TOYOTA

18R ENGINE

REPAIR MANUAL

INCLUDES

18R, 18R-C & 18R-G

TOYOTA MOTOR CORPORATION

Pub. No. 98196E

FOREWORD

This manual describes the repair procedures for the 18R, 18R-C & 18R-G engines equipped on the TOYOTA CELICA, CORONA, CRESSIDA, HI-LUX, and HIACE.

Under DISASSEMBLY and ASSEMBLY, you will find disassembled views which carry numbers indicating the sequence of operation procedure. The operations can be accomplished by following these numbers. To facilitate understanding, there are also some figure numbers after operation numbers showing the locations of work details. The texts have different symbol marks which supersede the figure explanation.

This manual provides complete information on the maintenance and service of those engines, and it is hoped that it will see much use.

All information contained in this manual is the most up-to-date at the time of publication, and we reserve the right to make any changes without further notice.

For service of emission control devices, refer to each emission control repair manual.
For new service specification data, refer to service specification manuals.

TOYOTA MOTOR CORPORATION

SECTION CONTENT

GENERAL

Page

1

GENERAL REPAIR INSTRUCTIONS

1. Use fender, seat and floor covers to keep the car clean and prevent damage.
2. During disassembly, keep parts in order to facilitate reassembly.
3. Before performing electrical work, disconnect the cable from the battery terminal.
4. Always replace cotter pins, gaskets and O rings with new ones.
5. When necessary, use a sealer on gaskets to prevent leaks.
6. Carefully observe all specifications for bolt tightening torques. Always use a torque wrench.
7. Use genuine Toyota parts.
8. When replacing fuses, be sure the new fuse is the correct amperage rating. DO NOT exceed the fuse amp rating or use one of a lower rating.
9. If the vehicle is to be jacked up only at the front or rear end, be sure to block the wheels in order to ensure safety.
10. After the vehicle is jacked up, be sure to support it on stands. It is extremely dangerous to do any work on the vehicle raised on a jack alone, even for a small job that can be finished quickly.
11. Use of a special service tool (SST) may be required, depending on the nature of the repair. Be sure to use SST where specified and follow the proper work procedure. A list of SST can be found at the back of this manual.

ABBREVIATIONS USED IN TOYOTA REPAIR MANUALS

For convenience, the following abbreviations are used in Toyota repair manuals.

Abbreviation	Term	Abbreviation	Term
A/T	Automatic Transmission	O/S	Oversize
BDC	Bottom Dead Center	RH	Right-hand
BTDC	Before Top Dead Center	RHD	Right-hand Drive
EX	Exhaust	SST	Special Service Tool
IN	Intake	STD	Standard
LH	Left-hand	T	Tightening Torque
LHD	Left-hand Drive	TDC	Top Dead Center
MP	Multipurpose	U/S	Undersize
M/T	Manual Transmission	W/	with
OPT	Option	W/O	without

SYMBOLS

The following symbols have been adopted for simplicity and for easy comprehension.


REMOVE or DISASSEMBLE


INSTALL or ASSEMBLE


INSPECT


MEASURE


TIGHTEN


CLEAN


IMPORTANT

18R ENGINE TUNE-UP

18R ENGINE TUNE-UP ITEM

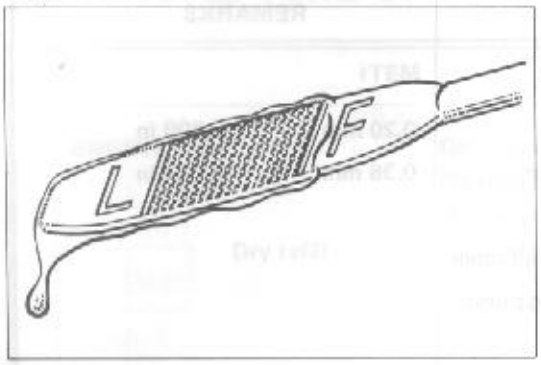
	ITEM				REMARKS		
1	ENGINE OIL		Oil level check		"Full" line		
			Oil replenishment		API service SE classification		
			Oil capacity				
		Dry refill	w/Oil filter	RX, RT	4.2 liters	4.4 US qt	3.7 Imp.qt
				RH	5.4 liters	5.7 US qt	4.8 Imp.qt
				RN	4.4 liters	4.7 US qt	3.9 Imp.qt
				RN4WD	5.5 liters	5.8 US qt	4.8 Imp.qt
		Drain & refill	w/Oil filter	RX, RT	3.8 liters	4.0 US qt	3.3 Imp.qt
				RH	5.0 liters	5.3 US qt	4.4 Imp.qt
				RN	3.8 liters	4.0 US qt	3.3 Imp.qt
				RN4WD	5.1 liters	5.4 US qt	4.5 Imp.qt
			w/o Oil filter	RX, RT	3.2 liters	3.4 US qt	2.8 Imp.qt
				RH	4.4 liters	4.7 US qt	3.9 Imp.qt
				RN	3.2 liters	3.4 US qt	2.8 Imp.qt
				RN4WD	4.5 liters	4.8 US qt	4.0 Imp.qt
			Quality check				
			Oil filter replacement		SST [09228-44010]		
2	COOLING SYSTEM		Coolant level check		"Full" line		
			Quality check				
		Coolant capacity	w/Heater	RX, RT	8.0 liters	8.5 US qt	7.0 Imp.qt
				RH	9.6 liters	10.1 US qt	8.4 Imp.qt
				RN	9.0 liters	9.5 US qt	8.0 Imp.qt
3	DRIVE BELT		Tension Fan – Alternator				
				New	5 – 6 mm	0.20 – 0.24 in	
				Used	7 – 8 mm	0.28 – 0.31 in	
			AC – Crankshaft		15 – 18 mm	0.59 – 0.71 in	
4	AIR CLEANER		Element cleaning				
5	BATTERY		Specific gravity		1.25 – 1.27	at 20°C (68°F)	
			Electrolyte level				
6	SPARK PLUG		Visual check				
			Cleaning				
			Plug gap		0.8 mm	0.03 in	
7	HIGH TENSION CORD		Resistance		Less than 25 kΩ per cord		
8	DISTRIBUTOR		Distributor cap				
			Heel gap		0.45 mm		
			Damping spring gap		0.1 – 0.4 mm	0.004 – 0.168 in	
			Dwell angle		50 – 54°		
			Dwell angle variation		within 3°		
			Ignition timing		7° BTDC/750 ± 50 rpm		
			Governor operational				
			Vacuum operational				

	ITEM		REMARKS	
	WARM UP ENGINE			
9	VALVE CLEARANCE (HOT)	Intake	0.20 mm	0.008 in
		Exhaust	0.36 mm	0.014 in
10	CARBURETOR	Automatic check		
		Check throttle valve full open		
		Check the accelerating pump		
		Float level		
11	INITIAL IDLE SPEED	Idle speed	750 ± 50 rpm	
		Manifold vacuum	420 mm Hg	16.5 in Hg
12	CO CONCENTRATION		1–3 %	
13	ENGINE CONDITION			
14	FAST IDLE		2600 ± 200 rpm	
15	COMPRESSION PRESSURE	Standard	11.5 kg/cm^2	163.1 psi
		Limit	9.0 kg/cm^2	127.8 psi
		Difference of pressure between cylinders	Less than 1.0 kg/cm^2	14.2 psi

ENGINE OIL

CHECK OIL LEVEL

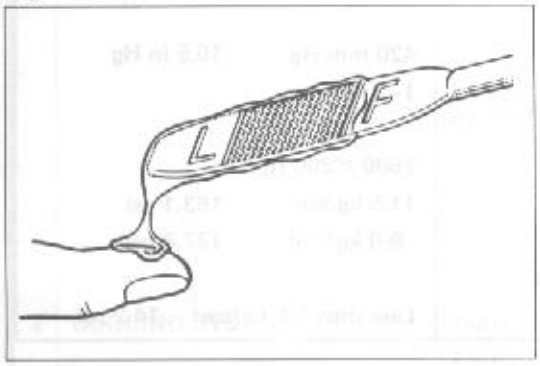
Fig. 2-1



The oil level should be between the L and F marks. If low, check for leakage and add oil up to the F mark. Use API service SE classification oil.

CHECK OIL QUALITY

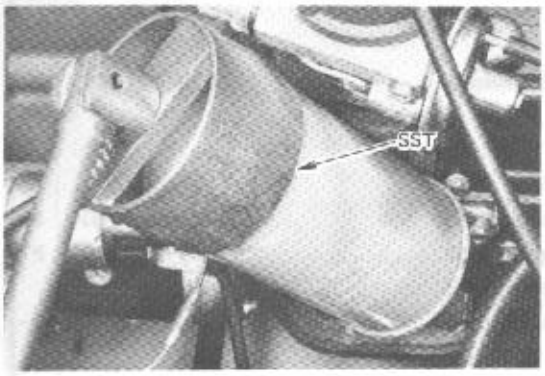
Fig. 2-2



Check the oil for deterioration, entry of water, discoloring or thinning.

REPLACE OIL FILTER

Fig. 2-3

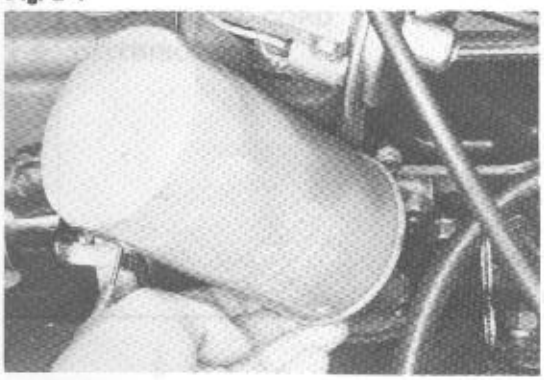


1. Remove the oil filter with SST.
   SST [09228-44010]
2. To install new filter, tighten firmly by hand.

— Note —

Do not tighten with SST or wrench.

Fig. 2-4

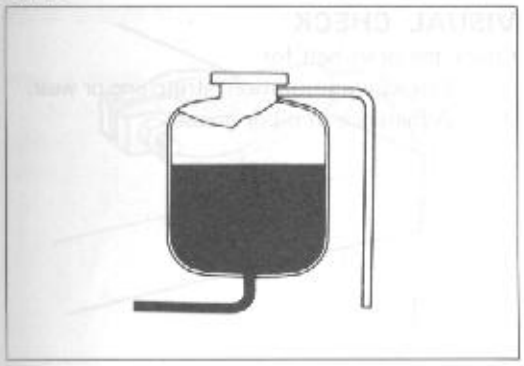


3. Start the engine and check for oil leakage.
4. Stop the engine and recheck the oil level.

COOLING SYSTEM

CHECK COOLANT LEVEL

Fig. 2-5



If low, fill reservior to FULL line.

– Note –

To maintain freeze protection, use a recommended anti-freeze.

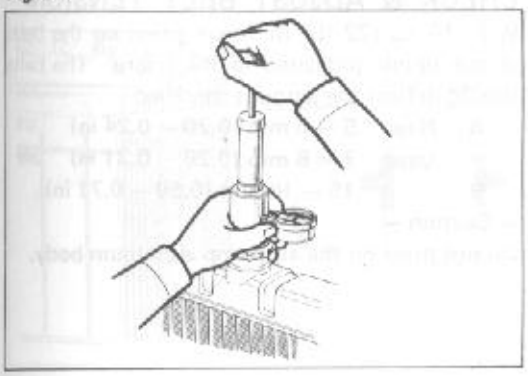
CHECK COOLANT QUALITY

Fig. 2-6

1. Check coolant cleanliness.
2. Check for rust or scale deposits around radiator cap and filler neck.
3. Check to see that there is no oil in the coolant.

CHECK COOLING SYSTEM

Fig. 2-7

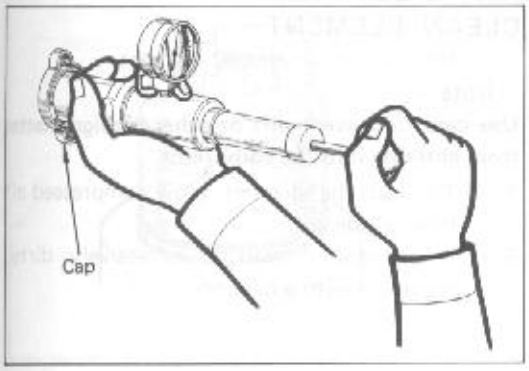


Check for:

1. Damaged or deteriorated radiator and water hoses.
2. Loose hose clamps.
3. Damage or corrosion in the radiator core.
4. Leakage from the water pump, radiator core or a loose water drain cock.

INSPECT RADIATOR CAP OPERATION

Fig. 2-8



Inspect the spring tension and seating condition of the radiator cap vacuum valves. Replace the cap if the valve opens at a pressure below the specified or is otherwise defective.

Valve opening pressure limit

	0.6 kg/cm² (8.5 psi)
Standard	**0.9 kg/cm² (12.8 psi)**

Fig. 2-9

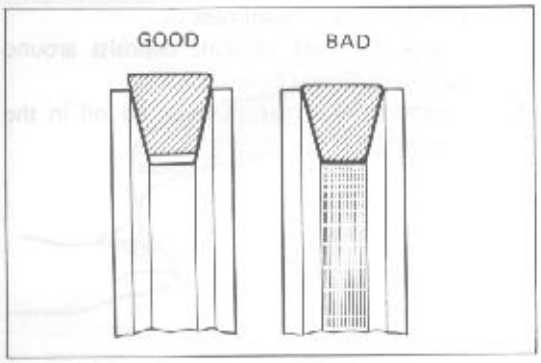
DRIVE BELT

VISUAL CHECK

Check the drive belt for:

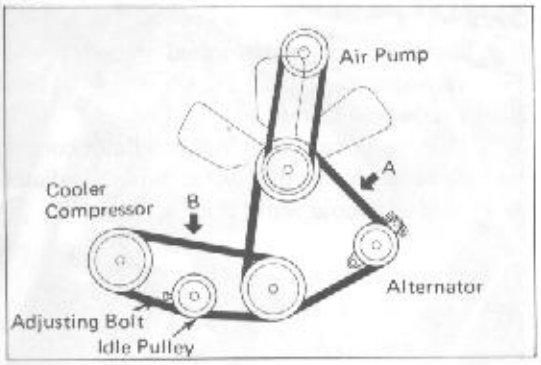
1. Cracks, deterioration, stretching or wear.
2. Adherence of oil or grease.

Fig. 2-10



3. Improper belt-to-pulley contact.

Fig. 2-11



CHECK & ADJUST BELT TENSION

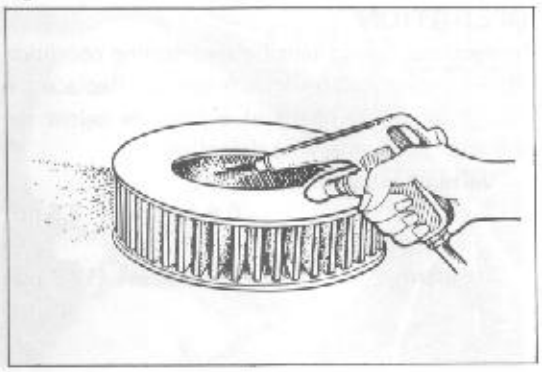
With 10 kg (22 lb) of force, press on the belts at the points indicated in the figure. The belts should deflect the amount specified.

A:	New	5 – 6 mm (0.20 – 0.24 in)
	Used	7 – 8 mm (0.28 – 0.31 in)
B:		15 – 18 mm (0.59 – 0.71 in)

– Caution –

Do not press on the air pump aluminum body.

Fig. 2-12



AIR CLEANER

CLEAN ELEMENT

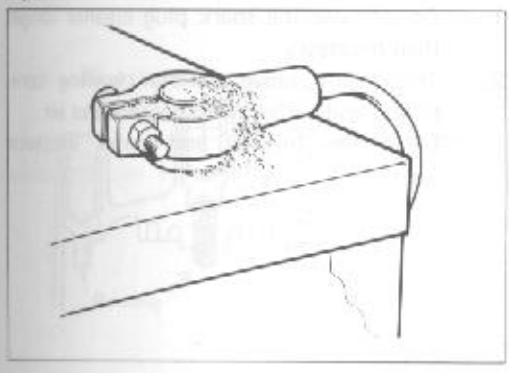
1. Remove the air cleaner element.

– Note –

Use care to prevent dirt or other foreign matter from entering into the carburetor.

2. To clean the element, blow compressed air from inside.
3. If element is torn or excessively dirty, replace it with a new one.

Fig. 2-13



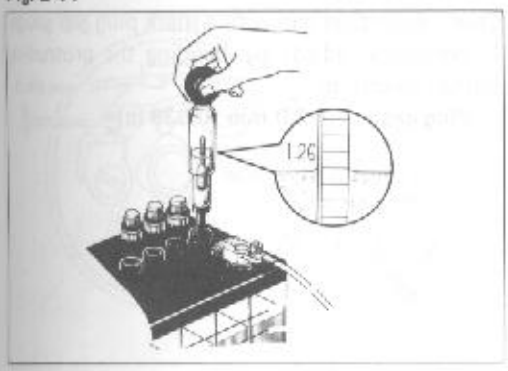
BATTERY

VISUAL CHECK

Check the battery for the following:

1. Rusted battery support.
2. Loose terminal connections.
3. Rusted or deteriorated terminals.
4. Damaged or leaking battery.

Fig. 2-14

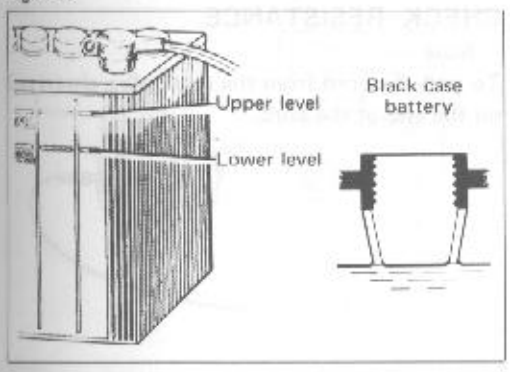


MEASURE SPECIFIC GRAVITY

1. Insert the hydrometer into the cell and hold it so that the float does not the cylinder wall.
2. Draw in sufficient water so that the float is suspended free from both the top and bottom of the cylinder.
3. Read the graduation.

Specific gravity 1.25 – 1.27 at 20°C (68°F)

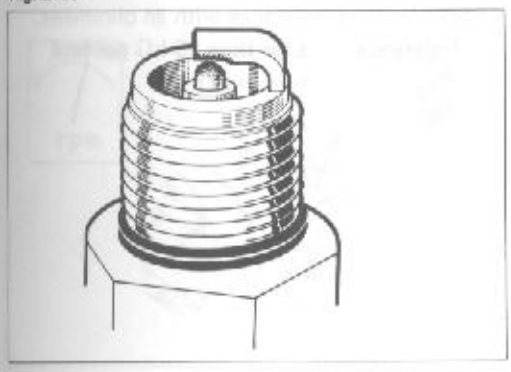
Fig. 2-15



CHECK ELECTROLYTE LEVEL

The water should be up to the upper electrolyte level. If low, add distilled or purified water.

Fig. 2-16



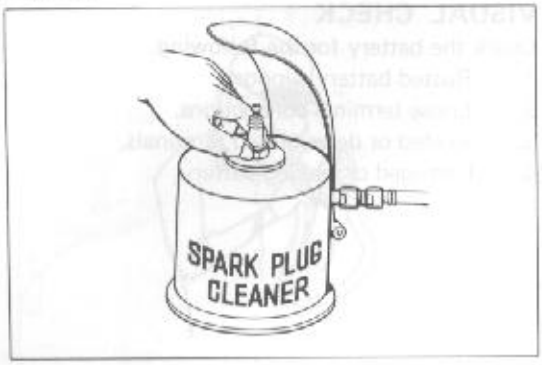
SPARK PLUG

VISUAL CHECK

The spark plugs for the following:

1. Cracks or other damage on the threads and insulator.
2. Electrode wear.
3. Damaged or deteriorated gaskets.
4. Burnt electrode or excess carbon deposits.

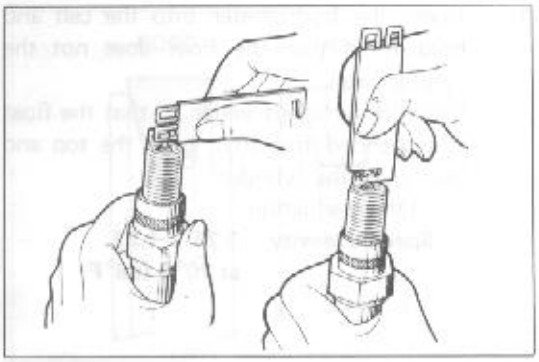
Fig. 2-17



CLEAN SPARK PLUGS

1. Do not use the spark plug cleaner longer than necessary.
2. Thoroughly blow off the cleaning compound and carbon with compressed air.
3. Clean the threads and outer insulator surface.

Fig. 2-18

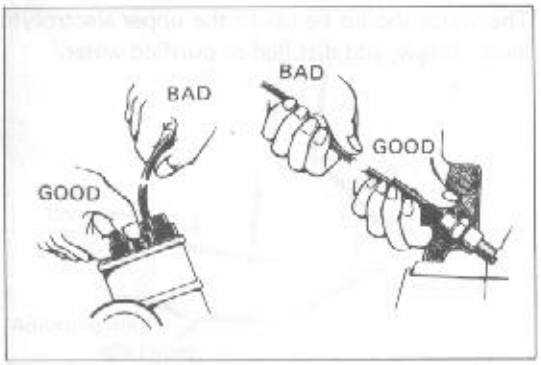


ADJUST GAP

Check each plug gap with a spark plug gap gauge. If necessary, adjust by bending the protruding (outer) electrode.

Plug gap 1.0 mm (0.039 in)

Fig. 2-19



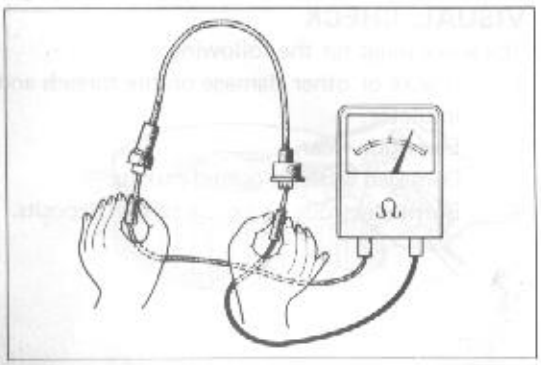
HIGH TENSION CORD

CHECK RESISTANCE

– Note –

To pull the cord from the spark plug, always pull on the end of the cord.

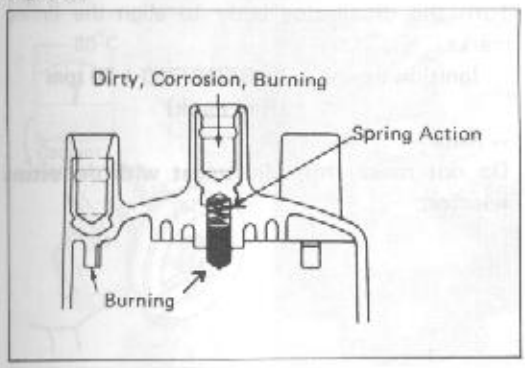
Fig. 2-20



Check the cord resistance with an ohmmeter.

Resistance Less than 25 kΩ per cord

Fig. 2-21



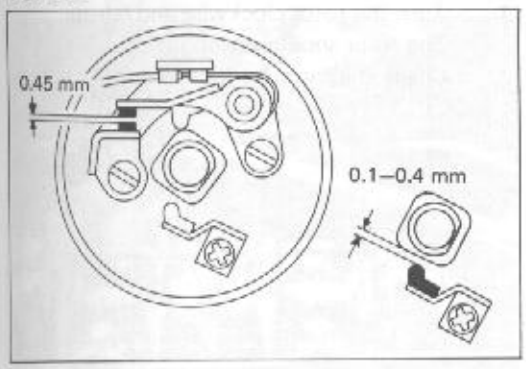
DISTRIBUTOR

CHECK DISTRIBUTOR CAP

Check the cap and rotor for:

1. Cracks, damage, corrosion, burning and dirty cord hole.
2. Burnt electrode terminal.
3. Weak center piece spring action.

Fig. 2-22

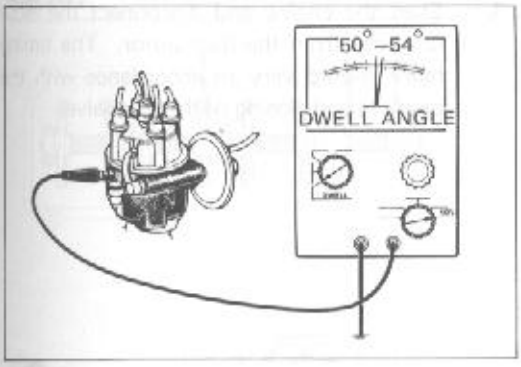


ADJUST HEEL GAP

1. Replace the breaker points if excessively burnt or pitted.
2. Adjust the point gap and damping spring.

Point gap **0.45 mm (0.018 in)**
Damping spring gap
0.1 – 0.4 mm
(0.004 – 0.016 in)

Fig. 2-23

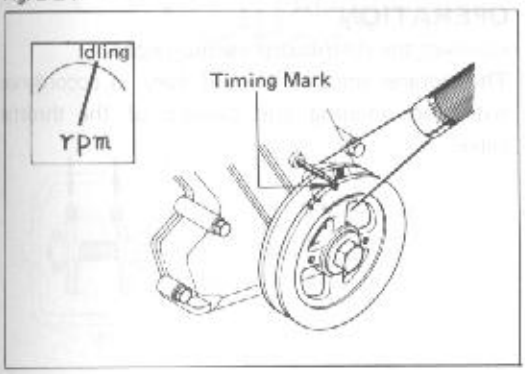


INSPECT DWELL ANGLE

Inspect the dwell angle with a dwell angle tester.

Dwell angle **50 – 54°**
Variation
within 3° (at idling to 2000 rpm)

Fig. 2-24

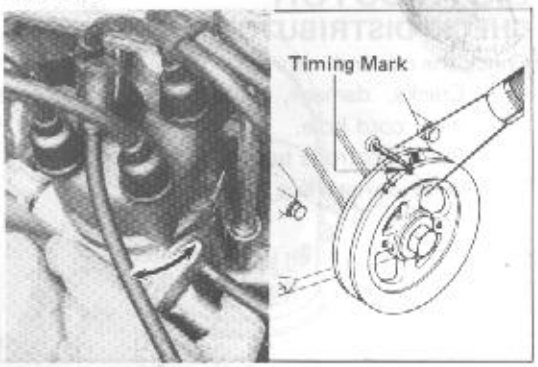


INSPECT IGNITION TIMING

1. To inspect the ignition timing, the engine should be running at idle.
2. The octane selector must be set at the standard position.

Ignition timing
7° BTDC/750 ± 50 rpm
(Red mark)

Fig. 2-25



ADJUSTMENT

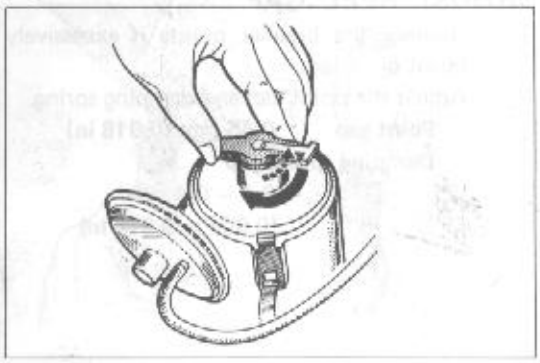
Turn the distributor body to align the timing marks.

Ignition timing **7° BTDC/750 ± 50 rpm (Red mark)**

– Note –

Do not make this adjustment with the octane selector.

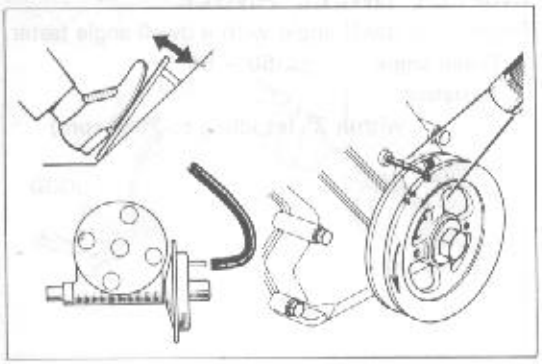
Fig. 2-26



GOVERNOR CHECK OPERATION

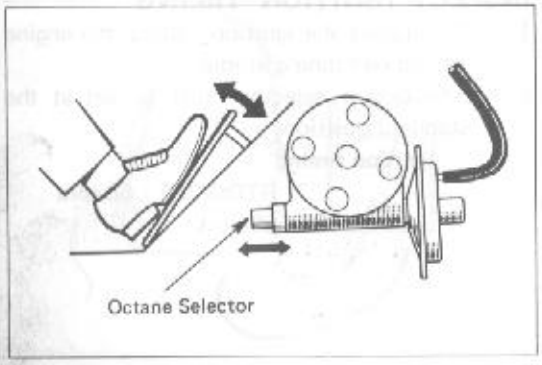
1. Turn the rotor clockwise and release. The rotor should return quickly.
2. Check the rotor for looseness.

Fig. 2-27



3. Start the engine and disconnect the vacuum hose from the distributor. The timing mark should vary in accordance with the opening and closing of throttle valve.

Fig. 2-28



VACUUM ADVANCE CHECK OPERATION

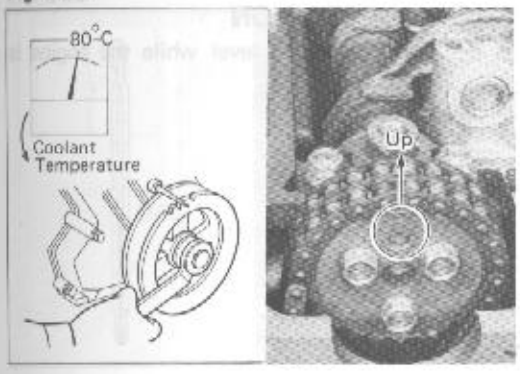
Connect the distributor vacuum hose.

The octane selector should vary in accordance with the opening and closing of the throttle valve.

VALVE CLEARANCE

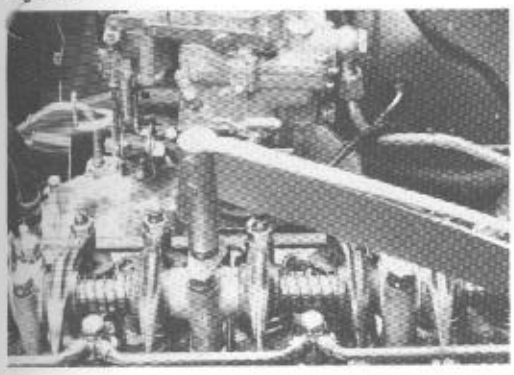
ADJUSTMENT

Fig. 2-29



1. Warm up the engine.
2. Stop the engine.
3. Set the No. 1 cylinder to TDC/compression. At TDC position, the camshaft knock pin should point upwards.

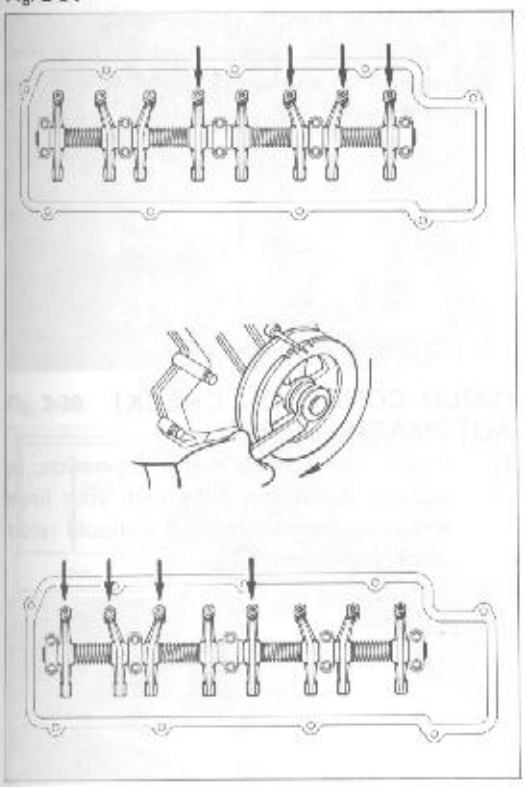
Fig. 2-30



4. Tighten the rocker support.

Torque	**1.7 – 2.3 kg-m (12.3 – 16.6 ft-lb)**

Fig. 2-31



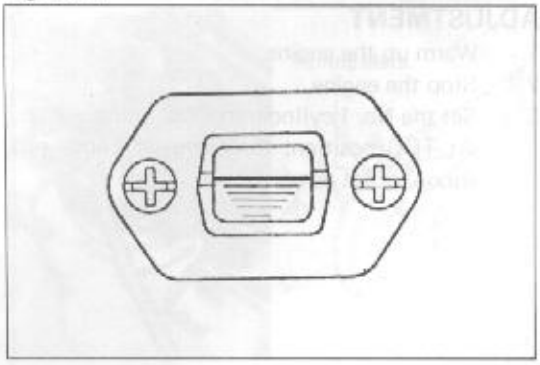
5. Adjust only the valves indicated by arrows in the figure.
   Valve clearance is measured between the valve stem and rocker arm adjusting screw.

Intake	**0.2 mm (0.008 in)**
Exhaust	**0.36 mm (0.012 in)**

6. Rotate the crankshaft 360°.

7. Adjust the remaining valves indicated by arrows.

Fig. 2-32

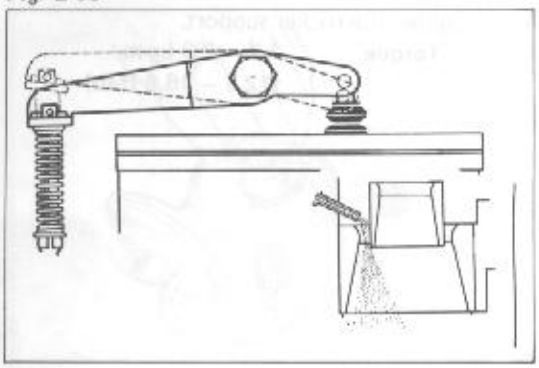


CARBURETOR

CHECK OPERATION

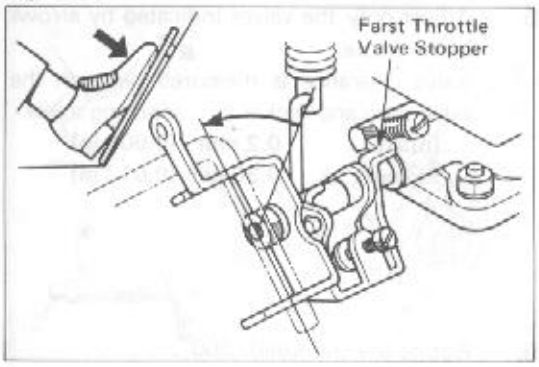
1. Check the float level while the engine is idling.

Fig. 2-33



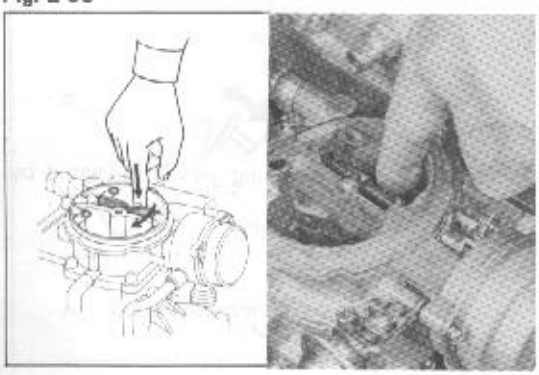
2. Check the acceleration pump operation. Gasoline should shoot out with force from the jet when the throttle valve is opened.

Fig. 2-34



3. Check the throttle valve opening. The throttle valve should be fully open when the accelerator pedal is depressed all the way.

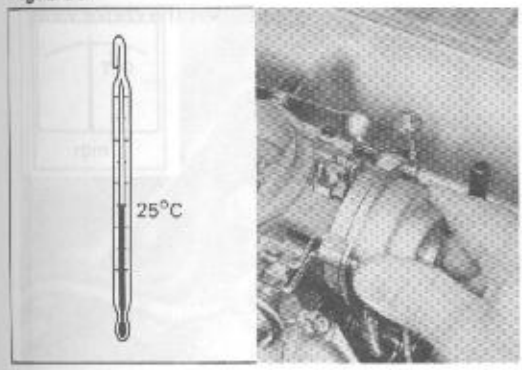
Fig. 2-35



[COLD CONDITION CHECK] AUTOMATIC CHOKE

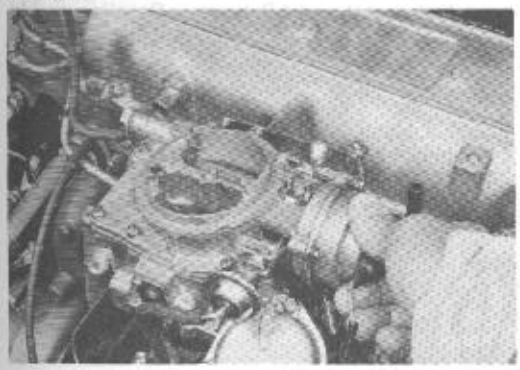
1. Check the choke valve operation by pushing down the valve with your finger and releasing it. The valve should return quickly and smoothly.

Fig. 2-36



2. Check to see that the choke valve just closes exactly when the atmospheric temperature reaches 25°C (77°F).
If it doesn't, loosen the three screws and adjust by turning the coil housing.

Fig. 2-37



3. Check the engine starting and running condition. If necessary, readjust the automatic choke setting by turning the coil housing.

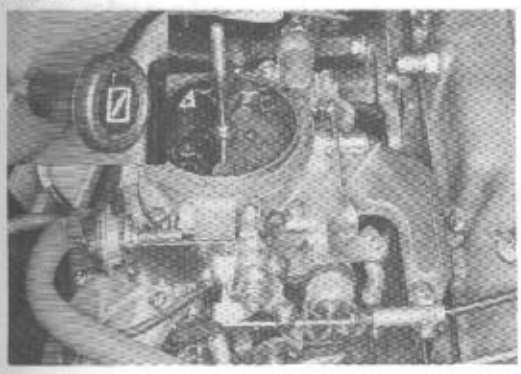
– Note –

If mixture is too rich ..... Turn clockwise

If too lean ..... Turn counterclockwise

MANUAL CHOKE

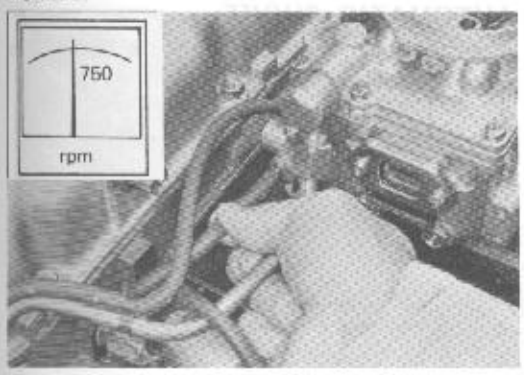
Fig. 2-38



1. Pull out the choke knob all the way and check to see that the choke valve is fully closed.

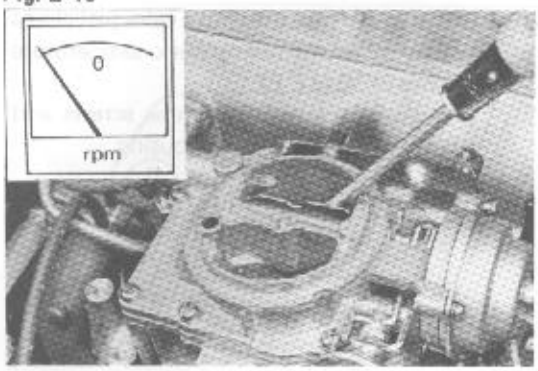
AAP

Fig. 2-39



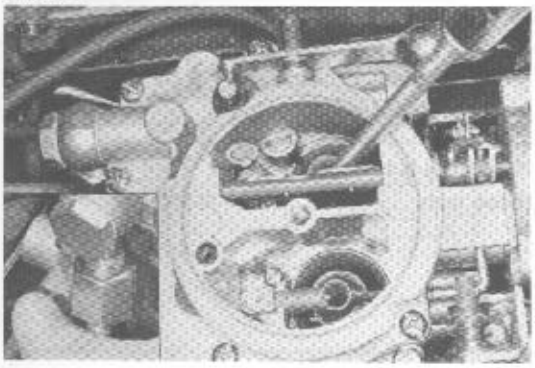
1. Start the engine.
2. Pinch the AAP hose shut.

Fig. 2-40



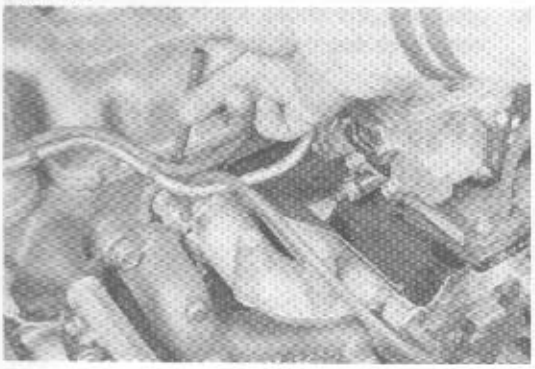
3. Stop the engine and open the choke valve.

Fig. 2-41



4. Release the AAP hose. Gasoline should spurt out of the accelerator pump jet.

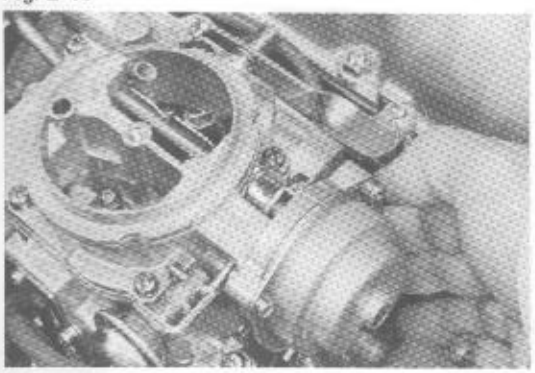
Fig. 2-42



TVSV (for AAP)

With engine idling (below 60°C, 140°F), disconnect the hose from the AAP diaphragm. The engine should idle roughly or die.

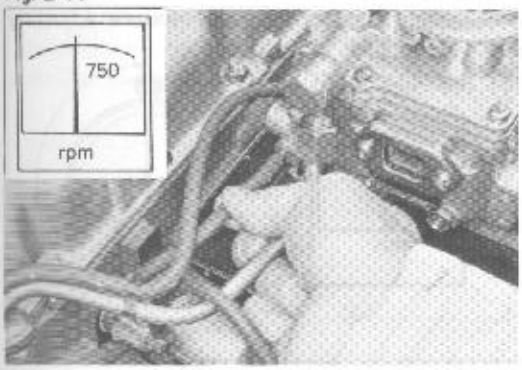
Fig. 2-43



[HOT CONDITION] AUTOMATIC CHOKE

When the engine is warmed up the choke valve should be fully opened.

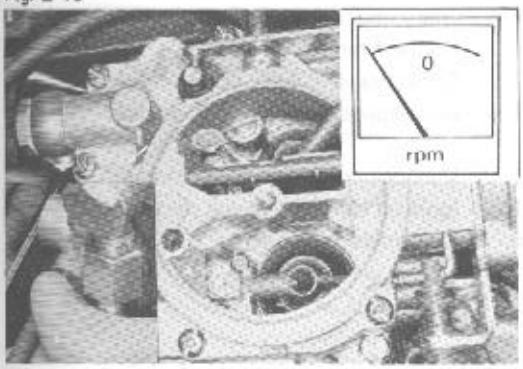
Fig. 2-44



AAP

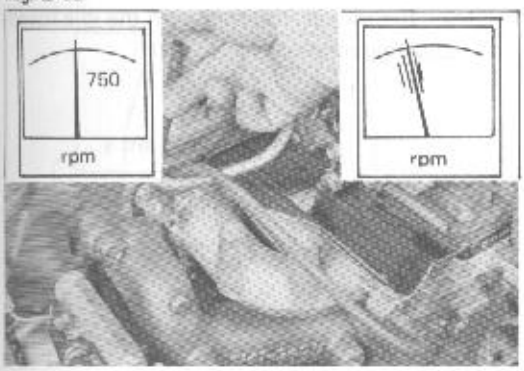
1. Start the engine.
2. Pinch the AAP hose shut.

Fig. 2-45



3. Stop the engine.
4. Release the hose. Gasoline should not spurt out.

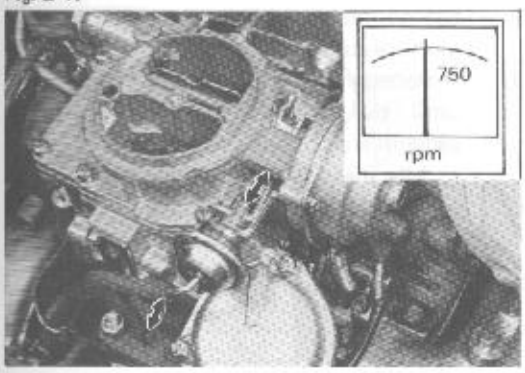
Fig. 2-46



TVSV (for AAP)

With the engine idling (above 60°C, 140°F), disconnect the hose from the AAP diaphragm. The engine should continue idling smoothly and not die.

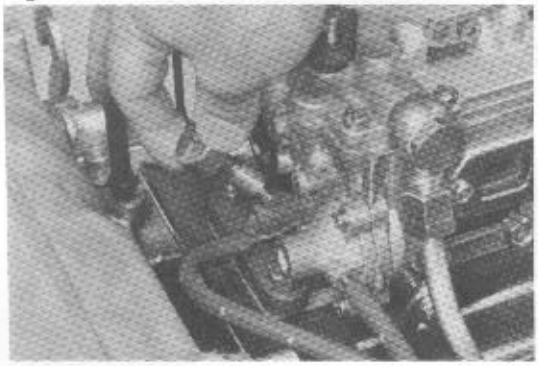
Fig. 2-47



CHOKE BREAKER

1. With the engine idling, disconnect the hose from the intake manifold. Check to see that the choke breaker link has returned.
2. Reconnect the hose and check to see that the choke breaker link is pulled in by the diaphragm.
   If defective, replace the diaphragm.

Fig. 2-48



INITIAL IDLE SPEED

If necessary, adjust the idle mixture adjusting screw with SST.
SST [09243-00020]

Preliminary check

1. Coolant temp. – about 80°C (180°F)
2. Choke valve – fully open
3. Accessories – all off (wiper, heater, lights, air conditioner, etc.)
4. Vacuum lines – all connected
5. Ignition timing – initial set position
6. Transmission – Neutral

BEST IDLE

1. Set the idle at 750 rpm with the idle speed adjusting screw.

Fig. 2-49

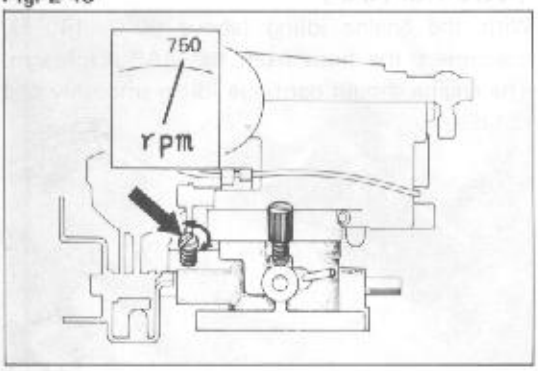
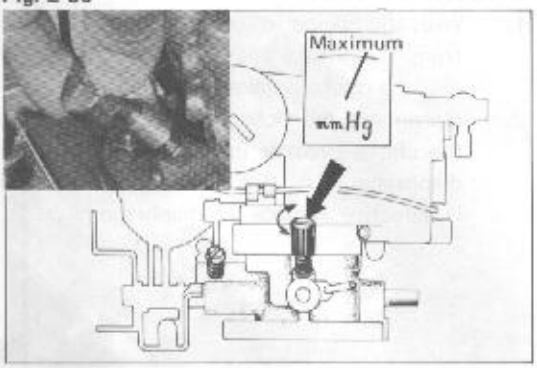


Fig. 2-50

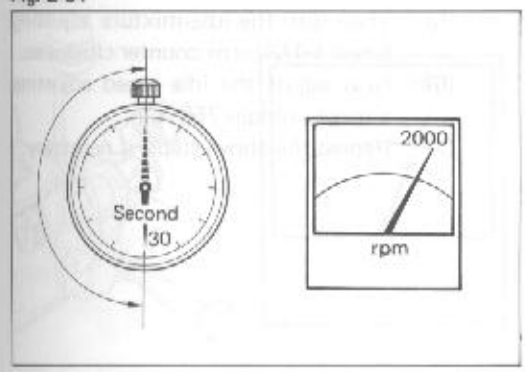


2. Set to maximum vacuum with the idle mixture adjusting screw.
3. If necessary, repeat the adjustments above until the specified rpm and maximum vacuum are obtained.

Idle speed	**750 ± 50 rpm**
Vacuum	**420 mmHg (16.5 inHg)**

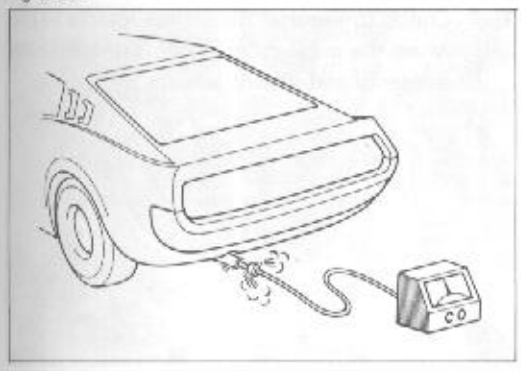
CO CONCENTRATION

Fig. 2-51



1. Measure the CO concentration.
   (1) Race the engine about 2000 rpm for 30 – 60 seconds.

Fig. 2-52

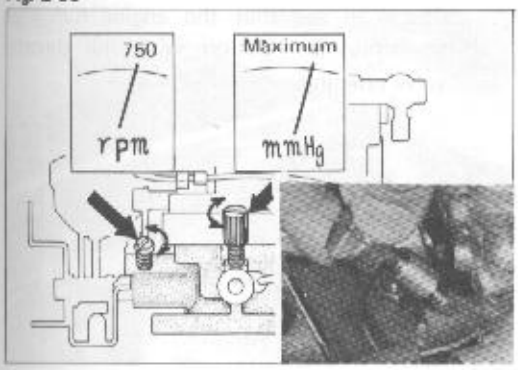


   (2) Before measuring, wait 1 to 3 minutes after racing the engine to allow the concentration to stabilize.

CO concentration

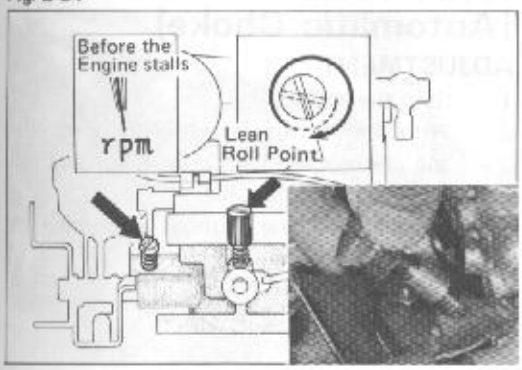
Less than 1 – 3%

Fig. 2-53



2. Adjust the CO concentration
   (1) Set the idle to 750 rpm with the idle adjusting screw.
   (2) Set to maximum vacuum with the idle mixture adjusting screw.
   (3) If necessary, repeat the steps above until adjustments are as specified.

Fig. 2-54

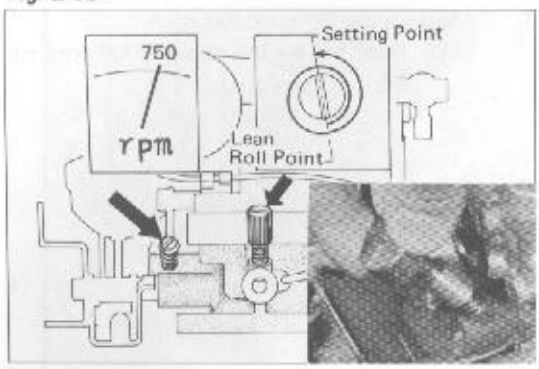


   (4) Turn the idle mixture adjusting screw clockwise until the lean roll point is obtained.

– Note –

The lean roll point is where the engine idle becomes very rough just before the engine stalls.

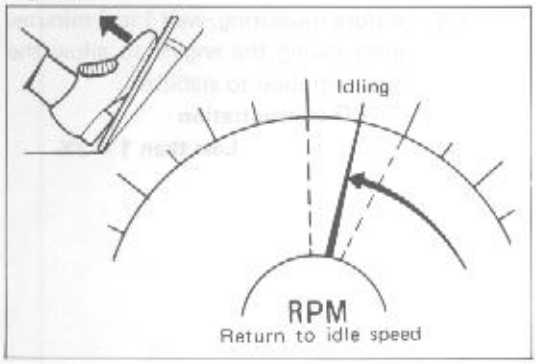
Fig. 2-55



(5) Then turn the idle mixture adjusting screw 1-1/2 turns counter clockwise.
(6) Now adjust the idle speed adjusting screw to obtain 750 rpm.
(7) Repeat the above steps, if necessary.

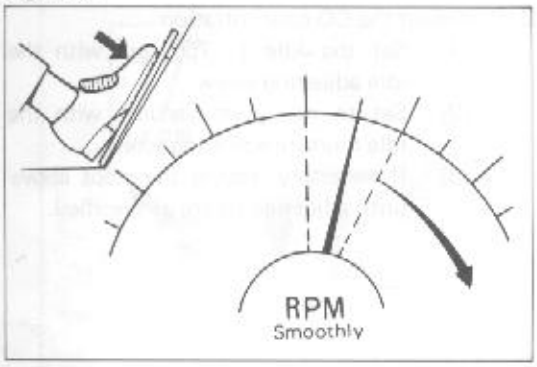
ENGINE CONDITION

Fig. 2-56



1. Check to see that the engine returns to idle when the accelerator pedal is released both suddenly and slowly.

Fig. 2-57

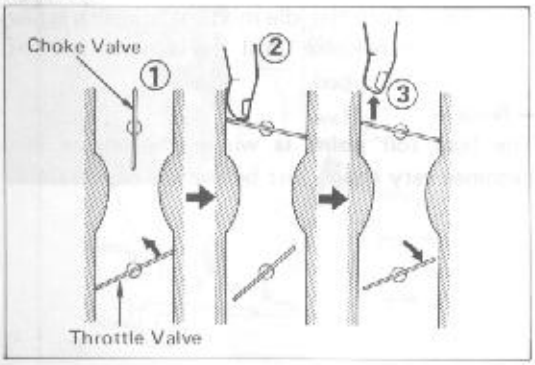


2. Check to see that the engine rpm rises smoothly in relation with the throttle valve opening.

FAST IDLE (Automatic Choke)

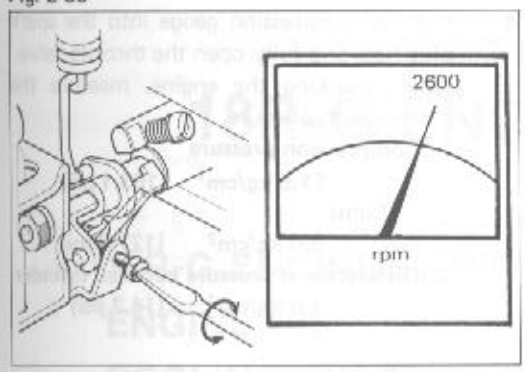
ADJUSTMENT

Fig. 2-58



1. Stop the engine.
2. With the throttle valve slightly open, close the choke valve with your finger and then close the throttle valve.
3. Start the engine without depressing the accelerator pedal.

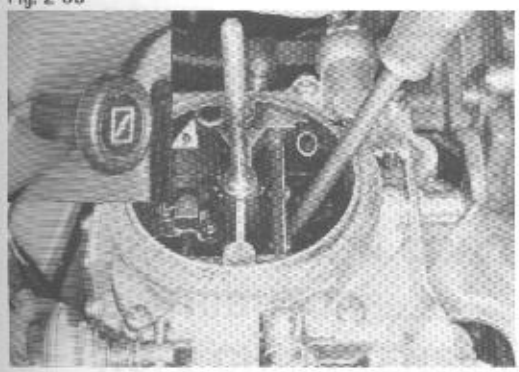
Fig. 2-59



4. Insure that the engine is running at the specified rpm. If not, adjust with the fast idle adjusting screw.

Fast idle speed **2600 ± 200 rpm**

Fig. 2-60



FAST IDLE [Manual Choke]

ADJUSTMENT

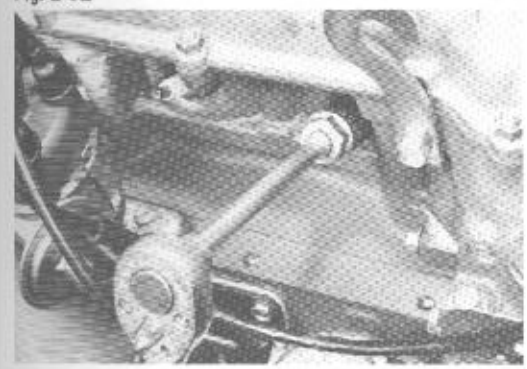
1. Pull the choke knob out all the way.
2. Fully open the choke valve with a screwdriver.

Fig. 2-61

3. Start the engine.
4. To adjust, turn the fast idle adjusting screw.

Fast idle speed **2600 ± 200 rpm**

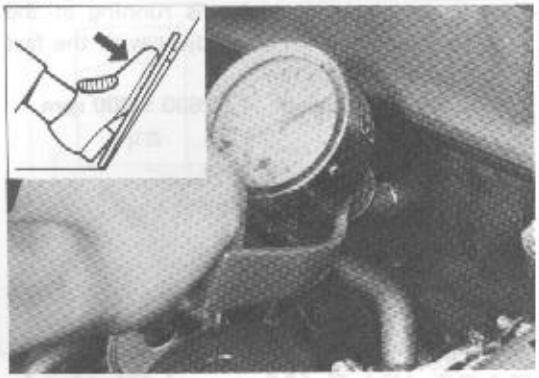
Fig. 2-62



COMPRESSION PRESSURE

1. Warm up the engine.
2. Remove all the spark plugs.
3. Disconnect the high tension cord from the ignition coil to cut off the secondary circuit.

Fig. 2-63



4. Place a compression gauge into the spark plug hole and fully open the throttle valve. While cranking the engine, measure the compression pressure.

Compression pressure
11.5 kg/cm² (163.1 psi)
Limit
9.0 kg/cm² (127.8 psi)
Difference of pressure between cylinder
1.0 kg/cm² (14.2 psi)

18R-G ENGINE TUNE-UP

18R-G ENGINE TUNE-UP ITEM

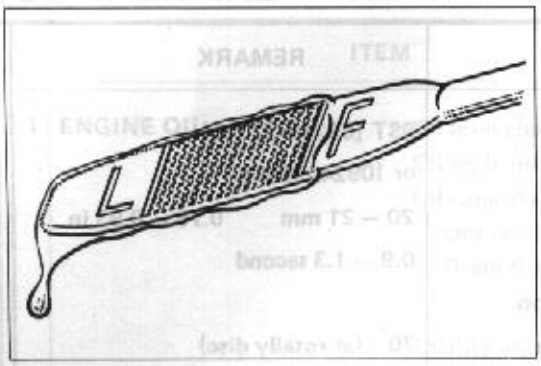
	ITEM		REMARK
1	ENGINE OIL	Oil level check	"Full" line
		Oil replenishment	API service SE classification
		Oil capacity	
		Dry refill w/Oil filter	3.9 liter 4.1 US qt. 3.4 Imp.qt.
		Drain & refill w/Oil filter	3.3 liter 3.5 US qt. 2.9 Imp.qt.
		w/o Oil filter	2.9 liter 3.1 US qt. 2.6 Imp.qt.
		Quality check	
		Oil filter replacement	SST [09228-44010]
2	COOLING SYSTEM	Coolant level check	"Full" line
		Quality check	
		Coolant capacity (w/Heater)	8.4 liter 8.9 US qt. 7.4 Imp.qt.
3	DRIVE BELT	Tension Fan – Alternator	
		New	5 – 6 mm 0.20 – 0.24 in.
		Used	6 – 9 mm 0.24 – 0.35 in.
		A/C – Crankshaft	16 – 19 mm 0.63 – 0.75 in
4	AIR CLEANER	Element cleaning	
5	BATTERY	Specific gravity	1.25 – 1.27 at 20°C 68°F
		Electrolyte level	
6	SPARK PLUG	Visual check	
		Cleaning	
		Plug gap	0.7 – 0.8 mm 0.028 – 0.031 in
7	HIGH TENSION CORD	Resistance	10 – 50 kΩ/Meter
8	DISTRIBUTOR	Distributor cap	
		Point gap	0.45 mm
		Dwell angle	50 – 54°
		Dwell angle variation	within 3°
		Ignition timing	
		at Idle speed	12° BTDC
		Governor operational	
		Vacuum operational	
9	NO.2 CHAIN TENSIONER	Back stroke	0.5 – 1.0 mm at 3 – 5 kg
10	VALVE TIMING		SST [09248-27010]
11	VALVE CLEARANCE (COLD)	Intake	0.24 – 0.34 mm 0.009 – 0.013 in
		Exhaust	0.29 – 0.39 mm 0.011 – 0.015 in

	ITEM		REMARK
12	CARBURETOR	Float level	SST [09240-27010] or [09240-27020] 20 – 21 mm 0.79 – 0.83 in
	ACCELERATION PUMP	Fuel discharging time	0.9 – 1.3 second
		Fuel injection direction	
		Starter wire	70° (at rotally disc)
		Throttle valve full open	
	WARM UP ENGINE		
13	THROTTLE LINK (INITIAL IDLE SPEED)	Idle speed	1000 ± 50 rpm
		Manifold vacuum	380 mm Hg 14.96 in Hg
		Vacuum difference	below 10 mm Hg 0.39 in Hg
14	BEST IDLE ADJUSTMENT	Idle mixture adjusting screw preset position	Screw out 2 turn
		Best idle speed	1000 ± 50 rpm
		Manifold vacuum	above 380 mm Hg 14.96 in Hg
15	CO CONCENTRATION		1.0 – 1.5%
16	ENGINE CONDITION		
17	COMPRESSION PRESSURE	Standard	12.7 kg/cm² 152.0 psi
		Limit	10.0 kg/cm² 142.0 psi
		Difference of pressure between cylinders	Less than 1.0 kg/cm² 14.2 psi

ENGINE OIL

CHECK OIL LEVEL

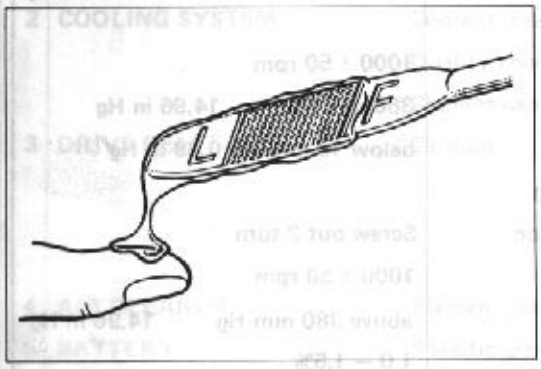
Fig. 3-1



The oil level should be between the L and F marks. If low, check for leakage and add oil up to the F mark. Use API service SE classification oil.

CHECK OIL QUALITY

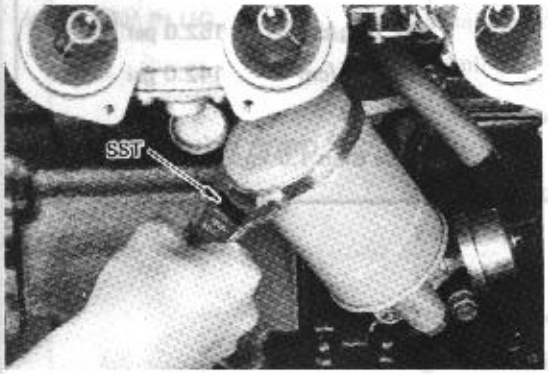
Fig. 3-2



Check the oil for deterioration, entry of water, discoloring or thinning.

REPLACE OIL FILTER

Fig. 3-3



1. Remove the oil filter with SST.
   SST [09228-34010]
2. To install new filter, tighten firmly by hand.

— Note —

Do not tighten with SST or wrench.

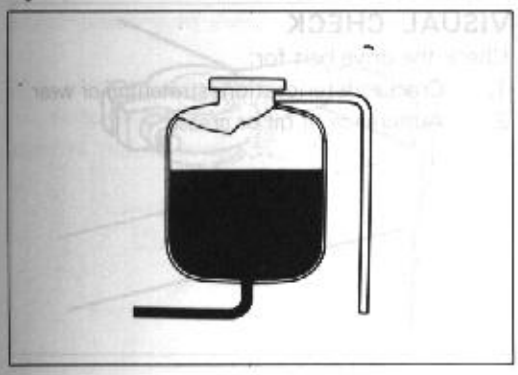
Fig. 3-4

3. Start the engine and check for oil leakage.
4. Stop the engine and recheck the oil level.

COOLING SYSTEM

CHECK COOLANT LEVEL

Fig. 3-5



If low, fill reservior to FULL line.

— Note —

To maintain freeze protection, use a recommended anti-freeze.

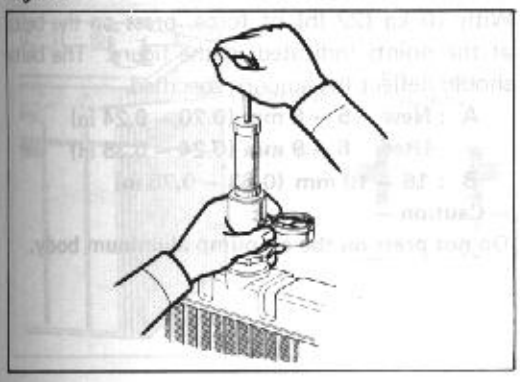
CHECK COOLANT QUALITY

Fig. 3-6

1. Check coolant cleanliness.
2. Check for rust or scale deposits around radiator cap and filler neck.
3. Check to see that there is no oil in the coolant.

CHECK COOLING SYSTEM

Fig. 3-7

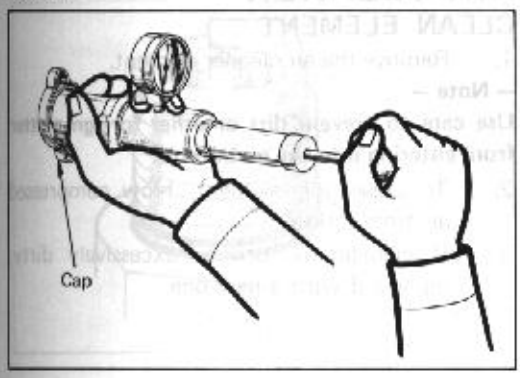


Check for:

1. Damaged or deteriorated radiator and water hoses.
2. Loose hose clamps.
3. Damage or corrosion in the radiator core.
4. Leakage from the water pump, radiator core or a loose water drain cock.

INSPECT RADIATOR CAP OPERATION

Fig. 3-8

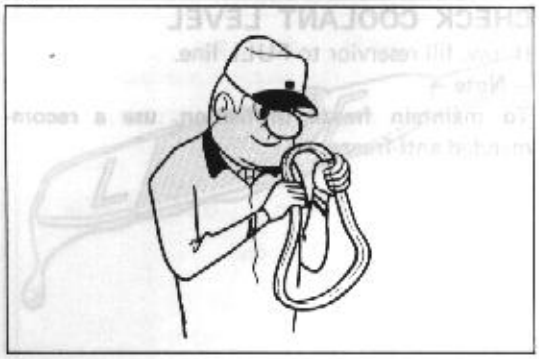


Inspect the spring tension and seating condition of the radiator cap vacuum valves. Replace the cap if the valve opens at a pressure below the specified or is otherwise defective.

Valve opening pressure limit

	0.6 kg/cm² (8.5 psi)
Standard	**0.9 kg/cm² (12.8 psi)**

Fig. 3-9



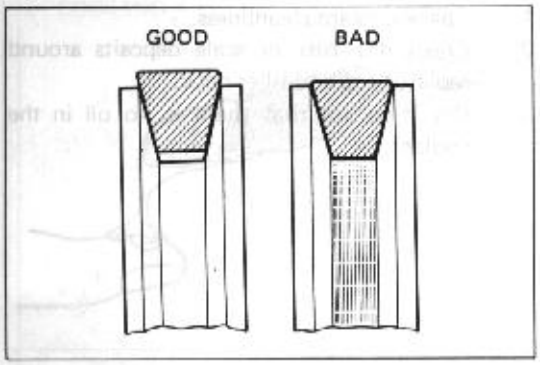
DRIVE BELT

VISUAL CHECK

Check the drive belt for:

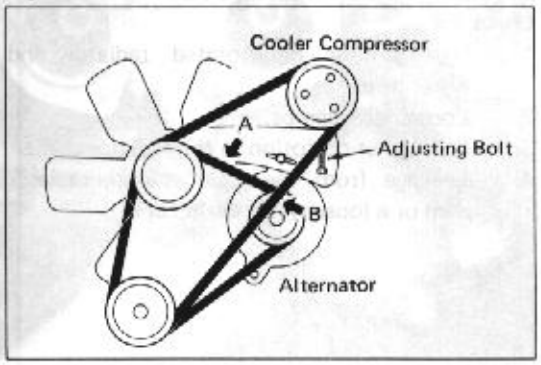
1. Cracks, deterioration, stretching or wear.
2. Adherence of oil or grease.

Fig. 3-10



3. Improper belt-to-pulley contact.

Fig. 3-11



CHECK & ADJUST BELT TENSION

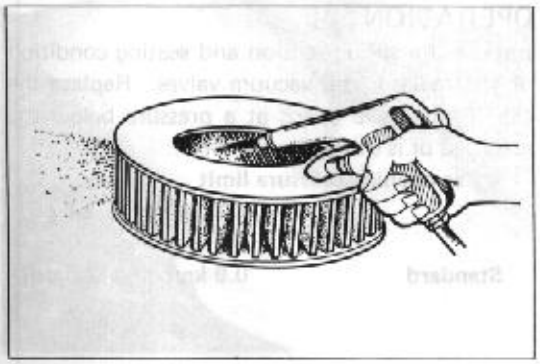
With 10 kg (22 lb) of force, press on the belts at the points indicated in the figure. The belts should deflect the amount specified.

A : New 5 – 6 mm (0.20 – 0.24 in)
Used 6 – 9 mm (0.24 – 0.35 in)
B : 16 – 19 mm (0.63 – 0.75 in)

– Caution –

Do not press on the air pump aluminum body.

Fig. 3-12



AIR CLEANER

CLEAN ELEMENT

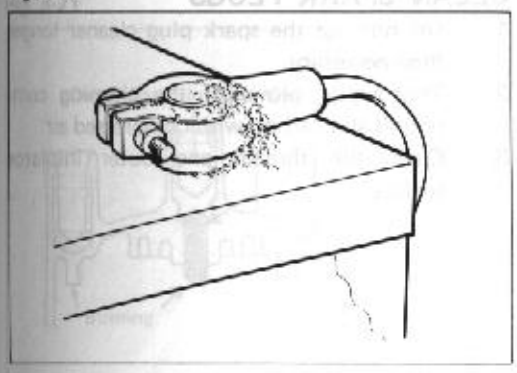
1. Remove the air cleaner element.

– Note –

Use care to prevent dirt or other foreign matter from entering into the carburetor.

2. To clean the element, blow compressed air from inside.
3. If element is torn or excessively dirty, replace it with a new one.

Fig. 3-13



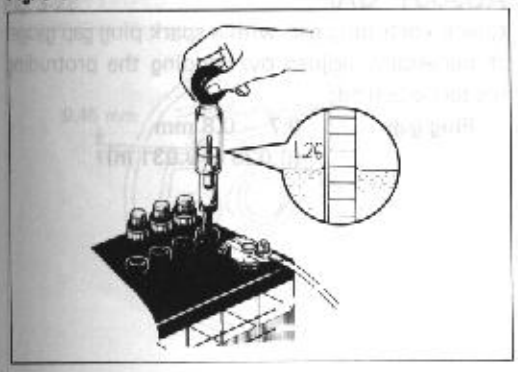
BATTERY

VISUAL CHECK

Check the battery for the following:

1. Rusted battery support.
2. Loose terminal connections.
3. Rusted or deteriorated terminals.
4. Damaged or leaking battery.

Fig. 3-14

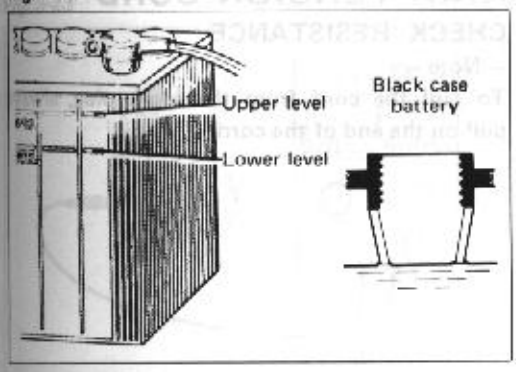


MEASURE SPECIFIC GRAVITY

1. Insert the hydrometer into the cell and hold it so that the float does not the cylinder wall.
2. Draw in sufficient water so that the float is suspended free from both the top and bottom of the cylinder.
3. Read the graduation.

Specific gravity 1.25 – 1.27 at 20°C (68°F)

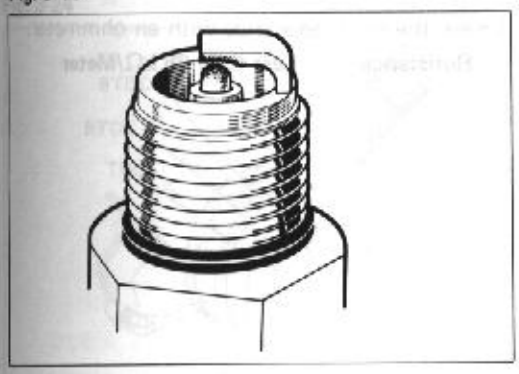
Fig. 3-15



CHECK ELECTROLYTE LEVEL

The water should be up to the upper electrolyte level. If low, add distilled or purified water.

Fig. 3-16



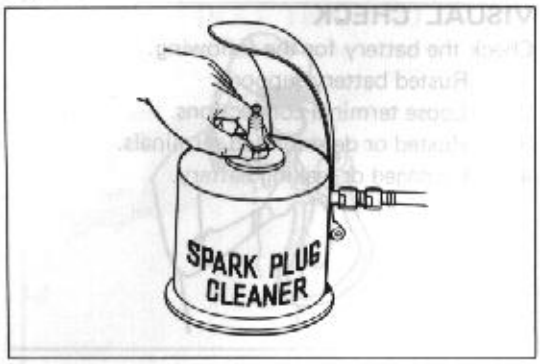
SPARK PLUG

VISUAL CHECK

The spark plugs for the following:

1. Cracks or other damage on the threads and insulator.
2. Electrode wear.
3. Damaged or deteriorated gaskets.
4. Burnt electrode or excess carbon deposits.

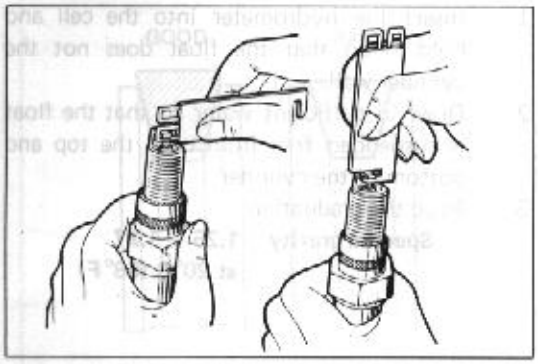
Fig. 3-17



CLEAN SPARK PLUGS

1. Do not use the spark plug cleaner longer than necessary.
2. Thoroughly blow off the cleaning compound and carbon with compressed air.
3. Clean the threads and outer insulator surface.

Fig. 3-18

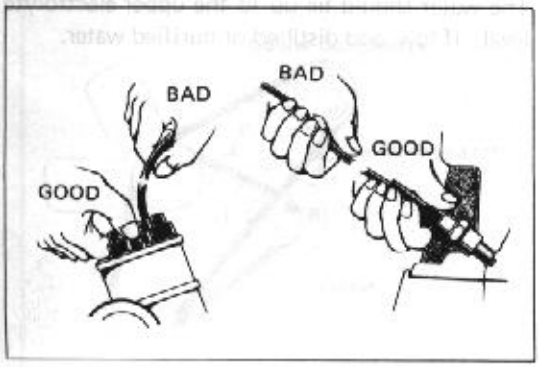


ADJUST GAP

Check each plug gap with a spark plug gap gauge. If necessary, adjust by bending the protruding (outer) electrode.

Plug gap	**0.7 – 0.8 mm (0.028 – 0.031 in)**

Fig. 3-19



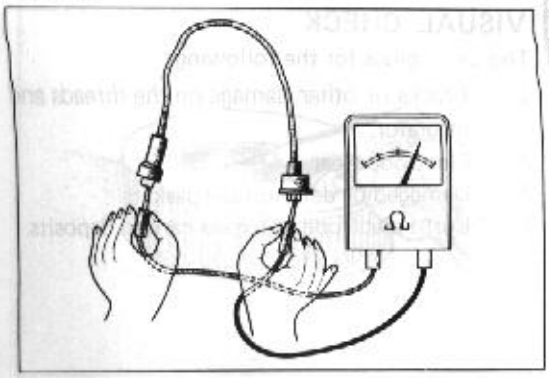
HIGH TENSION CORD

CHECK RESISTANCE

– Note –

To pull the cord from the spark plug, always pull on the end of the cord.

Fig. 3-20



Check the cord resistance with an ohmmeter.

Resistance	**Less than 25 kΩ/Meter**

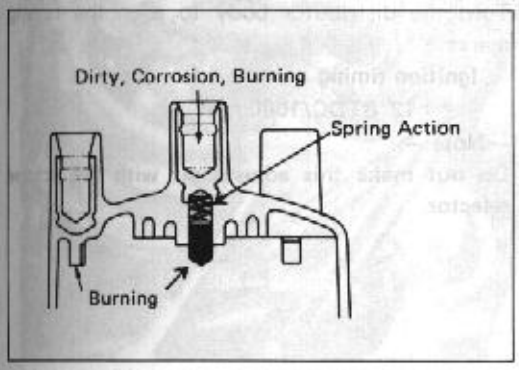
DISTRIBUTOR

CHECK DISTRIBUTOR CAP

Check the cap and rotor for:

1. Cracks, damage, corrosion, burning and dirty cord hole.
2. Burnt electrode terminal.
3. Weak center piece spring action.

Fig. 3-21

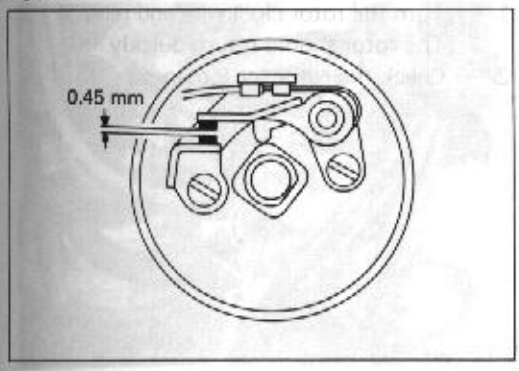


ADJUST POINT GAP

1. Replace the breaker points if excessively burnt or pitted.
2. Adjust the point gap and damping spring.

Point gap 0.45 mm (0.018 in)

Fig. 3-22



INSPECT DWELL ANGLE

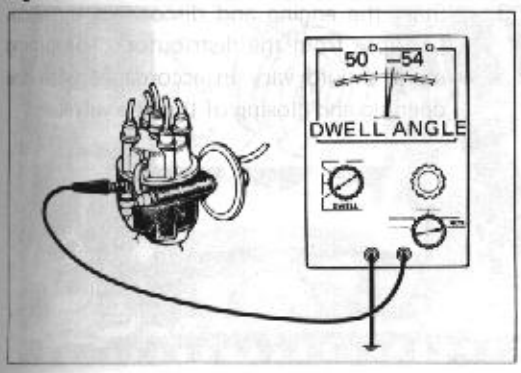
Inspect the dwell angle with a dwell angle tester.

Dwell angle 50 – 54°

Variation

within 3° (at idling to 2000 rpm)

Fig. 3-23



INSPECT IGNITION TIMING

1. To inspect the ignition timing, the engine should be running at idle.
2. The octane selector must be set at the standard position.

Ignition timing

at Idle speed 12°BTDC

Fig. 3-24

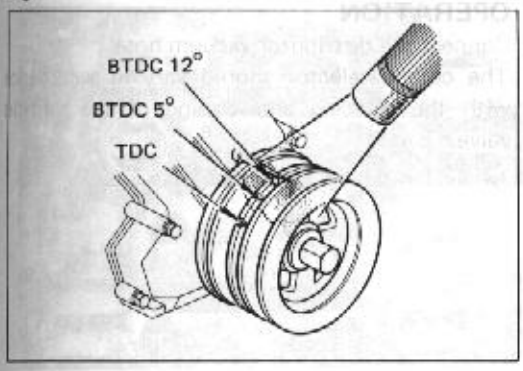
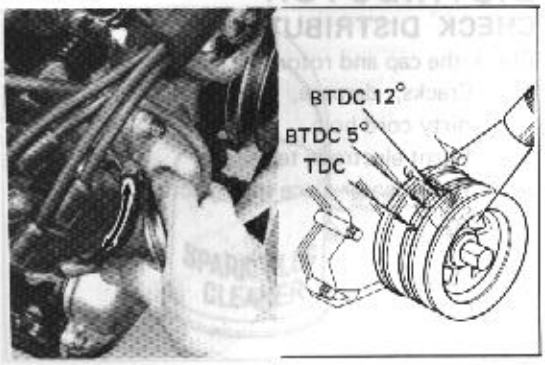


Fig. 3-25



ADJUSTMENT

Turn the distributor body to align the timing marks.

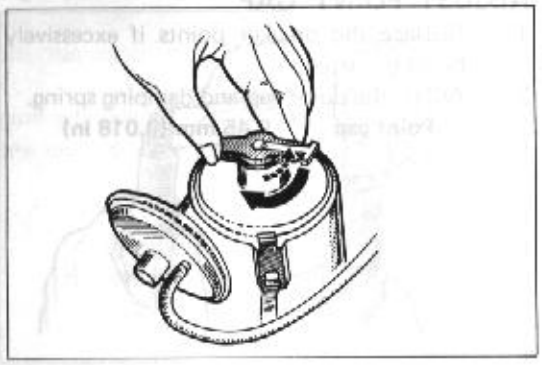
Ignition timing

12°BTDC/1000 rpm

— Note —

Do not make this adjustment with the octane selector.

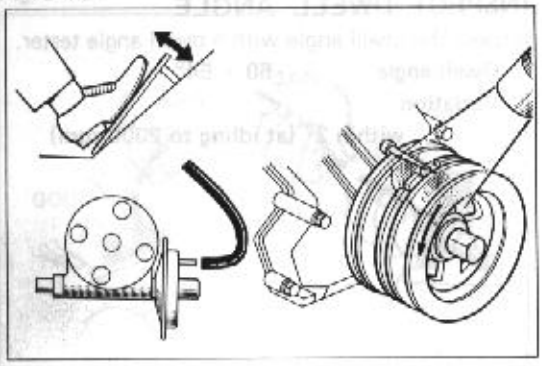
Fig. 3-26



GOVERNOR CHECK OPERATION

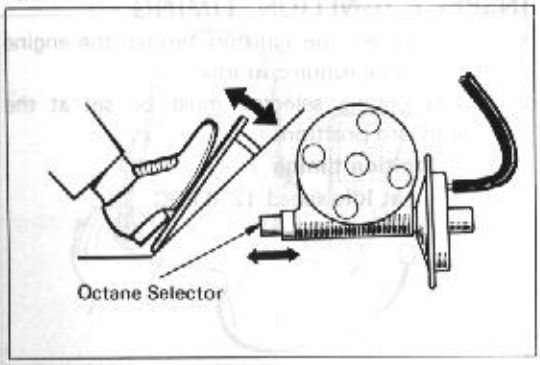
1. Turn the rotor clockwise and release. The rotor should return quickly.
2. Check the rotor for looseness.

Fig. 3-27



3. Start the engine and disconnect the vacuum hose from the distributor. The timing mark should vary in accordance with the opening and closing of throttle valve.

Fig. 3-28

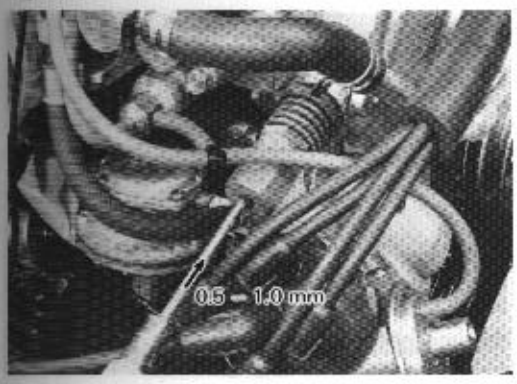


VACUUM ADVANCE CHECK OPERATION

Connect the distributor vacuum hose.

The octane selector should vary in accordance with the opening and closing of the throttle valve.

Fig. 3-29



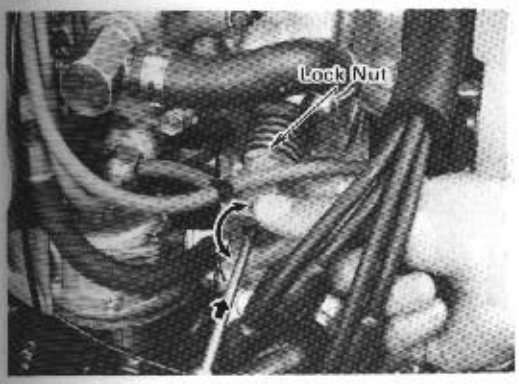
NO.2 CHAIN TENSIONER

CHECK BACK STROKE

With a screwdriver, press in the plunger with 3 – 5 kg (6.6 – 11 lb) of force and measure the stroke length.

Stroke 0.5 – 1.0 mm (0.02 – 0.04 in)

Fig. 3-30

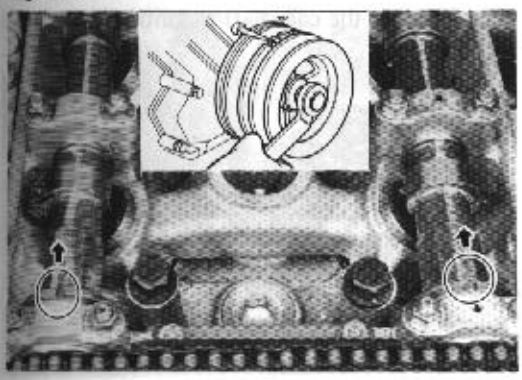


ADJUSTMENT

Adjust the back stroke by the following procedure:

1. Loosen the lock nut.
2. Press in the plunger with 3 – 5 kg (6.6 – 11 lb) of force, and screw in the adjust nut until it rests on the plunger.
3. Unscrew the adjust nut 1/3 – 2/3 turns and secure it with the lock nut.
4. Check the stroke again to see that it is within the specified value.

Fig. 3-31

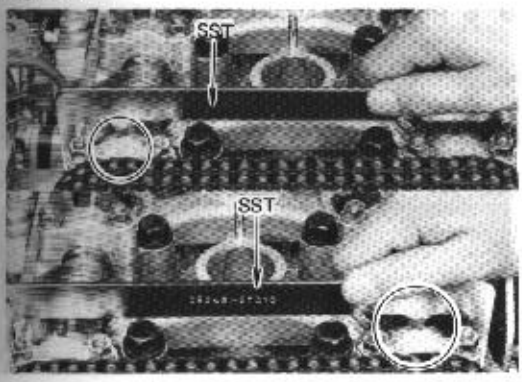


VALVE TIMING

INSPECTION

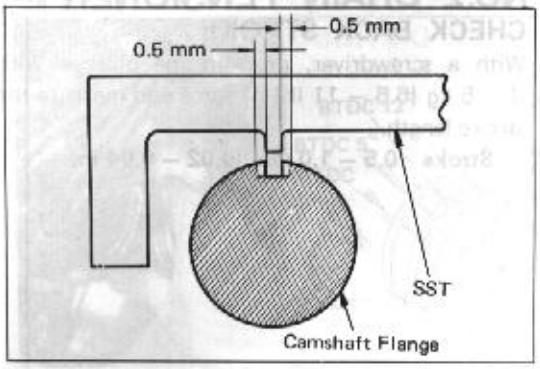
1. Remove the engine cylinder head cover.
2. Set the No. 1 cylinder to TDC/compression. In this position, the timing slits in the flange of the camshaft are positioned upward.

Fig. 3-32



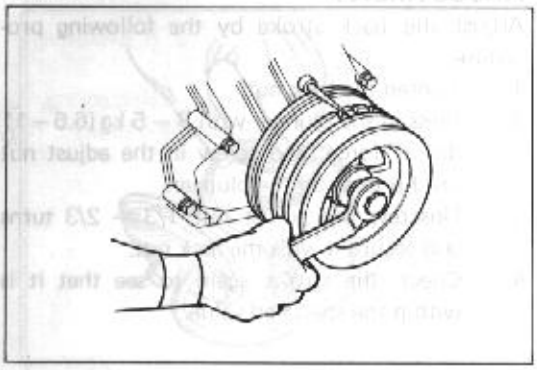
3. Check the positions of camshaft No. 1 and No. 2 with SST.
   SST [09248-27010]

Fig. 3-33



4. Valve timing permissible error: (on the camshaft outer flange):
   ± 2° Camshaft rotation angle.
   ± 0.5 mm (0.020 in)
   Camshaft flange outer perimeter.

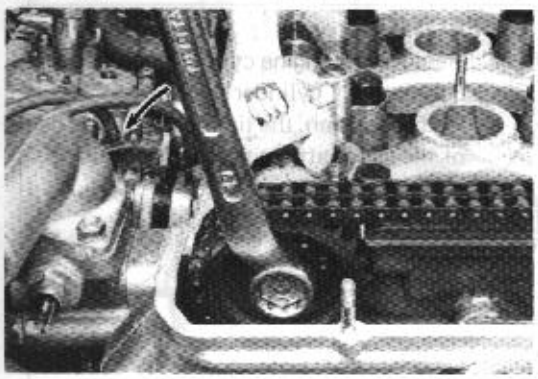
Fig. 3-34



ADJUSTMENT

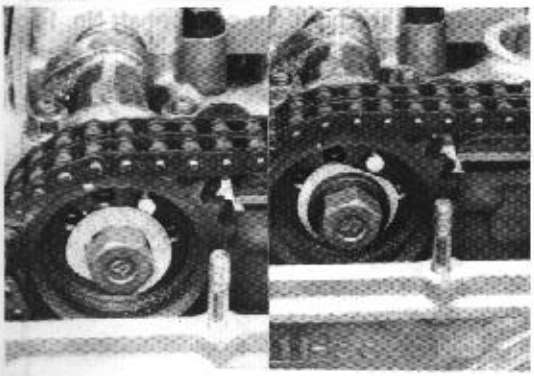
1. Reset No. 1 cylinder TDC/compression.

Fig. 3-35



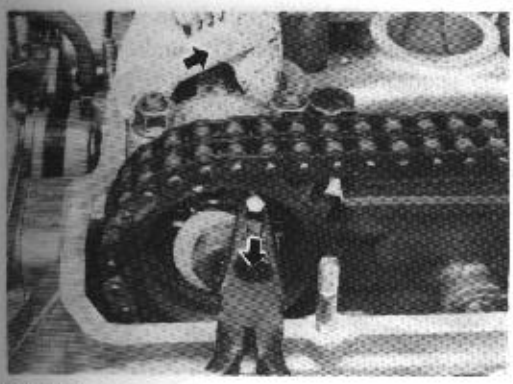
2. Loosen the camshaft mounting bolt.

Fig. 3-36



3. Rotate the washer until the pin head is completely exposed.

Fig. 3-37

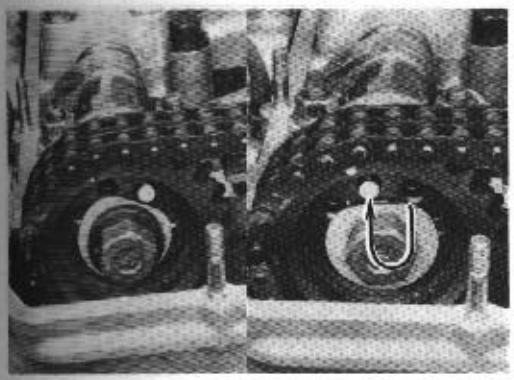


4. Pull out the pin.

– Note –

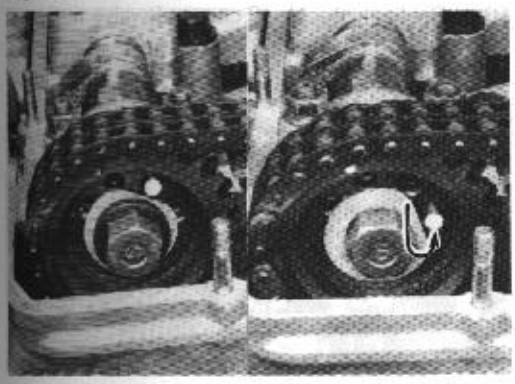
This will be easier if the camshaft is turned slightly forward to provide some play.

Fig. 3-38



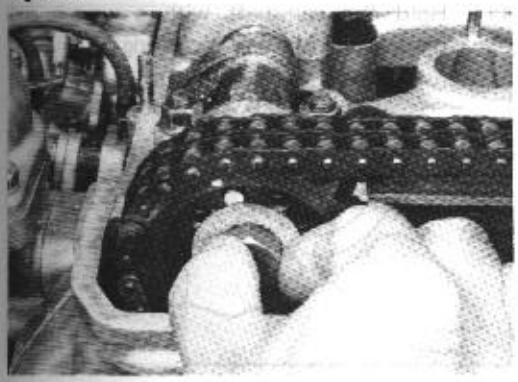
5. Valve timing advanced.
   (1) Align the pin hole in the counter-clockwise direction.
   (2) Turn the camshaft so that the slit is aligned with the adjust gauge and insert the pin.

Fig. 3-39



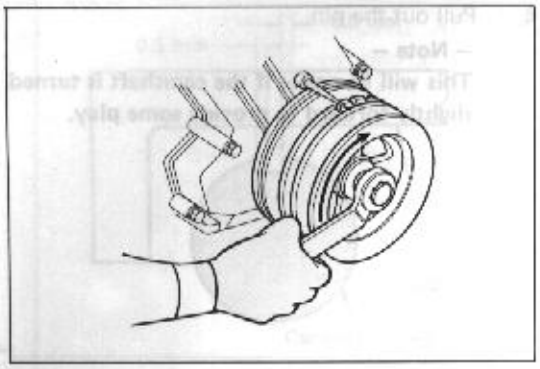
6. Retarded valve timing.
   (1) Align the pin hole in the clockwise direction.
   (2) Turn the camshaft so that the slit is aligned with the adjust gauge and insert the pin.

Fig. 3-40



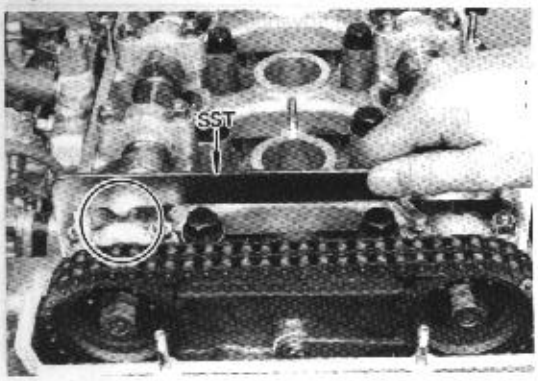
7. Support the pin with the washer and tighten the bolt.

Fig. 3-41



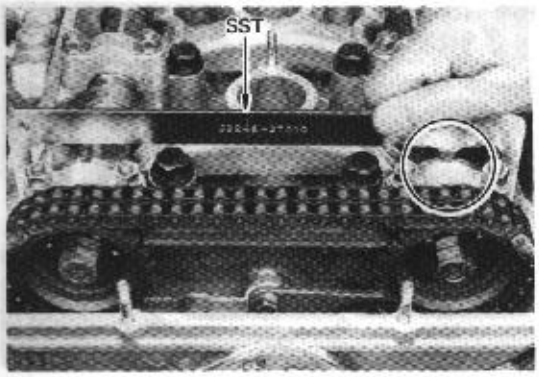
8. Rotate the crankshaft in the clockwise direction until No.1 cylinder is at TDC/ compression.

Fig. 3-42



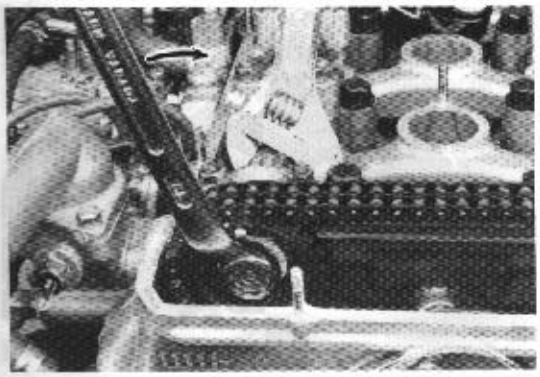
9. Recheck the No. 1 camshaft valve timing. Use SST [09248-27010].
The camshaft and SST protrusion should line up.

Fig. 3-43



10. Recheck the No. 2 camshaft valve timing. Use SST [09248-27010].
The camshaft slit and SST protrusion should line up.

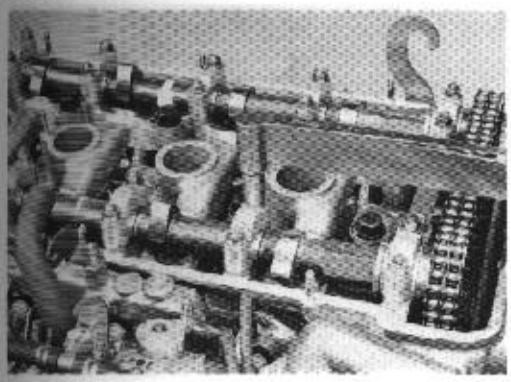
Fig. 3-44



11. Hold the camshaft with a wrench and tighten the camshaft mounting bolt.

Torque 7.0 – 8.0 kg-m (50.6 – 57.9 ft-lb)

Fig. 3-45



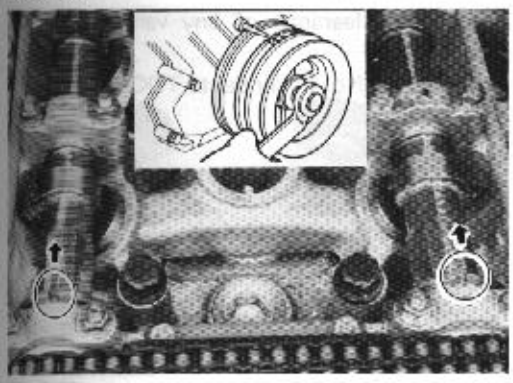
VALVE CLEARANCE

INSPECTION

(Cold Condition)

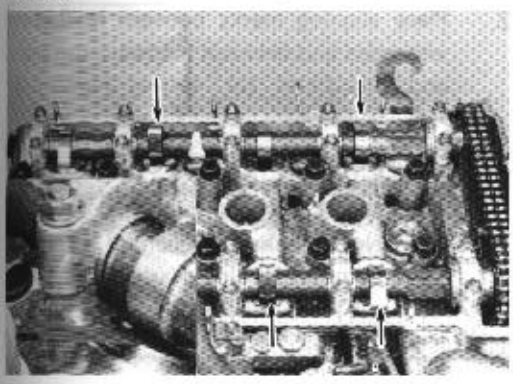
1. Before inspection, insure the following:
   (1) Camshaft bearing cap torque.
   Torque 1.6 – 2.2 kg-m (12 – 15 ft-lb)
   (2) Valve time is correct.
   SST [09248-27010]

Fig. 3-46



2. Set the No. 1 cylinder to TDC/compression. In this position, the timing check slits in the camshaft flange are facing upward.

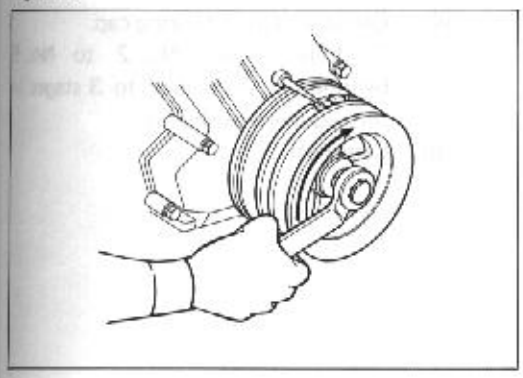
Fig. 3-47



3. Measure and keep a record of the clearances of only the valves indicated by arrows in the figure.

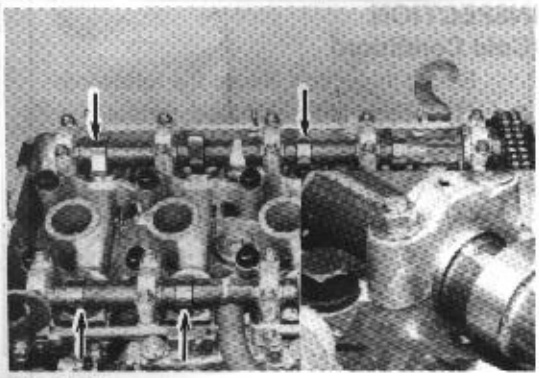
Clearance	
Intake	**0.24 – 0.34 mm (0.009 – 0.013 in)**
Exhaust	**0.29 – 0.39 mm (0.011 – 0.015 in)**

Fig. 3-48



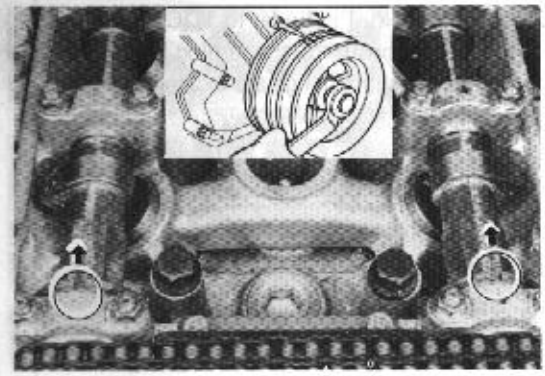
4. Turn the crankshaft 360° forward to No. 4 cylinder is TDC/compression.

Fig. 3-49



5. Check the remaining valve clearances of the remaining valves (indicated by arrows in the figure).

Fig. 3-50

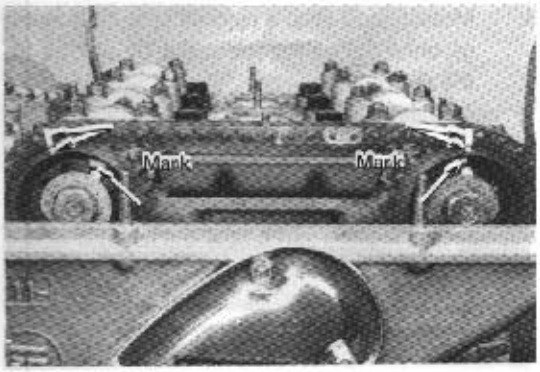


ADJUSTMENT

Adjust the clearance of any valve not within specification.

1. Set the No. 1 cylinder to TDC/compression

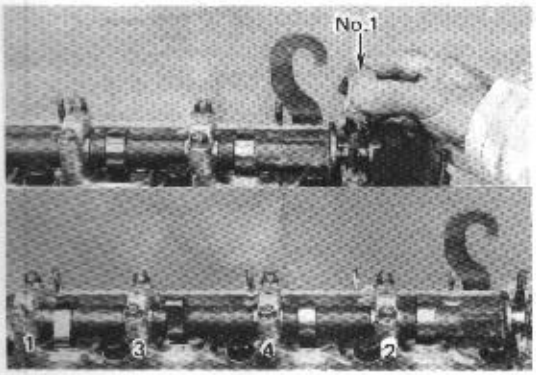
Fig. 3-51



2. Place aligning marks between No.2 chain and gears and between the respective gears and pin holes for correct reassembly.

3. Remove parts as follows.
   (1) No. 2 chain damper.
   (2) No. 2 chain tensioner.
   (3) Camshaft timing gear.

Fig. 3-52

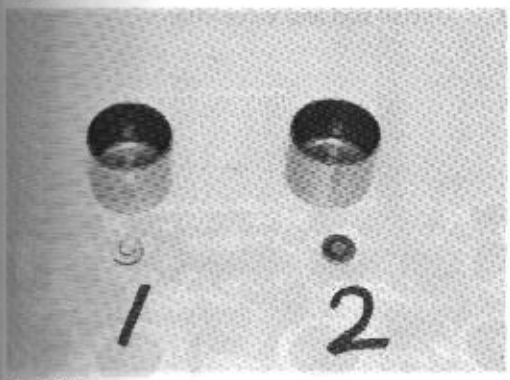


   (4) Camshaft No. 1 bearing cap.
   (5) Gradully loosen No. 2 to No. 5 bearing cap nuts in 2 to 3 stages in the sequence as shown.
   (6) Camshaft.

Fig. 3-53

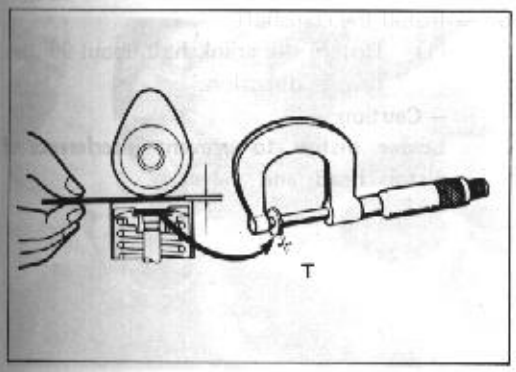
4. Remove valve lifter when valve clearance is not within specified valve.

Fig. 3-54



5. Keep valves and adjusting pads in order.

Fig. 3-55

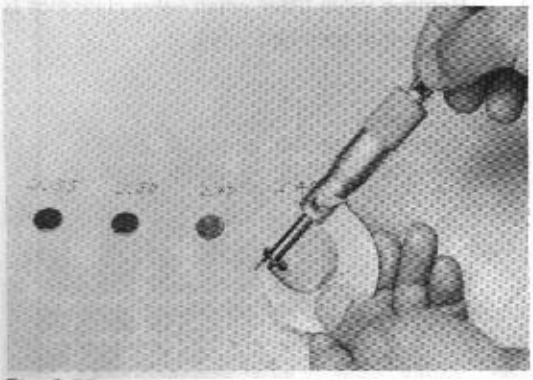


6. Select a new pad that will give the specified valve clearance as follows.
   (1) Measure the pad that was off with a micrometer.
   (2) Calculate thickness of new pad so valve clearance comes within specified valve.
   T ..... Thickness of pad used
   A ..... Valve clearance measured

Intake Side
New Pad Thickness
= T + (A–0.29mm)

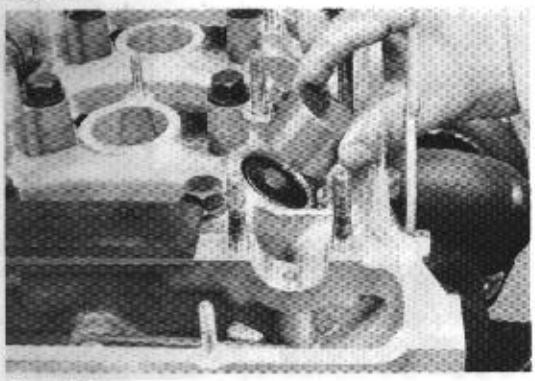
Exhaust Side
New Pad Thickness
= T + (A–0.34mm)

Fig. 3-56



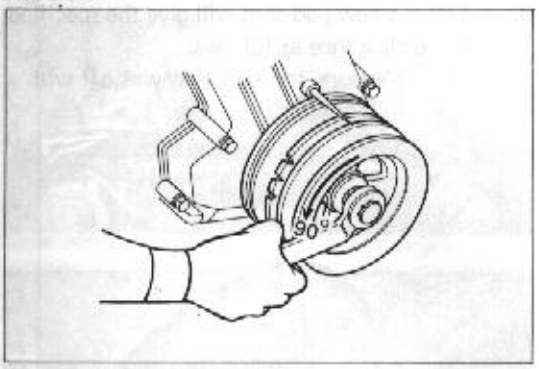
(3) Select a pad with a thickness as close as possible to the valve calculated. Pads are available in 41 sizes, in increments of 0.05 mm (0.002 in) from 1.00 mm (0.039 in) to 3.00 mm (0.118 in).

Fig. 3-57



7. Install pad and valve lifter

Fig. 3-58



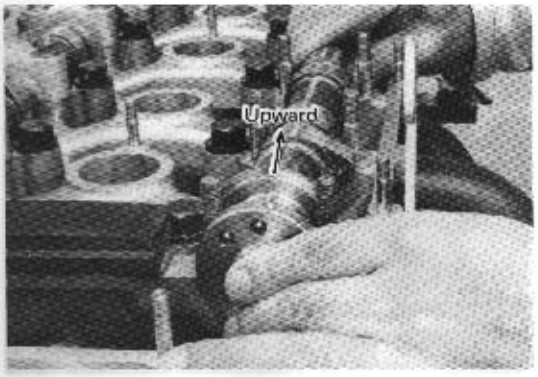
8. Install the camshaft

(1) Rotate the crankshaft about 90° the reverse direction.

– Caution –

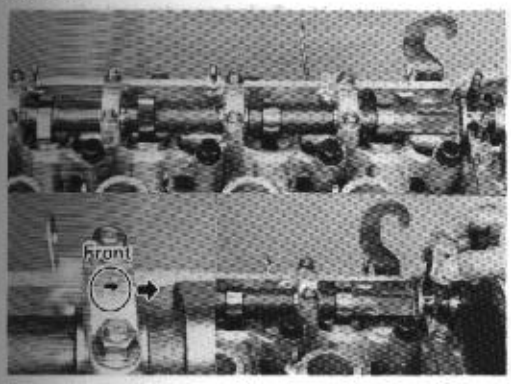
Lower piston to prevent interference of piston head and valve.

Fig. 3-59



(2) Position slit of camshaft upward as shown.

Fig. 3-60

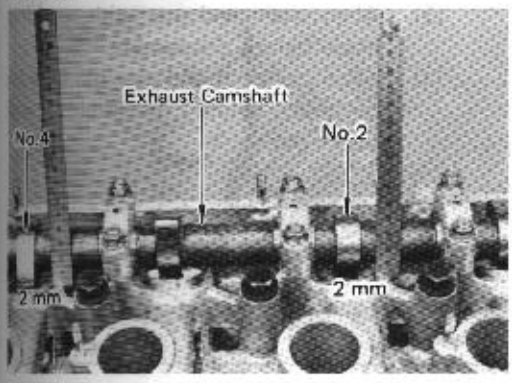


(3) Install the No. 2 to No. 5 camshaft bearing caps.
Face the arrow mark toward front.

(4) Gradually tighten bearing cap nuts in 3 to 4 stages in the sequence as shown.
Torque 1.6 – 2.2 kg-m (12 – 15 ft-lb)

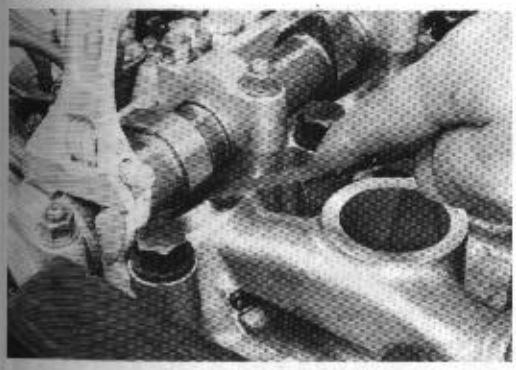
(5) Then tighten No. 1 bearing cap to 1.6 – 2.2 kg-m (12 – 15 ft-lb).

Fig. 3-61



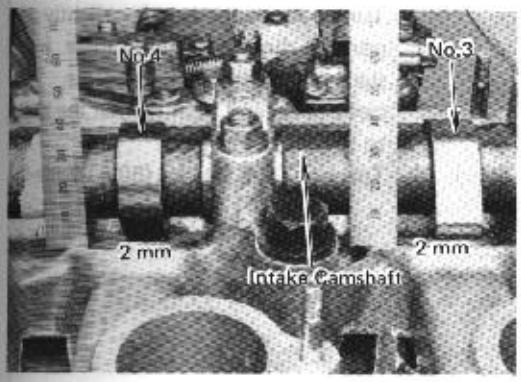
9. Recheck intake side valve clearance.
(1) Exhaust side valve lifter No. 2 and No. 4 shoud protrude the same amount (approx. 2 mm)

Fig. 3-62



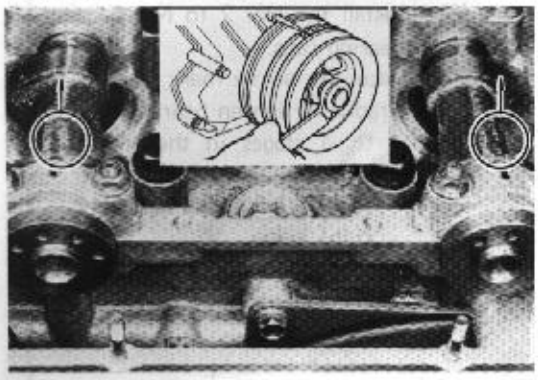
(2) Measure intake side valve clearance. If outside the specified valve, choose another pad.

Fig. 3-63



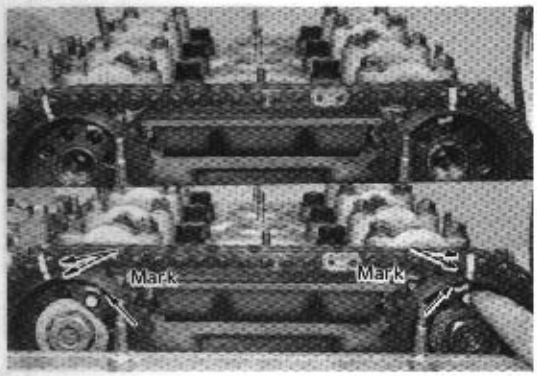
10. Recheck exhaust side valve clearance.
(1) Intake side valve lifter No. 3 and No. 4 should protrude the same amount.
(2) Measure exhaust side clearance.
If outside the specified value, choose another pad.

Fig. 3-64



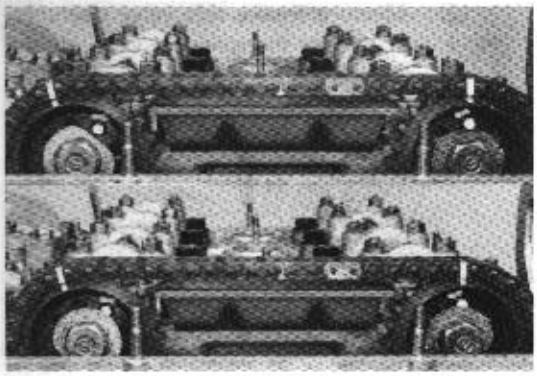
11. Install the No. 2 chain and camshaft gears.
    (1) Position the No.1 and No. 2 camshaft slit vertically upward.
    (2) Set the No.1 cylinder to TDC/compression.

Fig. 3-65



    (3) Align chain and gear with marking made before disassembly.
    (4) Align camshaft and gear pin hole to position before disassembly and insert pin.

Fig. 3-66

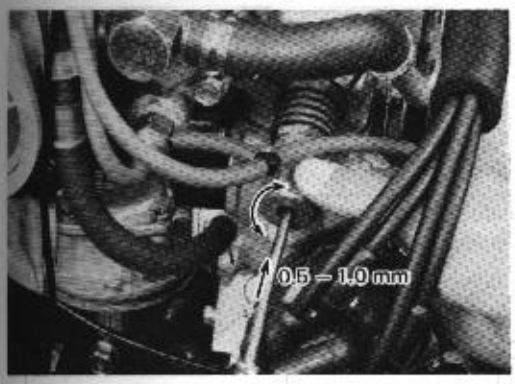


    (5) Hold the pin with the washer.

Fig. 3-67

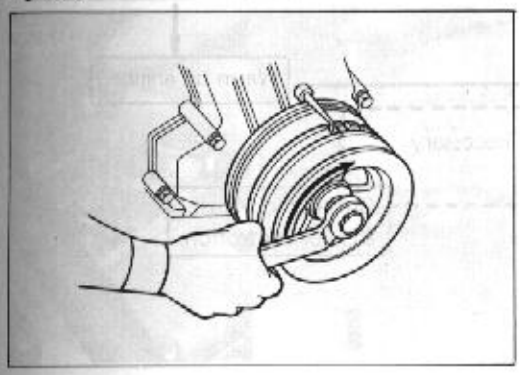
    (6) Turn the crankshaft slightly in normal direction, until there is no slack in the pins, gears, and camshafts, and then tighten the bolts to specified torques.
    Torque 7.0-8.0kg-m (50.6-57.8ft-lb)

Fig. 3-68



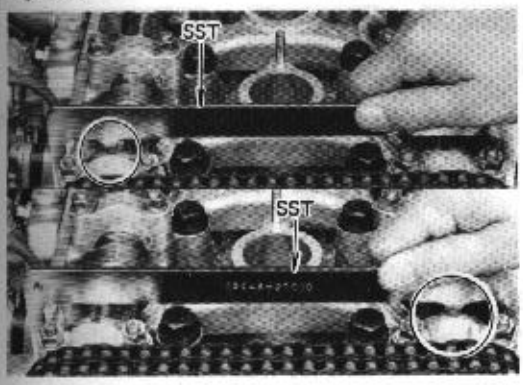
(7) Adjust the No. 2 chain tensioner.
Back stroke 0.5-1.0mm (0.02-0.04in)
at 3-5kg (6.6-11lb)

Fig. 3-69



12. Recheck valve timing.
(1) Rotate the crankshaft two turn in normal direction until No. 1 cylinder TDC/comperssion.

Fig. 3-70



(3) Recheck valve timing with SST [09248-27010].

CARBURATOR

CARBURATOR ADJUSTMENT PROCEDURES

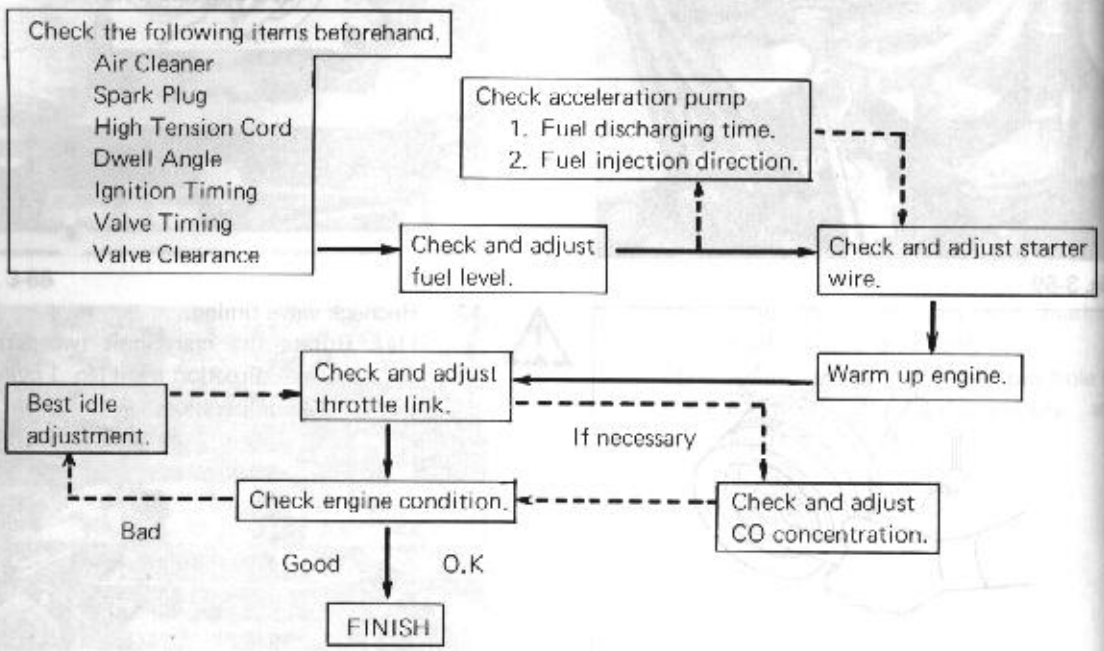


Fig. 3-71

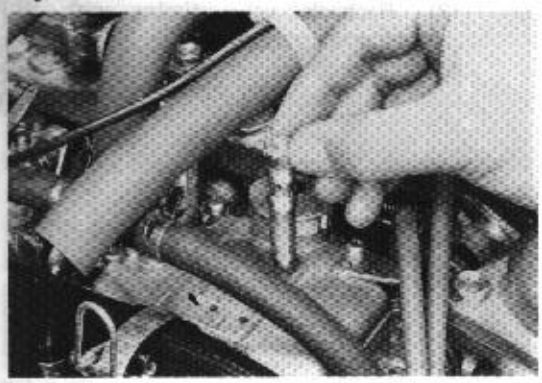
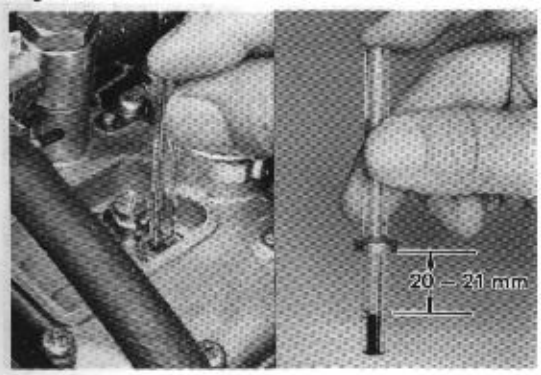


Fig. 3-72

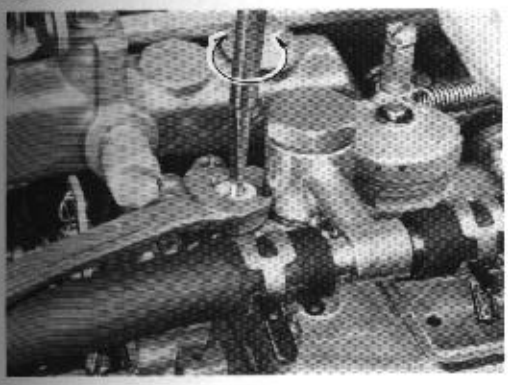


FLOAT LEVEL

Inspection

1. Start the engine and ilde.
   About 1000rpm
2. Take out one of the main jet holders i assembled form.
3. Insert SST [09240-27010] or [09240 27020] in the hole from which the mai jet holder was removed.
4. Check the gasoline level inside the gauge t see if within the limit.
   Standard level 20 – 21 mm (0.79 – 0.83 in)

Fig. 3-73



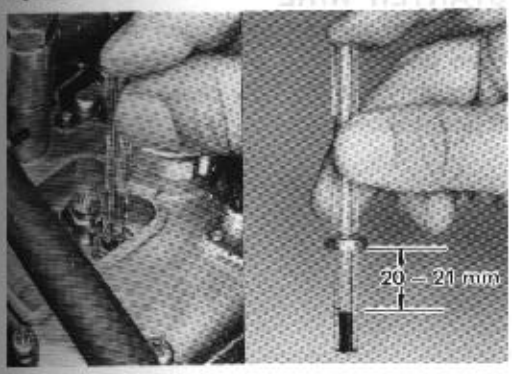
ADJUSTMENT

1. Adjust by turning the float level adjusting screw.

   One turn

   Float level change to 1.8mm (0.07in)

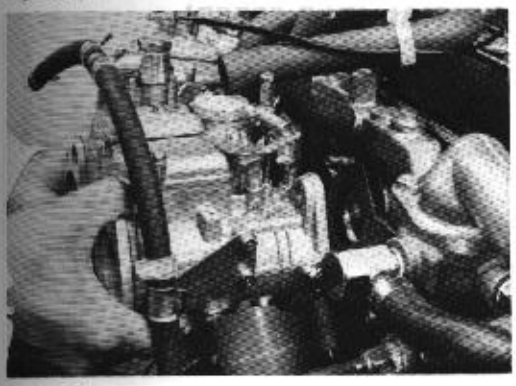
Fig. 3-74



2. Recheck the float level.

   Condition where the fuel pump is operating and applying fuel pressure.

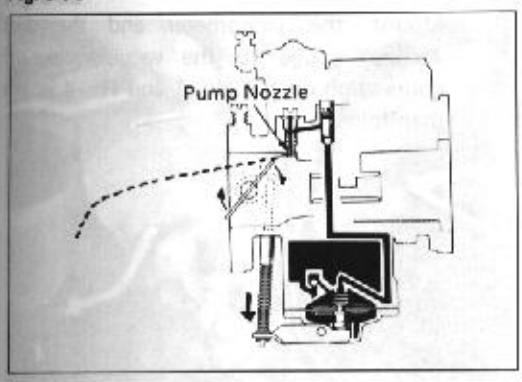
Fig. 3-75



ACCELERATION PUMP INSPECTION

1. Remove the carburetor.
2. Check the fuel in the float chamber.

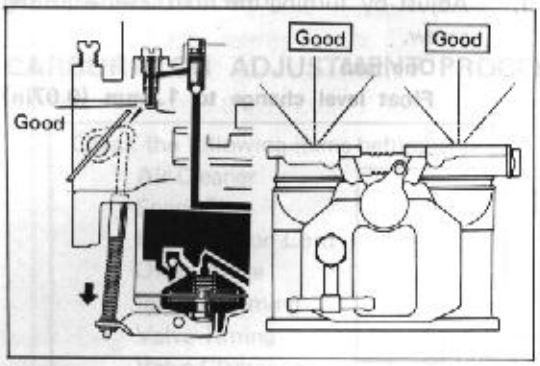
Fig. 3-76



3. Check the fuel discharging time

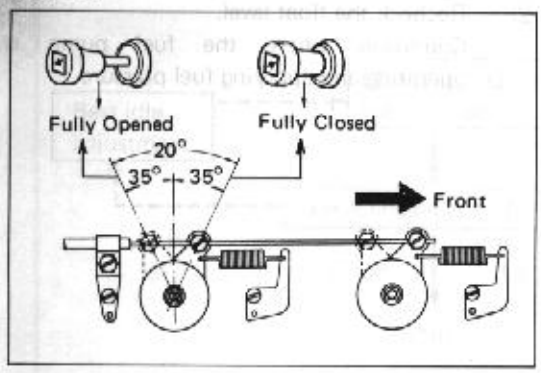
   0.9 – 1.3 second

Fig. 3-77



4. Check the fuel injection direction.

Fig. 3-78



STARTER WIRE

Insure that the carburetor discs are in the fully open position when the starter knob is pulled completely out and fully closed position when it is returned.

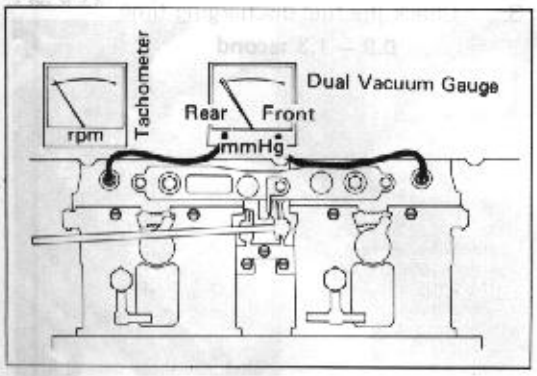
THROTTLE LINK

(INITIAL IDLE SPEED) INSPECTION

Check the following items beforehand.

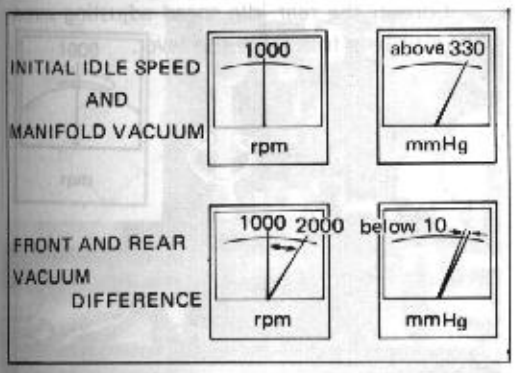
1. Coolant temperature 80°C (180°F)
2. Accessory parts All switched off.

Fig. 3-79



3. Mount the tachometer and the dual vacuum gauge to the vacuum take-off connection on the No. 1 and No. 4 intake manifolds.

Fig. 3-80



4. Check the idle speed and the difference between front and rear manifold vacuum.

Idle speed	**1000 ± 50rpm**
Manifold Vacuum	**380 mmHg (14.96inHg)**

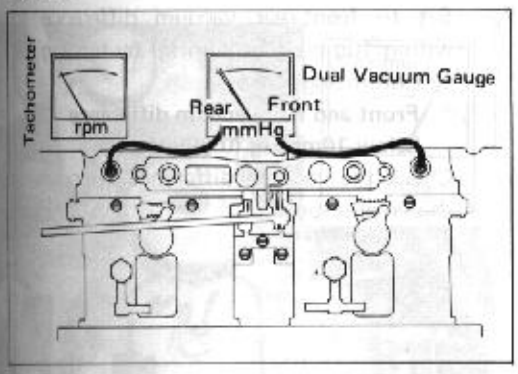
Front and Rear Vacuum Difference (idle to 2000 rpm) below 10mmHg (0.39inHg)

ADJUSTMENT

Check the following items beforehand.

1. Coolant temperature 80°C (180°F)
2. Accessory parts All switched off.

Fig. 3-81

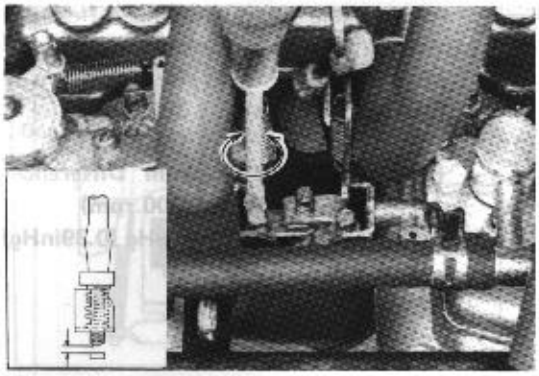


3. Mount the tachometer and the dual vacuum gauge to the vacuum take-off connection on the No. 1 and No. 4 intake manifolds.

Fig. 3-82

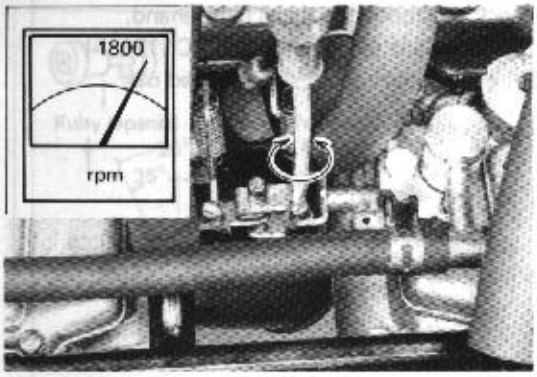
4. Disconnect the connecting rod at the body.

Fig. 3-83



5. Loosen the rear idle speed adjusting screw until it is free from the lever.

Fig. 3-84

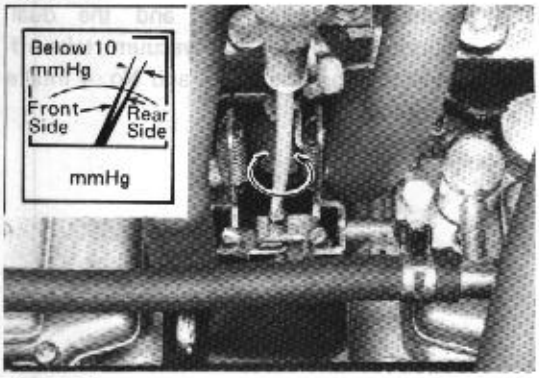


6. Set to 1800rpm by turning the front idle speed adjusting screw.

Engine speed 1800 rpm

Check the engine speed after raising the engine speed.

Fig. 3-85

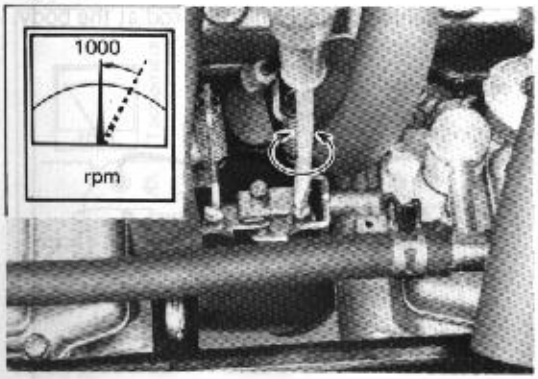


7. Set to front-rear vacuum difference to within 10mmHg (0.39inHg) by turning the synchronizing screw.

Front and rear vacuum difference below 10mmHg (0.39inHg)

Check the vacuum difference after raising the engine speed.

Fig. 3-86

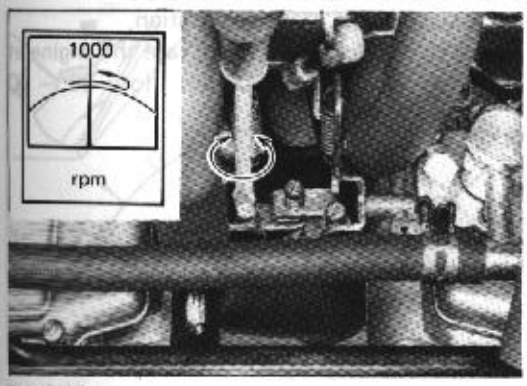


8. Loosen the front idle speed adjusting screw and lower the engine speed to 950 ~ 1,050 rpm.

Engine speed 1000 ± 50 rpm

Check the engine speed after raising the engine speed.

Fig. 3-87



9. Screw in the slightly the rear idle speed adjusting screw and raise the engine speed, then adjust the engine speed to 950 ~ 1050 rpm.

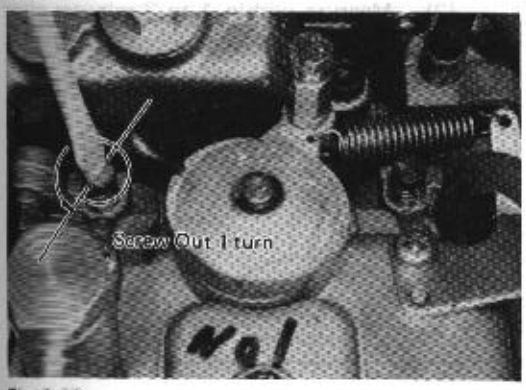
   Engine speed 1000 ± 50rpm

   Check the engine speed after raising the engine speed.

10. Readjust front-rear vacuum difference.

    Below 10mmHg (0.39inHg)

Fig. 3-88



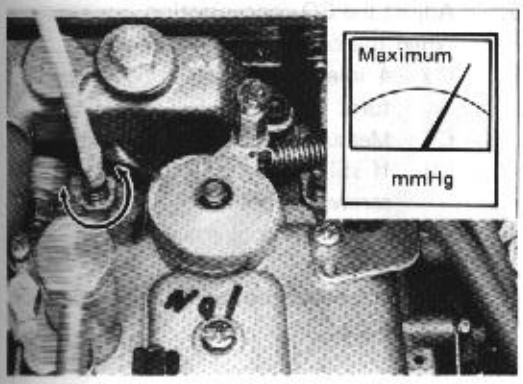
BEST IDLE ADJUSTMENT

1. Screw out all of the idle mixture adjusting screws 1 turn from fully closed position.

   – Note –

   Screw in gently until fully closed, taking care not to injure the carburetor idle port or the screw tapered point.

Fig. 3-89



2. Set to the maximum vacuum reading by turning each idle mixture adjusting screw.

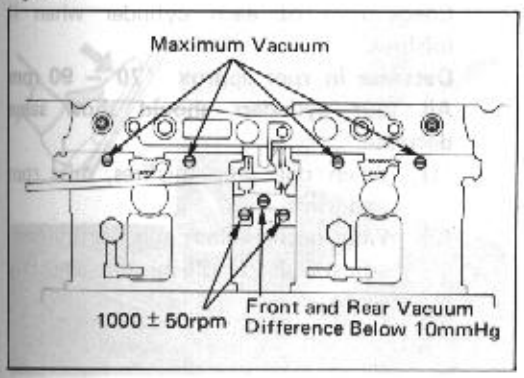
   – Caution –

   Repeat adjustment 2 or 3 times to obtain maximum vacuum setting.

   Best idle speed 1000 rpm

   Manifold vacuum Above 330mmHg (13.00inHg)

Fig. 3-90



3. Readjust the following 2 or 3 times.

   (1) Idle speed adjusting screw

   Idle speed 1000 ± 50rpm

   (2) Synchronizing screw (Idle to 2000rpm)

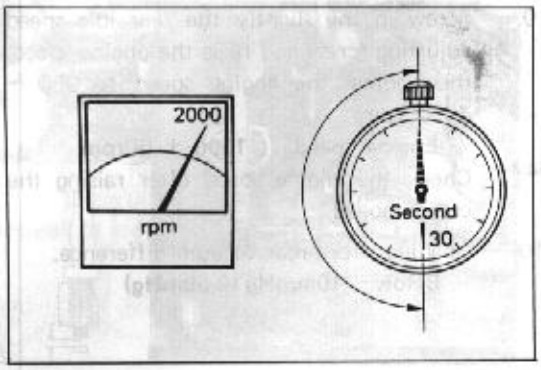
   Front and rear vacuum difference Below 10mmHg (0.39inHg)

   (3) Idle mixture adjusting screw

   Manifold vacuum Above 380mmHg (14.96inHg)

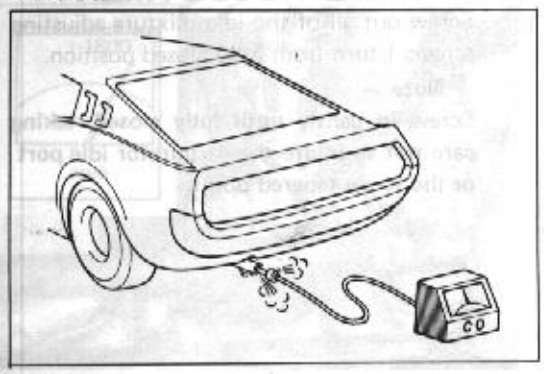
CO CONCENTRATION

Fig. 3-91



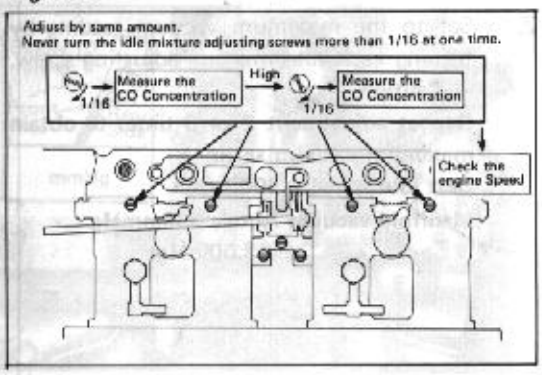
1. Measure the CO concentration
   (1) Before measuring, race the engine at about 2,000 rpm for 30 – 60 seconds.

Fig. 3-92



   (2) Measure within 1 to 3 minutes after racing the engine to allow the concentration to stabilize.

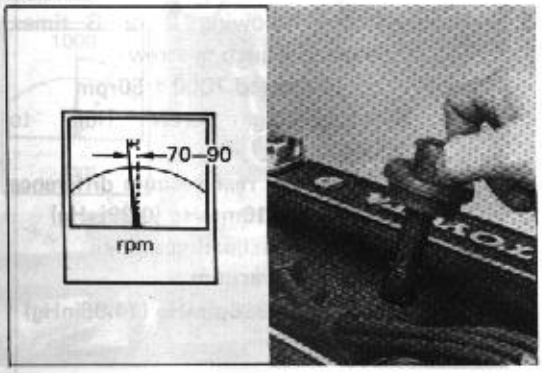
Fig. 3-93



2. Adjust the CO concentration.
   When the concentration is high:
   (1) 4 idle mixture adjusting screws 1/16 turn.
   (2) Measure the CO concentration again.
   (3) If still high, 4 idle mixture adjusting screws another 1/16 turn.
   (4) Check the engine speed.

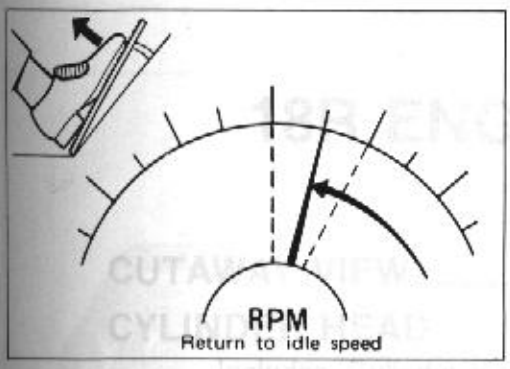
   – Note –
   Do not allow rpm to be below best idle speed.

Fig. 3-94



3. Check rpm of each cylinder when it misfires.
   Decrease in rpm approx. 70 – 90 rpm
   All four cylinders should show same decrease.
   (1) When one plug misfires, raise rpm and clean.
   (2) When decrease in rpm is not uniform, adjust with the idle mixture adjusting screw.

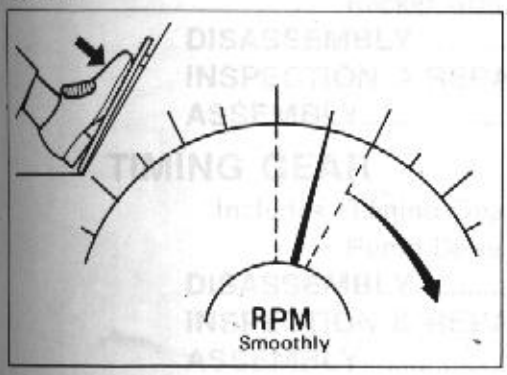
Fig. 3-95



ENGINE CONDITION

1. Check if the engine returns to idle speed when both suddenly and slowly accelerated.

Fig. 3-96



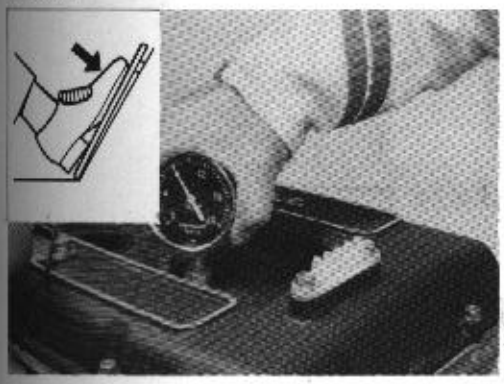
2. Opening throttle valve gradually should cause engine to speed up smoothly in relation to amount of valve opening.

Fig. 3-97

COMPRESSION PRESSURE

1. Warm up the engine.
2. Remove all spark plugs.
3. Disconnect the high tension cord from ignition coil to cut-off the secondary circuit.

Fig. 3-98



4. Insert a compression gauge into the spark plug hole, open the throttle valve fully, and measure the compression pressure while cranking the engine with starter motor.

Compression Pressure (at 200 rpm)

STD	**12.7kg/cm² (180.3psi)**
Limit	**10.0kg/cm² (142.0psi)**

Difference of pressure between cylinders Less than 1.0kg/cm² (14.2psi)

18R ENGINE SERVICE

CUTAWAY VIEW

Fig. 4-1

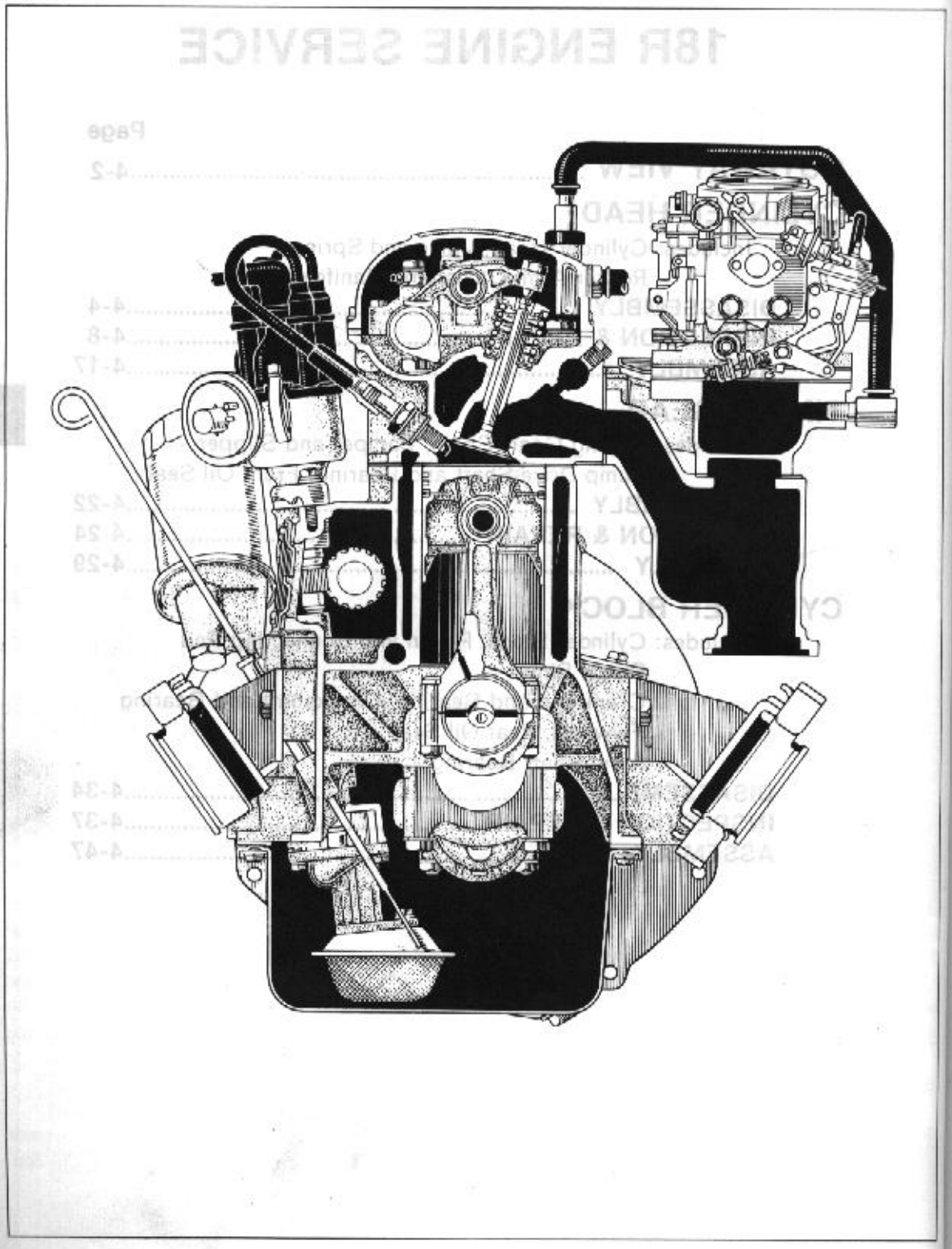
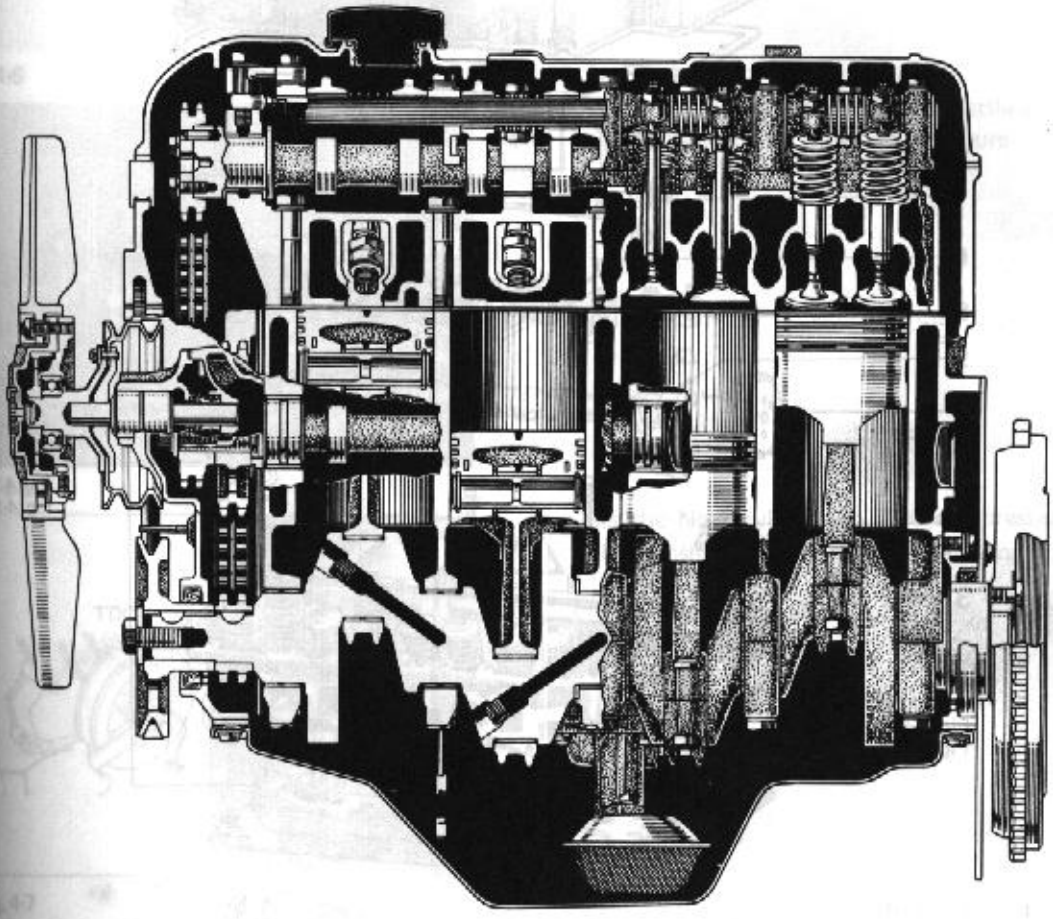


Fig. 4-2

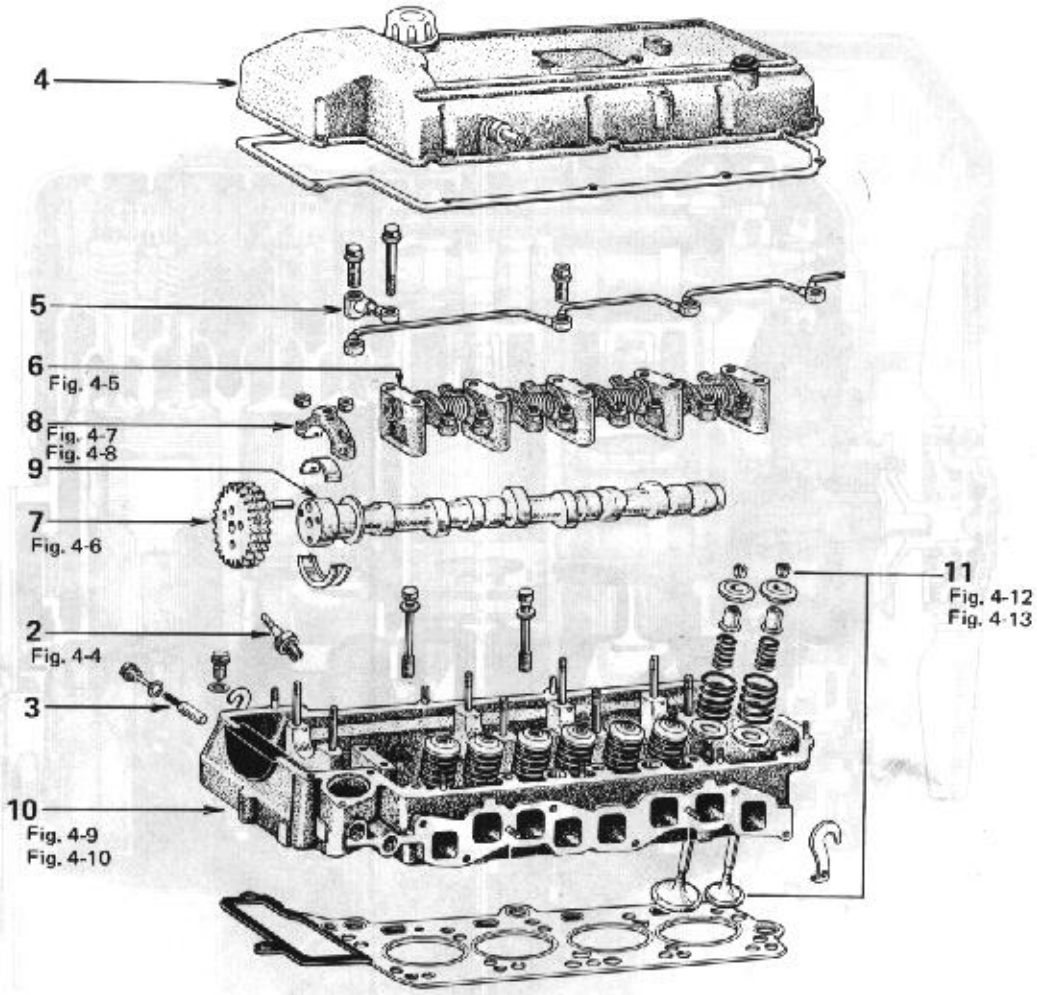


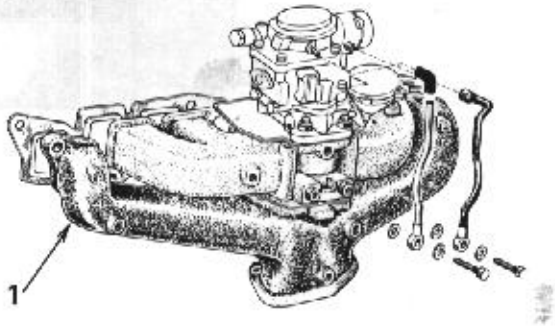
CYLINDER HEAD

DISASSEMBLY

Disassemble in numerical order.

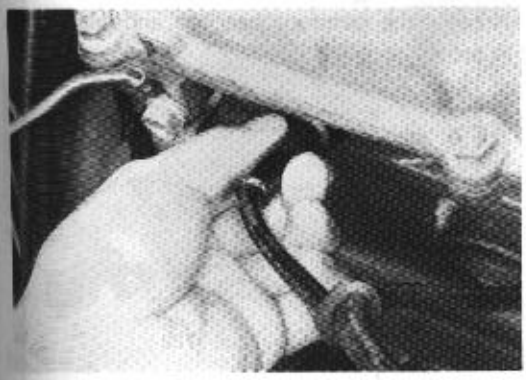
Fig. 4-3





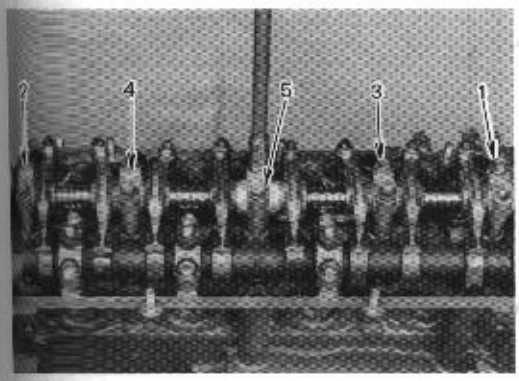
1	Manifold
2	Spark plug
3	No.2 chain tensioner
4	Cylinder Head Cover
5	Oil Pipe
6	Valve Rocker
7	Camshaft Gear
8	Bearing Cap
9	Camshaft
10	Cylinder Head
11	Valve

Fig. 4-4



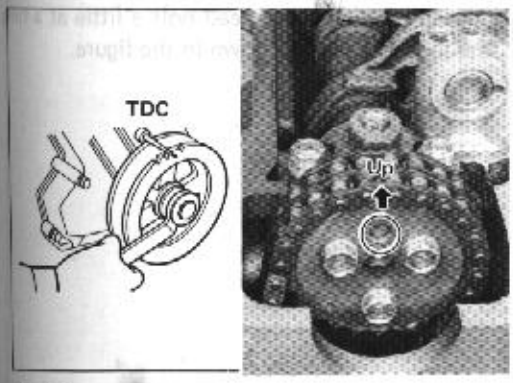
Remove the plug cords by carefully pulling on the rubber boots.

Fig. 4-5



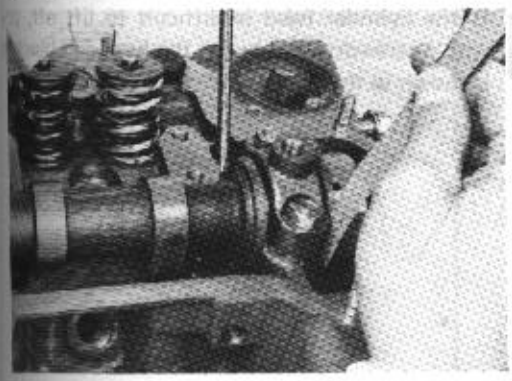
Loosen each rocker support bolt a little at a time and in the sequence shown in the figure.

Fig. 4-6



Set the No.1 cylinder to TDC/compression. The camshaft knock pin should be facing upward.

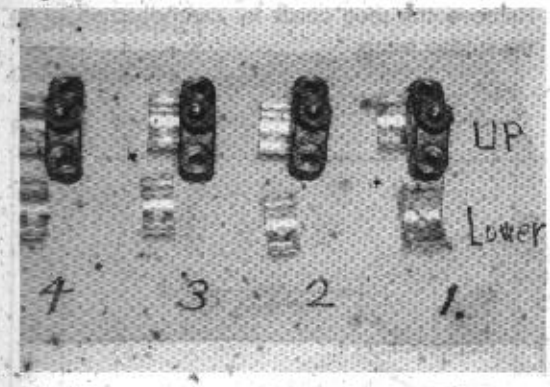
Fig. 4-7



Measure camshaft thrust clearance.

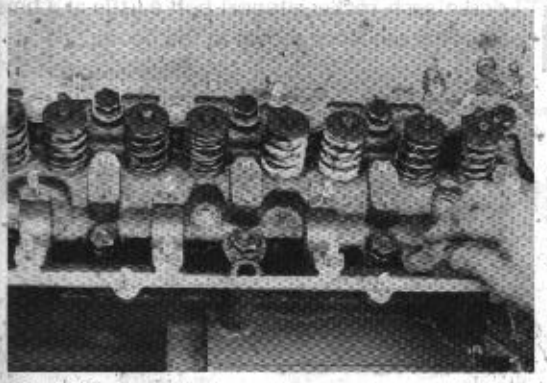
Thrust clearance limit	**0.25 mm (0.0098 in)**

Fig. 4-8



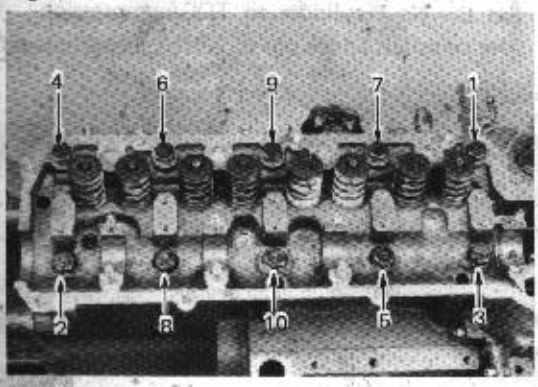
Arrange the camshaft bearings and bearing caps in order.

Fig. 4-9



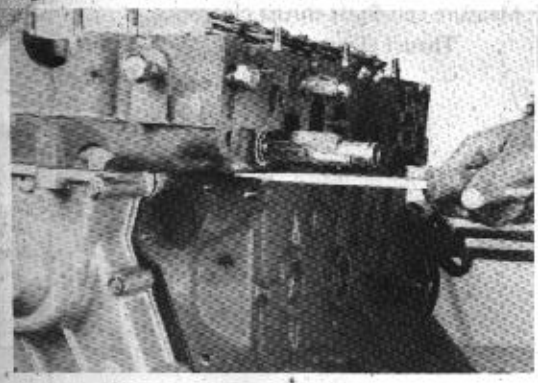
Wipe off the remaining oil on the camshaft.

Fig. 4-10



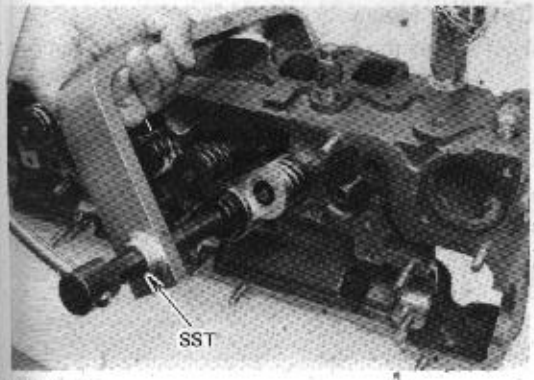
Loosen each cylinder head bolt a little at a time and in the sequence shown in the figure.

Fig. 4-11



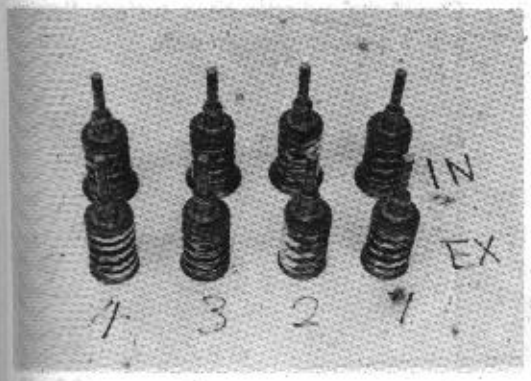
If the cylinder head is difficult to lift off, pry with a screwdriver between the head and block as is shown in the figure.

Fig. 4-12



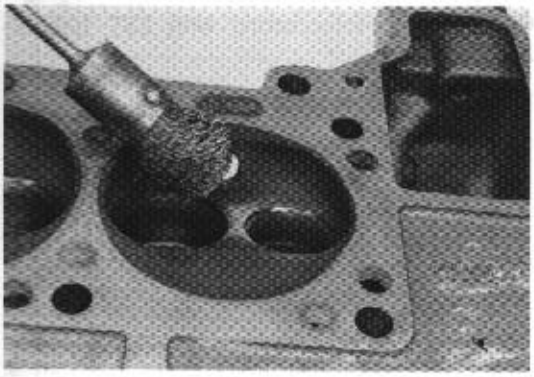
Compress the valve spring with SST [09202 43013].

Fig. 4-13



Arrange the disassembled parts in order.

Fig. 4-15

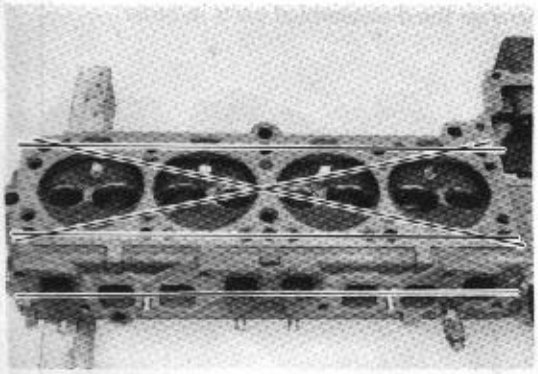


INSPECTION & REPAIR

Cylinder Head

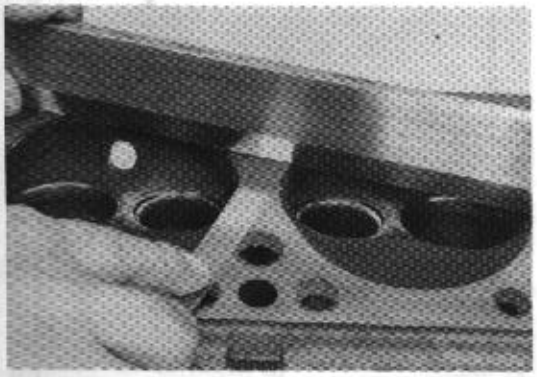
1. Clean the combustion chamber and remove any gasket material from the manifold and head surface.
   Check the cylinder heads for cracks or excessively burnt valve surfaces.

Fig. 4-16



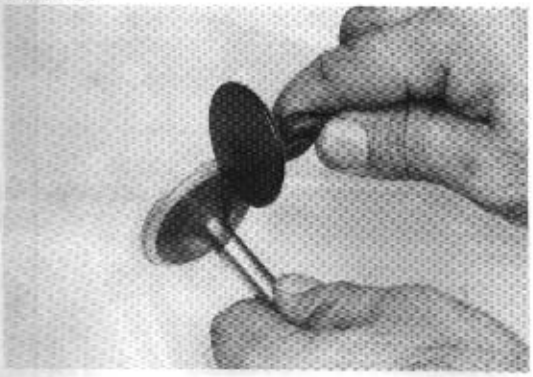
2. Check the cylinder head surface flatness with a precision straight edge.

Fig. 4-17



3. If warpage exceeds the limit, correct it by machining, or replace the head.
   Head surface warpage limit
   0.05 mm (0.0019 in)
   Maximum reface limit
   0.2 mm (0.0079 in)

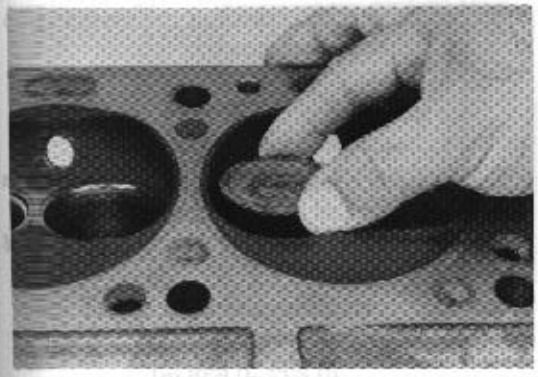
Fig. 4-18



Valve, Guide and Seat

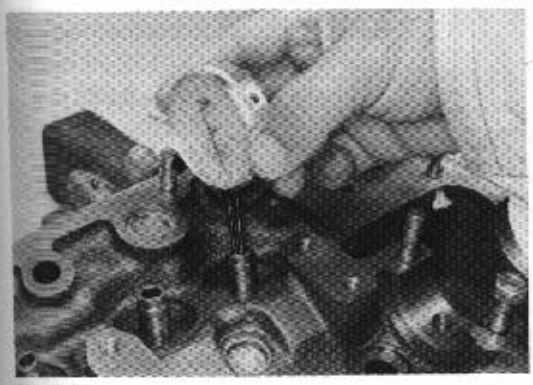
1. Clean valves.

Fig. 4-19



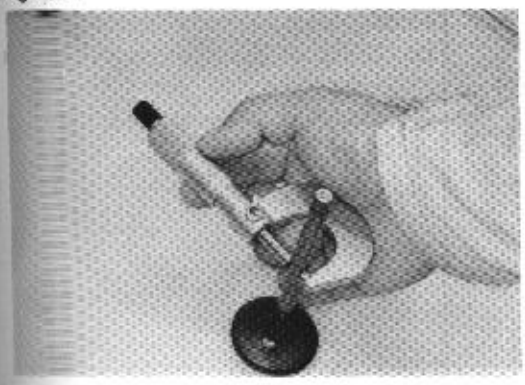
2. Check the valve stem to valve guide clearance of each valve by inserting the valve stem into the guide and moving back and forth as is shown in the figure.

Fig. 4-20



3. Measure the valve stem oil clearance.
   (1) Measure the inside diameter of the valve guide at several places with an inside dial gauge.

Fig. 4-21



   (2) Measure the valve stem diameter.
   (3) Calculate the clearance between the valve stem and valve guide by subtracting the difference where the clearance is the largest.

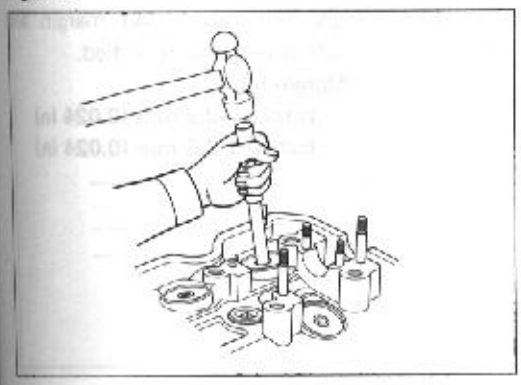
Clearance limit

Intake 0.08 mm (0.0032 in)

Exhaust 0.10 mm (0.0039 in)

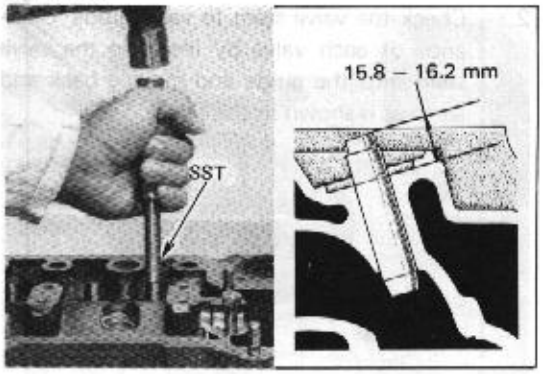
If the clearance exceeds the limit, replace both valve and guide.

Fig. 4-22



4. Replacing guide
   (1) From the top, drive out the guide toward the combustion chamber with SST.
   SST [09201-60011]

Fig. 4-23



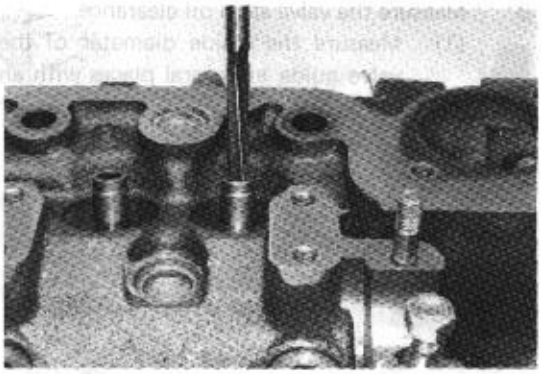
(2) With SST, drive in the new guide to the specified depth.
SST [09201-60011]

– Note –

1. **Insure that the hole is clean.**
2. **Before inserting the guide apply a thin coat of oil to it and the guide hole.**
3. **Do not drive in past the specified depth.**

Guide protrusion
15.8–16.2 mm
(0.622–0.638 in)

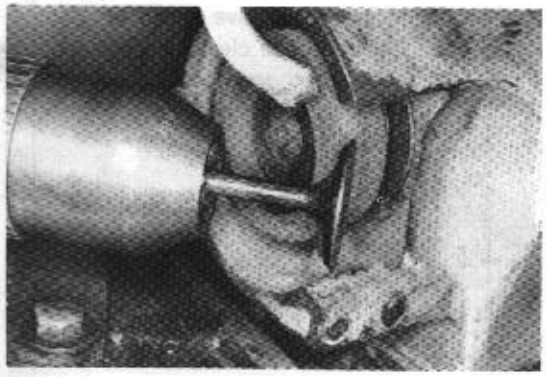
Fig. 4-24



(3) Ream the guide to the specified clearance with an 8 mm (0.32 in) reamer.

Intake	**0.025 – 0.060 mm (0.0010 – 0.0024 in)**
Exhaust	**0.035 – 0.070 mm (0.0014 – 0.0028 in)**

Fig. 4-25

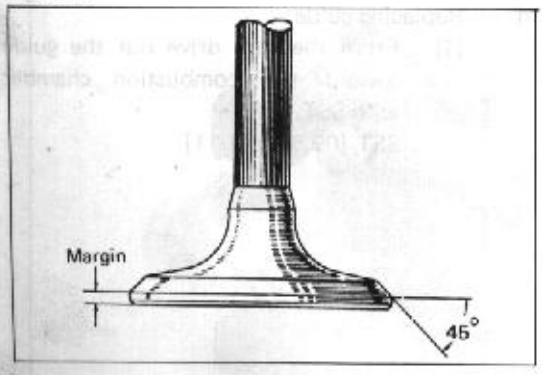


5. Grinding valves and seats

(1) Grind all valves to remove the pits and carbon.

Valve face angle: 45.5°

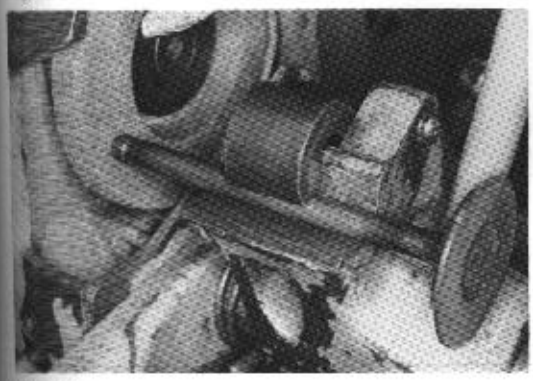
Fig. 4-26



(2) Check the valve head margin and replace if less than specified.

Margin limit
Intake 0.6 mm (0.024 in)
Exhaust 0.6 mm (0.024 in)

Fig. 4-27

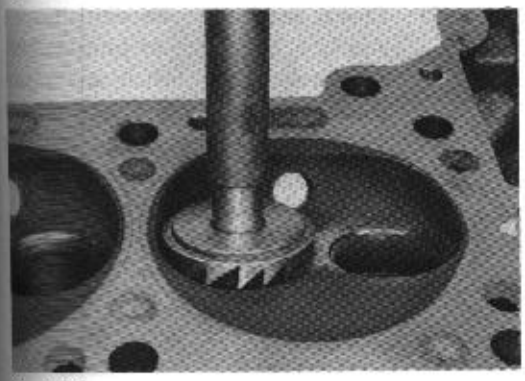


(3) If the valve stem end is worn, resurface with a valve grinder, but do not grind off more than 0.5 mm (0.02 in).

Overall length limit

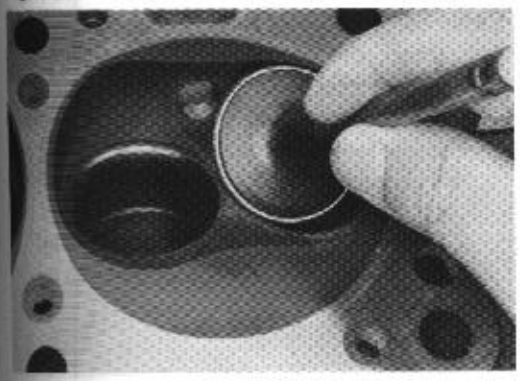
Ex.	**113.2 mm (4.457 in)**
In.	**112.7 mm (4.437 in)**

Fig. 4-28



(4) Resurface valve seats with 45° carbide cutter.
Remove only enough metal to clean seat.

Fig. 4-29



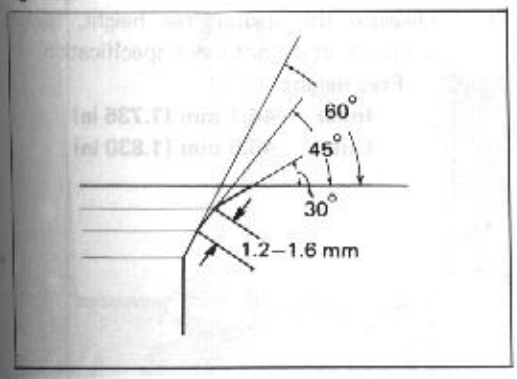
(5) Coat valve face with prussian blue or white lead. Locate contact point on valve by rotating valve against seat.

— Note —

Seat contact should be in middle of valve face with following width:

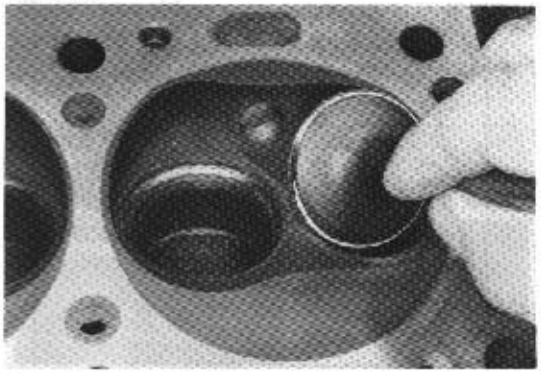
Intake 1.2–1.6 mm (0.047–0.063 in)
Exhaust 1.2–1.6 mm (0.047–0.063 in)

Fig. 4-30



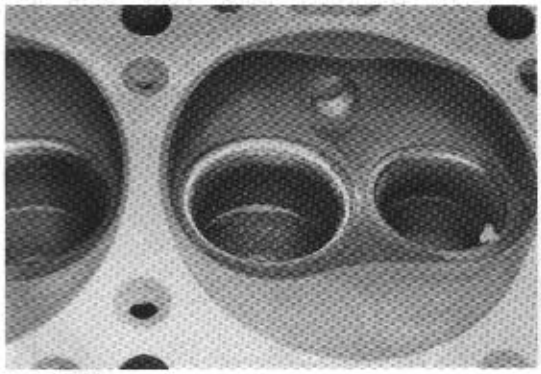
(6) Correct the seat position.
To correct seating that is too high, use 30° and 45° cutters. If seating is too low, use 65° and 45° cutters.

Fig. 4-31



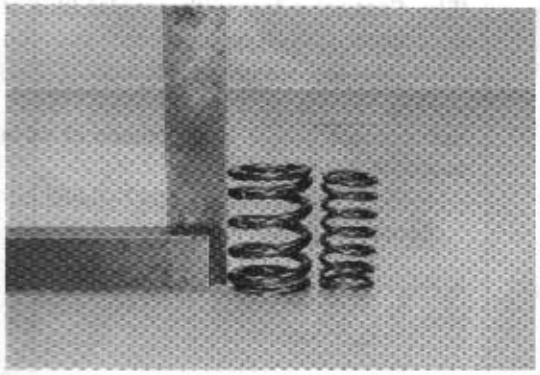
(7) Check valve concentricity.
Lightly coat seat with prussian blue. Install valve and rotate. If blue appears 360° around face, valve stem and face are concentric. If not, replace valve.

Fig. 4-32



(8) Check seat/guide concentricity.
Apply a light coat of prussian blue on valve face. Install and rotate valve. If blue appears 360° around valve seat, guide and seat are concentric. If not, recut seat.

Fig. 4-33

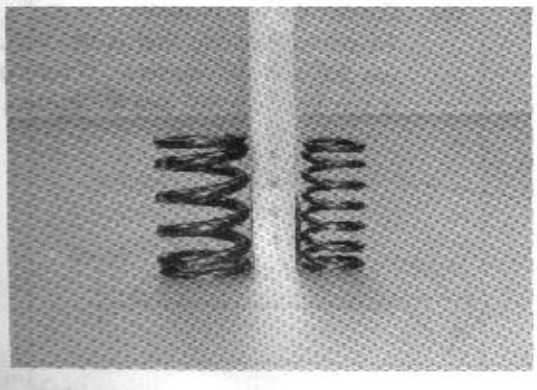


Valve Springs

1. Check the squareness of the valve springs with a steel square and surface plate. Turn the spring around slowly and observe the space between the top of the spring and the square. Replace the spring if it is out of square more than the specified limit.

Limit	**Inner**	**1.6 mm (0.063 in)**
	Outer	**1.6 mm (0.063 in)**

Fig. 4-34

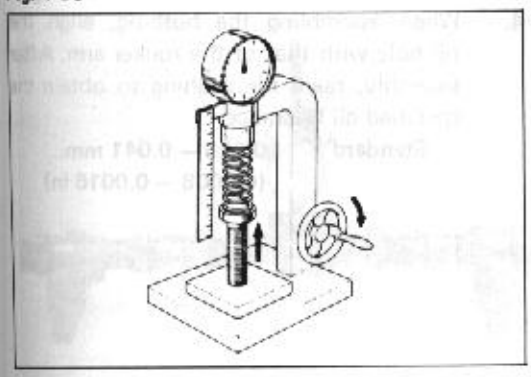


2. Measure the spring free height. Replace springs that do not meet specification.

Free height

Inner	**44.1 mm (1.736 in)**
Outer	**46.5 mm (1.830 in)**

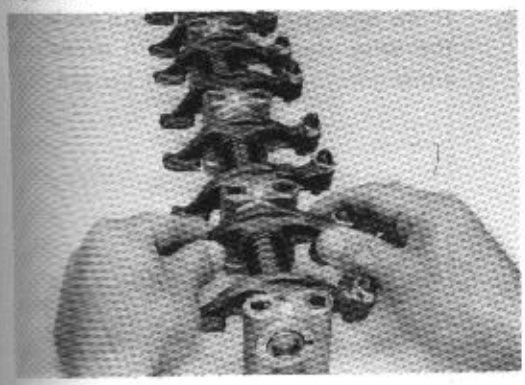
Fig. 4-35



3. Using a spring tester, measure the tension of each spring at the specified installed height. Replace any spring that does not meet specification.

	Inner	Outer
Limit	**6.8 kg (15.0 lb)**	**23.9 kg (52.7 lb)**
Standard	**7.6 kg (16.8 lb)**	**26.3 kg (58.0 lb)**

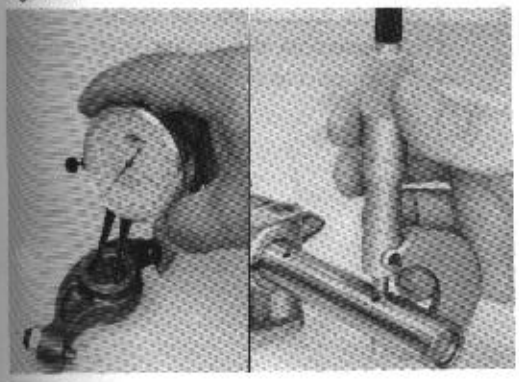
Fig. 4-36



Rocker Arm and Shaft

1. Check the rocker arm to shaft clearance. If worn excessively, disassemble and inspect.

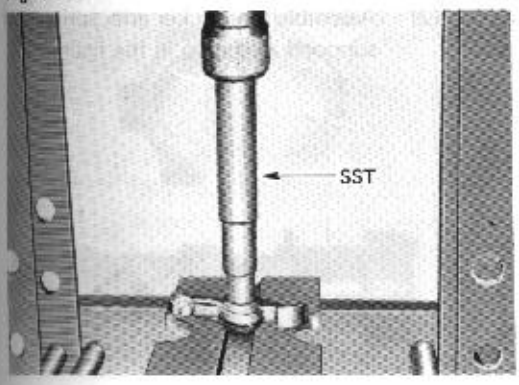
Fig. 4-37



2. Measure the clearance with a dial indicator and outside micrometer. If clearance exceeds the limit, replace the rocker arm bushings and/or shaft.

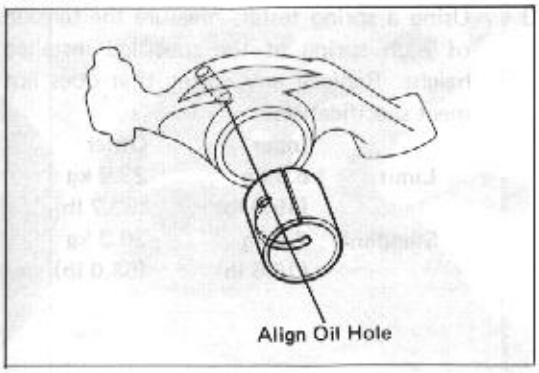
Clearance limit 0.08 mm (0.0032 in)
Standard 0.02–0.05 mm (0.0008–0.0020 in)

Fig. 4-38



3. With SST, remove the rocker arm bushing.
SST [09222-30010]

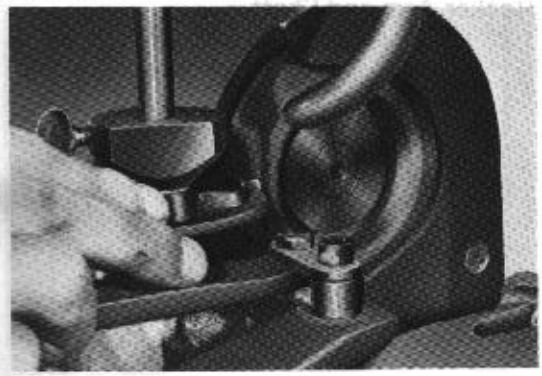
Fig. 4-39



4. When assembling the bushing, align the oil hole with that of the rocker arm. After assembly, ream the bushing to obtain the specified oil clearance.

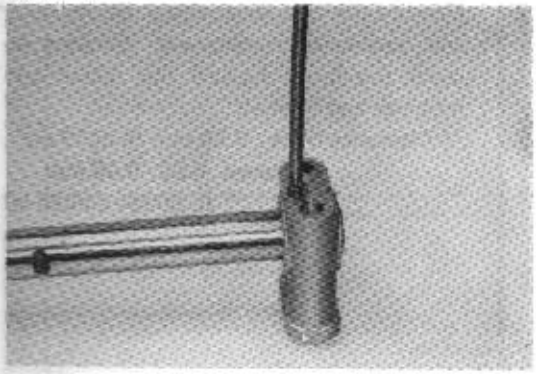
Standard	**0.020 – 0.041 mm (0.0008 – 0.0016 in)**

Fig. 4-40



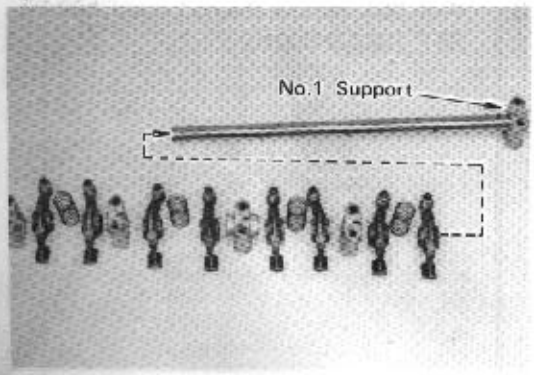
5. If the valve rocker arm surface contacting the valve stem end is worn excessively, either grind or replace the rocker arm.

Fig. 4-41



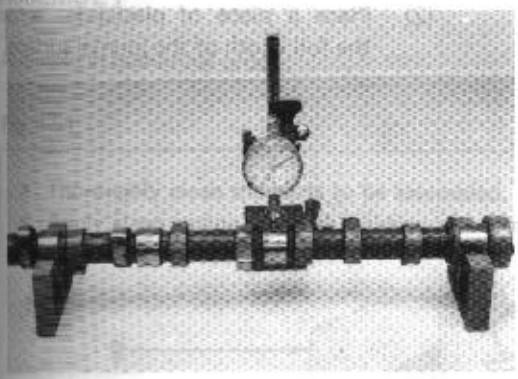
6. Assemble the rockers and shaft.
   (1) Assemble the rocker shaft and No.1 support as shown in the figure.

Fig. 4-42



   (2) Assemble the rocker arm, springs and supports as shown in the figure.

Fig. 4-43

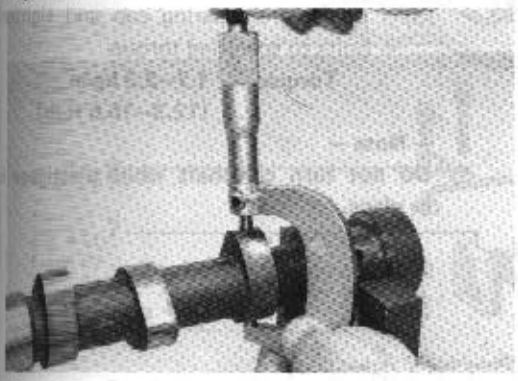


Camshaft and Bearing

1. Check the camshaft for runout. Replace camshaft if it exceeds limit.

   Limit 0.1 mm (0.004 in)

Fig. 4-44

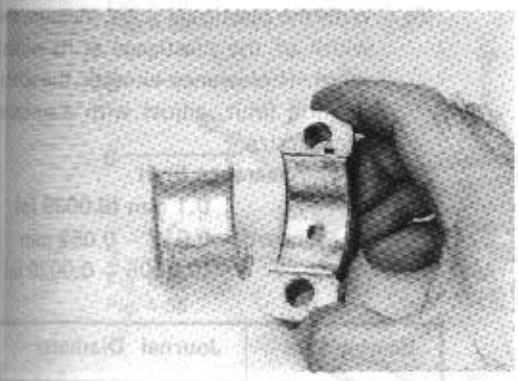


2. Measure the cam lobe height and check for wear. If wear exceeds the limit, replace the camshaft.

   Height limit Intake 43.7 mm (1.720 in)

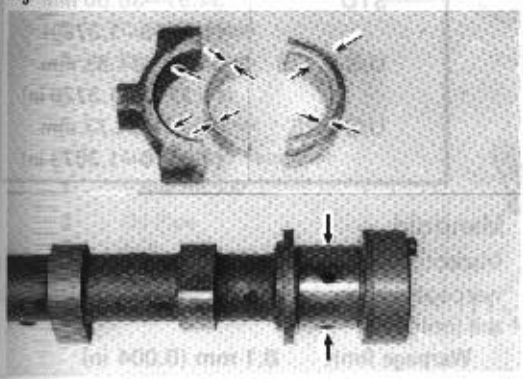
   Exhaust 43.8 mm (1.724 in)

Fig. 4-45



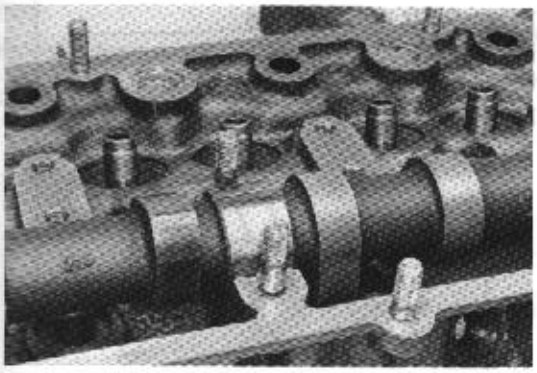
3. Check the bearings for flaking or scoring. Replace bearings, if damaged.

Fig. 4-46



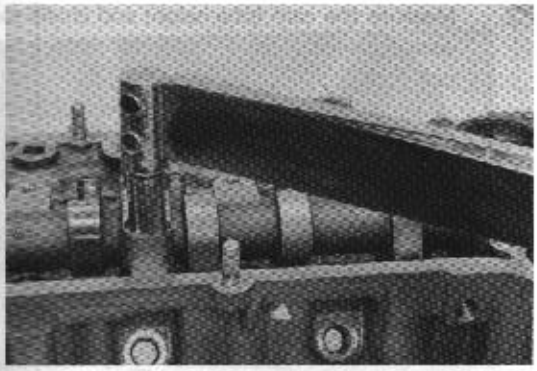
4. Measure the camshaft oil clearance.
   (1) Clean the bearing, cap and camshaft journal.

Fig. 4-47



(2) Place a piece of plastigage across the full width of the journal surface.

Fig. 4-48



(3) Install the bearing cap and tighten bolts to specified torque.

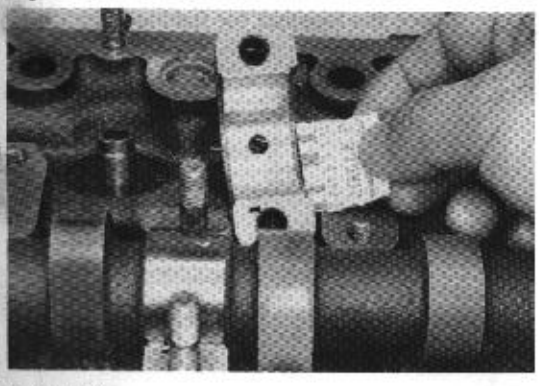
Torque 1.7–2.3 kg-m (12.3–16.6 ft-lb)

— Note —

Do not turn camshaft while plastigage is in place.

(4) Remove the bearing cap.

Fig. 4-49



(5) With the plastigage scale, measure the width of the plastigage at its widest point. If clearance exceeds the specification limit, adjust with a suitable bearing size.

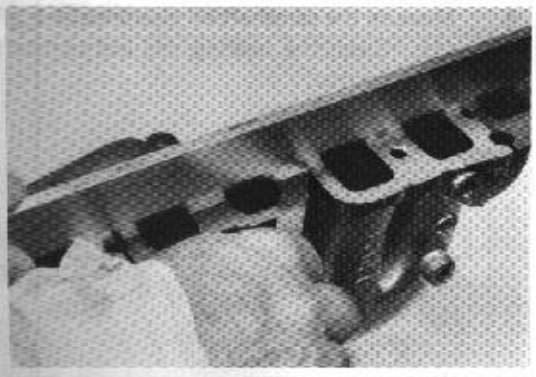
Oil clearance limit

0.1 mm (0.0039 in)

Standard 0.012 – 0.052 mm (0.0005 – 0.0020 in)

Bearing Size	Journal Diameter
STD	34.97–35.00 mm (1.3768–1.3780)
U/S 0.125	34.84–34.85 mm (1.3717–1.3720 in)
U/S 0.25	34.72–34.73 mm (1.3670–1.3673 in)

Fig. 4-50



Manifold

Inspect the cylinder head contacting surfaces for warpage and replace the manifold if it exceeds the limit.

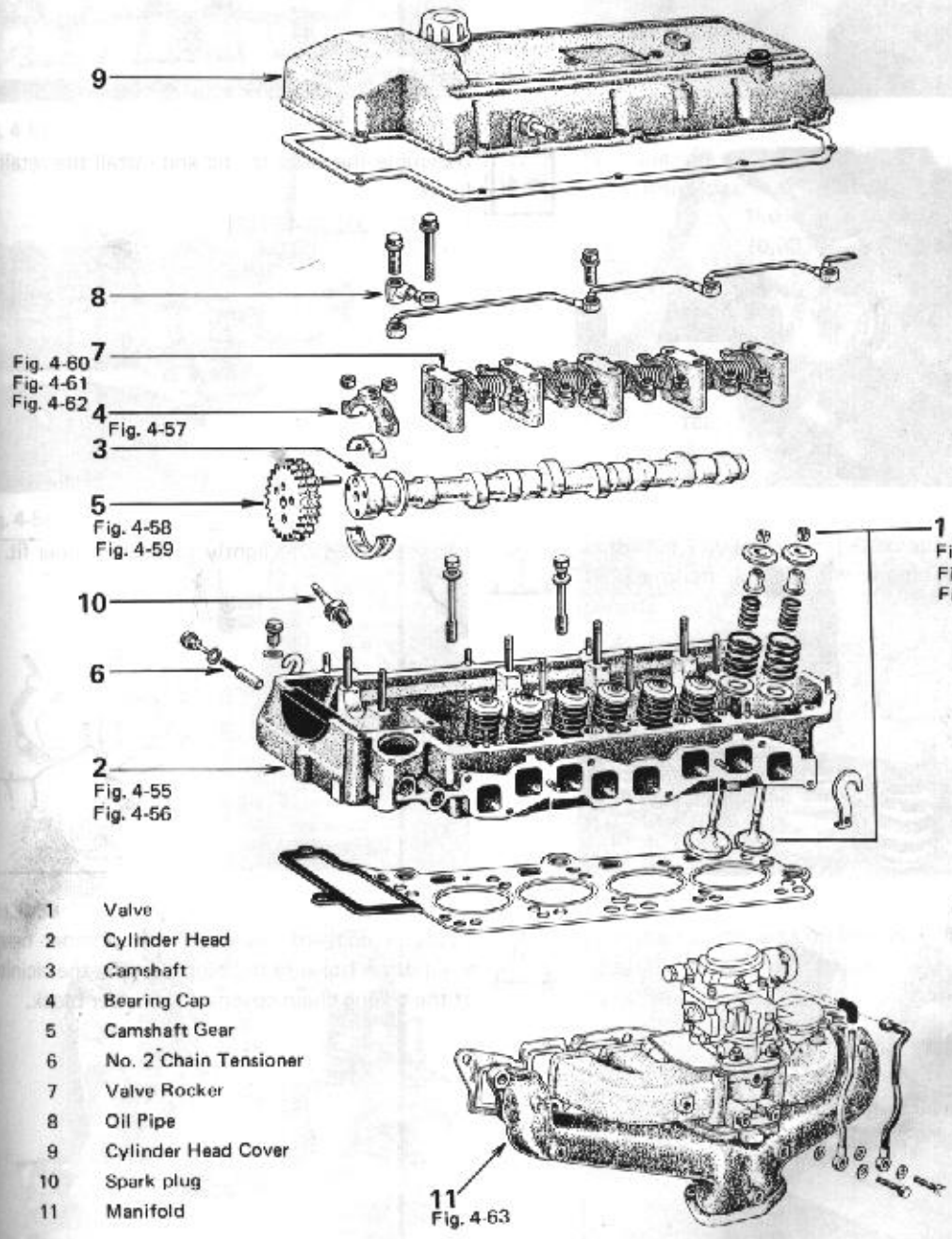
Warpage limit 0.1 mm (0.004 in)

ASSEMBLY

Assemble in numerical order.

Fig. 4-51

- **Thoroughly clean the parts to be assembled.**
- **Apply clean engine oil on the sliding and rotating surfaces of the parts before assembly.**

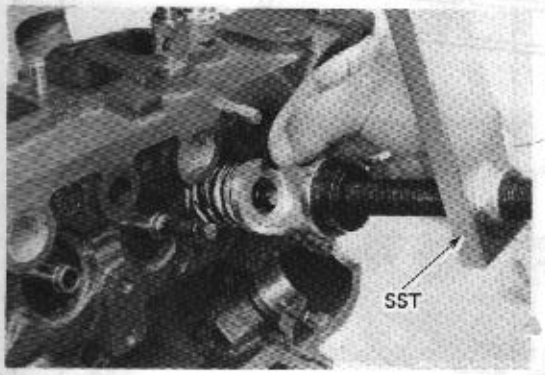


1	Valve
2	Cylinder Head
3	Camshaft
4	Bearing Cap
5	Camshaft Gear
6	No. 2 Chain Tensioner
7	Valve Rocker
8	Oil Pipe
9	Cylinder Head Cover
10	Spark plug
11	Manifold

Fig. 4-52

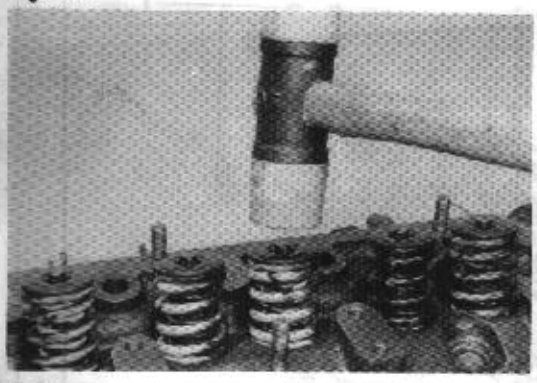
Install the spring seat and oil seal as shown in the figure. The head must be clean and the oil seal inserted to where the end contacts the spring seat top.

Fig. 4-53



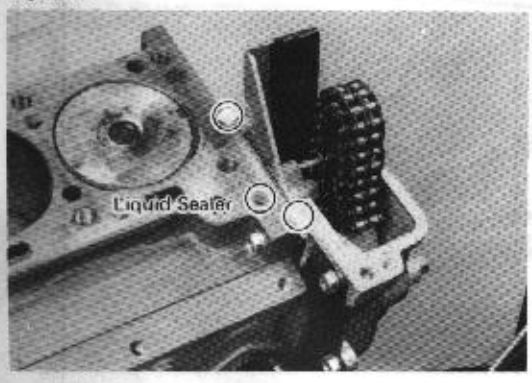
Assemble the valve spring and install the retainer locks.
Use SST [09202-43012].

Fig. 4-54



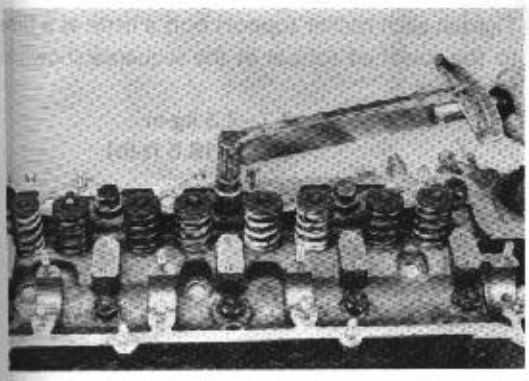
Tap the valve stems lightly to assure proper fit.

Fig. 4-55



Apply a coat of sealer to the cylinder head, around the holes in the block, and in the vicinity of the timing chain cover and cylinder block.

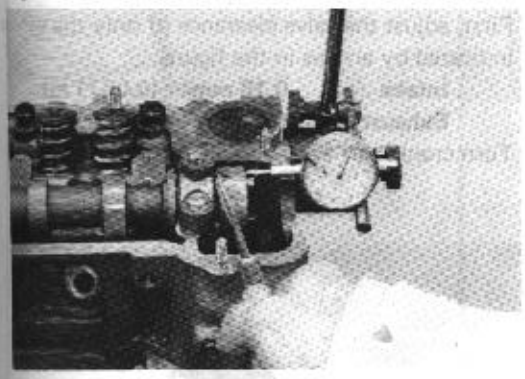
Fig. 4-56



Tighten each cylinder head bolt a little at a time to the specified torque in the sequence shown in the figure.

Torque 10–12 kg-m (72.3–86.8 ft-lb)

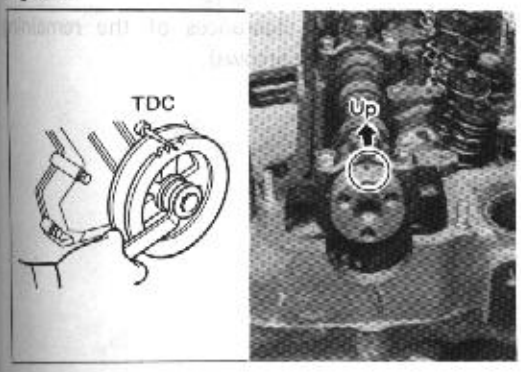
Fig. 4-57



Check the camshaft thrust clearance.

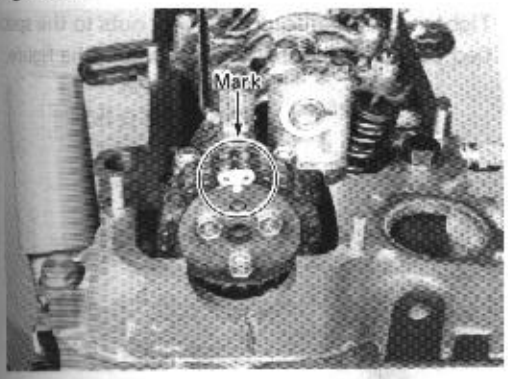
Thrust clearance standard
0.042 – 0.167 mm
(0.0017 – 0.0118 in)

Fig. 4-58



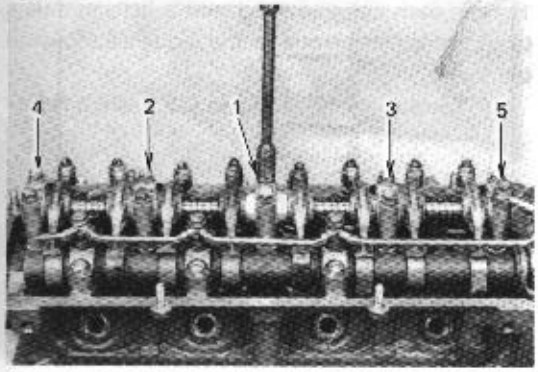
Set the No.1 cylinder to TDC/compression. The camshaft knock pin should be pointing upwards.

Fig. 4-59



Align the matchmarks on the chain and gear, and install the No.2 chain. Align the gear pin hole and camshaft knock pin and install them.

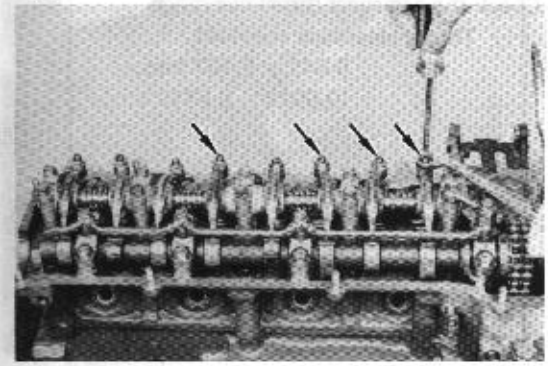
Fig. 4-60



Tighten each rocker support bolt a little at a time to the specified torque in the sequence shown in the figure.

Torque **1.7–2.3 kg-m (12.3–16.6 ft-lb)**

Fig. 4-61

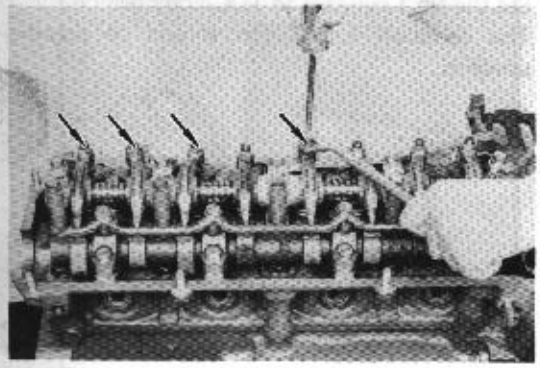


First, adjust the valve clearance of only the valves indicated by arrows in the figure.

Intake	**0.18 mm**	**(0.0071 in)**
Exhaust	**0.33 mm**	**(0.0130 in)**

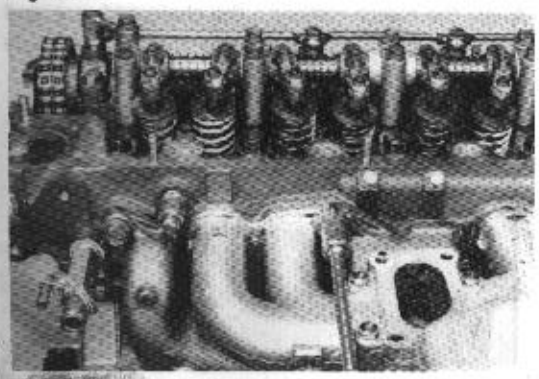
Turn crankshaft 360° and align timing mark.

Fig. 4-62



Next, adjust the clearances of the remaining valves (indicated by arrows).

Fig. 4-63



Tighten the manifold bolts and nuts to the specified torque in the sequence shown in the figure.

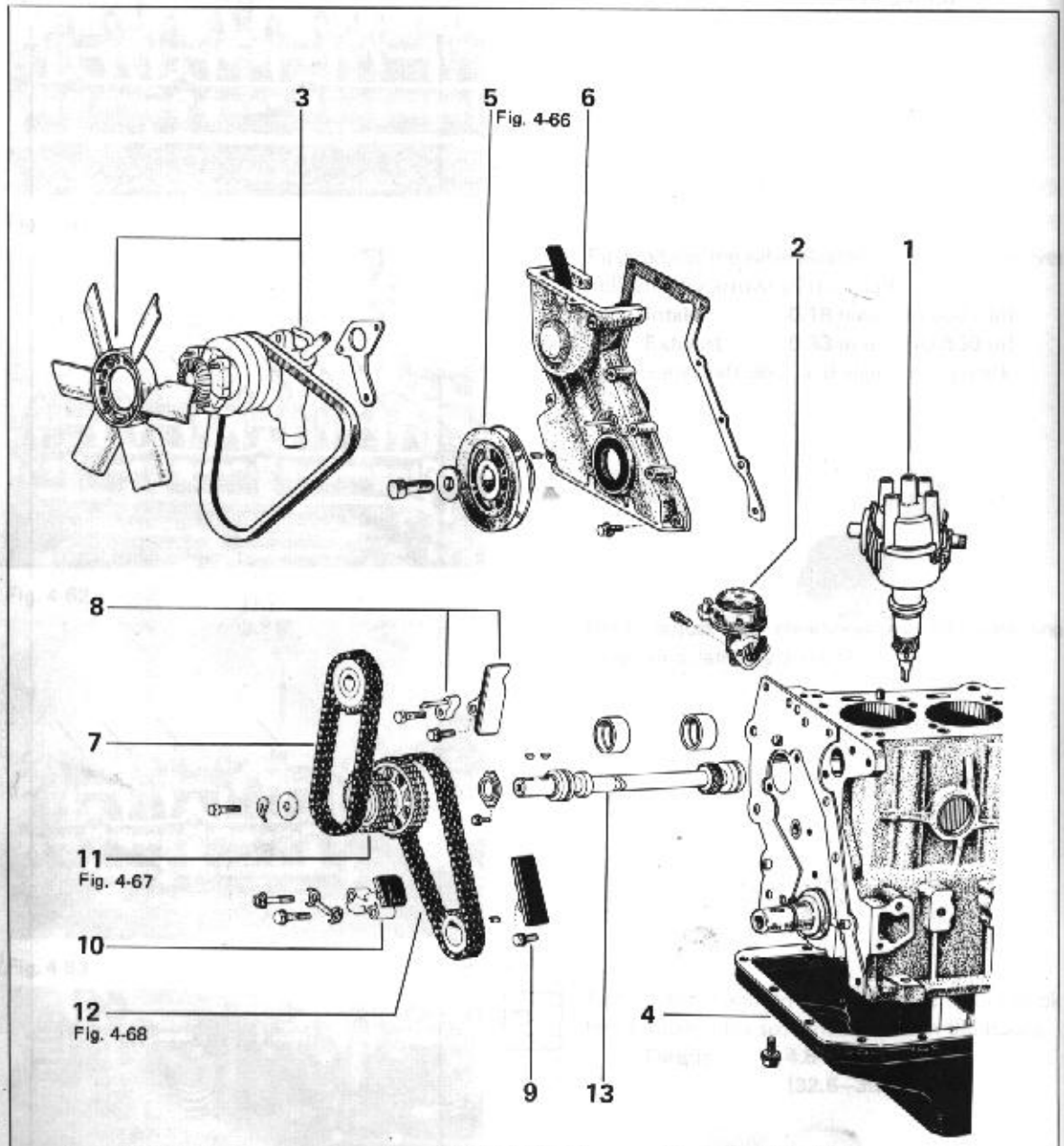
Torque **4.5–5.5 kg-m (32.6–39.8 ft-lb)**

TIMING CHAIN

DISASSEMBLY

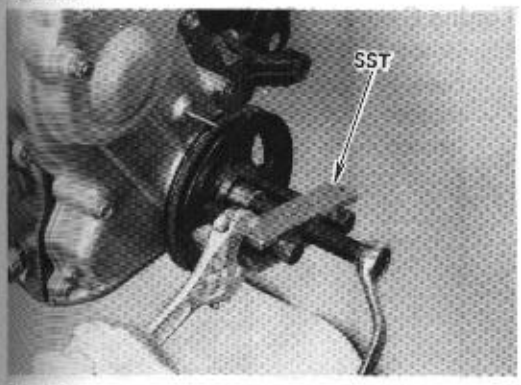
Disassemble in numerical order.

Fig. 4-65



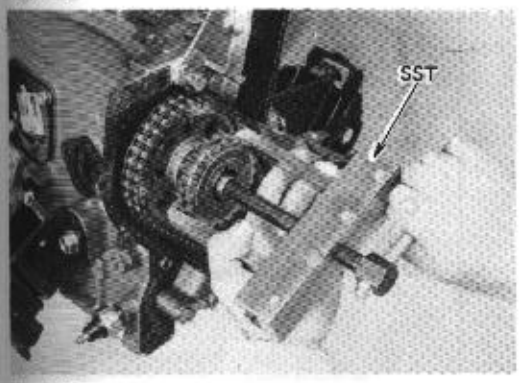
1	Distributor	5	Crankshaft Pulley	9	No. 1 Chain Damper
2	Fuel Pump	6	Timing Gear Cover	10	No. 1 Chain Tensioner
3	Fan and Water Pump	7	No. 2 Timing Chain	11	Camshaft Drive Gear
4	Oil Pan	8	No. 2 Chain Damper and Oil Jet	12	No. 1 Timing Chain and Gear
				13	Pump Drive Shaft

Fig. 4-66



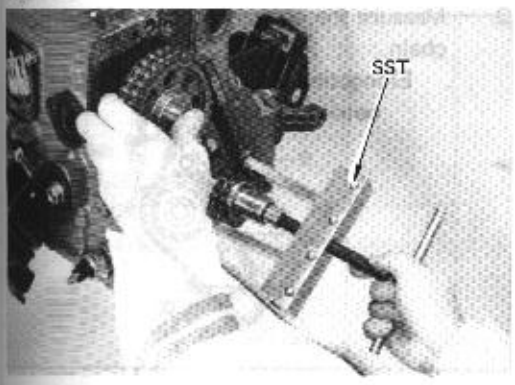
Remove the crankshaft pulley with SST.
Use SST [09213-31021].

Fig. 4-67



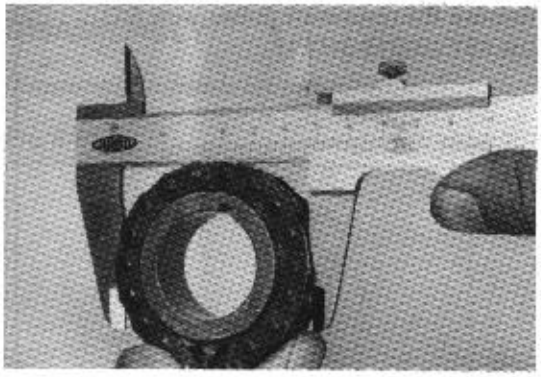
Remove the camshaft drive gear with SST.
Use SST [09213-36020].

Fig. 4-68



Attach the SST to the two gears and slide out both gears and chains as a unit.
Use SST [09213-36020].

Fig. 4-70

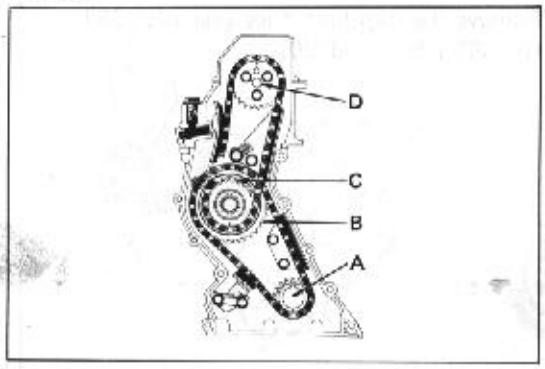


INSPECTION AND REPAIR

Timing Gear and Chains

1. Inspect the gears and chains for cracks, wear or chipped teeth.
2. Measure the gear for wear in the method shown in the figure.

Fig. 4-71

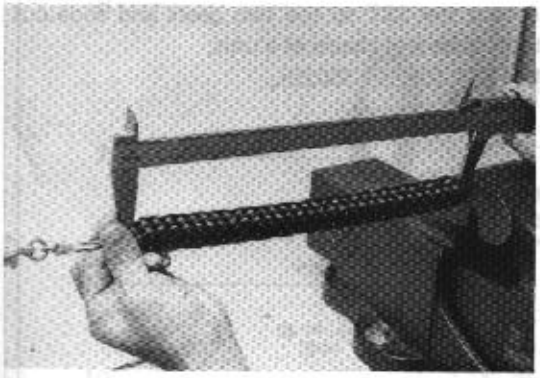


If measurement is below limit, replace gears and chain.

Wear limit

A: Crank shaft gear 60.0 mm (2.362 in)
B: Pump drive shaft gear 114.5 mm (4.508 in)
C: Camshaft drive gear 78.2 mm (3.079 in)
D: Camshaft timing gear 78.2 mm (3.079 in)

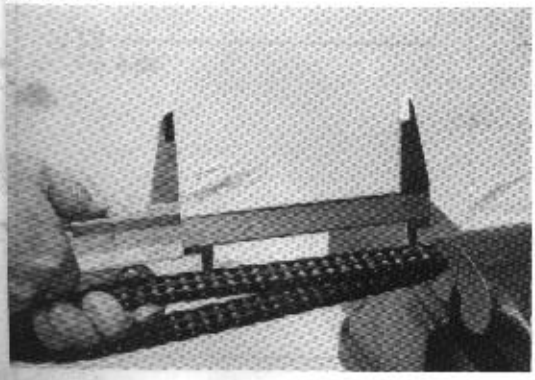
Fig. 4-72



3. Measure the elongation of the No. 1 timing chain.

Elongation limit 291.4 mm (11.47 in) tension at 5 kg (11 lb)

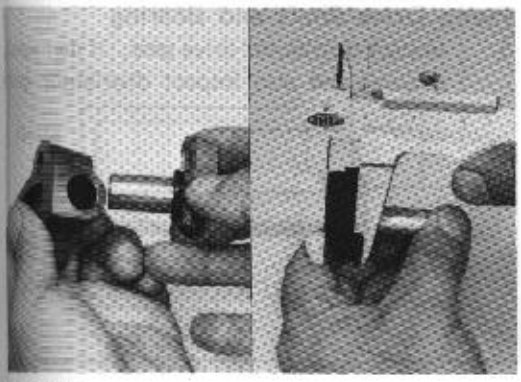
Fig. 4-73



4. Measure the 17-link elongation of the No. 2 timing chain. Replace the chain if over the elongation limit.

Elongation limit (at 17-links) 147 mm (5.787 in)

Fig. 4-74

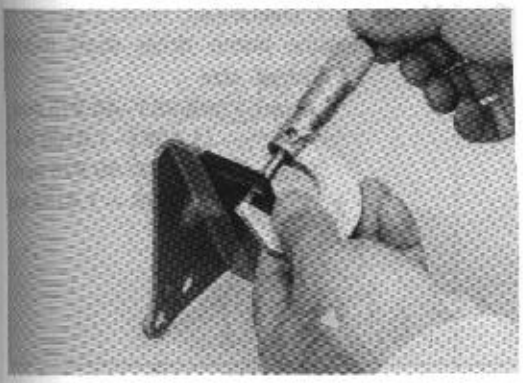


No. 1 Chain Tensioner

Check the body and plunger for wear and measure the tensioner head as shown in the figure. If worn down over the limit, replace as a unit.

Wear limit 11.5 mm (0.453 in)

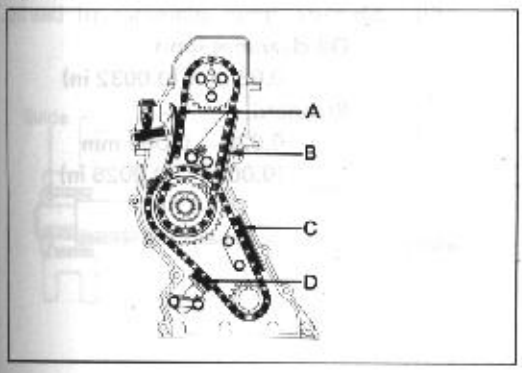
Fig. 4-75



Chain Damper and Slipper

Measure each chain damper and check for wear.

Fig. 4-76

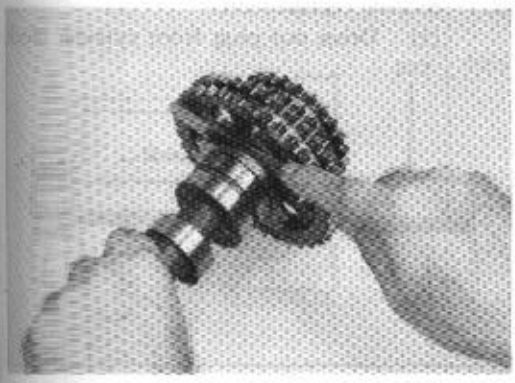


If either is visibly worn or measures less than limit, replace unit

Wear limit

A: Slipper
6.8 mm (0.26 in)
B: No. 2 damper
5.7 mm (0.224 in)
C: No. 1 damper
5.0 mm (0.20 in)
D: No. 1 tensioner
11.5 mm (0.45 in)

Fig. 4-77

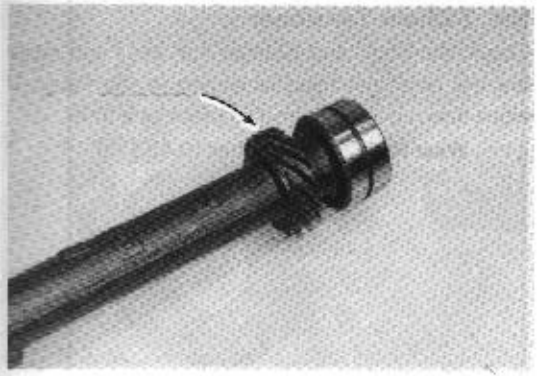


Timing Gear and Thrust Plate

Measure thrust clearance.
If it exceeds limit, replace thrust plate.

Thrust clearance
limit 0.3 mm (0.012 in)
Standard
0.06–0.13 mm (0.0024–0.0051 in)

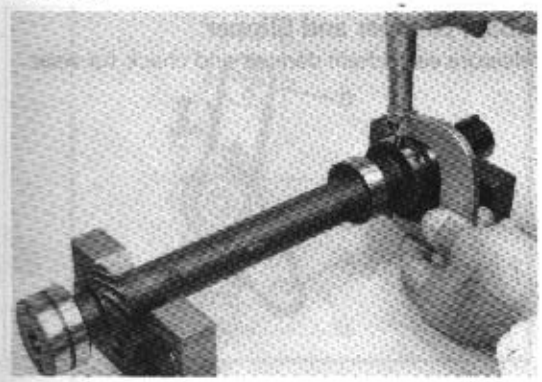
Fig. 4-78



Pump Drive Shaft and Bearing

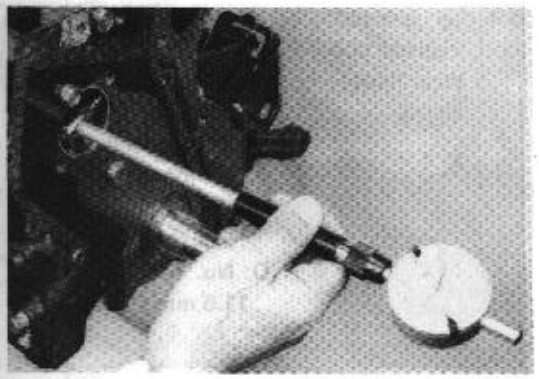
1. Inspect distributor drive gear. If damaged, replace, and also inspect distributor gear.

Fig. 4-79



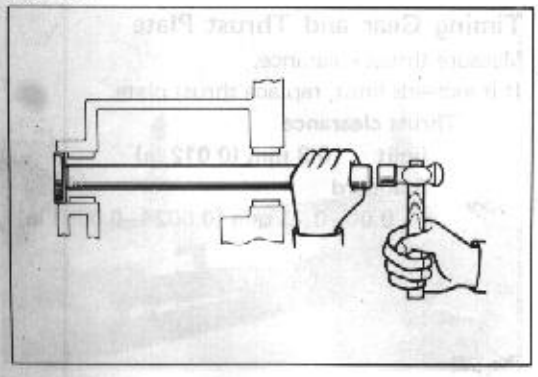
2. Measure oil clearance
   (1) Measure pump drive shaft journal.
   Finished size
   Front 45.951–45.975 mm (1.8091–1.8100 in)
   Rear 40.959–40.975 mm (1.6126 – 1.6132 in)

Fig. 4-80



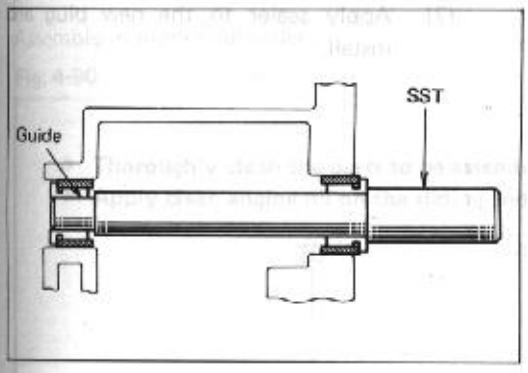
   (2) Measure inner diameter of bearing.
   Oil clearance limit
   0.08 mm (0.0032 in)
   Standard
   0.025 – 0.066 mm (0.0010 – 0.0026 in)

Fig. 4-81



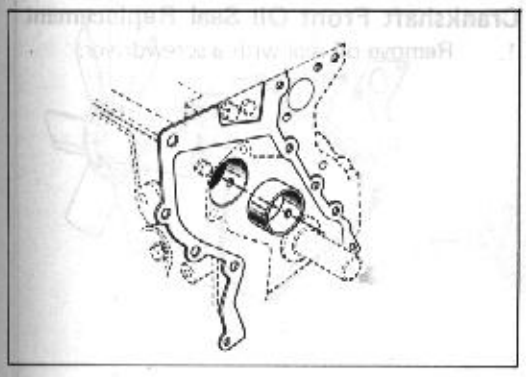
3. Bearing replacement
   (1) Drive out plug from cylinder block.

Fig. 4-82



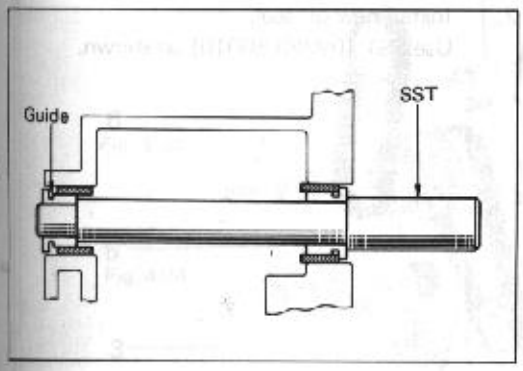
(2) Remove front bearing.
Use SST [09233-33010] as shown.

Fig. 4-83



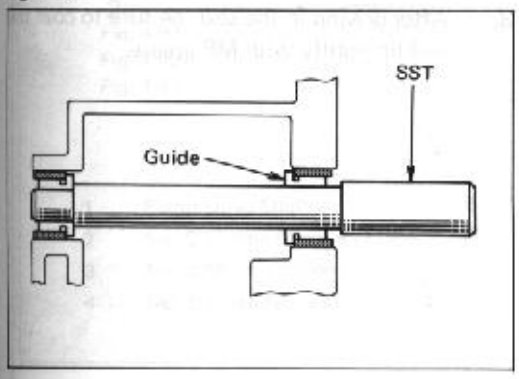
(3) Aligh bearing oil hole.

Fig. 4-84



(4) Install front bearing.
Use SST [09233-33010] as shown.
Bearing fitting tolerance
0.02–0.06 mm
(0.0008–0.0024 in)

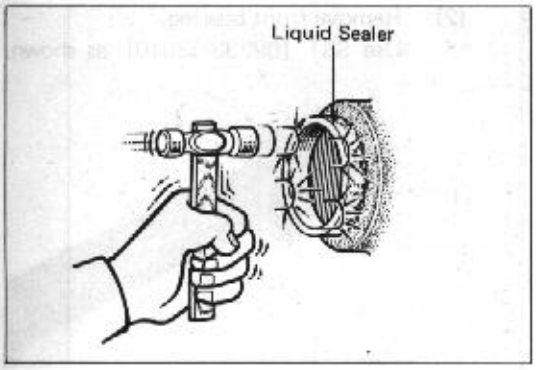
Fig. 4-85



(5) Remove the rear bearing.
(6) Install the rear bearing.

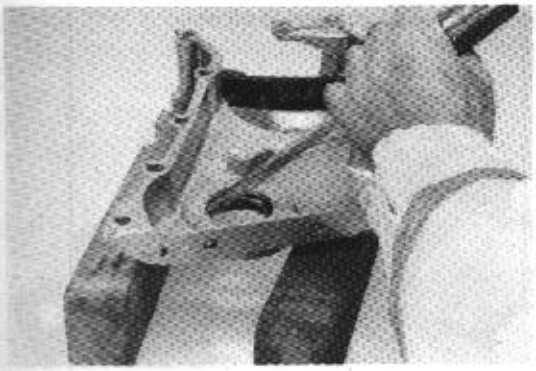
— Note —
Installation procedure is the same as for the front bearing.

Fig. 4-86



(7) Apply sealer to the new plug and install.

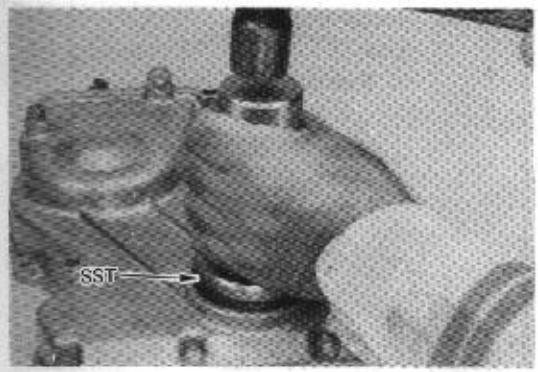
Fig. 4-87



Crankshaft Front Oil Seal Replacement

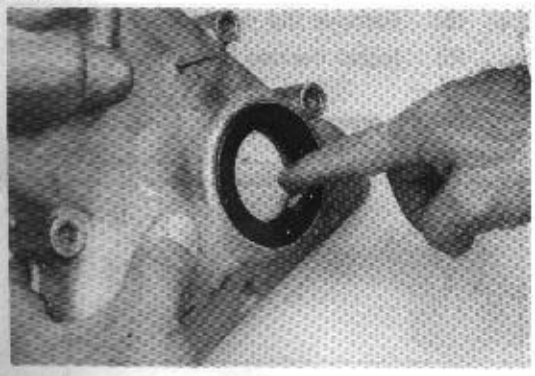
1. Remove oil seal with a screwdriver.

Fig. 4-88



2. Install new oil seal.
   Use SST [09223-50010] as shown.

Fig. 4-89



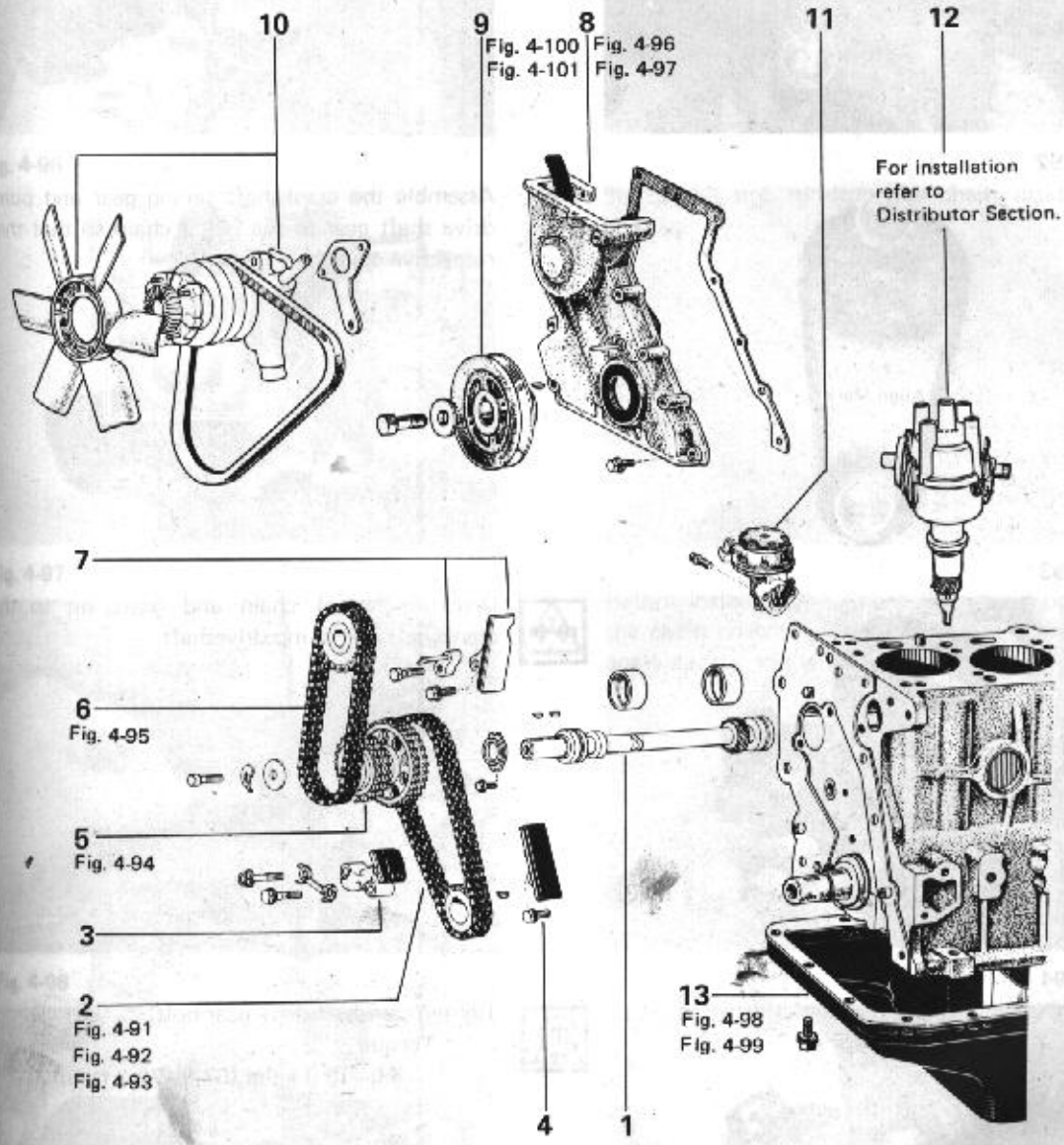
3. After driving in the seal, be sure to coat the seal lip lightly with MP grease.

ASSEMBLY

Assemble in numerical order.

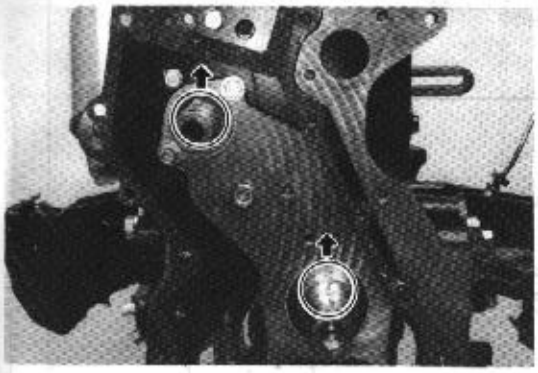
Fig. 4-90

- **Thoroughly clean the parts to be assembled.**
- **Apply clean engine oil on the sliding and rotating surfaces of the parts before assembly.**



1	Pump Drive Shaft	5	Camshaft Drive Gear	9	Crankshaft Pulley
2	No. 2 Timing Chain and Gear	6	No. 2 Timing Chain	10	Fan and Water Pump
3	No. 1 Chain Tensioner	7	No. 2 Chain Damper and Oil Jet	11	Fuel Pump
4	No. 1 Chain Damper	8	Timing Gear Cover	12	Distributor
				13	Oil Pan

Fig. 4-91

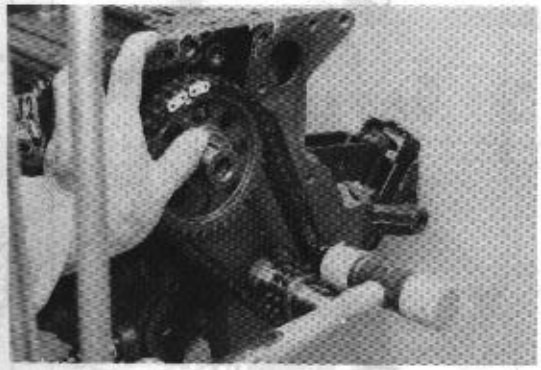


Set the crankshaft keyway and the pump drive shaft keyway vertically upward.

Fig. 4-92

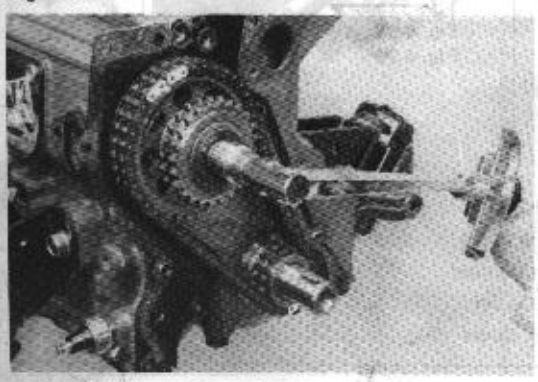
Assemble the crankshaft timing gear and pump drive shaft gear to the No. 2 chain so that their respective marks are aligned.

Fig. 4-93



Drive in No. 1 chain and gears on to the crankshaft and pump driveshaft.

Fig. 4-94

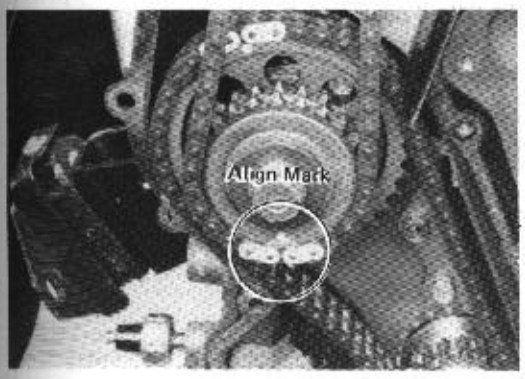


Tighten camshaft drive gear bolt.

Torque

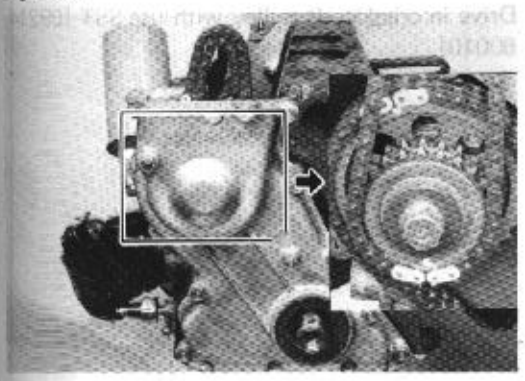
8.0–10.0 kg-m (57.9–72.3 ft-lb)

Fig. 4-95



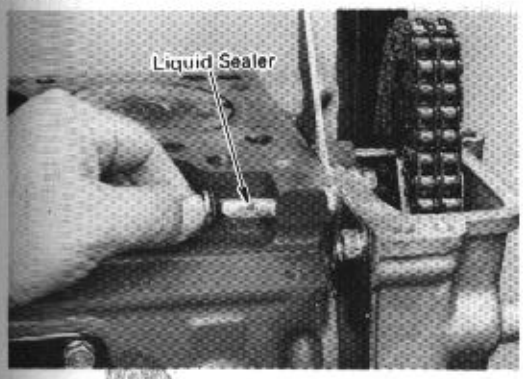
Align the No. 2 chain and gear matchmarks and install.

Fig. 4-96



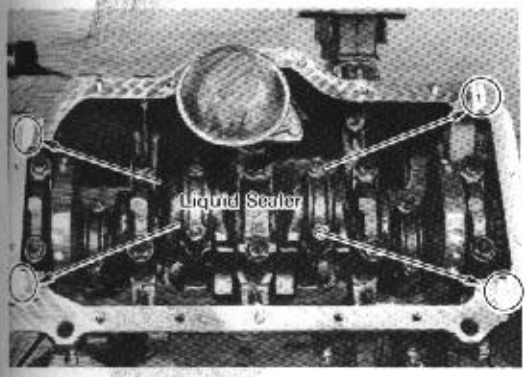
Be careful not to drop the chain inside the housing.

Fig. 4-97



Before installing the upper right hand bolt for the chain cover mount, insert a seal washer and apply a sealer to the threads.

Fig. 4-98



Apply sealer to the areas indicated in the figure.

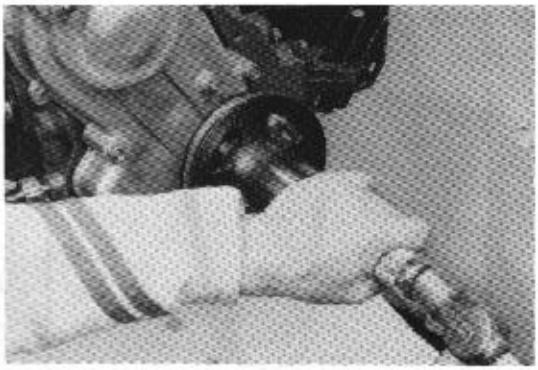
Fig. 4-99

Install oil pan.

Torque

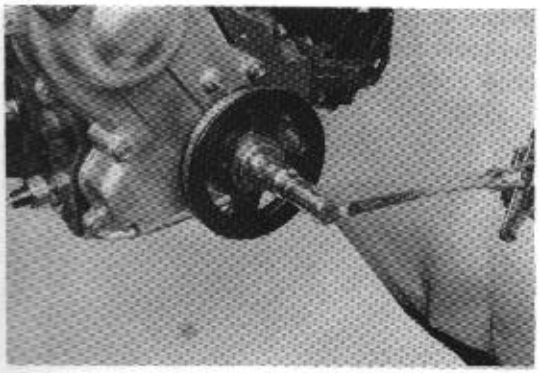
0.4–0.8 kg-m (2.9–5.8 ft-lb)

Fig. 4-100



Drive in crankshaft pulley with use SST [09214-60010].

Fig. 4-101



Tighten claw nut.

Torque

12.0 – 15.0 kg-m

(86.8 – 108.4 ft-lb)

CYLINDER BLOCK

DISASSEMBLY

Disassemble in numerical order

Fig. 4-110

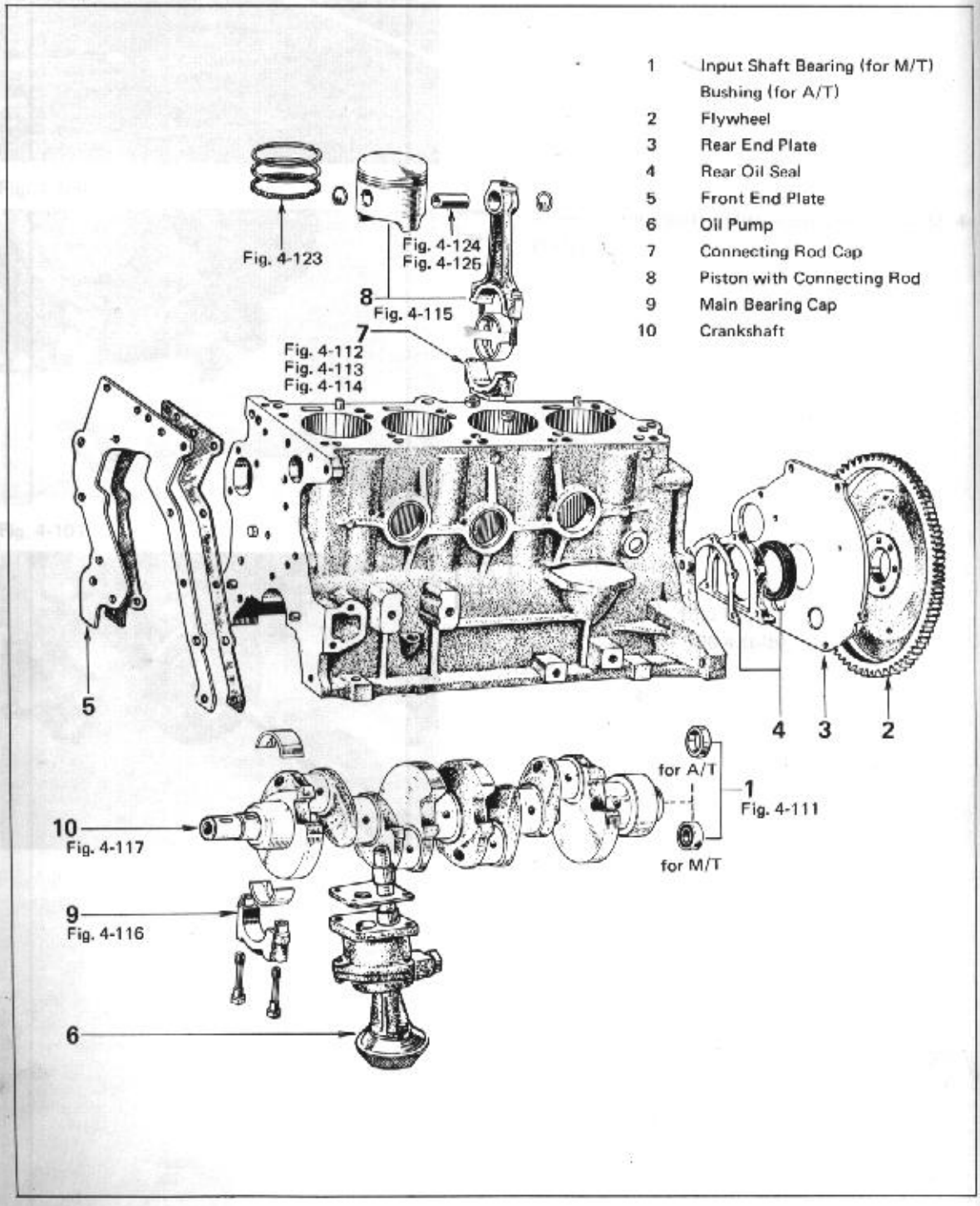
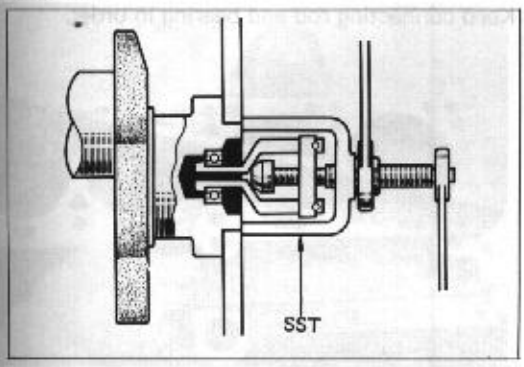
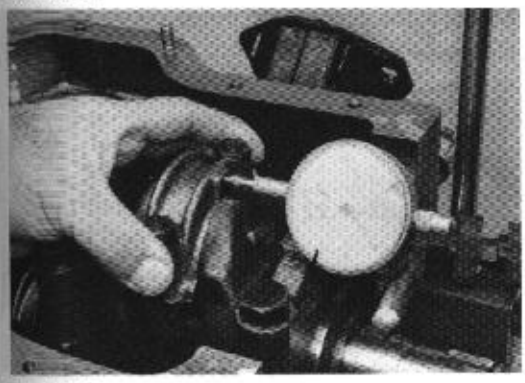


Fig. 4-111



Using SST [09303-35011], remove input shaft bearing.

Fig. 4-112



Measure connecting rod thrust clearance. If it exceeds limit, replace connecting rod.

Thrust clearance limit

0.4 mm (0.016 in)

Standard **0.21 – 0.34 mm (0.0083 – 0.0133 in)**

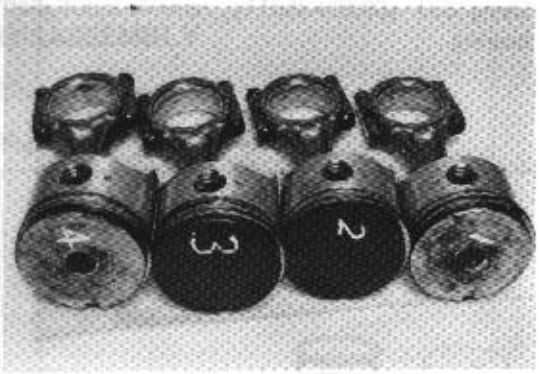
Fig. 4-113

Mark connecting rod and cap for correct reassembly.

Fig. 4-114

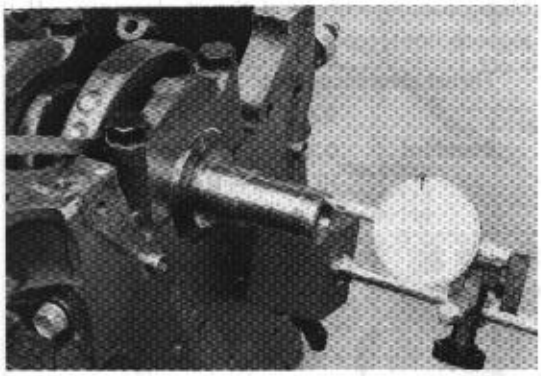
Cover the rod bolts with short pieces of hose to protect the crankshaft from damage.

Fig. 4-115



Keep connecting rod and bearing in order.

Fig. 4-116

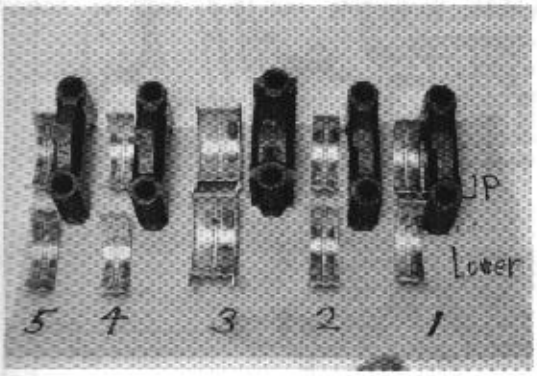


Measure the crankshaft thrust clearance. If the clearance exceeds the limit, replace the bearing as a set.

Thrust clearance limit
0.3 mm (0.012 in)

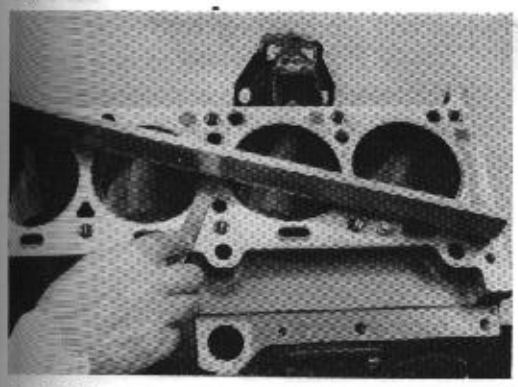
Standard
0.02–0.22 mm (0.0008–0.0087 in)

Fig. 4-117



Keep crankshaft bearing and cap in order.

Fig. 4-118



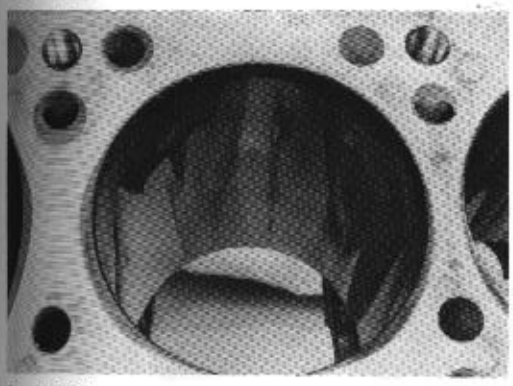
INSPECTION & REPAIR

Cylinder Block

1. Check the block gasket surface for warpage. If warpage exceeds the specified limit, either machine the block or replace.

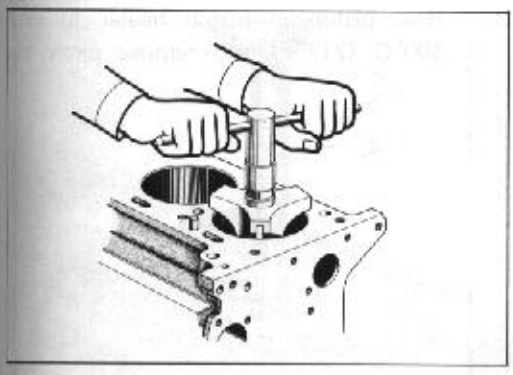
Warpage limit	**0.05 mm (0.0019 in)**

Fig. 4-119



2. Visually inspect cylinders for vertical scratches. If deep scratches are present, cylinder must be rebored.

Fig. 4-120

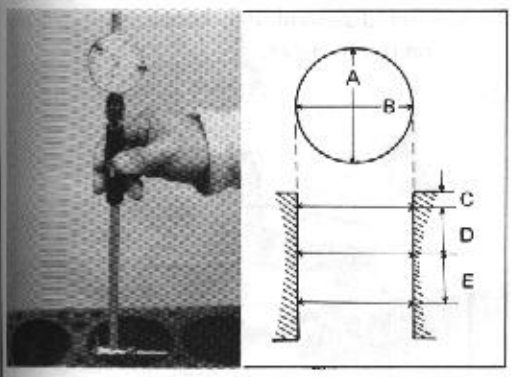


3. Machine piston ring ridge from top of cylinder.

— Note —

If this step is not performed prior to removing pistons, piston ring lands will be damaged.

Fig. 4-121



4. Measure cylinder bore at position as shown.

A : Thrust Direction
B : Axial Direction
C : 15 mm (0.59 in)
D : 60 mm (2.36 in)
E : 60 mm (2.36 in)

If bore exceeds specification, it must be rebored.

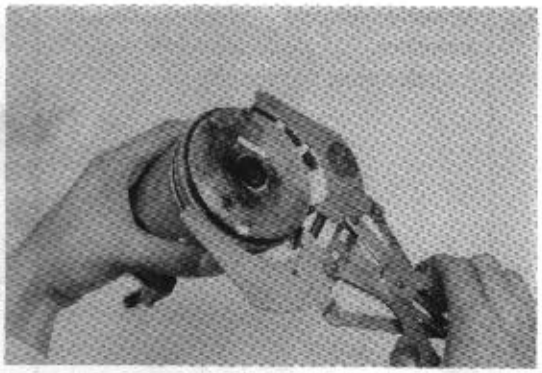
Wear limit	**0.2 mm (0.008 in)**
Standard	**88.50–88.55 mm (3.4842–3.4862 in)**

Fig. 4-122

Piston and Connecting Rod

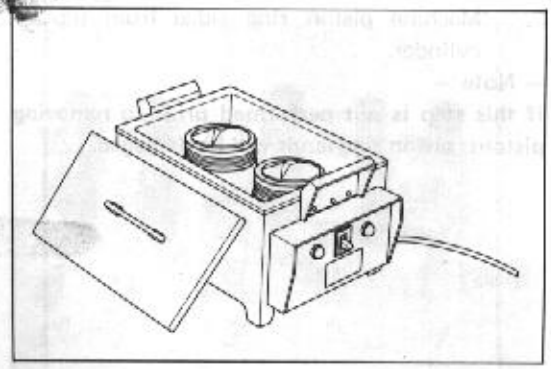
1. Check pin fit by trying to rock piston at right angle to pin. If any movement is felt, piston with pin must be replaced.

Fig. 4-123



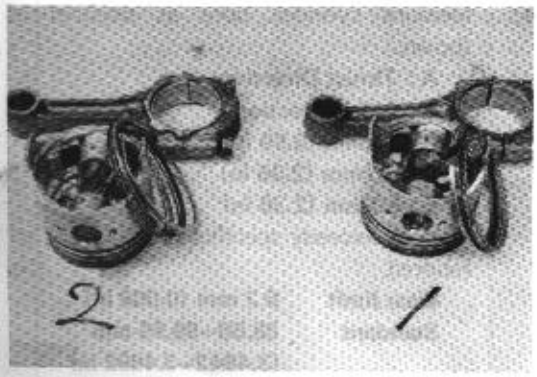
2. Remove piston ring, using the piston ring expander.

Fig. 4-124



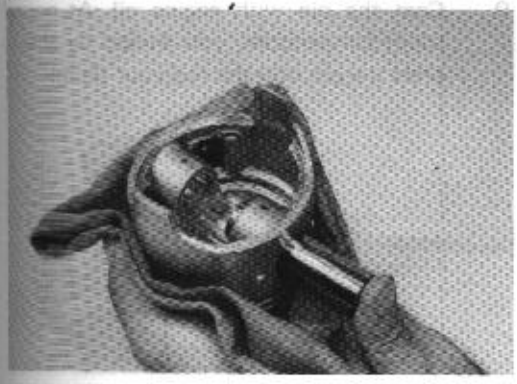
3. Heat piston in piston heater to about 100°C (212°F) and remove piston pin.

Fig. 4-125



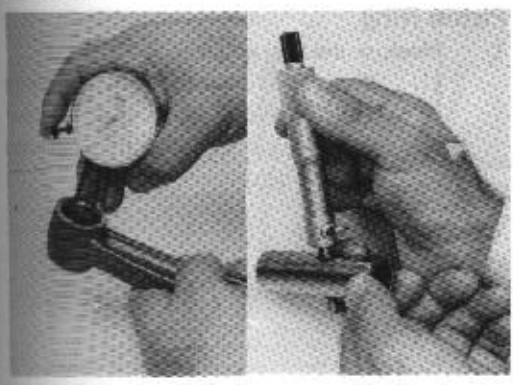
4. After disassembling, keep piston, pin, ring and rod in order.

Fig. 4-126



5. Heat piston to 100°C (212°F) coat pin with engine oil.
The pin should be able to be pushed into piston hole with thumb pressure.

Fig. 4-127

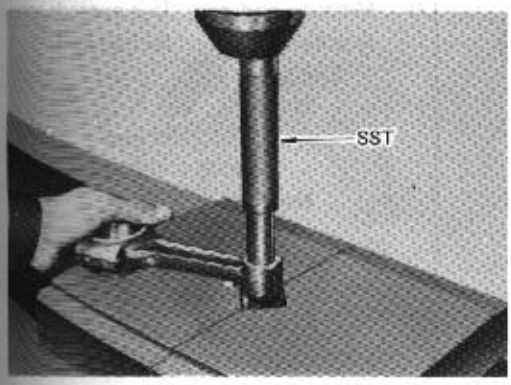


6. Measure oil clearance between bush and pin.

Oil clearance:

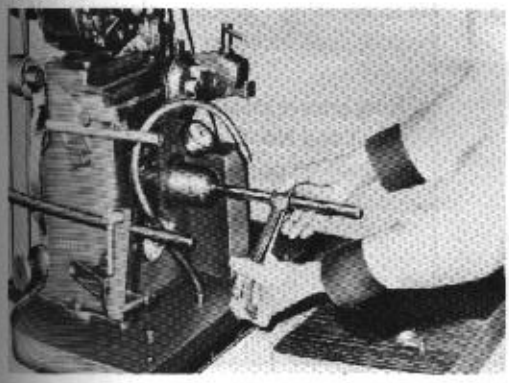
Limit	**0.02 mm (0.0008 in)**
Standard	**0.005–0.014 mm (0.00020–0.00055 in)**

Fig. 4-128



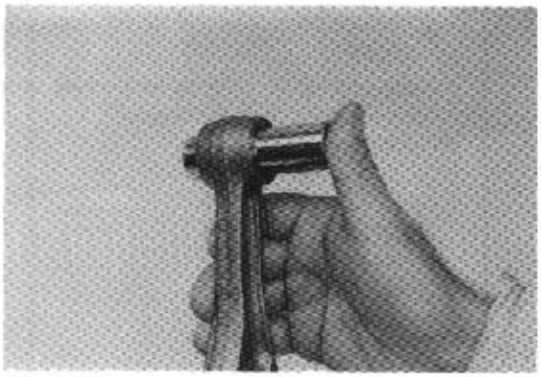
7. Replace bushing with SST [09222-30010].

Fig. 4-129



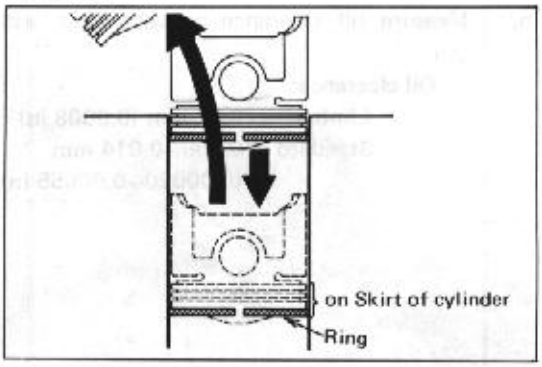
8. After pressing in the bushing, finish the bushing bore with a pin hole grinder.

Fig. 4-130



9. Coat the pin with engine oil. At normal room temperature, you should be able to press the pin into the rod your thumb.

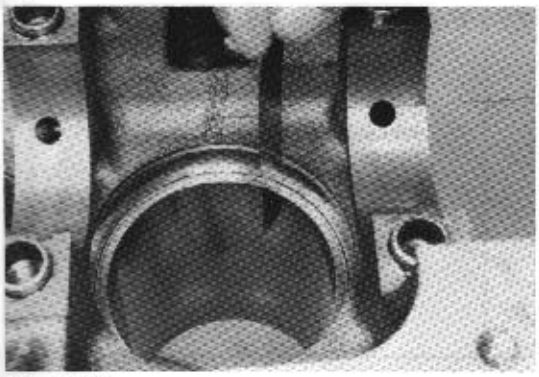
Fig. 4-131



Piston Ring

1. Measure the ring end gap.
   (1) Insert the ring into the cylinder using a piston. With the ring at the lower part of the cylinder bore, measure the end gap.

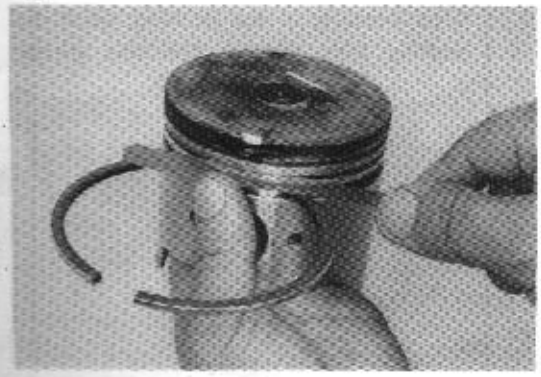
Fig. 4-132



(2) Measure end gap. If it exceeds specification, ring must be replaced.

End gap:
No.1
0.19 – 0.34 mm
(0.0075 – 0.0133 in.)
No.2
0.15 – 0.48 mm
(0.0059 – 0.0189 in.)
Oil ring (Side Lail)
0.20 – 0.88 mm
(0.0079 – 0.0346 in.)

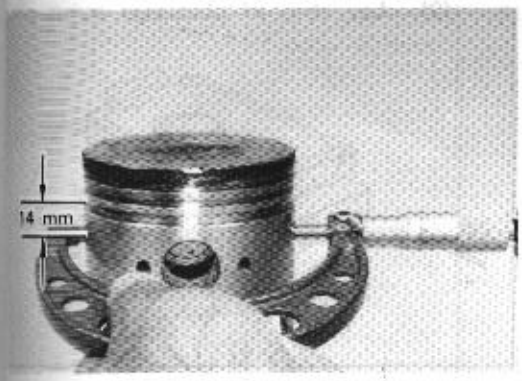
Fig. 4-133



2. Measure ring groove clearance. If it exceeds specification, replace ring and/or piston.

Ring groove clearance
No. 1 and No. 2
0.02–0.06 mm (0.0008–0.0024 in)

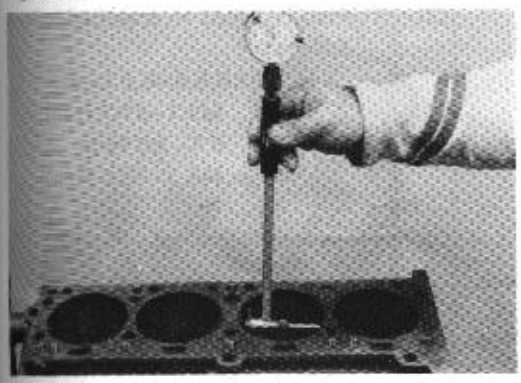
Fig. 4-134



Piston Clearance

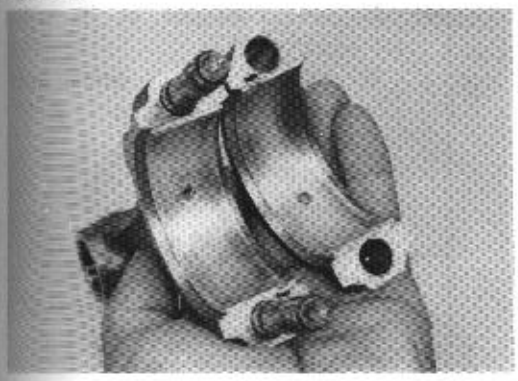
1. Measure piston diameter at right angle to piston pin center line.
   Measurement must be made at normal temperature (20°C or 68°F).
   Piston diameter (STD)
   88.44–88.49 mm
   (3.4819–3.4839 in)

Fig. 4-135



2. Measure cylinder bore and subtract piston measurement. If clearance exceeds specification, replace piston.
   Piston clearance
   0.05–0.07 mm (0.0020–0.0028 in)

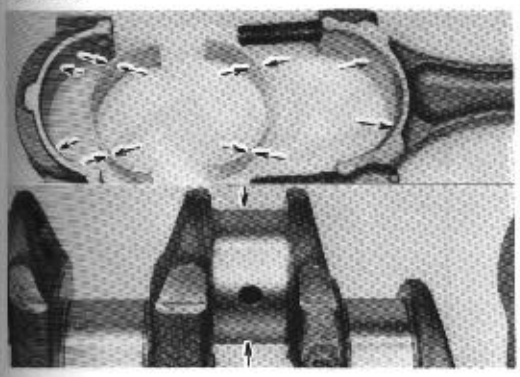
Fig. 4-136



Crankpin and Bearing

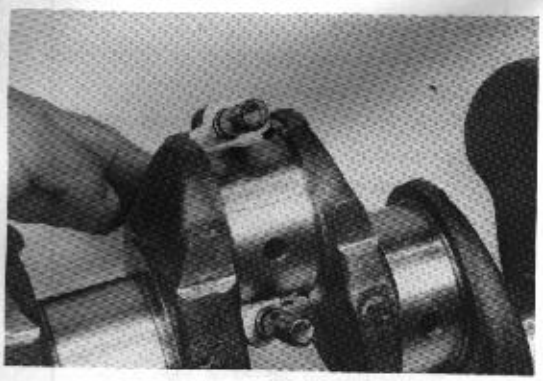
1. Inspect bearings for flaking or scoring. If bearings are damaged, replace.

Fig. 4-137



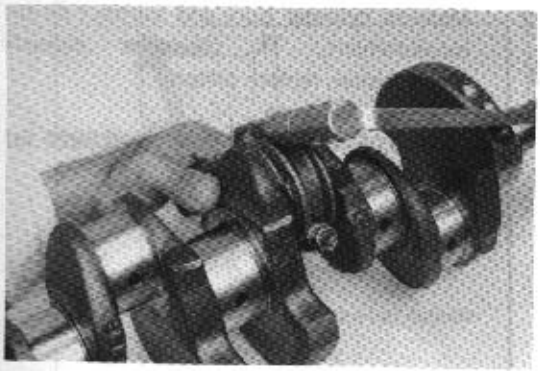
2. Measure crankpin oil clearance.
   (1) Clean crankshaft pin, rod, cap and bearing.

Fig. 4-138



(2) Lay strip of plastigage across pin.

Fig. 4-139



(3) Tighten cap nuts to specified torque.

Torque

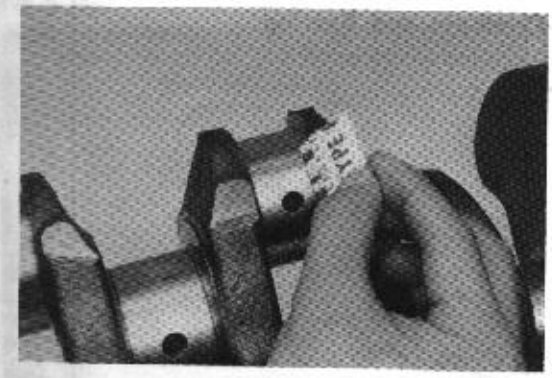
16R, 18R 5.4–6.6 kg-m (39.1–47.7 ft-lb)

18R-G 6.4–7.0 kg-m (46.3–50.6 ft-lb)

— Note —

Do not turn connecting rod.

Fig. 4-140



(4) Measure plastigage at its widest point.

If clearance is not within specification, replace bearings.

Clearance limit

0.08 mm (0.0032 in)

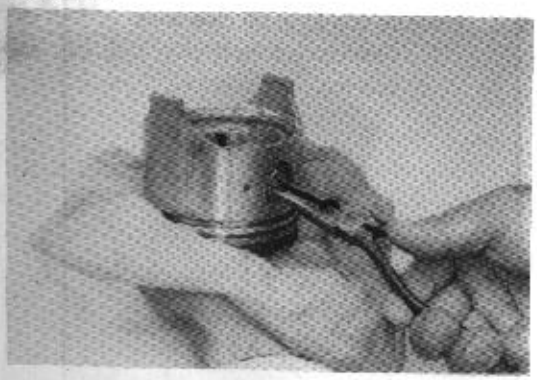
Standard

0.24 – 0.48 mm (0.0094 – 0.0189 in)

U/S Bearing sizes

U/S 0.05, 0.25, 0.50

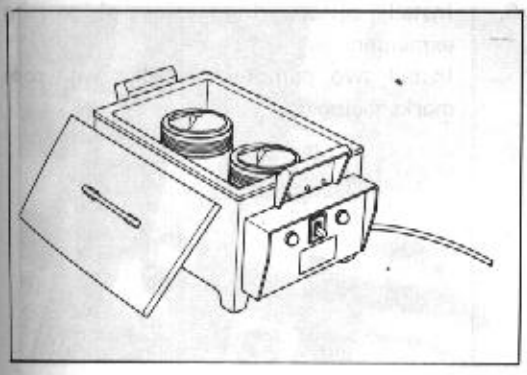
Fig. 4-141



Assemble piston and rod as follows.

1. Install snap ring on one side.

Fig. 4-142

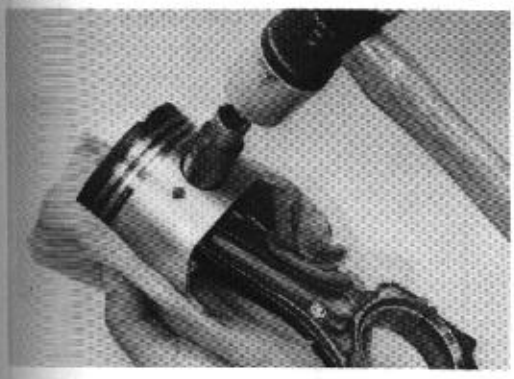


2. Heat piston to about 100° (212°F).

Fig. 4-143

3. Aligning piston notch and rod mark as shown.

Fig. 4-144

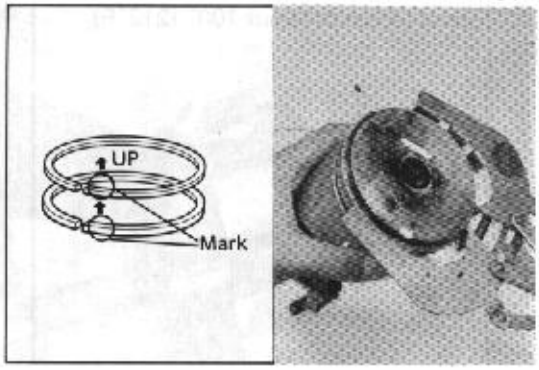


4. Install piston pin.

Fig. 4-145

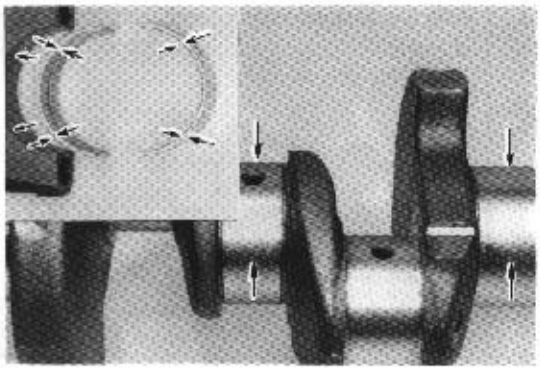
5. Install snap ring on other side.
Make sure snap ring is completely in place.

Fig. 4-146



6. Install piston ring, using piston ring expander.
   Install two compression rings with code marks facing up.

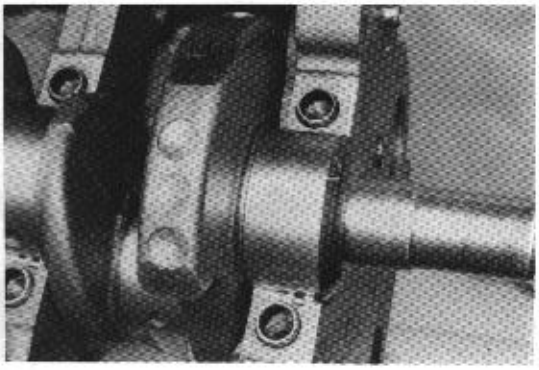
Fig. 4-147



Crankshaft and Bearing

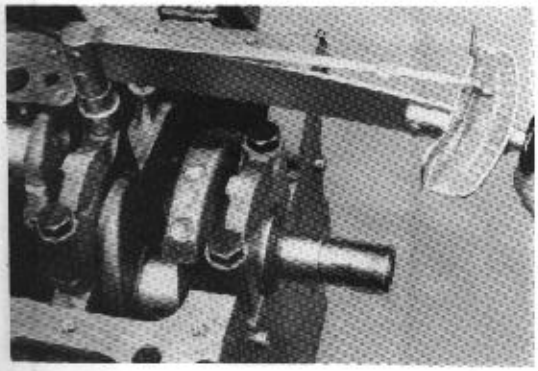
1. Measure crankshaft oil clearance.
   (1) Clean journal, cap and bearing

Fig. 4-148



(2) Lay strip of plastigage across journal.

Fig. 4-149



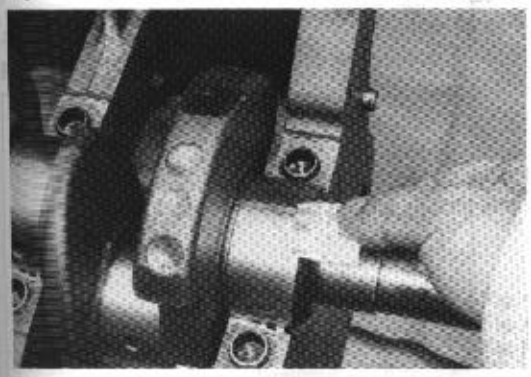
(3) Tighten cap nuts to specified torque.

Torque	**16R, 18R**	**9.5–11.5 kg-m (68.7–83.2 ft-lb)**
	18R-G	**10.0–11.0 kg-m (72.3–79.6 ft-lb)**

— Note —

Do not turn crankshaft.

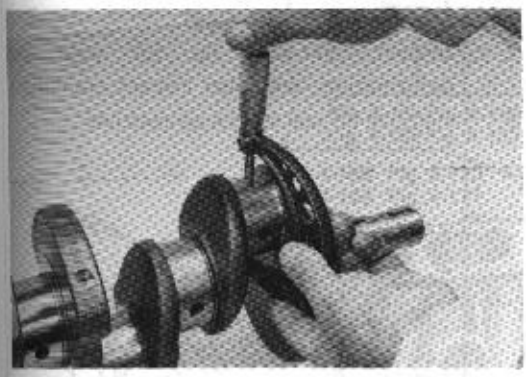
Fig. 4-150



(4) Measure plastigage at its widest point. If clearance is not within specification, replace bearing.

Clearance limit
0.08 mm (0.0032 in)
Standard
0.16 – 0.040 mm
(0.0063 – 0.0016 in)
U/S bearing sizes
U/S 0.05, 0.25, 0.50

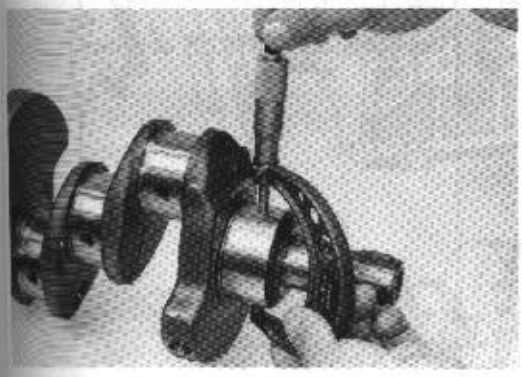
Fig. 4-151



2. Measure crankpin journal.
If wear is excessive, crankshaft must be reground or replaced.

Crank Pin Journal Size	
STD	52.976–53.000 mm (2.0857–2.0867 in)
U/S 0.25	52.70–52.71 mm (2.0748–2.0752 in)

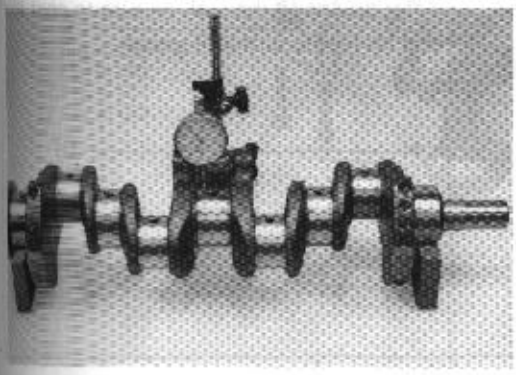
Fig. 4-152



3. Measure crankshaft main journal.
If wear is excessive, crankshaft must be reground or replace.

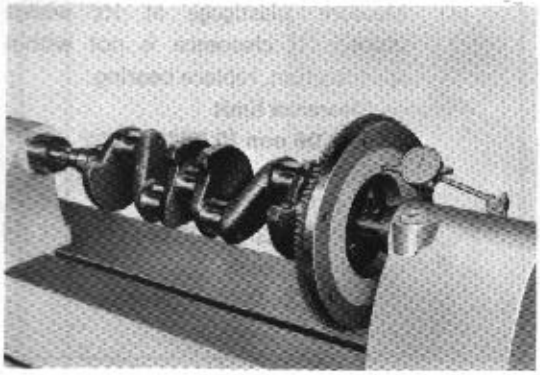
Crankshaft Main Journal Size	
STD	59.976–60.000 mm (2.3613–2.3622 in)
U/S 0.25	59.70–59.71 mm (2.3504–2.3508 in)

Fig. 4-153



4. Check crankshaft for bend and if it exceeds limit, replace.
Limit **0.03 mm (0.0012 in)**

Fig. 4-154



Flywheel

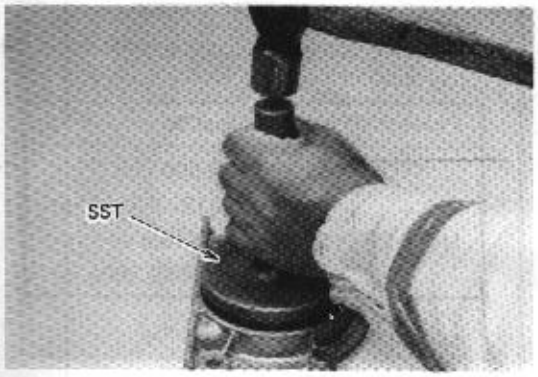
1. Inspect the surface contacting the clutch disc.
2. Measure the runout of the surface contacting the clutch disc.
   Runout limit 0.3 mm (0.012 in)
3. Inspect the ring gear.

Fig. 4-155

Crankshaft Rear Oil Seal

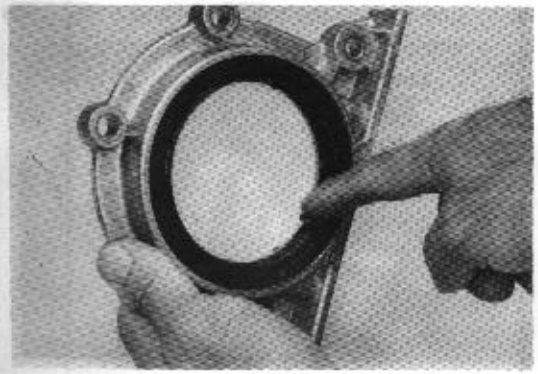
1. Inspect oil seal lip for wear and deformation, and also inspect crankshaft.
2. Remove oil seal with a screwdriver.

Fig. 4-156



3. Install new oil seal.
   Use SST [09223-41020] as shown.

Fig. 4-157



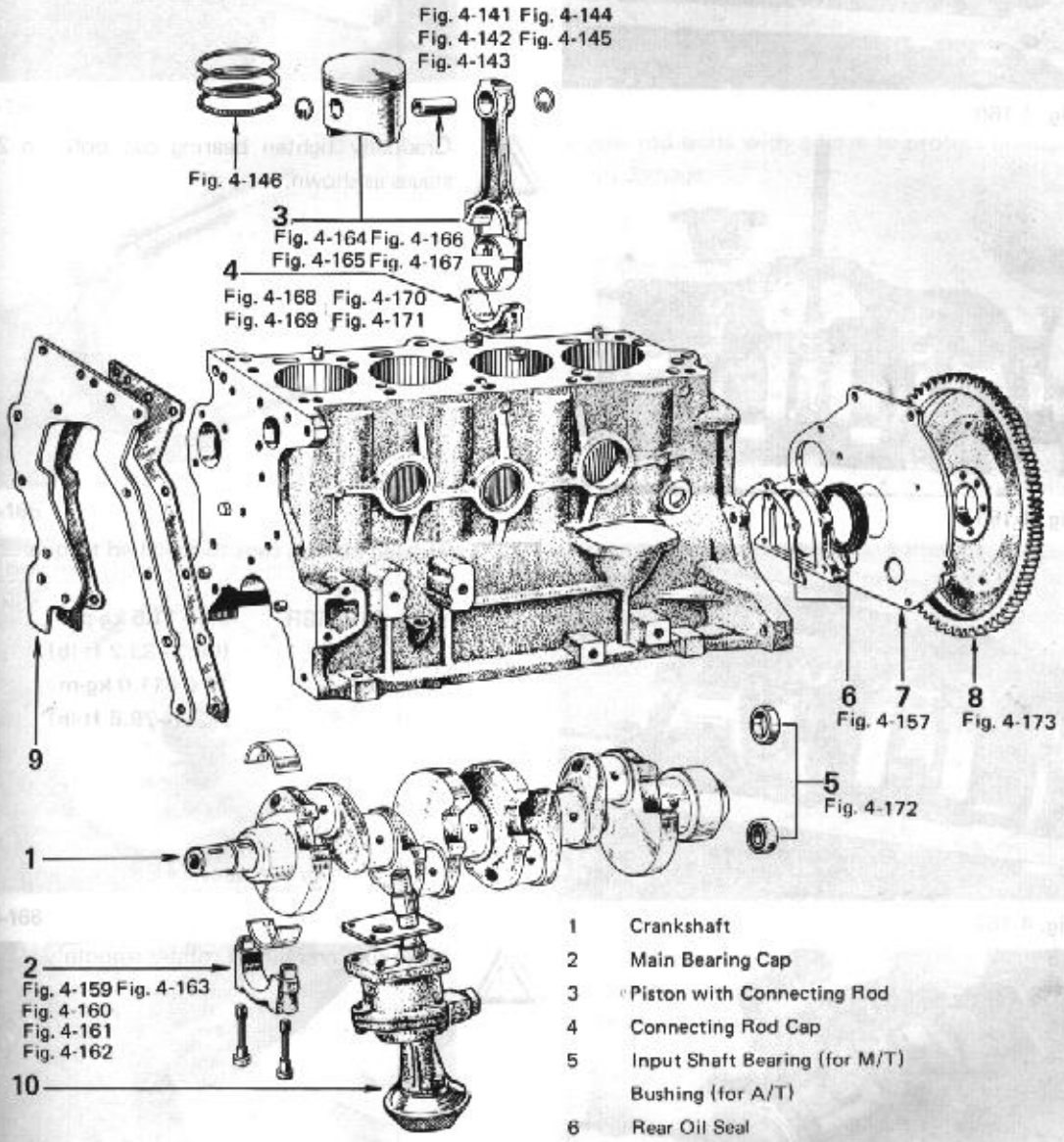
4. After driving in the seal, be sure to coat the seal lip lightly with MP grease.

ASSEMBLY

Assemble in numerical order

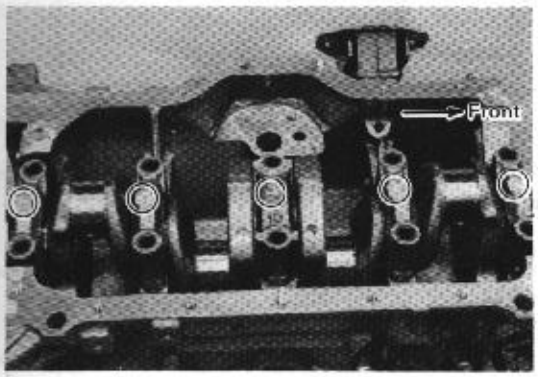
Fig. 4-158

- **Thoroughly clean the parts to be assembled.**
- **Apply clean engine oil on the sliding and rotating surfaces of the parts before assembly.**



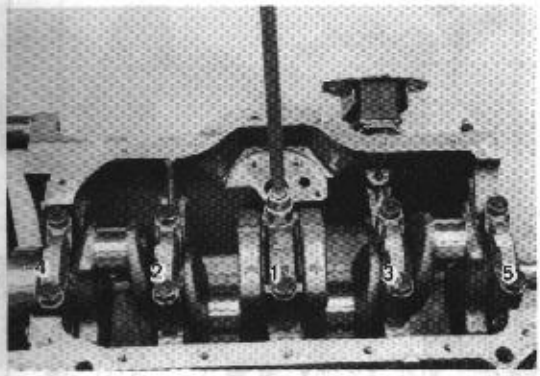
1	Crankshaft
2	Main Bearing Cap
3	Piston with Connecting Rod
4	Connecting Rod Cap
5	Input Shaft Bearing (for M/T)
	Bushing (for A/T)
6	Rear Oil Seal
7	Rear End Plate
8	Flywheel
9	Front End Plate
10	Oil Pump

Fig. 4-159



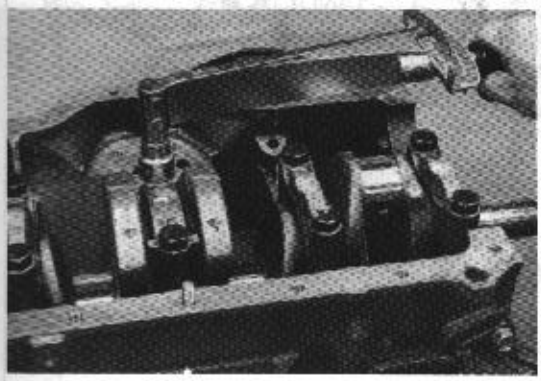
Face the arrow mark toward front.

Fig. 4-160



Gradually tighten bearing cap bolts in 2 to 3 stages as shown.

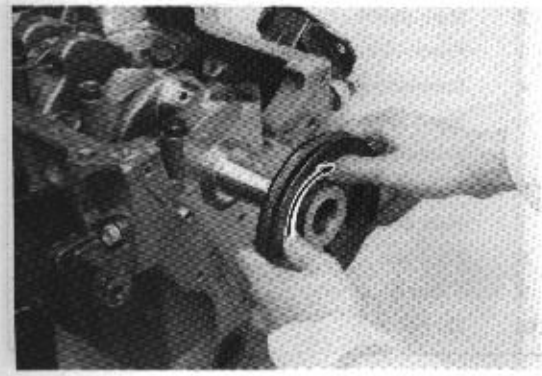
Fig. 4-161



Tighten bearing caps to specified torque.

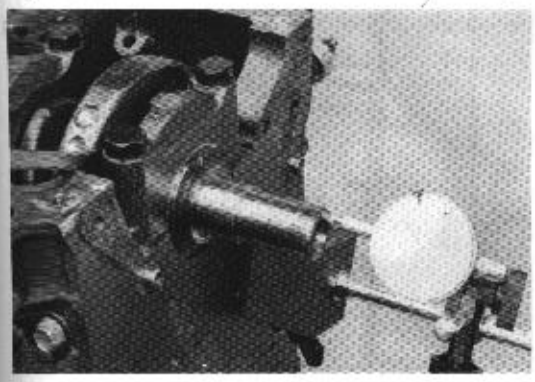
Torque	
16R, 18R	9.5–11.5 kg-m (68.7–83.2 ft-lb)
18R-G	10.0–11.0 kg-m (72.3–79.6 ft-lb)

Fig. 4-162



Make sure crankshaft rotates smoothly.

Fig. 4-163

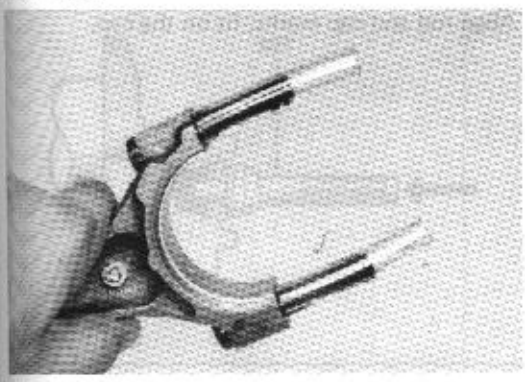


Make sure crankshaft thrust clearance.

Thrust clearance

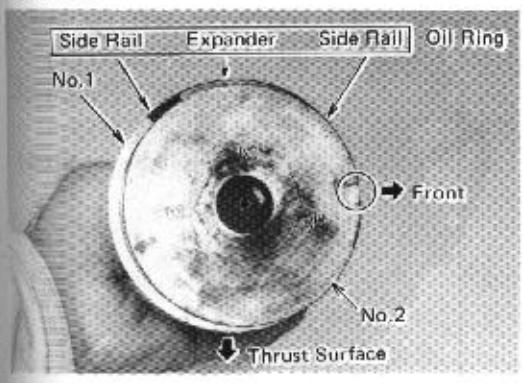
Limit	**0.3 mm (0.0118 in)**
Standard	**0.002–0.22 mm (0.0008–0.0087 in)**

Fig. 4-164



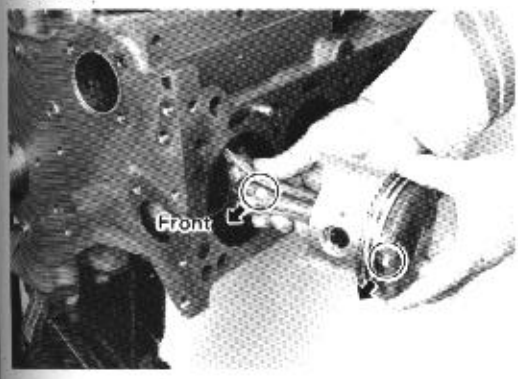
Cover rod bolts with a hose to protect crankpin from damage.

Fig. 4-165



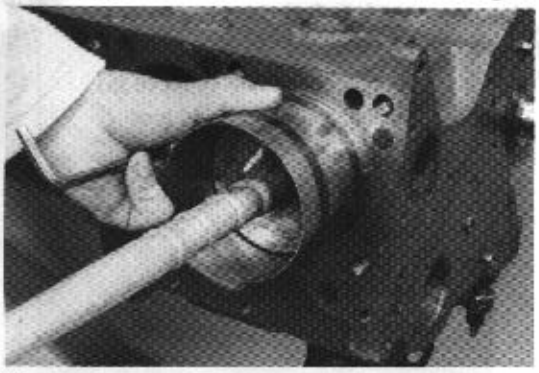
Position ring gap in direction as shown.

Fig. 4-166



Push correctly numbered piston/rod assembly with notch forward.
Mark on connecting rod should face frontward.

Fig. 4-167

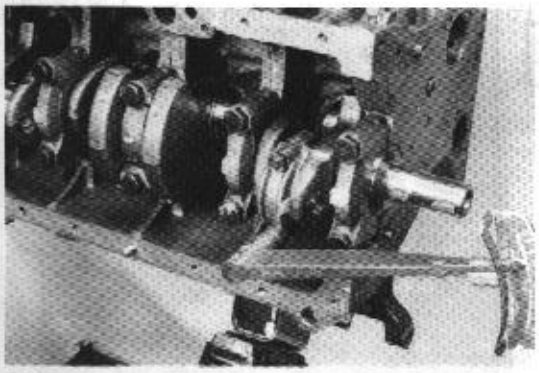


Insert piston into the cylinder while compressing the rings with a piston ring compressor.

Fig. 4-168

Align rod and cap marks, fit on the cap.

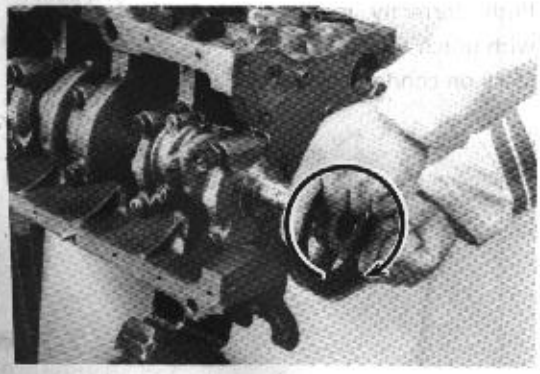
Fig. 4-169



Tighten rod cap to specified torque.

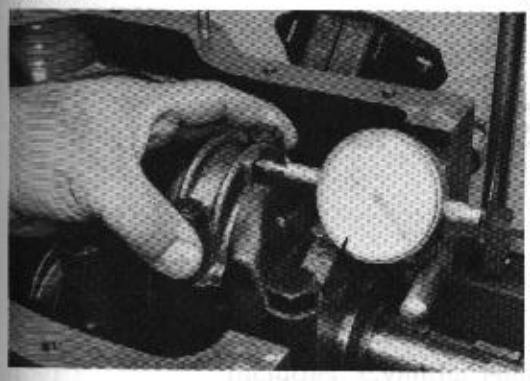
Torque	**18R**	**5.4–6.6 kg-m (39.1–47.7 ft-lb)**
	18R-G	**6.4–7.0 kg-m (46.3–50.6 ft-lb)**

Fig. 4-170



Make sure the crankshaft rotates smoothly.

Fig. 4-171



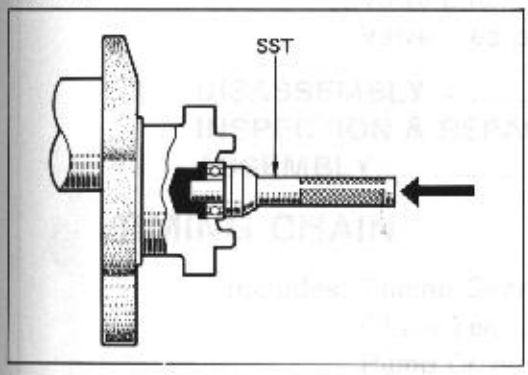
Check connecting rod thrust clearance.

Thrust clearance limit

0.3 mm (0.012 in)

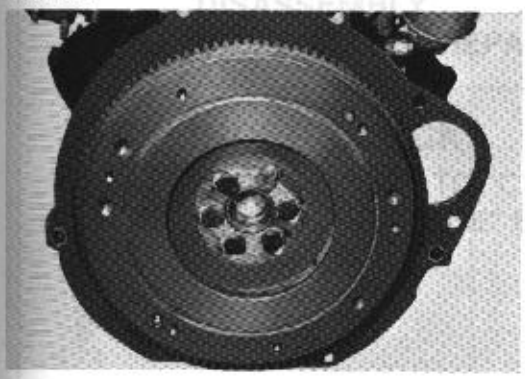
Standard 0.16–0.26 mm (0.0063–0.0102 in)

Fig. 4-172



Drive in input shaft bearing.
Use SST [09304-30012].

Fig. 4-173



Tighten flywheel to specified torque.

Torque	**18R**	**8.0–9.0 kg-m (57.7–65.1 ft-lb)**
	18R-G	**8.2–8.8 kg-m (59.3–63.7 ft-lb)**

18R-G ENGINE SERVICE

CUTAWAY VIEW

Fig. 5-1

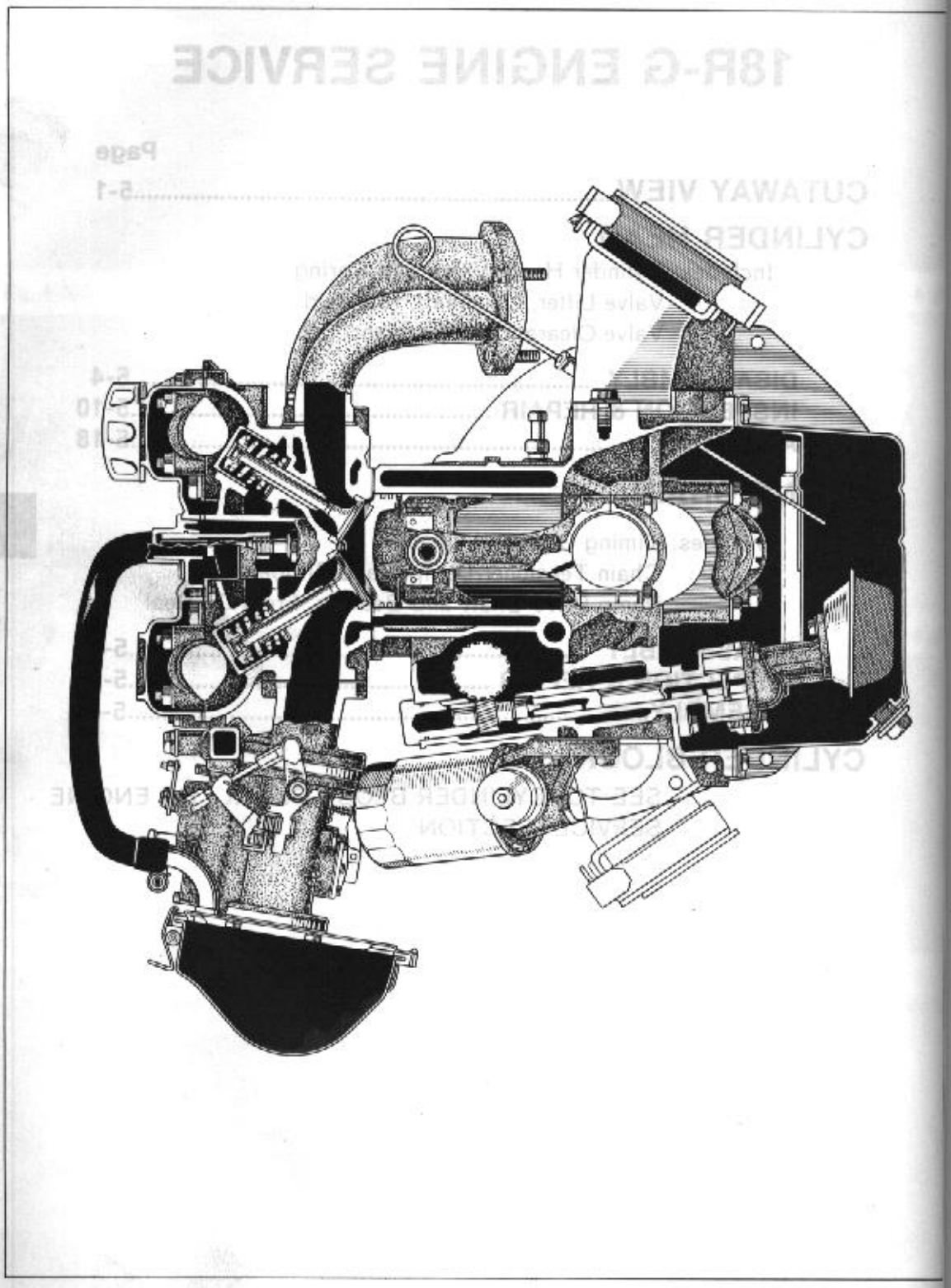
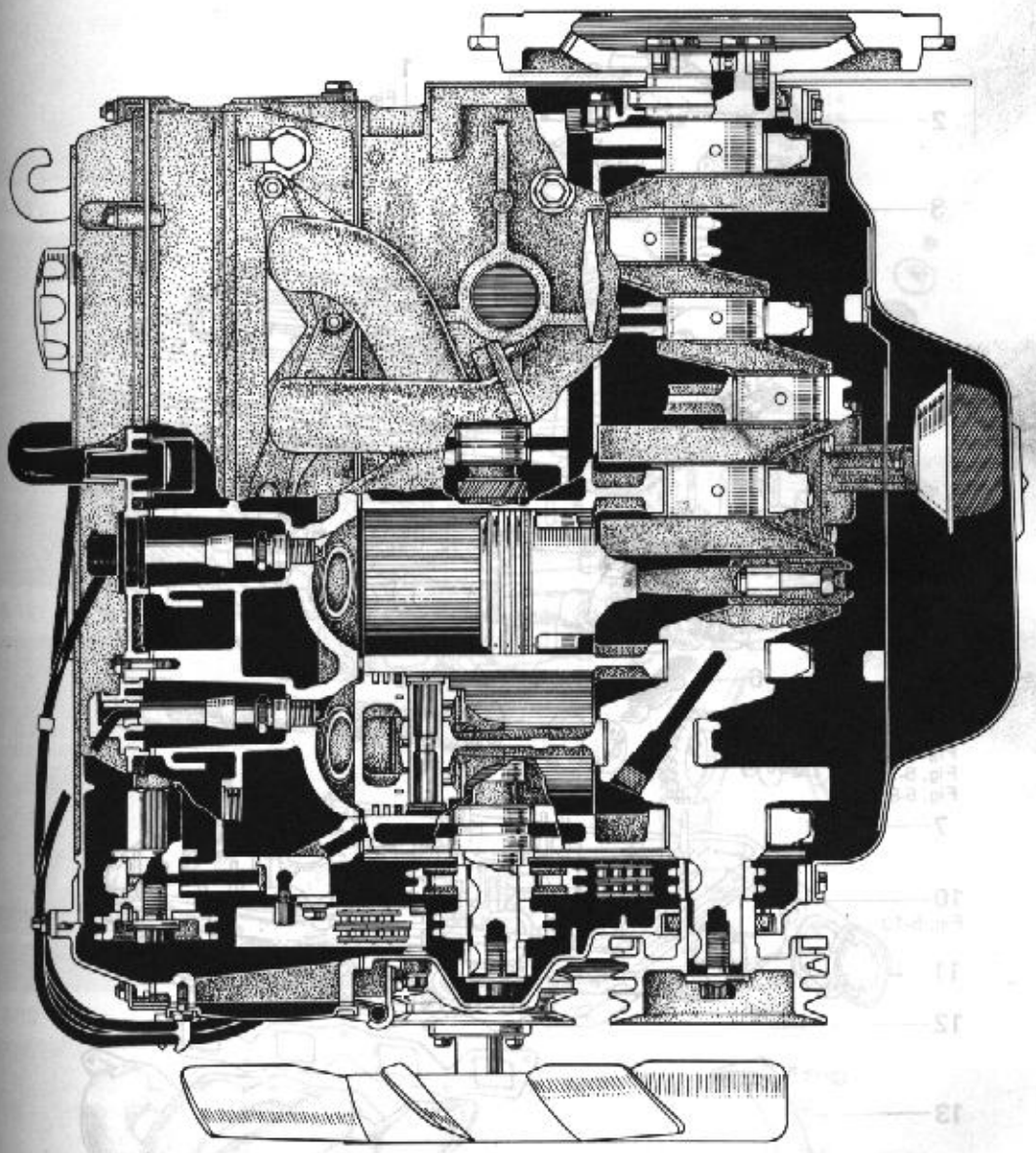


Fig. 5-2



CYLINDER HEAD

DISASSEMBLY

Disassemble in numerical order.

Fig. 5-3

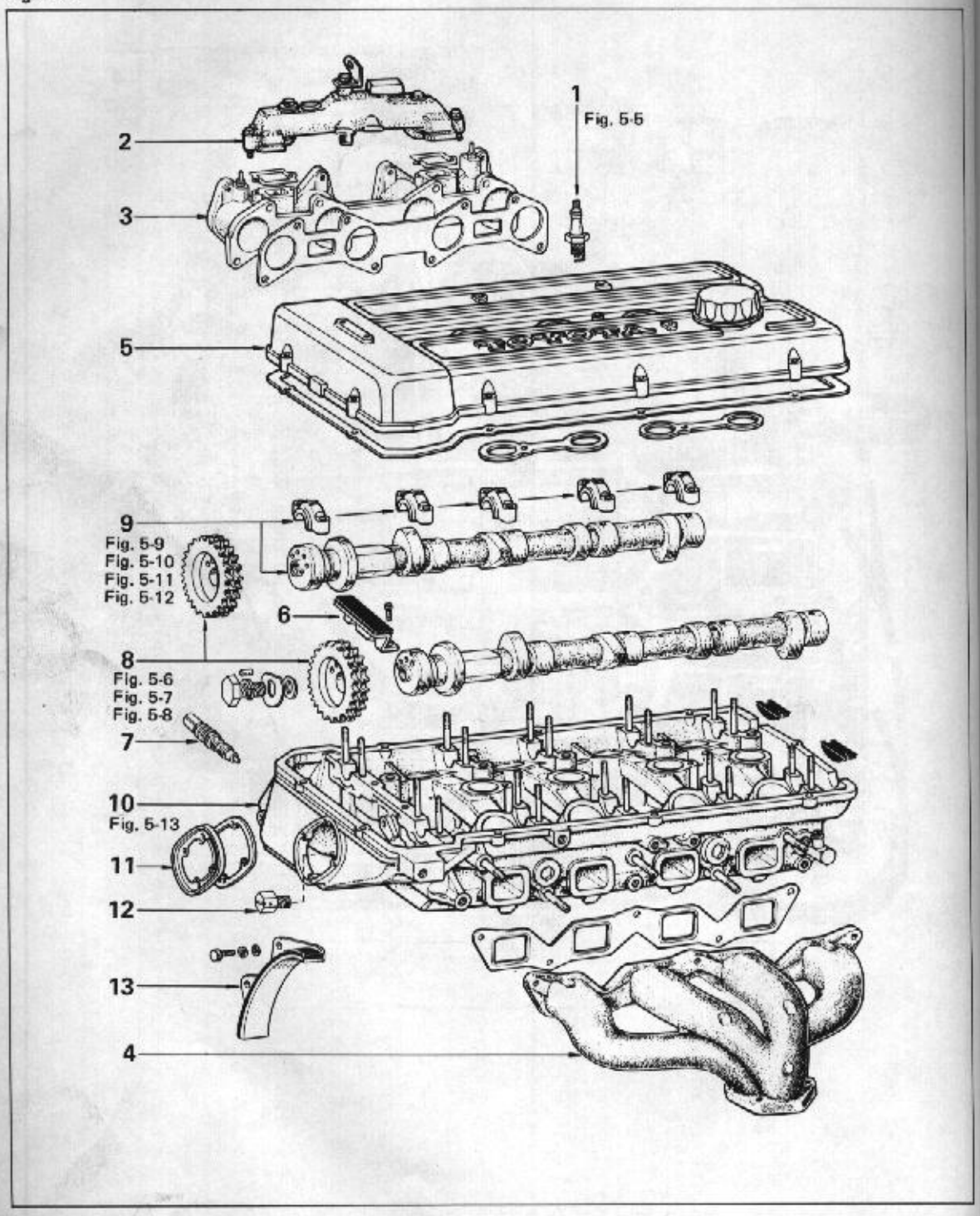
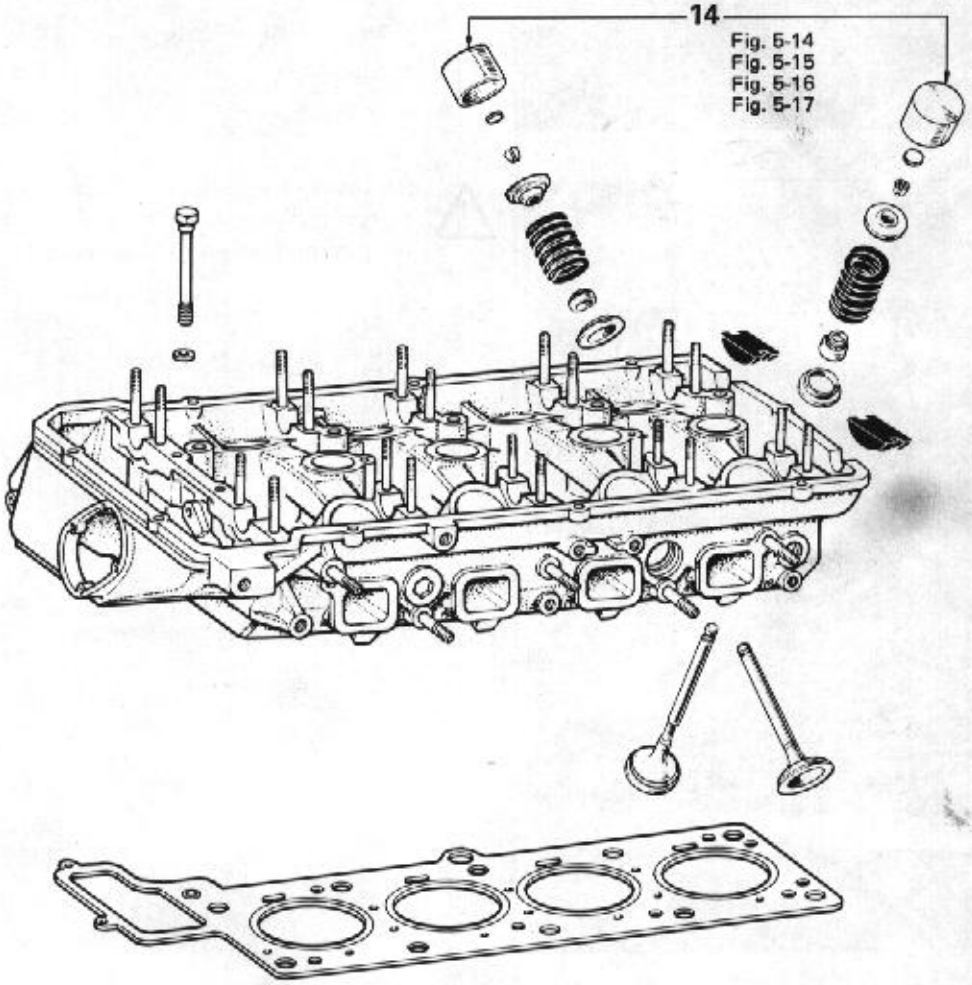
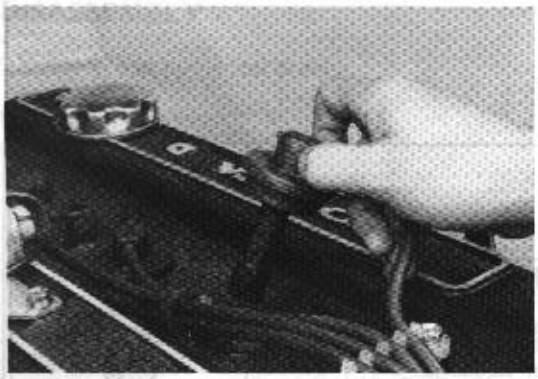


Fig. 5-4



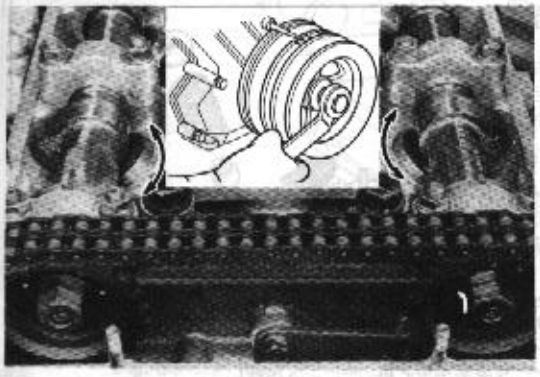
1	Spark Plug	8	Camshaft Timing Gear
2	Balance Tube	9	Camshaft and Bearing Cap
3	Carburetor and Intake Manifold	10	Cylinder Head
4	Exhaust Manifold	11	Front Cover
5	Cylinder Head Cover	12	Oil Nozzle
6	No.2 Vibration Damper	13	No.3 Vibration Damper
7	No.2 Chain Tensioner	14	Valve and Spring

Fig. 5-5



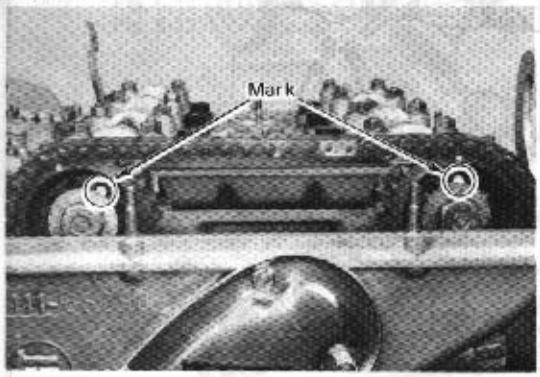
Remove the plug cords by carefully pulling on the rubber boots.

Fig. 5-6



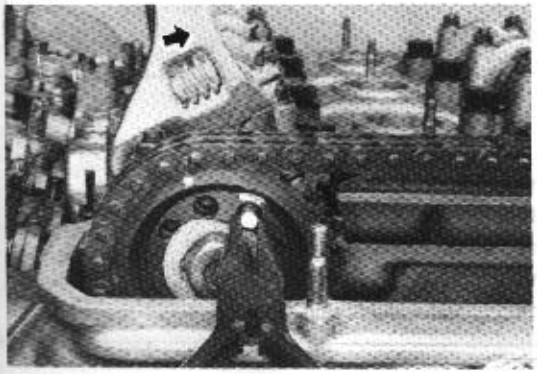
Set the No.1 cylinder to TDC/compression.
In this position, the timing slits in the flange of the camshaft are positioned upward.

Fig. 5-7



Place aligning marks between the gears and the pin holes for correct reassembly.

Fig. 5-8



Pull out the pin.

— Note —

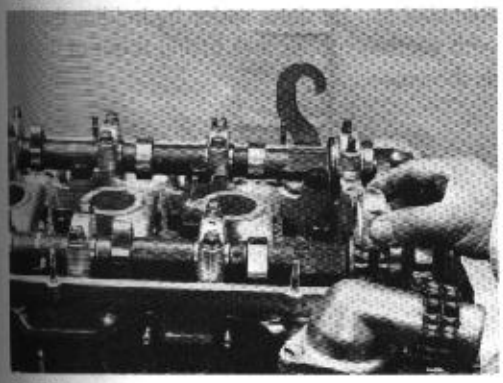
This will be easier if the camshaft is turned slightly forward to provide some play.

Fig. 5-9

Measure camshaft thrust clearance.

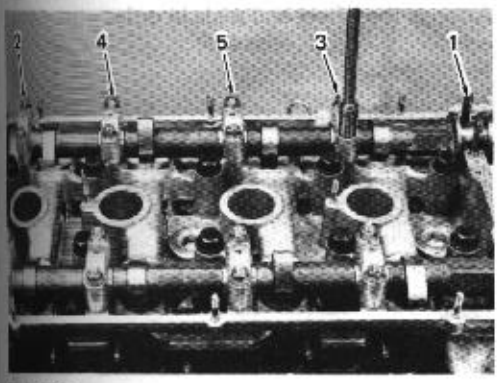
Thrust clearance
limit 0.4 mm (0.0158 in)

Fig. 5-10



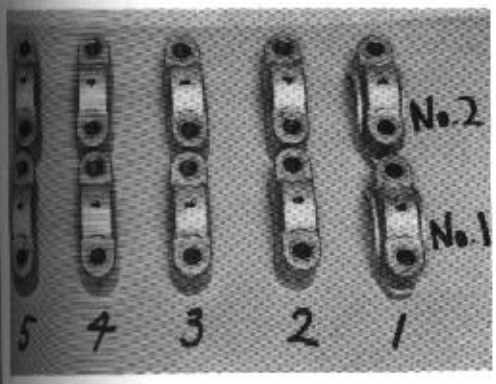
Remove No.1 bearing cap.

Fig. 5-11



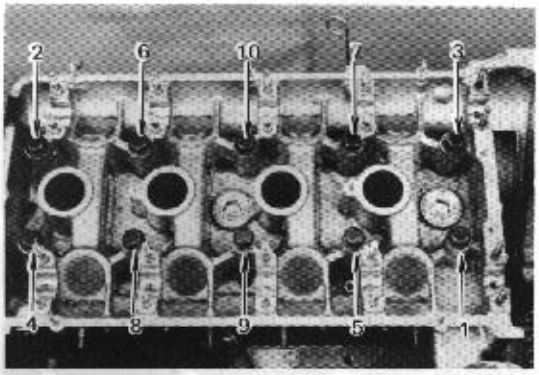
Loosen each the other cap nuts a little at a time and in the sequence shown in the figure.

Fig. 5-12



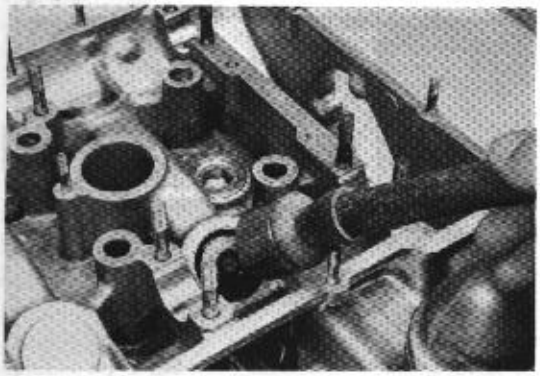
Arrange the bearing caps in order.

Fig. 5-13



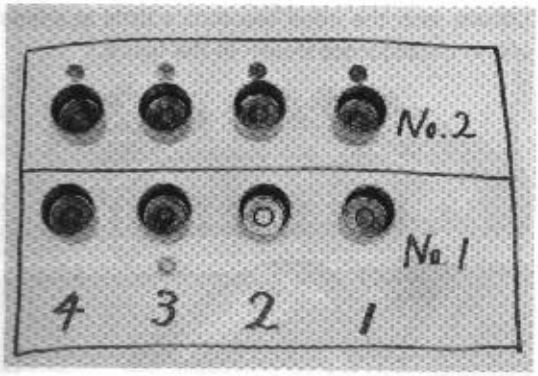
Loosen each cylinder head bolt a little at a time and in the sequence shown in the figure.

Fig. 5-14



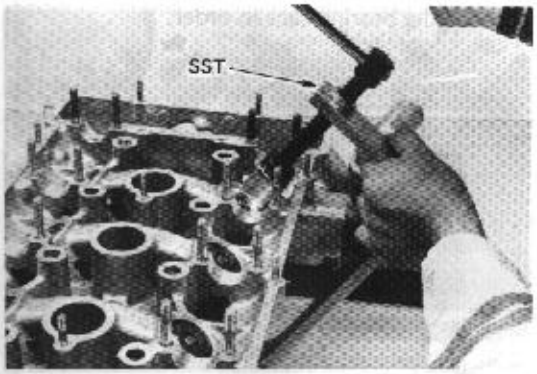
Removal can be done easier by holding the lifter with suction rubber and lifting it out of the hole as shown.

Fig. 5-15



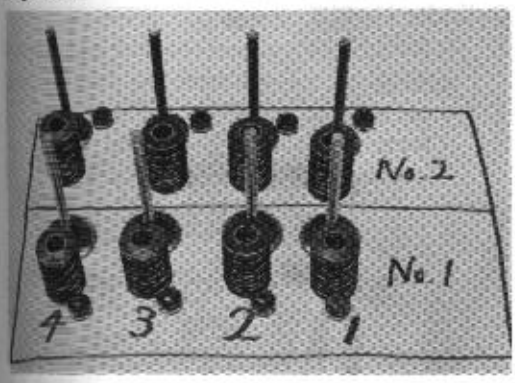
Arrange the lifters and pads in order.

Fig. 5-16



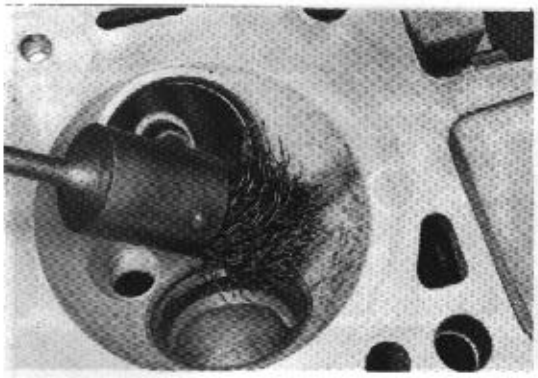
Remove the valve springs.
Use SST [09202-43013].

Fig. 5-17



Arrange the valves, springs and oil seal in order.

Fig. 5-20

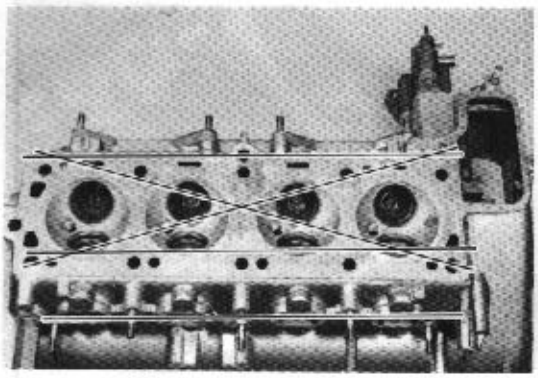


INSPECTION & REPAIR

Cylinder Head

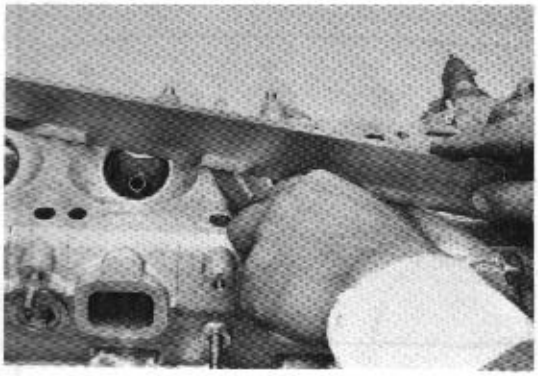
1. Clean the combustion chamber and remove any gasket material from the manifold and head surface.
   Check the cylinder heads for cracks or excessively burnt valve surfaces.

Fig. 5-21



2. Check the cylinder head surface flatness with a precision straight edge.

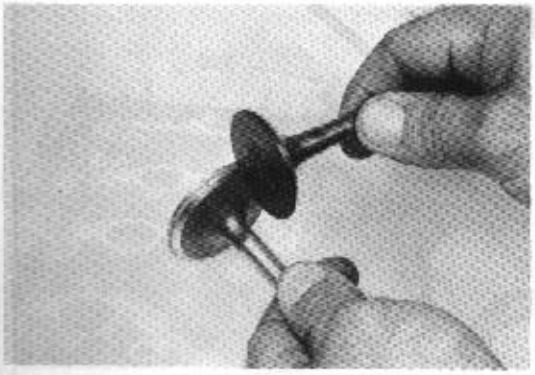
Fig. 5-22



3. If warpage exceeds the limit, correct it by machining, or replace the head.

   Head surface warpage limit
   0.05 mm (0.002 in)
   Maximum reface limit
   0.2 mm (0.008 in)

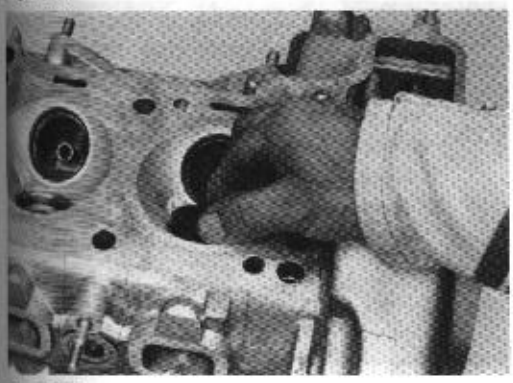
Fig. 5-23



Valve, Guide and Seat

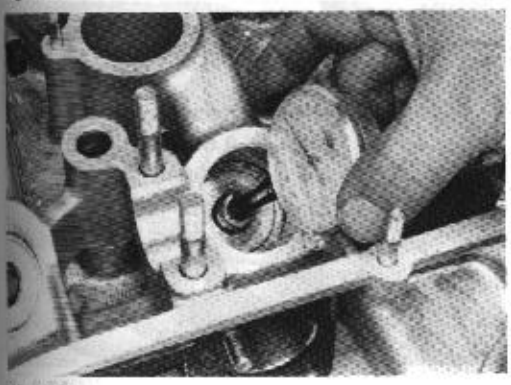
1. Clean valves.

Fig. 5-24



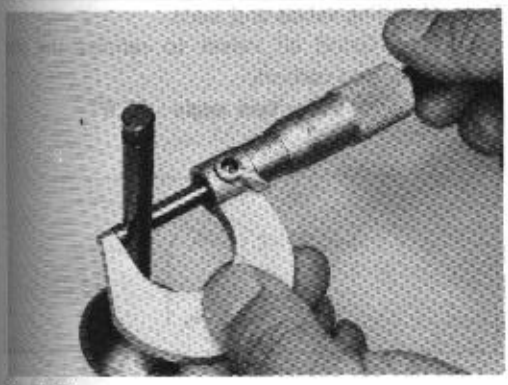
2. Check the valve stem to valve guide clearance of each valve by inserting the valve stem into the guide and moving back and forth as is shown in the figure.

Fig. 5-25



3. Measure the valve stem oil clearance.
   (1) Measure the inside diameter of the valve guide at several places with an inside dial gauge.

Fig. 5-26



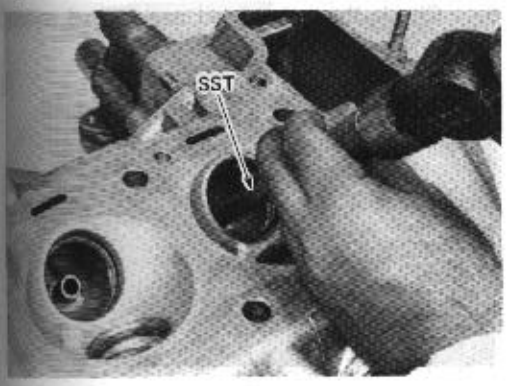
   (2) Measure the valve stem diameter.
   (3) Calculate the clearance between the valve stem and valve guide by subtracting the difference where the clearance is the largest.

Clearance limit

Intake	**0.08 mm (0.003 in)**
Exhaust	**0.10 mm (0.004 in)**

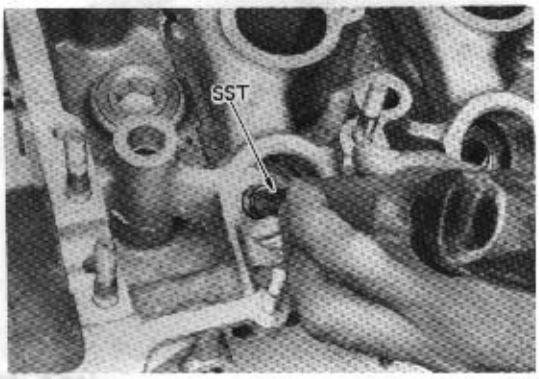
If the clearance exceeds the limit, replace both valve and guide.

Fig. 5-27



4. Valve guide replacement.
   (1) Break the valve guide at combustion chamber.
   (2) Heat cylinder head about 100°C (212°F).
   (3) From the combustion chamber, drive out the guide toward the top of cylinder head with SST.
   SST [09201-60011]

Fig. 5-28



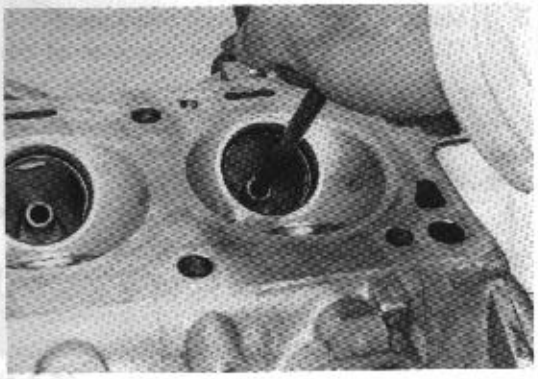
(3) With SST, drive in the new guide until the snap ring contacts the cylinder head.
SST [09201-60011].

– Note –

1. Insure that the hole is clean.

2. Before inserting the guide apply a thin coat of oil to it and the guide hole.

Fig. 5-29

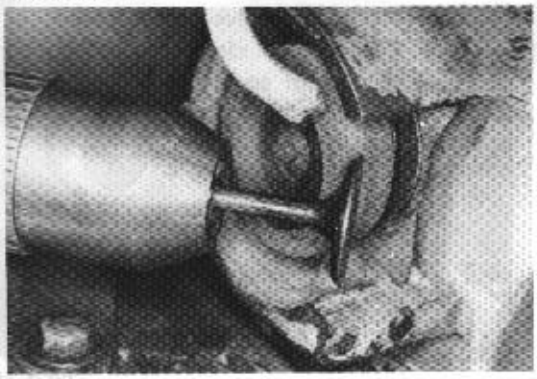


(4) Ream the guide to the specified clearance with an 8.5 mm (0.33 in) reamer.

Oil clearance standard

Intake	**0.025 – 0.055 mm (0.0010 – 0.0022 in)**
Exhaust	**0.03 – 0.06 mm (0.0012 – 0.0024 in)**

Fig. 5-30

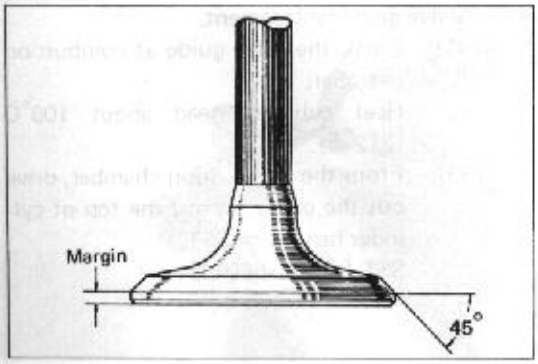


5. Grinding valves and seats

(1) Grind all valves to remove the pits and carbon.

Valve face angle : 45.5°

Fig. 5-31

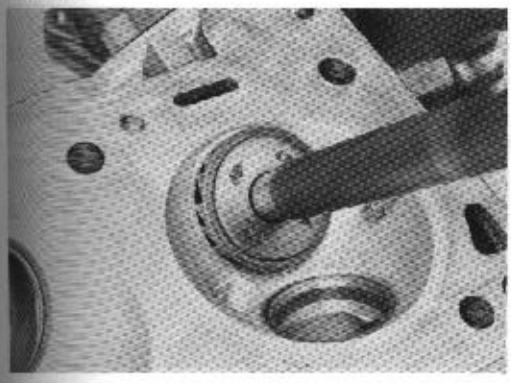


6. Check the valve head margin and replace if less than specified.

Margin limit

Intake	**0.5 mm (0.020 in)**
Exhaust	**0.6 mm (0.024 in)**

Fig. 5-32



7. Resurface valve seats with 45° carbide cutter.
Remove only enough metal to clean seat.

Fig. 5-33

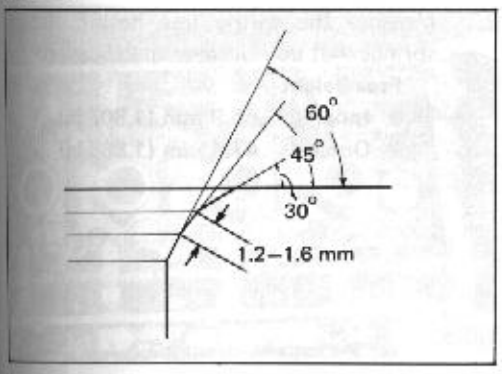
8. Coat valve face with prussion blue or white lead. Locate contact point on valve by rotating valve against seat.

— Note —

Seat contact should be in middle of valve face with following width:

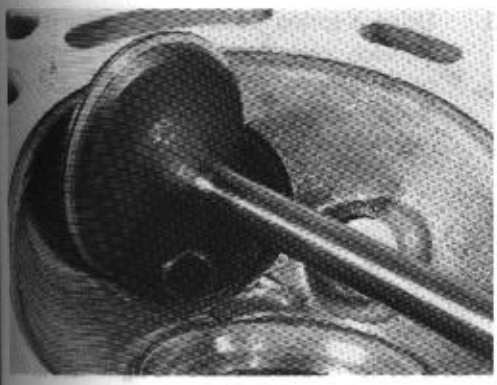
Intake 1.2 – 1.6 mm (0.047 – 0.063 in)
Exhaust 1.2 – 1.6 mm (0.047 – 0.063 in)

Fig. 5-34



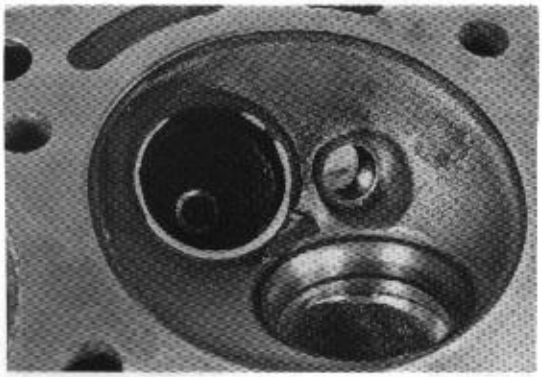
9. Correct seat position.
To correct seating that is too high, use 30° and 45° cutters. If seating is too low, use 60° and 45° cutters.

Fig. 5-35



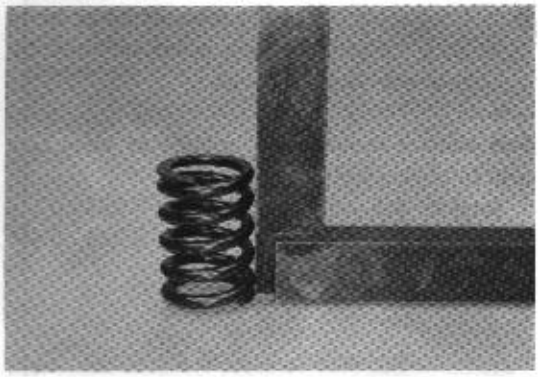
10. Check valve concentricity.
Lightly coat seat with prussian blue. Install valve and rotate. If blue appears 360° around face, valve stem and face are concentric. If not, replace valve.

Fig. 5-36



11. Check seat/guide concentricity.
Apply a light coat of prussian blue on valve face. Install and rotate valve. If blue appears 360° around valve seat, guide and seat are concentric. If not, recut seat.

Fig. 5-37

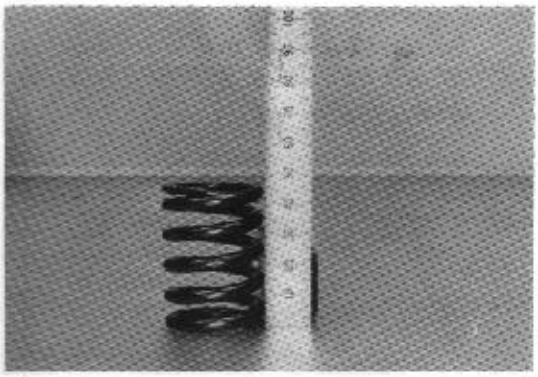


Valve Springs

1. Check the squareness of the valve springs with a steel square and surface plate. Turn the spring around slowly and observe the space between the top of the spring and the square. Replace the spring if it is out of square more than the specified limit.

Squareness limit (intake, exhaust)
1.6 mm (0.063 in)

Fig. 5-38

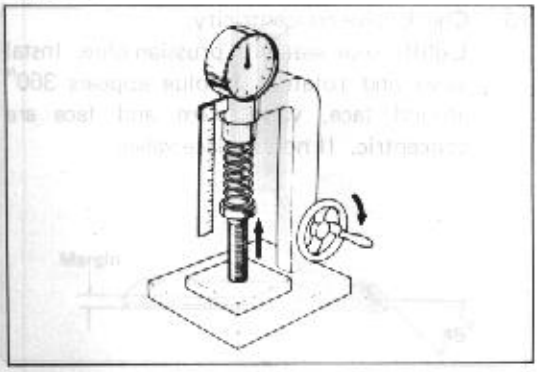


2. Measure the spring free height. Replace springs that do not meet specification.

Free height

Inner	**45.9 mm (1.807 in)**
Outer	**47.4 mm (1.866 in)**

Fig. 5-39



3. Using a spring tester, measure the tension of each spring at the specified installed height. Replace any spring that does not meet specification.

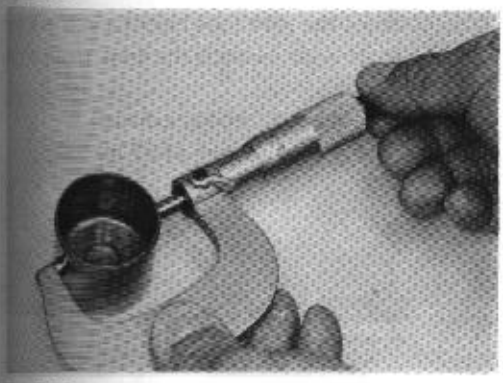
Installed length

	Inner	**36.5 mm**	**1.347 in**
	Outer	**39.0 mm**	**1.535 in**

Installed tension

STD	**Inner**	**7.3 kg**	**16.1 lb**
	Outer	**23.7 kg**	**52.3 lb**
Limit	**Inner**	**6.7 kg**	**14.8 lb**
	Outer	**21.8 kg**	**48.1 lb**

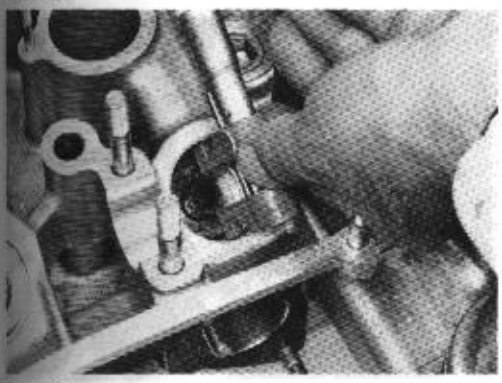
Fig. 5-40



Valve Lifter

1. Measure valve lifter oil clearance.
   (1) Measure outside diameter of lifter.

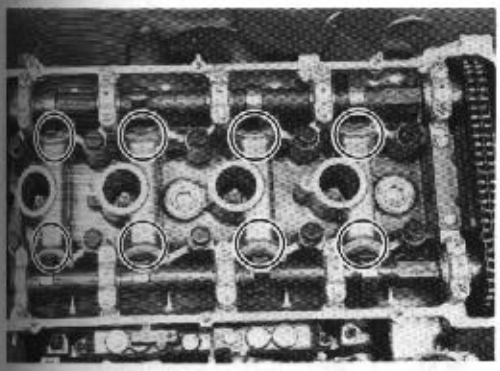
Fig. 5-41



(2) Measure inside diameter of cylinder head.

Oil clearance limit
0.1 mm (0.004 in)
Standard 0.02 – 0.03 mm (0.008 – 0.0012 in)

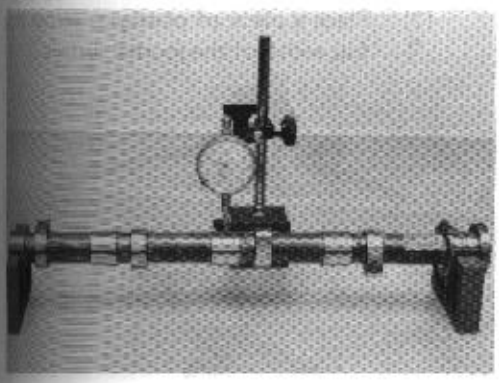
Fig. 5-42



2. Valve lifter selective fits.

Fit Code (Paint)	Cylinder Head Valve Sleeve Bore	Valve Lifter Outside Diameter
Black	37.951–37.957 mm (1.4941–1.4944")	37.925–37.931 mm (1.4931–1.4933")
Blue	37.957–37.963 mm (1.4944–1.4946")	37.931–37.937 mm (1.4933–1.4936")
Yellow	37.963–37.969 mm (1.4946–1.4948")	37.937–37.943 mm (1.4936–1.4938")
Red	37.969–37.975 mm (1.4948–1.4951")	37.943–37.949 mm (1.4938–1.4941")

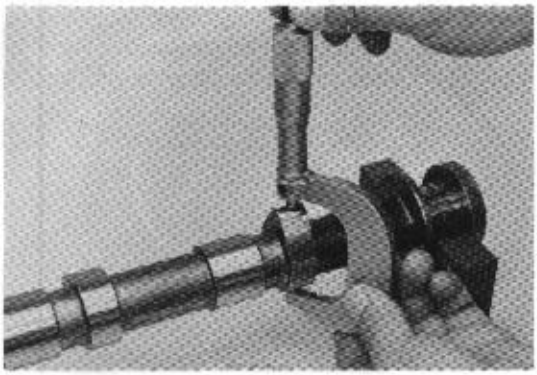
Fig. 5-43



Camshaft and Bearing

1. Check the camshaft for runout. Replace camshaft if it exceeds limit.
   Limit 0.03 mm (0.0012 in)

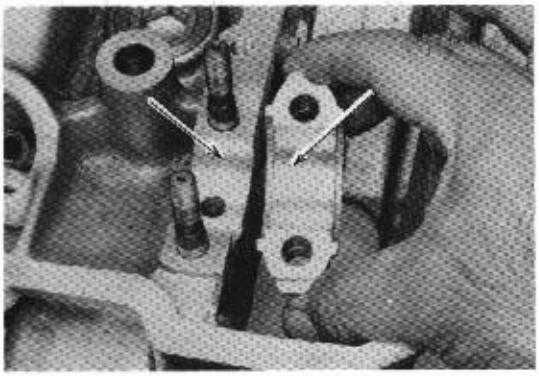
Fig. 5-44



2. Measure the cam lobe height and check for wear. If wear exceeds the limit, replace the camshaft.

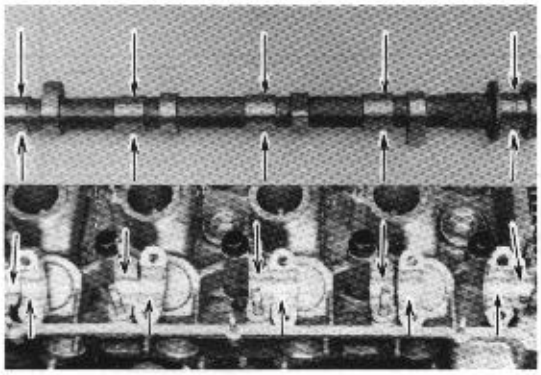
Height limit (intake, exhaust)
45.0 mm (1.77 in)

Fig. 5-45



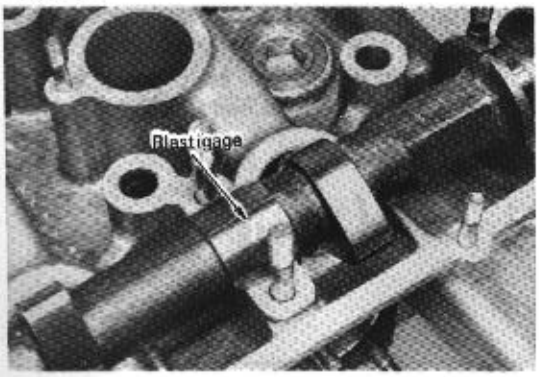
3. Check bearing for flaking or scoring.

Fig. 5-46



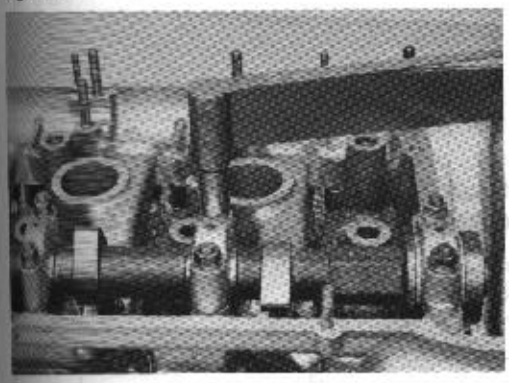
4. Measure camshaft oil clearance.
   (1) Clean bearing and camshaft.

Fig. 5-47



   (2) Place a piece of plastigage across the full width of the journal surface.

Fig. 5-48



(3) Install the bearing cap and tighten bolts to specified torque.

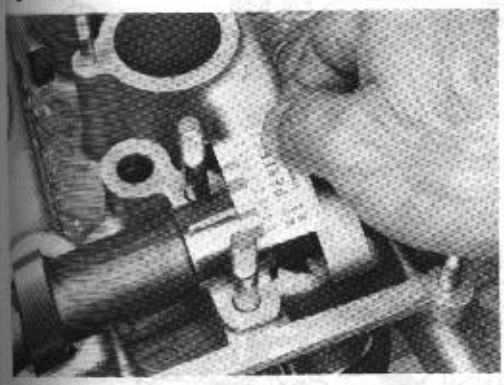
Torque 1.2 – 1.8 kg-m (8.7 – 13.0 ft-lb)

– Note –

Do not turn camshaft while plastigage is in place.

(4) Remove the bearing cap.

Fig. 5-49



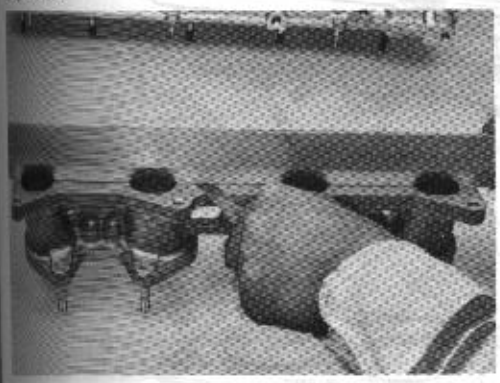
(5) With the plastigage scale, measure the width of the plastigage at its widest point. If clearance exceeds the specification limit, adjust with a suitable bearing size.

Oil clearance

Limit 0.15 mm (0.0059 in)

Standard 0.03 – 0.07 mm (0.0012 – 0.0028 in)

Fig. 5-50

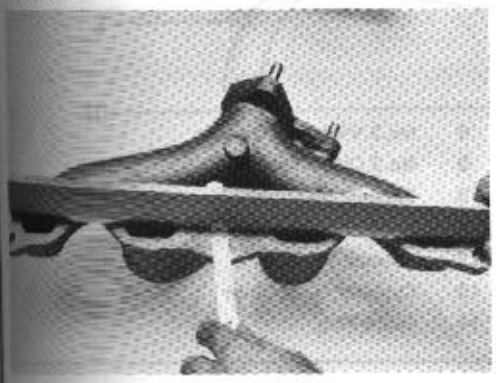


Manifolds

1. Inspect the cylinder head contacting surfaces for warpage and replace the manifold if it exceeds the limit.

Warpage limit 0.1 mm (0.0039 in)

Fig. 5-51



2. Inspect the cylinder head contacting surfaces for warpage and replace the manifold if it exceeds the limit.

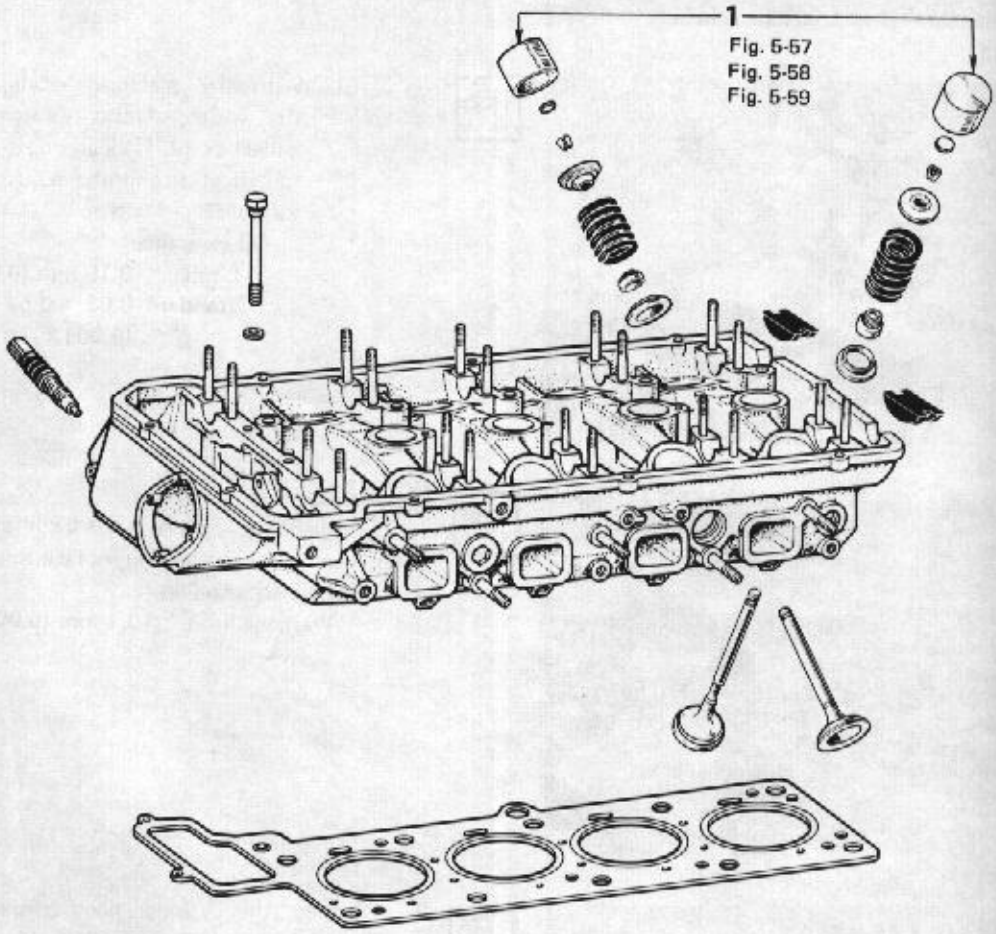
Warpage limit 0.1 mm (0.0039 in)

ASSEMBLY

Assemble in numerical order.

Fig. 5-55

- **Thoroughly clean the parts to be assembled.**
- **Apply clean engine oil on the sliding and rotating surfaces of the parts before assembly.**



1	Valve and Spring	8	No.2 Vibration Damper
2	Cylinder Head	9	No.2 Chain Tensioner
3	No.3 Vibration Damper	10	Exhaust Manifold
4	Oil Nozzle	11	Intake Manifold and Carburetor
5	Front Cover	12	Balance Tube
6	Camshaft and Bearing Cap	13	Cylinder Head Cover
7	Camshaft Timing Gear	14	Spark Plug

Fig. 5-56

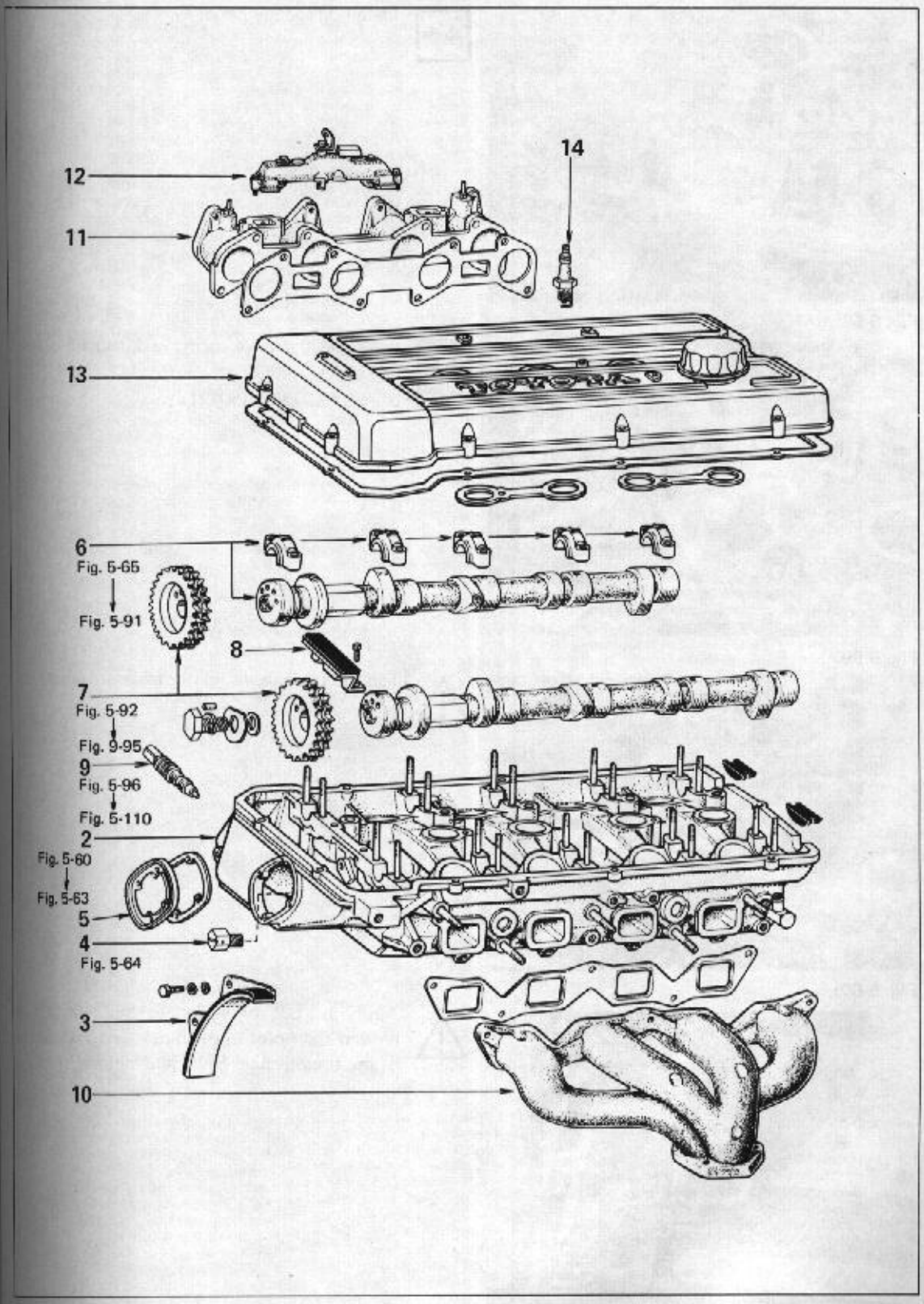
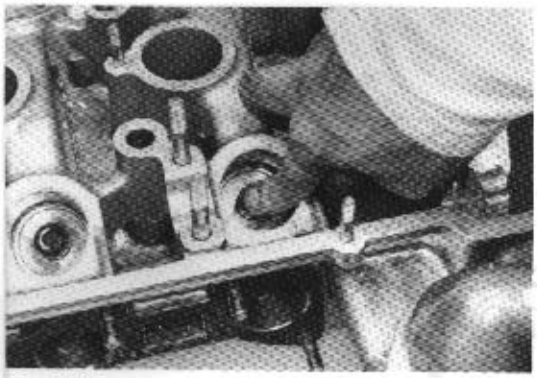
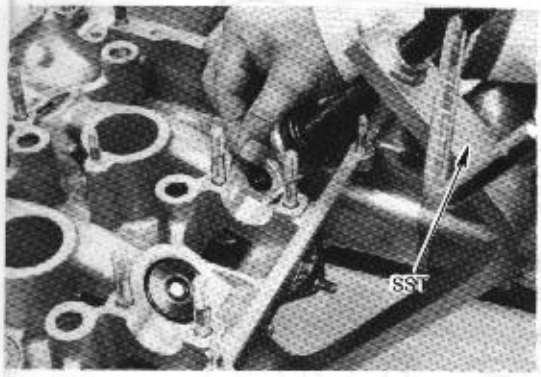


Fig. 5-57



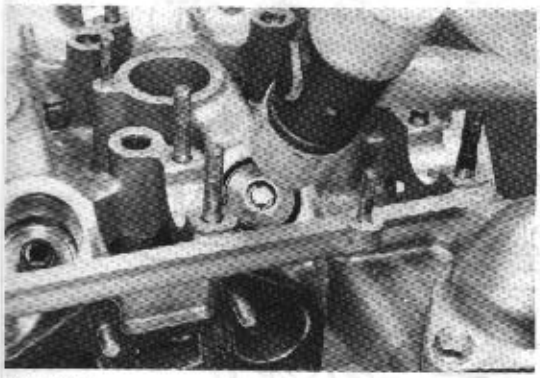
Install oil seal by hand.

Fig. 5-58



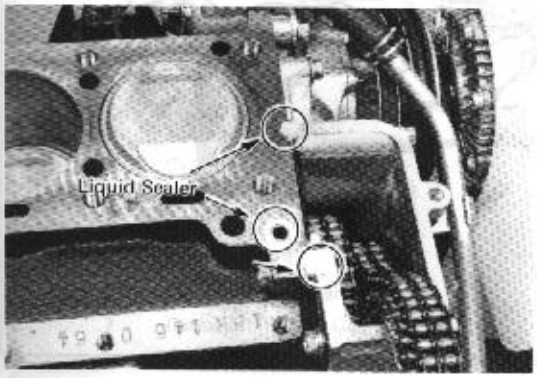
Assemble the valve spring and install the retainer locks.
Use SST [09202-43012].

Fig. 5-59



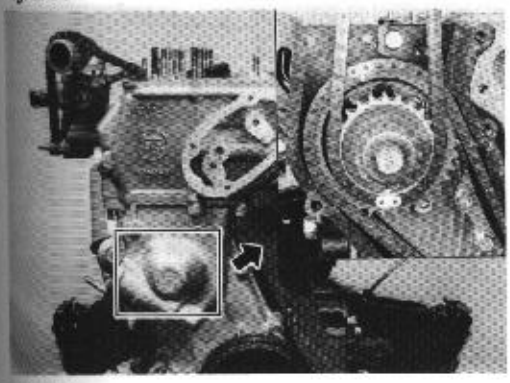
Tap the valve stems lightly to assure proper fit.

Fig. 5-60



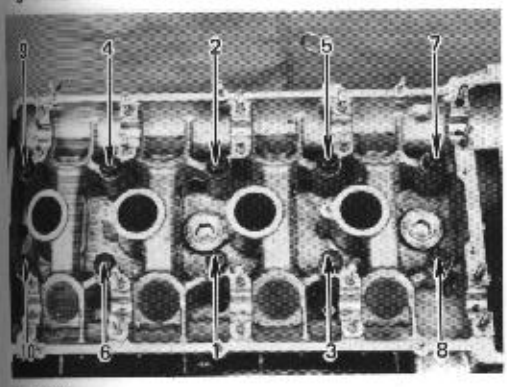
Apply a coat of sealer to the cylinder head, around the holes in the block, and in the vicinity of the timing chain cover and cylinder block.

Fig. 5-61



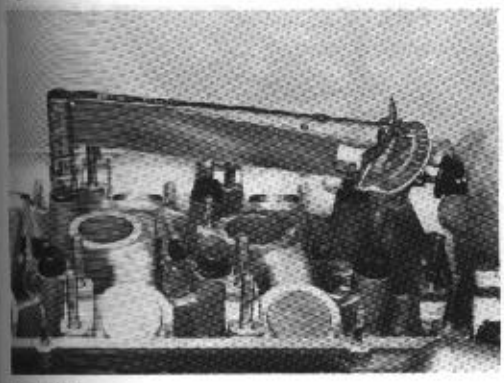
Install cylinder head with No.2 chain will not fall off.

Fig. 5-62



Tighten each cylinder head bolt a little at a time to the specified torque in the sequence shown in the figure.

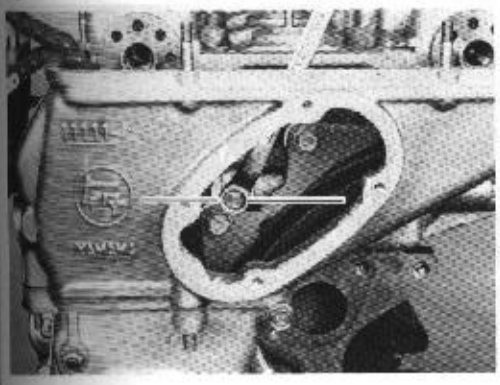
Fig. 5-63



Tighten head bolts to specified torque.

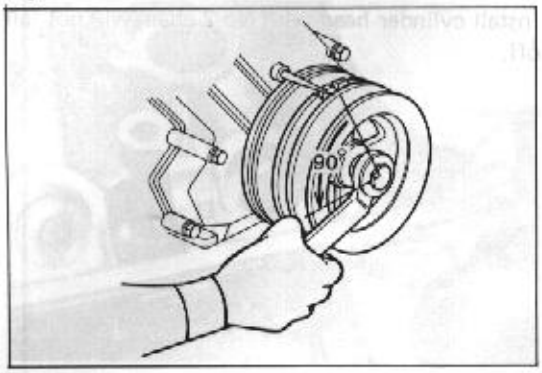
Torque 7.2 – 8.8 kg-m (52.1 – 63.7 ft-lb)

Fig. 5-64



Install the oil nozzle with its slot positioned horizontally.

Fig. 5-65

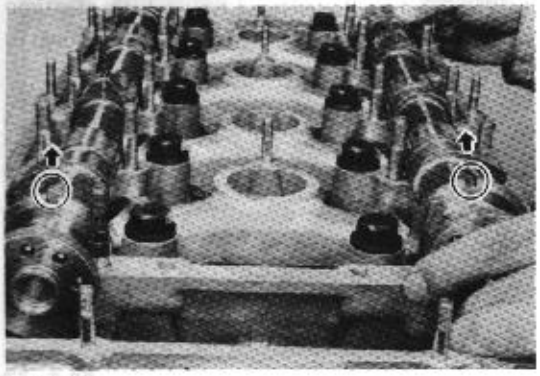


Rotate the crankshaft about 90° the reverse direction.

– Note –

Lower piston to prevent interference of piston head and valve.

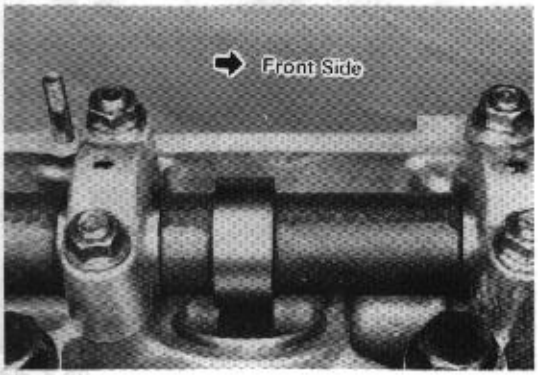
Fig. 5-66



Install Camshaft as Follows

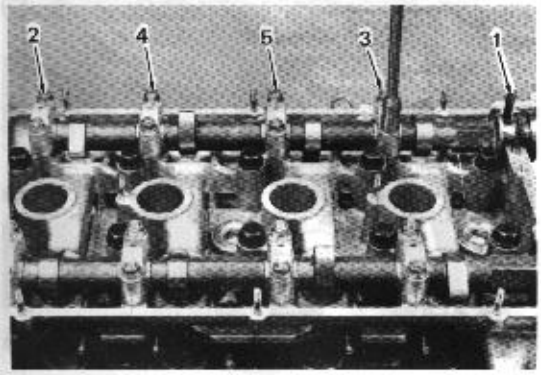
1. Position the camshaft so that the slit in the front end will point upward.

Fig. 5-67



2. Face the arrow mark of bearing cap toward front.

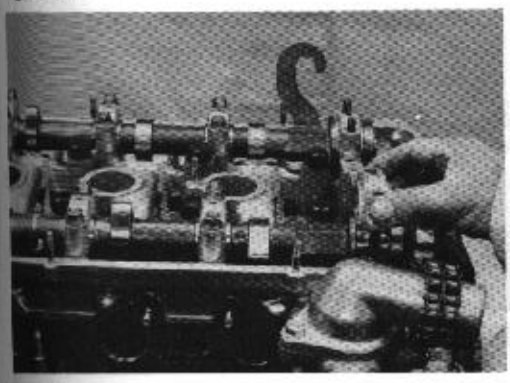
Fig. 5-68



3. Tighten each cap nuts a little at a time to the specified torque in the sequence shown in the figure.

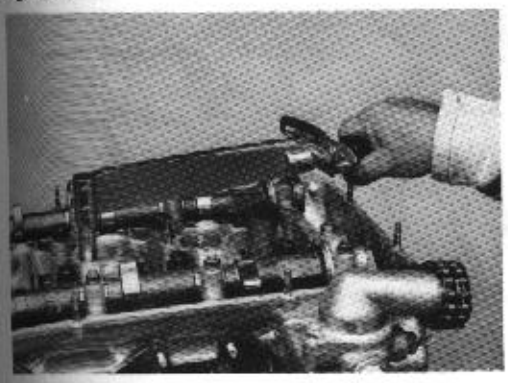
Torque **1.6 – 2.2 kg·m (12 – 15 ft-lb)**

Fig. 5-69



4. Then, install No.1 bearing cap.

Fig. 5-70



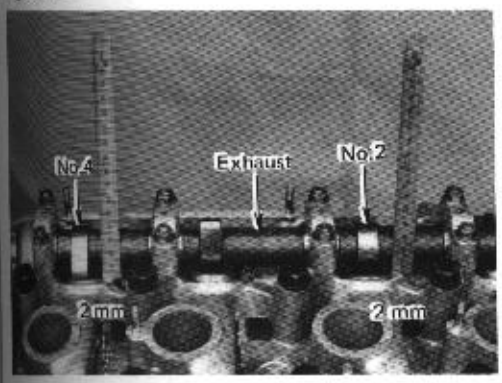
5. Tighten cap nuts to specified torque.
Torque 1.6 – 2.2 kg-m (12 – 15 ft-lb)

Fig. 5-71

6. Check camshaft thrust clearance.
Thrust clearance

Limit	**0.4 mm (0.0158 in)**
Standard	**0.15 – 0.35 mm (0.0059 – 0.0138 in)**

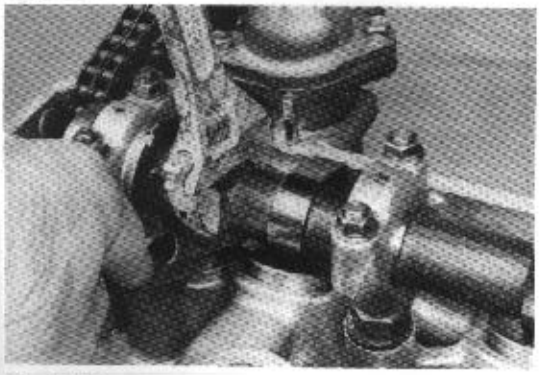
Fig. 5-72



Adjust The Valve Clearance

1. Measure the intake side valve clearance.
   (1) Exhaust side valve lifter No.2 and No.4 should protrude the same amount.
   (approx. 2 mm)

Fig. 5-73

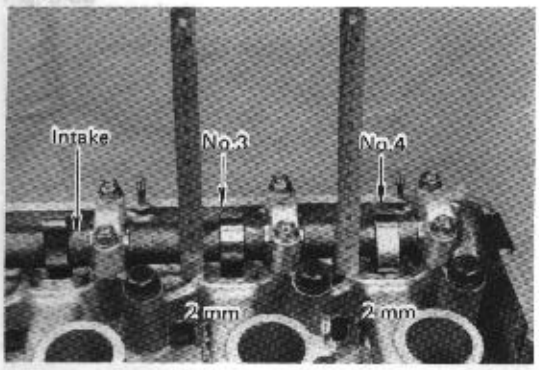


(2) Measure intake side valve clearance while turning the camshaft with tool.

Intake valve clearance
0.24 – 0.34 mm
(0.0094 – 0.0134 in)

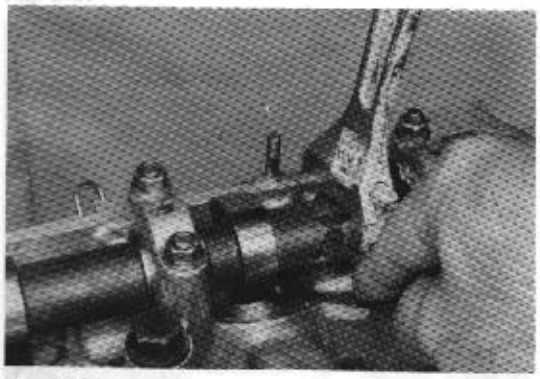
If outside the specified value and record the results.

Fig. 5-74



(3) Intake side valve lifter No.3 and No.4 should protrude the same amount.

Fig. 5-75

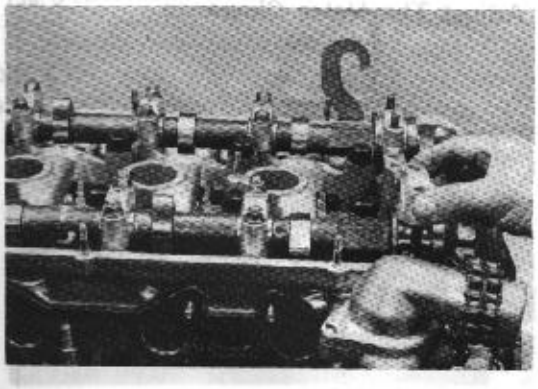


(4) Measure exhaust side valve clearance while turning the camshaft with tool.

Exhaust valve clearance
0.29 – 0.39 mm
(0.0114 – 0.0154 in)

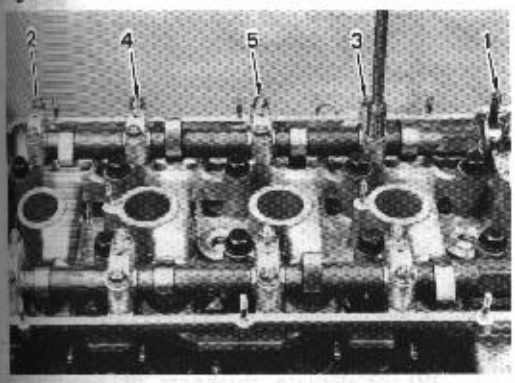
If outside the specified value and record the results.

Fig. 5-76



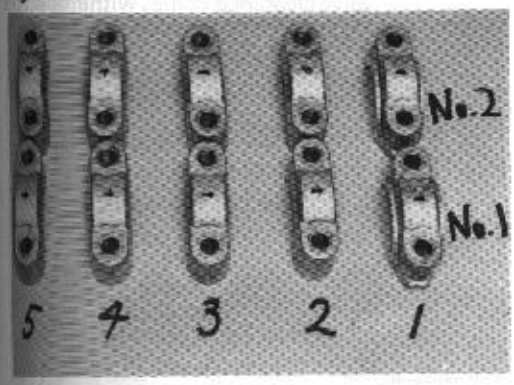
2. Remove No.1 bearing cap.

Fig. 5-77



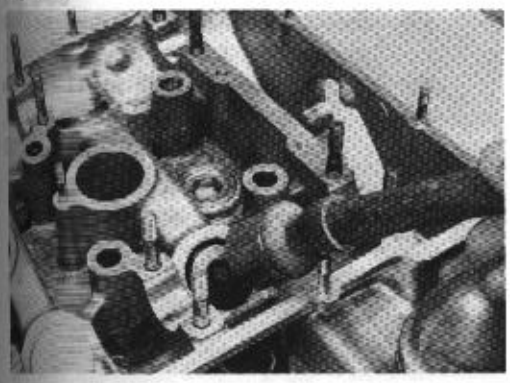
3. Gradually loosen the other cap nuts in 2 to 3 stages in the sequence as shown.

Fig. 5-78



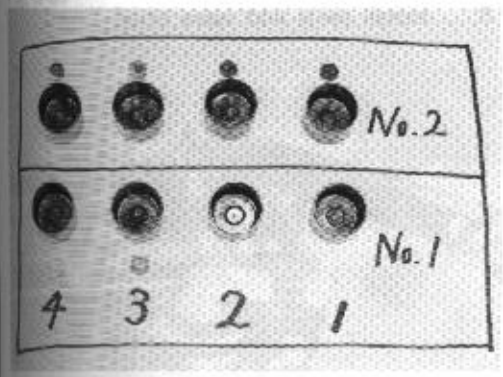
4. Arrange the bearings and caps in order.

Fig. 5-79



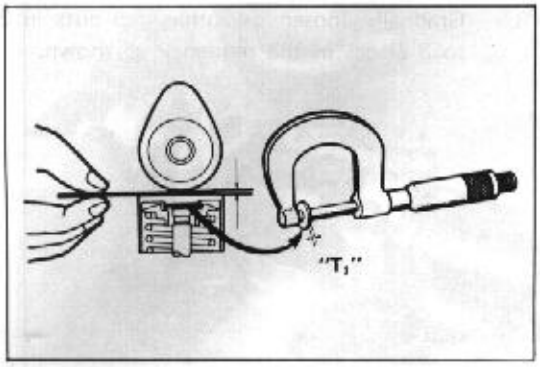
5. Remove valve lifter when valve clearance is not within specified value.

Fig. 5-80



6. Arrange the valves and adjusting pads in order.

Fig. 5-81



7. Select a new pad that will give the specified valve clearance as follows.
   (1) Measure the pad that was off with a micrometer.

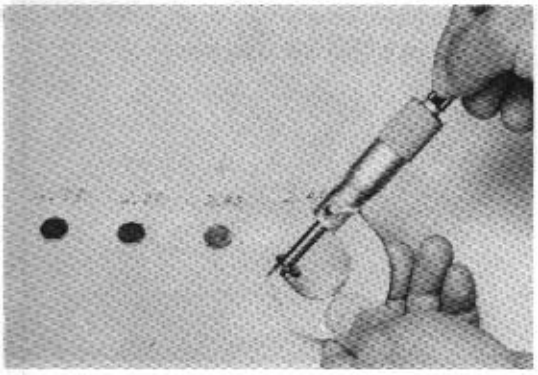
   (2) Calculate thickness of new pad so valve clearance comes within specified valve.

   T_1 .... Thickness of pad used.
   A ..... Valve clearance measured.

   Intake Side
   New Pad Thickness
   $= T_1 + (A - 0.29$ mm)

   Exhaust Side
   New Pad Thickness
   $= T_1 + (A - 0.34$ mm)

Fig. 5-82

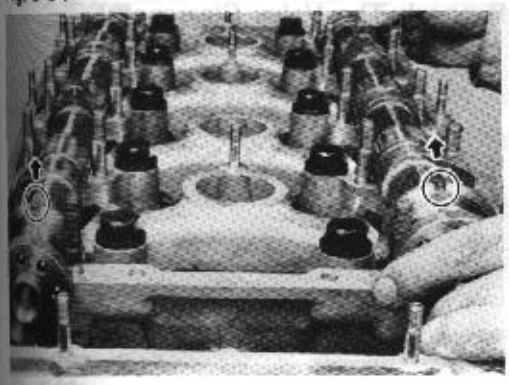


   (3) Select a pad with a thickness as close as possible to the valve calculated. **Pads are available in 41 sizes, in increments of 0.05 mm (0.002 in), from 1.00 mm (0.039 in) to 3.00 mm (0.118 in).**

Fig. 5-83

8. Install parts and valve lifter.

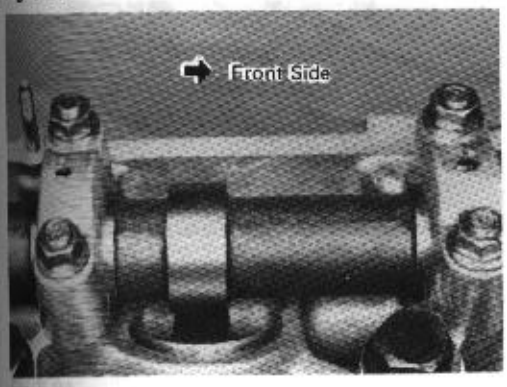
Fig. 5-84



Install Camshaft as Follows

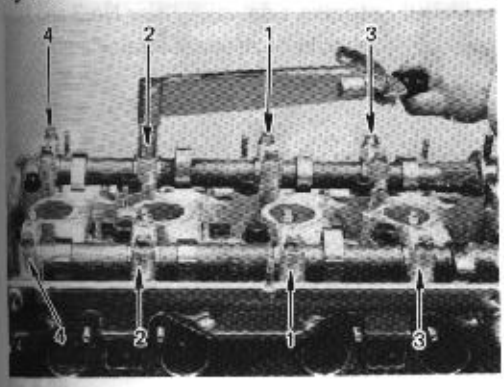
1. Position the camshaft so that the slit in the front end will point upward.

Fig. 5-85



2. Face the arrow mark of bearing cap toward front.

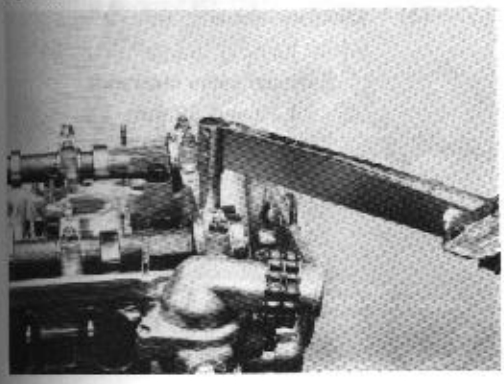
Fig. 5-86



3. Tighten each cylinder head bolt a little at a time to the specified torque in the sequence shown in the figure.

Torque **1.6 – 2.2 kg-m (12 – 15 ft-lb)**

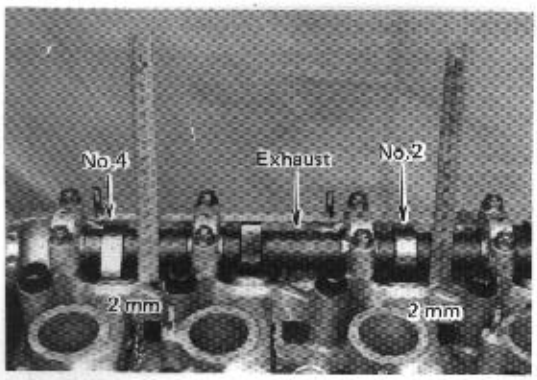
Fig. 5-87



4. Then, install No.1 bearing cap.
Tighten cap nuts to specified torque.

Torque **1.6 – 2.2 kg-m (12 – 15 ft-lb)**

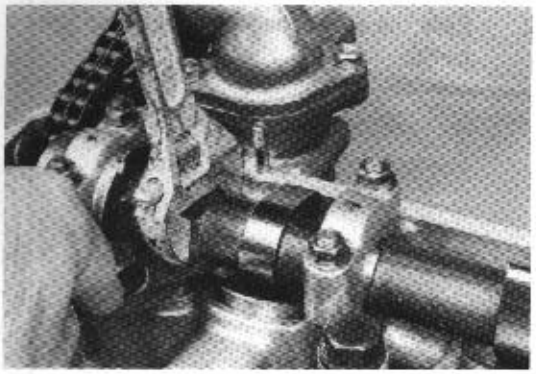
Fig. 5-88



Recheck The Valve Clearance

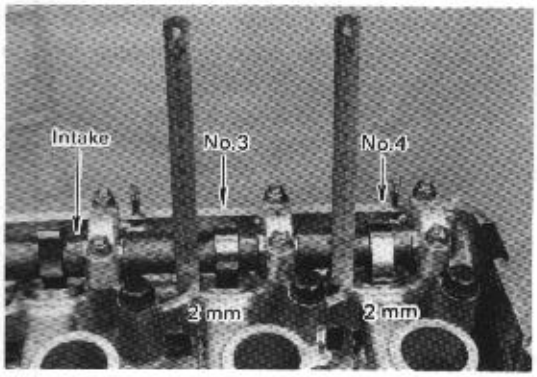
1. Measure the valve clearance.
   (1) Exhaust side valve lifter No.2 and No.4 should protrude the same amount.
   (approx. 2 mm)

Fig. 5-89



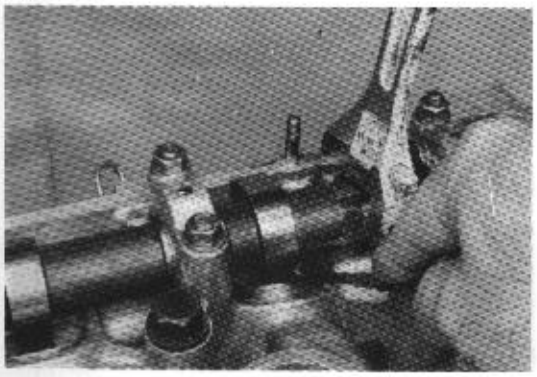
(2) Measure intake side valve clearance while turning the camshaft with tool.
Intake valve clearance
0.24 – 0.34 mm
(0.0094 – 0.0134 in)
If outside the specified value, choose another pad.

Fig. 5-90



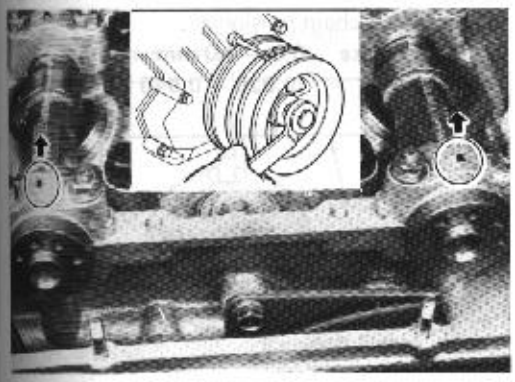
(3) Intake side valve lifter No.3 and No.4 should protrude the same amount.

Fig. 5-91



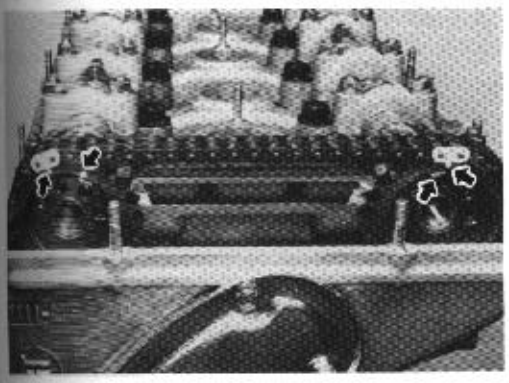
(4) Measure exhaust side valve clearance while turning the camshaft with tool.
Exhaust valve clearance
0.29 – 0.39 mm
(0.0114 – 0.0154 in)
If outside the specified value, choose another pad.

Fig. 5-92



Set the No.1 cylinder to TDC/compression.
In this position, the timing slits in the flange of the camshaft are positioned upward.

Fig. 5-93

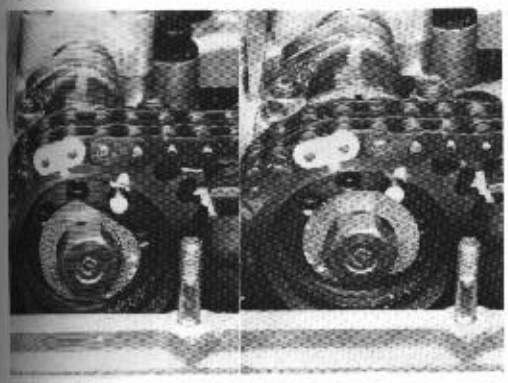


Install the No.2 chain with its mark aligned with the gear mark.
Align camshaft pin hole and gear pin hole to position before disassembly and insert pin.

— Note —

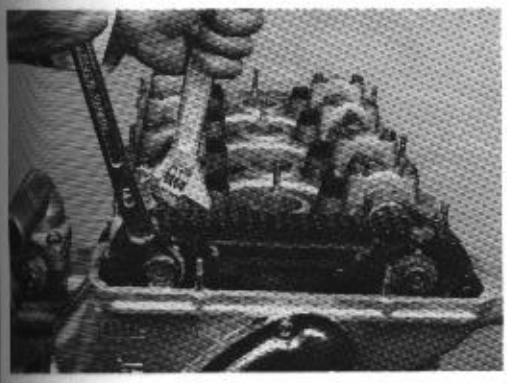
If the pin holes do not line up, turn the camshaft and make the nearest holes line up, but do not turn more than 45'.

Fig. 5-94



Hold the pin with the washer.

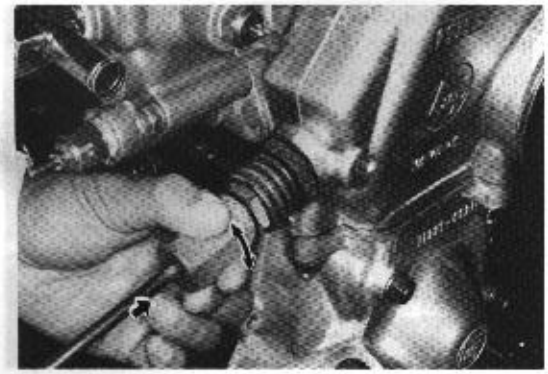
Fig. 5-95



Turn the crankshaft slightly in normal direction, until there is no slack in the pins, gears, and camshafts, and then tighten the bolts to specified torques.

Torque 7.0 – 8.0 kg-m (50.6 – 57.8 ft-lb)

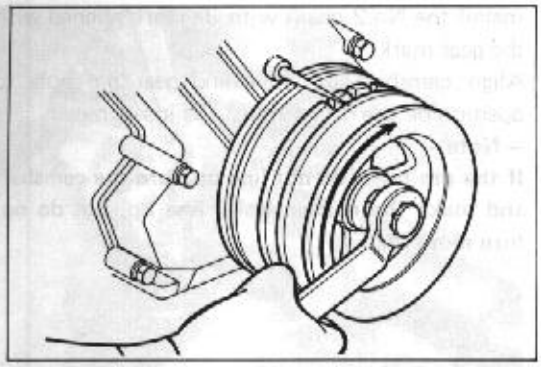
Fig. 5-96



Adjust No.2 chain tensioner.

Back stroke 0.5 – 1.0 mm (0.020 – 0.040 in)

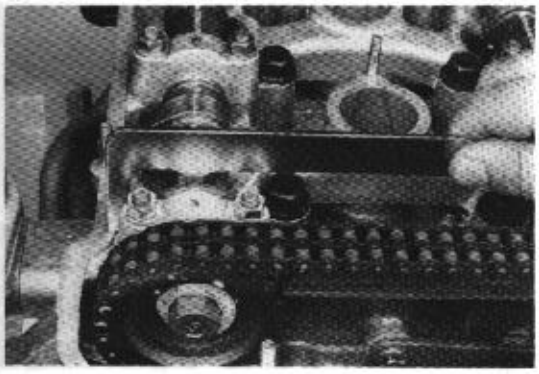
Fig. 5-97



Adjust Valve Timing

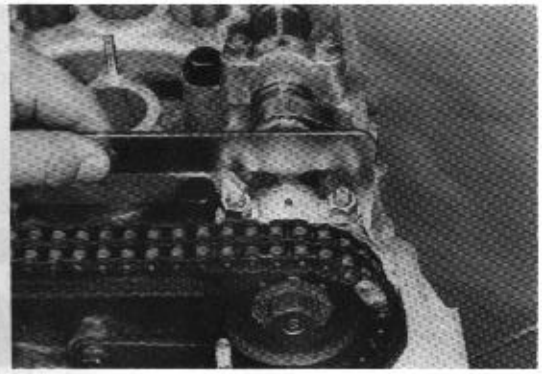
1. Rotate the crankshaft 720° in normal direction until No.1 cylinder TDC/compression.

Fig. 5-98



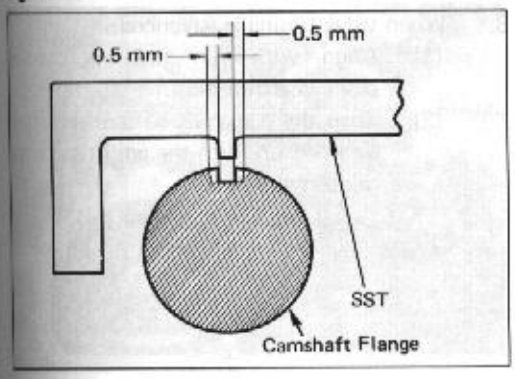
2. Check the No.1 camshaft valve timing with SST [09248-27010].

Fig. 5-99



3. Check the No.2 camshaft valve timing with SST [09248-27010].

Fig. 5-100

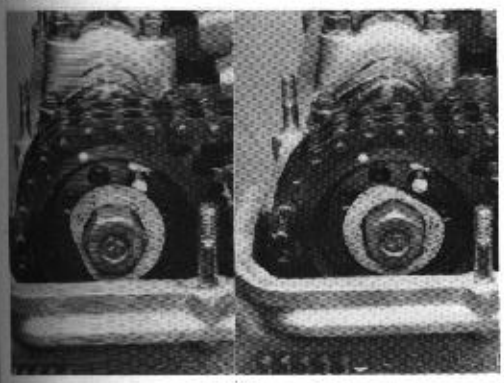


4. Valve timing permissible, error.
   ± 2° Camshaft rotation angle.
   ± 0.5 mm Camshaft flange outer perimeter.
   Adjust valve timing if it is off.

Fig. 5-101

5. Loosen the camshaft mounting bolt.

Fig. 5-102

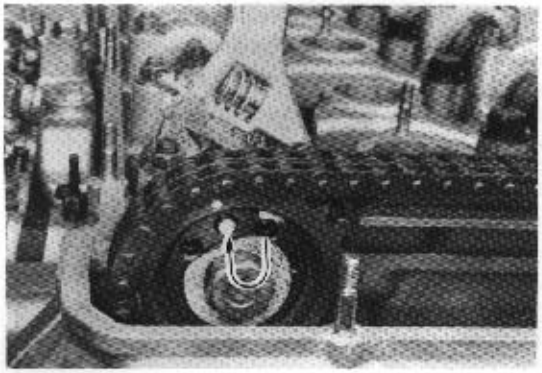


6. Rotate the washer until the pin head is completely exposed.

Fig. 5-103

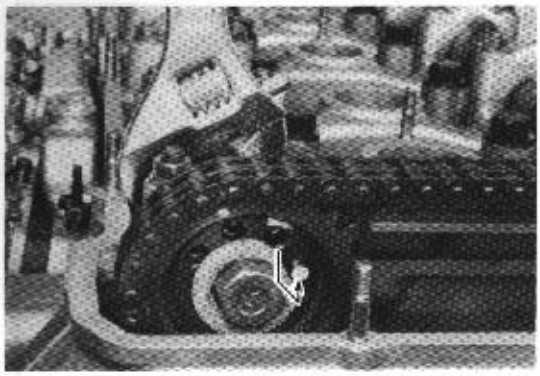
7. It will be easier to pull out the pin if the camshaft is turned slightly in the forward direction so as to provide play.

Fig. 5-104



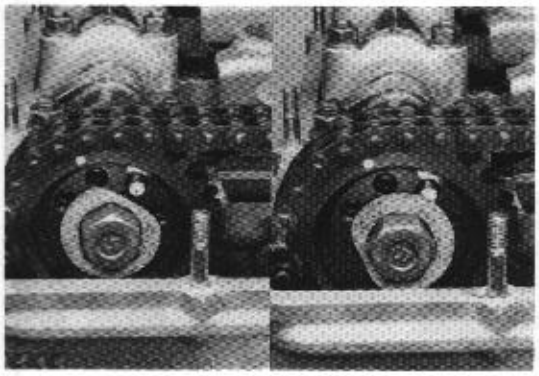
8. When valve timing is advanced.
   (1) Align with pin hole in counter-clockwise direction.
   (2) Turn the camshaft so that its slit will be lined up with the adjust gauge and reinsert the pin.

Fig. 5-105



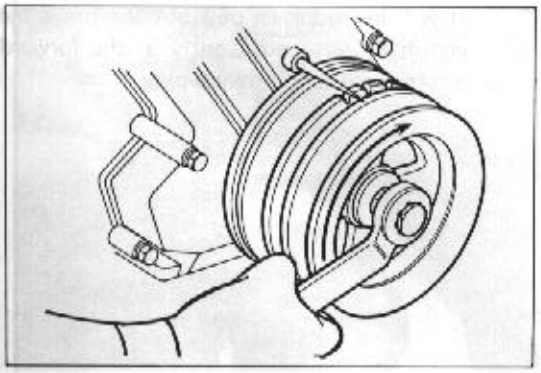
9. When valve timing is retarded.
   (1) Align with hole pin in clockwise direction.
   (2) Turn the camshaft so that its slit will be lined up with the adjust gauge and reinsert the pin.

Fig. 5-106



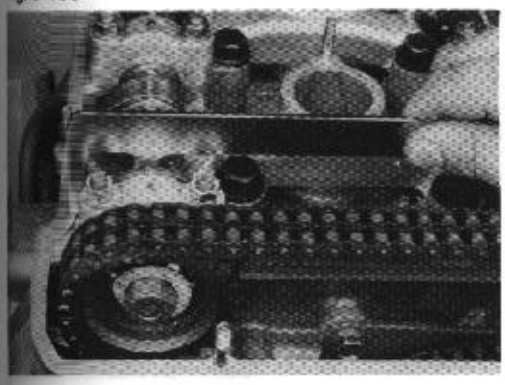
10. Hold the pin with the washer and tighten the bolt.

Fig. 5-107



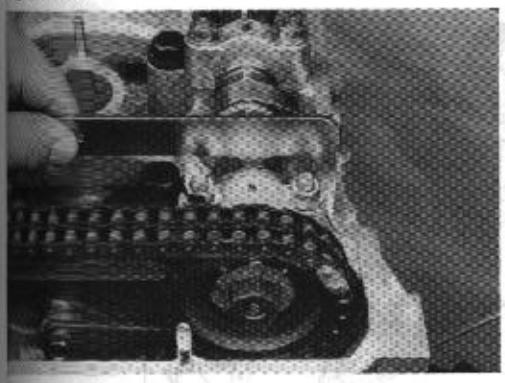
11. Assemble the rockers and shaft.
   (1) Assemble the rocker shaft and No.1 support as shown in the figure.

Fig. 5-108



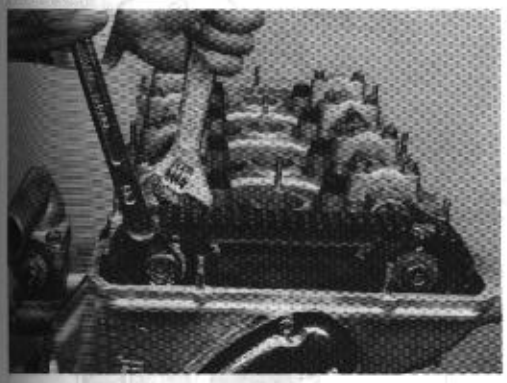
12. Recheck the No.1 camshaft valve timing. Use SST [09248-27010].
The camshaft and SST protrusion should line up.

Fig. 5-109



13. Recheck the No.2 camshaft valve timing. Use SST [09248-27010].
The camshaft slit and SST protrusion should line up.

Fig. 5-110



14. Hold the camshaft with a wrench and tighten the camshaft mounting bolt.

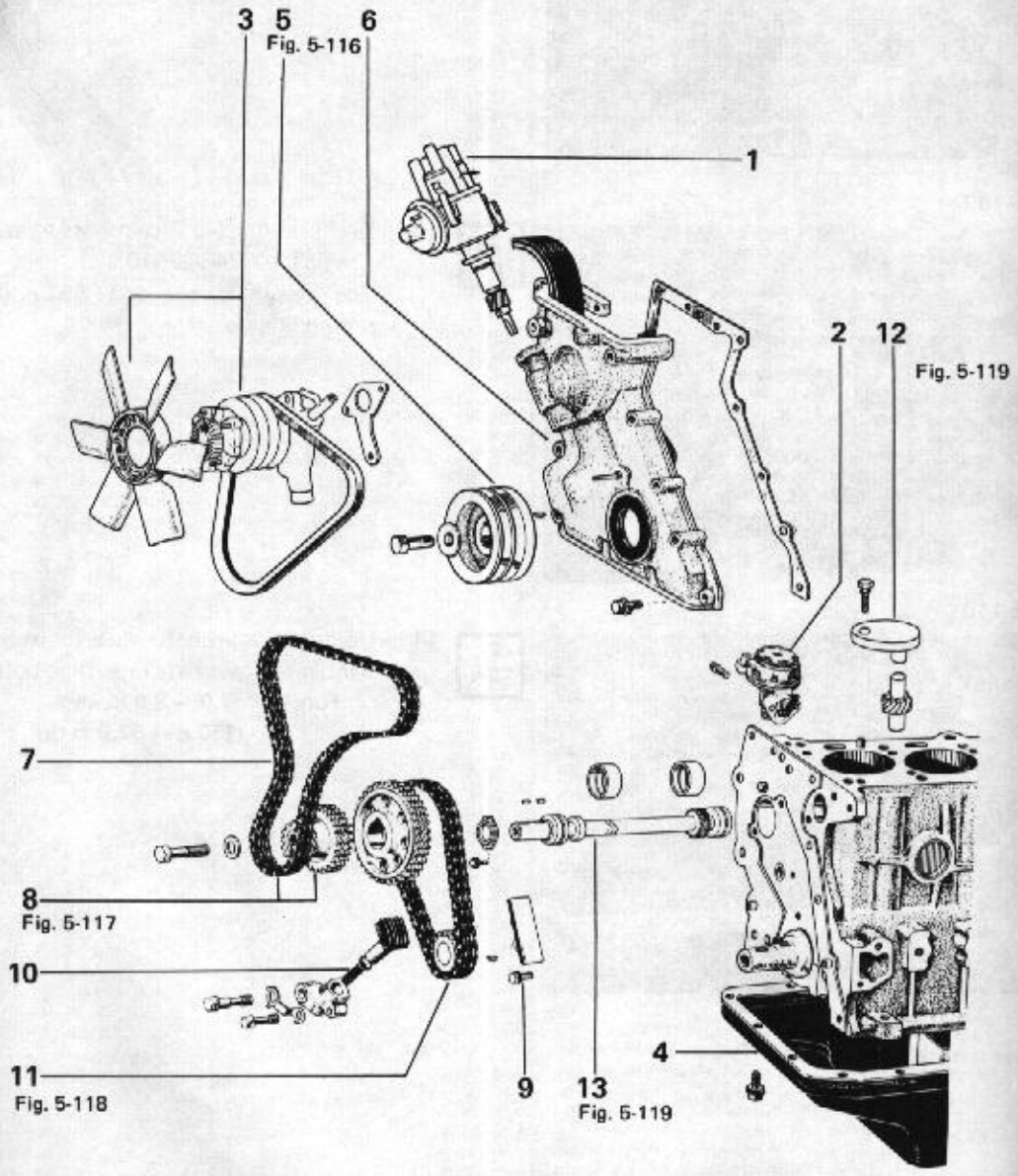
Torque 7.0 – 8.0 kg-m (50.6 – 57.9 ft-lb)

TIMING CHAIN

DISASSEMBLY

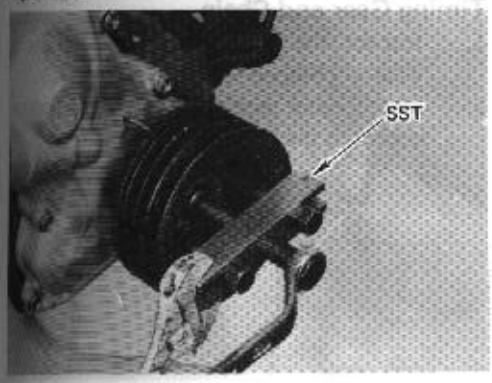
Disassemble in numerical order.

Fig. 5-115



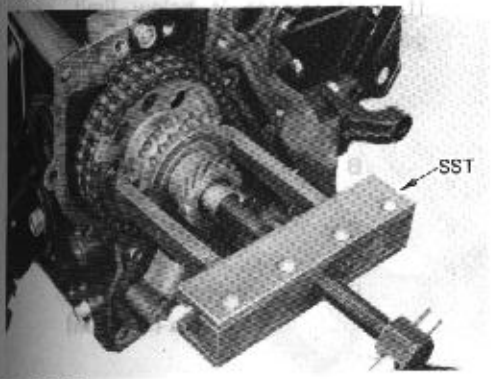
1. Distributor
2. Fuel Pump
3. Fan and Water Pump
4. Oil Pan
5. Crankshaft Pulley
6. Timing Chain Cover
7. No.2 Timing Chain
8. Distributor Drive Gear and Camshaft Drive Gear
9. No.1 Chain Damper
10. No.1 Chain Tensioner
11. No.1 Timing Chain and Gear
12. Oil Pump Drive Gear
13. Pump Drive Shaft

Fig. 5-116



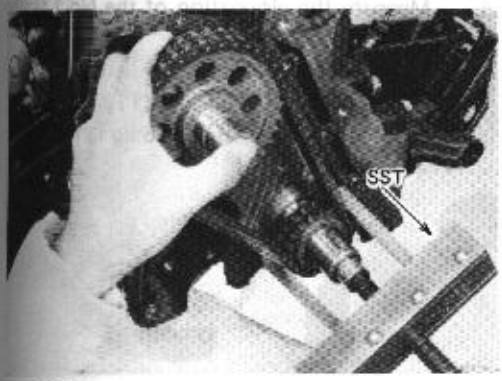
Remove the crankshaft pulley with SST.
SST [09213-31021]

Fig. 5-117



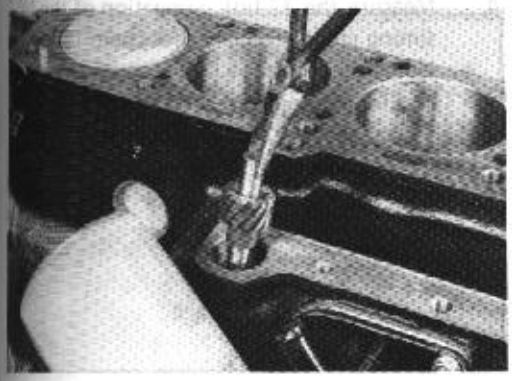
Remove the camshaft drive gear with SST.
SST [09213-36020]

Fig. 5-118



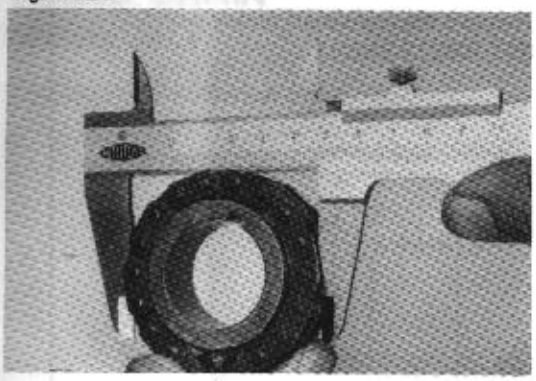
Attach the SST to the two gears and slide out both gears and chains as a unit.
SST [09213-36020]

Fig. 5-119



Remove pump driveshaft from cylinder block before removing pump driveshaft gear.

Fig. 5-120

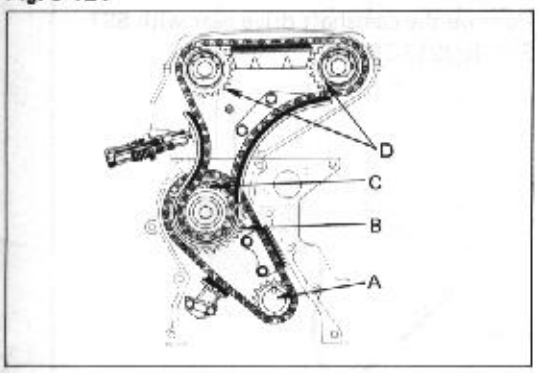


INSPECTION AND REPAIR

Timing Gear and Chain

1. Inspect the gears and chains for cracks, wear or chipped teeth.
2. Measure the gear for wear in the method shown in the figure.

Fig. 5-121



If measurement is below limit, replace gears and chain.

Wear limit

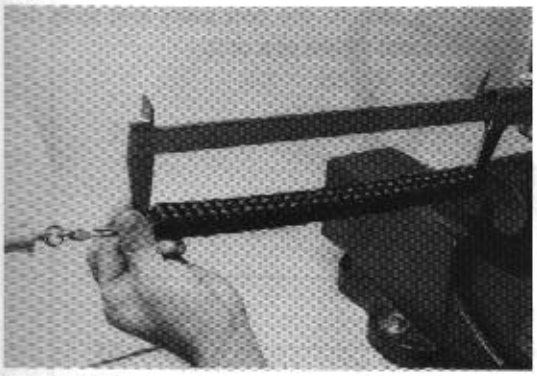
A : Crankshaft gear
60.0 mm (2.362 in)

B : Pump drive shaft gear
114.5 mm (4.503 in)

C : Camshaft drive gear
78.2 mm (3.079 in)

D : Camshaft timing gear
78.2 mm (3.079 in)

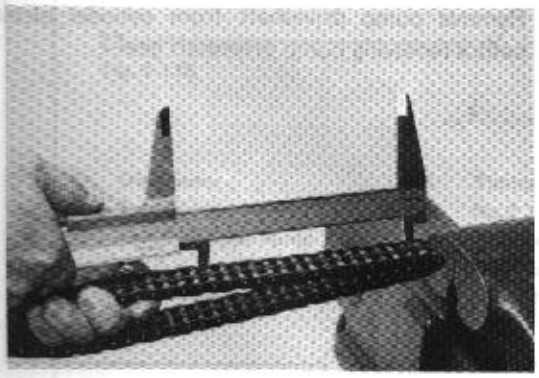
Fig. 5-122



3. Measure the elongation of the No.1 timing chain.

Elongation limit
291.4 mm (11.47 in)
tension at 5 kg (11 lb)

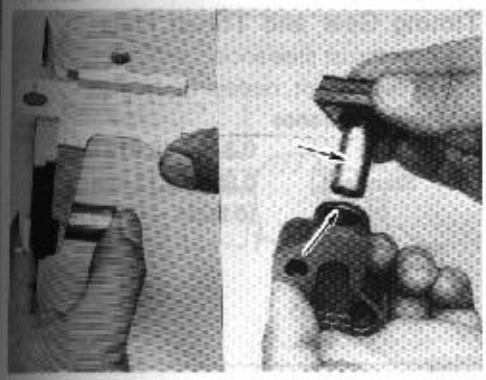
Fig. 5-123



4. Measure the 17-link elongation of the No.2 timing chain. Replace the chain if over the elongation limit.

Elongation limit (at 17-links)
147 mm (5.79 in)

Fig. 5-124

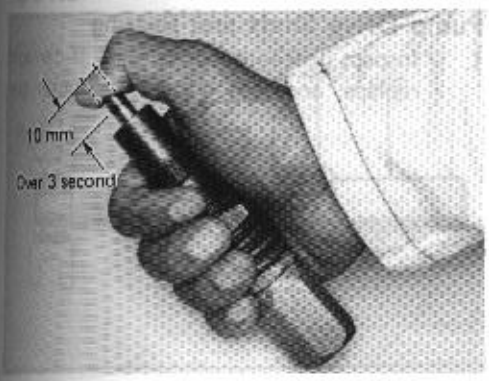


No.1 Chain Tensioner

Check the body and plunger for wear and measure the tensioner head as shown in the figure. If worn down over the limit, replace as a unit.

Wear limit 11.5 mm (0.453 in)

Fig. 5-125

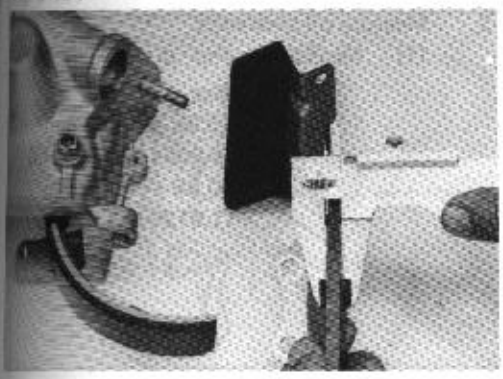


No.2 Chain Tensioner

Air Seal Test

1. Immerse plunger in engine oil and work so as to remove the air.
2. Press plunger with thumb , 10 mm (0.39 in) stroke should take 3 seconds or more.

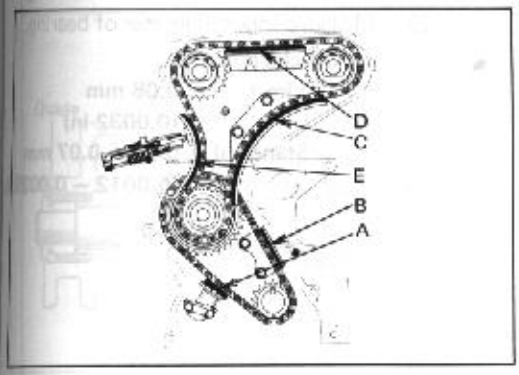
Fig. 5-126



Chain Damper and Slipper

Inspect chain dampers for wear. Measure each damper.

Fig. 5-127



If either is visibly worn or measures less than limit, replace units.

Wear limit

A : No.1 chain tensioner
11.5 mm (0.453 in)

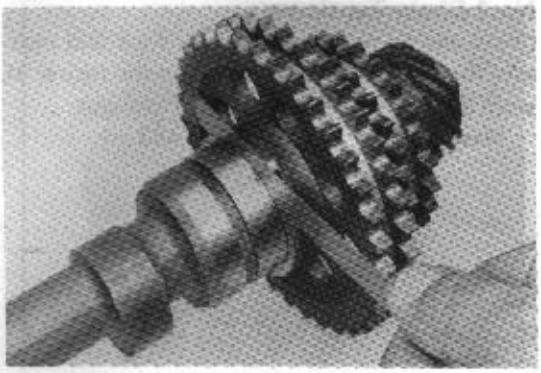
B : No.1 chain damper
5.0 mm (0.197 in)

C : No.3 chain damper
6.5 mm (0.256 in)

D : No.2 chain damper
5.5 mm (0.217 in)

E : Chain tensioner slipper
7.5 mm (0.295 in)

Fig. 5-128



Timing Gear and Thrust Plate

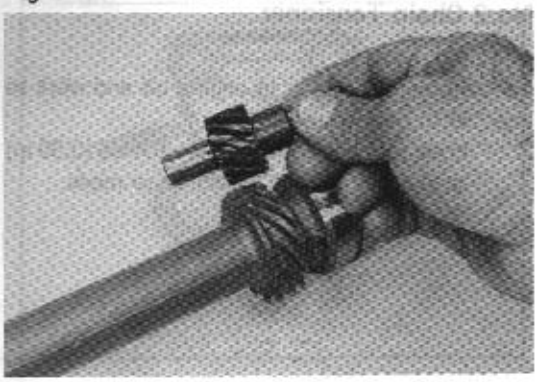
Measure thrust clearance.

If it exceeds limit, replace thrust plate.

Thrust clearance

Limit	**0.3 mm (0.012 in)**
Standard	**0.06 – 0.13 mm (0.0024 – 0.0051 in)**

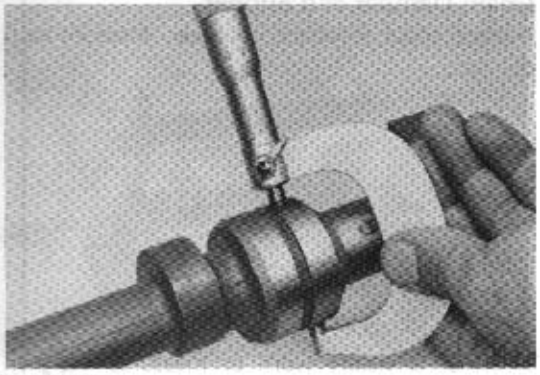
Fig. 5-129



Pump Drive Shaft and Bearing

1. Inspect distributor drive gear. If damage replace, and also inspect distributor gea

Fig. 5-130

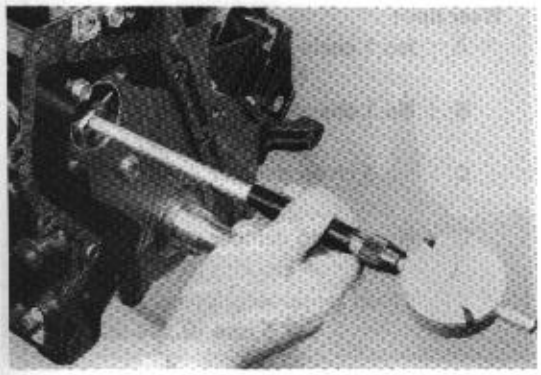


2. Measure oil clearance.
   (1) Measure pump drive shaft journ

Finished size

Front	**45.96 – 45.98 mm (1.8094 – 1.8102 in)**
Rear	**40.96 – 40.98 mm (1.6126 – 1.6134 in)**

Fig. 5-131

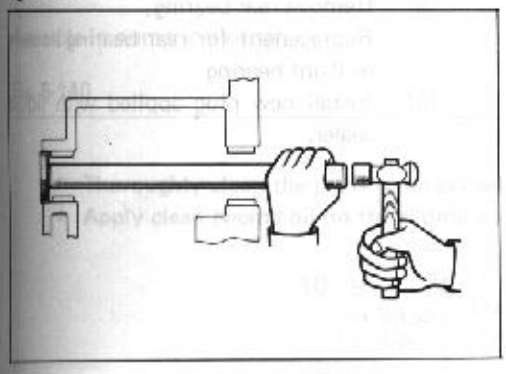


   (2) Measure inner diameter of bearing.

Oil clearance

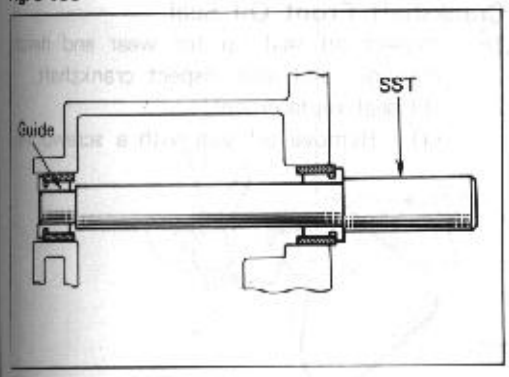
Limit	**0.08 mm (0.0032 in)**
Standard	**0.03 – 0.07 mm (0.0012 – 0.0028**)

Fig. 5-132



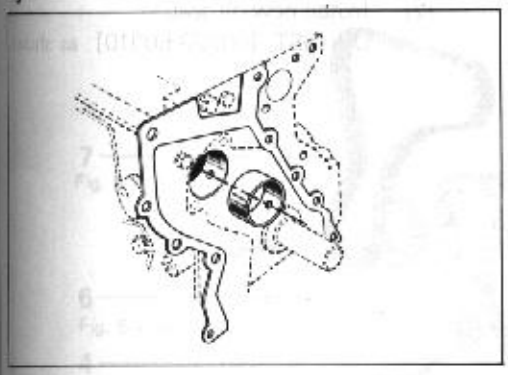
3. Bearing replacement.
   (1) Drive out plug from cylinder block.

Fig. 5-133



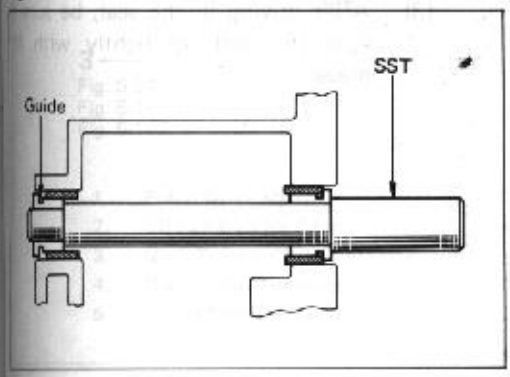
(2) Remove front bearing.
Use SST [09233-33010] as shown.

Fig. 5-134



(3) Align bearing oil hole.

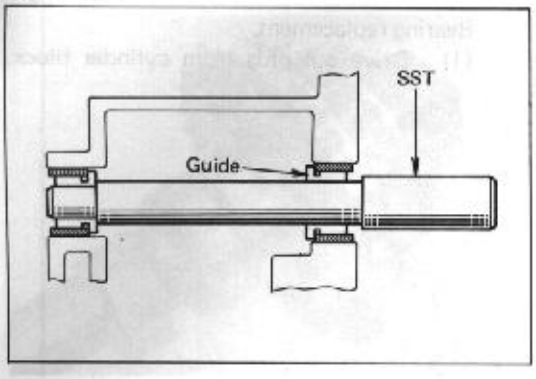
Fig. 5-135



(4) Install front bearing.
Use SST [09233-33010] as shown.

Bearing fitting tolerance
0.02 – 0.06 mm
(0.0008 – 0.0024 in)

Fig. 5-136



(5) Remove rear bearing.
Replacement for rear bearing as same as front bearing.

(6) Install new plug applied with liquid sealer.

Fig. 5-137

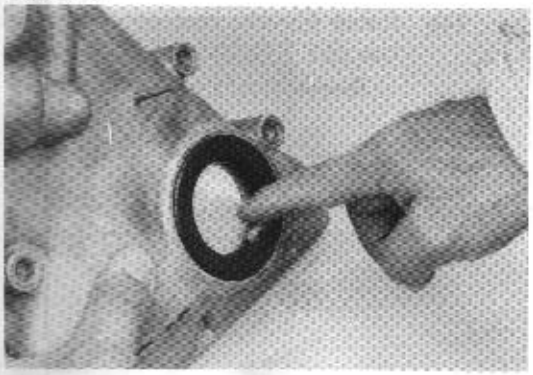
Crankshaft Front Oil Seal

1. Inspect oil seal lip for wear and deformation, and also inspect crankshaft.
2. Oil seal replacement.
   (1) Remove oil seal with a screwdriver.

Fig. 5-138

(2) Install new oil seal.
Use SST [09223-50010] as shown.

Fig. 5-139



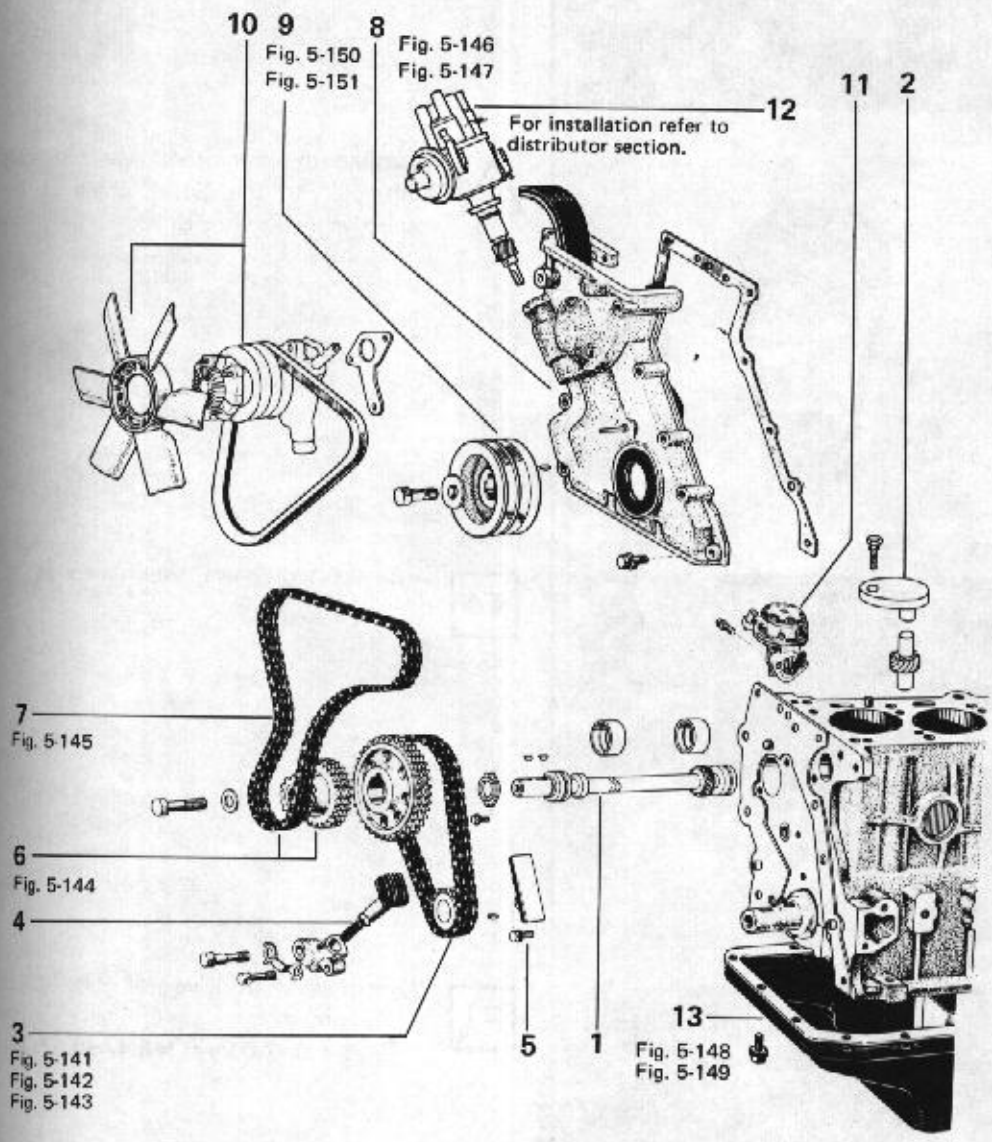
(3) After driving in the seal, be sure to coat the seal lip lightly with MP grease.

ASSEMBLY

Assemble in numerical order.

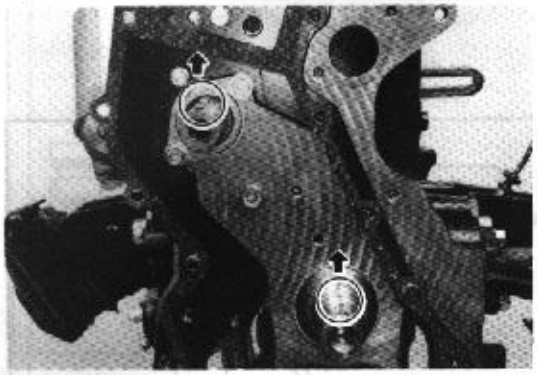
Fig. 5-140

- **Thoroughly clean the parts to be assembled.**
- **Apply clean engine oil on the sliding and rotating surfaces of the parts before assembly.**



1. Pump Drive Shaft
2. Oil Pump Drive Gear
3. No.1 Timing Chain and Gear
4. No.1 Chain Tensioner
5. No.1 Chain Damper
6. Distributor Drive Gear and Camshaft Drive Gear
7. No.2 Timing Chain
8. Timing Gear Cover
9. Crankshaft Pulley
10. Water Pump and Fan
11. Fuel Pump
12. Distributor
13. Oil Pan

Fig. 5-141

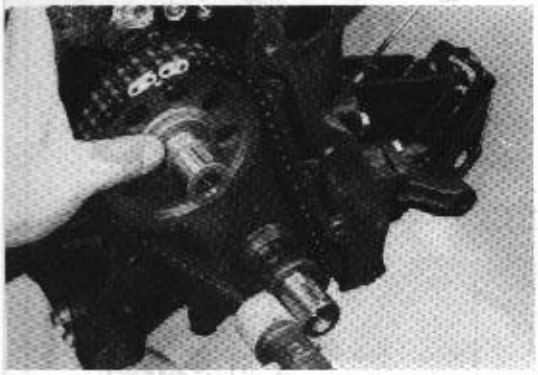


Set the crankshaft keyway and the pump drive shaft keyway vertically upward.

Fig. 5-142

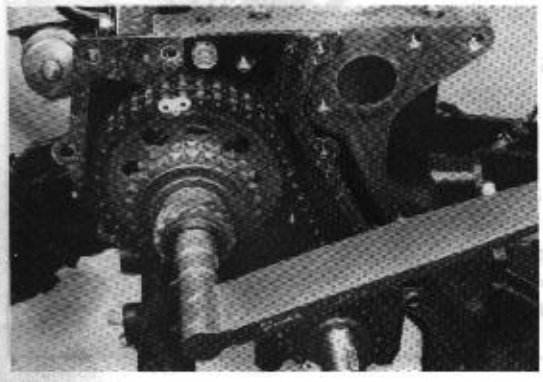
Assemble the crankshaft gear and pump drive shaft gear to the No. 1 chain so that their respective marks are aligned.

Fig. 5-143



Drive in two gears simultaneously to shafts.

Fig. 5-144



Tighten camshaft drive gear bolt.

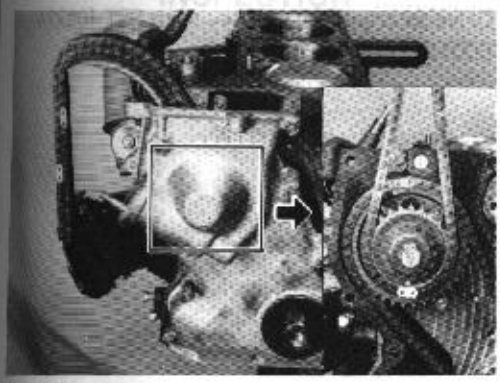
Torque

6.0–7.0 kg-m (43.4–50.6 ft-lb)

Fig. 5-145

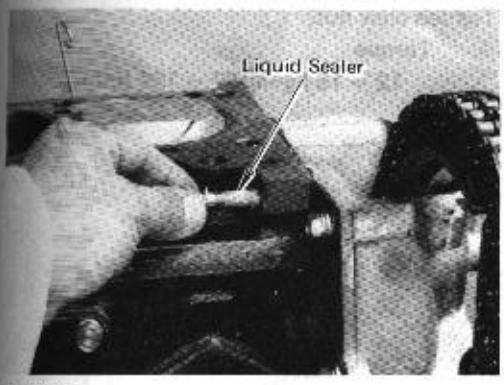
Align the No. 2 chain and gear matchmarks and install.

Fig. 5-146



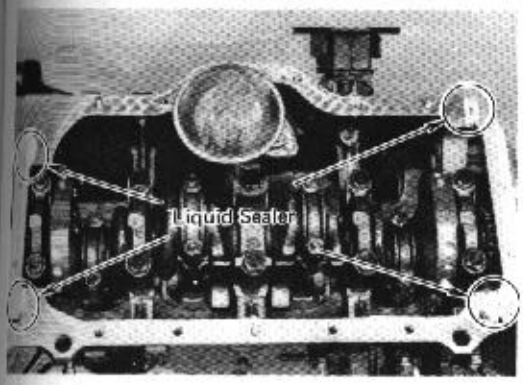
Be careful not to drop the chain inside the housing.

Fig. 5-147



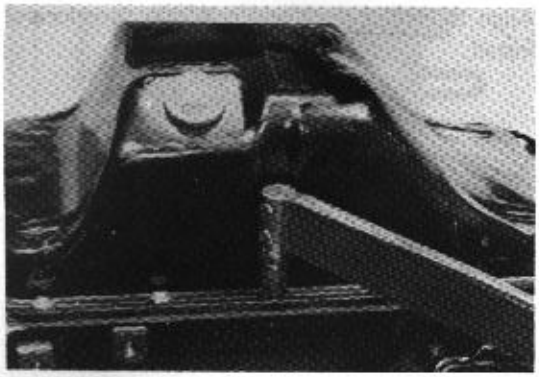
In installing the upper right bolt for mounting the chain cover, insert seal washer and apply liquid sealer on the threads.

Fig. 5-148



Apply sealer to the areas indicated in the figure.

Fig. 5-149

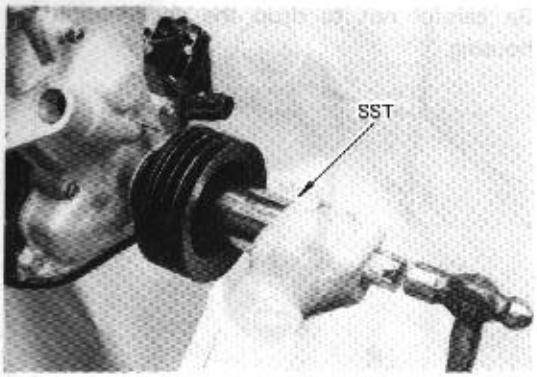


Install oil pan.

Torque

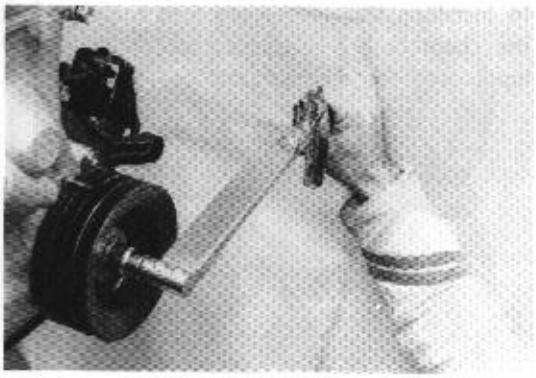
0.4–0.8 kg-m (2.9–5.8 ft-lb)

Fig. 5-150



Drive in crankshaft pulley with SST [09214-60010].

Fig. 5-151



Tighten claw nut.

Torque

12 – 15 kg-m (87 – 108 ft-lb)

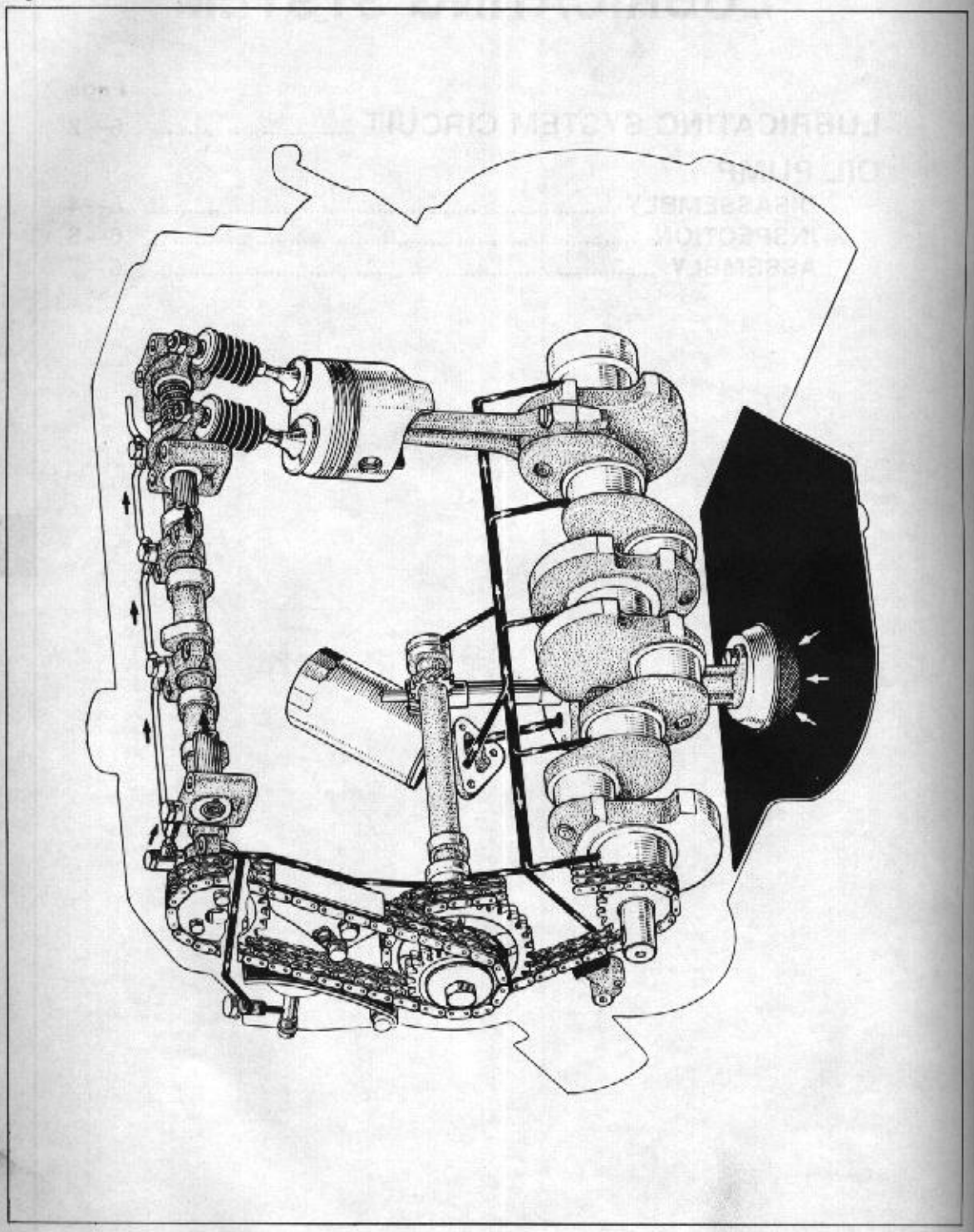
LUBRICATING SYSTEM

6

LUBRICATING SYSTEM CIRCUIT

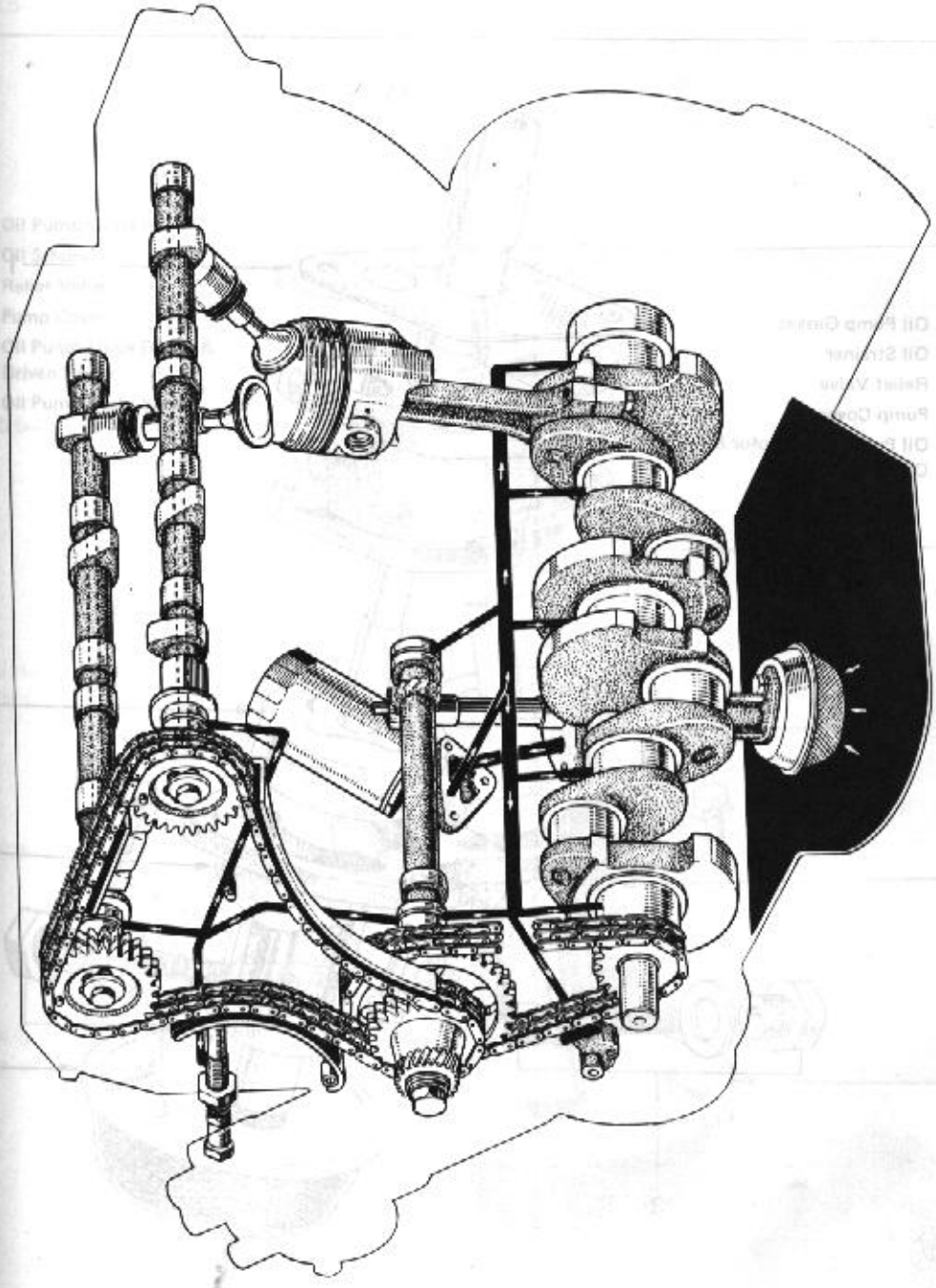
16R, 18R ENGINE

Fig. 6-1



18R-G ENGINE

Fig. 6-2

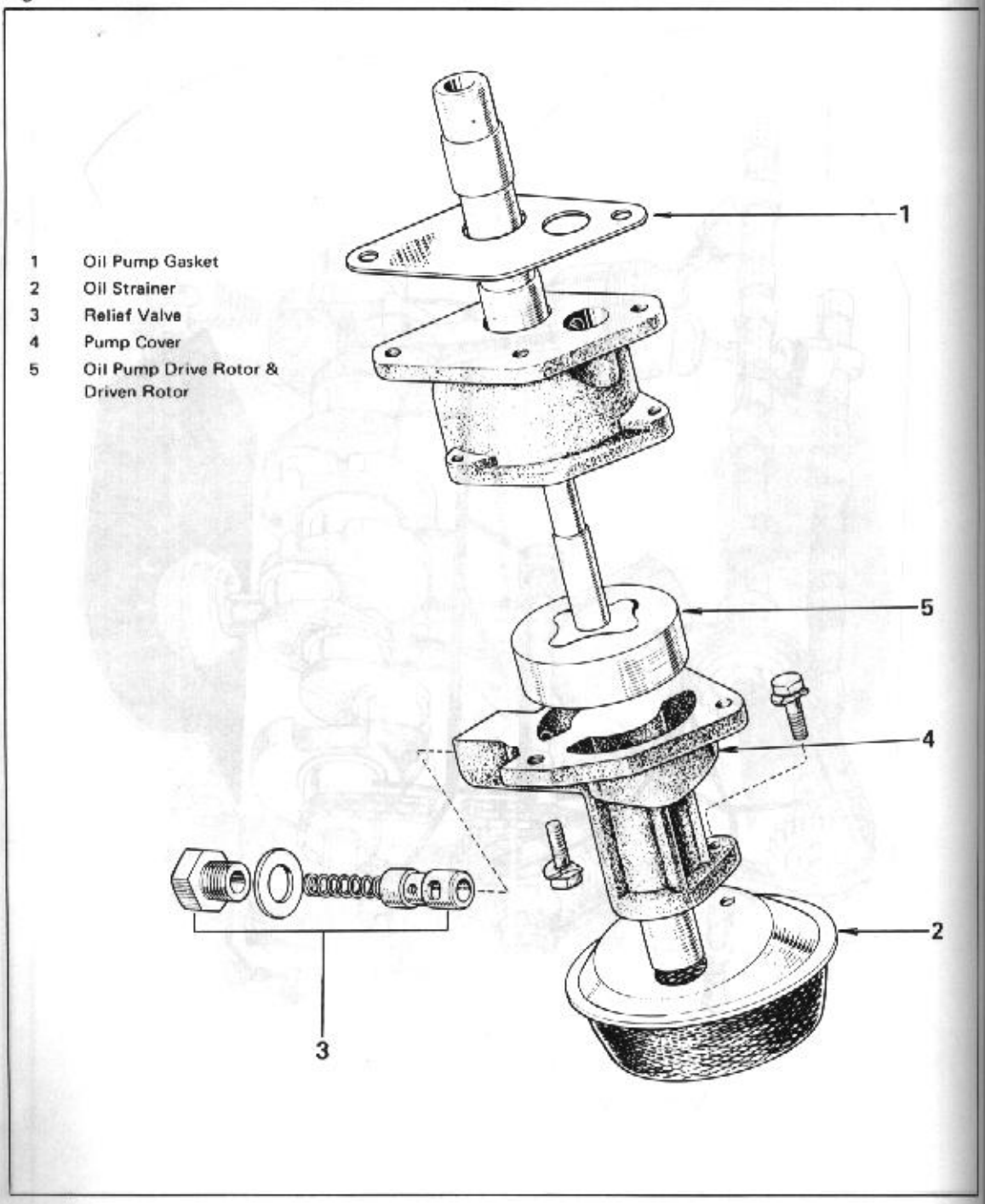


OIL PUMP

DISASSEMBLY (FOR 16R, 18R ENGINE)

Disassemble in numerical order.

Fig. 6-3



DISASSEMBLY (FOR 18R-G ENGINE)

Disassemble in numerical order.

Fig. 6-4

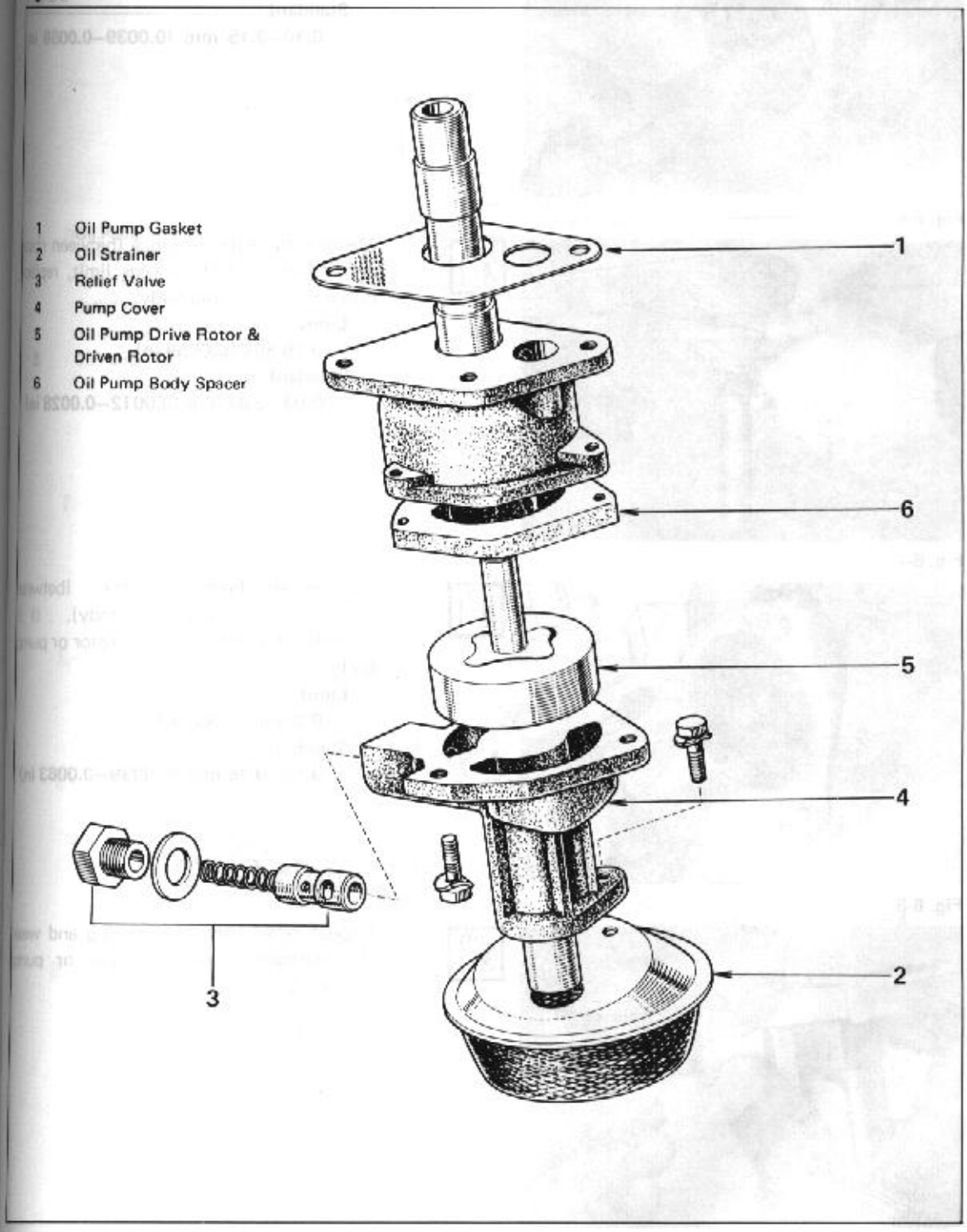
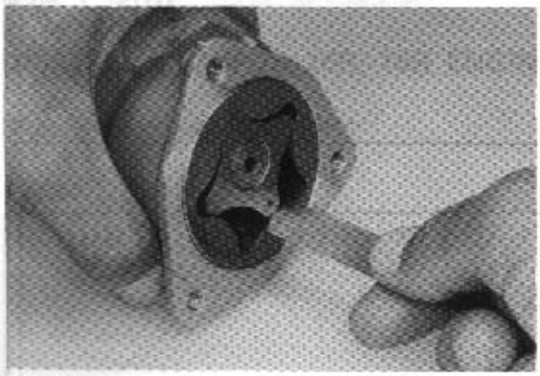


Fig. 6-5

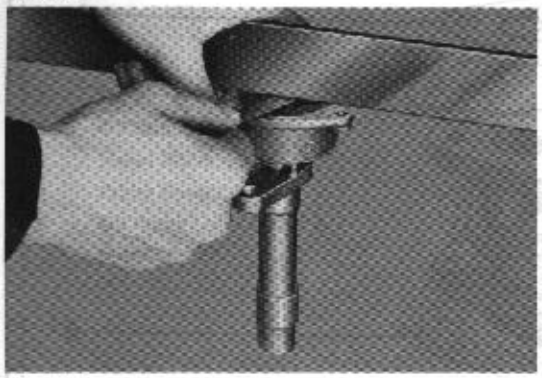


INSPECTION

1. Measure the tip clearance. If it exceed limit, replace the oil pump drive rotor or

   Limit
   0.2 mm (0.008 in)
   Standard
   0.10–0.15 mm (0.0039–0.0059 in

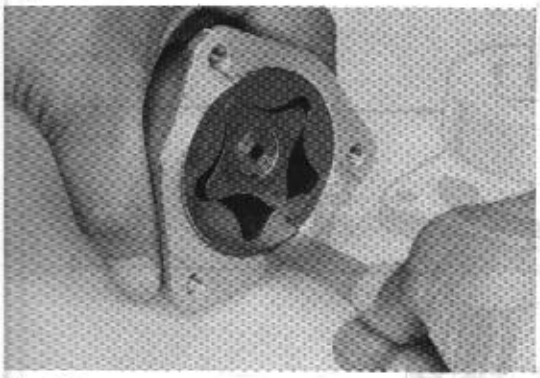
Fig. 6-6



2. Measure the side clearance (between rot and cover). If it exceeds limit, replac either rotor or pump body.

   Limit
   0.15 mm (0.0059 in)
   Standard
   0.03–0.07 mm (0.0012–0.0028 in)

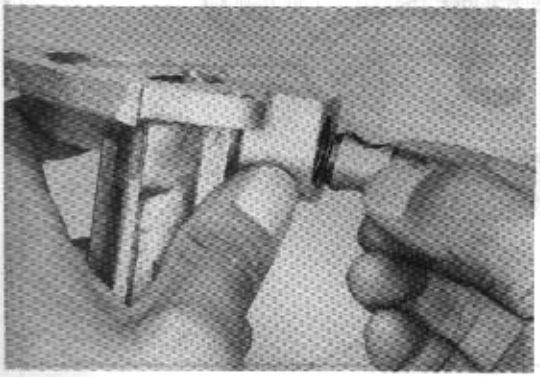
Fig. 6-7



3. Measure the body clearance (betwee driven rotor and pump body). If i exceeds limit, replace either rotor or pump body.

   Limit
   0.2 mm (0.008 in)
   Standard
   0.10–0.16 mm (0.0039–0.0063 in)

Fig. 6-8



4. Inspect relief valve for scoring and wear. If damaged, replace valve or pump assembly.

ASSEMBLY (FOR 16R, 18R ENGINE)

Assemble in numerical order.

Fig. 6-9

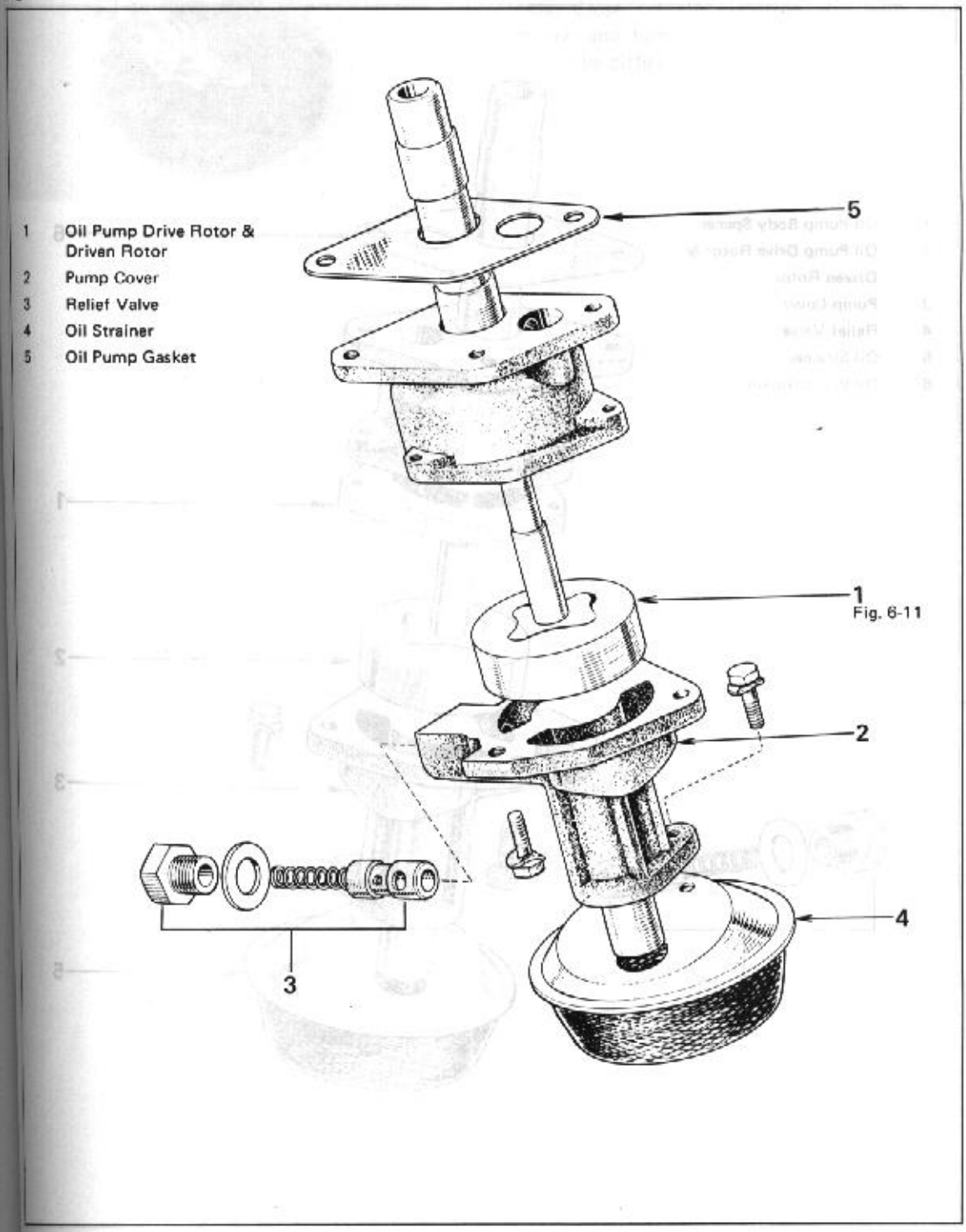


Fig. 6-11

ASSEMBLY (FOR 18R-G ENGINE)

Assemble in numerical order.

Fig. 6-10

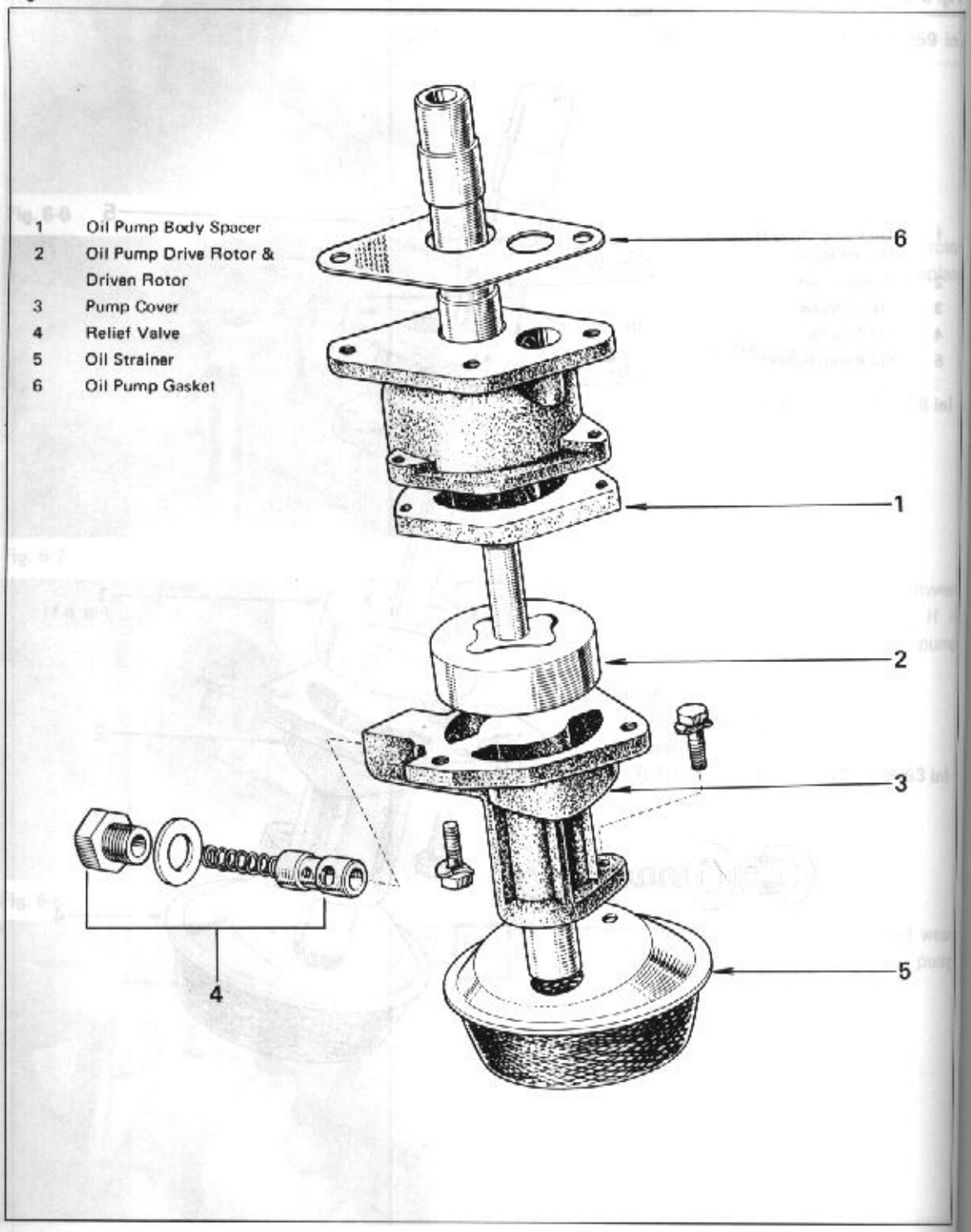
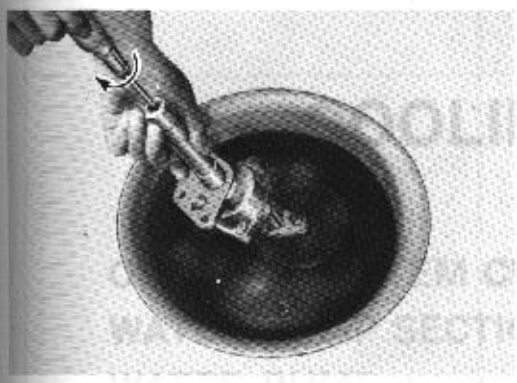


Fig. 6-11



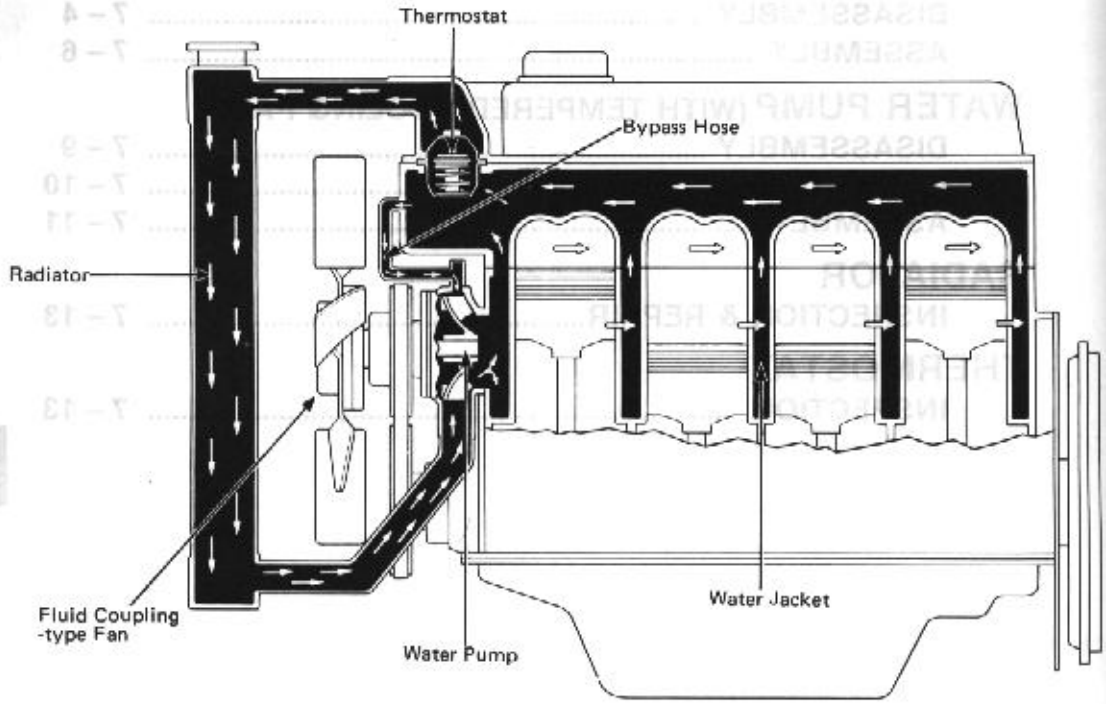
Check pump operation

Immerse the suction end of the pump into clean engine oil and turn the shaft clockwise with a screwdriver. Oil should come out of the discharge hole. Close off the discharge hole with your thumb and turn the shaft as before. The shaft should be difficult to turn.

COOLING SYSTEM

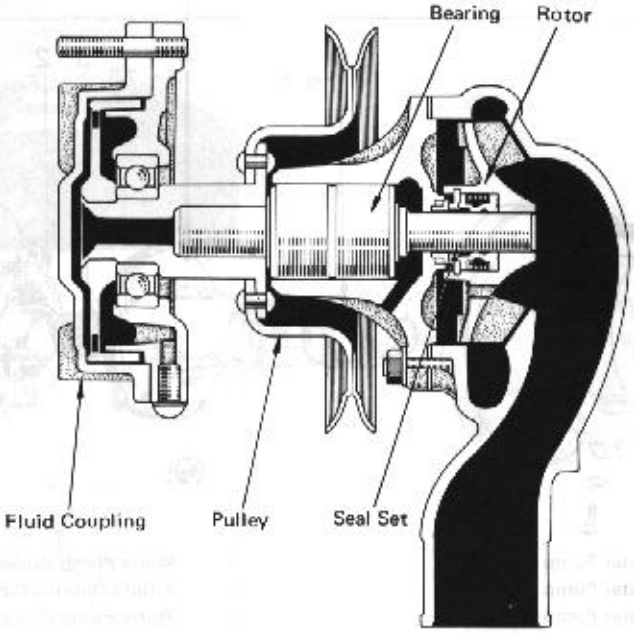
COOLING SYSTEM CIRCUIT

Fig. 7-1

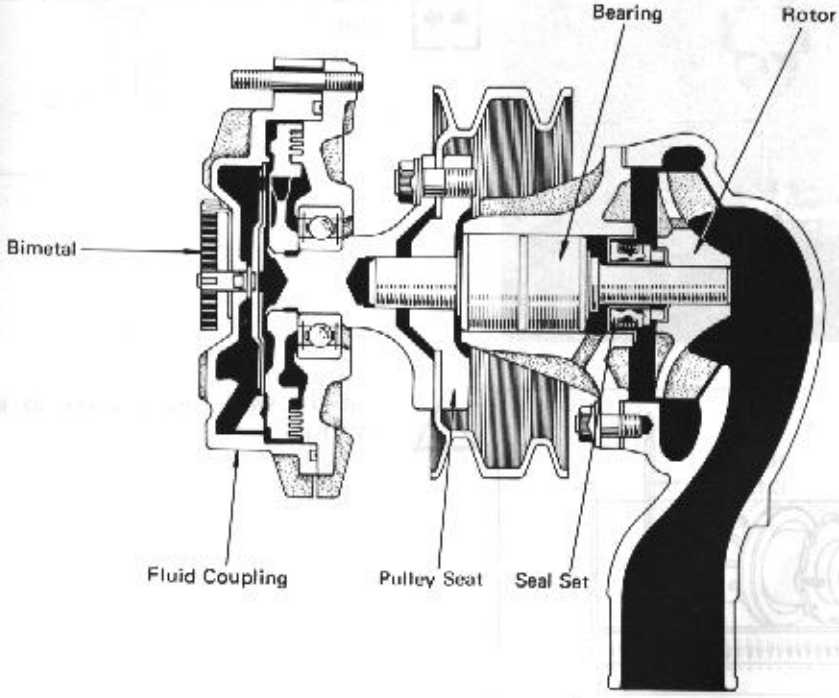


WATER PUMP SECTIONAL VIEW

Fig. 7-2



WITHOUT TEMPERED COOLING FAN



WITH TEMPERED COOLING FAN

WATER PUMP(WITHOUT TEMPERED COOLING FAN)

DISASSEMBLY

Disassemble in numerical order.

Fig. 7-3

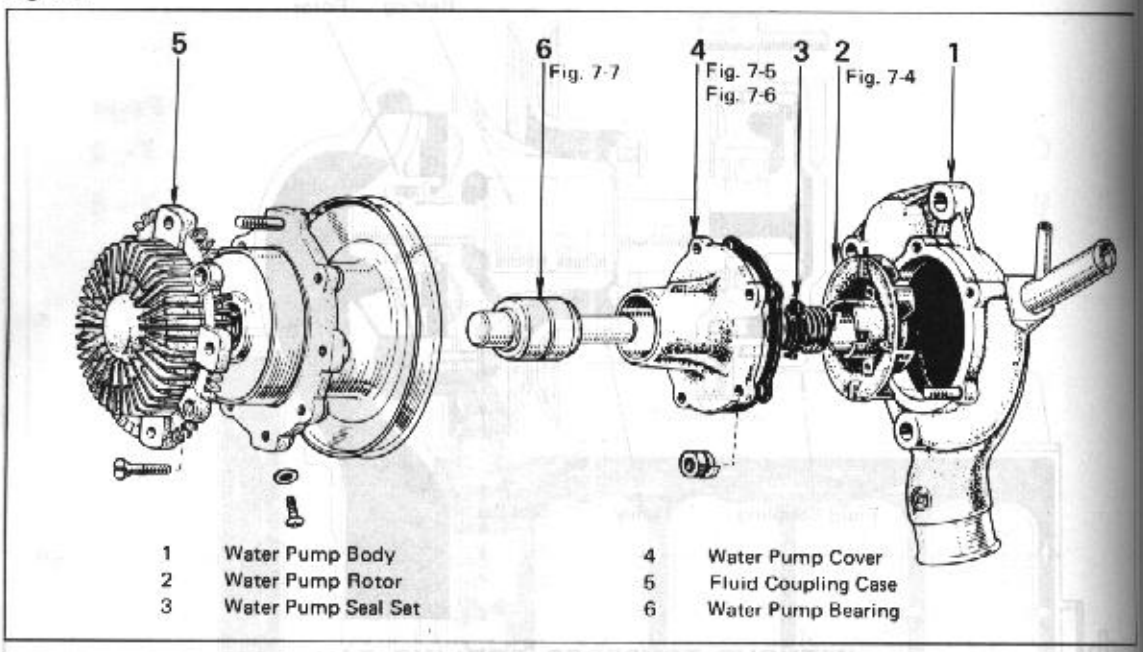
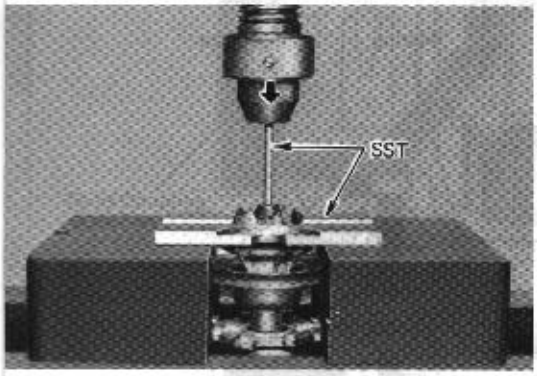
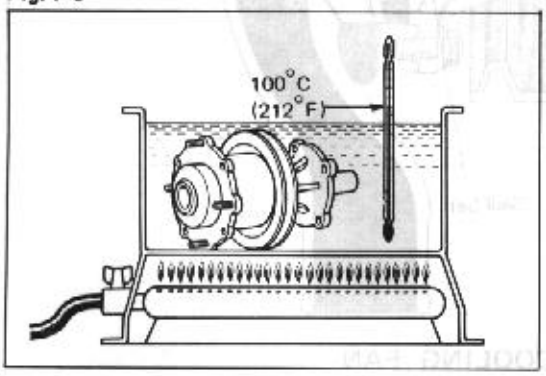


Fig. 7-4



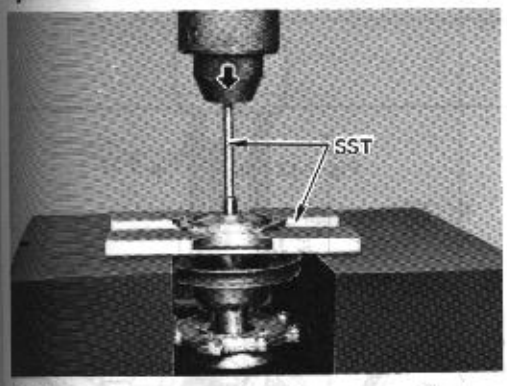
Using SST [09236-00100] and press, remove the rotor.

Fig. 7-5



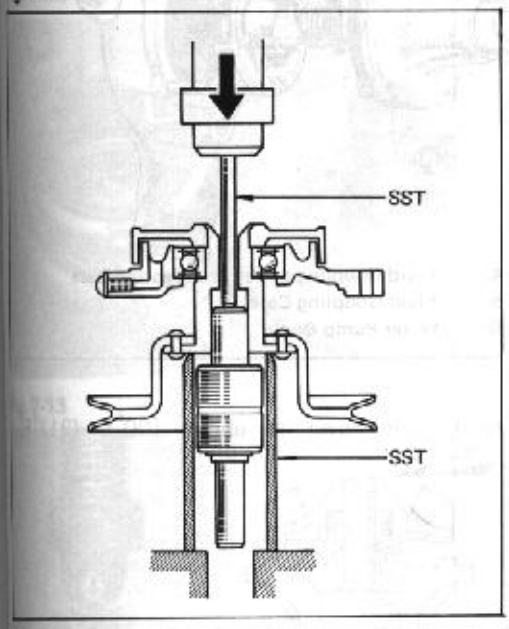
Heat the water pump cover to about 100°C (212°F).

Fig. 7-6



Using SST [09236-00100] and press, force out the bearing from cover.

Fig. 7-7



Using SST [09236-00100] and press, force out the bearing from fluid coupling.

ASSEMBLY

Assemble in numerical order.

Fig. 7-8

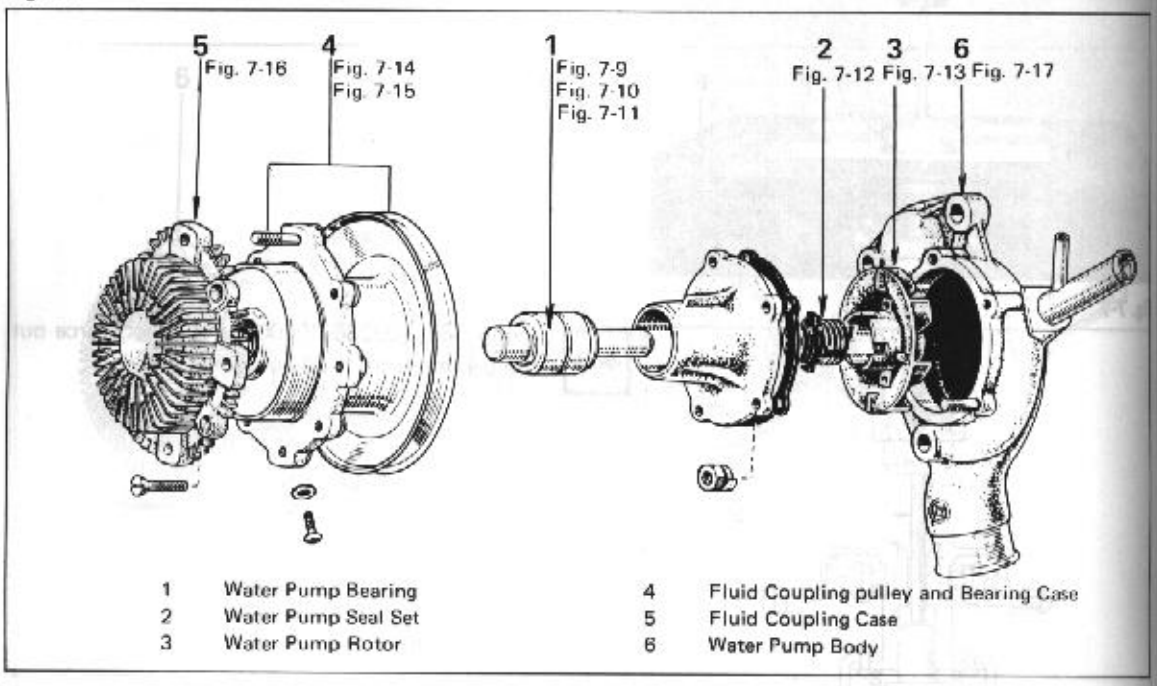
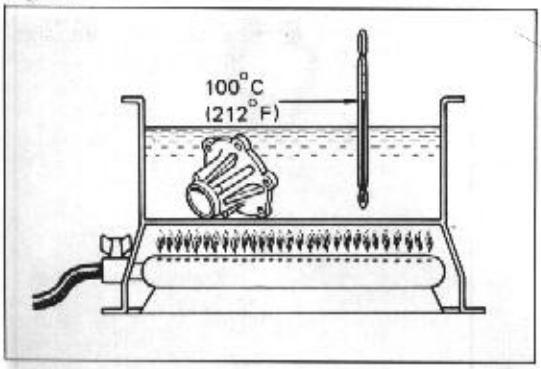
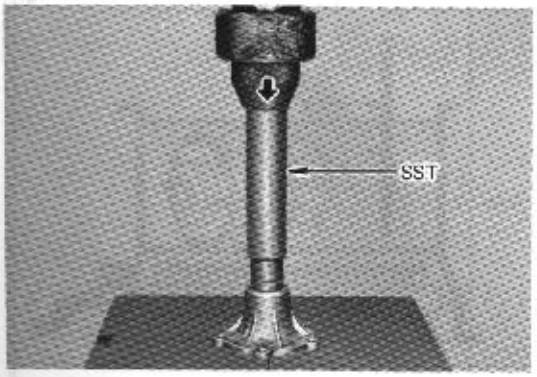


Fig. 7-9



Heat the cover to about 100°C (212°F).

Fig. 7-10

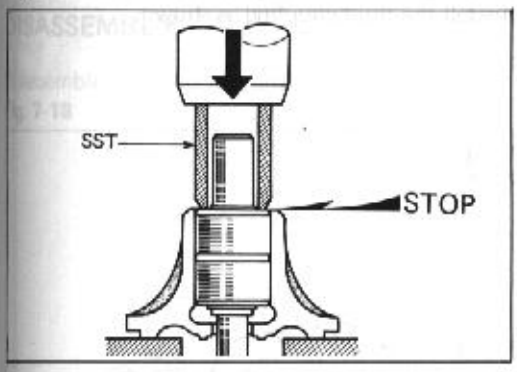


Using SST [09236-00100], press the bearing into the cover.

— caution —

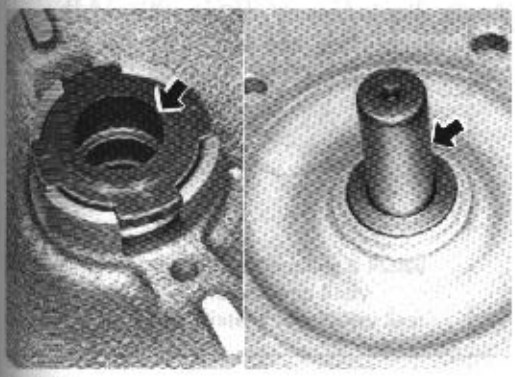
Never press on the bearing shaft.

Fig. 7-11



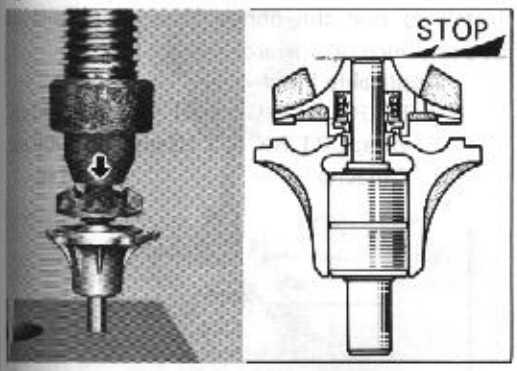
Press in until the bearing end surface is flush with the cover upper surface.

Fig. 7-12



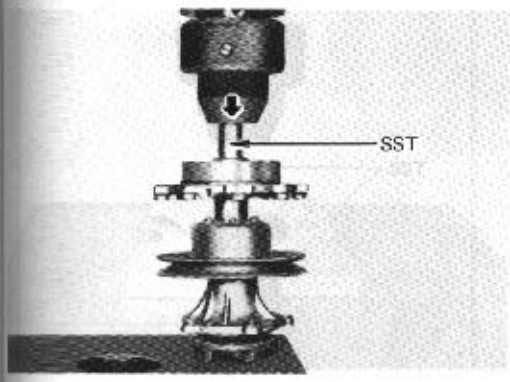
Apply a small amount of silicon oil on contacting surface between the floating seat and the thrust washer, and assemble the seal set.

Fig. 7-13



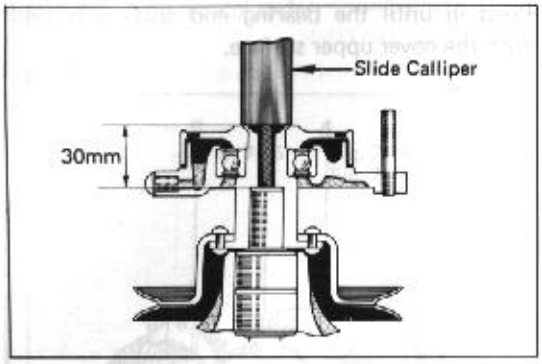
Press the rotor into the bearing shaft, and align the shaft and rotor at top end surface.

Fig. 7-14



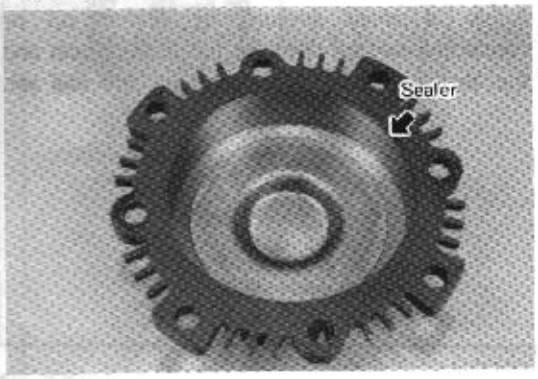
Using SST [09236-00100] and press, install the fluid coupling onto the bearing shaft.

Fig. 7-15



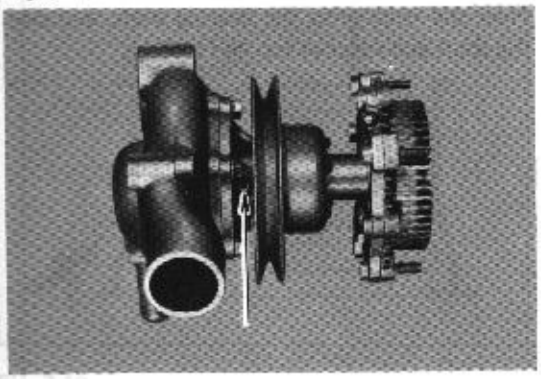
Install the fluid coupling as shown.

Fig. 7-16



Apply liquid sealer on the coupling case mounting surface and install the coupling case.

Fig. 7-17



Install so that the pump cover drain hole will be positioned downward.

Applicable Fluid

RT,RX A/T (General)	**6,000 cst**
except RT,RX A/T (General)	**3,000 cst**
Capacity	**25 cc**

WATER PUMP (WITH TEMPERED COOLING FAN)

DISASSEMBLY

Disassemble in numerical order.

Fig. 7-18

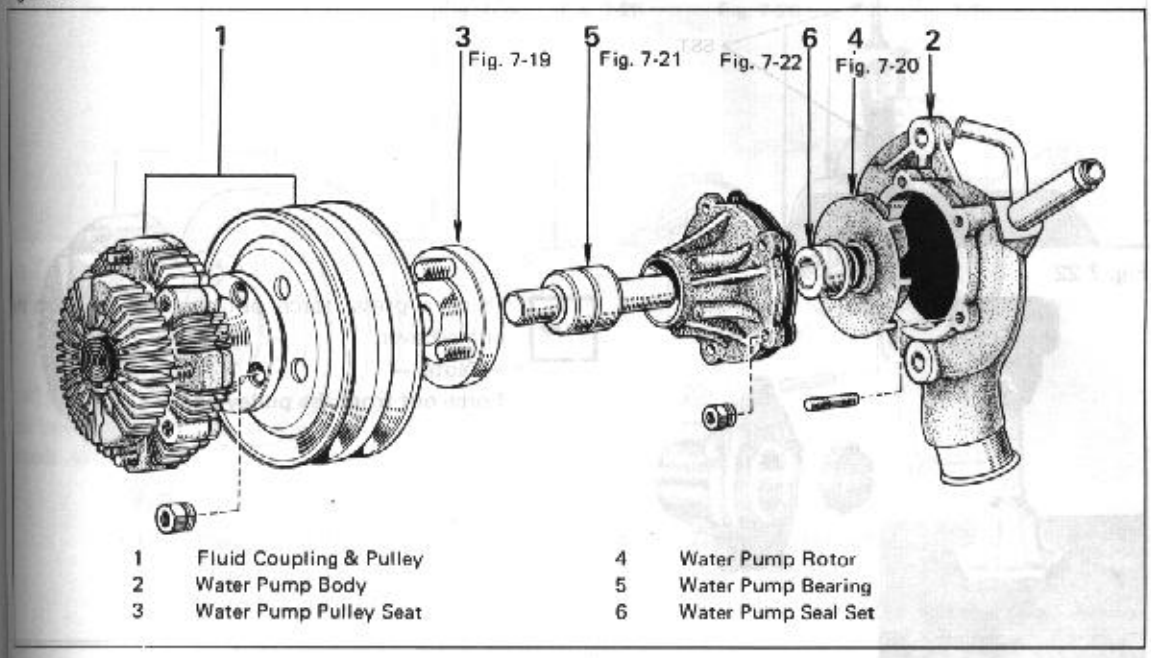
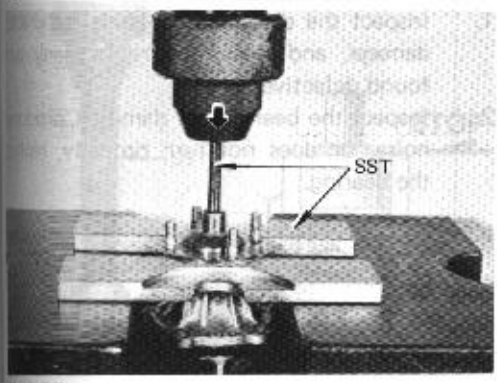
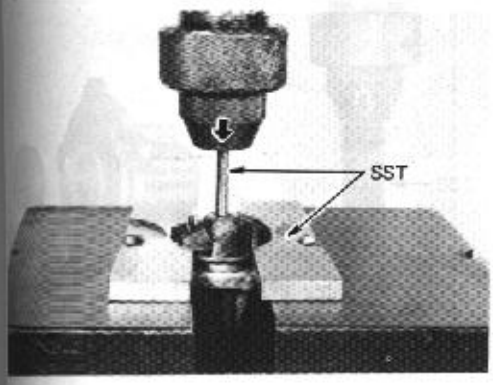


Fig. 7-19



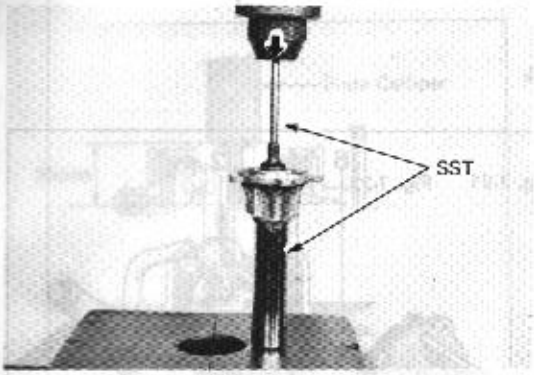
Using SST [09236-00100] and a press, force out the bearing shaft from the pulley seat.

Fig. 7-20



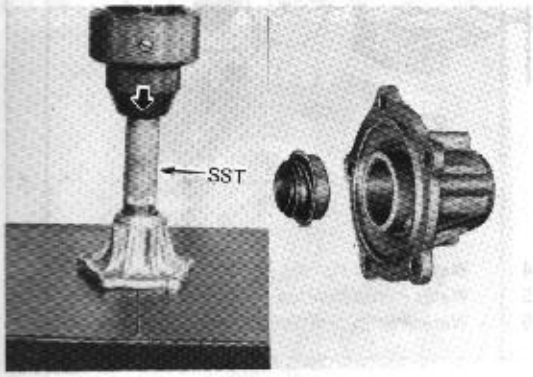
Using SST [09236-00100] and a press, force out the bearing shaft from the rotor.

Fig. 7-21



Heat the water pump cover to about 100°C (212°F), and using SST [09236-00100] and a press, force out the bearing from the pump cover.

Fig. 7-22

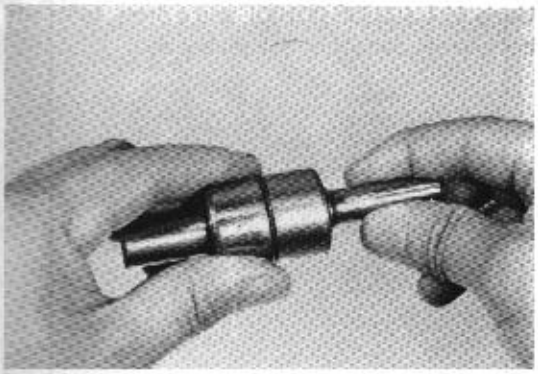


Using a press, force out the seal set from the pump cover.

— Note —

Force out from the pulley end.

Fig. 7-23



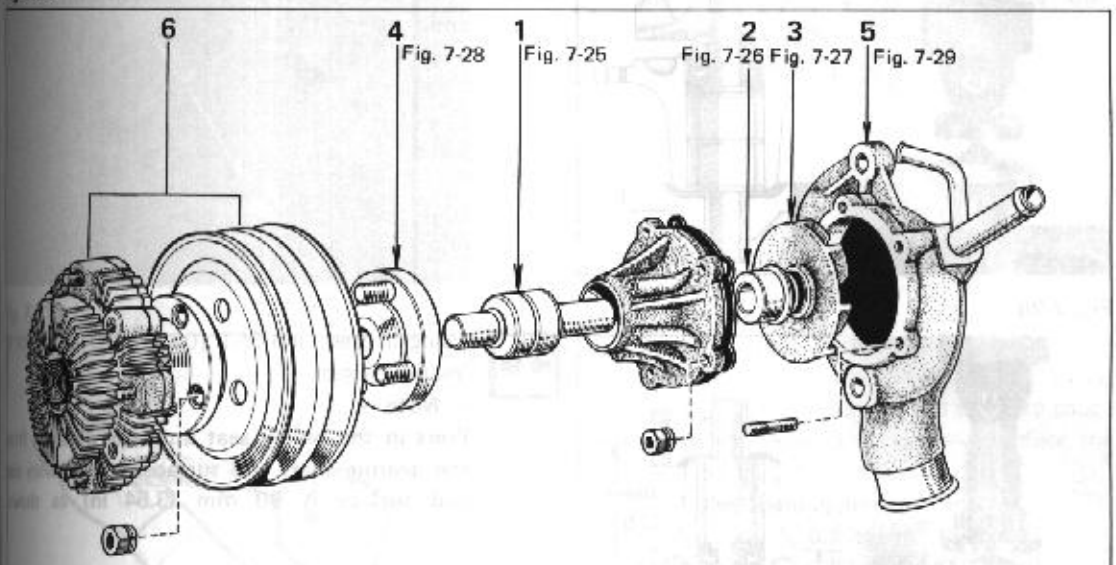
INSPECTION

1. Inspect the disassembled parts for cracks, damage, and wear, and replace any part found defective.
2. Inspect the bearing. If damaged, produces noise, or does not turn properly, replace the bearing.

ASSEMBLY

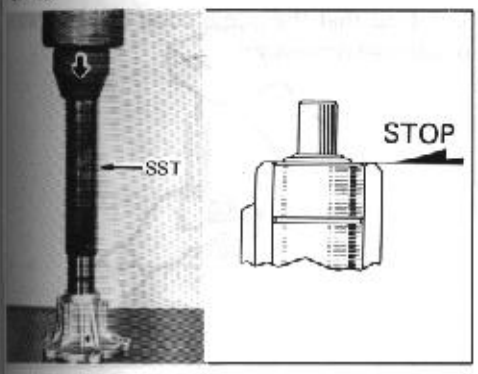
Assemble in numerical order.

Fig. 7-24



1	Water Pump Bearing	4	Water Pump Pulley Seat
2	Water Pump Seal Set	5	Water Pump Body
3	Water Pump Rotor	6	Fluid Coupling & Pulley

Fig. 7-25

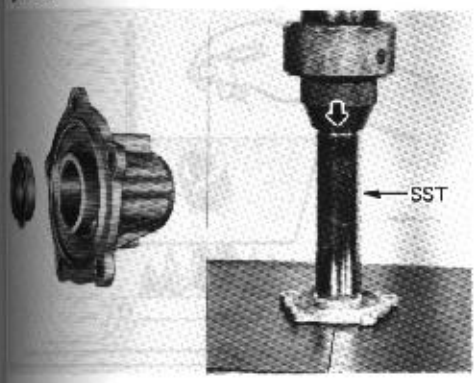


Heat the pump cover to about 100°C (212°F) and force in the bearing with SST [09236-00100] and press.

— Note —

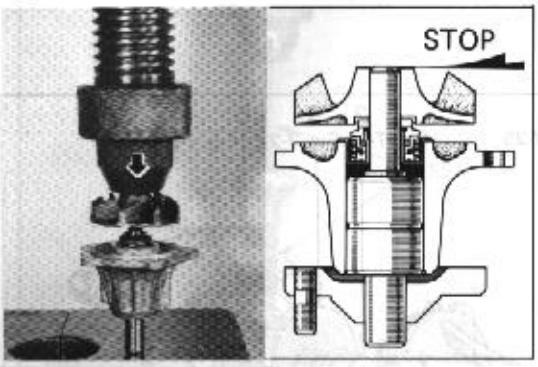
Press in the bearing until its end surface is flush with cover surface.

Fig. 7-26



Apply liquid sealer on the seal set, and press the seal set into the pump cover.

Fig. 7-27

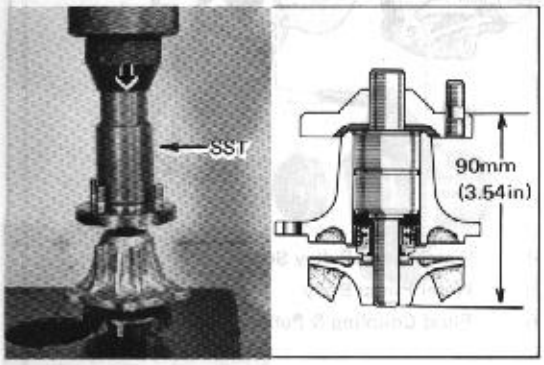


Using a press, force in rotor.

– Note –

Press in the rotor until it is flush with the shaft end.

Fig. 7-28

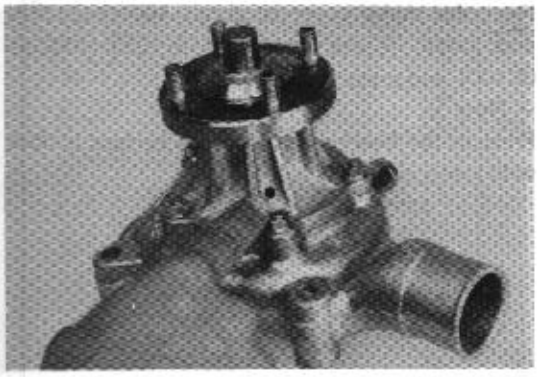


Using a press and SST [09238-40010], force in the pulley seat.

– Note –

Press in the pulley seat until the distance from the bearing shaft end surface to the pulley seat end surface is 90 mm (3.54 in) as shown.

Fig. 7-29

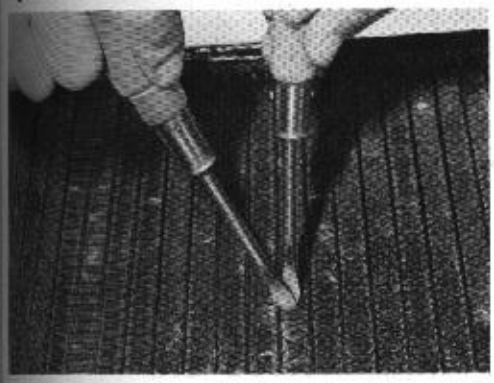


Install so that the pump cover drain hole will be positioned downward.

RADIATOR

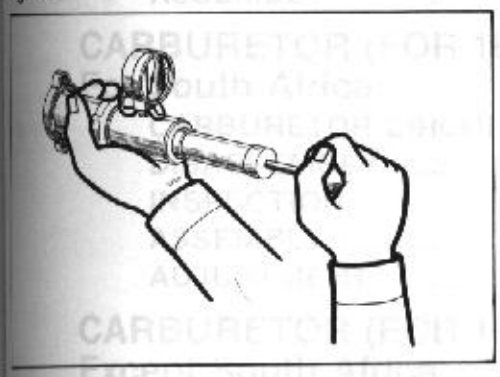
INSPECTION & REPAIR

Fig. 7-30



1. Inspect the radiator core fins, and repair any fins blocking air passage by the method as shown.

Fig. 7-31

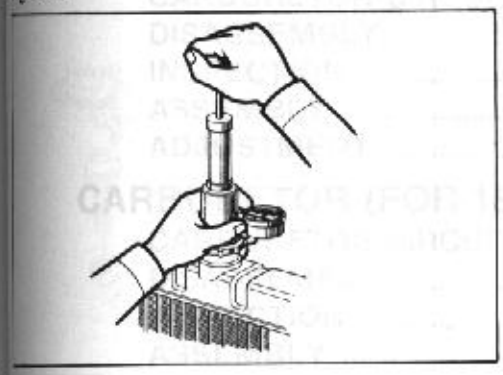


2. Inspect the radiator cap regulation pressure and vacuum valves for spring tension and seating. If the pressure gauge drops rapidly and excessively, replace the radiator cap.

Valve opening pressure limit

	0.6 kg/cm² (8.5 psi)
Standard	**0.9 kg/cm² (12.8 psi)**

Fig. 7-32

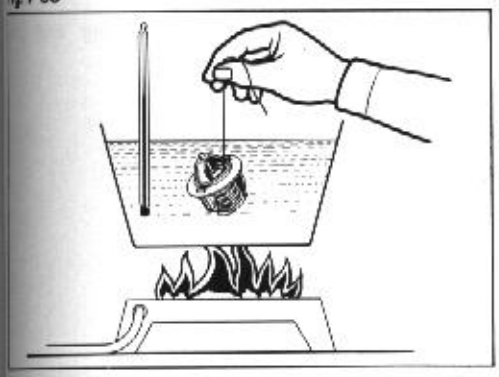


3. Inspect the cooling system for leaks. Attach the pressure tester to the radiator and pump it to the specified pressure. If the pressure gauge drops, inspect all hoses and fittings for an external leak. If no external leak is found, an internal intake manifold, block or heater core leak should be suspected.

THERMOSTAT

INSPECTION

Fig. 7-33



1. Replace if the valve remains open at normal temperature or does not have proper tightness when fully closed.
2. Immerse the thermostat in the water, and check the valve opening temperatures by heating the water gradually.
   The valve is satisfactory if it starts to open at 88°C (190°C) and opens to more than 8 mm (0.32 in) at 100°C (212°F).
   Replace if necessary.

FUEL SYSTEM

FUEL PUMP

DISASSEMBLY

Disassemble in numerical order.

Fig. 8-1

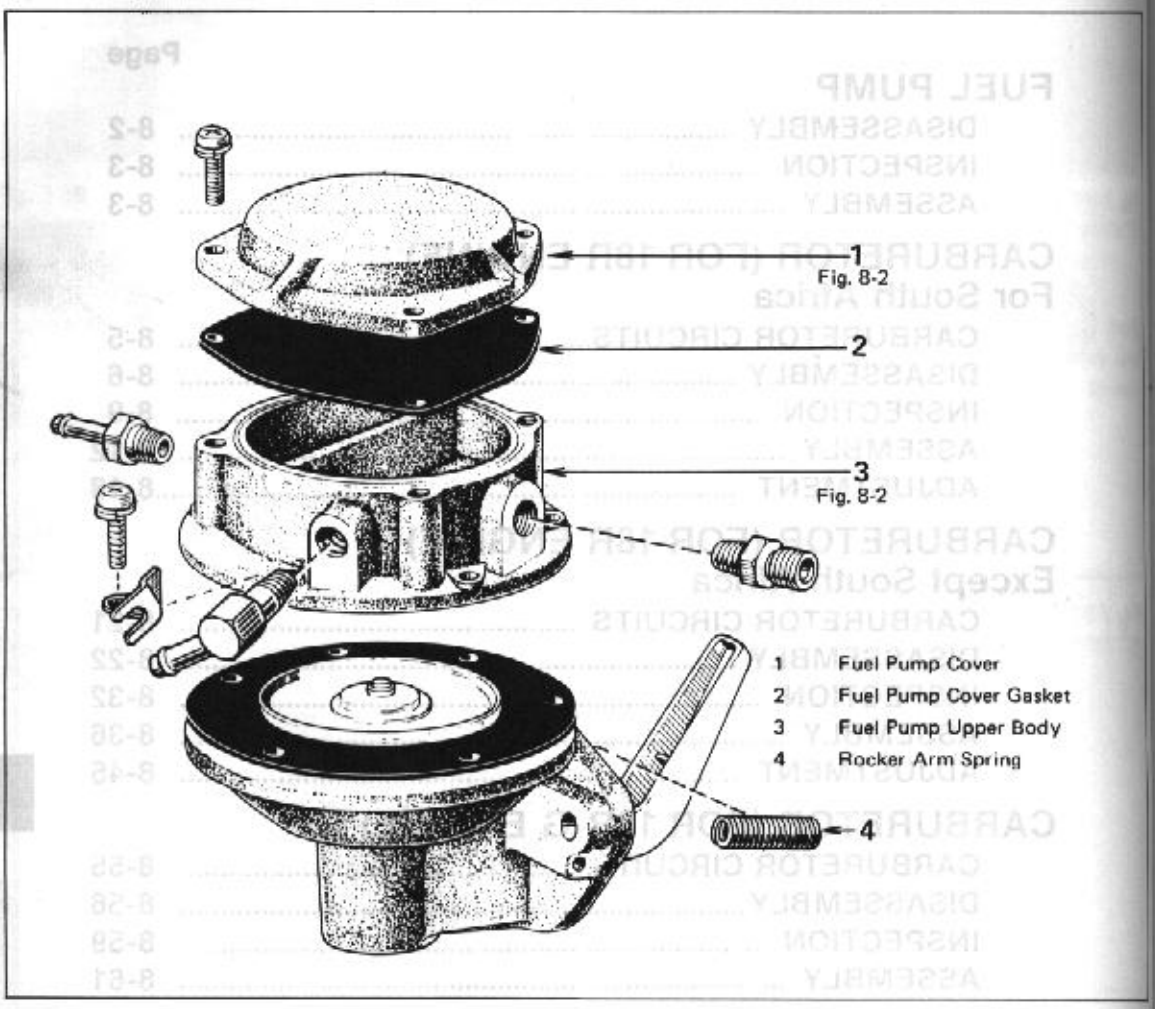
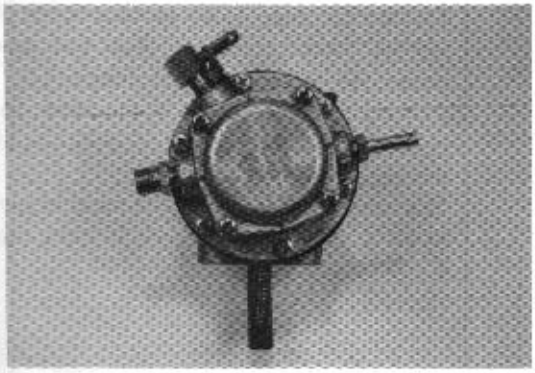
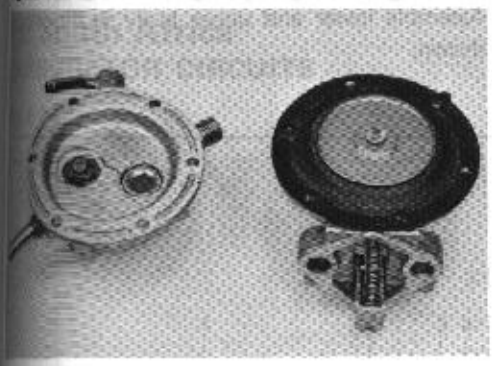


Fig. 8-2



⚠ Mark the position of pump cover and upper body.

Fig. 8-3



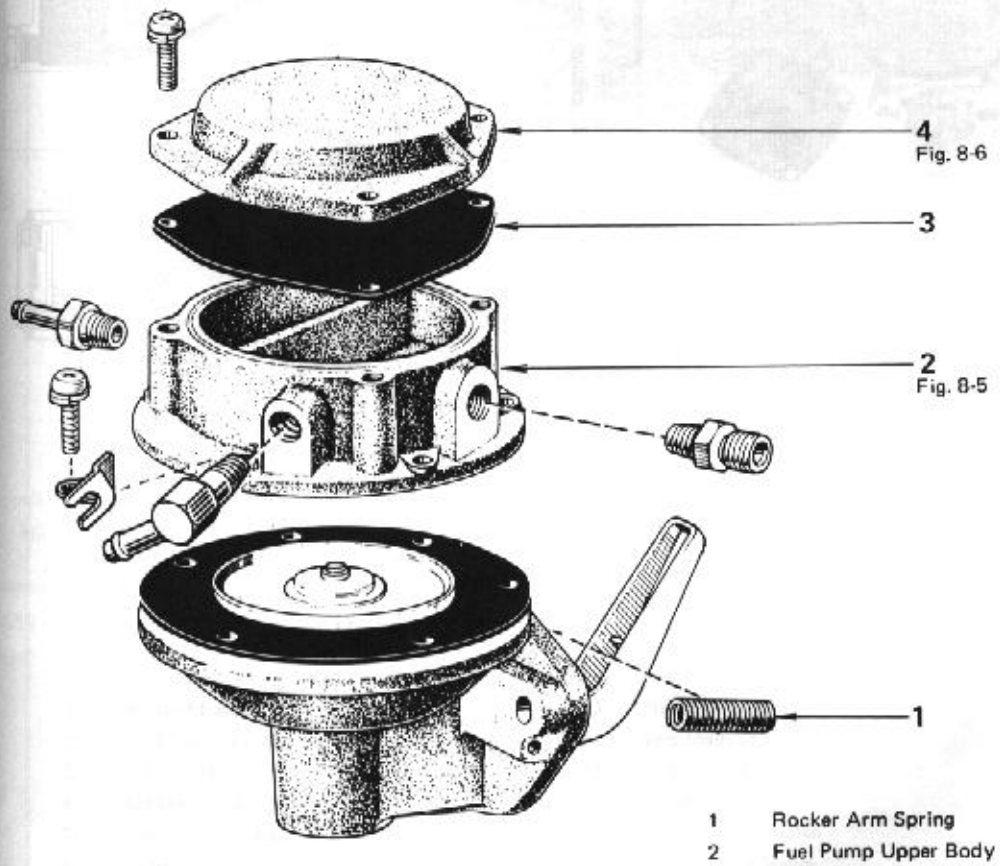
INSPECTION

Inspect diaphragms for tear and check valves for defective operation. Replace if damaged.

ASSEMBLY

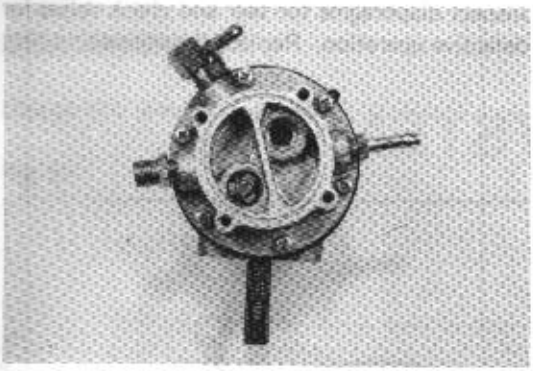
Assemble in numerical order.

Fig. 8-4



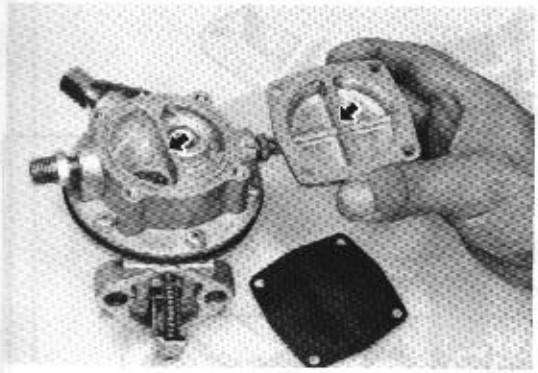
1 Rocker Arm Spring
2 Fuel Pump Upper Body
3 Fuel Pump Cover Gasket
4 Fuel Pump Cover

Fig. 8-5



Assemble lower and upper body in direction as shown.

Fig. 8-6



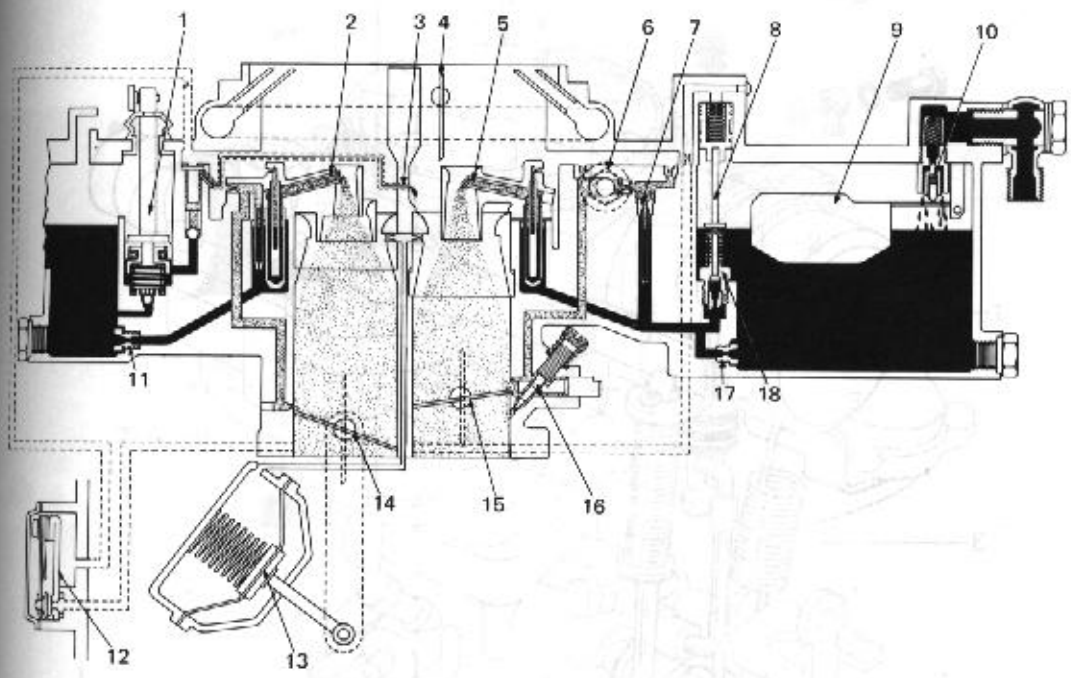
Assemble upper body and cover over the diaphragm.
Inlet and outlet chamber separating walls should be aligned.

CARBURETOR(FOR 18R ENGINE)

For South Africa

CARBURETOR CIRCUITS

Fig. 8-7



1	Pump Plunger	10	Needle Valve
2	2nd Main Nozzle	11	2nd Main Jet
3	Pump Jet	12	Thermostatic Valve
4	Choke Valve	13	Diaphragm
5	1st Main Nozzle	14	2nd Throttle Valve
6	Solenoid Valve	15	1st Throttle Valve
7	Slow Jet	16	Idle Mixture Adjusting Screw
8	Power Piston	17	1st Main Jet
9	Float	18	Power Valve

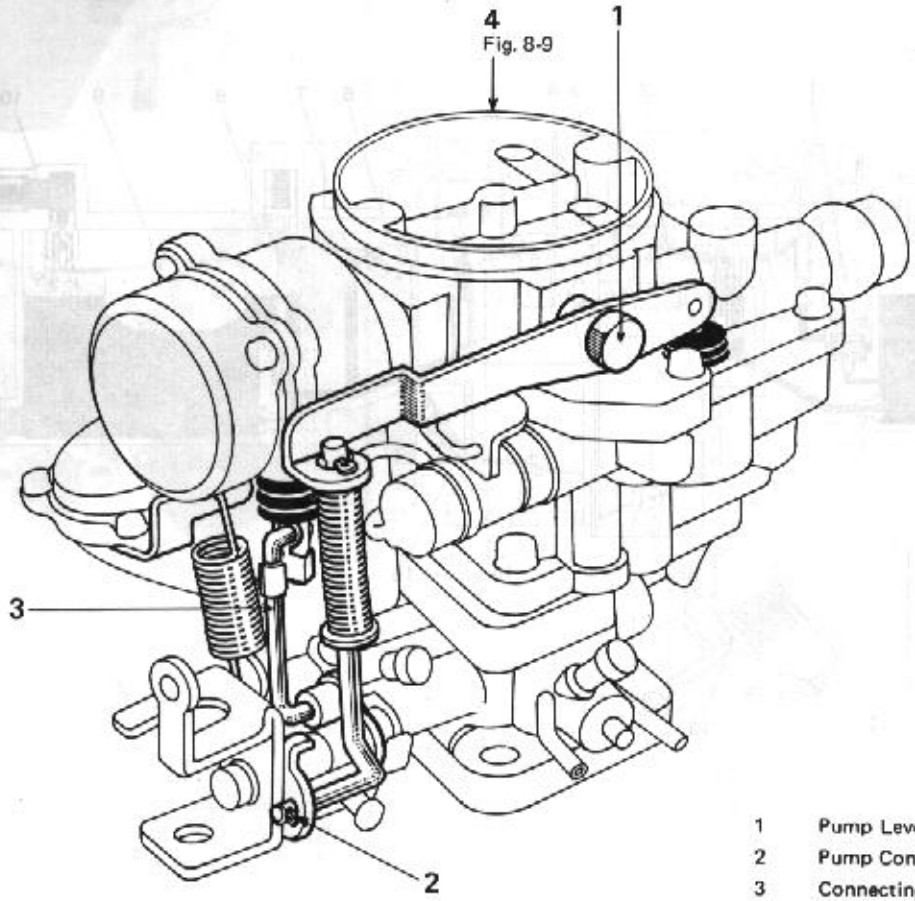
DISASSEMBLY

Air Horn

Disassemble in numerical order.

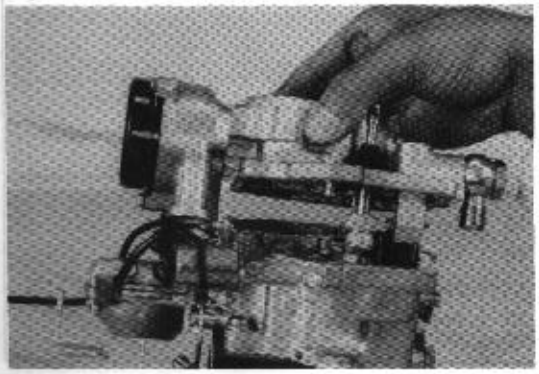
Fig. 8-8

USE SST [09860-11011] FOR CARBURETOR SERVICING



1 Pump Lever
2 Pump Connecting Link
3 Connecting Link
4 Air Horn

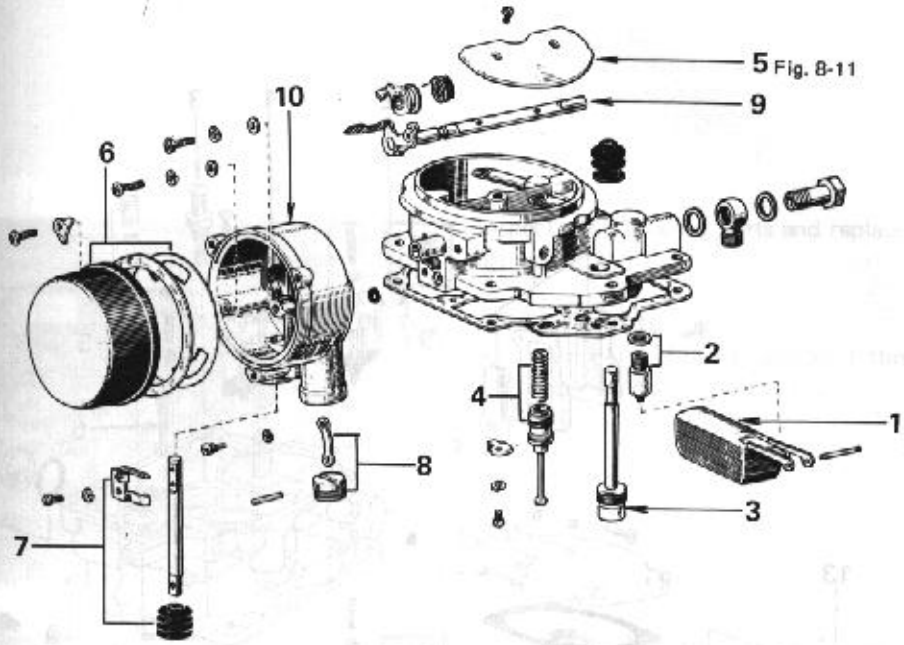
Fig. 8-9



Lift out air horn.

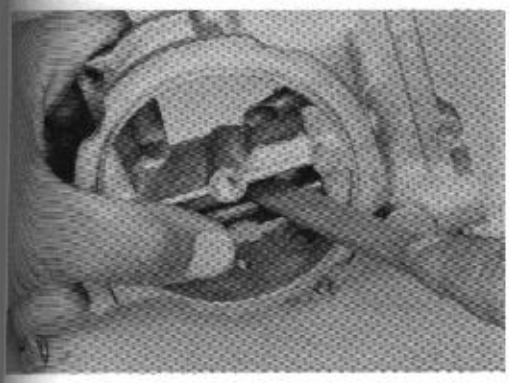
Disassemble in numerical order.

Fig. 8-10



1	Float	6	Coil Housing & Plate
2	Needle Valve Sub-assembly	7	Sliding Rod & Fast Idle Cam Follower
3	Pump Plunger	8	Vacuum Piston & Connector
4	Power Piston & Spring	9	Choke Shaft
5	Choke Valve	10	Thermostat Case

Fig. 8-11

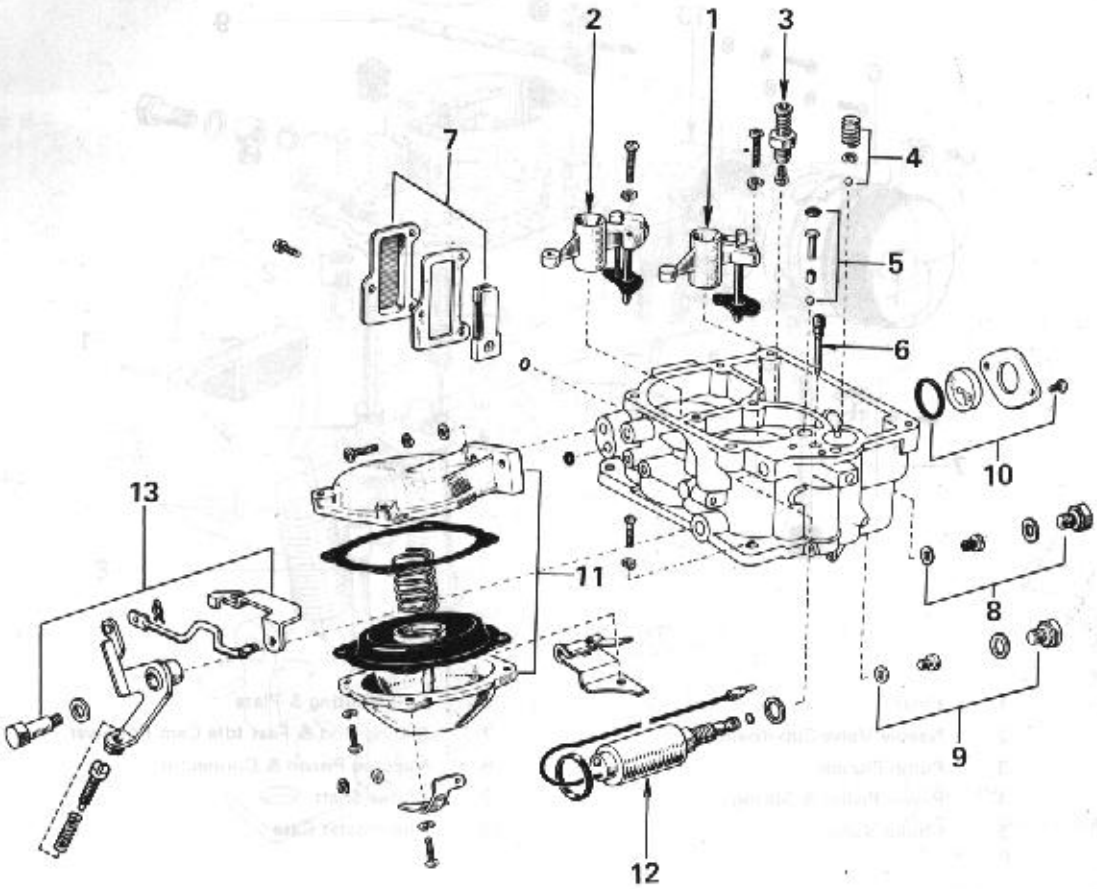


File off the set screw ends and remove the choke valve.

Body

Disassemble in numerical order.

Fig. 8-12



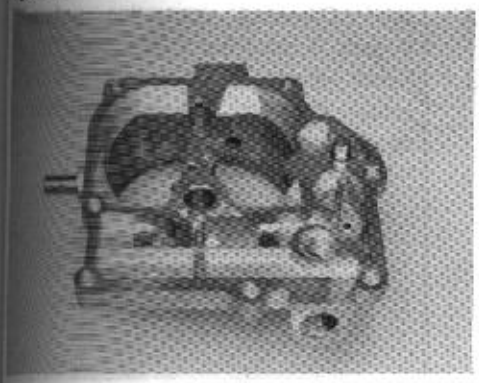
1	First Small Venturi	8	First Main Jet
2	Second Small Venturi	9	Second Main Jet
3	Power Valve	10	Level Gauge Glass
4	Pump Damping Spring & Steel Ball	11	Diaphragm Sub-assembly
5	Pump Discharge Weight & Steel Ball	12	Solenoid Valve
6	Slow Jet	13	Lever (For T.P.)
7	Thermostatic Valve		

INSPECTION

- Precaution –

1. Before inspecting the parts, wash them thoroughly in gasoline. Using compressed air, blow all dirt and other foreign matter from the jets and similar parts, and from the fuel passages and apertures in the body.
2. **Never clean the jets or orifices with wire or a drill. This could enlarge the openings and result in excessive fuel consumption.**

Fig. 8-13

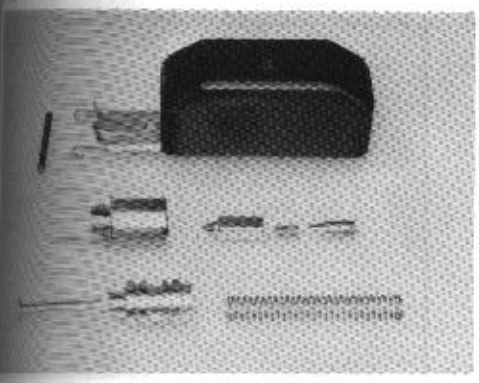


Inspect the following parts and replace any part damaged.

Air Horn Parts

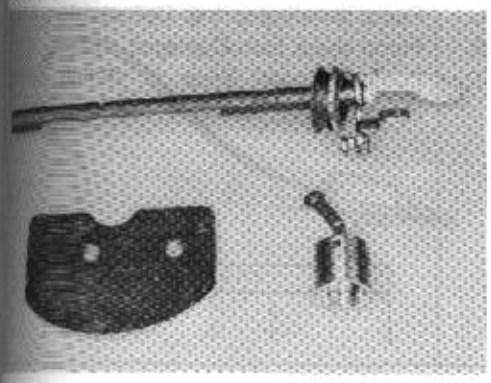
1. Air horn: Cracks, damaged threads, and wear on choke shaft bores.

Fig. 8-14



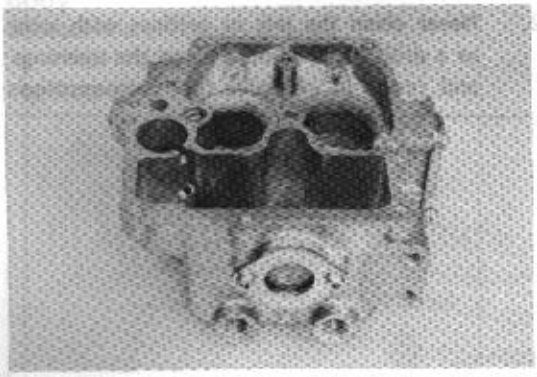
2. Float: Broken lip, wear in float pivot pin holes.
3. Needle valve surface contacting valve seat.
4. Strainer: Rust, breaks.
5. Power piston : Scratches, excessive wear. Power piston spring broken or deformed.

Fig. 8-15



6. Vacuum piston: Defective sliding of piston, carbon adhering to the inside thermostat case.
7. Choke valve: Deformation. Choke shaft worn, bent, or not fitting properly into housing.

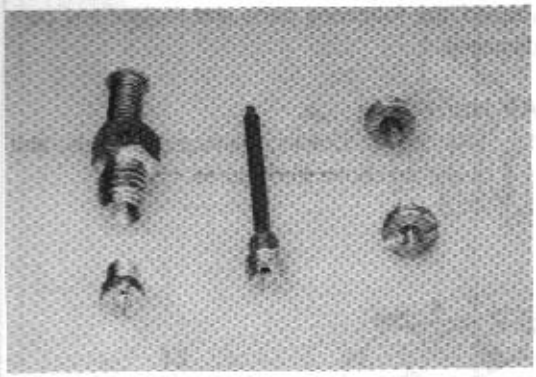
Fig. 8-16



Body Parts

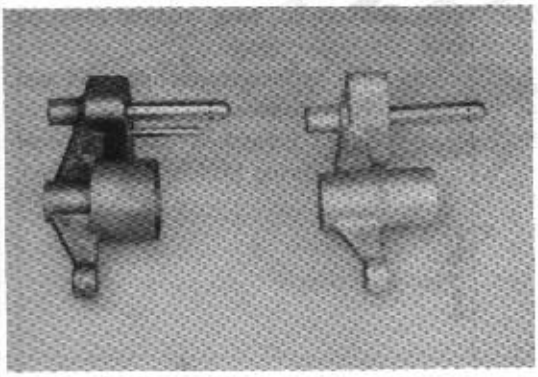
1. Body: Cracks, scored mounting surfaces, damaged threads.

Fig. 8-17



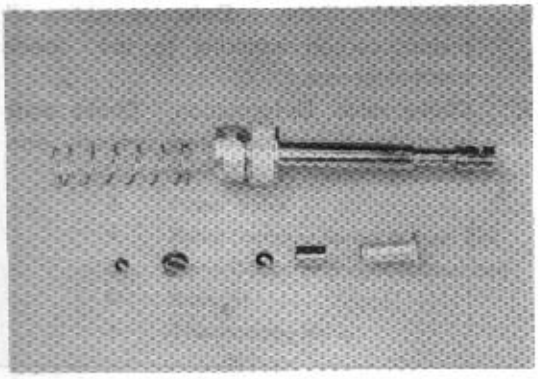
2. Jets: Damaged contacting surface or threads. Screwdriver slots.
3. Power valve: Faulty opening and closing action. Clogged. Damaged contacting surface or threads.

Fig. 8-18



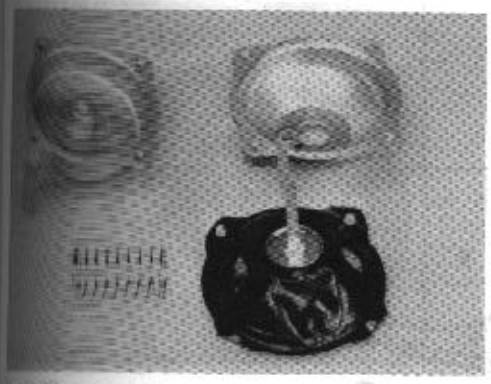
4. Venturi: Clogged or damaged.

Fig. 8-19



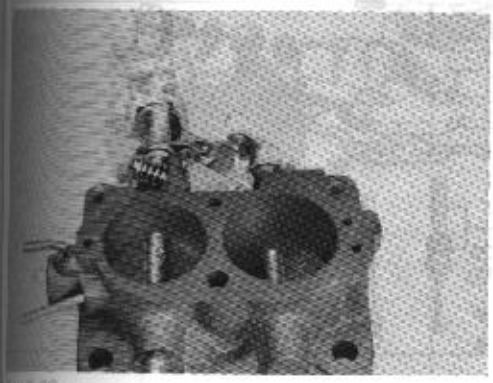
5. Pump damping spring: Deformation, rust.
6. Pump check ball: Damaged, rusted.
7. Pump plunger: Wear at sliding surface, deformed or damaged leather.

Fig. 8-20



8. Secondary diaphragm: Damaged.

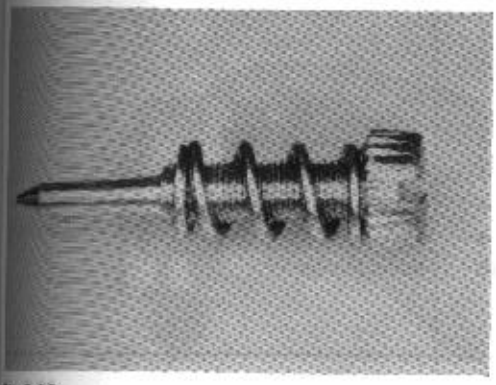
Fig. 8-21



Flange Parts

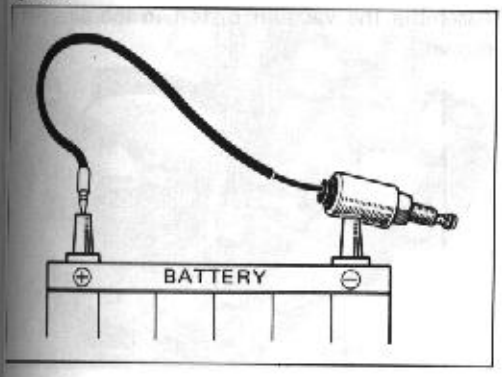
1. Flange: Cracks, injured mounting surfaces, damaged threads, wear at throttle shaft bearings.
2. Throttle valves: Wear or deformation in valves. Wear, bending, twisting, or faulty movement inside housing of shaft.

Fig. 8-22



3. Idle mixture adjusting screw: Damage at tapered tip or threads.

Fig. 8-23



Solenoid Valve

Check operation of solenoid valve.

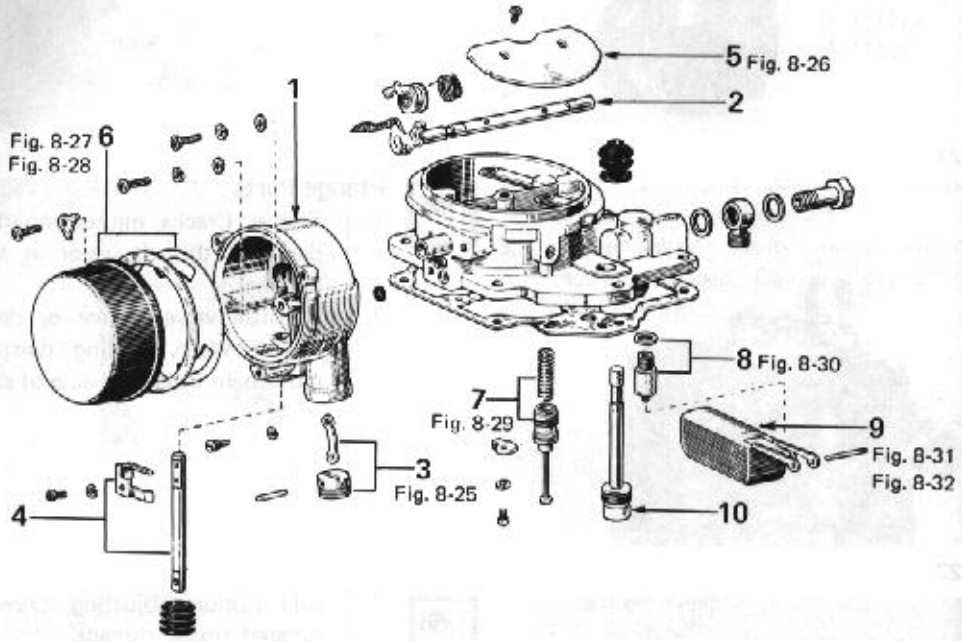
Connect wiring to the battery positive terminal and ground the body. The needle valve should be pulled in.

ASSEMBLY

Air Horn

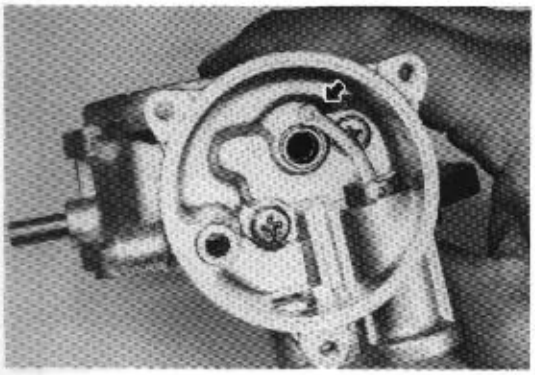
Assemble in numerical order.

Fig. 8-24



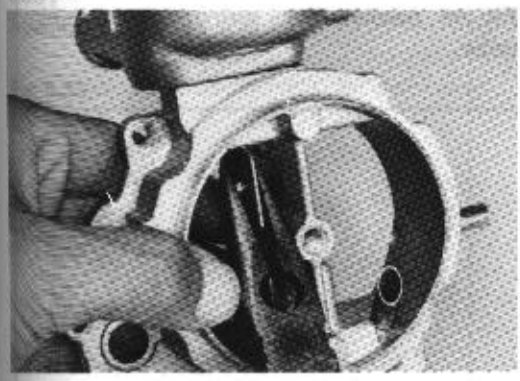
1	Thermostat Case	6	Coil Housing & Plate
2	Choke Shaft	7	Power Piston & Spring
3	Vacuum Piston & Connector	8	Needle Valve Sub-assembly
4	Sliding Rod & Fast Idle Cam Follower	9	Float
5	Choke Valve	10	Pump Plunger

Fig. 8-25



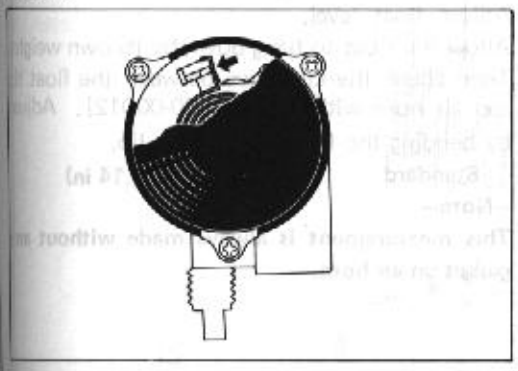
Assemble the vacuum piston in the direction as shown.

Fig. 8-26



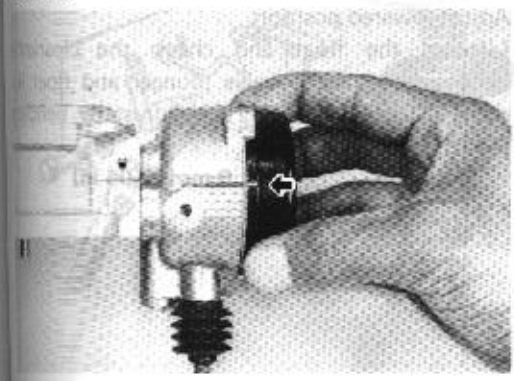
Install the choke valve and peen the screws.

Fig. 8-27



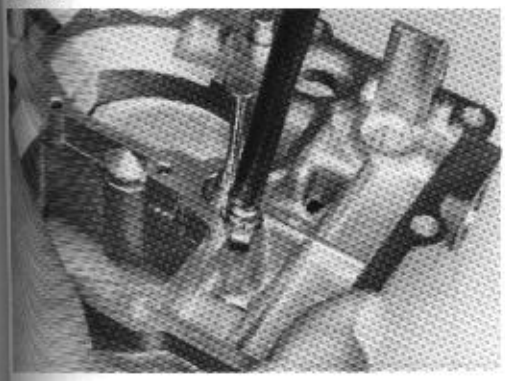
Align the bimetal with the choke shaft when installing the housing.

Fig. 8-28



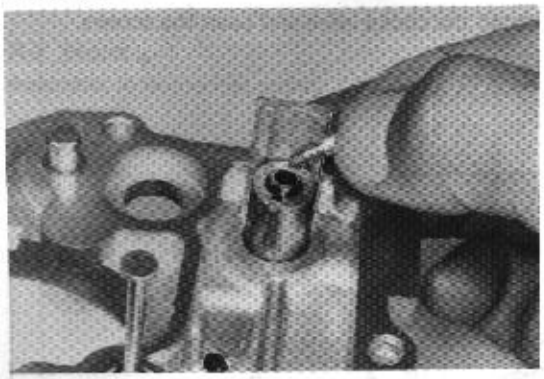
Align the case scale center line against the housing scale line.
Check the choke valve to see that it will close completely when released from fully open position. (Atmospheric temperature below 25°C or 77°F).

Fig. 8-29



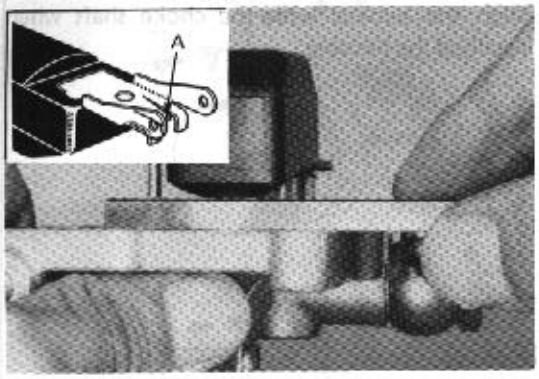
Install power piston and spring.
Make sure that the piston moves smoothly.

Fig. 8-30



Fit on needle valve, spring and push pin in order.

Fig. 8-31



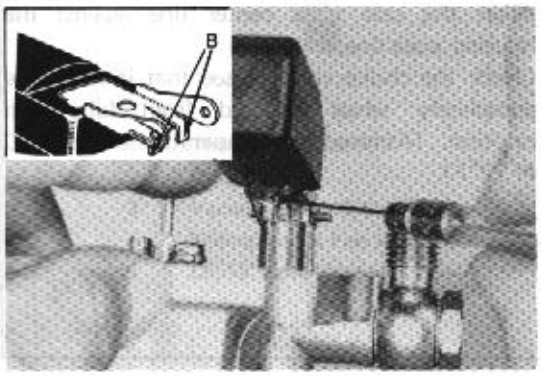
Adjust float level.
Allow the float to hang down by its own weight. Then check the clearance between the float tip and air horn with SST [09240-00012]. Adjust by bending the (A) part of float lip.

Standard **3.5 mm (0.14 in)**

–Note–

This measurement is always made without any gasket on air horn.

Fig. 8-32



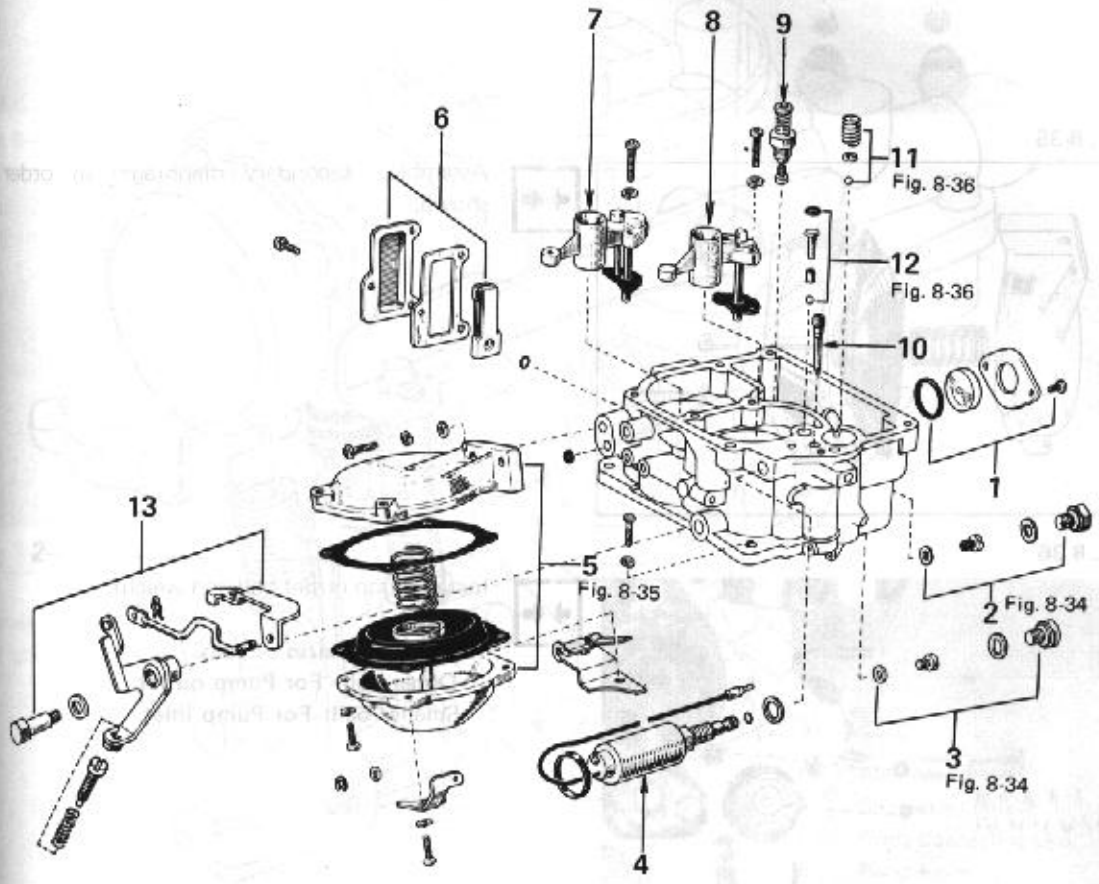
Adjust lowered position.
Lift up the float and check the clearance between the needle valve plunger and float lip with SST [09240-00012]. Adjust by bending the (B) part of float lip.

Standard **1.0 mm (0.04 in)**

Body

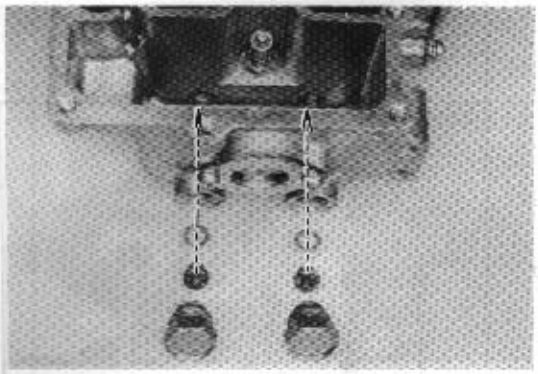
Assemble in numerical order.

Fig. 8-33



1	Level Gauge Glass	8	First Small Venturi
2	First Main Jet	9	Power Valve
3	Second Main Jet	10	Slow Jet
4	Solenoid Valve	11	Pump Damping Spring & Steel Ball
5	Diaphragm Sub-assembly	12	Pump Discharge Weight & Steel Ball
6	Thermostatic Valve	13	Lever (For T.P.)
7	Second Small Venturi		

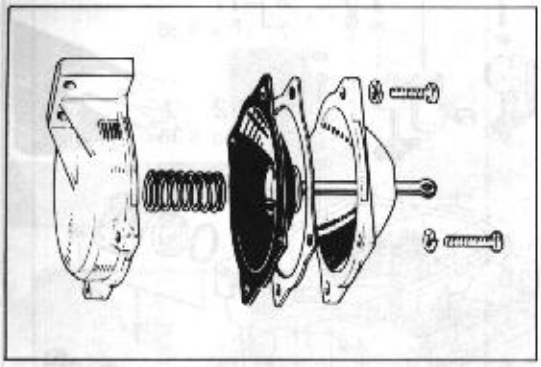
Fig. 8-34



Install main jets over gasket.

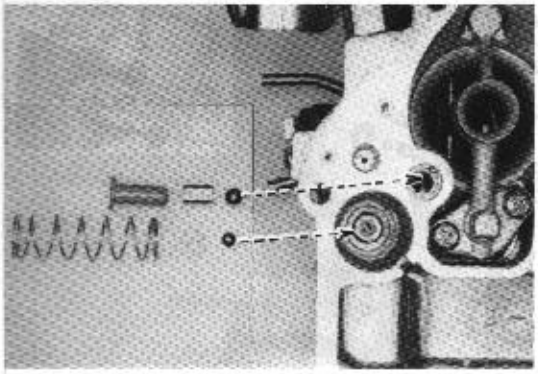
Primary jet	**Brass colored**
Secondary jet	**Chrome colored**

Fig. 8-35



Assemble secondary diaphragm in order as shown.

Fig. 8-36



Install pump outlet ball and weight.

– Note –

There are two sizes of balls.

Larger ball: For Pump outlet.

Smaller ball: For Pump inlet.

Body And Air Horn

Assemble in numerical order.

Fig. 8-37

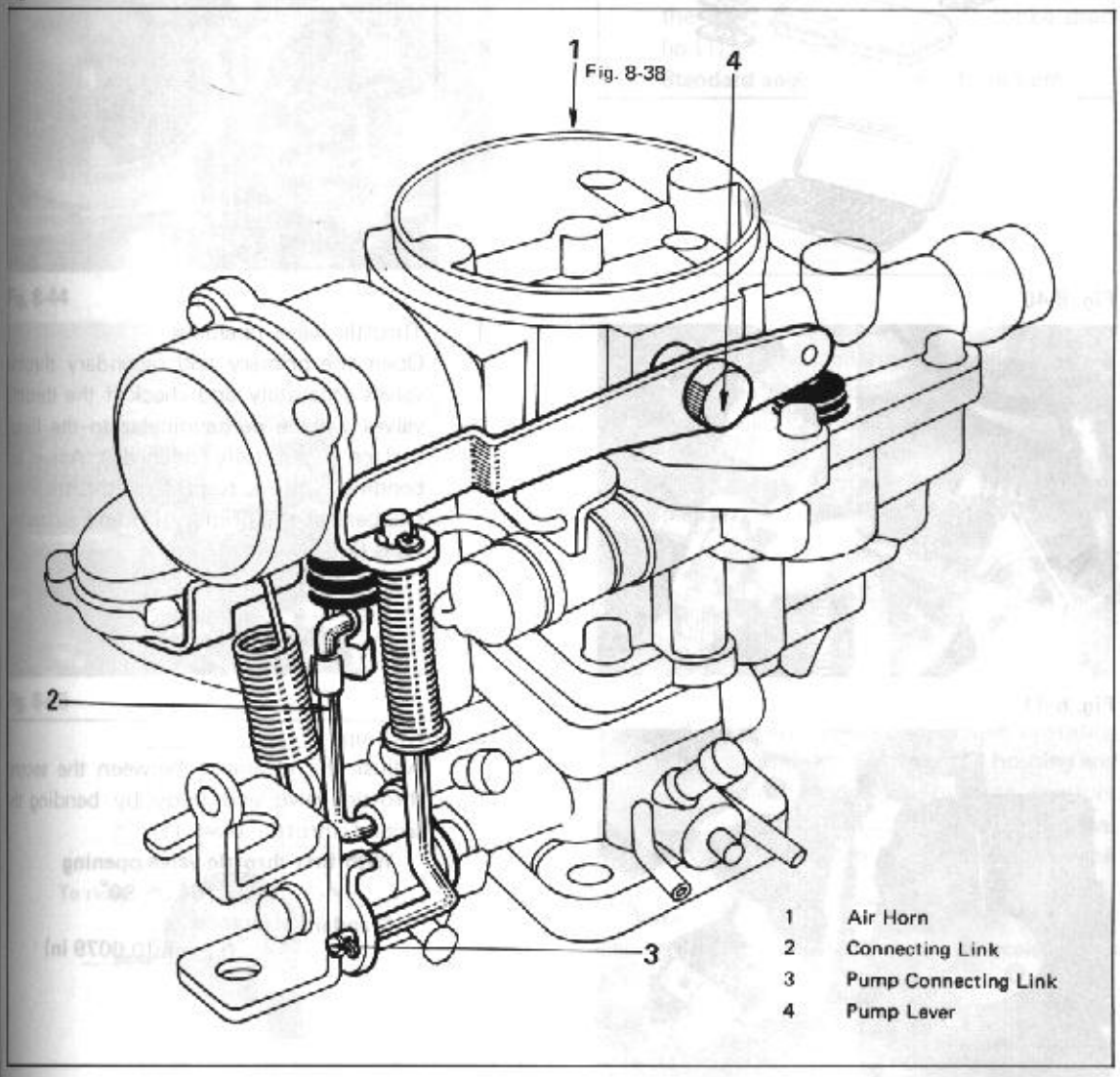
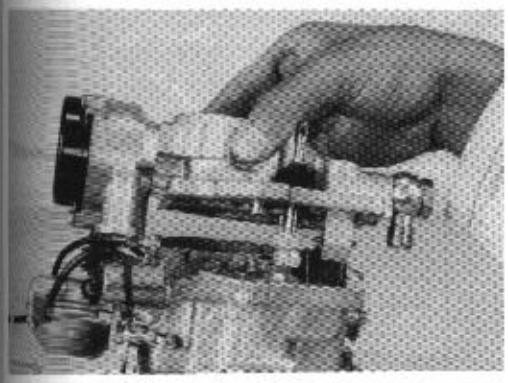
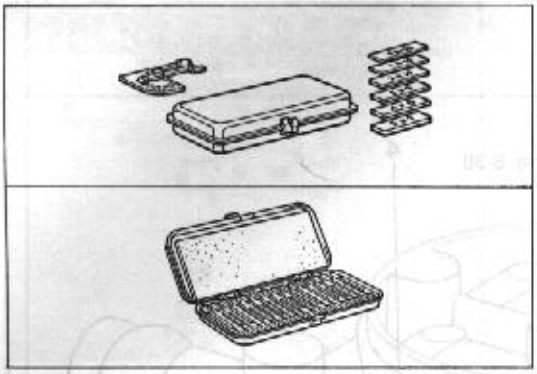


Fig. 8-38



Assemble body and air horn over new gasket. Take care not to damage pump plunger leather.

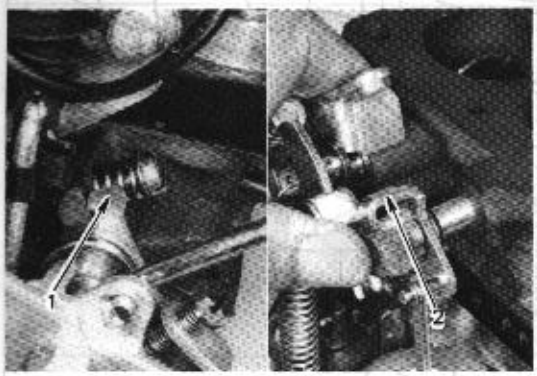
Fig. 8-39



ADJUSTMENT

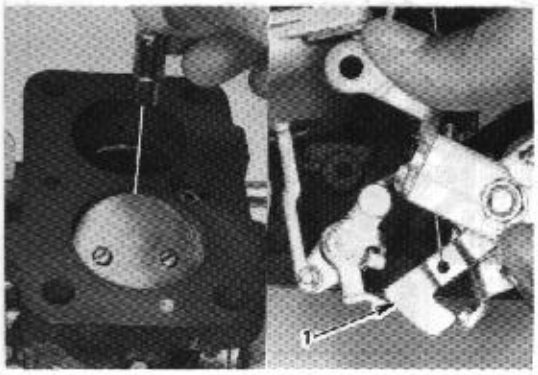
Use SST [09240-00014 and 09240-00020] to make adjustments.

Fig. 8-40



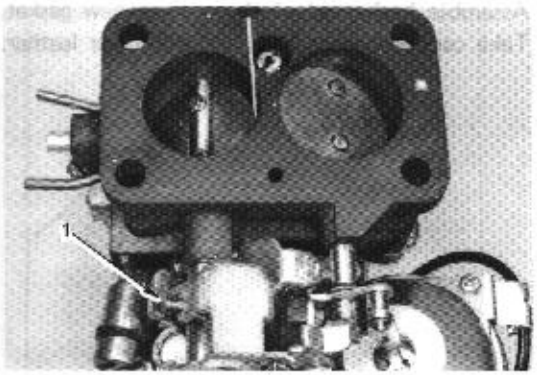
1. Throttle valve openings
   Open the primary and secondary throttle valves separately and check if the throttle valves will be perpendicular to the flange surface when fully opened. Adjust by bending the respective throttle lever stoppers at the primary (1) and secondary sides (2).

Fig. 8-41



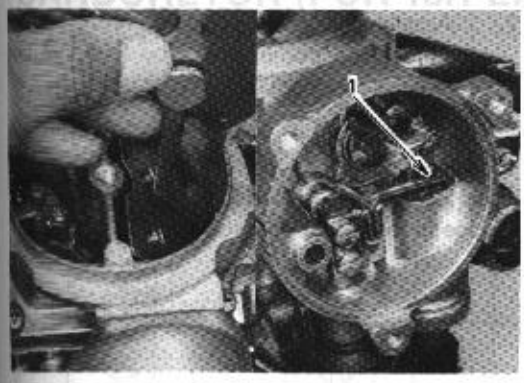
2. Kick up
   Adjust the clearance between the second throttle valve and body by bending the second throttle lever (1).
   With first throttle valve opening
   64 ~ 90°
   Standard clearance
   0.2 mm (0.0079 in)

Fig. 8-42



3. Fast idle
   With choke valve fully closed, check the clearance between bore and primary throttle valve. Adjust by turning fast idle adjusting screw (1).
   Standard clearance
   0.91 mm (0.036 in)

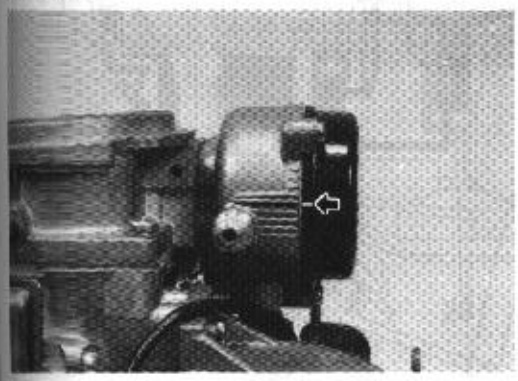
Fig. 8-43



4. Unloader
With the first throttle valve fully opened, adjust the choke valve angle by bending the fast idle cam follower or choke shaft lip (1).

Standard angle 47° from bore

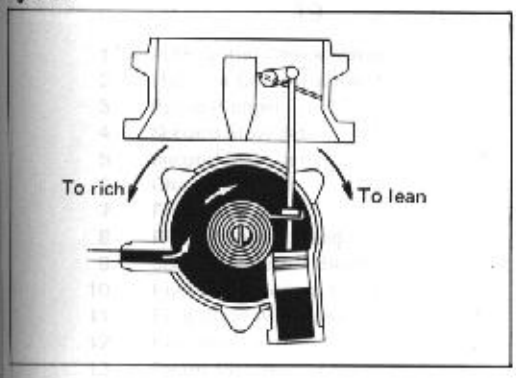
Fig. 8-44



5. Automatic choke
(1) Set the coil housing scale mark so that it will be aligned with the center line of the thermostat case.

— Note —
The choke valve becomes fully closed when atmospheric temperature reaches 25°C (77°F).

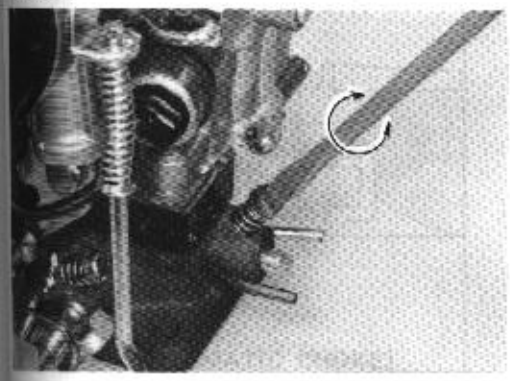
Fig. 8-45



(2) Depending on the vehicle operating conditions, turn the coil housing and adjust the engine starting mixture.
If too rich ..... Turn clock-wise.
If too lean ..... Turn counterclock-wise.

— Note —
One graduation of thermostat case scale equals 5°C (9°F) change.

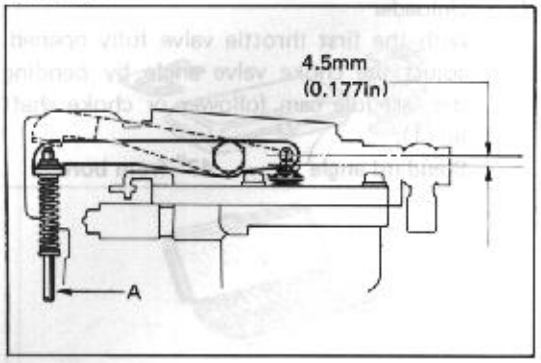
Fig. 8-46



6. Fully screw in the idle mixture adjusting screw and then unscrew it about 2-1/2 turns.

— Note —
Be careful not to damage the screw tip by tightening the screw too tight.

Fig. 8-47



7. Accelerating pump
   Adjust the pump stroke by bending part (A).

Standard 4.5 mm (0.177 in)

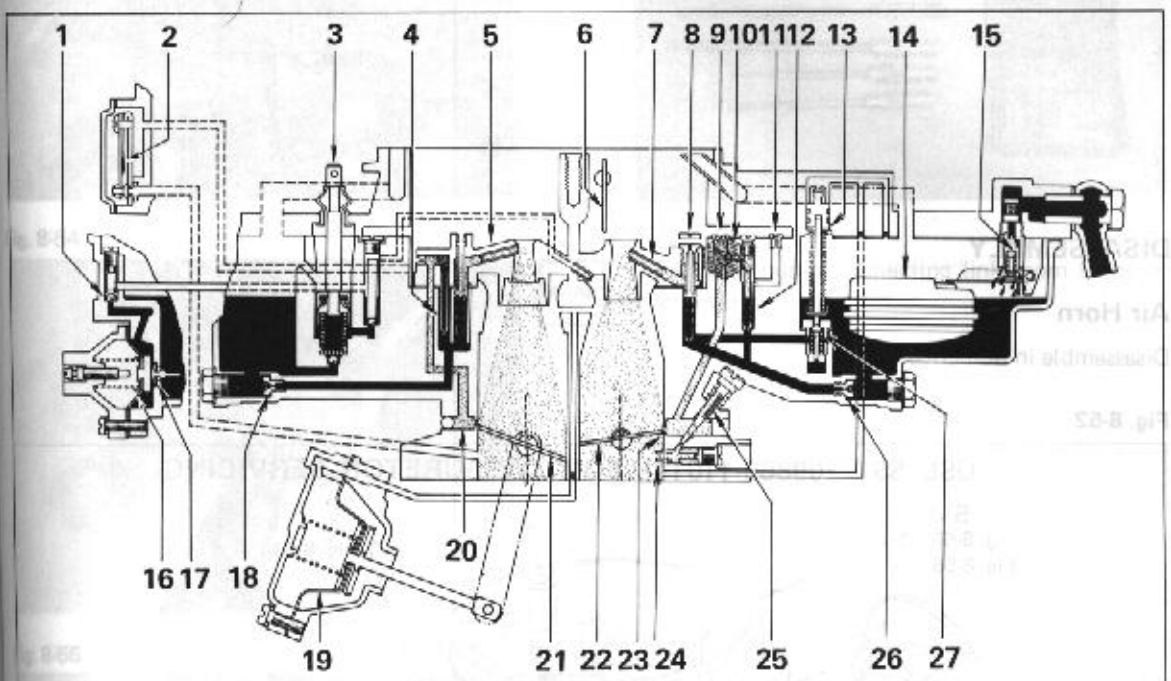
– Note –

After adjustment is made, be sure to check the linkage to see that it operates smoothly.

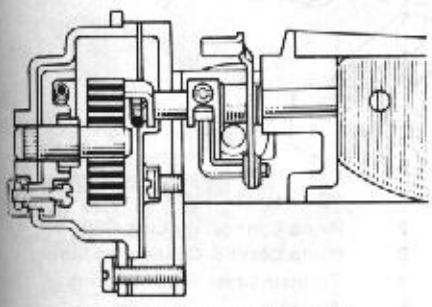
CARBURETOR (FOR 18R ENGINE)
Except South Africa

CARBURETOR CIRCUITS

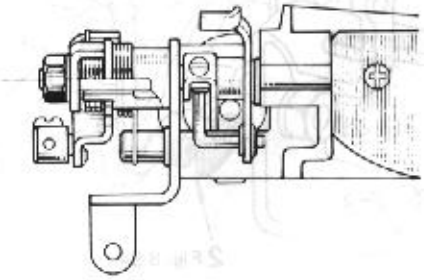
Fig. 8-50



1	AAP Outlet Check Valve	15	Needle Valve
2	Hot Idle Compensator	16	AAP Diaphragm
3	Pump Plunger	17	AAP Inlet Check Valve
4	Second Slow Jet	18	Second Main Jet
5	Second Main Jet	19	Second Throttle Valve Diaphragm
6	Choke Valve	20	Second Slow Port
7	First Main Jet	21	Second Throttle Valve
8	First Main Air Bleed	22	First Throttle Valve
9	Second Slow Air Bleed	23	First Slow Port
10	Fuel Cut Solenoid Valve	24	Idle Nozzle
11	First Slow Air Bleed	25	Idle Mixture Adjusting Screw
12	First Slow Jet	26	First Main Jet
13	Power Piston	27	Power Valve
14	Float		

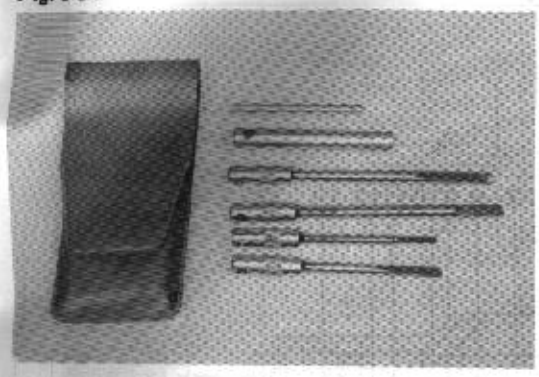


[AUTOMATIC CHOKE]



[MANUAL CHOKE]

Fig. 8-51



⚠ Use SST [09860-11011] for carburetor servicing.

DISASSEMBLY

Air Horn

Disassemble in numerical order.

Fig. 8-52

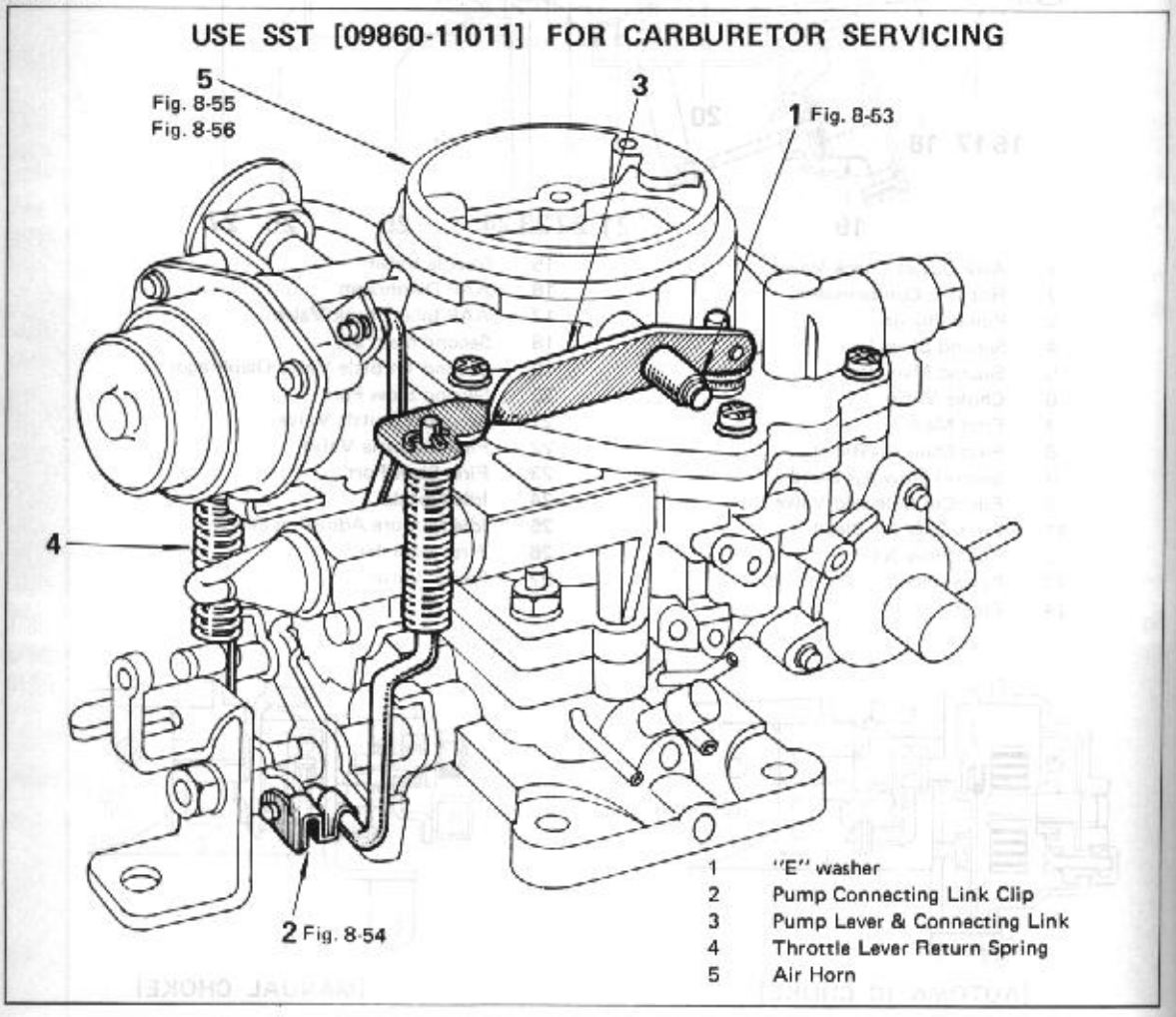
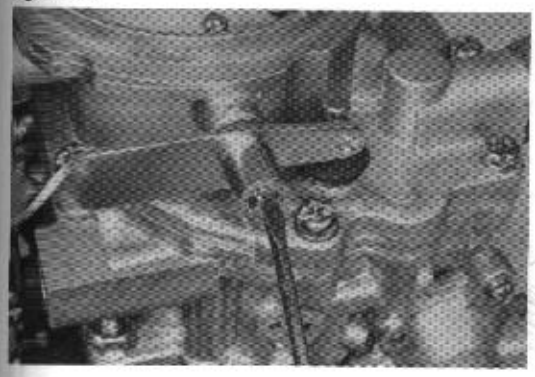
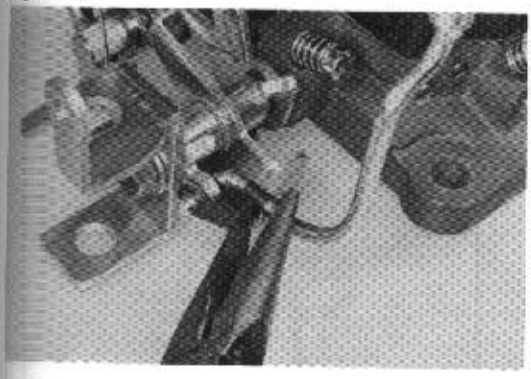


Fig. 8-53



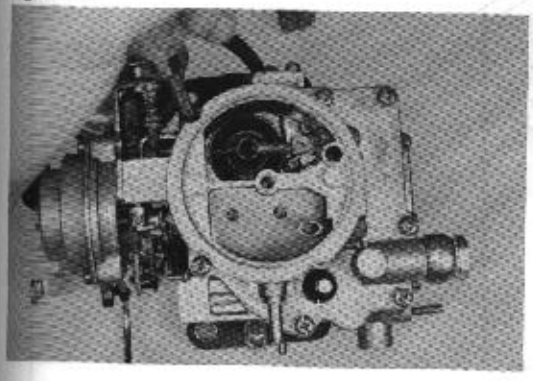
Remove "E" washer with a small screwdriver.

Fig. 8-54



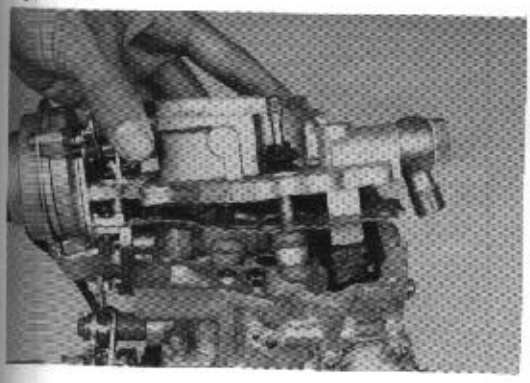
Disconnect pump connecting link from throttle shaft lever.

Fig. 8-55



Gradually loosen air horn set screw in 2 or 3 stages in diagonal order.

Fig. 8-56



Lift out air horn.

Float

Disassemble in numerical order.

Fig. 8-57

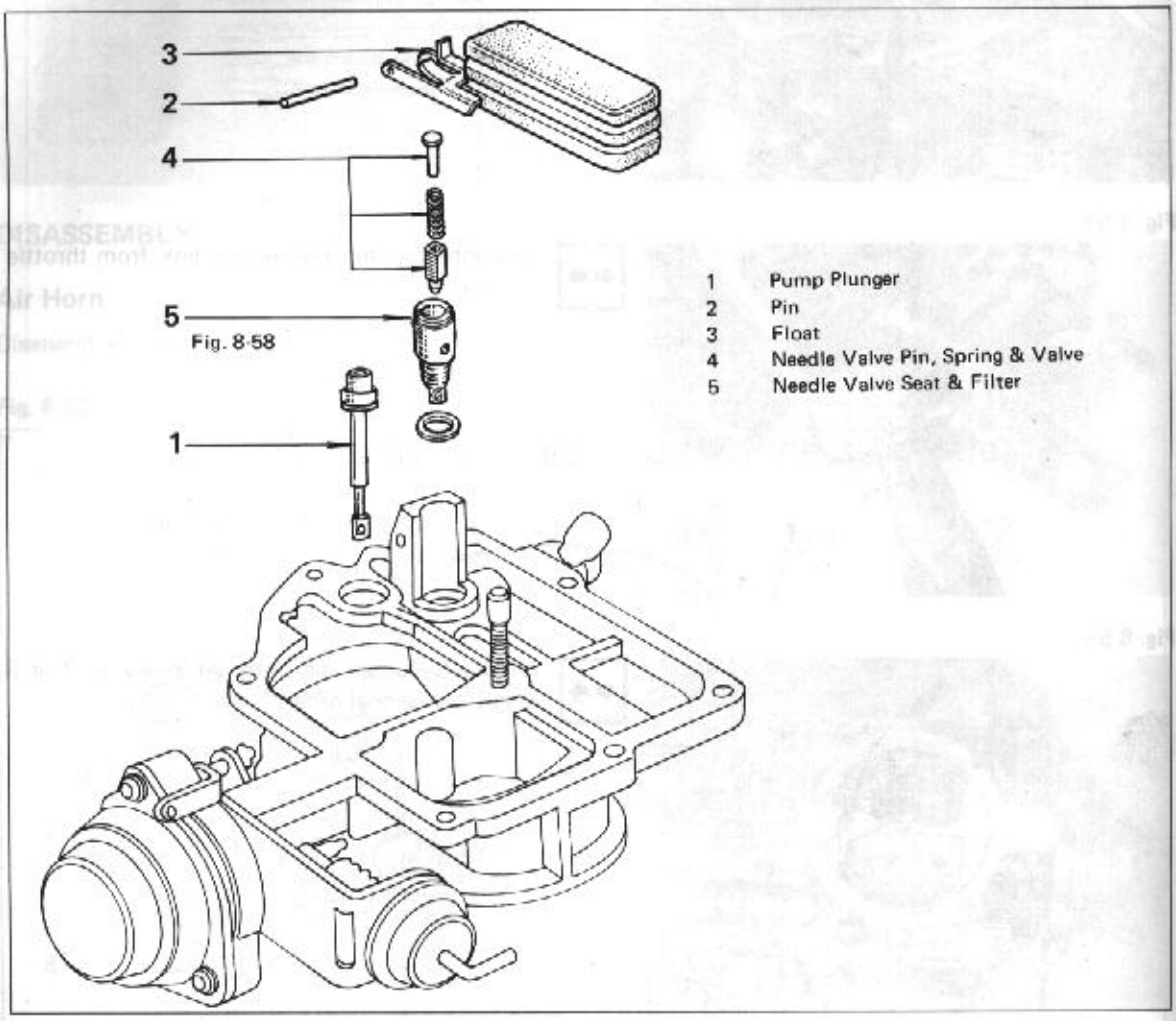
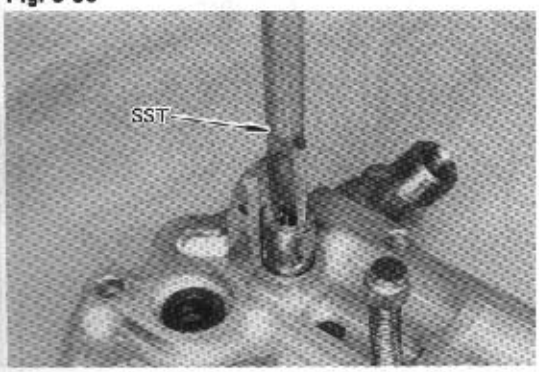
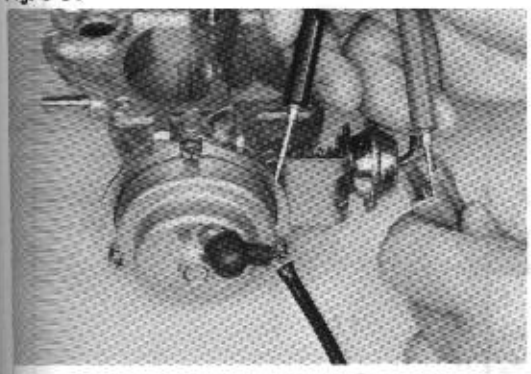


Fig. 8-58



Remove needle valve seat with SST [09860-11011].

Fig. 8-59



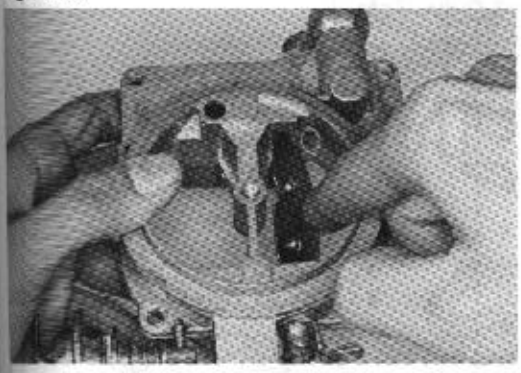
Air Horn

Before disassembling, check following items.

1. Measure heating coil resistance with ohmmeter.

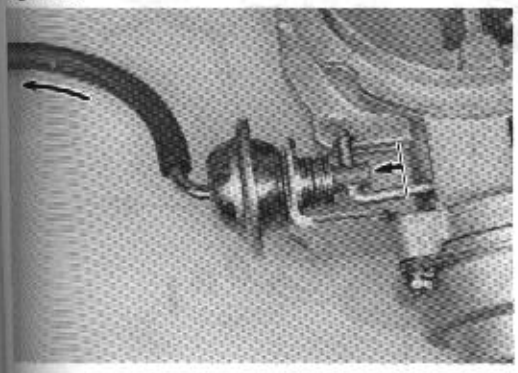
   Resistance **7.5 – 10.0 Ω**

Fig. 8-60



2. Check choke valve action.

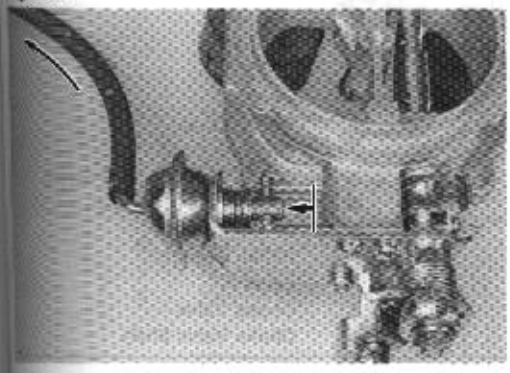
Fig. 8-61



3. Check choke breaker diaphragm action.

   Automatic choke

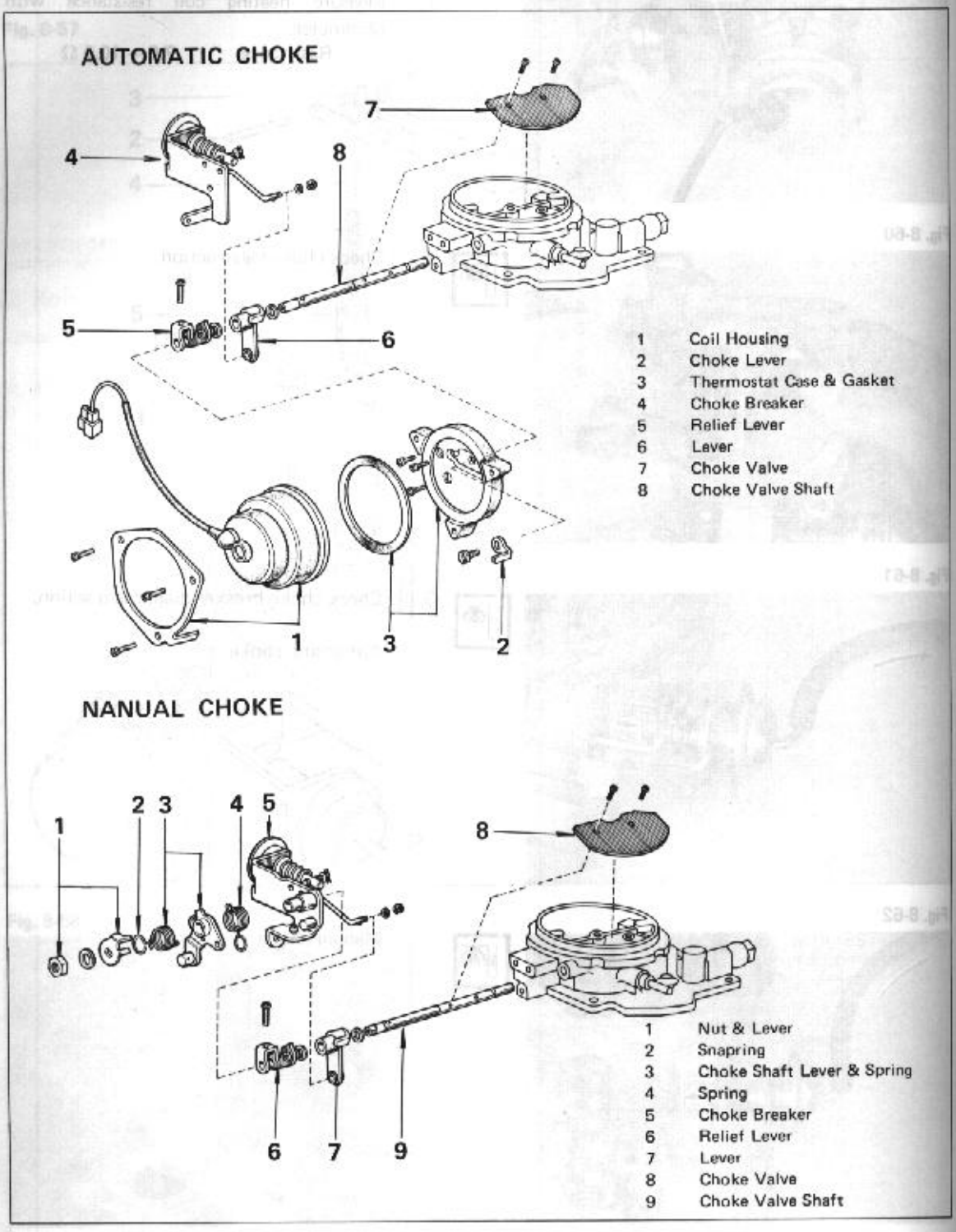
Fig. 8-62



Manual choke

Disassemble in numerical order.

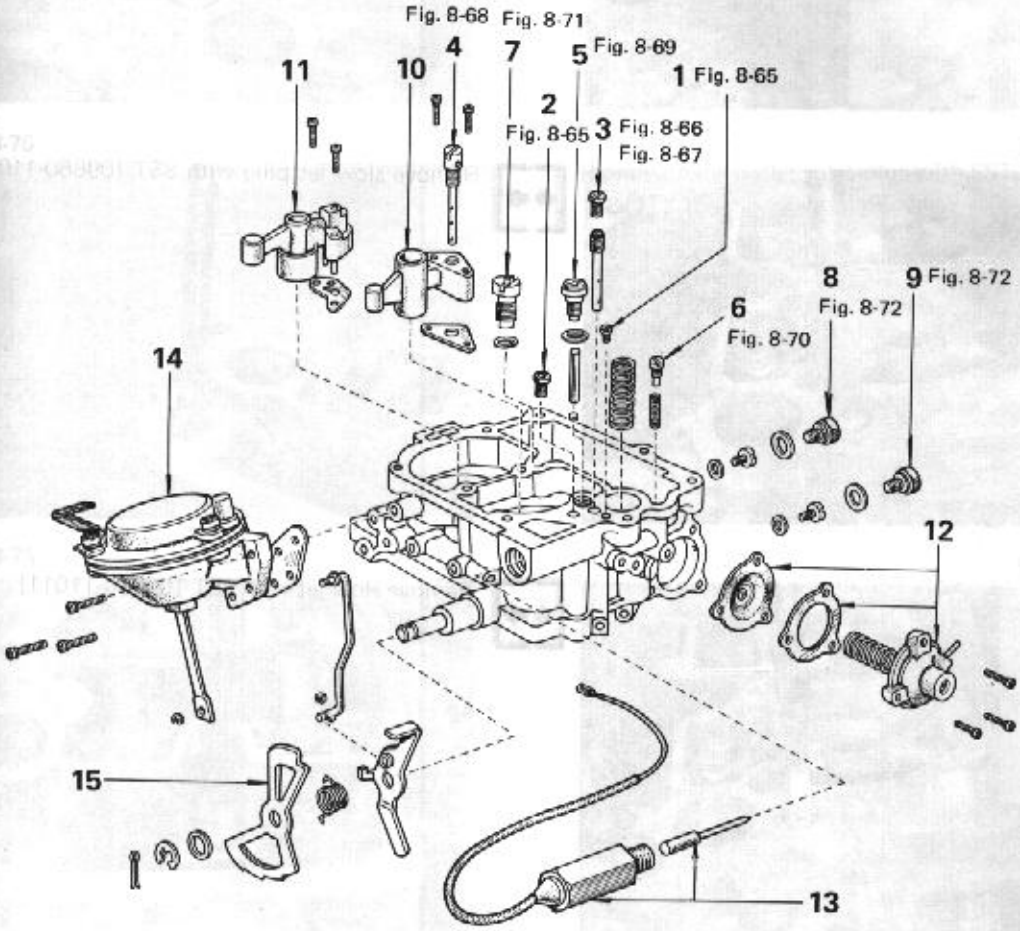
Fig. 8-63



Body

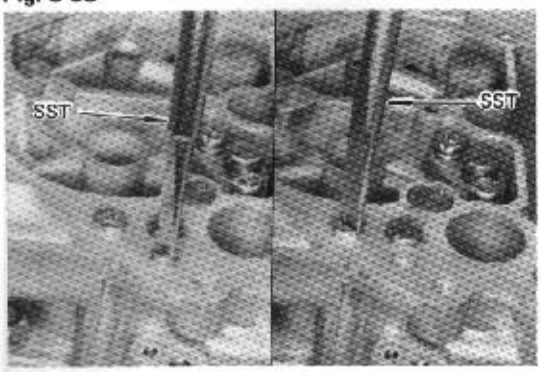
Disassemble in numerical order.

Fig. 8-64



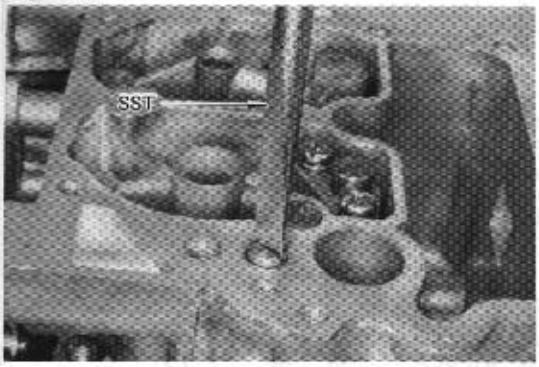
1	1st Air Bleed Jet	9	First Main Jet
2	2nd Air Bleed Jet	10	First Small Venturi
3	Slow Jet	11	Second Small Venturi
4	Main Air Bleed	12	AAP Diaphragm
5	Pump Discharge Weight & Outlet Valve	13	Solenoid Valve
6	AAP Outlet Valve	14	Second Throttle Valve Diaphragm
7	Power Valve	15	Fast Idle Cam
8	Second Main Jet		

Fig. 8-65



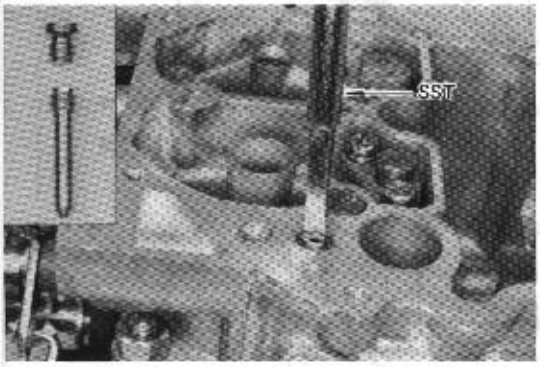
Remove 1st and 2nd slow air bleed jet with SST [09860-11011].

Fig. 8-66



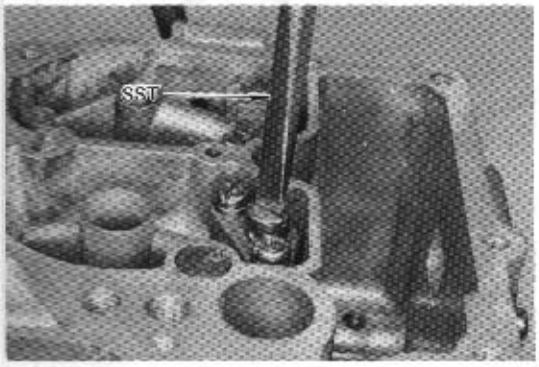
Remove slow jet plug with SST [09860-11011].

Fig. 8-67



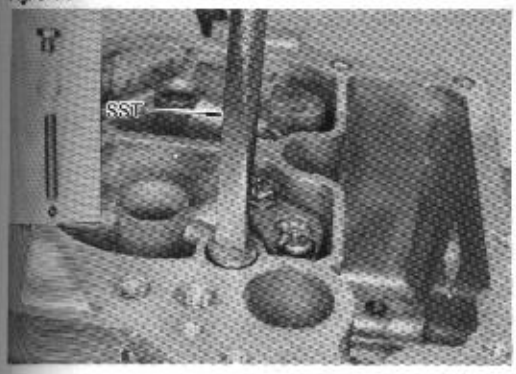
Remove slow jet with SST [09860-11011].

Fig. 8-68



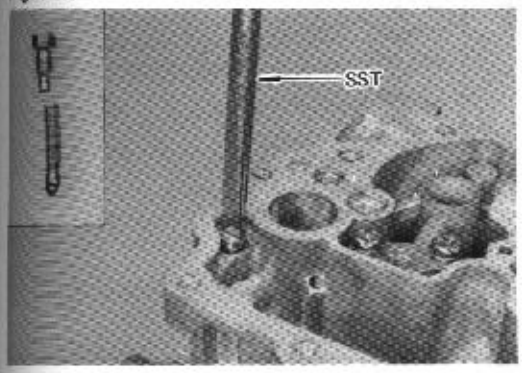
Remove 1st main air bleed with SST [09860-11011].

Fig. 8-69



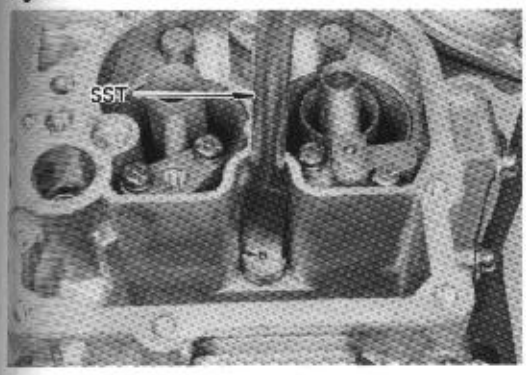
Remove discharge weight plug with SST [09860-11011], then remove discharge weight and outlet check valve.

Fig. 8-70



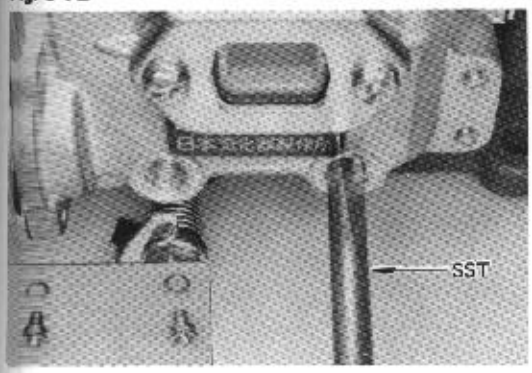
Remove AAP outlet valve plug with SST [09860-11011], then remove spring and outlet check valve.

Fig. 8-71



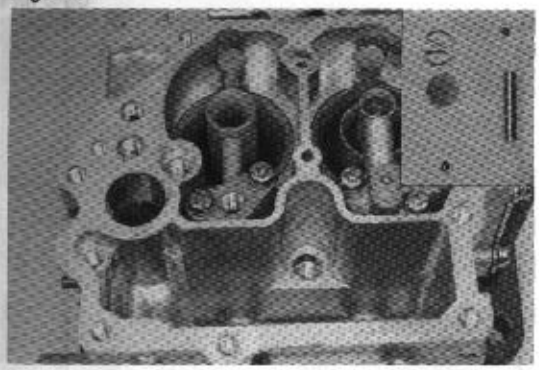
Remove power valve with SST [09860-11011].

Fig. 8-72



Remove 1st, 2nd main jet and gaskets.

Fig. 8-73

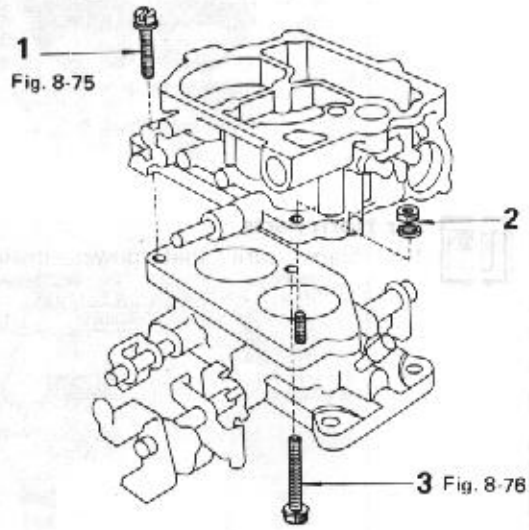


Remove snap ring, strainer and inlet check valve.

Flange

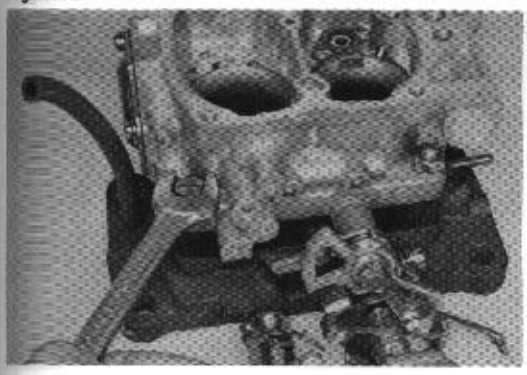
Disassemble in numerical order.

Fig. 8-74



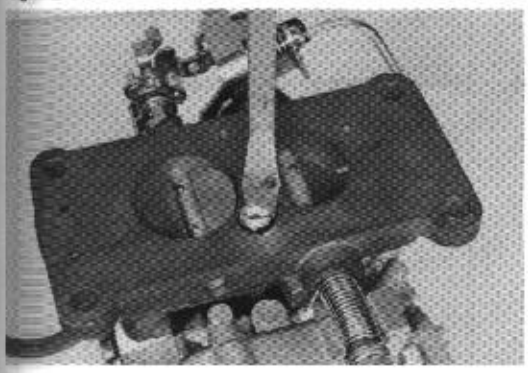
1	Bolt
2	Nut
3	Bolt

Fig. 8-75



Remove bolt and nut from body.

Fig. 8-76



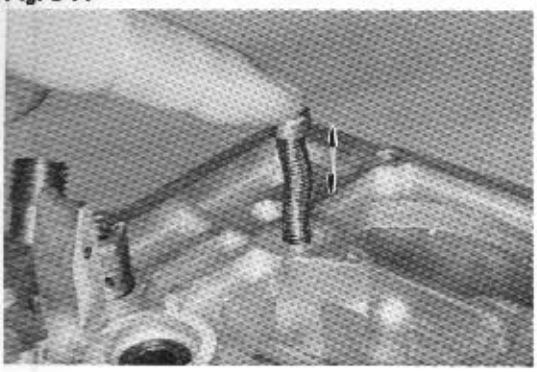
Remove bolt from flange.

INSPECTION

— Precaution —

1. **Before inspecting the parts, wash them thoroughly in gasoline. Using compressed air, blow all dirt and other foreign matter from the jets and similar parts, and from the fuel passages and apertures in the body.**
2. **Never clean the jets or orifices with wire or a drill. This could enlarge the openings and result in excessive fuel consumption.**

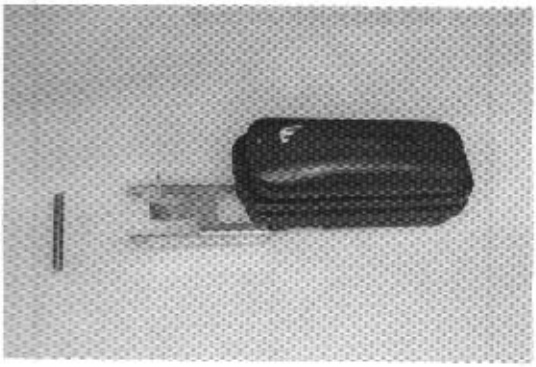
Fig. 8-77



Air Horn Parts

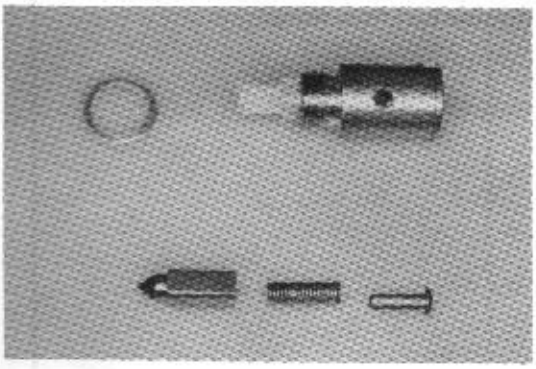
1. Make sure that power piston moves smoothly.

Fig. 8-78



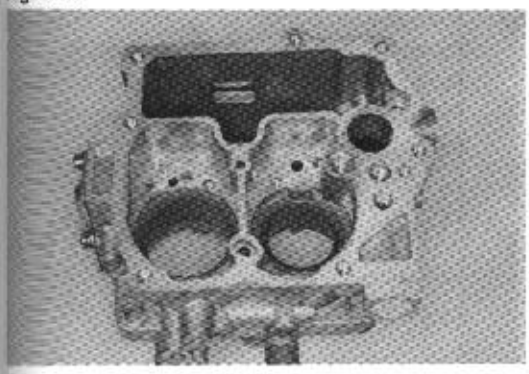
2. Check float and pivot pin for wear or broken.

Fig. 8-79



3. Strainer : Rust, breaks.
4. Needle valve surface.
5. Needle valve seat.

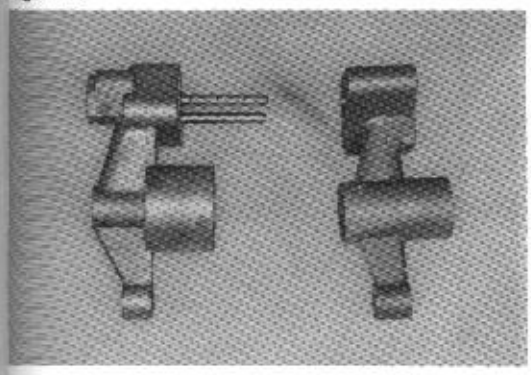
Fig. 8-80



Body Parts

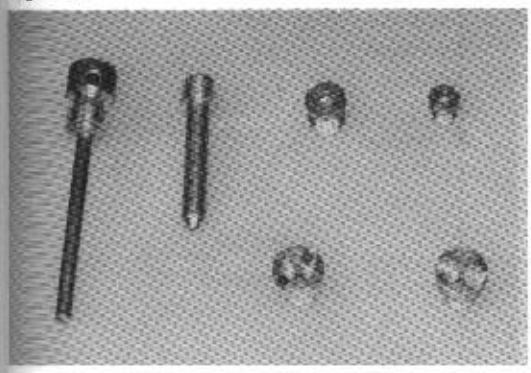
1. Body
   Cracks, scored mounting surfaces, damaged threads.

Fig. 8-81



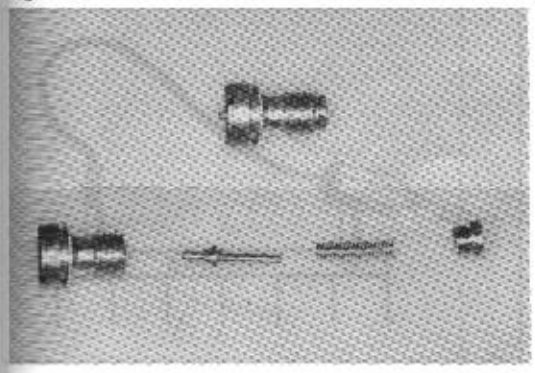
2. Venturi
   Damaged or clogged.

Fig. 8-82



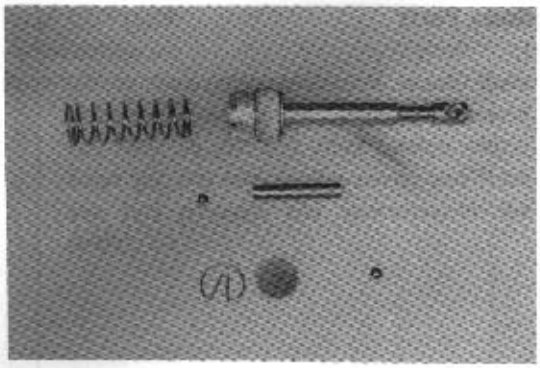
3. Jets
   Damaged or clogged.
   Damaged contact surface or threads.
   Screwdriver slots.

Fig. 8-83



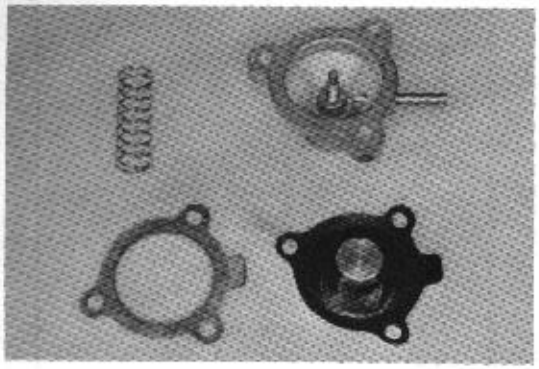
4. Power valve
   Faulty opening and closing action.
   Clogged.
   Damaged contact surface or threads.

Fig. 8-84



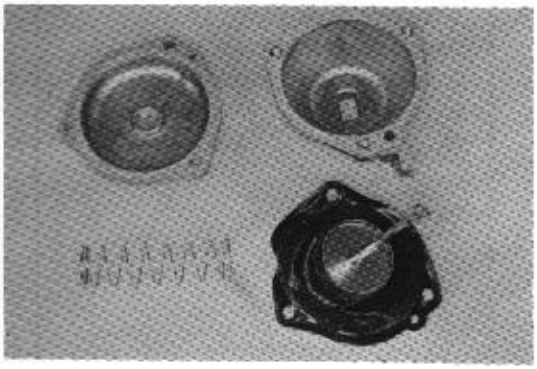
5. Acceleration pump
Pump damping spring: Deformation, rust.
Pump check ball: Damaged, rusted.
Pump plunger: Wear at sliding surface, deformed or damaged leather.

Fig. 8-85



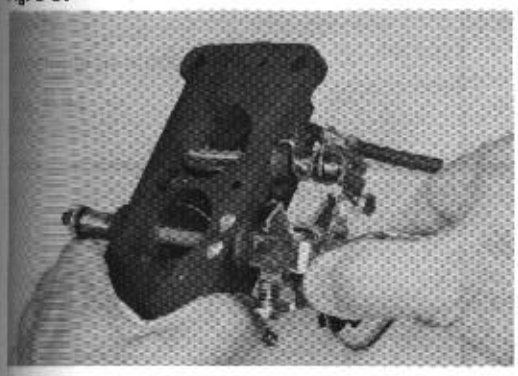
6. Auxuliary acceleration pump
Diaphragm damaged.

Fig. 8-86



7. Secondary diaphragm
Damaged.

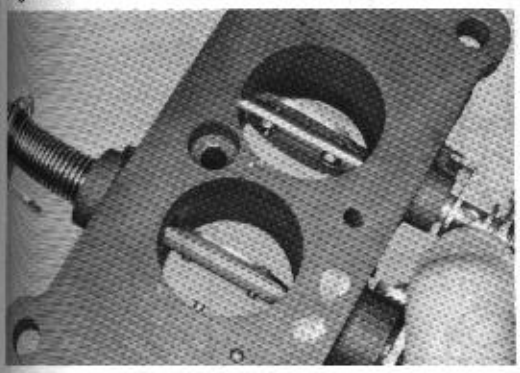
Fig. 8-87



Flange Parts

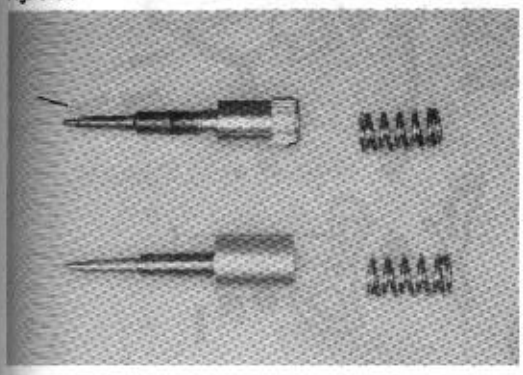
1. Flange: Cracks, injured mounting surfaces, damaged threads, wear at throttle shaft bearings.

Fig. 8-88



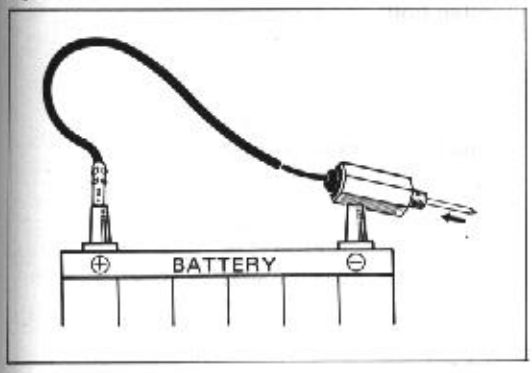
2. Throttle valves: Wear or deformation in valves. Wear, bending, twisting, or faulty movement inside housing of shaft.

Fig. 8-89



3. Idle mixture adjusting screw: Damage at tapered tip or threads.

Fig. 8-90



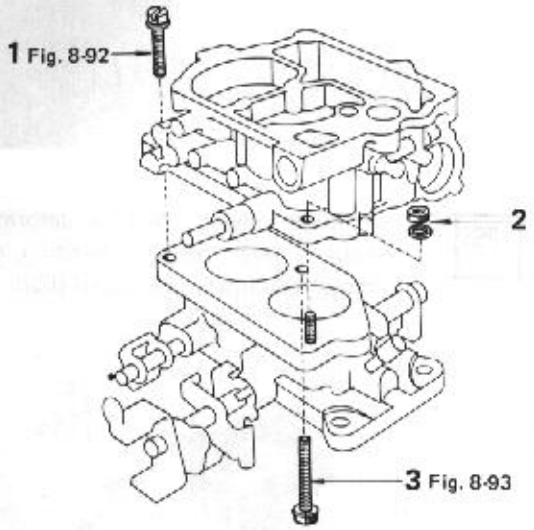
Solenoid Valve

1. Check operation of solenoid valve.
   Connect wiring to the battery positive terminal and ground the body. The needle valve should be pulled in.
2. Check needle valve "A" part.

ASSEMBLY

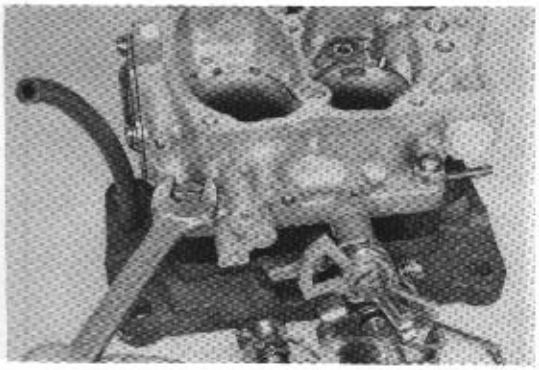
Assemble in numerical order.

Fig. 8-91



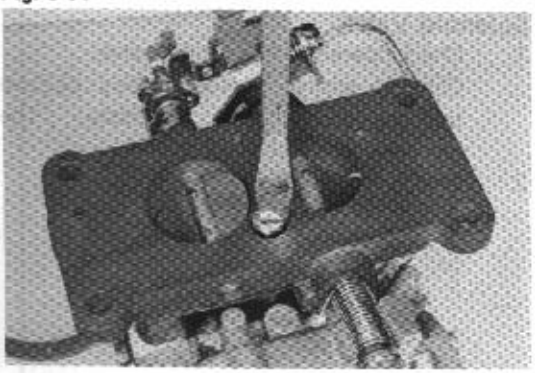
1	Bolt
2	Nut
3	Bolt

Fig. 8-92



Tighten bolt and nut.

Fig. 8-93

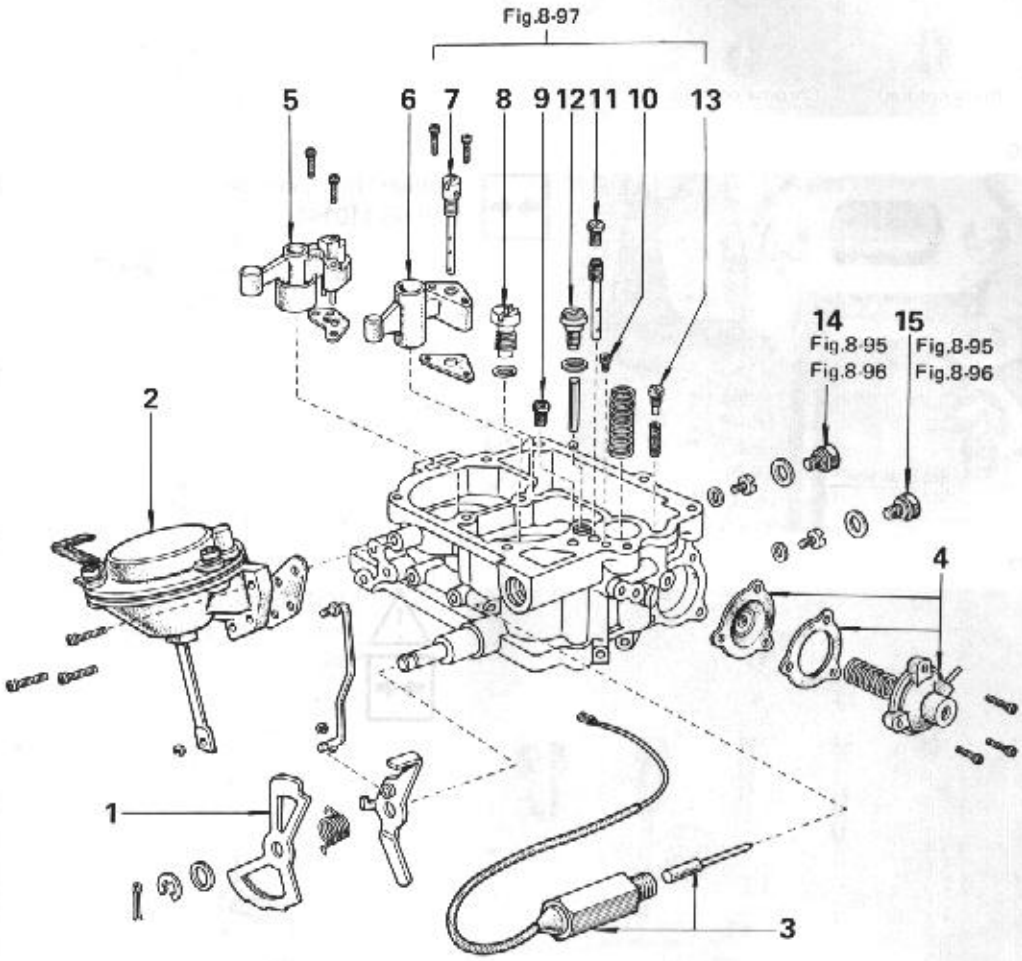


Tighten bolt.

Body

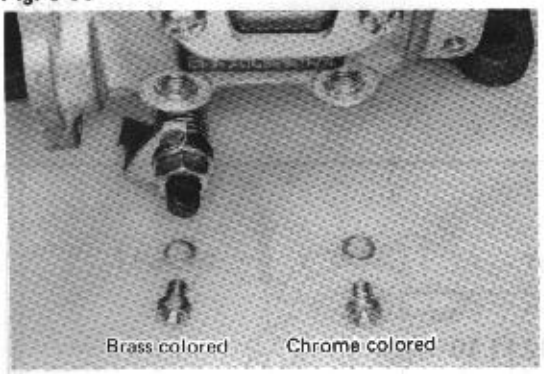
Assemble in numerical order.

Fig. 8-94



1	Fast Idle Cam	9	Second Air Bleed Jet
2	Second Throttle Valve Cam	10	First Air Bleed Jet
3	Solenoid Valve	11	Slow Jet
4	AAP Diaphragm	12	Pump Discharge Weight & Outlet Valve
5	Second Small Venturi	13	AAP Outlet Valve
6	First Small Venturi	14	Second Main Jet
7	Main Air Bleed	15	First Main Jet
8	Power Jet		

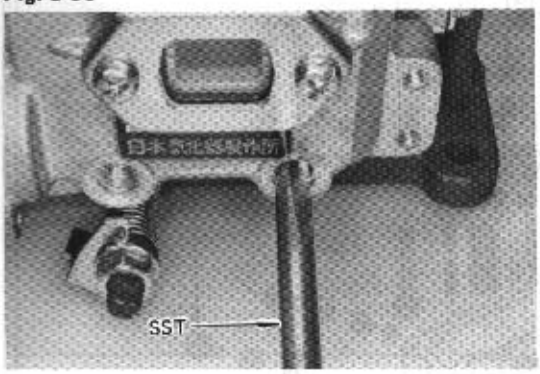
Fig. 8-95



Install main jets over gasket.

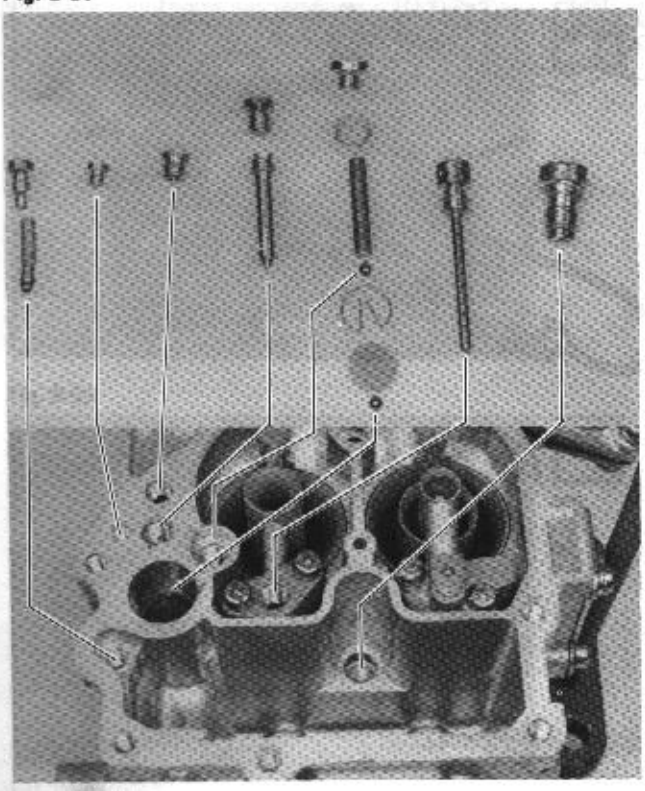
First jet	**Brass colored**
Second jet	**Chrome colored**

Fig. 8-96



Tighten first and second main jets with SST [09860-11011].

Fig. 8-97



Install jets, air bleed, valve and plugs as shown.

Air Horn

Assemble in numerical order.

Fig. 8-98

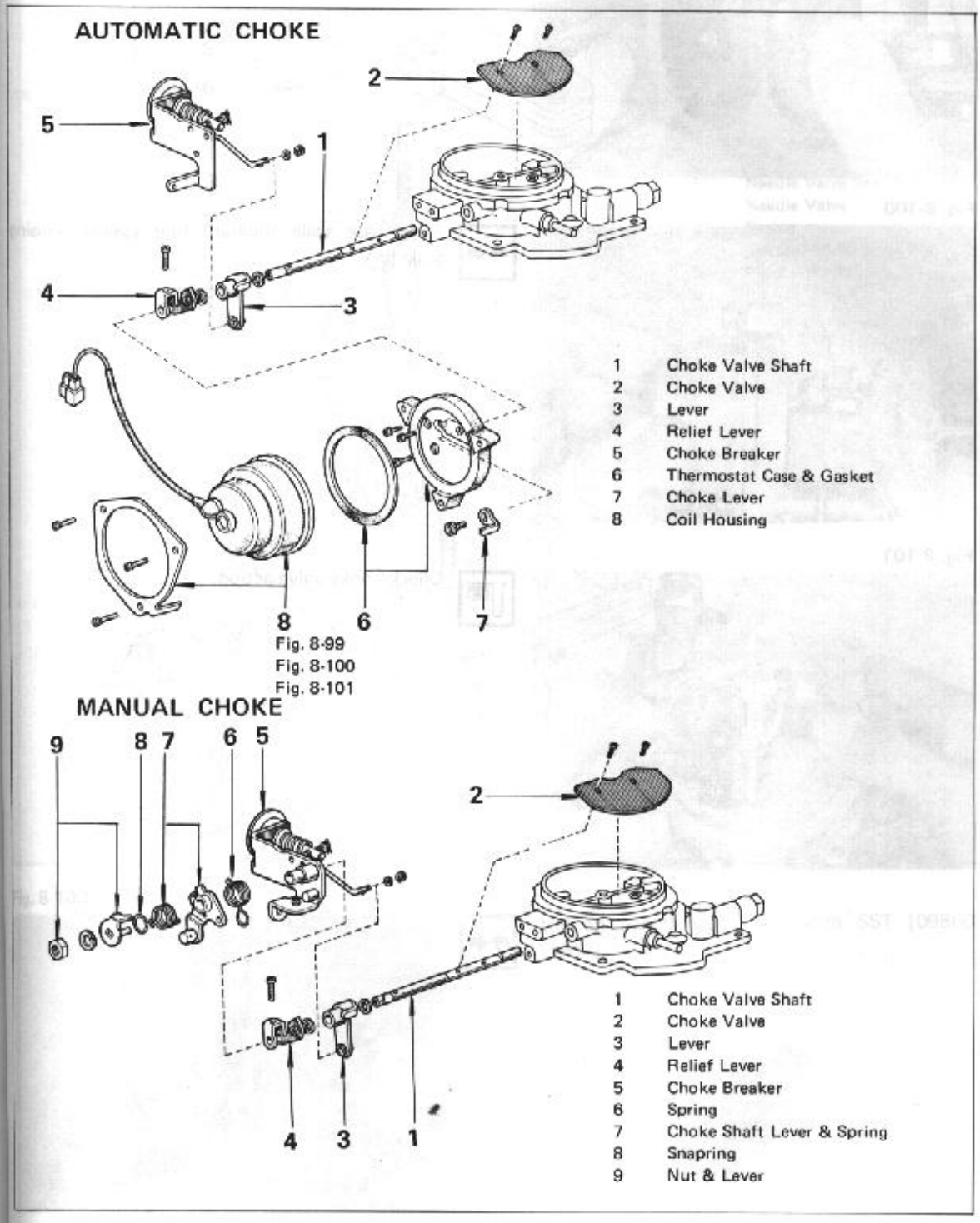
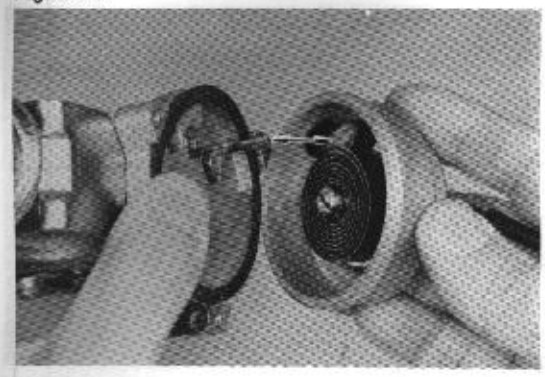
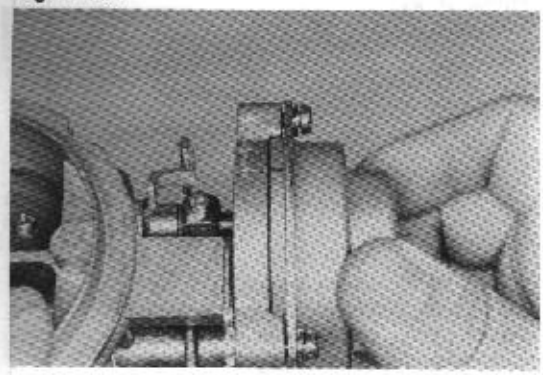


Fig. 8-99



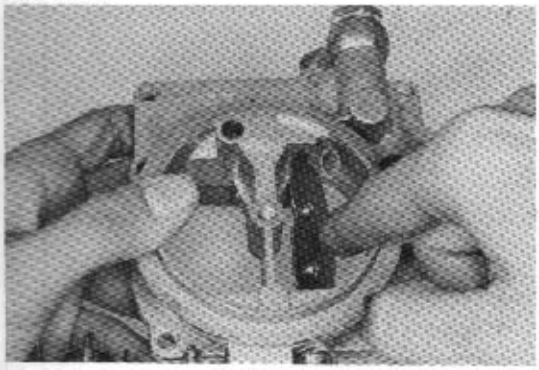
Hook lever to bimetal spring.

Fig. 8-100



Align case scale standard line against housing scale line.

Fig. 8-101



Check choke valve action.

Float

Assemble in numerical order.

Fig. 8-102

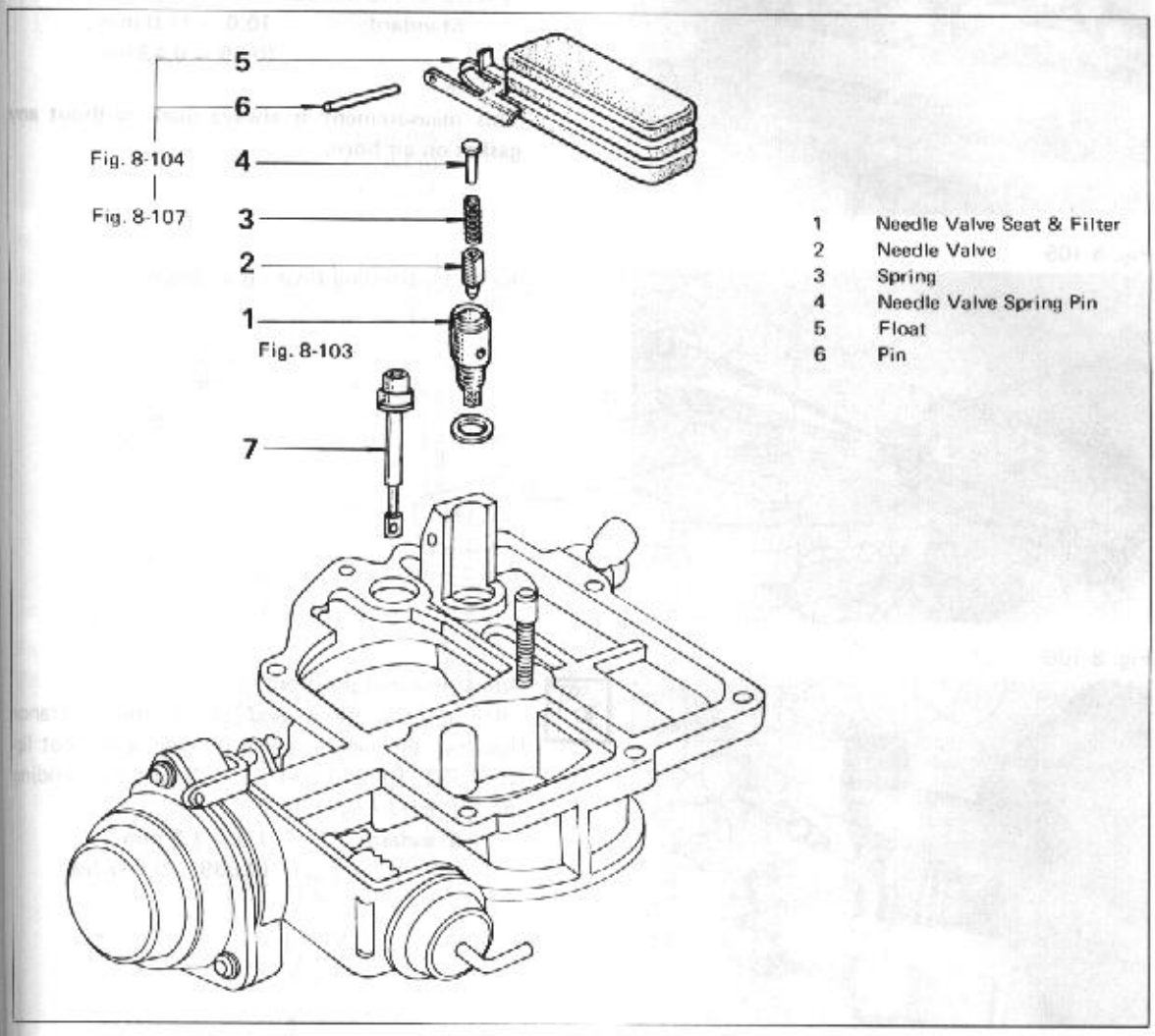
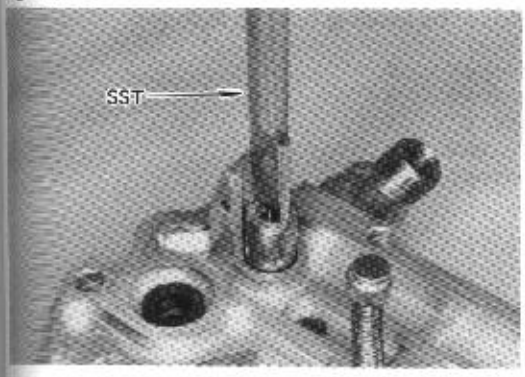
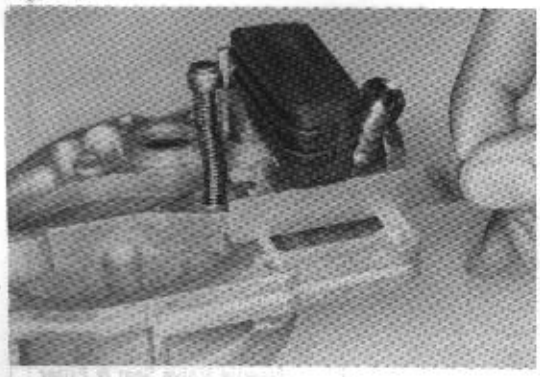


Fig. 8-103



Tighten needle valve seat with SST [09860-11011].

Fig. 8-104

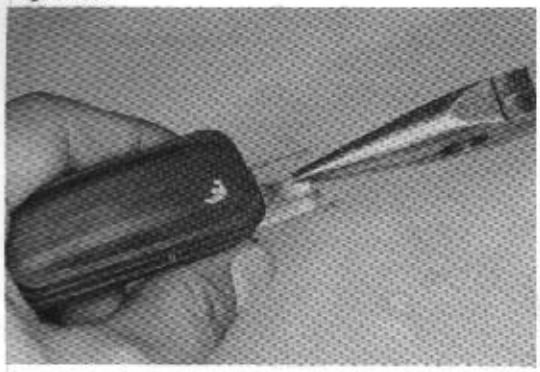


Adjust float level.
Allow the float to hang down by its own weight. Then check the clearance between the float tip and air horn with SST [09240-00014]. Adjust by bending the (A) part of float lip.

Standard	**10.0 – 11.0 mm (0.39 – 0.43 in)**

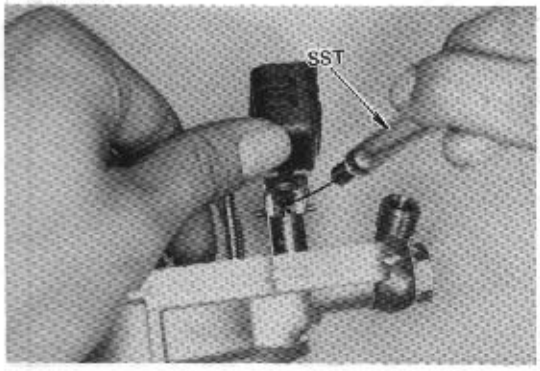
– Note –
This measurement is always made without any gasket on air horn.

Fig. 8-105



Adjust by bending float lip as shown.

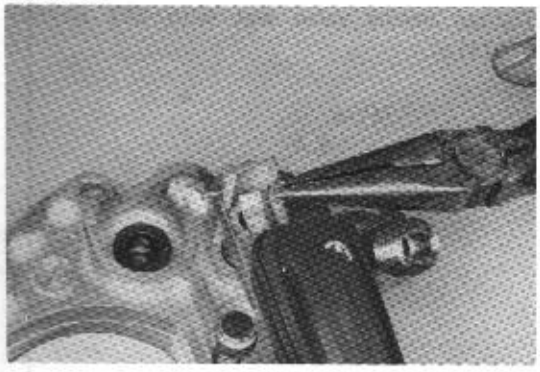
Fig. 8-106



Adjust lowered position.
Lift up the float and check the clearance between the needle valve plunger and float lip with SST [09240-00020]. Adjust by bending the (B) part of float lip.

Standard	**1.0 – 1.2 mm (0.039 – 0.047 in)**

Fig. 8-107

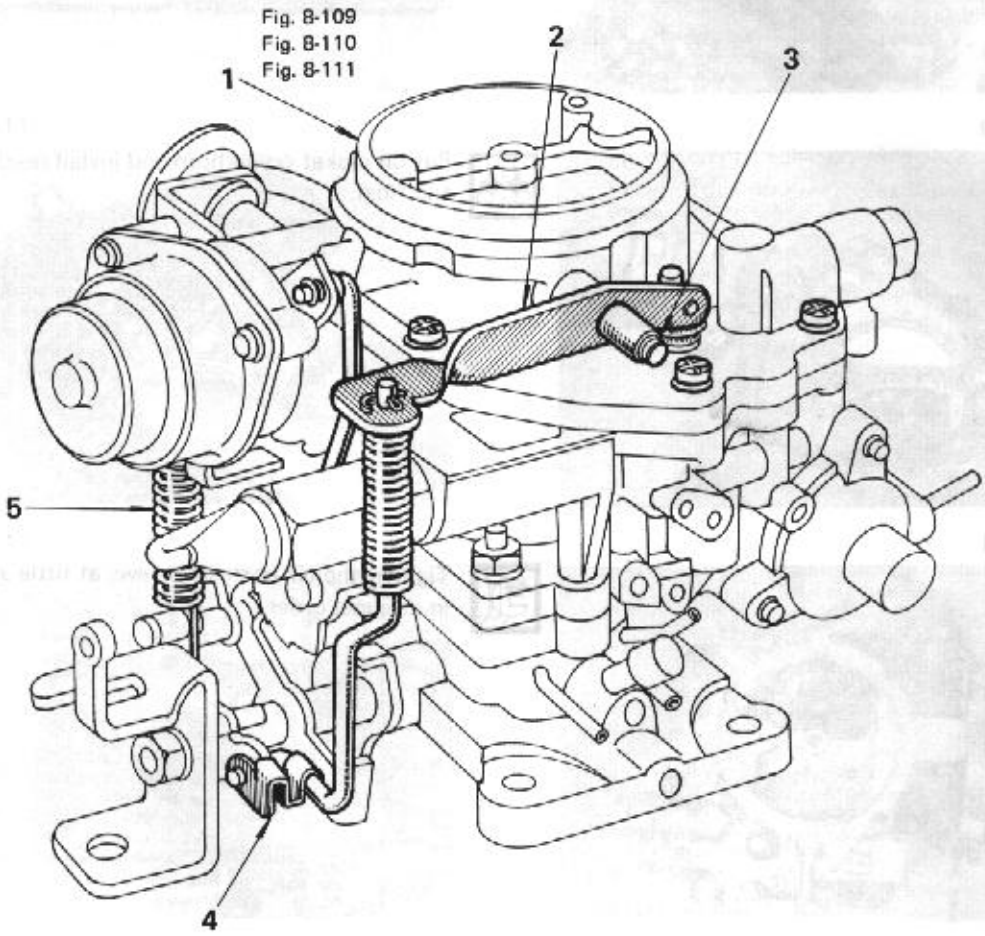


Adjust by bending float lip as shown.

Body And Air Horn

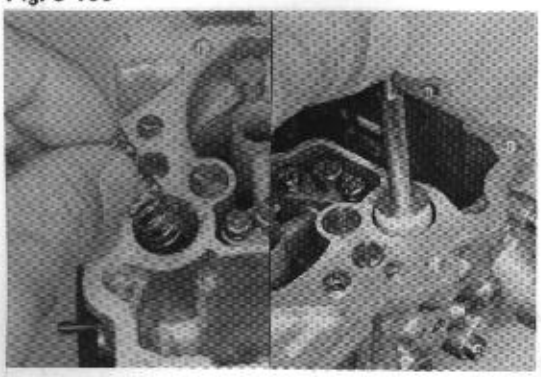
Assemble in numerical order.

Fig. 8-108



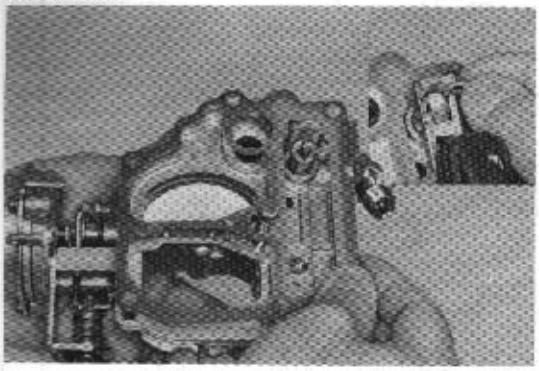
1	Air Horn
2	Pump Lever & Connecting Rod
3	"E" Washer
4	Clip
5	Throttle Lever Return Spring

Fig. 8-109



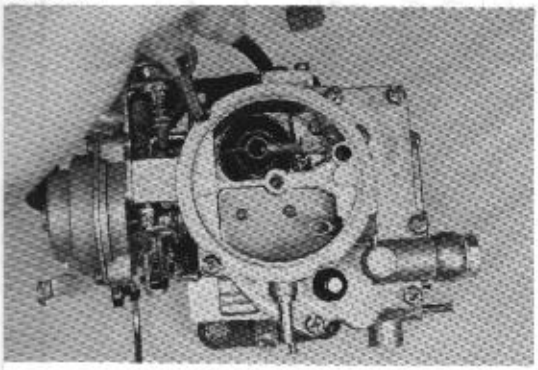
Before assembling air horn, pump damping spring and plunger.

Fig. 8-110



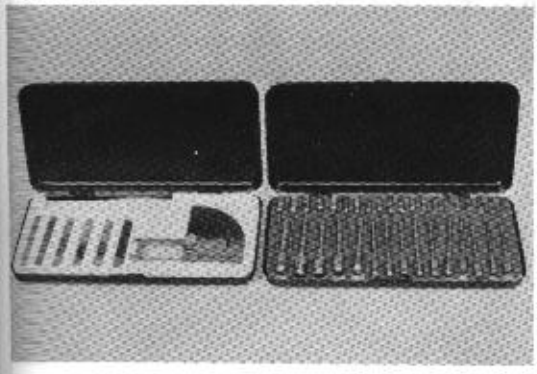
Put on gasket on air horn and install needle valve and float.

Fig. 8-111



Tighten the air horn set screws at little at a time in diagonal order.

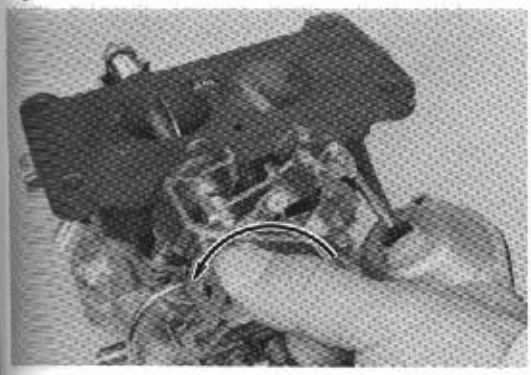
Fig. 8-112



ADJUSTMENT

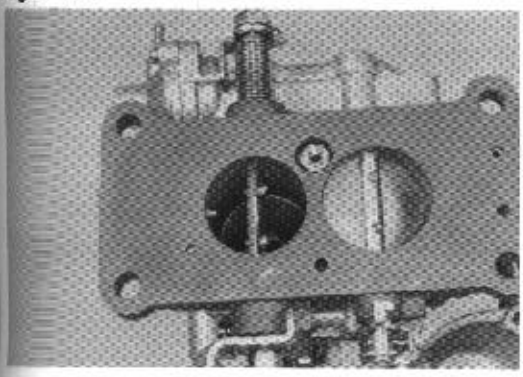
Use SST [09240-00014 and 09240-00020] to make adjustments.

Fig. 8-113



1. First throttle valve opening.
   (1) Fully open first throttle valve.

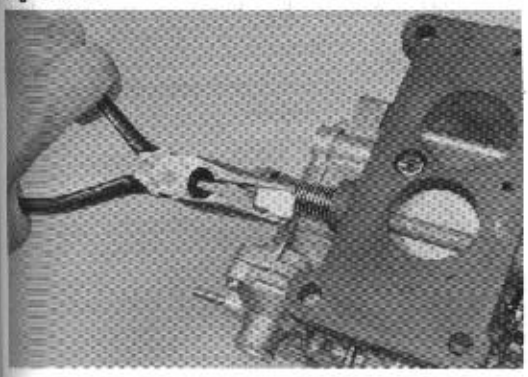
Fig. 8-114



(2) Check first throttle valve opening angle.

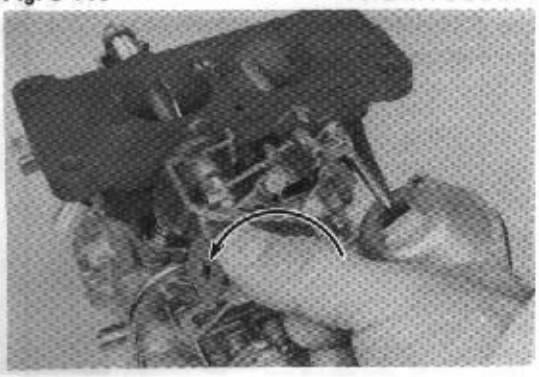
Opening Angle 90°

Fig. 8-115



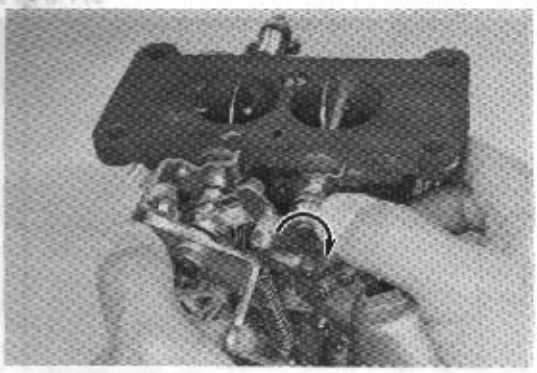
(3) Adjust by bending throttle lever stopper.

Fig. 8-116



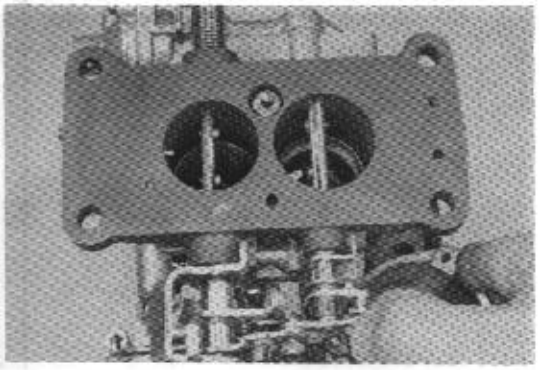
2. Second throttle valve opening
   (1) Fully open first throttle valve.

Fig. 8-117



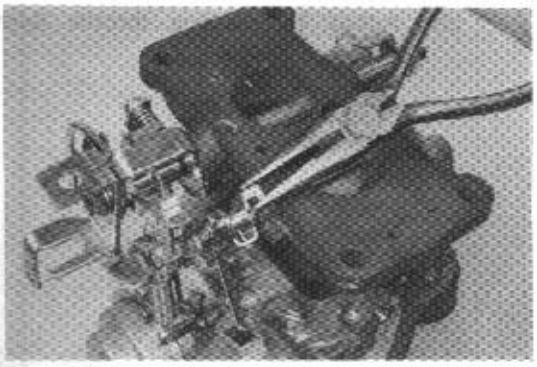
(2) Fully open second throttle valve lever.

Fig. 8-118



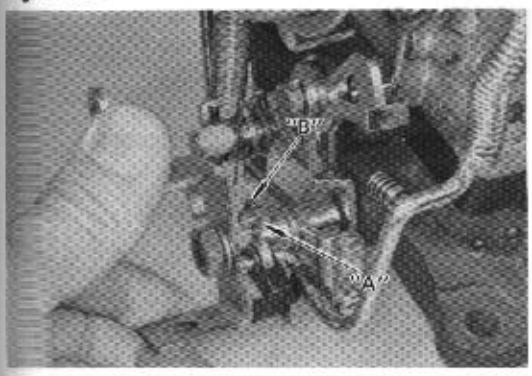
(3) Check throttle valve opening angle.
   Opening Angle 90°

Fig. 8-119



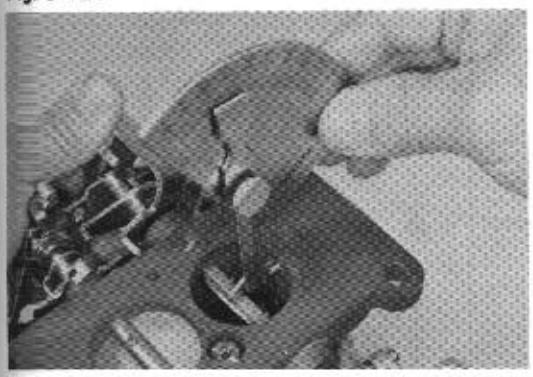
(4) Adjust by bending throttle lever stopper.

Fig. 8-120



3. Seco-touch angle.
   (1) Open first throttle valve until throttle valve lever "A" part touch "B" part.

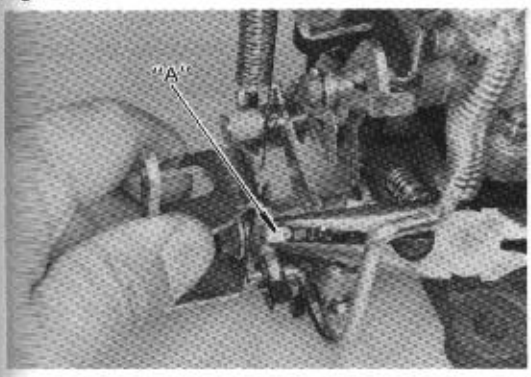
Fig. 8-121



   (2) At this time, check first throttle valve opening angle.

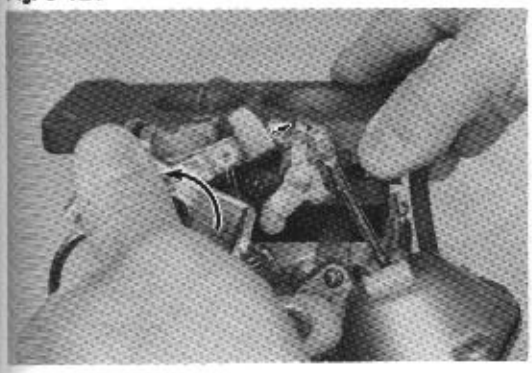
Seco-touch Angle 57 – 61°

Fig. 8-122



   (3) Adjust by bending "A" part.

Fig. 8-123



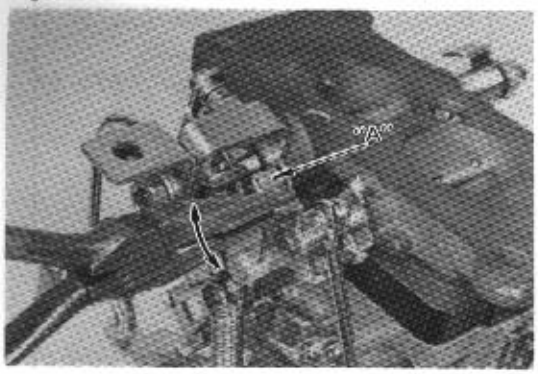
4. Kick up
   (1) Open first throttle valve until kick arm slightly open second throttle valve.

Fig. 8-124

(2) Check clearance between second throttle valve and body.

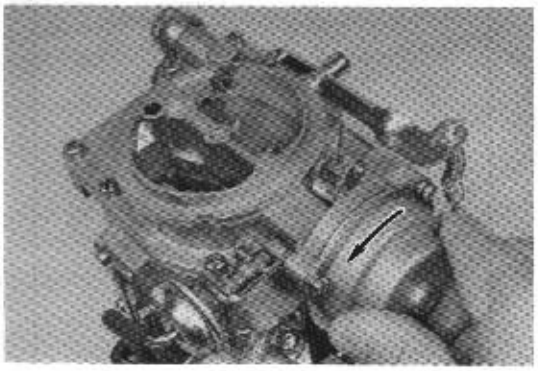
Kick up clearance
0.1 – 0.2 mm
(0.004 – 0.008 in)

Fig. 8-125



(3) Adjust by bending "A" part.

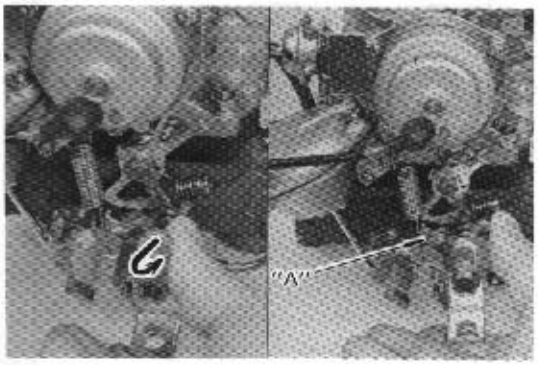
Fig. 8-126



5–1. Fast idle (only automatic choke)

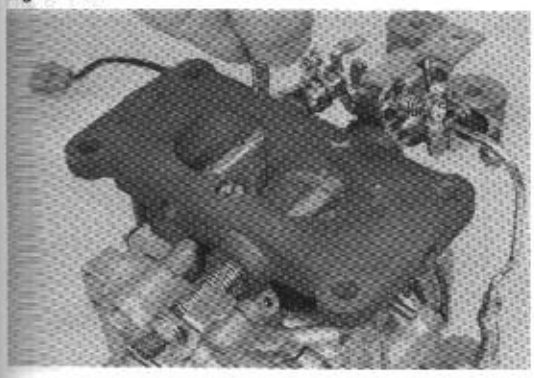
(1) Fully close choke valve by turning coil housing.

Fig. 8-127



(2) Slightly open the first throttle valve and then close it. Insure that the throttle lever "A" part hooks to the fast idle cam.

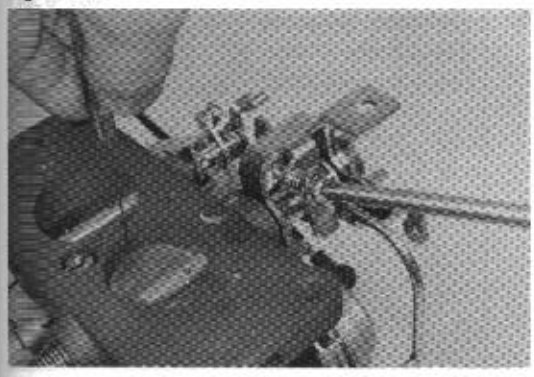
Fig. 8-128



(3) Check clearance between first throttle valve and bore.

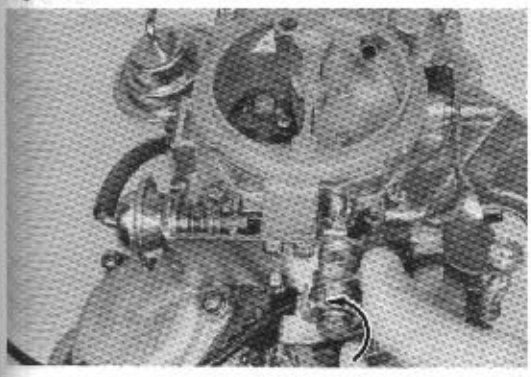
Fast idle clearance
0.81 mm (0.032 in.)

Fig. 8-129



(4) Adjust by turning fast idle adjusting screw.

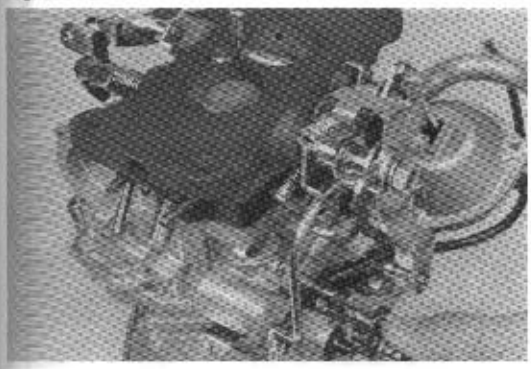
Fig. 8-130



5–2. Fast idle (only manual choke)

(1) Fully close choke valve by turning choke shaft lever.

Fig. 8-131



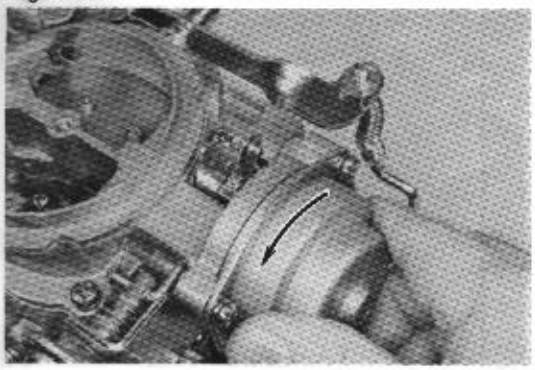
(2) Check clearance between first throttle valve and bore.

Fast idle clearance
1.01 mm (0.039 in)

Fig. 8-132

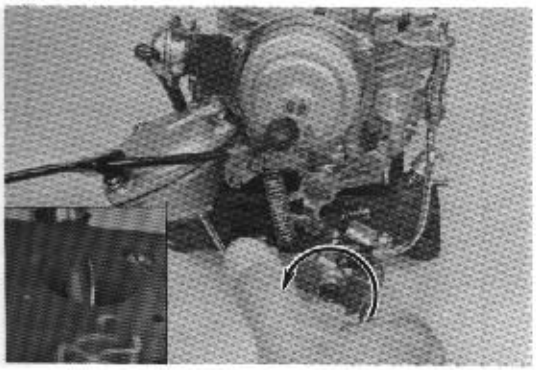
(3) Adjust by turning fast idle adjusting screw.

Fig. 8-133



6. Unloader (only automatic choke)
   (1) Fully close choke valve by turning coil housing.

Fig. 8-134

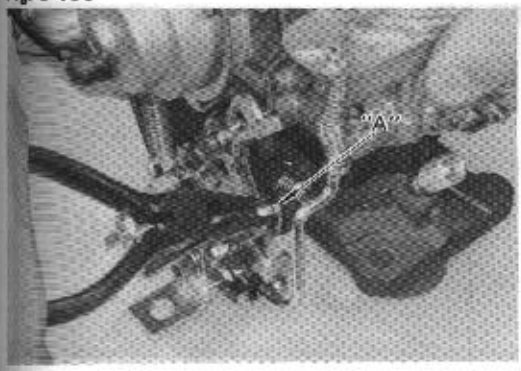


(2) Fully open first throttle valve.

Fig. 8-135

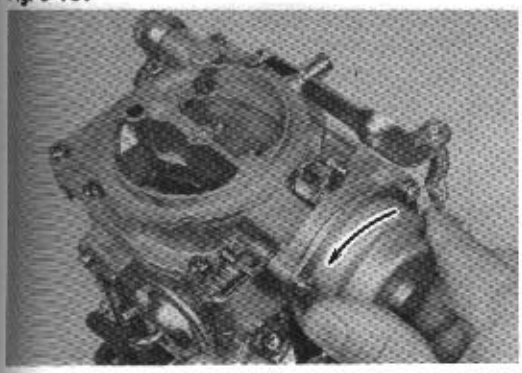
(3) At this time, check chock valve opening angle.
   Unloader Angle 47°

Fig. 8-136



(4) Adjust by bending "A" part.

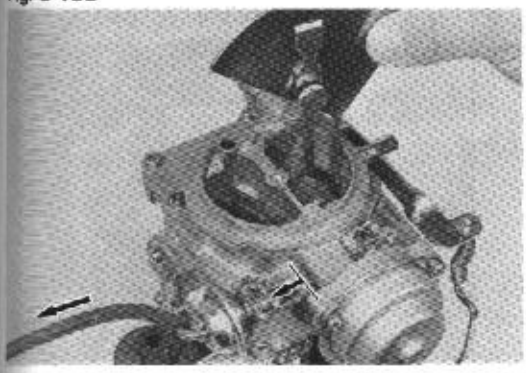
Fig. 8-137



7-1. Choke breaker (only automatic choke)

(1) Fully close chock valve by turning coil housing.

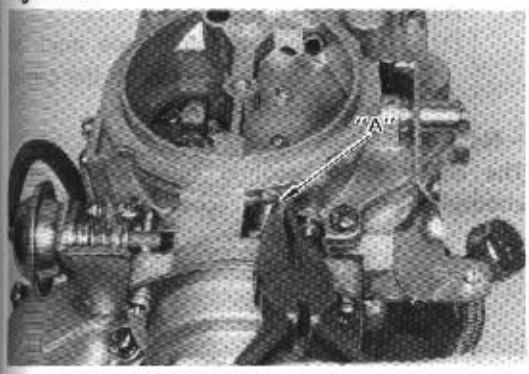
Fig. 8-138



(2) Connect hose to diaghragm and suck hose with mouth.

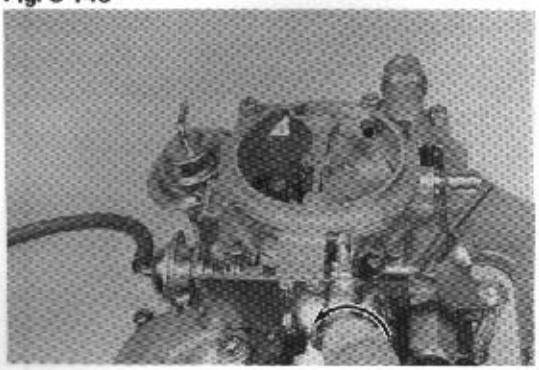
(3) At this time, check clearance between choke valve and bore.

Fig. 8-139



(4) Adjust by bending "A" part.

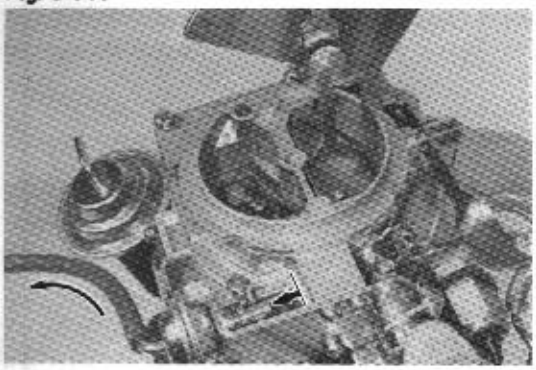
Fig. 8-140



7-2. Choke breaker (only manual choke)

(1) Fully close chock valve by turning choke lever.

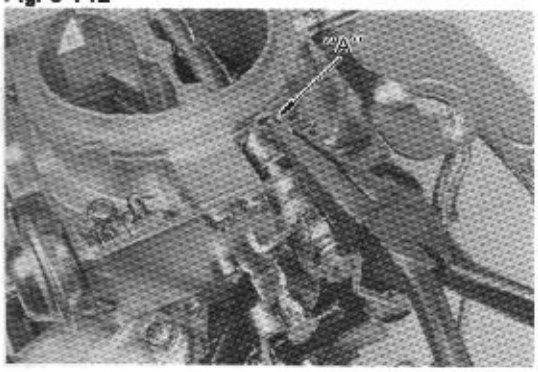
Fig. 8-141



(2) Connect hose to diaghragm and suck hose with mouth.

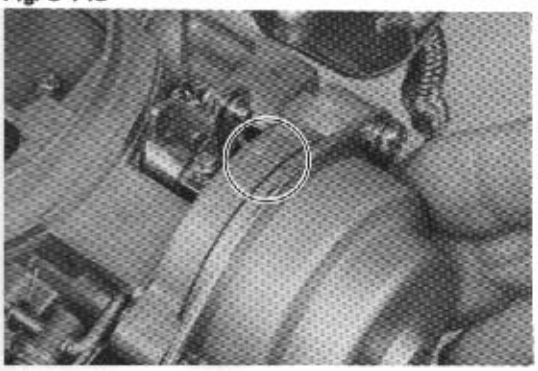
(3) At this time, check clearance between choke lever, and bore.

Fig. 8-142



(4) Adjust by bending "A" part.

Fig. 8-143



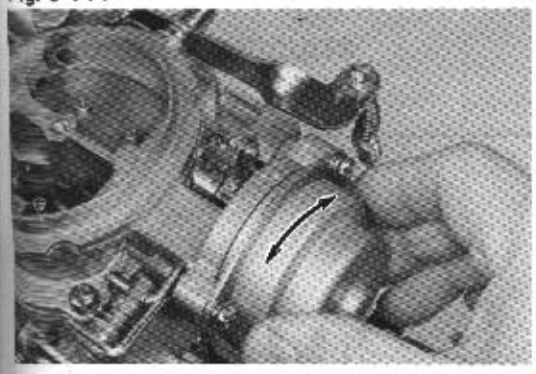
8. Automatic choke

(1) Set the coil housing scale mark so that it will be aligned with the center line of the thermostat case.

– Note –

The choke valve becomes fully closed when atmospheric temperature reaches 25°C (77°F).

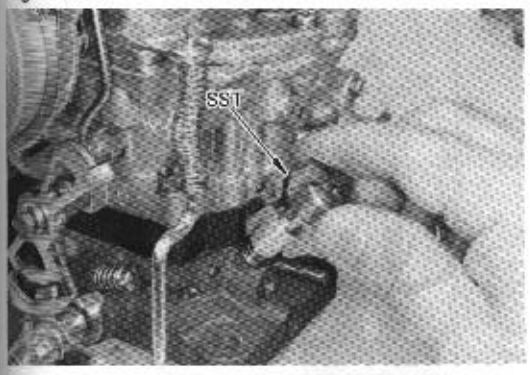
Fig. 8-144



(2) Depending on the vehicle operating conditions, turn the coil housing and adjust the engine starting mixture.

If too rich ..... Turn clock-wise.
If too lean ... Turn counterclock-wise.

Fig. 8-145



9. Idle mixture adjusting screw.
Tighten the idle mixture adjusting screw and then unscrew it about three turns.

– Note –
Be careful not to damage the screw tip by tightening the screw too tightly.

Fig. 8-146

10. Accelerating pump
Adjust the pump stroke by bending part (A).

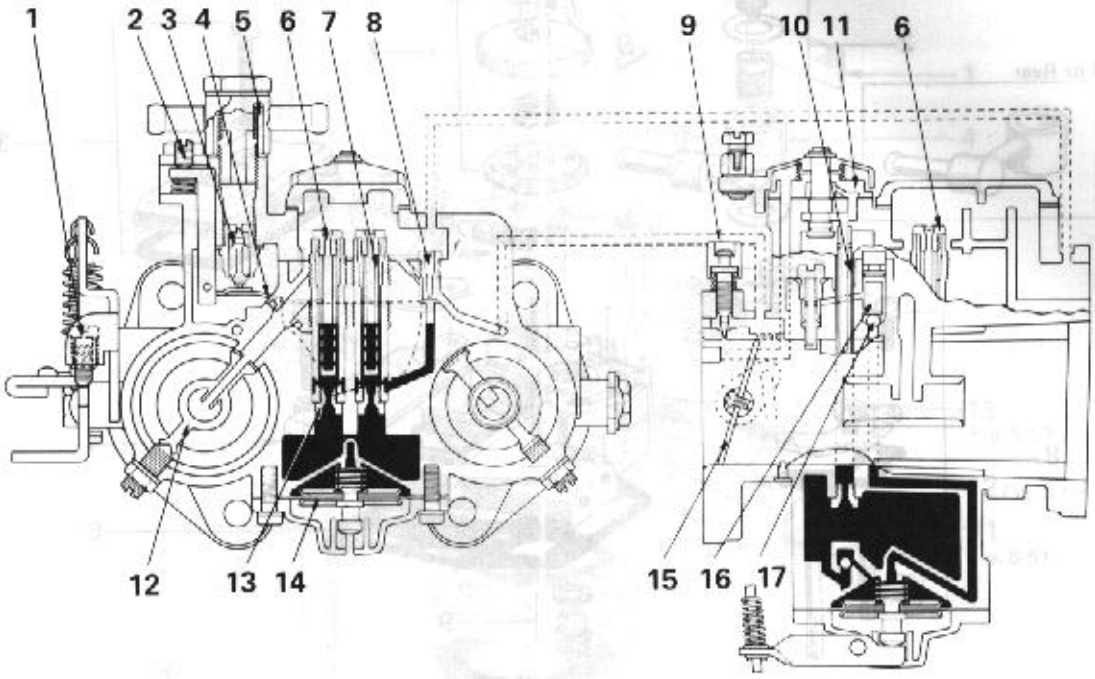
Standard	**Europe**	**3.7 mm (0.146 in)**
	Australia General	**3.8 mm (0.150 in)**

– Note –
After adjustment is made, be sure to check the linkage to see that it operates smoothly.

CARBURETOR(FOR 18R-G ENGINE)

CARBURETOR CIRCUITS

Fig. 8-150



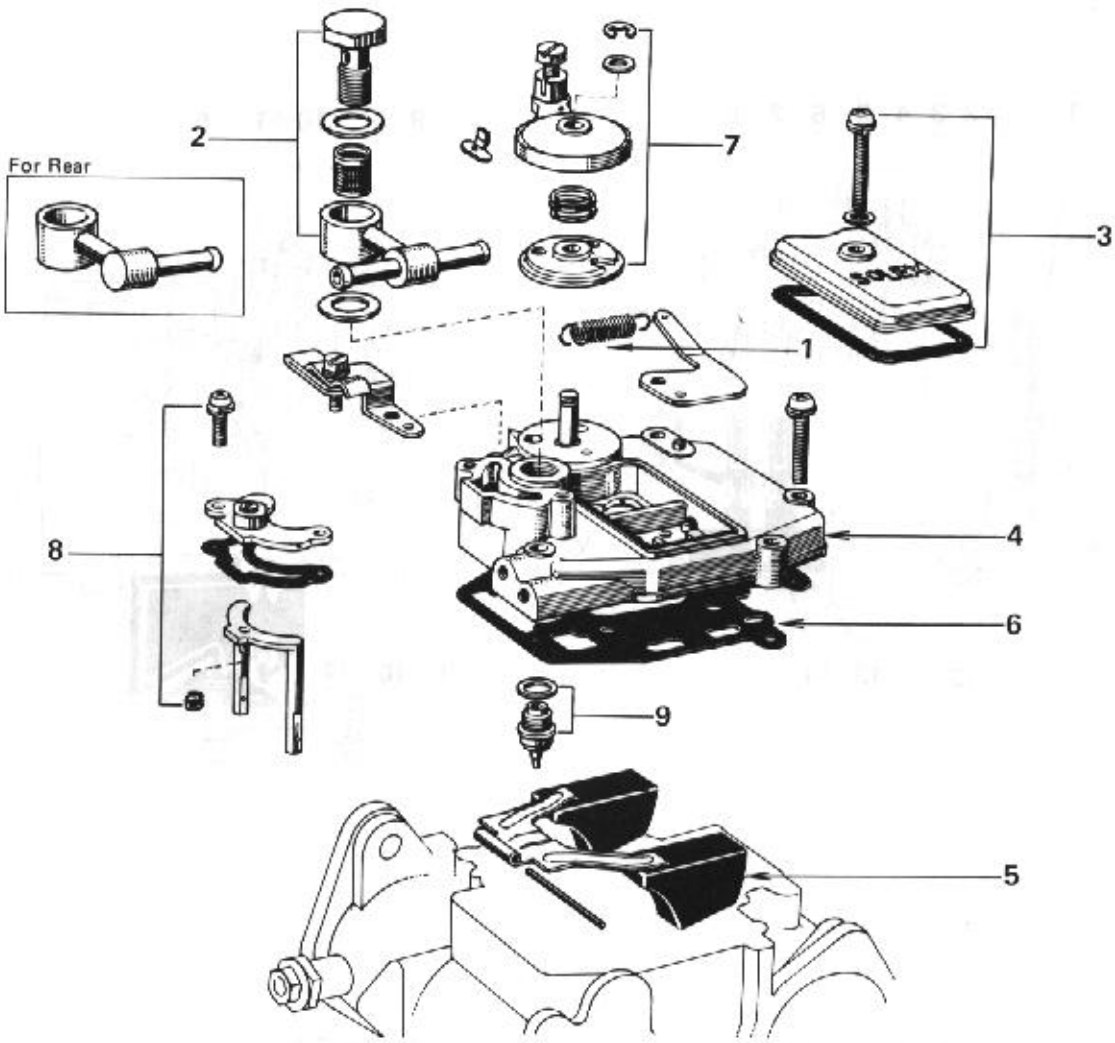
1	Idle Speed Adjusting Screw	10	Air Bleed Tube
2	Screw (For Float Adjustment)	11	Starter Disc
3	Needle Valve Sub-assembly	12	Inner Venturi
4	Float Sub-assembly	13	Main Jet
5	Strainer	14	Diaphragm Rod Sub-assembly
6	Main Air Bleed Jet	15	Throttle Valve
7	Main Air Bleed Tube	16	Pump Valve Weight
8	Slow Jet	17	Pump Valve Check Ball
9	Idle Mixture Adjusting Screw		

DISASSEMBLY

Bowl Cover

Disassemble in numerical order.

Fig. 8-151

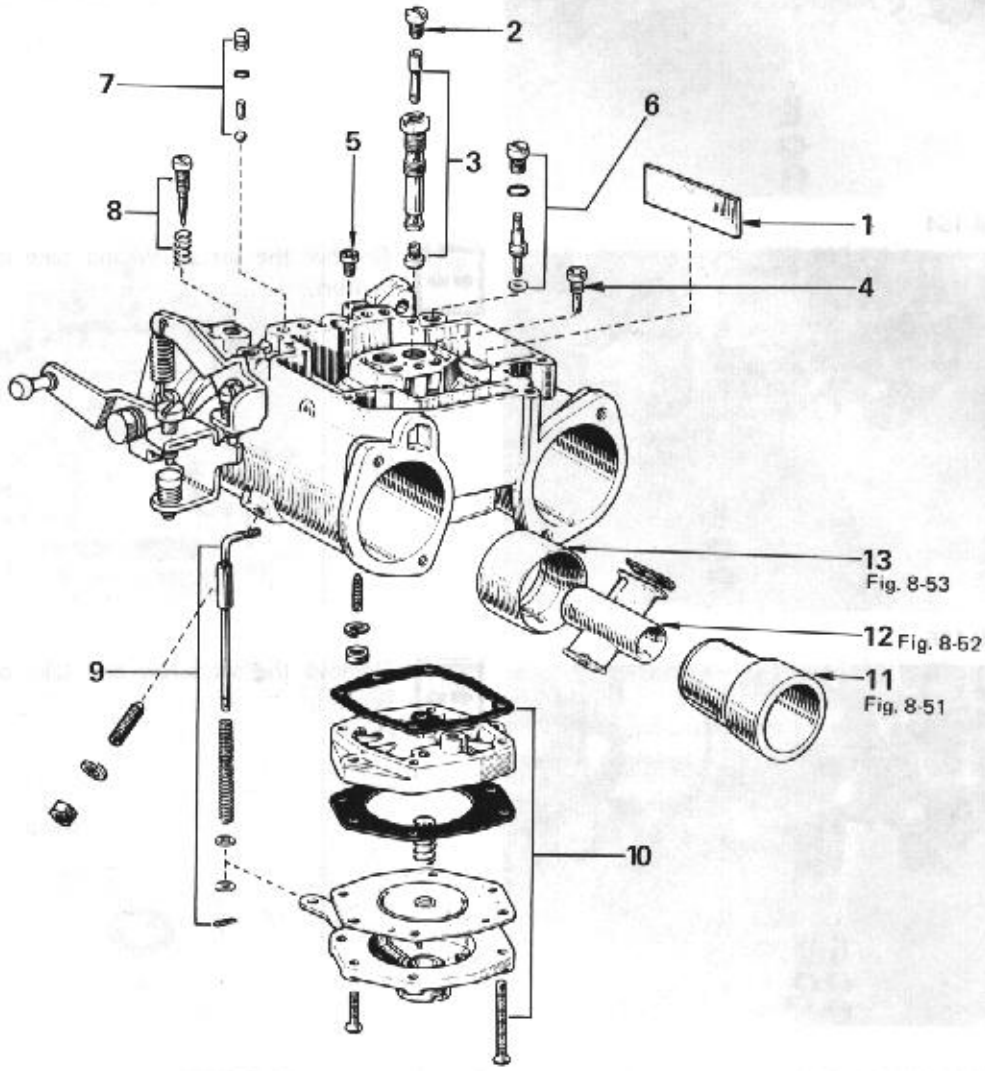


1	Starter Back Spring	6	Bowl Cover Gasket
2	Fuel Union	7	Starter Disc
3	Jet Chamber Cover	8	Float Adjusting Stay
4	Bowl Cover Sub-assembly	9	Needle Valve Sub-assembly
5	Float		

Body

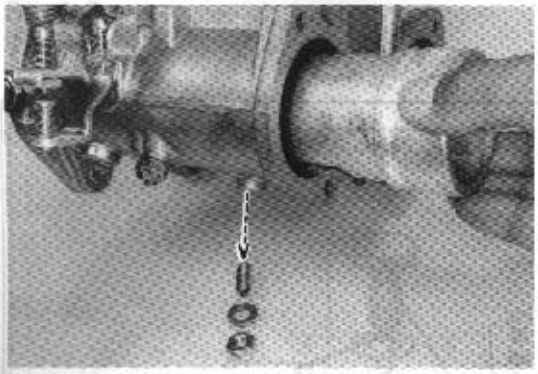
Disassemble in numerical order.

Fig. 8-152



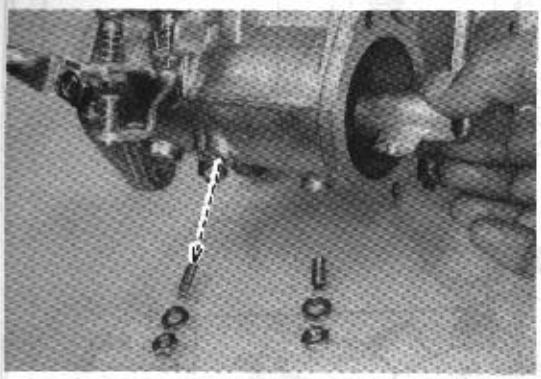
1	Float Chamber Plate	8	Idle Mixture Adjusting Screw
2	Main Air Bleed Jet	9	Pump Rod
3	Main Jet Holder	10	Accelerating Pump
4	Slow Jet	11	Sleeve
5	Starter Jet	12	Small Venturi
6	Pump Nozzle	13	Large Venturi
7	Pump Check Valve		

Fig. 8-153



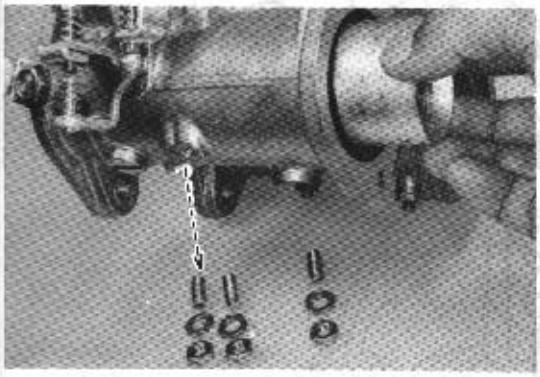
Remove the set screw and take out the sleeve.

Fig. 8-154



Remove the set screw and take out the small venturi.

Fig. 8-155



Remove the set screw and take out the large venturi.

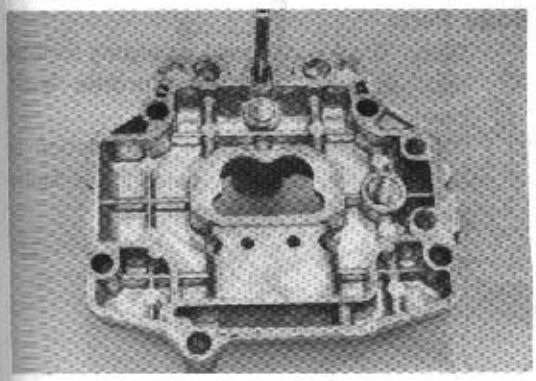
INSPECTION

– Precaution –

1. **Before inspecting the parts, wash them thoroughly in gasoline. Using compressed air, blow all dirt and other foreign matter from the jets and similar parts, and from the fuel passages and apertures in the body.**

2. **Never clean the jets or orifices with wire or a drill. This could enlarge the openings and result in excessive fuel consumption.**

Fig. 8-156

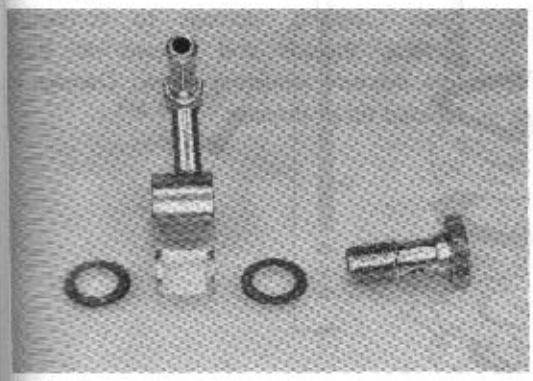


Inspect the following parts and replace any part damaged.

Bowl Cover Parts

1. Bowl cover: Cracks, damaged threads.
2. Starter pipe: Damaged and/or clogged.

Fig. 8-157

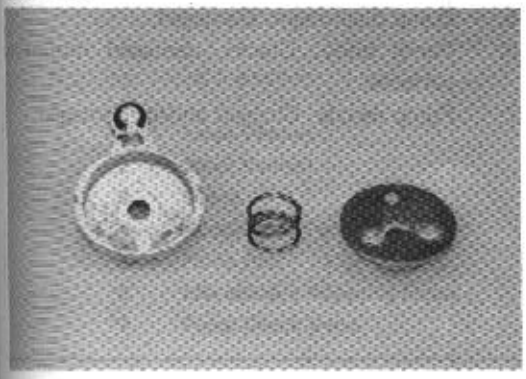


3. Filter: Clogged, rusted, or damaged.

– Note –

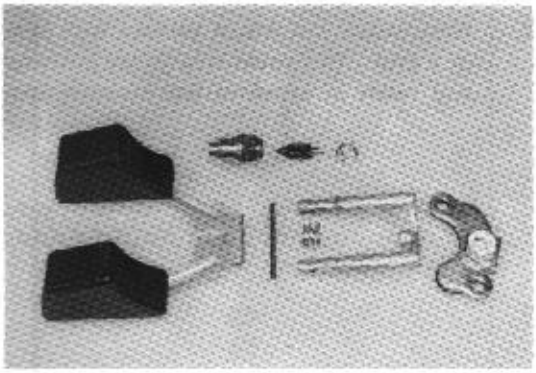
New gasket must always be used whenever the union is removed.

Fig. 8-158



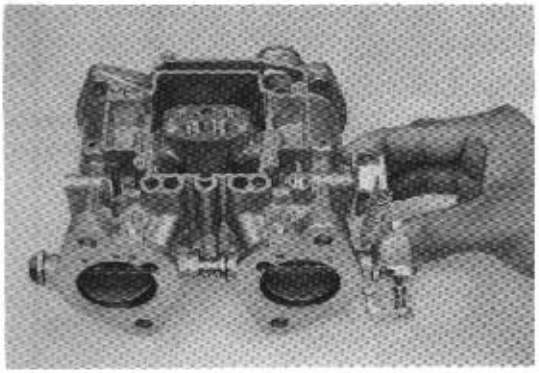
4. Starter disc: Damaged or worn sliding surface.

Fig. 8-159



5. Needle valve: Contacting valve seat.
6. Float: Deformed, wear in float lever pin holes, bent float arms.

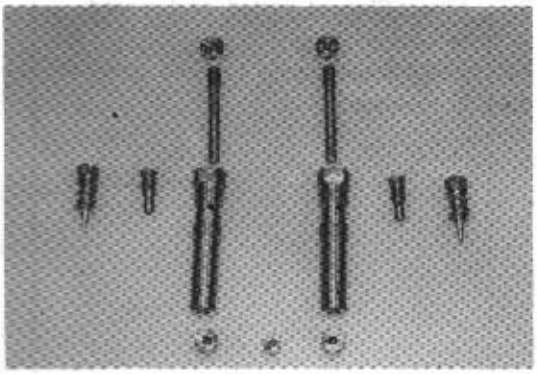
Fig. 8-160



Body Parts

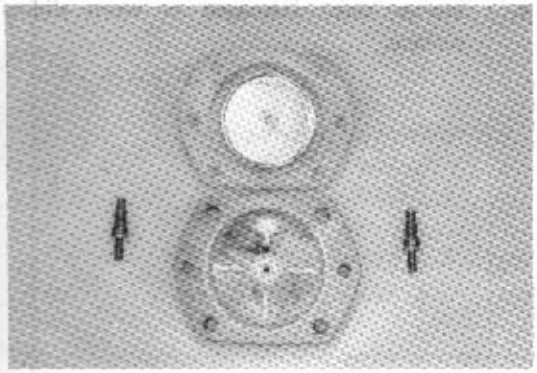
1. Body: Cracks, damaged mounting surfaces and threads, wear on throttle shaft bearings, and carbon adherence.
2. Throttle valves: Wear or deformation in valves. Wear, bending, twisting, or faulty movement inside housing of shaft.

Fig. 8-161



3. Jets: Clogging, damage to contacting surface, threads and screwdriver slots.
4. Idle mixture adjusting screw: Damage to tapered tip or threads.

Fig. 8-162



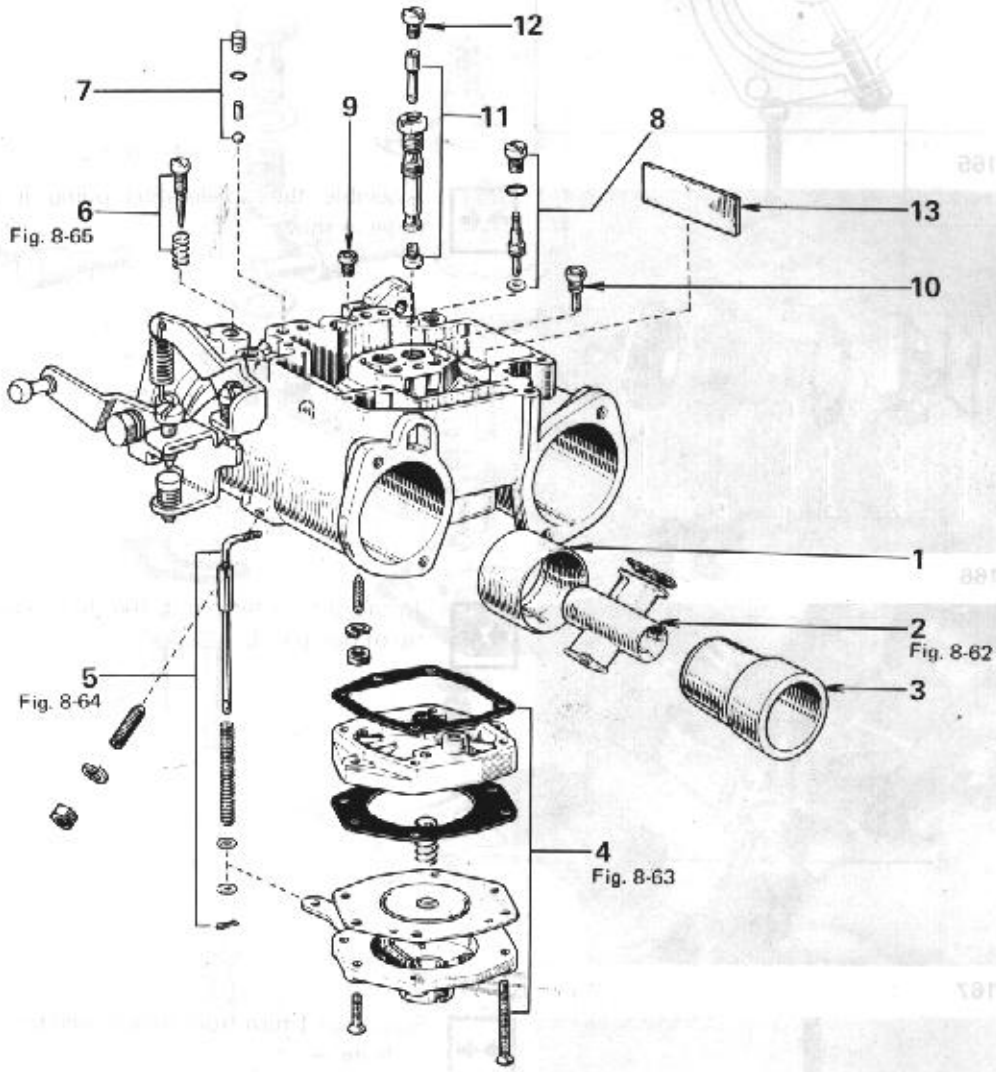
5. Pump diaphragm: Damaged.
6. Pump body: Cracks, damaged mounting surfaces.
7. Pump nozzle: Clogged and/or damaged.

ASSEMBLY

Body

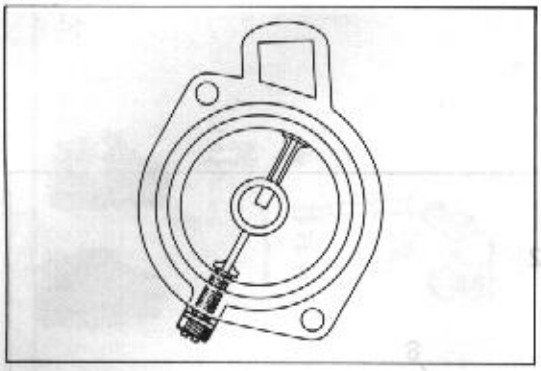
Assemble in numerical order.

Fig. 8-163



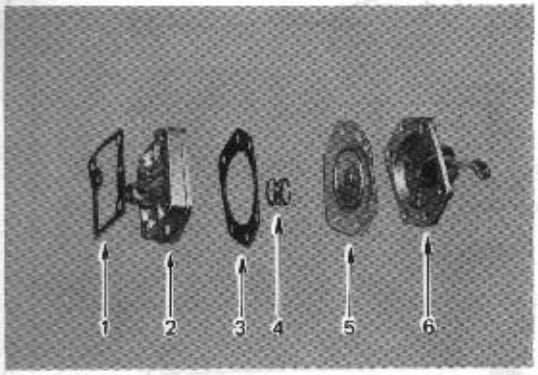
1	Large Venturi	8	Pump Nozzle
2	Small Venturi	9	Starter Jet
3	Sleeve	10	Slow Jet
4	Accelerating Pump	11	Main Jet Holder
5	Pump Rod	12	Main Air Bleed Jet
6	Idle Mixture Adjusting Screw	13	Float Chamber Plate
7	Pump Check Valve		

Fig. 8-164



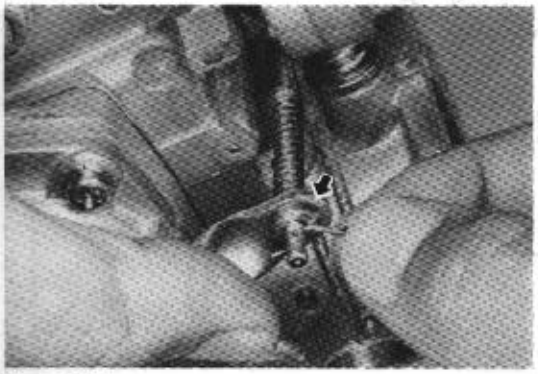
Using the longest screw, assemble the small venturi as shown.

Fig. 8-165



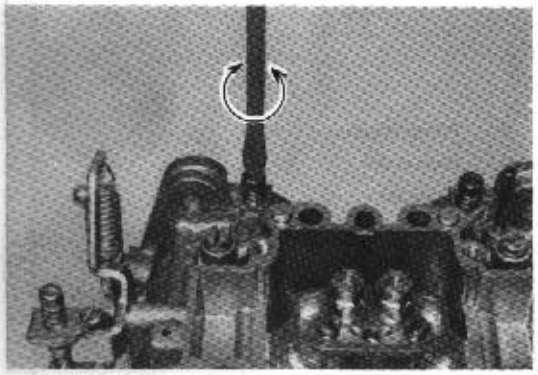
Assemble the accelerating pump in numerical order as shown.

Fig. 8-166



Install the cotter pin in the third hole from the tip of pump rod.

Fig. 8-167



Screw out 1 turn from fully closed position.

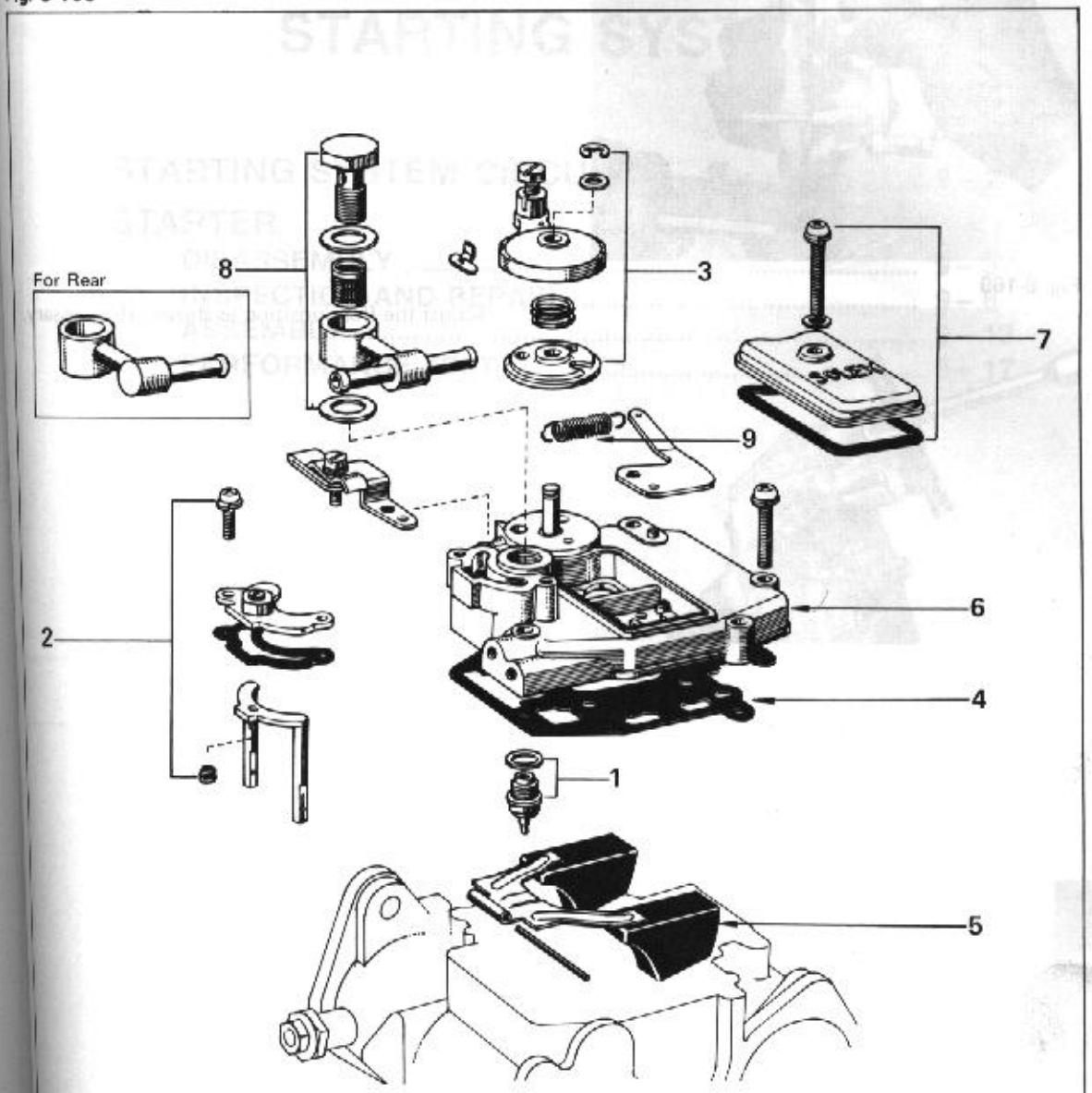
— Note —

Take care not to mistake the left and right sides.

Bowl Cover

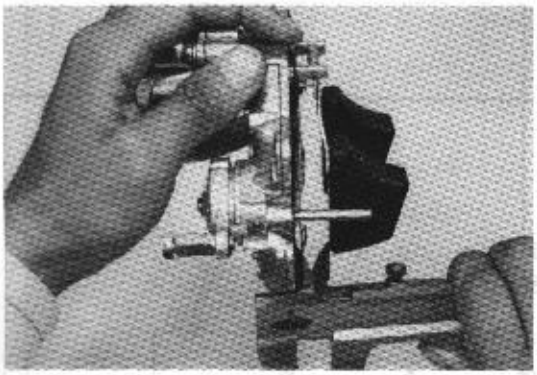
Assemble in numerical order.

Fig. 8-168



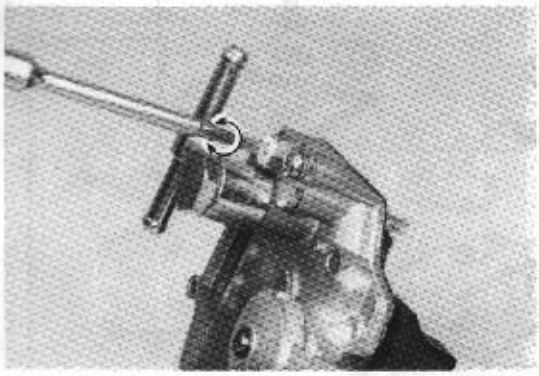
1	Needle Valve Sub-assembly	6	Bowl Cover Sub-assembly
2	Float Adjusting Stay	7	Jet Chamber Cover
3	Starter Disc	8	Fuel Union
4	Bowl Cover Gasket	9	Starter Back Spring
5	Float		

Fig. 8-170



Preset the float position.
About 16 mm (0.63 in) from bowl cover lower surface.

Fig. 8-169



Adjust the float position as shown, if necessary.

STARTING SYSTEM

9

STARTING SYSTEM CIRCUIT

Fig. 9-1

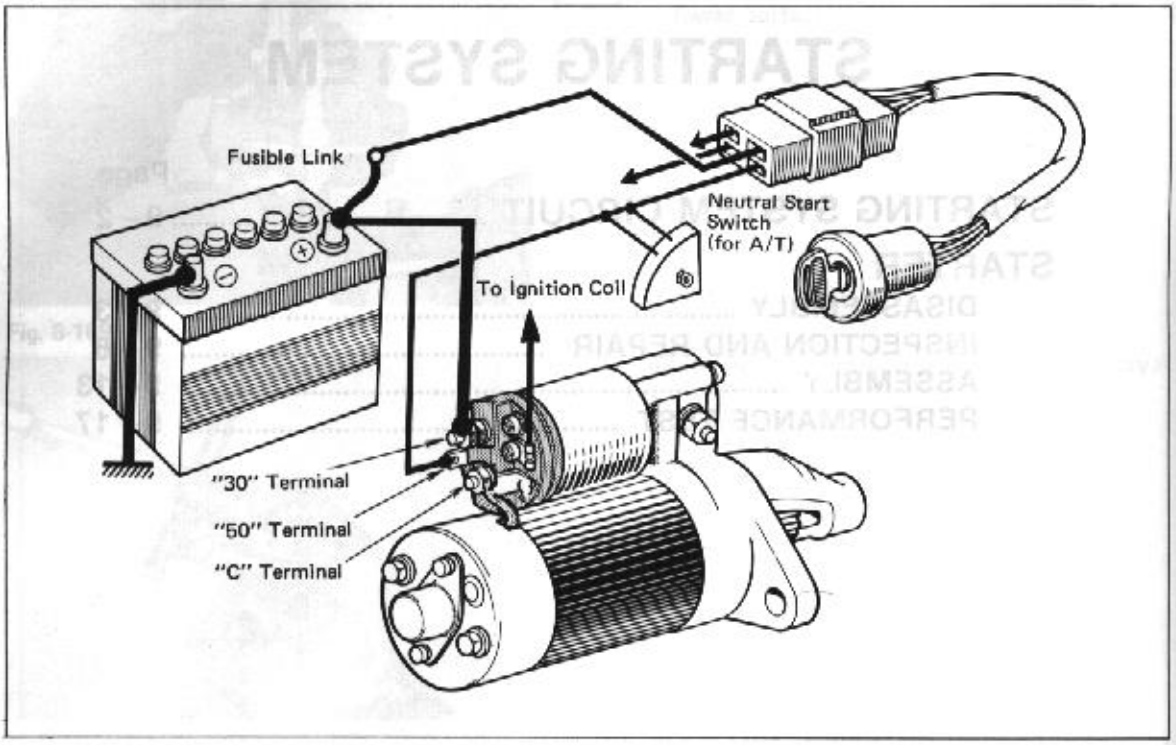
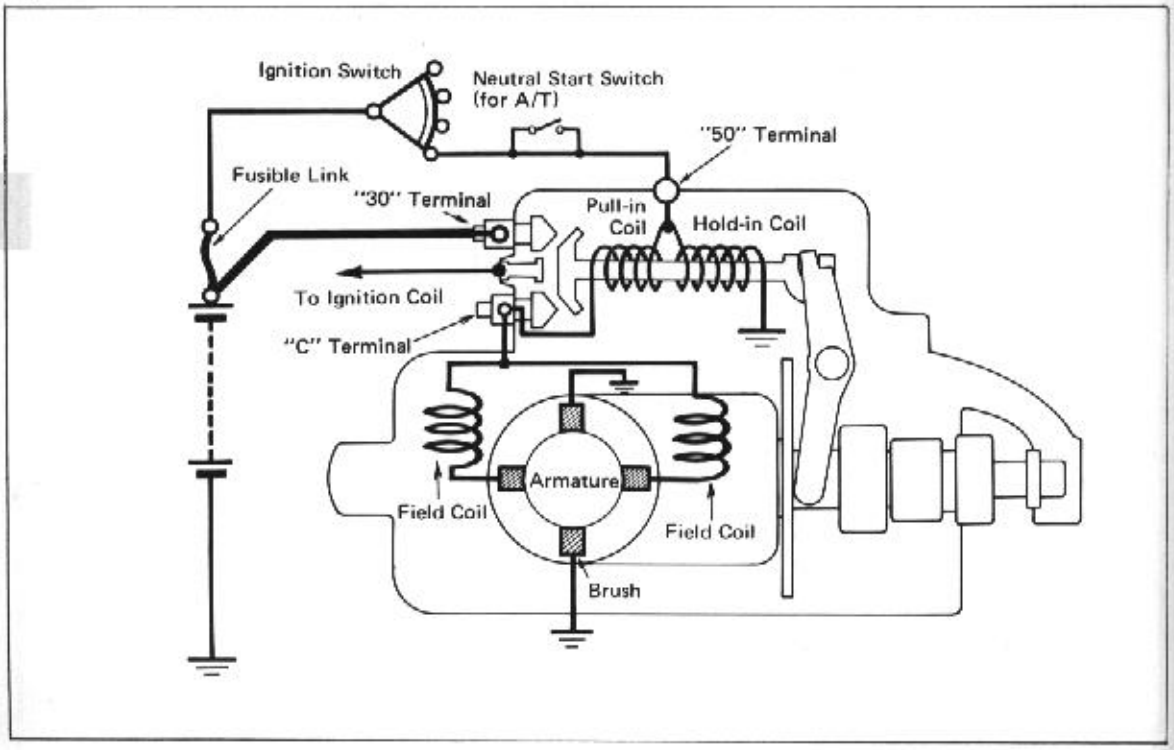


Fig. 9-2



STARTER

DISASSEMBLY

Disassemble in numerical order.

Fig. 9-3

1 Magnetic Switch
2 Bearing Cover
3 Lock Plate and Spring
4 Bolt
5 Commutator End Frame
6 Yoke with Brush Holder
7 Drive Lever Bolt
8 Armature and Drive Lever
9 Brush Holder
10 Snap Ring
11 Stop Collar
12 Clutch with Pinion Gear
13 Center Bearing (for 1.0KW)

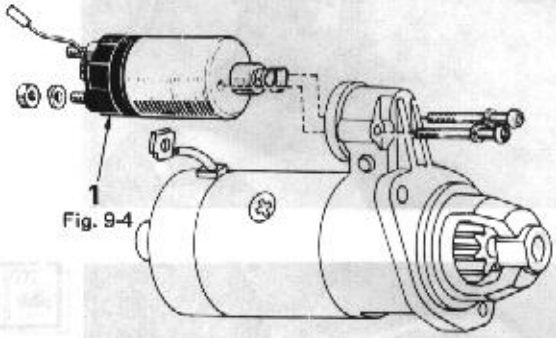


Fig. 9-4

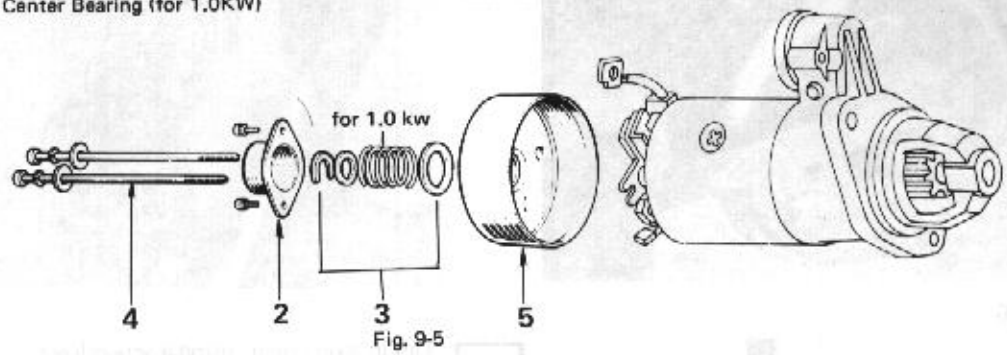


Fig. 9-5

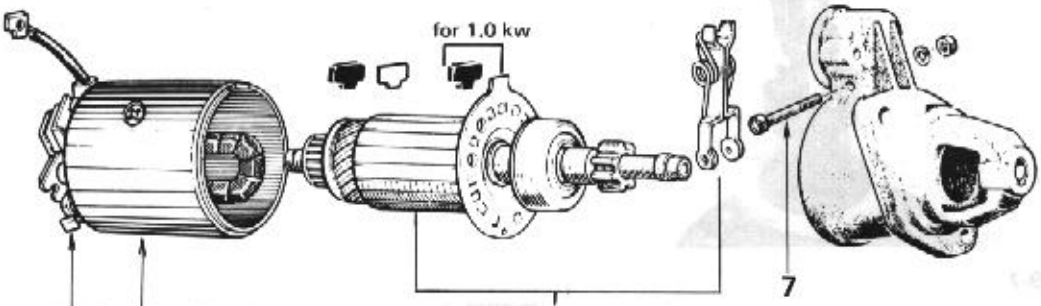


Fig. 9-9

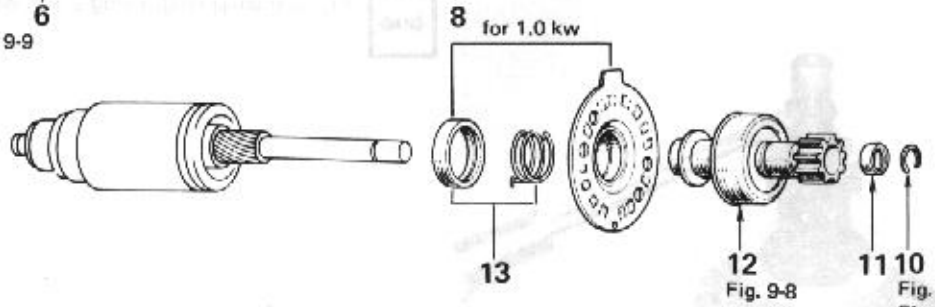
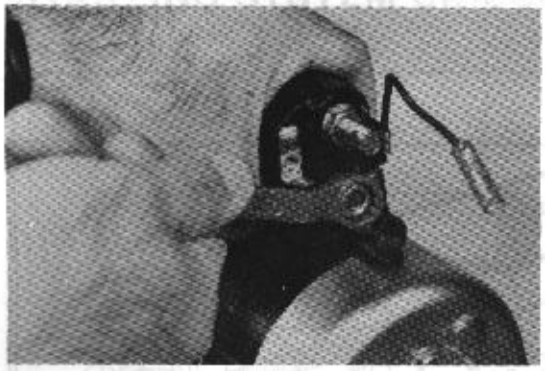


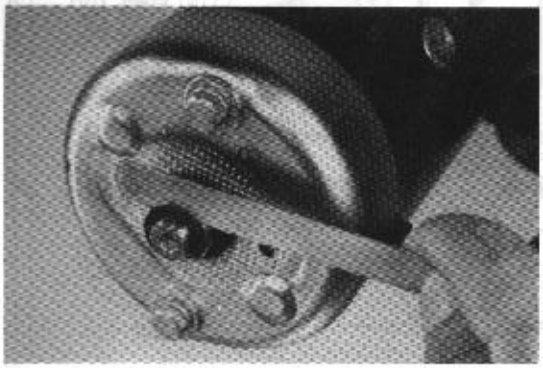
Fig. 9-8 Fig. 9-6 Fig. 9-7

Fig. 9-4



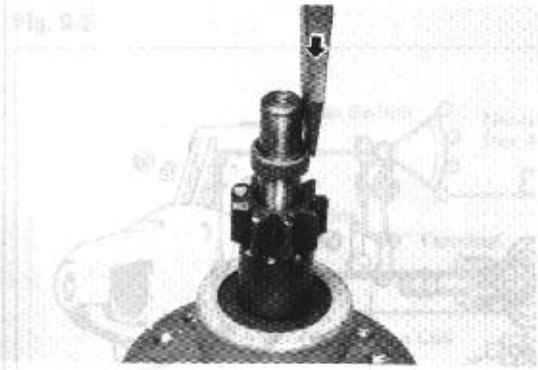
Disconnect lead wire before removing magnetic switch.

Fig. 9-5



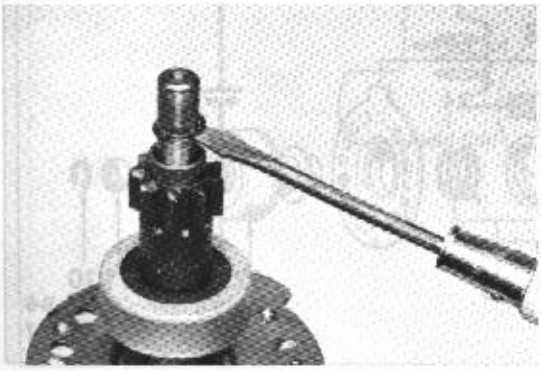
Check the armature shaft thrust clearance.
Thrust clearance limit 0.8 mm (0.032 in)

Fig. 9-6



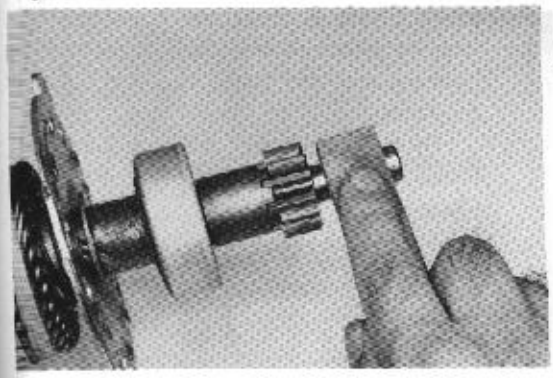
Tap in stop collar, using a screwdriver.

Fig. 9-7



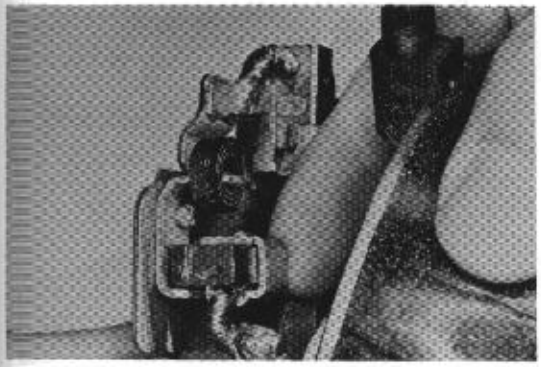
Pry the snap ring, using a screwdriver.

Fig. 9-8



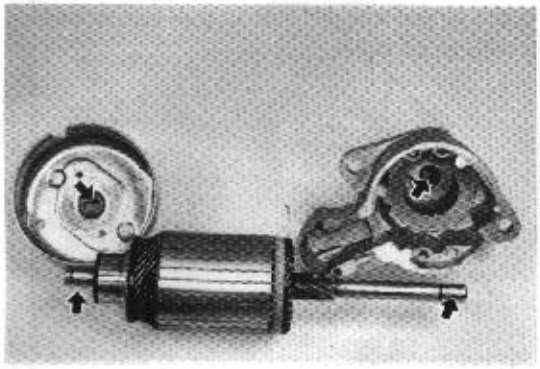
If the pinion was difficult to pull out, smoothen it with an oil stone.

Fig. 9-9



Take off brushes and remove brush holder.

Fig. 9-11



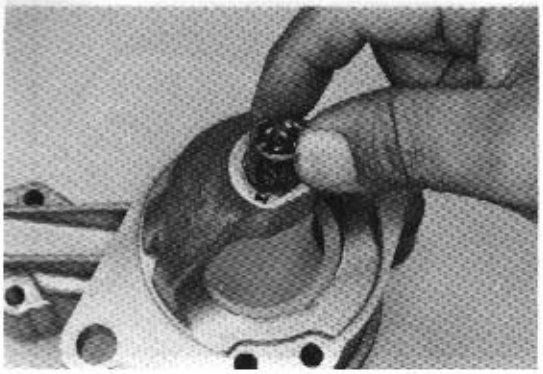
INSPECTION AND REPAIR

Armature Shaft & Bearings

1. Inspect armature shaft end, drive housing bushing and end frame bushing for wear or damage.

   Oil clearance limit 0.2 mm (0.008 in)

Fig. 9-12

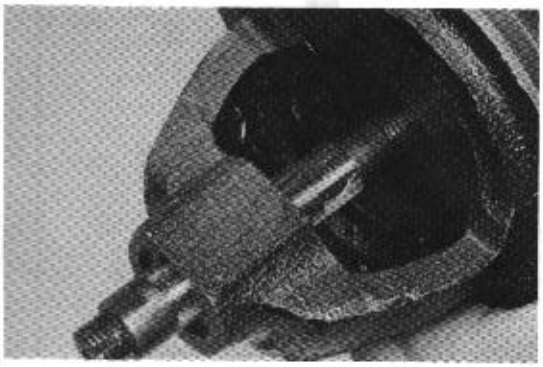


2. Bushing replacement.

   (1) Pry out the bushing cover and press out the bushing.

   (2) Aligning the bushing hole with the housing groove, Press in new bushing.

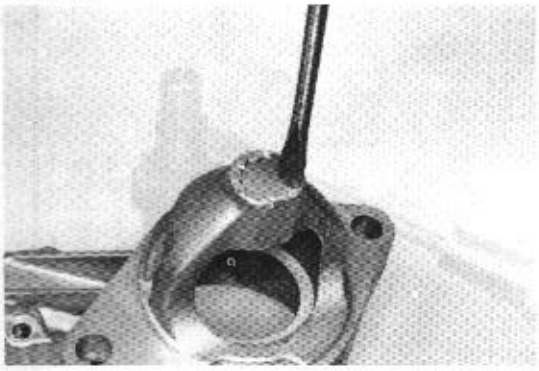
Fig. 9-13



   (3) Ream bushing to obtain the specified clearance.

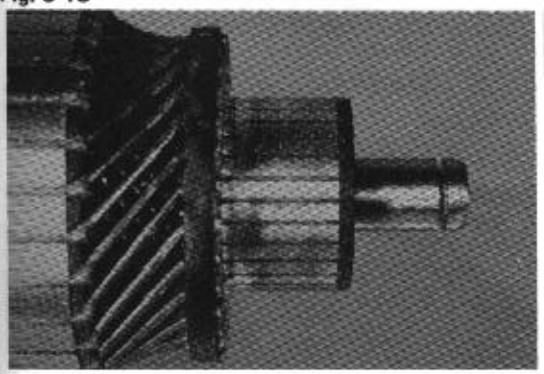
   Oil clearance 0.10 – 0.14 mm (0.0039 – 0.0055 in)

Fig. 9-14



   (4) Clean the bore, and install new bushing cover.

Fig. 9-15

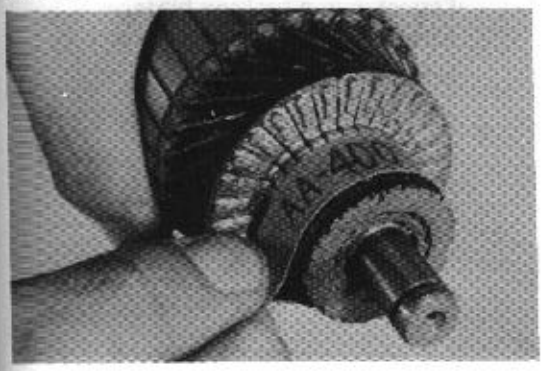


Commutator

Inspect for the following items and repair or replace.

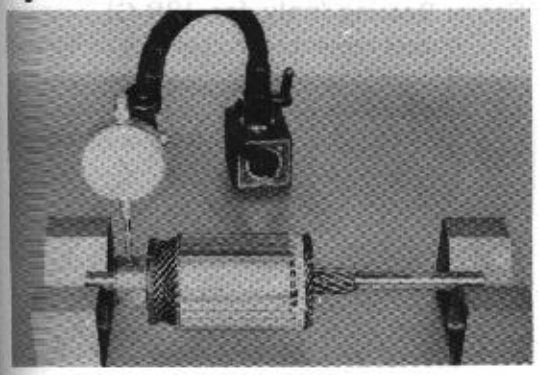
1. Dirty or burnt surface.
   Correct by sandpaper or lathe if necessary.

Fig. 9-16



Use # 400 sandpaper.

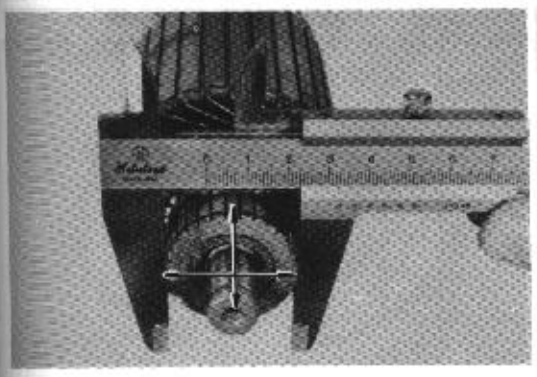
Fig. 9-17



2. Runout: Correct on a lathe if it exceeds the limit.

Runout limit	**0.4 mm (0.016 in)**
Standard	**0.05 mm (0.0020 in)**

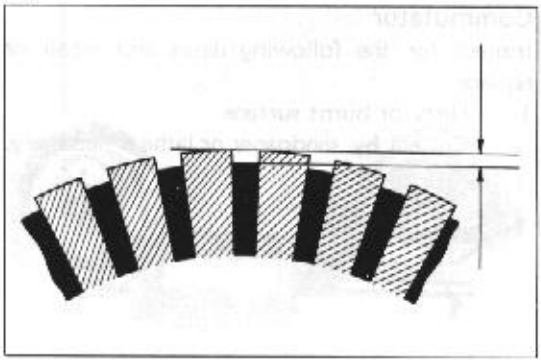
Fig. 9-18



3. Surface wear: If below the limit, replace armature.

Limit	**31 mm (1.22 in)**
Standard	**32.7 mm (1.287 in)**

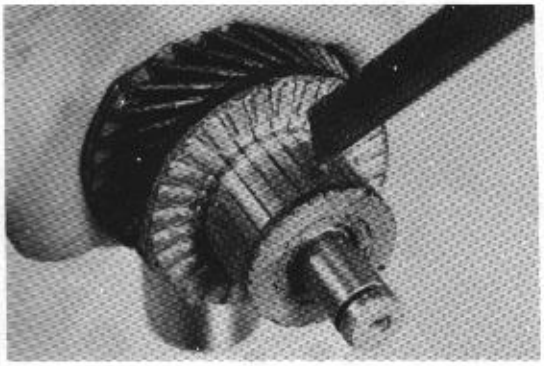
Fig. 9-19



4. Depth of segment mica.

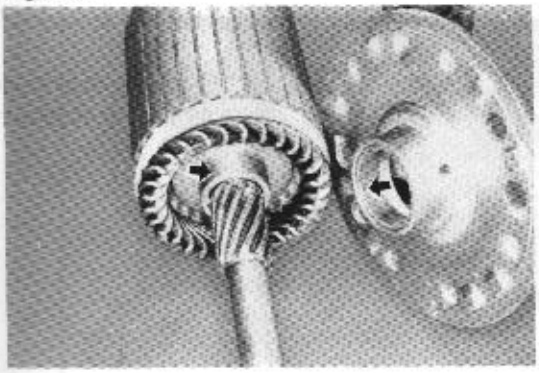
Limit	**0.2 mm (0.008 in)**
Standard	**0.5-0.8 mm (0.020-0.031 in)**

Fig. 9-20



Correct with a hacksaw blade.
After correcting, eliminate chips using sandpaper.

Fig. 9-21



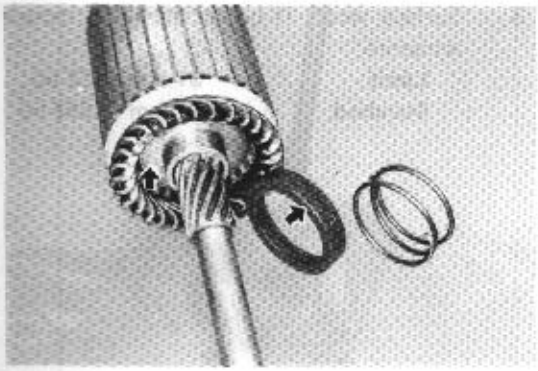
Center Bearing (only for 18R-G)

1. Inspect center bearing for wear or damage. Replace if necessary.

Clearance limit

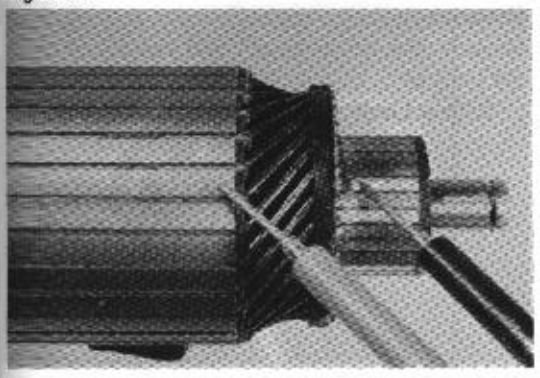
0.2 mm (0.008 in)

Fig. 9-22



2. Inspect spring holder, spring and armature shaft for cracks, wear or damage. Replace if necessary.

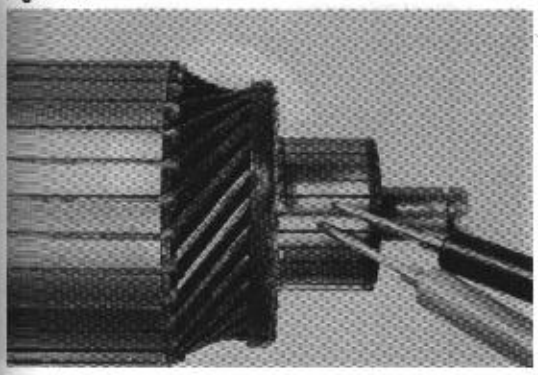
Fig. 9-23



Armature Coil

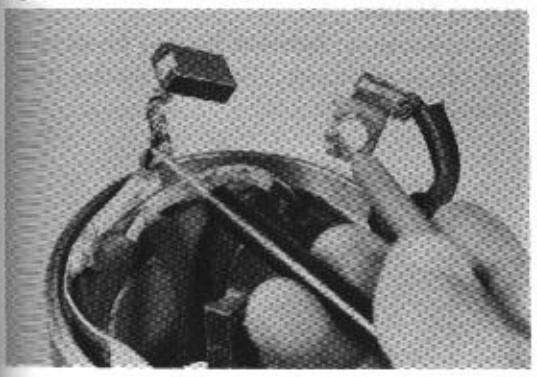
1. Ground test
   Check commutator and armature coil core. If there is continuity, the armature is grounded and must be replaced.

Fig. 9-24



2. Open-circuit test
   Check for continuity between the segments. If there is no continuity at any test point, there is an open-circuit and armature must be replaced.

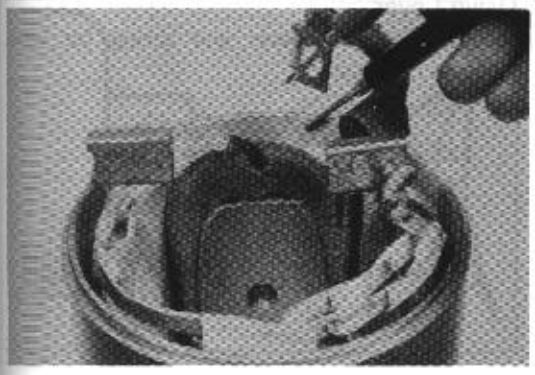
Fig. 9-25



Field Coil

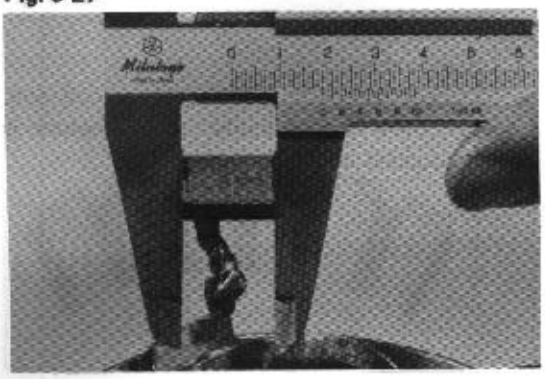
1. Open-circuit test
   Check for continuity between the lead wire and field coil brush soldered connection. If there is no continuity, there is an open-circuit in the field coil, and it should be replaced.

Fig. 9-26



2. Ground test
   Check for continuity between field coil end and field frame.
   If there is continuity, repair or replace the field coil.

Fig. 9-27



Brushes

Measure the brush length and replace if below the limit.

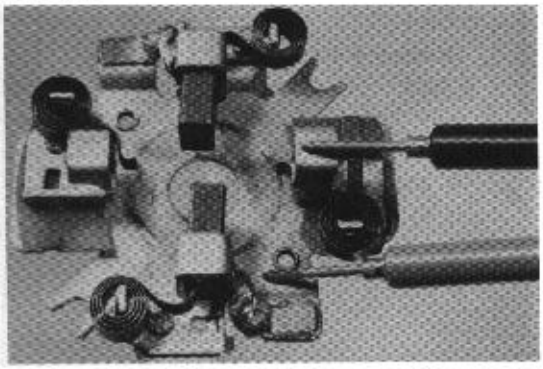
0.8 kw Limit	**10 mm (0.39 in)**
Standard	**16 mm (0.63 in)**
1.0 kw Limit	**12 mm (0.47 in)**
Standard	**19 mm (0.75 in)**

Fig. 9-28

Brush Replacement

Solder brush lead firmly.

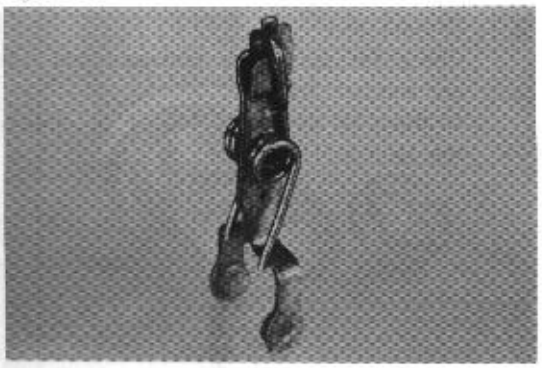
Fig. 9-29



Brush Holder

Check insulation between the (–) brush holder and (+) brush holder. Repair or replace if continuity is indicated.

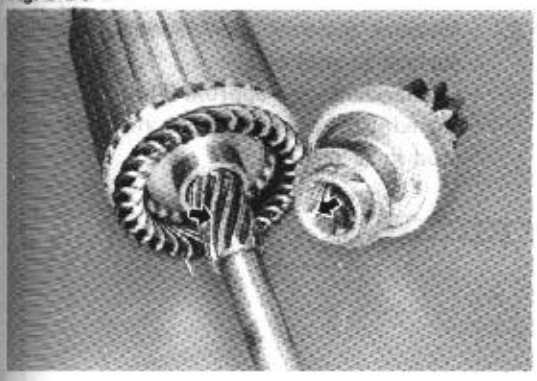
Fig. 9-30



Drive Lever

Inspect the drive lever and spring for wear. Replace if necessary.

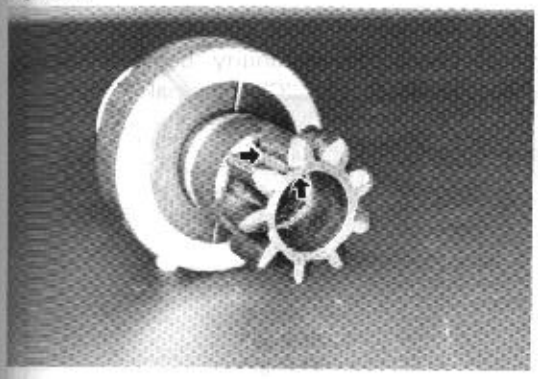
Fig. 9-31



Starter Clutch and Pinion Gear

1. Inspect spline teeth for wear and damage. Replace if necessary.
2. Inspect pinion for smooth movement.

Fig. 9-32

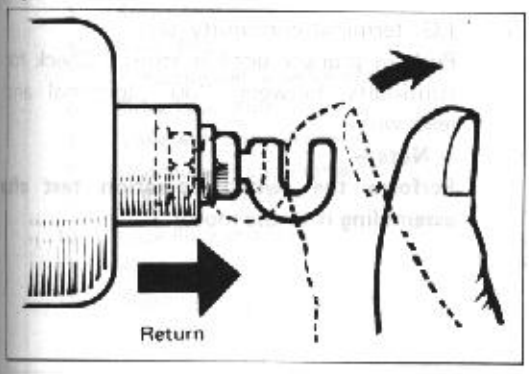


3. Inspect pinion gear teeth and chamfer if worn or damaged.

Fig. 9-33

4. Rotate pinion. It should turn free in clockwise direction and lock when turned counterclockwise.

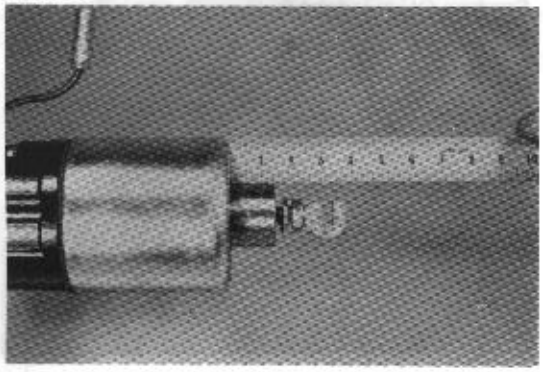
Fig. 9-34



Magnetic Switch

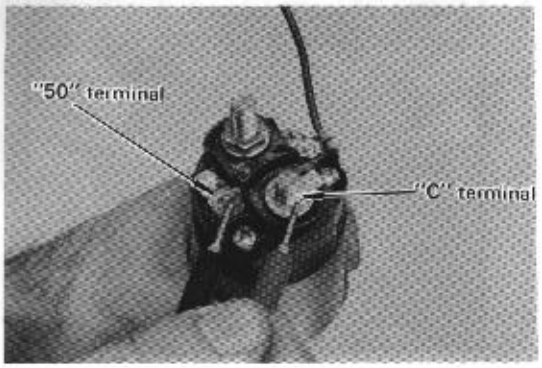
1. Push in plunger and release it.
   The plunger should return quickly to its original position.

Fig. 9-35



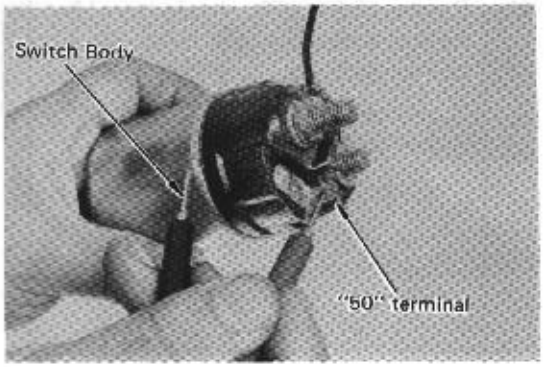
2. Measure distance from switch mounting surface to stud end.
   Standard approx. 34 mm (1.34 in)
   To adjust, loosen the lock nut and screw stud in or out.

Fig. 9-36



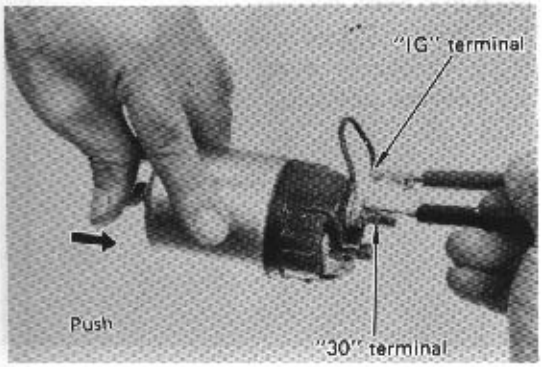
3. Pull-in coil open circuit test.
   Check for continuity between the "50" terminal and "C" terminal.

Fig. 9-37



4. Hold-in coil open circuit test.
   Check for continuity between the "50" terminal and switch body.

Fig. 9-38

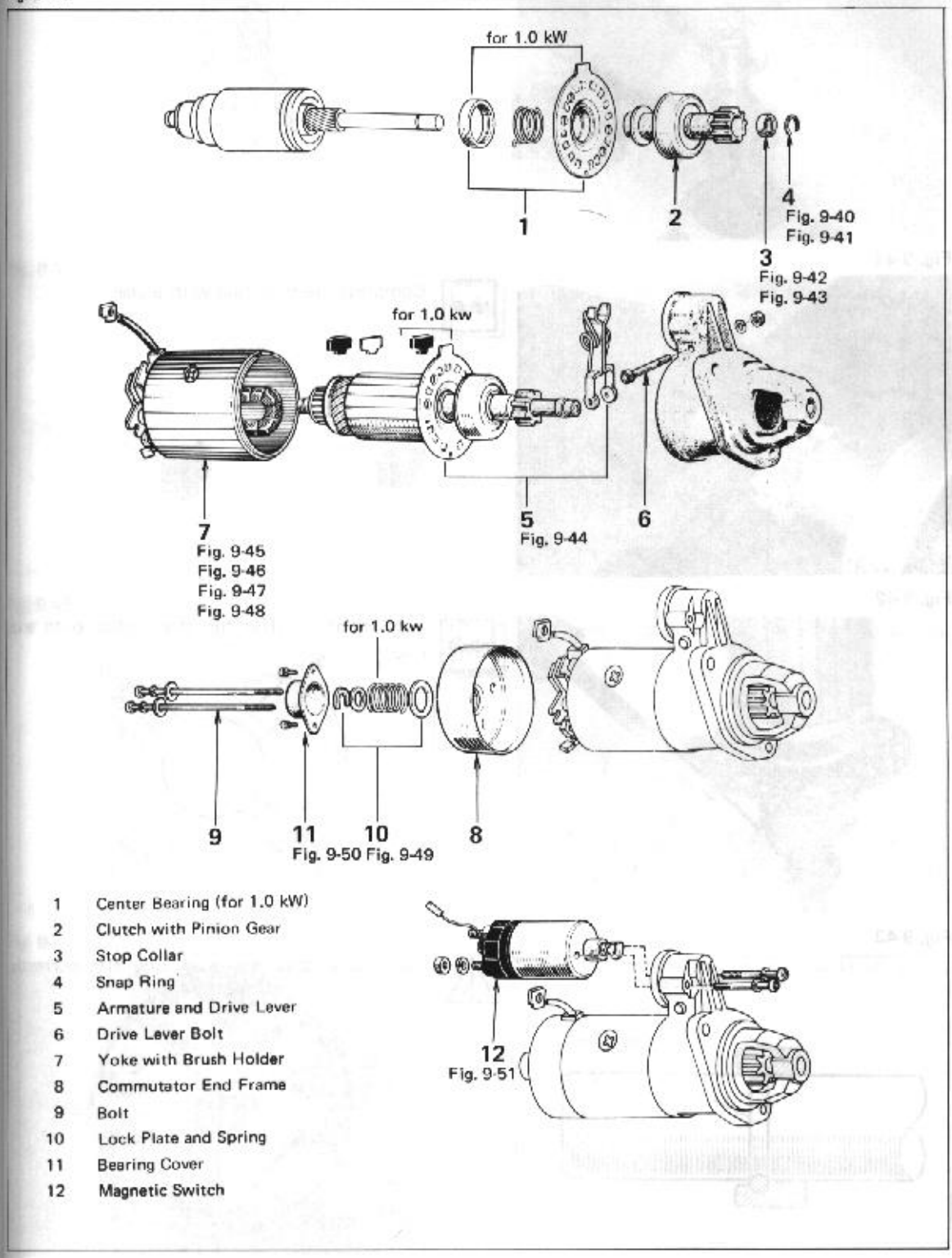


5. I.G. terminal continuity test.
   Push in plunger until it stops. Check for continuity between "30" terminal and lead wire.
   – Note –
   Perform the switch operation test after assembling it to the motor.

ASSEMBLY

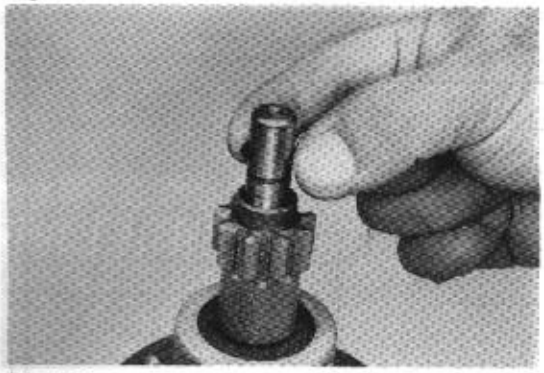
Assemble in numerical order.

Fig. 9-39



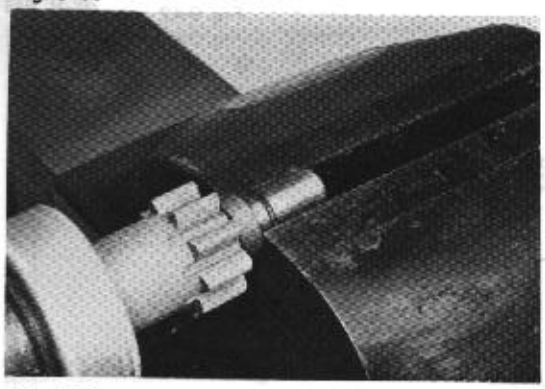
1 Center Bearing (for 1.0 kW)
2 Clutch with Pinion Gear
3 Stop Collar
4 Snap Ring
5 Armature and Drive Lever
6 Drive Lever Bolt
7 Yoke with Brush Holder
8 Commutator End Frame
9 Bolt
10 Lock Plate and Spring
11 Bearing Cover
12 Magnetic Switch

Fig. 9-40



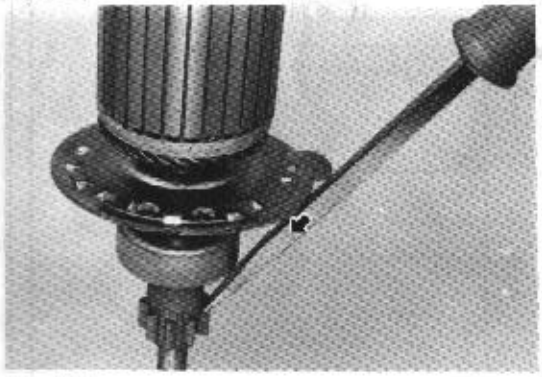
Fit snap ring into shaft groove.

Fig. 9-41



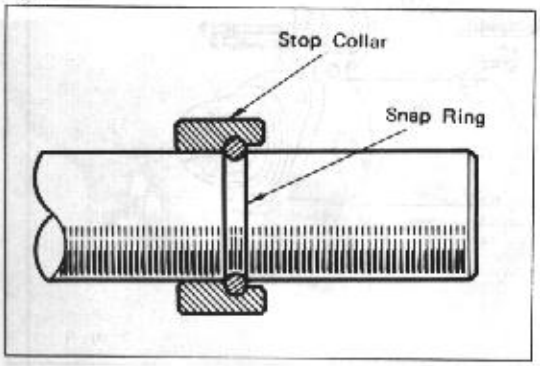
Compress the snap ring with a vise.

Fig. 9-42



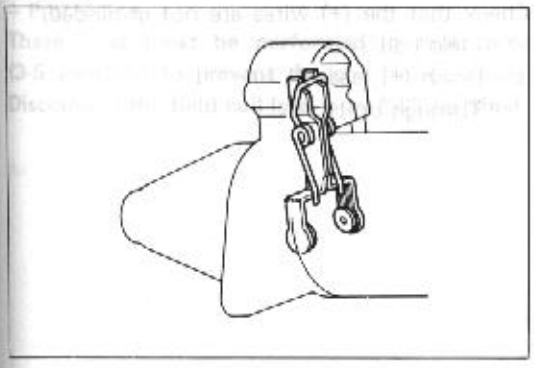
Tap pinion to slide the stop collar onto snap ring.

Fig. 9-43



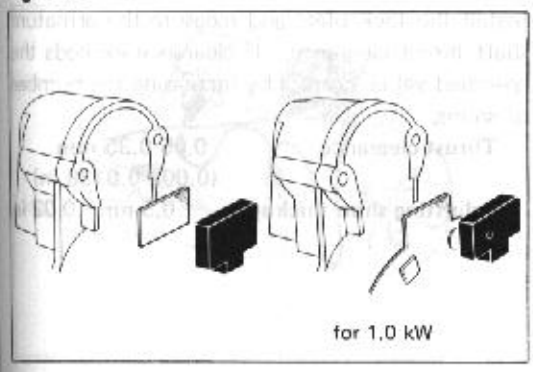
Make sure that the snap ring fits correctly.

Fig. 9-44



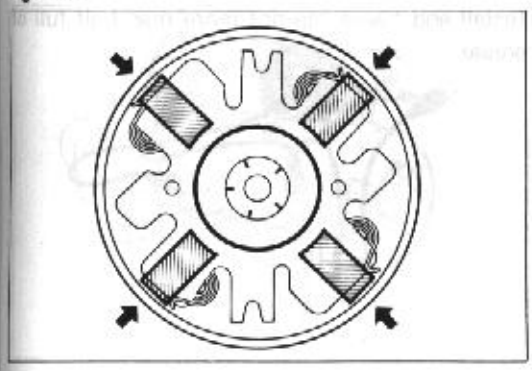
Assemble drive lever in direction as shown.

Fig. 9-45



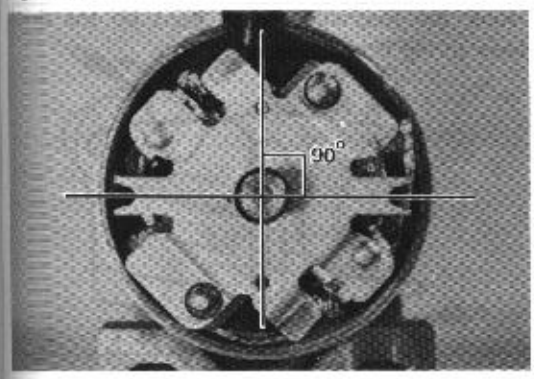
Match noctch in york with tab on rubber plate and assemble york with drive housing.

Fig. 9-46



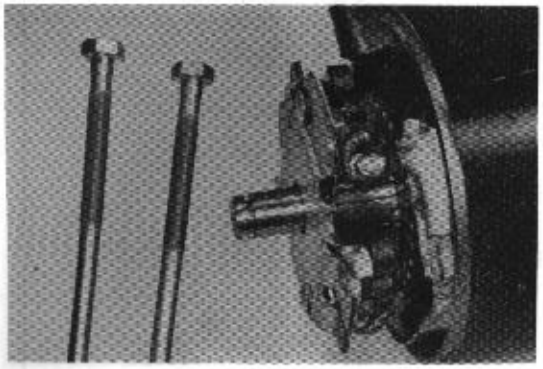
Assemble brushes, being careful not to damage them.

Fig. 9-47



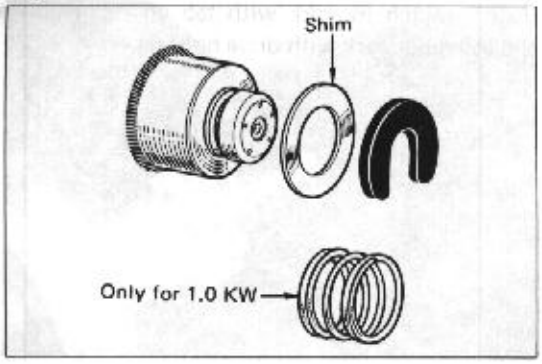
After installation, position the holder as shown.

Fig. 9-48



Check that the (+) wires are not grounded.
- Field coil
- Brush (+) leads
- Through bolts

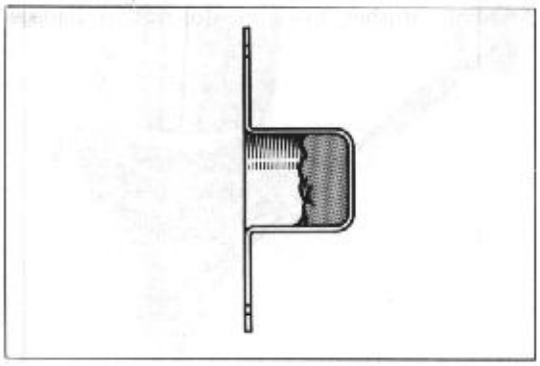
Fig. 9-49



Install the lock plate and measure the armature shaft thrust clearance. If clearance exceeds the specified value, correct by increasing the number of shims.

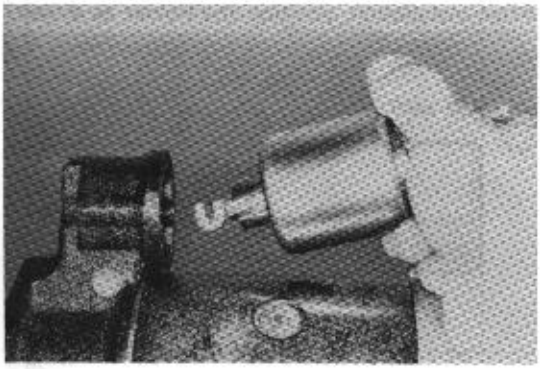
Thrust clearance	**0.05-0.35 mm (0.002-0.0138 in)**
Adjusting shim thickness	**0.5 mm (0.02 in)**

Fig. 9-50



Install end frame cap not more than half full of grease.

Fig. 9-51



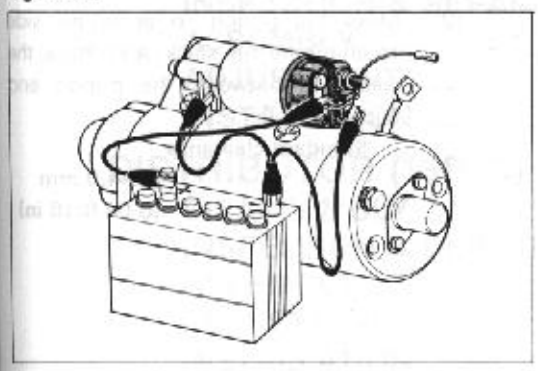
Hook the magnetic switch joint on the drive lever spring from the lower side.

– Precaution –
These tests must be performed in short time (3-5 seconds) to prevent the coil from burning. Disconnect the field coil lead from "C" terminal.

PERFORMANCE TEST

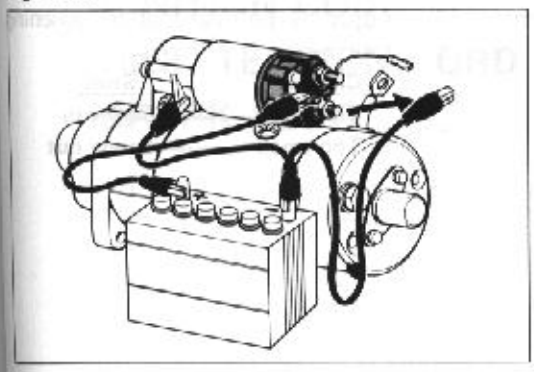
Check the magnetic switch performance and pinion gap as follows:

Fig. 9-52



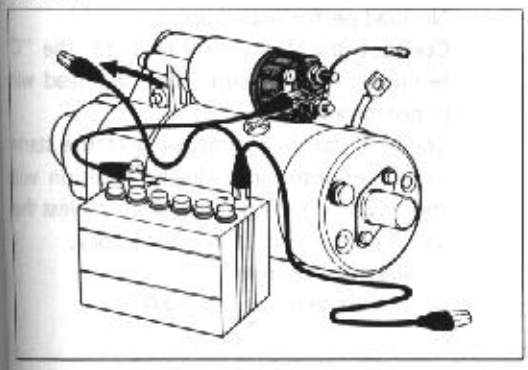
1. Pull-in test
Connect magnetic switch to battery as shown. (negative side to "C" terminal and switch body; positive side to "50" terminal). If the pinion has definitely jumped out, the pull-in coil is satisfactory.

Fig. 9-53



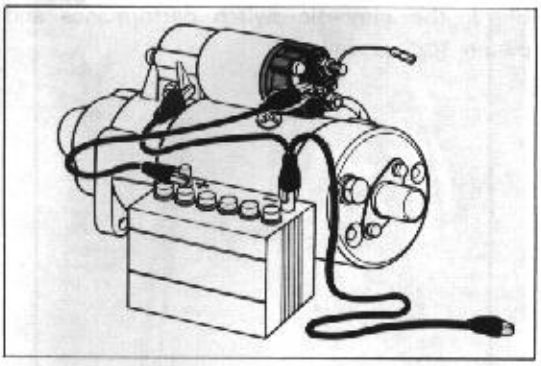
2. Hold-in test
Disconnect the "C" terminal.
The pinion should remain projected.

Fig. 9-54



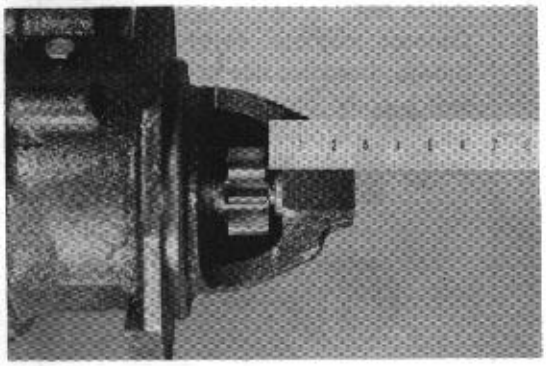
3. Check the plunger return.
When disconnecting the switch body, the pinion should return quickly.

Fig. 9-55



4. Check the pinion clearance.
(1) Connect the magnetic switch to battery as shown.
Field coil lead to "C" terminal
Battery negative side to body
Battery positive side to 50 terminal

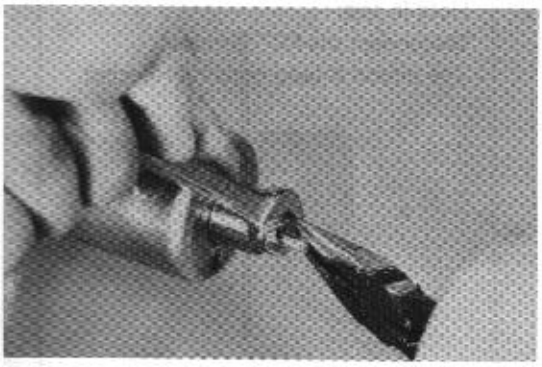
Fig. 9-56



(2) Move the pinion to armature side to eliminate the slack, and check the clearance between the pinion end and stop collar.

Standard clearance
1.0-4.0 mm
(0.04-0.16 in)

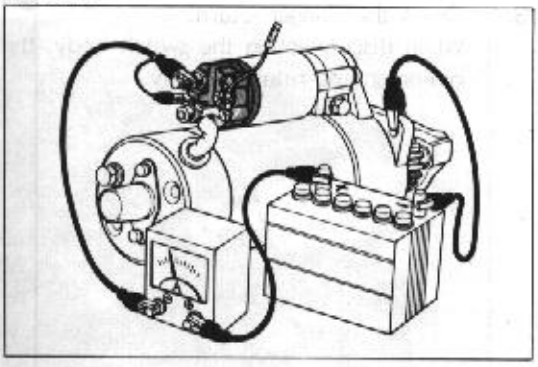
Fig. 9-57



(3) Adjust if necessary after loosening lock nut.

Clearance	Stud
Too large →	Screw in
Too small →	Screw out

Fig. 9-58



5. No-load performance test
Connect the field coil lead to the "C" terminal, making sure that the lead wire is not grounded.
Connect starter to battery. If the starter shows smooth and steady rotation with the pinion jumping out and draws less than specified current, it is satisfactory.

Specified current
Less than 50 A

IGNITION SYSTEM

IGNITION SYSTEM CIRCUIT

Fig. 10-1

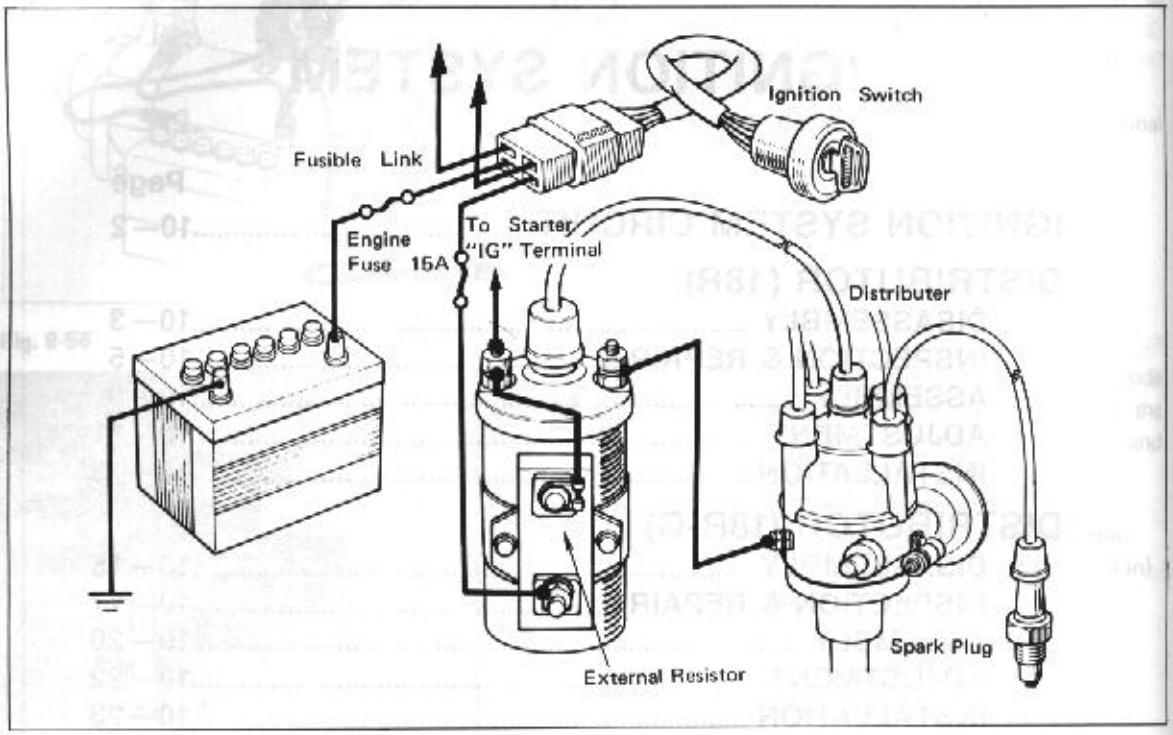
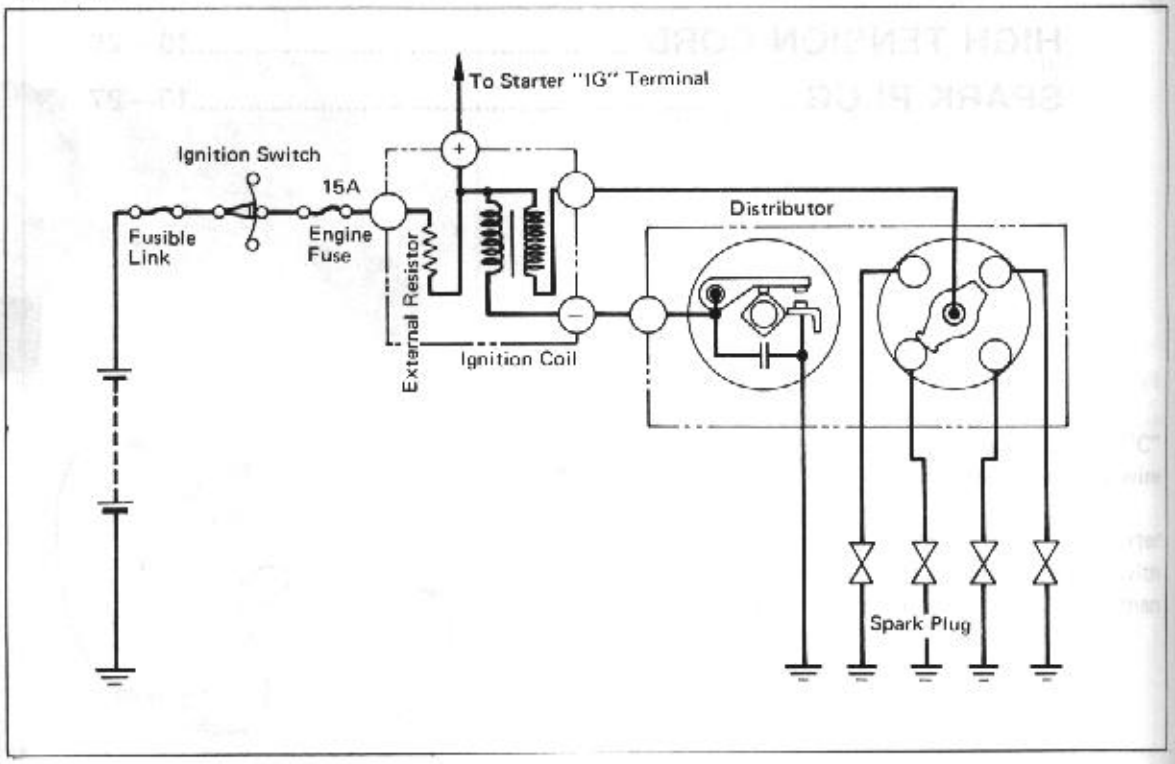


Fig. 10-2



DISTRIBUTOR (18R)

DISASSEMBLY

Disassemble in numerical order.

Fig. 10-3

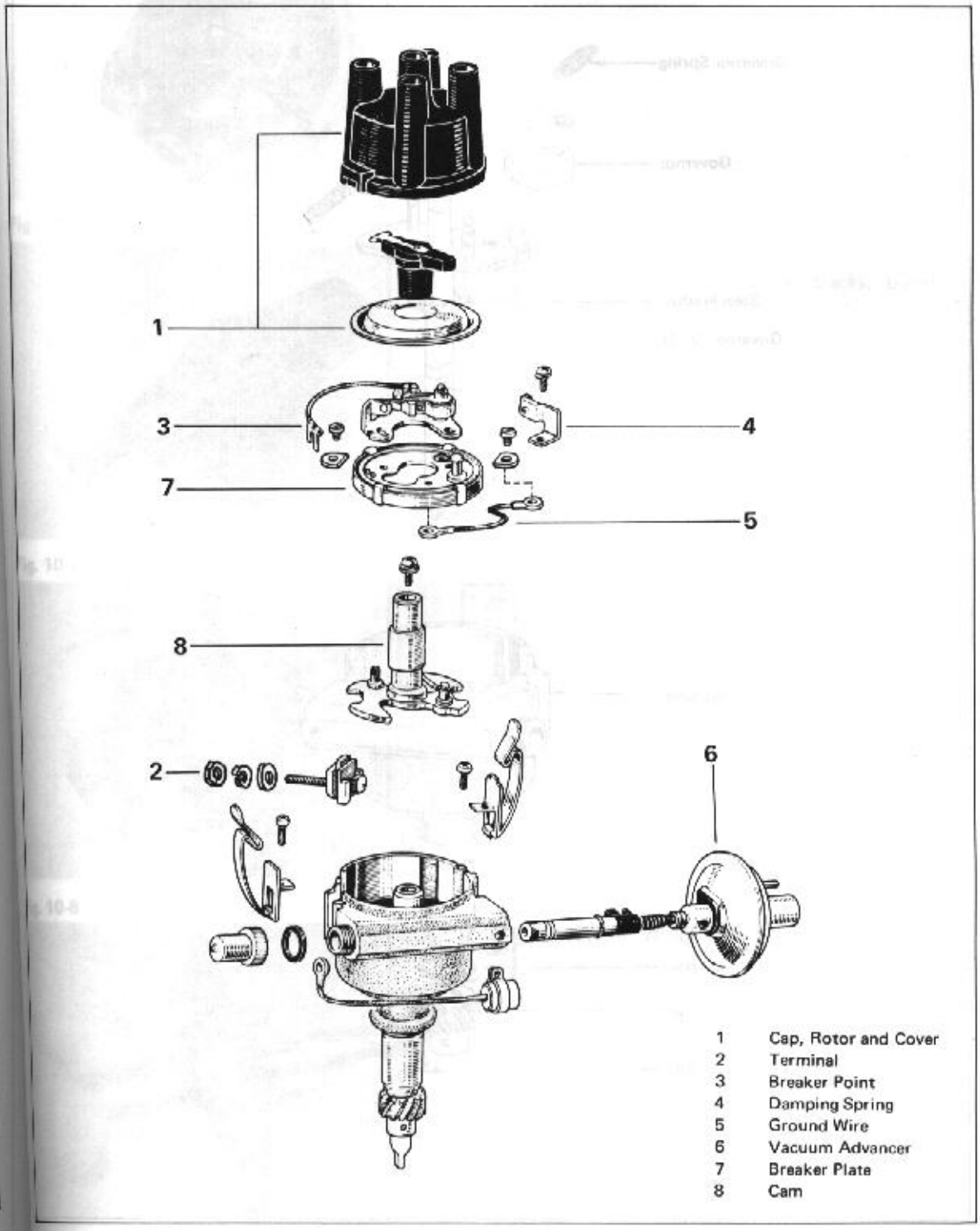


Fig. 10-4

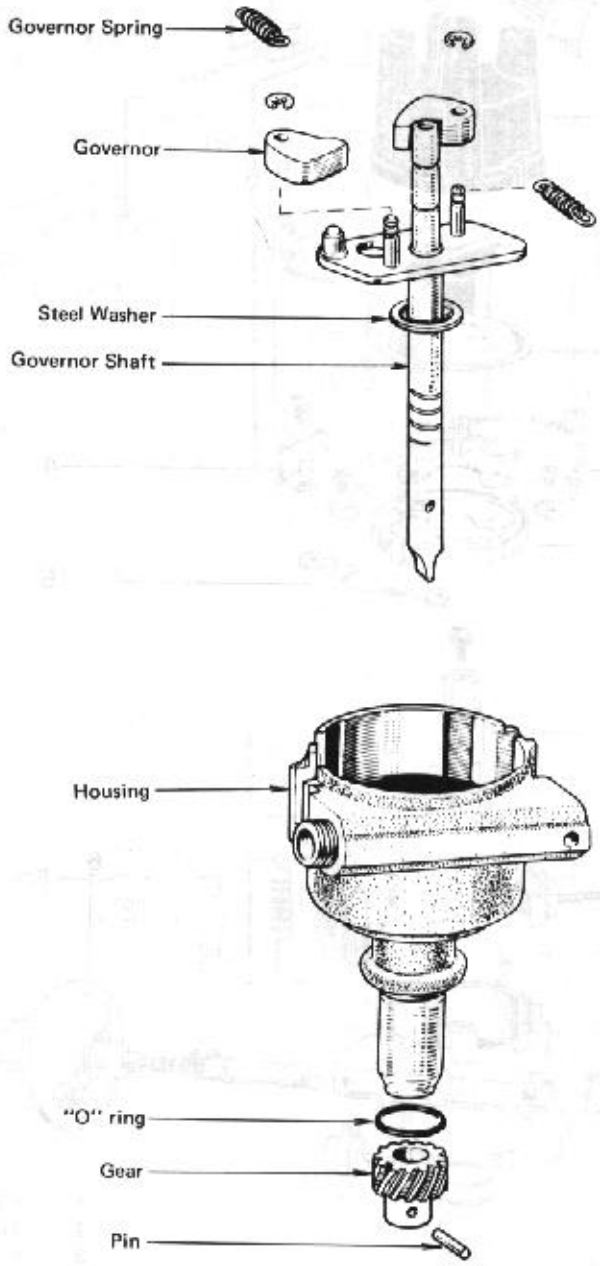
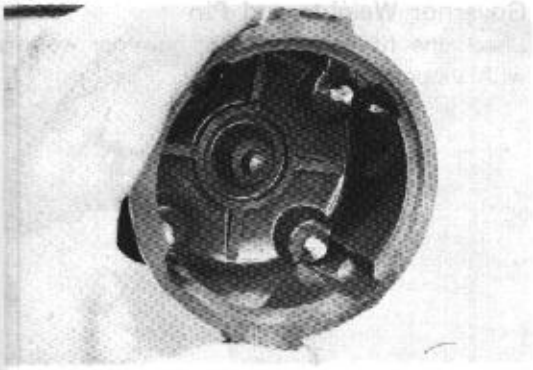


Fig. 10-5

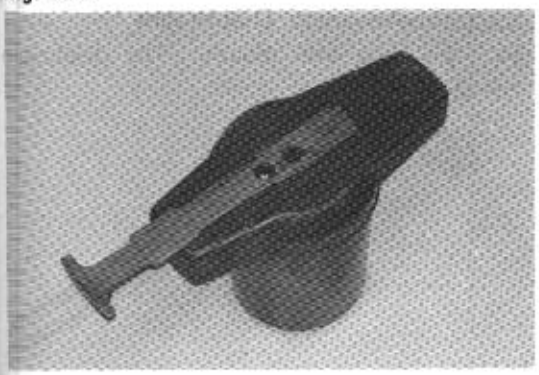


INSPECTION & REPAIR

Cap

Inspect for cracks, carbon tracks, burnt or corroded terminals, and check center contact for wear.

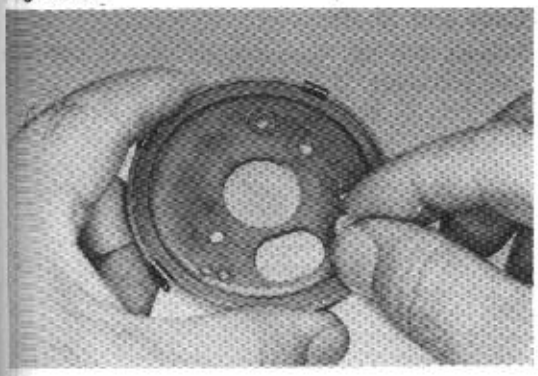
Fig. 10-6



Rotor

Inspect for cracks, carbon tracks, burnt or corroded terminals.

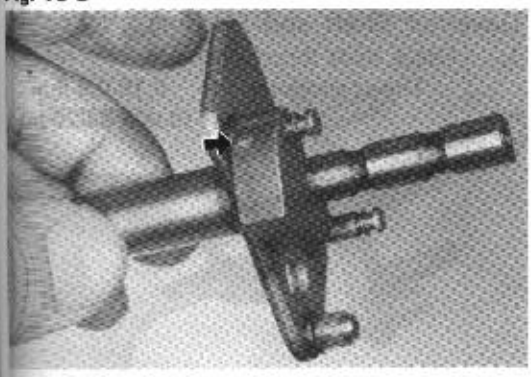
Fig. 10-7



Breaker Plate

Check breaker plate for smooth rotation.

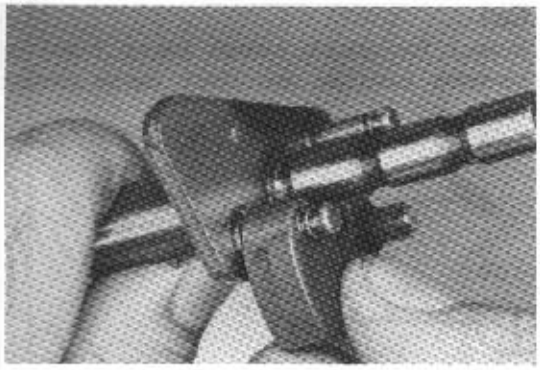
Fig. 10-8



Governor Weights

Inspect governor weights for damage.

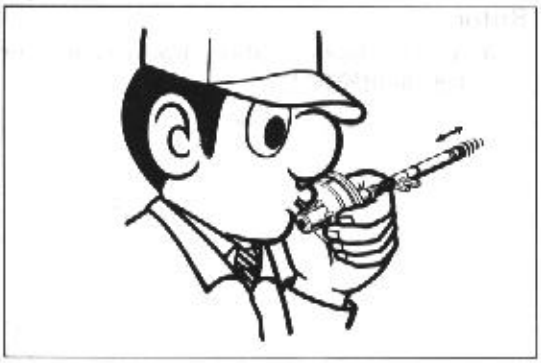
Fig. 10-9



Governor Weights and Pin

Check the fitting portions of governor weights with support pins for binding.

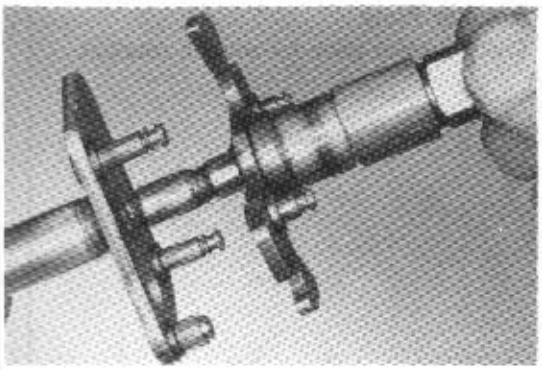
Fig. 10-10



Vacuum Advancer Diaphragm

Suck the tube with mouth. The diaphragm should move.

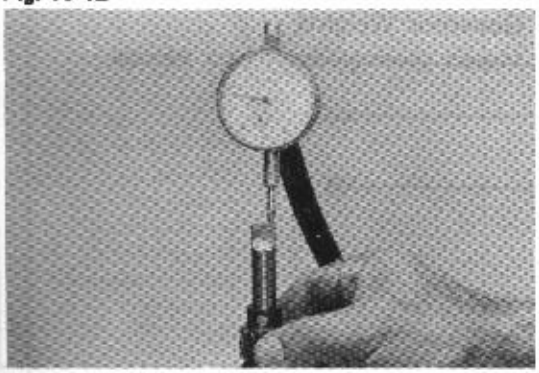
Fig. 10-11



Cam and Shaft

Inspect cam for wear, damage, and fit between cam and shaft.

Fig. 10-12

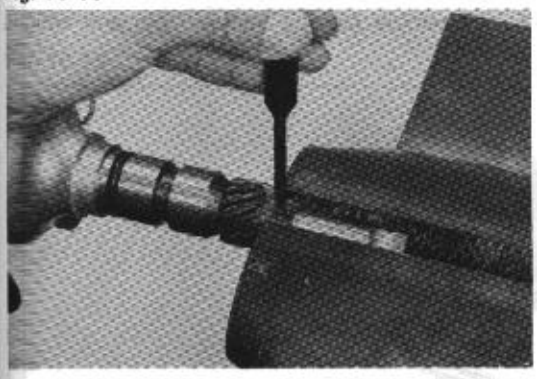


Governor Shaft and Housing

1. Check shaft thrust clearance.

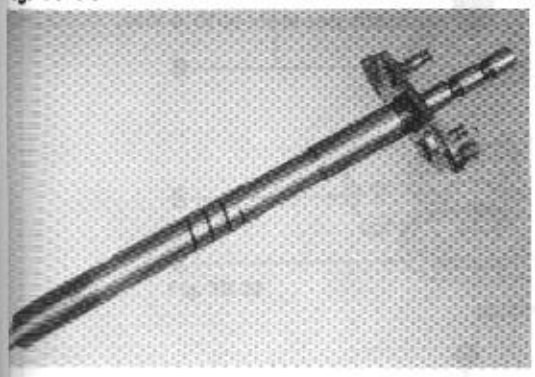
Thrust clearance	**0.15-0.5 mm (0.006-0.020 in)**

Fig. 10-13



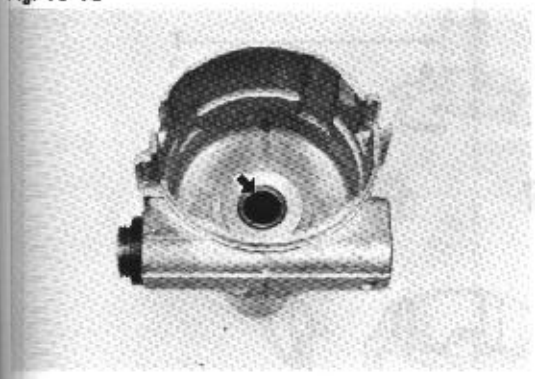
2. Remove gear and pin .
Grind off the pin end, then remove the pin and gear.

Fig. 10-14



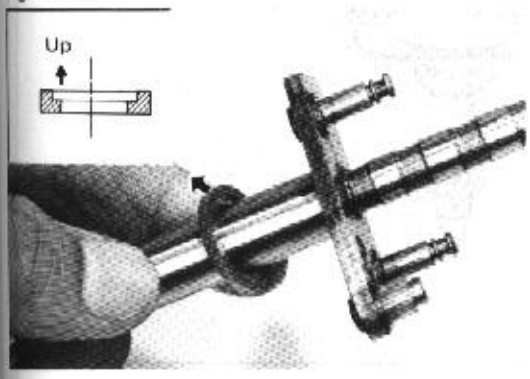
3. Inspect governor shaft for wear and damage.

Fig. 10-15



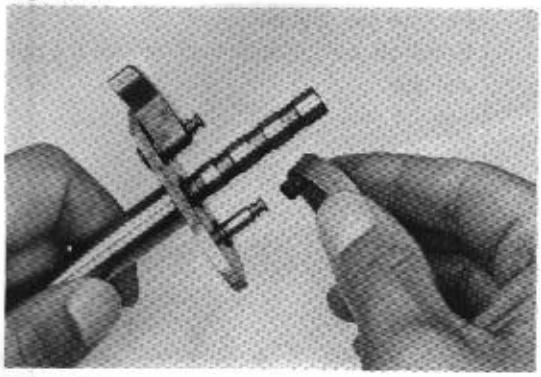
4. Inspect housing bushings, and O ring for wear, deformation, and damage.

Fig. 10-16



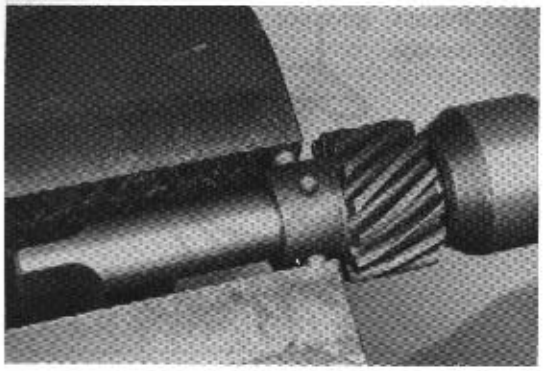
5. Assemble washer as shown.

Fig. 10-17



6. Assemble bearing between pin and weight.

Fig. 10-18

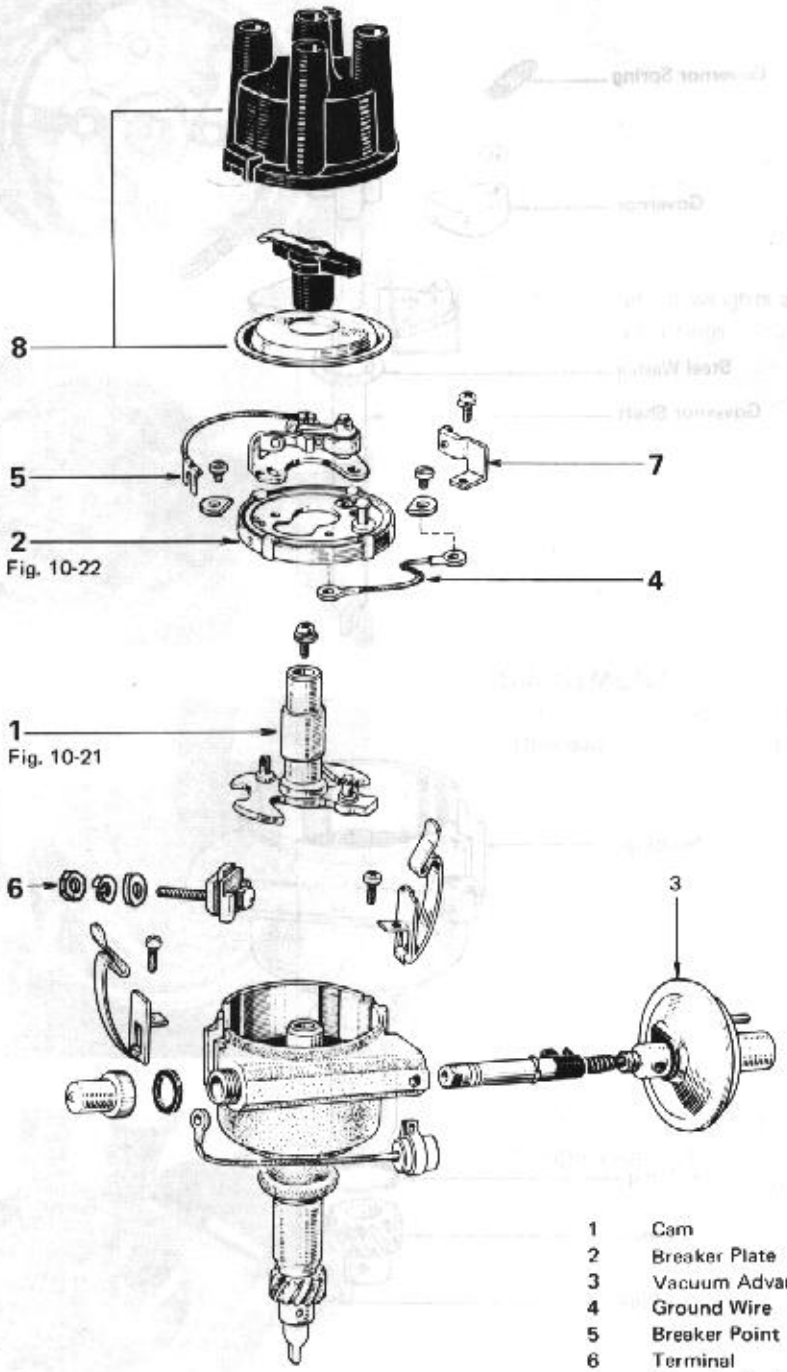


7. Peen both pin ends with a vise.

ASSEMBLY

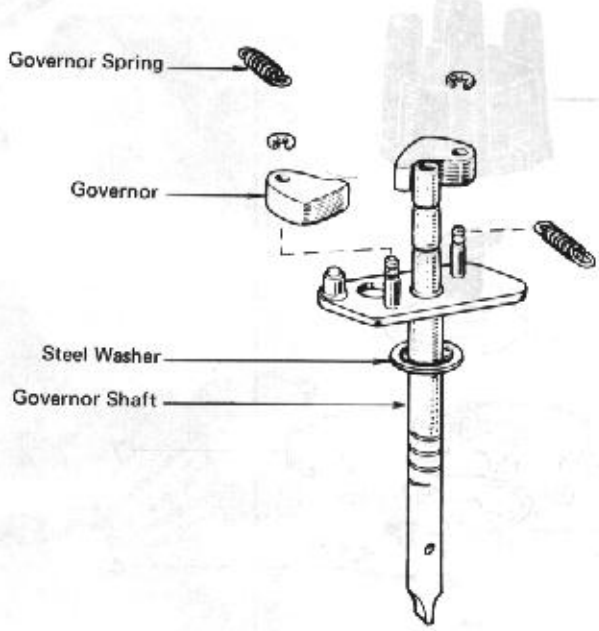
Assemble in numerical order.

Fig. 10-19



1 Cam
2 Breaker Plate
3 Vacuum Advancer
4 Ground Wire
5 Breaker Point
6 Terminal
7 Damping Spring
8 Cover, Rotor and Cap

Fig. 10-20



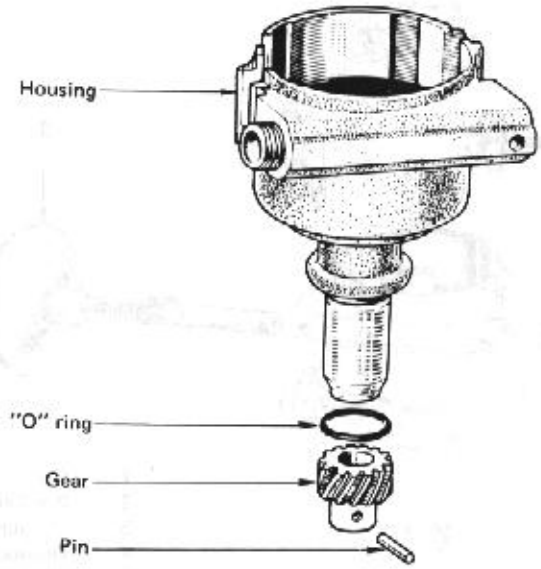
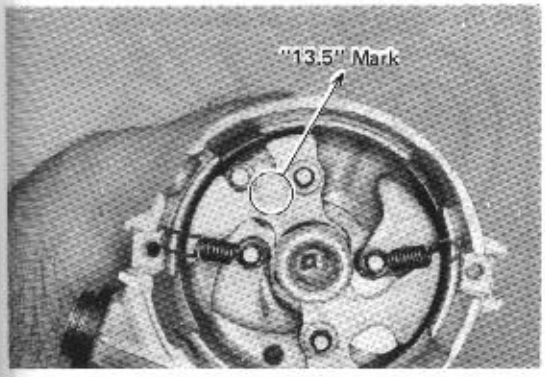
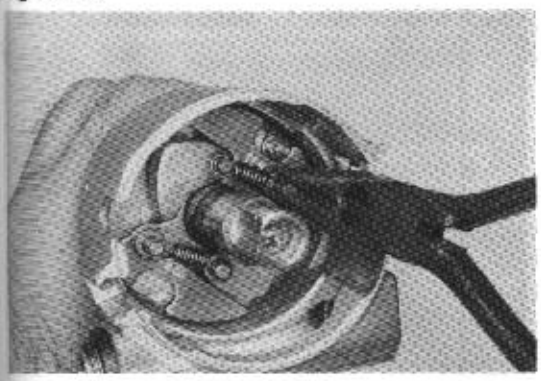


Fig. 10-21



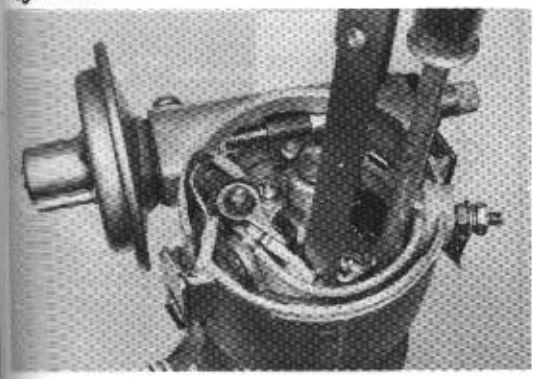
Match 13.5 mark with stopper, fit on the cam and tighten with screw.

Fig. 10-22



Assemble governor weights and lock with E ring. Install governor springs.

Fig. 10-23

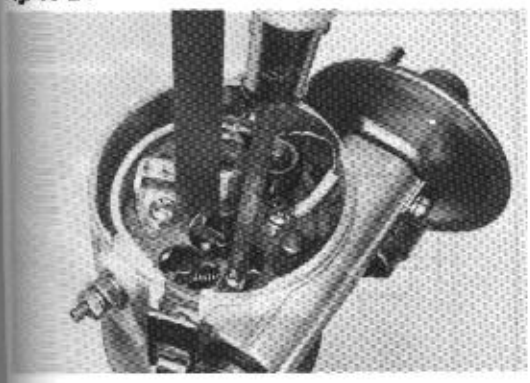


ADJUSTMENT

Install breaker points and adjust the gap.

Heel gap	**0.45 mm (0.018 in)**

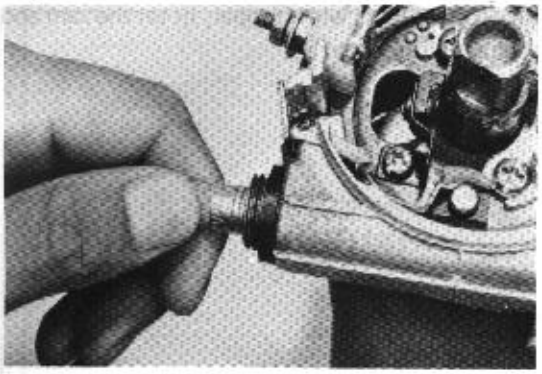
Fig. 10-24



Install damping spring and adjust it.

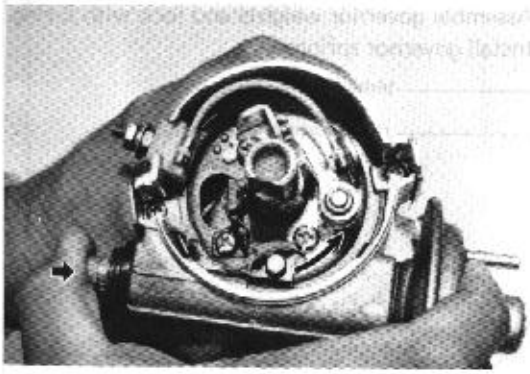
Damping spring gap	**0.1 – 0.4 mm (0.004 – 0.016 in)**

Fig. 10-25



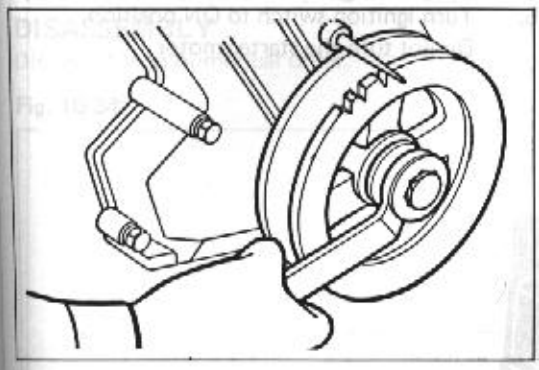
Set the octane selector at standard line.

Fig. 10-26



Check breaker plate for smooth rotation.

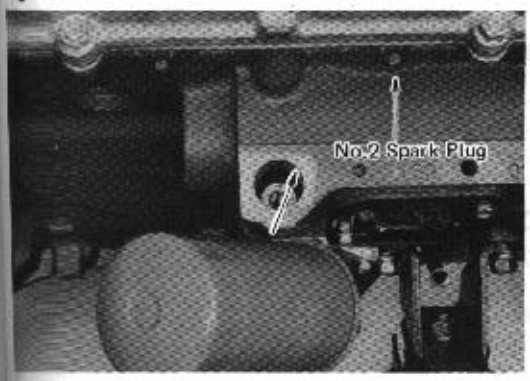
Fig. 10-27



INSTALLATION

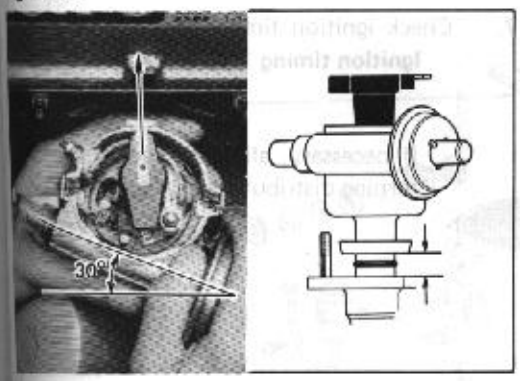
1. Set No. 1 cylinder to 7° BTDC/compression. Align the timing mark with pointer.
   At this time, rocker arms on No.1 cylinder should be loose and rockers on No.4 should be tight.

Fig. 10-28



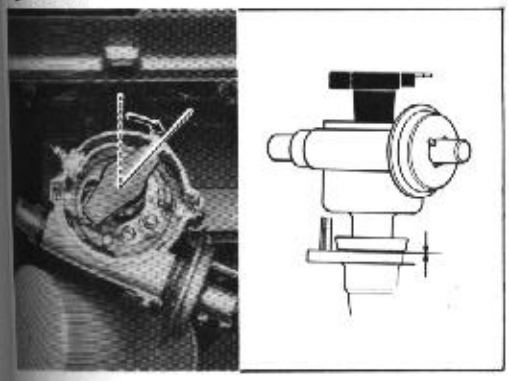
2. Set the oil pump shaft slot in direction as shown.

Fig. 10-29



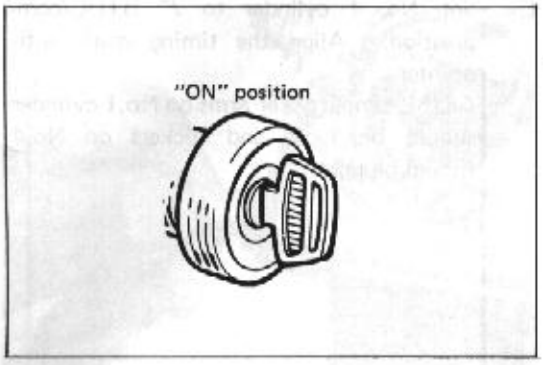
3. Before inserting the distributor, position the rotor and diaphragm as shown.

Fig. 10-30



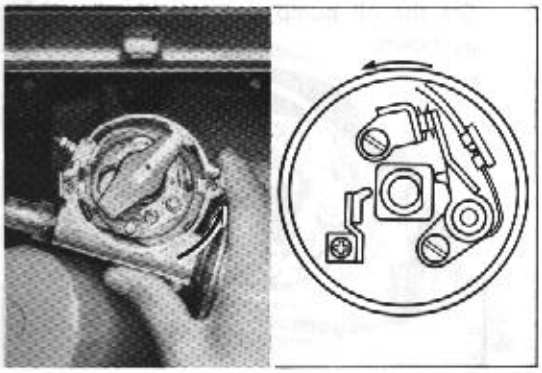
4. When fully installed, rotor should point toward as shown.

Fig. 10-31



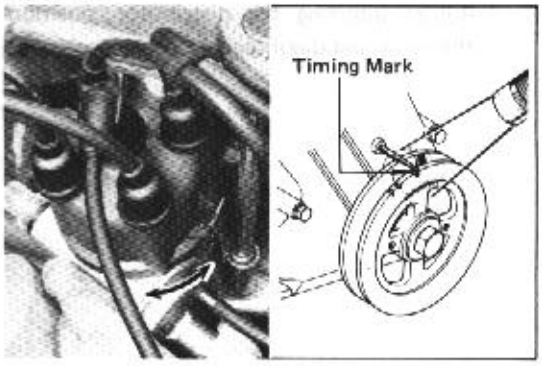
5. Turn ignition switch to ON position. Do not turn the starter motor.

Fig. 10-32



6. Rotate the distributor body counterclockwise until a spark jumps between the points, and tighten the clamp bolt in that position.

Fig. 10-33



7. Check ignition timing in idling condition.
Ignition timing 7° BTDC

If necessary, align the timing marks by turning distributor body.

DISTRIBUTOR (18R–G)

DISASSEMBLY

Disassemble in numerical order.

Fig. 10-34

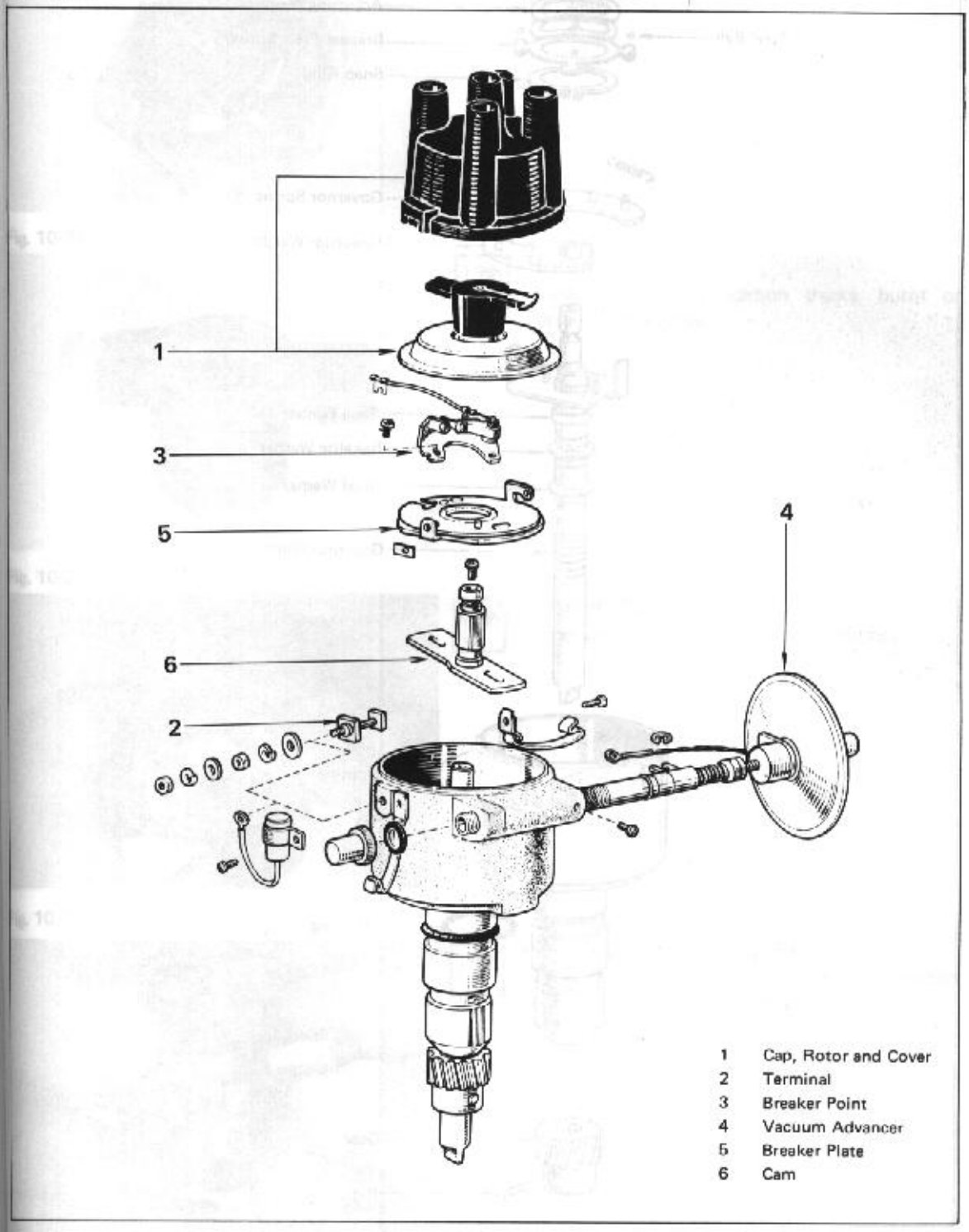


Fig. 10-35

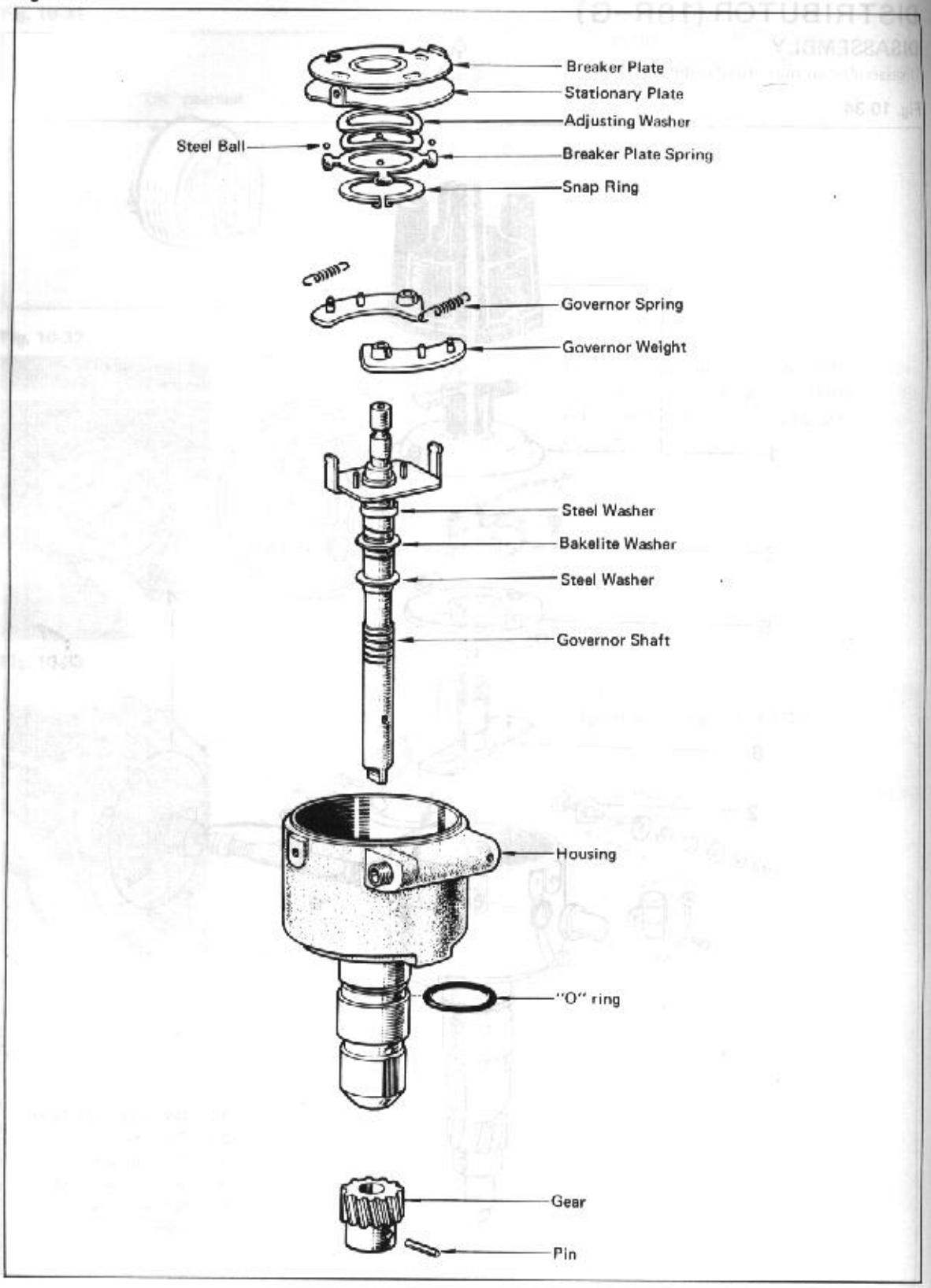
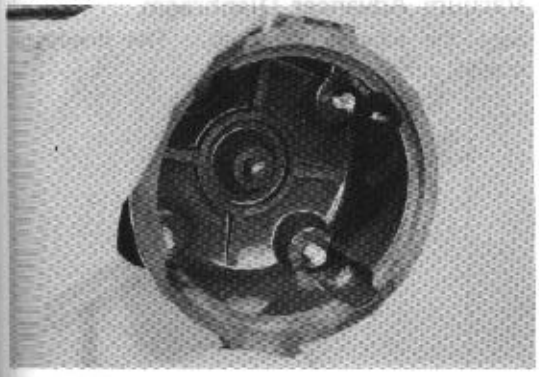


Fig. 10-36

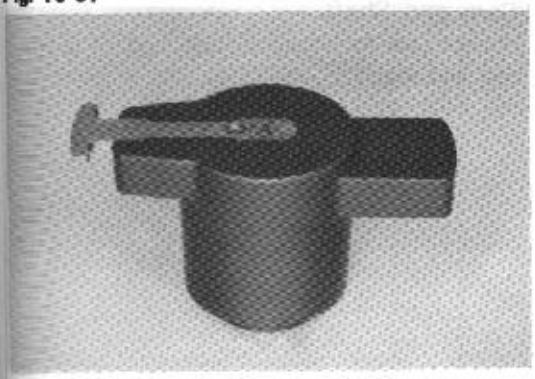


INSPECTION & REPAIR

Cap

Inspect for cracks, carbon tracks, burnt or corroded terminals, and check center contact for wear.

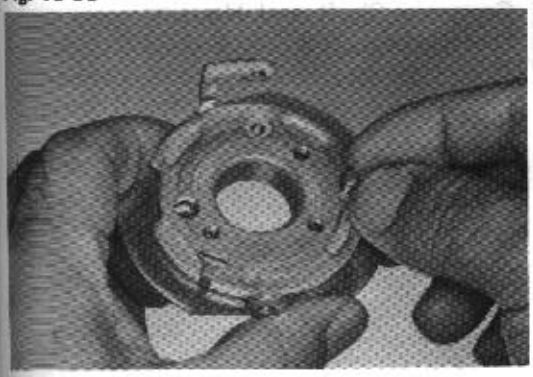
Fig. 10-37



Rotor

Inspect for cracks, carbon tracks, burnt or corroded terminals.

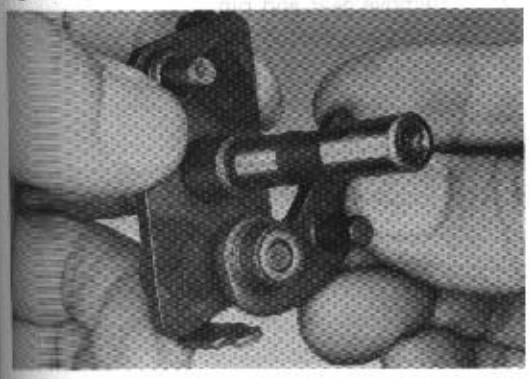
Fig. 10-38



Breaker Plate

Check breaker plate for smooth rotation.

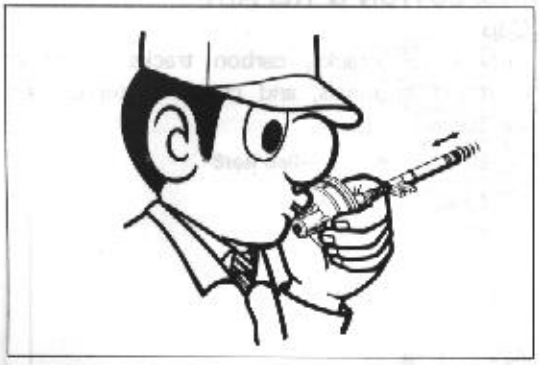
Fig. 10-39



Governor Weights and Pin

Check the fitting portions of governor weights with support pins for binding.

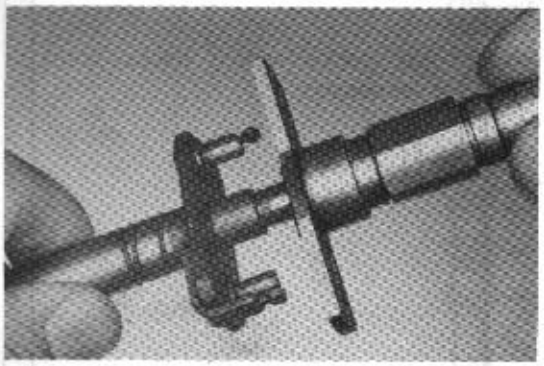
Fig. 10-40



Vacuum Advancer Diaphragm

Suck the tube with mouth. The diaphragm should move.

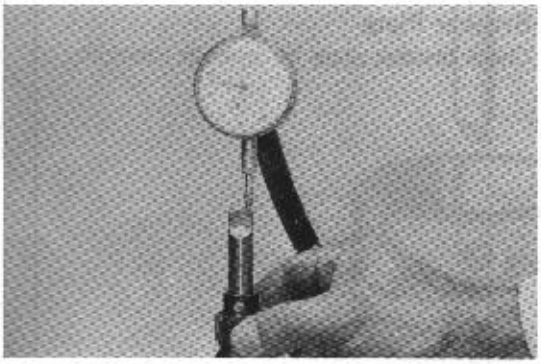
Fig. 10-41



Cam and Shaft

Inspect cam for wear, damage, and fit between cam and shaft.

Fig. 10-42



Governor Shaft and Housing

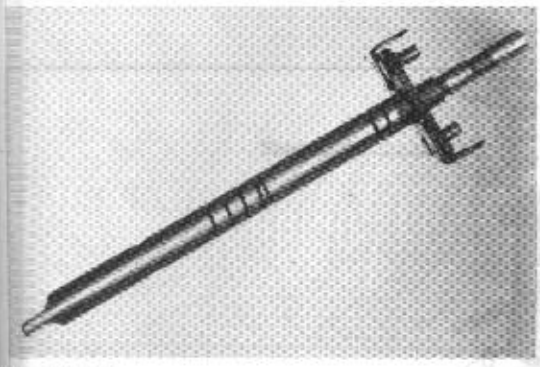
1. Check shaft thrust clearance.

Thrust clearance	**0.15-0.5 mm (0.006-0.020 in)**

Fig. 10-43

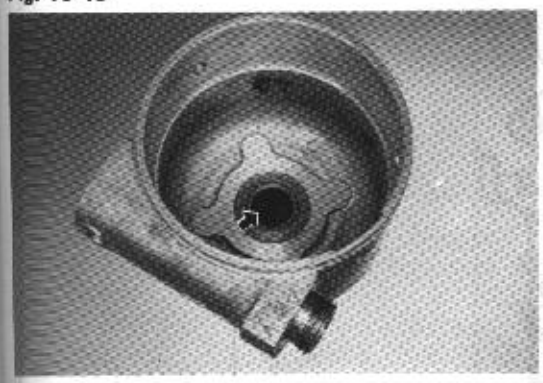
2. Remove gear and pin.
   Grind off the pin end, then remove the pin and gear.

Fig. 10-44



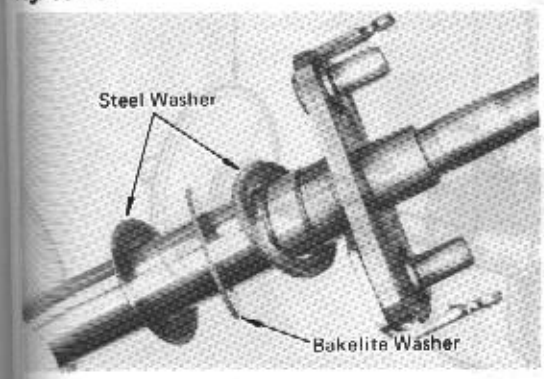
3. Inspect governor shaft for wear and damage.

Fig. 10-45



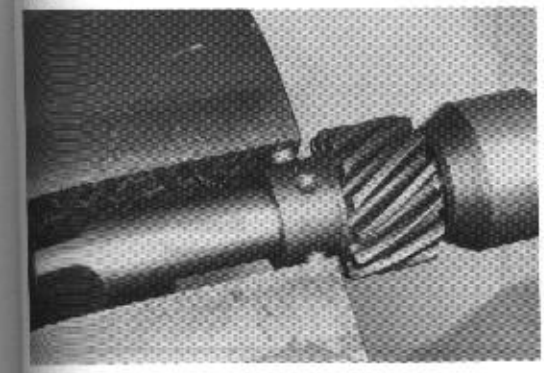
4. Inspect housing bushings, and O ring for wear, deformation, and damage.

Fig. 10-46



5. Assemble washers as shown.

Fig. 10-47



6. Peen both pin ends with a vise.

ASSEMBLY

Assemble in numerical order.

Fig. 10-48

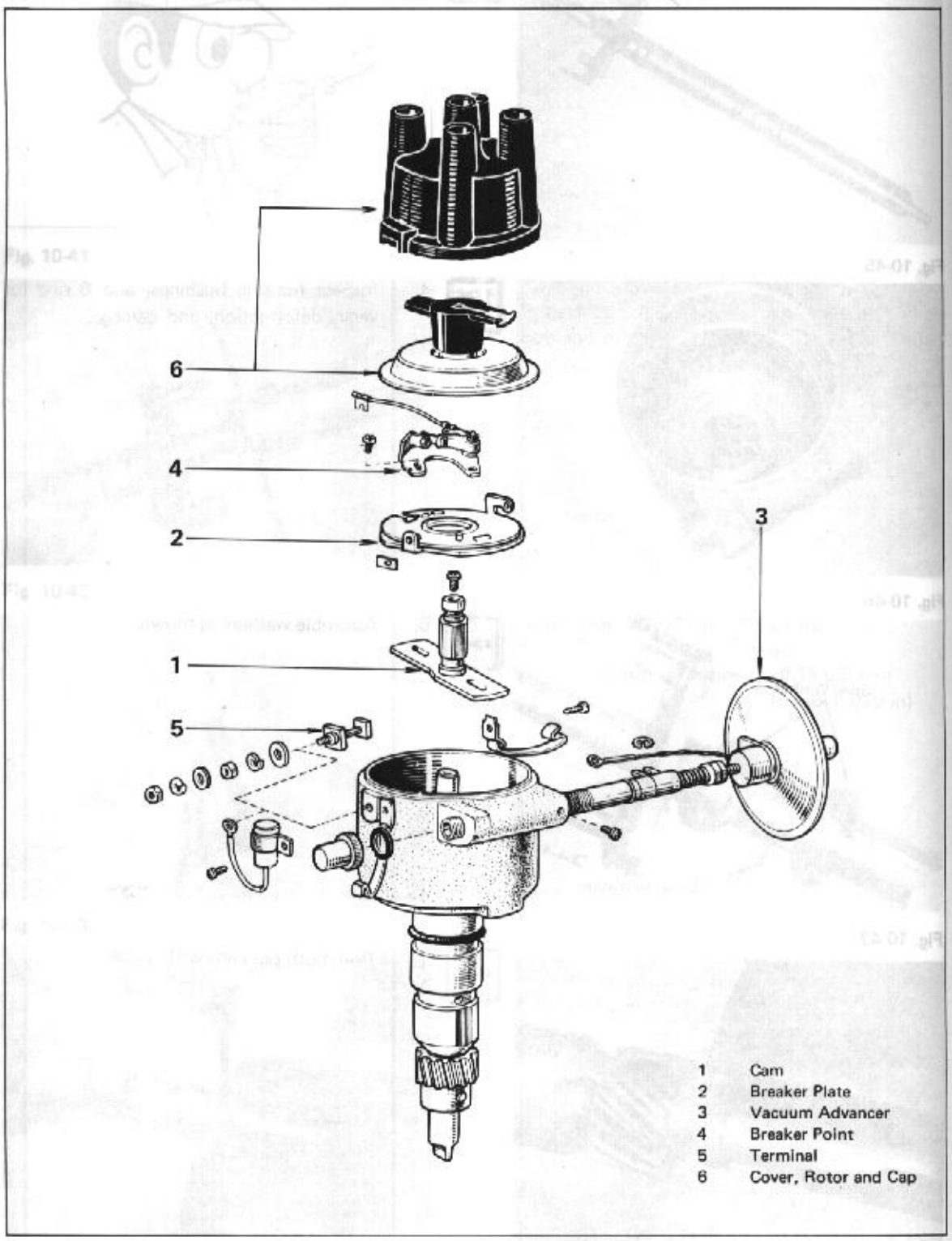


Fig. 10-49

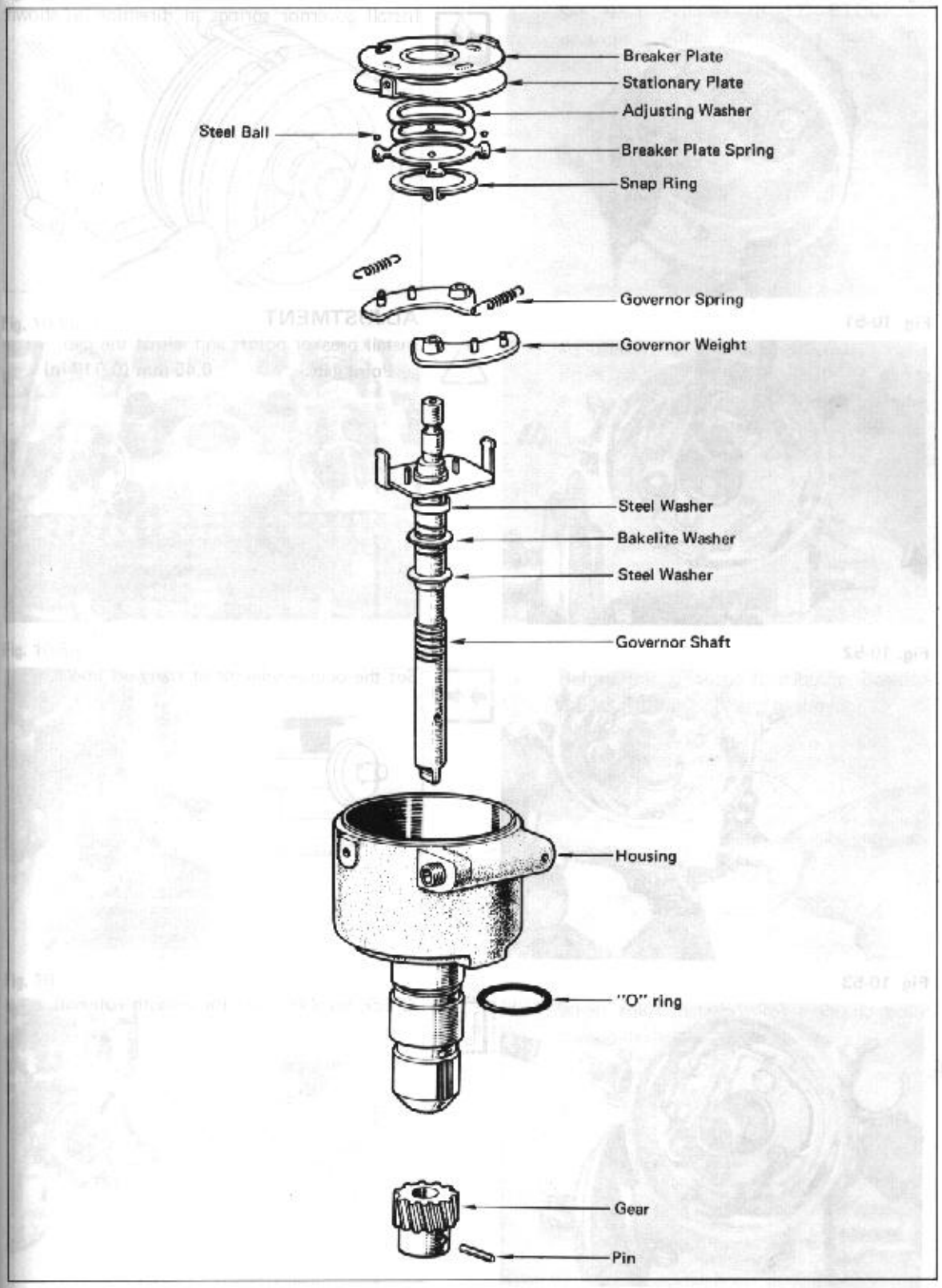
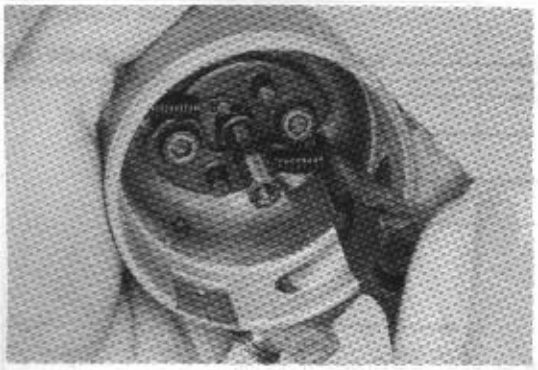
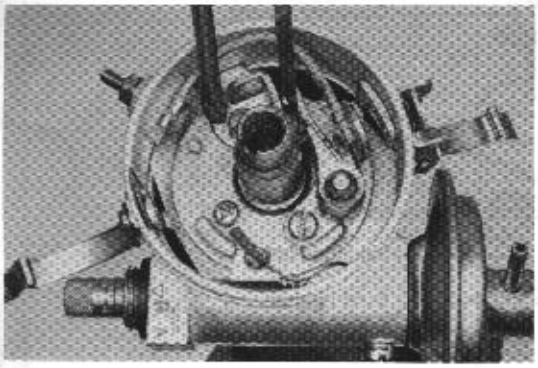


Fig. 10-50



Install governor springs in direction as shown.

Fig. 10-51

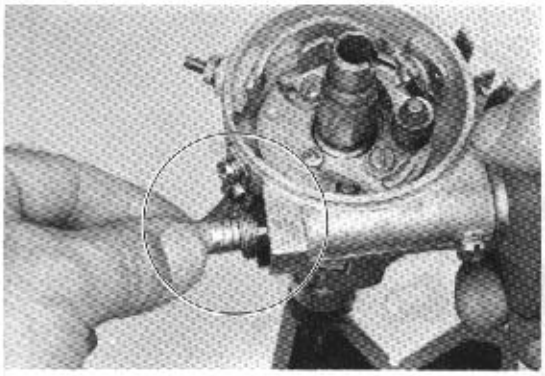


ADJUSTMENT

Install breaker points and adjust the gap.

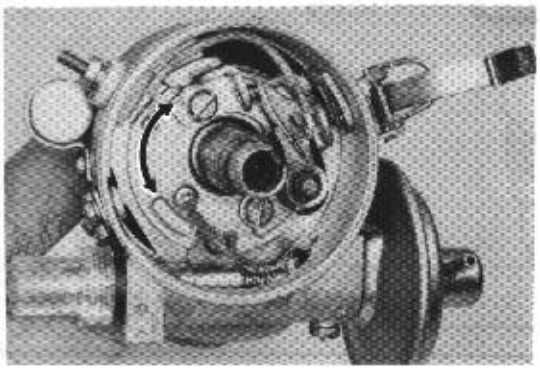
Point gap	**0.45 mm (0.018 in)**

Fig. 10-52



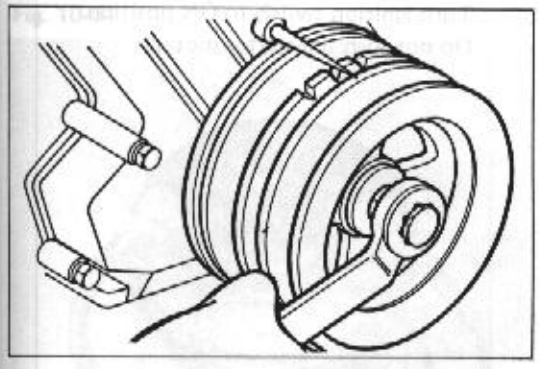
Set the octane selector at standard line.

Fig. 10-53



Check breaker plate for smooth rotation.

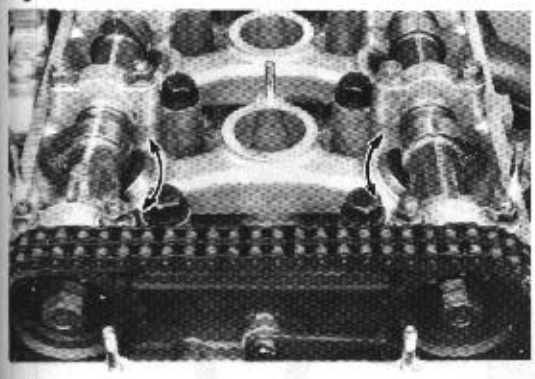
Fig. 10-54



INSTALLATION

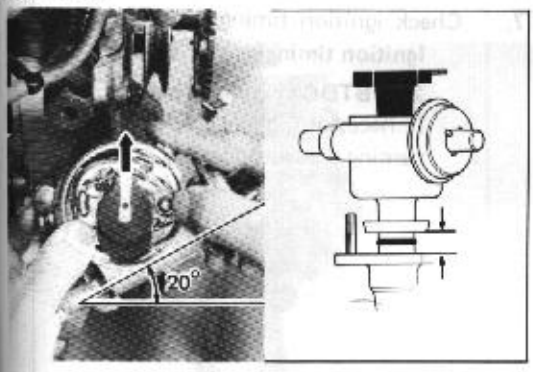
1. Set No.1 cylinder to 12° BTDC/compression. Align the timing mark with pointer.

Fig. 10-55



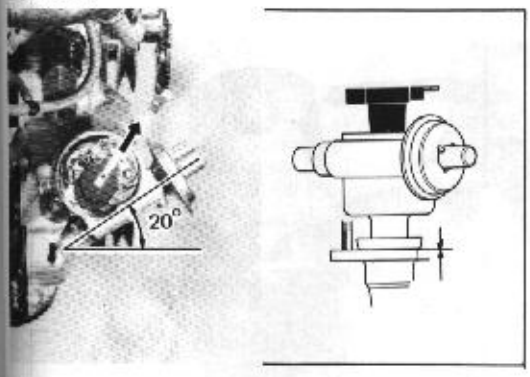
2. At this time, intake and exhaust valve lifter on No.1 cylinder should be rotate and valve lifters on No.4 should be tight.

Fig. 10-56



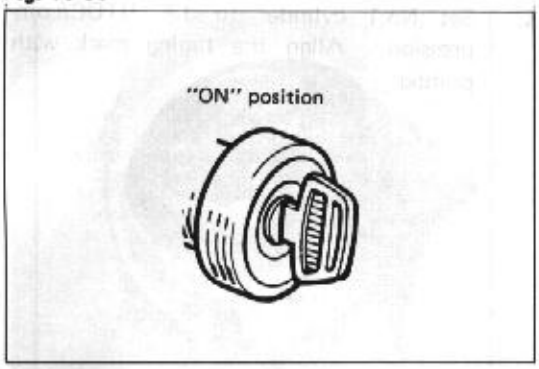
3. Before inserting the distributor, position the rotor and diaphragm as shown.

Fig. 10-57



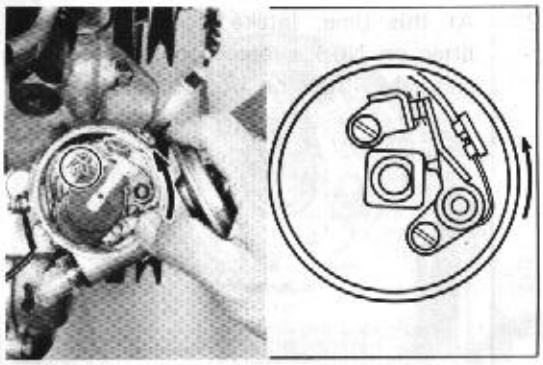
4. When fully installed, rotor should point toward as shown.

Fig. 10-58



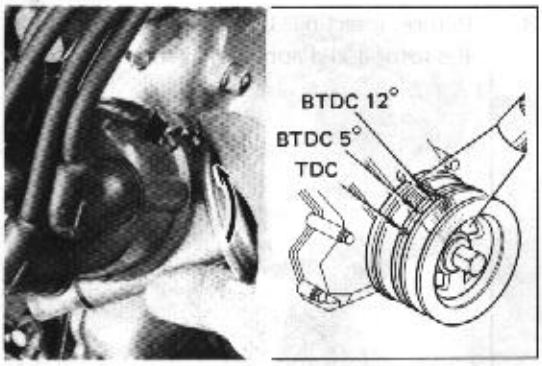
5. Turn ignition switch to ON position.
Do not turn the starter motor.

Fig. 10-59



6. Rotate the distributor body counter-clockwise until when just sparking between points, then, tighten the clamp bolt in that position.

Fig. 10-60

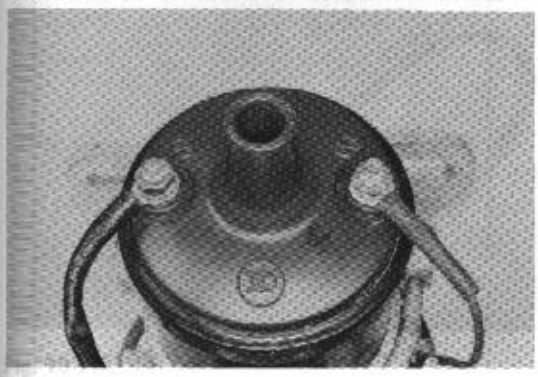


7. Check ignition timing in idling condition.
Ignition timing 12°BTDC
20° BTDC at coolant below 60°C
If necessary, align the timing marks by turning distributor body.

IGNITION COIL

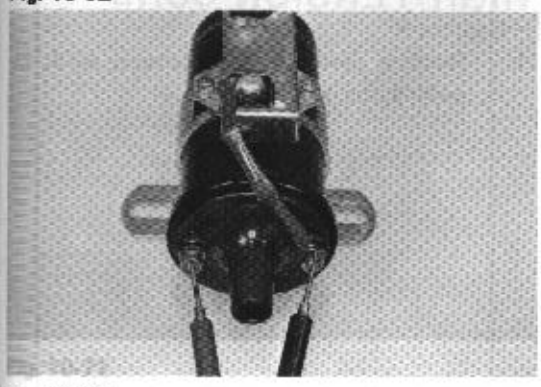
INSPECTION

Fig. 10-61



1. Clean the coil and inspect it for carbon paths around the terminals, and check the outside body for cracks.
2. Inspect the high tension cord insertion hole for carbon deposit or corrosion.

Fig. 10-62

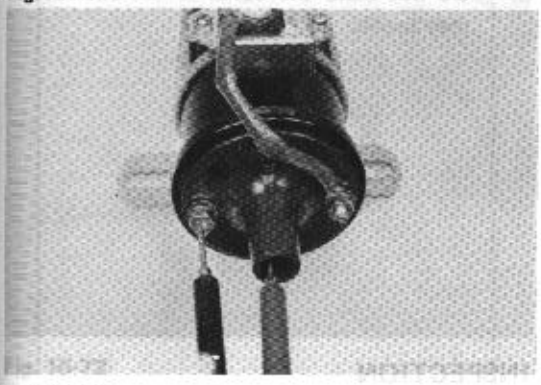


3. Measure the following resistances.
   If the reading is not within the specified resistance replace coil.

   Primary coil resistance (Reference only)

   1.3 – 1.6 Ω

Fig. 10-63

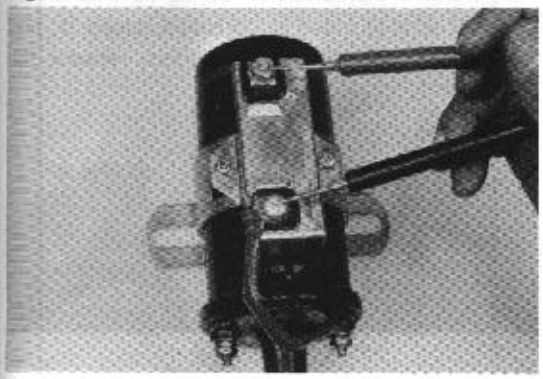


Secondary coil resistance

(Reference only)

10.2 – 13.8 kΩ

Fig. 10-64

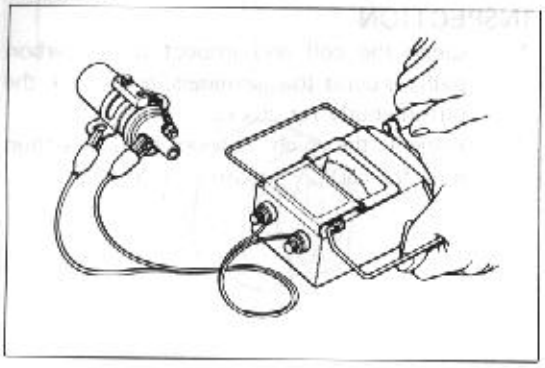


External resistor resistance

(Reference only)

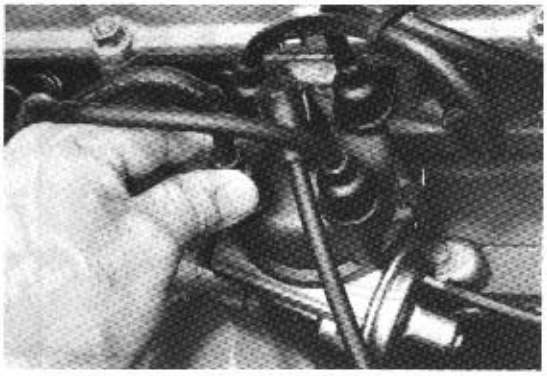
1.3 – 1.5 Ω

Fig. 10-65



Insulation resistance Over 10MΩ at 500V

Fig. 10-66

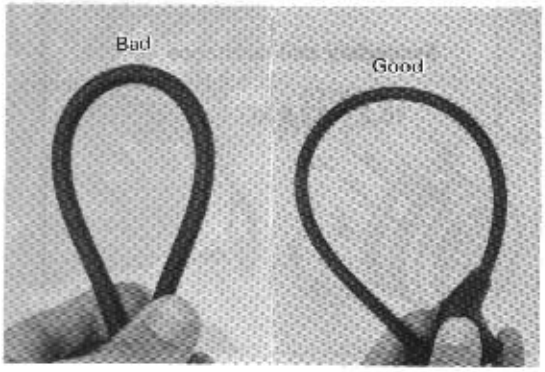


HIGH TENSION CORD

– Caution –

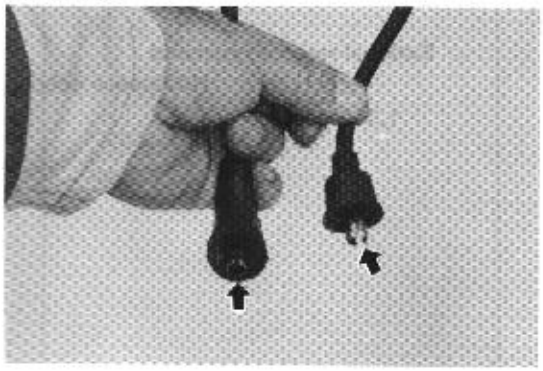
1. **Remove carefully high tension cords by pulling the rubber boot.**

Fig. 10-67



2. **Do not bend the cords as the conductors may break.**

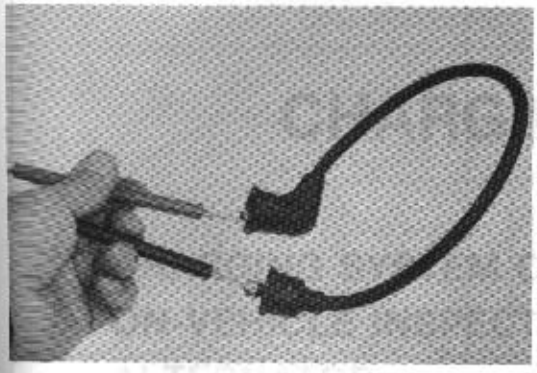
Fig. 10-68



INSPECTION

1. Check the condition of the cord terminal. If any terminal is corroded, clean it, and if it is broken or distorted, replace the cord.

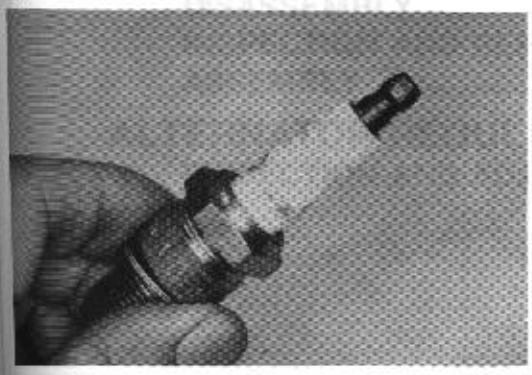
Fig. 10-69



2. Check the resistance of each cord between both ends. If the reading exceeds the limit, replace the cord.

Resistance 10 – 50 kΩ/Meter

Fig. 10-70



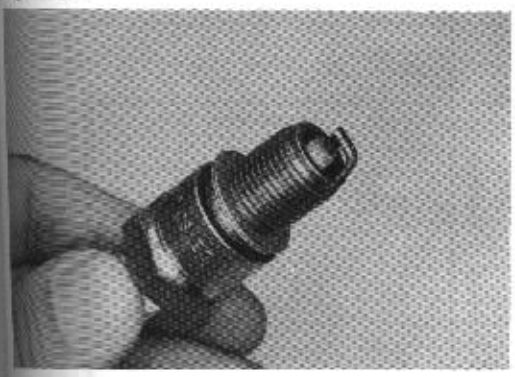
SPARK PLUG

INSPECTION

Inspect for the following items. Clean or replace plugs if necessary.

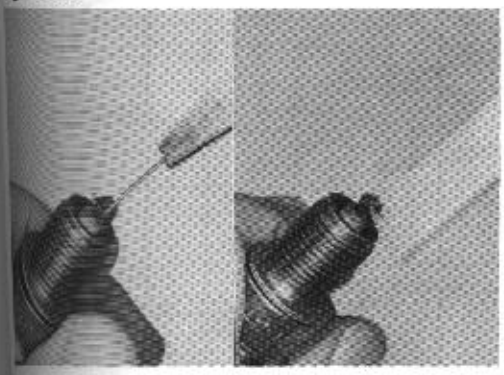
1. Cracks or damages in the threads or insulator.
2. Damaged or deteriorated gaskets.

Fig. 10-71



3. Wear on the electrodes.
4. Burnt condition of electrode and amount of carbon deposit.

Fig. 10-72



GAP ADJUSTMENT

Check the plug gap with plug gap gauge.
If not to specified value, adjust by bending the ground (outer) electrode.

Spark plug gap 0.7 – 0.8 mm (0.028 – 0.031 in)

CHARGING SYSTEM

CHARGING SYSTEM CIRCUIT

Fig. 11-1

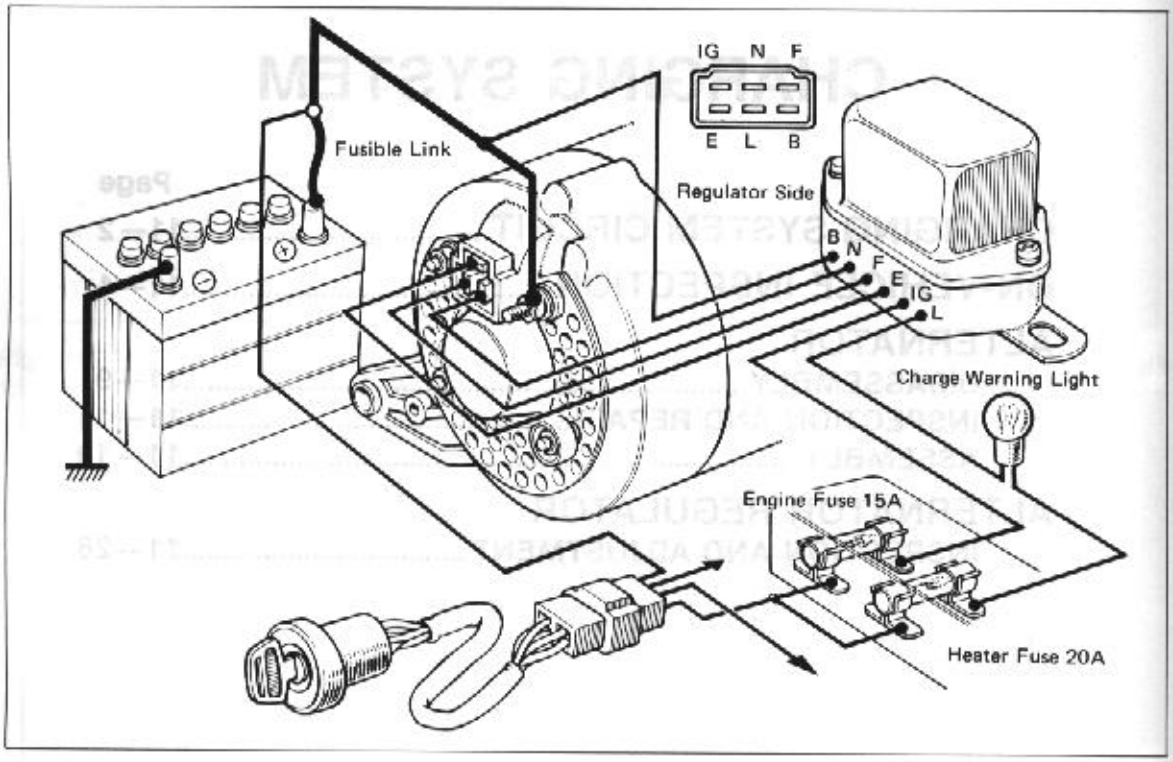
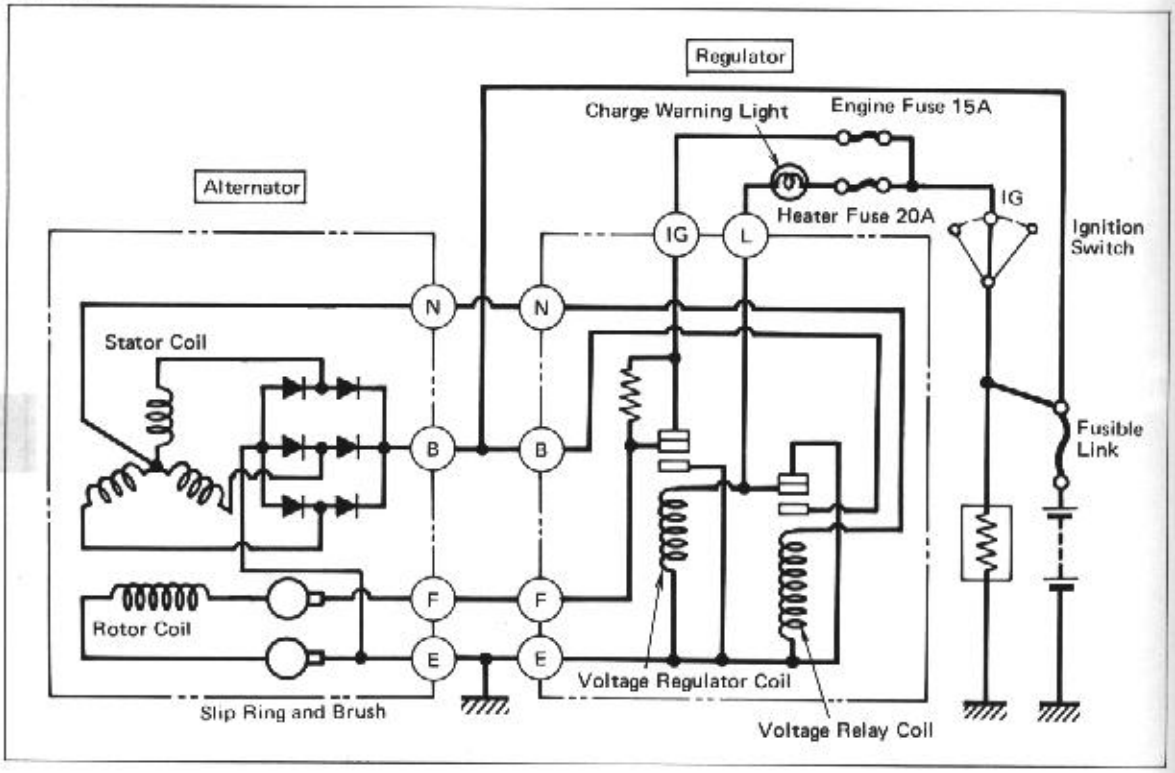


Fig. 11-2



FOR ALTERNATOR WITH IC REGULATOR

Fig. 11-3

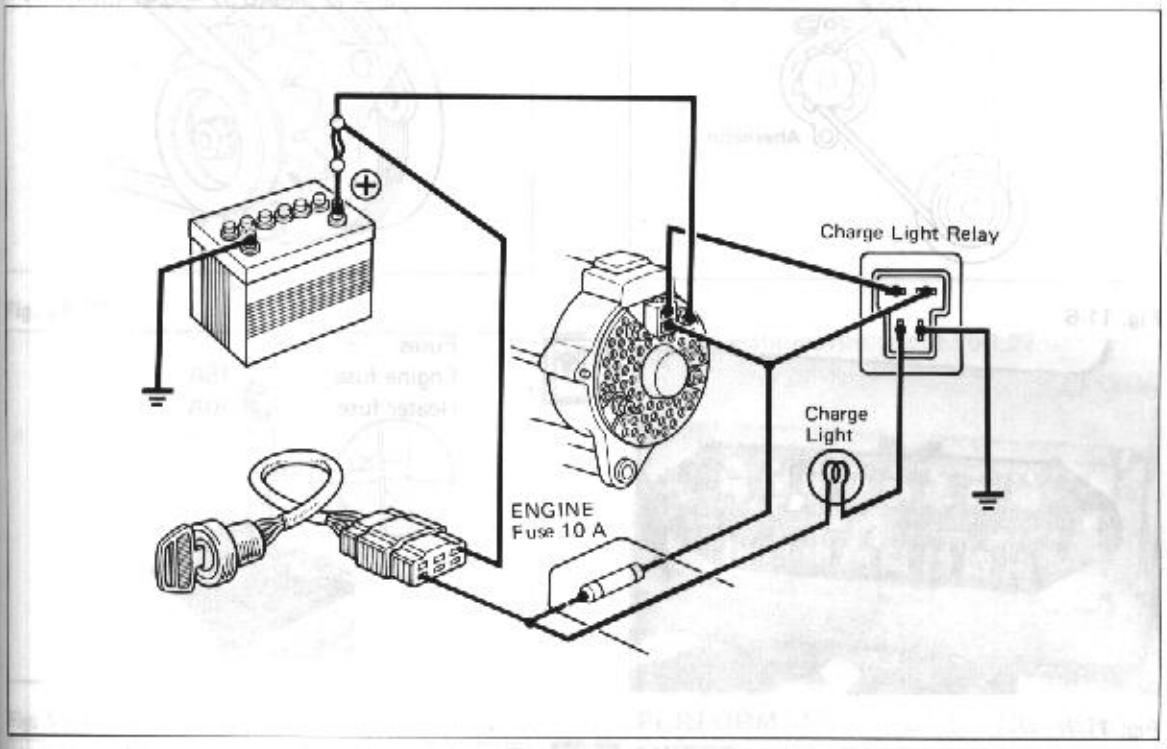
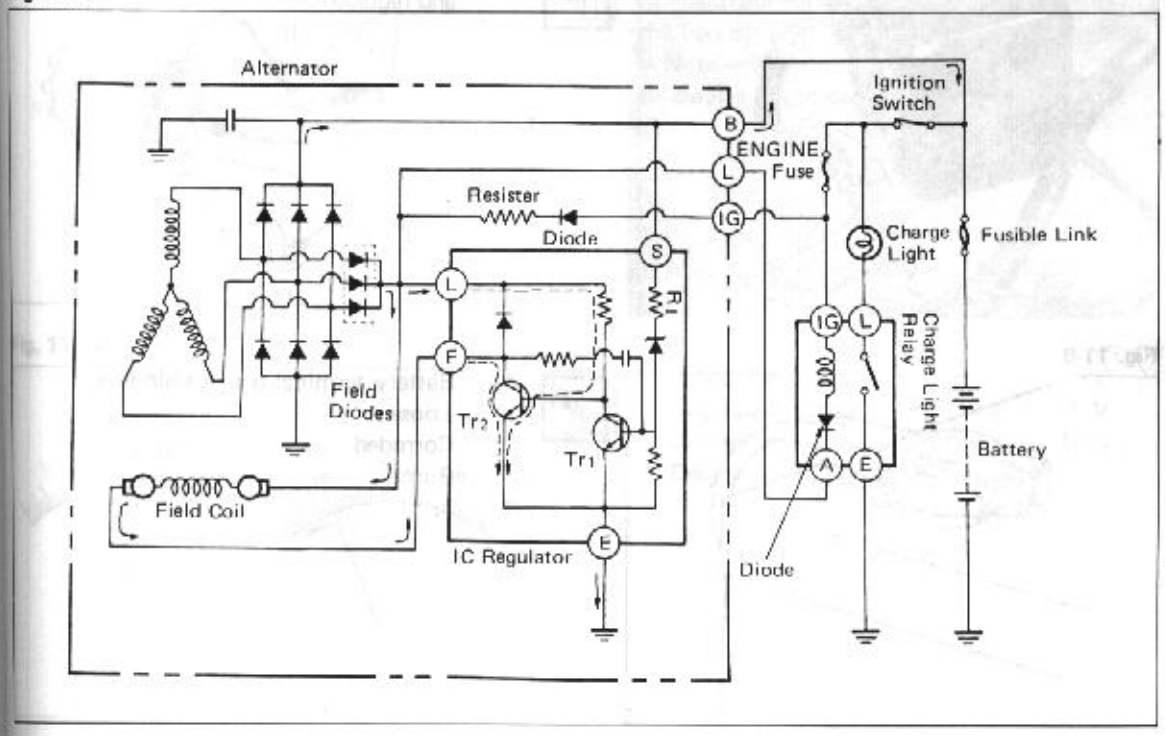
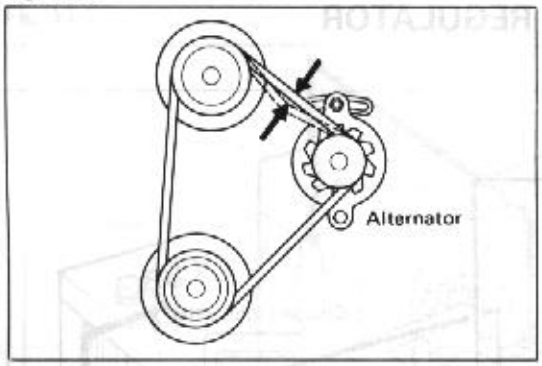


Fig. 11-4



ON-VEHICLE INSPECTION

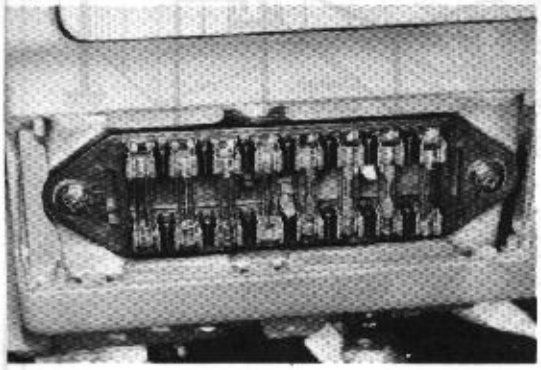
Fig. 11-5



Inspect the following system components:

1. Drive belt tension (at 10 kg)
   8 – 12 mm (0.32 – 0.47 in)

Fig. 11-6



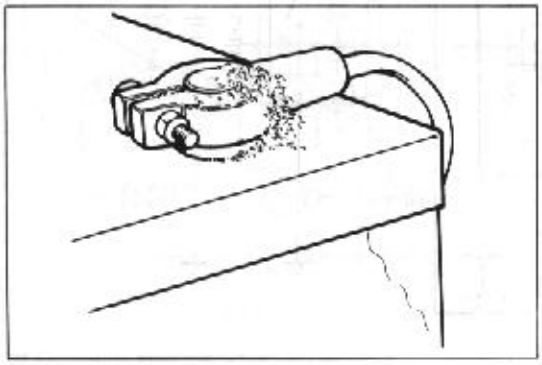
2. Fuses

Engine fuse	15A
Heater fuse	20A

Fig. 11-7

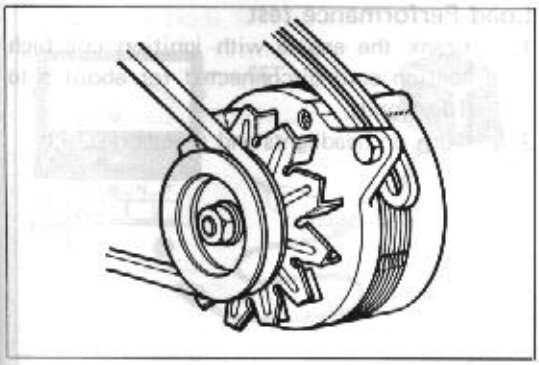
3. Installed condition of wiring for alternator and regulator.

Fig. 11-8



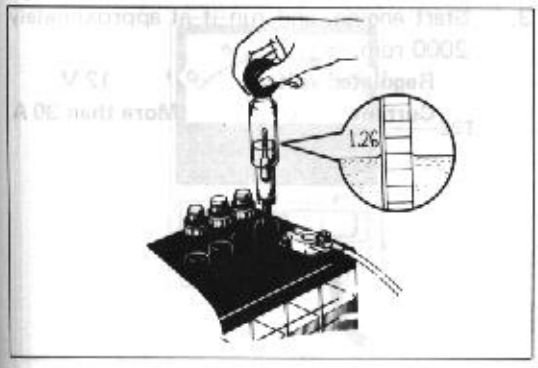
4. Battery terminal and fusible link
   Loose
   Corroded
   Burnt

Fig. 11-9



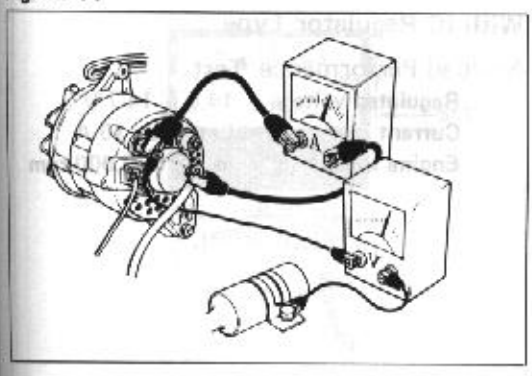
5. Alternator on-vehicle condition
Abnormal noise from alternator when engine is running.

Fig. 11-10



6. Specific gravity 1.25-1.27

Fig. 11-11



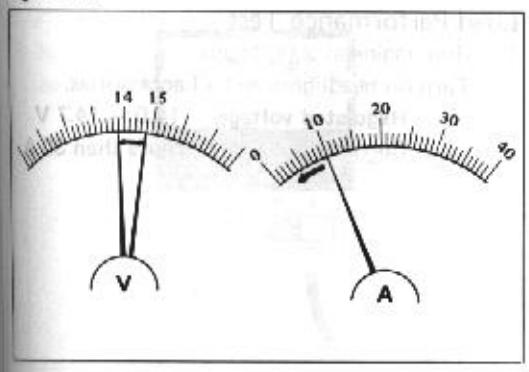
PERFORMANCE TEST USING VOLTMETER AND AMMETER

Connect the voltmeter and ammeter as shown in the figure.

— Note —

Be careful not to cause a short.

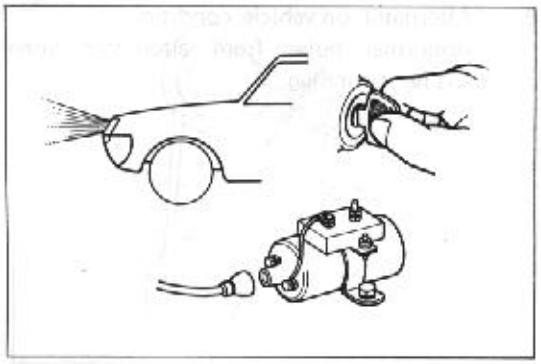
Fig. 11-12



No-load Performance test

Regulated voltage	**13.8 – 14.8 V**
Current	**Less than 10 A**
Engine speed	**Idling to 2000 rpm.**

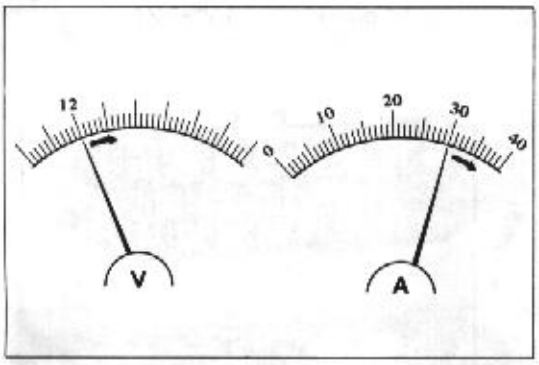
Fig. 11-13



Load Performance test

1. Crank the engine with ignition coil high tension cord disconnected for about 5 to 10 seconds.
2. Turn on headlights and accessories.

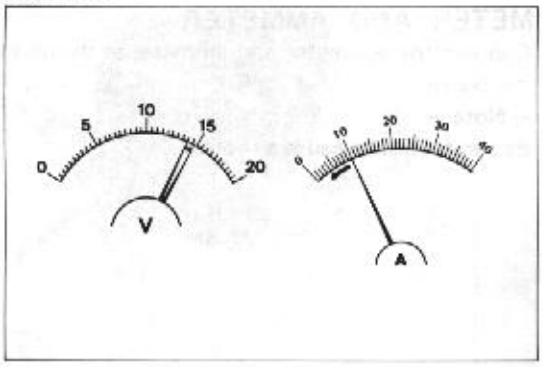
Fig. 11-14



3. Start engine, and run it at approximately 2000 rpm.

Regulated voltage	**12 V**
Current	**More than 30 A**

Fig. 11-15

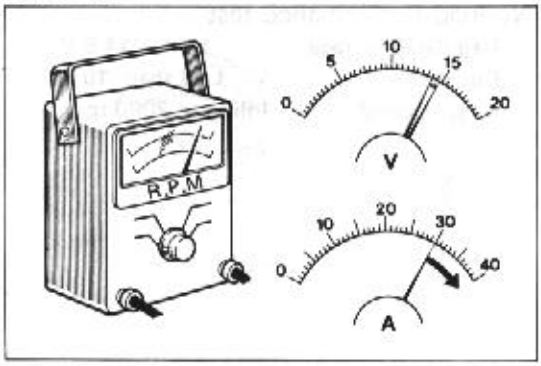


With IC Regulator Type

No-load Performance Test

Regulated voltage	**14.0 – 14.7 V**
Current	**Less than 10 A**
Engine speed	**Idling to 2,000 rpm**

Fig. 11-16

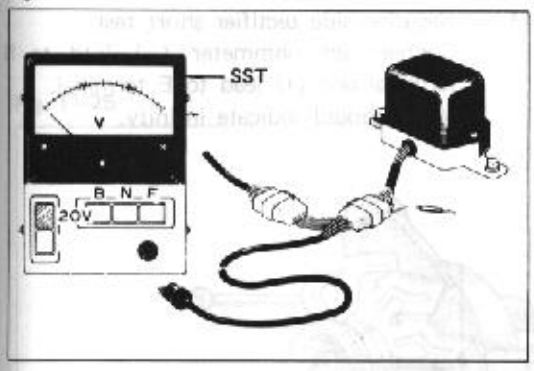


Load Performance Test

1. Run engine at 2,000 rpm.
2. Turn on headlights and all accessories.

Regulated voltage	**14.0 – 14.7 V**
Current	**More than 30 A**

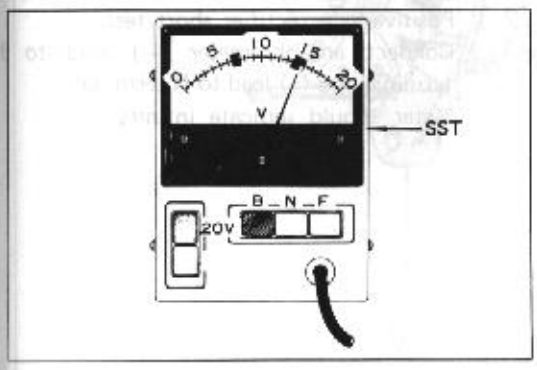
Fig. 11-17



PERFORMANCE TEST BY ALTERNATOR CHECKER

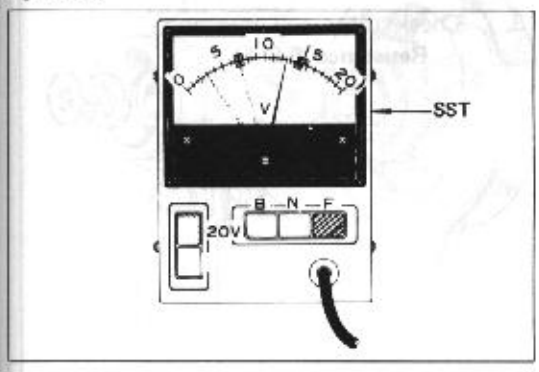
1. Unplug the alternator regulator connector and plug in the checker connector.
   SST [09081-00011]
   Push "20 V" switch.

Fig. 11-18



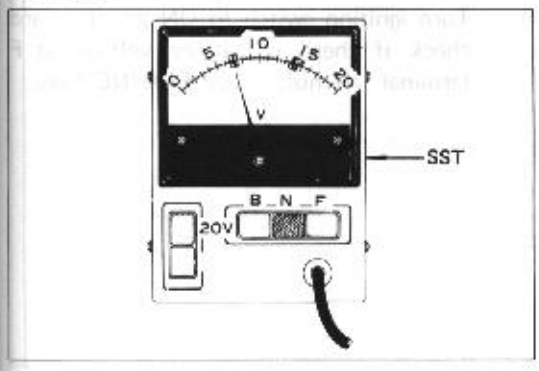
2. Check "B" terminal voltage.
   Push "B" switch.
   Raise engine speed from idling to 2000 rpm.
   SST [09081-00011]
   Standard voltage 13.8 – 14.8 V

Fig. 11-19



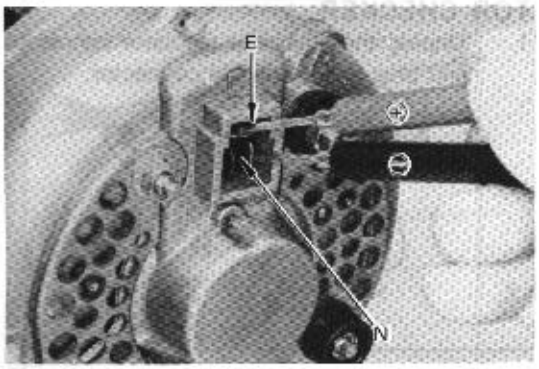
3. Check "F" terminal voltage.
   Push "F" switch.
   Gradually raise engine speed. The checker reading should gradually decrease from 12 volt to 3 volt.
   SST [09081-00011]

Fig. 11-20



4. Check "N" terminal voltage.
   Push "N" switch.
   Maintain engine speed at approx. 1500 rpm. The pointer should be at a half of "B" terminal voltage.
   SST [09081-00011]

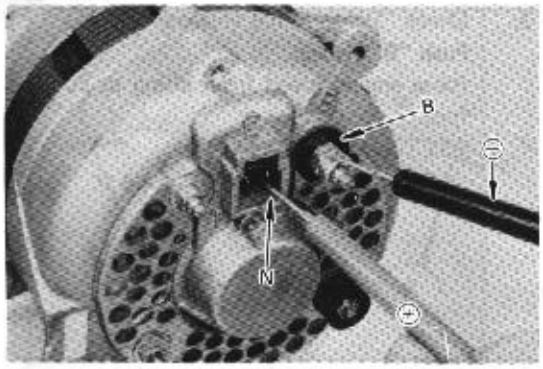
Fig. 11-21



ALTERNATOR INSPECTION

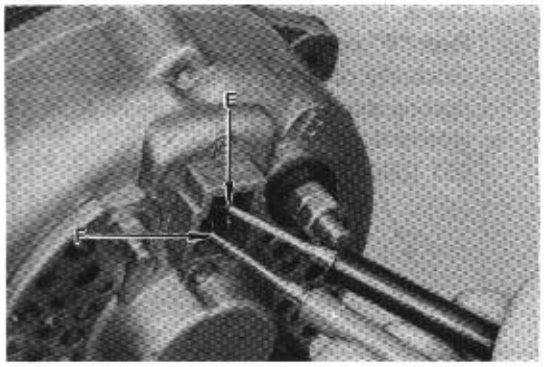
1. Negative side rectifier short test.
   Connect an ohmmeter (–) lead to N terminal and (+) lead to E terminal.
   Meter should indicate infinity.

Fig. 11-22



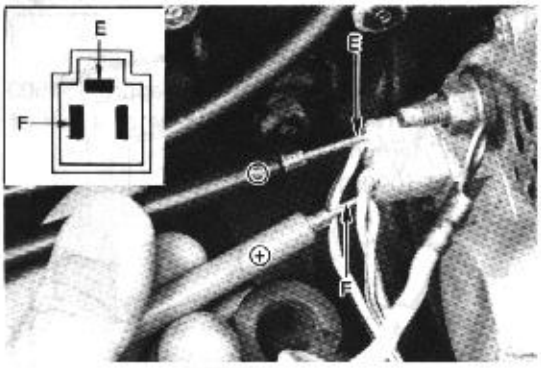
2. Positive side rectifier short test.
   Connect an ohmmeter (–) lead to B terminal and (+) lead to N terminal.
   Meter should indicate infinity.

Fig. 11-23



3. Check rotor coil resistance.
   Resistance 5-9 Ω

Fig. 11-24



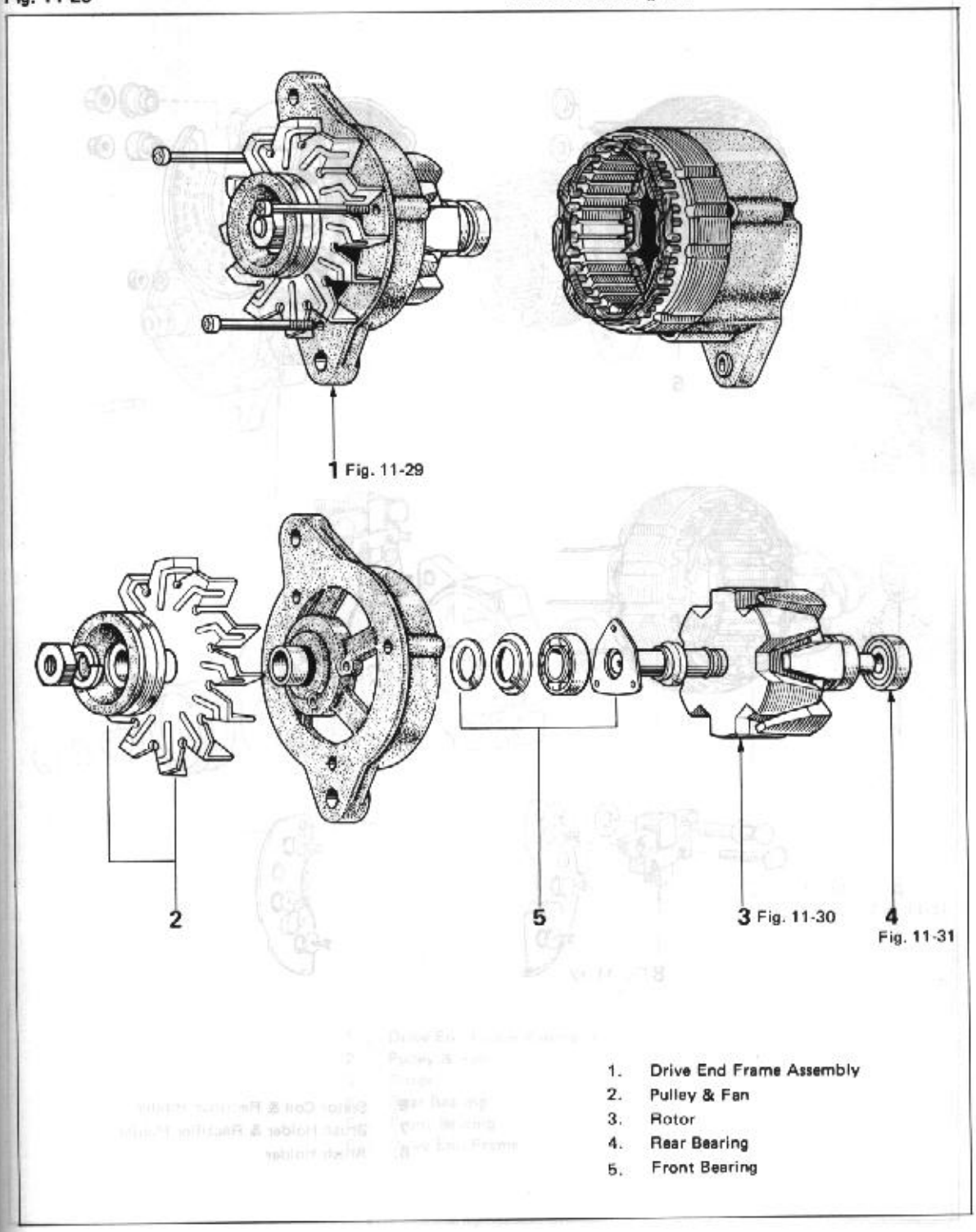
4. Turn ignition switch to ON position, and check if there is battery voltage at F terminal. If not, check ENGINE fuse.

ALTERNATOR

DISASSEMBLY

Disassemble the parts in the numerical order shown in the figure.

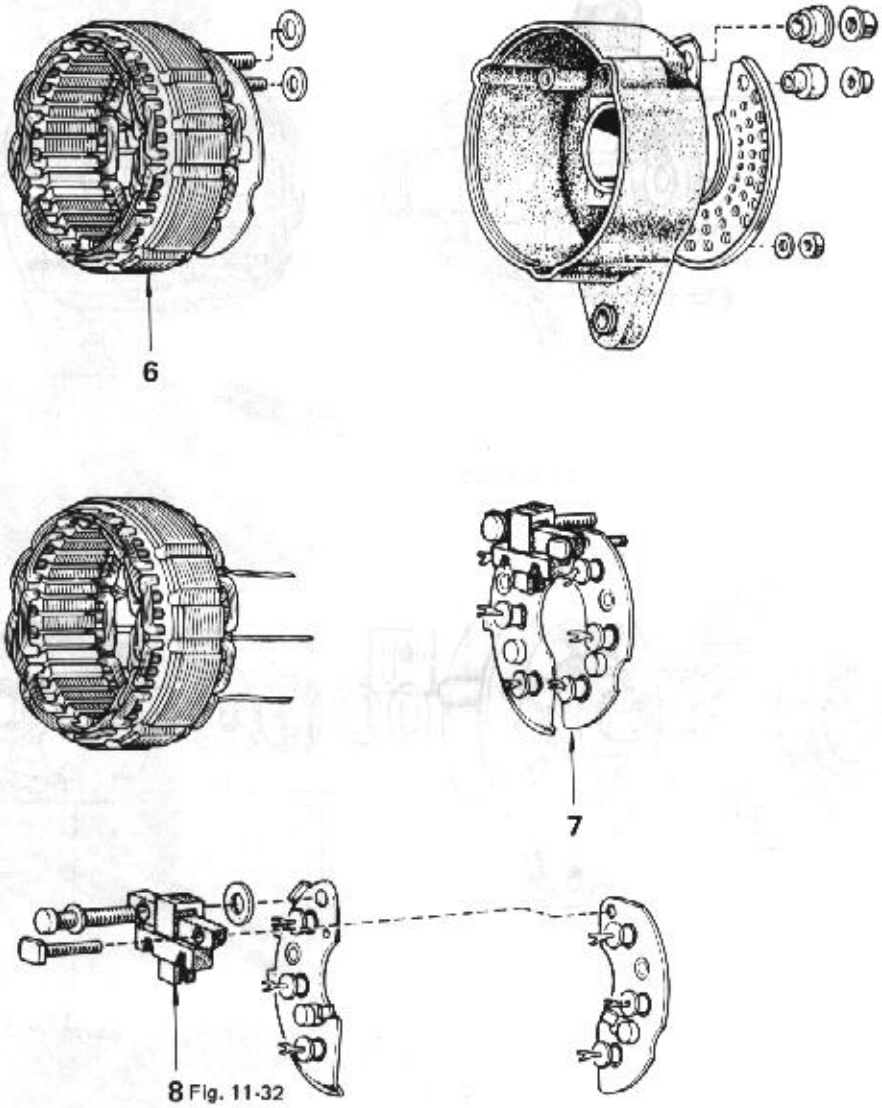
Fig. 11-25



1. Drive End Frame Assembly
2. Pulley & Fan
3. Rotor
4. Rear Bearing
5. Front Bearing

Disassemble the parts in the numerical order shown in the figure.

Fig. 11-26

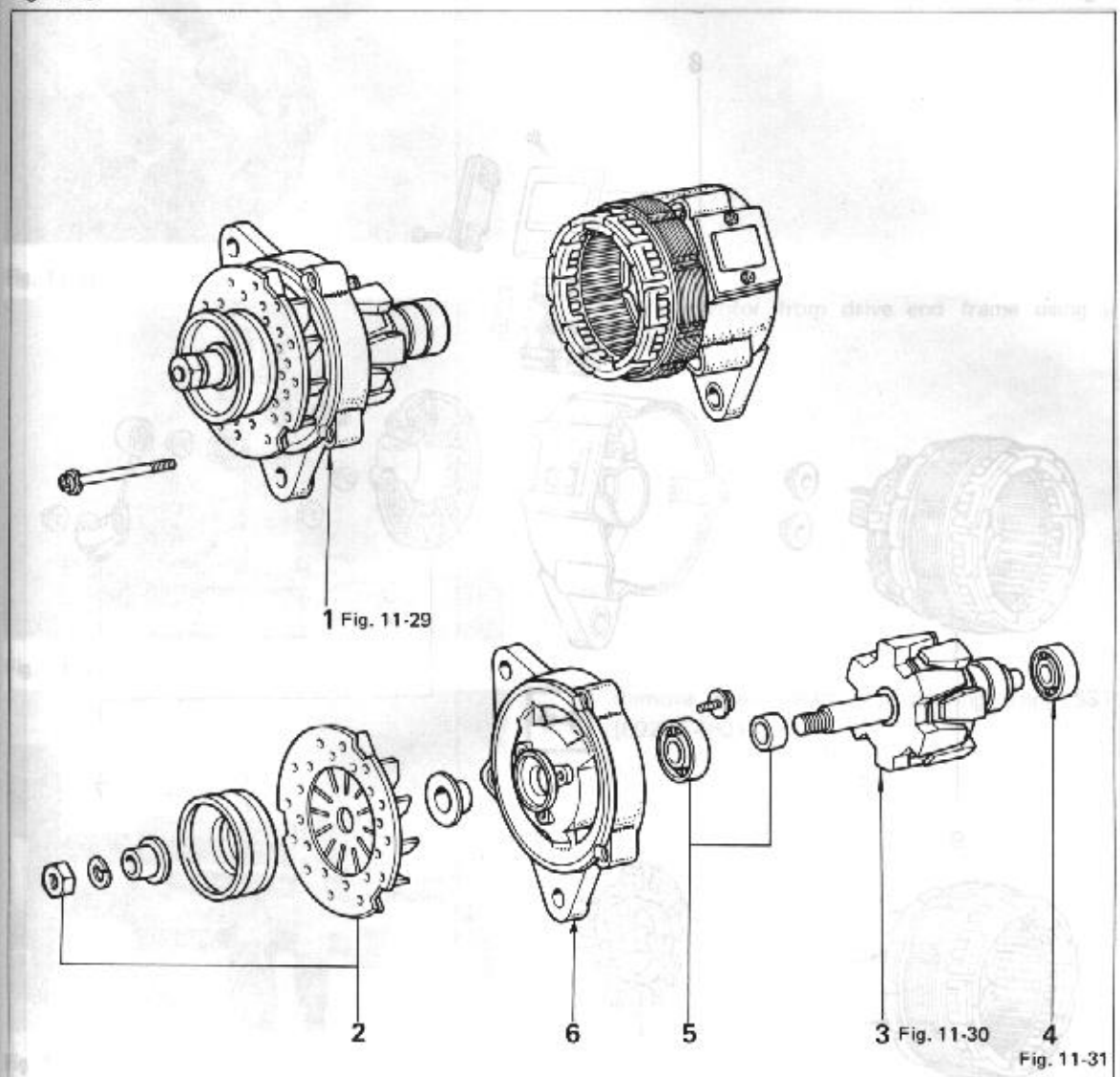


6. Stator Coil & Rectifier Holder
7. Brush Holder & Rectifier Holder
8. Brush Holder

For Alternator with IC Regulator

Disassemble the parts in the numerical order shown in the figure.

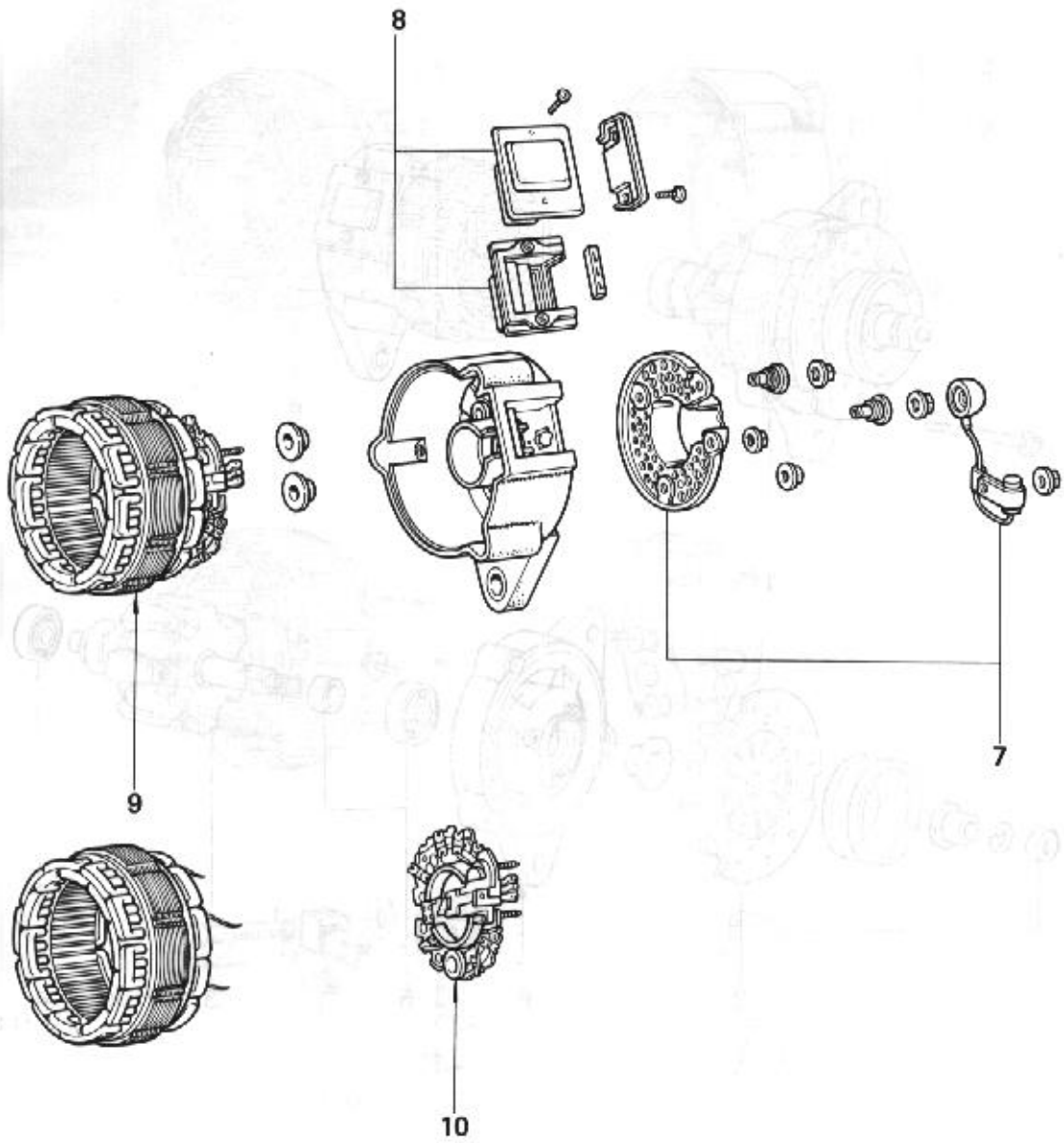
Fig. 11-27



1. Drive End Frame Assembly
2. Pulley & Fan
3. Rotor
4. Rear Bearing
5. Front Bearing
6. Drive End Frame

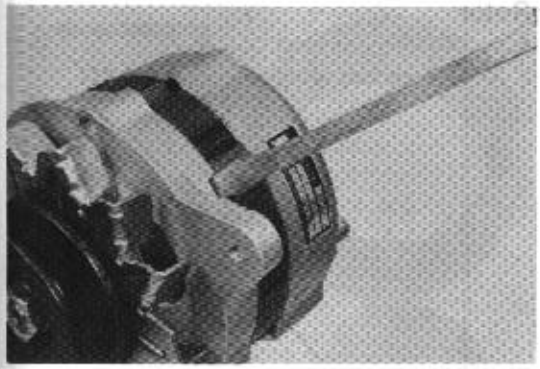
Disassemble the parts in the numerical order shown in the figure.

Fig. 11-28



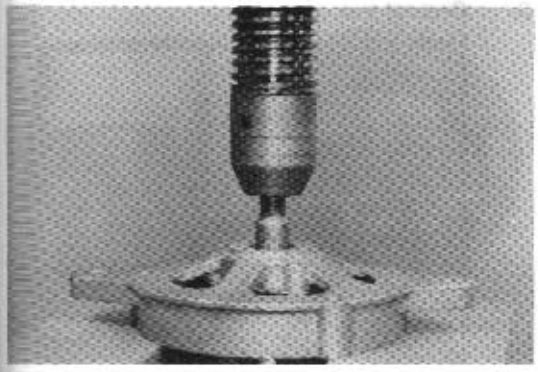
7. Nut, Insulator & Dust Cover
8. IC Regulator
9. Stator Coil & Rectifier Holder
10. Rectifier Holder with Brush

Fig. 11-29



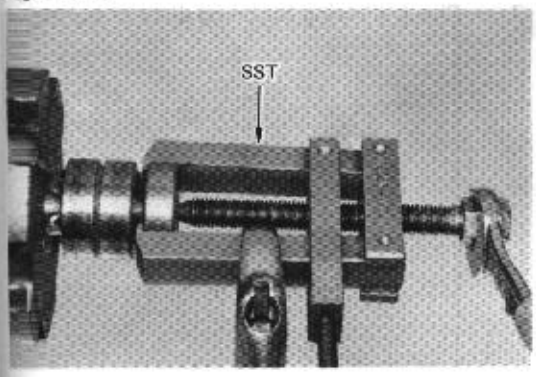
Pry drive end frame from stator.
Do not pry coil wires.

Fig. 11-30



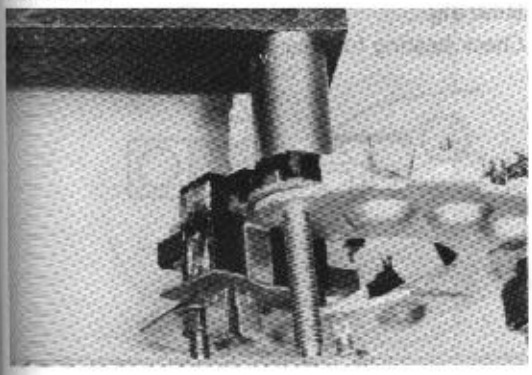
Remove rotor from drive end frame using a press.

Fig. 11-31



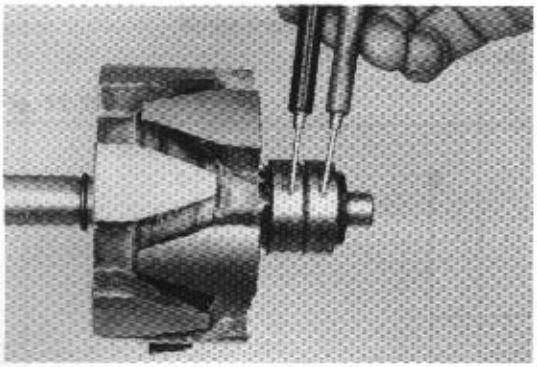
Remove rotor shaft rear bearing using SST [09286-46011].

Fig. 11-32



Remove brush holder assembly using a 10 mm socket wrench and vise.

Fig. 11-33



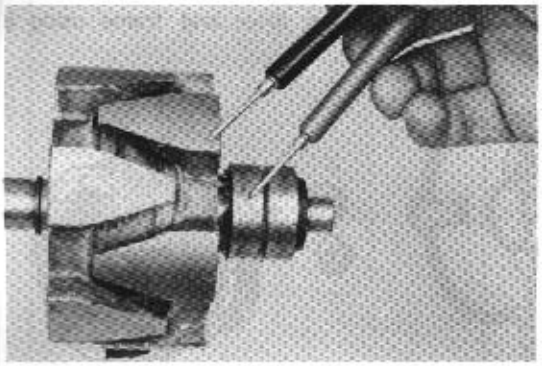
INSPECTION AND REPAIR

Rotor

1. Open circuit test

   Standard resistance **4.1-4.3Ω**

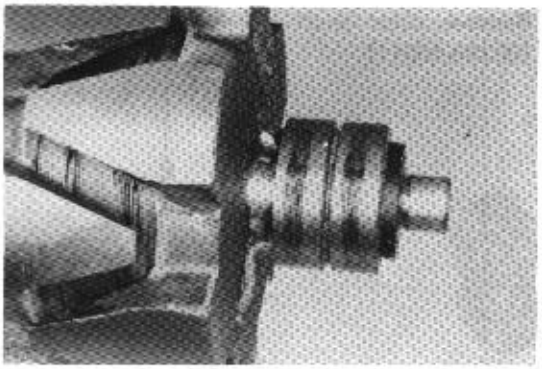
Fig. 11-34



2. Ground test

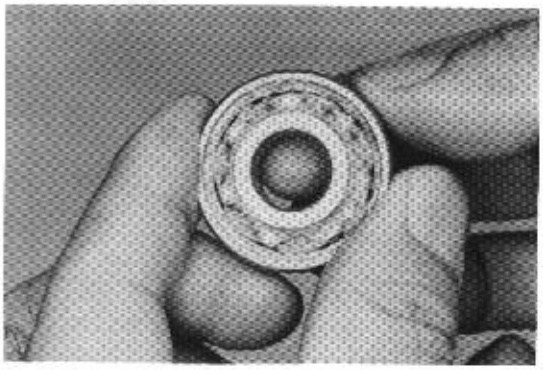
   Meter should indicate infinity.

Fig. 11-35



3. Check slip ring for being dirty or burnt.

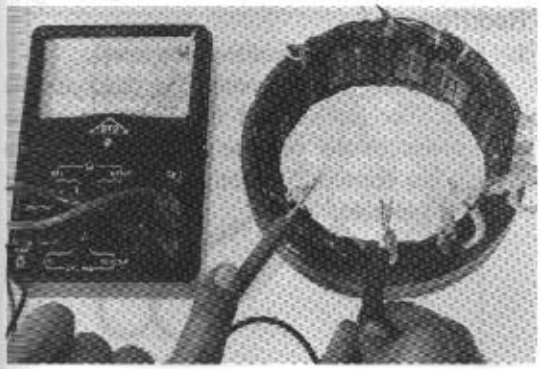
Fig. 11-36



Bearing

Check bearing for wear or roughness.

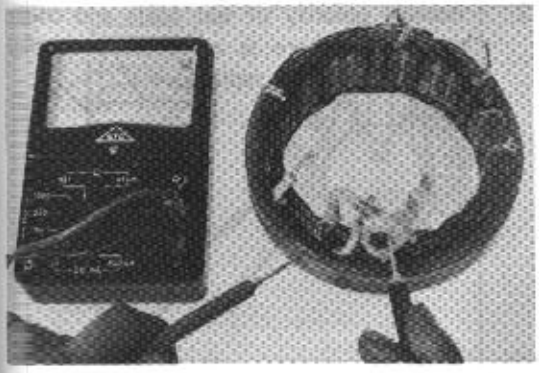
Fig. 11-37



Stator

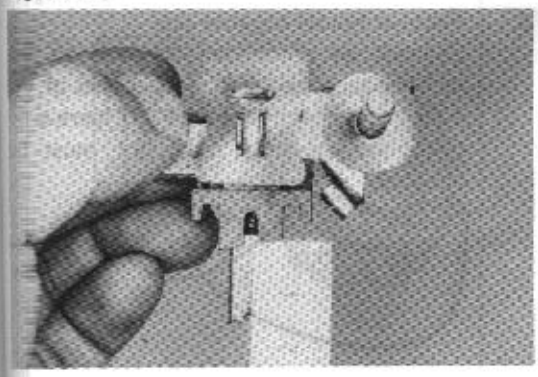
1. Open circuit test
   Test all four leads for continuity.

Fig. 11-38



2. Ground test
   Meter should indicate infinity.

Fig. 11-39

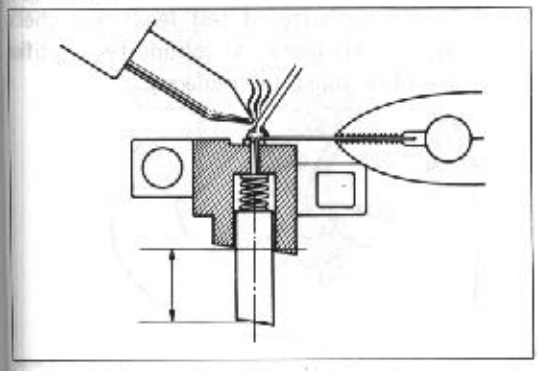


Brush and Brush Holder

Check exposed brush length.

Minimum exposed length	**5.5 mm (0.22 in)**

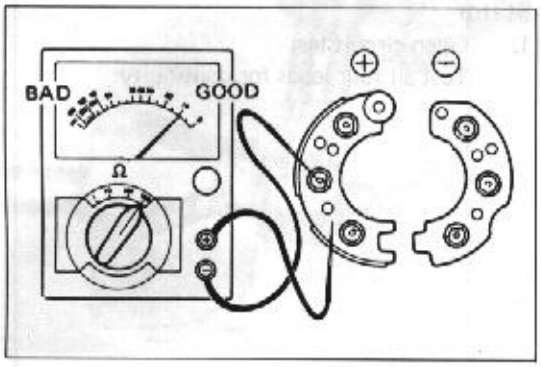
Fig. 11-40



When replacing brushes, assemble them as shown.

Exposed length	**12.5 mm (0.49 in)**
with IC regulator	**16.5 mm (0.650 in.)**

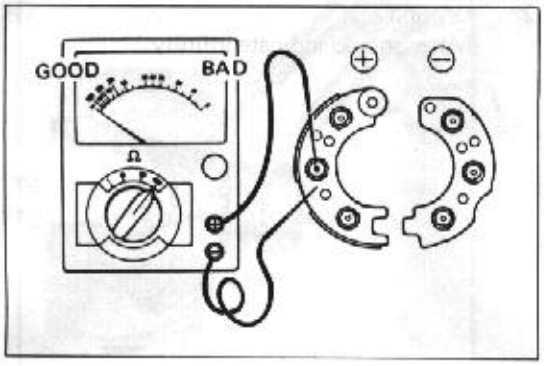
Fig. 11-41



Rectifier

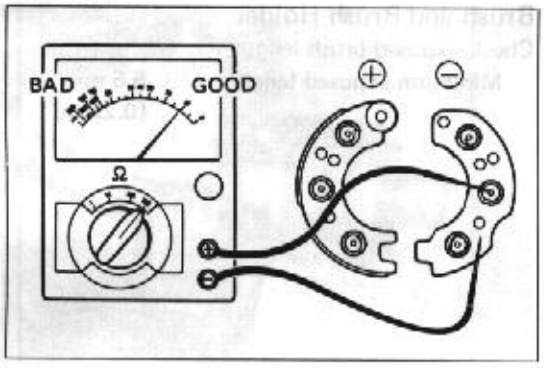
1. Rectifier holder positive side
Connect an ohmmeter (+) lead to the rectifier holder, and the (–) lead of the meter to the rectifier terminal. If there is no continuity, rectifier assembly must be replaced.

Fig. 11-42



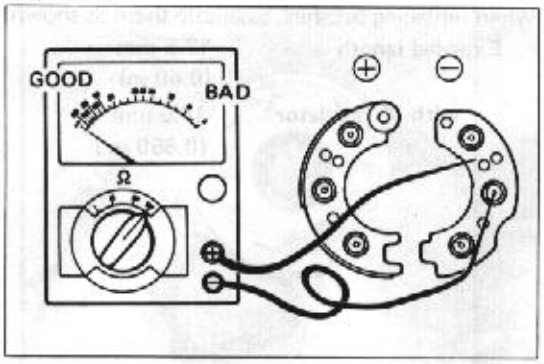
2. Reverse polarity of test leads and check again. If there is continuity, rectifier assembly must be replaced.

Fig. 11-43



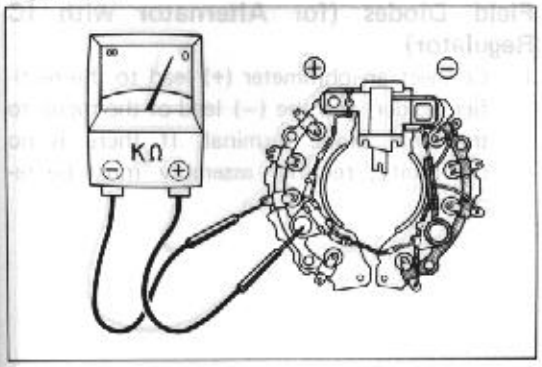
3. Rectifier holder negative side
Connect an ohmmeter (+) lead to the rectifier terminal, and the (–) lead of the meter to the rectifier holder. If there is no continuity, rectifier assembly must be replaced.

Fig. 11-44



4. Reverse polarity of test leads and check again. If there is continuity, rectifier assembly must be replaced.

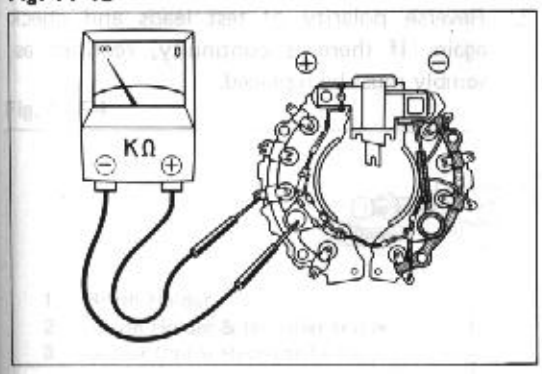
Fig. 11-45



Rectifier (for Alternator with IC Regulator)

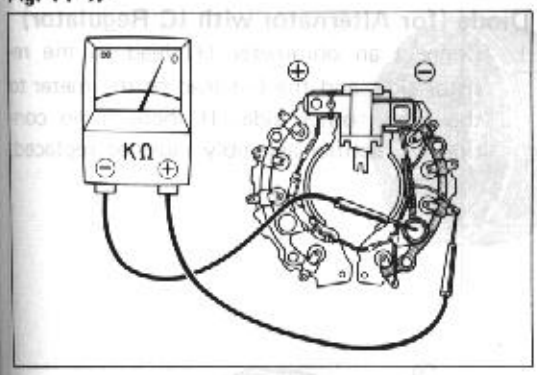
1. Rectifier holder positive side
   Connect an ohmmeter (+) lead to the rectifier holder, and the (–) lead of the meter to the rectifier terminal. If there is no continuity, rectifier assembly must be replaced.

Fig. 11-46



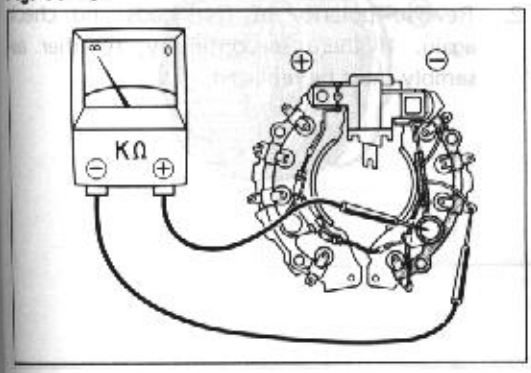
2. Reverse polarity of test leads and check again. If there is continuity, rectifier assembly must be replaced.

Fig. 11-47



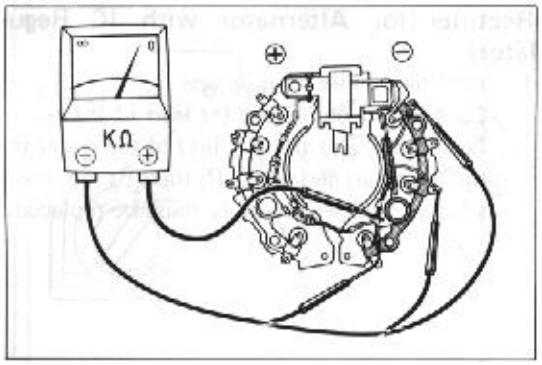
3. Rectifier holder negative side
   Connect an ohmmeter (+) lead to the rectifier terminal, and the (–) lead of the meter to the rectifier holder. If there is no continuity, rectifier assembly must be replaced.

Fig. 11-48



4. Reverse polarity of test leads and check again. If there is continuity, rectifier assembly must be replaced.

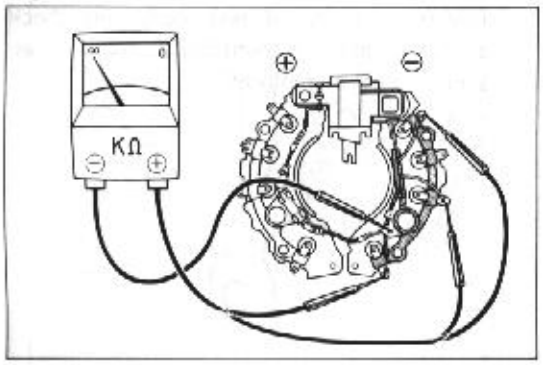
Fig. 11-49



Field Diodes (for Alternator with IC Regulator)

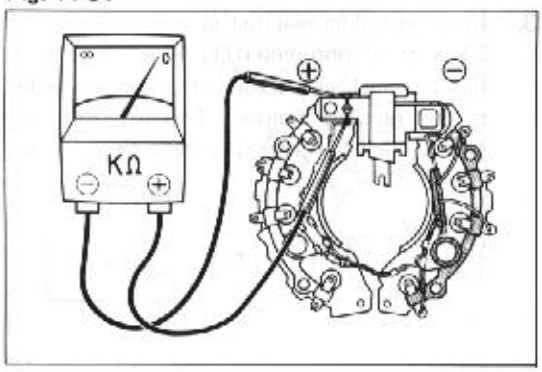
1. Connect an ohmmeter (+) lead to the rectifier holder, and the (–) lead of the meter to the field diode terminal. If there is no continuity, rectifier assembly must be replaced.

Fig. 11-50



2. Reverse polarity of test leads and check again. If there is continuity, rectifier assembly must be replaced.

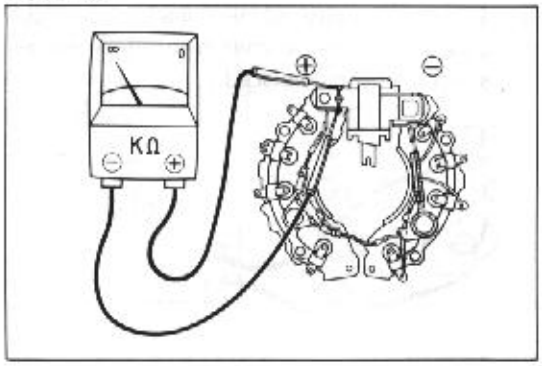
Fig. 11-51



Diode (for Alternator with IC Regulator)

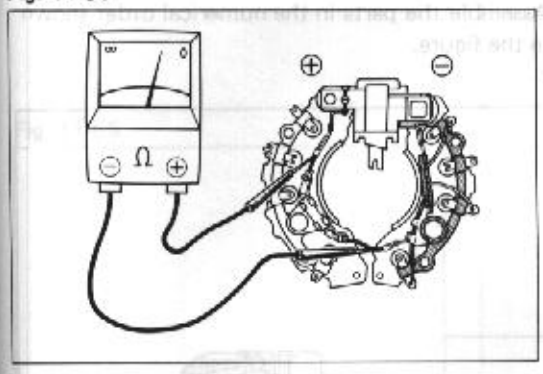
1. Connect an ohmmeter (+) lead to the resistor side, and the (–) lead of the meter to the diode other side. If there is no continuity, rectifier assembly must be replaced.

Fig. 11-52



2. Reverse polarity of test leads and check again. If there is continuity, rectifier assembly must be replaced.

Fig. 11-53



Resistor (for Alternator with IC Regulator)

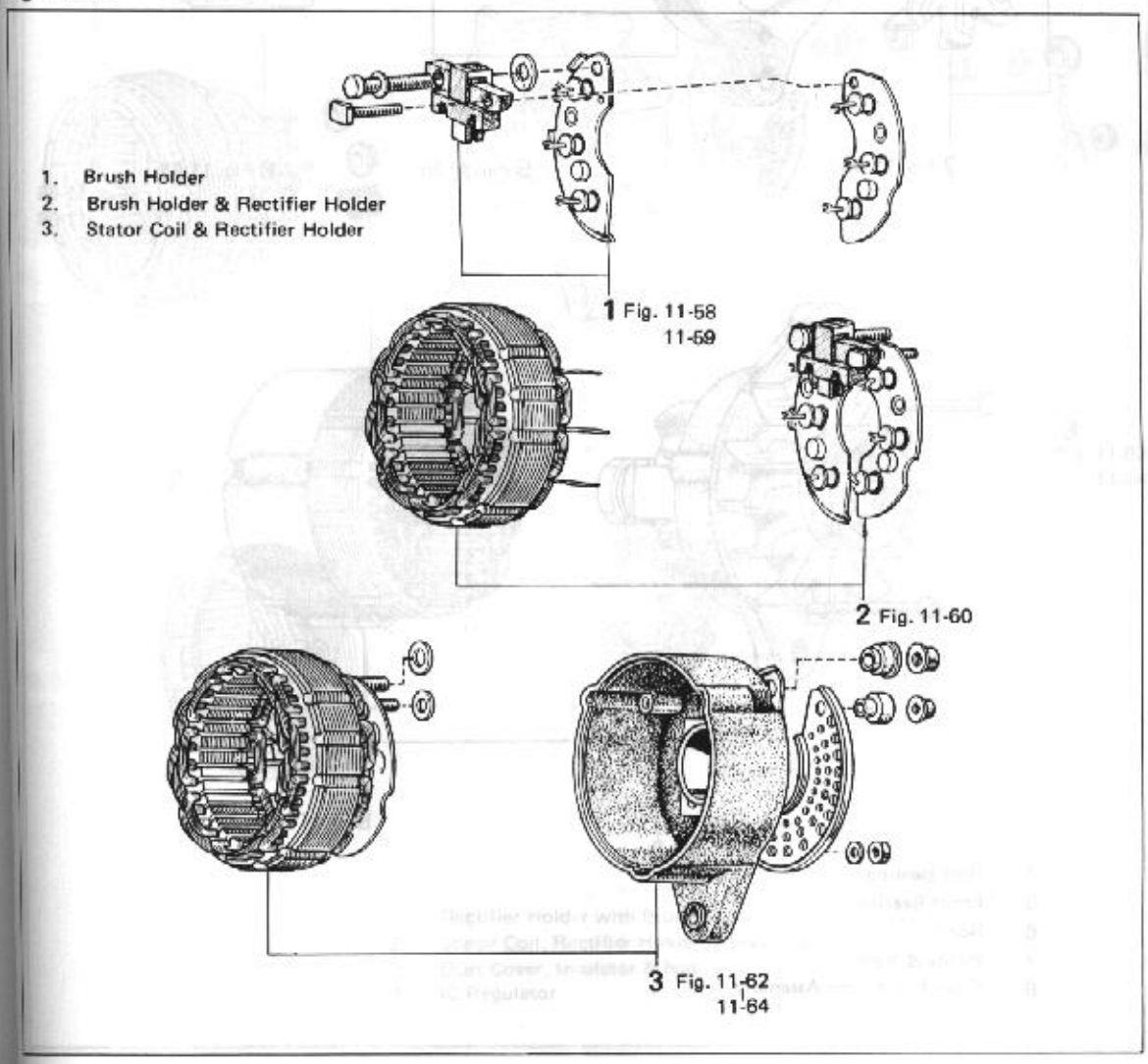
Connect an ohmmeter (+) lead to the diode side, and the (–) lead of the meter to the (–) rectifier side. If there is no continuity, rectifier assembly must be replaced.

Resistance 2.8 – 3.0Ω

ASSEMBLY

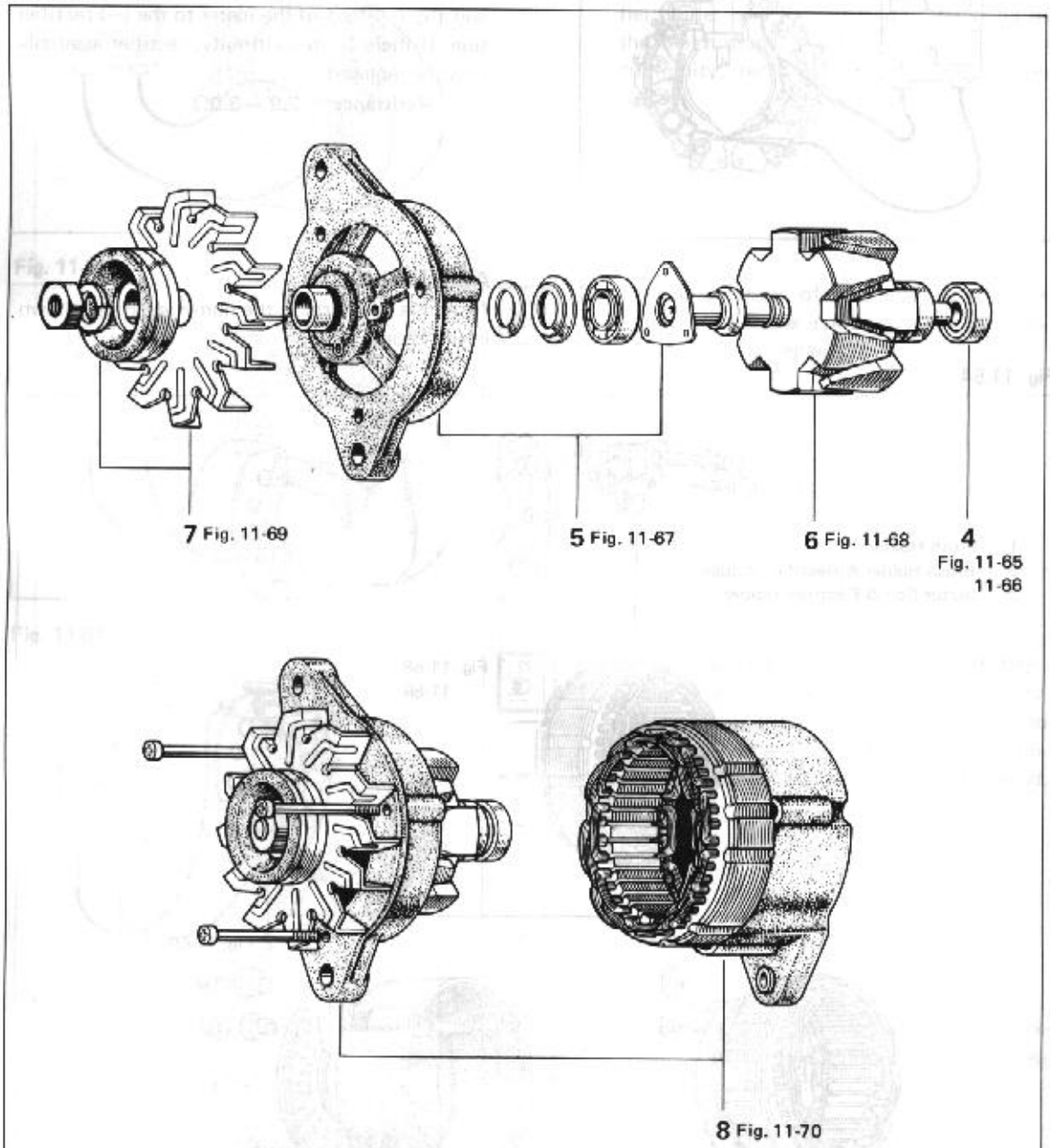
Assemble the parts in the numerical order shown in the figure.

Fig. 11-54



Assemble the parts in the numerical order shown in the figure.

Fig. 11-55

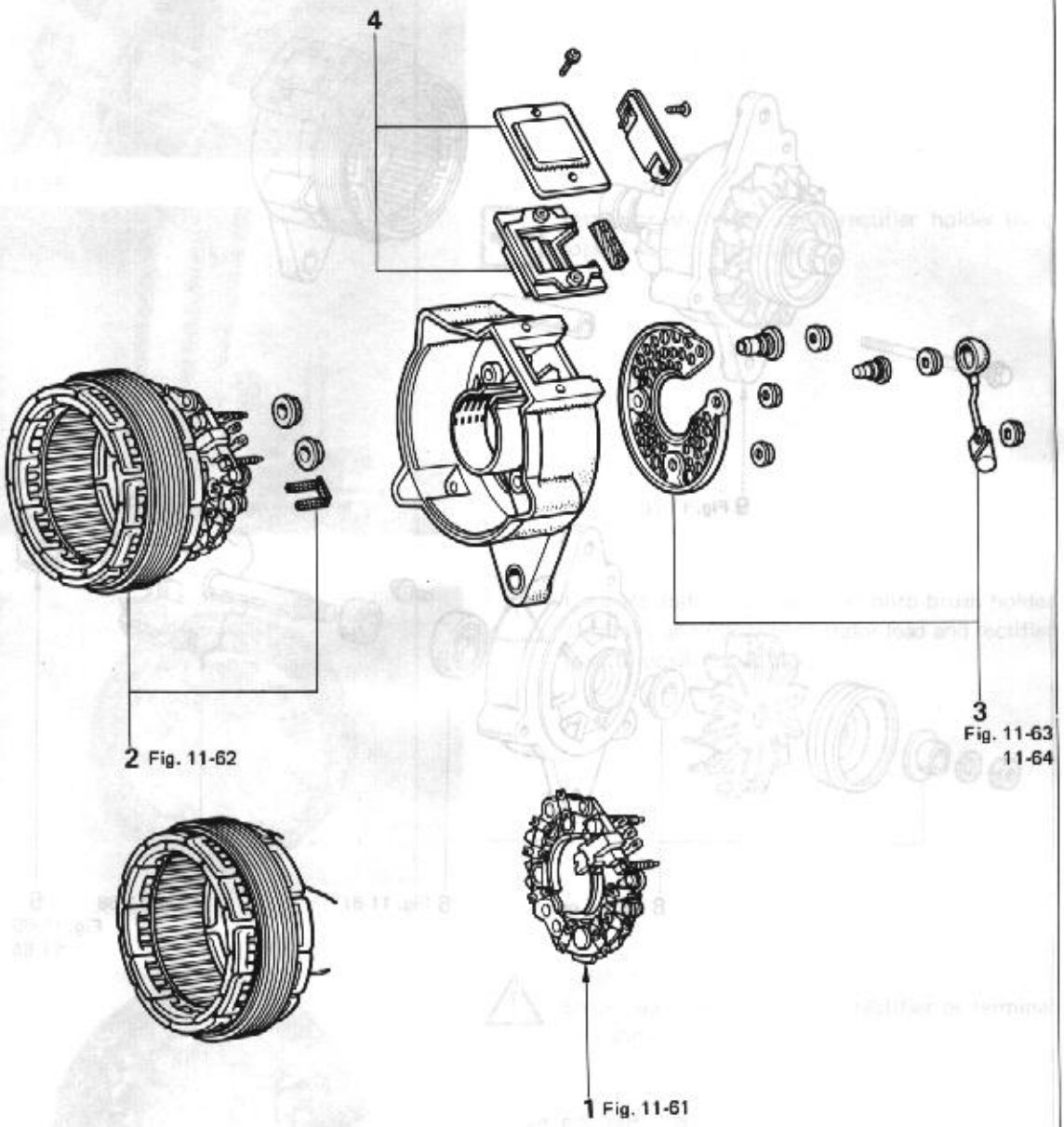


4. Rear Bearing
5. Front Bearing
6. Rotor
7. Pulley & Fan
8. Drive End Frame Assembly

For Alternator with IC Regulator

Assemble the parts in the numerical order shown in the figure.

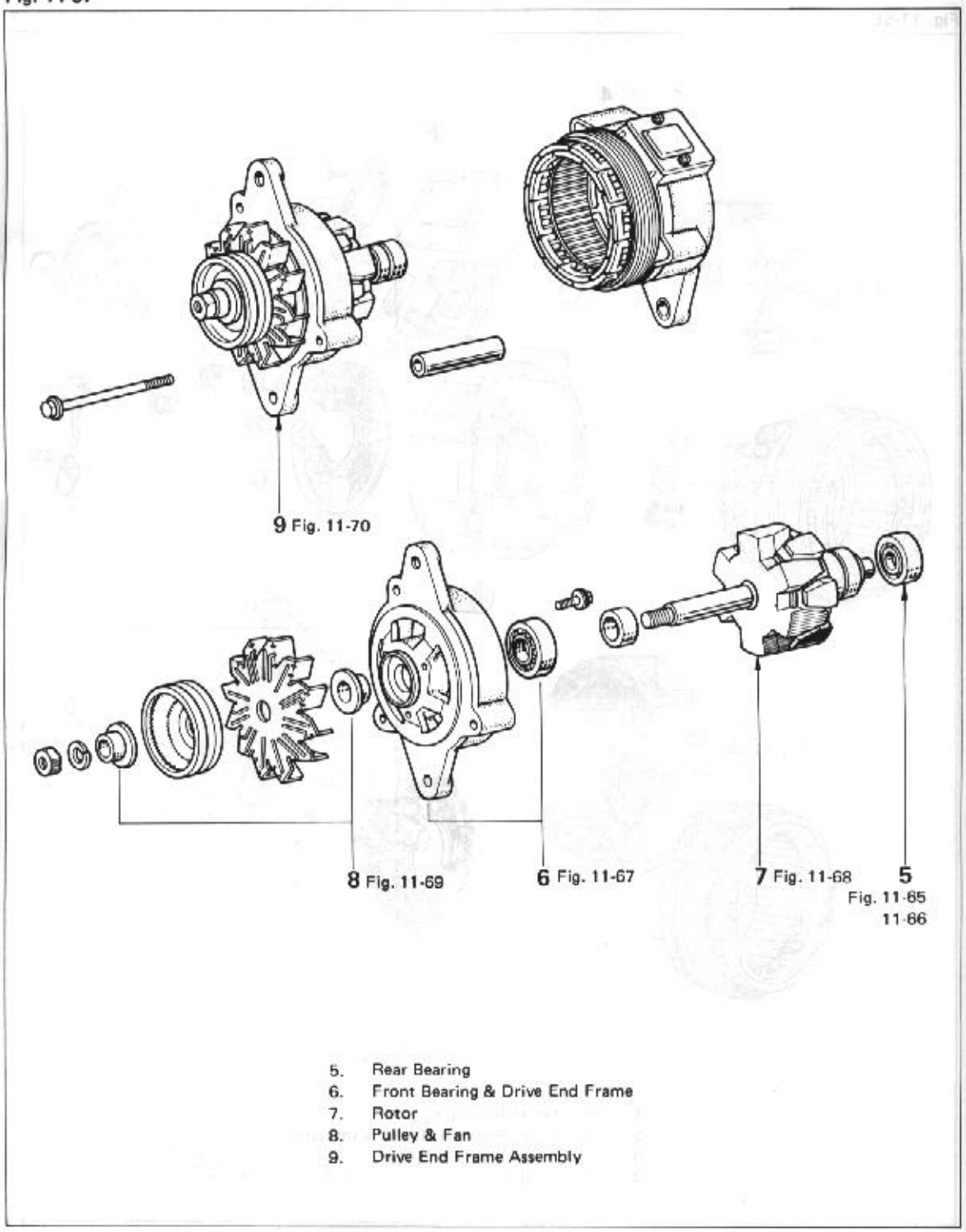
Fig. 11-56



1. Rectifier Holder with Brush
2. Stator Coil, Rectifier Holder & Insulator
3. Dust Cover, Insulator & Nut
4. IC Regulator

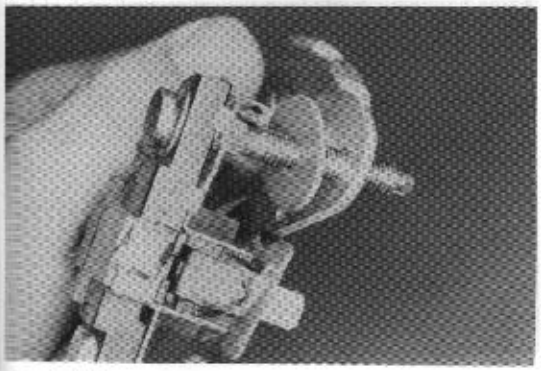
Assemble the parts in the numerical order shown in the figure.

Fig. 11-57



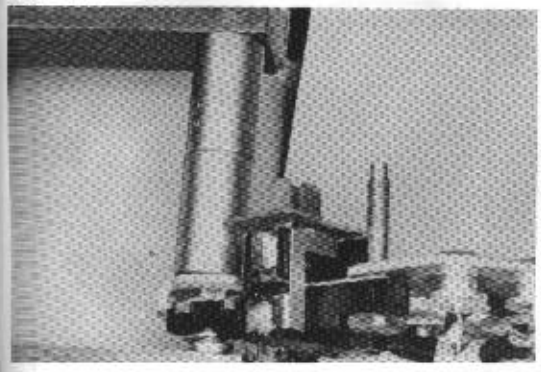
5. Rear Bearing
6. Front Bearing & Drive End Frame
7. Rotor
8. Pulley & Fan
9. Drive End Frame Assembly

Fig. 11-58



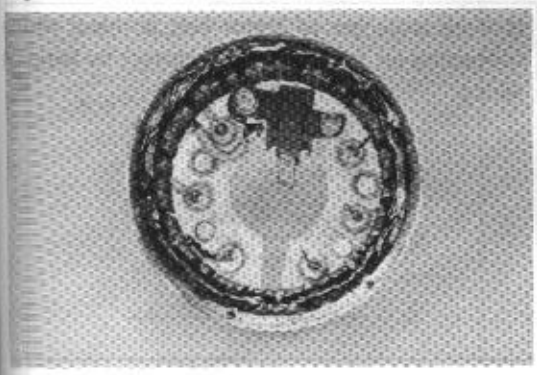
Insert insulator between positive rectifier holder and brush holder.

Fig. 11-59



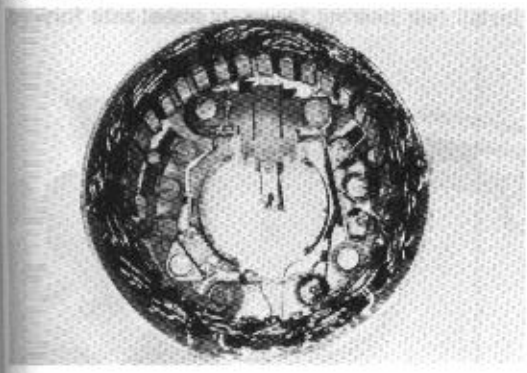
Install brush holder onto rectifier holder using socket wrench and a vise.

Fig. 11-60



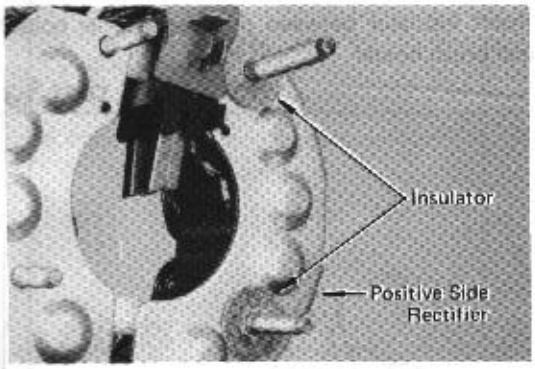
Connect stator coil "N" lead onto brush holder terminal, and solder each stator lead and rectifier lead to positive rectifier.

Fig. 11-61



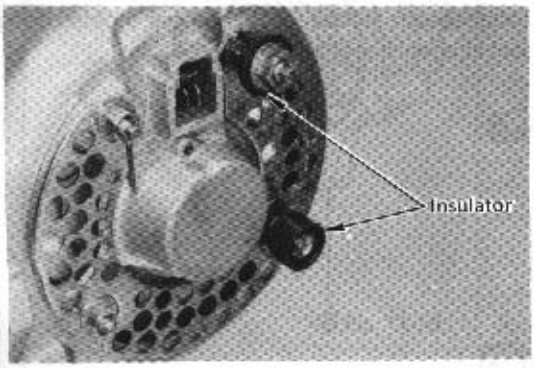
[with IC regulator]
Solder each lead wire onto rectifier or terminal as is shown in the figure.

Fig. 11-62



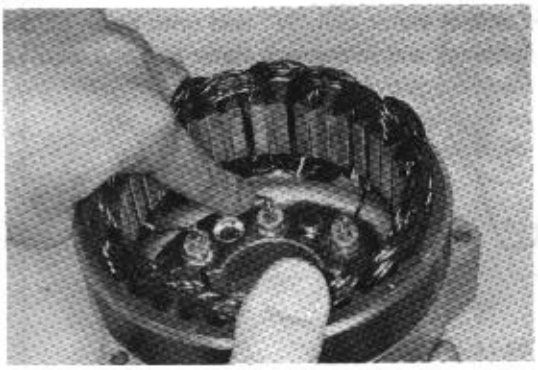
Assemble rear end frame and rectifier holder with insulators.

Fig. 11-63



Assemble rear end cover with insulators.

Fig. 11-64

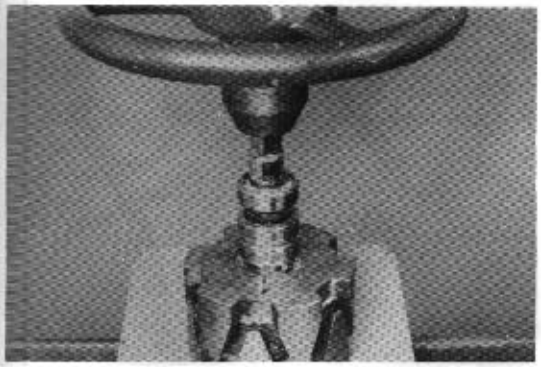


If there is danger of stator coil terminal wiring contacting on frame or rotor, correct by bending wiring.

Fig. 11-65

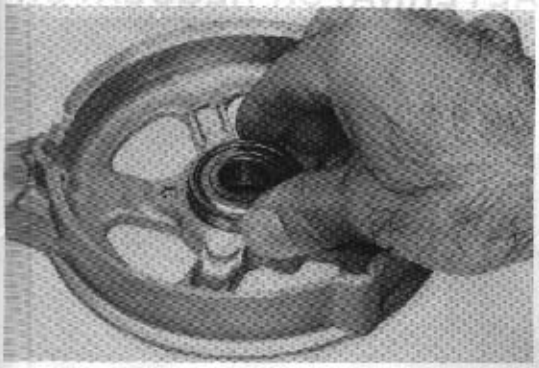
Install rear bearing facing its sealed side forward.

Fig. 11-66



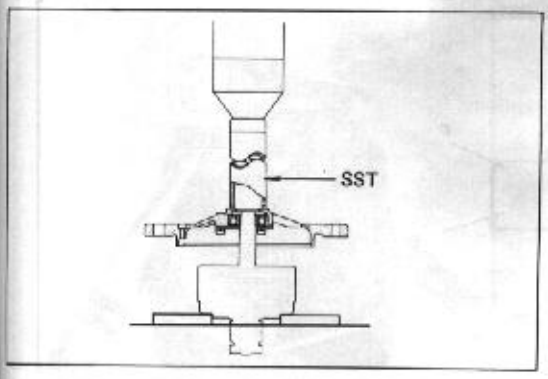
Press rear bearing onto rotor shaft, using a press.

Fig. 11-67



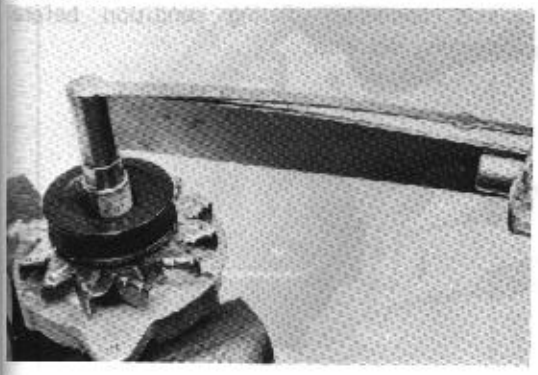
Install the front bearing facing its sealed side rearward.

Fig. 11-68



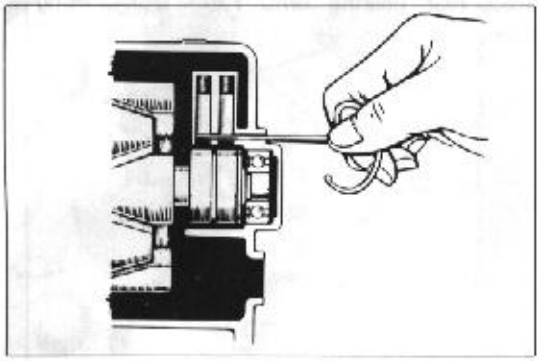
Press drive end frame assembly onto rotor shaft, using SST [09612-22010].

Fig. 11-69



Tighten nut to specified torque.
Torque 5 – 6.5 kg-m (36 – 47 ft-lb)

Fig. 11-70



Push in brushes and temporarily lock in place with wire inserted through access hole in end frame.
Position lead wires to clear rotor.

ALTERNATOR REGULATOR

Fig. 11-71

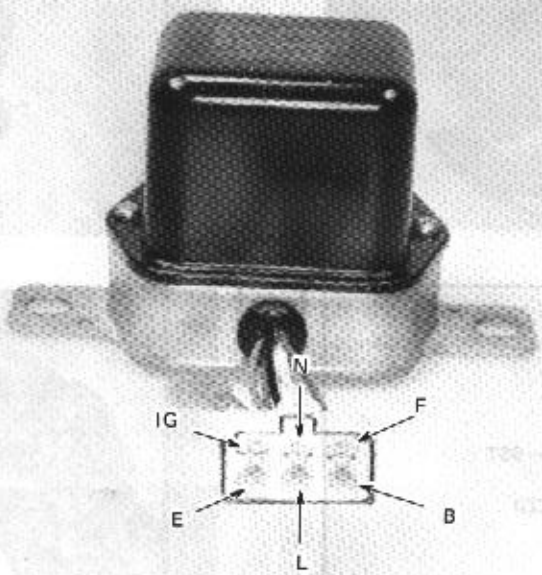
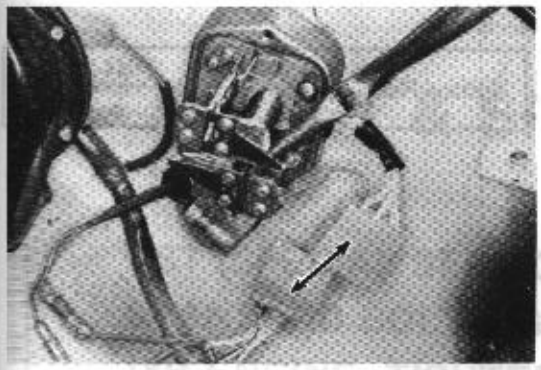


Fig. 11-72

INSPECTION AND ADJUSTMENT

Check connector fitting condition before inspecting regulator.

Fig. 11-73

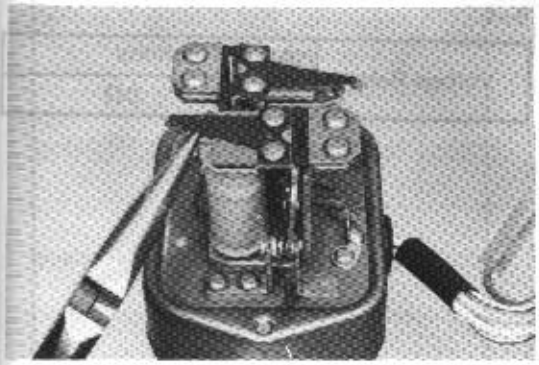


Always be sure to have the regulator connector pulled out when inspecting and adjusting.

Fig. 11-74

Inspect each point surface for burn or excessive damage. Replace if defective.

Fig. 11-75



Voltage adjustment

To adjust, bend the voltage regulator adjusting arm.

Regulated voltage **13.8-14.8V**

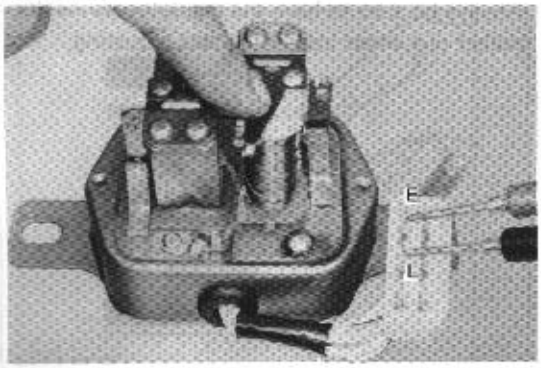
Fig. 11-76

Resistance measurement between terminals.

IG–F

Voltage Regulator	At rest	0Ω
	Pulled in approx. 11Ω	

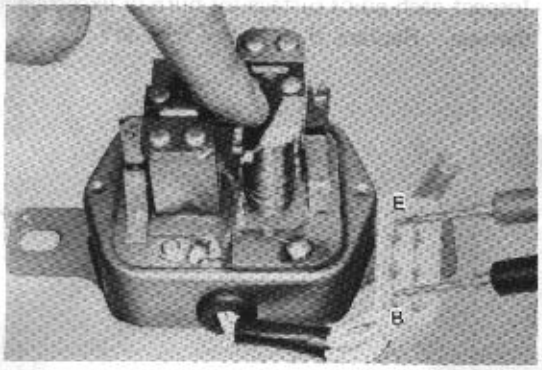
Fig. 11-77



L–E

Voltage Relay	At rest 0Ω
	Pulled in approx. 100Ω

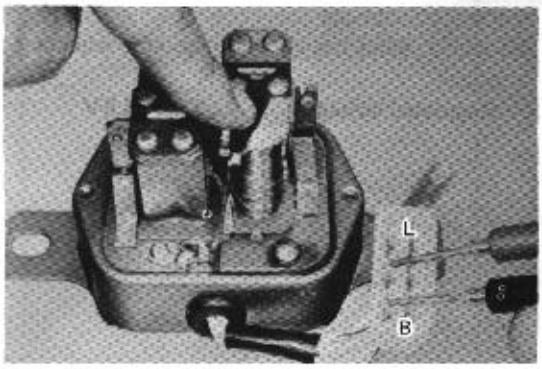
Fig. 11-78



B–E

Voltage Relay	At rest infinity
	Pulled in approx. 100Ω

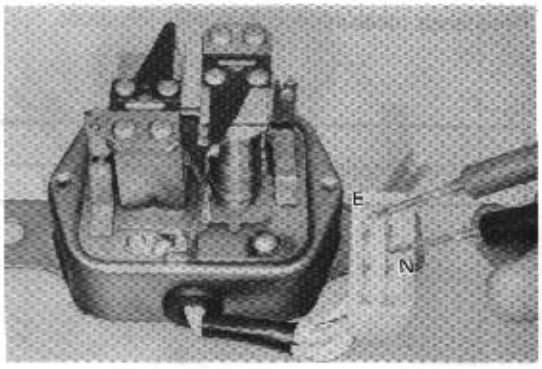
Fig. 11-79



B–L

Voltage Relay	At rest infinity
	Pulled in 0Ω

Fig. 11-80



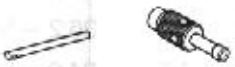
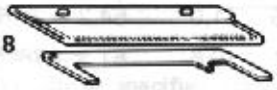
N–E

approx. 25Ω

SST & SPECIFICATION

SST (SPECIAL SERVICE TOOL)

Illustration	Tool Number	18R	18R-G	Tool Name
1	09081-00011	○	○	Alternator Checker
2	09201-60011	○	○	Valve Stem Guide Remover & Replacer
3	09202-43013	○	○	Valve Spring Compressor
4	09213-31021	○	○	Crankshaft Pulley & Gear Puller
5	09213-36020	○	○	Timing Gear Remover
6	09214-60010	○	○	Crankshaft Pulley & Gear Replacer
7	09222-30010	○	○	Connecting Rod Bushing Remover & Replacer
8	09223-41020	○	○	Crankshaft Rear Oil Seal Replacer
9	09223-50010	○	○	Crankshaft Front Oil Seal Replacer
10	09228-22020	○		Oil Filter Wrench
11	09228-34010		○	
12	09233-33010	○	○	Pump Drive Shaft Bearing Replacer
13	09236-00100	○	○	Water Pump Overhaul Tool Set (For Fluid Coupling Service)

Illustration	Tool Number	18R	18R-G	Tool Name
14 	09240-00014	○	○	Carburetor Adjusting Gauge Set
15 	09240-00020	○	○	Wire Gauge Set
16 	09240-27010		○	Float Level Gauge (Before Sept., 1979)
	09240-27020		○	Float Level Gauge (After Sept., 1979)
17 	09243-00020	○	○	Idle Mixture Adjusting Screw Wrench
18 	09248-27010		○	Valve Timing Adjusting Gauge
19 	09286-46011	○	○	Injection Pump Spline Shaft Puller (For Alternator Service)
20 	09303-35011	○	○	Input Shaft Front Bearing Puller
21 	09304-30012	○	○	Input Shaft Front Bearing Replacer
22 	09308-10010	○	○	Oil Seal Puller
23 	09612-22010	○	○	Tilt Steering Bearing Replacer
24 	09816-30010	○	○	Oil Pressure Switch Socket
25 	09860-11011	○	○	Carburetor Drive Set
26 	09992-00010		○	Dual Vacuum Gauge

STANDARD BOLT TIGHTENING TORQUE

STANDARD BOLT CLASSIFICATION

Class	Basic diameter mm	Pitch mm	Standard Torque		Torque Limit	
			kg-m	ft-lb	kg-m	ft-lb
4T	6	1	0.47	3.4	0.4 – 0.7	2.9 – 5.1
	8	1.25	1.11	8.0	1.0 – 1.6	7.2 – 11.6
	10	1.25	2.25	16.3	1.9 – 3.1	13.7 – 22.4
	10	1.5	2.14	15.5	1.8 – 3.0	13.0 – 21.7
	12	1.25 (ISO)	4.40	31.8	3.5 – 5.5	25.3 – 39.8
	12	1.5	3.89	28.1	3.5 – 5.5	25.3 – 39.8
	12	1.75	3.74	27.0	3.0 – 5.0	21.7 – 36.2
	13	1.5	5.08	36.8	4.5 – 7.0	32.5 – 50.6
	14	1.5	6.33	45.8	5.0 – 8.0	36.2 – 57.9
	14	2	5.93	42.8	4.7 – 7.7	34.0 – 55.7
	16	1.5	9.57	69.2	7.5 – 11.0	54.2 – 79.6
	16	2	9.10	65.8	7.1 – 10.6	51.3 – 76.7
5T	6	1	0.71	5.1	0.6 – 0.9	4.3 – 6.5
	8	1.25	1.66	12.0	1.5 – 2.2	10.9 – 15.9
	10	1.25	3.34	24.1	3.0 – 4.5	21.7 – 32.5
	10	1.5	3.22	23.3	2.7 – 4.2	19.5 – 30.4
	12	1.25 (ISO)	6.60	47.7	5.0 – 8.0	36.2 – 57.9
	12	1.5	5.84	42.2	5.0 – 7.0	36.2 – 50.6
	12	1.75	5.61	40.6	4.8 – 6.8	34.7 – 49.2
	13	1.5	7.63	55.2	6.5 – 9.0	47.0 – 65.1
	14	1.5	9.50	68.7	7.5 – 11.0	54.2 – 79.6
	14	2	8.90	65.3	7.0 – 10.5	50.6 – 75.9
	16	1.5	14.36	103.8	12.0 – 17.0	86.8 – 123.0
	16	2	13.58	98.1	11.5 – 16.5	83.2 – 119.2
6T	6	1	0.71	5.1	0.6 – 0.9	4.3 – 6.5
	8	1.25	1.66	12.0	1.5 – 2.2	10.9 – 15.9
	10	1.25	3.37	24.0	3.0 – 4.5	21.7 – 32.5
	10	1.5	3.20	23.1	2.7 – 4.2	19.5 – 30.4
	12	1.25 (ISO)	6.60	47.7	5.0 – 8.0	36.2 – 57.9
	12	1.5	5.84	42.2	5.0 – 7.0	36.2 – 50.6
	12	1.75	5.61	40.6	4.8 – 6.8	34.7 – 49.2

Class	Basic diameter mm	Pitch mm	Standard Torque		Torque Limit	
			kg-m	ft-lb	kg-m	ft-lb
7T	6	1	0.95	6.5	0.8 – 1.2	5.8 – 8.6
	8	1.25	2.21	16.1	2.0 – 3.0	14.5 – 21.7
	10	1.25	4.49	32.5	4.0 – 5.5	28.9 – 39.8
	10	1.5	4.29	31.0	3.7 – 5.2	26.8 – 37.6
	12	1.25 (ISO)	8.80	63.6	7.5 – 10.5	54.2 – 75.9
	12	1.5	7.78	56.2	7.0 – 9.0	50.6 – 65.1
	12	1.75	7.48	54.1	6.0 – 8.5	43.3 – 61.4
	13	1.5	10.17	73.5	8.0 – 12.0	57.9 – 86.8
	14	1.5	12.67	91.6	10.0 – 15.0	72.3 – 108.5
	14	2	11.86	85.8	9.5 – 14.0	68.7 – 101.2
	16	1.5	19.15	138.5	15.0 – 23.0	108.5 – 166.2
	16	2	18.11	131.0	14.0 – 22.0	101.2 – 159.0

– Note –

The above specified tightening torque is applicable only for female threads in steel material. If the female threads are for materials other than steel and/or the tightening surface are subjected to heat or vibrations, must be reconsidered.

18R ENGINE TIGHTENING TORQUE FOR MAIN PARTS

Tightening Part	Tightening Torque	
	kg-m	ft-lb
Cylinder head	10.0 – 12.0	72.3 – 86.8
Valve rocker support	1.7 – 2.3	12.3 – 16.6
Manifold	4.5 – 5.0	32.6 – 36.2
Camshaft bearing cap	1.7 – 2.3	12.3 – 16.6
Camshaft timing gear	1.7 – 2.3	12.3 – 16.6
Camshaft drive gear	8.0 – 10.0	57.7 – 72.3
Crankshaft bearing cap	9.5 – 11.5	68.7 – 83.2
Connecting rod cap	5.4 – 6.6	39.1 – 47.7
Oil pan	0.4 – 0.8	2.9 – 5.8
Crankshaft pulley	12.0 – 15.0	86.8 – 108.5
Flywheel	8.0 – 9.0	57.7 – 65.1
Pump shaft sprocket	8.0 – 10.0	57.7 – 72.3
Pump shaft thrust plate	1.5 – 2.1	10.8 – 15.2

18R SERVICE SPECIFICATION

18R ENGINE TUNE-UP

Drive belt tension at 10 kg (22 lb)					
Fan – Alternator		New	5 – 6 mm		0.20 – 0.24 in
		Used	7 – 8 mm		0.28 – 0.31 in
A/C Compressor – Crankshaft			15 – 18 mm		0.59 – 0.71 in
Battery specific gravity at 20°C (70°F)			1.25 – 1.27		
Engine oil capacity					
Dry refill	w/Oil filter	RX, RT	4.2 liters	4.4 US qt	3.7 Imp.qt
		RH	5.4 liters	5.7 US qt	4.8 Imp.qt
		RN	4.4 liters	4.7 US qt	3.9 Imp.qt
		RN4WD	5.5 liters	5.8 US qt	4.8 Imp.qt
Drain & refill	w/Oil filter	RX, RT	3.8 liters	4.0 US qt	3.3 Imp.qt
		RH	5.0 liters	5.3 US qt	4.4 Imp.qt
		RN	3.8 liters	4.0 US qt	3.3 Imp.qt
		RN4WD	5.1 liters	5.4 US qt	4.5 Impqt
	w/o Oil filter	RX, RT	3.2 liters	3.4 US qt	2.8 Imp.qt
		RH	4.4 liters	4.7 US qt	3.9 Imp.qt
		RN	3.2 liters	3.4 US qt	2.8 Imp.qt
		RN4WD	4.5 liters	4.8 US qt	4.0 Imp.qt
Coolant capacity	w/Heater	RX, RT	8.0 liters	8.5 US qt	7.0 Imp.qt
		RH	9.6 liters	10.1 US qt	8.4 Imp.qt
		RN	9.0 liters	9.5 US qt	8.0 Imp.qt
Spark plug heat range					
ND			W16EX-U, W16EXR-U		
NGK			BP5EA-L	BPR5EA-L	
Spark plug gap			0.8 mm		0.03 in
Distributor					
Dwell angle			50 – 54°		
Heel gap			0.4 – 0.5 mm		0.016 – 0.020 in
Damping spring gap			0.1 – 0.4 mm		0.004 – 0.168 in
Ignition timing			7° BTDC/650 rpm		
Firing order			1 – 3 – 4 – 2		
Valve clearance (Hot)					
Intake			0.20 mm		0.0079 in
Exhaust			0.36 mm		0.0141 in
Initical idle speed					
M/T & A/T			750 ± 50 rpm		
Manifold vacuum (at idle speed)					
Manual transmission			More than 420 mm Hg		16.5 in Hg
Automatic transmission			More than 350 mm Hg		13.8 in Hg
CO Concentration			1 – 3%		
Fast idle speed			2600 ± 200 rpm		
Compression pressure (at 250 rpm)					
STD			11.5 kg/cm²		163.0 psi
Limit			9.0 kg/cm²		127.8 psi
Difference of pressure between cylinders			Less than 1.0 kg/cm²		14.2 psi

18R ENGINE

Cylinder Head

Surface warpage limit		0.05 mm	0.0019 in
Maximum reface limit		0.2 mm	0.008 in
Valve	Contacting surface angle	45°	
	Contacting width	1.2 – 1.6 mm	0.047 – 0.063 in
	Refacing angle	30° 45°	60°

Valve Guide Bushing

Inner diameter		8.01 – 8.03 mm	
Outer diameter	STD	14.023 – 14.041 mm	0.5521 – 0.5528 in
Projection from cylinder head		15.8 – 16.2 mm	0.622 – 0.638 in

Valve

Valve overall length	Intake	STD	113.2 mm	4.457 in
		Limit	112.7 mm	4.437 in
	Exhaust	STD	113.7 mm	4.476 in
		Limit	113.2 mm	4.457 in
Valve head contacting face angle			45.5°	
Valve stem diameter		Intake	7.970 – 7.985 mm	0.3138 – 0.3144 in
		Exhaust	7.960 – 7.975 mm	0.3134 – 0.3140 in
Valve stem oil clearance	STD	Intake	0.025 – 0.060 mm	0.0010 – 0.0024 in
		Exhaust	0.035 – 0.070 mm	0.0014 – 0.0028 in
	Limit	Intake	0.08 mm	0.0032 in
		Exhaust	0.10 mm	0.0039 in
Valve head thickness limit (Both intake and exhaust)			0.6 mm	0.024 in

Valve Spring

Free length		Inner	44.1 mm	1.736 in
		Outer	46.5 mm	1.830 in
Installed length		Inner	36.8 mm	1.449 in
		Outer	40.8 mm	1.606 in
Installed Tension	STD	Inner	7.6 kg	16.8 lb
		Outer	26.3 kg	58.0 lb
	Limit	Inner	6.8 kg	15.0 lb
		Outer	23.9 kg	52.7 lb
Squareness	Limit	Inner	1.6 mm	0.063 in
		Outer	1.6 mm	0.063 in

Camshaft

Bend limit			0.10 mm	0.004 in
Thrust clearance		STD	0.042 – 0.167 mm	0.0017 – 0.0066 in
		Limit	0.25 mm	0.0098 in
Journal oil clearance		STD	0.012 – 0.052 mm	0.0005 – 0.0020 in
		Limit	0.1 mm	0.0039 in
Journal diameter			34.972 – 34.996 mm	1.3768 – 1.3778 in
Bearing U/S Type			0.125, 0.25	
Cam height	STD	Intake	44.04 mm	1.7339 in
		Exhaust	44.14 mm	1.7378 in
	Limit	Intake	43.7 mm	1.720 in
		Exhaust	43.8 mm	1.724 in

Valve Rocker Arm and Shaft

Oil clearance	STD	0.020 – 0.041 mm	0.0008 – 0.0016 in
	Limit	0.08 mm	0.0032 in

Manifold

Manifold surface warpage limit	0.1 mm	0.004 in

Timing Chain

Elongation limit at 5 kg(11 lb)	No.1	291.4 mm	11.47 in
	No.2 (17-Links)	147.0 mm	5.79 in

Timing Gear

Wear limit	Crankshaft gear	60.0 mm	2.362 in
	Pump drive shaft gear	114.5 mm	4.508 in
	Camshaft drive gear	78.2 mm	3.079 in
	Camshaft timing gear	78.2 mm	3.079 in

Chain Tensioner and Vibration Damper

Wear limit	No.1 tensioner	11.5 mm	0.45 in
	No.1 damper	5.0 mm	0.20 in
	No.2 damper	5.7 mm	0.224 in
	Tensioner slipper	6.8 mm	0.26 in

Pump Drive Shaft and Bearing

Thrust clearance	STD	0.06 – 0.13 mm	0.0024 – 0.0051 in
	Limit	0.3 mm	0.012 in
Journal diameter	Front	45.951 – 45.975 mm	1.8091 – 1.8100 in
	Rear	40.959 – 40.975 mm	1.6126 – 1.6132 in
Oil clearance	STD	0.025 – 0.066 mm	0.0010 – 0.0026 in
	Limit	0.08 mm	0.0032 in
Bearing fitting tolerance		0.02 – 0.06 mm	0.0008 – 0.0024 in

Cylinder Block

Warpage limit		0.05 mm	0.0019 in
Cylinder bore	STD	88.50–88.55 mm	3.4842–3.4862 in
Cylinder bore wear limit		0.2 mm	0.008 in
Difference of bore limit between cylinders		0.05 mm	0.002 in
Taper and out-of-round		0.02 mm	0.0008 in

Crankshaft

Bend limit		0.03 mm	0.0012 in
Crank journal taper and out-of-round limit		0.01 mm	0.0004 in
Crank pin journal taper and out-of-round limit		0.01 mm	0.0004 in
Thrust clearance	STD	0.02 – 0.22 mm	0.0008 – 0.0087 in
	Limit	0.3 mm	0.0118 in
Thrust washer thickness	STD	1.94 – 1.99 mm	0.0764 – 0.0783 in
	O/S 0.125	2.003 – 2.053 mm	0.0789 – 0.0808 in
	O/S 0.25	2.065 – 2.115 mm	0.0813 – 0.0833 in
Crank pin journal oil clearance	STD	0.024 – 0.048 mm	0.0009 – 0.0019 in
	Limit	0.08 mm	0.0032 in
Bearing U/S		0.05, 0.25,	0.50
Journal diameter	STD	52.976 – 53.000 mm	2.0857 – 2.0866 in
	U/S 0.25	52.70 – 52.71 mm	2.0749 – 2.0751 in
	U/S 0.50	52.45 – 52.46 mm	2.0650 – 2.0654 in
Crank journal oil clearance	STD	0.016 – 0.040 mm	0.0006 – 0.0016 in
	Limit	0.08 mm	0.0031 in
Bearing U/S		0.05, 0.25,	0.50
Journal diameter	STD	59.976 – 60.000 mm	2.3613 – 2.3622 in
	U/S 0.25	59.70 – 59.71 mm	2.3504 – 2.3508 in
	U/S 0.50	59.45 – 59.46 mm	2.3406 – 2.3409 in

Piston and Piston Ring

Piston outer diameter	STD	88.44 – 88.49 mm	3.4819 – 3.4839 in
	O/S	0.50, 0.75, 1.00	
Cylinder to piston clearance		0.05 – 0.07 mm	0.0020 – 0.0028 in
Piston pin installing temperature		100°C	212°F
Piston ring end gap	Compression ring No.1	0.19 – 0.34 mm	0.0075 – 0.0133 in
	Compression ring No.2	0.15 – 0.48 mm	0.0059 – 0.0189 in
	Oil ring	0.20 – 0.88 mm	0.0079 – 0.0346 in
Piston ring to ring groove clearance	Comp. ring No.1	0.02 – 0.06 mm	0.0008 – 0.0024 in
	Comp. ring No.2	0.02 – 0.06 mm	0.0008 – 0.0024 in

Connecting Rod and Bearing

Big end thrust clearance	STD	0.21 – 0.34 mm	0.0083 – 0.0134 in
	Limit	0.4 mm	0.016 in
Bearing oil clearance	STD	0.024 – 0.048 mm	0.0009 – 0.0019 in
	Limit	0.08 mm	0.0031 in
Bearing U/S		0.05, 0.25, 0.50, 0.75, 1.00	
Bushing oil clearance	STD	0.005 – 0.014 mm	0.00020 – 0.00055 in
	Limit	0.02 mm	0.0008 in

Flywheel

Run-out limit	0.3 mm	0.012 in

LUBRICATING SYSTEM

Oil Pump

Tip clearance	STD	0.10 – 0.15 mm	0.0039 – 0.0059 in
	Limit	0.2 mm	0.008 in
Side clearance	STD	0.03 – 0.07 mm	0.0012 – 0.0028 in
	Limit	0.15 mm	0.0059 in
Body clearance	STD	0.10 – 0.16 mm	0.0039 – 0.0063 in
	Limit	0.2 mm	0.008 in

COOLING SYSTEM

Water Pump

Bearing fitting temperature	100°C	212°F

Fluid Coupling

Silicon oil viscosity	for RA, RX A/T (General)	6000 cst
	except RA, RX A/T (General)	3000 cst
Capacity		25 cc
	w/Temperature controled coupling	35 cc

Thermostat

Valve opening temperature		
Starts to open at	88°C	190°F
except RN, RA, RT (Australia)	82°C	180°F
Valve opening travel only 18R-C	8 mm	0.31 in
Identification mark	88 punch mark or Red painting mark	
	82 punch mark or Blue painting mark	

Radiator

Relief valve opening pressure STD	0.9 kg/cm²	12.8 psi
Limit	0.6 kg/cm²	8.5 psi

FUEL SYSTEM

Carburetor (for South Africa)

Part Number	21100 – 34620	21100 – 34640
Float Level Raised position	3.5 mm	0.138 in
Lowered position	1.0 mm	0.040 in
Throttle Valve Fully opened angle (from bore) Primary	90°	
Secondary	75°	
Kick up Secondary Throttle Valve to Body Clearance	0.2 mm	0.008 in
Primary Throttle Opening Angle (from bore)	64 – 90°	
Fast Idle (Clearance)	0.91 mm	0.036 in
Unloader Angle (from bore)	47°	
Accelerating Pump Stroke	4.5 mm	0.0173 in
Idle Mixture Adjusting Screw Preset Position	Screw out 2½ turns	
Choke Valve Fully Closed Temperature	below 25°C	77°F

Carburetor (except South Africa)

Float Level	Raised position	10.0 – 11.0 mm	0.39 – 0.43 in
	Lowered position	1.0 – 1.2 mm	0.039 – 0.047 in
Throttle Valve Fully opened angle (from bore)		90°	
Kick up	Secondary Throttle Valve to Body Clearance	0.1 – 0.2 mm	0.004 – 0.008 in
Seco-touch		57 – 61°	
Fast Idle		Automatic Choke	0.81 mm (0.032 in)
First Throttle Valve to Body Clearance		Manual Choke	1.01 mm (0.039 in)
Unloader Angle (from bore)		47°	
Accelerating Pump Stroke	Europe	3.7 mm	0.146 in
	Australia, General	3.8 mm	0.150 in
Idle Mixture Adjusting Screw Preset Position		Screw out 3 turns	
Choke Valve Fully Closed Temperature		Below 25°C	77°F
Choke Breaker			
	Automatic Choke	19° + 20°	
	Manual Choke	16° + 20°	

STARTING SYSTEM

Starter

No load characteristics	Ampere	Less than 50 A at 11.5 V	
	RPM	More than 5000 rpm	
Armature shaft to bushing clearance	STD	0.1 – 0.14 mm	0.0039 – 0.0055 in
	Limit	0.2 mm	0.008 in
Armature shaft thrust clearance	STD	0.05 – 0.35 mm	0.002 – 0.014 in
	Limit	0.8 mm	0.032 in
Brush length 1.0 kw	Limit	12 mm	0.47 in
0.8 kw	Limit	10 mm	0.39 in
Commutator runout	STD	Less than 0.05 mm	0.002 in
	Limit	0.4 mm	0.016 in
Commutator diameter	STD	32.7 mm	1.287 in
	Limit	31 mm	1.22 in
Mica depth	STD	0.5 – 0.8 mm	0.020 – 0.031 in
	Limit	0.2 mm	0.008 in
Pinion end to stop collar clearance		1.0 – 4.0 mm	0.04 – 0.16 in
Moving stud length (Reference only)		34 mm	1.34 in

IGNITION SYSTEM

Distributor

Shaft thrust clearance	0.15 – 0.50 mm	0.006 – 0.020 in
Point gap	0.45 mm	0.018 in
Dwell angle	50 – 54°	
Damping spring gap	0.1 – 0.4 mm	0.004 – 0.016 in

Distributor (Cont'd)

	Governor Advance Angle		Vacuum Advance Angle		
	Dis. rpm	Advance Angle	mmHg	inHg	Advance Angle
Distributor advance angle 19100–34290 19100–34250 19100–34260 19100–34230 19100–34220 19100–34221 19100–34214	500 ± 97	Advance begins	80	3.15	Advance begins
	878	2.9 $^{+0.8°}_{-0.7°}$	130	5.12	3.2 $^{+0.7°}_{-0.8°}$
	1600	10.0 $^{+0.8°}_{-0.7°}$	268	10.55	9.2 $^{+0.7°}_{-0.8°}$
	2800	15.0 ± 1.0°	360	14.17	12.0 ± 1.0°
	3000	14.9 ± 1.0°			
Distributor advance angle 19100–34240 19100–34270 19100–34202	600 ± 75	Advance begins	80	3.15	Advance begins
	1500	5.5 ± 0.7°	172	6.77	3.9 $^{+0.7°}_{-0.8°}$
	1600	7.9 $^{+0.8°}_{-0.7°}$	300	11.81	8.0 ± 1.0°
	2600	13.0 ± 1.0°			
	3000	12.9 ± 1.0°			
Distributor advance angle 19100–34310	500 ± 97	Advance begins	80	3.15	Advance begins
	920	2.2 ± 1.0°	178	7.01	4.2 $^{+0.8°}_{-0.7°}$
	1500	6.5 ± 1.0°	300	11.81	8.0 ± 1.0°
	2750	10.5 ± 1.0°	70	2.76	Advance begins
	3000	10.4 ± 1.0°	150	5.91	3.5 ± 1.0°

Ignition Coil

Primary coil resistance	1.2 – 1.5 Ω
Secondary coil resistance	10.2 – 13.8 kΩ
External resistor resistance	1.3 – 1.7 Ω
Insulation resistance at 500 V	Over 10 MΩ

High Tension Cord

End to end resistance	Less than 25 kΩ

Spark Plug

Heat range	ND	W16EX-U	
		W16EXR-U (for E.C.E., Sweden)	
	NGK	BP5EA-L	
		BPR5EA-L (for E.C.E., Sweden)	
Plug gap		0.8 mm	0.031 in

CHARGING SYSTEM

Alternator

Maximum output ampere		40A	
Rotor coil resistance		4.1 – 4.3 Ω	
Brush length	STD	12.5 mm	0.49 in
	with IC regulator	16.5 mm	0.65 in
	Limit	5.5 mm	0.22 in

Alternator Regulator

Voltage regulator regulating voltage	13.8 – 14.8 V

18R-G ENGINE TIGHTENING TORQUE FOR MAIN PARTS

Tightening Part		Tightening Torque	
		kg-m	ft-lb
Cylinder head		7.2 – 8.8	52.1 – 63.7
Camshaft bearing cap		1.6 – 2.2	12 – 15
Camshaft timing gear		7.0 – 8.0	50.6 – 57.9
Camshaft drive gear		6.0 – 7.0	43.4 – 50.6
Manifold	Intake	1.0 – 1.6	7.2 – 11.6
	Exhaust	3.5 – 4.5	25.3 – 32.6
Crankshaft bearing cap		10.0 – 11.0	72.3 – 79.6
Connecting rod cap		6.4 – 7.0	46.3 – 50.6
Oil pan		1.0 – 1.6	8 – 11
Crankshaft pulley		12 – 15	87 – 108
Flywheel		8.2 – 8.8	59.3 – 63.7

18R-G ENGINE SERVICE SPECIFICATION

18R-G ENGINE TUNE-UP

Drive belt tension at 10 kg (22 lb)					
	Fan – Alternator	New	5 – 6 mm		0.20 – 0.24 in
		Used	6 – 9 mm		0.24 – 0.35 in
	A/C compressor – Crankshaft		16 – 19 mm		0.63 – 0.75 in
Battery specific gravity at 20°C (70°F)			1.25 – 1.27		
Coolant capacity (w/heater)			8.4 Liter	8.9 US qt	7.4 Imp.qt
Engine oil capacity	Dry refill	w/Oil filter	3.9 Liter	4.1 US qt	3.4 Imp.qt
	Drain & refill	w/Oil filter	3.3 Liter	3.5 US qt	2.9 Imp.qt
		w/o Oil filter	2.9 Liter	3.1 US qt	2.6 Imp.qt
Spark plug heat range	ND		W20EXR-U		
	NGK		BPR6EA, BPR6EY		
Spark plug gap			0.7 – 0.8 mm		0.028 – 0.031 in

18R-G ENGINE TUNE-UP (Cont'd)

Ignition timing	at Idle speed	12° BTDC	
Firing order		1 – 3 – 4 – 2	
Valve clearance (Cold)	Intake	0.24 – 0.34 mm	0.0094 – 0.0134 in
	Exhaust	0.29 – 0.39 mm	0.0114 – 0.0154 in
Initial idle speed		1000 rpm	
Manifold vacuum	at Idle speed	380 mm Hg	15.0 inHg
	Front and rear difference	below 10 mm Hg	0.39 inHg
Compression pressure	STD	12.7 kg/cm²	170 psi
	Limit	10.0 kg/cm²	142 psi
Difference of pressure between cylinders		Lrss than 1.0 kg/cm²	14 psi

18R-G ENGINE

Cylinder Head

Surface warpage limit		0.05 mm	0.002 in
Maximum reface limit		0.2 mm	0.008 in
Valve	Contacting surface angle	45°	
	Contacting width	1.2 – 1.6 mm	0.047 – 0.063 in
	Refacing angle	30° 45°	60°
Valve lifter inner diameter	Black	37.951 – 37.957 mm	1.4941 – 1.4944 in
	Blue	37.957 – 37.963 mm	1.4944 – 1.4946 in
	Yellow	37.963 – 37.969 mm	1.4946 – 1.4948 in
	Red	37.969 – 37.975 mm	1.4948 – 1.4951 in

Valve Guide Bushing

Inner diameter		8.500 – 8.515 mm	0.3346 – 0.3352 in
Outer diameter	STD	14.02 – 14.04 mm	0.5520 – 0.5528 in
	O/S 0.05	14.07 – 14.09 mm	0.5548 – 0.5551 in
Replacing temperature		110 – 130°C	230 – 237°F

Valve

Valve overall length	Intake	106.8 mm	4.205 in
	Exhaust	105.1 mm	4.138 in
Valve head contacting face angle		45.5°	
Valve stem diameter	Intake	8.465 – 8.475 mm	0.3333 – 0.3337 in
	Exhaust	8.455 – 8.470 mm	0.3329 – 0.3335 in
Valve stem oil clearance	Intake	0.025 – 0.055 mm	0.0010 – 0.0022 in
	Exhaust	0.03 – 0.06 mm	0.0012 – 0.0024 in
Limit	Intake	0.08 mm	0.0031 in
	Exhaust	0.10 mm	0.004 in
Valve head thickness limit	Intake	0.5 mm	0.020 in
	Exhaust	0.6 mm	0.024 in

Valve Spring

Free length		Inner	45.9 mm	1.807 in
		Outer	47.4 mm	1.866 in
Installed length		Inner	36.5 mm	1.347 in
		Outer	39.0 mm	1.535 in
Installed tension	STD	Inner	7.3 kg	16.1 lb
		Outer	23.7 kg	52.3 lb
	Limit	Inner	6.7 kg	14.8 lb
		Outer	21.8 kg	48.1 lb
Squareness	Limit	Inner	1.6 mm	0.063 in
		Outer	1.6 mm	0.063 in

Valve Lifter

Oil clearance	STD	0.02 – 0.03 mm	0.0008 – 0.0012 in
	Limit	0.1 mm	0.004 in
Outer diameter	Black	37.925 – 37.931 mm	1.4931 – 1.4933 in
	Blue	37.931 – 37.937 mm	1.4933 – 1.4936 in
	Yellow	37.937 – 37.943 mm	1.4936 – 1.4938 in
	Red	37.943 – 37.949 mm	1.4938 – 1.4941 in

Camshaft

Bend limit		0.03 mm	0.0012 in
Thrust clearance	STD	0.15 – 0.35 mm	0.0059 – 0.0138 in
	Limit	0.4 mm	0.0158 in
Journal oil clearance	STD	0.03 – 0.07 mm	0.0012 – 0.0028 in
	Limit	0.15 mm	0.0059 in
Journal diameter	STD	31.954 – 31.970 mm	1.2580 – 2.2587 in
Cam height (Both intake and exhaust)	STD	45.37 – 45.47 mm	1.786 – 1.790 in
	Limit	45.0 mm	1.77 in

Manifold

Manifold surface warpage limit (Both intake and exhaust)	0.1 mm	0.0039 in

Timing Chain

Elongation limit	No.1 (at 5 kg)	291.4 mm	11.47 in
	No.2 (17 Links)	147.0 mm	5.79 in

Timing Gear

Wear limit	Crankshaft gear	60.0 mm	2.362 in
	Pump drive shaft gear	114.5 mm	4.503 in
	Camshaft drive gear	78.2 mm	3.079 in
	Camshaft timing gear	78.2 mm	3.079 in

Chain Tensioner and Vibration Damper

Wear limit	No.1 tensioner	11.5 mm	0.453 in
	No.1 damper	5.0 mm	0.197 in
	No.2 damper	5.5 mm	0.217 in
	No.3 damper	6.5 mm	0.256 in
	Tensioner slipper	7.5 mm	0.295 in

Pump Drive Shaft and Bearing

Thrust clearance	STD	0.06 – 0.13 mm	0.0024 – 0.0051 in
	Limit	0.3 mm	0.012 in
Journal diameter	Front	45.96 – 45.98 mm	1.8094 – 1.8102 in
	Rear	40.96 – 40.98 mm	1.6130 – 1.6134 in
Oil clearance	STD	0.03 – 0.07 mm	0.0012 – 0.0028 in
	Limit	0.08 mm	0.0032 in
Bearing fitting tolerance		0.02 – 0.06 mm	0.0008 – 0.0024 in

Cylinder Block

Warpage limit		0.05 mm	0.0020 in
Cylinder bore	STD	88.50 – 88.55 mm	3.484 – 3.486 in
Cylinder bore wear limit		0.2 mm	0.008 in
Difference of bore limit between cylinders		0.05 mm	0.002 in
Taper and out-of-round		0.02 mm	0.0008 in

Crankshaft

Bend limit		0.05 mm	0.0020 in
Crank journal taper and out-of-round limit		0.01 mm	0.0004 in
Crank pin journal taper and out-of-round limit		0.01 mm	0.0004 in
Thrust clearance	STD	0.02 – 0.22 mm	0.0008 – 0.0087 in
	Limit	0.3 mm	0.0118 in
Thrust washer thickness	STD	1.940 – 1.990 mm	0.0764 – 0.0783 in
	O/S 0.125	2.003 – 2.053 mm	0.0789 – 0.0808 in
	O/S 0.25	2.065 – 2.115 mm	0.0813 – 0.0833 in
Crank pin journal oil clearance	STD	0.02 – 0.05 mm	0.0008 – 0.0020 in
	Limit	0.08 mm	0.0032 in
Bearing U/S		0.25	
Journal diameter	STD	52.976 – 53.000 mm	2.0857 – 2.0866 in
	U/S 0.25	52.73 – 52.75 mm	2.0760 – 2.0768 in
Crank journal oil clearance	STD	0.03 – 0.06 mm	0.0012 – 0.0024 in
	Limit	0.08 mm	0.0032 in

Crankshaft (Cont'd)

Bearing U/S		0.25	
Journal diameter	STD	59.976 – 60.000 mm	2.3613 – 2.3622 in
	U/S 0.25	59.73 – 59.75 mm	2.3516 – 2.3524 in

Piston and Piston Ring

Piston outer diameter	STD	88.44 – 88.49 mm	3.4819 – 3.4839 in
	O/S 0.50	88.94 – 88.99 mm	3.5016 – 3.5035 in
	O/S 1.00	89.44 – 89.49 mm	3.5213 – 3.5232 in
Cylinder to piston clearance		0.05 – 0.07 mm	0.0020 – 0.0028 in
Piston pin installing temperature		Approx 80°C	176°F
Piston ring end gap	Compression ring No.1	0.25 – 0.51 mm	0.0098 – 0.0201 in
	Compression ring No.2	0.18 – 0.43 mm	0.0071 – 0.0169 in
	Oil ring	0.15 – 0.40 mm	0.0059 – 0.0157 in
Piston ring to ring groove	Comp. ring No.1	0.02 – 0.06 mm	0.0008 – 0.0024 in
Clearance	Comp. ring No.2	0.02 – 0.06 mm	0.0008 – 0.0024 in

Connecting Rod and Bearing

Big end thrust clearance	STD	0.16 – 0.26 mm	0.0063 – 0.010 in
	Limit	0.3 mm	0.012 in
Bearing oil clearance	STD	0.02 – 0.05 mm	0.0008 – 0.0020 in
	Limit	0.08 mm	0.0032 in
Bearing U/S		0.25	
Bushing oil clearance	STD	0.005 – 0.014 mm	0.00020 – 0.00055 in
	Limit	0.02 mm	0.0008 in

Flywheel

Run-out limit	0.2 mm	0.008 in

LUBRICATING SYSTEM

Oil Pump

Tip clearance	STD	0.10 – 0.15 mm	0.0039 – 0.0059 in
	Limit	0.2 mm	0.008 in
Side clearance	STD	0.03 – 0.07 mm	0.0012 – 0.0028 in
	Limit	0.15 mm	0.0059 in
Body clearance	STD	0.10 – 0.16 mm	0.0039 – 0.0063 in
	Limit	0.2 mm	0.008 in

COOLING SYSTEM

Water Pump

Bearing fitting temperature	80°C	176°F

Fluid Coupling

Silicon oil viscosity	
w/Tempered fan	3000 cst
Capacity	
w/Tempered fan	35 cc

Thermostat

	Low Temp. Type		High Temp. Type	
Valve opening temperature				
Start to open at	82°C	180°F	88°C	190°F
Fully open at	95°C	203°F	100°C	212°F
Valve opening travel	8 mm	0.31 in	8 mm	0.31 in
Identification mark	"82" punch mark or "Blue" painting mark		"88" punch mark or "Red" painting mark	

Radiator

Relief valve opening pressure	STD	0.9 kg/cm²	12.8 psi
	Limit	0.6 kg/cm²	8.5 psi

FUEL SYSTEM

Carburetor

Model	40 PHH–4	
Float adjusting screw one turn		
Float level adjustment (one turn with float level adjust screw)	1.8 mm	0.07 in
Float level (Use SST) (From Carburetor upper surface)	20 – 21 mm	0.79 – 0.83 in
Accelerating pump		
Discharging time	0.9 – 1.3 second	
Idle mixture adjusting screw preset position	Screw out 2 turn	

STARTING SYSTEM

Starter

No load characteristics		Ampere	Less than 50 A at 11V	
		RPM	More than 5000 rpm	
Armature shaft to bushing clearance		STD	0.1 – 0.14 mm	0.004 – 0.006 in
		Limit	0.2 mm	0.008 in
Armature shaft thrust clearance		STD	0.05 – 0.35 mm	0.002 – 0.014 in
		Limit	0.8 mm	0.031 in
Brush length	0.8 kw	STD	16 mm	0.63 in
		Limit	10 mm	0.39 in
	1.0 kw	STD	19 mm	0.75 in
		Limit	12 mm	0.47 in
Commutator runout		STD	Less than 0.05 mm	0.002 in
		Limit	0.4 mm	0.016 in
Commutator diameter		STD	32.7 mm	1.287 in
		Limit	31 mm	1.22 in
Mica depth		STD	0.5 – 0.8 mm	0.020 – 0.031 in
		Limit	0.2 mm	0.008 in
Pinion end to stop collar clearance			1.0 – 4.0 mm	0.04 – 0.16 in
Moving stud length (Reference only)			34 mm	1.34 in

IGNITION SYSTEM

Distributor

Shaft thrust clearance			0.15 – 0.50 mm	0.006 – 0.020 in
ADVANCE CHARACTERISTICS	Part No. 19100-88233			
Vacuum advance angle	mmHg	inHg	Dis. advance angle Degrees	
	65	2.56	Advance begins	
	200	7.87	7.5° ± 1.0°	
Governor advance angle	Distributor	rpm	Dis. advance angle Degree	
	600		Advance begins	
	800		3.5 ± 0.5°	
	1600		10.0 ± 1.0°	
	3000		8.9 ± 1.0°	

Ignition Coil

Primary	1.3 – 1.6 Ω
Secondary coil resistance	10.2 – 13.8 kΩ
External resistor resistance	1.3 – 1.5 Ω
Insulation resistance at 500V	Over 10 MΩ

High Tension Cord

End to end resistance	10 – 50 kΩ/meter

Spark Plug

Heat Range	W20EXR-U	
	BPR6EA, BPR6EY	
Plug gap	0.7 – 0.8 mm	0.028 – 0.031 in

CHARGING SYSTEM

Alternator

Maximum output ampere		45A	
Rotor coil resistance		4.1 – 4.3 Ω	
Brush length	STD	12.5 mm	0.49 in
	Limit	5.5 mm	0.22 in

Alternator Regulator

Voltage regulator regulating voltage	13.8 – 14.8 V

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