contamination	8. Diesel fuel being used, not petrol; free of water, dirt, ice and wax
	●												9. Low viscosity / low density fuel	9. Check for origin of fuel
		●											10. Low cranking speed	10. Battery, Starter, Cable Connections, Correct engine lubricating oil
		●				●			●				11. Starting aid* ineffective (Plugs or Thermostart)	11. Correct functioning. Fuel supply* timer* and electrical connections
		●	●		●	●	●	●	●	●			12. Injection timing incorrect	12. Pump to engine timing
		●											13. Timing belt* slipped several teeth	13. Belt / Chain condition and tension
		●	●	●				●					14. Feed pump* faulty	14. Feed Pump Pressure
		●	●	●				●		●			15. Fuel return restricted	15. Rotary pump backleak, tank returns, filter vents are clear
		●	●	●	●			●					16. Fuel circuit incorrect	16. Inlet and backleak pipes correct way round. Banjo bolts of correct Lucas-TVS type
		●	●	●	●	●	●	●	●	●			17. Engine condition	17. Cylinder compression. Valve timing and clearances. Air filter not choked, Injector seating
								●	●				18. Exhaust system defective	18. System Unrestricted
		●	●		●	●	●	●	●				19. Fuel atomisation	19. Injectors : correct type, opening pressure, spray conditions, evenly tightened
		●	●		●			●					20. Fuel tank blockage	20. Tank vent and outlet filter unrestricted
		●	●	●	●	●		●	●				21. HP Pipe type / firing order incorrect	21. HP Pipes type and fitted in correct firing order
			●		●			●					22. HP Pipe restriction	22. HP Pipes not kinked or bore reduced at nipples
		●	●		●			●	●	●			23. HP vent* leaking	23. Vent screw tight
		●	●		●			●	●				24. HP Pipe leaking	24. HP Pipe joint tightness
								●	●				25. LP Leakage	25. Feed and return pipe, filter, feed pump and tank for leakage
●	●		●						●	●			26. Idling speed incorrect	26. Idling speed
			●							●	●		27. Anti-stall* setting incorrect / high	27. Recovery from acceleration, engine warm (if necessary, reset idling and anti-stall)
				●				●					28. Maximum speed setting incorrect	28. Engine fly-off (maximum.) speed
●													29. Throttle lever not returning to min position	29. Check for stickiness of throttle lever / PLLA lever
			●	●	●			●			●		30. Accelerator linkage faulty	30. Throttle lever tight on pump and reaches stop screws. Linkage wear, adjustment, free movement
			●		●		●						31. Engine Vibration	31. Engine mountings tight and effective
			●		●								32. Vibration	32. Vibrations transmitted to engine (e.g. from gear box)
								●					33. Overloading	33. Vehicle payload
				●				●	●				34. Vehicle brakes binding	34. Brake freedom wheel by wheel, handbrake off
		●	●		●								35. Injection pump mountings loose	35. Tightness of pump drive mounting bolts.
		●	●	●	●	●	●	●	●	●	●	●	36. Injection pump defective * If fitted	36. If all other relevant checks are satisfactory, remove pump for specialist check at Delphi-TVS Authorised Centre

FAULT DIAGNOSIS INJECTORS

Cylinder Knock - Uneven Running - Misfire	Loss of Power - Excessive Consumption	Engine Overheating	Black Smoke	Poor Starting	Cause	Check
Symptom						
●	●			●	1. Injector not sealing in cylinder head	1. For cleanliness and sealing washers; if specified
●	●	●	●	●	2. Two sealing washers under injector	2. Number of washers and if specified
●	●			●	3. High pressure pipe joint leaks	3. Pipe unions for leaks
	●				4. Back leak pipe joint leaks	4. Unions for leaks
●					5. High Pressure pipe restricted	5. High pressure pipe bores
●	●	●	●	●	6. Injector / Nozzles Sticky	6. Fixing nuts tightened / injectors screwed in to the correct torque, fuel contamination / adulteration, dirt / burrs / debris in HP pipes
●	●	●	●	●	7. Incorrect injectors fitted	7. Manufacturer's specification
●	●	●	●	●	8. Injector Faulty	8. Check injector on a nozzle setting outfitAuthorised Centre

Back Leakage	Opening Pressure	Atomisation	Seat Tightness	Cause	Check
Symptom					
●				1. Pressure face leak	1. Nozzle cap nut torque and pressure faces clean and undamaged
●				2. Nozzle valve scored or having excessive clearance	2. Valve stem and nozzle body visually
	●	●		3. Incorrect setting	3. Opening pressure and reset if necessary
	●	●	●	4. Nozzle seized or sticking	4. For foreign matter, distortion or damage
	●	●		5. Spray holes blocked	5. Holes are free of carbon
●	●	●	●	6. Valve not seating	6. Nozzle valve and body for carbon pitting or damage
	●	●		7. Broken or distorted spring	7. Spring visually and replace if necessary
	●	●		8. Auxiliary hole blocked	8. Hole is free of carbon
		●		9. Pintle broken or damaged	9. Nozzle valve tip visually for damage
	●	●		10.Nozzle holder spindle worn	10. Spindle ends for wear and replace if necessary
	●	●	●	11. Nozzle cap nut overtightened	11. Cap nut torque

Removing Injectors : Always ensure that injectors are not knocked during removal particularly pintle nozzles as the valve tips can easily be damaged. Impact extractors to be used for flanged / clamped injectors.

Fitting Injectors : Ensure Injector, cylinder head bore and seat are clean. Ensure manufacturer's specification is observed for fitment of sealing washer and heat shield. Tighten fixing bolts or nuts evenly to the correct torque.

If nozzle body or valve is worn or damaged the nozzle must be replaced or sent for specialist repair, to Delphi-TVS Authorised Centres.

FAULT DIAGNOSIS SMOKE

Speed	Black / Dark Grey at full load	Black / Dark Grey at high load	Black / Dark Grey any load	Blue / White at light load	Blue at light load / acceleration	Blue any load	Cause	Check
	Symptom							
Maximum	●						1. Overspeeding	1. Maximum speed setting
						●	2. Lub oil induction	2. Oil bath air cleaner for overfilling (Wherever fitted)
	●						3. Choked Venturi	3. Venturi (Pneumatic Governor) is not restricted (Wherever fitted)
Medium to Maximum	●						4. Retarded timing	4. Pump to engine timing, auto advance function
	●	●					5. Incorrect atomisation	5. Injectors - see chart
	●						6. Air Starvation	6. Air cleaner ducting restrictions; turbo operation
	●						7. HP Pipes	7. Bore size; length; restrictions
				●			8. Cold Engine	8. Thermostat : Cooling system, operation
		●					9. EGR valve is permanently open	9. Functioning of valve, setting of EGR switch
		●					10. Carbon deposition in intake system	10. Cleanliness of EGR valve, intake manifold
		●					11. VSV valve not working properly	11. Vacuum connections to VSV and its functioning
Low to Medium All	●						12. Advanced Timing	12. Pump to engine timing; auto advance function
		●					13. Poor Compression	13. Setting / condition of valves, piston rings + air intake
	●						14. Overfuelling	14. F.I. Pump, excess fuel device
	●		●	●			15. Incorrect Atomisation	15. Injector type / setting / condition
			●				16. Poor combustion	16. Injector fitment
				●			17. Retarded timing	17. Pump to engine timing; auto advance function
						●	18. Lub oil passing pistons	18. Piston / ring/ bore condition
					●		19. Lub oil passing valves	19. Valve stem / guide condition

F.I.P. TIMING SETTING PROCEDURE (LUCAS PUMP)

1. Lock flywheel in TDC position (with FIP gear and camshaft gear holes matched as per procedure followed for timing belt fitment) by inserting locking pin 2654 5890 0309 through cylinder block rear wall into flywheel.
2. Remove sealing plug on FIP located at the top. Refer figure. 163.

Insert timing rod Pt No. 2654 5890 06 01 (Lucas part no. : 9190-212). Refer figure. 164

Fit assembly timing bracket Pt no. 2654 5890 06 02 (Lucas part no. : 1804- 607) and dial gauge using clamping screw provided on timing bracket. Refer figure 165.

Loosen high pressure pipe lines from FIP, if fitted.

For setting timing on vehicle, use assembly timing bracket Pt No. 2654 5890 0603 (Lucas part no. : 1804-606).
Refer figure. 166

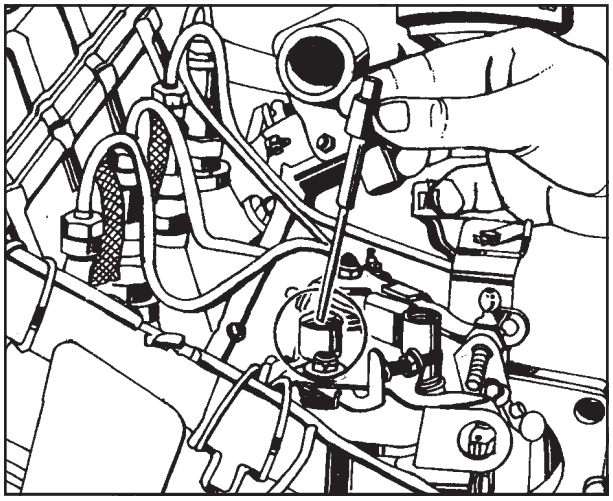


Fig. 164

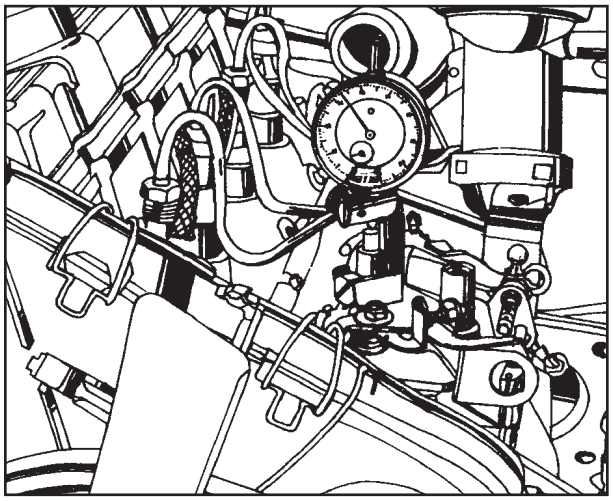


Fig. 165

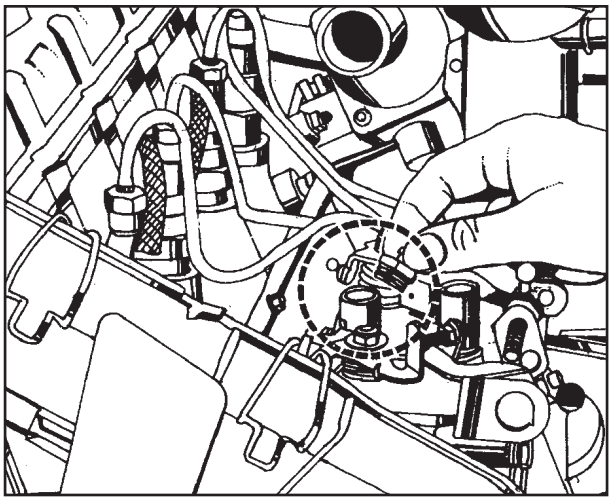


Fig. 163

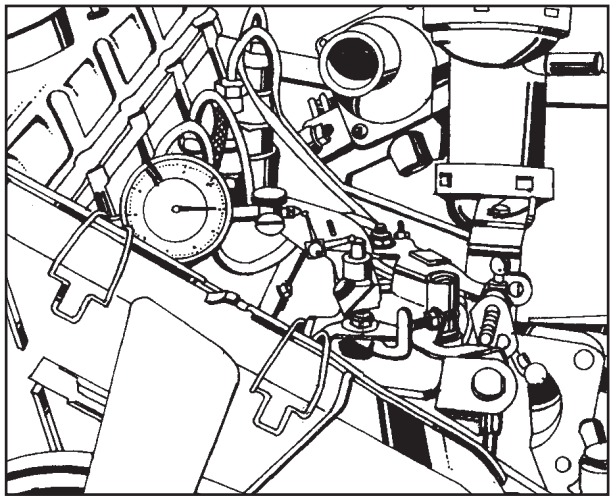


Fig. 166

3. Remove locking pin from flywheel (Refer figure 167) and rotate crankshaft anticlockwise (as seen from the front) by about 30 degrees till dial gauge on FIP shows minimum reading. Set dial gauge to zero. Refer figure. 168
4. Loosen FIP mounting nuts and also the screw for rear support for FIP.
5. Rotate crankshaft clockwise as seen from the front to TDC position and lock it by inserting locking pin in flywheel.
6. Rock FIP till, dial gauge on FIP reads $0.90^{\pm 0.02}$ mm and tighten FIP mounting fastners. This value is same for Euro II & Euro III engines.
7. Remove locking pin and rotate crankshaft anticlockwise by maximum 2 (two) revolutions. (DO NOT rotate clockwise, to avoid damage to timing spindle and dial gauge). Recheck timing by rotating clockwise and refitting locking pin at TDC position. If timing is not within $0.90^{\pm 0.02}$ mm, repeat the procedure (from points 3 to 6) till this is achieved.
8. Remove locking pin from cylinder block, timing bracket with dial gauge and timing spindle from FIP. Refit sealing plug and tighten to 0.5 mkg, and connect high pressure lines. Refer figure. 169. Bleed the system before starting engine.

NOTE :

DO NOT overtighten sealing plug to prevent damage to adaptor and its setting.

DO NOT interchange assembly banjo bolt fitted at fuel return line on FIP, to avoid changes in fuel delivery values & timing advance settings.

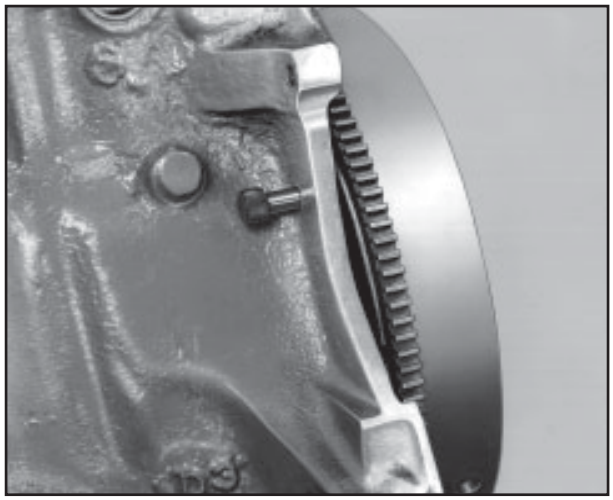


Fig. 167

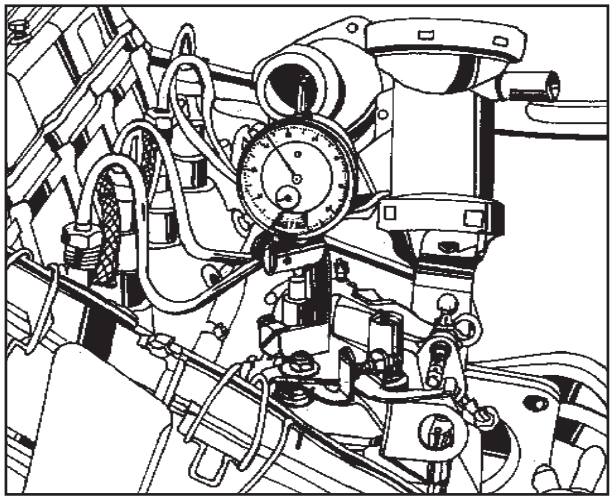


Fig. 168

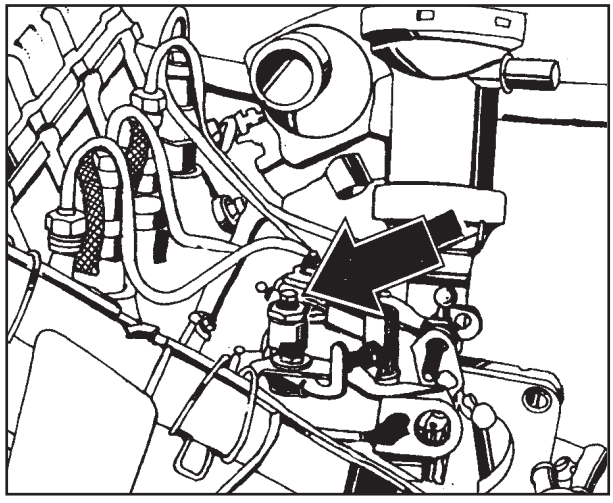


Fig. 169

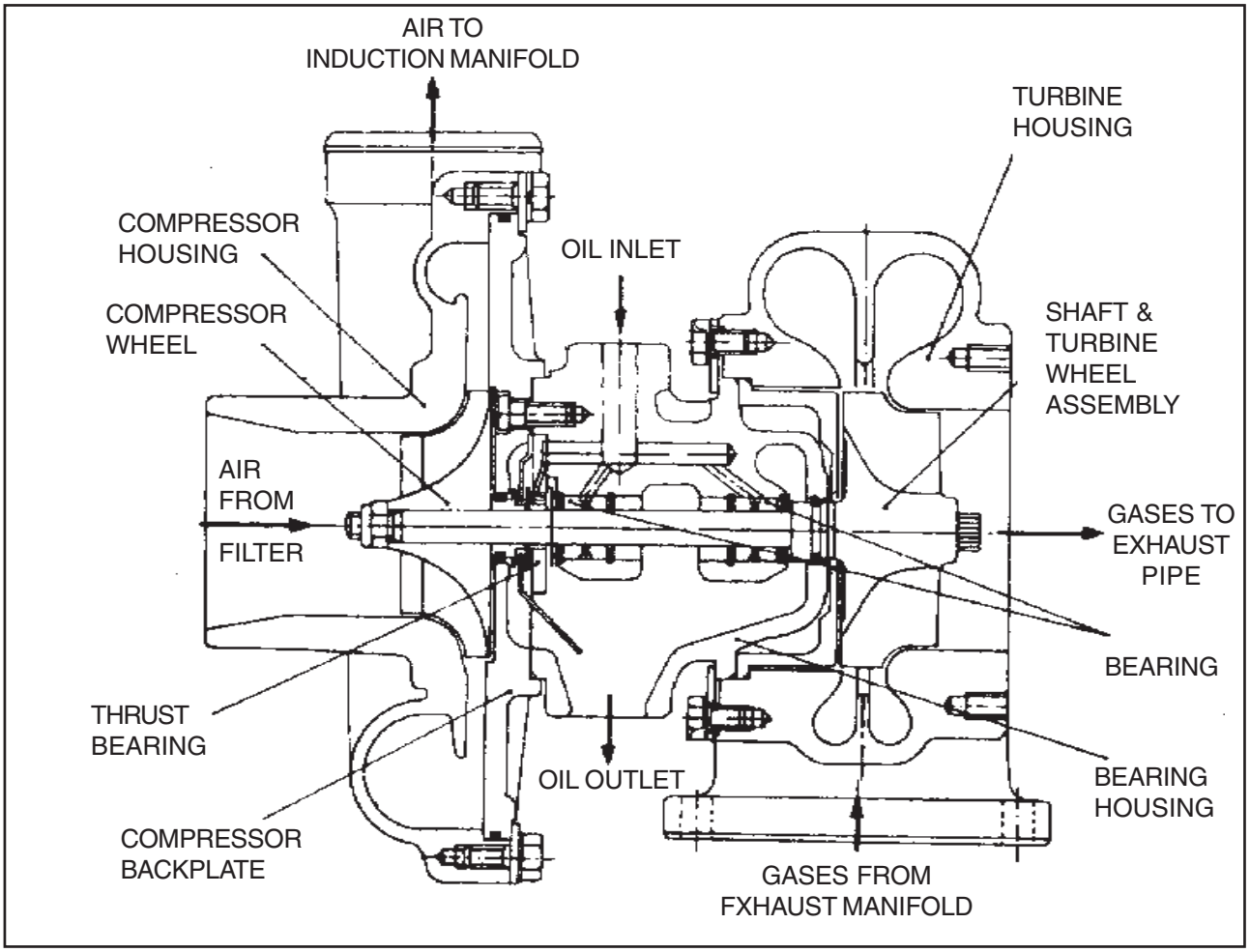


Fig. 170

TURBO CHARGER

Working Principle of Turbocharger

Power output from an internal combustion engine depends on mass of the air and fuel quantity that are available for combustion.

To increase engine horse power, more air for combustion and more fuel have to be delivered.

In case of a naturally aspirated engine, power increase is obtained by increasing swept volume or by raising speed.

Increasing swept volume, leads to larger and heavier engines that are expensive. Speed increase involves considerable technical problems and disadvantages like low mechanical efficiency, increased wear and tear and increase in noise etc.

Power increase with unchanged swept volume at same engine speed can be obtained by supercharging of engine.

Super charger delivers pre compressed air to engine cylinders i.e. engine intake pressure is higher than atmospheric. In naturally aspirated engines intake pressure is slightly below atmospheric.

Turbocharger is one of the super charging devices used in an engine. It makes use of thermal energy of engine exhaust gases to run a turbine which in turn drives a compressor to pressurise inlet air.

Wastegate Fig. 171

This feature in turbocharger consists of a bypass valve built into turbine housing. Some part of the exhaust gas going to the turbine is bypassed through this valve.

This is as shown in the sketch. wastegate arrangement reduces high boost pressure developed by compressor to the desired value, thus obtaining optimum engine performance with controlled peak cylinder pressure.

Intercooler : Intercooler is air to air heat exchanger used to cool compressed air from turbocharger prior to entry to inlet manifold. This increases the density of air entering engine inlet manifold and helps in improving engine power output, fuel efficiency and emissions.

Boost control device (FIP LDA)

During sudden acceleration, there is a time lag for turbocharger to supply air at desired pressure, sufficient for proper combustion. This causes heavy black smoke till turbocharger attains desired speed and delivers air at required pressure.

To overcome this, a boost control device (LDA unit) is incorporated in fuel injection pump which is actuated by air pressure inside inlet manifold and controls fuel delivery in accordance with air pressure available in inlet manifold.

Maintenance of the turbocharger

There is no mechanical drive connection between engine and turbocharger.

No adjustments or repairs should be carried out on turbocharger.

In case of doubtful performance or difficulties experienced, get it checked by authorised agency.

Following precautionary measures should be taken to obtain trouble free performance of turbocharger.

1. During regular engine inspection look carefully for any oil leakage at the oil inlet banjo connection on bearing housing. Do not run engine unless leakage at this point is rectified.
2. Do not stop engine suddenly as it may damage rotor bearings. Allow engine to idle for some time before switching it off. Similarly, do not race engine suddenly and unnecessarily.
3. Since the speed of rotor assembly is tremendously high, it must get clean filtered oil. Ensure cleanliness of engine oil by adhering to regular schedules of engine oil and oil filter cartridge change intervals.
4. As unfiltered dust particles entering compressor may prove dangerous, make sure that there is no leakage in air intake system and that air filter element is in good condition and sealed perfectly.

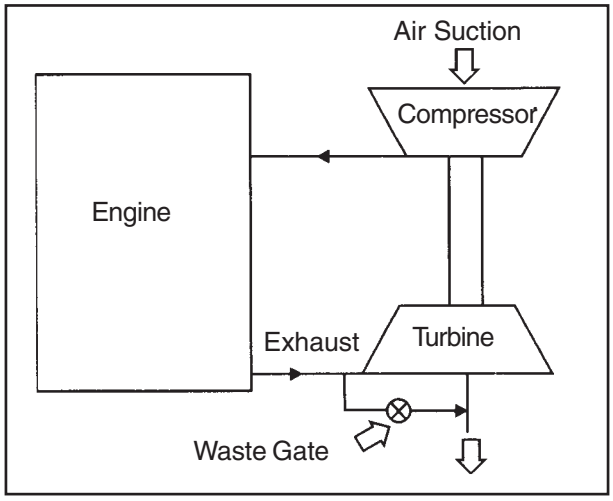


Fig. 171

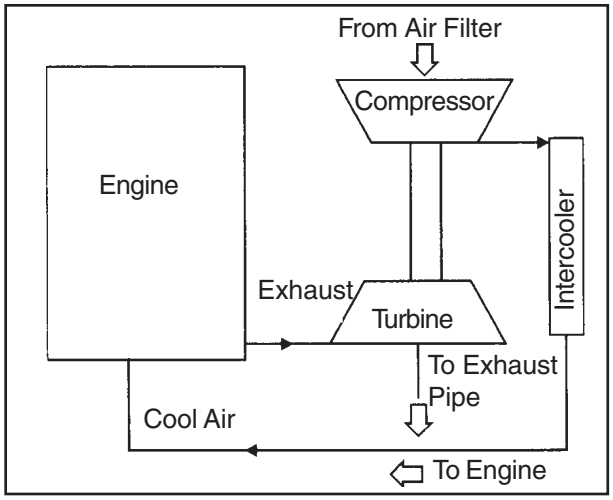


Fig. 172

Repair of turbocharger

We do not recommend servicing of turbocharger. In case of unsatisfactory performance, a new unit has to be fitted.

TURBOCHARGER TROUBLE SHOOTING

Number code	Problem
1	Engine lacks power
2	Black exhaust smoke
3	Excessive engine oil consumption
4	Blue exhaust smoke
5	Turbocharger noise
6	Cyclic sound from turbocharger
7	Oil leak from compressor seal
8	Oil leak from turbine seal

1	2	3	4	5	6	7	8	Cause	Remedy
x	x							Clogged air filter element	Replace element
	x	x	x	x	x	x		Obstructed air intake duct from compressor to intake manifold	Remove obstruction or replace damaged parts as required.
x	x			x				Obstructed air outet duct from compressor to outlet manifold	Remove obstruction or replace damaged parts as required.
x	x			x				Obstructed air intake manifold	Remove obstruction
				x				Air leak in duct from air cleaner to compressor	Correct leaks by replacing seals or tightening fastners as required
x	x	x	x	x				Air leak from compressor to intake manifold	Correct leaks by replacing seals or tightening fastners as required
x	x	x	x	x				Air leak at intake manifold to engine joint	Replace gaskets or tighten fastners as required
x	x	x	x	x		x		Obstruction in exhaust manifold	Remove obstruction
x	x					x		Obstruction in exhaust system	Remove obstruction or replace faulty component as required
x	x					x		Gas leak in exhaust manifold to engine joint	Replace gaskets or tighten fastners as required
x	x			x		x		Gas leak in turbine inlet to exhaust manifold joint	Replace gaskets or tighten fastners as required
				x				Gas leak in ducting after turbine outlet	Repair leak
		x	x			x	x	Obstructed turbocharger oil drain line	Replace gasket or tighten fastners as required Repair leak
		x	x			x	x	Obstructed engine crankcase ventilation	Remove obstruction or replace line as required Clear obstruction
		x	x			x	x	Turbocharger centre housing sludged or chocked	Change engine oil & oil filter Replace turbo if required
x	x							Engine camshaft timing inoorrect	Rectify
x	x	x	x			x	x	Worn engine piston rings or liners (blow by)	Rectify
x	x	x	x	x	x	x	x	Dirt on compressor wheel	Clean using a non-caustic cleaner & soft brush. Find source of unfiltered air & change oil / oil filter
x	x	x	x	x	x	x	x	Damaged turbocharger	Analyze failed turbocharger, find correct cause of failure. Replace turbocharger as required

2.1 Catalytic converter maintenance / service precautions

Catalytic convertor :

Telcoline with Euro-II/Euro-III engine is fitted with a two way Diesel oxidation catalytic converter to reduce exhaust pollution. Catalytic converter has coating of precious metals which enables conversion of pollutants.

Care of the catalytic Converter :

Catalytic converter does not require any special maintenance. However following precautions should be taken for the effective functioning of converter and to avoid damage to converter.

- It is mandatory to use diesel as specified by us to meet emission level as per regulations. Use of inappropriate diesel can increase pollutants and damage Catalytic converter.

- Avoid parking the vehicle over inflammable materials such as dry leaves, grass, etc., as exhaust system can be hot enough to initate "FIRE"

Maintenance of Catalytic converter :

Catalytic converter should be flushed daily by giving full throttle 4 to 5 times in vehicle stand still position.

In addition to this it is recommended to run vehicle at high speeds (60 to 80 kmph) for few kms. This will help to flush carbon soot deposits from exhaust system and catalytic converter. High speed running of vehicle is helpful to clean up Catalytic converter for deposits, if any.

Alternatively catalytic converter can be removed from vehicle and cleaned by dry compressed air draft 3 to 4 bar. Compressed air has to be directed on honey comb structure for this purpose.

EGR SYSTEM (If fitted)

Schematic diagram of EGR Circuit for 4 DLTC Euro III Engine :

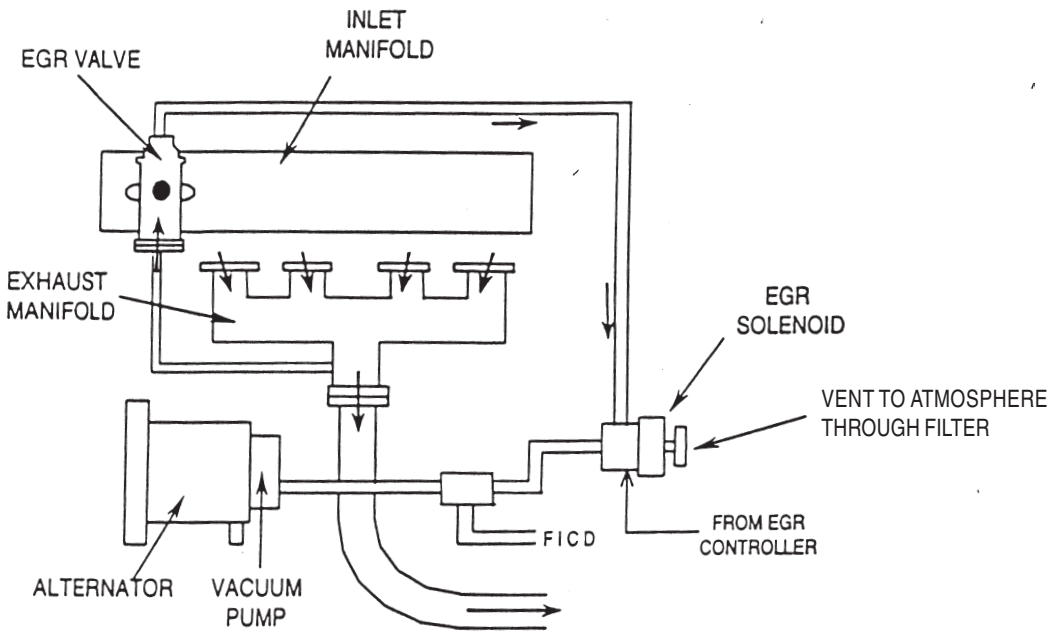


Fig. 173 Schematic diagram of EGR circuit on Euro - III Engine

Exhaust Gas Recirculation

TATA 4DL Turbo Inter-Cooled engine (Euro III) is equipped with an Exhaust Gas Recirculation system. This is to reduce exhaust emissions (mainly Nitrogen Oxides). Refer schematic diagrams of EGR circuit.

In this system a controlled quantity of exhaust gas is re-circulated in to Inlet-manifold via EGR Valve in part load & part speed conditions.

Induction of exhaust gas into intake air results in controlled combustion, thereby reducing Nitrogen Oxides emissions.

During cold starting till the glow plug remains on, EGR system does not function thus avoiding any hunting or vibration at initial start conditions.

System Components

EGR CONTROLLER :

EGR system is controlled more precisely based on engine speed, throttle lever position.

EGR CONTROLLER is mounted on the firewall inside eingine compartment.

EGR Valve (EGR-V)

EGR valve is a diaphragm valve that is actuated by vacuum from Vacuum Pump. This valve is mounted on air inlet manifold. It has three connections, one for vacuum, one for exhaust gas inlet from exhaust manifold and one for the exhaust gas outlet to air inlet manifold. Exhaust gas starts flowing into inlet manifold once the vacuum is fed into valve.

EGR Electro pneumatic solenoid switch

Note : Care should be taken to connect the ports of the Electro pneumatic solenoid switch to their respective hoses. Any interchanging of connections will lead to malfunctioning of EGR system. Additionally, existence of small filter with foam needs to be ensured on the connection open to atmosphere.

EGR pipe :

This pipe connects exhaust manifold to EGR valve.

Exhaust / Inlet Manifold

Exhaust manifold has a precisely machined hole through which the exhaust gas is tapped out.

Inlet manifold also has a precisely machined hole through which exhaust gas is fed into engine. Manifold has a provision to mount EGR valve onto it so as to match hole in valve to the hole on inlet manifold.

Note :

Ensure exhaust system and catalytic converter (if fitted) are not blocked and are free from obstruction.

- Blockages in exhaust can create back pressure which will result in low top speed, poor pick up, black smoke, carbon build up and high fuel consumption.

Check and ensure EGR valve & control system is clean and functioning properly.

- Excessive carbon build up / sticky valve.
- Damaged Vacuum lines.

All these can keep 'EGR' valve open when not desired and vice versa. Either way these can seriously affect power output and also emission levels.

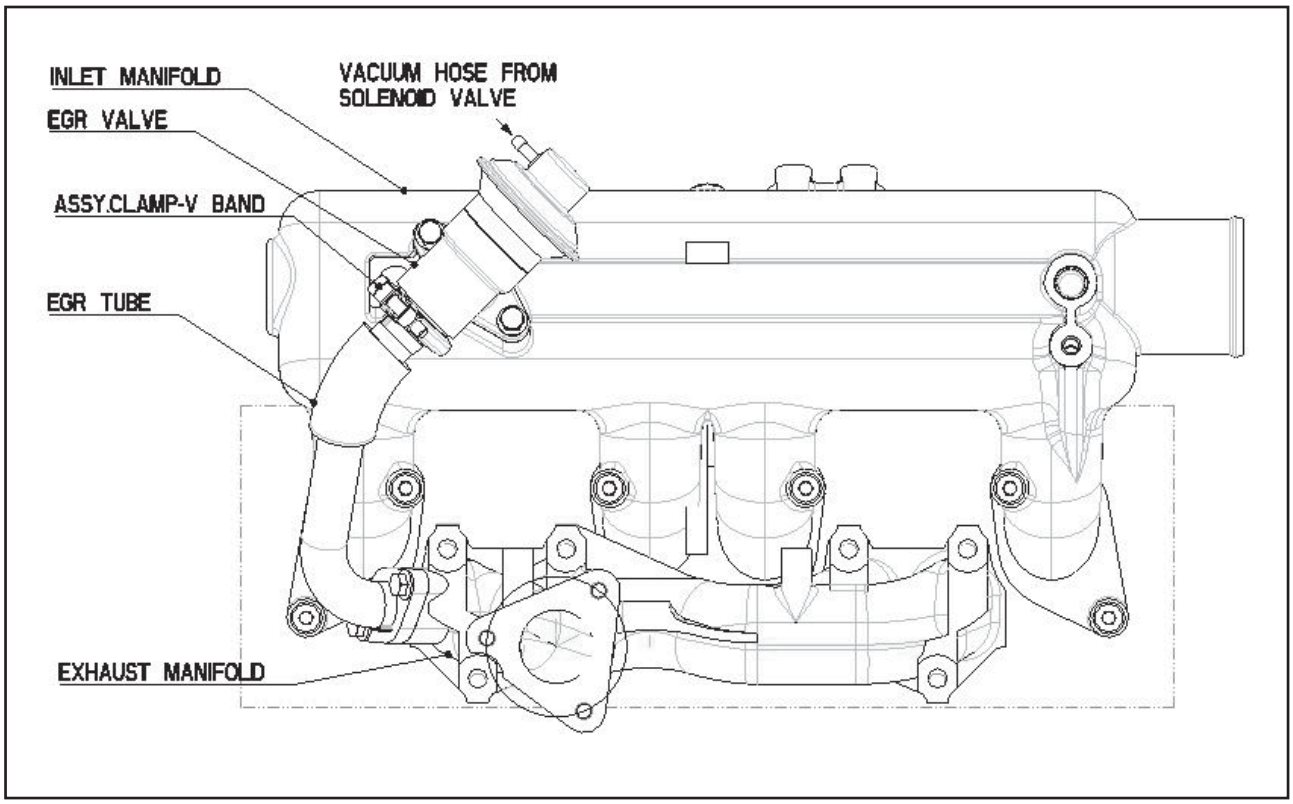


Fig. 173 Schematic diagram of EGR circuit on Euro - III Engine

ASSEMBLY :

EGR valve and EGR tube to be assembled as per following instructions :

1. Hand tighten EGR tube flange to exhaust manifold with respective fasteners.
2. Locate EGR tube and clamp on EGR valve.
3. Assemble EGR valve on Inlet Manifold and tighten it with respective fasteners.
4. Tighten clamp connecting EGR valve and tube.
5. Tighten EGR tube flange to exhaust manifold with respective fasteners.

Removal of EGR valve & EGR tube

Follow the reverse sequence of assembly.

ENGINE TESTING

Mount engine on test bed.

Connect gear box to dynamometer flange with suitable coupling or propeller shaft

Connect oil pressure gauge and temperature gauge.

Connect water hoses to and from radiator. Fill coolant.

Fit radiator cap.

Fill recommended running- in oil.

Mount air cleaner assembly on test bed suitably. Connect hoses from air cleaner outlet to turbocharger, turbocharger to intercooler and intercooler to intake manifold. Connect oil drain line.

Make suitable linkage for controlling accelerator lever.

Connect exhaust pipe to exhaust manifold.

Connect battery cables to starter motor. Ensure that -ve terminal is earthed. Make suitable connection from +ve terminal of battery to FIP solenoid switch.

Crank engine with accelerator lever in idling position. Run engine for few minutes.

Check and ensure that oil pressure indicated by gauge is satisfactory.

Slightly raise engine speed and check for oil, fuel, water and air leakages. Rectify if any. Check colour of exhaust gas. Check for any unusual noise from engine.

Connect engine to dynamometer and run for running-in test as per schedule.

Engine running in test schedule

Engine Speed (rpm)	Time (minutes)	Torque (mkg)
900	5	-
1500	5	3.5
2000	5	5.9
2500	5	7.1
3000	5	8.8
3500	5	9.0
4000	5	9.5
4300	5	10.0
4300	5	13.0

After running-in test, reduce dynamometer load to zero and allow engine to run at idling speed for about 5 minutes and then stop it.

Ensure that oil pressure at idling speed & max. speed is as specified.

To prevent entry of dirt/debris into Turbocharger, during testing follow procedure given below :

1. Remove inlet adaptor from turbocharger and preserve it in a clean place for refitment after the test.
2. Fit assy. connector using new & clean filter sieve.
3. Fit assy. oil line inlet. Ensure that this line is internally clean.
4. Complete engine testing.
5. Remove assy. oil line & assy. connector.
6. Remove used filter sieve & the strainer. Do not reuse old filter sieve & strainer again. Fit a new sieve & strainer and the sealing washer and keep assy. connector ready for next eng.
7. Fit original Adaptor on turbocharger (Refer Sr. No. 1) after ensuring that it is clean.
8. Connect the cleaned standard assy. oil line.
9. Run engine to ensure no oil leakage.

ENGINE TROUBLE SHOOTING

SR.NO.	COMPLAINT	CAUSE REMEDY
1. Engine does not crank	Electrical connection loose/came out	Correct
	Battery discharged	Recharge/replace
	Starter Motor not working	Repair/Replace
	Main line switch defective	Replace
2. Engine Cranks but does not start	No Diesel	Fill Diesel
	Fuse for engine stop blown	Replace fuse.
	Fuel filters choked	Replace fuel filters.
	Solenoid switch on FIP malfunctions	Replace solenoid switch
	Air Cleaner choked	Clean/Change filter cartrige
	Engine seized	Repair engine
	Exhaust system choked	Clean exhaust system
	Hydrostatic lock due to cylinder head gasket blown	Repair engine
	Valve train failure due to timing belt failure/breakage	Repair engine
	Glow plugs defective	Replace
3. Engine Seizure	Low coolant level	Arrest leak/Repair
	Cooling fan not working	Check belt tension
	Thermostat failure	Replace affected parts
	Radiator hose leakage	-Do-
	Radiator leakage	-Do-
	Water pump defective/pump bearing damaged	-Do-
	Fan belt loose/broken	Adjust/Replace affected parts
	FIP timing incorrect/defective	-Do-
4. High Engine Oil Consumption	Oil leakage from :-	
	a) Crankshaft front oil seal	Replace oil seal
	b) Crankshaft rear oil seal	Replace oil seal
	c) Sump gasket	Tighten sump screws/Replace gasket, if necessary.
	d) Oil cooler	Tighten fastener/Replace oil cooler, if necessary.
	e) Oil filter	Tighten filter/Replace if necessary
	f) Camshaft front oil seal	Replace oil seal.
	g) Camshaft rear oil seal	Replace oil seal.
	h) Cylinder head cover gasket	Replace gasket
	i) Cylinder head cover warpage	Replace cylinder head cover
	j) Oil seal on valve guide	Replace valve guide seal
	k) Valve guide worn out	Replace valve guide
	Excessive oil filling	Fill oil to correct level
	Excessive piston ring butt/ Lateral clearance	Replace piston rings
	Excessive cylinder bore wear (Excessive blow-by)	Repair the engine

SR.NO.	COMPLAINT	CAUSE REMEDY
5. Low Engine Oil Pressure	Low Pressure warning bulb/indicator switch defective	Replace bulb/indicator switch
	Low oil level in sump	Top-up
	Oil pump siezed :-	
	a) Siezed	Replace
	b) Oil pump relief valve stuck in open position	Repair/Replace the valve and affected engine parts
	Main bearing /con rod bearings & journals excessively worn out	Replace affected parts
	Bearing shells peeled off	Replace affected parts
	Wrong grade of oil	Fill in correct grade of oil
	Diesel dilution	Rectify
6. Engine overheating	Defective temperature gauge	Replace defective gauge
	Less coolant in the system	Top up
	Defective water pump	Replace water pump
	Cooling fan not working	Check belt tension
	Engine overloaded due to :-	
	a) Brake binding	Adjust brake
	b) Clutch slippage	Replace affected parts
	Defective FIP/Nozzle	Repair/Replace nozzles
	Wrong FIP timing	Correct FIP timing
	Dribbling Injection Nozzles	Repair/Replace nozzles.
7. Abnormal Noise from engine	Noise from bearing block	Repair/Replace bearing block
	Noise from Alternator	Repair/Replace
	Noise from power steering pump	Repair/Replace
	Noise due to improper tappet setting	Adjust tappet clearance
	Timing belt/Power steering belt loose	Adjust tension/Replace belt
	Water pump bearing failure	Replace bearings/Water pump
	Con Rod bush worn out	Replace Con Rod bushes
	Big end/Main bearings & journals of crankshaft worn out	Replace affected parts
	Piston Ring broken	Replace affected parts
	Crankshaft broken	Replace affected parts
	Silencer choked	Clean silencer
	Air Cleaner Element choked	Clean/Change element
	Fuel Filters choked	Replace fuel filters
	Malfunctioning of Solenoid switch on FIP	Replace solenoid switch
	Malfunctioning of FIP	Recalibrate/Repair the FIP
	Defective Injectors	Repair/Replace Injectors

SR.NO.	COMPLAINT	CAUSE REMEDY
8. Low compression pressure	a) Leakage of compression from engine valves	Repair /Replace valves and valve seat inserts
	b) Cylinder Head gasket blown between two cylinders	Replace gasket
	c) Leakage of compression past piston ring butt clearance (blow by)	Replace piston rings
	d) Leakage of compression due to excessive cylinder bore/ring wear (indicated by excessive blow by).	Overhaul the engine

NOTES

CLUTCH

INTRODUCTION :

Clutch is the mechanism interposed between engine and the gear box which enables engine power as well as torque of the engine to be transmitted at WILL to the gear box through friction drive. When clutch pedal is depressed the clutch is disengaged therefore motion and power flow from engine to gear box and hence to road wheels is disconnected.

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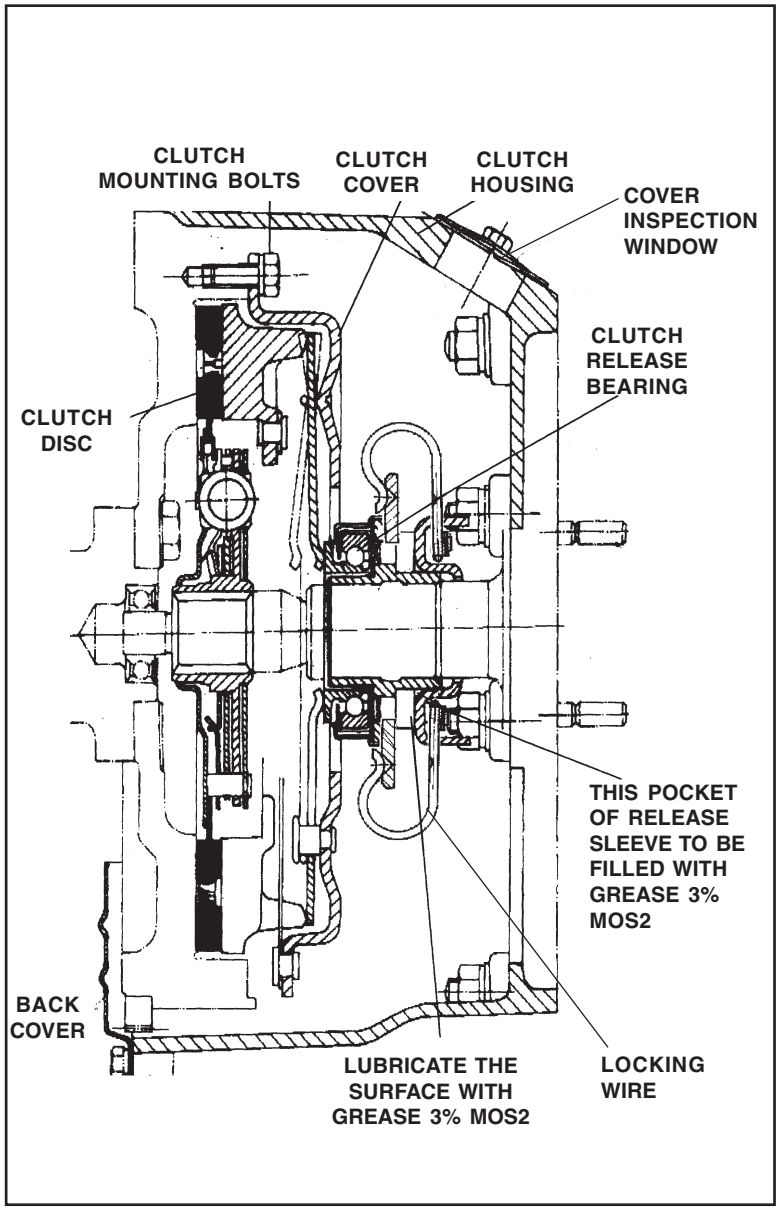


Fig.2 - Clutch parts and the mounting arrangement

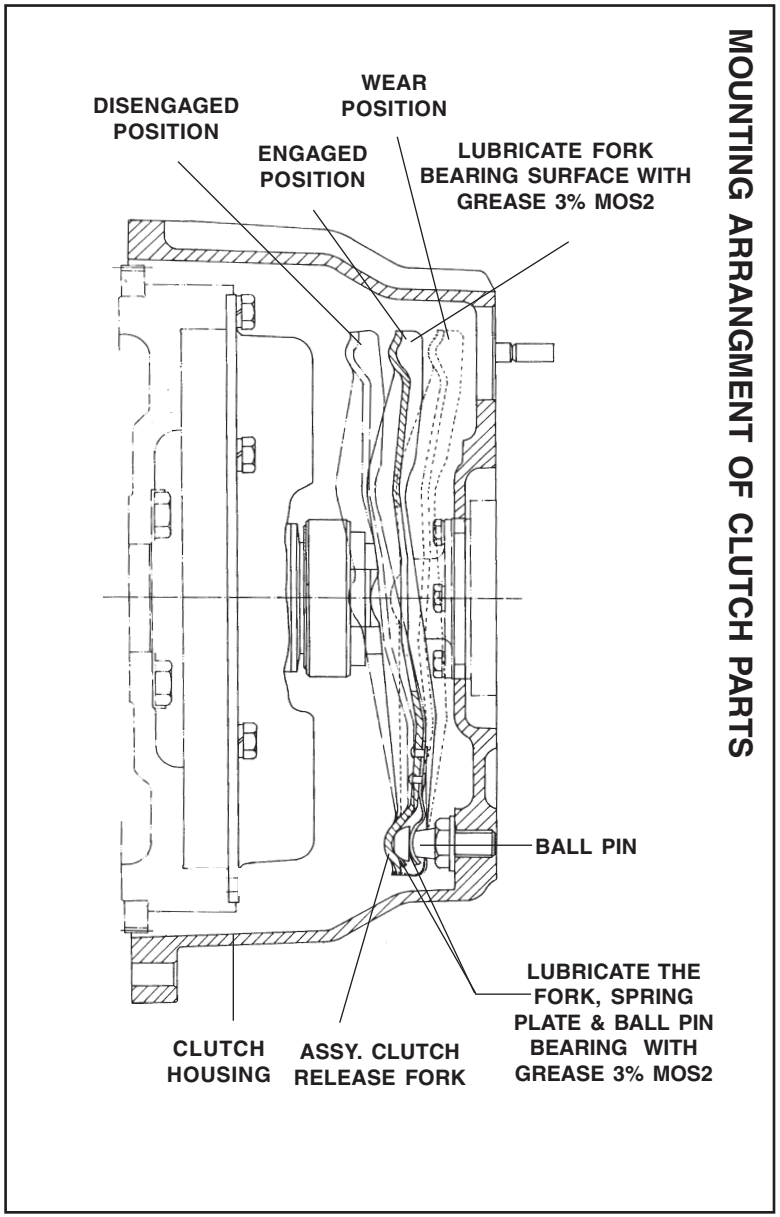


Fig.1 - Clutch release fork arrangement

1. CONSTRUCTION

Single disc dry friction clutch with 228 mm dia. clutch disc is used.

Pressure plate assembly is diaphragm spring type. Clutch release bearing is self centering type and assembled with release fork and guided on drive shaft cover tube of gear box. Clutch is actuated by a hydraulic master cylinder and slave cylinder. Routine clutch adjustments are not necessary due to diaphragm clutch & hydraulic actuation system.

2. FACTORS AFFECTING CLUTCH WEAR

Clutch is designed to give maximum life under most severe conditions when handled carefully. However, while in operation, clutch lining is subjected to wear. Apart from this, the extent of wear also depends on following.

A. PROPER MAINTENANCE

Maintenance of clutch includes adjustment of pedal stopper bolt, checking oil level and bleeding the system for defect free operation of clutch actuation mechanism and periodic lubrication.

B. DRIVING

Following driving conditions will affect performance of clutch.

i. Clutch riding

Using clutch pedal as a foot rest by keeping foot constantly on pedal while driving will cause partial clutch disengagement. It will result in slipping of the clutch disc and premature failure of the clutch.

ii. Permitting the clutch to slip too long

Half clutch driving and thereby permitting the clutch purposely to slip too long will have the same result as above.

iii. Permitting the clutch to jerk

Sudden clutch engagement at higher engine speed specially while moving out stranded vehicle will cause severe instantaneous clutch loading, resulting in clutch slippage and burning of the lining. Starting the vehicle in first gear under such conditions will avoid such problem. Always start vehicle in first gear.

C. OPERATING CONDITIONS

Vehicles operating on shorter runs, city operations, off highway and operations in hilly terrains are obviously subjected to more number of clutch operations and thereby higher clutch wear.

3. PRELIMINARY INSPECTION OF CLUTCH

Clutch needs replacement mainly on account of clutch slippage or imperfect engagement and disengagement. This may be due to worn out / damaged clutch parts. It is desirable to carry out following preliminary checks before removal of clutch.

A. CLUTCH SLIPPAGE TEST

Clutch slippage can be confirmed by any of the following methods given below :

a) Drive vehicle in 1st or 2nd gear at maximum speed corresponding to that gear. With accelerator pedal fully pressed, apply brake gradually with left foot. If the engine stalls, it means that clutch does not slip.

b) Drive loaded vehicle in 3rd gear on level ground and let vehicle speed drop down to approximately 15 kmph / 9 mph. Now press accelerator pedal fully. With slipping clutch, vehicle speed will not pick up and also clutch burning smell will be noticed. If this does not occur and vehicle picks up speed, it indicates that clutch does not slip.

B. CLUTCH ENGAGEMENT AND DISENGAGEMENT TEST

During the above test, when vehicle is in motion, depress clutch pedal fully without changing accelerator pedal position. If engine speed increases immediately, perfect clutch disengagement is indicated. Further, release the clutch pedal suddenly. If vehicle moves forward with a little jerk, perfect clutch engagement is indicated.

Caution

This test should be carried out with utmost care because sudden release of clutch might cause heavy jerk and damage to clutch lining.

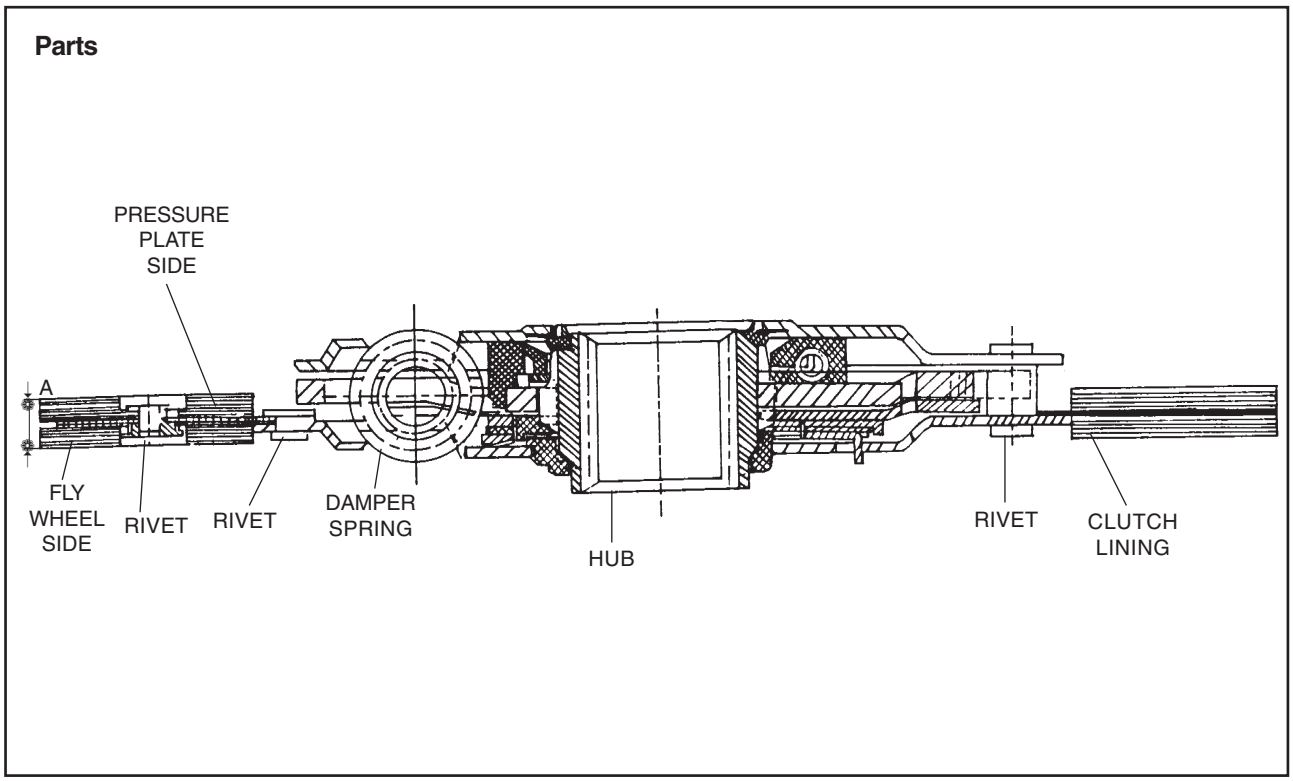


Fig. 3 - Cutch disc

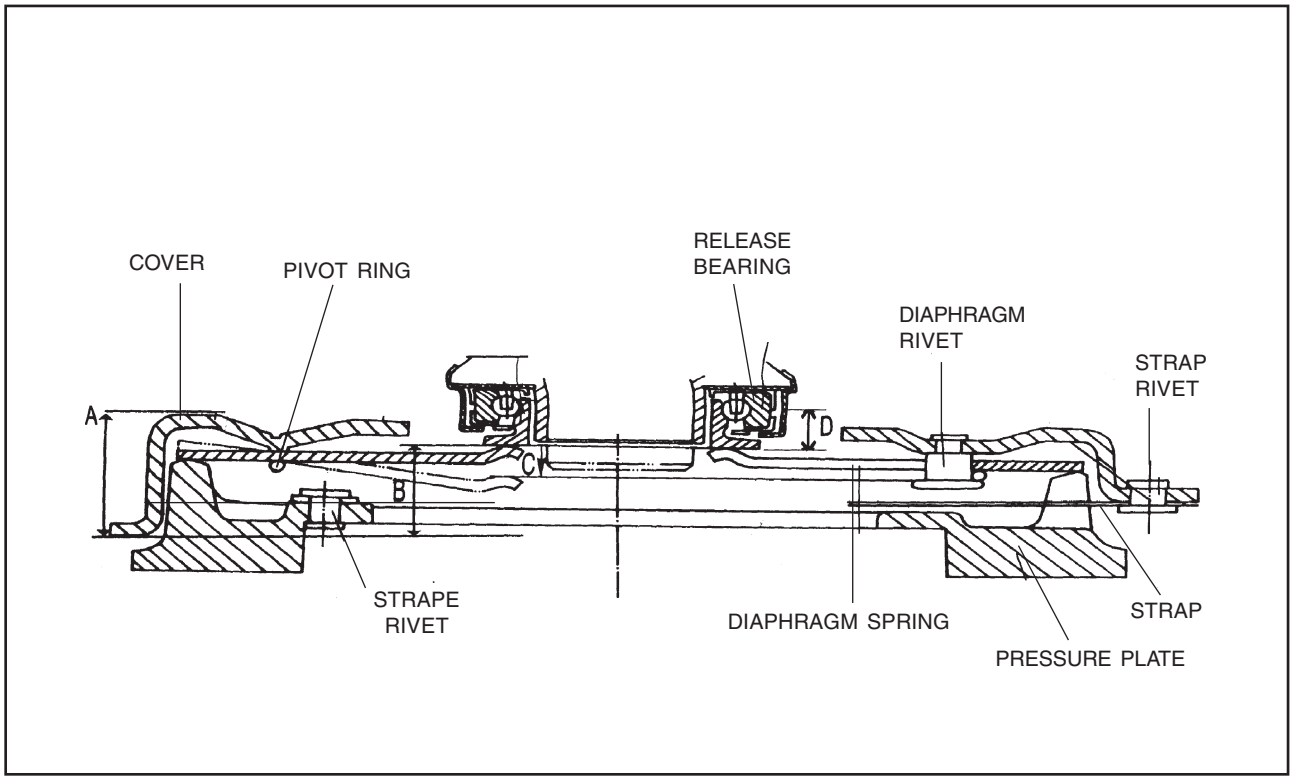


Fig.4 - Clutch pressure plate assembly

4. SPECIFICATIONS

A. CLUTCH DISC (Fig.3)

Outside diameter	228 ±1	mm.
Inside diameter	150 + 1.5 – 1.0	mm.
Thickness of clutch disc with new lining under 570 kg load 'A'	9.3 ± 0.3	mm.
Maximum permissible out of perpendicularity of each lining surface of clutch disc w.r.t. spline axis at 223 mm diameter	0.5	mm.
Maximum permissible imbalance of clutch disc	25	gm-cm.
Cushioning of clutch disc	0.9/1.2	mm
Spline size of clutch disc	A10 x 23 x 29 (DIN 5464)	
Total friction area (both sides)	463	sq.cm.

B. CLUTCH PRESSURE PLATE ASSEMBLY (Fig.4)

Height of pressure plate housing 'A' max.	34.5	mm.
Height of diaphragm tip from cover mounting surface 'B'	28.2 ± 1	mm.
Max. permissible imbalance of pressure plate assembly	20	gm-cm.
Max. permissible face run out of release bearing contact surface of diaphragm	0.5	mm.
Clamp load on clutch disc	570 to 660	kg.
Diaphragm release load Max. (with gauge plate)	210	kg.
Tip travel, 'C'	8 +1	mm.
Max tip travel after use of disk, 'D'	max.8.5	mm.
Pressure plate lift for release travel 8+1 mm	min. 1.8	mm.

C. CLUTCH ACTUATION HYDRAULIC SYSTEM

Clutch master cylinder diameter	19.05	mm.
Clutch master cylinder stroke	34.5	mm.
Slave cylinder diameter	23.81	mm.
Slave cylinder stroke	52.0	mm.

5. REMOVAL OF CLUTCH FROM VEHICLE

- Place chokes on wheels to prevent movement of vehicle.
- Disconnect battery and electrical connections of starter motor.
- Loosen mounting bolts and remove starter motor.
- Unlock and remove U/J cross mounting strip screws at gear box end. Disconnect propeller shaft from gear box and suspend it sideways suitably.
- Loosen and remove clutch slave cylinder mounting nuts and tie it suitably.
- Pull out reverse indicator switch cable connector.
- Disconnect speedo cable
- Disconnect and remove gear box along with clutch housing from engine
- Remove clutch release bearing with sleeve.
- Pull out clutch release fork from spring clip.
- As a safety measure, support clutch pressure plate and clutch disc with mandrel 2654 5890 25 01. Unscrew six mounting bolts evenly (alternately and crosswise) in small steps.
- Remove pressure plate assembly and clutch disc along with mandrel.

6. INSPECTION OF COMPONENTS

i. Check clutch disc hub splines for damage and wear. Clutch disc should slide easily on gear box drive shaft but should not have excessive play and wobble.

ii. Check torsion damper mechanism springs for distortion, damage etc. For this purpose, hold drive shaft in vice. Insert clutch disc and slide it as far back as possible. Rotate disc by hand. Rattling noise and excessive play indicates damaged torsional damping mechanism and such disc must be replaced.

iii. Check disc facing for wear, cracks, contact pattern, burning marks and oil contamination. Facings with any of the above defects or worn out beyond permissible limits must be replaced.

Note

It is recommended to replace a NEW genuine clutch disc if any defects are noticed. We do not recommend clutch lining change.

We do not recommend overhauling of clutch pressure plate assembly. It should be checked for serviceability and should conform to specifications.

Caution

Prior to installing a new clutch disc, check for face run-out and straighten, if required.

Ensure that clutch facing material is not contaminated with oil or grease as this will result in clutch slippage.

7. INSTALLATION OF CLUTCH ON VEHICLE

Proceed in reverse order of removal of clutch. However, following care must be taken during installation :

- Clean friction face of flywheel and check for cracks, scoring, burn marks or unevenness. If necessary, machine flywheel friction face just to clear the defect.
- Check spigot bearing in crankshaft for free rotation. Replace sticky/damaged bearing. Fit new bearing after filling with bearing grease and press in the retaining cover.

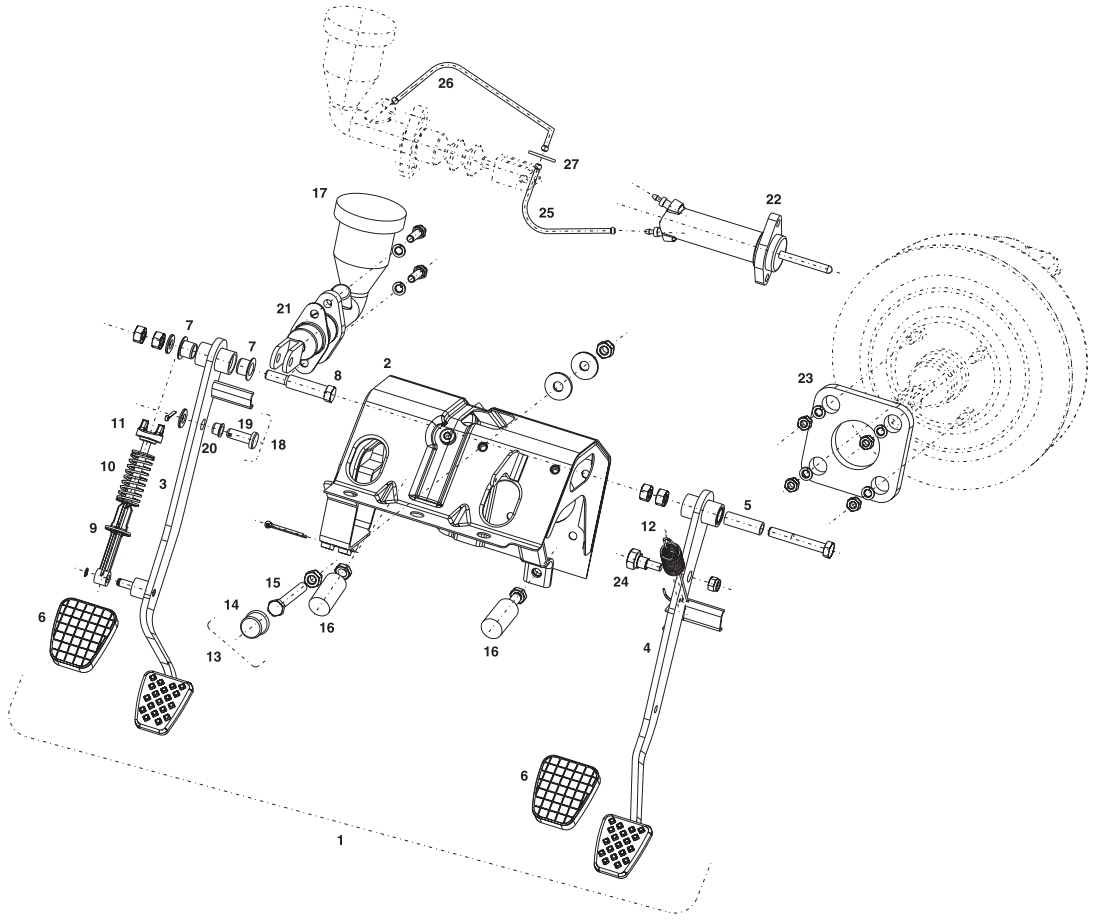
  Lightly apply grease (3% MoS2) on the disc splines. Install disc and pressure plate assembly (Gear box side is marked on the disc). Press aligning arbor through pressure plate assembly and clutch disc and centralize clutch disc on flywheel by locating front end of the arbor in crank shaft spigot bearing.
- Locate the cover assembly in the spigot diameter of the flywheel and align its mounting holes with tapped holes in flywheel. Screw in clutch mounting screws with spring washers. Aligning arbor still in position, tighten mounting screws evenly and equally (alternately and cross wise) in small steps. Tighten these screws in the same sequence to 3 mkg torque.

Note

Do not mix clutch mounting bolts with other fasteners. Do not use longer or shorter screws. Longer screws may not tighten the clutch at all. Shorter screws will not provide enough threads to achieve desired tightening.

- While tightening clutch mounting screws check aligning arbor for continuous free sliding to ensure concentric installation of clutch disc which will avoid trouble when installing gear box.
- Fill pocket of release bearing sleeve with (3% MoS2) grease.
- Lubricate the fork, spring plate and ball pin bearing area with (3% MoS2) grease.
- Lubricate slave cylinder fork bearing surface with (3% MoS2) grease.

CLUTCH & BRAKE CONTROL

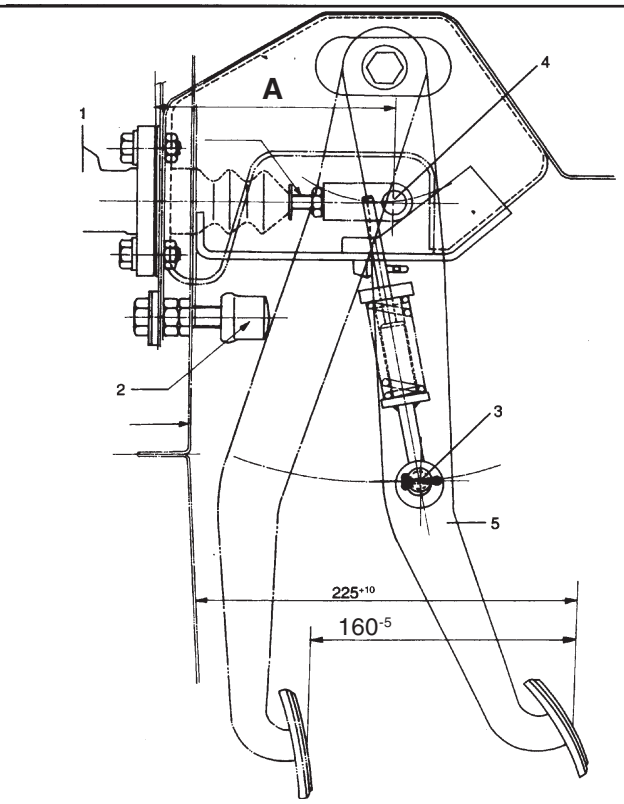


S. NO.	DESCRIPTION
1.	ASSY CNTRL MTG BRKT WITH BRAKE & CLUTCH PEDALS
2.	ASSY CONTROL MTG BRACKET
3.	ASSY. CLUTCH PEDAL LEVER
4.	ASSY BRAKE PEDAL LEVER
5.	SPACER
6.	RUBBER COVER (BRAKE & CLUTCH PEDAL)
7.	PIVOT BUSH
8.	PIN (FOR PEDAL MTG.)
9.	STAY ROD (FOR CLUTCH ASSISTANCE)
10.	COMPRESSION SPRING (FOR CLUTCH ASSISTANCE)
11.	PIVOT PIN
12.	RETURN SPRING (PEDAL LEVER)
13.	ASSY. STOPPER BOLT

S. NO.	DESCRIPTION
14.	RUBBER CAP (FOR PEDAL LEVER STOPPER)
15.	STOPPER BOLT
16.	STOP LIGHT SWITCH
17.	ASSY. CLUTCH MASTER CYLINDER
18.	ASSY. PIN
19.	CLEVIS PIN
20.	BUSH
21.	RUBBER SPACER
22.	CLUTCH SLAVE CYLINDER
23.	RUBBER SEALING
24.	ADJUSTING ECCENTRIC PIN
25.	ASSY. HOSE
26.	ASSY. CLUTCH PIPE
27.	CLAMPING PLATE

Fig.5

1. Clutch master cylinder
2. Clutch pedal stopper
3. Split pin
4. Clevis pin
5. Clutch pedal



Adjust clutch pedal stopper to get pedal travel of 160^{-5}

* If required adjust the Master Cylinder dimension A = 126 to ensure diamension 225^{+10}

Fig. 6 - Clutch Actuation Mechamism for vehicle with 4DL TC engine

7. CLUTCH ACTUATION MECHANISM

Removal

1. Connect bleeding tube to bleeding screw on slave cylinder.
2. Loosen bleeding screw on slave cylinder by 1/ 2 to 3/4 turn. Operate clutch pedal number of times and pump out fluid into a clean container.
3. Remove bleeding tube.
4. Disconnect pipe connection from master cylinder.
5. Disconnect pipe connection from slave cylinder.
6. Remove split pin and clevis pin, locking master cylinder push rod fork end with clutch pedal.
7. Unscrew and remove master cylinder mounting screws. Pull out master cylinder.
8. Remove filling container cap and unscrew container mounting banjo bolt. Remove gasket.
9. Unscrew and remove slave eylinder mounting screws and pull out slave cylinder.

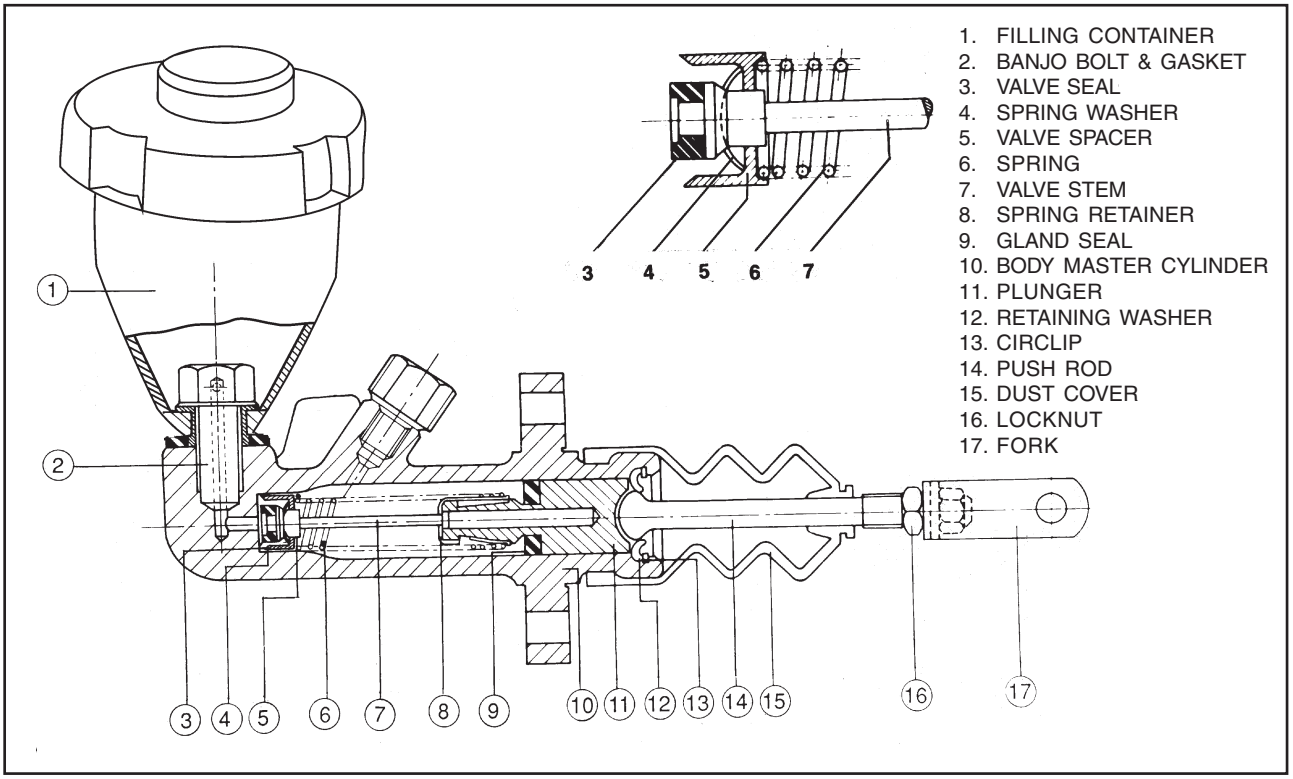


Fig. 7 - Clutch Master Cylinder Sectional View - Brakes India Make

8. CLUTCH MASTER CYLINDER - *Brakes India Make*

DISMANTLING OF MASTER CYLINDER (Fig. 7)

- Pull back dust cover. (15)
- Remove circlip retaining push rod (14)
- Remove push rod with retaining washer (12)
- Remove plunger (11) and valve assembly from body by lightly tapping the body on wooden block.
- Using a screw driver, lift the leaf of spring retainer (8). Remove spring assembly from plunger.
- Compress spring (6) to free valve stem (7) from eccentrically positioned hole in the end face of spring retainer. This will separate spring retainer from valve stem.
- Remove spring, valve spacer (5) and spring washer (4) from valve stem.
- Carefully remove valve seal (3) from valve stem.
- Carefully remove gland seal (9) from plunger.

INSPECTION AND ASSEMBLY OF MASTER CYLINDER (Fig. 7)

- Examine bore of body. If it is not scored, ridged or corroded, do not replace. If there is damage in the bore, the cylinder assembly should be replaced. Even otherwise if the clearance between plunger and the bore exceeds 0.13 mm, the assembly should be replaced.
- Examine plunger for rust, burrs and ridges, Replace if necessary.
- Fit new gland seal on plunger such that it fits squarely in plunger groove.
- Fit new valve seal on valve stem with the smallest diameter leading.
- Assemble spring washer on valve stem such that it bends away from valve shoulder.
- Now assemble valve spacer on valve stem. Hold the spacer between fingers such that the valve stem hangs down vertically. Pull the stem downwards as far as possible. Release the stem. Observe whether the valve stem has moved freely upwards. If movement is not free replace valve spacer.
- Install spring over valve stem behind valve spacer, followed by spring retainer. Compress spring and locate valve stem end in key hole slot of spring retainer.
- Fit spring assembly on plunger assembly and lock the leaf of spring retainer by pressing it with nose pliers.
- Lubricate bore of body with brake fluid and dip plunger valve assembly in it. Insert the assembly into bore with valve end leading.
- Check condition of dust cover. If necessary replace.
- If disturbed, adjust push rod length with fork to specified value.
- Place push rod with retaining washer on plunger and fit circlip for retaining push rod in the body groove.
- Fit dust cover on body.

CLUTCH MASTER CYLINDER - *KBX*

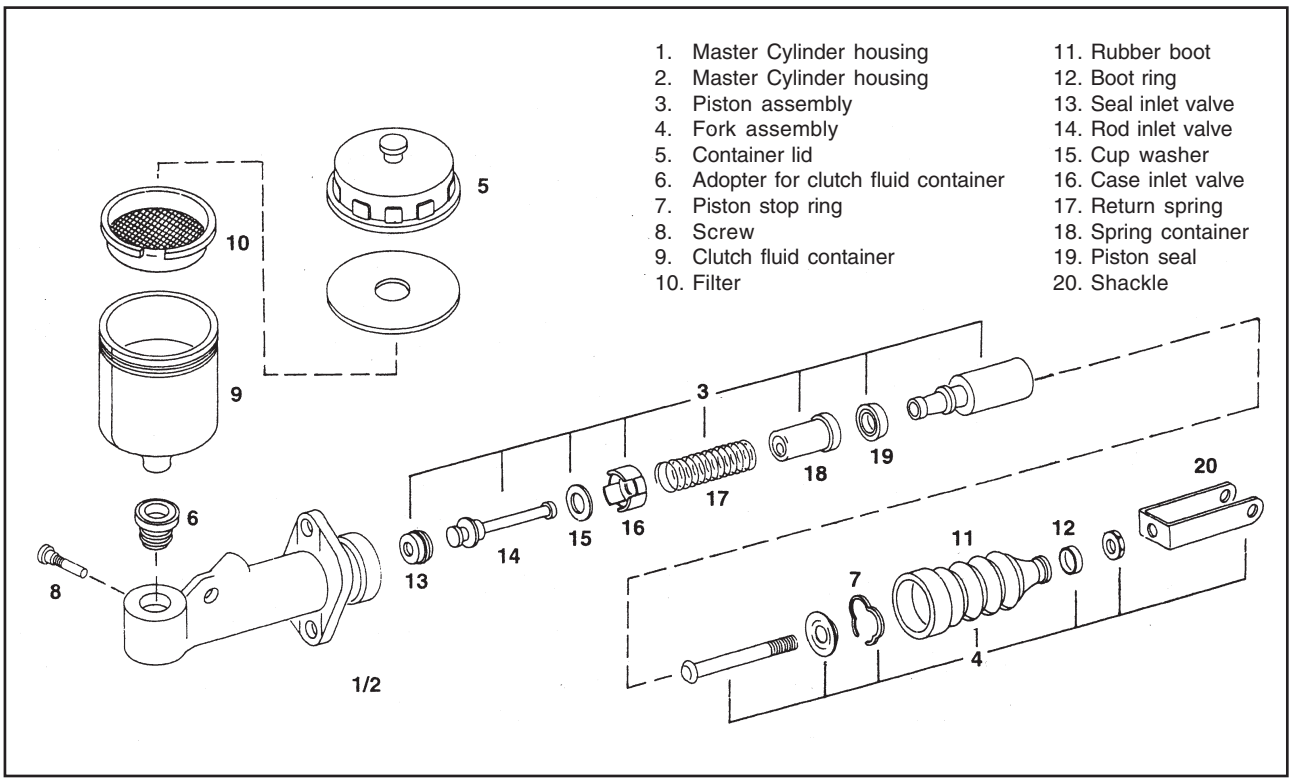


Fig. 8 - Clutch Master Cylinder - KBX make Exploded view

Hydraulic Clutch Actuation used in modern vehicles minimizes the driver's effort while clutch application. This system consists of Clutch Master Cylinder & Clutch Slave Cylinder. When the clutch pedal is depressed the hydraulic pressure is generated in the clutch master cylinder & the pressure is transmitted to slave cylinder via pipe & this pressure is used for declutching.

1. <u>Operation</u> –

Clutch Master Cylinder (CMC) of this particular type is of center valve type & consists of a piston assembly , Seal , return spring & push rod assembly & clutch fluid reservoir. When the clutch pedal is depressed the push rod pushes the piston in the bore of clutch cylinder. This movement of piston closes the inlet port by actuating the center valve & the fluid in front of the seal is then pressurized & the hydraulic pressure thus created actuates the slave cylinder which in turn declutches the transmission.

2. **<u>Overhauling of CMC Assembly (KBX)</u> –**

2.1 <u>Dismantling of CMC Assembly</u> (KBX) –

1. Hold the CMC assembly in a soft jaw vice.
2. Fold the boot & after pushing the push rod gently in the bore, remove the piston stop ring with the help of a screw driver.
3. Remove the piston assembly by tapping the CMC assembly gently on a wooden block.
4. Dismantle the piston assembly by slightly bending the locking lug of the spring retainer (18).
5. Remove the rod, inlet valve (14) by compressing the spring(17). Remove the case inlet valve (16) ,inlet valve seal (13) & cup washer (15) & also the piston seal (19).

6. Hold the shackle (20) of pushrod subassembly in a soft jaw vice.. Unscrew the lock nut & remove push rod & boot (11).

7. Clean all the dismantled internal parts with the fresh brake fluid.

2.2 Inspection of Parts –

Inspect the bore & piston of the CMC. If it is not scored , ridged or pitted and smooth, the CMC can be rebuilt with the genuine repair kit. If in case of slightest doubt on the bore condition, like deep groves or score marks in the bore then a new cylinder assembly should be replaced.

Note :
Do not polish the piston od / cylinder bore with any abrasive material which may damage the surface.

Destroy all old parts to prevent misuse.

2.3 Assembly of CMC Assembly (KBX) –

1. Lubricate all the internals like piston & new rubber seals with fresh specified brake fluid.

2. With the help of mandrel assemble the seals on the piston properly.

3. Assemble seal - inlet valve (13) on rod - inlet valve (14). Insert cup washer(15) & case - inlet valve (16) & return spring (17) with spring retainer (18) on rod - inlet valve (14) .Insert this whole assembly on piston & lock the spring retainer lug on the piston stem.

4. After lubricating the CMC bore with fresh brake fluid insert the piston gently into the bore.

NOTE :

Keep the piston straight while inserting in the bore. Any tilt may jam it half way through into the bore.

5. Assemble piston stop plate & rubber boot (11) & boot ring (12) on push rod & assemble lock nut & shackle (20).

6. By pressing the pushrod & inturn the piston, gently in the bore fit the piston stop ring (7).

7. Hold the CMC assembly in vertical direction by keeping the pushrod pointing downwards. Check the distance from mounting flange to shackle pin hole center. Adjust this distance to 126 + (-) 0.5 mm by rotating the pushrod & lock the shackle by tightening the lock nut to 1.3 to 1.6 Kg- m torque.

8. Install the CMC Assembly on the vehicle referring the vehicle manufacturer's instructions.

9. Bleed the hydraulic circuit to remove air from the system.

10. Ensure that the filter (10) is clean before refitting the cap (5). Ensure the breathing hole provided in the cap (5) is not blocked by dust or dirt.

NOTE :

Clutch master cylinder assemblies make BI TVS & KBX makes are used in selection. Repair kits for for both makes are different.

Please ensure usages of correct make / size of repair kit during overhaul.

9. SLAVE CYLINDER - *Brakes India Make*

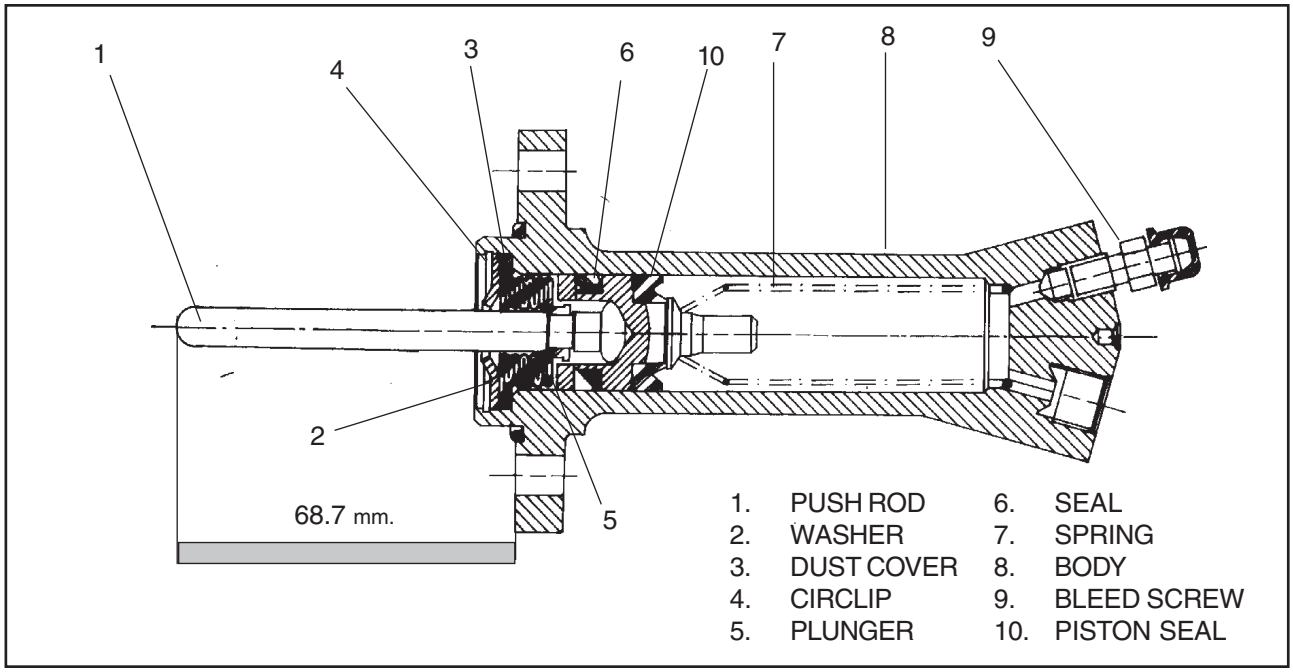


Fig. 9 - Slave Cylinder - Brakes India Make

DISMANTLING OF SLAVE CYLINDER (Fig. 9)

- Remove circlip (4) and washer (2).
- Remove rubber boot (3).
- Remove plunger (5) with gland seals and plunger spring (7) from body by lightly tapping it on wooden block.
- Remove gland seals (6 & 10) from plunger.

INSPECTION AND ASSEMBLY OF SLAVE CYLINDER (Fig. 9)

- Examine bore of body. If it is not score, ridged or corroded do not replace. If there is doubt about condition of bore, then it should be replaced with new slave cylinder assembly. Even otherwise if the clearance between the plunger & bore exceeds 0.13 mm. the assembly should be replaced.
- Examine plunger for rust, burrs, and ridges, Replace if necessary.
- Fit new gland seals on plunger such that it fits squarely in plunger groove.
- Fit small end diameter of spring to plunger.
- Lubricate bore of body with brake fluid and dip plunger assembly in it. Insert plunger assembly into bore with bigger end diameter of spring leading.
- Fit rubber boot & washer over push rod and place it over plunger as shown. Fit circlip.
- Ensure the push rod length from the slave cylinder mounting face is as shown in sketch.

SLAVE CYLINDER - KBX

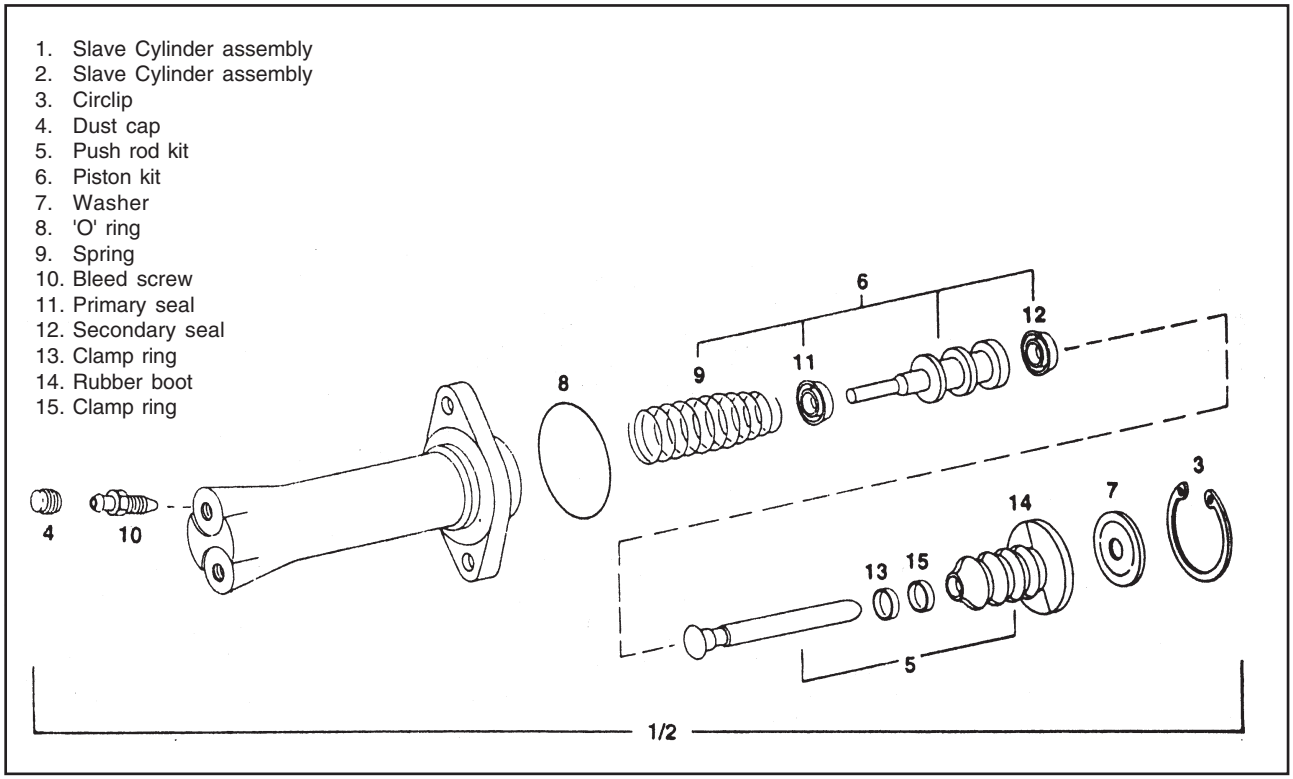


Fig. 10 - Slave Cylinder - KBX make Exploded view

Hydraulically Actuated Clutch used in modern vehicles optimize the driver's effort while clutch application. The actuation system consists of Clutch Cylinder (CMC) & Clutch Slave Cylinder (CSC).

1. Construction –

The hydraulic clutch system consists of Clutch Master Cylinder & Clutch slave cylinder.

The hydraulic pressure developed in Clutch Master Cylinder is transmitted to the Clutch Slave Cylinder through a hydraulic line where the hydraulic pressure actuates the clutch slave cylinder push rod which operates the clutch release mechanism. The clutch slave cylinder is mounted on clutch housing.

The slave cylinder consists of a piston , piston return spring, seals & boot .

Note :

Length of slave cylinder push rod for Telcoline & other tata models may vary. Please ensure to use appropriate slave cylinder push rod during repairs.

2. Overhauling of CSC Assembly –

2.1 Removal of CSC from vehicle –

1. Remove the bleed screw cap from the bleeder provided on CSC assembly.
2. Attach a plastic tube to the bleed screw & put other end of the tube into a container.
3. Unscrew the bleed screw for ½ or ¾ turn.
4. Push the clutch pedal to pump the fluid out from the CSC.
5. Dismantle the CSC assembly from the vehicle referring to the vehicle manufacturer's instructions.

2.2 Servicing of CSC assembly –

1. Hold the clutch slave cylinder in a soft jaw vice.
2. Unscrew the bleed screw.
3. Remove the boot.
4. Push the piston with a hylem rod or blunt edge screw driver & remove the circlip.

5. Remove the piston & piston return spring by tapping the CSC assembly gently on

   a wooden block.

6. Remove the seals by cutting it from the piston.
7. Clean all the dismantled parts with the fresh brake fluid.

NOTE :

Never use any mineral oil base fluids like kerosene,diesel thinner, petrol etc,. For cleaning of removed parts.

2.3 Inspection of Parts —

Inspect the bore & piston of the CSC. If it is not scored , ridged or pitted and smooth, the CSC can be rebuilt with the genuine KBX spare parts kit. If in case of slightest doubt on the bore condition, like deep groves or score marks in the bore then a new cylinder assembly should be replaced.

Note :

Do not polish the piston/ cylinder bore with any abrasive material which may damage the surface.

Destroy all old parts to prevent misuse.

2.4 <u>Assembly of the Clutch Slave Cylinder</u> –

1. Lubricate all the internals like piston & new rubber seals with fresh specified brake fluid.
2. With the help of mandrel assemble the seals on the piston properly.
3. Insert the piston return spring on the piston stem.
4. Insert the piston assembly with return spring into the bore with the spring end leading.
5. Push the piston slightly into the bore & apply rubber grease provided in the repair kit on piston spherical end where the push rod of CSC assembly is fitted.
6. Assemble pushrod , boot ring, boot & by gently pushing the boot into the bore, assemble the piston stop plate & fit the circlip.
7. Install the CSC Assembly on the vehicle referring the vehicle manufacturer's instructions.
8. Bleed the system to remove air from the system

NOTE :

Clutch slave cylinder assemblies make BI TVS & KBX makes are used in selection. Repair kits for for both makes are different.

Please ensure usages of correct make / size of repair kit during overhaul.

10. INSTALLATION OF CLUTCH ACTUATION MECHANISM

- Install clutch pedal bush if removed earlier, using suitable drift.
- Locate clutch pedal in the mounting bracket properly and insert hex bolt. Smear oil on inside surface of clutch pedal bush while assembling.
- Fit and tighten two hex nuts on clutch pedal mounting bolt. Ensure free movement of lever after tightening.
- Locate clutch master cylinder fork properly. Push the eye end and fit it on the mounting pin at clutch pedal carefully. Install washer and split pin and bend the split pin.
- Mount slave cylinder on clutch housing. Make sure that push rod end is properly located at clutch fork seat.
- Ensure that bleeding screw of slave cylinder is at top. Tighten slave cylinder mounting nuts.
- Install master cylinder on fire wall and tighten its mounting screws.
- Connect pipe connection to slave cylinder.
- Connect pipe connection to master cylinder properly.

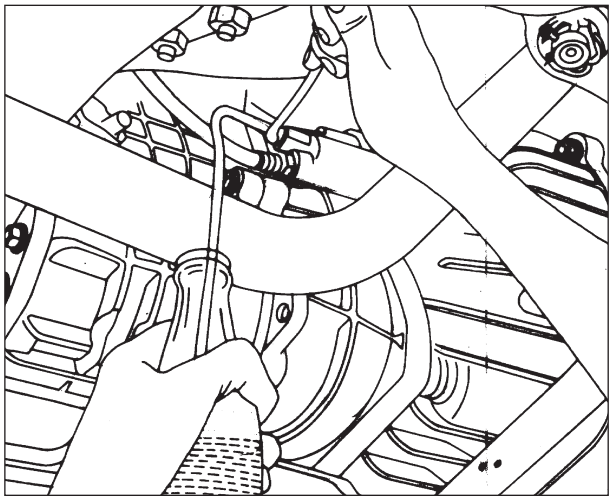


Fig. 10- Bleeding the clutch system

11. BLEEDING THE CLUTCH SYSTEM

Procedure for bleeding the system given below :

- Top up clutch fluid container.
- Ensure that fluid level in clutch fluid container is up to 'Max' level and not above it. Add clutch fluid to maintain level while bleeding.
- Remove dust cap from slave cylinder bleed screw and clean the screw thoroughly. Attach bleeding tube to bleed screw and place other end of tube in a clean glass jar containing sufficient clutch fluid to submerge tube end.
- Pump clutch pedal twice or thrice slowly throughout its stroke and by holding clutch pedal in depressed condition, loosen bleed screw on cylinder.
- Retighten bleed screw on slave cylinder and repeat the above operation until air bubbles cease to appear at the end of tube in glass jar, allowing only fluid to flow.
- After completing bleeding operation, ensure that bleed screw on slave cylinder is fully tightened. Replace dust cap on the bleed screw.

Note

During bleeding process keep a watch on fluid level in container and top up if the level falls below the indicated mark.

12. CLUTCH PEDAL LINKAGE ADJUSTMENT

Clutch pedal free play is due to clearance between plunger and push rod of master cylinder. This cannot be adjusted. It is built in design feature.

- Adjust the dimension between push rod fork hole centre to master cylinder flange face (A=126 mm) Refer fig. 6
- Assemble master cylinder on firewall.
- Assemble clutch pedal and master cylinder push rod fork with pin, collar bush, washer and split pin. Smear oil while assembling pivot pin of clutch lever.
- Screw in pedal stopper bolt completely. Press pedal fully till the pedal bottoms on the floor. Now screw out the pedal stopper bolt till it touches the pedal lever, release pedal. (Fig.5)
- Set the clutch pedal travel to 160-5 mm by adjusting clutch pedal stopper.
- Screw out the bolt further by one turn. Tighten the locknut.
- Press the clutch pedal 3-4 times and check for proper functioning.

GEAR BOX G-76

INTRODUCTION :

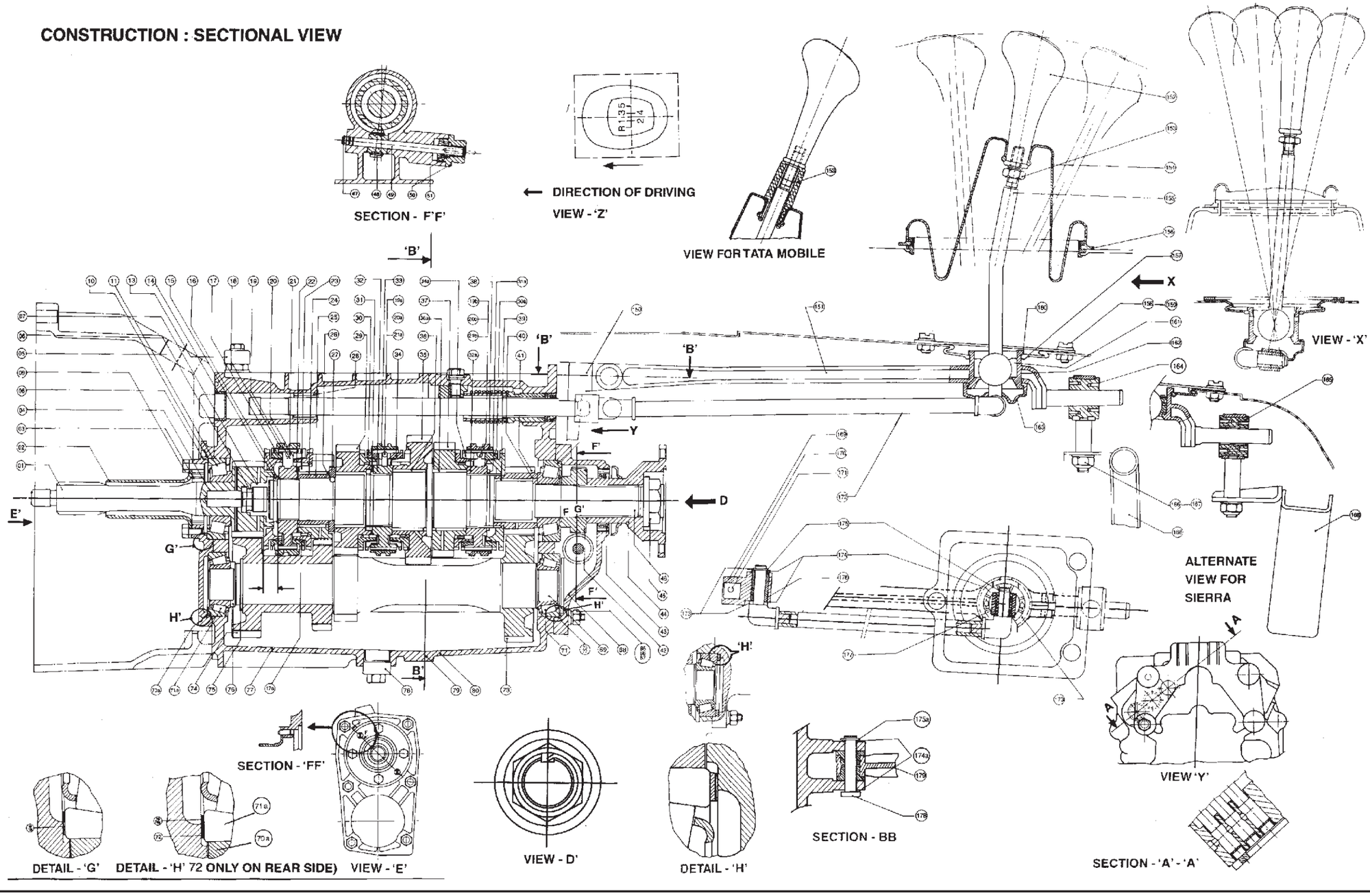
The G-76 gear box has an input torque capacity of 20.5 kgm. All gears, five forward and one reverse are synchromesh. The fifth gear is an overdrive for better fuel efficiency at higher speeds.

In order to improve the gear shifting user friendly pattern is introduced. Aluminium alloy die cast shifting system is used to keep the weight of the gear box low, & its function is improved by multi rail shifting system.

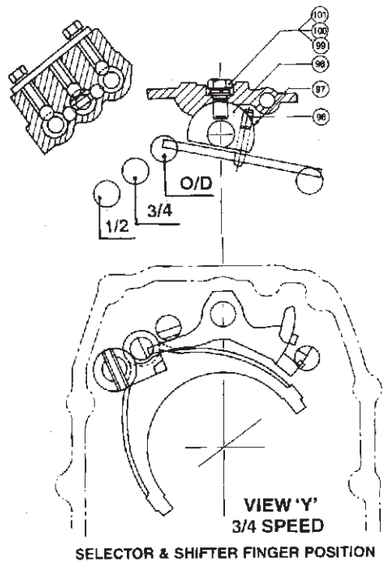
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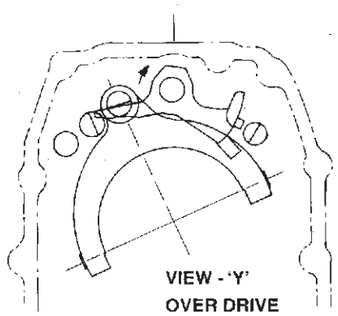
CONSTRUCTION : SECTIONAL VIEW



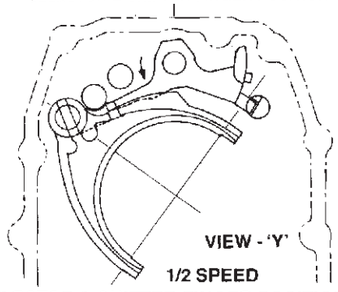
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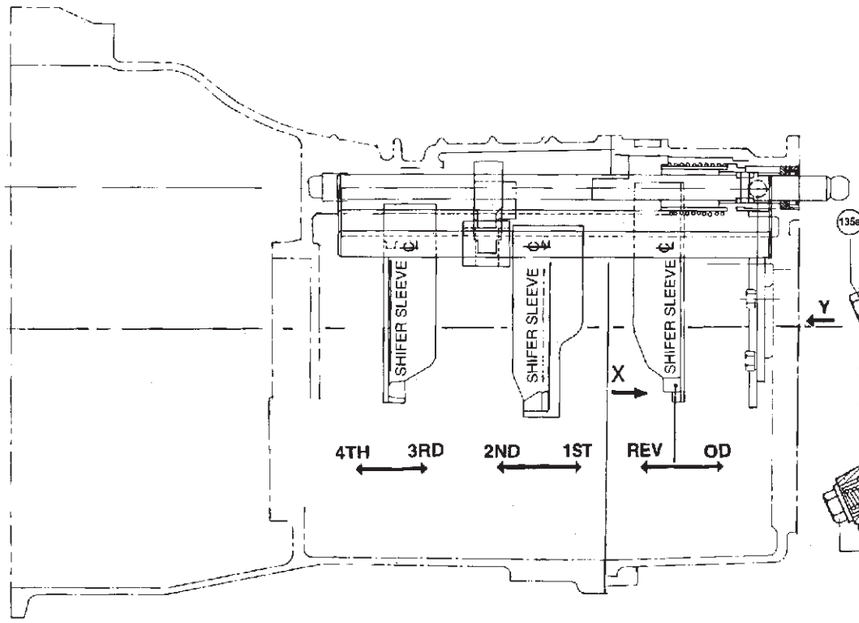
SELECTOR & SHIFTER FINGER POSITION

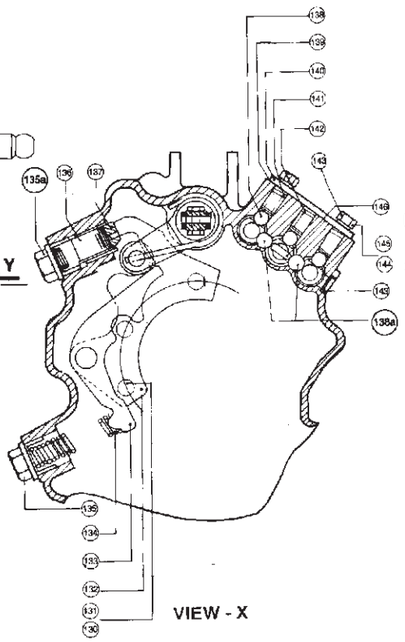


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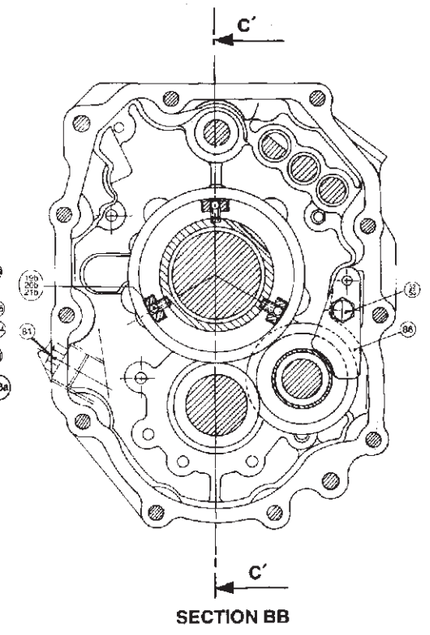


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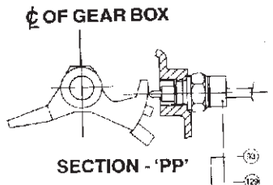




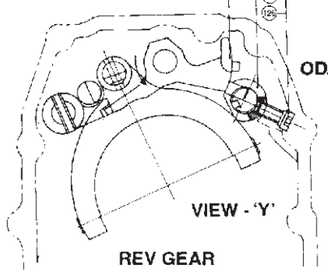
VIEW - X



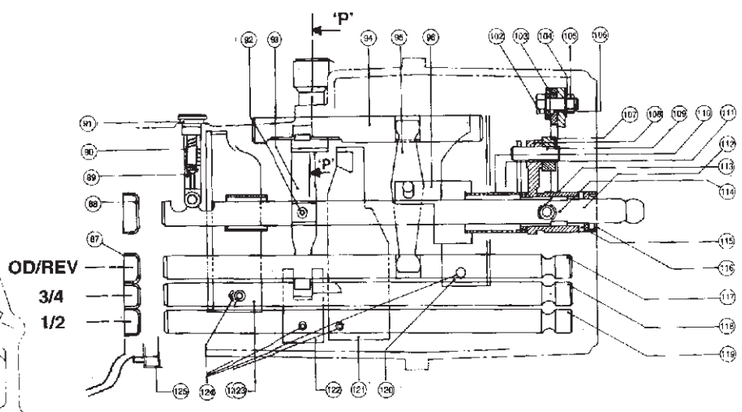
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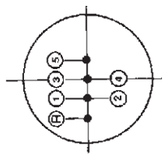


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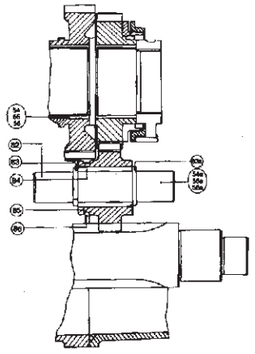


REV GEAR
SELECTOR & SHIFTER FINGER POSITION





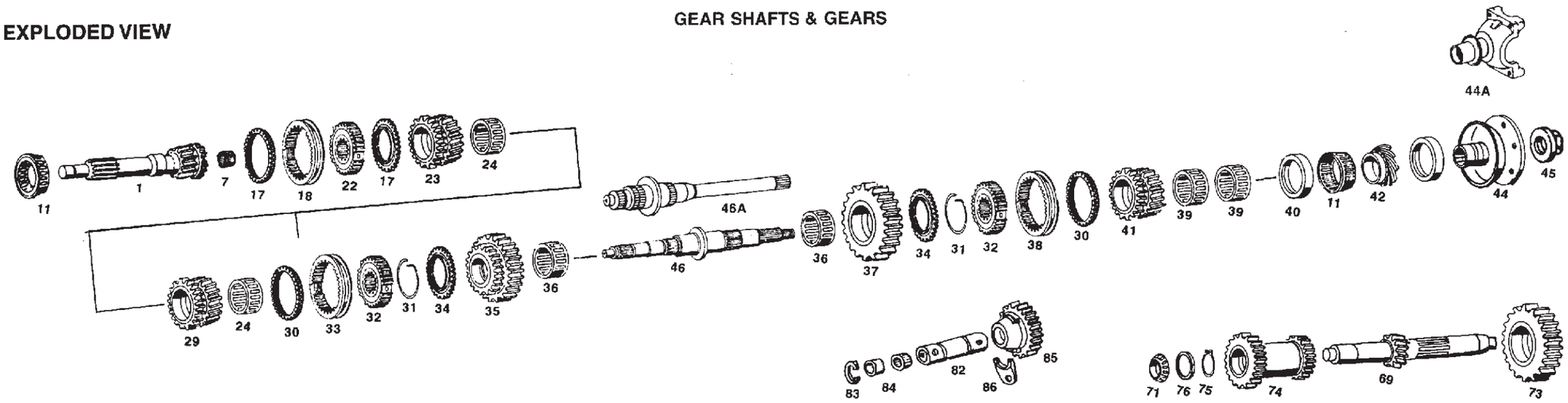
DRIVING DIRECTION



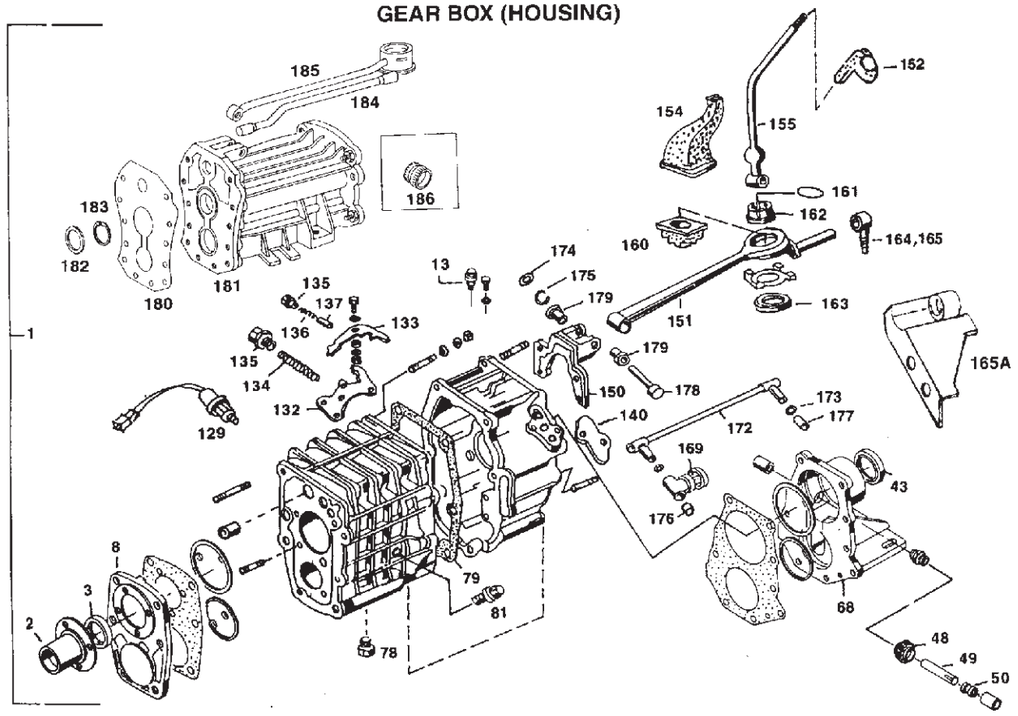
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EXPLODED VIEW

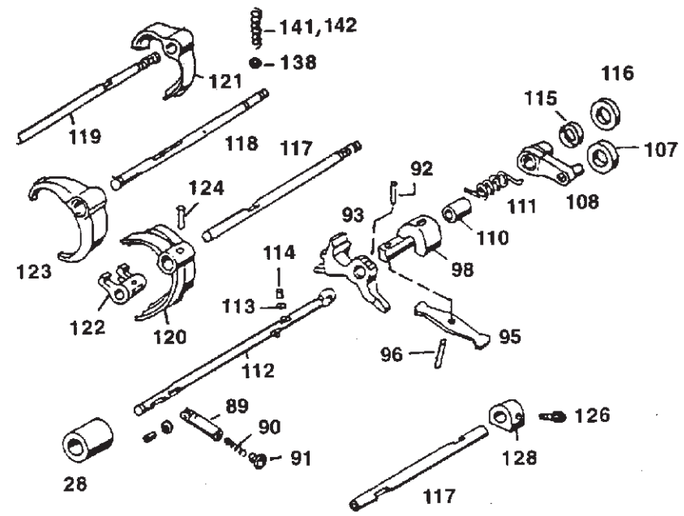
GEAR SHAFTS & GEARS



GEAR BOX (HOUSING)



GEAR SHIFTING LINKAGES



List of Parts Illustrated in fig. A, B, C.

ILLU.NO.	DESCRIPTION
1.	DRIVE SHAFT
2.	BEARING TUBE (DRIVE SHAFT cover)
3.	OIL SEAL (DRIVE SHAFT)
4.	COMPRESSION SPRING (DRIVE SHAFT)
5.	SPACER THRUST BEARING
6.	THRUST BEARING (MAIN SHAFT)
7.	ROLLER CAGE (DRIVE SHAFT)
8.	GEAR CASE COVER - Front
9.	HEX SCREW -M6X12
10/10a	SHIM (MAIN SHAFT)
11/11a	TAPER ROLLER BEARING DRIVE SHAFT
12.	DOWEL PIN
13.	BREATHER
14.	SEALING CAP
15.	SNAP RING
16.	SPACER - Engaging gear 3rd
17/17a	SYNCHRO CONE 3rd/4th
18.	SHIFTER SLEEVE 3rd & 4th
19/19a/19b	SPRING
20/20a/20b	Carriers
21a/21b/21c	BALL 5 dia
22.	ENGAGING GEAR 3rd/4th
23.	3rd SPEED GEAR
24/24a	NEEDLE CAGE 2nd/3rd
25.	BUSH 3rd
26.	BALL 3 dia
27.	SPACER 2nd/3rd
28.	LINEAR BEARING
29.	2nd SPEED GEAR
30.	SYNCHRO CONE 2nd & 5th
31/31a	SNAP RING

ILLU.NO.	DESCRIPTION
32/32a	ENGAGING GEAR 1st/2nd & Rev/5th
33.	SHIFTER SLEEVE 1st/2nd
34/34a	SYNCHRO CONE 1st & Rev.
35.	1st SPEED GEAR
36/36a	NEEDLE CAGE 1st & Rev.
37.	REVERSE SPEED GEAR
38.	SHIFTER SLEEVE Rev./5th
39.	NEEDLE CAGE (5th)
40.	SPACER (5th/Tapper Roller Bearing)
41.	5th GEAR
42.	SPEEDO DRIVE GEAR
43.	OIL SEAL - Main Shaft)
44/44a	COUPLING FLANGE / SPICER YOKE
45.	COLLARED HEX NUT
46.	MAIN SHAFT
47.	PLUG SPEEDO METER DRIVE
48.	SPEEDO METER DRIVE GEAR
49.	SPEEDO SHAFT
50.	THREADED PLUG - Speedo shaft
51.	OIL SEAL - Speedo shaft
52.	HEX. SCREW M8X20
53.	SPR. WASHER B8
54/54a	HEX SCREW M8x40
55/55a	BRIGHT WASHER 8.4
56/56a	SPR. WASHER B8
65.	HEX. NUT M8
66.	BRIGHT WASHER 8.4
67.	SPR. WASHER B8
68.	GEAR CASE COVER -Rear
69.	COUNTER SHAFT
70/70a	SHIMS (COUNTER SHAFT)
71/71a	TAPER ROLLER BEARING (COUNTER SHAFT)
72.	SPACER COUNTER SHAFT Rear Cover

ILLU.NO.	DESCRIPTION
73.	O.D. GEAR (COUNTER SHAFT)
74.	DOUBLE GEAR (COUNTER SHAFT)
75.	EXTERNAL CIRCLIP 38x1.75
76.	SPACER (COUNTER SHAFT)
77.	G.B. HOUSING - Front half
78.	MAGNETIC DRAIN PLUG
79.	GASKET - Front half
80.	G.B. HOUSING - Rear half
81.	SCREW PLUG - Oil filling
82.	R.I. SHAFT
83/83a	SNAP RING Reverse Idler Gear
84.	ROLLER RING Reverse Idler Gear
85.	REVERSE IDLER GEAR
86.	RETAINER PLATE
87.	CAP Shifter Shaft
88.	CORE PLUG 25 dia.
89.	DETENT
90.	DETENT SPRING - Shifter Shaft Central
91.	PLUG
92.	SPIRAL PIN 6x28
93.	SELECTOR & SHIFTER FINGER
94.	SHIFTER SHAFT - Rev.
95.	SWING LEVER
96.	PIN Swing Lever
97.	CIRCLIP
98.	BEARING BLOCK - Swing Lever
99.	HEX. FIT. BOLT
100.	SPR. WASHER B10
101.	BRIGHT WASHER 10.5
102.	HEX SCREW M6x18
103.	BRIGHT WASHER A6.4
104.	SPR. WASHER B6
105.	HEX. NUT M6

ILLU.NO.	DESCRIPTION
106.	ROLLER Detent plate
107.	ROLLER Selector lever
108.	ASSY. SELECTOR LEVER
109.	PIN SELECTOR LEVER
110.	TUBULAR SPACER
111.	TORSION SPRING
112.	ASSY SELECTOR & SHIFTER SHAFT
113.	ROLLER - Selector & Shifter shaft
114.	PIN
115.	SPACER - Selector & shifter shaft
116.	OIL SEAL - Selector & shifter shaft
117.	SHIFTER SHAFT REV/5th
118.	SHIFTER SHAFT 3rd/4th
119.	SHIFTER SHAFT 1st/2nd
120.	SHIFTER FORK REV/5th
121.	SHIFTER FORK 1st/2nd
122.	SHIFTER DOG 1st/2nd
123.	SHIFTER FORK 3rd/4th
124.	SPIRAL PIN 6 x 24
125.	PLUG MC 10x1
126.	SOCKET HD. CAP SCREW M8x16
127.	SPR. WASHER B8
128.	LOCATING PIECE Rev. shifter shaft
129.	REVERSE LIGHT SWITCH
130.	HEX SCREW M6x18
131.	SPR. WASHER
132.	PRESSURE PLATE Rev. Speed
133.	PRESSURE PLATE 5th. Gear
134.	SPRING Detent plate 5th gear
135.	THREADED PLUG 5th. Pressure plate
135a.	THREADED PLUG Rev. Pressure plate
136.	SPRING Plunger
137.	PLUNGER Rev. Gear detent

ILLU.NO.	DESCRIPTION
138/138a	BALL 8 dia
139.	GASKET Detent cover
140.	DETENT COVER
141.	DETENT SPRING Rev/5th Shifter shaft
142.	DETENT SPRING 1st/2nd & 3rd/4th Shifter shaft
143.	SEALING CUP
144.	HEX. SCREW M8x18
145.	SPRING WASHER B6
146.	PIN 12.8 LENGTH
147.	HEX. NUT M8
148.	BRIGHT WASHER 8.4
149.	SPRING WASHER B8
150.	EXTENSION ARM BRACKET
151.	EXTENSION ARM
152.	GEAR SHIFT LEVER KNOB
153.	HEX LOCK NUT or SPACER for Tatamobile
154.	RUBBER BELLOW
155.	GEAR SHIFT LEVER
156.	BASE PLATE
157.	CLAMPING PLATE
158.	SL. CH. SCREW M8x16
159.	BRIGHT WASHER 8.4
160.	RUBBER SEALING Ext. arm to tunnel
161.	O RING 31.5 x 2.65
162.	BUSH - Ball seat gear shift lever
163.	RUBBER BELLOW
164.	EXTENSION BOX SUPPORT ESTATE
165.	EXTENSION BOX SUPPORT SIERRA
165a.	ASSY. BRACKET WITH BUSH (EXT. ARM SUPPORT) SAFARI
166.	BRIGHT WASHER 10.5
167.	NYLOCK NUT M10x1
168.	EXTENSION ARM SUPPORT BRACKET
169.	SHIFTING YOKE sel. & shifter shaft
170.	SPRING CLIP
171.	CYLINDRICAL PIN
172.	SHIFTING LINK
173.	SPRING WASHER A10
174.	WASHER
175/175A	EXTERNAL CIRCLIP E7x0.9
176.	BUSH Shifting yoke
177.	BUSH G B lever
178.	PIN Extension arm bkt.
179.	BUSH Extension arm.

4 x 4

180.	GASKET (Between Rear cover & Adaptor Housing)
181.	ADAPTER HOUSING
182.	SPACER (OIL SEAL)
183.	EXTERNAL CIRCLIP 30 X 1.5
184.	ASSY. SHIFTING LINK
185.	EXTENSION ARM
186.	BUSH EXTENSION ARM

TECHNICAL SPECIFICATIONS

Model G-76 5/3.87 with overdrive

Type : Synchromesh on all gears five forward (including overdrive) & one Reverse

Gear Ratio :

I - 3.87

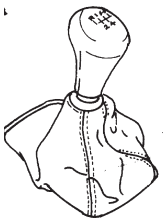
II - 2.22

III - 1.37

IV - 1.00

V - 0.82

Rev. - 3.4



Gear Lever Knob

Oil Capacity - 1.6 liters

Change frequency :

If multi grade 80W 90 API GL 4 is used : 1st change at 10,000 km, 2nd change at 40,000 km & thereafter every 40,000 km.

If synthetic oil 75W 90 API GL 4 is used : 1st change at 40,000 km, 2nd change at 1,20,000 km & thereafter every 80,000 km.

IMPORTANT CHECKS AND ADJUSTMENTS

For securing main shaft nut; collar to be staked in the slot. Tightening Torque : 24 to 28 mkg.(Telco make)

0.05 to 0.15 mm end play to be maintained only on drive shaft side.

Distance from rear cover half outer wall to front end of 2nd gear on main shaft 197 $\pm$ 0.1 mm.

Counter shaft Taper roller half bearing - 0.00 to 0.03 mm pre load (only on front side).

Distance from rear cover outer wall to 3rd gear rear side on counter shaft : 198 $\pm$ 0.1 mm.

Dimension between drive shaft synchronizing face to engaging gear 3rd - 4th front face : 11.1 $\pm$ 0.1

Engaging gear to be free from play.

Use sealing compound Maxifix s-758 Dunlop or Duraplex 120 for sealing plugs.

Gap between synchro cone and mating gear = 1$\pm$0.3 mm

Tightening torque of drain plug - 5 mkg

Tightening torque of level plug - 2.5 mkg.

LIST OF SPECIAL TOOLS

Sr.No.	Tool Description	Part Number
1	Handle - For drifts	2640 5890 35 11
2	Holder - For main shaft coupling flange (Telco)	2651 5890 35 11
3	Puller - For taper roller bearing counter shaft	2654 5890 26 04
4	Drift - For drive shaft taper roller bearing	2654 5890 26 05
5	Drift - For counter shaft taper roller bearing	2654 5890 26 06
6	Drift - For rear cover oil seal	2654 5890 26 07
7	Puller - For drive shaft & main shaft taper roller bearing	2654 5890 26 12
8	Mounting plate	2654 5890 26 13
9	Drift - For main shaft 2nd speed spacer	2654 5890 35 11
10	Puller - For main shaft 2nd speed spacer	312 589 25 33
11	Holder for coupling Yoke (Spicer make)	2698 5890 3505 or 2698 5890 4102
12	Socket for end yoke nut (Spicer make)	2698 5890 4101
13	Puller	2654 5890 2609

REMOVAL OF GEAR BOX FROM VEHICLE

Place chocks on wheels.

Disconnect battery terminals, electrical connections of starter motor and remove starter motor.

Remove rubber bellow from collar of base plate . Loosen lock nut or spacer (in case of Tatamobile) and remove gear shift lever knob . Take out rubber bellow.

Remove screws and take out clamping plate of the rubber bellow - bottom.

Disconnect exhaust pipe from manifold end and main muffler.

For 4x2 vehicles

Disconnect propeller shaft from gear box end and remove center bearing mounting bolts.

Slide the propeller shaft side ways and support it suitably.

Loosen nylock nuts and washer of extension arm support bracket and take it out.

For 4x4 vehicles

Disconnect extension arm support bracket from transfer case housing.

Disconnect electrical connector of electrical shift motor and speed sensor.

Disconnect electrical connector of vehicle speed sensor, In case of petrol engine.

Disconnect front and rear propeller shaft at transfer case end.

Slide the propeller shaft side ways and support it suitably.

Remove circlip from both ends of shift link and take it out along with teflon washers

Remove circlip and take out pin along with Teflon washer to disconnect extension arm from extension arm bracket . Remove extension arm assembly.

Disconnect and remove clutch slave cylinder from clutch housing.

Disconnect speedo cable and connector from reverse indicator switch.

Remove clutch housing front sheet metal cover.

Loosen and remove clutch housing mounting bolts.

Loosen and remove gear box adapter housing support - Rear mounting bolts. (4x2) / adapter housing (**4x4**)

Lift the gear box **(4x2)** / transfer case, gear box assembly **(4x4)** from rear and support the engine suitably.

Remove cross member supporting gear box, from the chassis.

Pull out gear box **(4x2)** / gear box along with transfer case **(4x4)** to disengage drive shaft from the clutch plate splines.

Lower the assembly carefully.

Loosen the adaptor housing bolts and separate gear box and transfer case. **(4x4)**

DISMANTLING OF GEAR BOX

(The gear box is removed from the vehicle)

Remove clutch release bearing and fork. *Fig.1*

Remove clutch housing by loosening nuts. *Fig. 2*

Mount the gear box on drive shaft end face on work stand (Pt. No. 2573 5890 37 01) fitted with adapter plate (Pt.No. 2654 5890 2613). Drain the oil.

Remove breather (13). Remove reverse light switch (129) *Fig. 3*

Unscrew nuts and loosen extension arm bracket (150) *Fig. 4*

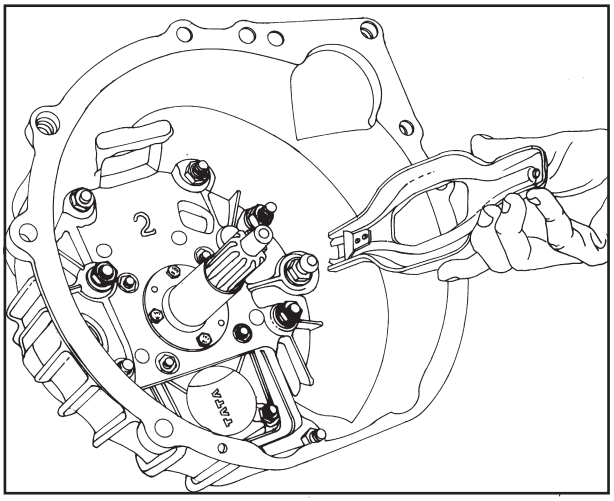


Fig. 1

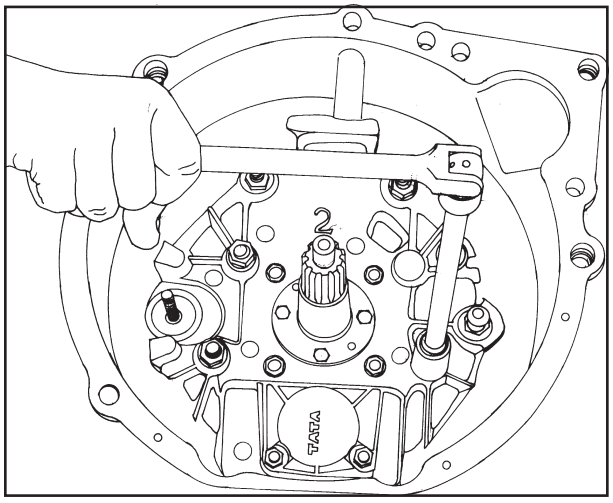


Fig. 2

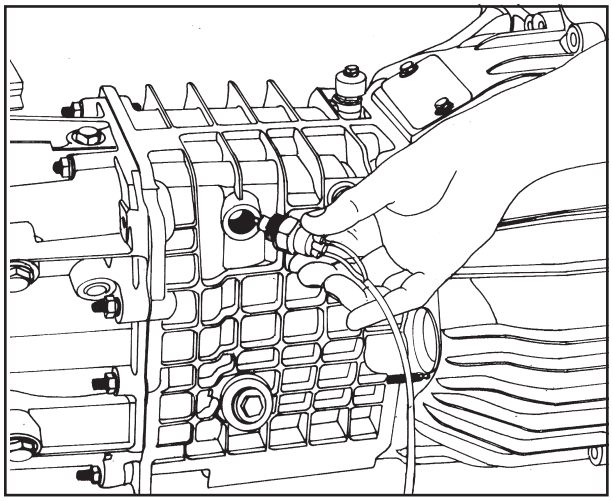


Fig. 3

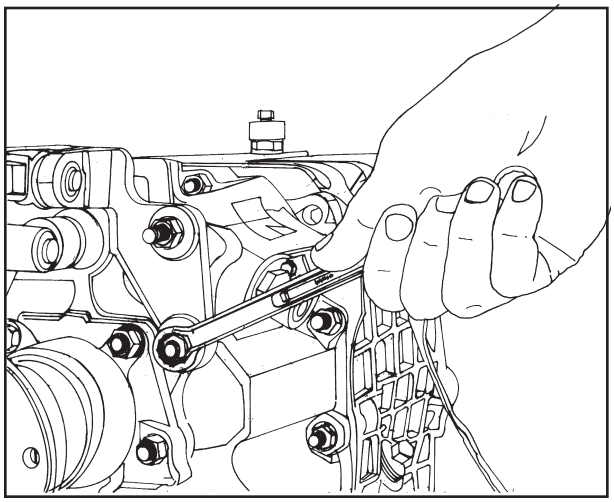


Fig. 4

Remove spring clip (170) and push out cylindrical pin (171). *Fig. 5*

Pull out shifting yoke (169) from selector & shifter shaft.

Pry out oil seal (116) from selector and shifter shaft. Remove spacer (115)

Hold the coupling flange (44) with the holder, Pt.No. 2651 5890 35 11. (for Telco make)

Un-stake and remove main shaft nut (45). Pull out coupling flange. *Fig. 6*

Unscrew nuts (65) and take out Assy. gear case cover - Rear (68). Take out main shaft and counter shaft play adjusting shims (10a & 70) from cover and keep them properly. *Fig. 7*

Take out speedo drive gear (42) from main shaft (46) *Fig. 8*

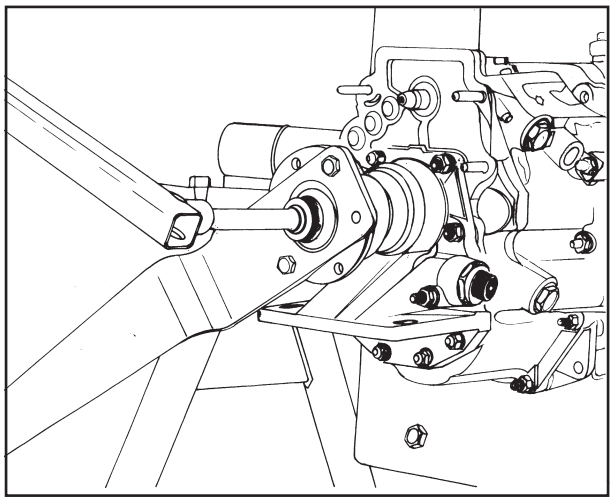


Fig. 6

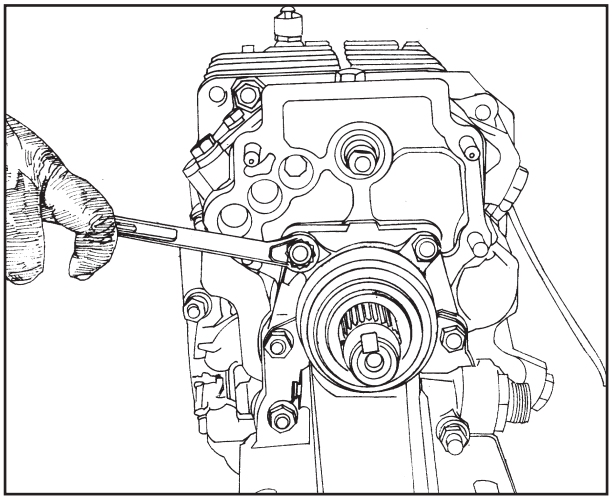


Fig. 7

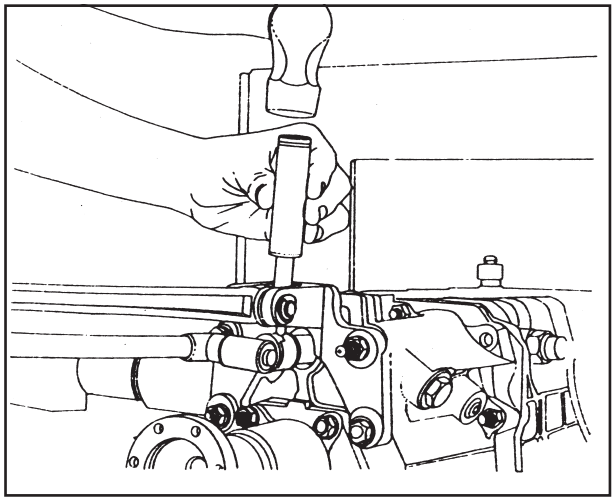


Fig.5

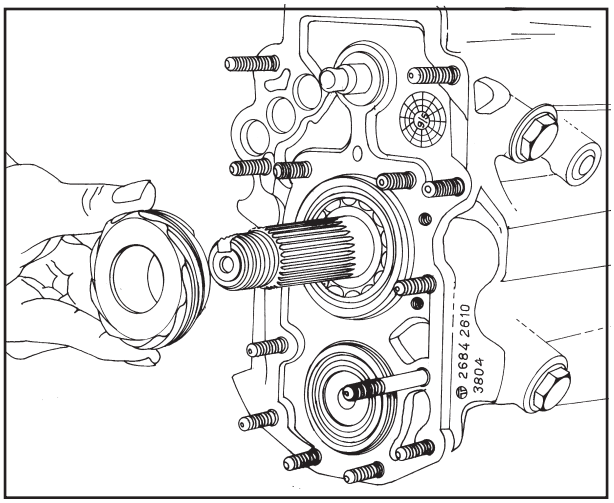


Fig. 8

Mount the gear box with up side down such that drive shaft is facing upwards. *Fig. 9*

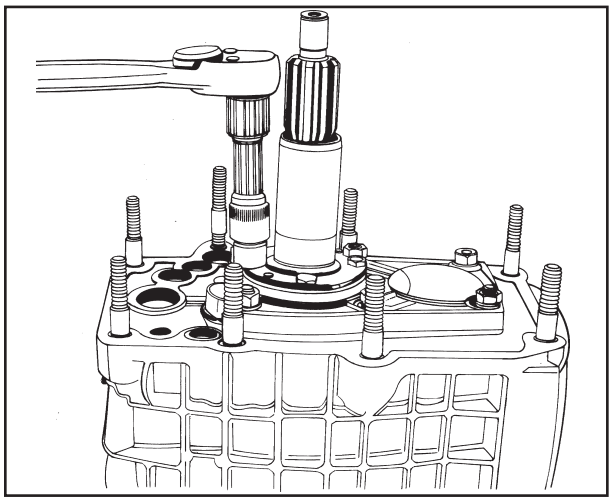


Fig. 9

Loosen screws and pull out Front cover bearing tube (2) *Fig. 10*

Fig. 10

Loosen nuts and remove Assy. gear case cover - Front (8). Take out main shaft & Counter shaft bearing play adjusting shims (10&70a) from cover and keep them properly. *Fig. 11*

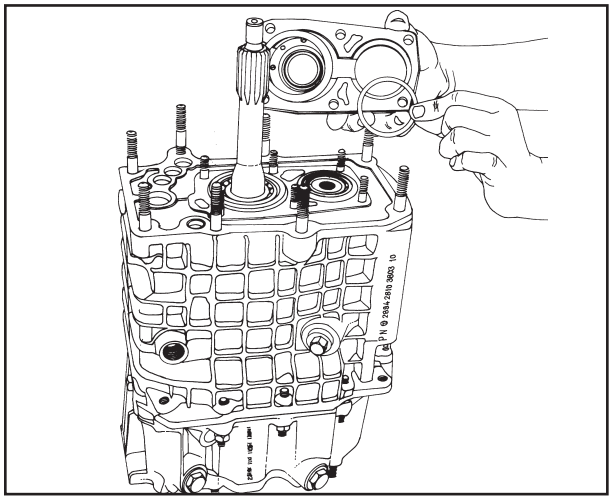


Fig.11

Loosen and take out reverse Idler shaft mounting screw (54) from housing - Front half. *Fig. 12*

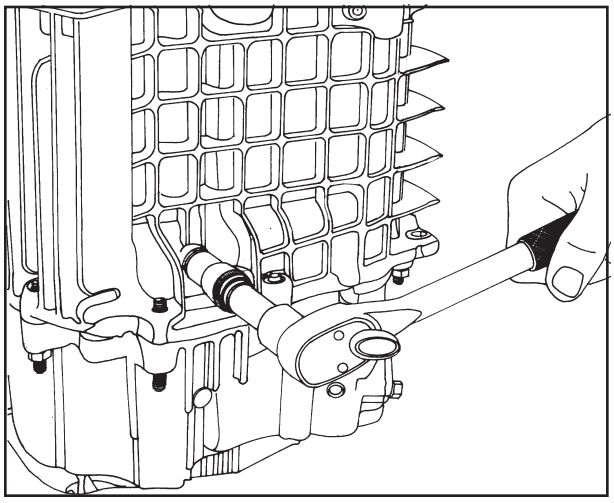


Fig.12

Pull out plug (91) and then take out detent (89) along with spring (90) *Fig. 13*

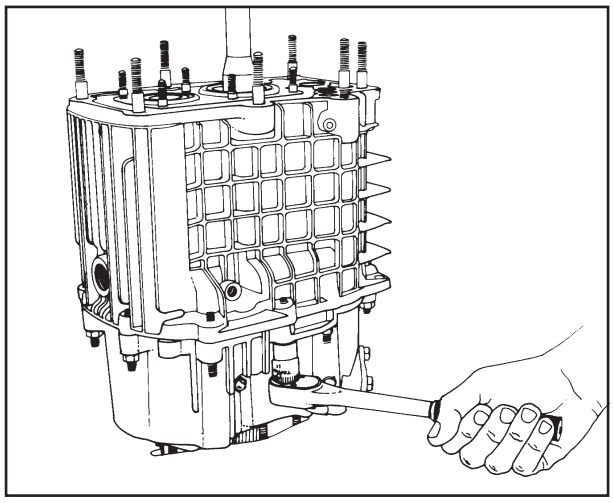


Fig. 14

Loosen nuts of housing - Front half (77) and separate out Front half. (If required, use puller Pt. no. 2654 5890 2609) *Refer fig. 14 and 15*

Separate out drive shaft assy. (1) from housing - Front half. *Fig. 16*

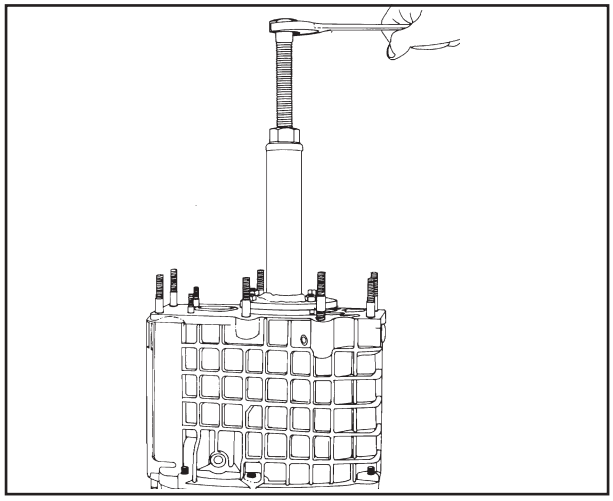


Fig. 15

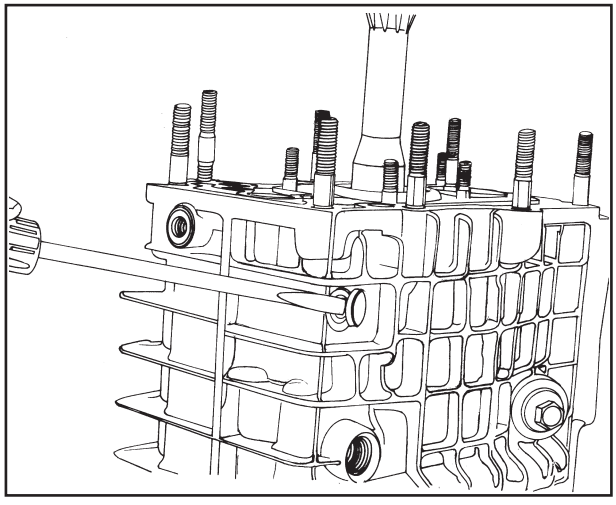


Fig.13

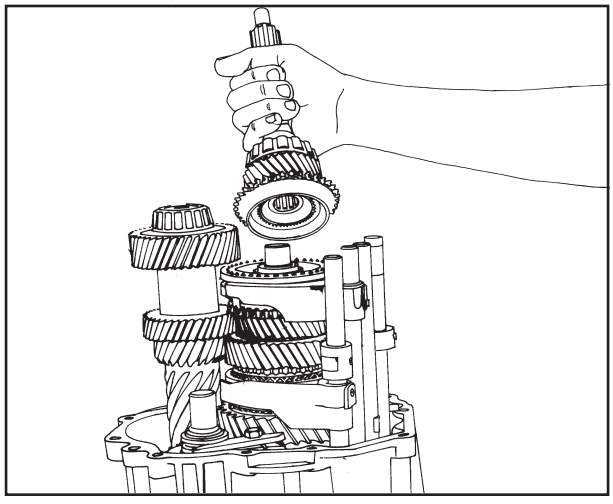


Fig. 16

Loosen mounting screw (52) and remove Reverse Idler gear retainer plate (86) *Fig. 17*

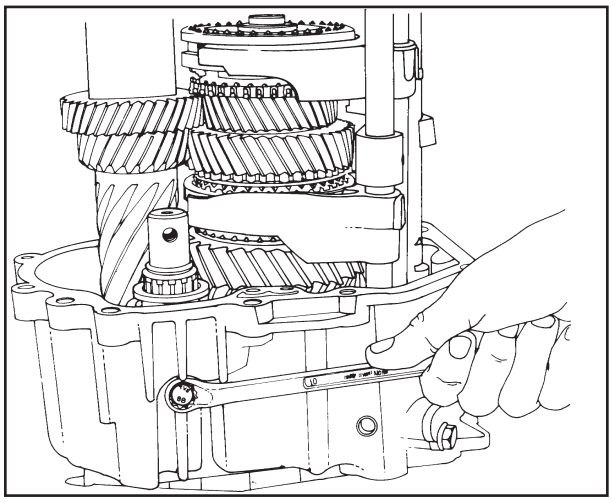


Fig. 18

Loosen another mounting screw (52a) of Reverse Idler gear shaft. *Fig. 18*

Remove Assy. Reverse Idler Shaft (82) from housing - Rear half. *Fig. 19*

Remove pin (96) and remove swing lever (95) *Fig. 20 (For gear box with 4 gate shifting)*

Remove reverse shifter shaft (94)

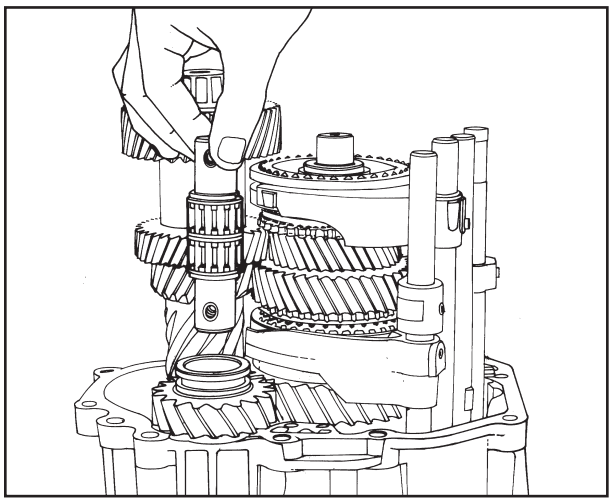


Fig.19

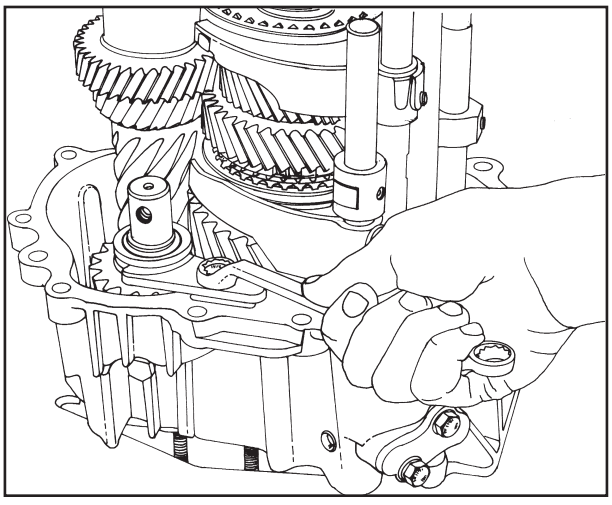


Fig. 17

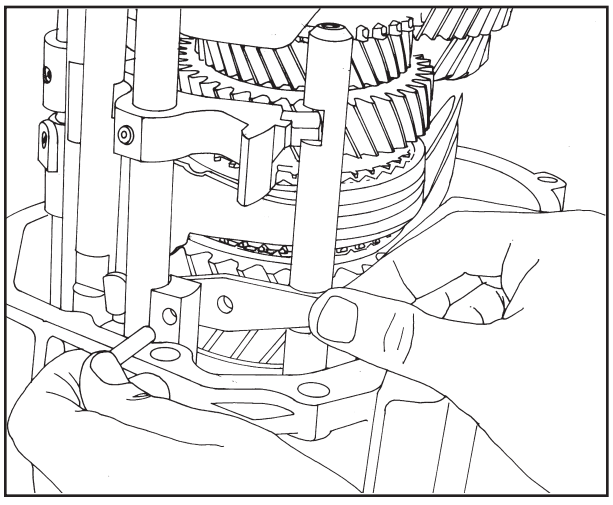


Fig. 20

Remove socket with allen key (126) and take out locating piece (128) *Fig. 21*

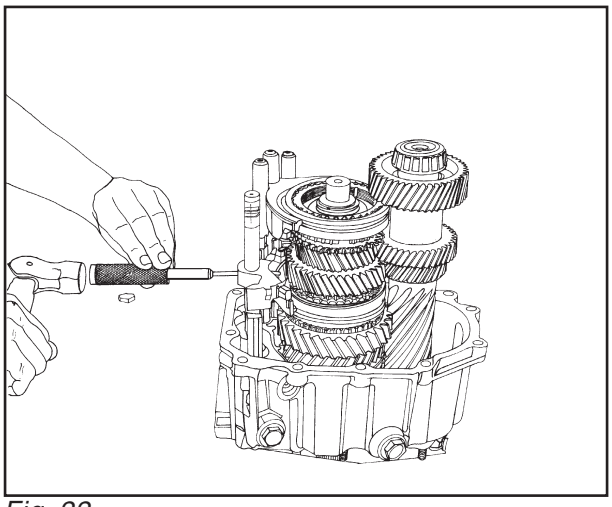


Fig. 22

With suitable punch, press out spiral pin (92) from selector & shifter finger (93). *Fig. 22*

Take out selector shaft (112) from bottom.

Press out spiral pin (124) of 3rd/4th shifter fork. *Fig. 23*

Loosen and remove screws (144) of detent cover (140). Remove springs (141 & 142) and balls (138) *Fig. 24*

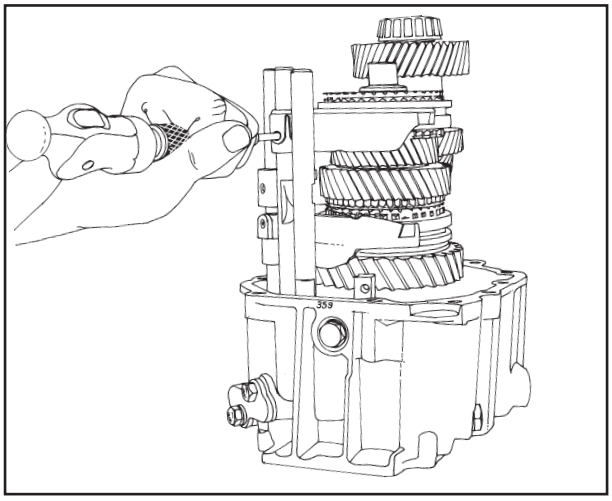


Fig. 23

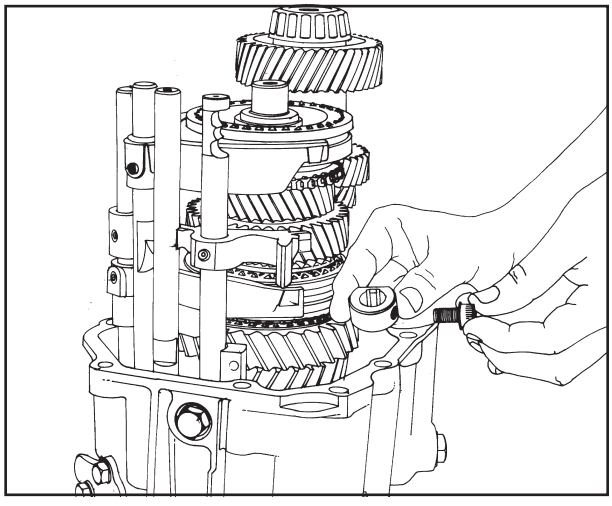


Fig. 21

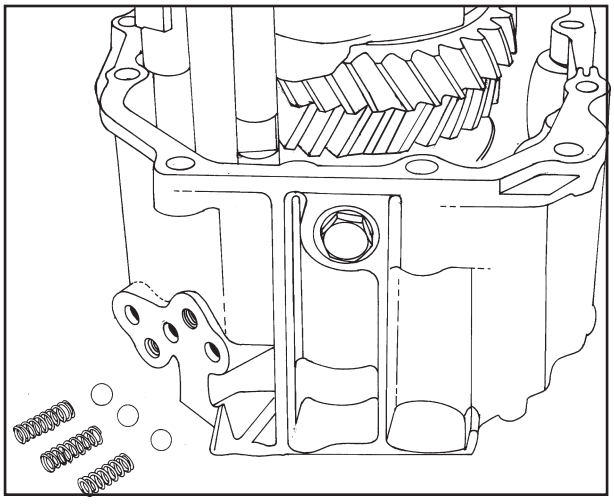


Fig. 24

Take out shifter shaft 3rd/4th (118) along with inter lock pin (146) *Fig. 25*

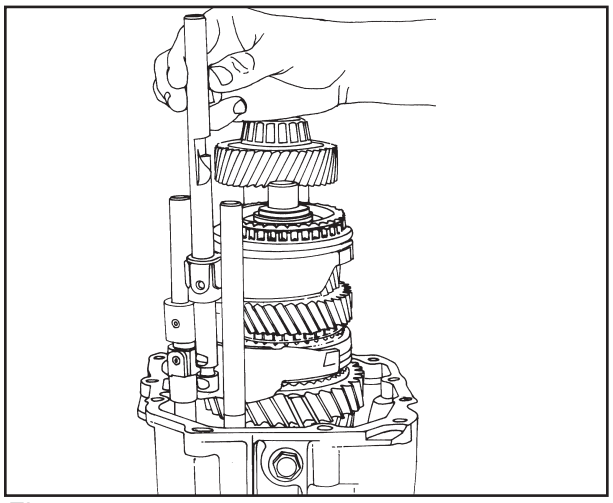


Fig. 25

Take out main shaft assembly along with the counter shaft and shifter shafts from the gear box housing - Rear half. *Fig. 26*

Note : Ensure that engaging sleeve does not jump out of engaging gear.

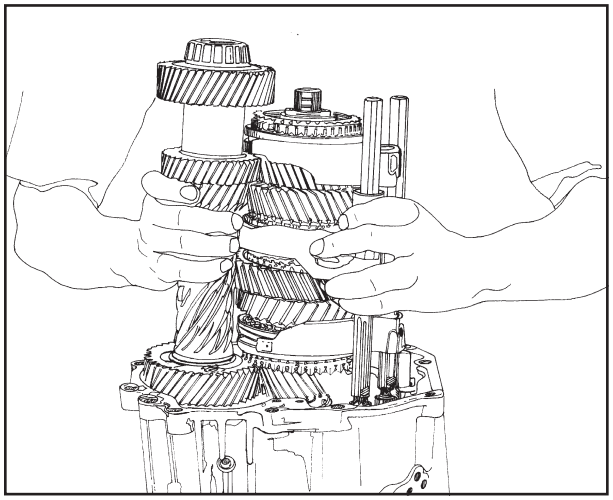


Fig. 26

Take out inter lock balls (138a) *Fig. 27*

Separate out counter shaft assembly and shifter shafts from main shaft assembly.

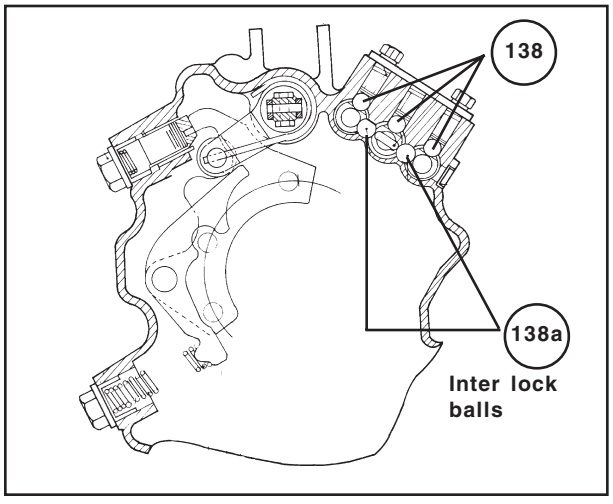


Fig.27 (For 4 gate gear box)

DIS-ASSEMBLY

DIS-ASSEMBLY OF DRIVE SHAFT *Refer Fig. 28*

Remove synchro cone (17)

Remove needle roller bearing (7)

Remove thrust bearing (6), spacer (5) and compression spring (4).

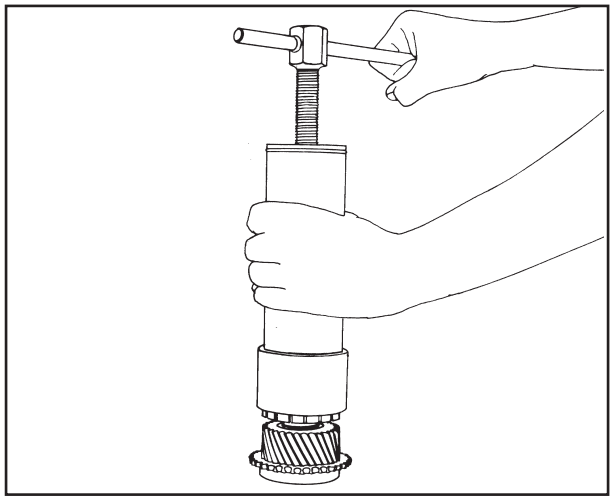


Fig. 29

Remove taper roller bearing inner race (11) with the help of puller Pt.No. 2654 5890 26 12. *Fig. 29*

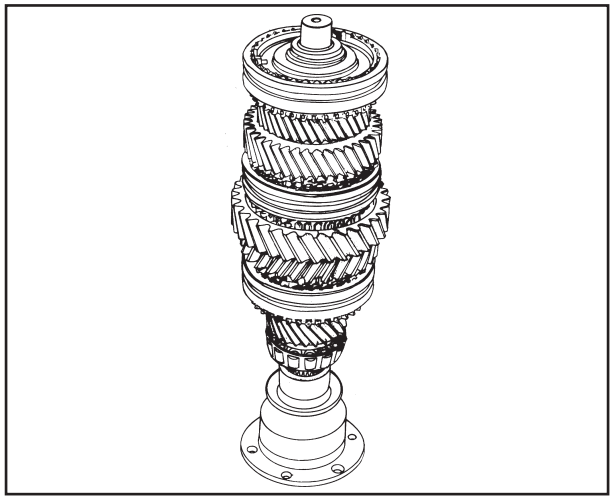


Fig. 30

DIS-ASSEMBLY OF MAIN SHAFT

Hold the main shaft assembly (46) such that drive shaft end is upward. *Fig. 30*

Remove snap ring (15) and spacer (16) *Fig. 31*

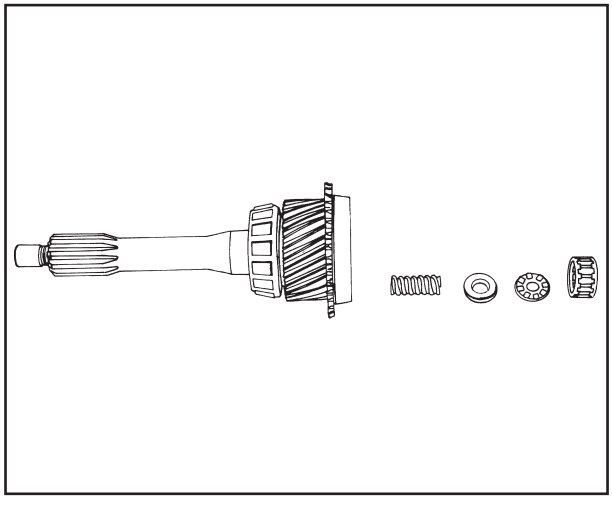


Fig. 28

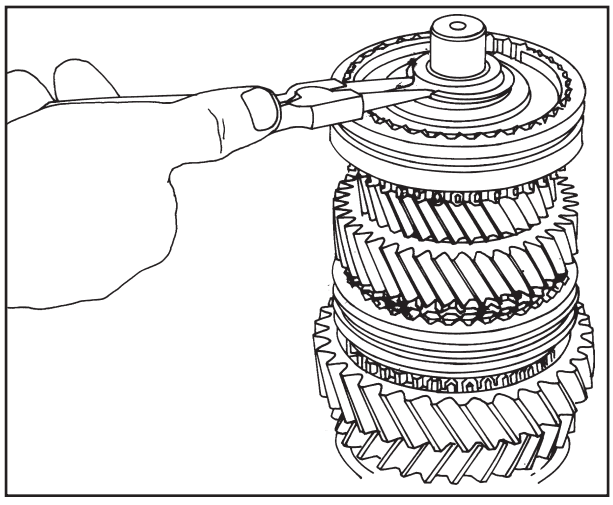


Fig. 31

Take out 3rd speed gear (23) along with 3rd/4th shifter sleeve (18) and engaging gear (22). *Fig. 32*

Remove needle roller cage (24).

Gently separate out shifter sleeve from engaging gear and remove carriers (20), springs (19) and balls - 5 mm dia. (21).

Separate out synchro cone (17a)

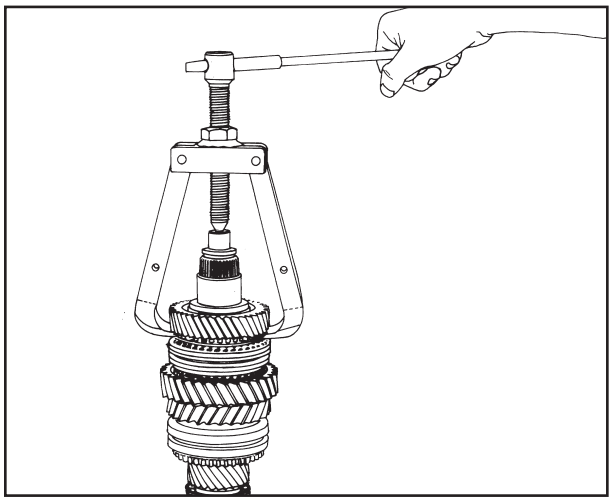


Fig. 33

Hold the shaft firmly and pull out bush (25) along with spacer (27) and 2nd speed gear (29) with the help of puller. Pt.No. 312 589 25 33. *Fig. 33*

Remove spacer locking ball - 3 dia. (26). *Fig. 34*

Remove snap ring (31). *Fig. 35*

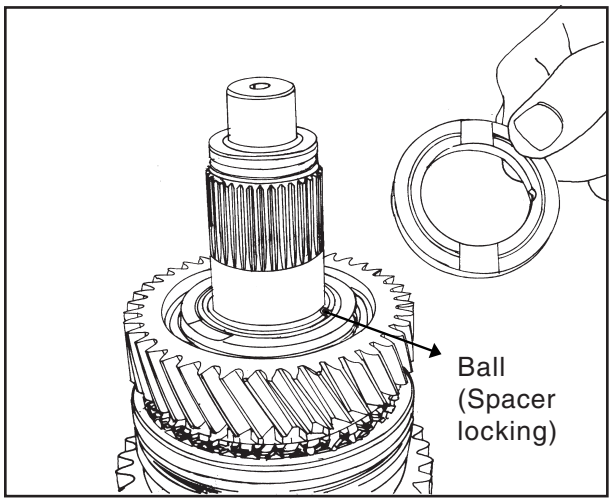


Fig. 34

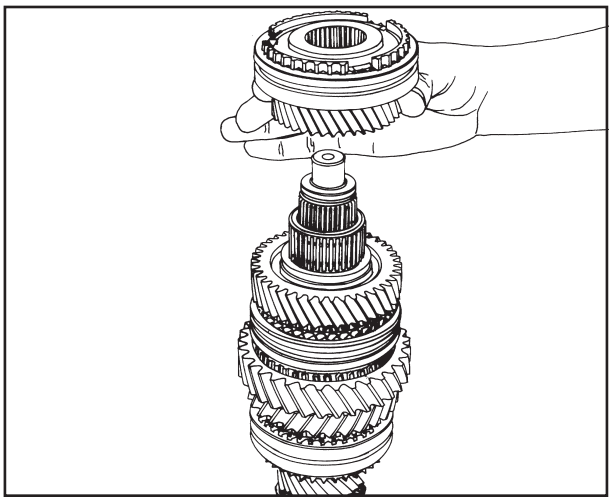


Fig. 32

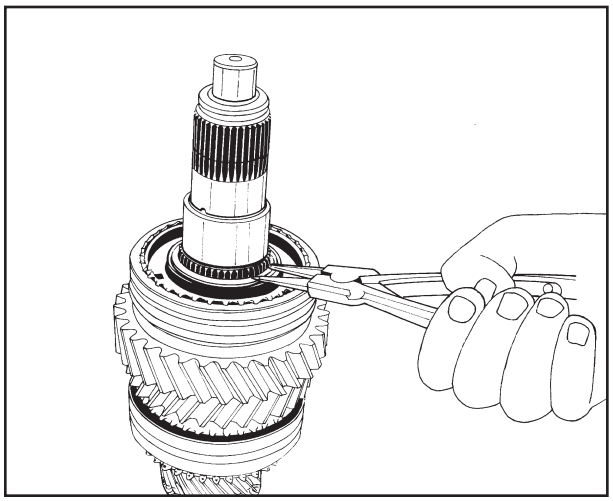


Fig. 35

Take out 1st speed gear assy. (35) along with 1st/2nd shifter sleeve (33) and engaging gear (32). *Fig. 36*

Remove needle roller cage (36)

Separate out synchro cones (17a)

Gently separate out shifter sleeve from engaging gear and remove springs (19a) carriers (20a) and balls (21a).

Hold the main shaft assembly upside down.

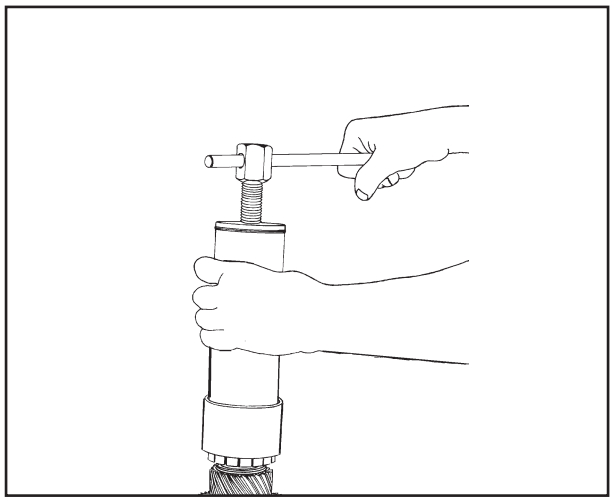


Fig. 37

Pull out taper roller bearing inner race (11a) with help of puller 2654 5890 26 12. *Fig. 37*

Pull out spacer and 5th assembly (41). *Fig. 38*

Remove needle roller cage (39).

Separate out spacer (40).

Remove snap ring (31a). *Fig. 39*

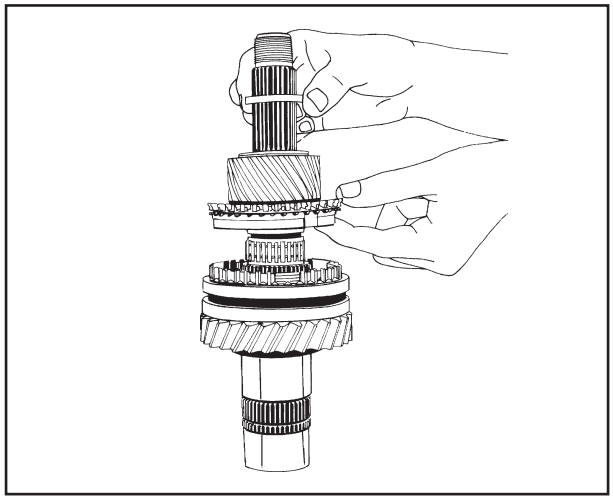


Fig. 38

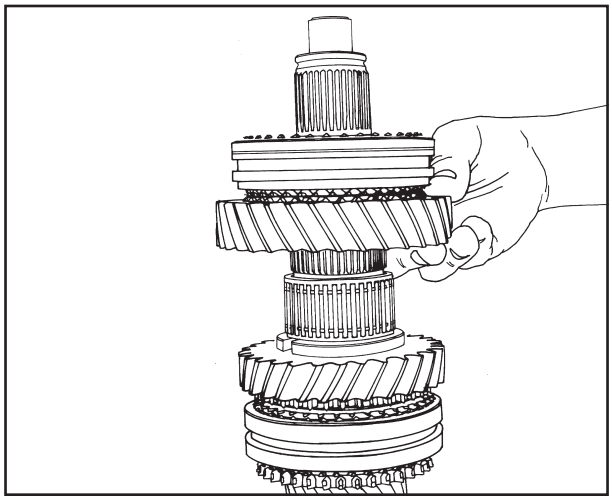


Fig. 36

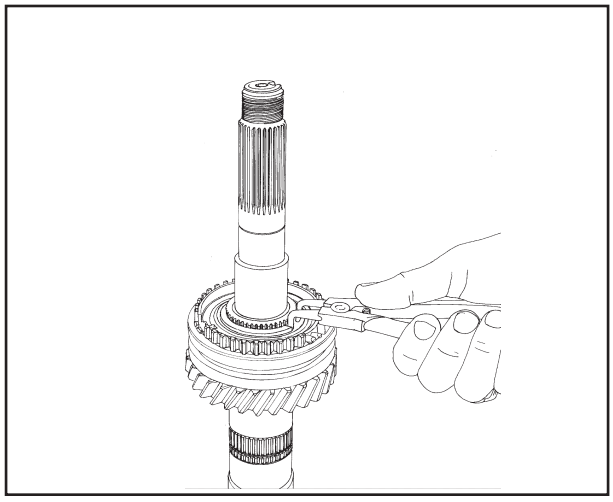


Fig. 39

Take out reverse gear assembly (37) along with Reverse/5th shifter sleeve and engaging gear.
Fig. 40

Remove needle roller cage (36a)

Gently separate out shifter sleeve from engaging gear and removing springs (19b) carriers (20b) and balls (21b)

Separate out synchro cones - Reverse (34a)

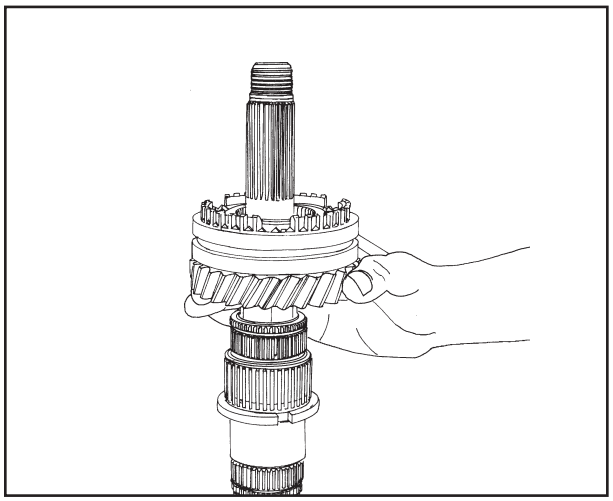


Fig. 40

DIS-ASSEMBLY OF COUNTER SHAFT
Refer fig. 41

Hold counter shaft (69) vertically such that 5th constant mesh gear (73) is downwards.

Pull out taper roller bearing inner race (71a) from shaft with the help of Puller Pt. no. 2654 5890 26 04.

Remove spacer (76) and circlip (75).

Reverse the shaft upside down. Pull out taper roller bearing inner race (71) from shaft with the help of Puller Pt.No. 2654 5890 26 04

Press out constant mesh 5th (73) and 3rd/4th gear (74) using hydraulic press and with proper support.

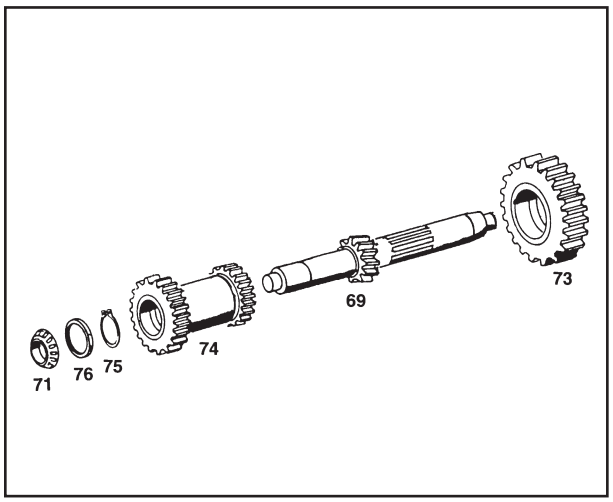


Fig. 41

DISASSEMBLY OF REVERSE IDLER GEAR SHAFT
Refer fig. 42

Remove snap ring (83)

Take out Reverse Idler gear (85) along with roller ring (84) from Reverse Idler gear shaft (82).

Remove other snap ring (83a)

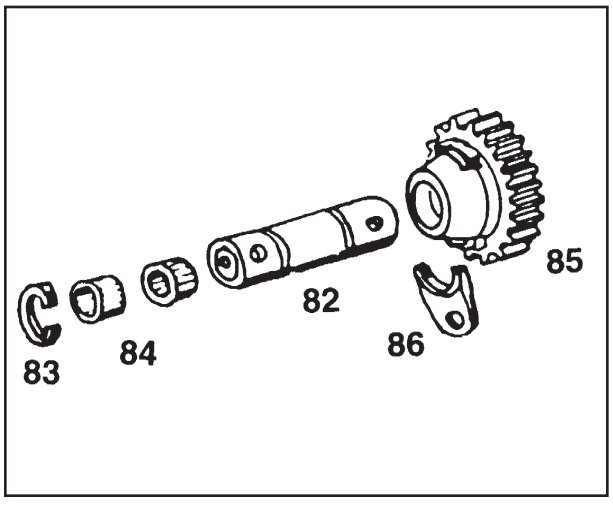


Fig. 42

DISASSEMBLY OF GEAR BOX HOUSING - REAR HALF

Loosen bearing block locking fit bolt (99) and remove bearing block (98). *Fig. 43*

Remove torsion spring (111) from selector lever pin (109) and take out torsion spring along with tubular spacer (110)

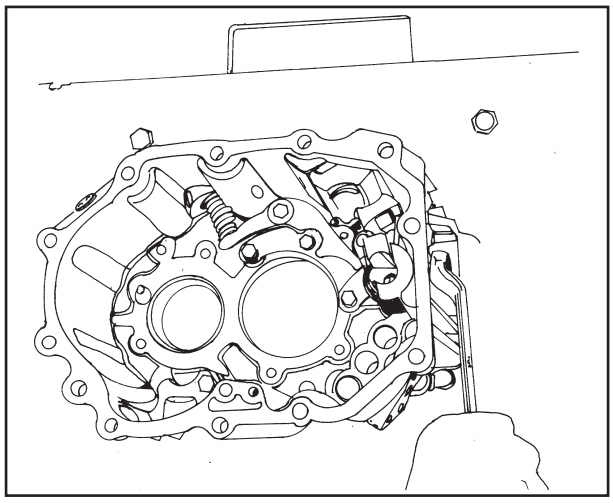


Fig. 43

Remove selector lever (108) along with roller (107) from housing. *Fig. 44*

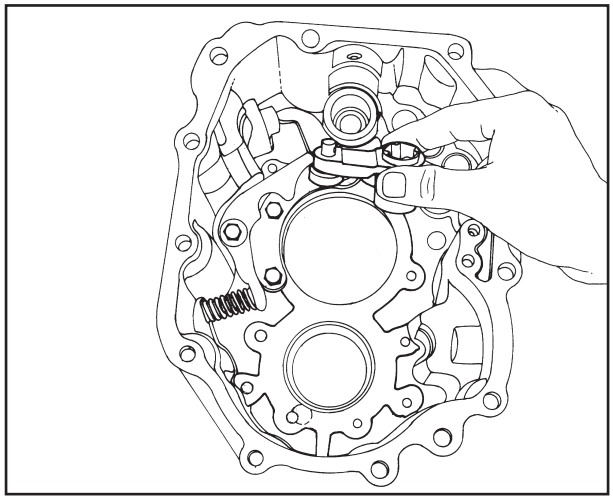


Fig. 44

Unscrew plug (135) and remove spring - Detent plate 5th gear (134). Unscrew plug (135a) and remove plunger - Reverse gear detent (137) along with spring (136). *Fig. 45 (only for 4 gate gear box)*

Unscrew mounting screws (130) and take out pressure plate - reverse speed (132) along with pressure plate 5th gear (133).

Loosen and remove Hex. screw (102) along with nut (105), spr. washer (104) and bright washer (103). Remove roller - detent plate (106), if required.

Disconnect pressure plate 5th gear from pressure plate - Rev. speed.

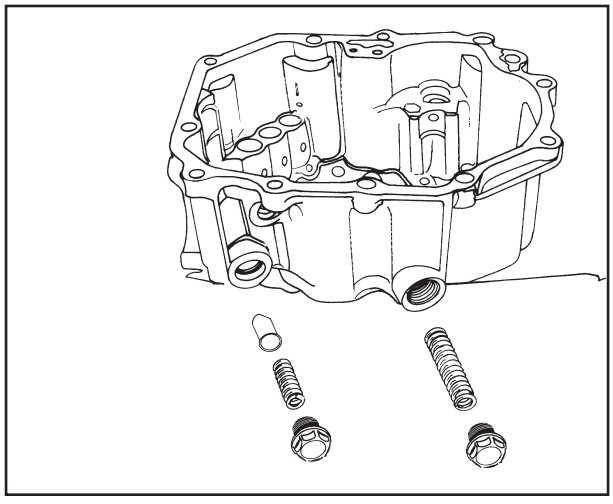


Fig. 45

DIS-ASSEMBLY OF GEAR CASE COVER-FRONT

Remove oil seal (3) with suitable punch. Press out dowel pins (12), if required.

DISASSEMBLY OF GEAR CASE COVER - REAR
Refer fig. 46

Remove main shaft oil seal (43) from assy. gear case cover rear (68) with suitable drift.

Unscrew and remove assy. threaded plug (50). Remove oil seal speedo shaft (51).

Pull out plug speedo drive (47). Press out shaft speedo drive (49) with suitable punch. Remove speedo drive gear (48).

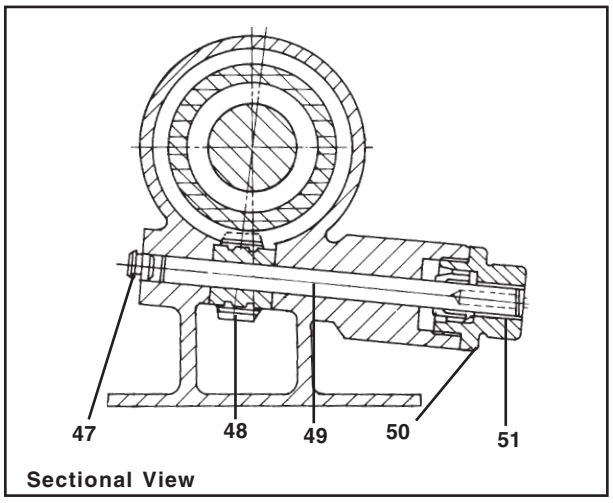


Fig. 46

INSPECTION

Inspect inside of synchro cone for wear

Inspect the synchro cone teeth and matching teeth on gear for wear (rounded off). *Fig. 47*

Inspect the gear hub thrust surface for wear.

Inspect the cone surface for wear on 1st, 2nd, 3rd, 4th & 5th mainshaft gear; countershaft gears.

Inspect the teeth on all gears for uneven wear, scoring, galling, cracks.

Place the synchro cone on matching gear cone and rotate until it stops (approx. 10 to 20 degrees), then measure the clearance between ring and gear. *Fig. 48*

Check for synchro cone gaps. It should be
1 $\pm$ 0.3 mm.

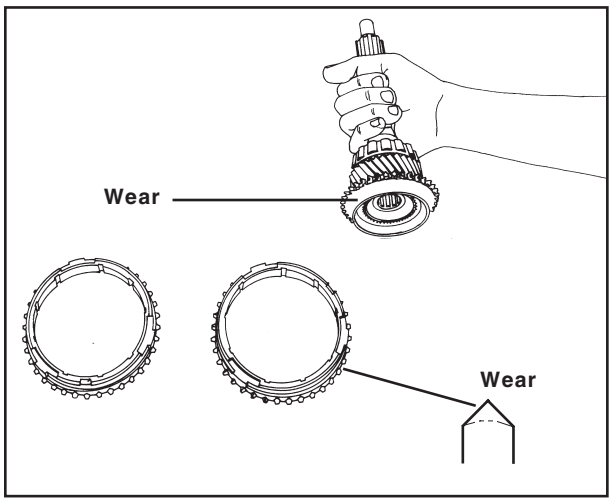


Fig. 47

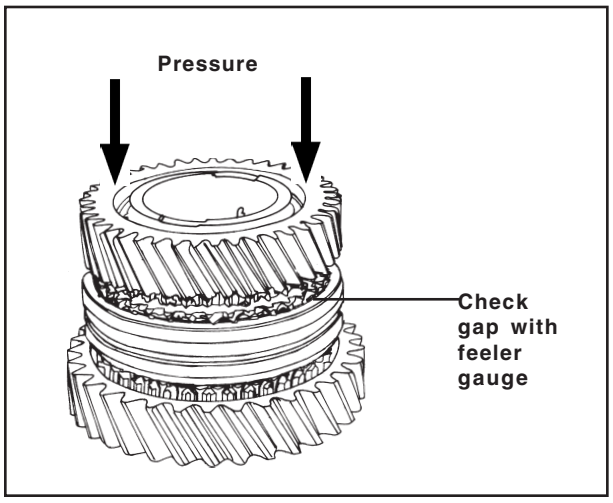


Fig. 48

Synchro Sleeve and Hub Inspection

Inspect the gear teeth on all synchro hubs and sleeves for rounded off corners, indicating wear.

Install each hub in its mating sleeve and check for free movement.

Note :If replacement is required, always replace the synchro sleeve and hub as a unit.

ASSEMBLY OF SUB - ASSEMBLIES

GENERAL INSTRUCTIONS

The chips collected by the magnetic drain plug must be removed at every oil change.

Clean all the parts thoroughly to be assembled.

CHECK

- Shafts for scoring or grooving and spline wear

- Gears for chipped teeth

- Bushes for wear and cracks

- Bearings for wear and cracks by spinning them. If they shake or rattle then they must be replaced.

Change all worn out and damaged parts.

Maintain proper cleanliness while assembling bearings and oil seals to avoid premature failures.

Lubricate the shaft and seat before assembling oil seals or fitting bearings.

Do not interchange inner and outer races of taper roller bearings.

Oil seals and gaskets should be changed at the time of overhaul.

Pay attention to the direction of the oil seal and insert all the way after applying oil to the lips.

Do not reuse dowel sleeve and nyloc nut. Always replace them with NEW one.

Circlip/snap ring should not have axial play.

Use sealing compound MAXIFIX S-758 DUNLOP or DURAPLEX 120 for sealing plugs and screws.

Use adhesive ANARBOLIC medium duty for fasteners.

Use Grease 3% MO S2 320 for metal/plastic parts.

Use Grease silicon mollycote medium-33 between metal/rubber parts.

Synchro cone gap is to be checked. It should be 1 ± 0.3 mm. If found less or if the threads are found to be damaged, replace synchro cone.

Spin the shaft to see the gears are running smoothly.

Engaging gear should be free from play.

IDENTIFICATION PARAMETERS

ENGAGING GEARS *Refer fig. 49*

There is a common engaging gear for 1st/2nd (32) and Reverse/5th (32a) application. However, it has unsymmetrical shank.

Engaging gear for 3rd/4th (22) has symmetrical shank.

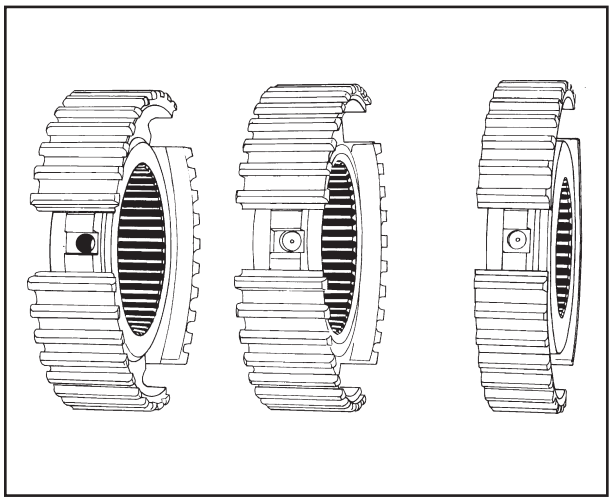


Fig. 49

SYNCHRO CONES *Refer fig. 50*

There are three types of synchro cones.

1st/Reverse synchro cone (34)/(34a) is bigger in diameter and having slender dog teeth.

2nd/5th synchro cone (30)/(30a) is also bigger in diameter but having thicker dog teeth.

3rd/4th (17)/(17a) synchrocone is smaller in diameter and having depressions on minor diameter side face.

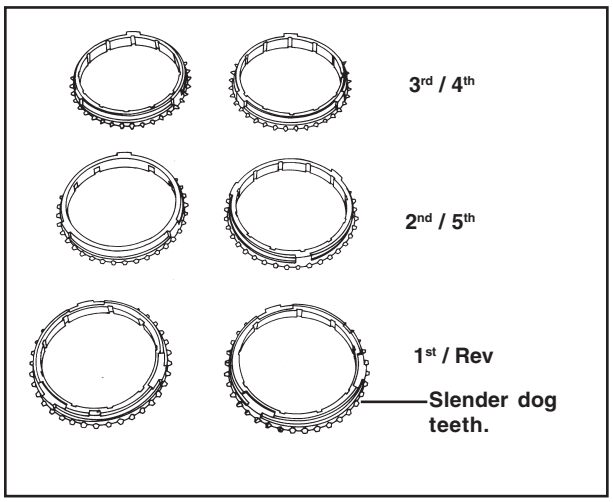


Fig. 50

SHIFTER SLEEVES *Refer fig. 51*

There are three types of shifter sleeves.

3rd/4th shifter sleeve (18) is without any groove on its outer diameter.

1st/2nd shifter sleeve (33) is with one groove on its outer diameter.

Reverse/5th shifter sleeve (38) is having two grooves on its outer diameter.

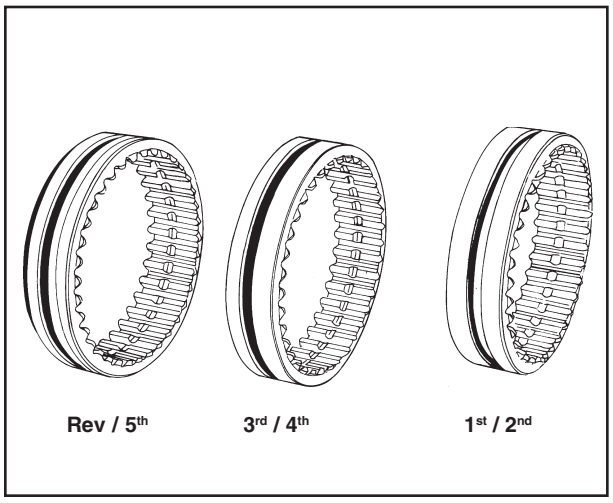


Fig. 51

SHIFTER FORKS *Refer fig. 52*

There are three types of shifter forks.

1st/2nd shifter fork has the engaging collar at the centre.

3rd/4th shifter fork has step collar and ribs supporting the engaging collar. Rev./5th shifter fork has the installing hole in the centre.

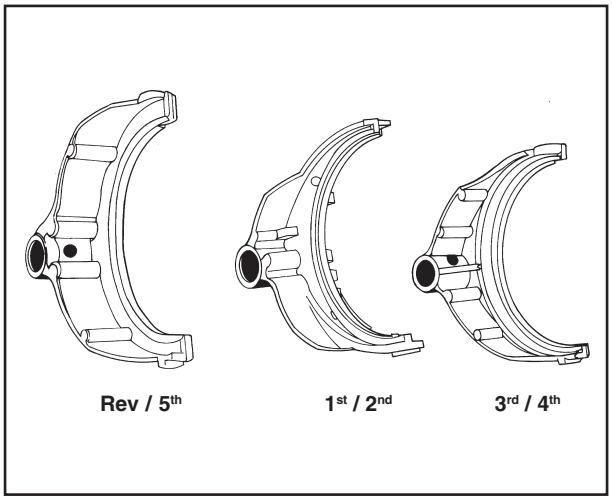


Fig. 52

SHIFTER SHAFTS *Refer fig. 53*

1st / 2nd shifter shaft has two installation holes.

3rd / 4th shifter shaft has inter locking pin in the groove cut at the bottom.

Rev. / 5th shifter shaft has the installing hole near the notch.

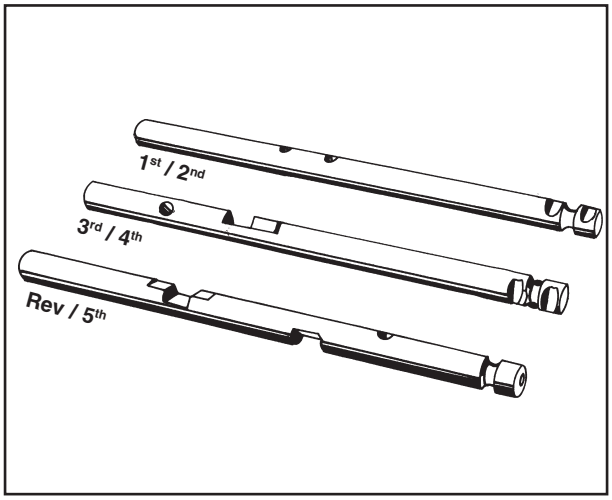


Fig. 53

SUB ASSEMBLY OF ENGAGING GEARS
Refer fig. 54, 55 & 56

Identify all the gears and needle bearing cages. The gears are to be assembled in pairs of 1st/2nd, 3rd/4th and Reverse/5th

Keep gear such that dog teeth are facing upwards.

Fit proper synchro cone. Fit proper engaging gear over synchro cone, Fit other pair of gears.

Note : While assembling 1st/2nd engaging gear the longer shank to be on 2nd gear side. In the same way for Reverse/5th engaging gear, the longer shank to be assembled towards reverse gear.

Locate 3 Nos. carriers in slot of engaging gear such that chamfer over carrier is facing outwards. Place springs & balls at seat of carrier with help of grease.

Assemble proper shifter sleeve over engaging gear, pressing all the balls simultaneously.

Note : While assembling 3rd/4th gear, the shifter sleeve (18) without groove to be fitted with broader side towards 3rd gear.

While assembling 1st/2nd gear, **single groove side of shifter sleeve (33) is to be assembled towards 2nd gear.**

In Reverse/5th gear assembly, **fit double groove side of shifter sleeve (38) towards reverse gear.**

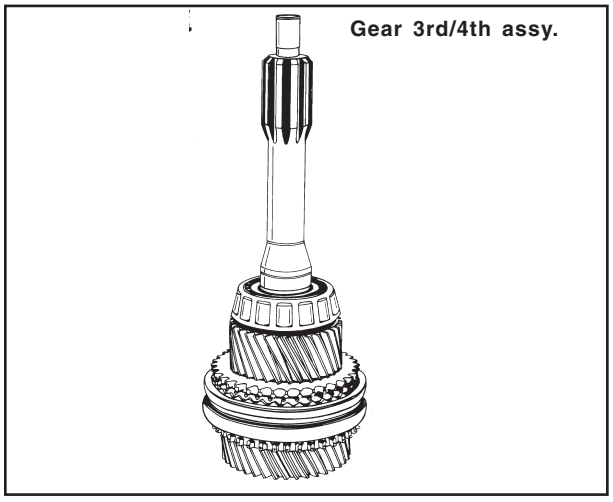


Fig. 54

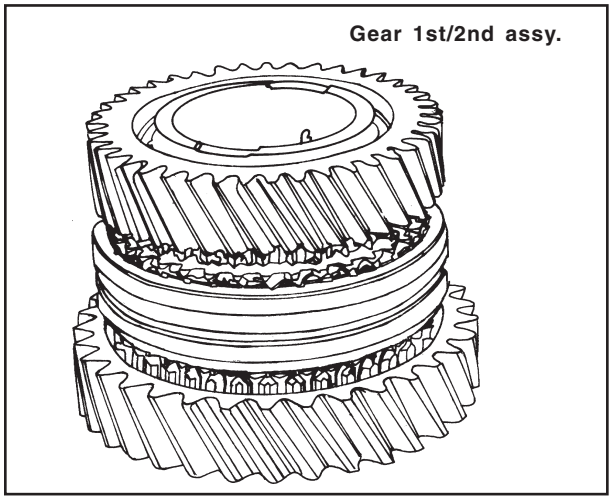


Fig. 55

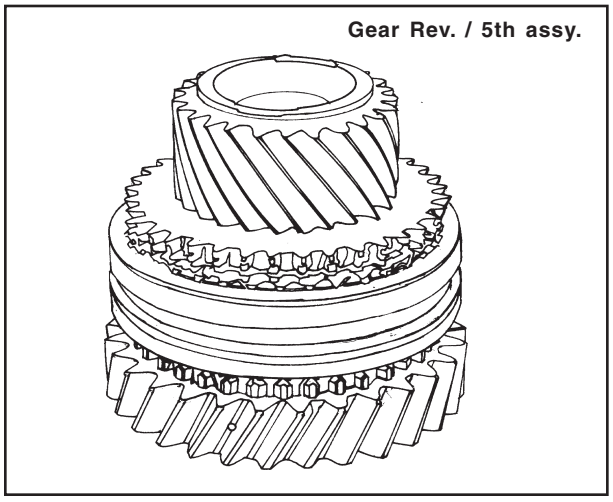


Fig. 56

SUB ASSEMBLY OF MAIN SHAFT

Hold the main shaft (41) vertically keeping the coupling flange end upwards.

Slide reverse gear sub-assembly (37) on main shaft along with needle roller cage (36a) and engaging gear (32a) keeping engaging gear upwards. *Fig. 57*

Fit snap ring (31a) Select snap ring such that it is snug fit in the groove. Snap rings are available in thicknesses ranging from 1.7 to 2 mm in the step of 0.05 mm. Fig. *58*

Slide the 5th gear sub-assembly (41) along with the needle roller cage (39) and synchro cone (30a) such that the synchro cone is towards engaging gear. *Fig. 59*

Slide spacer (40)

Press taper roller bearing inner race (11a) with help of drift, Pt.no.2654 5890 26 05 such that taper is upwards. Ensure that bearing inner race is butting against spacer. *Fig. 60*

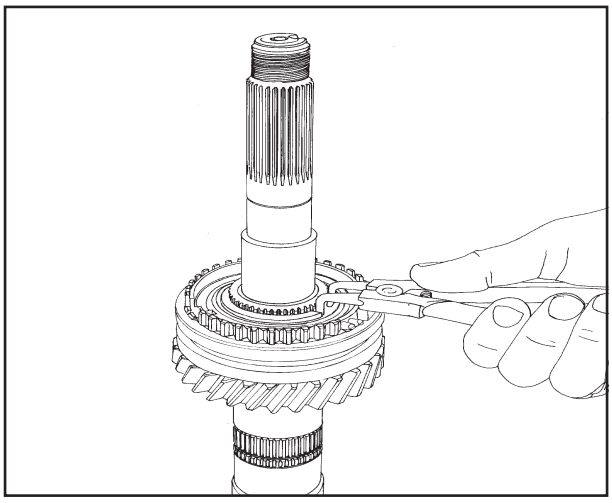


Fig. 58

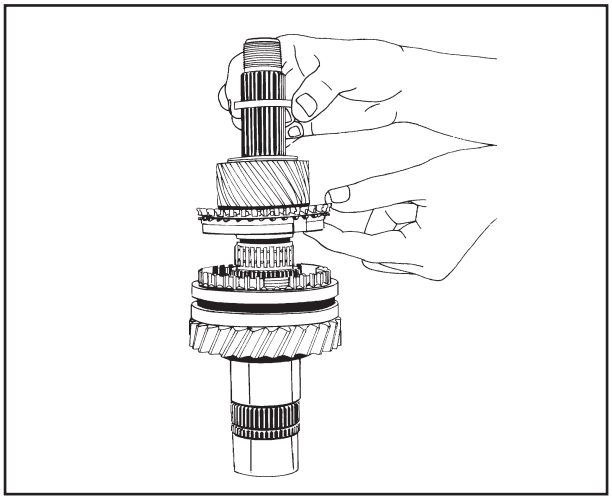


Fig. 59

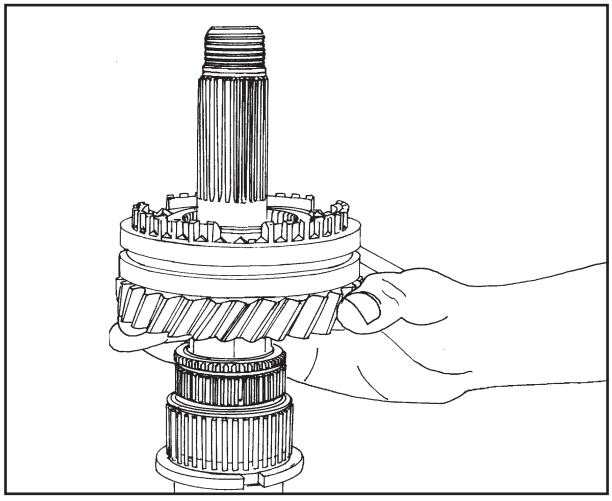


Fig. 57

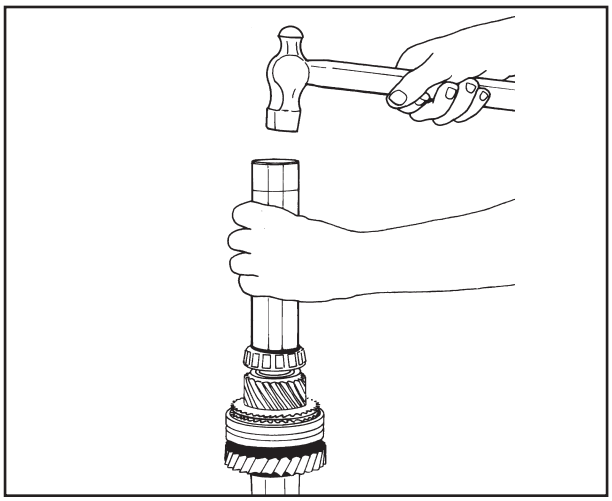


Fig. 60

Hold the main shaft vertically in coupling flange with up side down.

Slide the 1st gear sub-assembly (35) along with the needle roller cage (36) and engaging gear 1st/2nd (32) over main shaft such that engaging gear is upwards. *Fig. 61*

Select suitable snap ring (31) and fit it over main shaft groove. Snap rings are available in the thickness ranging from 1.7 to 2 mm in the step of 0.05 mm. *Fig. 62*

Slide the 2nd gear sub-assembly (29) over main shaft along with the needle roller cage (24a) and synchro cone (30) such that synchro cone facing downwards. *Fig. 63*

Locate 3 mm Dia. locking ball (26) at seat on main shaft with help of grease. Slide spacer (27), aligning notch with the locking ball. Ensure that oil pocket over the spacer is facing upwards i.e. towards 3rd gear. *Fig. 64*

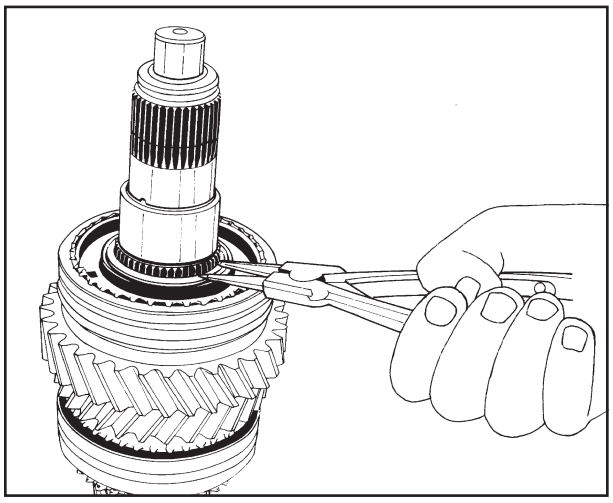


Fig. 62

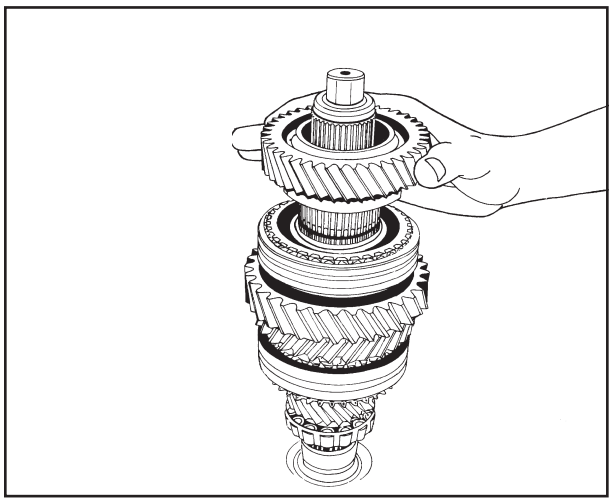


Fig. 63

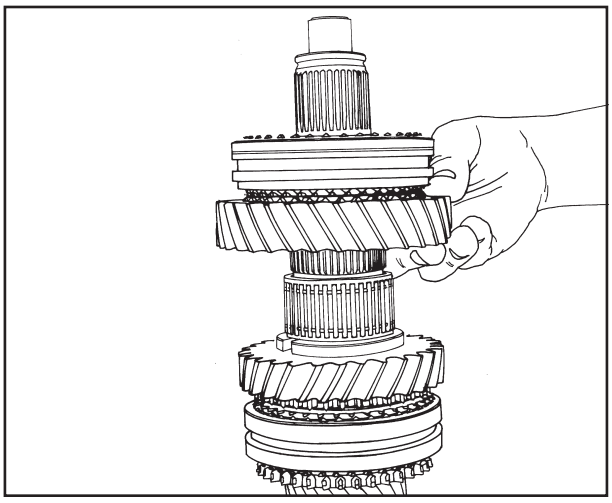


Fig. 61

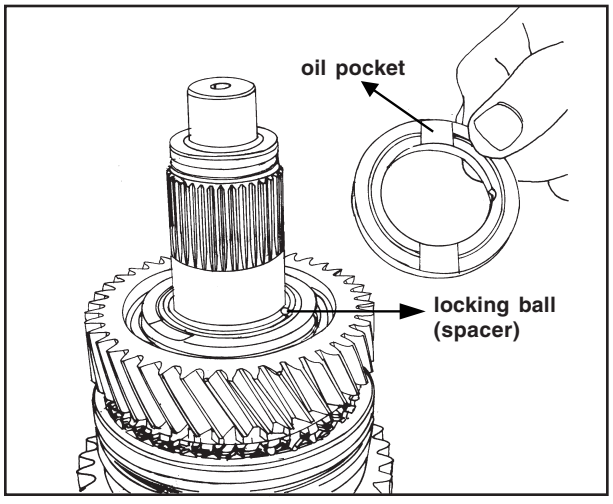


Fig. 64

Push the bush (25) with the help of drift, Pt.No. 2654 5890 35 11. *Fig. 65*

Note : The spacer has to be heated to 100 to 120 degree Centigrade before assembly.

Slide 3rd gear sub-assembly (23) along with the needle roller cage (24) and engaging gear 3rd/4th (22) over main shaft keeping engaging gear upwards. *Fig. 66*

Slide spacer ring (16) over main shaft. Fig. *67*

Select suitable snap ring (15), which will fit snugly. Snap rings are available from 2.0 to 2.4 mm in the step of 0.1 mm. *Fig. 68*

Measure the dimensions for the selection of shims. (As per procedure mentioned).

Shims (10/10a) are available in thickness of 0.05, 0.125, 0.240 & 0.5 mm.

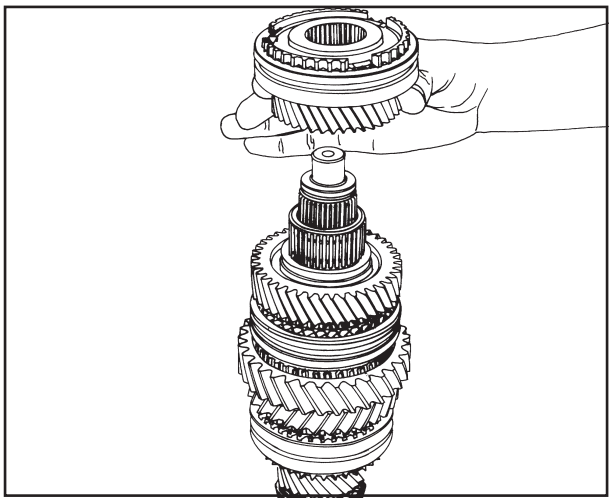


Fig. 66

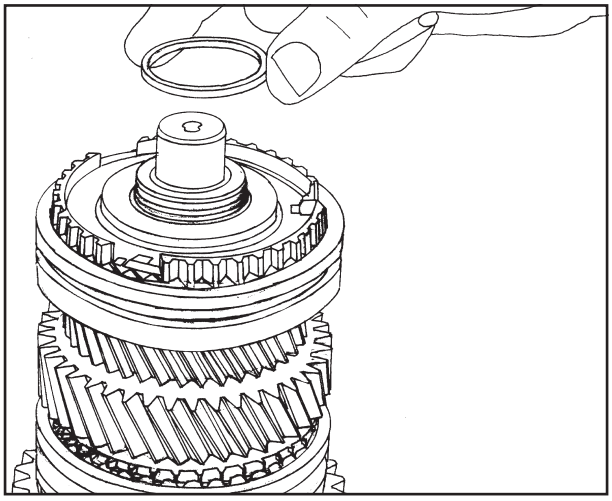


Fig. 67

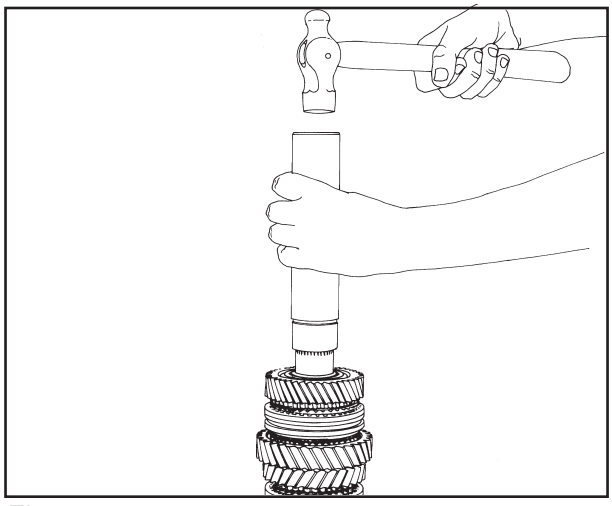


Fig. 65

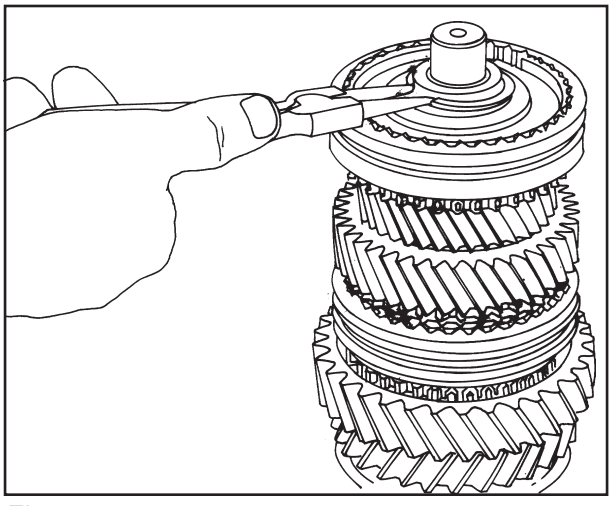


Fig. 68

SUB ASSEMBLY OF COUNTER SHAFT
Refer fig. 69

Heat the constant mesh 3rd/4th gear (74) to 100-120 deg.C and press over counter shaft (69) with proper support in such a way that bigger gear i.e. 4th is facing upward. Fit circlip (75).

In the same way fit 5th gear (73) over other side such that longer boss is facing upwards. Ensure proper abutment of gear on the counter shaft.

Press inner race of taper roller bearing (71) over counter shaft 5th gear side end with help of drift, Pt.No. 2654 5890 26 06 and handle Pt.No. 2640 5890 35 11. Place outer race over it.

Reverse the assembly, slide spacer (76) and press another taper roller bearing inner race (71a). Place outer race over it.

SUB ASSEMBLY OF DRIVE SHAFT

Press inner race of taper roller bearing (11) with the help of drift Pt.No. 2654 5890 26 05. *Fig. 70*

Fit compression spring (4), spacer (5) of required thickness, thrust bearing (6) and roller cage (7) in drive shaft bore. *Fig. 71*

Select spacer thickness as per procedure given.

SUB ASSEMBLY OF REVERSE IDLER GEAR SHAFT *Refer fig. 72*

Fit snap ring (83a) over R.I. gear shaft (82).

Slide roller ring (84) along with R.I. gear (85) over shaft. Fit another snap ring (83).

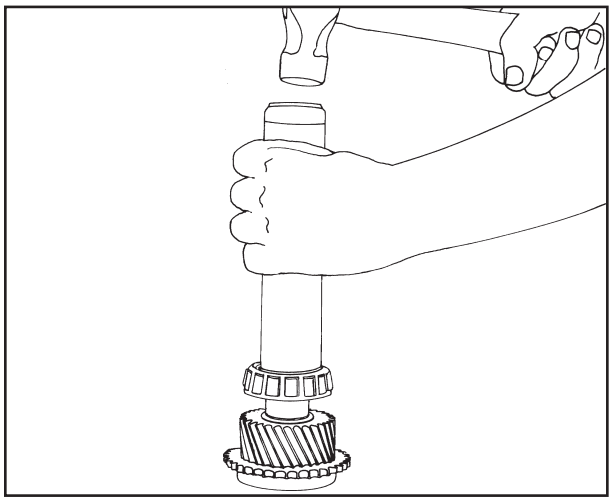


Fig. 70

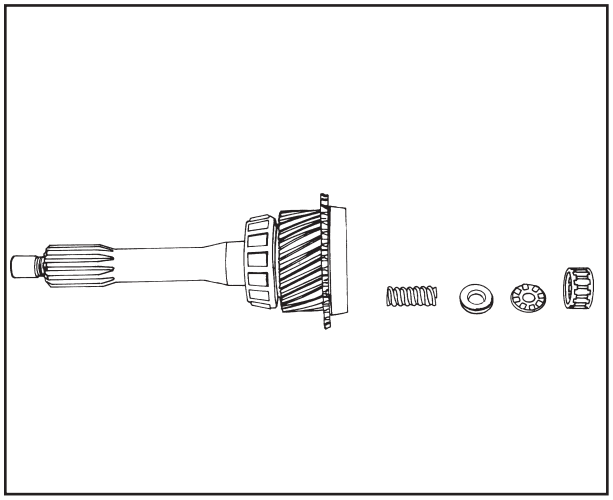


Fig. 71

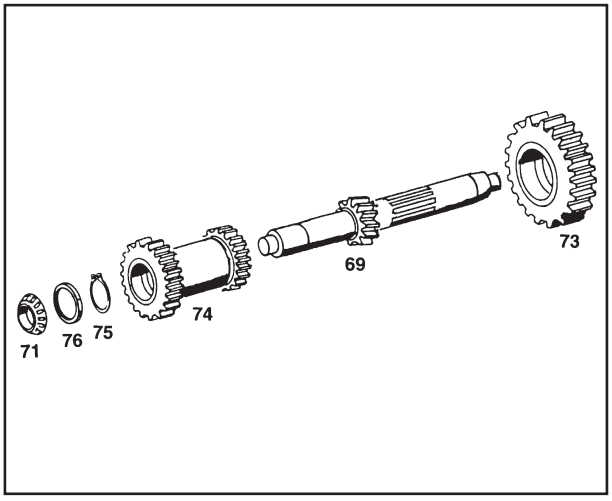


Fig. 69

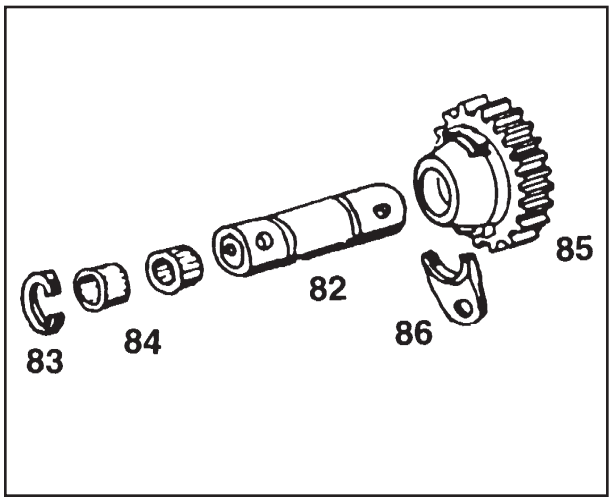


Fig. 72

MEASUREMENT OF CONTROL DIMENSIONS (FOR SELECTION OF SHIMS)

OVER THE COUNTER SHAFT

The control dimension to be maintained between Counter Shaft 3rd gear rear face and housing face-Rear half.		198 ± 0.1mm	
1.0	**Dimensions to be measured**	**Symbol**	**Example**
1.1	Measure the dimension between Counter Shaft 3rd gear rear face and taper roller bearing outer race face. *Fig. 76 and 77*	A	200.00
1.2	Measure the rear cover depth. *Fig. 73 and 76*	B	2.30
1.3	Difference A-B	C	197.70
1.4	Shims required : 198 - C	D	0.30

OVER THE MAIN SHAFT

The control dimension to be maintained between Main Shaft 2nd gear shoulder face front and housing face - Rear half		197±0.1mm	
2.0	**Dimensions to be measured**	**Symbol**	**Example**
2.1	Measure the dimension between Main Shaft 2nd gear shoulder face front and taper roller bearing outer race face *Fig. 75 and 76*	E	202.00
2.2	Measure the rear cover depth *Fig. 74 and 76*	F	5.50
2.3	Difference E - F	G	196.50
2.4	Shims required 197 - G	H	0.50

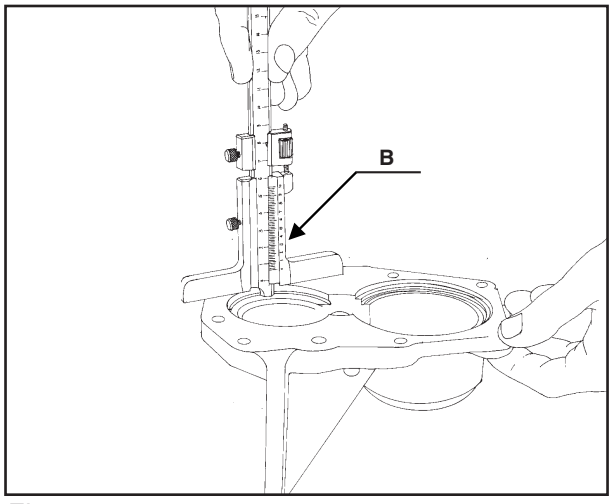


Fig. 73

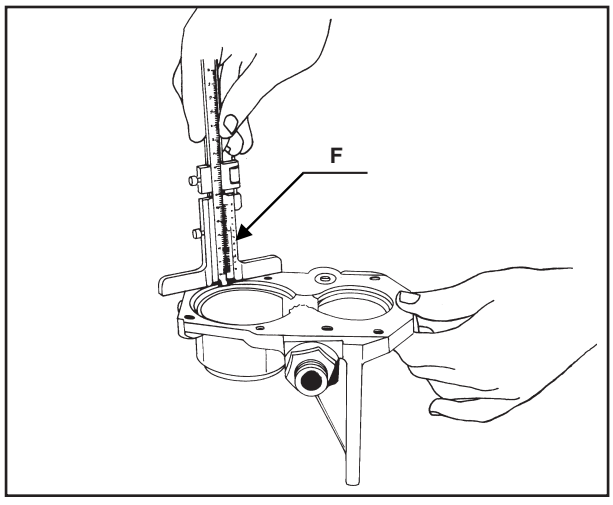


Fig. 74

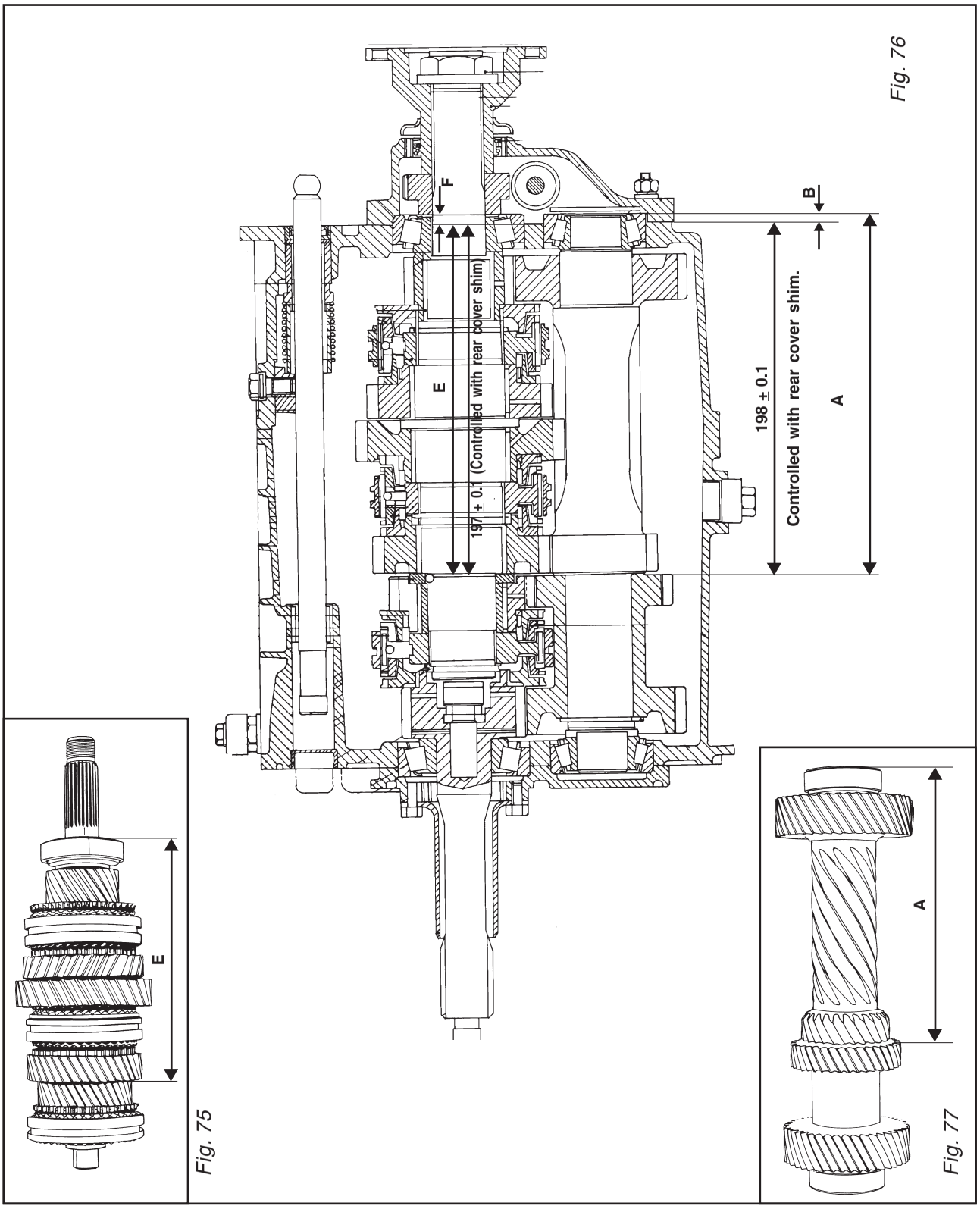


Fig. 76

Fig. 75

Fig. 77

OVER THE DRIVE SHAFT

During measurement, remove compression spring (4). Check for the spacer of measured thickness, thrust bearing and needle roller cage in drive shaft bore. Place drive shaft assembly over main shaft assembly.

The control dimension to be maintained between Drive Shaft synchro ring front face to engaging gear 3rd/4th shoulder face		11.1 ± 0.1 mm	
3.0	**Dimensions to be measured.**	**Symbol**	**Example**
3.1	Place Drive Shaft over Main Shaft Assy. with spacer of measured thickness	I	4.50
3.2	Measure the dimension between engaging gear 3rd/4th shoulder face to Taper Roller bearing outer race face on main shaft *Fig.78 and 79*	J	252.00
3.3	Measure the dimension between Drive Shaft synchro ring front face to Taper Roller bearing outer race face on main shaft *Fig.78 and 79*	K	262.80
3.4	Difference K-J	L	10.80
3.5	Incremental spacer thickness required 11.1-10.8	M	0.50
3.6	Spacer thickness required 4.50 + M	N	5.00

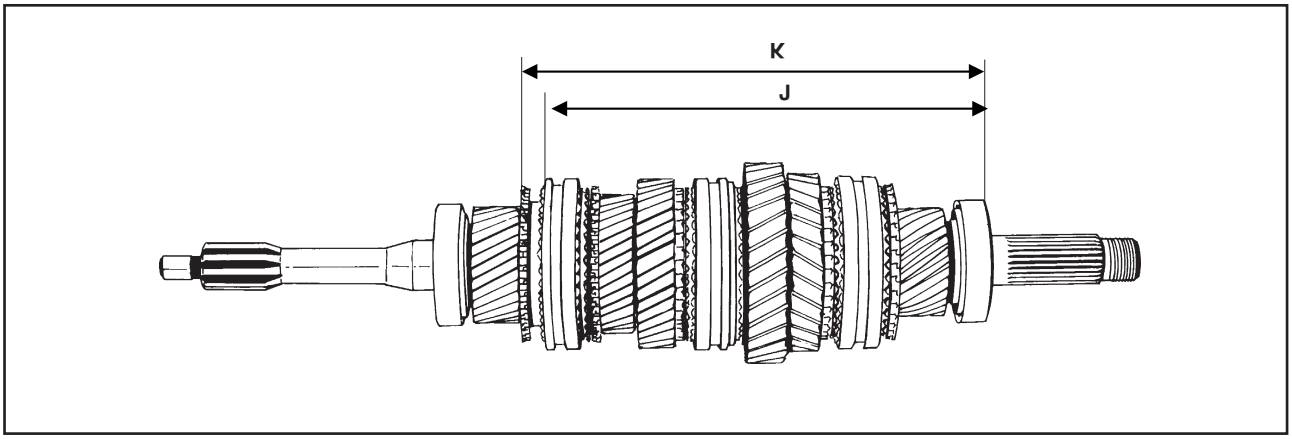
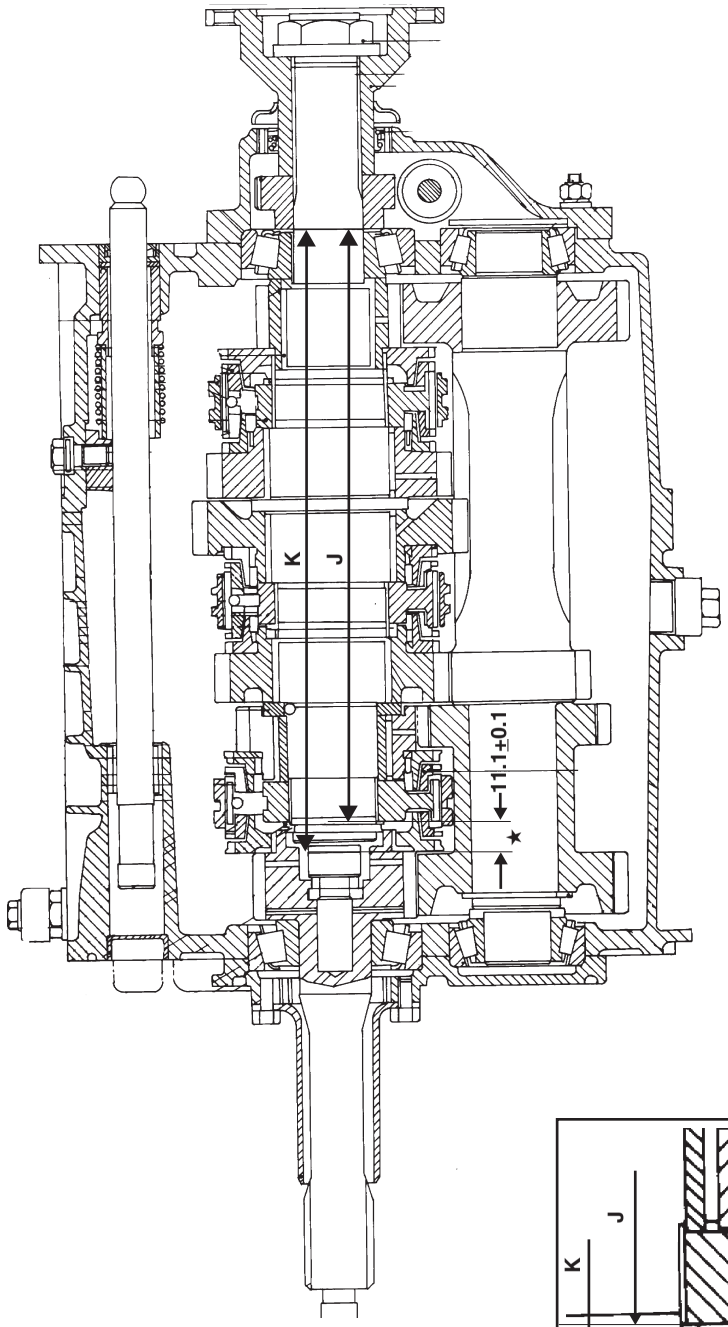


Fig. 78



★ Controlled with thrust bearing spacer

Fig. 79

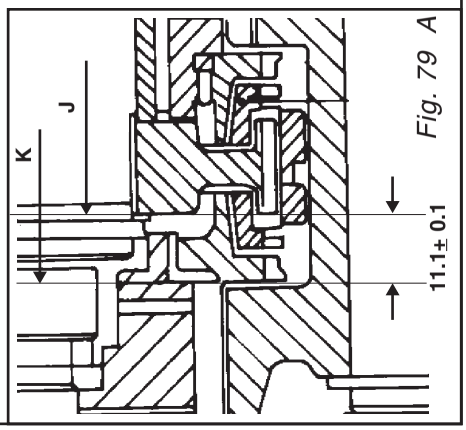


Fig. 79 A

DRIVE SHAFT SHIM SELECTION AT FRONT COVER

Assemble the gear box without compression spring (4) and without Front Cover.			
4.0	**Dimensions to be measured**	**Symbol**	**Example**
4.1	Measure the Front Cover depth along with the gasket *Fig. 80 and 83*	P	5.75
4.2	Measure drive shaft bearing projection over housing face *Fig. 83*	Q	5.50
4.3	Difference P-Q	R	0.25
4.4	Shims required (Maintain end play of 0.05 to 0.15 mm)	S	0.15

Fit Front Cover with shims 'S' and check axial play at coupling flange. The play must be with in 0.07 to 0.10 mm. Change shims if required, to get required play. Remove Front half and re-assemble compression spring.

COUNTER SHAFT SHIM SELECTION AT FRONT COVER

Assemble the gear box without compression spring and without Front Cover			
5.0	**Dimensions to be measured**	**Symbol**	**Example**
5.1	Measure Front Cover depth along with the gasket *Fig. 81 and 83*	T	4.75
5.2	Measure counter shaft bearing projection over housing face *Fig. 83*	U	4.50
5.3	Difference T-U	V	0.25
5.4	Shims required (Maintain pre-load of 0.00 to 0.03 mm) V+0.03	W	0.28

Fit compression spring and Front cover with shims 'W' and check for free rotation.

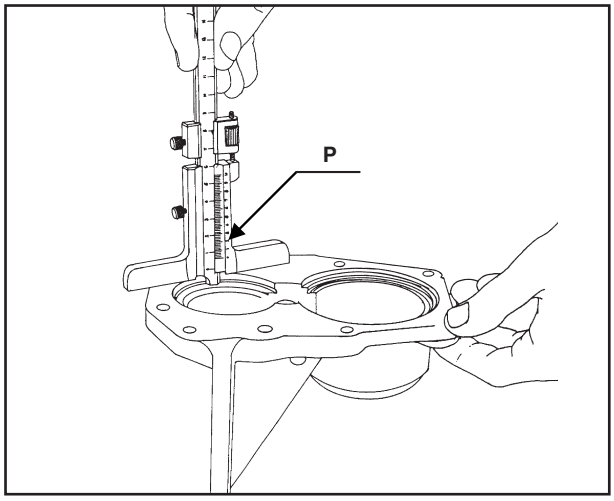


Fig. 80

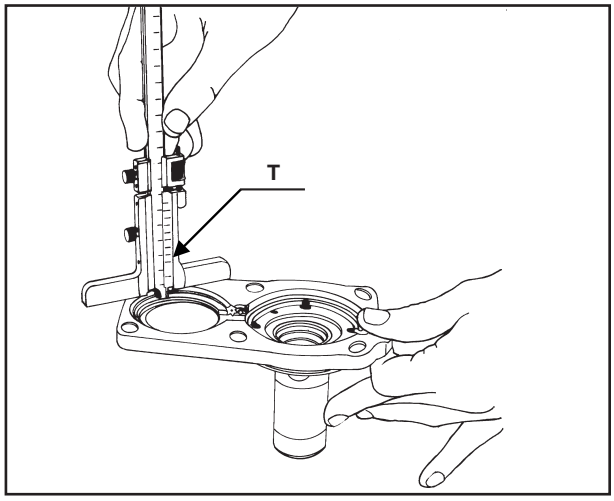


Fig. 81

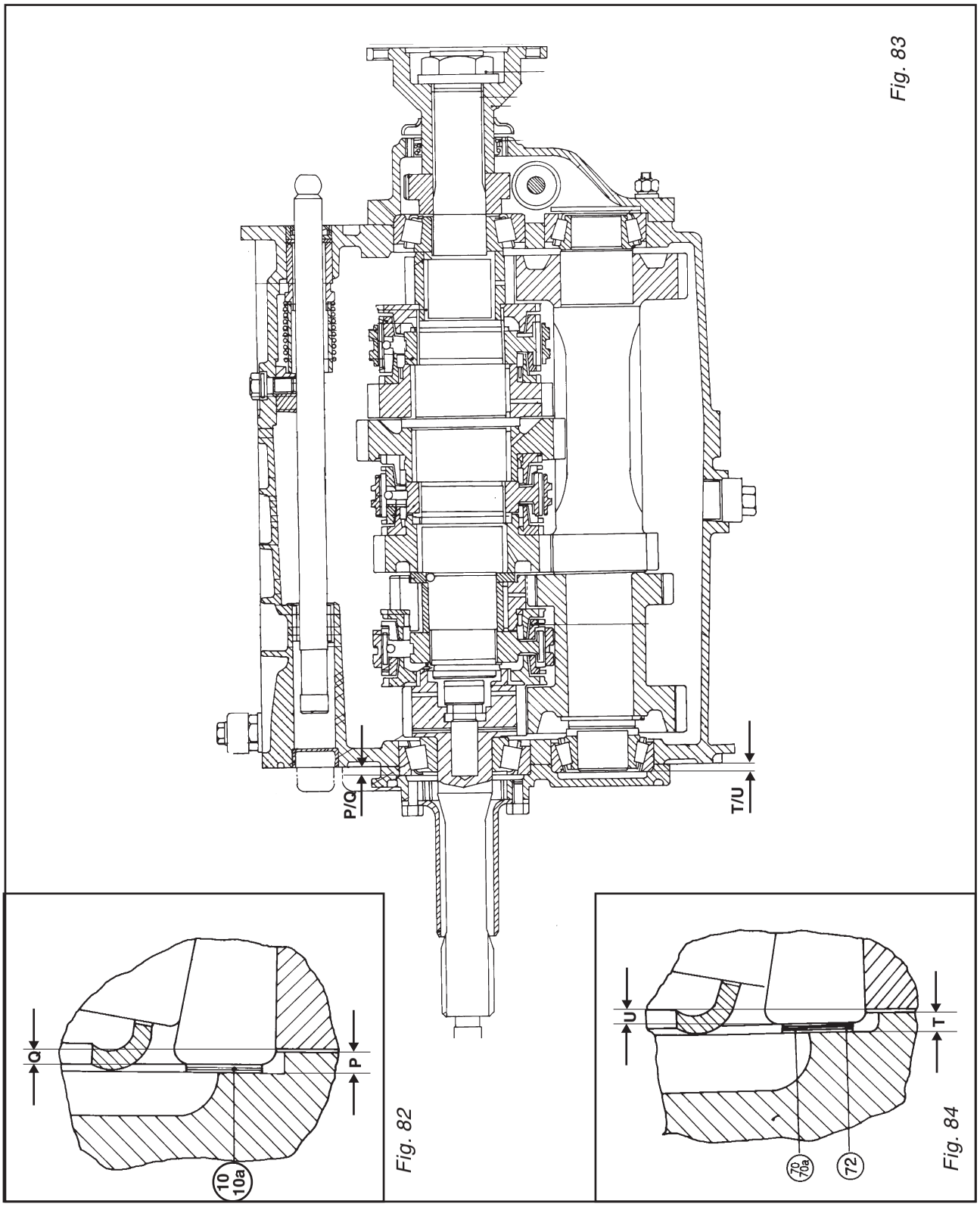


Fig. 83

Fig. 82

Fig. 84

SUB ASSEMBLY OF GEAR BOX HOUSING COVER FRONT

Press dowel pins (12) to bearing tube, if removed earlier. Fit bearing tube to the cover.

Push in oil seal (3) with help of drift Pt.No. 2654 5890 26 07 and handle Pt.No. 2640 5890 35 11. *Fig. 85*

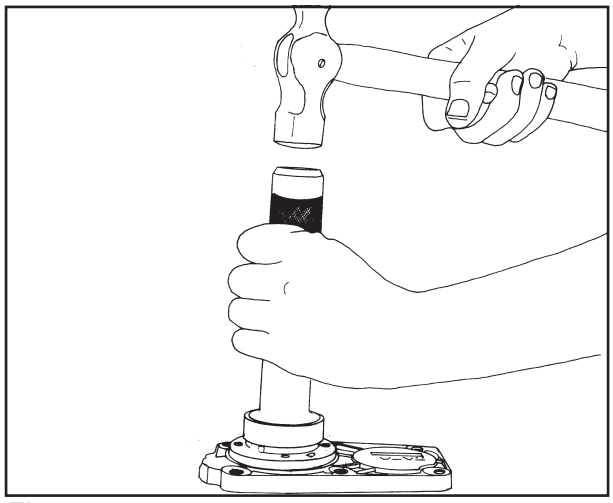


Fig. 85

SUB ASSEMBLY OF GEAR CASE COVER REAR
Refer fig. 86&87

Fit oil seal (43) with the help of drift, Pt.No. 2654 5890 26 07 and handle 2640 5890 35 11.

Fill 3% grease Mo S2 320 in the pocket between main lip and dust lip of oil seal.

Keep speedo drive gear (48) inside the cavity then push in speedo shaft (49) such that cable end goes towards tapped hole side.

Fit oil seal - speedo shaft (51) in the threaded plug - speedo shaft (50) keeping lip side outwards. Tighten plug in the housing.

Press plug - speedo drive (47) in housing from other side. Ensure gap of 1 mm between plug face to speedo shaft end.

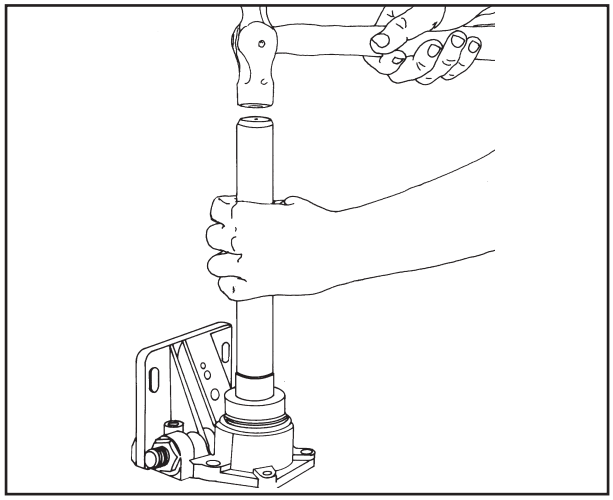


Fig. 86

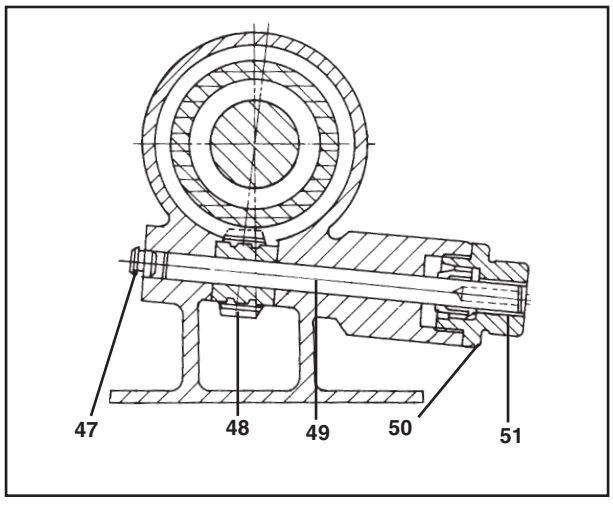


Fig. 87

Fit locating piece reverse shifter shaft (128) in the housing with the help of socket head cap screw (126) and spring washer (127) such that it sits properly. *Fig. 88*

Fit spacer (115) and oil seal (116) in housing before shifter and selector shaft. Ensure proper direction of oil seal lip. *Fig. 89*

ASSEMBLY OF SHIFTER AND SELECTOR SHAFTS
Refer fig. 90

There are three shifter shafts, one selector shaft and one shifter shaft for reverse speed.

Assembly of 1st/2nd shifter shaft

This shaft (119) is having two Nos. holes for spiral pins approximately at the centre of the shaft.

Hold shaft horizontally keeping notch upward and towards yourself.

Slide shifter dog 1st/2nd (122) over shifter shaft from other end such that shaft relieving radius is at top and towards right side.

Align shifter dog with outer hole of shaft and press spiral pin (124).

Select shifter fork 1st/2nd (121) which is having engaging collar at centre and slide over shaft. Align it with shaft hole and press spiral pin (124)

Assembly of Reverse / 5th shifter shaft.

This shaft (117) is having hole nearer to notch. Corresponding shifter fork (120) is almost symmetrical and there is no step in the collar at the flange.

Slide shifter fork on shaft such that engaging collar is facing outwards. Fit spiral pin (124).

Note : Assembly of 3rd/4th shifter shaft (118) which is having through hole in notch for inter locking pin, to be done at the time of final assembly.

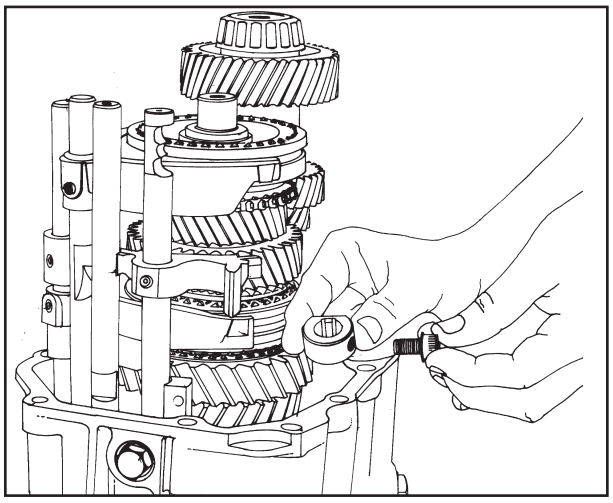


Fig. 88

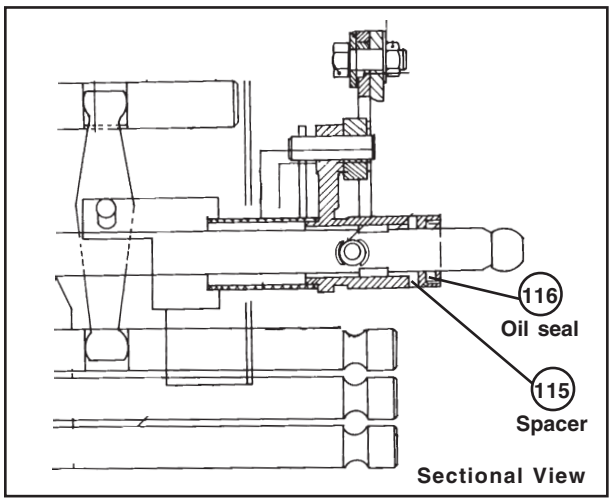


Fig. 89 (For 4 gate shifting gear box)

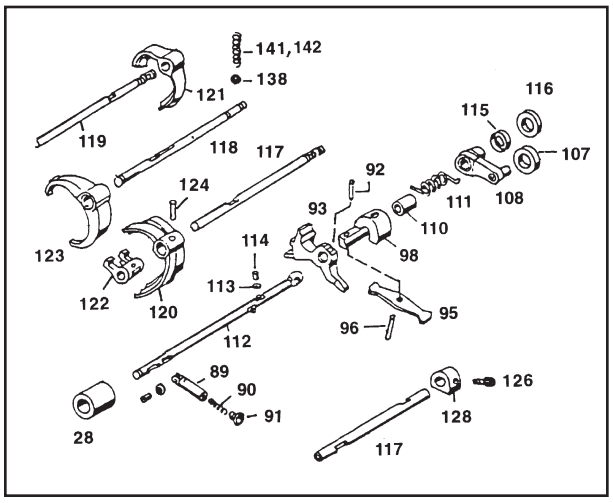


Fig. 90

SUB ASSEMBLY OF GEAR BOX HOUSING - REAR HALF *Refer fig. 91*

Mount gear box housing - rear (80) on the work stand. Check for all mounting studs.

Fit roller - detent plate (106) in pressure plate 5th gear (133), if removed earlier.

Fit pressure plate 5th gear above pressure plate - Reverse speed (132). Fit hex. screw (102), bright washer (103), spr. washer (104) and nut (105).

Fit pressure plate Reverse speed in the housing - rear. Tighten hex. screw (130) with spr. washer (131)

Fit main shaft and counter shaft bearing outer races in the housing half.

Assemble plunger Reverse gear detent (137) along with spring (136) in the housing **such that its taper face is towards roller.** Tighten threaded plug (135). Ensure correct orientation of detent.

Assemble spring - detent plate 5th gear (134) and tighten threaded plug (135a) *Fig. 92*

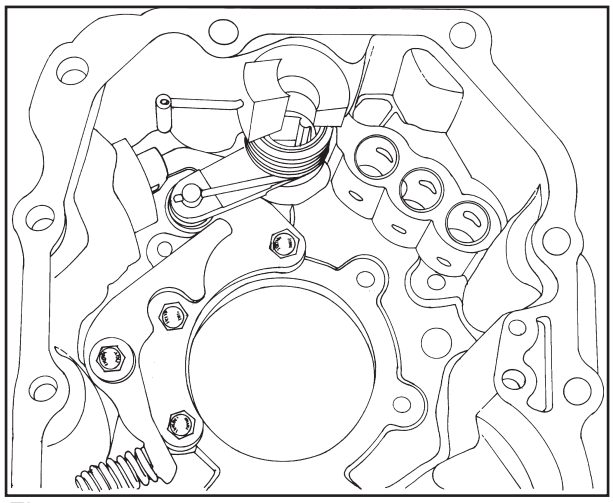


Fig. 91

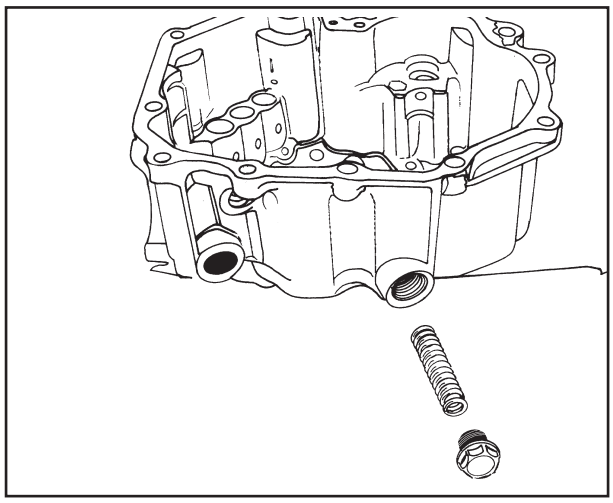


Fig. 92

Fit assy. selector lever (108) along with roller selector lever (107)

Locate straight end of torsion spring (111) in the hole of selector lever pin and place tubular spacer (110) in the torsion spring.

Locate bearing block (98) over torsion spring and tighten hex bolt (99) along with bright washer (101) and spring washer (100) in the housing. *Fig. 93*

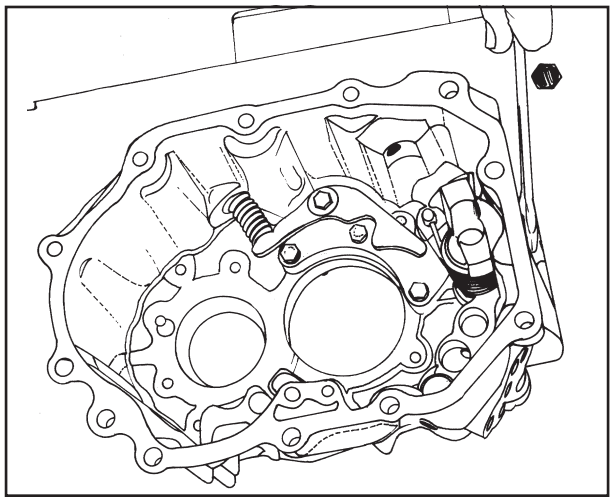


Fig. 93

ASSEMBLY OF GEAR BOX

Place shifter fork assembly 1st/2nd and Reverse/5th over main shaft assembly at its proper place, keeping notches towards coupling flanges side.

Place shifter fork 3rd/4th (123) alone without shaft at its place over main shaft sleeve such that its collar is facing outwards.

Keep counter shaft assembly aligned with main shaft.

Insert two Nos. ball (138a) in holes of shifter shaft bore in housing. Use grease for keeping them in position. *Fig. 94*

Hold and place main shaft assembly along with counter shaft assembly and shifter fork assembly in position in the housing - Rear. *Fig. 95*

While inserting shifter shafts in the housing, **ensure that interlocking balls are not displaced.**

Fit interlock pin - 12.8 mm length (146) in shifter shaft 3rd/4th (118). Insert shaft through the shifter fork. Align shaft with hole of fork and then press spiral pin (124). *Fig. 96*

Place 3 Nos. ball - 8 mm dia. (138) and detent spring in holes of housing. Detent spring (142) is to lock 1st/ 2nd & 3rd/4th shifter shafts where as short and stiff detent spring (141) is to be used for Reverse/5th shifter shaft. *Fig. 97*

Fix gasket (139) to detent cover (140) and tighten hex. screws (144) along with spr. washer (145). Fit rollers 4 Nos. (113) over pins (114) of selector shaft (112).

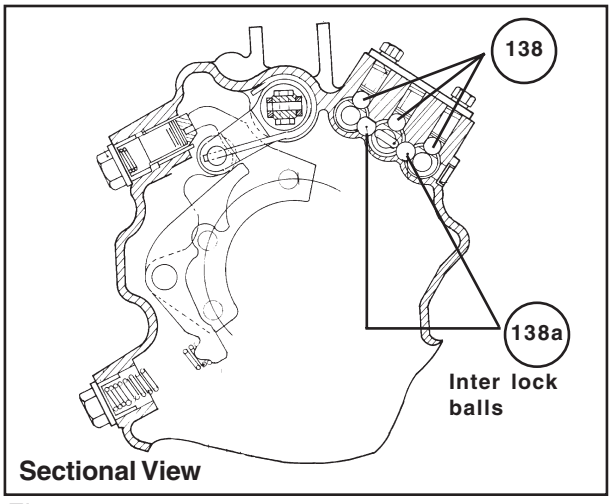


Fig. 94

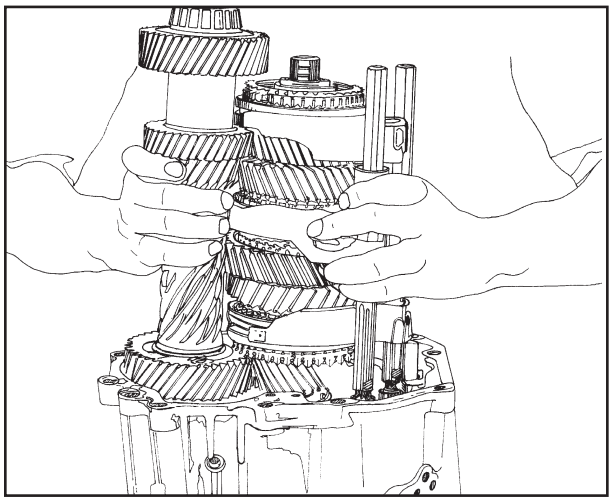


Fig. 95

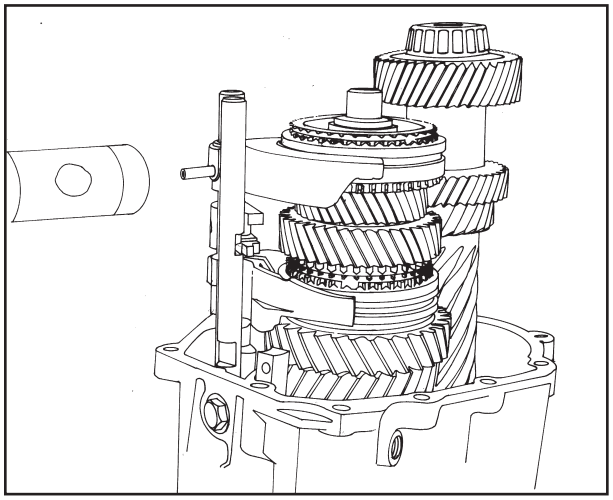


Fig. 96

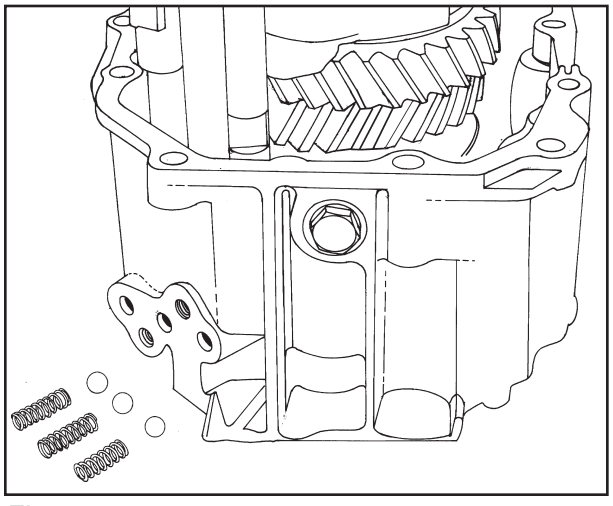


Fig. 97

Slide shifter shaft - Rev. speed (94) in the housing bore. *Fig. 98*

Locate selector & shifter finger (93) between shifter dog - 3rd/4th notch and reverse speed shifter shaft under cut.

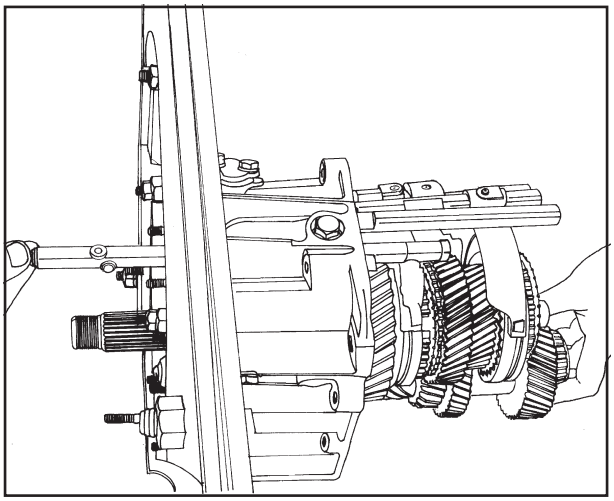


Fig. 99

Insert selector shaft from bottom through selector lever (108) aligning rollers with its splines. Then pass it through selector & shifter finger and **ensure that notch at end is facing towards detent (89).** (To be fitted afterwards). *Fig. 99*

Align hole of selector shaft and selector & shifter finger. Fit spiral pin (124). *Fig. 100*

Locating swing lever (95) between under cut of reverse shifter shaft and shifter shaft Reverse/5th. **Ensure that notch on the lever is at the top and towards reverse shifter shaft.** *Fig. 101*

Fit circlip (97) to pin (96), if removed earlier. Insert pin through bearing block and swing lever.

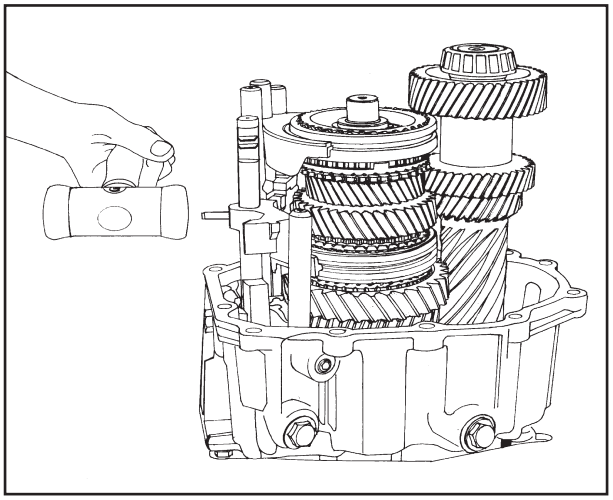


Fig. 100

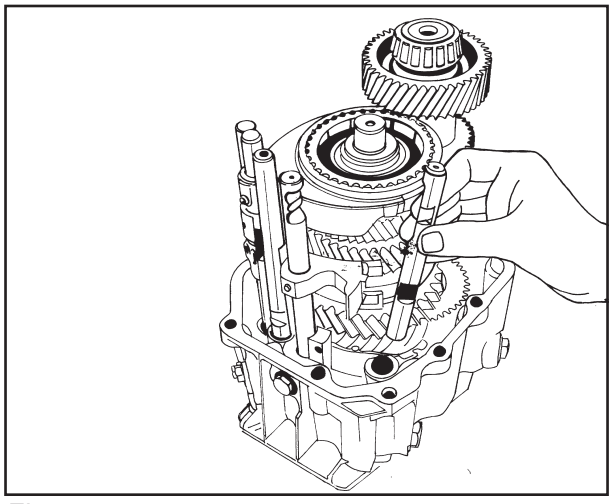


Fig. 98

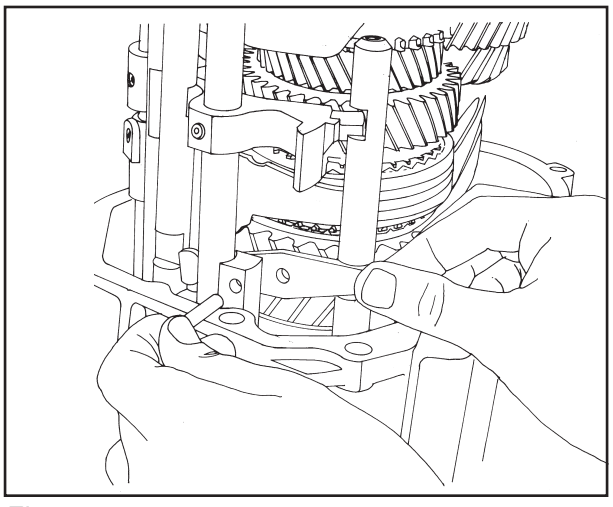


Fig. 101

Fit Reverse Idler gear shaft assy. (82) in the housing such that reverse gear collar is at top. *Fig. 102*

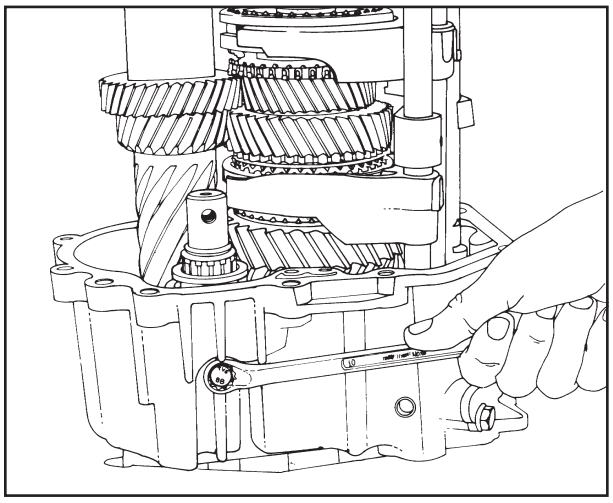


Fig. 103

Tighten hex. screw (54a) along with bright washer (55a) and spr. washer (56a) to hold Reverse Idler shaft in the housing - rear. *Fig. 103*

Align retainer plate (86) in Reverse Idler gear collar, simultaneously locating its pin in housing. Tighten hex. screw (52) along with spr. washer (53) in the housing. *Fig. 104*

Fit linear bearing (28) in the housing - Front, if removed earlier.

Place drive shaft. *Fig. 105*

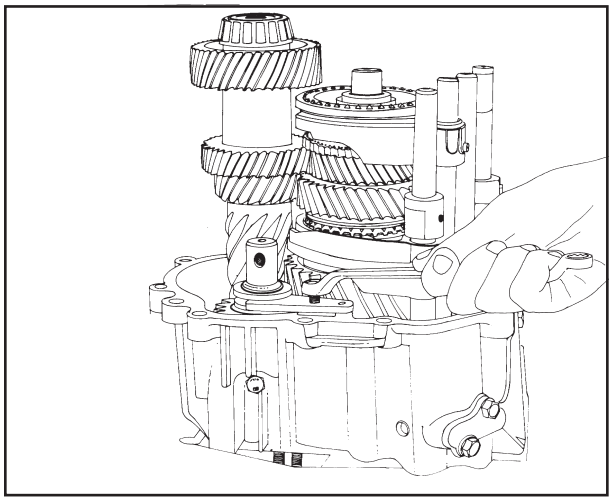


Fig. 104

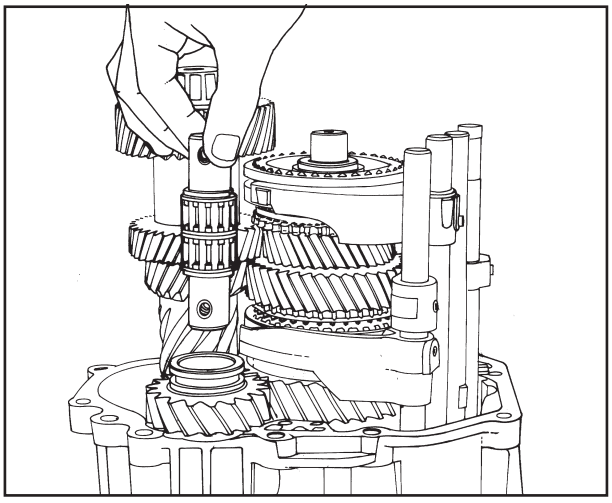


Fig. 102

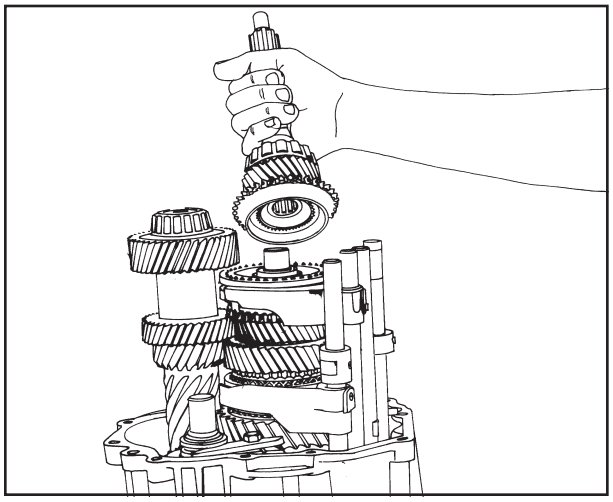


Fig. 105

Apply shellac and put gasket (79) over housing parting surface. Place gear box housing - Front (77) over the rear half aligning dowel pins and gently tap it with mallet.

Put hex. nuts along with plain and spring washer. Tighten all nuts evenly. *Fig. 106*

Apply adhesive gasket eliminator over front cover face and fit it over housing front.

Place measured shims of drive shaft and counter shaft at the seat of front cover.

Put hex. nuts along with bright washer and spring washer and tighten them. *Fig. 107*

Check free movement of roller of detent (89). Carefully fit detent in a bore of housing - front, keeping roller horizontally and **ensure that it is located properly over selector shaft notch.** *Fig. 108*

Fit detent spring (90) and then press plug (91)

Slide speedo drive gear over main shaft. *Fig. 109*

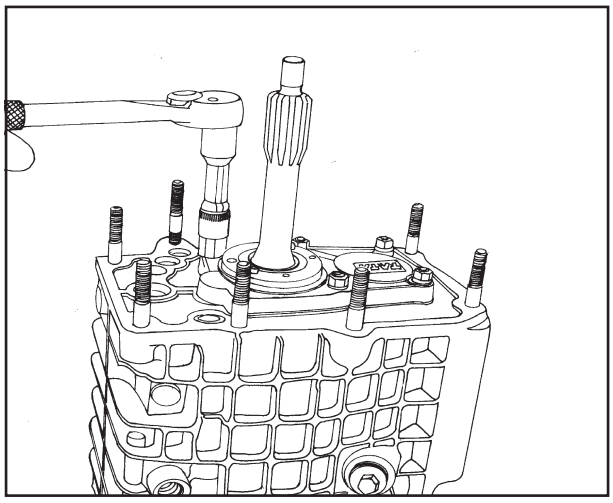


Fig. 107

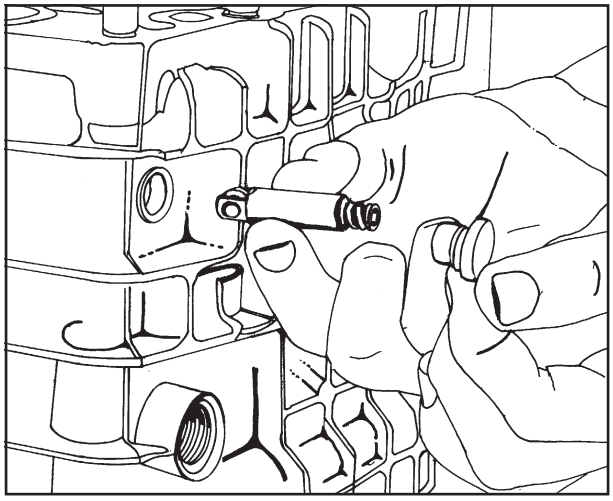


Fig. 108

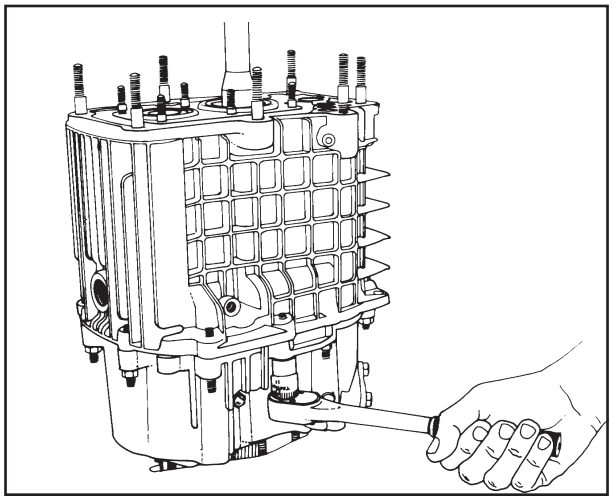


Fig. 106

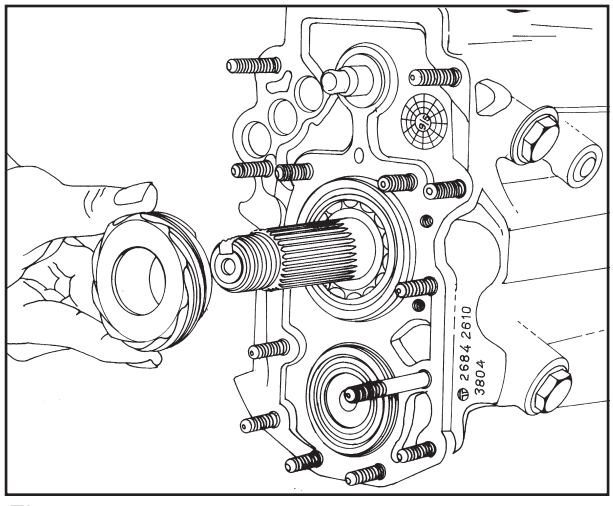


Fig. 109

Apply adhesive gasket eliminator over rear cover face. Place measured shims of main shaft and counter shaft at the seat of rear cover. Fit rear cover to housing half - rear. Put hex. nuts (65) along with bright washer (66) and spring washer (67) and tighten them. *Fig. 110*

Press coupling flange over main shaft rear end. Fit collared hex. nut and tighten it to the specified torque of 24-28 mkg. *Fig. 111*

Stake the collar in undercut with suitable chisel to secure the nut. (For Telco make)

Slide washer (115) over selector shaft in the housing and then press oil seal (116) with suitable drift.

Fit bracket - extension arm (150) to the housing. *Fig. 112*

Apply grease on spherical seat of shifter shaft end.

Check for condition of bush shifting yoke (176).

Slide shifting yoke (169) over spherical seat of shifter shaft. Align its hole with shaft hole such that projected end of the bush is towards right hand side.

Fit cylindrical pin (171). Slide spring clip (170) over the under cut of shifting yoke. *Fig. 113*

Fit oil drain plug (78), breather (13) and reverse indicator switch (129).

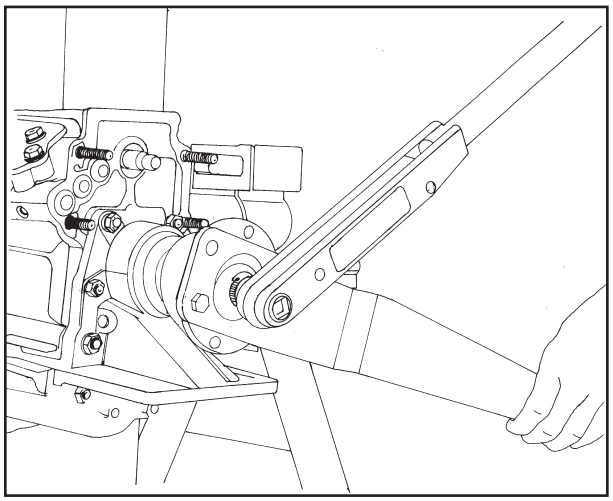


Fig. 111

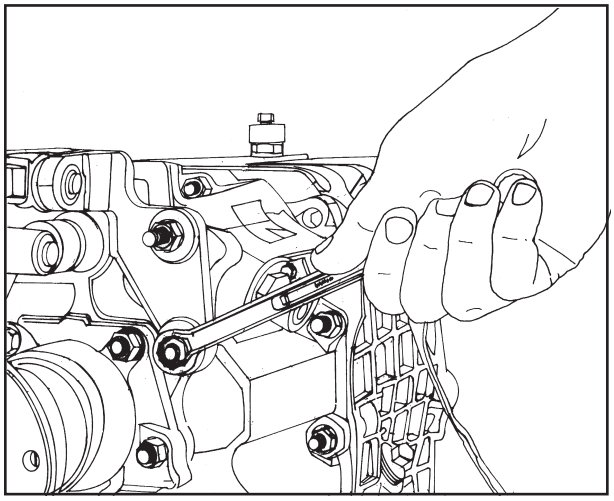


Fig. 112

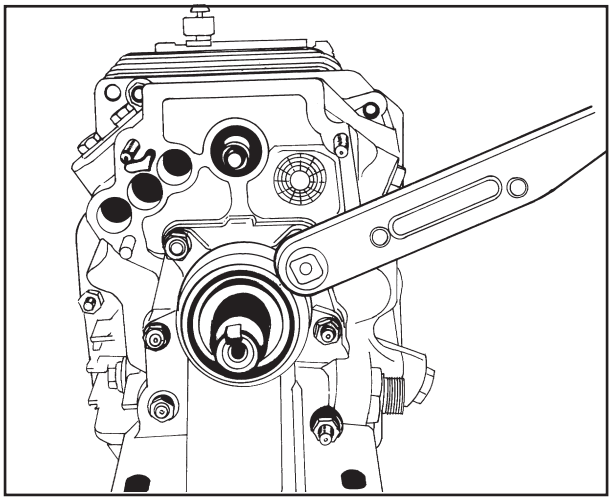


Fig. 110

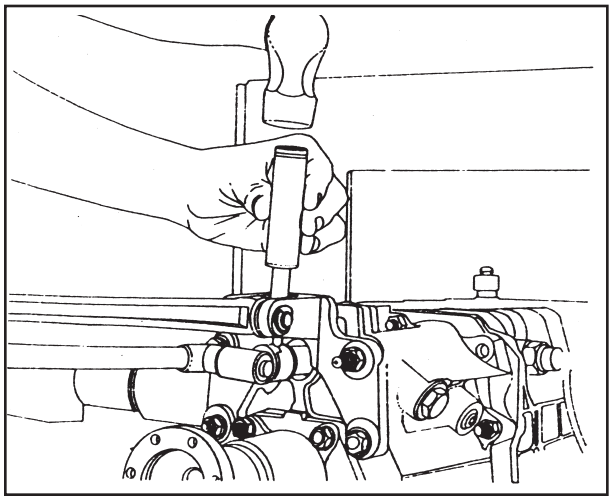


Fig. 113

ASSEMBLY OF GEAR SHIFT LINKAGE

Refer fig. 114

Check condition of bush fitted at the bottom end of gear shift lever.

Apply light coat of grease over gear shift lever ball seat and also on inner surface of bush (162). Press bush over ball seat.

Slide 'O' ring (161) over bush. Then press bush along with the gear shift lever inside the housing bore of extension arm (151) such that arrow marks on the bush are perpendicular to the arm.

Lock the bush by turning it clockwise by 90 deg.

Slide rubber bellow (163) over bottom end of gear shift lever and fit over collar of extension arm bore housing.

Press bush (176) from one side in bore at front end of extension arm. Fill some grease inside bore from other side and then press another bush (176) inside the bore.

Smear light coat of grease over outer surface of bush and bracket flanges.

Align front end of extension arm between flanges of extension arm bracket (150). Then insert pin (178) along with Teflon washer (177) through flange and bracket bush hole. Slide another teflon washer over pin from other end and then fit circlip. (175).

Check both pin ends of shift link (172). Apply grease over pins and also inside the bushes of shifting yoke (169) and gear shift lever bottom end.

Align gear shift lever such that its bend is towards rear side.

Fit spring washer (173) and plain washer (174) over both pins of shift link.

Fit shift link end with longer pin in shifting yoke bore and other end with smaller pin in gear shift lever bottom bush bore simultaneously from LH side.

Fit plain washer (174) & spring washer (173) and then fit circlip over both pins.

Slide rubber seal (160) of extension arm to tunnel over extension arm rear end bore housing.

Slide rubber bellow (154) over gear shift lever knob.

Fit hex. lock nut (153 or spacer for Tatamobile) and then gear shift lever knob at threaded end of gear shift lever. Fix position of knob aligned with the direction of driving. Tighten hex. lock nut.

Check movement of gear shift lever for proper engagement of all gears.

Fill recommended oil to specification up to plug level. Tighten oil filler plug (81) to 2.5 mkg.

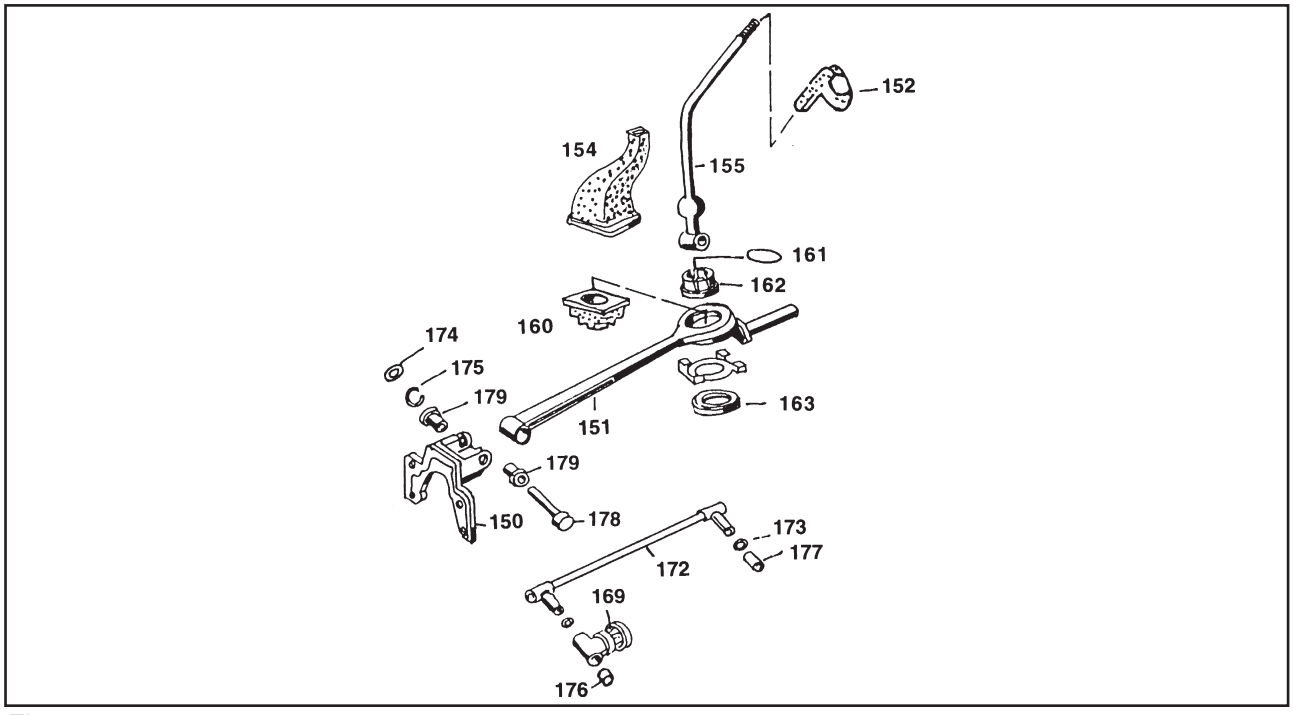


Fig. 114

INSTALLATION OF GEAR BOX ASSEMBLY ON VEHICLE

Note :Take guidelines from the write up on removal of gear box.

Fit clutch housing to gear box front face. *Fig. 115*

Fit clutch release bearing and release fork. *Fig. 116*

Lift and mount the gear box at cylinder block face, aligning drive shaft splines with clutch plate hub splines and clearing gear shift lever through opening provided on the cab.

Tighten all mounting bolts of clutch housing.

Apply grease over supporting pin of extension arm and also inside rubber bush of extension arm support. Slide support over pin.

Fit extension arm support (164) on cross member.

Tighten nylock nut (167) along with washer (166) such as to maintain a clearance of 10 mm between extension arm stud end and propeller shaft.

Fit

- Clutch slave cylinder and its piping.

- Speedo cable

- Reverse indicator switch connector *Fig. 117*

- Propeller shaft

Fix rubber seal in its seat over tunnel cut out and over plate, tighten screws along with washer.

Slide rubber bellow over collar of cover plate.

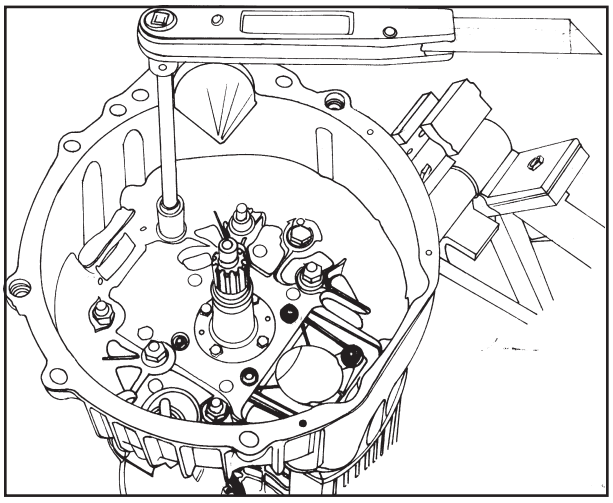


Fig. 115

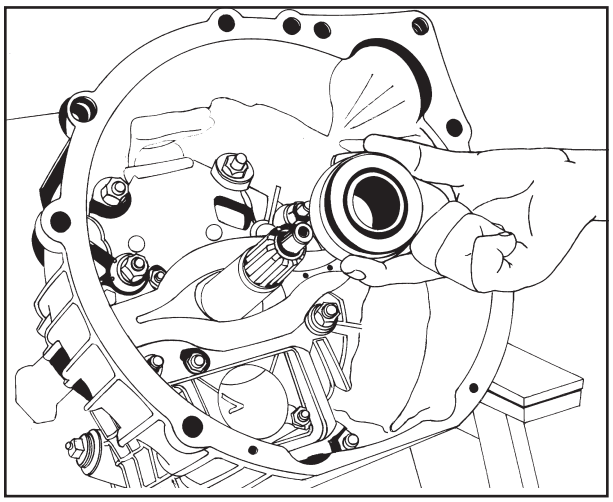


Fig. 116

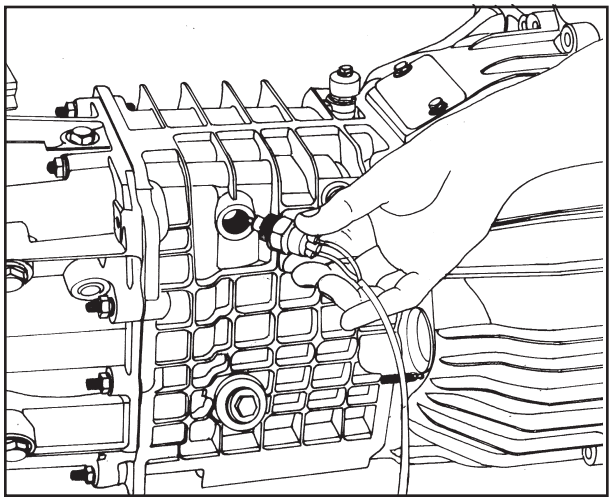


Fig. 117

TROUBLE SHOOTING

Sr.No.	Problem	Possible Cause	Remedy
1.	Hard and / or noisy gear shifting linkage.	Check the synchro cone wear	Change synchro cone and gear.
		Insufficient lubricant, improper grade or quality of oil. leakage, if any.	Fill to proper lever with recommended oil. Rectify
		Defective clutch linkage or gear linkage	Rectify/adjust clutch/gear shift
		Damaged main shaft spigot roller baring.	Replace damaged parts.
		Worn or wrapped gear shift fork / shifter rods etc.	Repair or replace the damaged parts.
		Shifter sleeve tight on matching gears.	Repair or replace
2.	Slips out of gear	The groove in the gear shifter rod towards front is shallow.	Replace the shifter rod.
		The pressure spring is weak or broken.	Replace the pressure spring.
		Dog teeth on gears worn out	Replace the affected gears.
		Shifter sleeve worn out	Replace the affected sleeve
		Shifter fork thrust pad/surface worn.	Replace the damaged parts.
		Excess end play in drive, main or counter	Replace / repair
		Gear box mounting loose.	Tighten mounting.
3.	Gears sticky	Insufficient lubricant, improper grade or quality. if any	Fill the proper lever with recommended oil, rectify leakage
		Sliding shifter sleeve synchro cone jammed.	Repair / replace.
4.	Noisy gears	Insufficient lubricant, improper grade or quality	Rectify leakage if any fill to proper level with recommended oil
		Excess end play in drive, main or counter shaft.	Repair / replace
		Gear box out of line with clutch housing.	Loosen gear box mounting. Realign and secure.
5.	Loss of drive	Defective clutch	Rectify / replace
		Striped teeth on affected meshing gears.	Replace damaged parts.
6.	Repeated gear failure	Breather chocked	Clean and refit breathe.
		Insufficient or improper grade or quality	Fill to proper level with recommended oil after stopping leakages.
		Defective clutch	Adjust or replace clutch.
		Improper assembly or installation of gear box, Incorrect location of shifter sleeve on the main shaft during assembly.	Gear box front face must lie flat flush with mating clutch housing face. Tighten bolts only after the gear is in place.

G-76 Gear Box

IMPROVEMENTS -SUPPLEMENT

Please refer this supplement in conjunction with the assembly/dismantling procedure explained in G-76 Gear Box group in this manual.

Basic overhauling procedure remains same as explained for G-76 (4 gate) Gear Box.

This supplement gives details of major modifications incorporated on G 76 Gear Box till Nov. 2003.

Part Nos. of modified & unmodified components, precautions to be taken while fitting modified components etc. have been explained.

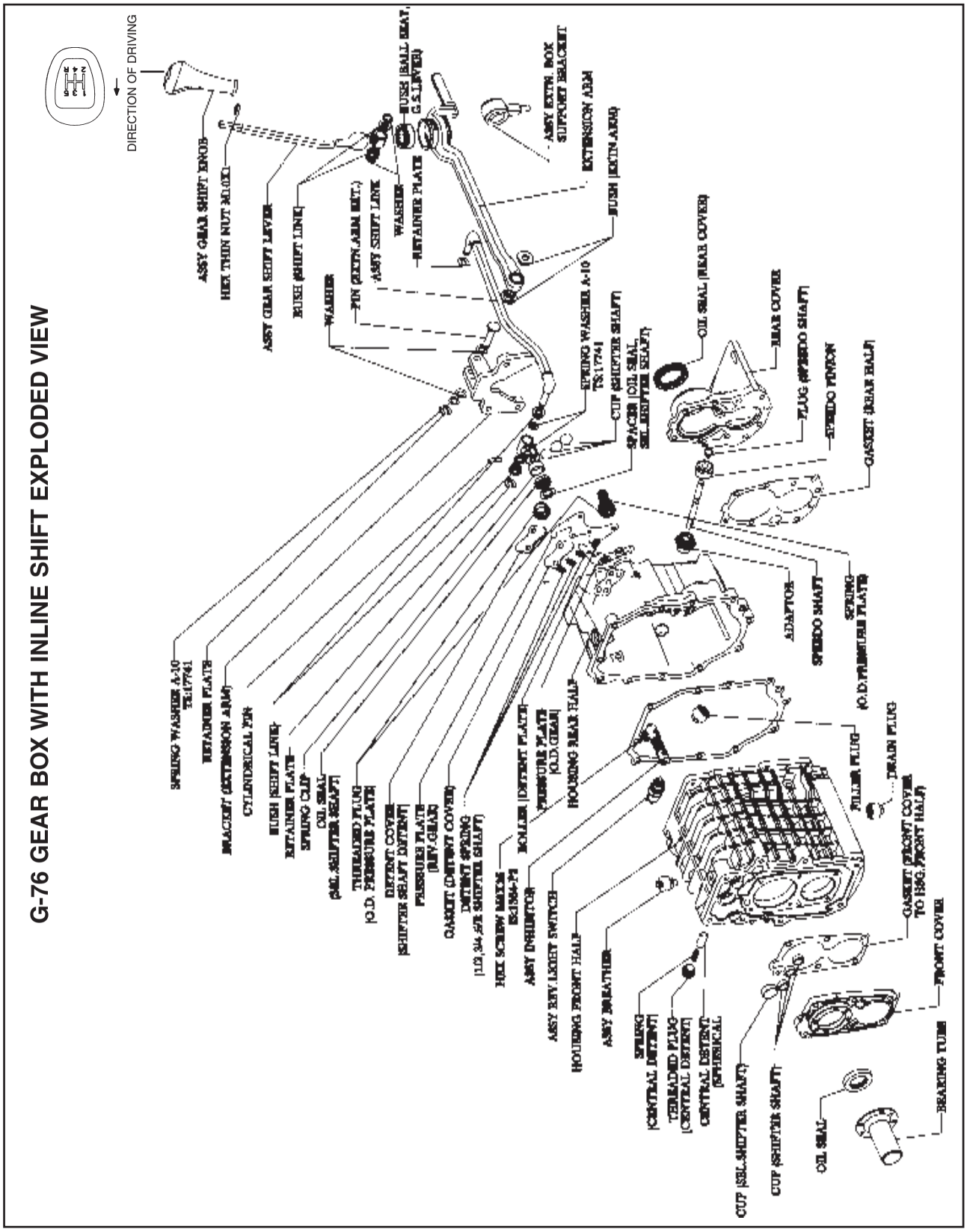

G-76 GEAR BOX WITH INLINE SHIFT EXPLODED VIEW
DIRECTION OF DRIVING
ASSY GEAR SHIFT KNOB
HEX THIN NUT M10 (3)
ASSY GEAR SHIFT LEVER
BUSH (SHIFT LINK)
WASHER
PIN (ZERN.ARM DIT.)
ASSY SHIFT LINK
WASHER
BUSH (BALL SEAT, G.S.LEVER)
RETAINER PLATE
ASSY EXTN. BOX SUPPORT BRACKET
EXTENSION ARM
BUSH (EXTN.ARM)
SPRING WASHER A-10 TS:17741
CUP (SHIFTER SHAFT)
SPACER (OIL SEAL SEL.SHIFTER SHAFT)
OIL SEAL (REAR COVER)
REAR COVER
PLUG (SPEEDO SHAFT)
SPEEDO PINION
GASKET (REAR HALF)
SPRING WASHER A-10 TS:17741
RETAINER PLATE
BRACKET (EXTENSION ARM)
CYLINDRICAL PIN
BUSH (SHIFT LEVER)
RETAINER PLATE
SPRING CLIP
OIL SEAL (SEL.SHIFTER SHAFT)
THREADED PLUG (O.D. PRESSURE PLATE)
DETENT COVER
SHIFTER SHAFT DETENT
PRESSURE PLATE (REV.GEAR)
GASKET (DETENT COVER)
DETENT SPRING (1/2,3/4,5/R SHIFTER SHAFT)
HEX SCREW M6X30 ES1354-P1
ROLLER (DETENT PLATE)
ASSY DETENTOR
PRESSURE PLATE (O.D.GEAR)
ASSY REV.LIGHT SWITCH
HOUSING REAR HALF
ADAPTOR
SPEEDO SHAFT
SPRING (O.D.PRESSURE PLATE)
HOUSING FRONT HALF
ASSY BREATHER
FILLER PLUG
DRAIN PLUG
SPRING (CENTRAL DETENT)
THREADED PLUG (CENTRAL DETENT)
CENTRAL DETENT (SPHERICAL
GASKET (FRONT COVER TO HSG.FRONT HALF)
CUP (SEL.SHIFTER SHAFT)
CUP (SHIFTER SHAFT)
FRONT COVER
OIL SEAL
BEARING TUBE

Fig. 1

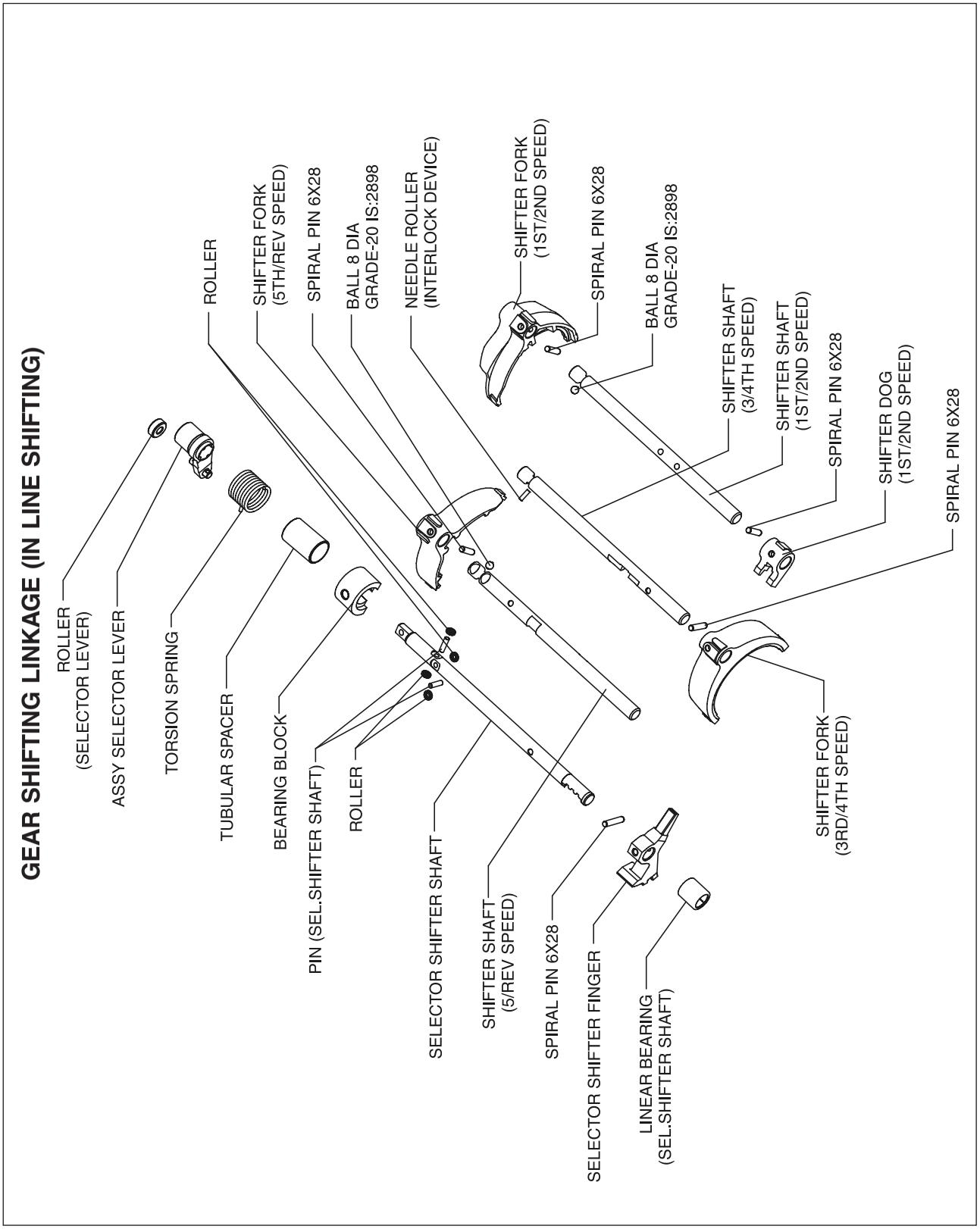
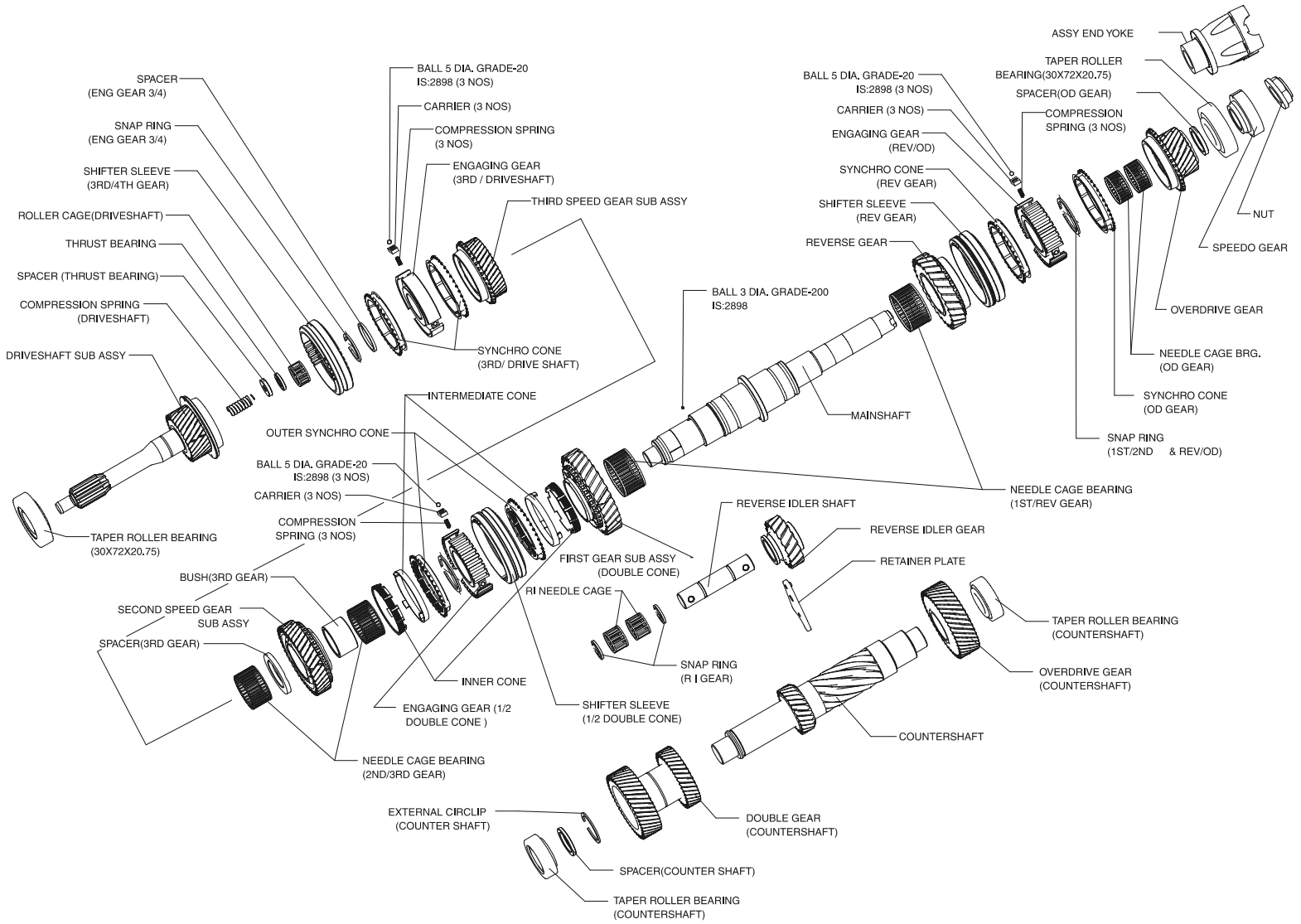

GEAR SHIFTING LINKAGE (IN LINE SHIFTING)
ROLLER (SELECTOR LEVER)
ASSY SELECTOR LEVER
TORSION SPRING
TUBULAR SPACER
BEARING BLOCK
PIN (SEL.SHIFTER SHAFT)
ROLLER
SELECTOR SHIFTER SHAFT
SHIFTER SHAFT (5/REV SPEED)
SPIRAL PIN 6X28
SELECTOR SHIFTER FINGER
LINEAR BEARING (SEL.SHIFTER SHAFT)
ROLLER
SHIFTER FORK (5TH/REV SPEED)
SPIRAL PIN 6X28
BALL 8 DIA GRADE-20 IS:2898
NEEDLE ROLLER (INTERLOCK DEVICE)
SHIFTER FORK (1ST/2ND SPEED)
SPIRAL PIN 6X28
BALL 8 DIA GRADE-20 IS:2898
SHIFTER SHAFT (3/4TH SPEED)
SHIFTER SHAFT (1ST/2ND SPEED)
SPIRAL PIN 6X28
SHIFTER DOG (1ST/2ND SPEED)
SPIRAL PIN 6X28
SHIFTER FORK (3RD/4TH SPEED)

Fig. 2

Fig. 3

GEAR BOX WITH DUAL CONE SYNCHRONISERS ON 1st & 2nd GEARS



Procedure to remove inhibitor assy. :

The inhibitor is located in housing front half. Fig 4

Loosen allen screw & take out inhibitor assy. Fig. 5 & 6

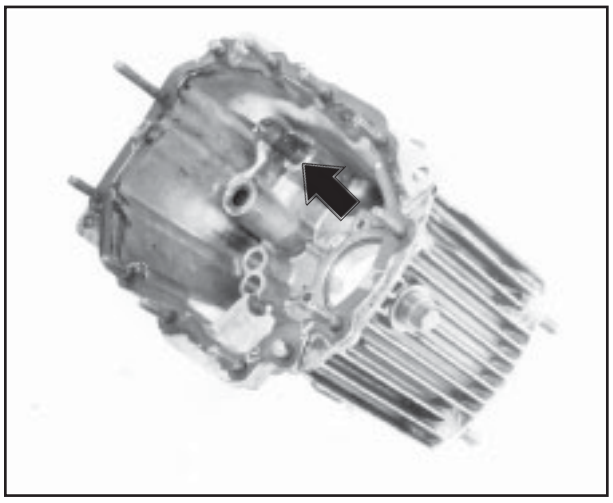


Fig. 4

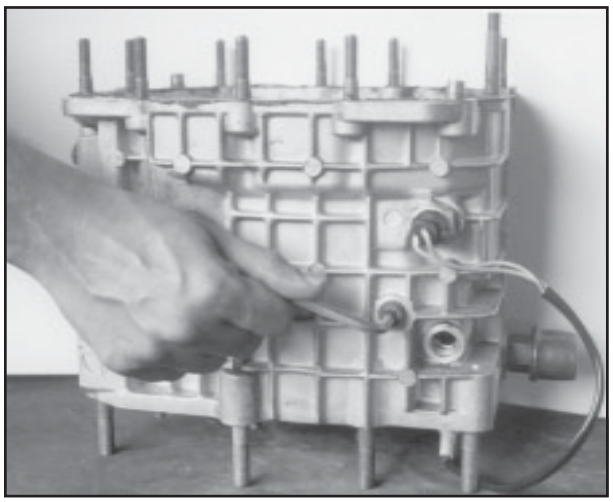


Fig. 5



Fig. 6

The detent for assy. selector & shifter shaft is fixed with screw plug type arrangement. Fig. 7 & 8

To remove detent unscrew & take out detent spring & central detent assy.

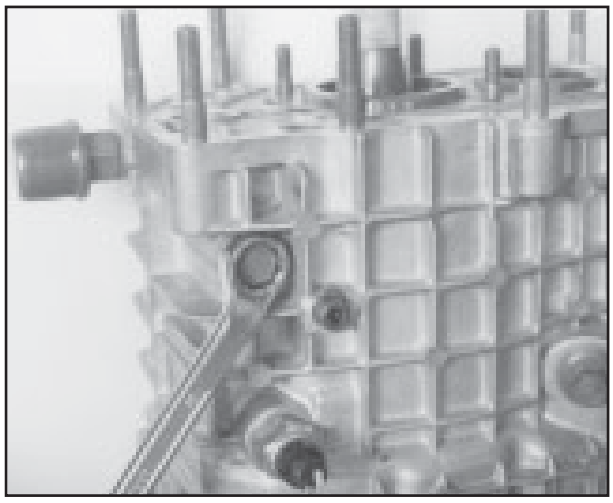


Fig. 7



Fig.8

The assy. selector shifter shaft grooves are modified for smoother engagement. Fig. 9

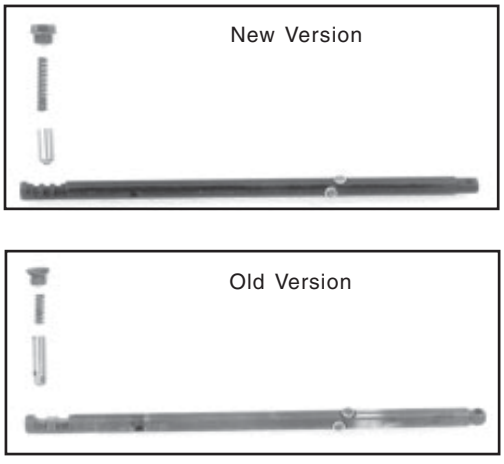
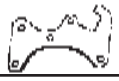
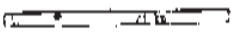
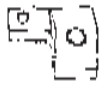
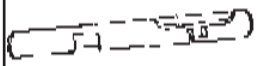
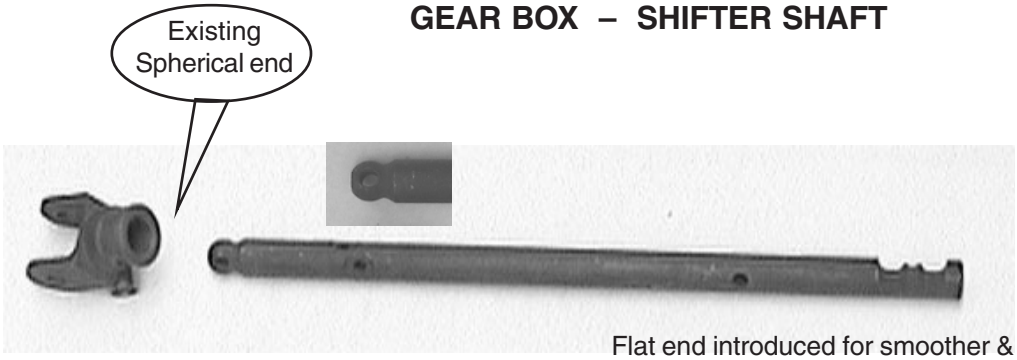


Fig.9

G-76 Gearbox with Rev/od in line shift pattern - List of parts modified / deleted :

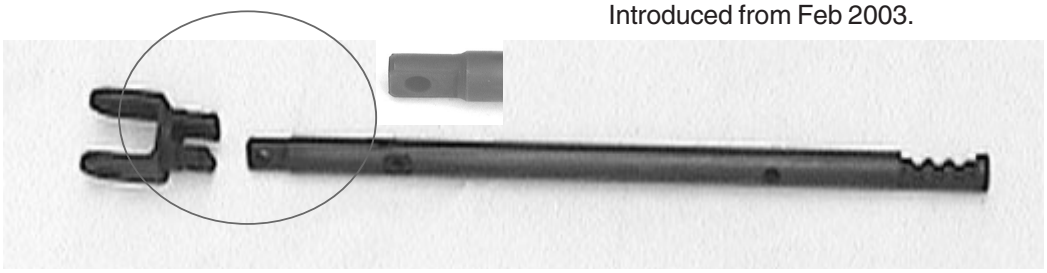
No.	Old Part No.	Part Description	New Part No.	Part Description	Old Part Status
1.	2684 2651 8204	Pressure Plate Rev 	2684 2651 8202	Pressure Plate Rev 	Modified
2.	2684 2651 6707	Pin Swing Lever 	--	Pin Swing Lever	Deleted
3.	2684 2670 7910	Shifter Shaft 3/4 	2684 2670 7916	Shifter Shaft 3/4 	Modified
4.	2684 2670 7903	Shifter Shaft R/OD 	2685 2670 7917	Shifter Shaft R/OD 	Modified
5.	2684 2680 0108	Assy. G. S. Knob 	2684 2680 0174	Assy. G. S. Knob 	Modified
6.	2684 2651 3404	Rev. Plunger 	--	Rev. Plunger	Deleted
7.	2684 2651 8203	Swing Lever 	--	Swing Lever	Deleted
8.	2684 2651 8704	Rev. Plunger Spring 	--	Rev. Plunger Spring	Deleted
9.	2684 2651 9901	Locating piece 	--	Locating piece	Deleted
10.	2684 2651 9905	Bearing Block 	2684 2651 9906	Bearing Block 	Modified
11.	2684 2670 7909	Shifter Shaft Rev 	2684 2651 0114	Assy. Inhibitor 	Modified
12.	2684 2651 9903	Selector Shifter Finger 	2684 2651 5106	Selector Shifter Finger 	Modified

GEAR BOX – SHIFTER SHAFT



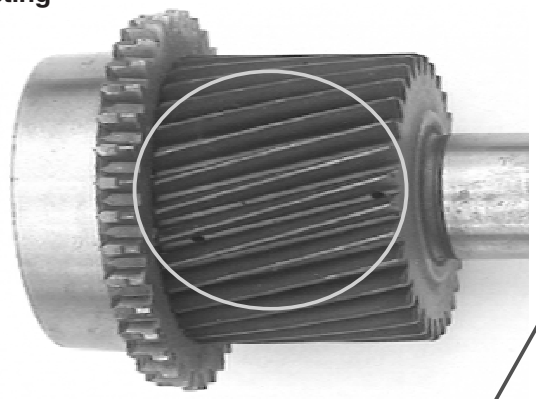
Flat end introduced for smoother & precise Gear shifting

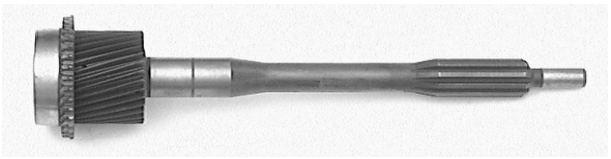
Introduced from Feb 2003.



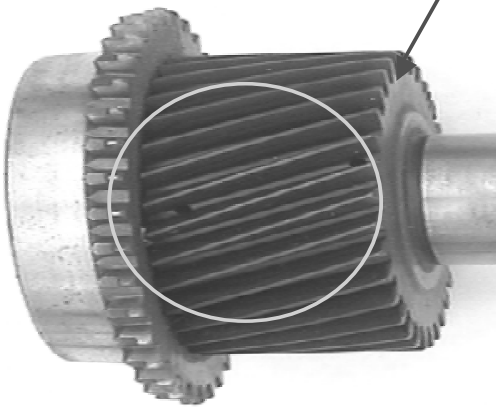
GEAR BOX - DRIVE SHAFT

Existing





Modified

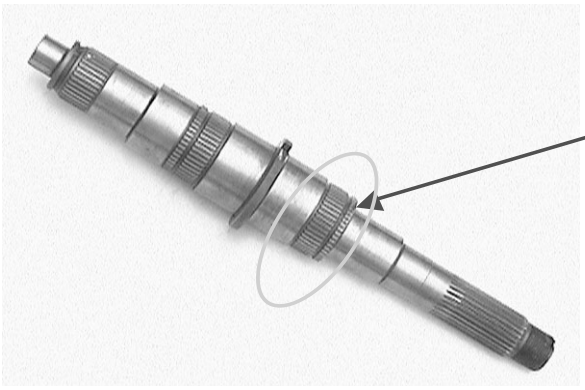


FOR BETTER LUBRICATION

1. OIL HOLE DIA INCREASED FROM 1.5 TO 2 mm.
2. NUMBER OF OIL HOLES INCREASED FROM 6 TO 12

Introduced from October 2002

GEAR BOX - MAIN SHAFT

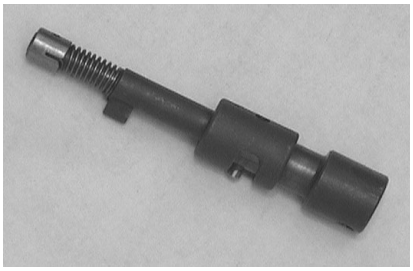


Anticarb Paste application on Splines to eliminate chipping.

Introduced from Nov 2002.

GEAR BOX - INHIBITOR ASSEMBLY

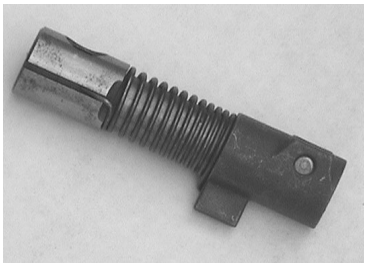
Existing



SHORTER VERSION INTRODUCED FOR BETTER GEAR SHIFTING OF 5TH & REVERSE GEAR.

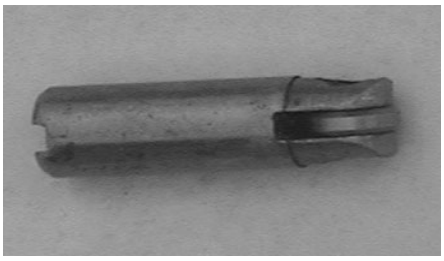
Introduced from Feb 2003.

Modified



GEAR BOX - ASSEMBLY DETENT

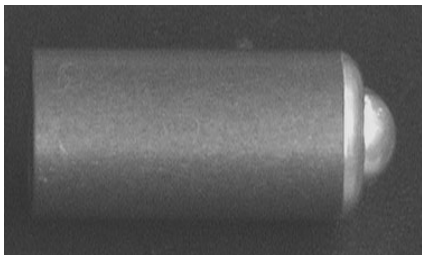
Existing



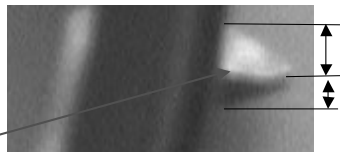
Roller type changed to Ball type for smooth Gear Shifting

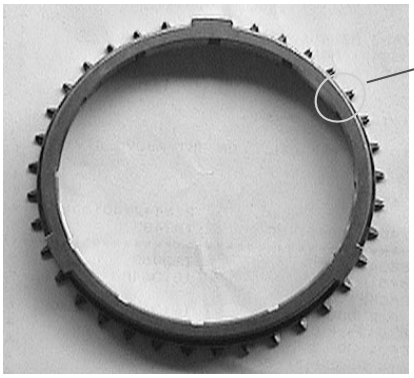
Introduced from Feb.2003.

Modified



GEAR BOX - SYNCHROCONE





Dog Teeth with unequal Dach chamfer introduced for Smooth shifting of 1st & Reverse Gear.

Introduced from May 2002.

MODIFICATIONS ON G 76 GEAR BOX APPLICABLE FOR TELCOLINE

Sl No.	Modification	Reasons for Modification	Break point (100 %)	Parts involved							Remarks
			Chassis No	Description	Old item		New item		Identification of new item	Caution	
					Part No	Qty	Part No.	Qty			
1	Introduction of 9 degree back taper angle on all gears and shifter sleeve at dog teeth area	To avoid gear slippage	Introduced in September 2001. JYZ 9 16744 for RHD & J29 00537 for LHD.	Shifter sleeve 1/2nd	2684 2620 4614	1	2684 2620 4622	1	By part number only	To be replaced **as a set** when switching over from 7 degree version to 9 degree version.	Parts of 7 degree & 9 degree are not interchangeable. Whenever a particular gear or shifter sleeve is replaced, it should be with same angle (either 7 degree or 9 degree). **In case a particular gear or shifter sleeve of same angle is not available, then that particular gear, shifter sleeve and other side gear of relevant sleeve are to be replaced as a set. Manufacture of 7 degree components have been stopped. All requirements to be raised only for 9 degree components.**
				1st gear 3.87 ratio	2684 2620 0101	1	2684 2620 0146	1	By part number only		
				2nd gear 2.22 ratio	2684 2620 0102	1	2684 2620 0196	1	By part number only		
				Shifter sleeve 3/4th	2684 2620 4613	1	2684 2620 4623	1	By part number only	To be replaced **as a set** when switching over from 7 degree version to 9 degree version.	
				3rd gear	2684 2620 0103	1	2684 2620 0148	1	By part number only		
				Drive shaft	2684 2625 0101	1	2684 2625 0103	1	By part number only		
				Shifter sleeve Rev/OD	2684 2620 4615	1	2684 2620 4624	1	By part number only	To be replaced **as a set** when switching over from 7 degree version to 9 degree version.	
				Reverse gear	2684 2620 0105	1	2684 2620 0149	1	By part number only		
				OD gear	2684 2620 0115	1	2684 2620 0150	1	By part number only		
2	Multi grade oil 80 W 90	To enhance oil drain period & longer life of components	Intoduced in September 2002. MAT 374 501 39L 00313 for LHD & JXZ 9 15468 for RHD.	Nil	Nil	Nil	Nil	Nil	NA	Nil	First Oil change at 10000 kms. Second oil change at 40000kms. Subsequent Oil changes after every 40000 Kms. Earlier type mono grade oil & multi grade oil not compatible with each other & hence should not be mixed.

MODIFICATIONS ON G 76 GEAR BOX APPLICABLE FOR TELCOLINE

Sl No.	Modification	Reasons for Modification	Break point (100 %)	Parts involved						Remarks
			Chassis No	Description	Old item		New item		Identification of new item	Caution	
					Part No	Qty	Part No.	Qty			
3	Inline shifting arrangement for reverse & OD.	Easy gear shifting & cost reduction	Introduced in March 2002. CXZ 9 04812 for RHD & C29 01911 for LHD.	Pressure plate Rev	2684 2651 8204	1	2684 2651 8202	1	By part number only. Stopper position for pin of selector lever reduced by 5 mm.	Not inter-changeable	In line shifting is 3 gate shifting configuration.
				Pin swing lever	2684 2651 6707	1	Nil			Deleted	
				Shifter shaft 3/4th	2684 2670 7910	1	2684 2670 7916	1	Slot for shifter finger extended to travel forward & backward.	Not inter-changeable	
				Shifter shaft Rev/OD	2684 2670 7903	1	2685 2670 7917	1	Slot for Pin swing lever deleted.	Not inter-changeable	
				Assy G S knob	2684 2680 0108	1	2684 2680 0174	1	3 gate shift system embossed on top.	Not inter-changeable	
				Plunger	2684 2651 3404	1	Nil			Deleted	
				Swing lever	2684 2651 8203	1	Nil			Deleted	
				Spring	2684 2651 8704	1	Nil			Deleted	
				Locating piece	2684 2651 9901	1	Nil			Deleted	
				Bearing block	2684 2651 9905	1	2684 651 9906	1	Bearing block does not have 6 mm dia hole for mounting Pin swing lever.	Not inter-changeable	
				Shifter shaft Rev	2684 2670 7909	1	Nil			Deleted	
				Assy Inhibitor	NA	NA	2684 2651 0112	1		**New item.**	
				Selector shifter finger	2684 2651 9903	1	2684 2651 5106	1	Position of lug to actuate reverse light switch changed.	Not inter-changeable	

MODIFICATIONS ON G 76 GEAR BOX APPLICABLE FOR TELCOLINE

Sl No.	Modification	Reasons for Modification	Break point (100 %)	Parts involved						Remarks
			Chassis No	Description	Old item		New item		Identification of new item	Caution	
					Part No	Qty	Part No.	Qty			
4	Qualis type flat end shaft gear box with spherical detent	Easy gear shifting & cost reduction	Introduced in February 2003. MAT 374 582 39L 00815 for LHD & 374 415 BWZ 9 02892 for RHD.	Assy hsg for 4x2	2684 2610 0129	1	2684 2610 0133	1	Inhibitor hole position shifted to front half of housing. Inhibitor mounting hole on rear half made blind.Spherical detent threaded hole dia on front half increased.	To be used **as a set** only	For Gear shift lever assy 1) O-ring 2) Bush, 3) Sintered moulded bush replaced with new moulded bush along with crinkled washer.
				Assy hsg for 4x4	2684 2610 0130	1	2684 2610 0134	1	Inhibitor hole position shifted to front half of housing. Inhibitor mounting hole on rear half made blind.Spherical detent threaded hole dia on front half increased.		
				Inhibitor assy	2684 2651 0112	1	2684 2651 0114	1	0112 - length - 160mm 0114 - length - 70mm		
				Torsion spring	2684 2651 8710	1	2684 2651 8714	1	only by Part No		
				CD spring	2684 2651 8709	1	2684 2651 8715	1	only by Part No		

MODIFICATIONS ON G 76 GEAR BOX APPLICABLE FOR TELCOLINE

Sl No.	Modification	Reasons for Modification	Break point (100 %)	Parts involved						Remarks
			Chassis No	Description	Old item		New item		Identification of new item	Caution	
					Part No	Qty	Part No.	Qty			
				Central detent	2684 2651 0102	1	2684 2651 3115	1	0102 - has roller 3115 - has sperical ball	To be used **as a set** only along with gearbox hsg	
				Spring for detent	2684 2651 8701	1	2684 2651 8717	1	8701 - length - 23 mm 8717 - length - 41 mm		
				Plug	2684 2651 6702	1	2684 2651 6501	1	6702 - round end 6501 - threaded with hex head		
				Sel & shifter shaft 4x2	2684 2670 7913	1	2684 2670 7920	1	7913/19 - sperical end, dull grey colour 7920/21 - flat end, black coating		
				Sel & shifter shaft 4x4	2684 2670 7919	1	2684 2670 7921	1			
				Shifting yoke	2684 2651 3703	1	2684 2651 3706	1	3703 - round bore at pin joint, dull grey colour 3706 - flat cut at pin joint, black coating		
				Bush (ext arm)	2684 2671 3403	2	2684 2671 6302	2	3403 - steel, 6302 - white plastic	"o" ring deleted	
				Bush shift link	2684 2651 3409	2	2684 2671 6301	2	3409 - black rubber, 6301 - white plastic	"o" ring deleted	
				Bush shift link	2684 2651 3410	1	Nil		3410 - black plastic	Deleted	
				Bush lever bottom	2684 2680 3402	1	2684 2671 6301	2	3402 - not collared, 6301 - collared	"o" ring deleted	

MODIFICATIONS ON G 76 GEAR BOX APPLICABLE FOR TELCOLINE

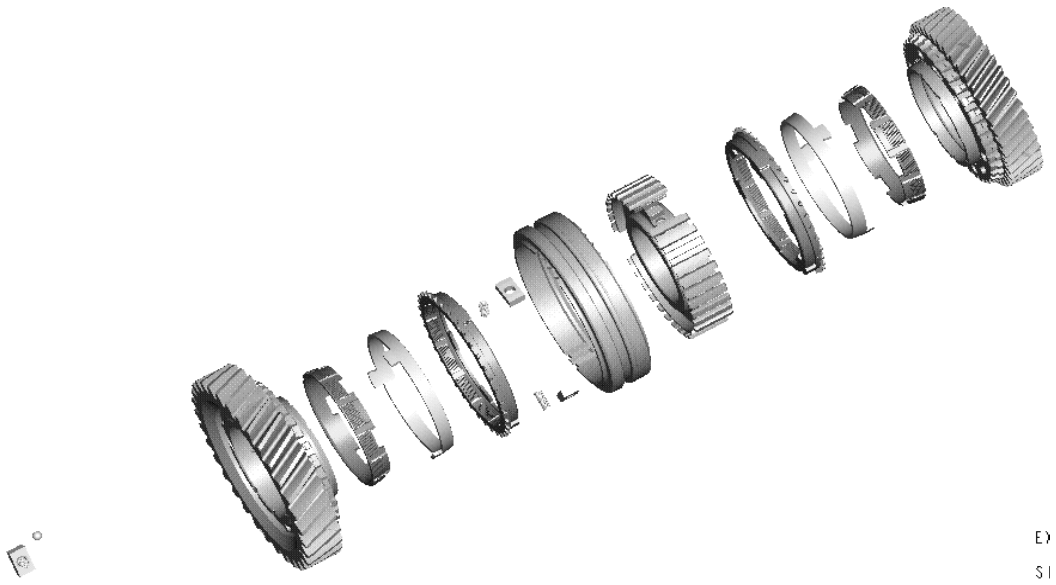
Sl No.	Modification	Reasons for Modification	Break point (100 %)	Parts involved						Remarks
			Chassis No	Description	Old item		New item		Identification of new item	Caution	
					Part No	Qty	Part No.	Qty			
5	Introduction of unequal Dach chamfer on 2nd(Single cone)/3rd & Driveshaft	To Improve Gear shift Feel	Introduced in July 2003	2nd gear 2.22 ratio *	2684 2620 0196	1	2684 2620 0210	1	Un equal dach chamfer on syncro ring teeth	Inter-changeable	Can be interchanged on one to one basis
				3rd gear	2684 2620 0148	1	2684 2620 0212	1	Un equal dach chamfer on syncro ring teeth	Inter-changeable	Can be interchanged on one to one basis
				Driveshaft	2684 2625 0103	1	2684 2625 0115	1	Un equal dach chamfer on syncro ring teeth	Inter-changeable	Can be interchanged on one to one basis
6	Dual syncro cones for 1st/2nd gear	To over come hard gear shifting complaints	Introduced in October 2003. MAT 374 531 49L 00694 for LHD. Yet to be introduced in RHD version.All these modifications were introduced as a package.	Inner cone *	Not applicable		2684 2620 3828	2	Provided with 6 lugs & made of brass.	New item. Common for 1st/2nd gear	For Synthetic Oil, First Oil change is at 40000 kms & subsequent changes after coverage of every 80000 Kms. If synthetic oil is not available, 80 W 90 oil recommeneded earlier can be used with oil drain period of 40000 Kms. But both oils should not be mixed, since they are not compatible with each other. **Items with * mark have to be replaced as a set when switching over to Dual cone version in unmodified gear box.** Inner cone, intermediate cone & outer cone are available under kit part no. 2684 2620 0160. Qty/vehicle - 2.
	Un equal dach chamfer angle for 2nd(Dual cone) gear syncro ring teeth	To eliminate complaint of hitting feeling during gear shift		Intermediate cone *	Not applicable		2684 2620 3833	2	Provided with 3 lugs & Made of steel	New item. Common for 1st/2nd gear	
	Synthetic oil 75 W 90 API GL4	To over come hard gear shifting complaints & to extend oil drain priod		Syncro cone outer *	Not applicable		2684 2620 3830	2	Provided with 6 lugs to match corresponding lugs in inner cone & made of brass.	New item. Common for 1st/2nd gear	

MODIFICATIONS ON G 76 GEAR BOX APPLICABLE FOR TELCOLINE

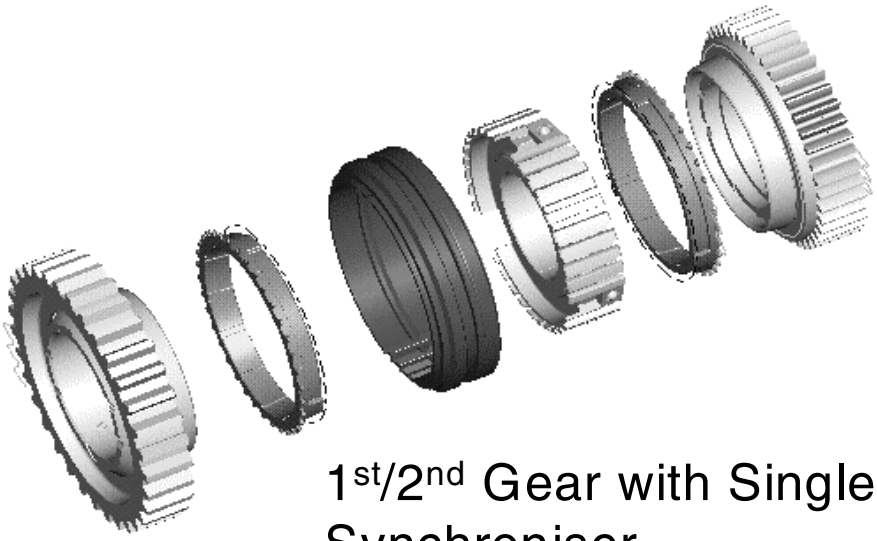
Sl No.	Modification	Reasons for Modification	Break point (100 %)	Parts involved						Remarks
			Chassis No	Description	Old item		New item		Identification of new item	Caution	
					Part No	Qty	Part No.	Qty			
	Tumblinig of engaging gears, shifter sleeves & syncro rings	To elminate scratchy feeling during gear shift		Syncro cone 1st gear	2684 2620 3823	1	Nil			Deleted	
				Syncro cone 2nd gear	2684 2620 3824	1	Nil			Deleted	
				1st gear 3.87 ratio *	2684 2620 0146	1	2684 2620 0161	1	Syncro ring has 3 slots to accommodate lugs of intermediate cone	Not inter-changeable	
				2nd gear 2.22 ratio *	2684 2620 0196	1	2684 2620 0164	1	Syncro ring has 3 slots to accommodate lugs of intermediate cone. Also un equal dach chamfer on syncro ring teeth.	Not inter-changeable	
				Engaging gear 1st/2nd *	2684 2620 4611	1	2684 2620 4628	1	Inner collar symmetric on both sides. Can be fitted either way.	Not inter-changeable	
				Shifter sleeve 1st/2nd *	2684 2620 4622	1	2684 2620 4629	1	Shifter sleeve OD has one circular groove on 1st gear side & two circular grooves on 2nd gear side.	Not inter-changeable	

Chassis break points indicated here is only for reference.It is possible that few vhicles prior to break point may with modified version. Chassis break points for RHD version is applicable for Domestic. Separate break point for Exports RHD version not maitained at Works.

DUAL CONE SYNCHRONISER

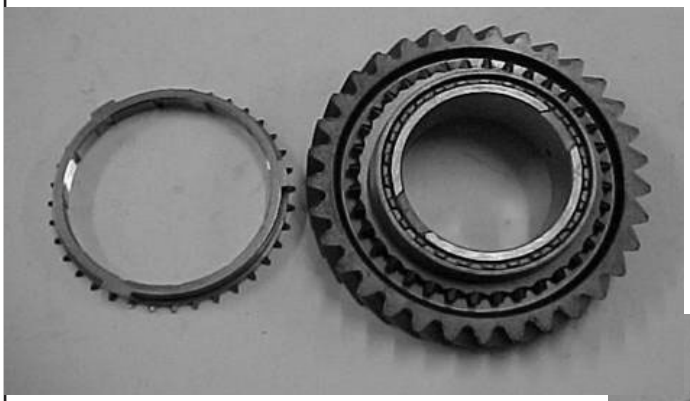


1st/2nd Gear with Dual Cone Synchroniser



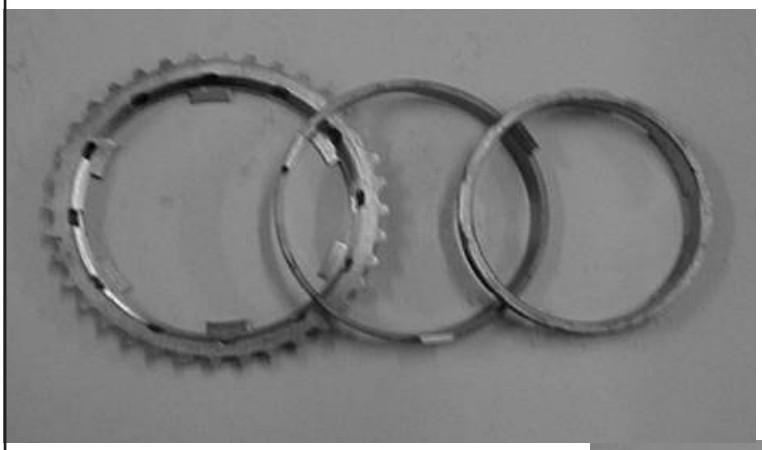
1st/2nd Gear with Single Cone Synchroniser

EXISTING – SINGLE SYNCHROCONE FOR 1ST & 2 ND SPEED





DUAL SYNCHROCONE INTRODUCED – OCT03. (1ST & 2ND SPEED)

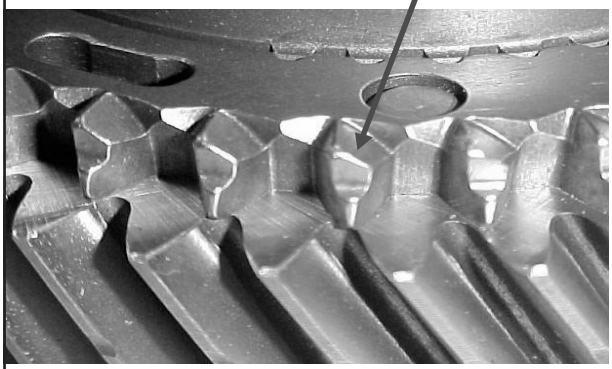




EQUAL DACH CHAMFER (2ND & 3RD SPEED GEAR)

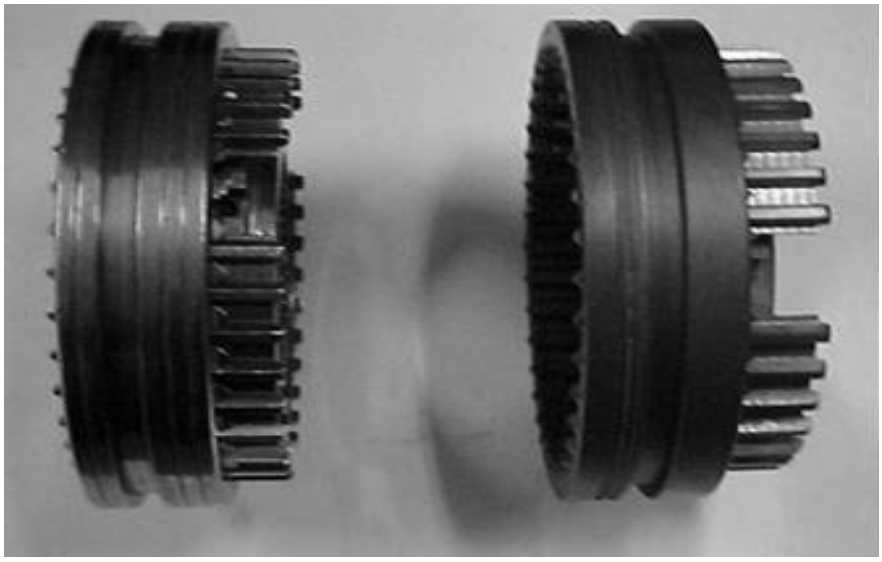


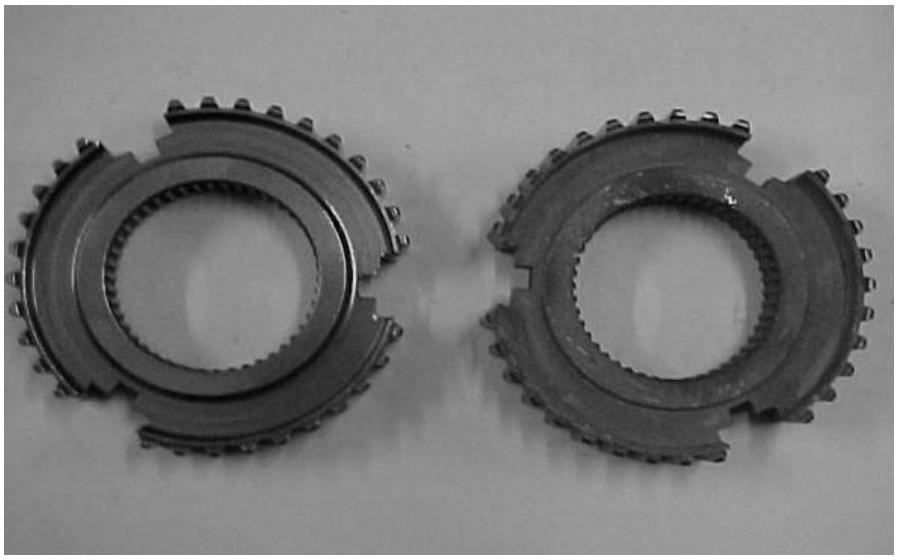
UNEQUAL DACH CHAMFER INTRODUCED (OCT-03)





TUMBLING FOR ENGAGING GEAR & SHIFTER SLEEVE INTRODUCED





G76 GEARBOX SPEED GEAR VARIETIES FOR VARIOUS MODELS

Gears may be identified by counting the number of Teeth on each Gear

	Safari Diesel 4x2 & 4x4		Safari Petrol 4x2 & 4x4		Telcoline (Diesel & Petrol) 4x2 & 4x4	
	No of Teeth	**Part No**	**No of Teeth**	**Part No**	**No of Teeth**	**Part No**
1st Gear	33	2684 2620 01 46 (With Single Cone Synchro) 2684 2620 01 61 (With Double Cone Sunchro)	35	2684 2620 01 95 (With Single Cone Synchro) 2684 2620 01 63 (With Double Cone Sunchro)	33	2684 2620 01 46 (With Single Cone Synchro) 2684 2620 01 61 (With Double Cone Sunchro)
2nd Gear	42	2685 2620 02 11 (With Single Cone Synchro) 2684 2620 01 62 (With Double Cone Sunchro)	41	2685 2620 02 10 (With Single Cone Synchro) 2684 2620 01 64 (With Double Cone Sunchro)	41	2685 2620 02 10 (With Single Cone Synchro) 2684 2620 01 64 (With Double Cone Sunchro)
3rd Gear	38 (only one variety)	2684 2620 02 12	38	2684 2620 02 12	38	2684 2620 02 12
5th Gear (Overdrive Gear)	25	2684 2620 01 50	25 (0.82 OD Ratio) 28 (0.73 OD Ratio)	2684 2620 01 50 2684 2620 02 07	25 (0.82 OD Ratio)	2684 2620 01 50
Coutershaft	25(2nd Gear)	2684 2630 79 03	26 (2nd gear)	2684 2630 79 05	26 (2nd Gear)	2684 2630 79 05
Double Gear(c/s)	45/39 (only one variety)	2684 2630 54 01		2684 2630 54 01		2684 2630 54 01
OD Gear (c/s)	43	2684 2630 54 04	43 (0.82 OD Ratio) 54 (0.73 OD Ratio)	2684 2630 54 04 2684 2630 54 13	43 (0.82 OD Ratio)	2684 2630 54 04
Driveshaft	32	2684 2625 0115 (Unequal dach chamfer)	32	2684 2625 0115 (Unequal dach chamfer)	32	2684 2625 0115 (Unequal dach chamfer)

TRANSFER CASE

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INTRODUCTION

1.1 Construction & operation

Divgi-Warner's 45-54 Transfer case is a two speed, part time electric transfer case. The system consists of

1. Transfer case with motor, speed sensor, and electric clutch
2. Electronic control unit (ECU)
3. Mode selector switch
4. Indicator lights 4H and 4L
5. Harness to connect above parts and power input

Power is received by input shaft, which is coupled with output shaft of transmission gearbox by matching splines. There are two outputs, one for rear wheels and one for front wheels.

Position	Speed Ratio	Operation
N - *Neutral position*	-	(Available only in manual shift type transfer case). Out put shaft is disconnected from input shaft and no power is transmitted to wheels
2H - *Two high position*	1: 1	Only two rear wheels are driven and transfer case operates at 1: 1 speed ratio
4H - *Four high position*	1: 1	All four wheels are driven at 1: 1 speed ratio
4L - *Four low position*	2.48: 1	All four wheels are driven and transfer case operates at 2.48: 1 speed reduction ratio

A planetary gear set is used to provide gear reduction. Power is transferred to front wheel drive through a Morse Hi-Vo chain drive. Unit operates in an oil bath. An oil pump is used to provide positive lubrication to planetary gear set and other upper shaft components.

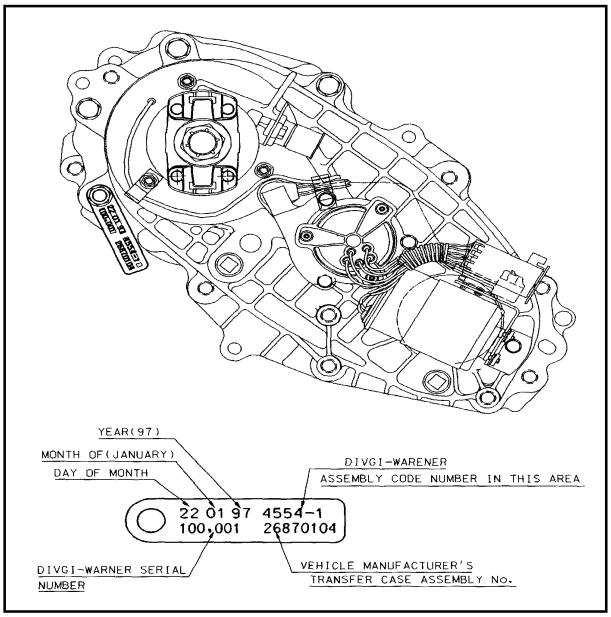
Different drive modes are obtained by rotating selector switch for selection. This in turn gives signal to Electronic Control Unit (ECU). ECU senses the conditions and shifts drive into mode selected.

Control system consists of :

1. Control unit housed below driver's seat or under dashboard
2. Rotary switch provided for selection of different modes
   - 2H
   - 4H
   - 4L
3. Indicator lights on dashboard to indicate the status (4H-4L)

1.1.1 Identification tag

Identification tag is attached to the transfer case at location shown in figure. Manufacturing details are stamped on tag. This information is necessary for ordering replacement spare parts.



1.2 Features and benefits

Part-time system	Allows driver to select two or four wheel drive operation
Light weight construction	Reduces total vehicle's weight to enhance efficiency
Hi-Vo Chain-driven output	Provides quiet four-wheel drive
Upper disconnect to chain	Reduces unnecessary parasitic losses in two-wheel drive
Positive displacement oil pump and filter	Assures full lubrication while driving or towing. Reduces maintenance needs.
Helical gearing	Delivers quiet low-range operation
Four-wheel drive indicator light switch	Indicates four wheel drive for driver's convenience
Selector switch for different modes	Simplifies selection of transfer case operating modes
Electromagnetic shift-on-the-fly	Provides effortless engagement of four wheel drive at highway speeds

1.3 Abbreviations used

2H	Two High Position	Kmph	Kilo meter per hour
2WD	Two Wheel Drive	lb.	Pounds
4H	Four High Position	N	Neutral position
4L	Four Low Position	Nm	Newton meter
4WD	Four Wheel Drive	oz	Ounces
ATF	Automatic Transmission Fluid	RTV	Room Temperature Vulcanizer
Kg	Kilo gram	ECU	Electronic Control Unit
Km	Kilo meters	V	Volts



SPECIFICATIONS - TRANSFER CASE 45-54

2.1 Transfer Case 45-54 technical specifications :

Configuration	Part time, Single Off set
Rear Output Configuration	Fixed Yoke
Front Output Configuration	Fixed Yoke
Input Configuration	Female Spline
Drop Angle	40 degrees
Offset hand	Right hand
High Range Ratio	1 : 1
Low Range Ratio	2.48 : 1
Lubrication System	Forced lubrication by Gerotor pump
Fluid Type	Multigrade oil conforming to ATF to General Motors, Type A, Suffix A specifications.
Housing Material	Aluminium
Dry Weight in kg	29
Oil Capacity in liter	1.2
Shift Pattern	2H - 4H- 4L
Shift Control	Selector switch
4WH Shift-on-the-fly	Optional

EXPLODED VIEW OF TRANSFER CASE

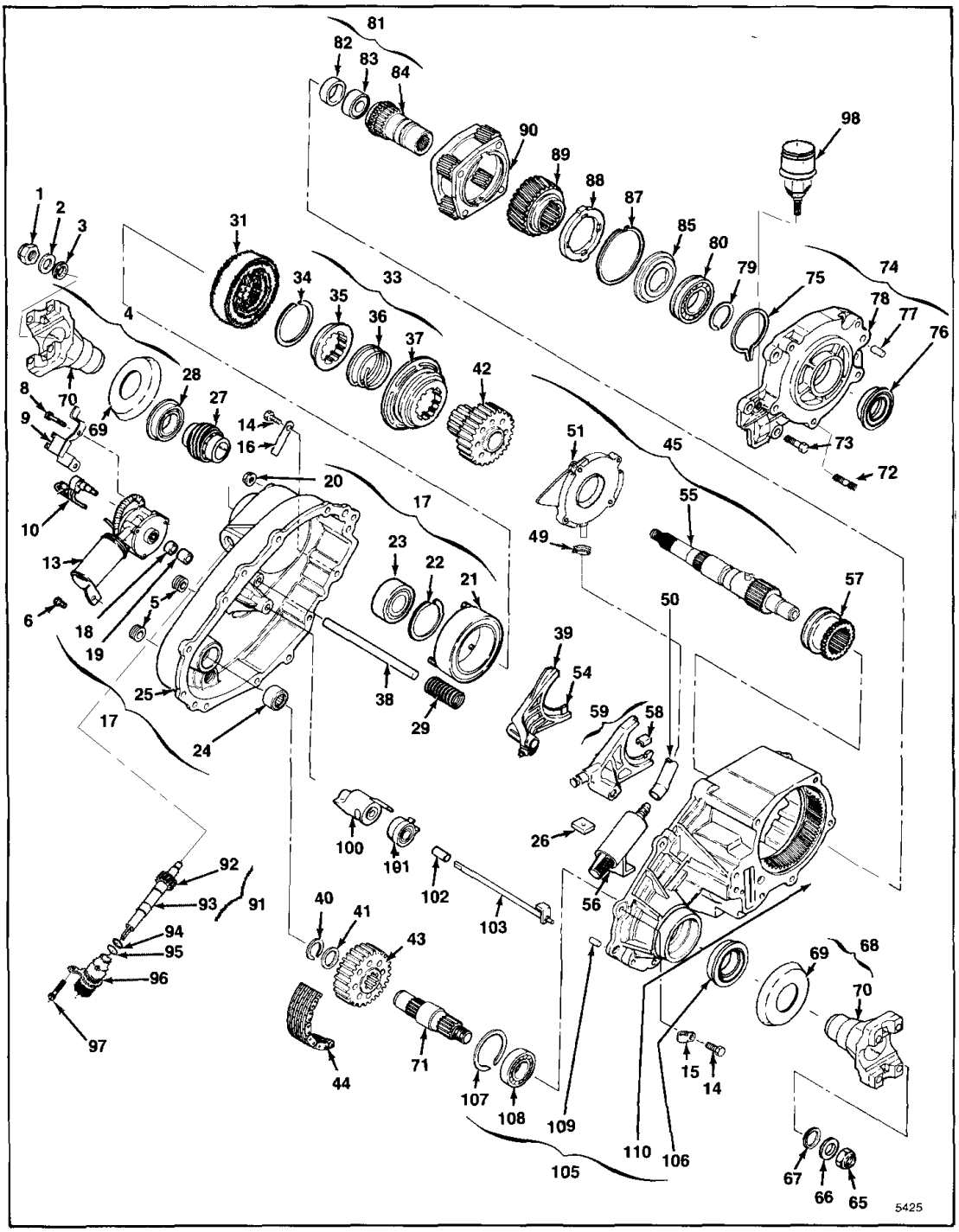


Figure A . 1 : Exploded view with part codes

TRANSFER CASE



Index No.	Part Name	Quantity
1.	Nut	1
2.	Washer	1
3.	Seal	1
4.	Rear Yoke	1
5.	Plug, Pipe	2
6.	Bolt, Hex Head	1
8.	Bolt, Hex Head	3
9.	Bracket, Sensor and Harness	1
10.	Sensor Assembly	1
13.	Motor Assembly	1
14.	Bolt, Hex Head	9
15.	Clip, Wiring Harness	1
16.	Tag Identification	1
17.	Cover Assembly Transfer Case	1
18.	Seal Oil	1
19.	Bearing Sleeve	1
20.	Nut, Hex	3
21.	Coil Assembly, Clutch	1
22.	Ring, Snap	1
23.	Bearing Annular	1
24.	Bearing, Needle	1
25.	Cover, Transfer Case	1
26.	Magnet	1
27.	Gear, Speed (8T)	1
28.	Seal, Oil	1
29.	Spring Return	1
31.	Housing, Clutch	1
33.	Lockup Assembly 2W-4W	1
34.	Ring, Snap	1
35.	Hub, Lockup	1

Index No.	Part Name	Quantity
36.	Spring, Sleeve Return	1
37.	Collar, Lockup	1
38.	Shaft, Rail	1
39.	Fork, Lockup	1
40.	Ring Snap	1
41.	Spacer	1
42.	Sprocket, Drive	1
43.	Sprocket, Driven	1
44.	Chain, Drive	1
45.	Shaft and Pump Assembly	1
49.	Clamp, hose	1
50.	Coupling Hose	1
51.	Gerotor Pump	1
54.	Facing, Lockup fork	2
55.	Assy. Shaft, Output	1
56.	Strainer, Oil	1
57.	Hub, Reduction	1
58.	Facing Reduction Fork	2
59.	Fork Assembly Reduction Shift	1
60.	Pin Roller and Retainer Assembly	1
65.	Nut	1
66.	Washer	1
67.	Seal, Oil	1
68.	Yoke Assembly DC	1
69.	Deflector Dust	1
70.	Yoke DC	1
71.	Shaft, Front Output	1
72.	Stud	5
73.	Bolt, Hex Stud.	6
74.	Adapter Assembly, Front	1

Index No.	Part Name	Quantity
75.	Ring, Snap	1
76.	Seal Oil	1
77.	Pin, Spirol	1
78.	Adapter, Front	1
79.	Ring, Snap	1
80.	Bearing Annular	1
81.	Shaft Assembly, Input	1
82.	Bearing, Bush	1
83.	Bearing, Needle	1
84.	Shaft, Input	1
85.	Washer, Thrust	1
86.	Carrier Assembly, (Complete)	1
87.	Snap Ring	1
88.	Plate, Thrust.	1
89.	Gear, Sun	1
90.	Carrier Assembly, Planet	1
91.	Assembly Speedo Gear & Shaft	1
92.	Gear Speedo Driven	1
93.	Shaft Speedo Driven	1
94.	Seal, Speedo	1
95.	“O” Ring	1
96.	Body, Speedo	1
97.	Bolt	1
98.	Breather Assembly	1
100.	Cam, Electric Shift	1
101.	Spring, Torsion	1
102.	Spacer	1
103.	Shaft, Shift	1
105.	Case Assembly, Transfer	1
106.	Seal, Oil	1

Index No.	Part Name	Quantity
107.	Ring Snap	1
108.	Bearing, Annular	1
109.	Pin, Dowel	2
111.	Case, Transfer	1
112.	Sealing Compound	1
113.	Wire Connector, Electrical Coil	1
114.	Clip Connector, Electrical Coil	1
115.	ECU Module	1
116.	Bracket, Relay Mounting	1
117.	Connector, Three Terminal	1
118.	Connector, Locking Clip	1

LUBRICATION

Precautions

- Before checking or removing oil, warming up the transfer case is necessary. This should be done by driving the vehicle for a short distance.
- Do not use an impact wrench to open or tighten the drain and oil level plugs. This may damage threads in transfer case housing.

3.1 Checking oil level

- Clean oil level plug and surrounding area
- Remove oil level plug and check whether oil is dripping out
- If oil is not dripping out, oil level must be below the required level. Add specified oil to bring it to level till it starts dripping out
- Tighten oil level plug

3.2 Changing

- Clean oil level plug, drain plug and surrounding area
- Place a container to collect oil, under the transfer case
- Remove drain plug
- Remove oil level plug
- Let the oil drain out
- Tighten drain plug
- Fill new oil through oil level plug hole, till it begins to drip out
- Tighten oil level plug

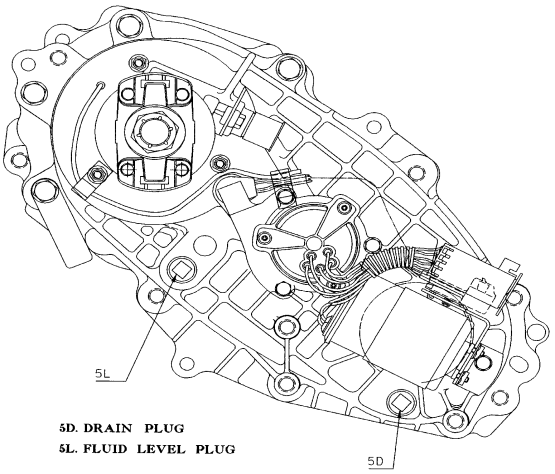


Figure 3.1 : Drain and Fluid level plugs

3.3 Lubrication Schedule

Frequency	Procedure
Every 10,000 km	Check transfer case oil level, if required, top up
Yearly or after every 40,000 km whichever occurs earlier	Change transfer case oil with the specified lubricant

NOTE :
- Use Torque wrench to tighten threaded parts
- Torque Values are specified in Table 6.1, on page 27

TROUBLESHOOTING

4.1 Troubleshooting

Malfunctions of transfer case due to system elements are diagnosed by ECU and indication is given by flashing of both 4H and 4L indicator lights. Refer self diagnosis to identify the cause detected by ECU.

Problem	Possible causes	Remedy
Electric shift problems	Faulty or damaged ECU, speed sensor, clutch or internal wiring	Refer to self diagnosis
	Damaged or worn shift cam, hub, fork and rail shaft	Overhaul and check for wear and damage. Replace if necessary
No front wheel drive when shifted to 4H or 4L	Broken drive chain	Check internal parts and replace if necessary
Noise in 4WD operation	Low oil level/contaminated oil	Top up / change oil
	Loosened bolts or mounting parts	Re-tighten as specified
	Noisy transfer case bearings/parts	Disassemble bearings and parts and check for wear or damage. Replace if necessary Check for wear and damage including speedometer gear and replace if necessary
	Worn or damaged sprockets of drive chain	Disassemble and check for wear and damage. Replace if necessary
	Incorrect tire pressure	Adjust tire pressure
Transfer case oil leakage	Cracked transfer case	Replace the case
	Leakage from other parts	Clean case and parts and check for leakage
	Breather clogging	Remove breather with breather adapter and clean it. Replace if necessary
	Oil level higher than required or improper specification of oil being used	Use specified oil. Adjust oil level
	Loosened sealing bolts	Re-tighten
	Improper specification of sealant or improperly applied sealant	Use specified sealant and re-tighten
	Worn or damaged oil seal	Replace oil seal

REMOVAL AND INSTALLATION

5.1 Removal of transfer case 45-54

1. Disconnect negative terminal from battery
2. Lift up vehicle
3. Remove transfer case drain and level plugs. Drain oil and reinstall plugs
4. Remove breather assembly
5. Disconnect speedometer cable connector, motor connector and sensor connector
6. Support transfer case with jack and disconnect front and rear propeller shafts from transfer case
8. Remove transfer case by removing mounting stud nuts attaching transfer case to transmission

5.2 Installation of transfer case 45-54

Follow procedure in reverse order for installation

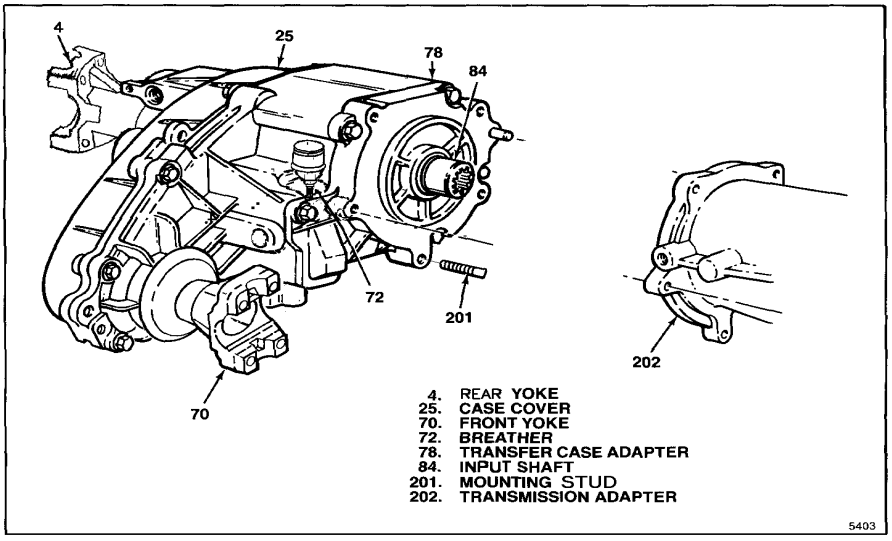


Figure 5.1 : Transfer Case installation

LIST OF SPECIAL TOOLS

LEVEL - I SERVICE (At Dealer Level)

Sr. No.	Tool Description	Telco Part No.
1.	Repair Fixture I	2704 5890 2807 N
2.	Yoke holder	2704 5890 2802 N
3.	Oil seal fitting tool (Motor)	2704 5890 2804 N
4.	Seal driver	2704 5890 2801 N

LEVEL - II SERVICE (At Distributor Level)

Sr. No.	Tool Description	Telco Part No.
1.	Repair Fixture II	2704 5890 2808 N
2.	Yoke holder	2704 5890 2802 N
3.	Oil seal fitting tool (Motor)	2704 5890 2804 N
4.	Seal driver	2704 5890 2801 N
5.	NRB removing fixture (input shaft)	2704 5890 2805 N
6.	Needle bearing puller (Cover)	2704 5890 2809 N
7.	Snap ring pliers (Lower output shaft)	2704 5890 2810 N
8.	Snap rings pliers (Adapter)	2704 5890 2803 N
9.	Drift for ball bearing	2704 5890 2811 N

TORQUE TABLE

Level & Drain Plug	:	(20-30 ft.lb)	2.8 - 4.2 kgm.
Yoke Nut Front	:	(250-275 ft.lb)	34 - 38 kgm.
Case Bolts	:	(20-30 ft.lb)	2.8 - 4.2 kgm.
Breather Adapter	:	(6-14 ft.lb)	0.8 - 1.9 kgcm.
Motor Mount	:	(6-8 ft.lb)	0.8 - 1.1 kgcm.
Motor Bracket	:	(6-8 ft.lb)	0.8 - 1.1 kgcm.
Clutch Coil Nut	:	(6-8 ft.lb)	0.8 - 1.1 kgcm.
Rear Output Yoke Nut	:	(250-275 ft.lb)	34 - 38 kgm

DISASSEMBLY, INSPECTION, CLEANING AND ASSEMBLY

6.1 Disassembling

End Yoke

1. Holding end yoke by yoke holding tool, remove nut and washer and then remove end yoke
2. Remove the two plugs from the cover
3. Remove bolt and remove speedo assembly

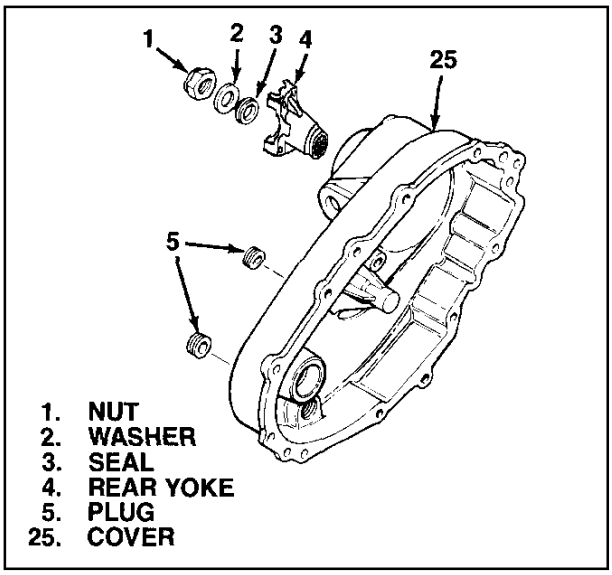


Figure 6.1 : Yoke Group

External electric shift parts

1. Remove bolt/washer holding motor assembly.
2. Remove 3 bolts holding sensor and harness bracket.
3. Remove sensor assembly and remove O-ring from speed sensor.
4. Remove motor assembly.

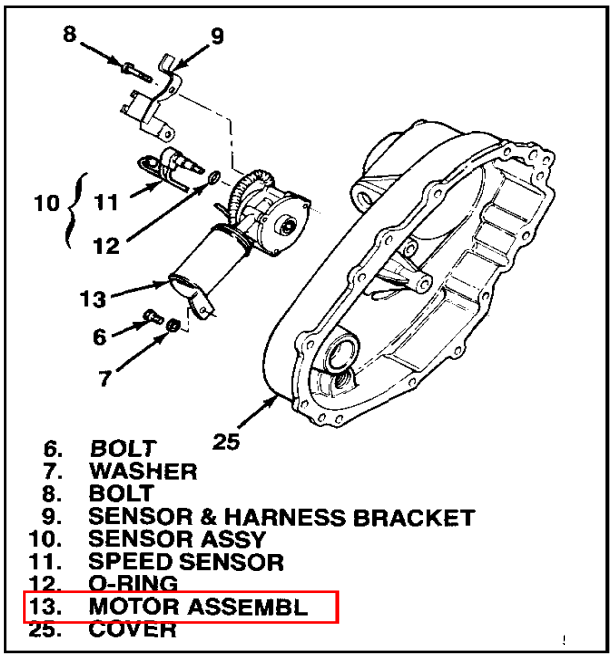


Figure 6.2 : External Electrical Shift Parts

Cover assembly

1. Remove 9 bolts holding transfer case cover to housing, wiring harness clip and identification tag.
2. Pry and disconnect sealant bond of cover and transfer case in such a way that metal surface of cover & housing is not damaged.
3. Remove oil seal, bearing, 3 nuts holding clutch coil assembly of electric shift unit.
4. Remove snap ring and pull out ball bearing from cover. Remove speedo drive gear.
5. Pull out needle bearing from cover.
6. Pull out oil seal from cover
7. Remove magnet from its slot in the case.
4. Remove return spring from rail shaft
5. Clean and remove sealant from cover and case. Be careful not to damage metal surface.

Note : Identification tag has information related to ordering of spare parts. Preserve it carefully.

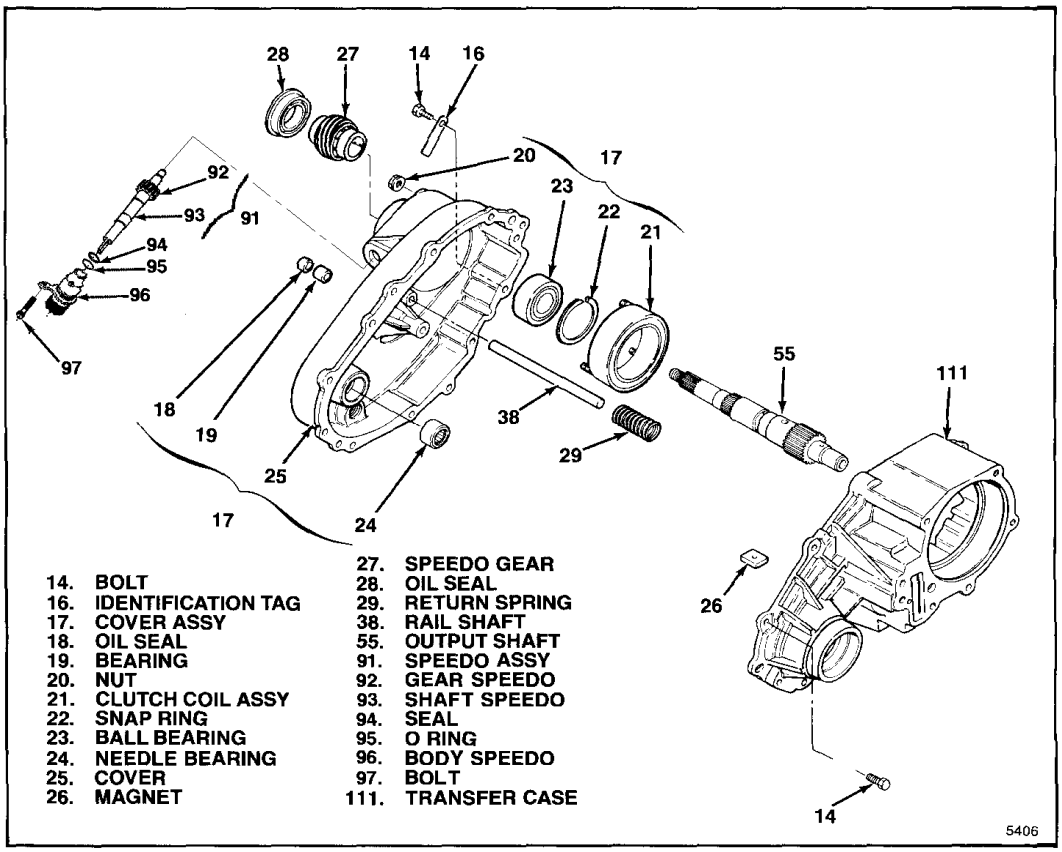


Figure 6.3 : Cover Assembly

Lock up shift parts

1. Remove snap ring and clutch housing assembly.
2. Separate 2WD and 4WD lock up assembly and lockup fork from rail shaft
3. Remove snap ring, lock up hub and return spring from lock up collar.

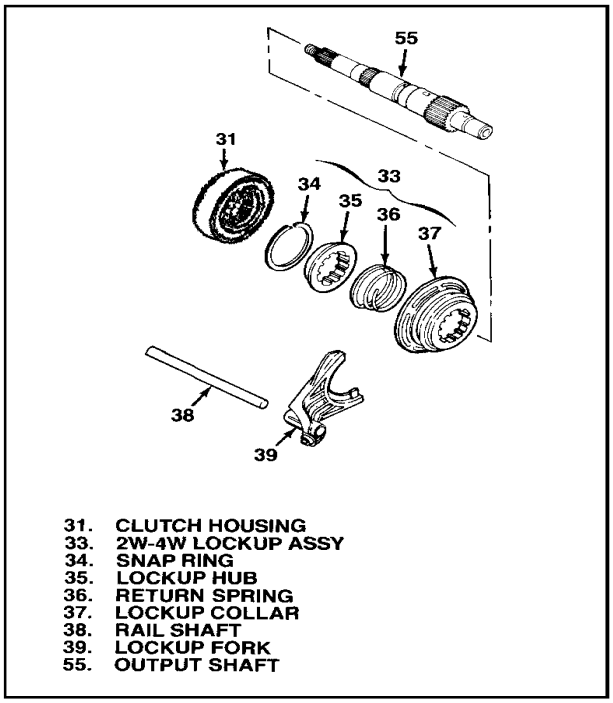


Figure 6.4 : Lock up Shift parts (Electrical shift)

Drive chain

1. Remove snap ring and spacer from the output shaft (front)
2. Remove drive chain, driven sprocket and drive sprocket from output shaft (front)
3. Separate chain from sprocket during removal.

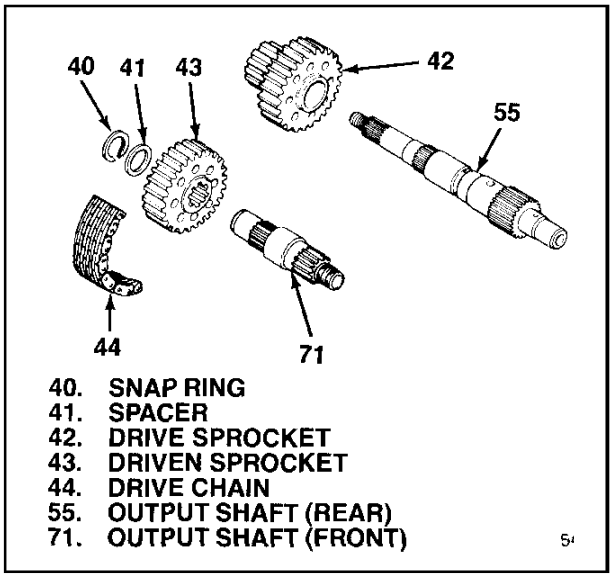


Figure 6.5 Chain Drive

Gerotor pump assembly

1. Loosen hose clamp and remove hose coupling from pump housing.
2. Remove hose clamp, hose coupling and strainer.
3. Take output shaft (rear) with gerotor pump.
4. Separate pump and output shaft.

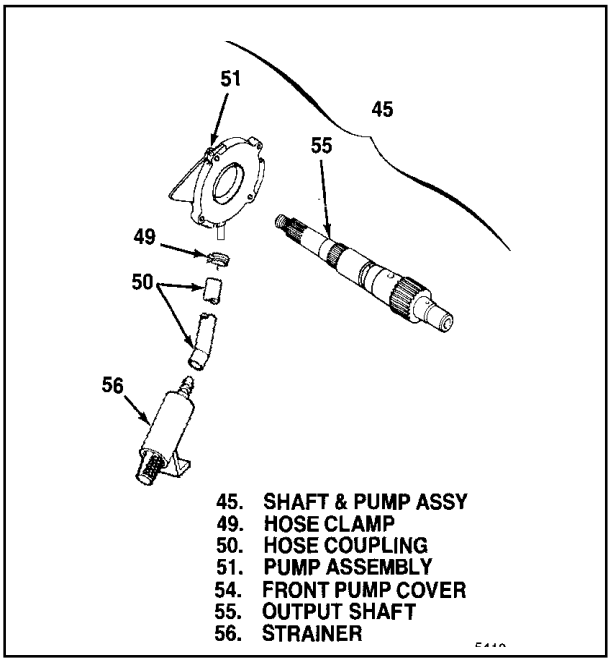


Figure 6.6 Gerotor Pump

Reduction shift parts

1. Remove reduction hub and reduction fork assembly from case.
2. Remove shift fork facings (2 nos.) from shift fork.

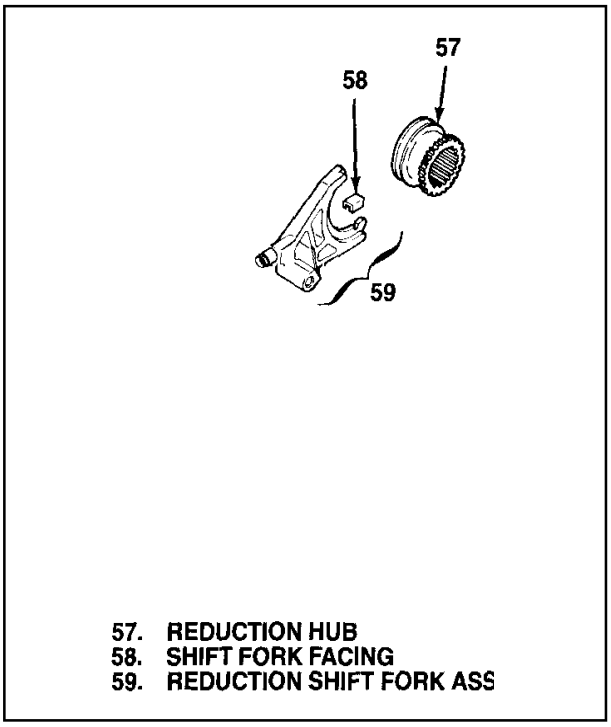


Figure 6.7: Reduction Shift Parts

Front output assembly

1. Holding end yoke with yoke holder, remove nut and washer. Remove end yoke and seal.
2. Separate end yoke and deflector. Remove output shaft

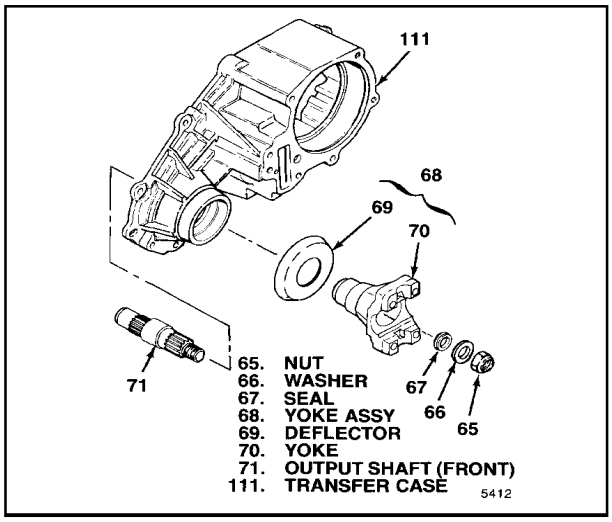


Figure 6.8 : Front out put shaft Assembly

Adapter Input and carrier gear

1. Remove breather and adapter
2. Remove six bolts
3. Remove adapter by separating adapter sealer bond (pry front adapter, take care not to damage the adapter or case).
4. Remove adapter assembly, input shaft assembly and carrier gear assembly.
5. Remove snap ring and oil seal from front adapter.
6. After removing snap ring, pull out bearing and thrust washer from input shaft assembly and separate input shaft assembly from carrier group assembly.
7. Remove needle bearing and sleeve bearing from input shaft assembly.
8. Remove retainer ring, thrust plate and sun gear from planet carrier assembly. Do not disassemble planet carrier assembly.

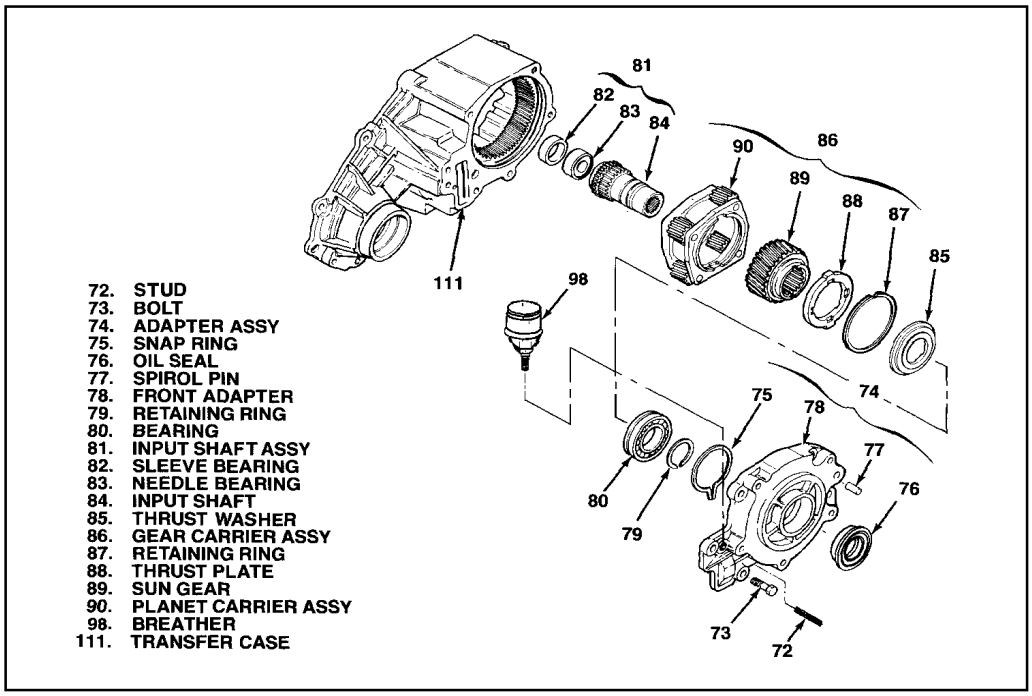
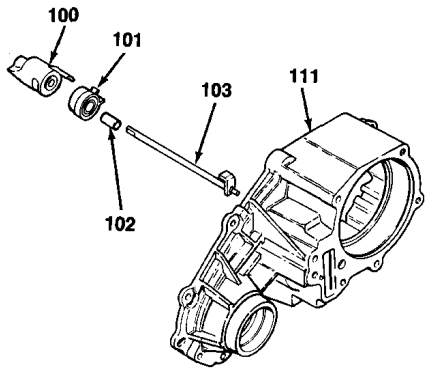


Figure 6.9 : Adapter, input shaft and gear carrier group

Electric shift cam parts

1. Remove electric cam shift parts from case assembly.
2. Separate electric shift cam from shift shaft.
3. Holding shift shaft in a soft jaw, remove torsion spring and spacer from shift shaft using a 1/2" screw driver.

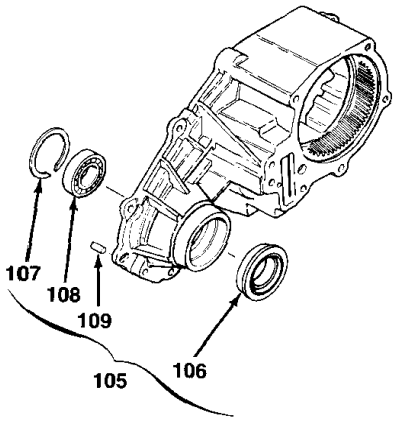


100. ELECTRIC SHIFT CAM
101. TORSION SPRING
102. SPACER
103. SHIFT SHAFT
111. TRANSFER CASE

Figure 6.10 : Electric shift cam part

Transfer case assembly

1. Remove oil seal.
2. Remove retaining ring and ball bearing.
3. Remove the pin from transfer case.
   (Do not remove Ring Gear)



105. TRANSFER CASE ASSEMBLY
106. OIL SEAL
107. RETAINING RING
108. BALL BEARING
109. DOWEL PIN

Figure 6.11 : Transfer Case

6.2 Cleaning

Note : Before cleaning, check magnet for presence of metal particles which indicate internal chipping of transfer case.

1. Using a cleaning solvent, clean old oil and dirt deposits.
2. After cleaning, dry parts with low pressure (20 psi maximum) compressed air.
3. Lubricate ball bearings and needle bearing with ATF oil. Protect lubricated bearings from dust.

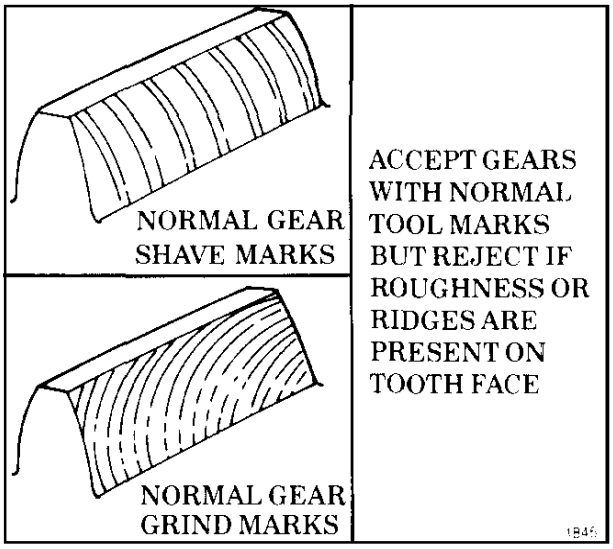


Figure 6.12 : Normal Gear tooth tool marks

6.3 Inspection

1. Visually check all parts for damage.
2. Referring to normal gear tooth face, specifically inspect uneven wear and chips of gear tooth. Replace if necessary.

Note : Always replace hose couplings, O-rings and oil seals with new parts.

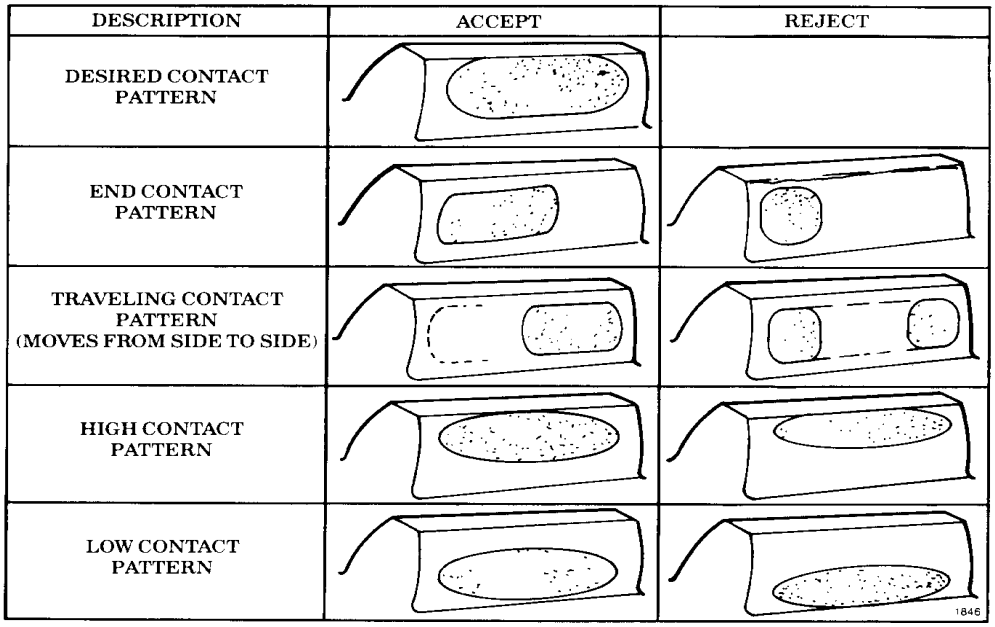


Figure 6.13 : Gear tooth contact pattern

6.3.1 Inspection terms

Burr	Local rise of material forming protruding sharp angle
Chip	An area from which a small fragment has broken off or cut
Crack	Surface break of line nature indicating partial or complete separation of material.
Excessive wear	Heavy or obvious wear beyond expectations, considering conditions of operation.
Indentation	Displacement of material caused by localized heavy contact
Galling	Breakdown of metal surfaces because of excessive friction between parts. Particles of the soft material are torn loose and welded to the harder material.
Nick	Local break or notch. Usually displacement of material rather than loss.
Scoring	Tear or break in metal surface from contact under pressure. May show discoloration caused because of heat generated by friction
Step wear	Heavy wear that produces step that can be seen or felt between adjacent contact and non-contact surfaces.
Uneven wear	Condition of localized, unevenly distributed wear. Includes hollows, shiny spots, uneven polish and other visual conditions.

6.4 Assembling

General information

- Do not use hammer to drive in oil seal and bearing. Use special tools for assembly of oil seals and bearings (described in Appendix B)
- Torque values are specified in Table 6.1 on page 27.
- Lubricate bearings, oil seals, O rings, bushings and matching metal parts before assembly.

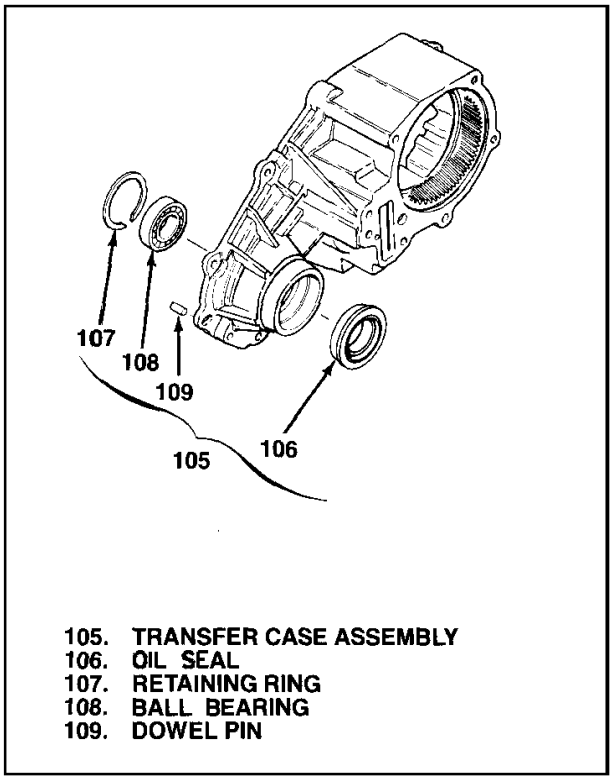


Figure 6.14 : Transfer case Assembly

Transfer case

1. Insert new dowel pins (2 nos.) in transfer case.
2. Insert ball bearing into the case and install retaining ring.
3. Install new oil seal, by pressing it into case.
4. Make sure that all parts are correctly and firmly installed into case.

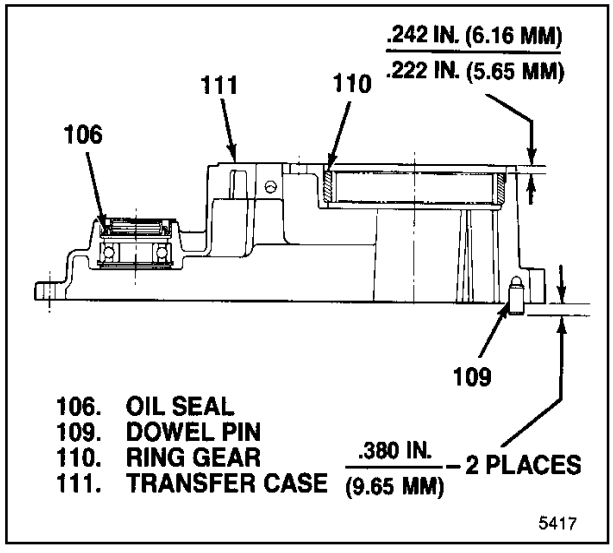


Figure 6.15 : Installing parts in Transfer case

Electric shift cam parts

1. Insert spacer into torsion spring.
2. Insert end of the shift shaft into spacer.
3. Slide torsion spring and spacer to the left of shift shaft and position end of first spring to fix on drive tang (figure 6.17).
4. Push the end of second spring to right and fix it on drive tang (figure 6.18).
5. Push torsion spring and spacer back together and fix them (figure 6.19).
6. Slide electric shift cam onto shift shaft.
7. Install electric shift cam assembly into transfer case after installation of shift fork.

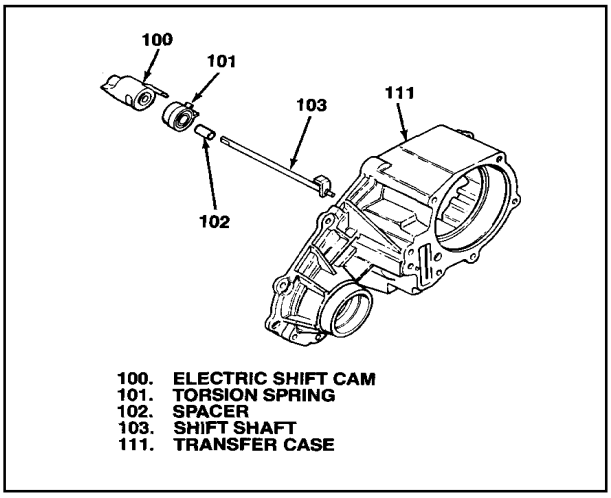


Figure 6.16 : Electric shift cam parts

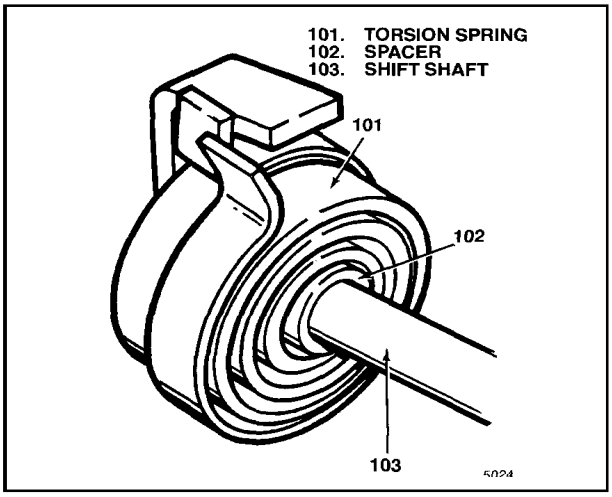


Figure 6.17 : Installing first spring end

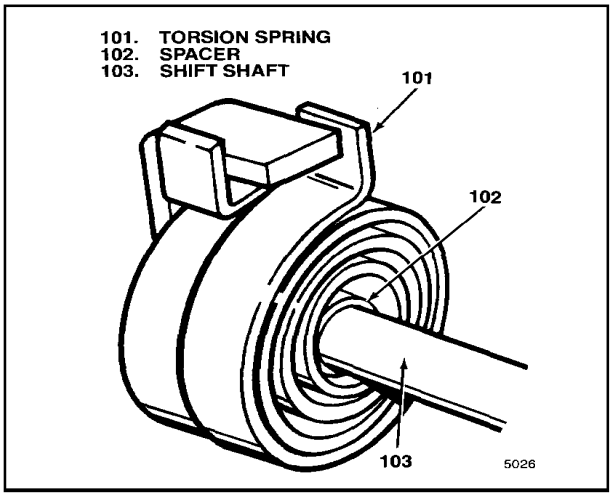


Figure 6.19 : Complete Spring assembly

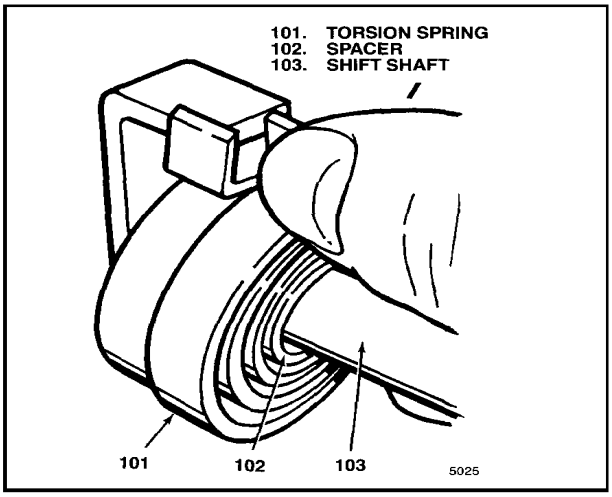


Figure 6.18 Installing second spring end

Adapter, input shaft and carrier

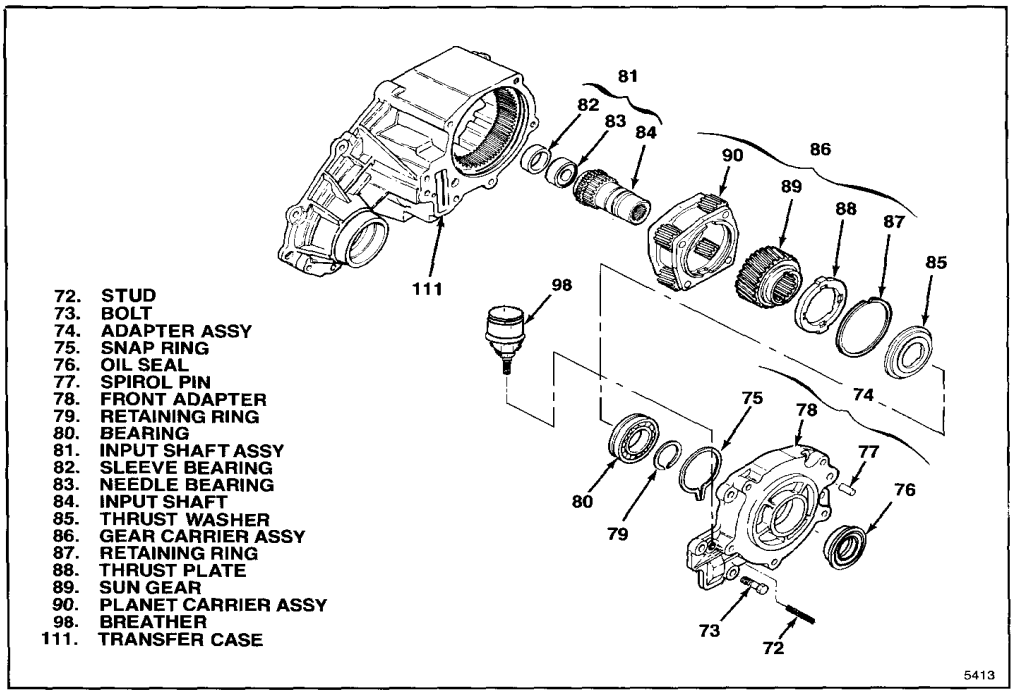


Figure 6.20 : Adapter, input shaft and gear carrier group

1. Place planet carrier assembly on a work bench such that retaining ring's mounting groove faces upward.
2. Install sun gear with the hub end up into planet carrier assembly. Rotate sun gear to make sure that gears are fully meshed.
3. Align tabs and install thrust plate into planet carrier assembly.
4. Install retaining ring to planet carrier assembly.
5. Press needle bearing and bearing sleeve into input shaft assembly (figure 6.21). Use new bearing sleeve.
6. Install planet carrier assembly onto input shaft and install thrust washer. Press the bearing over input shaft.
7. Install retaining ring.
8. Press spirol pin into front adapter.

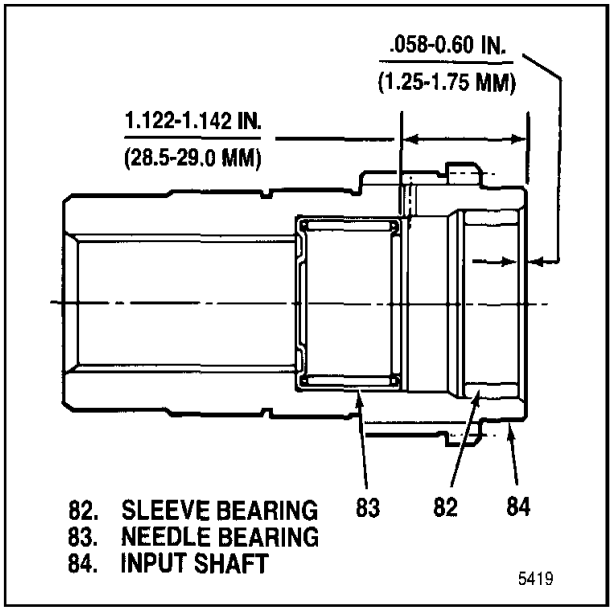


Figure 6.21 Input shaft assembly

9. Press oil seal into front adapter (figure 6.22).
10. Install front adapter assembly. Make sure that snap ring is correctly installed into the groove.
11. Position input shaft assembly over front cover and engage into bearing groove by expanding the ends of snap ring
12. Apply 1.6 mm bead of sealant on mounting face for transfer case and tighten six bolts.
13. Install breather with adapter.

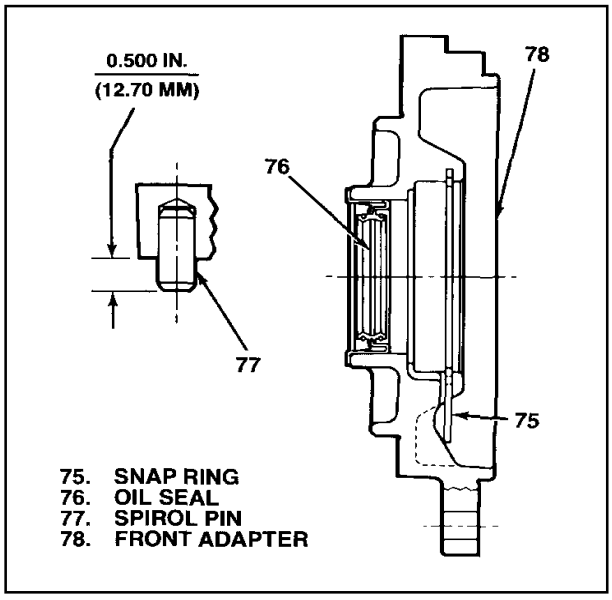


Figure 6.22 : Front adapter assembly

Front Output shaft

1. Press the deflector onto yoke (figure 6.23)
2. Position output shaft in transfer case and install end yoke assembly, seal, washer and nut.
3. Holding end yoke, tighten the nut.

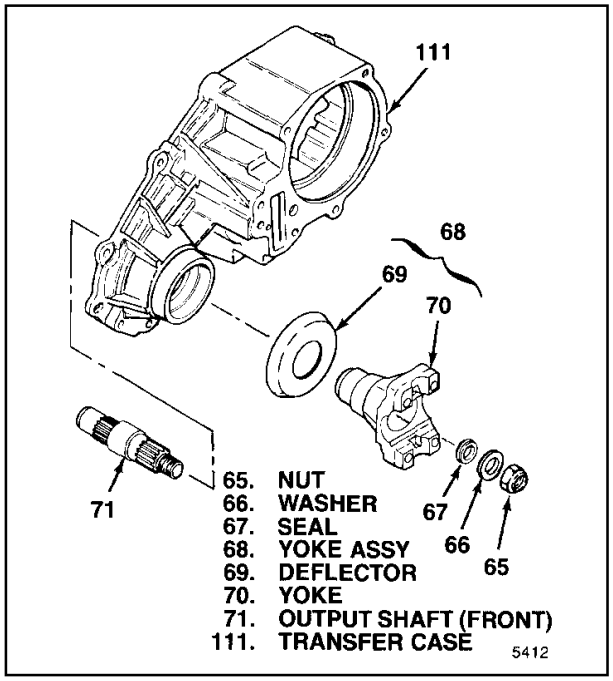


Figure 6.23 : Front output shaft assembly

Reduction shift parts

1. Install new pin, roller into reduction shift fork.
2. Press pin, roller into reduction shift fork bore. Ensure that cam roller turns freely
3. Install fork facings (2 nos.) on reduction shift fork assembly.
4. Install reduction shift fork onto reduction hub in transfer case.
5. Install output shaft spline into reduction hub and engage output shaft end with input shaft bearing.

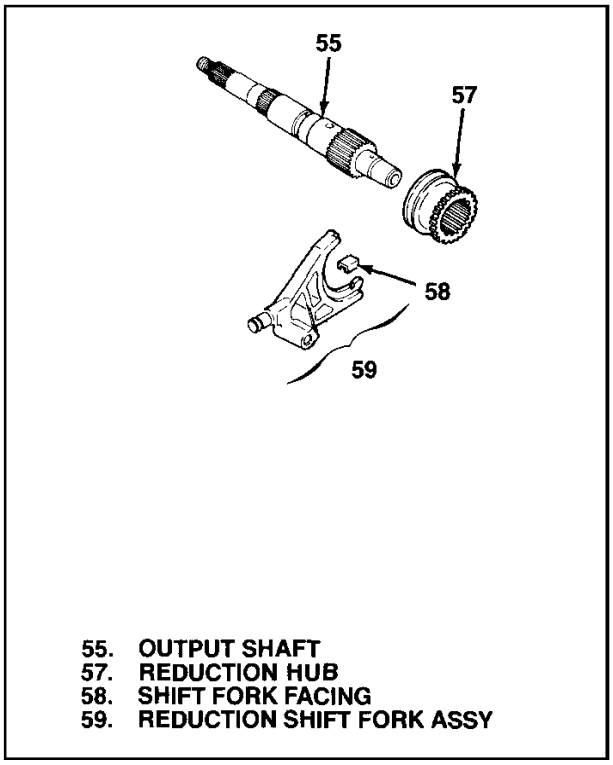


Figure 6.24 : Reduction shift parts

Gerotor pump assembly

1. Fit the pump pin in output shaft.
2. Slide pump assembly on output shaft over pump pin.
3. Slip hose clamp over free end of hose coupling with strainer and push onto hose barb on pump and tighten.

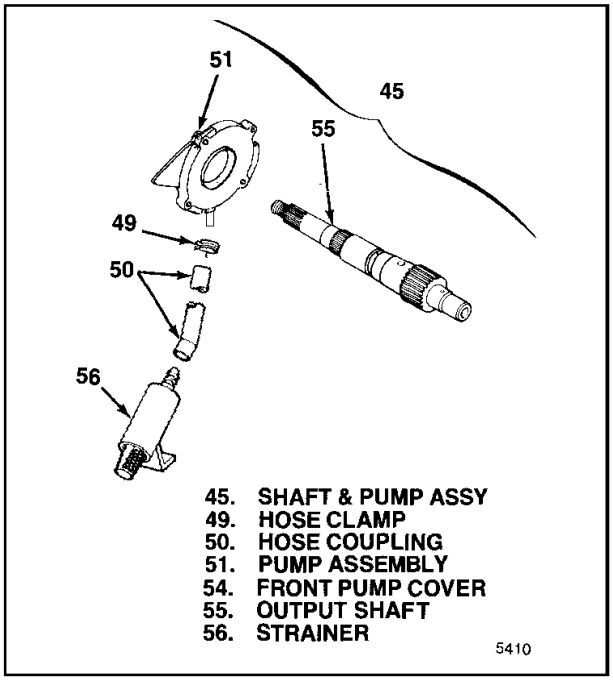


Figure 6.25 : Gerotor pump assembly

Drive Chain

1. Position drive sprocket to rear output shaft end and driven sprocket to front output shaft end.
2. Install drive chain onto sprocket.
3. Holding each sprocket with drive chain tight and parallel with transfer case, install the drive chain assembly to output shaft.
4. Rotate driven sprocket slightly to engage splines on front output shaft.
5. Install spacer to front output shaft and insert snap ring into the groove over spacer.

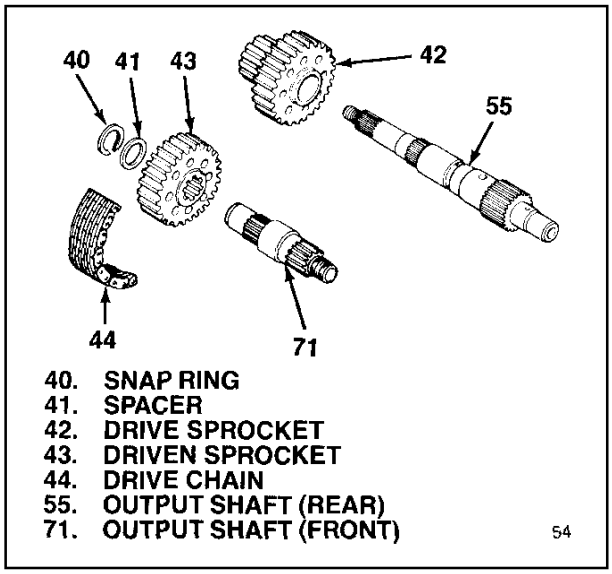


Figure 6.26 : Chain Drive

Lockup shift

1. Install lockup hub and return spring to the lock up collar and insert snap ring.
2. Install rail shaft through reduction shift fork assembly and into the blind holes in case.
3. Engage lockup fork in 2WD-4WD groove and check operation.
4. Install electric shaft cam and assemble clutch housing as follows (figure 6.28).
   - Rotate shift cam assembly to right so that the end of torsion spring contacts with reduction shift fork inside.
   - Holding rail shaft, lift up fork assembly slightly. Adjust electric shift cam assembly so that the roller on reduction shift cam assembly is in groove in shift cam and button on lockup fork is on cam end.
   - Install clutch housing assembly.

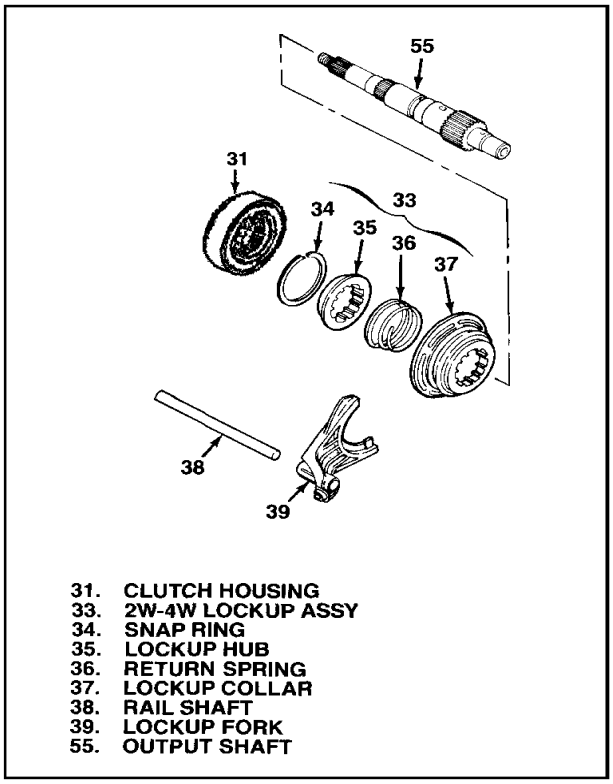


Figure 6.27 : Lockup shift parts

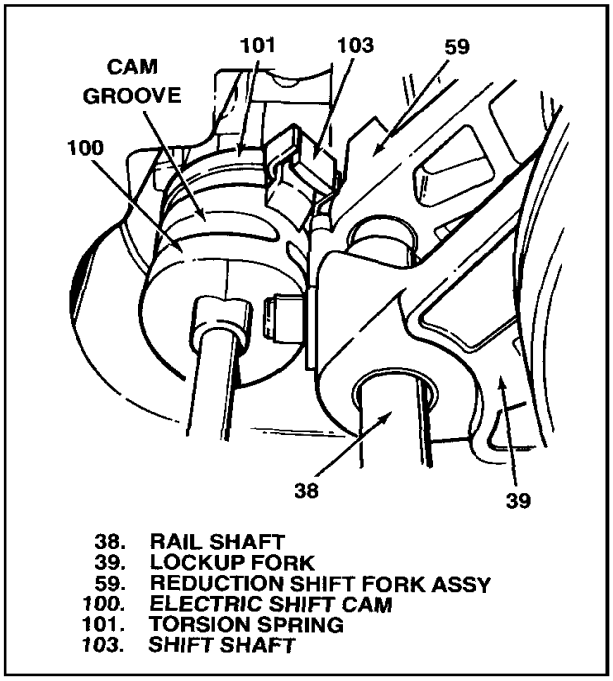


Figure 6.28 : Electric shift cam installation

Cover

1. Position the cover with open end facing up on the table.
2. Position needle bearing with identification mark up and press into the cover until upper end of bearing is 40.47 - 40.97 mm below cover face.
3. Press ball bearing into cover and install snap ring.
4. Install remaining parts as follows
   - Install four O-rings on stud bolts of clutch coil assembly.
   - Install clutch coil assembly inside the cover and tighten three nuts.
   - Install bearing and motor bearing into the cover.

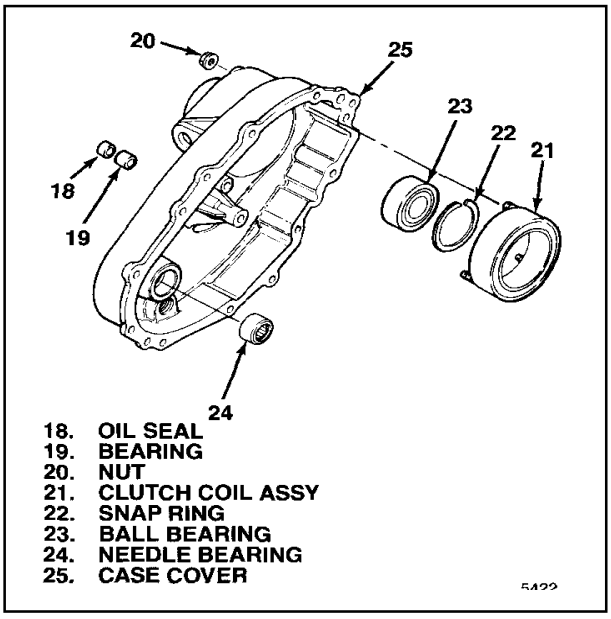


Figure 6.29 : Cover assembly

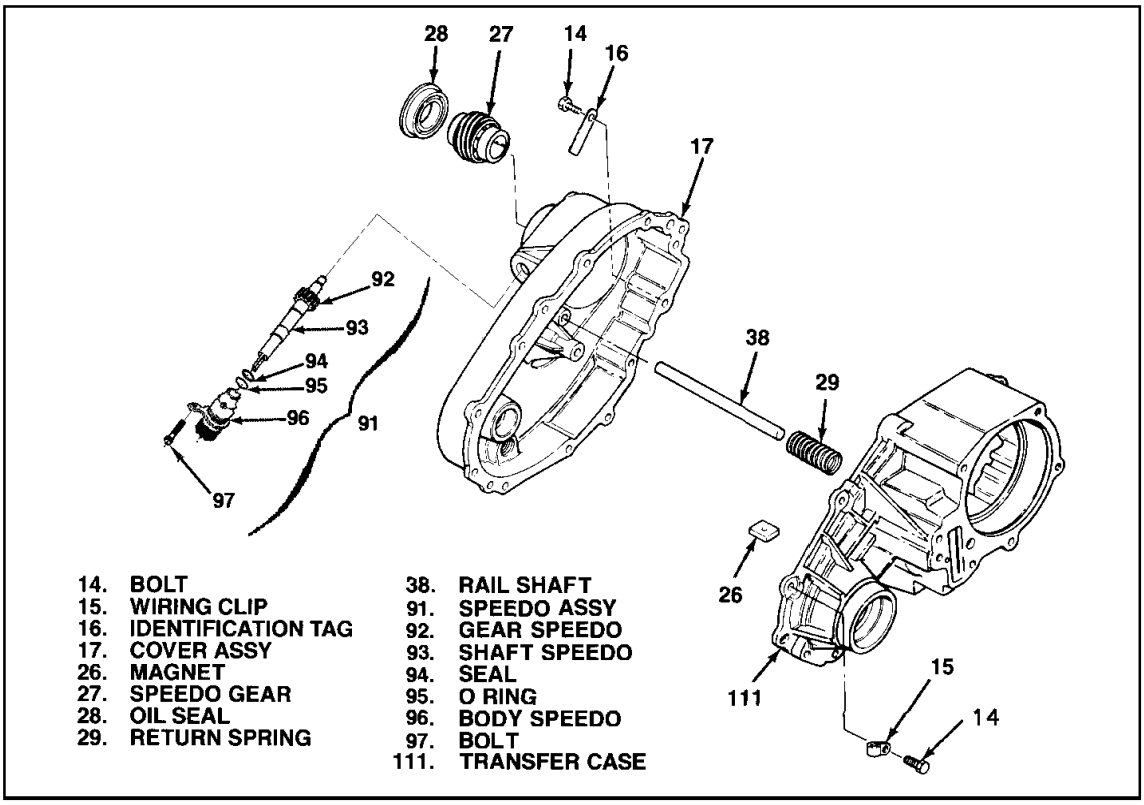


Figure 6.30 : Cover installation

Cover assembly

1. Install return spring over rail shaft in transfer case.
2. Insert magnet into transfer case slot.
3. Apply 1.6 mm bead of Loctite RTV598 to transfer case mounting surface. For installation of cover, align transfer case with cover. Do not use excessive force.
4. Install the cover into transfer case as follows:
   - Align cover holes with transfer case dowel pins.
   - Align cover bearings with output shafts.
   - Align the cover blind hole with rail shaft and make sure that return spring is not cocked.
5. Tighten nine bolts positioning identification tag and wiring clip.
6. Install speedo gear over output shaft spline in cover assembly.
7. Press new oil seal into cover assembly.

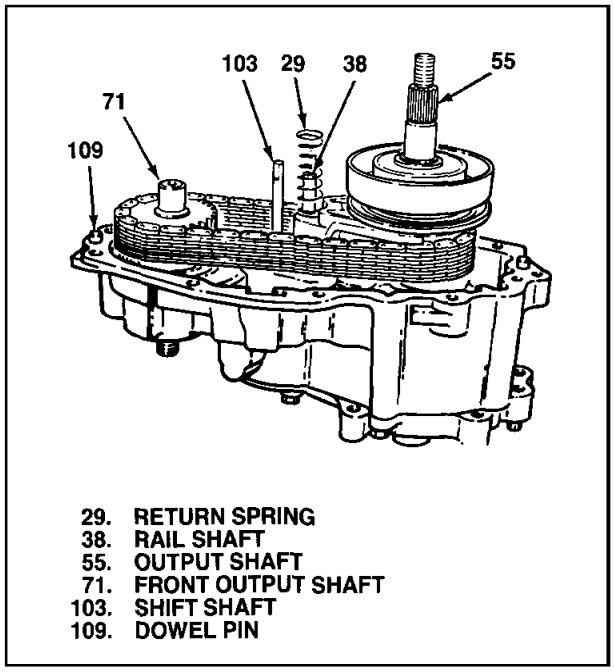


Figure 6.31 : parts to be aligned with the cover

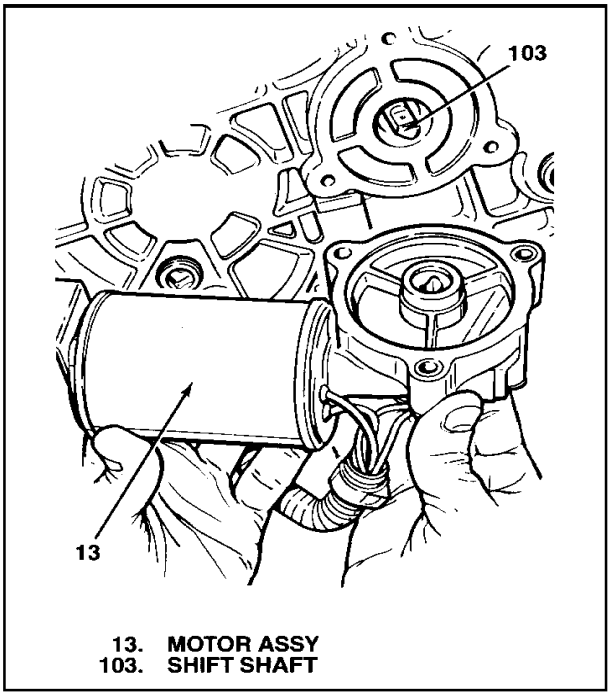


Figure 6.32 : Motor assembly alignment

External electric shift

1. Align motor with shift shaft and position motor assembly onto the cover (figure 6.32).
2. Install the motor to shift shaft and contact cover. Rotate the motor clockwise direction to check correct engagement.
3. Insert O-ring on speed sensor and install speed sensor assembly to cover.
4. Install the bracket to motor assembly and tighten three bolts (figure 6.33).

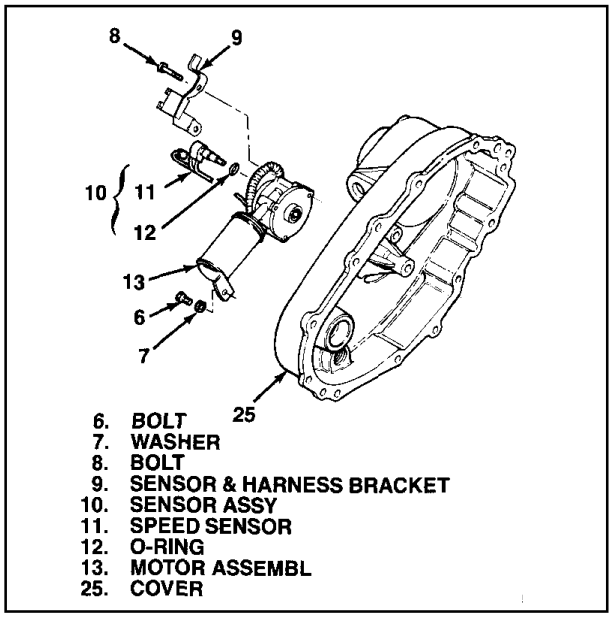


Figure 6.33 : External electric shift parts

End yoke

1. Install two plugs to cover (figure 6.34).
2. Install end yoke, seal and washer.
3. Holding end yoke tighten nut.

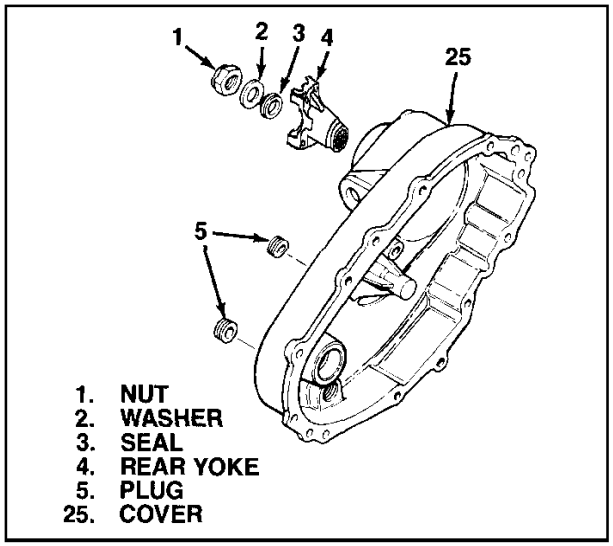


Figure 6.34 : Yoke Group

Note : Apply Locitte 262 to nut before installation.

ELECTRONIC CONTROL UNIT

7. 1 Description

Electronic Control Unit (ECU) is located under co-driver's seat or under dashboard. Driver operates a selector switch to shift the drive from two-wheel drive to four-wheel drive (and vice versa). Shifting during driving is possible only between 2H & 4H modes.

Interconnections between ECU and other system blocks are shown in Figure 7.1

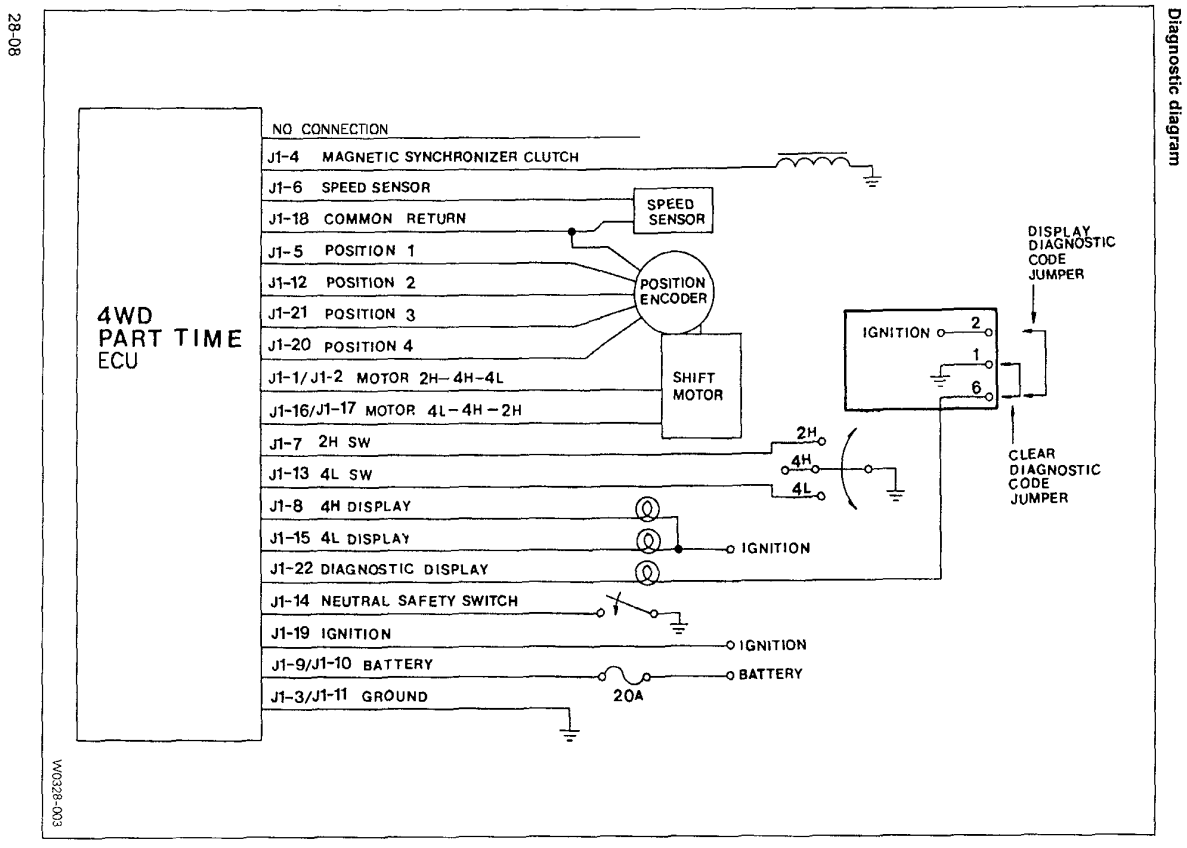


Figure 7.1 : wiring schematic

7.2 Operating transfer case:

1. Shifting from 2WD to 4WD
   - Shift selector switch mode from 2H to 4H. 4WD HI indicator light will turn On
   - Shifting is possible during driving

2. Shifting from 4WD to 2WD
   - Shift selector switch mode from 4H to 2H. 4WD HI indicator light will turn Off
   - Shifting is possible during driving

3. Shifting from 4H to 4L
   - Stop the vehicle
   - Apply clutch
   - Shift selector switch mode from 4H to 4L. 4WD LO indicator light will turn On

4. Shifting from 4L to 4H
   - Stop the vehicle
   - Apply clutch
   - Shift selector switch mode from 4L to 4H. 4WD HI indicator light will turn On

Note : In case of malfunctioning in shifting, 4WD HI and 4WD LO indicator lights will flash.

Important Note :

1. Do not march the vehicle till 4H/4L indicator lamp stops blinking.
2. Disengage the hub lock by shifting the vehicle in 2H mode for servicing. Make sure that ehe hand brake is 'Engaged'

Caution :

Do not engage 4H/4L on tarmac roads / hard surfaces like concrete road or floors.

Auto Hub lock functioning :

a) Locks automatically after shifting to 4H/4L.

b) To unlock / free wheeling (From 4H/4L to 2H) reverse the vehicle (if in forward gear) OR forward the vehicle (if in reverse gear).



7. 3 Self diagnosis of ECU:

ECU detects transfer case system malfunctions and indicates through flashing indictor lights. Operator will be alerted of fault condition by continuous illumination of both 4WD HI and 4WD LO lights when ignition is On.

A service connector is provided to indicate fault codes in binary. Connect one end to the pin hole number 22 in ECU connector, and other end to ignition switch. Flashing of indicator light will show defective code (as illustrated in the table). Identify malfunctioning part and replace it.

L1	L2	L3	Binary code	Decimal equivalent	Fault with
Off	Off	On	001	1	ECU Module
Off	On	Off	010	2	Shift Motor
Off	On	On	011	3	Synchronizer Clutch
On	Off	Off	100	4	Speed Sensor
On	On	Off	110	6	Selector switch
On	On	On	111	7	Motor Position Switch

If only one part is malfunctioning, indicator light will display defective code three times continuously. If more than two parts are malfunctioning, first malfunctioning part will be displayed three times and then other malfunctioning parts will be displayed.

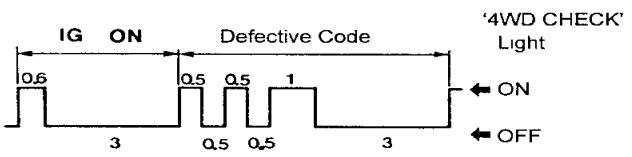
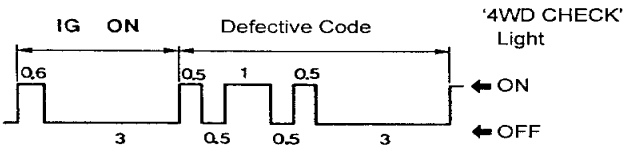
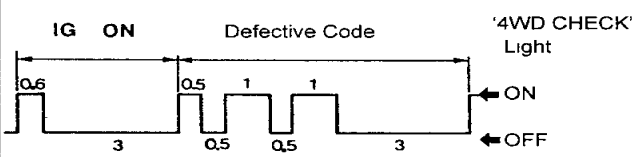
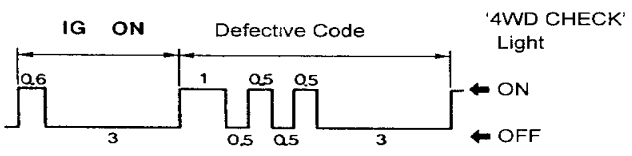
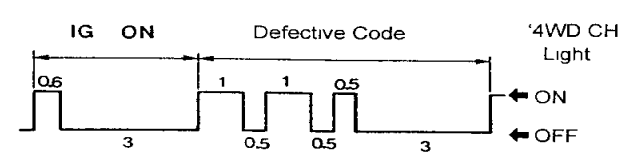
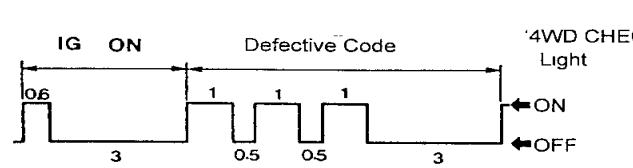
After repair, clear the fault stored in memory. Ground the service connector and keep ignition 'On' for five seconds continuously to erase defective code.

Note :

- **Before replacing malfunctioning parts as indicated by system, check wires and connectors for proper condition.**
- **Use only 12v 3-watt bulb for diagnostic purpose.**

Diagnostic Table

Connect a service connector as described earlier. Turn ignition switch On. 4WD CHECK indicator will turn On for 0.6 seconds and turn Off for 3 seconds. Then it will display a defective code 3 times continuously.

No.	Defective Code	Malfunctioning Part
1		E C U
2		Shift Motor
3		Synchronizer Clutch
4		Speed Sensor
6		Selector Switch
7		Motor Position Sensor

28-06

Figure 7.2 : Defect code diagram

ELECTRIC SHIFT ASSEMBLY

Electric shift assembly is externally attached to transfer case. Disassembling and assembling procedure is covered in Chapter 6. This chapter explains operation of these parts.

8.1 Electric shift assembly parts

Electric shift assembly consists of

1. Activating Motor
2. Sensor
3. Speed Sensor
4. ECU
5. Selector Switch
6. Magnetic Synchronizer Clutch

8.2 Functioning of electric shift assembly

Motor : It is used to turn the shift shaft. Shaft rotates in steps.

Position Sensor : It senses the position of shaft and thus the operating mode of transfer case.

Speed sensor : It is a rotary encoder embedded in transfer case. It is not a user serviceable part. In case of any problem, entire assembly has to be replaced.

ECU : Refer page 33 for details.

Selector Switch : To shift transfer case in different modes.

Magnetic Synchronizer Clutch : Electromagnetic sub-component of the transfer case, controlled by ECU and used for shifts from 2H to 4H.

ACCELERATOR CABLE & IDLING ADJUSTER CABLE



Introduction

FIP lever is operated by accelerator cable. One end of cable is connected to accelerator pedal & other end to FIP lever.

Engine speed is controlled by travel of FIP lever, which is actuated by accelerator pedal through cable.

Engine idling speed, if required, can also be adjusted by operating idling speed adjuster knob. This provision is given to increase fuel flow to the system, which is required for cold start conditions.

This mechanism is operated by a cable connecting idling adjuster knob & FIP lever.

If this device is used, adjuster knob has to be brought back to normal idling position after engine warms up.

ACCELERATOR /IDLING ADJUSTER CABLE

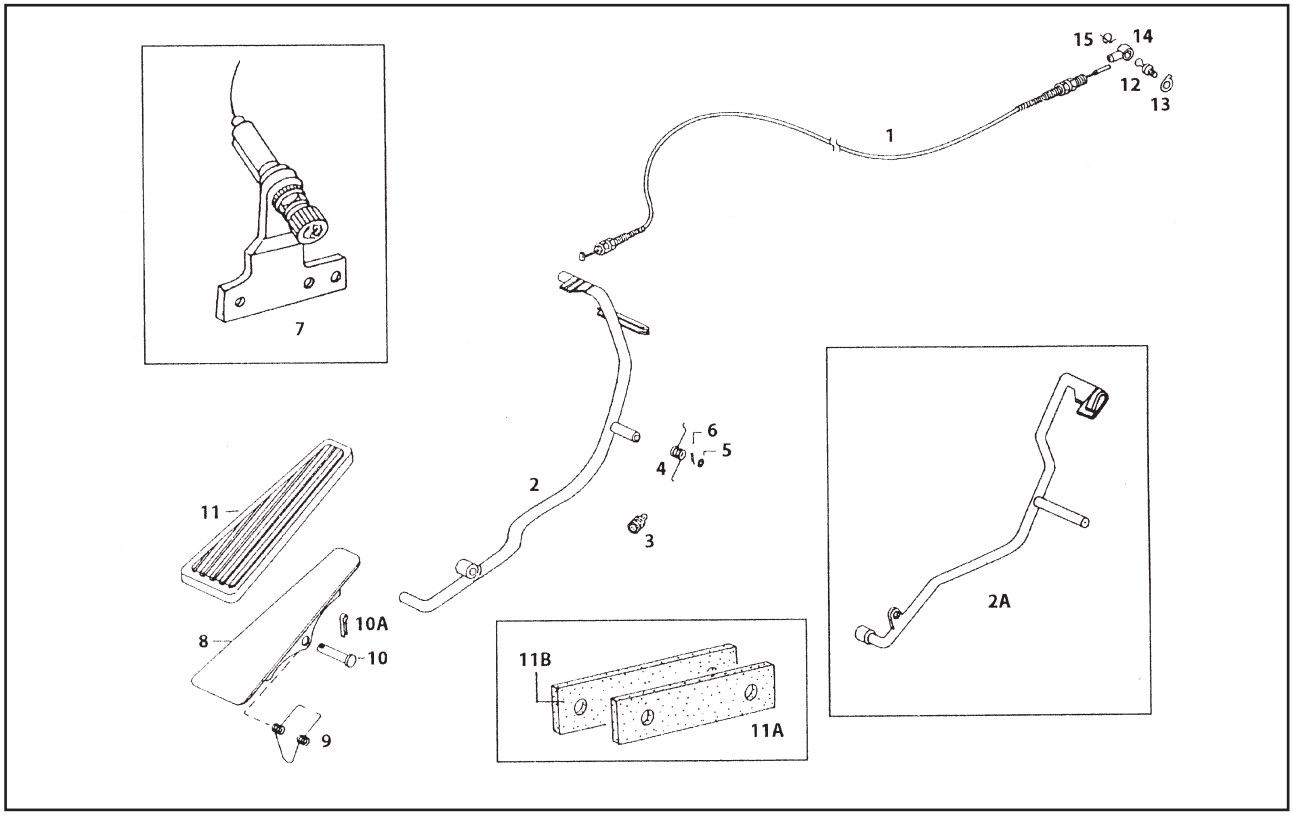


Fig. 1

Description

1	Assy. Accelerator Cable
2	Assy. Accelerator Pedal Rod Complete - LHD
2A	Assy. Accelerator Pedal Rod Complete - RHD
3	Rubber Stopper
4	Spring (for Accelerator Rod)
5	Spacer
6	Split Pin 3.2 x 16 IS549 SS8451-8C
7	Assy. Idling adjuster cable with bracket
8	Assy Pedal Plate
9	Spring
10	Clevis Pin (Acc. Control)
10A	Split Pin 1.6 x 10
11	Rubber Cover
11A	Packing Foam
11B	Packing Foam
12	Ball Pin C10
13	Lock Plate
14	Ball End Assy B10
15	Locking Ring 10

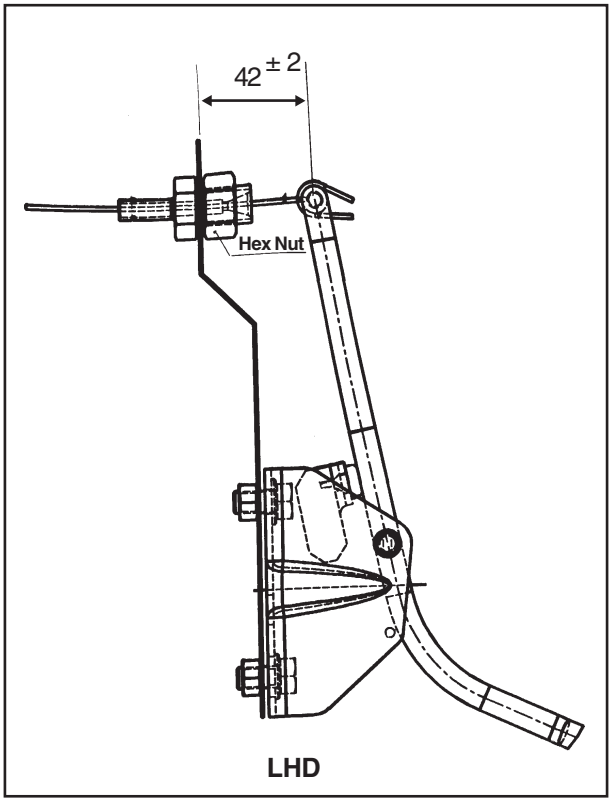


Fig. 2

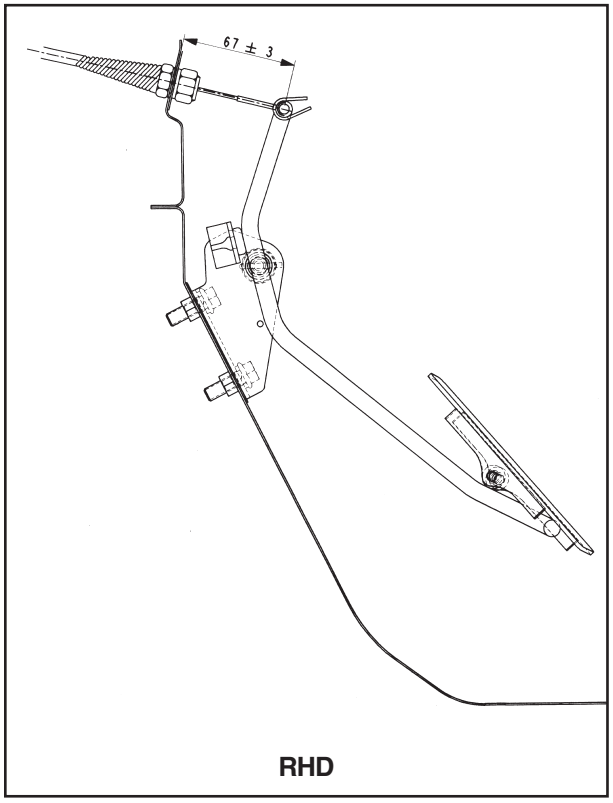


Fig. 3

INSTALLATION OF ACCELERATOR CABLE

1. Remove hex nut & sealing washer from accelerator cable pedal end.
2. Insert accelerator cable pedal end inside fire wall hole.
3. Fasten hex nut & sealing washer removed earlier.
4. Insert inner cable end in accelerator pedal. (Refer fig. 2 & 3).
5. Loosen the nut from the threaded end of cable. Engage threaded end of cable in throttle body bracket. Tighten ball end assembly (14) on FIP end of accelerator cable. Insert ball end assembly in FIP lever ball pin (12). Lock the ball end assembly with locking ring. (Refer fig 1 & 5)

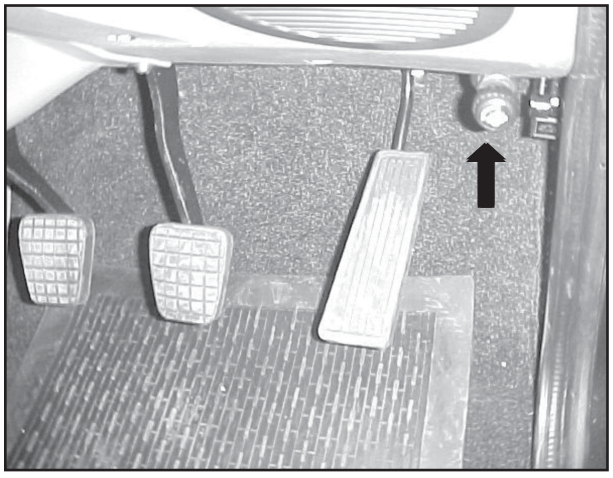


Fig. 4

6. Ensure dimensions 67 ± 3 for RHD and 42 ± 2 for LHD. Ensure tightness in inner cable by adjusting the nuts on threaded end of the cable.
7. Ensure that when accelerator pedal is fully pressed, full travel of throttle lever is achieved.

REMOVAL OF ACCELERATOR CABLE

Removal of accelerator cable is in reverse order of installation.

INSTALLATION OF IDLING ADJUSTER CABLE

1. Assemble idling adjuster cable & bracket assembly on BIW bracket.
2. Rotate idle control knob anticlockwise completely (as seen by driver) and connect the cable to the pedal. Tighten the hex nut on knob end such that there is no slackness on idling adjuster cable. (Refer fig. 4)

REMOVAL OF IDLING ADJUSTER CABLE

Removal of idling adjuster cable is in reverse order of installation.

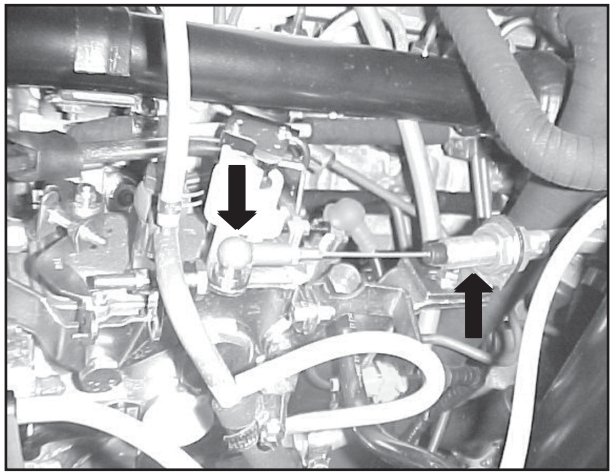


Fig. 5

SUSPENSION
(FACELIFT VERSION)

INTRODUCTION :

Independent suspension arrangement has been used at front. In this design, each wheel is a separately suspended unit connected to chassis in such a manner that rise and fall of one wheel does not affect the other directly.

As a result, each wheel has the ability to maintain a level position regardless of the influences on other front wheel.

In addition independent front suspension improves the ride quality and handling of the vehicle.

Facelift version :

Torsion bar spring is used in front suspension with wide upper and lower wishbones. Torsion bar preload can be adjusted by adjusting screws provided at rear end of torsion bar. Wheel alignment is by means of shims provided on upper wishbone.

Parabolic leaf spring, underslung type is provided at rear. Axle is connected to leaf spring at the bottom through 'U' bolts.

Telescopic shock absorbers at front and rear, antiroll bar in front ensure vehicle stability & smooth ride.

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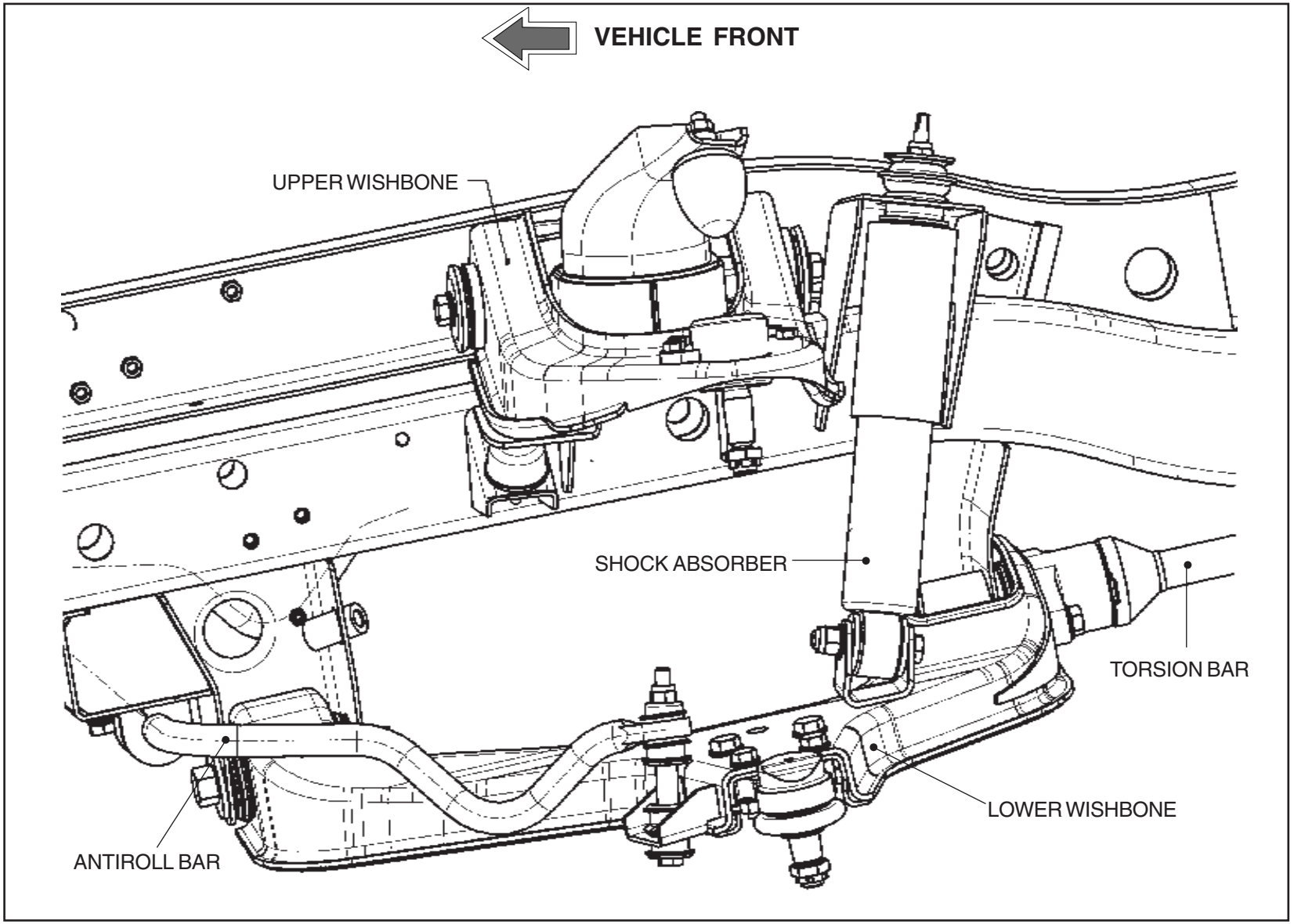


Fig. 1 - Front independent suspension (Torsion bar type)

I. FRONT INDEPENDENT SUSPENSION

1. CONSTRUCTIONAL DETAILS (Fig.1)

In this arrangement each wheel has a separate suspension unit. Wheels are connected to chassis in such a manner that the rise and fall of one wheel has no direct effect on the other.

As a result, each wheel has the ability to maintain a level position regardless of the action of other wheel. In addition, independent front suspension improves the ride and handling qualities of the vehicle.

Open end of upper wishbone is mounted on chassis long member through a spindle and pivoted bushes. Closed end of upper wishbone is connected to top of stub axle by a ball joint.

Lower wishbone is pivoted to chassis frame.

Front end of torsion bar is connected to lower wishbone with bracket at rear pivot pin and rear end to torsion bar adjustment lever connected at cross member.

Ball joint on lower wishbone is connected to bottom end of stub axle.

Antiroll bar middle portion is connected to brackets on RH and LH long member with bearing blocks (rubber) and clamps. Antiroll bar ends are connected to brackets on lower wishbones with bolts, cups, sleeves and rubber bushes.

As the wheel moves up and down, the two control arms (upper wishbone and lower wishbone) pivot up and down , as torsional torque of preloaded torsion bar increased or reduces. Thus torsion bar gives springing actions.

The shock absorber located between frame and lower wishbone, dampens the springing oscillations.

2A. TECHNICAL SPECIFICATIONS

Type : Double wishbone type with torsion bar springs, double acting hydraulic shock absorber and antiroll bar.

2B. REPAIR/ADJUSTMENT DATA

Shock absorber data	
Extended length (eye centre to middle of cups)	370 ± 4 mm
Collapsed length (eye centre to middle of cups)	264 ± 3 mm
Stroke	106 ± 7 mm
Front wheel alignment data	
Camber angle	0^0 ± 30'
Castor angle	3^0 ± 30'
Toe-in	2 - 5 mm
Wheel lock angle (outer)	26^0 - 1^0
LH/RH variation in castor	45'

2C. LUBRICANTS

Antiroll bar contact surface in bearing block to be lubricated with Silicon Molycote 33 (medium) grease.

Torsion bar splines to be lubricated with 3% MOS2 grease (Servo molex grease)

2D. TIGHTENING TORQUES (mkg.)

Top ball joint (at upper wishbone castle nut)	12-15
Bottom ball joint (at lower wishbone castle nut)	12-15
Upper wishbone spindle attachment to chassis, M14 x 1.5 bolt/nut	18
M12 Screws connecting washer, pivot bus to spindle	8-9
Lower wishbone mounting pin nyloc nut	14-16
Bolts connecting top ball joint to upper/lower wishbone	3
Antiroll bar bearing block clamp mounting bolts	5
Wheel nuts	12 to 15
Bolts connecting lower ball joint to lower wish bone	
M10 Screws	6-7
M12 Bolts	10

3. SPECIALTOOLS

Description	Part Number
Adaptor for lower wishbone mounting	2699 5890 41 01
Adaptor for upper wishbone mounting	2699 5890 41 02
Mandrel for installation of clip ring on ball joint.	2654 5890 32 01
Puller for removal of upper & lower ball joints	2654 5890 32 03

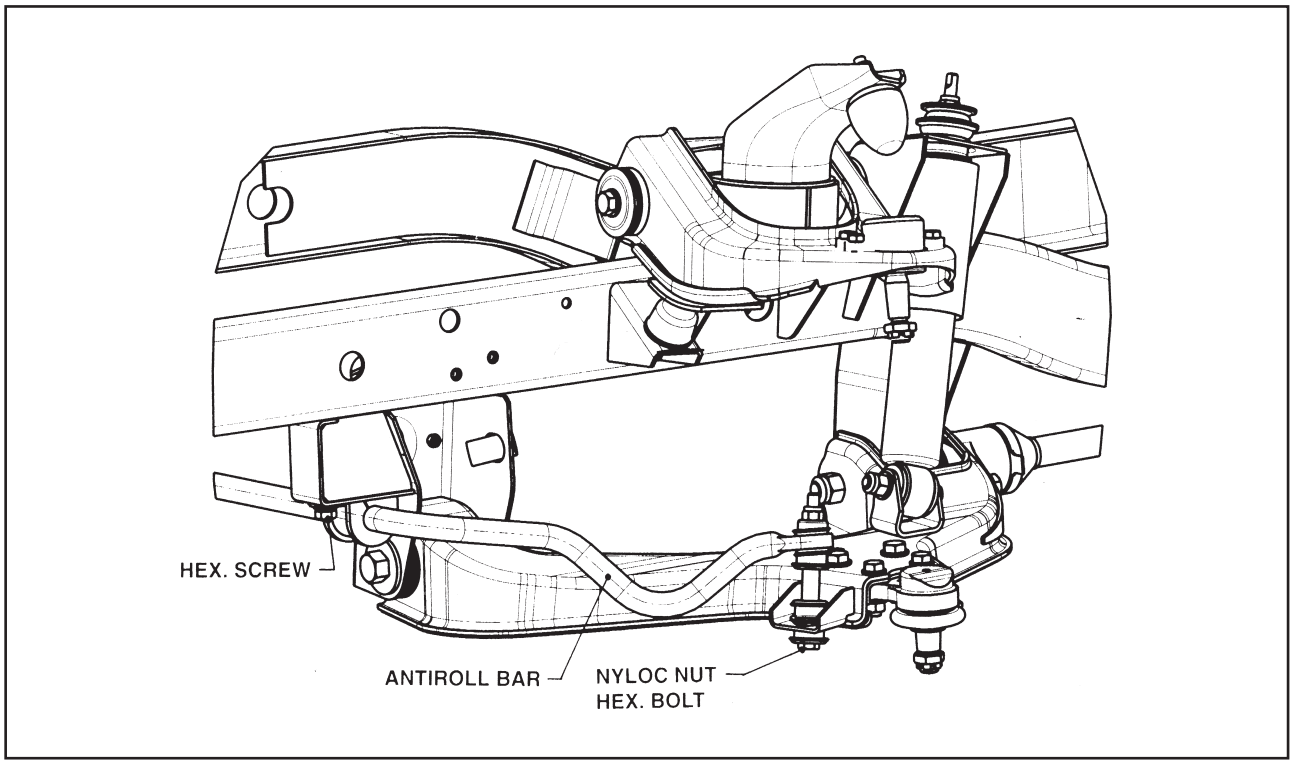


Fig. 2 - Removal of antiroll bar

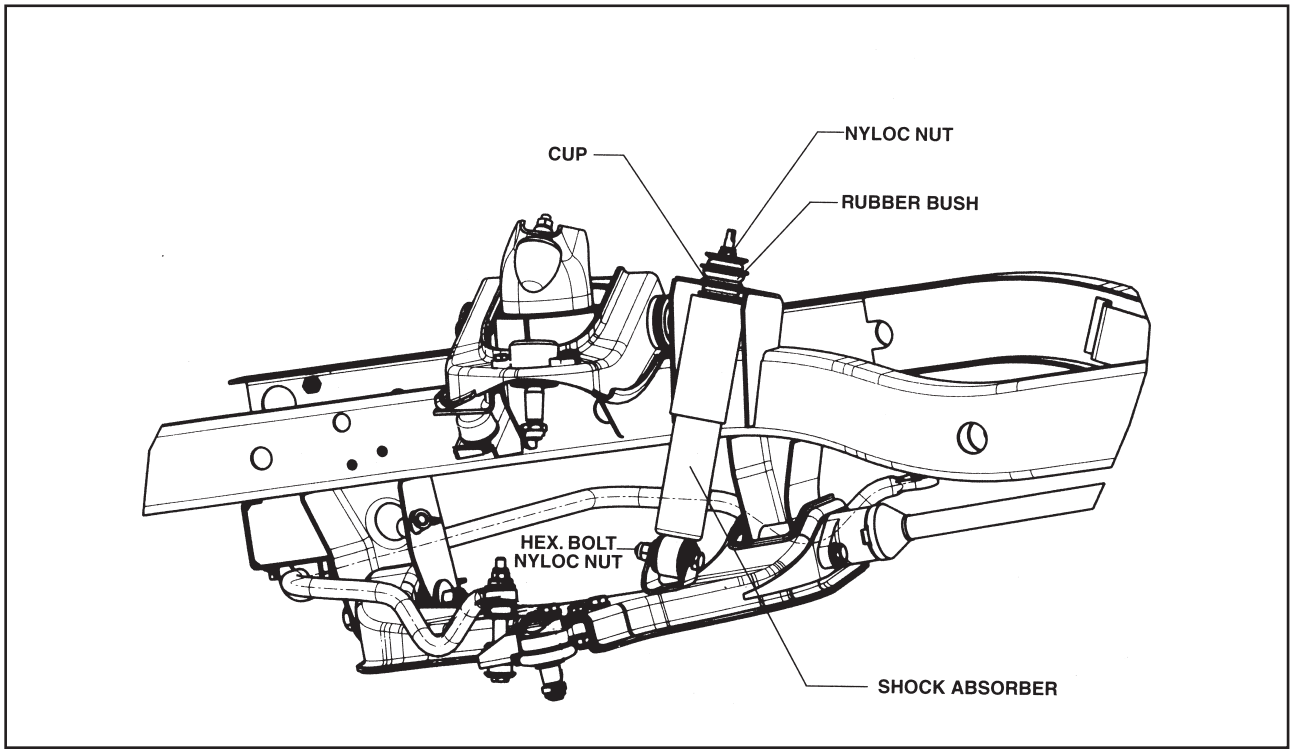


Fig. 3 - Removal of shock absorber

4. REMOVAL & DISMANTLING PROCEDURE

4A. REMOVAL OF FRONTWHEELS

- Place wheel chocks on both sides of rear wheels to secure the vehicle against any movement.
- Loosen front wheel nuts.
- Keep the jack below long member, behind front wheel and jack up (Fig.4). Support the frame long member behind front wheel with suitable support.
- Similarly jack up other side and support long member.
- Unscrew and remove wheel nuts.
- Remove front wheels.

48. REMOVAL OF ANTIROLL BAR (Fig. 2)

- Unscrew and remove nuts holding antiroll bar to the bracket on lower wishbone and remove bolt, cups, sleeve and rubber bushes (Fig.5).
- Unscrew and remove hex. screws holding antiroll bar bearing block (rubber) and lamp with the bracket on chassis frame long member.
- Remove bearing block (rubber) and clamp from antiroll bar assembly.
- Take out antiroll bar.

4C. REMOVAL OF SHOCK ABSORBER (Fig.3)

- Unscrew and remove nyloc nut holding shock absorber top (Fig.6). Remove spacer and bush.
- Unscrew and remove bolt connecting the shock absorber bottom with mounting bracket on lower wishbone.
- Compress the shock absorber and remove it.

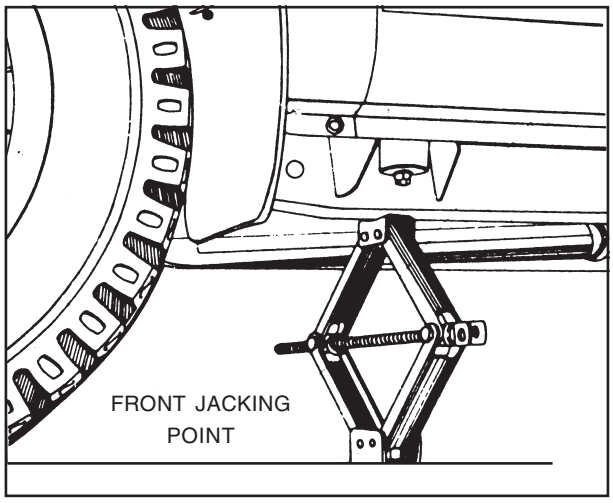


Fig. 4 - Jacking the wheel

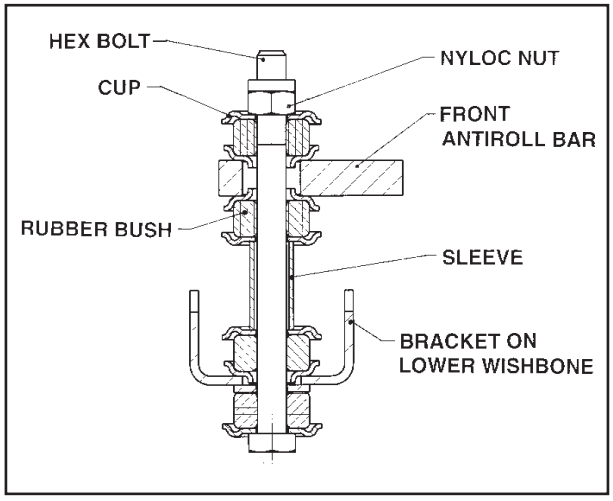


Fig. 5 - Antiroll bar mounting on lower wishbone

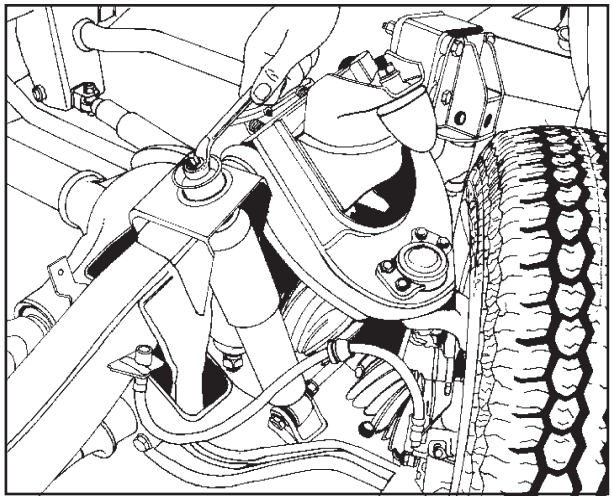


Fig. 6 - Removal of shock absorber

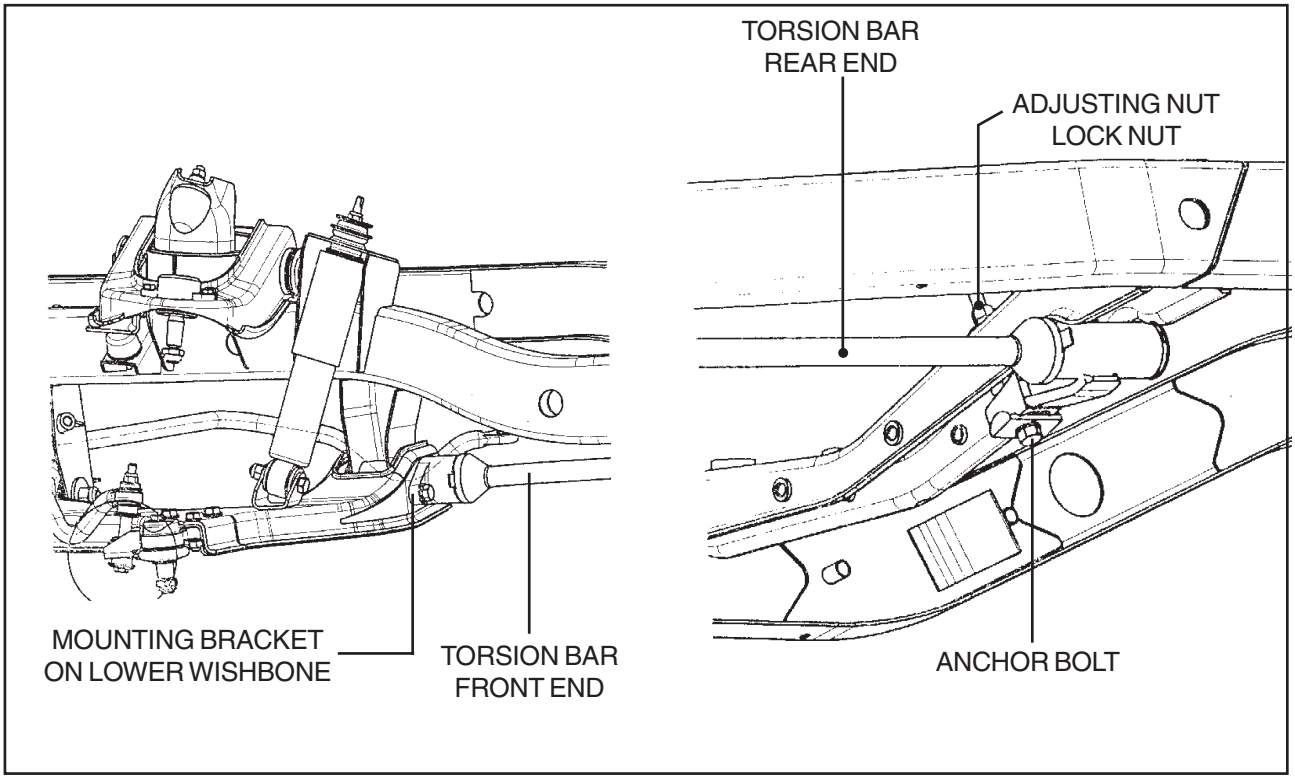


Fig. 7 - Removal of torsion bar

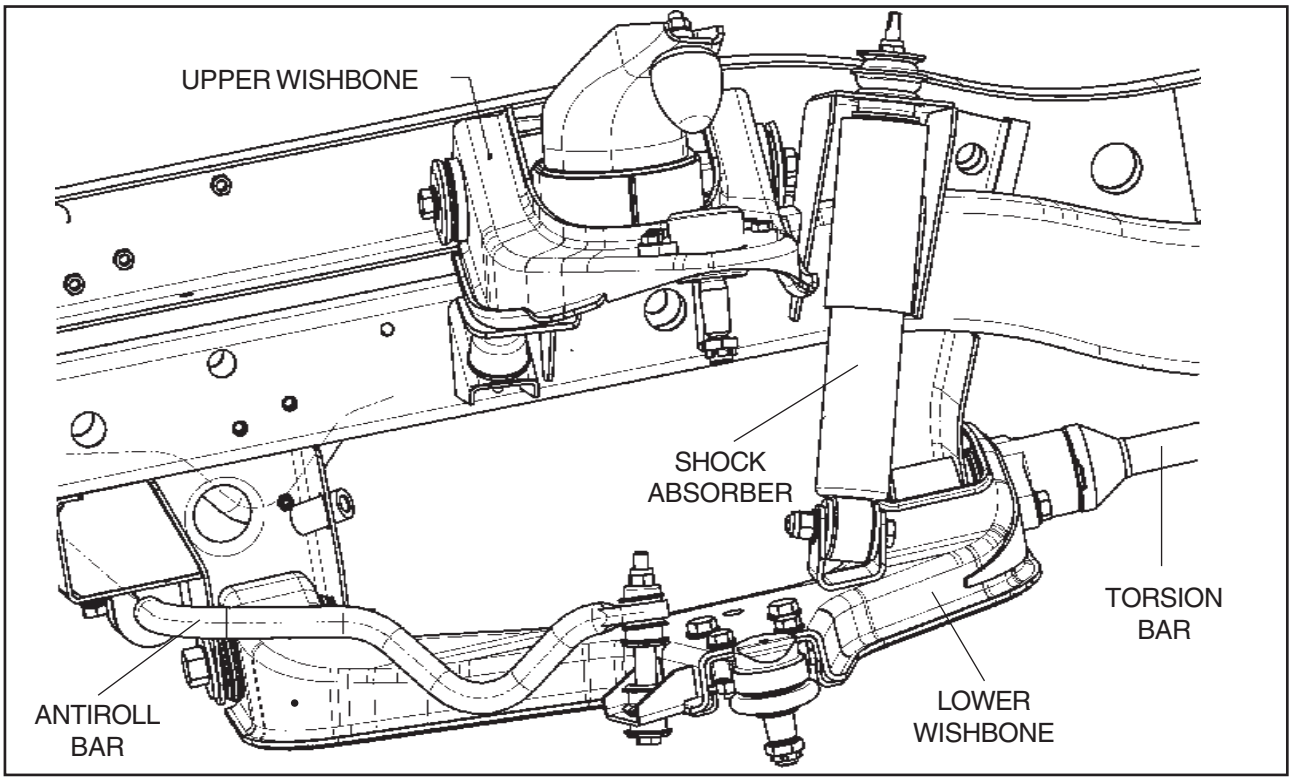


Fig. 8 - Removal of upper wishbone and lower wishbone

4D. REMOVAL OF TORSION BAR (Fig.7)
Caution :

Torsional load is applied on torsion bar by tightening the lever adjusting nut and lock nut.

Front suspension is working on torsional springing action of torsion bar.

Before removing torsion bar or upper wishbone or lower wishbone or ball joints of stub axle mounting, torsion bar load must be released fully by loosening lever adjusting lock nut and nut to avoid flyout of components and thereby causing any injury.

- Loosen torsion bar lever adjusting lock nut and nut till torsion bar load is fully released.(Fig.9) Remove lock nut, nut bolt and spherical washer.
- Pull out torsion bar from mounting bracket on lower wishbone. Remove lever.

4E. REMOVAL/DISMANTLING OF UPPER WISHBONE (Fig.8)

- Take out the split pin locking castle nut of top ball joint of stub axle. Hold steering wheel. Unscrew and remove castle nut.
- Push out ball joint from the stub axle using special tool Pt. No. 2654 5890 32 01. Properly support stub axle.
- Unscrew and remove 2 screws (Fig. 10) connecting spindle on top wishbone to bracket on chassis frame, using adaptor (Pt. No. 2699 5890 4102).
- Take out top wish bone complete with ball joint, spindle etc. Collect the shims located between spindle and bracket.
- Unscrew and remove 4 screws holding ball joint assembly to top wishbone. Take out ball joint assembly. (Fig. 11)
- Unscrew and remove the 4 screws connecting top wishbone and spindle. Remove washers.
- Press out the spindle with one pivot bush from top wishbone assembly in a press using suitable brass punch/handle. Press out the other pivot bush also from top wishbone.

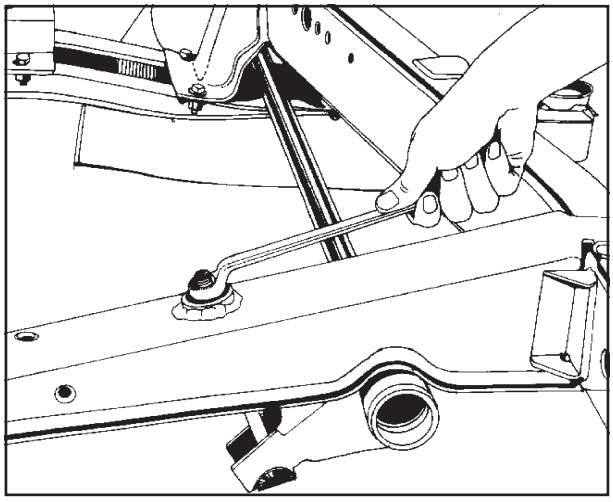


Fig. 9 - Removal of torsion bar

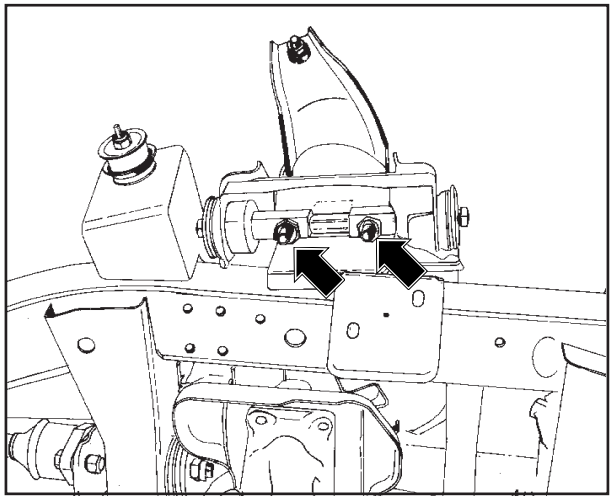


Fig. 10 - Removal of upper wishbone

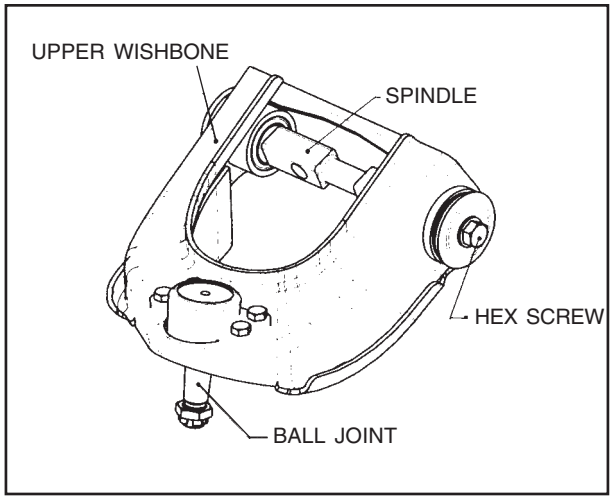


Fig. 11 - Dismantling of upper wishbone

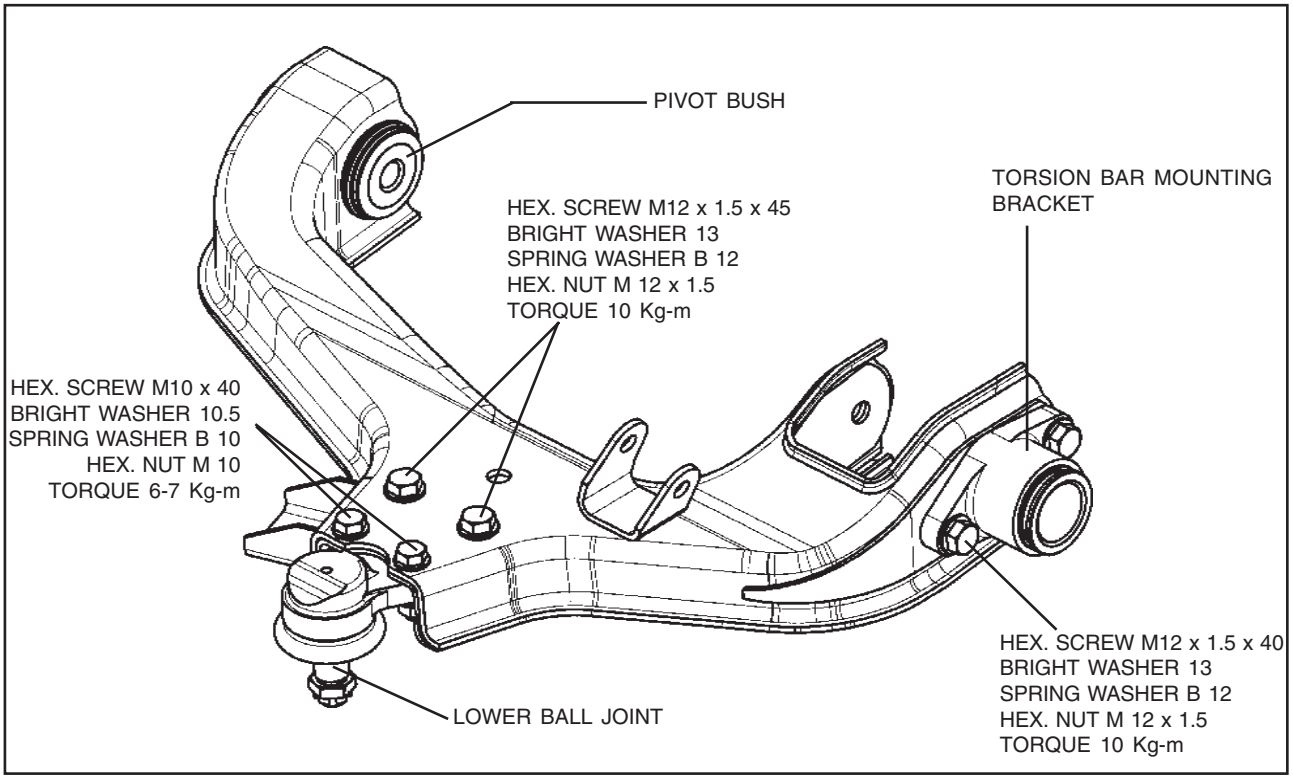


Fig. 12 - Assembly of lower wishbone

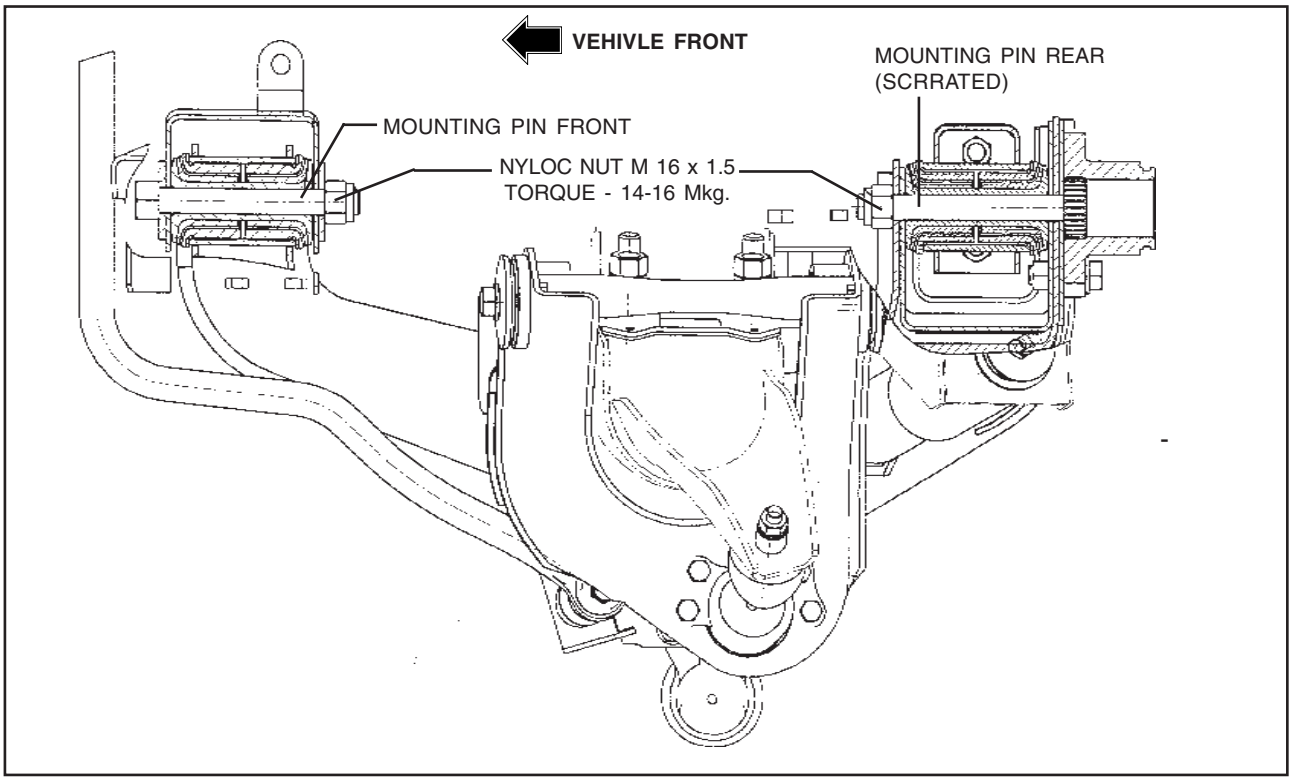


Fig. 13 - Installation of lower wishbone

4F. REMOVAL/DISMANTLING OF LOWER WISHBONE (Fig. 8)

Unscrew and remove 2 screws holding bracket (torsion bar mounting) to lower wishbone. Take out the bracket.

- Take out split pin locking castle nut of stub axle bottom ball joint. Properly support stub axle. Push out the ball joint from stub axle.
- Unscrew and remove two nyloc nuts of pivot pins holding lower wishbone with mounting brackets on frame, using adaptor (Pt.No. 2699 5890 41 01). Push out pivot pins and remove lower wishbone (Fig.14)
- Unscrew and remove 4 screws holding the ball joint to lower wishbone. Take out ball joint.
- Pry out pivot bushes from lower wishbones, if necessary.
- Pry out pivot bushes from lower wishbone mounting bracket, if necessary.

5. INSPECTION OF PARTS

- Check condition of the following for wear, damage. If necessary replace with new ones.
- Antiroll bar for bend, cut, damage etc.
- Rubber links and bushes of antiroll bar.
- Pivot bushes, washer and spindle of upper wishbone assembly.
- Ball joints of upper wishbone and lower wishbone. Check for excessive play in ball joints.
- Rubber boots of top and bottom ball joints. If it is damaged, check the condition of ball joints. If damaged, replace ball joints. Install new boots with lithium base grease.
- Shock absorber for leakage etc. Check the condition of rubber bushes, washer etc.
- Torsion bar spring for sagging, wear cuts etc.
- Bump and rebound stopper for wear and damage.
- Upper wishbone and lower wishbone.

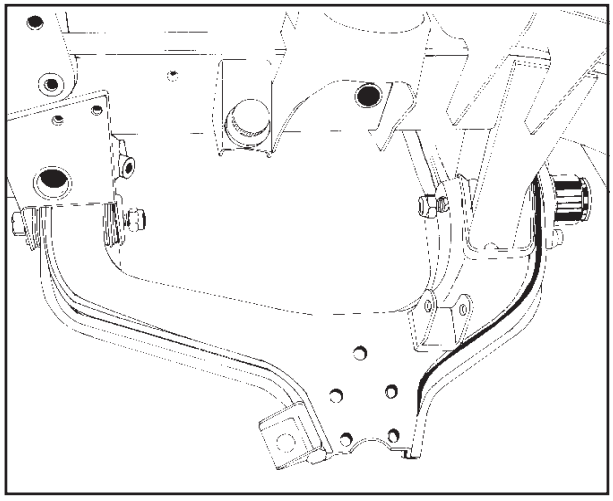


Fig.14 Lower wishbone assembly

6. ASSEMBLY/INSTALLATION PROCEDURE

6A. ASSEMBLY / INSTALLATION OF LOWER WISHBONE

- Assemble lower ball joint on stub axle for 4 x 4 version 8 than the lower wishbone.
- If 2 halves of pivot bushes were removed earlier from lower wishbone & upper wishbone, fit each half from either sides, using suitable drift.
- Locate lower ball joint on lower wishbone & install 2 hex bolt (M12), washer, spring washer, hex. nut and then 2 hex screws (M10), washer, spring washer, hex nut. Tighten M 12 bolts to 10 mkg.. torque and M10 screws to 6-7 mkg. torque.
- Fit torsion bar mounting bracket on lower wishbone with 2 hex screws and washers. Tighten hex screws to 10 mkg. torque.
- Position lower wishbone on chassis frame. Align pivot bushes and holes on bracket using suitable punch.
- Insert shims to fill the gap at front pivot. Install pivot pins (serrated pin in the torsion bar mounting bracket) and nyloc nuts. Tighten nyloc nuts to 14-16 mkg. torque, using adaptor (Pt. No. 2699 5890 41 01).

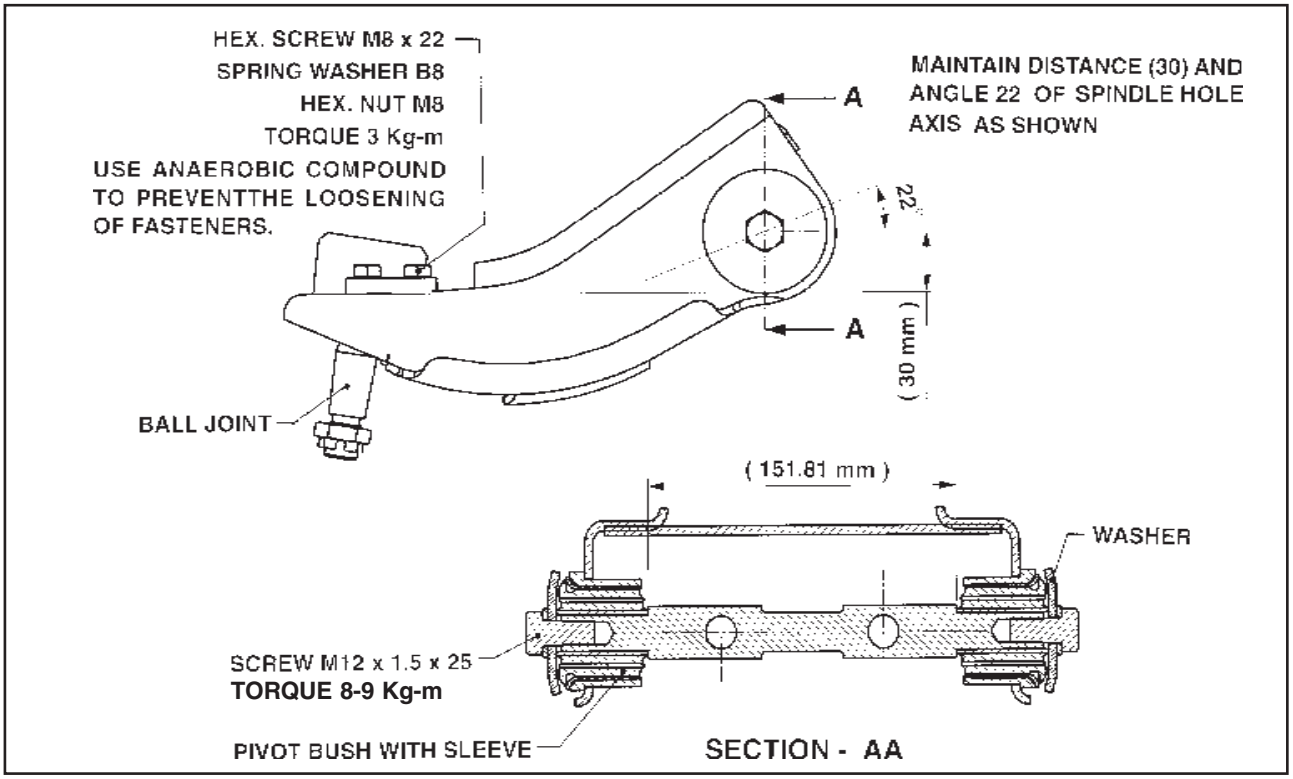


Fig. 15 - Upper wishbone assembly

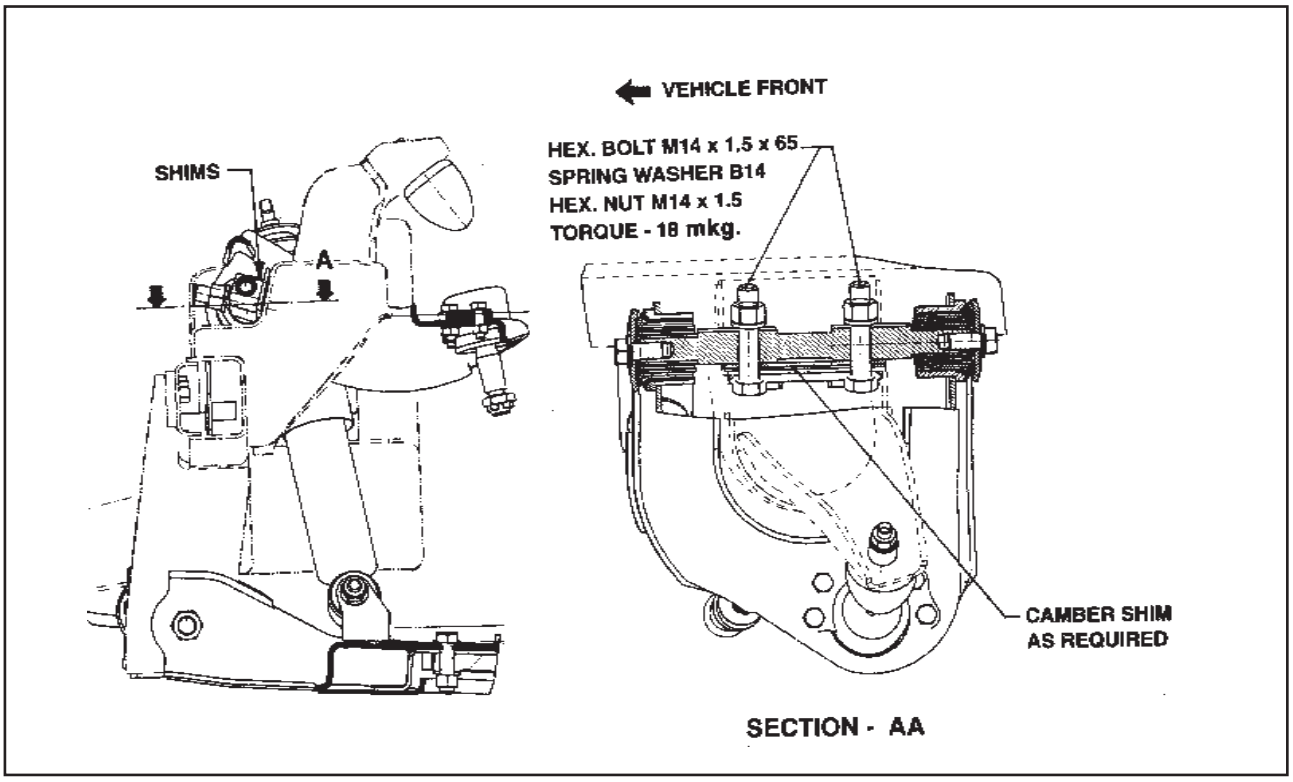


Fig. 16 - Installation of upper wishbone on vehicle

6B. ASSEMBLY/INSTALLATION OF UPPER WISHBONE (Fig. 16)

- If pivot bushes and spindle were removed earlier, press new pivot bush on upper wishbone using suitable drift.
- Insert spindle into upper wishbone and then press the other pivot bush.
- Fit washers, spring washers and two M12 screws connecting spindle and upper wishbone. Maintain angle 22^{O} & height 30 mm from the flat surface of wishbone as shown in Fig.15. Tighten screws to 8-9 mkg. torque.
- Check the condition of rubber boot of top ball joint. If it is damaged, check the condition of ball joint and replace ball joint if necessary. Install a new boot with lithium base grease.
- Using special tool, mandrel Pt. No. 2654 5890 32 03, fit the clip ring of the boot.
- Fit top ball joint on upper wishbone and tighten 4 screws with spring washers. Use anaerobic compound and tighten to specified torque.
- Position upper wishbone assembly on chassis frame. Insert the shims removed earlier. Tighten 2 screws connecting the spindle of upper wishbone to the bracket on chassis frame (Fig.16).
- Install stub axle (Refer front axle Group).

6C. INSTALLATION OF FRONT SHOCK ABSORBER (Fig.17)

- Install washer, spacer tube and rubber bush on to top mounting bolt of shock absorber.
- Position the shock absorber properly between top mounting bracket on frame and bottom mounting bracket on lower wishbone.
- Install hex bolt in bottom mounting bracket and tighten nyloc nut to 3.5 mkg. torque.
- Install rubber bush, washer and nyloc nut on shock absorber top mounting bolt and tighten nyloc nut to 3.5 mkg. torque.
- Take out jack.

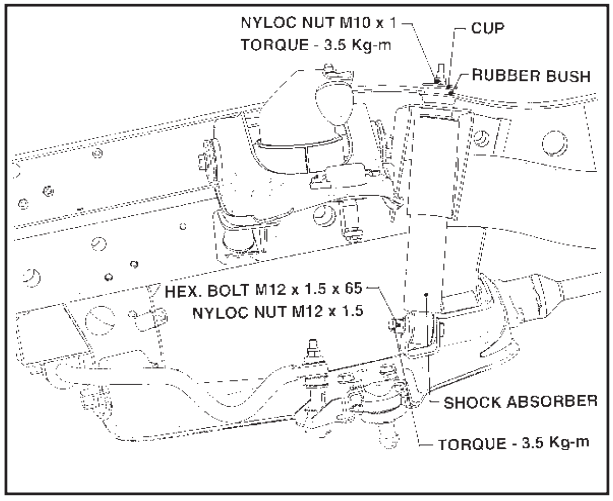


Fig. 17 - Installation of shock absorber

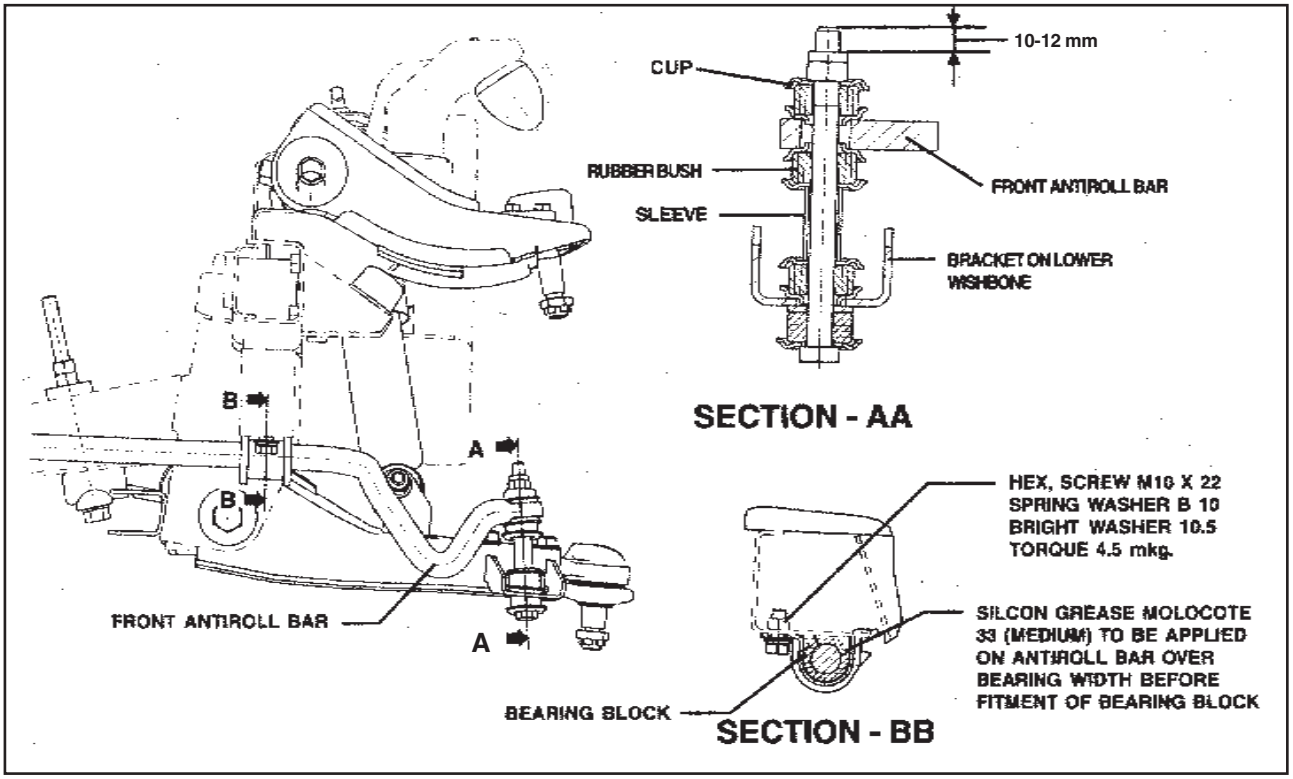
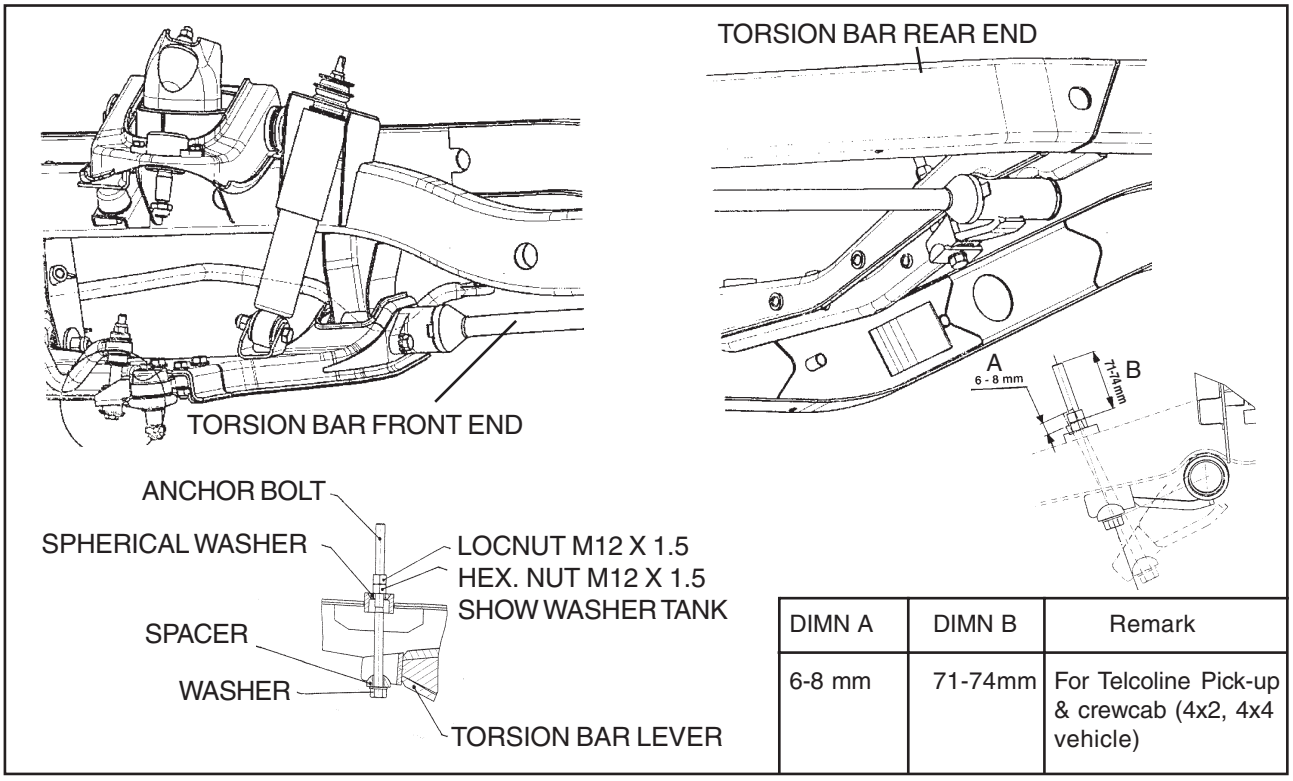


Fig. 18 - Installation of antroll bar



DIMN A	DIMN B	Remark
6-8 mm	71-74mm	For Telcoline Pick-up & crewcab (4x2, 4x4 vehicle)

Fig. 19 - Installation of torsion bar

6D. INSTALLATION OF FRONT ANTIROLL BAR (Ref. Fig.18)

- Position anti roll bar between the brackets on lower wishbone.
- Install cup, rubber bush & washer on antiroll bar mounting bolt. Insert mounting bolt in mounting bracket on lower wishbone. Install cups, rubber bushes, sleeve, antiroll bar 8 nyloc nut on mounting bolt properly. Tighten nyloc nut such that bolt end should project 10 to 12 mm above nyloc nut.
- Apply silicon grease molykote 33 (medium) on antiroll bar over bearing width of bearing block to be mounted on chassis frame. Fit bearing block and mounting clamp with hex. screw, spring washer and bright washer.
- Tighten bearing block clamp mounting screws to 4.5 mkg. torque.
- Ensure equal gap between wishbone and antiroll bar on both sides.

6E. INSTALLATION OF FRONTWHEELS

- Install wheels on the hub and tighten wheel nuts by hand.
- Remove the supports, supporting chassis long member.
- Tighten wheel nuts to a torque of 12-15 mkg.

Note

Hold the steering wheel and tighten castle nuts of stub axle top mounting ball joint ancf stub axle bottom mounting ball joint to 13.5 mkg. torque. Lock the castle nuts with split pins.

6F. INSTALLATION OF TORSION BAR (Fig.19)

- Assemble wheels, if removed earlier.
- Jack up chassis from behind front wheels from (RH & LH) side and adjust chassis height to (Top of chassis at the front Location hole) 550 ± 3 mm.

  (Alternatively adjust the distance between upper wishbone mounting bracket & lower wishbone to appox. 295 mm or angle of lower wishbone to appox. 6^0 as shown in fig. 20)
- Apply a light coat of 'Servo Molex grease 3% MoS2' to the splines of torsion bar.

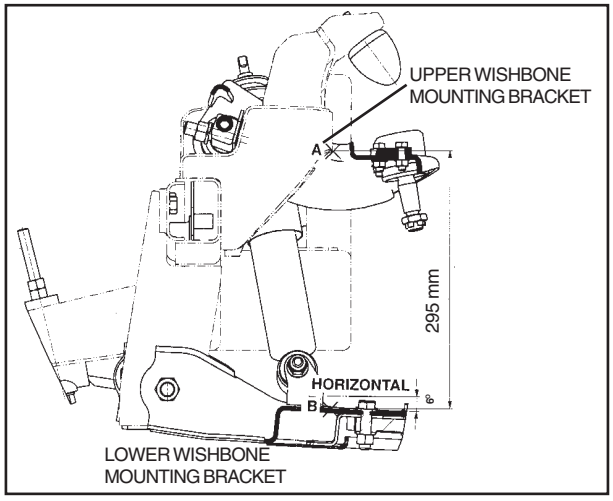


Fig. 20 - Lower wishbone height adjustment

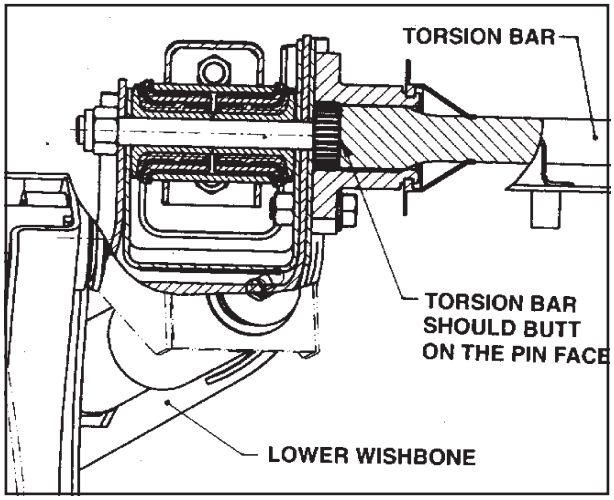


Fig. 21 - Installation of torsion bar

- 'R' and 'L' are marked at one end of RH and LH torsion bars respectively. Install unmarked end of torsion bar RH to the bracket on lower wishbone of RH side. Similarly install torsion bar LH. (Fig. 21)
- Assemble the levers on torsion bar at rear end, such that after putting one nut, 1 to 3 mm protrusion of the anchoring bolt is maintained.
- Tighten nut up to approx. 68 mm. protrusion of anchor bolt. Fit lock nut and tighten it.
- Remove jack. Bounce the wheel to settle suspension.
- Measure front chassis height from the ground. If it is not 550 ± 3 mm. adjust it by torsion bar anchoring bolt.

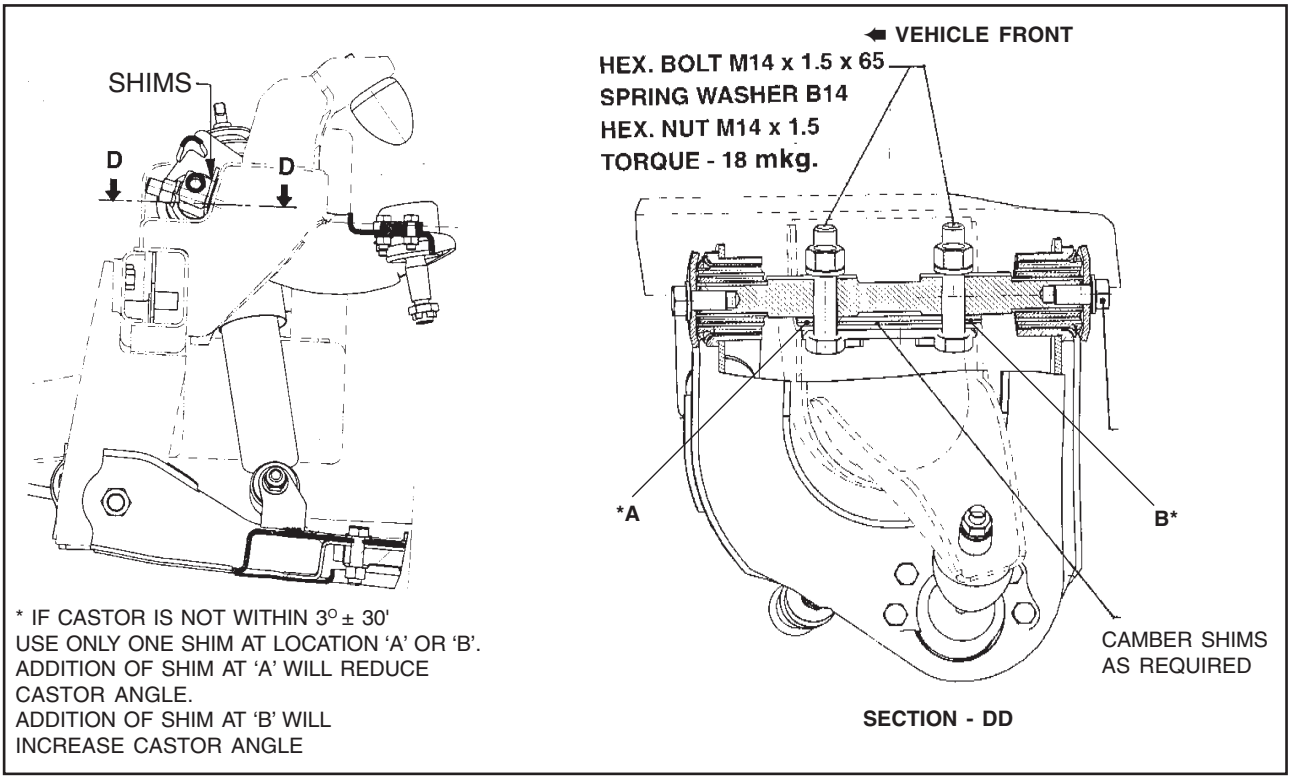


Fig. 22 – Camber angle and castor angle

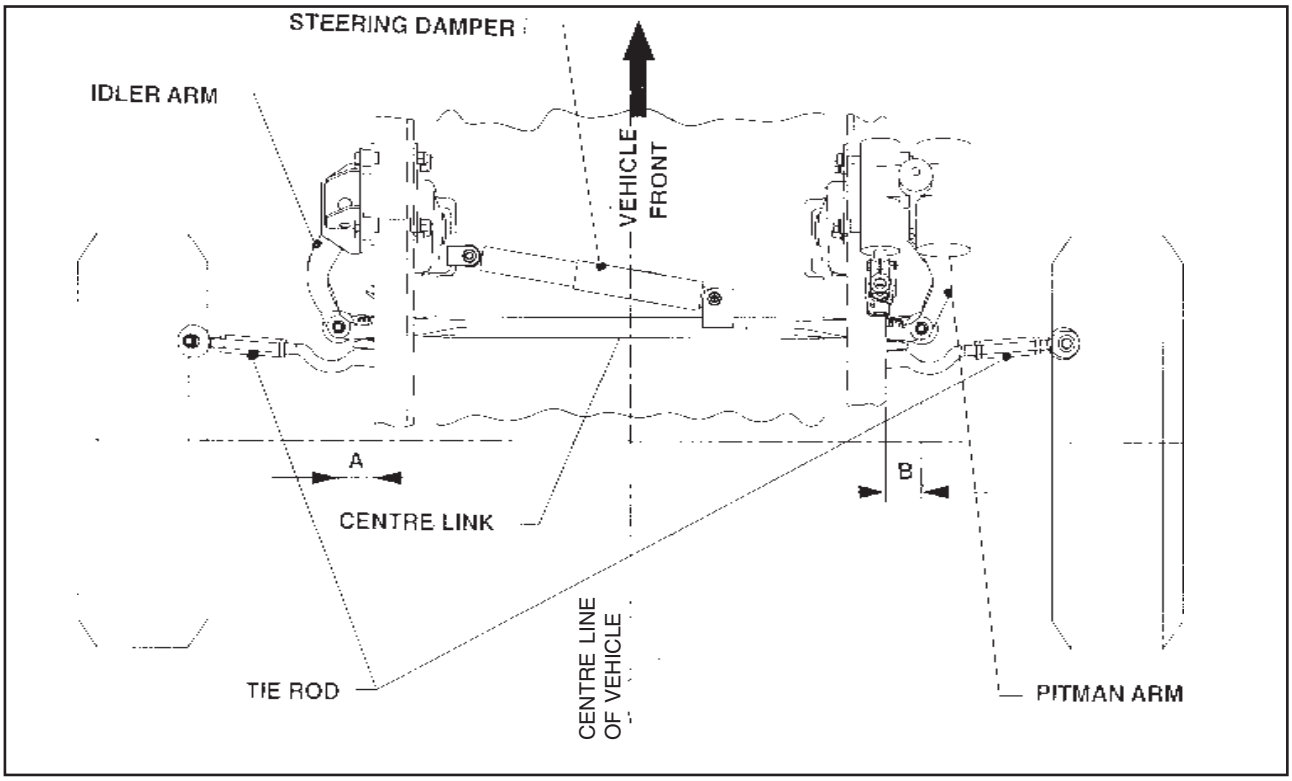


Fig. 23 - Toe -in adjustment

7. WHEEL ALIGNMENT

Following order is to be maintained while doing wheel alignment

i) Camber angle
ii) Caster angle
iii) Toe-in
iv) Wheel lock angle

Caution

Not following the above order will lead to incorrect wheel alignment even though individual adjustments are done correctly.

Note

All adjustments for wheel alignment are to be done in UNLADEN CONDITION ONLY.

Following precautions to be taken before commencing wheel alignment.

- Vehicle should be unladen and parked on level surface.
- Front tyre should have uniform wear and inflated to correct pressure.
- Height of front LH & RH Hub cap centre from ground level should be equal (counter check for even tyre wear and inflation).
- Ensure that hub play is correct.
- Ensure that silent bushes in front suspension are in satisfactory condition.
- Ensure that front suspension fasteners are tightened to specified torque.
- Ensure that there is no play in steering linkages and suspension ball joints.

Note

In case wheel alignment is done using computerised wheel aligner, please follow instruction manual of equipment manufacturer.

7A. CAMBER ANGLE ADJUSTMENT (Fig.22)

- While adjusting camber angle nobody should sit inside the vehicle.
- To adjust camber angle, add or remove shims between the chassis frame and the spindle of upper wishbone mounting.
- Adding shims will reduce the camber angle and removing shims will increase the camber angle. Adjust camber angle to 0^{O} + 30'.

Note

After addition or removal of shims tighten the bolts to 18 mkg. Recheck camber angle.

7B. CASTOR ANGLE ADJUSTMENT (Fig.22)

- Adding shim at location 'A' will reduce the castor and at location 'B' will increase the castor. Adjust caster angle to $3^{o} \pm 30'$ as shown in (Fig. 22)
- Check castor angle. If castor angle is not within $3^{o} \pm 30'$ add only one shim of 0.8 mm thick at location 'A' or 'B' as shown in (Fig.22) it will increase angle by 16'.

Note

Variation in castor between LH/RH sides should not exceed 45'.

After adding shim, tighten the bolts to 18 mkg. torque. Recheck castor angle.

7C. TOE-IN ADJUSTMENT (Fig.23)

- Reading at the front of wheel rim should be less than the reading at the rear of wheel rim by 2 to 5 mm.
- Toe-in is adjusted by varying the length of tie rods after loosening their hex nuts. After adjusting the length of tie rods recheck toe-in and tighten back the hex. nuts.
- Increasing length of tie rod will reduce the toe-in and vice-versa. While adjusting toe-in, adjust the length of both the tie rods by rotating them in the same direction such that their lengths remain equal at all times.

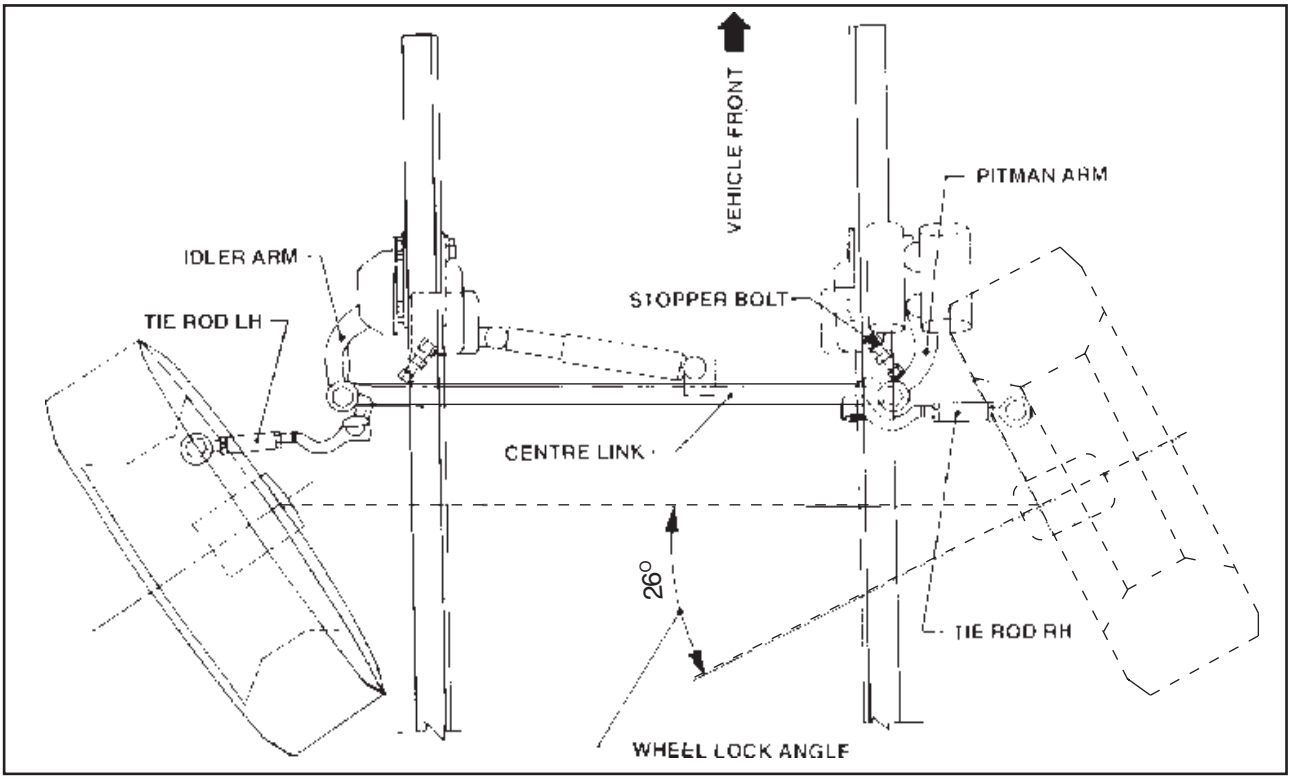


Fig. 24 – Wheel lock angle adjustment

Precautions

To maintain steering linkages symmetrical to vehicle centre line, centralise linkages i.e. the distance between chassis frame long member outside face and centre of centre link ball joint should horizontally equal (55 mm) at both RH & LH sides.

This will ensure that when the wheels are in straight ahead position, steering linkages will also be centralised.

7D. WHEEL LOCK ANGLE ADJUSTMENT (Fig.24)

Wheel lock angle is to be set with the help of stopper bolts fitted in the bracket on chassis frame. Proper adjustment of wheel lock angle ensures correct turning circle and also safeguards steering linkages.

- Place turn tables beneath front wheels, ensure that wheels are centrally positioned on turn table.
- Make front wheels in straight ahead position and set turn table scale to ZERO.
- Press brake pedal and turn steering to right till a reading of 26^{O} to 25^{O} is attained on the left hand wheel turn table. In this condition adjust stopper bolt on LH side of chassis bracket to touch the

  idler arm and lock adjusting bolt with lock nut.
- Similarly turn steering to left till a reading of 26 to 25^{O} is attained on right wheel turn table. In this condition adjust stopper bolt on RH side chassis bracket to touch the pitman arm. Lock stopper bolt with lock nut.

II. REAR SUSPENSION

1. TECHNICAL SPECIFICATIONS

Type	:	Underslung spring

SPRING

Type	:	Parabolic leaf spring
2 Stage	:	Telcoline Pickup/Crewcab
No. of leaves	:	3
Thickness	:	1-2 leaves 12 mm thick 3rd leaf 15 mm thick
Rate	:	5.6 kg/mm first stage 10.1 kg/mm second stage

REAR SHOCK ABSORBER

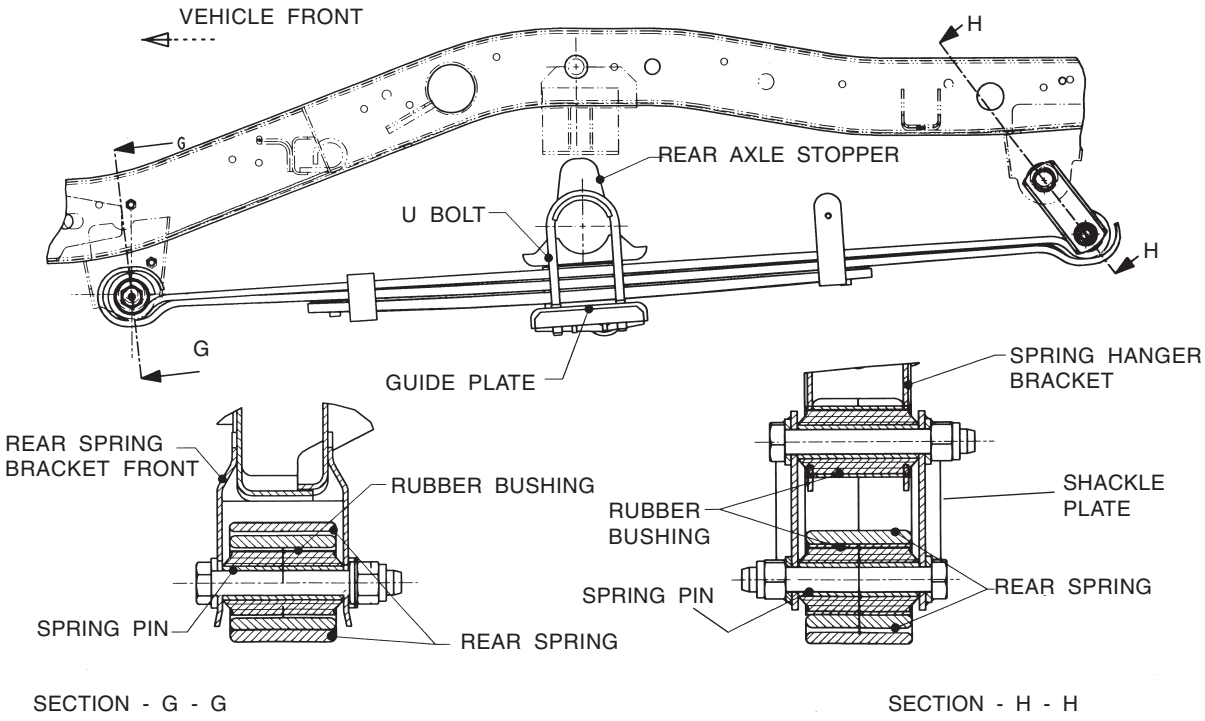
Type	:	Hydraulic, Telescopic, Double acting
Closed length	:	366 mm
Open length	:	606 mm
Stroke	:	240 mm

2. SPECIAL TOOLS

Puller for removal and installation of rubber bush at spring hanger braket rear and spring eye)	Pt. No. 2654 5890 32 05

3. TIGHTENING TORQUES

Rear spring 'U' bolt nut and lock nut	:	8 mkg & 4 mkg respectively
Spring eye bolts, shackle bolts	:	16 mkg
Shock absorber eye bolts	:	6 - 7 mkg
Antiroll bar mounting bolts. (to rear axle)	:	8 mkg
Bolts connecting antiroll bar to connecting rod assy.	:	4 mkg



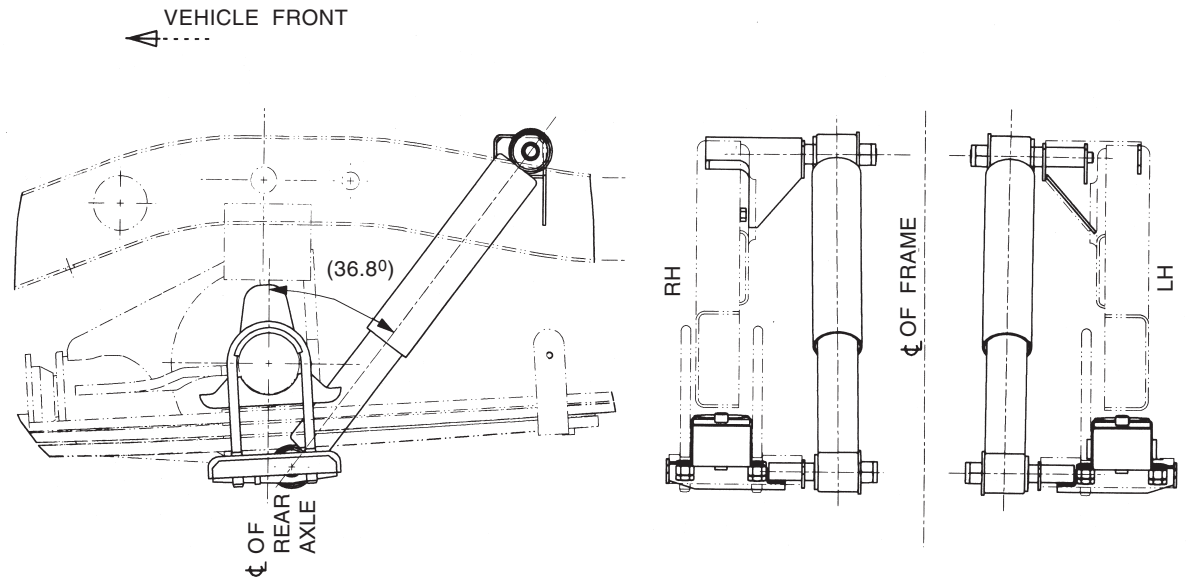
FITMENT OF REAR SPRING

Fig. 1

4. CONSTRUCTIONAL DETAILS

REAR SPRING

Rear suspension of Telcoline pickup/crewcab vehicle is of 'underslung' type. i.e. Rear spring is connected to the rear axle at the bottom through ‘U’ bolts and guide plate. Fig. 1.



FITMENT OF REAR SHOCK ABSORBER

Fig. 2

REAR SHOCK ABSORBER
(Refer fig. 2)

Rear shock absorber is connected inclined to the chassis frame i.e. both side shock absorber are connected at the top to the rear of rear axle. Shock absorber is eyed at both ends.

5. REMOVAL OF REAR SHOCK ABSORBER *(Refer fig. 2)*

1. Unscrew and remove the nut and bolts connecting shock absorbers to guide plate.
2. Unscrew and remove the nut holding top end of shock absorber to bracket on chassis frame.
3. Take out shock absorber.

6. INSTALLATION OF REAR SHOCK ABSORBER *(Refer fig. 2)*

1. Connect shock absorber bottom end to guide plate pin. Tighten the nut to 6-7 mkg. torque.
2. Connect shock absorber top end to the bracket on chassis frame and tighten nut to 6-7 mkg.

7. REMOVAL OF REAR SPRING ASSEMBLY

1. Place suitable wheel chocks on front wheels.
2. Unscrew and remove locknuts of U bolts connecting rear spring and rear axle. Also loosen the nuts slightly, but do not take them out.
3. Jackup the vehicle (Fig. 3) until wheels are off the ground. Support chassis frame long member with suitable supports, in front of rear spring front bracket.
4. Unscrew and remove nuts of U bolts. Take out U bolts, guide plate and rear axle stopper. Fig. 1.
5. Remove nyloc nuts of spring eye pins at front and rear eyes of the spring. Unscrew and remove nyloc nuts. Take out spring pins.
6. Remove rear spring assembly out.
7. Remove spring eye bushes from spring if they are damaged.

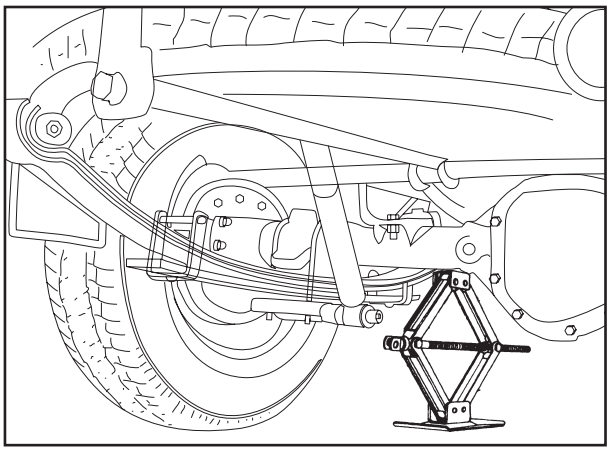


Fig. 3

8. INSPECTION

Inspect following parts for wear/damages. Replace with new ones, if necessary.

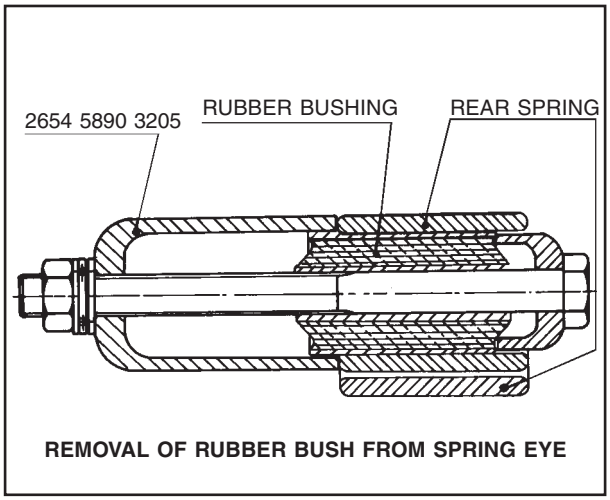
1. Shock absorber
2. Rear spring, spring eye bush, shackle plates, pins and U bolts.

Note

i. In case rubber bushing on spring eye and spring hanger bracket (rear) is defective, remove defective rubber bush using special tool Pt. No. 2654 5890 32 05. Fig. 4 & 5.

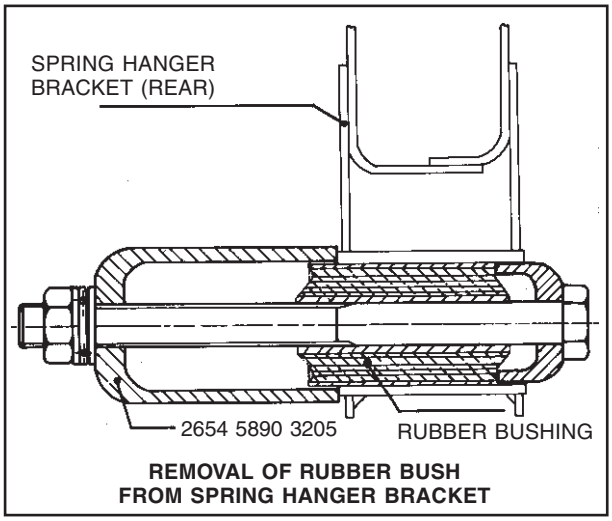
ii. Check the condition of friction pads between spring leaves. If found damaged or dislodged, install new friction pads in position.

iii. Check the condition of spring leaves. If found damaged / broken, dismantle rear spring assembly and replace the defective leaf along with friction pads with new ones.



REMOVAL OF RUBBER BUSH FROM SPRING EYE

Fig. 4

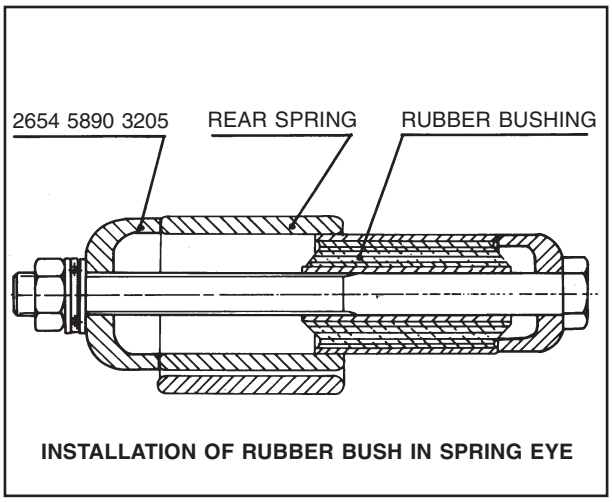


REMOVAL OF RUBBER BUSH FROM SPRING HANGER BRACKET

Fig. 5

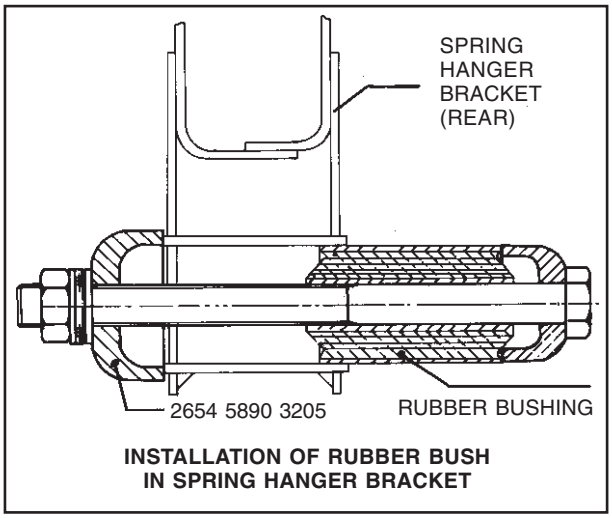
9. INSTALLATION OF REAR SPRING ASSEMBLY

1. Fit new spring eye bushes on spring front eye if removed earlier, using drift Pt. No. 2654 5890 32 05. Fig. 6.
2. Fit new spring eye bush in spring bracket (rear) using drift Pt. No. 2654 5890 32 05. Fig. 7.
3. Connect shackle plates to the spring bracket (rear) with pin and nyloc nuts. Tighten the nyloc nuts to 14 mkg. torque. Lock nyloc nuts.
4. Place the spring assembly under rear axle. Assemble front end of spring assembly to spring bracket (front). Align holes on spring eye bush and spring bracket. Install pin, tighten castle nut to 14 mkg. torque. Lock nyloc nuts.
5. Jack up rear axle, lift rear spring, align hole of spring eye bush at rear with hole on shackle plates. Insert pin, tighten nyloc nut to 14 mkg. torque. Lock nyloc nuts.
6. Remove the support below chassis frame long member, remove the jack below rear axle, lift the wheel, align the centre bolt of rear spring with hole on spring seat of rear axle.
7. Install U clamps, with rear axle stopper on the rear axle in position; keep the guide plate in position, tighten nuts of U clamps to 8 mkg. torque and locknuts to 4 mkg. torque.



INSTALLATION OF RUBBER BUSH IN SPRING EYE

Fig. 6



INSTALLATION OF RUBBER BUSH IN SPRING HANGER BRACKET

Fig. 7

FRONT AXLE - 4X2

INTRODUCTION :

The hub which is mounted on taper roller bearings on the stub axle is independently suspended with the chassis frame. The stub axle is pivoted on two ball joints, upper and lower.

This manual provides information on removal/ installation of front hub and adjustment of wheel bearings.

It also provides information on removal / installation of stub axle assembly.

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	B.	Installation of stub axle	8
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	D.	Installation of hub on stub axle	10

A. TECHNICAL SPECIFICATIONS

FRONT AXLE

Type	Independently suspended stub axle and hub

B. REPAIR/ADJUSTMENT DATA

Axial play of hub bearing	0.03 to 0.06 mm

C. LUBRICANTS

Front hub to be packed with Lithium base grease LIT MP. 301.	80 gm per hub

D. TIGHTENING TORQUES (mkg)

Top ball joint (at stub axle)	13.5
castle nut	
Bottom ball joint (at stub axle) castle nut	13.5
Bolts connecting tie rod arm to stub axle M 12	10 to 12
Bolts connecting disc assy. and front hub	5.5 - 6.5
Bolts connecting caliper assy. to stub axle	6.8 to 8.3
Bolts connecting top ball joint to top wish bone	3
Bolts connecting bottom ball joint to lower wish bone	6.5 for M10, 9.7 for M12
Wheel nuts	12 to 15
Castle nuts of tie rod ball joints	7 to 9

SPECIAL TOOLS FOR INDEPENDENT FRONT AXLE (Applicable for Tata Motors Hubs).

Sr. No.	Description	Part No.
1.	Puller for front hub.	2654 5890 33 01
2.	Rocker for removal of front hub inner bearing with oil seal.	2654 5890 33 02
3.	Rocker for removal of front hub outer bearing outer race.	2654 5890 33 03
4.	Puller for tie rod ball joints	2654 5890 33 04
5.	Puller for removal of upper and lower ball joints	2654 5890 32 01
6.	Mandrel for installation of clip ring on ball joint bellows	2654 5890 32 03
7.	Drift for installation of oil seal in front hub (to be used with handle 2640 5890 3511).	2654 5890 35 04
8.	Drift for installation of i) Front hub outer bearing outer race ii) Front hub inner bearing outer race. (to be used with handle 2640 5890 3511).	2654 5890 35 07
9.	Handle for drift (to be used with 2654 5890 35 03. 2654 5890 35 04, 2654 5890 35 07)	2640 5890 35 11
10.	Drift for installation of i) Seal race on stub axle	2654 5890 35 11
11.	Drift for installation of front hub outer bearing inner race with cage on stub axle	2651 5890 33 08

3. DISMANTLING OF FRONT AXLE

A. REMOVAL OF FRONT WHEELS :

a. Place wheel chokes on both sides of rear wheels.

b. Loosen front wheel nuts.

c. Keep the jack below long member behind front wheel and jack up (Fig. 1 & 2). Support frame long member behind front wheels with suitable support.

d. Similarly jack up the other side and support long member.

e. Unscrew and remove wheel nuts.

f. Remove front wheels.

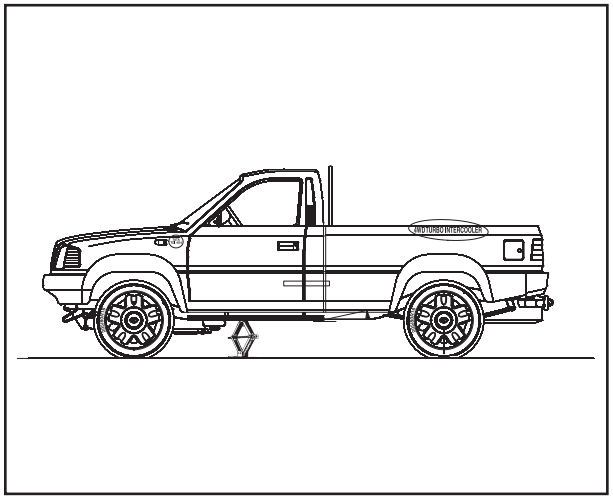


Fig. 1 Pickup

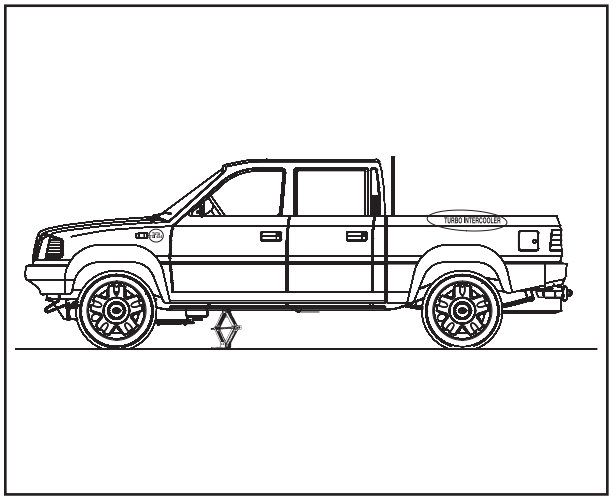


Fig. 2 Crew cab

B. REMOVAL / DISMANTLING OF FRONT HUB ASSEMBLY

a. Disconnect front brake hose from brake bundy pipes on the bracket on chassis frame. Close bundy pipes with plugs to avoid brake fluid loss.

b. Disconnect brake hose from caliper by taking out banjo bolt.

c. Unscrew and remove two screws connecting caliper assy to stub axle and remove caliper assy from stub axle.

d. Unscrew and remove cap screws connecting hub cover and hub, and remove hub cover with gasket.

e. Unscrew cap screw on split nut.

f. Unscrew and remove split nut from stub axle.

g. Remove thrust washer from stub axle.

h. Using puller part no. 2654 5890 33 01, remove front hub assy. with disc from stub axle.

i. Remove puller from hub.

C. DISMANTLING OF FRONT HUB ASSY.

a. Take out the inner race with cage of outer bearing from hub assy.

b. Using special tool, Rocker, Pt. No. 2654 5890 33 03 and a suitable handle remove outer race of outer bearing.

c. Using special tool, Rocker, Pt. No. 2654 5890 33 02 and a suitable handle remove inner bearing with oil seal.

d. Clean all parts thoroughly.

D. REMOVAL / DISMANTLING OF STUB AXLE ASSEMBLY

Removal -

a. Release load on torsion bar fully. (Fig.3)

b. Take out split pins locking castle nuts of ball joints at tie rod end on stub axle.

c. Using Puller Pt. No. 2654 5890 33 04 push out ball joints of tie rods from tie rod arms.

d. Take out split pins locking castle nuts of top and loosen the castle nuts ball joint of stub axle.

e. Unscrew and remove 4 screws holding ball joint assy. to the top wishbone. Take out ball joint assy.

f. Push out top ball joint from stub axle using special tool Pt. No. 2654 5890 32 01. Properly support stub axle.

g. Unscrew 4 screws of lower ball joint on lower wishbone. Take out stub axle along with ball joint.

h. Remove ball joint from stub axle with a mallet.

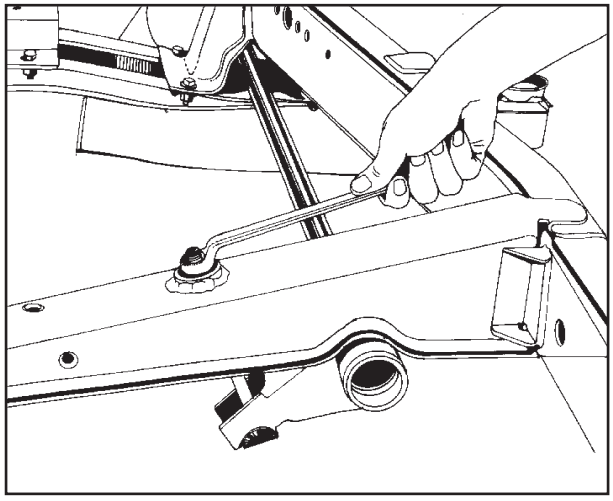


Fig. 3

E. DISMANTLING OF STUB AXLE ASSEMBLY

a. Unlock tab of 2 bolts connecting tie rod arm to the stub axle. Unscrew and remove bolts. Remove tie rod arm from stub axle.

b. Unscrew and remove 3 screws connecting dust shield to stub axle. Remove dust shield.

c. In case oil seal race on stub axle is worn out/ damaged, take out seal race by hammering.

4. INSPECTION OF PARTS

1. Check condition of bearing seats and oil seal seat on hub for wear/scoring marks. If necessary replace with new hub.

2. Check condition of wheel bolts for worn out / stripped threads. Replace bolts if necessary. Bolts are press fitted into hub.

3. Check condition of bearings for wear/pitting marks. If necessary replace with new ones.

4. Check condition of bearing seats on stub axle for wear/scoring marks, condition of threads of stub axle for worn out/stripped threads, condition of seal race for wear/scoring marks etc. If necessary, replace with new stub axle.

5. Check condition of split nut for stripped or worn out threads, ease threads, if necessary. Change split nut if necessary.

6. Check condition of ball joints. Check for excessive play in ball joints. If necessary replace with new ones.

   While replacing ball joints check condition of taper bore in stub axle.

7. Check condition of rubber boots of top and bottom ball joints. If it is damaged, dismantle the boot and install a new boot after ensuring that enough grease is available inside ball joint.

5. ASSEMBLY / INSTALLATION OF PARTS

A. ASSY. OF STUB AXLE

a. Assemble tie rod arm to stub axle (if removed earlier) and tighten bolts to specified torque. Lock bolts with tab washers.

b. Fit back dust shield on stub axle (if removed earlier) and tighten the screws.

c. In case seal race is removed earlier, assemble a new seal race on stub axle using drift Pt.No. 2654 5890 3511 Fig. 4.

d. Inspect condition of rubber boots of ball joints. If damaged, remove boot, and install a new boot after ensuring that enough grease is available inside. Using mandrel Part No. 2654 5890 3203, fit circlip of boot in position.

If there is excessive play in ball joint, replace ball joint assy. with a new one.

B. INSTALLATION OF STUB AXLE

a. Install lower ball joint in to stub axle & tighten four screws on lower wishbone. Tighten castle nut.

Fit stub axle assembly between upper and lower wishbone. Tighten 4 screws of lower ball joint on lower wishbone.

b. Install upper ball joint in to stub axle and tighten four screws in upper wishbone. Tighten castle nut.

c. Connect tie rod ball joints. Tighten castle nuts to specified torques and fit split pins.

Note : Tightening of castle nuts of upper and lower ball joints to specified torque can be done after connecting steering linkages, if it is not possible at this stage.

INSTALLATION OF SEAL RACE ON STUB AXLE

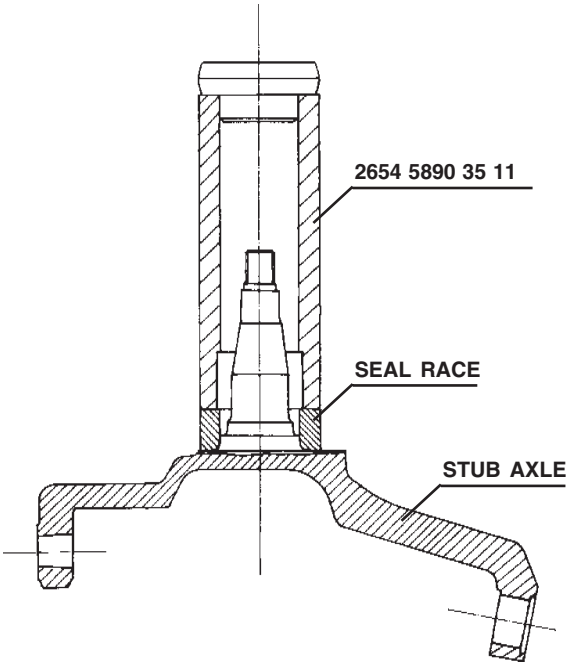


Fig. 4

C. ASSY / INSTALLATION OF FRONT HUB :

I. ASSEMBLY

a. Before proceeding to assembly of hub, ensure that all parts are cleaned properly; especially the bearings.

Smear little grease on the OD of inner bearing outer race. Press outer race in hub using

1) Drift 2654 5890 35 07

2) Handle 2640 5890 35 11. Fig. 5

b. Pack roller cage of inner bearing with grease and locate it in hub.

c. Smear little grease on the OD of the oil seal (always fit a new oil seal) and press seal in hub using

1) drift 2654 5890 35 04

2) Handle 2640 5890 35 11. Fig. 6

d. Smear little grease on OD of outer bearing outer race and press outer race in hub using

1) Drift 2654 5890 35 07

2) Handle 2640 5890 35 11. Fig.7

e. Pack space between hub bearings with wheel bearing grease.

INSTALLATION OF OIL SEAL IN FRONT HUB

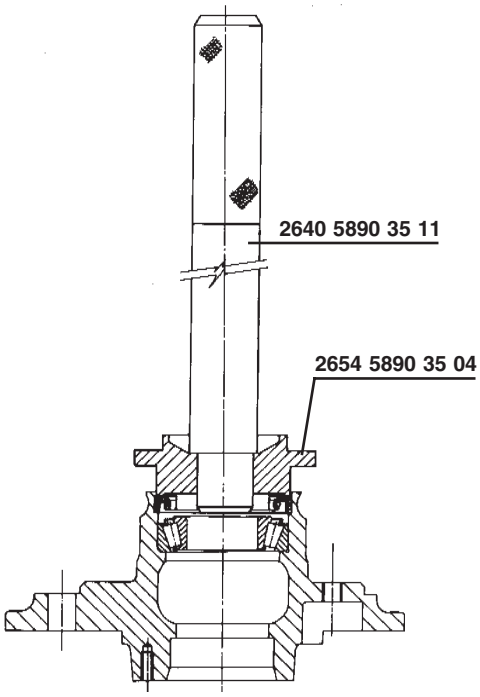


Fig. 6

INSTALLATION OF FRONT HUB INNER BEARING OUTER RACE

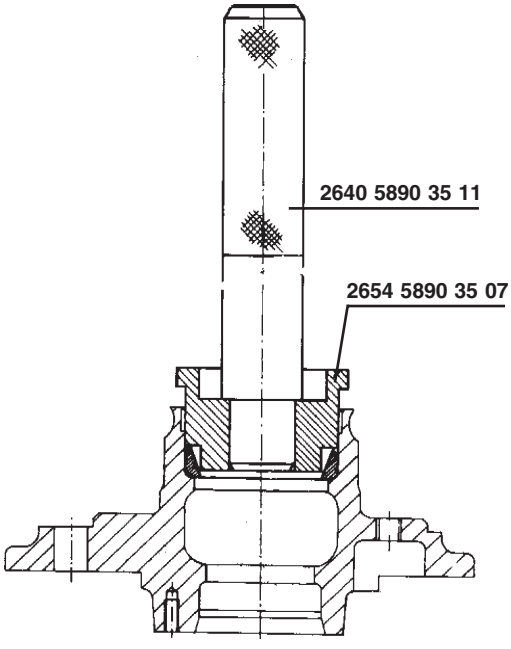


Fig. 5

INSTALLATION OF FRONT HUB OUTER BEARING OUTER RACE

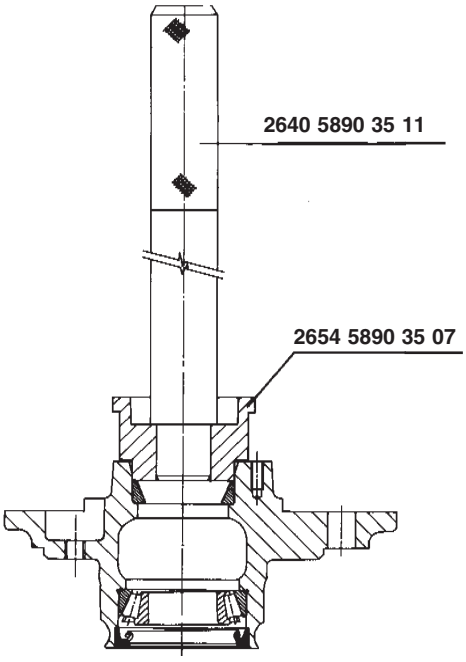


Fig. 7

II) INSTALLATION OF HUB ON STUB AXLE (Fig. 8).

a. Slide assembled hub on stub axle.

b. Insert inner race with roller cage of outer bearing into stub axle after packing rollers with grease, using drift 2651 5890 33 08. Insert thrust washer and screw on the split nut.

c. **Wheel Bearing Adjustment:**

- Fit dial gauge on a magnetic stand. Fit magnetic stand on hub and adjust spindle of dial gauge in such a way that it rests against the face of stub axle. Dial gauge should have a pre-load of approx. 2 mm.
- Tighten split nut with suitable spanner fully. Loosen nut slightly, gently tap hub all around with a mallet.
- Check axial play of hub on the dial gauge by pulling and pushing hub by hand and go on tightening split nut until play is within 0.03 - 0.06 mm.
- Tighten cap screw on split nut.
- Check and ensure again axial play of hub, that it is within limit of 0.03 - 0.06 mm.
- Fit hub cover with gasket and tighten cap screws. Fill approx. 30 gms grease in cover before fitting.

d. Install caliper assy on disc and tighten screws connecting the caliper assy to stub axle to 6.8 - 8.3 mkg torque.

e. Connect one end of brake hose to caliper assy by banjo bolt.

f. Connect other end of brake hose to bundy pipe on bracket on chassis frame. Install the clip.

g. Fill brake fluid in brake fluid container and bleed the system.

D. INSTALLATION OF THE FRONT WHEELS

a. Install front wheels on hub assy and tighten wheel nuts by hand.

b. Remove supports, supporting chassis long member.

c. Tighten wheel nuts to a torque of 12-15 mkg.

NOTE :

Front hubs manufactured by Tata Motors & Dana Spicer are used in selection in 4x2 version.

Procedure given in this section is applicable only for Tata Motors front hubs.

Repair procedure for Dana Spicer front hub & Dana Spicer rear hub are same. Please refer relevant portion of Spicer rear axle for repair of Spicer front hubs.

Spicer hubs only are used for front wheels in 4x4 version. Dismantling, inspection, repairs & assembly procedure for spicer front hubs used in 4x4 version & special tools required are same as that of spicer rear hubs.

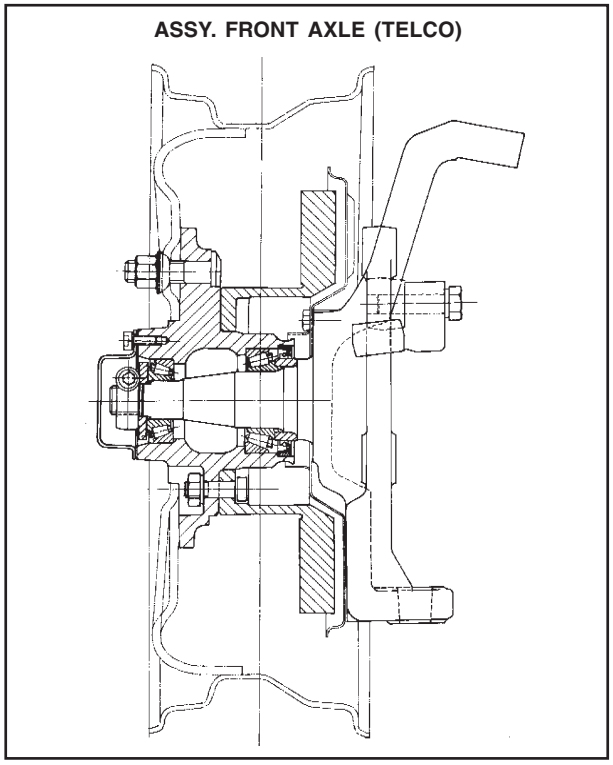


Fig. 8

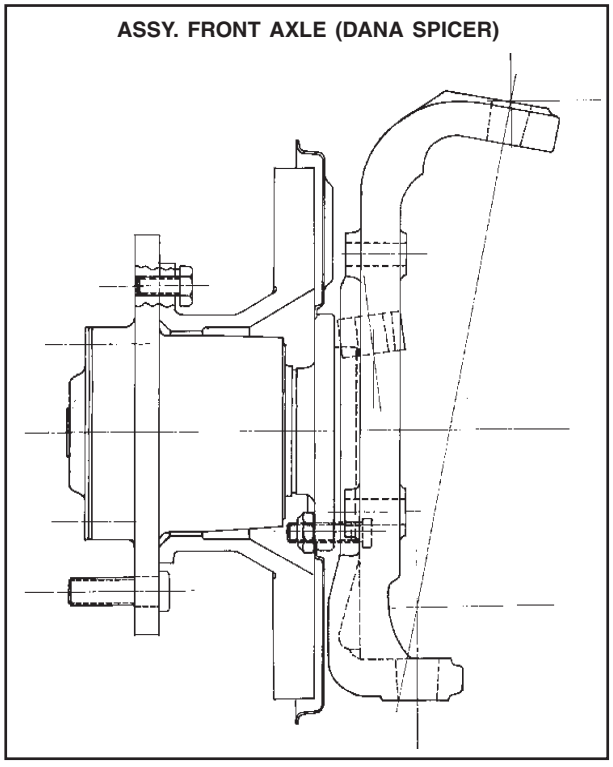


Fig. 9

FRONT AXLE - 4X4

INTRODUCTION :

Live Front Axle (Dana Spicer) has following unique features.

Centre section of Front Axle Assembly is an integrated type axle housing. Axle bearings are lubricated with hypoid lubricant. Thus it does not require grease.

Automatic hub lock at the wheel end is very convenient for user with its characteristic of automatic locking by engaging transfer case & of free wheeling possibility by reversing the vehicle. The response is very sharp with angle of wheel rotation needed for locking & unlocking being mere ninty degrees.

The constant velocity (CV) shafts are connected between side gear in differential case and spindle assembly. These shafts provide power transfer maintaining a constant shaft speed regardless of operating angles, while allowing for steering and suspension movement.



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CONSTRUCTION OF FRONT LIVE AXLE

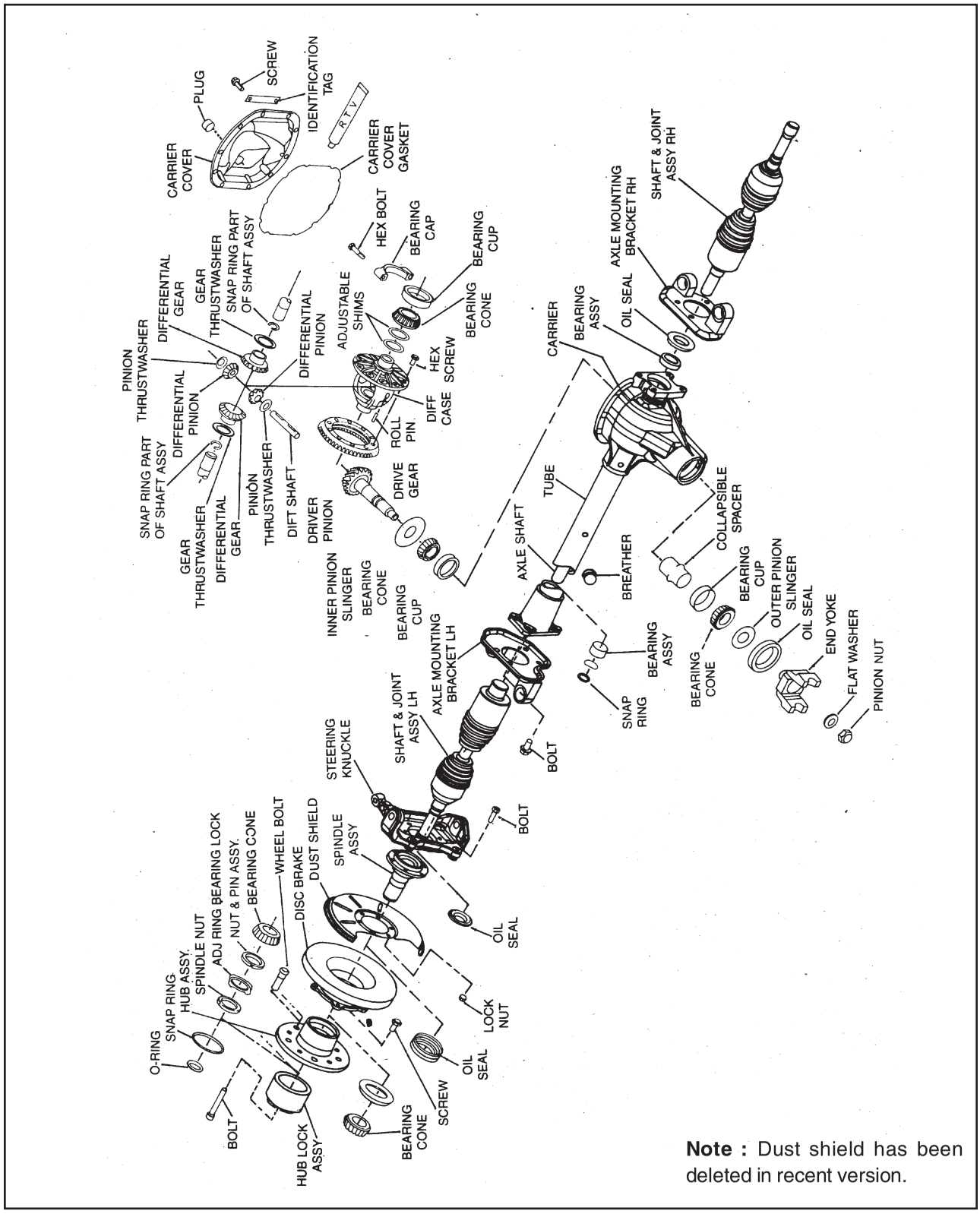


Fig. 1



SPECIFICATION AND SERVICE DATA

Type	:	Single reduction, with hypoid gears
		Independently suspended, with automatic hub locks.
Axle ratio	:	4.875 (39 / 8) Facelift version
		4.1 (41/10) OR 4.56 (41/9) Non-Facelift version
Weight of axle including brake disc	:	105 Kg ± 2.5 %
Amount of grease required at each wheel end	:	92 gms
Hub bearing play	:	0.00 to 0.10 mm
Maximum torque to rotate Hub, when end play is 0.00 mm	:	2.30 Nm
To adjust bearing (spindle assembly)		
(i) Torque inner locknut and lock	:	68 Nm
(ii) Install outer locknut	:	203 to 305 Nm
Oil Capacity	:	1.2 Lit. ± 3%
Lubricant change Interval	:	At every 40,000 km (24,000 miles) of operation
Tightening Torque		
Cover Screws	:	38-45 Nm
Fill Plug	:	20-34 Nm
Differential Bearing Cap screws	:	47-68 Nm
Ring Gear Screws	:	95-122 Nm
Drive Pinion Nut	:	217 Nm Min.
Drain Plug	:	27-34 Nm
Spindle to Knuckle Nuts	:	34-47 Nm
Brake Disc to Hub Flange	:	58-70 Nm
Hub Lock Screws to Hub	:	54-63 Nm
Breather	:	20-34 Nm
Mounting Brackets to Carrier	:	54-75 Nm
Pinion Bearing Preload		
Torque to rotate drive pinion only	:	1.7-3.9 Nm
Backlash Specification		
Ring gear to pinion gear	:	0.13 mm to 0.23 mm (to be checked at 3 different locations)
Maximum permissible variation between checked points.	:	0.08 mm

SPECIAL TOOLS FOR INDEPENDENT FRONT LIVE AXLE (DANA SPICER).

Sr. No.	Description	Part No.		
1.	Dolley to press oil seal in hub	2704	5890	33 01
2.	Dolley for pressing oil seal in tube	2704	5890	33 02
3.	Dolley to press cup in hub (outer)	2704	5890	33 03
4.	Dolley to press cup in hub (inner)	2704	5890	33 04
5.	Dolley for pressing Needle Roller Bearing in the tube	2704	5890	33 05
6.	Dolley for pressing Cylindrical Roller Bearing in housing	2704	5890	33 06
7.	Adaptor to remove cup from hub (inner)	2704	5890	33 07
8.	Adaptor to remove cup from hub (outer)	2704	5890	33 08
9.	Dummy Bearing	2704	5890	33 09
10.	Adaptor to remove pinion inner cup	2704	5890	33 10
11.	Handle for dollies	2704	5890	33 11
12.	Expander from M 30 carrier	2704	5890	33 12
13.	Pinion height setting gauge	2704	5890	33 13
14.	Dolley for pressing outer pinion bearing cup in housing	2704	5890	33 14
15.	Adaptor to remove pinion outer cup	2704	5890	33 15
16.	Dolley for pressing inner bearing cone on pinion	2704	5890	33 16
17.	Height setting gauge master block	2704	5890	33 17
18.	Check nut spanner	2704	5890	33 18
19.	Dolley to press oil seal in spindle	2704	5890	33 19
20.	Dolley to press bearing cone in spindle	2704	5890	33 20
21.	Dolley for pressing inner pinion bearing cup in housing	2704	5890	33 21
22.	Adaptor to remove differential bearing	2704	5890	33 22
23.	Adaptor to remove pinion inner bearing	2704	5890	33 23
24.	Puller to remove right side bearing from flange carrier	2704	5890	33 24
25.	Dolley for pressing differential case bearing	2704	5890	33 25
26.	Adaptor to remove bearing cone on spindle	2704	5890	33 26
27.	Dolley to press needle roller bearing in spindle	2704	5890	33 27
28.	Bearing puller	2704	5890	33 28
29.	Adaptor plug spindle	2704	5890	33 29
30.	Plain pliers, snap ring	2704	5890	33 30
31.	Tank pliers - snap ring	2704	5890	33 31
32.	Clamp crimper	2704	5890	33 32
33.	Ball assembly tool	2704	5890	33 33
34.	Puller	2654	5890	33 04
	Following tools are common with Rear Axle (Spicer)			
35.	Holder yoke	2698	5890	35 05
36.	Press	2698	5890	35 15
37.	Adaptor ring	2698	5890	35 16
38.	Slide hammer puller	2698	5890	35 07
39.	Installer pinion oil seal	2698	5890	35 13
40.	Handle universal	2698	5890	35 06
41.	Drive square for drain plug	2698	5890	35 24

REMOVAL OF WHEEL END WITH CV SHAFT FROM VEHICLE

Place wheel chocks on both sides of rear wheels.

Disengage the hub locks if need be, by shifting the vehicle to 2H mode.

Loosen front wheel nuts.

Jack up front wheels and support them suitably.

Unscrew and remove wheel nuts. Remove front wheels.

Disconnect front brake hoses and plug them to avoid brake fluid loss. Unscrew and remove caliper assemblies from stub axles.

Release torsion bar load fully. Loosen steering knuckle ball joint nuts top and bottom, but do not remove.

Remove tie rod assembly nut.

Disconnect tie rod from knuckle by pushing out ball joint of tie rods, using puller pt. no. 2654 5890 33 04.

Caution : Do not allow CV shaft to hang unsupported. Damage to out board and in board CV joint may result.

Wrap axle shaft with layers of tape. *Fig. 2*

Tie axle shaft to chassis frame with a rope, in order to hold the shaft level while knuckles are being removed.

Remove nuts from the ball joint and remove knuckle. Tap with mallet, if required. Hold axle shaft with one hand next to the axle housing, gently pry the shaft assembly loose from the side gear with a large screw driver.

Hold axle shaft at out board CV joint and remove supporting wire.

Carefully remove shaft from axle housing.

Wheel End Assembly

(Disassembly is done on a work table.)

Install wheel end assembly on a soft jaw vice.

Remove six allen screws which secure hub - lock assembly. *Fig. 3*

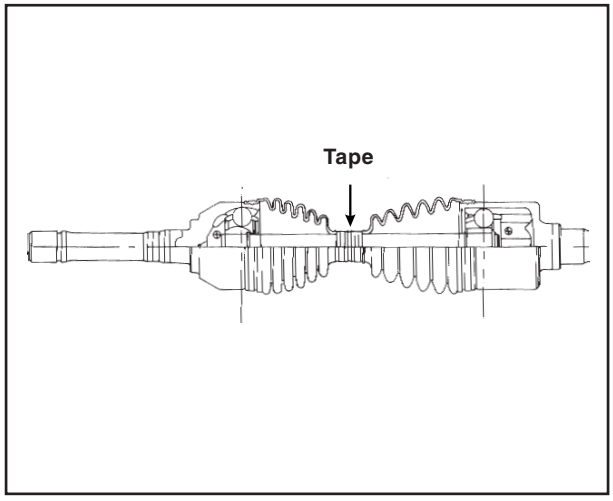


Fig. 2

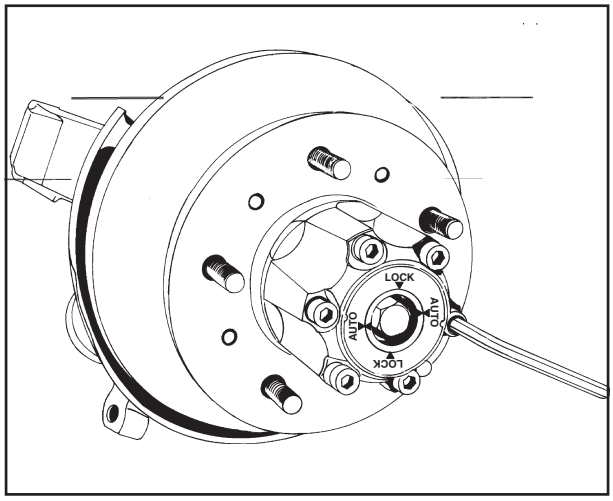


Fig. 3

Remove hub - lock assembly.

Note : 1. The knob should be at lock position. *Fig. 4* (only for TF hub lock)

Note : 2. Hub - lock assembly is a non - serviceable component. If it is established that problem is in hub - lock, it is to be replaced with a new one. (only for TF hub lock)

Remove snap ring from axle shaft. *Fig. 5*

Remove washer.

Remove outer & inner brake assembly (only for TF hub lock)

Remove axle shaft.

Using a socket, spanner pt. no. 2704 5890 3318 remove spindle lock nut, lock washer and inner wheel bearing adjusting nut. *Fig. 6*

Note : Pin on wheel bearing adjusting nut engages to a hole in lock washer. During removal, take care not to damage pin. Replace wheel bearing adjusting nut, if pin is found bent or damaged.

Remove spindle assembly by pulling steering knuckle from hub.

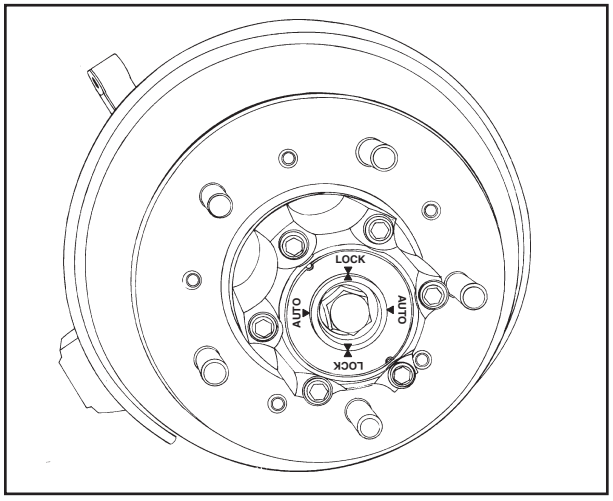


Fig. 4

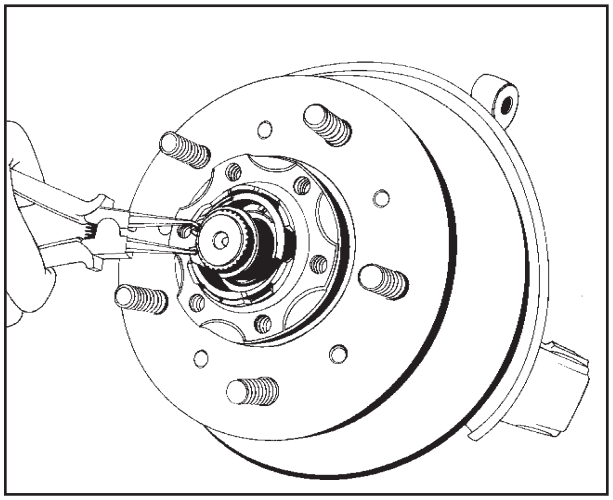


Fig. 5

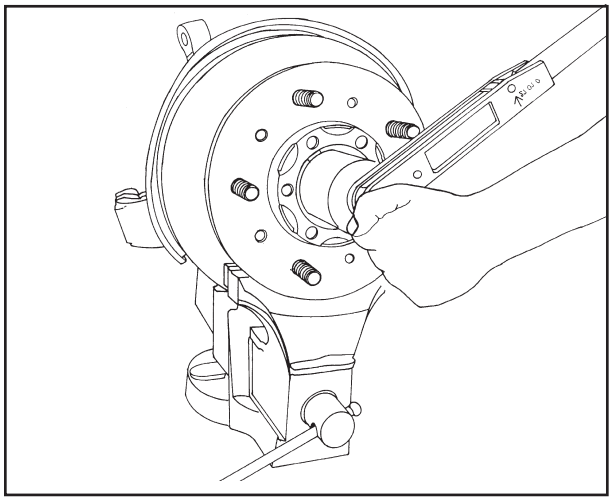


Fig. 6

Remove outer bearing cone and roller assembly.

Remove outer bearing cup from hub, using adaptor Pt. no. 2704 5890 3308.

Turn hub upside down.

Remove inner bearing cup from hub using Adaptor Pt. no. 2704 5890 3307.

If necessary, remove five bolts and lock washers which secure hub and brake disc. *Fig. 7*

Separate hub and brake disc.

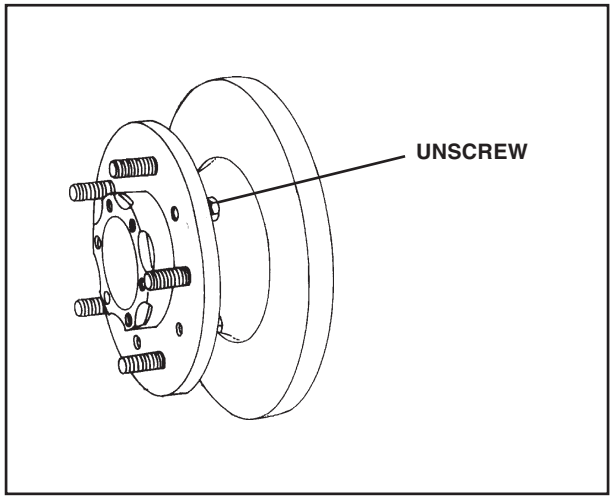


Fig. 7

Spindle Assembly :

Place spindle assembly on work table.

Remove inner bearing from spindle as shown on *Fig. 8* using.

1. Adaptor ring Pt. no. 2698 5890 3516
2. Press Pt. no. 2698 5890 3515
3. Adaptor, plug spindle Pt. no. 2704 5890 3329
4. Adaptor to remove bearing cone on spindle. Pt. no. 2704 5890 3326.

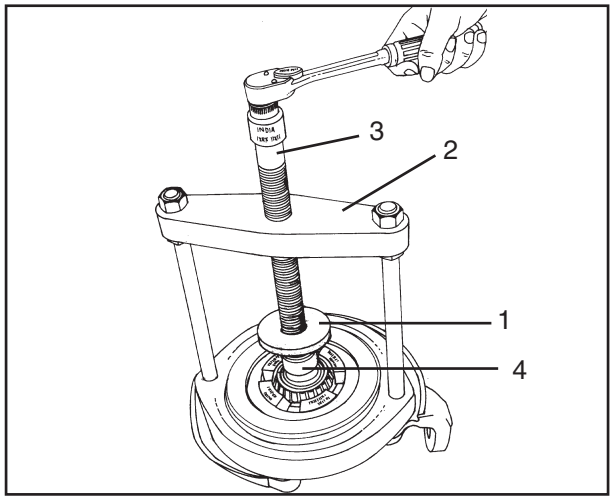


Fig. 8

Remove hub seal.

Remove six nuts which hold spindle on knuckle.

Fig. 9

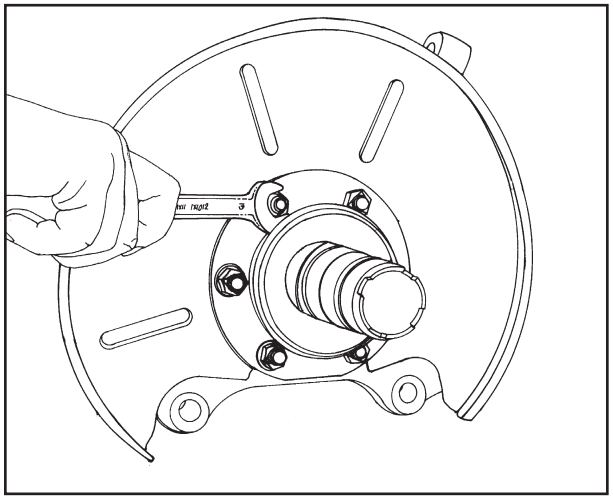


Fig. 9

Remove spindle from steering knuckle by tapping with soft hammer. *Fig. 10*

Note : Striking the threaded portion will damage spindle.

Place spindle in a soft - jaw vise.

Remove spindle needle bearing and seal using Bearing puller Pt. no. 2704 5890 3328. *Fig. 11*

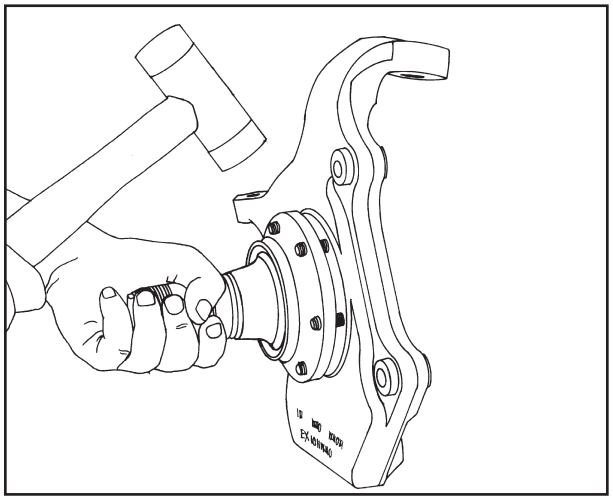


Fig. 10

Cleaning and Inspection

Clean hub and brake disc with a metal part cleaner.

Inspect parts for wear and damage. If brake disc is heavily worn or damaged, replace it.

Inspect bearings and cones for scoring and wear marks. Replace if required.

Inspect pin on wheel bearing adjusting nut. If pin is found bent or dislodged, replace adjusting nut.

Clean spindle with metal cleaning solvent and dry it.

Inspect inner and outer bearing seating area in spindle. If scored/damaged, replace spindle.

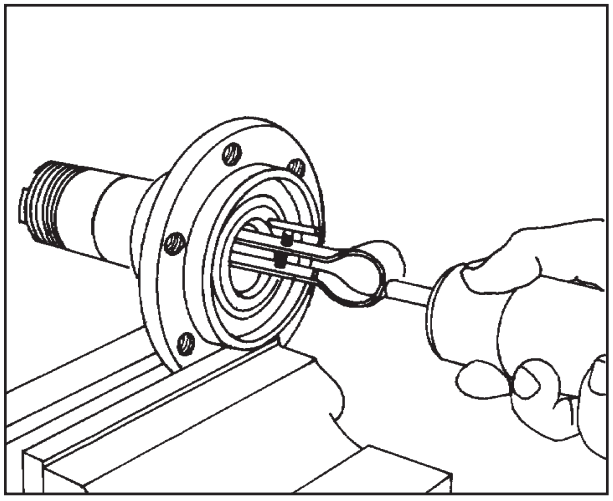


Fig. 11

ASSEMBLY

Install brake disc on a soft - jaw vise.

Assemble hub on brake disc with five bolts and lock washers.

Torque bolts to specified value.

Assemble outer bearing cup using. Dolley Pt. no. 2704 5890 3303. *Fig. 12*

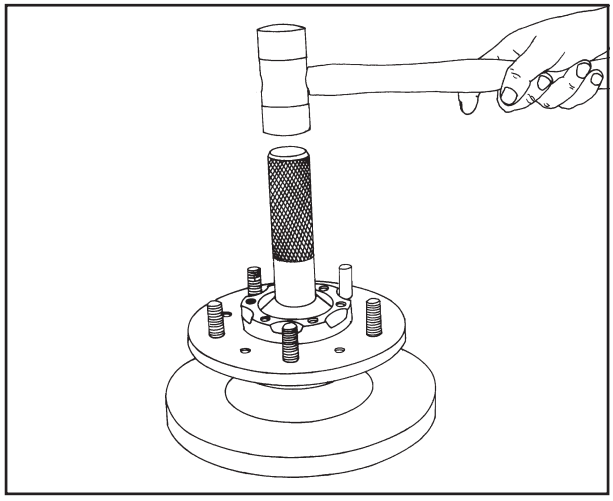


Fig. 12

Assemble inner bearing cup using. Dolley Pt. no. 2704 5890 3304 *Fig. 13*

Pack spindle, inner and outer bearings with specified grease.

Mount the spindle suitably.

Assemble spindle needle bearing using Dolley Pt. no. 2704 5890 3327. Drive the bearing until tool bottoms out against spindle.

Note : Make sure that the bearing number on the race is placed against the tool.

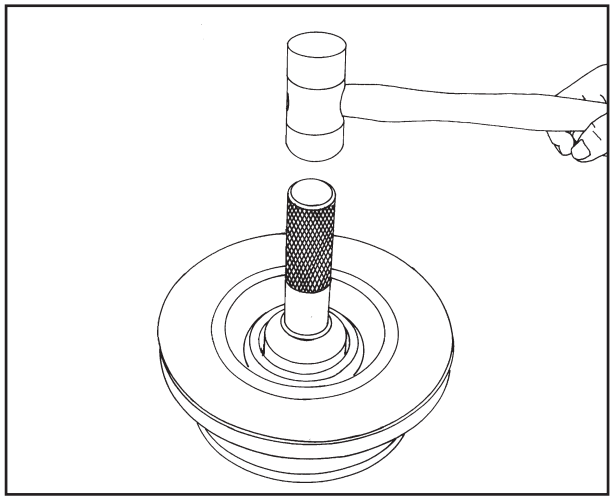


Fig. 13

Assemble spindle to steering knuckle. Tighten sin nuts to specified torque. *Fig. 14*

Assemble new hub seal.

Assemble inner bearing to spindle using. Dolley Pt. no. 2704 5890 3320.

Apply grease to assemble bearing on spindle, if required.

Mount hub and brake disc assembly suitably.

Assemble spindle onto hub and brake disc assembly.

Note : Small amount of rocking motion of steering knuckle may be required.

Assemble outer bearing cone onto spindle.

Assemble inner wheel bearing adjusting nut.

Note : Ensure that lock pin is towards outside (tool side).

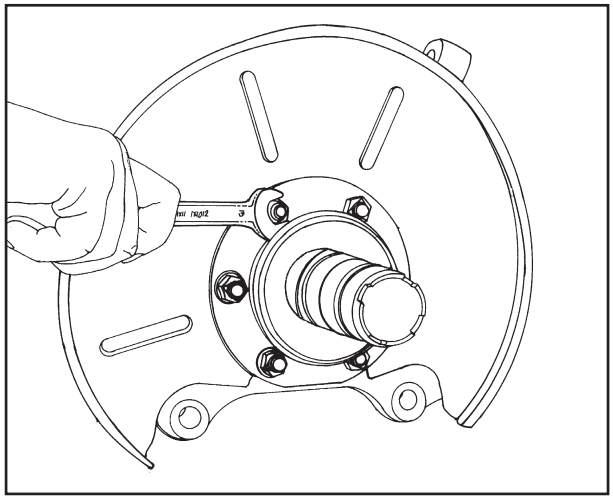


Fig.14

Torque inner adjusting nut to 68 Nm. using spanner Pt. no. 2704 5890 3318 *Fig. 15*

Rotate hub, loosen inner adjusting nut 90 degrees maximum and assemble lock washer by turning inner adjusting nut so that pin on adjusting nut aligns with a hole in lock washer.

Install lock nut and torque 203-305 Nm.

Final bearing adjustment to have 0.00 to 0.10 mm total end play.

Maximum torque to rotate the hub is 2.3 Nm (When end play is 0.00)

Install axle shaft in spindle.

Reassemble assembly outer brake.

Install washer and reassemble the snap ring to axle shaft.

Reassemble hub - lock assembly

Note : Refer hub lock installation and removal procedure.

Screw in allen screws and tighten to specified torque.

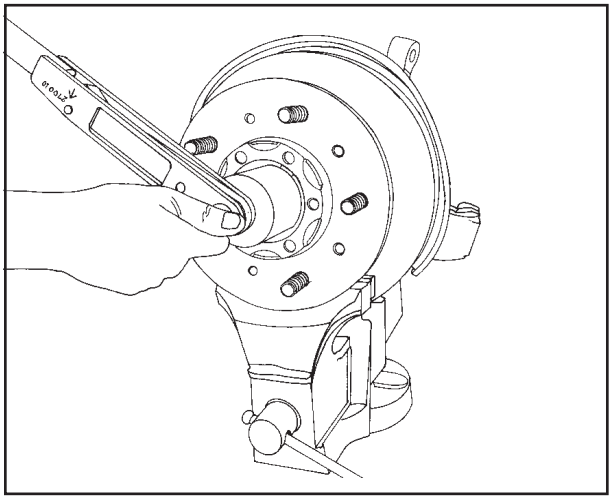


Fig. 15

Wheel End Components :

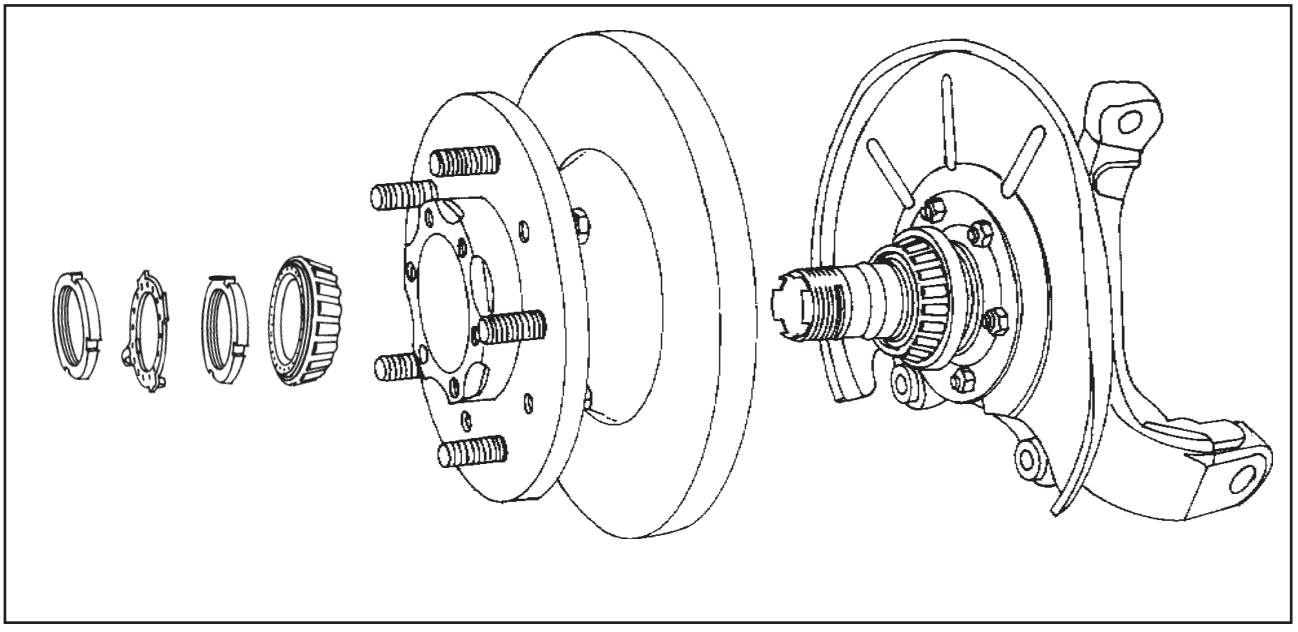


Fig. 16

CARRIER CENTRE SECTION

DISASSEMBLY

Remove wheel ends, steering knuckles and both out board shaft assemblies.

Mount axle on a suitable stand.

Drain oil by unscrewing drain plug.

Remove cover plate screws, and cover plate.

Clean the liquid gasket on housing & cover mating surfaces.

Remove axle shaft snap ring. *Fig. 17*

Inspect snap ring, discard if damaged.

Remove axle shaft. *Fig. 18*

Remove mounting bracket. *Fig. 19*

Remove the mounting bracket from centre section.

Remove RH carrier trunnion seal and LH tube seal using puller Pt. no. 2698 5890 3507.

Note : Discard seals and replace with new ones during assembly. Both seals are interchangeable.

Remove LH side needle roller bearing from tube using bearing puller Pt. no. 2704 5890 3328.

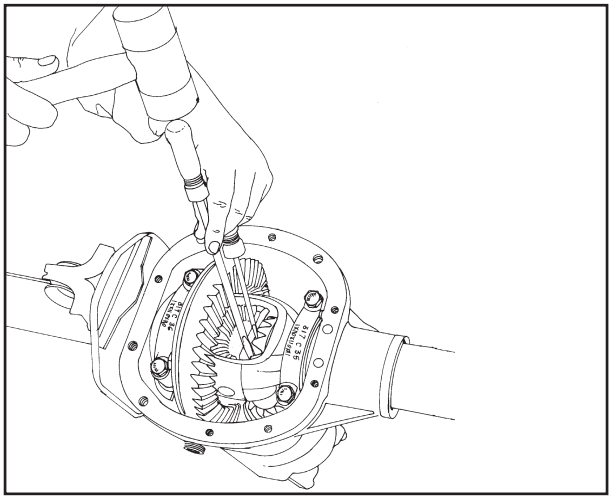


Fig. 17

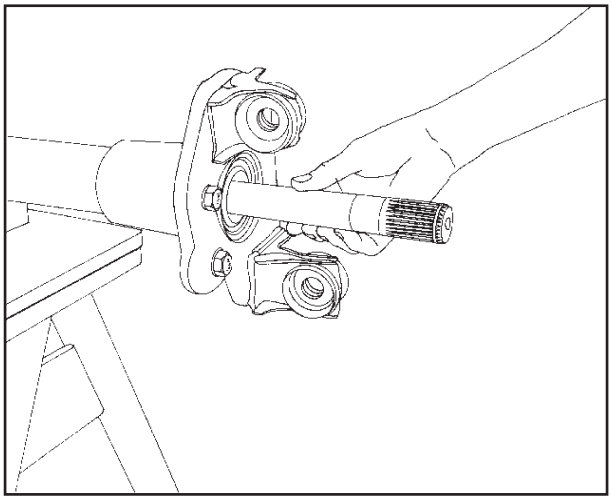


Fig. 18

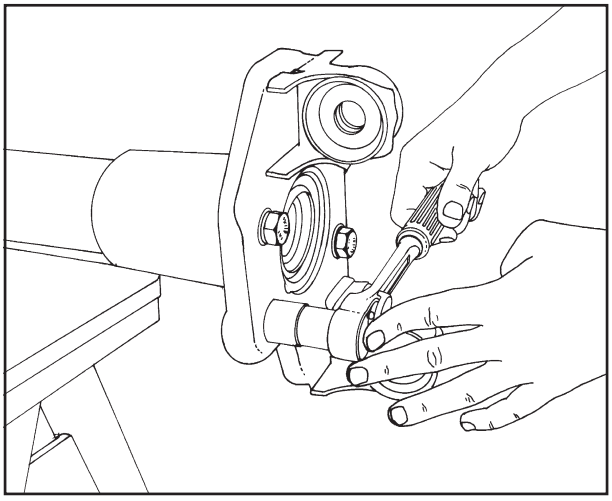


Fig. 19

Carrier Section

Remove bearing caps. *Fig. 20*

Note mating letters stamped on caps and carrier.

Mount Expander Pt. no. 2704 5890 3312 to housing & expand housing. Do not spread carrier over 0.50 mm. Use dial indicator. *Fig. 21*

Remove dial indicator.

Pry differential case from carrier with two pry bars. *Fig. 22*

Remove Expander.

Remove RH side bearing from flange carrier using puller Pt. no. 2704 5890 3324.

Remove differential side bearings using :

Press Pt. no. 2698 5890 3515

Adaptor ring Pt. no. 2698 5890 3516

Adaptor to remove differential bearing Pt. no. 2704 5890 33 22. *Fig. 23.*

Identify shims, bearing cups and bearing cones as to from which side they were removed.

Caution : When pulling bearing, differential assembly may fall and get damaged.

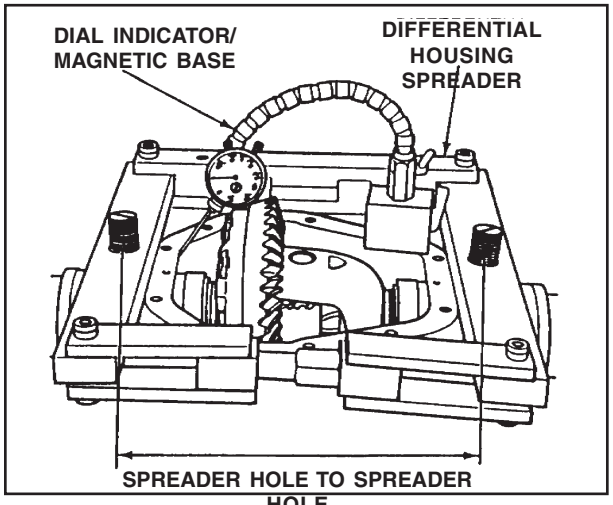


Fig. 21

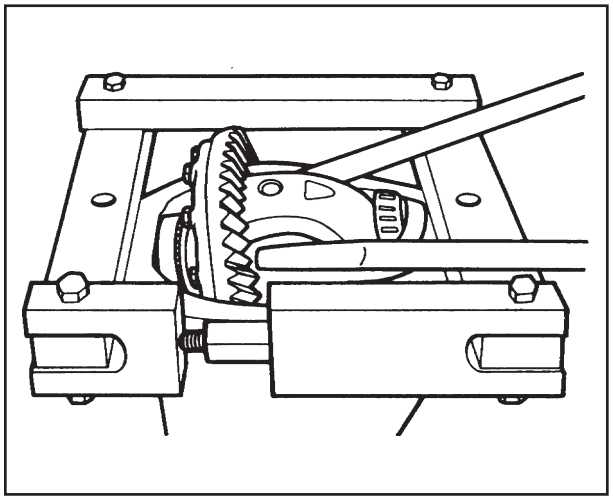


Fig. 22

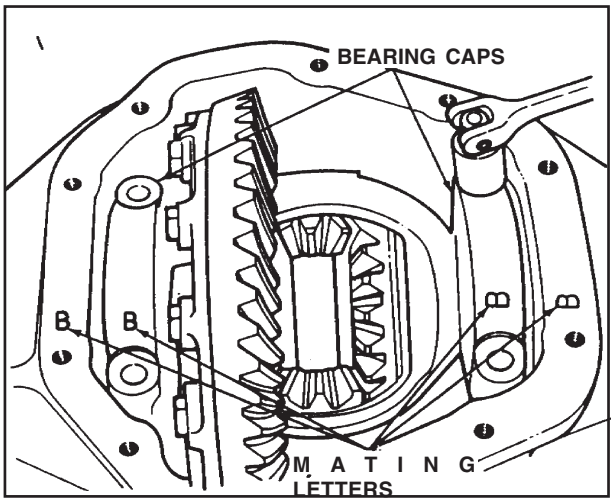


Fig. 20

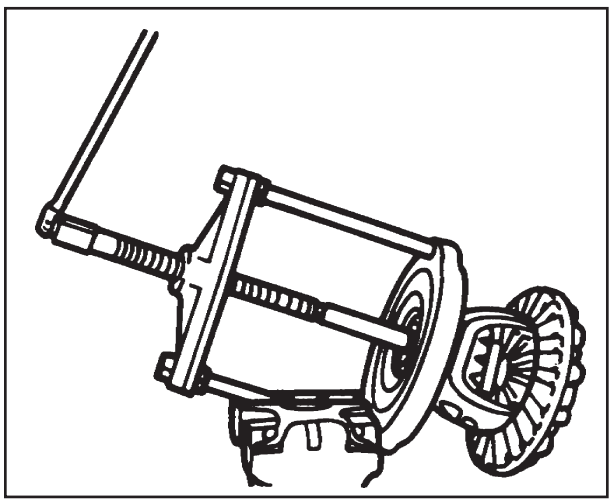


Fig. 23

Remove ring gear screws and ring gear. *Fig. 24*

Note : Protect gear teeth from getting damaged. Discard the ring gear screws.

Case Disassembly

Drive out roll pin securing pinion mate shaft. *Fig. 25*

Remove pinion mate shaft. *Fig. 26*

Remove pinion mate gears by rotating side gears.

Remove side gears. *Fig. 27*

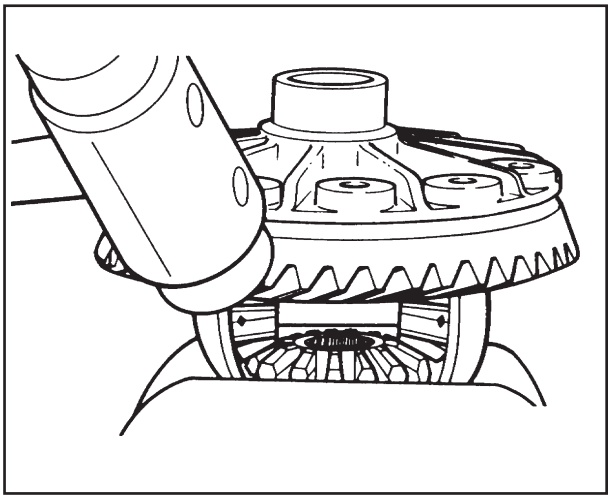


Fig. 24

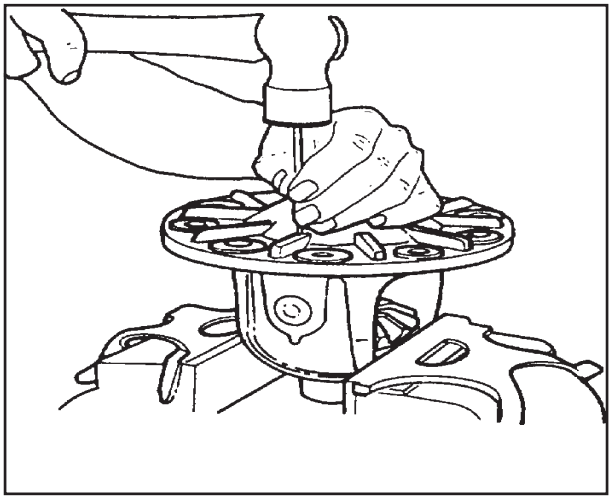


Fig. 25

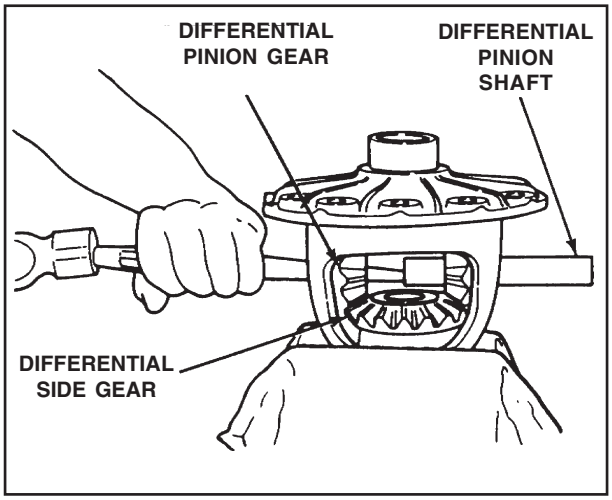


Fig. 26

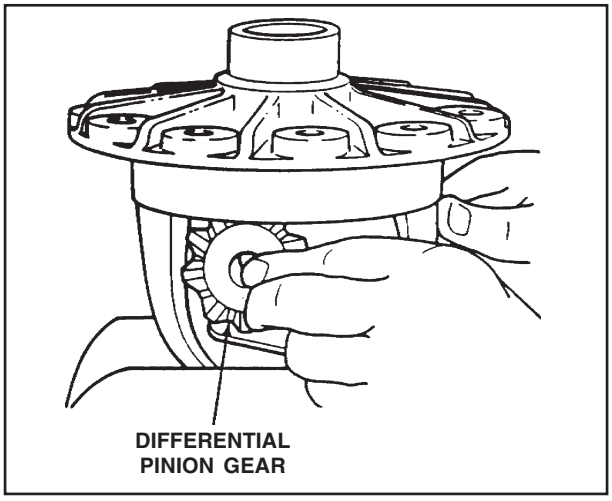


Fig. 27

Drive Pinion Removal

Turn nose of carrier to vertical position and remove pinion nut and end yoke. *Fig. 28*

Note : Discard pinion nut.

Remove pinion by tapping. *Fig. 29*

Note : Do not allow to pinion to fal. It can get damaged or strike foot. Discard collapsible spacer.

Pull out pinion seal using puller slide hammer Pt. no. 2698 5890 3507 *Fig. 30*

Note : Discard seal.

Remove pinion outer bearing cone and outer slinger.

Remove pinion inner bearing cup using Adaptor Pt. no. 2704 5890 3310. *Fig. 3*1

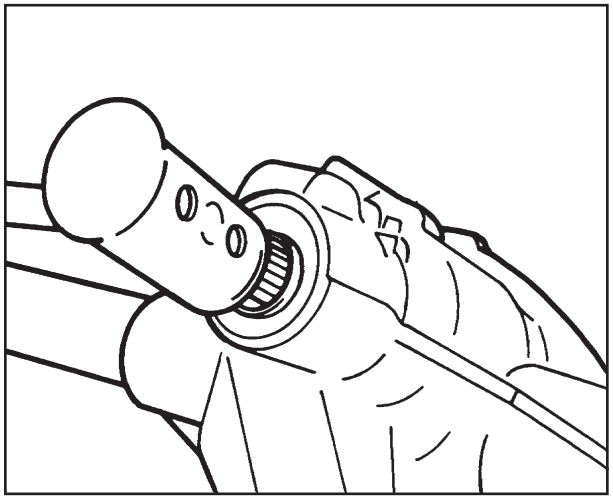


Fig. 29

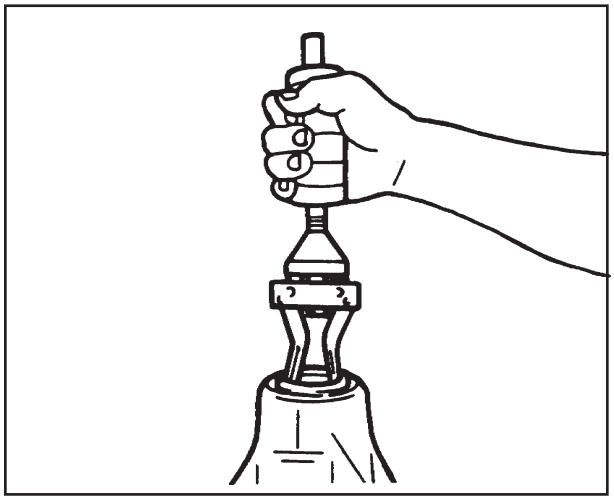


Fig. 30

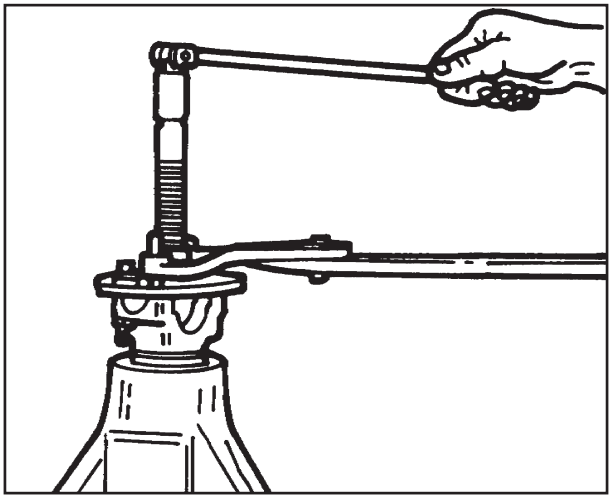


Fig. 28

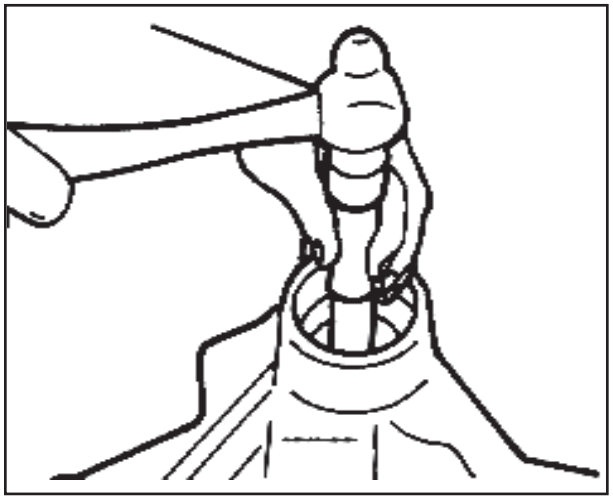


Fig. 31

Remove pinion outer bearing cup using Adaptor Pt. no. 2704 5890 3315 *Fig. 32*

Caution : Do not nick carrier bore.

Note : Pinion inner slinger is located between pinion inner bearing cone and pinion gear.

Remove pinion inner bearing. using :

1] Press Pt. no. 2698 5890 3515.

2] Adaptor ring Pt. no. 2698 5890 3516.

3] Adaptor to remove pinion inner bearing Pt. no. 2704 5890 3323.

Remove pinion inner slinger.

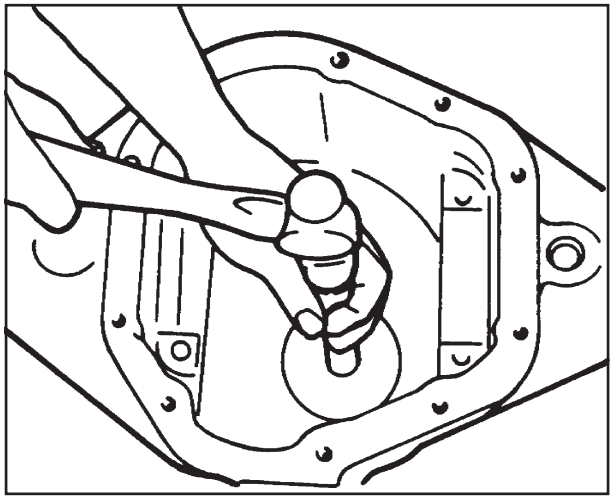


Fig. 32

ASSEMBLY

Shaft Bearing & Seals.

Install RH roller bearing assembly into the carrier trunnion with Dolley Pt. no. 2704 5890 3306 until the tool bottoms out against carrier.

Note : Make sure that the bearing number on race is placed against tool.

Install LH needle bearing assembly into axle tube with Dolley Pt. no. 2704 5890 3305.

Note : Make sure that bearing numbers on race is placed against tool.

Assemble oil seal in tube with Dolley Pt. no. 2704 5890 3302.

Carrier Section

Inspect side gears & pinion mate for wear & damage. Replace gears as a complete set. Do not mix new gears with old gears.

Discard old side gear thrust washers and pinion mate spherical washers. New washers have to be used during assembly.

Apply grease to side gear thrust washers and hubs of side gears.

Assemble both side gears.

Apply grease to pinion mate spherical washers and pinion mate gears.

Assemble pinion mate gears. *Fig. 33*

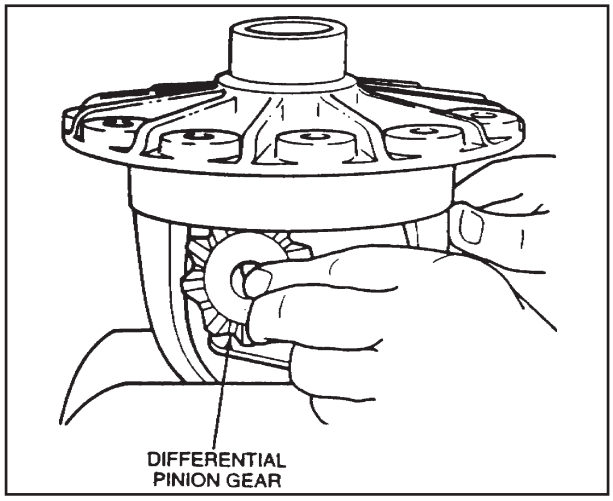


Fig. 33

Align holes of the gears with case and assemble shaft. *Fig. 34*

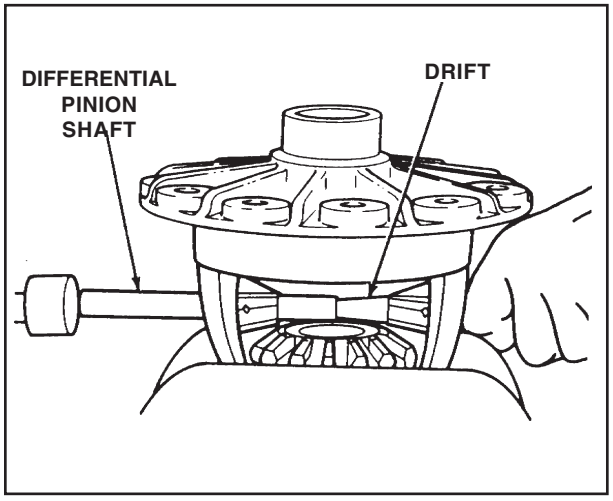


Fig. 34

Ensure that vertical lock pin hole is lined up with that of the case, and that pinion mate washers are in place and lined up with gear and case.

Assemble roll pin. *Fig. 35*

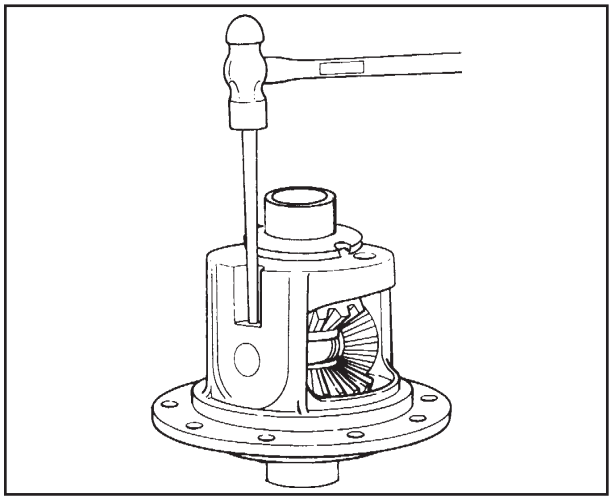


Fig. 35

Stake (peen) metal of case over roll pin at two places 180^0 apart to lock differential pinion shaft on case. *Fig. 36*

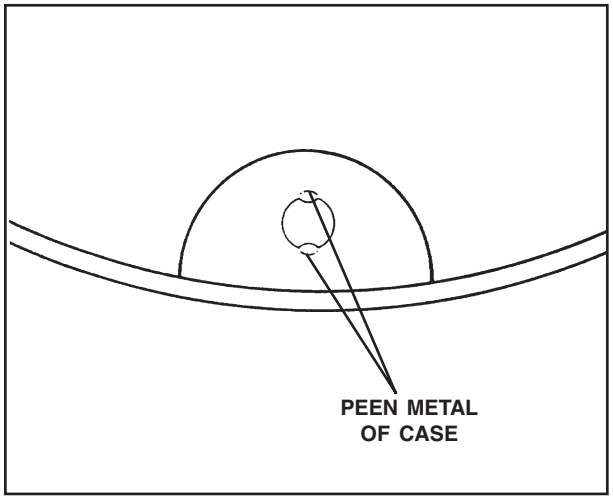


Fig. 36

RING AND PINION GEAR ASSEMBLY

Ring gear and pinion is supplied as a sets only. They are matched with each other during manufacture. Matching numbers on both pinion and ring gear are etched for verification. Fig. 37 or 38.

If a new gear set is used, verify numbers on pinion and ring for matching before proceeding with assembly.

Standard mounting distance from center line of ring gear to back face of pinion is 92.08 mm. This dimension is controlled by selecting shims, which are positioned between the inner pinion bearing cone and pinion gear. Best running position of gear set is achieved by proper shim selection.

This dimension for rear axle will be different.

On the bottom face of pinion a numbered is etched. It can be a plus (+) number, a minus (-) number or Zero (0). Required pinion shim selection is achieved with help of this number.

If alphabet "m" appears on pinion face shim selection has to be done in mm (Metric).

If alphabet "m" does not appear on pinion face shim selection has to be done in inches (English).

Please refer tables given below for calculations :
Example 1

	In metric	In inches
No punched on removed pinion	+ 8m	+ 3
No punch on new pinion	- 5m	- 2
Value derived from table	+ 0.13	+ 0.005
Thickness of shims in OE assembly	x	y
Thickness of shims to be selected for new ring/pinion	x + 0.13	y + 0.005

Example 2

	In metric	In inches
No punched on removed pinion	- 5m	- 3
No punch on new pinion	+ 5m	+ 4
Value derived from table	- 0.1	- 0.007
Thickness of shims in OE assembly	x	y
Thickness of shims to be selected for new ring/pinion	x - 0.1	y - 0.007

Shims with different thicknesses are available for selection.

Use tables on next page as a guide for selecting correct thickness of shims either for addition or for subtraction from old shim pack.

Fig. 37 shows ring and pinion etched with inch identification. Refer Table **A.**

Fig. 38 shows ring and pinion etched with metric indentification. Refer Table **B.**

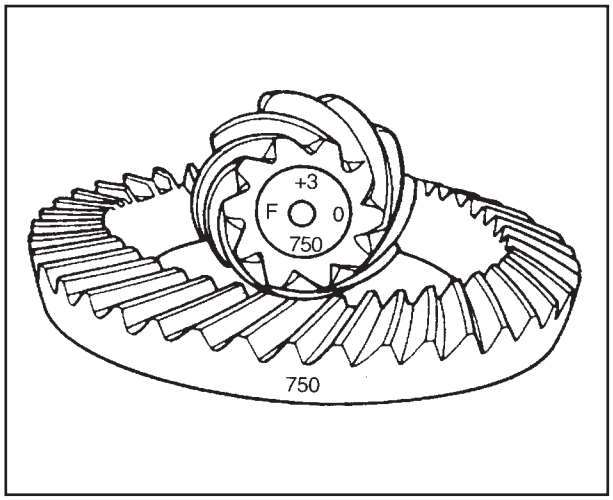


Fig. 37

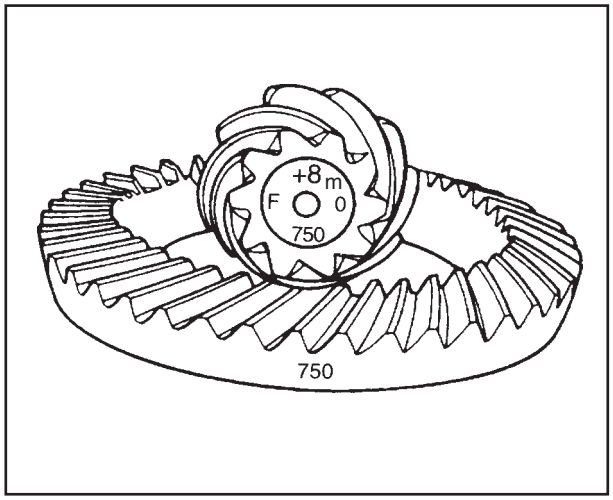


Fig. 38

TABLE A

Old Pinion Marking (English)	New Pinion Marking (English) (Value in Inches)								
	-4	-3	-2	-1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003
0	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004
-1	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005
-2	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006
-3	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007
-4	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007	-0.008

TABLE B

Old Pinion Marking (Metric)	New Pinion Marking (Metric) (Value in mm)								
	-10	-8	-5	-3	0	+3	+5	+8	+10
+10	+.20	+.18	+.15	+.13	+.10	+.07	+.05	+.02	0
+8	+.18	+.16	+.13	+.11	+.08	+.05	+.03	0	-.02
+5	+.15	+.13	+.10	+.08	+.05	+.02	0	-.03	-.05
+3	+.13	+.11	+.08	+.06	+.03	0	–.02	-.05	-.07
0	+.10	+.08	+.05	+.03	0	-.03	-.05	-.08	-.10
-3	+.07	+.05	+.02	0	-.03	–.06	-.08	-.11	-.13
-5	+.05	+.03	0	–.02	-.05	–.08	–.10	-.13	-.15
-8	+.02	0	-.03	-.05	-.08	-.11	-.13	–.16	–.18
-10	0	-.02	–.05	-.07	–.10	-.13	-.15	–.18	–.20

Note: Please observe the marking on pinion. If ‘m’ is found etched on the face, refer table **B**. If not refer table **A**.

PINION POSITION SHIM SELECTION

Install height setting gauge master block Pt. no. 2704 5890 3317 over inner bearing cup seat.

Install dial gauge on Pinion height setting gauge Pt. no. 2704 5890 3313.

Set dial gauge to 0 (zero), on a surface plate.

Install special tool depth gauge on differential side bearing housing.

Install dial gauge, such that the plunger is in contact with pinion master.

Rock the depth gauge.

Record the reading when indicator is at the highest point. Let it be 'x' *Fig. 39*

To calculate the shim thickness proceed as follows.

Shim thickness required = x - etched value on pinion (when etched+ve)

= x + etched value on pinion (when etched-ve)

Assembly pinion bearing cup

Drive pinion inner bearing cup into carrier using dolley Pt. no. 2704 5890 33 21. *Fig. 40*

Assemble pinion outer bearing cup into carrier using dolley Pt. no. 2704 5890 33 14. *Fig. 41*

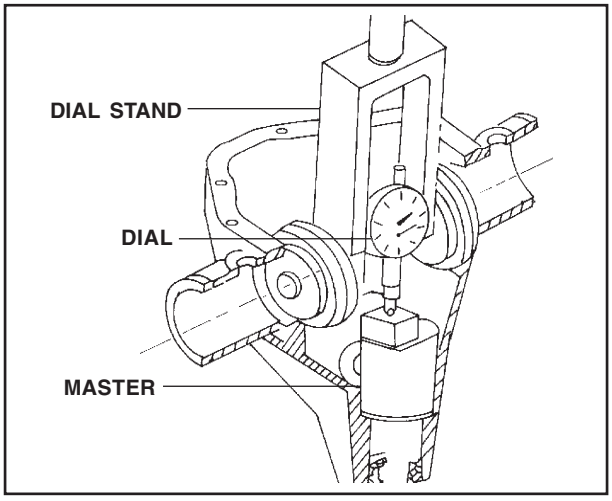


Fig. 39

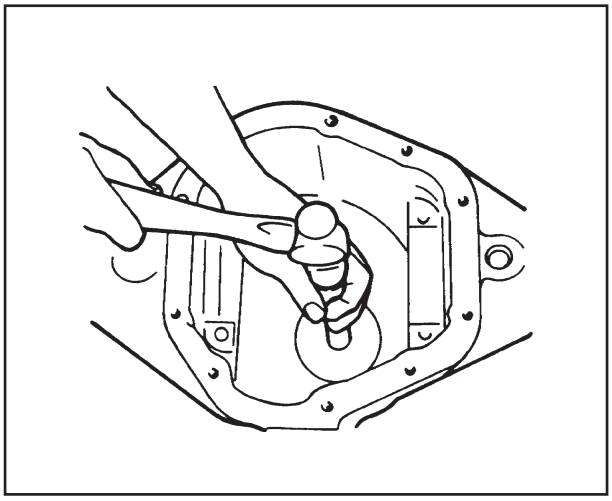


Fig. 40

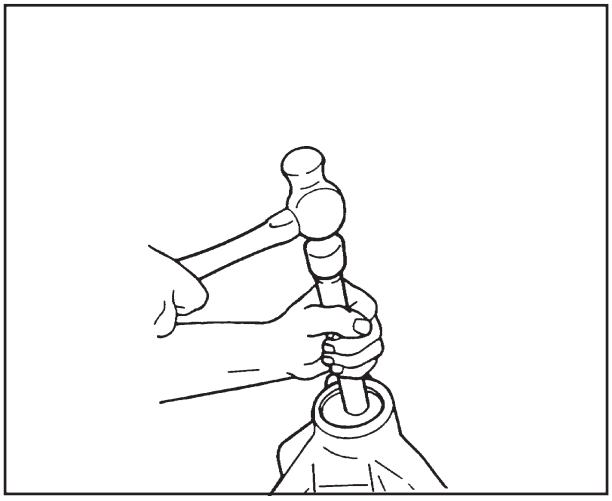


Fig. 41

Place proper thickness depth shim on pinion gear and install pinion rear bearing cone. Drive until it seats against the throat face of pinion. Use dolley Pt. no. 2704 5890 3316. *Fig. 42*

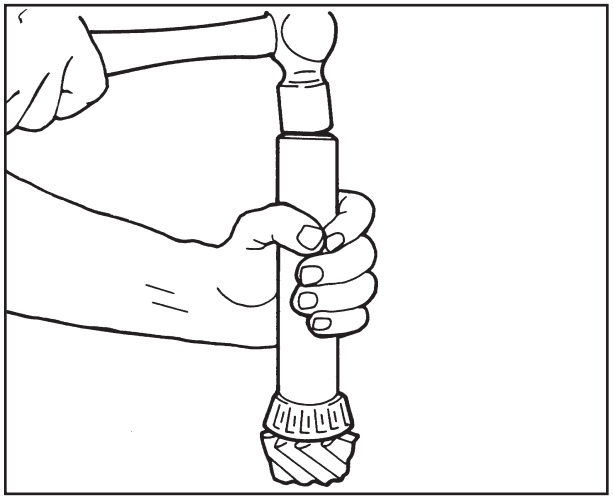


Fig. 42

Assemble bearing cone, slinger and new pinion seal into housing using :

1] Installer, pinion oil seal Pt. no. 2698 5890 3513

2] Universal handle Pt. no. 2698 5890 3506. *Fig. 43*

Apply a light coat of oil to the lip of oil seal.

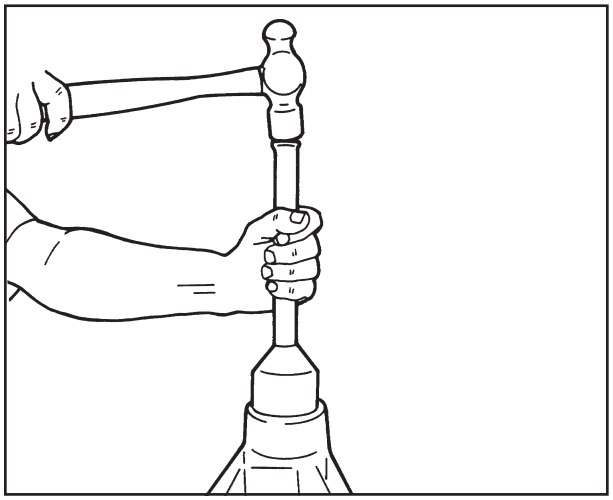


Fig. 43

Install new collapsible spacer onto pinion stem and assemble into housing. Assemble end yoke, washer into housing.

Note : Collapsible spacer should rest on bearing inner race, and it can be fitted in any one direction.

Continue to tighten nut in small increments until the rotating torque is achieved using Holder, yoke Pt. no. 2698 5890 3505 and torque wrench. *Fig. 44*

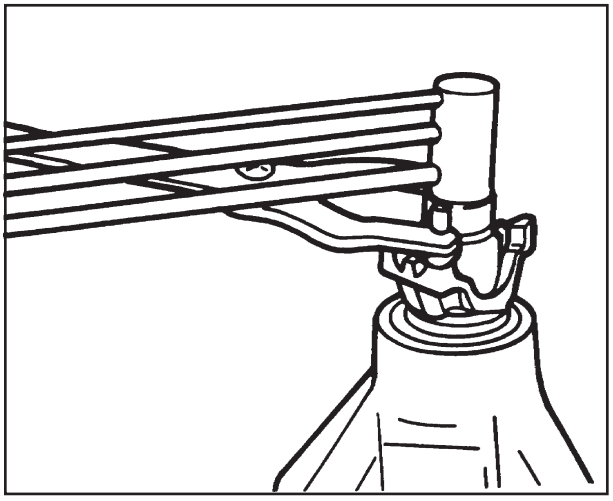


Fig. 44

Note : Tighten nut only enough to remove shaft end play. Then continue to tighten nut in small increments until correct bearing preload torque is attained. Exercise care during bearing preload torque adjustment. DO NOT OVERTIGHTEN or loosen and then retighten nut. Do not exceed bearing preload torque.

If exceeded, collapsible spacer will have to be replaced. Bearing preload torque will have to be readjusted again as per procedure.

Using a torque wrench, ensure that the rotating torque of pinion is between 1.7 - 3.9 N.m. with new bearings *Fig. 45*

Clean & Assemble dummy differential bearings Pt. no. 2704 5890 3309 onto case. *Fig. 46*

Assemble differential case into carrier **[without Ring Gear]**

Mount dial guage and locate tip of indicator on flat surface of case. Force the differential case as far as possible in the direction towards dial guage. *Fig. 47*

With force still applied, set needle to zero (0).

Force differential assembly as far as it will go, in opposite direction. Repeat until the same reading is obtained. Record the reading. *Fig. 48*

This is the total amount of shims required. This is measurement **A**.

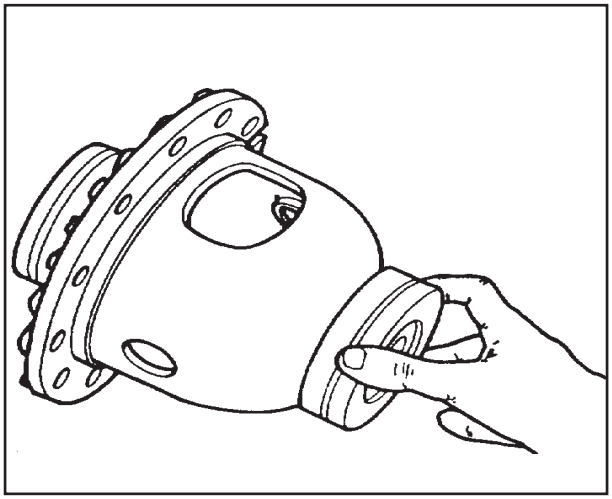


Fig. 46

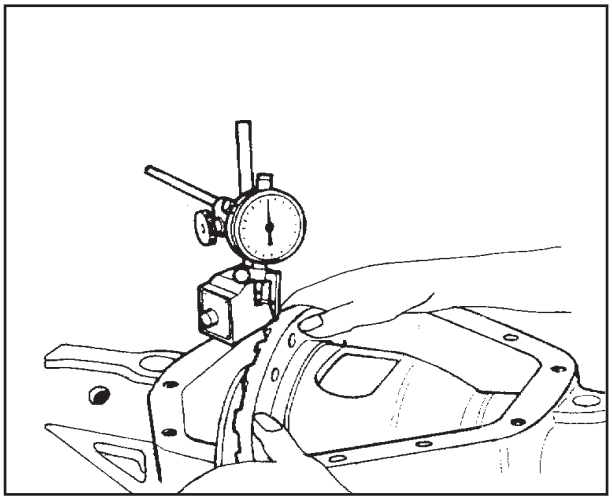


Fig. 47

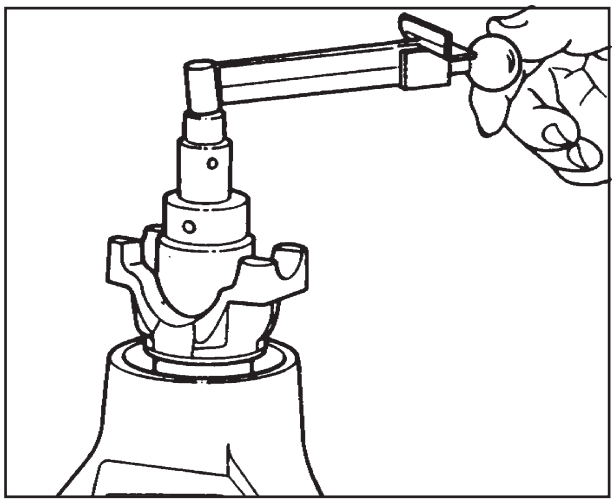


Fig. 45

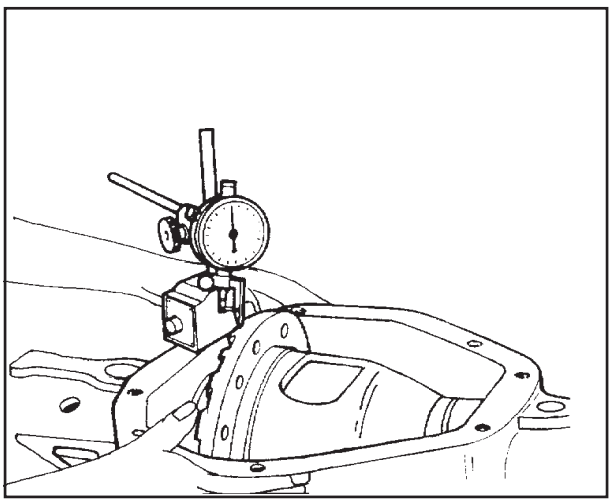


Fig. 48

Remove dial guage and differential assembly from housing.

Remove master bearings from differential case and set aside.

Assemble ring gear to case. *Fig. 49*

Note : Use new ring gear screws.

Draw up screws alternately and evenly. Torque ring gear screws to specification.

Assemble master bearings onto case.

Place differential assembly into housing. Install dial guage and locate tip of indicator on flat surface of one of the ring gear screws.

Force differential case assembly away from pinion gear. With force still applied to case, set needle at (0) zero. *Fig. 50*

Now push case assembly to the other side.

Force case assembly and ring gear to mesh with pinion gear. Rock ring gear to allow teeth of gears to mesh. Take reading.

Repeat the exercise until same reading is obtained.

Record this as measurement **B**

Remove master bearings.

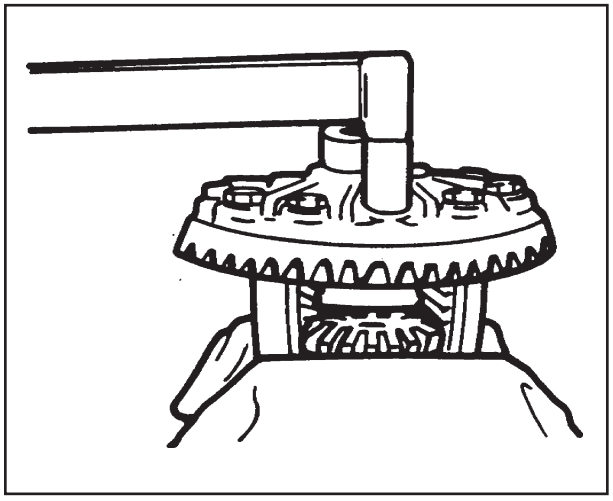


Fig. 49

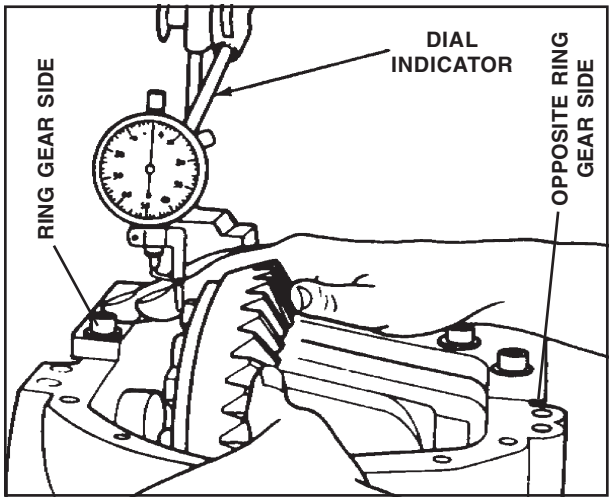


Fig. 50

WORKSHEET FOR CALCULATING RING GEAR BACKLASH AND DIFFERENTIAL BEARING PRELOAD SHIMS.

1. Total amount of space measured without ring gear. Measurement **A**_____

2. Total amount of space measured with gear set assembled in carrier. Measurement **B**_____

3. Measurement A minus Measurement B dimensions. Measurement **C**_____

Assemble shim pack using dimensions determined in A,B,C adjusting the packs as described below.

RING GEAR SIDE :

Assemble shim pack to measurement **B** - 0.125 mm. or B - 0.005"

OPPOSITE SIDE OF RING GEAR :

Assemble shim pack to measurement **C**. Add shim thickness 0.20 mm or 0.008" for differential bearing preload and backlash.

Assemble required thickness of shims onto ring gear side and opposite side of case as determined using Dolley Pt.no. 2704 5890 3325. *Fig. 51*

Install spreader and indicator. Spread the carrier. Do not spread carrier over 0.5 mm. *Fig. 52*

Remove indicator.

Install differential assembly into carrier. *Fig. 53*

Install bearing caps. *Fig. 54*

Ensure correct fitment of caps by matching letters on bearing cap and carrier on both sides.

Torque bearing cap screws to specification.

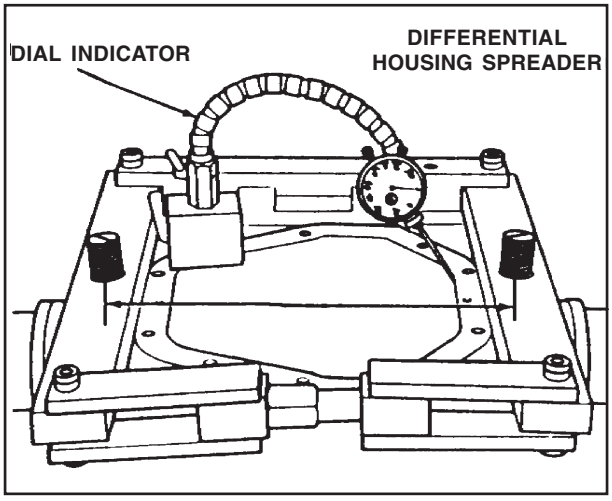


Fig. 52

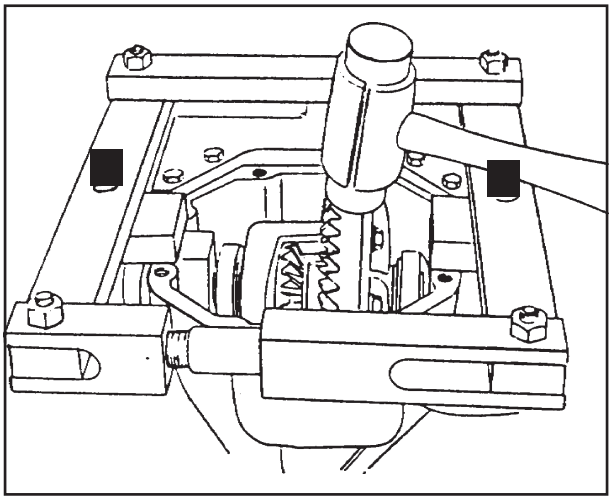


Fig. 53

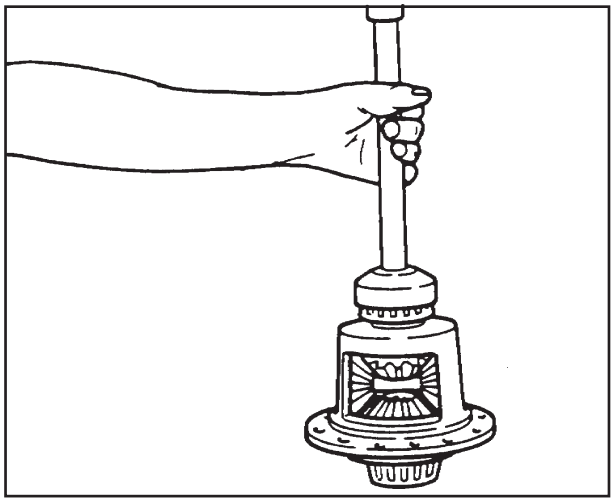


Fig. 51

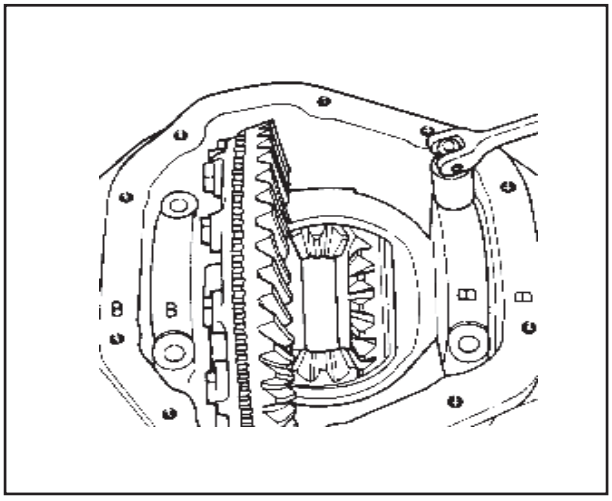


Fig. 54

Check ring gear and pinion backlash at three equally spaced points with dial guage. *Fig. 55*

Backlash should be between 0.13 mm and 0.23 mm. Variation in back lash should not exceed 0.08 mm between 3 readings.

High backlash is corrected by moving ring gear closer to pinion. Low backlash is corrected by moving ring gear away from pinion.

These corrections are made by switching shims from one side of differential case to other side.

Note : If backlash is to specification, check gear and pinion tooth contact pattern, and adjust accordingly.

Refer procedure in rear Axle section for correcting tooth contact pattern.

Install axle shafts through splines inside gear. Place the snap ring in the shaft's groove. *Fig. 56*

Assemble Cylindrical roller bearing in carrier housing using Dolley Pt. no. 2704 5809 3306.

Assemble oil seals using

1 Installer pinion oil seal Pt. no. 2698 5890 3513

2) Handle universal Pt. no. 2698 5890 3506.

Install mounting brackets on either side and torque bolts as specified. Replace brackets if necessary. Fig. 57

Note : Brackets on LH and RH sides are not interchangable.

Apply liquid gasket (Anabond 676) to cover plate surface. *Fig. 58*

The bead must be 1/8 to 1/4 inch in height and width.

Tighten cover screws evenly to a torque of 38-45 N.m.

Allow one hour curing time before vehicle operation.

Fill specified oil after curing.

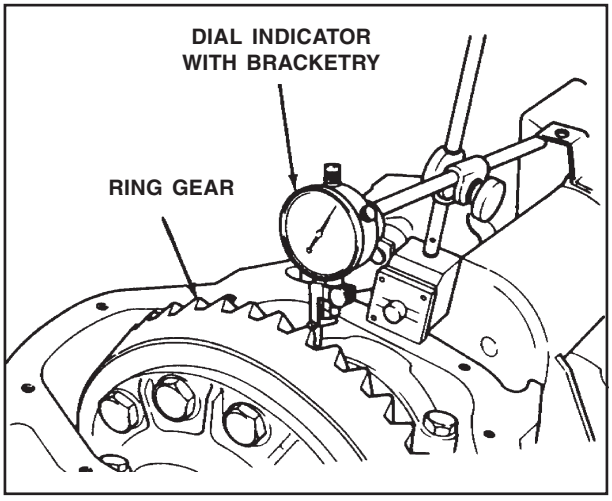


Fig. 55

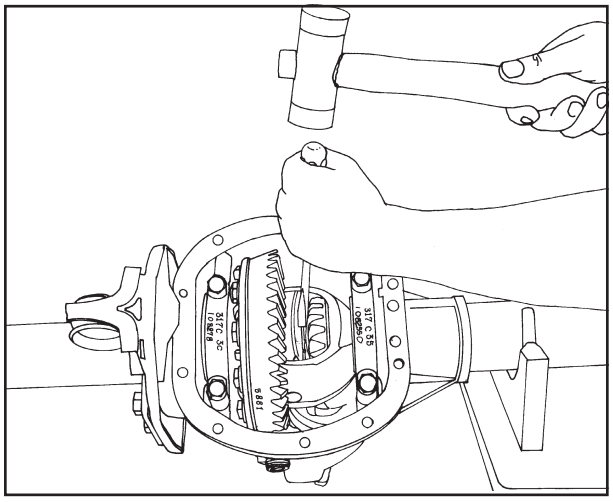


Fig. 56

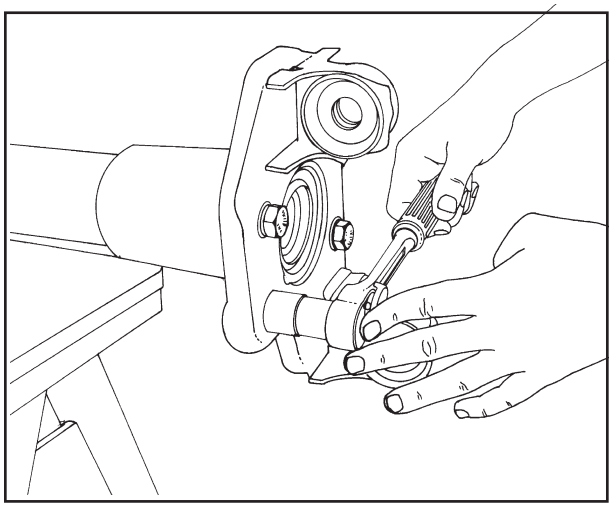


Fig. 57

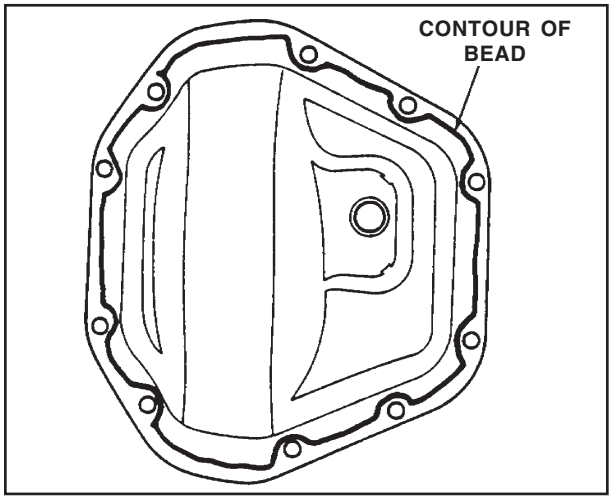


Fig. 58

CONSTANT VELOCITY SHAFTS

Introduction :

Fixed Rzeppa Joint *Fig. 59*

Rzeppa joints are built with outer race, inner race, cage & six balls. Outer race & inner race have spherical ball grooves. Cage is assembled first with inner race / six balls and then outer race is assembled. Torque is transferred from inner race to outer race through six balls.

Plunging Double offset (DOJ) Joint *Fig. 60*

DOJ is similar to Rzeppa joint, except for outer race which has straight & longer ball grooves, instead of spherical grooves as in case of Rzeppa joint. Inner race & cage can slide in and out on six balls to compensate change in length of CV shafts.

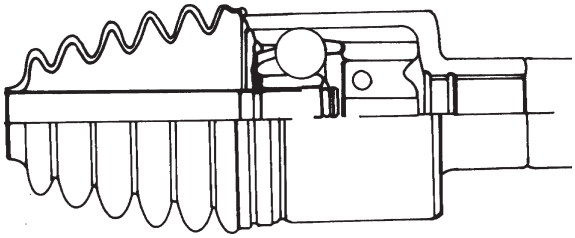
Constant velocity joints used on both RH side and LH side are same, but for the difference in male & female splines at DOJ end.

RH half shaft has male splines on DOJ side and it fits in side gear in differential case. *Fig. 61*

LH half shaft has female splines and it fits on axle shaft. *Fig. 62*

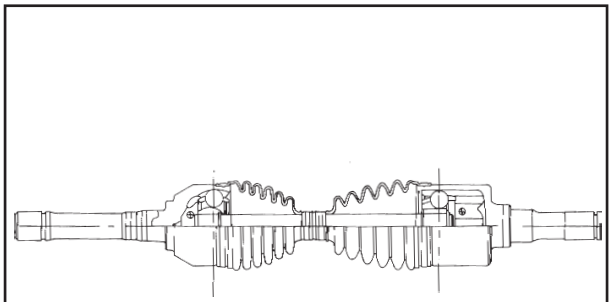
Fix Rzeppa joints are used at wheel end.

Double offset joints are used at centre section.



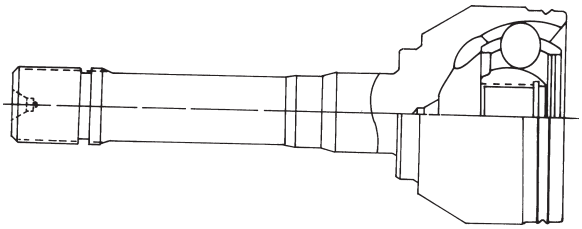
Plunging Double Offset Joint

Fig. 60



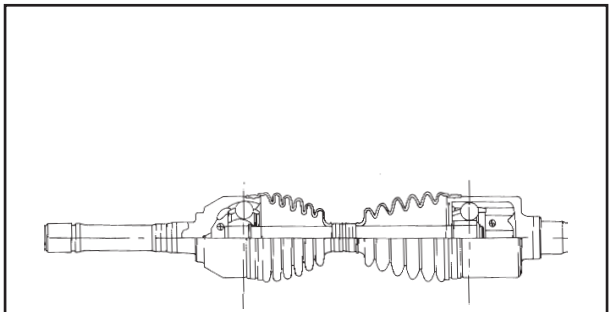
Right hand side

Fig. 61



Fixed Rzeppa Joint

Fig. 59



Left hand side

Fig. 62

TOOLS FOR CV JOINT ASSEMBLY

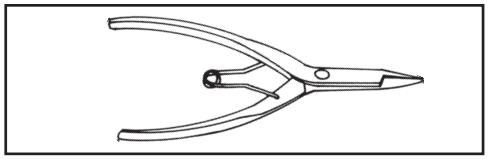
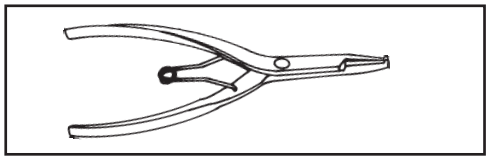
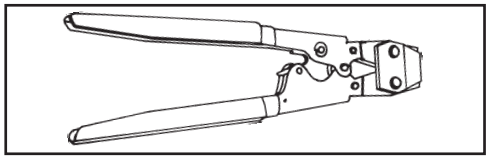
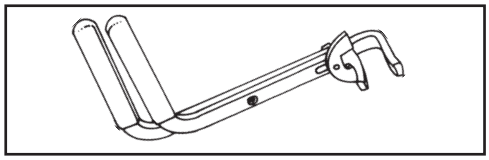
1.		Plain plier, snap ring. Pt. no. 2704 5890 3330
2.		Tang plier : snap ring Pt. no. 2704 5890 3331
3.		Clamp crimper Pt. no. 2704 5890 3332
4.		Ball assembly Pt. no. 2704 5890 3333

Fig. 63

DISASSEMBLY AND ASSEMBLY

DISASSEMBLY RZEPPA CV JOINT

Mark the position of small end of the boot on shaft. It has be fitted back in the same position during reassembly *Fig. 64*

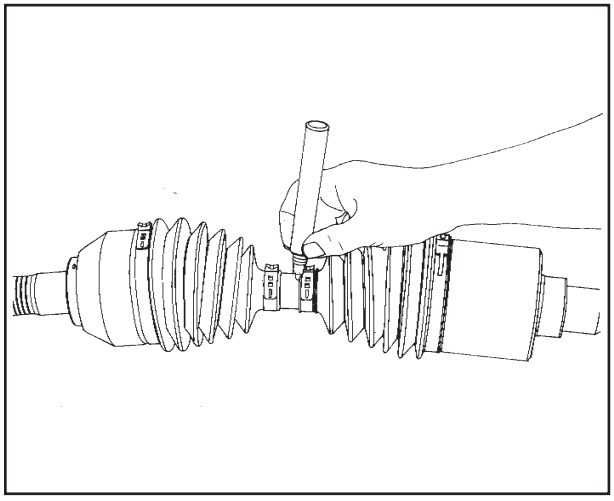


Fig. 64

Cut boot clamps & discard. *Fig. 65*

Cut boots and discard. *Fig. 66*

Boot clamps and boots are not to be reused.

Wipe away grease, to make snap ring of inner race visible.

Expand snap ring and remove shaft by tapping on outer race by brass hammer.

Place the CV joint in vice

Note : Use soft Teflon V-jaws, to prevent damage to splines.

Mount Ball assembly tool Pt. no. 2704 5890 3333. *Fig. 67*

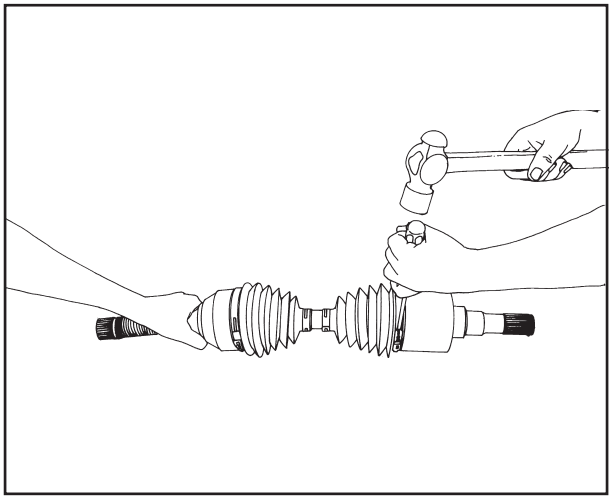


Fig. 65

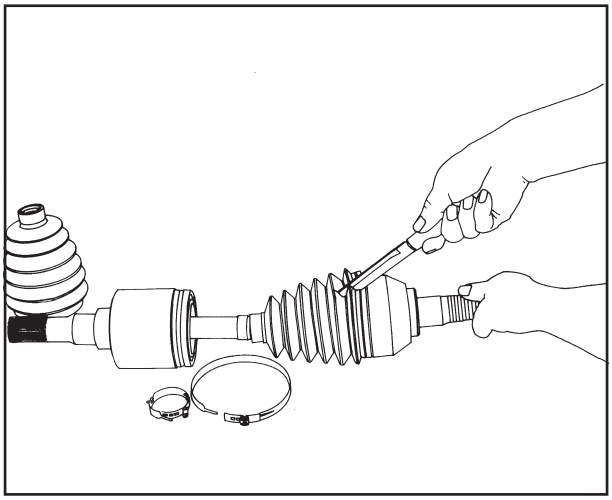


Fig. 66

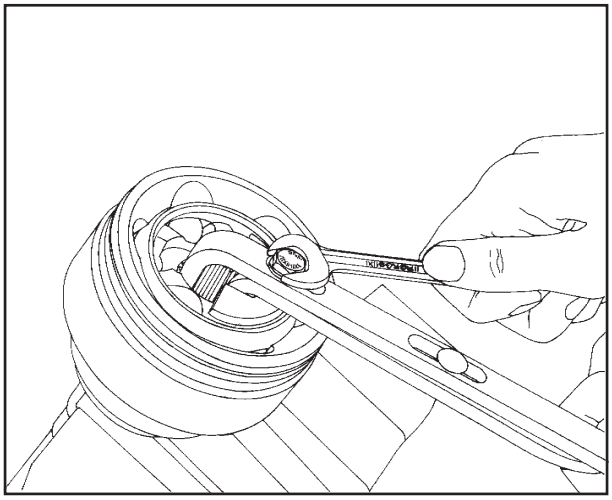


Fig. 67

Using Ball assembly tool tilt inner race from side to side in star pattern and remove all balls from cage. *Fig. 68*

Pivot cage and remove inner race assembly from outer race. *Fig. 69*

Pivot Inner Race and remove from cage. *Fig. 70*

Note : Mark positions of inner race, cage & balls before dismantling. Same position to be retained during reassembly.

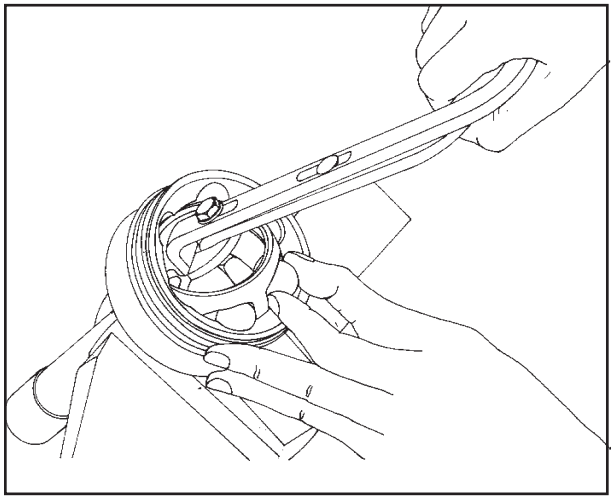


Fig. 68

REASSEMBLY RZEPPA CV JOINT

Clean CV joint components and boot area on shafts using approved solvents. Do not use gasoline.

Apply tape to shaft splines to protect boot during installation.

Slide new small clamp and boot on one side of shaft having one Circlip groove. Do not tighten shaft at this time.

Lightly coat inner and outer race with approved Lithium grease. To reassemble joint, follow the procedure in reverse for disassembly.

Install new circlip in inner race.

Pack CV joint only with specified grease. If there is any remaining grease, place it inside the boot.

Align CV joint splines with shaft splines. Gently rock CV joint while pushing onto shaft, until click is heard. Pull firmly on CV joint to make sure circlip is seated.

NOTE : If necessary, tap CV joint shaft with brass or soft face mallet.

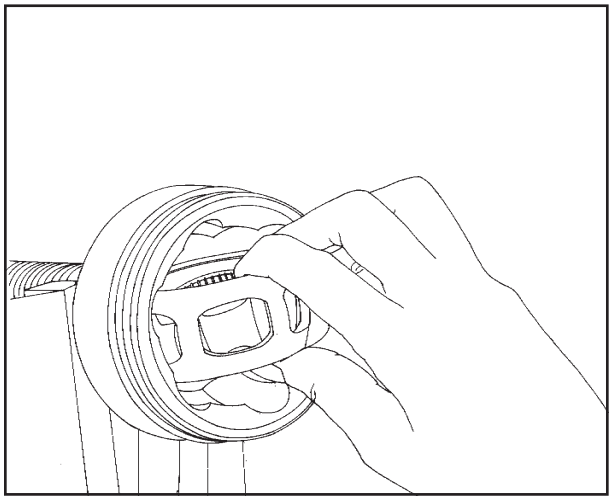


Fig. 69

Position the boot and clamp over CV joint (large end) and secure with appropriate clamp.
Use Clamp climper Pt. no. 2704 5890 3332.

Insert blunt screw driver between shaft and small end of boot to equalize air. Align boot marks on shaft. Install and tighten small clamp.

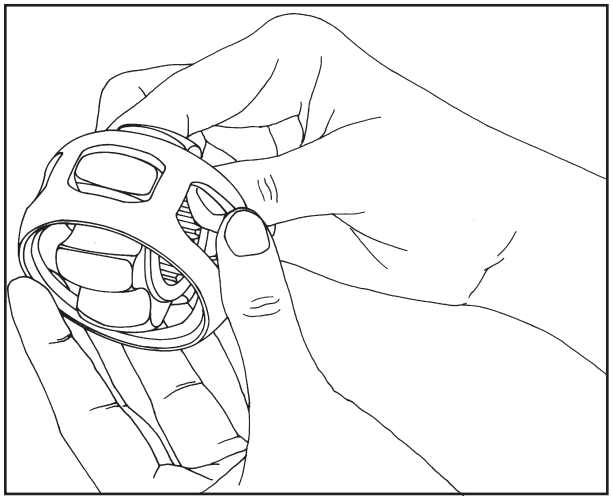


Fig. 70

DISASSEMBLY PLUNGING DOUBLE OFFSET CV JOINT

Mark position of boot. It has to be assembled in same position during reassembly.

Cut and discard boot clamp.

Cut and discard boot.

Inspect Grease for contamination.

Note : If grease is contaminated CV joint needs to replaced.

Wipe away excess grease to access retainer ring in outer race.

Remove retainer ring, using a screw driver. *Fig. 71*

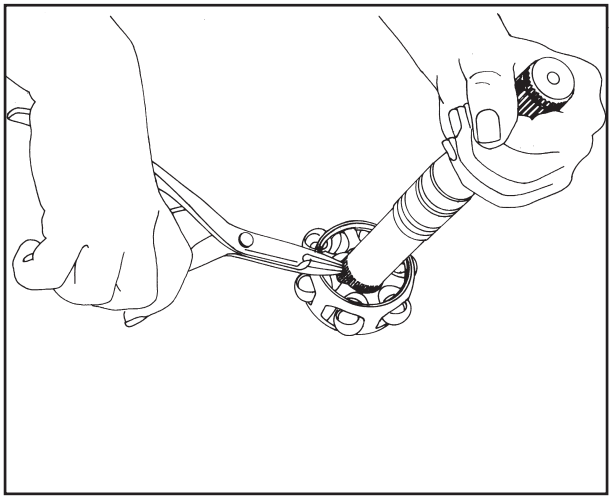


Fig. 72

Remove Outer Race.

Using tang snap ring plier, Pt. no. 2704 5890 3331 expand and slide back inside circlip. *Fig. 72*

Remove outer circlip using plain snap ring Pt. no. 2704 5890 3330. *Fig. 73*

Remove inner race assembly from shaft.

If required, use a soft mallet.

By slight tapping, remove balls from inner race.

Pivot inner race and remove from cage. *Fig. 74*

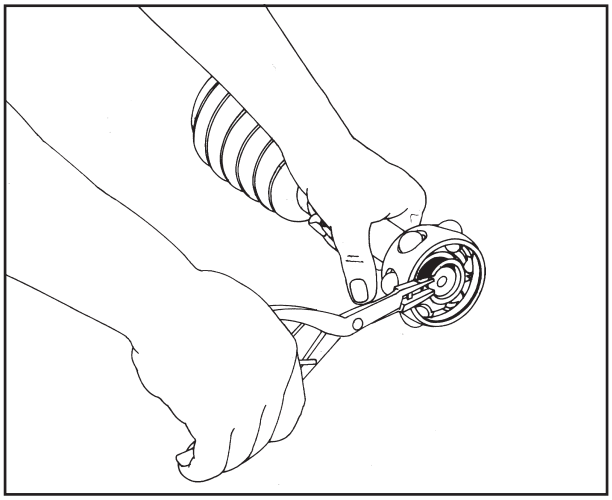


Fig. 73

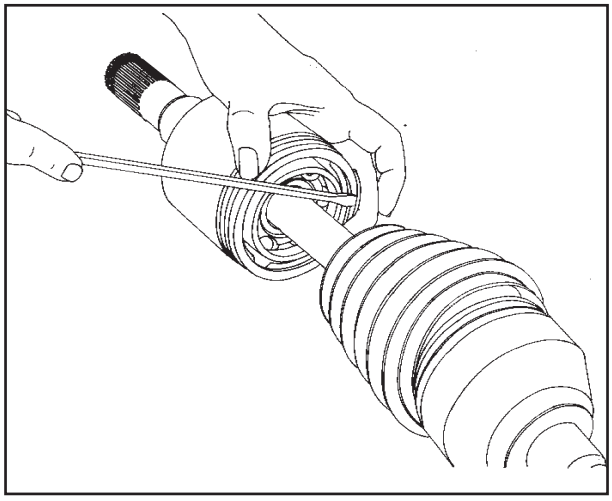


Fig. 71

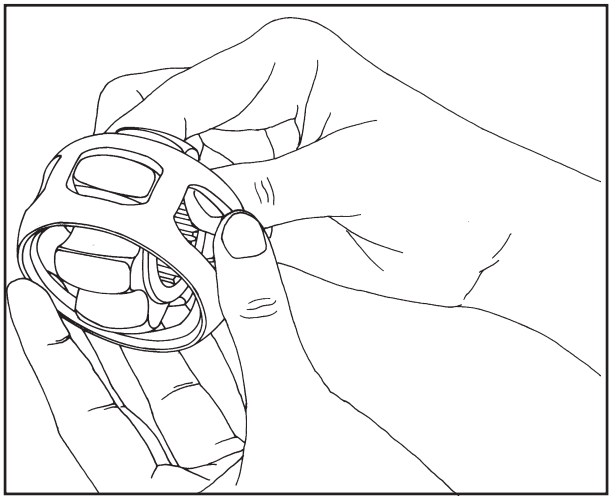


Fig. 74

ASSEMBLY PLUNGING DOUBLE OFFSET CV JOINT

Clean CV joint components using approved solvent.

Apply tape to protect boot during installation.

Slide new small clamp and boot on the side of shaft having two Circlip grooves. Do not tighten clamp at-this time.

Assemble inner race, cage and ball assembly.

Install Inner race assembly and two types of new circlips on shaft.

Pack approximately with 2/3th of grease in outer race.

Place remaining grease inside boot.

Install outer race assembly over ball and cage assembly.

Push back inner race with balls & install large retaining ring.

Position boot and clamp over CV joint using Clamp crimper Pt. no. 2704 5890 3332.

Align boot marks on shafts and tighten small clamps.

INSTALLATION OF CV JOINT SHAFT ON VEHICLE.

Refer the section of removal from vehicle for guide lines.

Holding axle shaft assembly with both hands at CV joints, insert axle shaft assembly into differential side gear.

Note : Ensure that oil seal is not cut or nicked in above process.

Push the shaft in to place until a click is heard or a bump is felt as the snap ring engages the end of side gear.

Holding shaft assembly with one hand at outboard CV joint, attach supporting wire.

Assemble steering knuckles to ball joint studs. Assemble nuts at top and bottom and torque to specification.

CV JOINT FAILURE ANALYSIS

Most common cause of CV joint failure is due to boot failure. While inspecting boots, it is important to observe the boot for any missing portion, cracks, and holes. These defects will allow water, dirt to enter joint, as well as loss of lubrication. If this occurs, shaft must be disassembled and inspected for damage to internal components.

TROUBLE SHOOTING - AXLE

Most drive axle problems fall into the categories of noise, vibration, leaks and failure to transmit power. Problem diagnosis begins with customer's complaint, which includes exact description of the type of noise or vibration and when it occurs.

This is to be followed by a road test over various types of road surfaces and speeds where complaint occurs. This helps to locate the fault area and to eliminate it.



CONDITION	POSSIBLE CAUSES
Noise in all driving modes	Road and tires, wheel bearings
Noise changes with type of road surface	Road and tires
Noise tone lowers with vehicle speed	Tires
Noise increase on turns	Differential pinion and side gears, axle wheel bearings
Noise in one or more driving modes	Ring and pinion gears
Clunk on change of speed or direction of power flow	Worn differential shaft or thrust washers ,worn U-joints
Wheel noise	Wheel loose; faulty or bad wheel bearing
Vibration	Damaged drive shaft, missing drive shaft balance weight, worn or out-of-balance wheels, loose wheel nuts, worn U-joints, loose/broken spring, damaged axle shaft bearings, loose pinion gear nut, excessive pinion yoke run out, bent axle shaft.
Differential gears scored	Insufficient lubrication, improper grade of lubricant, lubricant contamination, excessive spinning of wheels.
Loss of lubricant	Lubricant level too high, worn axle shaft seals, cracked differential housing, worn drive pinion gear shaft seal, scored and worn yoke, axle cover not properly sealed, plugged vent or vent tube.
Axle overheating	Lubricant level too low, incorrect grade of lubricant, contaminated lubricant, bearing preload too high, excessive gear wear, insufficient ring gear backlash.
Gear teeth broken	Overloading, erratic clutch operating, wheel spinning, improper adjustment
Axle gear noise	Insufficient lubricant, incorrect backlash, improper tooth contact, worn/damaged gears
Axle noise	Insufficient lubricant, improper ring gear and drive pinion gear adjustment, unmatched ring gear and drive pinion gear, worn teeth on ring gear or drive pinion gear, Loose drive pinion gear shaft bearings, loose differential bearings, misaligned ring and pinion gear, loose differential bearing capscrews, worn bearings.

Automatic Locking Hub (Model : 1704-000-002) of Divgi Warner Limited

Introduction

Automatic Hub Locks Model : 1704-000-002 of Divgi Warner Limited is presently used on Telcoline 4x4 vehicles.

When 4-wheel drive is selected, automatic hub, locks axle shaft to wheel hub. This occurs when vehicle is driven in either forward or reverse direction. Hub unlocks when 2-wheel drive is selected, and vehicle is driven in opposite direction for a few feet.

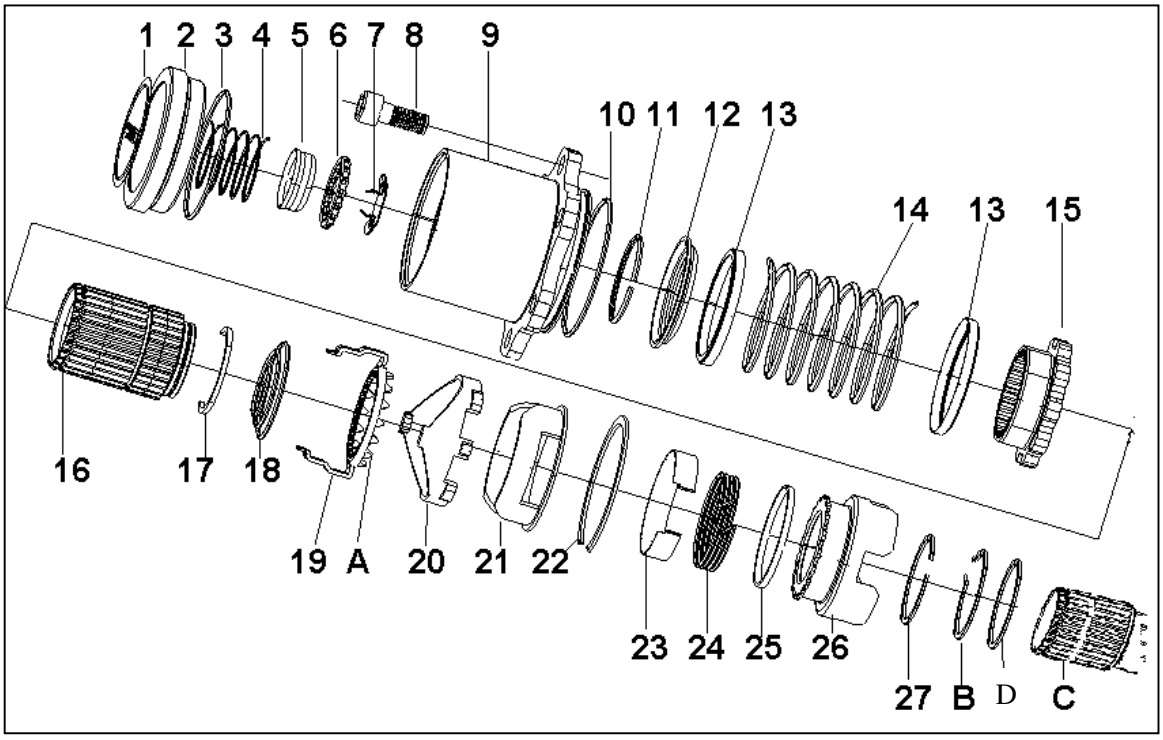


Fig. 75 Construction & operation

Construction

The 4 Tanged washer is held in place on the Wheel Spindle. The cut-outs on the drag sleeve(26) fit over the tangs on the washer, preventing the drag sleeve from rotating. The brake band (24) fits over the serrated portion of the drag sleeve. The tangs of the brake band are fitted through the window in the steel inner cage (21). The plastic outer cage (20) fits over the inner cage. Each tang of the brake band fits through each cutout in the outer cage. The cam follower (19) is attached to the clutch gear (15). The follower profile on the cam follower (A) ride against the cam faces or ramps of the steel inner cage. The clutch gear slides on the splines on the out side the hub sleeve (16). The axle shaft(C) is splined to the inside of the hub sleeve. The large teeth on the outside of the clutch gear can engage the teeth inside the outer clutch housing (9).The outer clutch housing is bolted to the wheel hub. An End Cap (2) fits over the hub lock assembly. The end cap contains a bearing assembly (6) that supports the other end of the hub sleeve. The End Cap is fitted with an Aluminium Decorative Plate(1) for better aesthetics.

Operational Summary

Briefly, this is what happens when the hub locks,

The clutch gear (15) and cam follower (19) rotate up the cam face of the inner cage (21). This causes the clutch gear to move outward on the hub sleeve (16). The out side teeth of the clutch gear engage the inside teeth of the outer clutch housing (9), locking the wheel hub to the axle shaft.

When the hub un-locks,

The clutch gear and cam follower rotate in the opposite direction, back down the cam face of the inner cage. Spring pressure forces the clutch gear inward, unlocking the wheel hub from the axle shaft.

Operation

Now, let's examine how the hub operates in detail. When 4-wheel drive is engaged (and vehicle starts to move), the axle shaft starts to turn the hub sleeve (16), clutch gear (15) and cam follower (19). The steel inner cage (21) and plastic outer cage (20) also start to turn. (Remember, the drag sleeve (26) is fixed to the wheel spindle and doesn't rotate) When the inner cage window hits the first brake band tang (30) the band tightens up on the drag sleeve. This stops the inner cage. The cam follower (19) is forced up the ramp of the inner cage (21).

As the cam follower moves up the ramp of the inner cage, it is moved outward along the hub sleeve (16), pushing the clutch gear (15) into engagement with the outer clutch housing. The cam follower (19) also pushes against the lugs of the outer cage (20). The outer cage tang contacts the second brake band tang (30). This unlocks the brake band and allows it to turn freely on the drag sleeve serration's.

When 2-wheel drive is selected to disengage the hubs, and the vehicle is driven in the opposite direction for a few feet, the rotating front wheel turns the outer clutch housing, clutch gear (15) and cam follower (19) in the opposite direction. The cam follower moves down the ramp of the inner cage (20). The return spring (14) pushes the clutch gear (15) along the hub sleeve (16) and out of engagement with the outer clutch housing.

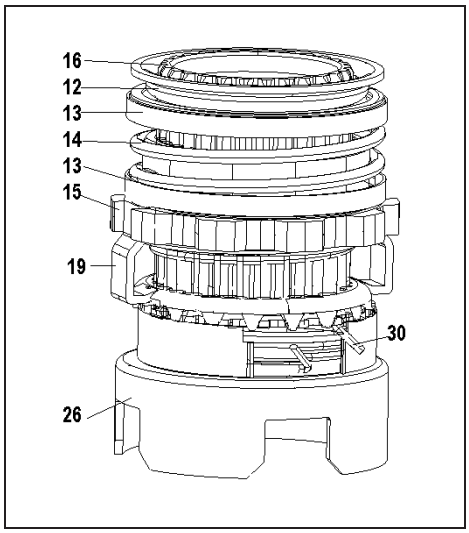


Fig. 76

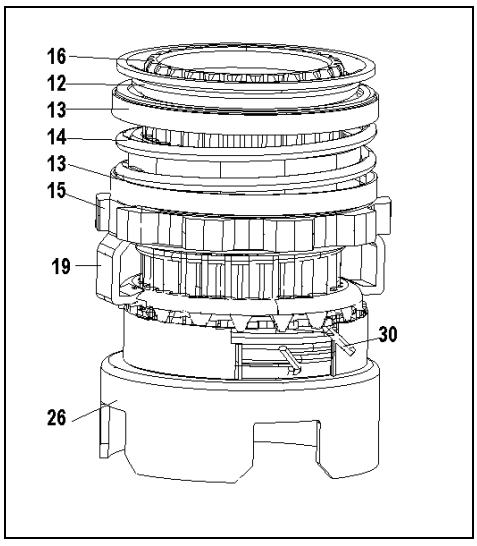


Fig. 77

SPECIFICATIONS :

Input Configuration	Female Splines
Output Configuration (M10 X 25MM, 6Nos.Bolts)	Bolted Flange
Location	74 mm dia and 'O' Ring for water resistance
Working Principle	Automatic Locking.
Projected Length over from the face of the wheel hub	74.0 mm (Nom.)
Lubricant : Drag sleeve - Assly. Cam and Follower - Assly. Bearing race -	 Darmex 123 LT grease (2 to 4 gms.) Castrol ATF- TQ Light wheel Bearing grease (Castrol LCG –2 OR Darmex 123 LT grease) (2 to 5 gms.)
Locking & Unlocking in degree.	90 Deg. (Clockwise & Counter clockwise)
Gross Weight	1.75 Kgs. Approx.
Appearance	Black Powder Coated with Aluminium Decorative Plate

DIAGNOSIS

3.1

NOTE : In this diagnosis section, there are some numerical call-outs (such as (1), (2) etc.). For these call-outs refer to the drawing on page - 3

Oil Leaks

Make sure that a suspected oil leak is actually coming from the hub. Oil leaks can originate in the axle shaft (oil seal).

An oil leak from the hub can be caused by :

1. A cracked or porous or improper fitment of protective end cap
2. Damaged or missing “O” rings.
3. Incorrectly installed or damaged sealing ring (10) between the End Cap and outer clutch housing and wheel hub.

Does not Engage or Disengage

Before disassembly of a locking hub, be sure the problem is caused by the hub and not another component in the drive train.
Other possible problems include :

- Transfer case not engaging or disengaging front axle shaft.
- Viscosity of front differential lubricant too high (i.e. due to cold weather).
- Front differential pre-load too high.
- Seized front axle shaft bearing.

3.2

IMPORTANT : When diagnosing a “ratcheting” hub, remember that the noisy hub is “NOT” always the defective one. It depends up on whether the hubs have just been disengaged. Let’s examine why.

If only one hub disengages after 2-wheel drive is selected, the faulty hub transmits the wheel rotation to the axle shaft. The mechanical situation is like a conventional axle raised off the ground. The axle shaft drives the differential pinions through the side gear. The ring gear and cage are not turning, so the other side gear and axle shaft are driven in the opposite direction to the first one. The axle shaft tries to engage the hub against the direction of the wheel rotation, causing the noise from the hub. In this case, the faulty hub is not making the noise. The non-noisy hub should be checked. If 4-wheel drive is selected and only one hub engages, there may not be any noise from the hub, depending on the malfunction. The only symptom might be a loss of drive at that hub. If the hub is “ratcheting” in 4-wheel drive, it should be inspected.

Possible Causes

A broken or missing 4 tanged washer can cause problems in 2- or 4- wheel drive.

A broken or missing washer will allow the drag sleeve to rotate with the brake band . If the hub are not engaged , the brake band is unable to lock on the drag sleeve and initiate the locking action of the clutches. If the hubs are engaged, the brake band can not be released to allow the clutch gear to disengage.

A broken or missing brake band (24) cannot lock the inner cage to engage the hub or be unlocked by the outer sleeve to allow the clutch gear to disengage.

If both brake band tangs are touching the center post of the outer sleeve, there cannot be proper locking or unlocking action of the brake band through the movement of the inner cage (21) and outer cage (20). The center post of the outer cage and the window of the inner cage move relative to each other when the hub is locking or unlocking. If the cages are not rotating freely over each other, the hub may fail to engage or disengage.

A sticking clutch gear can cause the hub to bind in either the engage or the disengage position. A broken return spring will cause the hub to remain in the engaged position.

In each case, the defective component should be replaced with the correct part or assembly. Always check the most recent parts list for the correct part numbers and available assemblies for the type of the hub you are servicing.

DIS-ASSEMBLY & INSPECTION

4.1 AUTOMATIC LOCKING HUB DIS-ASSEMBLY

1. Remove the end cap and bearing race spring (4). Remove the bearing inner race and retainer(5). Note the position of the components for correct assembly.

2. Remove 6 nos. bolts of auto locking hub.

3. And pull out the hub assembly.

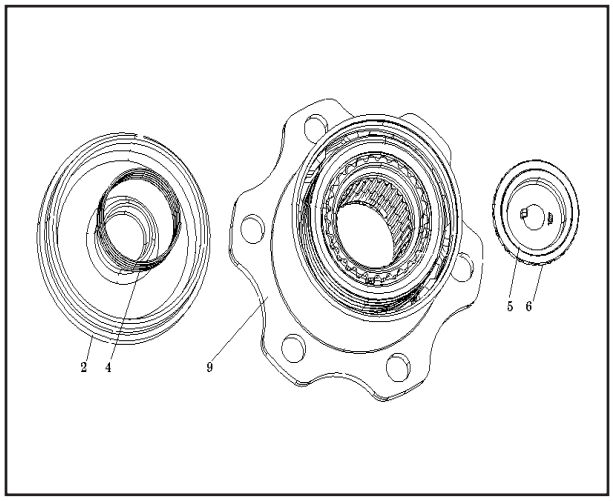


Fig. 78

4. To make disassembly easier, install hub assembly on the stand, so that the entire assembly can be positioned vertically.

5. Remove the snap ring (27) with suitable plier. Exercise caution when removing the snap ring.

6. Remove the drag sleeve, with brake band(26). To lift out the drag sleeve, rotate it slightly to release the brake band tangs from the sleeves and tilt it up on the side opposite the tangs.

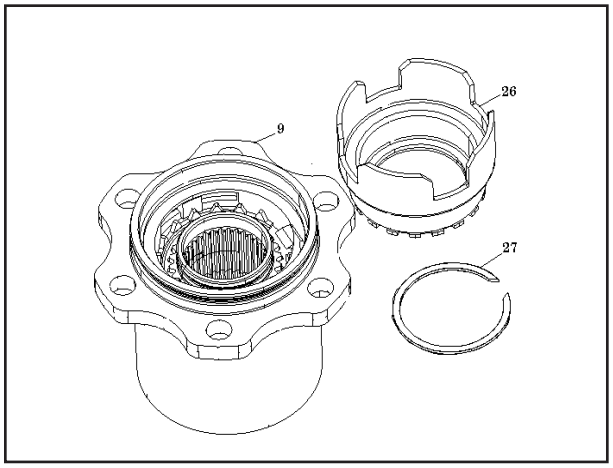


Fig. 79

7. The clip doesn't need to be removed for the normal servicing. However, if it's damaged, remove it using thumbnail force only to avoid stretching or distorting it. **Do not remove the brake band for normal servicing.**

8. Remove the large snap ring from the outer clutch housing.

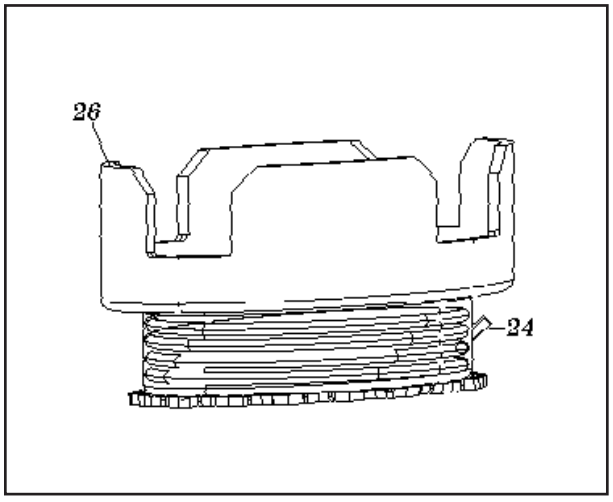


Fig. 80

9. Remove the steel inner cage (21) by pressing it over the tang of the outer cage (20) (in the window). Lift the inner cage straight out, don't tilt it.

10. Remove the plastic outer cage by prying one lug out of the large groove in the outer clutch housing. Hold the lug and go on to the next one. It's easiest to start with the lugs opposite the one that fits into the window of the steel inner cage.

11. Invert the entire hub and slide the cam & follower assembly out of the outer clutch housing.

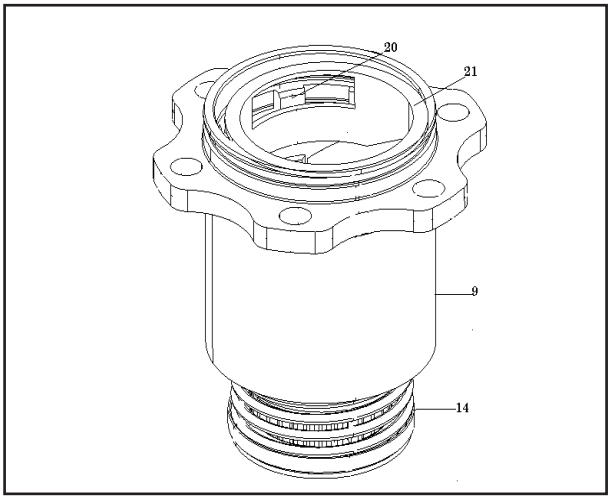


Fig. 81

4.2 Inspection

- Examine the protective end cap (2) for cracks, O - ring(3).
- Brake band (24) for damage or distortion.
- Also, inspect the teeth on the cam follower, clutch gear and outer clutch housing for wear or damage.
- Not all components are replaceable separately.

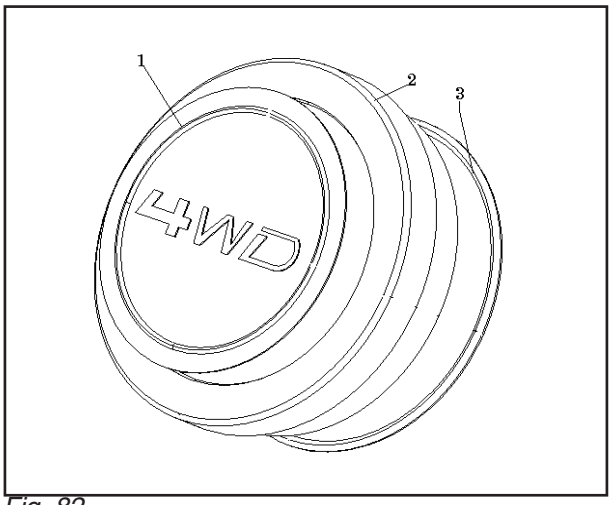


Fig. 82

LUBRICATION AND ASSEMBLY

5.1 Lubrication

The automatic hub lock should be lubricated after every 24,000 miles.

1. Remove drag sleeve assembly and keep aside, **DO NOT lubricate drag sleeve assembly as it is permanently lubricated with Darmex grease.**
2. Check the brake band and drag sleeve serration for presence of appropriate quantity of grease and wear, in case of insufficient grease, replace the drag sleeve.
3. DO NOT remove the brake band as this could change the spring tension and affect hub operation.
4. All components except drag sleeve assembly and outer bearing race assembly are lubricated by dipping them in automatic transmission fluid. Allow excess fluid to drip off before assembling the hub.
5. Lubricate the outer bearing race with light wheel bearing grease. DO NOT use axle grease.

5.2 Assembly

1. Install the hub sleeve and return spring into the outer clutch housing from the inside.
2. Install the plastic outer cage (21) into the large groove in the outer clutch housing (9). The cage may be easier to install if the tangs on the each side of the cutout are installed first.
3. Install the steel inner cage (20) inside the plastic outer cage (21). (For clarity, the cages on the right are shown outside the hub.) The window (A) must engage the tang (B) of the outer cage for correct positioning.

Note: After installation, the V-shaped cutout in both cages must ride over the tangs of the cam follower.

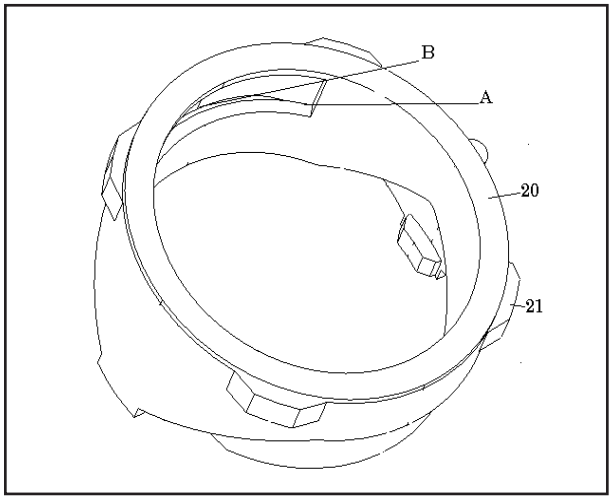


Fig. 83

4. Install the large snap ring in the top groove of the outer clutch housing.

6. Install the drag sleeve assembly in the inner cage, so that the tangs of the brake band are located on each side of the outer cage tang (C)and in the window of the inner cage. Tilt the drag sleeve slightly to engage the tangs, but be careful not to cock the hub sleeve.

7. Install the snap ring (27) to the hub sleeve.

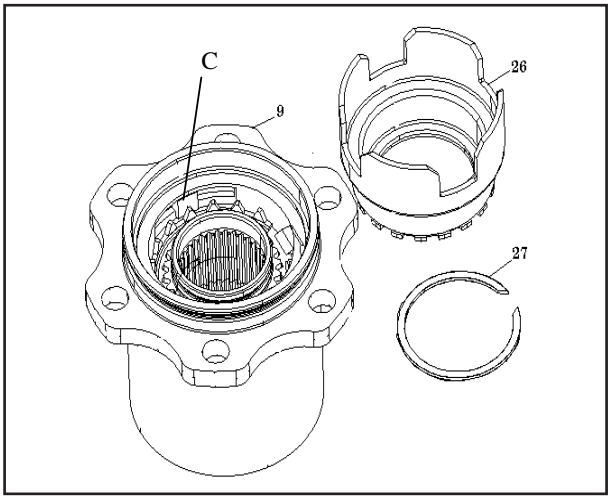


Fig. 84

8. Install the outer bearing assembly, with the retainer and bearing facing the interior of the hub and the cap facing out.

9. Install the cap with the bearing race spring.

10. Ensure that the ALH is in ‘Unlock ‘ mode while installing on the wheel hub.



Fig. 85

11. Push the hub partway into the wheel, making sure cutouts in the drag sleeve are aligned with the tangs of the four tang washer (D). Install the bolts on the hub.

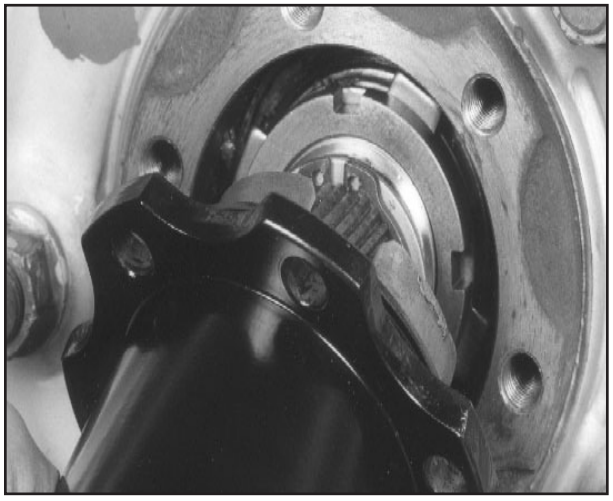


Fig. 86

12. Tight the end cap with the help of pin spanner.



Fig. 87



Fig. 88

Torque for M-10 X 25mm Bolt is 6 Kgm.

PARTS LIST OF SERVICEABLE ITEMS (EXPLODED VIEW)

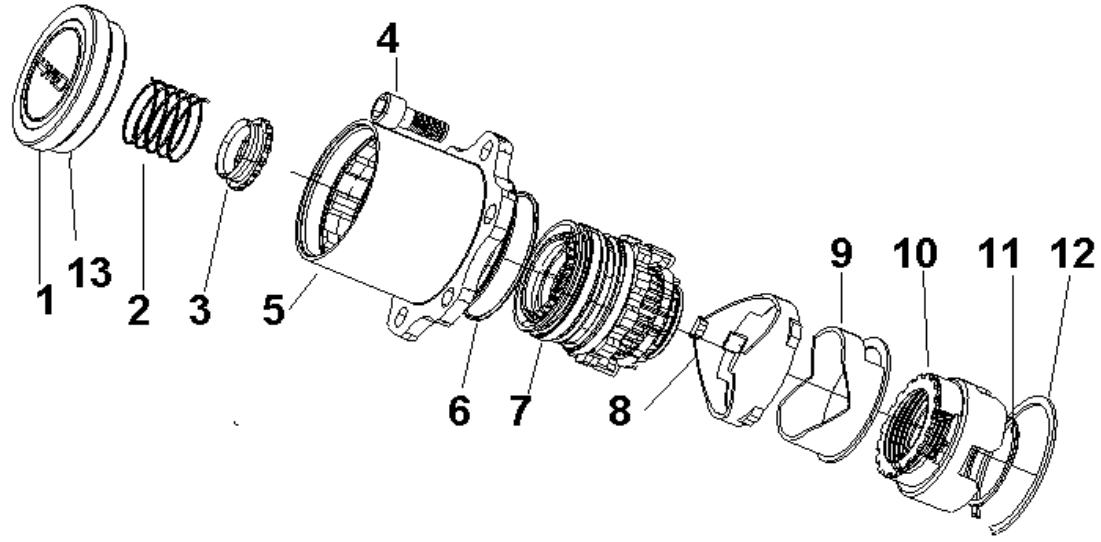


Fig. 89

SR. NO.	PART NAME	QTY/ HUB
1	END CAP WITH DECAIL PLATE.	1
2	SPRING, BEARING RACE	1
3	ASSY. BEARING	1
4	BOLT (M 10 X 1.5 X 25mm)	6
5	OUTER CLUTCH HSG.	1
6	'O' RING (OCH)	1
7	ASSLY. CAM AND FOLLOWER	1
8	CAGE OUTER	1
9	CAGE INNER	1
10	ASSY., DRAG SLEEVE	1
11	RING, RETAINER	1
12	RING, RETAINER	1
13	"O" RING (Cover)	1

SERVICE TOOLS

Sr. No.	Tool Description.	Tool No.	Size
1	Torque wrench	Standard	10-50 lbft
2	Work holding tool	T-10101-A	
3	Screw driver	Standard	9"
4	Hex. Socket	Standard	13 mm
5	Pin spanner	T-10068	
6	External circlip plier	Standard	8"
7	Special Allen for M-10 Bolt	T-10099	
8	Lock-Unlock fixture	F- 10240	

2 - TF - WAY LOCK FREE RUNNING HUB (IF FITTED)

(PART NO. : 2667 3375 0105)

NOTE : This assembly was used earlier (Before introduction of Divgi Warner Automatic Locking Hub). This assembly is non - serviceable. If it is established that there is malfunctioning, the unit has to be replaced with automatic hub lock of Divgi Warner Ltd.

Procedure for replacing TF hub lock with Divgi Warner hub lock is given in page 48.

The construction is shown only for the purpose of understanding its functioning.

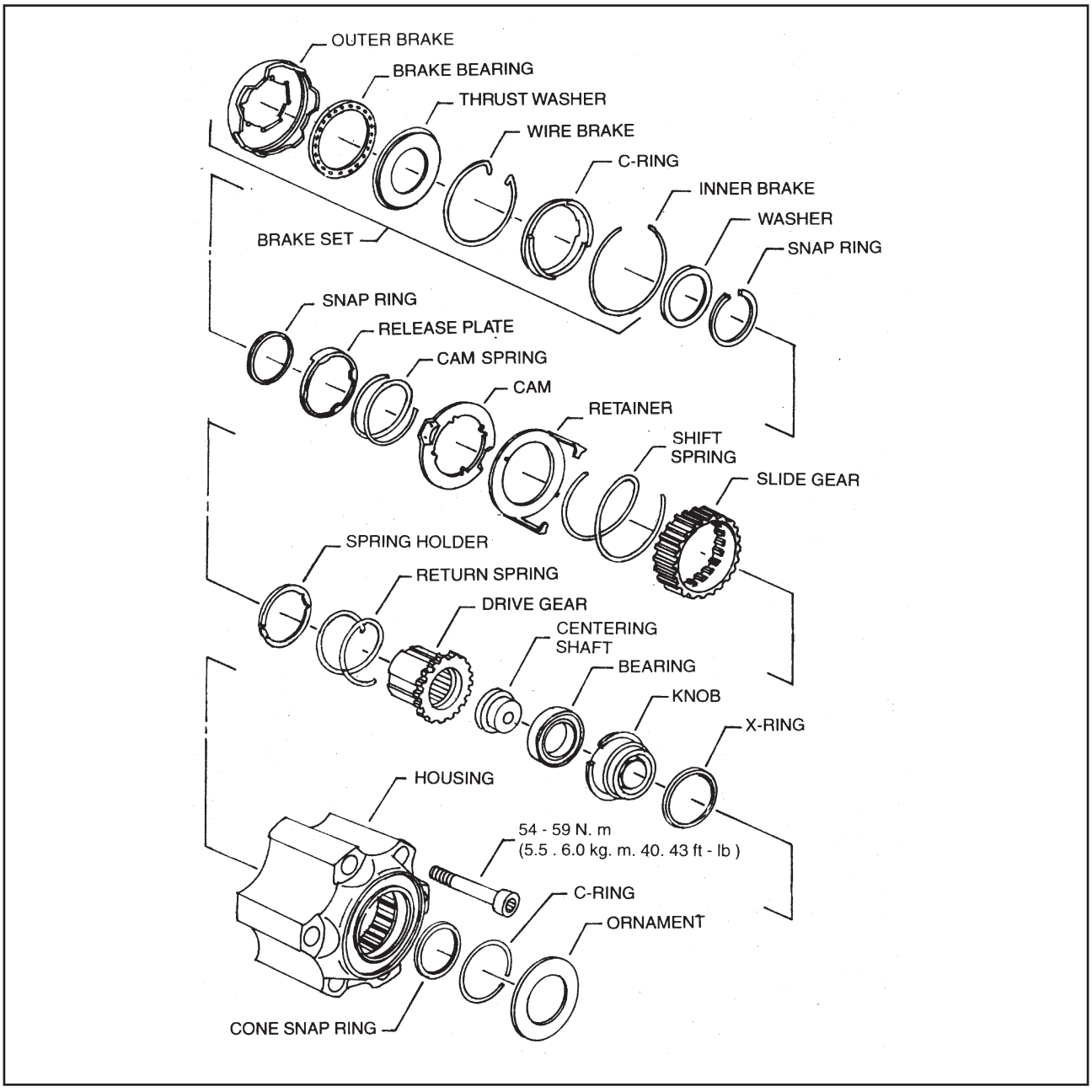


Fig. 90

REMOVAL & INSTALLATION OF FREE RUNNING HUB ON VEHICLE

Removal :

Set the knob to "Lock" *Fig. 91*

Remove free - running hub main body assembly after removing fixing bolts.

Remove spindle washer and brake set after removing snap ring from drive shaft. *Fig. 92*

Note : The drive shaft will become free after removing the snap ring. Take care to support it suitably.

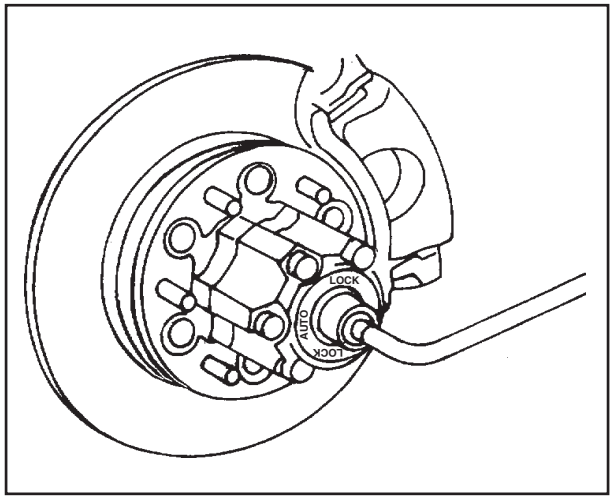


Fig. 91

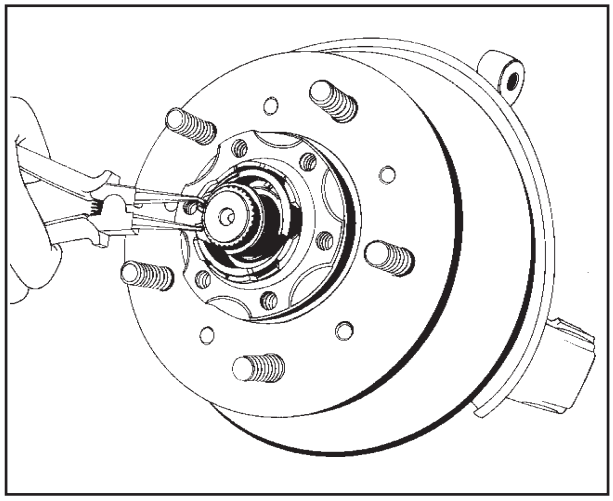


Fig. 92

Installation :

Install brake set to spindle. Install snap ring to minimize drive shaft axial end play. *Fig. 92*

Note : Allowable drive shaft axial end play to 0.2 mm or less.

Confirm the knob to lock position.

Install free - running hub main body assembly after aligning position of release plate and wire brake so that the end portion of wire brake does not overlap protruded portion of release plate. *Fig. 93*

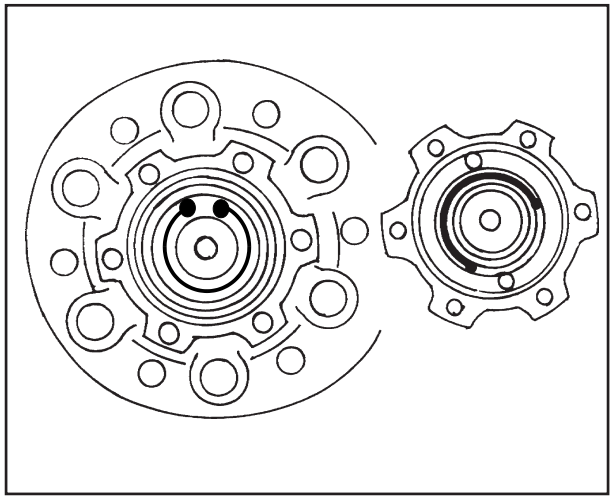


Fig. 93

Make sure that the free - running hub is installed correctly by pushing it lightly by hand. If there is some clearance between wheel hub and free - running hub housing, reinstall it. *Fig.94*

After free - running hub is installed correctly, tighten bolts to specified torque.

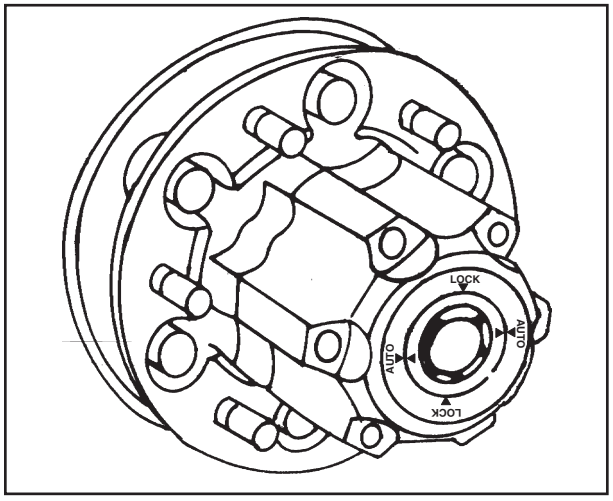


Fig. 94

After installation, set knobs on both sides to Auto, then release hub from Lock position by moving loaded wheels forward and backward when drive shafts are stationery. *Fig. 95*

The reason for above manoeuvre is that the difference in the lock and free position from other side which might cause differential carrier gear noise.

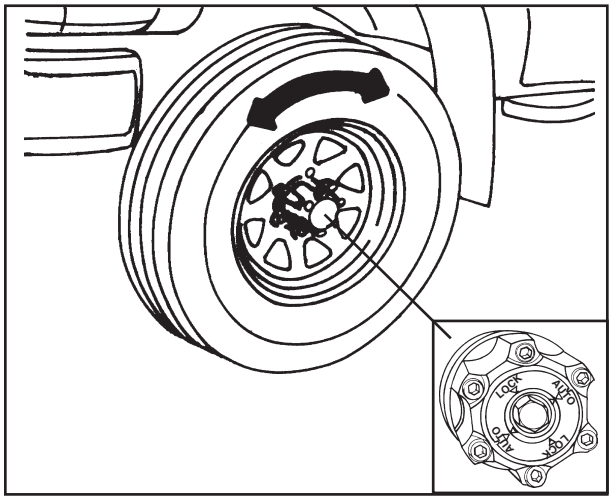
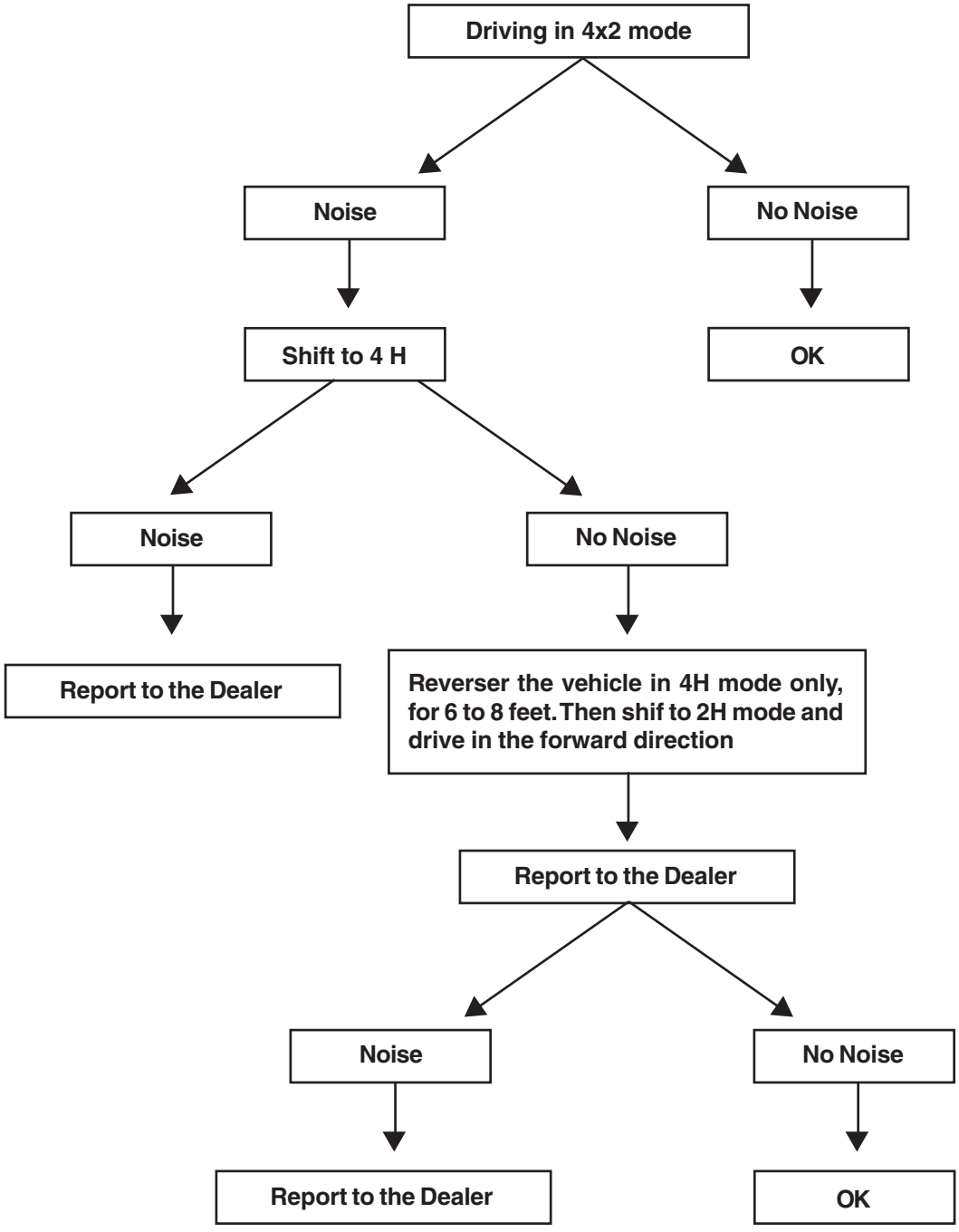


Fig. 95

SOLUTION TO NOISE PROBLEM IN 4X2 MODE
(Pertaining to hub lock)



PROCEDURE FOR REMOVAL OF T.F. (2667 3375 01 05) HUB LOCK & INSTALLATION OF INDIGENOUS DIVGI-WARNER "1704" HUB LOCK

Checks before following the procedure :

Disengage the Hub Locks by shifting the vehicle in "2H" mode. Make sure that the hand brake is "Engaged".

1. Remove the Hub Cap from the Wheel.



Fig. 96

2. Turn the "Knob" on the Tochigi-Fuji Hub Lock to "Lock" with a 21 mm socket & ratchet.

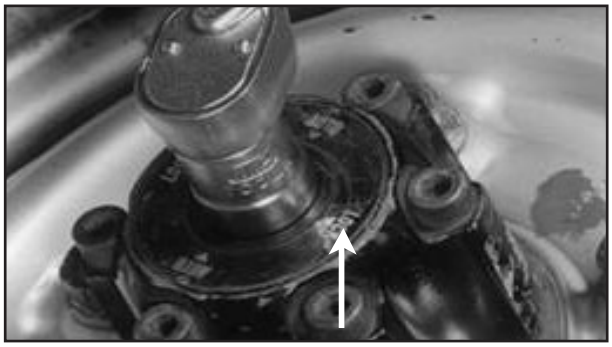


Fig. 97

3. Remove 6 bolts with a std. 8 mm Allen key or Spl. Allen key T-10099. Take out the Hub from Wheel.

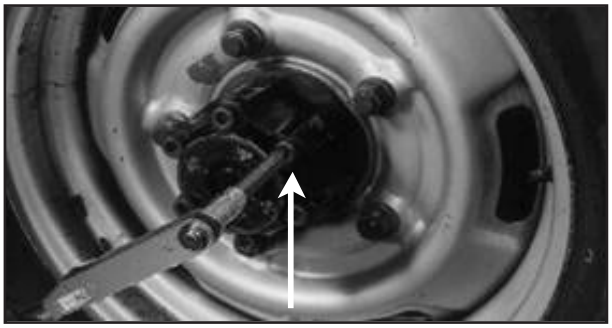


Fig. 98

4. Remove the axle circlip with 12" Ext. circlip plier. Take out the circlip, Tochigi-Fuji spacer and Brake Set assembly.



Fig. 99

5. Install the new spacer (for 1704 ALH) on the axle and re-install the axle circlip in the axle groove.

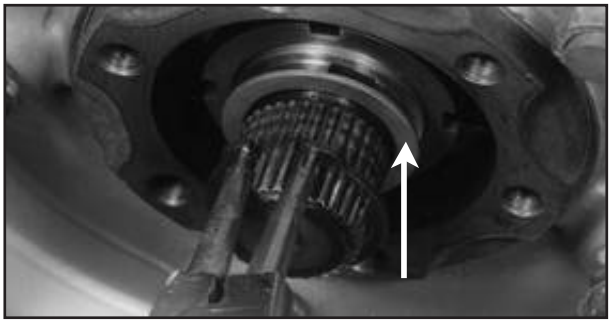


Fig. 100

6. Install the “1704” Hub Lock in the wheel hub. Make sure that the slots on the Drag Sleeve are engaging with the 4 tanged washer.



Fig. 101

7. Rotate the Hub Lock to match the threaded holes & holes on the flange of the Hub Lock.



Fig. 102

8. Tighten 6 “1704” bolts with Spl. Allen key T-10099 to approx. 6 kg-m torque using Torque Wrench.



Fig. 103

9. Ensure proper tightening of the bolts. Install the hub cap on the wheel to complete the installation.



Fig. 104

REAR AXLE



INTRODUCTION :

Rear axle of Telcoline has unique features of unitised bearings.

Unitised bearings are pre-set and require no adjustments. Lubrication is through differential lube and draining of axle lube is not required to service hub bearing or seal.

Vehicles with 4x4 arrangement are equipped with Track - Lok limited slip differential. We have introduced limited slip differential in 4x2 facelift vehicles also (100% fitment). This system is similar to conventional differential, except that part of torque from ring gear is transmitted through clutch packs between side gears and differential case. In case of wheel slippage clutch pack opposite to slipping side, is activated by separating forces between pinion mate and corresponding side gear. This increases torque delivered to non slipping wheel and vehicle begins to move.

It is important to recognize that if, with unequal traction, both wheels slip, the Track - Lok has done all it can possibly do.



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Note : For Rear Axle without limited slip differential, refer to Front Axle section for guidelines.

CONSTRUCTION :

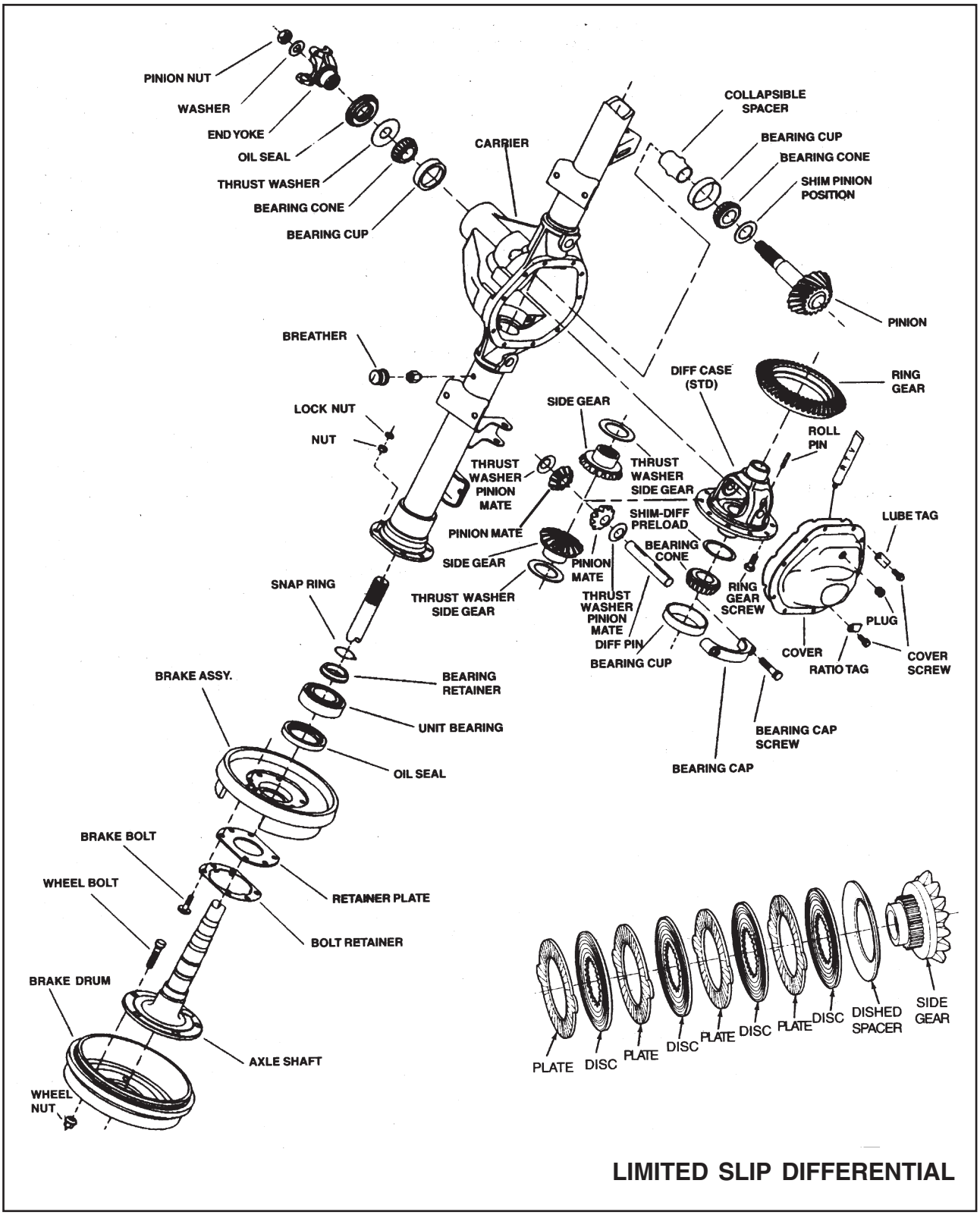


Fig. 1

SPECIFICATION & SERVICE DATA :

Type : Single reduction, salisbury type with hypoid gears and semi floating axle shafts.

Vehicles with 4x4 arrangement are provided with Limited slip differential .

Limited slip differential has been introduced in 4x2 face lift version also.

Axle Ratio	:	44/9
Weight of Axle	:	115 kg.
Quantity of Oil	:	2.2 Liters
Tightening Torque		
Cover Screws	:	38 - 45 Nm
Filling plug	:	20 - 35 Nm
Drain Plug	:	20 - 35 Nm
Differential Bearing caps screws	:	95 - 122 Nm
Brake Backing plate nut	:	37 - 55 Nm
Ring Gears Screws	:	95 - 122 Nm
Drive pinion nut	:	220 - 680 Nm
Lubrication		
Centre Housing	:	2.2 Liters
Type of oil	:	Multigrade oil conforming to SAE 85W140 API GL5 specifications. * Friction modifier 40819 (2-5%) to be added to oil for rear axle with limited slip differential.
Lubricant change interval	:	40000 kms / 24000 miles of vehicle running.
Grease for rear Hub (Only at the time of assembly)	:	25 gm each, lithium base multipurpose EP2
Pinion Bearing Pre load		
Torque to rotate drive pinion only	:	2.26 - 4.52 Nm
Differential Assembly		
Ring gear to pinion gear Backlash	:	0.13 - 0.20 mm
Maximum permissible variation between checked points.	:	0.08 mm
Pre load of Differential side bearing	:	0.07 to 0.20 mm
Axle End Play		
Permissible axle end play	:	0.025 mm to 0.38 mm max.

LIST OF SPECIAL TOOLS

Sr. No.	Description		Part No.
1.	Adapter plug, differential hub	:	2698 5890 3501
2.	Adapter, differential bearing cone	:	2698 5890 3502
3.	Adapter, rear pinion bearing cone	:	2698 5890 3503
4.	Remover, Yoke	:	2698 5890 3504
5.	Holder, yoke	:	2698 5890 3505
6.	Handle universal	:	2698 5890 3506
7.	Puller Slide Hammer	:	2698 5890 3507
8.	Installer, front pinion bearing cup	:	2698 5890 3508
9.	Installer, rear pinion bearing cup	:	2698 5890 3509
10.	Remover, front pinion bearing cup	:	2698 5890 3510
11.	Remover, rear pinion bearing cup	:	2698 5890 3511
12.	Installer, differential side bearing	:	2698 5890 3512
13.	Installer, pinion oil seal	:	2698 5890 3513
14.	Master Bearing differential	:	2698 5890 3514
15.	Press	:	2698 5890 3515
16.	Adapter ring	:	2698 5890 3516
17.	Spreader axle housing	:	2698 5890 3517
18.	Installer, yoke	:	2698 5890 3518
19.	Installer, rear pinion bearing cone	:	2698 5890 3519
20.	Pinion Height set (Includes Master block, Pinion height gauge)	:	2698 5890 3520
21.	Bearing Puller for Axle shaft	:	2698 5890 3521
22.	Drive square for drain plug	:	2654 5890 3524
Carrier with Limited slip differential			
23.	Track lock tool (Includes 2 adapter, 1 driving bar)	:	2698 5890 3501

REMOVAL FROM VEHICLE

Place wheel chocks on front wheel.

Drain oil from rear axle while it is hot. Use Drive square Pt. no. 2654 5890 3524 for loosening drain plug.

Disconnect propeller shaft from tail pinion and lay it on side.

Unscrew and remove nuts and bolts connecting end of shock absorber to the bracket on rear axle (if fitted).

Unscrew and remove bolts and nuts holding antiroll bar to rear axle (if fitted).

Disconnect rear brake hose from bracket on chassis frame after removing lock clip. Remove brake bundy pipe from wheel cylinder and keep it safely. Plug the opening to avoid oil flow and entry of dirt.

Slightly loosen wheel nuts and lift rear axle assembly by jacks placed under axle tube near spring seat.

Caution : Do not place jack under rear axle centre housing but only on axle tube especially on a loaded vehicle.

Place suitable supports below long members.

Remove wheel nuts and take out wheels.

Release brake shoes by turning brake adjusting cams until brake drum rotates freely.

Remove brake drums. Use two bolts M10 X 1.0 X 25 mm. Fig. 2

Remove spring clips holding parking brake cable with anchor plate assembly.

Disconnect parking brake cable from lever on anchor plate assembly and pull out cable.

Supporting rear axle at centre by a trolly jack, draw out axle assembly. Mount it on workstand.

WARNING:

A serious or fatal injury can occur if vehicle is not properly jacked.

Exercise extreme care when working on components utilizing snap rings or spring loaded retention devices.

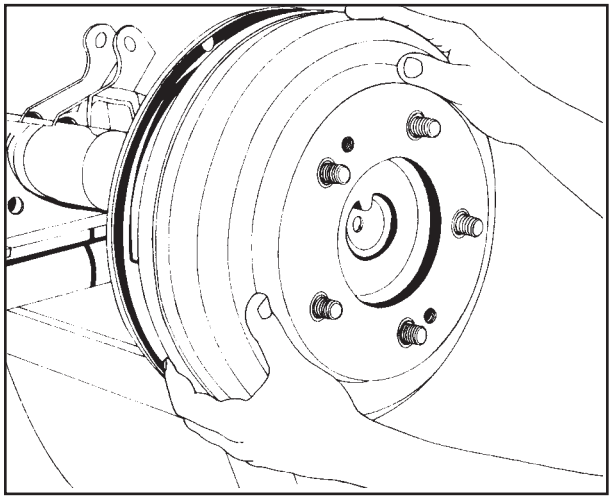


Fig. 2

DISASSEMBLY OF REAR AXLE

Unitised wheel bearing lubrication is from hypoid gear lube, thus it is without grease seal. *Fig. 3*

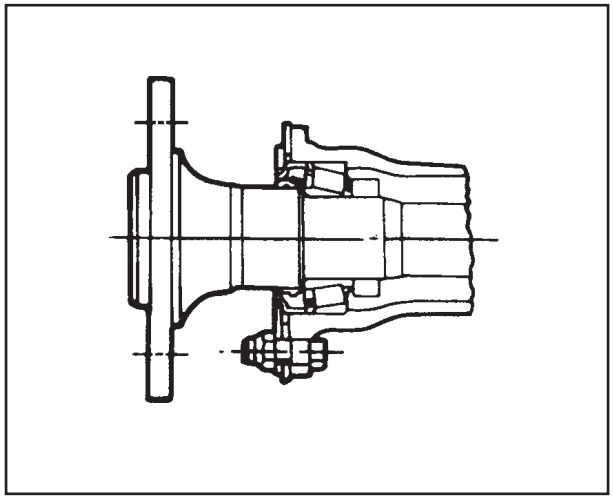


Fig. 3

Unscrew and remove anchor plate nuts, holding anchor plates to axle housing. *Fig. 4*

Note : Discard nuts, replace with new ones during assembly.

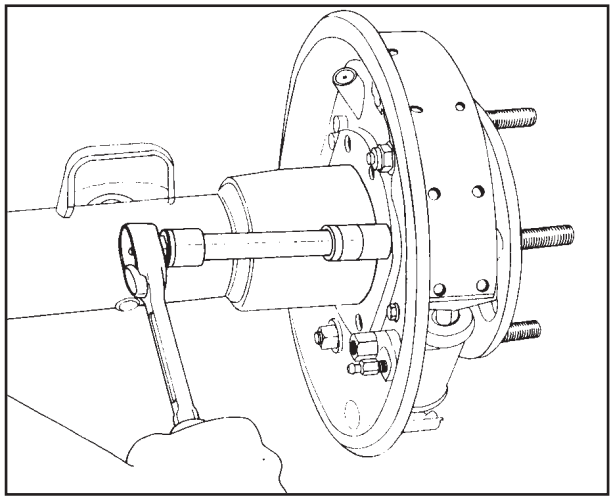


Fig. 4

Remove axle shafts. *Fig. 5*

Note : While removing axle shafts make sure that they are marked properly (LH & RH). In case bearing cups also are needed to be removed from axle housing, tie them with respective axle shafts.

Bearing cups & wheel bearings are prematched. In case they are interchanged, performance wheel bearings may get affected.

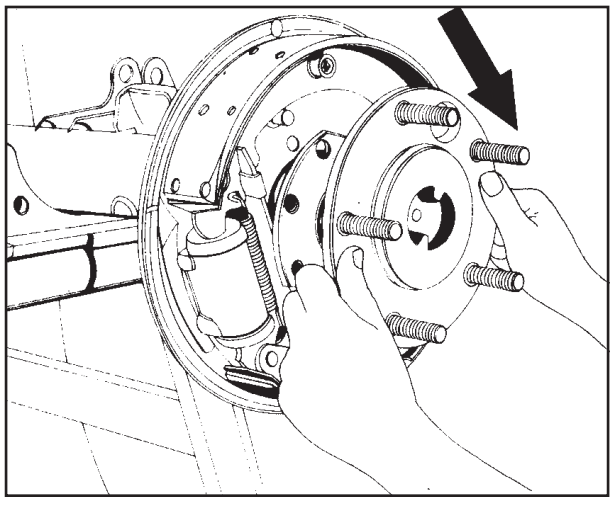


Fig. 5

To remove bearing cup, use Puller slide hammer Pt. No. 2698 5890 3507. *Fig. 6*

Removal of Unitised bearing.

Remove snap ring from axle shaft.

Clamp axle shaft in a vice. Drill a 6.5 mm hole to depth of 5 mm in retainer ring. *Fig. 7*

Caution : Drill can damage axle shaft if used negligently.

Use chisel and strike sharply to break retainer ring. Fig. 8

Note : Discard retainer ring. Use new one during assembly.

Push retainer plate and seal towards flange of axle shaft.

Use Bearing Puller for Axle shaft Pt. no. 2698 5890 3521.

Install flange plate (Pt. no. xxxxxxxxxxxxxxx) to flange of axle shaft.

Install bolts into flange plate. Slide forcing plate over axle shaft. Install adapters so that they seat under cup rib ring.

Gradually tighten bolts until bearing cone is removed. Fig. 9

Caution : Do not heat or cut bearing cone assembly.

Remove seal and retainer plate. Discard Seal. Discard retainer plate, if found distorted.

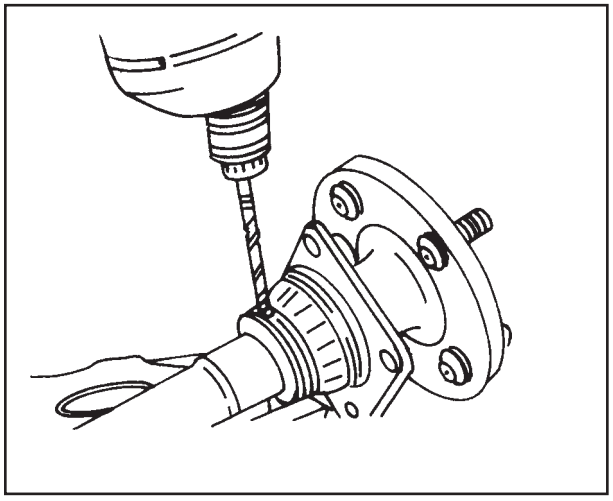


Fig. 7

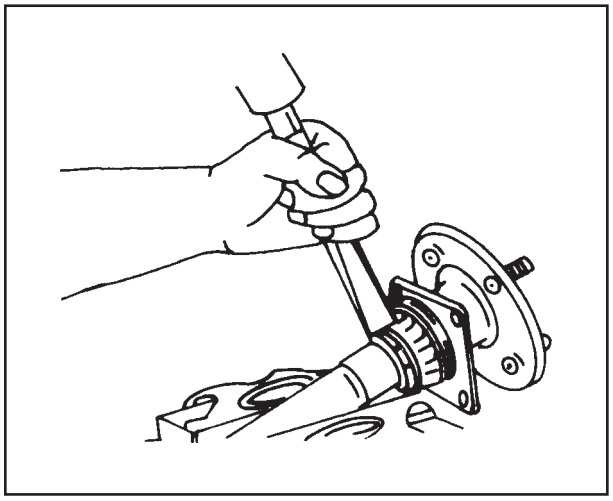


Fig. 8

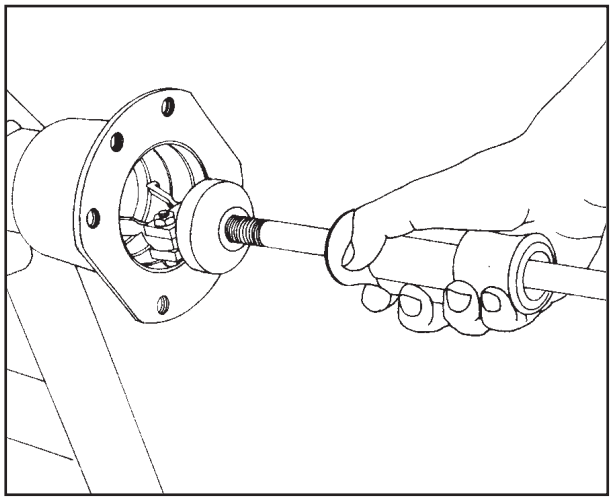


Fig. 6

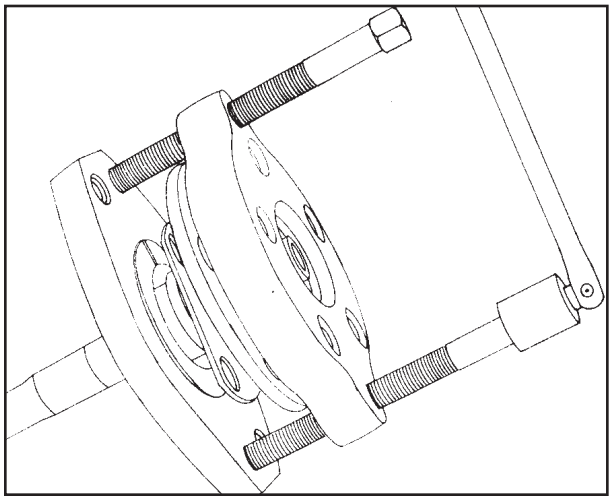


Fig. 9

Remove cover plate screws & cover plate. *Fig 10*

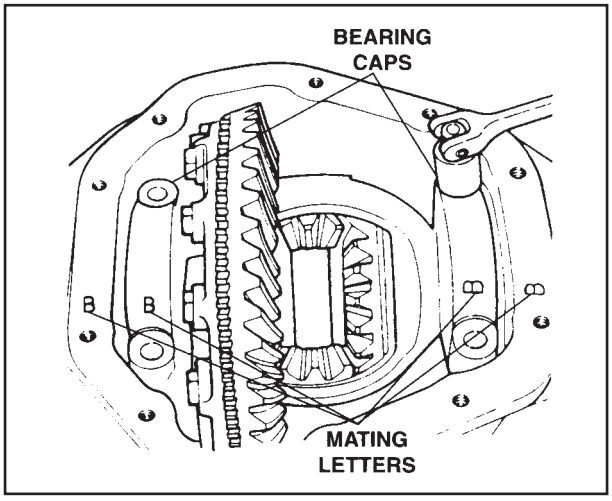


Fig. 11

Disassembly of Carrier Center Section.

Note: Liquid gasket is used to seal cover plate. Scrape and clear it.

Remove bearing caps. *Fig 11*

Note : Mating letters are stamped on caps and carrier on either side. It is essential to match letters on both sides.

Mount spreader Pt. No. 2698 5890 3517 to housing. Do not spread carrier more than 0.58 mm. Use dial gauge. *Fig 12*

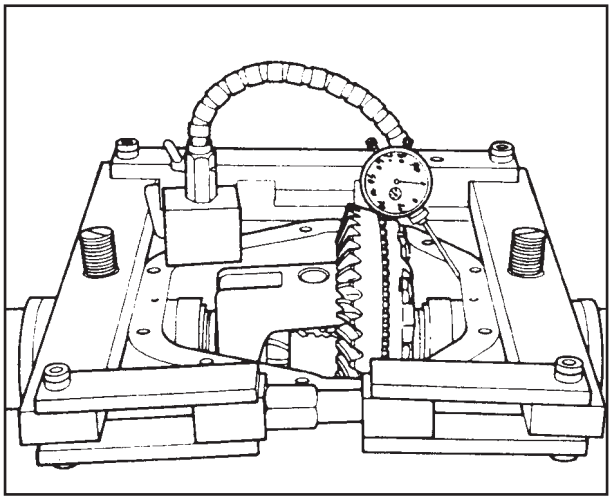


Fig. 12

Pry out differential case from carrier. *Fig 13*

Remove spreader.

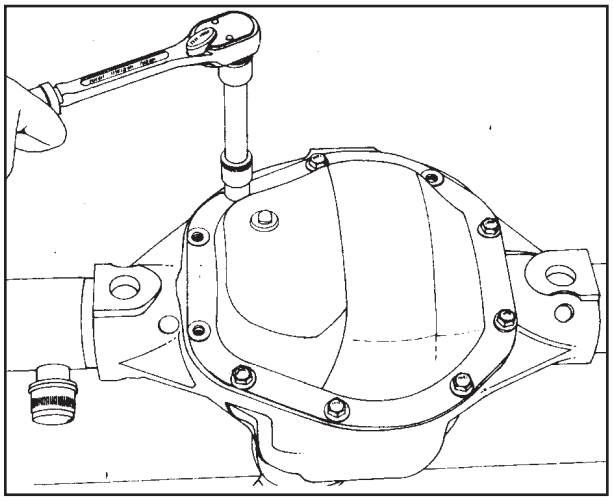


Fig. 10

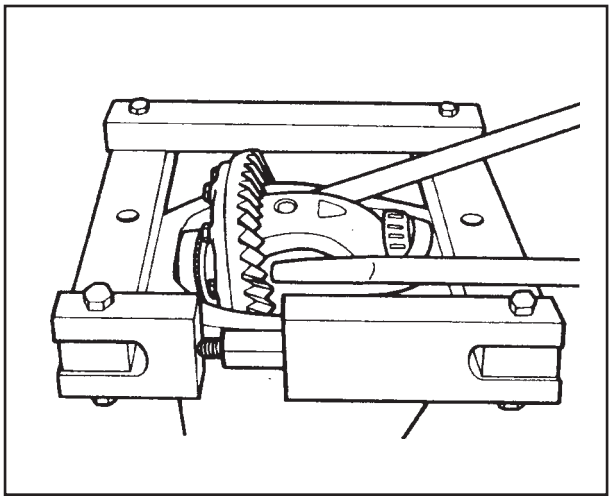


Fig. 13

Remove side bearing cone from differential case using special tools given below:

1. Adapter, differential bearing cone Pt. no. 2698 5890 3502
2. Adapter plug, differential hub Pt. no. 2698 5090 3501
3. Adapter ring Pt. no. 2698 5890 3516. *Fig. 14*

Identify shims and side bearings on both sides. They are not to be interchanged during assembly.

If shims are damaged, replace with new shims during assembly.

Reposition case in puller and remove side bearing cone on the other side in same manner.

Note : It is always preferred to replace side bearings once pulled out. But one can confirm free rolling of bearings and reuse it, if they are defect free.

Remove ring gear screws. *Fig. 15*

Remove ring gear.

If required tap ring gear with a mallet to free it from case. Fig. 16

Note: Discard ring gear screws and replace with new ones.

Clamp any one of axle shafts in vice firmly. *Fig. 17*

Caution: Vice jaws should not locate on axle splines or any machined surfaces.

Install differential case on axle shaft.

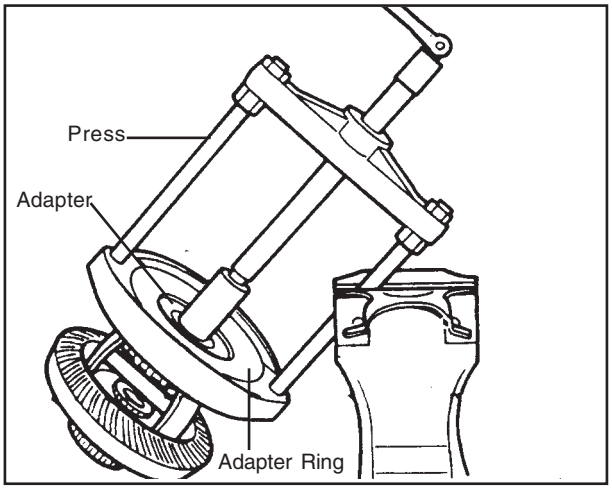


Fig. 14

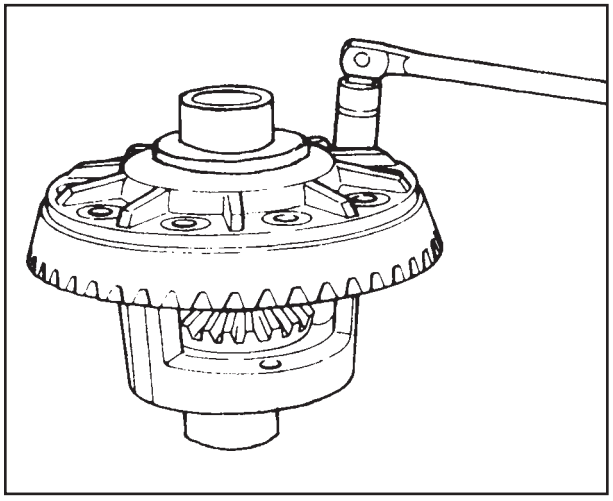


Fig. 15

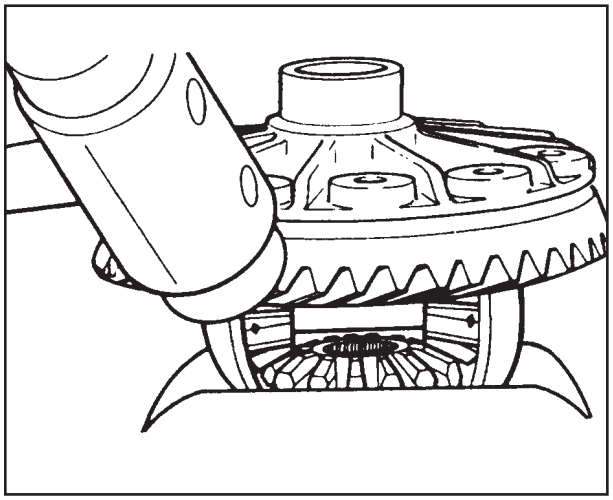


Fig. 16

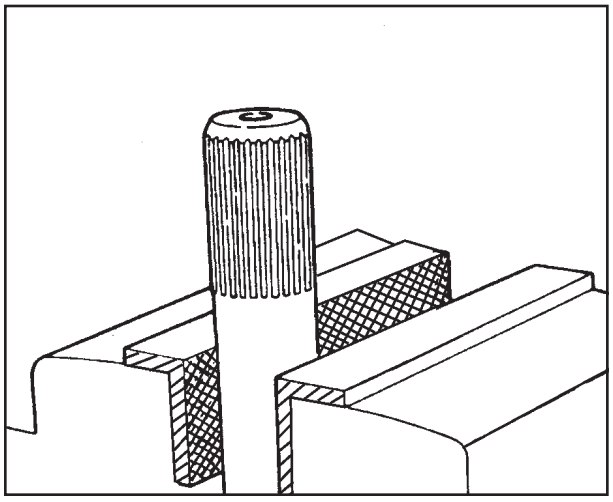


Fig. 17

Use a suitable drift to remove the roll pin retaining cross shaft. *Fig. 18*

Use hammer and punch as shown to remove the cross pin from case. *Fig. 19*

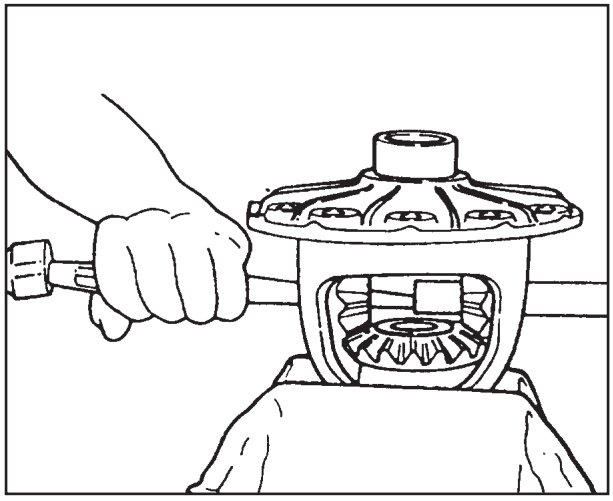


Fig. 19

Install adapter plate of track lock tool Pt. no. 2699 5890 3501 into bottom side gear. Apply a small amount of grease to centering hole of adapter plate. *Fig. 20*

Install threaded adapter of track lock tool into top side gear.

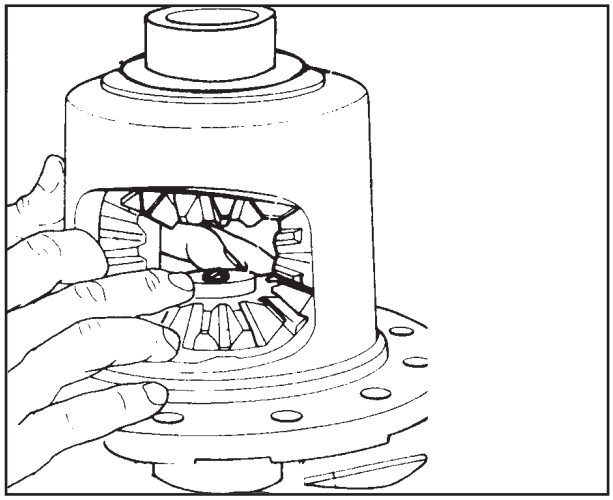


Fig. 20

Screw into threaded adapter until it is centered into adapter plate. Use small screw driver to prevent adapter from turning. *Fig. 21*

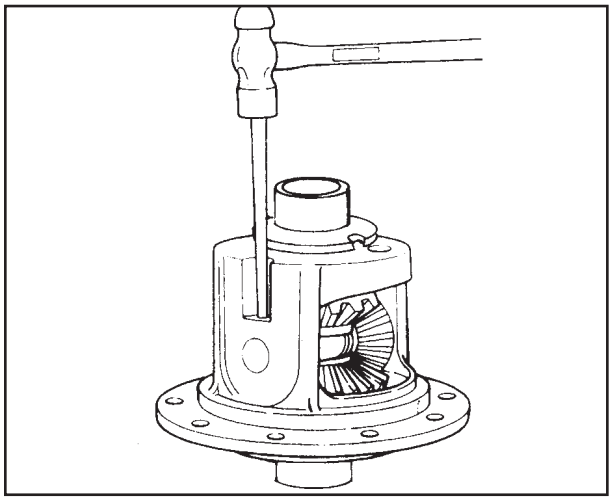


Fig. 18

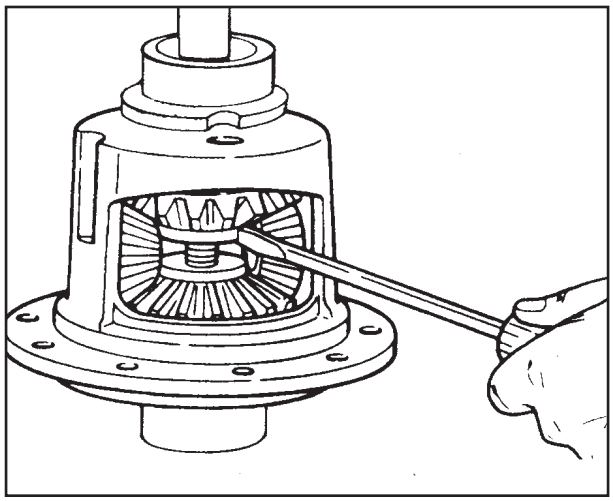


Fig. 21

Apply torque to driving bar of track lock tool to collapse belleville plates.

Remove both pinion mate spherical washers.

Use a shim stock of 0.76 mm thickness or an equivalent tool to push out spherical washers. *Fig. 22*

Relieve tension of belleville plates by loosening driving bar.

Suitably rotate pinion mate gears and take them out. *Fig. 23*

Hold top clutch pack with one hand & remove tools.

Remove top side gear and clutch pack. *Fig. 24*

Note: Keep the pack of plates and discs intact in exactly the same position.

Remove the case from axle shaft. Turn case with ring gear side up and remove thrust washer, side gear and clutch pack. *Fig. 25*

Remove retainer clips and allow separation of plates and discs.

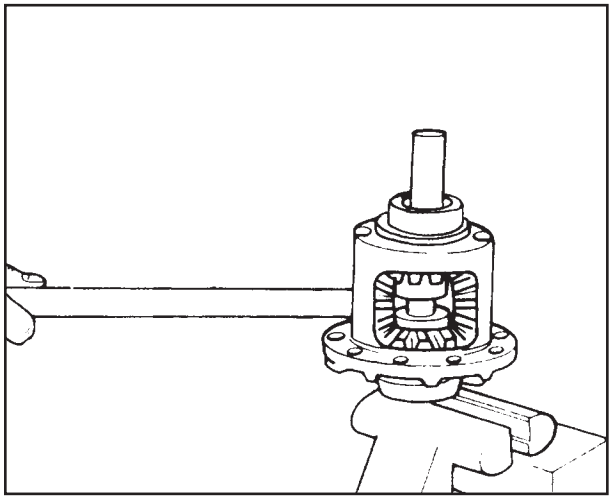


Fig. 23

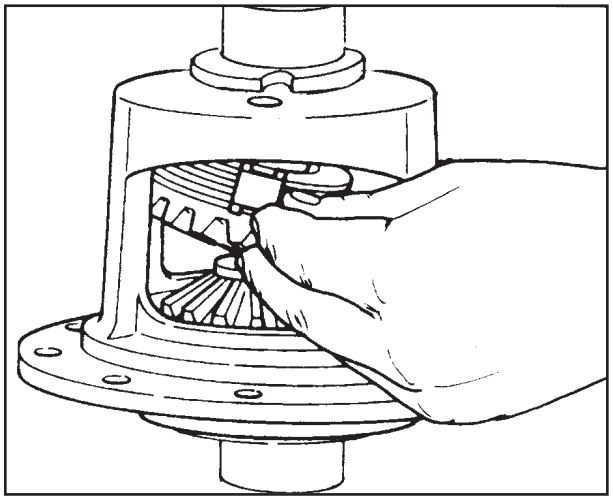


Fig. 24

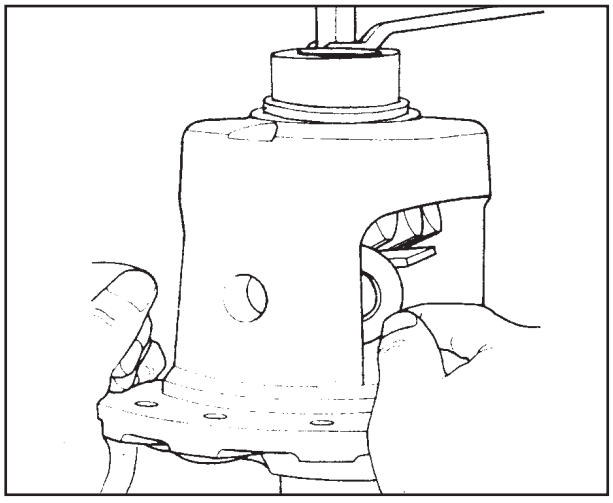


Fig. 22

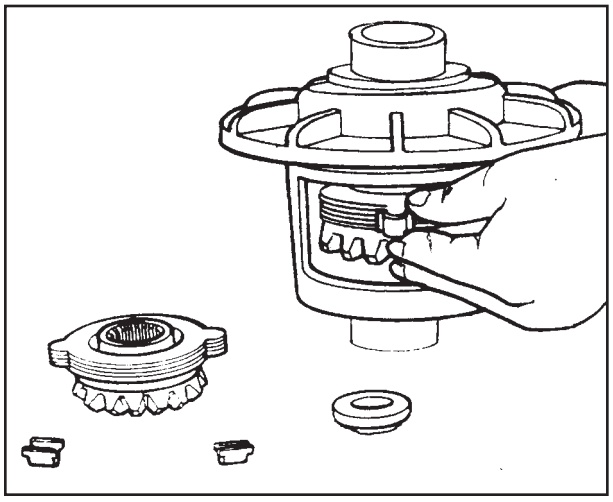


Fig. 25

Note : Keep the pack of plates and discs exactly as they were removed.

Drive Pinion Removal

Remove end yoke using tools given below :

1. Holder Pt. No. 2698 5890 3505
2. Remover, yoke Pt. no. 2698 5890 3504. *Fig. 26*

If yoke or flange shows wear in the area of seal contact, it should be replaced.

Remove pinion by tapping with mallet. Hold the pinion with hand to avoid it's fall. *Fig. 27*

Caution : Gear teeth have sharp edges. Handle gears carefully to avoid injury. *Fig. 27*

Collect shims and keep them together. Replace shims if found damaged.

Note : Discard collapsible spacer. New one to be used during assembly.

Pull out pinion oil seal with puller slide hammer Pt. No. 2698 5890 3507. Fig. 28

Note : Discard oil seal

Remove bearing cone and outer thrust washer.

Turn nose of carrier down. Remove outer pinion bearing cup using tools given below :

1. Remover front pinion bearing cup Pt. No. 2698 5890 3510
2. Handle Pt. No. 2698 5890 3506. *Fig. 29*

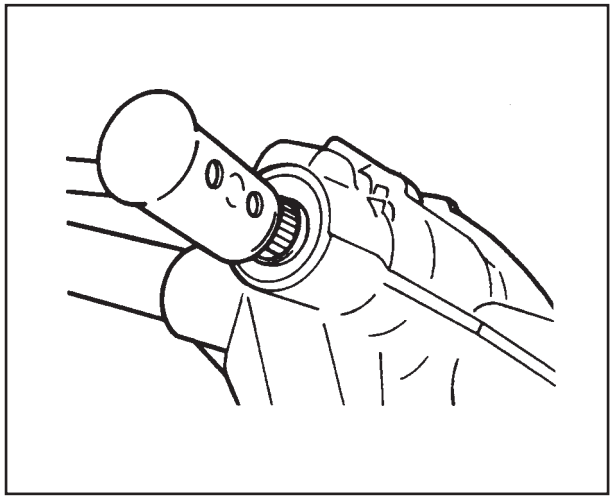


Fig. 27

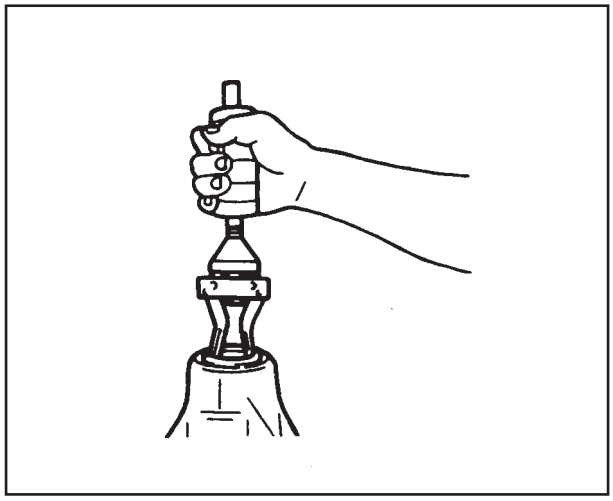


Fig. 28

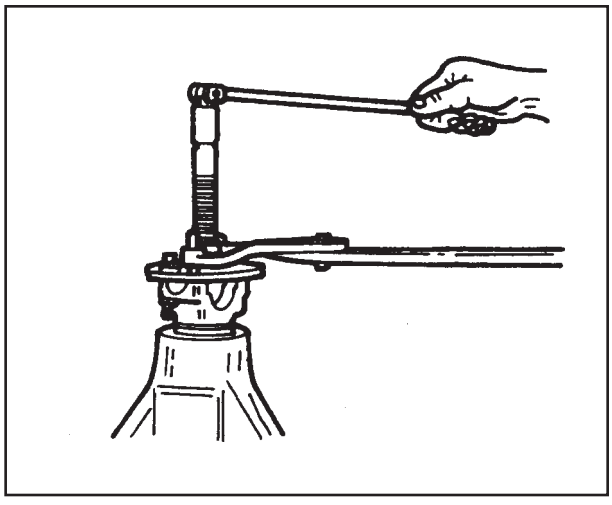


Fig. 26

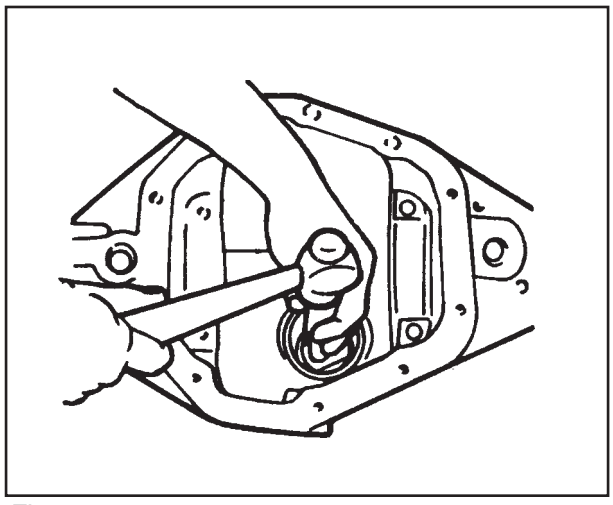


Fig. 29

Turn nose of carrier up and remove inner pinion bearing cup using tools given below :

1. Remover rear pinion bearing cup. Pt. No. 2698 5890 3511
2. Handle Pt. No. 2698 5890 3506. *Fig. 30*

Note: Pinion depth shim is located between inner pinion bearing cone and pinion gear.

Remove inner pinion bearing using tools given below:

1. Press Pt. No. 698 5890 3515
2. Adapter, rear pinion bearing cone. 2698 5890 3503
3. Adapter ring Pt. No. 2698 5890 3516. *Fig. 31*

Remove pinion depth shim from pinion.

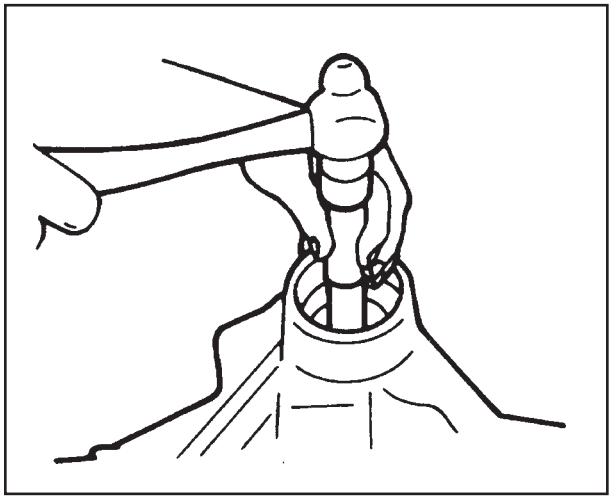


Fig. 30

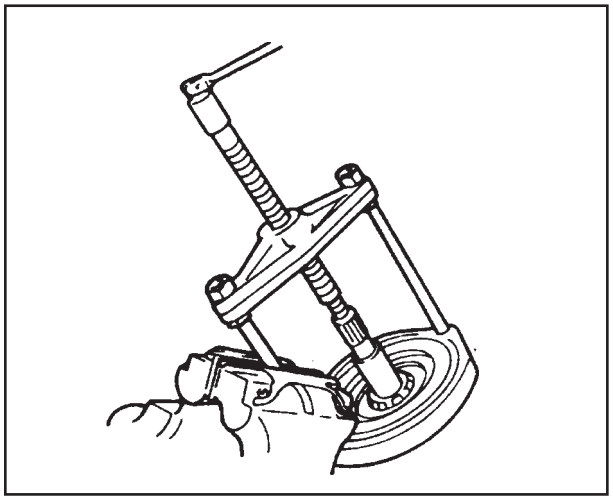


Fig. 31

CLEANING AND INSPECTION

Unitised Wheel Bearing

Clean bearing cup with metal cleaning solvent. Inspect cup for any possible wear, nicks etc.

Cone assembly can be cleaned in its installed position on axle shaft.

Use stiff bristle brush and compressed air.

Note : Bearing should not be 'Spin dried' with compressed air. Air should be directed so that it goes through the bearing.

Clean bearing bore in housing.

Lubricate bearing with a small amount of specified lube during installation.

Carrier Centre Section

Inspect plates and discs for wear and scoring. *Fig.32*

Note : If any one member of either stock shows evidence of excessive wear or scoring, complete stock needs to be replaced on BOTH sides.

Inspect gear teeth of side gears and pinion mate gears for wear and cracks.

Inspect external teeth of side gears for wear & crack.

Note : If replacement of one gear is required, then BOTH side gears, pinion mate gears and washers are to be replaced.

Inspect cross pin for excessive wear. Replace if necessary.

Inspect for wear on clutch retainer clips.

Note : Replace all four clips if wear is evident on any one of retainer clips.

Inspect differential case for scoring, wear or metal pick up. If noticed on machined surfaces, then case needs to be replaced.

Pre lubricate thrust face of side gears & plates / discs. *Fig. 33*

Note : Plates and discs to be assembled in the reverse sequence for removal *Fig. 34*

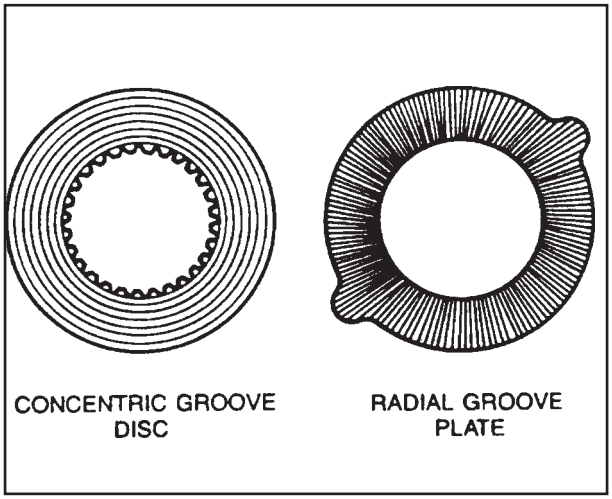


Fig.32

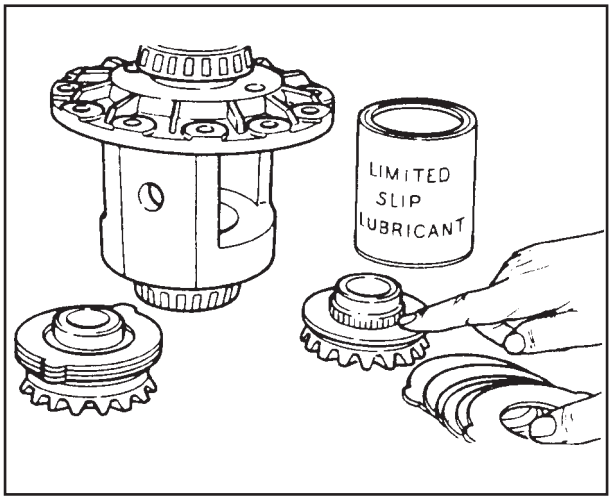


Fig. 33

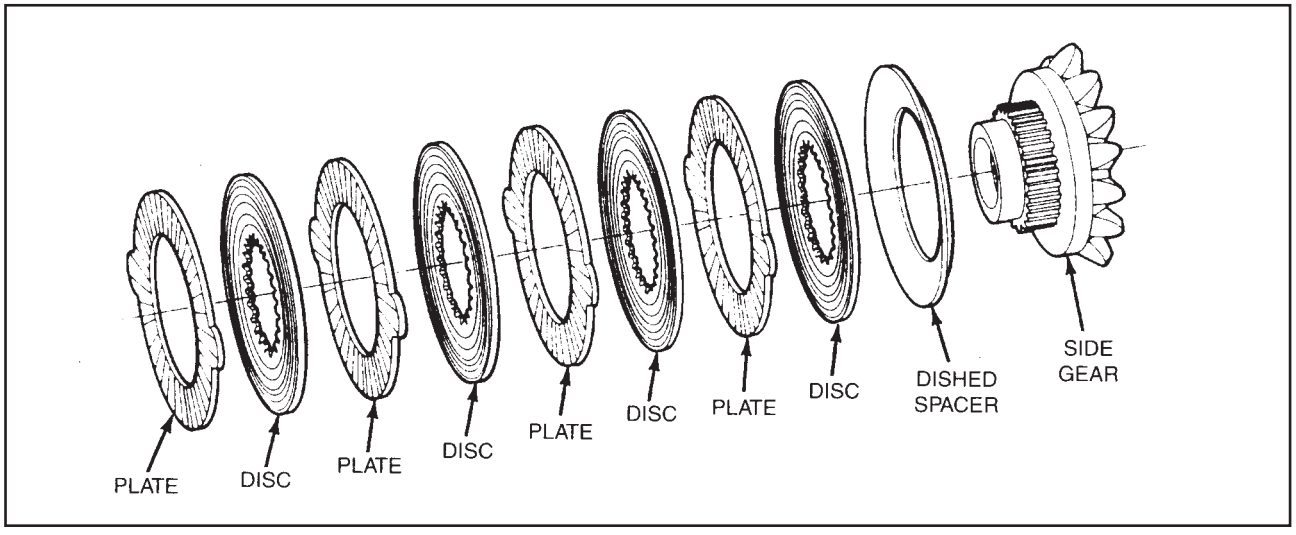


Fig. 34

ASSEMBLY

INSTALLATION OF UNITISED BEARING

Note : Apply grease by hand before assembly (Lithium Base Multipurpose EP2) on unitised bearing. Minimum quantity should be 25 gms.

Use bearing puller for axle shaft Pt. no. 2698 5890 3521, as shown

Install flange plate to the flange of axle shaft. Remove bolts from flange plate.

Assemble retainer plate, if required new; and assemble new oil seal.

Note : Rubber portion of oil seal, which extends beyond the casing has numbers bonded in rubber. These numbers are to face towards the flange of axle shaft.

Install bolt retainer.

Slide installing ring on axle shaft. Locate bearing on inside of installing ring. Slide forcing plate on axle shaft and locate on installing ring. Install bolts.

Tighten bolts evenly until unit wheel bearing is seated. *Fig. 35*

Note : Bearing requires 700 kgs. to 2000 kgs. force for pressing.

Ensure proper seating of bearing by checking with a 0.038 mm. feeler gauge. Gauge should not enter.

Press retainer ring on axle shaft using suitable press.

Insert a feeler gauge of 0.038 mm thickness between retainer ring and bearing inner race. If feeler gauge enters, retainer ring must be forced farther onto axle shaft.

Note : Retainer ring requires 3200 kgs. force for proper seating.

Install snap ring.

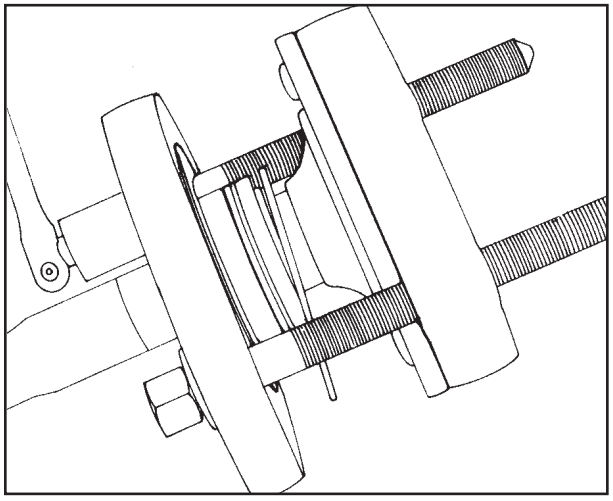


Fig. 35

Assemble bearing cup into bearing bore of the tube using a suitable drift. *Fig. 36*

Make sure the cup sits properly against bearing seat of the tube.

Note : Ensure that oil seal is not damaged.

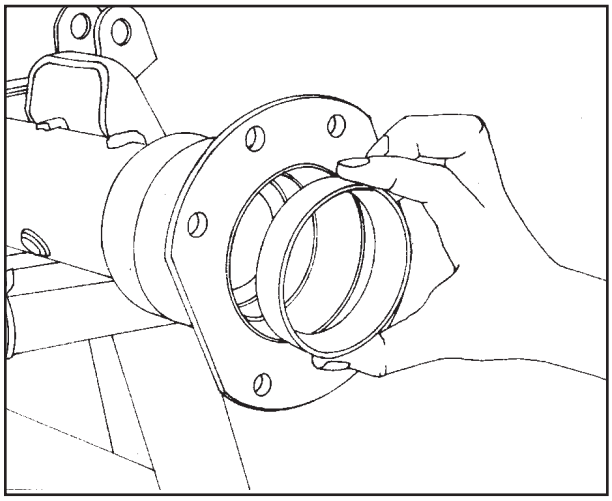


Fig. 36

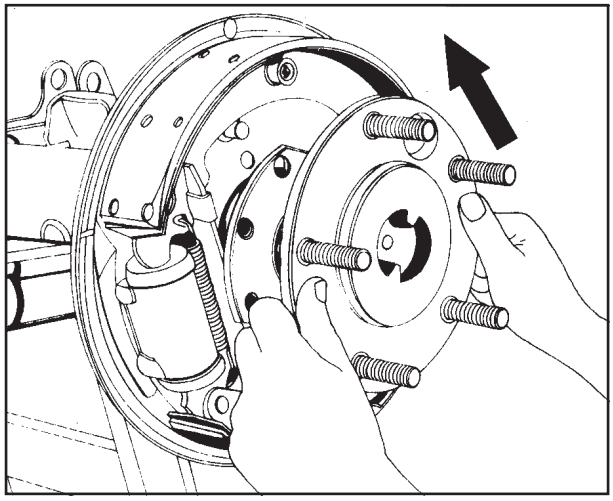


Fig. 37

Assemble axle into housing. *Fig. 37*

Line up holes of retainer plate with bolts. Push axle shaft into housing as far as possible.

Tighten nuts evenly. *Fig. 38*

Caution : Ensure that seal and cup rib ring are drawn evenly against the cup in housing.

Use a torque wrench to torque nuts to specified value. *Fig. 39*

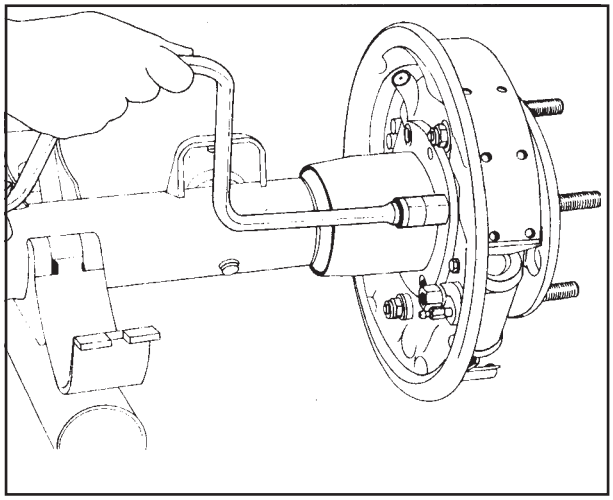


Fig. 38

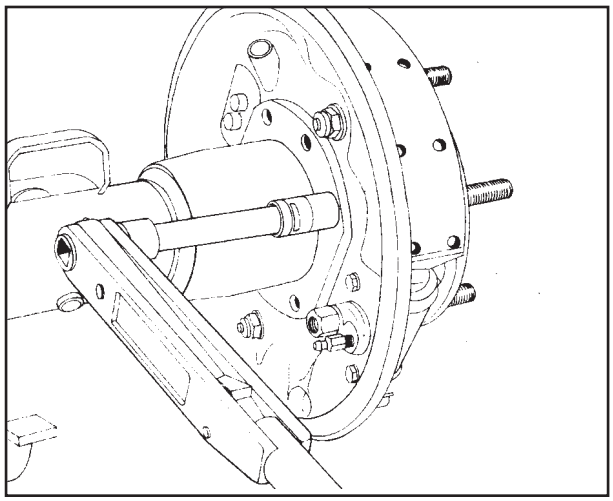


Fig. 39

RING AND PINION GEAR ASSEMBLY

Ring gear and pinion is supplied as a sets only. They are matched with each other during manufacture. Matching numbers on both pinion and ring gear are etched for verification. Fig. 40 or 41

If a new gear set is used, verify numbers on pinion and ring for matching before proceeding with assembly.

Standard mounting distance from center line of ring gear to back face of pinion is 109.5 mm. This dimension is controlled by selecting shims, which are positioned between the inner pinion bearing cone and pinion gear. Best running position of gear set is achieved by proper shim selection.

This dimension for front live axle will be different.

On the bottom face of pinion a numbered is etched. It can be a plus (+) number, a minus (-) number or Zero (0). Required pinion shim selection is achieved with help of this number.

If alphabet "m" appears on pinion face shim selection has to be done in mm (Metric).

If alphabet "m" does not appear on pinion face shim selection has to be done in inches (English).

Please refer tables given below for calculations :
Example 1

	In metric	In inches
No punched on removed pinion	+ 8m	+ 3
No punch on new pinion	- 5m	- 2
Value derived from table	+ 0.13	+ 0.005
Thickness of shims in OE assembly	x	y
Thickness of shims to be selected for new ring/pinion	x + 0.13	y + 0.005

Example 2

	In metric	In inches
No punched on removed pinion	- 5m	- 3
No punch on new pinion	+ 5m	+ 4
Value derived from table	- 0.1	- 0.007
Thickness of shims in OE assembly	x	y
Thickness of shims to be selected for new ring/pinion	x - 0.1	y - 0.007

Shims with different thicknesses are available for selection.

Use tables on next page as a guide for selecting correct thickness of shims either for addition or for subtraction from old shim pack.

Fig. 40 shows ring and pinion etched with inch identification. Refer Table **A.**

Fig. 41 shows ring and pinion etched with metric indentification. Refer Table **B.**

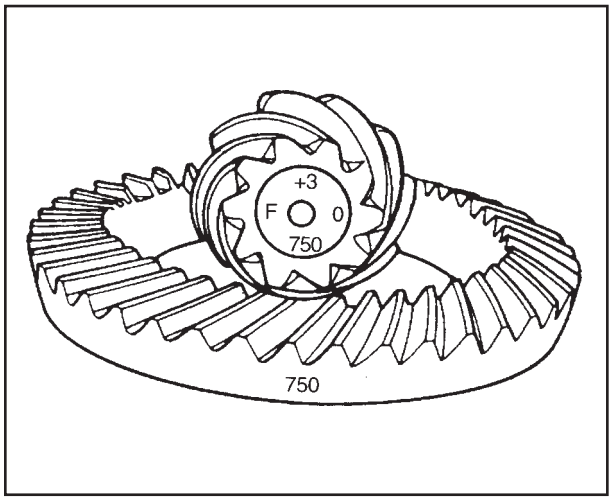


Fig. 40

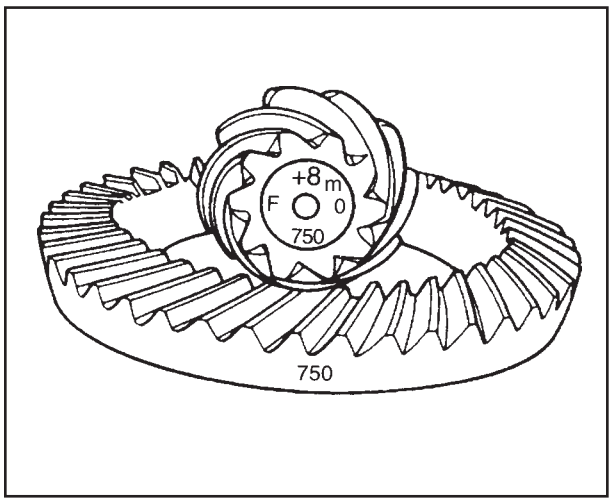


Fig. 41



TABLE A

Old Pinion Marking (English)	New Pinion Marking (English) (Value in Inches)								
	-4	-3	-2	-1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003
0	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004
-1	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005
-2	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006
-3	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007
-4	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007	-0.008

TABLE B

Old Pinion Marking (Metric)	New Pinion Marking (Metric) (Value in mm)								
	-10	-8	-5	-3	0	+3	+5	+8	+10
+10	+.20	+.18	+.15	+.13	+.10	+.07	+.05	+.02	0
+8	+.18	+.16	+.13	+.11	+.08	+.05	+.03	0	-.02
+5	+.15	+.13	+.10	+.08	+.05	+.02	0	-.03	-.05
+3	+.13	+.11	+.08	+.06	+.03	0	–.02	-.05	-.07
0	+.10	+.08	+.05	+.03	0	-.03	-.05	-.08	-.10
-3	+.07	+.05	+.02	0	-.03	–.06	-.08	-.11	-.13
-5	+.05	+.03	0	–.02	-.05	–.08	–.10	-.13	-.15
-8	+.02	0	-.03	-.05	-.08	-.11	-.13	–.16	–.18
-10	0	-.02	–.05	-.07	–.10	-.13	-.15	–.18	–.20

Note: Please observe the marking on pinion. If ‘m’ is found etched on the face, refer table **B**. If not refer table **A**.

PINION POSITION SHIM SELECTION

Pinion position shim selection can also be done using a special tool, in the absence of removed ring/pinion gear.

Install pinion height set master block which is part of tool Pt. no. 2698 5890 3520 over pinion inner bearing cup seat.

Set the dial gauge to 0 (zero), on surface plate.

Install dial gauge on pinion height gauge which again is part of tool Pt no. 2698 5890 3520.

Install pinion height set gauge with dial gauge on side bearing seats. Ensure that plunger of dial gauge touches top face of pinion height set master.

Rock depth gauge.

Record maximum reading on gauge needle. Let it be 'X' *Fig. 42*

To calculate shim thickness proceed as follows :

Shim thickness required = x - etched value on pinion (when etched+ve)

= x + etched value on pinion (when etched-ve)

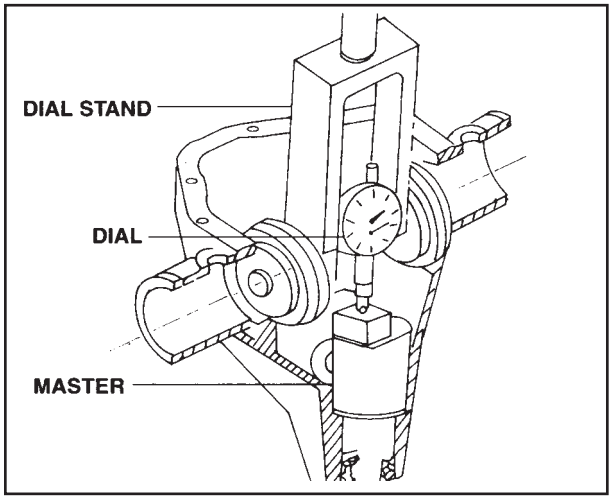


Fig. 42

Assembly pinion bearing cup

Drive inner bearing cup into carrier using tools given below :

1. Installer rear pinion bearing cup Pt. No. 2698 5890 35 09
2. Handle Pt. No. 2698 5890 35 06. *Fig. 43*

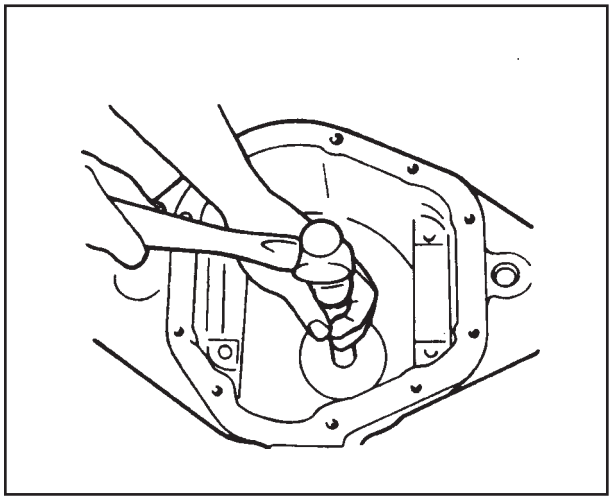


Fig. 43

Assemble outer pinion bearing cup into carrier using tools given below :

1. Installer, front pinion bearing cup Pt. No. 2698 5890 35 08
2. Handle Pt. No. 2698 5890 35 06. *Fig. 44*

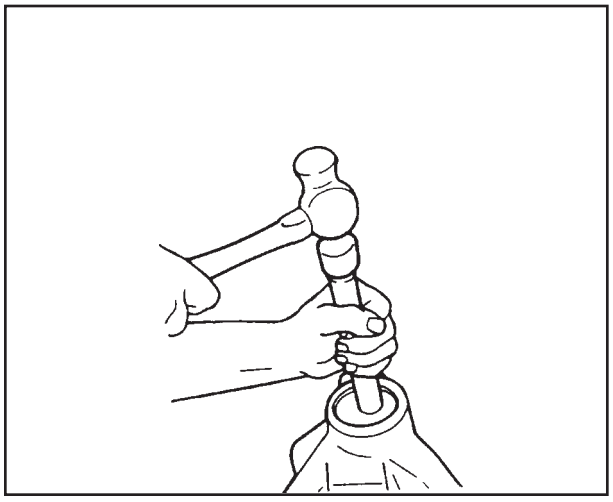


Fig. 44

Place shims selected as per procedure on pinion gear and install rear pinion bearing cone; using Installer, rear pinion bearing cone Pt. no. 2698 5890 3519 Fig. 45

Assemble bearing cone, slinger and new pinion seal into housing. Use Installer, pinion oil seal Pt. no. 2698 5890 3513 and handle universal Pt. no. 2698 5390 3506. Fig. 46

Apply a light coat of oil to the lip of oil seal.

Install new collapsible spacer onto pinion stem and assemble in housing using tools given below :

1. Holder, yoke Pt. no. 2698 5890 3505
2. Installer, yoke Pt. no. 2698 5890 3518.

Assemble end yoke, washer and new pinion nut.

Tigten pinion nut using torque wrench by holding end yoke with help of special tool Pt. no. 2698 5890 3505. Tighten nut to specified torque or until all end play is removed. Continue to tighten in small increments until specified rotating torque is achieved. *Fig. 47*

Note: Exercise care during bearing preload torque adjustment. Do not over tighten loosen and then retighten nut. Do not exceed specified bearing preload torque.

If preload torque is exceeded, a new collapsible spacer must be installed and torquing sequence as above to be repeated.

Check for rotating torque of pinion. It should read between 2.26 to 4.52 Nm with new bearings. *Fig. 48*

Note: If only oil seal needs to be changed, measure rotating torque of pinion with the help special tool. In this case use new collapsible spacer and keep same rotational torque of pinion as before.

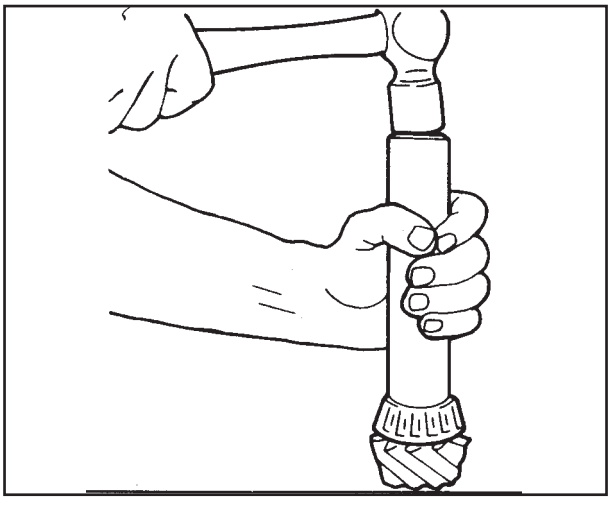


Fig. 45

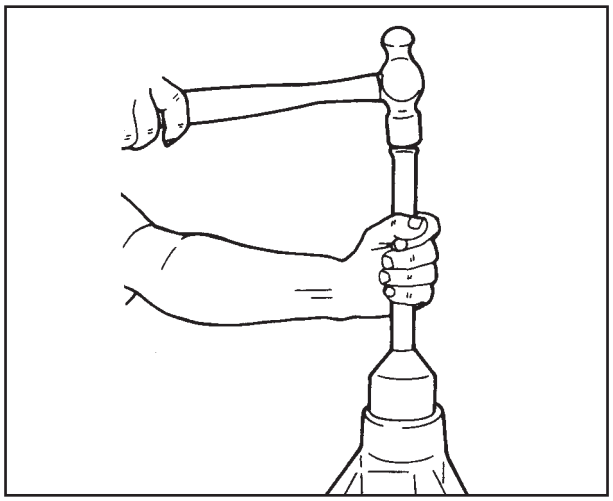


Fig. 46

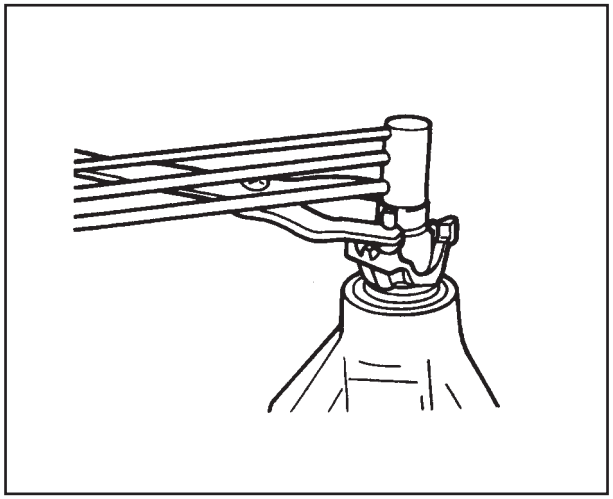


Fig. 47

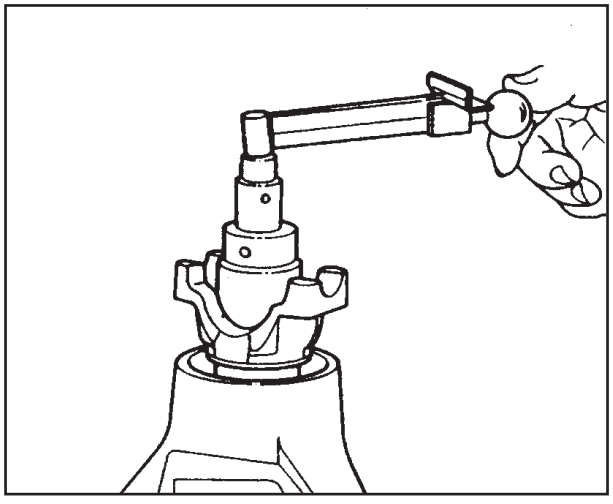


Fig. 48

Assembly of carrier centre section

Prior to assembly, prelubricate each disc and plate with friction modifier by pre soaking for a inimum of 20 minutes. Fig. 49

Assemble retainer clips to the ears of plates.

Assemble clutch pack and side gear into the case. *Fig. 50*

Note: Ensure clutch pack stays assembled to side gear splines and that retainer cups are completely seated into the pockets of case.

Reposition case. Assemble adapter of Track Lock tool pt. no. 2699 5890 3501 plate into side gear.

Apply a small amount of grease into the centering hole of adapter plate. *Fig. 51*

Assemble clutch pack and side gear on opposite side. *Fig. 52*

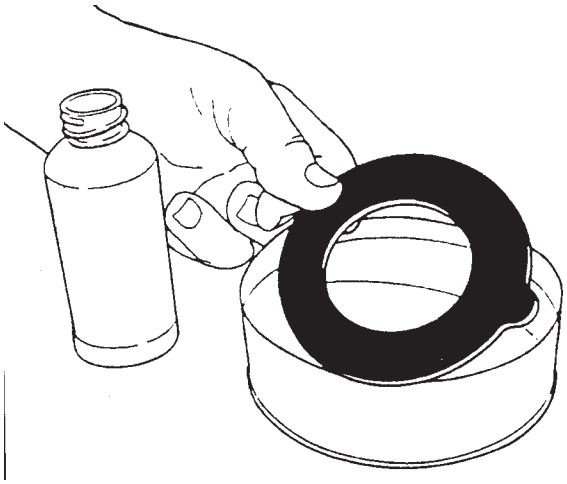


Fig. 49

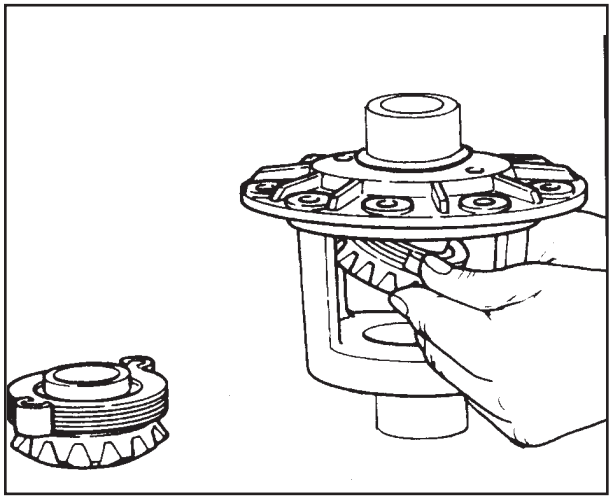


Fig. 50

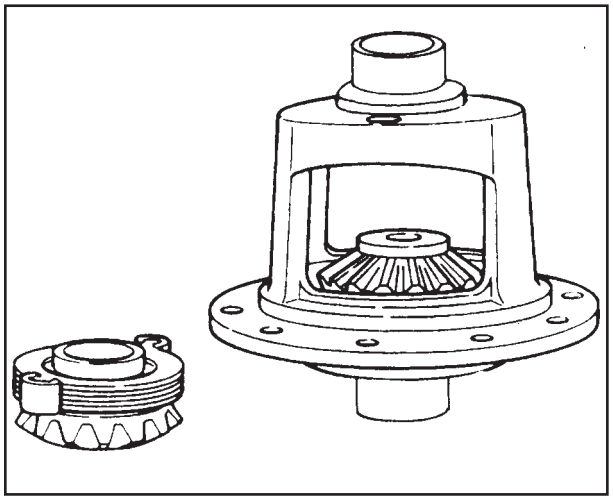


Fig. 51

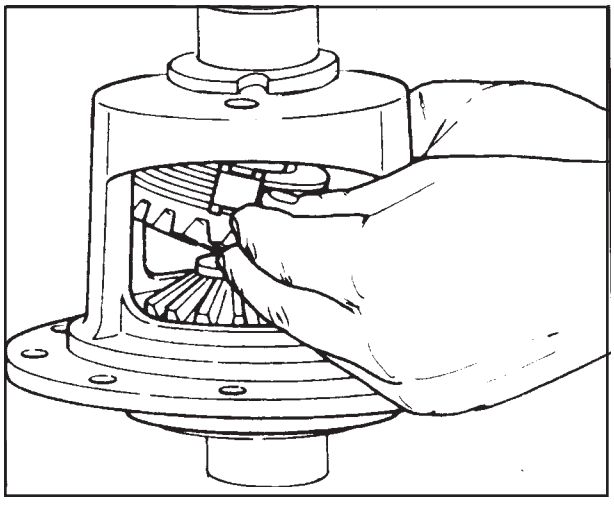


Fig. 52

Hold clutch pack in position and insert threaded adapter ofTrack lock tool into side gear on top.

Insert forcing screw of Track lock tool and tighten to hold both clutch packs in position. *Fig. 53*

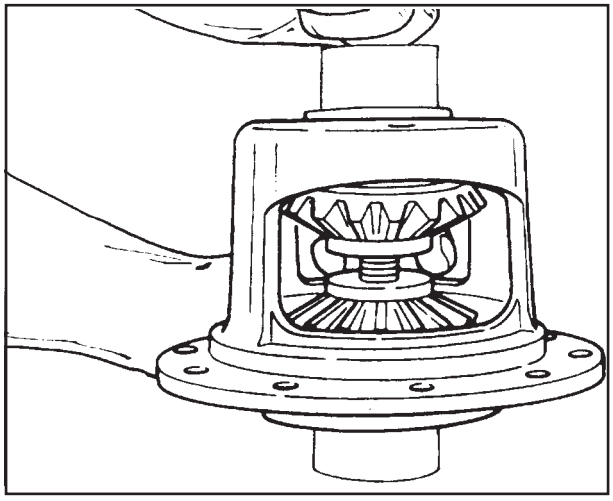


Fig. 53

Install case into the axle shaft by aligning splines of side gear with those of shafts.

Loosen forcing screw slightly and assemble both pinion mate gears. *Fig. 54*

Hold gears in position by hand and insert turning bar into case.

Pull on bar to rotate case allowing gears to turn.

Note: Ensure that holes of pinion mate gears are in alignment with holes of case.

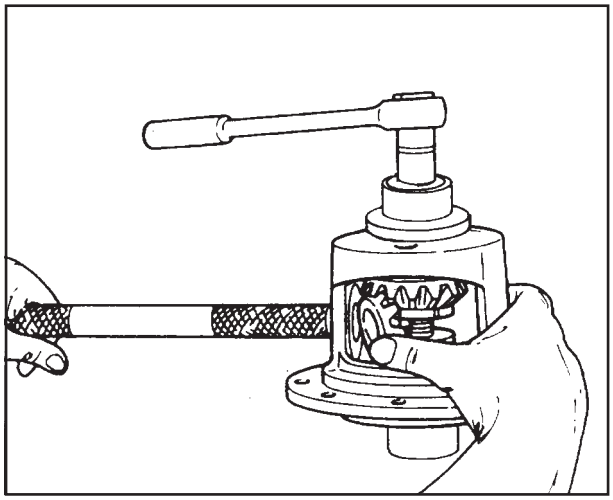


Fig. 54

Prelubricate spherical washers. Tighten screw of Track lock tool to collapse Belleville plates. Assemble spherical washers into case. *Fig. 55*

Caution: Ensure holes of washers and gears are lined up exactly with those of case.

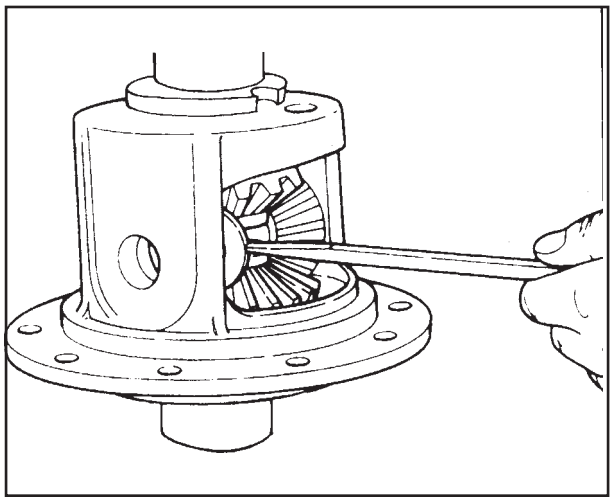


Fig. 55

Remove all tools.

Assemble cross pin shaft. If required use a suitable drift to guide cross pin. *Fig. 56*

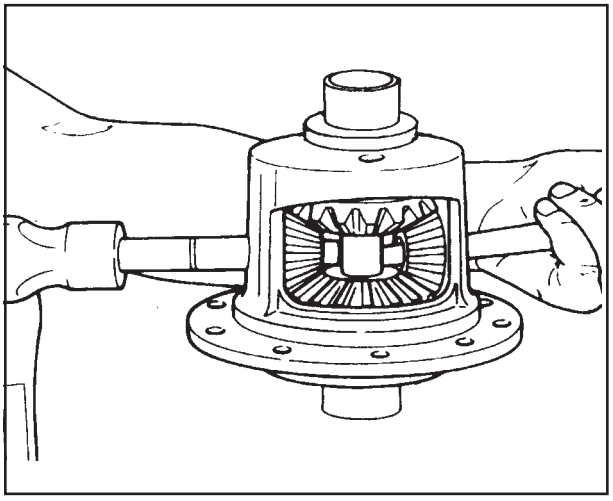


Fig. 56

Use a small drift to fit roll pin on cross shaft. Fig. 57

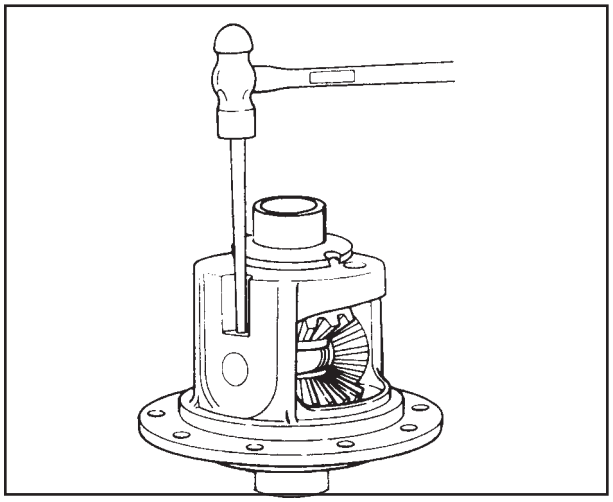


Fig. 57

As the role pin bottoms out, stake (peen) a little metal over edges in two places 180° apart. *Fig. 58*

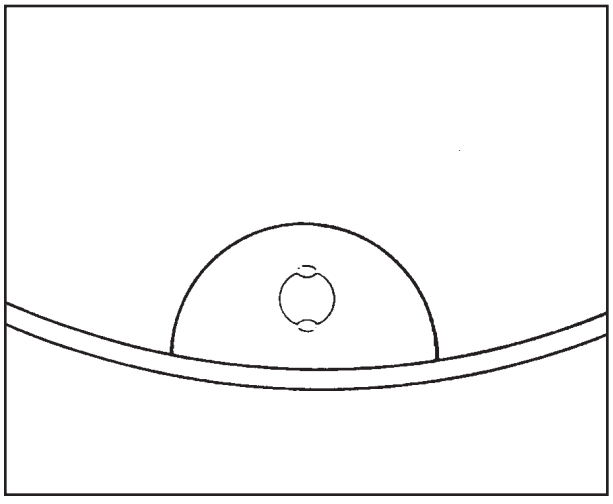


Fig. 58

Assembly of Differential

Assemble Master differential bearings Pt. No. 2698 5890 35 14. *Fig. 59*

Assemble differential case into carrier. **(Less ring gear.)** Mount dial indicator with a magnetic base.

Locate its tip on that surface of case & force differential assembly to the extreme in the direction towards the indicator. *Fig. 60*

With force still applied, set indicator to 0.00.

Force differential assembly to the extreme end in opposite direction. *Fig. 61*

Repeat above steps until the same reading is obtained. *Fig. 60*

Record reading in the format given as **'A'.**

Remove master bearing and set aside.

Assemble ring gear to case.

Note: Use new ring gear screws. Torque ring gear screws to specification. *Fig. 62*

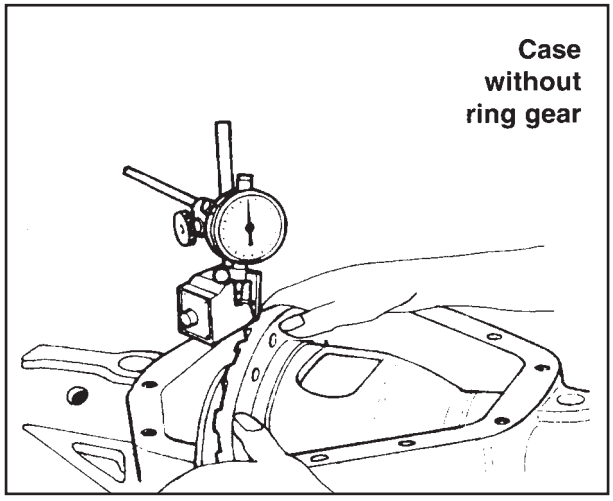


Fig. 60

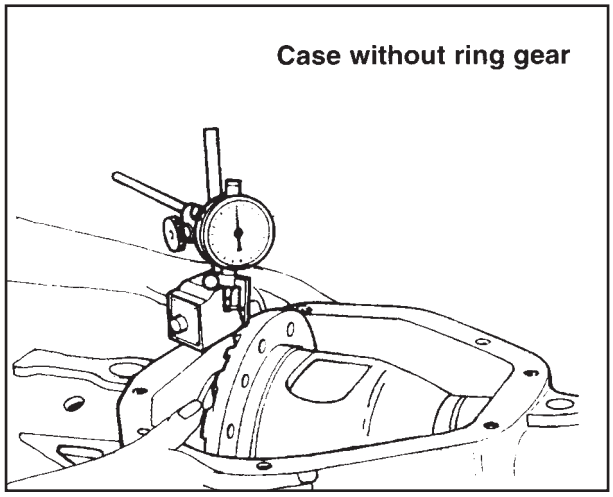


Fig. 61

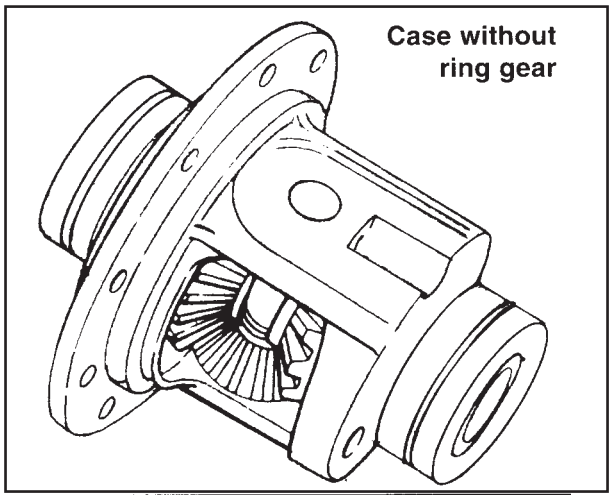


Fig. 59

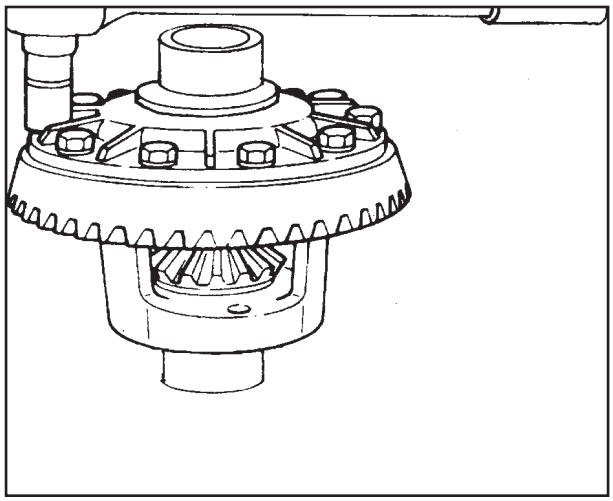


Fig. 62

Assemble master differential bearing Pt. No. 2698 5890 3514 on to case hubs.

Place differential assembly into housing. Install dial gauge and locate tip of indicator on the surface of one of the ring gear screws.

Force differential case assembly away from pinion gear. With force still applied set indicator at 0 (Zero). *Fig. 63*

Force differential case assembly and ring gear to mesh with pinion gear. Fig. 64

Rock ring gear to allow teeth of the gear to mesh Repeat to obtain a stable reading. Record in given format as B. *Fig. 63*

Remove indicator and master differential bearings.

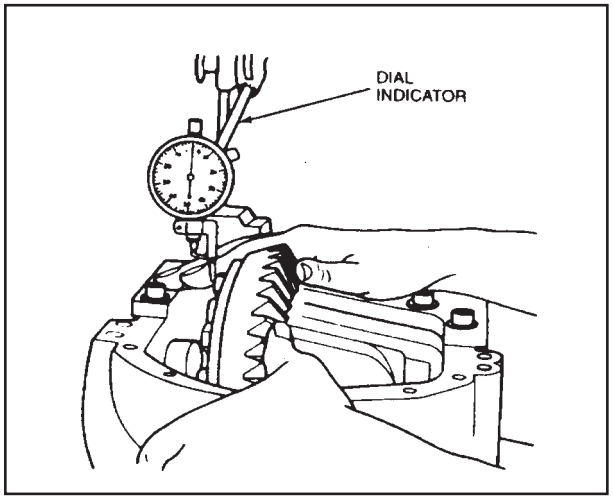


Fig. 63

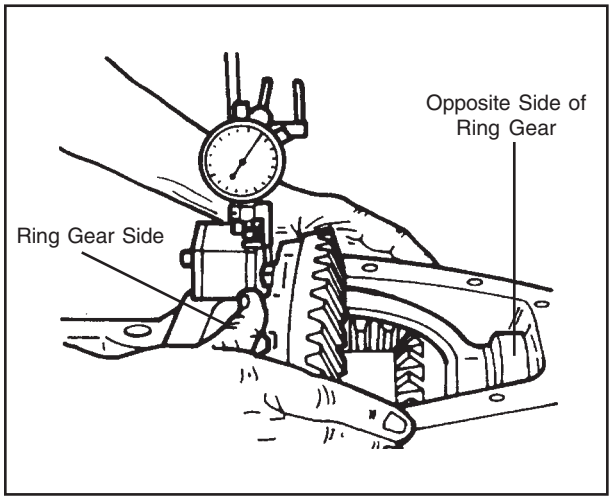


Fig. 64

WORK SHEET FOR CALCULATION OF RING GEAR BACKLASH AND SIDE BEARING PRELOAD SHIMS

1. Total amount of space measured without ring gear. Measurement A _____
2. Total amount of space measured with gear set assembled in carrier. Measurement B _____
3. Measurement A minus Measurement B. Measurement C _____

Assemble shim pack using figures determined in A, B & C. Adjust packs as described below.

RING GEAR SIDE :

Assemble shim pack to measurement **B** - 0.125 mm. or **B** – 0.005"

OPPOSITE SIDE OF RING GEAR :

Assemble shim pack to measurement **C.** Add 0.20 mm or **C**+0.008" for side bearing preload and backlash.

Assemble selected shims pack on hub of differential case. Place side bearing cone above shims. Install bearing cone in its seat using tools given below :

1. Installer differential side bearing Pt. no. 2698 5890 3512
2. Handle Pt. No. 2698 5890 3506. *Fig. 65*

Repeat this procedure for installation of shims/ bearing cone on opposite side of differential case

Install spreader and dial indicator. Spread the carrier. Do not spread it over 0.58 mm. *Fig. 66*

Remove dial indicator.

Install differential case assembly into carrier. Fig. 67

Caution : Carelessness while installing differential case asssembly may result in injury.

Install bearing caps. Fig. 68

Ensure correct fitment of caps by matching letters on caps and carrier on either side.

Torque bearing cap screws to specification.

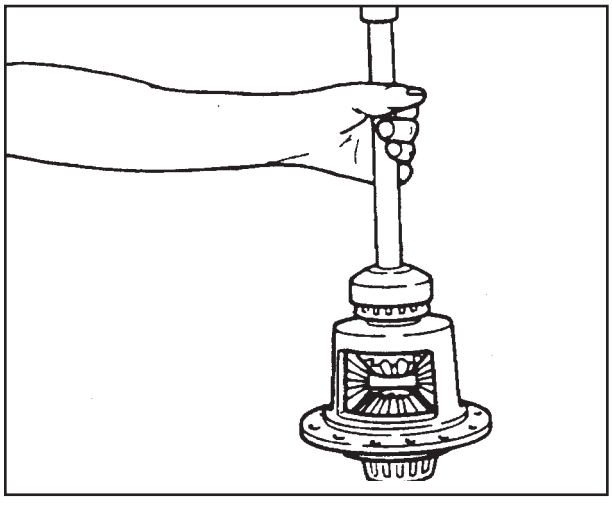


Fig. 65

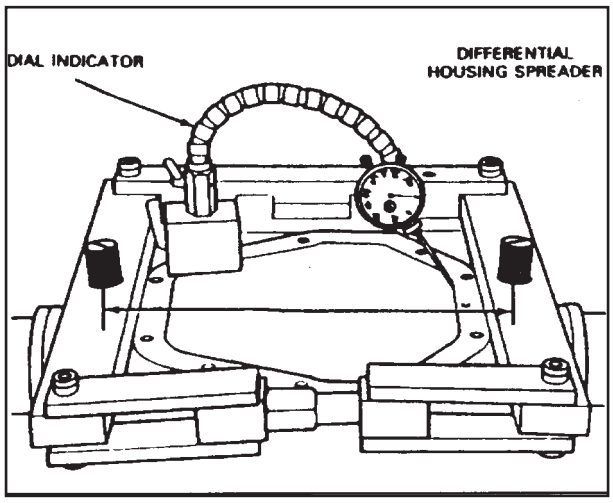


Fig. 66

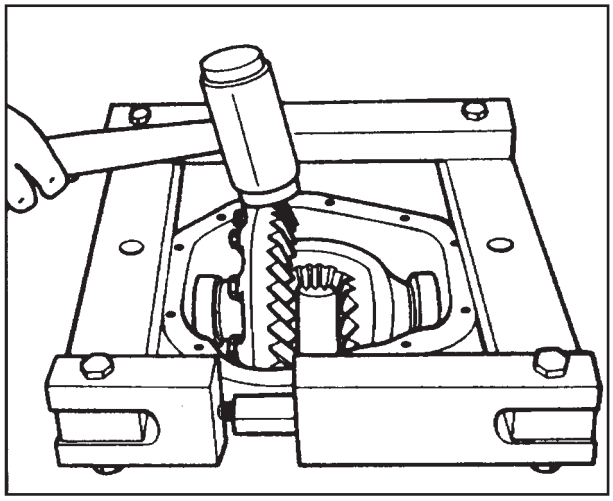


Fig. 67

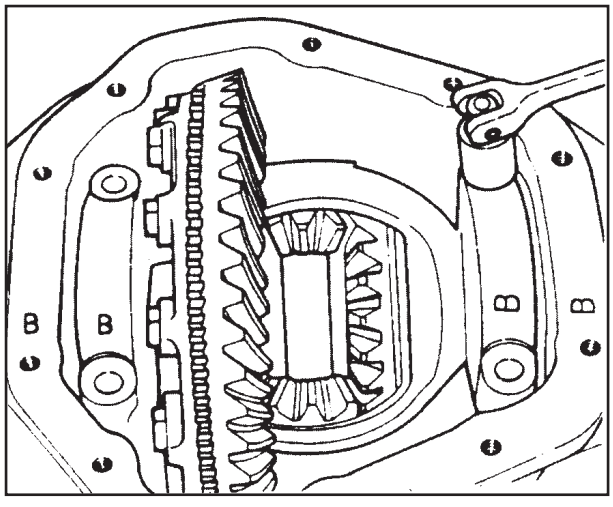


Fig. 68

Check ring gear and pinion backlash at three equally spaced points with dial indicator. *Fig. 69*

Backlash tolerance is 0.13 to 0.20 mm. and should not vary more than 0.08 mm. between the three points checked.

High backlash is corrected by moving ring gear closer to pinion. Low backlash is corrected by moving ring gear away from pinion.

These corrections are made by switching shims from one side of differential case to other.

If backlash is to specification check ring gear and pinion tooth contact pattern.

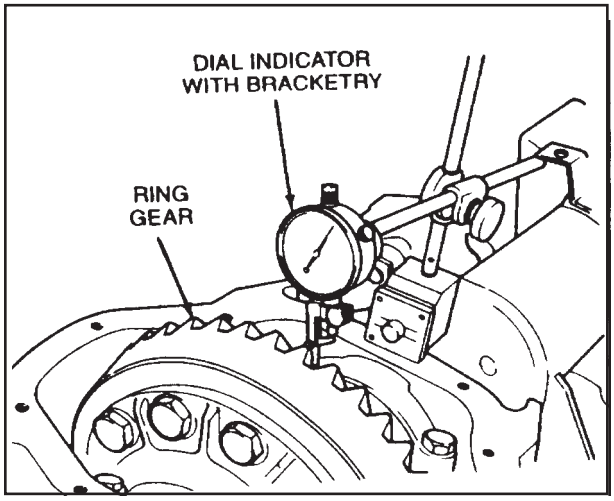


Fig. 69

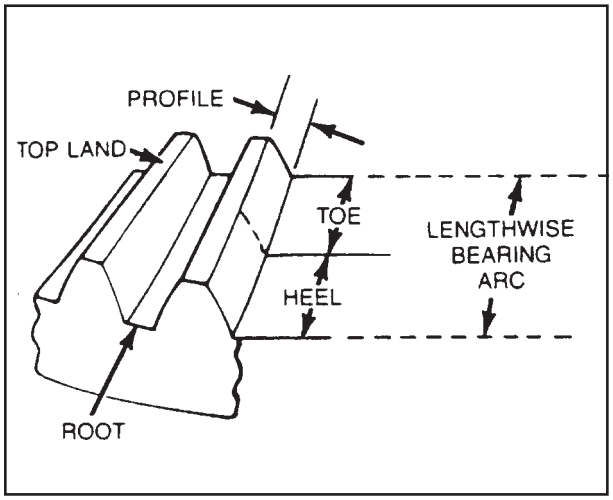


Fig. 70

Note: Making changes involves two variables. Example : if you have the backlash set correctly to specifications and you change the pinion position shim, you may have to readjust the backlash to the correct specification before checking the pattern. Refer to pattern interpretation.

INTERPRETING RING GEAR AND PINION TOOTH PATTERN

Toe of gear tooth is the portion of the tooth surface at the end toward center. Heel of gear tooth is the portion of tooth surface at outer end. Top land of a gear is the surface of top of the tooth. *Fig. 70*

Illustrations explain how contact pattern shift as gear location changes.

When making pinion position changes, shims should be changed in steps of 0.05 mm, until correct pattern has been obtained.

When a change in backlash is required, shims should be changed in the range of 1.5 times the amount of backlash required. For example, if backlash must be changed by .10mm shim pack should be changed by .15mm as a starting point. Actual amount of backlash change obtained will vary, depending upon the ratio and gear size.

Paint right gear teeth with a marking compound on both drive and coast side.

Rotate ring one complete revolution in both directions while applying load with a large screwdriver between carrier casting and differential case flange.

Refer Fig. 71

A. Normal or desirable pattern. Drive pattern should be centered on the tooth. Coast pattern should also be centered on the tooth, but may be slightly towards the toe. There should be some clearance between the pattern and top of the tooth.

B. Backlash correct. Thinner pinion position shim required.

C. Backlash correct. Thicker pinion position shim required.

D. Pinion position shim correct. Decrease backlash.

E. Pinion position shim correct. Increase backlash.

Pattern movements summary

- Decreasing backlash moves the ring gear closer to pinion.

  Drive pattern (convex side of gear) moves slightly lower and toward the toe.

  Coast pattern (concave side of gear) moves lower and toward the toe.

- Increasing backlash moves ring gear away from pinion.

  Drive pattern moves slightly higher and toward the heel.

  Coast pattern moves higher and toward the heel.

- Thicker pinion position shim with backlash constant moves pinion closer to ring gear.

  Drive pattern moves deeper on the tooth and slightly toward the toe.

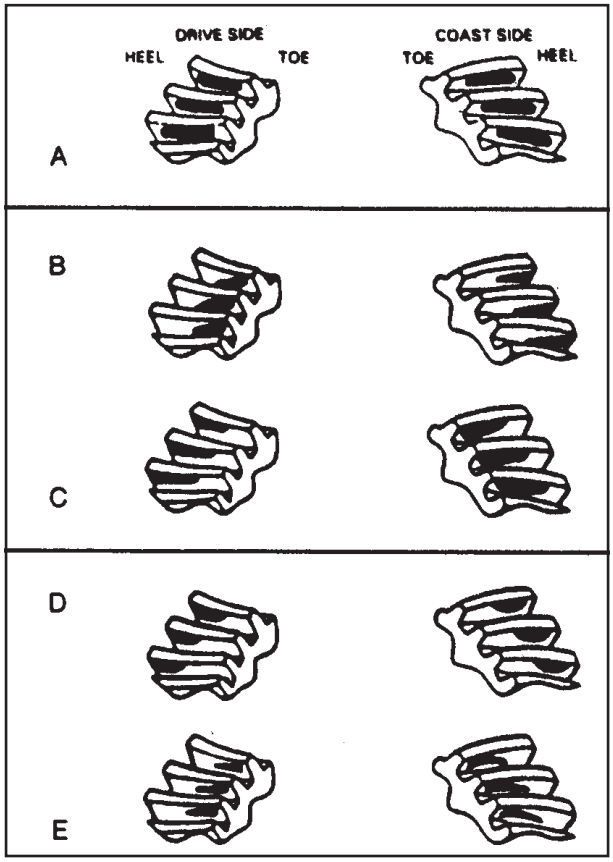


Fig. 71

  Coast pattern moves deeper on the tooth and slightly toward the heel.

- Thinner pinion position shim with the backlash constant moves pinion farther from ring gear.

  Drive pattern moves toward top of the tooth (face contact) and toward heel.

  Coast pattern moves toward top of the tooth and slightly toward toe.

INSTALLING COVER PLATE ON CARRIER

Cover face of the carrier and flat surface of the cover plate must be free of any oil film or foreign material.

Apply sealer to cover place surface. Ensure that sealer bead is on the inside of cover screw holes. *Fig. 72*

Bead must be 3 to 6 mm high and 3 to 6 mm wide.

Install cover screws into cover at 8-'O'clock and 2-'O'clock positions. Use two holes to guide cover plate into position on the carrier.

Install remaining screws. *Fig. 73*

Tighten alternately and evenly. Torque screws to 38-45 Nm.

Allow one hour cure time before vehicle operation.

Measuring Axle end play

With a magnetic stand and dial, locating it on a proper base, make the dial pointer to touch the flange face of axle shaft.

Pull the flange towards you and set dial to zero at this point.

Now Push the flange away from you and mark the dial reading at this point.

This is axle end play reading. This should be within specified values.

Assemble brake drum and put wheels. Tighten wheel nuts to specified torque.

Note : To measure axle end play with axle assembly installed on the vehicle proceed as given below.

Support the vehicle by placing two V-stands under the axle locating it on tubes. Confirm axle is in horizontal plane and vehicle is steady.

Take out wheel and brake drum. Measure end play as above.

Fill specified quantity of oil. Use drive square for drain plug. Pt. no. 2654 5890 3524. to tighten the drain plug to specified torque.

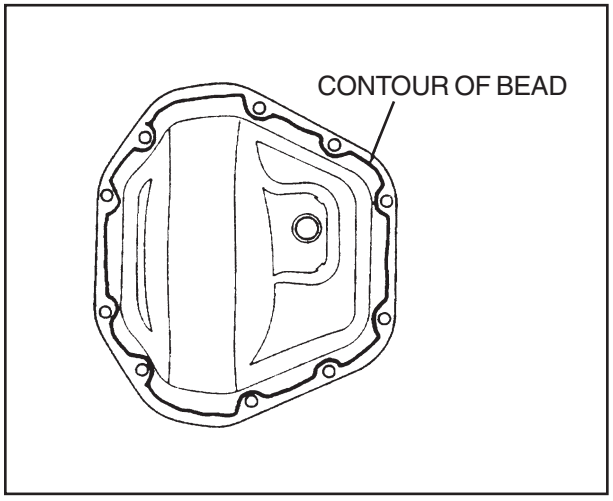


Fig. 72

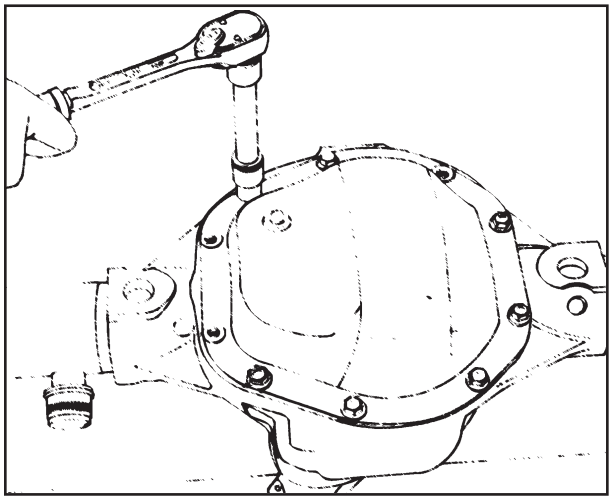


Fig. 73

Installation of axle assembly :

Install the axle in reverse order of steps of removal of axle from vehicle.



TROUBLE SHOOTING - AXLE ASSEMBLY

CONDITION	POSSIBLE CAUSES
Noise in all driving modes	Road and tires, wheel bearings
Noise changes with type of road surface	Road and tires
Noise tone lowers with car speed	Tires
Noise louder on turns	Differential pinion and side gears, axle wheel bearings
Noise in one or more driving modes	Ring and pinion gears
Metallic noise on change of speed or direction of power flow	Worn differential shaft or thrust washers; worn U-joints
Wheel noise	Wheel loose; faulty or bad wheel bearing
Vibration	Damaged drive shaft, missing drive shaft balance weight, worn or out-of-balance wheels, loose wheel nuts, worn U-joints, loose spring U-bolts, loose/broken spring, damaged axle shaft bearings, loose pinion gear nu',, excessive pinion yoke run out, bent axle shaft.
Differential gears scored	Insufficient lubrication, improper grade of lubricant, lubricant contamination, excessive spinning of wheels.
Loss of lubricant	Lubricant level too high, worn axle shaft seals, cracked differential housing, worn drive pinion gear shaft seal, scored and worn yoke, axle cover not properly sealed, plugged vent or vent tube.
Axle overheating	Lubricant level too low, incorrect grade of lubricant, contaminated lubricant, bearing preload too high, excessive gear wear, insufficient ring gear backlash.
Gear teeth broken	Overloading, erratic clutch operating, wheel spinning, improper adjustment
Axle gear noise	Insufficient lubricant, incorrect backlash, improper tooth corrtact worn/damaged gears
Axle noise	Insufficient lubricant, improper ring gear and drive pinion gear adjustment, unmatched ring gear and drive pinion gear, worn teeth on ring gear or drive pinion gear, Loose drive pinion gear shaft bearings, loose differential bearings, misaligned ring and pinion gear, loose differential bearing cap screws, worn bearings.
'Chatter' noise from Limited slip differential while cornering	Probable cause is incorrect or contaminated lubricant or lack of friction modifier additive in lubricant. Worn or damaged bellivelle plates and discs. Otherwise bellivelle plates and discs improperly assembled.

WHEELS & TYRES

INTRODUCTION :

Pneumatic tyres are fitted to provide good ride & handling of the vehicle. A good wheel and tyre assembly ensures that no harsh & bumpy ride is experienced and least rolling resistance is encountered for improving fuel economy.

Wheel rim & Tyre

WHEELS	
1	Tubeless tyre LT 205/80 R16
2	Valve Tr No. 415
3	Assy. Wheel Rim 5.5J x 16
4	Wheel Nut
5	Assy. Wheel Rim cover

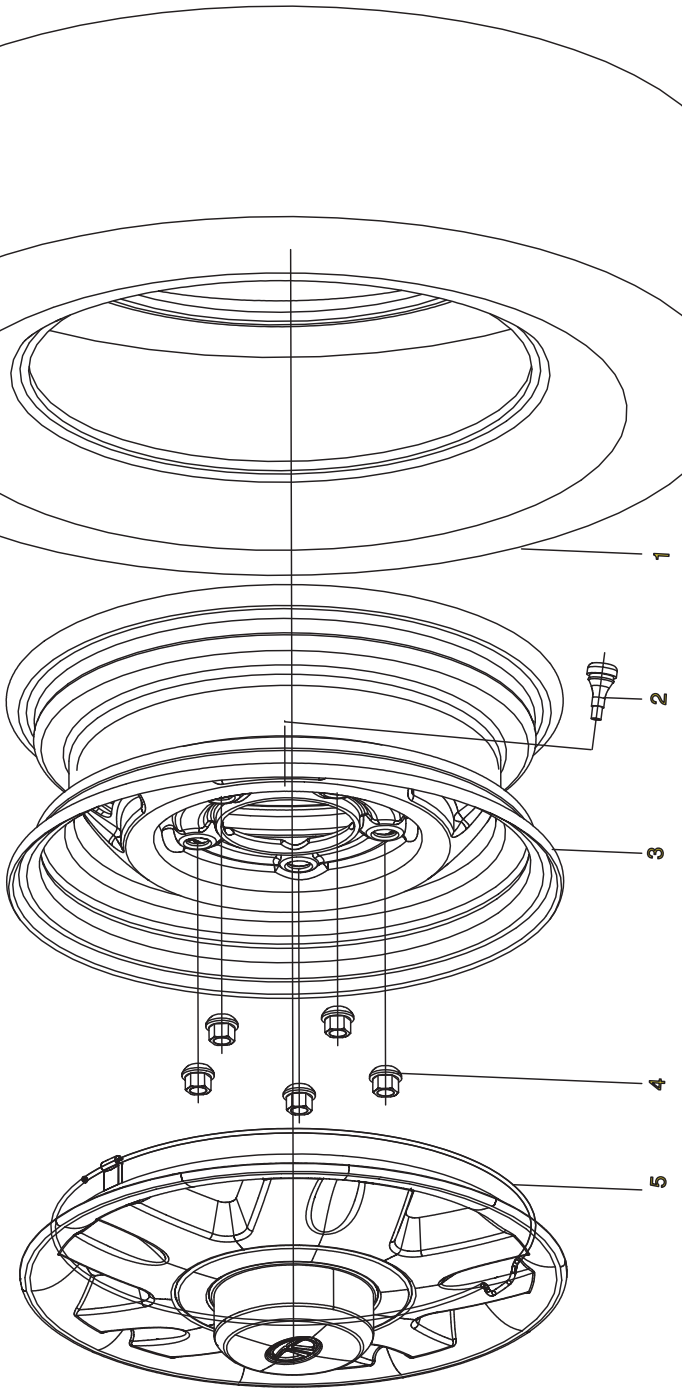


Fig. 1

WHEELS AND TYRES

TYRES :

Vehicle is equipped with 205/80 R16 radial tubeless tyre. Tyre is designed to operate satisfactorily with loads upto full rated load capacity when inflated to recommended inflation pressures. It is important to maintain correct tyre pressures. Heavy cornering, excessively rapid acceleration, and unnecessary sharp braking increases tyre wear.

WHEELS :

Wheel rim size : 5.5 J x 16 Steel.

Advantange of tubeless tyres :

1] Air leakage after puncture is very slow.

2] Better fuel efficiency.

3] Less chance of run-flat damages.

4] No tube related problems.

5] Less balance weight required.

6] Easy repairing.

Special care for tubeless tyre :

1) Do not stand over tyre when inflating. Bead may break when bead snaps over rim's safety hump and cause serious personal injury.

2) Do not exceed specified pressure when inflating. If specified pressure will not seat beads, deflate, re-lubricate and reinflate.

3) While removing tyre from wheel rim and mounting it back on wheel rim, take precautions not to damage tyre bead. Use tyre removal and assembly machines. Damage or cut on tyre bead may cause gradual loss of air and deflation of tyre.

4) Do not scratch inside of tubeless tyre with metallic or sharp object. Tubeless tyres are coated with impermeable layer of rubber from inside which hold the air inside tyre. Removal of this layer due to scratching may cause gradual loss of air and deflation.

5) If wheel rims get damaged in service, get the wheel rims repaired/replaced immdiately. Running the vehicle with damaged rim my cause deflation of tyre and subsequent disloging of tyre from rim.

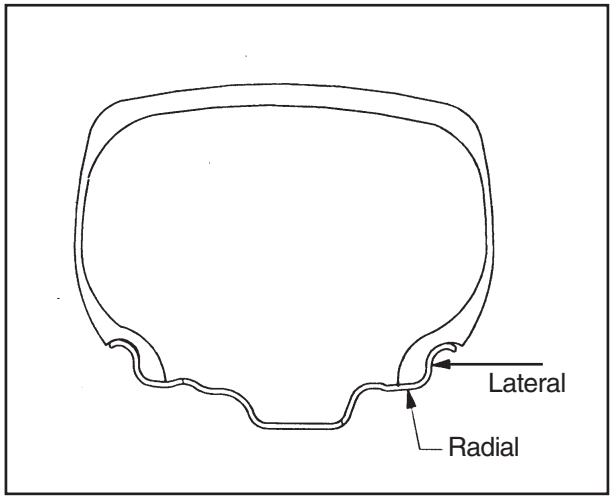


Fig. 2

6) Maintain recommended inflation pressures in tyre. Over in flation, in particular, may cause puncture or bursting of tyre.

Replacement Tyres :

When replacement is necessary, tyre recommended only should be used. Replacement tyres should be of the same size, load rating and construction as those originally on the vehicle. Use of any other size or type tyre may affect ride, handling, speedometer/ odometer calibration, vehicle ground clearance and tyre clearance to the chassis.

It is recommended that new tyres be installed in pairs on same axle. If necessary to replace only one tyre, it should be paired with the tyre having the most tread, to equalize braking traction.

Also, do not mix different types of tyres (viz. radial, bias etc) on the same vehicle, because it badly affects the handling of the vehicle. Tyre pressures is usually printed on sticker, stuck on driver side door.

Replacement of wheels :

Wheels must be replaced if they are bent, dented, have excessive lateral or radial runout, air leak through welds, have elongated bolt holes, if lug nuts won't stay tight, or if they are heavily rusted. Wheels with greater runout than specification may cause vibrations.

Replacement wheels must be equivalent to the OE wheels in load capacity, diameter, rim offset and mounting configuration.

A wheel of improper size or type may affect wheel and bearing life, brake cooling, speedometer/odometer calibration, vehicle ground clearance and tyre clearance to body and chassis.

How to measure wheel runout :

Wheel runout has to be measured by installing it in a wheel balancer & using a dial indicator. Wheel runout can be checked in tyre installed condition.

Take measurements of lateral & radial runouts at inside/ outside of rim flange. Turn wheel one full revolution slowly and record maximum reading of the indicator. (Fig.2)

Both lateral & radial runout should not exceed 1.5 mm.

When runout exceeds the specification and correction by balancer adjustment is not possible, replace wheel.

Matched tyres and wheels :

Tyres are match mounted by us at Works. Radially least stiff part of the tyre or "low spot" marked yellow on side wall of tyre is matched to the valve location of assembly.

This is done to provide smoothest possible ride by reducing assembly imbalance.

Whenever a tyre is dismounted from wheel, it should be remounted so that the tyre paint dot & valve location are matched. If the tyre's paint dot can not be located, a line should be marked on the tyre and wheel before dismounting to assure that it is remounted in the same position.

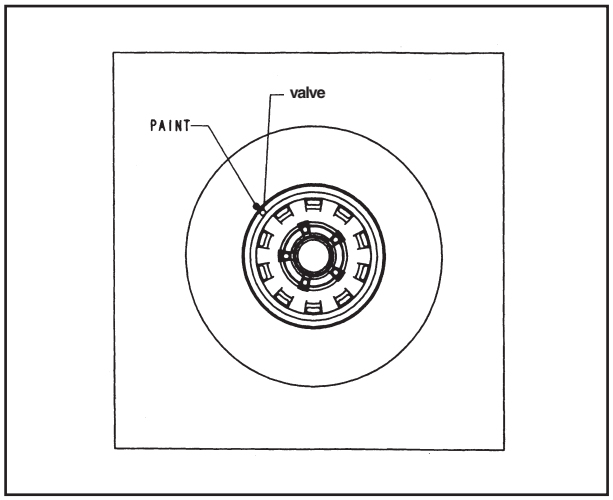


Fig. 3

Inflation of Tyres :

Recommended tyre pressure is carefully calculated to give a satisfactory ride, stability, steering tread wear, tyre life and resistance to bruises.

Tyre pressure, with tyres cold, (after vehicle set for three hours or more, or driven less than one mile) should be checked monthly or before any extended trip.

It is normal for tyre pressure to increase (4 psi approx.) when the tyres become hot during driving. Do not bleed or reduce tyre pressure after driving. Bleeding reduces the “Cold Inflation Pressure”.

Valve caps should be on the valves to keep dust and water out.

Higher than recommended pressure can cause :

1. Hard ride
2. Tyre brushing or carcass damage
3. Rapid tread wear at center of tyre

Unequal pressure on same axle can cause :

1. Uneven braking
2. Steering pull
3. Bad handling

Lower than recommended pressure can cause :

1. Tyre squeal on turns.
2. Hard steering
3. Rapid and uneven wear on the edges of the tread
4. Tyre rim bruises and rupture
5. Tyre chord breakage
6. High tyre temperature
7. Bad handling
8. High fuel consumption

Tyre Rotation :

To equalize wear, rotate tyres according to figure No.4 periodically. Set tyre pressure.

NOTE :

Due to their design, radial tyres tend to wear faster in the shoulder area, particularly in front positions. This makes regular rotation necessary.

Wheel Removal :

1. Loosen all wheel nuts (M14 x 1.5) by approximately 180 deg. (half a rotation).
2. Hoist vehicle
3. Remove nuts and then wheel

Wheel nuts must be tightened in sequence given in figure and to proper torque to avoid bending wheel or brake disc. (Figure 5)

NOTE :

Clean all parts and remove any build up of corrosion any parts, before installation of the wheel.

Never heat any part to loosen tight wheel, it will shorten life of wheel and bearings.

Tightening Torque :180 Nm - 195 Nm (18-19.5 kgm)

Tyre Mounting and Demounting :

Use a tyre changing machine to mount or demount tyres. Follow equipment manufacturer's instructions. Do not use hand tools or tyre irons alone to change tyres as they may damage tyre beads or wheel rim.

Rim bead seats should be cleaned with a wire brush or coarse steel wool to remove lubricants, old rubber and light rust.

After mounting, inflate to specified pressure so that beads are completely seated.

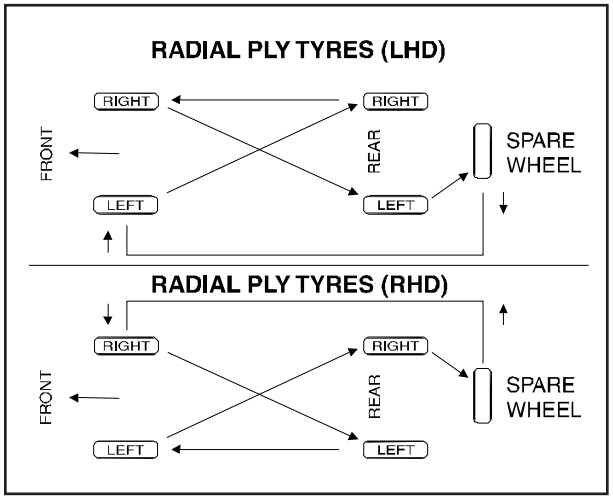


Fig. 4

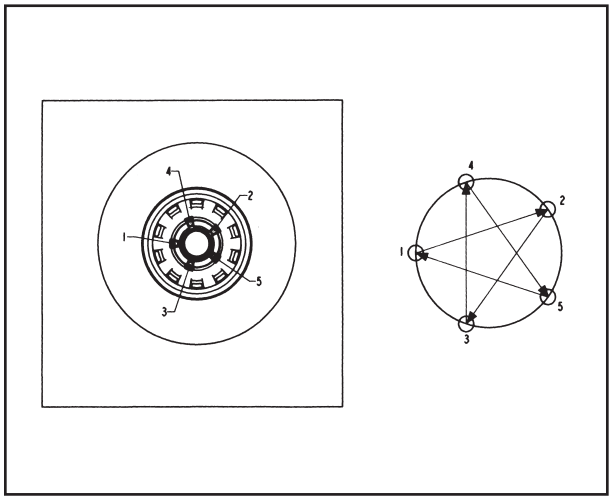


Fig. 5

SPARE WHEEL CARRIER

SR. NO	DESCRIPTION
1	ASSY. TUBE
2	RUBBER BUSH
3	CLAMP
4	HEX SCREW M8 X 20
5	SPRING WASHER B8
6	HEX NUT M8
7	SCREW WITH NYLON INSERT
8	BRIGHT WASHER 10.5
9	ASSY. SUPPORT (SPARE WHEEL MTG),
10	PLASTIC BUSH
11	SPH. WASHER 13
12	SPRING WASHER 13
13	HEX. BOLT
14	PIN
15	DISC SPRING B25
16	SPACER
17	NYLOC NUT M10
18	ASSY CLAMP
19	HEX. SCREW

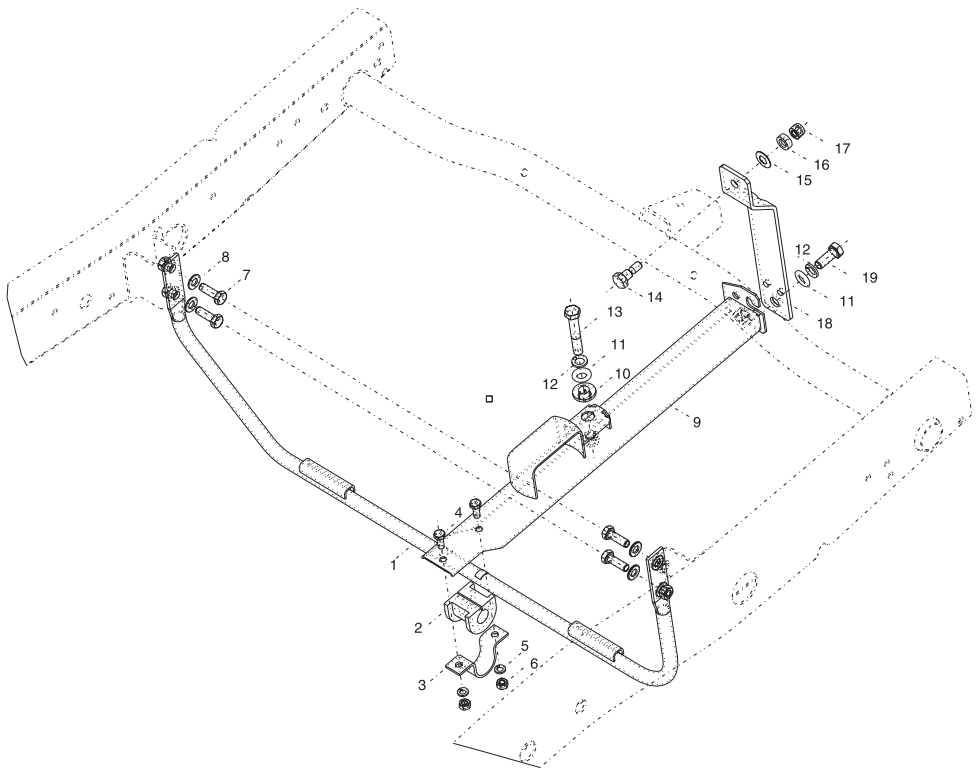


Fig. 6

Removal of Spare Wheel

1) For removing spare wheel, unscrew the Hex screw which is holding the clamp (18) and spare wheel support bracket (9).

2) Holding the spare wheel support bracket & spare wheel with one hand, rotate the clamp by approx. 45^0 with other hand in clockwise direction (when viewed from rear of vehicle).

3) Holding the clamp in rotated position, gradually lower the spare wheel support bracket along with spare wheel. Lower till spare wheel touches the ground.

4) Unscrew the Hex bolt and fasteners (10 to 13) which clamp the wheel rim on spare wheel support bracket.

5) Lift the spare wheel and take it out from spare wheel support bracket.

Assembly of spare wheel

Assembly of spare wheel is in reverse order of removal.

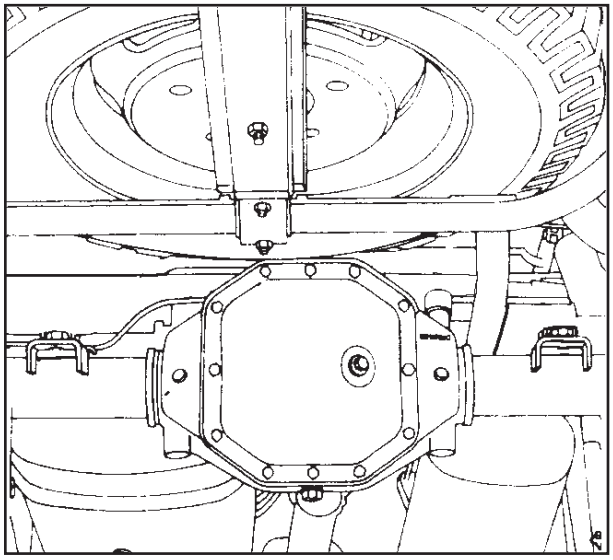


Fig. 7

Balancing Wheels :

Dynamic balance, as shown in Fig. 8, is the equal distribution of weight of each side of the wheel center line so that when the tyre spins there is no tendency for the assembly to move from side to side. Wheels that are dynamically unbalanced may cause shimmy.

1. Permissible imbalance for tyre with rim = 250 gm-cm max.
2. Total balance weight should be within 140 gms on each side.
3. Relocate the tyre if the weight required to balance is more than 140 gm.
4. Balance weights are available from 10 gms to 140 gms in steps of every 10 gms and from 15 gms to 135 gms in steps of every 10 gms.
5. Do not use more than one balance weight on one side.

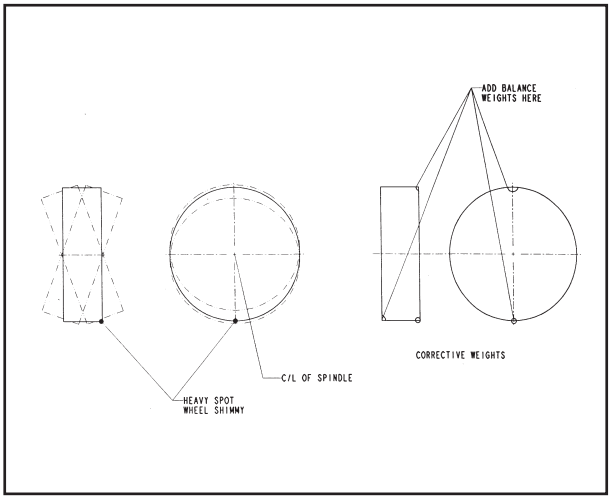


Fig. 8

General Balance Procedures :

Deposits of mud, etc. must be cleaned from inside of rim.

Warning :

Remove stones from tread, clean the tyre and rim before balancing for safety & to achieve better results.

Each tyre should be inspected for any damage, then balanced according to equipment manufacturer's recommendation.

Off-Vehicle Balancing :

Most electronic off-vehicle balancers are more accurate than the on-vehicle spin balancers. They are easy to use and give a dynamic (two plane) balance. Although they do not correct for drum or disc unbalance as does on vehicle spin balancing, this is overcome by their accuracy.

TROUBLE SHOOTING CHART - TUBELESS TYRES



Wear on the outer edges.

Possible cause - Under-inflated tyres. If the tyre is under-inflated the outer edges (shoulders) of the tyre will be the main part that is in contact with the road.



Feathered treads (easier to feel than see)

Possible cause - Wheel alignment out.



Wear on the centre section of the tyre.

Possible cause - Over-inflated tyres.

If the tyre is over-inflated the tyre will bulge in the middle with the centre section of the tyre being the main part in contact with the road.



Irregular bald spots

Possible cause - Unbalanced tyre.



Wear on one side of the tread

Possible cause - Wheel alignment is out.



Cupped depressions

Possible cause - Worn shock absorbers or unbalanced braking system.



Steering Wobble

If you are experiencing any form of steering wheel "wobble" or driving disturbances, it could be that your tyre & wheel assembly need balanced.

Wheel Balancing

Steering "wobble" is usually caused by a tyre not being "balanced". Most tyre & wheel assembly require a balance weight to be attached to them when tyres are fitted and these may fall off over time.

PROPELLER SHAFT

INTRODUCTION :

The propeller shaft used is a Quick Disconnect Half Round End Yoke type.

It has a torque carrying capacity of 2000 Nm and a maximum operating speed of 6000 rpm.

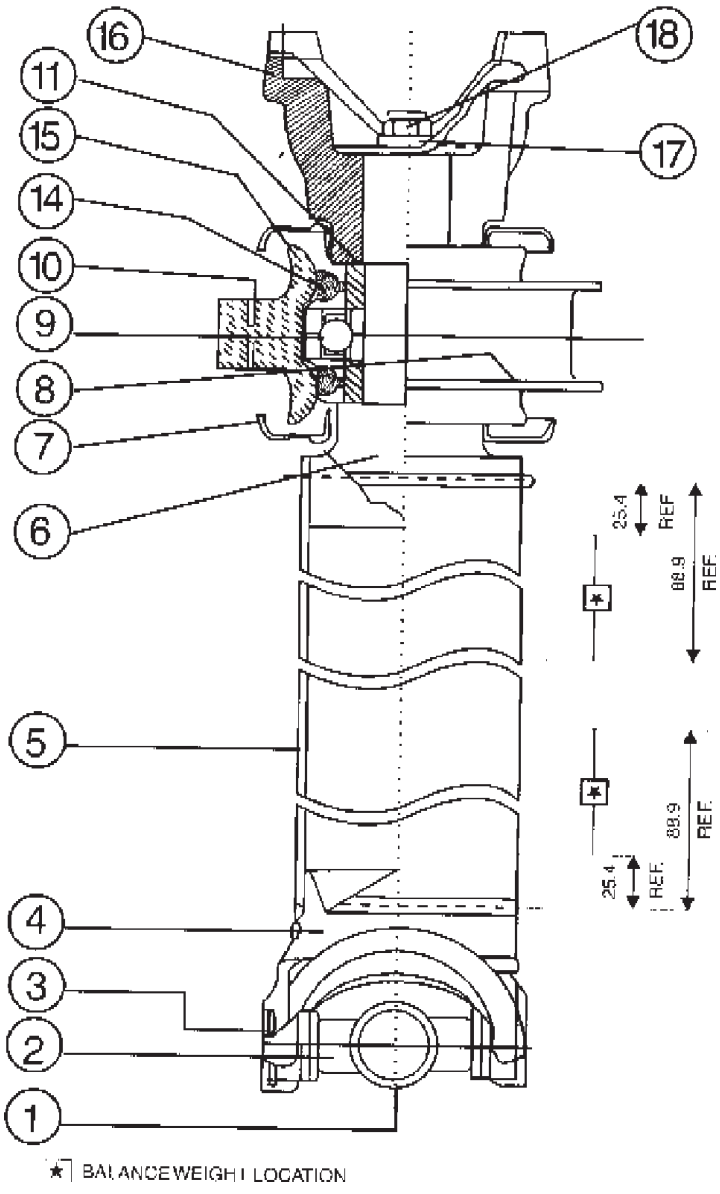
The cross and bearing in universal joint as well as the shaft support (centre) bearing are lubricated for life.

There are no lube fittings.

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CONSTRUCTION



SR. NO.	DESCRIPTION
1.	CUP ASSY.
2.	CROSS
3.	CIRCLIP
4.	TUBE YOKE
5.	TUBE
6.	MIDSHIP TUBE SHAFT
7.	SLINGER
8.	BRACKET
9.	BEARING
10.	RUBBER BEARING
11.	SPACER
12.	RETAINER
13.	CLAMP
14.	DUST SEAL
15.	DUST SEAL RETAINER
16.	INT. END YOKE
17.	WASHER
18.	NUT

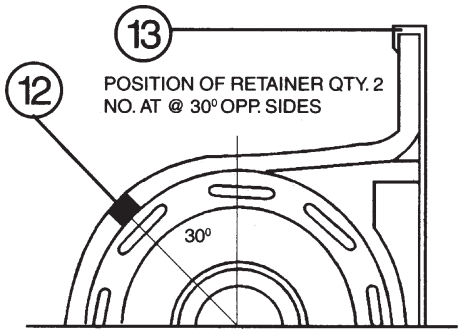


Fig. 1 4 x 2 Front propeller shaft

CONSTRUCTION

SR. NO.	DESCRIPTION
1.	CUP ASSY.
2.	U-J CROSS ASSY.
3.	CIRCLIP
4.	SLIP YOKE
5.	DUST CAP ASSY
6.	TUBE SHAFT
7.	TUBE
8.	TUBE YOKE

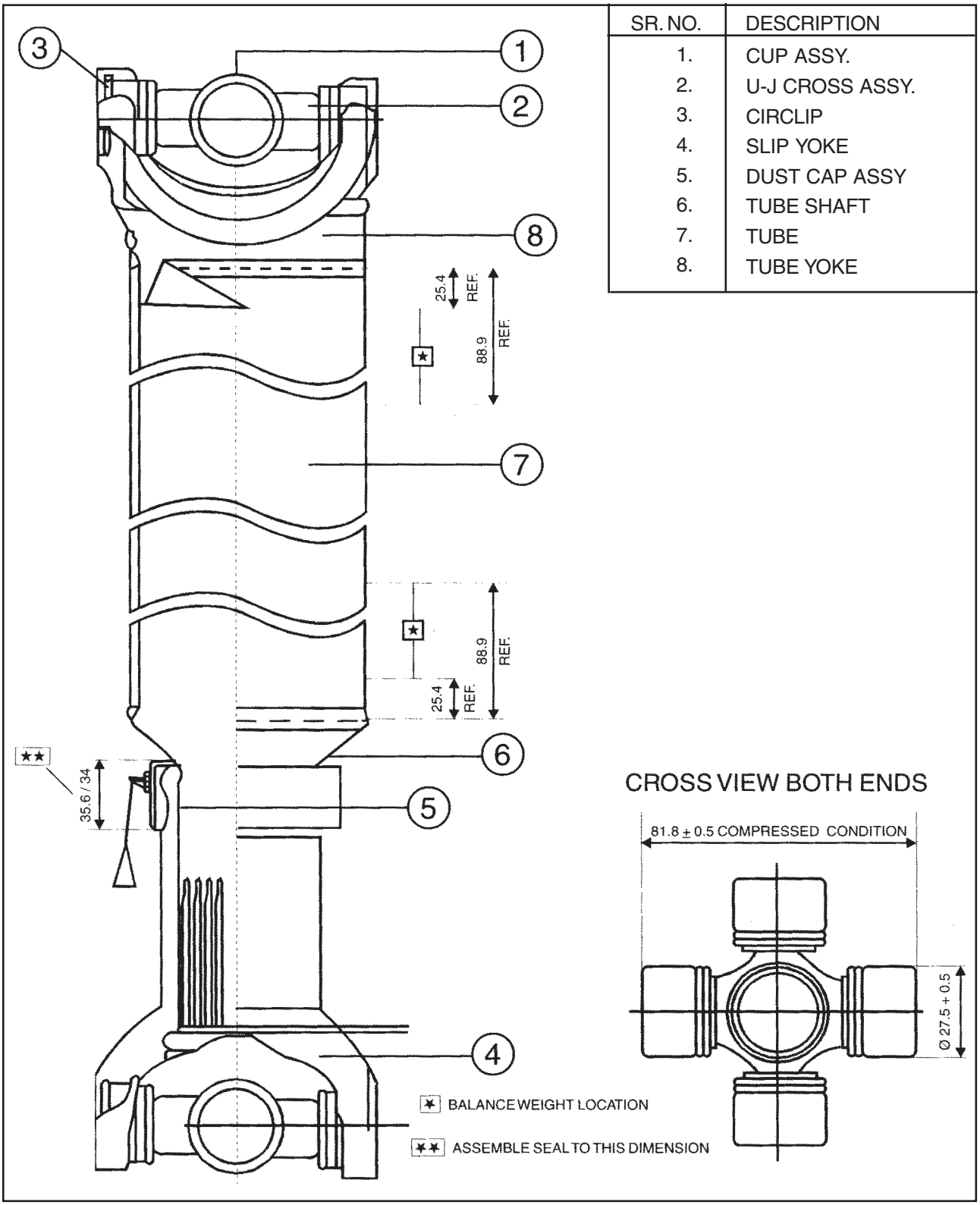


Fig. 2 4 x 2 Rear Propeller Shaft



LIST OF SPECIAL TOOLS

Sr. No.	Description	Part No.
1.	Holder for coupling yoke	2698 5890 35 05 or 2698 5890 41 02
2.	Puller for center bearing	312 589 25 33
3.	Socket for end yoke nut.	2698 5890 41 01

SERVICE DATA

Tightening Torque :

End Yoke nut	14-16 mkg
Bearing strap retaining bolt	1.8 - 2.2 mkg.

Adjustment Data :

Maximum permissible displacement in lateral axial direction under load of 3.3 kgm.	0.15 mm.
Maximum permissible radial or axial looseness between the slip yoke & tube shaft	0.18 mm.
Maximum Permissible dynamic unbalance	18 gm cm at 3200 rpm.
Total Indicator Reading of Maximum permissible ovality	0.25 mm.
Runout to be measured within 12.7 mm of tube length centre and within 80 mm of tube-weld location at both ends	0.76 mm
Grease splines at the intervals.	10,000 km. / 6,000 miles

Use :

W/NLGI 2 - Grade grease for slip spline

REMOVAL FROM VEHICLE

Note : Before removal of the driveshaft set the brakes, block the wheels, and mark the slip yoke assembly and tube shaft with a marking stick or paint to assure prope r alignment when reassembled. This is known as keeping the driveshaft yokes “in Phase”.

Unscrew bearing strap retaining bolts at pinion yoke.

Unscrew bearing strap retaining bolts of the rear shaft, at centre bearing joint for 4x2 vehicle & at transfer case for 4x4 vehicle. Disconnect & remove rear propeller shaft. Fig. 2.

Carefully place the propeller shaft on a work table.

For 4x2, Unscrew nuts to remove centre bearing bracket from cross member & unscrew bearing strap bolts at the gear box, to disconnect front propeller shaft.

For 4x4, Unscrew bearing strap bolts at the front axle tail pinion end yoke & transfer case end yoke and Disconnect front propeller shaft.

Unscrew end yoke mounting nut by holding the yoke with holder Pt. no. 2698 5890 3505 or Pt. no. 2698 5890 4102 and using socket Pt. no. 2698 5890 4101 at gear box or at the transfer case.

Unscrew end yoke mounting nut at tail pinion by holding yoke with the same holder as above and using a suitable socket. Fig. 3

Place all parts on work table.

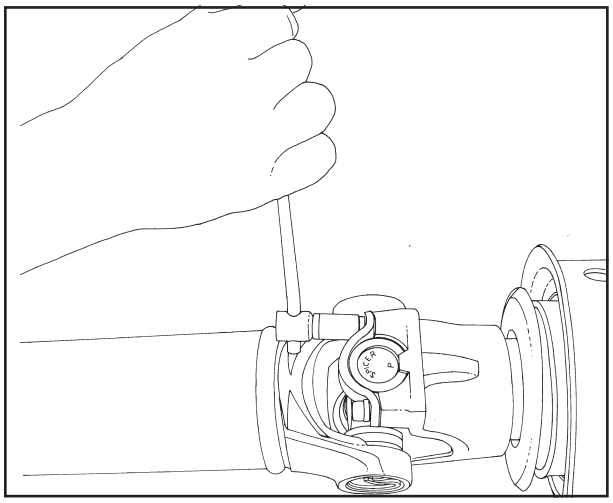


Fig. 3

To remove the old seal, hold the yoke assembly firmly in a vise. Using a large chisel, drive the seal off the yoke.

FOR 4x2

Disassembly of Centre Bearing. Refer fig.1.

Mount holder Pt. no. 2698 5890 35 05 or 2698 5890 41 02 on end yoke. Grip the holder in vice. Unscrew and remove end yoke mounting nut with socket. Pt. no. 2698 5890 41 01.

Remove holder.

DISASSEMBLY

Note : The unitized one piece seal used on Spicer driveshafts is not intended to be removed in service. To separate the tube shaft from the slip yoke, pull the tube out of the slip yoke, leaving the seal in place.

A significant amount of force is required to remove as well as reinstall the tube shaft through the seal.

Removal of the unitized seal causes damage to the seal lip where it contacts the slip yoke.

Pull out end yoke. *Fig.4*

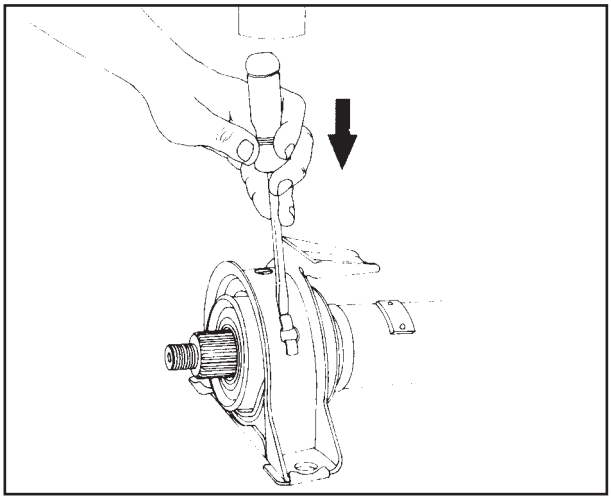


Fig. 5

Unstake clamping strap and remove centre bearing bracket. *Fig.5*

Slide off rubber housing from centre bearing assembly.

Remove rear spacer ring.

With puller Pt. No. 312 589 25 33 pull out centre bearing assembly from propeller shaft. *Fig. 6*

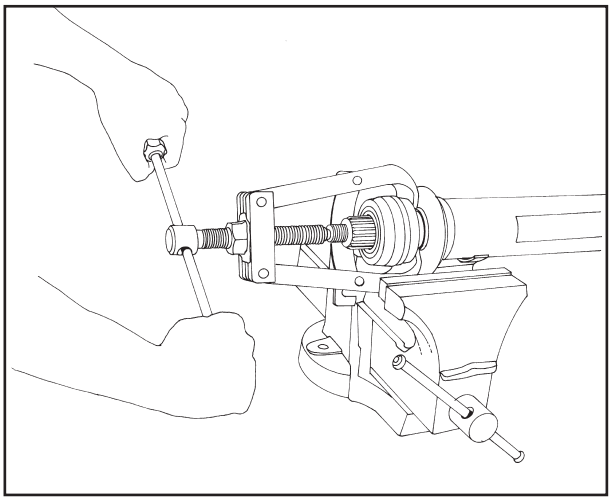


Fig. 6

Remove front spacer ring.

DISASSEMBLY OF UNIVERSAL JOINT :

Using a soft drift, tap the outside of the bearing assembly to loosen snap ring. Tap bearing only hard enough to break assembly away from snap ring. Fig. 7

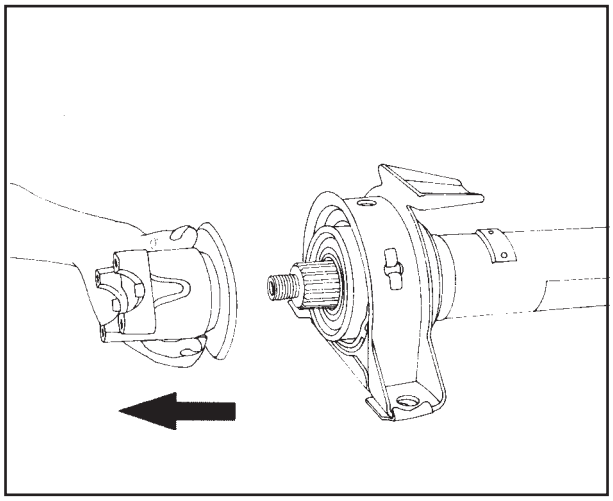


Fig. 4

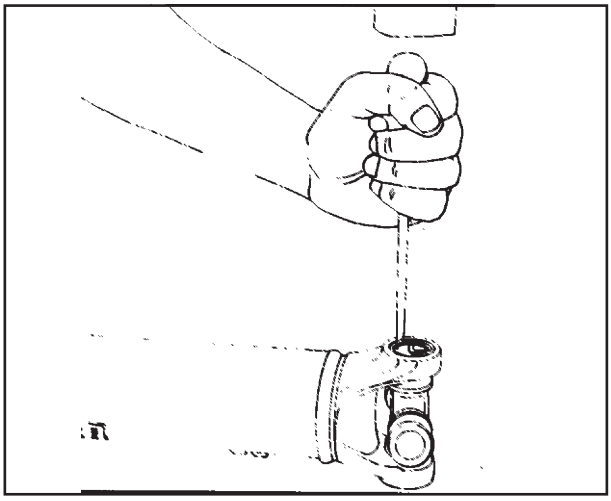


Fig. 7

Remove snap ring from yoke. Turn joint over, tap bearing away from snap ring, then remove opposite snap ring. *Fig. 8*

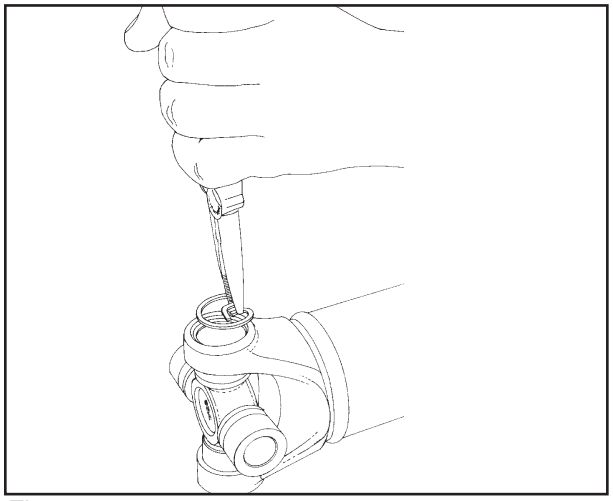


Fig. 8

Set the yoke in the arbor press with a piece of tube stock beneath it. Position the yoke with the tube fitting bearing up to prevent interference during disassembly. Place a solid plug on the upper bearing assembly and press it through to release the lower bearing assembly. Fig. 9

If the bearing assembly will not pull out by hand after pressing, tap the base of the lug near the bearing assembly to dislodge it.

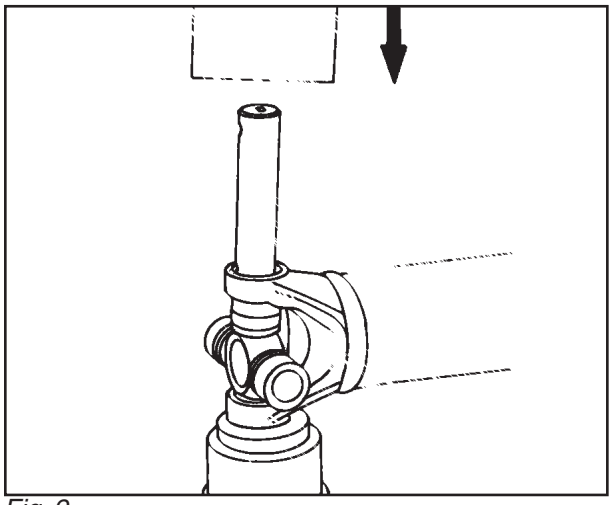


Fig. 9

To remove the opposite bearing assembly, turn the yoke over and straighten the cross in the open cross hole. Then carefully press on the end of the cross so the remaining bearing assembly moves straight out of the bearing cross hole. *Fig. 10*

Repeat this procedure on the remaining bearing assemblies to remove the cross from the yoke.

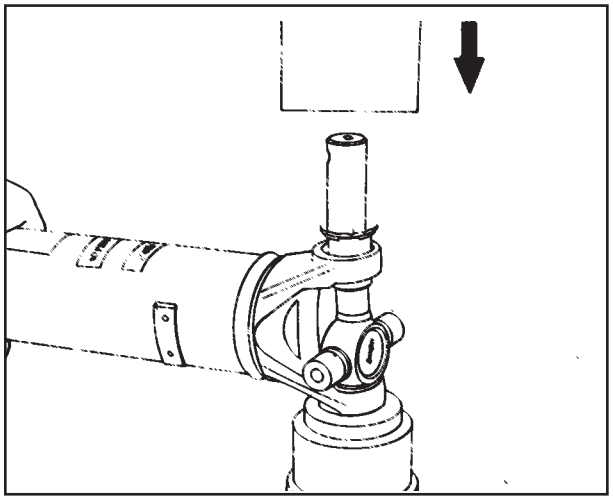


Fig. 10

INSPECTION

Check the output and input end yokes for looseness. If loose, disconnect the drive shaft and re-torque the end yoke retaining nut to specification, using a new nut. *Fig.11*

Check condition of the spline of end yoke.

Check the U. J. cross for defects like Brineiling and End Galling. *Fig. 12*

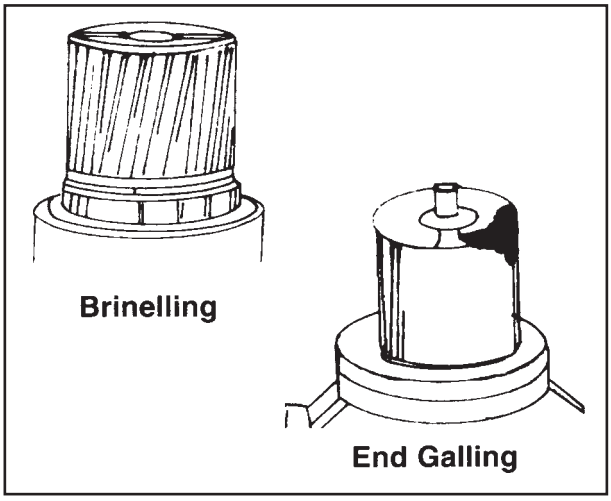


Fig. 12

Check for excessive looseness across the ends of the bearing assemblies and trunnions. This looseness should not exceed 0.15 mm maximum. *Fig. 13*

If necessary, replace U. J. cross.

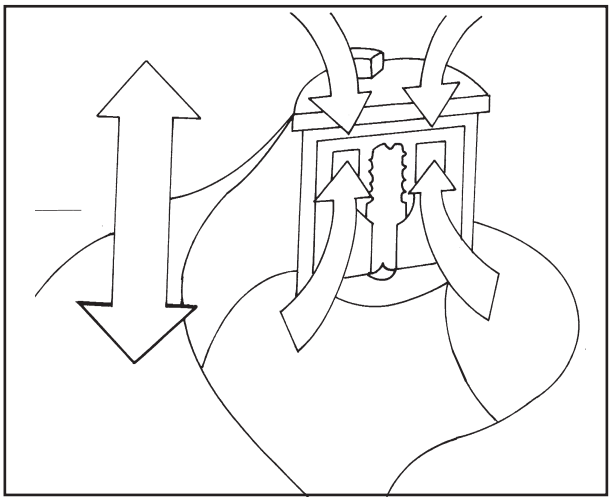


Fig. 13

Check the slip spline for excessive radial movement. Radial looseness between the slip yoke and the tube shaft should not exceed 0.15 mm. *Fig. 14*

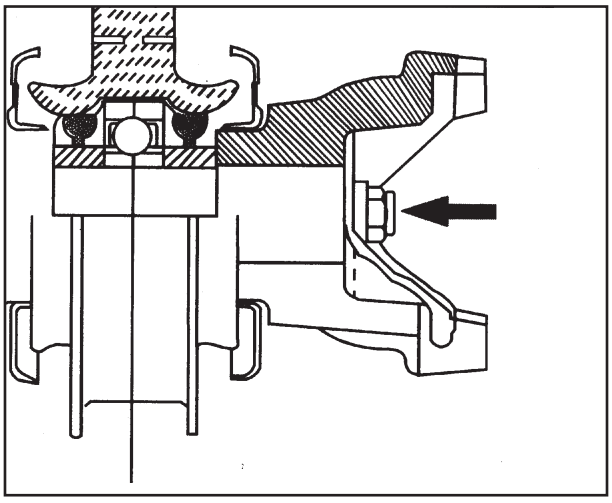


Fig. 11

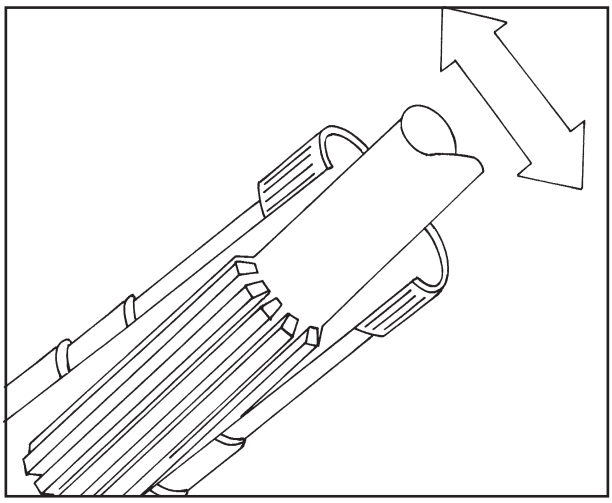


Fig. 14

Check the shaft for damage, bent tubing or missing balance weights. Make certain there is no build up of foreign material on the shaft such as undercoat or concrete. If found, remove it carefully to avoid damage to the drive shaft. If shaft is found bent, straighten it. *Fig.15*

Check for runout. Check tube for ovality.

Remove the end yoke from the drive shaft and place in a soft jawed vise to inspect the cross hole surfaces. Raised metal can be removed with a rat tail or half round file. Emery cloth should be used to remove all rust and corrosion from cross hole bores. *Fig. 16*

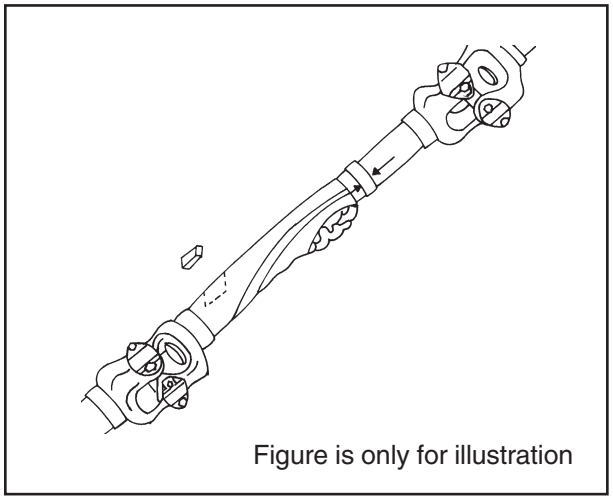


Fig. 15

Runout readings are taken with the drive shaft mounted in the vehicle with the transmission in neutral and the axle shafts pulled or by jacking rear wheels off the ground and placing axles on jack stands. This will allow rotating the drive shaft by hand to check indicator readings. The runout readings taken at the various locations should not exceed an additional 0.25 mm. Total Indicator Reading over the specified runout. *Fig. 17*

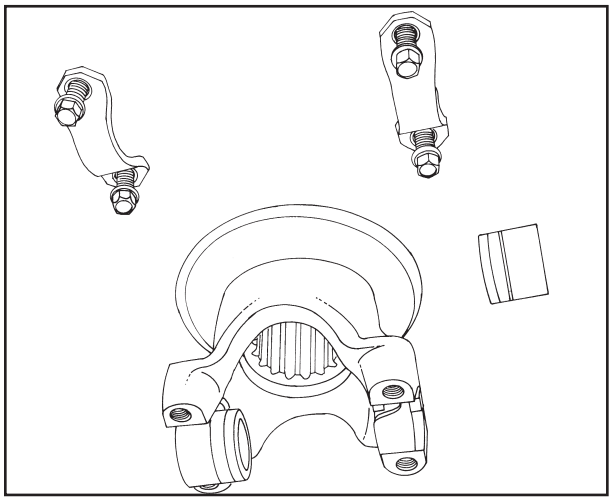


Fig. 16

INSPECTION OF CENTRE BEARING

Clean all parts thoroughly.

Note : *Do not apply solvent in bearing assembly and rubber housing.*

Check the following :

Condition of splines and threads on shaft.

Condition of splines and holes on coupling flange.

Condition of rubber housing. Replace with new one if necessary.

Condition of centre bearing bracket bearing surface and mounting holes.

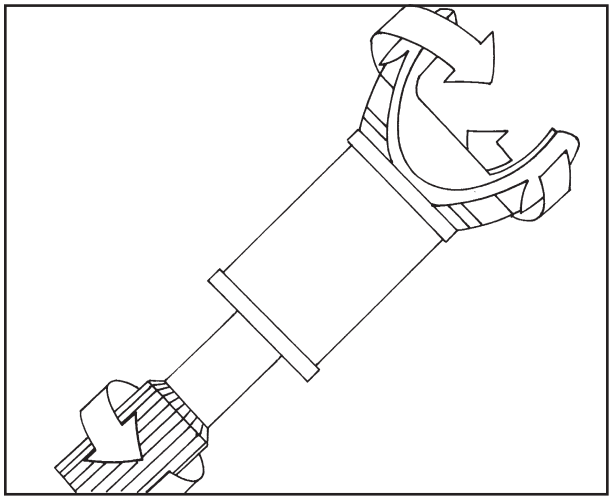


Fig. 17

Condition of clamping strap for any damage specially at crimping portion.

Free and smooth rotation of bearing unit in centre bearing assembly.

The bearing should have negligible radial play.

Condition of dust seals in centre bearing assembly.

If any of the above defects are noticed in the centre bearing assembly, complete centre bearing assembly should be replaced.

Condition of dust caps on propeller shaft and coupling flange. These are tack welded to respective components.

Check both spacer rings for wear score marks. If found defective replace with NEW one.

Replace defective parts.

LUBRICATION

PRELUBE OR LUBE FOR LIFE DESIGNS

Universal joint crosses and bearings are prelube or lube for life designs and have no lube fittings. Special seals are used to contain the lubricant in the cross bearings in this design. *Fig.18*

Replacement of the cross and bearing kit is recommended rather than relubrication.

LUBRICATION FOR SLIP SPLINES

Apply grease gun pressure to the tube fitting until lubricant appears at the pressure relief hole in the plug at the slip yoke end of the spline. *Fig.19*

Now cover the pressure relief hole with your finger and continue to apply pressure until grease appears at the slip yoke seal. *Fig.20*

Caution : In cold temperatures be sure to drive the vehicle immediately after lubricating. This activates the slip spline and removes the excessive lubricant. Failure to do so could cause the excess lubricant to stiffen in the cold weather and force the plug out. The end of the spline would then be open to collect contaminants and cause the spline to wear and/or seize.

LUBE FOR LIFE CENTRE BEARING :

Centre bearing is packed with grease for life. No filling of bearing with grease is recommended.

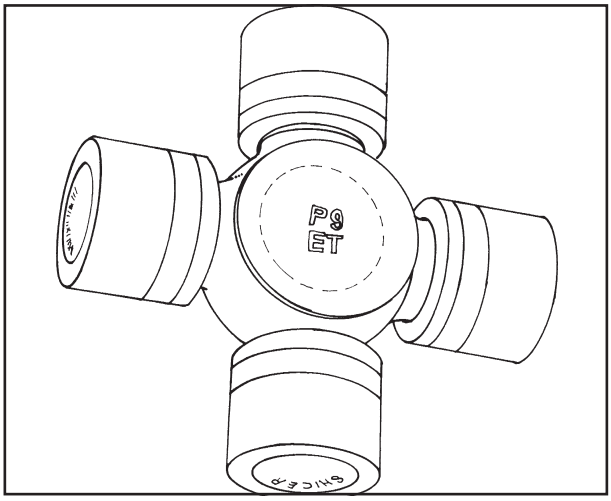


Fig. 18

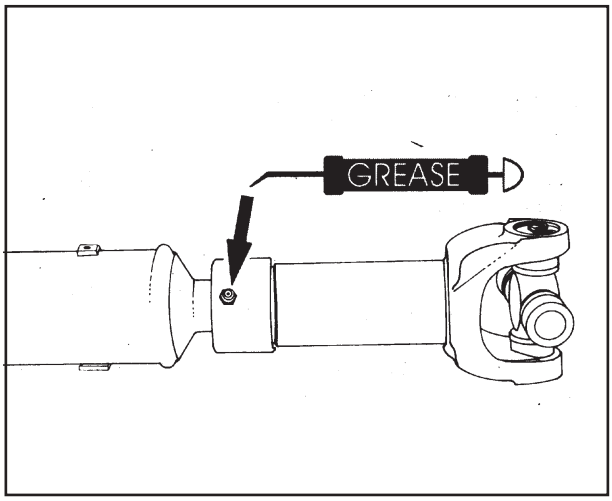


Fig. 19

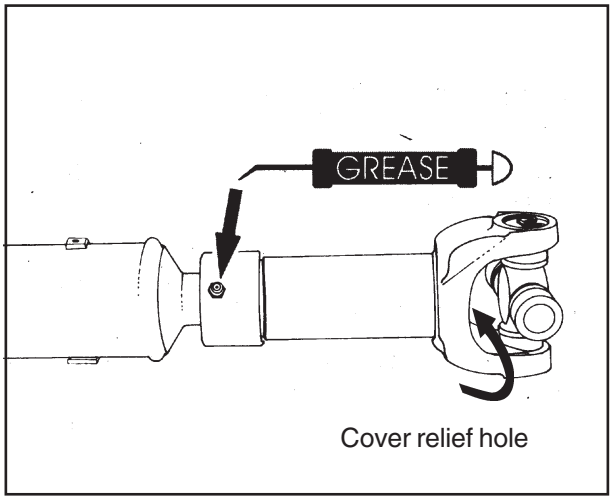


Fig. 20

ASSEMBLY

FOR 4X2

ASSEMBLY OF CENTRE BEARING ON FRONT PROPELLER SHAFT

Pack cavities between dust seals and centre bearing with lithium base grease (bearing grease)

Smear grease on the seating surface of centre bearing on front propeller shaft.

Install centre bearing assembly on front propeller shaft rear end. *Fig.21*

Install other spacer ring of centre bearing on propeller shaft bearing, using a suitable drift.

Apply glycerin on inner periphery of rubber housing and slide it on to the centre bearing assembly.

Apply grease on the splines of front propeller shaft and coupling flange. Insert end yoke on front propeller shaft. *Fig.22*

Screw in NEW end yoke mounting nut on front propeller shaft.

Mount holder Pt. no. 2698 5890 3505 or Pt. no. 2698 5890 4102 on end yoke. Clamp holder in vice and tighten coupling flange nut.

Assemble centre bearing bracket and clamping strap on rubber housing. Clamp strap on to the bracket at both ends. Ensure that there are no cracks at crimping.

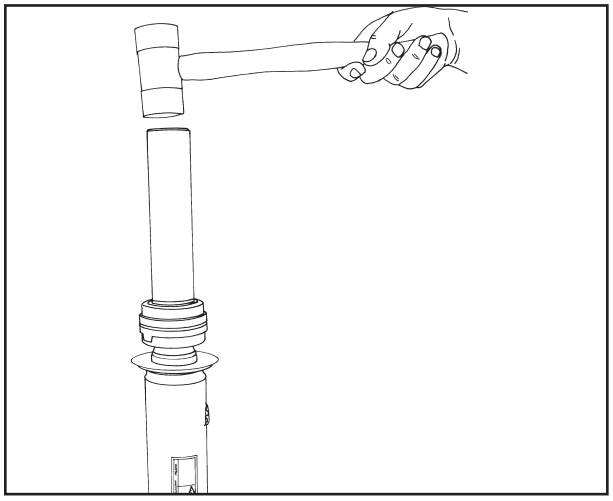


Fig. 21

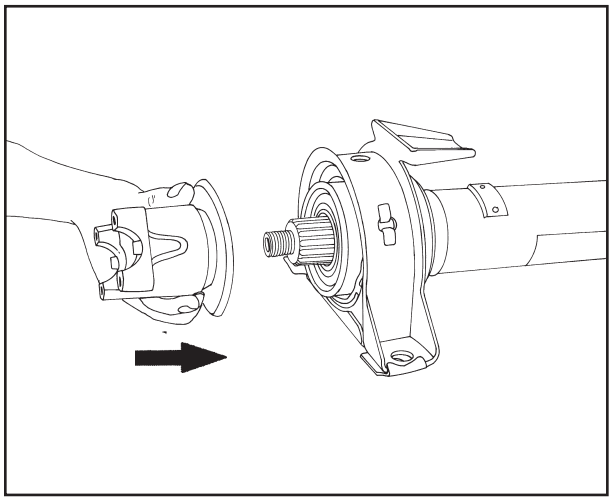


Fig. 22

ASSEMBLY OF UNIVERSAL JOINT

Position the cross in the yoke. *Fig.23*

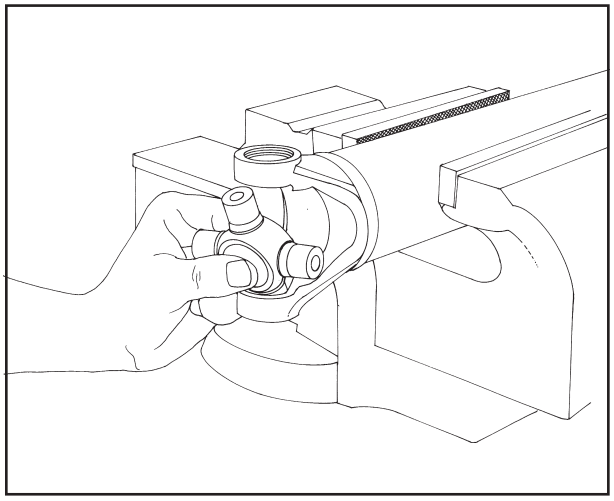


Fig. 23

Move one end of the cross to cause a trunnion to project through the cross hole beyond the outer machined face of the yoke lug. Place a bearing assembly over the trunnion diameter and align it to the cross hole. Using an arbor press, hold the trunnion in alignment with the cross hole and place a solid plug on the upper bearing assembly.

Press the bearing assembly into the cross hole enough to install a snap ring. *Fig.24*

Install a snap ring. *Fig.25*

Repeat the above two steps to install the opposite bearing assembly. *Fig.26*

If the joint is stiff, strike the yoke ears with a soft hammer to seat the needle bearings. *Fig.27*

Caution : Be sure that snap rings are properly seated in grooves.

Repeat the above steps at the opposite end of the drive shaft in installing a second kit.

If removed earlier, the unitized seal should be replaced with a new unit.

Install a new seal by generously lubricating the seal lip and press it over slip yoke using a small arbor press.

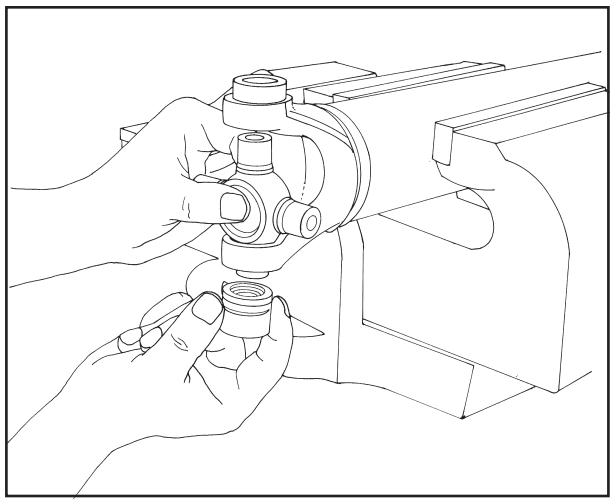


Fig. 24

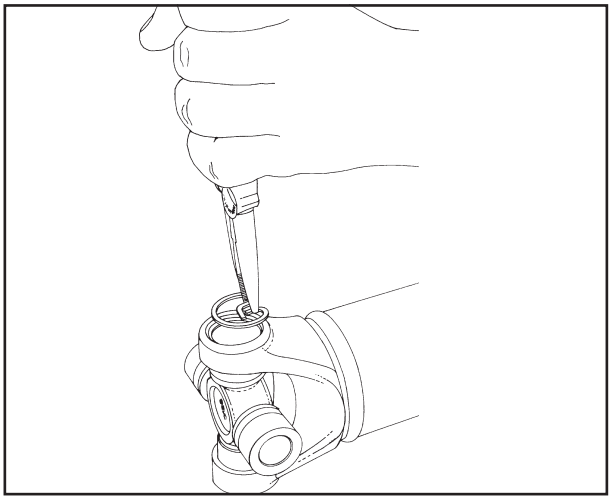


Fig. 25

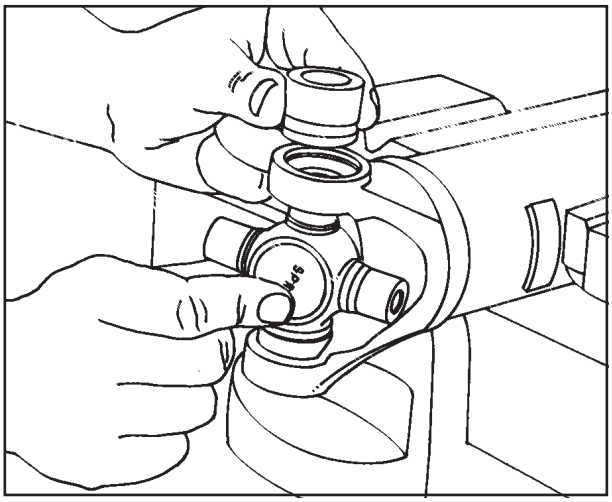


Fig. 26

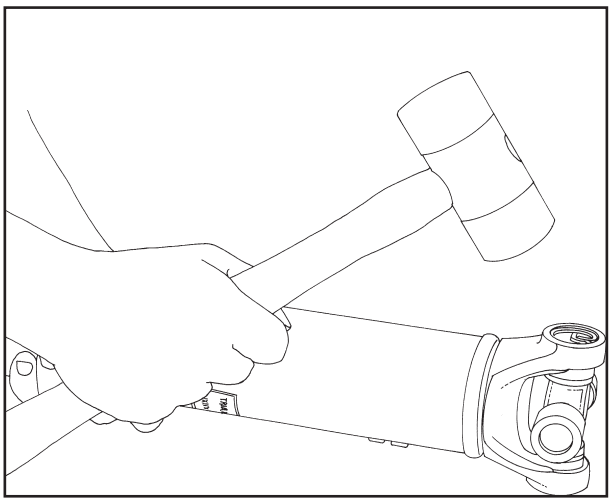


Fig. 27

Assemble tube shaft and slip yoke, making sure that the alignment marks are in line. This will ensure that slip yoke lugs and tube yoke lugs are in line. Fig.28

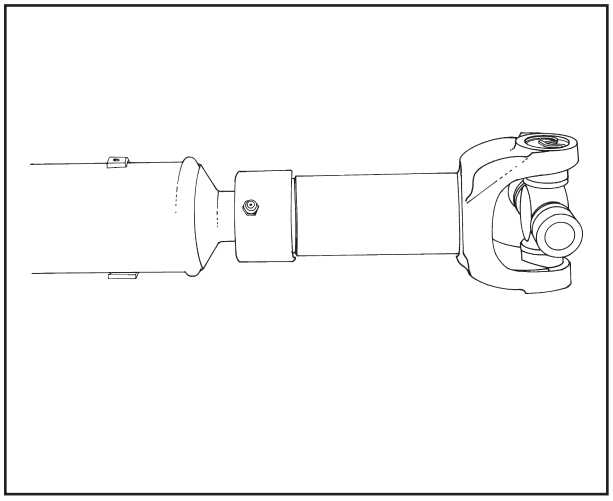


Fig. 28

INSTALLATION :

PREPARING FOR INSTALLATION

In propeller shaft assembly, when there is replacement of worn cross and bearing assemblies with a new kit, it is desirable to rebalance it.

Take runout with entire drive shaft assembly mounted on master tooling which locates on the outboard bearing assemblies of the u-joint kit.

All yokes should be selected for dynamic balance to eliminate as much unbalance as possible. During balancing, the drive shaft again should be mounted on the same master tooling or yokes.

After straightening, balance the entire assembly to the specified limit.

INSTALLATION ON VEHICLE

Before installation ensure that :

Splines should slide freely with slight drag from spline shaft seal.

Cross should flex and be free from excessive bind.

Note : A slight drag is the most desirable condition on a new cross and bearing kit. Excessive looseness is not desirable and will result in an unbalanced drive shaft.

Mounting Flange should be free from burrs, paint and foreign substances which would not allow proper seating at assembly.

While installing and servicing system balanced assemblies, The following rules should be strictly adhered to :

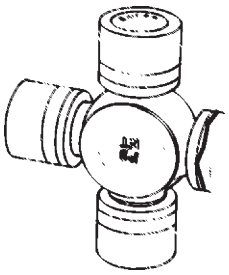
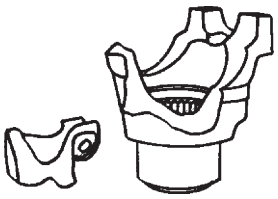
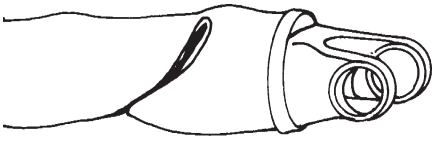
End yokes must not be rotated from their original position during reassembly.

FOR INSTALLATION PROCEED INTHE REVERSE ORDER OF REMOVAL.

Tighten the mounting nuts 8 bearing strap bolts to specified torques.

Caution : Self locking bolts used with bearingstraps should not be reused.

TROUBLESHOOTING

COMPLAINTS	CAUSES	CORRECTION
VIBRATION	Improper phasing	Replace u-joint
	Loose outside diameter fit on slip spline	Straighten and balance shaft Replace shaft bearing
	Driveshaft out of balance,	Check driveshaft for correct yoke
	Worn u-joint	phasing.
	Inadequate torque on bearing strap bolts.	
PREMATURE WEAR	Improper lubrication	Replace the affected parts.
	Excessive u-bolt torque on retaining nuts	
	Worn or damaged seals	
SLIP SPLINE WEAR	Improper lubrication Worn or damaged part	Lubricate slip spline according to specifications
	Contamination	Check for installed lengths check condition of slip yoke seal.
YOKE FRACTURE	Mating yoke lug interference at full jounce and rebound	Replace yoke
		
TUBE BENT	Balance weight located in apex of weld yoke lug area	Normal bearing wear - replace
	Balance weight too close to circle weld	Check installed lengths
	Improper circle weld Shaft support bearing misaligned – interferes with slinger	Realign mounting bracket to frame cross member to eliminate interference with slinger.

BRAKES

INTRODUCTION :

Vaccum assisted hydraulic brake system has been provided.

System consists of disc brakes in front & drum brakes in rear.

A dual hydraulic brake circuit consisting of tandem master cylinder & calipers in front / wheel cylinders in rear has been provided to actuate front & rear brakes.

Hydraulic pressure developed by tadem master cylinder is transmitted to caliper assembly (front circuit) and wheel cylinder (rear circuit) to actuate brake pads/shoes.

Vaccum assistance is provided by vaccum pump on mounted on alternator.

In the event of failure in one circuit, other one remains unaffected and vehicle can be brought to a halt.

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	Schematic circuit of brake lines (LHD)	7
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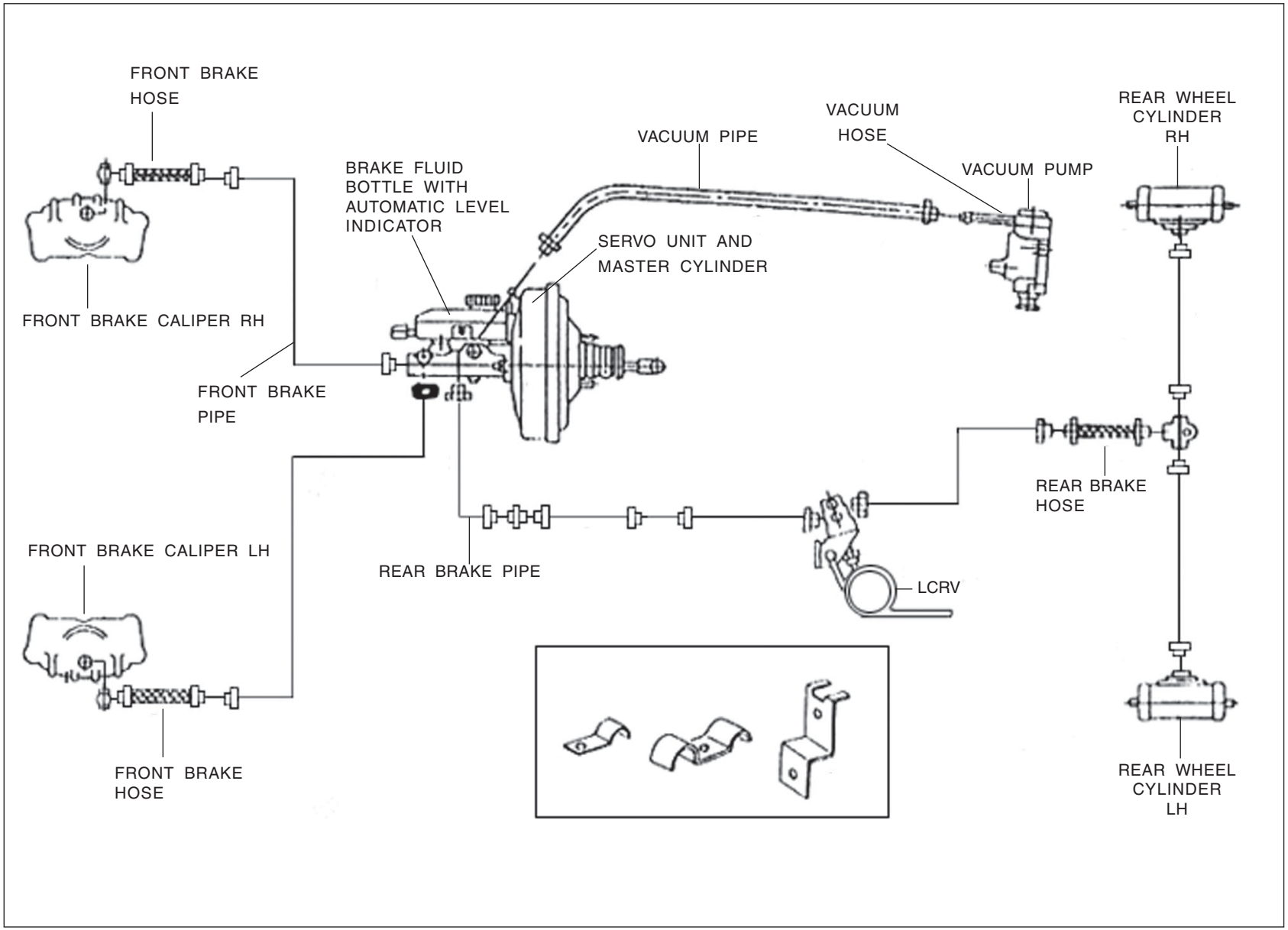


Fig. 1 - Schematic Circuit of Brake Lines (LHD)

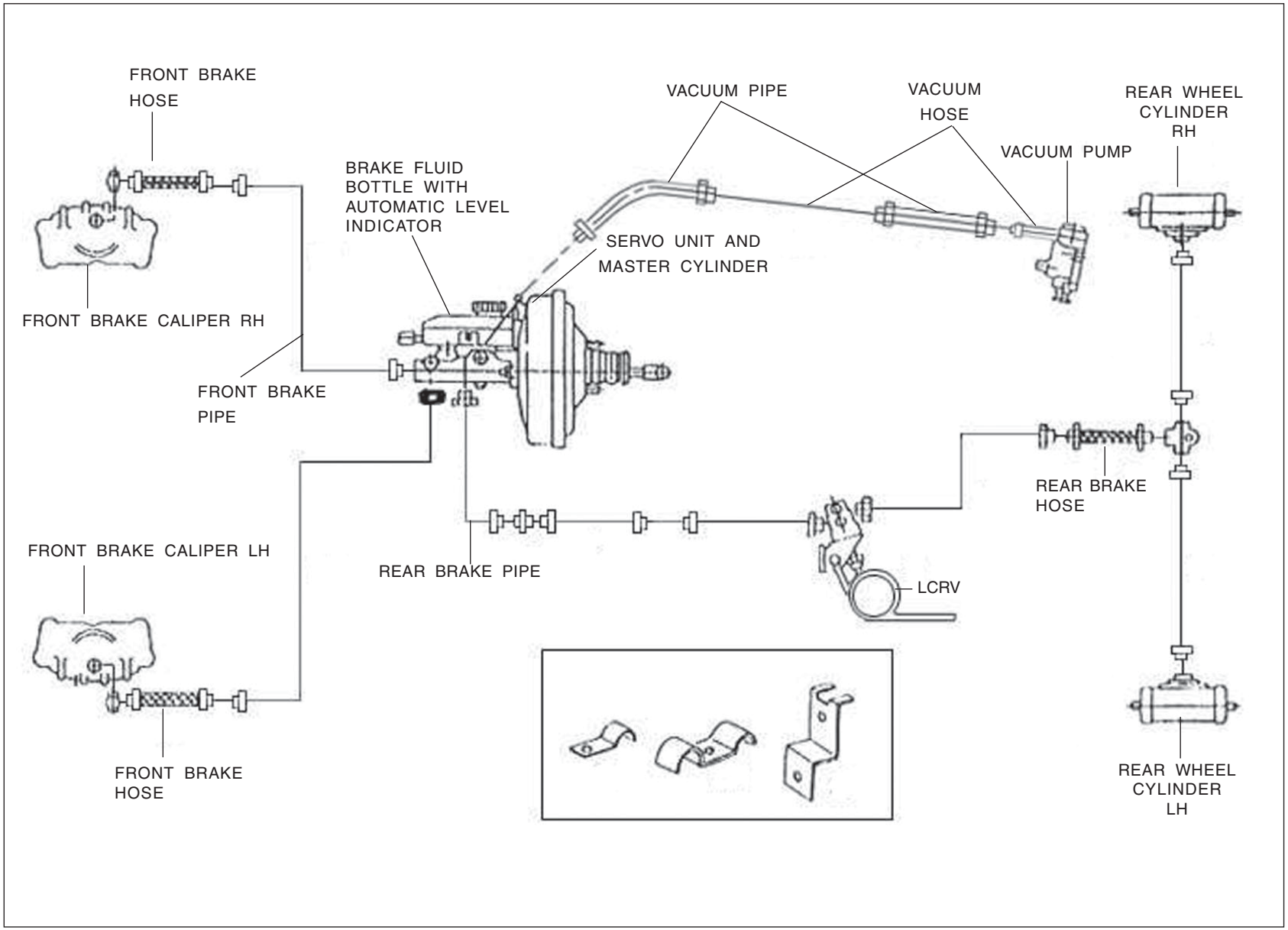


Fig. 1a - Schematic Circuit of Brake Lines (RHD)

SPECIFICATIONS

BRAKES

Front

Type : C 57 Colette
Single Pot (Sliding Caliper)

Size : Piston dia. 57 mm
Brake disc thickness 21.0 mm
Discard thickness : 19.0 mm
Pad thickness : 11.3 ±0.5 mm
Discard thickness : 7.0 mm

Rear

Type : Hydro non-servo sliding shoe brake
Leading Trailing Shoe Drum Brake
with Hand Brake attachment

Size : Drum dia : 282mm
Drum dia : 283.6 ±0.1 mm (RS)
Brake Lining width 50.8 mm
Brake lining thickness
STD : 6.0 ±0.45mm
RS : 6.8 ±0.45mm
Lining used : TVS AF 2873 GG

Rear Wheel Cylinder - Double Acting

Dia. (mm) - 22.2

	Front	Rear
Brake lining area	99.6 cm^2/wheel	287.46 cm^2/wheel
Type of lining	Moulded	Rivetted

TANDEM MASTER CYLINDER

Type : AS/AS Tandem Vertical Split

Bore Size : 23.81 (15/16") dia

Stroke : 33 mm

Split : 15 mm Primary 18 mm Secondary

Type of mounting : Flange

Reservoir : Non-integral polypropeylene reservoir coupled to the master cylinder.

VACCUM BOOSTER (YELLOW HOUSING)

Dia. : 254 mm (10")

Boost ratio : 5:1

Stroke : 33 mm

Working pressure : 0.2 bar absolute

VACCUM BOOSTER (ZERO DEAD STROKE-DOUBLE DIAPHRAGM) (BLACK HOUSING) (if fitted)

Dia. : 254 mm (10")

Boost ratio : 6.7 : 1

Stroke : 33 mm

Working pressure : 0.8 kg/cm^2 absolute

LCRV (LOAD CONSCIOUS PRESSURE REDUCING VALVE)

Ratio : 2.78 : 1

Fitted on rear brake circuit

Brake fluid : SAE J 1703f - DOT4

System capacity : 0.5 ltr

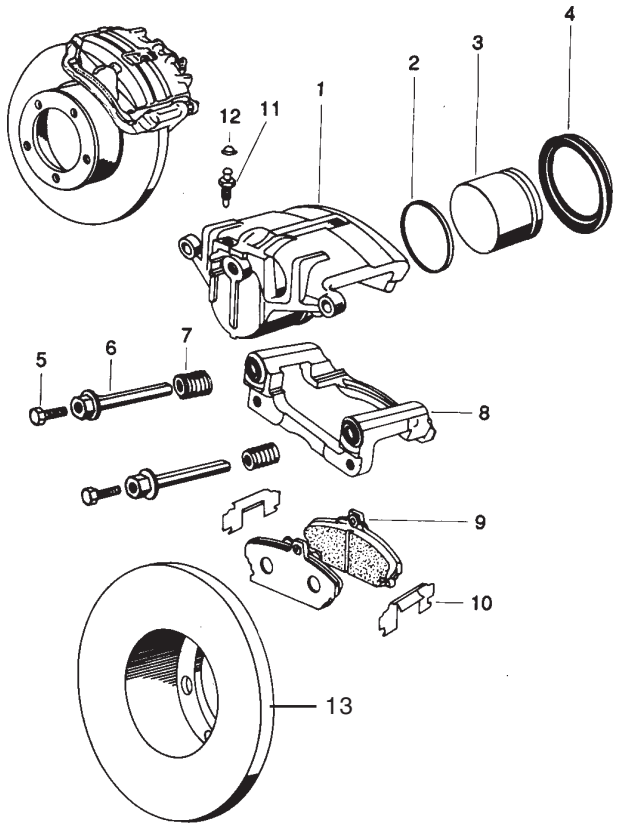
TIGHTENING TORQUES

Sr. No.	Description	Torque in kg-m
1.	Booster mounting bolt to firewall	2.1 - 2.5
2.	Mounting nuts of master cylinder to vaccum booster	1.0 - 1.6
3.	All brake pipe line joints (coupling nuts)	1.4 - 1.8
4.	Front caliper, retaining bolt to steering knuckle	6.8 - 9.0
5.	Front caliper carrier retaining bolt	3.1 - 3.5
6.	Front brake hose mounting (banjo) to caliper	2.5 - 2.8
7.	Front caliper bleed screw	0.55 - 0.8
8.	LCRV mounting screw on chassis bracket	2.1 - 2.5
9.	LCRV linkage to bracket on axle	1.1 - 1.4
10.	Rear brake assembly to dust shield	3.7 - 5.5
11.	Rear brake hose to wheel cylinder	2.5 - 2.8
12.	Rear wheel cylinder bleed screw	0.55 - 0.8
13.	Rear wheel cylinder mounting to brake plate	0.54 - 0.68
14.	Parking Brake cable / brake pipe line clamp to shell	2.1 - 2.5
15.	Parking brake lever mounting on shell / floor	2.1 - 2.5
16.	Wheel mounting nuts	12 - 15

FRONT DISC BRAKES

Front disc brakes are fitted with Colette Type C 57 Single Pot Calipers.

SALIENT FEATURES OF DISC BRAKES



1. BODY ASSEMBLY
2. SEALING RING
3. PISTON
4. BOOT
5. BOLT
6. SLIDING PIN
7. BOOT
8. BRACKET
9. ASSEMBLY. PAD & SPRING
10. ANTI RATTLE CLIP
11. BLEED SCREW
12. DUST CAP
13. BRAKE DISC

Fig. 2 - Exploded view of caliper assembly (Brakes India make)

Disc brakes with higher thermal capacity are more suited for modern vehicles, which can take care of higher braking torques needed with higher speeds.

C 57 is the latest in Caliper design from Girling, which has a minimal corrosion of sliding members and can offer uniform pad wear on either side of disc.

Colette Caliper Assembly consists of a Caliper bracket bolted to stub axle and the body assembly slides on two sliding pins fixed in the bracket.

Sliding pins are sealed against corrosion by dust covers there by avoiding possible unequal sliding loads caused by dirt, corrosion.

Drag of the pads is taken directly by bracket. Consequently the pins are only loaded by the weight of body assembly.

CALIPER OPERATION

When brake pedal is pressed, hydraulic pressure from master cylinder pushes the piston and with it the in-board pad on to the disc.

Body assembly reacts and slides on sliding pins to bring out-board pad into contact with disc. Clamping forces on both sides of disc thus become equal.

When hydraulic pressure is released, sealing ring fitted in the grooves of the cylinder retracts the piston by a small amount which allows moving parts to relax sufficiently for the disc pads to retract and remain in close proximity to disc.

CLEARANCE CORRECTION

When fluid pressure is applied on piston, it moves forward. Rubber seal, which exert pressure against piston, is fixed into grooves in the caliper. Hence the shape of rubber seal is distorted at the I.D.

When pressure is withdrawn from brake pedal and fluid pressure is released from piston, a restoring force is generated by seal and is pushes the piston back to its original position.

As the pads wear, clearance between disc and pads becomes larger. Hence the piston has to move a larger distance. Seal then could change in shape further but, since it is fixed into the grooves in cylinder, distortion is limited to same amount as previously described. Due to this, piston moves further to cover distance of clearance relative to seal in case.

When pedal is released, piston returns by same distance and rubber seal recovers its shape as described above.

Thus the clearance between the disc and pads are maintained automatically. Caliper brake needs no adjustment.

BRAKE MAINTENANCE :

BRAKE ADJUSTMENT :

Disc brake is of self adjusting type. Needs no adjustment.

SERVICING :

Check pads for wear at specified intervals and fit new pads when lining and metal pad thickness measured together is 7 mm.

An indication groove is provided at the centre of friction pad. If it is vanished, that is the indication for changing pad. Caliper should be overhauled at specified intervals.

FITMENT OF NEW PADS :

Jack up and remove both front wheels. Inspect pads for wear. If they are found to have worn, proceed as follows to replace them.

Loosen and remove bottom sliding pin retaining bolt, holding guide pin head.

Swing up the caliper and hold it with one hand. Remove both pads one by one.

Measure lining and metal pad together with a vernier. If thickness is less than 7 mm anywhere in pad, replace pads.

CAUTION :

Mark friction pads for their positions during removal. If pads have to be reused, install them at respective locations.

Alway use genuine pads for replacement.

Do not contaminate pad surface with grease or oil.

NOTE :

If you find any difficulty in swinging the caliper up, after removing the guide pin retaining bolt, it may be necessary to push the caliper plunger back along with the pad, using a screw dirver, after loosening the bleed screw.

But make sure to bleed the system if pedal is found spongy after replacing the pads.

INSPECTION :

Thoroughly clean the disc. If found scored, recondition the disc as per instructions.

Check condition of rubber boots for caliper piston & sliding pin.

If there is no visible deterioration in piston rubber boot and sliding pin rubber boot, new pads can be fitted.

Check condition of anti rattle clips. If found OK, same clips can be reused after cleaning.

Insert both pads in between carrier and disc in the axle so that friction material faces disc.

After inserting push both pads against disc with both hands and swing down the caliper and fit bottom sliding pin bolt.

Tighten retaining bolt to a torque of 3 to 3.5 kgm by holding the guide pin.

Rotate the disc and make sure it is free to rotate. If it is not free to rotate, inspect and make sure that the pads are sitting square with the disc without any tilt.

Follow same procedure for the other front wheel.

NOTE :

Caliper assembly make BI TVS & KBX are used in selection. In case the pads are fitted with anti squeal shim, they have to be fitted back while changing pads. Please note the positions of anti squeal shims during dismantling, so that they can be fitted back in correct location.

Fit wheels, jack down the vehicle.

CAUTION :

Apply brake couple of times with engine running before taking vehicle for a road test.

Before applying heavy brake, it is advisable to apply brake gently several times at 50 kmph to allow brake pads to align.

Heavy braking or prolonged braking should be avoided in the initial 100 - 150 km of run until the new pads are bedded.

Always replace all four pads at a time. Mixing of old and new pads strictly prohibited

DISMANTLING OF CALIPER : (BI TVS)

Jack up and remove wheels. Disconnect hose from chassis anchoring point and block bundy pipe with bleed screw dust cover to prevent loss of brake fluid.

Remove pads by swinging the caliper. Caliper can be taken out from carrier by sliding the caliper body towards inboard of disc. Take out the remaining sliding pin left in the carrier by releasing the guide pin boot from the carrier. Remove hose from caliper body by taking out the banjo bolt.

After cleaning the surfaces, remove rubber boot for cliper piston from caliper body & piston by pulling the same with fingers.

Keep a wooden piece in between the plunger and the caliper body and blow compressed air into the caliper gradually through the inlet port. Now you will observe the plunger coming out of the caliper gradually.

Remove sealing ring from the groove in the caliper housing by using a thin blunt screw driver, taking care not to damage the bore. Remove the bleed screw from caliper body.

NOTE :

1. Take care to avoid puncturing of the dust boot while removal. Replace punctured boot.
2. Do not apply high compressed air, which will cause piston to jump out of the cylinder. It should be taken out gradually with moderately compressed air about 2 bar.
3. Do not place your fingers in front of piston when using compressed air.

INSPECTION

Clean all parts thoroughly with fresh brake fluid. Never use mineral oil like kerosene, petrol, diesel etc. After thoroughly cleaning, examine all parts for damages and corrosion.

PLUNGER :

Outer surface should be free from nicks, score or rust and should be smooth to touch. Caliper housing bore should be free from score, pitting, corrosion and should be smooth to touch. The seal groove in the bore should be there at the edges.

If the above conditions are satisfactory then kit replacement will give satisfactory performance. If not the caliper assembly should be replaced.

Do not use emery paper on piston surface.

SLIDING PINS :

Should be free from rust and bends and guide pin dust covers should be soft and free from cracks or puncture. If in doubt, replace them.

PISTON SEALING RING :

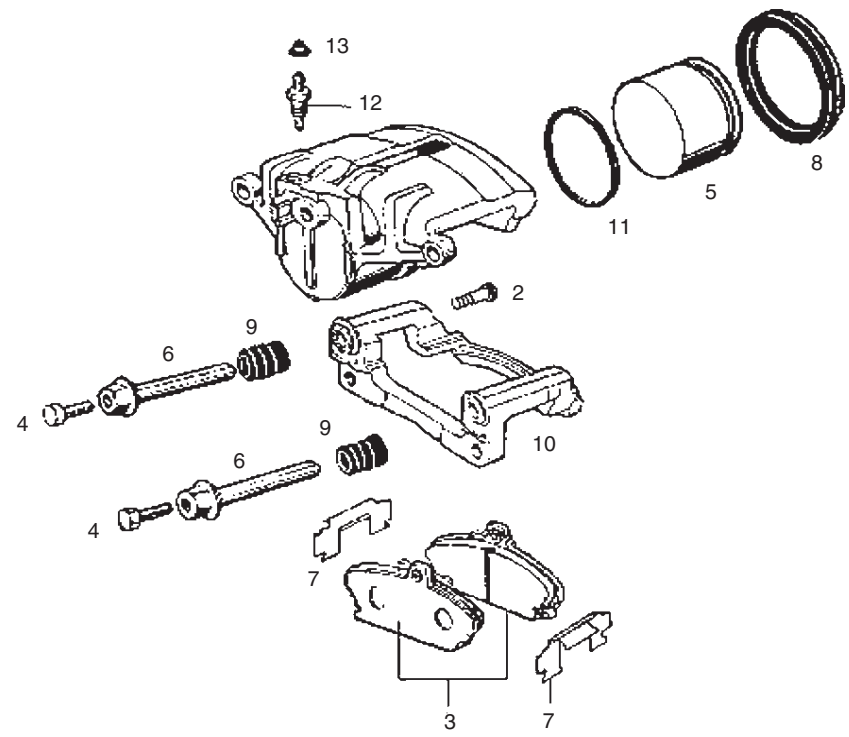
Piston sealing ring is used to seal piston and cylinder and it is used to adjust the clearance between pad and disc. Replace the piston sealing ring with a new one at every overhaul. Fit piston sealing ring into groove in the cylinder taking care that it should not be twisted.

ASSEMBLY OF CALIPER : (BI TVS)

Dip the plunger seal in fresh brake fluid and fit it on to the groove in the cylinder bore. Smear fresh brake fluid to the bore and on plunger surface. Assemble dust cover on to the plunger by reversing the dust cover. Now push the plunger gradually into the bore until it reaches the bottom.

Fit the other end of the dust cover on to the caliper body. Smear sliding pins with special red rubber grease. Insert the loose guide pin into the top hole of the bracket and fit the dust cover on to the carrier. Now fit the caliper assembly to the carrier in the reverse order of removal.

EXPLODED VIEW CALIPER ASSEMBLY - KBX MAKE



1. CALIPER ASSEMBLY
2. BRACKET MOUNTING BOLT
3. PAD
4. BOLT PIN
5. CALIPER PISTON
6. SLIDING PIN
7. RATTLE CLIP/SPRING
8. BOOT PISTON
9. SLIDING PIN BOOT
10. BRACKET
11. SEAL PISTON
12. BLEED SCREW
13. DUST CAP

Fig. 2a - Exploded view of caliper assembly (KBX)

CALIPER ASSEMBLY - KBX MAKE

Specifications –

Bore Dia. – 57 mm

Friction pad Grade – R 802 (Asbestos Free)

Type – Single Piston Floating Caliper

These disc brakes have more braking efficiency & higher thermal withstanding capacity & are suitable on vehicles like Telcoline range of vehicles where the operating speeds and required braking torques are very high. These are self adjusting type and hence do not require brake adjustment after pad wear.

The clamping force exerted by the pads on both sides of the disc is equally distributed by virtue of it's design, which results in uniform wear on both the pads .

Since the caliper assembly along with disc is very much exposed to atmosphere the heat dissipation is much faster compared to that of drum brakes which results in consistent braking performance.

1. <u>Construction & Working</u> —

The Disc Brake consists of a carrier and caliper body. The carrier is mounted on the stub axle by means of two mounting bolts and the housing slides on two guide pins (6) also called as sliding pins fixed on the carrier. Two pads (3 & 3A) one on the piston side and other on the opposite side are fitted and are held by the pad spring. The pads are also guided over the anti rattle clips / spring (7) fitted on to the carrier. An anti-squeal shim is fitted on outboard pad which helps in dampening the squeal noise.

The sliding pins are well protected from dirt , water entry and corrosion by means of boot, pins (9) and thereby avoiding improper sliding loads caused due to dust entry. The bore of the caliper housing accommodates a piston (5) and a seal- piston (11)

whose cross section is square in shape. The seal is fitted in to the groove in the bore and the piston slides thro the ID of the seal with certain amount of interference. Dust or water entry inside the bore is protected by Boot – Piston (8).

When the brakes are applied the hydraulic pressure from the TMC makes the caliper piston to move forward and thereby the piston side pad also moves forward till it touches the rotating disc face. Then further movement of the pad results in reactive force, which makes the caliper body to slide on the sliding pins to bring the opposite side pad in contact with the disc. Due to this reaction effect the forces acting on both the pads remains equal always.

When the brakes are released , the pressure in the system drops and the sealing ring inside the bore retracts the piston by a small amount . This makes the pads to get free from the disc face , however remains in close proximity to the disc.

2. Maintenance & Overhauling —

2.1 Fitment of New Pads –

Apply hand brakes to prevent vehicle from rolling. Jack up the front axle and remove both the wheels. Inspect the pads through the inspection window and if found worn out replace them with the new set as per the following procedure.

1. Insert a screw driver between the outer pad backplate and the caliper housing and push the screw driver outwards to push the piston inside the caliper bore.
2. Loosen and remove the bolt - Pin (4) of the sliding pin. Swing up the caliper and by holding it, remove the pads one by one from its position.
3. Replace the old pads (3 & 3A) with the new ones assembling the anti-squeal shim on outer pad and swing down the caliper and retighten the Bolt - Pin (4) with a tightening torque of 2.2 to 3.2 Kgm. Old anti-squeal shim can be reused if it is not damaged.
4. After tightening, rotate the disc and ensure that the disc is free to rotate. If not check whether the pads are sitting square with the disc or for any abnormality in pad seating.
5. Repeat the above procedure for the other side caliper.

Note :

Always replace all four pads at a time.

If the pads are to be reused make sure they are assembled back in the same position as they were when removed ie , piston side pad on to the piston side and outer side pad on to the outer side. This is possible only when at the time of removal these pads are marked for their positions and kept aside.

Never to lubricate the pad seating areas as this may lead to jamming.

After assembly of pads , apply brake pedal 5 to 6 times in static condition in order to make the pads align properly.

It is recommended to apply light braking stops during road test and avoid heavy and continuous braking during the initial 200 kms of run or until the new pads are bedded.

Anti squeal shim should be put on outer side pad always.

2.2 Servicing of Caliper (KBX) –

2.2.1 Dismantling —

1. Apply hand brake and if necessary place wedges at the rear wheels in order to prevent the vehicle from rolling. Jack up the front of the vehicle and remove the front wheels by loosening / removing the wheel nuts.
2. Disconnect the hose from the caliper by removing the banjo bolt .
3. Loosen and remove the bottom retaining bolt of the sliding pin(4). Swing up the caliper and by holding it, remove the pads one by one from its position. Now remove the top retaining bolt of the sliding pin (6) and remove the caliper.
4. Clean the caliper externally with alcohol or fresh brake fluid. Remove the caliper piston (5) from the bore by blowing dry compressed air through the inlet port of the caliper. Remove the boot (8).
5. Then by using a blunt edged connector or screw driver, remove the seal- Piston (11)

from the groove. While removing the seal care to be taken not to damage the bore. Then remove the bleed screw (12) from the caliper body.

6. All the removed parts should be cleaned properly using fresh brake fluid or alcohol and kept in a clean tray.

NEVER USE ANY MINERAL OIL BASE FLUIDS LIKE KEROSENE, DIESEL, PETROL etc,. FOR CLEANING OF REMOVED PARTS.

7. Remove the sliding pins (6) from the carrier along with the sliding pin boots (9). Then separate the boots from the sliding pins. Ensure the sliding pins are without any bends or damages and their bores to be free from corrosion.

8. After thorough cleaning ensure that the piston (5) is free from any damages, score marks on it's outer surface. Also the caliper bore must be free from score marks, corrosion / pitting and the sealing ring groove in the caliper should be free from damages. If these parts are found perfectly acceptable, then the caliper can be overhauled with the new repair kit. Otherwise the whole caliper should be replaced with a new one.

2.2.2 Assembly —

1. The Piston seal (11) is to be lubricated with fresh brake fluid and assembled in to the seal groove in the caliper bore. Make sure the seating of this is properly done. Then lubricate the outer surface of the piston (5) with fresh brake fluid.

2. The lips of the piston boot (8) to be smeared with the special red rubber / BN2 grease before it is assembled . Locate the outer lip of the boot on to the boot groove in the caliper and ensure firm location of the boot lip in the groove.

3. Stretch the Piston end of the boot by fingers & insert the caliper piston into the boot & push it gently into the bore. Once the piston is home , ensure the fitment of the boot on to the boot groove on the piston. The piston should be inserted into the bore in a straight position only. If it gets tilted while pushing, there is a chance that the piston will get jam half way & also can damage the seal.

4. Smear the sliding pins (6) and the sliding pin bore with BN2 or special red rubber grease. Fit the sliding pin boots (9) on to the pins and assemble it on to the carrier bore. Ensure proper location of the boot lip on to the carrier. Move the pins in and out 3 to 5 times in order to allow for the trapped air inside the bore to escape.

5. Now fit the caliper body to the carrier in the reverse order of removal and repeat the above procedure for the other side & bleed the vehicle .

During the assembly of caliper the following points are to be ensured —

The braking surface on brake disc should be free from score marks. Thickness , runout and faceout of the disc to be within the prescribed limits.

Bleed screw to be torque tightened to 1.0 to 1.2 Kgm

Banjo bolt to be torque tightened as per vehicle manufacturers specification. Use of new copper washers is highly recommended.

In case the carrier is removed from stub axle, then the mounting bolts to be checked for its tightening torque as per vehicle manufacturer's instructions .

DISC INSPECTION :

Before assembling the caliper back to the carrier, the disc should be inspected.

The disc should be free from score marks. If scores are found, this should be ground and refitted. But at no time more than 0.25 mm (0.010") material should be ground per side. If the total thickness of the disc after grinding is found to be less than 19.00 mm, the disc should be changed. After fitment, the face run out of the disc should be less than 0.1 mm (0.004"). Otherwise pedal pulsation will be felt during brake application.

The disc thickness variation to be checked by measuring the thickness of disc at 4 or more points around the circumference of disc.

All measurements must be made at the same distance from edge of the disc. During the measurement confirm that the dial gauge probe to be approx. 10 mm from the outer edge of the disc and perpendicular to disc with slight pre load.

Check front wheel bearing for looseness before face run out measurement. The control of the braking surface finish is necessary to avoid pulls and erratic performance. It will also help in extending pad life.

Fit the bottom guide pin dust cover's other end to carrier. Fit new pads as explained earlier and check for the gap of 21.4 mm minimum, as explained under "Fitment of New Pads". Swing back the caliper to its place and fit guide pin retaining bolt and tighten to recommended torque (3.1 to 3.5 mkg).

Fit bleed screw and tighten to a torque of 0.55 to 0.8 mkg; connect banjo end of the hose with caliper body by fitting banjo bolt using new copper washer. Before fully tightening the banjo bolt, make sure that the other end of the hose is anchored to the chassis end. In this condition the hose should be free from twists. Tighten the banjo bolt to a torque of 3 to 4 mkg. Connect pipe nuts to the female end of the hose after removing the dust cap from the bundy tube and tighten.

Caliper carrier mounting bolts to be checked for its tightness to a torque of 6.3 to 8.3 mkg.

The other side of the caliper can be serviced in the same way.

Bleed the brake system as per procedure given on page 23.

If bleeding equipment or power bleeding is used to bleed the system, which does not necessitate application of pedal, you must make sure several brake pedal applications are made to maintain minimum clearance between pad and the disc before taking the vehicle for road test.

HOSE REPLACEMENT

Hoses should be replaced as per recommended schedule.

Check hoses/pipes for leak/crack/damage. Replace if necessary.

NOTE :

Disc brake assemblies of BI TVS & KBX makes are used in selection.

Individual components, brake pads, calliper repair kits etc. for both makes are different & not interchangeable with each other.

Please ensure to use appropriate make of items during repair/overhaul.

REAR DRUM BRAKES

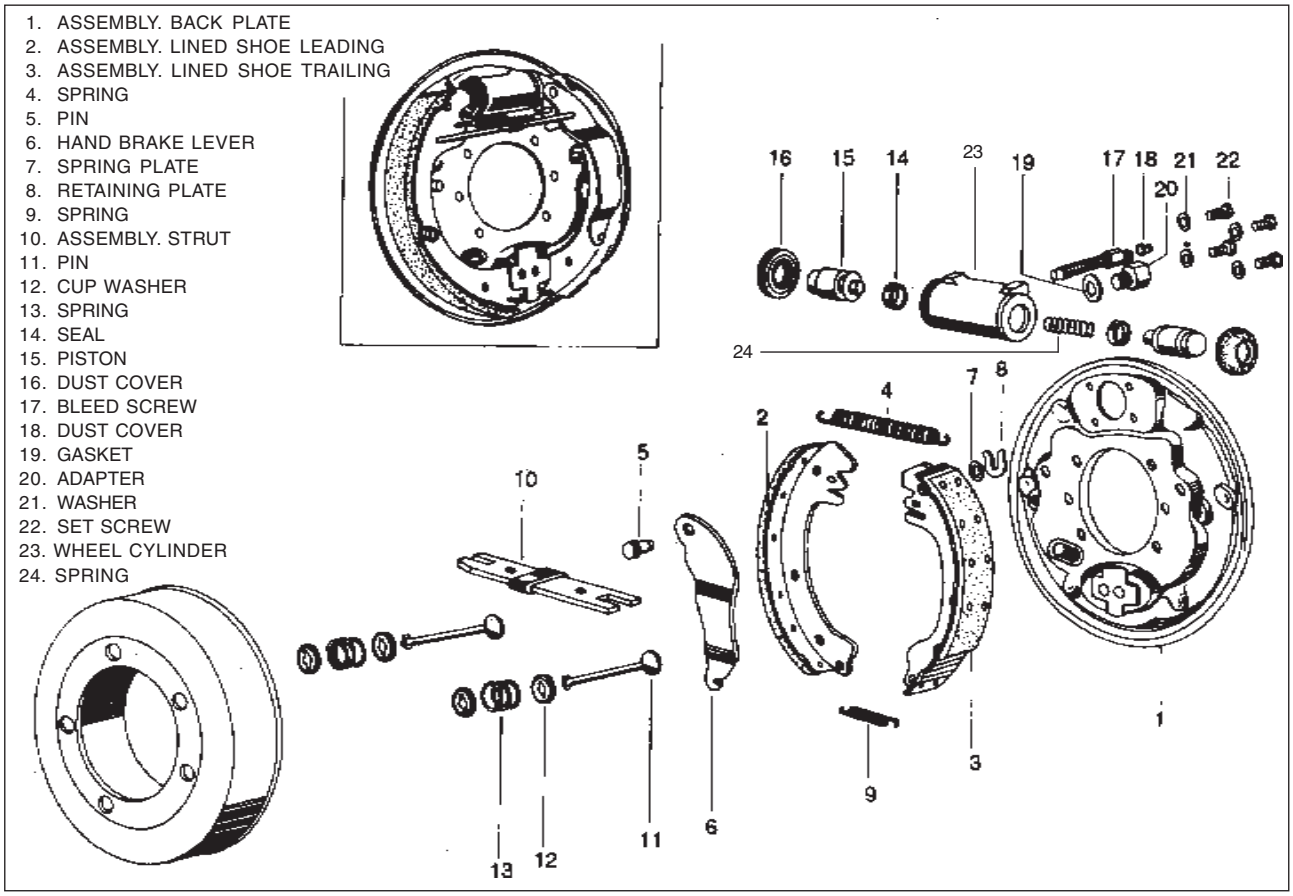


Fig. 3 - Exploded view of rear brake assembly.

DESCRIPTION

Hydraulic non-servo sliding shoe brake (HNSS) is of the leading/trailing shoe type. It is simple in design, robust in construction.

Sliding shoe arrangement provides high braking efficiency, and allows shoes to centralise themselves automatically with brake drum to give uniform lining wear.

Shoe return springs are fitted between shoes to provide a positive shoe retraction. This avoids any possibility of brakes 'hanging on'.

To maintain shoes squareness with drum, both shoe rims rest on pads formed at suitable places on backplate.

Shoe is held against backplate by means of a shoe hold down pin and spring. For independent adjustment of each shoe, two cam type adjusters are pivoted on the backplate. When adjuster stem is rotated in a clockwise direction, cam moves the shoe towards drum.

Wheel cylinder is double acting, and exerts equal force on both shoes. Rubber gland seals retain the fluid, and rubber boots fit around the pistons over the ends of the cylinder to prevent dust and water entering the wheel cylinder assembly.

Hand brake operating lever is attached to trailing shoe by means of a pin retained in position by retaining plate. A strut connects the leading end trailing shoes. A cable connects the pistol grip to the hook end of the operating lever. When hand brake is applied, operating lever pushes the strut, forcing the leading shoe against drum.

Once leading shoe is against drum, further movement of lever pushes the trailing shoe. A rubber sleeve is provided on strut to prevent rattling.

BRAKE MAINTENANCE

The gap between the lining and the drum should be checked at specified intervals through the inspection hole provided in the back plate, after removing grommet. If the gap exceeds 0.25 mm (0.010") brake should be adjusted.

BRAKE ADJUSTMENT *(Fig. 4)*

Jack up rear axle, place chocks at front wheel and clear off ground. Keep gear shifting lever in neutral poisition. Release hand brake.

Turn the hexagonal adjuster nut clockwise, until the shoe begins to bind on the drum. Turn the adjuster anti clockwise until the wheel gets rotated freely.

Repeat the same procedure for other shoe of the same wheel.

Operate brake pedal two or three times simultaneously rotating the wheel to allow the shoes to centralise in the drum.

Readjust if necessary until the wheel is just free.

Repeat the same procedure for the other wheel.

1) Linings should not be allowed to wear down to rivet heads.
2) Clean backplate and lubricate the tips of the shoe platforms with graphite grease and the moving parts of the adjuster with mineral grease at specified intervals. Keep grease away from shoe linings and all hydraulic parts.
3) Wheel cylinder should be overhauled at specified intervals.

MAJOR OVERHAUL

It is essential that shoe linings are inspected at regular intervals to prevent drums being permanently damaged and subsequently making drum removal extremely difficult. If drums are allowed to become scored or grooved, problem of drum removal can usually be overcome by increasing clearance between shoe linings and drum.

REMOVAL OF SHOES

Jack up the vehicle. Remove the wheels, Slacken the adjusters to keep the shoes in a completely retracted position. Remove the brake drum.

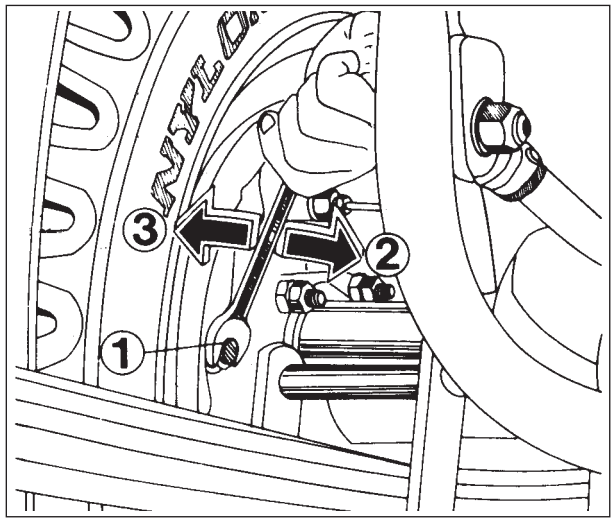


Fig. 4

Push the hand brake operating lever away from the shoe rim and remove the cable from the operating lever hook.

Using a 'spring plier' or a screw driver remove the shoe return spring at the wheel cylinder end.

Remove the shoe hold down pins from both the shoes by pressing down the spring and rotating the pin.

Remove both the shoes from the backplate alongwith the alongwith the abutment end spring. Slip an elastic band over the wheels cylinder to retain the pistons with the cylinder.

CLEANING

Clean the backplate thoroughly. Use a wire brush to remove any corrosion, but take care not to damage the rubber dust covers on the wheel cylinder.

Note : Never use petrol or kerosene, or paraffin etc. for cleaning brake parts as they are dangerous.

Ensure shoe-sliding platforms on the backplate are smooth and not corroded. If necessary, Clean the filings and apply a light smear of Graphite grease (high melting point grease) to each platform.

RELINING THE SHOES

Remove the rivets carefully. Before removing rivets, detach hand brake operating lever from trailing shoe. This may be done as follows :

Remove retaining plate from the pin groove by sliding with a screw driver. Remove spring plate. Lightly tap the pin to remove the operating lever from the shoe. If excessive wear on this pin is noticed, it should be replaced.

While removing rivets, ensure that the holes in the shoe rim are not enlarged.

Clean the shoe rim to ensure a smooth even surface for the lining.

Always use genuine linings and the rivets supplied with the relining kit.

Clamp the lining evenly to the shoe rim, and start rivetting at the centre and progress outwards to the end of the shoe. A flat ended anvil of the correct diameter should be used against the rivet head and the tabular shank of the rivet should be properly clinched.

Care should be taken, since overrivetting may crack the lining. Ensure that no clearance exists between the lining and the shoe rim.

Fit the hand brake operating lever to the trailing shoe in the reverse order of removal.

Ensure that the spring plate convex side is towards the retaining plate.

Make sure the lever is free to operate.

Do not contaminate the lining surface with oil or grease.

Refit the shoes in accordance with the following instructions :

FITTING SHOES

Clean the backplate. Check the backplate for grooving or other damages. The pads must be smooth and not corroded. If necessary, smoothen the pads with file or emery cloth, but do not remove any more material than is absolutely necessary and note that each set of these pads is reduced equally. Clean off the metal filings.

New shoe retaining spring should always be fitted during major overhaul.

Check the wheel cylinders for leaks by lifting the boot. Check the pistons for free movement. If a leak is suspected from the wheel cylinder or if the piston movement is unsatisfactory the unit must be serviced. Refer to “Wheel Cylinder Servicing”. Inspect the wheel cylinder boots for cuts, cracks, hardening or other signs of deterioration. If in doubt, the boot should be replaced.

Lightly smear vegetable based high melting point graphite grease on the backplate shoe pads and at abutment.

Do not use chassis grease.

Position the leading shoe (the shoe with the longer lining) on the backplate and fit shoe hold down pin, spring and washers. Ensure that the convex face of each washer is towards the spring.

The leading shoe (The shoe with the longer lining) should be fitted towards the front of the vehicle. Hook the smaller spring at the abutment end (bottom) and the longer spring at wheel cylinder end of the shoe.

Position the trailing shoe (the shoe with the shorter lining and the hand brake lever) on to the backplate and hook the smaller spring at the abutment end. Move the hand brake lever a little and fit the shoe hold down pin, washer, spring and washer, Position the strut between the leading and trailing shoe webs.

Two slots are milled on either end of the strut. One of them is wider than the other. The narrow slot should be on the leading shoe.

Ensure that the rubber sleeve on the strut is in position and that the straight portion of the strut is towards the backplate.

Using spring plier, hook the longer spring on to the trailing shoe.

While using the spring plier extreme care must be exercised as otherwise the lining may get damaged.

Connect the hand brake cable to the operating lever in the reverse order of removal.

Do not handle the lining more than it is necessary and be sure that it is completely free from grease.

Centralise the brake shoes on the backplate, before fitting the drum, by lightly tapping in the required direction.

Refit the drum and wheel.

Adjust the brakes as explained under “Brake Adjustment”.

Check and correct the hand brake cable adjustment and road test.

WHEEL CYLINDER SERVICING

OVERHAULING THE WHEEL CYLINDER

Wheel cylinder should be overhauled & replaced at specified intervals.

Wheel cylinder may be serviced using genuine repair kit, if piston and wheel cylinder bore are in good condition.

REMOVAL OF WHEEL CYLINDER (REAR)

When removing or servicing wheel cylinders, it is necessary to drain the brake fluid from the system and remove the brake shoes.

Attach a bleed tube to the bleed screw, having first removed its rubber dust cover. Unscrew the bleed screw 1/2 to 3/4 turn and pump out the fluid into a suitable container by operating the brake pedal. Remove the bleed tube.

Remove the brake shoes as explained under “Removal of Shoes”.

Remove the adaptor from the feed port along with the gasket. Remove the wheel cylinder from the wheel cylinder mounting bolts and take out the wheel cylinder from the backplate.

DISMANTLING OF WHEEL CYLINDER (BI TVS) *(Fig. 5)*

Clean the wheel cylinder externally. Remove the dust covers fitted on the wheel cylinder assembly and the bleed screw. Push out the pistons, and springs. Remove the seals from the pistons and clean all the parts thoroughly in fresh brake fluid or alcohol and place them on a clean sheet of paper.

Never clean the wheel cylinders of internal parts with kerosene or petrol.

EXAMINATION OF WHEEL CYLINDER (BI TVS)

Examine the cylinder bore and pistons. If they are not scored, corroded or ridged and are smooth to the touch, new seals can be fitted. If there is any doubt about the condition of the bore, a new wheel cylinder assembly must be installed.

If the system has been contaminated with mineral fluid of any type, the system should be flushed out with fresh Brake Fluid or Alcohol and all rubber parts including hoses should be replaced.

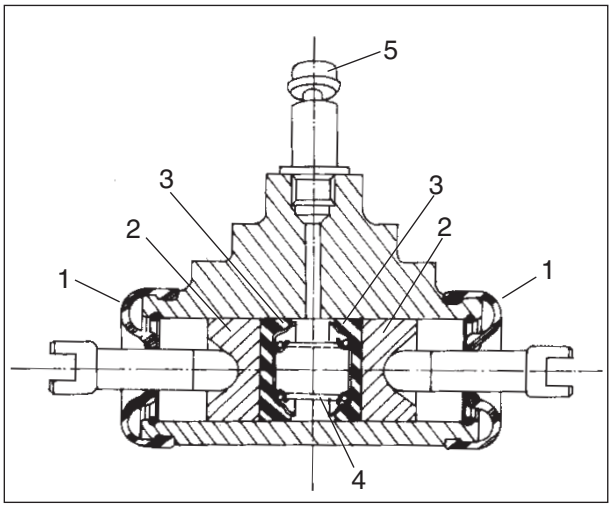


Fig. 5 - Wheel cylinder assembly
1. Dust cover
2. Piston
3. Seal
4. Spring
5. Bleed screw

Contaminated seal may be identified by comparing it with a new seal (but do not let them touch). If the old one is appreciably larger, seal contamination is indicated.

ASSEMBLY OF WHEEL CYLINDER (BI TVS)

1. Lubricate the bore liberally with fresh brake fluid. Dip new gland seals and pistons in fresh brake fluid.
2. Assemble gland seals on to piston in such a way that it fits squarely on piston stem (seal lip should be towards the thin collar of piston).
3. Assemble the spring on to one of the piston stems.
4. Assemble piston assembly into cylinder bore with the spring leading into the bore carefully easing seal lip.
5. Insert other piston with seal from other end.
6. Fit dust covers to wheel cylinder mouth and piston.
7. Fit bleed screw and tighten to specified torque.
8. Fit a rubber band around the piston to retain them in the bore.

Absolute cleanliness has to be maintained and a clean brake fluid must be used. Never use brake fluid bled from the system.

FITMENT WHEEL CYLINDER

Install wheel cylinder assembly on to the backplate and secure with bolts and washers. Tighten wheel cylinder mounting bolts to a torque of 0.54 to 0.68 mkg. Fit adaptor with a new gasket on to the feed port and tighten to a torque of 2.5 to 2.8 mkg.

Remove rubber band from wheel cylinder. Refit brake shoes as described under “Fitting Shoes”.

Connect the bundy pipe to the adaptor port.

Refit drum and wheel.

Bleed the system as per procedure.

Adjust brakes and road test.

NOTE :

Wheel cylinders make BI TVS and KBX are being used in selection. Repair kits for both the makes are different & non-interchangeable.

Please ensure to use correct make of repair kits during overhauled.

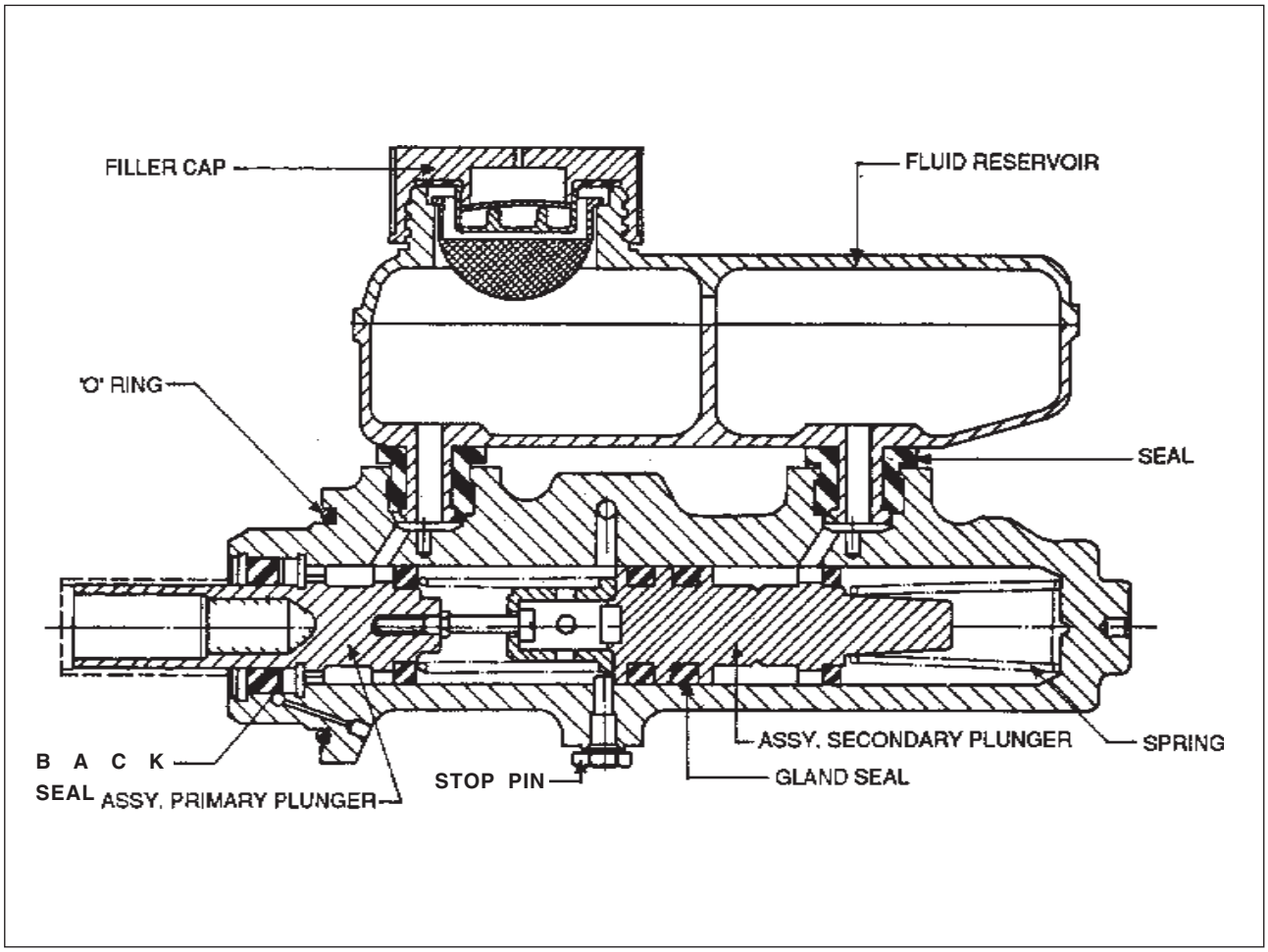


Fig. 6 - Tandem master cylinder Sectional View (BI TVS)

TANDEM MASTER CYLINDER (BI TVS)

(Fig. 6)

DESCRIPTION

The AS/AS tandem master cylinder consists of two independent chambers in a single casting, housing primary and secondary plungers fitted with gland seals having minimum friction.

Each hydraulic system is so designed that any failure of pressure seal in one of the systems would not result in total failure of braking system, since the other system remains completely operational and ensures minimum safe braking performance.

The specific design feature of this master cylinder is that pressure is developed in both the chambers simultaneously without any time lag.

Under normal conditions when brake pedal is depressed, booster output rod pushes primary plunger of master cylinder. At the same time, force of primary spring moves secondary plunger forward.

Simultaneously recuperating pressure seals on both plungers cover recuperating holes, developing pressure simultaneously in both chambers.

Pressurised fluid in primary chamber is transmitted to rear brakes and from secondary chamber to front brakes.

Fluid reservoir comprises of two separate chambers serving each system with a common topping up connection at upper portion.

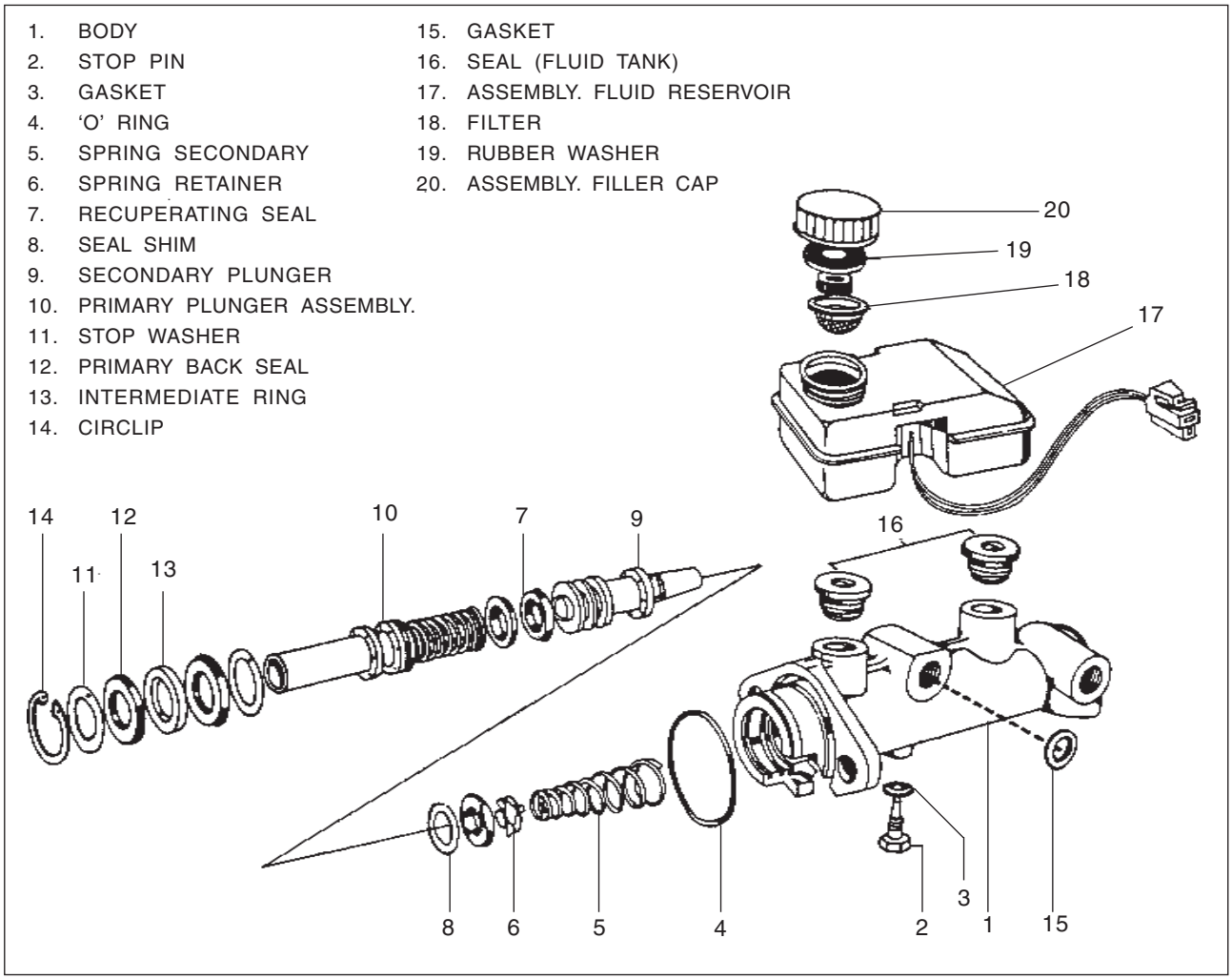


Fig. 7 - Tandem master cylinder - Exploded view (BI TVS)

OVERHAULING OF TANDEM MASTER CYLINDER

Master cylinder should be overhauled at specified intervals.

If condition of bore is satisfactory, overhauling can be done by using genuine repair kit.

Or else, a new cylinder assembly needs to be fitted.

During overhaul, all internal parts including plungers and springs should be replaced. with genuine parts provided in the kit.

REMOVAL OF TANDEM MASTER CYLINDER

Connect a bleed tube to one of the rear wheel cylinder's bleed screw and drain fluid into a container by pumping the pedal.

Repeat the same by connecting the bleed tube to one of the front wheel cylinder's bleed screws and collect the fluid.

Disconnect all outlet pipes from master cylinder.

Loosen master cylinder mounting nuts and remove the same.

DISMANTLING OF TANDEM MASTER CYLINDER (BI TVS)

Clean tandem master cylinder assembly externally with alcohol or fresh brake fluid before dismantling it.

Hold the fluid reservoir and by rocking it on either side, lift the same out of the grommets in the tandem master cylinder.

Remove both the grommets from the master cylinder body using a connector screw driver with blunt edge.

Remove the 'O' ring fitted in the groove on the mounting flange with a blunt edged pin.

Slightly push the primary plunger with a round rod, hold it in depressed position and remove the stop pin, with gasket.

Without removing the tandem master cylinder, the secondary plunger cannot be removed.

Remove the adaptor from the secondary outlet.

Then, clamp the cylinder (housing) in a vice with soft jaws. With the help of circlip plier, remove the circlip.

Remove the complete primary plunger assembly out of the bore.

Remove the stop washers intermediate ring and the primary back seals out from the shaft of the primary plunger.

Remove the cylinder from the vice.

Tap the cylinder, bore facing downwards, on a wooden block to allow the secondary plunger and the return spring to slide out of the bore.

Clean the cylinder bore in fresh brake fluid or alcohol and blow with compressed air.

Be sure that the four holes (two cut off holes and two feed holes visible through the primary and secondary inlet ports) in the cylinder body are clean, by blowing dry compressed air.

Do not poke the holes with sharp instrument.

Blow breather hole at the flange and make sure it is clear.

INSPECTION OF TANDEM MASTER CYLINDER (BI TVS)

Examine the bore of the tandem master cylinder.

If it is not scored, rodged or corroded and is smooth to the touch, the master cylinder can be re-assembled using the parts from the genuine kit.

If bore has deep grooves or pitting marks, fit a new master cylinder assembly.

If contamination is observed in the removed seals (normally they would have swollen and can be compared with new seals from the kit which will tell clearly that the size is enlarged), the entire system, i.e. wheels cylinder rubber parts including both front and rear hoses must be discarded and the entire system should be flushed.

CAUTION :
Do not use kerosene (or) petrol (or) any other mineral oils to clean the cylinder and its internal parts. As it will lead to contamination and damage of rubber parts. Clean all dismantled parts with alcohol or recommended fresh brake fluid only.

ASSEMBLING TANDEM MASTER CYLINDER (BI TVS) *(Fig. 7)*

To facilitate easy assembly, smear the cylinder bore with fresh brake fluid liberally.

Dip the plungers and all seals in fresh brake fluid.

Fit recuperating seals in the secondary plunger grooves. The first seal lip facing the primary plunger assembly and the lip of the second seal facing the opposite side.

Push the seal shim recuperating seal on the stem side of the secondary plunger in such a way that the lip of the seal faces towards the secondary spring.

Fit the spring retainer in correct position and fit the secondary spring.

Clamp the cylinder body with its mouth pointing upwards in a vice fitted with soft jaws.

Fit secondary plunger assembly with the secondary spring leading into the bore using seal guide.

Then slowly push the plunger down the bore, with a round ended rod. Press it down fully and whilst holding screw in the stop pin with a new gasket (stop pin) and tighten to a torque of 0.55 to 0.7 mkg.

Slowly let the secondary plunger back till it touches the stop screw.

Now insert the primary plunger assembly in the same manner into the bore using the seal guide.

Fit the first stop washer on to the primary plunger shaft.

Fit the primary back seal into bush and slide the bush on to the primary plunger shaft with the seal in the bush leading into the bore.

Press the bush firmly into the bore.

Insert guide on to the primary shaft. Whilst pressing down the guide remove the bush.

Remove the guide from the primary plunger shaft.

Insert intermediate ring on to the primary plunger shaft.

Fit the second primary back seal into Bush and fit the seal on to the primary plunger shaft as done earlier.

Fit the second stop washer on to the plunger shaft.

Fit circlip by using a circlip plier.

NOTE :

While fitting the primary back seals, make sure that lips of the seals are facing forward.

Actuate the primary plunger assembly for couple of times and check for the quick return of the plunger.

Fit a new 'O' ring in the groove on the mounting flange of the body.

Fit grommet into both inlet ports by liberally lubricating the same with fresh brake fluid.

Fit fluid collection tray on to the fluid reservoir outlets and position the same into the grommets and slightly rocking them on to the either side, press it home.

NOTE :

It is essential that the reservoir filler cap must be removed. The baffle and baffle cover taken out from its place and the breather hole in the cap is cleared and the baffle and the baffle cover refitted before fitting the filler cap on to the tank. It is advisable to replace the rubber washer in the filler cap during every overhaul.

Now the tandem master cylinder is ready for fitment.

Do not alter the height of the output push rod of the vacuum booster unit.

Tandem Master Cylinder is to be fitted back on to the vacuum booster in the reverse order of removal.

Tighten mounting nuts to specified torque.

Connect outlet pipes to master cylinder.

Tighten coulping nuts to specified torque.

Fill reservoir with recommended brake fluid and bleed the system.

Check for brake fluid leaks.

TANDEM MASTER CYLINDER (KBX) :

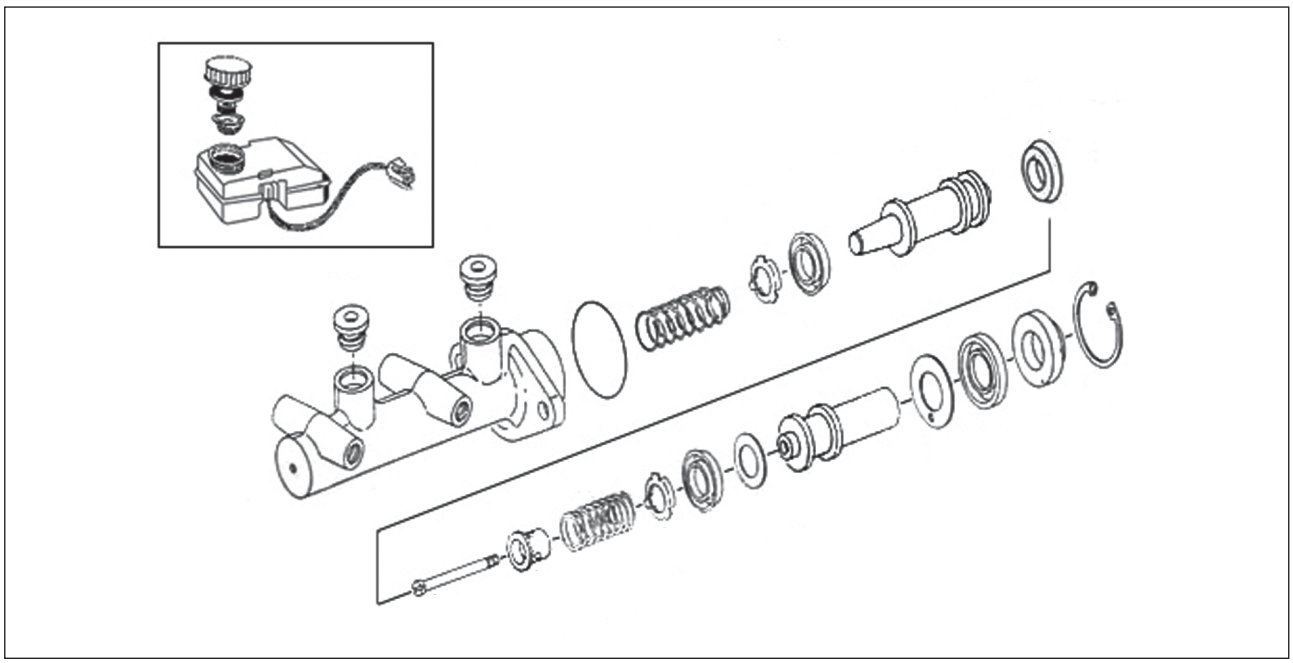


Fig. 7a - Tandem master cylinder - Exploded view (KBX)

ALUMINIUM TANDEM MASTER CYLINDER ASSEMBLY (KBX)

Type – Compensatory Port Type

Diameter – 23.81 mm

Primary Stroke – 15 mm

Secondary Stroke – 18 mm

Primary Connected to – RR . RH & LH

Secondary Connected to – FT. RH & LH

1. General –

This is a light weight master cylinder with heat treated Aluminium body & with bore anodized . It has rigid steel pistons & single static seal type design. There is no secondary piston stopper .

In this kind of Tandem Master Cylinder, TMC is attached to booster assembly with the help of nuts & bolts on its flange & plastic reservoir is inserted in to its inlet port , which has circular baffle to house float of level indicator switch which shows the low fluid level of reservoir & vertical baffles are provided in order to divide the brake fluid of the reservoir in two portions , one is for primary circuit & other is for secondary circuit. Fluid is circulated separately to primary port & secondary port of TMC due to this division.

Tandem Master Cylinder consists of two pistons, four seals,two springs & spring seats. Out of which two seals are fitted on secondary piston , one seal is fitted on primary piston & one seal is called static seal which is fitted on cup retainer & TMC body.

2. Operation –

2.1 Normal Operation –

Depression of the brake pedal forces primary piston inside the bore , which in turn pressurizes the brake fluid next to it & actuates rear (RH) & rear (LH) brakes. Simultaneously secondary circuit gets operated & actuates another set of brakes in front (LH) & (RH).

2.2 One Circuit Operation Primary (REAR – RH & LH) Failure –

Depression of the brake pedal makes primary piston to move inside the bore , but due to failure of primary circuit system can not hold the pressure, also brake fluid next to it will not get pressurized . Still primary piston keeps on moving finally compressing primary piston return spring. When the primary piston return is fully compressed the secondary piston moves & pressurises front (RH) & (LH) brakes.

2.3 One Circuit Operation Secondary (FRONT RH & LH) Failure –

In this case , the inward movement of the primary piston has little effect in pressurizing the brake fluid in the primary circuit initially , because the initial built up of pressure in the primary circuit causes the secondary piston to promptly yield & move inward without much resistance as the secondary has a leak. Very soon the secondary piston touches the cylinder wall & hence stops moving forward. From this point onwards, the pressure starts building up in the primary circuit which actuates one set of brake.

3. Overhauling of Tandem Master Cylinder –

TMC should be overhauled periodically as specified by us. During the overhaul all rubber parts along with pistons, springs and other hardware parts should be replaced with genuine KBX spare parts and kits. This should be done only if the condition of the cylinder bore is satisfactory, i.e. free from score marks, ridges, pittings etc., Otherwise the complete TMC is to be replaced with a new assembly.

Before removing TMC from Booster take out all the brake fluid from the reservoir with a syringe or attaching the bleeding pipe to Rear Brake & Front Caliper Pump the brake fluid out from the brake lines.

3.1 Dismantling of the TMC (KBX) –

1. Hold the brake fluid reservoir and by rocking it on both sides, lift the same out of the rubber grommets fitted on to the TMC ports.
2. Remove the rubber grommets from the TMC inlet ports with the help of a connector or screw driver with blunt edge..
3. By slightly depressing the primary piston, remove the circlip.
4. Remove the primary and secondary pistons by slightly tapping the cylinder on a wooden block.

5. Remove the static seal, piston guide and the retainer from the primary piston with the help of connector or screw driver with blunt edge.
6. Remove the secondary piston assembly by tapping the TMC gently on a wooden block.
7. Discard all rubber parts.
8. Clean all other parts using fresh brake fluid or alcohol and ensure these parts are kept in a clean tray or on a clean sheet of paper.

NEVER USE ANY MINERAL OIL BASE FLUIDS LIKE KEROSENE,DIESEL THINNER, PETROL etc,. FOR CLEANING OF REMOVED PARTS.

9. Ensure visually that the feed port holes (2 compensating holes + 2 vent holes) are clear. Do not poke these holes with sharp instruments.

3.2 Examination of TMC and Internal Parts –

Examine the bore of the TMC. If it is not scored , ridged or pitted and smooth, if felt, the TMC can be rebuilt with the genuine KBX spare parts kit. If in case of slightest doubt on the bore condition, like deep groves or score marks in the bore then a new cylinder assembly should be replaced.

Examine both the pistons for rust, ridges or burrs. Ensure both the plungers are in good condition, free from the above conditions.

If contamination is observed in the removed seals. (seals would have swollen and the size would have enlarged compared to the new seals) ensure all rubber parts in the system including rear wheel cylinder seals, front wheel cylinder / caliper seals and the front and rear rubber hoses must be discarded and the entire system to be flushed with new brake fluid.

3.3 Replacement of seal Kit –

After inspection of TMC bore & Pistons, if no abnormal wear or scratch marks , damage is observed then TMC can be rebuild using Minor Repair Kit. If pistons are found defective then also TMC can be rebuild by using Major Repair Kit.

Follow the instructions given below for replacement of Minor Kit —

1. Remove the Secondary Piston return spring & take out the primary seal.
2. By cutting the secondary seal remove it from the piston.
3. Unscrew the primary piston shoulder screw & take out Spring, Spring retainer, spring seat & Primary Seal.
4. Discard & destroy all old rubber seals. Wash the pistons & other parts thoroughly in fresh brake fluid.
5. Dip the new seals in fresh brake fluid for ten minutes.
6. With the help of appropriate mandrel assemble secondary piston secondary seal in the correct direction i.e. lip side of the seal pointing towards primary piston.
7. Assemble the Safety washer, primary seal, spring seat & spring on Secondary Piston.
8. Assemble Safety washer, Primary seal, spring seat, spring, spring retainer & shoulder screw on primary piston.
9. Hold this whole assembly, firmly press the spring down & tighten the shoulder screw till the shoulder touches the piston. Do not over tighten the shoulder screw. Cross check the total length of the piston.

3.4 Assembly Of TMC (KBX) –

1. Ensure the hands are clean and clear from any mineral oil.
2. Dip the pistons and all rubber parts supplied in the service kit in fresh brake fluid. Also lubricate the TMC bore with fresh brake fluid for easy entry of Piston Assemblies.
3. Insert the secondary piston assembly into the bore, with the spring end leading. Care must be taken to properly guide the seals into the bore and thereby avoiding any damage to the seals.
4. Assemble the Seal Retainer, Static Seal, piston guide to the primary piston assembly.
5. Insert the primary piston assembly into the bore, with the spring end leading.
6. Depress the primary piston and fit the circlip. Ensure the seating of the circlip squarely into the TMC groove.

7. With the help of a hylum rod actuate the primary piston couple of times to ensure the quick return of the piston.
8. Fit the fluid reservoir grommets after liberally lubricating the inlet ports with fresh brake fluid .Position the reservoir into the reservoir grommets holding it slightly at an angle & press it inside the grommets.

ENSURE FITMENT OF SEALING RING IN THE GROOVE OF THE TMC BEFORE MOUNTING ON TO THE BOOSTER.

NOTE –

1. It is essential that reservoir cap must be removed and cleaned.
2. After fitting TMC on to the vehicle / vacuum booster, the outlet pipes are to be connected and torque tightened.

NOTE :

Tandem master cylinders of BI TVS & KBX are being used in selection.

In both the makes we have TMCs with cast iron body & aluminium body.

BI TVS : TMC with cast iron body is used in normal 10" vaccum booster.

TMC with aluminium body is used in normal 10" booster & in Zero dead stroke double diaphragm boosters.

Repair kits for cast iron version & aluminium version are different.

KBX : This make of TMC (cast iron version & aluminium version) are presently used only for normal 10" vaccum booster.

Repair kits for cast iron version & aluminium version are same in KBX make.

In view of the above, please ensure to use correct make/type of repair kit while overhauling TMC.

BLEEDING THE HYDRAULIC BRAKE SYSTEM

The process of removing air from hydraulic pipe line and cylinders is known as 'Bleeding', and it is necessary whenever any part of the system has been disconnected, or the level of fluid in the plastic container has been allowed to fall so low that air has been drawn into the tandem master cylinder.

PROCEDURE

Carefully clean all dirt around filler cap. Remove filler cap, fill the reservoir with fresh brake fluid to the lower edge of filler neck. Fig. 8. Before commencing bleeding at each bleed screw, remove dust cap and clean thoroughly.

Disc brakes are bled first. Although they are closest to tandem master cylinder, plunger bore are much larger than wheel cylinder bores. Therefore they contain a greater amount of fluid.

Attach bleed tube to left front caliper bleed screw and place other end of the tube in a clean glass jar containing sufficient brake fluid to submerge the end of the tube. Fig. 9.

It may be advantageous to bleed the entire system with engine running.

Open bleed screws by 1/2 to 3/4 of a turn, sufficient to allow brake fluid to flow freely.

Depress foot pedal slowly throughout full stroke of the pedal, and allow it to return to its stop slowly.

There should be an interval of 3 to 4 seconds before making next stroke.

This action should be repeated until bubbles of air cease to appear at the end of the bleed tube.

Close the bleed screw immediately after the last downward stroke of the pedal.

Whilst the pedal is thus held, securely tighten the bleed screw and remove the tube.

Replace the dust cap on the bleed screw.

Ensure that the fluid level in the tandem master cylinder reservoir does not fall low enough to cause air to be drawn into the system, throughout the bleeding operation.

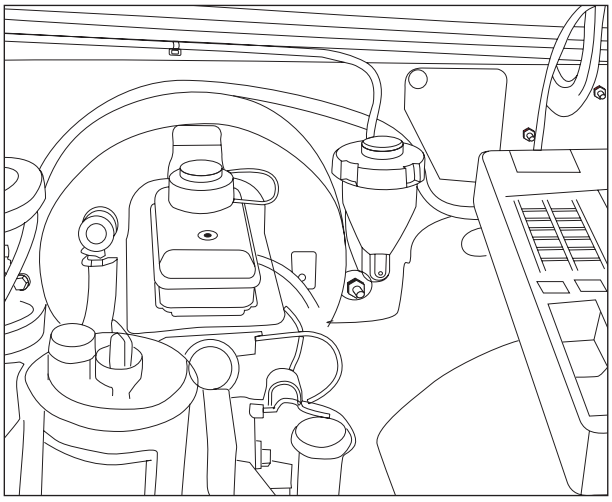


Fig. 8

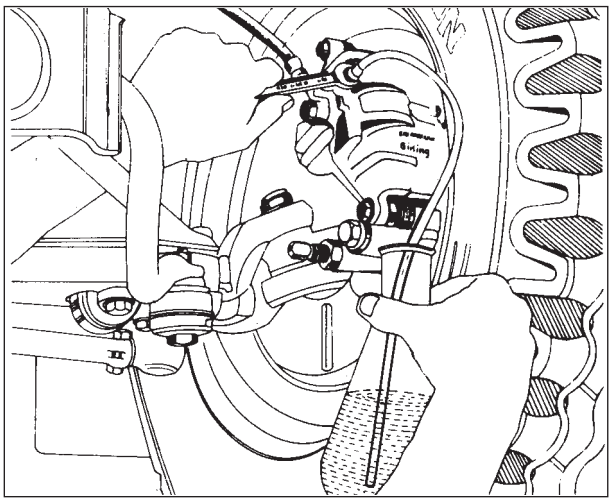


Fig. 9

Repeat the same procedure on the right front caliper, left rear wheel cylinder followed by the rear right wheel cylinder. Fig. 10.

If bleeding of any cylinder continues without success for a considerable time, it may be that air is being drawn in past bleed screw threads.

In such instances, bleed screw should be closed at the end of each downward stroke of the pedal, allowing the pedal to return fully to its stop before re-opening.

Tighten the bleed screw finally after the last downward stroke of the pedal.

Replace the dust cap on the bleed screw.

After completion of bleeding, apply brake pedal hard and check for any leak at the joints and bleed screws.

Check brake pedal for sponginess. If found spongy, repeat complete procedure of bleeding.

If pressure bleeding is done, engine need not run. But the sequence of bleeding operation should still be left front - right front - left rear and right rear only.

ALWAYS USE RECOMMENDED GRADE OF BRAKE FLUID.

Do not use the fluid bled from the system for refilling in to the reservoir.

CAUTION : Brake fluid may cause damage to paint. So make sure that brake fluid does not touch the painted surface. In case brake fluid comes in contact with painted surface, wipe immediately & clean the surface.

Set brake light switch dimensions 3 $\pm$ 0.5 and tighten lock nut.

Brake Fluid Level Inspection :

After completion of brake bleeding check the brake fluid level in the reservoir. The fluid level should be between MIN & MAX level indicated on the brake fluid reservoir.

If the warning lamp glows during engine 'ON' condition replenish fluid to MAX line.

Never use a container which has been used for mineral oil or which is wet. Always keep all brake fluid containers capped to prevent contamination.

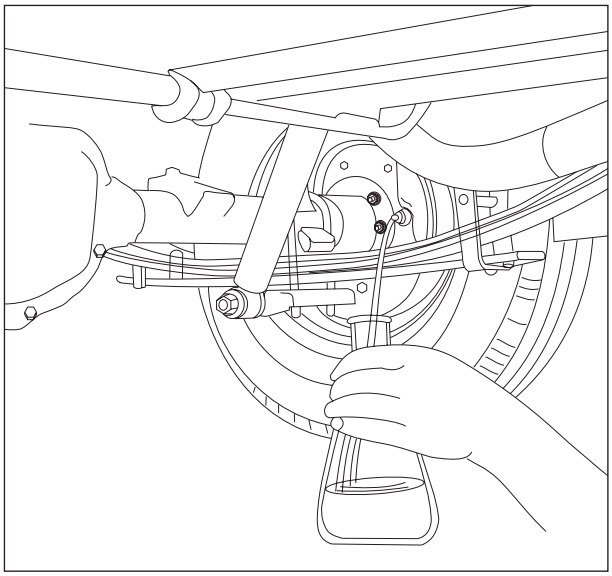


Fig. 10

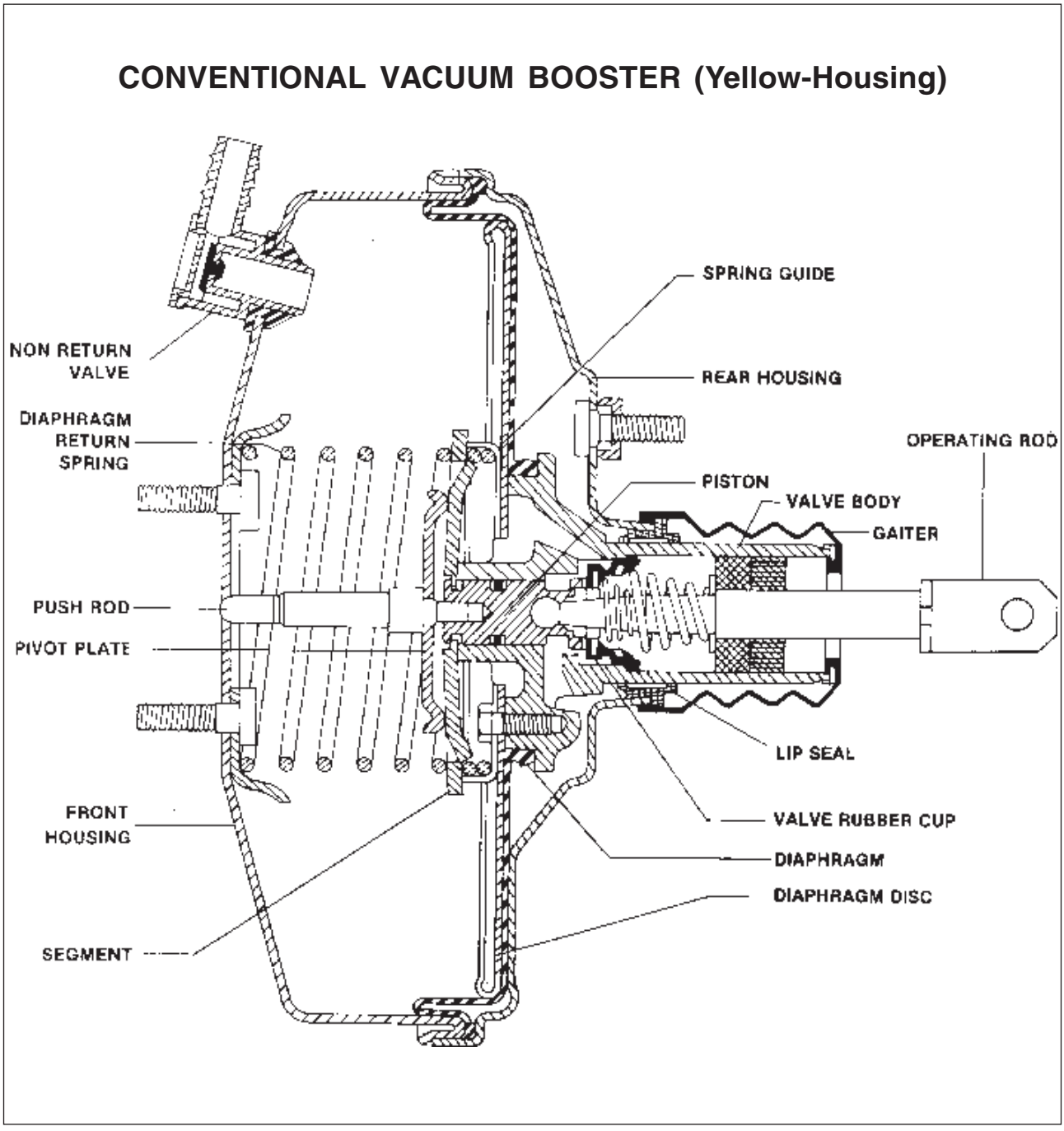


Fig. 11

VACUUM BOOSTER *(Fig. 11)*

FUNCTION

To provide power assistance by boosting up the mechanical effort on the attached hydraulic tandem master cylinder using the pressure difference between atmosphere and vacuum.

DESCRIPTION

This assembly is installed between the brake pedal and the tandem master cylinder. Employing the pressure difference between negative - pressure (VACUUM) developed from the vacuum

pump and atmosphere. The booster provides increased force resulting in more effective braking performance. The servo mechanism, which translates this auxiliary force into braking force uses a mechanical type lever balance system.

SERVICE CHECK

a. Inspection

- Check the tightness of the mounting nuts (torque 2.5 mkg)

b. Operating tests

- Check for free movement of the push rod without binding while applying / releasing brake.
- Check for vacuum leak in brakes applied / released position and ensure that the pipe lines and joints are from leakage.

PROCEDURE FOR CHECKING

Check the Vacuum Booster as per the procedure given below :

1. Connect a Vacuum gauge between Vacuum pump and vacuum booster with the help of a suitable T connector.
2. Bleed the hydraulic lines.
3. Apply and release the brake without vacuum assistance and check for free return of brake pedal. If not, check the brake linkage, brake light switch adjustment and pedal return spring. Replace the defective component if necessary.
4. Start the engine and note the vacuum in the gauge. It should be minimum 0.6 bar below atmospheric pressure. If it is less, check for leakages in the pipe line and condition of vacuum pump.
5. CHECK OFF LEAK : Build up maximum vacuum in the vacuum booster. Switch off the engine. With the pedal in released condition, drop in vacuum level in 30 seconds should be less than 0.03 bar.
6. CHECK ON LEAK : Build up maximum vacuum in the vacuum booster. Switch off the engine. When the brake, further drop in vacuum level in 30 seconds should be less than 0.05 bar.
7. Apply and release the brake with vacuum assistance and check for free return of brake pedal.

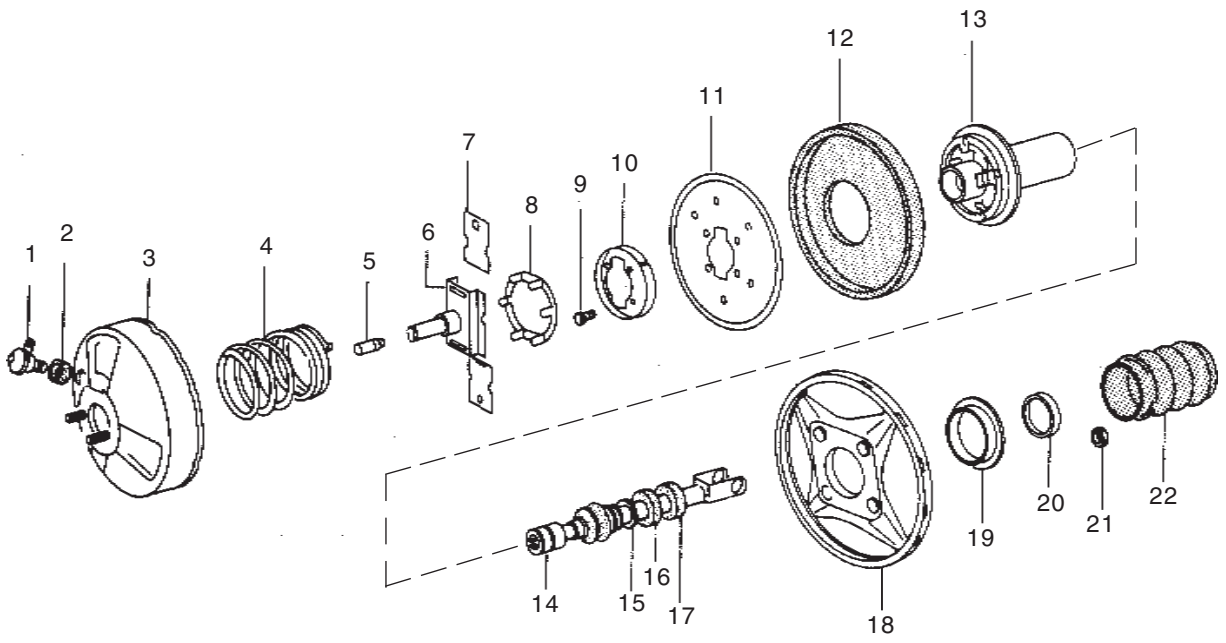
If conditions 5 and 6 are not fulfilled, replace the vacuum booster or repair kit.

REMOVAL

1. Place wheel chokes in front and behind the wheels to prevent movement of the vehicle.
2. Remove the brake pedal return spring.
3. Remove the fork pin of vacuum brake valve.
4. Disconnect the hydraulic lines.
5. Remove the tandem master cylinder.
6. Disconnect vacuum line connected to Non Return Valve.
7. Remove the mounting nuts of vacuum brake valve and remove the nuts.

DISASSEMBLY

1. Clean the exterior of the unit.
2. Remove the non return valve, grommet, gaiter and filter retainer.
3. Mark the position of front & rear housing to ensure proper orientation of tandem master cylinder mounting studs in front housing with respect to the rear housing mounting studs.
4. Place and position the unit in the disassembly / assembly fixture 2651 5890 42 04 while fixture is clamped on a bench vice.
5. Place and position the swivel block on the front housing.
6. Tighten the fixture handle to rest on the swivel block. Avoid overtightening.
7. Rotate the rods and match the notches & dimples in line. Do not over rotate, otherwise the assembly will get locked again. If loosening is difficult, loosen the handle slightly and then rotate the rods.
8. After the front housing gets unlocked loosen the fixture handle slowly until the front housing gets separated fully.
9. Unfold the segment retainer and remove the pivot assembly.
10. Push in the operating rod assembly from fork end and relieve the segments from piston groove.



COMPONENTS

1 NON RETURN VALVE	8 SEGMENT RETAINER	16 FILTER
2 RUBBER GROMMET	9 SCREW	17 FILTER
3 FRONT HOUSING ASSEMBLY	10 SPRING GUIDE	18 REAR HOUSING ASSEMBLY
4 DIAPHRAGM RETURN SPRING	11 DIAPHRAGM DISC	19 LIP SEAL
5 SPHERICAL END PIECE	12 DIAPHRAGM	20 FILTER RETAINER
PIVOT ASSEMBLY COMPRISING	13 VALVE BODY	21 NUT
6 PUSH ROD ASSEMBLY	14 SEALING RING	22 GAITER
7 SEGMENT	15 OPERATING ROD ASSEMBLY	

Fig. 12 - Vacuum brake valve (Exploded view)

11. Remove the diaphragm return spring, segments and the segment retainer.
12. Remove the operating rod assembly from valve body by pulling it out at the fork end.
13. Loosen and remove M6 set screw (10 A/F) four numbers from the value body.
14. Remove the spring guide, diaphragm disc and diaphragm from valve body.
15. Press out the lip seal from rear housing.

CLEANING AND INSPECTION

1. Wash and clean all metal parts and blow dry with compressed air.
2. Inspect all the parts for excessive wear and deterioration.
3. Check valve body piston bore and outer diameter for any score mark / crack / damage.

ASSEMBLY *(Ref. Figs. 12 and 13)*

1. Use recommended repair kit and diaphragm to replace old parts found to be worn out / scored during inspection.
2. Lubricate all moving parts and 'O' rings (except diaphragm) with **grease supplied alongwith repair kit.**

3. Press in the lip seal in the rear housing using a soft mandrel and ensure that the lip seal seats on the rear housing properly. Use a wooden mallet to tap the seal into the housing.
4. Pack adequate grease in the lip seal.
5. Place and position the diaphragm, the diaphragm disc and spring guide on the valve body
6. Secure the above onto the valve body using M6 set screws by tightening to a torque of 1 mkg. Use Loctite 242 or equivalent on the screws lightly before fixing them onto the valve body.
7. Assemble 'O' ring on the piston groove of operating rod assembly.
8. Drop the valve body in the rear housing bore and insert the operating rod assembly in the valve body.
9. Check the segments and pivot plate for proper orientation and assembly.
10. Ensure that there are two solid coils below both the segments as shown in Fig. 14.
11. Push in the operating rod allowing the piston to come out from valve body, so that the groove on piston protrudes out adequately to assemble the segments in the groove. Pull out segments slightly upward and check for proper seating.
12. Fold the segment retainer and secure the pivot assembly together.
13. Place the rear housing assembly with valve body and operating rod assembly secured with pivot assembly and diaphragm return spring on the fixture.
14. Locate the diaphragm on the rear housing and ensure proper seating of the diaphragm outer bead in the rear housing shell. Apply french chalk powder on the diaphragm surface and its outer beading.
15. Place and position the front housing on the return spring and match its notches with the dimples provided in the rear housing. Ensure that the marking made during dismantling lies closely apart.
16. Tighten the fixture handle simultaneously aligning the notches of front housing and dimples of rear housing in line. Continue tightening to allow the front housing to move freely and contact the diaphragm.

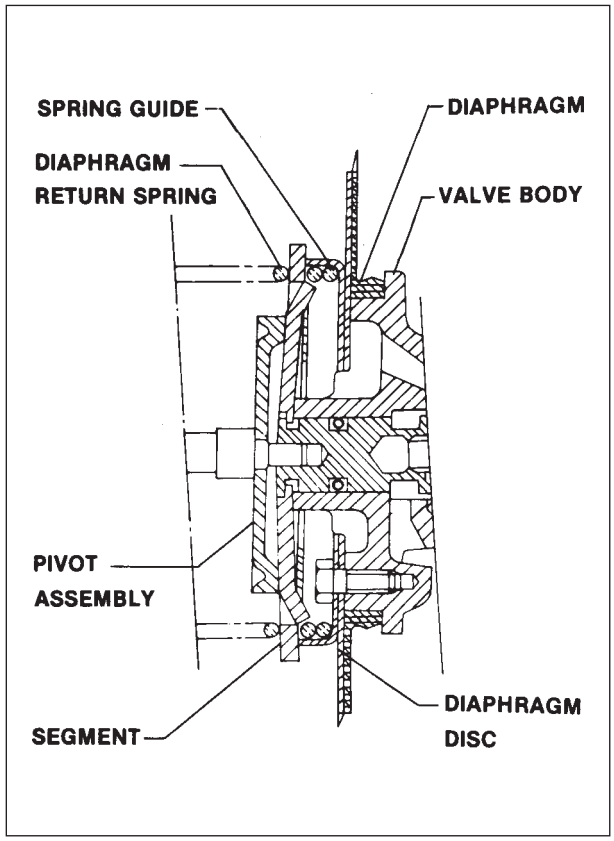


Fig. 13

17. Rotate the rods uniformly without jerk to avoid twisting of diaphragm and lock the housing and match the marking.
18. Avoid grease / oil from diaphragm during assembly.
19. Loosen the handle and remove the unit from the fixture.
20. Assemble the grommet, non return valve, filter retainer and gaiter. Ensure gaiter is located properly on both ends.
21. Mount the unit on the vehicle and connect brake pedal return spring. Adjust pedal position and free play.
22. Connect the vacuum pump line with the non return valve of vacuum brake valve.
23. Mount the master cylinder on the vacuum brake valve and connect the hydraulic lines. Bleed the hydraulic system.

ZERO DEAD STROKE DOUBLE DIAPHARM VACUUM BOOSTER (Black-Housing) (IF FITTED)

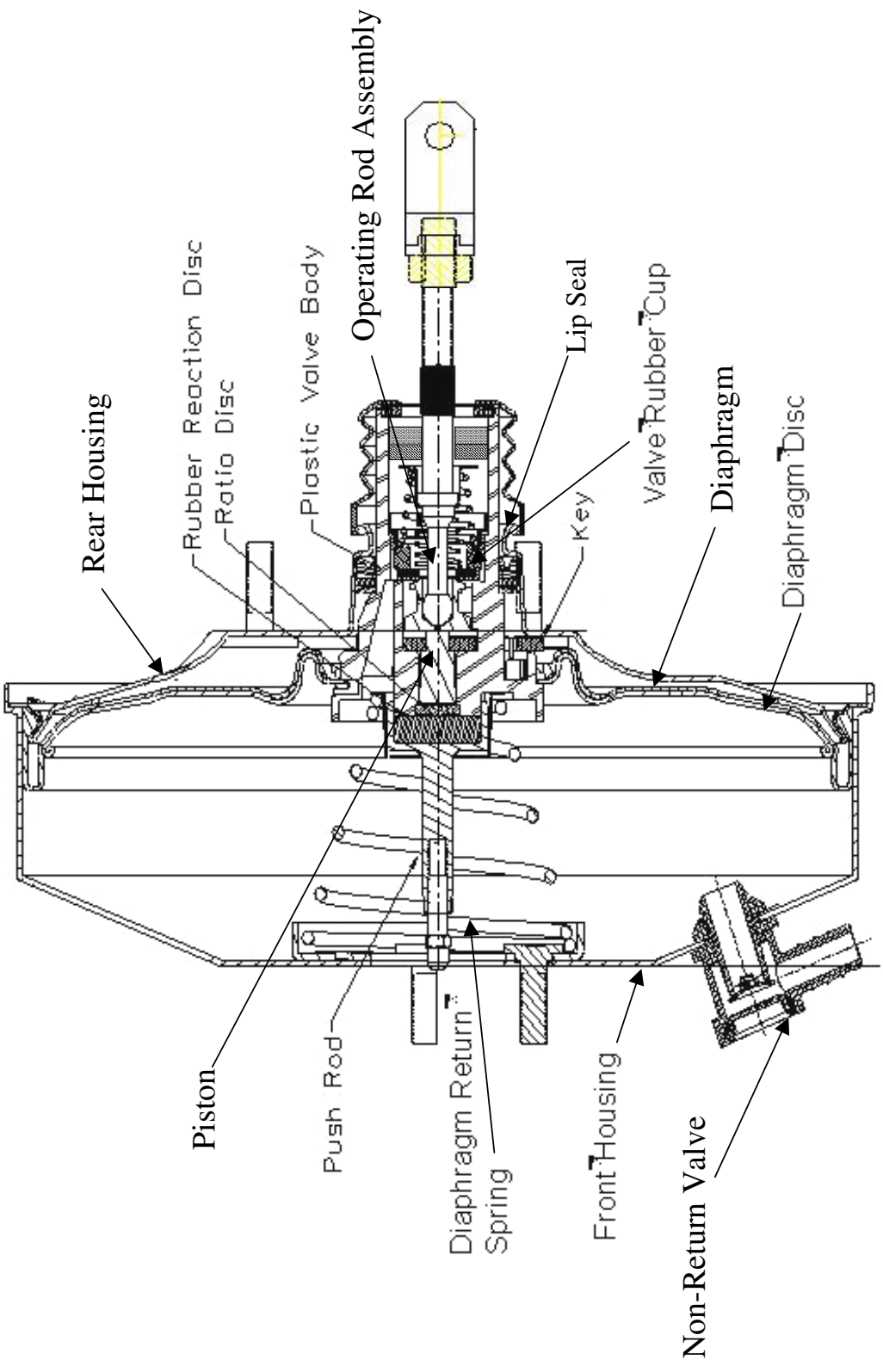


Fig. 14

ZERO DEAD STROKE DOUBLE DIAPHRAGM VACUUM BOOSTER

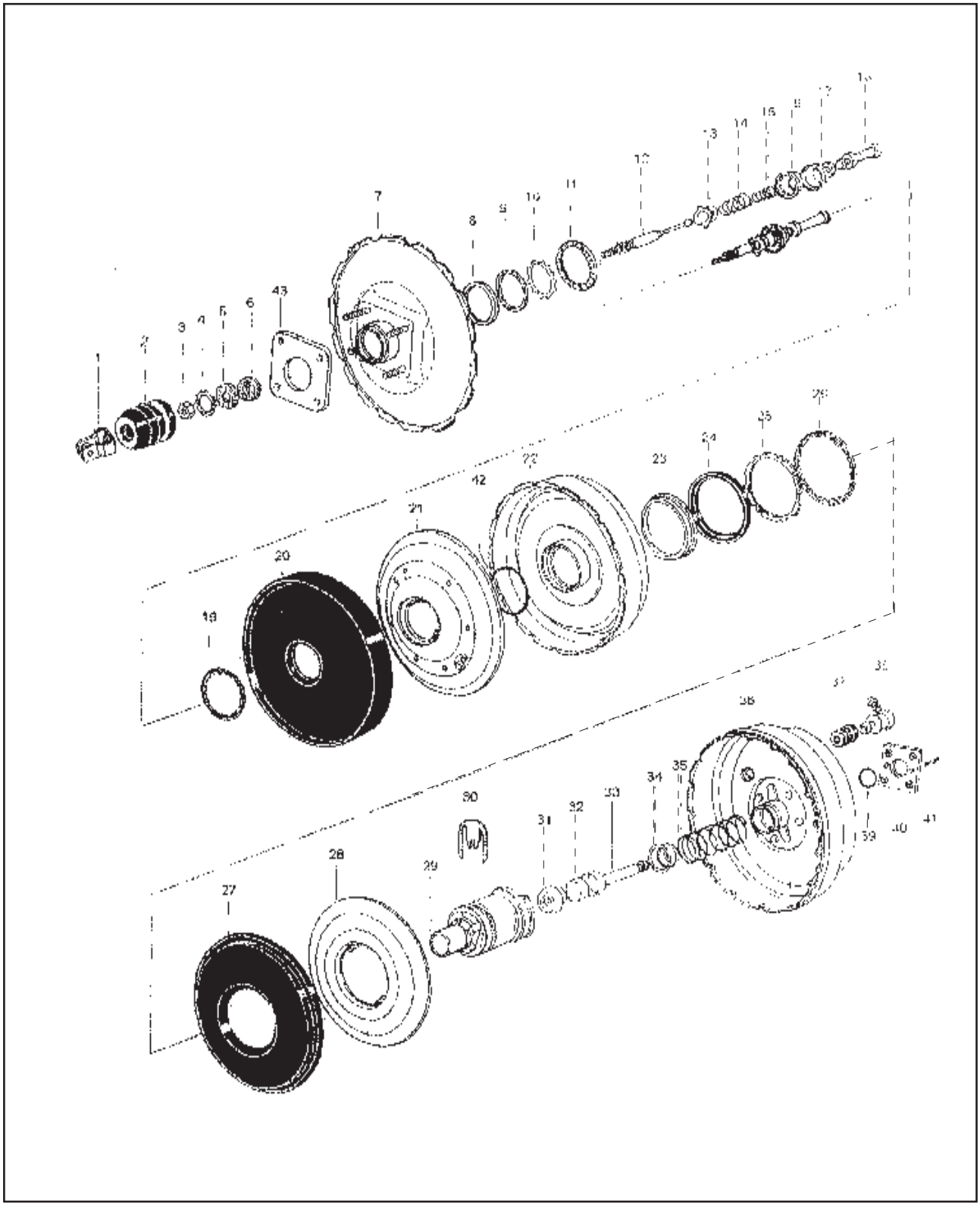


Fig. 15 Exploded view double diaphragm vacuum booster

DOUBLE DIAPHRAGM VACUUM BOOSTER PARTS

N0.	PART NAME
1.	Fork
2.	Gaiter
3.	M10* 1.5 ISO Nut
4.	Retainer
5.	Filter
6.	Filter
7.	Rear Housing
8.	Retainer
9.	Spacer
10.	Retainer
11.	Key Retainer
	Operating Rod Sub Assy.
12.	Operating Rod
13.	Spring Retainer
14.	Retainer spring
15.	Spring
16.	Spring seat cup
17.	Valve Rubber cup
18.	Piston
19.	Seal
20.	Diaphragm
21.	Diaphragm Disc
22.	Cover
23.	Cover
24.	Seal
25.	Seal Retainer
26.	Retainer

N0.	PART NAME
27.	Diaphragm
28.	Diaphragm Disc
29.	Valve Body
30.	Key
31.	Bush
32.	Rubber Reaction Disc
33.	Push Rod
34.	Push Rod Retainer
35.	Spring
36.	Front Housing
37.	Rubber Grommet
38.	Non Return Valve Assy.
39.	M8*1.25 Hex Nut
40.	Gasket
41.	Sealing Ring
42.	Spacer
43.	Stud
44.	Sealing Ring

ZERO DEAD STROKE (ZDS) DOUBLE DIAPHRAGM VACUUM BOOSTER

ADVANTAGES OF ZDS BOOSTER :

a. Lower dead stroke

b. Lower overhaul stroke

c. Lower pedal force

d. Lower force requried to start braking action

All this lead to improved pedal feel.

1. FUNCTION :

To provide power assistance by boosting up mechanical effort applied at the brake pedal on the hydraulic master cylinder attached to it, using vacuum. The vacuum brake valve operates on the pressure difference between vacuum and atmospheric air.



Fig. 16

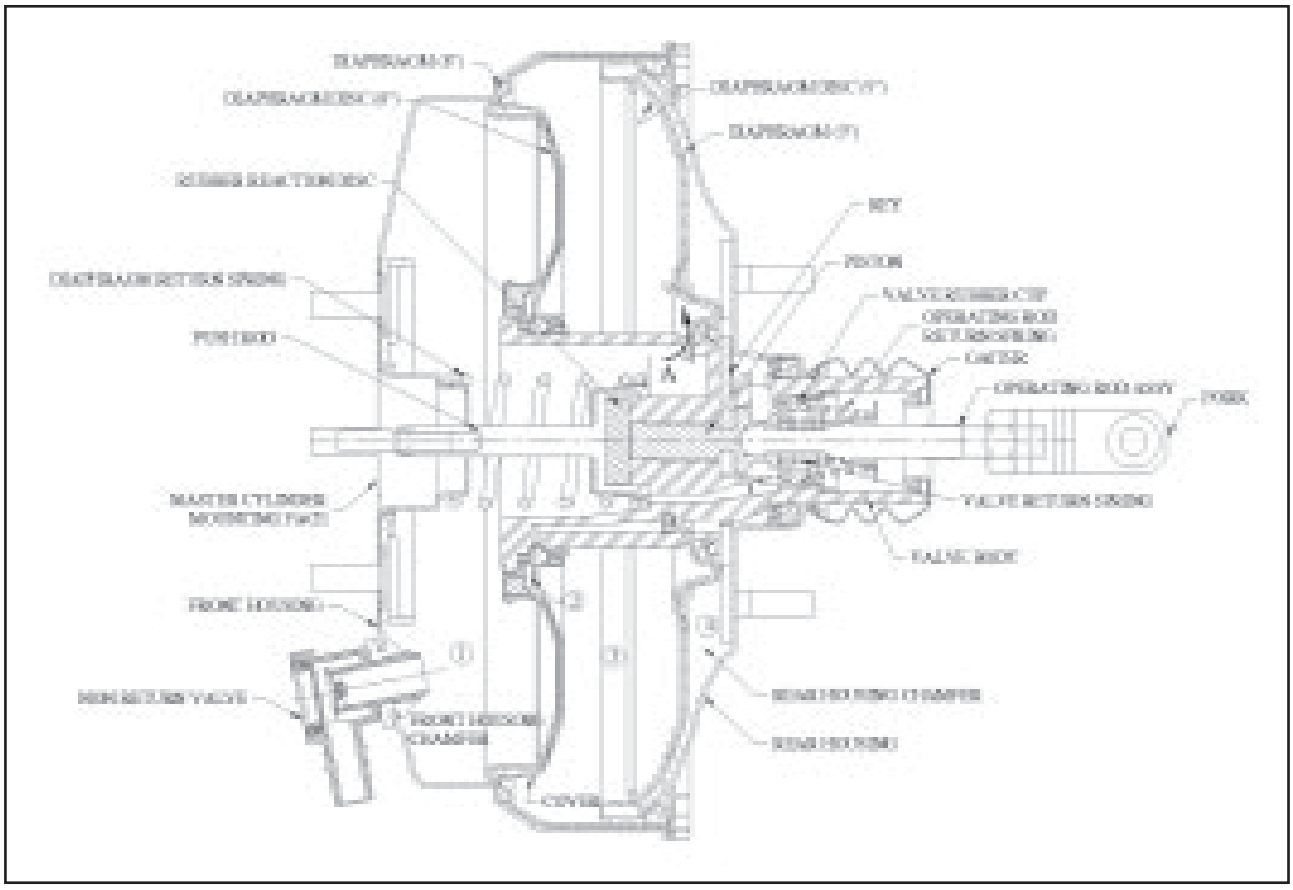


Fig. 17

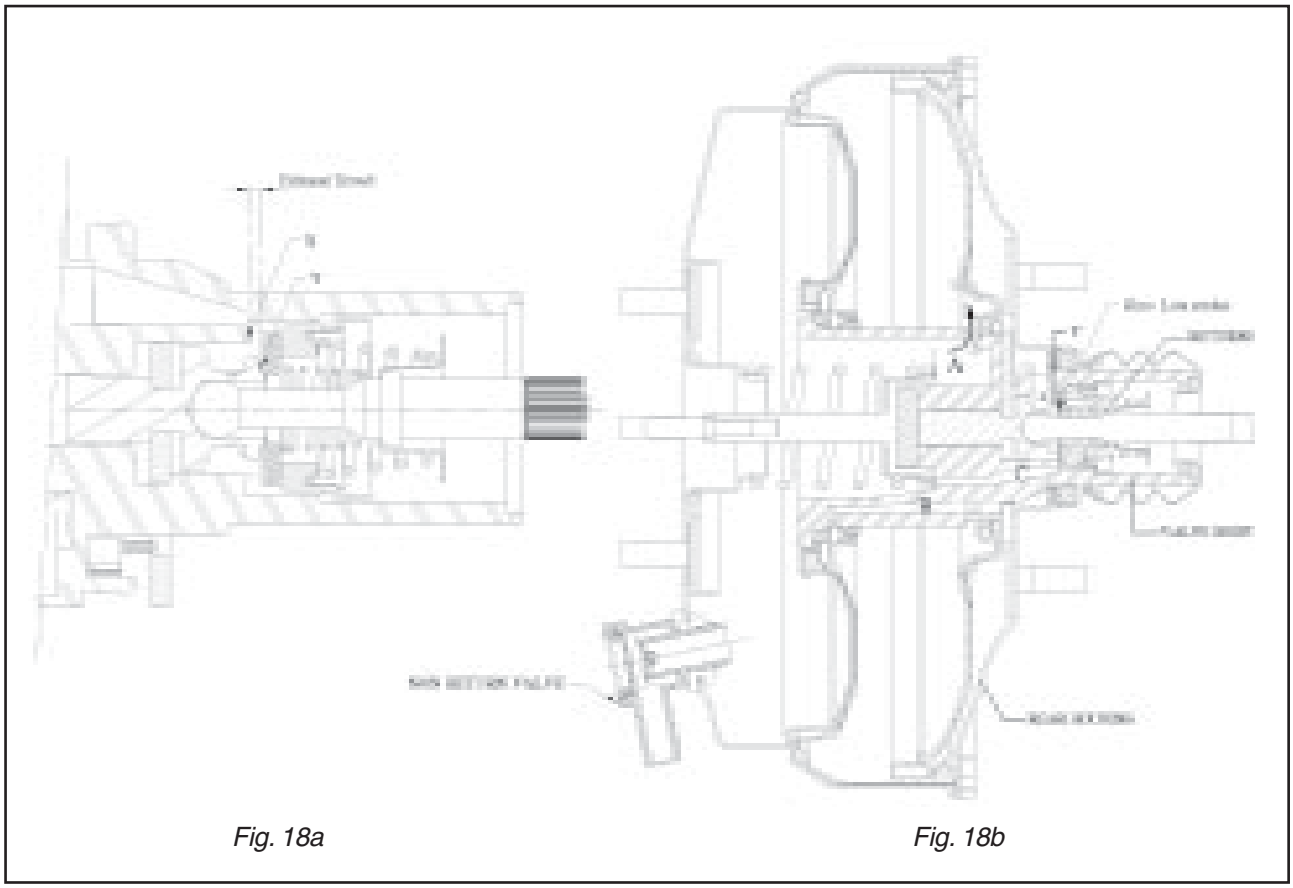


Fig. 18a *Fig. 18b*

Fig. 18

2. DESCRIPTION (Fig. 41):

This assembly is installed between the brake pedal and the master cylinder. Employing the pressure difference between the vacuum developed by the vacuum pump and atmospheric pressure, the vacuum brake valve amplifies the input force on the brake pedal resulting in more effective braking performance. The servomechanism, which converts this input force into braking force, is a rubber reaction disc type balancing system.

3. CONSTRUCTION (Fig. 41 & 42):

The assembly mainly consists of two diaphragms, sheet metal pressed front and rear housings, cover, valve body, operating rod assembly, push rod, key and rubber reaction disc. The 9" diaphragm's outer bead is clamped between the front and rear housing and its inner bead is mounted on the valve body. The 8" diaphragm's outer bead is clamped between front housing and cover and its inner bead is retained inside the diaphragm disc. The operating rod assembly consists of piston, valve rubber cup, operating rod, and valve retaining spring and operating rod return spring. This operating rod assembly is positioned inside the valve body by means of key. The rubber reaction disc is housed inside the push rod, which is retained in place against the valve body by the diaphragm return spring which is resting on the spring retainer. The assembly consists of four chambers namely 1,2,3 & 4 as in figure 2. In all conditions of operation, the chamber 1 and 3 will always be connected through passage A in the valve body and chambers 2 and 4 will be connected through another passage B in the valve body, as shown in figure 2. There is a vacuum passage C in the valve body, which connects the chamber 1 with chamber 4. The 8" diaphragm acts as a seal between chambers 4 and 3, while the 9" diaphragm acts as a seal between chambers 1 and 2.

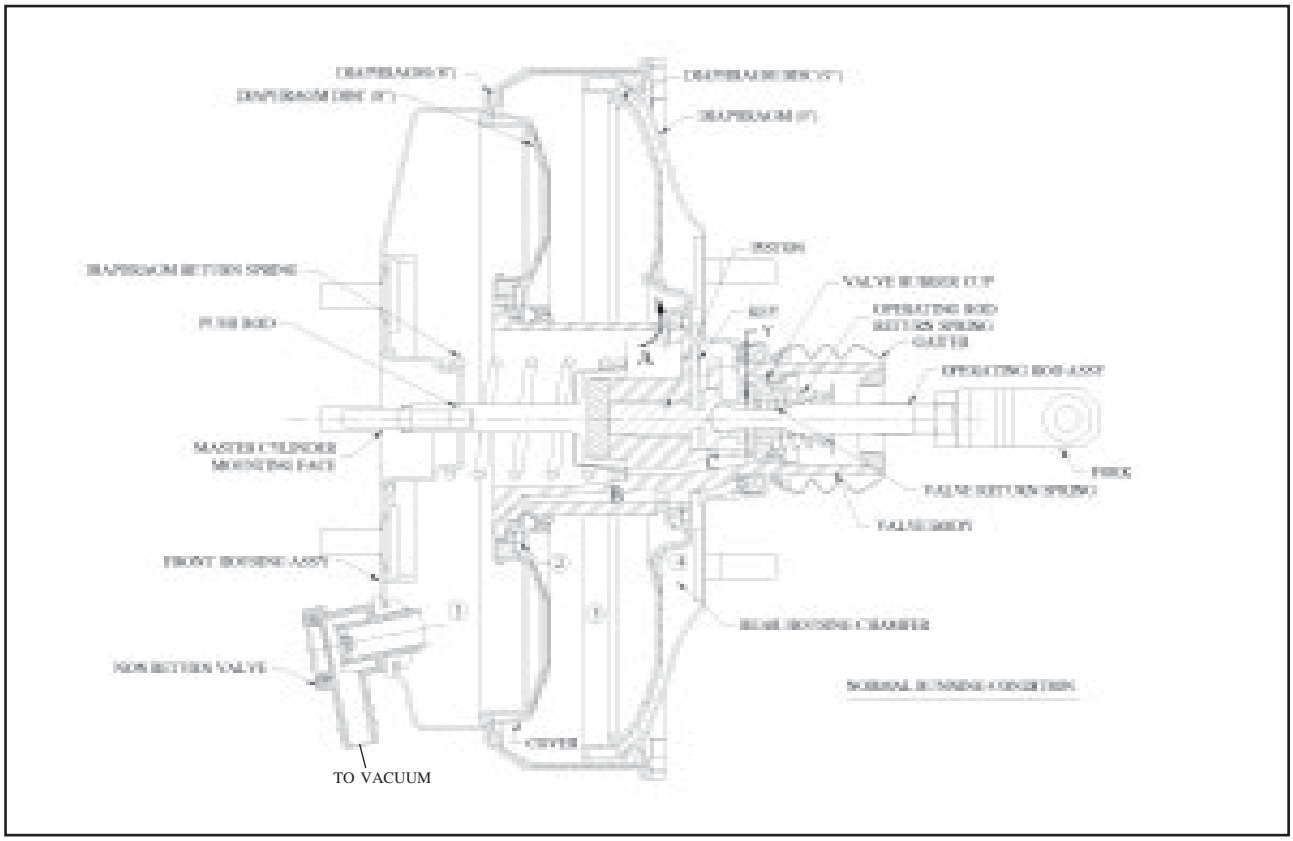


Fig. 19

4. ZERO LOST STROKE (Fig. 43):

From Fig. 43(a), we can see that the operating rod sub-assembly is attached to the valve body, by means of key. Due to the opposing force of operating rod return spring, the key is pulled towards the operating rod side, in the sub-assembly, keeping the vacuum valve (X) open. But when the valve body sub-assembly is fitted in the full assembly Fig. 43(b), the fitted force of diaphragm return spring pushes the valve body towards the rear housing, till the key butts against the rear housing. This movement of the valve body, results in the closing of the exhaust travel, thereby closing the vacuum valve and sometimes even opening the air valve (Y). On application of the vacuum, the valve body moves forward just enough to close the air valve (Y) and bring the assembly to a balanced condition. Hence, at normal running condition, both the vacuum and air valve are closed. This feature provides output force at nearly zero lost stroke of the operating rod.

5. OPERATION:

5.1 Released or normal running position (Fig. 44):

When the brakes are released, the vacuum brake valve is in released position. The valve body, operating rod sub-assembly, diaphragms and diaphragm discs are positioned towards the rear housing side due to the fitted load of diaphragm return spring. Both the vacuum valve (X) and air valve (Y) are in closed condition. Vacuum is applied to the vacuum brake valve, through the non-return valve in the front housing. Vacuum is communicated from chamber 1 to chamber 3 through the passage A and to chamber 4 through vacuum passage C. From chamber 4, vacuum is communicated to chamber 2 through the passage B. There is constant vacuum in all the 4 chambers, in the normal running condition. As the diaphragms and valve body are pushed towards rear housing by the diaphragm return spring, no force is transmitted to the master cylinder in this condition.

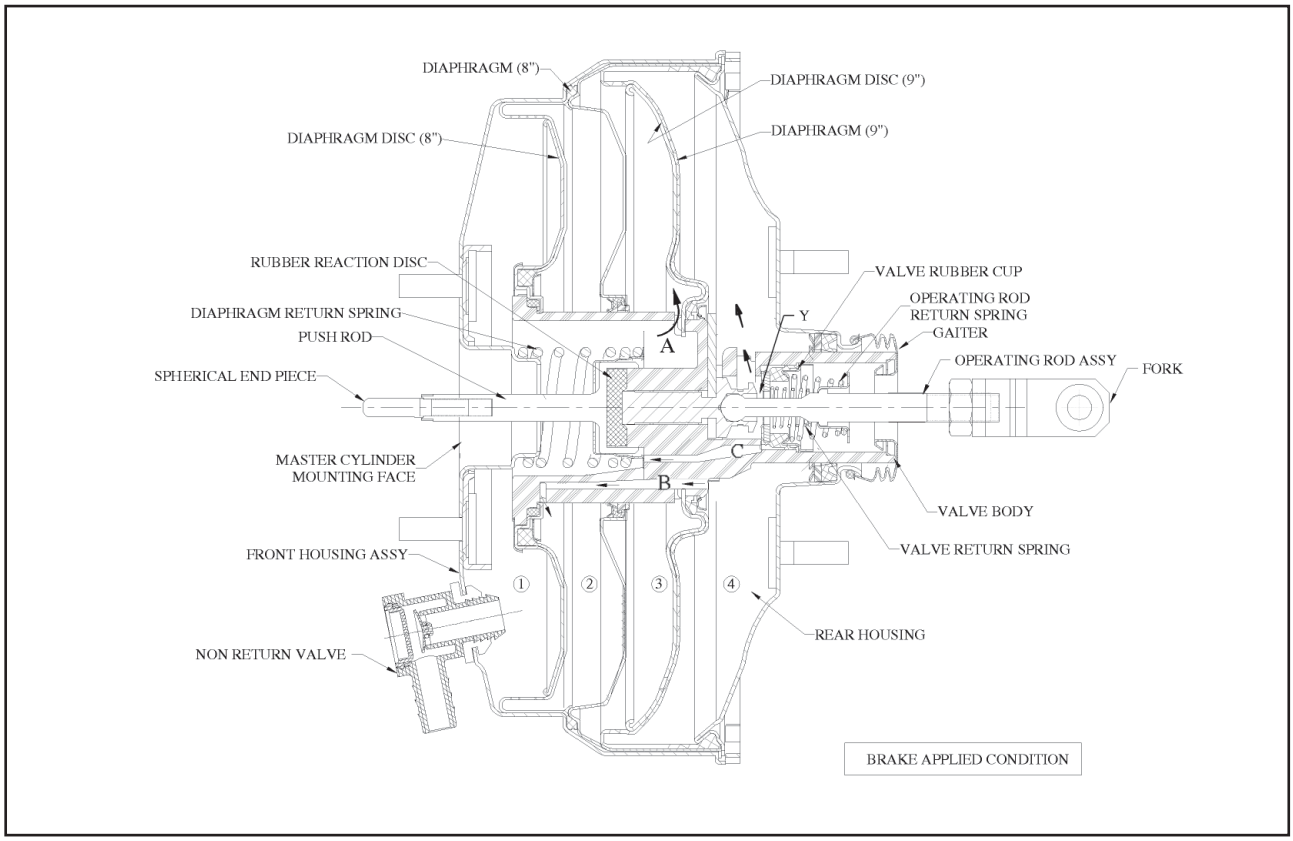


Fig. 20

5.2 Brakes applied condition (Fig. 45):

When the pedal is depressed, the operating rod is pushed in. The piston moves away from the valve rubber cup, opening the air valve (Y), thereby communicating atmospheric air to chamber 4 and to chamber 2. Fig. 45. This results in presence of air in chambers 2 & 4. During this time the vacuum valve (X) is closed and vacuum is retained in chambers 1 & 3 resulting in a pressure difference from those in chambers 2 & 4. This pressure difference results in net force acting towards the front housing side resulting in transfer of force to the master cylinder through the push rod.

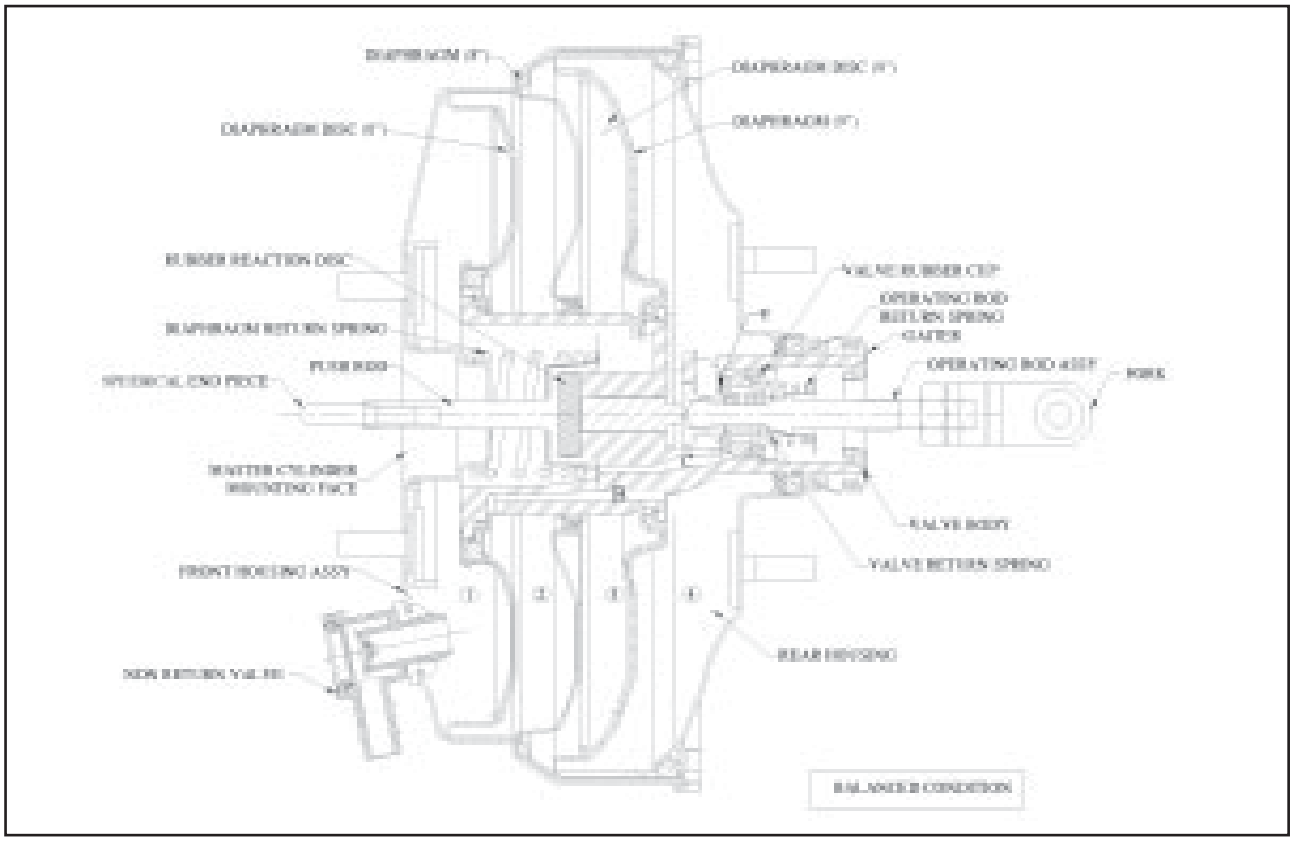


Fig. 21

5.3 Balancing (Fig. 46):

When the output force is conveyed through the push rod to the master cylinder, the reaction force from the master cylinder comes on the rubber reaction disc and pushes it backwards. This causes the valve body to traverse back and the piston to contact the valve rubber cup, thereby closing the air valve (Y) and vacuum valve (X). In this condition both the vacuum and atmospheric valves are closed. As a result, there is a fixed pressure differential between chambers 2 & 4 and chambers 1 & 3, so the level of power assist and braking force remains constant. The vacuum brake valve always seeks balancing position whenever the brake pedal force is constant.

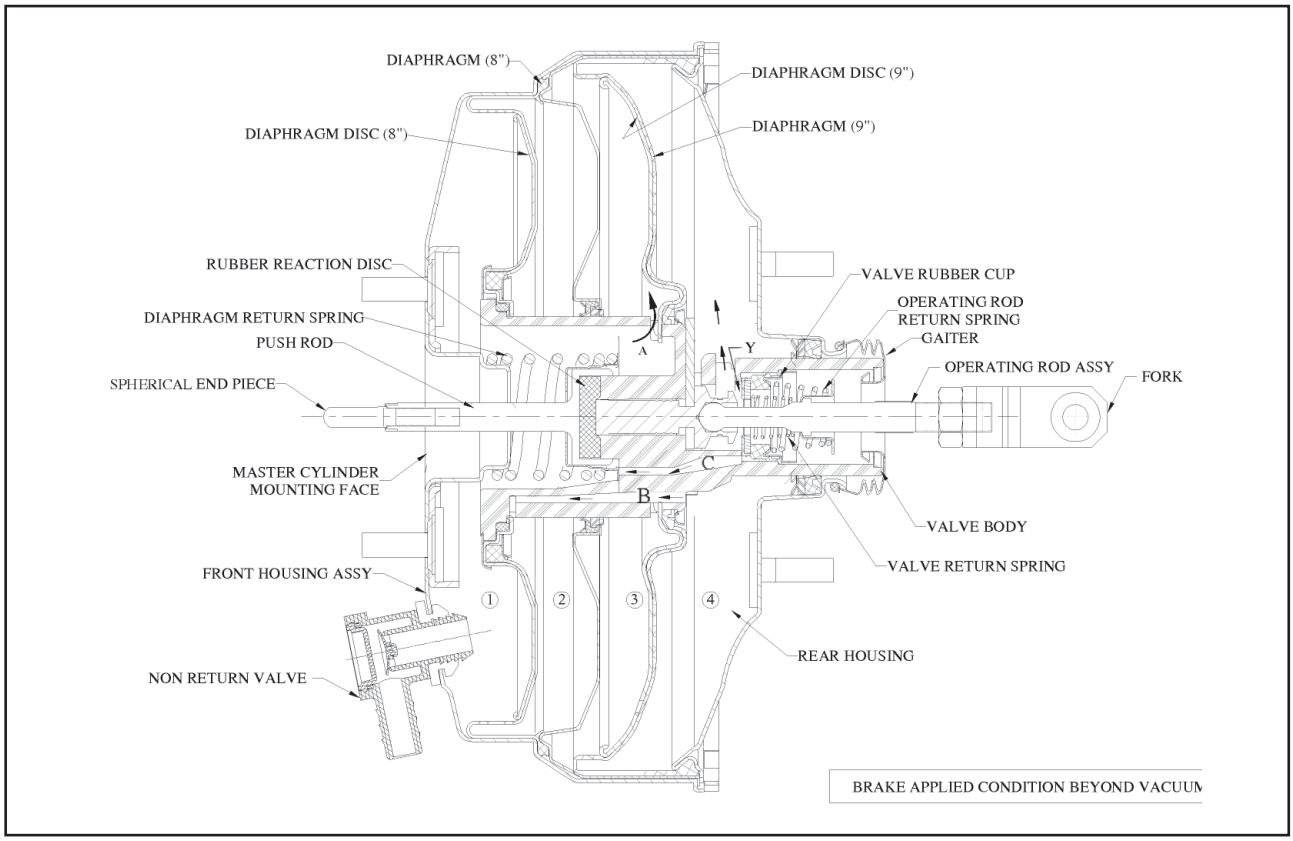


Fig. 22

5.4 Beyond Vacuum limit (Fig. 47):

As the pedal force becomes greater and the pressure in chambers 2 & 4 attains full atmospheric level, the pressure difference exerted on the diaphragms reaches the maximum and a force beyond it will no longer work on the diaphragm. So any further loading the output rod is directly transmitted to the master cylinder without vacuum assistance.

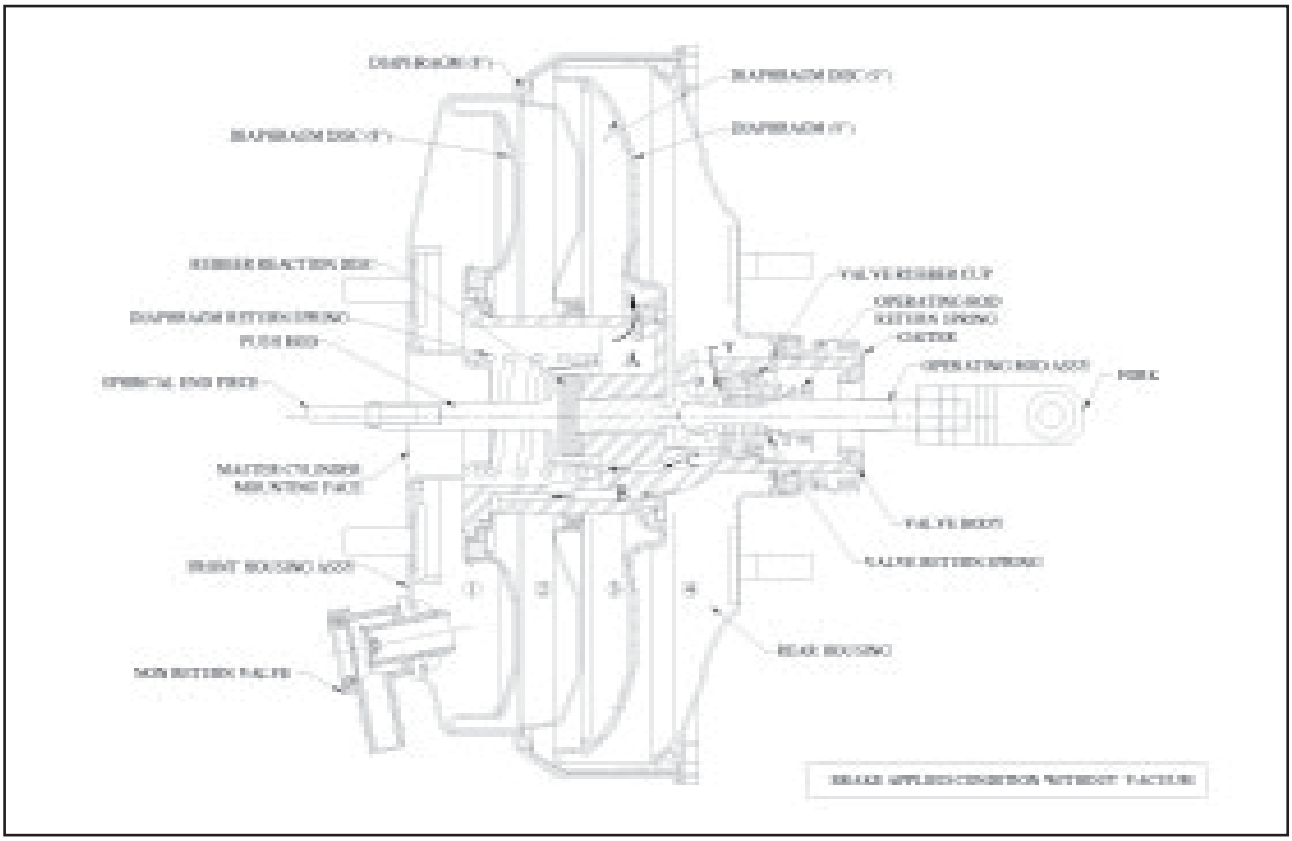


Fig. 23

5.5 Brakes on without vacuum (Fig. 48):

In this condition, all chambers are in atmospheric pressure. When the pedal is depressed, the piston moves forward hitting the rubber reaction disc. In this condition the vacuum brake valve has no boosting action and the output force on the push rod is given as below

Output force = Input force on the operating rod – Mechanical loss inside booster

The mechanical loss inside booster is mainly due to spring loads and friction due to seals in cover and rear housing.

6. BALANCING ARRANGEMENT:

The balancing action of vacuum brake valve is by means of rubber reaction disc arrangement Fig. 43. The input force on the operating rod moves the operating rod assembly, which further exerts force on the rubber reaction disc. The rubber reaction disc acts as a compressed fluid transmitting the force from the operating rod via. the piston to the push rod. The reaction force from the master cylinder compresses the rubber disc, which further transmits this force to the valve body. The valve body balances this reaction force by moving backwards, closing the air valve. The boost ratio is given by the ratio of the reacting areas on the push rod and the piston i.e

Boost ratio

= Area of inner diameter of reaction area of push rod / Area of Piston

= D^2/d^2

Where D = Inner diameter of reaction area in push rod

d = outer diameter of piston

By changing the diameter of piston and the corresponding diameter of valve body, various configurations of boost ratios can be obtained.

SERVICE CHECK

A. INSPECTION (As per recommended service schedule)

Check the tightness of the mounting nuts (torque 20 Nm)

B. OPERATING TESTS

- Check for free movement of the push rod without binding while applying/releasing brakes.
- Check for vacuum leak in brakes applied / released position by observing the vacuum gauge and ensure that the pipe lines and the joints are free from leakage.

REMOVAL

1. Place wheel chokes in front and behind the wheels to prevent movement of the vehicle.
2. Remove the brake pedal return spring
3. Remove the fork pin of vacuum brake valve
4. Disconnect the hydraulic lines
5. Remove the master cylinder
6. Disconnect vacuum line connected to Non Return Valve.
7. Loosen the mounting buts of vacuum brake valve and remove the unit

DISASSEMBLY

1. Clean the exterior of the unit.
2. Loosen Nut (A/F 17) on Fork and remove Fork, Gaiter, Retainer and Filters.
3. Loosen Nuts (A/F 13) on Spacer & Remove spacer and sealing ring.
4. Remove the Non return valve and Grommet.
5. Mark the position of the front & rear housing to ensure proper orientation of master cylinder mounting bolts in front housing with respect to the rear housing-mounting bolts.
6. Place and position the unit in the dismantling / assembly fixture while fixture is clamped on a bench vice.
7. Place and position the swivel block on the front housing.
8. Tighten the fixture handle to rest on the swivel block. Avoid over tightening.
9. Rotate the rods and match the notches & dimples in line. Do not over rotate otherwise the assembly will get locked again. If loosening is difficult, loosen the handle slightly and then rotate the rods.
10. After the front housing gets unlocked loosen the fixture handle slowly until the front housing gets separated fully.
11. Remove the Spring, Push rod, Spring seat and Rubber reaction disc.
12. Remove the Key retainer.
13. Press the Operating rod and remove Key.
14. Remove the operating rod assembly from the valve body by pulling it out at the fork end.
15. Separate cover and rear housing assembly.
16. Lift the Diaphragm on rear housing from the groove.
17. Remove the Retainer, Spacer and Seal from Rear housing.

CLEANING AND INSPECTION

1. Wash and clean all metal parts and blow dry with compressed air.
2. Inspect all the parts for excessive wear and deterioration.
3. Check Valve body bore and outer diameter for any score mark / crack / damage.
4. Check for any excessive wear in rubber reaction disc.
5. Check for any damage in valve rubber cup in operating rod assembly.
6. Check for any damage or holes or cut marks on Diaphragm.

REASSEMBLY

1. Use recommended repair kit and diaphragm to replace old parts
2. Lubricate all moving parts (except diaphragm) with Silicone grease. This grease is supplied along with repair kit.
3. Press in the Seal, Spacer and Retainer in the rear housing using a soft mandrel and ensure that the Seal seats properly on the rear housing.

Use always a wooden mallet to tap Seal into the Rear housing.

4. Apply grease on the Seal.
5. Push Operating rod assembly in the Valve body and assemble Key. Place Key retainer over Key and press it.
6. Place and position the Diaphragm, Diaphragm disc and Valve body assembly on the Rear housing.
7. Place Diaphragm over Rear housing groove.
8. Place the Rear housing assembly with valve body and operating rod assembly with Key on locking fixture.
9. Place Rubber reaction disc, Push rod, Spring seat and Spring.
10. Place and Front housing on the Spring and match its notches with Rear housing notches.
11. Tighten the fixture handle simultaneously aligning the notches of Front housing and Rear housing notches in line. Continue tightening to allow the Front housing notch groove matches with rear housing.
12. Rotate the rods uniformly without jerk to avoid twisting of Diaphragm and lock the housings and match the marking.
13. Avoid grease / Oil contact with diaphragm during assembly.
14. Loosen the handle and remove the unit from the fixture.
15. Assemble the Grommet and Non return valve in Front housing.
16. Assembly the Filters, Retainer and Gaiter. Ensure Gaiter is located properly on Rear housing groove.
17. Assemble Nut on Operating rod assembly and assemble Fork on Operating rod assembly. Ensure that booster input rod standout dim is 111 $\pm$ 0.5 mm Fig. 53
18. Place Sealing ring , Spacer on Front housing and tighten Nuts.
19. Mount the unit on the vehicle and connect brake pedal return spring. Adjust pedal position and free play. Install the eccentric pin (smear pin with molycoat grease)
20. Connect the vacuum pump line with the Non return valve of vacuum brake valve.
21. Mount the Master cylinder on the vacuum brake valve and connect the hydraulic lines.

TEST PROCEDURE

1. Bleed the hydraulic lines. Ref. brake bleeding procedure.
2. Apply / release the brake without vacuum assistance and check for free return if brake pedal.
3. Depress the brake pedal fully before starting the engine (i.e. without vacuum in the system). Start the engine. As vacuum builds up in the system, the brake pedal becomes light indicating proper function of the brake valve and the brake system.
4. Check for vacuum leak in brakes on/off positions by observing the vacuum gauge.
5. Apply / Release the brake with vacuum and check for free return of brake pedal.

NOTE :

Foam between firewall & vaccum booster is different between normal 10" booster & ZDS booster.

Thickness of foam is more in case of ZDS booster.

Please ensure to use foam with correct thickness during fitment.

ZDS booster & TMC are matched by manufacturer for improved performance.

However, this matching is not possible in field. Vaccum booster & TMC can be changed independently in field.

CHECK LIST FOR ENSURING SATISFACTORY FUNCTIONING OF VACUUM BOOSTER COMMON FOR NORMAL & ZDS BOOSTER

Engine Off : Depress and release brake pedal several times to remove vacuum from the system.

Depress pedal and hold with light pressure (7-12 kg) and start engine.

If Vacuum Booster is operative, pedal will fall slightly and then hold. Less pressure will be needed to hold pedal down, than with the engine in 'off'' condition.

If Vacuum Booster is not operative disconnect the vacuum hose from the Vacuum Booster non-return valve. Then with engine running, check the vacuum supply with a vacuum gauge. There should be atleast 20” of vacuum.

If vacuum supply is below 20" replace or repair the vacuum hose and vacuum fittings.
If the vacuum supply is 20" or more the Vacuum Booster is defective and should be replaced with new Vacuum Booster Assy.

If Vacuum Booster is operative, do the vacuum leak test as given.

With new hose fitting repeat the basic test.

VACUUM LEAK TEST
COMMON FOR NORMAL & ZDS BOOSTER

Run the engine to medium speed. Release the accelerator and turn the engine off. This builds up vacuum.

Wait 90 seconds and apply the brakes. Two or more applications should be Vacuum Booster assisted.

If the applications are Vacuum Booster assisted, there is no vacuum leak.

If the applications are not Vacuum Booster assisted disconnect the vacuum hose from the non-return valve. Then attach a short length of hose to the valve.

Blow air through the hose. The valve is defective if air passes through.

If the non-return valve is defective install a new non-return valve and repeat the vacuum leak test.

If the non return valve is OK, the Vacuum Booster is leaking. Replace the Vacuum Booster with a new kit.

Preventive Maintenance (applicable for ZDS booster)

Every 10,000 km	Every 20,000 km	Every 40,000 km	Every 80,000 km
Check the performance by applying / releasing the brakes. Pedal should go down easily when engine is running and the pedal should return swiftly on releasing the brakes. **Refer Fig 24**	Lubricate linkages & check for slackness at fork. Maximum allowed slackness-0.5mm. **Refer Fig 24** Check the gaiter for proper fitment / existence of damage & replace if necessary **Refer Fig 25**	Change filters & gaiter **Refer Fig 25**	Overhaul the assembly using recommended repair kit & diaphragma. Replace valve body & rubber reaction disc if necessary.

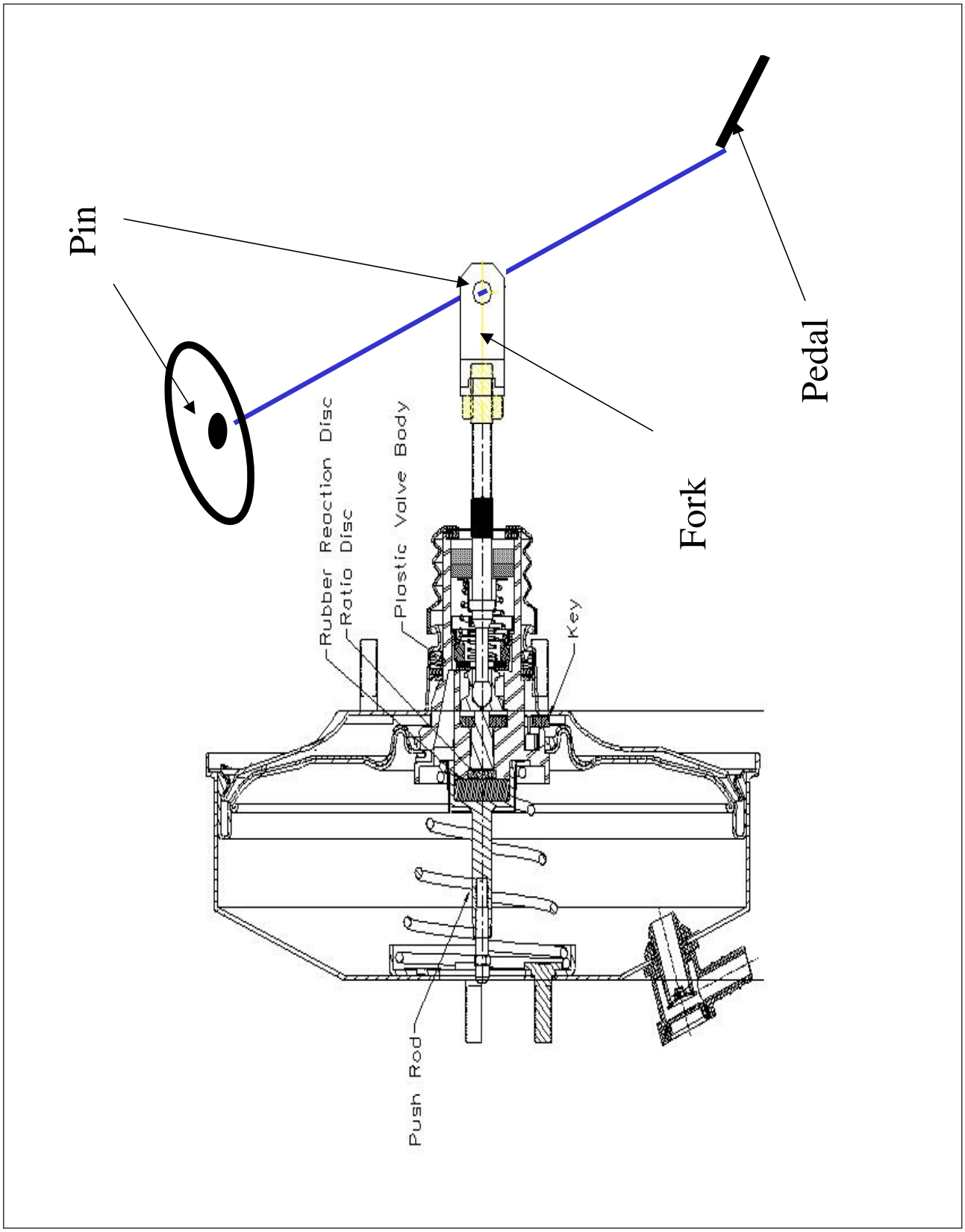

Pin
Pedal
Fork
Rubber Reaction Disc
Ratio Disc
Plastic Valve Body
Key
Push Rod

Fig 24

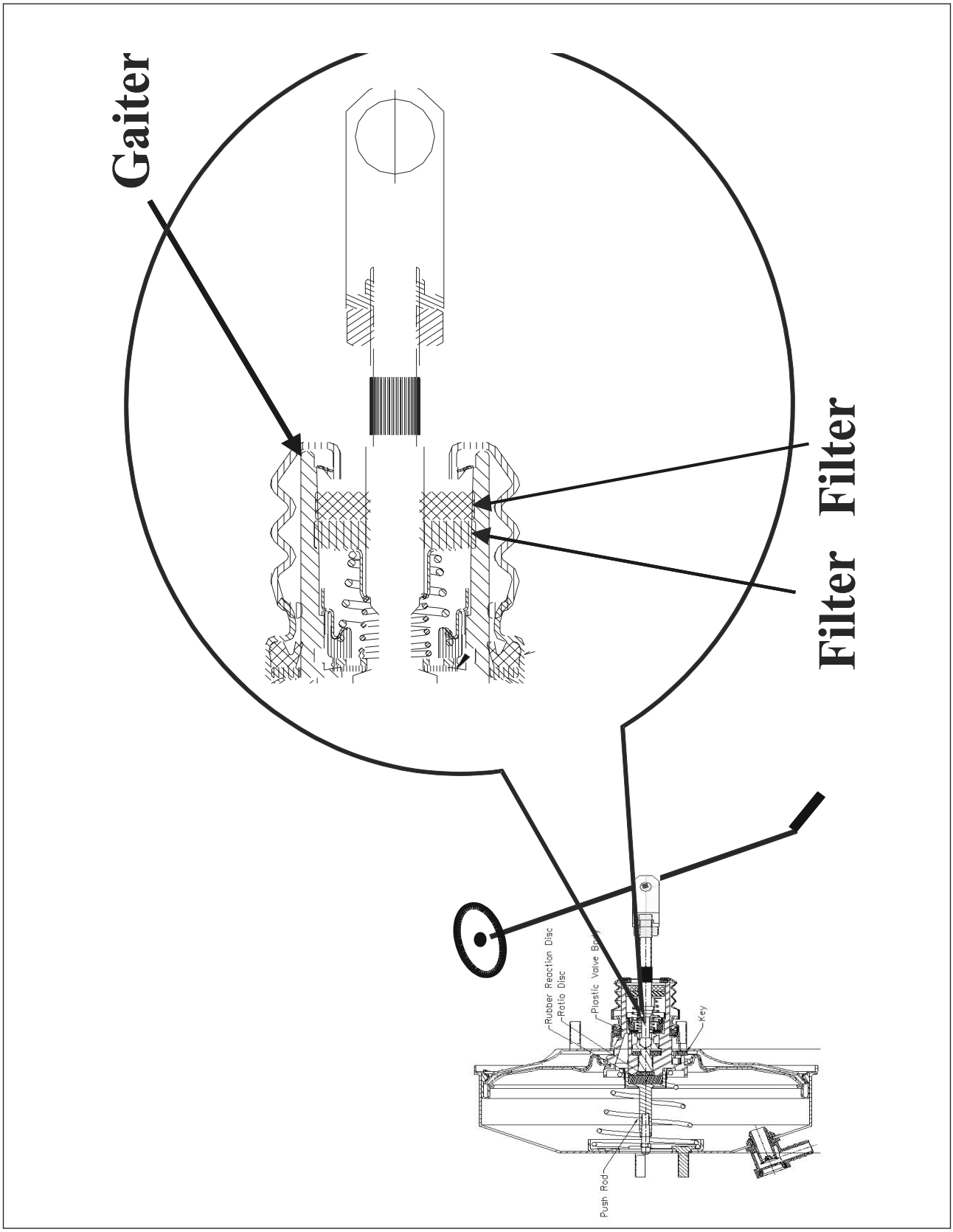

Gaiter
Filter
Filter
Rubber Reaction Disc
Ratio Disc
Plastic Valve Body
Key
Push Rod

Fig 25

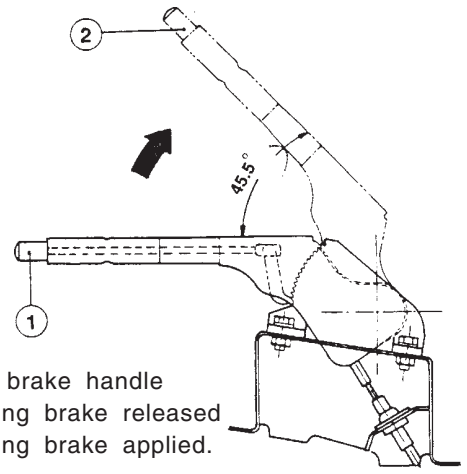
CONSOLE MOUNTED PARKING BRAKE *(Fig. 26)*

Parking brake is cable operated acting on the rear wheels.

It is operated by a handle situated in the cab on console. (Fig. 26)

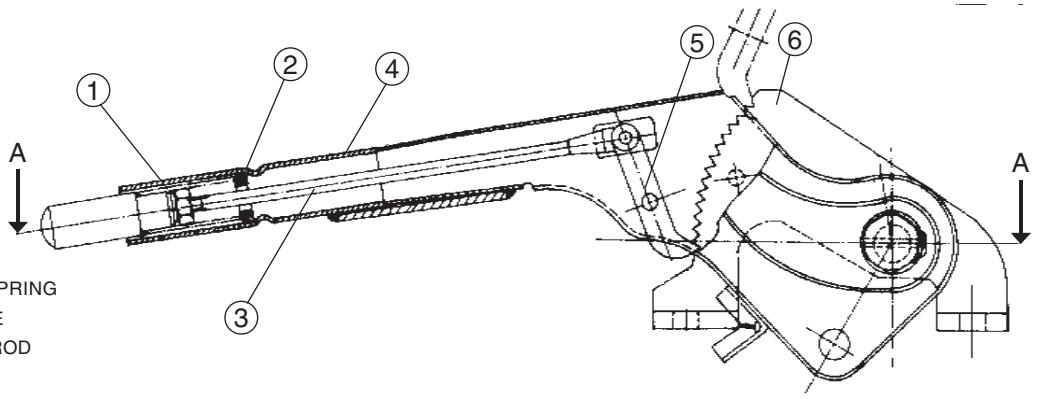
When the handle is pulled up, parking brake lever inside rear drum brakes is also pulled through the cable system.

This action expands rear brake shoes against drum, thus applying rear brakes.



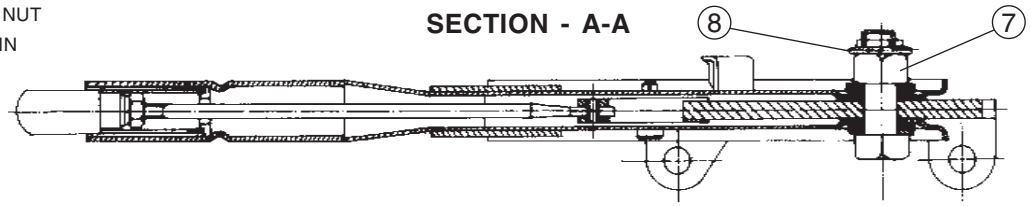
Parking brake handle
1. Parking brake released
2. Parking brake applied.

Fig. 26



1. COIL SPRING
2. SLEEVE
3. PAWL ROD
4. LEVER
5. PAWL
6. RATCHET
7. CASTLE NUT
8. SPLIT PIN

SECTION - A-A



NOTE :
LATERAL PLAY AT FULCRUM TO BE MINIMUM POSSIBLE (0.125 MM MAX.)
TO ADJUST THIS PALY, TIGHTEN THE CASTLE NUT FULLY, LOOSEN THE NUT ONLY TILL THE HANDLE IS FREE TO MOVE, ENGAGE THE SPLIT PIN AT THE NEAREST HOLE ON THE BOLT AND BEND THE SPLIT PIN.

Fig. 27

OPERATION *(Fig. 26 & 27)*

Parking brake handle inside cab is to be pulled up to apply parking brake on rear wheels. To release parking brake, handle is to be lifted slightly then keeping the release button pressed, handle is to be pushed down fully.

When button is pushed as above, pawl rod also get pushed, disengaging pawl from ratchet, thus releasing parking brake.

DISASSEMBLY *(Fig. 27)*

1. Ensure that parking brake is in released condition.
2. Unscrew and loosen parking brake adjusting lock nut and spherical nut at rear end of front cable.
3. Take out front ends of rear cables from link by moving out cable end with button from recess provided in link.
4. Remove clips holding front ends of rear cables and rear end of front cable on the brackets pull out the cables and remove the cables from mounting brackets.
5. Disconnect electric connection from parking brake switch.
6. Unscrew the mounting screws of ratchet of parking brake unit inside cab.
7. Take out the front end of front cable from parking brake lever after removing split pin, spacer and clevis pin. Remove parking brake lever with ratchet.
8. Remove holder from front end sleeve of front cable. Remove front cable.
9. Only if necessary, dismantle the pawl, pawl rod and lever from ratchet by removing split pin castle nut and bolt at, fulcrum. Remove split pin, shim and clevis pin holding pawl with lever, unscrew lock nut of knob on pawl rod, remove knob, lock nut, spring and sleeve. Remove pawl rod with pawl, push out dowel sleeve with suitable punch and remove pawl.

INSPECTION

1. Check front and rear cables for any damage. Replace the cable as an assembly if found damaged.
2. Check ratchet, pawl, for wear / damage and replace the defective parts.
3. Check other parts for damage and replace defective.

ASSEMBLY

Assemble all parts in reverse order of disassembly.

NOTE :

For adjusting parking brake switch, keep lever in the lowermost position and move switch mounting bracket upwards, to touch the bottom of the lever. Then tighten the bracket mounting screws.

ADJUSTMENT OF PARKING BRAKE

Ensure that all four rear brake shoes have been properly adjusted.

1. Put chocks on front wheels.
2. Jack up rear axle.
3. Loosen lock nut. Pull parking brake lever upto notches.
4. Tighten spherical nut till rear wheels start jamming and cannot be rotated.
5. Release parking brake and ensure that wheels are rotating freely. Hold spherical nut in this position and tighten lock nut.
6. Lower down rear axle.
7. Remove chock from front wheels.

INSPECTION OF PARKING BRAKE :

Pull parking brake lever at its centre by 20 kg force, with this force the travel should not exceed 5th notch position.

Check both wheels are locked at this condition and release lever (i.e. take it to '0' notch) and check for free rolling of wheels.

Both rear wheels should be free and there should not be rear brake dragging.

For counting the notches easily, listen to the click sound from ratchet while pulling parking brake lever without pressing button. A click sound pertaining to each notch movement.

BRAKE PEDAL HEIGHT ADJUSTMENT IN LINE WITH CLUTCH PEDAL *(Fig. 29)*

Push rod of vacuum booster serves as brake pedal stopper when pedal is fully released. Brake pedal height adjustment should be performed as below :

1. Before assembling vacuum booster on firewall ensure that the dimension 116.5 mm (Push rod fork hole centre to booster mounting face) is properly maintained.
2. Assemble booster unit with foam packing on firewall.
3. Install brake pedal with return spring on to the bracket. Connect brake pedal & push rod with eccentric pin.
4. Turn eccentric pin to get pedal height so that both clutch and brake pedals are at same level and tighten nut.

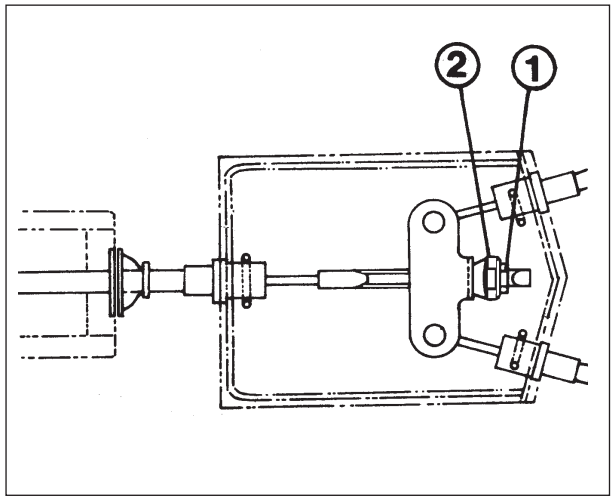


Fig. 28 - Parking brake linkage adjustment
1. Lock Nut 2. Spherical Nut

ENSURE THAT ON RELEASING THE PARKING BRAKE BOTH REAR WHEELS ARE FREE.

5. If pedal does not return to its original position mount return spring on distant hole.

CAUTION :

After rear brake drum is machined to repair size of 283.5 mm dia parking brake will become ineffective, when usable stock of brake lining thickness reduces to 0.7 mm and below. Hence change brake linings with new one as soon as usable stock of lining thickness reduces to 0.7 mm.

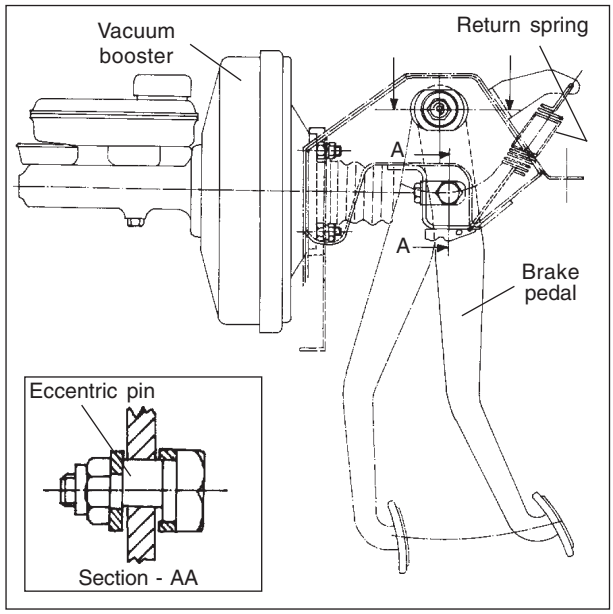


Fig. 29 - Brake pedal height adjustment

LOAD CONSCIOUS PRESSURE REDUCING VALVE

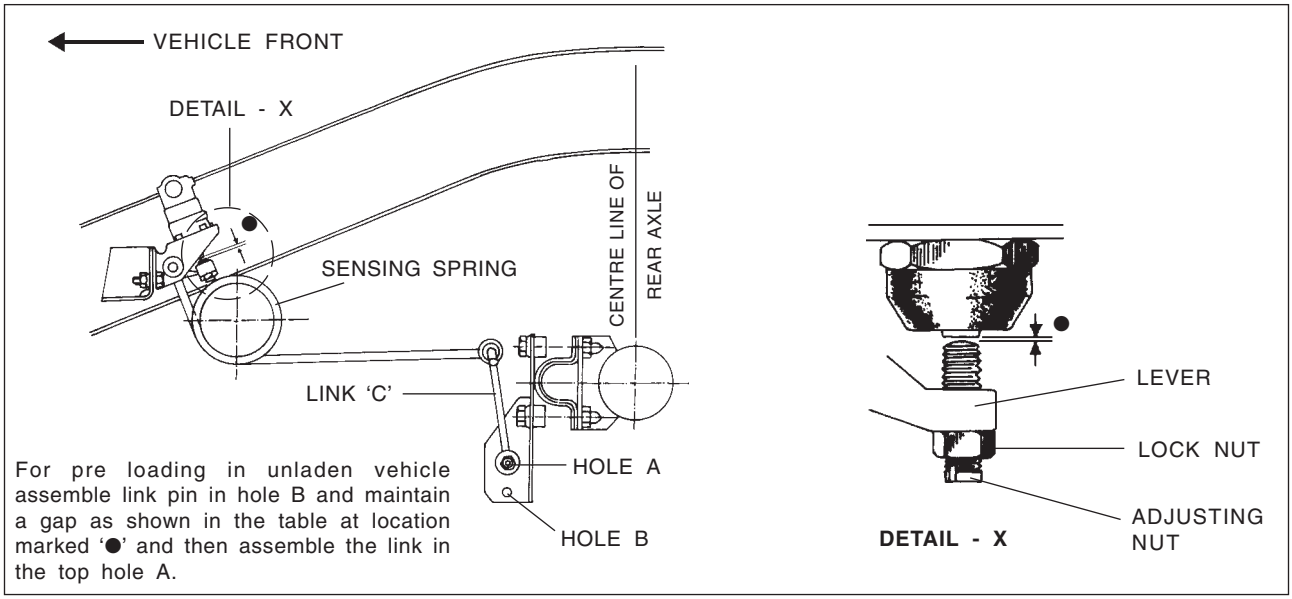


Fig. 30

CHART FOR L.C.R.V. GAP FOR 207 FAMILY

Sr. No.	Version	● Gap to be maintained
01.	Telcoline Pickup (4x2)	1.00 mm
02.	Telcoline Pickup (4x4)	1.00 mm
03.	Telcoline Crewcab (4x2)	1.00 to 1.2 mm
04.	Telcoline Crewcab (4x4)	1.00 to 1.2 mm

LOAD CONSCIOUS PRESSURE REDUCING VALVE (LCRV)

An LCRV valve is required in the brake system during severe braking. That time, most of the vehicle weight is transferred to the front, and the front brakes do most of the braking. The rear wheels are left with little traction and in this condition under high time pressure, they have a tendency to skid.

The valve is installed in the line to the rear brake drums. During heavy braking the valve limits the pressure to the wheels & this allows rear wheels to keep turning instead of locking up and skidding.

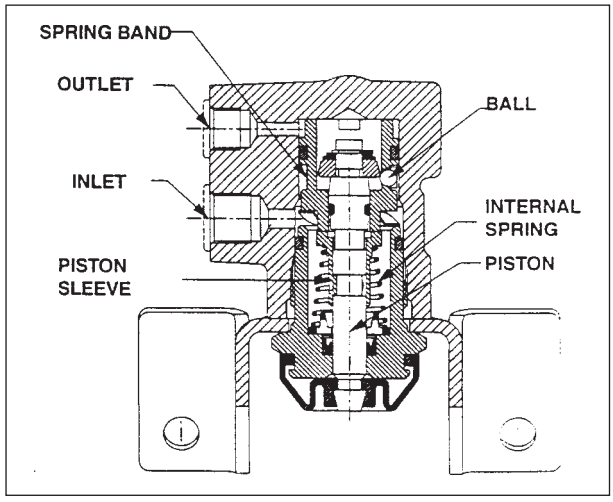


Fig. 31 - Construction of LCRV

REMOVAL OF LCRV

Unscrew and remove hex. nut holding LCRV linkage with mounting bracket on rear axle.

Unscrew and remove hex. screws holding LCRV with mounting, bracket on frame. Remove LCRV assembly.

INSTALLATION OF LCRV

Position LCRV on mounting bracket at frame. Fit hex. screws, and hex. nuts. Tighten screws to 2.1 - 2.5 mkg. torque.

Fit link end on mounting bracket at rear axle with spring washer and hex. nut (M8 x 1.25). Tighten hex. nut to torque of 1.1 to 1.4 mkg.

ADJUSTMENT - VALVE SETTING METHOD

With link 'C' in hole 'B' and vehicle in unladen condition, set the gap (●) between valve piston stem and adjusting screw (as shown in the table page no. 54) with help of adjusting screw and lock nut. Tighten lock nut of adjusting screw. Then engage the link 'C' in hole 'A' i.e. upper hole of the bracket.

NOTE :

Change the valve assembly and sensing spring together.

TROUBLESHOOTING HINTS FOR THE BRAKE SYSTEM

A. SERVICE BRAKE

Sr. No.	Trouble	Cause	Remedy
1.	Brake pedal is soft and spongy.	a. Air in brake system.	a. Bleed brake system.
		b. Brake fluid too hot (after long down gradient travel of long time operation of brake).	b. Give brake system time to cool and if necessary, bleed.
		c. One of both primary seals in tandem master cylinder damaged.	c. Replace primary seals.
		d. Brake shoes worn out.	d. Replace shoes.
		e. Soft or weak hose.	e. Check and replace.
2.	Brakes heat up when vehicle is travelling or fail to release.	a. Compensation port in tandem master cylinder clogged.	a. Dis-assemble tandem master cylinder and clean.
		b. Rubber parts swollen because of usage of non-recommended fluids.	b. Drain brake system and dismantle the whole brake system. Replace all rubber parts including the brake hoses. Fill brake system with one of the approved brake fluids.
		c. Brake drum shoe clearance is more.	c. Adjust.
		d. Brake shoe return spring weak/broken.	d. Replace
		e. Brake drum out of true of scored	e. Rectify.
		f. Anchor plate/caliper mounting loose.	f. Tighten bolts.
		g. Slack hub bearing.	g. Rectify.
		h. Vacuum booster piston seized.	h. Rectify/replace.
		i. Weak/broken pedal return spring. Pedal linkage binding.	i. Replace spring lubricate pivot and linkage.
3.	Unsatisfactory braking action despite hard pedal pressure (normal pedal travel)	a. Brake shoes oily or greasy.	a. Rectify the cause of leakage and clean brake drum/disc. Replace brake shoes/pads.
		b. Brake shoe/pads charred.	b. Replace the parts.
		c. Brake shoes/pads worn.	c. Replace.

Sr. No.	Trouble	Cause	Remedy
		d. Vacuum booster defective	d. Rectify/Replace.
		e. Brake shoe/drum distorted.	e. Check and rectify.
4.	Unsatisfactory braking action despite hard pedal pressure (short pedal travel)	a. Vacuum hose or connections leaky.	a. Eliminate leaks.
		b. Damaged vacuum seal in tandem master cylinder	b. Replace vacuum seals.
		c. Damaged O-ring between tandem master cylinder and vacuum booster.	c. Replace O-ring.
		d. Damaged seal on vacuum booster piston.	d. Replace vacuum booster.
		e. Tear in diaphragm.	e. Replace vacuum booster.
		f. Check valve sticking.	f. Replace vacuum line together with check valve.
		g. Defective vacuum pump.	g. Repair vacuum pump.
5.	Unsatisfactory braking action despite hard pedal pressure (long pedal travel)	a. Drum to shoe clearance excessive.	a. Adjust brakes.
		b. Incorrect brake fluid.	b. Flush the system and use specified brake fluid.
		c. Cracked drums.	c. Replace brake drum.
		d. Excessive wear in brake pedal linkage.	d. Inspect and rectify linkages.
		e. Wheel bearing play excessive.	e. Adjust.
		f. Mounting of brake part loose/defective.	f. Rectify and tighten.
		g. One brake circuit inoperative through leaks.	g. Eliminate leaks.
6.	Brakes dragging on one side.	a. Brake shoes/pads oily or greasy.	a. Check seals of wheel hub, replace brake pads/shoes.
		b. Brake shoes/pads of one side excessively worn.	b. Replace brake shoes/pads.

Sr. No.	Trouble	Cause	Remedy
		c. Difference in friction valve of brake shoes/pads.	c. Replace brake shoes/pads.
		d. Out of round drums.	d. Correct by grinding/turning.
		e. Bad tyres.	e. Replace worn tyres.
		f. Brake anchor plate/caliper mounting loose.	f. Tighten firmly.
		g. Corrosion traces on cylinder bores.	g. Check and rectify.
7.	Brakes squeaking or Judder.	a. Brake drum out of round.	a. Check and rectify.
		b. Brake drum/disc out of true.	b. Check and rectify.
		c. Brake linkages having high friction	c. Check and rectify.
		d. Brake liners not chamfered.	d. Check and rectify.
		e. Excessive air gap between liners and shoe.	e. Check and rectify.
		f. Loose lining rivets.	f. Check and rectify.
		g. Anchor plate/caliper brake mounting loose.	g. Tighten.
		h. Lining/pad worn out excessively.	h. Check and rectify.
		i. Wheel bearing play not in order.	i. Adjust
8.	Rattling brakes.	a. Unsatisfactory wear pattern of brake shoes.	a. Run in brake shoes.
		b. Uneven action of shock absorbers.	b. Check shock absorbers.
9.	Fluid reservoir needs frequent topping up.	a. Leak in hydraulic system.	a. Check all liners, hoses and unions for leaks.
		b. Brake fluid escaping from leak port of tandem master cylinder.	b. Replace vacuum seals in tandem master cylinder. If necessary, remove brake fluid from vacuum booster.

ZF Integral Hydraulic Ball & Nut Power Steering Gear - Short Version

INTRODUCTION

These instructions are intended to assist in the necessary maintenance and repair work carried out on the ZF hydraulic ball and nut power steering gears.

We would especially like to draw your attention to the fact, that steering systems must only be repaired in workshops, where the following are available :

1. Trained personnel
2. Authorized equipment, among others, test bench, crack testing unit and special tools

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I. TELCOLINE (4X2/4X4, LHD/RHD, 28/31 WHEELBASE) - STEERING WHEEL AND COLUMN MOUNTING

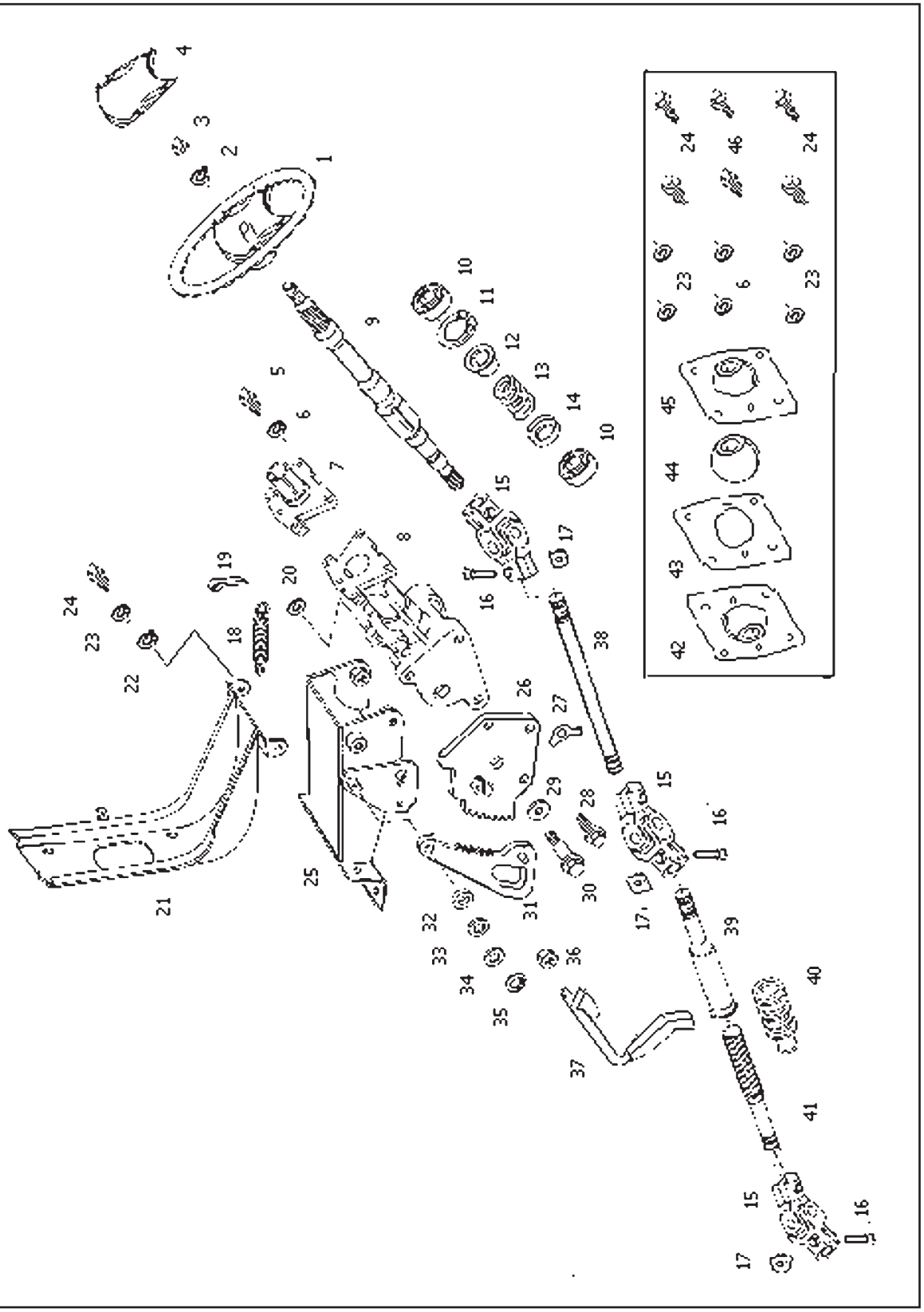


Fig. 1

LIST OF PARTS

S.NO	DESCRIPTION
1.	ASSY STEERING WHEEL (380 DIA BLACK)
2.	SPRING WASHER B14
3.	HEX THIN NUT M14 X 1.5
4.	HORN PAD (COL-BLACK, 380 DIA)
5.	HEX. SCREW M6 X 20
6.	SPRING WASHER B6
7.	BOSS
8.	ASSY. STEERING COLUMN (FOR STEERING LOCK)
9.	ASSY. STEERING SPINDLE TOP
10.	DEEP GROOVE BALL BEARING (M/S. SKF 6004 2Z)
11.	INTERNAL CIRCLIP 42X1.75 N
12.	SPRING SEAT
13.	COMPRESSION SPRING (STEERING COLUMN)
14.	SPRING SEATING CUP
15.	ASSY. UNIVERSAL JOINT
16.	BOLT
17.	NYLOC NUT M8
18.	TENSION SPRING
19.	SPLIT PIN 1.6X12
20.	BRIGHT WASHER 6.4
21.	ASSY. STAY BRACKET
22.	WASHER A8.4 IS:5370 ST.
23.	SPRING WASHER B8 IS3063
24.	HEX. SCREW M8 X 16
25.	ASSY. BRACKET (STG. COLUMN MTG.)
26.	ASSY. RATCHET
27.	TAB WASHER 8.4
28.	FITTING SCREW
29.	WASHER
30.	BOLT WITH NYLON INSERT
31.	ASSY. PAWL WITH GUIDE PIN
32.	DISC SPRING B16
33.	BRIGHT WASHER 8.4
34.	WASHER (1.25 MM THICK)
35.	CIRCLIP E 7.0 X 0.9
36.	BUSH (CAM PIVOT)
37.	ASSY. SLEEVE
38.	STEERING SPINDLE (MIDDLE)
39.	ASSY. SLEEVE
41.	RUBBER BELLOW (SLEEVE/TOP)
42.	STEERING SPINDLE BOTTOM
43.	SHIM (1 THICK)
	SHIM (0.5 THICK)
44.	SPHERICAL SUPPORT (STEERING SPINDLE)
45.	BRACKET (STG. SPINDLE SPH. SUPPORT)
46.	HEX. SCREW M6X16 IS:1364

II. Removal of Steering Column From vehicle :

Caution

This is tiltable steering column. Proper precaution must be taken to disassemble the unit.

1. Dismantle the universal joint connection on the steering gear box end & near the fire-wall & take out the steering spindle bottom.
2. Remove the steering wheel.
   a. Remove the side covers on the steering wheel.
   b. Dismantle the two screws on the side of steering wheel.
   c. Take out the top cover of steering wheel after dismantling the horn connections.
   d. Dismantle the steering wheel by proper puller.
   e. Dismantle the bottom cover of steering column.
3. Dismantle the nacelle top & bottom.
4. Dismantle the combination switch.
5. Removal of Steering column unit.
   a. Dismantle the screw of steering ball joint bracket assy. from fire wall.
   b. Dismantle the screws on the dash board cross member & assy stay bracket.
   c. Take out the steering column from the the vehicle.

Installation of Steering column on the vehicle :

1. Check the following for the condition of steering column.
   a. Free rotation of steering spindle.
   b. Steering spindle bottom for grease.
2. Assemble the steering column on the vehicle, at firewall & on the column mounting bracket.
3. Assemble the combination switch on the steering column.
4. Assemble the nacelle bottom & top on the steering column.
5. Assemble the steering spindle bottom, on the steering gear box end & on the fir wall end.
6. Assemble the steering wheel, on the steering column, in wheels straight ahead condition.

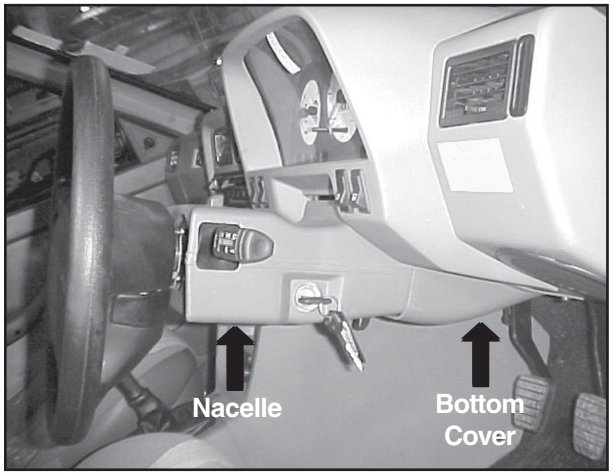


Fig. 2

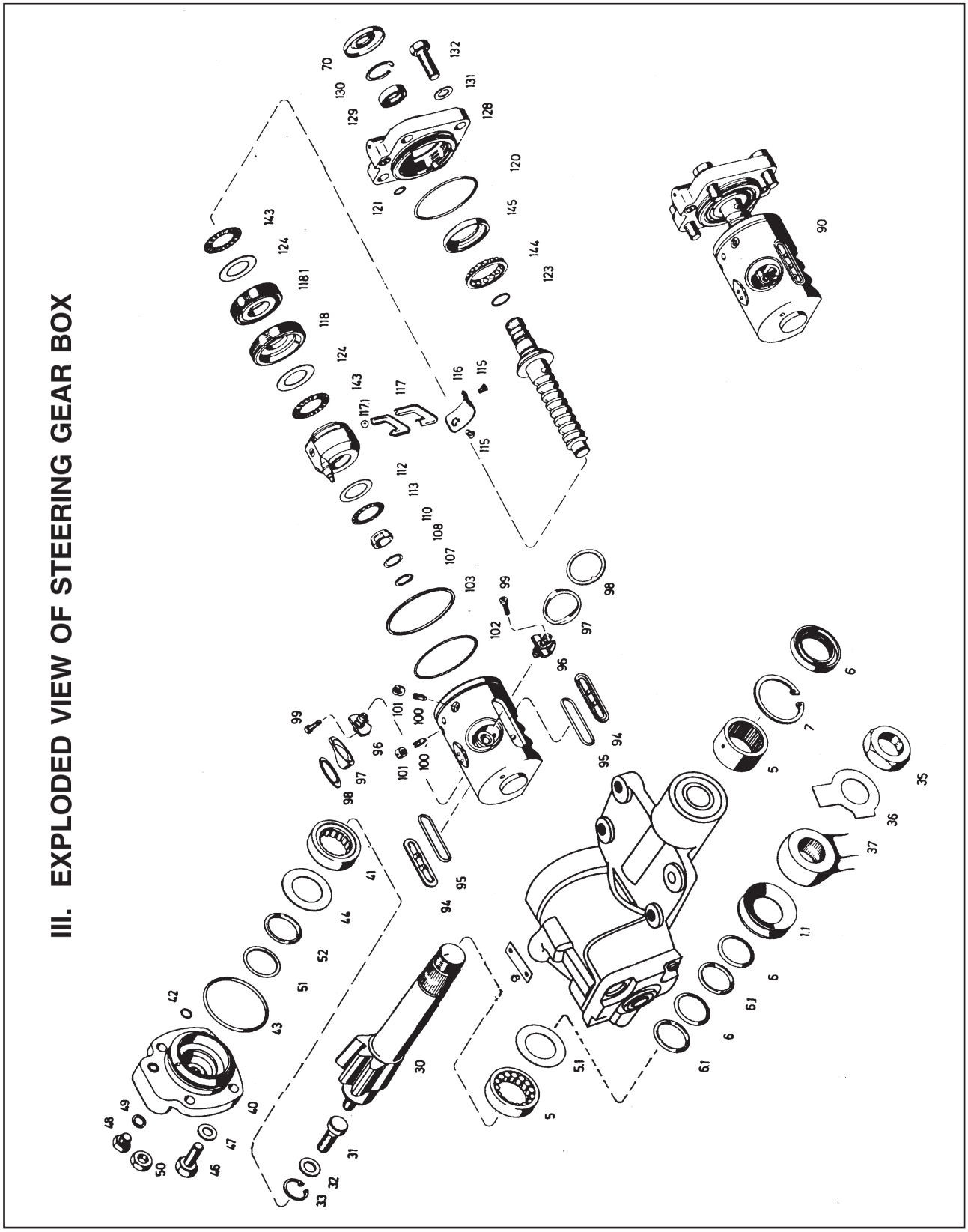


Fig. 3

LIST OF PARTS FOR STEERING GEAR BOX :

M033 955 802 - 2659 4620 0168 - Telcoline LHD **M033 955 805 - 2659 4620 0169 - Telcoline RHD**

S.NO	QTY	DESCRIPTION / EXPLODED VIEW NO.		REMARK
1	1	HOUSING ASSY		RHD
		1,5,5,1,6,6,1,6,2,7,10,11,5,2		LHD
2	2	SUPPORT RING	(6)	
3	2	GASKET	(6.1)	
4	1	NEEDLE ROLLER BRG	(5.2)	
5	1	SEALING RING	(6.2)	
6	1	SNAP RING	(7)	
7	1	PROTECTIVE CAP	(XXX)	M16X1.5
8	1	PROTECTIVE CAP	(XXX)	M14X1.5
9	1	SECTOR SHAFT ASSLY 30,31,32,33		RHD/LHD
10	1	HEX NUT	(35)	
11	1	TAB WASHER	(36)	
12	1	SEALING NUT	(50)	
13	1	PISTON ASSLY	(90)	RHD
		70,94,95,96,97,98,99,100,101,102,103, 107,108,110,112,113,115,		LHD
		116,117,117.1, 118,118,1,120,123,124,128,129,130, 131,143,144,145		
14	1	HOUSING COVER ASSLY		RHD
		(40,41,43,44,48,49,51,52)		LHD
15	2	O' RING	(42,121)	
16	2	O' RING	(43,120)	
17	4	HEX SCREW	(46)	
18	4	WASHER	(47)	
19	1	SUPPORT RING	(51)	
20	1	GASKET	(52)	
21	1	SHAFT SEAL	(129)	
22	1	V' RING	(130)	
23	1	PROTECTIVE CAP	(70)	
24	1	SEALING KIT COMPL.		RHD/LHD
		6,6.1,6.2,42,43,51,52,70,94,94.1,95,97, 98,98.1,102,103,120,121,129,1.1		
25	1	DUST SEAL	(1.1)	
26	4	HEX SCREW	(132)	
27	1	SMALL COMPONENTS (35,36,46,47,48,49,50,131,132)		
28	1	STEERING GEAR ASSLY		RHD
29	1	STEERING GEAR ASSLY		LHD

Note: All the components are common unless mentioned in the Remarks column.

IV. Design

1.1 Worm :

Both radial and axial roller bearings are mounted in intermediate cover (122*) and cover (128) or only in cover (128) depending on the version. Worm Shaft with grooved channel for ball circulation is mounted in this cover.

1.2 Piston :

Valve bush which accommodates the valve spool is pressed into cross bore hole. Underside of the piston is machined as a gear rack, which engages in the toothed segment of sector shaft. Steering nut and finger passes into longitudinal bore hole of the piston, thus establishing the connection with valve spool through worm.

Depending on the version, valve is centered by means of centering springs, leaf springs, or bending bar.

1.3 Steering nut :

Longitudinal bore hole for worm engagement with grooves for ball circulation are provided. Groove on the external diameter is milled and ground for accepting the finger, which engages in cross bore hole of valve spool. This establishes the connection to worm by means of ball chain. In, steering nut - worm, depends on the selection of the corresponding type of ball.

Steering nut is mounted in piston, play-free, between two roller bearings. Adjustment is carried out by turning threaded ring (118) which is secured on the open side of the piston.

1.4 Housing :

Housing has integrated passages for pressure and return lines and, a built-in pressure limiting valve. Oil passages which are required within the steering system are arranged as bore holes in housing, housing cover / plate or in piston. No external connecting lines are required due to this design. Housing has mounting holes and machined surfaces for securing steering gear box on mounting bracket of the vehicle.

1.5 Sector shaft :

Sector gearing is cut with a flat angle to the shaft axis in order to facilitate, service adjustment in axial direction. Center tooth is shaped more convex, so that re-adjustment can be carried out in straight ahead position (SAP), since this is the area where greatest amount of wear occurs, without the following gear teeth, both left and right, becoming jammed.

Forces in axial direction are taken up by means of an adjustment screw (31); screw is held into the bore hole of sector shaft, play-free and passes through threading in housing cover. Adjustment in axial direction is carried out by utilizing this thread pitch and locking is done by means of a lock nut.

1.6 Housing cover :

It houses the adjustment screw for supporting sector shaft & two built-in adjustable valves (55) for limiting the pressure at wheel lock. Valves are pushed open by the cam of sector shaft in predetermined positionat left or right lock. This enables pressurized oil to flow from the corresponding side of cylinder chamber to

a reduced required pressure of approximately 30 to 35 bar. The device is described as “hydraulic steering limiters.”

2. Function :

In order to obtain hydraulic support during steering of vehicle, spool valve must be moved out of neutral position.

Spool valve is held in neutral position by means of a centering spring or bending rod depending on the version. Steering forces must therefore be applied in order to overcome this initial setting.

Piston which is positively connected with sector shaft and steering wheel, offers resistance to rotation. Steering nut is therefore rotated by worm and ball chain during steering process, thus overcoming initial setting of centre spring or bending bar. Pressurized oil flowing into the gearbox housing from engine driven pump is then routed into the chambers from which the steering procedure is hydraulically supported.

Oil flows in from housing side into a longitudinal groove of piston and beneath the valve. It also flows into a longitudinal groove of the same size on opposite side in order to assist pressure compensation and then reaches, by means of cross bore holes, at the front surfaces of valve pistons which are separated from chambers by means of seals. In the neutral position of valve, oil flows to centre of the valve piston after first flowing through forward and return edges, and from there oil flows up through the corresponding holes into an opening of the piston. Oil is then drained for return motion. By operating the valve, side of the piston which is under pressure is separated from return and opposite side of the piston which is connected to return flow. Spool valve is equipped with two feed-back pistons which have the task of making movement of the valve, from neutral position more difficult, depending on oil pressure. Activating force on steering wheel increases proportional to the forces which are applied to wheels.

Steering gear boxs which only require a proportional increase of the steering force only up to a predetermined oil pressure, are equipped with Hydraulic reaction components (feedback piston). Valve which is into the feedback piston ensures that after reaching cut-off pressure, force on steering wheel only increase insignificantly.

Function of feedback pistons :

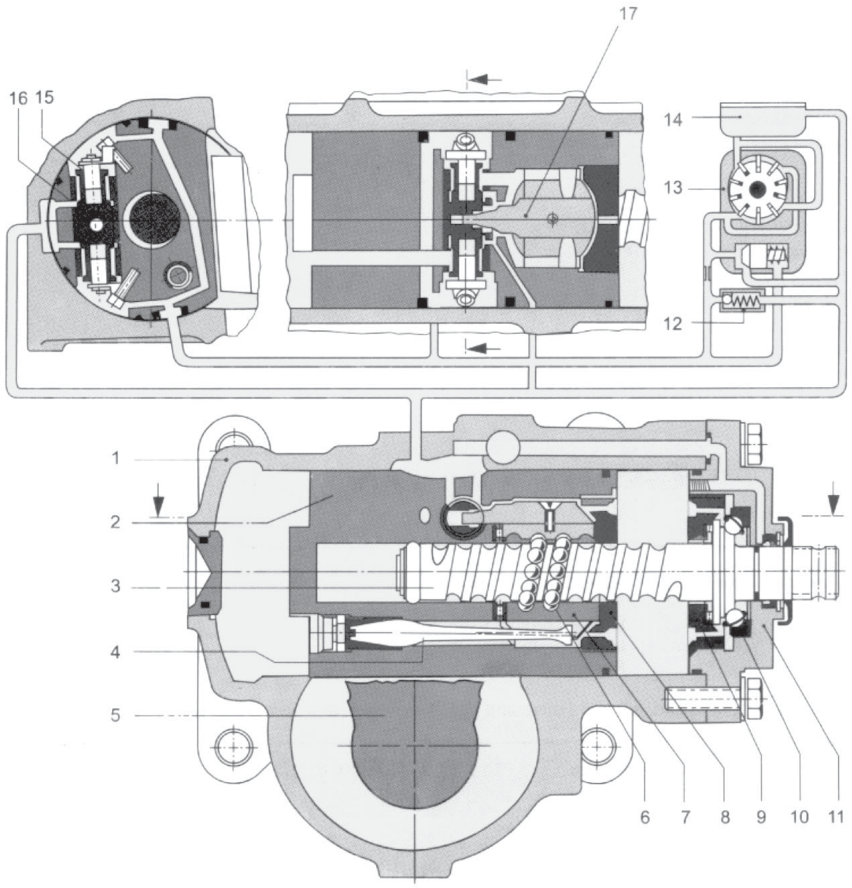
(Hydraulic Reaction)

They are floating pistons mounted in the bore hole of valve spool. They are, however, held axially and secured by connecting them with retaining plates. Outer front areas of two pistons are continually under pressure while only one of the internal front surfaces is under pressure in working position of valve. Same applies for the front surface in bore holes of valve spool. In this way, no force occurs which tries to push valve spool into neutral position. This property is described as “hydraulic reaction”.

Fig. 4 SECTION VIEW of a ball and power steering gear with vane pump connected to it, steering valve in neutral position. Centering of the steering valve by bending bar.

OIL FLOW : after flowing through supply and return flow control edges to the middle of the valve spool and through bores to the right and left cylinder Chamber.

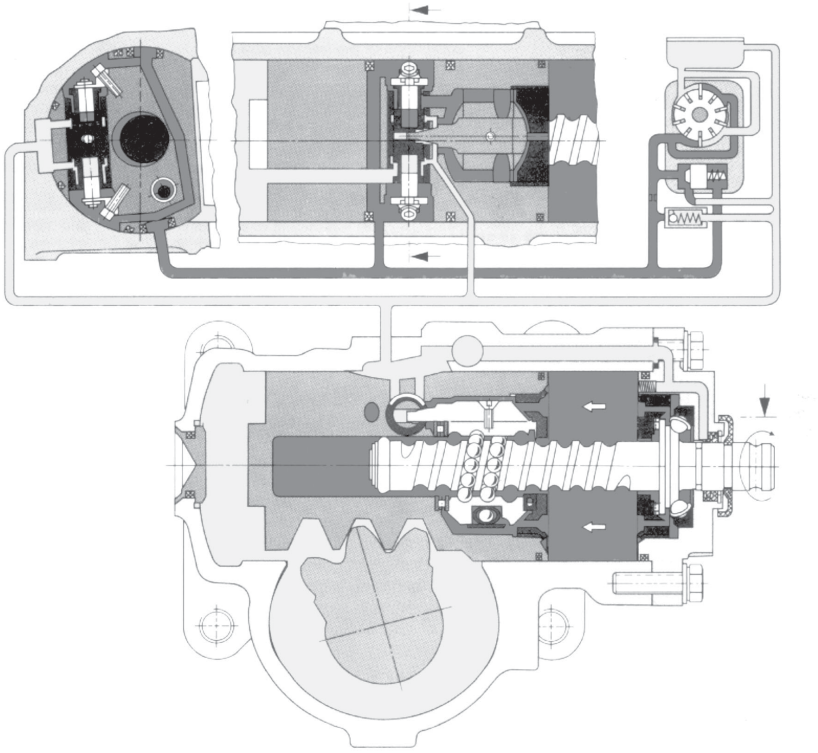
It goes through respective bores to a recess on the piston top, from here back to the oil tank.



1 Housing
2 Piston
3 Worm
4 Bending Bar
5 Sector shaft
6 Balls
7 Steering nut
8 Threaded ring
9 Threaded ring
10 Angular ball bearing
11 Cover
12 Pressure limiting valve
13 Vane pump with flow limiting valve
14 Oil Reservoir
15 Feedback piston (Hydraulic Reaction)
16 Valve piston
17 Driver

Fig. 4 Steering valve in neutral position

Fig.5 VALVE IN OPERATING POSITION, steering wheel turned clockwise, valve spool moved to the right, pressure oil gets into the cylinder chamber, left cylinder chamber connected to return flow.



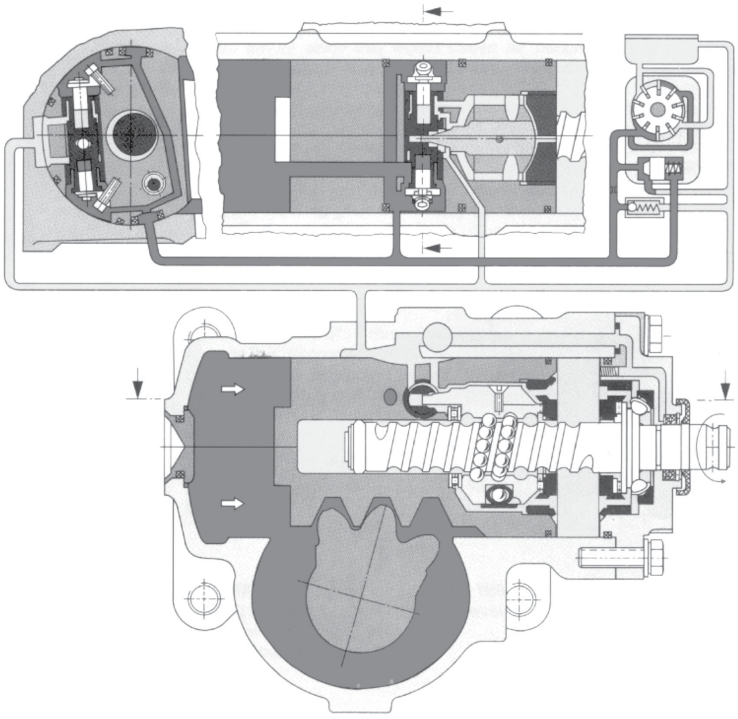


Fig.6 VALVE IN OPERATING POSITION, steering wheel turned anticlockwise, valve spool moved to the left, pressure oil gets into the cylinder chamber, right cylinder chamber connected to return flow.

Fig. 5 & 6 Steering valve in operating position

V. Oil Filling and Air Bleeding

Note :

There is a danger that dirt particles may enter steering oil circuit when filling steering system with hydraulic oil.

A high degree of cleanliness must be observed for first filling and for all subsequent topping up operations in order to prevent failure due to foreign bodies in the system. For this reason, thoroughly clean oil reservoir and the area around it before removing oil reservoir cover or dip- stick so that dirt does not get into oil.

1. Type of oil :

AFT oil must be used in order to ensure perfect function of the steering gear box and pump. The oil also carries out the lubrication of steering gearbox and pump.

2. Oil quantity :

Total system capacity is 1.6 ltrs.

3. Oil filling and air bleeding

3.1 Oil filling

Note :

Special care must be taken during the procedure given below, to ensure that oil reservoir is not allowed to run empty since this would cause air bubbles in the steering system.

In addition to this, special care must also be taken during oil filling and air bleeding to ensure that steering pump only turns at lowest possible speed (idling).

If the inlet flow is too great, small air bubbles would enter the pump and be split up into extremely small air bubbles during its passage through the pump; this situation may lead to foam formation thus greatly extending the bleeding process.

Due to various types of installation possibilities of gear box bleeding process may take longer time. In such a case, drop arm should be removed so that the entire piston stroke from stop to stop can be utilized for bleeding process.

In this way air remaining in the cylinder is reduced to a minimum. This is an insignificant amount which will be bled automatically during operation.

Steering system should be filled through the opening on reservoir. For the first filling and for oil changes, it is recommended to remove the cover of container and fill with oil up to the edge of container.

Engine should then cranked briefly a number of times with starter, in order to fill entire system with oil. Since this causes oil level in the container to fall rapidly, oil must be continually topped up during this process. Under all circumstances, the pump must be prevented from taking in air.

Ensure that oil level does not fall below upper marking on dipstick when engine is switched off.

3.2 Bleeding :

Jackup steering axle. Start engine and run at idling speed.

Allow engine to run for some time at idling speed, thus allowing most of the air to escape from cylinder. Oil level must be observed during this process. Oil must be topped up immediately if the level still sinks.

When the above instructions have been observed, oil level in container must not rise higher than 1 to 2 cm when engine is switched off.

Note :

Steering gear 8043 / 8033 / MO33 are system with automatic bleeding and do not have a bleeding screw. These steering systems automatically bleed remaining air in the system after the bleeding process has been carried out as described above.

Switch off engine.

4. Checking oil level :

Oil level should be checked at operating temprature at specified intervals.

4.1 Oil check on stationary engine :

In order to establish that no air is sucked in when engine is started, it must first be established whether oil loss has occurred when engine is stationery. Therefore, the container should be filled approximately 1 to 2 cm above the upper marking on dipstick.

4.2 Oil check on running engine :

Oil level falls slightly when engine is running since the oil requires a pressure of 2 to 4 bar to flow through the steering gear box as a result of the resistance to flow.

Oil should therefore once again be topped up so that oil level lies constantly at the upper marking. Engine can then be switched off again. If this level is exceeded, then this is a sign that there is still air in the system.

5. Changing oil and Filter

Filter has to be replaced at specified intervals.

Oil & filter has to be changed when steering gear box or pump are repaired or replaced. Oil pipes/hoses also have to be cleaned.

When soiled filter cartridge is removed, bottom opening of the filter must be closed immediately while removing from the filter from its support to prevent dirty oil in filter cartridge flowing back into reservoir and entering oil circuit.

6. Inspection Recommended :

Steeering system should be inspected in installed condition, corresponding to the intervals laid down in the following table depending on vehicle application.

Apart from installing a new filter this inspection also entails a functional test of the entire unit and repairs if needed.

It is not necessary to remove steering gear box and pump from vehicle for the first and second inspection. Removal of steering gear box or pump can be considered, if any defect is established.

In the case of the third inspection steering gear box and pump should be dismantled to check wear, damage, cracks & other parameters.

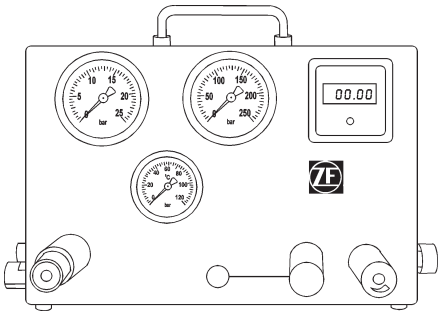
Note :

If oil loss is apparent, check for leaks and repair if necessary. Repairs to steering gear box and pump must only be carried out in authorised service stations.

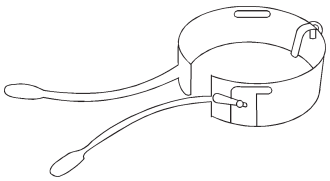
	Long distance traveling	Long and short distance traveling	Traveling on building sites and cross - country
I. Inspection	100 000 km	100 000 km	80,000 km
II. Inspection	200 000 km	175 000 km	1,50,000 km
III. Inspection	300 000 km	250 000 km	2,00,000 km

VI. SPECIAL TOOLS

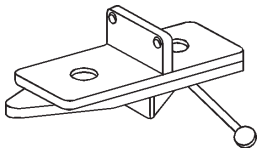
Tool No. 1
Servo Tester
7418 798 530



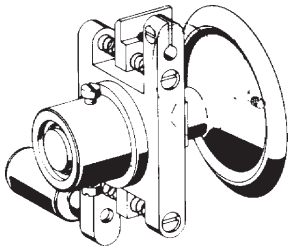
Tool No. 2
Tongue For Piston Assly.
M02851



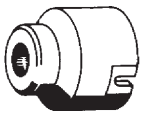
Tool No. 3
Assembly vice for steering gear
M02903



Tool No. 4
Torque measuring device
(without insert)
7470 798 703



Tool No. 5
Insert for torque measuring device
8052 798 552 (1 x 54 notches)



Tool No. 6
Entry bush for shaft seal
7832 798 001 (1 x 54 notches)



VII. Removal of steering gear box from vehicle

1. Thoroughly clean the steering gear box and the area around it paying particular attention to line connections.
2. Drain the oil, by opening drain plug (48) or one of the pipe connections.

   Turn steering wheel so that the piston is shifted upwards up to the stop. Then briefly (maximum 10 seconds) crank engine until oil is sucked out of pump and reservoir. After switching of engine, turn steering wheel several times to the left and the right stops, so that oil remaining in cylinder chambers is pumped out.
3. Disconnect pressure and return lines from steering gear box.
4. Plug all openings, to prevent dirt entering the system.
5. Remove steering drop arm with a suitable pulling device. Under no circumstances must drop arm be removed by driving a wedge between the neck of housing and steering drop arm or with hammer blows, since this may cause serious damages to gear box.
6. Valid for steering gear boxs with universal joints :

a) Loosen universal joint or flexible coupling between steering gear and steering column.

b) Remove securing bolts on housing and withdraw steering gear box.

VIII. Dismantling Steering Gear Box

A) Removal and dismantling of housing cover plate

1. Clamp steering gear box between the soft jaws of a vice.
2. Remove hexagonal bolts (46). Remove housing cover (40) by turning adjustment screw (31) in clockwise direction (Figure 7.)

Dismantling in ZF factory only or ZF dealers.

2.1 For steering version with needle bearing:

Withdraw needle sleeve (41) with a commercially available internal puller and withdraw protective disk (44) with seal parts (51 and 52) from bore hole.

Dismantling in ZF Factory or at ZF Authorised Centre only

2.2 For steering versions with roller bearing

Note :

Rollers of roller bearing (5 and 41) have been sorted into certain tolerance groups. Therefore, rollers removed from bearing external ring on the cover side must not be interchanged with rollers removed from the housing side.

B) Removal of Sector Shaft

Withdraw sector shaft (30) in the center position of the gearing(tooth), upwards out of the housing (Figure 8). **Further dismantling in ZF factory or ZF authorized dealers only**. Remove the circlip (33) from he sector shaft and withdraw the adjustment screw (31) with the guide washer (32).

C) Removal of Piston

1. Remove the protective cap (70) from the worm end. Screw out the securing bolts (132) (Fig. 9). A burr (ridge) may have formed on the side of the piston gearing depending on the service duty of the steering gear box, and this will damage the piston running surface when the piston is removed from the housing. This can be avoided if the unit is dismantled horizontally overhead (gearing tooth uppermost). (Fig. 10) shows dismantling in an unfavorable position,

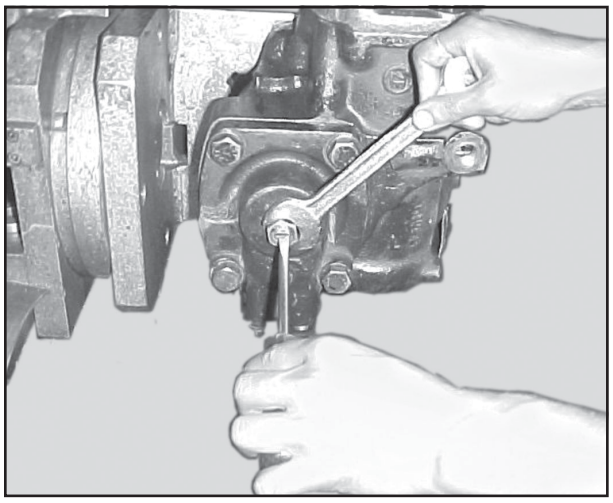


Fig. 7

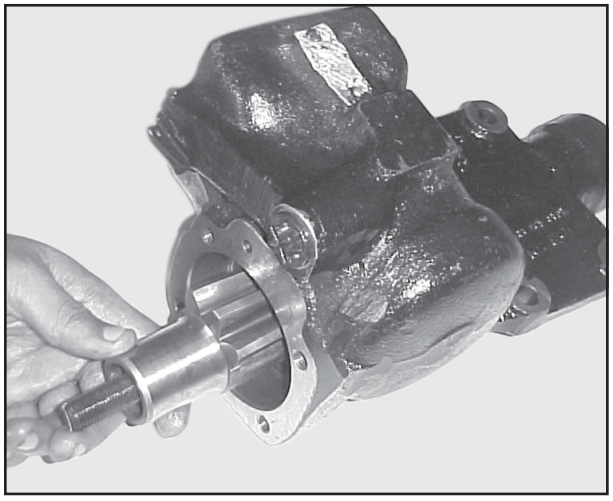


Fig. 8

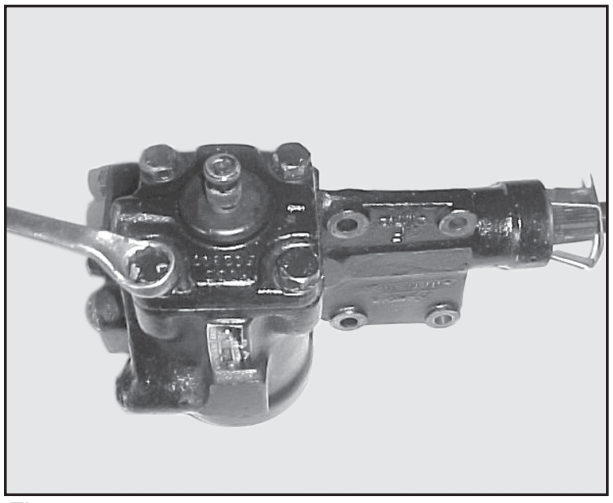


Fig. 9

1.2 For steering version with threaded ring.

Withdraw the piston with worm and cover (128) from the housing.

2. Remove the seal parts (94,94.1,95,97,98,102,103,120 and 121)

D) Dismantling housing,

Removal and fitment of seals 6 & 6.1 is allowed. **Further dismantling of rollers and bearing race is permissible in ZF factory only.**

E) Dismantling of piston

(Permissible in ZF factory only)

1. Removal of Spring Element

1.1 For steering version with centering spring

Loosen the slot nut (101) with special tool, and turn out of the piston with the threaded stud with slot nut.

2. Removal of Steering Nut and Valve Piston.

Permissible in ZF factory only:

2.1 Strike open the caulking at the grooves at the threaded ring (118) and unscrew the threaded ring with special tool.The ring is sealed with Loctite; it can only be removed by heating up to a temperature of approx. 1250C Heating must be carried out in a suitable oven. In this case, it is recommended to immediately loosen the two machine screw (99) and then the two countersunk screws (115) after removing the steering nuts (these are also fitted with Loctite.)

2.2 Withdraw the worm with the steering nut (114) from the piston.

2.3 Screw out the two machine screws (99) and withdraw the feedback (96) out of the valve piston.

3. Dismantling steering nut :

Unscrew the two countersunk screws (115) on the cover plate (116) (Figure 11). Remove the coverplate; shake the ball circulation tube (114). Remove the steering nut, needle cage (143), axial disk (124), threaded ring (118), intermediate shaft (122) axial disk (124) and the needle cage (144) from the worm.

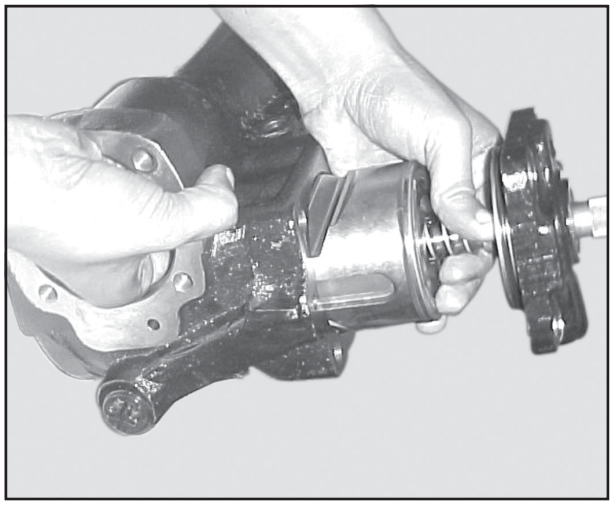


Fig. 10

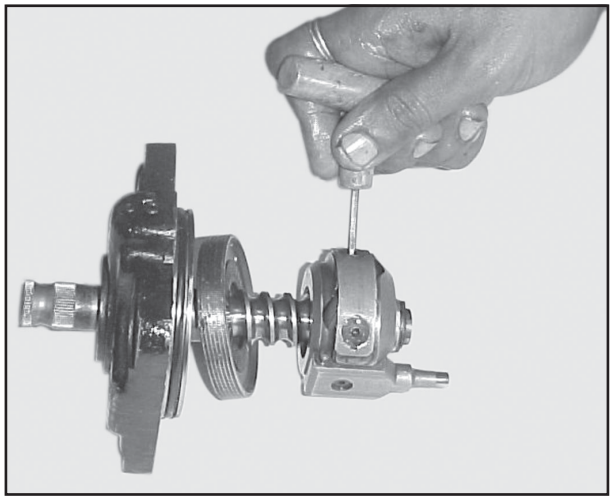


Fig. 11



Fig. 12

4. Dismantling the spring element :

Permissible in ZF factory or ZF Authorised Station only:

3.1 For steering version with centering spring

Unscrew the countersunk screw (114.3) and press the finger (114.2) out of the groove of the steering nut. Remove the two spring plates (114.6) and the centering spring (1144.5) from the finger.

F) Removal of worm from threaded ring in cover.

Permissible in ZF Factory or ZF Authorised Station only:

1. Clamp the cover (128) in the vice with the worm thread pointing upwards. Knock open the caulking of the two grooves of the threaded ring with special tool. The threaded ring is sealed with Loctite.

1.1 For steering version with angular ball bearing.

Remove the axial disk (124), axial needle cage(143), worm, ball holder (144) and bearing ring (145) one after another. Remove the circlip (130) and the shaft seal ring(129).

IX Checking Steering Parts

Note : *Thoroughly wash all parts in a cleaning fluid. Clean Loctite residue from the threads. The seal rings and other rubber parts must not be cleaned in trichloroethylene but with a suitable washing liquid, such as P 3 or Pril, which is completely soluble in water.*

Checking : Check the parts for wear, damage or other defects in order to establish whether the parts can be used again. Only new parts suitable for the type of steering and corresponding to the spare parts list should be used, see type plate. eg. M033 955 804

Important : The test requires detailed specialist knowledge and conscientiousness. The fitter must be responsible for the decision as to whether the parts needed changing or not.

1. Housing and housing cover

1.1 Cylinder bore. Max. wear dimensions of the bore diameters for honing:

8033/M033 = 78.055 mm

8043 = 101.56 mm

1.2 Threads

2. Piston*

2.1 External diameter

2.2 Gearing (crack testing longitudinally and laterally with a suitable testing procedure such as ferro flux). Scrap all parts with cracks. Remove any burr (ridges) on the sides of the gearing. **Permissible in ZF factory or ZF Authorised Station only**.

3. Sector shaft

1. Teeth (crack testing, longitudinally and laterally, with suitable testing procedure, e.g. ferro- flux.) Scrap all parts with cracks.
2. Running surfaces of the needle/roller sleeves and the shaft seal ring.

4. Needle/Roller bearing and Ball bearing

The relevant bearing should be changed in the case of indentation or wear on the running surfaces of the steering parts.

X TIGHTENING TORQUE :

SR.NO	DESCRIPTION	VALUES
1	FRICTION MOVEMENT OUT-SIDE“SAP”,MEASURED AT INPUT SHAFT OF STG. GEAR BOX	40-60 NCM
2	FRICTION MOVEMENT AT “SAP”, MEASURED AT INPUT SHAFT OF STG. GEAR BOX	ADD 70-150 NCM HIGHER TO 1.
3	HEX. BOLTS(132)/COVER(128)	M10 = 62NM M12X1.5 =115 NM M14X1.5 =190 NM
4	HEX. BOLTS(46)/COVER(40)	M10 = 62NM M12X1.5 =115 NM M14X1.5 =190 NM M16X1.5 =285 NM
5	SEALING-NUT(50)	70 NM

XI Assembly of the Steering Gear Box and Functional Testing

Before assembly, all traces of paint and damages must be removed from the face surfaces of the housing and cover. In addition, all parts must be thoroughly cleaned, lightly oiled and all sealing parts must be renewed. The measuring and adjusting tools used must be regularly checked for accuracy.

Permissible in ZF factory or ZF Authorised Station only.

Apply Loctite to the threaded rings (118 and 118.1), machine screws (99) and countersunk screws (115). This requires that the parts are dry, oil and grease free. That the oil Loctite deposits are removed and that the sprayed activator is ventilated. Pretreating the contact surfaces with activator T Accelerates the initial hardening time. The Loctite should be applied so that no excess loctite drips onto the parts after they have been joint together. Hardened Loctite drops may lead to functional disturbances. Loctite joints should only be separated after the Loctite has fully hardened and then refitted together. The use of Loctite is not dealt with in any further detail in the repair instructions, expect for the fact that care should be taken to select the correct identification number of the type of the Loctite to be used.

Hardening times for loctite identification No. 222 and 270 at room temperature.

After 2 hrs	It can be transported, Adjustment of the hydraulic medium possible with air.
After6 to 8 hrs	Completely hardened, adjustment of the hydraulic medium possible with oil or final testing on the testing rig.

A) Preassembly of housing

1. Clamp the housing in the Assembly Vice Tool-No 3.

1.1 For steering version with roller bearing

Note :
The rollers of the roller bearings (5 and 41) have been sorted out in certain tolerance groups by the manufacturer. Therefore, the rollers removed from the bearing outer ring on the cover side must not be interchanged with the rollers from the housing side.

Permissible in ZF factory only

1.1.1 Place the supporting disk (5.1) in the bearing neck bore hole

For roller bearings without roller cage.

Press the outer ring of the roller bearing (5), with the roller, into the housing until it reaches the collar using, and lock in position by making 6 notches around the circumference. (The rollers are fitted with with grease and a polymide filler piece in the roller gap; this provides protection when the parts are stored and remains in the steering gear box).Insert the sector shaft; this is important for installing the seal rings (6.1 and 6). Remove the sector shaft.

1.1.1 Place one round seal ring (6.1) and one seal ring (6) in each of the two radial grooves of the housing neck. Special care must be taken to ensure that the polyamide rings with the beveled surface lie on the same inclined surface of the groove.

B) Preassembling the segment shaft

Fit the adjustment screw (31), guide washer (32) and circlip (33) in the Sector Shaft with the punched curve outwards. The adjustment screw should be fitted play – free but must not jam. (Refer to technical data)

C) Preassembling the piston and adjusting the hydraulic reaction.

Permissible in ZF factory or ZF Autorised Station only.

D) Fitting the piston

1. Fit seals (95) in the longitudinal grooves of the piston and then fit the seals (94).(Fig. 12)
2. The pair of seals (97 and 98) are also fitted with the inner seal (97) first and then the outer seal (98). Place the round seal ring (102) in the recess of the piston and then fit the piston ring (103). Special care must be taken when passing the seal over the piston to ensure that no damage is caused by the edges of the piston. The small round seal rings (121) must be adhered to the recess of the of the cover (128) by means of grease. Lubricate the cylinder path well with oil.

   Slide in the preassembled piston up to the shoulder with the Tool –2. In order that the seal parts are not damaged the piston should be fitted in its final position, i.e. gearing(tooth) parallel to the housing sector Shaft bore. (Fig. No 13)

E) Fitting The End Cover

1 For steering version with threaded ring in the cover: screw in and tighten the hexagon bolts (132) with the washers (131).

   Slide the entry bush over the serrated gearing of the steering spindle, press the shaft seal ring (129) with the sleeve so deep that the circlip (130) can just be fitted in its groove (sealing lip pointing towards the inside of the housing. Fill the space between the sealing lip and the dust lip with hot bearing grease) fit the circlip (130) (Fig. No.14)

Refer to the technical data for tightening torques.

F) Pre-assembly of the Cover.

1. Fit the round seal ring (52) and the seal ring (51) in the radial groove. Special care must be taken to ensure that chamfered area of the polyamide ring lies in the same chamfered surface of the groove.
2. Fit the supporting washer (44) in the bore hole of the housing cover. Press the roller bearing duly fitted with the rollers with grease and the polyamide filler piece (41) upto the shoulders with a drift and secure by stalking the collar at 6 points on the periphery.

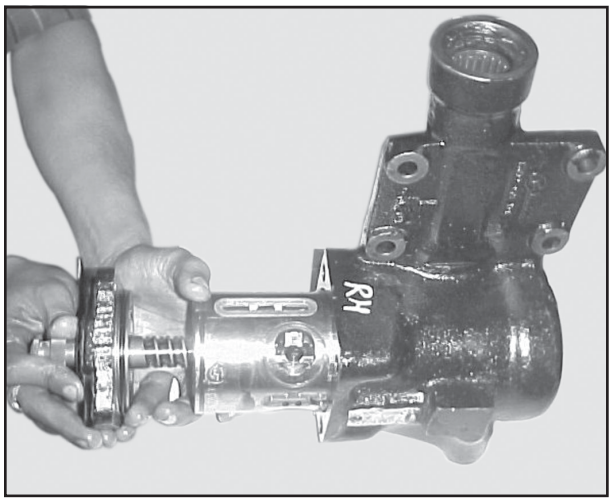
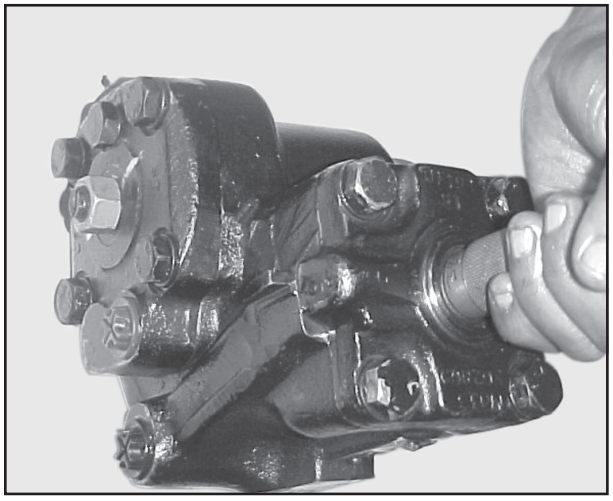
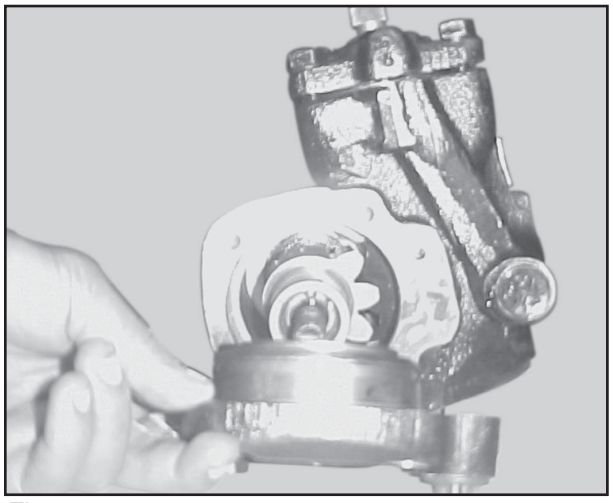


Fig. 13


Fig. 14


Fig. 15

G) Fitting the Sector Shaft.

1. Bring the piston to the center position by turning the Input Shaft. This center point is found by first determining the total number of turns of the worm then turning back the piston from one stop by half the total number of turns.

1.2 Insert the segment shaft into the housing, taking care not to damage the sealing parts.

H) Fitting the housing cover

1 Fit the two round seal rings (42 and 43) in the axial groove of the housing cover (40).

1.1 Fit the housing cover (Fig-15). Position the housing cover by turning the adjusting screw (31) on the front surface of the housing in a counter – clockwise direction and screw on the sealing nut (50) temporarily.

Screw in and tighten the hexagon bolts (46) with washers (47).

Screw in the threaded plug (48) and tighten (refer to the technical data for the tightening torque).

I) Setting the pressure Point

1. Place the torque measuring unit Tool No.4 and insert Tool no.5 on the worm.

2. Turn the steering from the one end position to the other. Measure the frictional force outside the pressure point and determine the total turn of the steering wheel.

3. Then set the frictional force in the area of the pressure point (mid position; half of the total turn of the steering wheel). The torque measuring device is turned both to the left land right of the center position and the adjusting screw should be screwed out so far until an increase in the friction torque of 40-60 Ncm compared to the value measured in point 2 is set (Figure 16).

4. Tighten the sealing nut (50) (refer to the technical data of the tightening torque), while holding the adjusting screw in a fixed position. Check the set torque once again. Fit the protective cap (70).

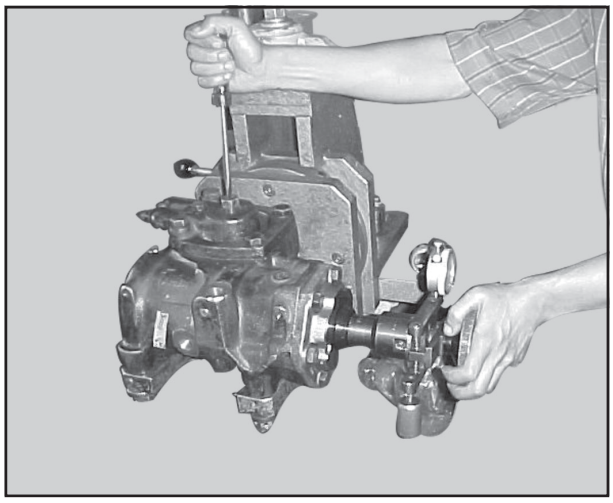


Fig. 16

J) Checking the frictional torque of the completely assembled steering gear box

Place the torque measuring device Tool no.4 and insert Tool no. 5 on the worm. Turn the steering gear box form one end position to the other. Measure that frictional torque outside the pressure point in a horizontal position (refer to the technical data.) piston (see Section D).

K) Functional Test :

Clamp the completely assembled steering gear box on the steering test rig according to the instructions given in section VII after Final hardening time for loctite. Bleed the steering gear box (see section II) and increase the oil temperature to approximately 50oC.

The adjustment values given in section VII are valid the for setting pressure point of the steering system after completion of the repairs on the workbench. There is no oil in the steering gear box.

L) Testing the maximum pressure :

Block the steering gear box in the mid position (steering gear boxs without hydraulic steering limiting system can also be turned to the stop). Turn the steering wheel until the maximum pressure has built up on one side of the cylinder. For this purpose it is necessary to apply a force of 100-200N (10-20 kg) to the periphery of the steering wheel so that the maximum path of the valve is utilized.

If the steering gear box is fitted with a pressure limiting valve a maximum pressure must be built up which corresponds to the specifications given on the type plate (tolerance + 10%). If the steering gear box has no pressure limiting valve then the pressure limiting valve built into the testing rig must be set to the rated pressure which is predetermined for the steering gear box (this would correspond to the rated pressure which is given on the type plate of the pump).

The same measurements are now carried out in the opposite direction of the steering wheel. If the maximum pressure is not reached within the specified tolerance, the oil leakage in the steering system is either too great or the pressure limiting valve, if applicable, is incorrectly adjusted. The latter can also be the reason for too high maximum pressure.

M) Checking for oil leaks :

The control valve must be fully activate in order to be able to determine the leakage oil in the steering system. For this reason a minimum of approx. 200 N (20 kg) must be applied to the steering wheel. The test is carried out with the pump running and a pressure is set on the steering testing rig which lies approximately 20 bar below the maximum pressure given on the type plate.

The maximum permissible leakage oil under these conditions is:

1.8 LPM for type 8033-8037

2.0 LPM for type 8038-8043

The test can be carried out with blocked steering drop arm or in the end position of the cylinder. Repeat the leakage oil check at a pressure of 20 – 30 bar.

N) Checking the valve setting :

The pump is running and the oil circulates through the hydraulic system of the steering gear box. No counter force is set on the steering shaft in the steering test rig. The hydraulic steering is turned slowly to both sides up to the stops in each case and the torque measuring device is released several times during this process. The steering must not move in any direction on its own. The difference in the torques when steering to left and right must not exceed 30% in respect of the low value up to a pressure of 3 bar compared with the flow pressure when the steering drop arm is blocked

O) Checking control valve :

Close the control valve by turning the steering wheel then build up the maximum pump pressure. The steering wheel should then be slowly released. The valve should then return to the 0 position, i.e. the oil pressure must fall to the flow pressure.

P) Checking the seals :

No leaks should be visible on the hydraulic steering gear box after running for 10 minutes in the neutral position of the steering valve.

Tightness at high pressure must be determined during the test in accordance with points 2 to 4 of this section. Place the dust seal (1.1) on the segment shaft up to the shoulder, applying HTR2 grease or equivalent between the dust seal and housing, and place the protective cap (70) on the steering spindle end, applying HTR2 grease or equivalent between the protective cap and valve housing.

IX Fitting the steering gear box in the vehicle

Note :

In order to ensure perfect functioning of the ZF hydraulic ball & nut steering, special emphasis must be paid to cleanliness when fitting all relevant units of the system and when laying oil lines. In order that faults can be avoided due to foreign bodies or dirt in the oil steering circuit the cap plugs on the line connections of steering gear box, oil pump, working cylinder, valves etc. should only be removed when connecting the lines. Connection lines and securing elements must be carefully cleaned and deburred.

1. Clean any paint or dirt from contact faces of mounting brackets.
2. Insert steering gear in mounting bracket and tighten bolts to required torque.
3 Stresses which may occur during the assembly of the steering gear/bearing block due to the position of dash board or on the

circumstances when securing steering column tube and steering spindle.

Stresses can cause bending forces especially in steering spindle which, depending on size and frequency, may lead to fractures or impair easy movement of steering gear.

To check whether the steering gear box has been installed correctly proceed as given below :

3.1 Check the movement of the steering gear at the mounting bracket, steering drop arm and drag links (s).

Fit universal joint or flexible coupling between steering column and steering gear. The angled fork section must be at right angles to the markings on steering spindle and steering columns tube or valve housing in straight ahead position. The angle should be the same if two joints are used and the joint forks must be arranged in one plane. If it is not possible to fit them in this way, synchronization can be achieved by positioning the forks on the serrated gearing in respect of each other.

Hammer blows on joints must be avoided in case of aluminium universal joints because this might lead to destruction or stiffness. Connect them by inserting the fit bolts and tightening the nuts. (Refer to the technical data for the tightening torques).

3. Bring steered wheels to straight ahead position.

4. Slide drop arm onto sector shaft (30), where by the markings of drop arm and segment shaft must coincide. Tighten hexagon nut (35) temporarily and turn steering clockwise until wheel stop. Remove drop arm and establish whether there is steering reserve in steering gear box by continuing to turn steering wheel. Repeat the measurement in clockwise direction. Tighten hexagon nut (35) to required torque and secure with split pin (34) or securing plate (36). Hook on and tighten drag link.

5. Secure hydraulic pump on bearing block and adjust tension of the V – belt. Thumb test.

6. Connect pressure and return lines between pump, steering and working cylinders. If the lines have to be bent then this must be carried out in a cold condition so that the risk of combustion is eliminated.

7. Commissioning the steering system

In order to prevent dirt particles which still could be in the system, from entering pressure limiting valve during first commissioning, we recommend that the oil is allowed to flow through the system for several minutes, with changing engine speed and without turning the steering wheel.

Steering should then be turned several times in both directions without completely reaching the stops of the steering system at a medium engine speed (until the operating temperature is reached). It is advantageous for steering gear boxs with a built in pressure limiting.

Finally bleed steering system (see section III).

XII. Vane Pump :

I. Functional description :

ZF vane pump has been specifically designed to supply oil to hydraulic- assisted steering systems.

Low number of moving parts (drive shaft, rotor and vanes) and the minimum possible face – end play of these elements with respect to the drive – side and cover – side faceplate ensure high efficiency and, consequently, the best possible utilization of power.

This efficiency is also partially the result of the pairs of two opposite suction and pressure lines, a design wherby the ten pump cells each convey twice their own cell volume per revolution. The double arrangement of the suction and pressure lines results in mutual cancellation of the hydraulic radial forces acting upon the rotor.

When turning the drive shaft and the rotor connected to it, the vanes guided therin are also driven. Centrifugal force and pressure oil which can pass via bores and grooves from the pressure chamber on the inside faces of the rotor, force the vanes against the track of the camring. The pump cells are thus separated from each other, causing intake as the volume rises and discharge as the volume decreases.

Oil passes from two pressure chambers into the space between cover and cover–side face plate, which is thus forced against cam ring at operation pressure, also to the flow – limiting valve, and via throttle to discharge line.

An increase speed and or increase flow results in an increasing pressure drop down stream of the choke and, consequently, on the spring side of the valve piston.

As soon as the hydraulic force (pressure difference X piston area) exceeds spring force, piston moves against spring, with the result that the superfluous conveyed oil can pass into the inlet channel of pump via bypass bore which is then opened.

Consequently, an almost constant oil flow delivered for the steering gear box over entire speed range.

Maximum pressure in the pump is controlled by a spring loaded valve in flow limiting piston. Fig. 17 & 18.

II. Checks :

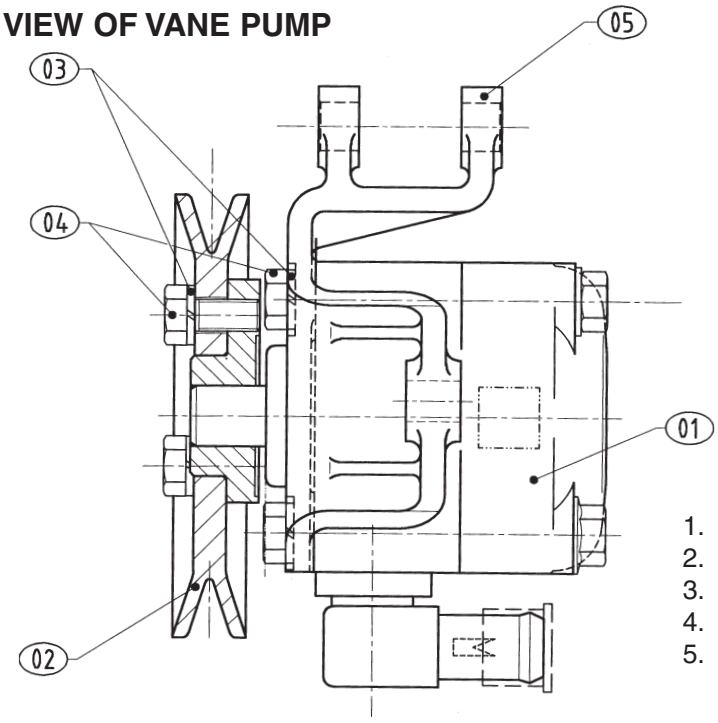
Pump is lubricated by the hydraulic oil. It is important that oil level in tank be checked at specified intervals. Oil level has to be checked with engine running in idling speed.

The trapped air is under pressure with pump running. Trapped air expand to atmospheric pressure when pump is shut down. This causes oil level to rise 1 to 2 cm in tank.

Check oil level in tank before starting engine. If necessary, top up oil until it is 2 cm above upper mark. Start the engine and run at idling speed. If oil level drops more than 1 to 2 cm, entire hydraulic system must be bled as specified.

In order to prevent air entry in the system, all hose connections and joints should be checked for tightness and, if necessary, retightened.

XIII. SECTIONAL VIEW OF VANE PUMP



1. Vane Pump
2. Pulley
3. Spring Washer
4. Hex Bolt
5. Bracket

Fig. 17

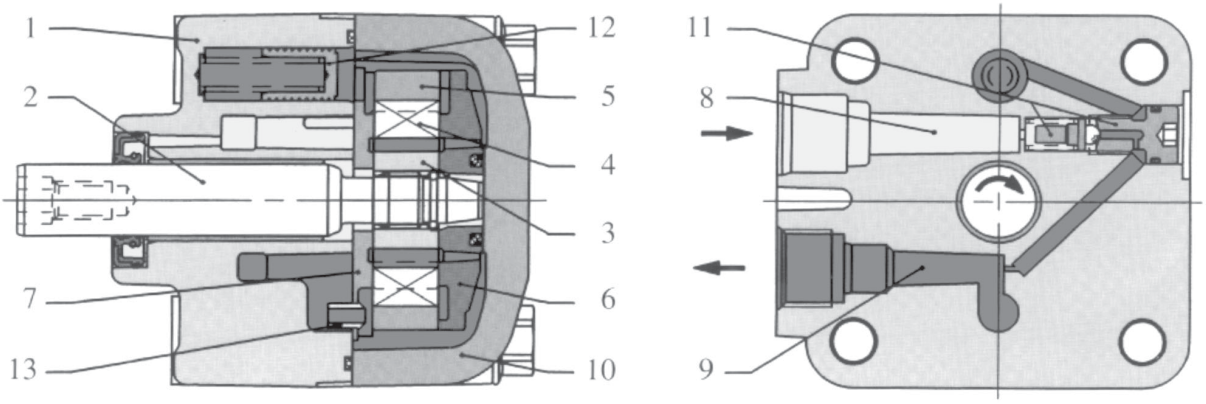
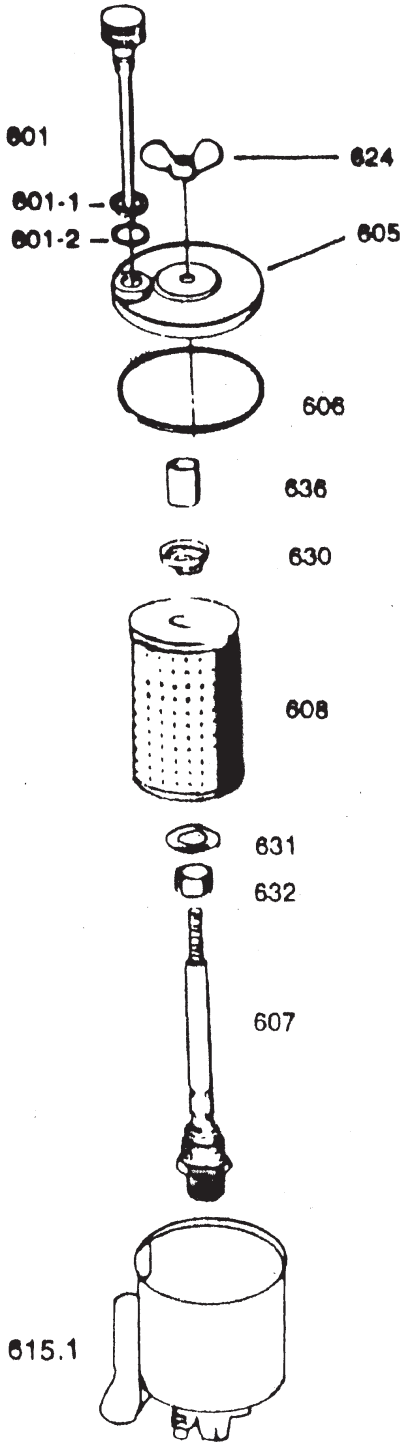


Fig.14b Functional Representation of ZF Vane CP1

1. Housing
2. Shaft
3. Rotor
4. Vanes
5. Cam ring
6. Rear control
7. Front control
8. Suction duct
9. Pressure duct
10. Cover
11. Pressure relief valve
12. Flow control valve
13. Throttle insert

Fig. 18

XIV. POWER STEERING OIL TANK



S.NO	DESCRIPTION / EXPLODED VIEW NO.
1	Bowl Assy. (615, 632, 607)
2	Cover Assy. (605)
3	Rubber Sleeve (636)
4	Dip Stick (601, 601.1, 601.2)
5	O' Ring Sleeve (601.1)
6	O' Ring (601.2)
7	Sealing Ring (606)
8	Filter (630, 631, 608)
9	Wing Nut (624)
10	Oil Tank Complete

Fig. 19

XV. Faults and Remedies :

ZF steering system is designed to meet exacting requirements. Gear box is designed in such a way that no faults can occur in case of correct maintenance and normal operation.

However, if a fault should occur, before the steering gear box is checked for individual faults, oil level must first be checked with engine running. Oil filling procedure is described in section II. Heavily foaming oil may lead to faults, since such oil release air with great difficulty or not at all, once it has entered the system.

TROUBLES AND REMEDY :

1. Hard steering when turning steering wheel to the right or to the left.

	CAUSE	**REMEDY**
a)	Not enough oil in system	Oil level less. Check system for leakages.
b)	Air in hydraulic system.	Check suction line and shaft sealing ring of pump shaft for leakages.
c)	Improper pump drive.	Check belt tension / gear drive.
d)	Flow control valve of pump stuck/clogged	Remove control valve, wash and check. Valve should move smoothly.
e)	Filter clogged or broken.	Drain oil and clean system and replace filter.
f)	Stiff universal joint.	Replace the universal joint.
g)	Inner seals of gear box / pump damaged	Gear box and pump to be repaired.
2. Hard steering in either direction of turning only.		
a)	Steering limiter valve responds too early	Readjust steering limiter as specified.
b)	Steering limiter valve does not close	Remove valve and inspect.
c)	Inner sealings damaged	Gear box to be repaired.
d)	steering spool adjustment incorrect	Gear box to be repaired.
3) Hard steering when steering wheel is turned fast.		
a)	Pump drive defective.	Retension belt / ensure proper gear drive.
b)	Spool valve in pump clogged.	Remove spool valve, clean and refit.
c)	Pump delivering less pressure (wear of rotor and pressure plates)	Pump to be repaired.
d)	Air in oil.	Check suction line and pump shaft seals for leakage. Bleed system.
4) Poor self centering of steering wheel		
a)	Steering column and steering Linkages stiff.	Grease / oil steering column, Steering knuckles, ball joints, stub axle etc.
b)	Steering gear box centre torque high.	Reset pressure point.

5) Inaccurate steering when driving straight ahead.		
a)	Not enough oil in system / air in system.	External leakages in system to be arrested.
b)	Air in system.	Check cause of air intake and repair (specially suction line)
c)	Mounting bolts of gear box loose.	Tighten bolts to specified torque.
d)	Play in ball joints or steering linkages.	Install new joints.
e)	Play in gear box spool valves.	To be repaired.
6) Severe steering wheel jerks while steering.		
a)	Not enough oil in system.	Top up oil and check for external leakages.
b)	Air in system.	Check cause of air intake and repair (specially suction line).
c)	Play in gear box sector shaft.	Adjust centre torque.
d)	Play in ball and nut / worm of gear box.	To be repaired.
7) Torsional viabrations on steering wheel (flutter)		
a)	Unbalanced wheels / break drums.	Wheels to be balance.
b)	Steering geometry not correct.	To be adjusted / corrected.
c)	Air in oil.	Leakages to be checked and corrected (suction line).
8) Excessive play noticed at steering wheel.		
a)	Steering gear mouting bracket loose.	Tighten bolts to required torque.
b)	Play in universal joint.	Replace joint.
c)	Play on sector shaft.	Adjust centre torque.
d)	Play in worm and nut of gear box.	To be repaired.
9) Excessive pump noise.		
a)	Not enough oil in system.	Check for external leak. Repair and top up with oil.
b)	Air in oil.	Check suction line and pump shaft seal for leaks.
c)	Pressure line touches frame or body	Provide for adequate distance between the pipes
	(noise due to direct metalic contact).	and use rubber padding.
d)	Pressure in suction line is too high	Check for clogged suction line Clean strainer.
10) Hydraulic oil loss.		
a)	loose oil tank cover / dip stick.	Fit the same properly.
b)	Shaft seal leakage on pump/gear box	Replace the seals.
c)	Loose adaptors and damaged Sealing	Replace sealing wahsers and tighten adaptors
	washers on gear box, Oil tank and pump.	/ joints.

FUEL SYSTEM

FUEL SYSTEM

Introduction :

Fuel system consists of following components :

1. Fuel tank assy.
2. Fuel tank strainer.
3. Fuel filter (on Engine)
4. Fuel level gauge.
5. Fuel filler cap & neck.
6. Fuel hoses and fuel lines (i.e. delivery & return lines)

Warning :

- While removing fuel tank from vehicle, keep sparks, cigarettes, and open flame away from it.
- Before repairing fuel tank assembly, clean it thoroughly
- Always wear safety glasses.

FUEL SYSTEM : TELCOLINE SINGLE CAB

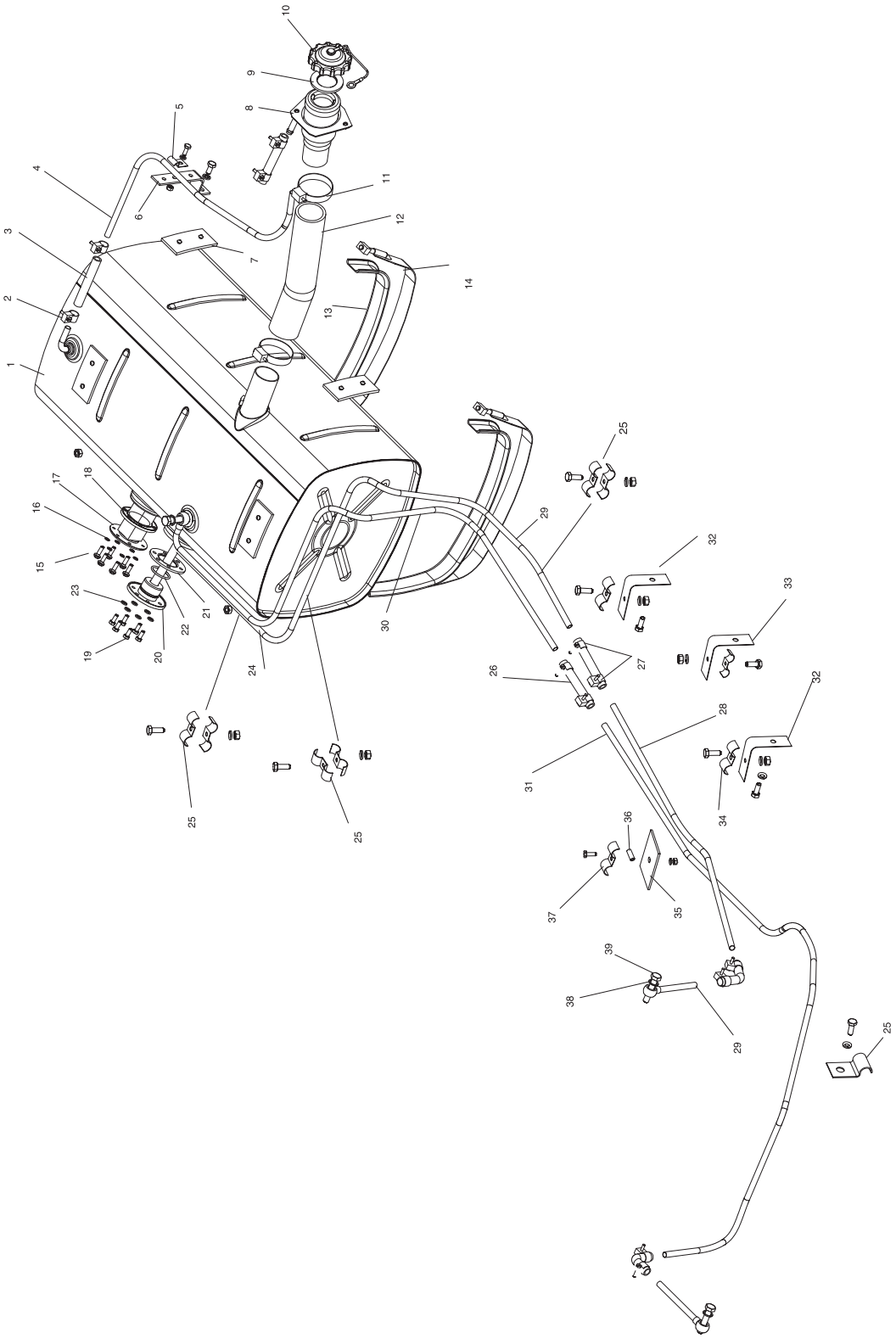


Fig. 1

FUEL SYSTEM - TELCOLINE SINGLE CAB 2825 WB

1 - ASSY FUEL TANK COMPLETE
2 - HOSE CLIP 17
3 - RUBBER HOSE
4 - TUBE 10X0.7 THK
5 - CLAMP
6 - BRACKET
7 - RUBBER PACKING
8 - ASSY FILLER NECK WITH BKT.
9 - SEALING WASHER
10 - ASSY FUEL TANK CAP COMPLETE (DIESEL)
11 - HOSE CLAMP 60
12 - RUBBER HOSE (FOR FUEL TANK NECK)
13 - RUBBER PACKING
14 - ASSY STRAP
15 - CR PAN HD SCREW M5X10
16 - SPRING WASHER B5
17 - FUEL TANK LEVEL GUAGE UNIT
18 - SEALING RING
19 - HEX SCREW M6 X 14
20 - ASSY. SUCTION TUBE
21 - SEALING RING
22 - O-RING 31.5 X 2.65
23 - SPRING WASHER B6
24 - ASSY SUCTION LINE (TANK TO HOSE)
25 - PIPE CLAMP
26 - RUBBER HOSE
27 - HOSE CLIP 16
28 - SUCTION LINE (TUBE 10 X 0.7)
29 - ASSY SUCTION PIPE (HOSE TO FILTER)
30 - ASSY RETURN LINE (HOSE TO TANK)
31 - RETURN LINE (TUBE 10 X 0.7)
32 - BRACKET
33 - BRACKET
34 - CLAMP (10 OD PIPE)
35 - PLATE
36 - RUBBER BUSH
37 - CLAMP
38 - SEALING WASHER 14 X 1.8
39 - PIPE UNION BOLT 10 M14 X 1.5

FUEL SYSTEM : TELCOLINE CREWCAB

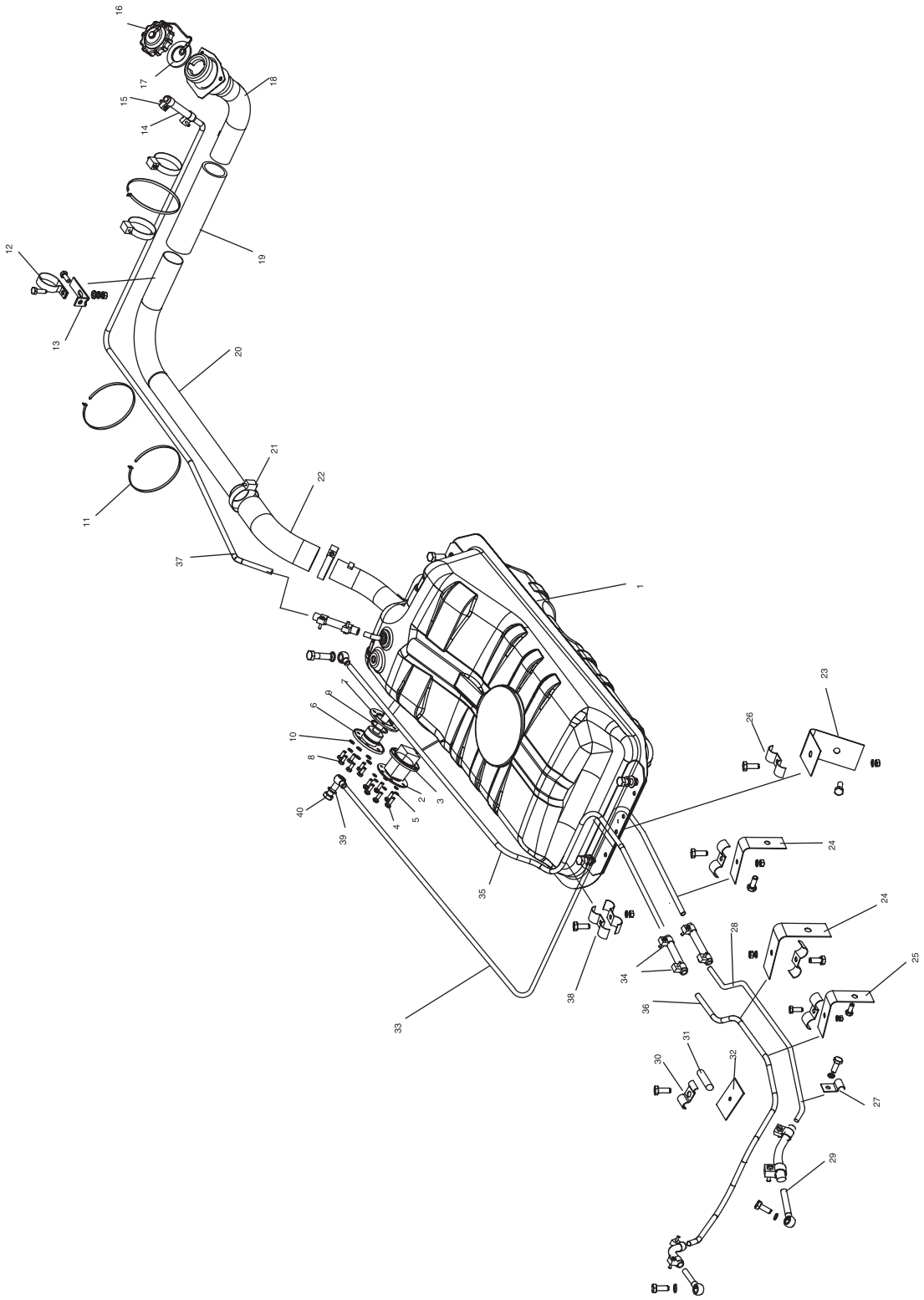


Fig. 2

FUEL SYSTEM - CREWCAB 3150 WB

1 - ASSY FUEL TANK COMPLETE
2 - FUEL TANK LEVEL GUAGE UNIT
3 - SEAL RING
4 - CR PAN HD SCREW M5 X 10
5 - SPRING WASHER B5
6 - ASSY SUCTION TUBE
7 - SEALING RING
8 - HEX SCREW M6 X 14
9 - O-RING 31.5 X 2.65
10 - SPRING WASHER B6
11 - CABLE TIE 80 X 300 BLACK
12 - CLAMP (FUEL FILLING PIPE)
13 - BRACKET
14 - RUBBER HOSE
15 - HOSE CLIP 17
16 - ASSY FUEL TANK CAP COMPLETE
17 - SEALING WASHER
18 - ASSY FILLER NECK WITH BRACKET
19 - RUBBER HOSE (FUEL FILLING)
20 - ASSY PIPE (FUEL FILLING)
21 - HOSE CLAMP 80
22 - RUBBER HOSE (FUEL FILLING)
23 - BRACKET
24 - BRACKET
25 - BRACKET
26 - CLAMP (10 OD PIPE)
27 - CLAMP
28 - SUCTION LINE (TUBE 10 X 0.7)
29 - ASSY SUCTION PIPE (HOSE TO FILTER)
30 - CLAMP
31 - RUBBER BUSH
32 - BRACKET
33 - ASSY SUCTION LINE
34 - HOSE CLAMP 16
35 - ASSY RETURN LINE (HOSE TO TANK)
36 - RETURN LINE (TUBE 10 X 0.7)
37 - TUBE 10 X 0.7 THK
38 - PIPE CLAMP
39 - SEALING WASHER 14 X 1.8
40 - PIPE UNION BOLT 10 M14 X 1.5

FUEL TANK

Fuel tank is located in front of rear axle.

Removal

1. Remove fuel tank cap.
2. Drain fuel in a container. Do not store fuel in an open container to avoid fire or explosion. Unscrew banjo bolt and disconnect suction line from fuel tank strainer.
3. Unscrew banjo bolt and disconnect return line from fuel tank.
4. Disconnect fuel gauge float unit connector.
5. Disconnect the fuel filler neck and connecting hose by loosening hose clamps.
6. Loosen fuel tank mounting screws and take out the tank .

Inspection

1. Visually inspect fuel tank for deterioration, leaks and damage. Replace tank if necessary.

Fuel tank purging procedure

1. Remove fuel tank from vehicle as above.
2. Remove strainer and float unit from tank. (Refer fig. 4 & 5).
3. Shift the tank to flushing area.
4. Fill tank with warm water or normal tap water and agitate vigorously and drain water.

   Repeat the procedure until inside of tank is clean.
5. Completely flush out remaining water after washing & let fuel tank dry from inside.
6. Replace the fuel tank if it is rusty from inside.

Warning :

Do not allow water to remain inside fuel tank after washing. This will cause corrosion inside fuel tank and damage to other parts in fuel system.

Assembly

1. Assemble strainer and float unit to fuel tank. Assemble strainer with new 'O' ring.
2. Assemble fuel tank on vehicle with fasteners/ straps. Replace rubber spacers/straps if found deterioated, cut or perished.
3. Connect suction line to fuel tank strainer and tighten banjo bolt. Always use new sealing washers.
4. Connect return line to fuel tank and tighten banjo bolt. Always use new sealing washers.
5. Install fuel filler hose after fuel tank has been mounted in place and tighten hose clamps. Failure to follow this caution could result in leakage of fuel from hose connections.
6. Fill the tank with fuel.
7. **Prime fuel system as follows :**

a. Unscrew fuel lift pump plunger knob. Pull and push it 10-15 times (30-40 times if fuel tank has been completely emptied) (Refer fig. 3)

b. Tighten fuel lift pump plunger knob.

c. Start engine and check for fuel leakage. Rectify if necessary.

d. Check for smooth running of engine. If erratic fuel supply is still felt, check for air suction in fuel pipelines from fuel tank to FIP and rectify.

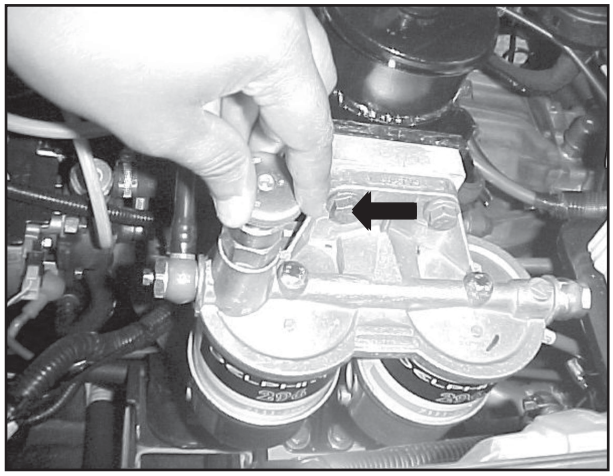


Fig. 3

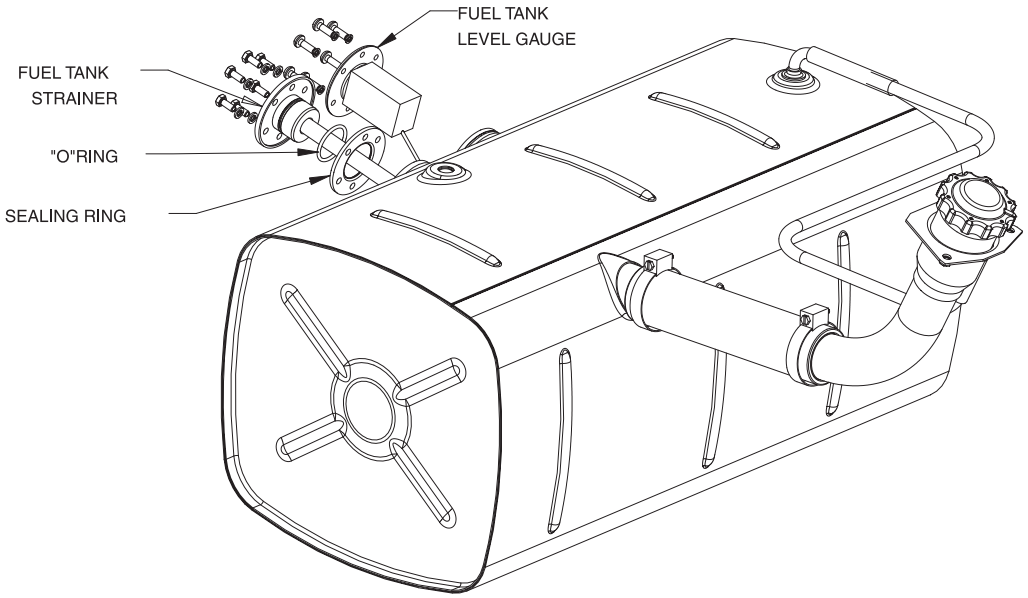


Fig. 4 TELCOLINE SINGLE CAB FUEL TANK

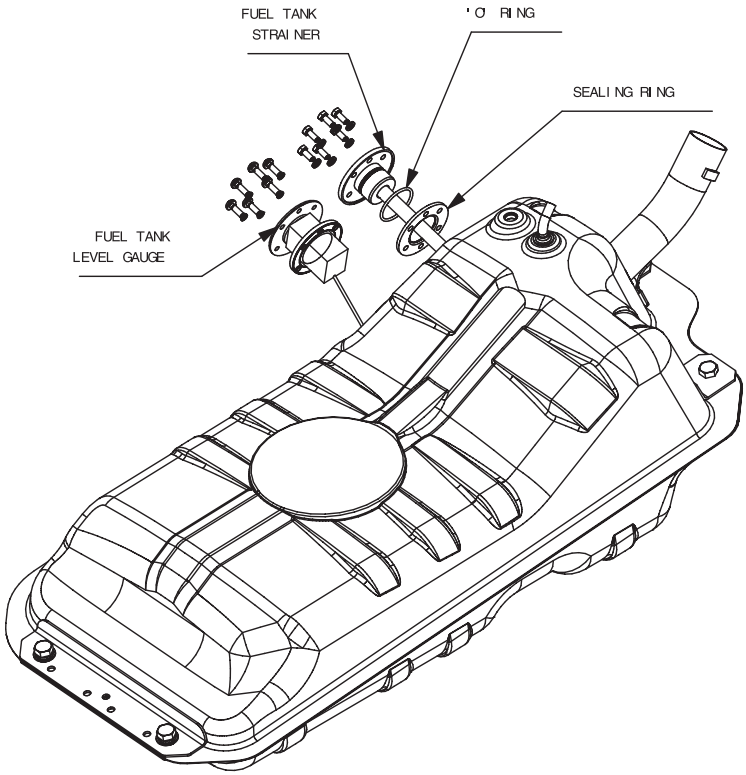


Fig. 5 TELCOLINE CREWCAB FUEL TANK

FUEL TANK STRAINER

Removal

1. Unscrew banjo bolt and disconnect suction line from fuel tank strainer.
2. Unscrew hex screws and pull out strainer. (Refer fig. 4 & 5)

Inspection

1 Check strainer mesh for clogging.

Warning :

Unless replacement of fuel tank strainer or purging of fuel tank is necessary, strainer should not be removed from tank.

Assembly

1 Clean strainer and refit with a new 'O' ring.

2. Connect suction line to fuel tank strainer and tighten banjo bolt.
3. Always use new sealing washers.
4. Prime fuel system as mentioned above.

FUEL FILTER

Filter assembly is located in engine compartment. It filters the fuel sucked from tank. This is essential to avoid clogging of injector nozzle holes.

Removal

1. Unscrew drain plug and drain fuel from filter bowls.
2. Loosen banjo bolts & disconnect suction line & supply line from filter.
3. Remove filter assembly with top cover from mounting bracket.
4. Unscrew fuel filter bowl mounting bolt & remove bowl with element.

Inspection

1. Check tank side filter element & FIP side filter element for clogging, damage. Replace if necessary.
2. Replace tank side filter element & FIP side filter element at recommended intervals.

Assembly

1. Assemble new filter element if necessary.
2. Assemble fuel filter and fit it on mounting bracket.
3. Connect suction line/supply line to fuel filters and tighten banjo bolts.
4. Always use new sealing washers.
5. Prime fuel system as mentioned above.

FUEL FILLER NECK CAP

The fuel tank filler neck has a vented cap.

Removal / Inspection

1. Remove filler cap (Refer fig. 6).
2. Check 'O' ring for even filler neck imprint.
3. Check 'O' ring for any deterioration or any damage. If found damaged replace cap.

Note :

If cap needs replacement, ensure usage of genuine cap. Otherwise it may result in malfunction of fuel system.

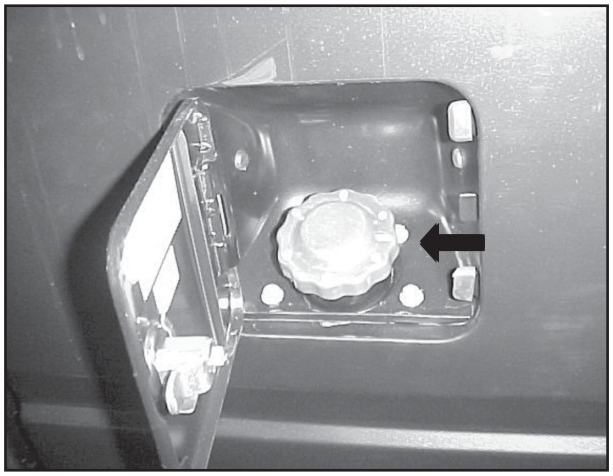


Fig. 6

FUEL HOSES AND FUEL LINES

Removal

1. Unscrew all fuel hose clamps for removing fuel lines & hoses. (Refer fig. 7)
2. To avoid damage to the fuel lines / hoses while disconnecting slide back the clamps then twist the lines as you pull.

Caution :

a. While removing fuel pipe & hoses use waste cloth etc. to prevent spilling fuel.

b. Spilt fuel should always be wiped away.

c. After the fuel pipe & hose have been removed, install blind caps to prevent entry of foreign particles.

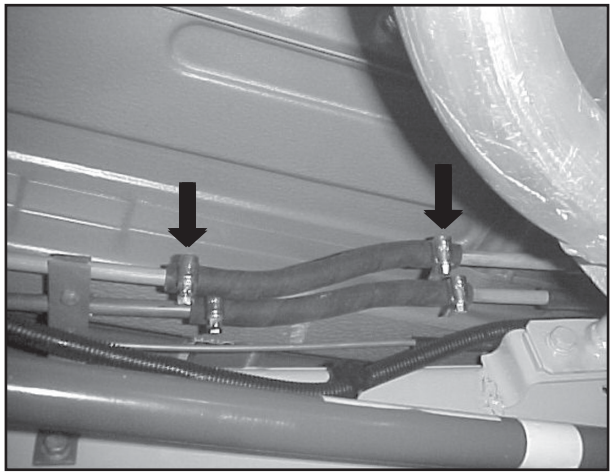


Fig. 7

Inspection

1. Visually check all hoses and pipes for leaks, loose connections, deterioration or damage, crack etc. Replace if necessary.
2. Make sure that all clamps are secured & tight.
3. If pipe clamps found deformed, bent or broken replace with new ones.

Assembly

1. Do not tighten clamps excessively to avoid damage to hoses.
2. Care to be taken to connect hose to pipe and clamp on hose.
3. Do not kink twist hoses when they are routed.
4. When attaching hose to pipe, be sure that hose is attached as shown in the Fig. 8
5. After pipes and hoses have been connected, prime fuel system, start the engine and ensure that there is no fuel leakage.

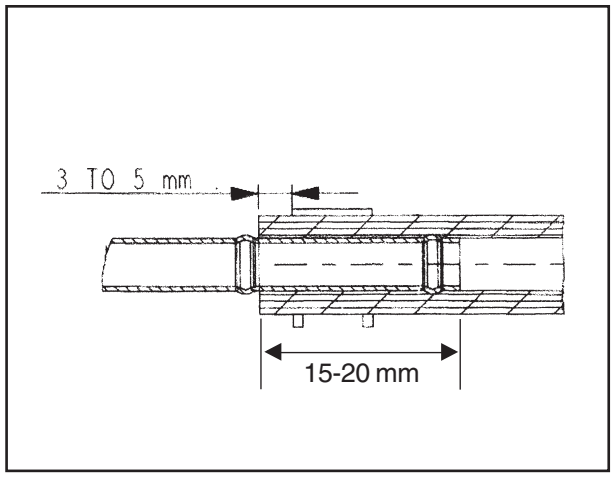


Fig. 8

EXHAUST SYSTEM



INTRODUCTION

Exhaust System consists of exhaust pipes, catalytic converter and silencer. Exhaust gases emitted from engine consists of harmful pollutants like Co, Nox, Unburnt hydro carbons & particulate matter. Two way diesel oxidation catalytic converter reduces pollution before exhaust gases are released to atmosphere, thus protecting environment.

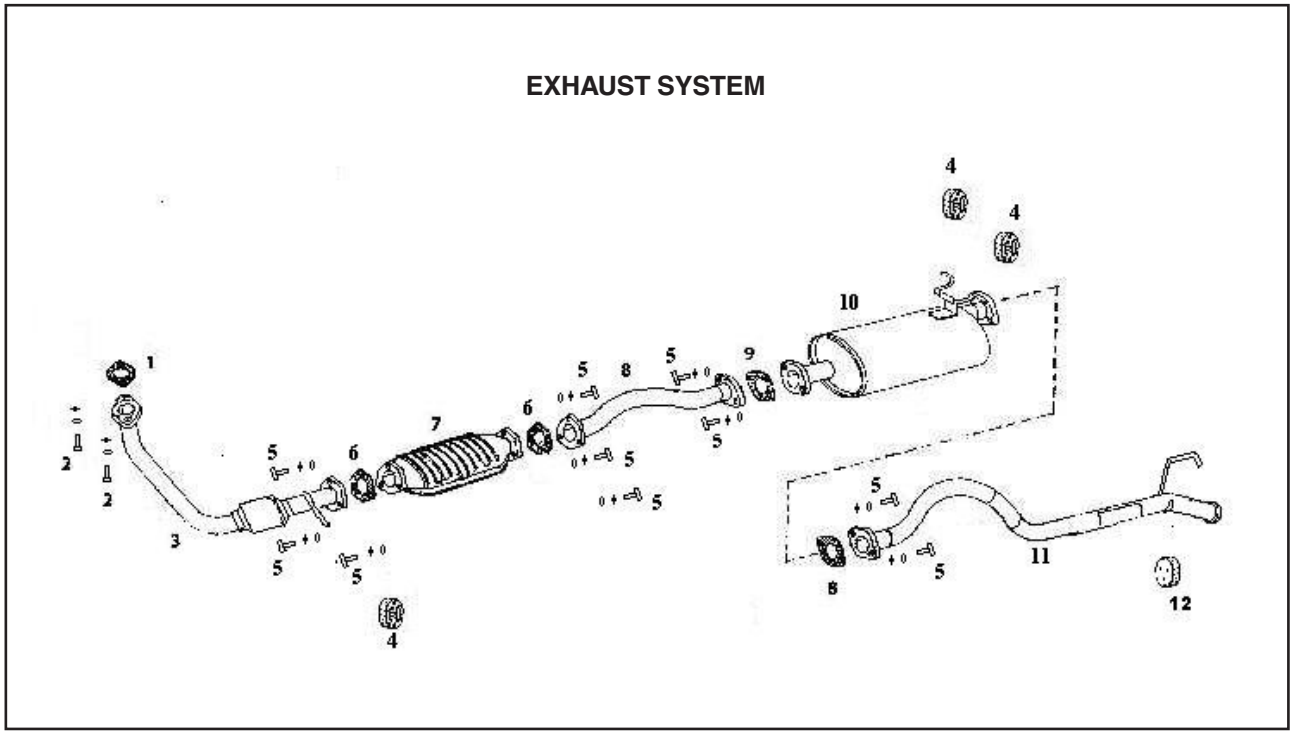


Fig. 1

1	GASKET
2	HEX SCREW M10 X 40
	HEX NUT M10
	BRIGHT WASHER 10.5
3	ASSY. EXHAUST PIPE FRONT
4	RUBBER HANGER
5	HEX BOLT M8 X 35
	SPRING WASHER B8
	BRIGHT WASHER 8.4
6	GASKET (CATALYTIC CONVERTER)
7	CATALYTIC CONVERTER
8	ASSY. EXHAUST PIPE (INTERMEDIATE)
9	GASKET
10	ASSY. MAIN SILENCER
11	ASSY. EXHAUST PIPE (REAR)
12	RUBBER HANGER

a. Removal of Exhaust pipe front

- Unscrew bolts connecting exhaust pipe front to manifold.
- Unscrew bolts connecting exhaust pipe front to catalytic convertor.

  Remove pipe from rear.

b. Removal of Exhaust Assembly

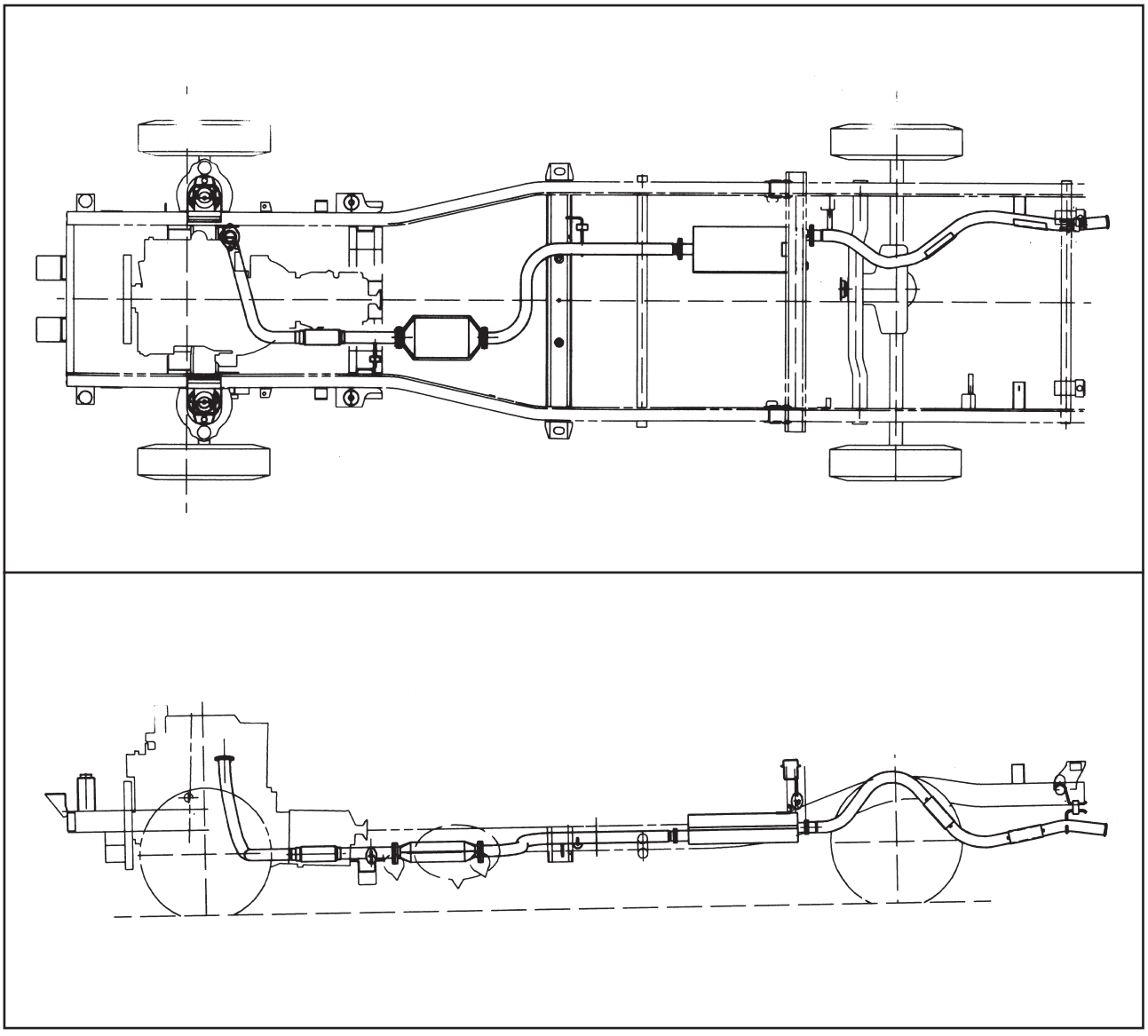
(Catalytic converter, silencer, intermediate pipe and tail pipe)

- Disconnect pipes one by one by removing bolts from joints and removing pipe hanging hooks from rubber hangers.

c. Tightening torques

At - Manifold end - 6.4 mkg

At - Other joints - 3.2 mkg



EXHAUST SYSTEM

Warning :

To avoid the danger of being burned, do not touch the exhaust system when the system is hot. Any service on the exhaust system should be performed when the system is cool.

MAINTENANCE :

At every interval of periodic maintenance service, and when vehicle is raised for other service, check exhaust system as follows :

- Check rubber mountings for damage, deterioration, and out of position.
- Keep sufficient clearance between exhaust system components and underbody or adjacent parts. (min. 25 mm)
- Check exhaust system for leakage, loose connection, dent and damage.

  If bolts or nuts are loosened, tighten them to specified torque.
- Check nearby body areas for damage, missing or mispositioned part, open seam, hole, loose connection or any other defect which could permit exhaust fumes to seep into vehicle.

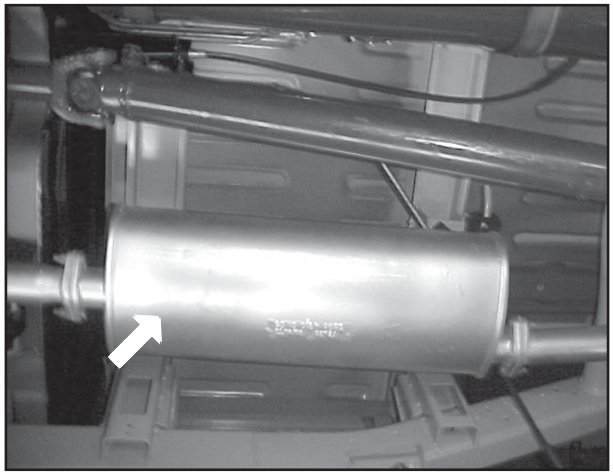
EXHAUST MANIFOLD

- Check gasket for deterioration or damage. Replace if necessary.

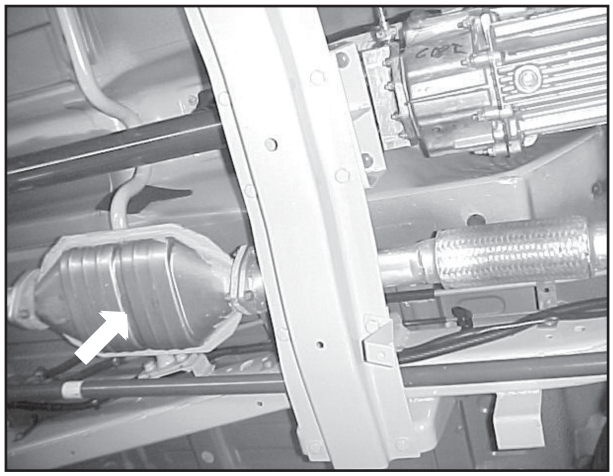
EXHAUST SYSTEM

In case exhaust pipe/silencor/catalytic convertor needs replacement, guidelines given below should be followed.

- Tighten bolts and nuts to specified torque when reassembling.
- After installation, start engine and check each joint of exhaust system for leakage.
- Exhaust silencer & catalytic converter should not be subjected to impulse force by dropping it or hitting it against hard object.



Silencor



Catalytic Convertor

RADIATOR

SERVICE INSTRUCTION FOR COPPER BRONZE RADIATOR

RADIATOR

Type	-	Maccord
Number of tubes	-	126
Number of tube rows	-	4
Capacity	-	6 liters
Leakage testing pressure	-	2 kg/cm^2

RADIATOR CAP

Pressure valve opening	-	1.0 kg/cm^2
Vacuum valve opening	-	0.05 kg/cm^2

REMOVAL OF RADIATOR FROM VEHICLE

Note : Before proceeding for removal of radiator ensure that cooling system is at room temperature.

Remove radiator cap.

Drain coolant from cooling system through radiator drain cock.

Fit back radiator cap and drain cock.

Remove hoses :

- Radiator to water pump.
- Radiator to upper cooling line.

Disconnect pipe from radiator to auxiliary tank.

Remove fan shroud bottom and top halves.

Check fan shroud for cracks, damage etc.

Replace if necessary.

Loosen/remove radiator mounting bolts. Now radiator can be removed from vehicle.

INSPECTION AND CLEANING

Cleaning

Fit radiator cap.

Close radiator drain cock firmly. Refer Figure 1.

Place radiator upside down on ground.

Connect water supply line to radiator bottom tank at its outlet.

Slowly increase water supply to radiator . Maximum

pressure in system should not exceed 1.0 bar.

Continue water flow till outlet water is visually clean and clear.

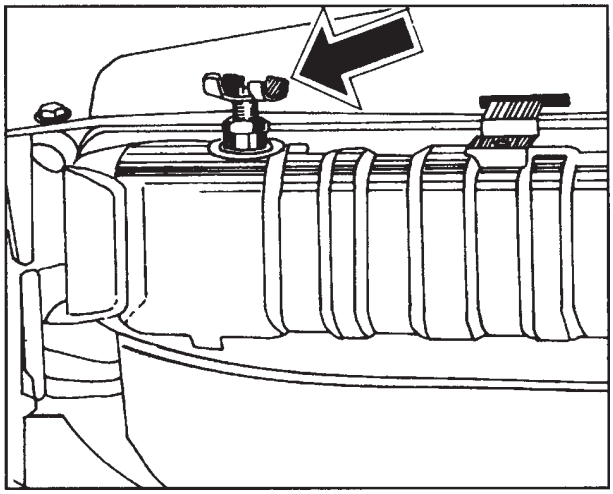


Fig. 1

Remove connection made for cleaning.

Remove radiator cap and suitably plug inlet and outlet of radiator.

Completely fill radiator with measured quantity of water. If radiator capacity is less than specified it reflects chocked tube.

Reclean / de-scale radiator using suitable cleaning compound as per manufacturer's instruction.

Fit back radiator cap.

Blow compressed air through radiator fins from engine side to clean air passages.

Do not brush or scrape radiator core in any way.

Testing for leaks

Remove radiator cap.

Suitably plug radiator inlet, outlet and filling neck.

Remove radiator drain cock adapter.

With suitable adapter connect pressurised air supply to radiator drain cock hole.

Submerge radiator in water tank.

Admit air at 1.0 bar (max) into radiator.

Check for leaks and if any suitably mark them.

Take out radiator from water tank.

Disconnect air supply connections.

Remove all plugs. Rectify leaks by soldering

Recheck radiator for leakage.

Fit back radiator drain cock adapter.

Fit back radiator cap.

Instruction for soldering Copper-Brass Radiator

Use 40% tin content solder. This solder has higher tin content and hence lower melting temperature than used in manufacture of radiator. Use of this will not have any effect on original soldering near by.

Use non corrosive fluxes for soldering. Neutralize and wash residues to avoid any consequent damage. Acid should not be used for this purpose.

SERVICE INSTRUCTION FOR ALUMINUM RADIATORS

1 Introduction

This manual explains the procedure for servicing of Aluminum Radiators with plastic tanks. Following aspects are covered:-

- Leakage spot detection
- Sealing Techniques
- Confirmation of proper sealing

2 Procedure for Servicing

2.1 Removal of Radiator from Vehicle

- Allow coolant in radiator to reach to room temperature
- Drain the coolant from radiator completely. Refit drain cock & radiator cap on radiator.
- Remove the hoses.
- Take out the radiator from vehicle carefully.

CAUTION : Radiator core and plastic tanks are susceptible to cracking due to impact and deformation

2.2 Detection of Leakage Spot

- Connect inlet of radiator to air supply at gauge pressure of 1.5 bar
- Seal all other outlet points
- Dip radiator completely in a clean water tank
- Tilt radiator and shake it vigorously to let the air bubbles trapped at the clinching area to escape
- Observe carefully for one minute and locate the source of air leakage from the direction of air bubbles that are coming out of radiator
- If Leakage spot is at radiator core then follow procedure given at **Sr. No. 2.3** to seal leakage
- Else if Leakage spot is found at Tank or its accessories then follow procedure given at **Sr. No. 2.4** to seal leakage

CAUTION : Do not use water tank that is used for copper radiator

2.3 Sealing Leakage at Radiator Core

Different procedure of sealing shall be followed for **MINOR** and **MAJOR** leaks in radiator core.

MINOR LEAKS : Leak spots which are very minute are to be sealed in following manner

- Install radiator on vehicle as explained **Sr. No. 3** (Radiator Installation)
- Pour contents of ALUMASEAL in radiator
- Fill proper quantity of coolant liquid
- Run engine in idling speed for 20 minutes

MAJOR LEAKS : Procedure of sealing major leaks in radiator is as follows :

- Wash core with clean water and brush to remove dirt, dust etc.
- To remove greasy spot on core, apply thinner with cotton swab and take off grease
- Dry core using a dryer (Do not use heating source)
- Mix adequate quantity of ARALDITE RESIN(Araldite rapid may be used in place of Araldite standard for faster drying & curing of seal) and HARDENER in the ratio of 1:1 and stir it thoroughly
- Apply the mixture immediately at the leakage spot with applicator
- Allow the mixture to dry and harden under the shade at room temperature for 10-12 hour
- Silver color paint may be used for touching

- Silver color paint may be used for touching up araldite spots and impart aluminum type appearance

NOTE : Araldite Rapid of M/s Ciba Geigy dries & hardens within one hour & hence users may use it to minimize down time

CAUTION :

- Do not damage the fins during process.
- As the Araldite is inflammable do not dry it by using any heating source.
- Proper cleaning of leakage area is must for proper setting of Araldite or else it will come off.

2.4 Servicing of Tank and its accessories

- If the source of leakage is tank, then replace the tank
- Take out the member support using correct size spanner
- Remove the tabs of the header plate using screw driver and monkey plier
- After making all clinching projections up, take out the tank from its seat in header plate
- In case it takes more effort, pat the tank with rubber or plastic hammer lightly
- Take of the tank packing
- Clean the area of header plate where tank sits thoroughly
- Insert new tank packing in place without twisting
- Clinch the header plate projections with monkey plier
- After clinching confirm dimension of header plate height as 10.2 to 10.6 mm
- Fix the member support & tighten bolts properly

CAUTION :

- Tank packing shall be replaced every time, when the tank is taken off for servicing.
- If any of the clinching projections is broken during clinching or releasing process, discontinue servicing & replace entire radiator by a new one.

2.5 Servicing of Pipe Component, Drain cock & pressure cap

- Replace 'O' rings of these component, clean the component while reassemble
- Replace pressure cap with new one if leakage is through even after cleaning filler neck

2.6 Confirmation of Proper Sealing

- After the sealing work is over, assemble radiator properly
- Subject the assembled radiator to leakage test as per **Sr.No. 2.2**

CAUTION : If the problem of leakage persists, it is advisable to replace radiator with new one

3 Radiator Installation

- Ensure that all the openings of radiator are closed properly except the inlet / outlet
- Install radiator on the vehicle ensuring proper alignment, damping etc. as applicable
- Connect inlet and outlet pipes and clamp them properly, Fit fan shroud etc.
- Fill radiator with proper quantity of **fresh coolant** as recommended

Checking cap (Refer Figure 2)

Check radiator cap for perfect sealing in filler neck.

Check radiator cap, main and vacuum valve opening pressures.

Replace defective cap with new one of recommended rating.

Test for main valve opening pressure.

Radiator cap shall be tightened after filling in with water. Water inside the radiator is pressurised. Check that main valve opens at specified pressure of 1.0 kg/cm^2

Radiator cap main valve should not open below specified pressure.

On the vehicle, functioning of radiator cap main valve can be checked by observing increase in coolant level in auxiliary tank at high coolant temperature.

Test for vacuum valve opening-

Radiator cap shall be tightened without water inside radiator and shall be connected to vacuum pump. Check that vacuum valve opens fully at 0.05 kg/cm^2 vacuum.

On the vehicle, functioning of radiator cap vacuum valve can be checked by observing decrease in coolant level in an auxiliary tank when it cools down compared to higher level at high temperature.

FITMENT ON VEHICLE

Fit radiator.

Fit fan shroud top and bottom halves.

Fit hoses

- Radiator to water pump
- Radiator to upper cooling line

Connect tube from auxiliary tank to radiator.

Close radiator drain cock firmly.

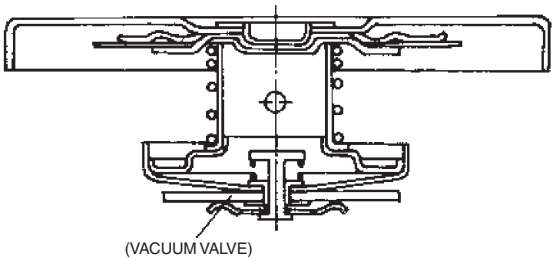
Fill coolant (clean water blended with anti freeze agent as per recommendation).

Fit radiator cap.

Top up coolant through auxiliary tank cap upto 'MAX'

mark.

RUN ENGINE FOR SHORT DURATION AND TOP UP COOLANT IF NECESSARY.



Pressure valve opening
pressure $0.9^{\pm 0.15}$ kg/cm^2 (gauge)
Vacuum valve opening
pressure $\leq$ 0.05 kg/cm^2 Max

Fig. 2

ELECTRICAL

INTRODUCTION

Electrical system incorporates a number of special accessories apart from standard ones. There is one Electronic Control Unit (ECU) with diagnostic capabilities for Transfer Case (4x4 version).

Wiring diagrams and schematic electrical circuits included in this manual are only for guidance during trouble shooting. Due to continuous improvements on the product, actual wiring layout, locations of components and connectors, wire colour codes etc. may change.

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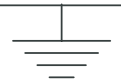
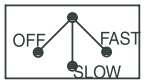
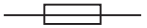
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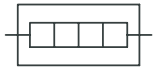
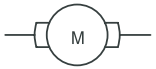
1. TECHNICAL SPECIFICATIONS

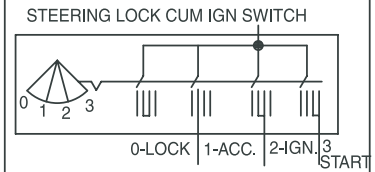
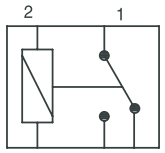
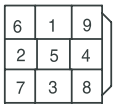
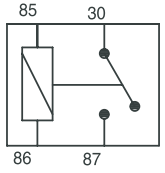
Battery	:	12 V, MF 70 Z
Capacity	:	75 Ah (20 Hr rating)
System voltage	:	12 Volts (–ve earth)
Alternator capacity	:	75 Amps for AC + Heating demisting vehicle 65 Amps for heating demisting vehicle
Head lamp	:	Semi sealed European beam asymmetrical pattern with halogen lamp, Built-in front parking light.
Wind screen washer	:	2 speed with intermittent wiping.
Steering lock cum Ignition switch	:	Standard fitment with key in sensor
Combi switch	:	With self cancelling turn signals and hazard warning switch.
Instruments	:	a) Speedometer (km/hr) and odometer (km) & trip meter (km) b) Fuel gauge with low fuel level indicator (LED) c) Water temperature gauge d) Engine RPM meter
Indicator lamps	:	For battery charging, low oil pressure, direction indicator, main beam, brake fluid level + hand brake and glow plug timer and hazard warning. 4x4 high and 4x4 low mode indicators for 4x4 vehicles.
Tail lamp	:	Four function tail lamp and separate reflex reflector at rear.
Other features		1. Blinkers on side bonnet. 2. Two Roof Lamps for TMCC 3. Provision for radio/ cassette player. 4. Rear number plate lamps.

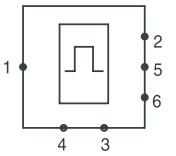
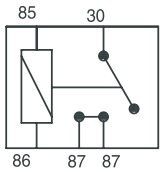
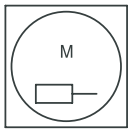
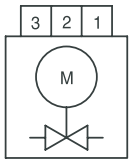
2. CIRCUIT DIAGRAM SYMBOLS

SYMBOLS

SYMBOL	DESCRIPTION
	GROUND OR EARTH
	DIODE
	SINGLE WAY SWITCH
	TWO WAY SWITCH
	2-SPEED BLOWER SW.
	FUSE
	RESISTOR
	VARIABLE RESISTOR
	THERMISTER

SYMBOL	DESCRIPTION
	CIGARETTE LIGHTER
	HEATER DEFROSTER
	MAGNETIC CLUTCH
	CABLE JOINT
	CROSSOVER WITH JOINT
	CROSSOVER WITHOUT JOINT
	LAMP/BULB
	MOTOR
	FRONT WIPER MOTOR
	W/S.WASHER MOTOR
	ALTERNATOR
	BLOWER MOTOR

SYMBOL	DESCRIPTION
	BATTERY
	DUAL TEMP. SENSOR
	DIGITAL CLOCK
	HORN
	
	RELAY
	ELECTRONIC CONTROLLER /RELAY BASE
	STARTER/AUXI RELAY

SYMBOL	DESCRIPTION
	SOLENOID VALVE
	ELECTRONIC CONTROLLER
	CONNECTOR
	FAN
	RELAY BOSCH 4-PL
	STARTER MOTOR W/ENGAGEMENT SOLENOID
	HEAD LAMP LEVELLING MOTOR

3. WIRE COLOUR CODING

Code	Colour Name
Lg	Light Green
Dg	Dark Green
Sb	Sky Blue
P	Pink
V	Violet
O	Orange
W	White
L	Blue
Br	Brown
Gr	Grey
G	Green
Y	Yellow
B	Black
R	Red

Note : Wire insulator has one colour or one main colour with another tracer colour stripe. (e.g. 'L' indicates blue colour. 'L-W' indicates blue main colour with white tracer colour stripe)

4A. LIST OF BULBS

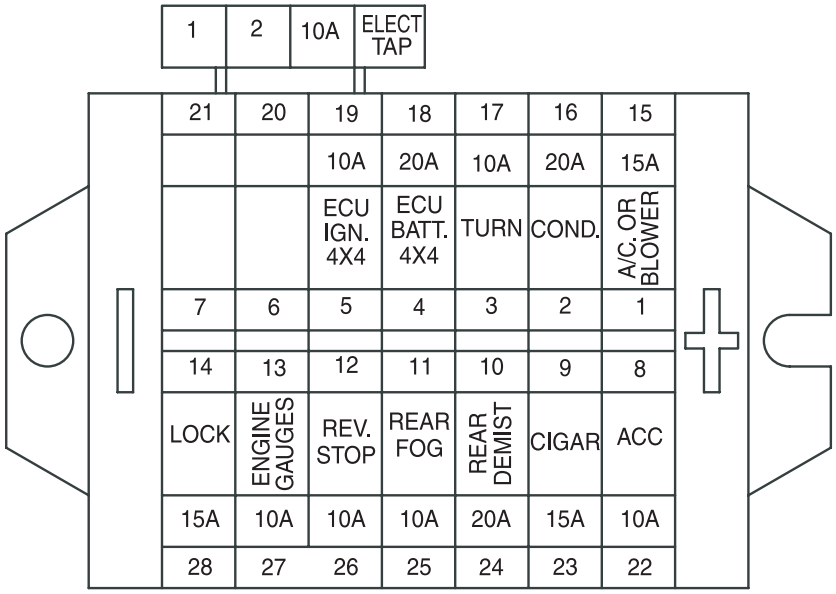
Description	Cap Type	Specs	Qty.
Head Lamp – Halogen H4	P43t	12V, 60/55 W	2
Front Direction Indicator	BAU15s	12V, 21W	2
Side Repeater Indicator	W2.1 X 9.5d	12V, 5W	2
Tail Lamp – Rear Direction Ind.	BA15s	12V, 21W	2
Tail Lamp – Rear Stop	BA15s	12V, 21W	2
Rear Registration Lamp	BA15s	12V, 10W	2
Tail Lamp – Rear parking	BA15s	12V, 10W	2
Parking Lamp – Front	BA9s	12V, 4W	2
Tail Lamp – Reverse Lamp	BA15s	12V, 21W	2

4B. LIST OF RELAYS :

1] AC condenser fan relay (on vehicle with AC)
2] AC cut off relay (on vehicle with AC)
3] Auxiliary relay
4] Starter relay
5] Ignition relay
6] Glow plug timer relay
7] Head lamp low beam relay
8] Head lamp high beam relay
9] Parking relay
10] Horn relay
11] Rear fog lamp relay
12] Rear glass demist relay

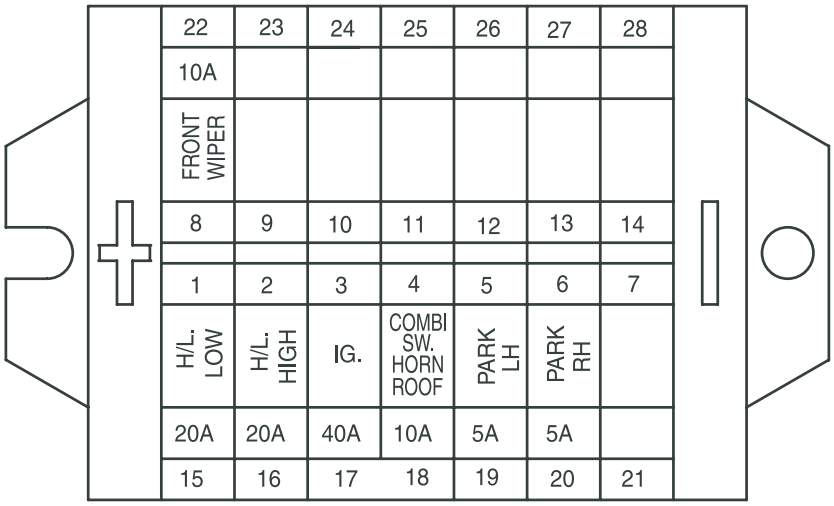
5. LIST OF FUSES

FUSE BOX NO.1
IN DRIVER COMPARTMENT
FUSE BOX VIEW SHOWN FROM TOP



F/B-1

FUSE BOX NO.2
IN ENGINE COMPARTMENT



FUSE BOX VIEW SHOWN FROM TOP

6) ALTERNATOR:

Removal :

- ❑ Disconnect battery earth lead.
- ❑ Loosen nut securing cable to alternator and release cable.
- ❑ Disconnect other connections from alternator.
- ❑ Remove nut and bolt securing alternator to adjustment bracket.
- ❑ Loosen bolt securing alternator to engine.
- ❑ Release drive belt tension by turning the tension adjusting bolt anti-clockwise.
- ❑ Release drive belt from alternator pulley.
- ❑ Remove nut and bolt securing alternator to engine.
- ❑ Release alternator from bracket and remove alternator.

Fitment

- ❑ Position alternator to engine and locate in support bracket.
- ❑ Fit nut and bolt securing alternator to engine, but do not tighten.
- ❑ Clean pulley vee's.
- ❑ Locate drive belt to alternator pulley. Ensure grooves on drive belt and pulleys are correctly located.
- ❑ Fit nut and bolt securing alternator to adjustment bracket.
- ❑ Adjust drive belt tension.
- ❑ Connect all connections including cable to alternator, fit and tighten cable nut.
- ❑ Connect battery earth lead.

Testing / Checking

Please refer 3SA23 alternator service details

Electrical Circuit Diagram for Starting, Charging and Engine Stop Solenoid may also be referred.

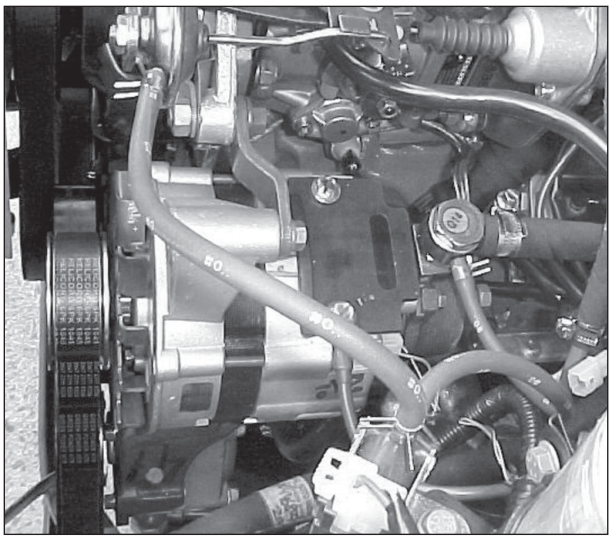


Fig. 1

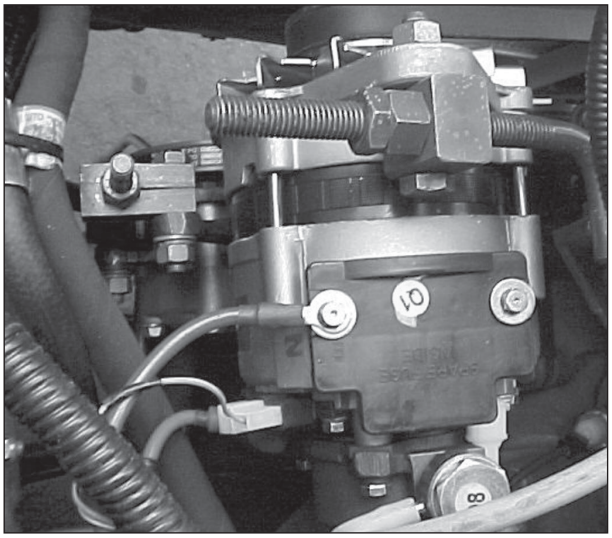


Fig. 2

GENERAL DESCRIPTION

The 3SA23 Alternator (65 Amps) and 3SA28 Alternator (75 Amps) with vacuum pump is intended for use on light commercial vehicles and similar automotive applications. This alternator is suitble for negative earth system.

This section deals with 3SA23 Alternator.

TYPICAL PERFORMANCE CURVE

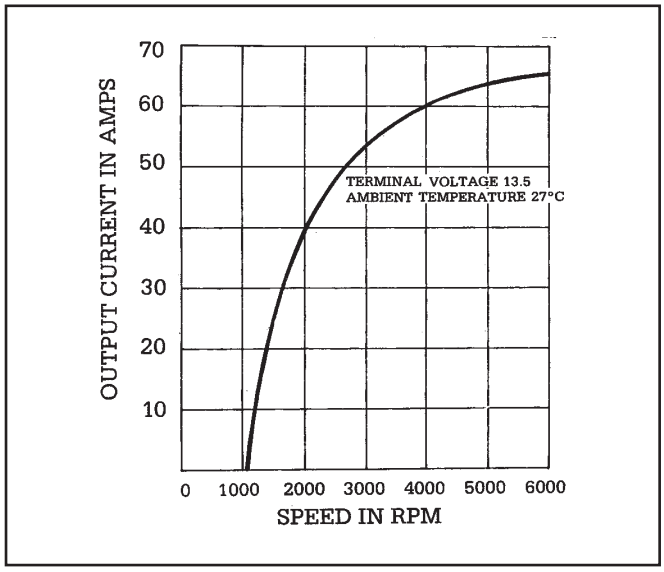


Fig. 3

DO'S ✔

ALTERNATOR

- Do ensure that all electrical connections are clean and secure.
- Do ensure that no electrical connection in the circuit including the battery is open.
- Do observe correct polarity. i.e. connect negative to negative and positive to positive. Otherwise, Alternator will be damaged.
- Disconnect all alternator terminals, while carrying out welding jobs on vehicle.
- Disconnect battery earth cable before removing alternator.
- It is advisable to replace a new 'OIL SEAL' in SRE Bracket, whenever alternator is dismantled for service.

DONT'S ✘

ALTERNATOR

- DO NOT DIS-ASSEMBLE ALTERNATOR WITHOUT REMOVING BRUSH BOX ASSEMBLY.
- Do not flash alternator output leads to check the working of the alternator.
- Do not run alternator with battery disconnected.
- Do not disconnect any lead of Alternator/ Regulator with engine in running condition.
- Do not disconnect battery cables while engine is running.
- Do not run the alternator with vacuum pump without oil. Running without oil may damage oil seal in SRE bracket.

DO'S ✔

VACUUM PUMP

- Remove vacuum pump from alternator before any electrical running tests.
- Whenever vacuum pump is removed for alternator, the 'O' ring (small) must be renewed.
- If alternator is to be dis-assembled, serrations of rotor shaft must be covered to avoid possible damage to serrations.
- Ensure oil feeding pressure at 3 kg/cm^2 and flow rate 0.5-1.0 litre/minute at 5000 RPM.
- Ensure proper tightening torques of oil hoses and vacuum hoses to avoid oil or air leakage.
- When refitting vacuum pump, it may be necessary to tilt it, in order to centralise the floating inner driven member, before sliding the assembly on to the splined rotor shaft.

DONT'S ✘

VACUUM PUMP

- Oil pump should not be run, if the alternator is not running. (e.g. engine is running but belt not fixed).
- Do not run pump without oil.
- Do not use any oil other than SAE-30 for testing. NOTE : Use an oil filter.
- Do not mount alternator close to exhaust manifold without any protection.

ROUTINE MAINTENANCE

- Keep the alternator clean.
- Ensure that the ventilation slots are clear.
- Check and ensure that mounting bolts are tightened properly.
- Check and ensure that hoses are connected to vacuum pump.
- Ensure that there is no leakage of air and oil.
- Ensure that the alternator belt is in good condition.
- Check belt tension and ensure that it is neither too slack nor too tight.
- Adjust belt deflection to 10-15mm when pressed out midway of the longest point between pulleys.
- Check brush length periodically & replace brush if necessary.
- Ensure correct battery electrolyte level.
- Check general condition of battery.
- Grease battery terminals with petroleum jelly.

TECHNICAL DATA

ALTERNATOR

1.	Type	3SA23
2.	Rating	Continuous
3.	Battery Voltage	12 V
4.	Nominal Output	65 A
5.	Weight	6.6 Kg. Approx. (Including Pump & Pulley)
6.	Rated Maximum Output Speed	6000 R.P.M
7.	Speed	1000 to 10,000 R.P.M.
8.	No. Of Poles	12
9.	Over Speed with Maximum Output	11000 RPM for 1.0 Minute
10.	Polarity	Negative Earth
11.	Regulating System	Bult-In Regulator
12.	Reg. Set Voltage	14.0 ± 0.2 V
13.	Direction of Rotation	Clockwise (Viewed from Pulley end)

VACUUM PUMP

1.	Type of Vacuum Pump	Vane Type	
2.	Capacity of the Pump	30 CC/REV.	
3.	**Operating Condition**		
(a)	Speed	1000 to 11,500 RPM	
(b)	Ambient Temperature	- 30^{O}C to + 80^{O}C	
(c)	Oil Feeding Pressure	1.0 to 3.0 kgf/cm^2	
(d)	Lubricating Oil	SAE 30	
(e)	Rotation	Clockwise (Viewed from Drive end)	
(f)	Oil Temperature	75^{O} ± 5^{O}C	
4.	**Exhaust Characteristics**		
	Test Specifications		
(a)	Speed	1000 RPM	5000 RPM
(b)	Time	35 SEC MAX.	10 SEC MAX
(c)	Vacuum	500 mm Hg.	500 mm Hg. 700mm Hg. at 5000 RPM Under oil Feeding
5.	Maximum Attainable degree of vacuum	Presssure of 1Kgf.cm^2 and oil temperatue of 75^{O} ± 5^{O} C Conditions.	
6.	Vacuum Drop (After stoppage of pump at 400 mm Hg.)	Vacuum drop 20mm Hg. max. in 15 secs.	

WIRING DIAGRAM

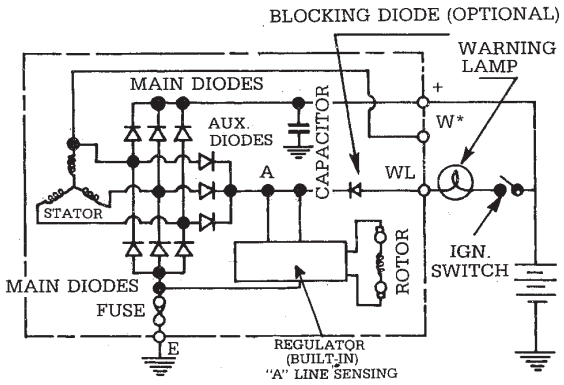


Fig. 4

SALIENT FEATURES OF 3SA23 ALTERNATOR :

- Starconnected 3-phase output winding wound on a laminated stator.
- 12-pole wound field rotor, carried on ball-race bearings in aluminium end brackets and belt driven from engine.
- Self-excited field (via three field diodes) at normal running speeds.
- RA65 recifier provides rectification of generated A.C
- Voltage control is provided via a built-in electronic regulator.
- An RFI suppression capacitor is provided across positive and negative terminals.
- As a safeguard against accidental reverse battery connections, a fuse is provided.
- A spare fuse is also provided.
- A phase connection can be made available if required.

WIRING DIAGRAM FOR TESTING ALTERNATOR

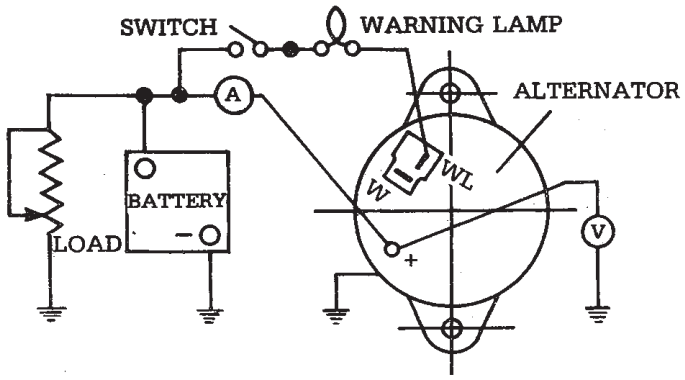


Fig. 5

NOTE :

- Performance value to be taken after one hour hot run at 6000 RPM and 40 AMPS. (Hot run is to be conducted with regulator in circuit)
- Ambient temperature 27^{O} C to 32^{O} C.
- Cut-In speed at 13.0 Volt at terminals to be 1000 RPM (Cold)

ALTERNATOR CHARGING SYSTEM CHECKS ON THE VEHICLE BEFORE STARTING CONDITION

SWITCH ON THE IGNITION

DOES WARNING LAMP GLOW ?

NO → CHECK WARNING LAMP FOR ANY DEFECT. CHECK "WL" TERMINAL IN ALTERNATOR FOR PROPER CONNECTION.

YES

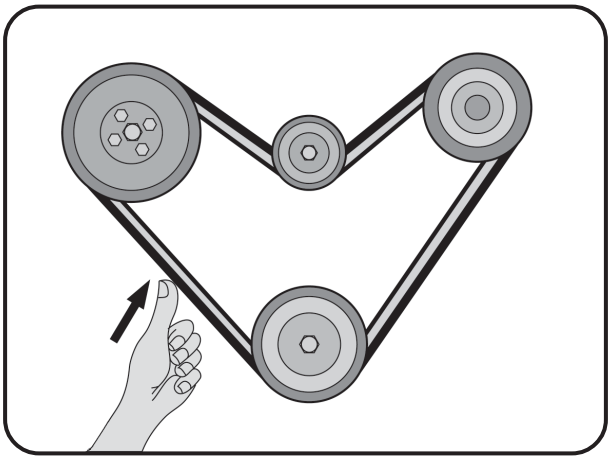
RUN THE ENGINE AT IDLE SPEED

DOES WARNING LAMP GO OFF ?

NO → CHECK THE BELT TENSION. IF FOUND SLACK ADJUST THE BELT DEFLECTION TO BE 10-15mm WHEN PRESSED MIDWAY AT THE LONGEST POINT BETWEEN PULLEYS (REFER FIGURE BELOW) AND CHECK FOR CHARGING. IF THE UNIT IS STILL NOT CHARGING REMOVE THE ALTERNATOR AND CHECK.

RAISE THE ENGINE SPEED TO AROUND 2800 ± 200 RPM.

YES



ENSURE THAT THE AMMETER READING IS LESS THAN 20A. INCASE THE BATTERY IS DISCHARGED ALLOW CHARGING OF BATTERY TILL THE AMMETER READING COMES TO LESS THAN 20A. CONNECT THE VOLTMETER ACROSS THE ALTERNATOR MAIN TERMINALS. CHECK THE VOLT METER READING

DOES THE VOLTMETER READ BETWEEN 14.0 TO 14.8 VOLTS ?

NO → REMOVE THE ALTERNATOR AND CHECK REGULATOR

YES

SWITCH "ON" THE HEADLAMP PARKING LAMP, TAIL LAMP AND OTHER ELECTRICAL LOADS EXCEPT HEATER.

IS RATED CURRENT OUTPUT REACHED WITHOUT VOLTAGE DROPPING BELOW 13.5 VOLTS ?

NO → REMOVE THE ALTERNATOR AND CHECK

YES

ALTERNATOR FOUND ACCEPTABLE

EXPLODED VIEW

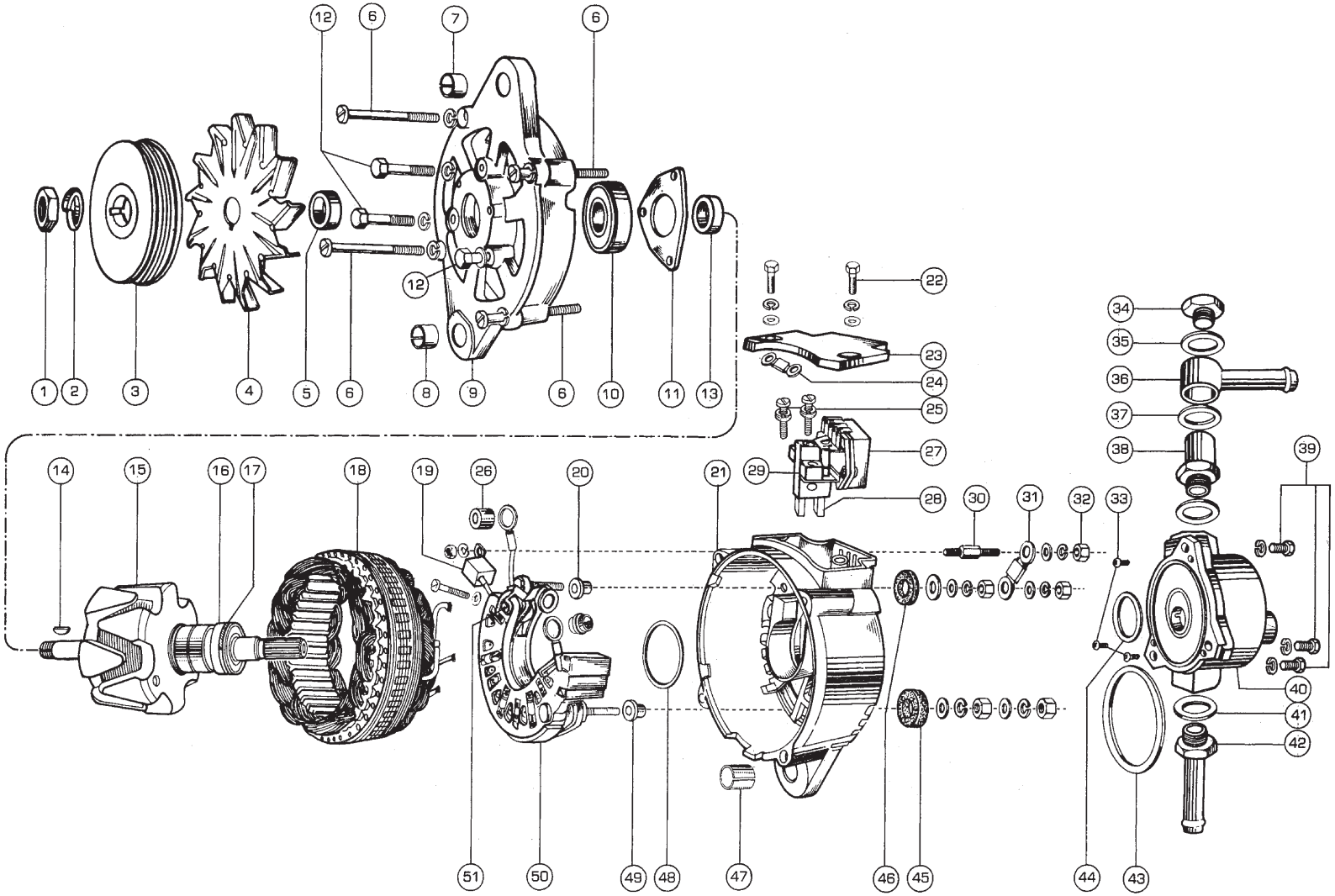


Fig. 6

SPARE PARTS LIST

SL. NO.	DESCRIPTION	NO. OFF
1.	PULLEY NUT	1
2.	SPRING WASHER (PULLEY)	1
3.	PULLEY	1
4.	FAN	1
5.	PULLEY COLLAR	1
6.	FIXING BOLT	4
7.	INSERT (TOP) DE	1
8.	INSERT (BOTTOM)	1
9.	DE BRACKET ASSEMBLY	1
10.	DE BALL BEARING	1
11.	BEARING RETAINER PLATE	1
12.	FIXING SCREW	3
13.	COLLAR	1
14.	KEY	1
15.	ROTOR ASSEMBLY	1
16.	BALL BEARING SRE	1
17.	SLIP RING	1
18.	STATOR ASSEMBLY	1
19.	CAPACITOR ASSEMBLY	1
20.	INSUL BUSH	1
21.	SRE BRACKET ASSEMBLY	1
22.	SCREW (COVER PLATE)	2
23.	COVER MOULDING PLATE	1
24.	SPARE FUSE	1
25.	CAPITAL SCREW	2
26.	INSUL BUSH	1

SL. NO.	DESCRIPTION	NO. OFF
27.	REG. & BRUSH BOX ASSY.	1
28.	BRUSH SET	1
29.	BRUSH SPRING	2
30.	STUD	1
31.	FUSE LINK	1
32.	NUT	2
33.	SCREW (CENTRE PLATE)	3
34.	SCREW SUCTION	1
35.	WASHER	1
36.	CONNECTOR SUCTION	1
37.	WASHER	1
38.	CHECK VALVE SUCTION	1
39.	SCREW VAC. UNIT FXG.	3
40.	VACUUM VALVE SUCTION	1
41.	WASHER	1
42.	CONNECTOR DELIVERY	1
43.	“O” RING (LARGE)	1
44.	“O” RING (SMALL)	1
45.	CUP WAHSER	1
46.	INSUL WASHER	1
47.	INSERT SRE	1
48.	“O” RING	1
49.	INSUL BUSH	1
50.	RECTIFIER ASSEMBLY	1
51.	EARTH LINK	1

DISMANTLING

Before dismantling, note down the position of various parts, in order to ensure their proper replacement on re-assembly.

Drian oil from the vacuum pump, and manually rotate the fan belt clock wise to discharge any oil which might have accumulated in vacuum pump.

Follow step by step procedure mentioned below

- ❑ Remove three fixing screws securing vacuum pump to SRE bracket. Ref. Fig. 7.
- ❑ Pull the vacuum pump assembly, away from alternator.

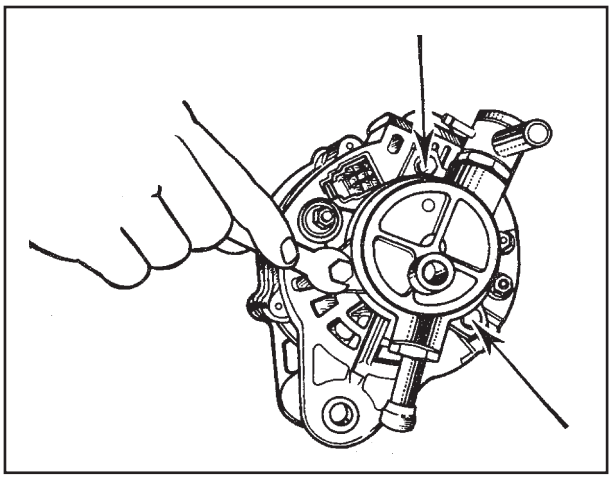


Fig. 7

- ❑ Place vacuum pump in a clean polythene cover and seal it properly.
- ❑ Tape the rotor shaft serrations to avoid damage to SRE bracket oil seal while pulling it out.

  Ref. Fig. 8.

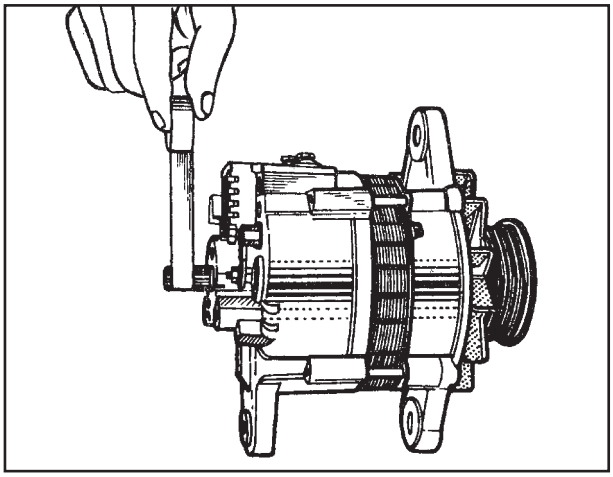


Fig. 8

DISASSEMBLY OF BRUSH BOX ASSEMBLY

NOTE: Do not remove rotor assembly without removing brush box assembly. Otherwise, brushes will break.

- ❑ Remove cover plate fixing screws (2 Nos.) Ref. Fig. 9.

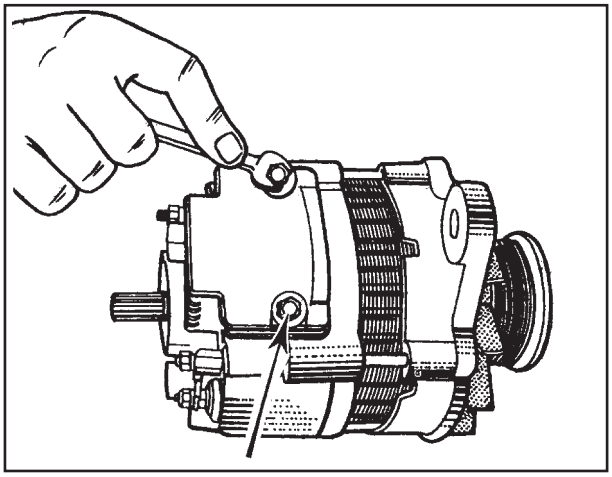


Fig. 9

- ❑ Remove regulator cum brush box fixing screws (2 Nos.)

  Ref. Fig.10.

- ❑ Lift the regulator cum brush box assembly.

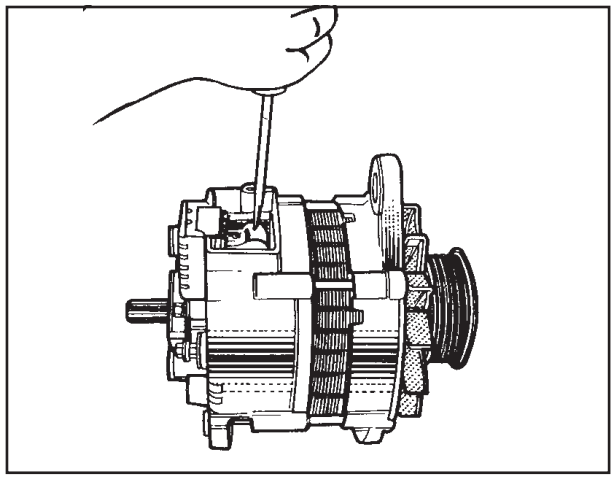


Fig. 10

DISASSEMBLY OF SRE BRACKET ASSEMBLY

- ❑ Remove the through bolts (4 Nos.) securing DE bracket and SRE bracket.

  Ref. Fig.11.

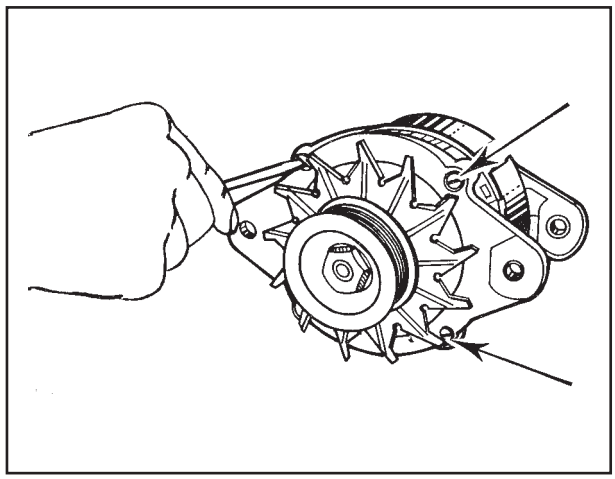


Fig. 11

- ❑ Protect pump seating surface of SRE bracket by using appropriate protective cap.
- ❑ Separate DE protective bracket assembly from stator assembly using a wooden mallet.

  Ref. Fig.12.

- ❑ Place SRE bracket assembly in a clean polythene cover.

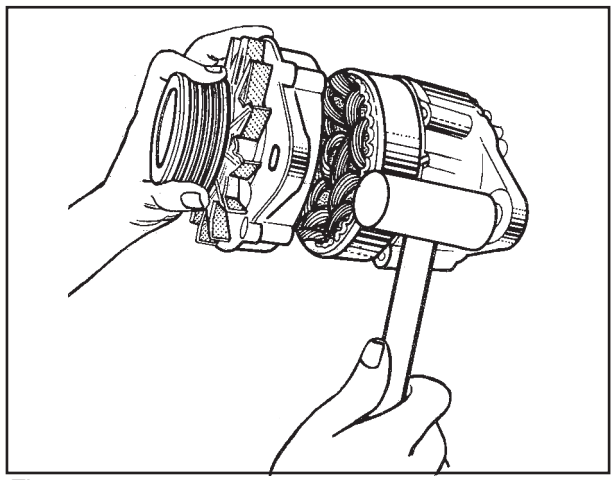


Fig. 12

DISASSEMBLY OF DE BRACKET ASSEMBLY

- ❑ Clamp rotor assembly in a soft jaw and remove pulley nut.

  Ref. Fig.13.

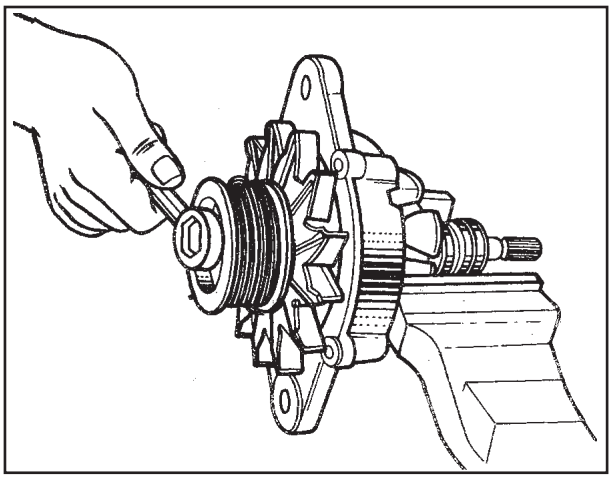


Fig. 13

- ❑ Push down rotor assembly from DE bracket using a fly press.
- ❑ Cover slip ring with a suitable protective cap.

  Ref. Fig.14.

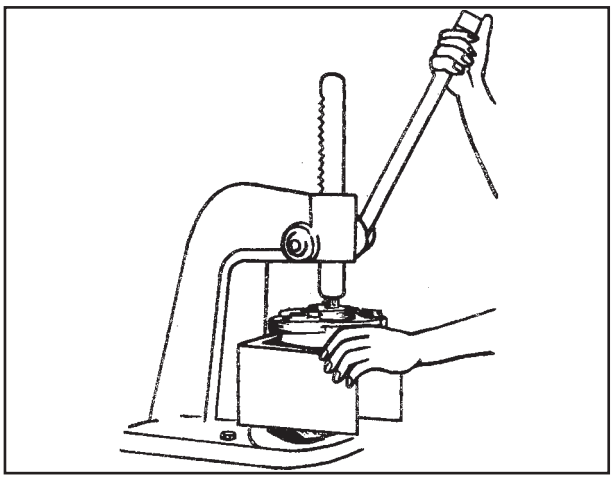


Fig. 14

REMOVAL OF DE BEARING

- ❑ Unscrew the rataining plate fixing screws (3 Nos.) and place DE Bracket assembly in a fly press and press down ball bearing from DE Bracket as shown.

  Ref. Fig. 15.

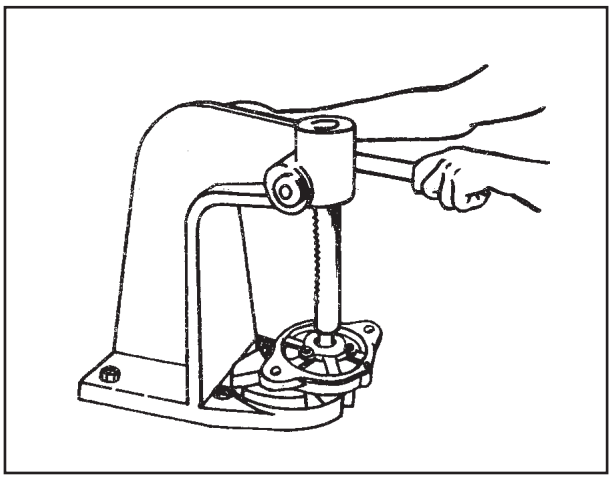


Fig. 15

DISASSEMBLY OF STATOR ASSEMBLY FROM SRE BRACKET

- ❑ Cover the oil seal portion with a protective cap to avoid dust entry.
- ❑ Note down the position of stator output leads.
- ❑ De-solder stator leads from rectifier.

  Ref. Fig.16.

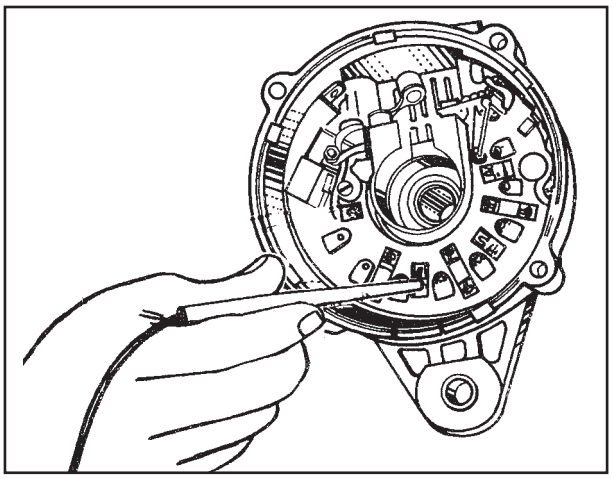


Fig. 16

Remove stator assembly.

- ❑ Remove earth link fixing screw

  Ref. Fig.17.

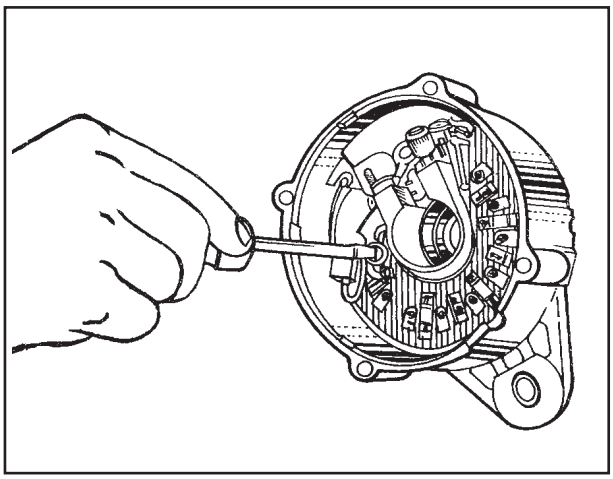


Fig. 17

Remove fuse assembly.

- ❑ Remove the nuts holding rectifier assembly

  Ref. Fig.18.

DISASSEMBLY OF RECTIFIER ASSEMBLY

- ❑ Remove the RFI CAPACITOR fixing nut.

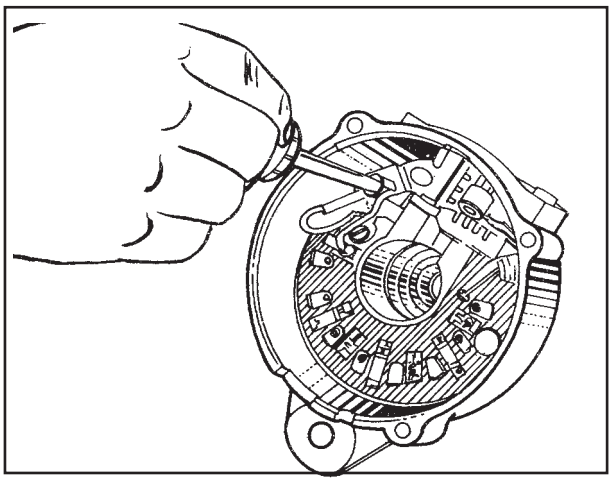


Fig. 18

REMOVAL OF OIL SEAL

NOTE : It is advisable to replace a new oil seal whenever it is removed from SRE Bracket, with a special tool.

❑ Using a sharp pin, push the oil seal from SRE bracket rear end.

Ref. Fig.19.

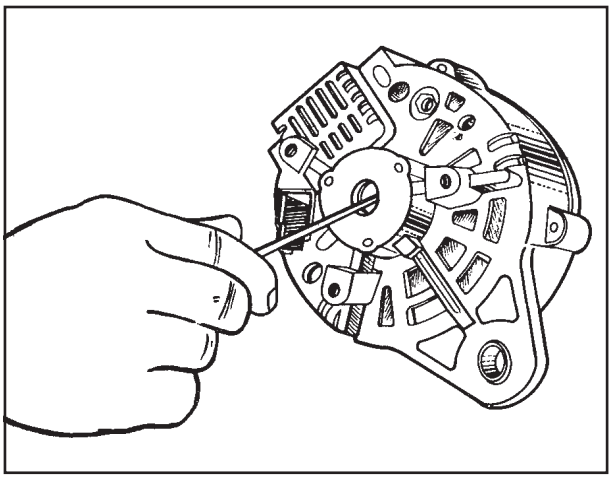


Fig. 19

BENCH INSPECTION

ALTERNATOR

On dismantling the unit conduct following checks

Brush Check

Exposed brush length

New brush length	27.5 mm
Minimum required length	20.5 mm

Ref. Fig.20.

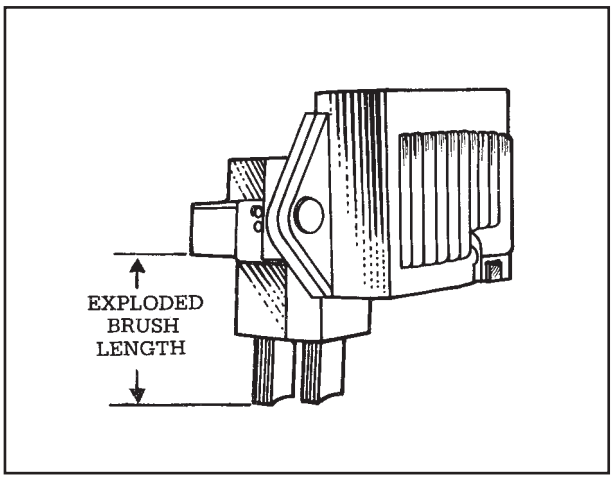


Fig. 20

If brushes are below minimum required length renew the brushes in sets not individually. De'solder brush leads. INSERT New brushes and solder to maintain required brush length. Make sure that the brushes move freely inside brush box.

SLIP RING CHECK

❑ Clean slip ring surface with a fine piece of cloth and ensure that the surface is smooth and clean.

Ref. Fig.21.

If the surface is very rough and cannot be polished replace rotor assembly. There should not be any trace of oil or grease on slip ring surface.

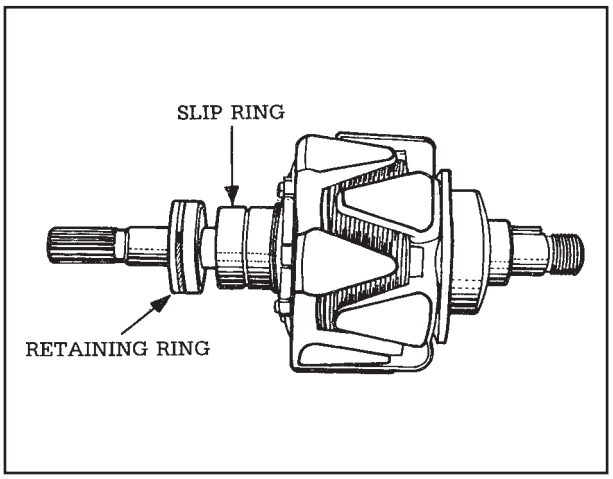


Fig. 21

BEARING CHECK (SRE & DE)

Bearings should rotate freely without any excessive play.

If play is observed, bearings should be replaced.

SRE bearing has a special retaining ring which should not be replaced or re-assembled.

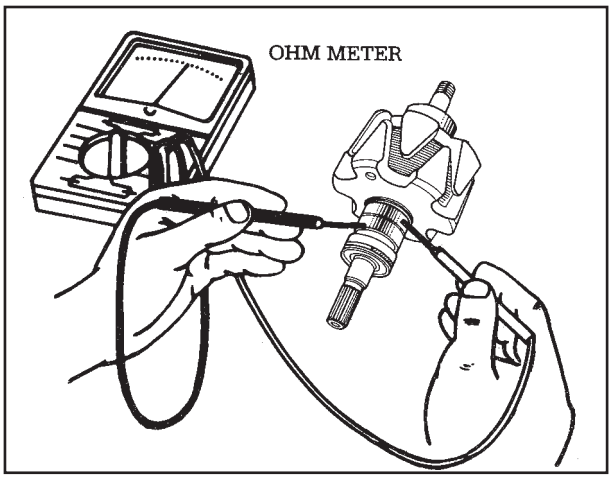


Fig. 22

ROTOR ASSEMBLY CHECK

RESISTANCE CHECK

- Use Ohm meter 0-10 Ohm range and connect as shown in fig.

  Connect the probes of the meter to slip ring. Value should be between 2.8 and 3.2 Ohms. If value is outside this limit, change rotor assembly.

  Ref. Fig.22.

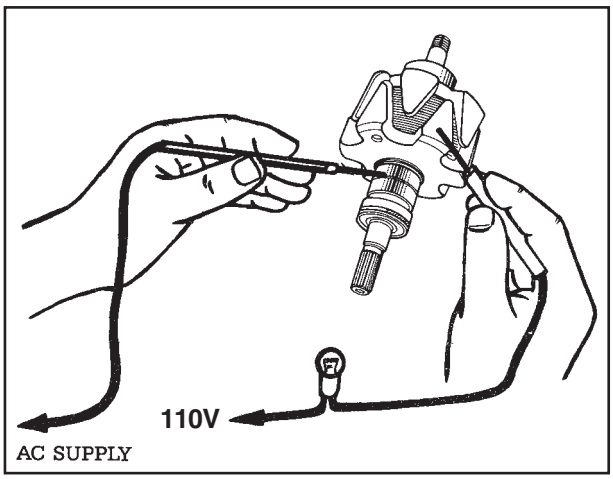


Fig. 23

ROTOR GROUND TEST

- Using 230 volt AC mains supply, connect a 15W bulb as shown in fig. Connect one of the probes to slip ring and the other to shaft. Lamp should not glow. If lamp glows it indicates earthing. Replace rotor assembly.

  Ref. Fig.23.

STATOR INSULATION TEST

- Using 230 volt AC mains supply, connect a 15W bulb. Connect one probe to any of the three leads and other probe to body. Lamp should not glow. If lamp glows it indicates poor insulation. Replace stator assembly.

  Ref. Fig.24.

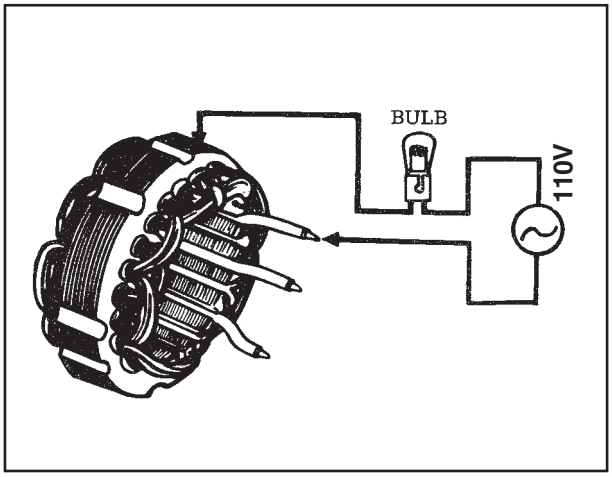


Fig. 24

STATOR WINDING RESISTANCE CHECK

❑ Use Ohm meter with two probes connect between 1 and 2 leads. The value should read around 0.12 Ohms. Repeat it between 2&3 and 3 & 1 leads.

Ref. Fig.25.

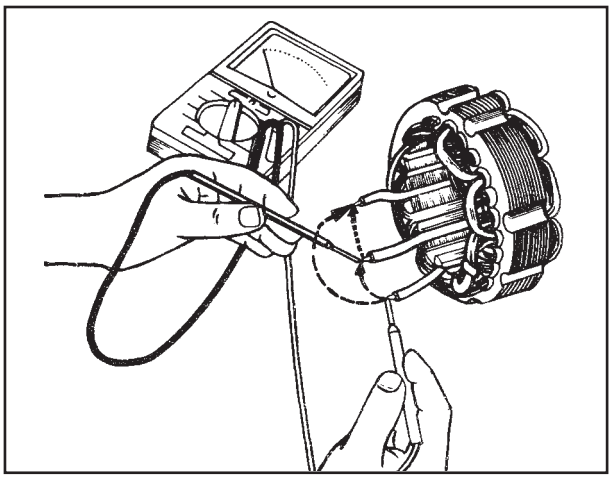


Fig. 25

REGULATOR CHECK

❑ Use authorised test equipment for checking Regulators and test as per instructions given in the test equipment manual.

Connect the equipment as per the markings on the regulator

Ref. Fig. 26.

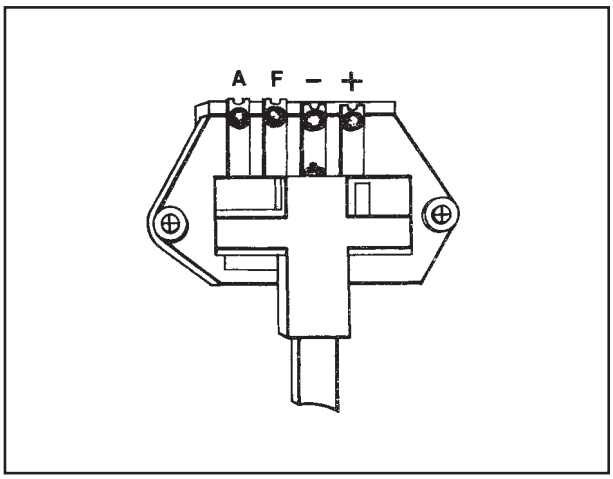


Fig. 26

RECTIFIER ASSY. CHECK

Remove rectifier assembly from the unit and check as follows using a multimeter with two probes as shown in fig.

(a) Testing positive heat sink diodes (Continuity check)

❑ Connect as shown in fig. use multimeter with two probes. Connect the positive probe of multimeter to positive heat sink and negative probe to phase connecting points on rectifier. It should not indicate open circuit. Replace rectifier assembly if it is open circuit.

Ref. Fig.27.

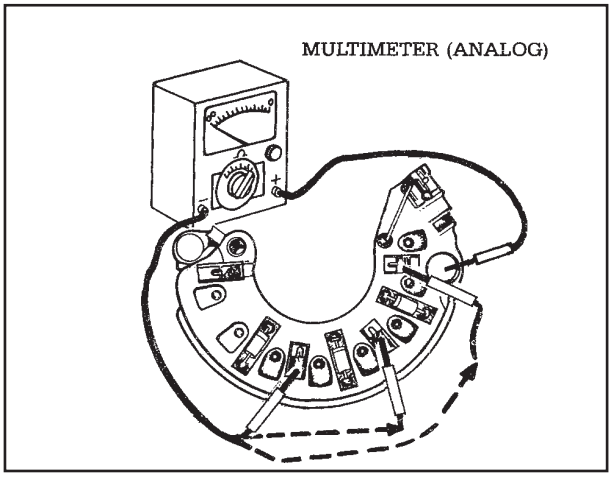


Fig. 27

(b) Testing Positive Heat Sink Diodes (No Continuity check) :

❑ Connect as shown in fig. Use multimeter with two probes.

Connect negative probe of multimeter to positive heat sink and positive probe to phase connector points on rectifier assemblies. All diodes should indicate no continuity. If there is continuity it indicates short circuit. Replace rectifier assembly.

Ref. Fig. 28

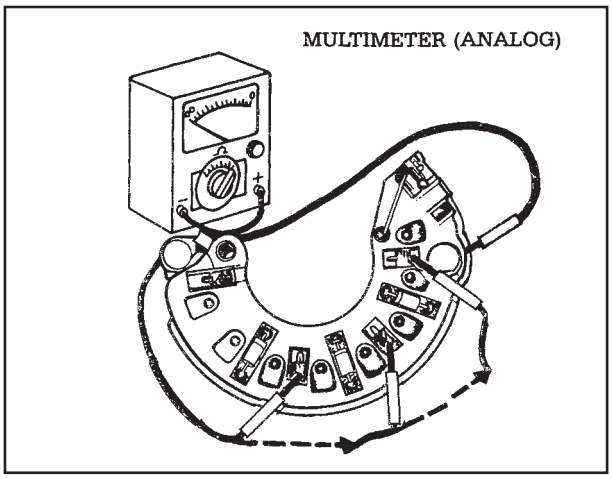


Fig. 28

(c) Testing negative heat sink diodes (Continuity check) :

❑ Connect as shown in fig. Use multimeter with two probes.

Connect positive probe of multimeter to phase connecting point and negative probe to rectifier body. All diodes should indicate continuity. If not, it indicates open circuit. Replace rectifier assembly.

Ref. Fig.29

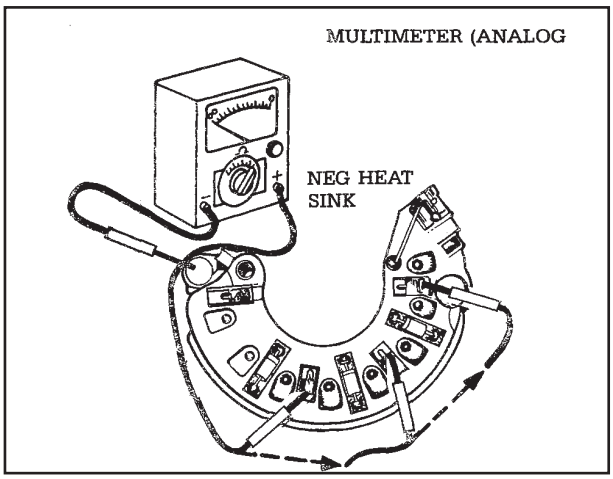


Fig. 29

(d) Testing negative heat sink diodes (No Continuity check) :

❑ Connect as shown in fig. Use a multimeter with two probes.

Connect negative probe of multimeter to phase connecting points and positive probe to rectifier body. Now all diodes should indicate no continuity. If not, it indicates short circuit. Replace rectifier assembly.

Ref. Fig. 30

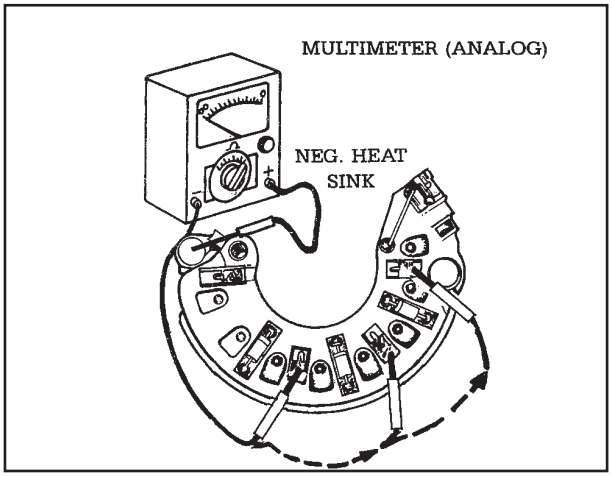


Fig. 30

(e) Testing of auxiliary diodes(Continuity test) :

❑ Connect as shown in fig. Use a multimeter with two probes.

Connect positive probe of multimeter to the field plate, and negative probe to the phase connection on rectifier. When the startor face leads or connect all diodes should indicate continuity. If not replace rectifier assembly.

Ref. Fig. 31

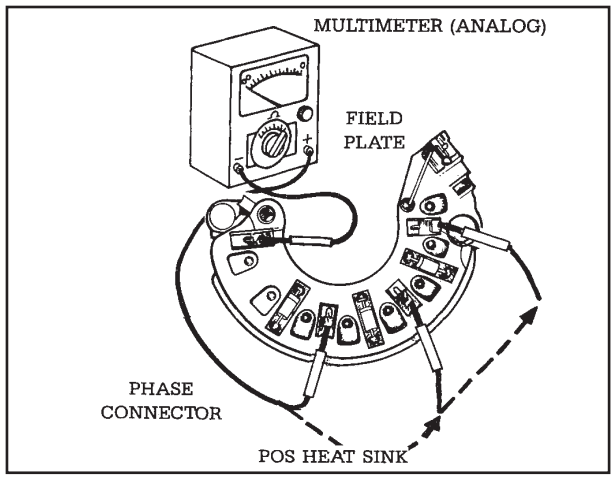


Fig. 31

(e) Testing of auxiliary diodes (No Continuity test) :

❑ Connect as shown in fig. Use a multimeter with two probes.

Connect negative probe of multimeter with the field plate, and positive probe to the phase connecting leads. It should indicate no continuity. If not replace rectifier assembly.

Ref. Fig. 32

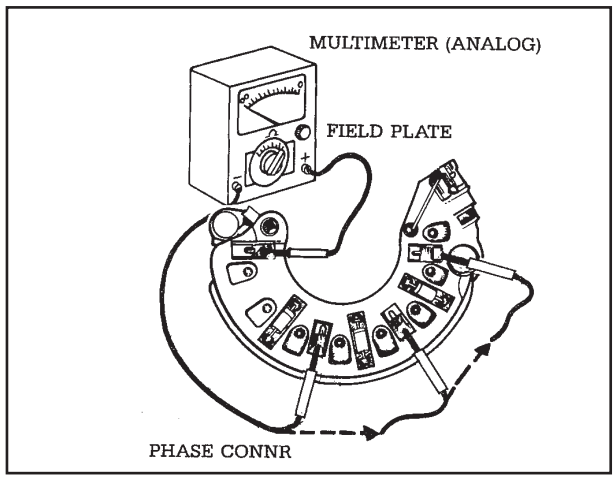


Fig. 32

SRE BALL BEARING ASSEMBLY

Place Rotor assembly on the base of wheel press and press down Ball bearing on to the shaft to dimension mentioned in Fig. 33.

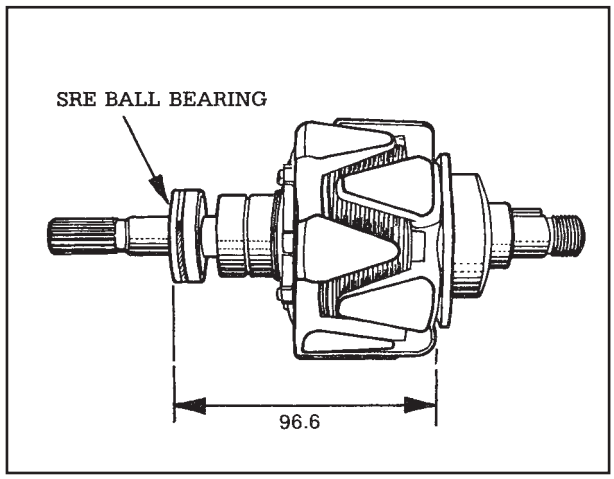


Fig. 33

OIL SEAL ASSEMBLY

Place SRE Bracket on the base of wheel press and press down oil seal into SRE Bracket assembly along with a locking disc.

Note the position of oil seal.

Ref. Fig. 34

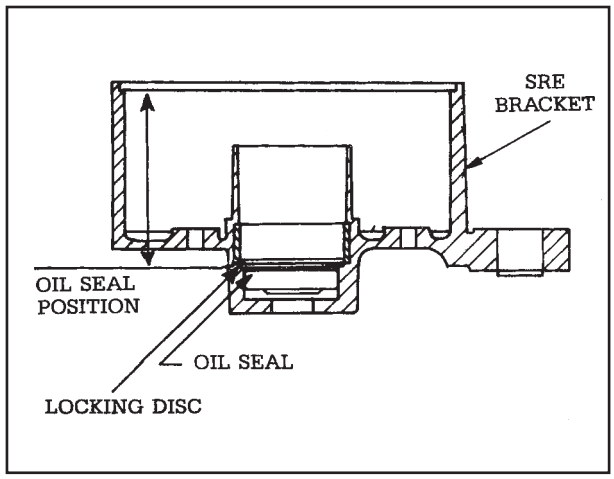


Fig. 34

RE-ASSEMBLY

It is a reverse order of dismantling procedure. Note folowing precautions.

- ❑ Use only 40-60 grade solder for soldering
- ❑ Use 65 watts soldering iron.
- ❑ Cover shaft serrations with a tap while assembling Rotor assy.
- ❑ Remove tape from shaft serrations after Rotor assembly.
- ❑ Ensure tightening torques to specified values given in the chart.

TIGHTIENING TORQUE DETAILS

DESCRIPTION	VALUE
SHAFT NUT	(M16) 70 $\pm$ 5. Nm
FIXING BOLTS	(M5) 5.0 - 5.7 Nm
+ VE OUT PUT TERMINAL NUT	(M6) 3.9 - 5.1 Nm
COVER MOULDING FIXING SCREEN	(M5) 2.5 - 3.0 Nm
VACUUM PUMP FIXING SCREEN	(M6) 5.8 - 6.8 Nm

TROUBLE SHOOTING

Before starting trouble shooting ensure the battery condition

DEFECT	CAUSE	REMEDY
1. Warning light does not appear when ignition switch is on.	(a) If bulb does not light, ground WL terminal of alternator.	
	(b) If bulb now lights the causes are :	
	(ii) Jammed brushes or brush lead adrift.	Free brushes, Replace , if necessary.
	(iii) Dirty slip ring	Clean slip ring.
	(iv) Rotor open circuit.	Check that the ends of the rotor
	(v) Yellow lead connecting rectifier to regulator open.	winding are soldered properly to slip ring terminals. Resolder the windings, if open, or replace the rotor.
	(c) If the bulb does not light even after grounding WL Terminal, the causes are :	
	(vi) Fused warning lamp bulb.	Check for short circuit, if any, in the wiring harness. After rectifying the short replace bulb.
	(vii) Short circuited warning lamp holder.	Replace Holder.
	(d) If still WL does not appear when Ignition switch is on, the cause is faulty Regulator.	Replace regulator.
2. Warning lamp glows dim	(i) High resistance in warning lamp	Check and correct.
	(ii) Regulator defective.	Replace Regulator.
	(iii) Rotor defective.	Replace Rotor.
3. Warning lamp 'on'. Ammeter shows no charge while engine is running.	(i) Loose belt.	Tighten the belt to the limits as indicated in routine maintenance.
	(ii) Aux. diode lead 'A' open.	Check diode connection and trace short. Rectify if possible or replace rectifier assembly.
	(iii) Shorted rotor	Replace rotor.
	(iv) Stator open/shorted	Replace stator assembly.
4. Warning lamp 'on' or dim but ammeter shows charges (low output)	(i) Faulty bridge.	Replace defective heat sink assy.
5. Warning lamp goes off. Ammeter shows low output	(i) Faulty rectifier bridge.	Replace defective heat sink assy.
	(ii) Stator winding short.	Rectify or replace stator assembly
6. Warning lamp (Ammeter) flickers considerably.	(i) High resistance in Negative line.	Check connections and ensure use of recommended wire.
	(ii) Slip ring dirty.	Clean the slip ring and recheck.
7. Overcharging (battery gases)	(i) Faulty regulator.	Replace regulator.
	(ii) Rotor shorted to earth on negative side.	Rectify or replace rotor assembly

Fault Diagnosis
Charging System

Warning lamp does not appear when ignition switch is '*ON*'.
Warning lamp glows dim when ignition switch is *'ON'*
Warning lamp '*ON*' while engine is running and no output.
Warning lamp reamins '*OFF*' while engine is running & reduced output.
Warning lamp flashes and ammeter flickers.
Warning lamp '*ON*' or '*DIM*' while engine is running but ammeter indicates charging.
Battery overcharging (pungent acid smell) & constant high output.

Fault	Cause	Check & Correct
● ●	Battery in poor state of charge.	Switch on loads. Check battery specific gravity & cell voltage. Replace if necessary.
● ●	Warning lamp bulb fused.	Replace with new bulb.
● ●	Bad connections.	Check for loose / rusty connections. Clean-up if found dirty
●	Fuse blown.	Replace fuse.
● ● ●	Loose belt.	Tighten the belt to the limits (deflection 8 to 12 mm).
● ●	Battery open circuit or ignition switch defective.	Ensure correct connections for battery circuit. Replace ignition switch if necessary.
● ●	Aux. Diode lead "A" open.	Check diode connections; repair if necessary.
● ●	Rotor short / earthed.	Trace fault; rectify or replace rotor if necessary.
● ● ● ● ●	Stator open / short.	Replace stator assy if necessary.
● ● ● ●	Faulty rectifier bridge.	Replace defective heatsink assy.
● ● ● ●	High resistance in the warning lamp.	Check connection and ensure use of recommended wire.
● ● ● ●	Slip ring dirty / jammed brush.	Clean the slip ring & brush box and re-check. Free the brushes
● ● ● ● ●	Faulty regulator	Check with ART-D and replace if necessary.
● ●	Reconditioned rotor; difference in OD.	Check clearance between rotor, stator & claw fingers; replace if not within spec.
●	High resistance in -ve line	Check -ve main terminal.
● ●	Improper "regulator lead earthing".	Ensure correct earthing asper circuit.
●	Auxliary diode open. Main diode short / open	Check diodes; replace if necessary.

Note : The 'dots' denote the fault appearing in the corresponding (vertical) column and the cause & corrective action to be carried out as mentioned in that (horizontal) row.

7) STARTER MOTOR:

D7 R24 Valeo Starter Motor are being fitted at present on Telcoline vehicle.

SPECIFICATION :

Voltage	:	12V
Weight	:	3.81 kg
Battery Terminal	:	M8 x 1.25
Exitation Terminal	:	V1SHM5
No. of teeth of pinion	:	10
Pressure angle for pinion	:	20^{O}
Teeth on ring gear	:	136

REMOVAL

- ❑ Disconnect battery cable from starter solenoid.
- ❑ Remove nut securing battery cable to starter solenoid.
- ❑ Remove upper bolt securing starter motor to engine.
- ❑ Disconnect earth lead from bolt.
- ❑ Remove starter motor.

FITMENT

- ❑ Clean starter motor and mating faces of starter motor and flywheel housing.
- ❑ Fit and align starter motor to engine.
- ❑ Connect earth lead to starter motor upper bolt.
- ❑ Fit upper bolt securing starter motor to engine and tighten it.
- ❑ Tighten lower bolts securing starter motor to engine.
- ❑ Connect battery cable to starter solenoid, fit nut and tighten it.

TESTING / CHECKING

START THE ENGINE

a) Engine not cranking at all

- ❑ Check Battery for connection
- ❑ Ensure Battery is in healthy condition
- ❑ Tighten starter motor terminals
- ❑ Check continuity as per circuit diagram
- ❑ Fix the connector properly
- ❑ Replace relay if found faulty
- ❑ Replace ignition switch if found faulty
- ❑ Replace starter motor.

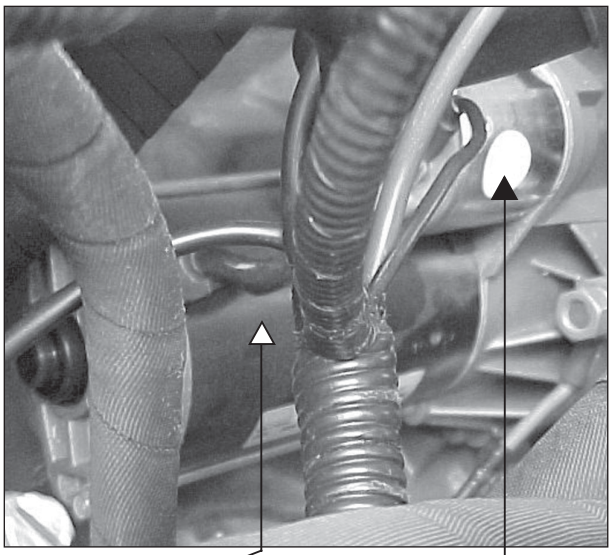


Fig. 35

b) Engine cranking but not starting

- ❑ Tighten starter motor terminals
- ❑ Ensure Battery is in healthy condition
- ❑ Replace starter motor
- ❑ Check & replace fuel pump.

c) Engine does not start / not starting in cold conditions

- ❑ Check Battery for connection
- ❑ Ensure Battery is in healthy condition
- ❑ Tighten glow plug terminals
- ❑ Replace glow plug
- ❑ Replace glow plug temp. sensor
- ❑ Replace glow plug timer.

d) Engine does not STOP after ignition is switched OFF

- ❑ Check wiring continuity
- ❑ Replace ignition switch if found faulty
- ❑ Check & replace fuel pump.
- ❑ *Electrical circuit diagram for starting, charging and engine stop solenoid may also be referred*

NOTE :

Please contact local authorised service agency of M/s. Valeo for repairs on this starter motor.

EXPLOTED VIEW OF D7R24 VALEO STARTER MOTOR

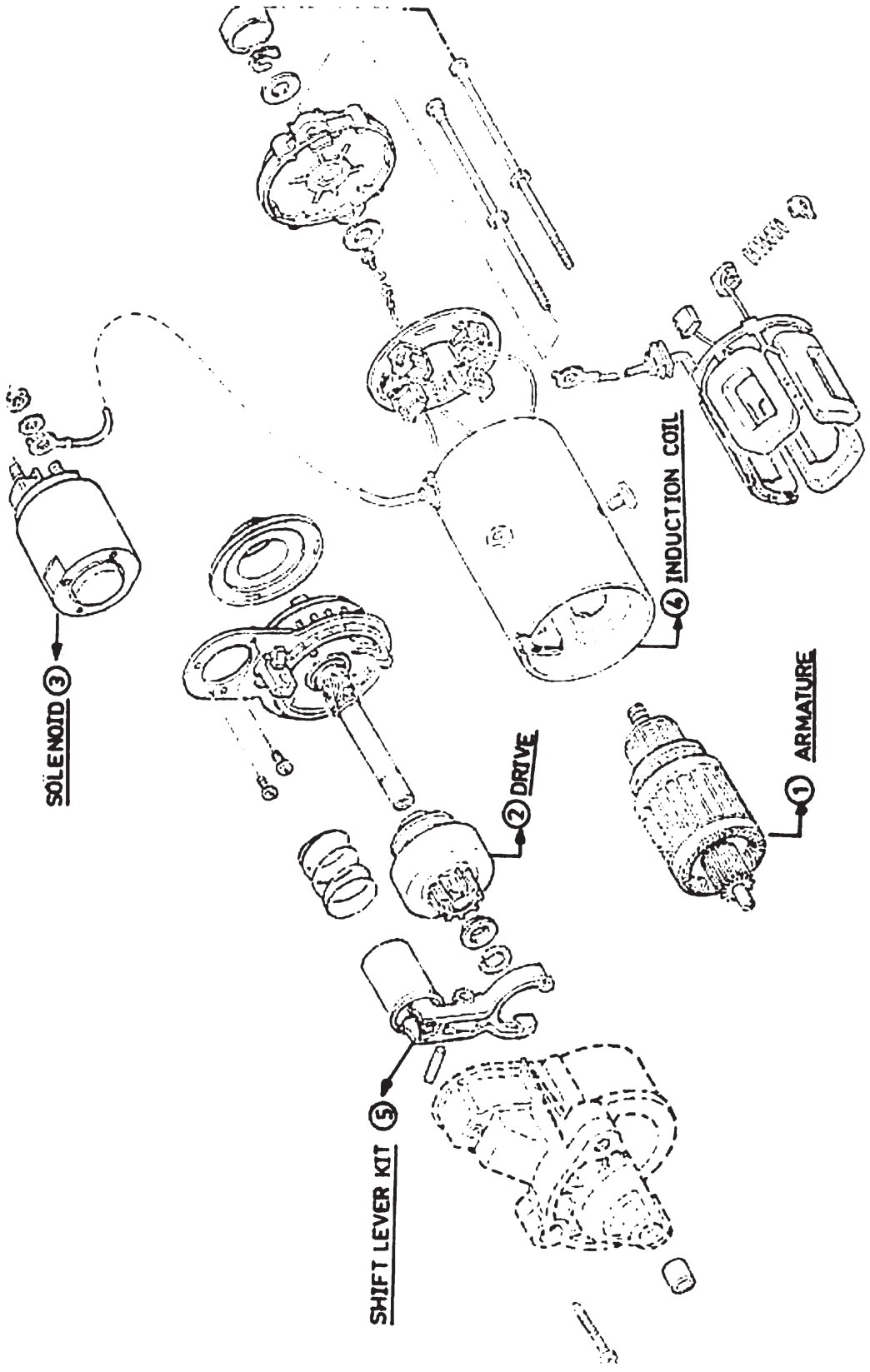


Fig. 36

8. SWITCHES, LAMPS AND OTHER COMPONENTS :

A. STEERING LOCK CUM IGNITION SWITCH

Function

1. To lock the steering.
2. To start and stop the engine.
3. To switch on accessaries and other electrical system.

Location

It is located on the right side of the steering column below steering wheel.

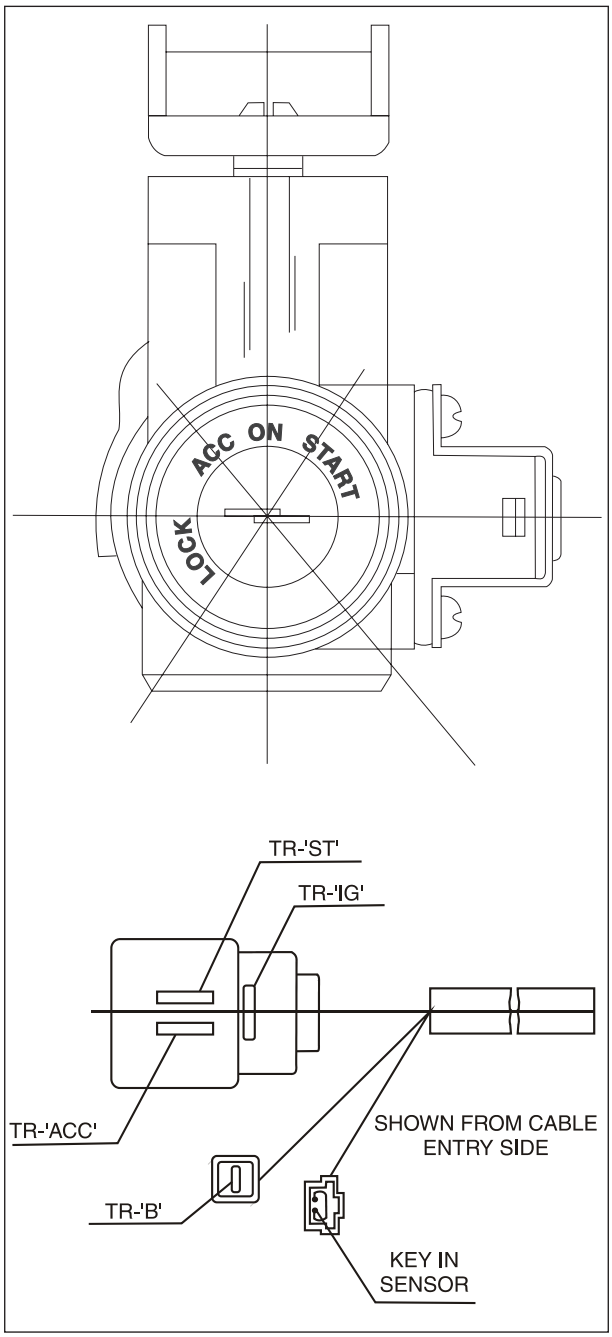


Fig. 37 : Steering lock cum Ignition switch

POSITION / KEY / TERMINAL		LOCK	ACC	ON	START
		OUT	IN		
KEY IN SENCER			○	○	○	○
B			○	○	○	○
ACC				○	○	
IG					○	○
ST						○
KEY MOVEMENT	FORWARD	L	L	F	F	F
	RETURN	L	F	F	F	F

F - FREE (LOCK BAR IN UNLOCK POSITION)

L - LOCK (LOCK BAR IN LOCK POSITION)

B. COMBINATION SWITCH RHD

Function

Right side lever of RHD operates turn signal, head lamp, low/high beam, parking & registration plate lamps. Left side lever of RHD operates the wind shield washer of wiper.

Location

It is mounted on steering column.

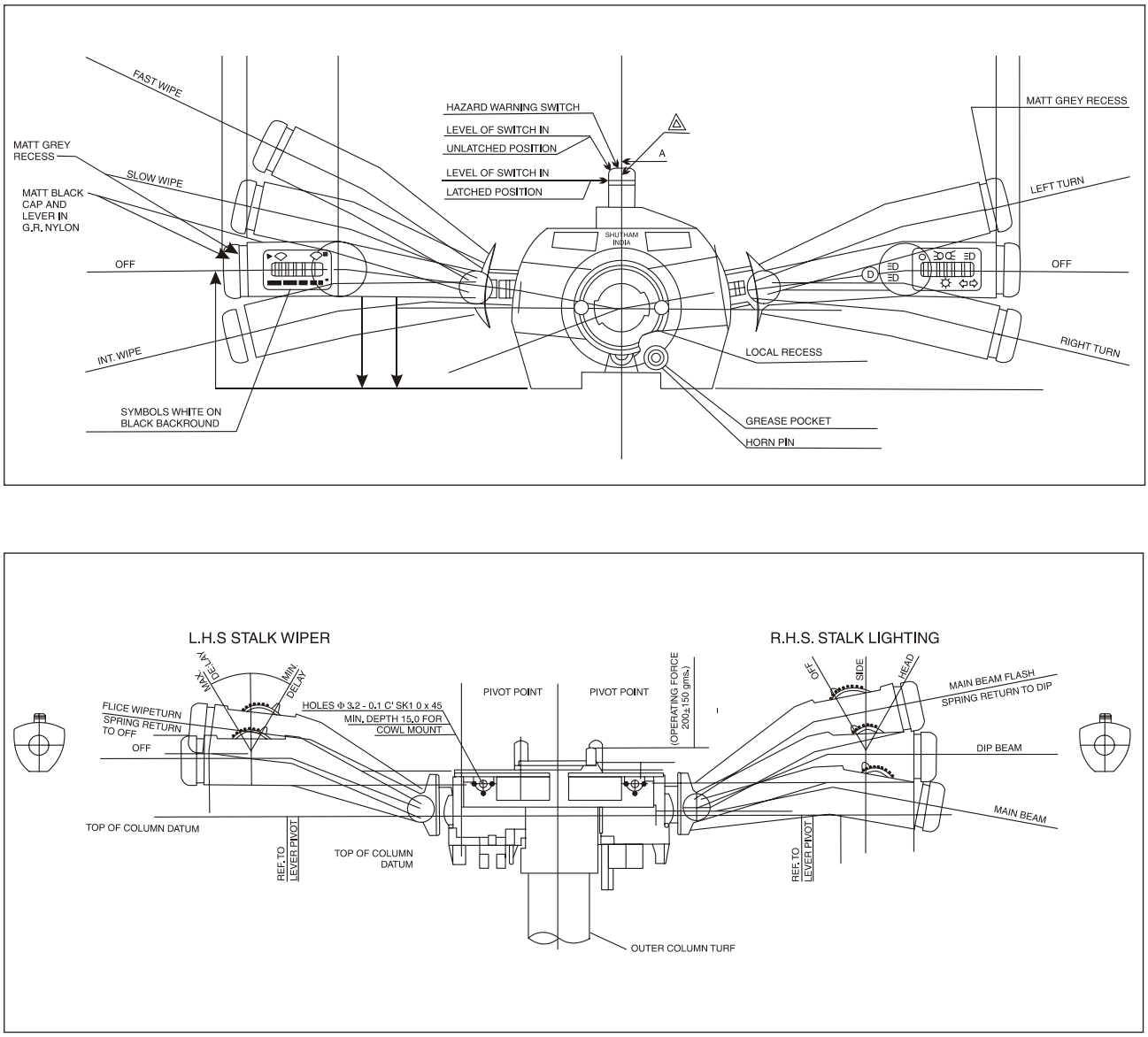
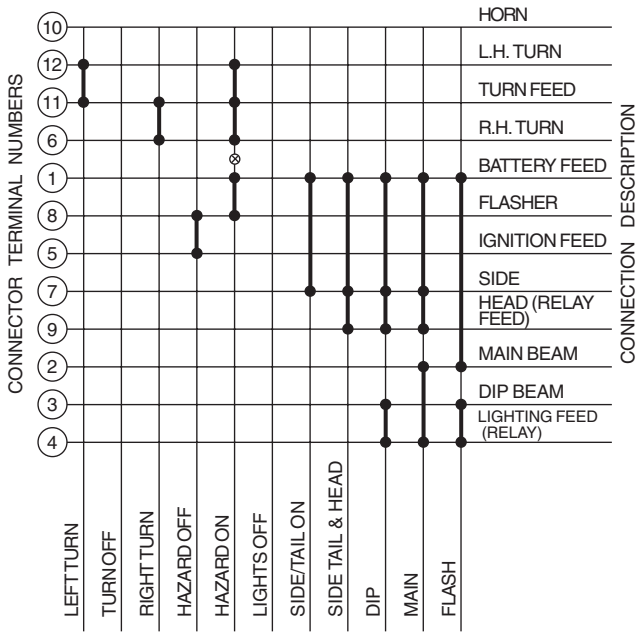
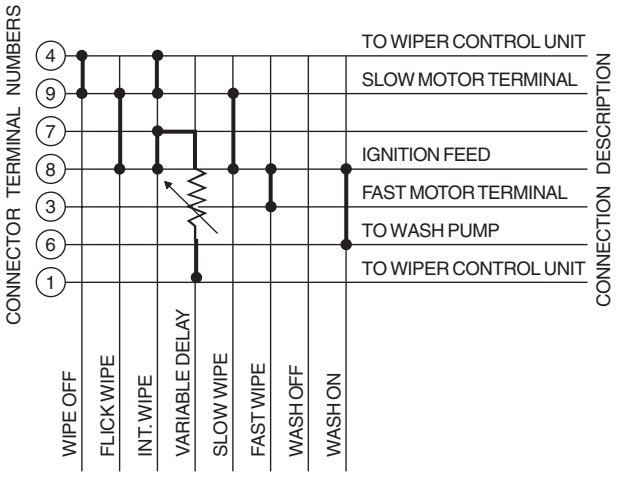


Fig. 38 : Combi Switch RHD



SWITCH POSITIONS
SWITCH CIRCUIT DETAILS
DIRECTION INDICATOR HAZARD CIRCUIT



SWITCH POSITIONS
SWITCH CIRCUIT DETAILS
WIPER CIRCUIT

C. COMBINATION SWITCH LHD

Function

Left side lever of LHD operates turn signals, head lamp, low/high beam, parking & registration plate lamps. Right side lever of LHD operates the wind shield washer of wiper.

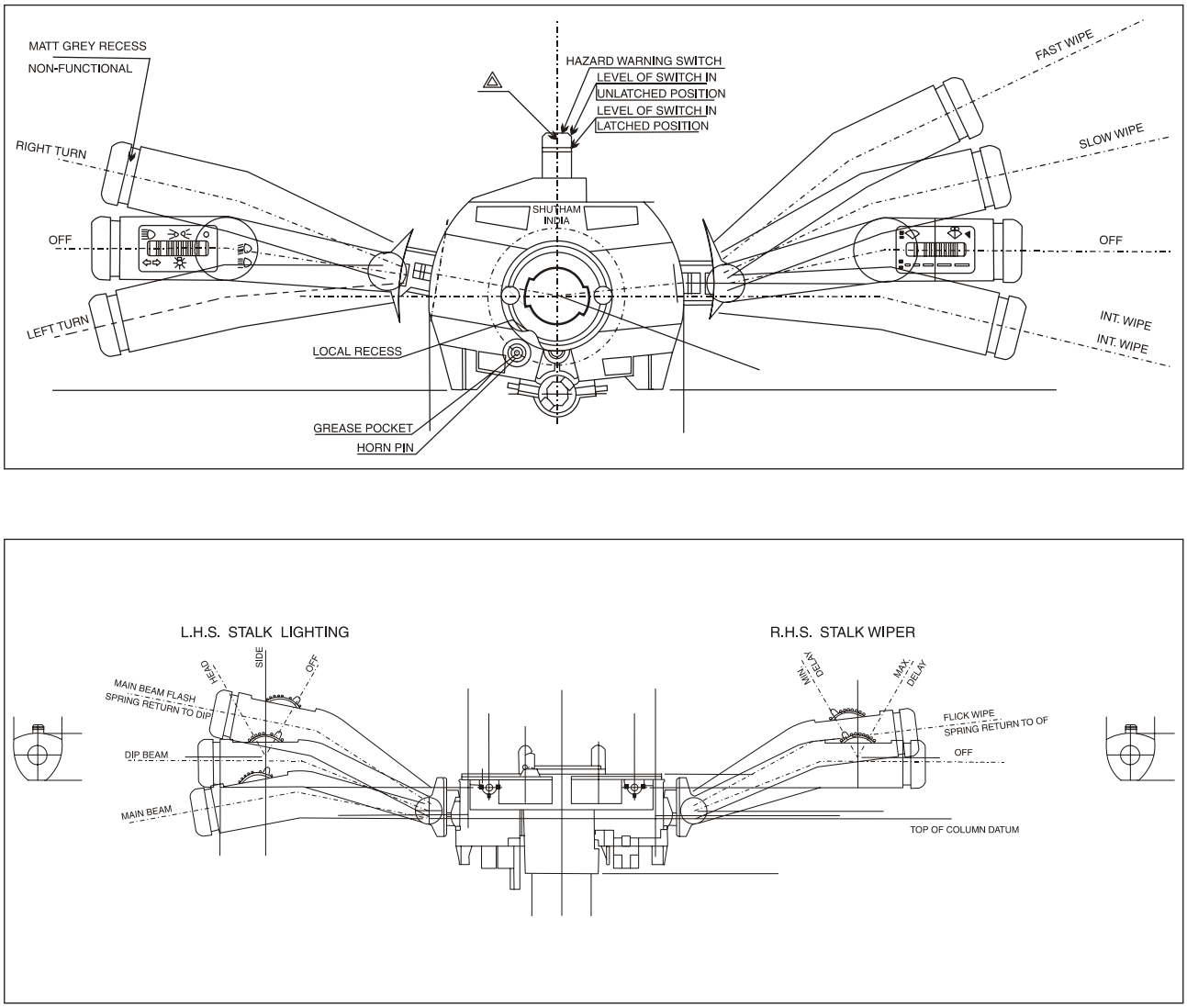
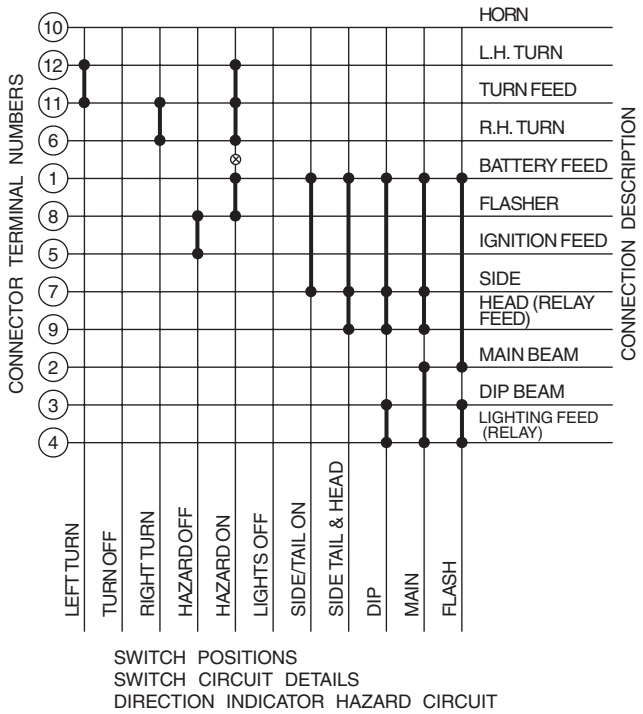
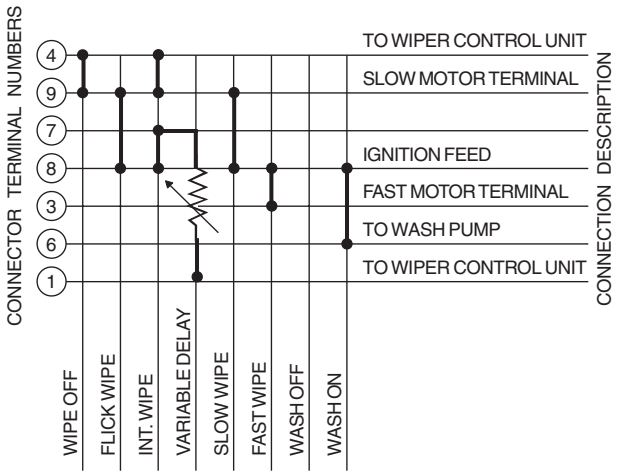


Fig. 39 : Combi Switch LHD



SWITCH POSITIONS
SWITCH CIRCUIT DETAILS
DIRECTION INDICATOR HAZARD CIRCUIT



SWITCH POSITIONS
SWITCH CIRCUIT DETAILS
WIPER CIRCUIT

D) COMBI SWITCH:

FITMENT

- ❑ The Switch should be located on the steering column with Anti Rotation projection engaged on the column slot.
- ❑ Hold the Switch down against the top of the column with switch body symmetrical about Y plane through column axis and tighten the clamping screw and check for firm fitment by operating the stalks into all positions.
- ❑ Fix the nacelle and check for fouling and operation of the stalks in the extreme positions. Rubber flaps (if fitted) should not come out of the window in the nacelle and should not obstruct the movement of the stalks.
- ❑ Apply contact grease on the horn contact pin and also smear the same to form a thin film on the contact face of the contact ring on the steering wheel.
- ❑ Care should be taken to engage the cancellation trigger projection into the slots on the steering wheel boss and check for self cancellation of RHS / LHS side indicator function and also clearance between the switch to & bottom of the spring boss and gap between contact ring and top of the contact pin guide.
- ❑ Make the electrical connections.

REMOVAL

Please follow reverse procedure (relevant points)

TESTING / CHECKING

All functions are described component wise.

No serviceable parts inside. Replace combiswitch, if found defective.

Please refer Electrical Circuits of Head Lamp Parking Lamp System, Front Wiper Washer System.

E) PIANO SWITCH:

Pl. refer assembly / removal of central console before you proceed.

SNAP FIT TYPE

Press holding latch & push from the back, disconnect wiring to remove. For fitment, make connections & insert in the cavity from front.

TESTING / CHECKING

No serviceable parts inside. Replace the Switch if not functioning.

F) GAUGES & INDICATORS - FUNCTIONAL DETAILS :

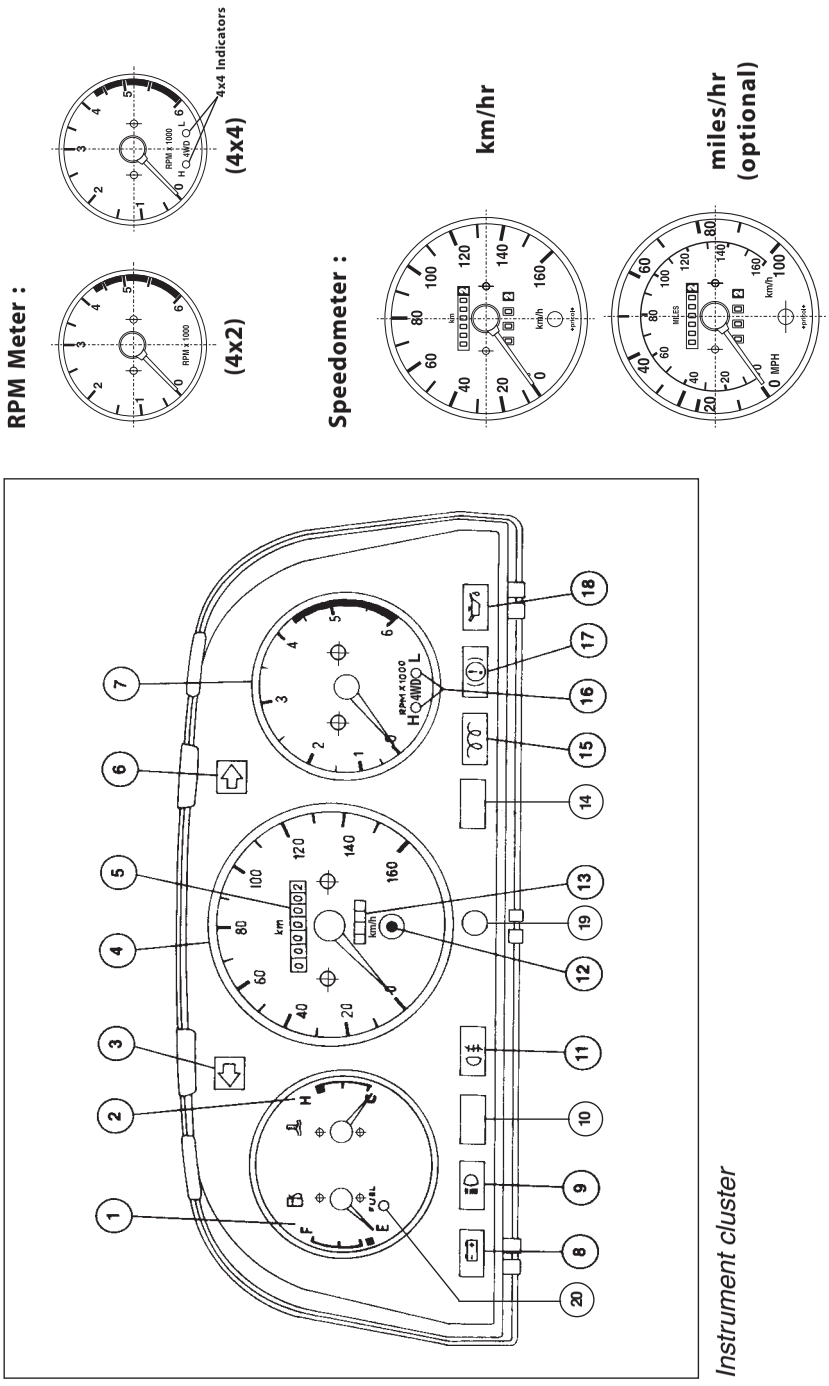


Fig. 40

F) GAUGES & INDICATORS - FUNCTIONAL DETAILS :

1. **Fuel gauge :**
   Indicates the approximate level of fuel in tank. Fill up tank with recommended diesel fuel before needle touches 'Red' mark on gauge.

2. **Water temperature gauge**
   When needle touches red band it indicates engine overheating.

3 & 6. **Turn signal indicators** (Green)

   Turn signal lamps can be operated only when ignition is 'ON' and by using turn indicator switch on the combi switch.

   Direction indicator arrow ⇦ (LHS) & ⇨ (RHS) on the instrument cluster flashes alongwith external indicator lights as selected.

4. **Speedometer**
   Indicates vehicle speed in km/hr or miles/hr.

5. **Odometer** registers total distance covered by the vehicle in km or miles.

7. **Engine RPM meter.**

   It shows engine speed in revolutions per minute (RPM).

8. **Battery charging indicator light.** (Red)

   This light should come ON when ignition is 'ON' and should go off after the engine starts. If it remains 'ON' when engine is running, it indicates battery is not getting charged.

   In such a case, avoid using electrical loads and get the problem attended at an authorised workshop.

9. **High beam indicator** (Blue)

   It comes on when head lamp is operated in high beam position.

10. **Spare for Indicator**

11. **Rear fog lamp indicator**

    Indicator comes 'ON' when fog lamp is switched on. Fog lamp operation is coupled with head lamps.

12. **Trip counter setting knob**

    To reset it push the knob. Trip counter will show zero.

13. **Trip Counter km. or miles**

    It indicates number of km or miles driven since last reset.

14. **Spare for Indicator**

15. **Glow plug indicator light** (Amber)

    It glows when the ignition key is turned to position 'ON' and after a few seconds depending on ambient temperature the indicator light goes off indicating that the engine can be started.

    If the glow plug indicator light does not go off automatically, get the electrical system of your vehicle checked.

16. **4WDH & 4WDL indicator** (Green)
    (For 4x4 vehicle)

    4WDH & 4WDL indicator lights glow up when ignition key is turned to position 'ON' and go off after a few seconds. Either 4WDH or 4WDL indicator light glows continuously when four wheel drive mode high or low respectively is selected.

17. **Hand Brake + Brake fluid level indicator** (Red)

    It comes on when the brake fluid level in the container is too low or when hand brake is on.

    In case fluid level in container is low, get your vehicle checked at authorised agency for leakages.

18. **Oil pressure indicator light** (Red)

    It lights up when ignition key is turned to position 'ON' and goes off as soon as the required oil pressure has developed after the engine has started. If the light continues to glow when the engine is running, it indicates low oil level in engine oil sump, or a fault in the lubrication system.

    Continued running of the engine when the oil pressure indicator light is on, may damage the engine.

19. **Immobilizer - Anti theft security system** (Red) (Optional)

    This system disables starter motor circuit, ignition supply & fuel cutoff solenoid supply. The vehicle can be started only if key fitted with corresponding transponder is inserted in ignition switch.

20. **Low Fuel Indicator** (Amber/Orange)

    It comes on when fuel level reaches 10 litres (approx.) in tank altering the user to fill fuel.

G) INSTRUMENT CLUSTER :

REMOVAL

1. Remove the bazel by unscrewing it.
2. Unscrew the cluster mounting screws from mounting bracket.
3. Remove speedocable by breaking the seal.
4. Remove electrical connector.

FITMENT

1. Insert the nyloc cage nuts in locating points on dashboard.
2. Fit the mating connectors of W/H cabin in respective cavities of Inst. Cluster.
3. Lay the speedocable and assemble at meter end and seal it by crimping the lead seal on the wire lead.
4. While pulling the speedocable from bottom, insert the inst. cluster in the dash board cutout.
5. Tighten the cluster mounting screws.
6. Ensure 2mm gap between lens surface and bazel

REMOVAL OF GAUGES:

1. Push the Assy. Front Dial by pulling the 7 Latch notches.
2. Unscrew the Gauges from the back for removal from the front.

REMOVAL OF BULBS :

1. Unwind the Lamp Holder.

2. Pull out the Bulb from the holder

3. Pull out the coloured cap (if fitted).

Note: Replace the specified bulb. Handle the coloured cap gently.

FITMENT

Please follow reverse procedure.

EXPLODED VIEW INSTRUMENT CLUSTER

1 - Instrument Cluster
2 - Front Dial
3 - Speedometer
4 - RPM Gauge
5 - Fuel & Temp Guage
6 - A/C Cut off & High Temp Module
7 - Assemble Case
8 - Bulb with cap
9 - Buld holder
10 - Capless Bulb

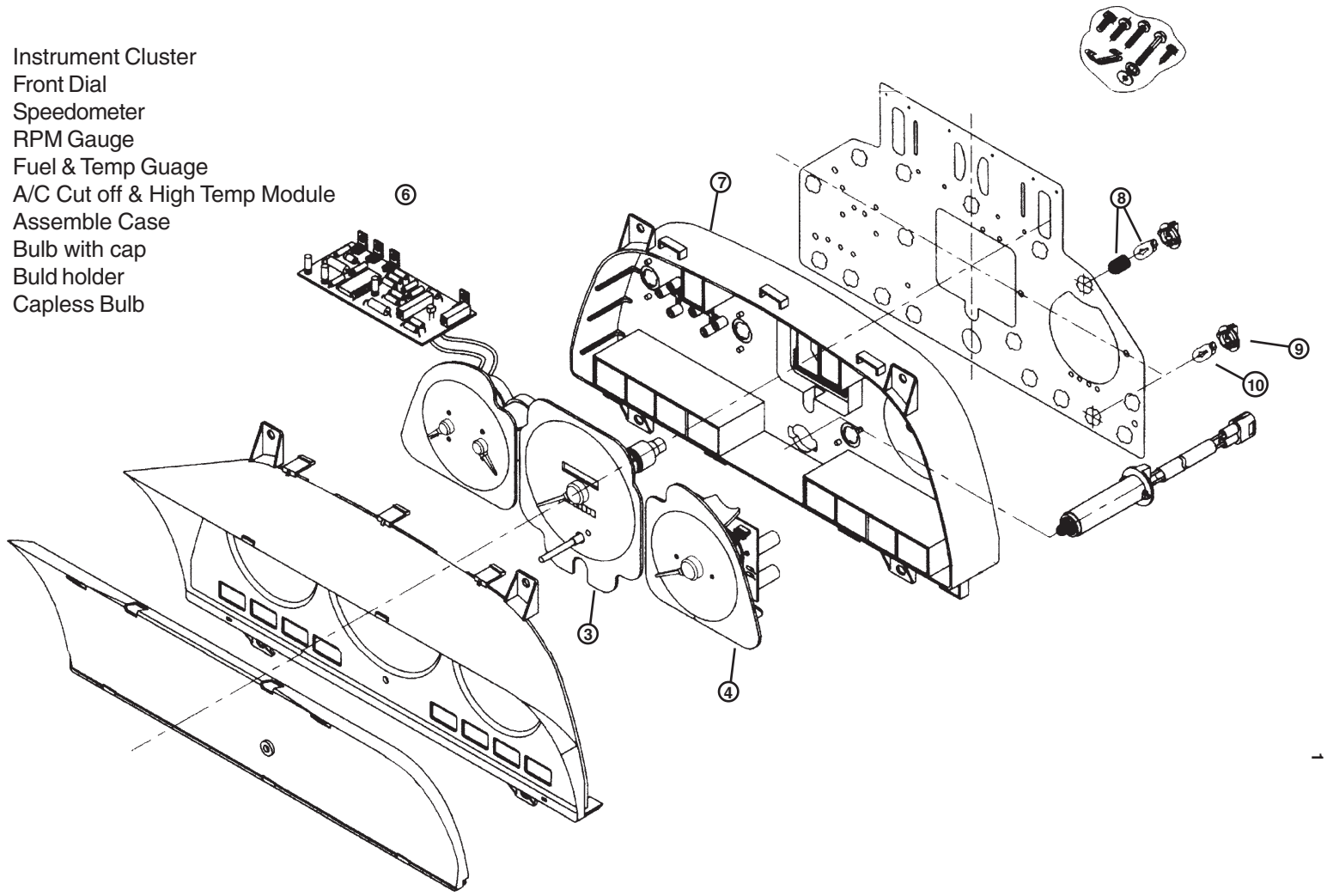


Fig. 41

H. TROUBLE SHOOTING OF GAUGES & INSTRUMENTS :

Description	Fault	Testing / Checking
Speedometer / Odometer	Speedometer / Odometer not working	❑ Ensure proper Speedocable engagement with Speedometer ❑ Remove Speedocable & ensure that it is healthy by checking manually. ❑ Replace speedocable if found faulty. ❑ Replace Speedometer / Odometer if found faulty **Note :** Use right Speedo ratio.
RPM Meter	RMP Meter not working	❑ Fix the connectors properly ❑ Check the output voltage of alternator ❑ If no output replace the alternator ❑ Check continuity to meter ❑ Replace RPM meter **Note :** Ensure correct pulley ratio
	4WDH / 4WDL indicators not working	❑ Replace the AC cutoff & high temp. module if found faulty. ❑ Replace the complete set of AC cutoff & high temp. module and gauge. **Note:** Ensure correct AC cutoff & high temp. module Model No.
Fuel Gauge	Fuel gauge not working	❑ Fix the connector properly. ❑ Check continuity from Fuel Tank Unit ❑ Check resistance value of Fuel Tank Unit as shown in the drawing. ❑ Replace Fuel Tank Unit if found faulty. ❑ Check Fuel Gauge by connecting external resistance as per drawing. ❑ Replace the fuel gauge if found faulty ❑ Replace the fuel gauge.
	Fuel gauge needle flickering Low Fuel level indicator not working	❑ Replace the AC cutoff & high temp. module if found faulty. ❑ Replace the complete set of AC cutoff & high temp. module and gauge. **Note :** Ensure correct AC cutoff & high temp. module Model No.
Temperature Gauge	Temperature gauge not working	❑ Fix the connector properly. ❑ Replace Temperature transducer. ❑ Replace temp. gauge.
	Temp. gauge needle flickering	❑ Replace temp. gauge.
Indicators	Indicators not working	❑ Fix the connector properly. ❑ Fix the Bulb Holder properly ❑ Replace the bulb.

Please refer Electrical Circuits of Instrument Cluster Indicators & Gauges, Hazard Warning & Direction Indicators & Flasher System.

I. GUAGES & INDICATORS - FITMENT, REMOVAL & TESTING :

FUEL GAUGE

Function

Fuel gauge indicates approximate level of fuel in the tank.

Location

It is located on the instrument cluster

Checking fuel gauge

Connect the fuel gauge, tank unit and battery as shown in fig. 43.

At the lowest position of the float the gauge should show E (empty) and at the highest position F (full).

To check defective gauge, the tank unit in the circuit should be alright and vise versa.

Note : Battery should be connected in correct polarity.

FUEL TANK UNIT ASSEMBLY:

Fitment

- ❑ Remove Fuel Tank assembly.
- ❑ Release clip & disconnect fuel feed hose.
- ❑ Release clip & disconnect fuel return hose.
- ❑ Remove electrical connections.
- ❑ Remove 6 nuts securing Float Unit from the fuel tank.
- ❑ Remove seal from the Float Unit.

Removal

Please follow reverse procedure

Testing / Checking

The sender is a float operated rotary potentiometer which provides a variable resistance to ground for the output from the gauge. When the sender float is at its lowest point, indicating an empty fuel tank, the resistance to earth is at its lowest. The resistance is sensed by the gauge which positions the needle accordingly.

Use ohm-meter to confirm that the resistance of the fuel level sensor (Fuel Tank Unit) changes with the level of float position.

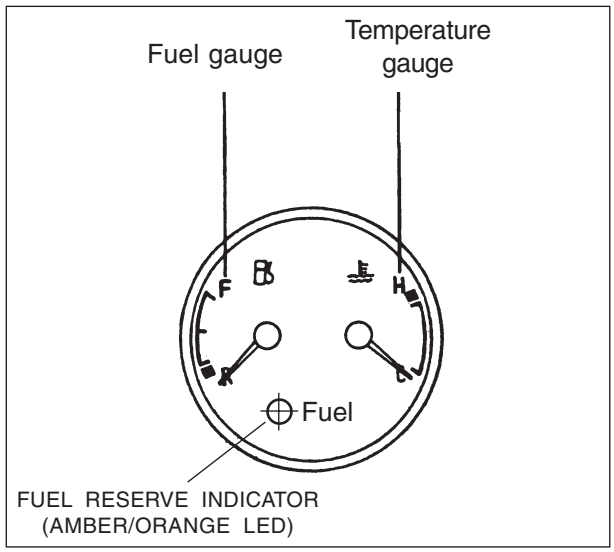


Fig. 42

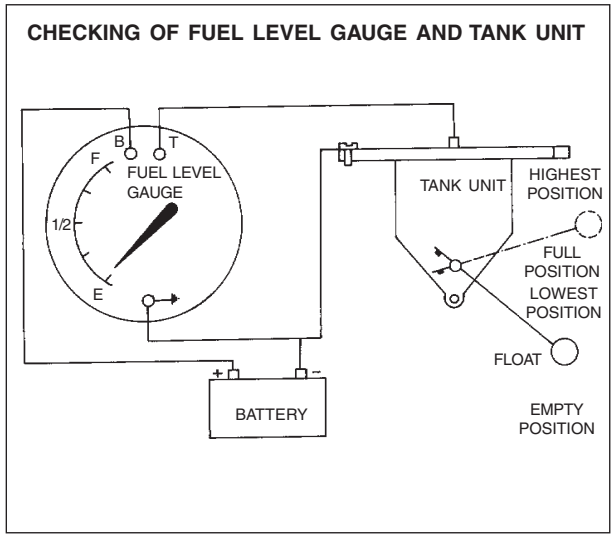


Fig. 43

J) HEAD LAMP / TAIL LAMP ASSY. :

Fitment (Head Lamp & Blinker)

- ❑ Locate the spring mounting bracket on the holes in the panel and tighten the bracket with the fasteners.
- ❑ Insert the Head Lamp into the cutout for the Head Lamp and align the four mounting locations.
- ❑ Tighten the lamp with the fasteners.
- ❑ Locate the Blinker in the locating panel.
- ❑ Insert the Blinker into the slots in the Head Lamp.
- ❑ Clamp the Blinker spring into the spring locating bracket.
- ❑ Connect the respective connectors for the Head Lamp and Blinker
- ❑ Check for the proper fitment of the Blinker by ensuring proper engagement of the spring and the Blinker locating lug.

Removal (Head Lamp & Blinker)

Please follow reverse procedure for fitment.

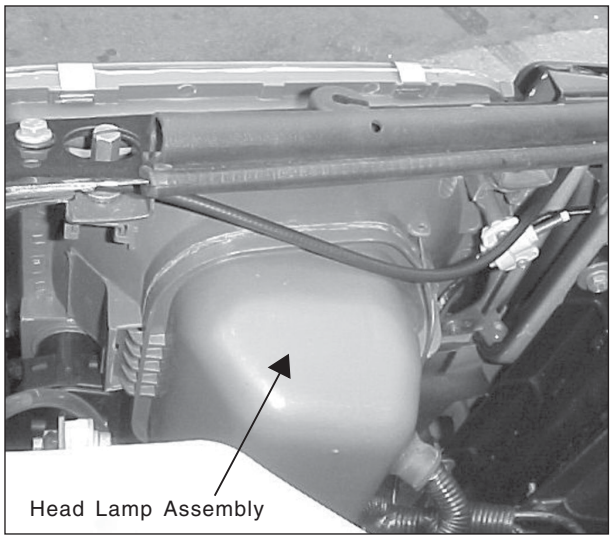


Fig. 44



Fig. 45



Fig. 46

K. TROUBLE SHOOTING CHART FOR LAMPS :

Description	Fault	Testing / Checking
Head Lamp	Single HL RH not working	❑ Tighten ground properly ❑ Fix Connector properly ❑ If fuse blown, check for any short circuit & then replace it ❑ Replace bulb
	Both Lamps not working	❑ Fix the fuse properly ❑ If fuse blown, check for any short circuit & then replace it ❑ Fix the relay properly ❑ Replace relay ❑ Fix the connector properly ❑ Check for the function of combi switch ❑ Replace combi switch if found faulty
	High Beam does not come ON when flash switch is operated	❑ Fix the connector properly ❑ If fuse blown, check for any short circuit & then replace it ❑ Check for the function of combi switch ❑ Replace combi switch if found faulty
	Low Beam not working	❑ Fix the fuse properly ❑ If fuse blown, check for any short circuit & then replace it ❑ Fix the relay properly ❑ Replace relay ❑ Fix the connector properly ❑ Check for the function of combi switch ❑ Replace combi switch if found faulty
Front Parking Lamps	Single front parking lamp not working	❑ Fix the connector properly ❑ Fix the bulb properly ❑ Replace bulb if blown ❑ Tighten the grounding properly ❑ Fix the fuse properly ❑ If fuse blown, check for any short circuit & then replace it ❑ Check for the function of combi switch ❑ Replace combi switch if found faulty
	Both Lamps not working	❑ Fix the connector properly ❑ If fuse blown, check for any short circuit & then replace it ❑ Check for the function of combi switch ❑ Replace combi switch if found faulty

Description	Fault	Testing / Checking
Front Turn Signal Lamps	Front right / left lamps not working	❑ Fix the connector properly ❑ Fix the bulb properly ❑ Replace bulb if blown ❑ Tighten the grounding properly ❑ If fuse blown, check for any short circuit & then replace it ❑ Check for the function of combi switch ❑ Replace combi switch if found faulty
Reverse Lamps	Single reverse lamp not working	❑ Fix the connector properly ❑ Fix the bulb properly ❑ Replace bulb if blown ❑ Tighten the grounding properly ❑ If fuse blown, check for any short circuit & then replace it
	Both Lamps not working	❑ Fix the connector properly ❑ Fix the bulb properly ❑ Replace bulb if blown ❑ Fix the fuse properly ❑ If fuse blown, check for any short circuit & then replace it ❑ Replace the switch if found faulty
Parking Lamps	Single parking lamp rear not working	❑ Fix the bulb properly ❑ Replace bulb if blown ❑ Check for the function of combi switch ❑ Replace combi switch if found faulty
	Both lamps not working	❑ Fix the connector properly ❑ If fuse blown, check for any short circuit & then replace it ❑ Check for the function of combi switch ❑ Replace combi switch if found faulty
Stop Lamp	Single stop lamp not working	❑ Fix the connector properly ❑ Fix the bulb properly ❑ Replace bulb if blown ❑ Tighten the grounding properly ❑ Fix the fuse properly ❑ If fuse blown, check for any short circuit & then replace it
	All lamps not working including High Mounted Stop Lamp	❑ Tighten the grounding properly ❑ Fix the fuse properly ❑ If fuse blown, check for any short circuit & then replace it

Description	Fault	Testing / Checking
		❑ Check brake switch, adjust if required ❑ Fix the connector properly ❑ Replace the switch if found faulty
Fog Lamps (If fitted)	Single Fog lamp not working	❑ Fix the connector properly ❑ Fix the bulb properly ❑ Replace bulb if blown ❑ Tighten the grounding properly
	Both Lamps not working	❑ Tighten the grounding properly ❑ Fix the fuse properly ❑ If fuse blown, check for any short circuit & then replace it ❑ Check relay & it's base ❑ Fix the connector properly ❑ Replace relay ❑ Fix the bulb properly ❑ Replace bulb if blown
Side Repeater Lamps	Side Repeater Lamps not working	❑ Fix the connector properly ❑ Fix the bulb properly ❑ Replace bulb if blown ❑ Tighten the grounding properly
Registration Number Plate Lamp	Registration Number Plate Lamp not working	❑ Fix the connector properly ❑ Fix the bulb properly ❑ Replace bulb if blown ❑ Tighten the grounding properly
Interior Lamps	Interior Lamps not working	❑ Fix the connector properly ❑ Fix the bulb properly ❑ Replace bulb if blown ❑ Tighten the grounding properly ❑ If fuse blown, check for any short circuit & then replace it
Hazard Warning	Indicators not working with hazard warning switch is operated	❑ Fix the connector properly ❑ Fix the bulb properly ❑ Replace bulb if blown ❑ Tighten the grounding properly ❑ If fuse blown, check for any short circuit & then replace it ❑ Check Hazard Warning switch ❑ Fix the connector properly ❑ Replace the switch if found faulty ❑ Replace the Flasher

Please refer Electrical Circuits of Head Lamp Parking Lamp System, Interior Lights , Hazard Warning & Direction Indicators & Flasher System.

L) HORN:

REMOVAL

1. Horn is located on front bumper mounting bracket LH.
2. Removal can be from the Bottom Left Side of the Vehicle.
3. Disconnect connection from horn.
4. Remove nut securing horn to mounting bracket.
5. Remove horn.

FITMENT

1. Position horn to mounting bracket and tighten nut .

2. Connect blade terminals to horn.

TESTING / CHECKING

a) Horn not working

q Tighten ground properly.

q Check fuse & continuity.

q Check relay & ensure it's fitment in the base.

q Fix connectors properly.

q Check contacts of horn switch, adjust if required.

q Replace the horn.

b) Horn Sound Deteriorated

q Adjust setting screw till clean & sharp sound is obtained.

Please refer Electrical Circuit of Twin Horns, Over-speed Warning Devices

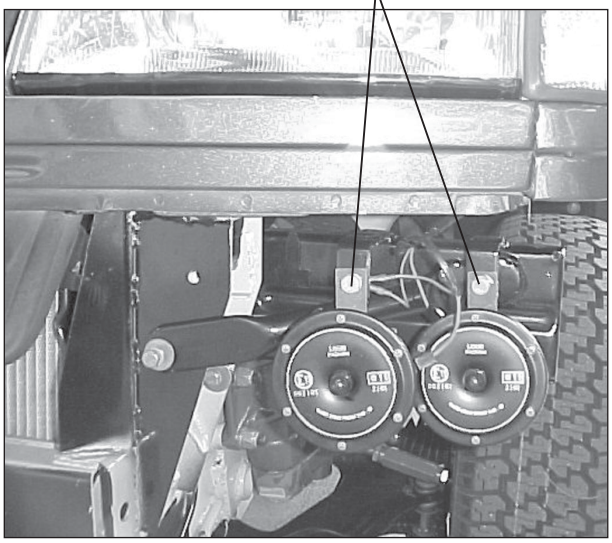


Fig. 47

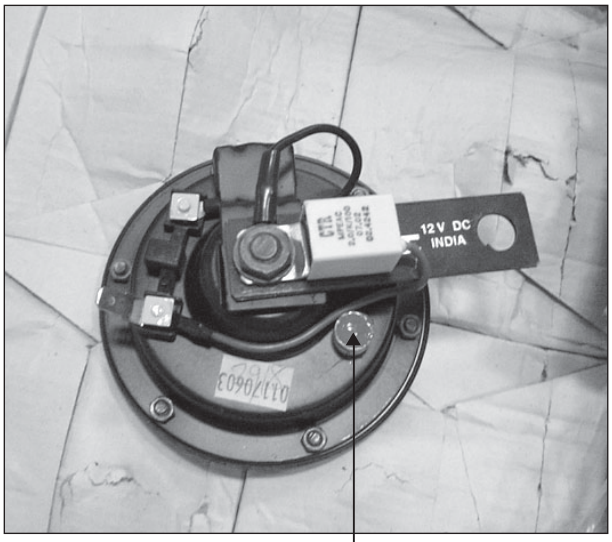


Fig. 48

9) CONTROL UNITS :

A - BUZZER UNIT

FUNCTION

Its function is to generate the warning sound to alert the driver about any abnormal condition of the vehicle. It receives the input from the chime unit.

Buzzers given below have been provided :

1] Buzzer with timer for seat belt warning device.

2] Buzzer for head lamp / rear fog lamp on and door open conditions.

3] Buzzer for over speed warning device (optional fitment).

Buzzers are located inside dash board behind instrument cluster.

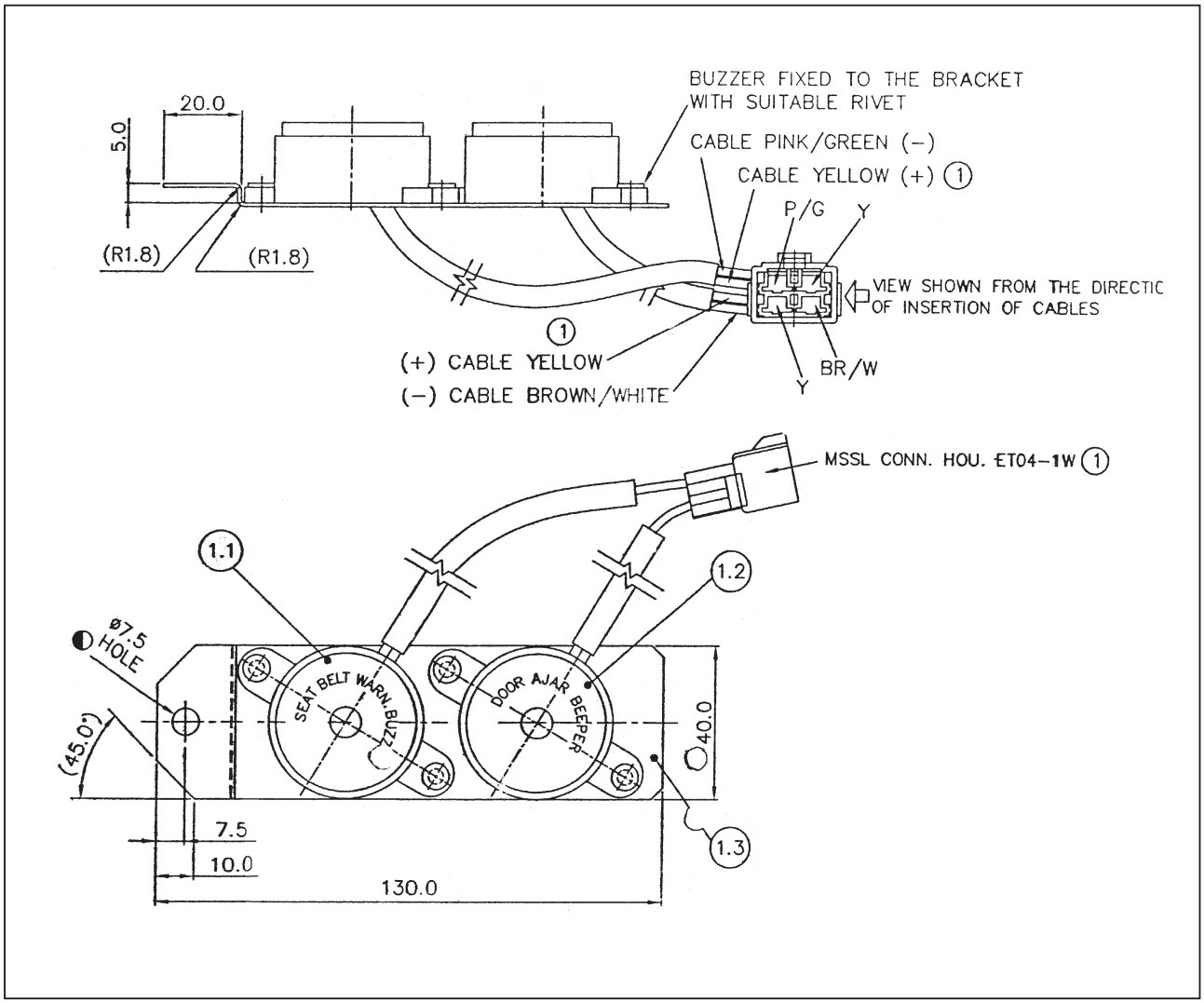


Fig. 49 : Buzzer Unit

B. CHIME UNIT

It generates an output singal in some faulty conditions/usage & passes it to the buzzer unit. It is mounted inside dash board on driver side.

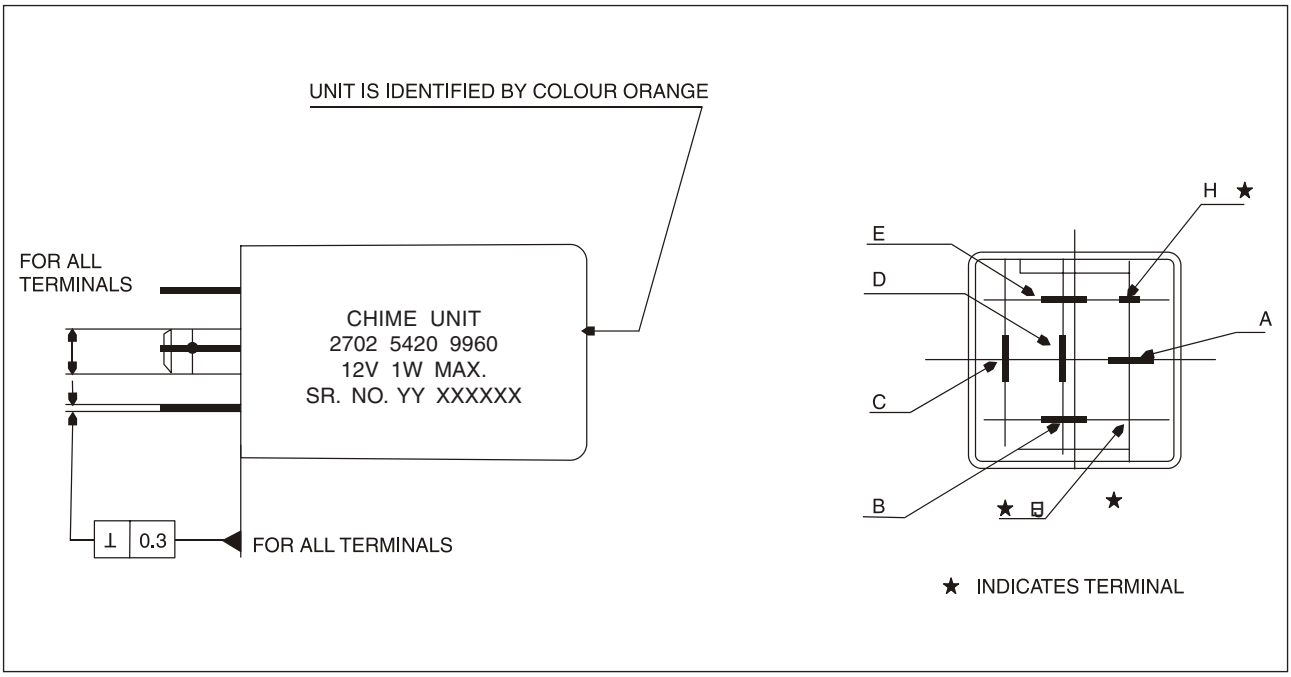


Fig. 50 : Chime Unit

TER NAME	TER TYPE	DESCRIPTION	ACTIVE LEVEL	CONDITION
H	INPUT	DRIVER DOOR SWITCH	GND	DOOR OPEN
J	INPUT	HEAD LAMP SWITCH	VCC	HEAD LAMP ON
D	INPUT	SEAT BELT SWITCH	GND	SEAT BELT NOT ATTACHED
C	INPUT	MAIN LINE SWITCH	VCC	KEY "IN" POSITION
A	OUTPUT	OUTPUT FROM UNIT	VCC	SEE PERF, CHECK TABLE
B	INPUT	MAIN LINE SWITCH (IGN)	VCC	KEY "IN" POSITION
E	GROUND	GROUND TO UNIT	GND	PERMANENT

PERFORMANCE CHECK

INPUT					OUTPUT
KEY IGN. POSITION	KEY IN POSITION	DRIVER DOOR SW.	HEAD LAMP SWITCH	SEAT BELT SWITCH	
- - - - - - - - -	ACTIVE	ACTIVE	- - - - - - - - -	- - - - - - - - -	ACTIVE
- - - - - - - - -	INACTIVE	ACTIVE	ACTIVE	- - - - - - - - -	ACTIVE
ACTIVE	ACTIVE	INACTIVE	- - - - - - - - -	ACTIVE	ACTIVE

C. FLASHER UNIT

Function

It provides blinking output to side indicators and hazard warning lamps.

Location

It is located below dashboard at driver side.

Connection details

Connection details are shown in fig. 53.

Checking flasher unit

a) Connect bulb to the flasher unit and battery as shown in fig. 5. The bulb should blink at 90 ± 30 cpm.

b) Disconnect one of 21 W bulbs. The remaining bulb should blink atleast 1.8 times of (a) or 140 cpm whichever is greater.

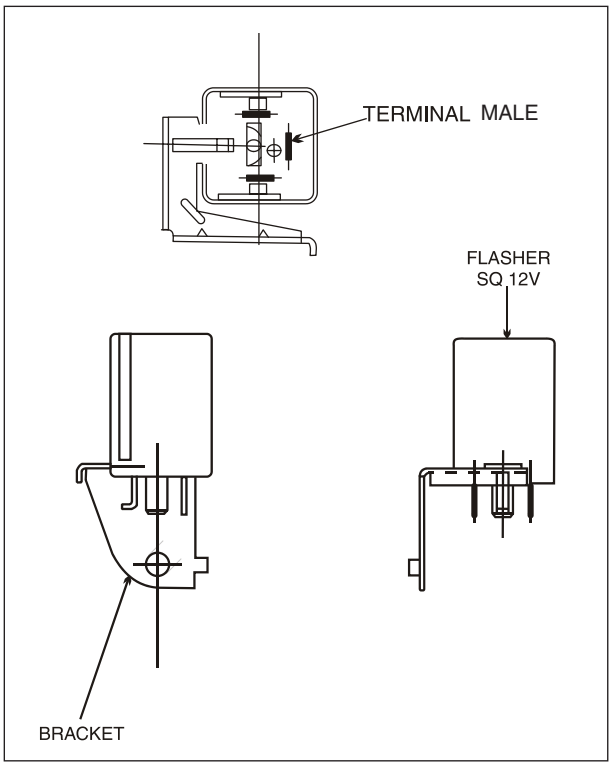


Fig. 51 : Flasher unit

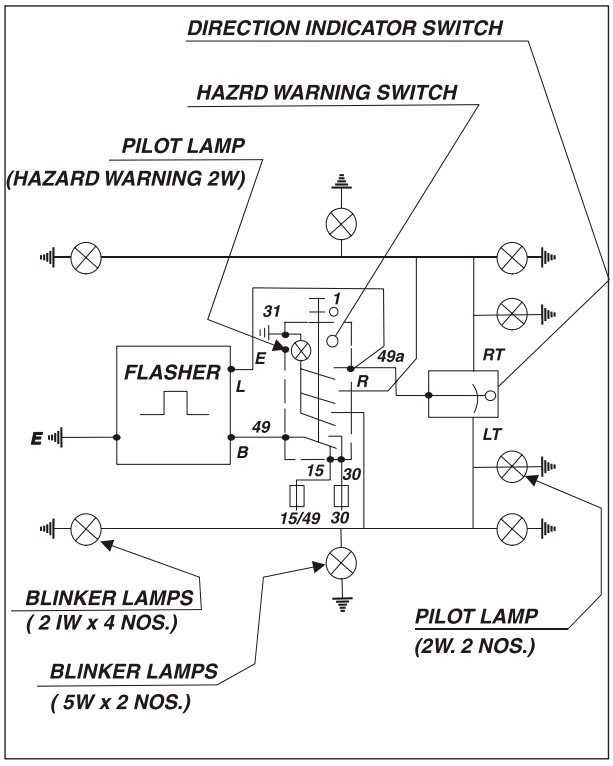


Fig. 53 : Circuit Diagram

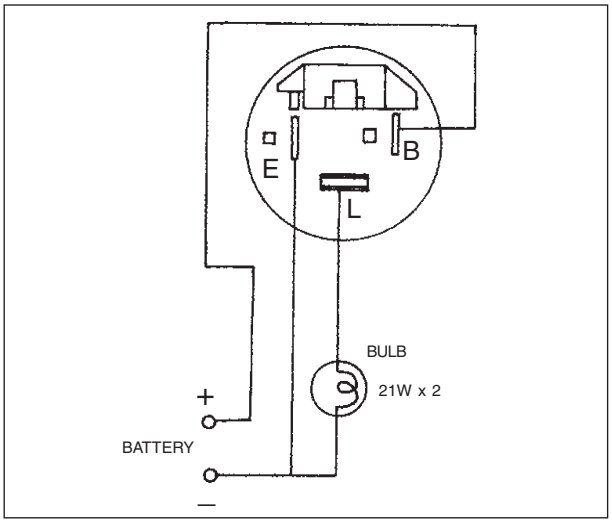


Fig. 52 : Checking flasher unit

D. GLOW PLUG TIMER

Function

It provides electrical supply to glow plugs for controlled period according to engine water temperature.

Location

It is located in fuse / relay box inside the engine compartment.

Connection details

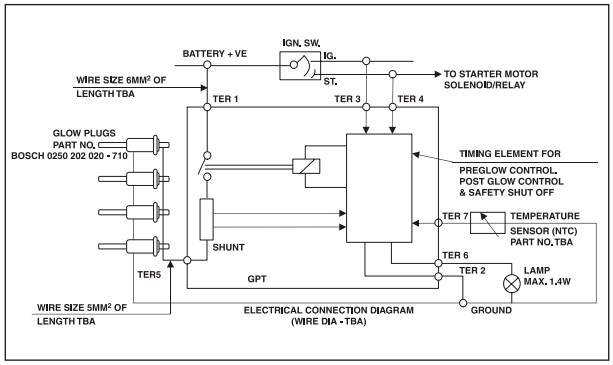


Fig. 54 : Electrical connection diagram

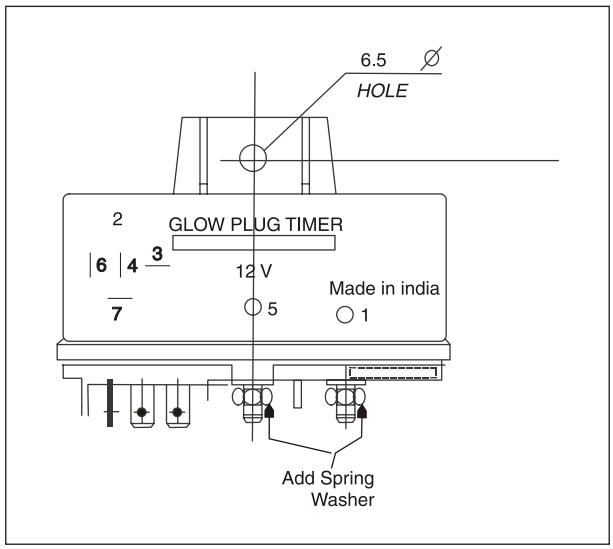


Fig. 55 : Glow plug timer

PERFORMANCE CHECK

1)	LAMP ON TIME	AS PER TABLE
2)	SAFETY SHUT OFF TIME	AS PER TABLE
3)	POST GLOW TIME	AS PER TABLE
4)	OVER VOLTAGE PROTECTION	14.5V ± 0.5
5)	LAMP OUTPUT AND GLOW PLUG OUTPUT ARE SHORT CIRCUIT PROTECTED	

TABLE

(°C) TEMP	TIME IN SECONDS		
	PRE GI.OW	SAFETY SHUT OFF	POST GI.OW
-30	30	40	200
-20	23	33	200
-10	17	27	200
0	10	20	200
10	8	18	200
20	6	16	200
30	4	14	120
40	4	14	90
50	4	14	60
60	4	14	30
70	4	14	15
80	4	14	0

Operating sequence

a. 'IG' contact 'ON' - indicator lamp burns upto duration as decided by zone control lamp extinguishes as shown in table 1 and 2. Glow plug continues to remain 'ON' even after lamp has extinguished. After control lamp extinguishes, engine should be started by making 'ST' contact 'ON'. If engine is hot, 'ST' contact may be made 'ON' without waiting for indicator lamp to extinguish. However, if 'ST' contact is not made 'on'. The glow plug supply is switched after a period as shown in the table 1 and 2. This is a safety feature.

b. 'ST' contact 'ON' - with 'IG ON', glow plugs continue to remain 'ON' while engine is cranked.

c. 'ST' contact 'OFF' - the supply to glow plugs is cut off but then 'IG' contact will be 'ON'. In case second cranking is attempted without 'IG' going 'OFF', the glow plugs will again receive supply as long as starter contact is 'ON'.

d. Glow plug timer can be checked by simple method as shown in fig. 56.

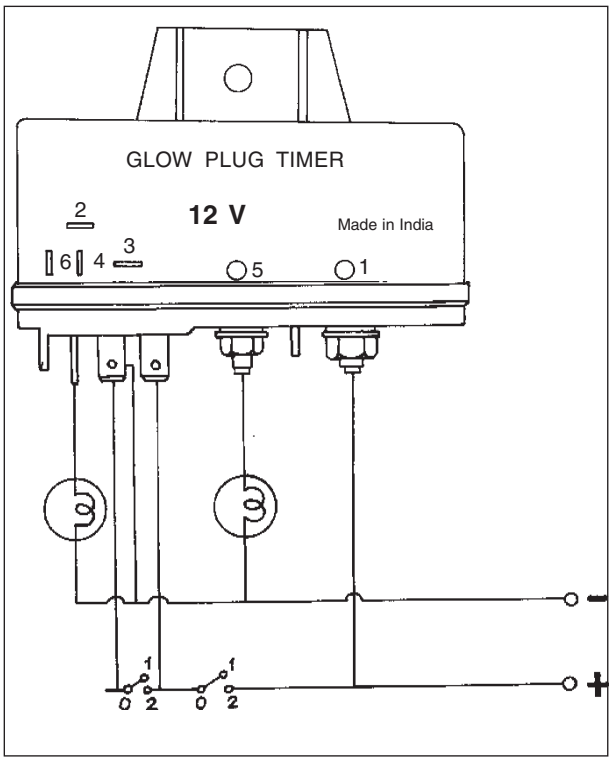


Fig. 56 : Glow plug timer

E. FRONT WIPER CONTROLLER

Wiper controller is responsible for controlling the function of windscreen wiping/washing system.

Combiswitch lever operates windshield wiper & washer.

Wiper controller is located in dashboard behind instrument cluster.

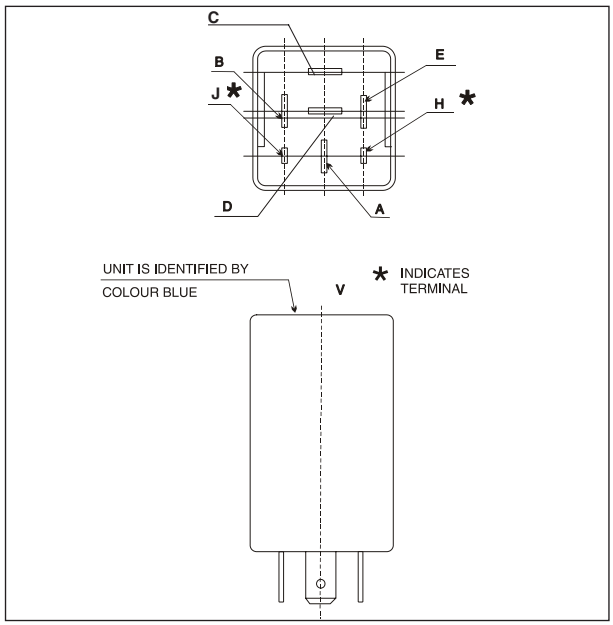


Fig. 57 : Front wiper Controller

CONNECTION DETAILS

TER NAME	TER TYPE	DESCRIPTION	ACTIVE LEVEL	CONDITION
H	INPUT	WATER LEVEL SENSE	GND	WATER LEVEL LOW
J	INPUT	COMBI SWITCH - WASH	VCC	SW. OPERATED
D	INPUT	COMBI SWITCH - INTERMITTENT	VCC	SW. OPERATED
C	INPUT	WIPER MOTOR PARK SW. A	VCC/GND	WIPER MOVING/WIPER PARK
B	SUPPLY	WIPER MOTOR PARK SW.B	VCC	I/G POSITION
E	GROUND	GROUND TO UNIT	GND	PERMANENT
A	OUTPUT	PARK TO COMBI SWITCH (53e)	VCC	- - - - - - - - -

INFORMATION FITMENT OF WIPER CONTROLLER & EGR CONTROLLER

1) Fitment of Wiper and EGR Controller is shown for LHD Vehicle for RHD Vehicle fitment will be mirror image of LHD

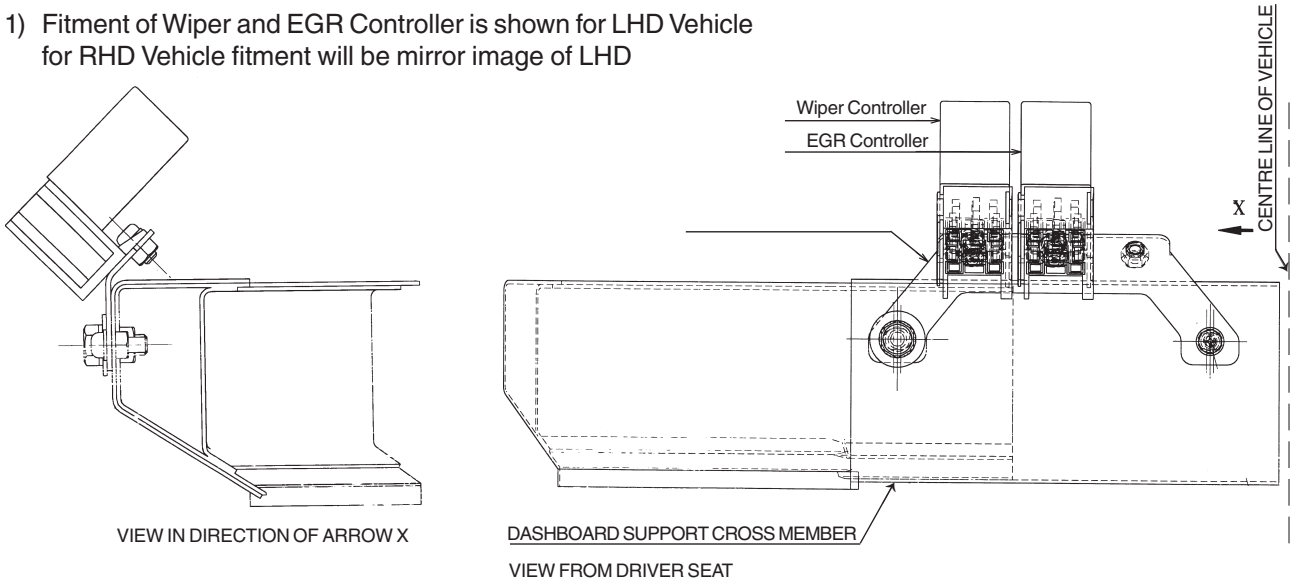


Fig. 58 : Wiper Controller & EGR Controller

F) EGR CONTROLLER

It takes input from engine rpm (alternator pulses), air conditioner 'ON' signal and controls output to EGR soleniod.

EGR controller is mounted on dashboard behind instrument panel.

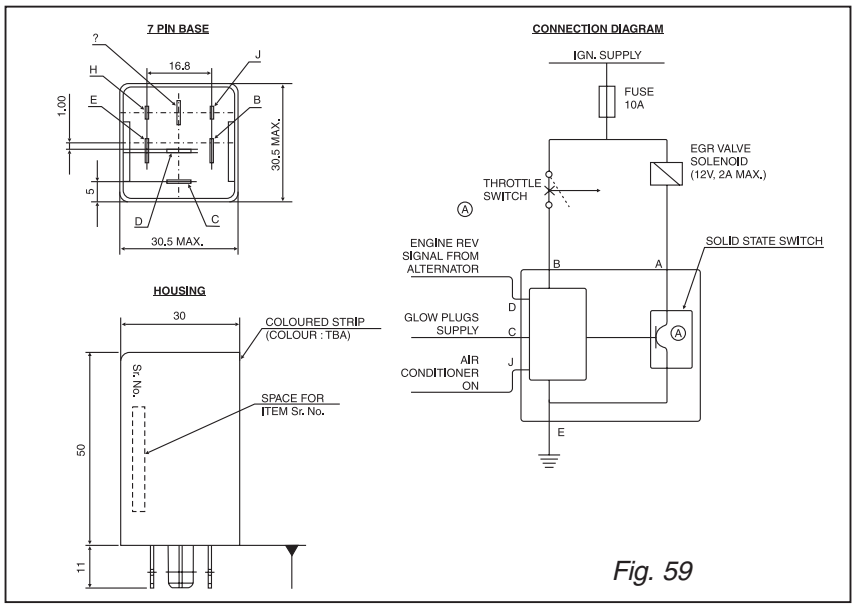


Fig. 59

CONNECTION DETAILS

Terminal	Terminal Type	Description	Active Level	Condition
E	Ground	Ground to Unit	GND	Permanent
C	Input	Glow Plug Supply	VCC	Glow Plugs ON
B	Input	Throttle Switch	VCC	I/P till Throttle Pedal Reaches Set Limit
A	Output	O/P to EGR Solenoid	GND	As per Perf. Table
D	Input	Engine RPM from Alternator	PULSES	As per Perf. Table
J	Input	Air Conditioner Supply	VCC	Air Conditioner ON
H	NC	Not Used	—	—

PERFORMANCE CHECK :

Operation of EGR Valve

Ignition Supply	Throttle Switch	Glow Plug Supply (Note)	Air Cond. ON	Engine Rev. Freq. (Hz)	EGR Valve
—	Ter. B	Ter. C	Ter. J	Ter. D	Ter. A
0	0	X	X	X	Float
1	0	X	X	X	Float
1	1	1	X	X	OFF
1	1	0	0	X	ON
1	1	0	1	< 334	OFF
1	1	0	1	> 334	ON

1 = VCC, 0 = GND / No Supply / Float, X = Don't Care

Note : Engine Rev. Freq. Signal is 334 Hz +/- 5% [317 Hz to 350 Hz]

10) CENTRAL LOCKING SYSTEM

This vehicle has a single key for operating ignition, steering lock, glove box and doors.

All the doors have electrically operated central locking system.

With central locking system all the doors can be locked or unlocked from out side with the key. From inside, the doors can be locked or unlocked by operating the knob on the driver side door.

The system consists of master cum follower at driver side door and one follower each at codriver side door, rear doors RH/LH and a control module.

Preliminary checks

Carry out the following preliminary checks as per given order before starting the repairs.

- Check fuse. Replace blown fuse, if any.
- Check battery condition and state of charge. Recharge or replace battery as required.
- Check all related electrical connections including earth connection for cleanliness and proper gripping. Check specially the control unit earth connection. Rectify as required.
- Operate driver's side door lock from inside and outside and check functioning of central locking system. Locate the faulty unit and carry out repairs as given in subsequent paras.
- If the central locking system is found inoperative in total, check for the power supply at control box input end.

  If this is OK, remove the control unit and check for proper functioning on the rig.

  (Note : A simple test rig as per circuit diagram can be made to check proper functioning of various electrical aggregates of central locking system.

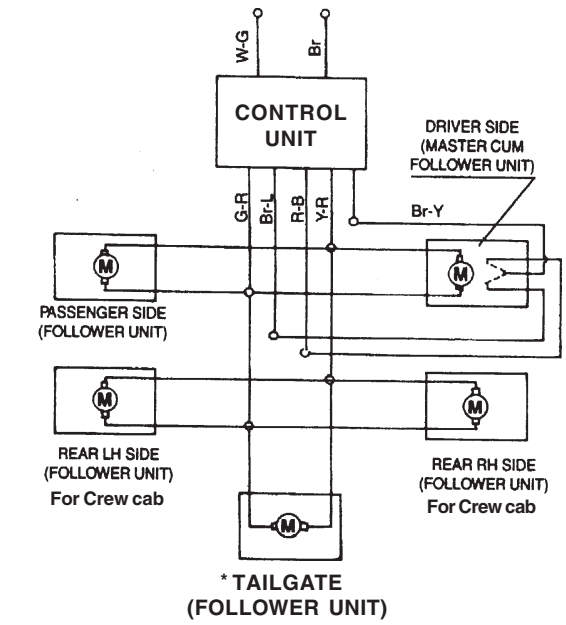
  Removal of Master cum follower unit / Follower unit

a) Take the door window glass in upper most position.

b) Remove door inner trim. Refer body group. Open out required portion of plastic membrane.

c) Disconnect electrical connectors of master cum follower for driver side door.

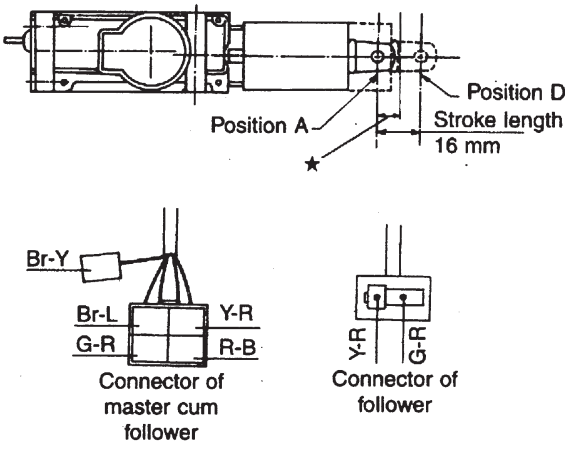
Circuit Diagram



* Tailgate (Follower Unit) features are not provided with Telcoline single cab & Crew cab

Fig. 60

Master cum follower unit / Follower unit



* For master cum follower unit, the changeover of sensor switch contacts takes place at 8 +0.5 mm from position A while travelling in either direction (from A to D or from D to A). Position D indicates lock position.

Fig. 61

d) Disconnect bell crank lever link for front door (inner lock link for rear door) from latch after unlocking plastic clip. Disconnect solenoid link of master cum follower from door latch after unlocking the plastic clip.

e) Loosen mounting nuts and remove master cum follower unit with mounting plate. Note the type of zaster cum follower.

f) Follow the above procedure ('a'to'e') for removal of follower unit from co-driver side door, rear LH door and rear RH door. Note.the type of follower unit.

g) Follow the above procedure ('b'to'd') for removal of follower unit from tail gate. Loosen mounting screws and remove the follower unit from tail gate. Inspection

- Cheek proper operation of door handle, lever, inner handle and door lock. Rectify for any defect.
- Check the proper functioning of the replaced master cum follower unit / follower unit on the rig. Hold the output lever lightly to check that unit is exerting force. If not, replace with the working unit.

Installation of Master cum follower unit / follower unit

a) For fitment of new master cum follower unit on driver side door remove the mounting plate from old master cum follower unit and fit on new master cum follower unit. (New master cum follower unit and old one should be same type)

b) Fit master cum follower unit along with mounting plate on the door.

c) Assemble the solenoid link from master cum follower to door latch. While fitment ensure that knob and master cum follower lever is in same mode i.e., both are in unlock position or in lock position. Lock the connecting link in position by plastic clip.

d) Assemble the bell crank lever link for front door (inner lock link for rear door) to door latch. Lock the connecting link in position by plastic clip.

e) Connect electrical connectors of the master cum follower to wiring harness.

f) Follow the above procedure ('a'to 'e') for installation of follower units on the co-driver side door, rear RH door and rear LH door.

g) Do not disturb the adjustment of door handle link and door lock link. If disturbed readjust and ensure proper functioning of door handle and door lock.

h) Check and ensure proper functioning of the central locking system.

i) Fix plastic membrane, door inner trim. Refer body group.

j) Check proper functioning of window winding.

11 ELECTRONIC CONTROL UNIT (ECU)

TROUBLE SHOOTING OF 4X4 OPERATION

Self diagnosis of ECU:

ECU detects transfer case system malfunctions and indicates through flashing indictor lights. Operator will be alerted of fault condition by continuous illumination of both 4WD HI and 4WD LO lights when ignition is On.

A service connector is provided to indicate fault codes in binary. Connect one end to the pin hole number 22 in ECU connector, and other end to ignition switch. Flashing of indicator light will show defective code (as illustrated in the table). Identify malfunctioning part and replace it.

L1	L2	L3	Binary code	Decimal equivalent	Fault with
Off	Off	On	001	1	ECU Module
Off	On	Off	010	2	Shift Motor
Off	On	On	011	3	Synchronizer Clutch
On	Off	Off	100	4	Speed Sensor
On	On	Off	110	6	Selector switch
On	On	On	111	7	Motor Position Switch

If only one part is malfunctioning, indicator light will display defective code three times continuously. If more than two parts are malfunctioning, first malfunctioning part will be displayed three times and then other malfunctioning parts will be displayed.

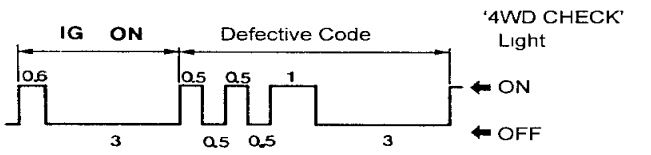
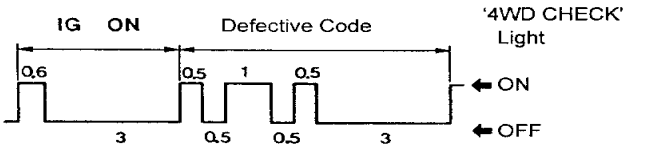
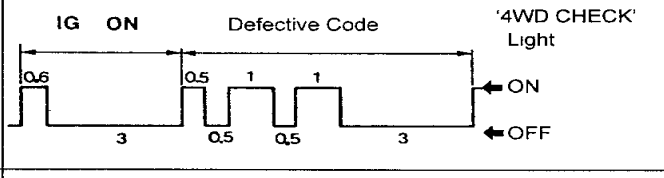
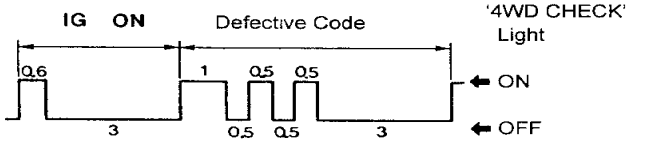
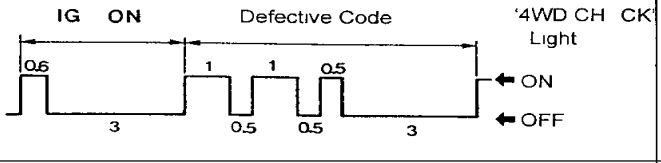
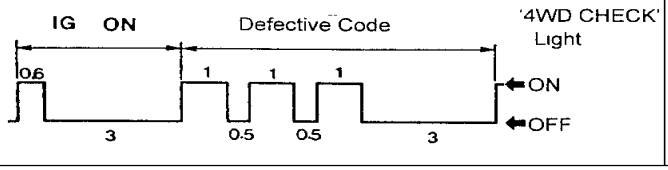
After repair, clear the fault stored in memory. Ground the service connector and keep ignition 'On' for five seconds continuously to erase defective code.

Note :

- **Before replacing malfunctioning parts as indicated by system, check wires and connectors for proper condition.**
- **Use only 12v 3-watt bulb for diagnostic purpose.**

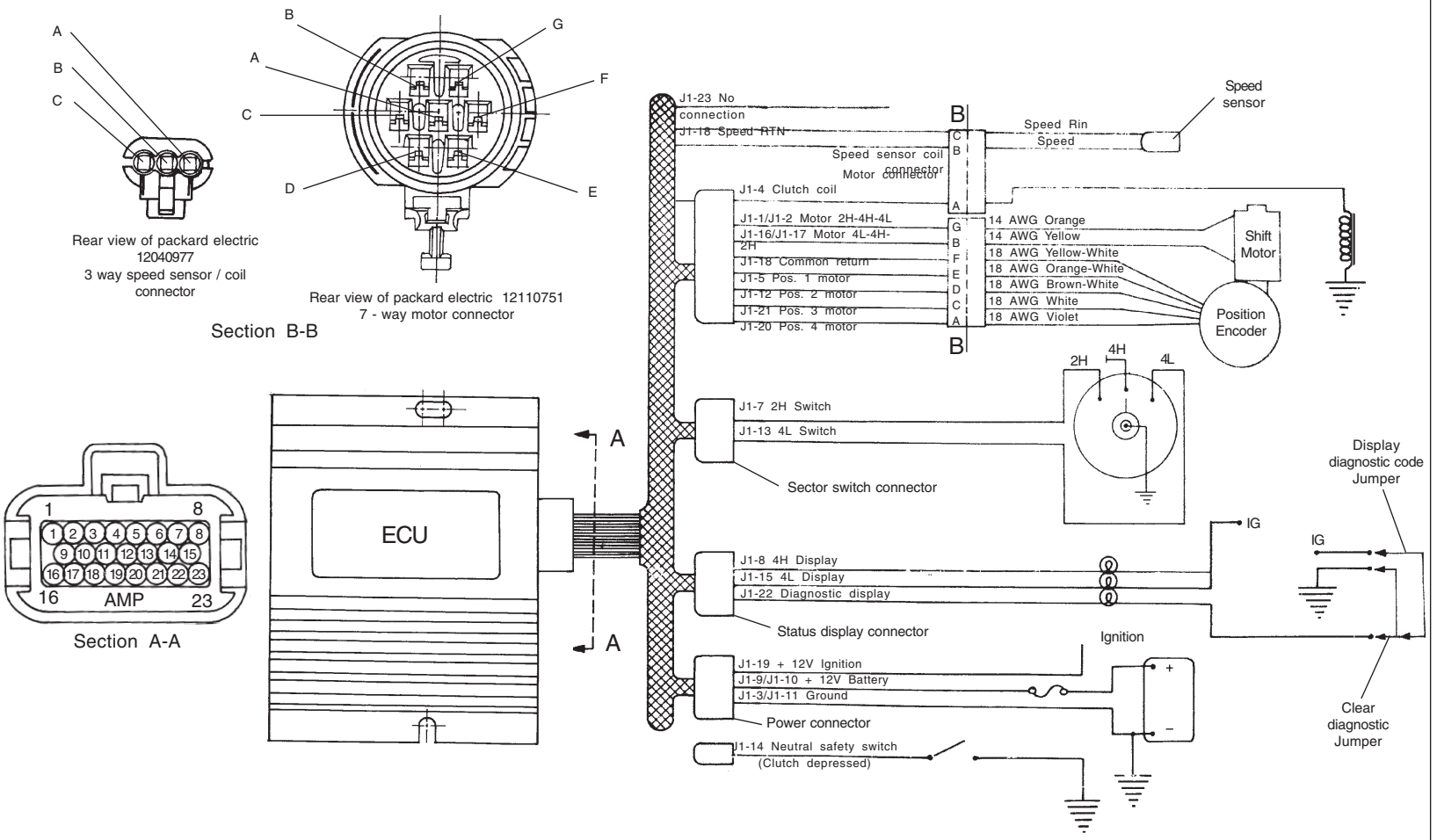
Diagnostic Table

Connect a service connector as described earlier. Turn ignition switch On. 4WD CHECK indicator will turn On for 0.6 seconds and turn Off for 3 seconds. Then it will display a defective code 3 times continuously.

No.	Defective Code	Malfunctioning Part
1		E C U
2		Shift Motor
3		Synchronizer Clutch
4		Speed Sensor
6		Selector Switch
7		Motor Position Sensor

28-06

Fig. 62 Defect code diagram



1. Motor control 2H-4H-4L
2. Motor control 2H-4H-4L
3. Ground
4. Clutch coil
5. Position 1
6. Speed sensor
7. 2H switch
8. 4H display
9. Battery in
10. Battery in
11. Ground
12. Position 2
13. 4L switch
14. Trans neutral
15. 4L display
16. Motor control 4L-4H-2H
17. Motor control 4L-4H-2H
18. Ground (common ground)
19. Ignition
20. Position 4
21. Position 3
22. Diagnostic display
23. No connection

Fig. 63 : Connection details of electronic control unit

12) WINDSHIELD WIPING & WASHING SYSTEM :

FITMENT

- Park the motor in parked position.
- Mount the wiper system assembly.
- Fix the arm / arms with blade / blades including overtravel.
- Check the wiper / wipers for satisfactory operation and fouling with rubber beading in wet condition.
- Ensure no fouling takes place.
- Adjust the washer nozzle for the jet.
- Tighten the wiper arm when mounted on the wiper spindle.
- Make the electrical connections.

REMOVAL

Please follow reverse procedure (relevant points)

TESTING / CHECKING

Description	Fault	Testing / Checking
Front Wiper	Front Wiper System not working at all	❑ Tighten ground properly ❑ Fix the connectors properly ❑ Fix the fuse firmly in the base. If blown, check for short circuit and replace the fuse. ❑ Fix the controller in the base ❑ Replace the controller ❑ Replace front wiper motor ❑ Replace the switch
	Front Wiper System does not work in all speeds	❑ Connect the terminals properly ❑ Replace the wiper controller
Front Windscreen wash	Front Windscreen washer not working	❑ Fill tank with windscreen washer fluid ❑ Connect joints properly ❑ Tighten ground properly ❑ Fix the connectors properly ❑ Fix the fuse in the base properly. Replace if blown ❑ Replace Pump ❑ Replace switch

Please refer Electrical Circuits of Front Wiper Washer System, Rear Wiper Washer System.

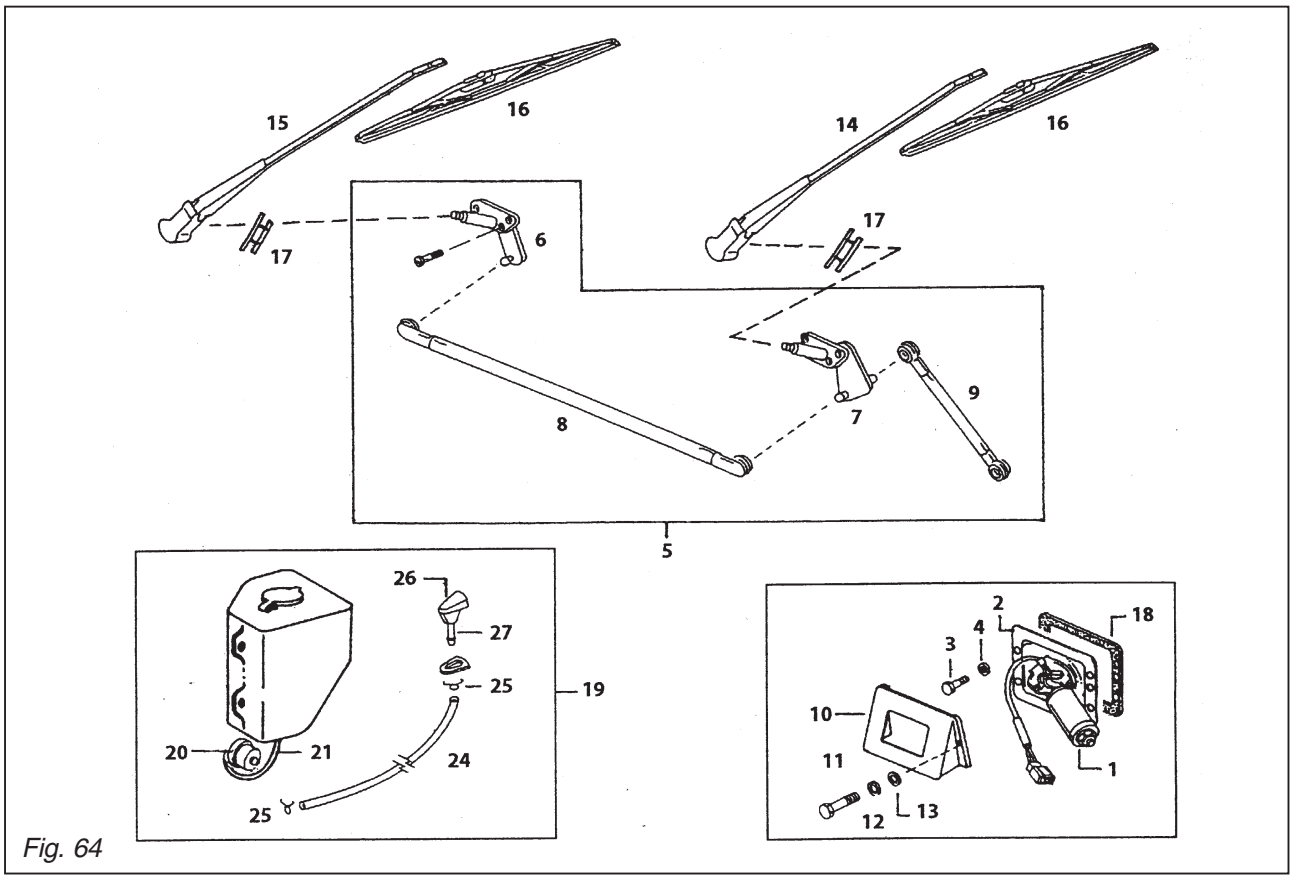


Fig. 64

1.	Wiper Motor W/Ris & Ther C/o RHD	12.	Bright Washer 6.4
1.	Wiper Motor W/Ris & Ther C/o RHD	13.	Spring Washer B6
2.	Assy Wiper Motor Mounting Bracket (RHD)	14.	Assy Wiper Arm RH LHD
2.	Assy Wiper Motor Mounting Bracket (LHD)	14.	Assy Wiper Arm LH LHD
3.	Hex Screw M6x20	15.	Assy Wiper Arm RH RHD
4.	Spring Washer B6	15.	Assy Wiper Arm LH RHD
5.	Assy Wiper Kit (RHD)	16.	Wiper Blade Front
5.	Assy Wiper Kit (LHD)	18.	Gasket (for Wiper Motor Bracket)
6.	Assy Wheel Box	18.	Gasket (for Wiper Motor Bracket)
6.	Assy Wheel Box	19.	Kit Ele W/s Washer Mssl. (2.5 ltr)
7.	Assy Wheel Box	20.	Pump Assy
8.	Assy Link Rod (i)	21.	Tube
9.	Assy Link Rod (ii)	24.	Tube 1800 mm
9.	Assy Link Rod LHD	25.	Clip
10.	Cover (Wiper Motor) RHD	26.	Nozzle Unit
10.	Cover (Wiper Motor) LHD	27.	Nozzle Adaptor
11.	SI Ch Screw M6x12	26.	Nozzle Twin Jet

GENERAL DESCRIPTION

Wind Shield Wiper Motor Model 5SW60B series are of units designed to operate a link type Wiper system to be used on Cars / Utility vehicles.

The Wiper Motor is a self switching two pole design having permanent magnet field system and provided with a gear box, housing a final gear. The power developed by the motor is transmitted by worm teeth, provided on the Armature shaft, through the final gear system to the rotary link. The rotary motion of the rotary link is converted to reciprocating linear motion (to and fro motion) of the connecting rods which in turn operates the wiping blades. The contacts in the cover plate ensure regenerative breaking to the Armature on completion of the wiping cycle when the switch turned 'OFF' and ensures consistent parking position of the Wiper arms and blades. The arms resting position is pre-set to suit the installation requirements.

PRECAUTIONS

** Circuit cable resistance drop does not exceed 1.0 volt with motor current of 5.0 Amps.

** Observe correct polarity while connecting motor.

** Ensure recommended Arm / Blade sizes are used.

ROUTINE MAINTENANCE

- Check for light run current, speed, direction of rotation and parking position of wiper motor to ensure correct assembly.
- Bring the motor to parking position electrically and then assemble the rotary link in line with the noted marking on the gear box casting to ensure correct parking position.
- Ensure that the fasteners are tightened to the recommended tightening torque values.

WIPING SYSTEM CHECK

- The wind screen wiper has a link type transmission, check spindle assembly for any signs of seizure or rusting. Ensure that there is no looseness on the spindles and between the bearings and the links. The linkages must operate freely. If the bearings are worn out replace with new linkages.

WIPER MOTOR ASSEMBLY CHECK

Motor terminal voltage.	13.5 Volts
Typical light Running current	1.8 Amps (Normal Speed) 2.8 Amps (High Speed)

SPECIFICATIONS

1.	TYPE		5SW60
2.	RATED VOLTAGE		12V
3.	TEST VOLTAGE		13.5 ± 0.2V
4.	STARTING VOLTAGE		8V MAX
5.	OPERATING VOLTAGE RANGE		10 ~ 15V
6.	TEST TEMPERATURE		25 ± 5°C
7.	OPERATING TEMPERATURE RANGE		- 20°C — +90°C
8.	INSULATION RESISTANCE		1M.ohm MIN
9.	SPEED	2 Nm LOAD	45 ± 5 RPM
10.		14 Nm LOAD	≥ 20 RPM
11.	LOCK TORQUE (AT 0 RPM)		≥ 25 NM
12.	LOCK CURRENT		20 Amps.
13.	NOISE - LOW SPEED / HIGH SPEED		50 dB (A) MAX / 60 dB (A) MAX

WIRING DIAGRAM

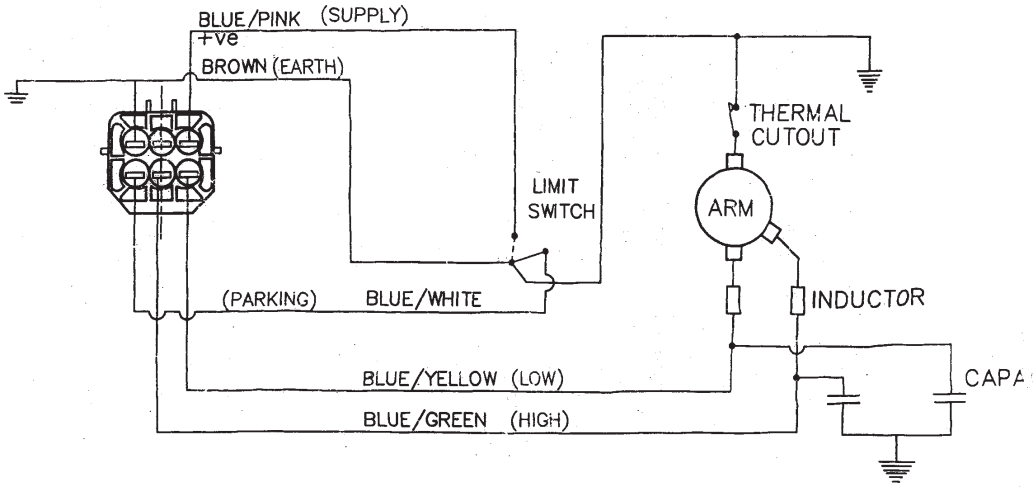


Fig. 65

EXPLODED VIEW

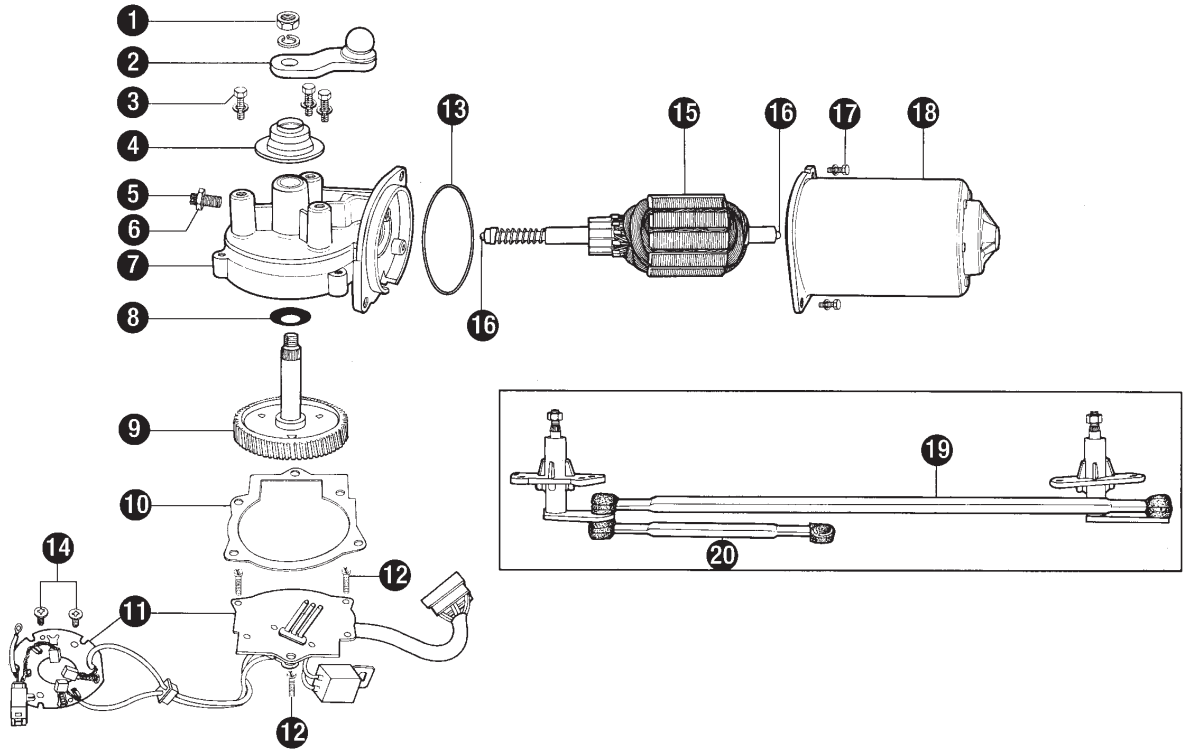


Fig. 66

SPARE PARTS LIST

SL. NO.	DESCRIPTION	NO. OFF
1.	NUT (ROTARY LINK)	1
2.	ROTARY LINK	1
3.	SCREW (MOUNTING PLATE)	3
4.	RUBBER SHROUD	1
5.	THRUST SCREW	1
6.	NUT (THRUST SCREW)	1
7.	GEAR BOX ASSEMBLY	1
8.	BELLIVELI WASHER	1
9.	FINAL GEAR ASSEMBLY	1
10.	GASKET (GEAR BOX)	1

SL. NO.	DESCRIPTION	NO. OFF
11.	COVER & BRUSH PLATE ASSY.	1
12.	SCREW (COVER PLATE)	3
13.	SEALING RNIG	1
14.	SCREW (BRUSH PLATE)	2
15.	ARMATURE ASSEMBLY	1
16.	BALL	2
17.	SCREW (YOKE FIXING)	2
18.	YOKE ASSEMBLY	1
19.	TANDEM LINK & SPINDLE ASSY.	1
20.	PRIMARY LINK & SPINDLE ASSY.	1

DISMANTLING

When dismantling the unit, carefully note down the positions in which the various components are fitted in order to ensure their correct replacement on re-assembly.

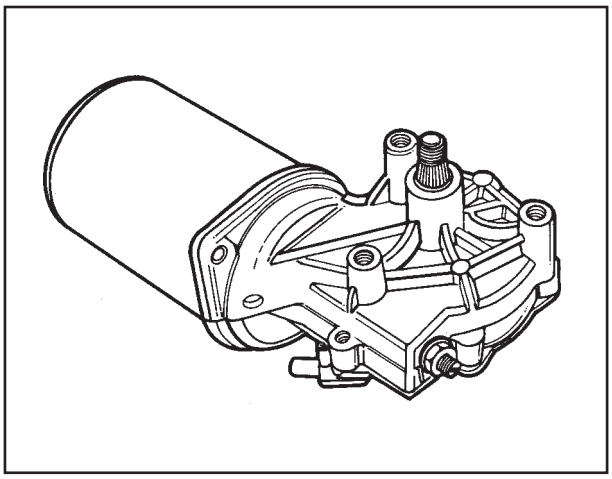


Fig. 67

- Remove the rubber grommet.

  Ref. Fig.68

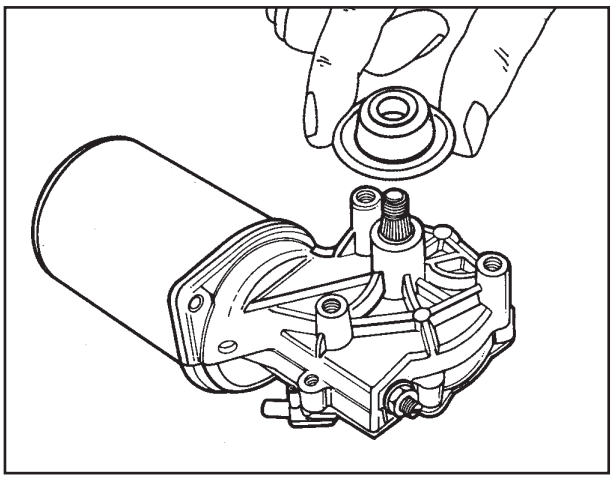


Fig. 68

- Unscrew the cover plate fixing screws (3 Nos).

  Ref. Fig.69

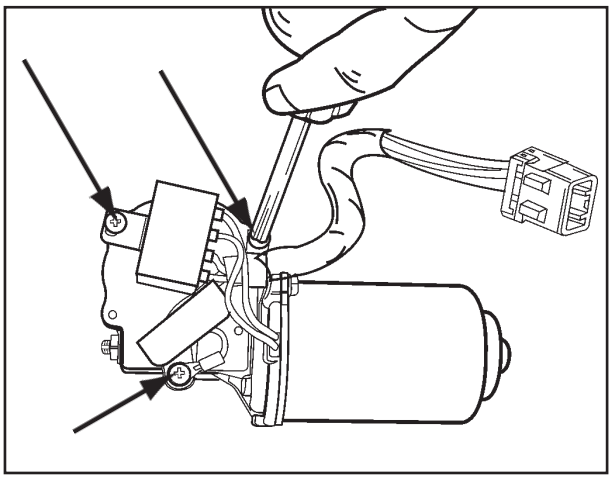


Fig. 69

- Remove the cover from the cover plate body casting.

  Ref. Fig.70

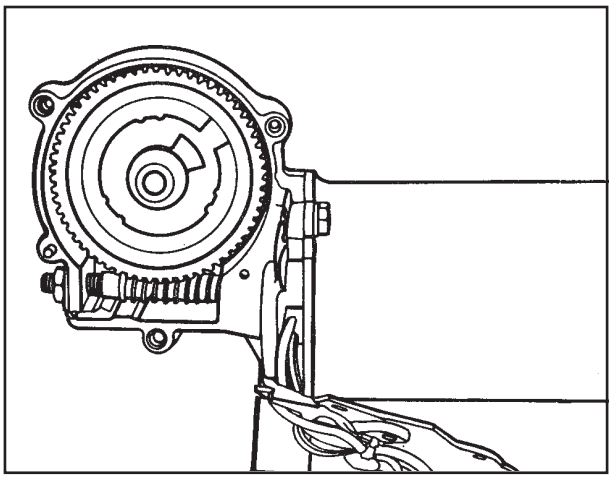


Fig. 70

- Remove the cover seal from the gear box assembly.

  Ref. Fig.71

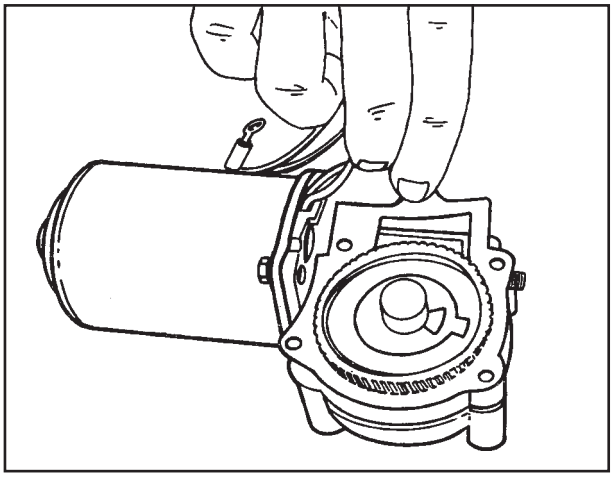


Fig. 71

- Remove the gear wheel.

  Ref. Fig.72

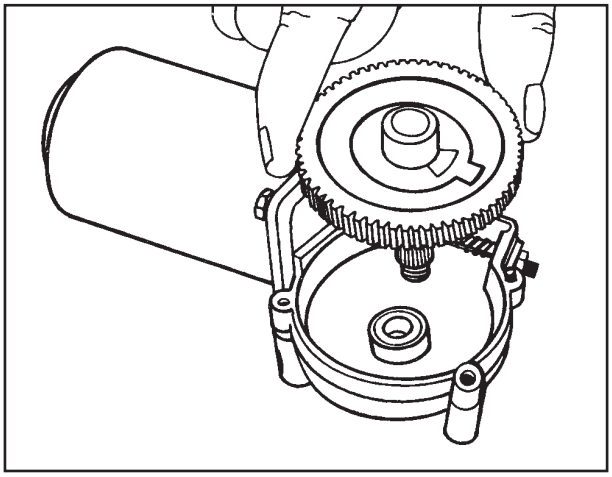


Fig. 72

- Remove the belliveli washer from the gear wheel shaft.

  Ref. Fig.73

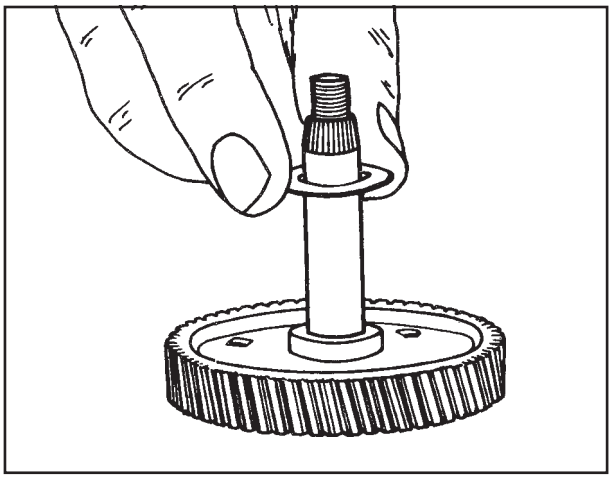


Fig. 73

- Unscrew the yoke fixing screws (2 Nos).

  Ref. Fig.74

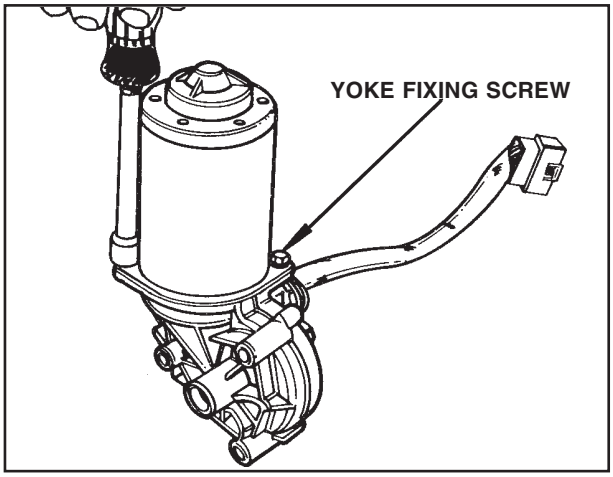


Fig. 74

- Hold the armature shaft and remove the yoke assembly to avoid brush damage.

  Ref. Fig. 75

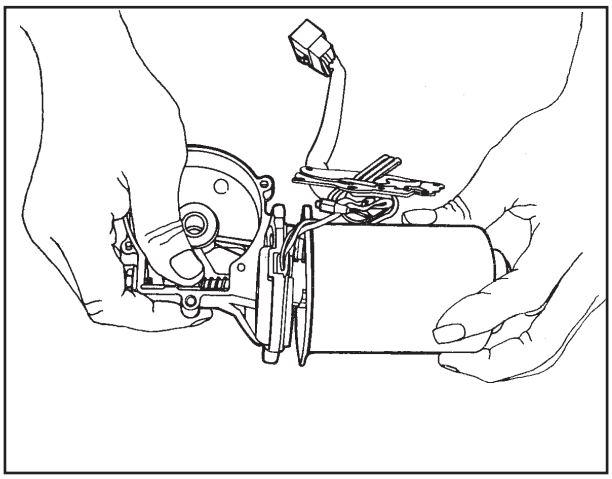


Fig. 75

- Please hold the 3 brushes by hand and remove the armature.

  Ref. Fig. 76

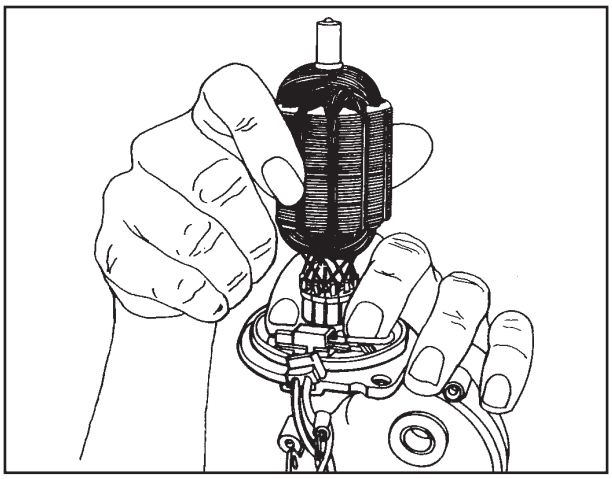


Fig. 76

- Unscrew 2 nos brush plate fixing screw and separate the brush plate assembly.

  Ref. Fig. 77

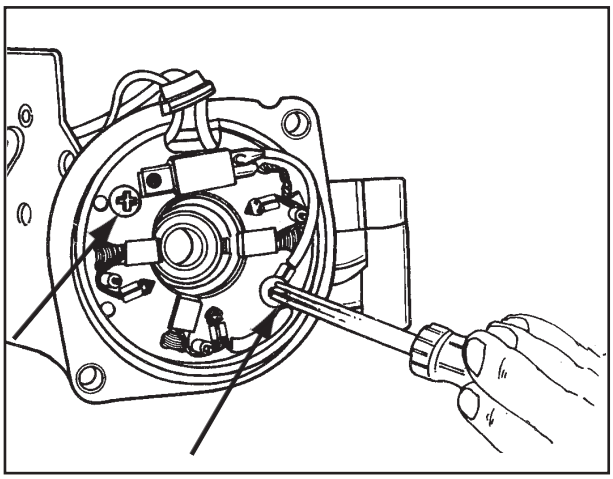


Fig. 77

BENCH INSPECTION

- Moulded gear check : Inspect the moulded gear teeth for any damage or excess wear.

  If so replace the gear assembly.

- Commutator check : Ensure that the commutator surface is clean and smooth. If not, clean with a smooth emery paper and wipe of the dust with petrol.

- Armature Electrical Check :

  Use 110 Volts AC mains 15W bulb with two probes. Connect as shown in figure. The bulb should not glow if the bulb glows replace the armature.

  Ref. Fig. 78

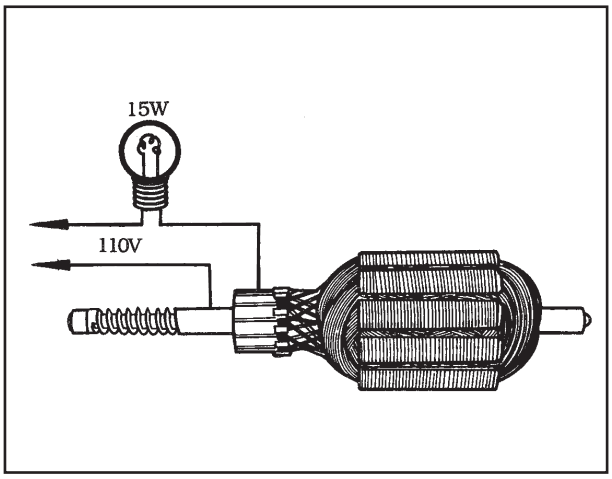


Fig. 78

- Armature winding ground test :

  Check the Armature on a growler tester for short circuit and continuity of windings.

  Ref. Fig.79

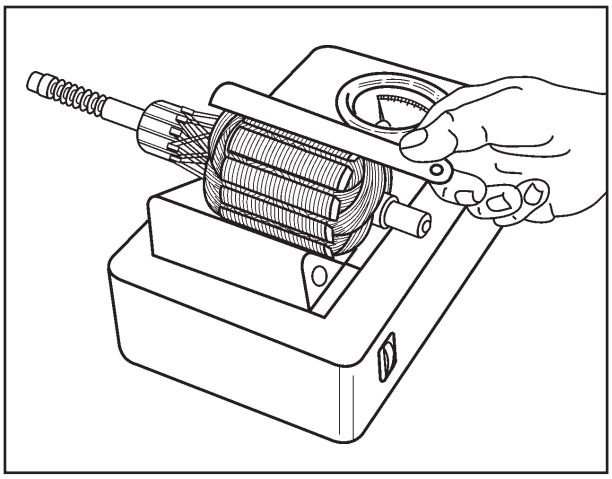


Fig. 79

PARKING POSITION CHECK

- Ensure proper positioning of the rotary links after every re-assembly. Align the rotary link position in line with the noted mark on the gear box casting.

RE-ASSEMBLY

It is reverse order of dismantling procedure. Note the following precautions.

- Ensure that the ball at the armature shaft end replaced in its groove with grease.

  Smear “Turbo 41’ oil over armature shaft and final gear output shaft before assembly.

  Prior to yoke fixing, ensure contact of brushes with the commutator.

  Ref. Fig.80

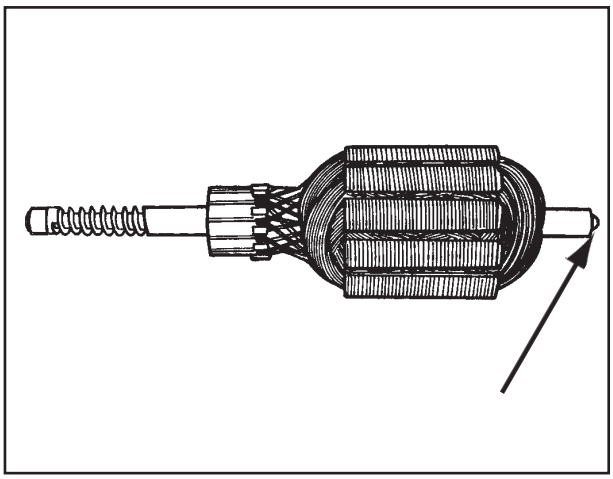


Fig. 80

If not in position, motor will have excessive frictional losses.

If the ball gets in between the magnets and the armature it will result in motor locking condition while energising, leading armature burning.

- Smear low temperature grease KRYOTEX EP2 over the armature shaft splines.

  Ref. Fig.81

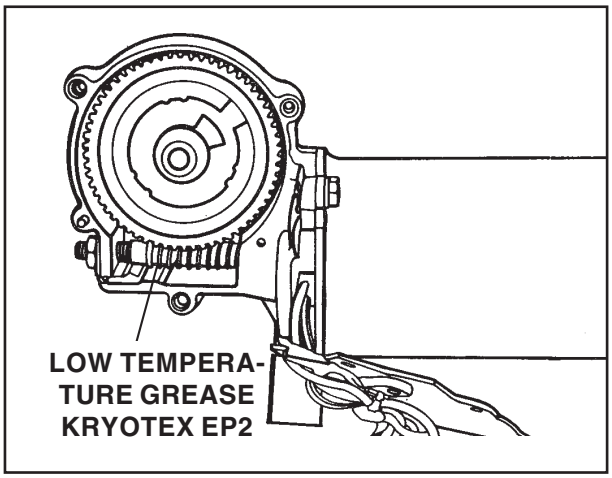


Fig. 81

- Assemble armature on to the gear box followed by brush carrier assembly, Ensure that the contact of brushes on to the commutator, before fixing yoke assembly on to the gear box.

  Ref. Fig.82

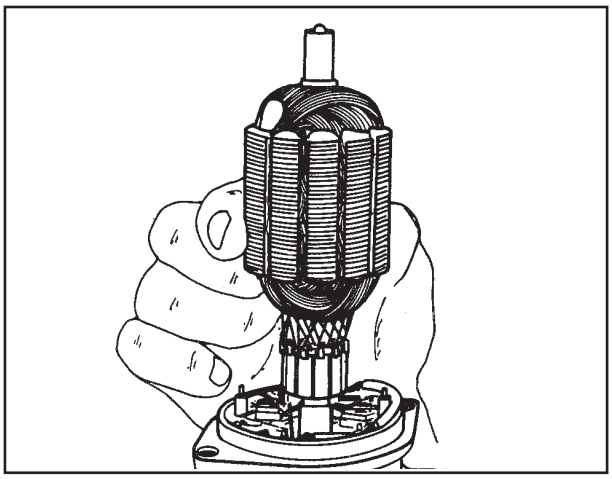


Fig. 82

- Ensure that the gaskets are replaced properly in its positions at the appropriate stage of re-assembly.

  Ref. Fig.83

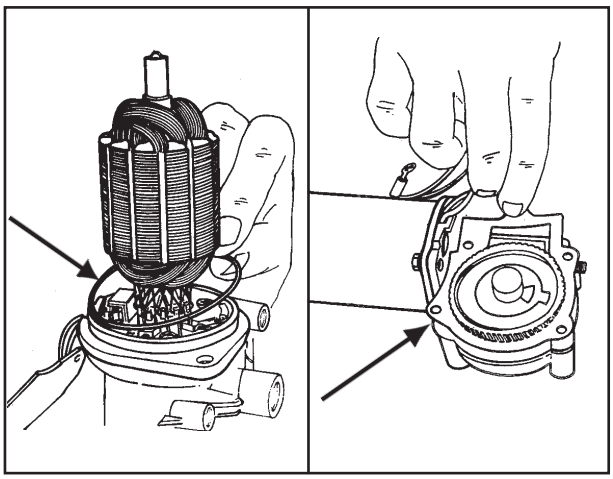


Fig. 83

- Belliveli washer in position. Ensure that the Belliveli Washer is replaced in proper position on to the gear spindle as shown in

  Ref. Fig.84

  If it is assembled vice-versa, motor will have frictional losses.

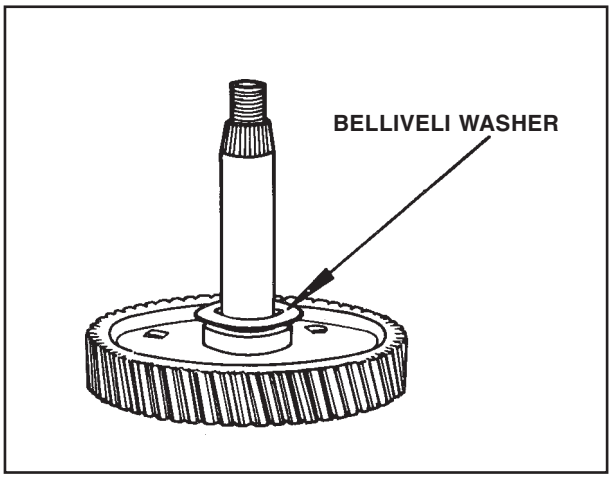


Fig. 84

- Adjust the armature end float with the thrust screw gap 0 to 0.05 mm.

  Ref. Fig.86

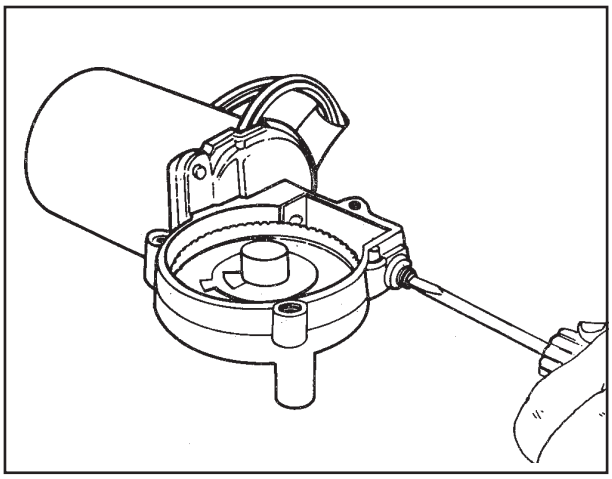


Fig. 86

- While assembling the yoke on to the gear box match the notch on the yoke and gear box for proper magnetic polarity.

  Ref. Fig. 87

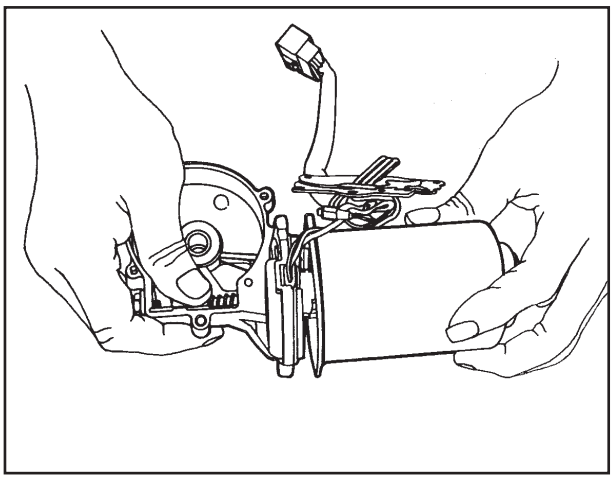


Fig. 87

- Do not mallet the yoke assembly. It might result in magnet breakage.

  Ref. Fig. 88

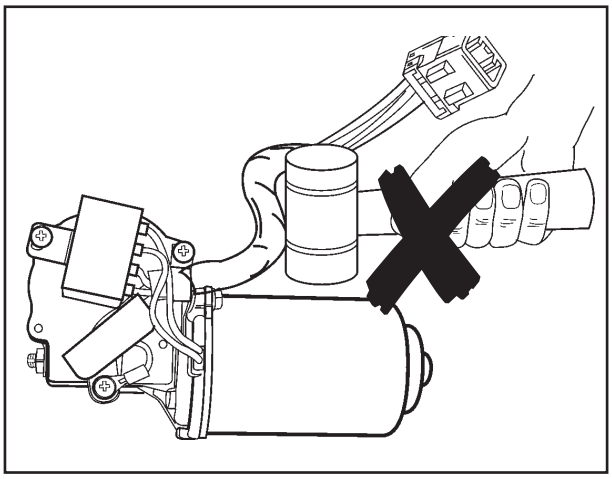


Fig. 88

TIGHTENING TORQUE

DESCRIPTION	VALUE
Thrust screw nut	2.0 — 2.6 Nm
Yoke fixing screw	2.0 — 2.6 Nm
Brush Plate fixing screw	0.8 — 0.9 Nm
Cover plate fixing screw	2.0 — 2.5 Nm
Rotary link nut	12 to 14 Nm

TROUBLE SHOOTING

BEFORE STARTING ENSURE THE BATTERY CONDITION

DIAGNOSTIC PROCEDURES

Following procedures assume that service technician has checked.

- Continuity of circuit harness wiring.
- That wiper-motor assembly-to-dash mounting hardware is tight.
- Circuit fuses
- That washer holes are clear, not kinked, disconnected or broken.

DEFECT	REMEDY
a) Motor not working when switched 'ON'	1) Check fuse. 2) Check connections of both socket and plug.
b) Motor does not park after switching 'OFF'	1) Cover plate defective --change cover plate.
c) Jerky movement of the motor while running.	1) Look for proper seating of brushes on commutator. 2) Ensure Armature is free for defects.
d) Intermittant function	1) Ensure Wiper Motor Switch contacts are OK.

13. ADDITIONAL FITMENTS :

DIGITAL CLOCK :

Digital clock is not offered as OE at present. If digital clock is to be fitted, please reffer wiring diagram 14B in page no. 91 for futher details.

HEADLAMP LEVELLING DEVICE :

A motorised head lamp levelling arrangement with the setting knob is provided in central console for 4x4 vehicles & on dash board for 4x2 vehicles.

This switch has 4 positions viz. 0,1,2,3. As and when required, depending on load, head lamp levelling is done by rotating the knob to select one of the positions.

Levelling motor is an integral part of head lamp. Please refer wiring diagram 12 B in page no. 88 for futher details.

REAR WINDSHIELD GLASS HEATING & DEMISTING DEVICE :

An illuminated switch is provided on dash board to operate electrical demister of rear glass. To operate this device, keep ignition switch ON and switch on demister switch. Lamp on switch will glow indicating that demister is ON.

Notice :

There no automatic control available to switch off this function. Ensure to switch it OFF, when not required.

Please refer wiring diagram 12A & 16 in page no. 89 & 93 for futher details.

OVERSPEED WARNING DEVICE : (OPTIONAL)

When vehicle speed reaches beyond 120 kmph, buzzer starts beeping, warning driver about over speed. When speed limit reduces below 120 kmph, it switches off.

Buzzer for over speed warning device is fitted on dash board behind instrument cluster.

Please refer wiring diagram 17 B in page no. 94 for futher details.

14. GENERAL TROUBLESHOOTING GUIDELINES

PRECAUTIONS

- Check fuses.
- Check the battery for damage, state of charge and clean and tight connections.
- Check the alternator belt tension.
- Make sure connectors are clean and have no loose terminals.

  Connection and disconnection of connectors should be done carefully.
- On the bracket mounted connector with dual locks, remove the connector from the bracket before disconnecting.
- When disconnecting locks, first press in the connection tightly (to provide clearance to the locking device), then operate the tab fully and remove the connector.
- When disconnecting a connector, pull it off from the mating connector by holding on both connectors.
- Never try to disconnect connectors by pulling on their wires.
- Place the plastic cover over the mating connector after reconnecting. Also check that the cover is not distorted.
- Before connecting connectors check to see that the terminals are in place and not bent or distorted.
- Check for loose retainer and rubber seals.
- Insert the connector tightly and make sure it is securely locked.
- Check all the wire harnesses are connected.
- There are two types of locking tab one that you have to push and the other you should not touch when connecting the connector. Check the shape of the locking tab before connecting.
- The locking tab having a taper end should not be touched when connecting.
- Insert connectors fully until they will no longer go.
- The connectors must be aligned and engaged securely.
- Do not use wire harnesses with a loose wire or connector.
- Before connecting check each connector cover for damage. Also make sure that the female connector is tight and not loosened from the previous use.
- Secure wires and wire harness to the frame with their respective cabel ties at the designated locations.

  Position the wiring in the bands so that only the insulated surfaces contact the wires or harnesses.
- After clamping, check each harness to be certain that it is not interfering with any moving or sliding parts of the vehicle.
- Relocate corrugated tube suitably.
- Always keep a safe distance between wire harnesses and any heated parts.
- Do not bring wire harnesses in direct contact with sharp edges or corners.
- Also avoid contact with the projected ends of bolts, screws and other fasteners.
- Route harnesses so that they are not pulled or slackened excessively.
- Protect wires and harnesses with a tape or a tube if they are in contact with a sharp edge or corner.
- Clean the attaching surface thoroughly if an adhesive is used. First wipe with solvent or alcohol if necessary.
- Seat grommets in their grooves properly.
- Do not damage the insulation when connecting a wire.
- Do not use wires or harnesses with a broken insulation.

  Repair by wrapping with protective tape or replace with new ones if necessary.
- After installing parts, make sure that wire harnesses are not pinched.
- After routing, check that the wire harnesses are not twisted or kinked.
- Wire harnesses should be routed so that they are not pulled or slackened excessively, pinched or interfering with adjacent or surrounding parts in all steering positions.

- When using the Service Tester, follow the manufacturers instructions.
- Always insert the probe of the tester from the wire harness side.
- Make sure to use the probe with a tapered tip.
- Do not drop parts.

GUIDELINES

- **Verify the Complaint.**

  Turn on all the components in the problem circuit to check the accuracy of the customer complaint. Note the symptoms. Do not begin disassembly or testing until you have narrowed down the problem area.

- **Analyze the Schematic**

  Look up the schematic for the problem circuit. Determine how the circuit is supposed to work by tracing the current paths from the power feed through the circuit components to ground. If several circuit fail at the same time, the fuse or ground is a likely cause.

  Based on the symptoms and your understanding of the circuit operation, identify one or more possible causes of the problem.

- **Isolate the Problem by Testing the Circuit.**

  Make circuit tests to check the diagnosis you made as above. Keep in mind that a logical, simple procedure is the key to efficient troubleshooting. Test for the most likely cause of failure first. Try to make tests at points that are easily accessible.

- **Fix the Problems**

  Once the specific problem is identified, make the repair. Be sure to use proper tools and safe procedures.

- **Make Sure the Circuit Works**

  Turn on all components in the repaired circuit in all modes to make sure you have fixed the entire problem. If the problem was a blown fuse, be sure to test all of the circuits on that fuse. Make sure no new problem turn up and the original problem does not recur.

15. WIRING DIAGRAMS :

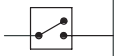
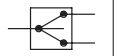
Includes locations, Connection, Routing, Circuit Diagrams

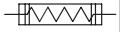
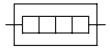
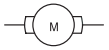
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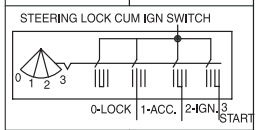
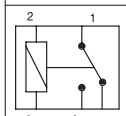
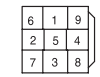
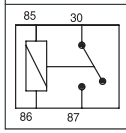
SR. NO.	WIRING DIAGRAMS
1	INDEX AND SYMBOLS
2	WIRING HARNESS CONNECTORS LOCATION LAYOUT-RHD
3	WIRING HARNESS CONNECTORS LOCATION LAYOUT-RHD
4	WIRING HARNESS CONNECTORS LOCATION DETAIL VIEWS
5	CONNECTOR AND LOCATION ZONE CHART
6	CONNECTOR AND LOCATION ZONE CHART
7	FUSES & LOAD DISTRIBUTION DIAGRAM-F/B.NO.1.
8	FUSES & LOAD DISTRIBUTION DIAGRAM-F/B.NO.2.
9	STARTING,CHARGING & ENGINE STOP SOLENOID
10	HEAD LAMP AND PARKING LAMPS
11	BLINKER,TAIL,STOP,REV,READING & ENGINE LAMPS
12	REAR WIND SHIELD GLASS HEATING AND DEMISTING HEAD LAMP LEVELLING
13	INSTRUMENT CLUSTER
14	2-SPEED WIPER,WASHER & INTERMITTANT DIGITAL CLOCK
15	REAR FOG LAMP WITH WARNING BUZZER & ROOF LAMP
16	AIR CONDITIONING & HEATING DEMIST M/s.SUBROS
17	TWIN HORNS & ELECTICAL TAPPING OVER SPEED WARNING DEVICE
18	CENTRAL LOCKING WITH SINGLE MASTER
19	CHIME UNIT & SEAT BELT WITH BUZZER UNIT

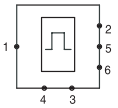
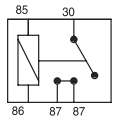
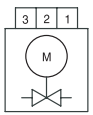
1- INDEX AND SYMBOLS

SYMBOLS

SYMBOL	DESCRIPTION
	GROUND OR EARTH
	DIODE
	SINGLE WAY SWITCH
	TWO WAY SWITCH
	2-SPEED BLOWER SW.
	FUSE
	RESISTOR
	VARIABLE RESISTOR
	THERMISTER

SYMBOL	DESCRIPTION
	CIGARETTE LIGHTER
	HEATER DEFROSTER
	MAGNETIC CLUTCH
	CABLE JOINT
	CROSSOVER WITH JOINT
	CROSSOVER WITHOUT JOINT
	LAMP/BULB
	MOTOR
	FRONT WIPER MOTOR
	W/S.WASHER MOTOR
	ALTERNATOR
	BLOWER MOTOR

SYMBOL	DESCRIPTION
	BATTERY
	DUAL TEMP. SENSOR
	DIGITAL CLOCK
	HORN
	
	RELAY
	ELECTRONIC CONTROLLER /RELAY BASE
	STARTER/AUXI RELAY

SYMBOL	DESCRIPTION
	SOLENOID VALVE
	ELECTRONIC CONTROLLER
	CONNECTOR
	FAN
	RELAY BOSCH 4-PL
	STARTER MOTOR W/ENGAGEMENT SOLENOID
	HEAD LAMP LEVELLING MOTOR

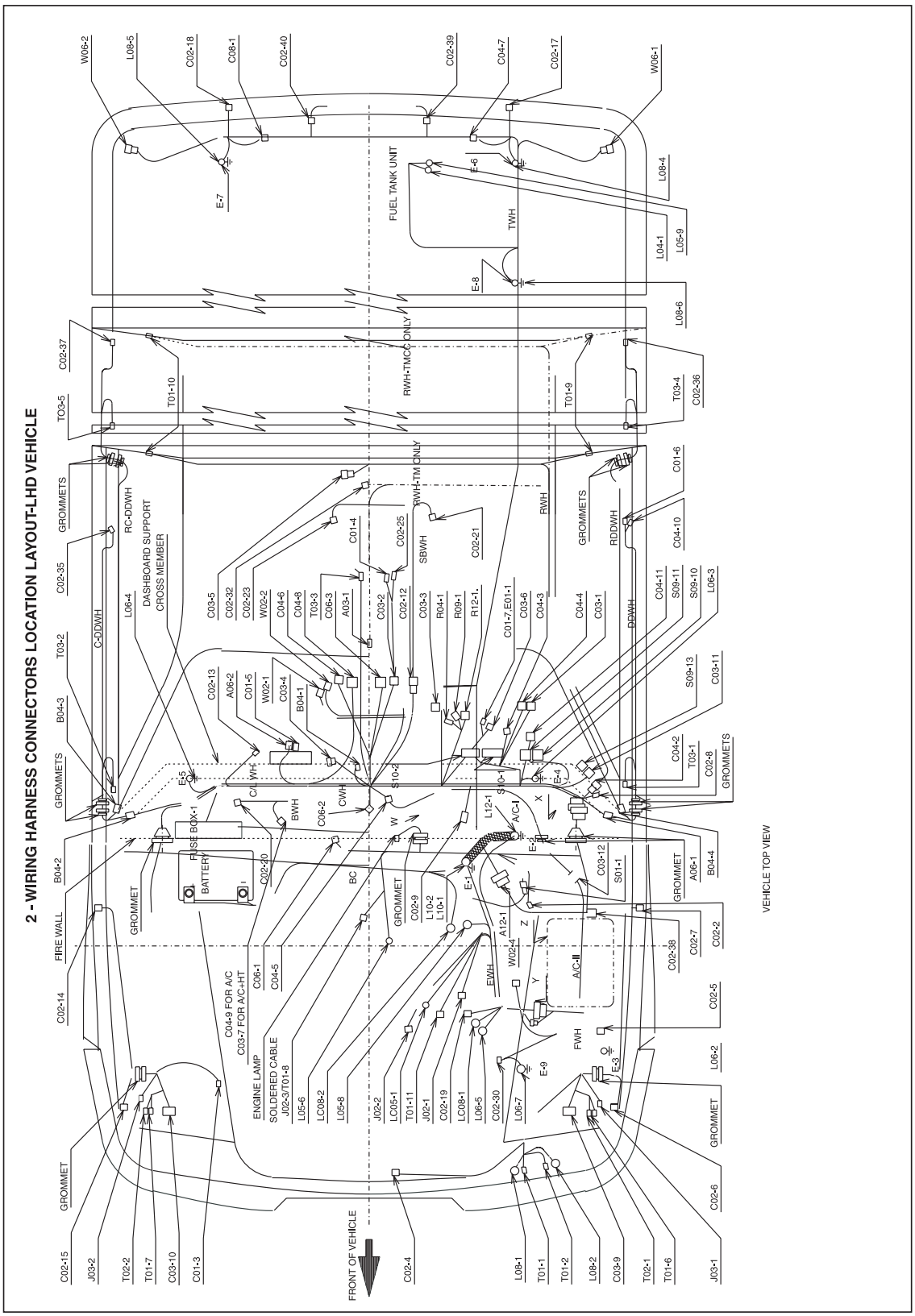
COLOUR CODE

CODE	CABLE COLOUR
B	BLACK
Br	BROWN
G	GREEN
Gr	GREY
L	BLUE
O	ORANGE
P	PINK
R	RED
W	WHITE
Y	YELLOW
V	VOILET
Lg	LIGHT GREEN
Sb	SKY BLUE
Dg	DARK GREEN

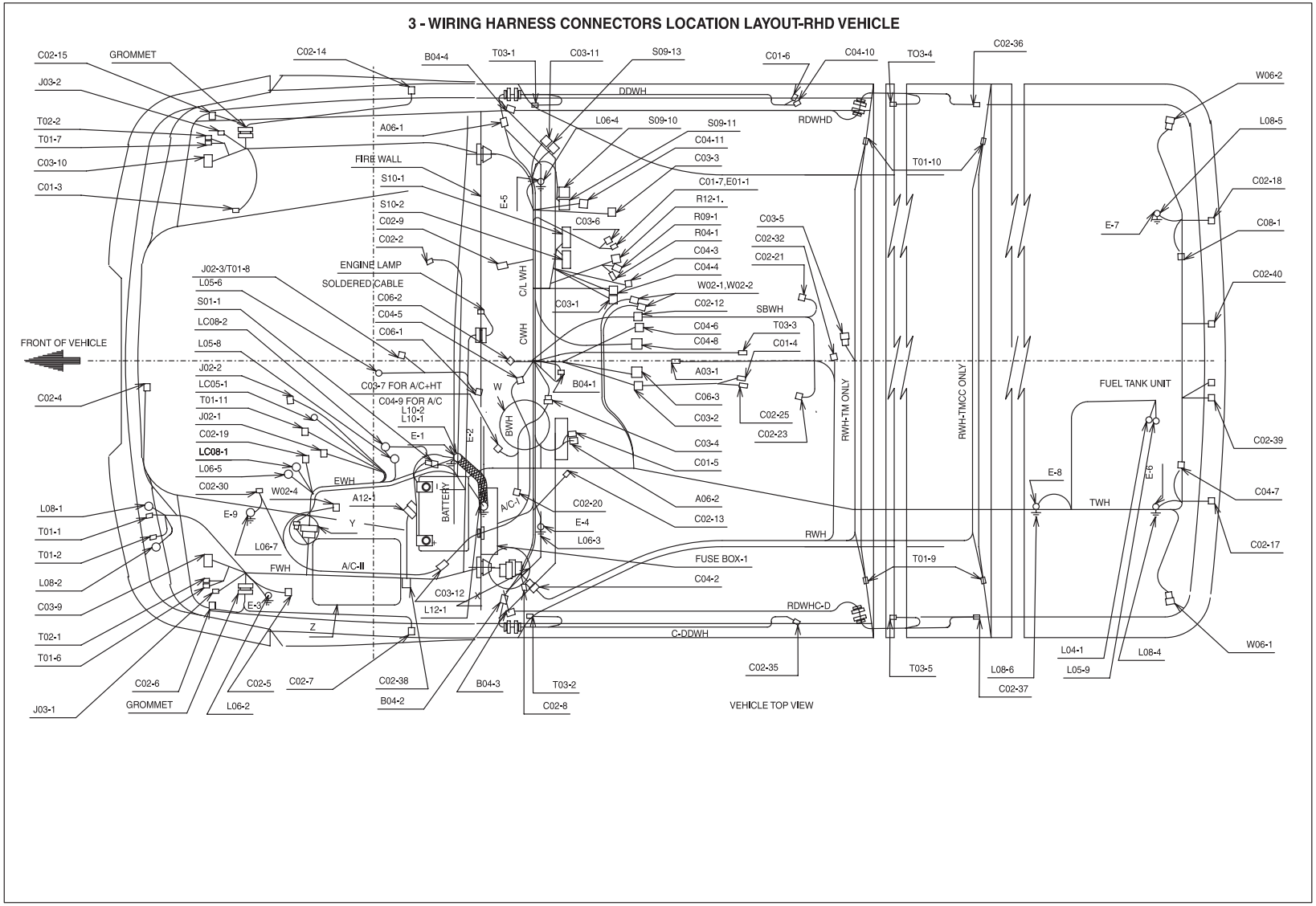
NOTE : WIRE INSULATOR HAS ONE COLOUR OR ONE MAIN COLOUR WITH ANOTHER TRACER COLOUR STRIPE (E.G. 'L' INDICATES BLUE COLOUR. 'L-W' INDICATES BLUE MAIN COLOUR WITH WHITE TRECER COLOUR STRIPE).

1 CABLE IDENTIFICATION-1.00 R-Y:1.00 INDICATES CONDUCTOR CROSS SECTION AREA IN mm˙ AND˙R-Y'INDICATES RED BASE COLOUR WITH YELLOW COLOUR STRIPE.
2 CONNECTORS' VIEW WHERE SHOWN IS FROM CABLE ENTRY SIDE

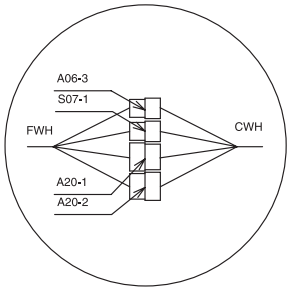
WIRING DIAGRAM



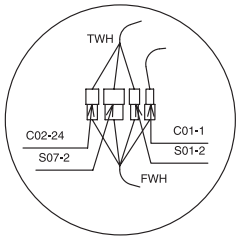
3 - WIRING HARNESS CONNECTORS LOCATION LAYOUT-RHD VEHICLE



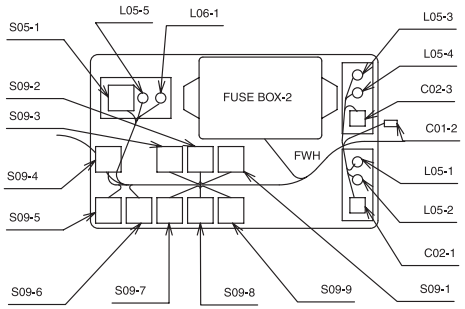
4 - WIRING HARNESS CONNECTORS LOCATION-DETAIL VIEWS



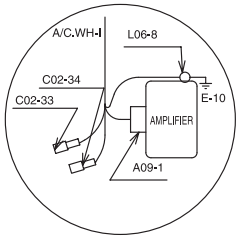
DETAILS AT-X



DETAILS AT-Y



DETAILS AT-Z



DETAILS AT-W

NOTE:-

1 FOR LOCATIONS OF W,X,Y,& Z ON VEHICLE REFER SHEET NOS.2 & 3.
2 WIRING HARNESSES WHICH ARE IN SELECTION ARE LISTED IN TABLE

WIRING HARNESS LIST

SL. NOS.	ITEM	PART DESCRIPTION	PART NOS.	REMARKS	EURO-II		EURO-III	
					LHD	RHD	LHD	RHD
1	EWH	ENGINE WIRING HARNESS	2701 5460 01 71		--	--	✓	✓
	EWH	ENGINE WIRING HARNESS	2698 5462 01 06		--	✓	--	--
2	FWH	FRONT WIRING HARNESS	2826 5460 01 04		--	✓	--	--
	FWH	FRONT WIRING HARNESS	2701 5460 01 94		--	--	✓	✓
3	CWH	CABIN WIRING HARNESS-RHD	2826 5460 01 05		--	✓	--	--
	CWH	CABIN WIRING HARNESS-RHD	2701 5460 01 87		--	--	--	✓
	CWH	CABIN WIRING HARNESS-LHD	2701 5460 01 91		--	--	✓	--
4	RWH	ROOF WIRING HARNESS	2653 5460 01 55	Single Cab	--	✓	--	--
	RWH	ROOF WIRING HARNESS	2653 5460 01 49	Dual Cab	--	✓	--	--
	RWH	ROOF WIRING HARNESS	2701 5460 01 93	Dual Cab	--	--	✓	✓
	RWH	ROOF WIRING HARNESS	2701 5460 01 65	Single Cab	--	--	✓	✓
5	C/L.WH	CENTRAL LOCKING WIRING HARNESS	2701 5460 01 90		--	✓	✓	✓
6	DDWH	DRIVER DOOR WIRING HARNESS	2701 5460 01 89		--	✓	✓	✓
7	C-DDWH	CO-DRIVER DOOR WIRING HARNESS	2701 5460 01 88		--	✓	✓	✓
8	DRDWH	DRIVER SIDE REAR DOOR W/H	2701 5460 01 97	Dual Cab	--	✓	✓	✓
9	C-DRDWH	CO-DRIVER SIDE REAR DOOR W/H	2701 5460 01 98	Dual Cab	--	✓	✓	✓
10	TWH	TAIL WIRING HARNESS	2701 5460 01 92		--	✓	✓	✓
11	BWH	BLOWER WIRING HARNESS-3POLE	2701 5460 01 52	A/C+HEAT	--	✓	✓	✓
		BLOWER WIRING HARNESS-4POLE	2701 5460 01 53	A/C ONLY	--	✓	✓	✓
12	SBWH	SEAT BELT WIRING HARNESS	2654 5460 01 81		--	✓	✓	✓
13	CHWH	A/C CTRL.HSG.WIRING HARNESS	2654 5461 01 17	A/C+HEAT	--	✓	✓	✓
		A/C CTRL.HSG.WIRING HARNESS	2658 5461 01 48	A/C ONLY	--	✓	✓	✓
14	A/C.-I	A/C.WIRING HARNESS-I	2658 5461 01 36		--	✓	✓	✓
15	A/C.-II	A/C.WIRING HARNESS-II	2658 5461 01 37		--	✓	✓	✓
16	BC	ASSY.BATT.CABLE +VE & -VE RHD	2654 5410 01 25		--	✓	--	✓
		ASSY.BATT.CABLE +VE & -VE LHD	2654 5410 01 24		--	--	✓	--
17	EPT	EARTH PIG TAIL	2701 5460 01 49		--	✓	✓	✓

5 - CONNECTORS AND LOCATION ZONE CHART

CONN.NOS.	ZONE LHD	ZONE RHD	SHEET NO.	APPLICATION
A03-1	C5	C5	2,3	RWH TO FRONT ROOF LAMP
A06-1	E3	A3	2,3	C/L.WH TO DDWH
A06-2	B4	D5	2,3	C/L.WH TO C/L.CTRL BOX
A06-3	A1	A1	4	FWH TO CWH
A09-1	D4	D4	4	A/C.WH-I TO AMPLIFIER
A12-1	D3	D3	2,3	FWH.TO TWH
A20-1	B1	B1	4	FWH TO CWH
A20-2	B1	B1	4	FWH TO CWH
B04-1	B4	B4	2,3	CWH TO C/L.WH
B04-2	A3	E3	2,3	C/L.WH TO C-DDWH
B04-3	A4	E3	2,3	C-DDWH TO RDWHC-D
B04-4	E4	A3	2,3	DDWH TO RDWHD
C01-1	B4	B4	4	FWH TO HEAD LAMP LEVELLING PIG TAIL
C01-2	D3	D3	4	FWH TO A/CWH-II
C01-3	B1	B1	2,3	CWH TO COMPRESSOR
CO1-4	C5	C5	2,3	CWH TO CIGARETTE LIGHTER ILL.LAMP
C01-5	B4	D5	2,3	C/L.WH TO C/L.CTRL BOX
C01-6	E6	A5	2,3	DDWH TO C/L.MASTER
C01-7	D5	B5	2,3	CWH TO STRG LOCK/IG.SW.KEY IN SENSOR TR
C02-1	E3	E3	4	FWH TO STARTER RELAY
C02-2	E3	B3	2,3	FWH TO BRAKR FLUID BOTTLE
C02-3	D3	D3	4	FWH TO AUXI.RELAY
C02-4	C1	C1	2,3	FWH TO CONDENSOR FAN
C02-5	E2	E2	2,3	FWH TO FRONT WIND SHIELD WASHER BOTTLE
C02-6	E1	E1	2,3	FWH TO FRONT BLINKER LAMP LH
C02-7	E3	E2	2,3	FWH TO SIDE INDICATOR LAMP LH
C02-8	E4	E4	2,3	CWH TO ROOF LAMP DIODE
C02-9	C3	B3	2,3	CWH TO MECHANICAL STOP LIGHT SWITCH
C02-10	--	--	--	
C02-11	--	--	--	
C02-12	C5	C5	2,3	CWH TO SBWH
C02-13	B4	D5	2,3	CWH TO READING LAMP
C02-14	A2	A2	2,3	CWH TO SIDE INDICATOPR LAMP RH
C02-15	A1	A1	2,3	CWH TO FRONT BLINKER LAMP RH
C02-16	--	--	--	

CONN.NOS.	ZONE LHD	ZONE RHD	SHEET NO.	APPLICATION
C02-17	D8	D8	2,3	TWH TO REAR FOG LAMP LH
C02-18	B8	B8	2,3	TWL TO REAR FOG LAMP RH
C02-19	C2	C2	2,3	EWH TO ALTERNATOR
C02-20	B3	D4	2,3	BWH TO BLOWER MOTOR
C02-21	D5	B5	2,3	SBWH TO DRIVER SIDE MICRO SWITCH
C02-22	--	--	--	
C02-23	B5	C5	2,3	SBWH TO CO-DRIVER SIDE MICRO SWITCH
C02-24	B3	B3	4	FWH TO EWH
C02-25	C5	C5	2,3	CWH TO CIGARETTE LIGHTER
C02-26	--	--	--	
C02-27	--	--	--	
C02-28	-- --	--	--	
C02-29	--	--	--	
C02-30	D2	D2	2,3	A/C WH-II TO RD BOTTLE
C02-31	--	--	--	
C02-32	B5	B5	2,3	RWH TO ROOF LAMP 207-TMCC
C02-33	D3	D3	4	A/C.WH-1 TO VARIABLE RESISTOR
C02-34	D3	D3	4	A/C.WH-1 TO THERMISTER
CO2-35	A5	E5	2,3	C-DDWH TO CO-DRIVER FOLLOWER
CO2-36	E6	A7	2,3	RDWHD TO DRIVER SIDE REAR DOOR FOLLOWER
CO2-37	A6	E7	2,3	RDWHC-D TO CO-DRIVER SIDE REAR DOOR FOLLOWER
CO2-38	E3	E3	2,3	ELECTRICAL TAPPING AVAILABLE IN FWH
C02-39	C8	C8	2,3	TWH TO REG PLATE LAMP LH
C02-40	B8	B8	2,3	TWH TO REG PLATE LAMP RH
C03-1	D5	C4	2,3	CWH TO HEAD LAMP LEVELLING SWITCH
C03-2	C5	C5	2,3	CWH TO A/C.SWITCH
C03-3	C5	B5	2,3	CWH TO REAR W/S DEMIST SWITCH
C03-4	B4	C5	2,3	CWH TO BWH
C03-5	B5	B5	2,3	RWH TO ROOF LAMP 207-TM
C03-6	D5	B4	2,3	CWH TO STRG LOCK CUM IGNITION SWITCH
C03-7	B2	C3	2,3	BWH TO 3-POLE RESISTOR A/C+HEAT,DEMIST
C03-8	--	--	--	
C03-9	E1	E1	2,3	FWH TO HEAD LAMP LH
C03-10	B1	B1	2,3	CWH TO HEAD LAMP RH
C03-11	E4	A4	2,3	CWH TO FLASHER UNIT
C03-12	E3	E3	2,3	A/CWH-I TO A/CWH-II

CONN.NOS.	ZONE LHD	ZONE RHD	SHEET NO	APPLICATION
C04-1	---	---	--	
C04-2	E4	D5	2,3	CWH TO RWH
C04-3	D5	B5	2,3	CWH TO OVER SPEED WARNING DEVICE
C04-4	D5	B5	2,3	CWH TO REAR FOG LAMP SWITCH
C04-5	B3	C3	2,3	CWH TO A/C WIRING HARNESS-I
C04-6	B5	C5	2,3	CWH TO DIGITAL CLOCK
C04-7	D8	D8	2,3	TWH TO TRAILER CONNECTOR LH SIDE
C04-8	B5	C5	2,3	BWH TO BLOWER SWITCH
C04-9	B2	C3	2,3	BWH TO 4-POLE RESISTOR A/C.ONLY
C04-10	E5	A6	2,3	DDWH TO C/L.MASTER
C04-11	E5	A5	2,3	CWH TO REAR FOG LAMP & SEAT BELT BUZZER
C06-1	B3	C3	2,3	FWH TO FRONT WIPER MOTOR
C06-2	C4	B3	2,3	CWH TO RADIO
C06-3	C5	C5	2,3	CWH TO CHWH BACK LIGHTING
C08-1	B8	B8	2,3	TWH TO TRAILER CONNECTOR RH SIDE
E01-1	D5	B5	2,3	CWH TO STRG LOCK CUM IGN SWITCH
J02-1	C2	C2	2,3	EWH TO THROTTLE SWITCH
J02-2	C2	C2	2,3	EWH TO EGR SOLENOID
J02-3	B2	B2	2,3	FWH TO TEMP TRANSDUCER EURO-III
J03-1	E1	E1	2,3	FWH TO HEAD LAMP LEVELLING MOTOR LH
J03-2	A1	A1	2,3	CWH TO HEAD LAMP LEVELLING MOTOR RH
L04-1	E7	E7	2,3	TWH TO FUEL TANK UNIT T'TER
L05-1	D3	D3	4	FWH TO STARTER RELAY TER NO.30
L05-2	D3	D3	4	FWH TO STARTER RELAY TER NO.87
L05-3	D3	D3	4	FWH TO AUXI RELAY TER NO.30
L05-4	C3	C3	4	FWH TO AUXI RELAY TER NO.87
L05-5	C1	C1	4	FWH TO GLOW PLUG TIMER TER NO.1

1) EWH:ENGINE WIRING HARNESS
2) FWH:FRONT WIRING HARNESS
3) CWH:CABIN WIRING HARNESS
4) TWH:TAIL WIRING HARNESS
5) RWH:ROOF WIRING HARNESS
6) BWH:BLOWER WIRING HARNESS
7) SBWH: SEATBELT WIRING HARNESS
8) EPT:EARTH PIG TAIL (HEAD LAMP LEVELLING)
9) CHWH:CTRL.HSG.WIRING HARNESS (BACK LIGHTING)
10) A/C.WH-I:A/C WIRING HARNESS-I
11) A/C.WH-II:A/C.WIRING HARNESS-II
12) C/L.WH:CENTRAL LOCKING WIRING HARNESS
13) DDWH:DRIVER DOOR WIRING HARNESS
14) C-DDWH:CO-DRIVER DOOR WIRING HARNESS
15) RDWHD:REAR DOOR WIRING HARNESS DRIVER SIDE
16) RDWHC-D:REAR DOOR WIRING HARNESS CO-DRIVER SIDE
17) BC-BATTERY CABLE

NOTE:-
1) FOR CONNECTORS,EARTH POINTS AND ITS LOCATIONS ON VEHICLEREFER SHEET NO.2 OF 14.

6 - CONNECTORS AND LOCATION ZONE CHART

CONN.NOS.	ZONE LHD	ZONE RHD	SHEET NO.	APPLICATION
L05-6	B2	B2	2,3	FWH TO GLOW PLUG CONNECTING STRIP
L05-7	--	--	--	
L05-8	C2	C2	2,3	EWH TO STARTER MOTOR SOL.TER
L05-9	E7	E7	2,3	TWH TO FUEL TANK UNIT MTG SCREW
L05-10				COLD ADVANCE UNIT LUG TO CONNECTING STRIP
LC05-1	C2	C2	2,3	EWH TO ENGINE STOP SOL.TER.
L06-1	C2	C2	4	FWH TO GLOW PLU TIMER TER NO.6
L06-2	E2	E2	2,3	FWH TO LH BONNET FRONT BEHIND HEAD LAMP
L06-3	E5	D4	2,3	CWH TO DASHBOARD SUPPORT CROSS MEMBER
L06-4	A5	A4	2,3	CWH TO DASHBOARD SUPPORT CROSS MEMBER
L06-5	D2	D2	2,3	EWH TO ALTERNAT0R -VE TER
L03-6	--	--		
L06-7	D2	D2	2,3	A/CWH-II TO RD BOTTLE
L06-8	C4	C4	4	A/CWH-I TO AMPLIFIER MTG.SCREW
L08-1	D1	D1	2,3	FWH TO HORN-I MTG.SCREW
L08-2	D1	D1	2,3	FWH TO HORN-II MTG.SCREW
L08-3	--	--	--	.
L08-4	E8	E8	2,3	TWH TO LH LONG MEMBER BOXING PLATE
L08-5	A8	A8	2,3	TWH TO RH LONG MEMBER BOXING PLATE
L08-6	E7	E7	2,3	TWH TO LH LONG MEMBER BOXING PLATE
LC08-1	D2	D2	2,3	EWH TO ALTERNATOR +VE TER
LC08-2	C2	C2	2,3	BATT.CABLE +VE TO STARTER MOTOR +VE TER
L10-1	C3	C3	2,3	EWH TO STARTER MOTOR MTG.SCR.ON CLUTCH HSG.
L10-2	C3	C3	2,3	BATT.CABLE -VE TO STARTER MOTOR MTG.SCREW
				ON CLUTCH HSG.
				207-TM/TMCC EURO-II & III EXPORT

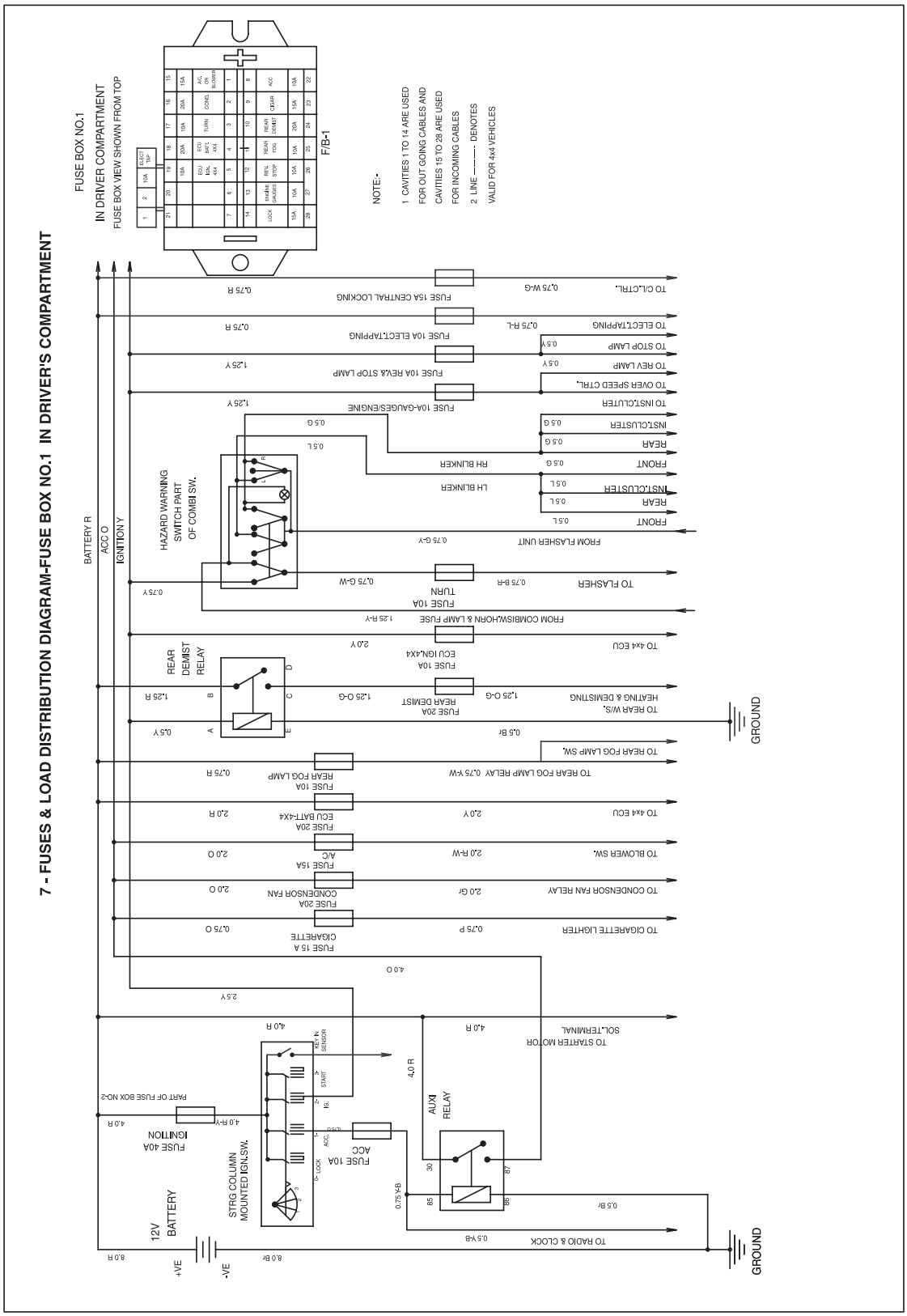
CONN.NOS.	ZONE LHD	ZONE RHD	SHEET NO	APPLICATION
L12-1	D4	E3	2,3	EARTH STRAP TO ENGINE MTG.SCR.REAR LH
EARTH STRAP	B2	B3	2,3	OTHER END OF EARTH STRAP CONNECTED
				ALONWITH BATT.CABLE -VE TO STARTER MOTOR
				MTG.SCREW ON CLUTCH HSG.
R04-1	C5	B5	2,3	CWH TO STEERING COMBI SWITCH
R09-1	D5	B5	2,3	CWH TO STEERING COMBI SWITCH
R12-1	D5	B5	2,3	CWH TO STEERING COMBI SWITCH
S01-1	E3	C2	2,3	BATTERY CABLE +VE PIG TAIL TO FWH
S01-2	B4	B4	4	FWH TO EWH
S05-1	C1	C1	4	FWH TO GLOW PLUG TIMER
S07-1	A1	A1	4	FWH TO CWH
S07-2	B3	B3	4	FWH TO EWH
S09-1	E3	E3	4	FWH TO CONDENSOR FAN RELAY
S09-2	D1	D1	4	FWH TO REAR W/S.DEMIST RELAY
S09-3	D1	D1	4	FWH TO IGNITION RELAY
S09-4	D1	D1	4	FWH TO HEAD LAMP LOW BEAM RELAY
S09-5	D1	D1	4	FWH TO HEAD LAMP HIGH BEAM RELAY
S09-6	E1	E1	4	FWH TO PARKING RELAY
S09-7	E1	E1	4	FWH TO HORN RELAY
S09-8	E2	E2	4	FWH TO REAR FOG LAMP RELAY
S09-9	E2	E2	4	FWH TO A/C.CUT OFF RELAY
S09-10	E5	A5	2,3	CWH TO EGR CTRL.
S09-11	E5	A5	2,3	CWH TO FRONT WIPER CTRL.
S09-12	--	--	--	
S09-13	E4	A5	2,3	CWH TO CHIME UNIT
S10-1	D4	B3	2,3	CWH TO INSTRUMENT CLUSTER
S10-2	C4	B3	2,3	CWH TO INSTRUMENT CLUSTER

CONN.NOS.	ZONE LHD	ZONE RHD	SHEET NO	APPLICATION
T01-1	D1	D1	2,3	FWH TO HORN-I
T01-2	D1	D1	2,3	FWH TO HORN-II
T01-6	E1	E1	2,3	FWH TO FRONT PARKING LAMP LH
T01-7	A1	A1	2,3	CWH TO FRONT PARKING LAMP RH
T01-8	B2	B2	2,3	FWH TO TEMP TRANSDUCER EURO-II
T01-9	D6	D6	2,3	RWH TO REAR W/S.HEATING COIL +VE TER
T01-10	B6	B6	2,3	RWH TO REAR W/S.HEATING COIL -VE TER
T01-11	C2	C2	2,3	EWH TO ENGINE OIL PR.SWITCH
T02-1	E1	E1	2,3	FWH TO FRONT PARKING LAMP LH
T02-2	A1	A1	2,3	CWH TO FRONT PARKING LAMP RH
T03-1	E4	A4	2,3	DDWH TO DOOR SWITCH
T03-2	A5	E4	2,3	C-DDWH TO DOOR SWITCH
T03-3	C5	C5	2,3	CWH TO PARKING BRAKE SWITCH
T03-4	E6	A6	2,3	RDWHD TO DOOR SWITCH
T03-5	A6	E6	2,3	RDWHC-D TO DOOR SWITCH
W02-1	B4	B5	2,3	TWH TO TO MAGNETIC REED SWITCH
W02-2	B5	B5	2,3	TWH TO TO REV.LIGHT SWITCH
W02-3	--	--	--	
W02-4	D3	D2	2,3	A/C.WH-II TO PR.SWITCH
W06-1	E8	E8	2,3	TWH TO TAIL LAMP LH
W06-2	A8	A8	2,3	TWH TO TAIL LAMP RH

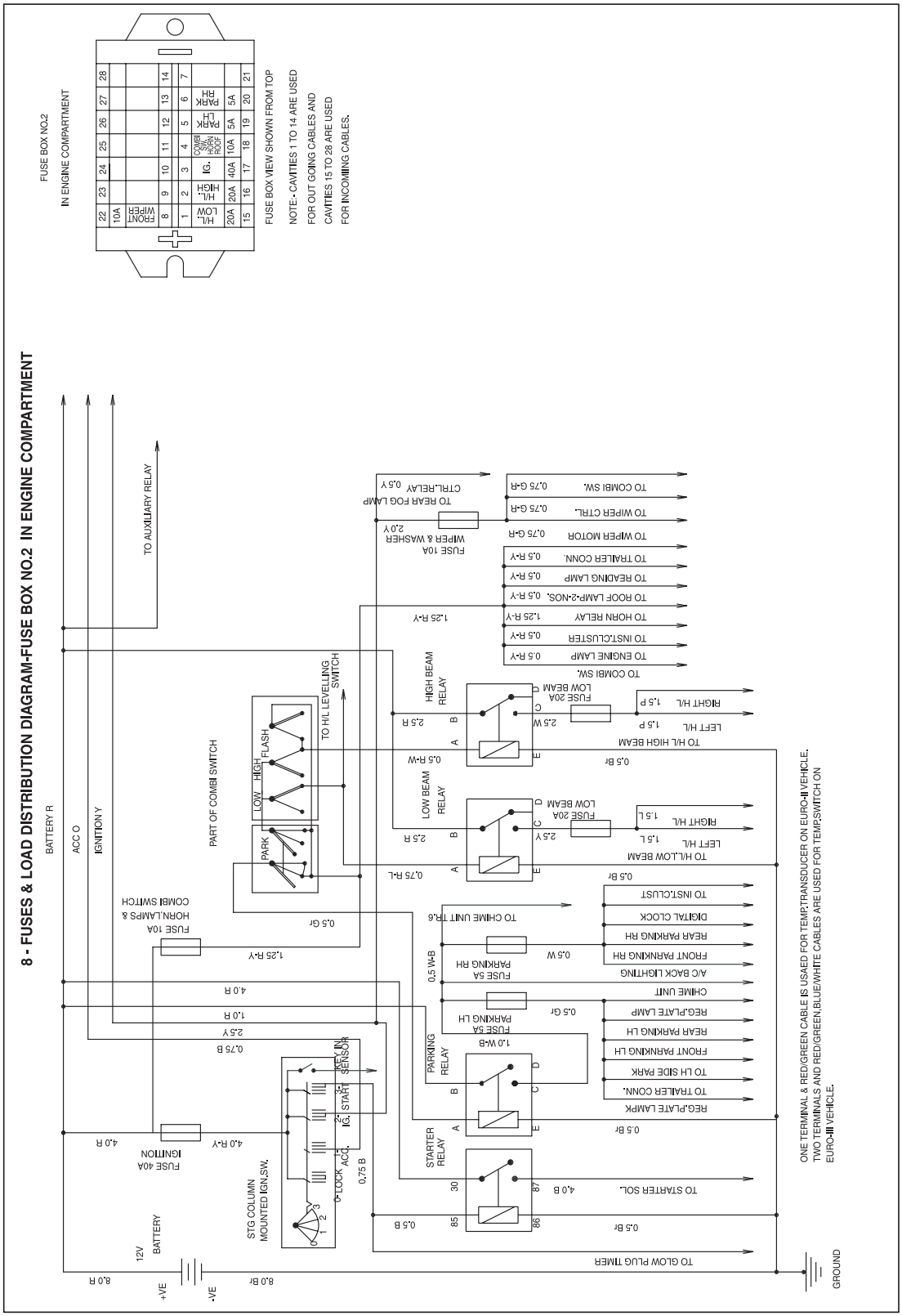
1) EWH:ENGINE WIRING HARNESS
2) FWH:FRONT WIRING HARNESS
3) CWH:CABIN WIRING HARNESS
4) TWH:TAIL WIRING HARNESS
5) RWH:ROOF WIRING HARNESS
6) BWH:BLOWER WIRING HARNESS
7) SBWH: SEATBELT WIRING HARNESS
8) EPT:EARTH PIG TAIL (HEAD LAMP LEVELLING)
9) CHWH:CTRL.HSG.WIRING HARNESS (BACK LIGHTING)
10) A/C.WH-I:A/C WIRING HARNESS-I
11) A/C.WH-II:A/C.WIRING HARNESS-II
12) C/L.WH:CENTRAL LOCKING WIRING HARNESS
13) DDWH:DRIVER DOOR WIRING HARNESS
14) C-DDWH:CO-DRIVER DOOR WIRING HARNESS
15) RDWHD:REAR DOOR WIRING HARNESS DRIVER SIDE
16) RDWHC-D:REAR DOOR WIRING HARNESS CO-DRIVER SIDE
17) BC-BATTERY CABLE

NOTE:-
1) FOR CONNECTORS,EARTH POINTS AND ITS LOCATIONS ON VEHICLEREFER SHEET NO.2 OF 14.

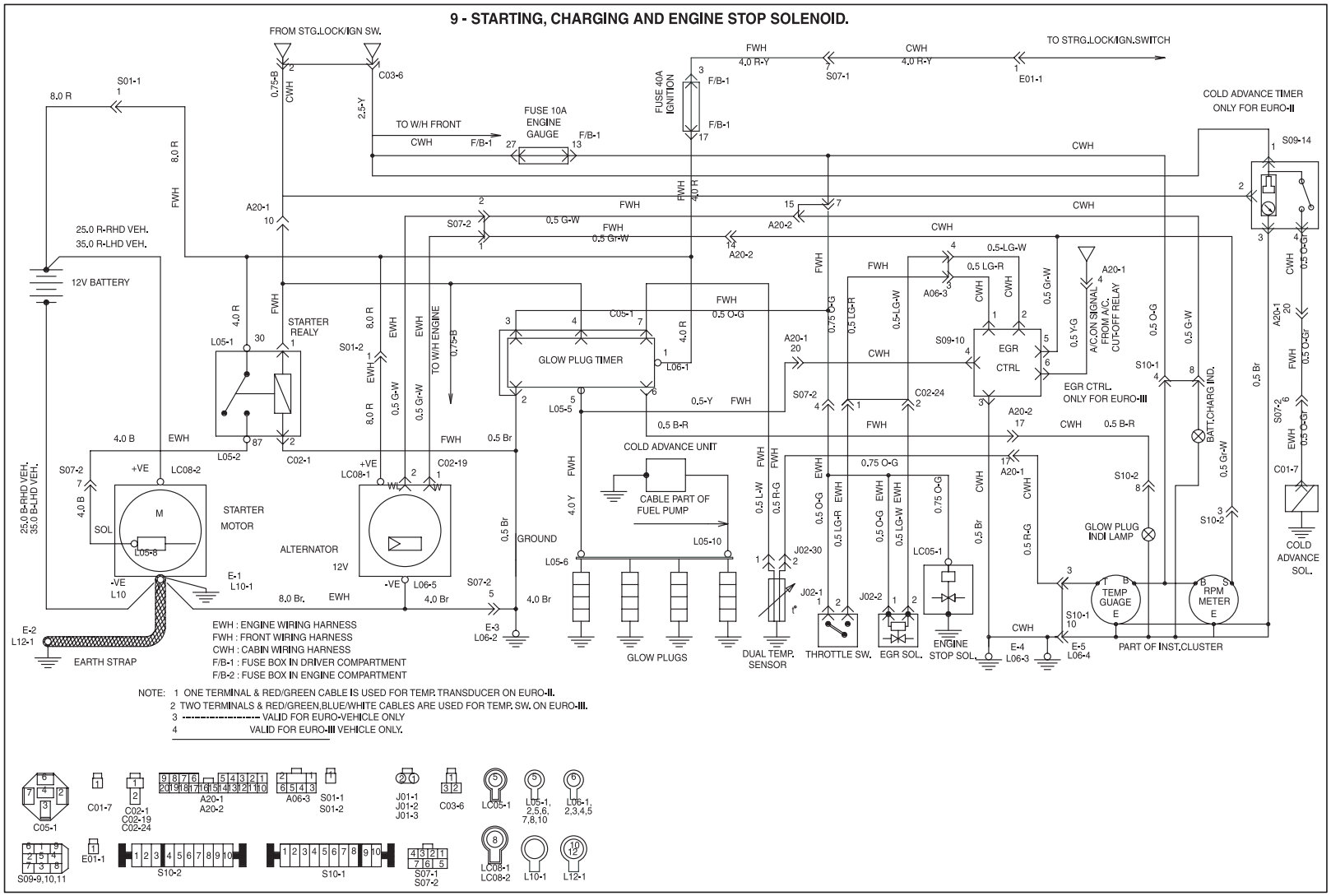
WIRING DIAGRAM



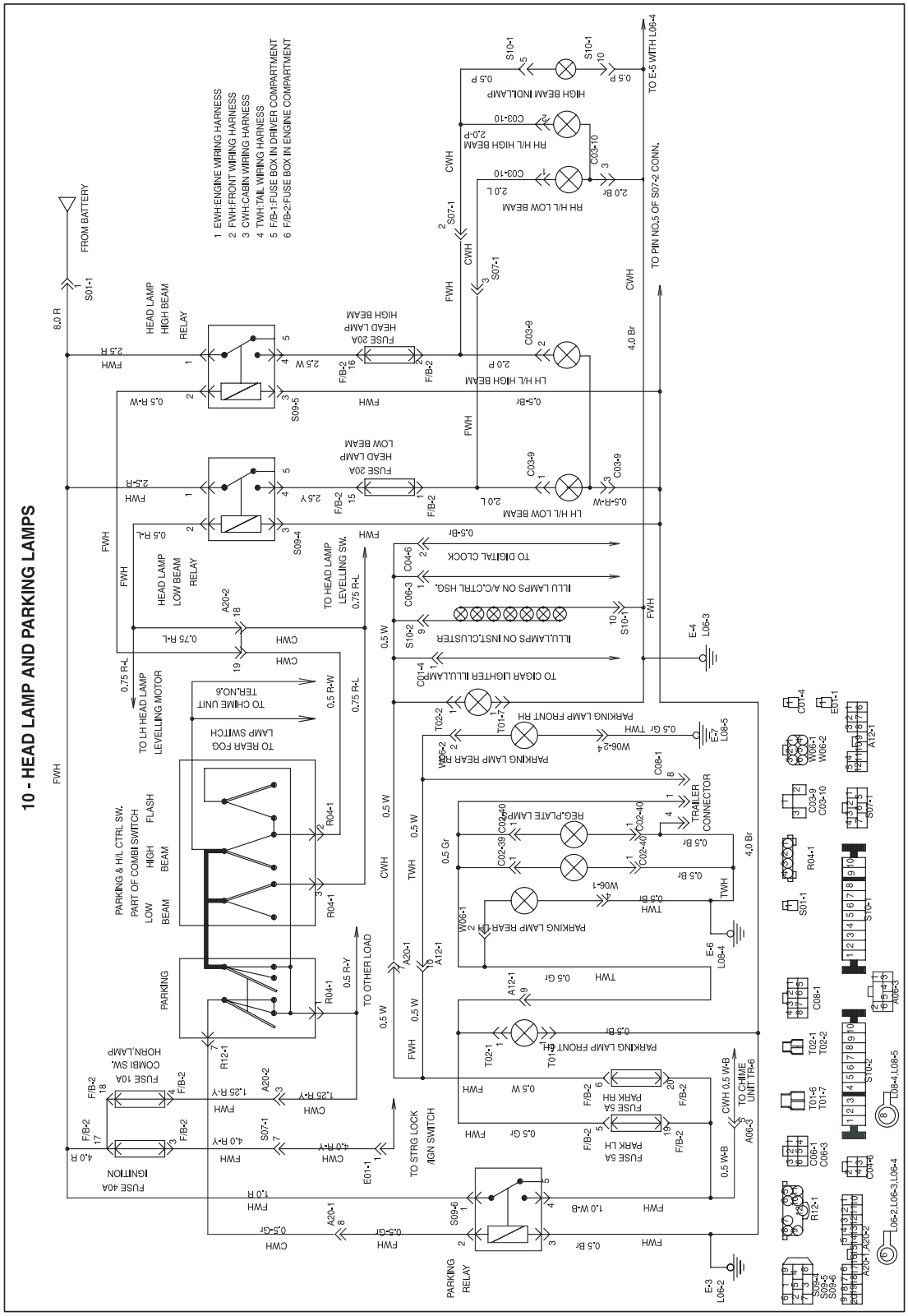
WIRING DIAGRAM



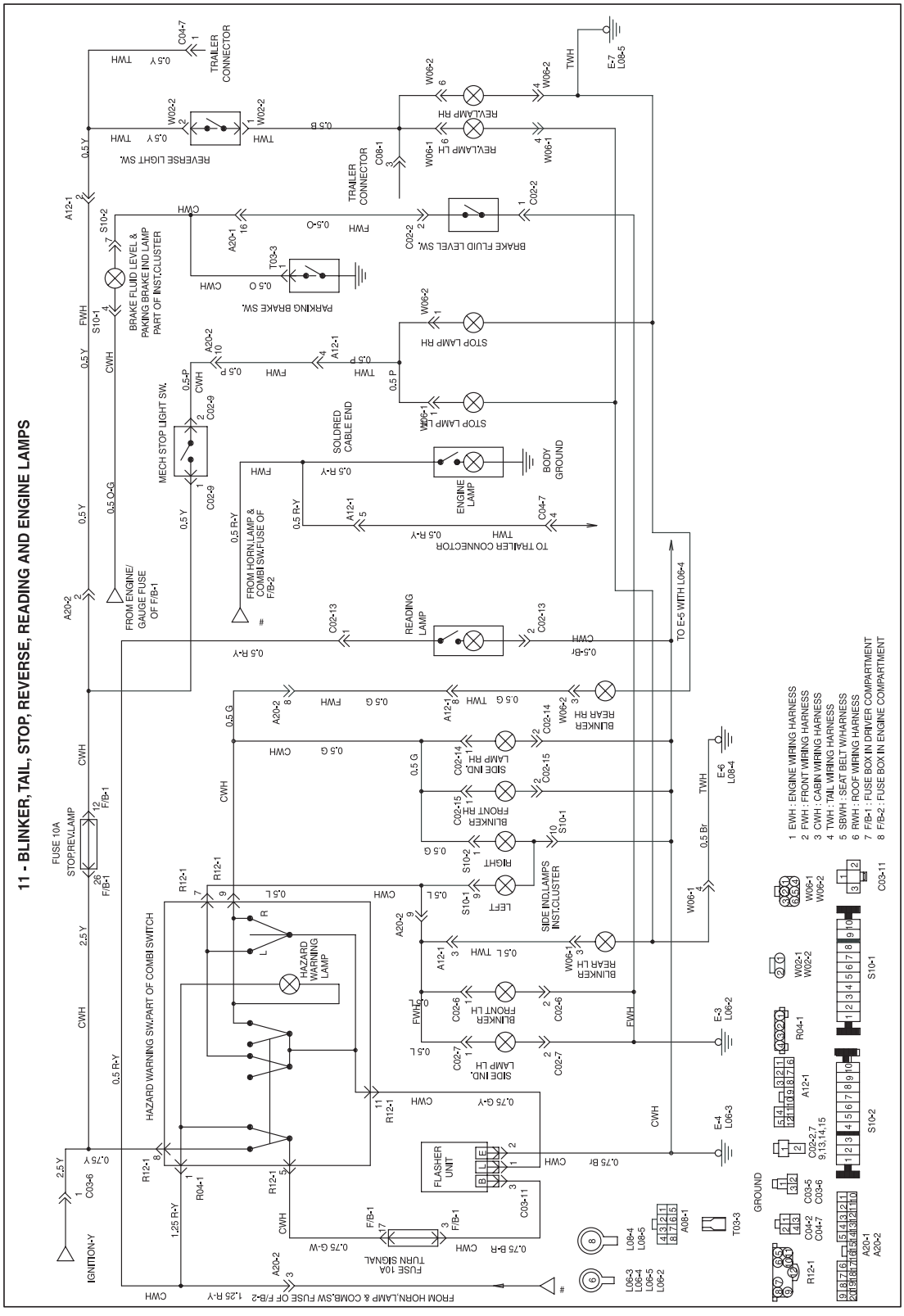
9 - STARTING, CHARGING AND ENGINE STOP SOLENOID.



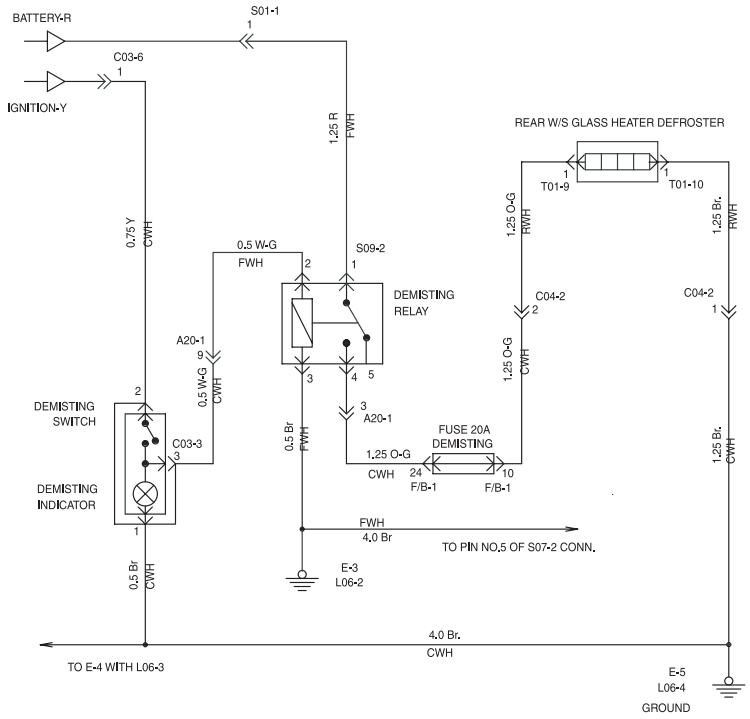
WIRING DIAGRAM

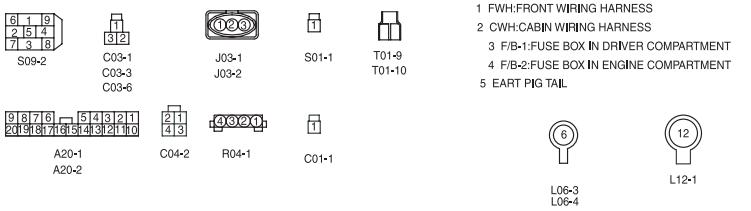


WIRING DIAGRAM



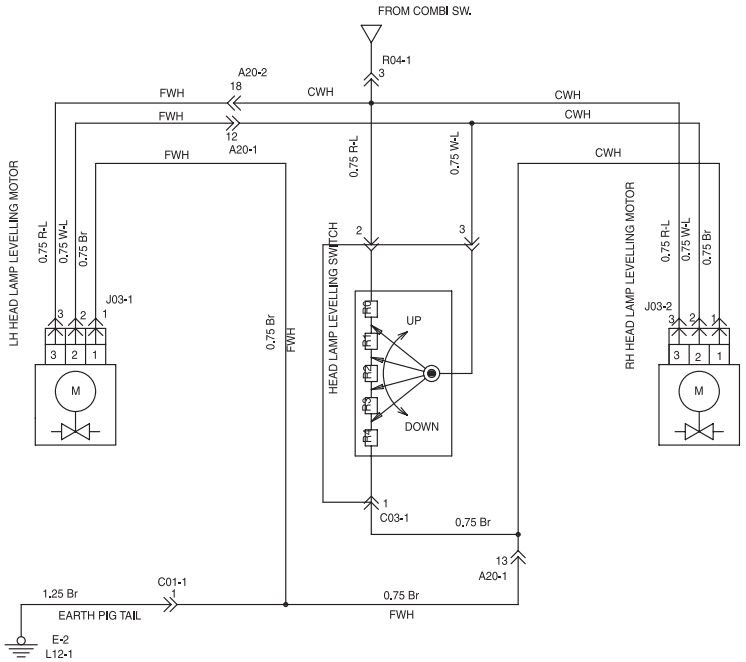
12A - REAR WIND SHIELD GLASS HEATING AND DEMISTING.



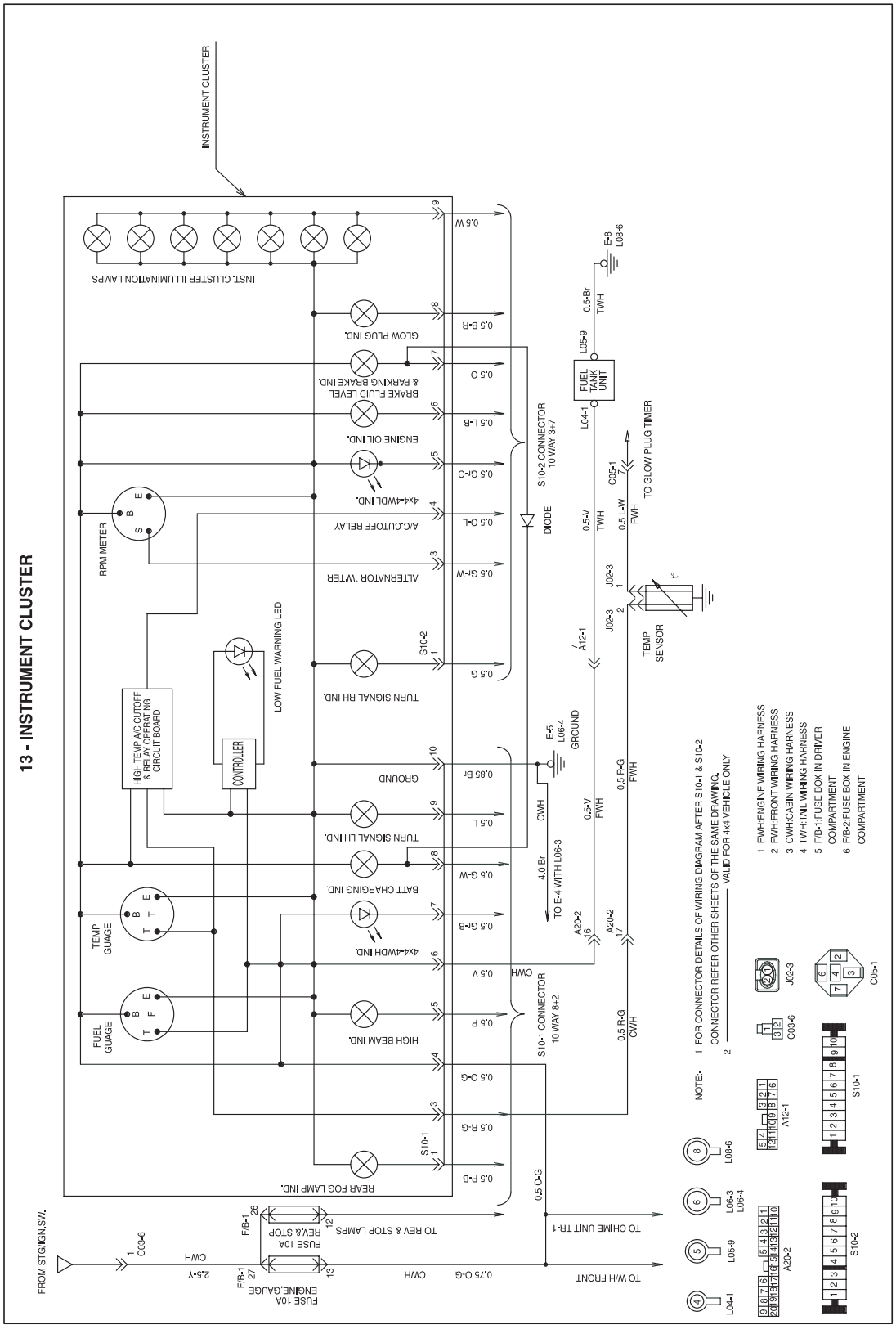


1 FWH:FRONT WIRING HARNESS
2 CWH:CABIN WIRING HARNESS
3 F/B-1:FUSE BOX IN DRIVER COMPARTMENT
4 F/B-2:FUSE BOX IN ENGINE COMPARTMENT
5 EART PIG TAIL

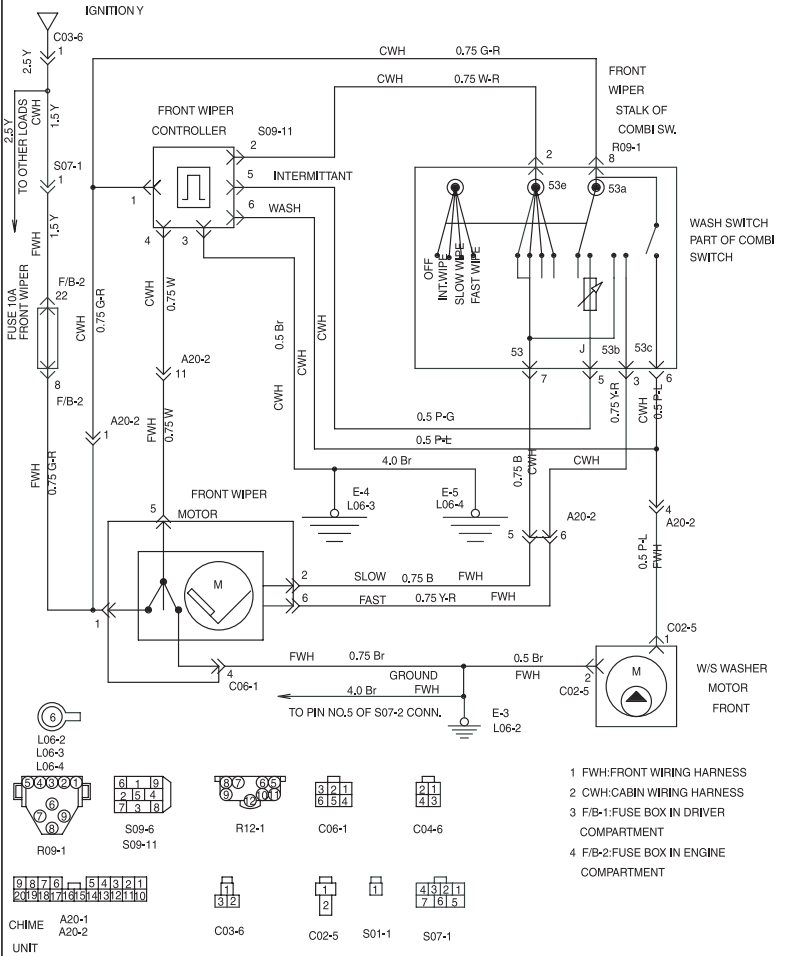
12B - HEAD LAMP LEVELING



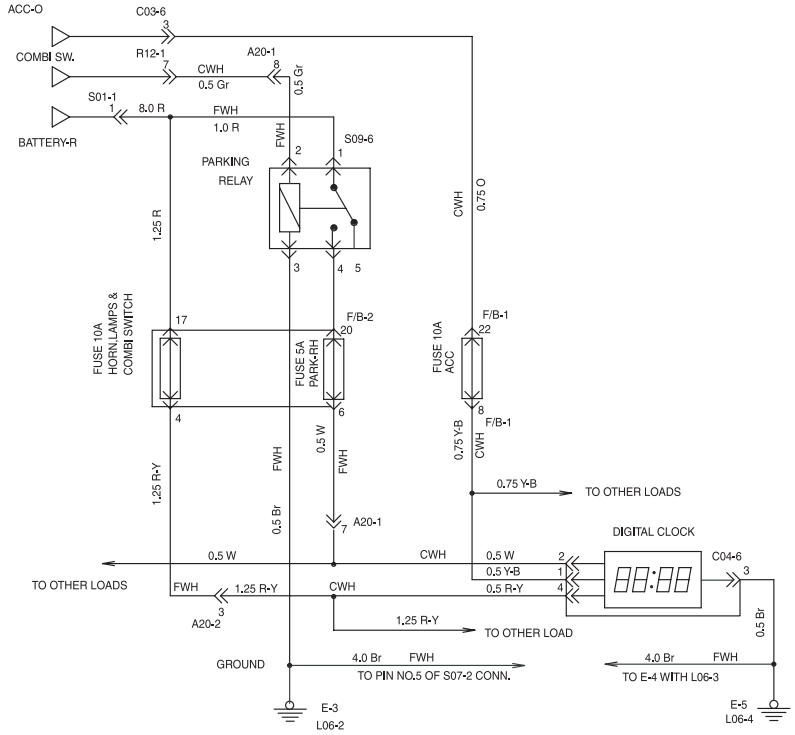
WIRING DIAGRAM



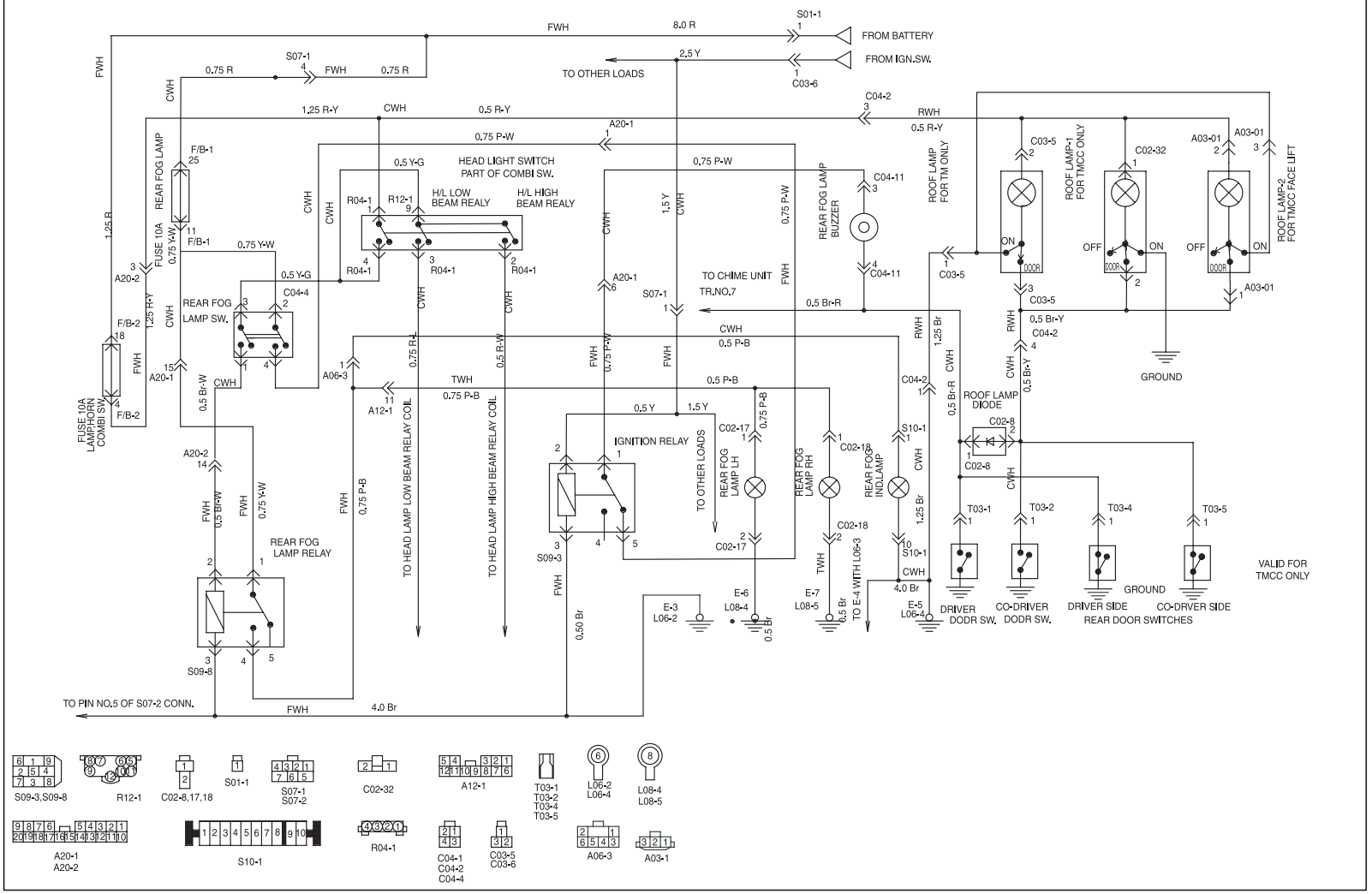
14A - 2-SPEED WIPER, WASHER & INTERMITTENT

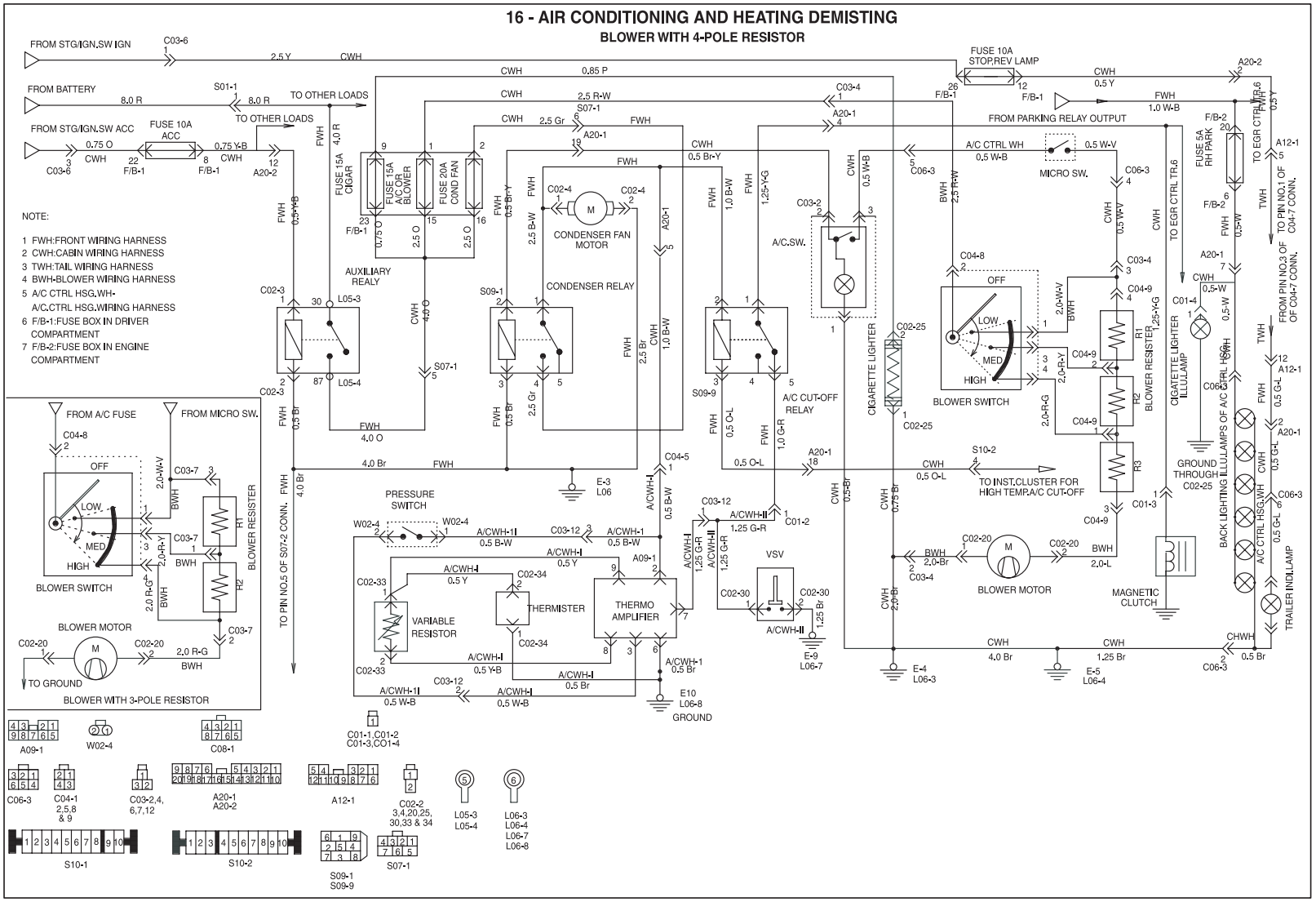


14B - DIGITAL CLOCK (IF FITTED)

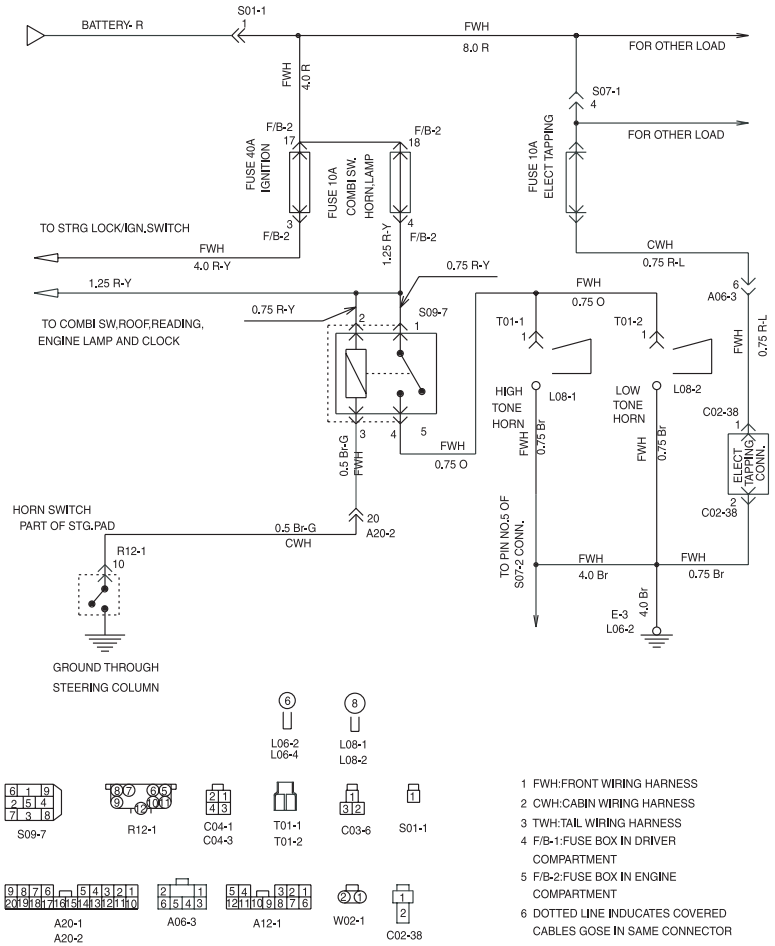


15 - REAR FOG LAMP WITH WARNING BUZZER & ROOF LAMP



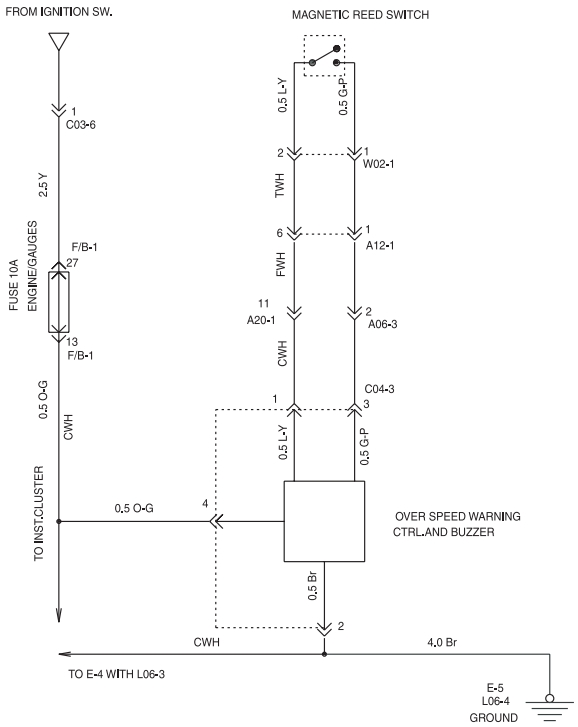

16 - AIR CONDITIONING AND HEATING DEMISTING
BLOWER WITH 4-POLE RESISTOR
NOTE:
1 FWH:FRONT WIRING HARNESS
2 CWH:CABIN WIRING HARNESS
3 TWH:TAIL WIRING HARNESS
4 BWH-BLOWER WIRING HARNESS
5 A/C CTRL HSG.WH-
A/C.CTRL HSG.WIRING HARNESS
6 F/B-1:FUSE BOX IN DRIVER COMPARTMENT
7 F/B-2:FUSE BOX IN ENGINE COMPARTMENT
FROM STG/IGN.SW IGN
FROM BATTERY
FROM STG/IGN.SW ACC
FUSE 10A ACC
TO OTHER LOADS
FUSE 15A CIGAR
FUSE 15A A/C CTRL BLOWER
FUSE 20A COND FAN
AUXILIARY REALY
CONDENSER FAN MOTOR
CONDENSER RELAY
A/C.SW.
A/C CUT-OFF RELAY
CIGARETTE LIGHTER
FUSE 10A STOP,REV LAMP
FROM PARKING RELAY OUTPUT
A/C CTRL WH
MICRO SW.
BLOWER SWITCH
OFF
LOW
MED
HIGH
BLOWER RESISTER
R1
R2
R3
CIGARETTE LIGHTER ILLULAMP
GROUND THROUGH C02-25
TO EGR CTRL TR-6
FUSE 5A RH PARK
TO PIN NO.1 OF C04-7 CONN.
FROM PIN NO.3 OF C04-7 CONN.
BACK LIGHTING ILLULAMPS OF A/C CTRL HSG.WH
A/C CTRL HSG.WH
TRAILER INDI.LAMP
TO INST.CLUSTER FOR HIGH TEMP.A/C CUT-OFF
PRESSURE SWITCH
VARIABLE RESISTOR
THERMISTER
THERMO AMPLIFIER
VSV
BLOWER MOTOR
MAGNETIC CLUTCH
GROUND
FROM A/C FUSE
FROM MICRO SW.
TO PIN NO.5 OF S07-2 CONN.
TO GROUND
BLOWER WITH 3-POLE RESISTOR
A09-1
W02-4
C08-1
C06-3
C04-1 2,5,8 & 9
C03-2,4, 6,7,12
A20-1 A20-2
A12-1
C02-2 3,4,20,25, 30,33 & 34
L05-3 L05-4
L06-3 L06-4 L06-7 L06-8
S10-1
S10-2
S09-1 S09-9
S07-1
C01-1,C01-2 C01-3,C01-4
E-3 L06
E-4 L06-3
E-5 L06-4
E-9 L06-7
E10 L06-8 GROUND

17A - TWIN HORNS & ELECTRICAL TAPPING

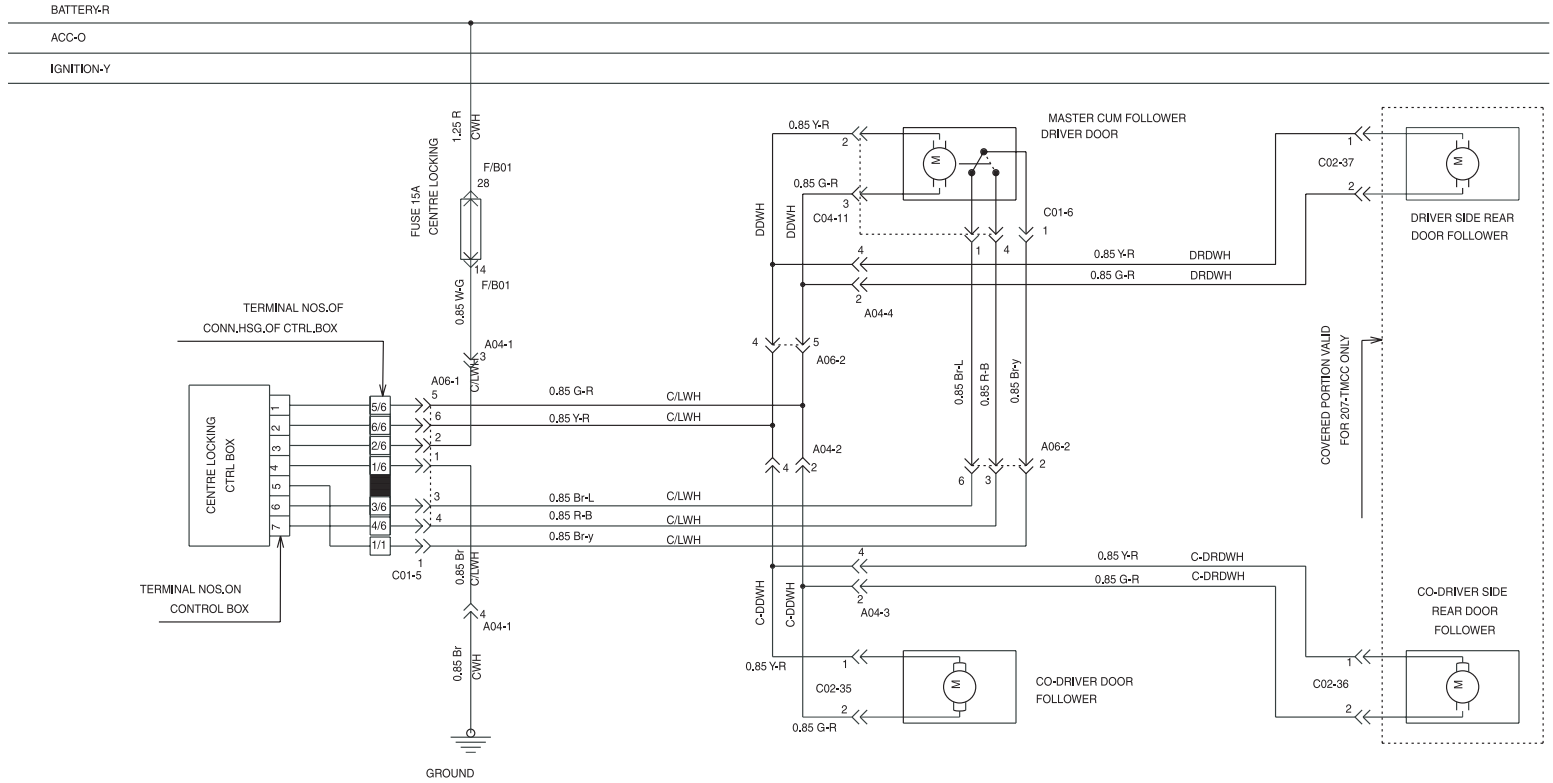


1 FWH:FRONT WIRING HARNESS
2 CWH:CABIN WIRING HARNESS
3 TWH:TAIL WIRING HARNESS
4 F/B-1:FUSE BOX IN DRIVER COMPARTMENT
5 F/B-2:FUSE BOX IN ENGINE COMPARTMENT
6 DOTTED LINE INDUCATES COVERED CABLES GOSE IN SAME CONNECTOR

17B - OVER SPEED WARNING DEVICE (IF FITTED)



18 - CENTRAL LOCKING SYSTEM WITH SINGLE MASTER

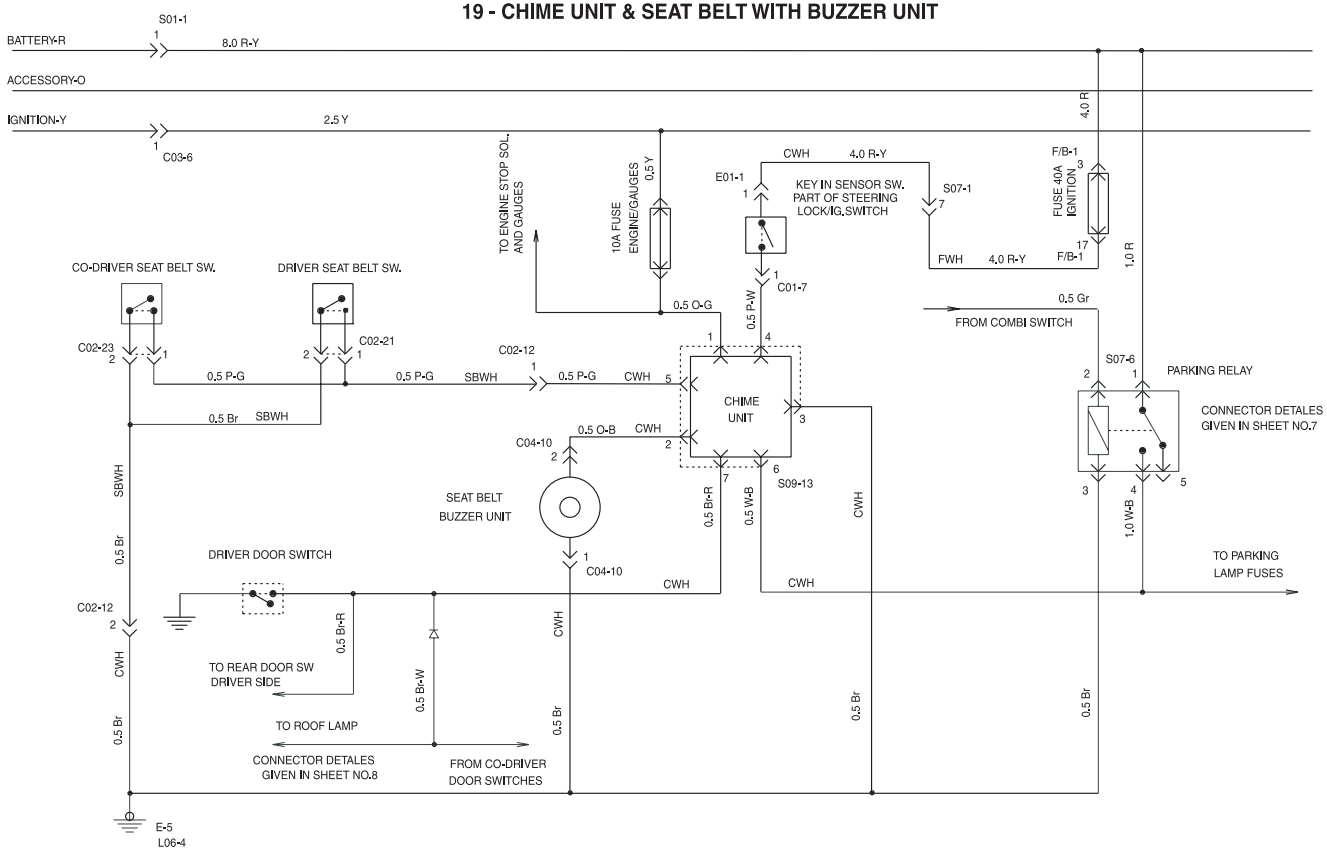


NOTE :LOCATIONS OF C/L MASTER & FOLLOWERS ARE SHOWN OF RHD VEHICLE,
FOR LHD VEHICLE LOCATIONS OF C/L MASTER & FOLLOWER WILL BE MIRROR.

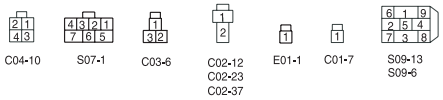
A06-1
A06-2
S07-1
C04-11
A04-1
A04-2
A04-3
A04-4
C02-35
C02-36
C02-37
C01-5
C01-6

CWH-CABIN WIRING HARNESS
C/LWH-CENTRAL LOCKING WIRING HARNESS
DDWH-DRIVER DOOR WIRING HARNESS
C-DDWH-CO-DRIVER DOOR WIRING HARNESS
DRDWH-DRIVER SIDE REAR DOOR WIRING HARNESS
C-DRDWH-DRIVER SIDE REAR DOOR WIRING HARNESS

19 - CHIME UNIT & SEAT BELT WITH BUZZER UNIT



CWH-CABIN WIRING HARNESS.
SBWH-SEAT BELT WIRING HARNESS



CABIN &
LOAD BODY

INTRODUCTION :

Cabin assembly is normal control type all steel version. Load body assembly is made of pressed sheet metal components.

Cab assembly is fitted with standard fitments like seats/seat belts, inner/outer rear view mirrors, roof/ map reading lamps, magazine pockets, arm rests grab handles, ash tray/cigarette lighter, components of HVAC/heating system, roof linings, door padding, carpets, trims, fender extensions, bonnet release mechanism, console, shroud, nacelle etc.

This manual guides you for dismantling & assembly of these components.

New NVH package has been introduced in face lift version for better passenger comfort.

Please refer section on product improvements for modifications carried out on cabin & load body.



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1. TECHNICAL SPECIFICATIONS

TELCOLINE SINGLE CAB & CREW CAB

Type (single cab) : Normal control all steel cabin

Type (crew cab) : Normal control all steel crew cabin with two front and two rear doors.

Seats :

Option I : Reclining bucket seats with foam laminated fabric, Front and Rear adjustment and with adjustable head restraints.

Option II : Bench seat with foam laminated fabric, Front and Rear adjustment and with adjustable head restraints.

Note :

Option I is standard fitment for 4 x 4 vehicles.

Rear Row (Crew cab) : Non adjustable bench seat with foam laminated fabric and with neck rests.

Seat Belt : 1) Three point mounting ELR Seat Belt for driver & co-Driver for Bucket Seat version.

2) Three point mounting ELR Seat Belt for driver & outboard passenger and two point mounting lap belt for middle passenger for Bench Seat version.

Seat belt rear row seat (crew cab) : Three point Mounting ELR Seat Belt for two outboard passengers and two point mounting lap belt for middle passenger.

Wind Shield : Single piece laminated and tinted with darker built-in green tint band at top.

Rear Window : Single piece fixed glass.

Option : Tinted glass for all windows (with HVAC)

Mirrors : LH/RH Side External Rear View Mirrors adjustable from in side & Inner Antiglare Rear View Mirror.

Ventilation :

Option I : Air conditioning with heating and demisting.

Option II : Heating and demisting.

Radio cum Cassette Player : Provision for fitment.

Digital Clock : Provision for fitment.

Load Body : Pick-up type with all steel non-integral load body.

Hinged tail gate with 90° opening and with lock handle at centre.

Provision for fixing canopy.

Recessed type tail lamp on load body.

Other Features :

1. Soft Feel Dash board / console
2. Moulded Roof Lining
3. Central Locking
4. Cab Guard on Load Body
5. Provision for fixing canopy on load body
6. Moulded Carpets
7. Sun Visors with Plastic Moulded Stem
8. Vanity mirror on sun visor (Co-driver side)
9. Magazine Pockets
10. Ash Tray & Cigarette Lighter
11. Rear under run protection bumper
12. Cab guard on load body
13. Roof lamp at front (for crew cab)
14. Pigmented fenders & rear corner bumpers

2. REMOVAL / INSTALLATION OF FRONT & REAR DOOR PADDING

(Fig. 1)

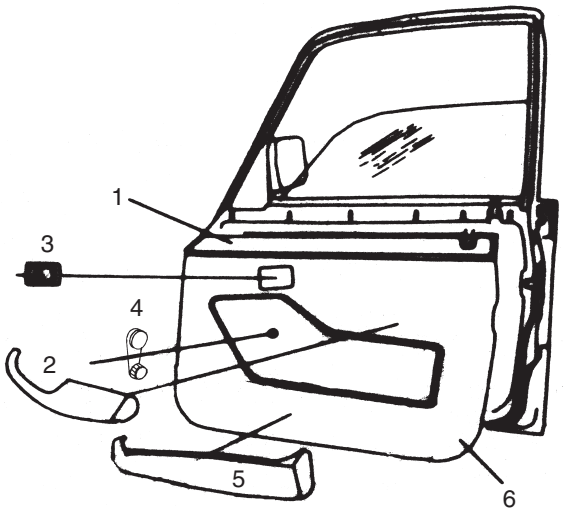
REMOVAL

Note : Disconnect battery before doing repair work on the body.

- Open the door.
- Pry out assembly cover padding from door shell. Cover padding is fitted with spring clips on door shell. While taking out cover padding, care should be taken to clear the pop-up knob.
- Remove mounting screws of door pull and remove door pull.
- Remove mounting screw of inner handle cover and remove cover.
- Remove window regulator handle by pulling the regulator hand from padding.
- Remove magazine pocket two mounting screws at bottom from door shell (for front door only). Magazine pocket will remain in position on padding after removal of screws.
- Remove door padding alongwith magazine pocket (for front door only) from door shell, by separating the padding clips and door shell clips with the help of screw driver.
- Rear door padding removal procedure is same as for front door, only magazine pocket is not there in rear door padding.

INSTALLATION

- Replace door padding clips, if necessary.
- Locate door padding alongwith magazine pocket (for front door only) on door shell.
- Ensure that door padding clips are properly located in mounting holes.
- Press the door padding properly on door shell.
- Locate two holes at bottom of magazine pocket (for front door only) and tighten with screws.
- Fit the door pull using screw and tighten screws.



1. Cover padding with inner weather strip
2. Door pull
3. Inner handle cover
4. Window regulator handle
5. Magazine pocket
6. Door padding

Fig. 1

- Fit cover inner door handle with screw.
- Fit window regulator handle with plastic ring by pushing the handle on window regulator spindle.
- Fit cover padding by locating cover padding lugs on to the spring clips on door shell and pushing the cover padding on shell.

3. REMOVAL / INSTALLATION OF DOOR

(Fig. 2)

REMOVAL

- Open the door
- Remove door padding. Refer 'Removal/ installation of front/rear door padding'.
- Remove plastic sheet.
- Disconnect all connectors of electrical components in side the door.
- Remove rubber grommet provided on the door for wiring harness.
- Take out wiring harness from door through the hole.
- Remove bonnet side panel for front door. Refer 'Removal of bonnet side panel'.
- Push out hinge pin of door check.
- Support the door properly and remove mounting screws of top and bottom hinges on the pillar.
- Remove door.

INSTALLATION

- Locate the door with the hinges on mounting holes at the pillar.
- Fit door top hinge with screws, spring washers and washers. Fit door bottom hinge with screws, spring washers and washers. Ensure proper alignment of door and tighten mounting screws.
- Align check strap hinge hole, with bracket on pillar and fit hinge pin using mallet.
- Insert wiring harness through grommet into the hole provided for harness on door. Fit grommet on door.
- Connect all electrical components' connectors to wiring harness properly. Apply sealant on door inner panel and fix plastic sheet on it properly.
- Fit bonnet side panel for front door.
- Fit door padding. Refer 'Removal/installation of front/rear door padding'.

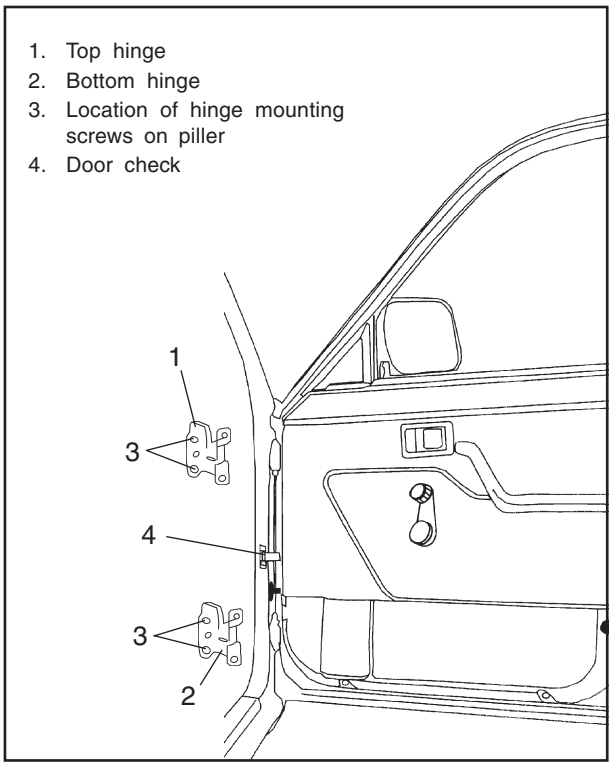


Fig. 2

4. REMOVAL / INSTALLATION OF DOOR OUTER HANDLE / INNER HANDLE / LATCH

(Fig. 3)

REMOVAL

- Remove door padding.
- Pull out required portion of plastic sheet.
- Disconnect links from outer handle.
- Remove mounting nuts and washers.
- Remove outer handle.
- Disconnect links from inner handle.
- Remove 2 mounting screws and 1 washer.
- Remove inner handle.
- Disconnect links from door latch.
- Remove 3 mounting screws of the latch.
- Remove latch.

INSTALLATION

- Locate outer handle on door panel. Install nuts and washers. Tighten nuts.
- Connect links to outer handle properly.
- Ensure handle functions properly.
- Locate inner handle on door panel.
- Install washers, screws and tighten screws.
- Locate latch on door.
- Install 3 screws and tighten screws.
- Connect links properly.
- Ensure proper functioning of latch.
- Fix the plastic sheet properly.
- Fit door padding.

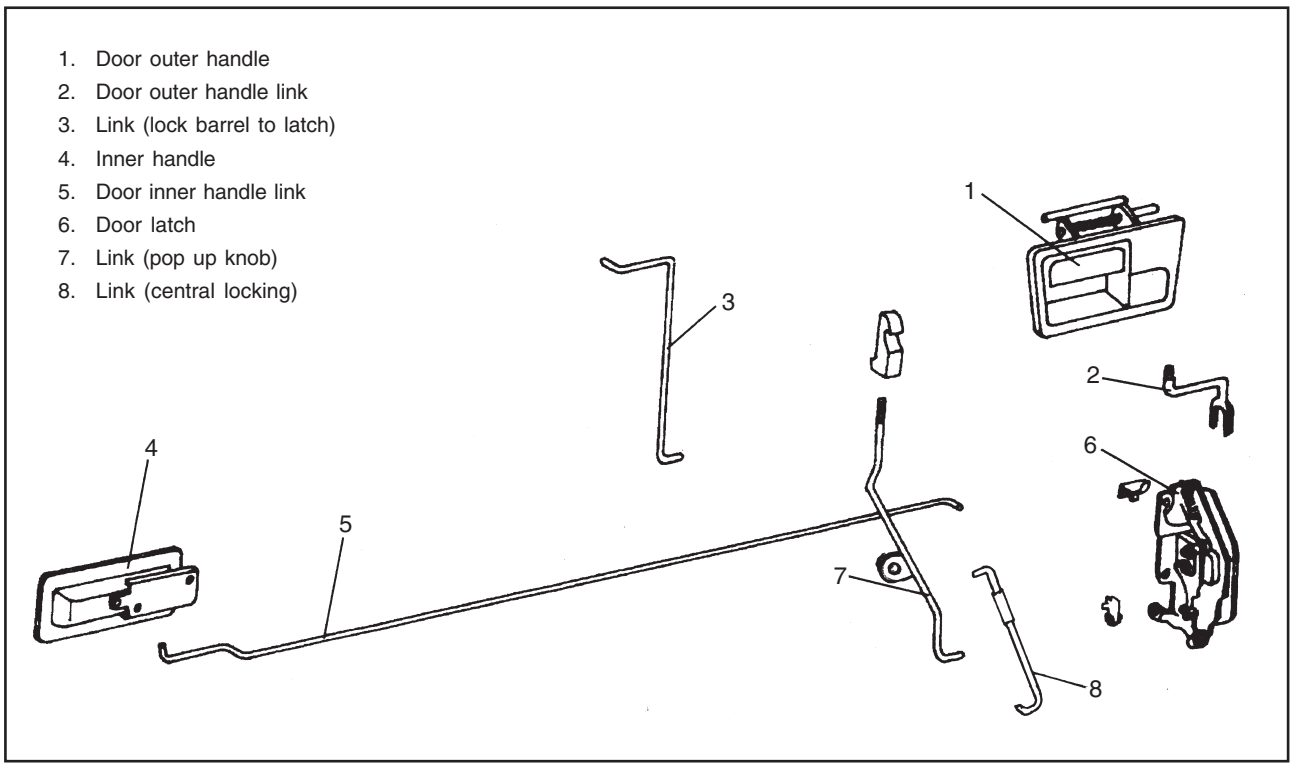


Fig. 3 : Front door locking linkages

5. REMOVAL / INSTALLATION OF WINDOW GLASS / WINDOW WINDING REGULATOR

(Fig. 4)

REMOVAL

- Pull out the inner plastic cover of door mirror.
- Remove mirror by unscrewing mounting screws.
- Unbent the lugs of outer end of outer weather strip. Remove outer weather strip.
- Remove cover door padding.
- Remove door padding.
- Pull out required portion of plastic sheet.
- Lower window glass using window regulator handle.
- Remove 2 window glass mounting screws, hold the handle in position and lift up the glass carefully.
- Remove mounting screws / nuts of window regulator.
- Remove window winding regulator carefully.

INSTALLATION

- Locate window regulator in door in proper position.
- Fit window regulator mounting screws / nuts.
- Insert door glass in the window slot properly.
- Align mounting holes of door glass and regulator. Fit 2 screws and tighten screws.
- Roll up and down the glass and ensure that glass is moving without binding. Ensure that there is no gap between glass and glass run mould, when glass is lifted up. Use window regulator handle for rolling up and down the glass.
- Tighten regulator mounting nuts/screws.
- Fix plastic sheet properly.
- Fit door padding.
- Fit cover door padding.

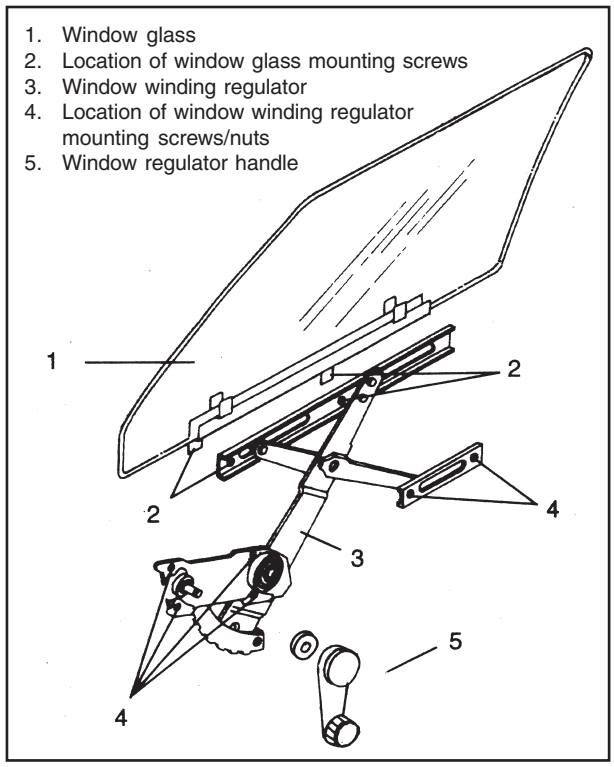


Fig. 4 : Front door window winding mechanism

- Fit outer weather strip. Lock outer end by bending the lugs.
- Align mirror with mounting holes and tighten mounting screws. Refer removal / installation door mirror.
- Press fit inner snap cover properly.

6. REMOVAL / INSTALLATION OF DOOR MIRROR

(Fig. 5 & Fig. 5a)

REMOVAL

- Pry out snap cover from inner plastic cover of mirror mountings, from in side door.

  For alternate design, pry out inner plastic cover (without additional snap cover) from in side door.

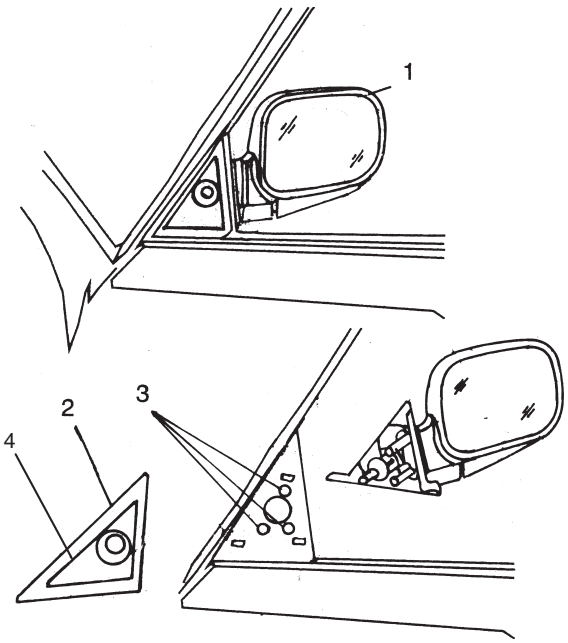
- Hold the mirror, remove mounting screws along with inner plastic cover & remove mirror.

  For alternate design, hold the mirror, remove mounting screws and remove mirror.

INSTALLATION

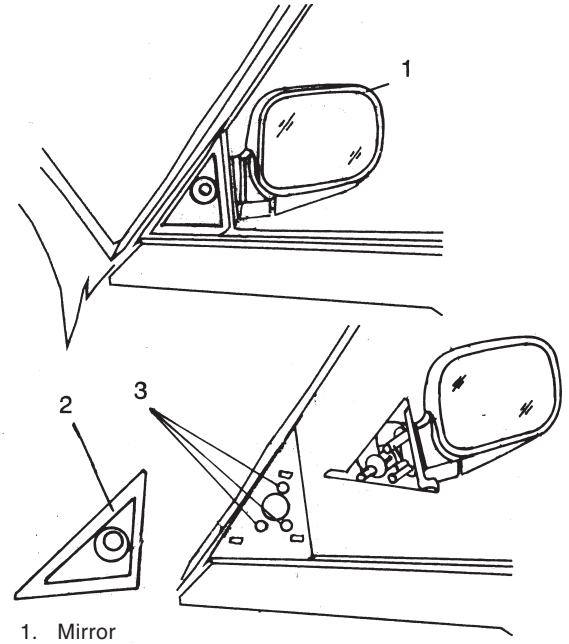
- Locate mirror properly on door gusset.
- Hold the mirror properly in such a way that three mounting points align with holes provided on door gusset.
- Fit inner plastic cover from in side with mounting screws, washers and spring washers. Press inner snap cover.

  For alternate design, put mounting screws, washers & spring washers on door gusset from in side. Press inner plastic cover.



1. Mirror
2. Inner plastic cover
3. Mirror mounting holes
4. Inner snap cover

Fig. 5 : Door mirror (Standard design)



1. Mirror
2. Inner plastic cover
3. Mirror mounting holes

Fig. 5a : Door mirror (For alternate design)

7. REMOVAL / INSTALLATION OF BONNET

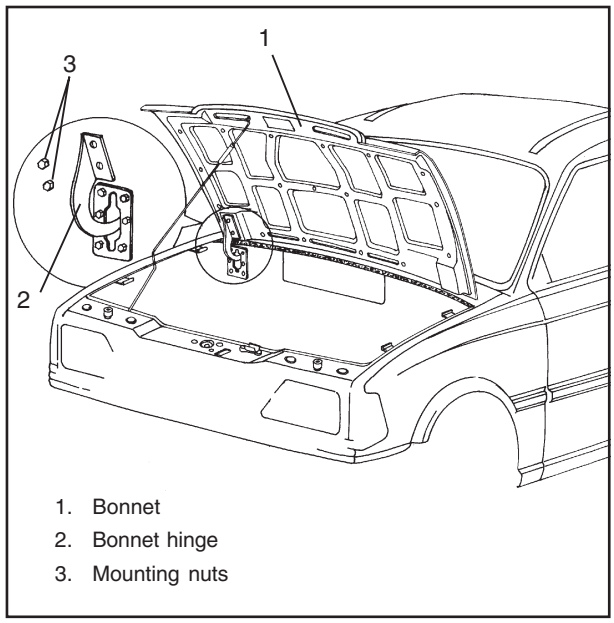
(Fig. 6)

REMOVAL

- Open the bonnet and support it with stay rod.
- Disconnect tube of wind screen washer from nozzle.
- Support the bonnet properly and remove hinge mounting nuts on bonnet from RH & LH sides.
- Remove bonnet.

INSTALLATION

- Locate the bonnet on hinges.
- Support the Bonnet with stay rod and hold it in proper position.
- Fit hex nuts, spring washers and washers for hinge mounting RH & LH to bonnet.
- Ensure correct position of bonnet by closing and opening bonnet.
- Tighten hinge mounting nuts.
- Connect tube of wind screen washer to nozzle.



1. Bonnet
2. Bonnet hinge
3. Mounting nuts

Fig. 6

8. REMOVAL / INSTALLATION OF BONNET SIDE PANEL

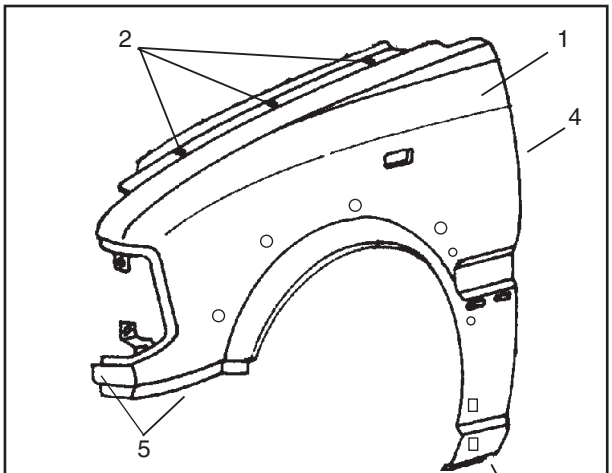
(Fig. 7 & 8)

REMOVAL

- Open the bonnet.
- Remove the side indicator at front corner by removing mounting screws.
- Remove side indicator cover on bonnet side panel using screw driver. Remove mounting screws and remove side indicator.
- Remove mud flap under wheel arch.
- Remove mounting screws of front fender extension for 4x4 vehicles. Pull up and remove front fender extension.
- Remove the mounting screws of bonnet side panel and remove bonnet side panel.

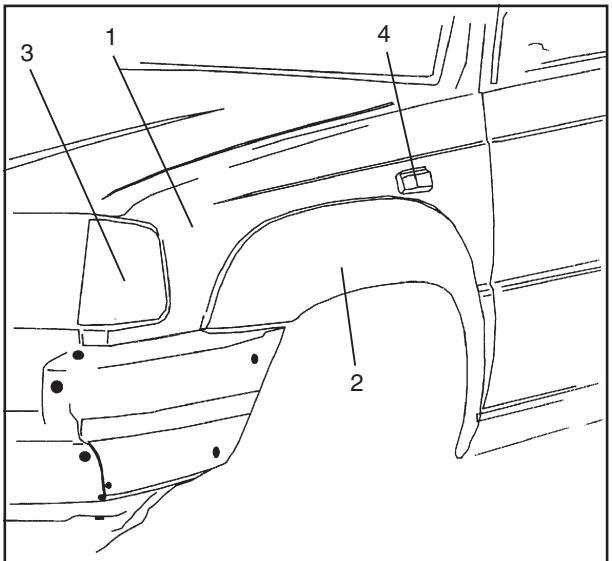
INSTALLATION

- Mount bonnet side panel in position fit and tighten mounting screws.
- Mount front fender extension in position and fit mounting screws for 4x4 vehicles.
- Fit mud flap under wheel arch.
- Connect electrical connector and fit side indicator at the front corner with mounting screws and tighten screws.
- Connect electrical connector and fit side indicator on bonnet side panel with mounting screws and press indicator cover.



1. Bonnet side panel
2. Location of mounting screws - top
3. Location of mounting screws - rear bottom
4. Location of mounting screws - rear middle
5. Location of mounting screws - front

Fig. 7 : Bonnet side panel



1. Bonnet side panel
2. Front fender extension
3. Side indicator at front corner
4. Side indicator on bonnet side panel

Fig. 8 : Bonnet side panel with fender extension

9. REMOVAL / INSTALLATION OF FRONT BUMPER / REAR CORNER BUMPER

(Fig. 9)

REMOVAL

Front Bumper

- Remove front skirt mounting screws and remove skirt.
- Remove bumper mounting screws from side bracket RH & LH.
- Support front bumper properly and remove mounting screws at centre of bumper and remove front bumper.

Rear Corner Bumper

- Hold rear corner bumper LH & remove nuts & reinforcements used for mounting corner bumper on side panel. Remove corner bumper LH.
- Apply same procedure for removal of corner bumper RH.

INSTALLATION

Front Bumper

- Align front bumper on centre support mounting holes & fit centre mounting screws.
- Align front bumper mounting holes on side bracket and fit mounting screws.
- Align the skirt with mounting holes and fit mounting screws.
- Tighten mounting screws of front bumper, guard and front skirt.

Rear Corner Bumper

- Fit bumper rear side RH / LH with mounting screws, spring washers, bright washers and tighten screws.

1. Front bumper
2. Location of mounting screws at side bracket
3. Location of mounting screws at number plate
4. Rear corner bumper

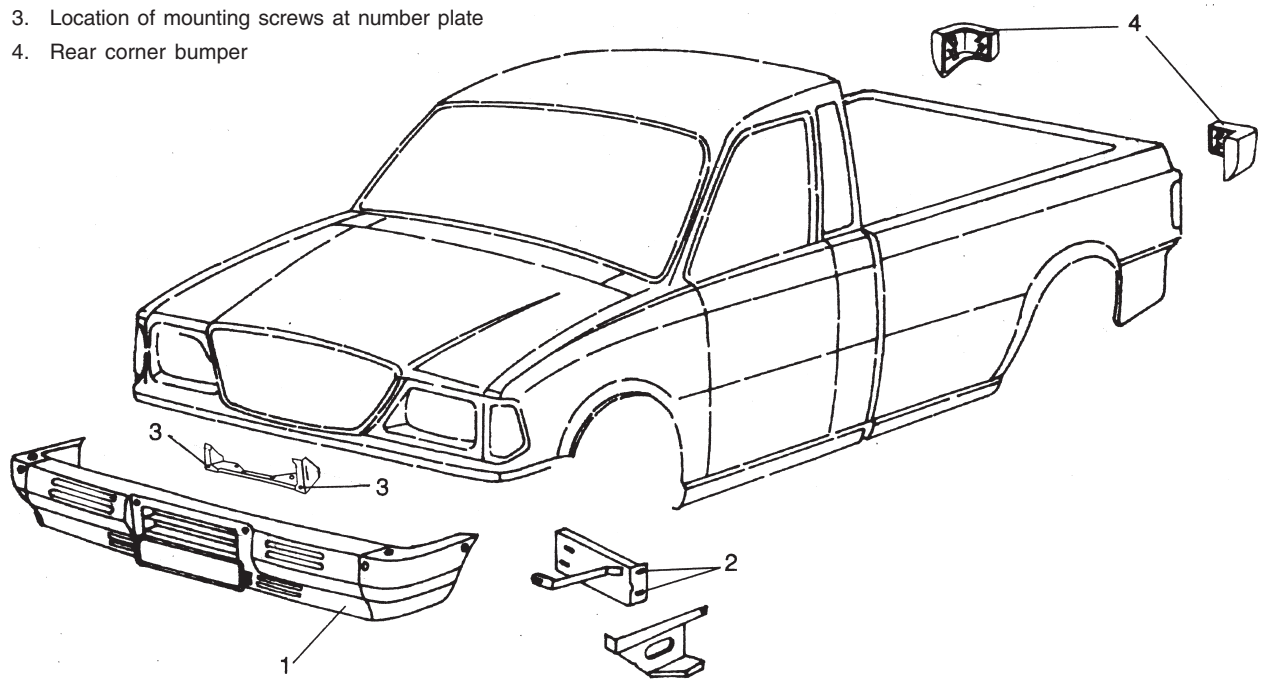


Fig. 9

10. REMOVAL / INSTALLATION OF SEATS

(Fig. 10)

REMOVAL

- Remove seat mounting screws and remove seat.

INSTALLATION

- Locate the seat on fitment holes.
- Fit the seat using hex. screws, spr. washers, bright washers and tighten screws.

1. Bucket Seat
2. Location of mounting screws for bucket seat
3. Lever for seat adjustment (to & fro)
4. Recliner handle knob
5. Rear bench seat
6. Location of mounting screws for rear bench seat
7. Front bench seat
8. Location of mounting screws for front bench seat
9. Back rest recliner lever
10. Lever for seat adjustment (to & fro)

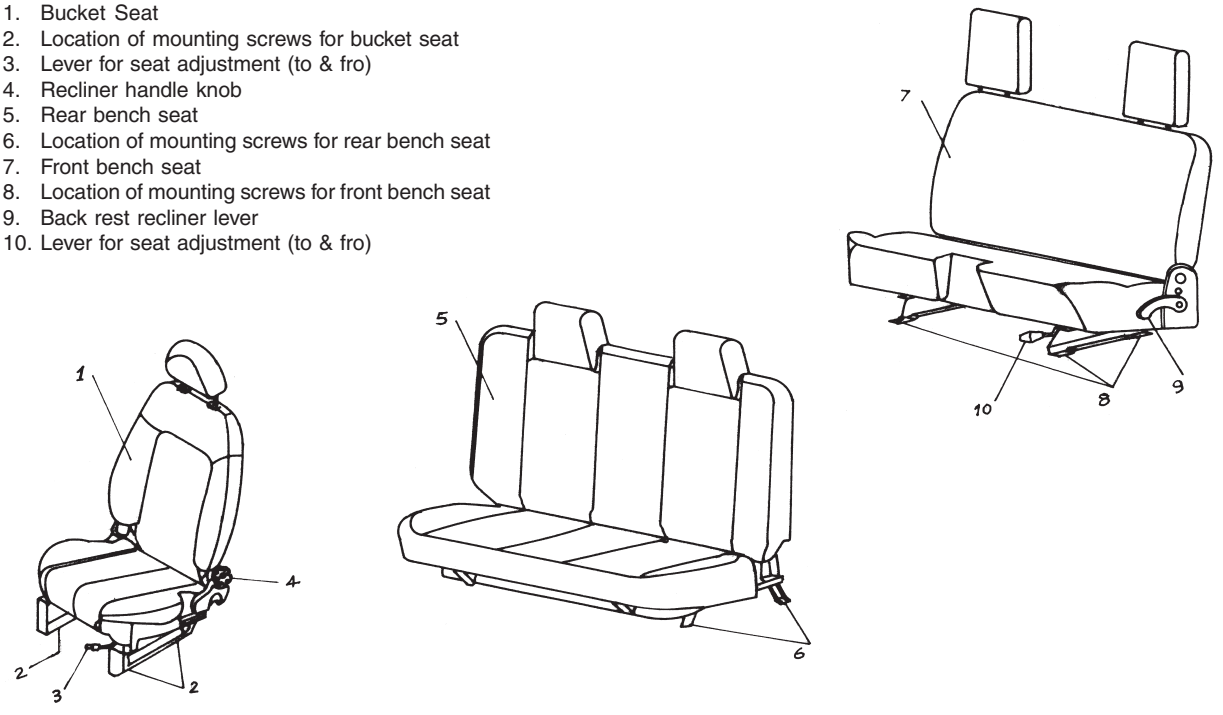


Fig. 10 : Seats

11. REMOVAL / INSTALLATION OF WIND SHIELD GLASS / REAR WINDOW FIXED GLASS

(Fig. 11)

REMOVAL

- Wind shield glass / rear window fixed glass needs to be replaced when glass is broken or surrounding sheet metal area is badly damaged.
- If glass is broken, remove the remaining part of damaged glass by braking it with mallet.
- Scrape the sealant between sheet metal & rubber mould.
- Remove rubber mould.
- If sheet metal portion is damaged and glass needs to be removed, cut off the rubber mould inner portion using knife and remove glass from in side.

INSTALLATION

- Fit the rubber mould on wind shield glass properly.
- Insert nylon rope in the rubber mould notch (to be fitted on window cut-out), such that rope ends are coming at the bottom centre of the glass.
- Apply sealant between sheet metal & rubber mould.
- Align the glass mould on windows cut-out from out side. Pull out the wire rope from both ends such that mould notch will fit on wind shield cut-out on body shell.

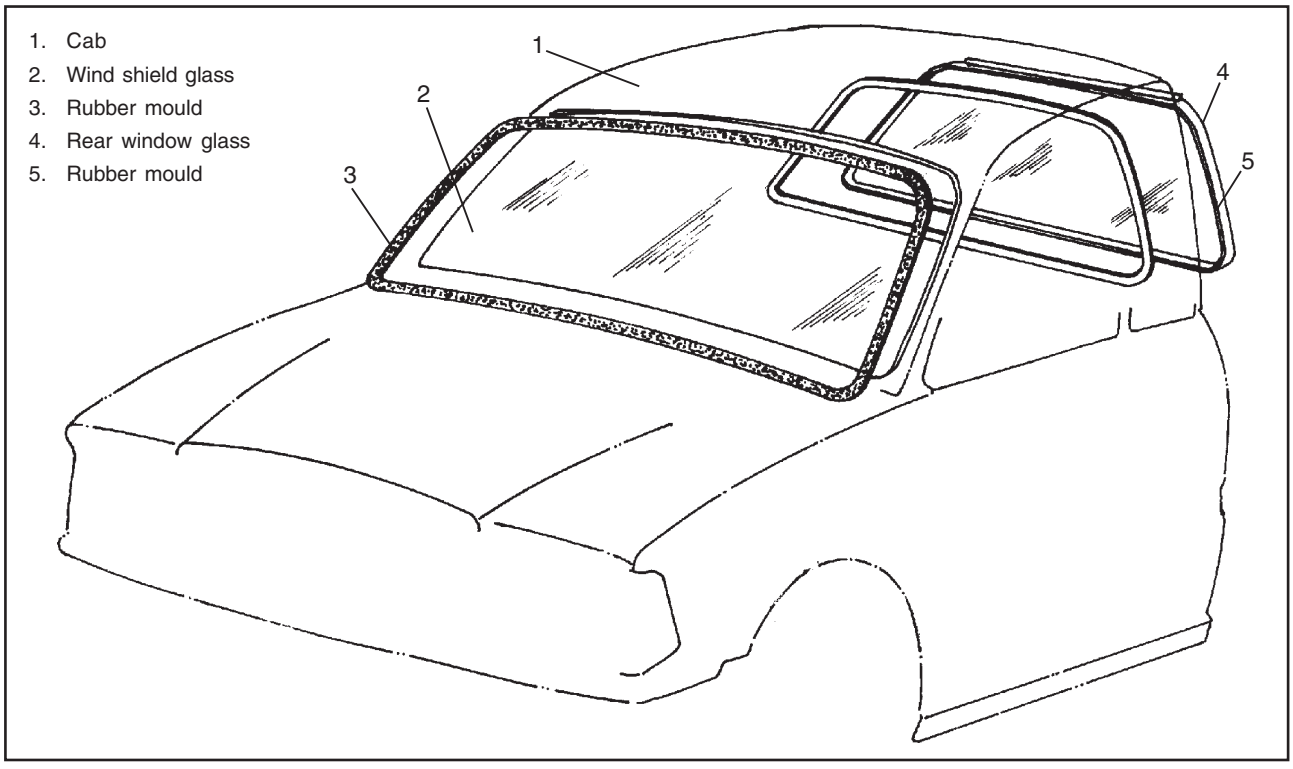


Fig. 11

12. REMOVAL OF MOULDED ROOF LINING

- Remove cab guard on load body.
- Disconnect all electrical connections.
- Remove rear glass (refer removal/installation of rear glass)
- Remove roof lamp front (for crew cab) and rear by unscrewing and disconnecting electrical connections.
- Hold the roof lining properly and remove rear end fitment pins (for crew cab), middle fitment pins (single cab) and driver side fitment pins by prying out with help of screw driver.
- Unscrew grab handles, sunvisors and inner rear view mirror.
- Clear the edges of roof lining from in side the beading.
- Pull the roof lining downword and push through rear glass opening and remove roof lining.



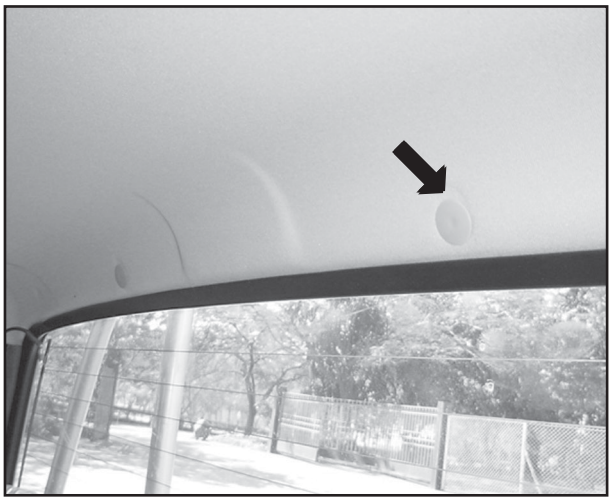
Roof lining fitment pins (Driver side)



Roof lining fitment pins (Middle -Single cab)



Cab guard on load body



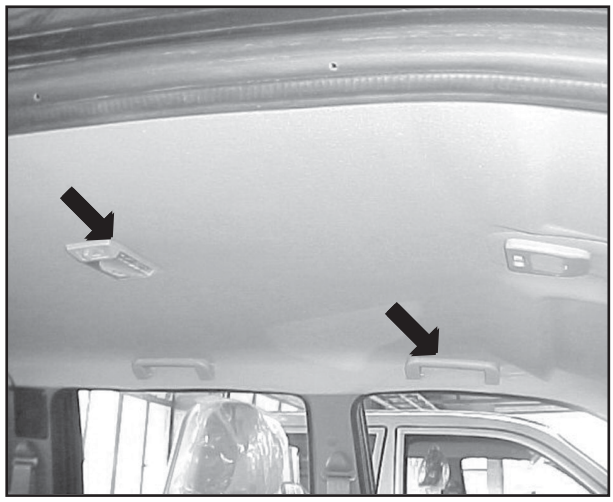
Roof lining fitment pins (Rear-Crew cab)

INSTALLATION OF MOULDED ROOF LINING

- Insert the moulded roof lining through opening of rear glass.
- Hold roof lining to the roof.
- Position roof lining in such a way that rear lamp connector & front lamp connector (for crew cab) passes through lamp fitment cut outs for fitment of lamps.
- Hold the lining and fit lamps with electrical connectors.
- Fit front grab handles with screws on cab through roof lining holes.
- Fit the roof lining on cab with plastic pins.

  Single cab : Driver side 2 pins, middle 4 pins.

  Crew cab : Driver side 2 pins, rear 2 pins
- Fit rear grab handles with screws on cab through roof lining holes. (for crew cab)
- Fit sun visor LH/RH & inner rear view mirror on cab through the holes on roof lining.
- Fit front lamp with electrical connector (for crew cab)
- Fit rear glass (see removal/installation of rear glass)
- Put the edges of roof lining in side the door inner beading front and rear glass beading.
- Fit cab guard on load body.
- Connect the electrical connections.



Roof lamps & grab handles



Front lamp (Crew cab)



Grab handle screws

13. REMOVAL OF FRONT SEAT BELT

- Remove the BC-Post bottom lining by unscrewing screws.
- Unscrew bottom anchor screw at B-C post (for crew cab)
- Remove B-C post ELR (Emergency locking retractor) cover by unscrewing belt bottom anchorage & two screws at top of ELR cover (for single cab)
- Remove seat belt guide bracket plastic cap by pulling the cap.
- Unscrew top anchor screw & hold seat belt. Remove ELR unit from BC post cavity & remove seat belt.
- Unscrew seat belt buckle side stock from floor bracket disconnecting electrical connector (for driver side buckle stock) & remove the stock.

INSTALLATION OF FRONT SEAT BELT

- Fit top anchor screw of ELR seat belt on plastic trim of BC-Post.
- Assemble ELR unit of belt in side the cavity at bottom of BC-Post. Ensure that the dust entry prevention cap is fitted prior to assembly of ELR unit.
- Fit seat belt guide bracket with two screws after placing outer part of seat belt, connected with ELR unit, within the guide bracket. Fit plastic cap on guide bracket by snap fit.
- Fit open end of seat belt anchor screw at BC-Post at bottom (for Crew Cab).
- Fit seat belt bottom anchor screw along with ELR cover & fit ELR cover with two screws (for single cab).
- Fit BC-Post bottom lining putting the top flange of lining under BC-Post plastic trim (for Crew cab).
- Fit seat belt buckle side stock to bracket on floor (inboard side of veh.) with screw. Connet electrical connector for driver side buckle stock.



B-C post bottom lining



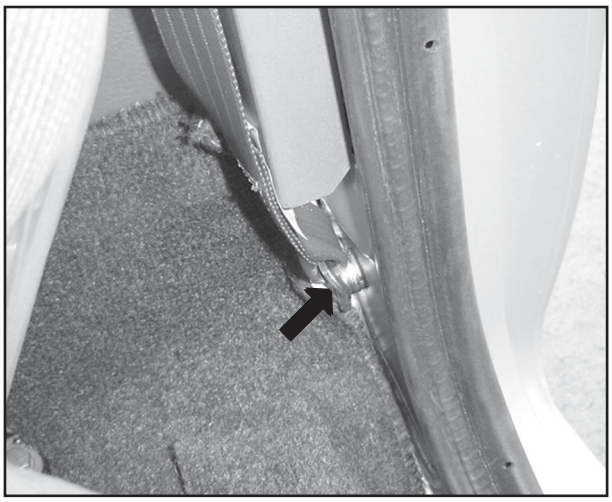
Top anchor screw



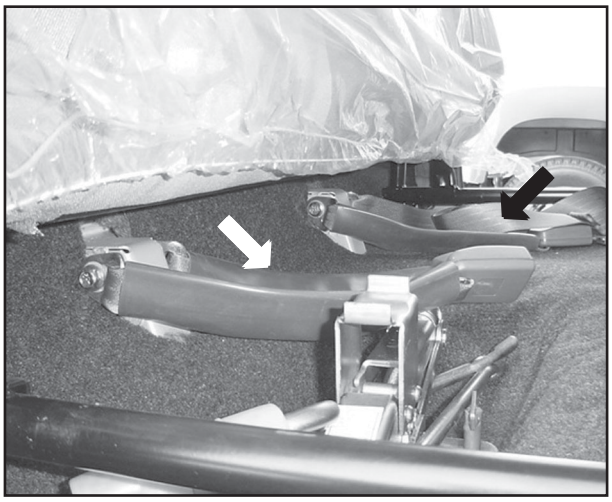
Seat belt buckle side stock

14. REMOVAL OF REAR SEAT BELT (CREW CAB)

- Open up seat cushion by putting rear end of cushion towards upside. Front end of cushion is hinged to seat frame. Hold the cushion vertically.
- Unscrew LH buckle side stock of ELR belt & lap belt tongue side from floor LH bracket. Remove belt.
- Unscrew RH buckle side stock of ELR belt & lap belt buckle side stock from floor RH bracket. Remove belt.
- Close seat cushion by gentle push.
- Unscrew seat belt anchor screw at D-post bottom.
- Unscrew ELR cover / ELR belt screw. Remove ELR cover by prying out two plastic pins.
- Remove plastic cap on guide bracket by pulling the cap.
- Unscrew seat belt guide bracket & remove bracket.
- Unscrew top anchor screw on D-post & hold the belt. Remove ELR unit from D-post cavity & remove seat belt.



Seat belt anchor screw at D post bottom



Buckle side stock for rear seat



Seat belt anchorage on B-C post

INSTALLATION OF REAR SEAT BELT (CREW CAB)

- Fit top anchor screw on D-post trim.
- Assemble ELR unit of belt in side the cavity at bottom of D-post. Ensure that dust entry prevention cap is fitted prior to assembly of ELR unit.
- Fit seat belt guide bracket with two screws after placing outer part of seat belt, connected with ELR unit, with in the guide bracket.
- Fit plastic cap on guide bracket, by snap fit.
- Assemble ELR cover at bottom & tighten with screw & two plastic pins.
- Fit open end of seat belt anchor screw at D-post bottom.
- Open seat cushioning by pulling rear end of cushion towards upside.
- Fit LH buckle side stock of ELR belt and lap belt tongue side on floor LH bracket with screw.
- Fit RH buckle side stock of ELR belt and lap belt buckle side stock on floor RH bracket with screw.
- Close seat cushion by gentle push.



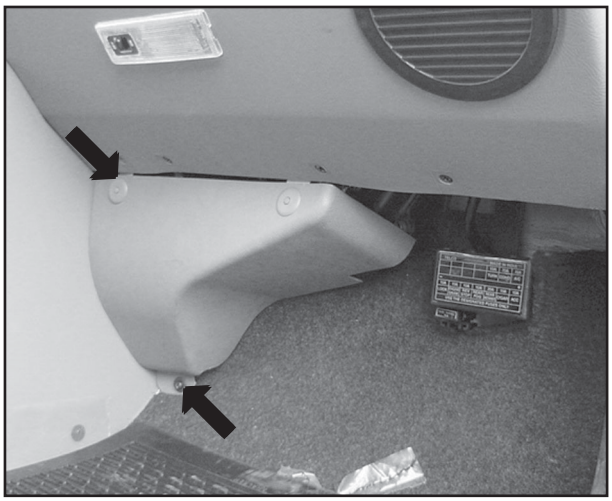
Top anchor screw on D-post

15. REMOVAL OF CONSOLE (4X4 VEHICLE)

- Unscrew three numbers of screws at each side of LH/RH used for fit of console with floor tunnel.
- Pry-out front console top fitment pins and rear end fitment pins.
- Remove gear shift lever bellow.
- Remove blower cover on co-driver side by the side of front console by prying out two plastic pins at top and unscrewing bottom fixation.
- Remove cigarette lighter, disconnecting electrical connector.
- Pry out two nos. pins used for connecting front & middle console.
- Now remove front console, middle console and rear console.



Console 4x4



Blower cover mounting pins

INSTALLATION OF CONSOLE (4X4 VEHICLE)

- After fitment of floor carpet and fitment of dash board, fit the console front by fixing two mountings at top with plastic pins on to the dash board.
- Fit middle console front edge below front console and fix with two plastic pins at front of middle console.
- Fit rear console with two screws (one LH & one RH) with floor tunnel.
- Fit front & middle console with two numbers of screws each side of LH/RH with floor tunnel.
- Snap fit rear console cover.
- Assemble cigarette lighter with electrical connector on console front.
- Assemble ash tray by gentle push on console front.



Front console fitment pins

16. REMOVAL OF CONSOLE (4X2 VEHICLE)

- Remove rear cover by pry out.
- Unscrew console body rear two screws on tunnel top bracket.
- Unscrew console rear - front bottom screws from LH & RH side.
- Unscrew the cover front screw, remove the snap fitment by pull out. Remove cover front.
- Remove console body rear.
- Unscrew console body front two screws on top of tunnel at front side.
- Unscrew console body front two screws at rear side on tunnel bracket.
- Unscrew one screw each side of LH & RH from console body front, at front bottom.
- Remove the console body front.

INSTALLATION OF CONSOLE (4X2 VEHICLE)

- After fitment of floor carpet & dash board fit the console body front on tunnel top with two screws.
- Fit console body front with one screw each side of LH & RH at front bottom, with tunnel side bracket.
- Fit console body front with two screws at rear end, with tunnel bracket.
- Fit console body on body front by snap fit & with one screw.
- Assemble console at rear of tunnel. Fit alongwith console body front flange on to the tunnel side bracket by one screw each side of LH & RH, at front bottom.
- Fit console body rear with two screws on to the tunnel top bracket at rear.
- Snap fit rear cover at rear end of body rear.



Console



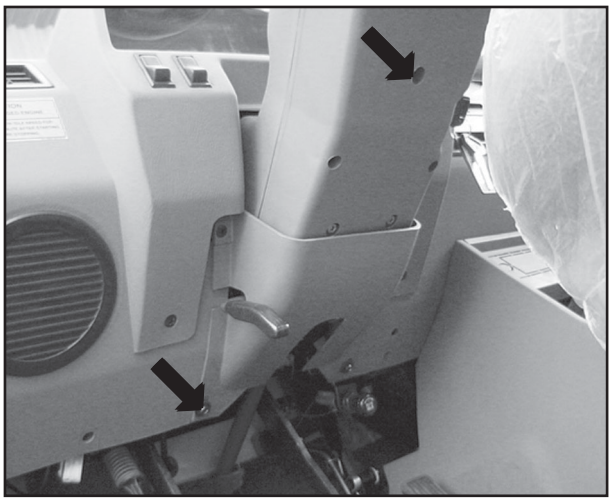
Console

17. REMOVAL OF DASH BOARD

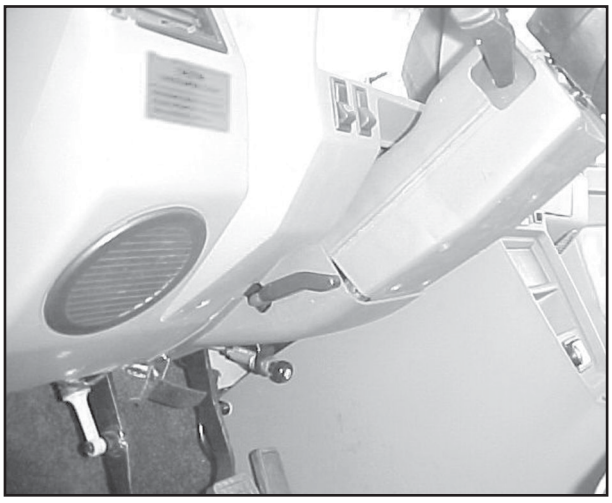
- Remove battery
- Unscrew two cut out covers near centre bonnet hinges on support panel (Engine house side)
- Unscrew the nuts used for fitment of dash board on fire wall, through support panel cut outs.
- Remove steering wheel.
- Remove shroud - refer removal of shroud procedure (page 29).
- Remove nacelle bottom, front & rear - refer removal of nacelle procedure (page 30).
- Remove instrument cluster.
- Remove combi switch.
- Remove the handbrake on dash board for bench seat version.
- Unscrew the bottom mounting screws of dash board with dash board cross member.
- For 4x2 vehicle remove control knob caps & cover from dash board after disconnecting push-pull cables.
- Remove map reading lamp & disconnect electrical connector.
- Before removing the dash board ensure that all electrical connectors are disconnected.
- Lift the front edge of dash board from under the wind shield glass mould.
- Remove console front - refer removal of console (page 25 & 31).
- Hold dash board & pull it towards rear to clear the dash board from top centre locator on fire wall.
- Pull dash board rear wards & remove it.



Dash board



Nacelle mounting screws



Nacelle front, rear & bottom

INSTALLATION OF DASH BOARD

- Assemble dash board front top centre on locator pin of fire wall.
- Ensure that front edge of dash board is placed under wind shield glass mould.
- Fit dash board with two nuts from engine house side, through the cut outs of support panel, near centre bonnet hinges & replace cut out covers.
- Fit instrument cluster on dash board.
- Fit combi-switch.
- Fit nacelle front / rear / bottom over steering column - refer nacelle installation (page 30).
- Fit shroud - refer shroud installation (page 29).
- Fit bottom mountings of dash board with dash board cross member with screws.
- For 4x2 vehicle fit the control cover, connecting the push pull cables. Fit the control knob caps.
- Fit map reading lamp & electrical connector.
- Ensure that all electrical connectors are connected.
- Refit front console in position - refer console installation (page 26 & 31).
- Assemble battery in position with connections.



Dash board



Control panel (HVAC) & air ducts

18. REMOVAL OF SHROUD ON DASH BOARD

- Disconnect all electrical connections.
- Unscrew two screws at bottom of shroud on dash board.
- Remove two screws caps on top of shroud by pry out.
- Unscrew two screws below screw caps.
- Remove switches on shroud & disconnect connectors.
- Remove shroud.



Shroud

INSTALLATION OF SHROUD ON DASH BOARD

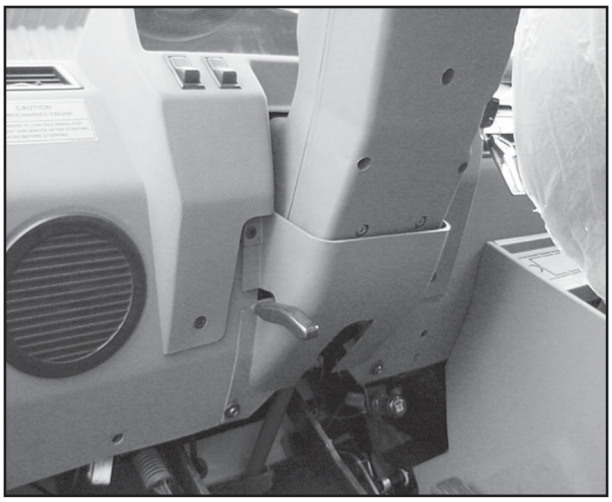
- Place the shroud on dash board.
- Fit the shroud with two screws at bottom, on dash board.
- Fit the shroud with two screws at top on dash board.
- Fit two screw caps by snap fit to cover top mounting.
- Fit electrical connectors for switches on shroud & fit switches.

19. REMOVAL OF NACELLE

- Unscrew four screws for fitment of nacelle bottom & remove nacelle bottom.
- Unscrew five screws for fitment of nacelle front & rear with steering column.
- Separate nacelle front & rear by pry out & remove.

INSTALLATION OF NACELLE

- Assemble nacelle front & rear above & below the steering column covering the combi switch.
- Fit nacelle front & rear with five screws.
- Fit nacelle bottom with four screws on dash board.



Nacelle

20. REMOVAL OF FRONT GRILL

- Unscrew four screws & washers from bottom of grill mounting bracket.
- Unscrew two screws & washers from top of grill mounting bracket.
- Remove assembly front grill.

INSTALLATION OF FRONT GRILL

- Fit four numbers of screw gromments on bottom brackets of grill mounting.
- Fit two numbers of screw grommets on top brackets of grill mounting.
- Place assembly front grill on to the mounting brackets & fit with screws / washers.



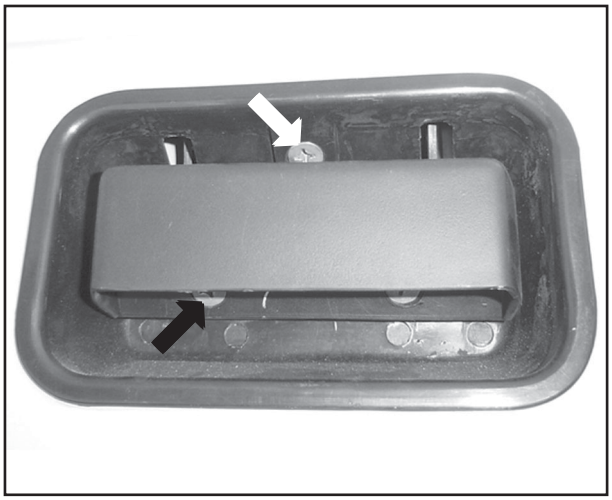
Front Grill

21. REMOVAL OF TAIL GATE LATCH MECHANISM

- Remove tail gate handle by unscrewing two mounting screws from tail gate centre latch handle lever.
- Remove cover by unscrewing two mounting screws from tail gate outer panel.
- Disconnect pull rod hook nylon clip end from centre latch levers at LH & RH sides after loosening the threaded adjustment of pull rod.
- Remove centre latch by unscrewing three mounting screws on tail gate inner panel.
- Unscrew bottom mounting screw of plunger/ striking strap/rope fitment at LH & RH side on tail gate.
- Unscrew assembly rope mounting screw at LH & RH from load body & remove assembly rope LH & RH.
- Unscrew top mounting screw of plunger/ striking strap fitment at LH & RH on tail gate.
- Remove striking strap, assembly plunger complete with pull rod assembly by pulling the assembly from out side at LH & RH.
- Seperate out assembly pull rod from assembly plunger by removing the bent end of pull rod from plunger slot.



Tail gate & rear body under runner



Tail gate handle screws



Tail gate rope

INSTALLATION OF TAIL GATE LATCH MECHANISM

- Assemble the assembly pull rod with assembly plunger complete by inserting bent end of pull rod in the slot of plunger. Assemble pull rod hook to the other end of assembly pull rod. Fit nylon clip to pull rod hook end. Apply grease on plunger for free movement while assembling.
- Insert pull rod end of above assembly through tail gate shell side top cut out to in side the tail gate shell & put the plunger housing flange & mounting strap out side the shell.
- Assemble striking strap on mounting strap & fit the assembly with tail gate with one screw on each side of LH & RH at top.
- At bottom put one spacer & assembly rope on striking strap & fit the assembly on tail gate with one screw on each side of LH & RH. Assembly rope LH & RH are to be fitted at LH & RH side respectively. Other end of rope is to be fitted on load body with a screw along with a spacer.
- Position the assembly centre latch on tail gate inner panel through the cut out provided on tail gate outer panel. Fit the latch with three screws from out side the inner panel. Apply grease on levers of latch for free movement of levers.
- After adjustment of pull rod length, with threaded adjustment, connect the pull rod hook nylon clip end to centre latch levers from LH & RH sides.
- Assemble cover in side the cut out of tail gate outer panel & fit with two screws.
- Fit the handle on centre latch handle lever with two screws.

22. REMOVAL OF LOAD BODY TAIL GATE

- Open the tail gate resting on two side ropes.
- Unscrew hinge mounting (tail gate side) screws three numbers each side of LH & RH.
- Support the tail gate properly & unscrew the rope mounting (tail gate side) screw one number each side of LH & RH along with spacer.
- Remove tail gate.



Tail gate hinge

INSTALLATION OF LOAD BODY TAIL GATE

- Position the tail gate (fitted with latches, pull rod & plungers) in such a way that the hinge leaf & LH / RH (tail gate side) goes in side the tail gate hinge cavity. (Hinge is already fitted on load body side).
- Support the tail gate suitably & fit the hinge leaf (tail gate side) LH & RH with three number of screws at each side.
- Fit the LH/RH assembly rope end (tail gate side) - refer installation of latch, pull rod, plunger (Other end of assembly rope LH & RH is already fitted on load body side.
- While fitment of tail gate, crease line of tail gate should match with crease line of load body & gap between load body & tail gate should be equal at LH & RH side.

23. REMOVAL OF INTERNAL TRIMS

A - POST TRIM

- Remove front door inner sealing.
- Remove three plastic pins by pry out.
- Clear top end of trim from below roof lining.
- Pull the trim slowly towards rear side, clearing the dash board & remove A-post trim.

B-C - POST TRIM (CREW CAB)

- Remove front & rear door sealing.
- Unscrew seat belt mounting top anchorage.
- Unscrew seat belt guide bracket.
- Remove plastic pins by pry out.
- Remove B-C post trim by clearing the trim from below roof lining.

B-C - POST TRIM (SINGLE CAB)

- Remove inner cover at top of B-C post by pry out.
- Remove door sealing.
- Unscrew seat belt mounting top anchorage.
- Unscrew seat belt guide bracket.
- Remove plastic pins by pry out.
- Remove rear wall trim plastic pins by pry out.
- Remove rear wall trim by clearing the top flange from below rear glass sealing mould & bottom flange from below rear wall padding.
- Remove rear wall padding.
- Remove B-C post trim by clearing the trim from below roof lining.

D - POST TRIM (CREW CAB)

- Remove inner cover at top of D-post by pry out.
- Unscrew seat belt top anchorage.
- Unscrew seat belt guide bracket.
- Unscrew ELR cover anchorage.
- Remove two pins for fitment of ELR cover by pry out.



B-C post trim

- Remove rear seat.
- Remove rear wall trim (below rear glass) plastic pins by pry out.
- Remove rear wall trim by clearing the top flange from below the rear glass sealing mould & bottom flange from below the rear wall padding.
- Remove rear wall padding.
- Remove D-post trim by clearing trim from below the roof lining.

INSTALLATION OF INTERNAL TRIMS

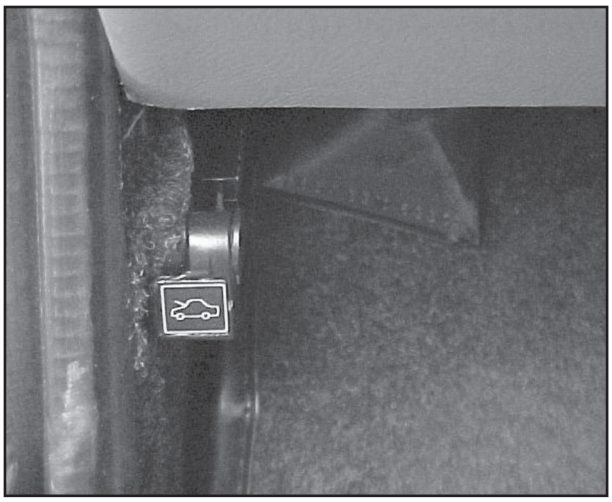
- Assemble A-post trim on A-post mounting location & fit with three plastic pins.
- For Crew Cab - Assemble B-C post trim on B-C post mounting location & fit with three plastic pins & one button.
- For Single Cab - Assemble B-C post trim on B-C post mounting location & fit two plastic pins.
- Fit rear wall trim (below rear glass) on mounting location with four plastic pins, pulling the ends of trim over B-C post trim. Rear wall trim bottom flange is to be put under rear wall padding.
- Assemble door inner sealing. Front edge of B-C post trim is to be put in side sealing flange.
- Rear edge of B-C post trim & rear wall trim top flange are to be put in side rear glass sealing mould.
- Assemble rear edge of A-post (for Single Cab & Crew Cab) in side door sealing flange.
- For Crew Cab - Assemble D-post trim on D-post mounting location & fit with two plastic pins.
- Fit rear wall trim (below rear glass) on mounting location with four plastic pins, pulling the ends of trim over D-post trim.
- Rear wall trim bottom flange is to be put under rear wall padding. Assemble rear door inner sealing. Front edge of D-post trim needs to be put in side rear door sealing flange. Rear edge of D-post trim & rear wall trim top flange are to be assembled in side rear glass sealing mould.
- Top ends of A, B-C & D post are to be assembled below roof lining.



A post trim

24. REMOVAL OF BONNET RELEASE CABLE

- Remove split pin, washer used for fitment of bonnet release cable fork end with centre bonnet mounting bracket bottom assembly.
- Loosen two nuts for fitment of release cable with centre bonnet mounting bracket bottom flange.
- Remove fork end of cable from bottom bracket assembly.
- Loosen screw of clamp for holding release cable on side bonnet inner panel & remove the cable from clamp.
- Unscrew release cable bracket assembly from the side of body.
- Remove rubber gromment from hole of fire wall.
- Pull release cable clearing the path through radiator mounting bracket & engine house. Remove the cable from in side cab.



Bonnet release cable

FITMENT OF BONNET RELEASE CABLE

- From in side the cab assemble bonnet release cable fork end, through the hole of fire wall, towards engine house.
- Fit the bracket of release cable to the side of body with screws at RH side for RHD vehicle & LH side for LHD vehicle.
- Hold release cable at engine house with clamp & screw, on side bonnet inner panel.
- Pass release cable through the cavity of radiator mounting bracket at top.
- Tighten two nuts of bonnet release cable with centre bonnet mounting bracket bottom flange (below tie member), with one nut at each side of flange.
- Tighten fork end of bonnet release cable with washer, screw & split pins to centre bonnet mounting bracket, bottom assembly.

25. REMOVAL OF FRONT FENDER EXTENSION

- Unscrew bottom mounting screws of fender extension.
- Hold fender extension & unscrew fender extension fitment bracket from side panel outer & remove the brackt.
- Lift fender extension upward to remove it from clips.

Note :

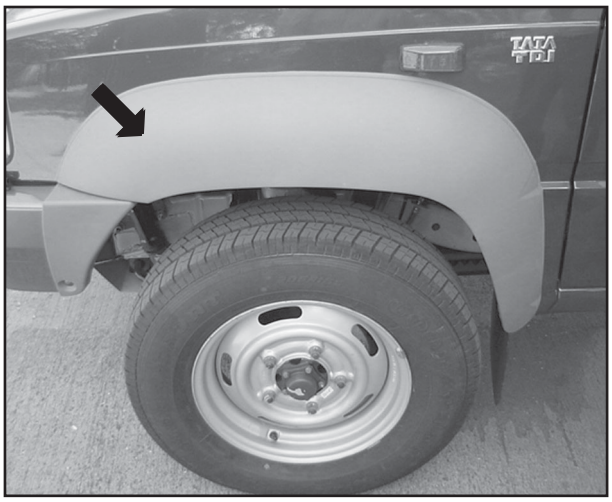
Process of removal of load body fender extension is same as above.

INSTALLATION OF FRONT FENDER EXTENSION

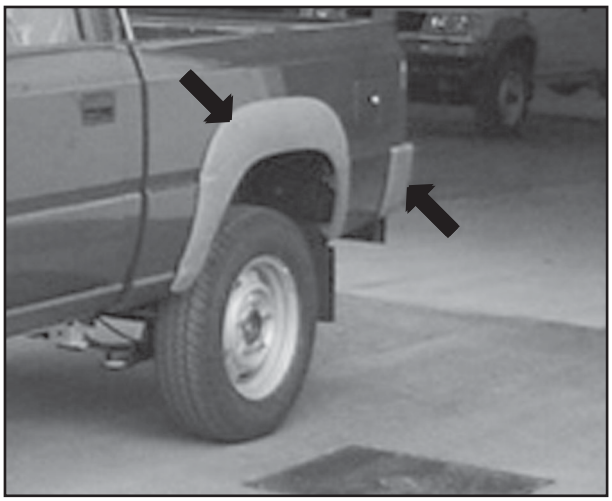
- Fit eight nos. of clips fender extension on the cut out of bonnet side panel outer.
- Fit front mud flap with top four nos. of screws & washers.
- Fit fender extension fitment bracket (4 nos.) on side panel outer in loose condition with screws & washers. One bracket fitment is through mud flap bottom mounting.
- Fit fender extension top flange in clip fender extension fitted on side panel outer.
- Fit bottom mountings of fender extension with screws, washers & nuts with fender extension bracket. After positioning fender extension & bracket in correct location, tighten all screws.
- Fit fender extension beading with adhesive. Through out the beading length along the periphery of fender extension before tightening screws.

Note :

Process of fitment of load body fender extension is same as above. Only number of clips for fender extension & brackets are different.



Front fender extension



Rear fender extension & rear corner bumper

HEATING, VENTILATION & AIRCONDITIONING

INTRODUCTION :

Two types of ventilation systems are available as option in Tata TL.

1] Heating and Airconditioning (HVAC)

2] Heating

In heating and airconditioning arrangement controls on central console can be adjusted to mix heating and cooling to get desired effect.

In heating arrangement temperature of air is controlled by adjusting flow of engine coolant through water valve and blower speed.

In both arrangements provision has been made for demisting windshield glass and door glasses.

This section deals with heating and air conditionining (HVAC) system.

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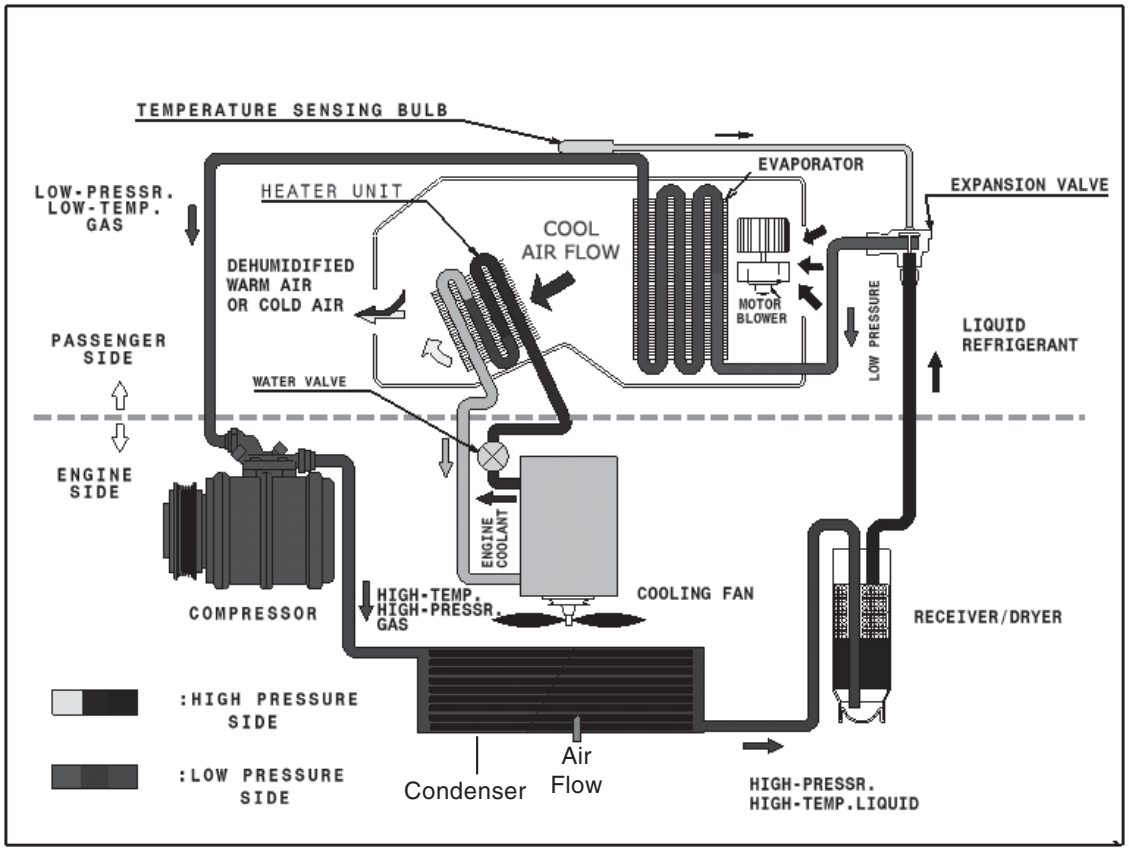
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VENTILATION SYSTEM

SPECIFICATIONS:

PARAMETER	VALUE
COOLING CAPACITY	3080 ±310 kcal/hr at 280 ±28 m^3/hr
AIR FLOW AMOUNT	400 m^3/hr
RATED VOLTAGE	13.5 V
ELECTRIC CONSUMPTION (Total)	376 W
BLOWER MOTOR	216 ±21w
MAGNETIC CLUTCH	40 W
COND. FAN MOTOR	120 W
EVAPORATOR	311 x 185 x 85 mm
CONDENSER (SERPENTINE)	330 x 490 x 22 mm
COMPRESSOR TYPE	10 P13 (133.6 CC/rev.)
REFRIGERANT TYPE	R 134a QUANTITY - 670 ± 20 grams
LUBRICATING OIL	DENSOIL - ND8 Quantity - 80 ± 20 c.c.

VENTILATION SYSTEM WITH HEATING AND AIRCONDITIONING



PARTS FOR AIRCONDITIONING SYSTEM :

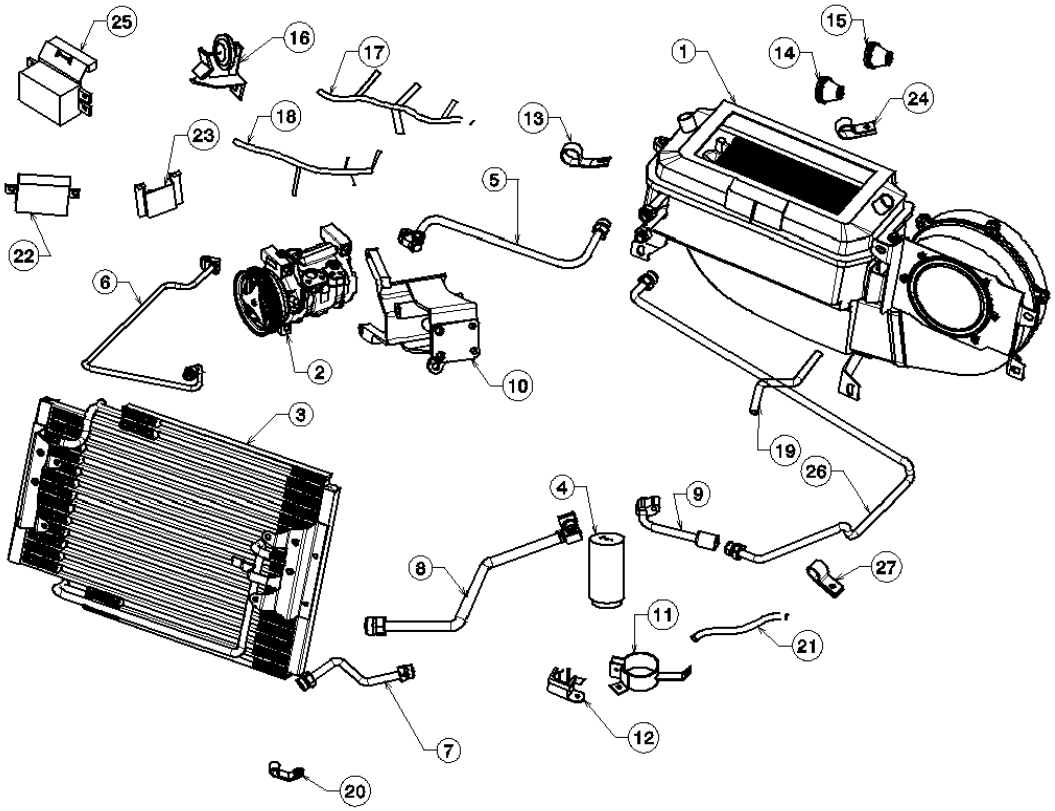


Fig. 1

S.No.	Part Name
1	ASSY INT UNIT W/AC BLOWER
2	COMP ASSY W/MAG CLUTCH
3	CONDENSER ASSY
4	TANK RECIEVER
5	FOSE SUCTION
6	HOSE DISCHARGE
7	TUBE LIQUID(COND. OUT)
8	TUBE LIQUID (R/D IN)
9	TUBE LIQUID (R/D OUT)
10	BKT COMP MOUNTING
11	HOLDER RECIEVER
12	VACCUM SWITCHING VALVE
13	CLAMP HOSE SUCTION
14	GROMMET

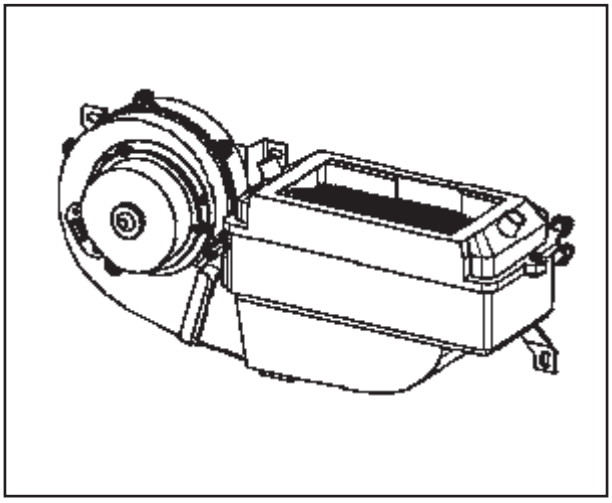
S.No.	Part Name
15	GROMMET
16	ACTUATOR SET IDEAL UP WITH BKT
17	HARNESS S/A WIRING A/C
18	HARNESS S/A WIRING A/C
19	HOSE DRAIN W/GROMMET
20	CLAMP PIPING (R/D INLET)
21	HOSE VACCUM
22	ASSY AMP W/BRACKET
23	ASSY BKT W/V. RESISTER
24	CLAMP PIPING
25	ASSY AMPLIFIER WITH VARIABLE RESISTOR COMPLETE
26	TUBE AND ACC ASSY
27	CLAMP PIPING

AIR CONDITIONING SYSTEM – FULL AIR MIX TYPE

BASIC COMPONENTS

The circuit consists of basic components given below. Refer Fig. No.1

- A/C compressor
- Condenser
- Receiver dryer
- Expansion Valve
- Evaporator
- Pipes and Hoses
- A/C controls



Assy. Int unit W/AC blower

Compressor :

10 P(A) type compressor is used in this system.

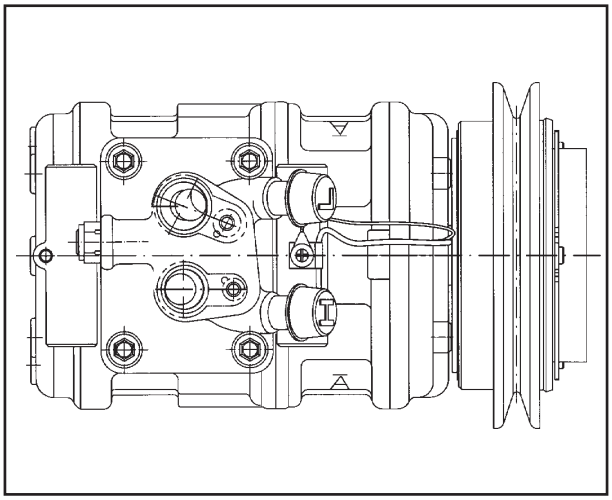
Compressor draws of gaseous refrigerant from evaporator & compresses it. This cause refrigerant gas temperature & pressure to raise rapidly.

It is critical that only gas be drawn into the compressor. If liquid enters, it will cause hydrostatic lock in compressor and stall it. Refrigerant drawn in compressor is compressed to over 14.1 kg/cm^2, which causes it to get very hot.

A safety valve has been provided in compressor to safe guard it from high pressure.

If discharge pressure in the system increases beyond 35 to 42.2 kg/cm2, safety valve will open and will release high pressure gas from the system.

When pressure drops down to 28 kg/cm2, safety valve will close with the help of spring force and will stop leakage of refrigerant.



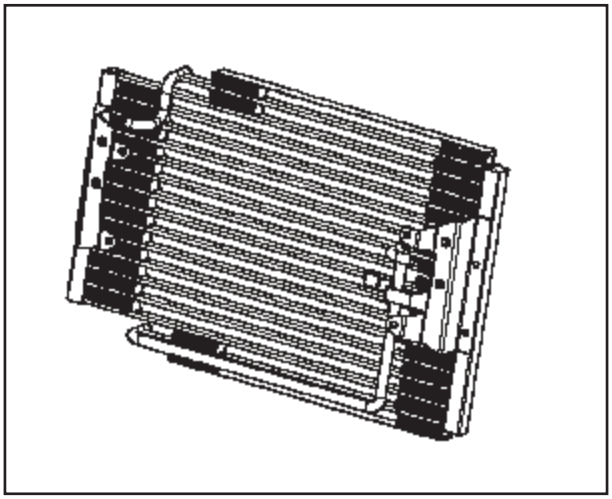
Compressor

Condenser :

Condeser, through heated refrigerant gas gives off heat to engine cooling air. Refrigerant gas cools off and once again becomes liquid.

Condenser is mounted in front of radiator. It changes high temperature gas into liquid under high pressure. When operating in normal conditions, inlet of condenser is full of hot gas and outlet is full of hot liquid.

Condenser fan cools refrigerant inside condenser core.



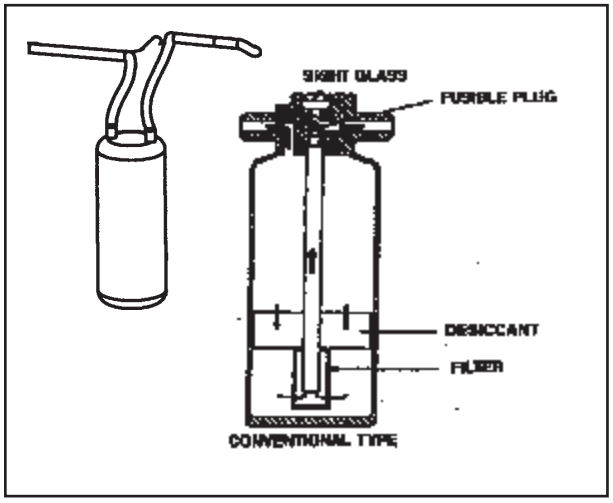
Condenser

Receiver dryer

Receiver dryer removes any traces of moisture and filters out dirt in the system. It also serves as a reservoir for excessive refrigerant.

This component acts as a storage device for liquid refrigerant. It also contains a filter and desiccant to absorb moisture from liquid refrigerant.

A sight glass has been provided to check the amount of refrigerant.

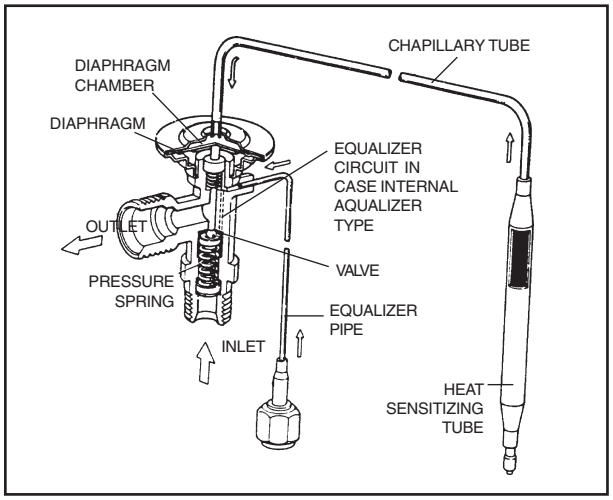


Receiver dryer

Expansion Valve

This valve controls flow of refrigerant into evaporator cores, causing drop in pressure and consequently drop in temperature. It is controlled by a temperature sensor at evaporator outlet. If outlet temperature is too high, it means not enough refrigerant is flowing into the evaporator and poor passenger cooling will result.

If outlet temperature is very cold, it means too much refrigerant is flowing and evaporator fins will probably load up with ice. In either case, temperature sensor opens or closes expansion valve opening to achieve correct flow rate and evaporator outlet temperature.

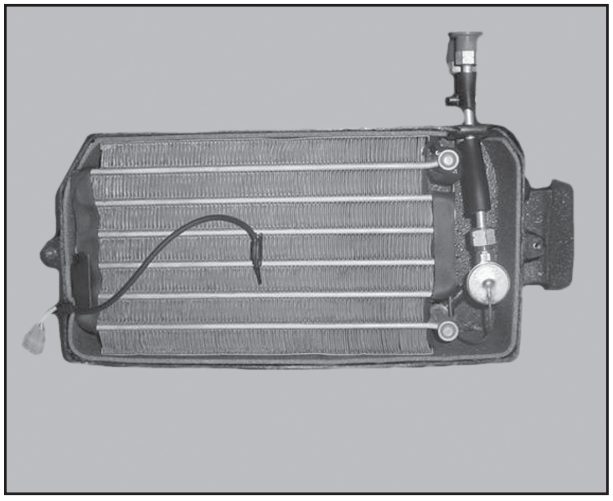


Expansion Valve

Evaporator

Evaporator in which the released refrigerant expands and flow through evaporator tubes. This removes heat from air blowing across the fins & tubes, and evaporates, causing temperature inside cabin gradually to be lowered.

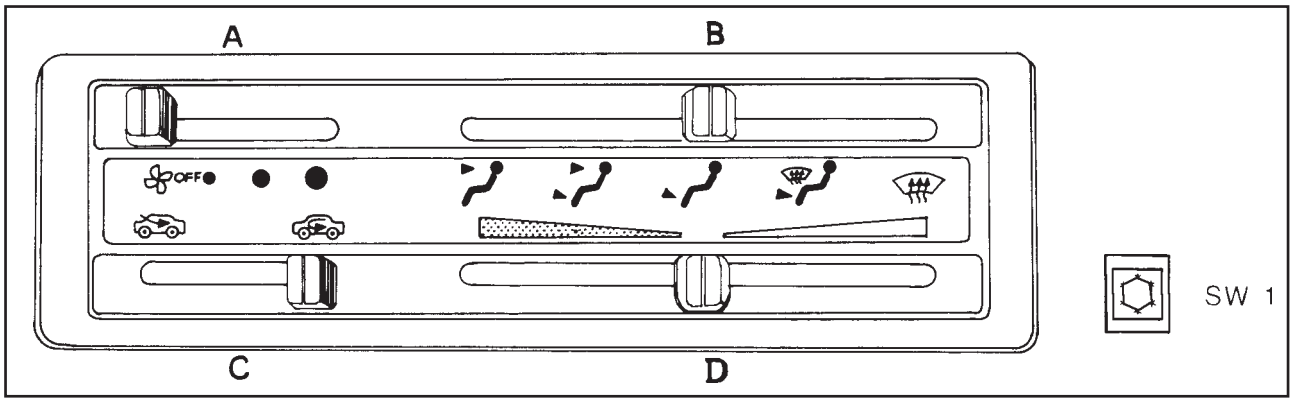
The last component in the cycle, and where we finally get around to cooling air. As the foggy mist of refrigerant enters, air passing over the evaporator fins gives up its heat to evaporating refrigerant. At the inlet refrigerant is liquid & at the outlet it has changed into gas.



Evaporator

HVAC CONTROL PANEL

This control panel has four knobs. Functions handled by these knobs given below. The airflow control switch has five positions for airflow direction.



Slot - 'A' Blower Regulator

- Blower off
- Blower slow speed
- Blower medium speed
- Blower high speed

Slot - 'B' Air Distribution Control

- Air directed towards chest
- Air directed towards chest and legs
- Air directed towards legs
- Air directed towards legs and windscreen
- Air directed towards windscreen (Demist / Defrost)

Demist : Switch-off heater. Direct air flow towards windscreen for a required period.

Defrost : Switch-on heater. Direct air flow towards windscreen for a required period.

Slot - 'C' - Fresh Air / Recirculation Operation

- Cab air recirculation
- Fresh air brought inside and circulated.

D. Air Cooling Controls (for A.C., heating & demisting)

I. Ventilation

When the knob is in middle of the slot, the system is in ventilation mode.

II. Air Cooling Control

AC temperature graduating scale is shown in blue colour. Movement of the knob ranges from middle to extreme right to give gradually minimum to maximum intensity of cooling. Keep blower in max speed for quick cooling effect.

III. Heater control

Heater control graduating scale is shown in red colour. Movement of the knob ranges from middle to extreme left to give gradually minimum to maximum intensity of heat. Flow of hot water supply to heater coil is regulated by this knob. Keep blower in max speed for quick heating effect.

Magnetic Clutch

It is part of AC compressor. It is used to connect and disconnect compressor from engine.

Its main components are stator, rotor with pulley and pressure plate to engage drive pulley and compressor magnetically.

Principle :

When current is fed to the coil, magnetic force is generated in iron II which attracts iron I.

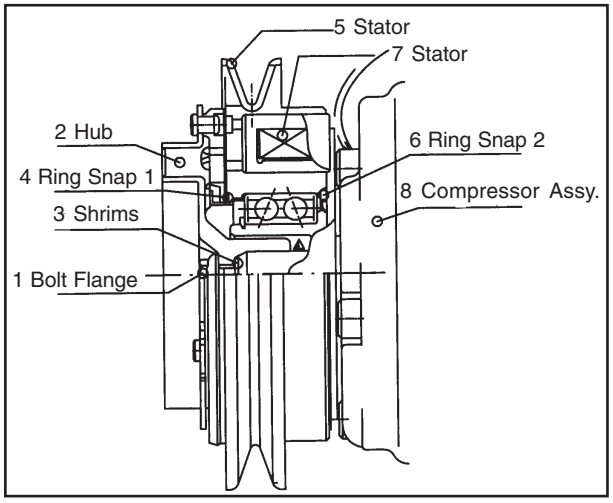
Construction :

Stator is fixed on compressor housing and pressure plate is attached to compressor shaft.

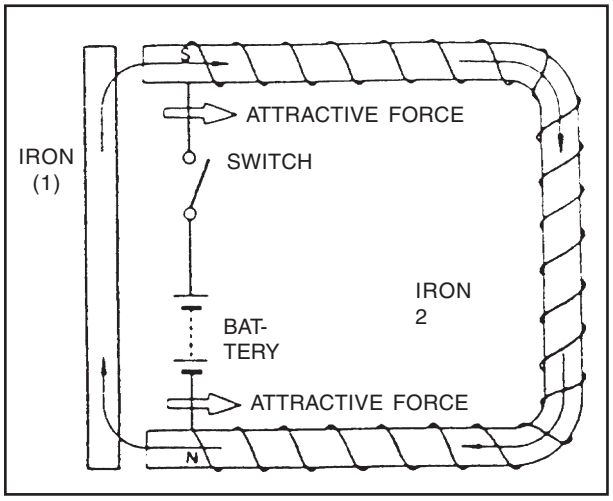
Two ball bearings are used between inner surface of the rotor and front housing of compressor.

Operation :

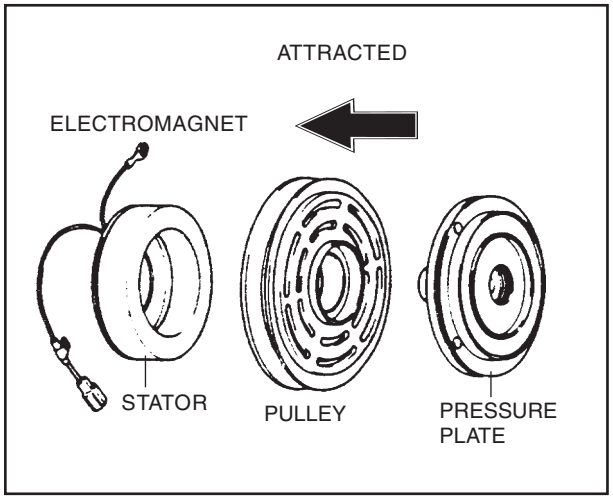
When engine is operating, pulley is rotating since it is connected to crankshaft by belt, but compressor does not operate until magnetic clutch is energized. When air conditioning system is on, current is supplied to stator coil. Electromagnet attracts pressure plate and pulls pressure plate against friction facing on pulley. Friction between facing on pulley and plate causes clutch assembly to rotate as a unit and drive AC compressor.



Magnetic Clutch



Principle



Construction

Vacuum Switching Valve (VSV)

It is a component of engine idling speed raising device. It is provided to enable cooler operation of AC system when vehicle passes through slow traffic conditions.

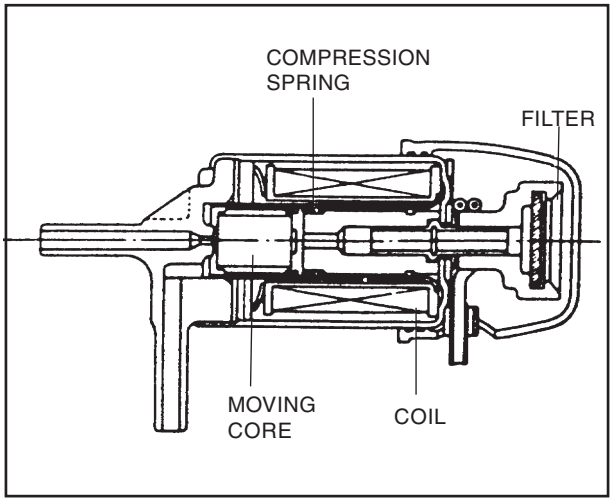
Operation :

When switching on air conditioner, current flows into the coil, and VSV opens to vacuum source by magnetic force.

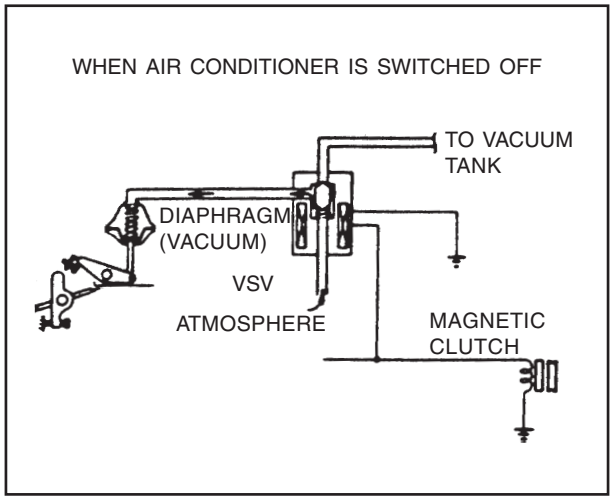
Thus, vacuum will act on diaphragm of actuator installed on FIP.

With the help of actuator accelerator lever is pushed to get higher idling rpm.

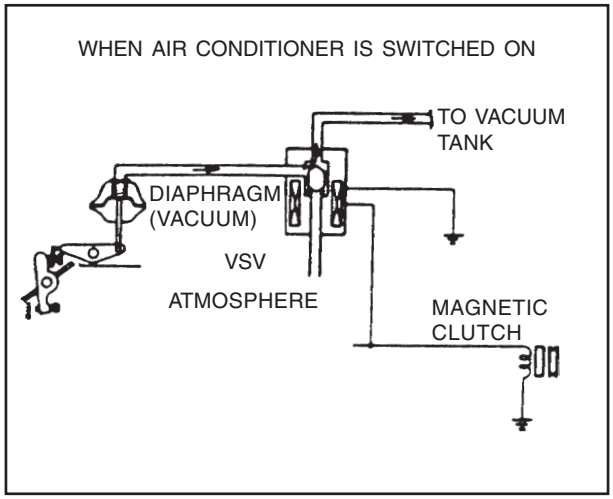
When switching off air conditioner, VSV opens to atmosphere side by compression spring force allowing FIP lever to return to normal idle position.



Vaccum Switching Valve



Idling speed raising mechanism



Idling speed raising mechanism

Dual Pressure Switch

Pressure switch is installed in the liquid line tube in cooling unit.

Pressure switch detects abnormally high or low pressure of refrigerant in system and turns off magnetic clutch to avoid compressor failure.

Standard pressure :

Low Side : 2.0 ± 0.20 Kg/cm^2

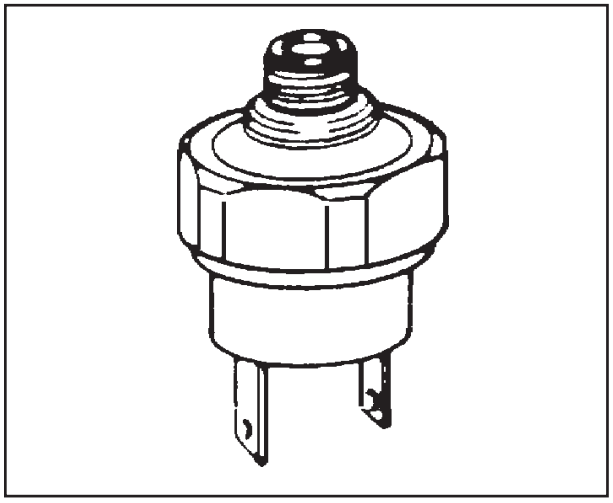
High Side : 32.0 ± 2.0 Kg/cm^2

The Switch will turn off automatically when low side pressure is less than 2 Kg/cm^2 and high side pressure is more than 32 Kg/cm^2.

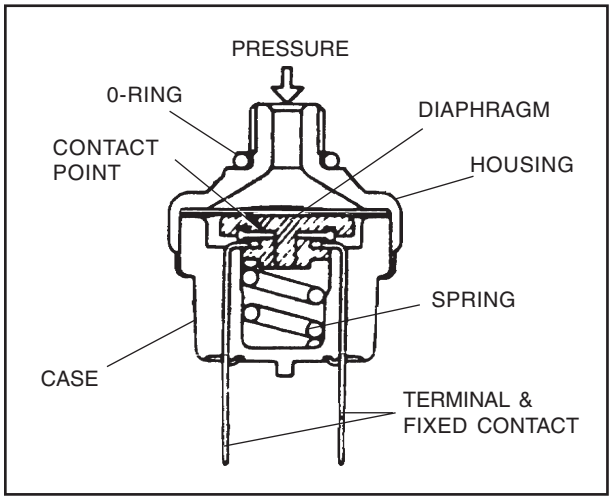
Magnetic clutch gets actuated when blower switch and A/C switch are turned on under and refrigerant pressure is higher than 2.0 Kg/cm2.

Thermo amplifier and thermister

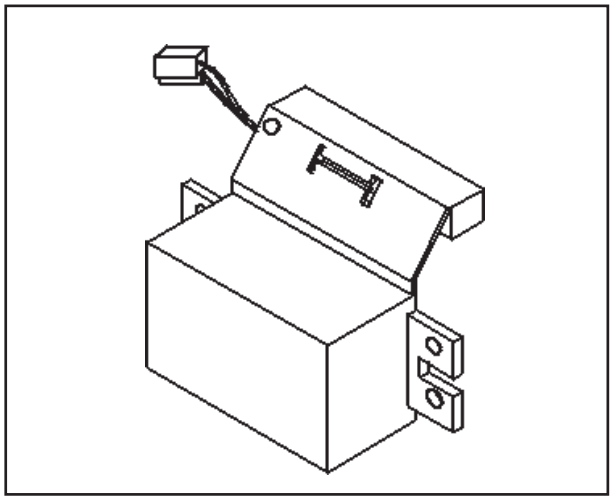
Thermister is a temperature-sensing device and is installed to sense the temperature of air discharged from evaporator. When outlet air temperature from evaporator goes below 3°C, amplifier senses the temperature through thermister and switches off compressor magnetic clutch.



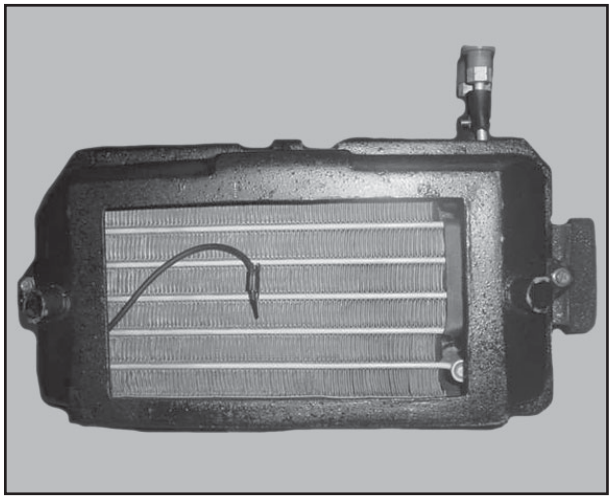
Dual Pressure Switch



Dual Pressure Switch



Thermo amplifier



Evaporator

Removal and Fitment of A.C. Components

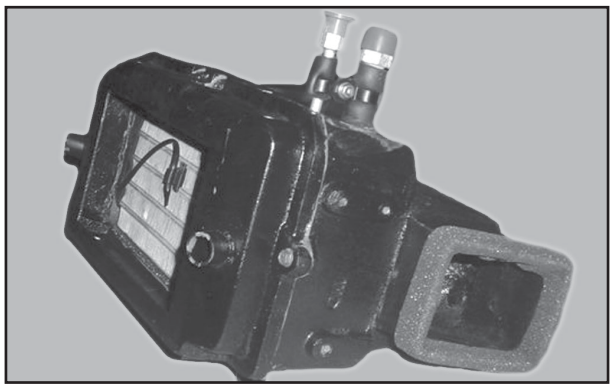
1. Cooling unit Assembly

REMOVAL :

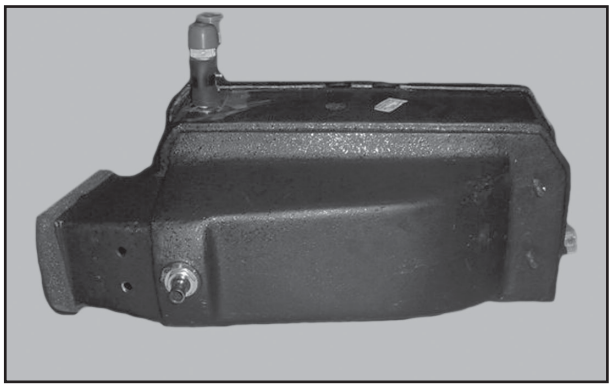
1. Discharge refrigerant with proper equipment.
2. Disconnect inlet & outlet pipes in engine compartment from union of cooling coil. Properly plug unions and pipes openings.
3. Remove hoses at heater inlet and outlet end, in engine compartment. (In case of heater)
4. Properly plug at heater inlet and outlet ends to avoid any leakages of coolant. (In case of heater)
5. Disconnect electrical connections for blower motor, blower resistor, control panel etc. and remove all connectors of wiring harness from cooling/heating unit.
6. Remove heater & face mode control cable.
7. Remove fasteners from mounting points of cooling unit and remove unit from its location. Also remove drain hoses.

FITMENT

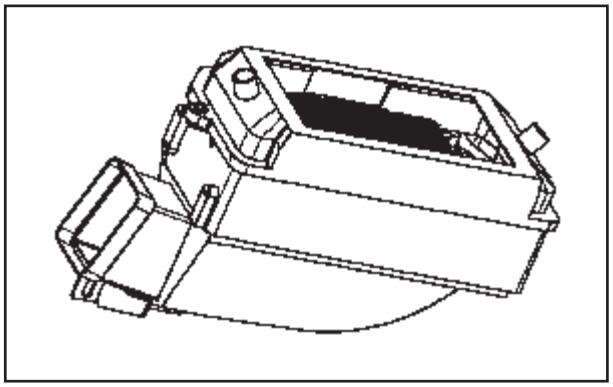
1. Assemble cooling unit and blower assembly with proper fasteners.
2. Fit cooling unit with drain hose on the firewall and tighten fasteners.
3. Fit all connectors of vehicle wiring harness to cooling and blower unit.
4. Fit control cable for face mode and heater control with cooling unit and control panel. Check for proper functioning of heater and foot-face mode controls.
5. Connect refrigerant pipes to respecitive unions on firewall. Make sure that O-rings are intact and properly seated in their grooves. Apply few drops of ND8 compressor Oil on O-rings before fitment.
6. Remove plugs from the heater inlet and outlet ends.
7. Connect hoses to heater inlet and outlet ends.
8. Check the system for leakages and charge the system with charge quantity of 670 ± 20 gms.



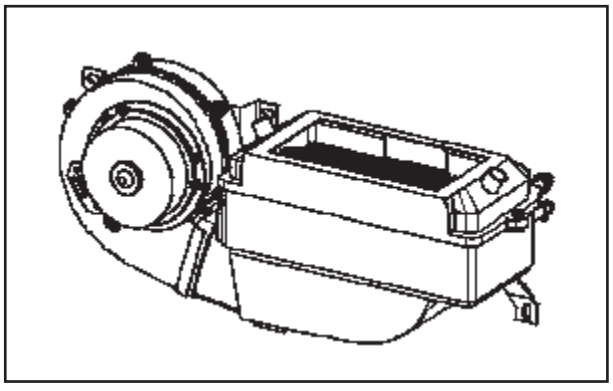
Assembly cooling unit



Assembly cooling unit

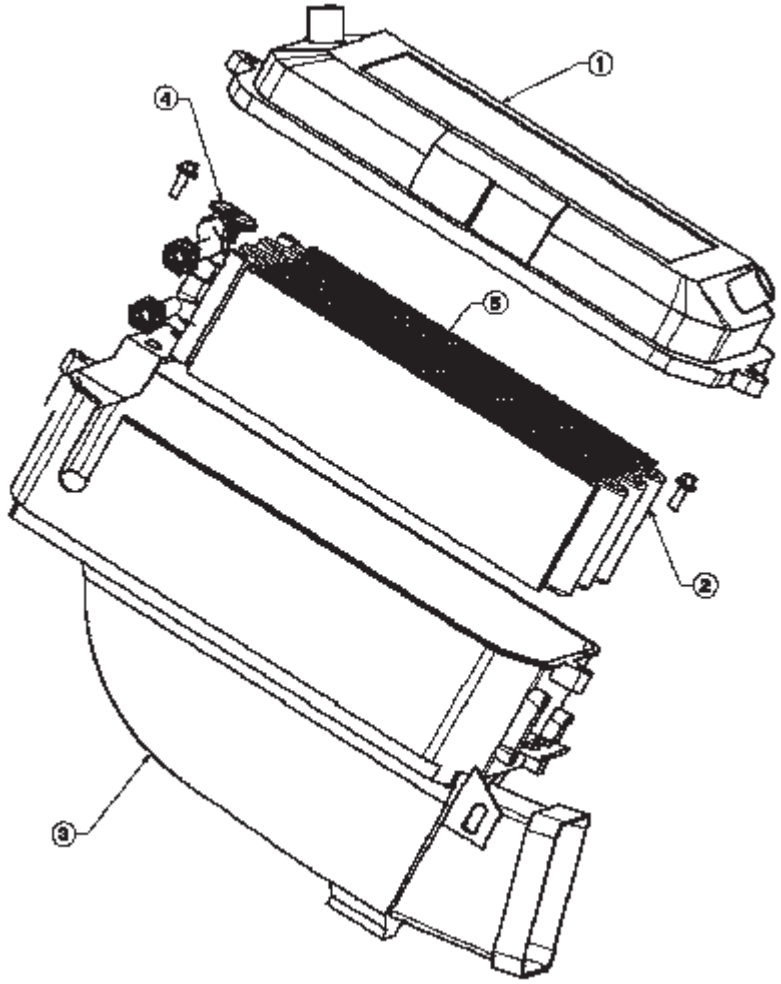


Assembly cooling unit



Assembly cooling unit

EXPLODED VIEW OF ASSEMBLY EVAPORATOR



Assembly Evaporator

S. No	Part Name
1	Adaptor Assy
2	Evaporator Sub Assy
3	Case Cooling Unit
4	Expanasion Valve
5	Thermister

2. Blower Assembly

Remove HVAC unit as explained above.

1. Remove fasteners connecting blower unit with firewall and take out blower unit.
2. Replace blower unit with new one, if necessary and assemble it on cooling unit.
3. Assemble complete cooling unit assembly to the vehicle as explained above.

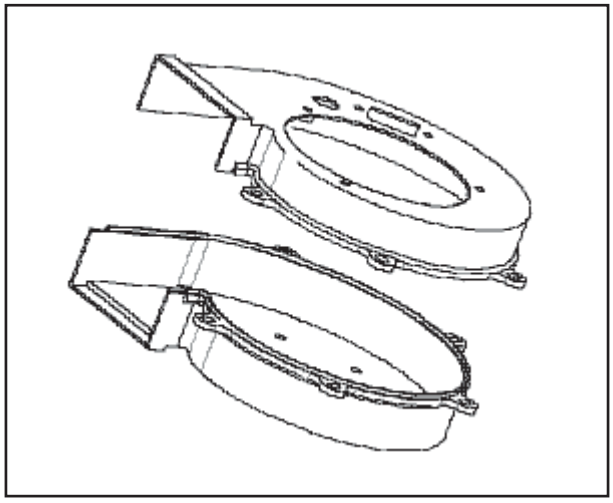
3. Blower Resistor

Blower resistor is meant for regulating blower speed. It is three-speed blower resistor and is also provided with safety features. When current increases beyond limit blower switches off automatically.

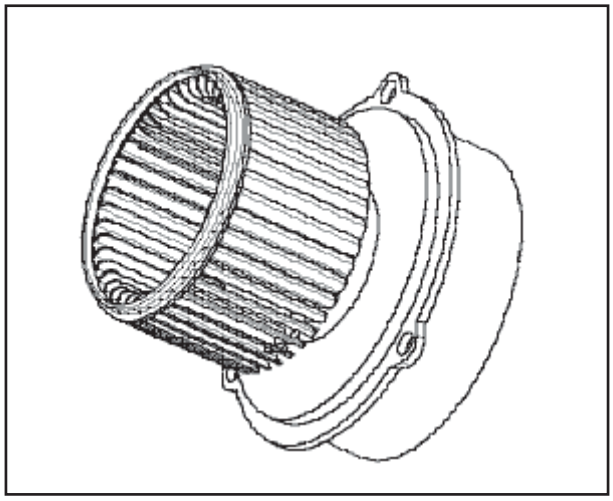
1. Remove bottom part of the dash panel.
2. From the bottom of dash, resistor is visible. Take out wiring harness connector from resistor.
3. Remove resistor by opening two screws. Replace it if necessary.
4. Connect wiring harness connector and fit dash pannel part as earlier.

4. Heater Assembly / Water Valve Assembly :

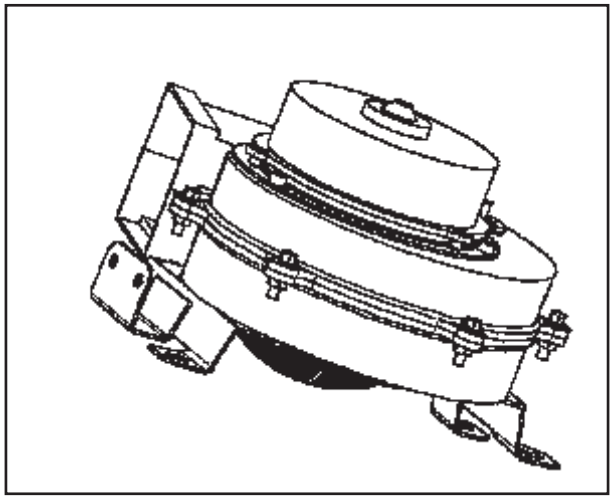
1. Remove complete HVAC unit and separate blower assembly.
2. Remove plastic covers from HVAC unit to expose heater assembly.
3. Pull out heater assembly along with water valve and pipes.
4. Disconnect hose on water valve by loosening and removing clamps.
5. Reassemble in reverse order.
6. Fit HVAC on the vehicle.



Blower Case

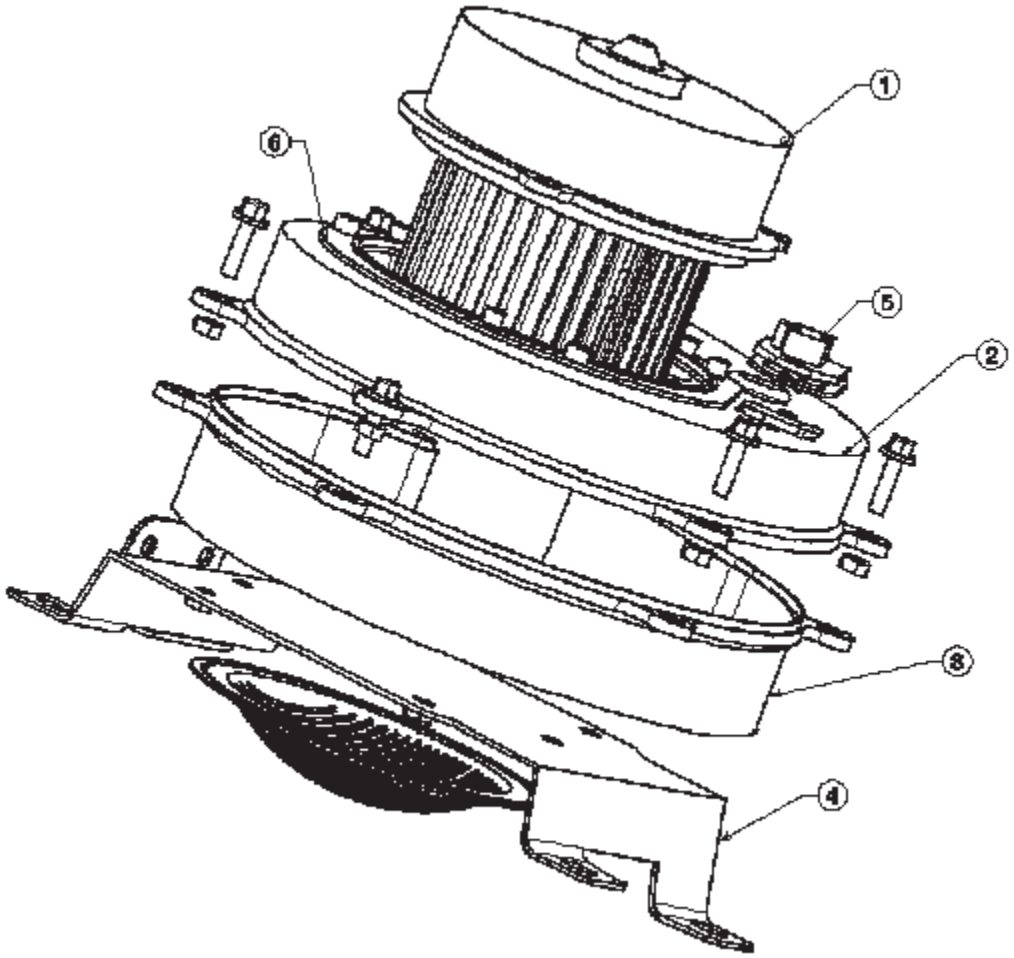


Blower Motor



Assembly Blower

EXPLODED VIEW OF ASSEMBLY BLOWER



Components of Blower System

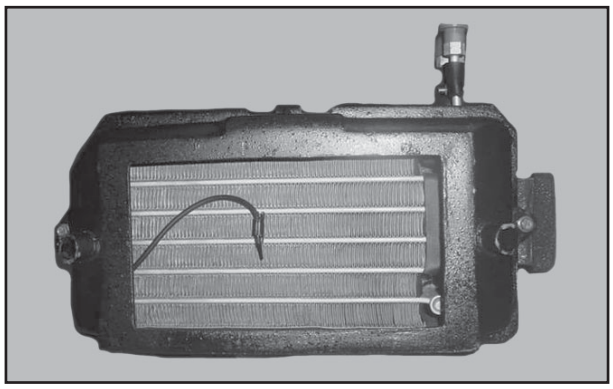
S. No.	Part Name
1	Blower Motor Assy
2	Case Blower RH
3	Case Blower LH
4	Bkt Assy Blower MTG
5	Resistor Blower
6	Plate

5. Evaporator Assembly / Thermister / Expansion Valve

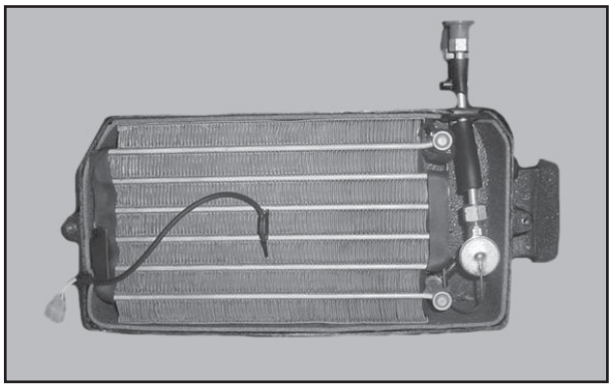
1. Remove HVAC unit & sepearate blower assembly.
2. Remove evaporator case top by removing fasteners.
3. Carefully pull out thermister from evaporator coil.
4. Lift evaporator assembly from cooling case.
5. Disconnect expansion valve and tube & accessories.
6. Reassemble in reverse order.
7. Make sure that the remote bulb of expansion valve is seated properly in dimple on suction tube and secured by holder remote bulb before covering the expansion valve with insulator packing.

   If remote bulb is loose on the pipe, expansion valve will work erratically.
8. Use proper tools while loosening and tightening nut and union joints on tubes.
9. Inset tube fully inside union half. Ensure that 'O' ring is properly fitted before tightening nut. This will avoid damage to 'O' ring.

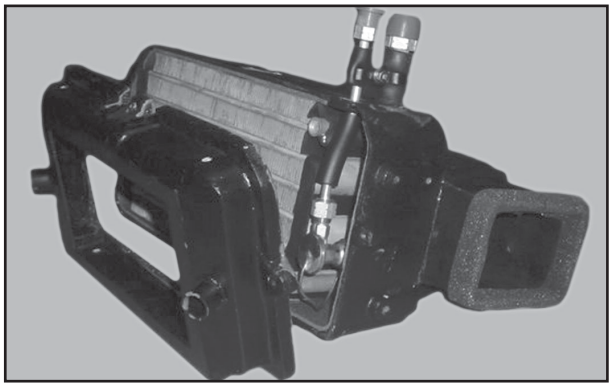
   If 'O' ring is not fitted properly, it may get damaged leading to leakage after charging the system.



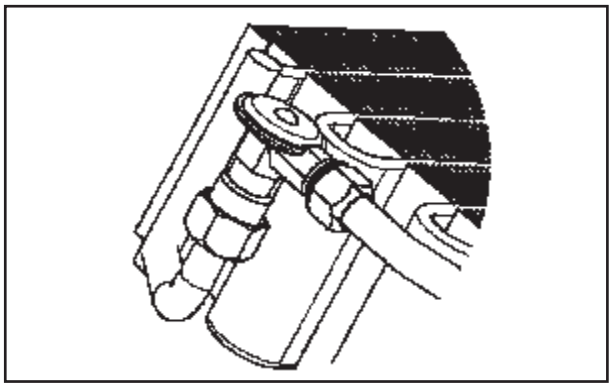
Evaporator Assembly



Evaporator Assembly



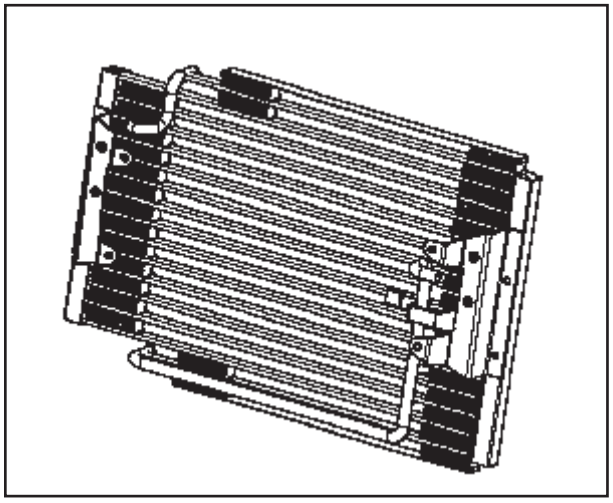
Cooling Unit



Expansion Valve

6. Condenser Assy

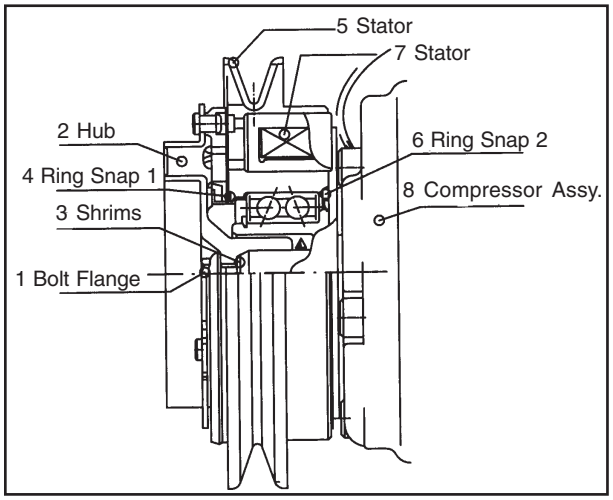
1. Remove bumper assy.
2. Remove front grills.
3. Remove bolts on shroud assy to condenser core.
4. Take out shroud fan and replace if necessary.
5. Follow steps in reverse for assembly of shroud on condenser core.
6. Fit back bumper assembly and grills.



Condenser

7. Compressor Clutch :

1. Discharge system refrigerant.
2. Remove bolt flange on rotor.
3. Remove hub.
4. Carefully remove shims.
5. Remove ring snap
6. Remove rotor.
7. Remove second ring snap
8. Remove stator.
9. Replace defective items.
10. Follow steps in reverse for assembly.
11. Check clutch operation before fitment of assembly.
12. Re-Charge the system.

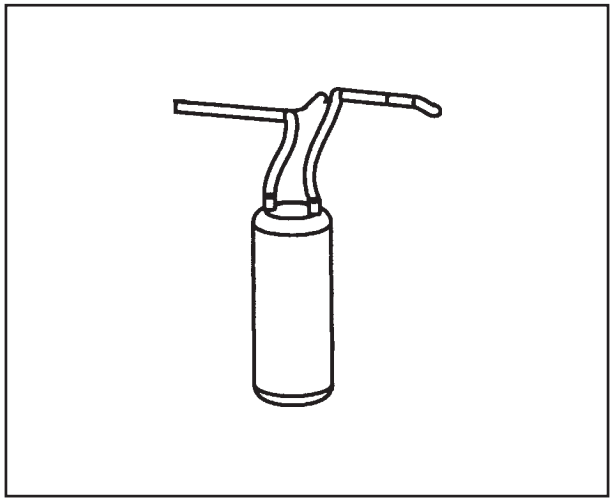


Magnetic Clutch

8. Receiver Dryer Bottle :

1. Discharge system refrigerant.
2. Remove inlet/outlet pipes.
3. Remove bolts on receiver dryer mounting bracket.
4. Replace receiver dryer bottle, if necessary.
5. Re-fix inlet/outlet pipes respectively.
6. Re-charge the system.

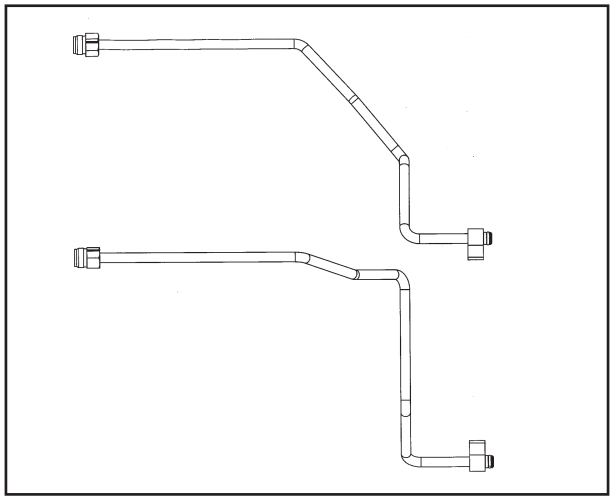
Note : Do not leave receiver dryer bottle unplugged.



Receiver Dryer

9. Refrigerant Pipe Lines

1. Discharge system refrigerant.
2. Unscrew pipe joints and remove pipes that need to be changed.
3. Replace pipe.
4. Tight joints properly so that there is no leakage.
5. Re-charge the system.



Refrigerant Pipe Lines

Recharging Compressor Oil in the system

Compressor oil tends to mix with refrigerant and flow in the system. A portion of this oil always remain in components like evaporator, condenser etc.

While changing compressor, flush the system with nitrogen gas to remove any oil left in the system. This will prevent reduction of cooling efficiency due to excess oil in the system.

Compressor oil can be charged in compressor only when there is no gas in the system. This can be done by pouring oil from suction side of compressor by removing suction hose.

Please do not charge oil when refrigerant is present in the system.

Avoid presence of moisture while recharging compressor oil.

Do not keep compressor oil bottle cap in open condition. Since oil is highly hygroscopic, it will catch moisture.

SAFETY FEATURES OF THE SYSTEM

Following are the safeties provided in the system.

1. Dual pressure switch
2. Thermo amplifier and thermister
3. Safety valve on compressor

GAS AND OIL

Refrigerant used in the system is R134a

Gas charge quantity 670gms ± 20gms

Oil ND 8

Oil charge quantity 80CC ± 20CC.

While gas refilling or changing component like condenser, evaporator, receiver dryer etc. charge 20CC ND-8 oil.

TROUBLE SHOOTING

DO'S AND DONT'S FOR AIRCONDITIONING SYSTEM

S.No	DO'S	REASON
1	Clean condenser during periodical service of the vehicle	Dirty & clogged condenser results in A/C tripping and less cooling
2	Maintain proper refrigerant level.	Less refrigerant results in less cooling
3	Add recommended oil quantity in compressor during refrigerant charging.	Adequate quantity of oil prevents poor pumping and premature wear of compressor components.
4	Clean evaporator periodically to remove dust and foreign particles.	Clogged evaporator results in less airflow and reduced cooling.
5	Adjust fresh air and heater cable properly to close damper firmly.	Unadjusted cable will result in less airflow and reduced cooling.
6	Educate customer on proper usage of A/C controls	Proper usage of A/C controls will give optimum cooling.
7	Maintain proper engine ilding rpm.	Less idling rpm will result in stalling of engine and less cooling
8	Maintain coolant level and ensure proper engine tuning	This will prevent overheating of engine.
9	Maintain proper AC belt tension	Loose belt will slip and over tight belt will result in noise and premature failure of magnetic clutch.

S.No	DONT'S	REASON
1.	Do not use A/C with fresh air mode open.	This will lead to mixing of outside air with cool air in side thereby reducing cooling effect.
2.	Do not operate A/C with heater on.	This will result in mixing of hot air with cool air.
3.	Do not operate A/C with out refrigerant in the system.	This will result in failure of compressor.
4.	Do not leave A/C joints open	Moisture tends to enter A/C system if joints remain open for long time.
5.	Do not charge refrigerant in the system without proper vacuum.	Will result in no or low cooling.
6.	Do not check A/C system for leaks with more than 20-kg/cm2 pressure.	This may result in damage to A/C components on low pressure side.

A/C CHECK POINTS

S.No	CHECK POINT	NORMAL CONDITION	RESULTS
A	**PASSENGER CABIN**		
	Fresh air/recirculation position	Should be in recirculation mode	Will stop entry of hot air from outside
	Air direction lever position	Should be in face mode	Will ensure proper cooling
	Temperature control lever position	Should be in maximum cool position	Will ensure that heater is not working with A/C on.
	Grill direction	Center grill towards rear seat. Side grills towards co-driver and driver seat	Will ensure proper distribution of cool air in cabin.
B	**ENGINE ROOM**		
	Condenser surface	Should be clean and dust/dirt free	Will ensure total liquidification of refrigerant
	Engine coolant level	Should be on maximum level	Will prevent engine over heating.
	Engine tuning	Should be as per manufacturer's specification	Will prevent engine over heating and minimise fuel consumption.
	Belt tension	Belt should not be too loose or too tight	Loose belt will slip and affect A/C performance. Tight belt will damage compressor magnetic clutch.

REFRIGERANT (R 134a)
(Tetra flouro ethane, CF3-CH2F)

R134a refrigerant is used in the system.

It is a hydro fluro carbon (HFC) which has no ozone destructive potential and its global warming potential is very much lower than that of R 12 refrigerant.

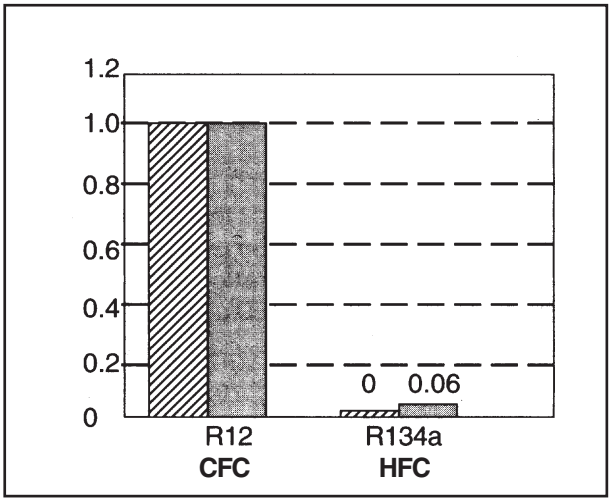
Form ..... Gas.

COLOUR..... Colourless.

Smell ..... Slightly of ether.

Crystallisation temperature ..... -117^0 C.

Boiling temperature ..... -26^{0}C.



Properties of R134a refrigerant

Ozone destructive potential
Global warming potential

Safety Precautions:

It is a safe refrigerant, i.e. non-flammable, non explosive, non-irritating and without smell. Precautions given below should to be taken while handling this refrigerant :

* Avoid any form of contact with liquid refrigerant. Wear safety glasses for eye protection. In case refrigerant gets into your eyes, immediately seek medical help. Do not rub eyes.
* In the event of work involving refrigerant circuit, refrigerant must not escape into atmosphere.
* Suitable suction/ extraction system or reprocessing systems are to be used.
* Refrigerant must not be released in confined spaces. As it is heavier than air, the danger of asphyxiation exists.
* Under no circumstances may parts of the system be cleaned from inside with super heated steam or compressed air. Only use nitrogen for cleaning.
* Refrigerant is completely non - toxic at normal temperatures. However it decomposes upon contact with flames or higher temperatures, to form hydrogen chloride and hydrogen fluoride. These products are hazardous to health. Therefore, under no circumstances, should welding be carried out on the closed system or in its close proximity.
* Switch off the system if a part of the air - conditioner system is damaged or leaking, due to some reason for example, a vehicle accident.

  This is to avoid damage to the compressor running in the absence of refrigerant.

COMPRESSOR OIL

Compressor oil is necessary for lubrication of compressor bearings, moving and sliding surfaces.

Compressor oil circulates through entire refrigeration cycle. Only recommended oil must be used.

Compressor Oil Quantity

When air conditioner is operated, some amount of oil is discharged together with refrigerant from compressor and circulates in the system.

If the amount of oil discharged by the compressor into the refrigeration cycle is very small, there will be hardly any adverse effect on refrigeration cycle. Instead, there will be benefit of improving lubrication of various valves in the system.

Conversely, if there is a large amount of oil circulating through refrigeration cycle troubles may develop.

Refer trouble shooting chapter.

Caution

Oil

ND oil 6 is used on system with CFC 12 refrigerant. It doesn't dissolve in HFC 134a refrigerant. If this oil is used on HFC 134a system, life of compressor will greatly reduce.

Therefore, ND-OIL 8 for 10 P(A) type compressor only to be used.

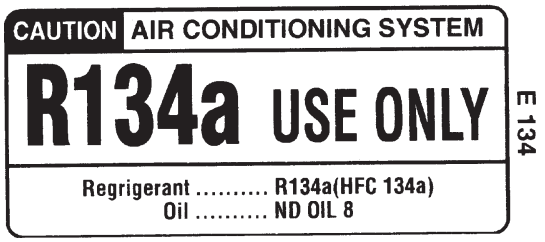
To distinguish HFC 134a, a sticker is pasted on compressor body as shown.

O rings

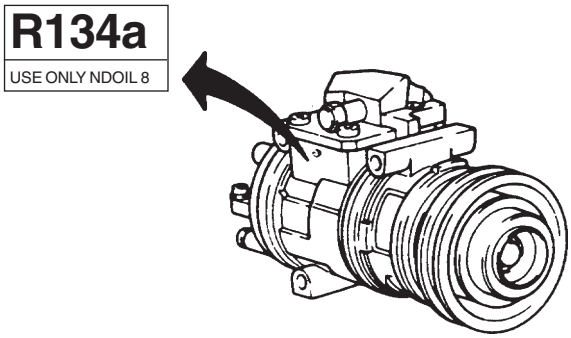
O-rings of piping connectors that are used in CFC 12 system and those that are used in HFC 134a system are not interchangeable. If O-rings for CFC 12 system are used by mistake in the connections of an HFC 134a system, O-rings will foam and swell, resulting in leakage of refrigerant.

Therefore, always use genuine O-rings suitable for HFC 134a system.

Label for Vehicles Equipped with HFC 134a Air Conditioning Systems



Sticker on AC Compressor



Sticker on AC Compressor

SERVICE AND REPAIR

Service Tools and Gas Leak Detector (FOR HFC 134a)

Service Tools

Special service tools are required for servicing air conditioner to prevent incorrect refrigerant charging and to prevent compressor oil from getting mixed.

Service Tool List for HFC 134a

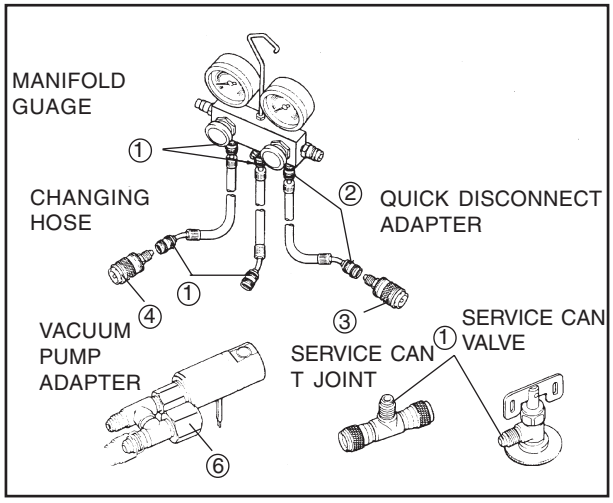
Sr. No.	(Metric size)
1.	M10X P 1.5 Adaptor
2.	M12 X P 1.75 High pressure side Adaptor
3.	“Quick - disconnect adapter which meets SAE standard (High pressure side)
4.	Quick - disconnect adapter which meets SAE Standard (Low Pressure side)
5.	M14 X P 1.25 D-Spanner
6.	Vaccum pump adaptor
7.	Belt tension guage

Inspection

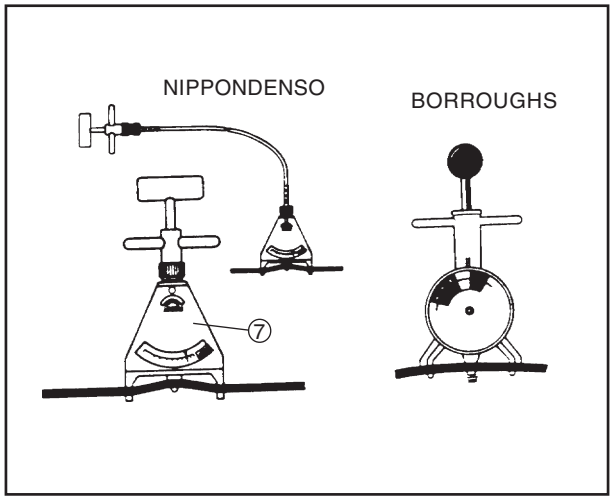
1. Check condenser fins for blockage or damage. If the fins are clogged, wash them with water. Be careful not to damage fins.
2. Make sure that drive belt is installed correctly.

   Check that drive belt fits properly in ribbed grooves.
3. Check drive belt tension.

   Using a belt tension gauge, check drive belt tension.



Service tool set for HFC-134a



Drive belt tension checking tool

4. Start engine.
5. Turn on A/C switch.

   Check that A/C operates at all positions of blower switch. If blower does not operate, check circuit breaker.

6. Check magnetic clutch operation.

   If magnetic clutch does not engage, check A/C fuse.

7. Check that idle speed increases. When magnetic clutch engages, engine speed should increase.
8. Check that condenser fan motor rotates.
9. If there is no cooling or it is insufficient, inspect for leakage.

   If piping connections are soiled with oil, it indicates leakage of refrigerant. Inspect by gas leak detector and retighten loose connectors, if necessary.

   Retightening of pipe connections must be done using two wrenches to avoid twisting of tubing.

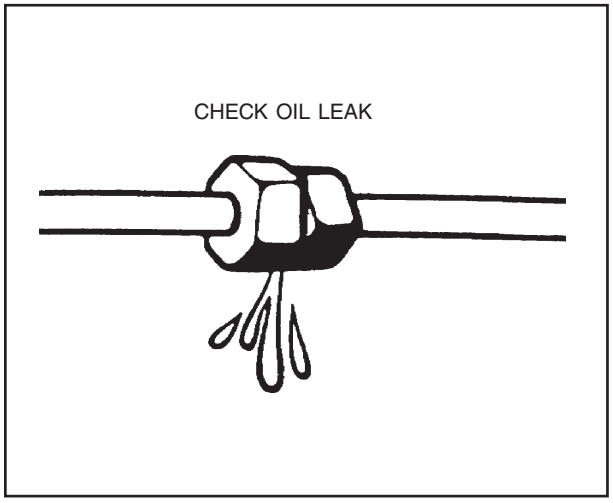
10 Check the Amount of Refrigerant.

a. Operate the air conditioner under conditions shown in table given below :

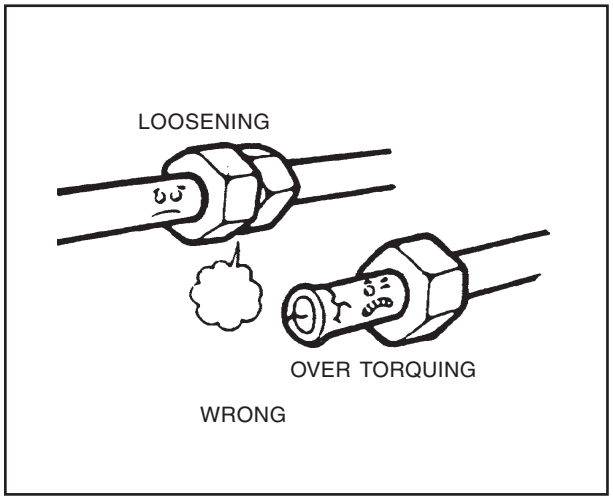
Item	**Condition**
Doors	Completely open
Temperature setting	Maximum cooling
Air flow direction	Air to face vents
Blower speed	High
Air Circulation Switch	Recirculation Mode
Engine speed (HFC 134a)	1500 rpm
A/C	ON

Note: When ambient temperature is more than 40^{O}C (113^{O}F) and the pressure on the high pressure gauge becomes 1.86 MPa (19 kg/ cm^{2}G) or more with the conditions in table, run the engine at idling speed to cool down condenser.

If high pressure gauge still indicates too high, perform this test in a cool place. Open all doors and set blower speed to LOW.



Leak in pipe joints



Leak in pipe joints

b. Check the Amount of Refrigerant.

1. Check sight glass on receiver dryer.

   Appropriate quantity:

   No bubbles. Occasionally bubbles appear.

   Excessive quantity:

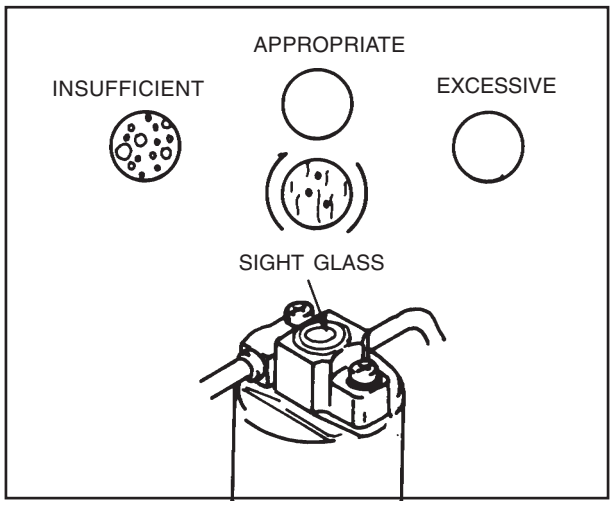
   No bubbles. In this case, high and low pressures will both be high. So cooling will be inadequate. Check manifold gauge.

   Empty :

   No bubbles. Check manifold gauge.

   Insufficient refrigerant:

   Bubbles visible. (Continuous flow of bubbles)



Sight glass indications (If fitted)

2. Check the amount of refrigerant as per instructions given in table below :

Item	Symptom	Amount of Refrigerant	Remedy
1.	Bubbles present in sight glass	Insufficient	Check for leak with gas leak detector
2.	No bubbles present in sight glass	Empty, proper or too much	Refer to items 3 and 4
3.	No temperature difference between compressor inlet and outlet	Empty or nearly empty	Evacuate and charge system. Then check for leak with gas leak detector.
4.	Temperature between compressor inlet and outlet is noticeably different	Proper or too much	Refer to items 5 and 6
5.	Immediately after air conditioner is turned off, refrigerant in sight glass stays clean.	Too much	Discharge excessive refrigerant.
6.	When air conditioner is turned off, refrigerant foams and then stays clear	Empty, proper or too much	Refer to items 3 and 4

Charging A/C system:

1. Installation of Manifold Gauge

a. Close both high and low pressure valves of manifold gauge.

b. Connect low pressure hose to low pressure valve and high pressure hose to high pressure valve. Tighten hose nuts by hand.

Do not apply compressor oil to the seats of connection.

2. Evacuate Air in Refrigeration System

a. Connect center hose of manifold gauge to vacuum pump inlet.

b. Open both high and low pressure valves and run vacuum pump.

When opening low pressure valve, if needle of high pressure gauge falls to vacuum range, there is no blockage in the system.

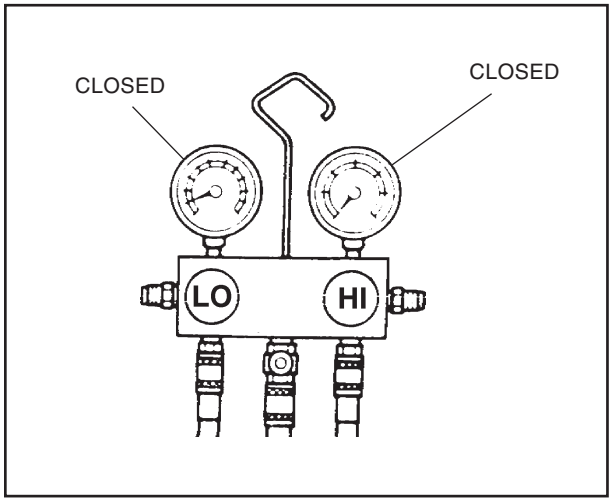
c. After about ten minutes, check that low pressure gauge indicates more than 600 mmHg (23.62 in Hg, 80.0 kPa) of vacuum.

If reading is not more than 600 mmHg (23.62 in Hg, 80.0 kPa), close both valves and stop vacuum pump. Check system for leaks and repair if necessary.

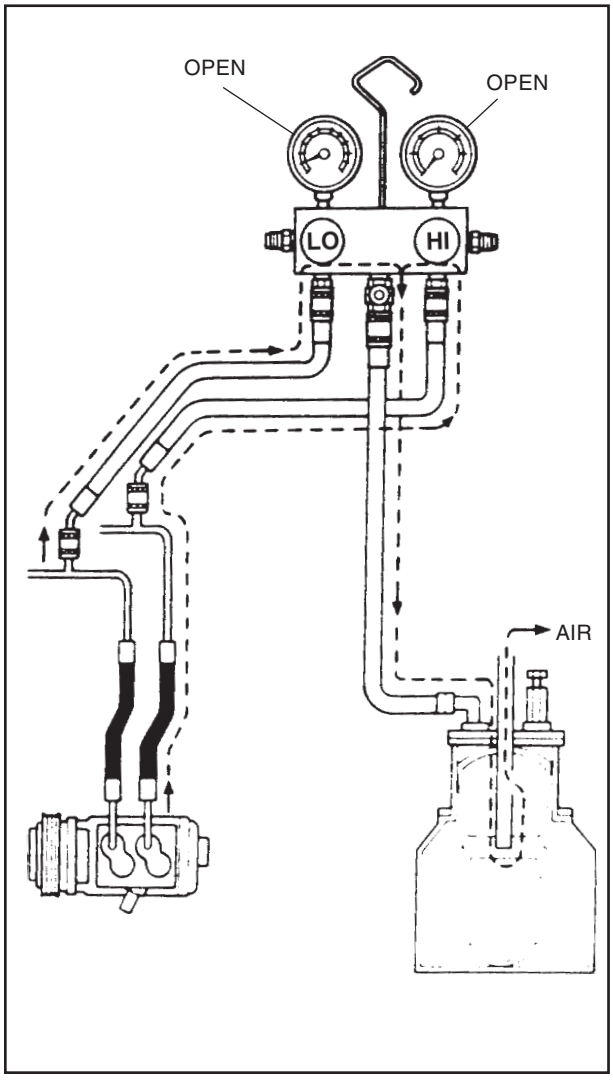
If no leaks are found, continue evacuating air in the system.

d. Continue evacuating air in the system until low pressure gauge indicates a vacuum of 750 mmHg (29.53 in Hg, 99.98 kPa).

e. Close both high and low pressure valves and stop vacuum pump. Leave the system in this condition for five minutes or longer and check that there is no change in gauge indication.



Manifold Gauge



Connections to Manifold Gauge

3. Install Refrigerant Service Can Tap Valve

Do not open high and low pressure valves of manifold gauge.

Press schrader valve on the side of manifold gauge set and expel air from center hose.

Press schrader valve until refrigerant come out of it.

Note :

Schrader valve is part of manifold gauge. This valve is used to open or close the suction and discharge lines to respective pressure gagues.

4. Inspect Refrigeration System for Leaks

After evacuating air in the system, check the system for leakage.

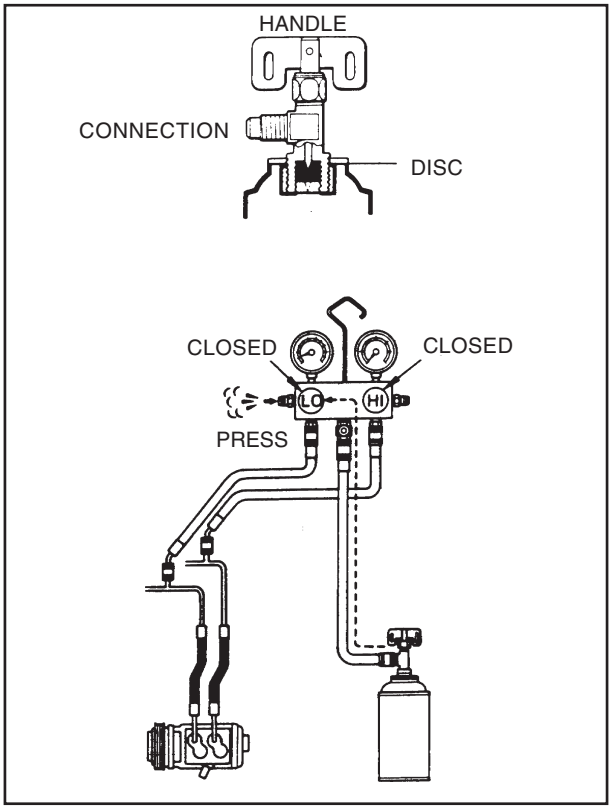
a. Open high pressure valve to charge the system with refrigerant vapour.

When refrigerant service can is placed right side up, refrigerant will enter the system as a vapour.

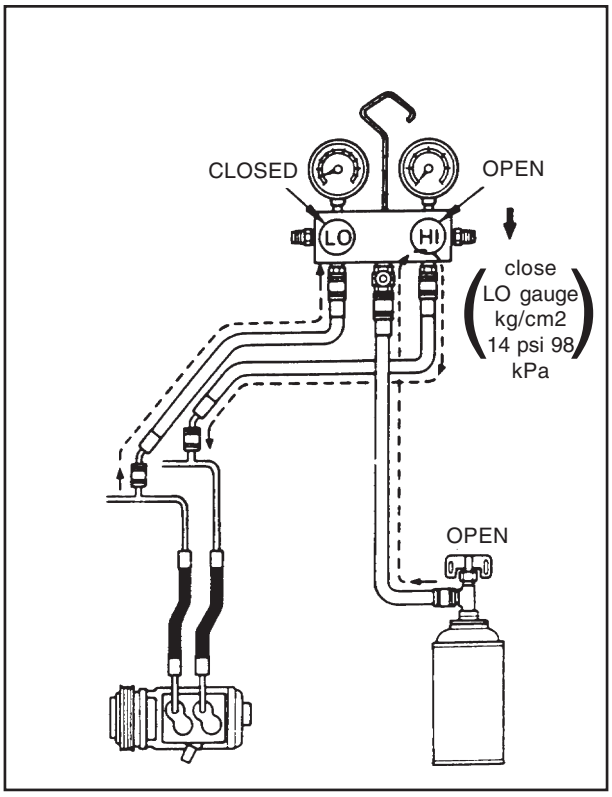
b. When low pressure gauge indicates 1 kg/cm^2 (14 psi, 98 kPa) pressure, close high pressure valve.

c. Using gas leak detector, check the system for leakage.

If leak is found, repair faulty component or connection.



Normal condition



Insufficient refrigerant

TROUBLE SHOOTING

Trouble shooting can be divided into three parts.

i] Visual & audio inspection of AC system (AC idle up check)

ii] Trouble shooting by using manifold gauge.

iii] Trouble shooting of electrical circuits.

Simplest to detect trouble is by looking and listening to AC system components.

Defects related to refrigerant cycle can be investigated by using manifold gauge.

When visual and audio inspection of AC system is OK and low side / high side pressure in manifold gauge is within specified limits, complaint may be due to fault in electrical circuits for blower/cooler or due to faulty components.

Specified refrigeration cycle pressures :

Low side : 1.5 to 2.5 kg/cm (0.15 to 0.25 MPa)

High side : 14 to 16 kg/cm (1.37 to 1.57 MPa)

i. Visual and Audio Inspection of AC System :

Start engine and run it at idling speed. Switch on blower and AC switches. Check blower operation, magnetic clutch operation, air temperature at AC outlet, etc.

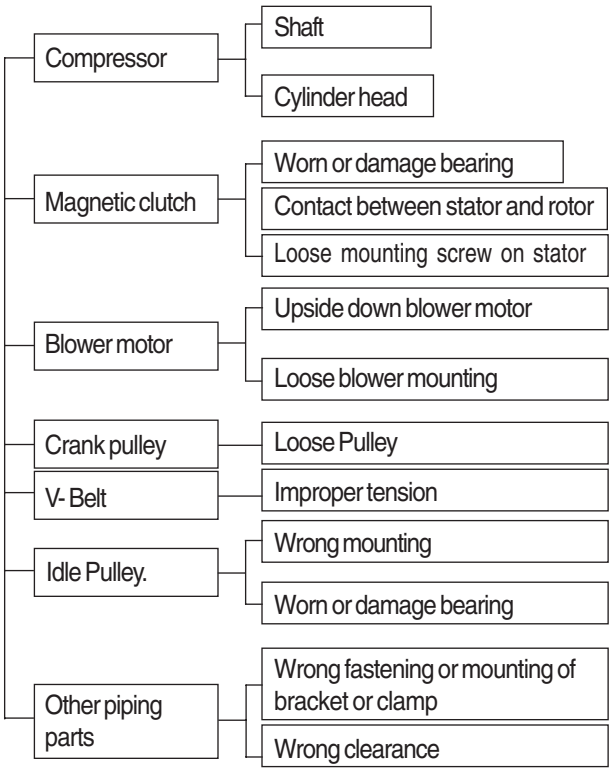
Look for conditions given below :

1. Is the drive belt loose?
2. Are the condenser fins covered with dirt and dust?

   In this case, condenser cooling effect will be greatly reduced. As a result, cooling capacity also will decrease.
3. Is the air filter clogged?

   A clogged air filter will reduce air flow and lower cooling capacity.
4. Can oil stains be seen in refrigeration cycle connections and joints?

   A place that shows oil stain indicates that refrigerant is leaking from that place together with compressor oil.
5. Check for bubbles in receiver dryer sight glass.
6. Check for abnormal noise from AC system components



If visual and audio inspection does not reveal any defects proceed trouble shooting by using manifold gauge.

Install manifold gauge to refrigeration cycle.

Prepare multimeter and gas leak detector.

ii. Trouble Shooting by using Manifold Gauge :

Manifold gauge indicates refrigeration cycle high and low pressure side pressures on respective gauge.

Important

Be sure to purge out air in charging hoses of manifold gauge by using refrigerant pressure in cycle.

1. Under Normal Conditions :

* After the engine has warmed - up, check the following conditions (for HFC 134a).

Engine Speed : 1500 rpm

A/C inlet temperature : 30^{O}-35^{O} C (86^{O}- 95^{O} F)

Blower Speed : HIGH

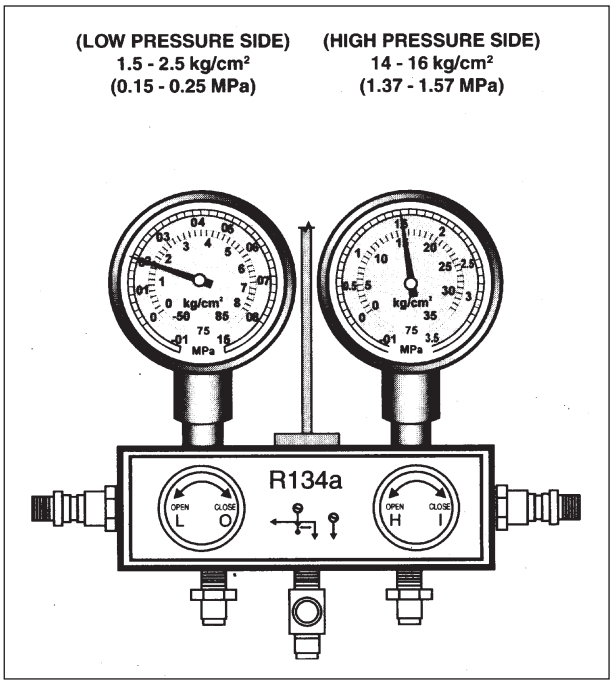
Temperature control : Maximum cooling.

Reference

Gauge indications before A/c operation

Both high and low pressure sides:

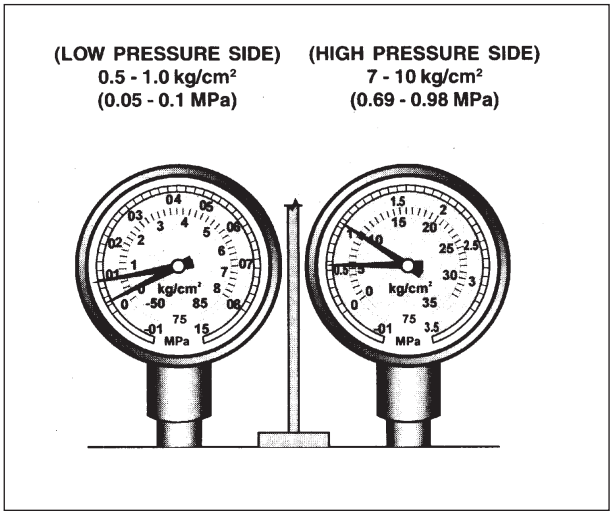
5-8 kg/cm^2 (0.5 - 0.8 MPa)



Normal condition

2. Insufficient Refrigerant :

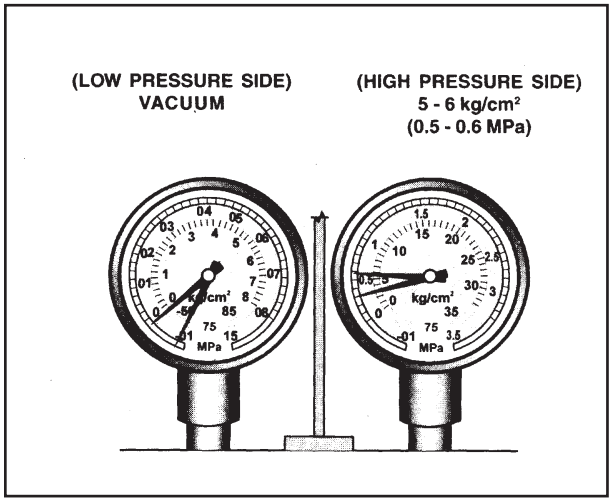
	Problem	Cause	Check and remedy
1.	Pressure is low on both low pressure and high pressure sides	Quantity of, refrigerant is too small-	-Check for gas leakage and repair -Replenishment of refrigerant
2	Bubbles can be seen in sight glass.	Gas leakage	If indicated pressure is near 0 when connected to gauge, evacuate air
3.	Air being blown out is not cool.		after checking and locating leak.



Insufficient refrigerant

3. Refrigerant Fails to Circulate (Cycle Is Clogged Up)

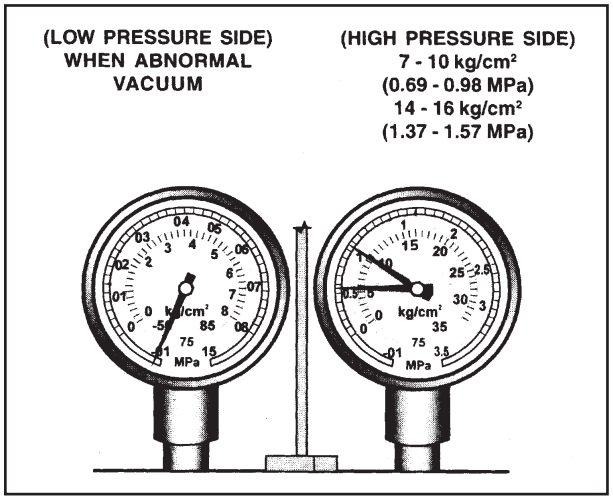
Problem	Cause	Check and remedy
1 when completely clogged up Vacuum is immediately indicated on low pressure side. 2. When slightly clogged up Vacuum is gradually indicated on the pressure side	Clogging of A/C cycle	-Check receiver, expansion valves, ERR, etc. -A tempreature difference occurs between IN and OUT of defective parts. -Be Sure to evacuate air after finishing remedy.



Refrigeant fails to circulate

4. Moisture Entered in the Cycle

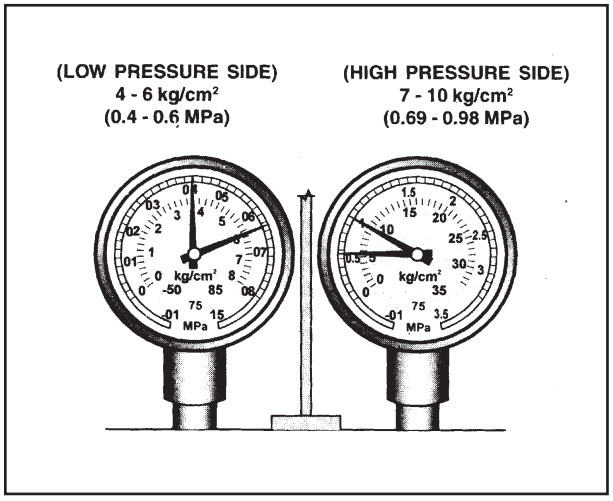
Problem	Cause	Check and remedy
1. Air conditioner operates normally at the beginning, but over time, vacuum is indicated on low pressure side.	Freezing of expansion valve due to presence of moisture	-Check expansion valve, etc. -Replace receiver (or dryer) Be sure to evacuate air after finishing remedy.



Moisture entered in cycle

5. Compressor Compression Failure

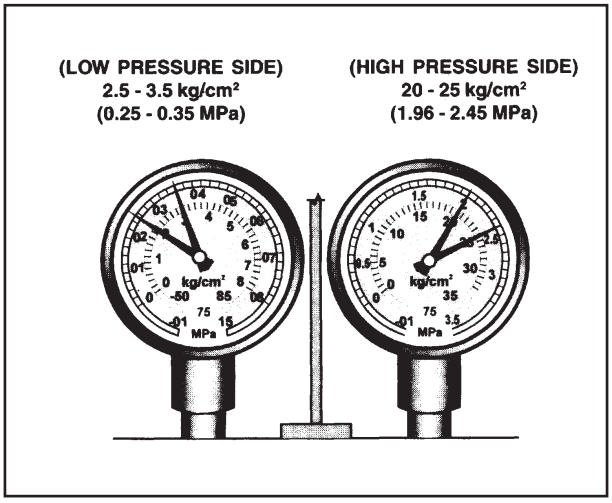
Problem	Cause	Check and remedy
1. Pressure on low pressure side is high; pressure on high pressure side is low. 2. When A/C is turned off low and high pressure sides soon equalize.	Compressor defect	- Check compressor. In case of malfunction, compressor will not be hot to touch.



Compressor compression failure

6. Excessive Refrigerant, or Insufficient Condenser Cooling

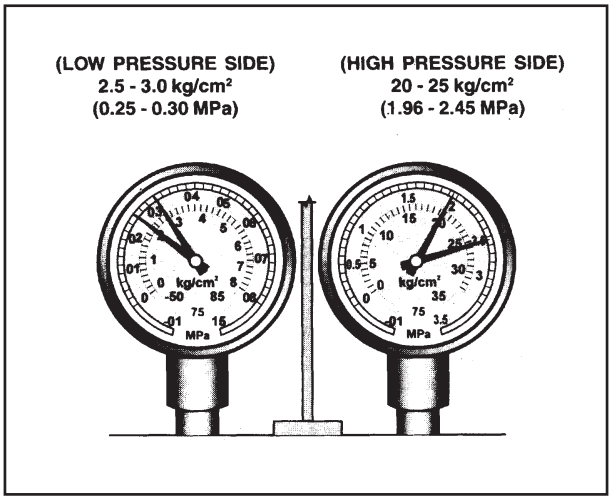
Problem	Cause	Check and remedy
1. Pressure is high on both low pressure and high pressure sides.	Excessive refrigerant	- Check refrigerant quantity. - Slowly vent out refrigerant if overcharged.
2. Bubbles can not be seen in sight glass	Poor condenser cooling	- Check and repair condenser fan. - Check engine cooling system.



Excessive refrigerant or insufficient condenser cooling

7. Air Entered in the Cycle

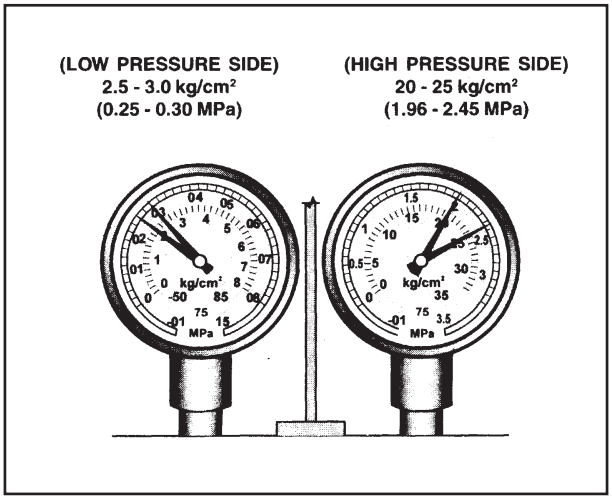
Problem	Cause	Check and remedy
1. Pressure is high on both low pressure and high pressure sides. 2. Low pressure piping is hot to touch. 3. Bubbles are visible in sight glass	Entry of air in cycle	- Replace refrigerant Be sure to evacuate air after finishing remedy.



Air entered in the cycle

8. Expansion Valve Opens too Far

Problem	Cause	Check and remedy
1. Pressure is high on both low pressure and high pressure sides. 2. Frost (dew) appears on low pressure side piping	Expansion valve fault	- Check expansion valve. - Check installation condition of temprerature sensing bulb. - This problem frequently occurs after replacing expansion valve



Expansion valve opens too far

iii. Troubleshooting of Electrical Circuits :

Chart given below indicates items to be checked for various types of troubles :

No.	Troubles	Main Inspection Areas						Others
		Fuses	Connectors	Wiring Harness	Body Ground	Servo Motors	Sensor Circuit*	
1	Fuse is blown easily	O	O	O	O			
2	No blower operation	O	O	O	O			Heater relay, Blower motor, Blower resistor, Blower switch
3	Blower speed does not change	O	O	O	O			Blower Resistor, Blower Switch
4	No compressor operation	O	O	O	O			Magnetic clutch & relay, Compressor, Heater relay, A/C sw.
5	A/C lamp does not light	O	O	O	O			Engine RPM signal lines, A/C switch
6	No A/C operation (No cool air comes out)	O	O	O	O	O		
7	Cabin temp. does not decrease (insufficient cooling)	O	O	O	O	O	O	
8	No warm air comes out					O		Engine coolant volume, A/C temp. Control lever, Heater radiator
9	No condenser fan operation	O	O	O	O		O	Relays (for condenser fan, radiator fan), Condenser fan motor, condenser fuse.
10	No engine idle-up when A/C is on.		O	O	O			Idle-up VSV, Idle-up actuator, Vacuum hose line

Note: * Sensors are thermister, pressure switch and water temp. switch.

Troubleshooting Flow Chart

After making sure that the blower circuit operation is good, troubleshoot the cooler circuit in the following procedures.

STEP 1 CHECK A/C SWITCH FUNCTION

With blower operated, push on A/C switch, and check whether A/C switch lamp is lit.
→ No
→ Inspect A/C fuse
→ OK
→ Check input voltage to A/C fuse
→ 12V
→ Check A/C switch

Inspect A/C fuse
↓ Blown or Bad Contact
Replace it

STEP 2 CHECK MAGNETIC CLUTCH

With A/C switch and blower switches On, check whether magnetic clutch is On.
→ Yes
→ Check condenser Fan relay circuit
→ OK
→ Check wiring between A/C fuse and the blower circuit.

With A/C switch and blower switches On, check whether magnetic clutch is On.
↓ No

STEP 3 CHECK POWER SOURCE TO CLUTCH

Check voltage of 1 - pole connector for the magnetic clutch.
→ 12V
→ Check magnetic clutch coil.

Check voltage of 1 - pole connector for the magnetic clutch.
↓ OK

STEP 4 CHECK MAGNETIC CLUTCH RELAY

Check voltages to clutch relay Connector
→ OK
→ Step 4-1
→ Check relay and its wiring

Check voltages to clutch relay Connector
↓ No Battery Voltage or No Grounding

STEP 5 CHECK OUTPUT FROM AMPLIFIER

Check output voltage from amplifier.
Terminal 1A – OK
→ OK
→ Check continuity of wiring between amplifier and magnetic clutch relay.

Check output voltage from amplifier.
Terminal 1A – OK
↓ No Good

STEP 6 CHECK INPUT TO AMPLIFIER

Check each input voltage and signal from sensor such as Thermistor, Dual Pressure S/W Engine RPM signal from eng. ECU. Also check the earth circuit for amplifier.
→ No Good
→ Check sensor and its wiring, which don't input correct signal.

Check each input voltage and signal from sensor such as Thermistor, Dual Pressure S/W Engine RPM signal from eng. ECU. Also check the earth circuit for amplifier.
↓ OK
Replace amplifier

Important
Also A/C idle up check should be done Visuallsy regardless of above troubleshooting result,

A/C PERFORMANCE CHECK UP PROCEDURE

STEP - I

- Open doors
- Check and adjust position of:

(a) Fresh/recirculation control

(b) Air direction control

(c) Temperature control

(d) Grill direction

STEP - II

- Open engine bonnet
- Check

(a) Condition of condenser surface-clean condenser with low pressure water if required

(b) Level of coolant - top up if required

(c) Belt tension - use belt tension checking gauge

STEP III

- Close both suction and discharge valves of manifold gauge.
- Install manifold gauge

(a) Blue hose to suction side

(b) Red /orange hose to discharge side

(c) Yellow hose free to air

STEP IV

- Start engine
- Check and adjust engine idling rpm. Use rpm meter

STEP-V

- Switch on blower to maximum speed.
- Switch on a/c switch

STEP-VI

- Check the function of engine idling spped raising device. Adjust engine rpm to 1000 if necessary

STEP-VII

- Check pressure on suction and discharge side gauges.
- Between 1500/2000 rpm & at an ambient temperature of 35 to 40^{O}c suction pressure should be 2 to 3 kg/cm^2 and discharge pressure should be 15 to 18 kg/cm^2
- Check sight glass on receiver dryer
- If refrigerant is adequate glass will be clear
- If refrigerant is less glass will show excessive bubbles

STEP VIII

If refrigerant level is low

(a) Switch off a/c and engine

(b) Check refrigerant leakage by using leak detector and soap solution

STEP IX

- Release all refrigerant
- Repair leakage and check again
- Vacuum a/c system by using vacuum pump
- Recharge refrigerant

STEP X

- Check a/c performance - use thermometer
- Sit on driver seat
- Close all doors and windows
- Start engine
- Switch on blower to maximum speed
- Install thermometer in centre grill
- Thermometer reading should be between 10^{O}c & 12^{O}c within 10 minutes at an ambient temperature between 35^{O}c & 40^{O}c.

HEATING & VENTILATION

INTRODUCTION :

Two types of ventilation systems are available as option in Tata TL.

1] Heating and Airconditioning (HVAC)

2] Heating

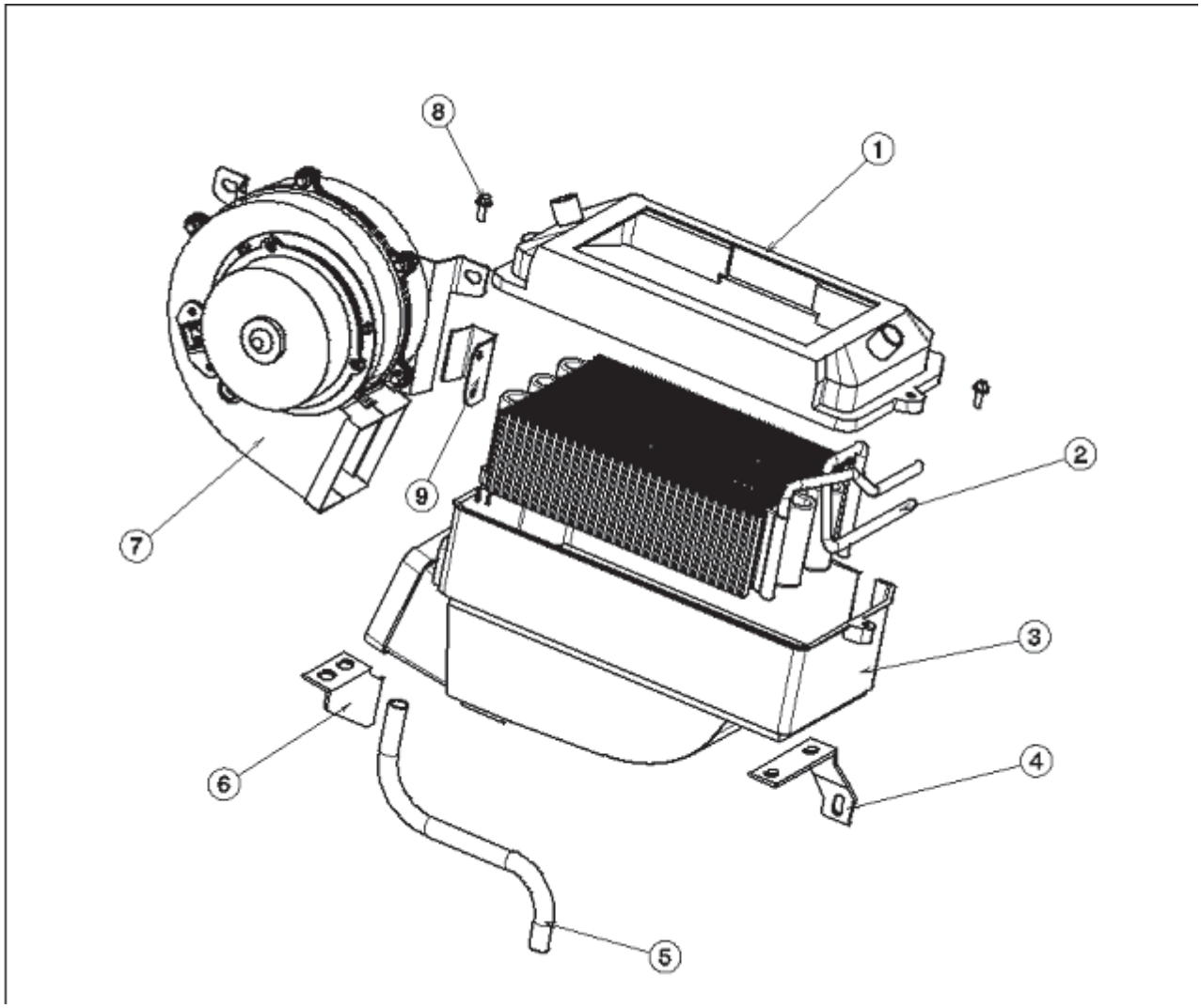
In heating arrangement temperature of air is controlled by adjusting flow of engine coolant through water valve and blower speed.

In both arrangements provision has been made for demisting windshield glass and door glasses.

This section deals with heating system.

CONTENTS :

SR. NO.	DESCRIPTION	PAGE NO.
1.	Exploded view of heater unit	7
2.	Basic components of heater unit & their functions	8
3.	Procedure for removal & fitment of heater components	10
4.	Do's & Don'ts for Cab heating system	12
5.	Trouble shooting chart	12



Heater Unit (Exploded view)

S.No.	Part Name
1	ADAPTOR ASSY
2	HEATER SUB ASSY
3	CASE HEATER UNIT
4	BRACKET ASSY DUCT MOUNTING
5	HOSE DRAIN
6	BRACKET DUCT MOUNTING
7	BLOWER ASSY
8	BOLT FLANGE
9	STAY BRACKET

AIR HEATING SYSTEM – FULL AIR MIX TYPE

Fresh air/recirculation valve & water valve can be adjusted manually to achieve desired temperature in cabin.

BASIC COMPONENTS

The circuit consists of following basic components.

- Heater casing with heater coil
- Air blower assy
- Water control valve (Coolant)
- Control panel

OPERATION OF COMPONENTS :-

HEATER CASING WITH HEATER COIL

In casing, there is a serpentine heater coil having inlet and outlet for radiator coolant water. Air from blower passes out side the serpentine tube and fins, hot coolant water from radiator inside the tubes. Air gain heat energy from water and its temperature increases instantaneously. More the water flow rate, more is the air outlet temperature from the system.

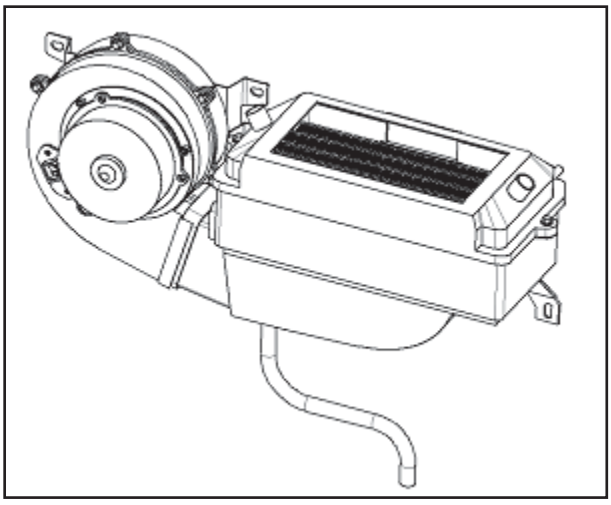
When heater is ON, it is always advisable to mix fresh air in the system to avoid dehydration of passengers in cabin.

BLOWER ASSY

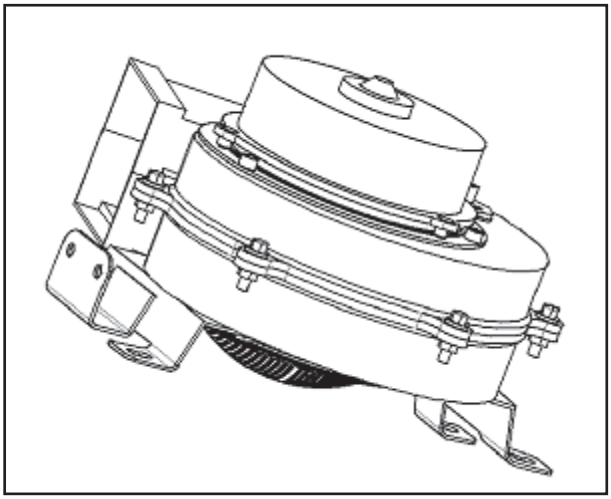
Function of blower is to generate air flow on heater coil which increase the temperature inside cabin.To achieve desired heating effect, air flow can be controlled by controlling speed of the blower. Blower speed can be increased or decreased by sliding knob on the control panel with the help of blower resister. In lower blower speed, temperature of the air is always higher.

WATER VALVE

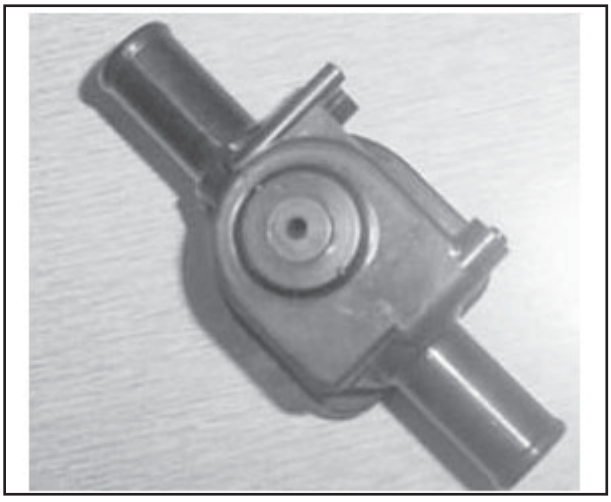
Function of water valve is to control water flow rate in side cooling coil. It is mounted in the engine cabin side on the inlet pipe. Water flow rate also control cabin temperature. Water valve can be controlled by knob on the control panel.



Heater Unit (Exploded view)



Blower Motor



Water Valve

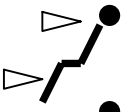
CONTROL PANEL

This system has full heating, and ventilation. System controls can be adjusted to mix these into various combinations. Air flow into the interior through different locations is controlled by switch (A) fitted on RH side top of control panel. Air flow control switch has five positions for air flow direction.

Switch A : Air Distribution Control



Air to face vents



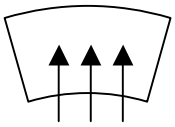
Air to face vents and for foot lets



Air to foot lets



Air to foot lets and wind screen recommended for clearing mild mist on wind screen.



Air to wind screen recommended for clearing heavy fog or snow.

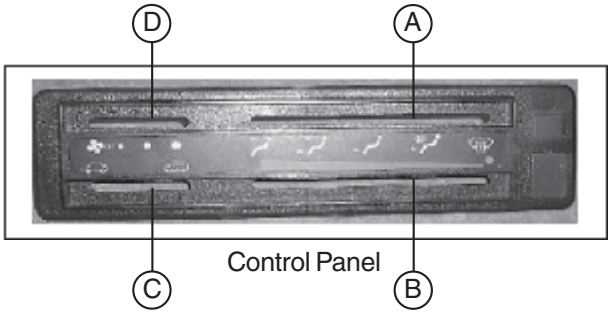
Switch B : Temperature Control.

This switch is at bottom RH side of panel. To achive maximum heating effect slide the knob towards red region.

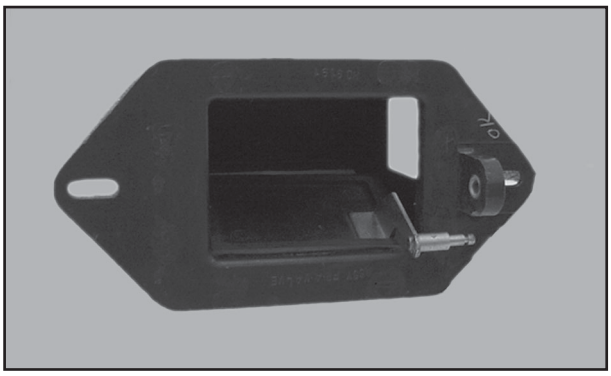
Switch D : Blower Regulation

This switch is on top LH side of panel. This switch is for controlling blower speeds as given below. Blower speed could be selected as per requirements.

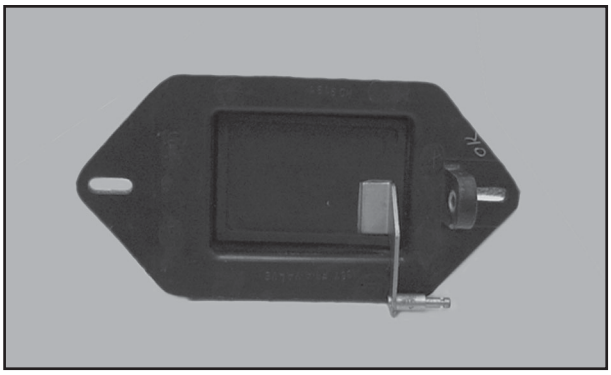
- Blower off
- Blower slow speed
- Blower medium speed
- Blower high speed



Control Panel



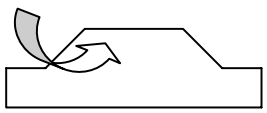
Fresh air valve (open position)



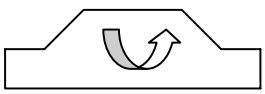
Fresh air valve (closed position)

Switch C : Fresh Air/Recirculation Option

This switch is provided on bottom LH side of panel. It has got two positions. Move the lever for desired air circulation mode.



Fresh air brought inside and circulated



Cab air recirculation

Removal and Fitment of heater Components

1. Heater unit Assembly (LHD and RHD)

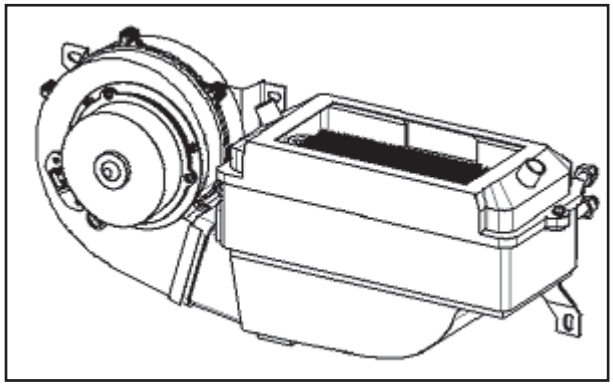
REMOVAL :

To replace the heating unit, following sequence to be followed.

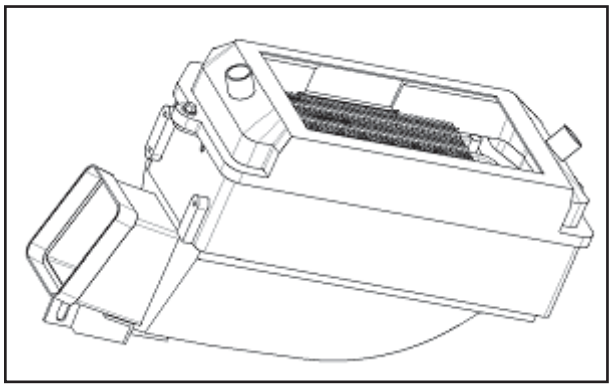
1. Discharge coolant with proper equipment and store in some vessel.
2. Disconnect inlet & outlet pipes in engine compartment after loosening pipe clamp before water valve. Put proper plug on inlet and outlet of heater pipe openings.
3. Remove hoses at heater inlet and outlet end, in engine compartment. (In case of heater)
4. Put proper plug at heater inlet and outlet ends to avoid any leakages of coolant.
5. Disconnect electrical connections for blower motor, blower resistor, control panel etc. and remove all the connectors of wiring harness from the heating unit.
6. Remove heater & face mode control cable.
7. Remove fasteners from mounting points of heating unit and remove the unit from vehicle. Also remove drain hoses.

FITMENT

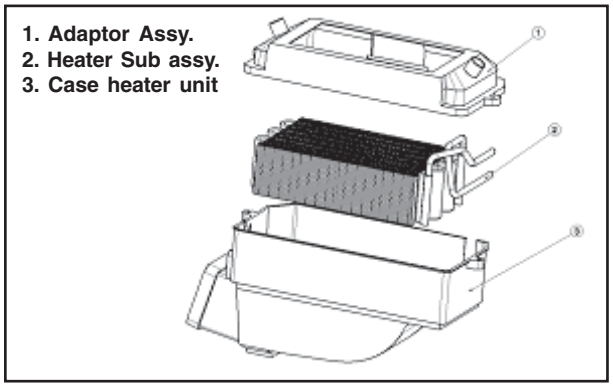
1. Replace heating unit with new one and assemble it with blower assembly with proper fasteners.
2. Fit heating unit with drain hose at the positions on firewall and tighten fasteners at specified positions.
3. Check and ensure that all connectors of wiring harness are fitted with heating and blower unit.
4. Fit the control cable for face mode and heater control with the cooling unit and control panel. Check for proper functioning of heater and foot-face mode controls.
5. Remove plugs from heater inlet and outlet ends.
6. Connect hoses to heater inlet and outlet ends.
7. Check system for leakage and fill it with coolant.



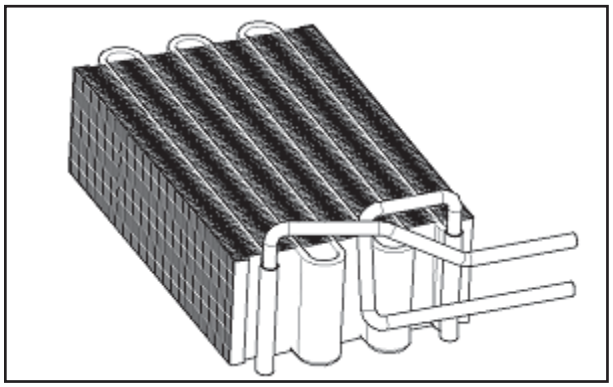
Assembly Heater unit



Heater Assembly



Exploded view of Heater Assembly



Heater Sub Assembly

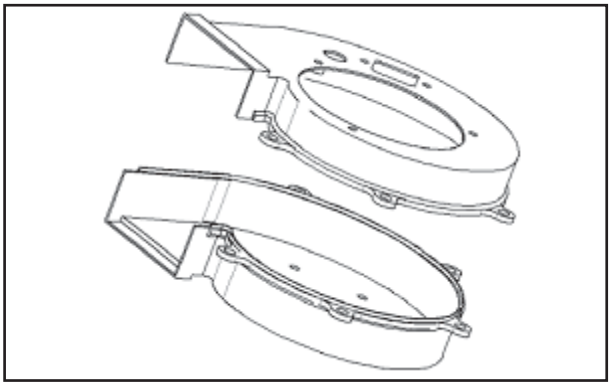
2. Blower Assembly

1. Remove fasteners connecting blower unit with firewall and take out blower unit.
2. Replace blower unit with new one and fit with fasteners on the heater unit.
3. Assemble heater unit assembly on the vehicle as explained above.

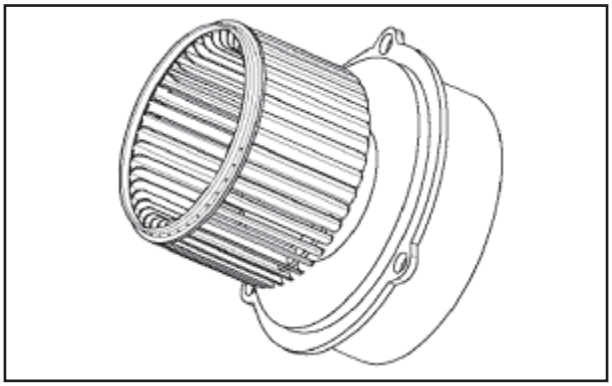
3. Blower Resistor

Blower resistor is meant for regulating blower speed. It is three-speed blower resistor and is also provided with safety features, which blows it off when current increases beyond limit.

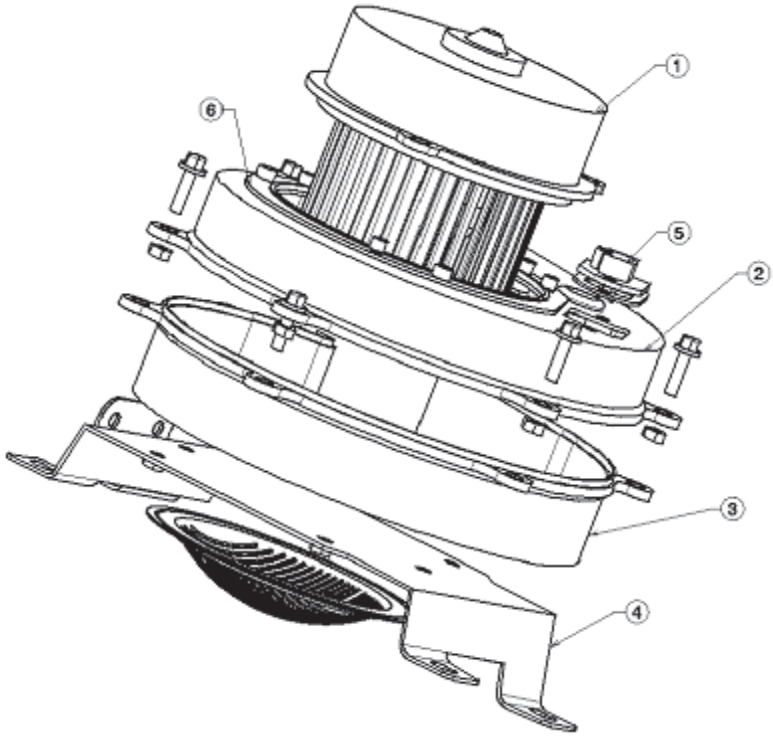
1. Remove bottom part of the dash panel.
2. From the bottom of dash, resistor is visible. Take out the wiring harness connector from resistor.
3. Remove the resistor by opening two screws and replace it with new one.
4. Connect wiring harness connector and fit dash panel part as earlier.



Blower Case



Blower Motor



1 Blower Motor Assy
2 Case Blower RH
3 Case Blower LH
4 Bkt Assy Blower MTG
5 Resistor Blower
6 Plate

Exploded view of Blower Motor assembly

TROUBLE SHOOTING

DO'S AND DONT'S FOR HEATING SYSTEM

S.No	DO'S	REASON
1	Clean heater core periodically to remove dust and foreign particles	Dirty & clogged heater core results in less heating and air flow.
2	Adjust fresh air and heater cable properly to close damper firmly.	Unadjusted cable will result in less airflow and reduced performance.
3	Educate customer on proper usage of heater controls	Proper usage of heating controls will give optimum performance..
4	Adjust proper engine rpm.	Less rpm will result in less heating of engine and less cabin temperature.
5	Check coolant level and ensuring proper engine tuning	This will ensure the proper flow of coolant in the heater core.

S.No	DONT'S	REASON
1.	Do not use heater for long time in recirculation mode.	This will lead to low relative humidity in the cabin and dehydration of the passengers.

Troubleshooting of Electrical Circuits :

Chart given below indicates items to be checked for various types of troubles :

No.	Troubles	Main Inspection Areas						Others
		Fuses	Connectors	Wiring Harness	Body Ground	Servo Motors	Sensor Circuit*	
1	Fuse is blown easily	O	O	O	O			
2	No blower operation	O	O	O	O			Heater relay, Blower motor, Blower resistor, Blower switch
3	Blower speed does not changes	O	O	O	O			Blower Resistor, Blower Switch
4	Less or no heating					O	O	Also check the coolant water level in radiator.
5	No warm air comes out					O		Engine coolant volume, Temperature Control lever, Heater radiator

Note: * Sensors are thermister, pressure switch and water temp. Switch.

PRODUCT IMPROVEMENTS



INTRODUCTION

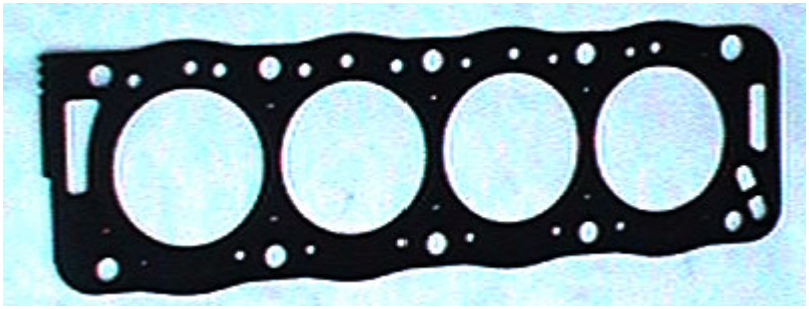
This section deals with improvements & modifications carried out in recent past & while introducing face lift version.

Modifications incorporated on G-76 Gear Box appear in the supplement section of gear box.

Please recheck part numbers in updated parts catalogue while ordering modified parts.

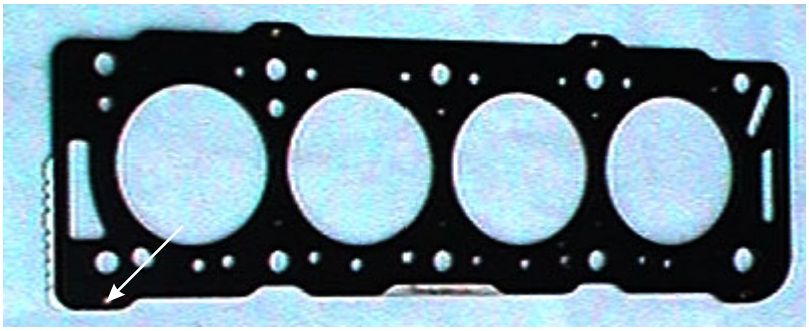
CYLINDER HEAD GASKET

EXISTING (NON RE TORQUE)



Old Part No. : 2547 0115 53 22 (Reinz 1.6 mm) / 2547 0115 5323 (Reinz 1.7 mm)

NEW MLS GASKET



Introduced from April '03

MULTI LAYER STEEL GASKET (Reinz Germany) WITH MODIFIED CYLINDER BLOCK INTRODUCED IN PLACE OF NON-RE TORQUE GASKET.

NOTE :
Old gasket can fit on new cyl. block
New gasket can not fit on old block due to gasket bridge configuration.
There is no change in cyl. Head mounting bolt and torque for head mounting .

Valid Part Numbers for new MLS cylinder head gasket :

Part No.	Identification Mark / No.	Gasket Thickness
2547 0115 5361	60 – 33155 – 40	1.5 mm
2547 0115 5362	60 – 33155 – 50	1.6 mm

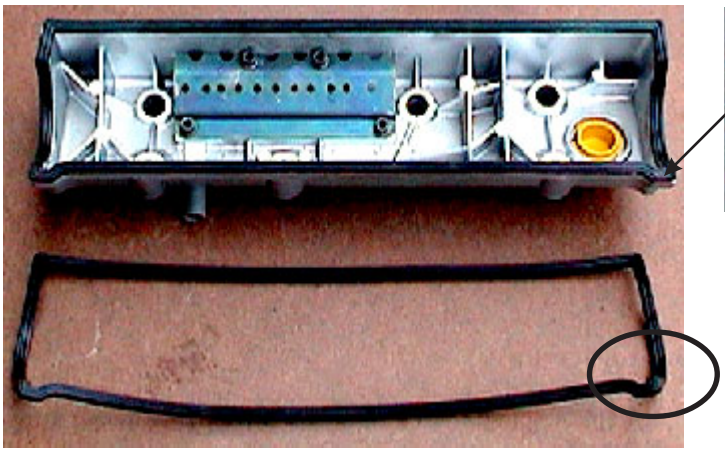
CHANGES DUE TO METALLIC (MLS) CYLINDER HEAD GASKET

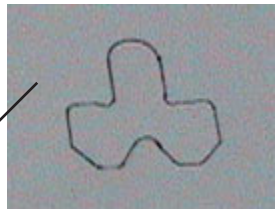
Component Name	Old Part no.	New part no.	Change in Parameter
Assy. Cylinder Crank case with Liners	2547 0110 0196	2547 0110 0237	1. Slit width changed to 1.6 mm-0.10 from 2.0 MM-0.2 2. Relieving for rivets
Cylinder Crank case	2547 0110 3729	2547 0110 3739	
Cylinder Head NA	2547 0115 3817	2547 0115 3823	Relieving for rivets
Cylinder Head TC	2547 0115 3815	2547 0115 3824	

CYLINDER HEAD COVER GASKET

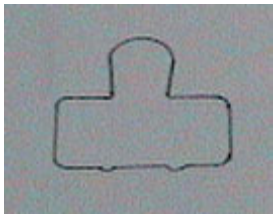
CYLINDER HEAD COVER GASKET PROFILE MODIFIED WITH THICKER SECTION FOR BETTER SEALING.

Introduced from Mar. 2001



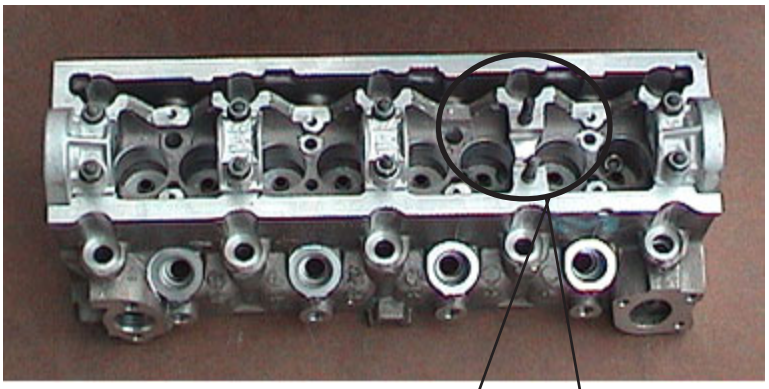


OLD PROFILE



MODIFIED PROFILE

ENGINE - CYLINDER HEAD

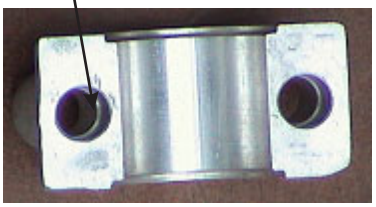


New part No. : 2547 0115 0195

ASSY. CYL. HEAD, W/O VALVES (INTERMEDIATE)

Old part No. : 2547 0115 0130

ASSY. CYL. HEAD, W/O VALVES (INTERMEDIATE)





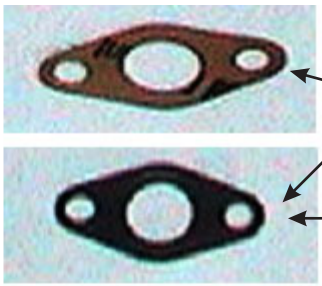
Locating dowels provided on cylinder head and cam shaft cap to control bore mis match/ ensuring better alignment, when reassembled again for camshaft fitment on 4DLTC engines. This avoids cam shaft oil seal leakage

Introduced from Feb. 2003

TURBO CHARGER GASKETS



OLD – NON ASBESTOS



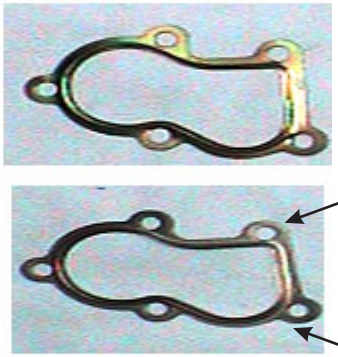
STEEL BACK BONE GASKET FOR BETTER SEALING.

Old part no. 2547 1413 5302

New part no. 2547 1413 5304

OLD – METAL GASKET

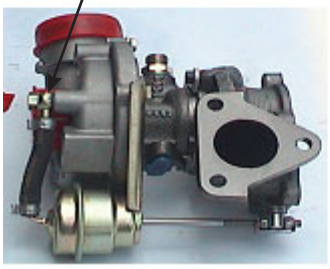




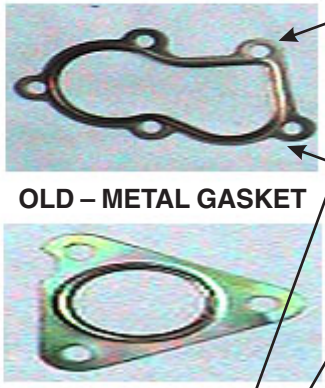
Valid Part Numbers:

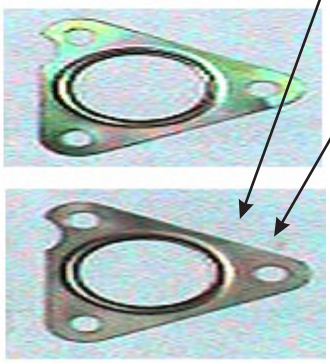
1. Turbocharger assy-2547 1451 0104
2. Gasket Turbine inlet -2547 1411 5332
3. Gasket Turbine outlet - 2547 1411 5333

Waste gate hose



OLD – METAL GASKET





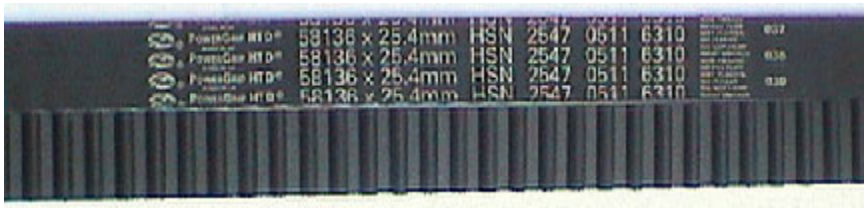
STAINLESS STEEL MATERIAL (SS304) FOR HIGH HEAT RESISTANCE

Introduced from October '02

TIMING BELT

OLD PART NO:2547 0511 6301

NEW PART NO:2547 0511 6310



GD100 (M/s GATES , GERMANY) MAKE BELTS INTRODUCED FOR IMPROVED LIFE.

Introduced from May '02

• **NOTE** : INTERCHANGEBLE

OIL RETURN LINE (TURBO CHARGER)

UN MODIFIED

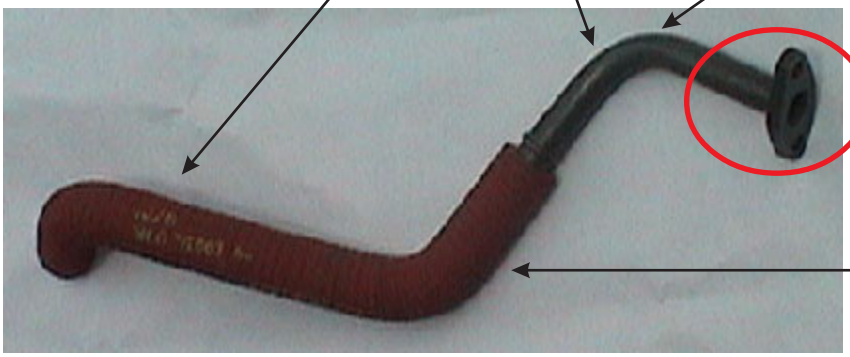


Oil outlet tube 2547 1817 0154

Oil outlet rubber hose 2547 1817 5807

METAL TUBE LENGTH REDUCED & HOSE LENGTH INCREASED FOR BETTER FLEXIBILITY.

MODIFIED



VACUUM BRAZING & IMPROVED FORM INTRODUCED.

Introduced from October '02

SILICON RUBBER HOSE INTRODUCED FOR HIGH HEAT RESISTANCE

Note: If the oil outlet pipe & hose of old version (Part No: 2547 1817 0138, 2547 1817 5805) is replaced with new version (Part No: 2547 1817 0154, 2547 1817 5807) it is essential to fit new version oil inlet pipe (Part No: 2547 1817 0153)

WATER PUMP ASSEMBLY

NON UNITISED SEAL



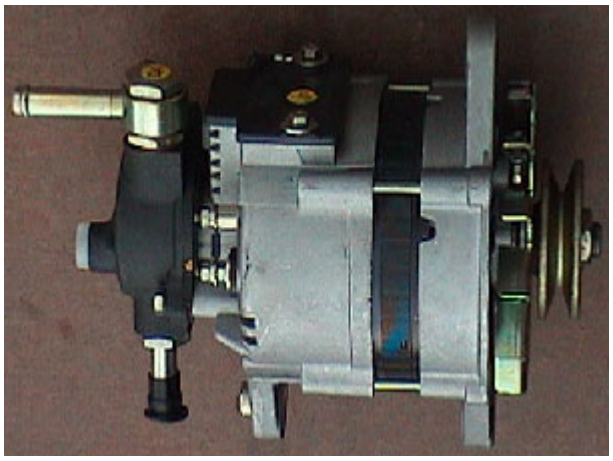




UNITISED SEAL ASSEMBLY INTRODUCED FOR BETTER WATER SEALING.

Introduced from July '01

BELT (ALTERNATOR)



SIX GROOVE DRIVE BELT ARRANGEMENT INTRODUCED IN PLACE OF SINGLE GROOVE FOR IMPROVED BELT LIFE

Introduced from JULY-2003

SINGLE GROOVE



SIX GROOVE



FAN BEARING HOUSING

ALUMINIUM HOUSING



CAST IRON HOUSING



Old part no. : 2547 2015 0112
(assy. Bearing housing comp.)

CAST IRON BEARING HOUSING INTRODUCED IN PLACE OF ALUMINIUM TO ELIMINATE BEARING FAILURES CAUSED DUE TO DISTORTION OF ALUMINIUM HOUSING

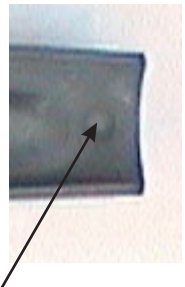
Introduced from Oct '02

New part no. : 2547 2015 0124
(assy. Bearing housing comp.)

2547 2015 3718
(Fan Bearing housing)

CLUTCH SLAVE CYLINDER





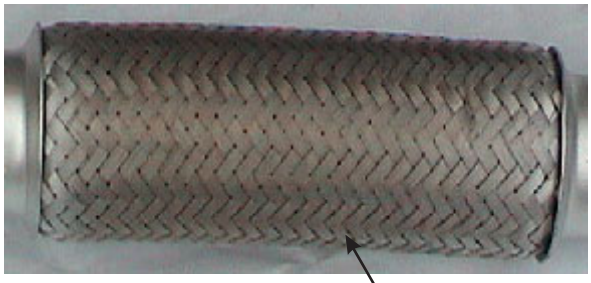


M/s KBX MAKE SLAVE CYLINDER ASSEMBLY INTRODUCED TO ELIMINATE SEAL WEAR (EPDM SEALS & BETTER BORE SURFACE FINISH)

DIMPLE FORM CORRECTED FOR BETTER ACTUATION OF CLUTCH

Introduced from Mar '02

FRONT EXHAUST PIPE

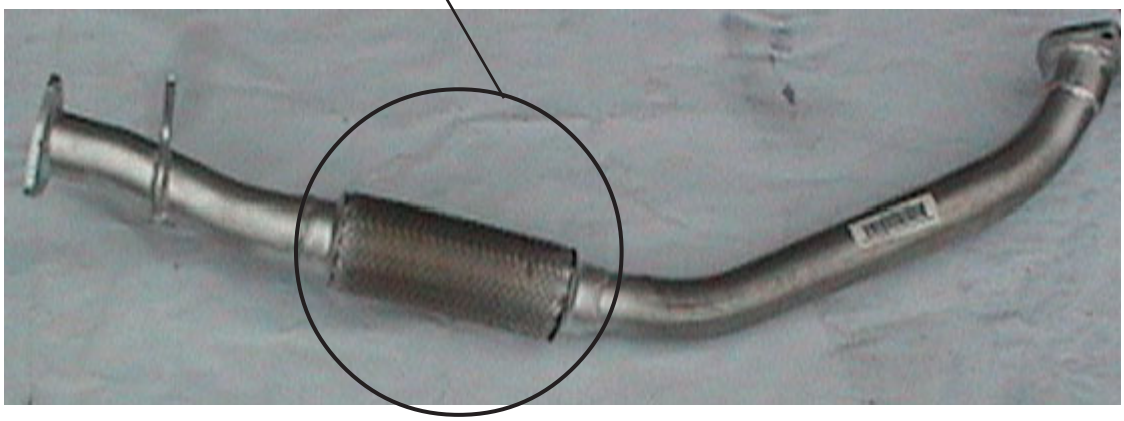


EXHAUST PIPE WITH FLEXIBLE JOINT INTRODUCED TO ELIMINATE FAILURE OF CATALYTIC CONVERTOR

Introduced from APR-02

Old. part no. 2701 4920 0124

New part no. 2721 4920 0120



RADIATOR

COPPER BRONZE RADIATOR



Old part no. : 2547 5010 0182

ALUMINIUM RADIATOR



New part no. : 2547 5010 0256

RADIATOR IN ALUMINIUM MATERIAL FROM M/S TATA TOYO INTRODUCED FOR BETTER COOLING PERFORMANCE & CORROSION PROPERTIES AGAINST THE EARLIER VERSION OF COPPER BRONZE

Introduced from Sep-2002

BRAKE MASTER CYLINDER



TANDEM MASTER CYLINDER IN ALUMINIUM WITH EPDM SEAL INTRODUCED TO ELIMINATE LEAKAGE COMPLAINTS.

Introduced from AUG-2002.

BALL JOINT (LOWER)

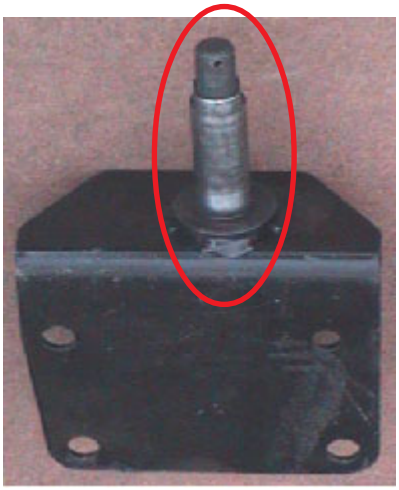


NECK DIA INCREASED TO 17 mm FROM 16 mm.

NECK RADIUS CHANGED TO 4 mm AGAINST 2.5 mm.

BALL SEAT MATERIAL IN POLYACETAL INTRODUCED AGAINST POLYURETHENE.

Introduced from Sep-2000



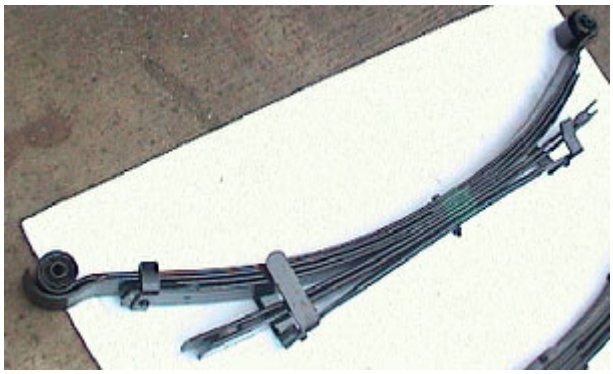
IDLER ARM

SINGLE PIECE PIN INTRODUCED TO MAINTAIN ACCURACY IN IDLER ARM BRACKET TO RETAIN TOE-IN VALUES & TO ELIMINATE TYRE WEAR.

Introduced from JULY '02

LEAF SPRING

SEMI ELIPTICAL



OLD PART NO : 2654 3240 0124

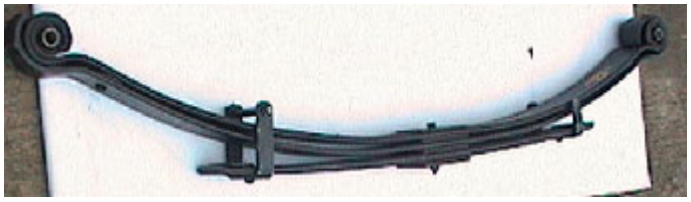
PARABOLIC SPRING INTRODUCED IN PLACE OF SEMI ELIPTICAL FOR BETTER RIDE & HANDLING

Introduced from JULY-2003.

NEW PART NO : 2698 3260 0111 (LH)

: 2698 3260 0112 (RH)

PARABOLIC





DRIVER & CO-DRIVER SEATS

INDICA TYPE SEATS WITH WATER REPELLANT SCOTCH GUARD INTRODUCED FOR BETTER COMFORTS & SUPERIOR AESTHETICS.

Introduced from JULY-03.

COVER PADDING - DOOR



Old part no. : 2654 7270 0124 (LH)

2654 7270 0125 (RH)

New part no. : 2654 7270 0124 (LH)

2654 7270 0125 (RH)

IMPROVED COVER PADDING MATERIAL CHANGED TO ZYLOC FROM ABS AND LUG THICKNESS INCREASED TO AVOID CRACKING

Introduced from DEC-2002.

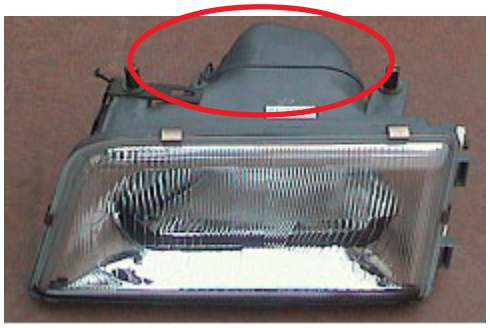
IMPROVEMENT IN PAINTING QUALITY – SOFT FEEL PAINTING SYSTEM

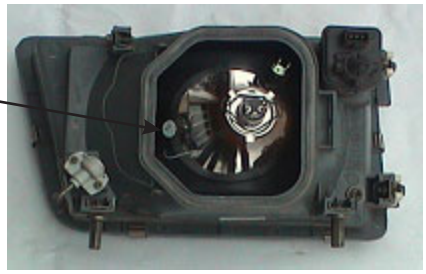


SOFT FEEL PAINTING SYSTEM ON DASHBOARD.

Introduced from JULY '03

HEAD LAMP





TO PREVENT WATER INGRESS CONTINUOUS GASKET WITH THICKNESS INCREASED FROM 5 mm TO 7 mm .

Introduced from JAN-2002

Old part no. : 2659 5441 0161 - RH RHD

2659 5441 0162 - LH RHD

2659 5441 0163 - RH LHD

2659 5441 0164 - LH LHD

New part no. : 2659 5441 0161 - RH RHD

2659 5441 0162 - LH RHD

2659 5441 0163 - RH LHD

2659 5441 0164 - LH LHD

POWER STEERING PUMP / GEAR BOX

RANE PUMP



ZF PUMP



M/S Z F MAKE PUMP & GEAR BOX INTRODUCED INPLACE OF M/S RANE

1. 90 BAR GEAR BOX WITH IMPORTED SEALS. 2. FULLY ASSEMBLED IMPORTED PUMPS.

Introduced from JULY '03.

EXHAUST MUFFLER



ALUMINISED EXHAUST SYSTEM INTRODUCED FOR BETTER CORROSION RESISTANCE.

Introduced from Sep. 2002.

TATA INDICA TYPE ARMREST, MAGAZINE POCKETS, GRAB HANDLES



Better passenger comfort & amenities.

NEW LOOK FRONT GRILL



Signifies upgraded version (face lift) with better styling.

PRODUCT IMPROVEMENTS

TATA SAFARI TYPE STEERING WHEEL



Improve look, better grip

NEW LOOK OUTER RVM



Internal adjustment of RVM from inside the vehicle, better convenience to driver, lesser virbations at high speeds.

SPOILER ON WIPER BLADES



Provided on driver side to improve wiping at high speeds.

ROOF LAMP AT FRONT FOR CREW CAB



For better illumination in passenger compartment, especially front row.

SAFARI TYPE GEAR SHIFT KNOB



Better look, better grip of gear knob

NEW WHEEL RIM COVERS



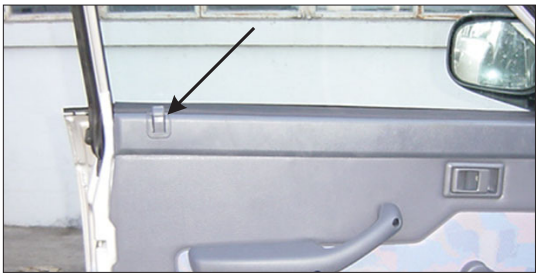
Improved look.

PIGMENTED FENDERS & REAR CORNER BUMPERS



Better finish / look, eliminates colour fading, long lasting finish.

CENTRAL LOCKING



Additional feature (100% fitment on face lift vehicle).

NEW MOULDED ROOF LINING



Better aesthetics & long lasting.

16" RIMS WITH 205/80 TUBELESS TYRES



To increase ground clearance to 200 mm (from 170 mm for 4x2 & 160 mm for 4x4)

DAMPER TUNED SHOCK ABSORBER



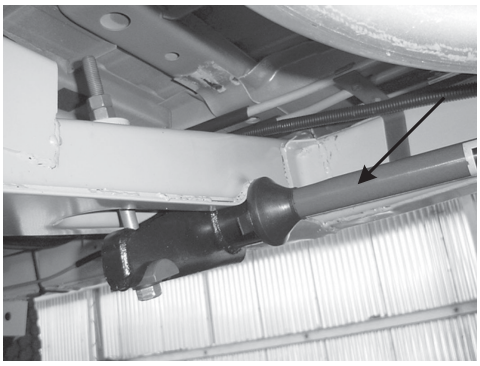
Better passenger comfort.

WINDSHIELD GLASS WITH SHADE BAND



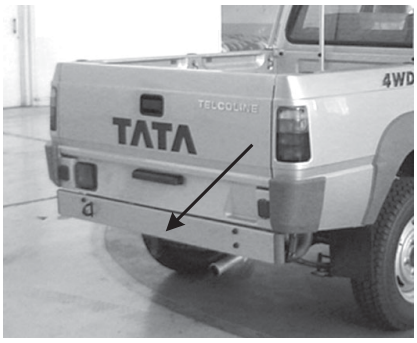
Better look / no extra shade band stickers required

TORSION BAR SUSPENSION FOR 4X2 ALSO (FACE LIFT VERSION)



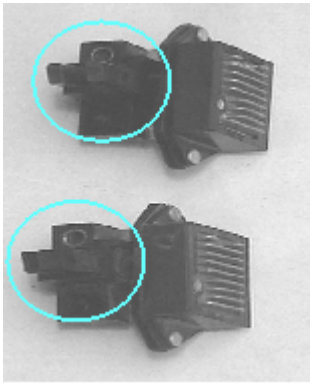
Better vehicle stability and ride comfort. Improved tyre life.

UNDER RUN PROTECTION BUMPER



Mandatory as per CMVR regulation (India) - Central Motor Vehicle Regulation in India.

ALTERNATOR



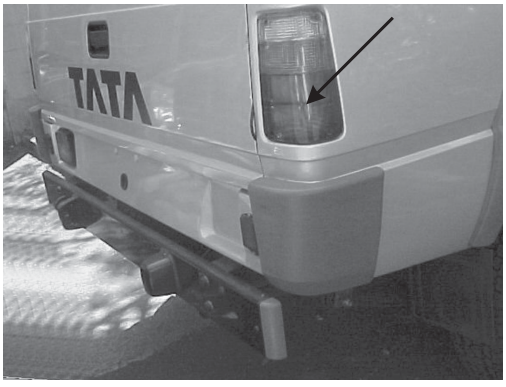
Brush material changed from graphite to copper graphite to minimise wear

CATALYTIC CONVERTOR



Inner welding introduced instead of outer side to eliminate breakage complaints.

RECESSED TYPE TAIL LAMP



Recessed type tail lamp on load body for better aesthetics.

GEAR BOX - BREATHER



Metallic breather introduced instead of plastic to avoid breakages & for better breathing



IMPROVEMENTS IN CABIN & LOAD BODY

NVH Package

Improved noise, vibration & heat resistance package introduced for better passenger comfort.

Door latch HYTRAL coating to reduce noise

Easy & silent operation of doors (opening & closing).

Grey Interiors

Improved look.

New Grey Carpet

Aesthetically better, grey colour matching with other interiors.

Load body with bolted hook

Better look, easy to remove if not required, better strength.

Fender

Fender beading fixed with 3m tape and adhesive to prevent dislodging

Cover padding - door

Improved cover padding. Material changed to zyloc from abs and lug thickness increased to avoid cracking

AC control unit

High density pu foam in black colour introduced inplace of cross link foam to improve aesthetics

Cover sill bottom

Mounting arrangement with slots & snap-on button changed to holes & screws for better holding

Rubber- plastics – door inner beading

Corner mould surface match, better trimming at edges, improved low-temperature performance due to presence of baked silicone on surface.

Combi switch

Hazard warning switch housing tightening with screw instead of snap on type introduced. Silver plate contact introduced

Tail lamp

Sealing gasket thickness changed from 2 to 6 mm.

Front blinker

Drain hole provided at bottom side.

OTHER IMPROVEMENTS

Limited slip differential for 4x2 also (100% fitment on all face lift version)

Excellent traction in difficult terrains.

Oil supply line (turbo charger)

Improved bending to avoid fouling

Turbo boost pressure line

Waste gate hose material & orientation has been changed. This would create enough gap from exhaust manifold to avoid fouling with exhaust manifold.

Oil sump stiffner

Stiffner die corrected to ensure proper flatness to arrest sump gasket leakages.

Clutch housing

Clutch housing mounting dimensions corrected to avoid misalignment of starter motor

Clutch master cylinder

Bore honing & seal in S.B.R. Material introduced to eliminate leakage complaints.

Tie rod

Rubber boot profile modified to avoid fouling with garter spring in the extreme articulation.

Centre link

Ball seat material changed from polyurethene to polyacetal for better wear properties.