SERVICE MANUAL

MODEL
L13, L16 & L20
ENGINE

NISSAN

NISSAN MOTOR CO., LTD.
TOKYO, JAPAN

P/N 99999-20012

SERVICE MANUAL

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QUICK REFERENCE INDEX

FOREWORD

This service manual has been prepared for the purpose of assisting service personnel of our distributors and dealers for effective service and maintenance of model L series engines.

Since proper maintenance and service are most essential to satisfy our customers by keeping their cars in the best condition, this manual should be carefully studied. The followings should be noted for effective utilization of this manual.

1. Since only the informations concerning the engine are described herein, please refer to both this and the DATSUN 510 SERVICE MANUAL and DATSUN 2000 SERVICE MANUAL for complete details of the car.

2. All the parts names in this manual conform to both DATSUN 510 PARTS CATALOG and DATSUN 2000 PARTS CATALOG, and only the genuine service parts listed in these parts catalogs should be used as replacements.

3. All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication approval.

4. It is emphasised that those who use this manual revise the contents according to the SERVICE JOURNAL issued by the factory, which carries the latest factory approved servicing method.

5. Rights for alternation in specifications and others at any time are reserved.

NISSAN MOTOR CO., LTD.
TOKYO, JAPAN

SERVICE MANUAL

MODEL L SERIES ENGINE

NISSAN

SECTION EG

ENGINE GENERAL

EG

EXTERNAL VIEW OF ENGINE

External view of model L13, L16 engine

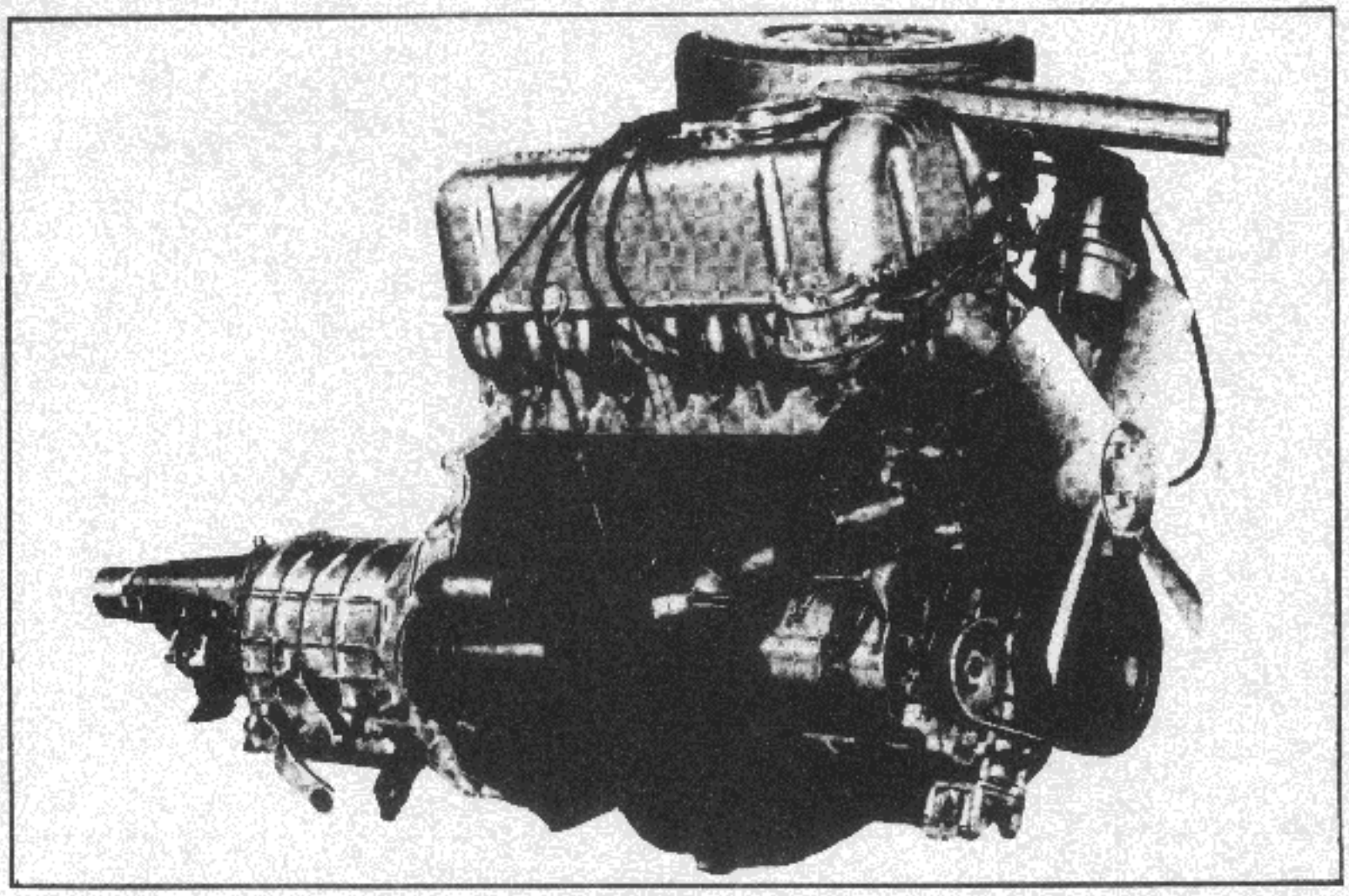


Fig. EG-1 Right hand side

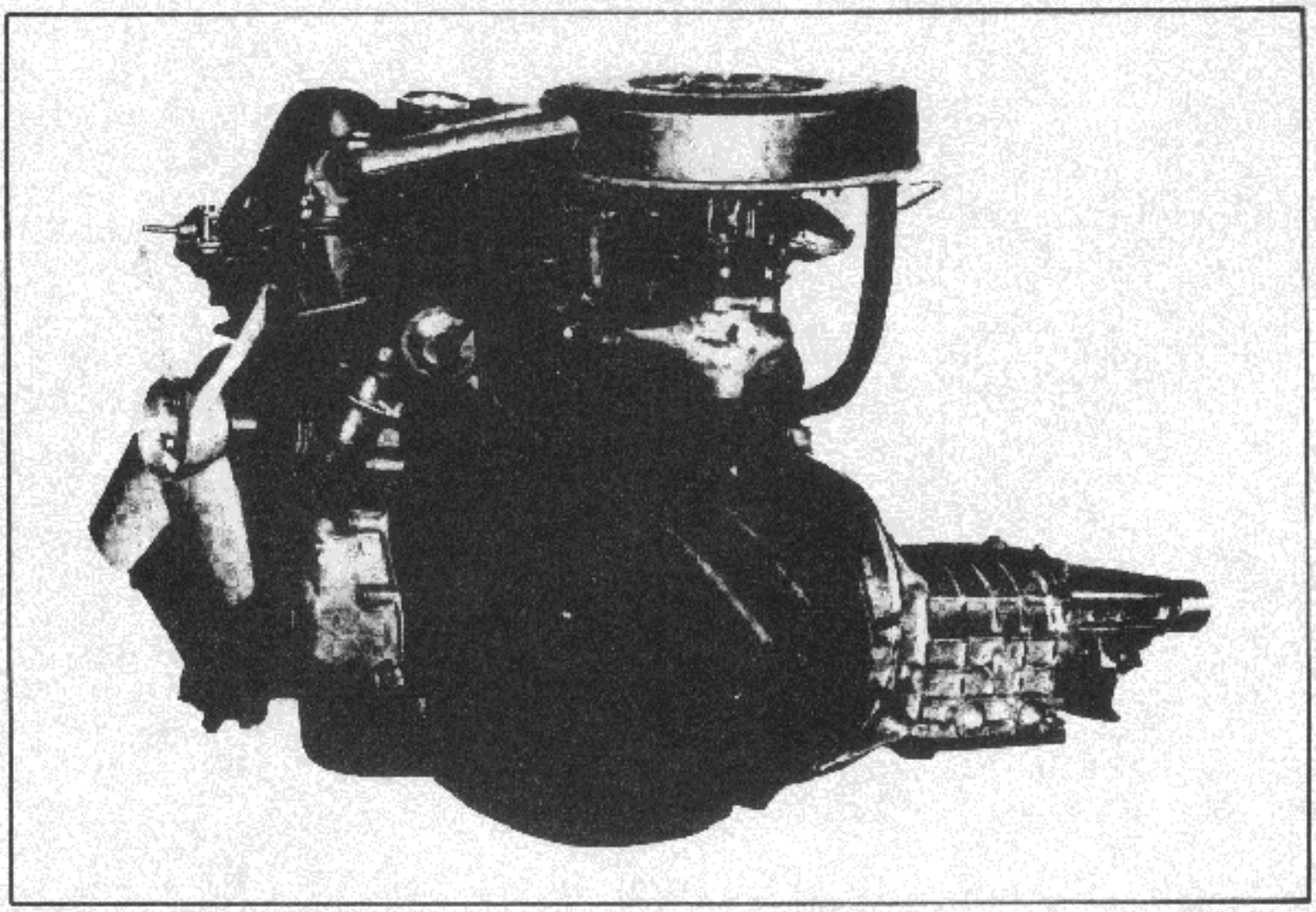


Fig. EG-2 Left hand side

External view of model L16 engine (SU carburetor)

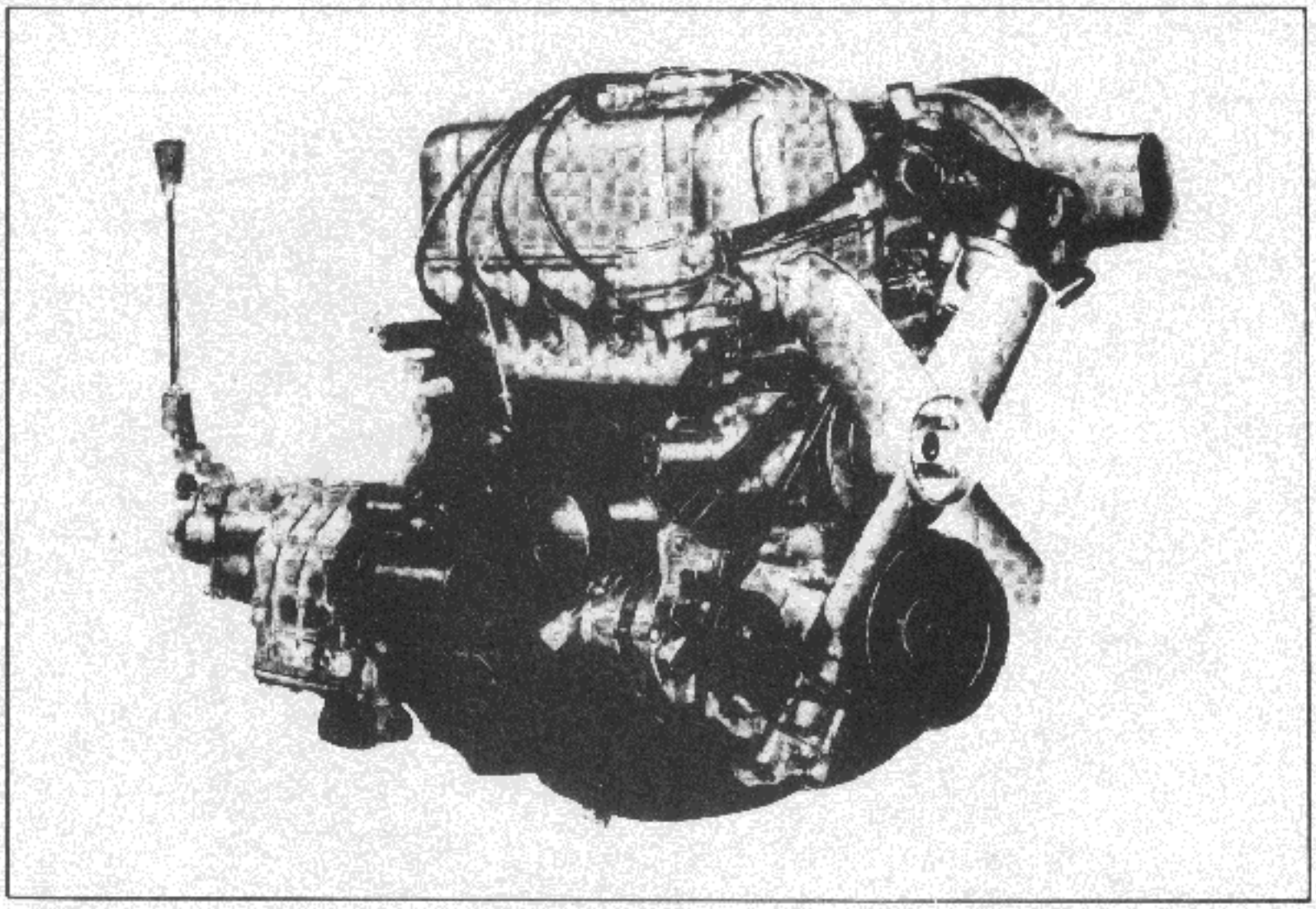


Fig. EG-3 Right hand side

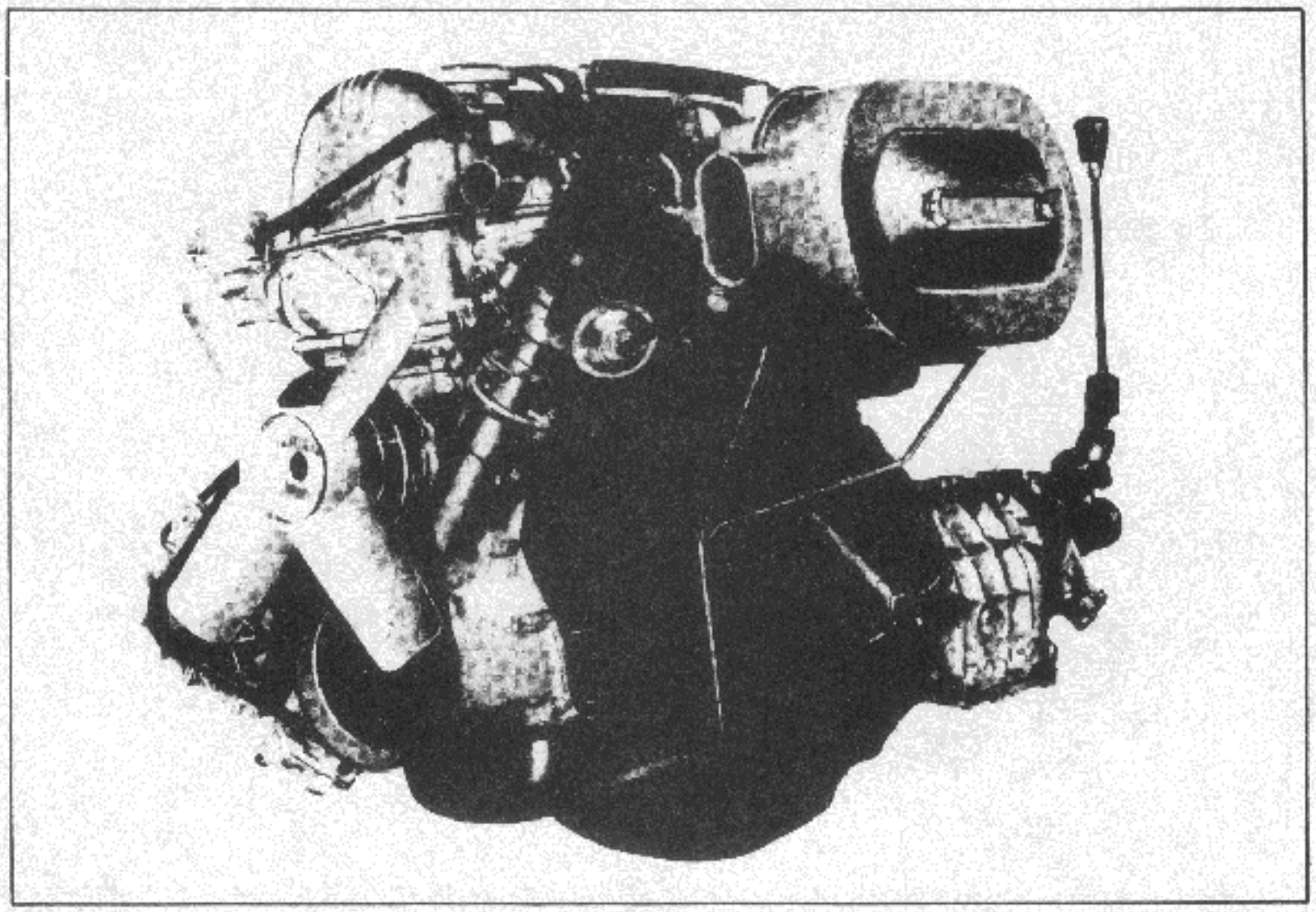


Fig. EG-4 Left hand side

External view of model L20 engine

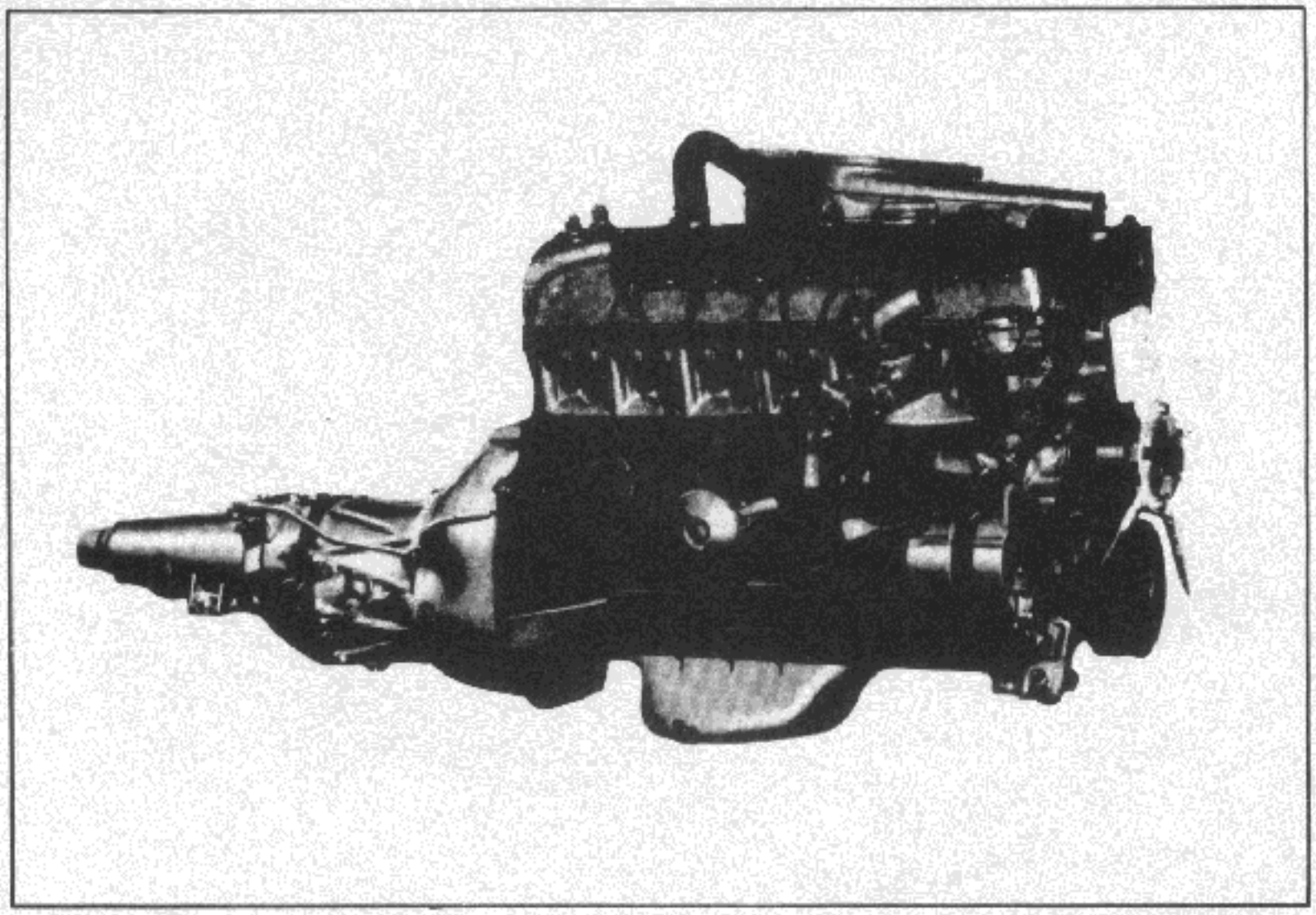


Fig. EG-5 Right hand side

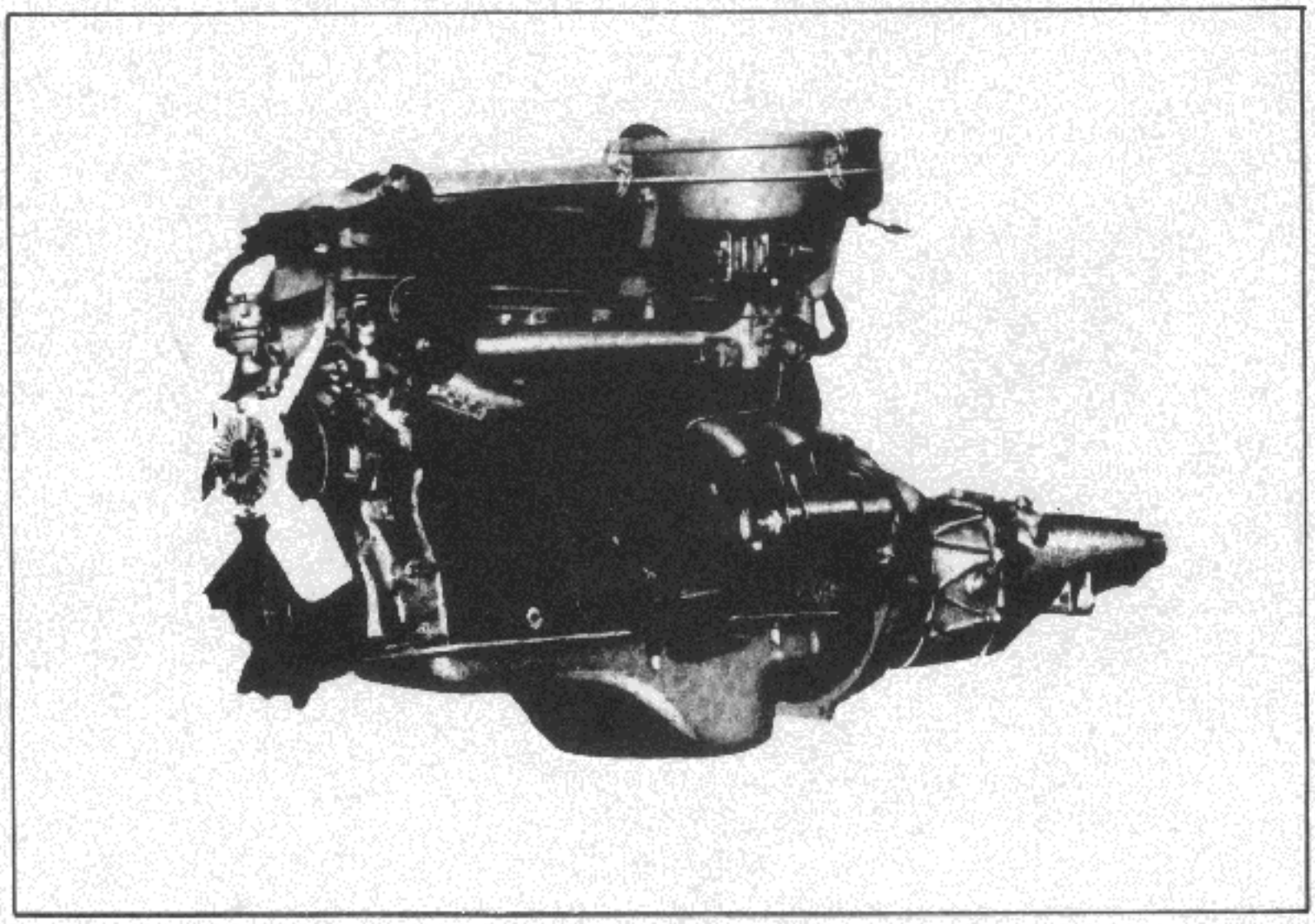


Fig. EG-6 Left hand side

External view of model L20 engine (SU carburetor)

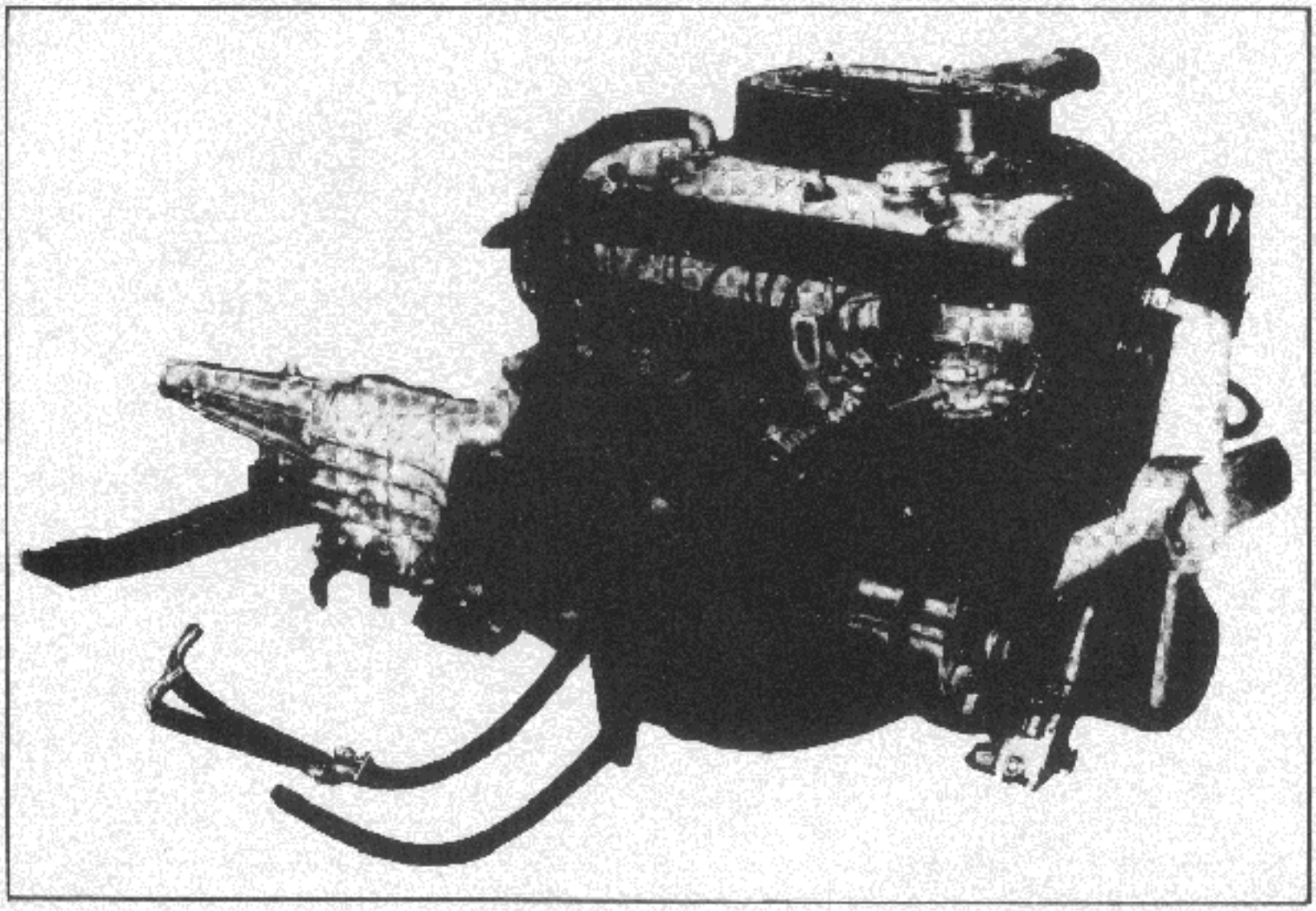


Fig. EG-7 Right hand side

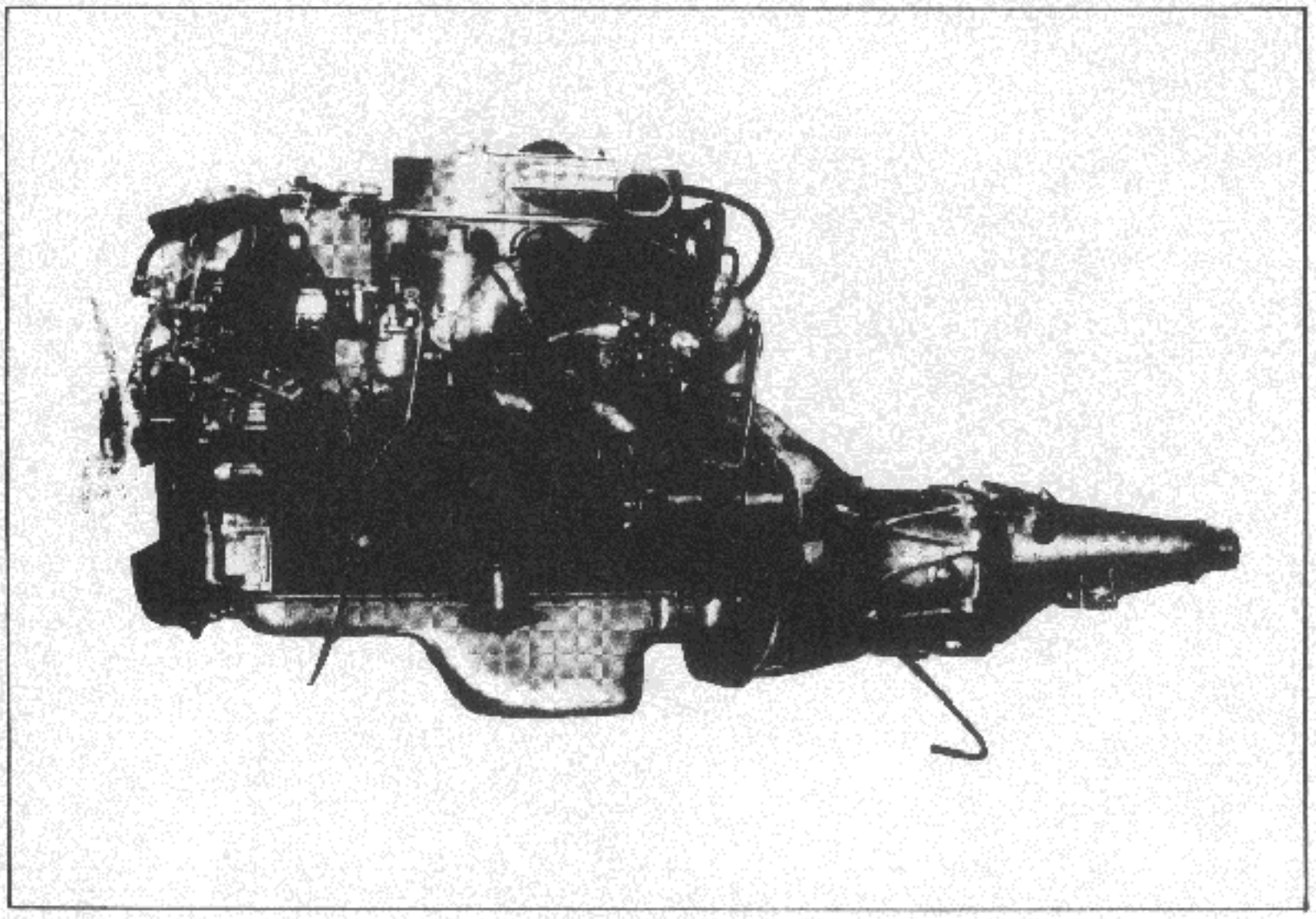


Fig. EG-8 Left hand side

MAIN SPECIFICATIONS

Engine model		L13	L16	L16 (SU carb.)	L20	L20 (SU carb.)
Number of cylinders, in line		4	4	4	6	6
Valve arrangement		OHC	OHC	OHC	OHC	OHC
Bore	mm (in.)	83 (3.2677)	83 (3.2677)	83 (3.2677)	78 (3.0709)	78 (3.0709)
Stroke	mm (in.)	59.9 (2.358)	73.7 (2.902)	73.7 (2.902)	69.7 (2.744)	69.7 (2.744)
Displacement	c.c. (cu. in.)	1,296 (79.1)	1,595 (97.3)	1,595 (97.3)	1,998 (121.9)	1,998 (121.9)
Compression ratio		8.5 : 1	8.5 : 1	9.5 : 1	8.5 : 1	9.0 : 1
Maximum power, SAE at	HP r.p.m.	77 6,000	96 5,600	109 6,000	112 5,600	123 5,600
Maximum torque, SAE at	m-kg (ft-lb.) r.p.m.	11.1 (80.3) 3,600	13.8 (99.8) 3,600	14.3 (103.4) 4,000	16.7 (120.8) 3,600	17.3 (125.1) 4,400
Capacities Oil pan (*)	ℓ U.S. qts/U.K. qts	4.0 4.2/3.5	4.0 4.2/3.5	4.0 4.2/3.5	4.0 4.2/3.5	4.0 4.2/3.5
Coolant	ℓ U.S. qts/U.K. qts	6.4 6.8/5.6	6.4 6.8/5.6	6.4 6.8/5.6	9.5 10.0/8.4	9.5 10.0/8.4

(*) The table specifies the quantity of oil which is required for periodic oil replacement, when oil filter is not replaced. Should also the filter be replaced, the total quantity is about 4.7 ℓ (5.0 U.S. qts/4.0 U.K./qts).

VEHICLE REFERENCE

As only the informations concerning power plant are described herein, please refer to both this and each manual for chassis and body for complete details of the car.

The vehicles on which L13, L16 and L20 engines are installed are as follows:

Vehicle			Engine	
Model		Name	Model	Displacement
510 series	Sedan, standard & deluxe	Datsun 1300	L13	1,300 c.c.
P510 series	Sedan, standard & deluxe	Datsun 1600	L16	1,600 c.c.
P(L)510-(U)TK	Sedan, SSS	Datsun 1600	L16 (Twin)	1,600 c.c.
WP510 series	Wagon	Datsun 1600	L16	1,600 c.c.
H130V series	Sedan, custom six	Datsun 2000	L20	2,000 c.c.
H130B series	Sedan, super six	Datsun 2000	L20	2,000 c.c.
H130 series	Sedan, super six	Datsun 2000	L20 (Twin)	2,000 c.c.

RECOMMENDED LUBRICANTS, PETROL AND COOLANT

Use the following grades of oil, gasoline and coolant.

Temperature	Engine oil (MS)
Above 32° C (90° F) average	SAE 30, 10W-30
32° to 0° C (90° to 32° F) - minimum	SAE 20, 20W, 10W-30
0° to -12° C (32° to 10° F) - minimum	SAE 10W, 10W-30
Below -12° C (10° F) - minimum	SAE 10W, 10W-30

Recommended lubricants

Lubricants \ Maker		Shell	Mobil	Caltex	Esso	BP	Castrol	Lubricating points
Engine Oil	Multi-grade	Shell Super Motor Oil Shell × -100 10W-30	Mobiloil Special HD 10W-30	Havoline Custom made 10W-30	Esso Extra Motor Oil 10W-30 20W-40	BP Viscostatic Longlife Motor Oil or Viscostatic Motor Oil	Castrolite 10W-30	Engine Carburetor linkage Distributor shaft
	Single-grade	Shell × -100 30, 20 20W, 10W	Mobiloil Arctic or Mobil-oil A or AF	Havoline or RPM Motor Oil HD	Esso Motor Oil, 30, 10W, 20W	BP H. D. Motor Oil	Castrol 20HD 30HD	
Multi-purpose Grease		Shell Retinax A	Mobil Grease	Marfak	Esso Multi-purpose Grease or Beacon	BP Energrease L_2	Castro-lease LM	Distributor cam heel

Engine model	Compression ratio	Octane No. of fuel
L13	8.5 : 1	85
L16	8.5 : 1	85
L16 (TWIN)	9.5 : 1	95
L20	8.5 : 1	85
L20 (TWIN)	9.0 : 1	95

Nissan long life coolant (L.L.C.)

This L. L. C. is an ethylene glycol base product containing chemical inhibitors to protect the cars cooling system against rusting and corrosion, L. L. C. does not contain any glycerine, ethyl or methyl alcohol. It will not evaporate or boil away and can be used with either high or low temperature thermostats. It flows freely, transfers heat efficiently, and will not clog the passages in the cooling system.
L. L. C. must not be mixed with other product. This coolant can be used through out the seasons of the year and exchange period is two years or total running mileage of 40, 000 km (24, 000 miles).

Perent concentration	Boiling point		Freeze protection
	Sea level	0.9 kg/cm^2 cooling system pressure	
30%	106° C (221° F)	124° C (255° F)	-15° C (5° F)
50%	109° C (228° F)	127° C (261° F)	-35° C (-31° F)

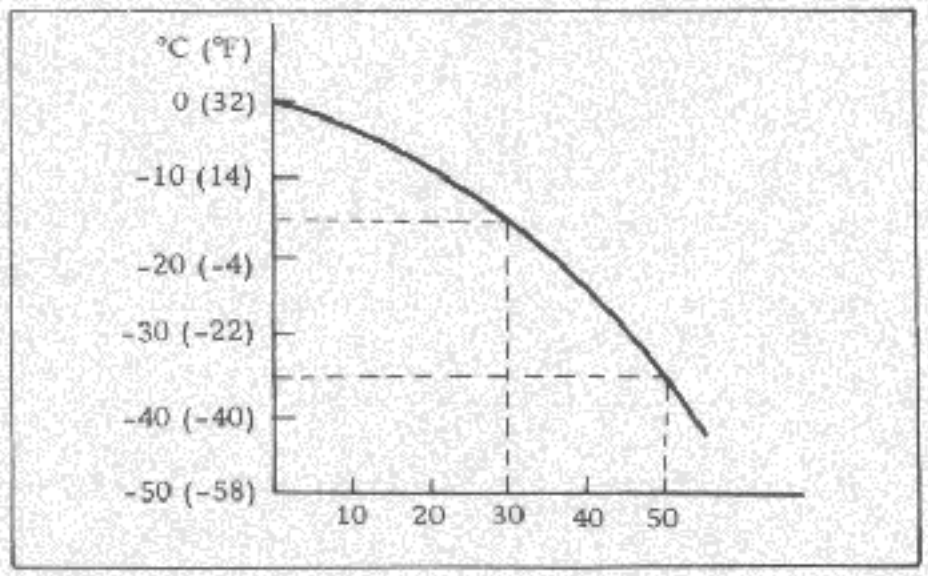


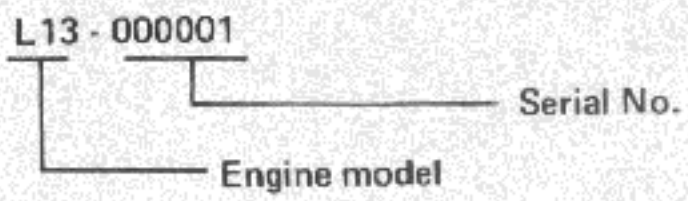
Fig. EG-9 Protection concentration

UNIT SERIAL NUMBER LOCATION

There are two serial numbers for unit identification: the engine number and the chassis number. These numbers are repeated in the car identification plate, which is located in an easy-to-read position.

Engine Serial Number

The engine number is stamped in the rear right side of cylinder block, at cylinder head contact surface. The number is preceded by engine model, L13, L16 and L20.



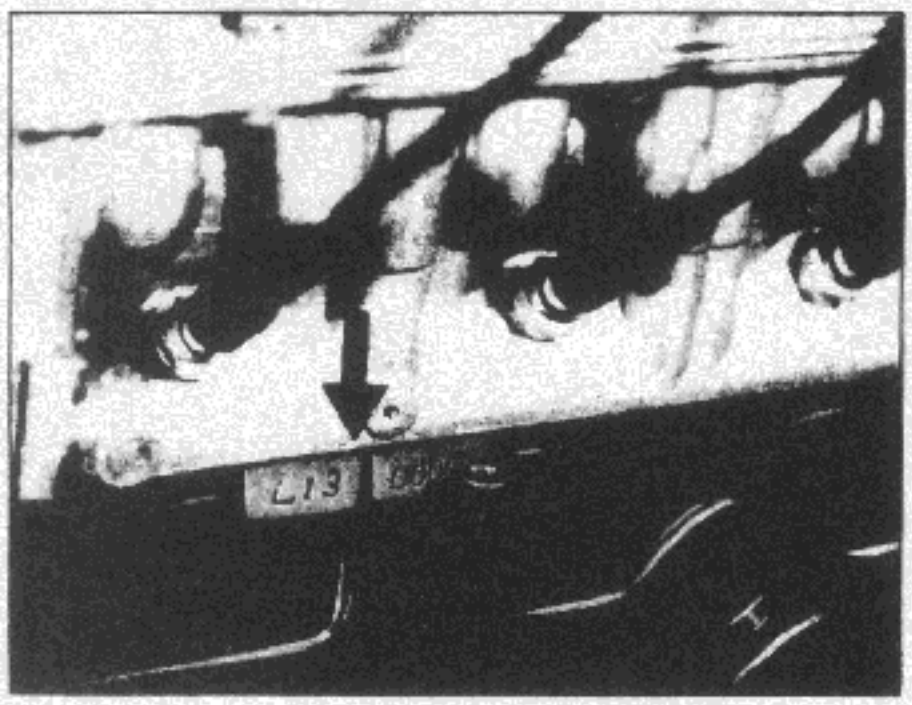


Fig. EG-10 Engine serial and model number

PERIODICAL INSPECTION AND MAINTENANCE

MAINTENANCE FREQUENCY EVERY				LUBRICATION AND CHECKING POINTS (ENGINE)		MAINTENANCE CALENDAR											
40,000 km (24,000 mile)	20,000 km (12,000 mile)	10,000 km (6,000 mile)	5,000 km (3,000 mile)			Daily	1,000 km (600 mile)	3,000 km (2,000 mile)	6,000 km (4,000 mile)	10,000 km (6,000 mile)	15,000 km (9,000 mile)	20,000 km (12,000 mile)	25,000 km (15,000 mile)	30,000 km (18,000 mile)	35,000 km (21,000 mile)	40,000 km (24,000 mile)
				Engine Oil	Check engine oil level, top-up if necessary	○										
			○		Change engine oil		●	●	●	●	●	●	●	●	●	●
		○			Lubricate carburetor linkage					○		○		○		○
		○			Lubricate distributor rotor shaft and arm shaft					○		○		○		○
		○		Grease	Apply grease to distributor cam heel					○		○		○		○
				Fluid	Check cooling water level	○										
		○			Change cooling water					●		●		●		●●
○					Change NISSAN LONG LIFE COOLANT											
					Check battery electrolyte level	○										
	○				Measure specific gravity of battery electrolyte							○				○
				Check engine starting, color of exhaust gas		○										
		○		Re-tighten cylinder head, manifolds and pipe flange						○		○		○		○
		○		Adjust valve clearance						○		○		○		○
		○		Check ignition timing						○		○		○		○
				Re-tighten carburetor, fitting parts			○									
			○	Check fan belt tension			○		○	○	○	○	○	○	○	○
				Check leak from oil pan		○										
	○			Re-tighten engine mountings			○					○				○
		○		Check fuel strainer				○		○		○		○		
○				Replace fuel strainer												●
				Check fuel leakage		○										
		○		Replace oil filter				●		●		●		●		●
			○	Check spark plugs				○	○	○	○		○	○	○	
	○			Replace spark plugs								●				●
			○	Check distributor cap, rotor and point				○	○	○	○	○	○	○	○	○
			○	Check engine idling				○	○	○	○	○	○	○	○	○
		○		Check air cleaner fittings						○		○		○		○
		○		Clean oil filler cap						○		○		○		○
		○		Check dirt of battery cords and terminals						○		○		○		○
	○			Check alternator, voltage regulator function								○				○
	○			Check starter motor function								○				○
○				Replace air cleaner element												●
○				Check fuel pump function												○
○				Measure compression pressure of cylinders												○
○				Clean jets, float chamber of carburetor												○
○				Check condenser of distributor												○
	○			Check crankcase ventilation control valve								○				○

○= Check or Supply
● = Change

AFTER FIRST 1,000 KMS (600 MILES)

Changing Engine Oil

Second replacement ..... at 3,000 kms (2,000 miles)
Third replacement ..... at 6,000 kms (4,000 miles)
Fourth and thereafter ..... every 5,000 kms (3,000 miles)

Draining is best done after a good run, when the oil, being thoroughly warm, will flow readily and freely and any foreign matter will be held in suspension.

Place a large bowl or other shallow container under the engine. Then remove the oil pan drain plug. Do this carefully, as the oil will be hot and it will spurt out with some force. After compeltely draining the dirty oil off securely replace the oil drain plug and finally refill the engine in the usual way up to the "H" mark on the dipstick. Make sure the car is on a level surface while draining and filling the engine.

Oil pan capacity

L13 ..... 4.0 ℓ
L16 ..... 4.0 ℓ
L20 ..... 4.0 ℓ

AFTER FIRST 3,000 KMS (2,000 MILES)

Replacing oil filter

Second and thereafter .... every 10,000 kms (6,000 miles)

The oil filter is of full-flow cartridge type. The element of oil filter is sealed in the container as a unit, it can easily removed by hand. Take care not to lose the rubber sealing ring. When it is assembled, the seal is lightly oiled, and when the seal contacted, it is tightened by hand further rotating it about 1/3 turn.

AFTER FIRST 6,000KMS (4,000MILES)

Fan belt tension

Second and thereafter ..... every 5,000 km (3,000 miles)

Incidentally, we call it the fan belt, but also it drives the water pump and alternator. It is advisable, however, to check the tension regularly, so that when the need for adjustment does arrive it is not overlooked. With the engine switched off and the bonnet up, push the belt gently downwards. You should be able to depress it about 10 mm (1/2 in.). If the fan belt has become slack through wear loosen the fixing and adjusting bolts, and move the whole of the alternator toward or away from the engine. This will take up the slack. Tighten the bolts again, and recheck to make sure the belt has the required free play. If you tighten it too much it will wear rapidly and also overload the water pump and alternator bearings.

EVERY 10,000 KMS (6,000 MILES)

Changing cooling water

Scale or sediment accumulated in water jacket or radiator is obstructive to heat radiation. The system should be thoroughly flushed out opening the two drain plugs, one at the bottom of the radiator and other at the right side of the cylinder block, until clean water comes out.

Always use clean soft water for filling the radiator. Immediately the cold weather arrives, the cooling system should be protected against frost by a good anti-freeze solution such as a NISSAN LONG LIFE COOLANT. To allow for expansion when hot, the level, when cold, should be just visible in the bottom of the filler neck. Do not overfill the system. This coolant (L. L. C.) can be changed every 40,000 kms (24,000 miles).

EVERY 40,000 KMS (24,000 MILES)

Replacing air cleaner element (wet paper type)

The air cleaner is of a wet papter type element (viscous type). As this element has been performed special treatment, there is no need to clean the element until it is replaced by new one. This element will look so dirty as to be required dust, but never try to clean, since there is no fear to reduce the cleaning action. Care must be taken not to injure filter element.

SERVICE JOURNAL OR BULLETIN REFERENCE

DATE	JOURNAL or BULLETIN No.	PAGE No.	SUBJECT

SERVICE MANUAL

MODEL L SERIES ENGINE

NISSAN

SECTION ET

ENGINE TUNE-UP

ET

ENGINE TUNE-UP

CONTENTS

GENERAL DESCRIPTION

A minor tune and test consists of testing battery, cleaning, regapping or replacing, if required, spark plugs and distributor points; adjusting distributor dwell angle, ignition timing, carburetor idle mixture, and hot idle speed.

The complete or major tune and test procedure consists of these basic items plus other ignition, compression, electrical and carburetor checks, and a final road test to ensure continued trouble-free operation.

BASIC PROCEDURE

Connect tune-up equipment

Follow manufacturer recommendations for the use of testing equipment. Fig. ET-1 shows a basic schematic for instrumentation which will apply to many types of test equipment and may be used as a rough guide if equipment manufacturer's instructions are not available.

Connections shown in Figure ET-1 are made as follows:

1. Voltmeter
   (1) Positive lead to resistor side of coil.
   (2) Negative lead to ground.
2. Timing light
   (1) Positive lead to positive battery terminal.
   (2) Negative lead to ground.
   (3) Trigger lead to number 1 spark plug.
3. Tachometer
   (1) Positive lead to distributor side of coil.
   (2) Negative lead to ground.

Note: With transistor ignition, it is necessary to use a tachometer which uses a high voltage pick-up. Attach pick-up to either number one or six spark plug.
This tachometer may also be used with conventional ignition system.

4. Dwell meter
   (1) Positive lead to distributor side of coil.
   (2) Negative lead to ground.

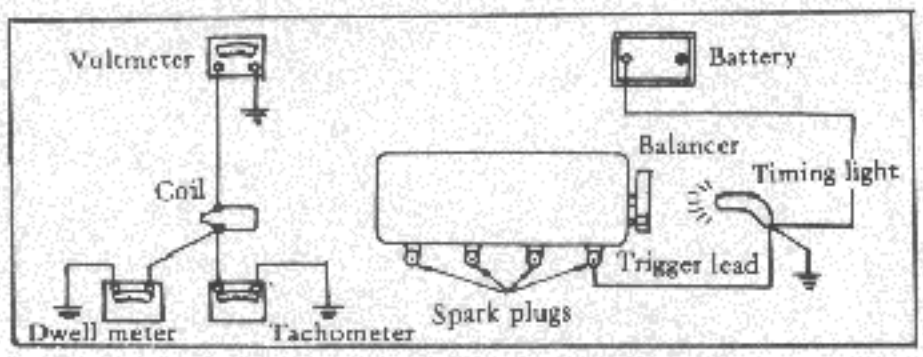


Fig. ET-1 Simple schematic of tune-up instrumentation

Battery inspection

1. Check the level of the electrolyte in battery cells.
Check the level line on the case with the battery electrolyte.
If necessary, replenish with distilled water.

2. Measure the specific gravity of the battery electrolyte.

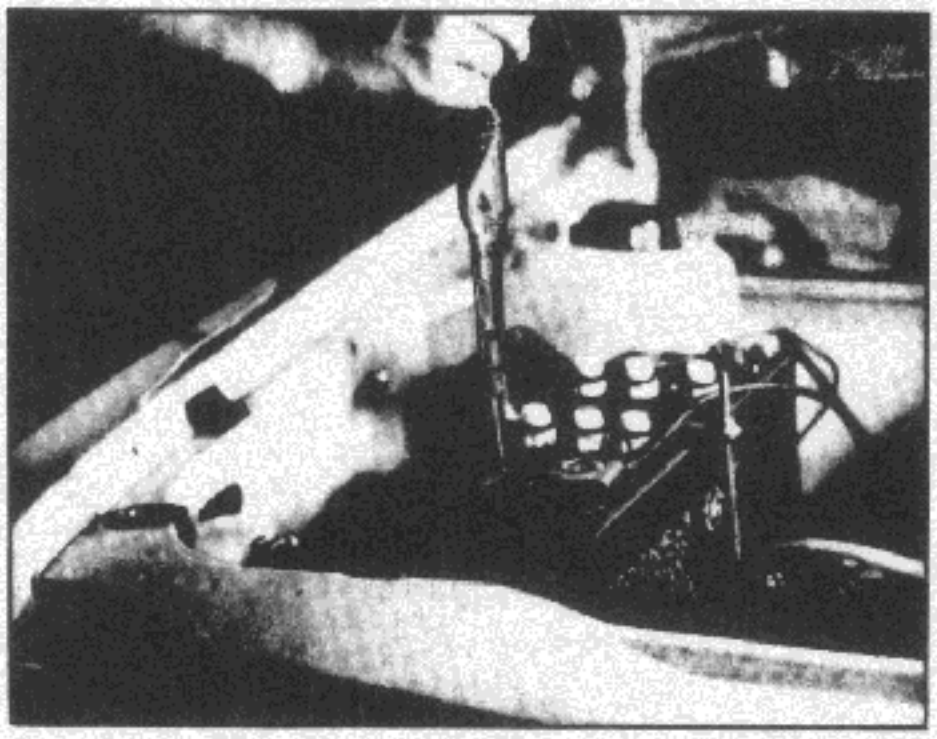


Fig. ET-2 Battery inspection

	Permissible value	Full charge value (at 68°F, 20°C)
Frigid climates	Over 1.22	1.28
Tropical climates	Over 1.18	1.23
Other climates	Over 1.20	1.26

Clean top of battery and terminals with a solution of baking soda and water. Rinse off and dry with compressed air. Top of battery must be clean to prevent current leakage between terminals and from positive terminal to hold-down clamp.

In addition to current leakage, prolonged accumulation of acid and dirt on top of battery may cause blistering of the material covering connector straps and corrosion of straps. After tightening terminals, coat them with petrolatum to protect them from corrosion.

Spark plugs-remove and recondition

See that correct spark plugs are used. Spark plug insulators should be thoroughly cleaned to prevent possible flash-over.
Thoroughly clean lower insulator and cavity by sand blasting. File both electrodes flat (rounded surfaces increase voltage required to fire plugs) and set gap to 0.8 to 0.9 mm (0.031 to 0.035 in.). When plugs are reinstalled, use new gaskets and tighten plugs to 1.5 to 2.0 kg-m (11.0 to 15.0 ft-lb) torque.

Clean and adjust distributor points

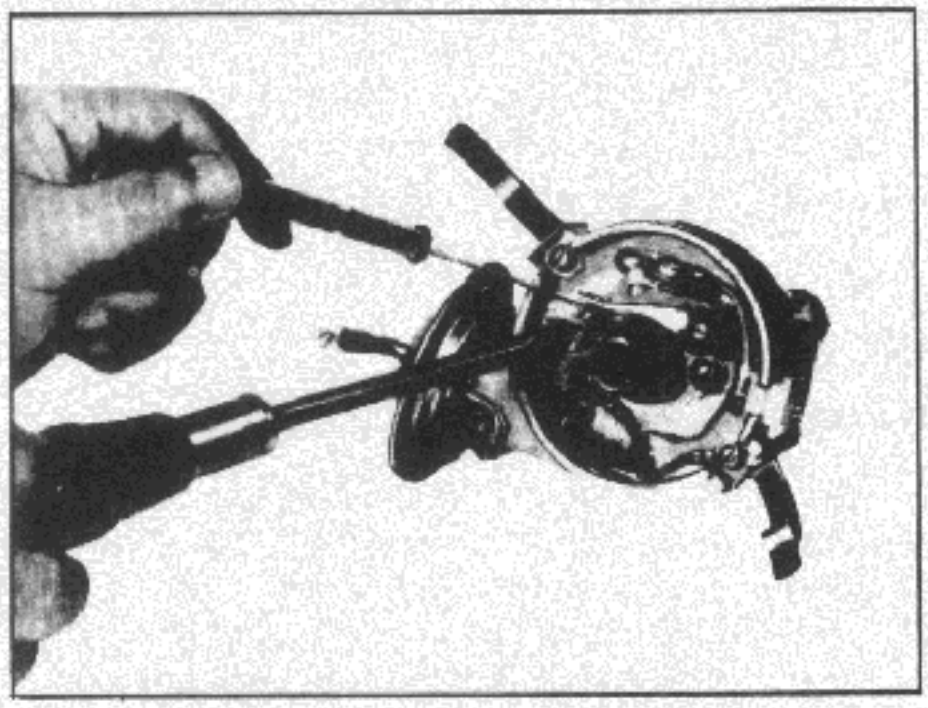


Fig. ET-3 Distributor point gap check

Remove distributor cap and inspect points for excessive burning or pitting. Replace points if necessary. Use a point file to clean contact area and remove scale from points. Filing is for cleaning purposes only. Do not attempt to remove all roughness. Apply a trace of bearing lubricant to the breaker cam. Adjust distributor dwell angle to 49 to 55 degrees on L13 and L16 engines and 35 to 41 degrees on L20 engine.

Set ignition timing

With distributor vacuum line disconnected and car operating at normal idle speed or below, set ignition timing.

The timing can be observed by the stationary pointer at the front cover and the markings on the crankshaft pulley with a drvice called a stroboscopic light (also referred to as a timing light) as shown in Figure ET-4.

Note that the pulley groove is graduated 5° per scale division in terms of the crank angle. The top dead center is located to the extreme left as viewed from the inspector's side.

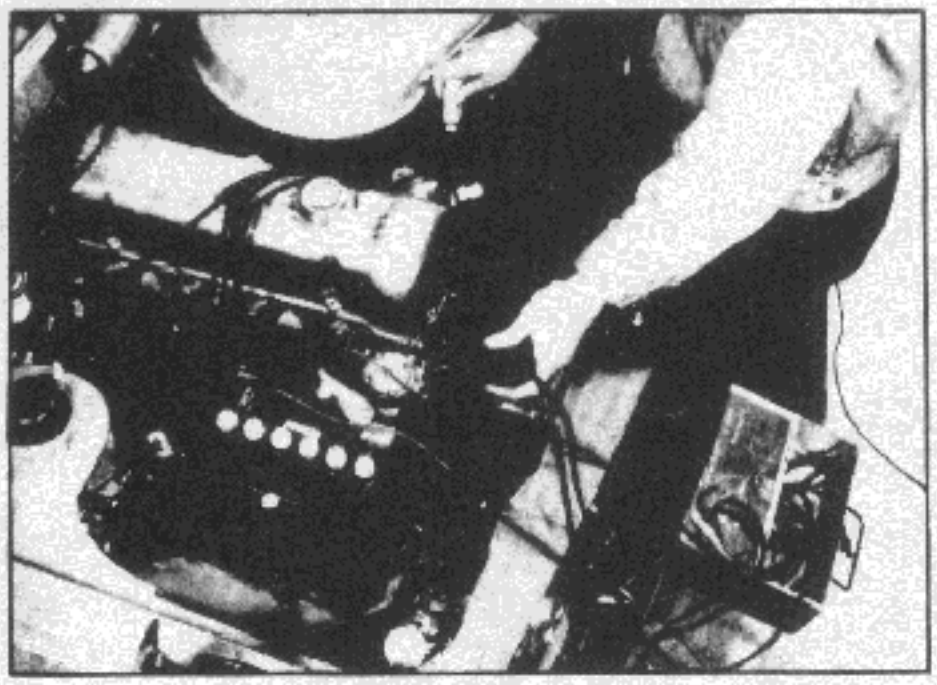


Fig. ET-4 Ignition timing check

Ignition Timing

L13	L16		L20	
	Single carb.	Twin carb.	Single carb.	Twin carb.
10°/600 r.p.m.	10°/600 r.p.m.	14°/650 r.p.m.	12°/550 r.p.m.	17°/600 r.p.m.

Inspection of fan belt

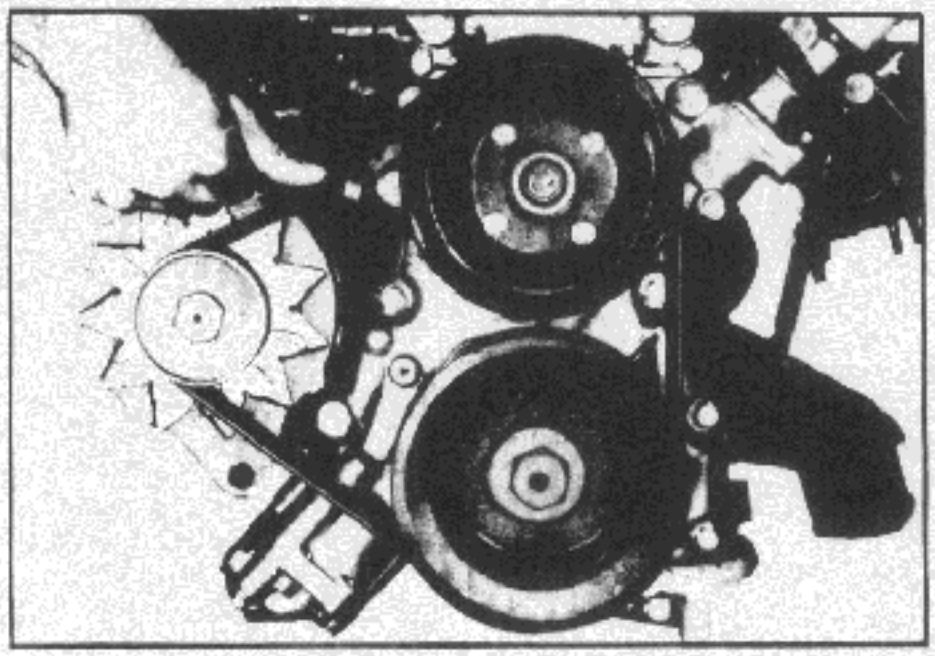


Fig. ET-5 Fan belt tension

1. Check for a cracked or damaged V-belt. Replace if defective.

2. Adjust the belt tension, if necessary.

Permissible slackness of fan belt: 10 to 15 mm (0.394 to 0.590 in.)

Belt tension measuring point: Between fan pulley and alternator pulley.

Inspection of engine oil

Oil capacity of engine

	L13	L16	L20
Maximum	4.0 ℓ (1.06 US. gal.) (0.88 Imp. gal.)	4.0 ℓ (1.06 US. gal.) (0.88 Imp. gal.)	4.0 ℓ (1.06 US. gal.) (0.88 Imp. gal.)
Minimum	3.0 ℓ (0.79 US. gal.) (0.66 Imp. gal.)	3.0 ℓ (0.79 US. gal.) (0.66 Imp. gal.)	3.0 ℓ (0.79 US. gal.) (0.66 Imp. gal.)

1. Check if the engine oil has been deteriorated by invading cooling water or gasoline. Drain and refill the oil, if necessary.

Note: **a. A milky oil indicates the presence of cooling water. Discover the cause for necessary treatment.**
b. An oil with extremely low viscosity suggests dilution with gasoline.

2. Check oil level, and if it is lower than necessary, replenish oil of the same grade up to the H level.

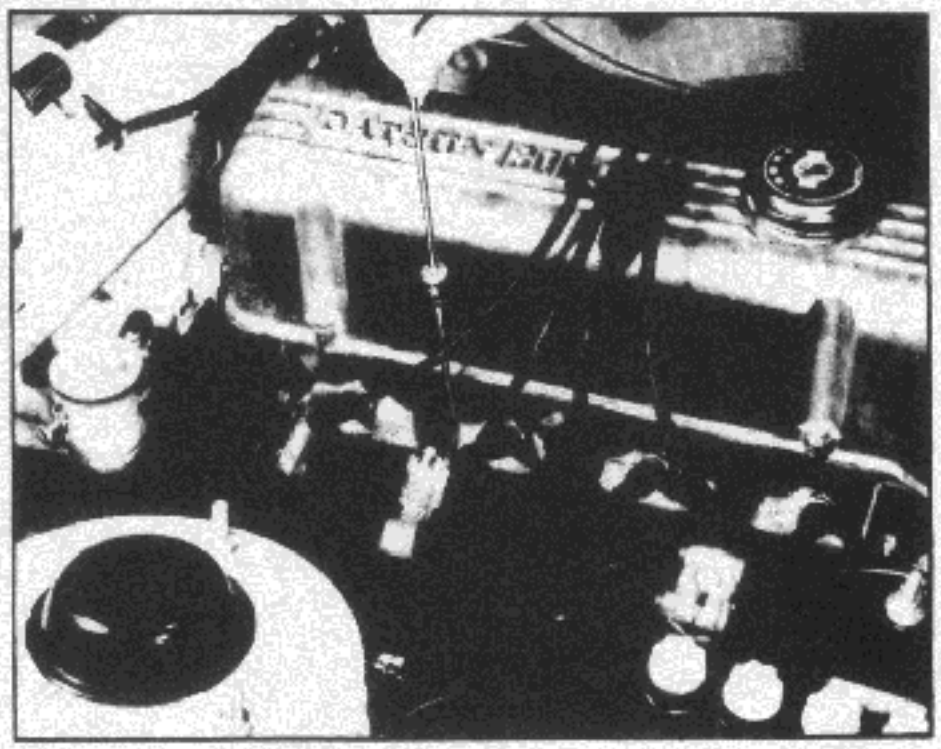


Fig. ET-6 Engine oil level check

Carburetor overhaul and adjustment

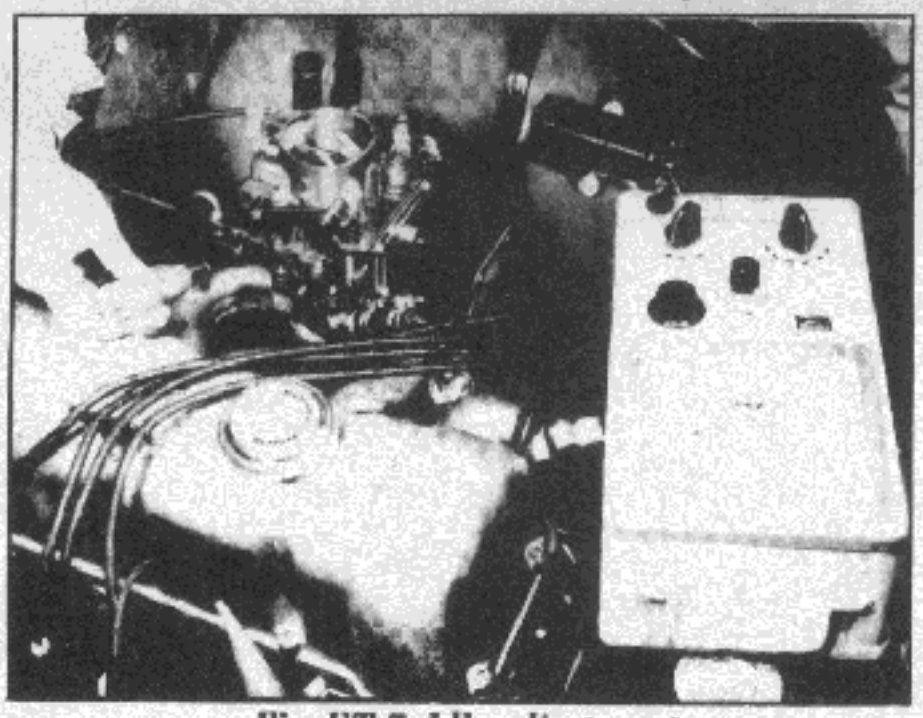


Fig. ET-7 Idle adjustment

OVERHAUL

The detailed information for carburetor overhauling is outlined in section EF (ENGINE FUEL SYSTEM).

Overhaul the carburetor assembly, referring to section EF.

ADJUSTMENT

Adjust carburetor idle speed and mixture to the following specifications.

Engine idling

L13 engine		600 r. p. m.
L16 engine	Single carb.	600 r. p. m.
	Twin carb.	650 r. p. m.
L20 engine	Single carb.	550 r. p. m.
	Twin carb.	600 r. p. m.

Check carburetor choke and unloader

OPERATION AND ADJUSTMENT
(Only for single carburetor L20 engine)

The specified choke setting provides ideal choke operation in all climates. No seasonal changes are necessary. Setting are listed in ENGINE FUEL SECTION.

The choke should just close at 75° F. When set at index. In rare cases, it may be necessary to change slightly (never more than two notches) from the standard setting to properly calibrate the choke. Excess carbon in choke housing may indicate a leaking choke heat tube.

Choke linkage and fast idle cam must operate freely. Do not lubricate linkage since this will collect dust and cause sticking.

Check unloader action. Inoperative unloader can cause complaints of difficult hot starting. Adjust as outlined in ENGINE FUEL SECTION.

VALVE CLEARANCE ADJUSTMENT

This adjustment is impossible when the engine is in operation. Follow the procedure descripted below:

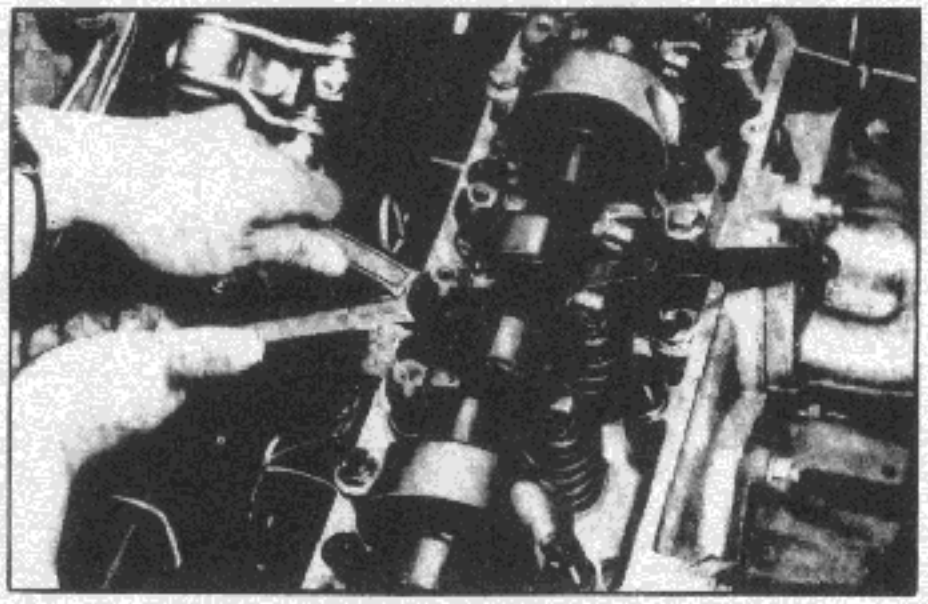


Fig. ET-8

1. Loosen the pivot locking nut and turn the pivot screw until the specified clearance is obtained with engine cold.
   Tighten the pivot locking nut securely after adjustment, and recheck the clearance.
2. Warm up the engine, and stop it. Then, measure the hot engine valve clearance in the same manner as above. If it deviates from the given hot-engine valve setting value, make necessary adjustment.

			L13 and L16	L20
Valve Clearance mm (in.)	Cold	Intake	0.20 (0.0079)	0.20 (0.0079)
		Exhaust	0.25 (0.0098)	0.25 (0.0098)
	Hot	Intake	0.25 (0.0098)	0.20 (0.0079)
		Exhaust	0.30 (0.0118)	0.30 (0.0118)

ADDITIONAL PROCEDURE

For diagnosis purposes, it is sometimes necessary to proceed further than the basic tune-up procedure. The following steps plus a

road test are included in a complete or major tune and test procedure.

Compression pressure-test each cylinder

Note: If this test is to be performed, it should be done when plugs are removed for service during basic tune-up procedure.

Unless checking for worn rings or for the cause of low speed miss, compression check should not be necessary.

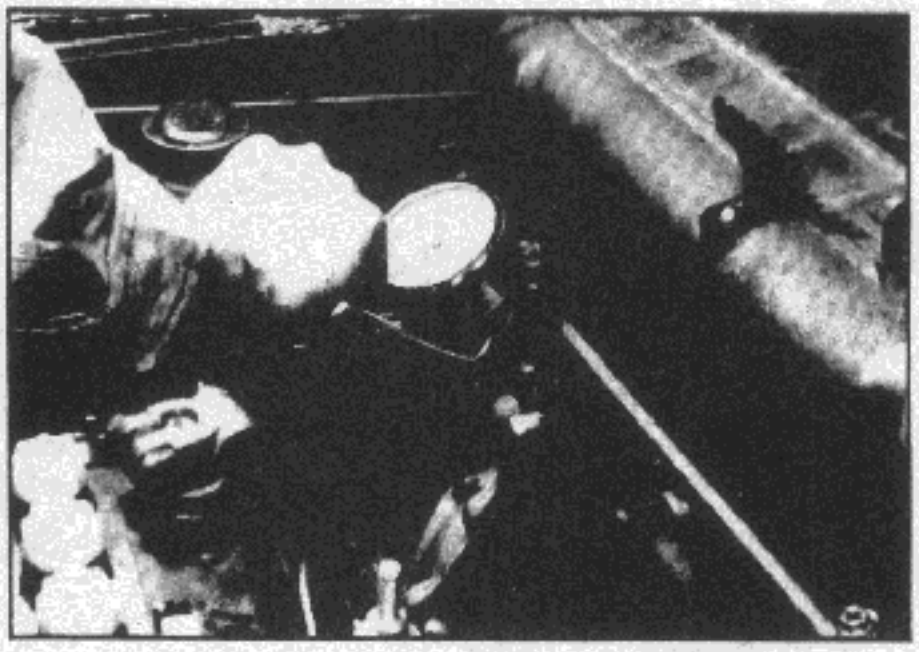


Fig. ET-9 Compression pressure test

Test compression with engine warm, all spark plugs removed and throttle and choke open. No cylinder should be less than 80% of the highest cylinder. Excessive variation between cylinders, accompanied by low speed missing of the cylinder or cylinders which are low, usually indicates a valve not properly seating or a broken piston ring. Low pressures, even though uniform, may indicate worn rings. This may be accompanied by excessive oil consumption.

Compression pressure kg/cm2 (lb/in2) at r.p.m.

		Standard	Minimum
L13		12.0 (171)/350	11.5 (159)
L16	Single carb.	12.0 (171)/350	11.5 (159)
	Twin carb.	12.5 (242)/350	11.5 (159)
L20	Single carb.	12.0 (171)/300	11.5 (159)
	Twin carb.	12.5 (242)/300	11.5 (159)

Clean and inspect high tension wires, distributor cap and rotor

Note: This operation is to be performed while checking distributor points during the basic tune-up procedure. Inspect distributor cap for cracks and flash over.

External surfaces of all parts of secondary system must be cleaned to reduce possibility of voltage loss. All wires should be removed from distributor cap and coil so that terminals can be inspected and cleaned. Burned or corroded terminals indicate that wires were not fully seated, which causes arcing between end of wire and terminal. When replacing wires in terminal, be sure they are fully seated before pushing rubber nipple down over tower. Check distributor rotor for damage, and distributor cap for cracks.

Distributor-lubricate

Wipe a very small amount of special cam and ball bearing lubricant on cam lobes when servicing.

Tighten intake manifold and carburetor attaching nuts

Intake manifold attaching bolts and nuts on engines should be tightened to proper torque. Carburetor attaching nuts should be tightened securely. Leaks at these areas can cause rough idle, surging, deceleration popping or deceleration whistle.

Inspection of oil filter

1. Check for oil leaks at the packing flange. If any leakage is discovered, tighten it a little, or replace the oil filter assembly. Do not overtighten.

2. Replace the filter every 10,000 km (6,000 mile) running.

Inspection of air cleaner

Viscous type element makes cleaning unnecessary until the engine used for two years, or for 40,000 km (24,000 mile) running. (under normal conditions)

Inspection of fuel strainer

L20 ENGINE

Check for a contaminated element, water deposit and/or a cracked glass ball.

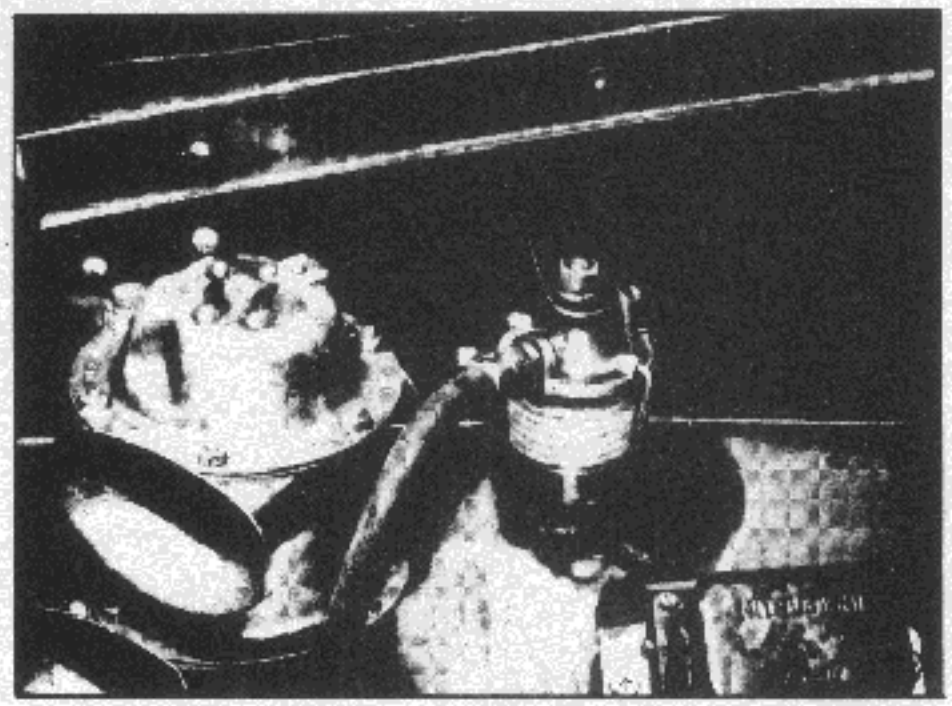


Fig. ET-10 Fuel strainer for L20 engine

Note: **Pay specific attention to the filter element packing and the strainer packing when the fuel strainer is installed.**
Particularly, prevent air suction through the strainer packing.

L13 AND L16 ENGINE

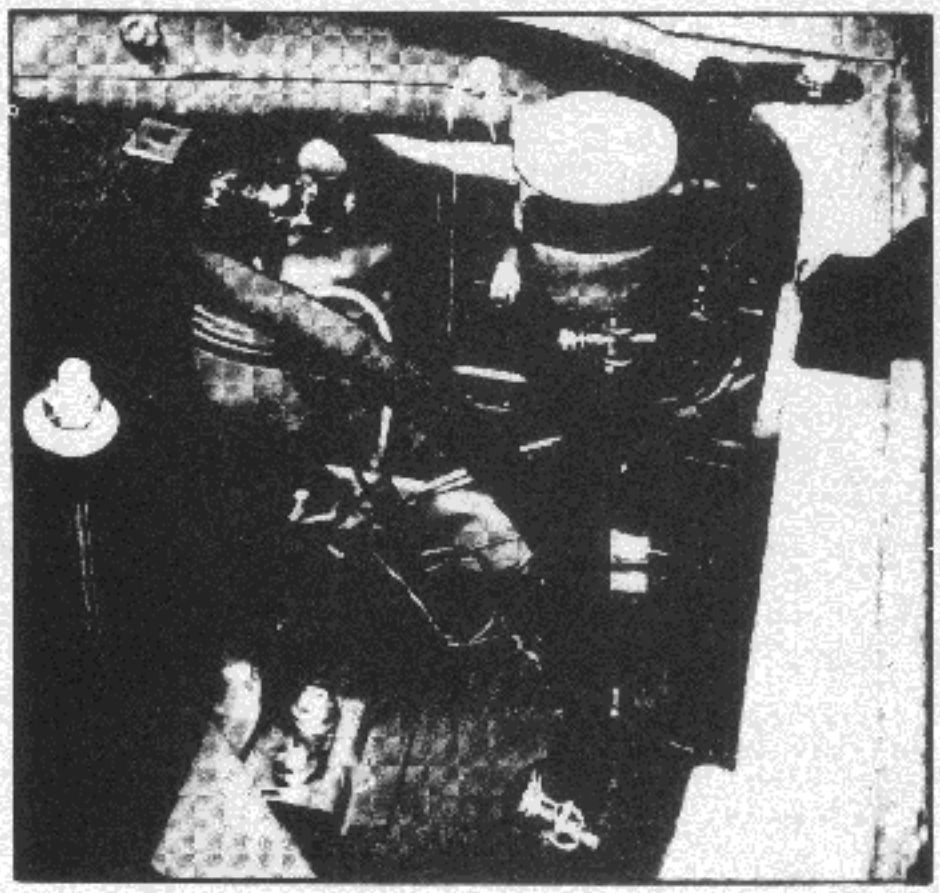


Fig. ET-11 Fuel strainer for L13 and L16 engine

These two engines use a cartridge type strainer, so if the malfunction is detected, replace as an assembly.

Inspection of cooling system

Inspection of Radiator Cap

Apply reference pressure (0.9 kg/cm2) to the radiator cap (in case of L13 and L16) and the reservoir tank cap (in case of L20) by means of a cap tester to see if it is satisfactory. Replace the cap assembly if necessary.

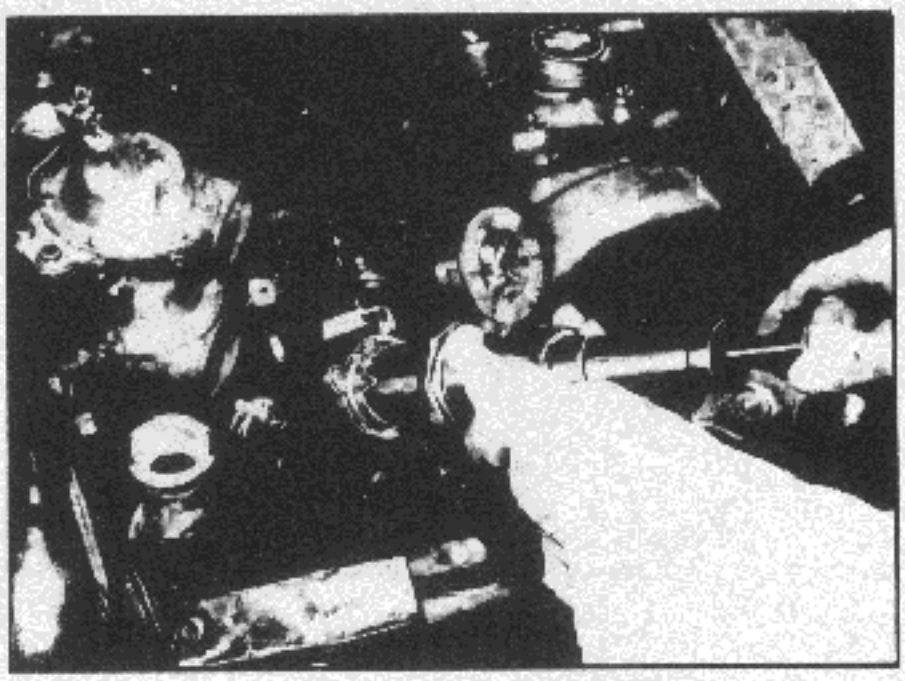


Fig. ET-12 Radiator cap test

Cooling System Pressure Test

With radiator cap removed, apply reference pressure (1.9 kg/cm2) to the cooling system by means of a tester to check for leaks at system components.

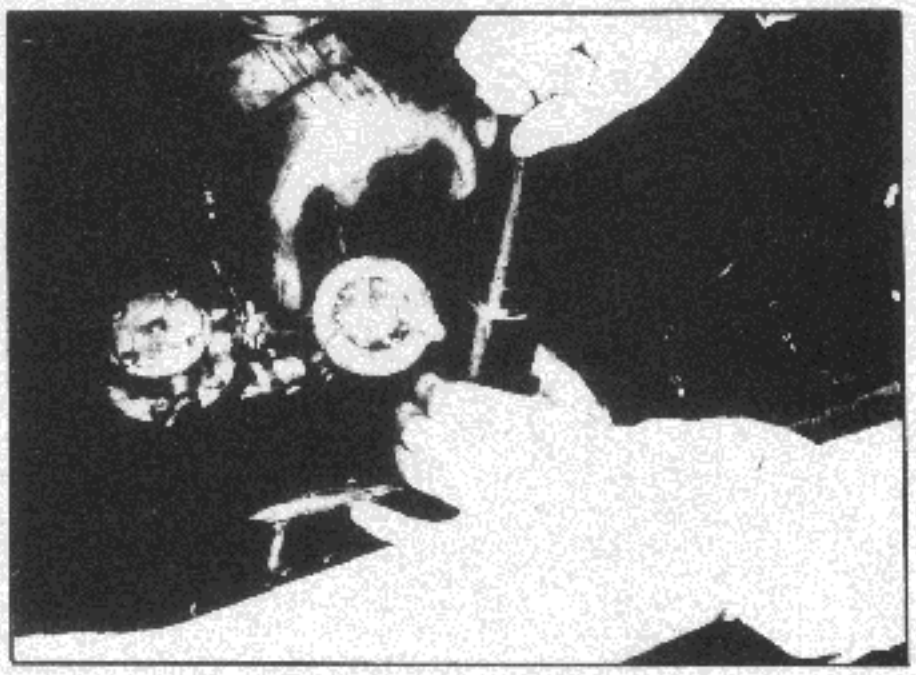


Fig. ET-13 Cooling system pressure test

TROUBLE DIAGNOSES AND CORRECTIONS

Trouble	Possible cause	Remedies
CANNOT CRANK ENGINE OR SLOW CRANKING	Improper grade oil.	Replace with proper grade oil.
	Discharged battery.	Charge battery.
	Defective battery.	Replace.
	Loosen fan belt.	Adjust.
	Trouble in charge system.	Inspect charge system.
	Wiring connection trouble in starting circuit.	Correct.
	Defective starter switch.	Repair or replace.
	Defective starter motor.	Repair or replace.

(Trouble shooting procedure on starting circuit)

Switch on the starting motor with light put on

When light goes off or dims considerably

a. Check battery
b. Check connection and cable
c. Check starter motor

When light stays bright

a. Check wiring connection between battery and starter motor
b. Check starter switch
c. Check starter motor

ENGINE WILL CRANK NORMALLY BUT WILL NOT START

In this case, following trouble cause may exist, but in many causes ignition system or fuel system is in trouble.

Ignition system in trouble
Fuel system in trouble
Valve mechanism does not work properly
Low compression

Check spark plug firstly by following procedure

Disconnect high tension cable from one spark plug and hold it about 10 mm (0.3937 in.) from the engine metal part and crank the engine.

Good spark occurs

a. Check spark plug
b. Check ignition timing
c. Check fuel system
d. Check cylinder compression

	No spark occurs	Check the current flow in primary circuit.
	Very high current.	Inspect primary circuit for short. Check breaker point operation.
	Low or no current	Check for loose terminal or disconnection in primary circuit. Check for burned points.
Ignition system in trouble	Distributor point burned.	Repair or replace.
	Improper point gap.	Adjust.
	Defective condenser.	Replace.
	Rotor cap and rotor leak.	Replace.
	Defective spark plug.	Clean, adjust plug gap or replace.
	Improper ignition timing.	Adjust.
	Defective ignition coil.	Replace.
	Disconnection of high tension cable.	Replace.
	Loose connection or disconnection in primary circuit.	Repair or replace.
Fuel system in trouble	Lack of fuel.	Supply.
	Dirty fuel strainer.	Replace (L13 and L16). Clean or replace (L20).
	Dirty or clogged fuel pipe.	Clean.
	Fuel pump will not work properly.	Repair or replace.
	Carburetor auto-choke will not work properly.	Check and adjust.
	Adjustment of float level no good.	Correct.
	Improper idling.	Adjust.
	Dirty or clogged carburetor.	Disassemble and clean.
	Clogged breather pipe.	Clean.
Low compression	Incorrect spark plug. tightening, defective gasket.	Tighten to normal torque, replace gasket.
	Improper grade engine oil or viscosity dropping.	Replace with proper gradé oil.
	Incorrect valve clearance.	Adjust.

	Compression leak from valve seat.	Remove cylinder head and lap the valves.
	Sticky valve stem.	Correct or replace valve.
	Weak or defective valve springs.	Replace valve springs.
	Compression leak at cylinder head gasket.	Replace gasket.
	Piston ring sticking or defective.	Replace piston rings.
	Worn piston ring or cylinder.	Overhaul engine.

(Trouble shooting procedure)

Pour the engine oil from plug hole, and then measure cylinder compression.

Compression increased.	Trouble in cylinder or piston ring.
Compression unchanged.	Compression leak from valve, cylinder head or head gasket.

IMPROPER ENGINE IDLING		
Fuel system in trouble	Clogged or damaged carburetor jets.	Clean or replace.
	Incorrect idle adjustment.	Adjust.
	Clogged air cleaner.	Replace element.
	Defective gaskets of manifolds or carburetor insulator.	Replace gasket.
	Malfunction of carburetor auto-choke (L20 engine).	Repair.
	Adjustment of float level no good.	Adjust.
Low compression		Previously mentioned.
Others	Incorrect valve clearance.	Adjust.
	Extremely low revolution.	Adjust.
ENGINE POWER NOT UP TO NORMAL		
Low compression		Previously mentioned.
Ignition system in trouble	Incorrect ignition timing.	Adjust.
	Defective spark plugs.	Clean, adjust or replace plugs.
	Defective distributor points.	Dress, or replace points also check condenser

	Incorrect octane selector setting.	Adjust octane selector.
Fuel system in trouble	Malfunction of choke system.	Adjust.
	Clogged fuel pipe.	Clean.
	Dirty or clogged fuel strainer.	Clean or replace (L20). Replace (L13 and L16).
	Fuel pump will not work properly.	Repair or replace.
	Clogged carburetor jets.	Disassemble and clean.
Air intake system in trouble	Clogged air cleaner.	Replace element.
	Air inhailing from manifold gasket or carburetor gasket.	Replace gasket.
Overheating	Insufficient coolant.	Replenish.
	Loosen fan belt.	Adjust fan belt.
	Worn or defective fan belt.	Replace.
	Defective thermostat.	Replace.
	Defective water pump.	Replace.
	Clogged or leaky radiator.	Flush, repair or replace.
	Defective radiator filler cap.	Replace.
	Air mixing into cooling system.	Retighten each part of cooling system.
	Improper grade engine oil.	Replace with proper grade oil.
	Incorrect ignition timing.	Adjust.
	Defective carburetor (lean mixture).	Overhaul carburetor.
Overcooling	Defective thermostat.	Replace.
Others	Low octane fuel.	Replace with specified octane fuel.
	Improper tire pressure.	Make specified pressure.
	Dragging brake.	Adjust.
	Clutch slipping.	Adjust.
NOISY ENGINE		
Car knocking	Overloading to engine.	Use right gear in driving.
	Carbon knocking.	Disassemble cylinder head and remove carbon.

	Timing knocking.	Adjust ignition timing.
	Fuel knocking.	Use specified octane fuel.
	Preignition (misusing of spark plug).	Use specified spark plug.
Mechanical knocking		
Crankshaft bearing knocking.	This strong dull noise increases when the engine is accelerated. To locate the place, cause a misfire on each cylinder. If the noise stops by the misfire, this cylinder generates the noise.	This is caused by the worn or damaged bearings, or unevenly worn crankshaft. Renew the bearings and adjust or change the crankshaft. Check the lubrication system.
Connecting rod bearing knocking.	This is a little higher-pitched noise than the crankshaft knocking, and also increases when the engine is accelerated. Cause a misfire on each cylinder and if the noise deminishes almost completely this crankshaft bearing generates the noise.	Same as the case of crankshaft bearings.
Piston and cylinder noise	When you hear an overlapping metalic noise which increases its magnitude with the revolution of the engine and which decreases as the engine is warmed up, this noise is caused by the piston and cylinder. To locate the place, cause a misfire on each cylinder.	This may cause an abnormal wearing of the cylinder and lower compression which in turn will cause a lower out-put power and excessive consumption of oil. Overhaul the engine.
Piston pin noise.	This noise is heared at each highest and lowest dead end of the piston. To locate the place, cause a misfire on each cylinder.	This may cause a wear on the piston pin, or piston pin hole. Renew the piston and piston pin assembly.
Water pump noise.	This noise may be caused by the worn or damaged bearings, or by the uneven surface of sliding parts.	Replace the water pump with a new one.
Others.	An improper adjustment of the valve clearance.	Adjust.
	Noise of the timing chain.	Adjust the tension of the chain.

	An excessive end-play on the crankshaft. Remarks: Disengage the clutch slightly and this noise will stop.	Dismantle the engine and renew the main bearing bush.
	Wear on the clutch pilot bush. Remarks: This noise will be heared when the clutch is disengaged.	Renew the bush and adjust the drive shaft.
ABNORMAL COMBUSTION (back fire, after fire, run-on etc.)		
Improper ignition timing	Improper ignition timing.	Adjust the ignition timing.
	Improper heat range of the spark plugs.	Use specified spark plugs.
Fuel system in trouble	Damaged carburetor or manifold gasket. (back fire, after fire)	Replace them with new parts.
	Defective carburetor jet.	Dismantle the carburetor and check it.
	Improper function of the float.	Adjust the level, and check the needle valve.
	Uneven idling.	Adjust.
Defective cylinder head, etc.	Improperly adjusted valve clearance.	Adjust it.
	Excess carbon in the combustion chamber.	Remove the head and get rid of the carbon.
	Damaged valve spring (back fire, after fire).	Replace it with a new one.
EXCESSIVE OIL CONSUMPTION		
Oil leakage	Loose oil drain plug.	Tighten it.
	Loose or damaged oil pan gasket.	Renew the gasket or tighten it.
	Loose or damaged chain cover gasket.	Renew the gasket or tighten it.
	Defective oil seal in front and rear of the crankshaft.	Renew the oil seal.
	Loose or damaged locker cover gasket.	Renew the gasket or tighten it (but not too much).
	Improper tightening of oil filter.	Renew the gasket and tighten it with the proper torque.

	Loose or damaged oil pressure switch.	Renew the oil pressure switch or tighten it.
Excessive oil consumption	Cylinder and piston wear.	Overhaul the cylinder and renew the piston.
	Improper location of the ring split or reversed assembly of it.	Remount the piston rings.
	Damage or seizure of rings.	Renew the rings.
		Repair or renew the piston and cylinder.
	Wear of piston ring groove and rings.	Renew the piston and piston ring.
	Fatigue of valve oil seal lip.	Replace the seal lip with a new one.
	Wear of vavlve stem.	Renew the valve or the guide.
Others	In adequate quality of engine oil.	Use the designated oil.
	Engine overheat.	Previously mentioned.
POOR FUEL ECONOMY		
See the explanation of the power decrease		
Others	Exceeding idling revolution.	Adjust it to the designated r.p.m.
	Defective acceleration recovery.	Adjust it.
	Fuel leakage.	Repair or tighten the connection of fuel pipes.
TROUBLE IN OTHER FUNCTIONS		
Decreased oil pressure	Inadequate oil quality.	Use the designated oil.
	Overheat.	Previously mentioned.
	Defective function of oil pump regulator valve.	Dismantle the oil pump and repair or renew it.
	Functional deterioration of oil pump.	Repair or replace it with new one.
	Blocked oil filter.	Renew it.
	Increased clearance in various sliding parts.	Dismantle and replace the worn parts with new ones.
	Blocked oil strainer.	Clean it.

	Troubles in the oil gauge pressure switch.	Replace it with a new one.
Excessive wear on the sliding parts	Oil pressure decrease.	Previously mentioned.
	Defective quality or contamination of oil.	Exchange the oil with proper one and change the element.
	Defective air cleaner.	Change the element.
	Overheat or overcool.	Previously mentioned.
	Improper fuel mixture. (Principally to cylinder walls)	Check the fuel system.
Seizure of sliding parts	Decrease of oil pressure.	Previously mentioned.
	Too small clearances.	Reassemble with the designated clearances.
	Overheat.	Previously mentioned.
	Improper fuel mixture.	Check the fuel system.

SERVICE JOURNAL OR BULLETIN REFERENCE

DATE	JOURNAL or BULLETIN No.	PAGE No.	SUBJECT

SERVICE MANUAL

MODEL L SERIES ENGINE

NISSAN

SECTION EM

ENGINE MECHANICAL

EM

GENERAL DESCRIPTION

CONTENTS

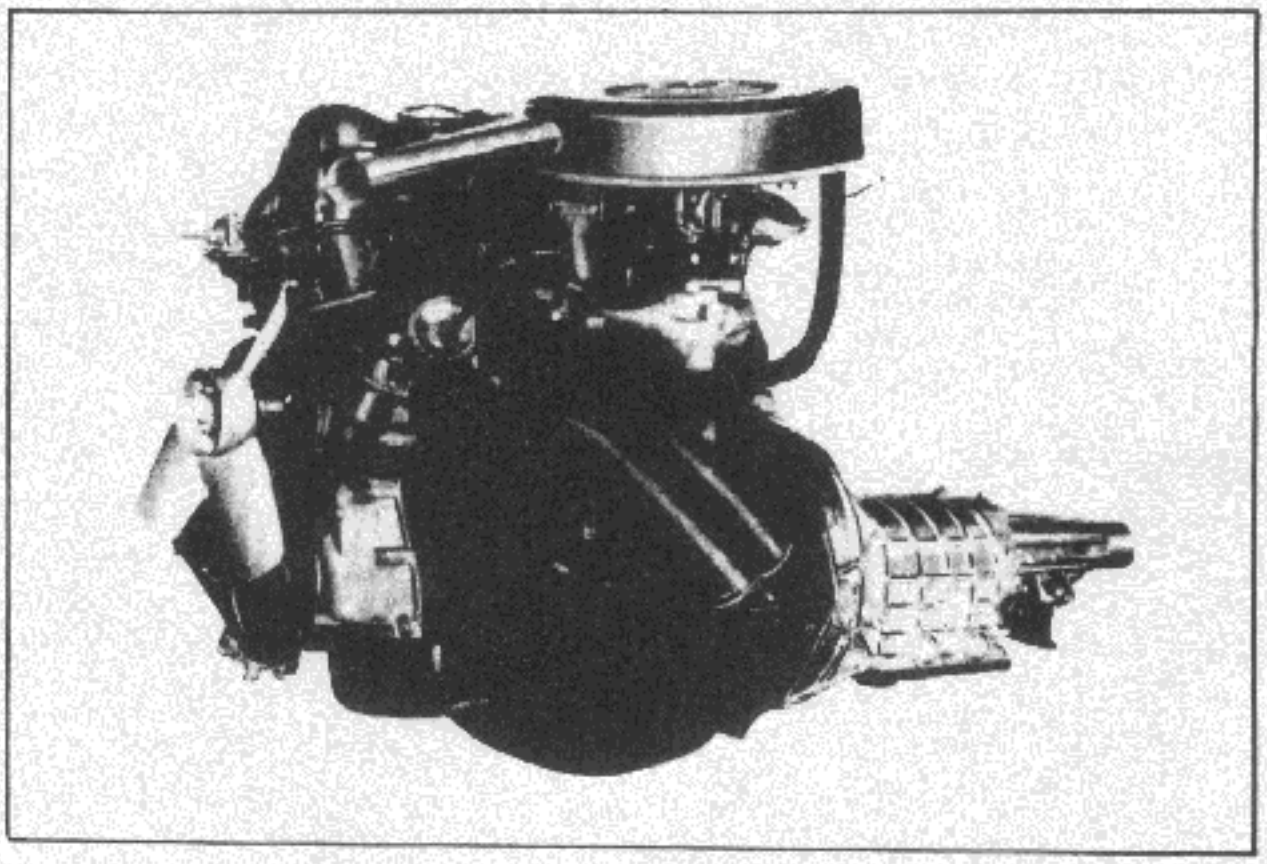


Fig. EM-1 General view of L13 engine

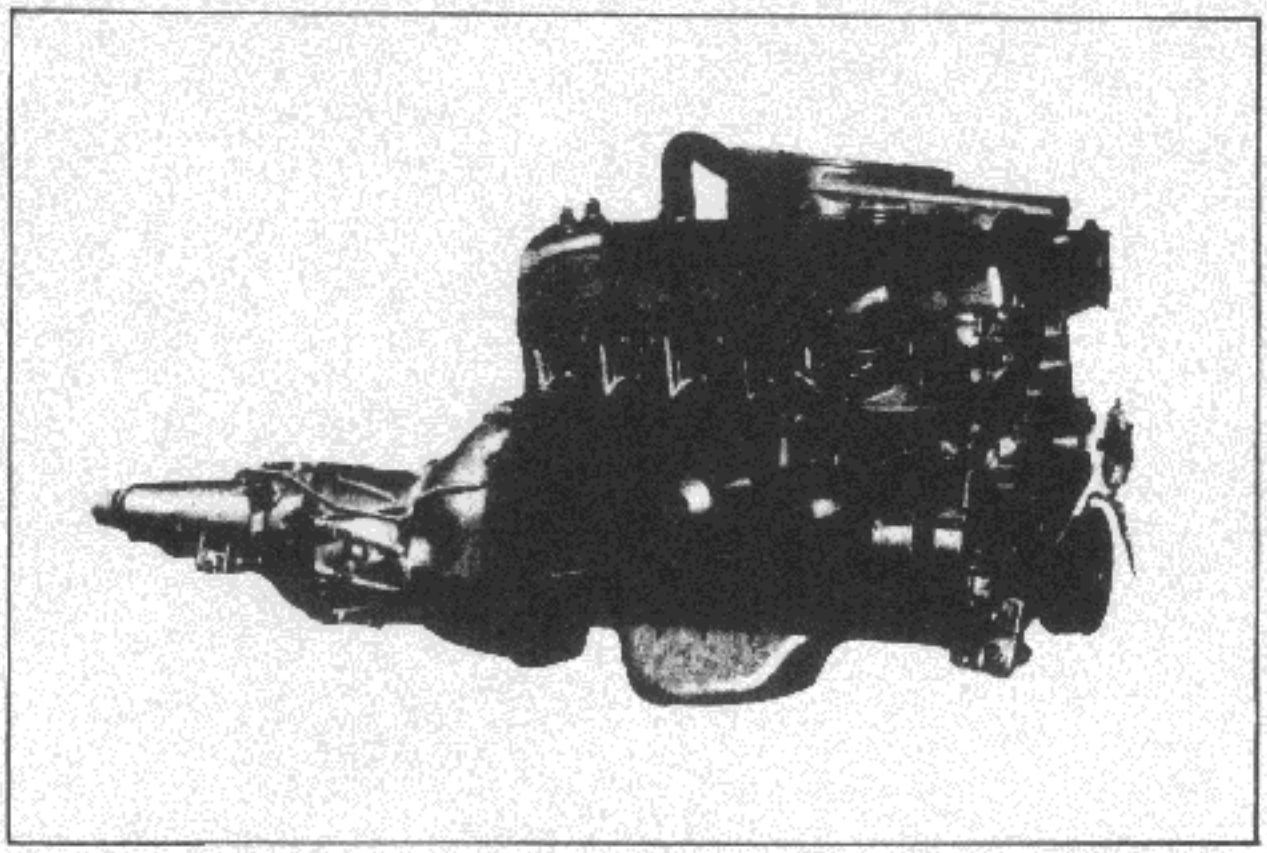


Fig. EM-2 General view of L20 engine

L13 ENGINE

L13 engine is a 1,296 cc (79.1 cu.in.) in line overhead camshaft four-cylinder engine and has 83 mm (3.2677 in.) bore and 59.9 mm (2.3583 in.) stroke with a compression ratio of 8.5 : 1. This engine is of a lightweight design using many aluminum dicast parts. Using a two barrel type single carburetor, L13 engine develops a maximum output of 77 HP/6,000 r.p.m. (SAE).

L16 ENGINE

L16 engine is of the same general design and external appearance as L13 engine, differing principally stroke, power and dimension of parts to bear higher output.

L16 engine is a 1,595 cc (97.3 cu.in.) in line OHC four-cylinder engine and has 83 mm (3.2677 in.) bore and 73.7 mm (2.9016 in.) stroke.

L16 engine is available in two types. In one type, which uses two SU type carburetors, it develops a maximum output of 109 HP/6,000 r.p.m. (SAE) at a compression ratio of 9.5 : 1. The other type, which uses a single carburetor of a two barrel type, develops a maximum output of 96 HP/5,600 r.p.m. (SAE) at a compression ratio of 8.5 : 1.

These two type engines are differing in the cylinder head, valves and pistons.

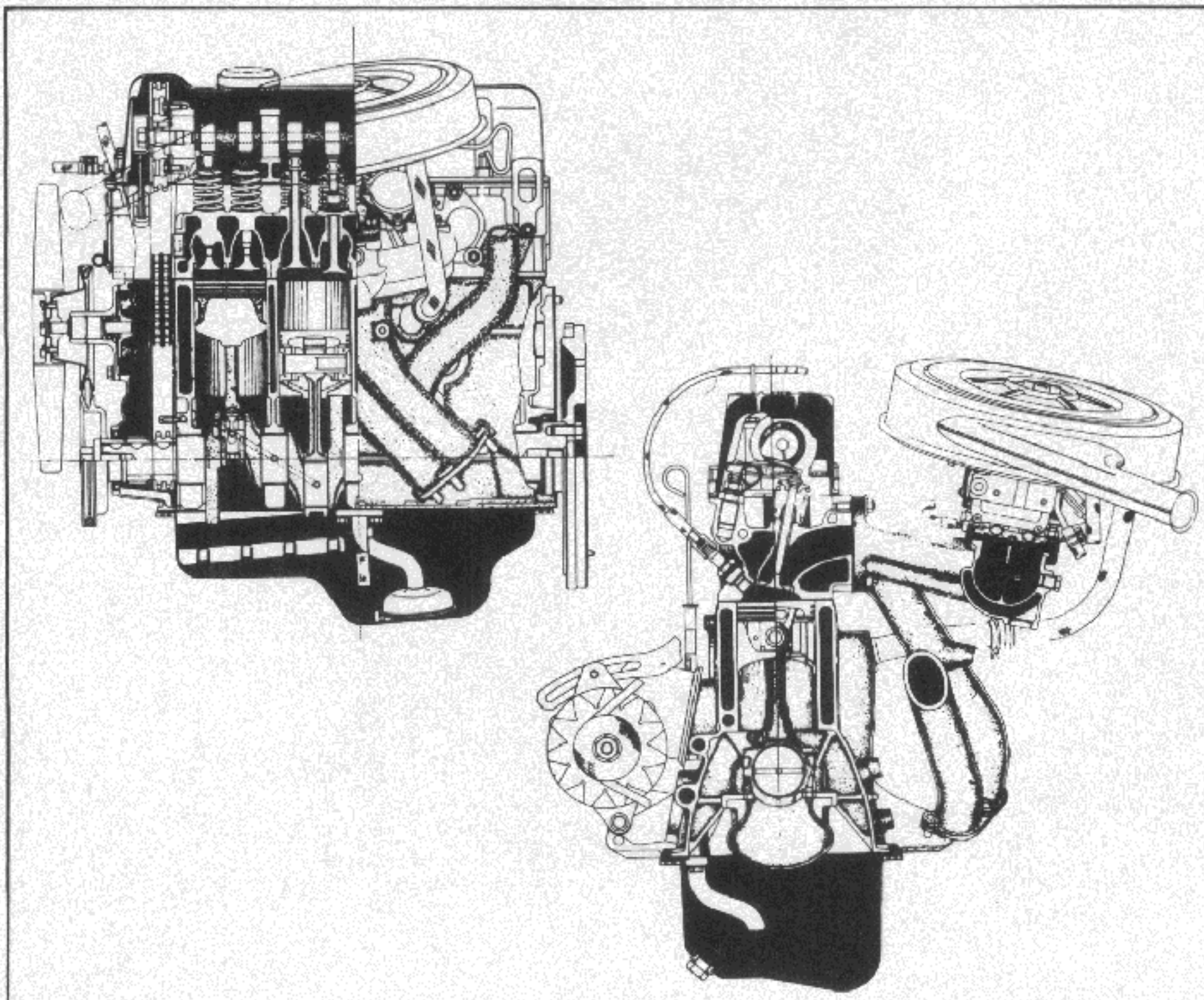


Fig. EM-3 Sectional view of L13 engine

L20 ENGINE

L20 engine is a 1,998 cc (121.9 cu. in.) in line overhead camshaft six-cylinder engine and of the same general design and external appearance as L13 or L16 engine differing principally in the number of cylinders.

L20 engine is available in two types. In one type, which uses two SU type carburetors, it develops a maximum output of 123 HP/5,600 r.p.m. (SAE) at a compression ratio of 9.0 : 1. The other type, which uses a single carburetor of a two barrel type, is capable of a maximum output of 112 HP/5,600 r.p.m. (SAE) at a compression ratio of 8.5 : 1.

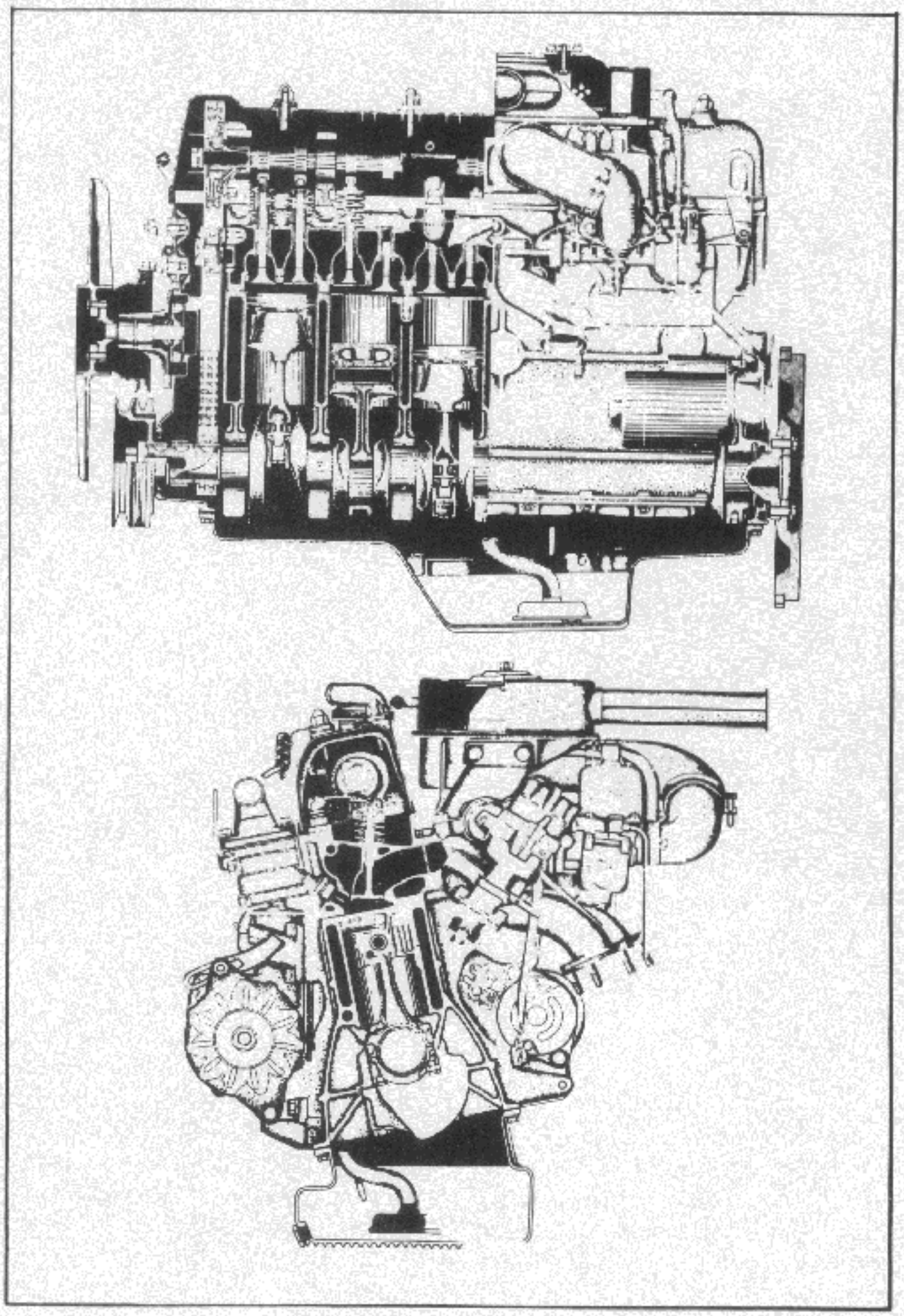


Fig. EM-4 Sectional view of L20 engine

CYLINDER BLOCK

The cylinder block, which is of a monoblock special casting structure, adopts the seven bearing-support system (L20 engine) and the five bearing-support system (L13 and L16 engine) for quietness and higher durability. Of a highly rigid deep-skirt design, it requires no complicated tappet chamber because of the OHC engine system and thus is light-weight.

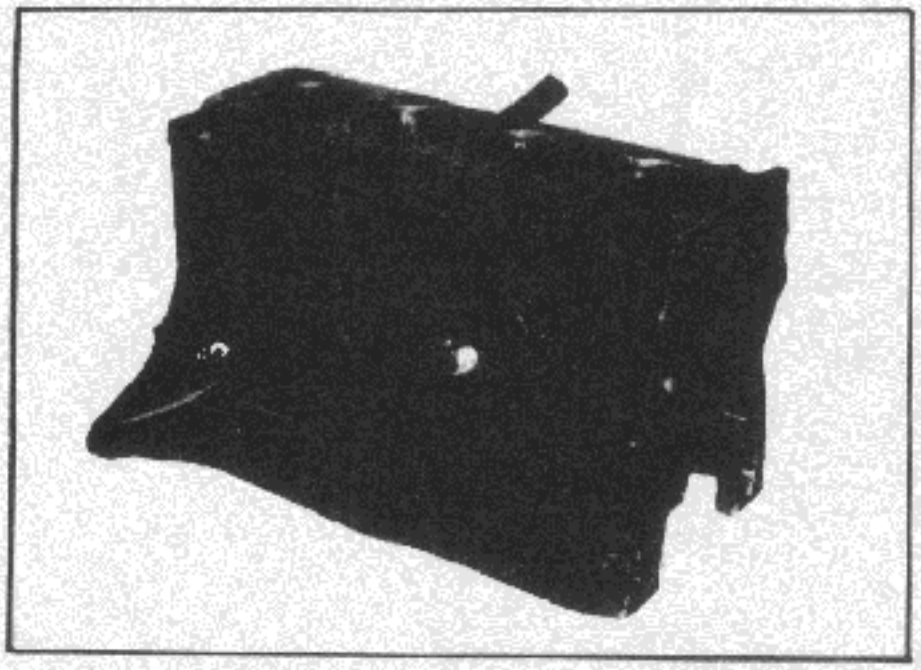


Fig. EM-5 L13 and L16 engine

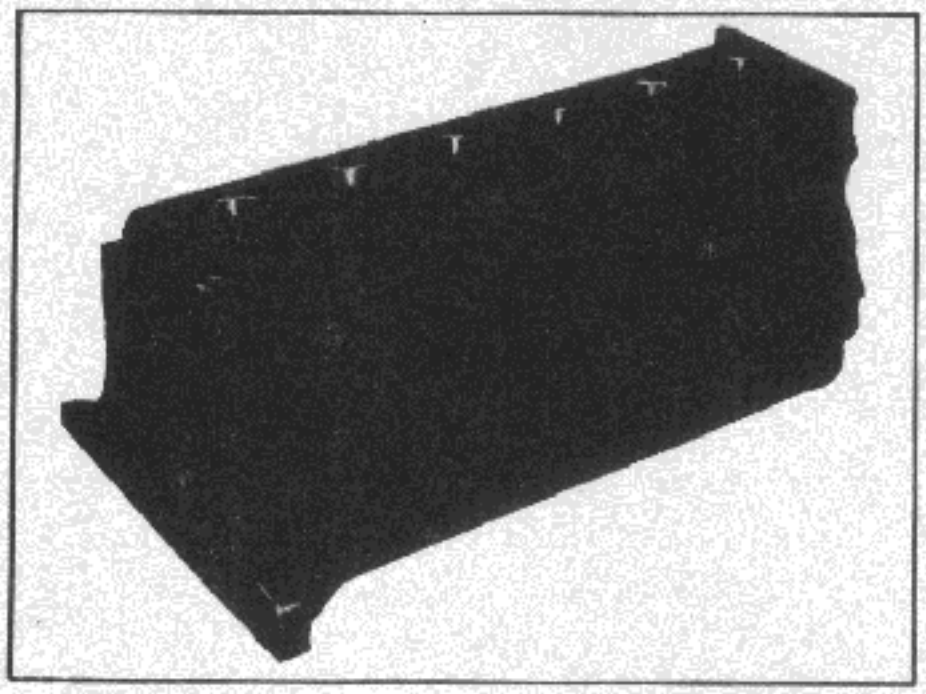


Fig. EM-6 L20 engine

CRANKSHAFT

The crankshaft is fabricated of special forged steel. Provided with a high capacity balance weight, it shows quietness and high durability at high speed operation. Main bearings are lubricated from oil holes which intersect the main oil gallery which runs parallel to the cylinder bores.

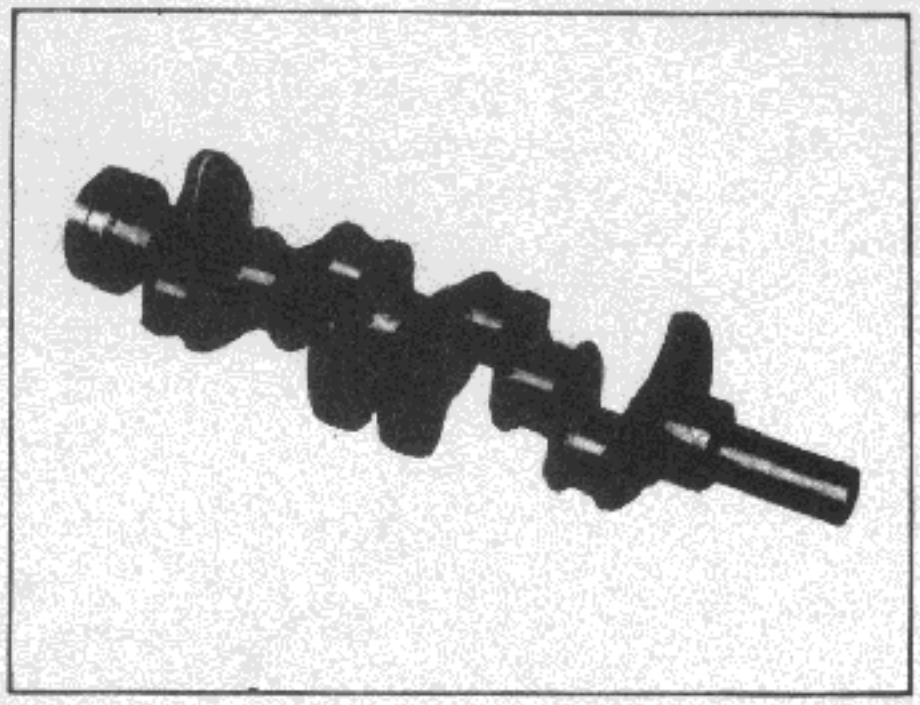


Fig. EM-7 L13 and L16 engine

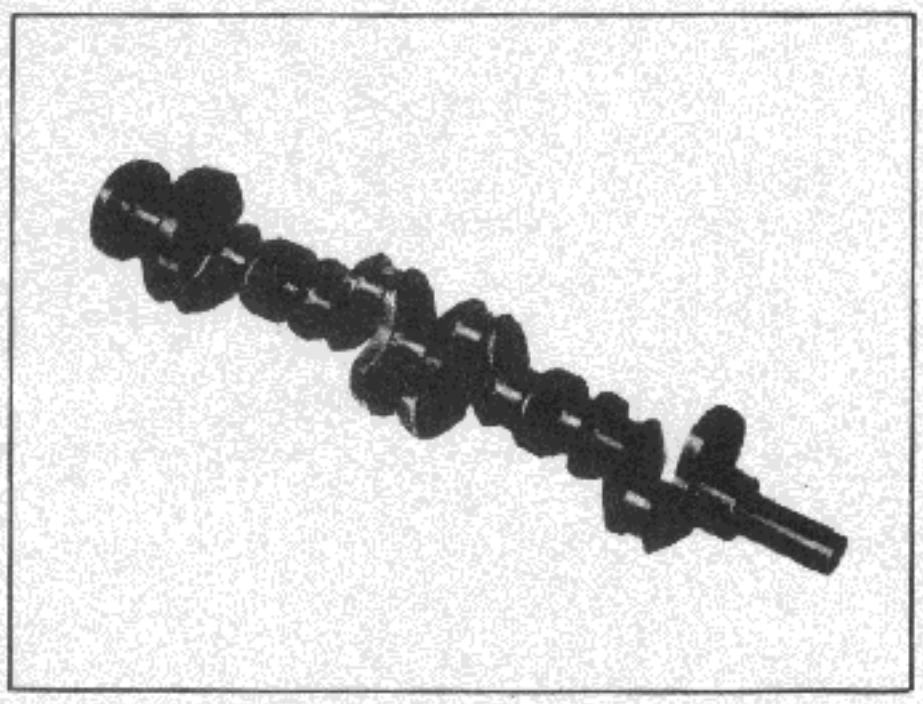


Fig. EM-8 L20 engine

PISTONS AND CONNECTING RODS

New-design light-weight pistons are of cast aluminum slipper-skirt type with invar-strut. Only L16 engine with a single carburetor uses the concave head pistons and others use the flat head pistons. The piston pin is of a special steel hollow type and is connected to the piston in a full floating fit, and is press-fitted onto the connecting rod.

Connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjucent main bearing journal. Oil holes at the connecting rod journals are located so that oil is supplied to give maximum lubrication just prior to full bearing load.

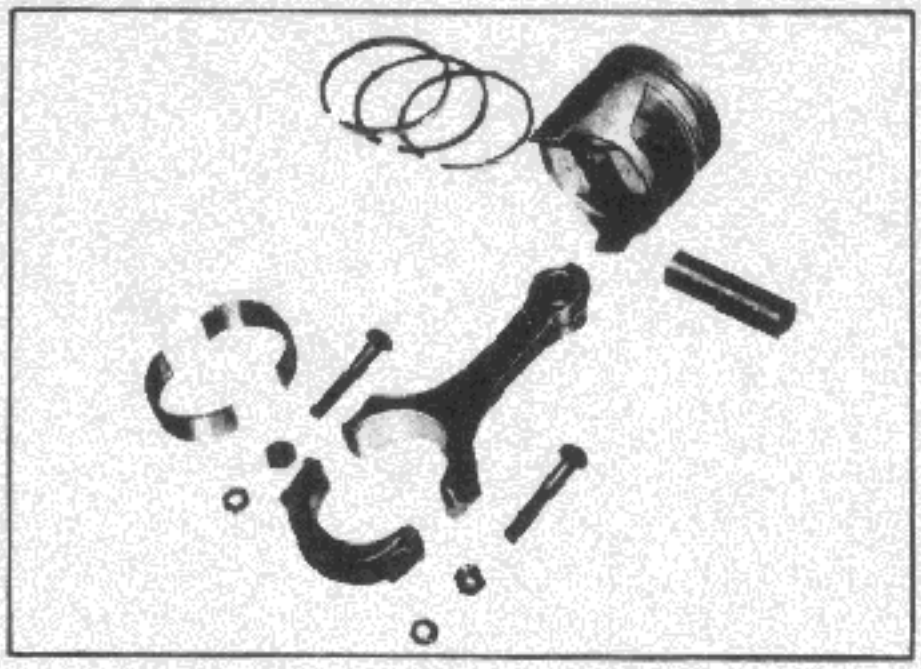


Fig. EM-9 Piston and connecting rod

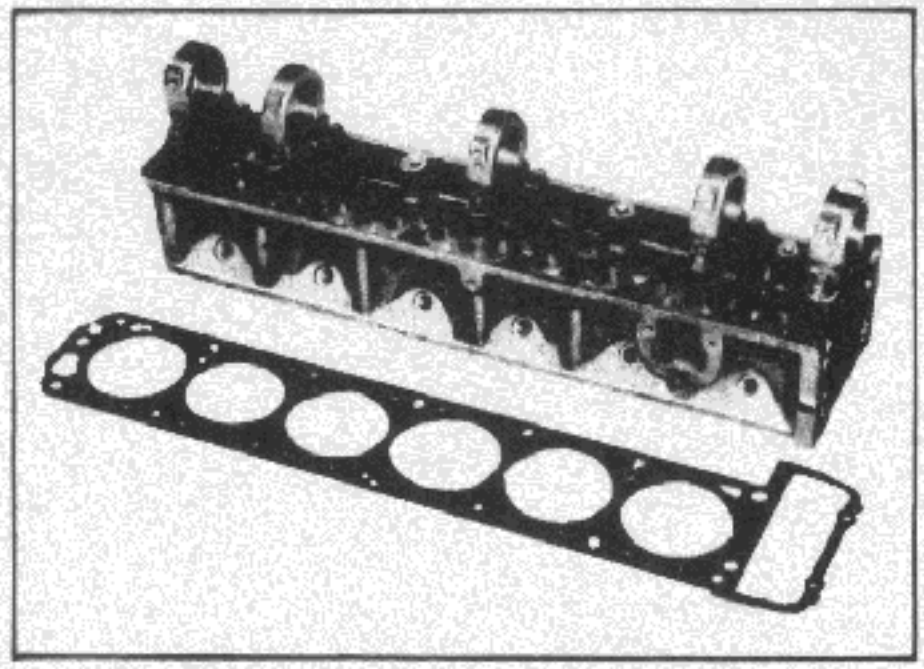


Fig. EM-11 Cylinder head (L20 engine)

CYLINDER HEAD

The cylinder head is made of light and strong aluminum alloy with good cooling efficiency. A special aluminum bronze valve seat is used on the intake valve, while a special cast valve seat is installed on the exhaust valve. These parts are all hot press-fitted.

The cylinder head of L16 engine is different between the single carburetor engine and the SU-twin carburetor engine. Though the valve diameters of the former are the same as those of L13 engine, L16 engine with SU carburetors uses the valves of larger diameter. And in connection with the compression ratio, the dome processing is adopted on the combustion chamber area of the cylinder head only for the single carburetor L16 engine.

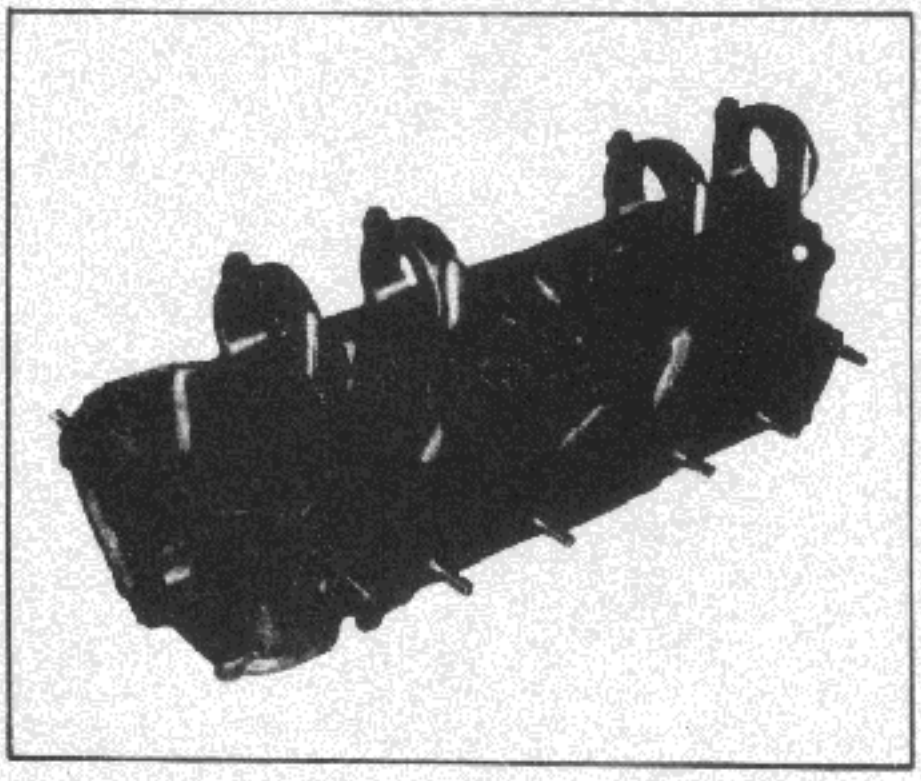


Fig. EM-10 Cylinder head (L13 and L16 engine)

CAMSHAFT

Camshaft is made of special cast iron and located inside the rocker cover. In L13 and L16 engine, four aluminum alloy brackets support the camshaft and in L20 engine five aluminum alloy brackets support the camshaft.

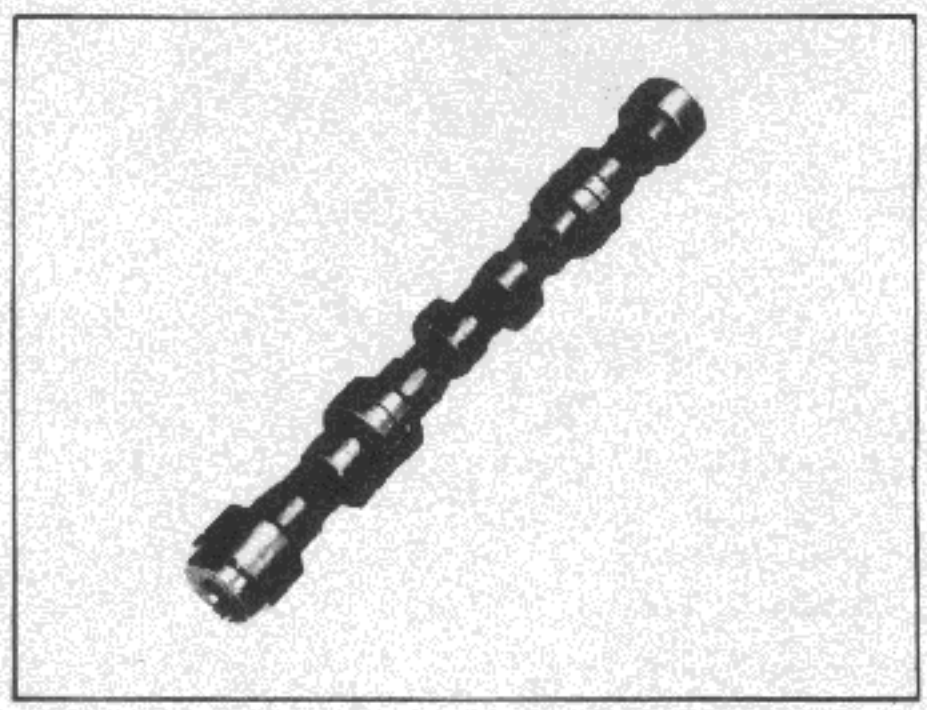


Fig. EM-12 Camshaft

Camshaft bearings are lubricated from oil holes which intersect the main oil gallery of the cylinder head.

The lubrication method to the cam pad surface of the rocker arm and to the valve tip end in L13 and L16 engine is quite different from that in L20 engine.

In L13 and L16 engine concentric passages drilled in the front and rear part of the camshaft from the galleries which supplies oil to each cam lobe through an oil hole drilled in the base circle of each lobe. Lubrication is

supplied to the front oil gallery from 2nd camshaft bearing and to the rear oil gallery from 3rd camshaft bearing. These holes on the base circle of lobe supply lubrication to the cam pad surface of the rocker arm and to the valve tip end.

In L20 engine there is no oil gallery in the camshaft and to lubricate the cam pad surface of the rocker arm an oil pipe with many oil holes is provided along the camshaft. This oil pipe provided is supported by No. 1, 3 and 5 camshaft brackets and from No. 3 brackets lubrication is supplied to this oil pipe.

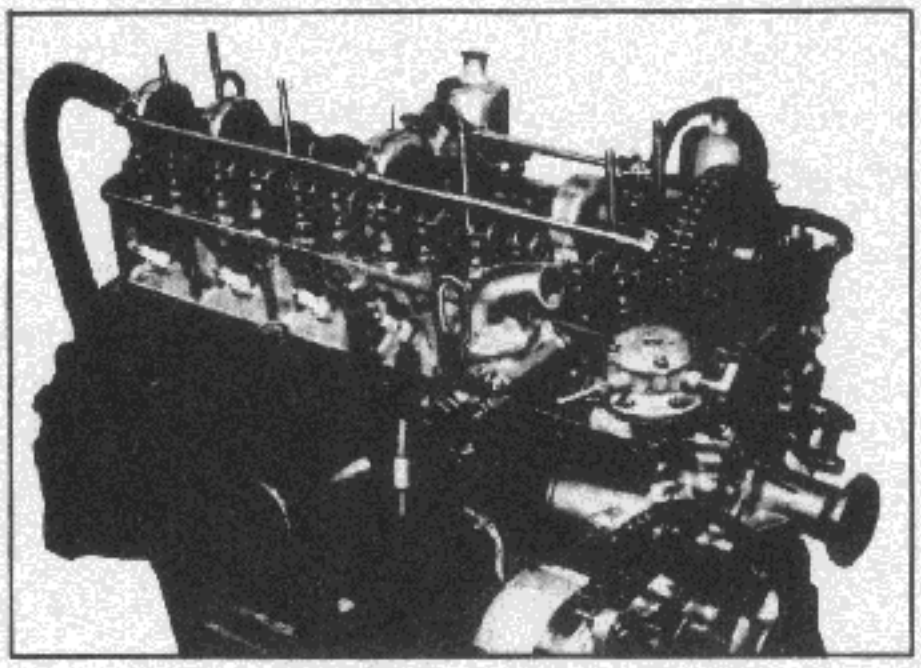


Fig. EM-13 L20 engine

VALVE MECHANISM

The valve system has a pivot type rocker arm that is activated directly by the cam mechanism, and this has made its moving parts considerably lighter and provides an ideal high-speed performance.

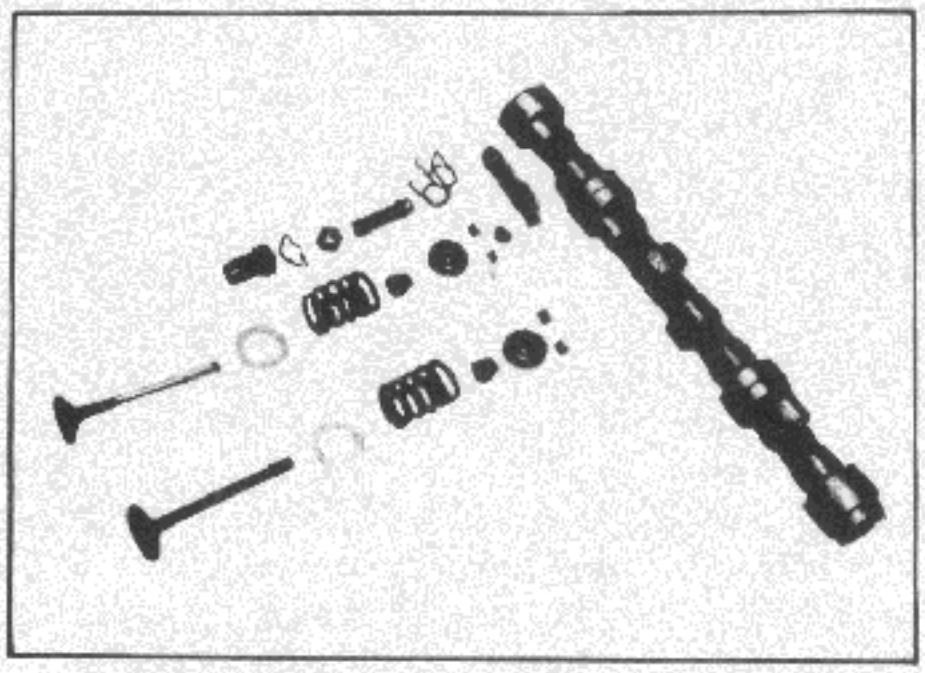


Fig. EM-14 Valve machanism (L13 engine)

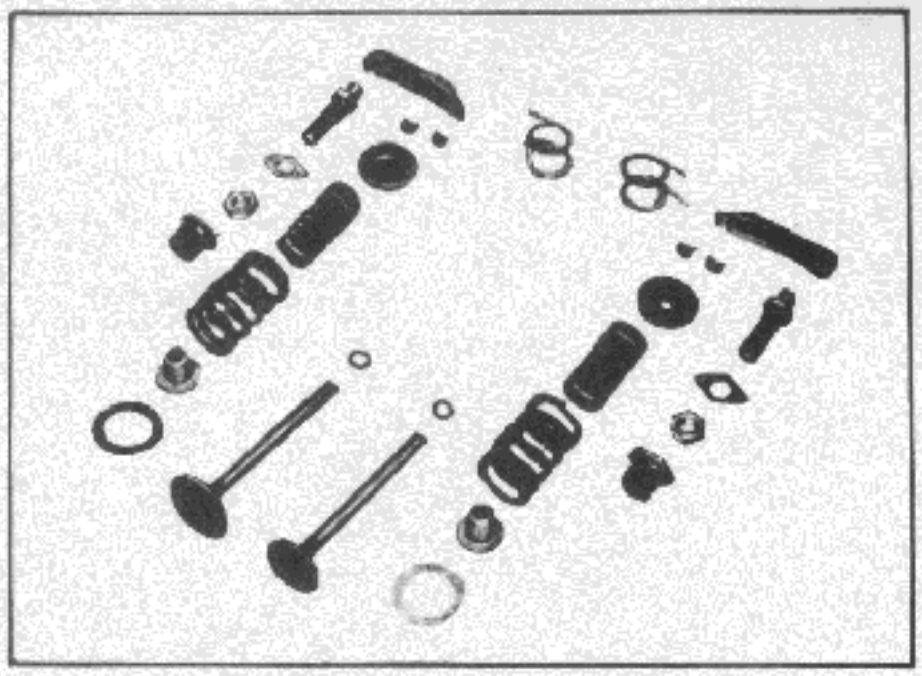


Fig. EM-15 Valve mechanism (L20 engine)

Only L13 engine uses the single type valve springs and all other engines use the dual type valve springs.

CAMSHAFT DRIVE

Camshaft is driven by a double row roller chains driven by crankshaft. The tension of the chain is controled by a chain tensioner which are operated by spring and oil pressure.
Two types of tensioner are used in this L engine series. In L13 and L16 engine a rubber shoe type tensioner will insulate the vibration of the chain and control the tension of the chain.
In L20 engine an idler gear combined with the chain damper is used.

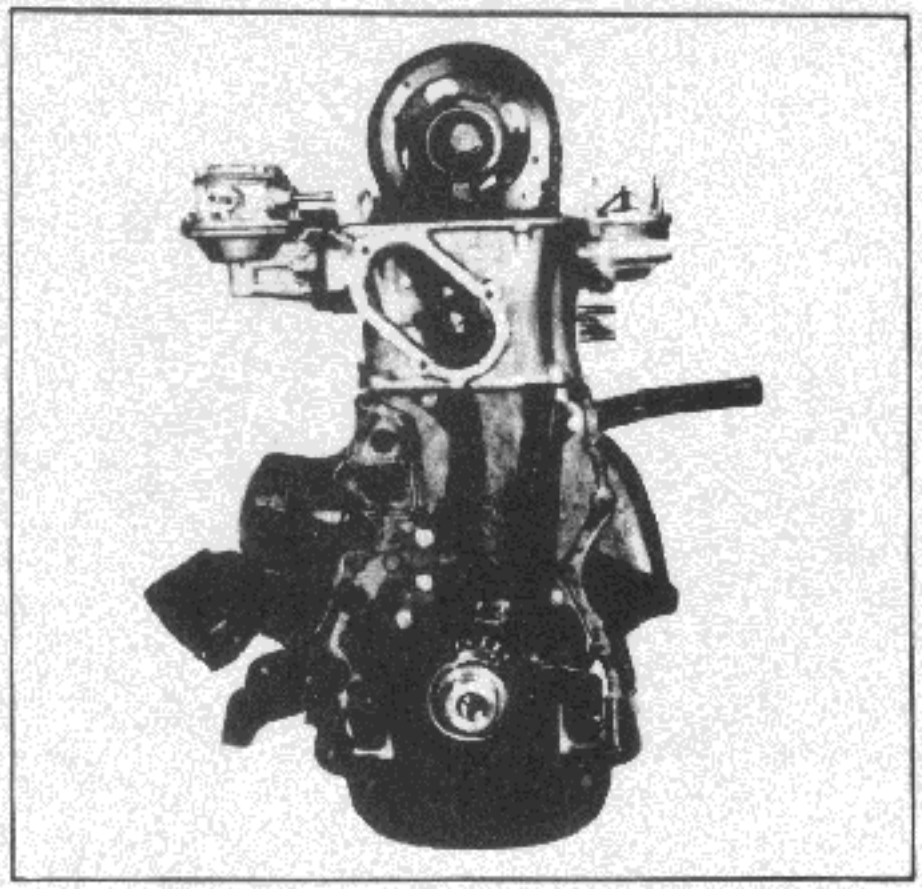


Fig. EM-16 L13 and L16 engine

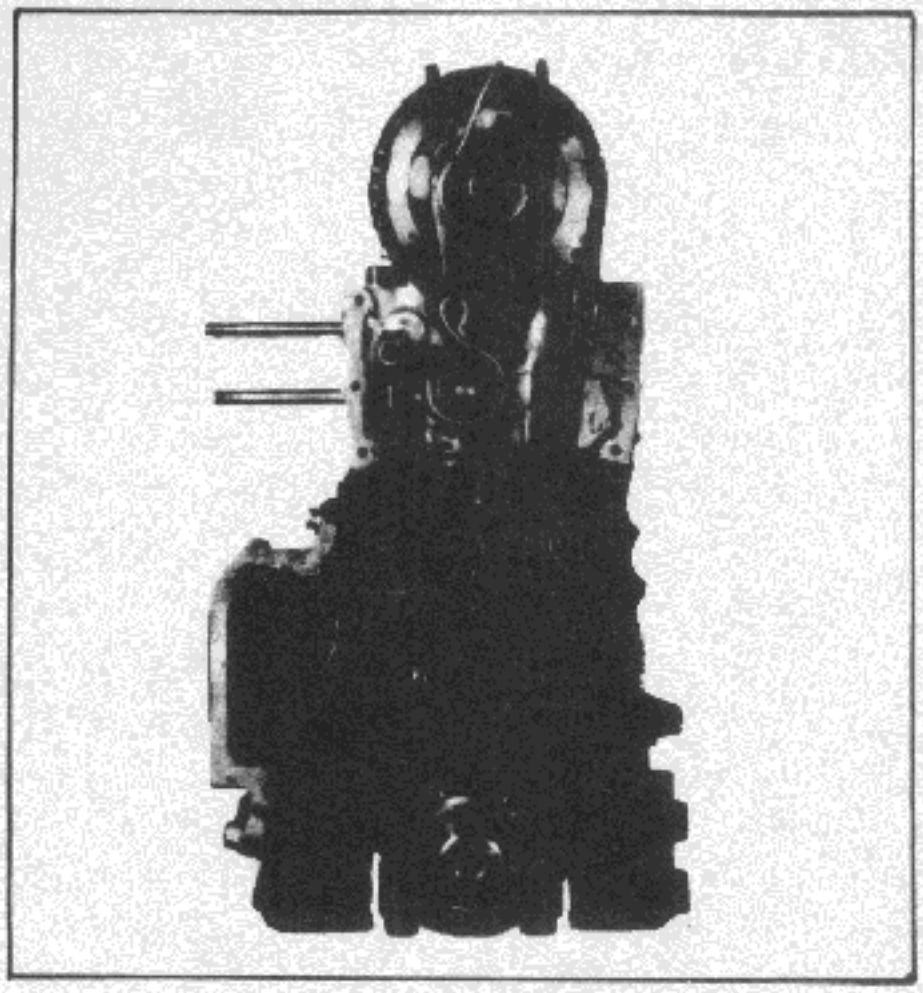


Fig. EM-17 L20 engine

MANIFOLDS

The intake manifold is aluminum cast. The twin-carburetor type engine uses one with an independent design for each carburetor, while the single-carburetor type has a monoblock manifold.

The exhaust manifold, identical in design on both engine types, is a dual exhaust system intended to prevent decline in output due to exhaust interference and to increase output through the inertia scavenging action. It is connected to exhaust pipes by flanges, which insure complete absence of exhaust leaks.

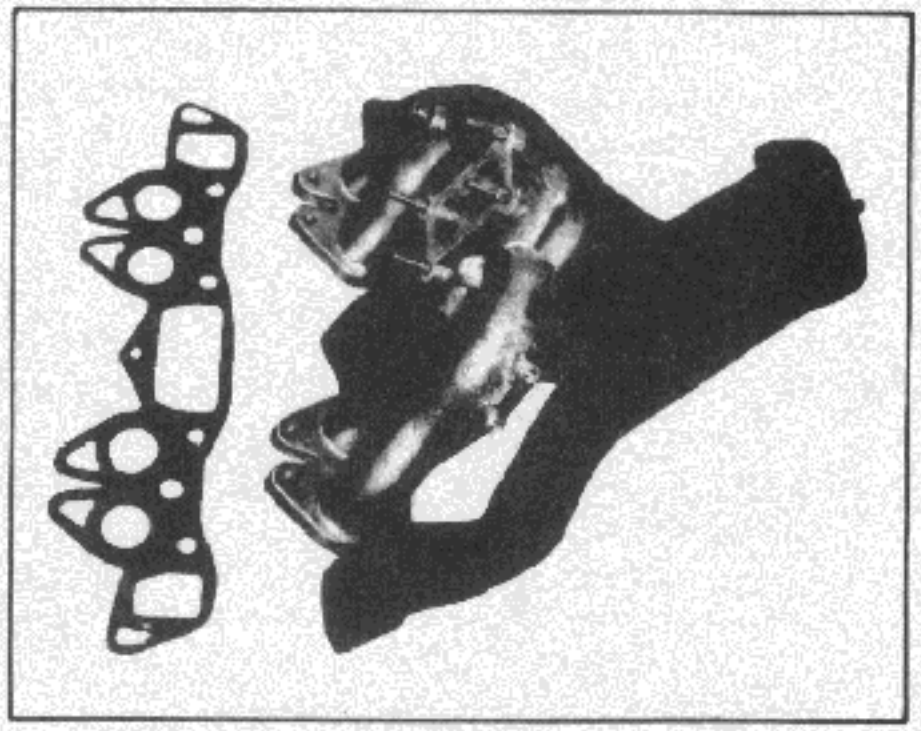


Fig. EM-18 Manifolds for L13 engine

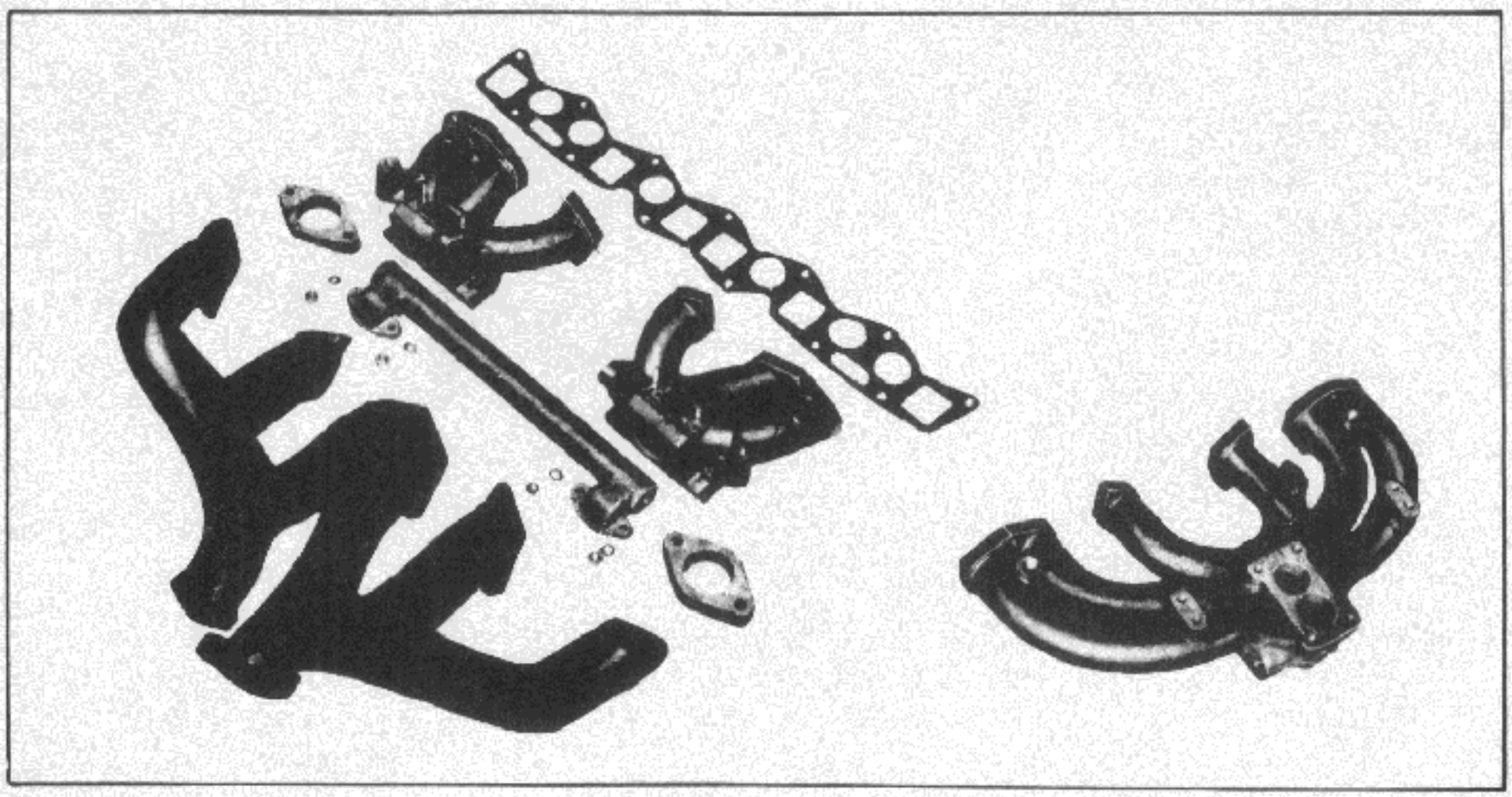


Fig. EM-19 Manifolds for L20 engine

ENGINE DISASSEMBLY

CONTENTS

CLEANING AND INSPECTING

Wash the engine throughly before disassembly. Before washing, remove the alternator, distributor and starter, and plug up the carburetor air-horn to avoid any infiltration of foreign matter.

1. The exterior of the engine: check the covers and bolts for breakage, rust, damage and loss.

2. Cylinder block: check throughly the water jacket for cracks and breakage.

3. Clutch housing: check for cracks.

4. Oil pan: check for excessive rust.

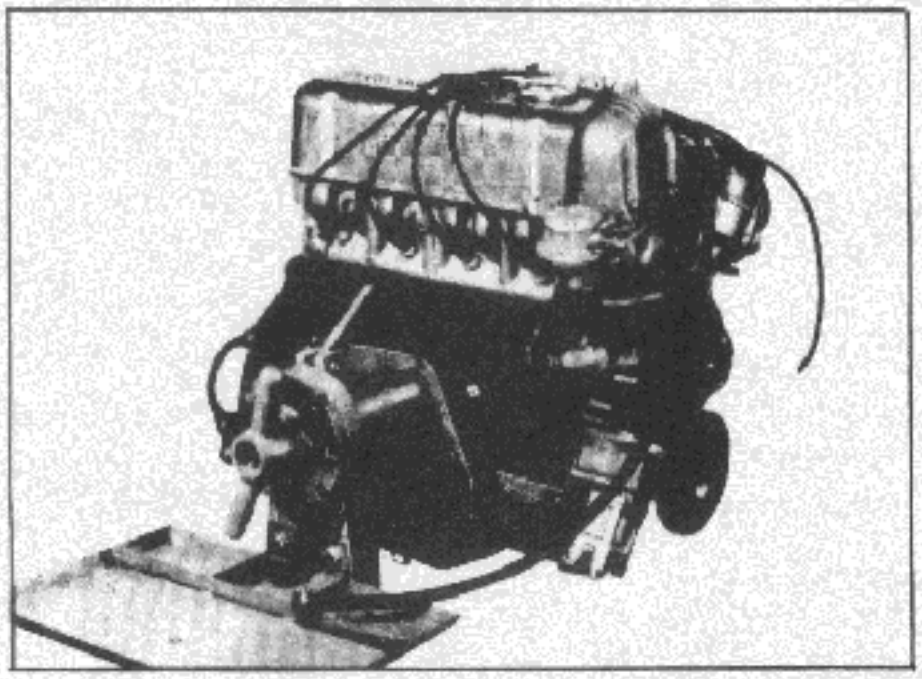


Fig. EM-20 L13 and L16 engine

DISASSEMBLY

1. Place the engine assembly on the engine stand.

(1) Remove the alternator (with bracket).

(2) Remove the engine mounting R. H.

(3) Remove the oil filter.

(4) Remove the water drain plug.

(5) Remove the oil pressure switch

(6) Remove the ignition coil. (only for L20 engine).

(7) Install the engine attachment.

(8) Set the engine on the stand.

Engine stand: ST37100000
Engine attachment ST37200510 (L13 and L16)
ST37200L20 (L20)

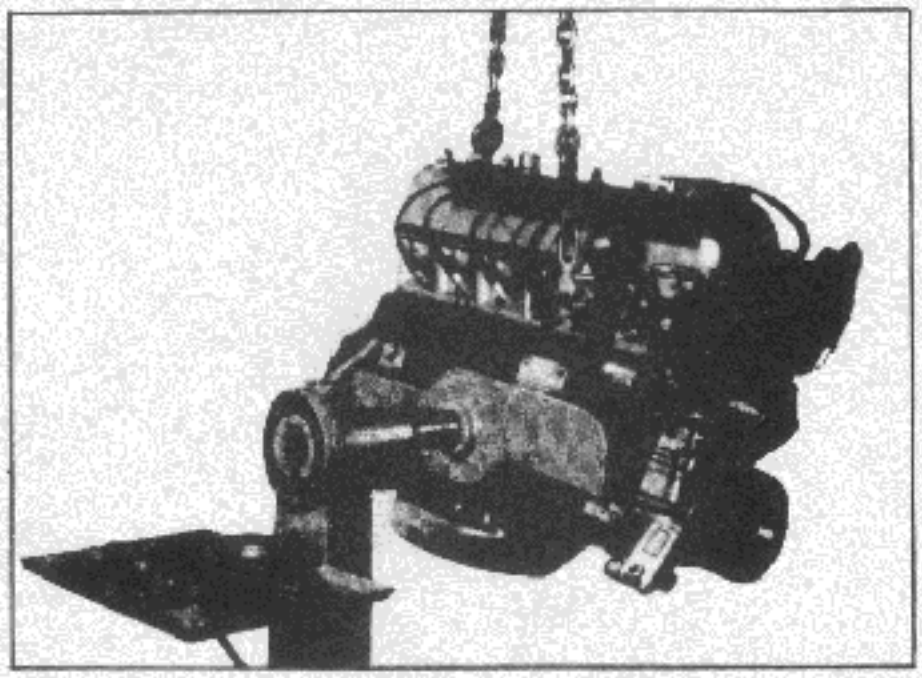


Fig. EM-21 L20 engine

2. Remove the high tension cable (with the distributor cap on).

3. Remove the spark plugs.

4. Remove the distributor assembly.

5. Remove the thermostat housing.

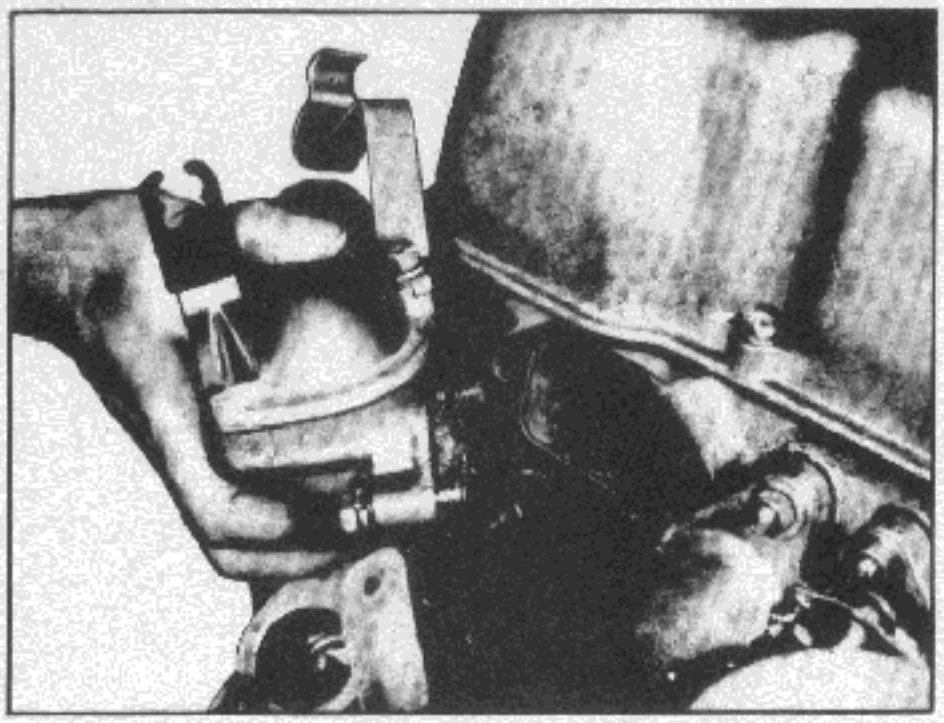


Fig. EM-22 Thermostat housing removal

6. Remove the intake and exhaust manifolds.

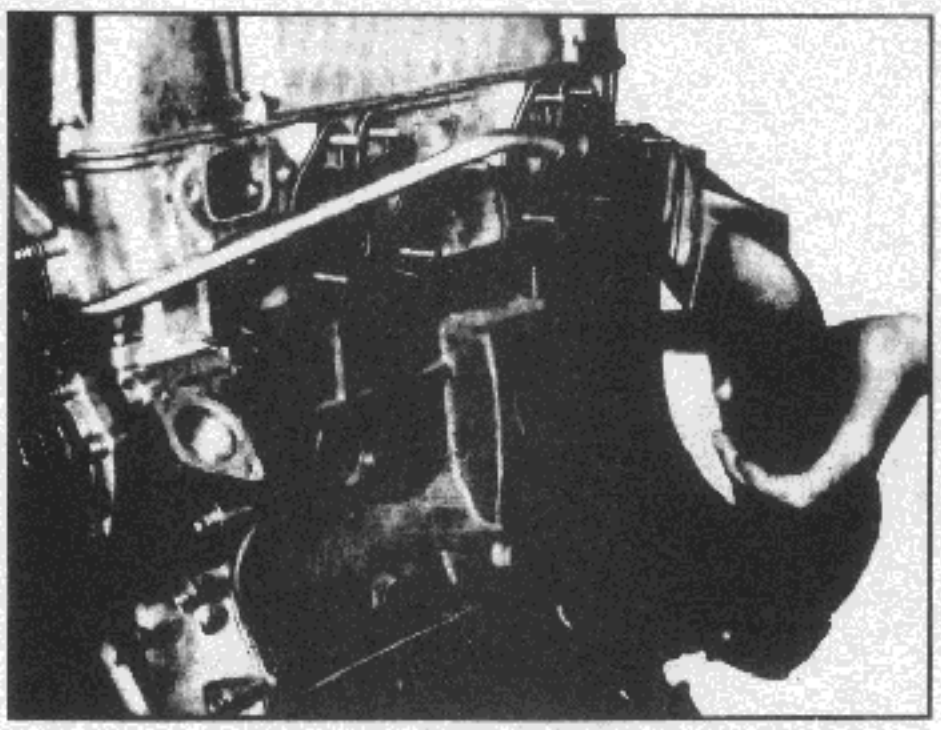


Fig. EM-23 Manifolds removal

7. Remove the engine mounting L.H.

8. Remove the crank pulley.

Note: **As for L20 engine the crank pulley is a vibration damper type. So on removal use a special tool.**

Special tool: ST44820000

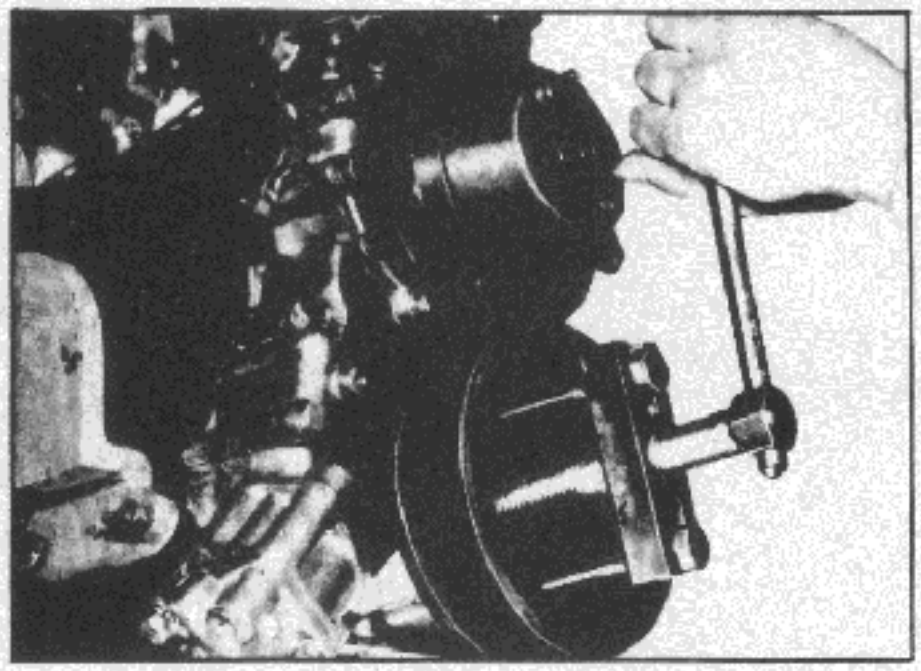


Fig. EM-24 Vibration damper removal

9. Remove the fan pulley and the water pump.

10. Remove the fuel pump.

11. Remove the rocker cover.

12. Remove the chain tensioner at the cylinder head front cover. Then, remove the cylinder head front cover. (Only for L20 engine).

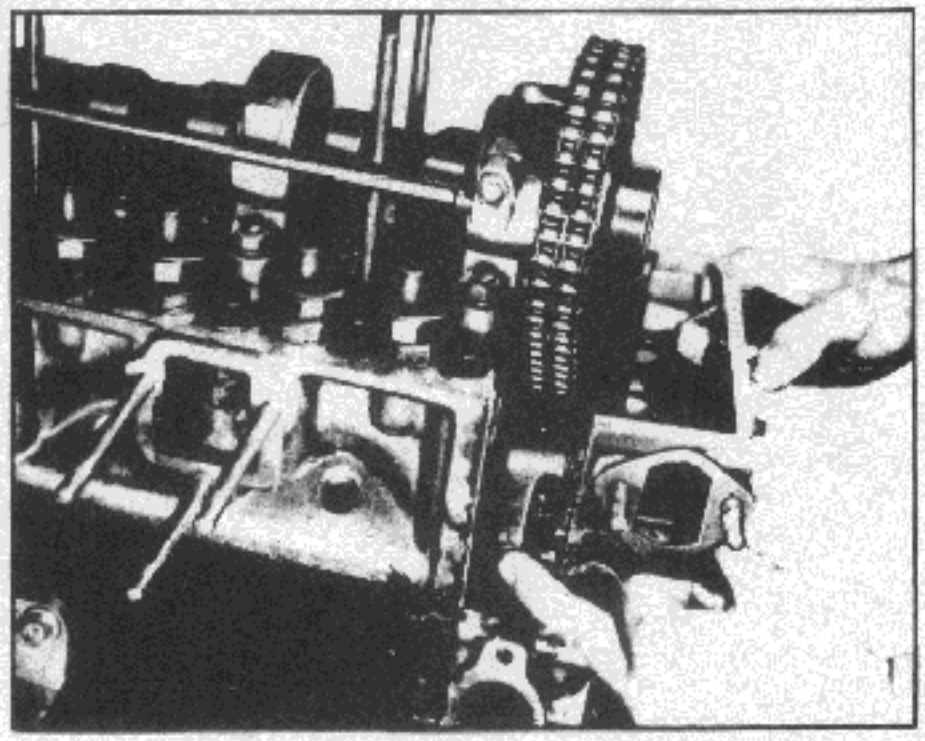


Fig. EM-25 Cylinder head front cover removal

13. Remove the fuel pump drive cam and the camshaft sprocket.

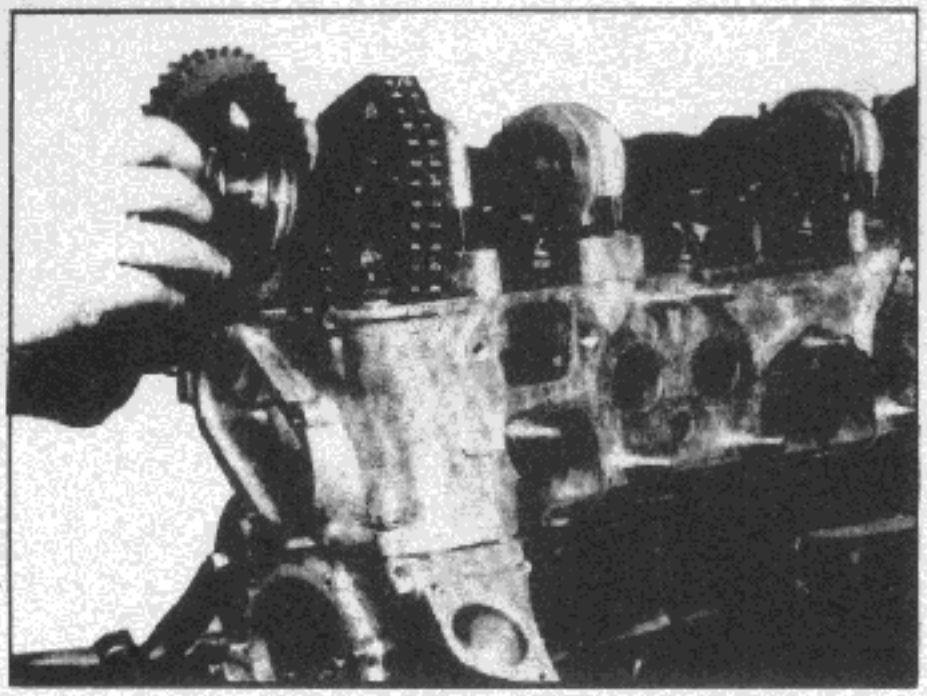


Fig. EM-26 Camshaft drive sprocket removal

14. Remove the idler gear (only for L20 engine).

15. Remove the cylinder head assembly. Use a special tool for removing the cylinder head bolts.

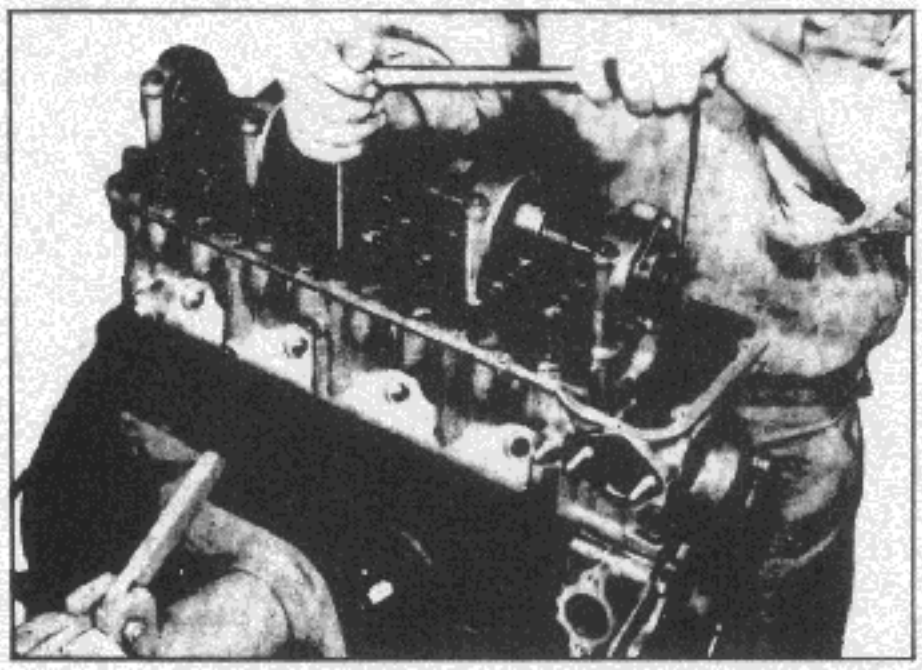
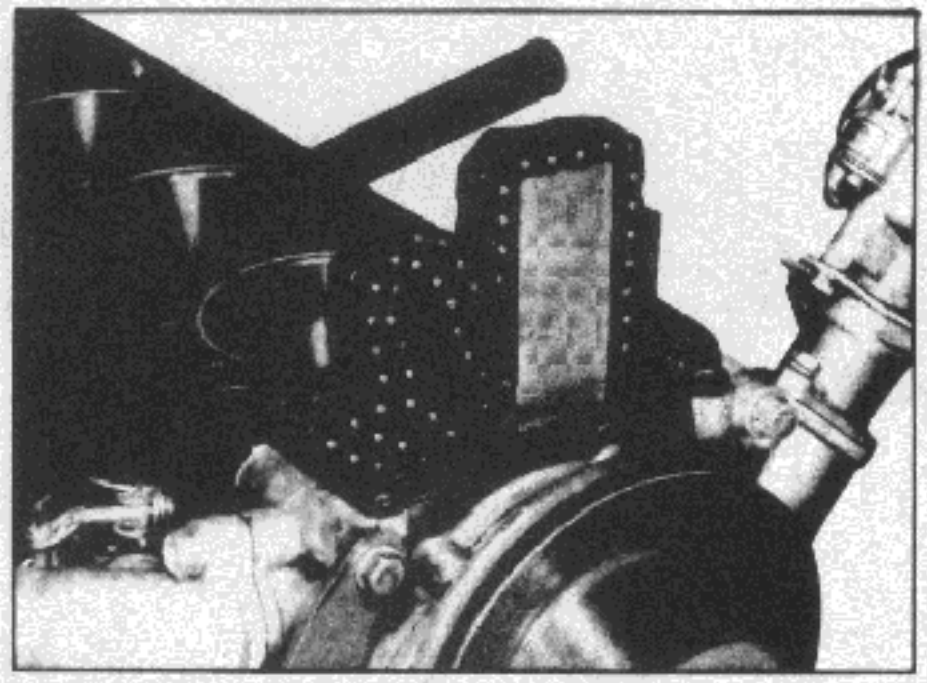


Fig. EM-27 Cylinder head removal

Special tool: ST44830000 for L20
ST49010000 for L13 and L16

Note: **For the convenience of the cylinder head replacement, a special service tool ST49350000 is prepared to support the timing chain during the service operation. By using this tool, the timing marks on the crankshaft sprocket and the timing chain will be unchanged. So the work for aligning the timing marks will be saved so much. This special tool is prepared only for L13 and L16 engine.**



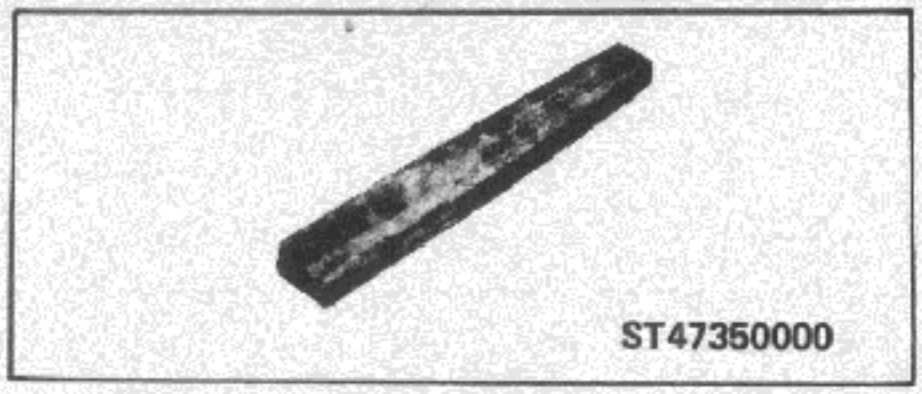


Fig. EM-28 Special tool for supporting the timing chain

16. Invert the engine.

17. Remove the oil pan and the oil strainer.

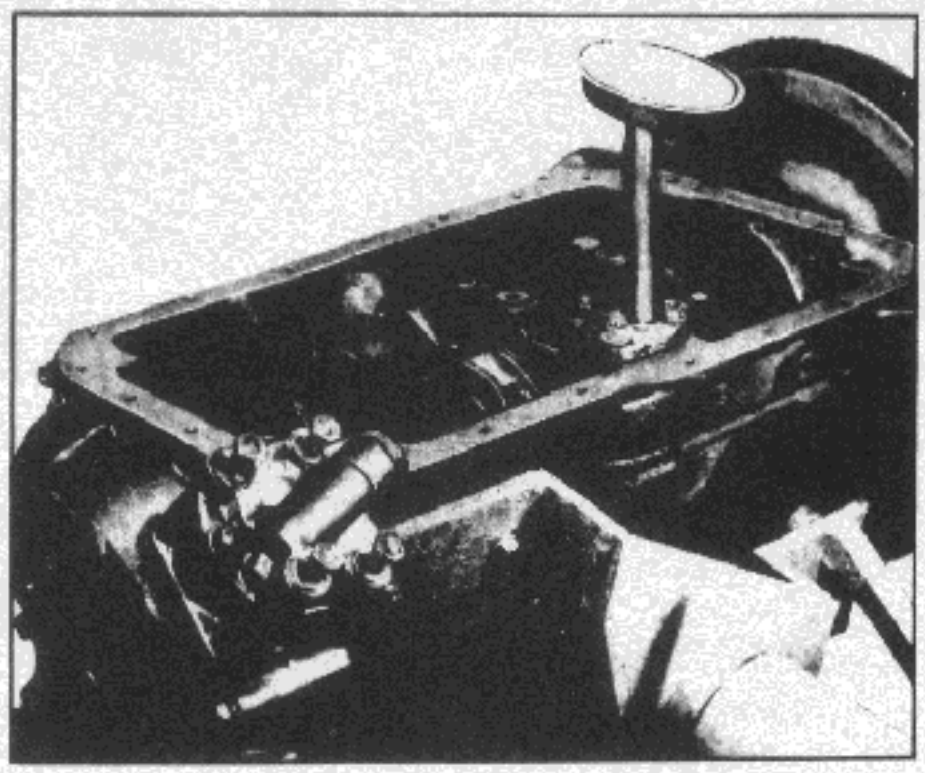


Fig. EM-29 Oil strainer removal

18. Remove the oil pump and its drive gear.

19. Remove the front cover.

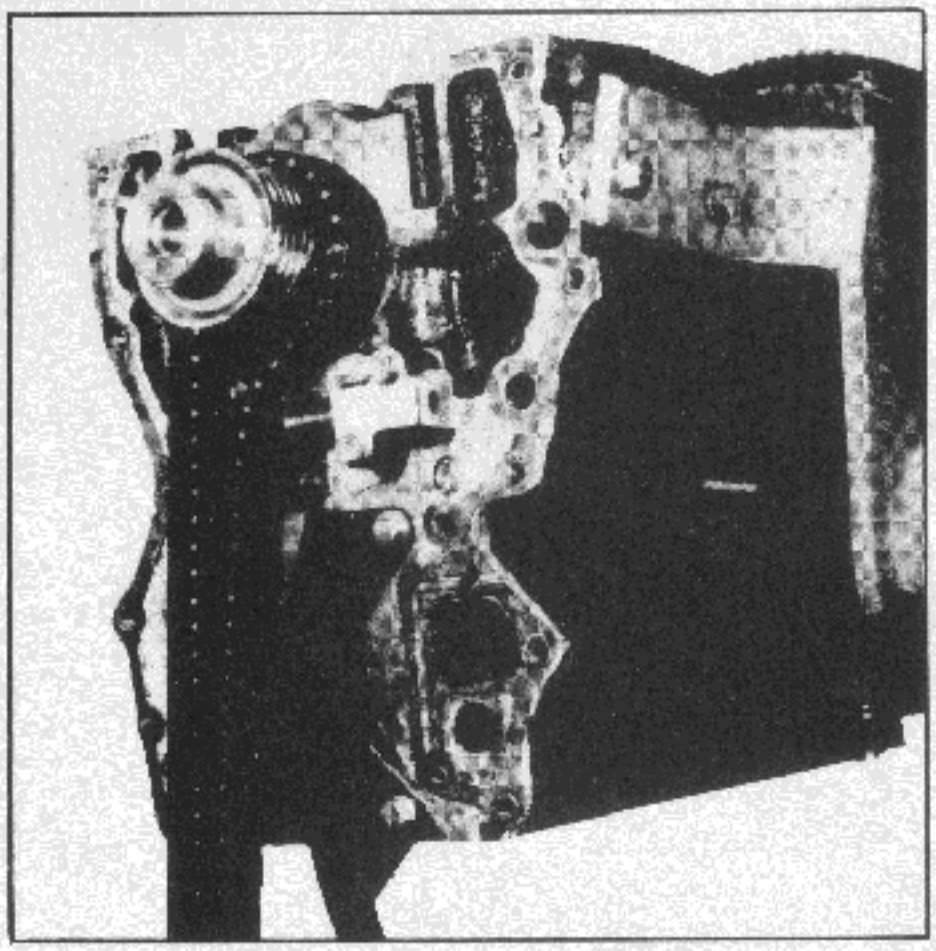


Fig. EM-30 Chain tensioner and timing chain removal

20. Remove the chain tensioner. (only for L13 and L16 engine)

21. Remove the timing chain.

22. Remove the oil thrower, the crankshaft worm gear and the chain drive sprocket.

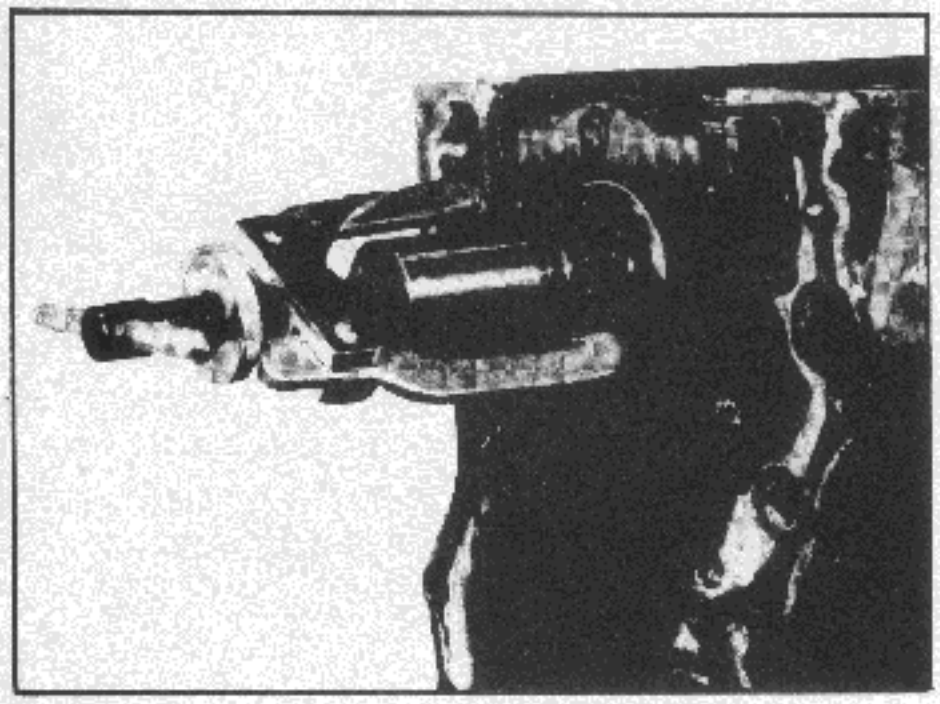


Fig. EM-31 Chain drive sprocket removal

23. Remove the piston and connecting rod assembly. Take off the connecting rod bearings at the same time and keep them in order.

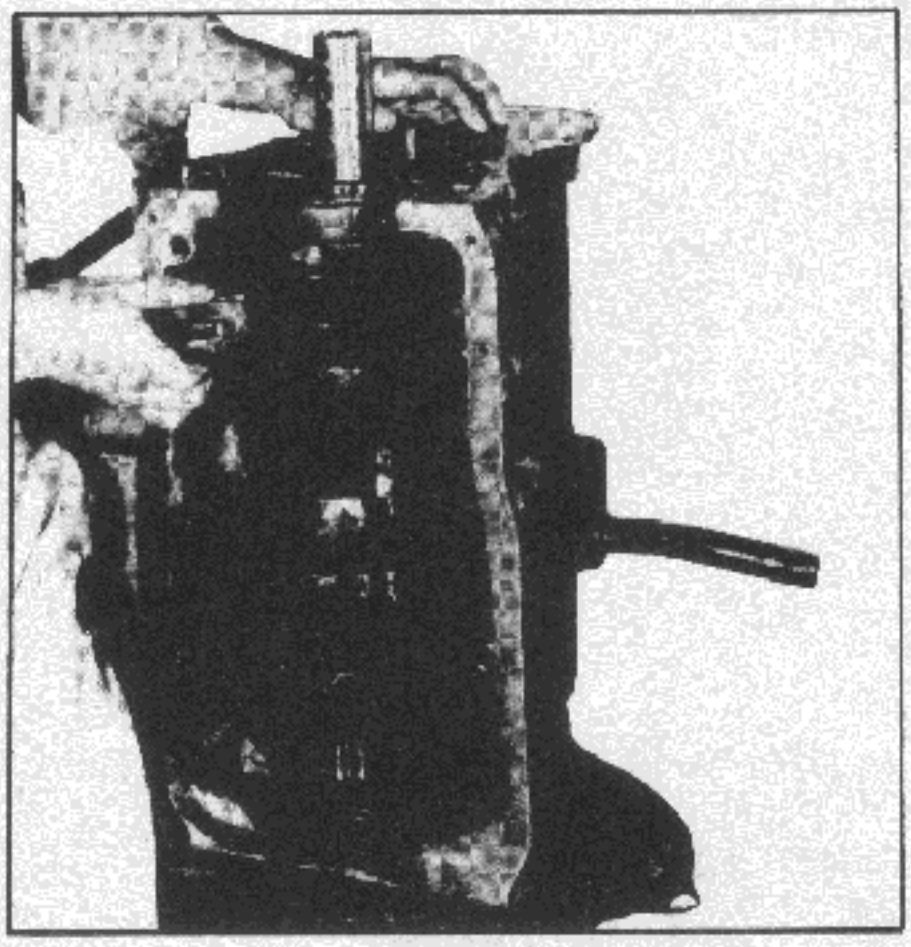


Fig. EM-32 Piston and connecting rod assembly removal

24. Remove the flywheel

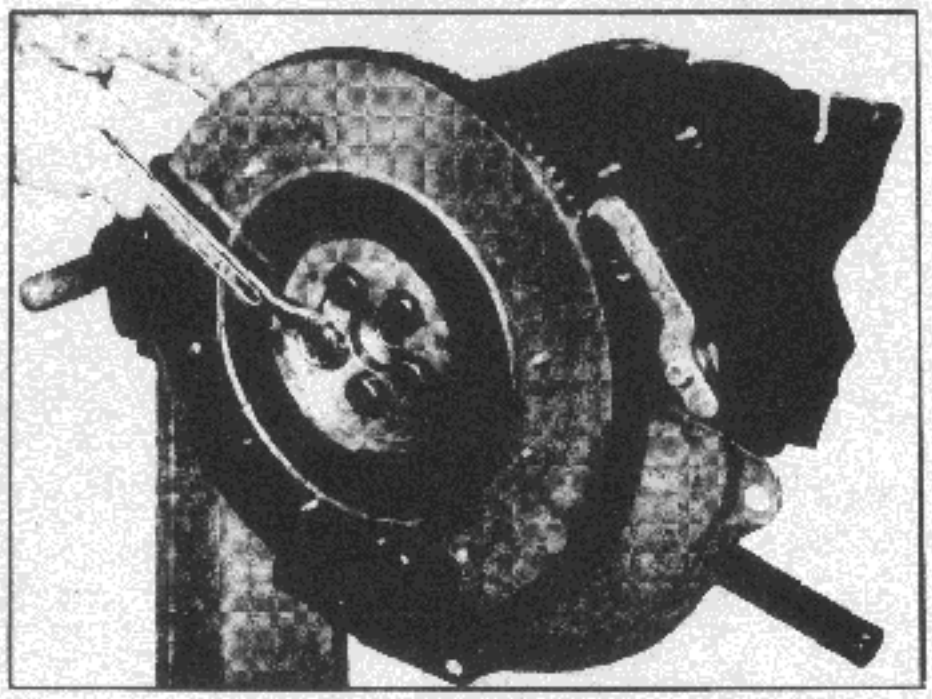


Fig. EM-33 Flywheel removal

25. Remove the main bearing cap.

Use a special tool for removing the rear main bearing cap.

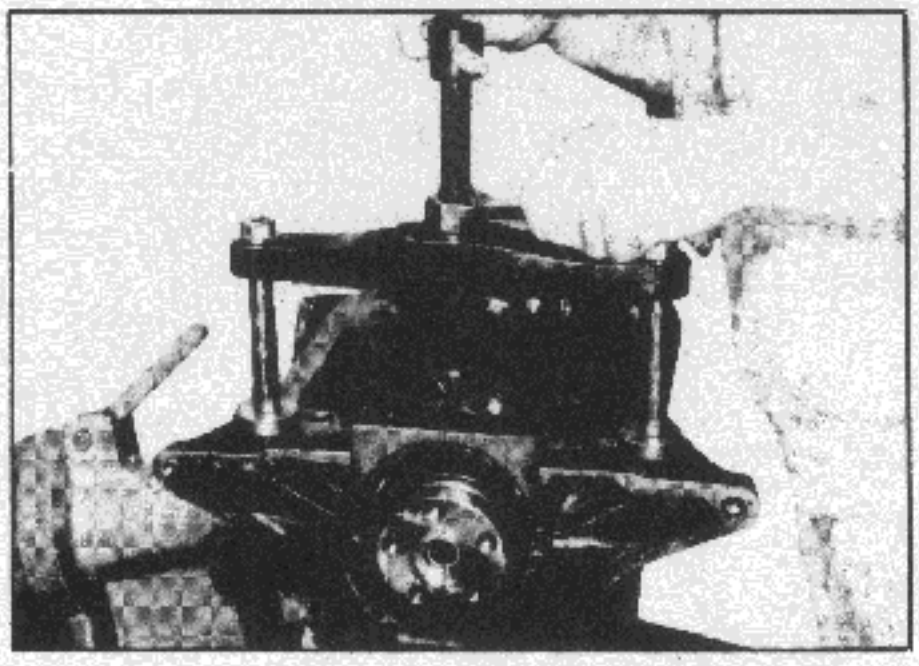


Fig. EM-34 Rear main bearing cap removal

Special tool: ST4463000D (L13 and L16)
ST44630000 (L20)

26. Remove the rear oil seal (only for L13 and L16 engine).

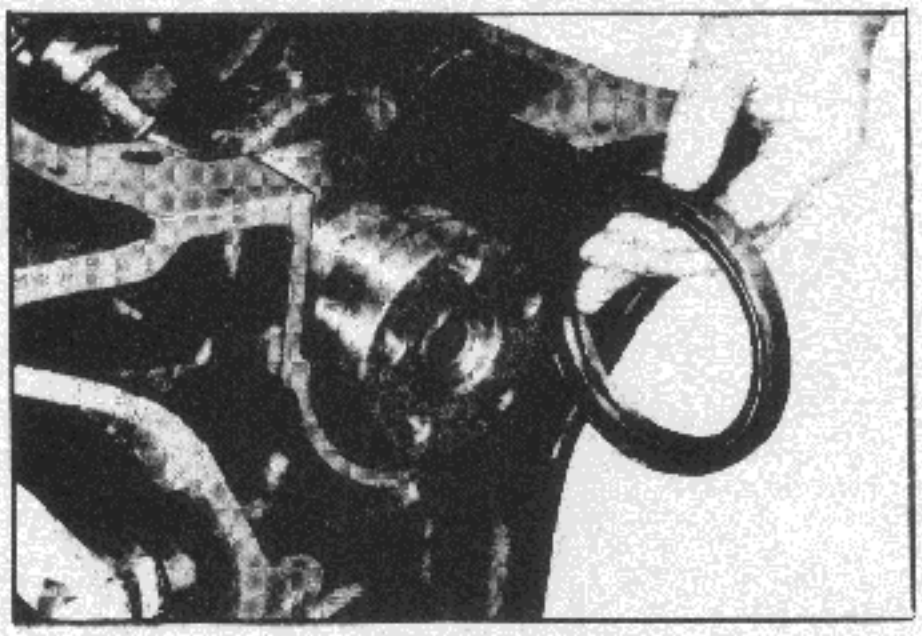


Fig. EM-35 Rear oil seal removal

27. Remove the crankshaft.

28. Remove the buffle plate and the cylinder block net (only for L13 and L16 engine).

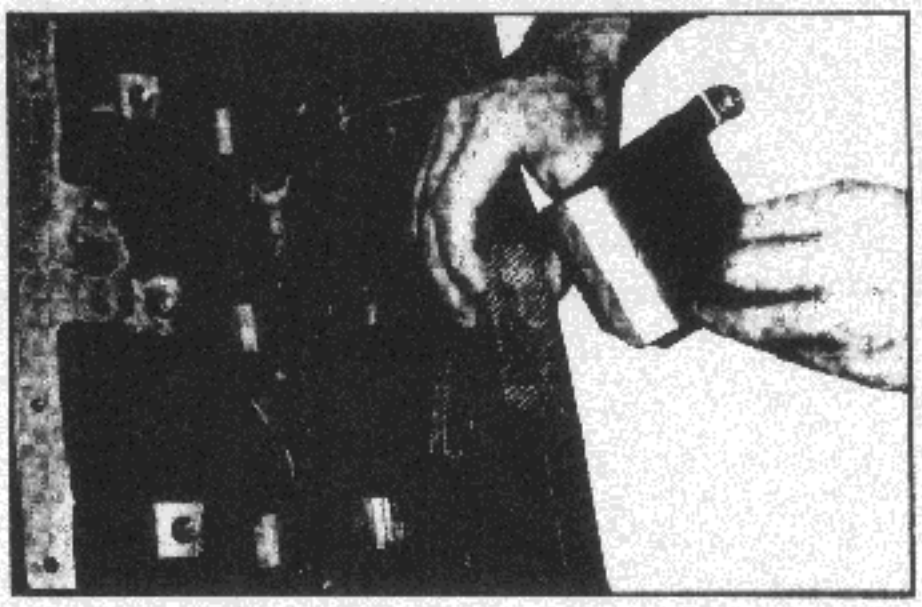


Fig. EM-36 Buffle palte and net removal

PISTON AND CONNECTING ROD

1. Remove the piston rings with a ring remover.

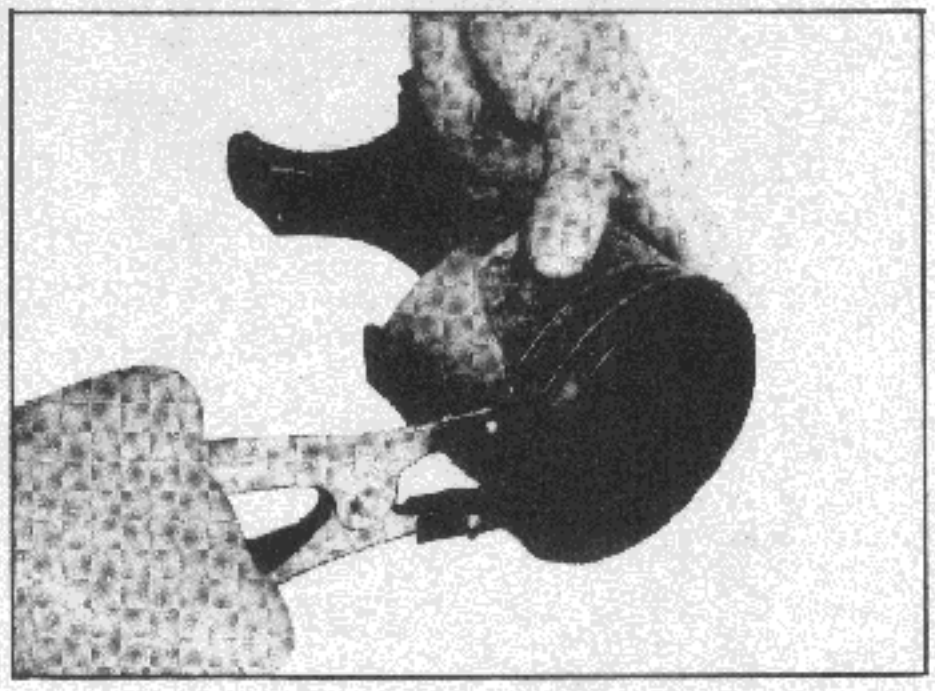


Fig. EM-37 Piston ring removal

2. Press out the piston pin with a piston pin remover and an anbor press.

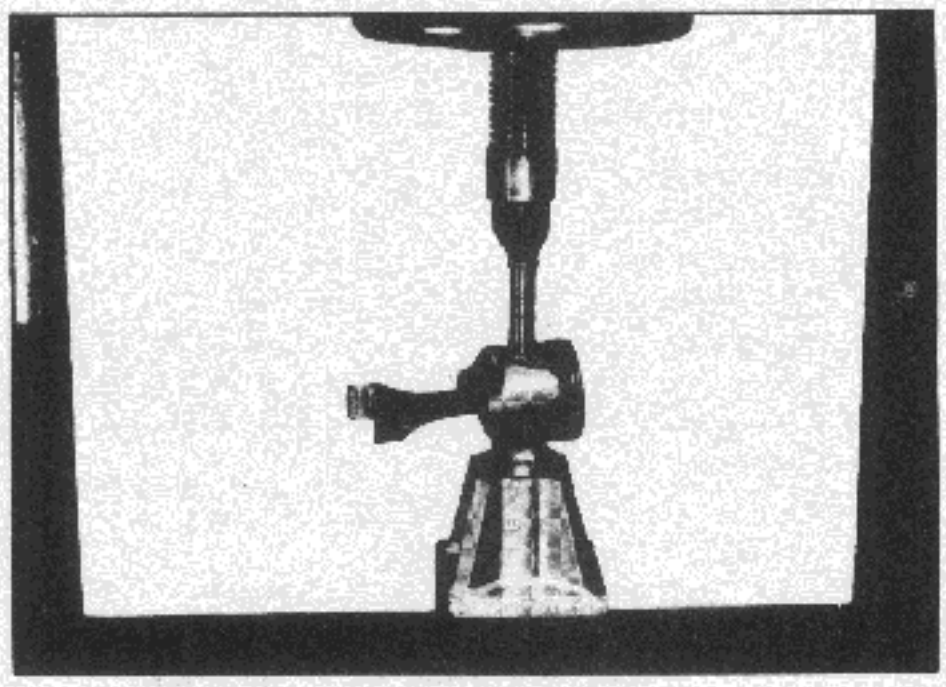


Fig. EM-38 Piston pin removal

Special tool: ST4484000D (L13 and L16)
ST44840000 (L20)

3. Keep the disassembled parts in order not to mix all parts.

CYLINDER HEAD

1. Remove the valve rocker spring.

2. Loosen the valve rocker pivot lock nut and remove the rocker arm by pressing down the valve spring.

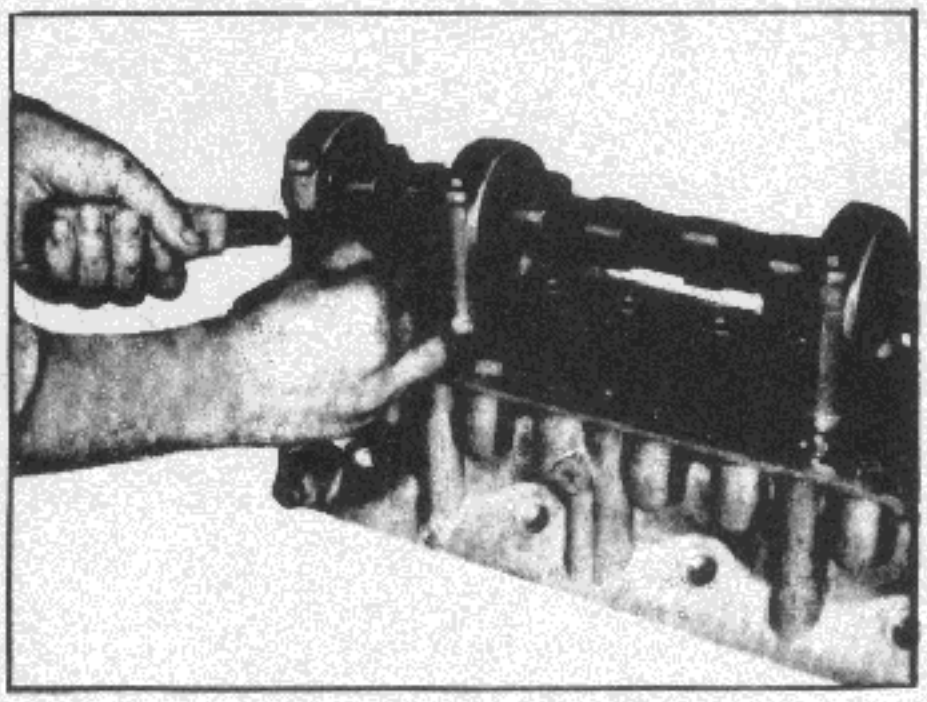


Fig. EM-39 Rocker arm removal

Note: **Take care not to lose the valve rocker guide.**

3. Remove the oil pipe. (only for L20 engine)

4. Remove the camshaft.

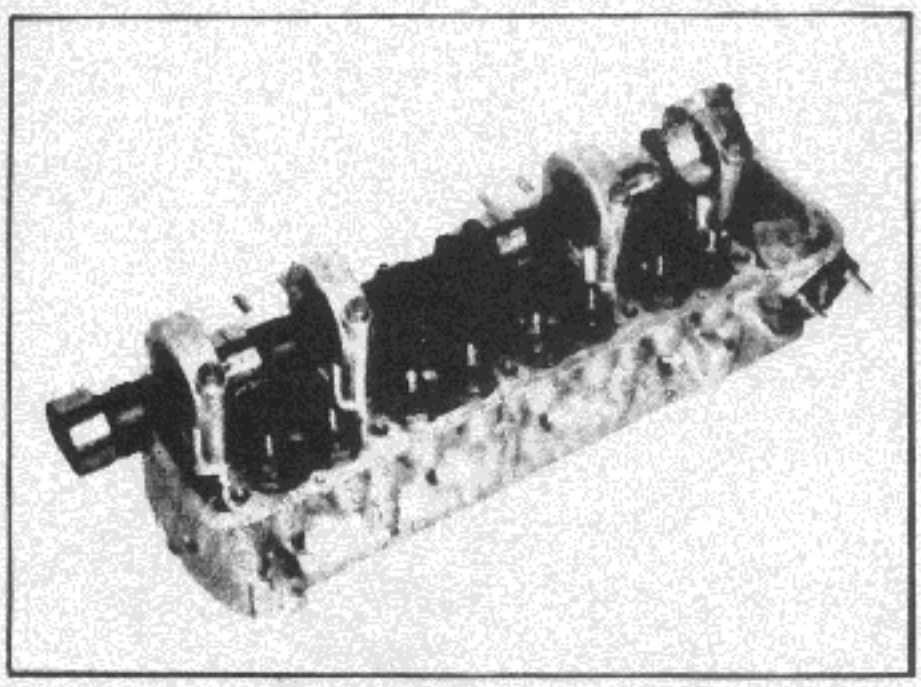


Fig. EM-40 Camshaft removal

Note: **At this time, take care not to let the camshaft scratch the cam bushing during removal.**

5. Remove the valves using a valve lifter.

   Special tool: ST47450000

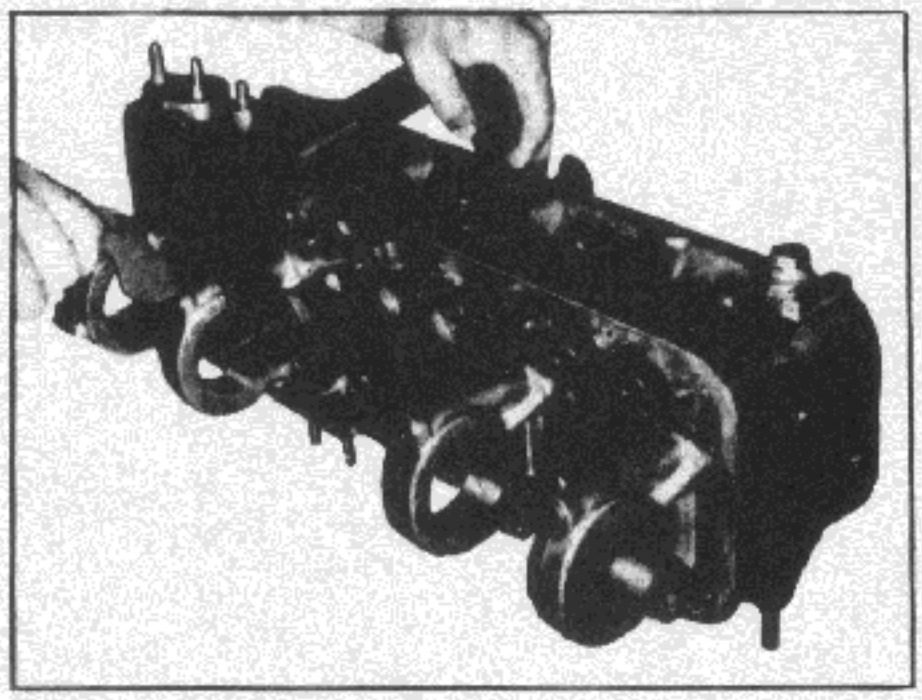
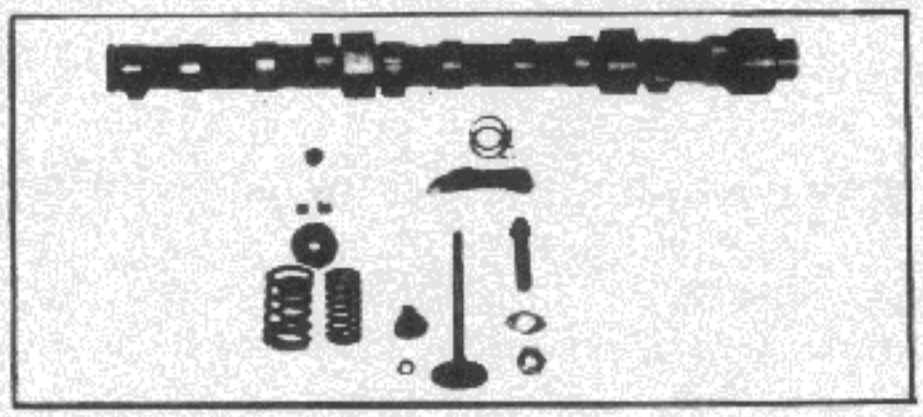


Fig. EM-41 Valve removal

6. Take care not to lose valve spring seat, oil seal, valve collet, and valve rocker guide.

L20 engine



L13 engine

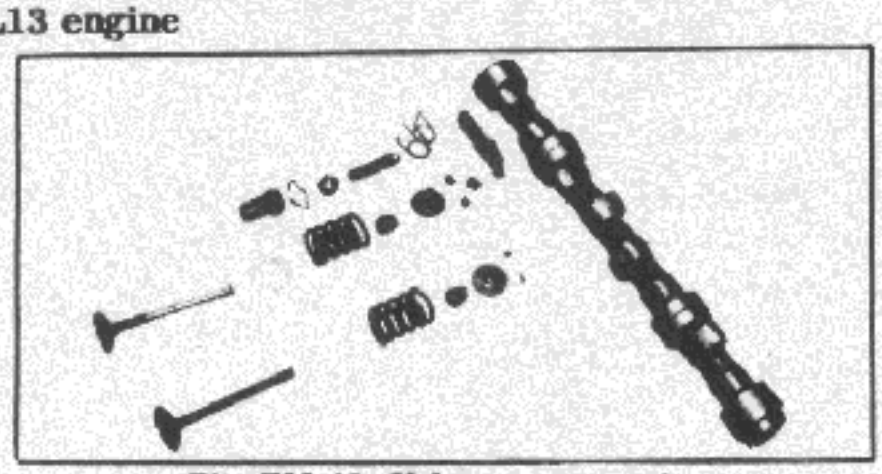


Fig. EM-42 Valve components

Note: **a. Be sure to leave the camshaft bearing intact. Because the bearing centers are liable to be out of alignment.**

b. L16 engine uses the dual type springs.

INSPECTION AND REPAIR

CONTENTS

PREPARATION FOR INSPECTION

1. Check the cylinder head and the cylinder block for traces of water leaks before cleaning.

2. Wash all the parts to clean them completely of oil stains, carbon deposits, fur, and sealing material.

3. Ascertain if all the oil holes are clear by blowing air into them.

4. Use every caution to secure proper assembly.

CYLINDER HEAD AND VALVES

Checking head mating face

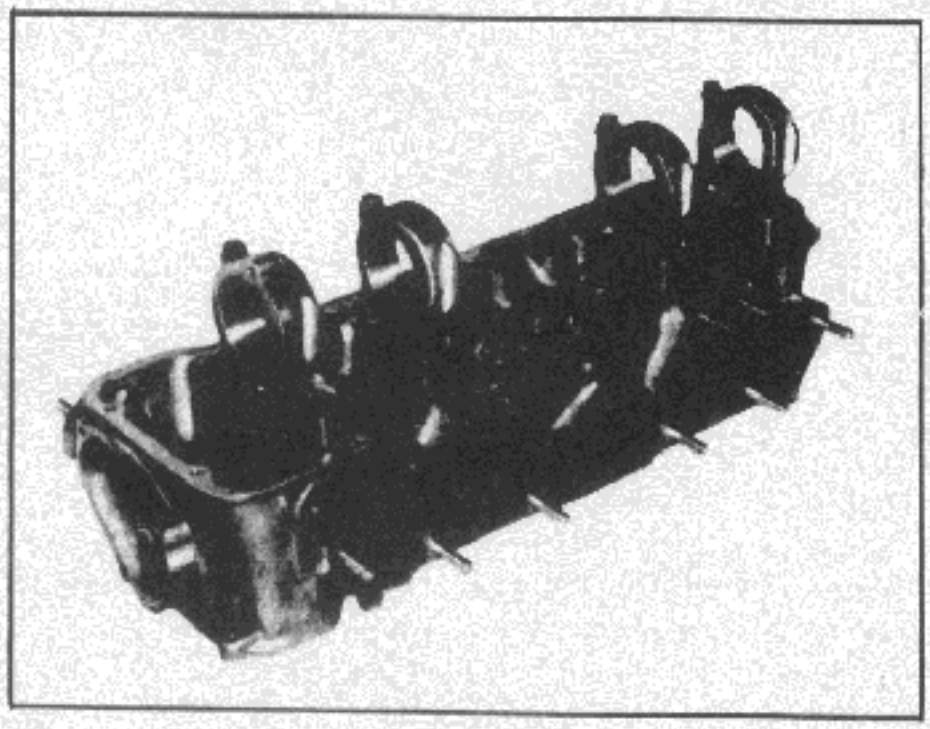


Fig. EM-43 Cylinder head

Note: Never remove camshaft bearings unless you have a suitable machine for boring camshaft bearing in line. If you once remove camshaft bearings, the bearing centers will be out of alignment and the recondition is very difficult without center borings.

1. Make a visual check for cracks and flaws.

2. Measure the surface of the cylinder head (on the cylinder block side) for warping. If it is found to be beyond the limit designated below, regrind the affected surface with a surface grinder.

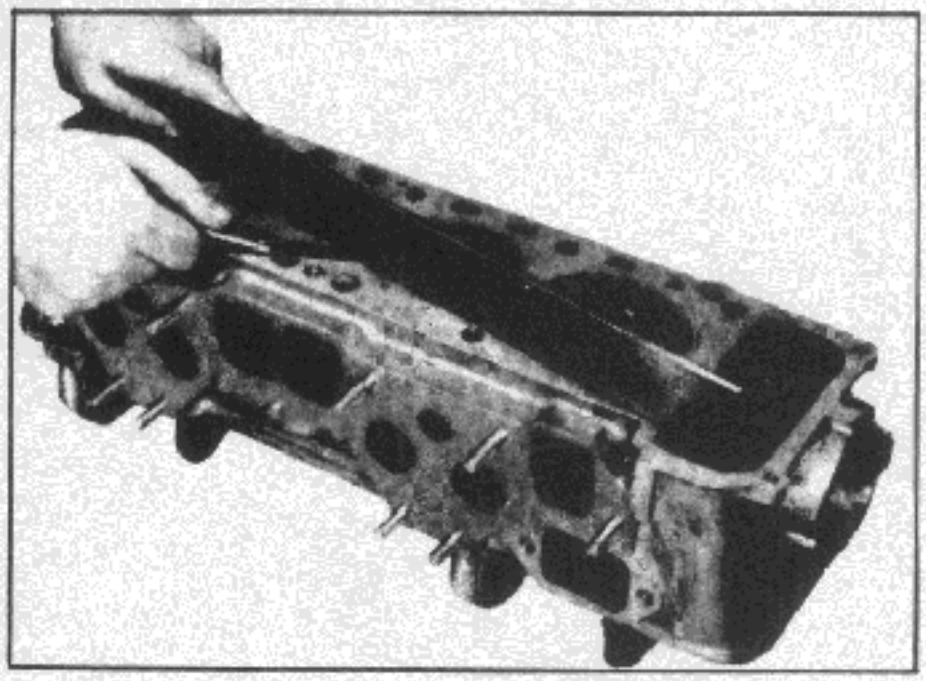


Fig. EM-44 Checking the cylinder head surface

Head surface flatness

	Standard	Maximum
L13 and L16 engine	less than 0.03 mm (0.0012 in.)	0.1 mm (0.0039 in.)
L20 engine	less than 0.05 mm (0.0020 in.)	0.1 mm (0.0039 in.)

Valve assembly

1. Check each of the intake and exhaust valve assemblies for worn, damaged or deformed valve caps and stems. Correct or replace the valve, if any excessive defects are detected.

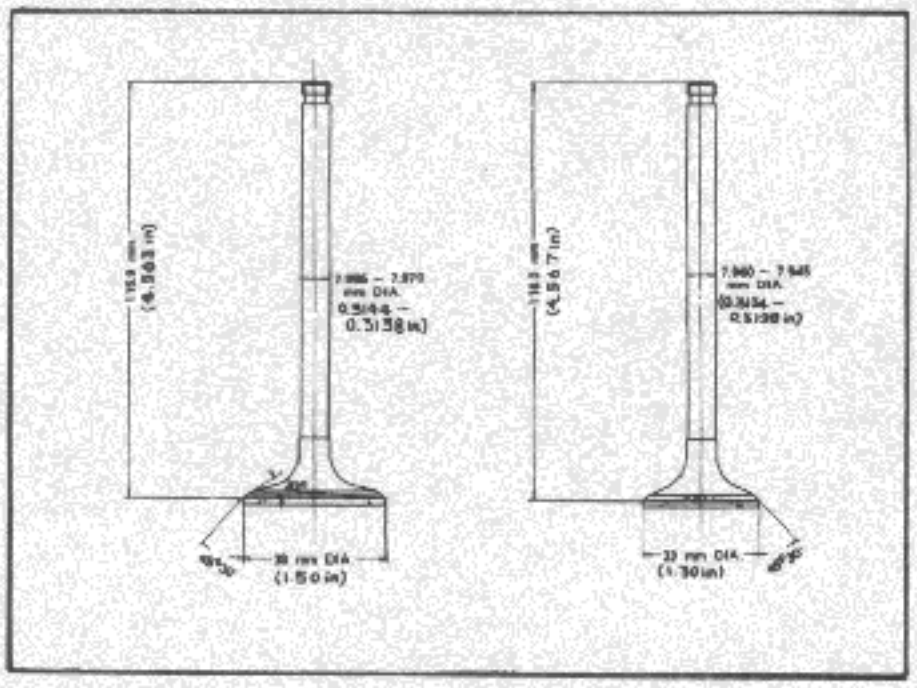


Fig. EM-46 Valves for L13 and L16 (Single carb.) engine

2. The valve face or valve stem end surface should be refaced by using a valve grinder.

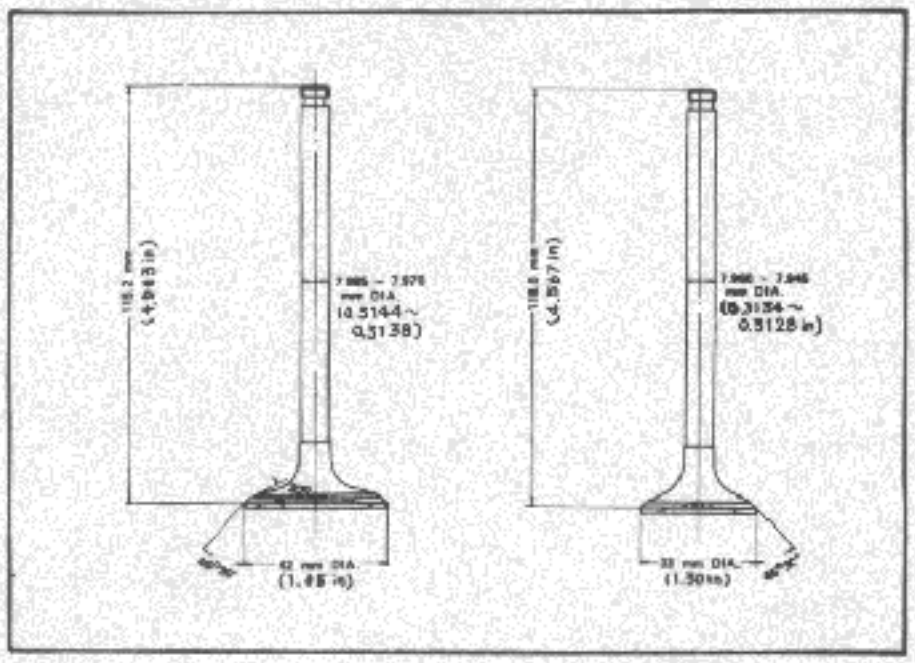


Fig. EM-47 Valves for L16 (Twin carb.) engine

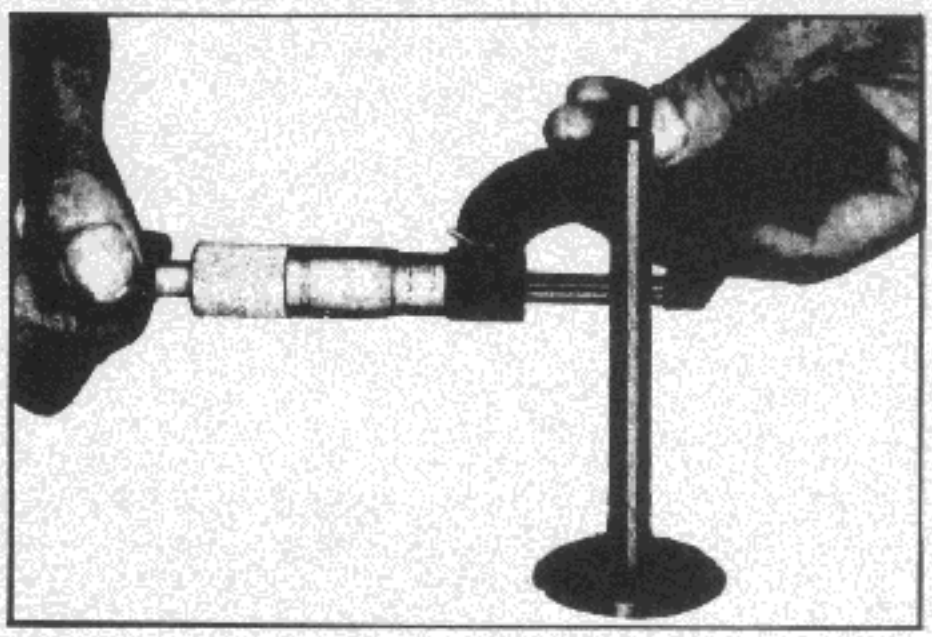


Fig. EM-45 Valve stem diameter check

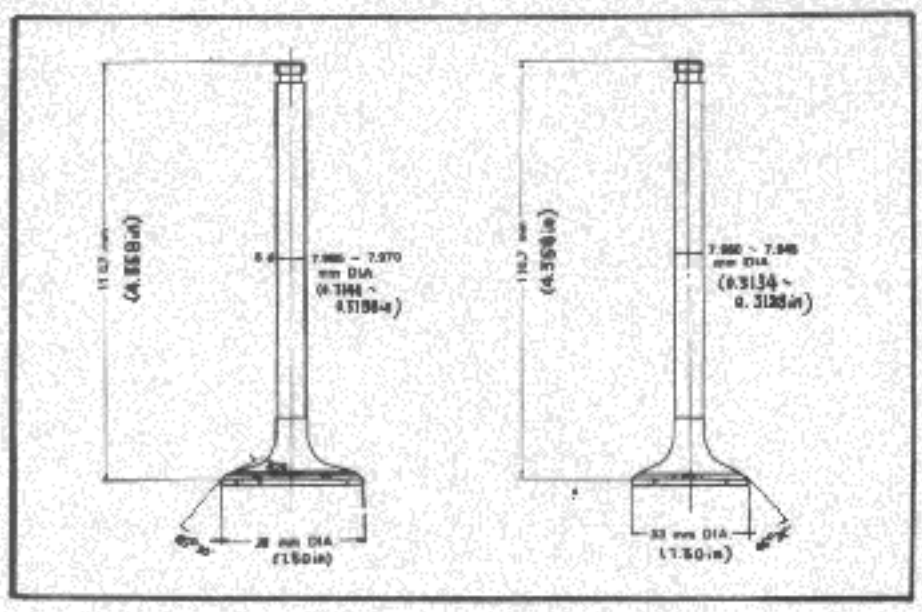


Fig. EM-48 Valves for L20 engine

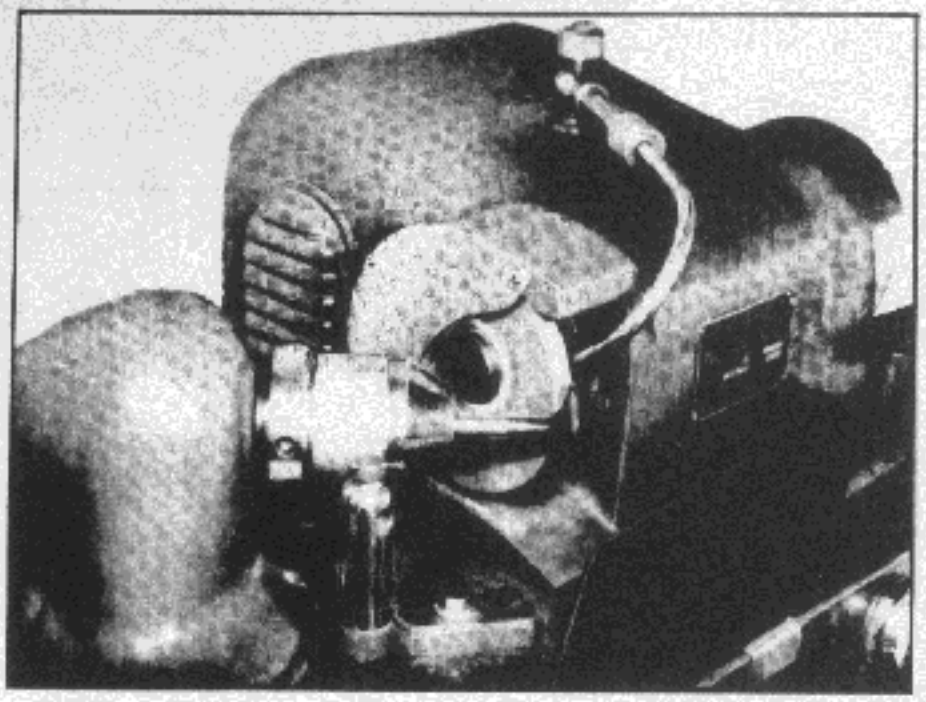


Fig. EM-49 Valve grinder

Note: **When the valve head has been reduced to 0.5 mm (0.0197 in.) or less in thickness, replace the valve.**
Grinding allowance for the valve stem end surface is 0.5 mm (0.0197 in.) or less.

Valve spring

1. Measure the free length and the tension of each spring. If the measured value exceeds the specified limit, replace the spring.

2. Check the deformation of each spring with a square. Any springs with the deflection of 1.6 mm (0.0630 in.) or more must be replaced.

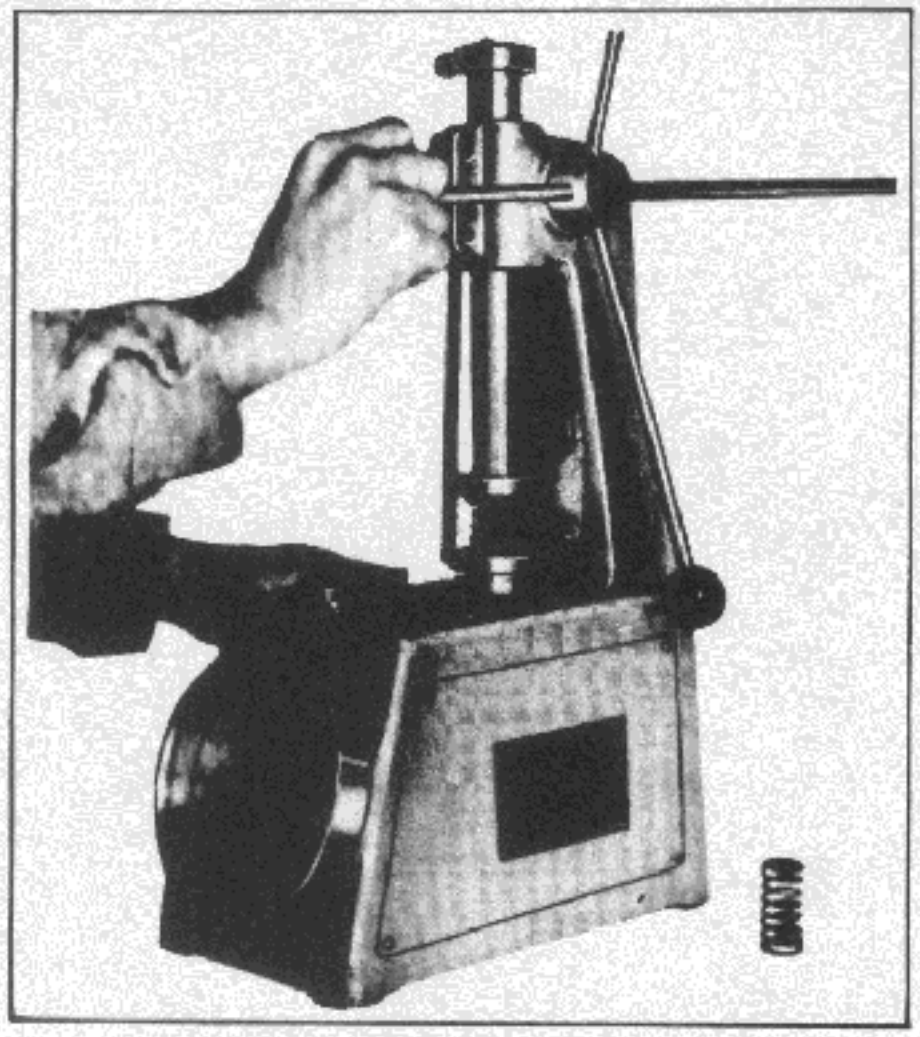


Fig. EM-50 Valve spring test

Spring specifications

		L13	L16	L20
Free length	Outer	48.12 mm (1.89 in.)	52.0 mm (2.0472 in.)	52.0 mm (2.0472 in.)
	Inner		44.85 mm (1.7657 in.)	50.0 mm (1.9685 in.)
Valve closed	Outer	40.0 mm at 30.7 ± 1.5 kg (1.57 in at 67.70 ± 3.31 lb.)	38.9 mm at 29.0 ± 1.5 kg (1.53 in. at 63.93 ± 3.31 lb.)	38.9 mm at 29.0 ± 1.5 kg (1.53 in. at 63.93 ± 3.31 lb.)
	Inner		35 mm at 12.3 ± 0.7 kg (1.38 in. at 27.12 ± 1.54 lb.)	36.9 mm at 13.1 ± 0.7 kg (1.45 in. at 28.88 ± 1.54 lb.)
Valve open	Outer	30.0 mm at 71.2 ± 3.5 kg (1.18 in at 156.9 ± 7.71 lb.)	30.7 mm at 47.8 ± 2.4 kg (1.21 in. at 105.38 ± 5.29 lb.)	30.7 mm at 47.8 ± 2.4 kg (1.21 in. at 105.38 ± 5.29 lb.)
	Inner		24.5 mm at 25.5 ± 1.3 kg (0.96 in. at 56.21 ± 2.87 lb.)	28.7 mm at 21.3 ± 1.2 kg (1.13 in. at 46.96 ± 2.65 lb.)

Rocker arm and valve rocker pivot

Check the pivot head and the cam contact and pivot contact surfaces of the rocker arm for damage or wear. If defects are found, replace them. A defective pivot necessitates its replacement together with the corresponding rocker arm.

Valve guide

Measure the clearance between the valve guide and the valve stem. If the clearance exceed the designated limit, replace the worn parts or both valves and valve guide. In this case, it is essential to determine if such a clearance has been caused by a worn or bent valve stem or by a worn valve guides.

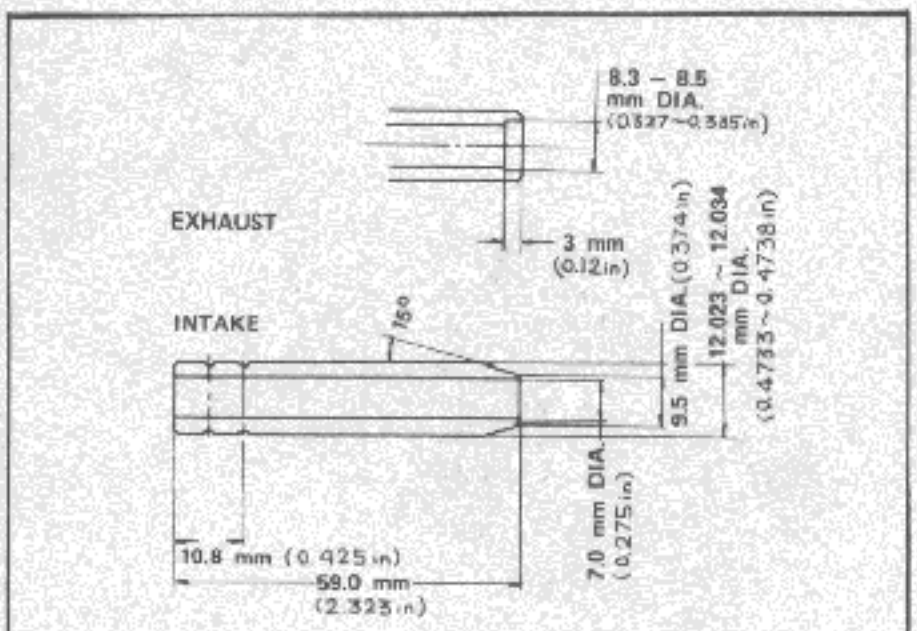


Fig. EM-51 Standard valve guide (L13 and L16 engine)

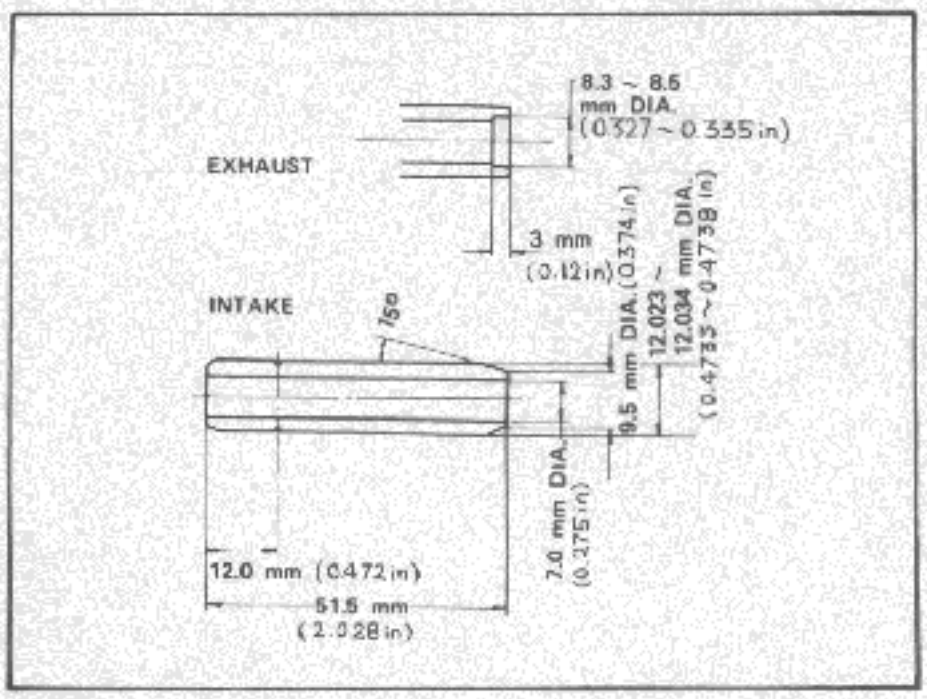


Fig. EM-52 Standard valve guide (L20 engine)

		Intake valve	Exhaust valve
Stem to guide clearance mm (in.)	L13, L16	0.015 ~ 0.048 (0.0006 ~ 0.0019)	0.04 ~ 0.073 (0.0016 ~ 0.0029)
	L20	0.02 ~ 0.05 (0.0008 ~ 0.0020)	0.06 ~ 0.07 (0.0024 ~ 0.0028)
Max. tolerance of above clearance mm (in.)	L13, L16	0.1 (0.0039)	
	L20	0.1 (0.0039)	

Determining clearance

Precise measurement of clearance between the valve stem and the valve guide needs the aid of a micrometer and a telescope hole gauge. By using these gauge, check the diameter of the valve stem in three places; top, center and bottom. Insert telescope hole gauge in valve guide bore, measuring at center. Subtract highest reading of valve stem diameter from valve guide bore measured to obtain its clearance from the two center diameter to obtain valve to valve guide clearance. As an emergency expendient, a valve is pushed in the valve guide and moved to the left and the right at which point if its tip deflects about 0.2 mm (0.0079 in.) or more, it will be known that the clearance between the stem and the guide exceeds the maximum limit of 0.1 mm (0.0039 in.).

Note: The valve should be moved in parallel with the rocker arm. (Generally, a large amount of wear occurs in this direction.)

Replacement of valve guide

A valve guide found defective must be replaced in the following manner:

1. Take out the old guide by means of a press and a drift pin (under a 2-ton pressure).
This job may be carried out at room temperatures but with better effect at higher temperature.

2. Ream cylinder head side guide hole at room temperature.

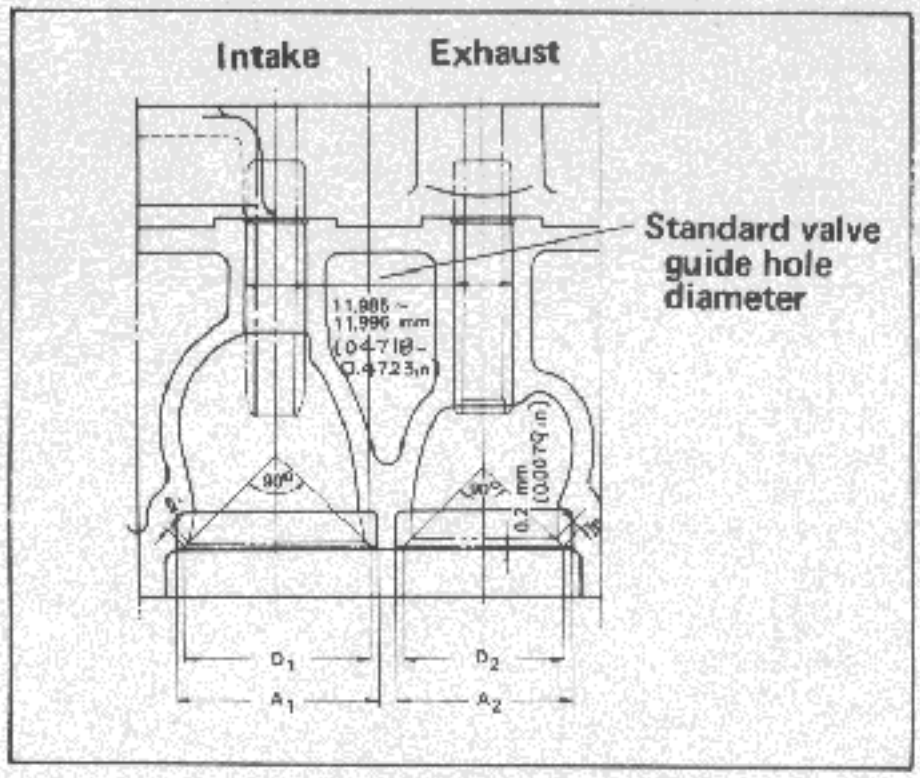


Fig. EM-53 Valve guide

	L13, L16	L20
Guide hole inner diameter mm (in.)	12.185 ~ 12.196 (0.4797 ~ 0.4802)	12.191 ~ 12.202 (0.4800 ~ 0.4804)

3. Press the new valve guide into the valve with care so that it will fit smoothly after heat the cylinder head to a temperature of 150° to 200° C (302° to 392° F).
The valves guides of 0.2 mm (0.0079 in.) oversize diameter are available for service.

	L13, L16 and L20
Interference fit of Valve guide to Guide hole mm (in.)	0.027 ~ 0.049 (0.0011 ~ 0.0019)

4. Ream the bore of the valve guide pressed in, using a valve guide reamer.

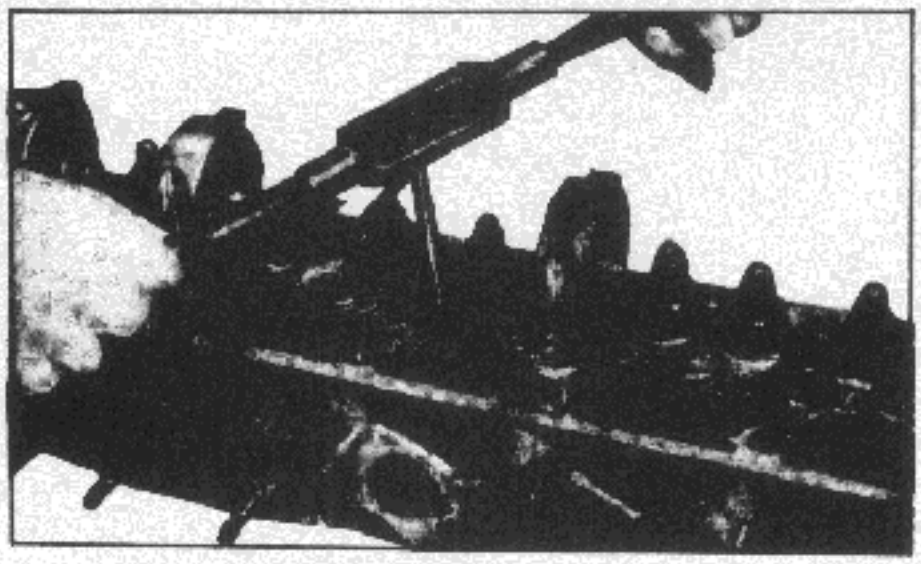


Fig. EM-54 Valve guide reaming

Valve guide reamer set: ST44800000
Reaming bore: 8.000 to 8.018 mm
(0.3150 to 0.3157 in.)

5. Correct the valve seat surface, with the new valve guide as the axis.

Valve seat inserts

Check the valve seat inserts for any evidence of pitting at valve contact surface, and reseat or replace valve seat inserts if the valve seat insert is worn out excessively.
The valve seat insert of 0.5 mm (0.0197 in.) over size is available for service in this L series engine (except L20 engine).

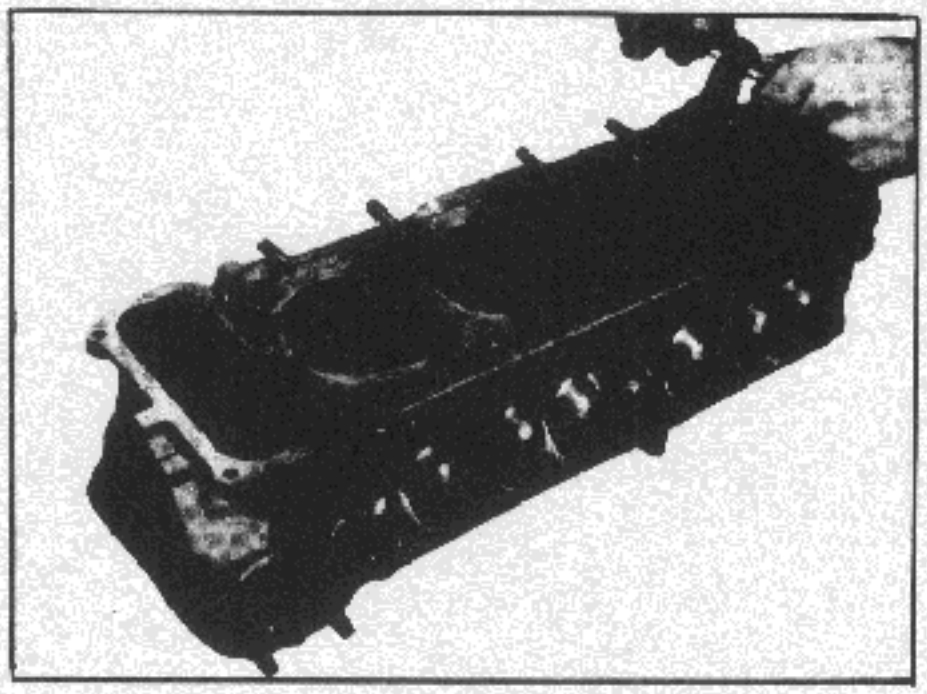


Fig. EM-55 Valve seat correction

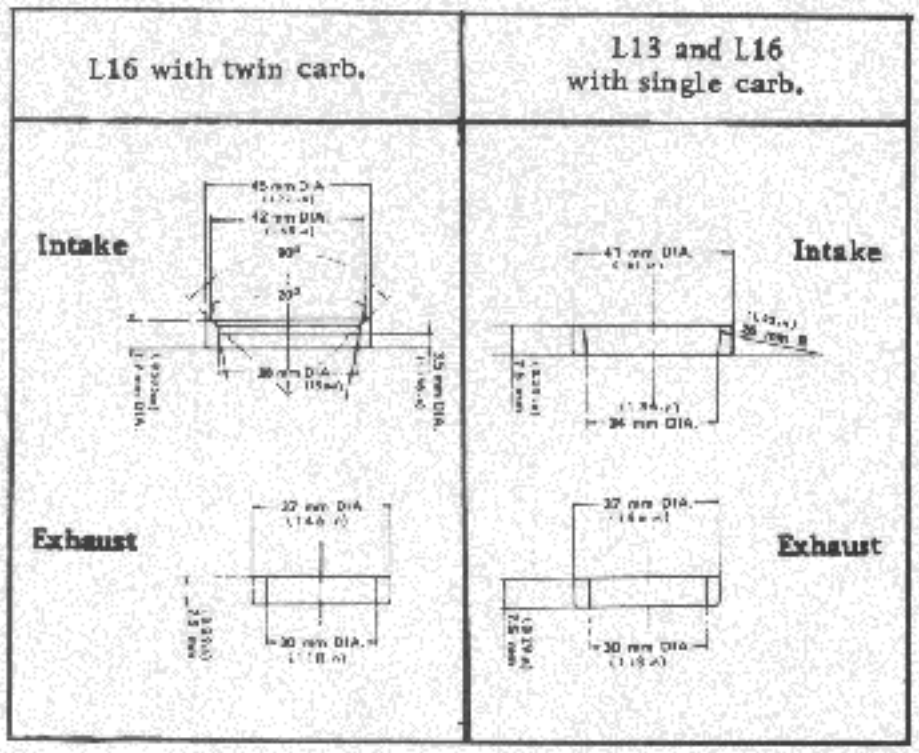


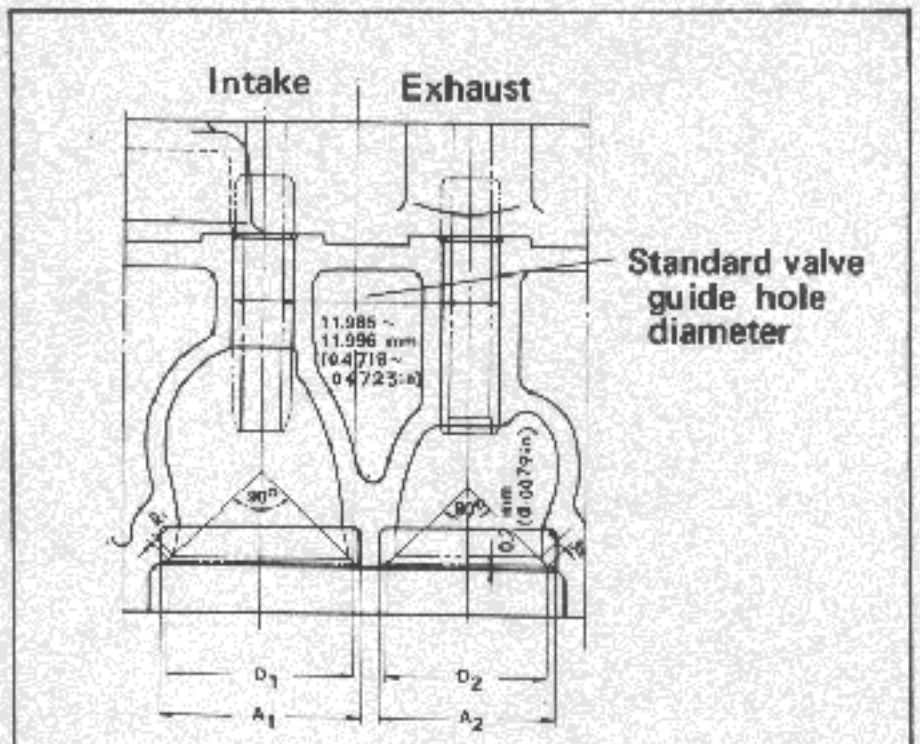
Fig. EM-56 Standard valve seat insert

		L13 and L16 (Single carb.)	L16 (Twin carb.)
Cylinder head recess diameter mm (in.)	Intake	$41.5\ ^{+0.02}_{0}$ $(1.634\ ^{+0.0008}_{0})$	$45.5\ ^{+0.02}_{0}$ $(1.791\ ^{+0.0008}_{0})$
	Exhaust	$37.5\ ^{+0.02}_{0}$ $(1.476\ ^{+0.0008}_{0})$	$37.5\ ^{+0.02}_{0}$ $(1.476\ ^{+0.0008}_{0})$

Interference fit mm (in.)	Intake	0.11 ~ 0.08 (0.0043 ~ 0.0031)
	Exhaust	0.10 ~ 0.06 (0.0039 ~ 0.0024)

Replacing the valve seat insert

1. Old inserts can be removed by boring out until the insert collapses. The machine depth stop should be set so that boring cannot continue beyond the bottom face of the insert recess in the cylinder head.



	L13 and L16 (Single carb.)	L16 (Twin carb.)	L20
A1 mm DIA.	41.0 ~ 41.016	45.0 ~ 45.016	41.0 ~ 41.016
A2 mm DIA.	57.0 ~ 37.016	37.0 ~ 37.016	36.0 ~ 36.016
D1 mm DIA.	37.6 ~ 37.8	41.6 ~ 41.8	37.6 ~ 37.8
D2 mm DIA.	32.4 ~ 32.6	32.4 ~ 32.6	32.4 ~ 32.6
ℓ 1 mm	1.4 ~ 1.8	1.4 ~ 1.8	1.4 ~ 1.6
ℓ 2 mm	1.6 ~ 2.0	1.6 ~ 2.0	1.8 ~ 2.2

Fig. EM-57 Valve seat insert

2. Select a suitable valve seat insert and check its outside diameter.

3. Machine the cylinder head recess diameter to the concentric circles to the valve guide center so that the insert will have the correct fit.

4. Heat the cylinder head to a temperature of 150° to 200° C (302° to 392° F).

5. Fit the insert ensuring that it beds on the bottom face of its recess.

6. The valve seats newly fitted should be cut or ground at the specified dimensions as shown in Figure EM-57.

CAMSHAFT AND CAMSHAFT BEARINGS

Camshaft bearing clearance check

1. Measure the inner diameter of the camshaft bearing and the outer diameter of the camshaft journal. If wear is found inside the bracket replace the cylinder head assembly.

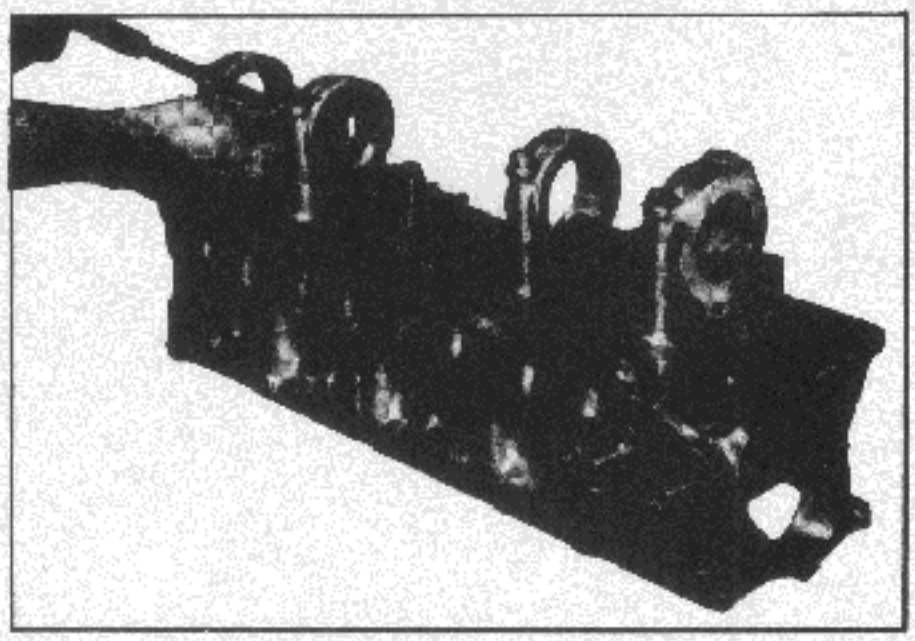


Fig. EM-58 Camshaft bearing check

		Standard	Wear limit
Oil clearance mm (in.)	L13, L16	0.038 ~ 0.076 (0.0015 ~ 0.0026)	0.1 (0.0039)
	L20	0.038 ~ 0.076 (0.0015 ~ 0.0026)	0.1 (0.0039)
Inner diameter of camshaft bearing mm (in.)	L13, L16	48.000 ~ 48.016 (1.8898 ~ 1.8904)	
	L20	48.000 ~ 48.016 (1.8898 ~ 1.8904)	

Valve timing check

If the camshaft shown no apparent damage although some valve operation troubles have been detected in the engine, compare valve timing data with the valve timing diagram to see whether the stroke beginning and end invarious cylinders are complying with specified advance and retard figures.

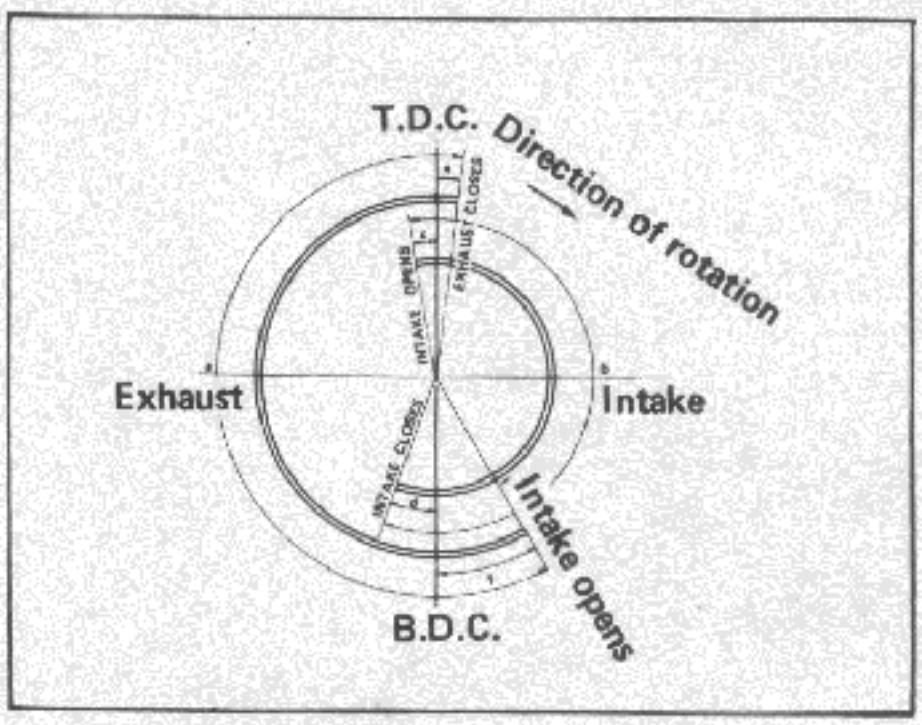


Fig. EM-59 Valve timing diagram

Unit: degree

		a	b	c	d	e	f
L13		240	232	8	44	10	50
L16	Single	240	240	12	48	8	50
	Twin	248	248	16	52	14	54
L20	Single	224	224	11	33	1	43
	Twin	248	248	17	51	13	55

Camshaft alignment check

1. Check the camshaft, camshaft journal and cam surface for bend, wear or damage. If the defects are beyond the limits, replace the affected parts.

2. Bend values are expressed in terms of half values of the readings obtained when the camshaft is given a turn with a dial gauge applied to the center journal.

		Standard	Bend limit
Camshaft bend	L13, L16	0.015 mm (0.0006 in.)	0.05 mm (0.0020 in.)
	L20	0.015 mm (0.0006 in.)	0.05 mm (0.0020 in.)

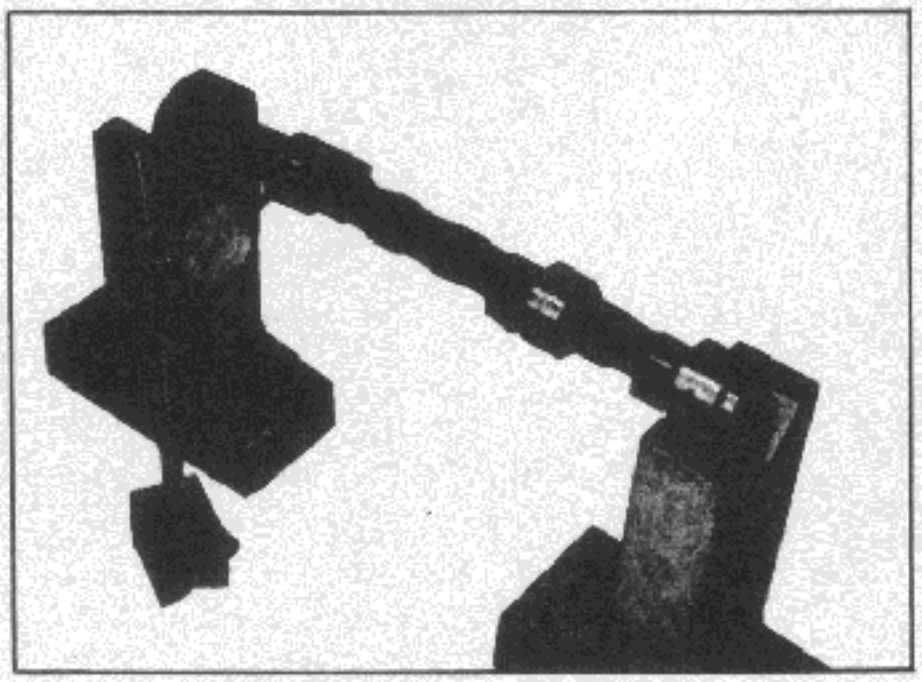


Fig. EM-60 Camshaft bend check

Unit: mm (in.) \ Engine model	L13 and L16 (Single carb.)	L16 (Twin carb.)	L20 (Single carb.)	L20 (Twin carb.)
Standard height of cam	39.95 ~ 40.00 (1.5728 ~ 1.5748)	40.30 ~ 40.35 (1.3866 ~ 1.5886)	40.00 ~ 40.05 (1.5748 ~ 1.5768)	40.30 ~ 40.35 (1.5866 ~ 1.5880)
Wear limit of cam height	0.25 (0.0098)			
Allowable difference in diameter between max. worn and min. worn parts of camshaft journal	0.05 (0.0020)			
Maximum tolerance in journal diameter	0.1 (0.0039)			
Camshaft end play	0.08 ~ 0.38 (0.0031 ~ 0.0150)		0.04 ~ 0.3 (0.0016 ~ 0.0118)	

CYLINDER BLOCK

1. Check visually for defects, such as cracks and flaws.

2. Measure the top face of the block (cylinder head mating face) for warping. If the warp exceeds the limit value, correct it.

		Standard	Maximum tolerance
Surface flatness mm (in.)	L13, L16	less than 0.05 (0.0020)	0.10 (0.0039)
	L20	less than 0.05 (0.0020)	0.10 (0.0039)

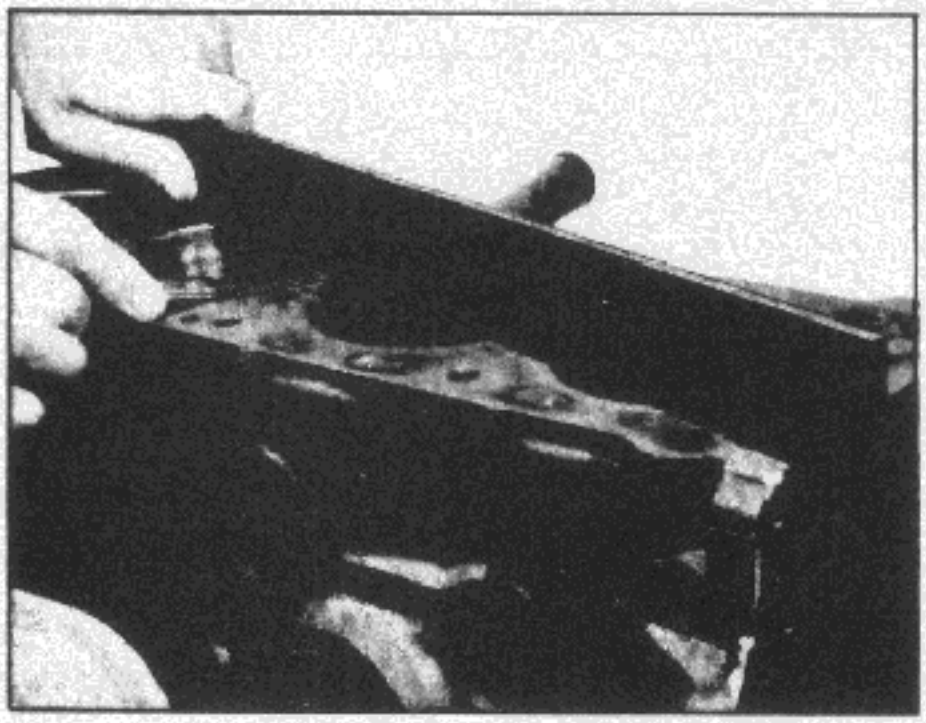


Fig. EM-61 Cylinder block surface check

3. Measure the cylinder bore for out-of-round or excessive taper with a bore gauge. If excessive wear, taper or out-of-round are detected on the cylinder wall, rebore the cylinder walls by a boring machine.

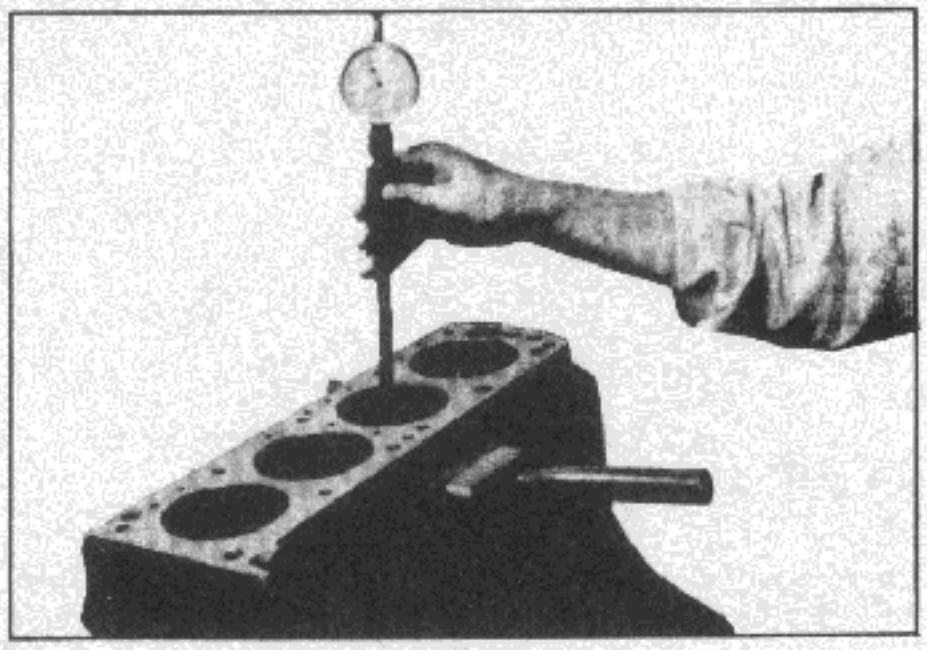


Fig. EM-62 Measuring the cylinder bore

4. When the wear, taper and out-of-round are not excessive to the limit, remove the step at the topmost portion of the cylinder by using a ridge reamer or the like.

How to measure cylinder bore

A bore gauge is used. Measure the cylinder bore at top, middle and bottom points in each direction A and B as illustrated and record the measured values.

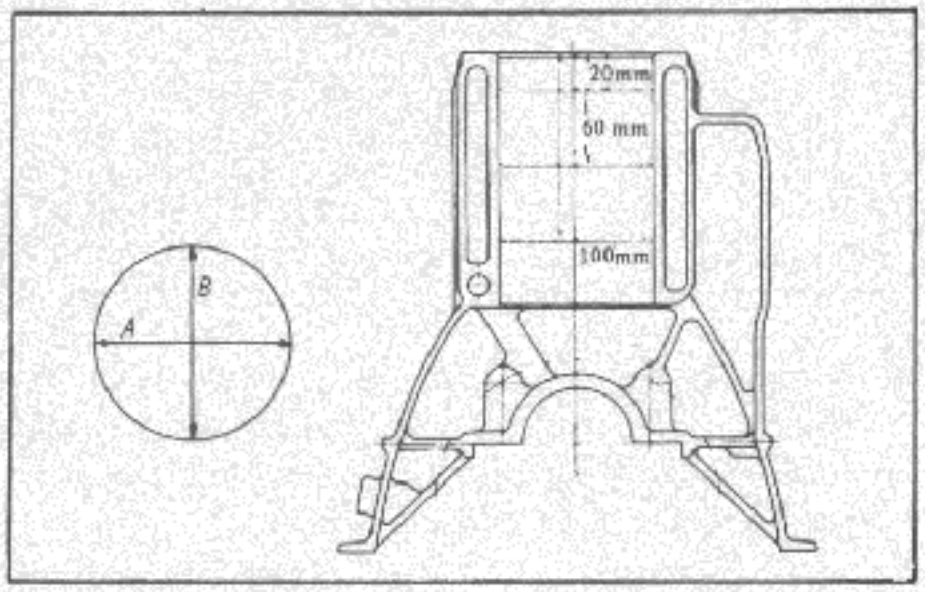


Fig. EM-63 Measuring points of cylinder bore

	Standard		Wear limit
	L13, L16	L20	
Cylinder bore mm (in.)	83.000 $^{+0.050}_{0}$ ($3.2677 $^{+0.0020}_{0}$)	78.000 $^{+0.050}_{0}$ ($3.0709 $^{+0.0020}_{0}$)	0.2 (0.0079)
Error in cylinder bore elliptic tapered mm (in.)	0.015 (0.0006) 0.015 (0.0006)	0.02 (0.0008) 0.02 (0.0008)	
Difference cylinder bore mm (in.)	0.05 (0.0020)	0.05 (0.0020)	0.2 (0.0079)

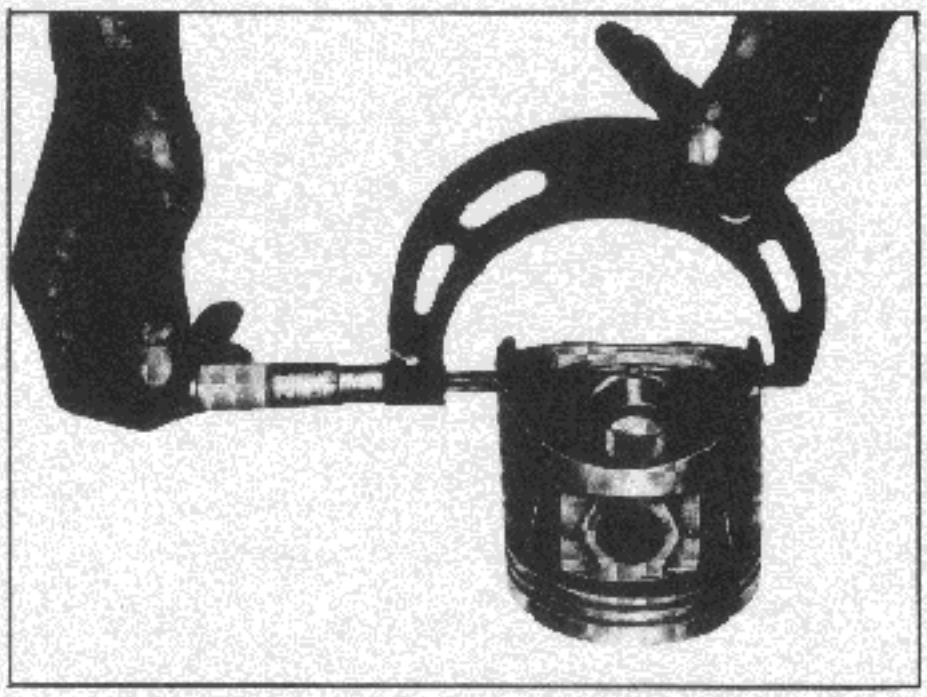


Fig. EM-64 Measuring the piston diameter

Boring of cylinder

1. When any of the cylinders needs boring, all other cylinders must be bored at the same time.

2. Determine piston oversize according to the amount of wear of the cylinder.

Piston for service Unit: mm (in.)

Piston size	Outside diameter (H)	
	L13 and L16 engine	L20 engine
STD	82.99 ~ 83.04 (3.267 ~ 3.269)	77.915 ~ 77.965 (3.0675 ~ 3.0695)
25 oversize	83.22 ~ 83.27 (3.276 ~ 3.278)	77.935 ~ 77.985 (3.0683 ~ 3.0702)
50 oversize	83.47 ~ 83.52 (3.286 ~ 3.288)	78.165 ~ 78.215 (3.0774 ~ 3.0793)
75 oversize	83.72 ~ 83.77 (3.296 ~ 3.298)	78.415 ~ 78.465 (3.0872 ~ 3.0892)
100 oversize	83.97 ~ 84.02 (3.305 ~ 3.308)	78.665 ~ 78.715 (3.0970 ~ 3.0990)
150 oversize	84.47 ~ 84.52 (3.326 ~ 3.328)	78.915 ~ 78.965 (3.1069 ~ 3.1089)

3. By measuring piston to be installed at piston skirt (side thrust face) and adding the mean of clearance specification, the finish hone cylinder measurement can be determined.

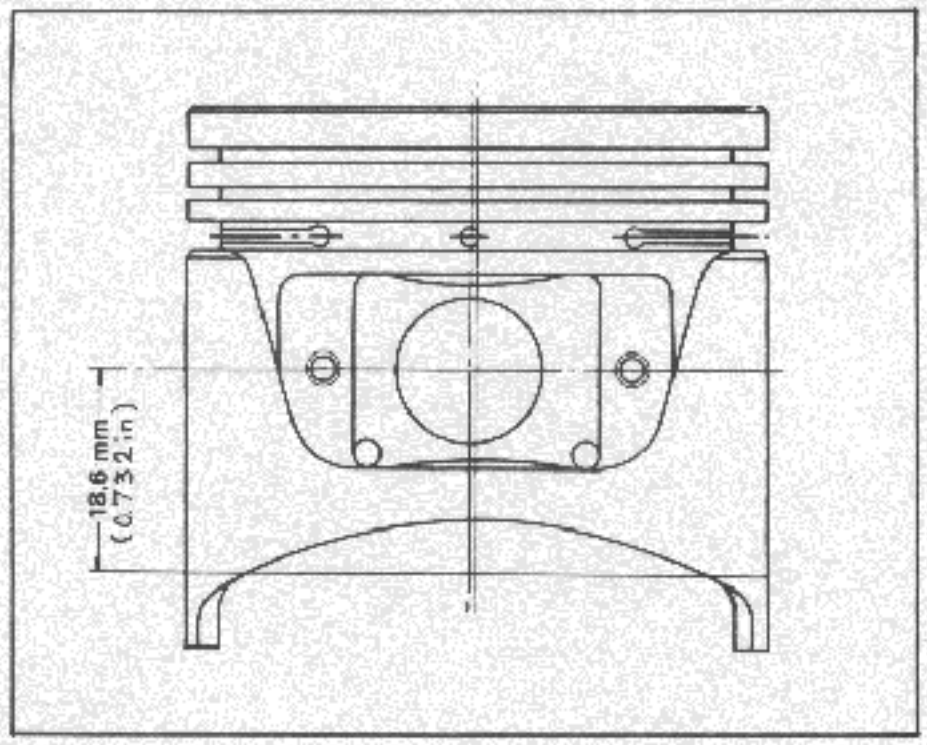


Fig. EM-65 Measuring point

Outer diameter of piston skirt (measured value): A, Piston-cylinder clearance:
B = 0.025 to 0.045 mm (0.0010 to 0.0018 in.)
Boring allowance C = 0.02 mm (0.0008 in.)
Cylinder bore to be treated:
A + B - C = A + (0.005 to 0.025 mm)
(0.0002 to 0.0010 in.)

4. Machine the cylinder bore to the determined inner diameter.

Note: To prevent strain due to cutting heat, bore the cylinders in the order of 1-5-3-6-2-4, (for L20 engine) and 2-4-1-3 (for L13 and L16 engine).

5. Do not cut too much out of the cylinder bore at a time, but cut 0.05 mm (0.0020 in.) or so at a time.

6. Measurement of the cylinder bore just machined requires the utmost care since it is expanded by cutting heat.

7. Finish the treated cylinder bore to a final finish bore by honing.

8. Measure the finished cylinder bore for elliptic or tapered part.

9. Measure the piston to cylinder clearance.
This clearance can be checked easily by using a feeler gauge and a spring scale.

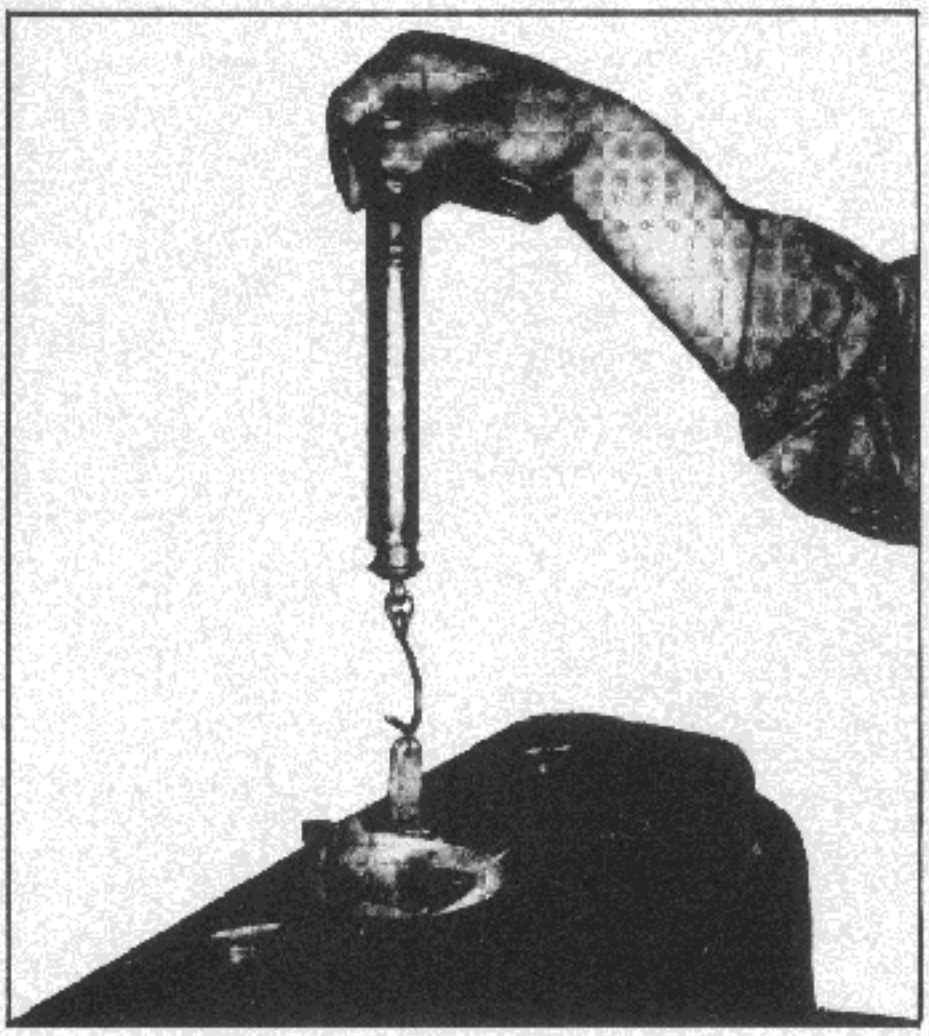


Fig. EM-66 Piston to cylinder clearance check

	L13, L16	L20
Standard clearance mm (in.)	0.025 ~ 0.045 (0.0010 ~ 0.0018)	0.025 ~ 0.045 (0.0010 ~ 0.0018)
Feeler gauge mm (in.)	0.04 (0.0016)	0.04 (0.0016)
Extracting force kg (lb.)	0.2 ~ 1.5 (0.4409 ~ 3.3069)	0.5 ~ 1.5 (1.1023 ~ 3.3069)

Note: **If the cylinder bore has worn beyond the wear limit, use the cylinder liner.**
Undersize cylinder liners are available for service (only for L13 and L16 engine).
Interference fit of cylinder liner Cylinder Block 0.08 to 0.09 mm (0.0031 to 0.0035 in.).

Cylinder liner for service

	Outside diameter mm (in.)	Inner diameter mm (in.)
400 undersize	87.00 ~ 87.05 (3.4252 ~ 3.4272)	82.45 ~ 82.55 (3.2461 ~ 3.2500)
450 undersize	87.50 ~ 87.55 (3.4449 ~ 3.4468)	82.45 ~ 82.55 (3.2461 ~ 3.2500)
500 undersize	88.00 ~ 88.05 (3.4646 ~ 3.4665)	82.45 ~ 82.55 (3.2461 ~ 3.2500)

PISTON, PISTON PIN AND PISTON RING

1. Check for seizing, scratches and wear.
Effect a replacement when such a defect is detected.

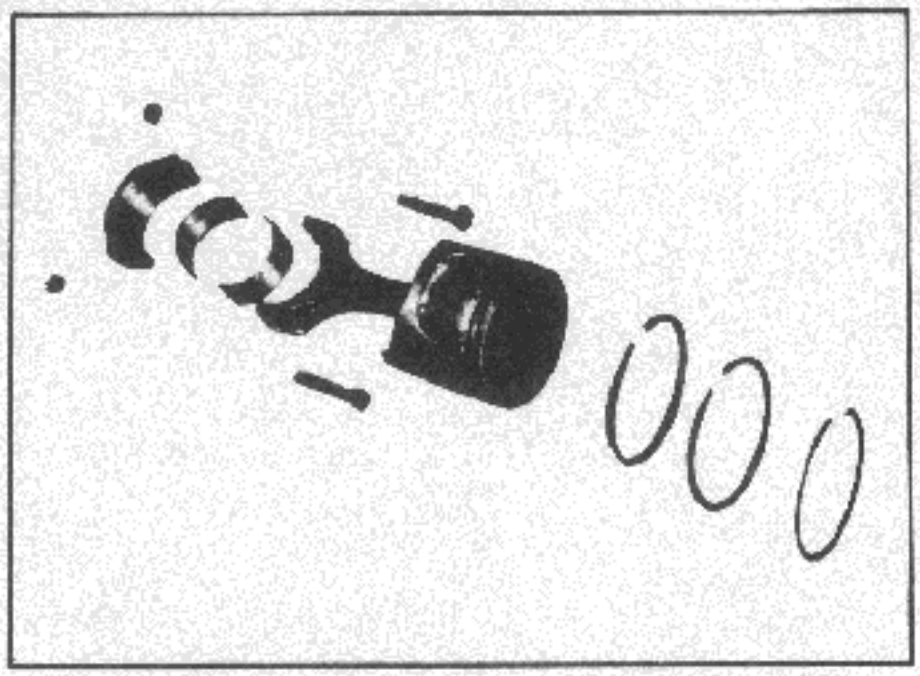


Fig. EM-67 Piston and connecting rod assembly

2. Measure the side clearance of rings in ring groove as each ring is installed. Clearance with new pistons and rings should be as follows.

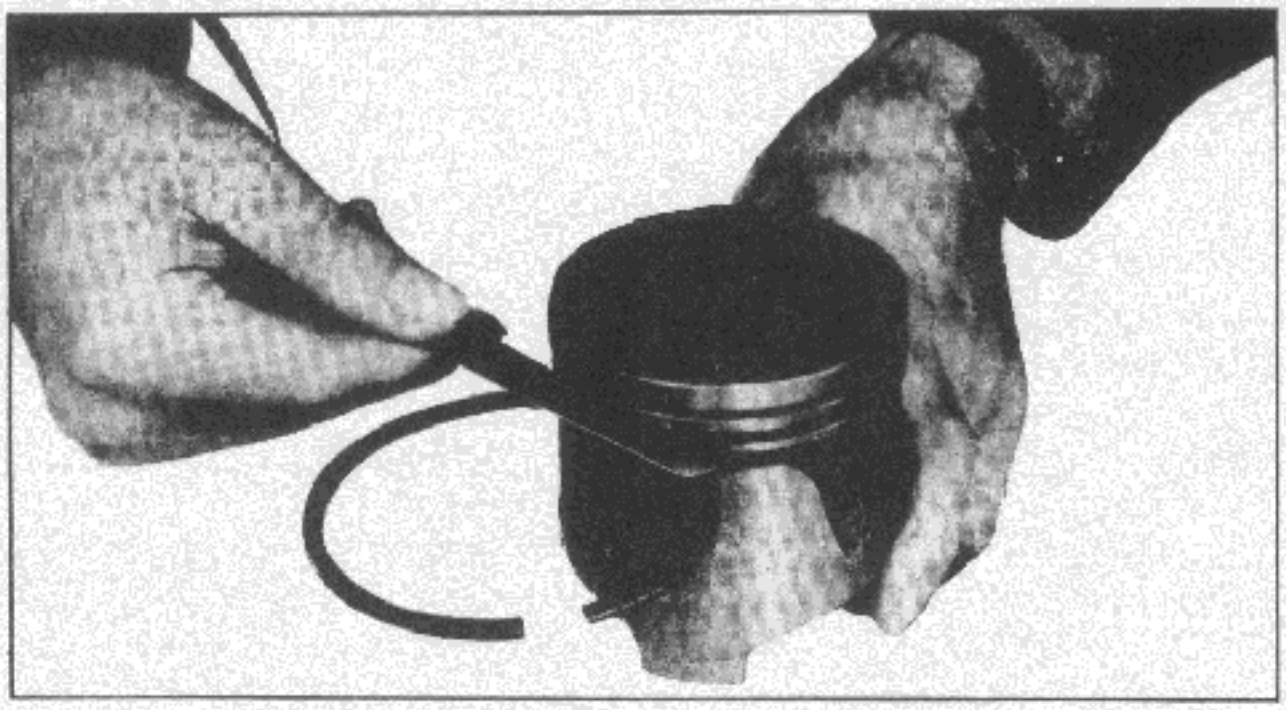


Fig. EM-68 Side clearance measurement

Side clearance

	Standard			Wear limit
	L13	L16	L20	L13, L16, L20
Top ring mm (in.)	0.040 ~ 0.073 (0.0016 ~ 0.0029)	0.045 ~ 0.078 (0.0018 ~ 0.0031)	0.040 ~ 0.078 (0.0016 ~ 0.0031)	0.1 (0.0039)
Second ring mm (in.)	0.030 ~ 0.063 (0.0012 ~ 0.0025)	0.030 ~ 0.063 (0.0012 ~ 0.0025)	0.030 ~ 0.068 (0.0012 ~ 0.0027)	0.1 (0.0039)
Oil ring mm (in.)	0.025 ~ 0.063 (0.0010 ~ 0.0025)	0.025 ~ 0.063 (0.0010 ~ 0.0025)	0.025 ~ 0.068 (0.0010 ~ 0.0027)	0.1 (0.0039)

Ring gap

	Standard		Wear limit
	L13, L16	L20	L13, L16, L20
Top ring mm (in.)	0.23 ~ 0.38 (0.0091 ~ 0.0150)	0.20 ~ 0.35 (0.0079 ~ 0.0138)	1.0 (0.0394)
Second ring mm (in.)	0.15 ~ 0.30 (0.0059 ~ 0.0118)	0.14 ~ 0.29 (0.0055 ~ 0.0114)	1.0 (0.0394)
Oil ring mm (in.)	0.15 ~ 0.30 (0.0059 ~ 0.0118)	0.14 ~ 0.29 (0.0055 ~ 0.0114)	1.0 (0.0394)

3. Place the ring at the bottom of the ring traveled part of cylinder bore in which it will be used.
Square ring in bore by pushing it into position with the head piston.
Measure the gap between ends of ring with feeler gauge. Gap should be as listed above.

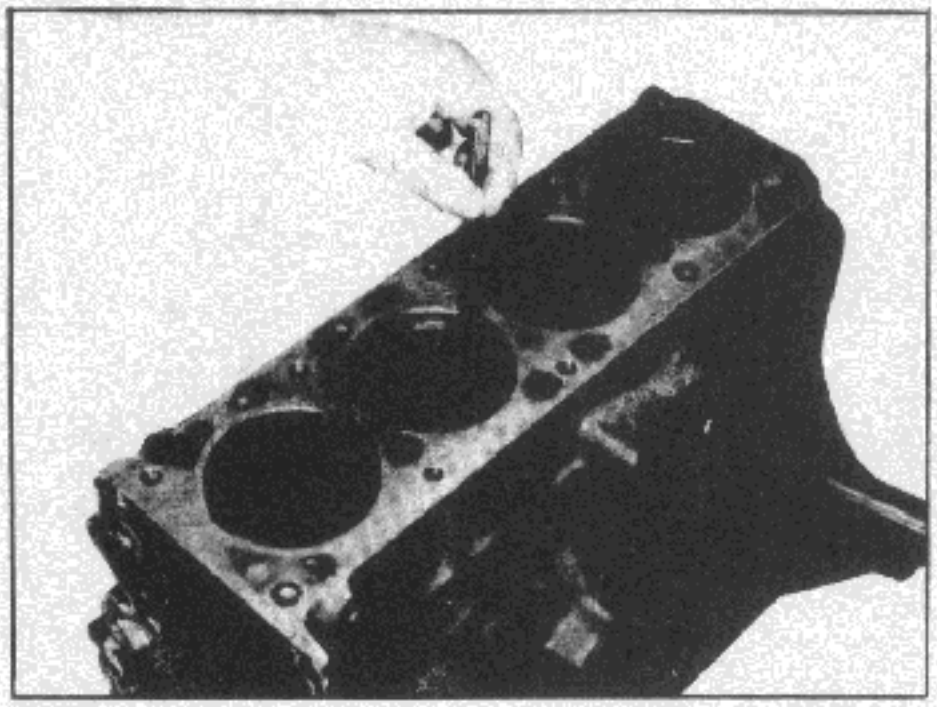


Fig. EM-69 Ring gap measurement

Note:
a. When the piston ring only is to be replaced, without the cylinder bore being corrected, measure the gap at the bottom of the cylinder where the wear is minor.
b. Oversize piston rings are available for service. (25, 50, 75, 100, 125, 150 oversize)

4. Measure the piston pin hole in relation to the outer diameter of the pin. If wear exceeding the limit is indicated, replace such piston pin together with the piston on which it is installed.

	L13, L16	L20
Piston pin outside diameter mm (in.)	20.993 ~ 20.998 (0.8265 ~ 0.8267)	19.995 ~ 20.005 (0.7872 ~ 0.7876)
Piston pin length mm (in.)	72.00 ~ 72.25 (2.835 ~ 2.844)	66.40 ~ 66.65 (2.6142 ~ 2.6240)
Piston pin hole diameter mm (in.)	21.001 ~ 21.008 (0.8268 ~ 0.8271)	19.999 ~ 20.010 (0.7874 ~ 0.7878)

5. Fitting of piston pin

Determine the fitting of the piston pin into the piston pin hole to such an extent that it can be finger pressed at room temperature. This piston pin must be a tight press fit into the connecting rod.

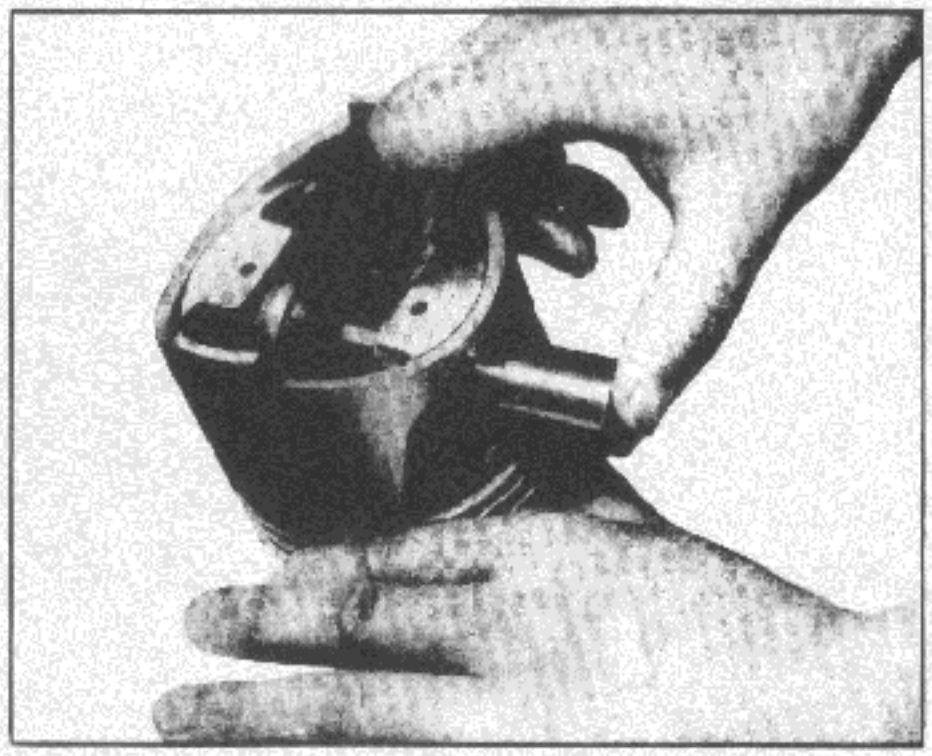


Fig. EM-70 Piston pin fitting

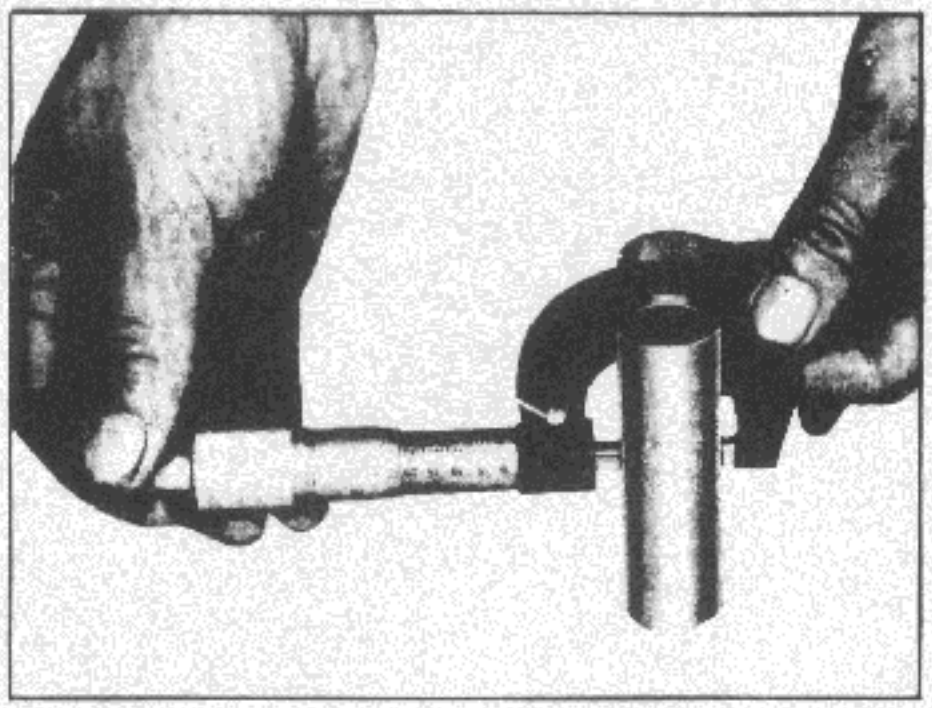


Fig. EM-71 Measuring piston pin diameter

	L13, L16	L20
Piston pin to piston clearance mm (in.)	0.008 ~ 0.010 (0.0003 ~ 0.0004)	0.004 ~ 0.011 (0.0002 ~ 0.0004)
Interference fit of piston pin to connecting rod mm (in.)	0.015 ~ 0.033 (0.0006 ~ 0.0013)	0.017 ~ 0.035 (0.0007 ~ 0.0014)

CONNECTING ROD

1. If a connecting rod has any flaw within the both sides of the thrust face and the large end, correct or replace it.

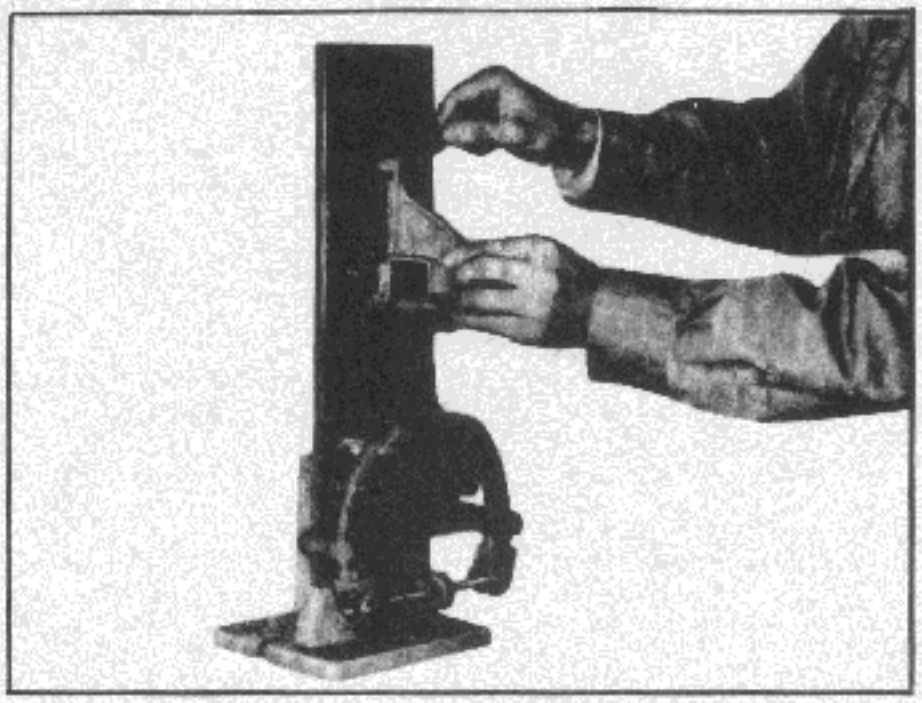


Fig. EM-72 Connecting rod aligner

2. Check for bend or torsion using a connecting rod aligner. If bends or torsion exceeds the limit, correct or replace the connecting rod.

		Standard	Maximum
Connecting rod bend or torsion (per 100 mm or 3.94 in. length mm (in.)	L13, L16	0.030 (0.0012)	0.05 (0.0020)
	L20	0.025 (0.0010)	0.05 (0.0020)

3. In replacing the connecting rod, select the rod so that the weight difference between new rods and old one become within 6 gr. (0.212 oz.) in unit weight.

4. Install connecting rods with bearings on to the corresponding crank pins and measure the thrust clearance. If the measured values exceed the limit, replace such connecting rod.

		Standard	Wear limit
Big end end play mm (in.)	L13, L16	0.2 ~ 0.3 (0.0079 ~ 0.0118)	0.30 (0.0118)
	L20	0.2 ~ 0.3 (0.0079 ~ 0.0118)	0.30 (0.0118)

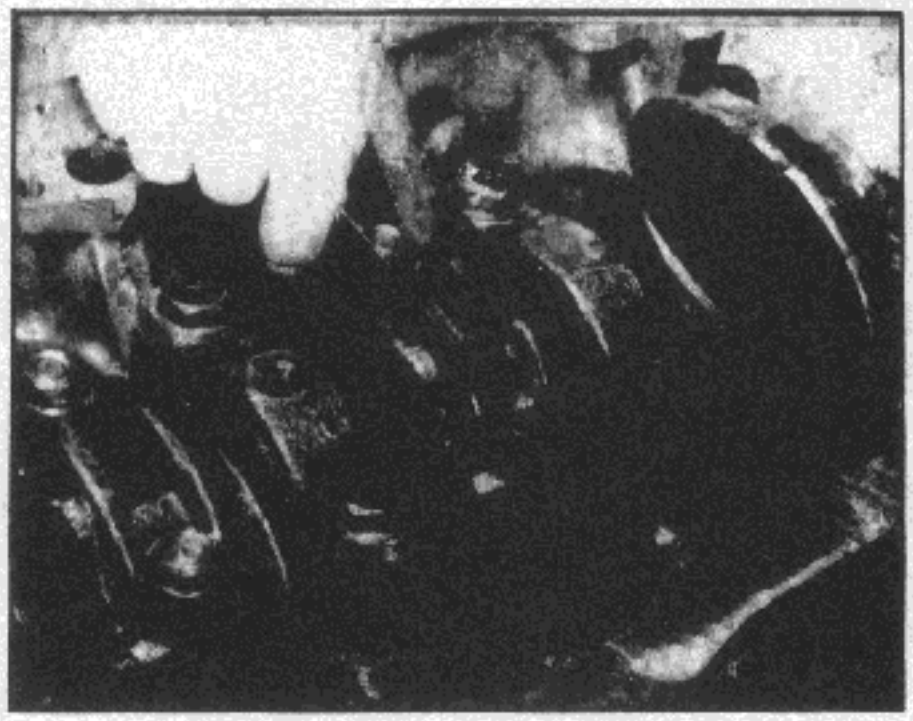


Fig. EM-73 Big end end play check

CRANKSHAFT

1. Check the shaft journal and crank pin for scars, biased wear and cracks.
Repair or replace affected parts.

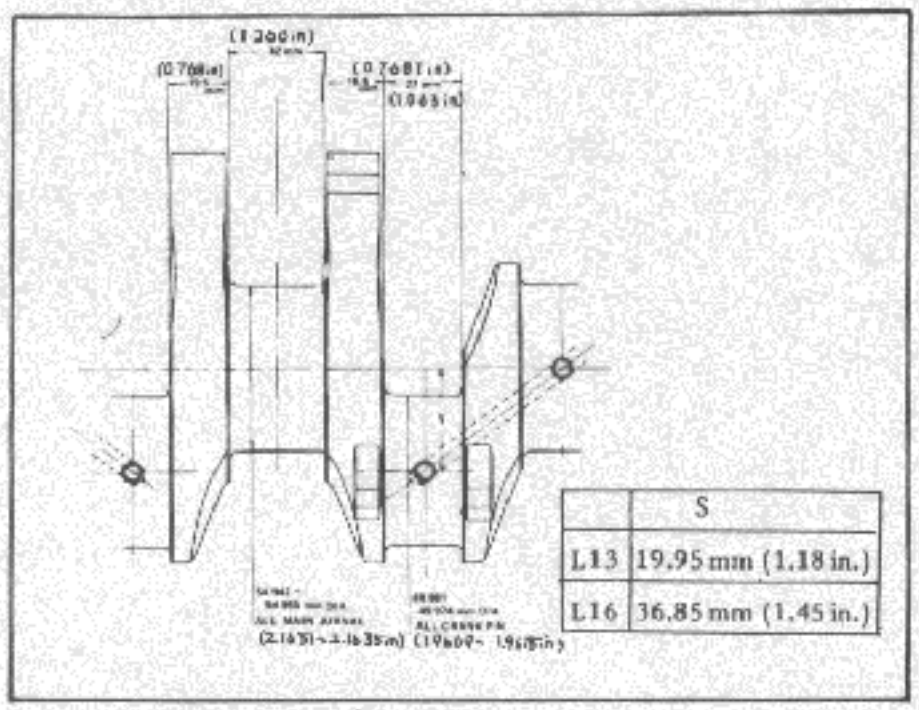


Fig. EM-74 L13, L16 engine

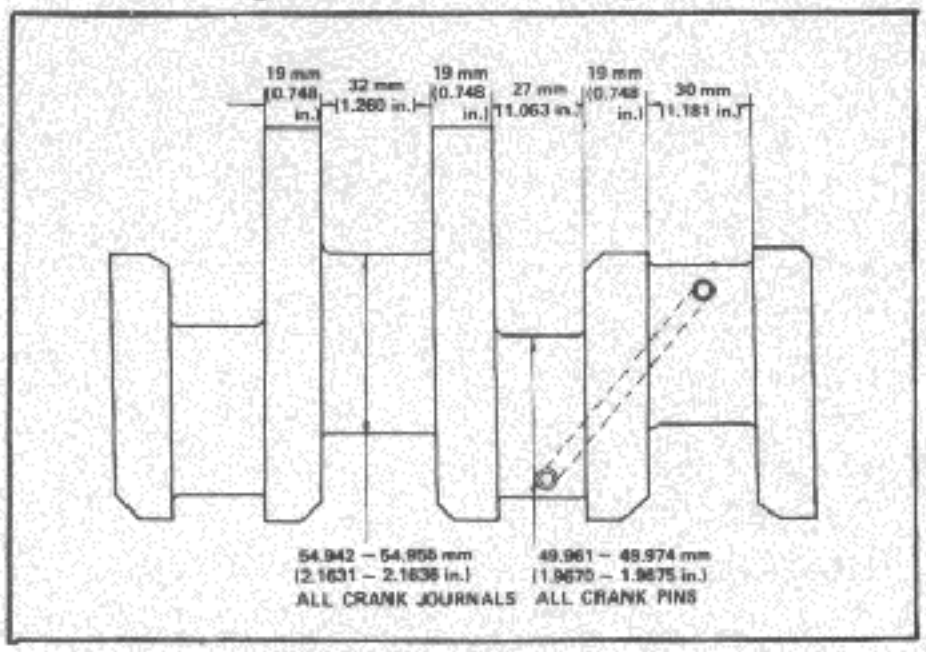


Fig. EM-75 L20 engine

		Standard	Maximum
Taper & out-of-round of crank journal and crank pin mm (in.)	L13, L16	0.01 (0.0004)	0.03 (0.0012)
	L20	less than 0.01 (0.0004)	0.03 (0.0012)

2. Check the crankshaft for bend. If the bend exceeds the specified value repair or replace the crankshaft.

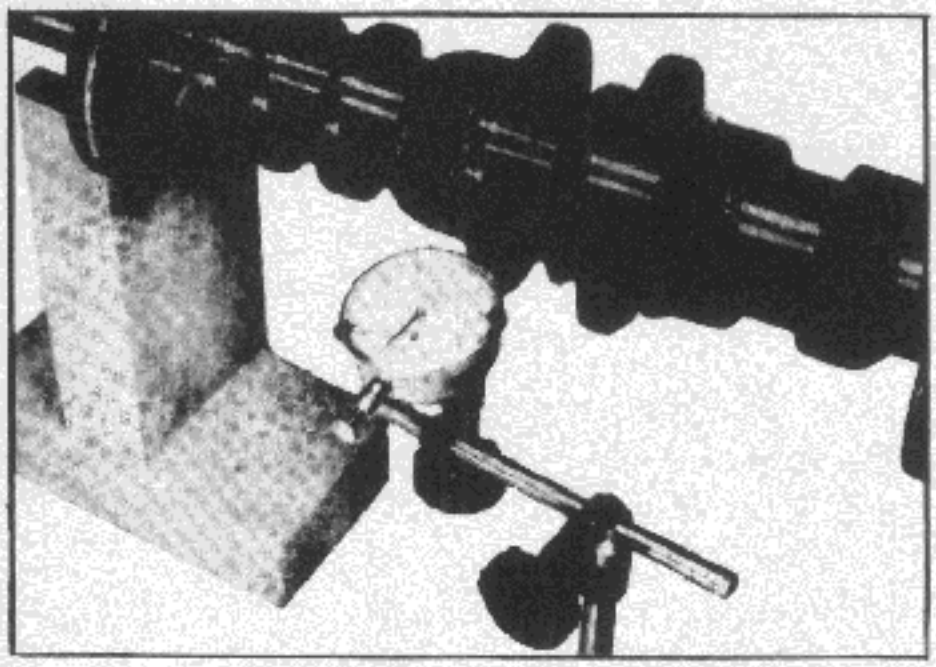


Fig. EM-76 Crankshaft bend check

		Standard	Maximum
Crankshaft bend mm (in.)	L13, L16	less than 0.02 (0.0008)	0.05 (0.0020)
	L20	less than 0.025 (0.0010)	0.05 (0.0020)

Note: **For measuring the bend, use a dial gauge. Bend values are half as much as the readings obtained when the crankshaft is given a turn with the dial gauge applied to its center journal.**

3. After regrinding the crankshaft, finish it to the necessary size indicated in the lists on page EM-29 and 30 by using an adequate undersize bearing according to the extent of required repair.

4. Install the crankshaft in the cylinder block and measure the thrust clearance. If it exceeds the specified value, replace the center shims.

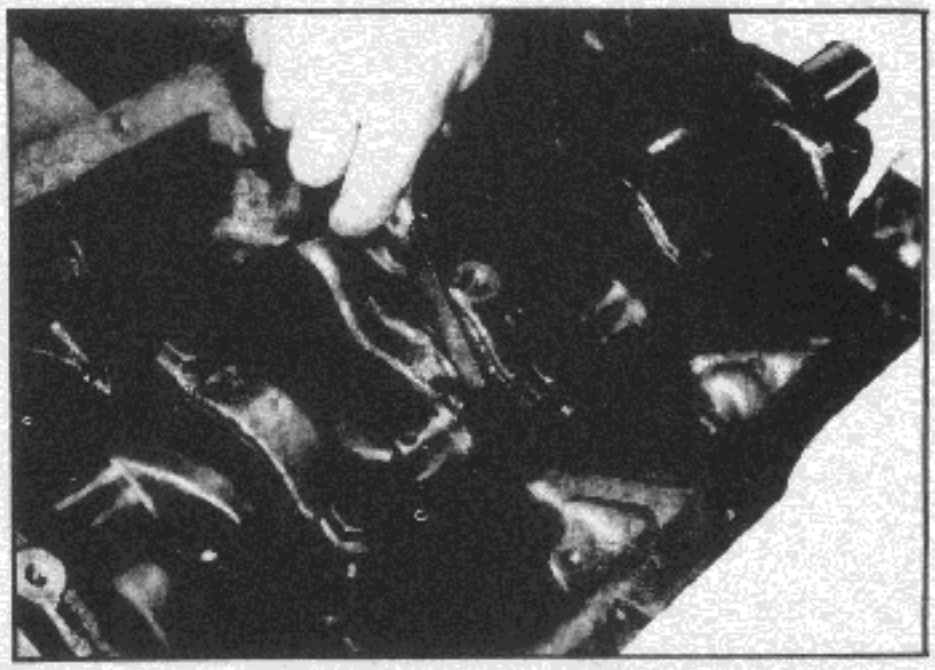


Fig. EM-77 Crankshaft end play check

		Standard	Wear limit
Crankshaft free end play mm (in.)	L13, L16	0.05 ~ 0.15 (0.0020 ~ 0.0059)	0.3 (0.0118)
	L20	0.05 ~ 0.18 (0.0020 ~ 0.0071)	0.3 (0.0118)

5. Check the main drive shaft pilot bearing at the rear of the crankshaft for wear and damage. Replace it if any defects are detected.

BUSHINGS AND BEARINGS

Measurement of main bearing clearance

1. Check all bearings and bushings for seizures, melts, scars and burrs.
Replace bushings, if any defects are detected.

2. Wipe off oil and dust (especially the rear of the bushing).

3. Set the main bearing on the cap block.

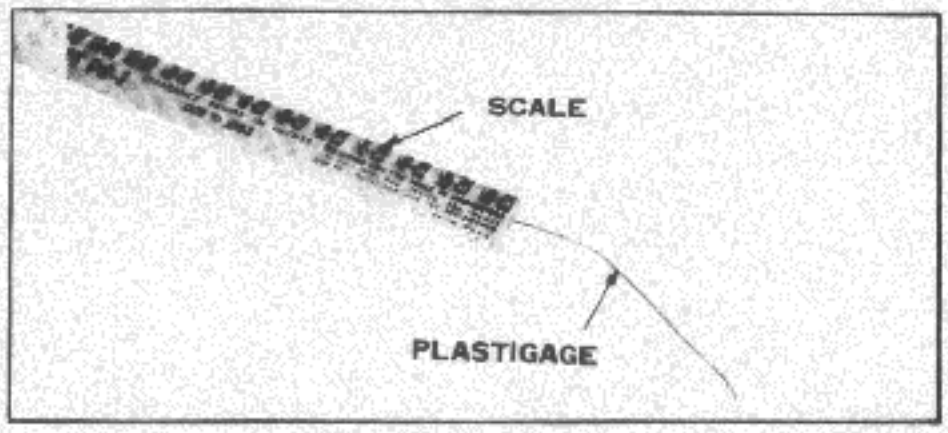


Fig. EM-78 Plastigage

4. Cut a plstigage to the width of the bearing and place it in parallel with the crank pin, getting clear of the oil hole. Install the cap on the assembly and tighten them together under the specified torque.

Tightening torque: 7.0 to 8.0 kg-m (50.6 to 57.8 ft-lb) for L20 engine

4.5 to 5.5 kg-m (32.5 to 39.8 ft-lb) for L13 and L16 engine

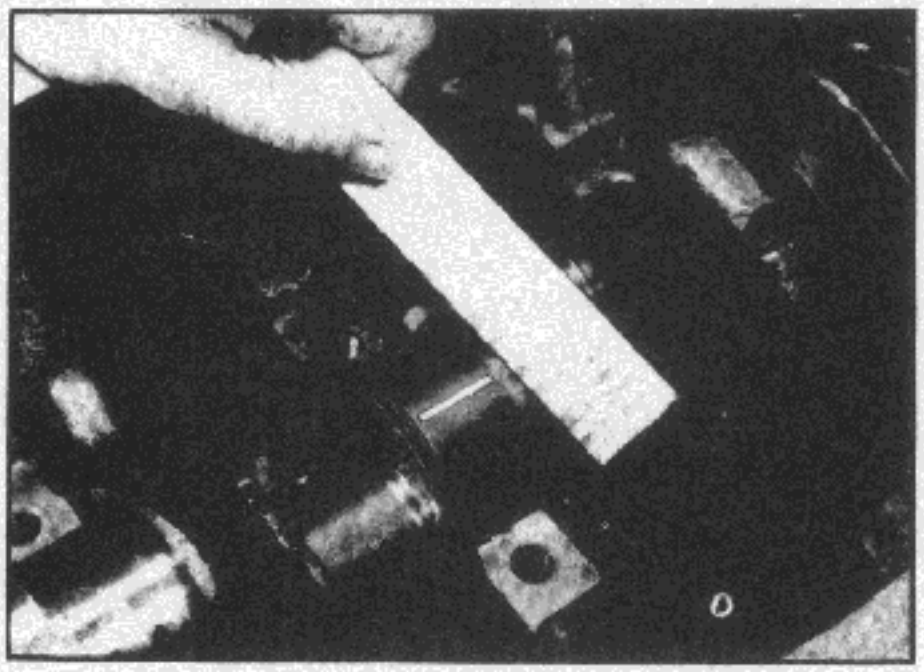


Fig. EM-79 Bearing clearance check

Note: Be sure not to turn the crankshaft when the plastigage is inserted.

5. Remove the cap, and measure the width of the plastigage at its widest part with the scale printed in the plastigage envelope.

Measurement of connecting rod bearing clearance

1. Measure the connecting rod bearing clearance in the same manner.

Tightening torque: 2.8 to 3.4 kg-m (20.2 to 24.6 ft-lb) for L20 engine

2.7 to 3.3 kg-m (19.5 to 23.9 ft-lb) for L13 and L16 engine

Bearing oil clearance

		Standard	Wear limit
Main bearing clearance mm (in.)	L13	0.020 ~ 0.062 (0.0008 ~ 0.0024)	0.10 (0.0039)
	L16	0.020 ~ 0.072 (0.0008 ~ 0.0028)	0.10 (0.0039)
	L20	0.020 ~ 0.072 (0.0008 ~ 0.0028)	0.12 (0.0047)
Connecting rod bearing clearance mm (in.)	L13	0.014 ~ 0.056 (0.0006 ~ 0.0022)	0.10 (0.0039)
	L16	0.014 ~ 0.066 (0.0006 ~ 0.0026)	0.10 (0.0039)
	L20	0.014 ~ 0.066 (0.0006 ~ 0.0026)	0.10 (0.0039)

2. If clearance proves to be in excess of the specified value, replace bearing by undersizes and, consequently, grind out the crankshaft journal.

Fitting bearings

1. Set the bushings on the main bearing cap and the cylinder block bearing recess and tighten the cap bolts to the specified torque.

Tightening torque: 7.0 to 8.0 kg-m (50.6 to 57.8 ft-lb)

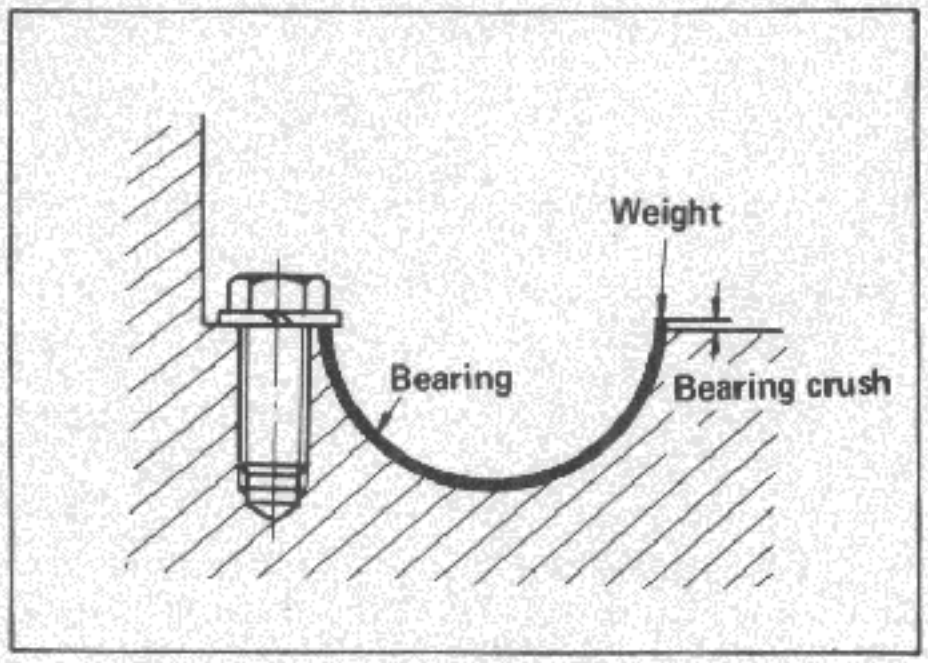


Fig. EM-80 Bearing crush check

2. Loosen the cap bolt on one side and measure the clearance between the cap and block side.

3. Ascertain that the clearance is within double the figures listed below. If it is not, replace the bearing.

4. Handle the connecting rod bearing in the same manner.

Connecting rod cap tightening torque:

2.8 to 3.4 kg-m
(20.2 to 24.6 ft-lb)
for L20 engine

2.7 to 3.3 kg-m
(19.5 to 23.9 ft-lb)
for L13 and L16 engine

Bearing crush

	L13	L16	L20
All main bearing mm (in.)	0∿0.03 (0∿0.0012)	0∿0.03 (0∿0.0012)	0∿0.03 (0∿0.0012)
All connecting rod bearing mm (in.)	0.015∿0.045 (0.0006∿0.0018)	0.015∿0.040 (0.0006∿0.0016)	0.015∿0.040 (0.0006∿0.0016)

Main bearing undersize

For L13 engine

Bearing size 1/1000 mm	Bearing top thickness mm (in.)	Crank journal diameter mm (in.)
STD	1.827 ~ 1.835 (0.0719 ~ 0.0722)	54.742 ~ 54.955 (2.1631 ~ 2.1636)
25 Undersize	1.952 ~ 1.960 (0.0769 ~ 0.0772)	54.692 ~ 54.705 (2.1532 ~ 2.1537)
50 Undersize	2.077 ~ 2.085 (0.0818 ~ 0.0821)	54.442 ~ 54.455 (2.1434 ~ 2.1439)
75 Undersize	2.202 ~ 2.210 (0.0867 ~ 0.0870)	54.192 ~ 54.205 (2.1335 ~ 2.1341)
100 Undersize	2.327 ~ 2.335 (0.0916 ~ 0.0919)	53.942 ~ 53.955 (2.1237 ~ 2.1242)

For L16 engine

Bearing size 1/1000 mm	Bearing top thickness mm (in.)	Crank journal diameter mm (in.)
STD	1.822 ~ 1.835 (0.0717 ~ 0.0722)	54.942 ~ 54.955 (2.1631 ~ 3.1636)
25 Undersize	1.947 ~ 1.960 (0.0767 ~ 0.0772)	54.692 ~ 54.705 (2.1532 ~ 2.1537)
50 Undersize	2.072 ~ 2.085 (0.0816 ~ 0.0821)	54.442 ~ 54.455 (2.1434 ~ 2.1439)
75 Undersize	2.197 ~ 2.210 (0.0865 ~ 0.0870)	54.192 ~ 54.205 (2.1335 ~ 2.1341)
100 Undersize	2.322 ~ 2.335 (0.0914 ~ 0.0919)	53.942 ~ 53.955 (2.1237 ~ 2.1242)

For L20 engine

Bearing size 1/1000 mm	Bearing top thickness mm (in.)	Crank journal diameter mm (in.)
STD	1.822 ~ 1.835 (0.0717 ~ 0.0722)	54.942 ~ 54.955 (2.1631 ~ 2.1636)
25 Undersize	1.947 ~ 1.960 (0.0767 ~ 0.0772)	54.692 ~ 54.705 (2.1532 ~ 2.1537)
50 Undersize	2.072 ~ 2.085 (0.0816 ~ 0.0821)	54.442 ~ 54.455 (2.1434 ~ 2.1439)
75 Undersize	2.197 ~ 2.210 (0.0865 ~ 0.0870)	54.172 ~ 54.205 (2.1328 ~ 2.1341)
100 Undersize	2.322 ~ 2.335 (0.0914 ~ 0.0919)	53.942 ~ 53.955 (2.1237 ~ 2.1242)

Connecting rod bearing undersize

For L13 engine

Bearing size 1/1000 mm	Bearing top thickness mm (in.)	Crank pin diameter mm (in.)
STD	1.498 ~ 1.506 (0.0590 ~ 0.0593)	49.961 ~ 49.974 (1.9670 ~ 1.9675)
6 Undersize	1.528 ~ 1.536 (0.0602 ~ 0.0605)	49.901 ~ 49.914 (1.9646 ~ 1.9651)

12 Undersize	1.558 ~ 1.566 (0.0613 ~ 0.0617)	49.841 ~ 49.854 (1.9622 ~ 1.9628)
25 Undersize	1.623 ~ 1.631 (0.0639 ~ 0.0642	49.711 ~ 49.724 (1.9571 ~ 1.9576)
50 Undersize	1.748 ~ 1.756 (0.0688 ~ 0.0691)	49.461 ~ 49.474 (1.9473 ~ 1.9478)
75 Undersize	1.873 ~ 1.881 (0.0737 ~ 0.0741)	49.211 ~ 49.224 (1.9374 ~ 1.9379)
100 Undersize	1.998 ~ 2.006 (0.0787 ~ 0.0790)	48.961 ~ 48.974 (1.9276 ~ 1.9281)

For L16 and L20 engine

Bearing size 1/1000 mm	Bearing top thickness mm (in.)	Crank pin diameter mm (in.)
STD	1.493 ~ 1.506 (0.0588 ~ 0.0593)	49.961 ~ 49.974 (1.9670 ~ 1.9675)
6 Undersize	1.523 ~ 1.536 (0.0600 ~ 0.0605)	49.901 ~ 49.914 (1.9646 ~ 1.9651)
12 Undersize	1.553 ~ 1.566 (0.0611 ~ 0.0617)	49.841 ~ 49.854 (1.9622 ~ 1.9628)
25 Undersize	1.618 ~ 1.631 (0.0637 ~ 0.0642)	49.711 ~ 49.724 (1.9571 ~ 1.9576)
50 Undersize	1.743 ~ 1.756 (0.0686 ~ 0.0691)	49.461 ~ 49.474 (1.9473 ~ 1.9478)
75 Undersize	1.868 ~ 1.881 (0.0735 ~ 0.0741)	49.211 ~ 49.224 (1.9374 ~ 1.9379)
100 Undersize	1.993 ~ 2.006 (0.0785 ~ 0.0790)	48.961 ~ 48.974 (1.9276 ~ 1.9281)

MISCELLANEOUS COMPONENTS

Crankshaft sprocket, camshaft sprocket

1. Check tooth surfaces for flaws and wears. Replace defective sprocket if any defects are found.

2. Install the camshaft sprocket in position and check for run-out. If it is found to exceed 0.1 mm (0.04331 in.), replace the camshaft sprocket. Check for thrust deviation at the same time. As for L20 engine three kinds of locating plate differing in thickness are available, so make the necessary adjustment using those locating plates.

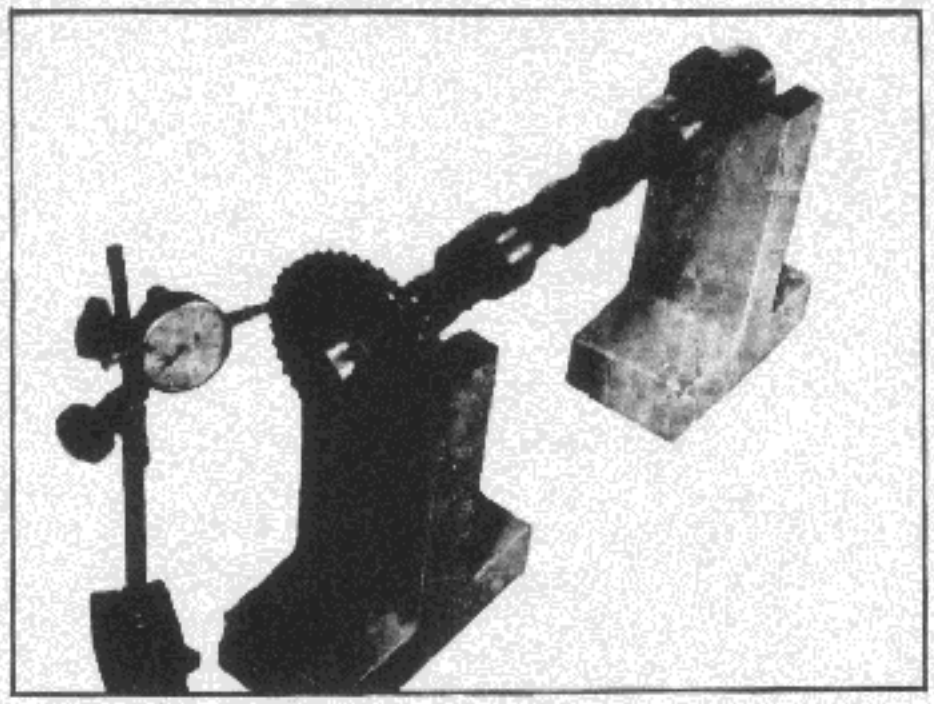


Fig. EM-81 Camshaft sprocket run-out check

Thrust deviation mm (in.)	L13, L16	0.08 ~ 0.38 (0.0031 ~ 0.0150)
	L20	0.04 ~ 0.30 (0.0016 ~ 0.0118)
Locating plate thickness (only for L20 engine) mm (in.)		4.8 ± 0.05 (0.1890 ± 0.0020)
		4.9 ± 0.05 (0.1929 ± 0.0020)
		5.0 ± 0.05 (0.1969 ± 0.0020)

3. Check the chain for damage, severe wear and stretch at its roller links. Replace a defective chain.

4. When the chain stretches extremely, the valve timing goes out of order. In L13 and L16 engine (except L20 engine), two locate (Camshaft set) holes are provided in the camshaft sprocket to correct the valve timing.

Adjustment of camshaft sprocket location for L13 and L16 engine

If the stretch of the chain roller links is extreme, adjust the camshaft sprocket location by transfering the camshaft set position of the camshaft sprocket to No.2 or No.3 holes.

1. Turn engine until No. 1 piston is at T.D.C. on its compression stroke. Examine whether the camshaft location hole on the camshaft sprocket comes off the left end of the oblong groove on the camshaft locate plate.
(If the camshaft location hole is off the left end of the oblong groove, the stretch of the chain is beyond the limit.)

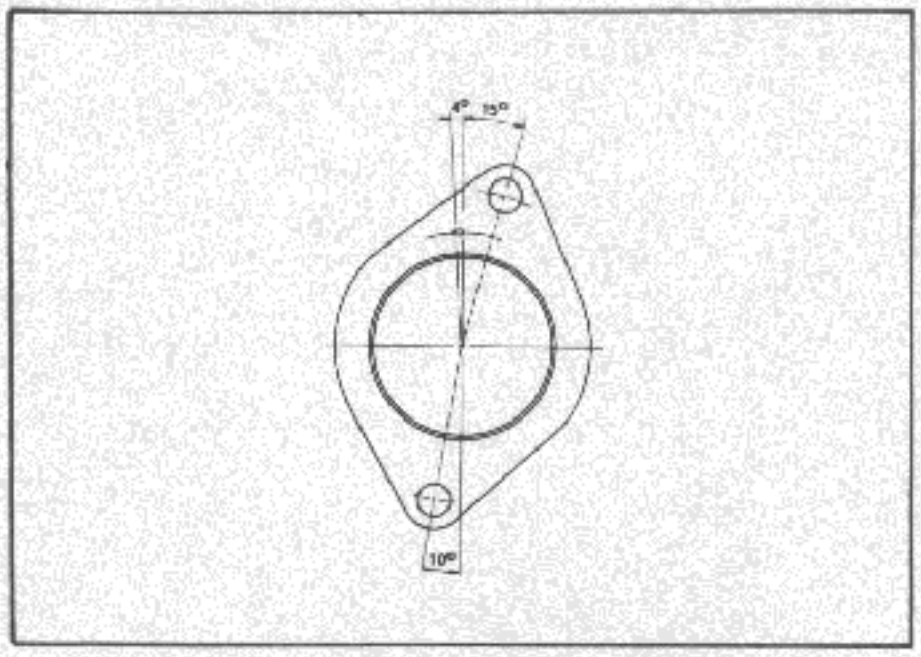


Fig. EM-82 Camshaft locate plate (L13 and L16 engine)

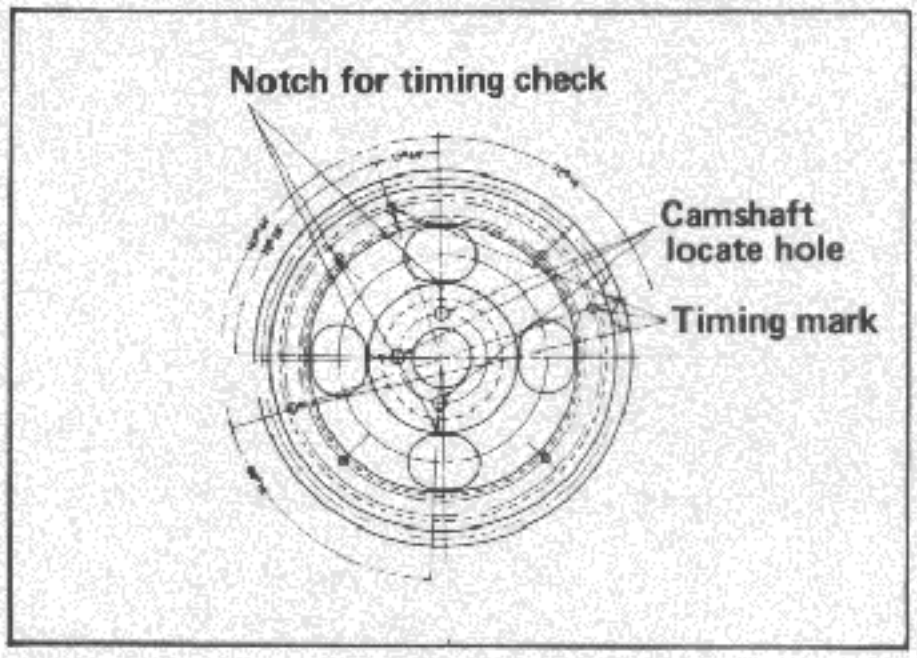


Fig. EM-83 Camshaft sprocket (L13 and L16 engine)

2. Turn the engine until No. 1 piston is at T.D.C. on its compression stroke set the camshaft on No. 2 location hole of the camshaft sprocket. Then this No. 2 hole should be on the right end of the oblong groove. When the No. 2 hole is used, the amount of the modification is 4° by the rotation of the crankshaft.

3. If the valve timing can not be corrected by using No. 2 hole, use No. 3 hole as the same procedure as mensioned above. The amount the modification by using No. 3 hole is 8° by the rotation of the crankshaft.

4. When the modification becomes inpossible even by transfering the camshaft location hole, replace the chain assembly.

Chain tensioner and chain guide

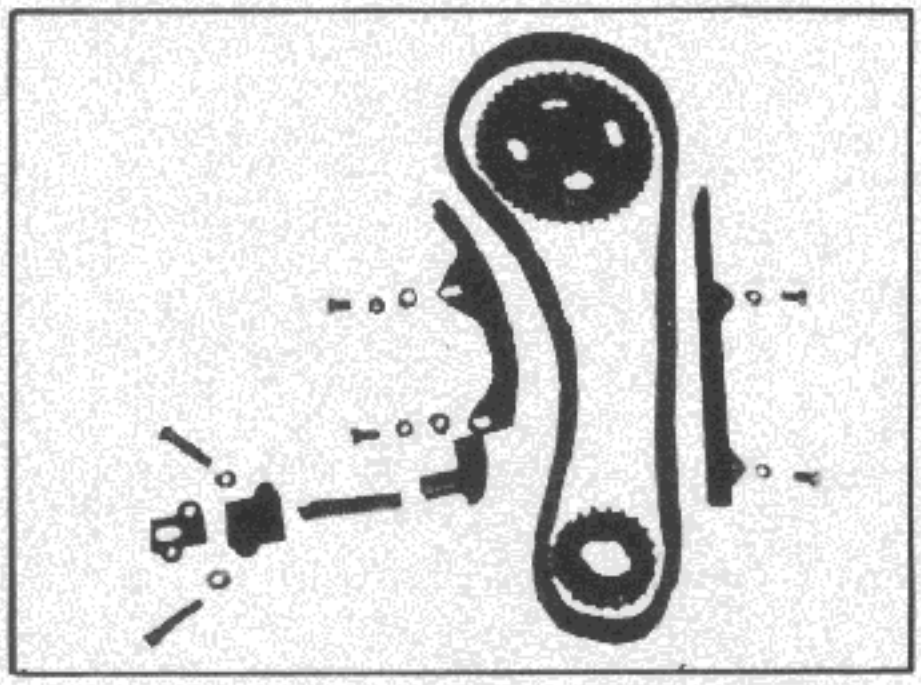


Fig. EM-84 Camshaft drive mechanism for L13 and L16 engine

Check for wear and breakage. Replace if necessary.

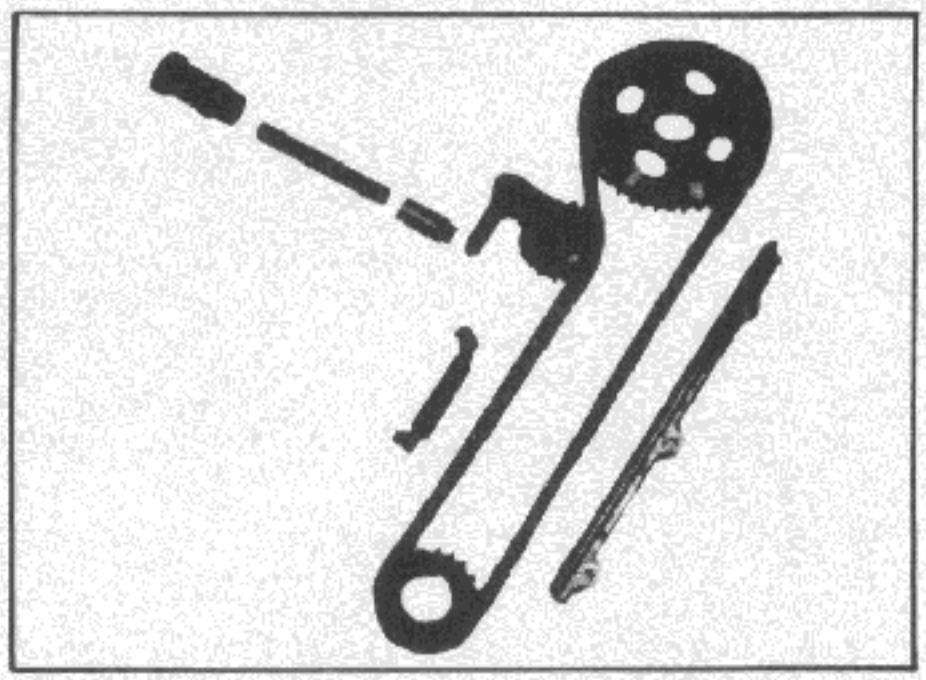


Fig. EM-85. Camshaft drive mechanism for L20 engine

Flywheel

1. Check the clutch disc contact surface of the flywheel for damage and wear. Repair or replace if necessary.

2. Measure deviation of the clutch disc contact surface with a dial gauge. If it exceeds 0.1 mm (0.04331 in.), replace it.

3. Check tooth surfaces of the ring gear for flaws and wear.
Replace if necessary.

Note: Replace the ring gear at about 180° to 200°C (356° to 392°F).

ENGINE ASSEMBLY

CONTENTS

PRECAUTIONS

1. Use thoroughly cleaned parts. Particularly, check whether oil holes are clear of foreign matter or not.

2. In installing sliding parts, such as bearings proceed after applying engine oil to them as required.

3. Use new packings and oil seals, in principle.

4. Keep tools and work benches clean and clear of dust and oil stains.

5. Keep the necessary parts and tools ready near at hand.

6. Be sure to follow specified tightening torque and orders where necessary.

CYLINDER HEAD

1. Assembly of valve and valve spring

Set the valve spring seat in position, and fit the valve guide with the oil seal.
Assemble the valve in order of the following, valve, inner and outer valve springs, spring retainer, valve collet and valve rocker guide.

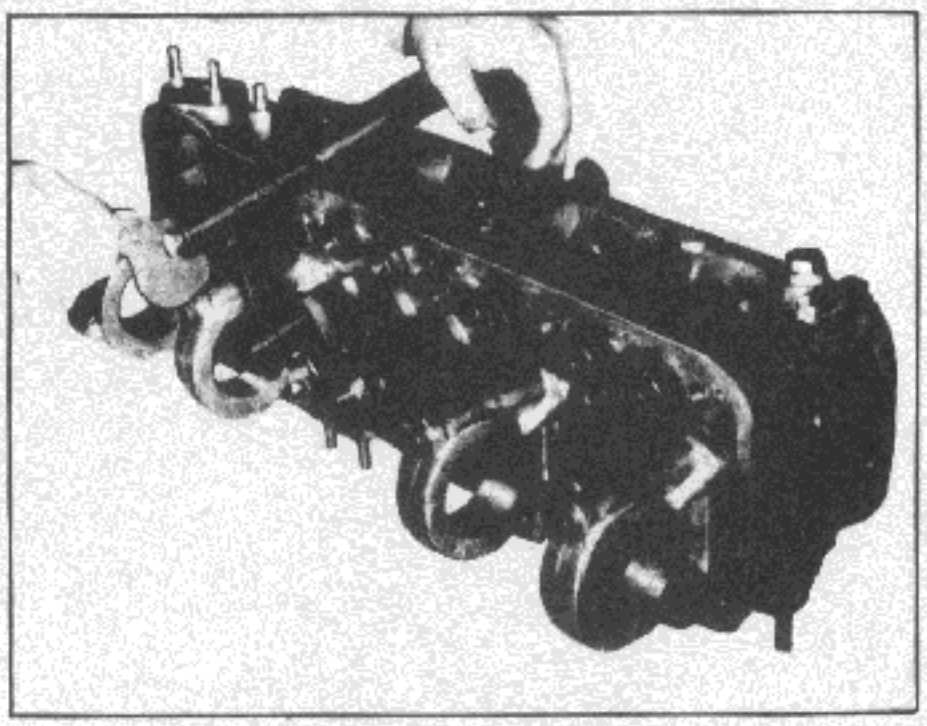


Fig. EM-86 Valve installation

Note: a. Check whether the valve face is clear from foreign matters.
b. As for L13 engine the valve springs are the single type, and other engines use the double valve springs.

2. Assembly of valve rocker pivot

Screw valve rocker pivots joined with rocker spring washer and lock nuts in the pivot bush. (In L13 and L16 engine the spring holders are combined with the rocker pivot bushes.)

3. Assembly of camshaft

Set the locating plate and install the camshaft in cylinder head carefully. Do not damage the bearing inside.

4. Install the camshaft sprocket on camshafts and tighten it together with fuel pump cam to the specified torque.

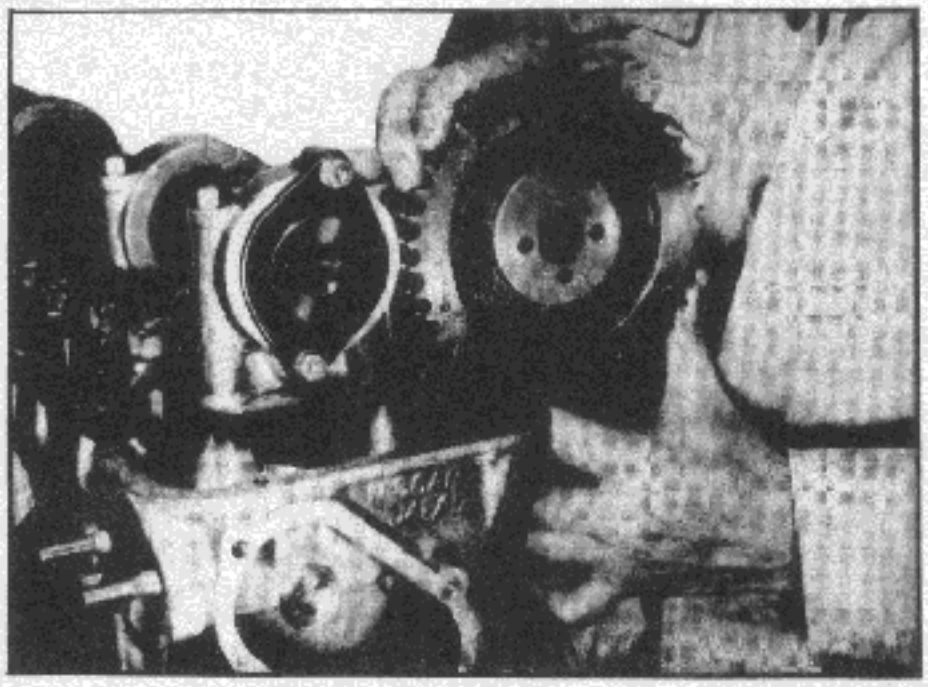


Fig. M Fig. EM-87 Camshaft sprocket installation (L13 and L16 engine)

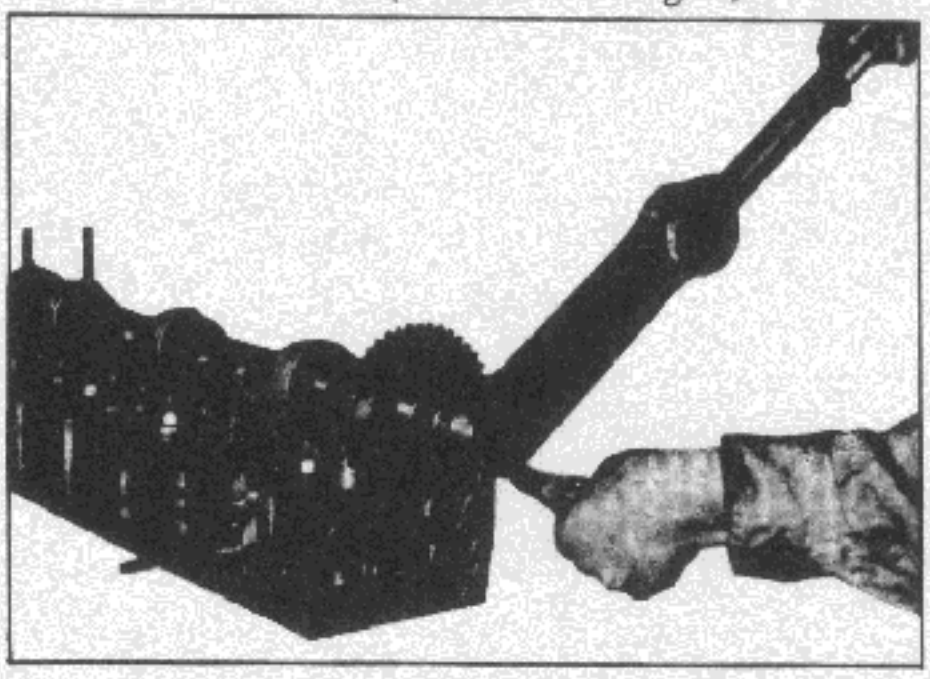


Fig. EM-88 Camshaft sprocket installation (L20 engine)

Tightening torque: 4.8 to 5.5 kg-m
(34.7 to 39.8 ft-lb)

At this time, check the camshaft for the end play.

5. Connect the oil pipe in position (only for L20 engine).

6. Install the rocker arms, pressing down the valve springs by screwdriver.

7. Install the valve rocker springs.

PISTON AND CONNECTING ROD

1. Assemble piston, piston pin and connecting rod assorted according to cylinder No. for every cylinder.

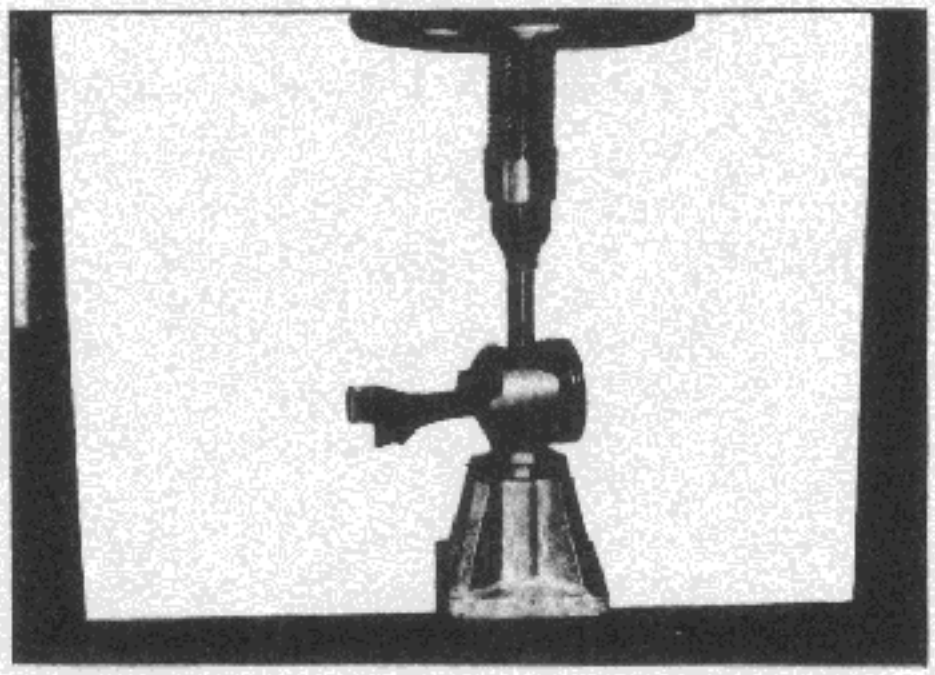


Fig. EM-89 Piston pin installation

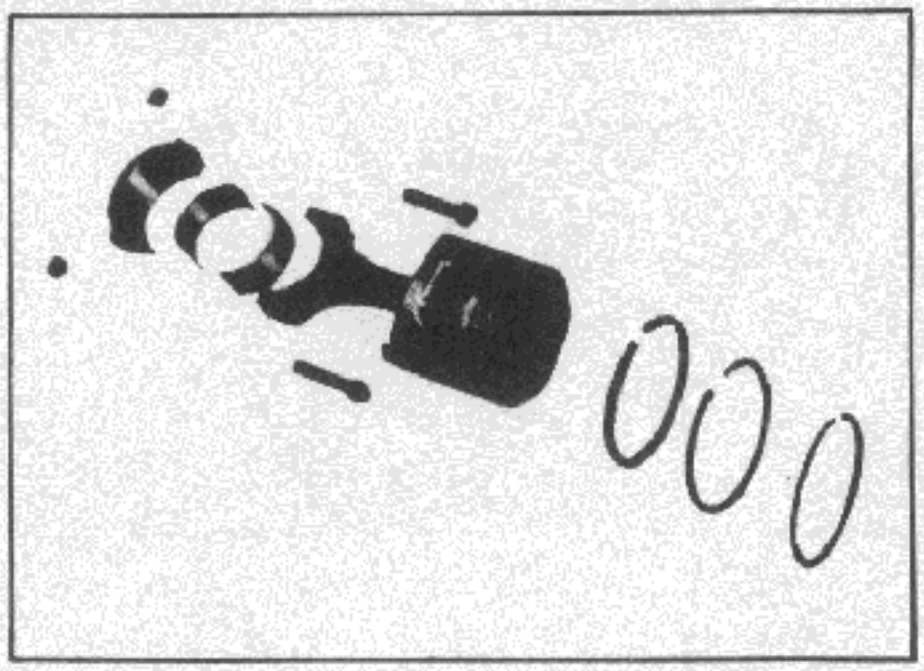


Fig. EM-90 Piston and connecting rod assembly

Note:
a. Piston pin is a tight press fit to the connecting rod, and fitting force is from 1 to 3 tons and the aid of the special tool is necessary. In pressing the piston pin in the connecting rod, apply engine oil to the pin and the small end of the connecting rod.
b. Arrange so as the oil jet of the connecting rod large end is directed toward the right side of the cylinder block.
c. As the center of the piston pin is off-set in relation to the center of the piston, be sure to make proper assembly.

2. Install the piston rings.

Install top and second rings in right position, as the rings with marks up.

3. Fix bearings on the connecting rod and the connecting rod cap.

Note: Clean the back side of the bearings carefully.

ASSEMBLING OF ENGINE

1. Set the cylinder block on the working stand.

2. Hold down jute seal into the cylinder block rear bearing using ST47810000 and trim the excessive seal ends with a knife. Be sure to **remove the entire excess. (only for L20 engine)**

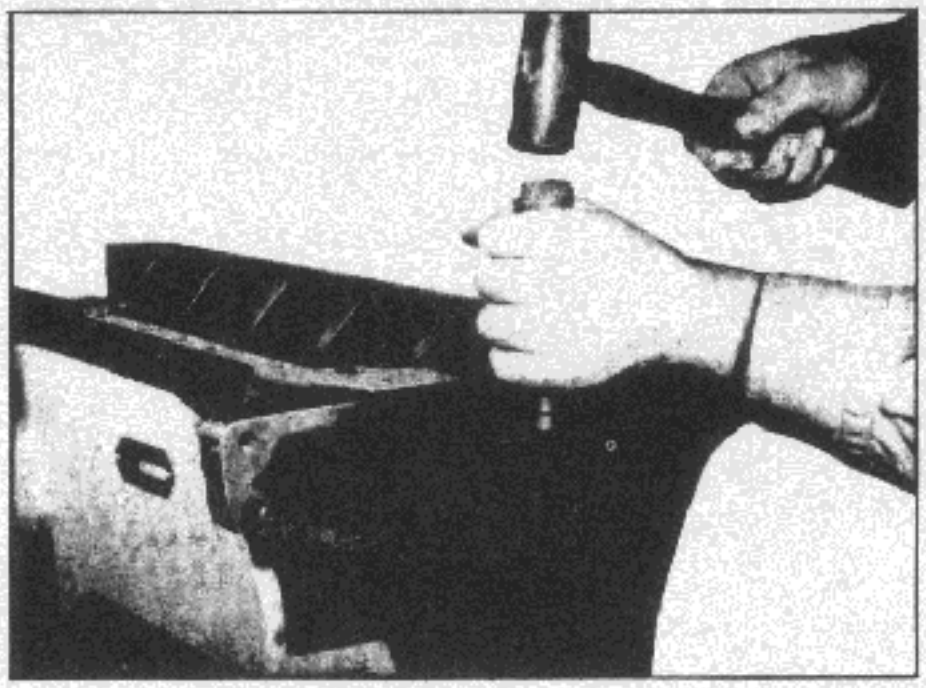


Fig. EM-91 Rear jute seal installation for L20 engine

3. Set the main bearings on the proper portion of the cylinder block.

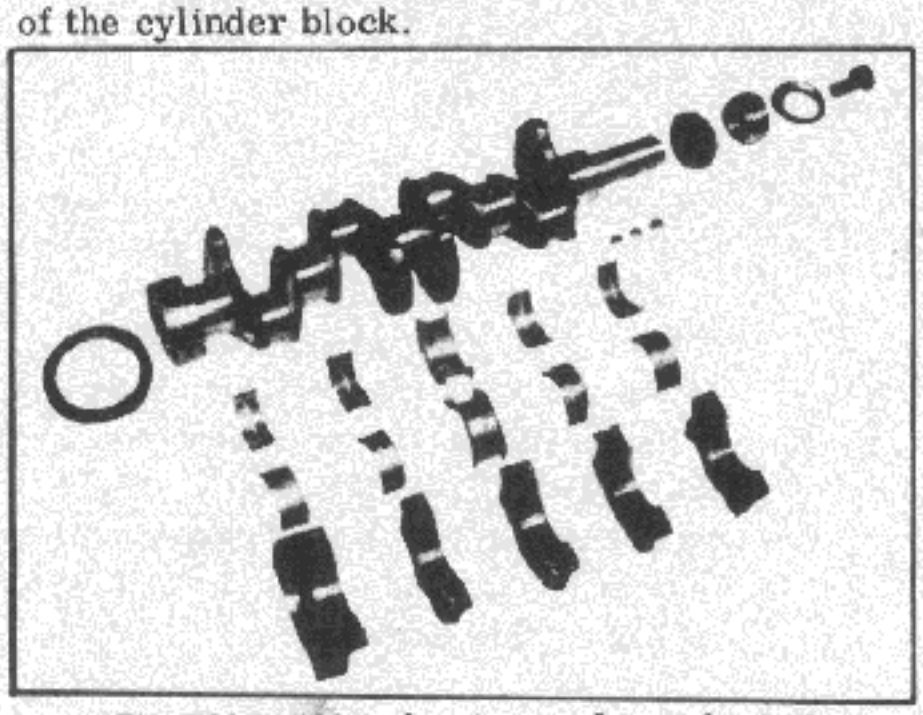


Fig. EM-92 Main bearings and caps for L13 and L16 engine

Note:
a. Only the center bearing (No.3 bearing of L13, L16 engine and No.4 of L20 engine) is a flanged type for thrust force.
b. All inter bearings (No.2 and No.4 of L13, L16 engine and No.2, 3, 5, 6 of L20 engine) are the same type ones.
c. The front bearing (No.1) is also the same type with the rear bearing (No.5 of L13, L16 and No.7 of L20).
Only difference between both bearings is that the front bearing has an oil hole and the rear one has no hole.
d. All bearings except No.1 bearing have a interchangeability between upper and lower bearings.

4. Apply the engine oil to the main bearing surfaces on the both side of the cylinder block and cap. Then, install the crankshaft.

5. Hold down the jute seal into the rear main bearing cap. (only for L20 engine)

6. Install the main bearing cap and tighten the bolts with specified torque.

Tightening torque: 7.0 to 7.8 kg-m
(50.6 to 57.8 ft-lb)
for L20 engine

4.5 to 5.5 kg-m
(32.5 to 39.8 ft-lb)
for L13 and L16 engine

Note:
a. Arrange so as the arrow mark on the bearing cap is faced toward the front of the engine.
b. Prior to the tightening of the bearing cap bolts, place the bearing cap at a proper position by shifting the crankshaft in the axial direction.
c. The tightening operation should be made gradually in separating three or four stages and outwardly from center bearing.
d. After securing the bearing cap bolts ascertain whether the crankshaft is easily rotatable.

7. Make sure of the crankshaft end play.

Crankshaft end play: 0.05 to 0.15 mm
(0.002 to 0.006 in.)
for L13 and L16 engine

0.05 to 0.18 mm
(0.002 to 0.007 in.)
for L20 engine

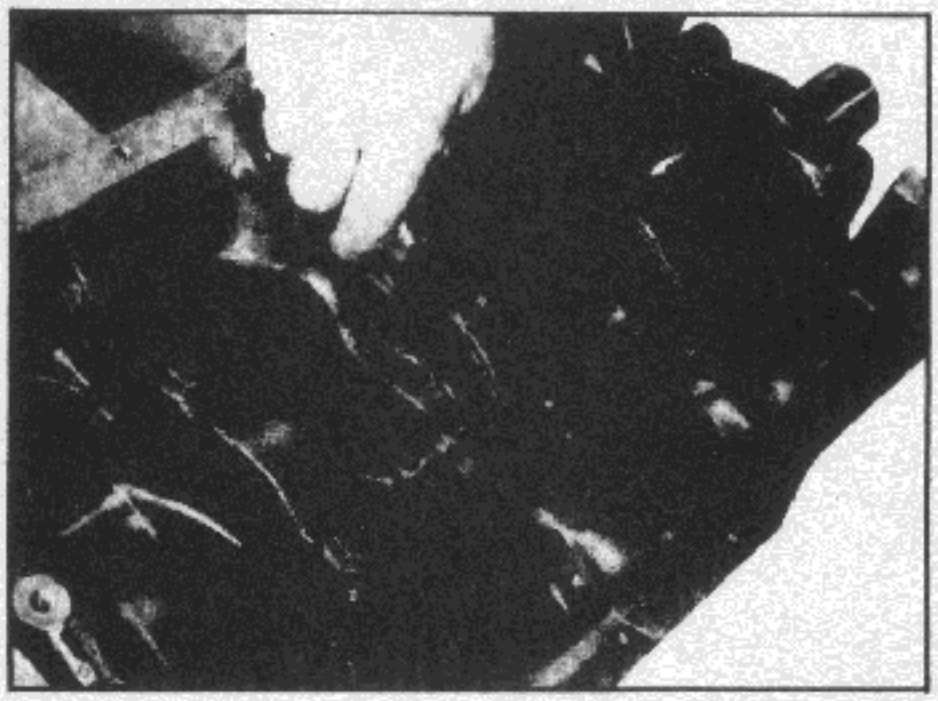


Fig. EM-93 Crankshaft end play check

8. Installed the side oil seals into the rear main bearing cap as same way in the cylinder block.

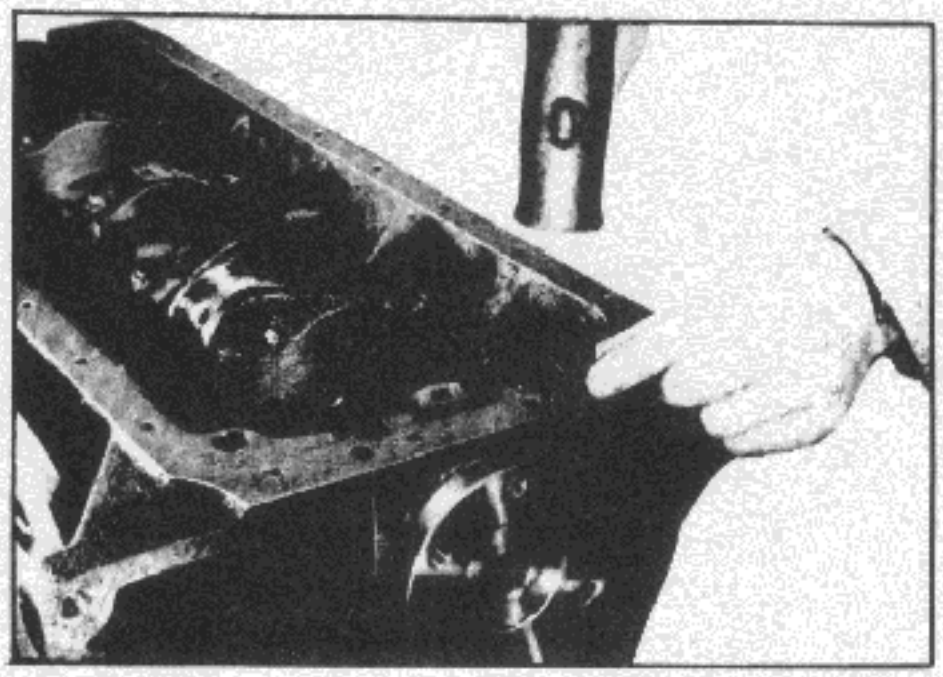


Fig. EM-94 Side oil seal installation

9. Install the rear oil seal. (only for L13, L16 engine) special tool: ST49370000

Note: **If the excessive wear is found at the contact surface of the rear oil seal on the crankshaft with the rear oil seal, install the rear oil seal shim and shift the surface of contatt.**

10. Install the rear end plate.

11. Install the flywheel securely using the lock washers, and tighten the bolts with specified torque.

Tightening torque: 4.8 to 6.1 kg-m
(34.7 to 44.1 ft-lb)
for L20 engine

9.5 to 10.5 kg-m
(68.7 to 75.9 ft-lb)
for L13 and L16 engine

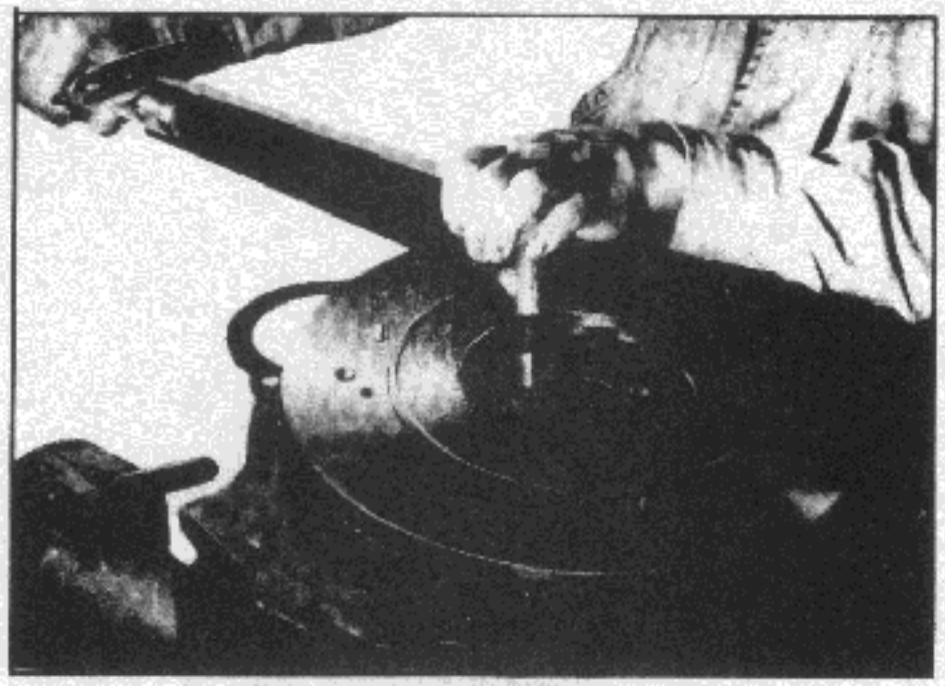


Fig. EM-95 Flywheel installation

12. Install the piston-rod assembly.

Note: **a. Insert the pistons in the corresponding cylinders.**

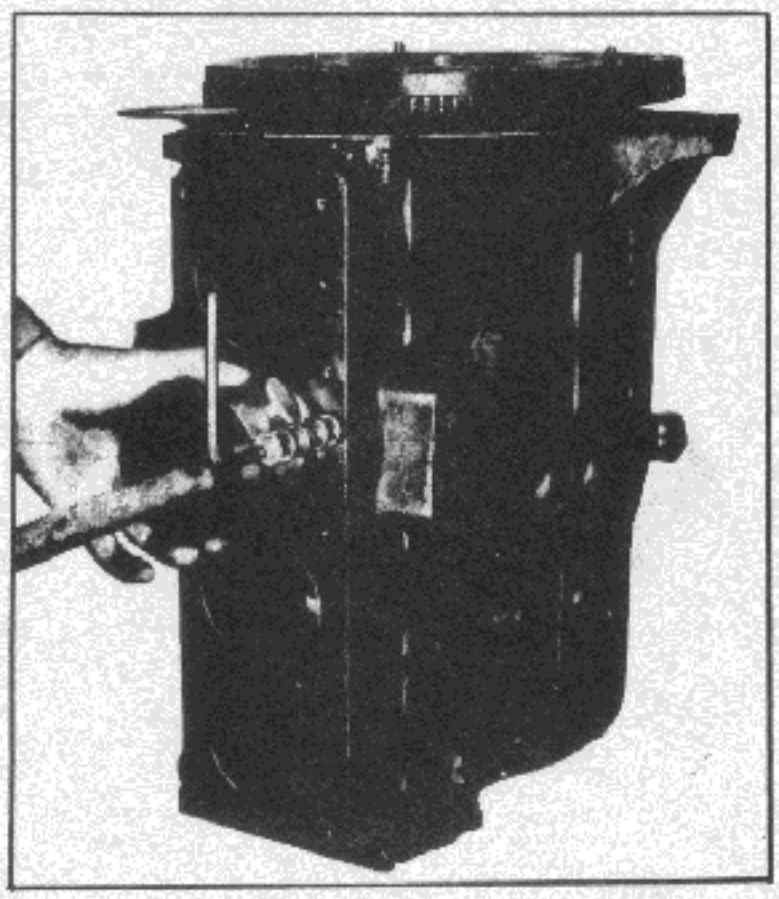


Fig. EM-96 Piston-rod assembly installation

b. Apply the engine oil on concerning parts.
c. Arrange so as the F marking on the piston is facing front of engine.
d. Install piston rings at 180° to each other, avoiding their fit in the thrust and piston pin axial directions.

13. Install the connecting rod cap.

Tightening torque: 2.8 to 3.4 kg-m
(20.2 to 24.6 ft-lb)
for L13, L16 and L20 engine

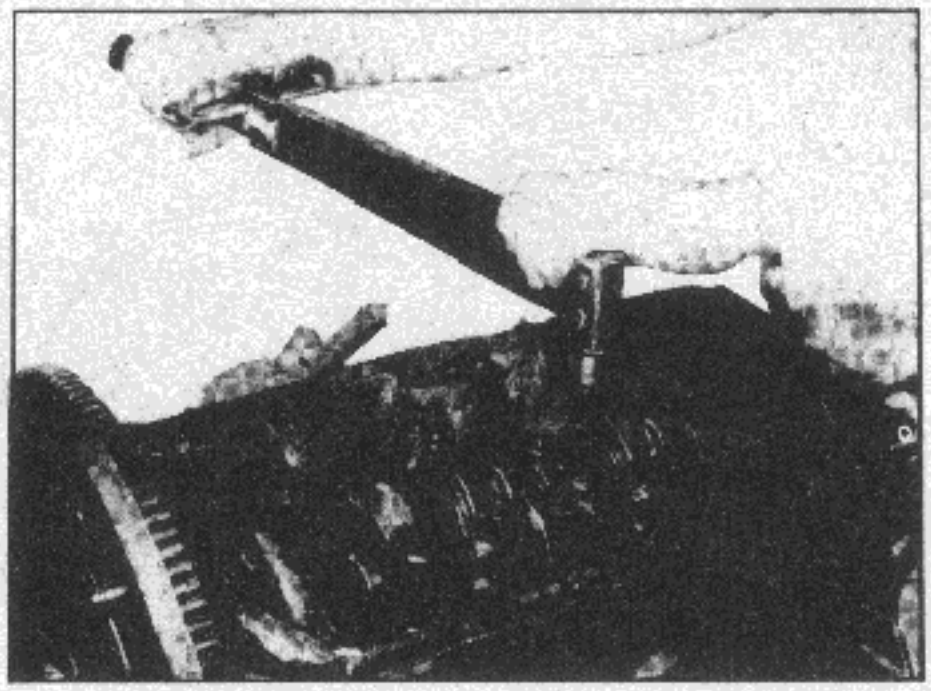


Fig. EM-97 Connecting rod cap installation

Note: a. Arrange connecting rods and connecting rod caps so that the cylinder number on them faces the same side.
b. In case of L20 engine lock the clamp with the locking-nut. (as for L13, L16 engine the locking-nut is unnecessary)

14. Make sure of the end play of the connecting rod big end.

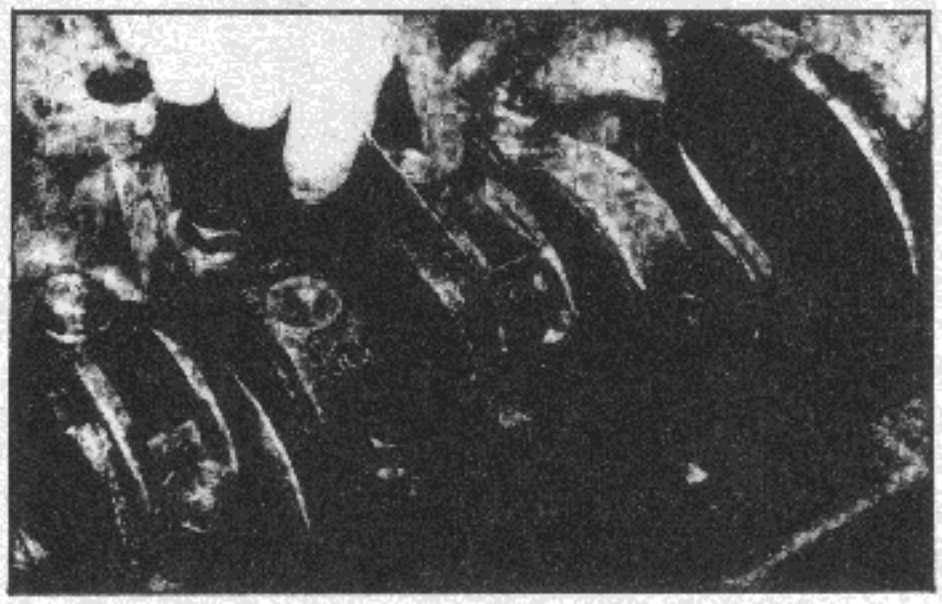


Fig. EM-98 Big end end play check

Big end end play: 0.20 to 0.30 mm
(0.0079 to 0.0118 in.)
for L13, L16 and L20 engine

15. Install the cylinder head assembly.

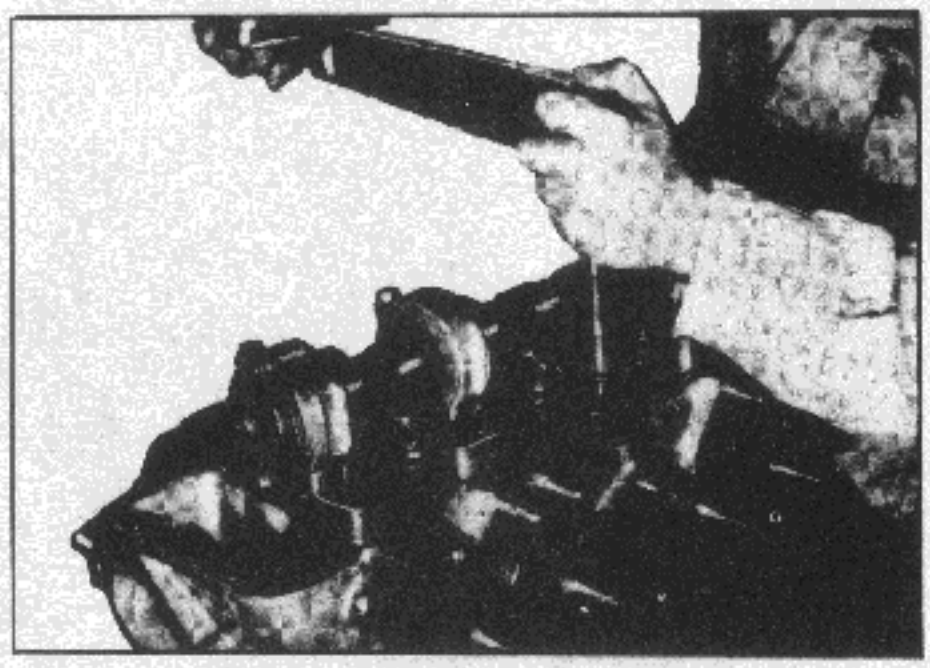


Fig. EM-99 Cylinder head installation

Note: a. Spread sealing agent over the cylinder block surface. Place the gasket on it, and apply sealing agent to the gasket top.
b. Tighten the head bolts to the specified torque.
Three different types of bolts are used. (So be careful when installing.)

Tightening torque: 5.0 to 6.0 kg-m
(36.2 to 43.4 ft-lb)
for L13, L16 and L20 engine

Applicable special tool:
ST44830000 for L20 engine
ST49010000 for L13 and L16 engine

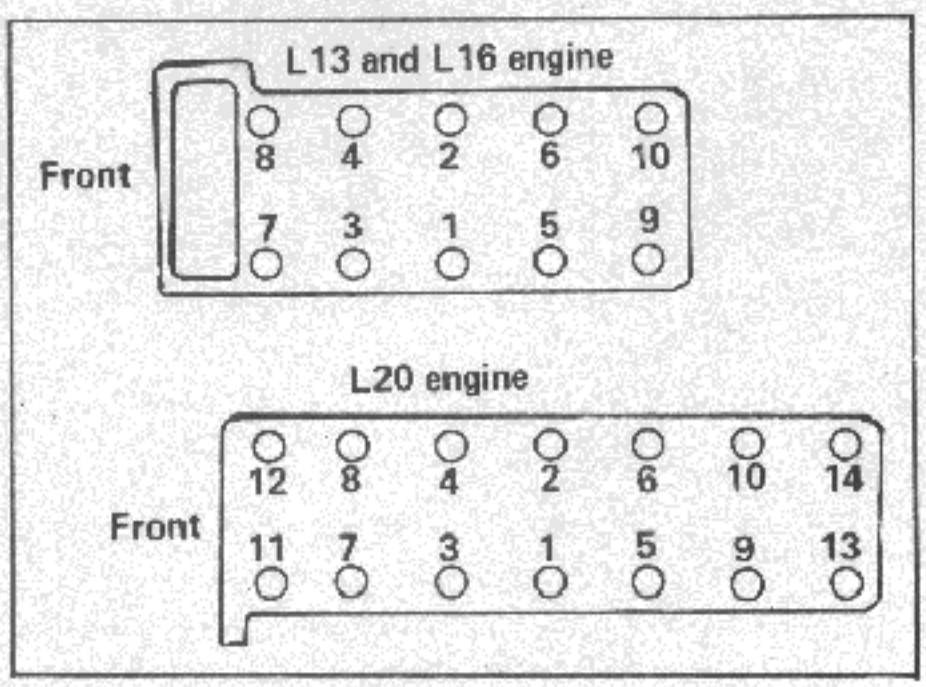


Fig. EM-100 Torque tightening sequence chart

Note: a. When installing the cylinder head, make sure that all the valves are apart from the head of the pistons.
b. Do not rotate the crankshaft and camshaft separately, because the valves will hit the head of the pistons.

16. Install the crankshaft sprocket and distributor drive gear and fit the oil throwers.

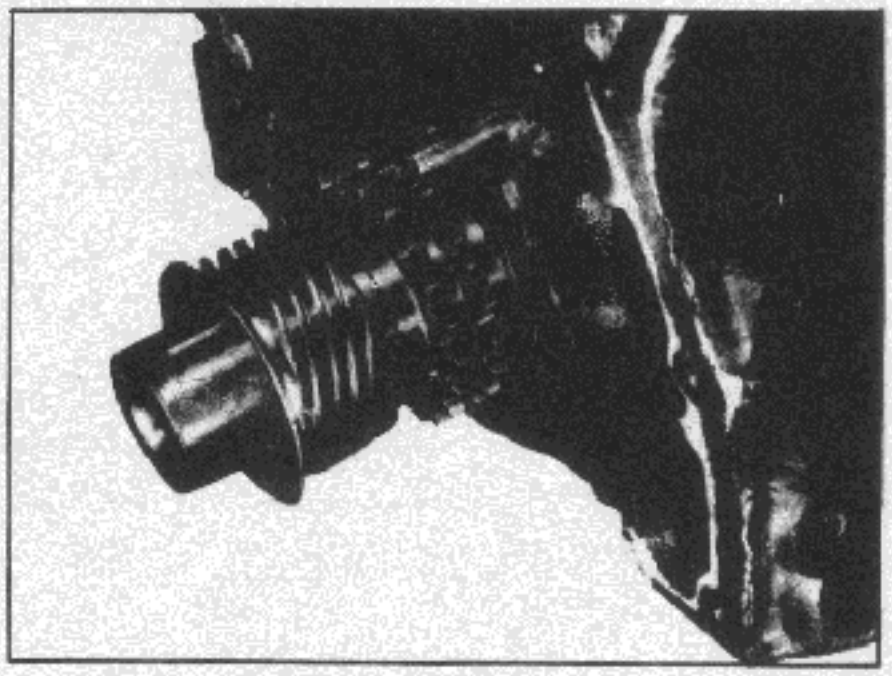


Fig. EM-101 Crankshaft sprocket and distributor drive gear

Note: Face the mating marks of the crankshaft sprocket forwards.

17. Install the timing chain.

Note: a. Make sure that the crankshaft and camshaft keys point upwards.

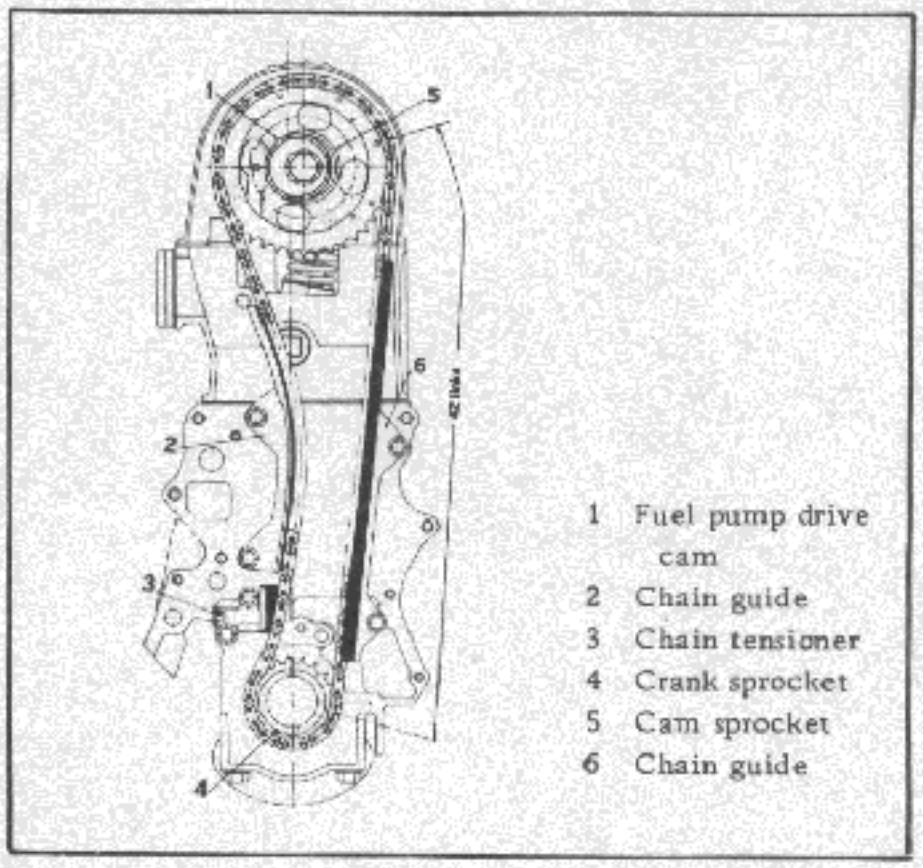


Fig. EM-102 Timing chain installation for L13 and L16 engine

b. Set the timing chain making its mating marks meet with those of the crankshaft sprocket and the camshaft drive sprocket at the right hand side. There are 42 (in case of L13 and L16) and 40 (in case of L20). Chain links between two mating marks of the timing chain.

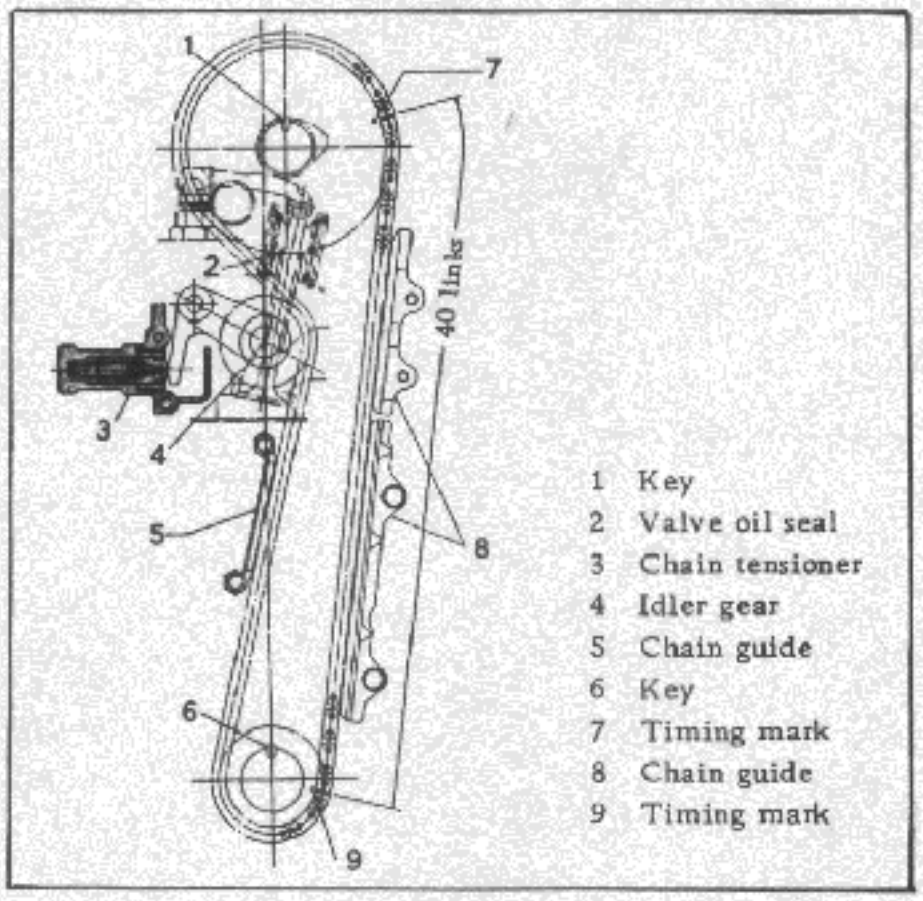


Fig. EM-103 Timing chain installation for L20 engine

18. Install the timing chain idler gear. (only for L20 engine)

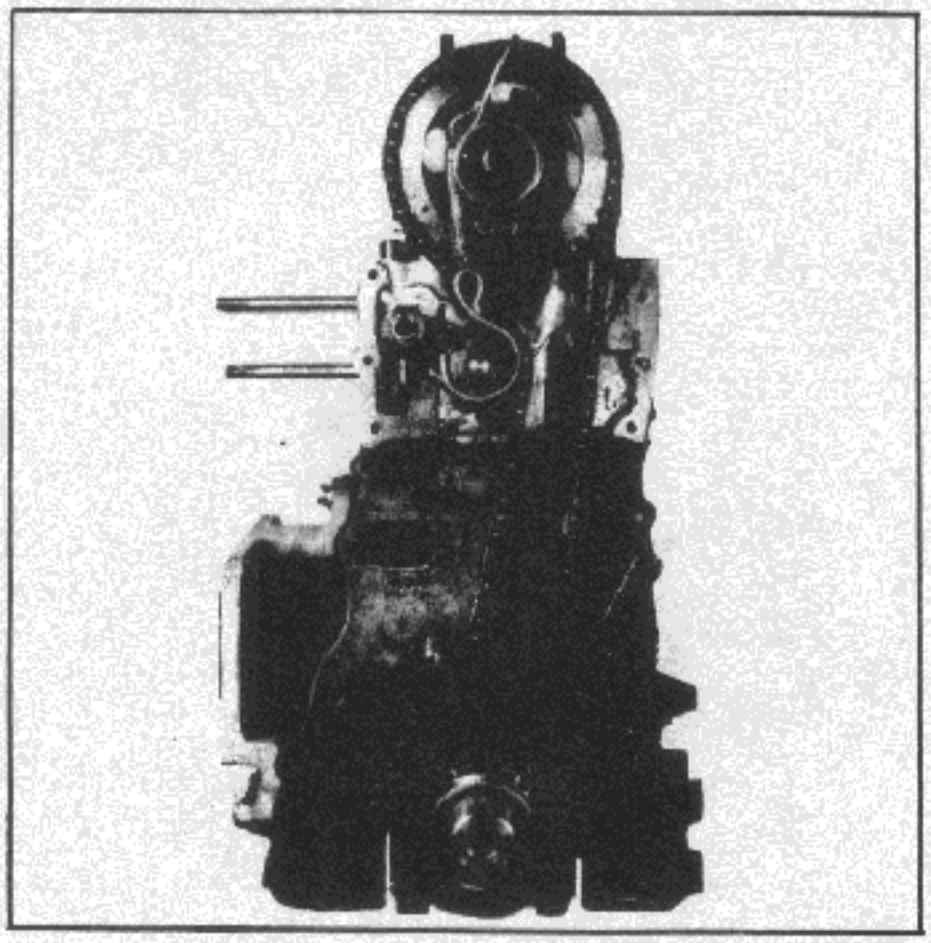


Fig. EM-104 Timing chain idler gear installation

19. Install the chain guide to the cylinder block.

20. Install the chain tensioner (only for L13, and L16 engine).

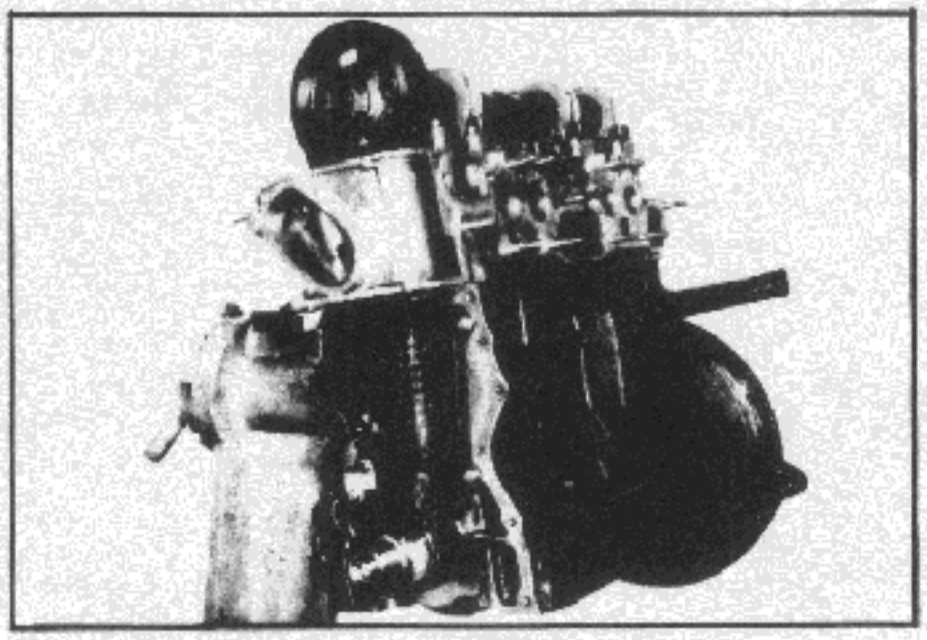


Fig. EM-105 L13 and L16 engine

21. Press in the new oil seal to the front cover. (the front cover oil seal should be replaced when the front cover is disassembled.)

22. Install lower front cover and upper front cover in that order, with the gasket in between. (As for L13, L16 engine, the upper Front cover is combined with Cylinder Head.)

Note:
a. Apply the sealing agent to the both surface of the gasket.
b. When installing the upper cover, pay attention to the head gasket fitting whether if it is inserted completely.
c. Check the height difference between the cylinder block upper face and the front cover upper face. Its difference must be less than 0.15 mm (0.0059 in.).

23. Install the chain tensioner assembly. (only for L20 engine)

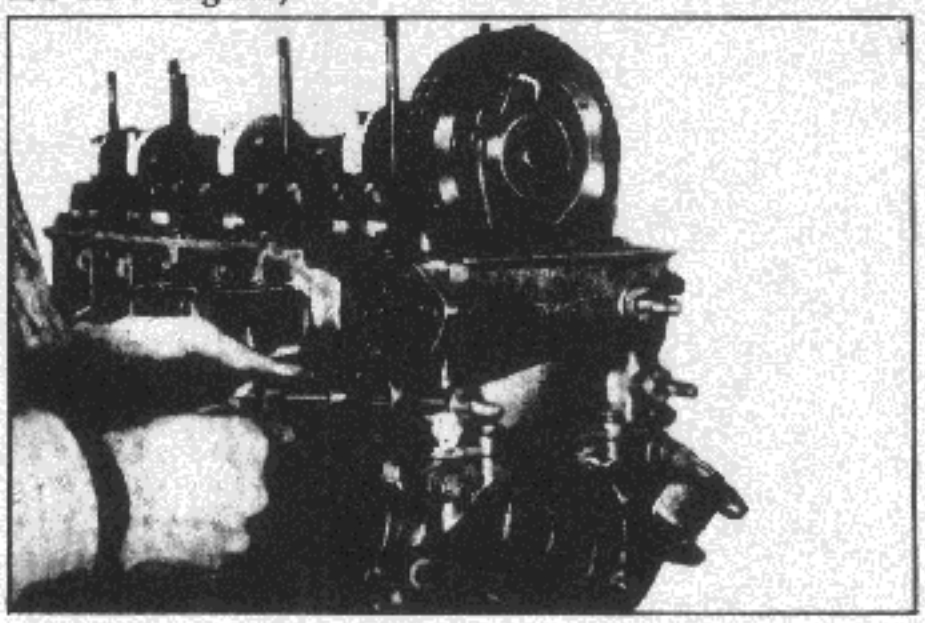


Fig. EM-106 Chain tensioner installation

24. Install the crankshaft pulley and water pump, then set the No. 1 - piston to its T. D. C. of the compression stroke.

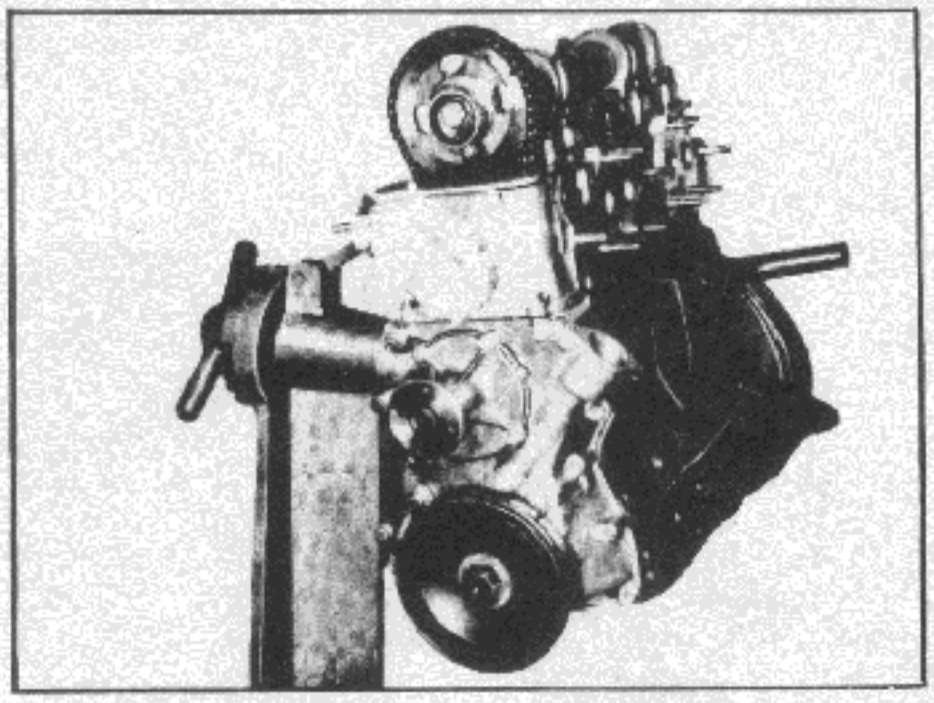


Fig. EM-107 Crankshaft pulley and water pump installation

25. Insert the oil pump and distributor driving spindle into the front cover.

Note: Install the driving spindle so as the projection on its top is located just in 11 : 25 a.m. position, at this time, the smaller bow-shape will be placed toward the front.

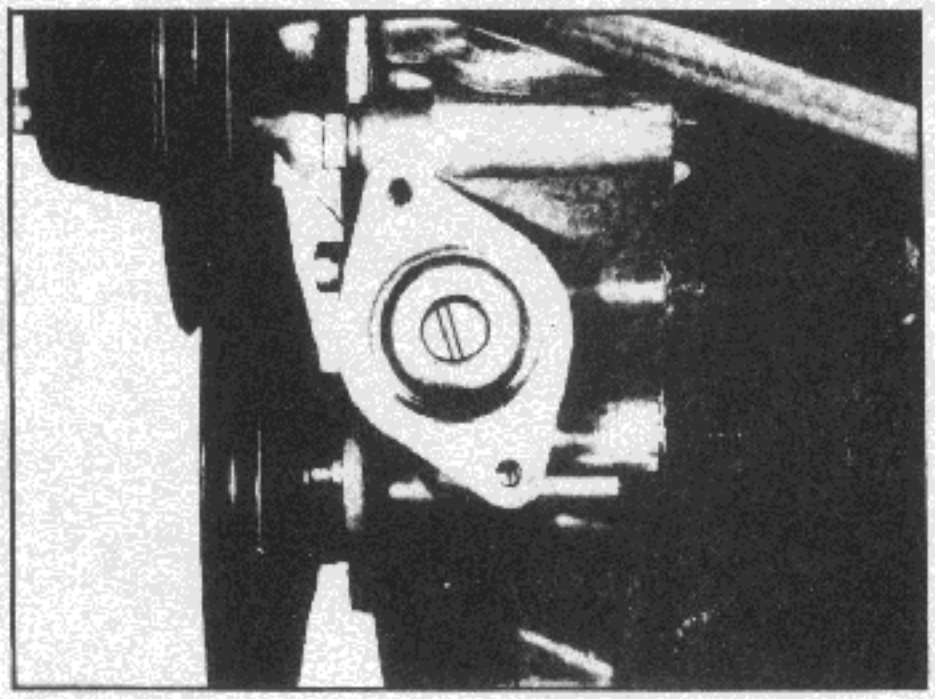


Fig. EM-108 Setting the distributor driving spindle

26. Install the fuel pump, water inlet elbow, thermostat housing front, engine slinger, thermostat and the water outlet elbow, in their position.

27. Install the oil strainer and the oil pan using the gasket.

Apply the sealing agent on the both surface of the gasket especially on the front and rear portions of oil pan.

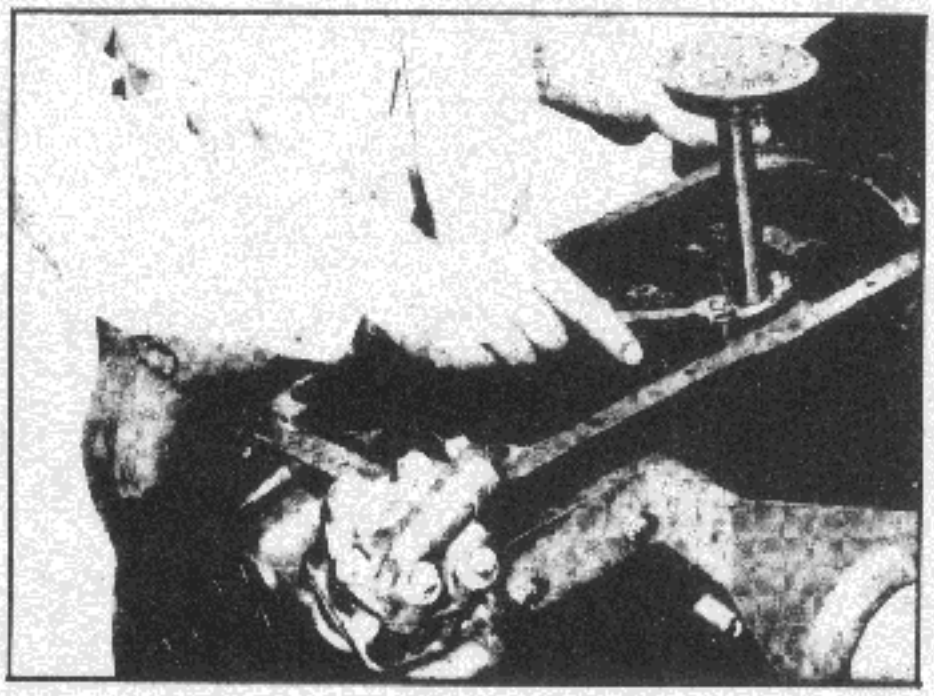


Fig. EM-109 Oil strainer installation

28. Install the distributor assembly.

29. Install the rear engine slinger, exhaust manifold and the intake manifold with carburetor.

30. Adjust the valve clearance with the specified dimensions.

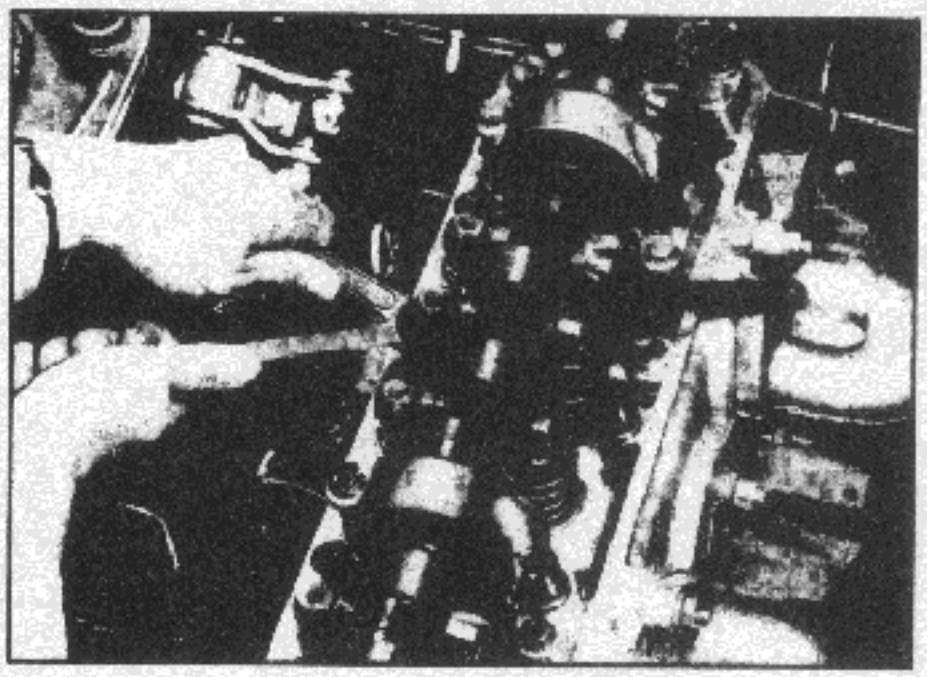


Fig. EM-110 Valve clearance adjustment

	L13 and L16	L20
Intake (at cold) mm (in.)	0.20 (0.0079)	0.20 (0.0079)
Exhaust (at cold) mm (in.)	0.25 (0.0098)	0.25 (0.0098)

31. Install the clutch assembly.

32. Connect the fuel hose on the front part of the engine.

Note: **Take care so as the spacers are fitted in their position.**

33. Install the rocker cover.

Note: **Bond the gasket to the rocker cover using the before-mentioned sealing agent.**
Then, install the rocker cover to the head.

34. Connect the distributor to plug high tension lead wire.

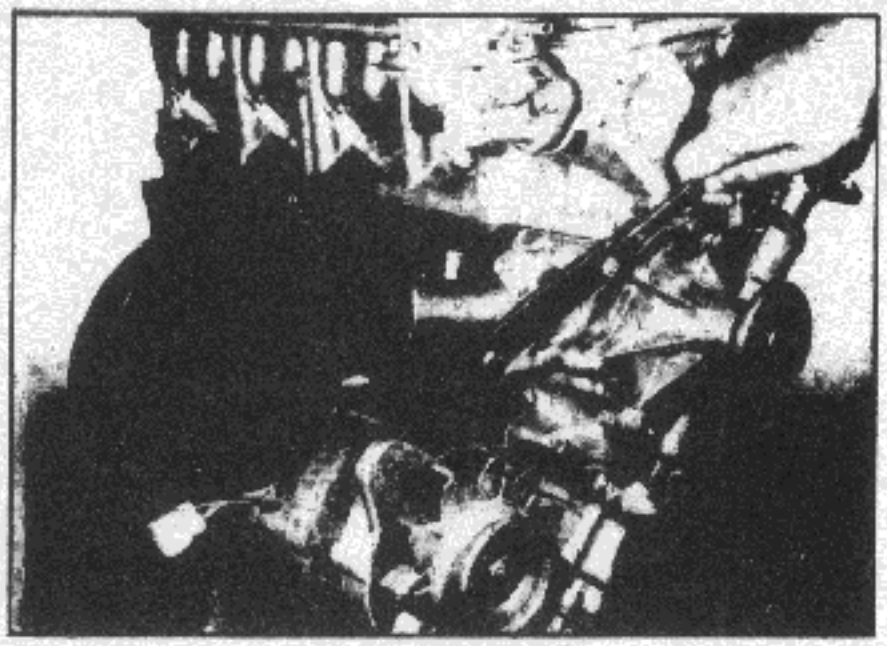


Fig. EM-111 Alternator installation

35. Dismount the engine assembly from the working stand. Install the alternator bracket, alternator, engine mountings, ignition coil, oil filter, oil pressure switch, oil level gauge and water drain plug, etc.

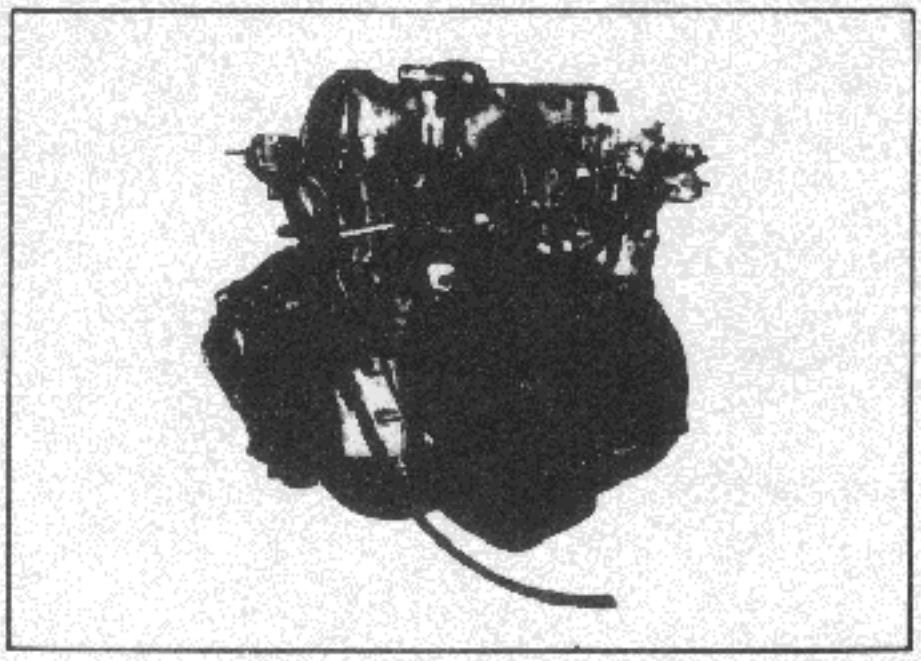


Fig. EM-112 Engine assembly

36. Connect the vacuum line.

SERVICE DATA AND SPECIFICATIONS

GENERAL SPECIFICATION

Model	L13	L16		L20	
Cylinder arrangement	4 in line			6 in line	
Displacement	1296 c. c. (51. 02 cu. in.)	1595 c. c. (62. 80 cu. in.)		1998 c. c. (121. 88 cu. in.)	
Bore and stroke	83 × 59. 9 mm (3. 2677 × 2. 3583 in.)	83 × 73. 7 mm (3. 2677 × 2. 9016 in.)		78. 0 × 69. 7 mm (3. 0709 × 2. 7441 in.)	
Valve arrangement	O. H. C.			O. H. C.	
		Single carb.	Twin carb.	Single carb.	Twin carb.
Max. brake horsepower	77 HP/ 6000 r. p. m.	96 HP/ 5600 r. p. m.	109 HP/ 6000 r. p. m.	112 HP/ 5600 r. p. m.	123 HP/ 5600 r. p. m.
Max. gross torque	11. 1 kg-m (80. 3 ft-lb)/ 3,600 r. p. m.	13. 8 kg-m (110 ft-lb)/ 3,600 r. p. m.	14. 3 kg-m (103 ft-lb)/ 4,000 r. p. m.	16. 7 kg-m (121 ft-lb)/ 3,600 r. p. m.	17. 3 kg-m (125 ft-lb)/ 4,400 r. p. m.
Firing order	1-3-4-2			1-5-3-6-2-4	
Engine idle r. p. m.	600	600	650	600	
Compression ratio	8. 5	Single carb. 8. 5 Twin carb. 9. 5		Single carb. 8. 5 Twin carb. 9. 0	
Engine idle manifold mmHg (In Hg) at idle r. p. m.		Over 450 (17. 7)		450/550 (17. 7)/550	
Oil pressure (Hot at 2, 000 r. p. m.)	3. 8 ~ 4. 2 kg-cm2 (54. 0 ~ 60. 0 lb/in2)			3. 5 ~ 4. 0 kg/cm2 (49. 7 ~ 56. 8 lb/in2)	

TIGHTENING TORQUE

Cylinder head bolts	1st Turn 4. 5 kg-m (32. 5 ft-lb)	2nd Turn 5. 5 kg-m (39. 8 ft-lb)	1st Turn 4. 5 kg-m (32.5 ft-lb)	2nd Turn 5. 5 kg-m (39.8 ft-lb)
Connecting rod big end nuts	2. 7 ~ 3. 3 kg-m (19. 5 ~ 23. 9 ft-lb)		2. 8 ~ 3. 4 kg-m (20. 2 ~ 24. 6 ft-lb)	
Flywheel fix bolts	9. 5 ~ 10. 5 kg-m (68. 7 ~ 75. 9 ft-lb)		4. 8 ~ 6. 1 kg-m (34. 7 ~ 44. 1 ft-lb)	
Main bearing cap bolts	4. 5 ~ 5. 5 kg-m (32. 5 ~ 39. 8 ft-lb)		7. 0 ~ 8. 0 kg-m (50. 6 ~ 57. 8 ft-lb)	
Camshaft gear bolt	12. 0 ~ 16. 0 kg-m (86.7 ~ 115. 8 ft-lb.)		4. 8 ~ 5. 5 kg-m (34. 7 ~ 39. 8 ft-lb)	
Oil pan	0. 4 ~ 0. 7 kg-m (2. 9 ~ 5. 1 ft-lb)		0. 4 ~ 0. 8 kg-m (2. 9 ~ 5. 8 ft-lb)	
Oil pump	1. 5 ~ 2. 1 kg-m (10. 8 ~ 15. 2 ft-lb)		2. 0 ~ 2. 5 kg-m (14. 5 ~ 18. 1 ft-lb)	

	L13	L16	L20
Oil strainer	0.8 ~ 1.2 kg-m (5.8 ~ 8.7 ft-lb.)		0.8 ~ 1.2 kg-m (5.78 ~ 8.7 ft-lb.)
Crank pulley bolt	16.0 ~ 18.0 kg-m (115.7 ~ 130.1 ft-lb.)		15.7 ~ 18.5 kg-m (113.5 ~ 133.8 ft-lb.)

SPECIFICATIONS

a) Valve mechanism

Valve clearance (Hot)		In. 0.25 mm (0.0098 in.)	Ex. 0.30 mm (0.0118 in.)		In. 0.25 mm (0.0098 in) Ex. 0.30 mm (0.0118 in.)
Valve clearance (Cold)		In. 0.20 mm (0.0079 in.)	Ex. 0.25 mm (0.0098 in.)		In. 0.20 mm (0.0079 in) Ex. 0.25 mm (0.0098 in.)
Valve head dia.	-Intake	38 mm (1.50 in.)	Single Carb. 38 mm (1.50 in.)	Twin Carb. 42 mm (1.65 in.)	38 mm (1.50 in.)
	-Exhaust	33 mm (1.30 in.)	33 mm (1.30 in.)	33 mm (1.30 in.)	33 mm (1.30 in.)
Valve stem dia.	-Intake		8 mm (0.31 in.)		8 mm (0.31 in.)
	-Exhaust		8 mm (0.31 in.)		8 mm (0.31 in.)
Valve length	-Intake		115.9 mm (4.56 in.)		110.7 mm (4.36 in.)
	-Exhaust		116.0 mm (4.57 in.)		110.7 mm (4.36 in.)
Valve lift		10.0 mm (0.3937 in.)	10.0 mm (0.3937 in.)	10.5 mm (0.4134 in.)	10.4 mm (0.409 in.)
Valve spring free length	-Outer	48.12 mm (1.89 in.)		52.0 mm (2.05 in.)	52.0 mm (2.05 in.)
	-Inner	———		44.85 mm (1.77 in.)	50.0 mm (1.97 in.)
Valve spring loaded length	-Outer	30.0 mm/71.2 kg (1.18 in./156.9 lb.)		30.7 mm/47.8 kg (1.21 in./105.4 lb.)	30.7 mm/47.8 kg (1.21 in./105.2 lb.)
	-Inner	———		24.5 mm/25.5 kg (0.96 in./56.2 lb.)	28.7 mm/21.3 kg (1.13 in./46.9 lb.)
Valve spring assembled hight	-Outer	40.0 mm/30.7 kg (1.57 in./67.7 lb.)		38.9 mm/29.0 kg (1.53 in./63.9 lb.)	38.9 mm/29.0 kg (1.53 in./63.8 lb.)
	-Inner	———		35 mm/12.3 kg (1.38 in./27.1 lb.)	36.9 mm/13.1 kg (1.45 in./28.8 lb.)
Valve spring effective turns					
	-Outer	3.75		4.5	4.5
	-Inner	———		5.5	6.5

		L13	L16	L20
Valve spring wire dia.	-Outer	4.5 mm (0.18 in.)	4.0 mm (0.16 in.)	4.0 mm (0.16 in.)
	-Inner	———	2.92 mm (0.11 in.)	2.8 mm (0.11 in.)
Valve spring coil dia.	-Outer	34.9 mm (1.37 in.)	33.2 mm (1.31 in.)	33.2 mm (1.307 in.)
	-Inner	———	24.9 mm (0.980 in.)	23.95 mm (0.943 in.)
Valve guide length	-Intake	59.0 mm (2.32 in.)		53.2 mm (2.09 in.)
	-Exhaust	59.0 mm (2.32 in.)		53.2 mm (2.09 in.)
Valve guide height from head surface		10.4 ~ 10.6 mm (0.409 ~ 0.417 in.)		11.4 ~ 11.6 mm (0.449 ~ 0.457 in.)
Valve guide inner dia.	-Intake	8.000 ~ 8.018 mm (0.3150 ~ 0.3154 in.)		8.000 ~ 8.018 mm (0.3150 ~ 0.3154 in.)
	-Exhaust	8.000 ~ 8.018 mm (0.3150 ~ 0.3154 in.)		8.000 ~ 8.018 mm (0.3150 ~ 0.3154 in.)
Valve guide outer dia.	-Intake	11.985 ~ 11.996 mm (0.4718 ~ 0.4723 in.)		11.985 ~ 11.996 mm (0.4718 ~ 0.4723 in.)
	-Exhaust	11.985 ~ 11.996 mm (0.4718 ~ 0.4723 in.)		11.985 ~ 11.996 mm (0.4718 ~ 0.4723 in.)
Valve guide to stem clearance	-Intake	0.015 ~ 0.045 mm (0.0006 ~ 0.0018 in.)		0.015 ~ 0.045 mm (0.0006 ~ 0.0018 in.)
	-Exhaust	0.040 ~ 0.070 mm (0.0016 ~ 0.0028 in.)		0.040 ~ 0.070 mm (0.0016 ~ 0.0028 in.)
Valve seat width	-Intake	1.4 ~ 1.8 mm (0.055 ~ 0.071 in.)		1.4 ~ 1.6 mm (0.055 ~ 0.063 in.)
	-Exhaust	1.6 ~ 2.0 mm (0.063 ~ 0.079 in.)		1.8 ~ 2.2 mm (0.071 ~ 0.087 in.)
Valve seat angle	-Intake	45°		45°
	-Exhaust	45°		45°
Valve seat interference fit	-Intake	0.08 ~ 0.11 mm (0.0031 ~ 0.0043 in.)		0.081 ~ 0.113 mm (0.0032 ~ 0.0044 in.)
	-Exhaust	0.06 ~ 0.10 mm (0.0024 ~ 0.0039 in.)		0.064 ~ 0.096 mm (0.0025 ~ 0.0038 in.)
Valve guide interference fit	-Intake	0.027 ~ 0.049 mm (0.0011 ~ 0.0019 in.)		0.027 ~ 0.049 mm (0.0011 ~ 0.0019 in.)

b) Camshaft and timing chain

		L13	L16	L20
Camshaft end play			0.08 ~ 0.38 mm (0.0031 ~ 0.0150 in.)	0.04 ~ 0.30 mm (0.0016 ~ 0.0118 in.)
Camshaft robe lift		Single carb. 6.65 mm (0.261 in.)	Single carb. 6.65 mm (0.261 in.) / Twin carb. 7.00 mm (0.275 in.)	Single carb. 7.05 mm (0.277 in.) / Twin carb. 7.35 mm (0.289 in.)
Camshaft journal dia	-1st		47.949 ~ 47.962 mm (1.8877 ~ 1.8883 in.)	47.949 ~ 47.962 mm (1.8877 ~ 1.8883 in.)
	-2nd		47.949 ~ 47.962 mm (1.8877 ~ 1.8883 in.)	47.949 ~ 47.962 mm (1.8877 ~ 1.8883 in.)
	-3rd		47.949 ~ 47.962 mm (1.8877 ~ 1.8883 in.)	47.949 ~ 47.962 mm (1.8877 ~ 1.8883 in.)
	-4th		47.949 ~ 47.962 mm (1.8877 ~ 1.8883 in.)	47.949 ~ 47.962 mm (1.8877 ~ 1.8883 in.)
	-5th		———	47.949 ~ 47.962 mm (1.8877 ~ 1.8883 in.)
Camshaft bend			0.05 mm (0.0020 in.)	0.05 mm (0.0020 in.)
Camshaft journal to bearing clearance			0.038 ~ 0.076 mm (0.0015 ~ 0.0026 in.)	0.038 ~ 0.067 mm (0.0015 ~ 0.0026 in.)
Camshaft bearing inner dia.	-1st		48.000 ~ 48.016 mm (1.8898 ~ 1.8904 in.)	48.000 ~ 48.016 mm (1.8898 ~ 1.8904 in.)
	-2nd		48.000 ~ 48.016 mm (1.8894 ~ 1.8904 in.)	48.000 ~ 48.016 mm (1.8898 ~ 1.8904 in.)
	-3rd		48.000 ~ 48.016 mm (1.8898 ~ 1.8904 in.)	48.000 ~ 48.016 mm (1.8898 ~ 1.8904 in.)
	-4th		48.000 ~ 48.016 mm (1.8898 ~ 1.8904 in.)	48.000 ~ 48.016 mm (1.8898 ~ 1.8904 in.)
	-5th		———	48.000 ~ 48.016 mm (1.8898 ~ 1.8904 in.)

c) Rocker arm lever ratio

1.5		1.45

d) Connecting rod

Center distance	132.97 ~ 133.03 mm (5.235 ~ 5.237 in.)	139.87 ~ 139.93 mm (5.507 ~ 5.509 in.)	127.97 ~ 128.03 mm (5.038 ~ 5.041 in.)
Bearing thickness (S. T. D.)	1.498 ~ 1.506 mm (0.0590 ~ 0.0593 in.)	1.493 ~ 1.506 mm (0.0588 ~ 0.0593 in.)	1.493 ~ 1.506 mm (0.0588 ~ 0.0593 in.)
Big end end play		0.20 ~ 0.30 mm (0.0079 ~ 0.0118 in.)	0.20 ~ 0.30 mm (0.0079 ~ 0.0118 in.)

	L13	L16	L20
Connecting rod bearing clearance	0.014~0.056 mm (0.0006~0.0022 in.)	0.014~0.066 mm (0.0006~0.0026 in.)	0.014~0.066 mm (0.0006~0.0022 in.)
Connecting rod bend (per 100 mm or 3.937 in.)	0.03 mm (0.0012 in.)	0.03 mm (0.0012 in.)	0.05 mm (0.0020 in.)
e) crankshaft and main bearing			
Journal dia.	54.942 ~ 54.955 mm (2.1631 ~ 2.1636 in.)		54.942~54.955 mm (2.1631~2.1636 in.)
Journal taper & out of round	less than 0.03 mm (0.0012 in.)		less than 0.03 mm (0.0012 in.)
Crankshaft free end play	0.05 ~ 0.15 mm (0.002 ~ 0.0059 in.)		0.05~0.18 mm (0.002~0.007 in.)
Wear limit of dittoed play	0.3 mm (0.012 in.)		0.3 mm (0.012 in.)
Crank pin dia.	49.961~49.975 mm (1.9670~1.9675 in.)		49.961~49.974 mm (1.9670~1.9675 in.)
Crank pin taper & out of round	less than 0.03 mm (0.0012 in.)		less than 0.03 mm (0.0012 in.)
Main bearing thickness	1.827~1.835 mm (0.0719~0.0722 in.)	1.822~1.835 mm (0.0717~0.0722 in.)	1.822~1.835 mm (0.0717~0.0722 in.)
Main bearing clearance	0.020~0.062 mm (0.0008~0.0024 in.)	0.020~0.072 mm (0.0008~0.0028 in.)	0.020~0.072 mm (0.0008~0.0028 in.)
Wear limit of dittoted clearance	0.12 mm (0.0047 in.)		0.12 mm (0.0047 in.)
Crankshaft bend	0.05 mm (0.0019 in.)		0.05 mm (0.0019 in.)
f) piston			
Piston dia. -STD	82.99~83.04 mm (3.267~3.269 in.)		77.915~77.965 mm (3.0675~3.0695 in.)
Oversize 1	83.22~83.27 mm (3.276~3.278 in.)		77.935~77.985 mm (3.0683~3.0702 in.)
Oversize 2	83.47~83.52 mm (3.286~3.288 in.)		78.165~78.215 mm (3.0774~3.0793 in.)
Oversize 3	83.72~83.77 mm (3.296~3.298 in.)		78.415~78.465 mm (3.0872~3.0892 in.)
Oversize 4	83.97~84.02 mm (3.305~3.308 in.)		78.665~78.715 mm (3.0970~3.0990 in.)
Oversize 5	84.47~84.52 mm (3.326~3.328 in.)		78.915~78.965 mm (3.1069~3.1089 in.)
Ellipse difference	0.32 ~ 0.35 mm (0.013 ~ 0.014 in.)		0.29~0.33 mm (0.011~0.013 in.)

		L13	L16	L20
Ring grove width	-Top	2.0 mm (0.08 in.)		2.0 mm (0.08 in.)
	-Second	2.0 mm (0.08 in.)		2.5 mm (0.10 in.)
	-Oil	4.0 mm (0.16 in.)		4.0 mm (0.16 in.)
Piston to bore clearance		0.025~0.045 (0.0010~0.0018 in.)		0.075~0.095 mm (0.0030~0.0037 in.)
Piston pin hole off-set		1 ± 0.05 mm (0.0394 ± 0.0020 in.)		1 ± 0.05 mm (0.0394 ± 0.0020 in.)

g) Piston pin

Pin dia.	20.995~21.000 mm (0.8266~0.8268 in.)		19.995~20.005 mm (0.7872~0.7876 in.)
Pin length	72.00~72.25 mm (2.8346~2.8445 in.)		66.40~66.65 mm (2.6142~2.6240 in.)
Piston pin to piston clearance	0.008~0.010 mm (0.0003~0.0004 in.)		L0.004~0.011 mm (0.0002~0.0004 in.)
Interference fit of piston pin to connecting rod bushing	0.015~0.033 mm (0.0006~0.0013 in.)		T0.017~0.035 mm (0.0007~0.0014 in.)

h) piston ring

Ring height	-Top	2.0 mm (0.0787 in.)		2.5 mm (0.0984 in.)
	-Second	2.0 mm (0.0787 in.)		2.5 mm (0.0984 in.)
	-Oil	4.0 mm (0.1575 in.)		4.0 mm (0.1575 in.)
Side clearance	-Top	0.040~0.073 mm (0.0016~0.0029 in.)	0.045~0.078 mm (0.0018~0.0031 in.)	0.040~0.078 mm (0.0016~0.0031 in.)
	-Second	0.030~0.063 mm (0.0012~0.0025 in.)	0.030~0.063 mm (0.0012~0.0025 in.)	0.030~0.068 mm (0.0012~0.0027 in.)
	-Oil	0.025~0.063 mm (0.0010~0.0025 in.)	0.025~0.063 mm (0.0010~0.0025 in.)	0.025~0.068 mm (0.0010~0.0027 in.)
Ring gap	-Top	0.23~0.38 mm (0.0091~0.0150 in.)		0.20~0.35 mm (0.008~0.014 in.)
	-Second	0.15~0.30 mm (0.0059~0.0118 in.)		0.14~0.29 mm (0.006~0.011 in.)
	-Oil	0.15~0.30 mm (0.0059~0.0118 in.)		0.14~0.29 mm (0.006~0.011 in.)

TROUBLE DIAGNOSES AND CORRECTIONS

Trouble	Cause	Correction
I. Noisy engine		
Knocking of crankshaft and bearing	Loose main bearing.	Replace.
	Burnt bearing.	Replace.
	Bent of crankshaft.	Repair or replace.
	Uneven wear of journal.	Regrinding.
	Too much end play of crankshaft.	Replace center bearing.
Piston and connecting rod knocking	Loose bearing.	Replace.
	Burnt bearing.	Replace.
	Loose piston pin.	Replace pin or bushing.
	Loose piston in cylinder.	Recondition cylinder.
	Broken piston ring.	Replace.
	Connecting rod alignment is not made.	Disassemble, and repair or replace.
Camshaft knocking	Loose bearing.	Replace.
	Too big axial play.	Replace bearing thrust plate.
	Rough teeth of gears.	Repair.
	Broken cam gear.	Replace.
Timing chain noise	Chain tension not adequate.	Adjust.
	Wear and damage of chain.	Replace.
	Wear of sprocket.	Replace.
	Wear or breakage of tension adjusting mechanism.	Replace.
	Clearance of camshaft and bearing too big.	Replace.
Camshaft and valve mechanism knocking	Valve clearance not correct.	Adjust.
	Wear of adjusting screw.	Replace.
	Wear of rocker face.	Replace.
	Loose valve stem in guide.	Replace guide.
	Yielded valve spring.	Replace.
	Burning of valve.	Mention later part.
Water pump knocking	End play of shaft.	Replace.
	Broken impeller.	Replace.

Trouble	Cause	Correction
II. Other mechanical trouble		
Sticked valve	Not correct valve clearance.	Adjust.
	Small clearance of valve stem with guide.	Clean stem or ream the guide.
	Yielded or broken valve spring.	Replace.
	Biting or damage of valve stem.	Replace or clean.
	Bad fuel.	Use good fuel.
Burnt valve seat Seat	Not correct valve clearance.	Adjust.
	Yielded valve spring.	Replace.
	Thin valve head edge.	Replace valve.
	Narrow valve seat.	Refacing.
	Overheat.	Mentioned
	Over speed.	Drive right.
	Sticked valve guide.	Repair.
Exceseive wear of cylinder and piston	Shortage of engine oil.	Check every day.
	Dirty engine oil.	Clean crankcase, replace oil filter element.
	Inadequate oil.	Use right oil.
	Overheat.	Mentioned.
	Wrong assembly of piston with connecting rod.	Repair or replace.
	Not correct clearance of piston ring.	Adjust.
	Broken piston ring.	Replace.
	Dirty air cleaner.	Clean periodically.
	Too rich mixture.	Adjust.
	Engine over run.	Drive right.
	Sticked choke valve.	Clean and adjust.
	Overchoking.	Start correct way.
Defective connecting rod	Shortage of engine oil.	Check oil daily.
	Low oil pressure.	Refer.
	Not adequate engine oil.	Use right oil.
	Rough surface of crankshaft.	Grind and replace bearing.
	Clogged oil passage.	Clean.
	Wear or eccentricity of bearing.	Replace.

Defective connecting rod	Wrong assembly of bearing.	Repair.
	Loose bearing.	Replace.
	Connecting rod alignment is not made.	Repair or replace.
Defective crankshaft bearing	Shortage of engine oil.	Check every day.
	Low oil pressure.	Mentioned.
	Not adequate engine oil.	Use right oil.
	Wear or out of round of crankshaft journal.	
	Clogged oil passage in crankshaft.	Clean.
	Wear or eccentricity of bearing.	Replace.
	Wrong assembly of bearing.	Repair.
	Not concentric crankshaft or bearing.	Replace.

MEMO:

SECTION EL

ENGINE LUBRICATION SYSTEM

LUBRICATION SYSTEM

CONTENTS

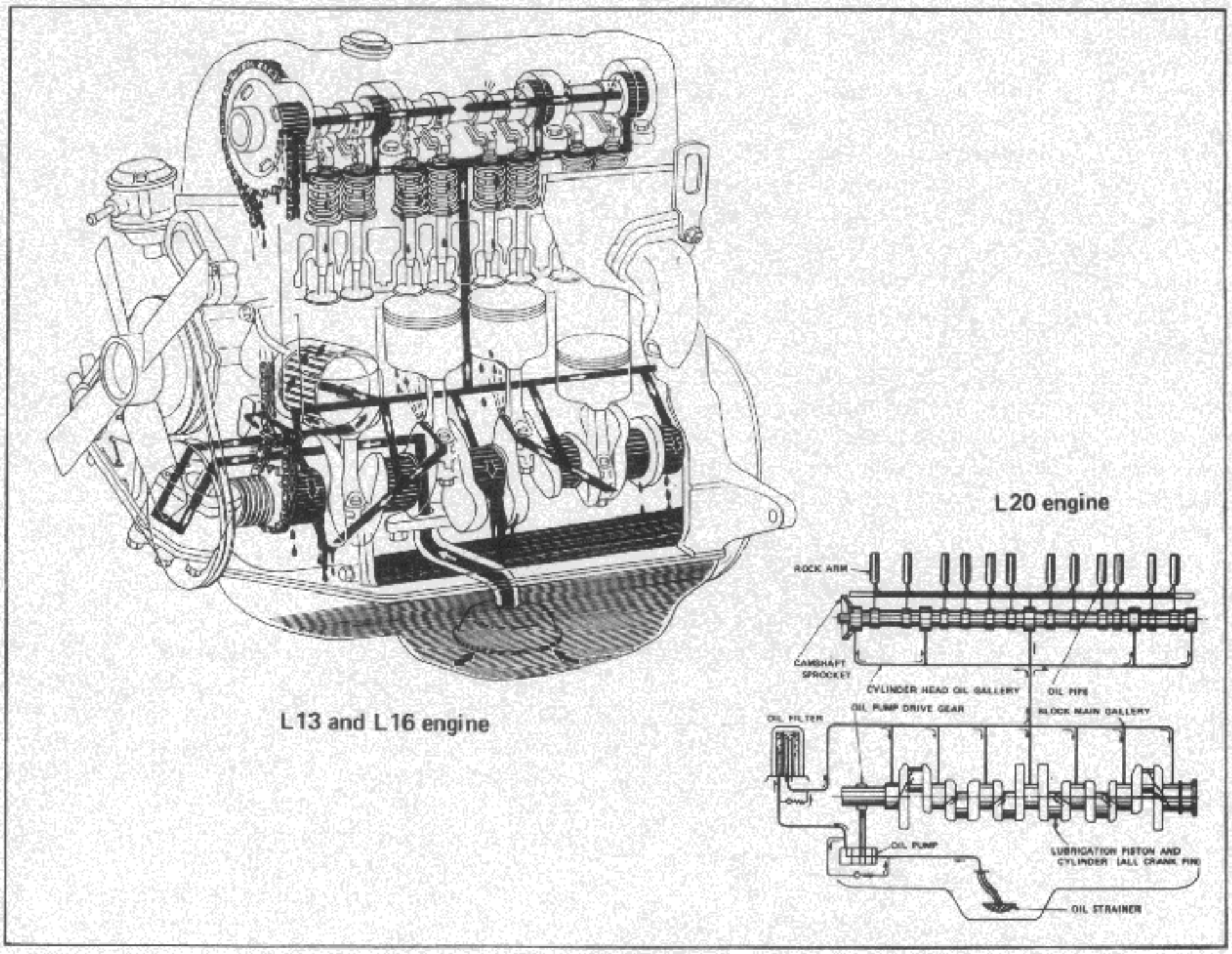


Fig. EL-1 Lubrication circuit

DESCRIPTION

The lubricating system is Pressure-feed type system and is composed of highly efficient functional components suited for high performance, i.e. high out-put and high speed running.

L13 and L16 engines adopt the same lubrication system. As for L20 engine, only the lubrication method of the rocker room and chain tensioner are different from that of L13 or L16 engine.

LUBRICATION CIRCUIT

Oil is drawn from the oil pan through the inlet screen and tube to the inlet side of the oil pump, then delivered by oil pump through the outlet portion of the oil pump and the oil gallery to the inlet side of the full flow oil filter and to the main oil gallery.

The main oil gallery supplies oil to the crankshaft main bearings and drilled passages in the crankshaft direct oil from main bearings to connecting rod bearings.

Oil injected from jet holes on connecting rods lubricates the cylinder walls and piston pins.

In L13 and L16 engine the oil distributed from the main gallery enters the chain tensioner and the pad is held against the chain by oil pressure and spring. And also the oil lubricates the timing chain through the jet located near the chain. (In L20 engine, the chain tensioner is situated on the cylinder head front cover).

Furthermore lubricant is supplied to cylinder head main oil gallery through the crankshaft center bearing and camshaft bearings on the cylinder head are fed directly from this gallery. Nextly, as mentioned before to lubricate the rocker mechanism, two types of the lubrication methods are adopted in this "L" engine series.

In L13 and L16 engine, the rocker arm and valve are lubricated intermittently by the oil through the oil gallery in the camshaft and the small channel at the base circle portion of each cam.

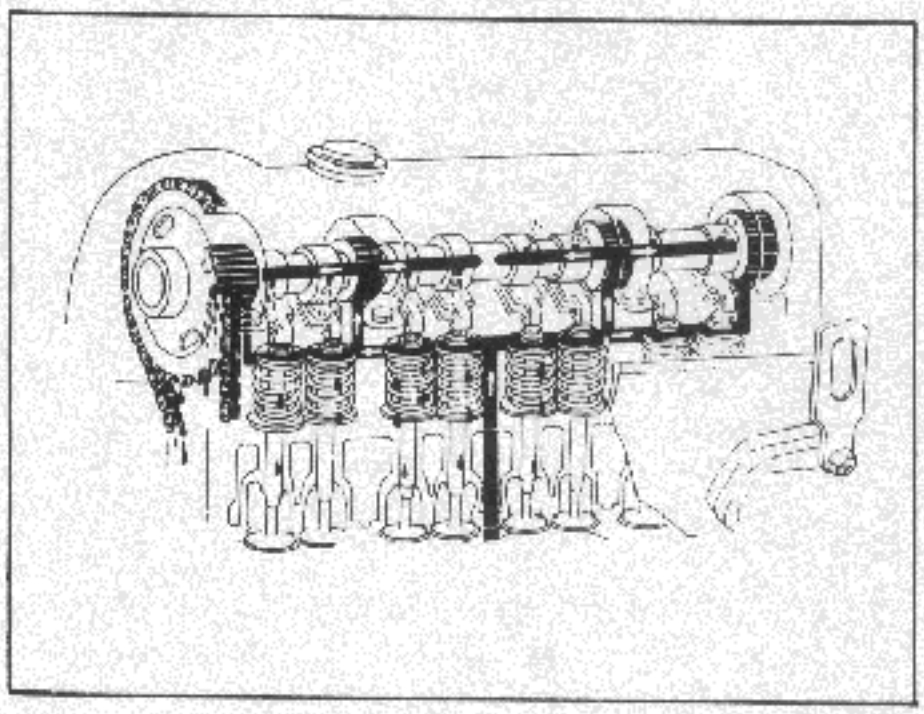


Fig. EL-2 Cylinder head lubrication for L13 and L16 engine

To this oil gallery, lubricant is supplied through the No. 2 and No. 3 camshaft bearing as shown in Figure EL-2.

In L20 engine, an oil pipe is provided extending through entire length of the camshaft as shown in Figure EL-3.

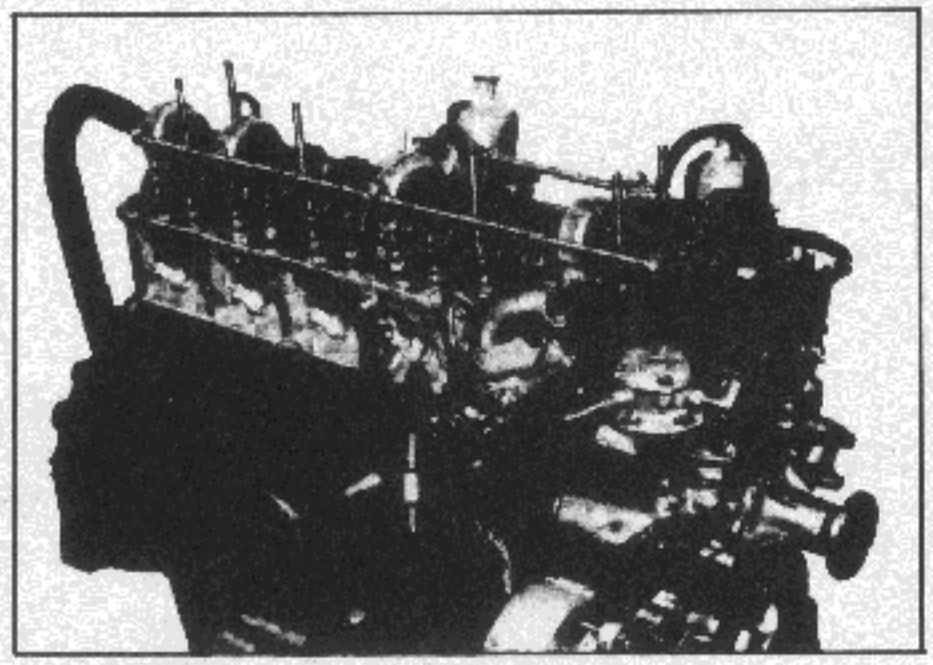


Fig. EL-3 Cylinder head lubrication for L20 engine

To this oil pipe lubricant is supplied through No. 3 camshaft bearing and the rocker arm and valve are lubricated intermittently by the oil through the samll holes or the oil pipe.

OIL PUMP

Description

The oil pump ass'y is installed to the bottom of the front cover (by three bolts in L20 and four bolt in L13 and L16)and driven by the distributor drive shaft ass'y. The oil pump is a rotor type. The oil pressure is regulated by the regulator valve. A slot provided at the top of the drive rotor is engaged with a dog clutch at the lower end of the distributor drive shaft ass'y.
The oil pump is thus operated by a gear on the crankshaft through the distributor drive shaft ass'y.

Removal (Engine in vehicle)

1. Detach the distributor.
2. Drain engine oil.
3. Remove the front stabilizer.

4. Remove the splash shield board.

5. Detach the oil Pump body together with drive gear spindle.

Installation

1. Before installing the oil pump in the engine set the crankshaft to the portion of T. D. C. of No. 1 cylinder due to its relation with the distributor. Then, install the oil pump together with the drive gear spindle in the front cover, at this time the punched mark on the drive gear spindle should be faced on front of engine.

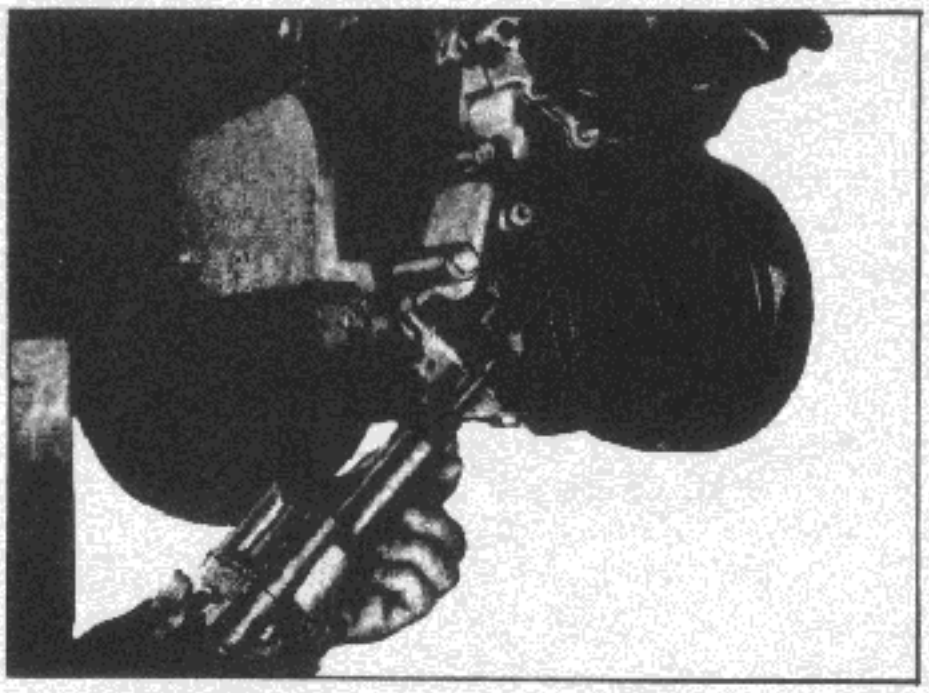


Fig. EL-4 Oil pump installation

Ascertain whether the engagement is in order or not by checking at the end of the spindle through the distributor fitting hole.
Tighten the bolts connected oil pump to front cover.

Disassembly and reassembly

1. Separate the body cover from the oil pump body by unscrewing one secure bolt, and take out pump drive and driver gears from the pump body.

Assemble oil pump carefully and do not turn up the oil pump cover gasket.

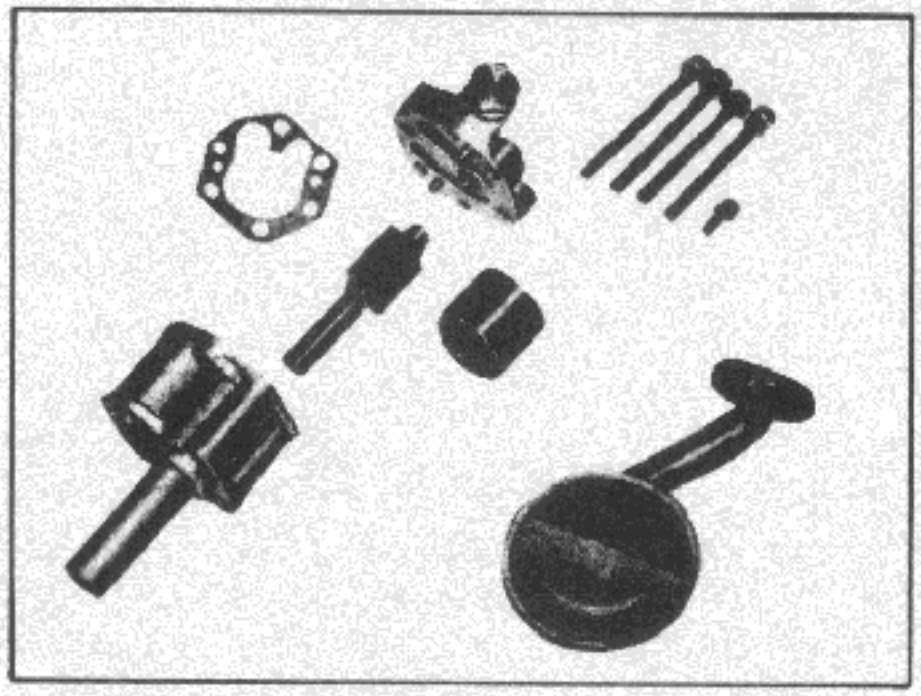


Fig. EL-5 Oil pump for L13 and L16 engine

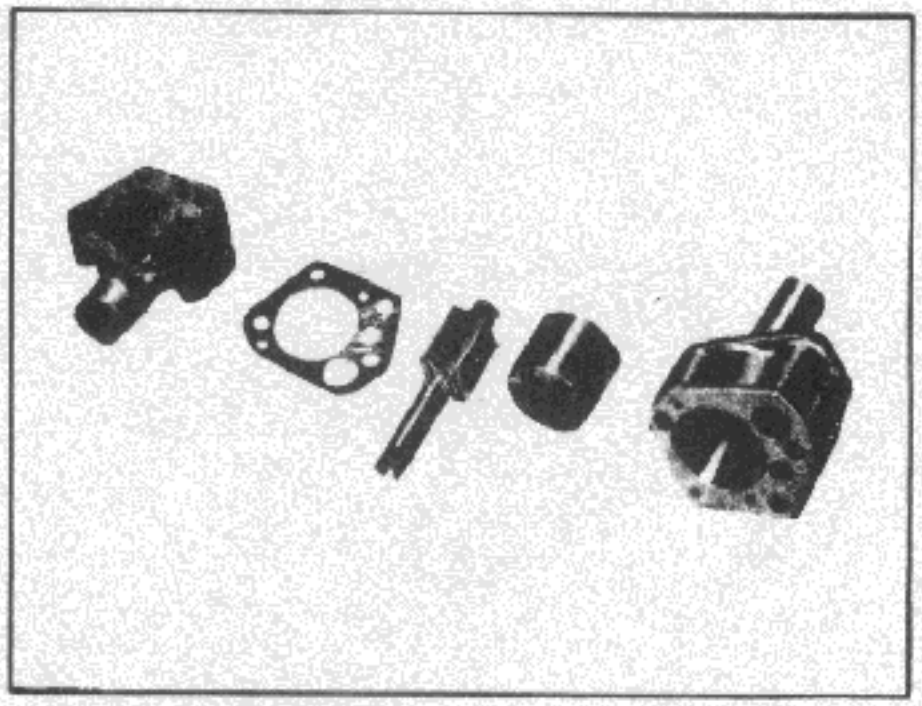


Fig. EL-6 Oil pump for L20 engine

Inspection and repair

Clean the disassembled parts with cleaning solvent, and inspect for defects.

Inspect the drive rotor shaft for excessive wear and scores and check the following clearances.

Though the oil pump of L20 engine is different from that of L13 or L16 engine in its shape, the main specifications are the same between those two oil pumps.

Side clearance between outer and inner rotor ..... 0.05 ~ 0.12 mm (0.0020 ~ 0.0047 in.)

Tip clearance ..... 0.12 mm (0.0492 in.)

Clearance between outer rotor and body ..... 0.15 ~ 0.21 mm (0.0059 ~ 0.0083 in.)

OIL PRESSURE RELIEF VALVE

The oil pressure relief valve is not adjustable. At the released position, the valve permits that oil is by-passed through a passage on the pump cover to the inlet side of the pump.

Check the relief valve spring dimension to ensure that it has not lost its tension.

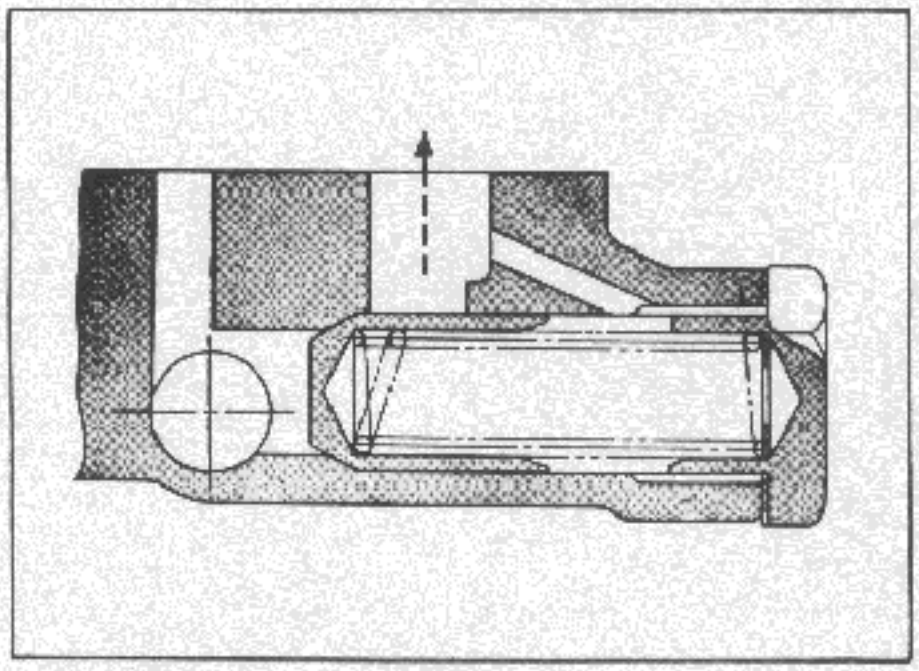


Fig. EL-7 Relief valve

Specifications	L13 and L16	L20
Oil pressure at idling	1.0 ∿ 1.2 kg/cm² (14.2 ∿ 17.1 lb/in²)	1.0 ∿ 1.2 kg/cm² (14.2 ∿ 17.1 lb/in²)
Relief valve spring		
Free length	57 mm (2.24 in.)	57 mm (2.24 in.)
Pressured length	39 mm (1.54 in.)	39 mm (1.54 in.)
Relief valve opening pressure	3.8 ∿ 4.2 kg/cm² (54.0 ∿ 59.7 lb/in²)	3.9 ∿ 4.3 kg/cm² (55.5 ∿ 61.2 lb/in²)

Tightening torque	L13 and L16	L20
Oil pump mounting bolts	1.5 ∿ 2.1 kg-m (10.8 ∿ 15.2 ft-lb)	2.0 ∿ 2.5 kg-m (14.5 ∿ 18.1 ft-lb)
Cap nut-release valve	3.0 ∿ 3.5 kg-m (21.69 ∿ 25.31 ft-lb)	

OIL FILTER

The oil filter is an easy-to-handle cartridge type product, removal and installation of then can be readily accomplished by hand.

The filter element and the filter body are caulked together, so interior cleaning is not necessary but the filter body with element has to be replaced at every 10,000 km running.

In case installing the oil filter, fasten it to the cylinder blocks by hand.

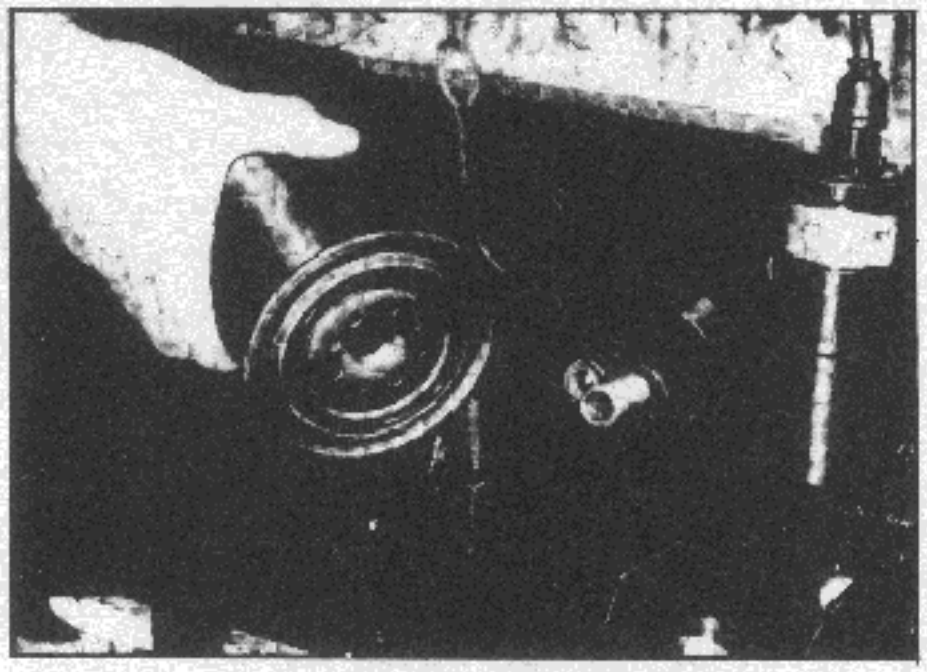


Fig. EL-8 Oil filter

Note: **Do not overfasten the filter, or oil leakage may occur.**

SERVICE JOURNAL OR BULLETIN REFERENCE

DATE	JOURNAL or BULLETIN No.	PAGE No.	SUBJECT

SERVICE MANUAL

MODEL L SERIES ENGINE

NISSAN

SECTION CO

COOLING SYSTEM

COOLING SYSTEM

CONTENTS

DESCRIPTION

The cooling system is a closed pressure type with high cooling capability. Cooling water flowing through resistance-free water passages in the cylinder head and block is maintained at adequate temperature range at all times by means of an ample capacity water pump, of a corrugated fin type radiator with high cooling efficiency and a pellet type thermostat.

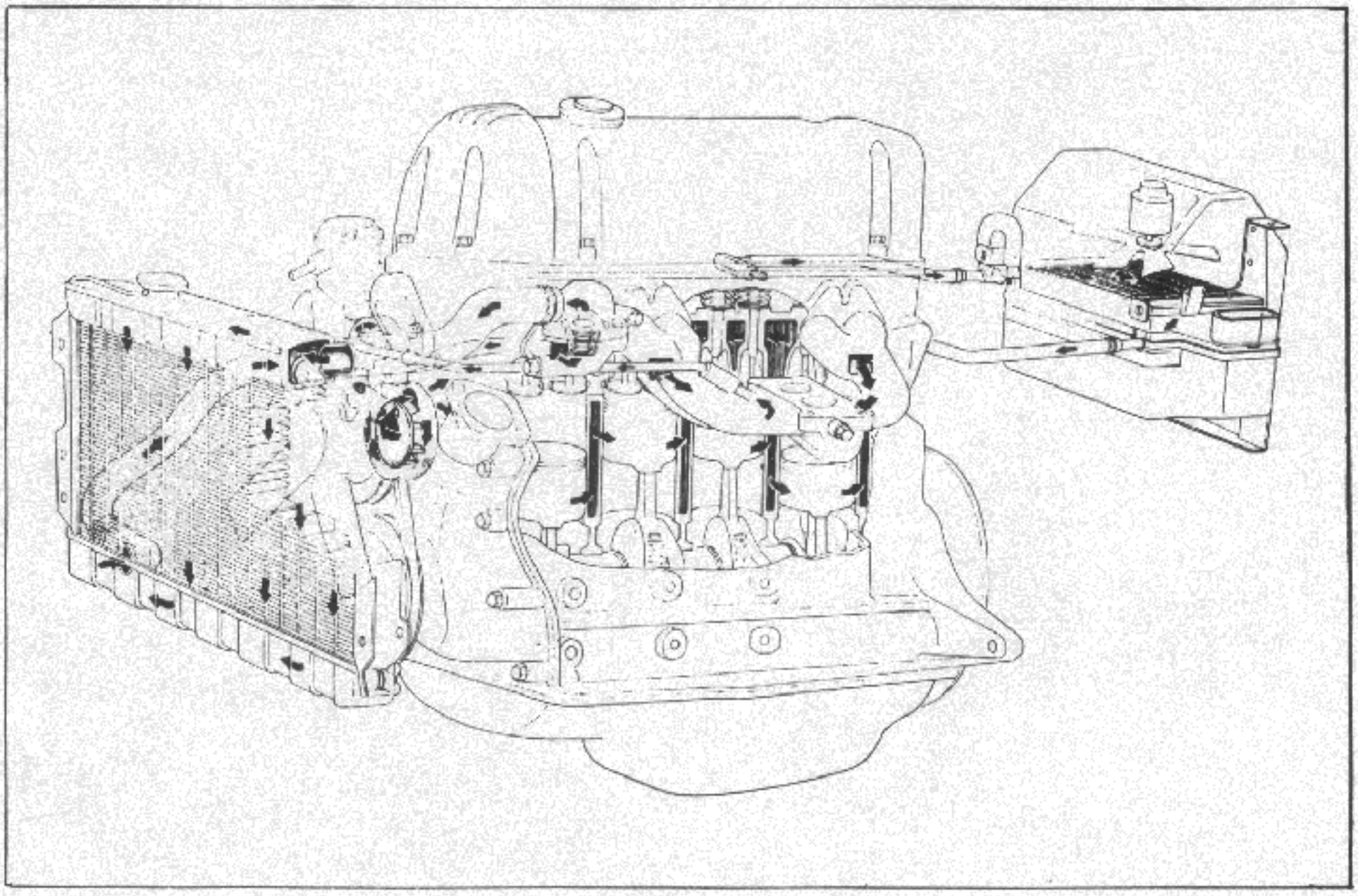


Fig. CO-1 Cooling system (L13 engine)

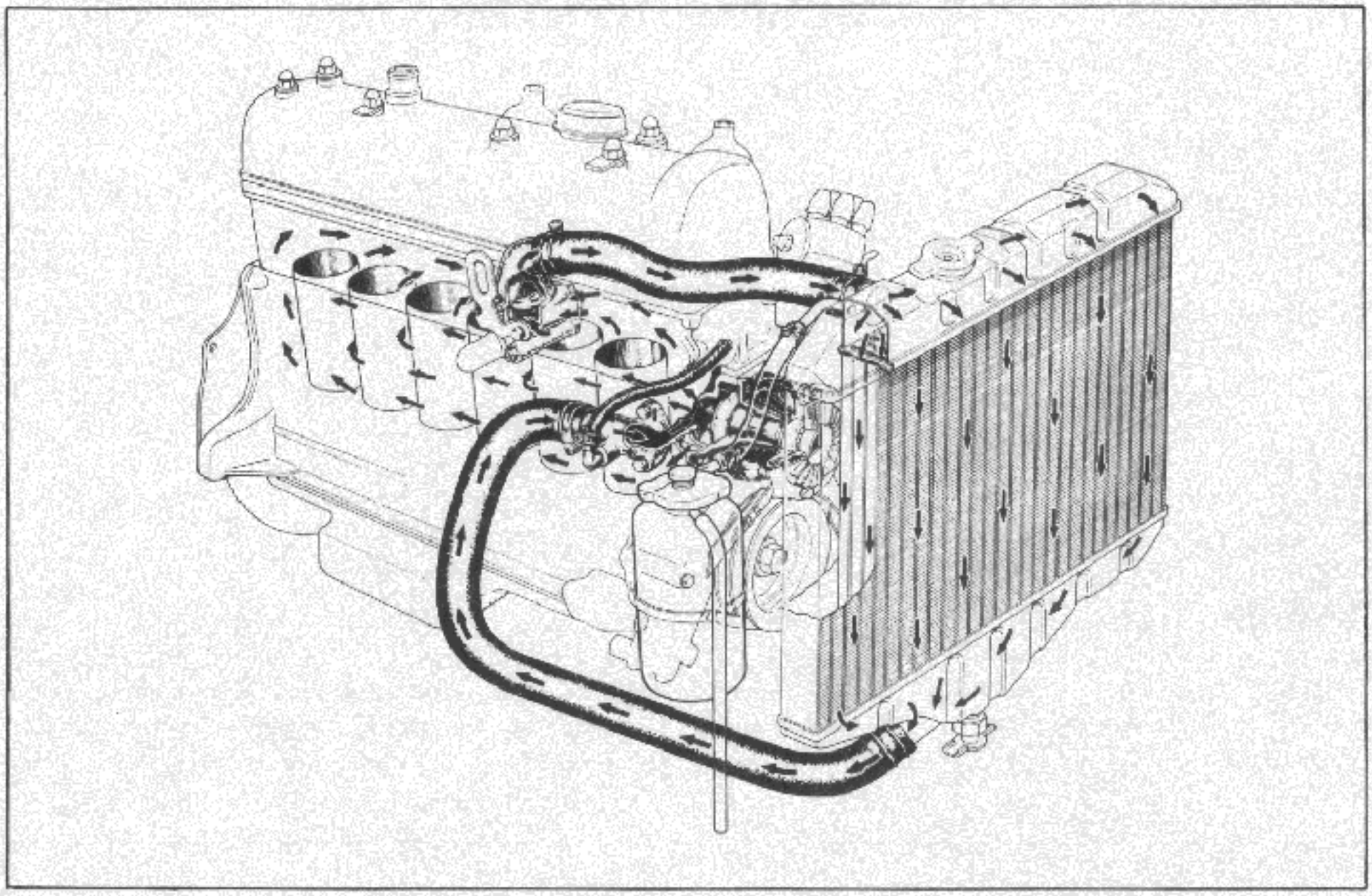


Fig. CO-2 Cooling system (L20 engine)

WATER PUMP

The water pump is a centrifugal type water pump with an aluminium diecast pump body. The volute chamber is built into the front cover assembly and a high pressure sealing mechanism is adopted to prevent the water leakage and noise thoroughly.

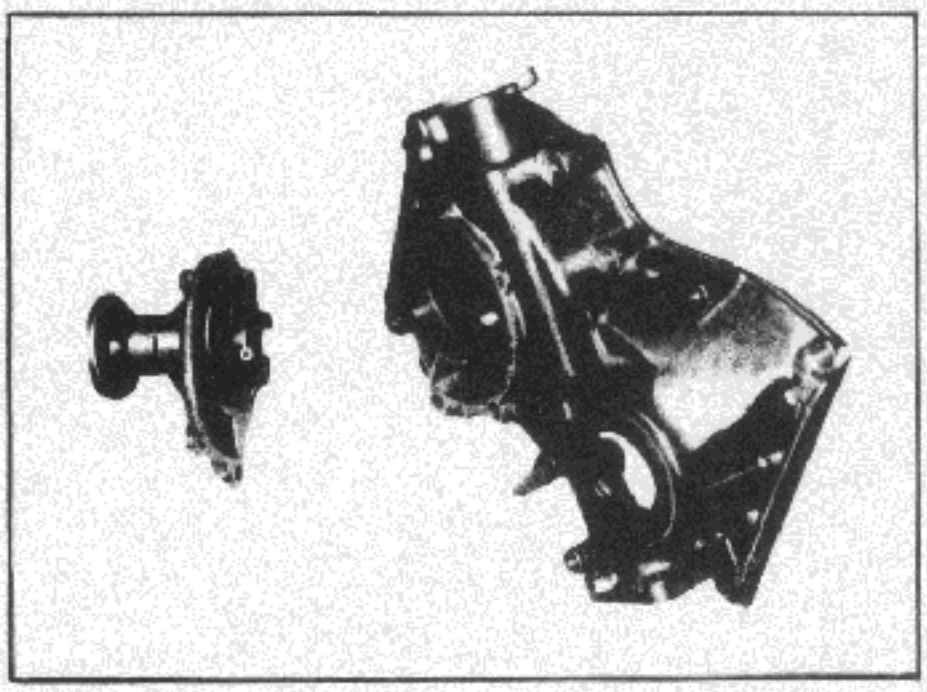


Fig. CO-3 Water pump and front cover

In case of L20 engine the water pump with fluid coupling will be equipped for the models with the torque convertor and the air conditioner. As for L13 and L16 engine, the fan clutch of mechanical type can be available only for the models with the air conditioner.

Removal

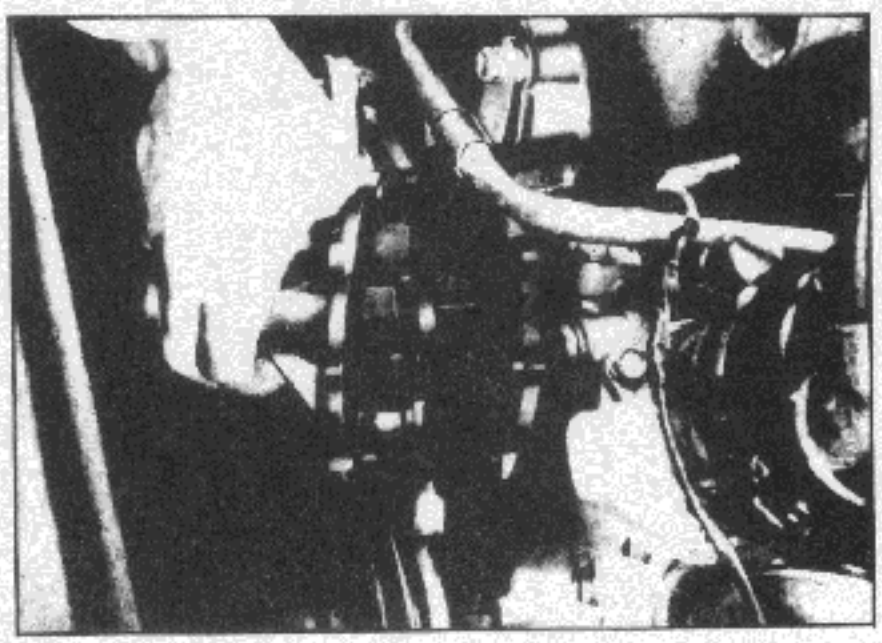


Fig. CO-4 Water pump removal

1. Drain cooling water completely.

2. Take the fan belt off the pulley.

3. Remove fan and pulley.

4. Remove the water pump.

Disassembly

1. By reason of an aluminium make, the water pump body is preferably not to be disassembled.

Inspection

Pump body

- Replace it if it has badly rusted or corroded vanes.
- Replace it if it grows up excessive bearing noise or squeak with the engine running.

Note: **To prevent a squeak, use Nissan CSP (Cooling System Protector).**
Prior to installing the pump, clean it with Nissan CSC (Cooling System Cleaner).

1. If a malfunction due to foreign matters, or sticking due to deteriorated oil are detected, disassemble the coupling for interior cleaning.

Note: **Wash the coupling in gasoline, in this case take care so that rubber seal will be kept away from gasoline.**

2. Check for seizure and a "gelatinized" oil (a phenomenon of oil thickened into a semi-solid form). Change such oil because thickened oil will make bearings and grooves sticky. At the same time, examine the condition of seal and bearing thoroughly. A blackened seal and bearing due to seizure requires the replacement of the pump body assembly.

Lubrication

Silicon oil is to be used.

1. If a malfunction and oil leakage are detected in the fluid coupling, remove the water pump for an overhaul. After reassembly, it must be filled with silicon oil of exactly 11.5 cc using a veterinary type injection syringe.

FLUID-COUPLING (For L20 engine)

In the models with the torque convertor and the air conditioner a fluid coupling is combined with the water pump to maintain cooling efficiency and to prevent power loss at high speed operation.

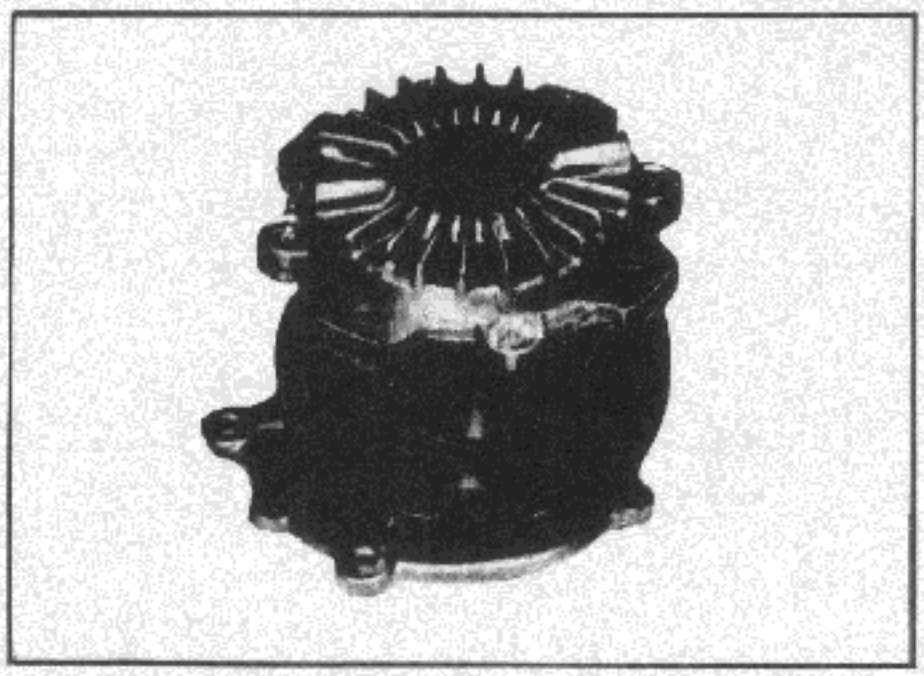


Fig. CO-5 Fluid coupling

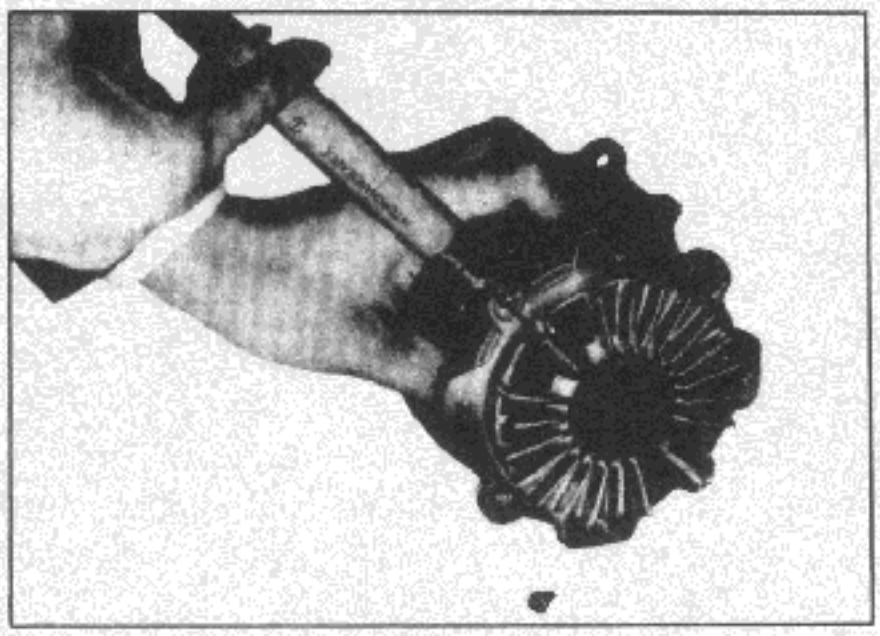


Fig. CO-6 Fluid-coupling lubrication

Note: **Carry out oil injection slowly to help air escape. A binding agent to be used in assembly:**
Three-Bond No.1
In this type of water pump, oil can be replenished with the coupling installed in the engine. The quantity of oil to be replenished must not exceed 5 cc.

FAN CLUTCH
(for L13 and L16 engine)

In the models with air conditioner the fan clutch will be equipped to maintain cooling efficiency and to prevent power loss. This fan clutch is combined with the thermostat which detects a temperature in the engine compartment. When the temperature goes up to a certain temperature, the thermostat begins to operate and the fan clutch will be engaged.

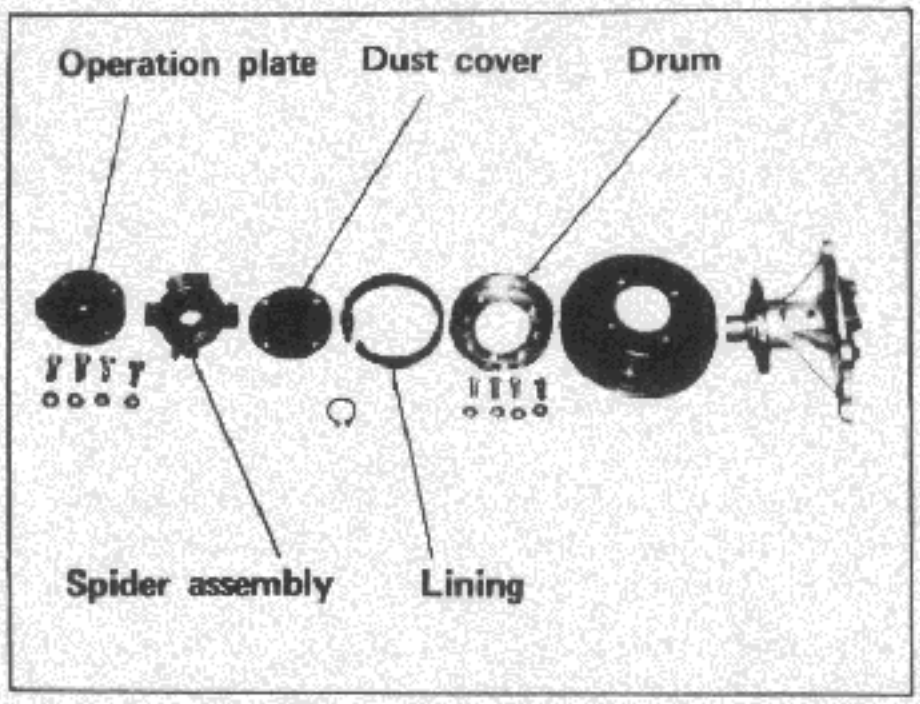


Fig. CO-7 Exploded view of fan clutch

Inspect fan clutch operation

Warm up the engine fully (20 ~ 30 minutes) and check the fan clutch operation at 2, 500 rpm. (engine revolution).

Clutch operating ..... temperature	ON 65° ± 4° C OFF 54° ± 4° C

Note: a. **Temperature should be mesured at the wicinity of the fan clutch in the engine conpartment.**

b. **Mesurement should be done two or three times because the thermostat operation has a time lag to some extent.**

Inspect thermostat operation

Take off the operation plate from the fan clutch and submerge it into the hot water (approximately 70° C) for two or three minutes to inspect the thermostat operation.

Disassembly

1. Unscrew the four bolts and take out the operation plate, the dust plate, the fan and the lining.

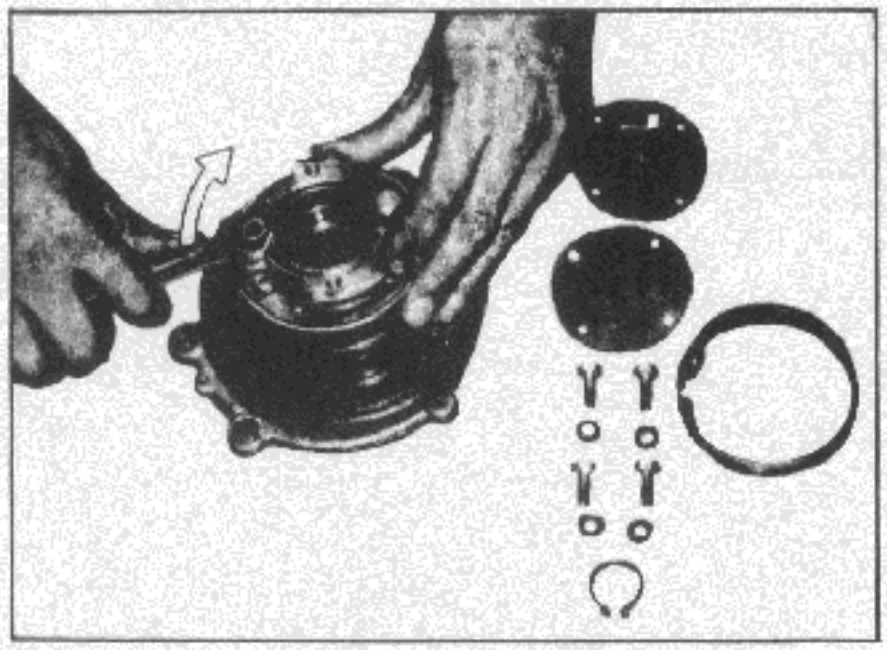


Fig. CO-8 Fan clutch disassembly

2. Take off the snap ring and pull out the spider assembly.

3. Remove the drum.

4. If necessary, remove the water pump hub.

THERMOSTAT

A pellet type thermostat is used in the water out-let passage to control the flow of coolant, providing fast engine warm-up and regulating coolant temperatures. A wax pellet in the thermostat expands when heated and contracts when cold. The pellet is connected through a piston to a valve and when the pellet is heated, pressure is exerted against a rubber diaphragm with forces the valve to open. As the pellet is cooled, the contraction 'allows a spring to close the valve.

Removal

1. Drain cooling water.

2. Remove radiator hose.

3. Remove water out-let elbow. Then, take out the thermostat.

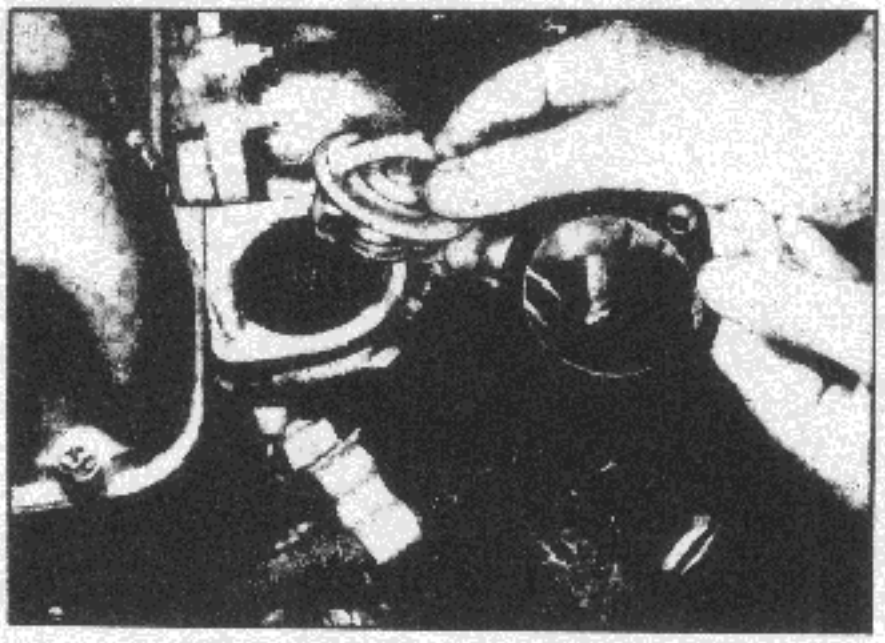


Fig. CO-9 Thermostat removal

Inspection

To test the thermostat for proper operating temperature, submerge the unit in a container of water. Heat the water and observe the temperature.

1. Measure the temperature when the thermostat valve just starts rising.

2. Measure the maximum lift of the thermostat valve.

Valve open temperature:	82° C ± 1.5° C (179.6° F ± 2.7° F)
Max. valve lift:	above 8 mm at 95° C (0.315 in. at 203° F)

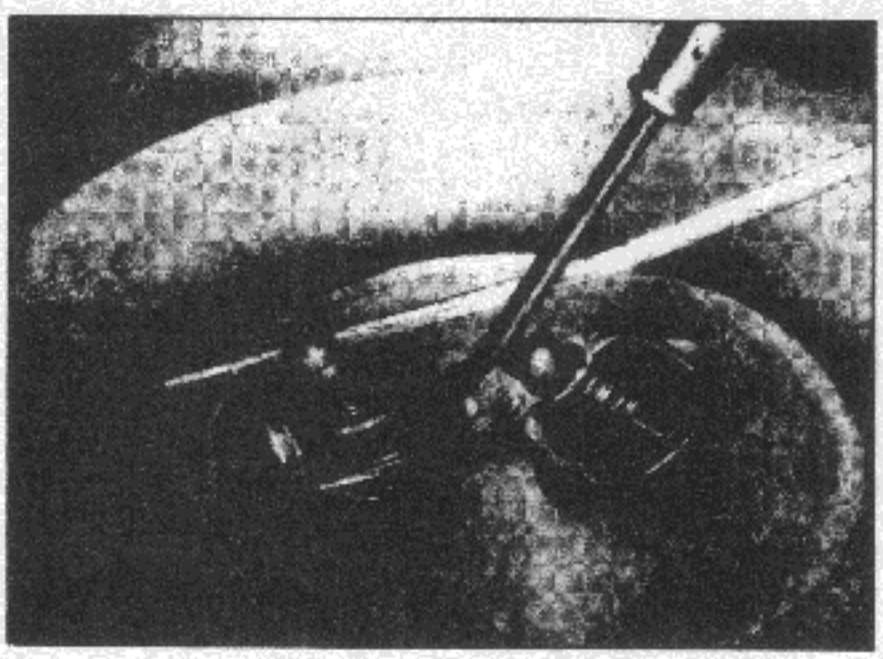


Fig. CO-10 Thermostat inspection

Provide a screwdriver with a marking at a point about 8 mm from the tip.

Inspect by inserting the marked screwdriver at 95°C.

It should be effective to use the following service parts, depending on where and how such parts will be used.

Installation

1. In installing, apply binding agent (Three-Bond) to both sides of the packing for prevention of water leakage.

2. Install by the removal procedure in reverse.

RADIATOR

The radiator is a conventional down flow type with the expantion tank located on top of the tube section.

The system is pressurized and the relief valve, incorporated in the radiator filler cap, controls the pressure at approximately 0.9 kg per sq. cm.

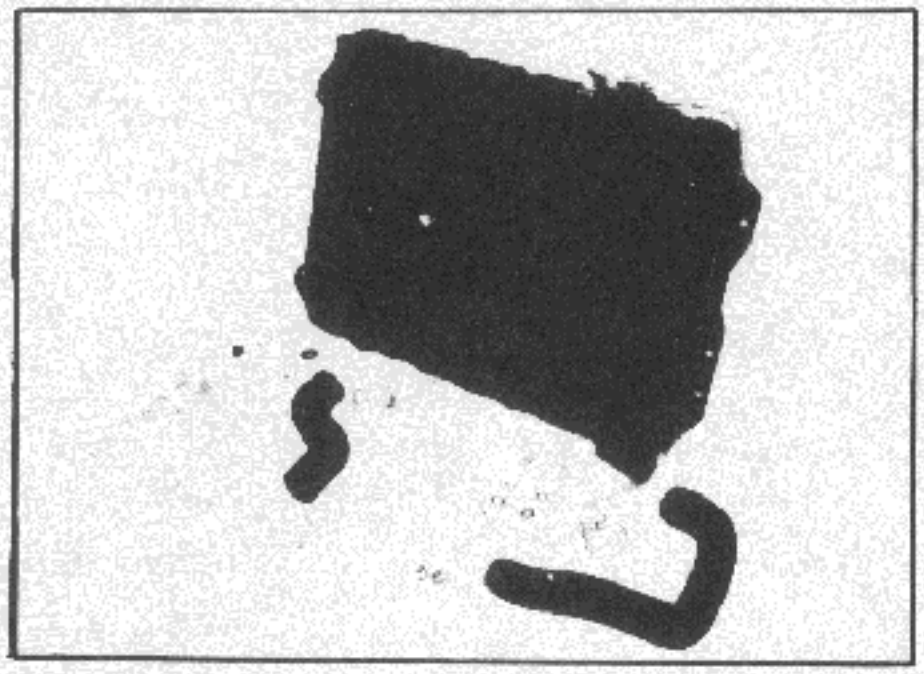


Fig. CO-11 L13 and L16 Engine

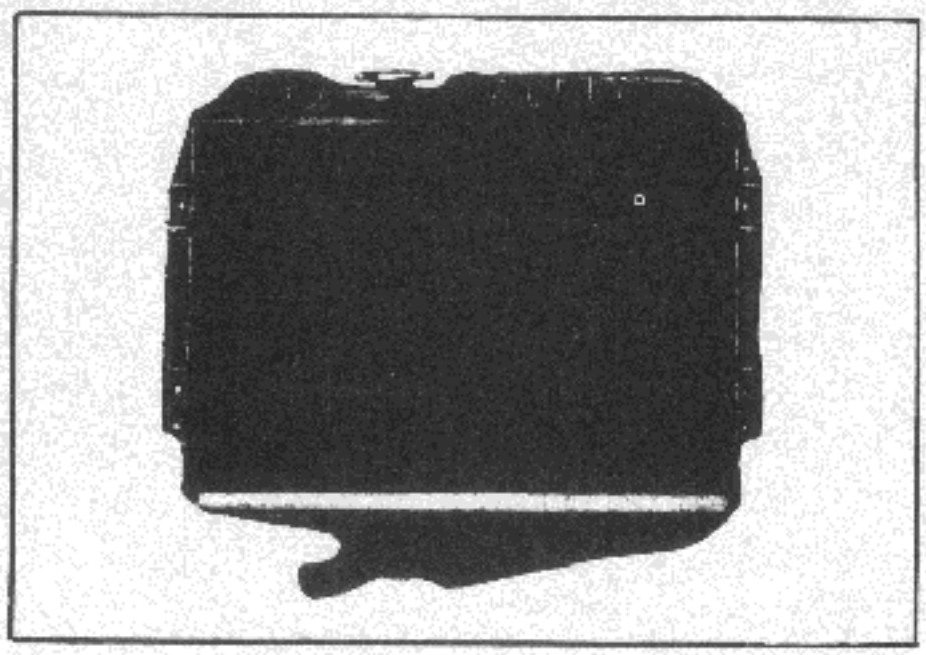
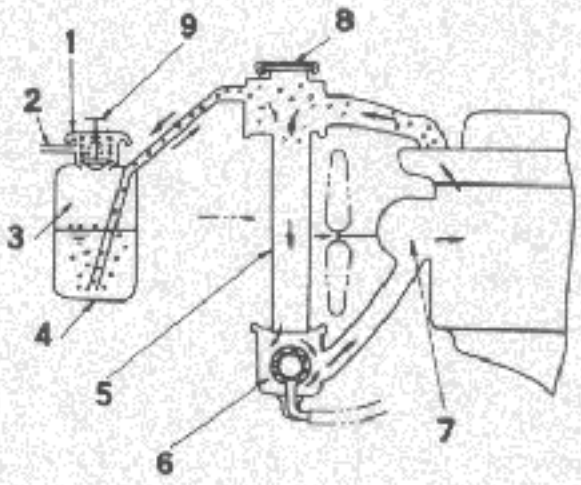


Fig. CO-12-a L20 Engine



1	Pressure valve	6	Oil cooler (Torque converter)
2	Overflow pipe	7	Water pump
3	Expanded part	8	Cap for water supply
4	Reservoir tank	9	Push button
5	Radiator		

Fig. CO-12-b L20 Engine

For the models with torque convertor the oil cooler to cool the torque converter oil will be combined with the radiator.

Romoval

1. Drain cooling water.

2. Disconnect radiator upper hose, lower hose and the hose to the reservoir tank.

(The reservoir tank is provided only for L20 engine.)

3. Detach the radiator assembly by removing the four fixing bolts.

Inspection

Check for water leakage and cracks using a cap tester. If such defects are detected, repair or replace the radiator assembly.

SPECIFICATIONS

	L20	L13 and L16
Dimensions of radiator core (height × width × thickness)	350 × 514 × 32 mm (13.78 × 20.24 × 1.26 in.)	280 × 488 × 38 mm (11.02 × 19.21 × 1.50 in.)
Type	Corrugated fin type	Corrugated fin type
Radiator fin spacing	1.8 mm (0.071 in.)	2.3 mm (L13) (0.091 in.) 1.8 mm (L16) (0.071 in.)
Radiator capacity	500 Kcal/h °C	360 Kcal/h °C
Cap working pressure	0.9 kg/cm^2 (12.8 lb/in^2)	0.9 kg/cm^2 (12.8 lb/in^2)
Water capacity	2.6 ℓ (0.687 US. gal.) (0.573 Imp. gal.)	6.4 ℓ (1.691 US. gal.) (1.409 Imp. gal.)

SERVICE MANUAL

MODEL L SERIES ENGINE

NISSAN

SECTION EF

FUEL SYSTEM

EF

AIR CLEANER

DESCRIPTION

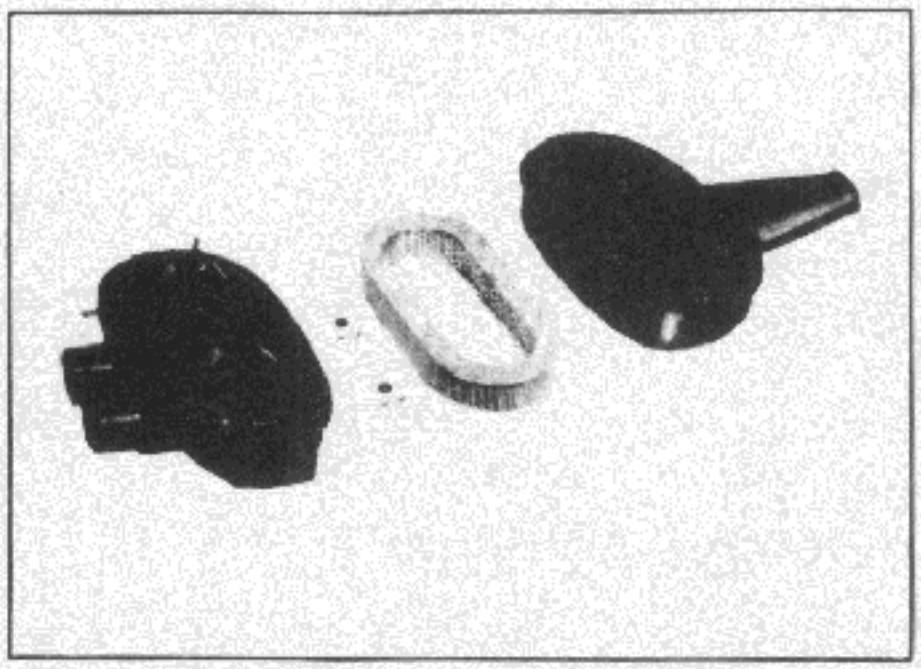


Fig. EF-1 Air cleaner for twin carburetor

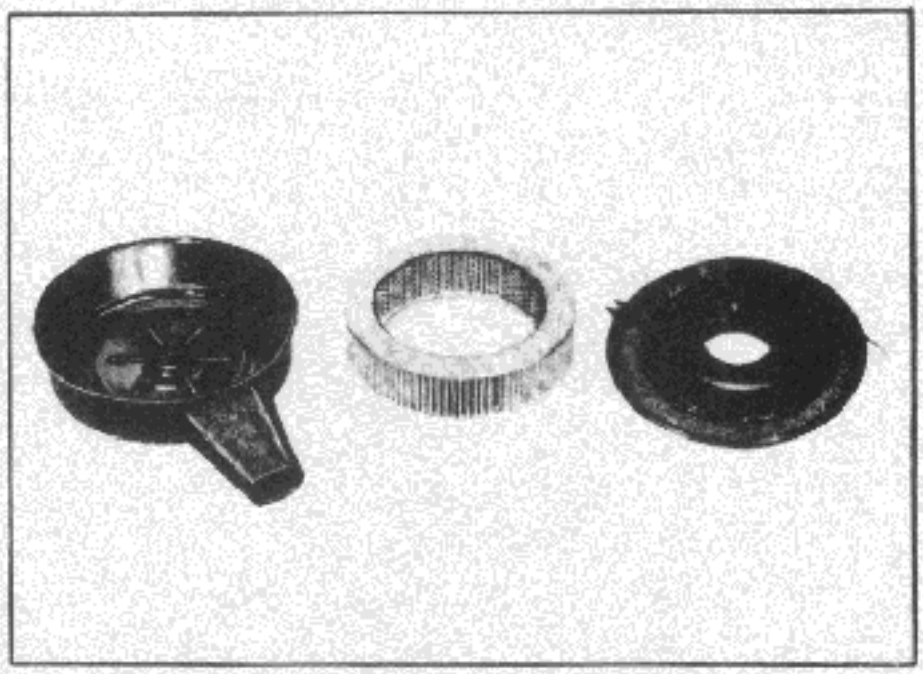


Fig. EF-2 Air cleaner for single carburetor of L20 engine

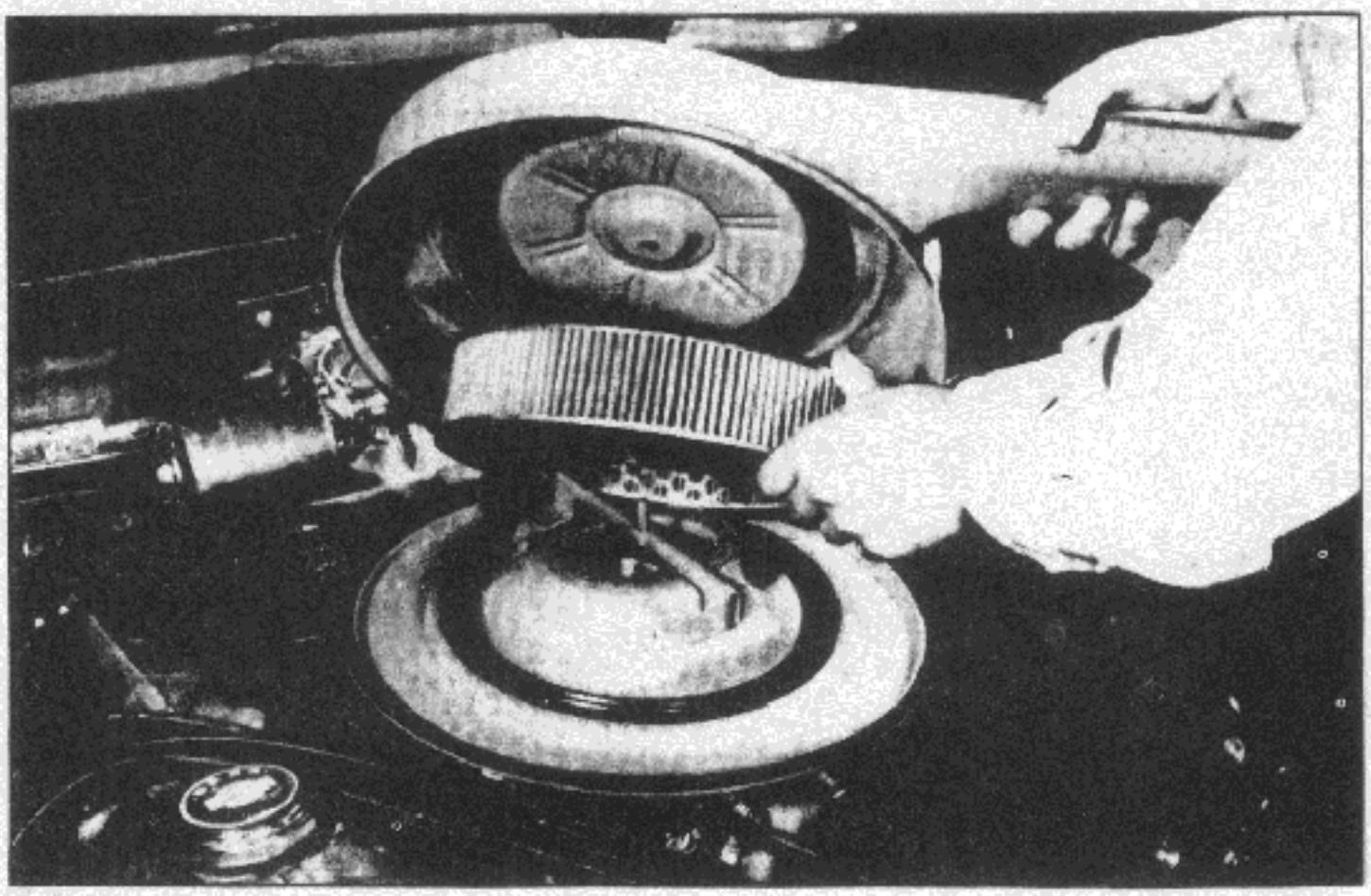


Fig. EF-3 Air cleaner for single carburetor of L16, L13 engine

The air filter elements used are viscous paper type elements and does not require any cleaning regardless of contamination until it is replaced at every 40,000 km (24,000 mile) of operation.

Note: **Never treat the element by brushing or air blasting before the time for replacement!**

FUEL STRAINER

DESCRIPTION

≪ Model L20 Engine ≫

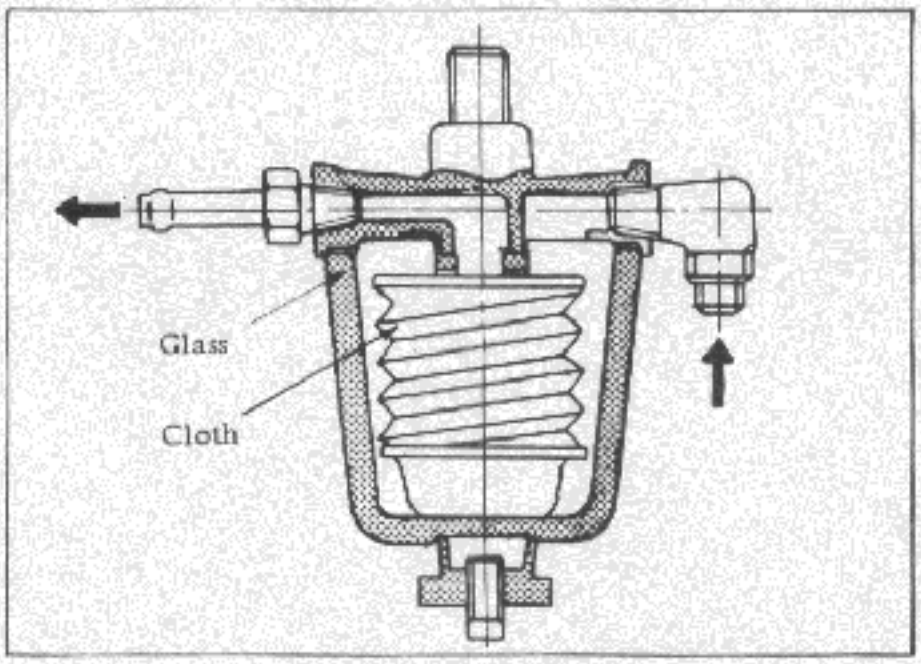


Fig. EF-4 Sectional view of conventional type fuel strainer

As illustrated above, the fuel strainer on the L13 & L16 engine is different from that on the L20 engine. The former, which has been newly adopted, is the cartridge type strainer, and a fiber mat is used as a strainer element. This strainer should be replaced at intervals not to exceed 40,000 km (24,000 mile). The latter is the conventional type strainer, having a cloth strainer element with high straining efficiency and is fitted into the glass bowl.

≪ Model L13 & L16 Engine ≫

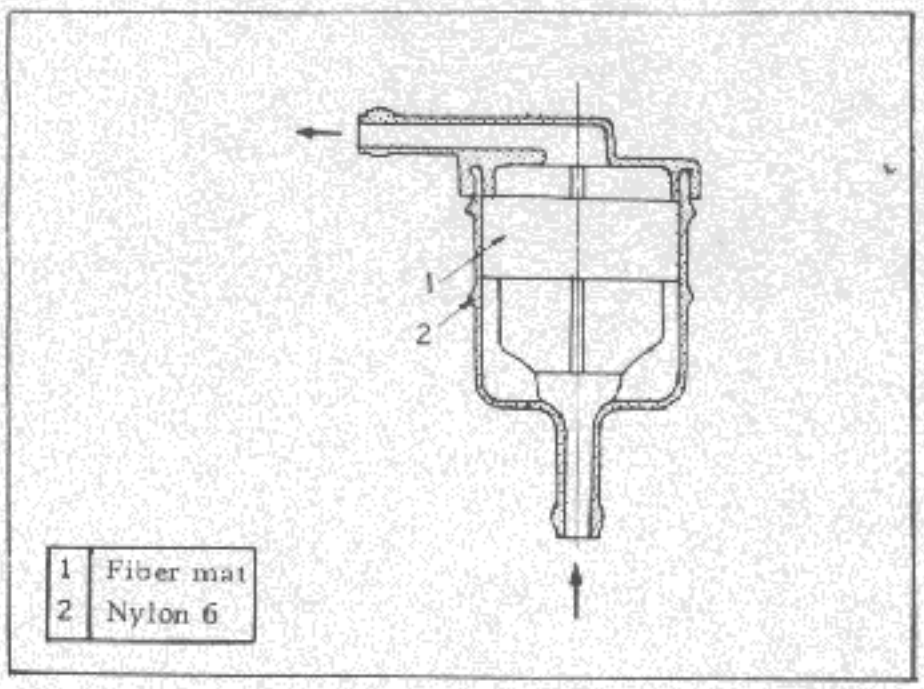


Fig. EF-5 Sectional view of cartridge type fuel strainer

The strainer element in both types can be seen through the bowl for convenience of checking the element's condition without removing the bowl.

REMOVAL

Disconnect the inlet and outlet fuel pipes, and the fuel strainer assembly is easily removed.

SERVICE REFERENCE

These fuel strainers have no pet cocks, therefore the strainer, carburetor lines, and fuel pump should not be removed or cleaned when the tank is full, unless absolutely necessary. If required, place the tube, at the rear of the strainer, above the top of the fuel tank.

Note: On the conventional type fuel strainer, when assembling the element and strainer packings are in proper position. Take special care to prevent air leakage from the element packing assembly.

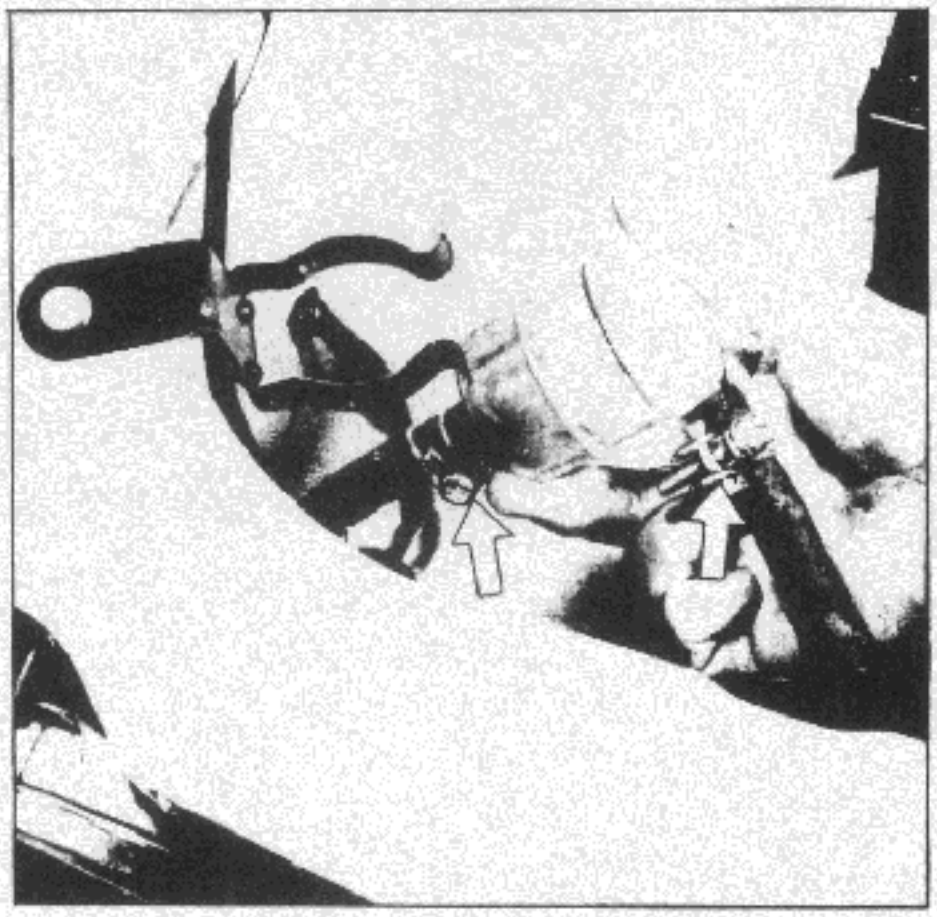


Fig. EF-6 Cartridge type fuel strainer

FUEL PUMP

CONTENTS

DESCRIPTION

The fuel pump transfers gasoline from the tank to the carburetor in sufficient quantity to meet engine requirements at any speed or load.

The fuel strainers used on the model L13, L16 and L20 engines are of the diaphragm type. The pumps are of similar construction, and the service procedures are the same for each. Fig. EF-7 shows a cross-section of the pump.

The fuel pump consists of a body, rocker arm and link assembly, fuel diaphragm, fuel diaphragm spring, seal, inlet and outlet valves. The fuel diaphragm consists of specially treated rubber, which is not affected by gasoline, held together by two metal discs and a pull rod.

FUEL PUMP TESTING

A fuel pump is operating properly when its pressure is within specifications and its capacity is equal to the engine's requirements at all speeds. Pressure and capacity must be determined by two tests, while the pump is still mounted on the engine. Be sure there is gasoline in the tank when carrying out the tests.

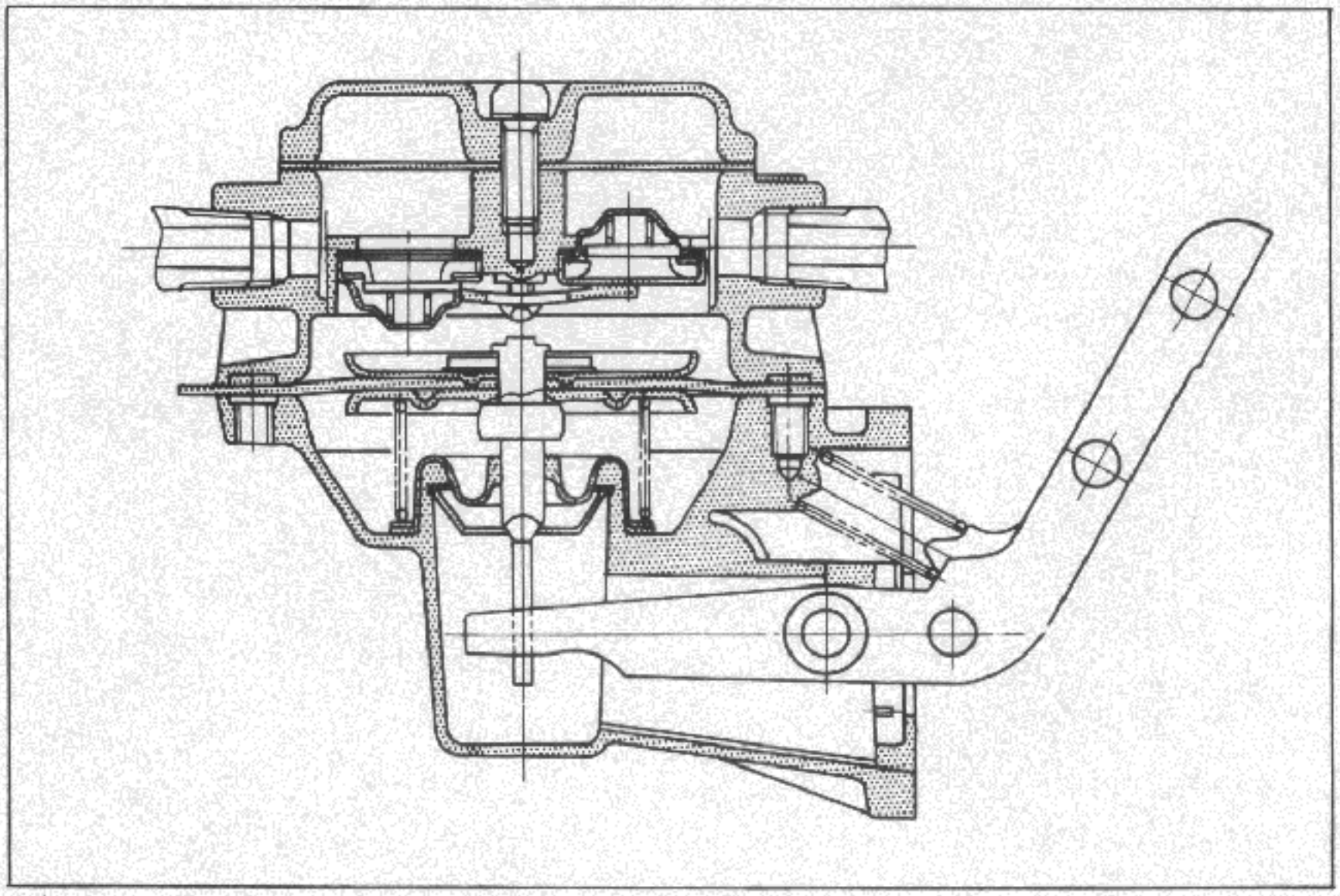


Fig. EF-7 Schematic view of fuel pump

Static pressure test

The static pressure test is made as follows:

1. Disconnect the carburetor fuel line at the carburetor.

2. Install the necessary adapter and "tee" fitting to the fuel line and attach a suitable pressure gauge.

3. Start and run engine at varying speeds.

4. The reading on the gauge is the static fuel pressure and this should remain within the following limits:

≪ Model L20 Engine ≫ 0.24 to 0.30 kg/cm^2 (3.41 to 4.27 lb/in^2)

≪ Model L13 & L16 Engine ≫ 0.18 to 0.24 kg/cm^2 (2.56 to 3.41 lb/in^2)

Pressure below the lower limit indicates extreme wear on one part or a small amount of wear on each working part. They also indicate a ruptured diaphragm; worn, warped, dirty or gumming valves and seats, or a weak diaphragm return spring. Pressure above the upper limit indicates an excessively strong diaphragm return spring or a diaphragm that is too tight. Both of these conditions require the removal of the pump assembly for replacement or repair.

Capacity test

The capacity test is used only if the static pressure test is within specifications, and is made as follows:

1. Disconnect the fuel pipe at carburetor.

2. Place a suitable container at the end of the pipe.

3. Start the engine and run at 1,000 r.p.m.

4. On model L20 engine, the pump should deliver 1,000 c.c. (2.32 U.S. pts.) of fuel in one minute or less.

On model L13 & L16 engines, 1,000 c.c. (2.11 U.S. pts.).

If no gasoline, or only a little flows from open end of pipe then the fuel pipe is clogged or the pump is malfunctioning. Before removing the pump, remove the gas tank cap, disconnect both inlet and outlet pipes and blow through them with an air hose to make sure they are clear.

This will climinate the possibility of a clogged gas strainer in the fuel tank. Reconnect pipes to pump and retest flow.

REMOVAL AND DISASSEMBLY

Remove the fuel pump assembly by unscrewing the two mounting nuts and disassembly in the following order.

1. Separate the upper body and the lower body by unscrewing the body set screws.

2. Take off the cap and the cap gasket by removing the cap screws.

3. Unscrew the elbow and the connector.

4. Take off the valve retainer by unscrewing the two valve retainer screws and two valves are easily removed.

5. To remove the diaphragm, the diaphragm spring, the lower body seal washer and the lower body seal from the lower body, press down the diaphragm counter to the force of the diaphragm spring and while doing this, cant the diaphragm so that the rectangular part in the lower end of the pull rod is unhooked from the rocker arm link.

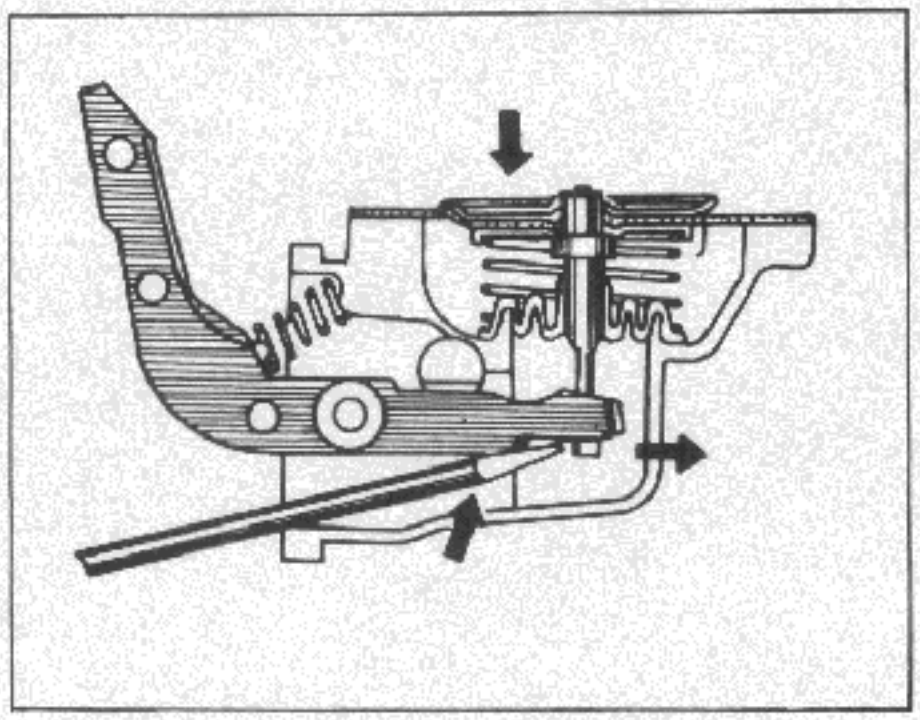
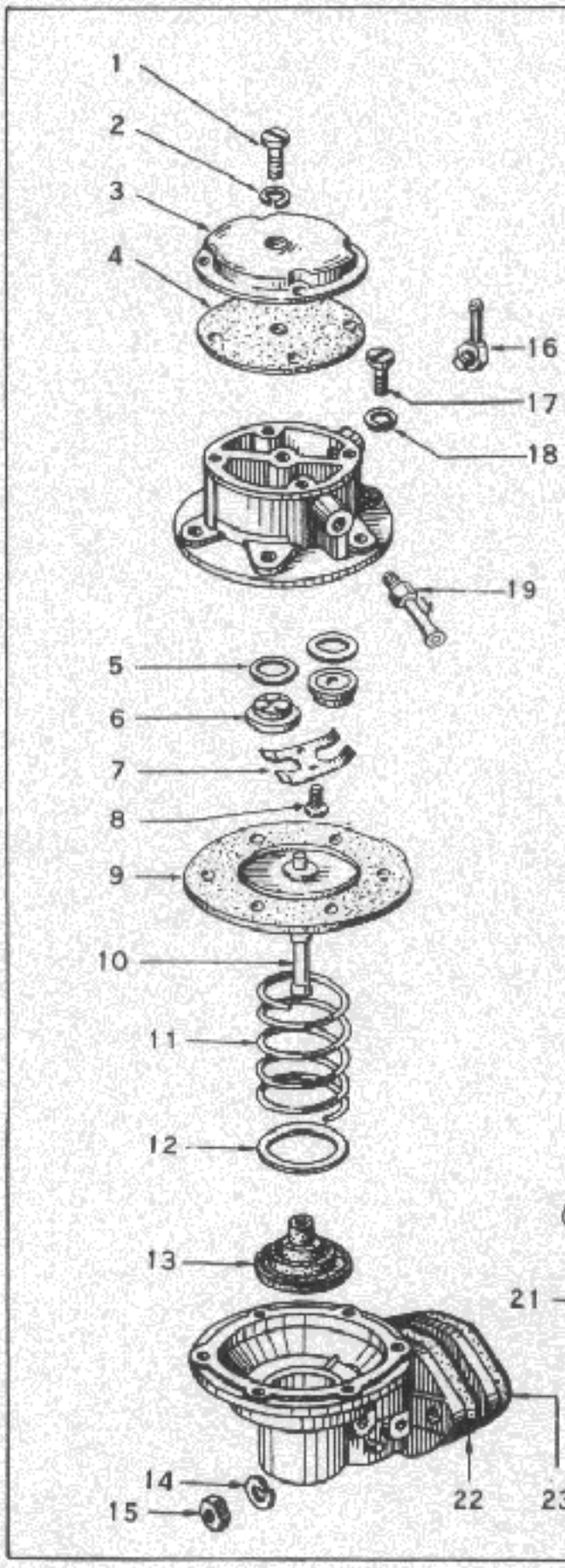


Fig. EF-8 Pull rod removal

6. Drive out the rocker arm pin by using a press or hammer.



1.	Screw
2.	Washer-spring
3.	Cap-fuel pump
4.	Gasket-cap
5.	Ass'y packing-valve
6.	Ass'y valve-fuel pump
7.	Retainer-valve
8.	Screw-retainer
9.	Ass'y diaphragm
10.	Pull rod
11.	Spring-diaphragm
12.	Washer-seal, lower body
13.	Seal-lower body
14.	Washer-lock
15.	Nut
16.	Elbow
17.	Screw
18.	Washer lock
19.	Connector
20.	Spring-rocker arm
21.	Spacer-side rocker arm
22.	Spacer-fuel pump to cylinder block
23.	Packing-fuel pump
24.	Ass'y arm rocker
25.	Pin-side rocker arm
26.	Spacer-side rocker arm

Fig. EF-9 Structure of fuel pump

INSPECTION

1. Check the upper body and the lower body for cracks.

2. Check the valve assembly for wear of the valve and valve spring. Blow the valve assembly by breath to examine its function.

3. Check the diaphragm for small holes, carcks and wear.

4. Check the rocker arm for wear at the portion in contact with the camshaft.

5. Check the rocker arm pin for wear since a worn pin may cause oil leakage.

6. Check all other components for any abnormalities and replace with new parts if the condition requires it.

ASSEMBLY

Assembly is done in the reverse order of disassembly. In case of reassembly and re-installation, the following points should be noted.

1. Use new gaskets.

2. Lubricate the rocker arm, the rocker arm link, the rocker arm pin and the lever pin before installation.

3. To test the function, position the fuel pump assembly about 1 meter (3.3 ft.) above fuel level with a pipe connecting the fuel pump and the fuel strainer and operate the rocker arm by hand. If fuel is drawn up soon after the rocker arm is released, the function of the pump is sufficient.

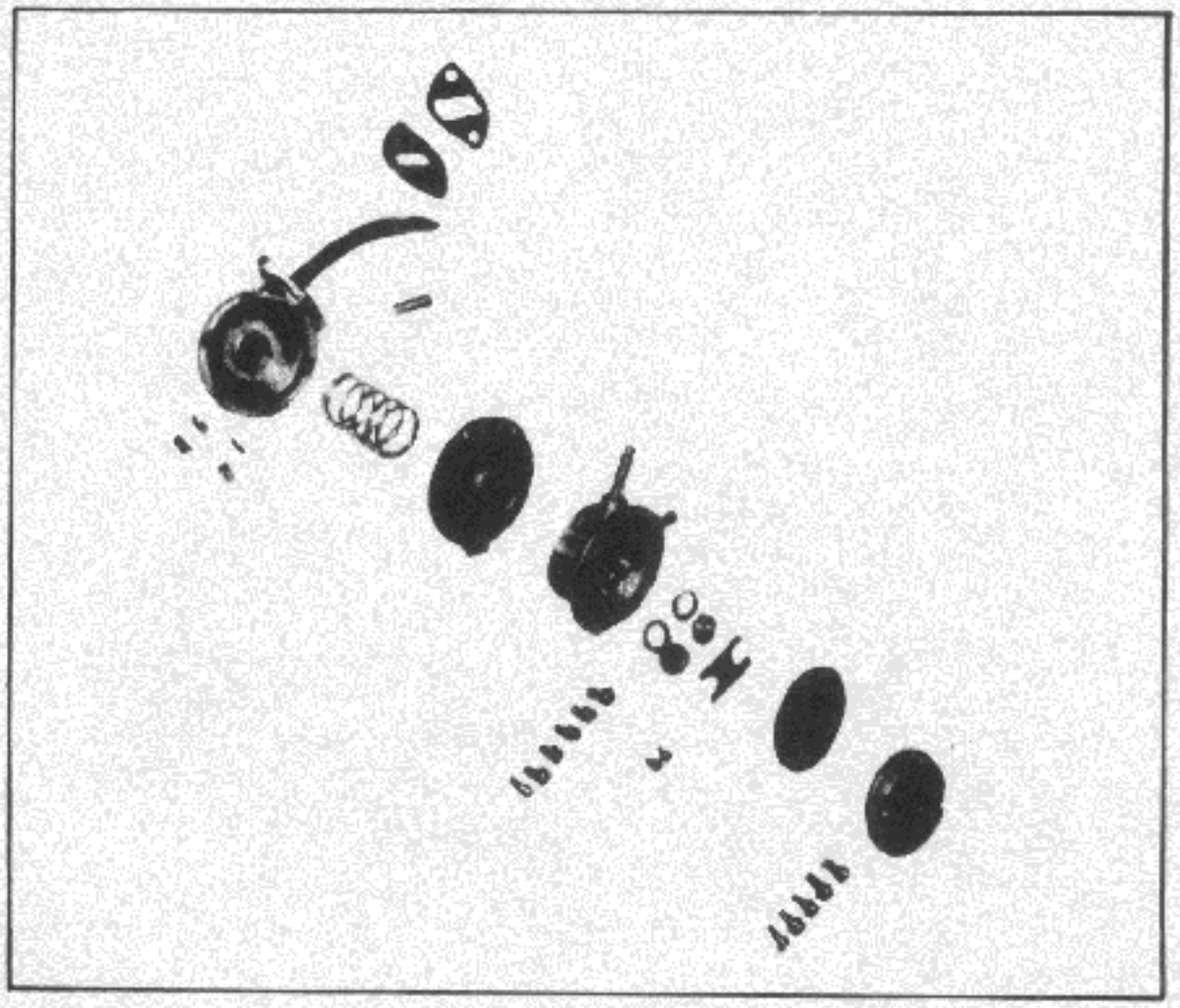


Fig. EF-10 Disassembly

CARBURETOR

Carburetor model installed each engine is as follows.

Engine model	Carburetor model
L20 (for H130)	DAH342 (Two barrel) HJG38W (Twin)
L16 (for P510)	DAF328 (Two barrel) HJL38W (Twin)
L13 (for 510)	DCK306 (Two barrel)

TWO BARREL CARBURETORS

CONTENTS

DESCRIPTION

As almost all the mechanism of these carburetors are quite similar, the general explanation is made in common except different points.

These are downdraft carburetors which were made aiming at the elevation of power and starting mechanism. These carburetors present several distinct features of importance to the car owner.

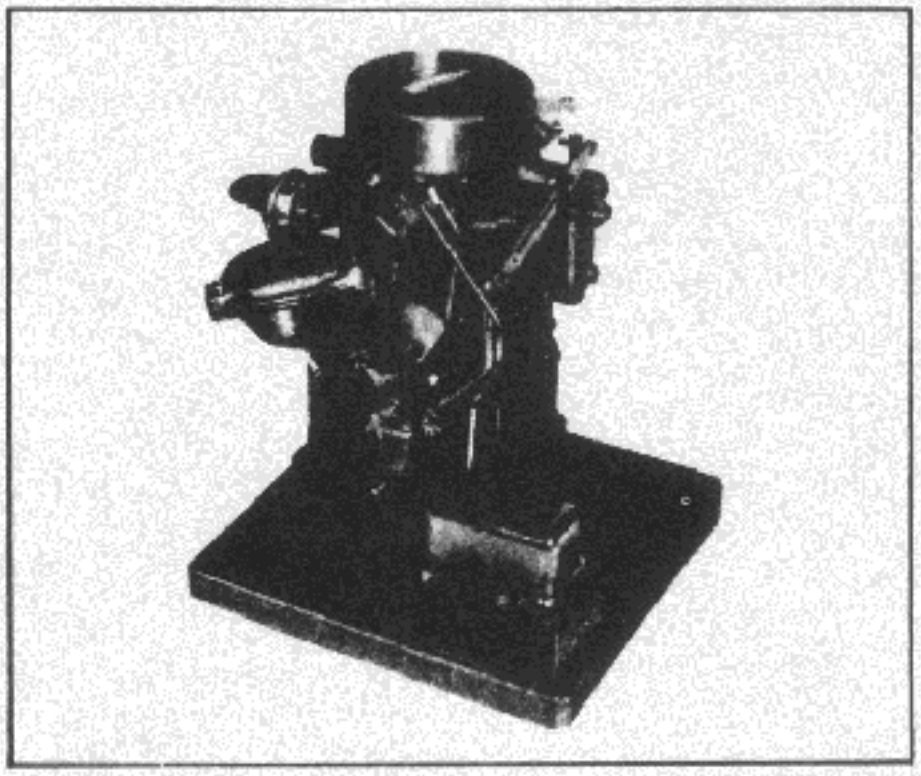


Fig. EF-11 DAH342 carburetor

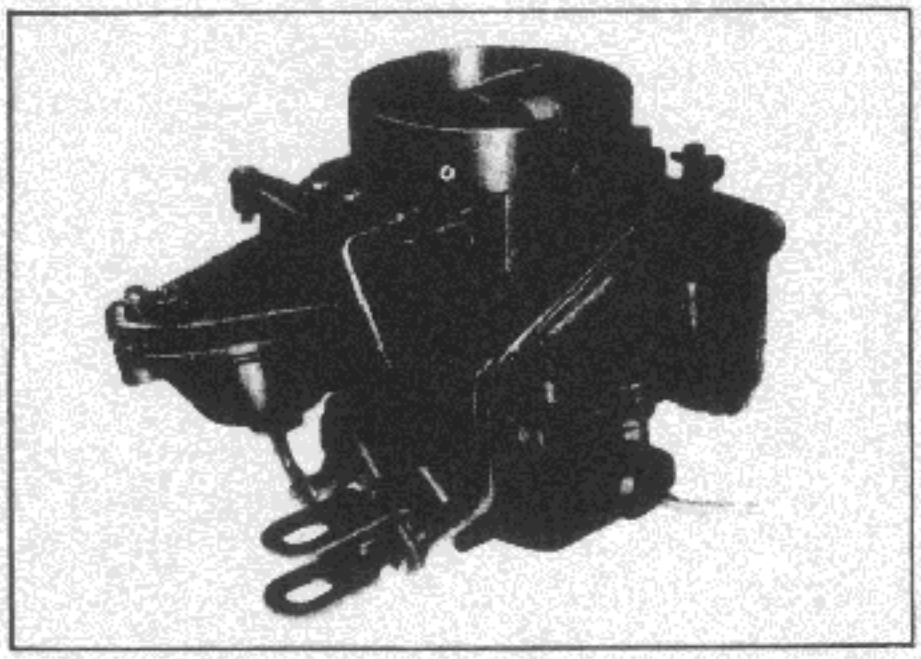


Fig. EF-12 DAF328 carburetor

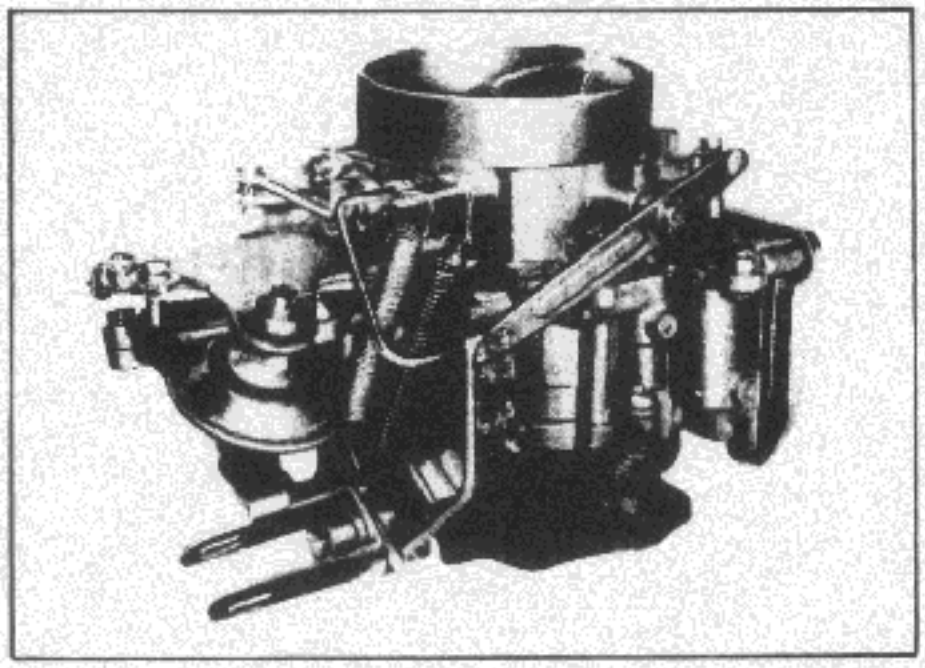


Fig. EF-13 DAF328 carburetor (only for the car equipped automatic transmission)

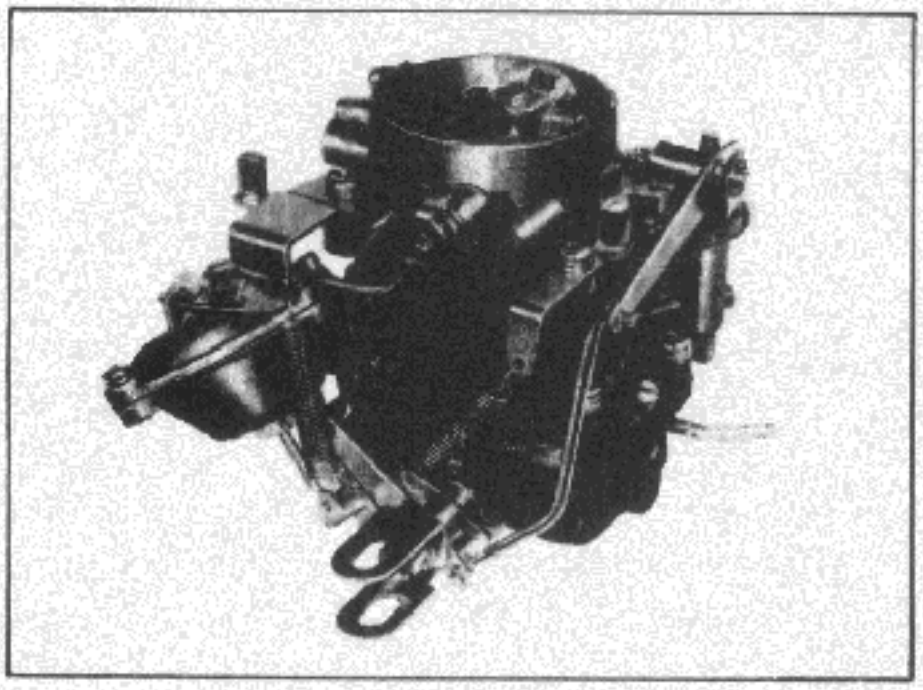


Fig. EF-14 DCK306

Foremost among these features are:

1. Secondary throttle valve is operated by the diaphragm which is pulled by the venturi vacuum so that the high power and good accceleration are gained in comparison with the auxiliary valve type.

2. Accelerating pump gives excelent acceleration.

3. The power valve mechanism, so-called vacuum actuated boost type, makes the good high speed drive. (For DAH342 and DCK306)

4. Slow economizer mechanism makes the smooth connection with acceleration or deceleration during light load running, and stable low speed performance is gained.
(For DAF328)

5. Automatic choke - Insures proper starting and driving carburetion during cold weather operation. (For the carburetor equipped with automatic choke.)

These carburetors are almost similar as already mentioned, but in some points they have different structures. Accordingly, their explanation items are different, so the reference table is shown below as you can make better use of this manual.

Item \ Carburetor model	DAH342	DAF328	DCK306
STRUCTURE AND OPERATION			
1. Primary System			
1-1 Primary main system	O	O	O
1-2 Idling and slow system	O	O	O
1-3 Accelerating mechanism	O	O	O
1-4 Starting mechanism	O	O	O
1-5 Power valve mechanism	O		O
1-6 Dash pot device		*O	
2. Secondary System			
2-1 Secondary main system	O	O	O
2-2 Step system	O	O	O
2-3 Secondary switch over mechanism	O	O	O
3. Float System	O	O	O
4. Fuel Return System	O	O	O
ADJUSTMENT			
1. Idling Adjustment	O	O	O
2. Fuel Level Adjustment	O	O	O
3. Starting Adjustment	O		
(a) Method	O		
(b) Fast idle adjustment	O		

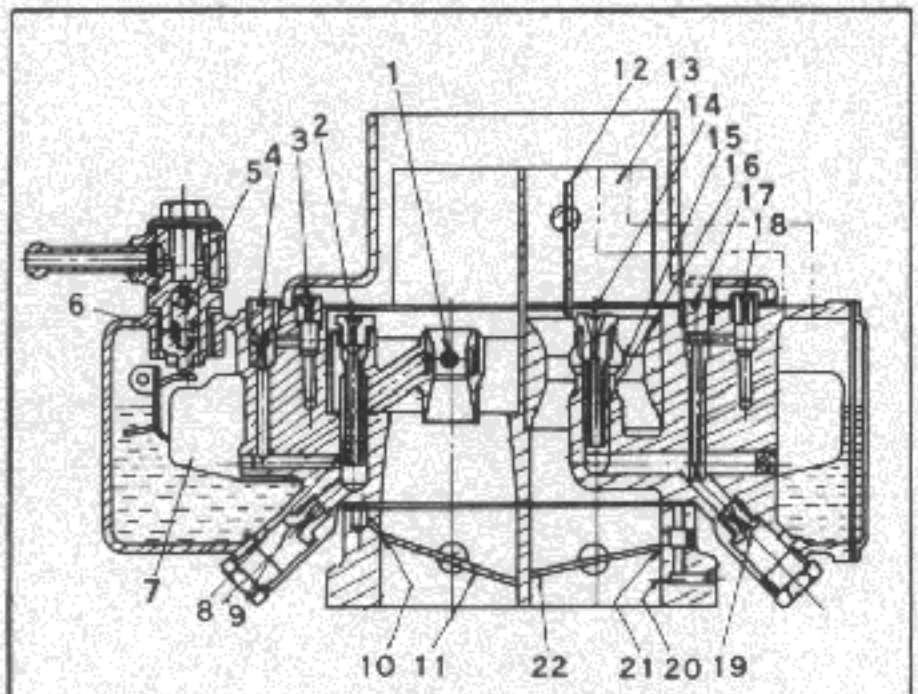
4. Adjustment of Starting Interlock Valve Opening		O	O
5. Adjustment of Interlock Opening of Primary and Secondary Throttle Valve	O	O	O
6. Adjustment of Dash Pot		*O	
MAJOR SERVICE OPERATIONS			
1. Removal	O	O	O
2. Disassembly	O	O	O
3. Disassembly and Assembly of Auto Choke	O		
4. Cleaning and Inspection	O	O	O
5. Assembly and Installation	O	O	O
JETS	O	O	O
TROUBLE DIAGNOSES AND CORRECTIONS	O	O	O
SPECIFICATIONS AND SERVICE DATA	O	O	O

* Only for the carburetor equipped with Automatic Transmission.

STRUCTURE AND OPERATION

≪ Model DAH342 Carburetor ≫

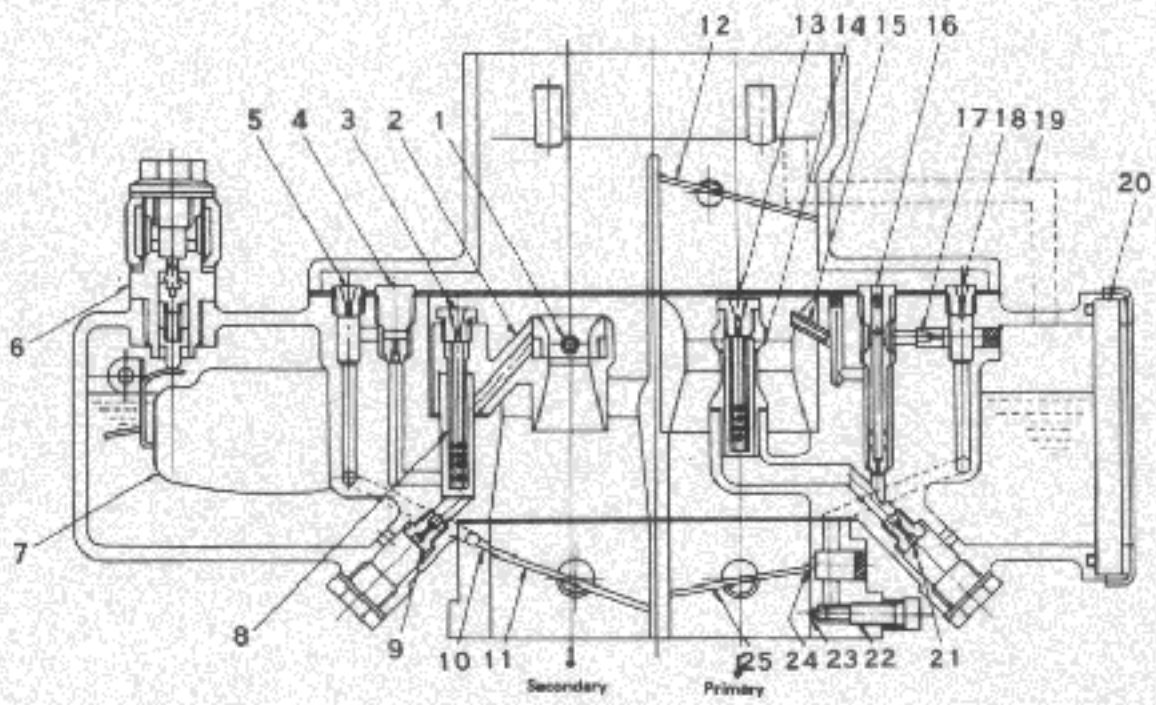
These carburetors consist of the primary system for normal running and the secondary system for full load running. The float system which the primary and secondary systems use in common, the secondary switch over mechanism, the starting mechanism, accelerating mechanism, etc. are also attached. For model DAH342 and DCK306 carburetors, the power valve mechanism is attached and only for model DAF328 the slow economizer system adopted. On model DAH342 and DAF328 carburetors, the primary main system is of Solex type and the secondary main system is of Zenith Stronburg type. On model DCK306, both primary and secondary are of Zenith Stronburg type.



1	S Main nozzle	12	Choke valve
2	S Main air bleed	13	Air vent
3	S Slow air bleed	14	P Main air bleed
4	S Slow jet	15	P Main nozzle
5	Needle valve	16	P Emulsion tube
6	Needle valve spring	17	P Slow jet
7	Float	18	P Slow air bleed
8	S Emulsion tube	19	P Main jet
9	S Main jet	20	P Idle hole
10	S By-pass hole	21	P By-pass hole
11	S Throttle valve	22	P Throttle valve

Fig. EF-15 Sectional view

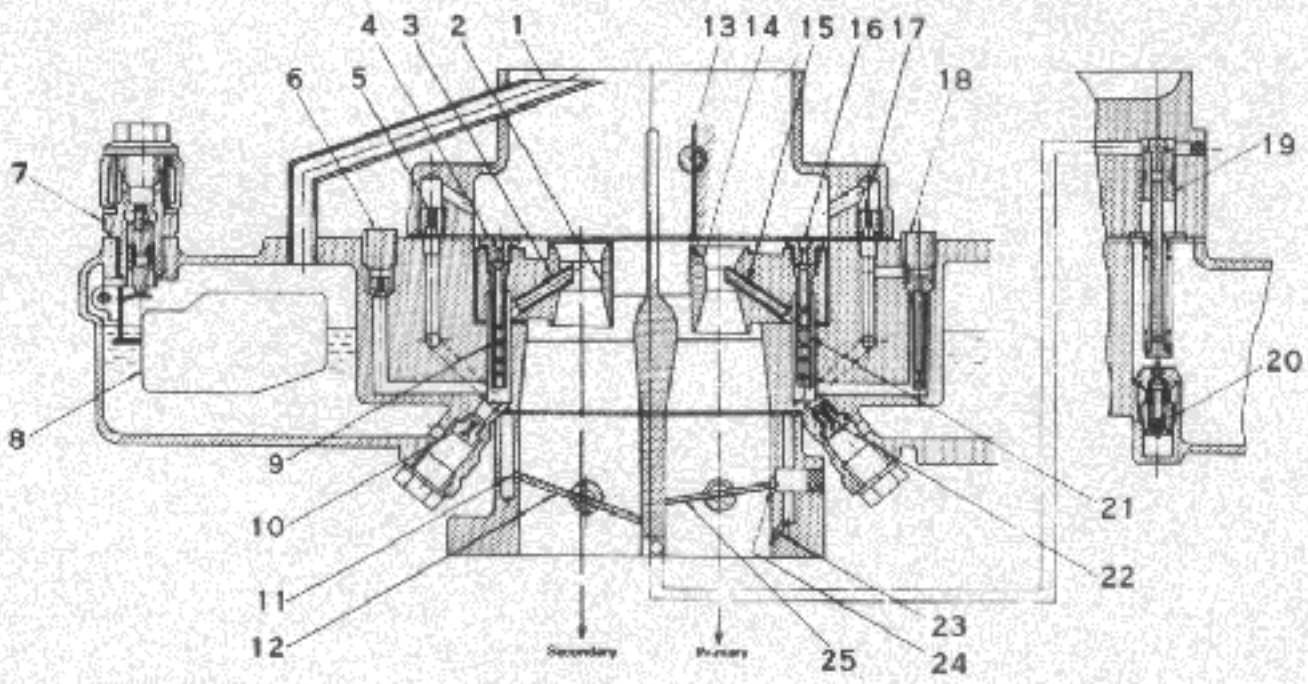
≪ Model DAF328 Carburetor ≫



1	S Main nozzle	6	Needle valve	11	S Throttle valve	16	P Slow jet	21	P Main jet
2	S Small venturi	7	Float	12	Choke valve	17	Slow economizer	22	Idle limitter
3	S Main air bleed	8	S Emulsion tube	13	P Main air bleed	18	P Slow air bleed	23	Idle hole
4	S Slow jet	9	S Main jet	14	P Main nozzle	19	Air vent	24	P By-pass hole
5	S Slow air bleed	10	S By-pass hole	15	Economizer bleed	20	Level gauge	25	P Throttle valve

Fig. EF-16 Sectional view

≪ Model DCK306 Carburetor ≫



1	Air vent pipe	6	S Slow jet	11	S By-pass hole	16	P Main air bleed	21	P Main jet
2	S Small venturi	7	Needle valve	12	S Throttle valve	17	P Slow air bleed	22	P Main jet
3	S Main nozzle	8	Float	13	Choke valve	18	P Slow jet	23	Idle hole
4	S Main air bleed	9	S Emulsion tube	14	P Small venturi	19	Vacuum piston	24	P By-pass hole
5	S Slow air bleed	10	S Main jet	15	P Main nozzle	20	Power valve	25	P Throttle valve

Fig. EF-17 Sectional view

1. Primary system

1-1 Primary main system

≪ Model DAH342 & DAF328 Carburetors ≫

Fuel flows, as shown in Fig. EF-15 & 16, through the main jet, mixing with air which comes in from the main air bleed and passes through the emulsion tube, and is pulled out into the venturi through the main nozzle. The multi-holed main nozzle insures a proper atomization of fuel and a low fuel consumption.

≪ Model DCK306 Carburetor ≫

The primary main system is of Zenith Stronburg type. Fuel flows, as shown Fig. EF-17, through the main jet, mixing with air which comes in from the main air bleed and passes through the emulsion tube, and is pulled out into the venturi through the main nozzle.

1-2 Idling and slow system

≪ Model DAH342 & DCK306 Carburetors ≫

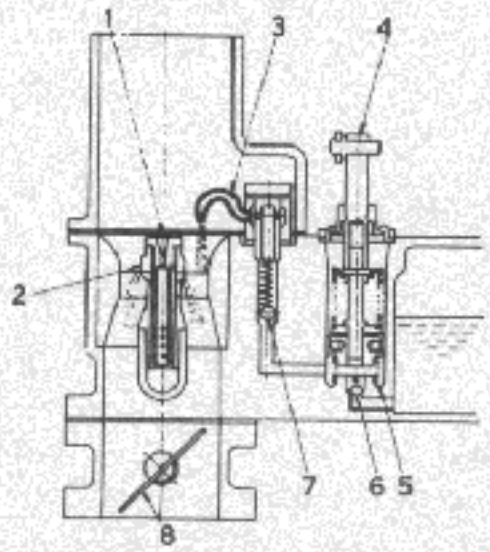
During low speed running, as Fig. EF-15 & 17 show, fuel flow through the slow jet located right behind the main jet, mixes with air coming from the slow air bleed, passing through the low speed passage and is pulled out into the engine through the idle hole and by-pass hole. The sinking type slow jet can eliminate operation troubles which may occur at sudden stops of the car.

≪ Model DAF328 Carburetor ≫

The throttle valve is opened at a small angle when idling and in slow speed running, with a large negative pressure prevailing down-stream of the fuel system. This negative pressure acts on the slow speed system equipped with a slow economizer. Through this action, fuel, measured through the jet section of the slow jet assembly located immediately behind the main jet shown in Fig. EF-16, and air coming from the economizer bleed, are mixed in the emulsion hole. This mixture is further mixed with air coming from the slow air bleed through the slow economizer and atomized. The atomized mixture is supplied to the engine from the idle hole and by-pass hole via the slow speed system line. As a result, there is an excellent linkage between the slow speed system and the main system, and the resultant stable slow speed performance is ensured.

1-3 Accelerating mechanism

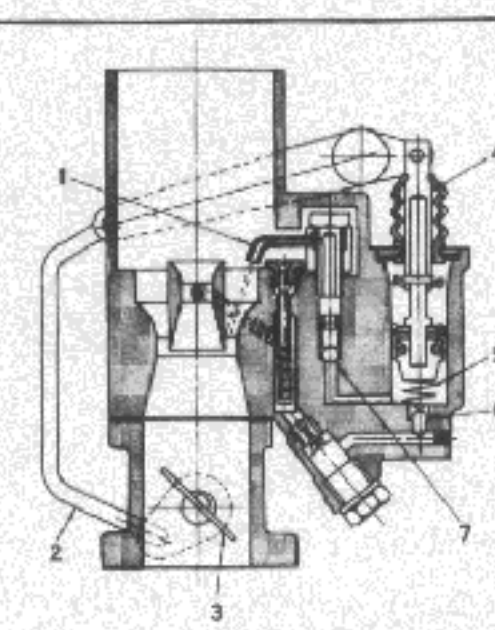
≪ Model DAH342 & DAF328 Carburetors ≫



1	Main air bleed	5	Piston return spring
2	Main nozzle	6	Inlet valve
3	Pump injector	7	Outlet valve
4	Piston	8	Throttle valve

Fig. EF-18 During accelerating

≪ Model DCK306 Carburetor ≫



1	Pump injector	5	Piston return spring
2	Pump connecting rod	6	Inlet valve
3	Throttle valve	7	Outlet valve
4	Piston		

Fig. EF-19 During accelerating

The carburetor is equipped with the piston type accelerating mechanism linked to the throttle valve. When the primary throttle valve, shown in Fig. EE-18 and 19, is closed, the piston goes up, and fuel flows from the

float chamber through the inlet valve into the space under the piston. When the throttle valve is opened, the piston goes down, opening the outlet valve, and fuel is forced out through the injector. The piston return spring in the cylinder not only assures the smooth movements of the linkage but also serves to place inlet valve in position so that the piston goes down quickly and fuel is forced out through the injector.

1-4 Starting mechanism

≪ Model DAF328 & DCK306 Carburetors ≫

Pull the choke button to close the choke valve fully, then start the engine. This provides a rich mixture, making it possible to start the engine quickly. When the engine is started, the choke valve is opened at an adequate angle automatically, which prevents overchoking and ensures a smooth engine performance. While the engine is being warmed up, it increases in speed at steps, and by releasing the choke button an optimum engine speed can be obtained. With the choke valve closed fully, the primary throttle valve is caused to open at an angle best suited for starting through a link mechanism.

≪ Model DAH342 Carburetor ≫
(equipped with Automatic Choke)

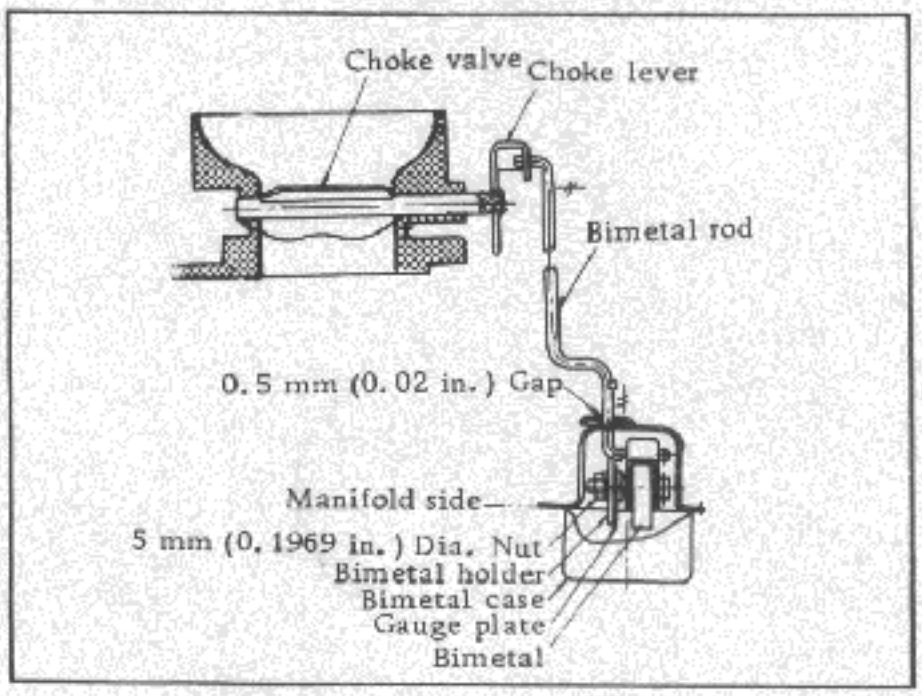


Fig. EF-20 Starting mechanism

The choke valve operating mechanism is an automatic choke of Well type, consisting of the bimetal mechanism (directly installed to the exhaust manifold) which cause the choke valve to function automatically, the diaphragm mechanism which open the choke valve after the engine starts and the fast idle mechanism which assures proper throttle valve opening and unloader mechanism.

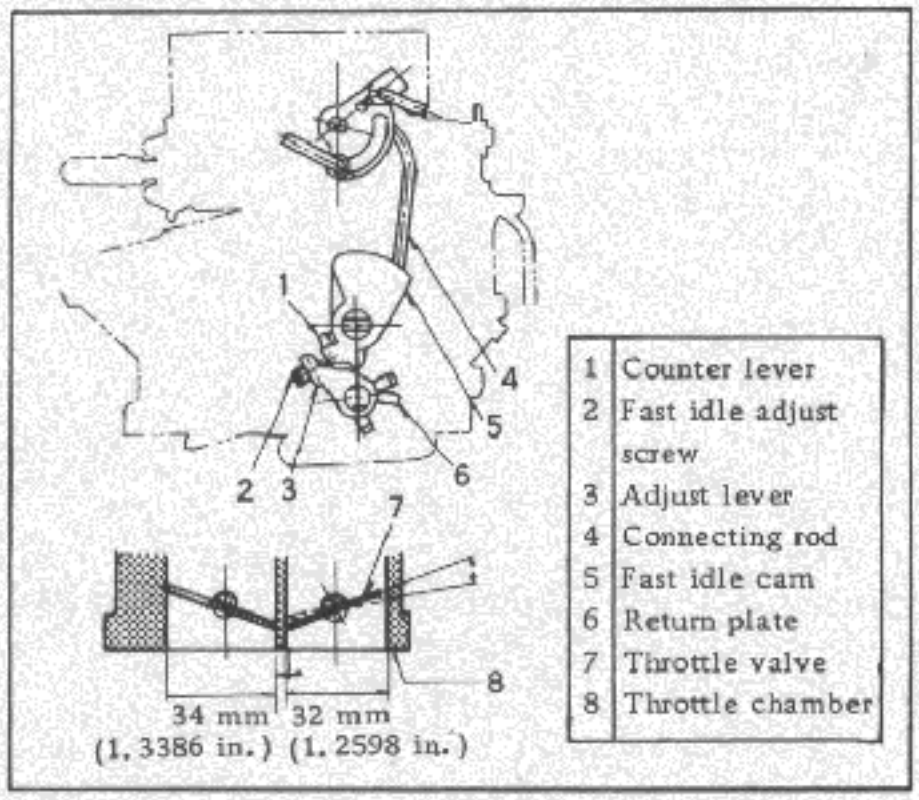


Fig. EF-21 Adjustment of starting interlock opening

(1) Before starting

As shown in Fig. EF-20, the choke valve is linked to the bimetal in the bimetal case by means of the choke lever and bimetal rod. The bimetal functions to insure proper choke valve openings under all conditions of temperature.

As Fig. EF-21 shows, the correct throttle valve opening for starting is given by the fast idle cam and link.

(2) Immediately after starting

When the engine starts, the vacuum created in the manifold pulls the diaphragm, permitting the choke valve to open against the bimetal spring, which prevents overchoke.

(3) Warming up

After the engine starts, the bimetal in the bimetal room warmed up by the heated exhaust air from the exhaust manifold causes the choke valve to open fully.

The choke valve is linked to the throttle valve by the link and the fast idle cam.

When the choke valve is opened 50°, the throttle valve opens until the correct opening for idle running is obtained.

(4) Unloader mechanism

This mechanism forcedly opens the choke vlave approximately 40° when the primary throttle valve is opened fully. It is effected even when the engine is cold by means of the unloader lever incorporated in the linkage and aids in facilitating acceleration.

1-5 Power valve mechanism

≪ Model DAH342 & DCK306 Carburetors ≫

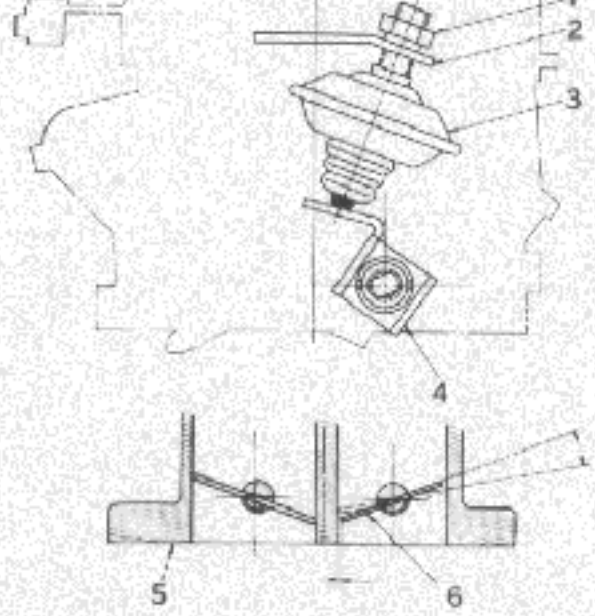
The power valve mechanism, so-called vacuum actuated boost type, makes use of the downward pulling force of the air stream below the throttle valve. When the throttle valve is slightly opened during light load running, a high vacuum is created in the intake manifold. This vacuum pulls the vaccum piston upward against the spring, leaving the power valve closed. When the vacuum below the throttle valve is lowered during full load or accelerating running, the spring pushes the vacuum piston downward, opening the power valve to furnish fuel.

1-6 Dash pot device

≪ only for Model DAF328 Carburetor equipped with Automatic Transmission ≫

This carburetor is equipped with a dash pot interlocked with the primary throttle valve through a link mechanism. The dash pot, which is exclusively installed on cars equipped with a torque converter, is intened to prevent engine stall that would otherwise result from quick application of the brake immediately after the car ran, or from the quick release of the accelerator pedal after giving only small pressure.

When the primary throttle valve is closed near full angle (1, 800 to 2, 000 r.p.m. in engine speed), a throttle lever strikes the dash pot stem shown in Fig. EF-22, making the primary throttle valve gradually open, and keeping the engine running.



1.	Lock nut	4.	Throttle lever
2.	Chok wire arm	5.	Throttle chamber
3.	Dash pot	6.	Throttle valve

Fig. EF-22 Dash pot mechanism

2. Secondary system

2-1 Secondary main system

≪ Model DAH342 & DAF328 Carburetors ≫

The secondary main system is of Zenith Strongburg type.

Fuel-air mixture produced by the functions of the main jet, main air bleed and emulsion tube, in the same manner as in the primary system, is pulled out through the main nozzle into the small venturi.

Due to the double venturi of the secondary system, the higher velocity air current passing through the main nozzle promotes the fuel atomization.

≪ Model DCK306 Carburetor ≫

The structure is almost same as the primary side, but emulsion tube and venturi are different. Take care not to assemble improperly.

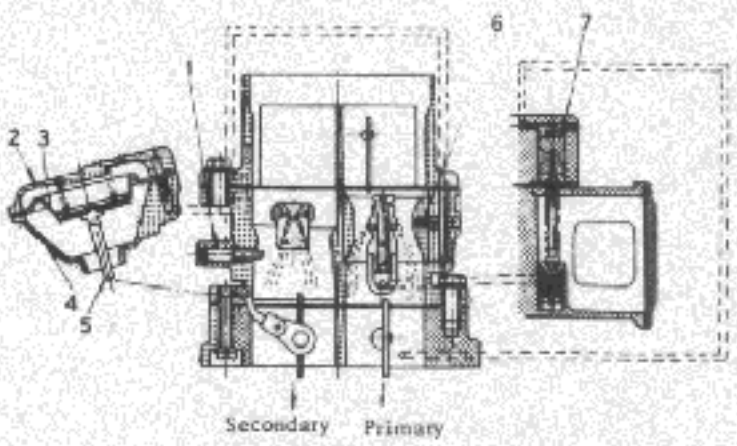
2-2 Step system

The construction of this system may correspond to the idling and slow system of the primary system.

This system aims in the proper filling up of the gap when fuel supply is transferred from the primary system to the secondary one. The step port is located near the secondary throttle valve in its fully closed state.

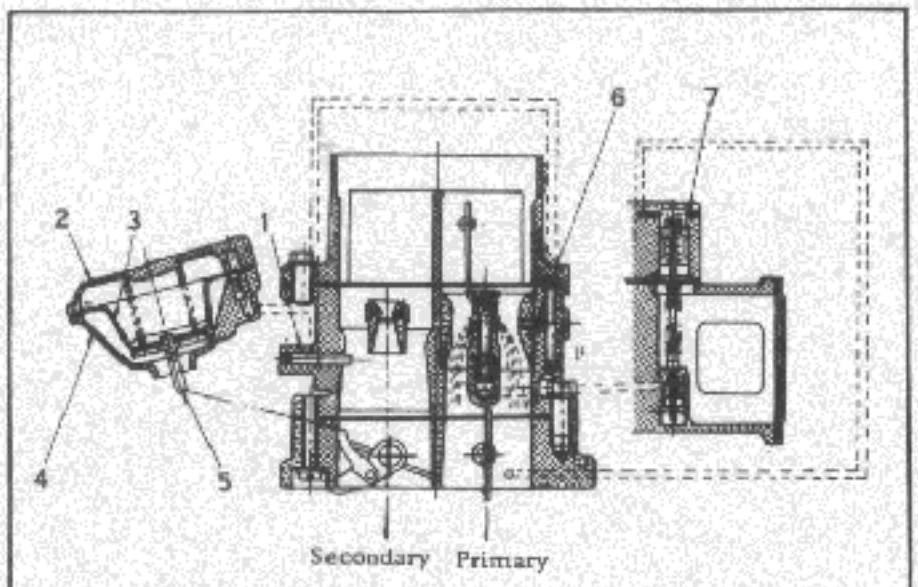
2-3 Secondary switch over mechanism

≪ Model DAH342 & DAF328 Carburetors ≫



1	S Vacuum jet	4	Diaphragm chamber
2	Diaphragm chamber cover	5	Diaphragm rod
3	Diaphragm	6	P Vacuum jet
		7	Vacuum piston

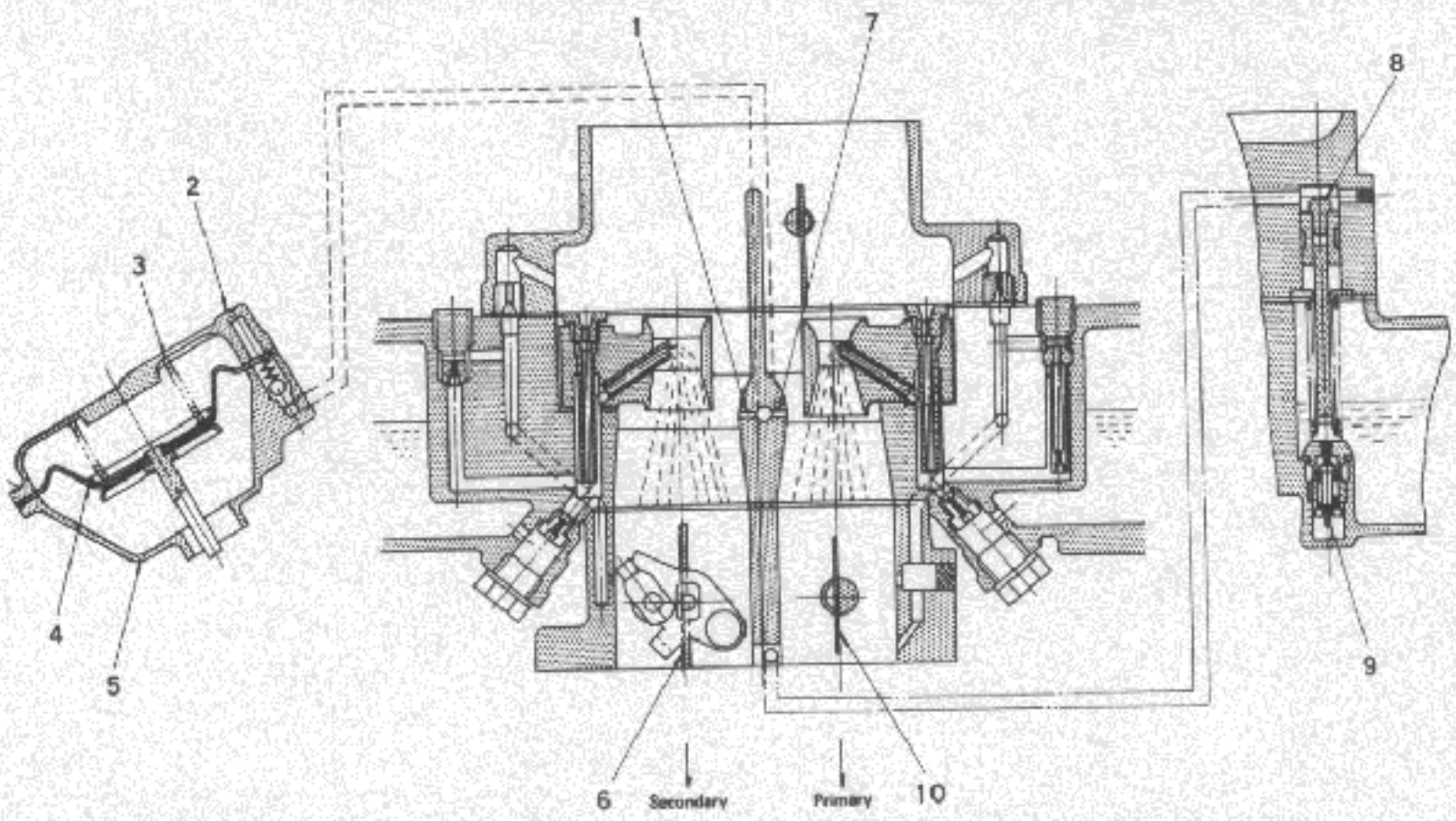
Fig. EF-23 Full throttle at high speed



1.	S Vacuum jet	3.	Diaphragm	5.	Diaphragm rod
2.	Diaphragm chamber cover	4.	Diaphragm chamber	6.	Vacuum jet
				7.	Vacuum piston

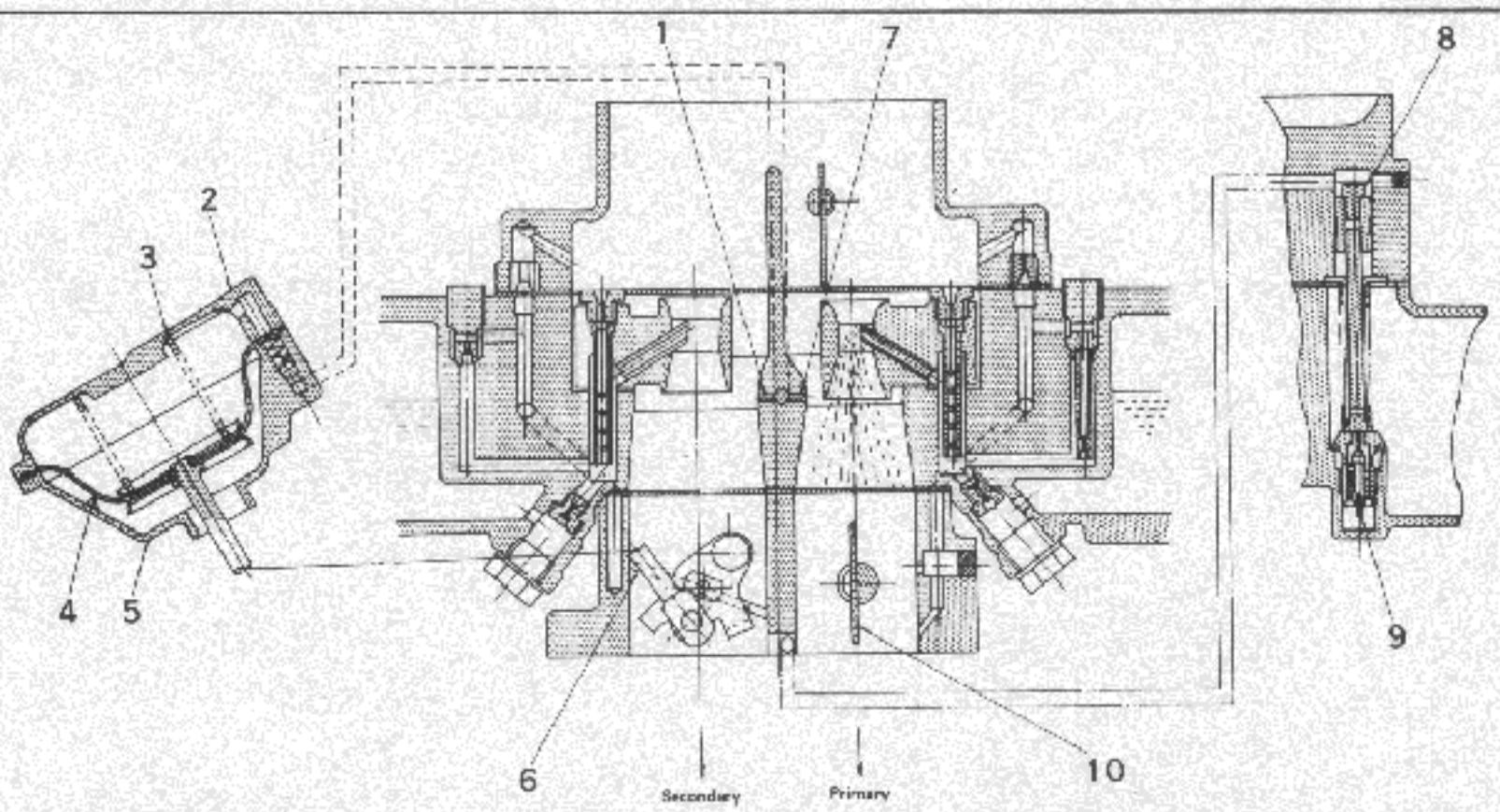
Fig. EF-24 Full throttle at low speed

≪ Model DCK306 Carburetor ≫



1.	S Vacuum jet	4.	Diaphragm	7.	P Vacuum jet	10.	P Throttle valve
2.	Diaphragm chamber cover	5.	Diaphragm chamber	8.	Vacuum piston		
3.	Diaphragm spring	6.	S Throttle valve	9.	Power valve		

Fig. EF-25 Full throttle at high speed



1.	S Vacuum jet	4.	Diaphragm	7.	P Vacuum jet	10.	P Throttle valve
2.	Diaphragm chamber cover	5.	Diaphragm chamber	8.	Vacuum piston		
3.	Diaphragm spring	6.	S Throttle valve	9.	Power valve		

Fig. EF-26 Full throttle at low speed

The secondary throttle valve is linked to the diaphragm which is actuated by the vacuum created in the venturi. A vacuum jet is provided at each of the primary and secondary venturies, and the composite vacuum of these jets actuates the diaphragm.

As the linkage, shown in Fig. EF-24 & 26, causes the secondary throttle valve not to open until the primary throttle valve opening reaches approximately 50° (as for DAF328, 59°; as for DCK306, 56°), fuel consumption during normal operation is not excessive.

During high speed running, as shown in Fig. EF-23 & 25, as the vacuum at the venturi is increased, the diaphragm is pulled against the diaphragm spring force, and then secondary throttle valve is opened.

The atmospheric side in the diaphragm chamber is connected to the atmosphere.

3. Float system

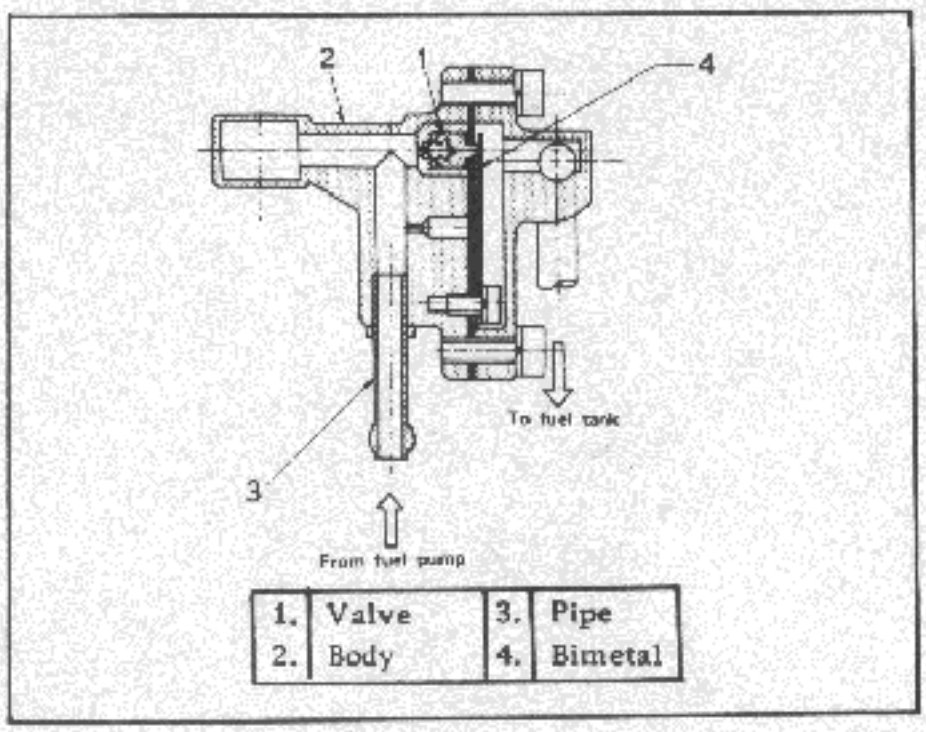
There is only one float chamber while two carburetor systems, primary and secondary, are provided.

Fuel fed from the fuel pump flows through the filter and needle valve into the float chamber. A constant fuel level is maintained by the float and needle valve.

Because of the air vent type of the float chamber ventilation, the fuel consumption will not influenced by some dirt accumulated in the air cleaner.

The needle valve is made of special hard steel and will not wear for all its considerably long use.

4. Fuel return system



1.	Valve	3.	Pipe
2.	Body	4.	Bimetal

Fig. EF-27 Fuel return system

This device is intened to prevent vapor lock or percolation and to ensure a constantly stable

idling in a hot engine compartment. As shown in Fig. EF-27, it consists of a body, pipe, bimetal and valve. The conventional system is employed up to the point where fuel delivered by the fuel pump is supplied to the float chamber in the carburetor. The extra feature is that, when the engine compartment reaches a certain high temperature level, the resultant displacement of the bimetal causes the valve to open, returning most of the fuel supplied for slow speed operation to the fuel tank.

Preferably, do not dismantle this device unless necessary. And, always leave the bimetal intact.

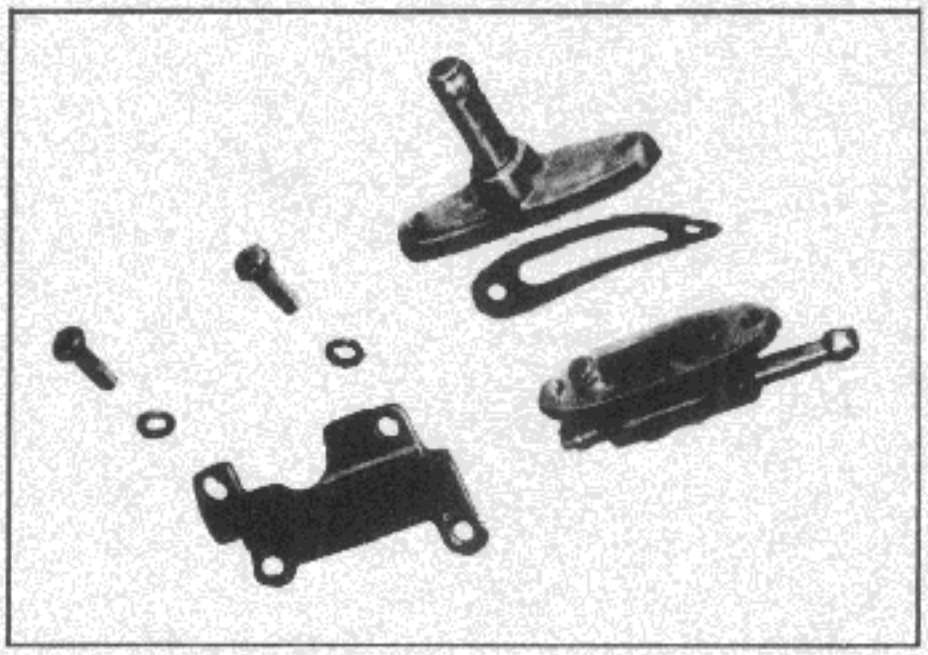


Fig. EF-28 Disassembly (DAH342)

ADJUSTMENT

1. Idling adjustment

Idling adjustment is made by the throttle adjust screw and idle adjust screw as shown in Fig. EF-29.

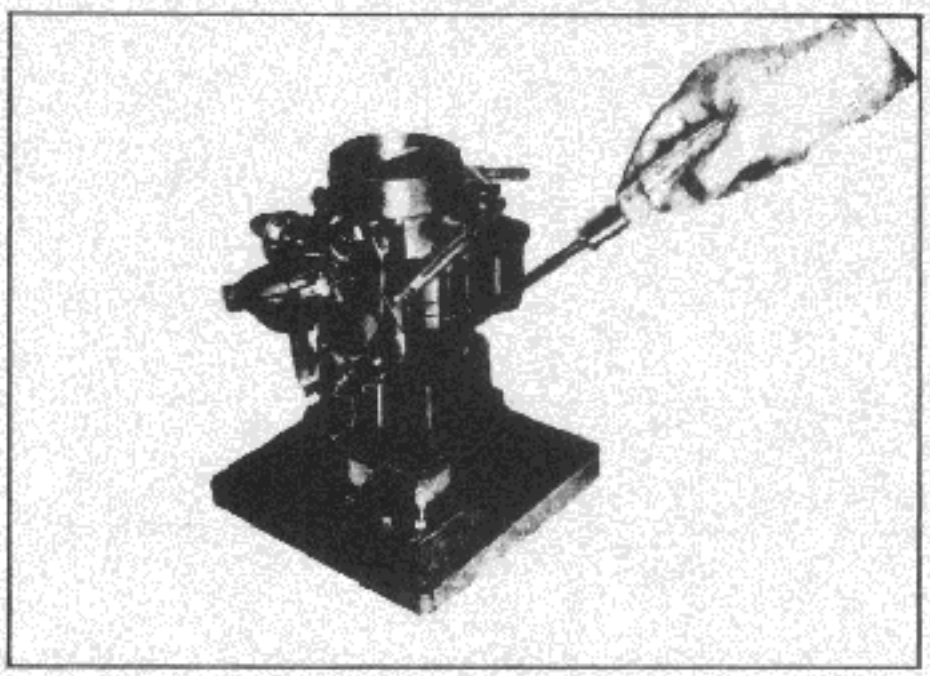


Fig. EF-29 Idling adjustment

(1) Give the idle adjust screw approximately three turns, starting from the fully closed position. Screw in the throttle adjust screw two or three turns and start the engine.

(2) Screw out the throttle adjust screw gently until the engine is about to rotate unevenly after the engine speed gradually drops.

(3) Screw in the idle adjust screw until the engine runs smoothly at the highest speed.

(4) Re-adjust the throttle screw to drop the engine speed.

Repeat these operations until a smooth engine speed of approximately 550 r.p.m. has been attained.

Note: **Do not attempt to screw down the idle adjust screw completely to avoid damage to the tip, which will tend to cause malfunctions.**

2. Fuel level adjustment

A constant fuel level is maintained by the float and needle valve.

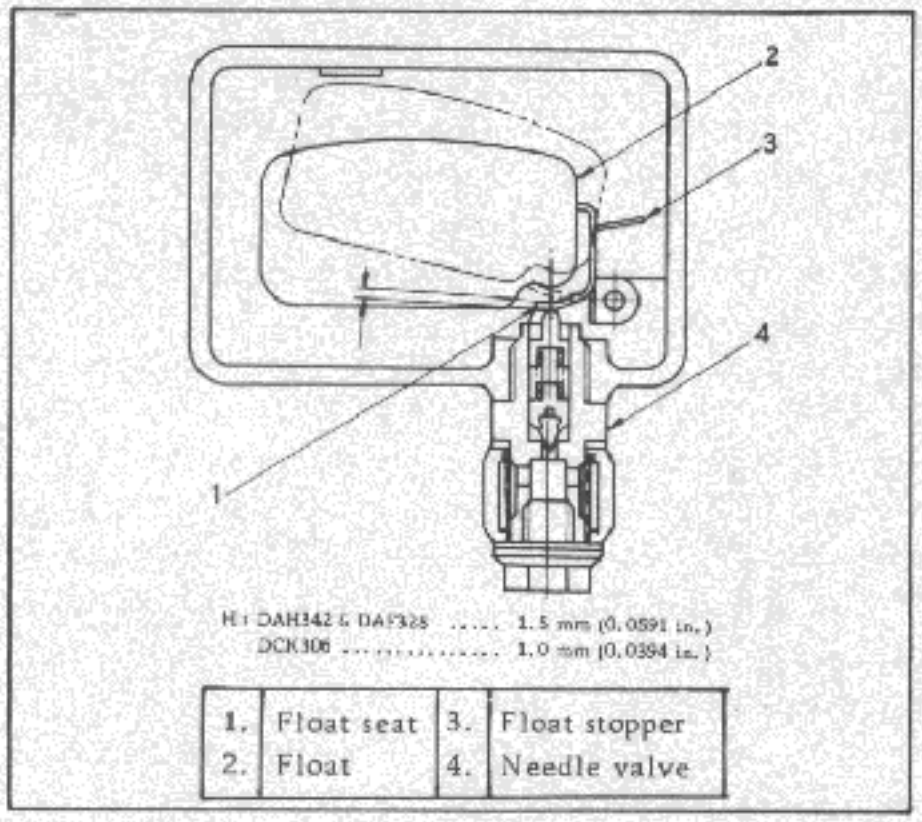


Fig. EF-30 Fuel level adjustment

If the fuel level is in accord with the level gauge line, the float level is properly set. If the float level is not correct, adjust it by bending the float seat as shown in Fig. EF-30.

Approximately *H mm is required as the effective stroke of the needle valve. So adjust the gap between the valve stem and the float

seat to *H mm with the float fully lifted up by bending the float stopper.

*H : Model DAH342 & DAF328 carburetors ... 1.5 mm (0.00591 in.)
Model DCK306 carburetor .... 1.0 mm (0.0394 in.)

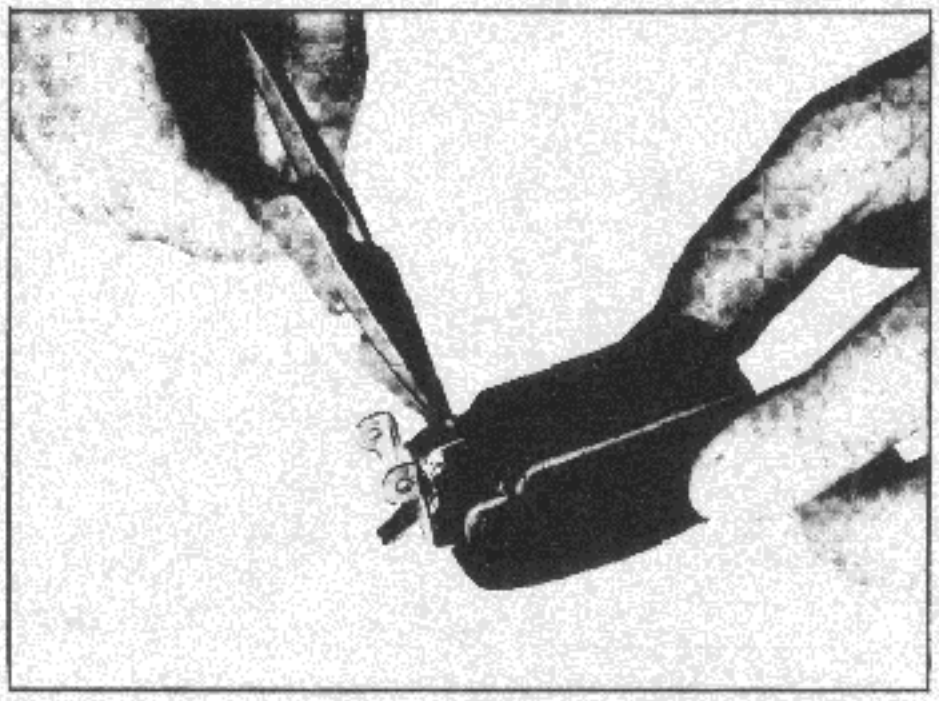


Fig. EF-31 Adjustment of float seat (DAH342)

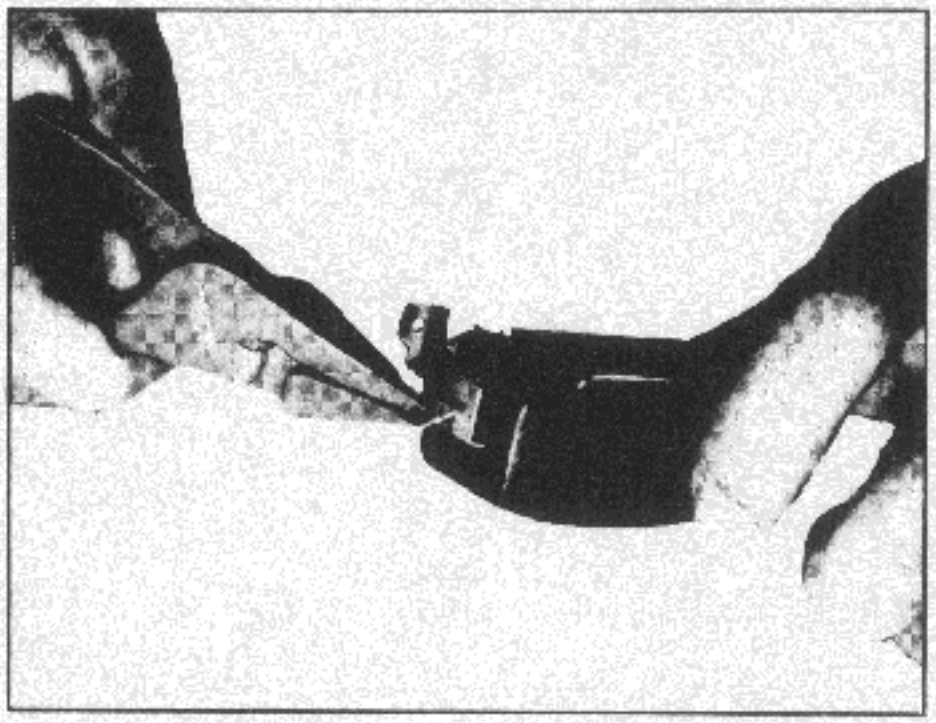


Fig. EF-32 Adjustment of float stopper (DAH342)

3. Starting adjustment

≪ Model DAH342 Carburetor ≫
(only for the carburetor equipped with Auto-Choke)

(1) Method

The choke valve operating mechanism of auto-choke type can make the engine start easily by only turning the key. However, it is necessary to step down the accelerator pedal first and then release it before switching on.

(2) Fast idle adjustment

When the choke valve is completely closed, the fast idle cam causes the throttle valve opening to be suitable for starting. It is correct if the throttle valve opens 11°. This checking can be done by measuring A in Fig. EF-21. The specified clearance is 0.77 mm (0.0303 in.). If necessary, adjust it by screwing the fast idle adjust screw.

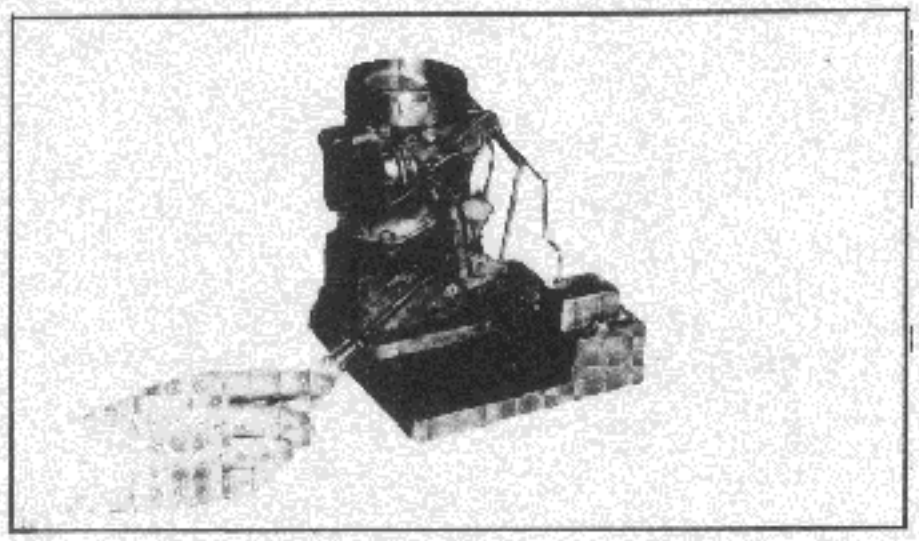
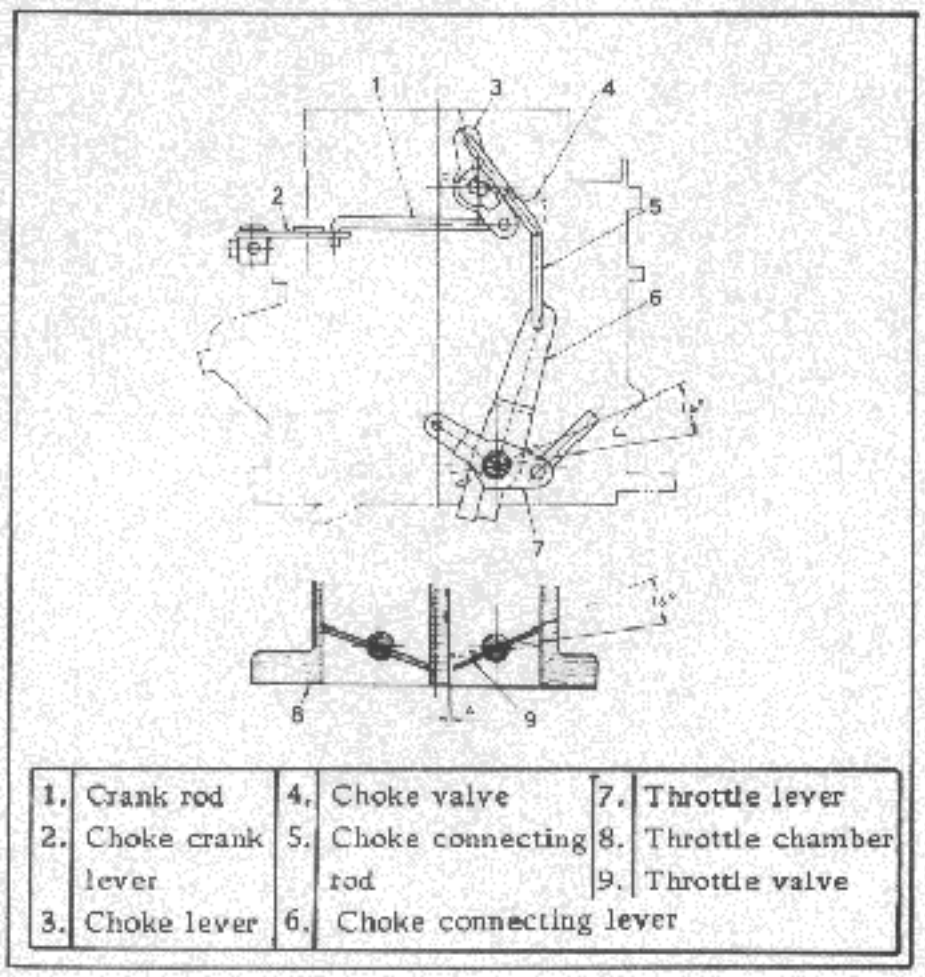


Fig. EF-33 Fast idle adjustment

4. Adjustment of starting interlock valve opening

≪ Model DAF328 & DCK306 Carburetors ≫

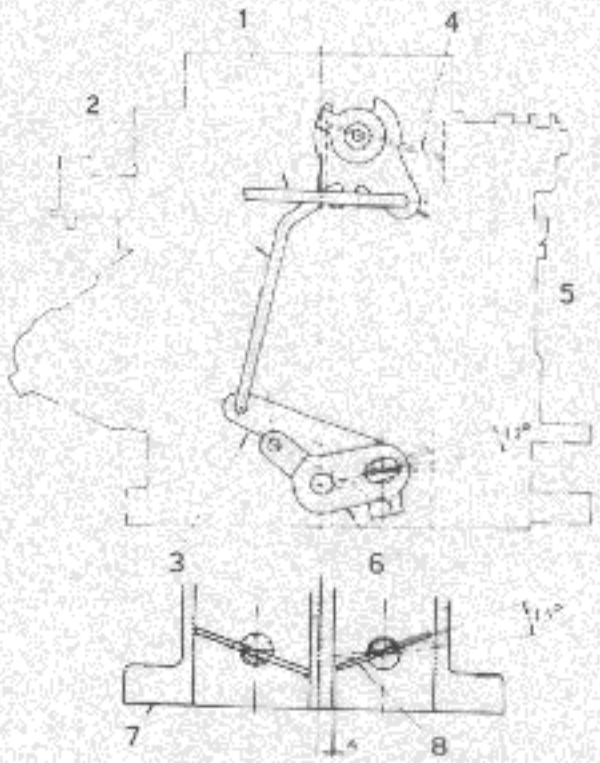
≪ Model DAF328 Carburetor ≫



1.	Crank rod	4.	Choke valve	7.	Throttle lever
2.	Choke crank lever	5.	Choke connecting rod	8.	Throttle chamber
3.	Choke lever	6.	Choke connecting lever	9.	Throttle valve

Fig. EF-34 Adjustment of starting interlock valve opening

≪ Model DCK306 Carburetor ≫



1	Choke crank rod	5	Choke lever
2	Choke connecting rod	6	Fast idle connecting lever
3	Starting lever	7	Throttle chamber
4	Choke valve	8	Throttle valve

Fig. EF-35 Adjustment of starting interlock opening

The choke valve at a full close position automatically opens the throttle valve at an optimum angle (as for DAF328, approximately 16°; as for DCK306, approximately 15°) for starting the engine through a link mechanism. After reassembly, or in a check on the interlocked opening angle, bend the choke connecting rod for adjustment so that a fully closed choke valve will bring the clearance A shown in Fig. EF-34 to 1.3 mm (0.0512 in.) [(as for DCK306, in Fig. EF-35 to 0.72 mm (0.0283 in.)].

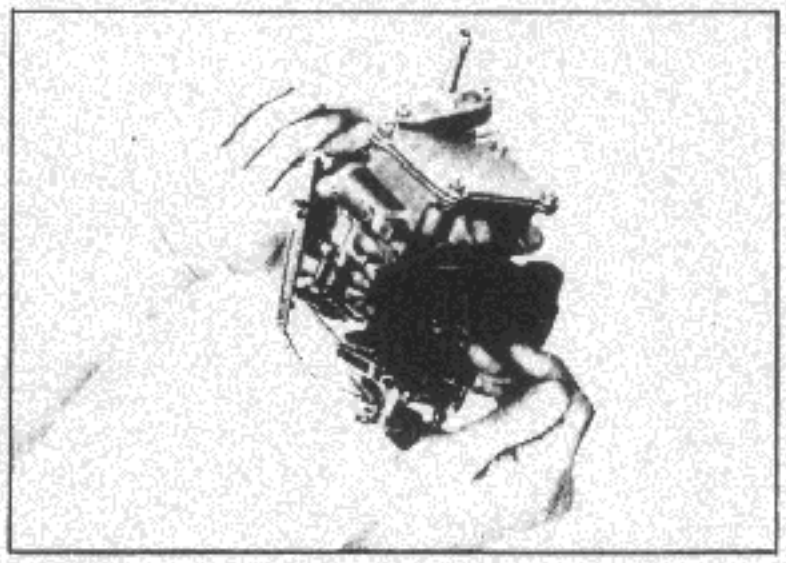
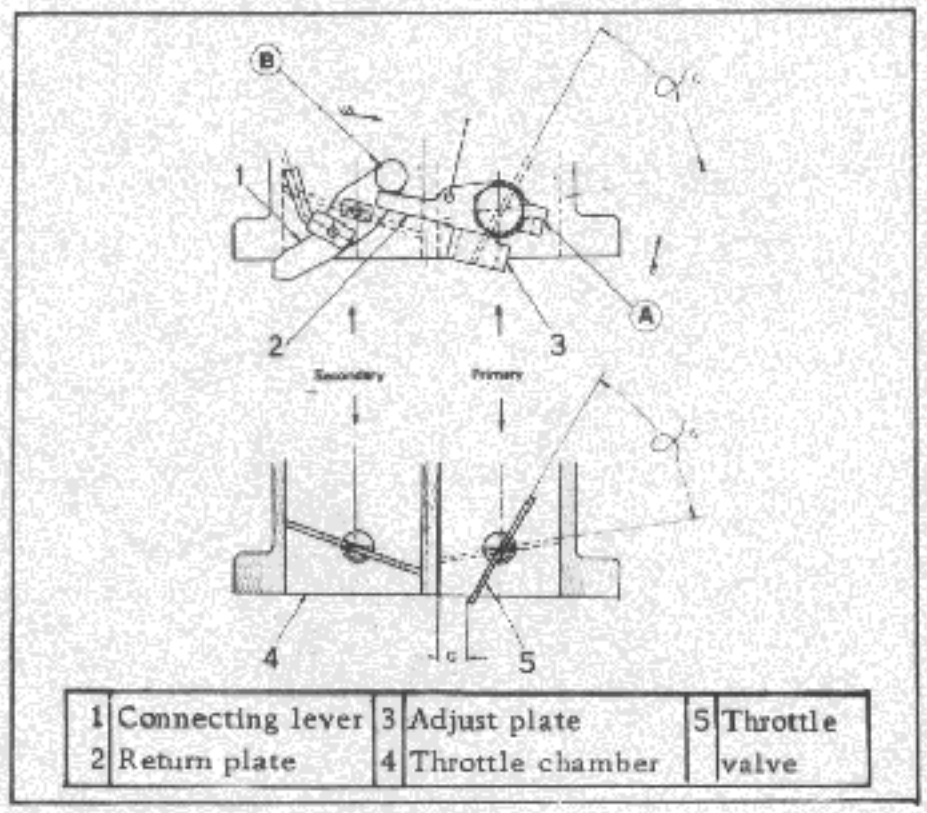


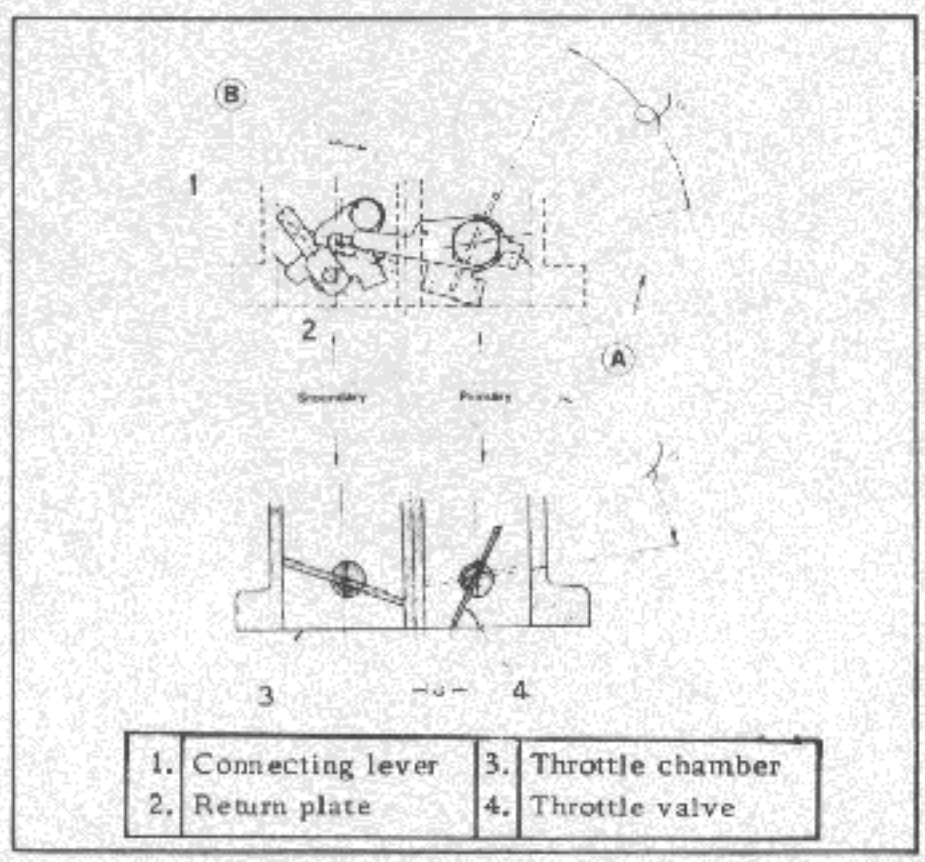
Fig. EF-36 Measurement of clearance of starting interlock valve opening (DAH342)

5. Adjustment of interlock opening of primary and secondary throttle valves



1	Connecting lever	3	Adjust plate	5	Throttle valve
2	Return plate	4	Throttle chamber		

Fig. EF-37 Model DAH342 & DAF328 carburetors



1.	Connecting lever	3.	Throttle chamber
2.	Return plate	4.	Throttle valve

Fig. EF-38 Model DCK306 carburetor

Fig. EF-37 & 38 show the primary throttle valve opened *α°. When the adjust plate fixed to the primary throttle valve is open *α°, it comes to contact with the connecting lever at Ⓐ. When the throttle valve is further opened, the point Ⓑ, where the connecting lever is in contact with the stopper, is detached, permitting the secondary system to start actuating.

The linkage between the primary and secondary throttles operates properly if the

distance between the throttle valve and inner wall of the throttle chamber, G, amounts to specifications as shown below. The adjustment is made by bending the point Ⓐ of the adjusting plate.

*α : Model DAH342 carburetor ..... 50°
Model DAF328 carburetor ..... 59°
Model DCK306 carburetor ..... 56°

G : Model DAH342
carburetor ..... 6.95 to 8.40 mm
(0.2736 to 0.3307 in.)
Model DAF328
carburetor ..... 9.10 mm
(0.3583 in.)
Model DCK306
carburetor ..... 6.40 mm
(0.2520 in.)

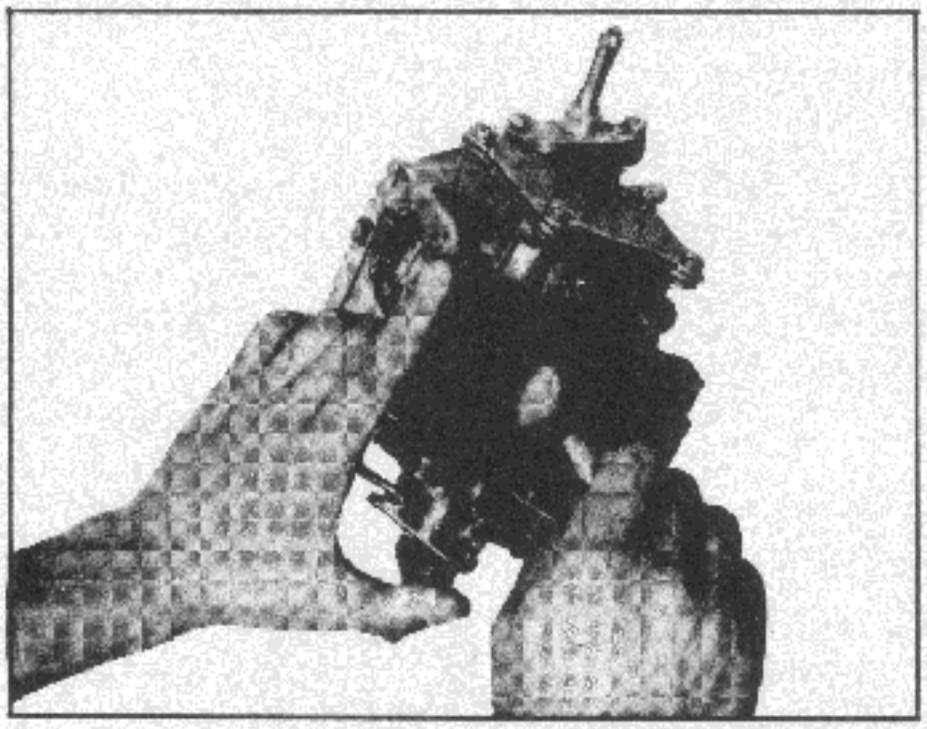


Fig. EF-39 Measurement of clearance

6. Adjustment of dash pot

≪only for Model DAF328 carburetor equipped with Automatic Transmission≫

The adjustment of the dash pot can be done by warming up the engine properly and checking if the throttle lever will touch the dash pot stem shown in Fig. EF-22 as the engine reaches between 1,800 and 2,000 r.p.m. under no load. Proper contact between the throttle lever and the dash pot stem produces a normal dash pot performance. Should no normal increase in engine speed be obtainable, loosen the lock nuts, rotate the dash pot right and left, and adjust it so that the throttle lever will hit the stem at between 1,800 and 2,000 r.p.m. Then, fasten the loosened lock nuts. Note that the clearance G2 between the throttle valve and the throttle chamber wall at this time should be about 0.8 mm (0.0709 in.) (10° in throttle valve angle).

MAJOR SERVICE OPERATIONS

The perfect carburetor delivers the proper gasoline and air ratios for all speeds of the particular engine for which it was designed. By completely disassembling at regular intervals, which will allow cleaning of all parts and passages, the carburetor can be returned to its original condition and it will then deliver the proper ratios as it did when new.

Accurate calibration of passages and discharge holes, require that extreme care be taken in cleaning. Use only carburetor solvent and compressed air to clean all passages and passage discharge holes. Never use wire or other pointed instrument to clean as calibration of carburetor will be affected.

1. Removal

(1) Remove air cleaner.

(2) Disconnect fuel line vacuum line and choke wire (in case of Auto-Choke, choke heat) from carburetor.

(3) Remove the throttle lever.

(4) Remove four nuts and washers retaining carburetor to manifold.

(5) Lift carburetor off manifold.

(6) Remove and discard carburetor to manifold gasket.

2. Disassembly

(1) The main jets, slow jets and needle valves on both primary and secondary sides are accessible from outside the carburetor for disassembly.

(2) The choke chamber can be detached by removing the connecting rod, pump connecting rod, return spring, stop pin and four set screws that hold it.

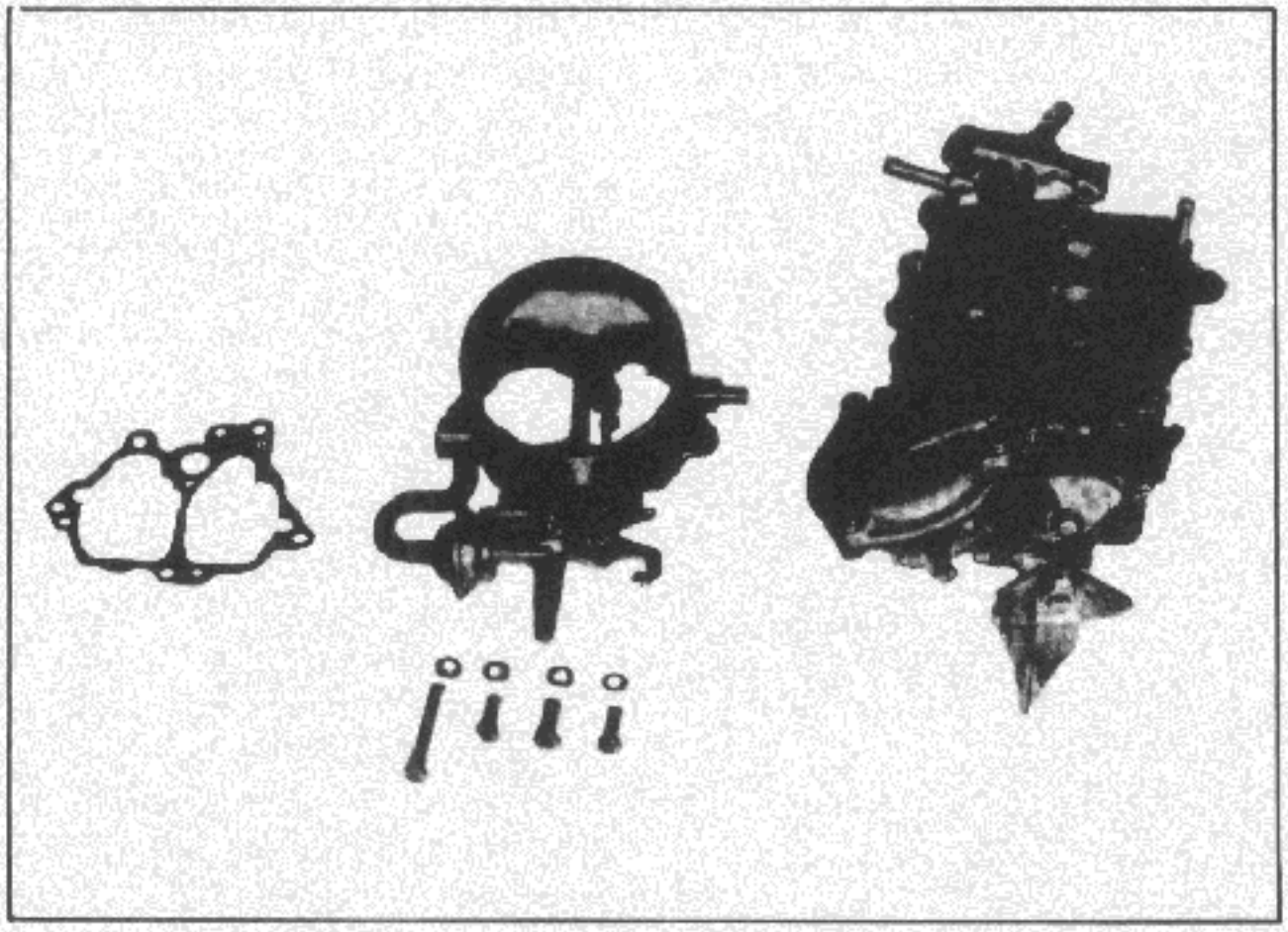


Fig. EF-40 DAH342

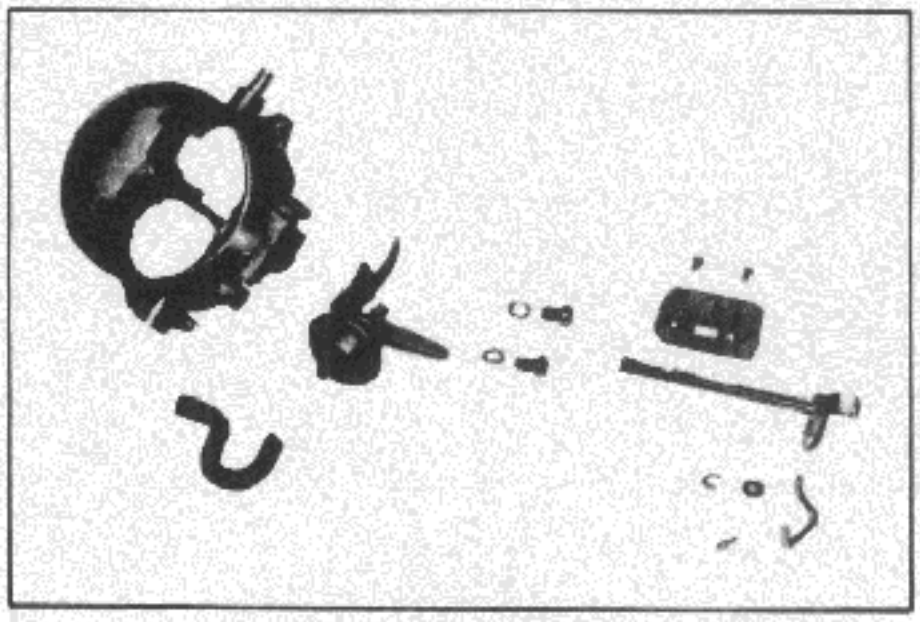


Fig. EF-41 DAH342

(3) The primary and secondary emulsion tubes can be disassembled for a check by removing the main air bleeds on the respective sides.

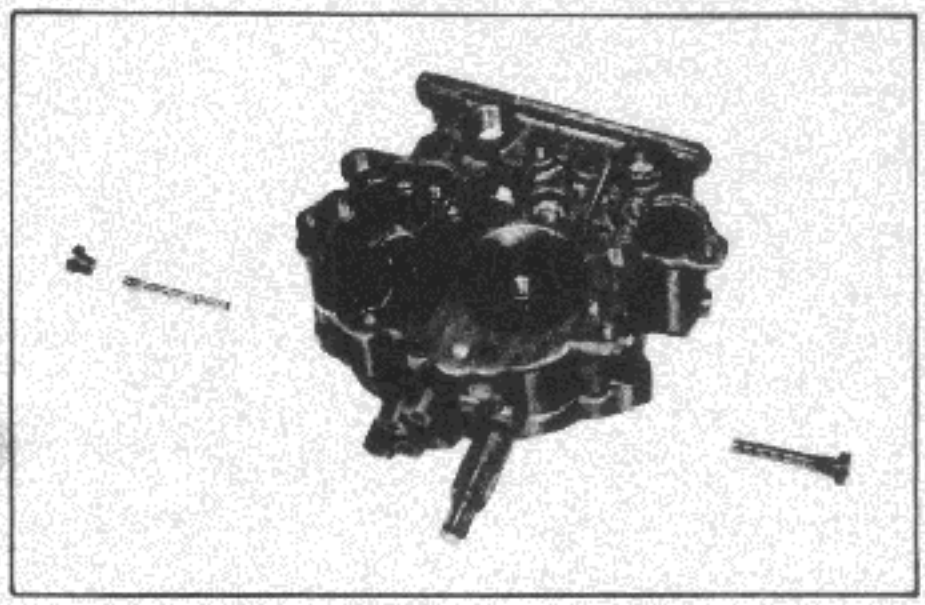


Fig. EF-42 DAH342

(4) To check the accelerator pump, the cylinder cover is removed. Be careful not to lose the return spring and inlet valve provided at the lower part of the piston during the disassembling operation.

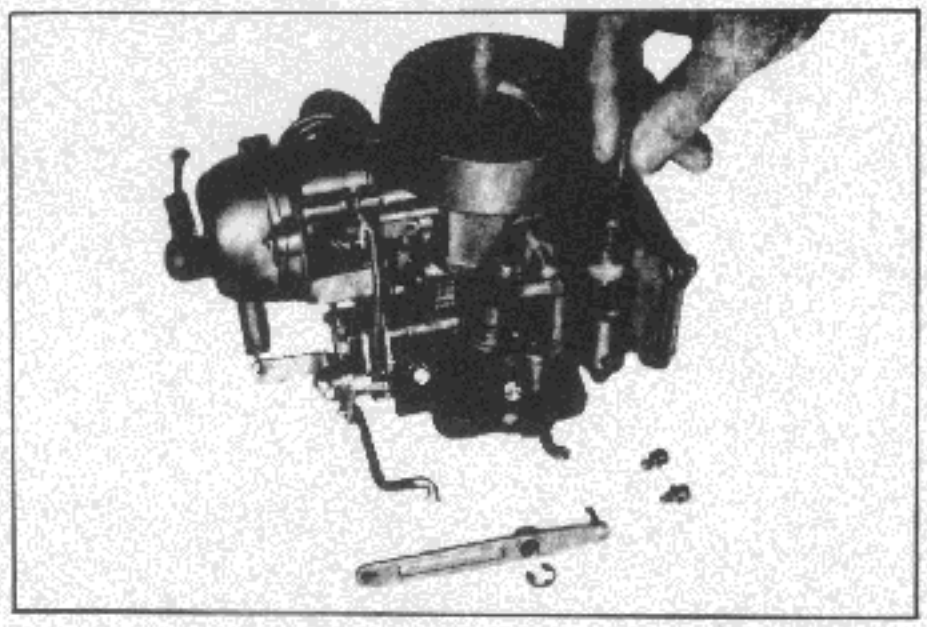


Fig. EF-43 DAH342

(5) The throttle chamber can be detached from the float chamber by removing the rod linking the diaphragm with the secondary throttle valve, and four set screws that hold it.

It is preferable to leave the throttle valve intact unless otherwise required. If a disassembled valve is required to remedy a defect, it should be installed so that the secondary throttle valve particularly will be gap-free. Otherwise, stable idling and slow speed performance will not be obtained.

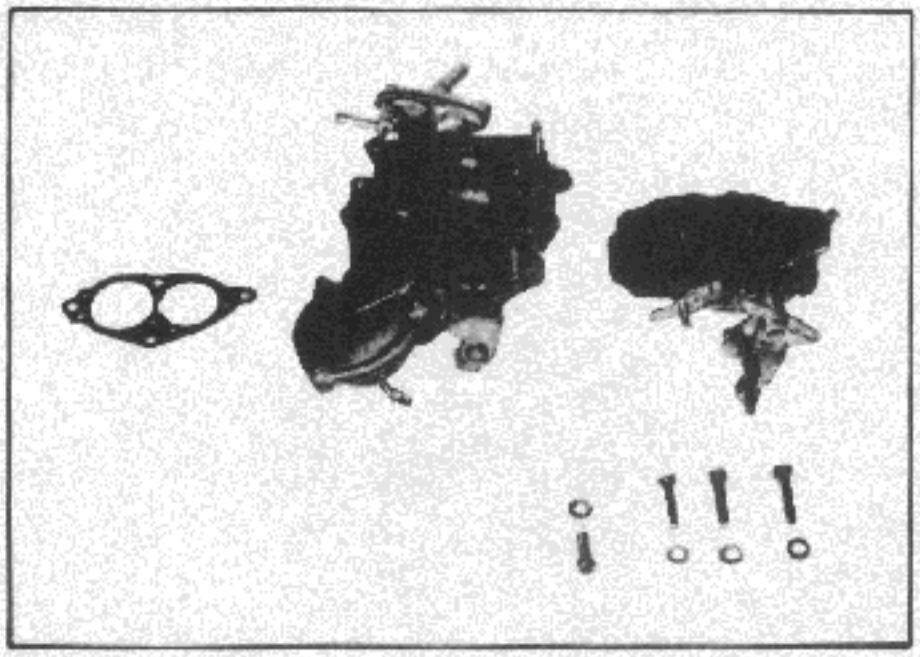


Fig. EF-44 DAH342

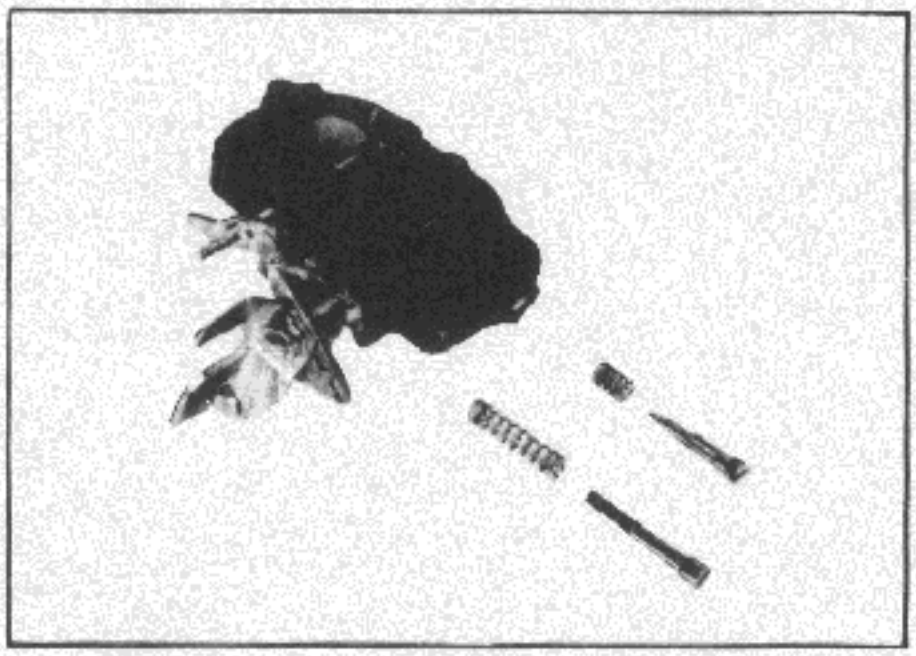


Fig. EF-45 DAH342

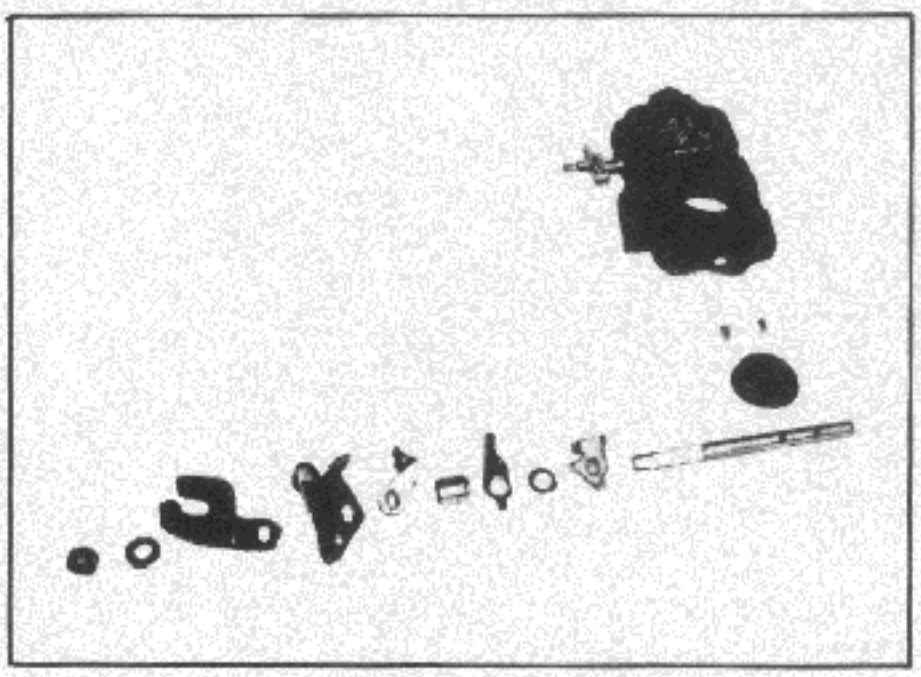


Fig. EF-46 DAH342

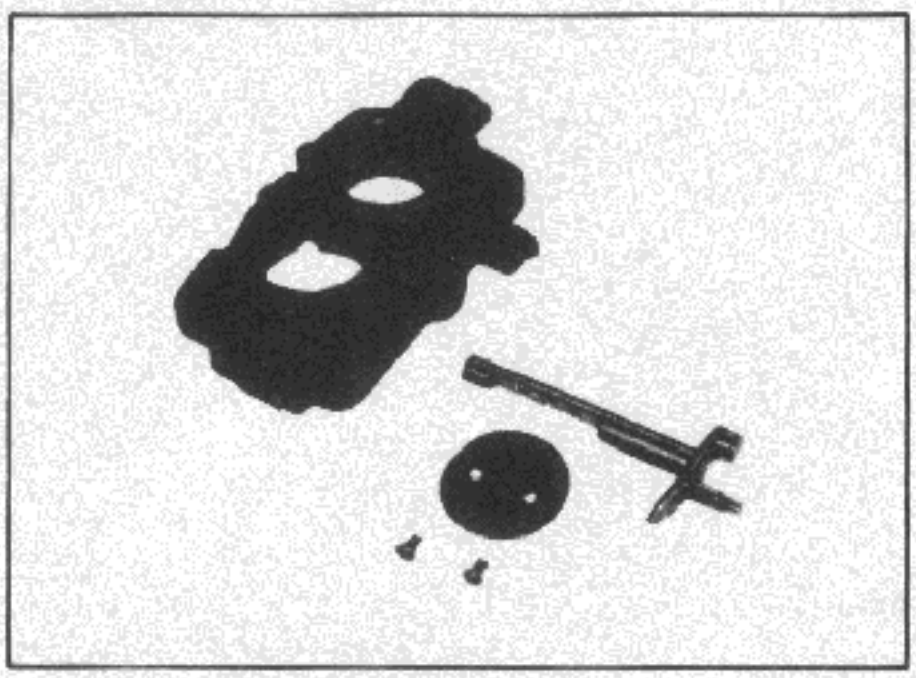


Fig. EF-47 DAH342

(6) To check the float, the float chamber cover is removed as instructed in a separate paragraph.

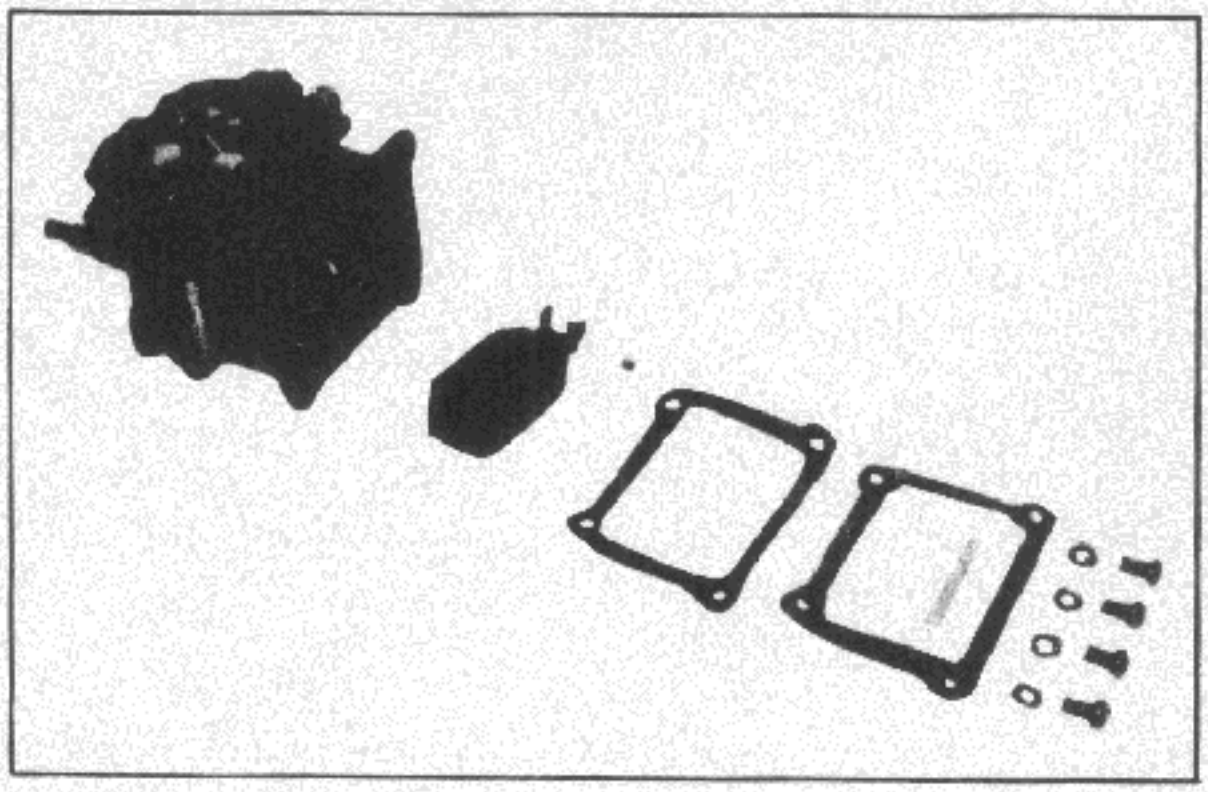


Fig. EF-48 DAH342

(7) The diaphragm can be disassembled by removing three set screws that hold the diaphragm chamber and another three set screws that hold the diaphragm chamber cover. In reassembling it, take care so that the edge of the diaphragm will not be turned up.

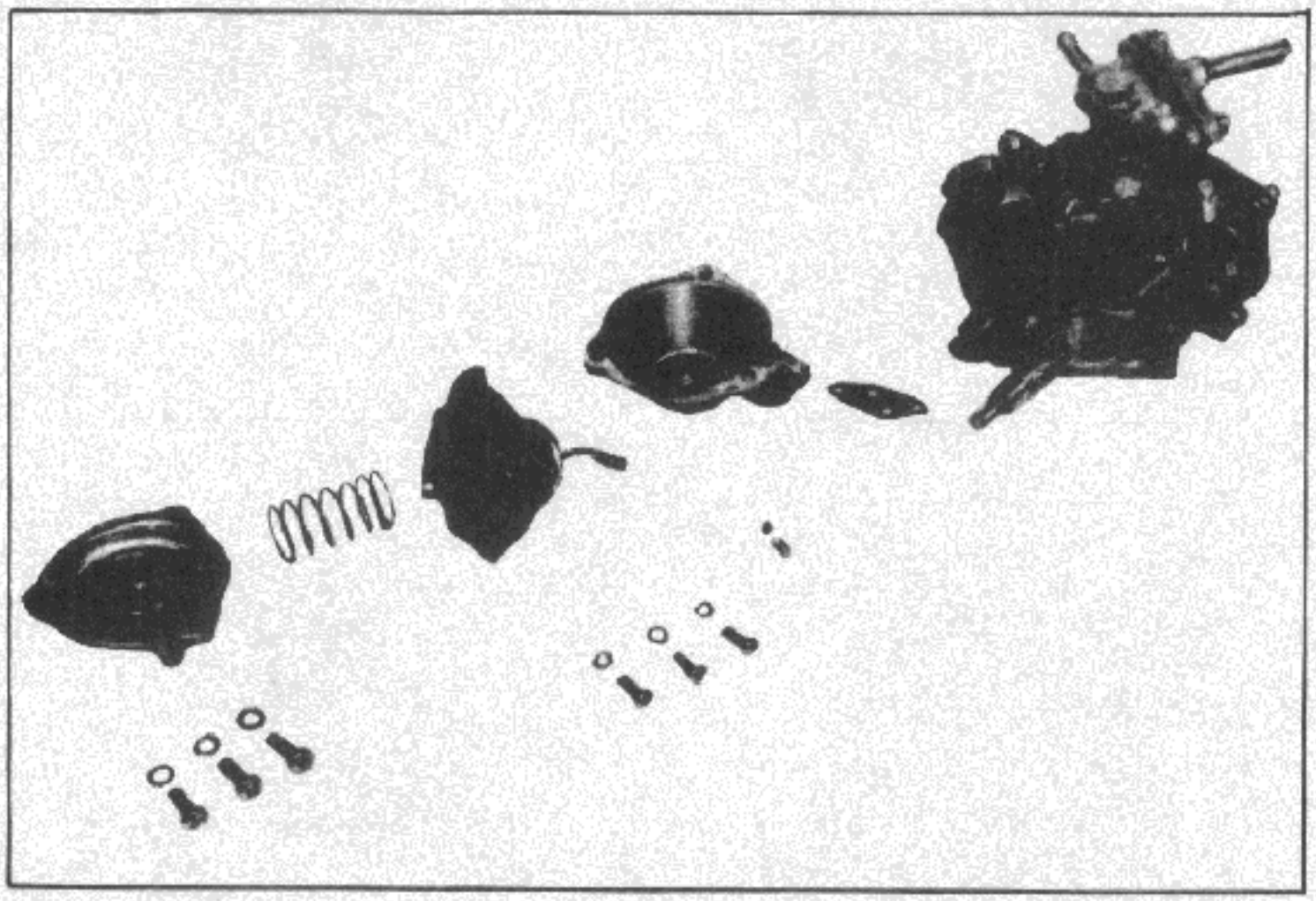


Fig. EF-49 DAH342

(8) In disassembling and reassembling the interlocking links, take care so that each linkage has a smooth action, and that it is not fitted in any forced position.

3. Disassembly and assembly of auto-choke

(only for the carburetor equipped with auto-choke)

(1) Remove bimetal case by releasing the two set screws.

(2) Since bimetal in the bimetal case is an important part with its sensitive performance, do not attempt to move it by force. Any improper handling may cause permanent distortion of bimetal.

(3) In assembling, place thermostat cover gasket gently and install thermostat cover after having been sure that the lever on which bimetal hangs moves smoothly.

(4) Make sure that bimetal in bimetal case hangs on lever.

(5) After tightening completely, bend and adjust bimetal rod so that the upside of bimetal case is level with the underside of a slit of 0.5 mm (0.02 in.) with on bimetal rod.

(6) Be sure that bimetal rod operates smoothly.

(7) To determine the opening, move diaphragm rod to the left ($\ell = 0$) as shown in Fig. EF-50, and adjust choke valve opening then (Re) to 1.8 mm (0.0709 in.) by bending connecting rod.

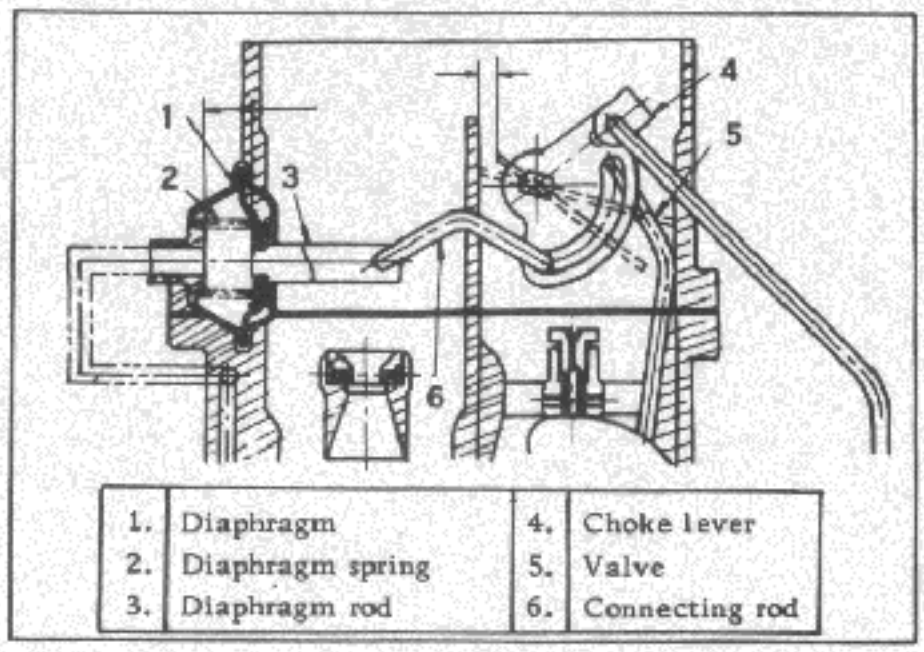


Fig. EF-50 Adjustment of opening where the engine starts firing

4. Cleaning and inspection

Dirt, gum, water or carbon contamination in or on the exterior moving parts of a carburetor are often responsible for unsatisfactory performance. For this reason, efficient carburetion depends upon careful cleaning and inspection while servicing.

(1) Blow all passages and castings with compressed air and blow off all parts until dry.

Note: Do not pass drills or wires through calibrated jets or passages as this may enlarge orifice and seriously affect carburetor calibration!

(2) Check all parts for wear. If wear is noted defective parts must be replaced. Note especially the following:

(a) Check float needle and seat for wear. If wear is noted the assembly must be replaced.

(b) Check throttle and choke shaft bores in throttle body and cover castings for wear or out of round.

(c) Inspect idle adjusting needles for burrs or ridges. Such a condition requires replacement.

(3) Inspect gaskets to see if they appear hard or brittle or if the edges are torn or distorted. If any such condition is noted they must be replaced.

(4) Check filter screen for dirt or lint. Clean and if it is distorted or remains plugged, replace.

(5) Check venturi clusters for loose or worn parts. If damage or looseness exists, replace cluster assembly.

(6) Check the linkage for operating condition.

(7) Inspect the operation of accelerating pump.

Put in the gasoline in the float chamber and make the throttle lever operate. And the check the injection condition of the gasoline from the accelerating nozzle.

(8) Push in the connecting rod of diaphragm chamber and block the passage of vacuum by finger. And when free the connecting rod, check the leakage of air and the damage of diaphragm.

5. Assembly and installation

Follow the disassembly and removal procedure in reverse.

Replace the gaskets, if necessary.

In disassembling and reassembling the interlock link and related components, be careful not to bend or deform any of the components. Reassemble so that all interlock links operate smoothly.

JETS

The carburetor performance depends on jets and air bleeds. That is why these components are fabricated with utmost care. To clean them, use gasoline and blow air on them. Larger numbers stamped on the jets indicate larger diameters. Accordingly, main and slow jets with larger numbers provide richer mixture, and the smaller numbers the leaner mixture. Inversely, the main and slow air bleeds, which are for air to pass through, make the fuel leaner if they bear larger numbers, and the smaller numbers the richer fuel.

Replacement of designated jets to meet the service condition of the car must be carried out with the above directions in mind. To cite a practical example, when it becomes necessary to economize fuel at the limited sacrifice of output to meet frequent light-load operation, use smaller main jets or slow jets, or larger main air bleeds or slow air bleeds than regularly specified. This should meet the purpose. Inversely, when increase in output is desired at the limited sacrifice of fuel consumption, use larger main jets or slow jets, or smaller main air bleeds or slow air bleeds, and that should bring a satisfactory result.

TROUBLE DIAGNOSES AND CORRECTIONS

In the following table, the symptoms and causes of carburetor troubles and remedies for them are listed to facilitate quick repairs.

There are various causes of engine troubles. It sometimes happens that the carburetor which has no defect seems apparently to have some troubles: when electric system is defective. Therefore, whenever the engine has troubles, electric system must be checked first before starting carburetor adjustment.

Troubles	Possible causes	Remedies
Overflow	Dirt accumulated on needle valve.	Clean needle valve.
	Fuel pump pressure too high.	Repair pump.
	Needle valve seat improper.	Lap or replace.
Excessive fuel consumption	Fuel overflow.	See above item
	Each main jet, slow jet too large.	Replace.
	Each main air bleed clogged.	Clean.
	Choke valve does not fully open.	Adjust.
	Outlet valve seat of accelerator pump improper.	Lap.
	Linked opening of secondary throttle valve too early.	Adjust.
Power shortage	Each main jet clogged.	Clean.
	Each throttle valve does not fully open.	Adjust.
	Fuel pump operated improperly.	Repair.
	Fuel strainer clogged.	Clean.
	Vacuum jet clogged.	Clean.
	Air cleaner clogged.	Clean.
	Diaphragm damaged.	Replace.
	Power valve operated improperly.	Adjust.
Improper idling	Slow jet clogged.	Clean.
	Each throttle valve does not close.	Adjust.
	Secondary throttle valve operated improperly.	Overhaul and clean.
	Each throttle valve shaft worn.	Replace.
	Packing between manifold/carburetor defective.	Replace packing.
	Manifold/carburetor tightening improper.	Correct tightening.
	Fuel overflow.	See the first item.

Engine hesitation	Each main jet, slow jet clogged.	Clean.
	By-pass hole, idle passage clogged.	Clean tube.
	Emulsion tube clogged.	Clean.
	Idling adjustment incorrect.	Correct adjustment.
	Secondary throttle valve operated improperly.	Overhaul and clean.
Engine does not start.	Fuel overflows.	See the first
	No fuel.	Check pump, fuel pipe and needle valve.
	Gauge plate adjustment incorrect.	Correct adjustment.
	Idling adjustment incorrect.	Correct adjustment.
	Fast idle adjustment incorrect.	Correct adjustment.
	Bimetal rod in contact with bimetal case.	Adjust.

SPECIFICATIONS AND SERVICE DATA

Item \ Carburetor model	DAH342		DAF328		DCK306	
Applied engine	L20		L16		L13	
	Primary	Secondary	Primary	Secondary	Primary	Secondary
Outlet diameter mm (in.)	32 (1.2598)	34 (1.3386)	28 (1.1024)	32 (1.2598)	26 (1.0236)	30 (1.1811)
Venturi diameter mm (in.)	24 (0.9449)	28 x 9 (1.1024 x 0.3543)	24 (0.9449)	28 x 9 (1.1024 x 0.3543)	21 x 8 (0.8268 x 0.3150)	27 x 12 (1.0630 x 0.4724)
Main jet	# 120	# 155	# 115	# 155	# 96	# 150
Main air bleed	# 240	# 70	# 240	# 120	# 80	# 90
Slow jet	# 50	# 90	# 48	# 180	# 43	# 180
Slow air bleed	# 200	# 50	# 180	# 100	# 220	# 100
Slow economizer mm (in.)	—		1.8 (0.0709)	—	—	
Economizer bleed mm (in.)	—		1.8 (0.0709)	—	—	
Power jet	# 60		—		# 40	

Float level mm (in.)	23 ± 1 (0.9055 ± 0.0394)	23 ± 1 (0.9055 ± 0.0394)	23 ± 1 (0.9055 ± 0.0394)
Fuel pressure kg/cm2 (lb/in2)	0.22 (3.129)	0.24 (3.414)	0.24 (3.414)
Weight kg (lb.)	2.60 (5.72)	2.35 (5.17)	2.55 (5.61)

≪ Main jet variation ≫

Altitude	Main jet (primary only)	
	DAF328	DCK306
1,000 m (3,300 ft.)	112	94
2,000 m (6,600 ft.)	109	92
3,000 m (10,000 ft.)	107	89
4,000 m (13,300 ft.)	104	87
5,000 m (16,600 ft.)	101	85

SU TYPE TWIN CARBURETORS

CONTENTS

DESCRIPTION

Carburetor model	Applied engine model
HJG 38W	L20 engine
HJL 38W	L16 engine

As these two carburetors are quite similar, the general explanation is made in common.

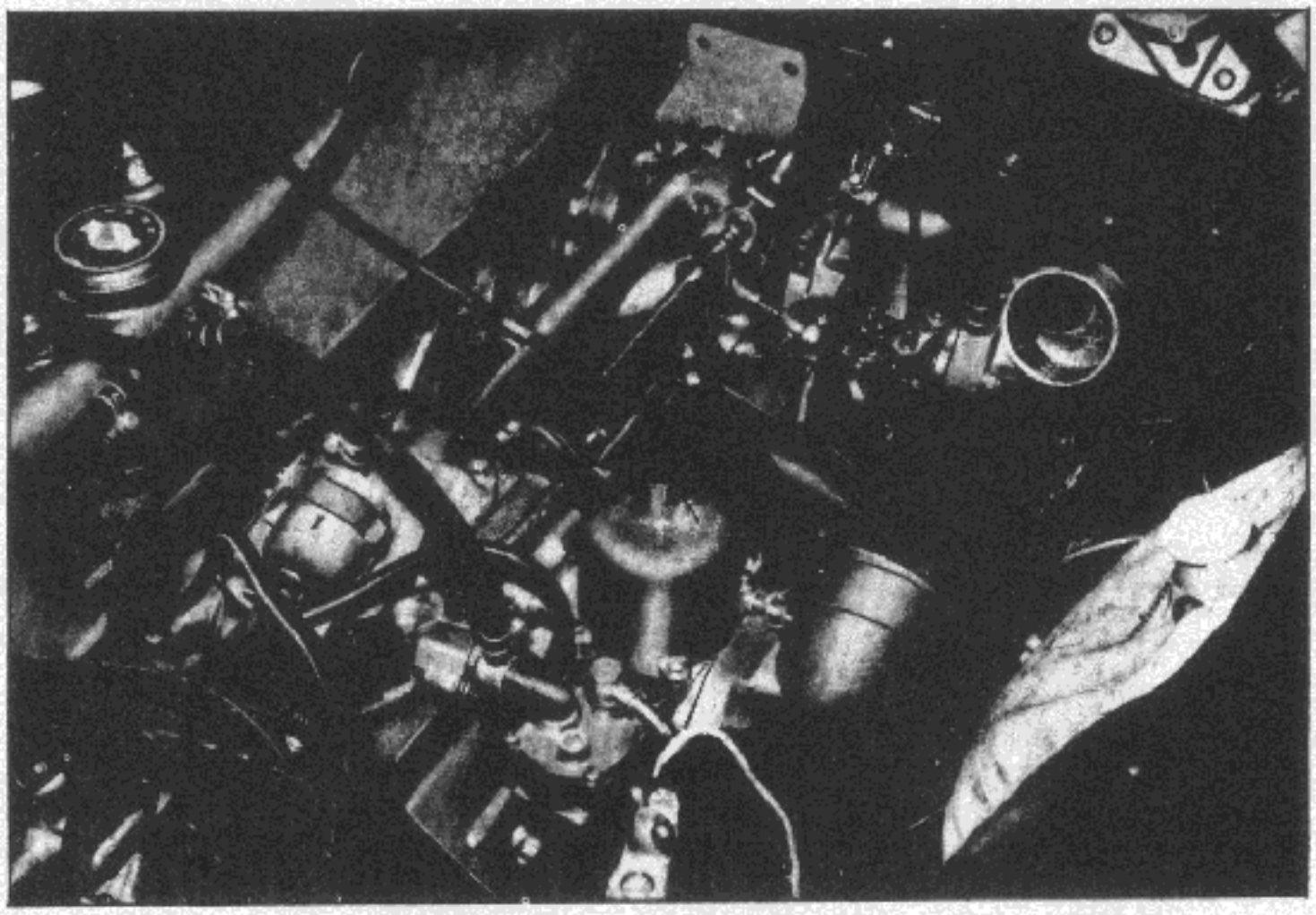


Fig. EF-51 Model HJG 38W carburetor

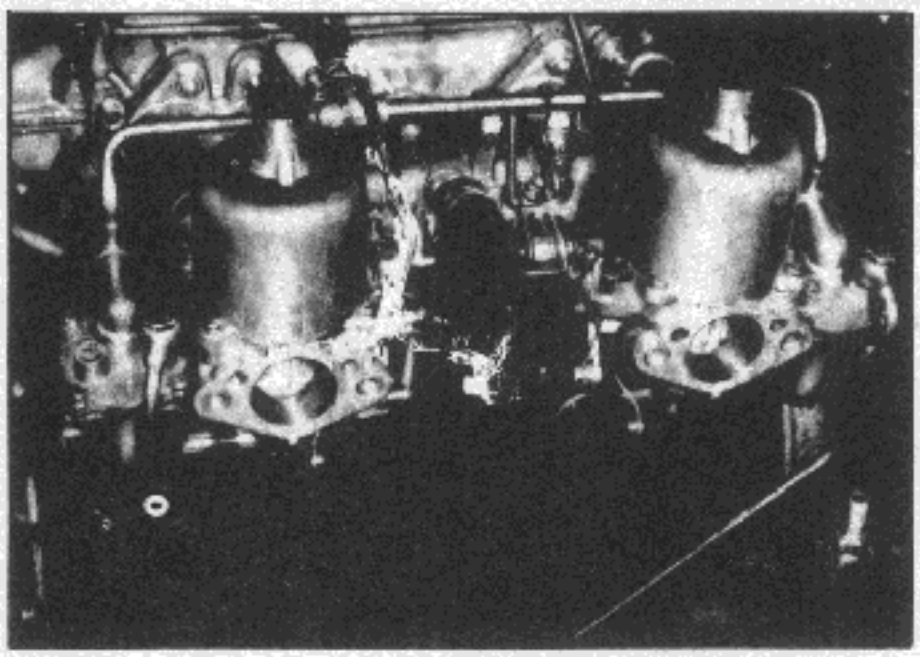


Fig. EF-52 Model HJL 38W carburetor

These carburetors are variable Venturi type suitable for 4-cylinder 1,100-2,000 c.c. class engines. Two parallel synchronized carburetors (dual carburetors) are used as a set.

The carburetor in the front facing forward (hereinafter refer to as F) applies to the 1st and 2nd cylinders, and the other rear carburetor (hereinafter refer to as R) applies to the 3rd and 4th cylinders. The operation of these two carburetors is identical except for the positioning arrangement of the vacuum nipple and float chamber.

The needle valve is made of specially hardened steel and, therefore, is not appreciably worn even when used over long periods of time.

Carburetor features are as follows:

1. The Venturi area is automatically changed according to engine air intake. Thus, the speed of the air flowing through the Venturi is nearly constant under all engine operating conditions.

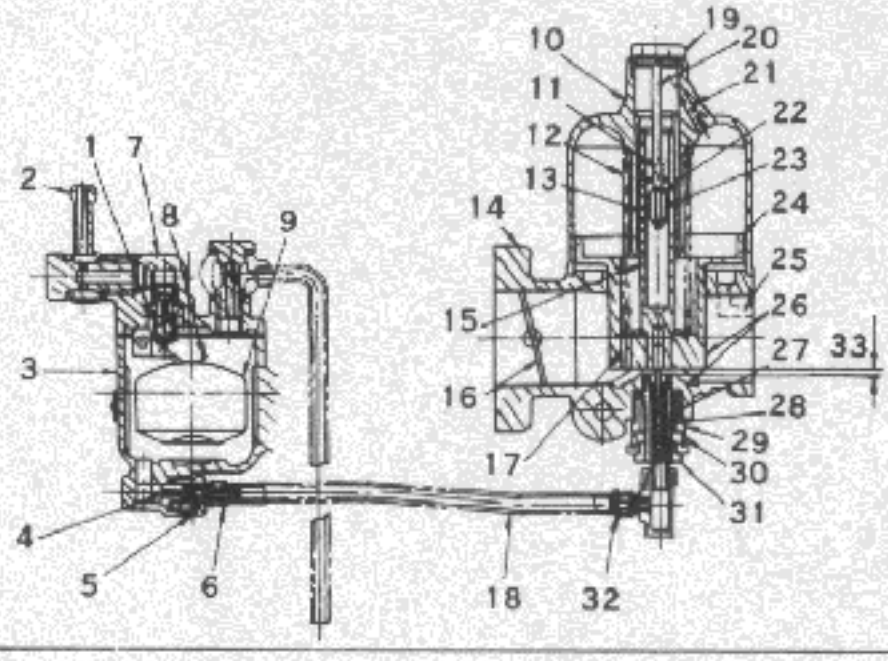
2. Thus, air flow speed in the Venturi is high even when the engine is operated at low speed, fuel spray is satisfactory, and fuel is distributed to the individual engine cylinders evenly. Vehicle fuel consumption is minimized, and the driving features such as acceleration and deceleration, are highly superior.

3. During high speed operation, the Venturi opens wide. Thereby reducing intake resistance to provide high output.

4. Moreover, engine output and vehicle accelerating characteristics are greatly improved by the use of two parallel carburetors.

5. None of the various fuel systems such as those required in conventional stationary Venturi carburetors are required. Individual fuel system operations of idling, deceleration, acceleration, and output are accomplished using a single nozzle. Thus, the construction is extremely simple.

STRUCTURE AND OPERATION



1	Needle valve	12	Suction spring	24	Suction piston
2	Nipple	13	Suction guide	25	Air intake port
3	Float chamber	14	Throttle chamber	26	Venturi
4	Sleeve	15	Suction piston rod	27	Nozzle
5	Sleeve nut	16	Throttle valve	28	Jet needle
6	Clip	17	Suction port	29	Nozzle sleeve set screw
7	Float chamber cover	18	Fuel line	30	Idling adjusting spring
8	Float lever	19	Oil cap nut	31	Idling adjusting nut
9	Float	20	Flanged rod	32	Clip
10	Suction chamber	21	Transverse passage	33	Lift
11	Damper oil	22	Oil damper		
		23	Plunger		

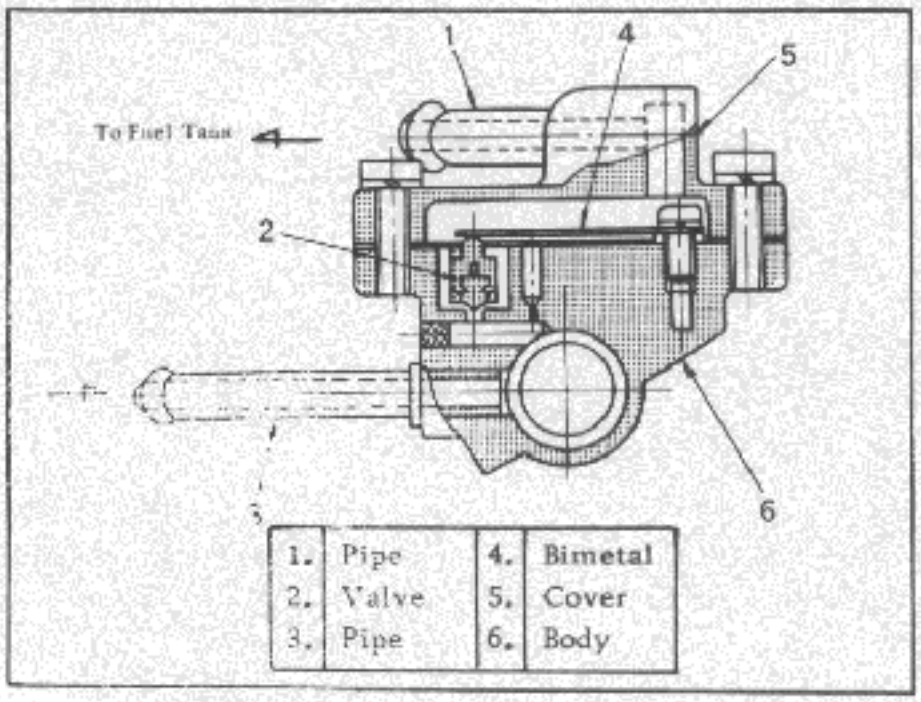
Fig. EF-53 Schematic view

Structure of these carburetors are shown in Fig. EF-53.

Float Chamber

Fuel fed from the fuel pump enters the float chamber through the needle valve. The fuel in the float chamber is maintained in the rated level by the combined operation of the needle valve and float.

Fuel return system



1.	Pipe	4.	Bimetal
2.	Valve	5.	Cover
3.	Pipe	6.	Body

Fig. EF-54 Fuel return system

This is a device which prevent vapor lock or percolation and to ensure a constantly stable idling in a hot engine compartment. As shown in Fig. EF-54, it consists of a body, pipe, bimetal and valve. The conventional system is employed up to the point where fuel delivered by the fuel pump is supplied to the float chamber in the carburetor. The extra feature is that, when the engine compartment reaches a certain high temperature level, the resultant displacement of the bimetal causes the valve to open, returning most of the fuel supplied for slow speed operation to the fuel tank.

Preferably, do not dismantle this device unless necessary. And, always leave the bimetal intact.

Venturi control system

The suction chamber is located in the upper part of the throttle chamber, the suction piston slides vertically within the vacuum chamber thus changing the Venturi opening. Venturi vacuum pressure applied to the head of the suction piston through the suction port, and atomospheric pressure in the air cleaner is introduced through the air intake port below the piston.

The suction piston automatically moves up and down due to differences between upper and lower pressures, and the balance maintained between the pressure of the piston and suction spring force. For example, when the throttle valve is opened for increased output, the flow of engine intake air is increased. Thus, vacuum pressure of the Venturi increases, the suction piston is lifted until the piston is balanced with the pressure, and the Venturi

opening enlarged.

When the throttle valve is closed to reduce output, the flow of engine intake air is decreased. Thus, vacuum pressure of the Venturi is reduced, the suction piston lowers until the piston is balanced with the pressure, and the Venturi is constricted. The pressure of the suction piston and suction spring force are properly calibrated so that the Venturi opening is optimum for any engine operating conditions.

In addition, the suction piston rod is equipped with an oil damper to improve vehicle acceleration performance. The oil damper protects the suction piston from opening too suddenly during acceleration.

Fuel system

Air velocity through the venturi (vacuum pressure) causes fuel to be sprayed from the float chamber, through the opening between the nozzle and jet needle into the Venturi.

The jet needle below the suction piston moves up and down in the nozzle according to the motion of the suction piston. Fuel flow changes automatically due to the tapered shape of the jet needle.

Moreover, operating conditions under various driving conditions from idling to the fully opened, maximum speed are shown in Figs. EF-55 through 58.

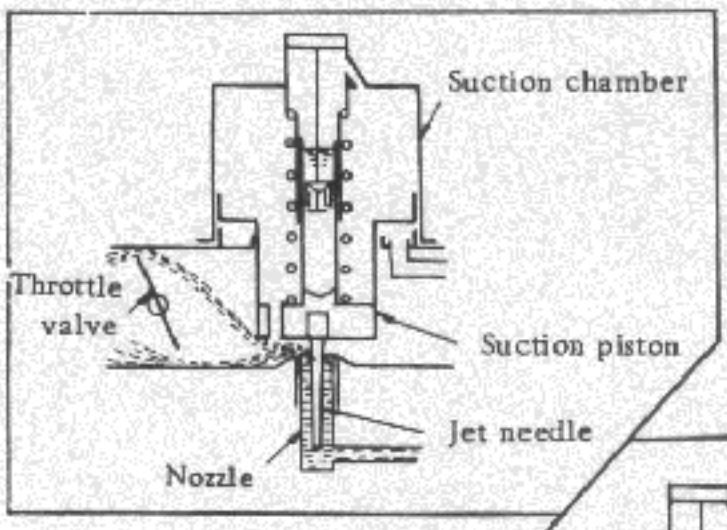


Fig. EF-55 Idling

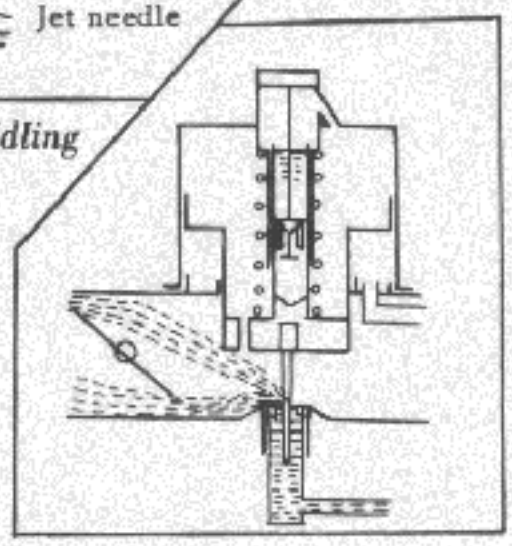


Fig. EF-56 Intermediate and low speed

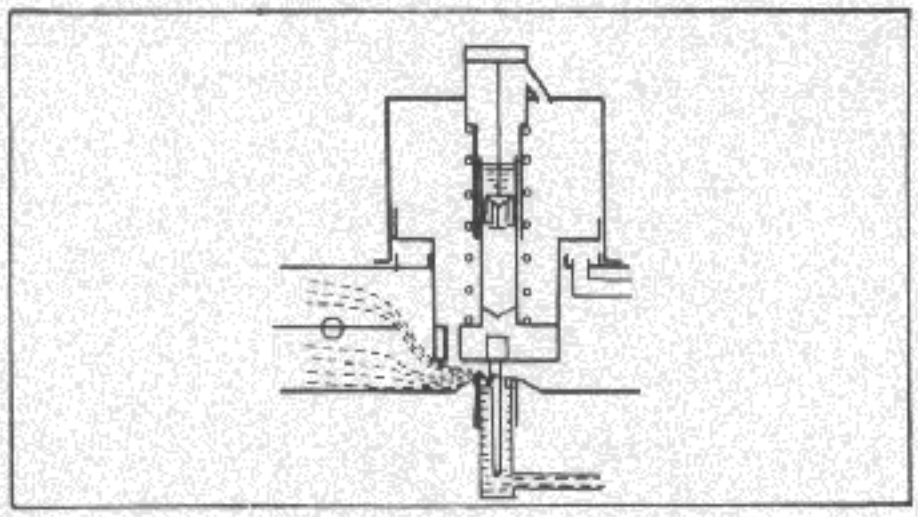


Fig. EF-57 Fully-opened low speed

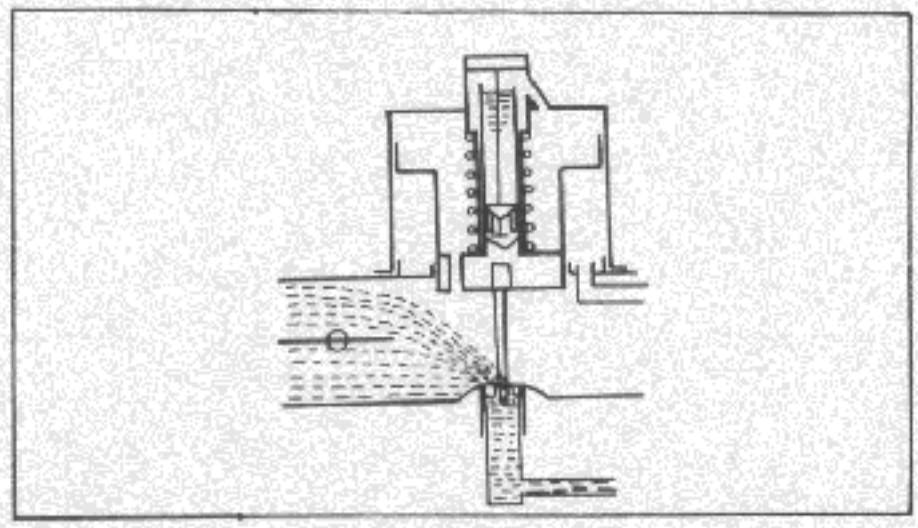


Fig. EF-58 Fully-opened high speed

Starting mechanism

By pulling the choke knob, the starting lever is moved, and the nozzle is drawn down by a link mechanism. As a result, the clearance between the nozzle and jet needle is increased, and an increased amount of fuel required for starting is fed to the system. Moreover, the throttle valve is automatically set to proper opening for starting (approximately 6°) by the connecting linkage.

CONTROL AND ADJUSTMENT

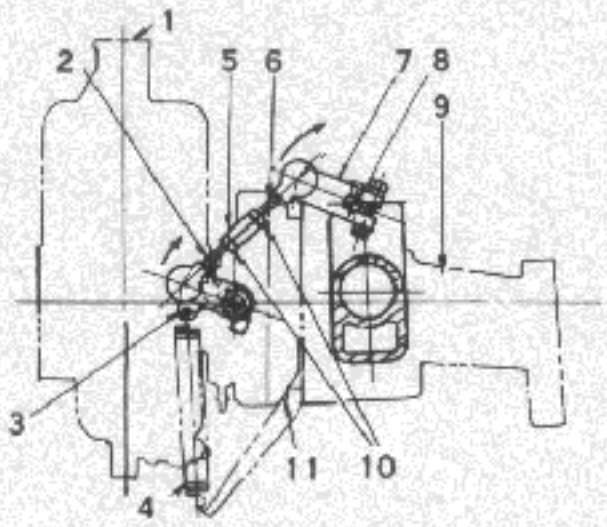
Idling adjustment

The procedure for idling adjustment is described herein, since proper idling adjustment of these two carburetors is extremely important in obtaining peak vehicle performance and in effectively reducing fuel consumption.

It should also be noted that improper carburetor adjustment not only has an adverse affect upon idling but also upon acceleration, output, fuel consumption, and other vehicle performance factors.

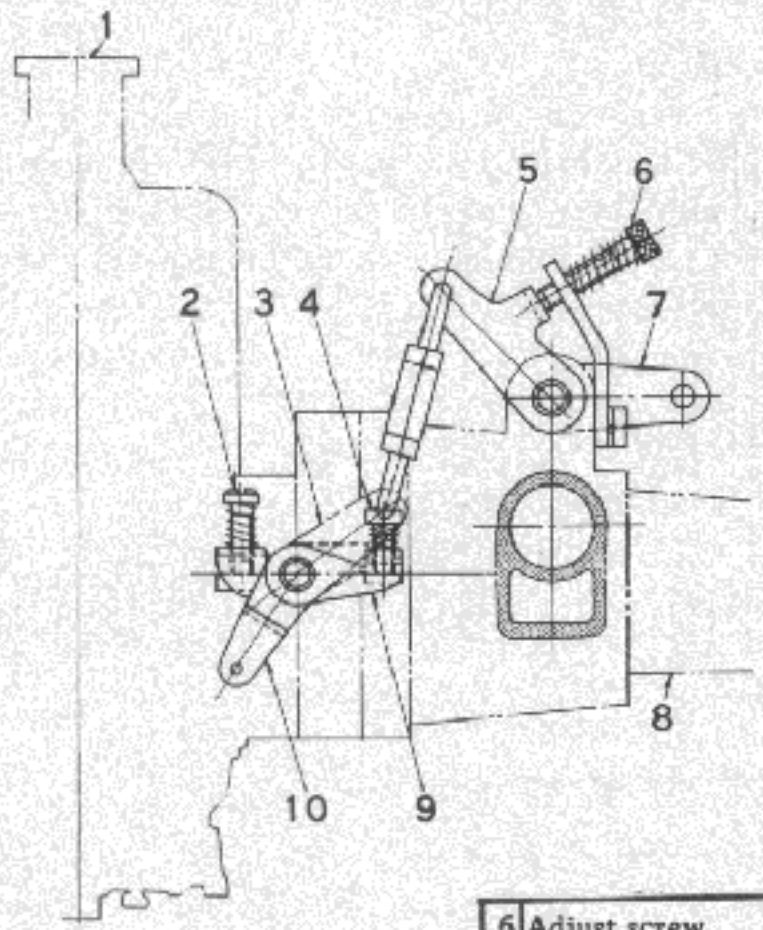
1. Throttle valve synchronization adjustment (using a flow meter) and idling adjustment

≪ Throttle Valve Shaft Interlock and Throttle Valve Full Closing Adjustment ≫



1	Carburetor (front side)	3	Throttle lever	6	Con' rod	9	Manifold
2	Throttle adjust screw	4	Throttle return spring	7	Lever	10	Lock nut
		5	Turn backle	8	Auxiliary shaft	11	Rubber spacer

Fig. EF-59 HJC 38W



1	Carburetor (front side)	3	Connecting lever	6	Adjust screw
2	Throttle adjust screw	4	Throttle adjust screw (C)	7	Lever
		5	Adjust lever	8	Intake manifold
				9	Throttle connecting lever
				10	Throttle lever

Fig. EF-60 HJL 38W

Operating procedure	Precautions and confirmation
1. Remove the air cleaner.	a. Warm up the engine prior to adjustment.
2. Loosen both the F and R carburetor throttle adjusting screws. Be careful that the heads of the adjusting screws do not contact the throttle lever.	a. Make sure the front and rear throttle shafts are not connected.
3. Tighten the front and rear idling adjusting nuts in the upper direction once, and gradually back them off. When turned approximately on half a turn, the nuts will contact the nozzle heads. Return the idling adjusting nuts from this position approximately one and a half turns (approximately 2 1/4 of a turn for HJL 38W).	a. Set both front and rear idling adjusting nuts to their standard positions. Under this conditions, dimension "A" (between jet bridge and nozzle head) is approximately 1.5 mm (0.0591 in.) [2.5 mm (0.0984 in.) for HJL 38W]. Refer to Adjustment of "A" Dimension.
4. Thread the front and rear throttle adjusting screws in a few turns, and start engine.	a. Make sure that the engine is at normal operating temperature.

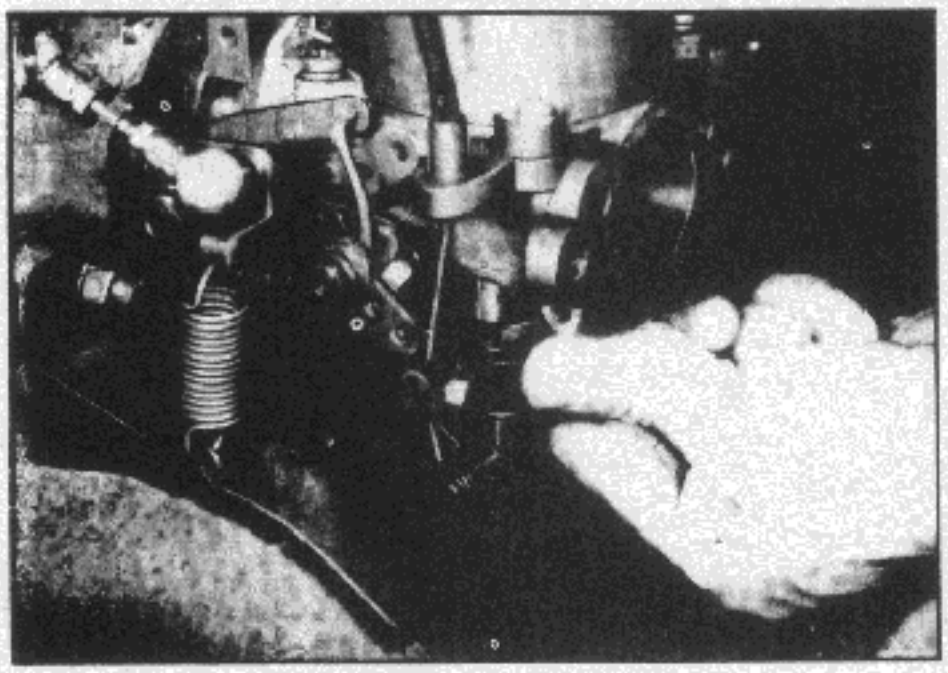


Fig. EF-61 Idle adjust nut

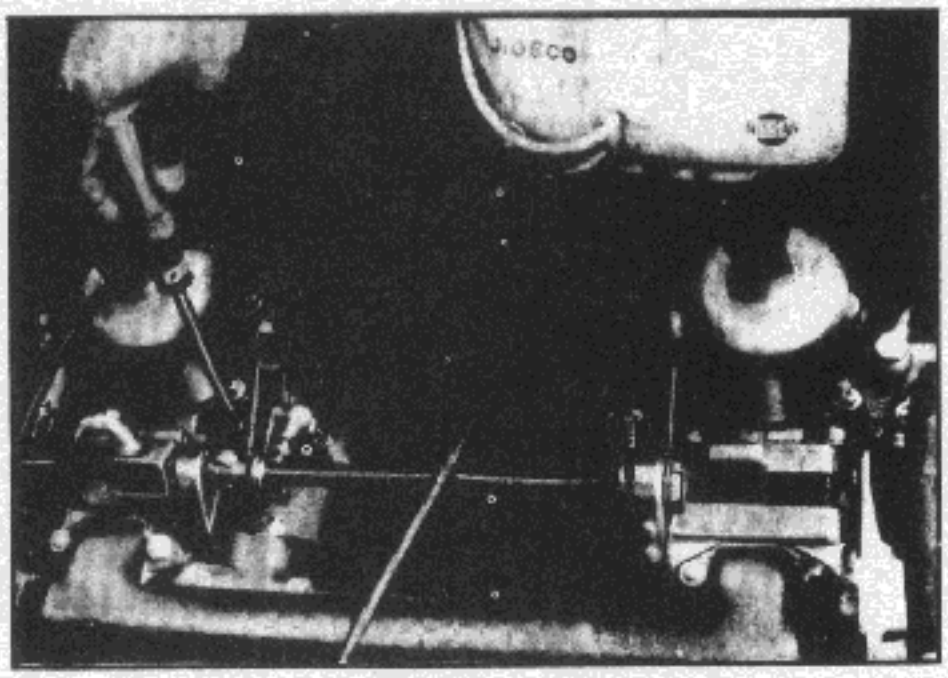


Fig. EF-62 Throttle adjust nut

Operating procedure	Precautions and confirmation
5. Turn front and rear throttle adjusting screws and reduce the engine speed to 600 to 700 r.p.m.	a. Reduce engine speed to the extent that the engine operates stably.
6. Apply a flow meter to the front carburetor air cleaner flange, turn the air flow adjusting screw, and align the upper end of the float in the glass tube to the scale.	a. Stand the flow meter float vertically.
7. Then apply a flow meter to the rear carburetor air cleaner flange. (Do not move the flow meter air flow adjusting screw.) If the flow meter float is not aligned with the front carburetor sclae, turn the rear carburetor throttle adjusting screw and align the float with the front carburetor scale.	a. Match front and rear throttle valve openings. b. Throttle valve openings are even, and air flow is also uniform when the positions of the floats in the glass tubes of the flow meters stop at the same position for both front and rear carburetors.

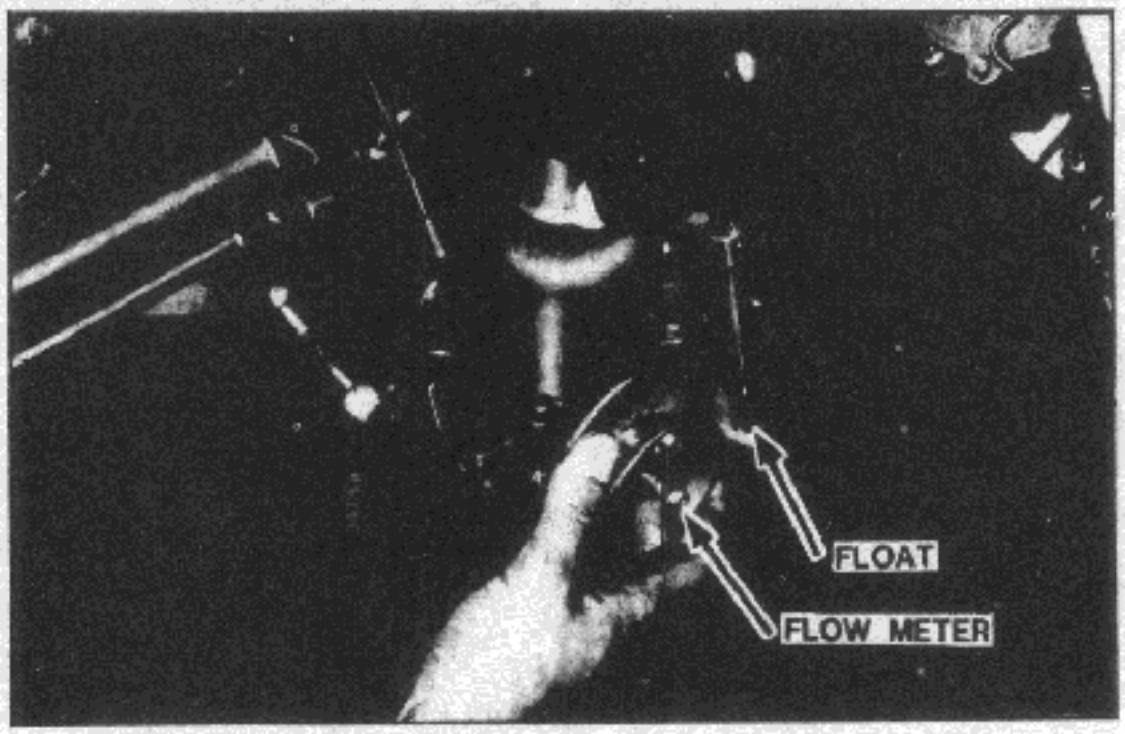


Fig. EF-63 Flow meter

Operating procedure	Precautions and confirmation
8. Tighten the front and rear idling adjusting nuts simultaneously by approximately 1/8 turns, and stop at the points where engine speed is fastest and most stable. When the idling adjusting nuts are tightened and the point at which engine speed is fastest and most stable can not be determined, back off (loosen) the idling adjusting nuts to their initial positions, loosen the F and R nuts alternately by 1/8 turns to determine this point, and stop turning the nuts when this point is located.	a. Idling fuel flow volume is reduced by tightening idling adjusting nut (turning it to the right), and is increased by loosening the idling adjusting nut (turning it to the left). b. The idling adjusting nut positions are set at their standard positions. Thus, the idling adjusting nut adjusting range should be less than approximately ± 1/2 of a full turn. c. The front and rear idling adjusting nut adjusting positions (number of turns by which both nuts are backed off) must be the same.
9. Back off (loosen) the front and rear throttle adjusting screws, and set engine speed to rated speed.	a. Repeat steps 6 and 7 above, and set engine speed to rated speed by adjusting the front and rear carburetors so that the air flow of both front and rear carburetors is the same. Rated idling speeds for Model L20 and L16 are as follows: Model L20 ..... 600 r.p.m. Model L16 ..... 650 r.p.m. Model equipped with cooler: .. 700 r.p.m.
10. Thread in the throttle adjusting screw until the screw head contacts the throttle connecting lever.	a. Interlock the front and rear throttle shaft. b. Make sure that idling speed does not change.

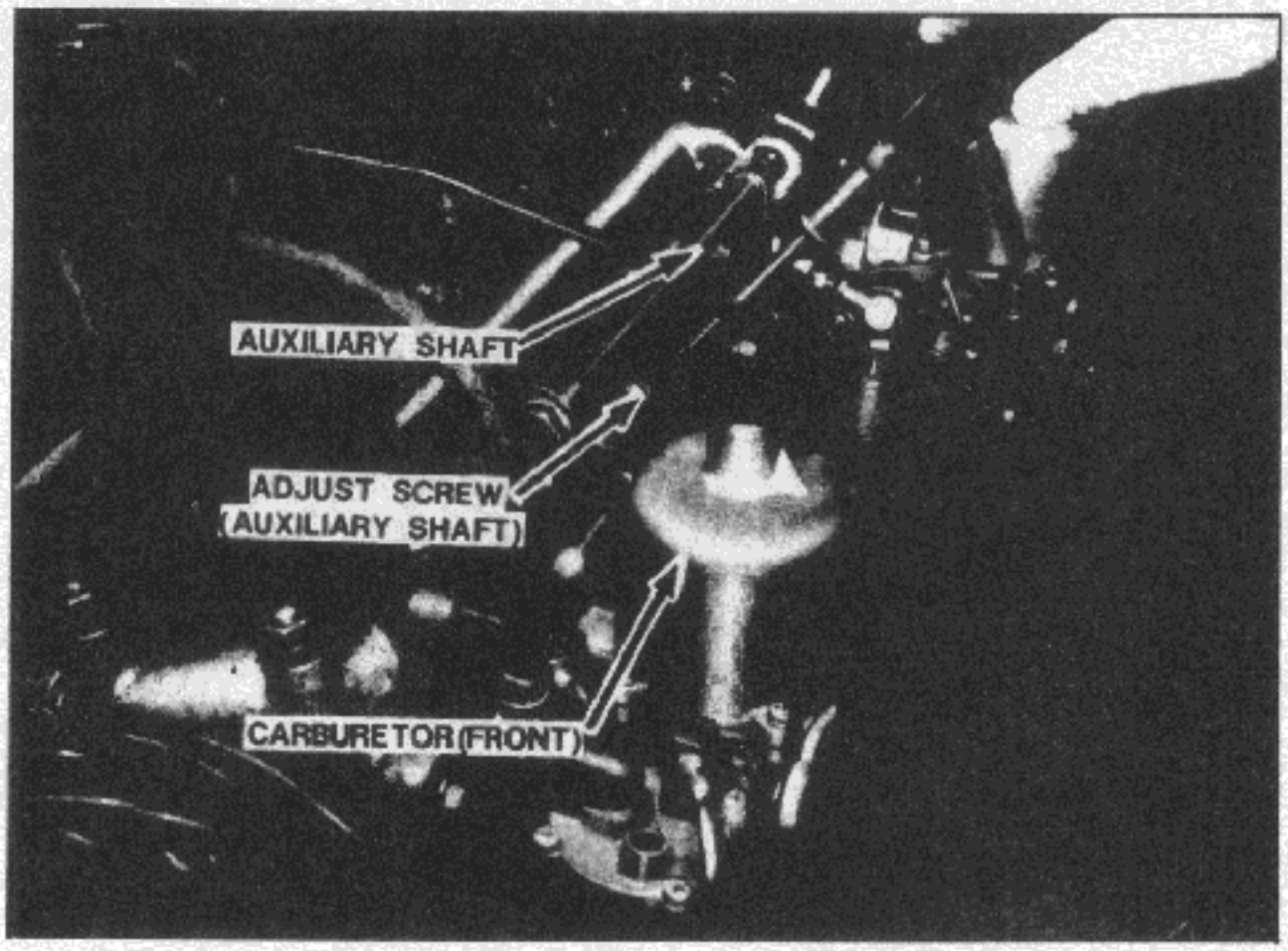
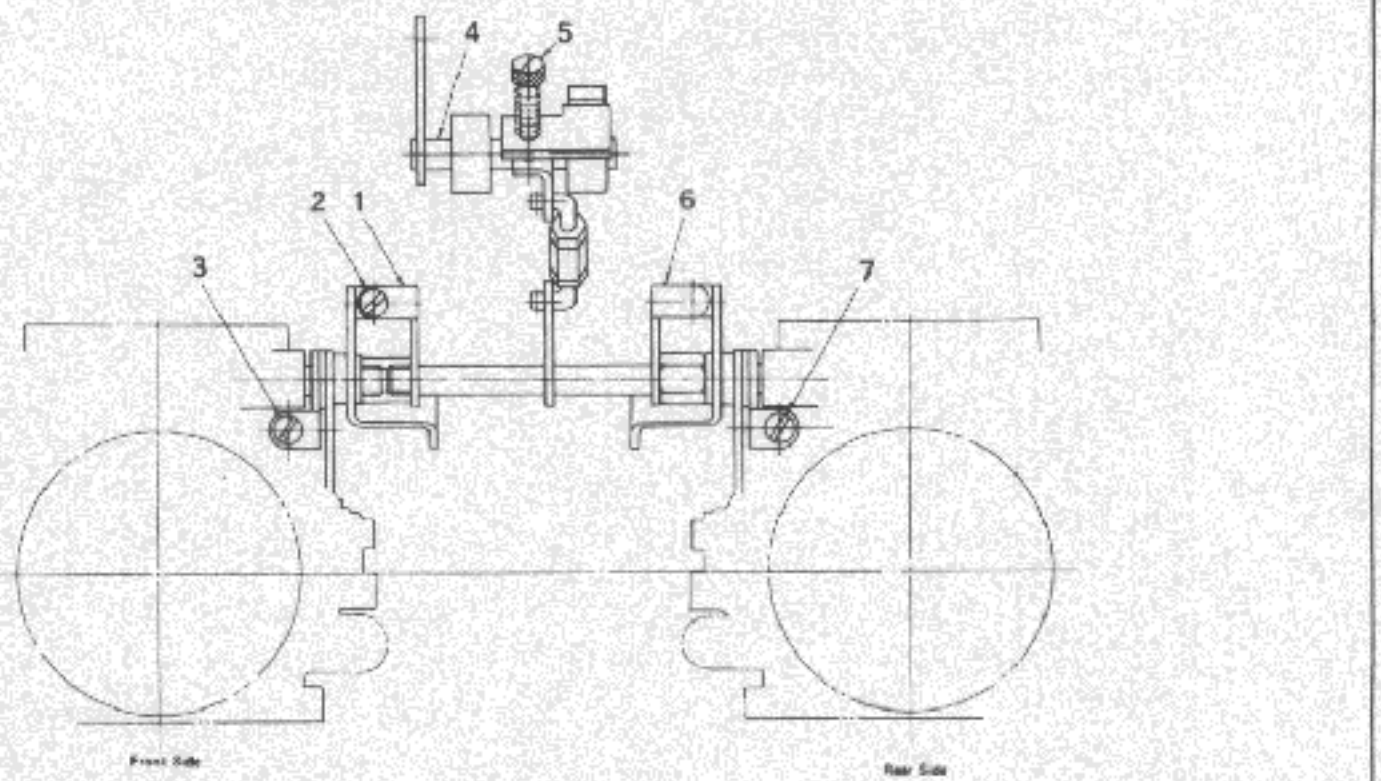


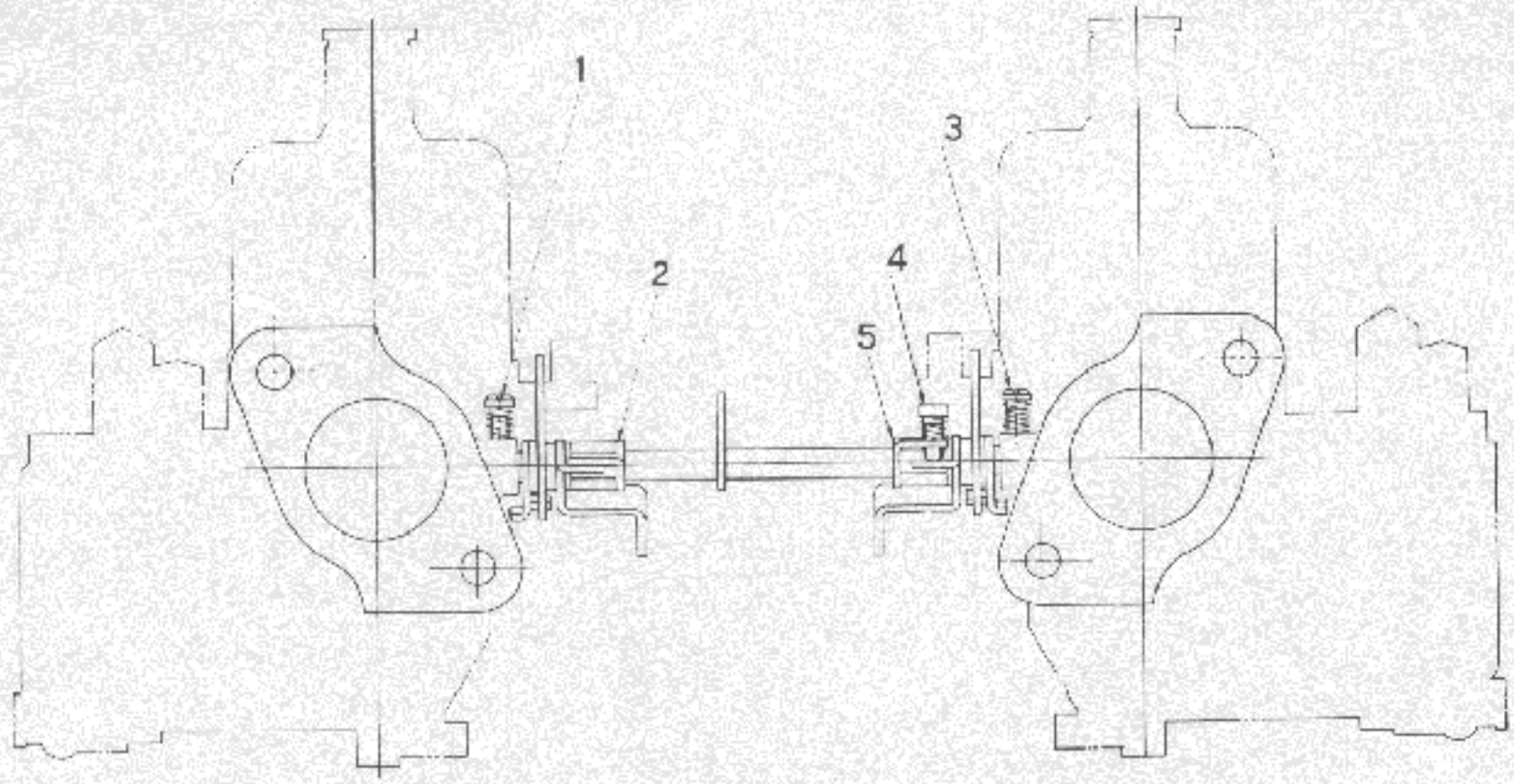
Fig. EF-64 Adjust screw-auxiliary shaft

Operating procedure	Precautions and confirmation
11. Move the auxiliary shaft, and rapidly accelerate the engine (race the engine) a few times. Make sure that idling speed does not change.	a. Make sure that interlock adjustment is proper.
12. Turn the auxiliary shaft adjusting screw to increase engine speed from 800 to 1,000 r.p.m., apply flow meters to both front and rear carburetors, and verify that the flow meter float positions are even. If uneven, readjust the length of connecting rod.	a. Increase engine speed, and insure that the link interlock action operates properly. b. Readjust connecting rod length and match the air flow of the front and rear carburetors.
13. Back off the auxiliary shaft adjusting screw, and decrease engine speed. Apply flow meters to the front and rear carburetors, and re-confirm that the float position are even. If uneven, adjust the front and rear throttle adjusting screws so that engine speed does not change, and equalize the flow meter float positions.	a. Correction of difference between the front and rear interlock links. b. Match the idling air flow of the front and rear carburetors. c. Adjust idling speed.
14. Stop the engine, and install the air cleaner and duct.	



1.	Throttle connecting lever	3.	Throttle adjust screw	5.	Adjust screw	7.	Throttle adjust screw
2.	Throttle adjust screw(C)	4.	Auxiliary shaft	6.	Throttle connecting lever		

Fig. EF-65 Throttle valve shaft interlock and throttle valve full closing adjustment



1.	Throttle adjust screw	3.	Throttle adjust screw
2.	Throttle connecting lever	4.	Throttle adjust screw(c)
		5.	Throttle connecting lever

Fig. EF-66 Throttle valve shaft interlock and throttle valve full closing adjustment

2. Adjustment of "A" dimension

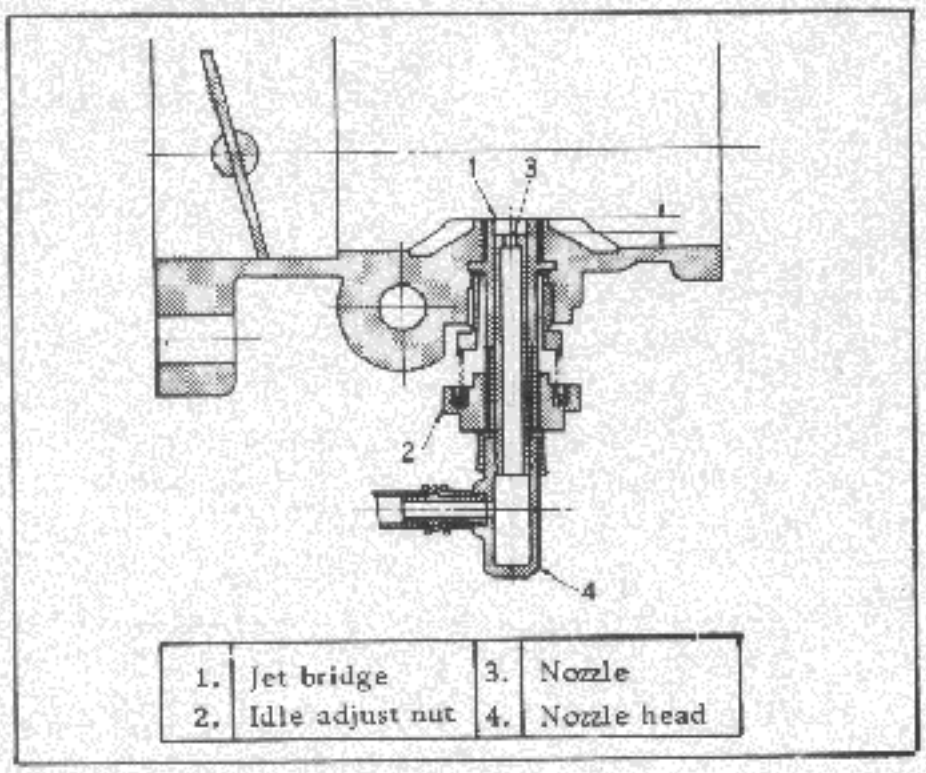
When the number of turns by which the idling adjusting nut has been backed off (loosened) cannot be accurately determined with the carburetors installed on the engine, adjust as follows. (See Fig. EF-67.)

(1) Loosen the suction chamber access screw, and disconnect the suction chamber and suction piston. Proceed carefully so that the nozzle and jet needle are not damaged or bent.

(2) Turn the idling adjusting nut, measure dimension "A" (between the jet bridge and nozzle head with slide calipers) and adjust the nozzle position so that dimension "A" is approximately 0.5 mm (0.0197 in.) (approximately 2.5 mm (0.0984 in.) for HJL 38W).
The pitch of the idling adjusting nut thread is 1 mm (0.0394 in.). Thus, the nozzle moves 1 mm (0.0394 in.) by turning this screw one full turn.

(3) Reinstall the suction chamber and suction piston, and make sure that the suction piston operates smoothly.

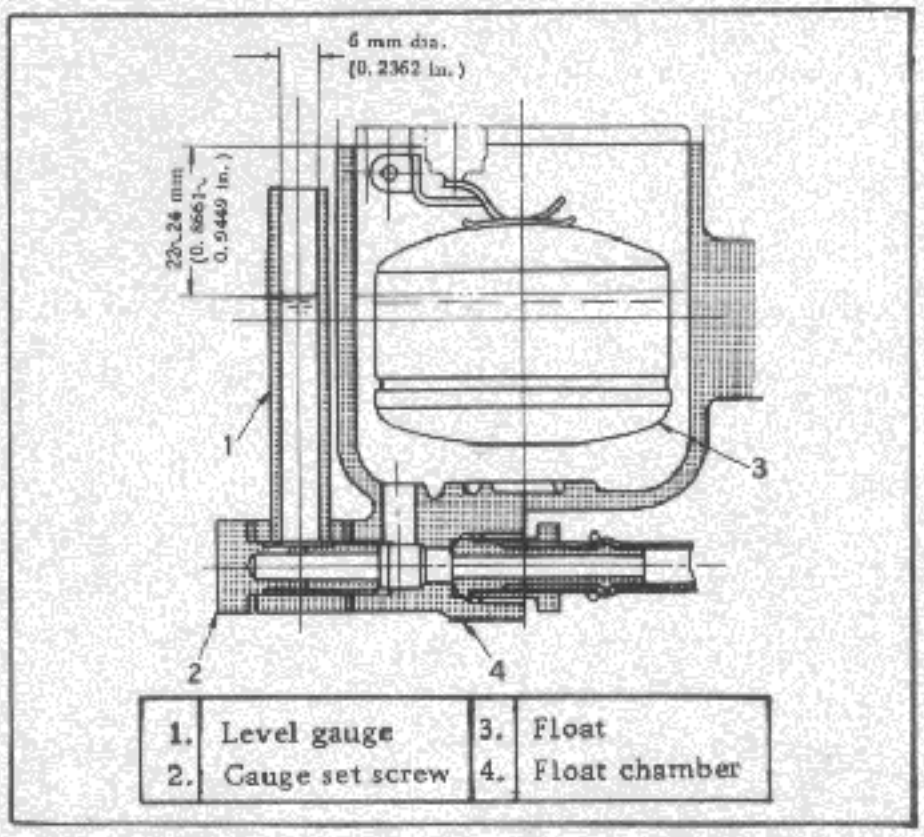
(4) The nozzle is now at its standard position. Thus, the adjusting range of the nut is within approximately ± 1/2 of a turn.



1.	Jet bridge	3.	Nozzle
2.	Idle adjust nut	4.	Nozzle head

Fig. EF-67 Adjustment of "A" dimension

Adjustment of float level



1.	Level gauge	3.	Float
2.	Gauge set screw	4.	Float chamber

Fig. EF-68 Adjustment of float level

To measure the float level, first, loose the float chamber clip, disconnect the fuel line, and remove the sleeve nut.

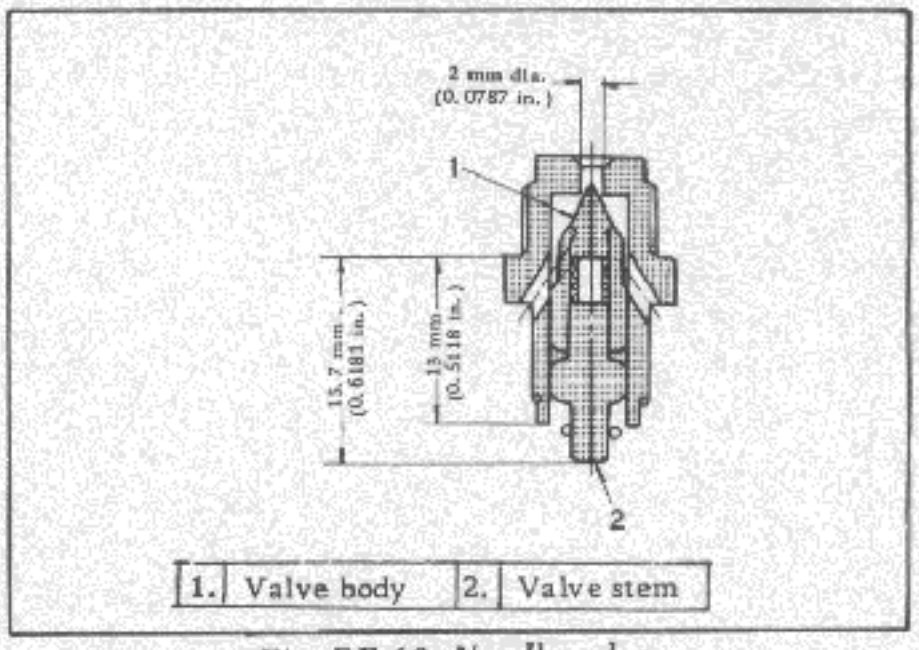
Next, stand a 6 mm (0.2362 in.) inner diameter glass tube (level gauge) in the level chamber as shown in Fig. EF-68, apply the fuel line to the nipple on the level gauge, and operate the engine at idling speed. If the fuel level indicated on the glass tube is 22 to 24 mm (0.8661 to 0.9449 in.) from the top of the float chamber, the float level is properly set.

If no level gauge is available, the following method of adjustment can be applied.

1. Remove the four set screws from the float chamber cover. The float chamber cover and the float lever can then be removed together. Place the cover on a work bench (with the float lever attached to the cover) with the float lever side up.

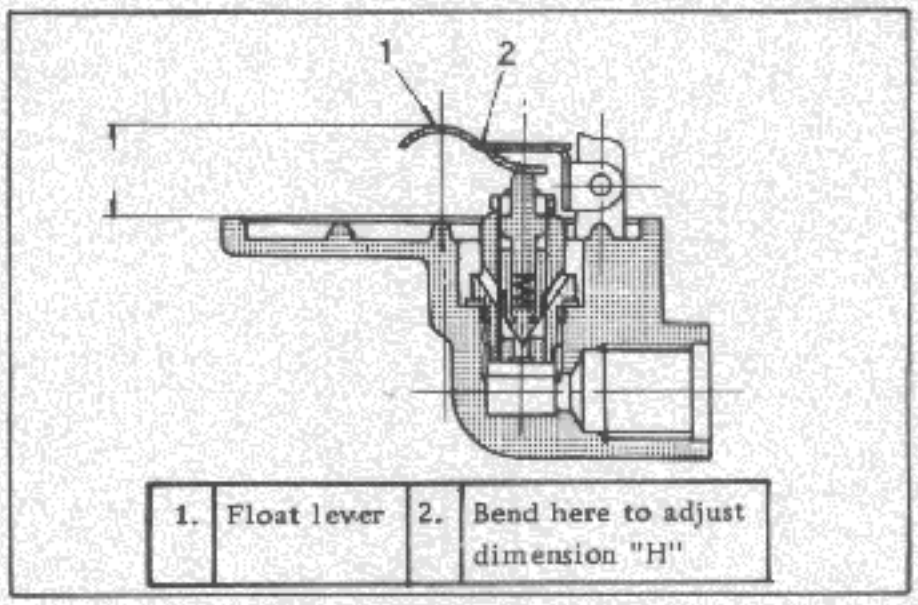
2. Lift up the float lever with the tip of your finger and then slowly lower the float lever. Stop lowering the float lever at the position at which the float lever seat just contacts the valve stem (See Fig. EF-69.)

3. The float level is correct if dimension "H" in Fig. EF-70 is 14 to 15 mm (0.5512 to 0.5906 in.) under the foregoing conditions. If the dimension is not correct, adjust by bending as shown in Fig. EF-70.



1.	Valve body	2.	Valve stem

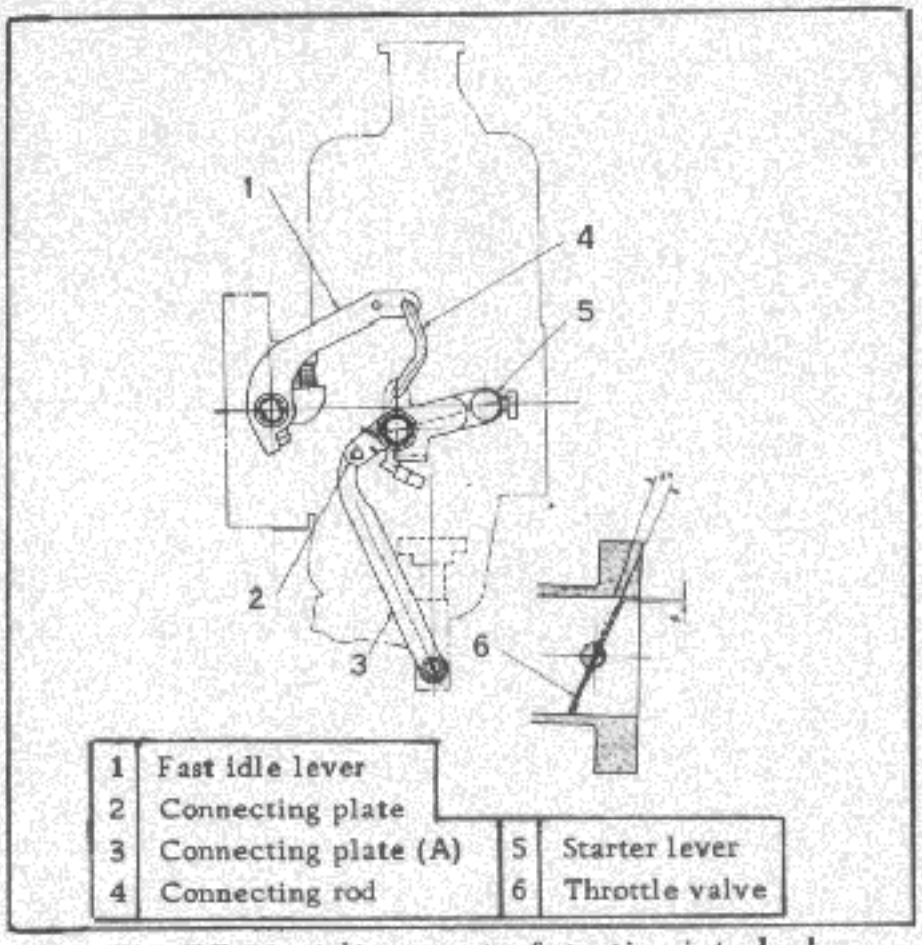
Fig. EF-69 Needle valve



1.	Float lever	2.	Bend here to adjust dimension "H"

Fig. EF-70 Adjustment of float level

Adjustment of starting interlock valve opening



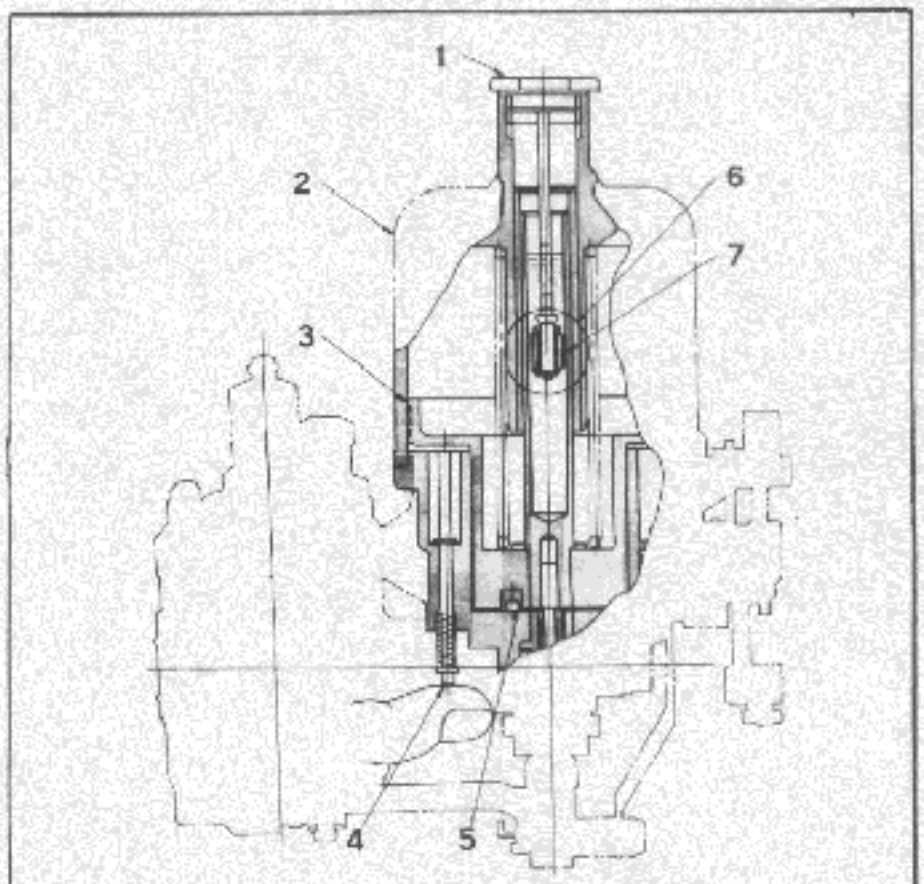
1	Fast idle lever		
2	Connecting plate		
3	Connecting plate (A)	5	Starter lever
4	Connecting rod	6	Throttle valve

Fig. EF-71 Adjustment of starting interlock opening

For the adjustment of starting interlock opening, bend the connecting rod as shown in Fig. EF-71 with an appropriate tool such as radio pinchers to change its length.

The interlock opening is increased by increasing the length of the connecting rod and is reduced when the rod is shortened. The interlock opening is correct, if clearance between the throttle valve and throttle chamber (dimension B) is 0.6 to 0.8 mm (0.0236 to 0.0315 in.) when the starter lever is pulled all the way out. To measure dimensions B, move the throttle lever to full-closing, and make sure that there is no play in the first idling lever and adjusting lever interlocked unit.

Checking the damper oil



1	Oil cap nut (Tightened by hand)	3	Suction piston	6	Oil damper
		4	Lifter	7	Plunger
2	Suction chamber	5	Stop pin		

Fig. EF-72 Inspection of suction piston

When there is not a sufficient amount of damper oil, acceleration and other operating performance features become sluggish. When new carburetors are installed on the engine, or when overhaul is performed, damper oil must be added without fail. Use Mobile oil SAE #20 for damper oil. Do not use SAE #30 or higher weight oils.

Periodic inspection may vary depending upon driving conditions. However, the damper oil should be checked approximately every 5,000 km (3,000 mile) of driving (or approximately every 3 months).

To check damper oil level, remove the oil cap nut as shown in Fig. EF-72 and check the oil level marking on the two grooves on the plunger rod. No difficulty will be encountered and there is no danger until the oil level reaches the lower line. If the oil level drops below the lower line, add oil. Total oil volume is approximately 3 c.c. Squirt oil into the damper little by little so that the oil level completely reaches the upper line.

When removing and replacing oil cap nut, be careful not to bend the rod. If the oil cap nut is loose, it may fall off. Be sure that it is sufficiently tightened by hand.

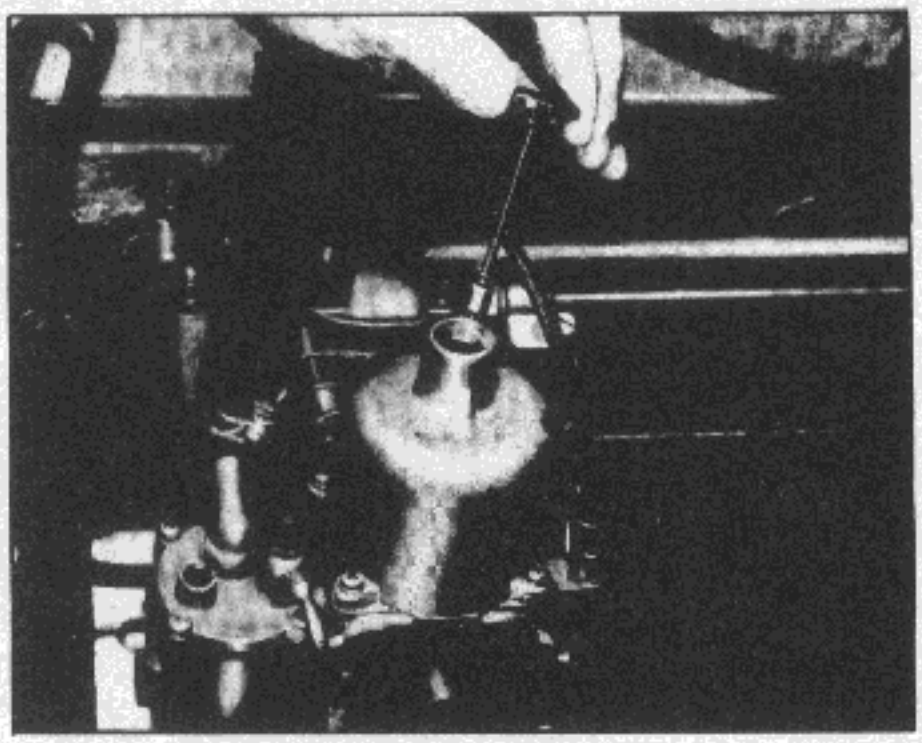


Fig. EF-73 Check damper oil

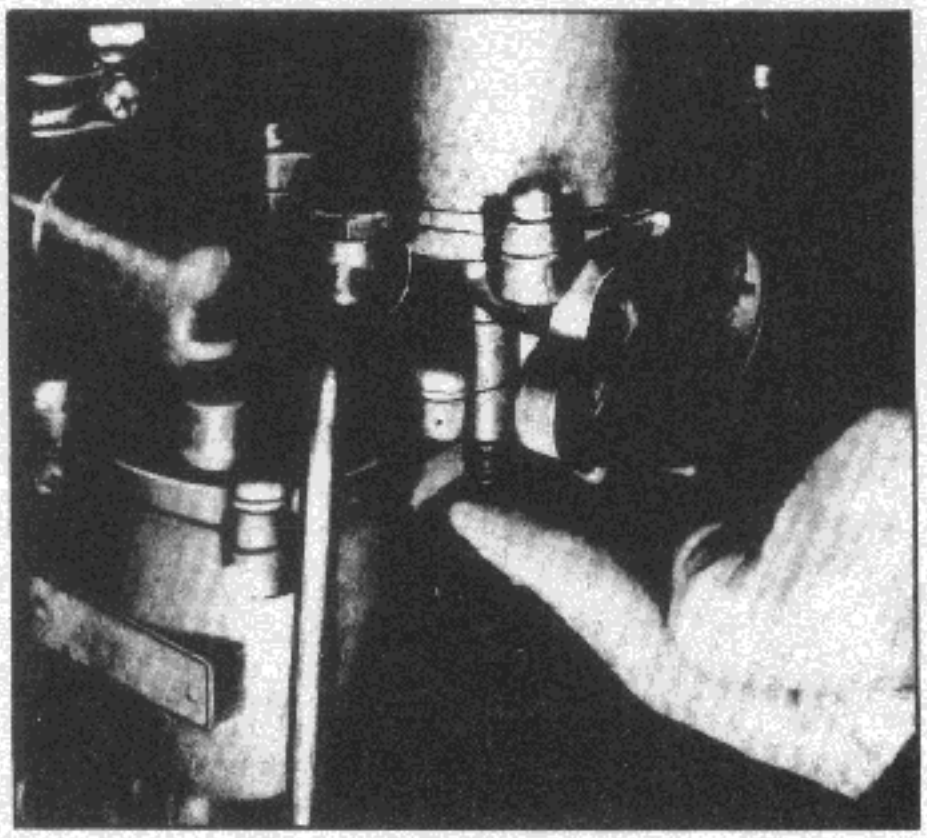


Fig. EF-74 Inspection of suction piston

Periodic inspection of suction chamber and suction piston

Periodic inspection is required to constantly maintain the suction chamber and suction piston in porper operating condition. This is due to the fact that dust in the air is drawn into the chamber and accumulates on the sliding portion of the suction piston.

Make sure that the suction piston operates smoothly with the suction piston installed on the engine by proceeding as follows:

1. First, remove the oil cap nut.

2. Gradually raise lifter with your finger. The lifter head will contact the suction piston when the lifter has been raised approximately 1.5 mm (0.0591 in.). Raise the lifter further. The suction piston will then be raised approximately 8 mm (0.3150 in.).

3. Release your finger from the lifter. The suction piston will drop, and the sound of the suction running against the Venturi will be heard.

The conditions of the piston and chamber are satisfactory if the suction piston rises smoothly. The condition of the center ring described in the following paragraph "DISASSEMBLY AND REASSEMBLY" can also be checked in this manner.

To check the bend of the plunger rod, remove the air cleaner, raise the suction piston with your finger tip with the oil cap nut applied to the assembly, and let the piston drop freely. The suction piston will offer strong resistance when lifted since the oil damper is actuated. Under satisfactory conditions, the piston will drop smoothly when your finger is removed from the suction piston.

DISASSEMBLY AND REASSEMBLY

The float chamber of this carburetor is almost identical to those in conventional carburetors. However, the carburetor must be disassembled and reassembled very carefully since the Venturi and fuel system are made of special high precision parts.

Disassembly and reassembly of suction piston and suction chamber

Disassemble and clean at least semi-annually. For disassembly and cleaning, or if the carburetor becomes defective, disassemble and reassemble as follows:

1. Remove the four set screws and then take off the suction chamber.

2. Then remove the suction spring, nylon packing and suction piston from the suction chamber.

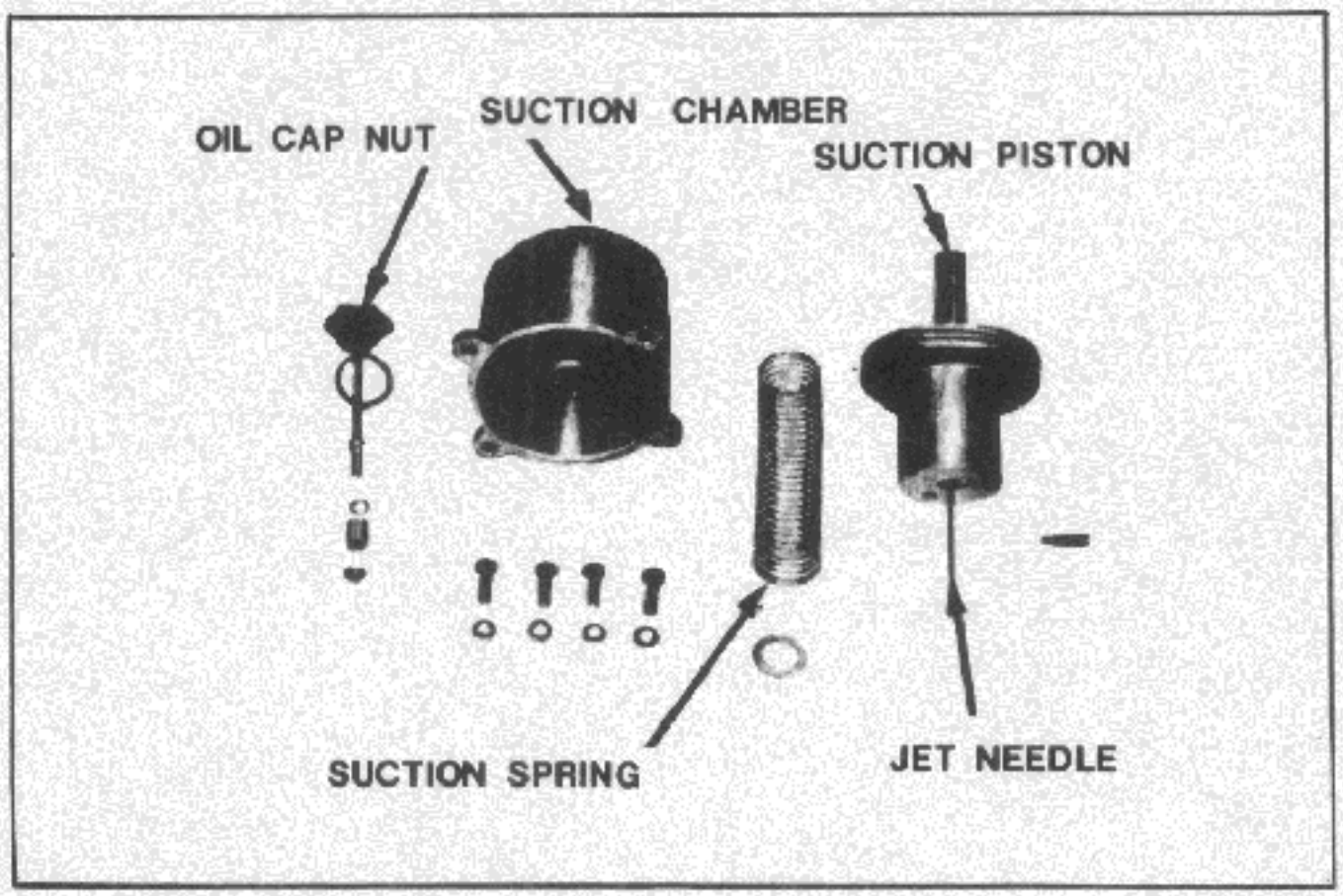


Fig. EF-75 Disassembly of suction chamber and suction piston

3. To remove these components, place the suction chamber and suction piston on a flat work bench so that the inside of the suction chamber and the sliding part of the suction piston are not damaged. Be extremely careful not to bend the jet needle on the lower part of the suction piston. (See Fig. EF-76.)

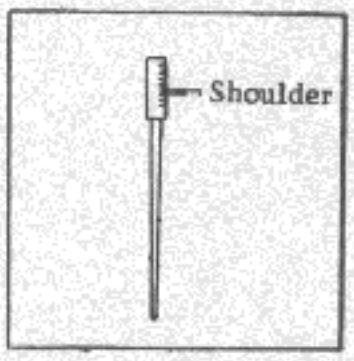


Fig. EF-76 Jet needle

4. Do not remove the jet needle from the suction piston unless absolutely necessary. When it must be removed, first loosen the jet needle set screw. To accomplish this, hold the jet needle within 2 mm (0.0787 in.) from the shoulder with a pair of pliers so as not to damage the needle and remove the needle by pulling and turning slowly so as not to bend the needle.

5. Idling and other operating performance features will be adversely affected if the jet needle is not installed correctly in the suction piston. Set the jet needle in the suction piston so that the shoulder portion is flush with the bottom of the suction piston. Apply an appropriate tool having a horizontal (flat) surface such as slide calipers to the lower end, as shown in Fig. EF-77, so that the shoulder of the jet needle contacts this surface, and tighten the jet needle set screw. The jet needle will then be installed correctly.

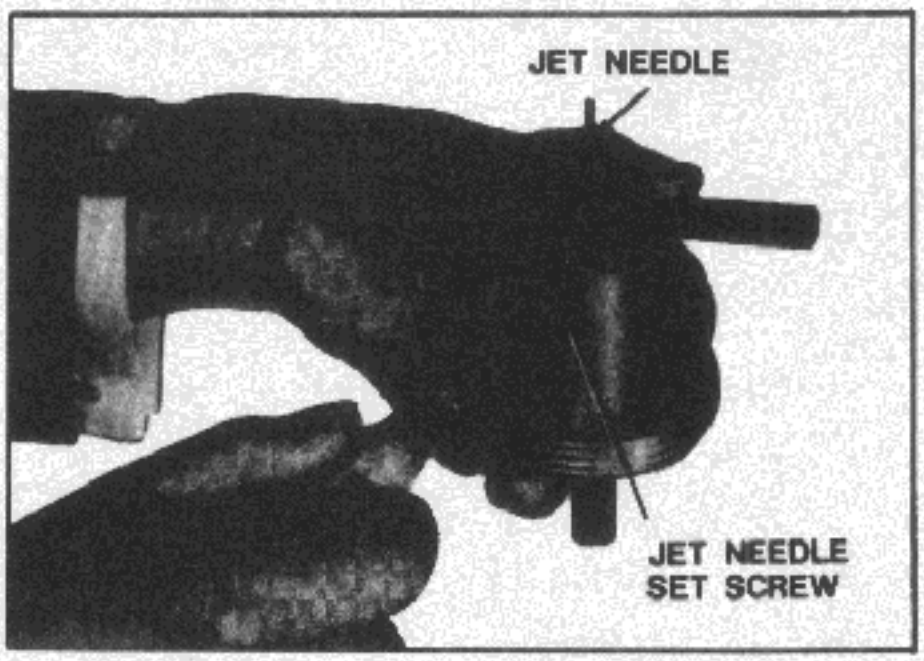


Fig. EF-77 Installing the jet needle

6. Wash the suction chamber and suction piston with clean gasoline, and dry with compressed air, so as to remove all dust, oil, etc. from the piston and chamber.

7. Then apply a few drops of light oil to the suction piston rod, and reassemble. Under no circumstances should oil be applied to the inside the suction chamber or to the large end of the suction piston, since this may cause of trouble and result in improper or defective operation.

Disassembly and reassembly of the nozzle

1. Disassembly

The nozzle can be easily removed. However, unless absolutely necessary do not disassemble the nozzle since reassembly of the nozzle sleeve, washer, and nozzle sleeve set screw is extremely difficult.

(1) First, remove the 4 mm (0.1575 in.) diameter screw, and then remove the connecting plate from the nozzle head. This can be done easier by pulling lightly on the starter lever.
Next, loosen the clip, and remove the fuel line. The nozzle can then be removed. When the nozzle is removed, the jet needle will remain inside. Thus, be careful not to damage either the jet needle or nozzle and not to bend the jet needle.

(2) Next, remove the idling adjusting nut and idling adjusting spring.

(3) The nozzle sleeve can be removed by removing the nozzle sleeve set screw.
(Recommend this not be disassembled unless absolutely necessary.) Exploded view of disassembled parts is shown in Fig. EF-78.
The nozzle jet is the heart of the carburetor, and is a high precision component. To clean the nozzle, use gasoline and dry with compressed air.

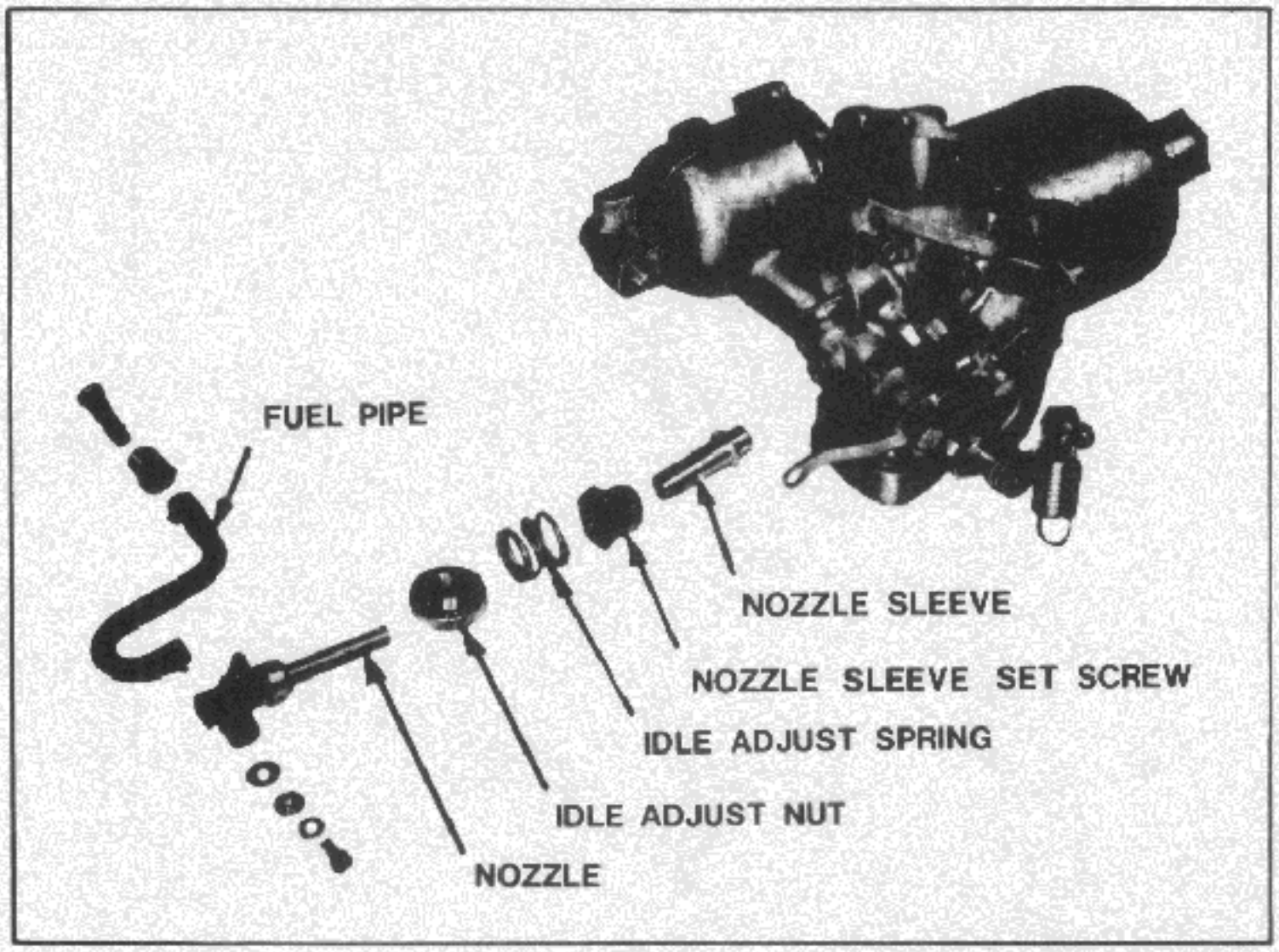


Fig. EF-78 Disassembly of nozzle

2. Assembly

(1) For centering the piston and suction chamber, remove the oil cap nut with the parts properly assembled (jet needle and suction piston assembled), without damper oil applied.

(2) Set the suction piston to its fully closed position, and insert the nozzle until it contacts the nozzle sleeve.

(3) When the nozzle jet contacts the jet needle, move the nozzle sleeve slightly so that it is at right angles to the center axis, and position the nozzle sleeve so that the nozzle jet does not contact the jet needle.

(4) Under the conditions described above, raise the suction piston with your finger, and lower it slowly. If the suction piston drops smoothly until the suction piston stop pin drops on the Venturi making a light striking sound, the condition of the piston is satisfactory. Securely tighten the nozzle sleeve at this position with the nozzle sleeve set screw.

(5) Remove the nozzle, install the idling adjusting spring and the idling adjusting nut on the nozzle sleeve, and re-apply the nozzle. Connect the fuel line leading to the float chamber to the nozzle nipple, and tighten the clip fully.
Tighten the fuel line at the position at which the enlarged part of the nipple holds and the fuel line is not twisted.

(6) Next, pull the starter lever lightly, hold connecting plate (A) with sleeve (C) and the 4 mm (0.1575 in.) diameter washer, and tighten it on the nozzle head with the 4 mm (0.1575 in.) diameter screw.
In doing this, move the starter lever slightly, and attach the sleeve (C) firmly to the connecting plate (A) opening.

(7) Upon completion of the reassembly, reconfirm that the suction piston drops smoothly.

Disassembly of the float chamber

Disassemble the float chamber in the sequence previously described under "Adjustment of the float level".

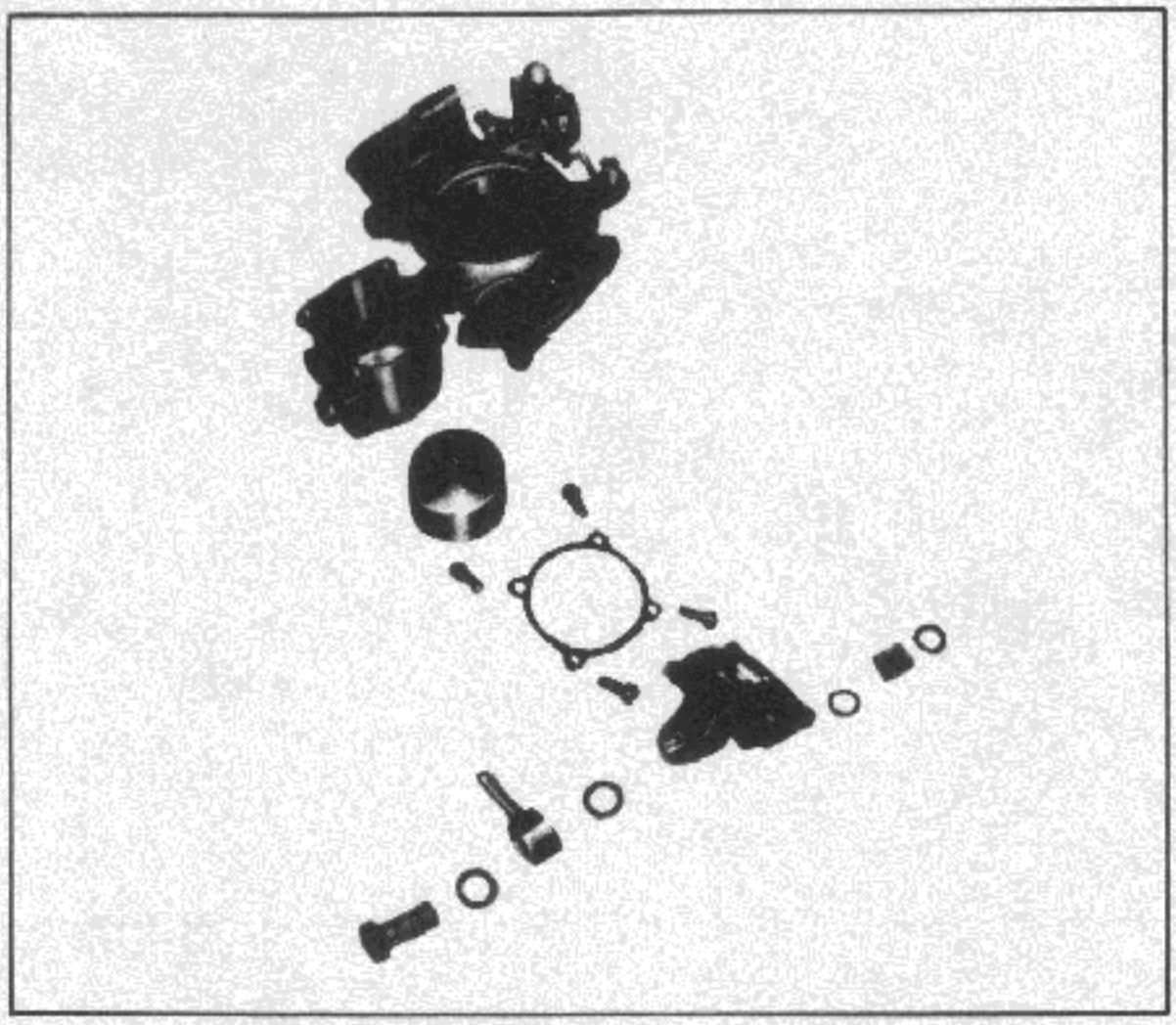


Fig. EF-79 Disassembly of float chamber

Disassembly of the link and related components

In disassembling and reassembling the interlock link and related components, be careful not to bend or deform any of the components.

Reassemble so that all interlock links operate smoothly.

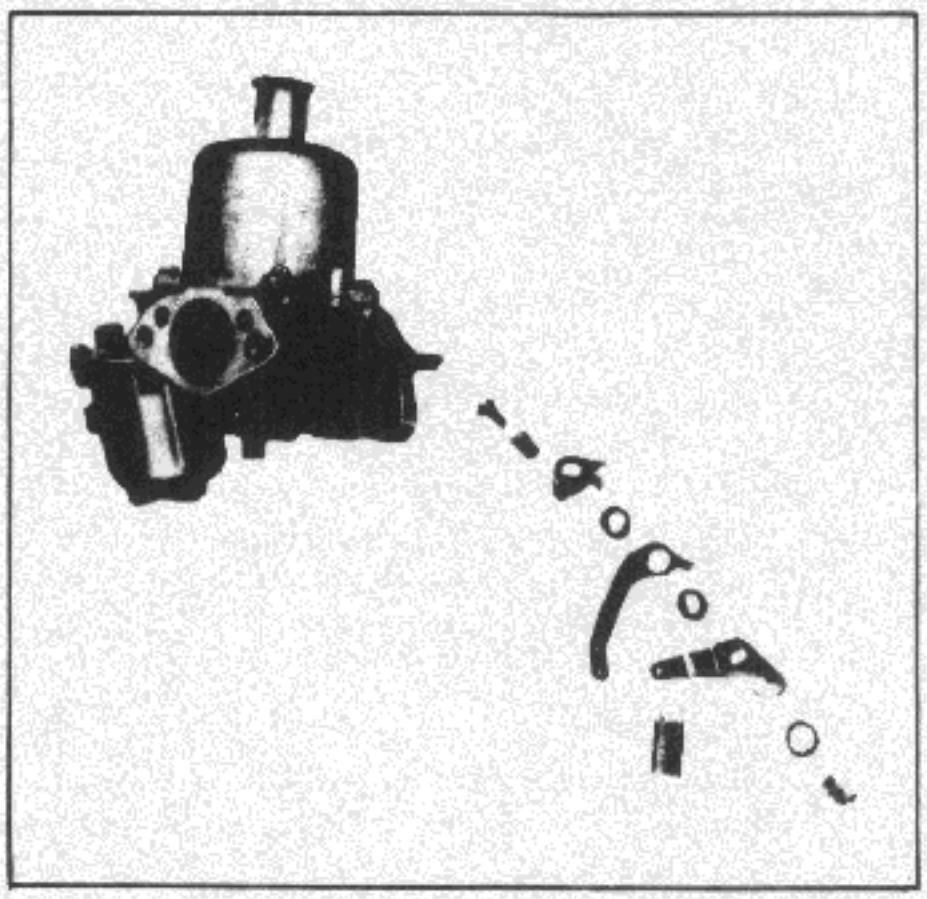


Fig. EF-80 Disassembly of throttle lever

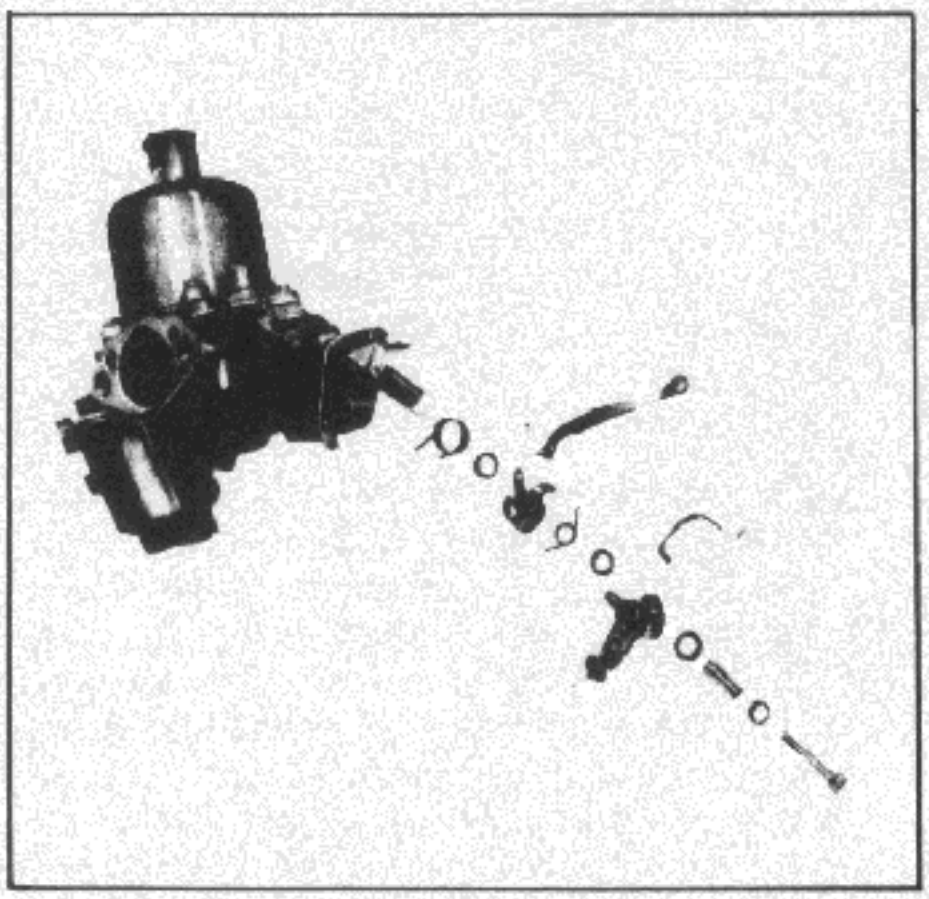


Fig. EF-81 Disassembly of starter lever

TROUBLE DIAGNOSES AND CORRECTIONS

The causes of trouble and appropriate corrective actions are shown on Table to permit immediate repair of the carburetor in the event carburetor trouble develops.

Improper engine operation can be attributed to many different causes. Although the carburetor may be normal, if the electrical system is defective, the cause of trouble sometimes may seem to be in the carburetor. If the engine does not operate satisfactorily, first check the electrical system before attempting to adjust the carburetor.

Troubles	Possible causes	Remedies
Overflow	Leakage from the float or float bent or damaged.	Replace the float.
	Dirty needle valve seat.	Clean the valve seat.
	Loose needle valve.	Retighten.
	Defective needle valve seat.	Refit or replace.
	Excessive fuel pump pressure.	Repair the pump.
	Fuel pump drawing in air.	Repair the pump.
Excessive fuel consumption	Overflow.	Described above.
	Faulty suction piston operation.	Described below.
	Defective nozzle return.	Readjust.
	Worn jet needle.	Replace.
	Worn nozzle jet.	Replace.
	Improper idling adjustment.	Readjust.
	Jet needle not properly installed.	Readjust.
	Improper throttle valve interlock adjustment.	Readjust.
Insufficient output	Throttle valve does not open fully.	Readjust.
	Faulty suction piston operation.	Described below.
	Defective nozzle return.	Readjust.
	Nozzle or fuel line clogged.	Clean.
	Jet needle not properly installed.	Readjust.
	Needle valve clogged.	Clean.
	Defective fuel pump.	Readjust.
Improper idling	Faulty suction piston operation.	Described below.
	Defective nozzle return.	Readjust.
	Worn jet needle.	Replace.
	Improper idling adjusting nut adjustment.	Readjust.

	Worn throttle valve shaft.	Replace.
	Air leakage due to defective packing between manifold and carburetor.	Replace the gasket.
	Improper throttle valve interlock adjustment.	Readjust.
	Loose throttle lever interlock link.	Readjust or repair.
Engine operation is irregular or erratic	Defective suction piston.	Described below.
	Insufficient damper oil, or improper oil used.	Replenish or replace.
	Improper idling adjustment.	Readjust.
	Jet needle not properly installed.	Readjust.
Engine does not start.	Overflow.	Described above.
	No fuel fed to the engine.	Check the pump, the fuel line, and needle valve.
	Improper idling adjustment.	Readjust.
	Defective suction piston.	Described below.
Faulty suction piston operation	Sticking due to dirt and other foreign matter.	Clean.
	Sticking due to deformation (bulging or caving) of suction chamber or suction piston.	Repair or replace.
	Nozzle not properly centered.	Correct.
	Bent jet needle.	Replace.
	Bent plunger rod.	Correct.

SPECIFICATIONS

Item \ Carburetor model	HJG 38W	HJL 38W
Applied engine	L20	L16
Bore diameter mm (in.)	38 (1.4961)	38 (1.4961)
Weight kg (lb.)	2.8 (6.16)	2.8 (6.16)
Nozzle	B	B
Needle valve mm (in.)	2.0 (0.0787)	2.0 (0.0787)
Jet needle	M-49	M-61
Suction spring	#23	#23
Float level mm (in.)	23 ± 1 (0.9055 ± 0.0394)	23 ± 1 (0.9055 ± 0.0394)
Fuel pressure kg/cm^2 (lb/in^2)	0.3 (4.267)	0.24 (3.414)

SERVICE MANUAL

MODEL A SERIES ENGINE

SECTION EC

EMISSION CONTROL SYSTEM

EC

POSITIVE CRANKCASE VENTILATION SYSTEM

CONTENTS

The positive crankcase ventilation system is standard equipment on these engines. There are two types of crankcase control devices. One is the tube-to-air cleaner device, and the other is the so called combination system (with valve controlled by intake manifold vacuum and tube-to-air cleaner device).

The tube-to-air cleaner device is standard equipment on model L13 engine, while the combination system is standard equipment on model L16 & L20 engines.

DESCRIPTION

Tube-to-air cleaner device

This system consists of a tube connecting the rocker cover to the carburetor air cleaner.

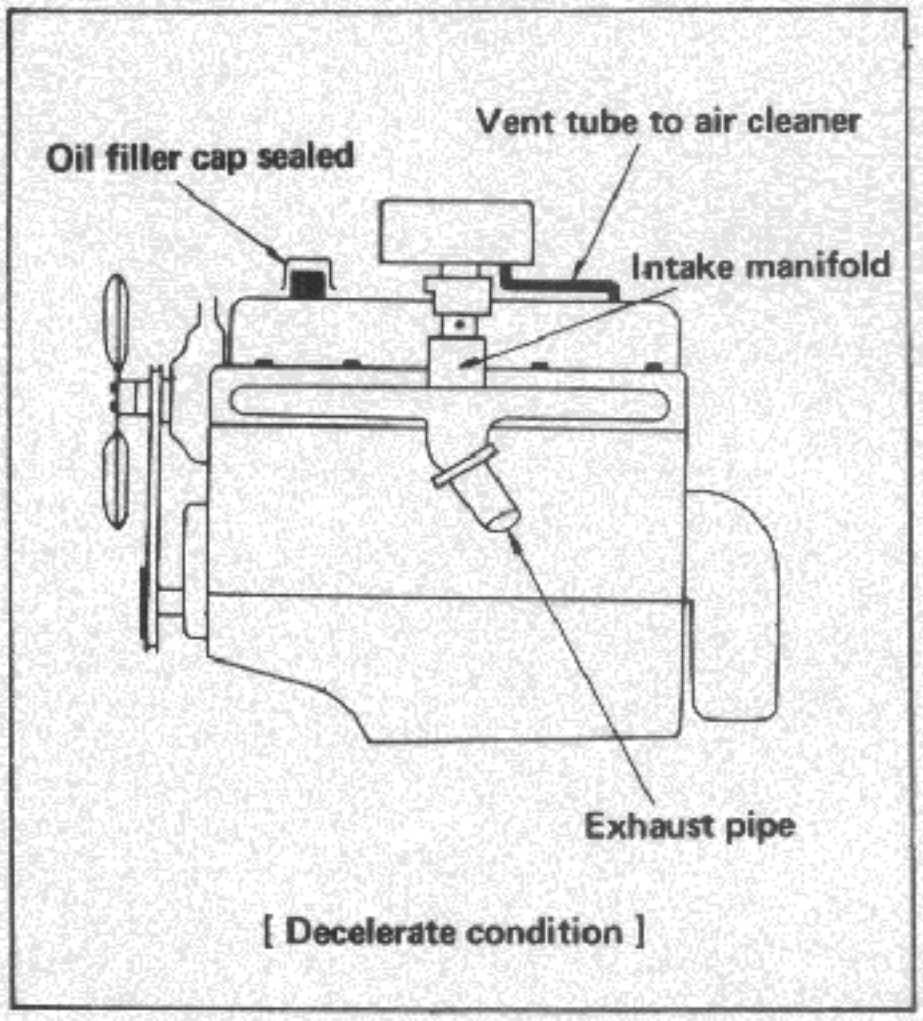


Fig. EC-1 Tube-to-air cleaner device

Flow is induced into the tube by pressure drop created when engine air flows through the air cleaner. This is referred to as a "sealed" system which provides an escape path for the blowby gases with no provision for the introduction of ventilation air into the crankcase. In connection with this system the oil filler cap and the oil level gauge have been changed from the open type to a sealed type to prevent the escape of crankcase emission.

Combination system

This system provides for the return of blowby gases to both the intake manifold and the carburetor air cleaner.

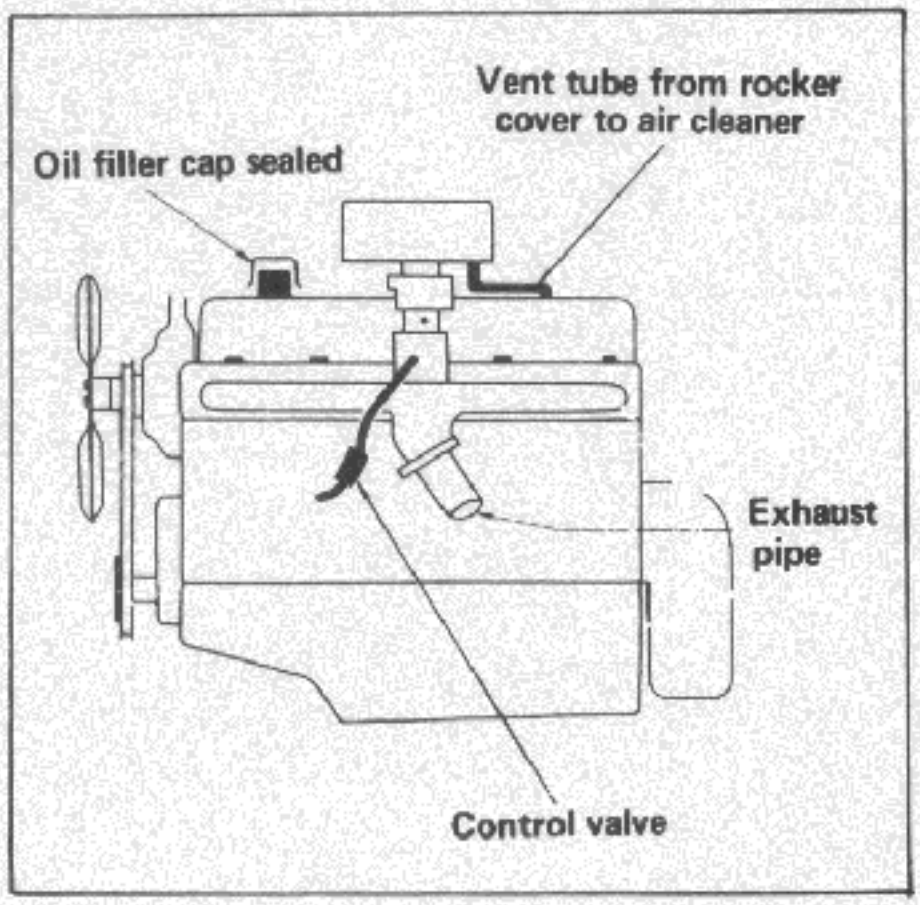


Fig. EC-2 Combination system

In addition to the already mentioned tube-to-air cleaner device, a variable orifice valve is provided to conduct crankcase blowby gases to the

intake manifold. During part-throttle operation of the engine the intake manifold sucks the blowby through the valve. Normally, the capacity of the valve is sufficient, under these conditions, to handle the blowby plus a small of ventilating air. The ventilating air is then drawn from the clean side of the carburetor air cleaner, through the tube connection, into the crankcase.

Under full-throttle conditions, the manifold vacuum is insufficient to draw the blowby flow through the valve, and the blowby flow goes through the tube-to-air cleaner in the reverse direction. In cars having excessively high blowby some of the flow will go through the tube connection to the carburetor air cleaner under all conditions.

MAINTENANCE AND ADJUSTMENT

With engine running at idle, remove the ventilator hose from the rocker cover, if the valve is working, a hissing noise will be heard as air passes through the valve and a strong vacuum should be felt immediately when a finger is placed over the valve inlet.

If valve is plugged, do not attempt to clean it. Replace with a new valve. Check for deposit plugging in the hose. Clean if necessary.

PERIODIC SERVICE

Once at 20,000 km (12,000 miles), the Positive Crankcase Ventilation System should be serviced as follows:

1. Disconnect all hoses and blow them out with compressed air. If any hose cannot be freed of obstructions, replace with new hose.

2. Check for proper function of crankcase ventilation control valve.

3. Clean crankcase and intake manifold connectors, using care not to allow dirt to enter openings.

4. Remove crankcase oil filler cap. Clean cap in solvent and blow dry.

SERVICE JOURNAL OR BULLETIN REFERENCE

DATE	JOURNAL or BULLETIN No.	PAGE No.	SUBJECT

SERVICE MANUAL

MODEL L SERIES ENGINE

NISSAN

SECTION EE

ENGINE ELECTRICAL SYSTEM

STARTING CIRCUIT

The electrical system operates on 12 volts. This section of the manual is subdivided into the following sections which pertain to engine electrical.

1. Starting motor 2. Alternator 3. Regulator 4. Ignition coil 5. Spark plugs

Information pertaining to body electrical, such as the lighting circuit, instrument and windshield wipers will be found in section BE.

STARTING MOTOR

CONTENTS

SPECIFICATIONS

	L20 engine	L13, L16 engine
Type	HITACHI S114-88	HITACHI S114-103
Voltage	12 volts	
Output	1.0 kw	
Starting current (voltage)	Less than 420 amps. (6 volts)	Less than 480 amps. (6 volts)
Lock torque	More than 1.0 kg-m (7.23 ft-lbs.)	More than 1.1 kg-m (7.95 ft-lbs.)
No load current (voltage)	Less than 60 amps. (12 volts)	
No load starter revolution	More than 6,000 r.p.m.	More than 7,000 r.p.m.
Shift type of pinion gear	Magnetic shift	
Number of teeth on pinion gear	9	
Number of teeth on ring gear	120	
Weight	5.4 kg (11.88 lb.)	5.1 kg (10.42 lb.)

DESCRIPTION

The starting system permits the engine to be cranked by turning the ignition switch to "start" position. While the ignition switch is turned to "start" position, the starting motor continues operation until the engine starts running on its own power, then the starting motor current is opened and the motor is disengaged by turning the ignition switch on to "ON" position. This starting motor utilizes an enclosed over-running clutch type and the compound motor as described following. The solenoid switch is mounted onto the yoke.

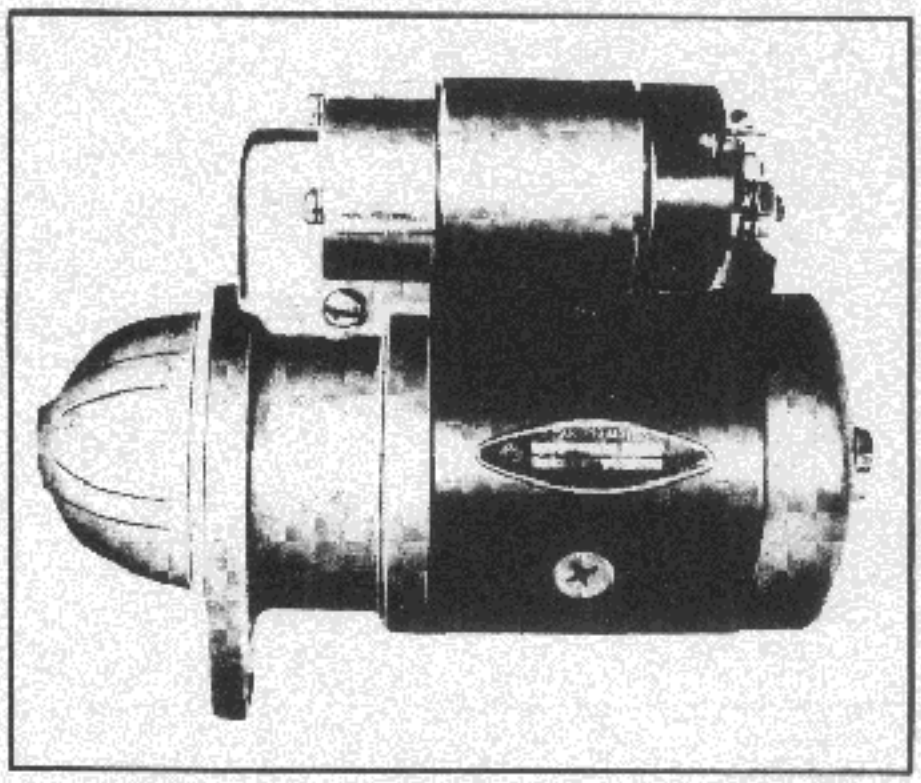
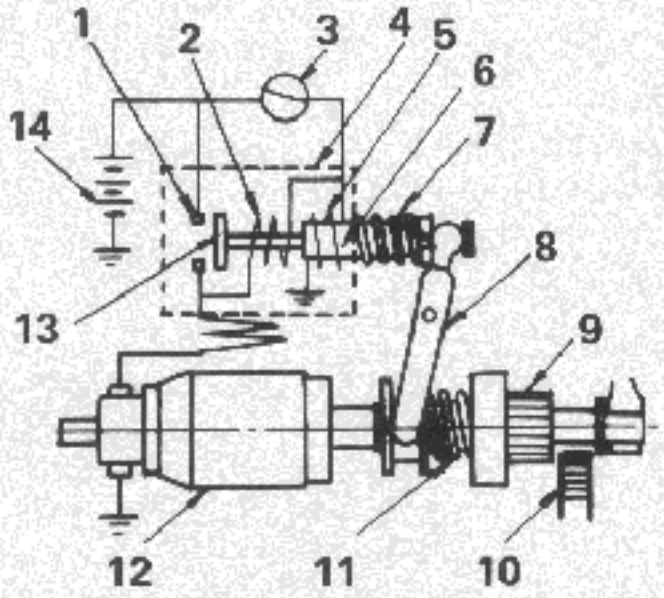


Fig. EE-1 S114-103



1.	Stationary contact	8.	Shift lever
2.	Series coil	9.	Drive pinion
3.	Ignition switch	10.	Ring gear
4.	Solenoid	11.	Pinion sleeve spring
5.	Shunt coil	12.	Armature
6.	Plunger	13.	Movable contactor
7.	Return spring	14.	Battery

Fig. EE-2 Starting motor circuit

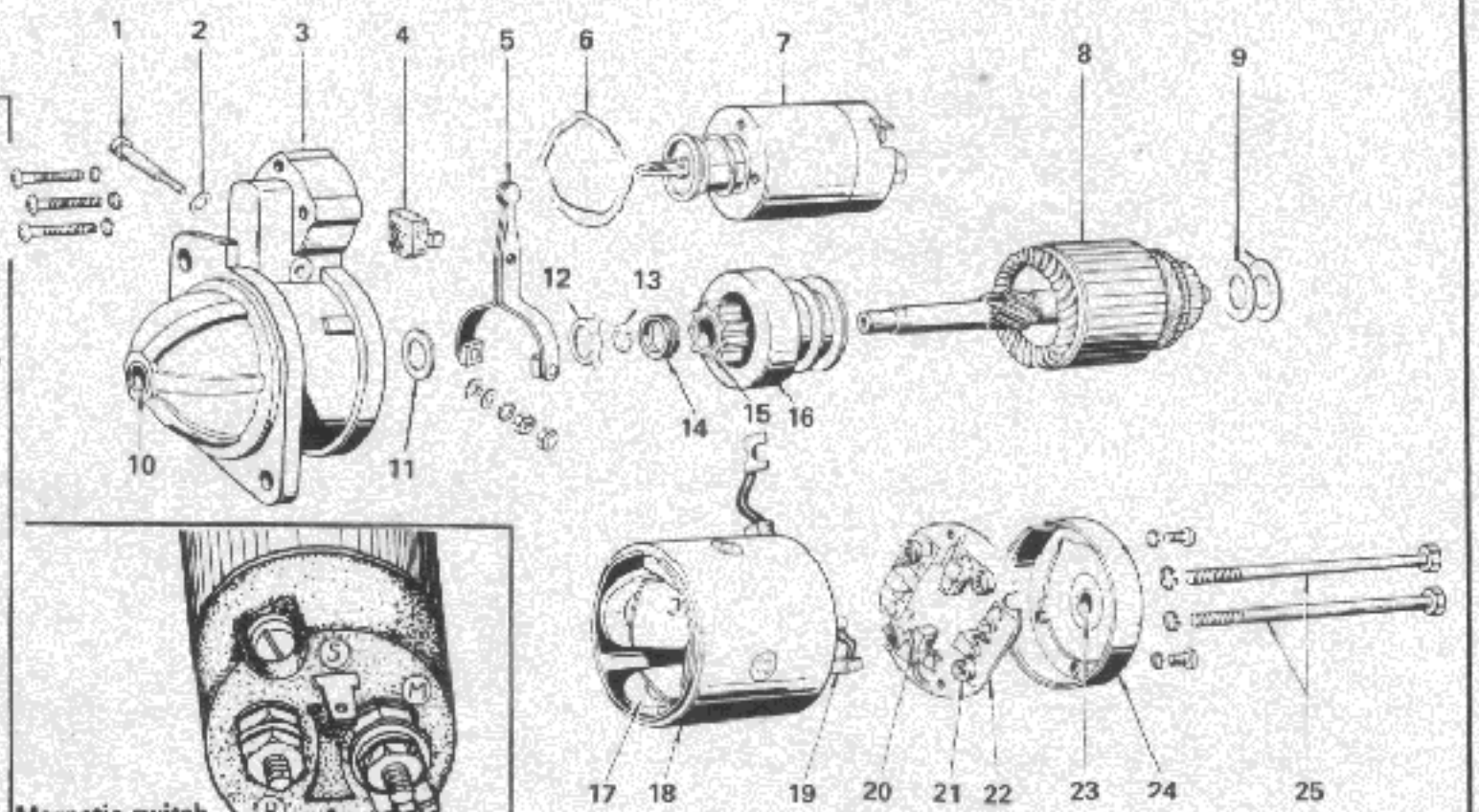
OPERATION

When the ignition switch is turned on to "start" position, current flows through the "series" and "shunt" coils of the solenoid and magnetize the solenoid. The plunger is pulled into the solenoid so that it operates the shift lever to move the drive pinion into engagement with flywheel ring gear and then closes the solenoid switch.

Closing of the contacts (stationary and movable) causes the motor to crank the engine and also cuts out the "series" coil of the solenoid, the magnetic pull of the "shunt" coil being sufficient to hold the pinion in mesh after the shifting has been performed.

After the cranking, and when the ignition switch is turned to "ON" position, the "series" coil demagnetizes against the "shunt" coil, then the return spring actuates the plunger to return to the original position, consequently stops the motor. More positive meshing and demeshing of the pinion and the ring gear teeth are secured by means of the over-running clutch. The over-running clutch employs a shift lever to slide the pinion along the armature shaft and into, or out of, mesh with the ring gear teeth. The over-running clutch is designed to transmit driving torque from the motor armature to the ring gear, but permit the pinion to over-run the armature after the engine has started.

CONSTRUCTION



1. Shift lever pin
2. Packing
3. Gear case
4. Dust cover
5. Shift lever
6. Dust cover
7. Magnetic switch ass'y
8. Armature
9. Thrust washer
10. Metal
11. Thrust washer
12. Stopper washer
13. Stopper clip
14. Pinion stopper
15. Pinion
16. Over running clutch
17. Field coil
18. Yoke
19. Brush(+)
20. Brush(-)
21. Brush spring
22. Brush holder ass'y
23. Metal
24. Rear cover
25. Through bolt

Fig. EE-3 S114-103 Construction

REMOVAL

1. Disconnect the battery ground cable.
Disconnect the black wire with yellow tracer from the magnetic switch terminal, and black battery cable from the magnetic battery terminal.

2. Remove two bolts securing the starting motor to the clutch housing. Pull starter assembly forward and remove starting motor.

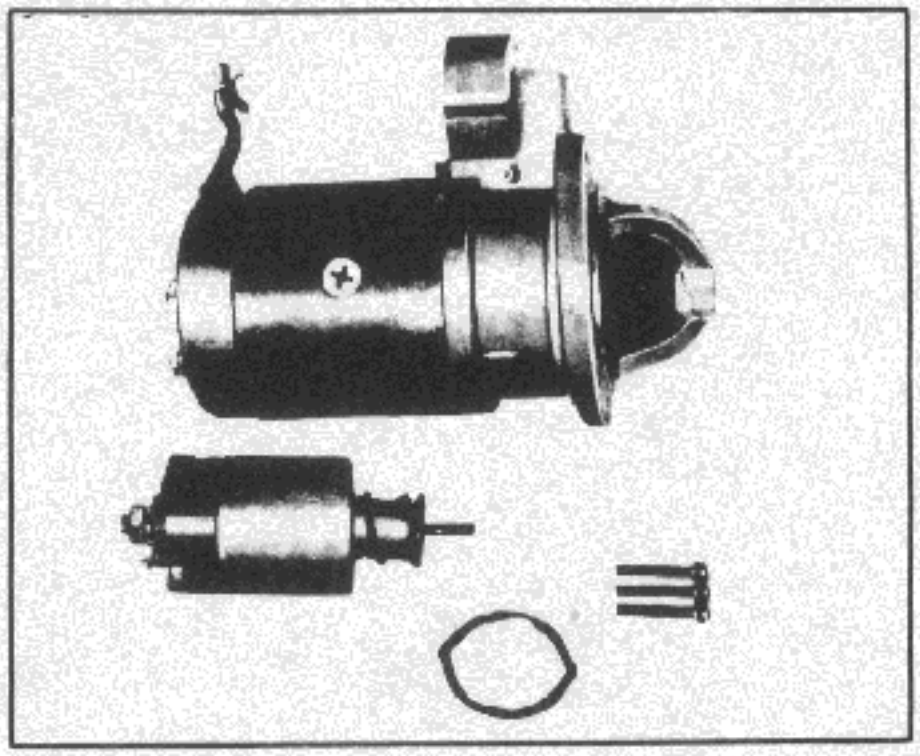


Fig. EE-4 Removing magnetic switch assembly

DISASSEMBLY

1. Loose the nut securing the connecting plate to the magnetic switch "M" terminal. Remove three screws securing magnetic switch and remove magnetic switch assembly.

2. Remove two through bolts and brush cover assembly.

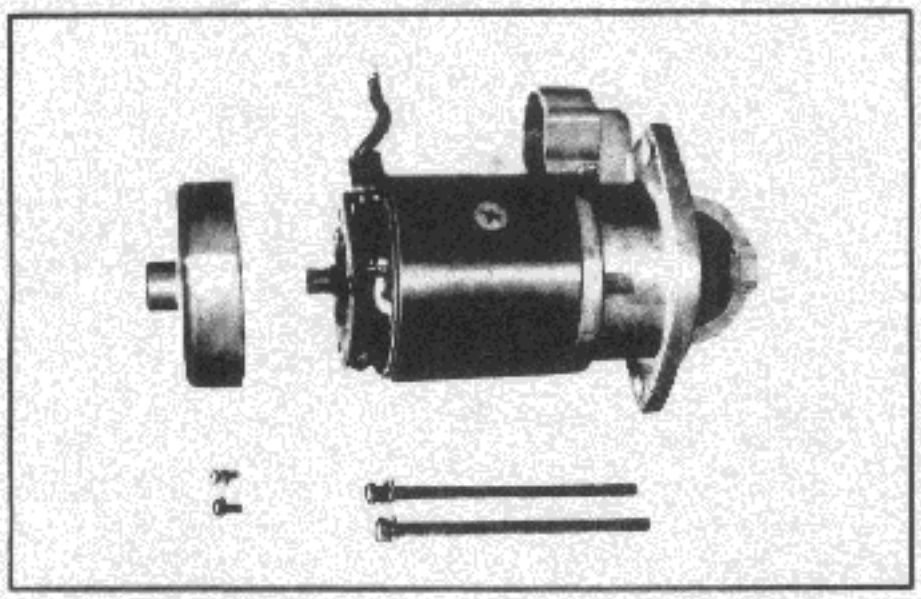


Fig. EE-5 Removing the brush cover

3. Remove the yoke assembly by hitting lightly with a wooden hammer.

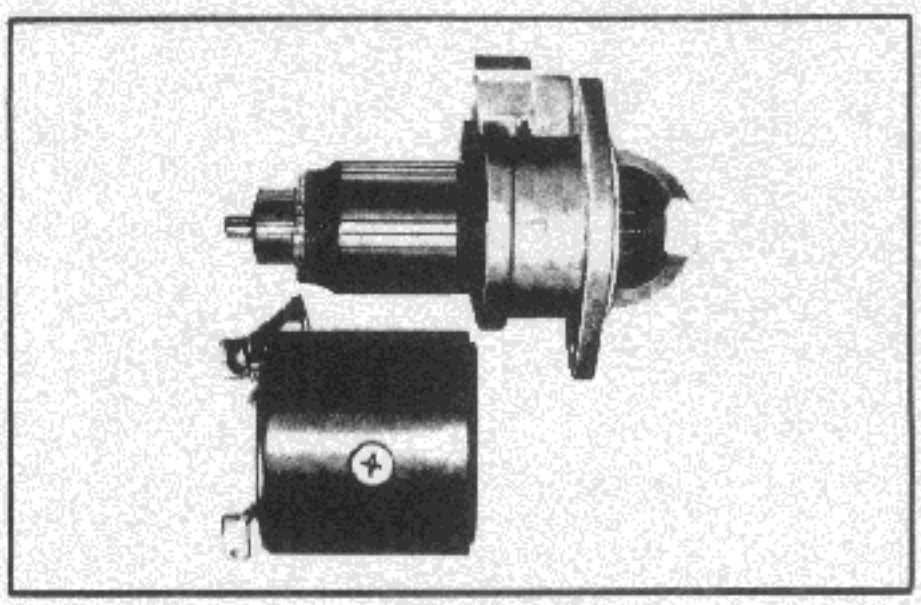


Fig. EE-6 Removing the yoke assembly

4. Withdraw the armature assembly and shift lever.

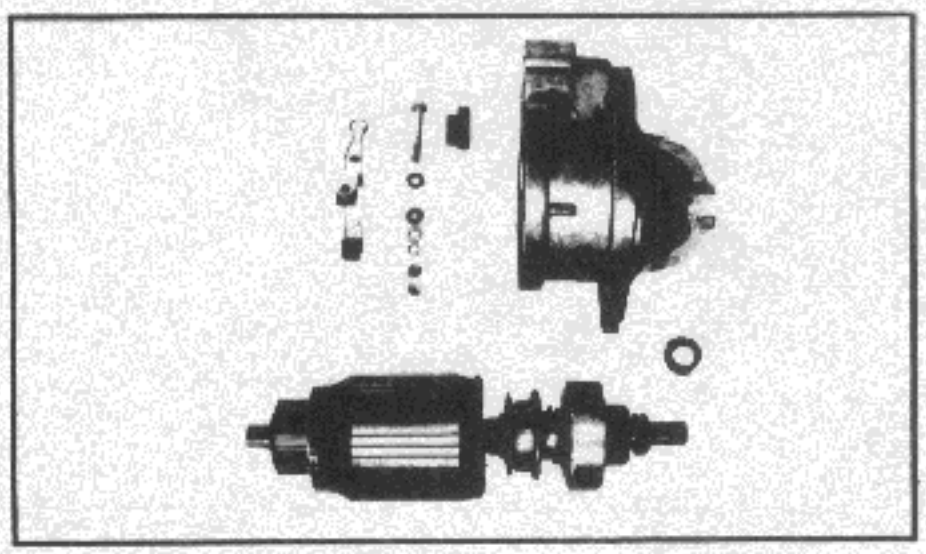


Fig. EE-7 Removing the armature assembly and shift lever

5. Remove the pinion stop ring located at the end of the armature shaft. To remove the stop ring, firstly push the stop ring to the clutch side and then, after removing the snap ring, remove the stop ring with the over-running clutch. Withdraw the over-running clutch assembly from the armature shaft.

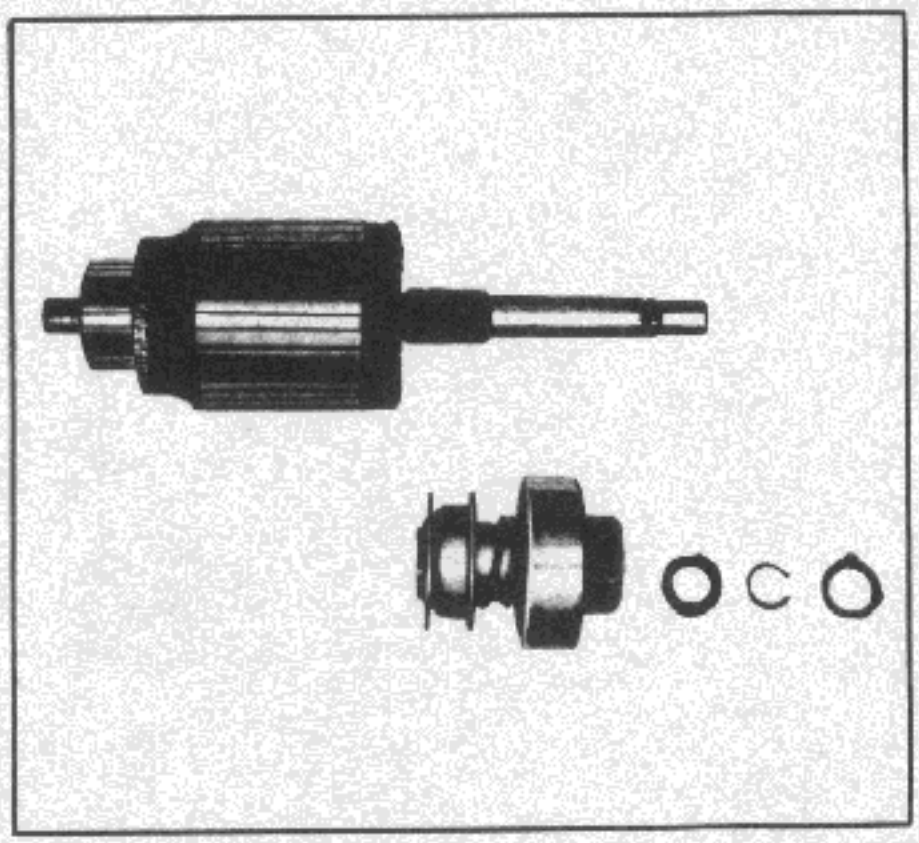


Fig. EE-8 Removal of the over-running clutch assembly

6. Dissolder the brushes, using a soldering-iron and remove each brush.

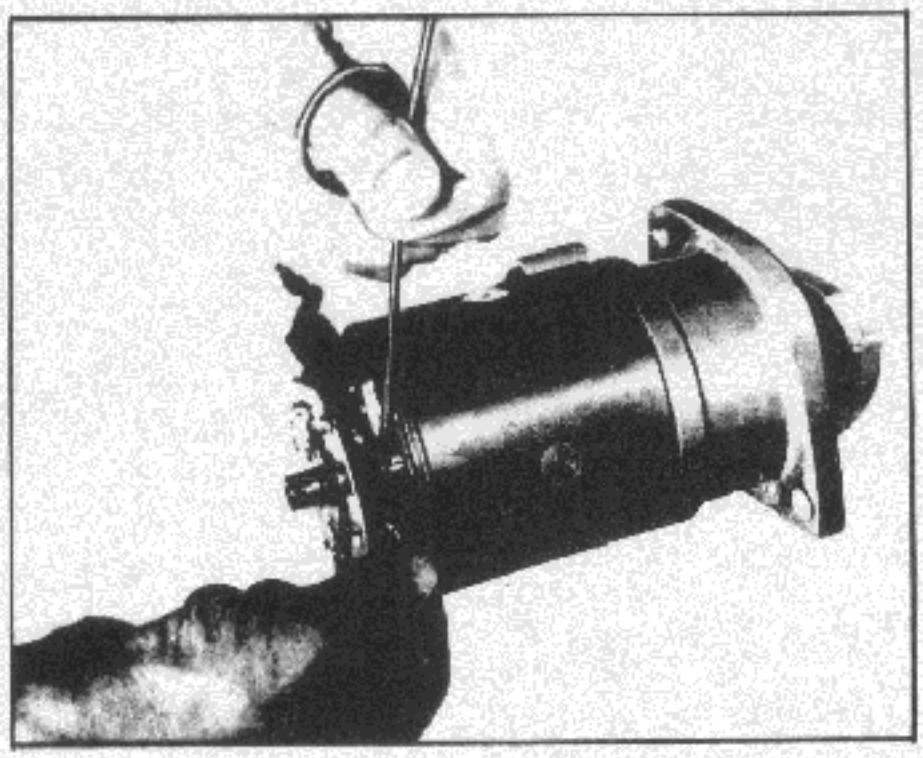


Fig. EE-9 Removing brush

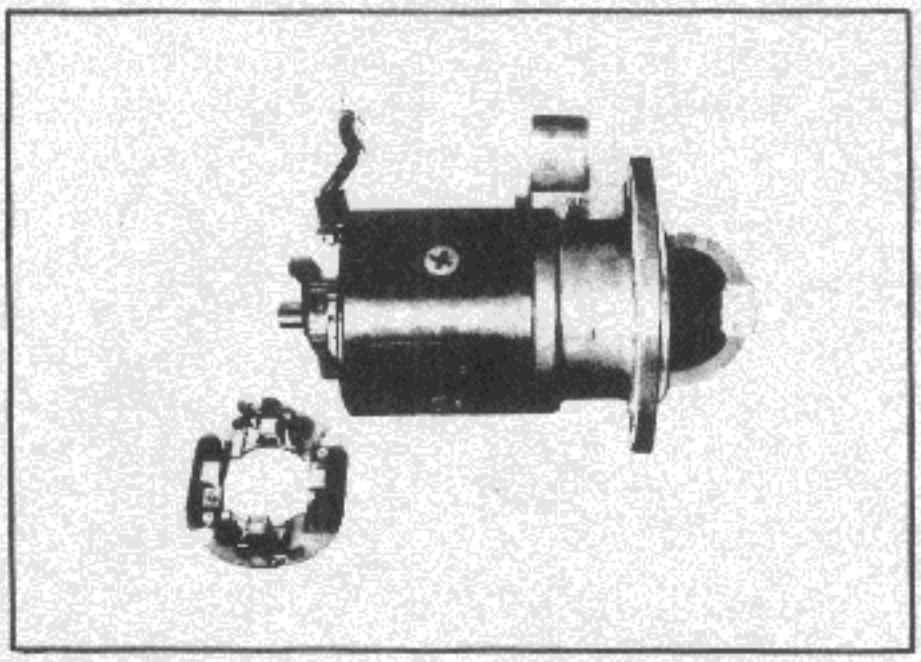


Fig. EE-10 Removing brush holder

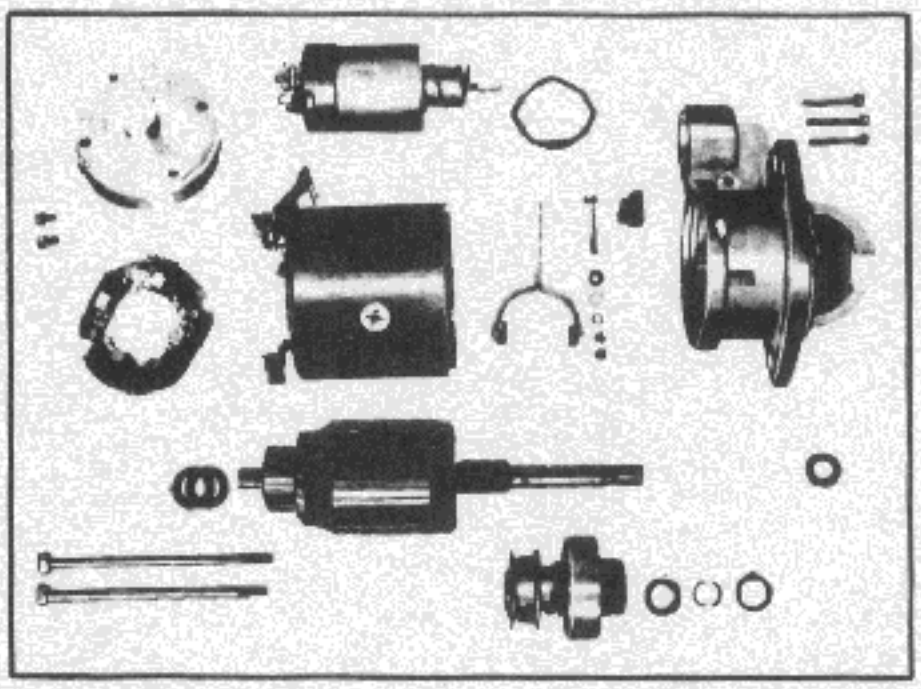


Fig. EE-11 Disassembly

CLEANING AND INSPECTION

Clean all disassembled parts, but do not use grease dissolving solvents for cleaning the over-running clutch, armature assembly, magnetic switch assembly and field coils since such a solvent would dissolve the grease packed in the clutch mechanism and would damage the coils or other insulators.

Check them for excessive damage or wear, and they should be replaced if necessary.

Terimal

Check for damage and wear, and replace if necessary.

Field coil

Check the field coil insulation. If the insulation of the coil is damaged or worn it should be replaced.

Field coil test for continuity:

Connect the test probe of a circuit tester or an ohmmeter to field coil positive terminal and positive brush holder.

If the tester shows no conduction the field circuit or coil is open.

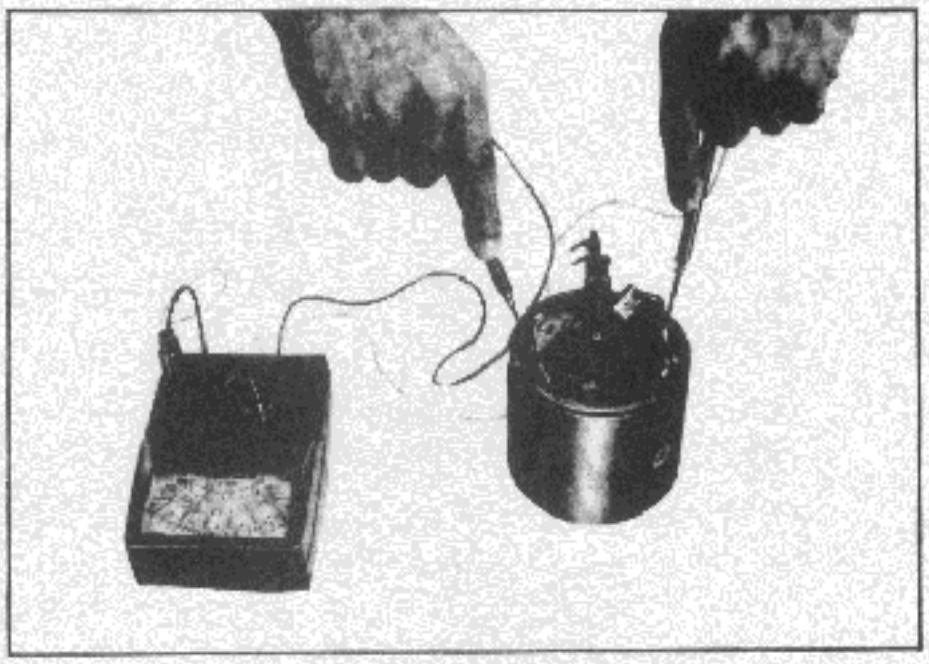


Fig. EE-12 Field coil test for continuity

Field coil test for ground:

Place one probe of the circuit tester onto the yoke and the other on to the field coil lead (positive terminal).

If very little resistance is read, the field coils are grounded.

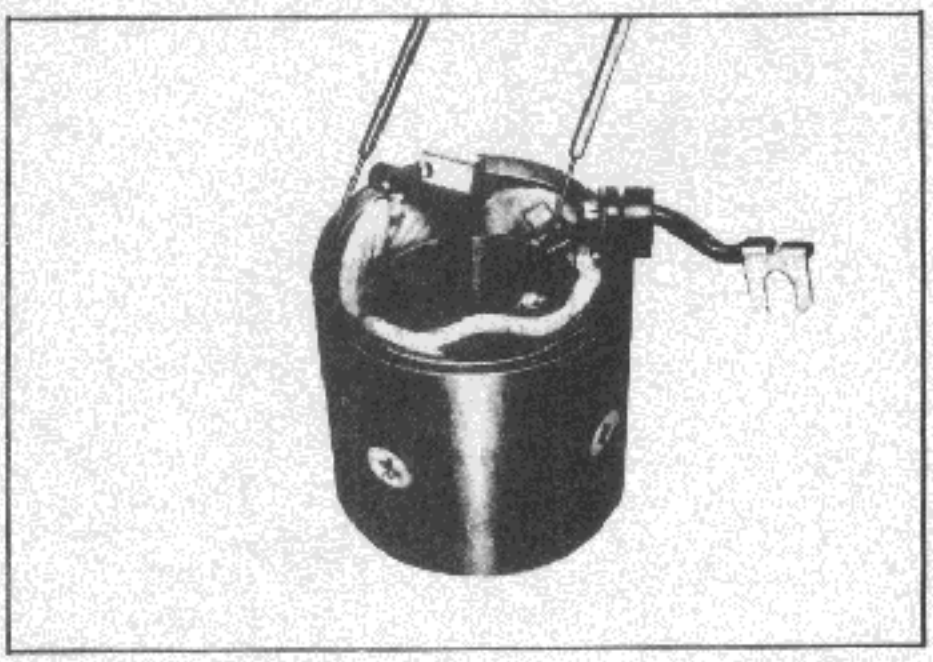


Fig. EE-13 Field coils test for ground

Field coil test for short:

Dissolder the connecting section of each coil and proceed to the same mentioned above.

If a defective coil is found, it should be replaced.

Brushes and brush lead wire

Check the condition of the brush contact surface and wear of the brush. If a loose contact may be found it should be replaced.

If the brush wear until its height is less than 6.0 mm (0.2362 in.), replace it.

Check the connection of the lead clip and lead wire.

Check brush holders and spring clip to see that they are not deformed or bent, but will properly hold brushes against the commutator.

If the brushes or brush holders are dirty, they should be cleaned.

Brush spring tension

Check the brush spring tension by a spring scale as shown in Figure EE-14. The reading should be 0.8 kg (1.76 lbs.). Replace the spring if the tension is lower than 0.7 kg (1.54 lbs.).

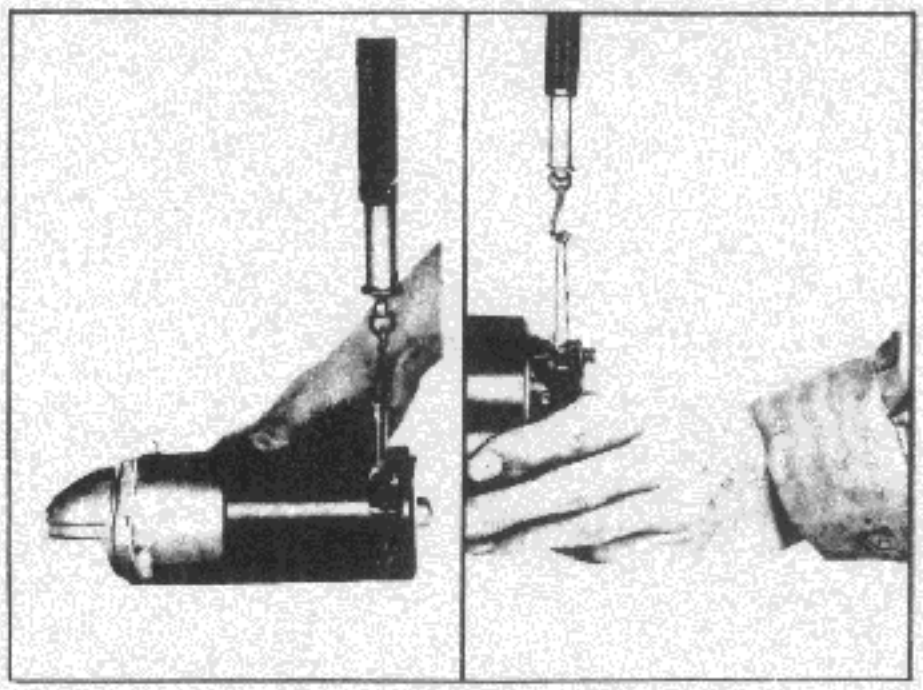


Fig. EE-14 Inspection of brush spring tension

Armature assembly

Check external appearance of the armature and the commutator.

1. Measure the armature shaft for bend by a dial gauge. Replace the armature shaft if the bend exceeds 0.08 mm (0.0031 in.).

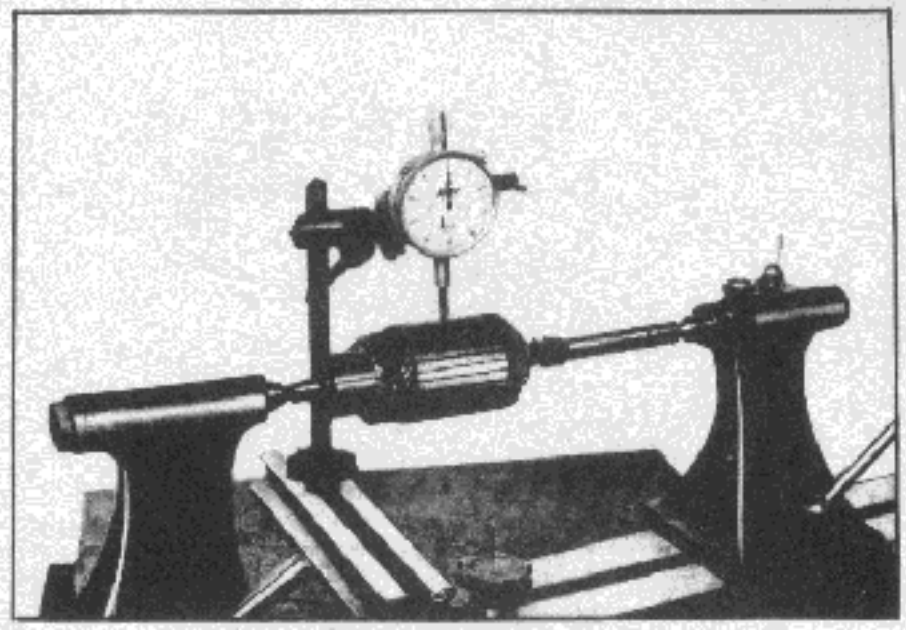


Fig. EE-15 Inspection of armature shaft for bend

2. Inspect the commutator. If the surface of the commutator is rough, it must be sanded lightly with a No. 500 emery paper. The commutator must be checked also for out-of-round. If the out-of-round is more than 0.2 mm (0.0079 in.), or the depth of the insulating mica is less than 0.2 mm (0.0079 in.) from the commutator surface, the commutator (armature) should be turned in a lathe, so that the out-of-round is less than 0.05 mm (0.0020 in.). Insulating mica should be also under-cut so that the depth of it is from 0.5 to 0.8 mm (0.0197 to 0.0315 in.).

The wear limit of the commutator diameter is 2 mm (0.0787 in.). If the commutator is beyond repair, replace it.

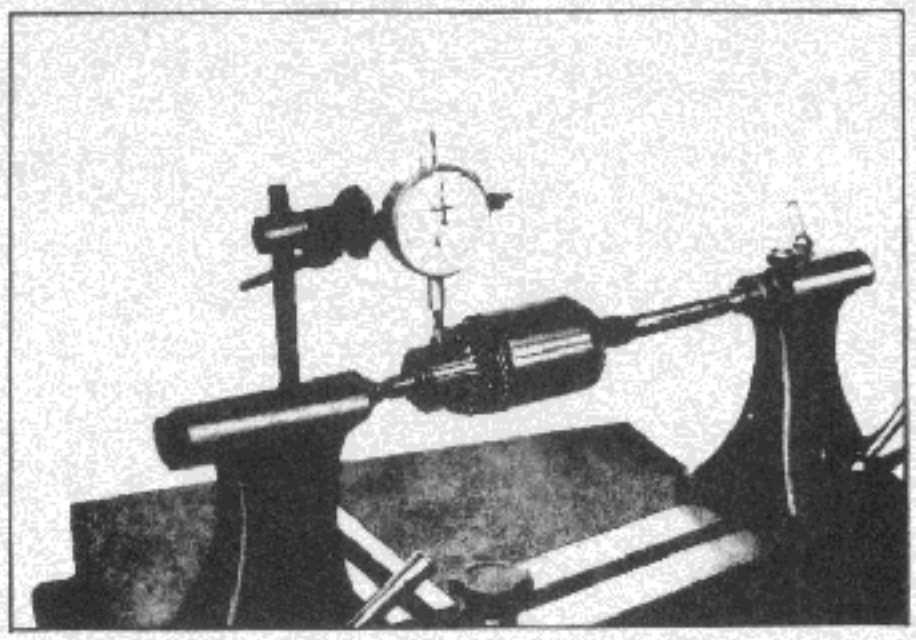


Fig. EE-16 Inspection of commutator

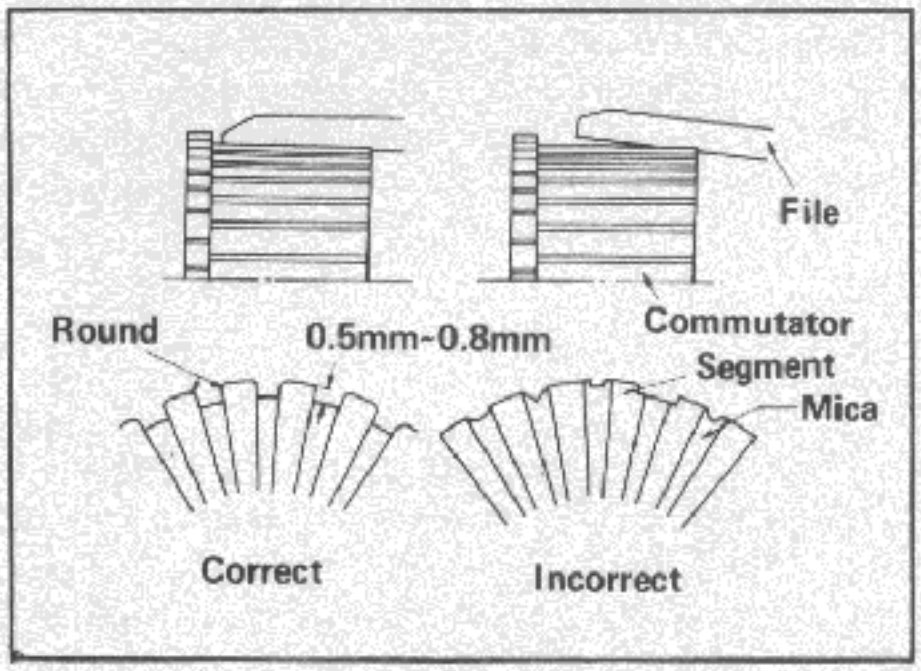


Fig. EE-17 Undercutting insulating mica

3. Inspect the soldered connection of armature lead and commutator. If the loose connection is found, solder it using rosin flux.

4. Armature test for ground

Using a circuit tester, place one test probe on to armature shaft and other on to each commutator bar.

If the tester shows conductive, armature is grounded and must be replaced.

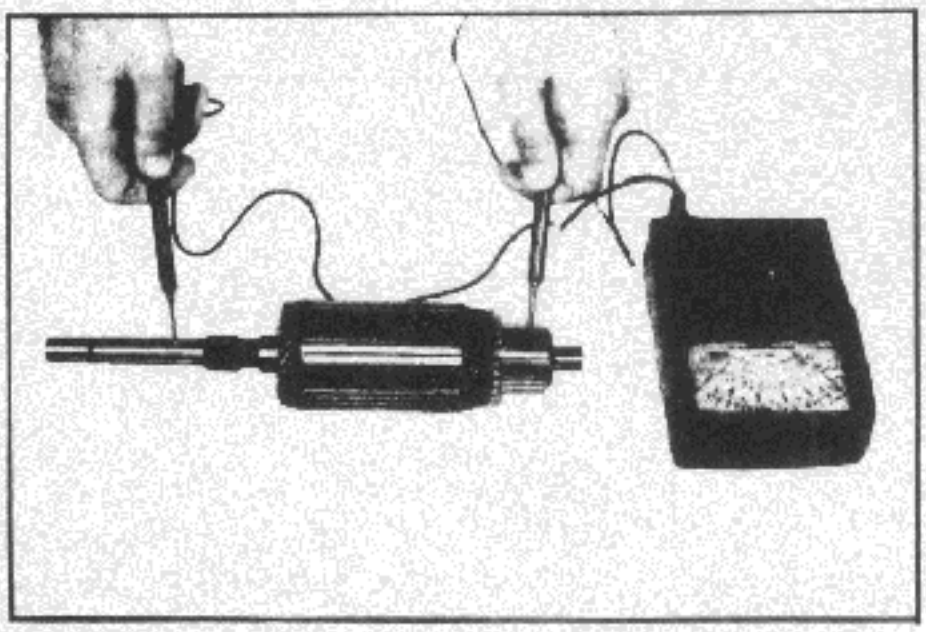


Fig. EE-18 Armature test for ground

5. Check armature for shorts by placing on the armature tester and with hack-saw blade over armature core, rotate armature. If saw blade vibrates, armature is shorted.

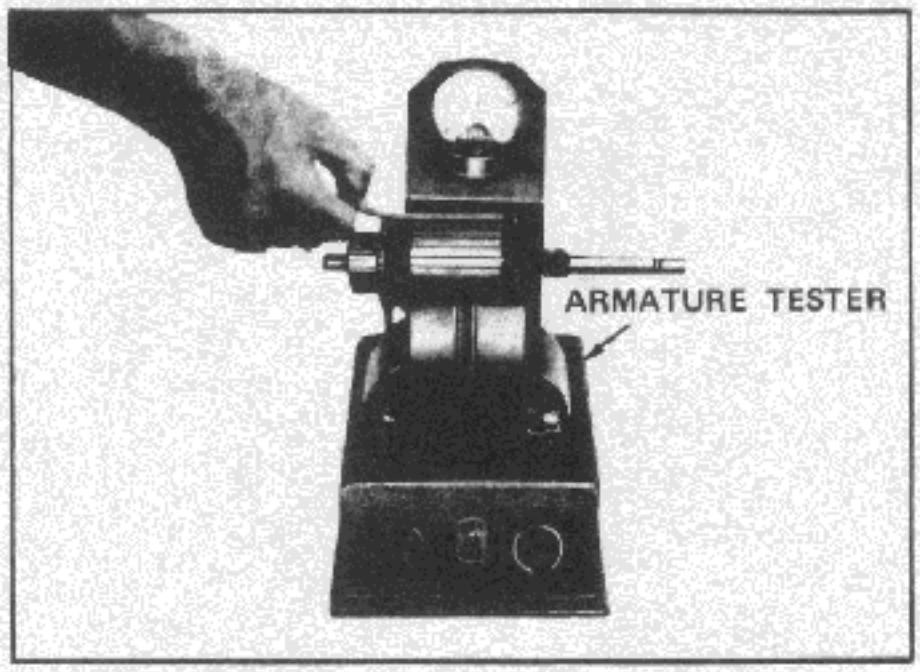


Fig. EE-19 Armature test for shaft

6. Check armature for continuity by placing the probes of tester on two segments side by side. If the tester shows no conduction, the circuit is open.

Over-running clutch assembly

Inspect the pinion assembly and screw sleeve. Screw sleeve must be freely slide along the armature shaft splined. If damages are found or resistance would be felt when sliding, it must be repaired. Inspect the pinion teeth. If excessive rubbing would be found on the teeth, it should be replaced. The flywheel ring gear also must be inspected.

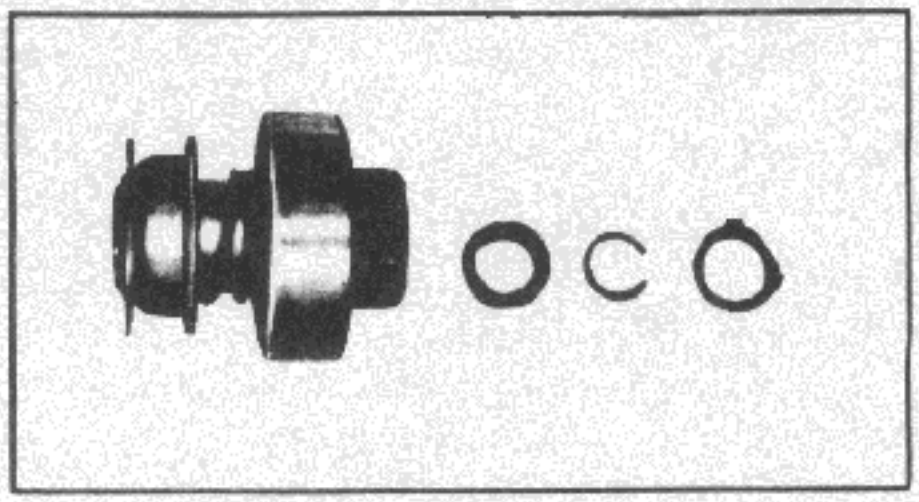


Fig. EE-20 Over-running clutch assembly

Brush holder test for ground

Using a circuit tester, place one test probe on to rear cover and another on to positive side brush holder. If the tester shows conduction the brush holder is shorted to ground. Replace an insulator or brush holder.

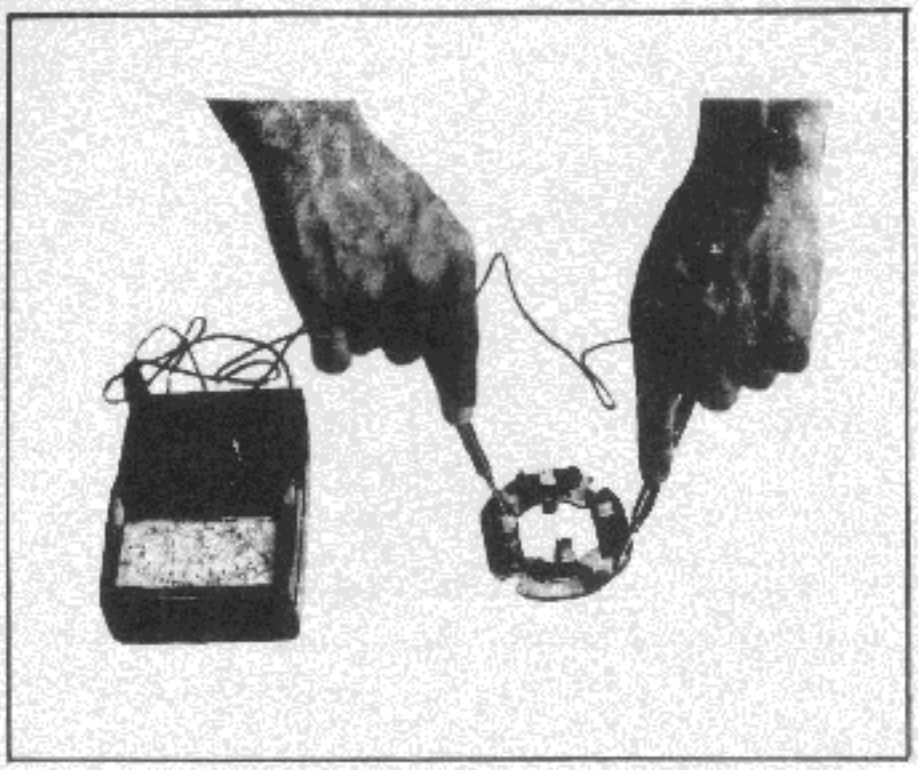


Fig. EE-21 Brush holder test for ground

Pinion case bearing metal

Inspect the bearing metal for wear or side play. If the clearance between the bearing metal and the armature shaft is more than 0.2 mm (0.0079 in.), replace the metal. Press in a new bearing and adjust the clearance to 0.03 to 0.10 mm (0.0012 to 0.0039 in.). The bearing metal should be so pressed in that the end of the bearing metal would be equal to gear case end plane.

Magnetic switch assembly

Inspect the magnetic switch contacts. If a rough welding be found on the contact it should be repaired.

ASSEMBLY

Assembling is a reversal of the disassembly procedure.

When assembling, pack the grease in the rear case and apply light coat of oil to the rear cover bearing metal and pinion.

TEST

Performance test

The starter motor should be subjected to a "no-load" and a "lock-torque" test whenever it has been overhauled to ensure that its performance will be satisfactory when installed to the engine. The starter motor should also be subjected to these tests when the cause of abnormal operation is to be determined. A brief outline of the two tests is given below.

No-load test

Connect the starting motor in series with the specified (12 volts) battery and an ammeter capable of indicating 1,000 amperes.

Specified current draw and revolution in these test are shown in "specification".

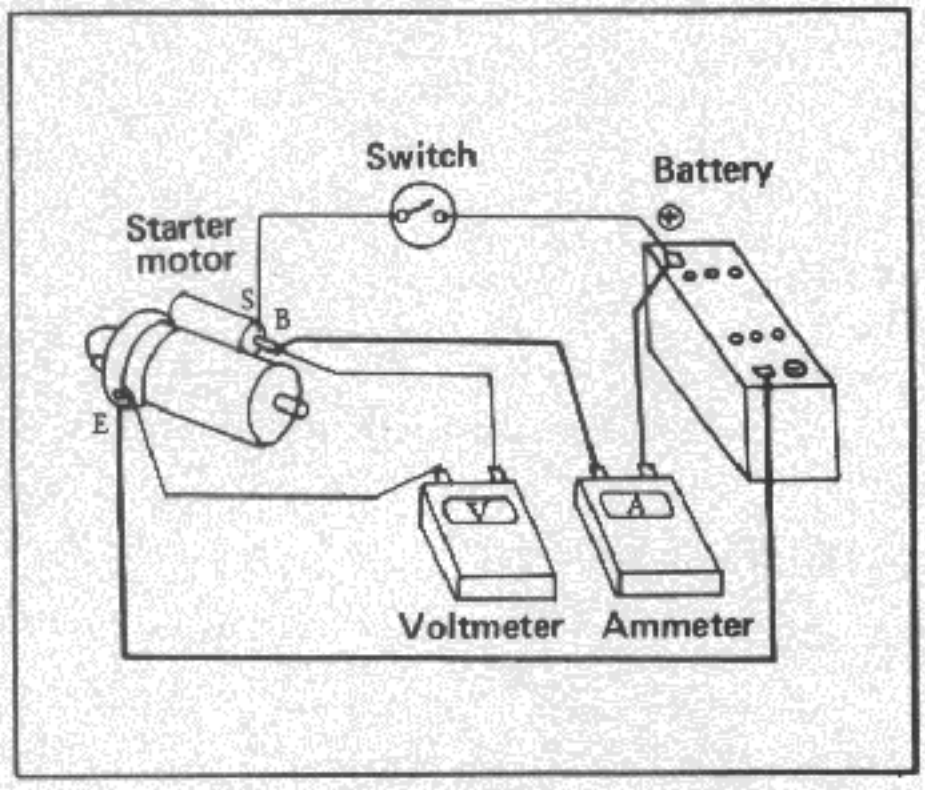


Fig. EE-22 No-load test

Torque test

Torque testing equipment should be used to determine the torque the motor will develop. A high current carrying variable resistance should be connected into the circuit so that the specified voltage at the starting motor may be obtained, since a small variation in the voltage will produce a marked difference in the torque development.

Specified power, voltage and torque are shown in Figure EE-23 & EE-24.

≪ Performance Curve ≫

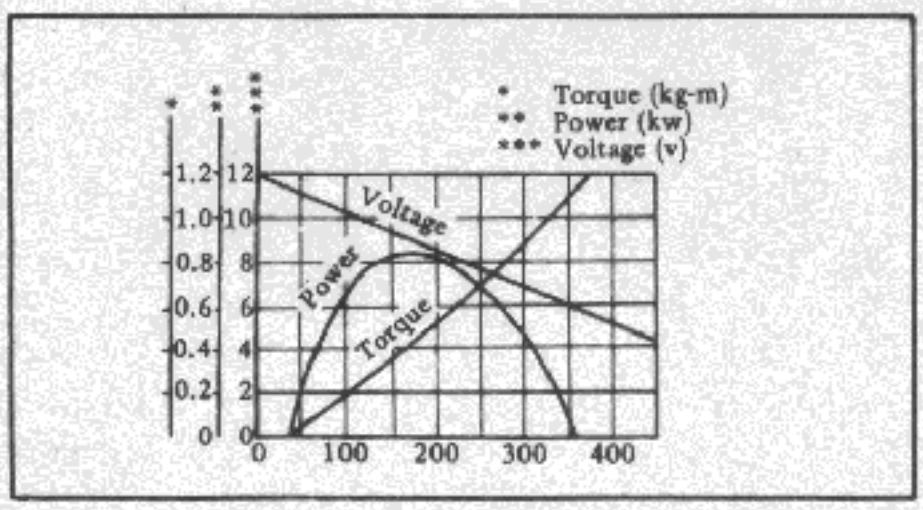


Fig. EE-23 S114-88

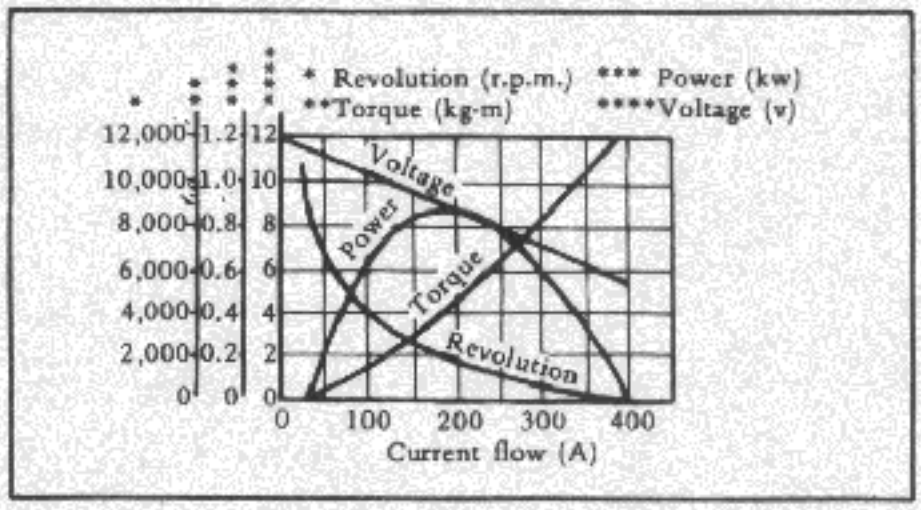


Fig. EE-24 S114-103

Diagnosis of test

Low speed with no-load and high current draw may result from followings.

(1) Tight, dirty or worn bearings

(2) Bent armature shaft or loosen field probe

(3) Shorted armature;

Check armature further.

(4) A ground armature of field;

Remove copper connector. Remove negative side brush and insulate it from the commutator before inspection. Using a circuit tester, place one probe on insulated terminal and another on rear cover. If the tester indicates conduction, remove other two brushes and check fields and armature separately to determine whether it is the fields or armature that is grounded.

2. Failure to operate with high current draw may result from followings.

(1) A grounded or open field coil:

Inspect the connection and trace the circuit by a circuit tester.

(2) The armature coil does not operate:

Inspect the commutator for excessive burned out. In this case, arc may occur on defective commutator, when the motor is operated with no-load.

(3) Burned out commutator bar:

Weak brush spring tension, broken brush spring, rubber brush, thrust out of mica in the commutator or a loose contact brush and commutator would cause to brun the commutator bar.

3. Low torque, low current draw and low no-load speed would cause high internal resistance due to loose connections, defective leads, dirty commutator and causes listed on item 2-(3).

4. High no-load speed with low developed torque would cause grounded field coil. Replace the field coil and check for improvement in performance.

Magnetic switch assembly test

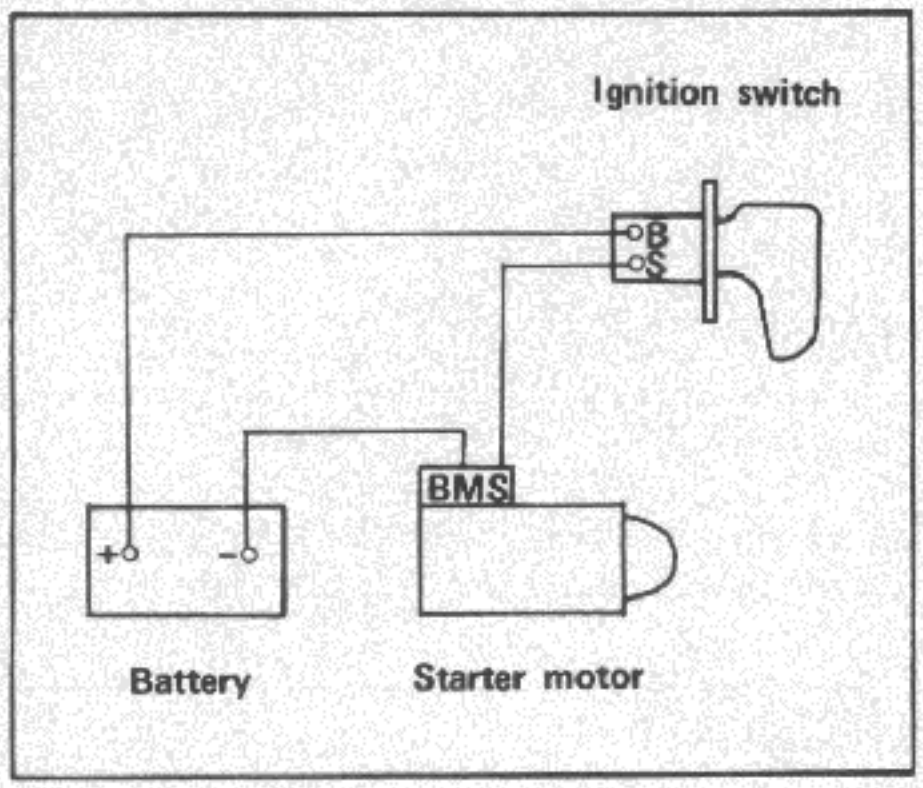


Fig. EE-25 Circuit of magnetic switch assembly test

If the starting motor check is "OK", check the magnetic switch assembly. Connect jumper cables between the "negative" battery terminal and the starting motor "M" terminal, the "positive" battery terminal and the starting motor "S" terminal connecting ignition switch in series as shown in Figure EE-25.

With the ignition switch on, measure the gap " ℓ " between the pinion front edge and the pinion stopper.

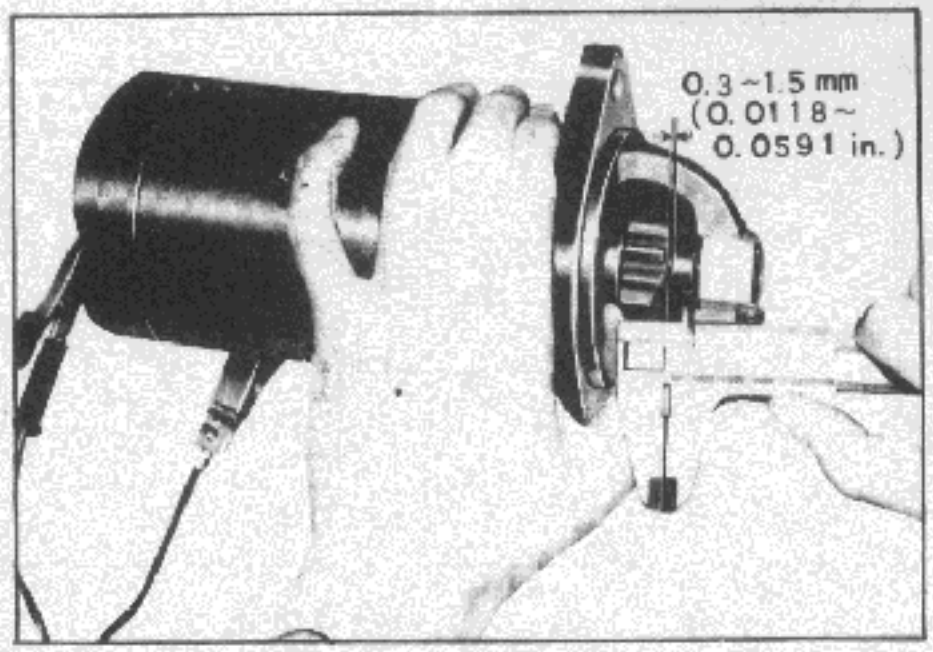


Fig. EE-26 Measurement of gap " ℓ "

SERVICE DATA

≪ S114-104 ≫

Armature shaft diameter (pinion side)	11.0 $\frac{-0.032}{-0.050}$ mm (0.4331 $\frac{-0.0013}{-0.0020}$ in.)
Armature shaft diameter (rear end)	11.5 $\frac{-0.032}{-0.050}$ mm (0.4528 $\frac{-0.0013}{-0.0020}$ in.)
Amendment limit of shaft diameter	0.1 mm (0.0039 in.)
Amendment limit of shaft bent	0.08 mm (0.0031 in.)
Clearance between shaft and bush	0.03 ~ 0.1 mm (0.0012 ~ 0.0039 in.)
Amendment limit of dittoed clearance	0.2 mm (0.0079 in.)
Outer diameter of commutator	35.0 mm (1.3780 in.)
Wear limit of commutator diameter	2.0 mm (0.0787 in.)
Brush length	18.5 mm (0.7283 in.)
Wear limit of dittoed length	6.0 mm (0.2362 in.)
(remaining brush should be more than)	12.5 mm (0.4921 in.)
Brush spring tension	0.8 kg (1.76 lbs.)
Front bracket metal inner diameter	11.0 $\frac{+0.018}{0}$ mm (0.4331 $\frac{+0.0007}{0}$ in.)
Rear cover metal inner diameter	11.5 $\frac{+0.021}{0}$ mm (0.4528 $\frac{+0.0008}{0}$ in.)

≪ S114-88 ≫

Armature shaft diameter (pinion side)	13.0 $\frac{-0.032}{-0.050}$ mm (0.5118 $\frac{-0.0013}{-0.0020}$ in.)
Armature shaft diameter (rear end)	11.5 $\frac{-0.032}{-0.050}$ mm (0.4528 $\frac{-0.0013}{-0.0020}$ in.)
Amendment limit of shaft dia.	0.1 mm (0.0039 in.)
Amendment limit of shaft bent	0.08 mm (0.0031 in.)
Clearance between shaft and bush	0.03 ~ 0.1 mm (0.0012 ~ 0.0039 in.)
Amendment limit of dittoed clearance	0.2 mm (0.0079 in.)
Outer diameter of commutator	33 mm (1.2992 in.)
Wear limit of commutator dia.	2 mm (0.0787 in.)
Brush length	14 mm (0.5512 in.)
Wear limit of dittoed length	7 mm (0.2756 in.)
(remaining brush should be more than)	7 mm (0.2756 in.)
Brush spring tension	0.8 kg (1.76 lbs.)
Front bracket metal inner diameter	13.0 $\frac{+0.018}{0}$ mm (0.5118 $\frac{+0.0007}{0}$ in.)
Rear cover metal inner diameter	11.5 $\frac{+0.021}{0}$ mm (0.4528 $\frac{+0.0008}{0}$ in.)

TROUBLE DIAGNOSES AND CORRECTIONS

Troubles	Possible causes	Remedies
Starting motor will not operate.	Discharged battery.	Charge or replace the battery.
	Defective solenoid switch.	Repair or replace the solenoid switch.
	Loosen connections of the terminal.	Clean and tighten the terminal.
	Defective brushes.	Replace the brush.
	Defective starting motor.	Remove the starting motor and make test.
Noisy starting motor.	Loose securing bolt.	Tighten the bolt.
	Worn pinion gear.	Replace the pinion gear.
	Poor lubrication.	Fill in oil.
	Worn commutator.	Disassemble the motor.
	Worn brushes.	Replace the brush.

Starting motor cranks slowly.	Discharged battery.	Charge or replace the battery.
	Loose connection of the terminal.	Clean adn tighten the terminal.
	Worn brushes.	Replace the brush.
	Locked brushes.	Inspect the brush spring tension or repair the brush holder.
	Dirty or worn commutator.	Clean and repair.
	The armature rubs the field coil.	Disassemble the motor.
	Defective solenoid switch.	Repair or replace the switch.
Starting motor operates but does not crank the engine.	Worn pinion.	Replace the pinion.
	Locked pinion guide.	Repair the pinion guide.
	Worn ring gear.	Replace the ring gear.
Starting motor will not disengage even the ignition switch is turned off.	Defective solenoid switch.	Repair or replace the solenoid switch.
	Defective gear teeth.	Replace the defective gear.

CHARGING CIRCUIT

The charging circuit includes the battery, alternator, regulator and necessary wiring to connect these parts. The purpose of this system is to convert just enough mechanical energy from the engine into electrical energy to supply all electrically operated units and keep the battery fully charged.

SPECIFICATIONS

Alternator

Item \ Model	AC500NR	LT130-41
Applied engine	L20	L16, L13
Maker	MITSUBISHI	HITACHI
Nominal output	14V-40A	12V-30A
Pole	Negative ground	Negative ground
Revolution	930~12,000 r.p.m.	1,000~13,500 r.p.m.
No-load minimum revolution	Less than 1,000 r.p.m.	Less than 1,000 r.p.m.
Output current	35.5A (14V, 2,500 r.p.m.)	22A (14V, 2,500 r.p.m.)
Pulley ratio	2.25	2.25

Regulator

Item \ Model	RQ2220B	TLIZ-17
Applied alternator	AC500NR	LT130-41
Applied engine	L20	L16, L13
Maker	MITSUBISHI	HITACHI
Type	Tirril type	Tirril type
Element	Constant voltage relay	Constant voltage relay
Constant voltage relay	3 contact point type	3 contact point type
No load regulating voltage	13.5~14.5V/ 4,000 r.p.m.	14~15V/ 5,000 r.p.m.

When the ignition switch is turned "on", current flows from the battery to ground through the ignition switch, voltage regulator IG terminal, primary side contact point "P1", movable contact point "P2", voltage regulator "F" terminal, alternator "F" terminal, field coil and alternator "E" terminal, as shown by the heavy arrows. Then the rotor in the alternator is exited. On the other hand, current flows from the battery to ground through the ignition switch, warning lamp, voltage regulator "L" terminal, lamp side contact point "P4", movable contact point "P5", and voltage regulator "E" terminal, as shown by dotted arrows. Then the warning lamp turns on.

When the alternator begins to operate, three phase alternating current is induced in the armature. This alternating current is rectified by the positive and negative silicon diodes. This rectified current of direct current output comes between the alternator "A" and "E" terminal. (Figure EE-27).

On the other hand, the neutral point voltage comes between "N" and "E" terminal (nearly a half of the output voltage) and this causes to flow the current from voltage regulator "N" terminal to "E" terminal or ground through the coil "VC1" as shown by the dotted arrows. Then the coil "VC1" is excited, and the movable contact point "P5" comes in contact with voltage winding side contact point "P6". This action causes to turn off the warning lamp and complete the voltage winding circuit, as shown by the heavy arrows.

When the alternator speed is increased or the voltage starts to go too high, the movable contact point "P2" is separated from primary side contact "P1" by the magnetic force of coil "VC2". Therefore, register "R1" is inserted in the field circuit and output voltage is decreased. As the output voltage is decreased, the movable contact point "P2" and primary side contact "P1" comes in contact once again, and the alternator voltage increases. Thus, the rapid vibration of the movable contact point "P2", or inserting and removing the registance in the alternator field circuit maintains an alternator output voltage to constant.

When the alternator speed is increased further or the voltage starts to go further high, at last the movable contact point "P2" comes in contact with secondary side contact point. Then the field current is shut off and alternator output voltage is decreased immediately. This action causes to separate movable contact "P2" from secondary contact "P3". Thus, the rapid vibration of the movable contact point "P2" or breaking and completing the field circuit maintains an alternator output voltage to constant.

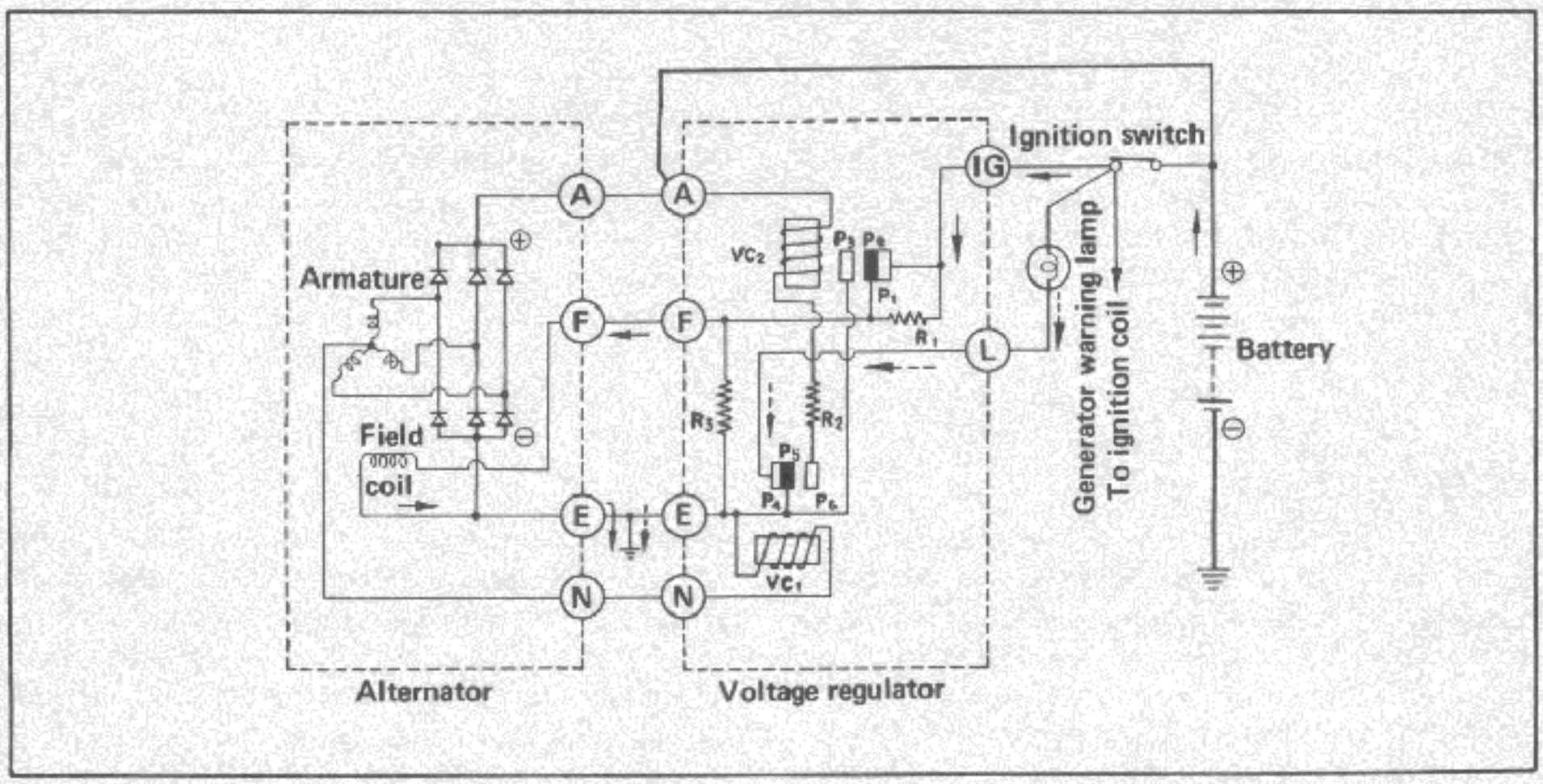


Fig. EE-27 Charging circuit (1)

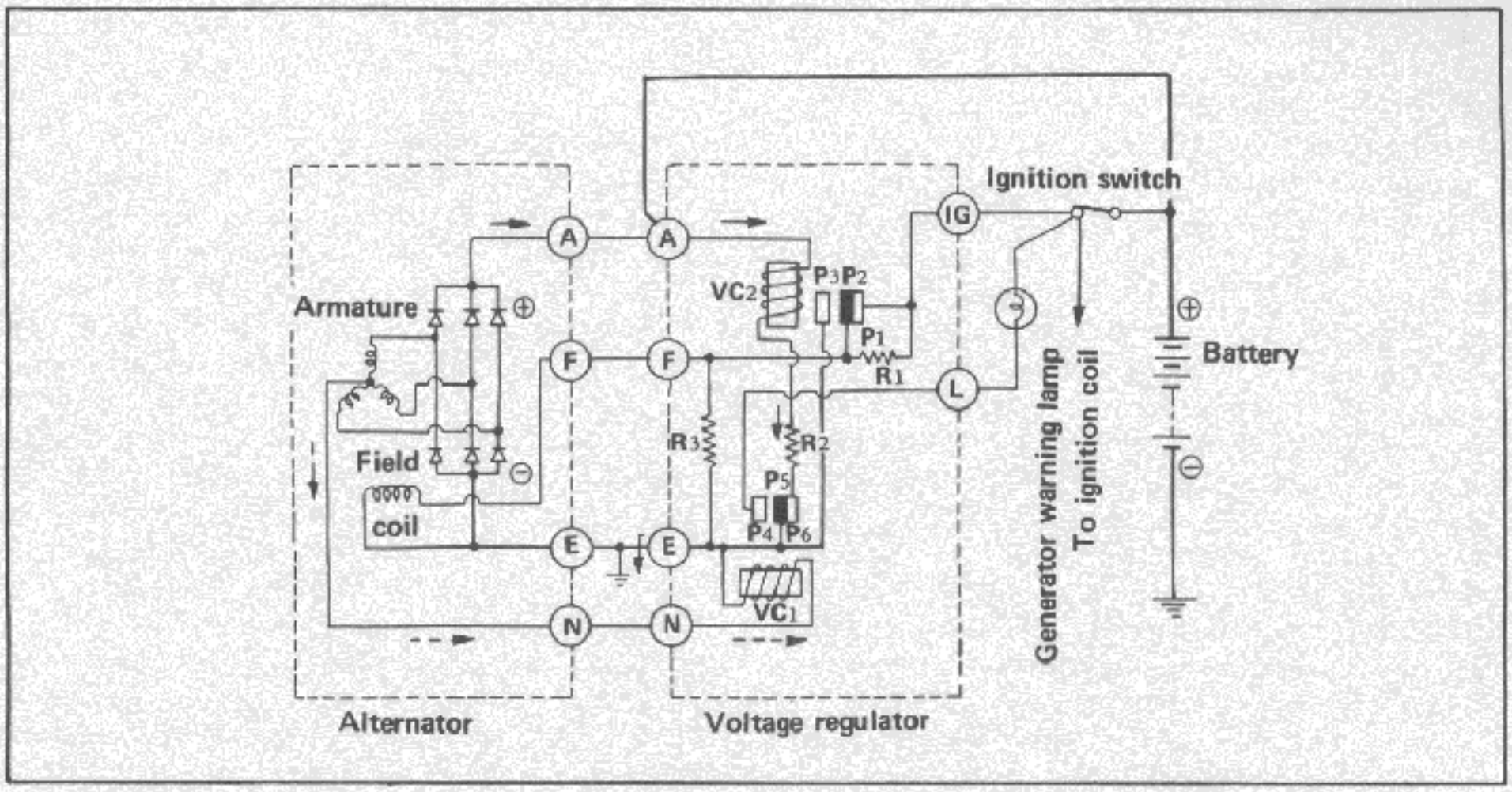


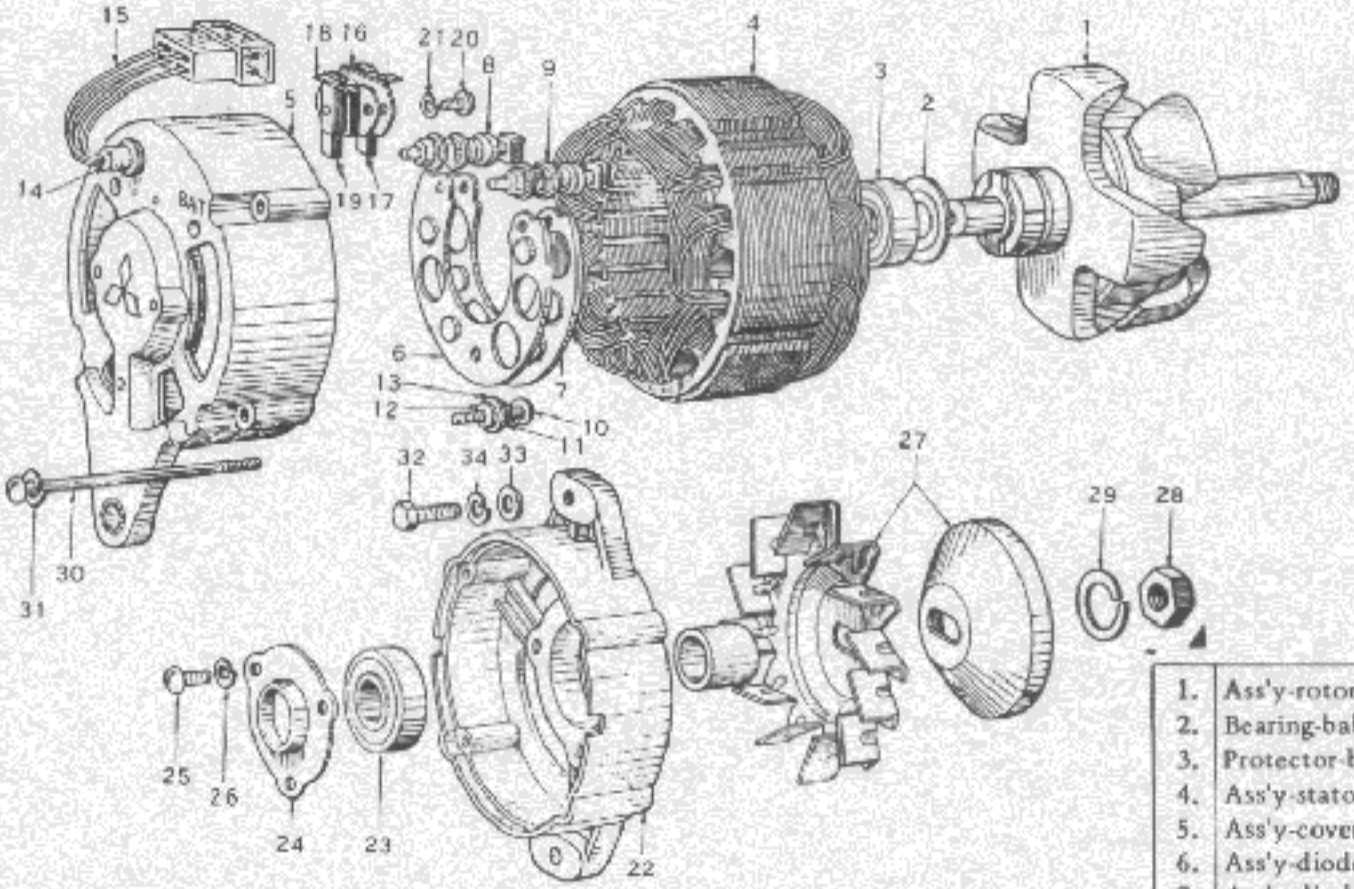
Fig. EE-28 Charging circuit (2)

ALTERNATOR

CONTENTS

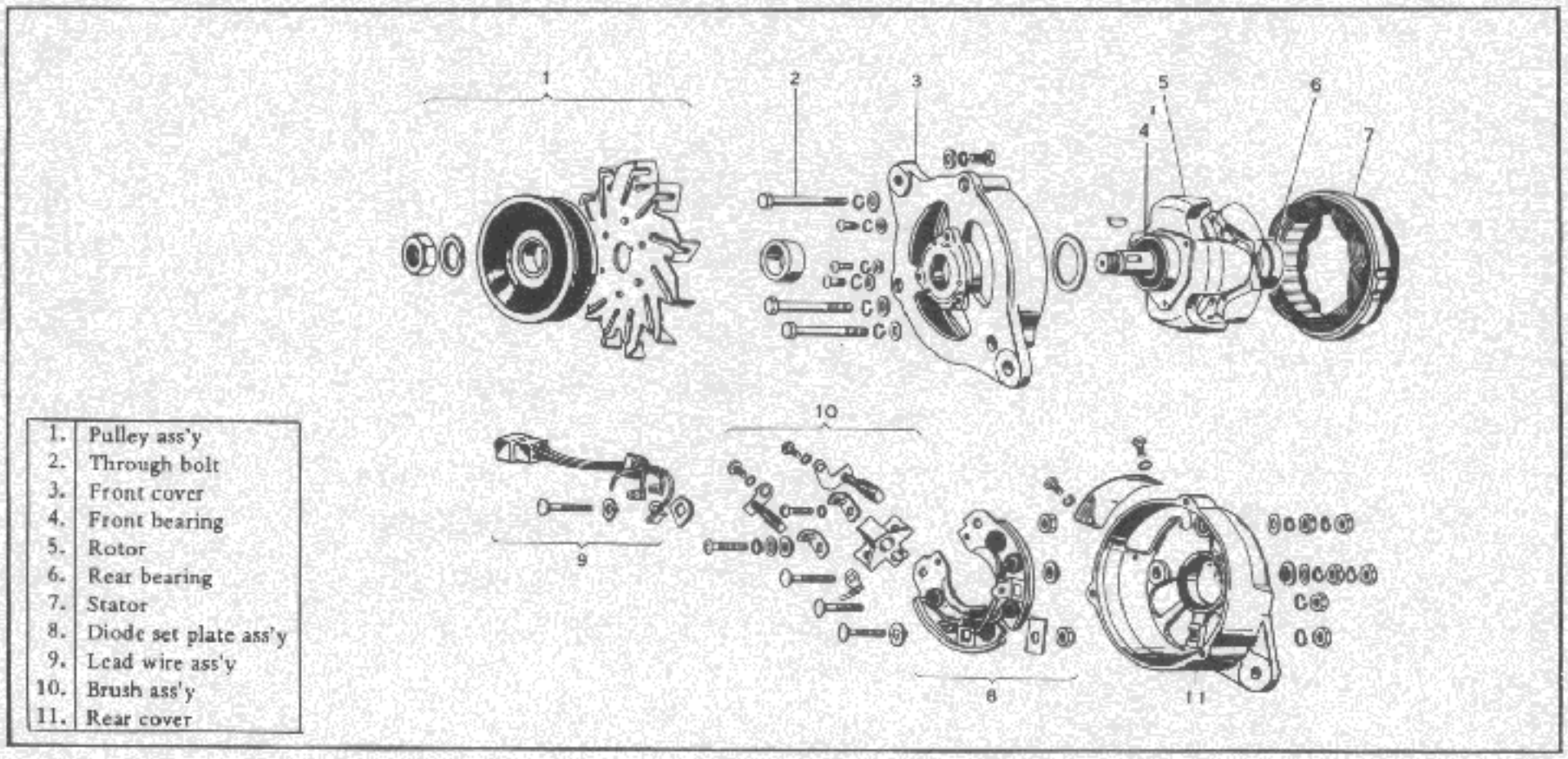
DESCRIPTION

Different from the DC generator, an alternator turns the magnetic pole and fixes the armature. In the alternator a magnetic field is produced by the rotor which consists of alternator shaft, field coil, pole pieces, and slip rings. The slip ring pressed in the shaft conducts only a small field current. Output current is generated in armature coils located in the stator. The stator has three windings and generates three-phase alternating current. Silicon diodes act like one way valves for electricity so that charging current passes easily but reverse current is shut out. In this alternator, six diodes are used three negatives and three positives, and three six diodes are installed in positive and negative heat sink, voltage control system is also basically same to D. C. system in principle.



1.	Ass'y-rotor
2.	Bearing-ball
3.	Protector-bearing
4.	Ass'y-stator
5.	Ass'y-cover, rear
6.	Ass'y-diode, set
7.	Ass'y-diode, set
8.	Ass'y-terminal (Battery)
9.	Ass'y-terminal (Earth)
10.	Screw
11.	Insulator
12.	Washer-insulator
13.	Washer
14.	Grommet
15.	Ass'y-wire, lead
16.	Ass'y-holder, brush
17.	Brush
18.	Ass'y-holder, brush
19.	Brush
20.	Screw
21.	Washer-lock
22.	Ass'y-cover, front
23.	Bearing-ball
24.	Retainer-bearing
25.	Screw
26.	Washer-lock
27.	Ass'y-pulley
28.	Nut
29.	Washer-lock
30.	Screw
31.	Washer-lock
32.	Bolt
33.	Washer-plain
34.	Washer-lock

Fig. EE-29 AC500NR (L20)



1.	Pulley ass'y
2.	Through bolt
3.	Front cover
4.	Front bearing
5.	Rotor
6.	Rear bearing
7.	Stator
8.	Diode set plate ass'y
9.	Lead wire ass'y
10.	Brush ass'y
11.	Rear cover

Fig. EE-30 LT130-41 (L16 & L13)

REMOVAL

1. Disconnect the negative battery terminal.
2. Remove two leads at the generator and connector.
3. Loosen the adjusting bolt.
4. Remove the generator drive belt.

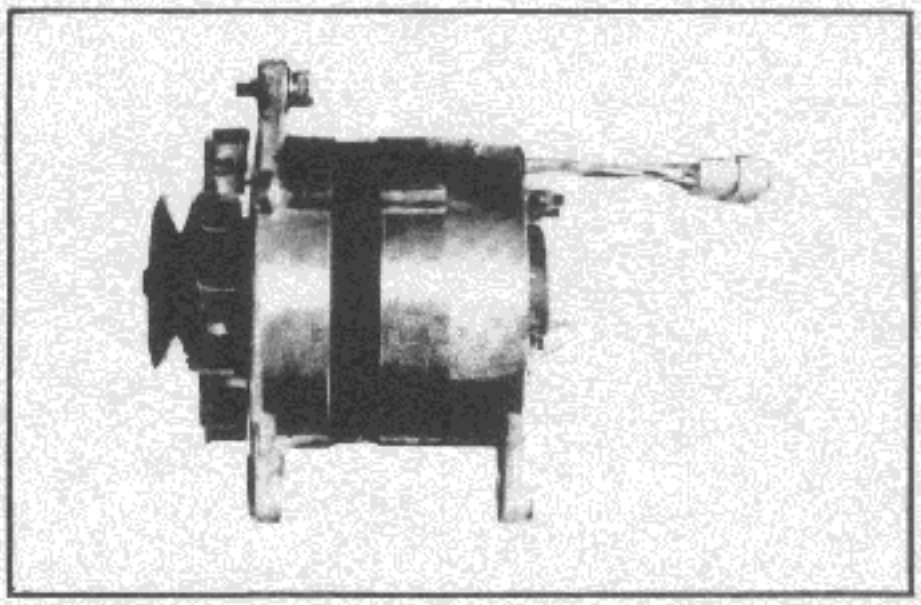


Fig. EE-31 LT130-41 (L16 & L13)

5. Remove the bolts which retain the generator.

6. Remove the generator from a car.

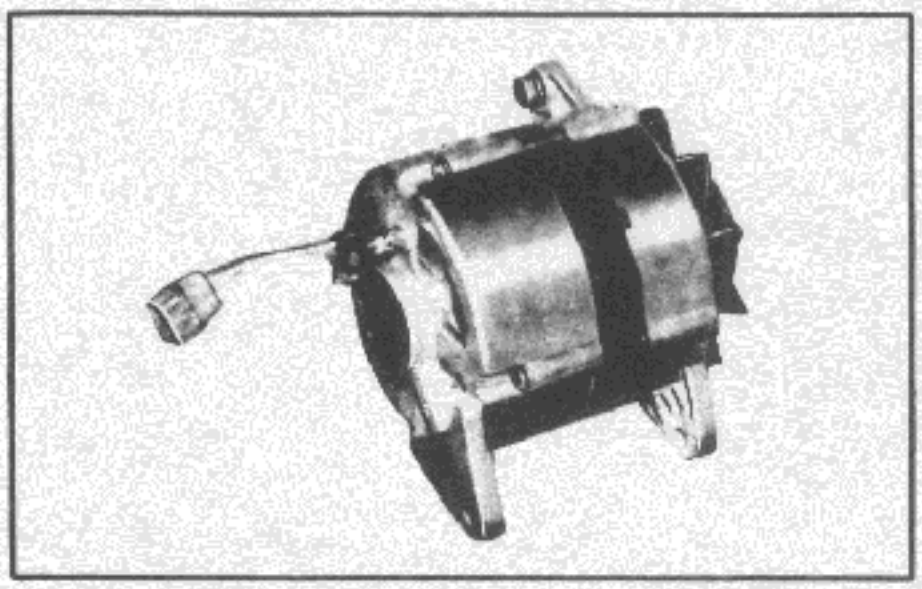


Fig. EE-32 AC500NR (L20)

DISASSEMBLY

1. Unscrew the through bolts.

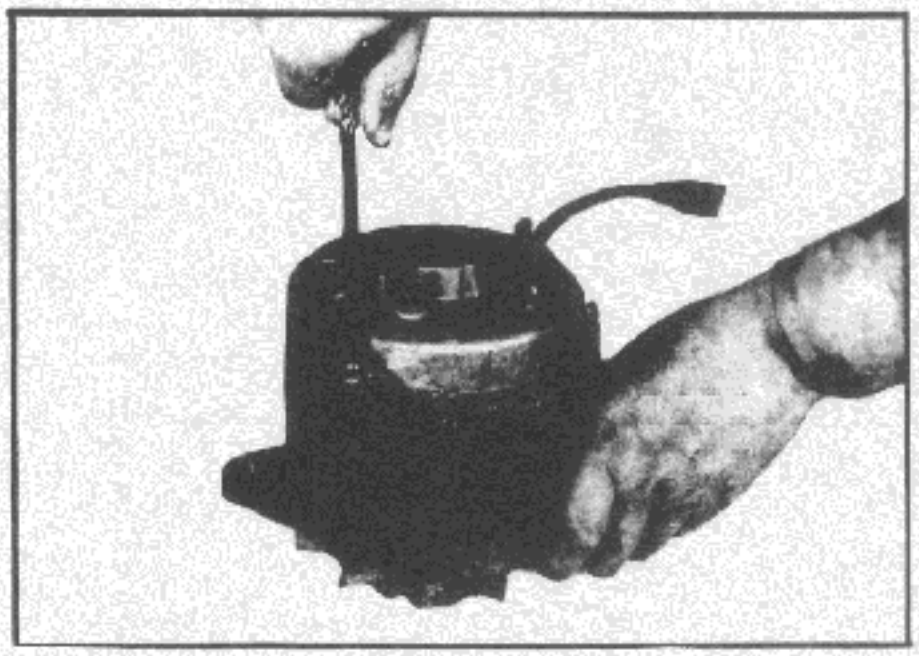


Fig. EE-33 Removal of through bolt (1)

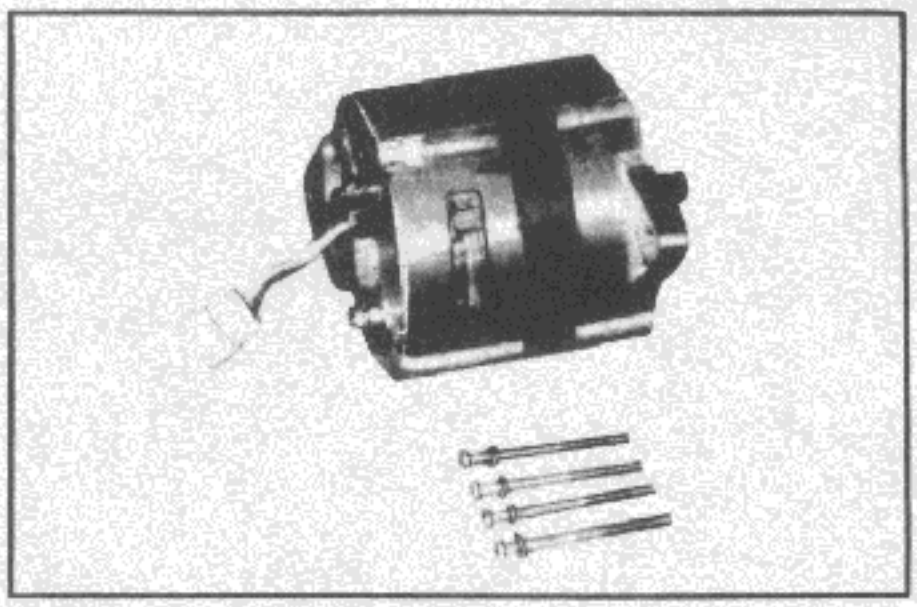


Fig. EE-34 Removal of through bolt (2)

2. Separate the diode end housing from the drive end housing assembly by hitting the front bracket lightly with a wooden hammer.

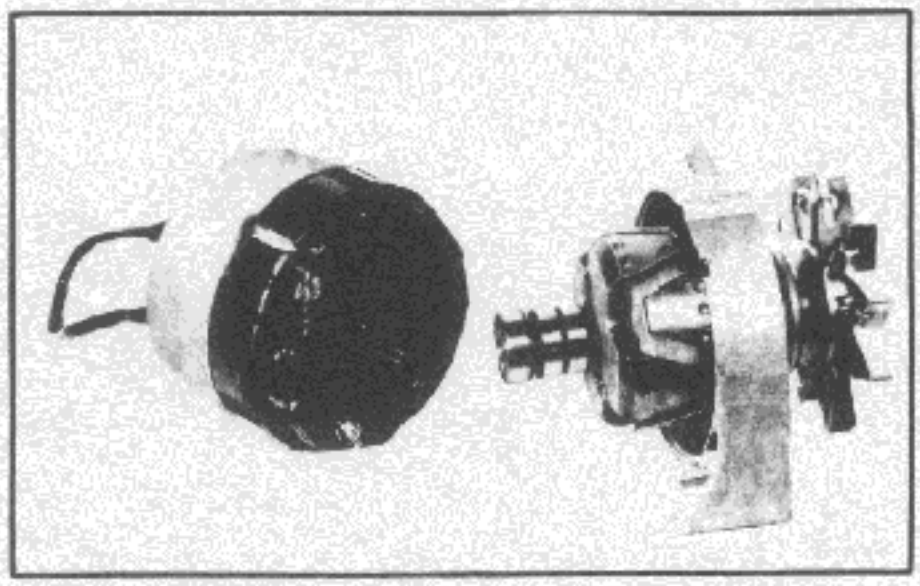


Fig. EE-35 Drive end housing and diode end housing separated

3. Vise the rotor of the drive end housing assembly carefully not to injure the rotor.
Remove the pulley nut, pulley rim, fan and the spacer.

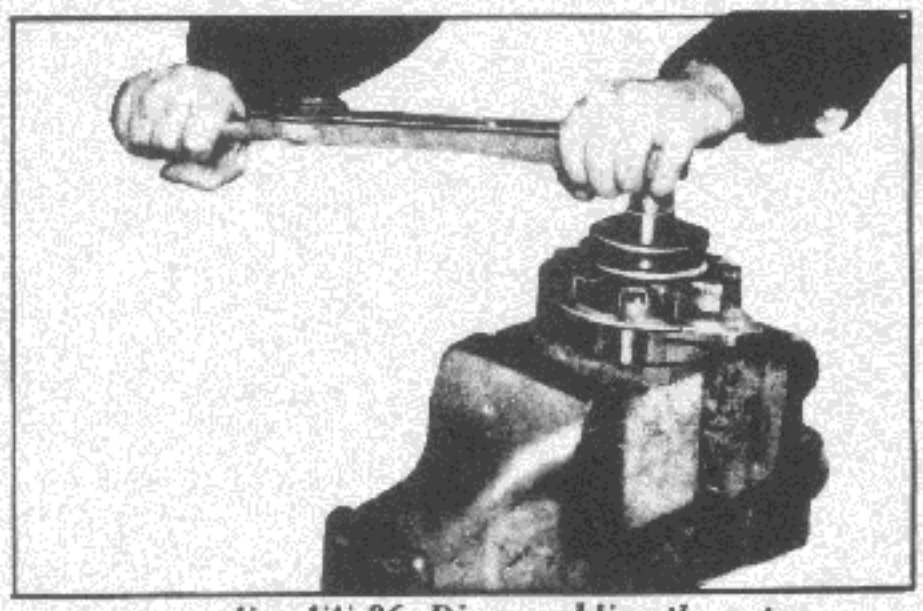


Fig. EE-36 Disassembling the rotor (AC500NR)

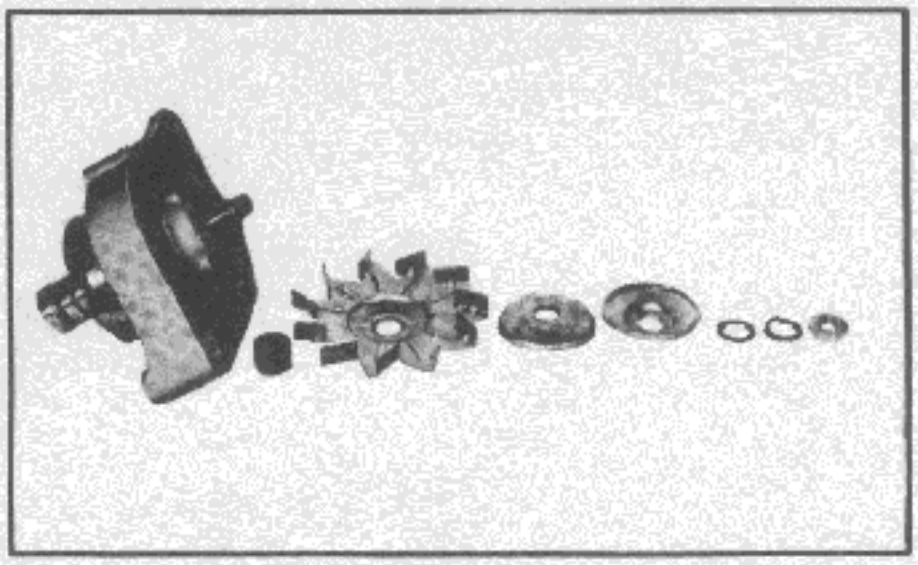


Fig. EE-37 Removal of pulley

4. Remove the rotor from the drive end housing assembly by hitting the drive end housing slightly with a mallet.

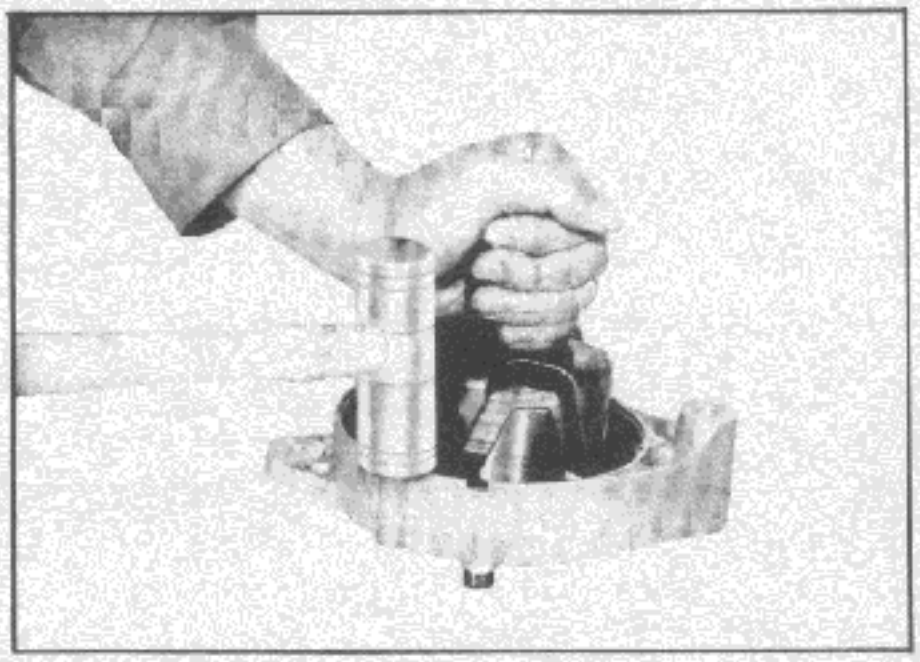


Fig. EE-38 Removal of rotor

5. Remove the bearing retainer by unscrewing three set screws and push out the bearing, using an arbor press.

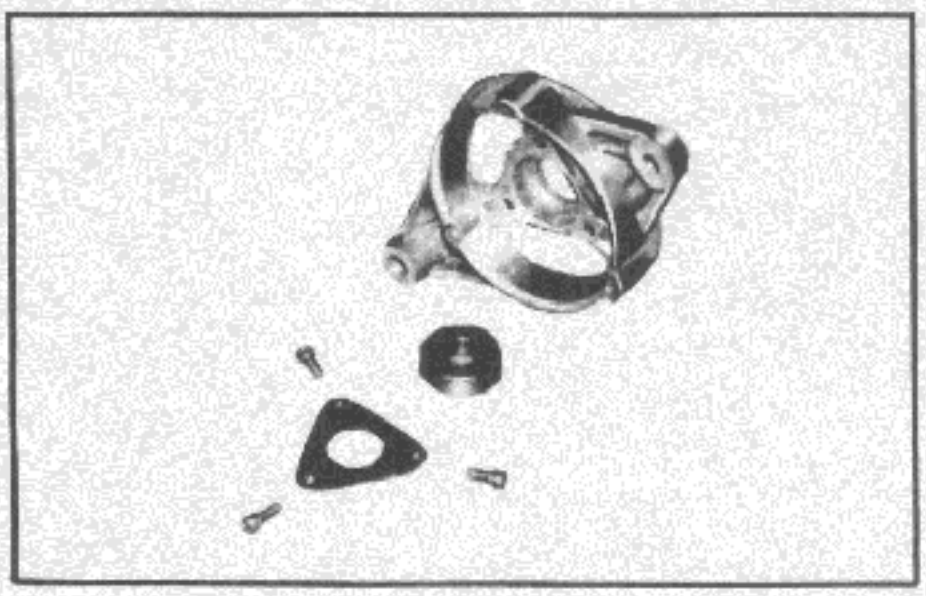


Fig. EE-39 Removal of bearing retainer (AC500NR)

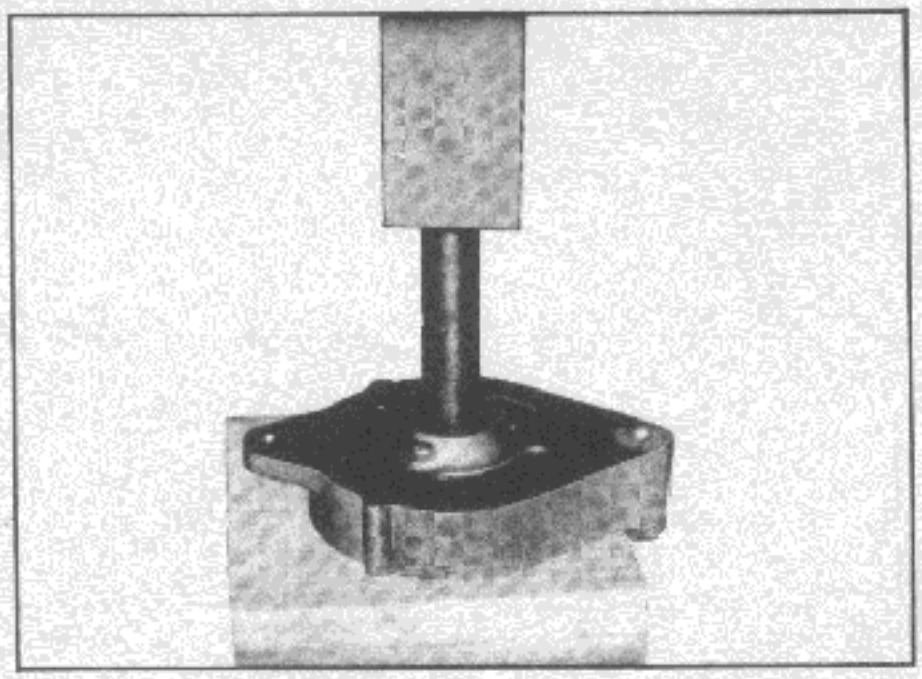


Fig. EE-40 Pulling out of bearing

6. Pull out the rear bearing from the rotor assembly, using an arbor press or bearing puller.

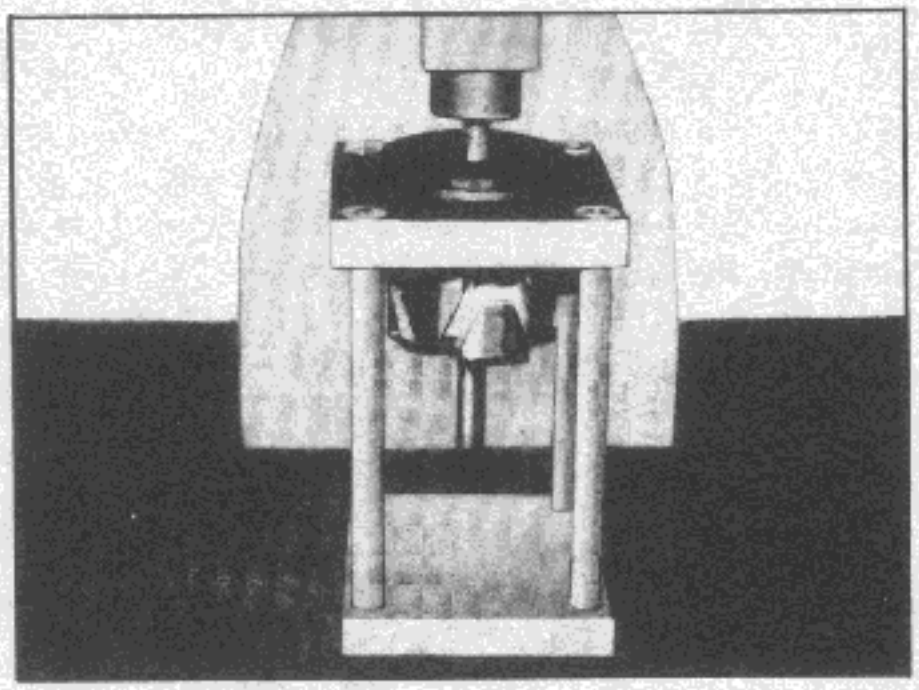


Fig. EE-41 Pulling out of rear bearing (1)

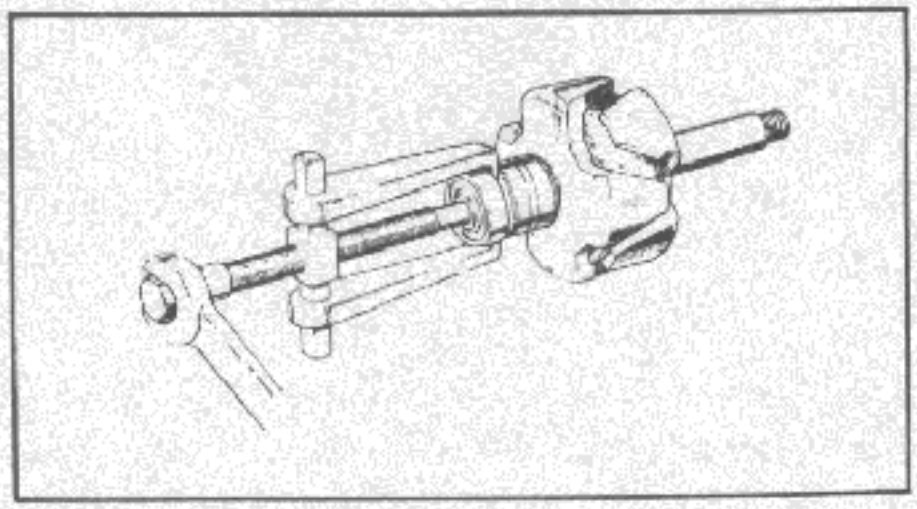


Fig. EE-42 Pulling out of rear bearing (2)

7. To separate the stator from the diode end housing assembly, disconnect the negative three diodes from three coil lead wires and each lead wire between diodes by melting solder with a soldering iron.

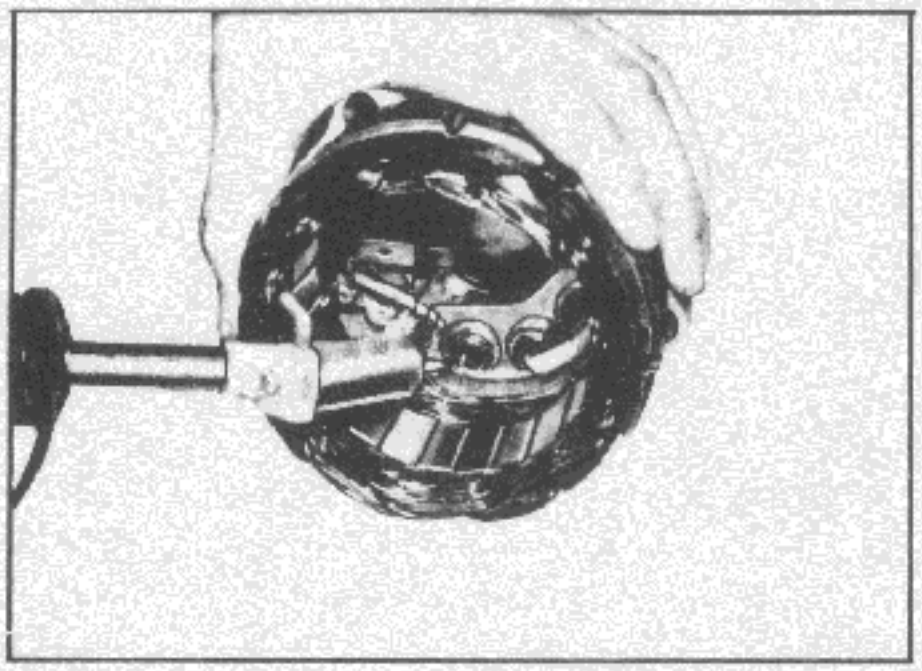


Fig. EE-43 Removal of stator (AC500NR)

8. Remove the brush cover by unscrewing each setscrew.
Disconnect N terminal lead wire by metling solder, then the diode end and the stator can be separated.

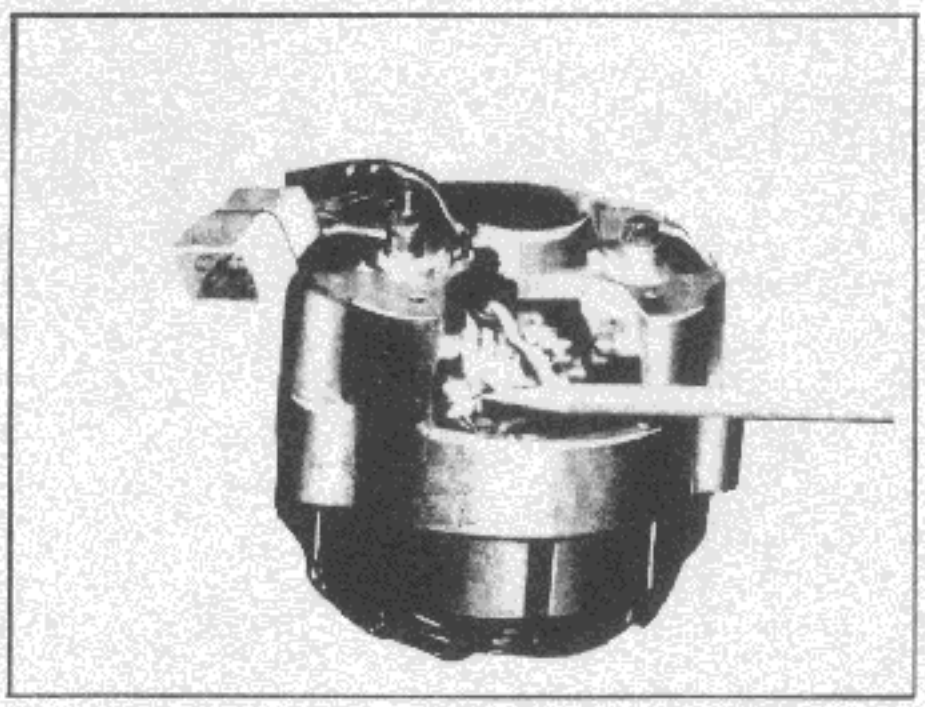


Fig. EE-44 Disconnecting of N terminal

Note: When the internal temperature of a diode goes up over 150°C (300°F) the diode will lose its function, so use the electric iron, 100W to 200W, for around 2 seconds at the soldered portions.

9. Remove the heat sink and the brush holder from the rear cover by unscrewing each set-screw. Be careful not to lose small parts such as screws, washers and bushings.

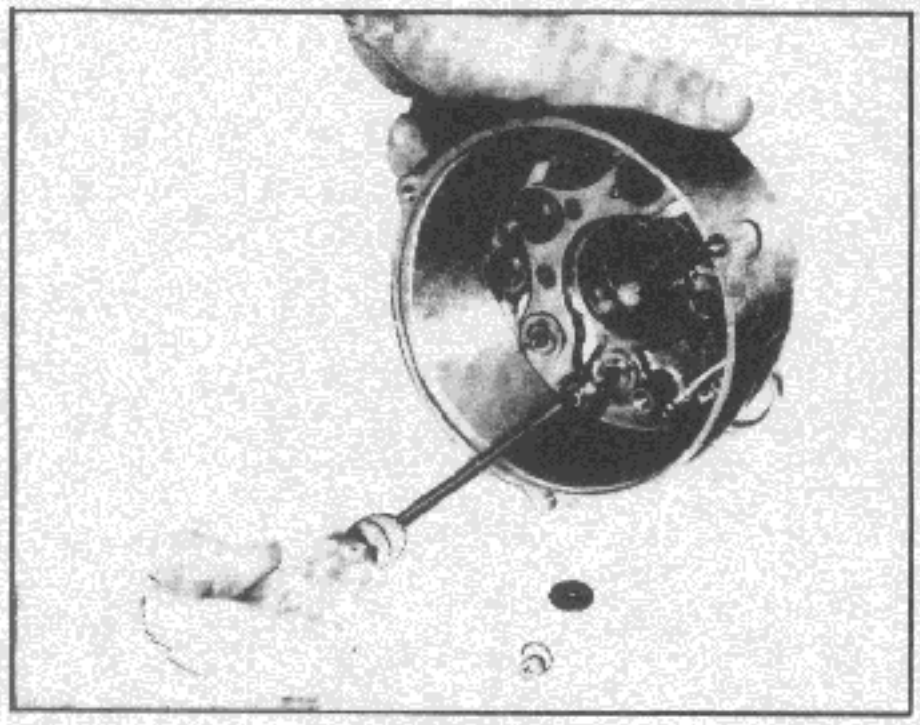


Fig. EE-45 LT130-41 (L16 & L13)

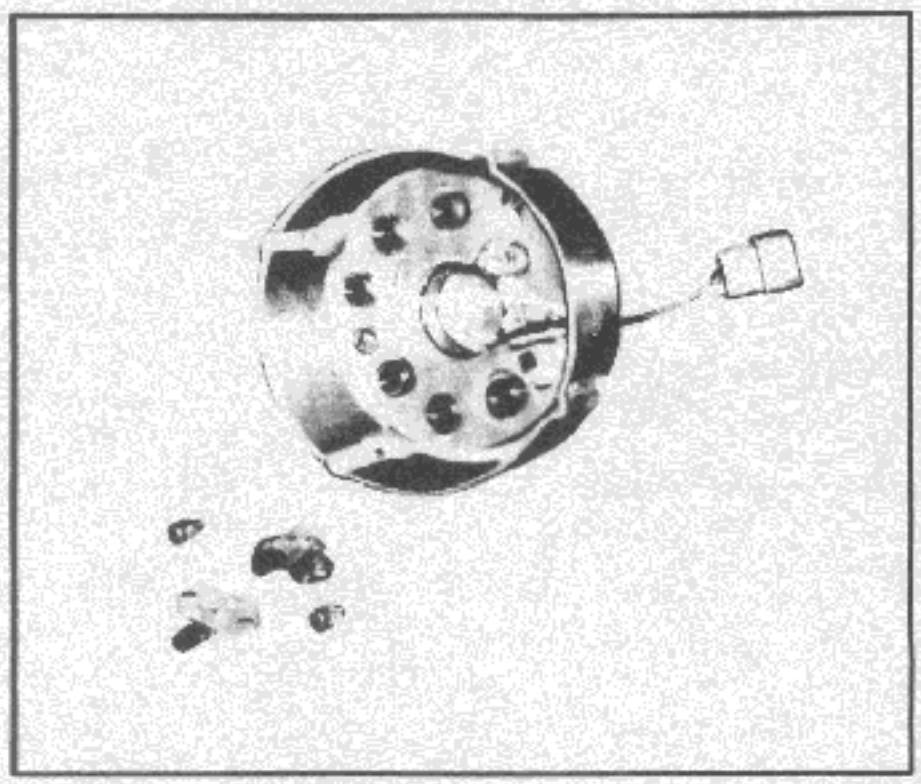


Fig. EE-46 AC500NR

10. Disassemble the brush holder.
Dissolder lead wire F (black/white color), lead wire E (black color) and the brush holder wires (negative and positive), using a soldering iron.

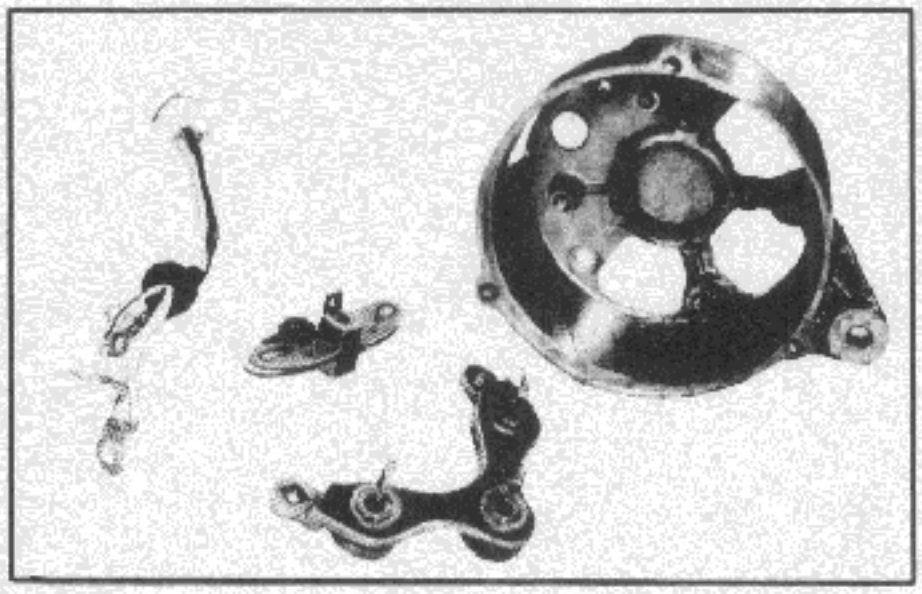


Fig. EE-47 LT130-41 (L16 & L13)

Note: There are two kinds of diode, "Positive" and "Negative".
The positive diode is marked with "red figure" on the bottom of the diode and the negative diode is marked with "black figure" in the same manner as shown in Figure EE-48.

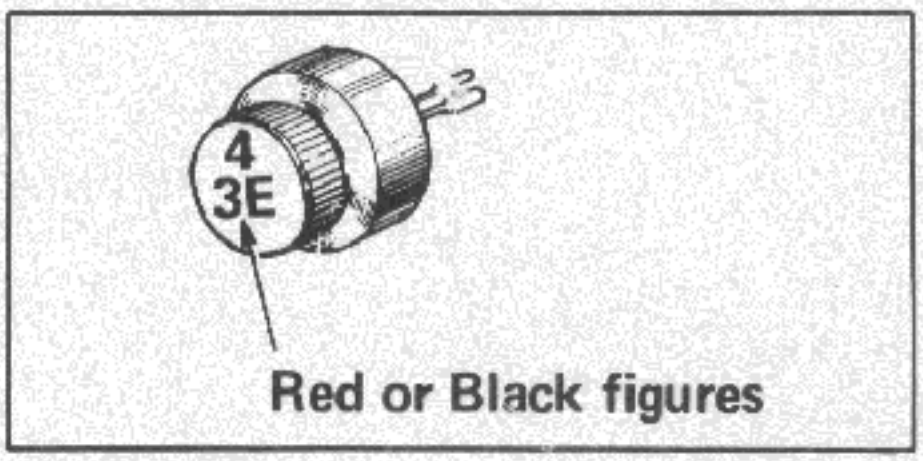


Fig. EE-48 Diode identification

DIODE REMOVAL

To remove a diode, use a suitable tool to support the heat sink, and push the diode out by using an arbor press as shown in Figure EE-49.

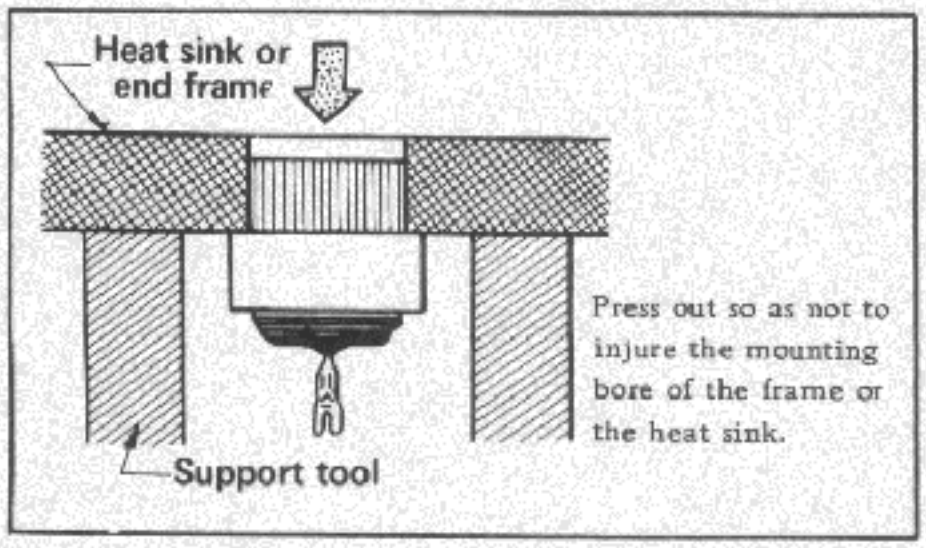


Fig. EE-49 Removal of the diode

Note: Do not strike the diode, as the shock may damage the other diodes.

DIODE INSTALLATION

Support the head sink with a suitable tool and then press the diode into the heat sinks by using the tool Ⓐ which fits over the outer diode edge A portion.

Press down perfectly the diode into the mounting bore of C portion to the lower edge of B portion of the diode. Replaced diode should not be taken out with a force smaller than 15 kg (33 lbs.).

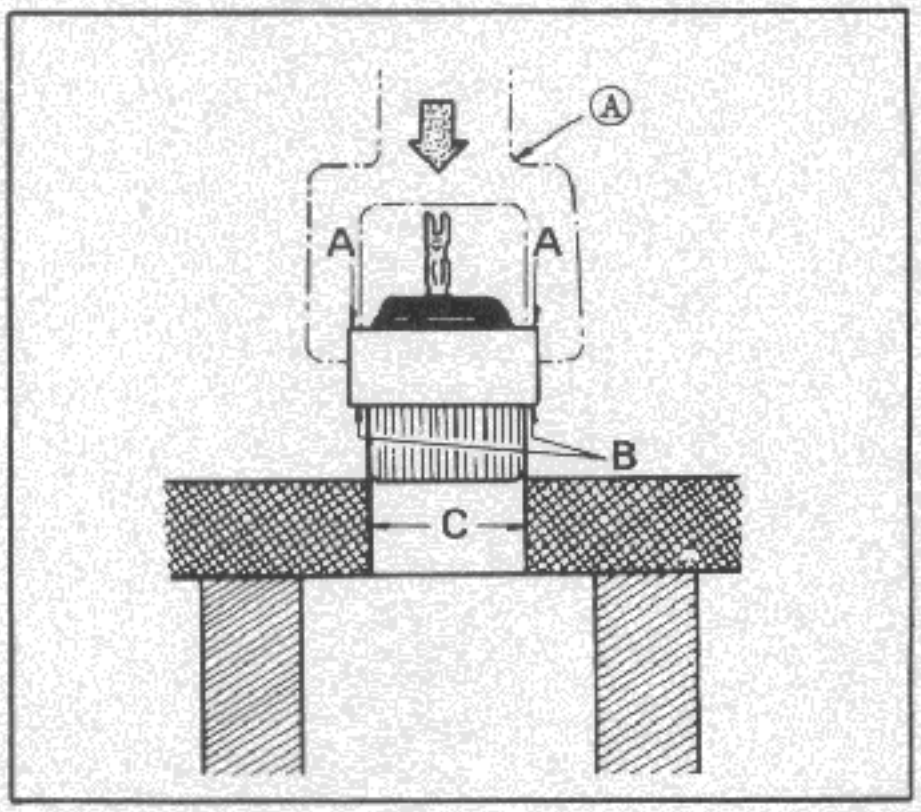


Fig. EE-50 Installation of the diode

INSPECTION AND REPAIR

Remove the alternator from the vehicle and put the tester between the lead wire F (black/white color) and the lead wire E (black color). When the resistance is approximately 5 to 6 Ω, the condition is all right.

Rotor inspection

1. Conduction test of field coil

As shown in Figure EE-51, put the tester between the slip rings of rotor and if there is no conduction, the disconnection of field coil will be thought. When the resistance is approximately 4.47 Ω at normal room temperature, the condition is all right.

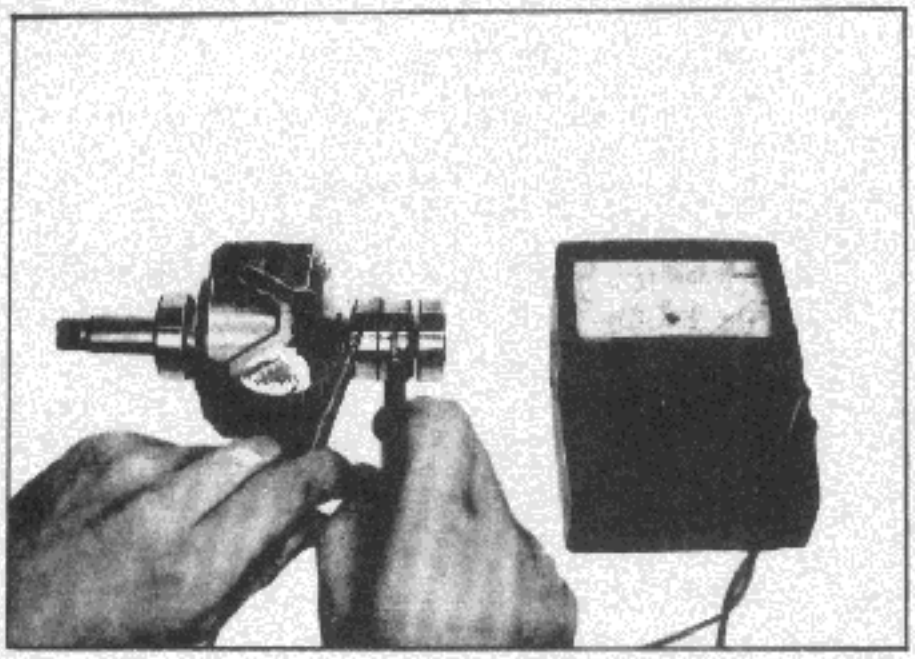


Fig. EE-51 Conduction test of field coil

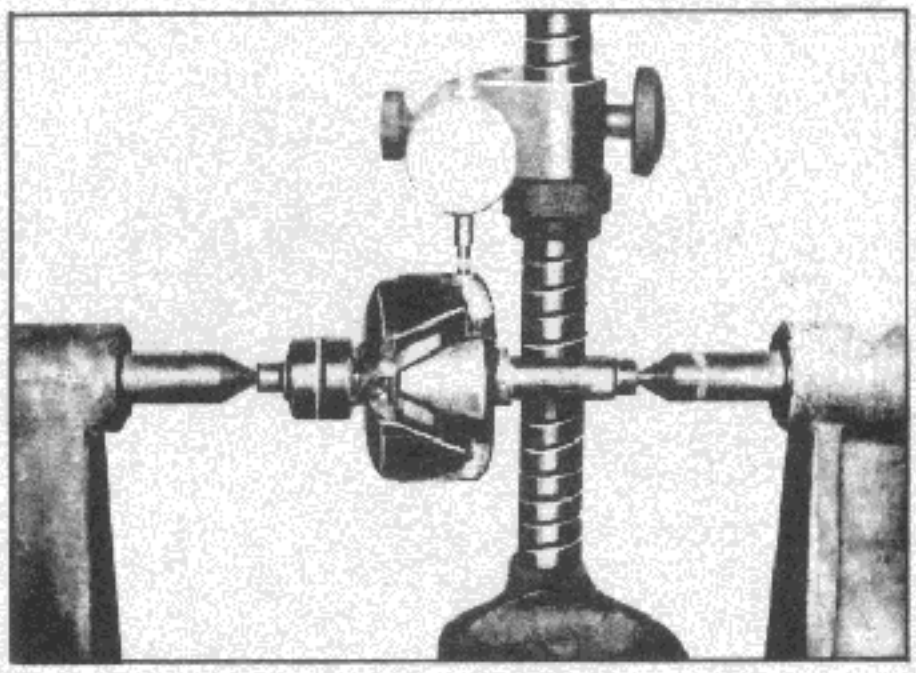


Fig. EE-53 Inspection of rotor eccentricity

2. Ground test of field coil

Check the conduction between slip ring and rotor core. If the conduction exists, replaced rotor assembly because in this case, field coil or slip ring must be grounded.

Inspection of stator

1. Conduction test

If the neutral wire of stator connected to the lead wire N (yellow color) is conductive with each lead wire of armature coil, the condition is all right.

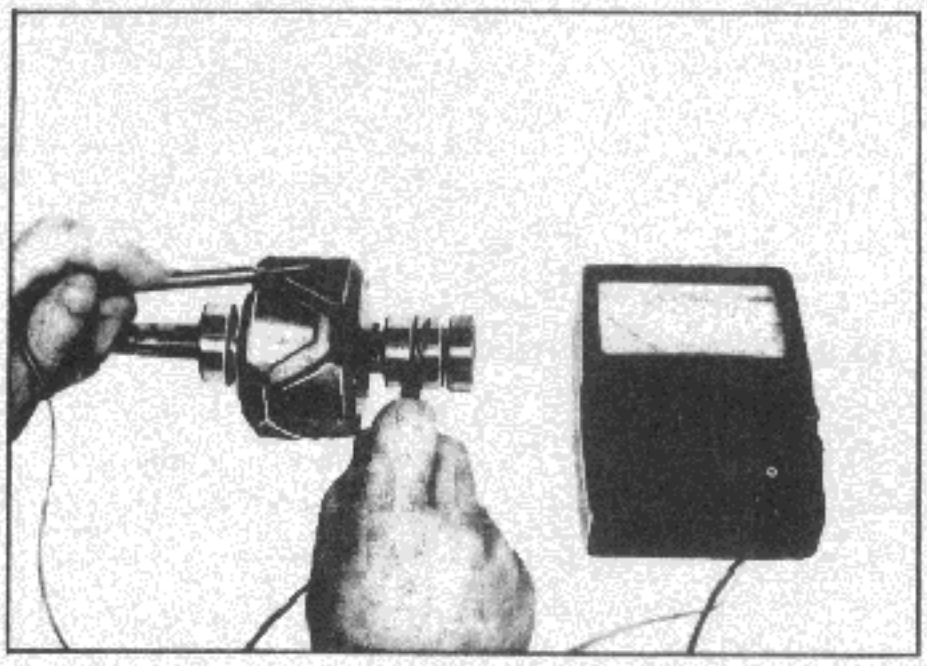


Fig. EE-52 Ground test of field coil

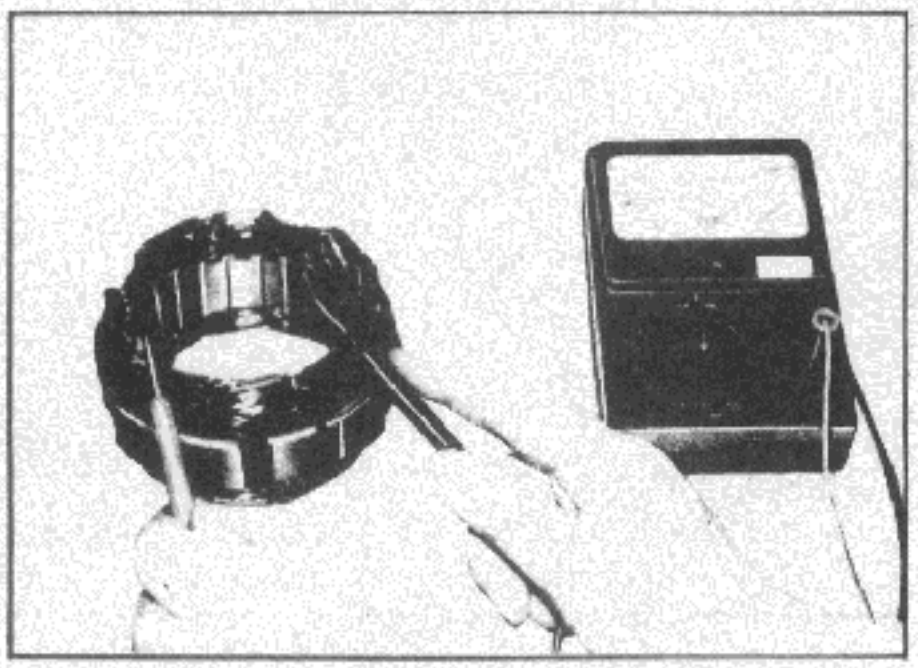


Fig. EE-54 Conduction test

3. Inspection of rotor eccentricity

Check the eccentricity of rotor as shown in Figure EE-53, using a dial gauge.
Repair or replace if the eccentricity is over 0.10 mm (0.0039 in.)

2. Ground test

If each lead wire of armature coil (including neutral wire) is not conductive with stator core, the condition is all right.

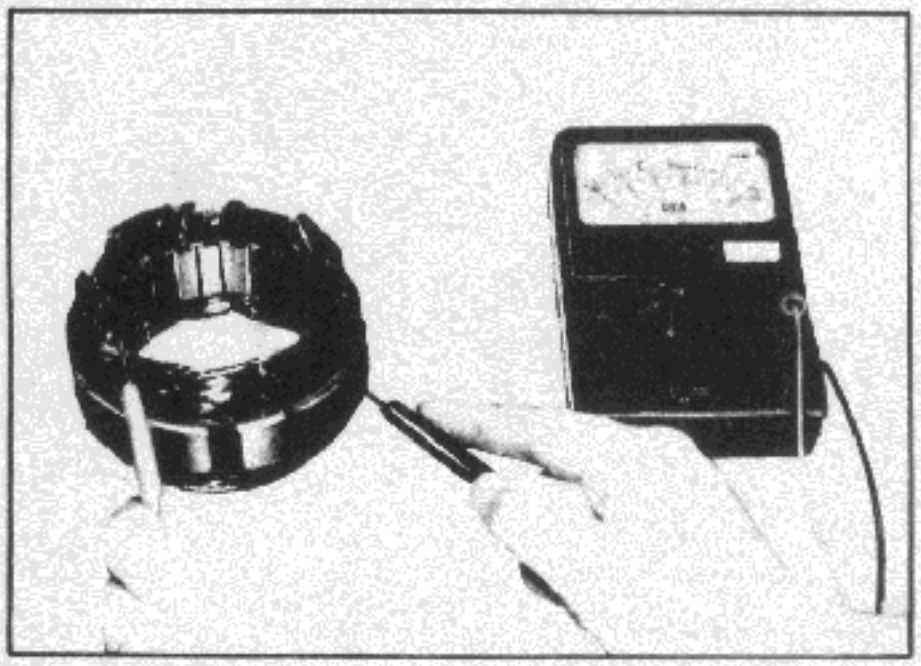


Fig. EE-55 Ground test

Inspection of diode
(Using lamp and battery)

1. Positive side diode

Connect the battery negative terminal with the connector A terminal (white color) and the battery positive terminal with connector N terminal (yellow color) as shown in Figure EE-56. Lamp in the circuit will light.

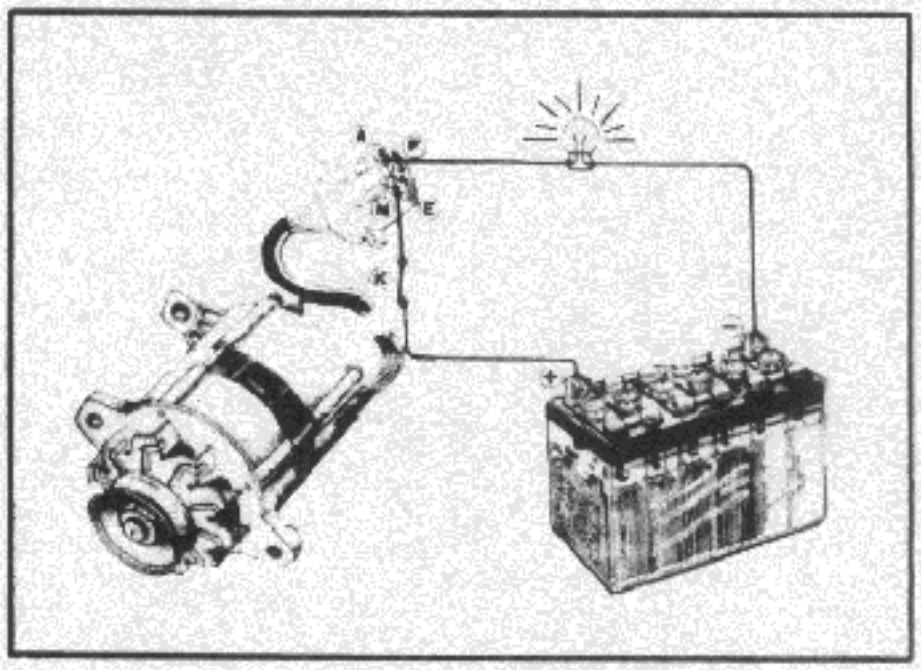


Fig. EE-56 Inspection of positive side diode

Nextly, if lamp does not light when the connection is made reversely as shown in Figure EE-57, the positive side diode is in good working condition.

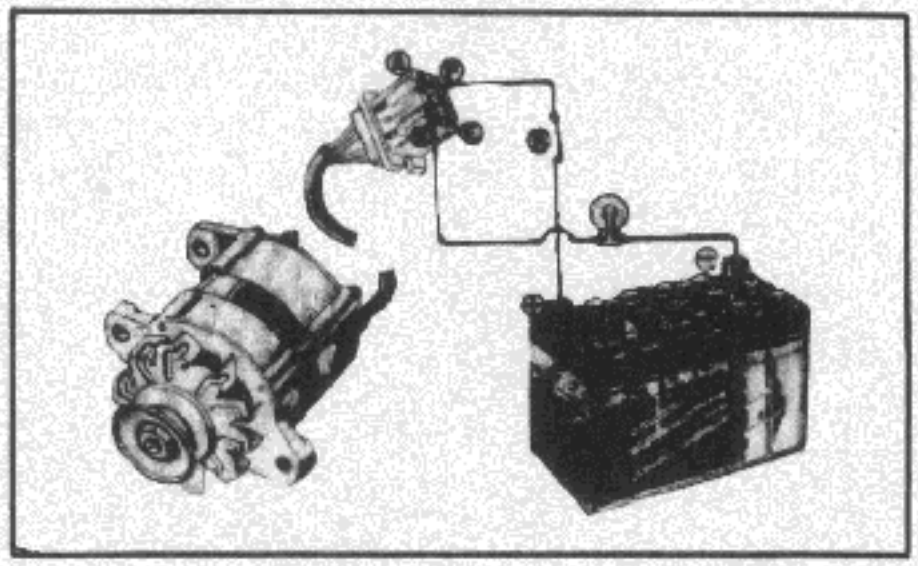


Fig. EE-57 Inspection of positive side diode

2. Negative side diode

Connect the battery negative terminal with connector N terminal (yellow color) and the battery positive terminal with connector E terminal (black color) as shown in Figure EE-58. Lamp in the circuit will light.

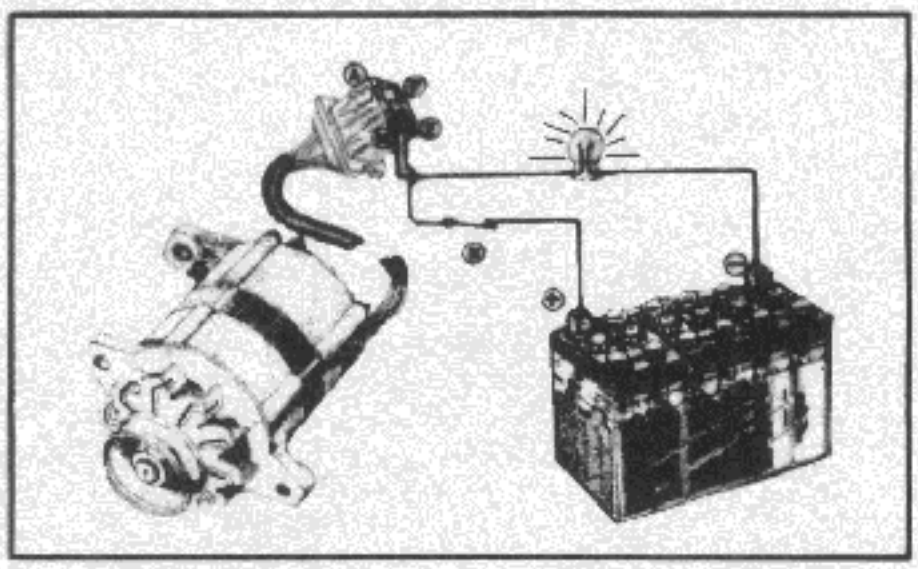


Fig. EE-58 Inspection of negative side diode

Nextly, if lamp does not light when the connection is made reversely as shown in Figure EE-59, the negative side diode is in good working condition.

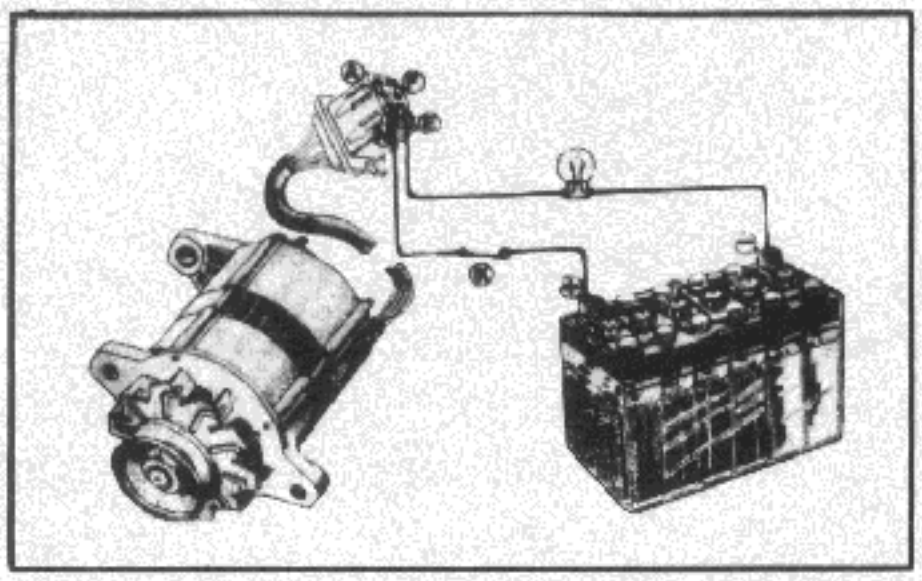


Fig. EE-59 Inspection of negative side diode

Inspection of diode with tester

There are two kinds of diodes as shown in Figure EE-60. Each diode can be discriminated its polarity by the color of the printed figures on each diode as follows.

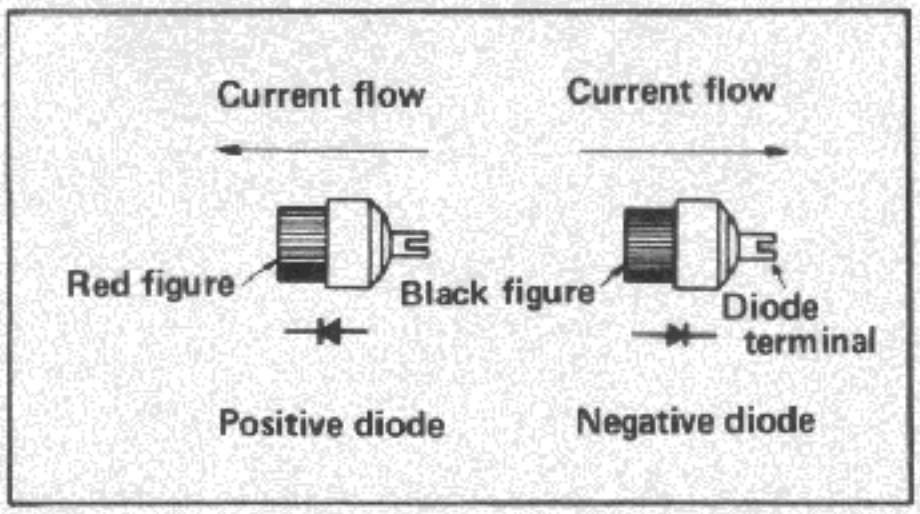


Fig. EE-60 Diode

Check diode resistance, using a tester, in a current flow direction and a reverse direction.

When one side shows low resistance and the other shows high resistance, the diode condition is all right.

If both sides are low, there will be a short circuit and if both sides are high, there will be a open circuit. In both cases, replace diode.

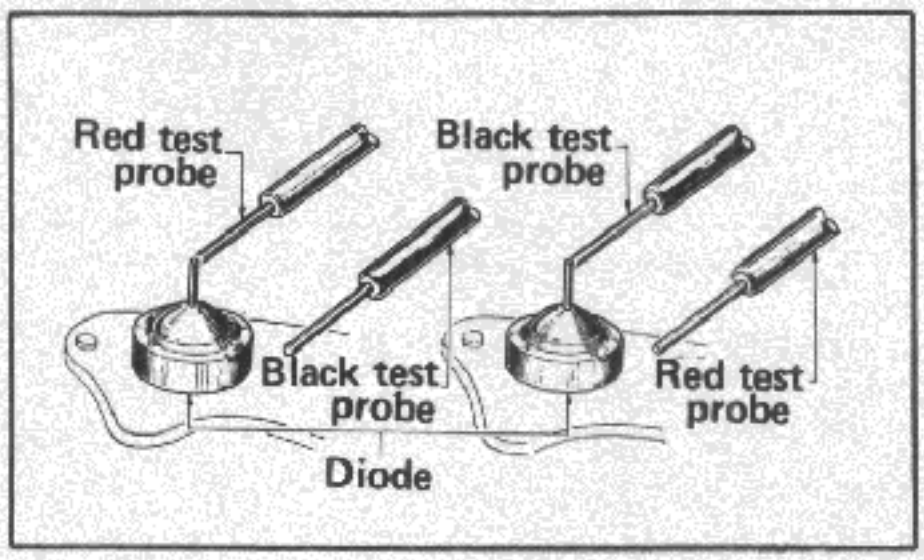


Fig. EE-61 Diode test

Inspection of brush

Check the movement of brush and if the movement is unsmooth, check brush holder and clean it.

If brush wore off smaller than specified dimension replace the brush with new one.

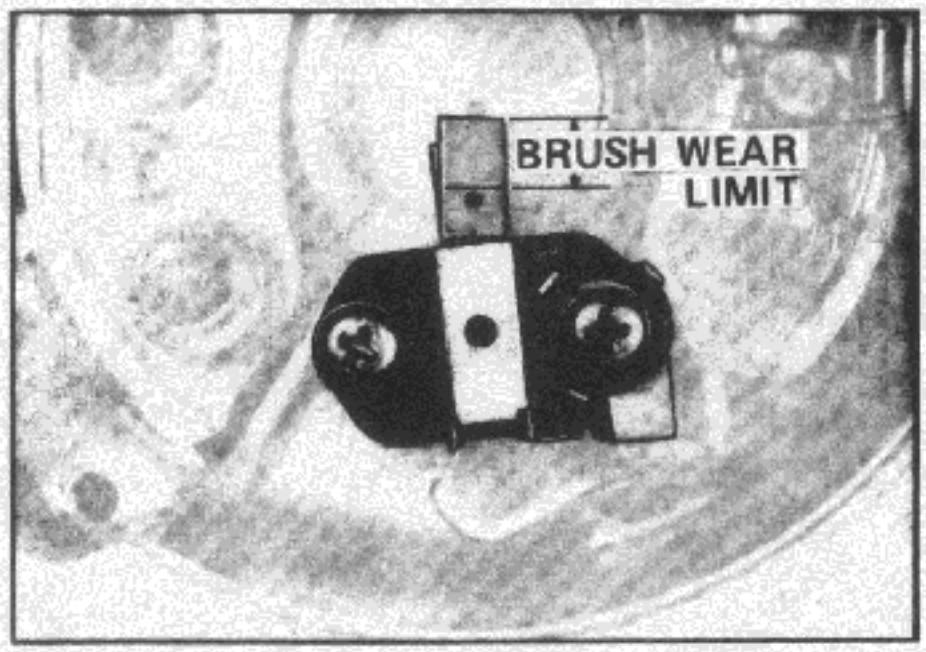


Fig. EE-62 Brush wear limit

	AC500NR	LT130-41
Brush length mm (in.)	12 (0.4724)	14 (0.5512)
Wear limit mm (in.)	5 (0.1969)	7.5 (0.2953)

Spring pressure test

Place a suitable block on a platform scale and press down brush holder with brush and spring on the block until brush sinks in the holder to 1 mm (0.0394 in.) height from the holder. The reading subtracted the block weight shows the spring pressure. The spring pressure should be 0.35 kg (0.77 lbs.). If the pressure is small than 0.2 kg (0.44 lbs.), replace it.

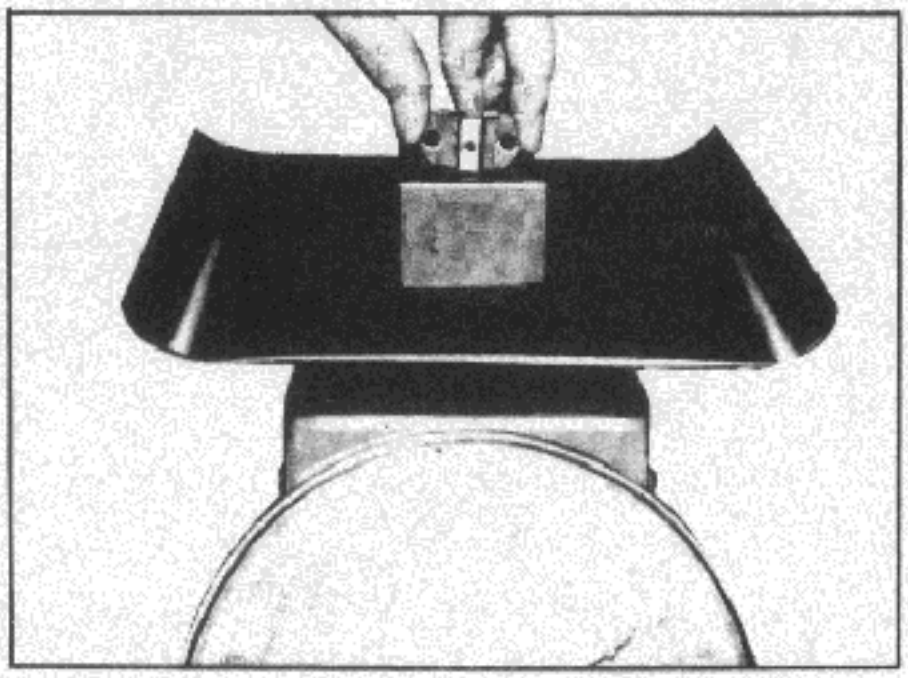


Fig. EE-63 Spring pressure test

Inspection of output

For output inspection, remove the alternator from the vehicle and connect wiring as shown in Figure EE-64 and drive it with motor.

Through the wiring shown in Figure EE-64 magnetic current flows from the battery to the field coil of the a alternator. In this state, raise revolution of the alternator slowly up to the speed where there is no reverse flow (2 A approx.) to the field coil and read the revolution. Correct revolution is approx. 1,000 r.p.m. without load.

Next, increase load resistance to the maximum and almost stop flowing of load current, and put off the switch. Then, raising the load current slowly, increase revolution of the alternator. Observe thus increasing output current as revolution of the alternator increases. If there is no large difference from the specification, it is correct.

No matter how the battery is over-charged or discharged, if the charging current is small, first make sure either the alternator or the relay is in disorder. Inspect the charging current by inserting the ammeter between A terminal of relay and the battery.

Disconnect wire passing from the alternator F terminal to the relay F terminal at the relay F terminal and make the removed lead wire short circuits at the relay A terminal, when if the charging current highly increases, the relay is in disorder.

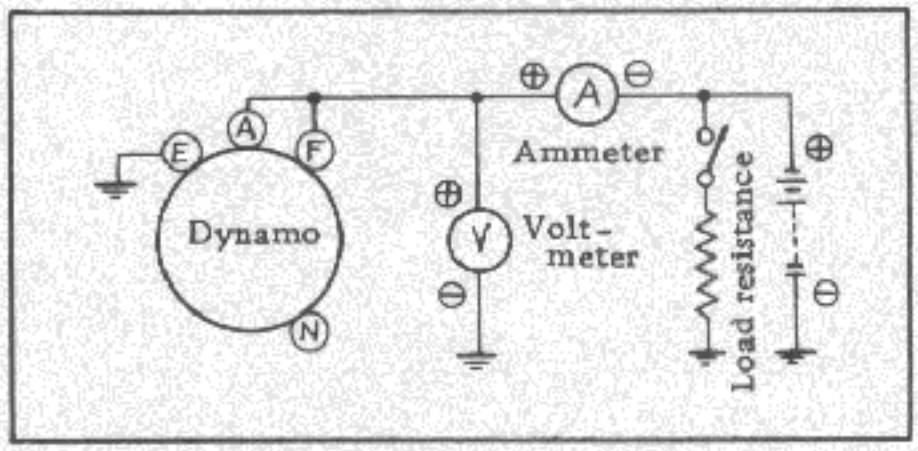


Fig. EE-64 Circuit for the output inspection

Note: Use the battery charged in full up to the normal capacity.

ASSEMBLY

Assembly is a reversal of disassembly procedure. Always make sure the polarity of alternator diode. Refer to Figure EE-60 Diode.

REGULATOR

CONTENTS

Regulator model	Applied generator	Applied engine
RQ2220B	AC500NR	L20
TL1Z-17	LT130-41	L16, L13

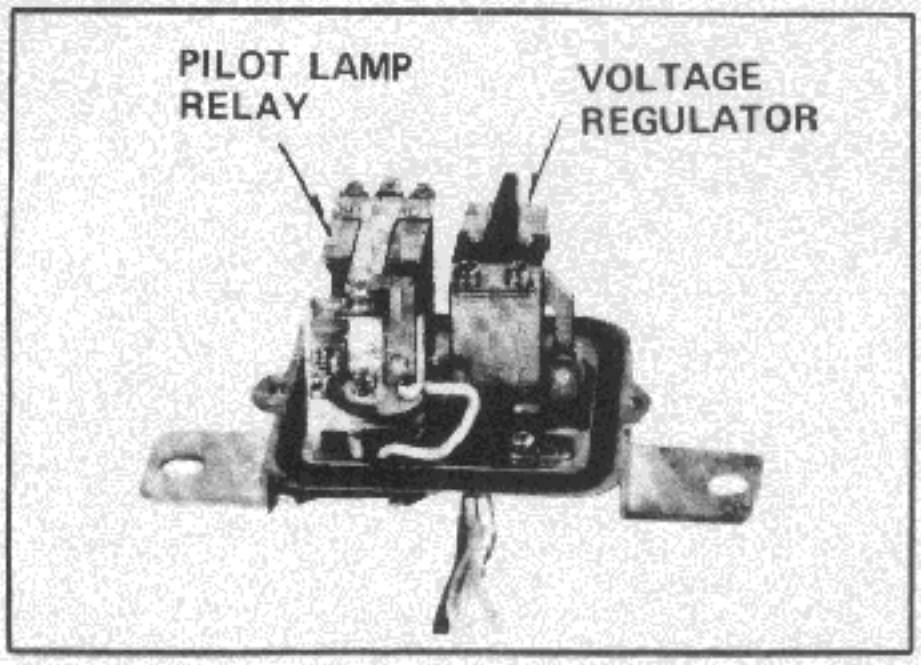


Fig. EE-65 TL1Z-17

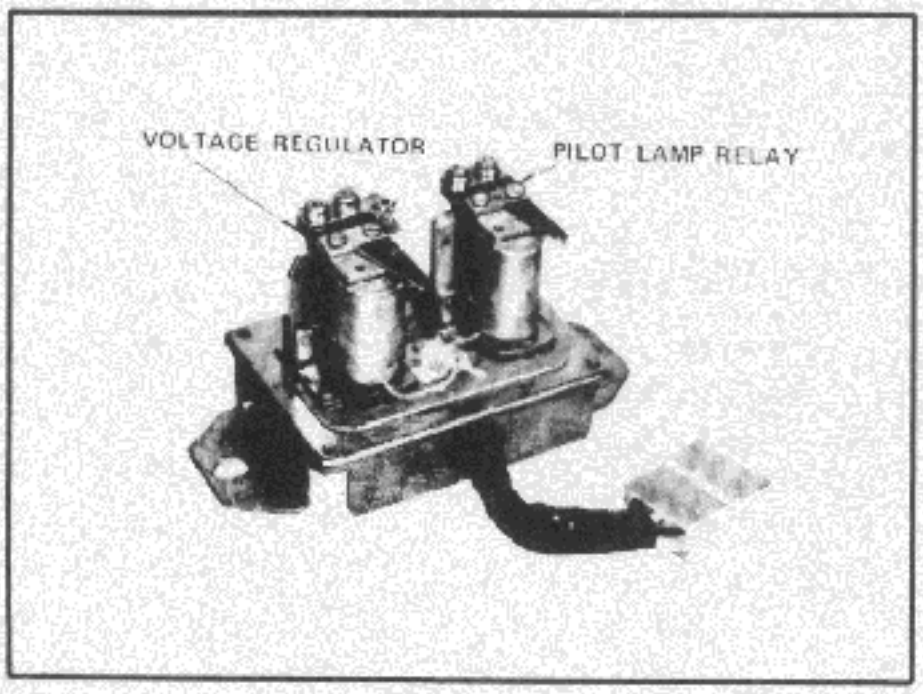
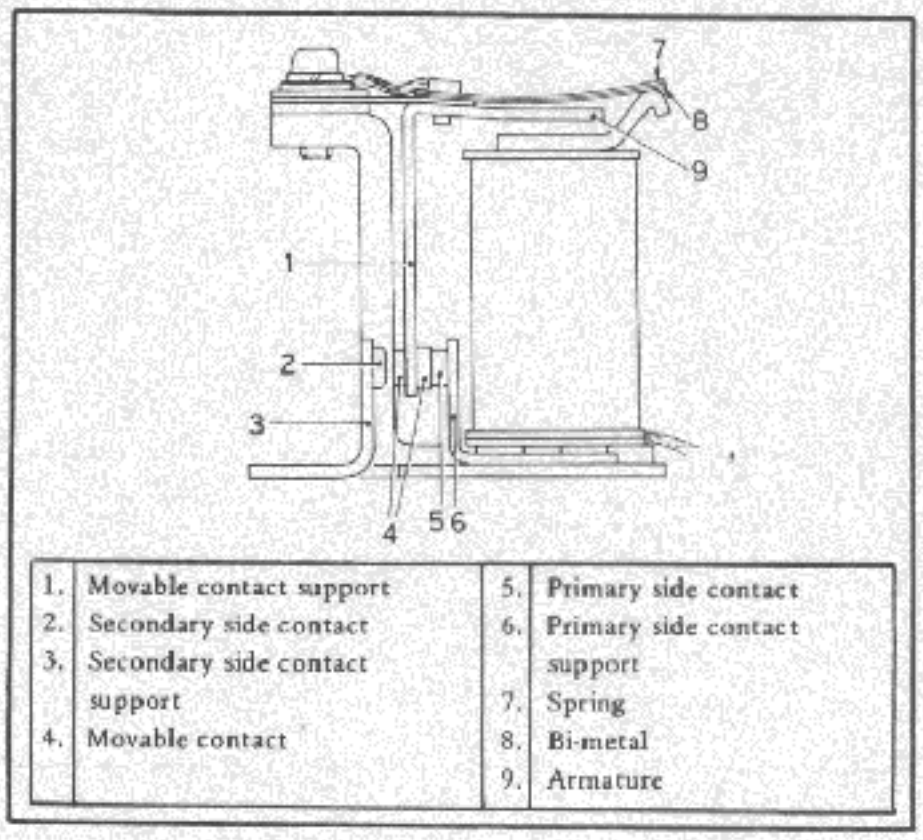


Fig. EE-66 RQ2220B



1.	Movable contact support	5.	Primary side contact
2.	Secondary side contact	6.	Primary side contact support
3.	Secondary side contact support	7.	Spring
4.	Movable contact	8.	Bi-metal
		9.	Armature

Fig. EE-67 Regulator (RQ2220B)

The voltage regulator RA2220B is temperature-compensated so that the charging voltage copes with the climatic variations and two units are housed in the regulator box: a voltage regulator relay and a pilot lamp relay. The effect of temperature fluctuation on their relay setting is minimized by the use of bi-metal spring.

REMOVAL

To remove the voltage regulator, disconnect the 6-way multiple connector and remove the screw securing the regulator to the bulkhead of the engine room.

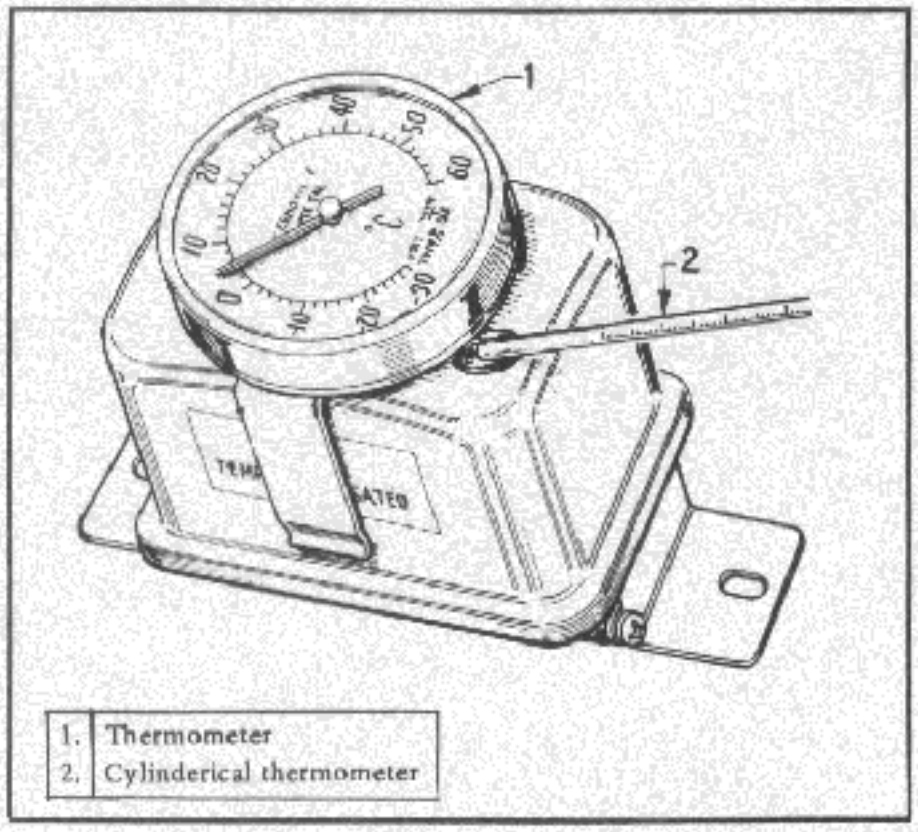
INSTALLATION

Installation is a reversal of removal procedure.

ADJUSTMENT

In the temperature-compensated regulator, it is necessitated to measure the temperature of the regulator cover as the regulating voltage is varied according to the surrounding temperature.

In this case, use the thermometer (90196-0001P) or cylindrical thermometer with putty as shown in Figure EE-68.



1.	Thermometer
2.	Cylinderical thermometer

Fig. EE-68 Measuring of regulator cover temperature

Check of regulated voltage

1. Connect the battery almost charged in full as shown in Figure EE-69.

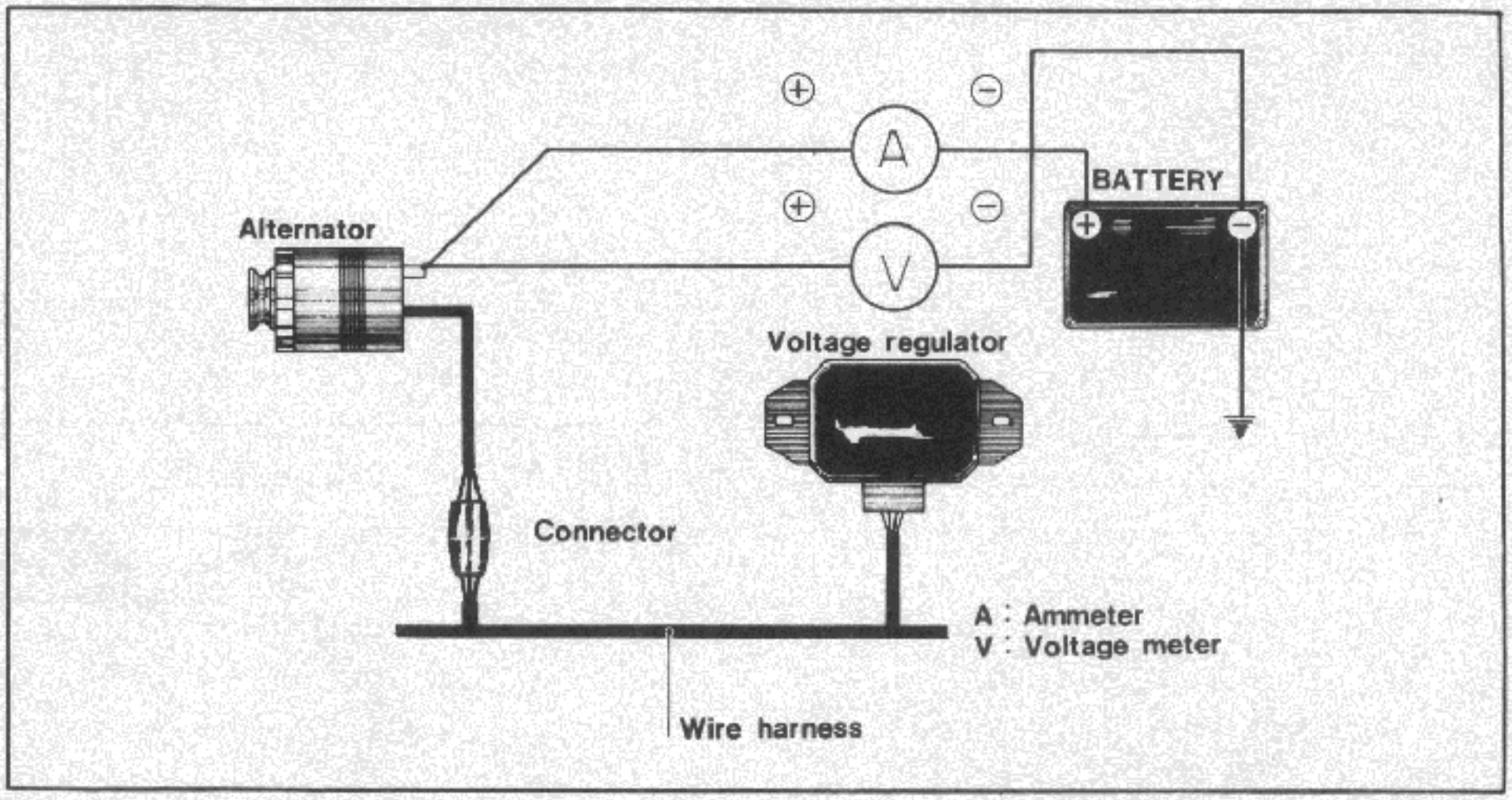


Fig. EE-69 Meter and instrument connection

2. Measure the temperature of regulator cover as shown in Figure EE-68. (RQ2220B)

3. Raise the alternator revolution to 4,000. (RQ2220B)

4. When the charging current is less than 5 ampere and the voltage of this time is within the limit of Figure EE-70, it is all right. (RQ2220B).

5. In case of TL1Z-17, the voltage of the alternator revolution 5,000 r.p.m. is 14.0 to 15.0 volt.

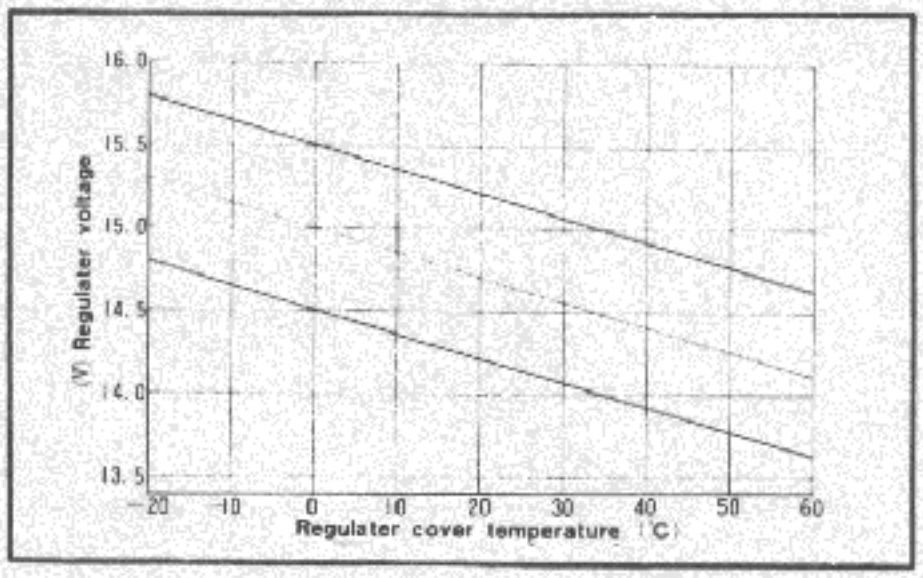


Fig. EE-70

Adjustment of gap

The gap adjust values of the constant voltage relay and the pilot lamp relay must be as follows.

		RQ2220B	TL1Z-17
Constant voltage relay mm (in.)	G_1	0.8 ∿ 1.1 (0.0375 ∿ 0.0433)	0.9 ∿ 1.0 (0.0354 ∿ 0.0394)
	G_2	0.8 ∿ 1.2 (0.0315 ∿ 0.0472)	0.8 ∿ 1.2 (0.0315 ∿ 0.0472)
	G_3	0.3 ∿ 0.4 (0.0118 ∿ 0.0157)	0.4 ∿ 0.5 (0.0157 ∿ 0.0197)
Pilot lamp relay mm (in.)	g_1	0.75 ∿ 1.1 (0.0295 ∿ 0.0433)	0.2 (0.0079)
	g_2	0.9 ∿ 1.2 (0.0354 ∿ 0.0472)	0.5 ∿ 0.6 (0.0197 ∿ 0.0236)
	g_3	0.75 ∿ 1.1 (0.0295 ∿ 0.0433)	0.4 ∿ 0.5 (0.0157 ∿ 0.0197)

≪ RQ2220B ≫ (MITSUBISHI)

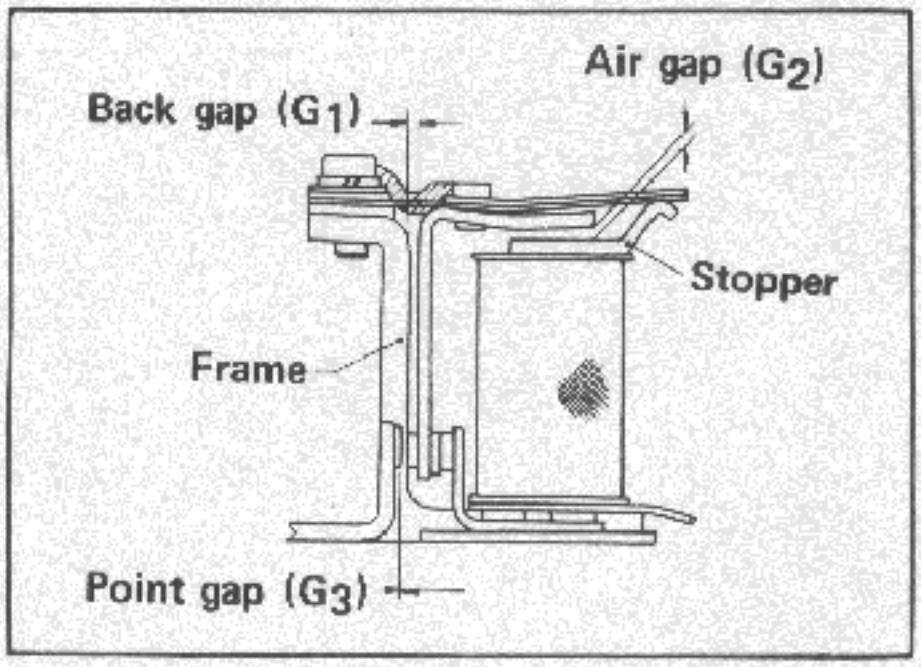


Fig. EE-71 RQ2220B

The voltage regulator and the pilot lamp relay are the same type. Accordingly, the adjusting method is also the same.

Adjust these gaps in order of G_1 (g_1), G_2 (g_2) and G_3 (g_3), if these are out of specifications.

*** Back gap (G1 or g1)**

Loose the armature hinge screw and adjust the position by sliding the armature.

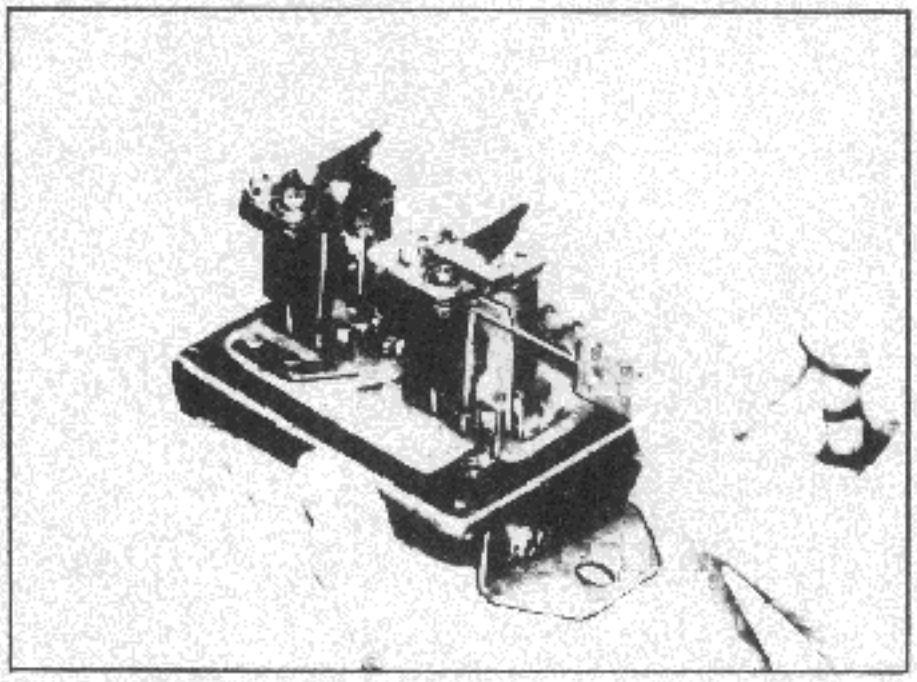


Fig. EE-72 Checking G1 (g1)

*** Top air gap (G2 or g2)**

Adjust the gap by bending the movable contact supports as shown in Figures EE-72 and EE-73.

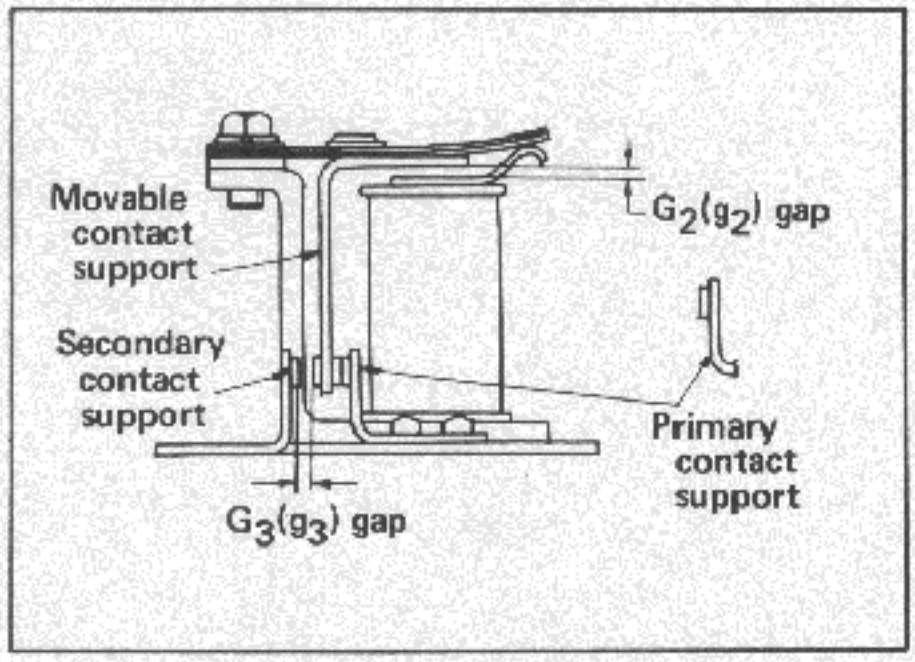


Fig. EE-73 Adjusting gap

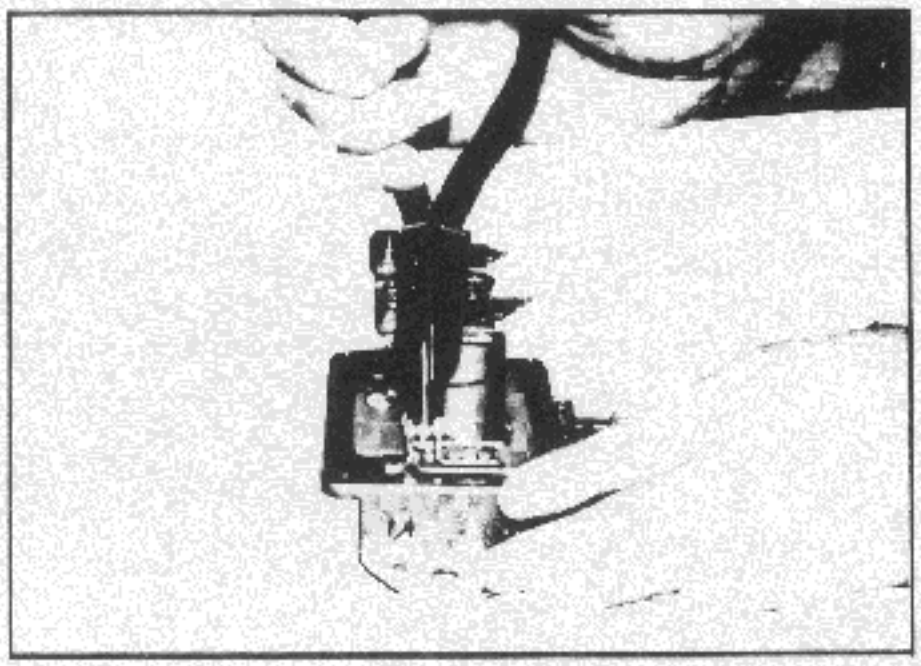


Fig. EE-74 Adjusting G2 (g2) gap

*** Point gap (G3 or g3)**

Adjust the gap by bending the secondary contact support as shown in Figures EE-73 and EE-75.

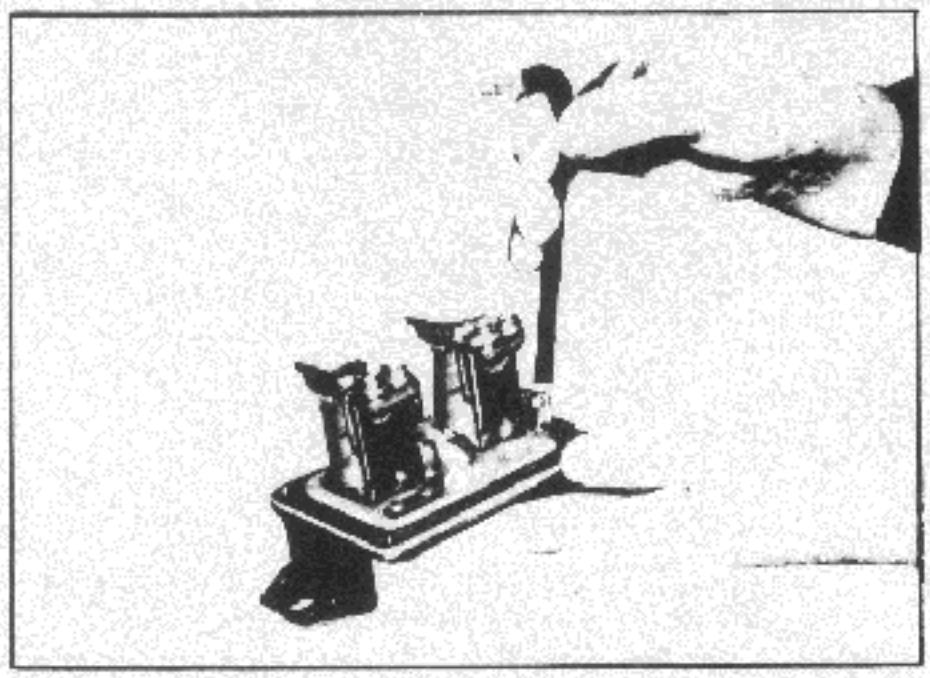


Fig. EE-75 Adjusting G3 (g3) gap

≪ TL1Z-17 ≫ (HITACHI)

Voltage regulator

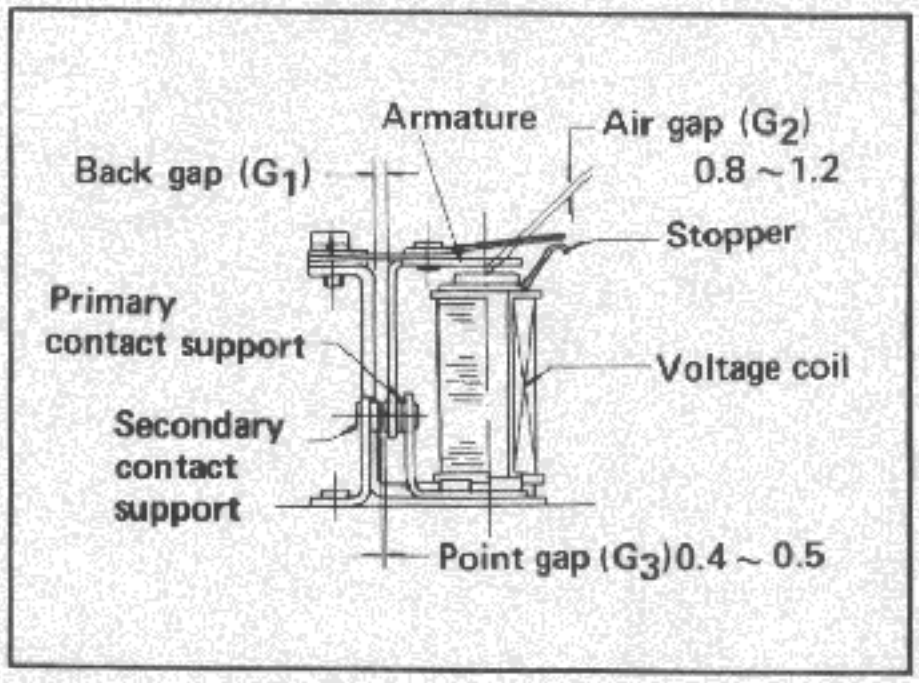


Fig. EE-76 TL1Z-17

* Back gap (G1)

Put in the normal gap gauge arm ature and the yoke, and fix by the armature set screw.

* Air gap (G2)

Adjust the gap by bending the primary contact support in the right or left direction using the adjusting tool.

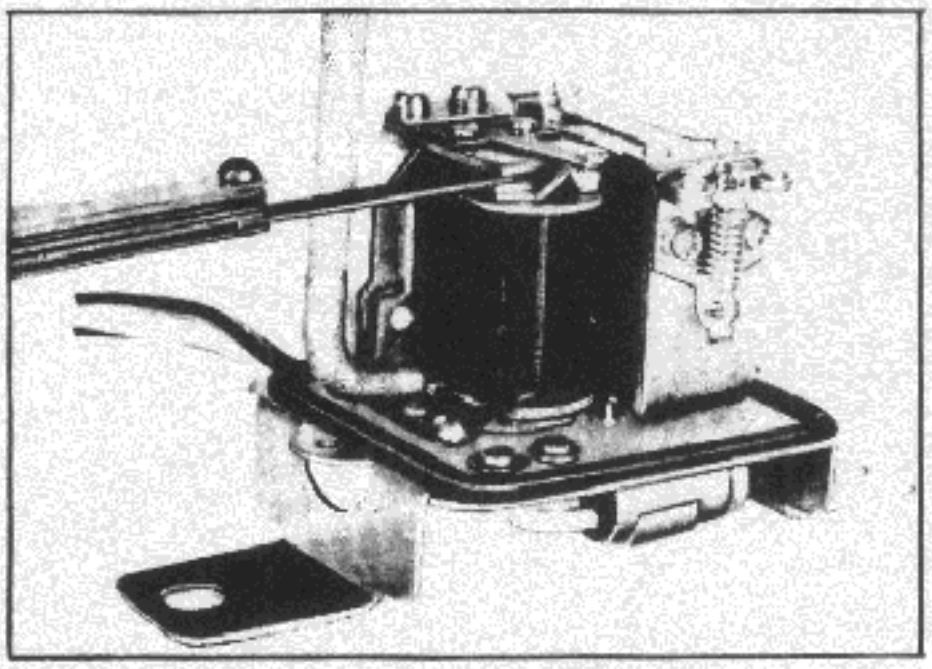


Fig. EE-77 Adjusting G2 gap

* Point gap (G3)

Adjust the gap by bending the secondary contact support in the right or left direction using the adjusting tool.

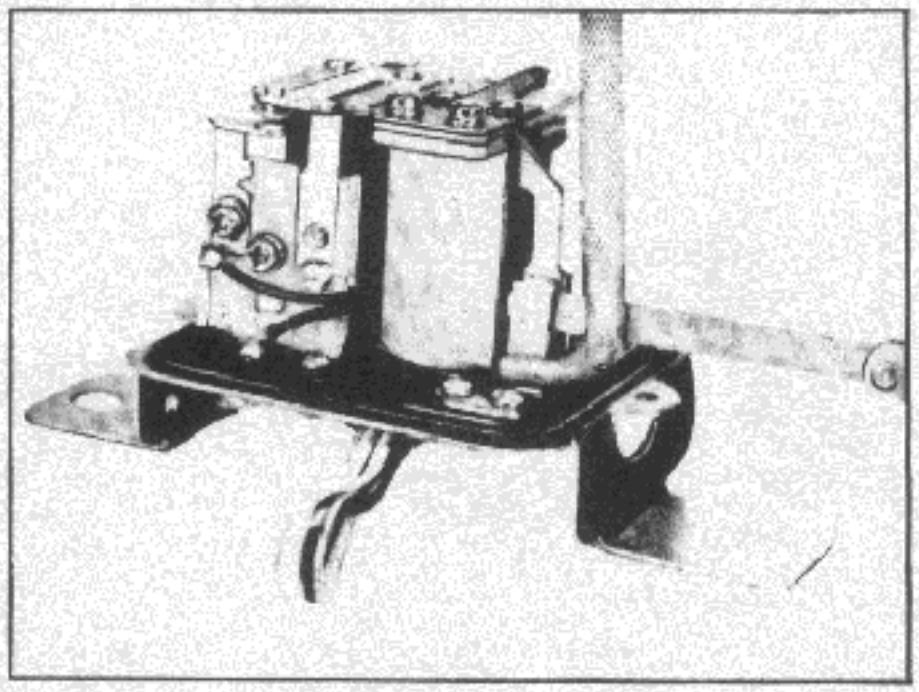


Fig. EE-78 Adjusting G3 gap

Pilot lamp realy

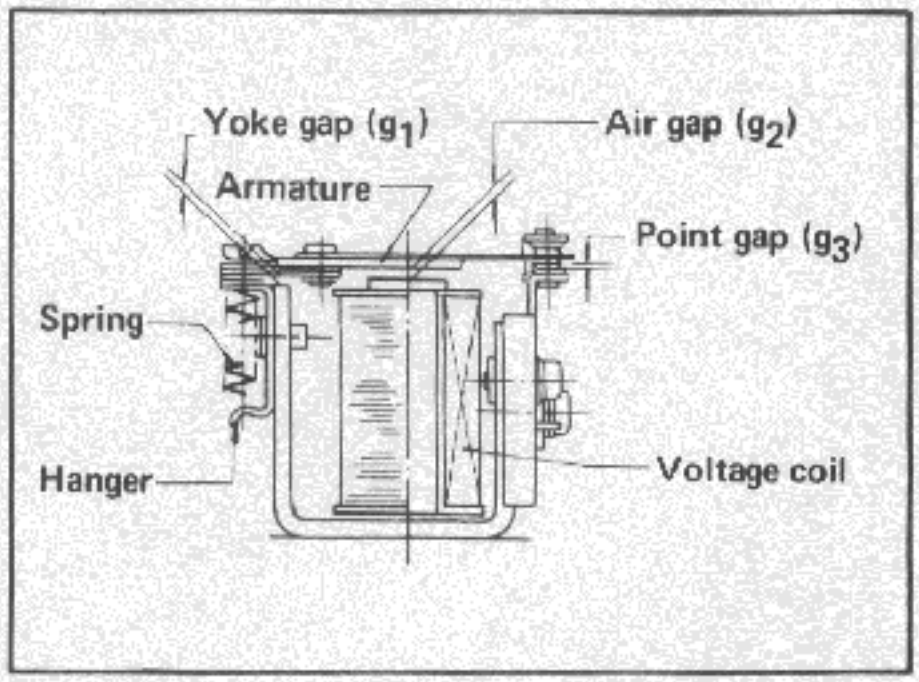


Fig. EE-79 TL1Z-17

* Yoke gap (g1)

Put in the normal gap gauge between the armature and the yoke, and fix by the armature set screw.

* Air gap (g2)

Loose the contact set fix screw, and adjust by putting the driver in the hole and moving in the upper and lower direction.

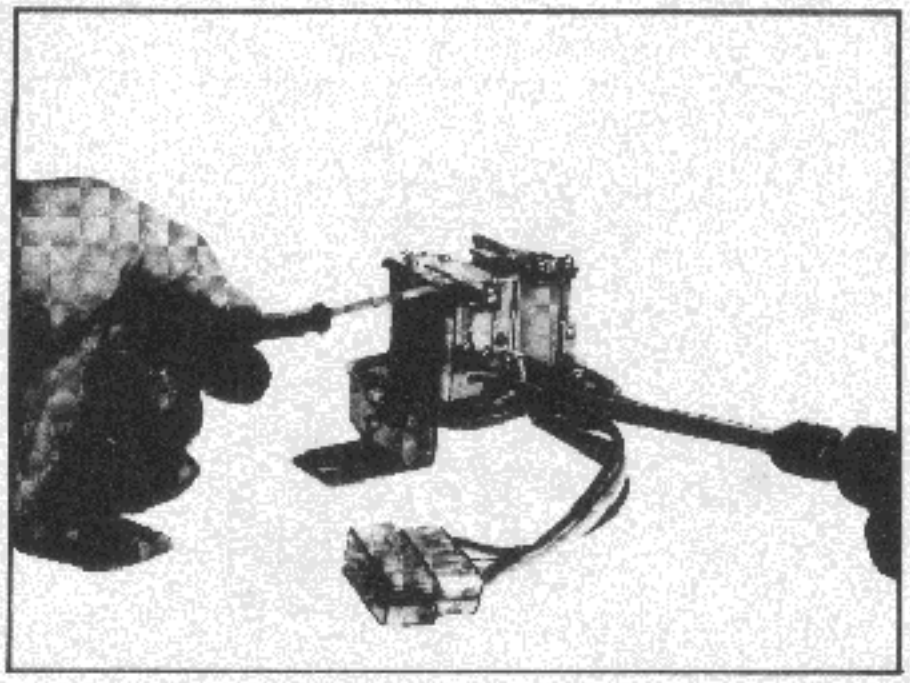


Fig. EE-80 Adjusting g2 gap

*** Point gap (g3)**

Loose the contact point fix screw, and adjust by putting the driver in the gap and moving in the upper and lower direction.

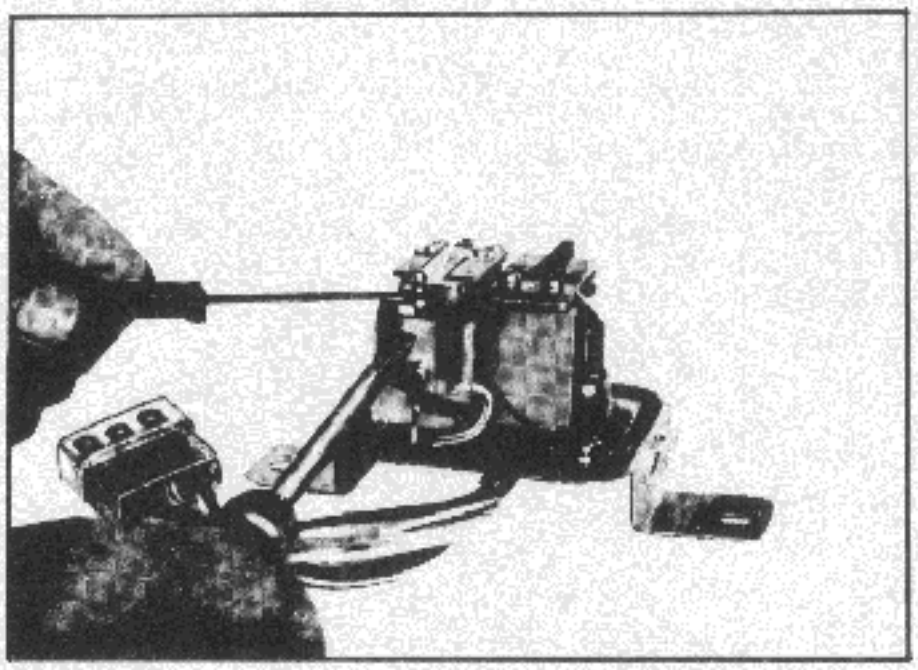


Fig. EE-81 Adjusting g3 gap

Adjustment of voltage

Adjust the voltage by bending the stopper up and down. Bend upward to heighten adjust value and downward to lower adjust value.

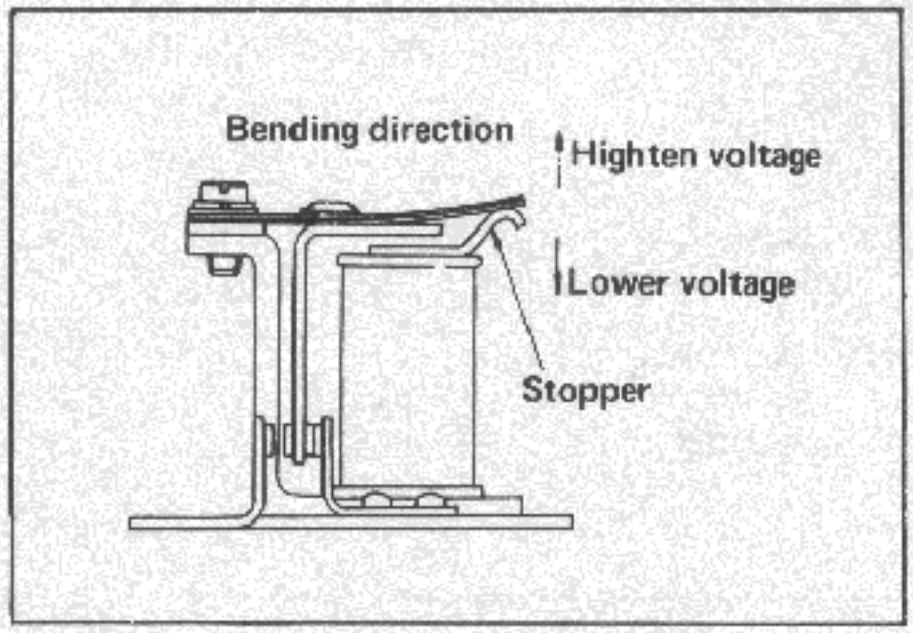


Fig. EE-82 Adjusting the voltage

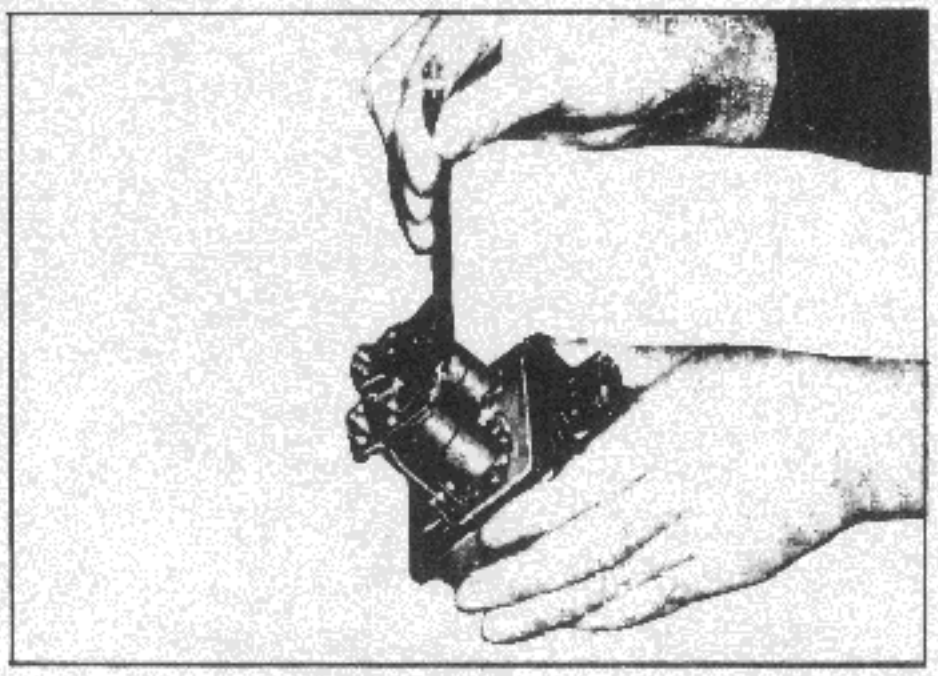


Fig. EE-83 Adjusting the voltage

TROUBLE DIAGNOSES AND CORRECTIONS

Troubles	Causes	Remedies
No output	Sticking brushes.	Free; replace brush and brush spring.
	Dirty brushes and slip rings.	Clean the brushes and slip rings.
	Loose connections or broken leads.	Tighten or solder connection. Replace leads.
	Open stator winding.	Repair or replace the stator.
	Open rotor winding.	Replace the rotor.

	Open diodes.	Replace the diodes.
	Shorted rotor.	Replace the rotor.
	Shorted stator.	Repair or replace the stator.
	Grounded "BAT" terminal.	Replace the insulator.
	Broken fan belt.	Replace the belt.
Excessive output	Broken neutral poiint wire (color of wire is white).	Replace the wire.
	Defective voltage regulator.	Check the regulator operation.
	Poor grounding of the alternator and voltage regulator "E" terminal.	Tighten the terminal connection.
	Broken ground wire (color of wire is black).	Replace the wire.
Low output	Loose or worn fan belt.	Tighten or replace the belt.
	Sticking brushes.	Free; replace brushes and spring if necessary
	Low brush spring tension.	Replace the brush spring.
	Defective voltage regulator.	Check the regulator operation.
	Dirty slip rings.	Clean the slip ring.
	Partial short, ground, or open in stator winding.	Replace the stator.
	Partial short or ground of rotor winding.	Replace the rotor.
	Open diode or defective diode.	Replace the diode.
Noisy alternator	Loose mounting.	Tighten mounting bolts.
	Loose drive pulley.	Tighten pulley.
	Defective ball bearings.	Replace the bearing.
	Improperly seated brushes.	Seat brushes properly.

IGNITION CIRCUIT

The ignition circuit includes the distributor, ignition coil, ignition switch, spark plugs, high tension cable and the battery.

DISTRIBUTOR

CONTENTS

Distributor model	Applied engine
D613-51	L20 (with single carb.)
D609-53	L20 (with twin carb.)
D410-58	L16 (with single carb.), L13
D409-54	L16 (with twin carb.)

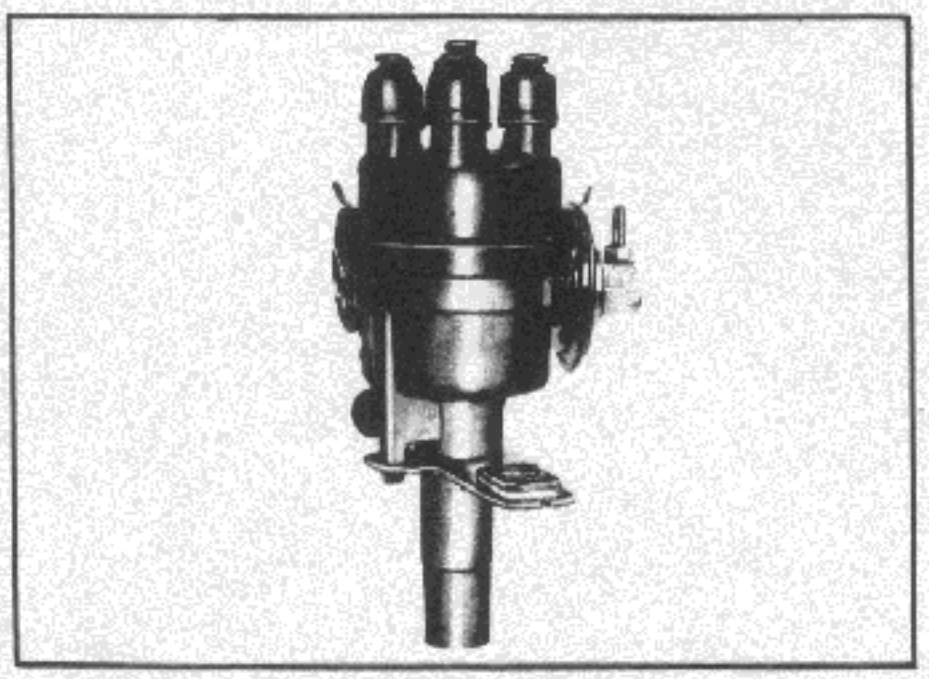


Fig. EE-84 D613-51 D609-53

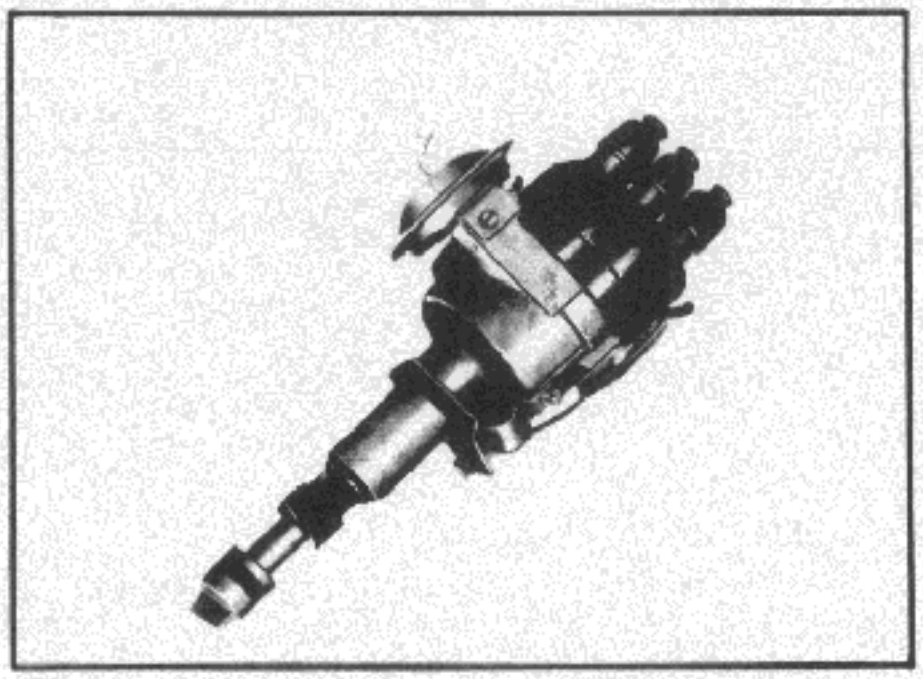


Fig. EE-85 D410-58 D409-54

SPECIFICATIONS

			D613-51	D609-53	D410-58	D409-54
Make			HITACHI	HITACHI	HITACHI	HITACHI
Applied engine			L20 (with single carb.)	L20 (with twin carb.)	L16 (with single carb.)L13	L16 (with twin carb.)
Firing order			1-5-3-6-2-4	1-5-3-6-2-4	1-3-4-2	1-3-4-2
Rotating direction			Counter-clockwise	Counter-clockwise	Counter-clockwise	Counter-clockwise
Ignition timing (B. T. D. C.)			12°/550	17°/600	10°/600	14°/650
Dwell angle (degree)			35°~41°	35°~41°	49°~55°	49°~55°
Condenser capacity (μ F)			0.22~0.24	0.22~0.24	0.22~0.24	0.22~0.24
Advance characteristic	Centrifugal	Start (r.p.m.)	450	500	450	450
		Maximum (degree/r.p.m.)	13°/1500	9°/1000	10°/1500	9°/1800
	Vacuum	Start (-mmHg)	100	150	150	150
		Maximum (degree/-mmHg)	8°/287	11.25°/390	9°/310	9°/310
Weight		kg (lbs.)	1.0 (2.2)	1.0 (2.2)	1.0 (2.2)	1.0 (2.2)

CONSTRUCTION AND OPERATION

Figure EE-86 shows ignition diagram of gasoline engine. Functionally, the distributor consists of high tension voltage part, switch off part, centrifugal advancing angle part, vacuum advance mechanical part and driving part.

Figure EE-87 shows structure of its typical product.

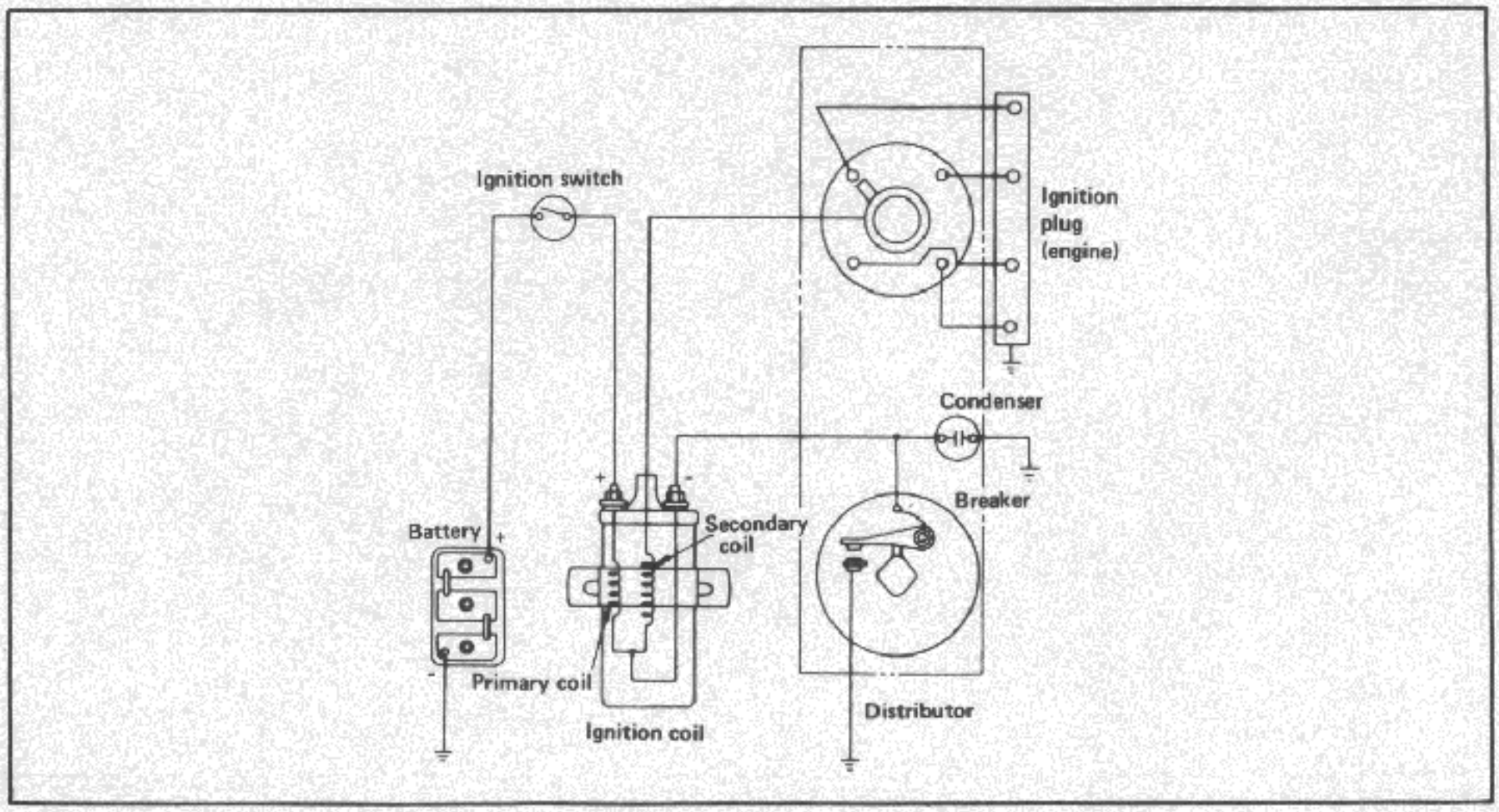


Fig. EE-86 Ignition diagram (D410-58) (D409-54)

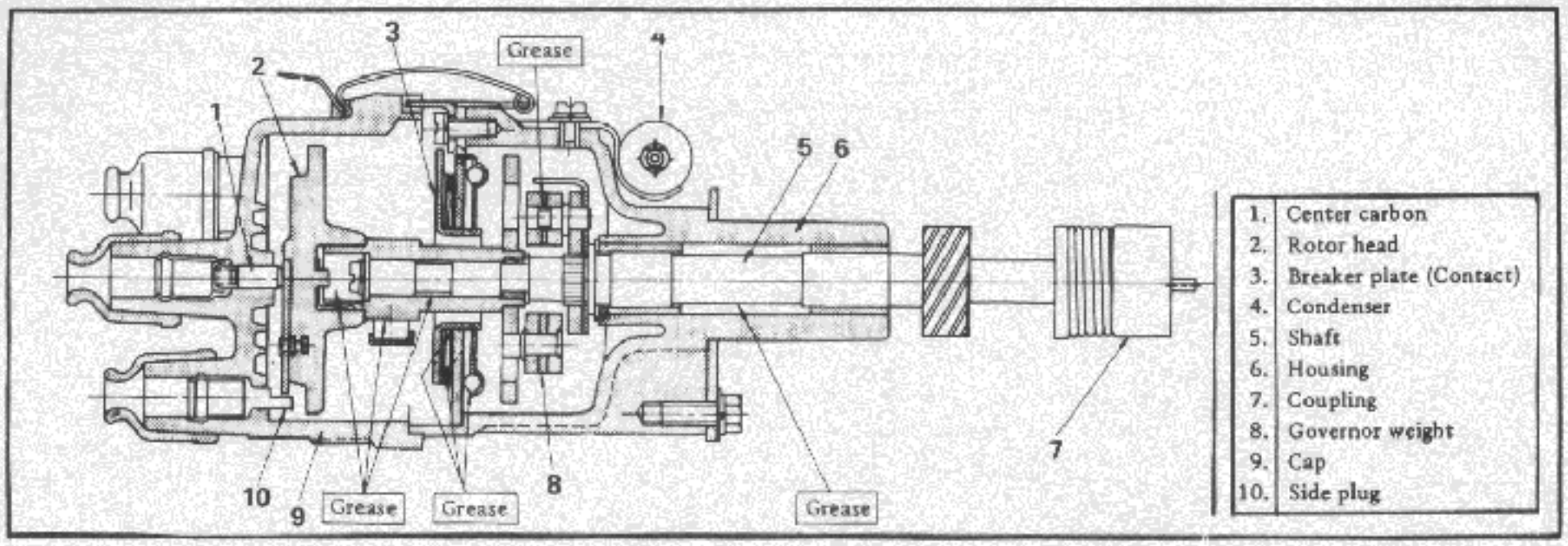


Fig. EE-87 Structure (D410-58)
(D409-54)

1.	Ass'y clamp cap
2.	Ass'y clamp cap
3.	Ass'y shaft
4.	Ass'y pinion set
5.	Ass'y cam
6.	Ass'y weight governor
7.	Spring governor
8.	Screw
9.	Ass'y rotor head
10.	Washer thrust
11.	Ass'y breaker
12.	Set contact
13.	Ass'y terminal
14.	Ass'y control vacuum
15.	Screw
16.	Ass'y condenser
17.	Screw
18.	Ass'y cap distributor
19.	Ass'y point carbon
20.	Cap gurn
21.	Plate fixing
22.	Bolt

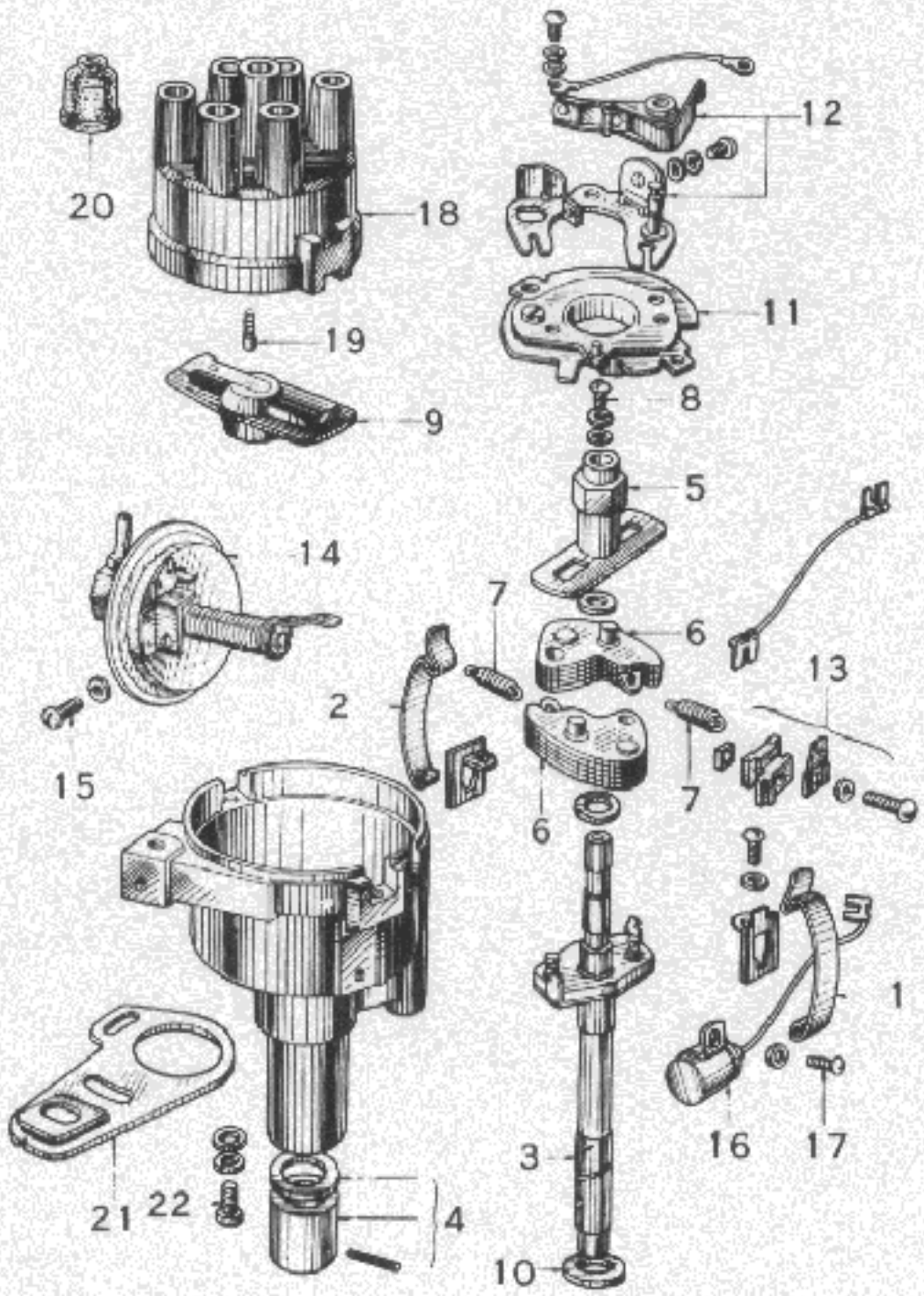


Fig. EE-88 D613-51
D609-53

CHECKING AND ADJUSTMENT

Cap and rotor head

Cap and rotor head must always be kept clean to maintain good insulation durability since high tension voltage from ignition coil is imposed on them. Sometimes, inside of cap and rotor head is covered by only fine carbon powder and dust, cleaning is required by gasoline once in a month. Whenever crack or trace of leakage is found on the cap, it must be replaced with a new one.

Point

Standard size of point gap is 0.45 to 0.55 mm (0.0177 to 0.0217 in.). In case size is off the standard, adjustment is required by loosening point screws. Gap gauge is required for adjustment. However, without gap gauge it can be adjusted by holding down the contact arm of which the stopper is 0.5 mm (0.0197 in.) thick. As for those with tungsten point, point gap must be checked at every 4,000 km (2,500 miles) run. When surface of the point is not smooth, fine sand paper No. 500 or 600 or oily whetstone must be applied for smoothing. At this time, grease must be supplied to both arm pivot receiver and surface of cam. In case wearing of point is remarkable, it must be replaced with a new one. In this case, contact arm and contact point are also to be replaced with. Details for replacement is as undermentioned.

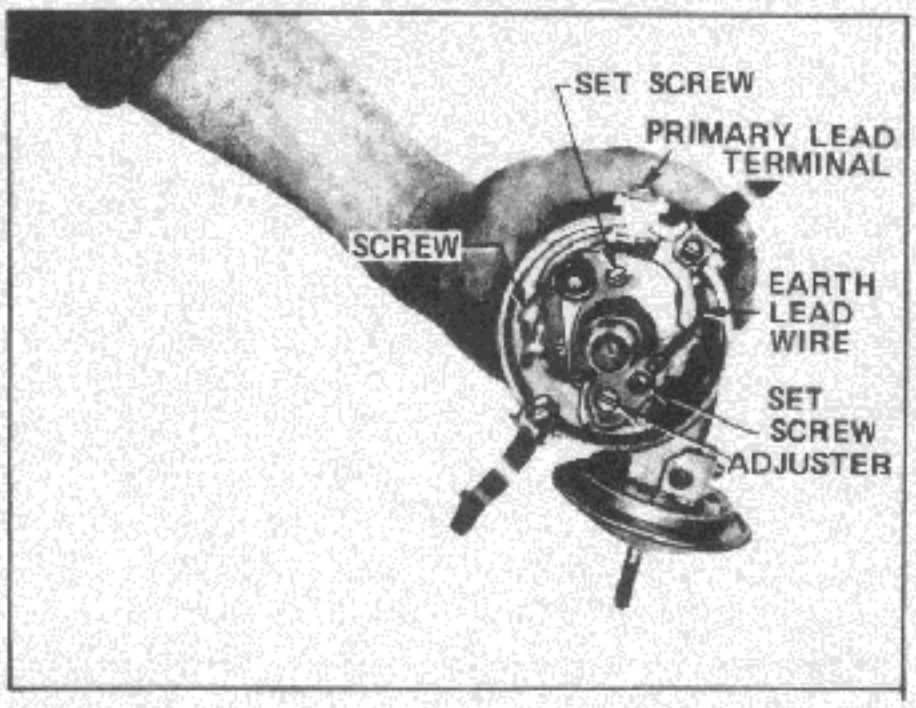


Fig. EE-89 Breaker

First loosen by 1 to 1.5 turns of screw at contact arm and primary lead wire connection part to pull out primary lead terminal. In this case, however, notice not to loosen the screw excessively. Refer to Figure EE-90.

As shown in Figure EE-90, take off the stopper from stem bar and hold the contact point by fingers and pull out toward you elevating it a little. The both cortact point and contact arm can be disconnected together.

When new contact set is connected, do just in opposite order. Apply slightly grease on both arm pivot receiver and surface of cam.

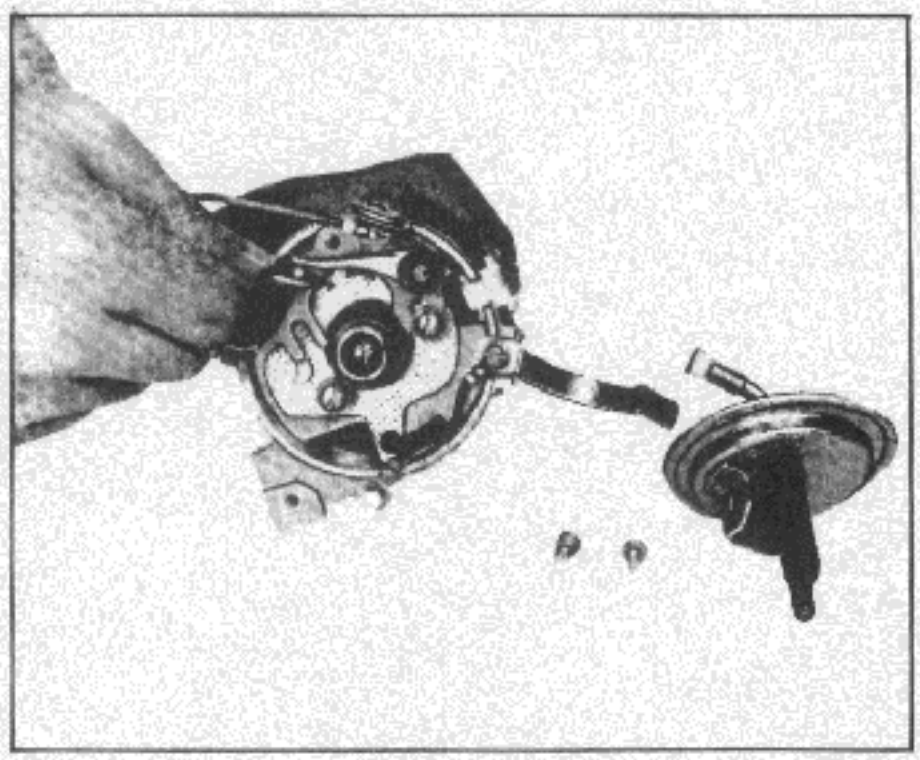


Fig. EE-90 Disassembling the contact arm and contact point

Condenser

Performance of condenser depends on the setting and insulating condition. Thus, frequent checking is required to clean the outlet of lead wire and to prevent set screw from loosening. Checking of condenser is made by capacity meter. Without capacity meter, it can be checked by tester by adjusting its range to measure large resistance value. When condenser is normal, tester indicator swings largely instantly and gradually moves back to the infinite. In case the indicator never stays or it points Zero in resistance, the transformer is out of order and must be replaced with.

Vacuum advance mechanical part and switch on-off part

≪ Vacuum advance characteristic ≫

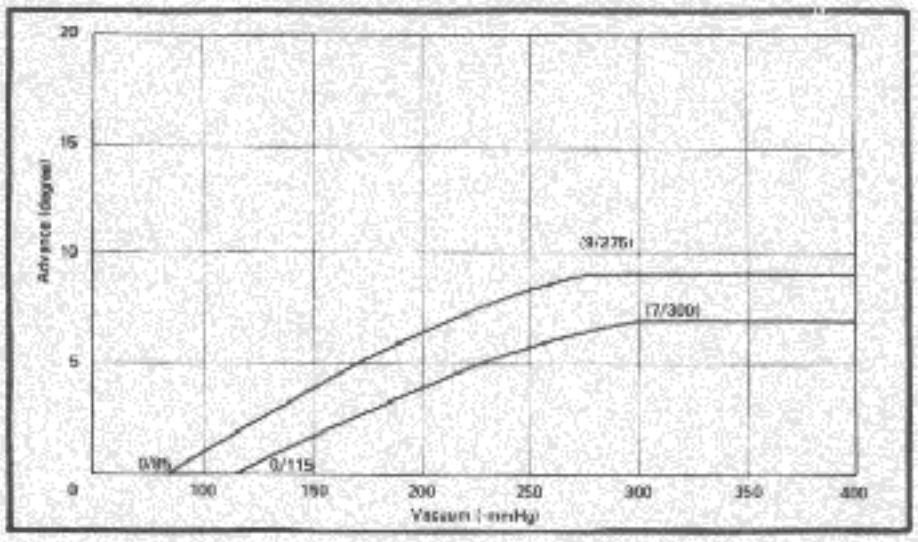


Fig. EE-91 D613-54

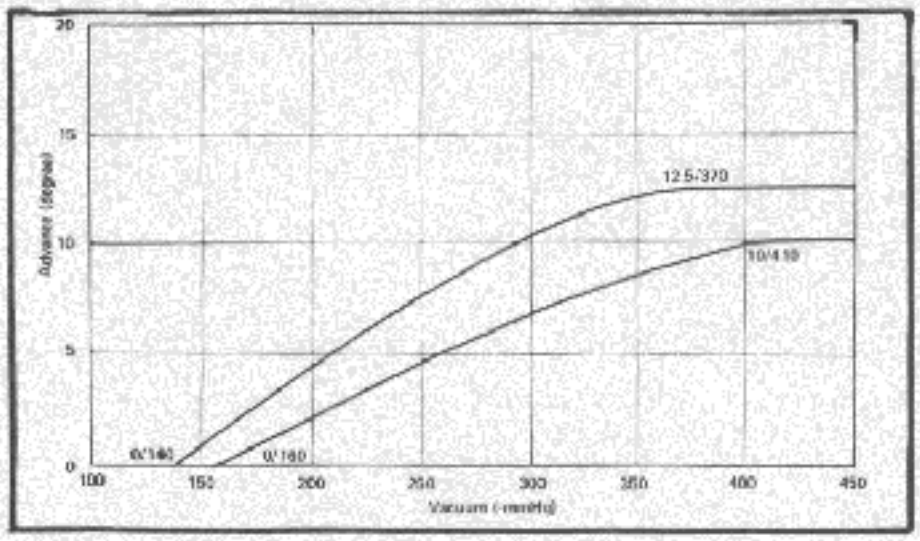


Fig. EE-92 D609-53

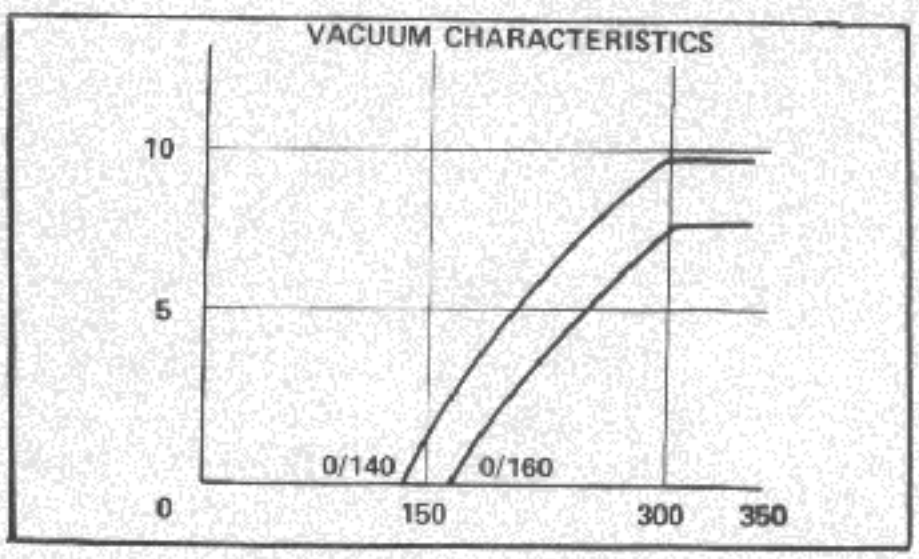


Fig. EE-93 D410-58

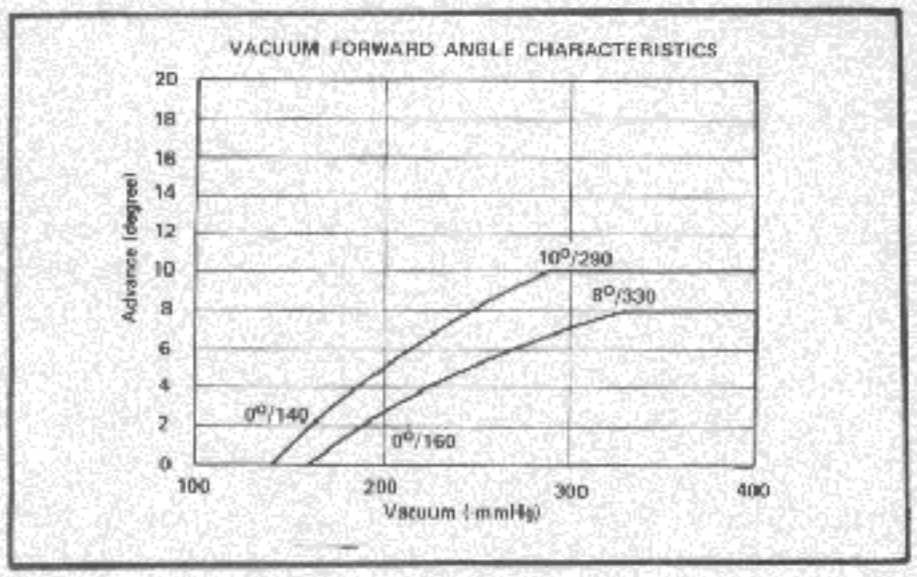


Fig. EE-94 D409-54

Check whether vacuum advance mechanism operates or not, by operation indicator attached to vacuum advance mechanism.

Followings are the causes considered for non-operation.

1. Leakage of air due to incomplete fastening of vacuum inlet.

2. Leakage due to defective diaphragm.

3. Fixed side and moving side of breaker plate is sticked.

Solution for 1. is to make complete fastening and 2. is to replace it with a new one.
Solution for 3. is as follows:

(1) Moving side of breaker plate is supported by three steel balls for each up and down side. Do these balls work smoothly?

(2) Moving side of breaker plate is to rotate with pivot receiver of fixed side.
Does this pivot receiver move?
In case of assembly, be sure to put in 3 steel balls for each up and down side and to apply grease.

Centrifugal advance mechanical part

When cause of engine trouble is traced to centrifugal advance mechanical part, use distributor tester to check its characteristic.
When nothing is wrong with its characteristci, conceivable causes are defectiveness or abnormal wearing-out of driving part or others.

So do not disassemble it. In case of improper characteristic, take off switch on-off part and check closely cam assembly, governor weight, shaft and governor spring, etc.

In case centrifugal advance mechanical part is reassembled, be sure to check advance characteristic by distributor tester.

≪ Centrifugal advance characteristic ≫

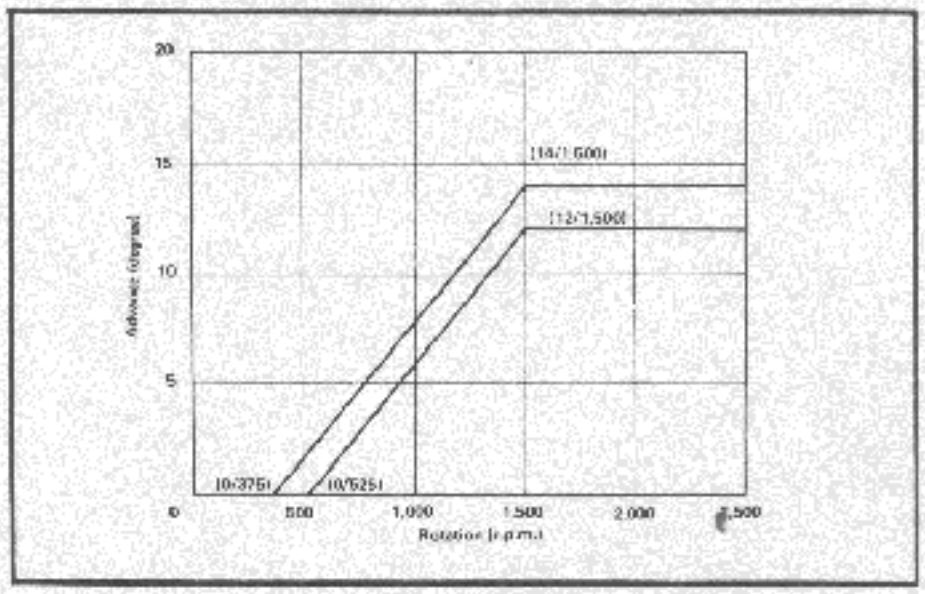


Fig. EE-95 D613-51

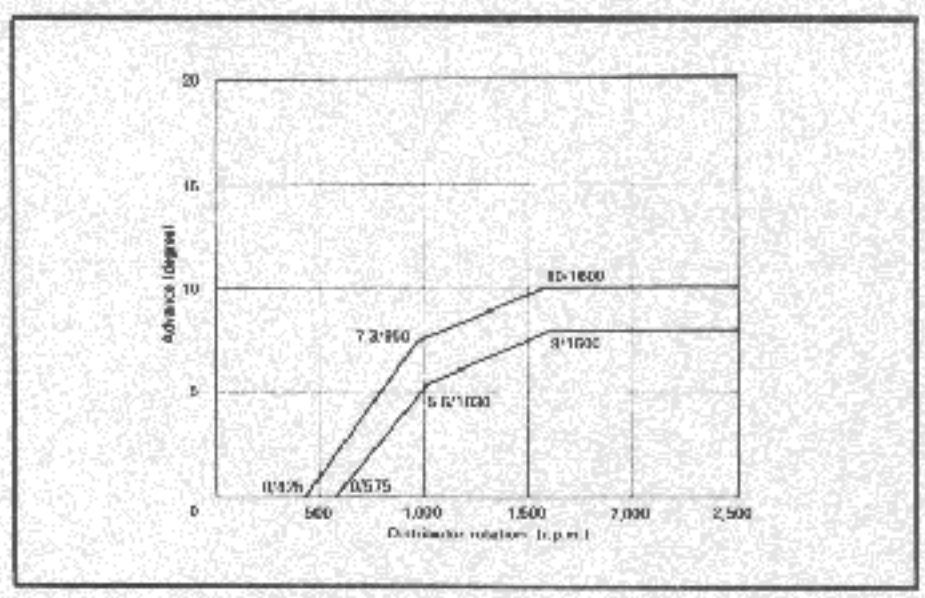


Fig. EE-96 D609-53

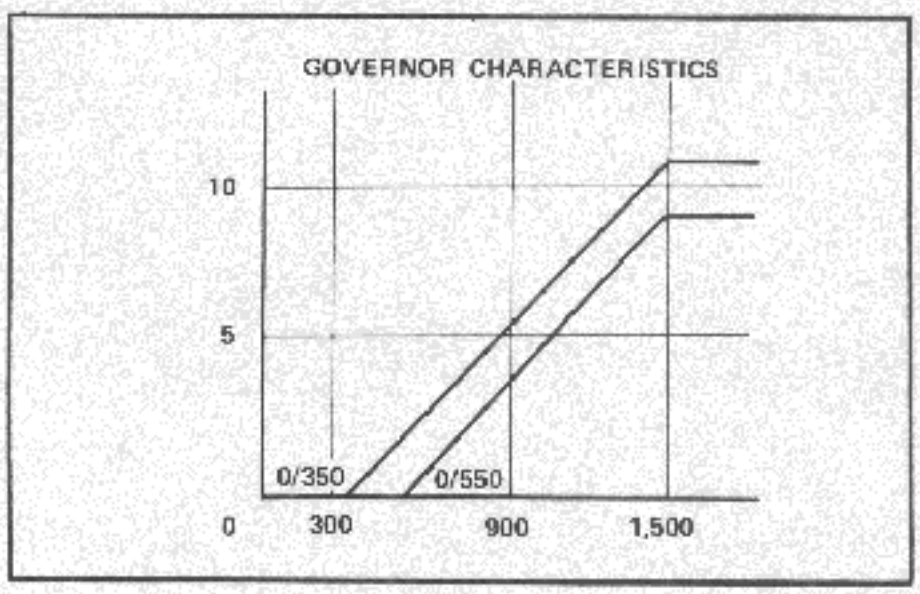


Fig. EE-97 D410-58

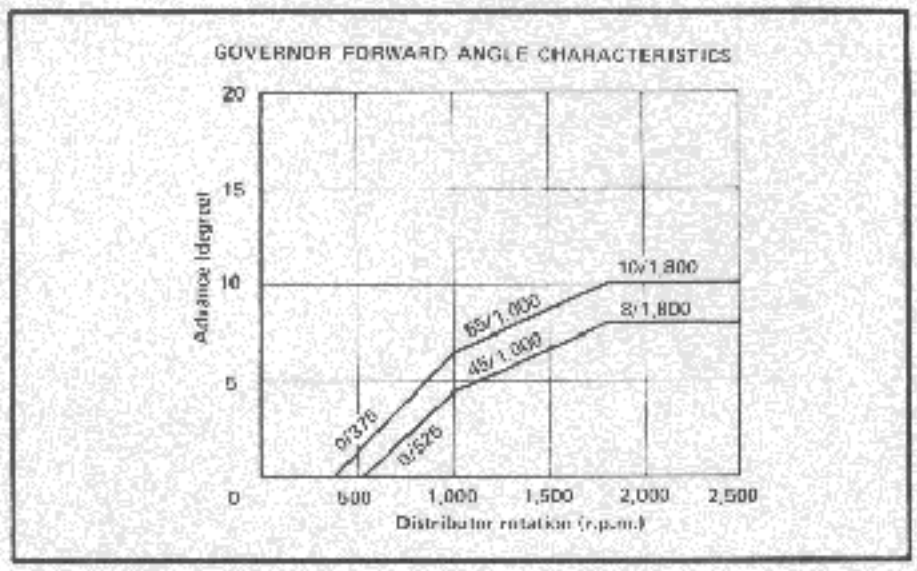


Fig. EE-98 D409-54

DISASSEMBLY AND ASSEMBLY

Disassembly

When distributor is disconnected from engine, position of distributor and rotor head for housing must be well remembered or marked.

If distributor is set to wrong place, no operation become possible. Disassembly is to be made in the following order.

1. Take off cap and disconnect rotor head.

2. Take off vacuum controller.

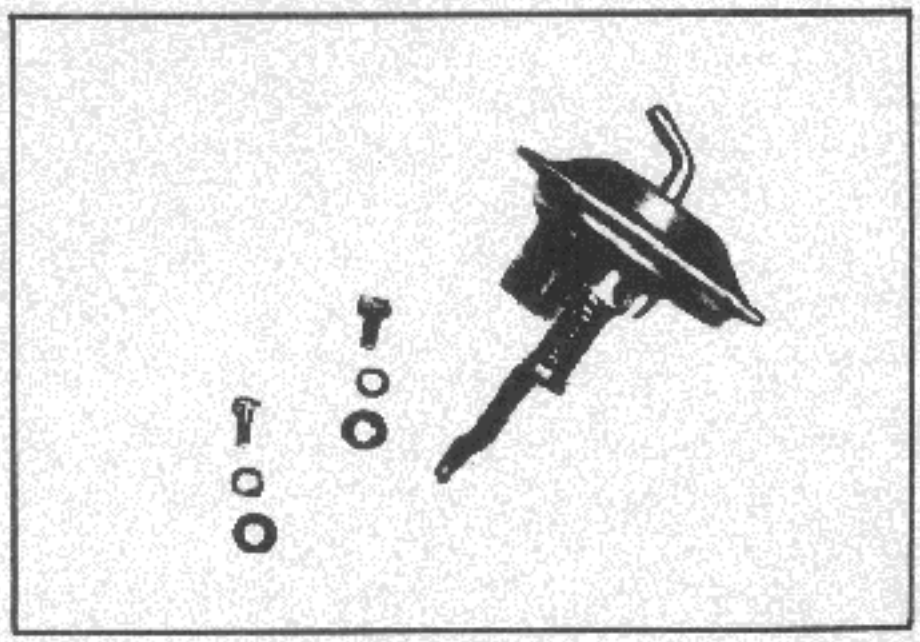


Fig. EE-99 Disassembly of vacuum controller

3. Take off contact breaker.
Refer to page EE-34 when contact set is to be disconnected.

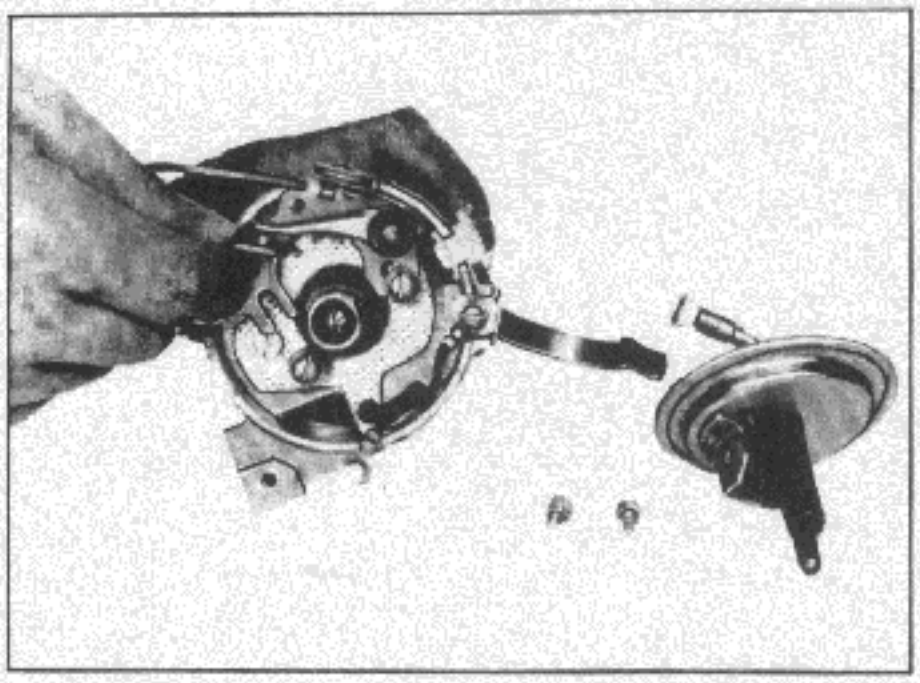


Fig. EE-100 Removal of contact set

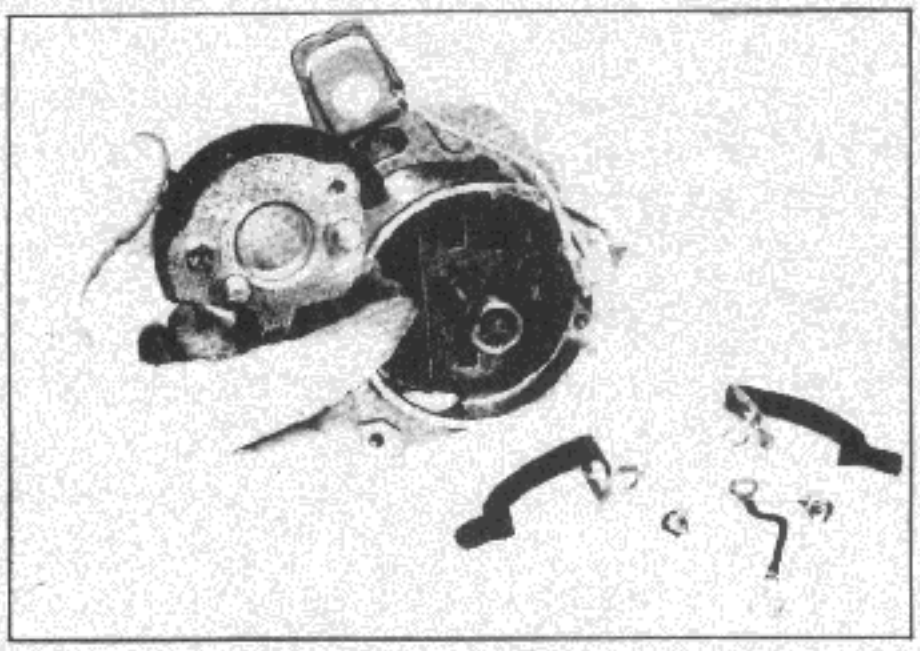


Fig. 101 Removal of contact breaker

4. When contact breaker is disassembled, take off, clip to disconnect breaker plate (fixed) putting down moving breaker plate.
Be careful not to lose steel balls between breaker spring and breaker plate as well as those between breaker plates.

5. Pull knock pin and disconnect gear to pull out whole rotation part. However before pulling out, put counter mark on gear and shaft or remember the relation between coupling direction and setting groove of cam rotor head.

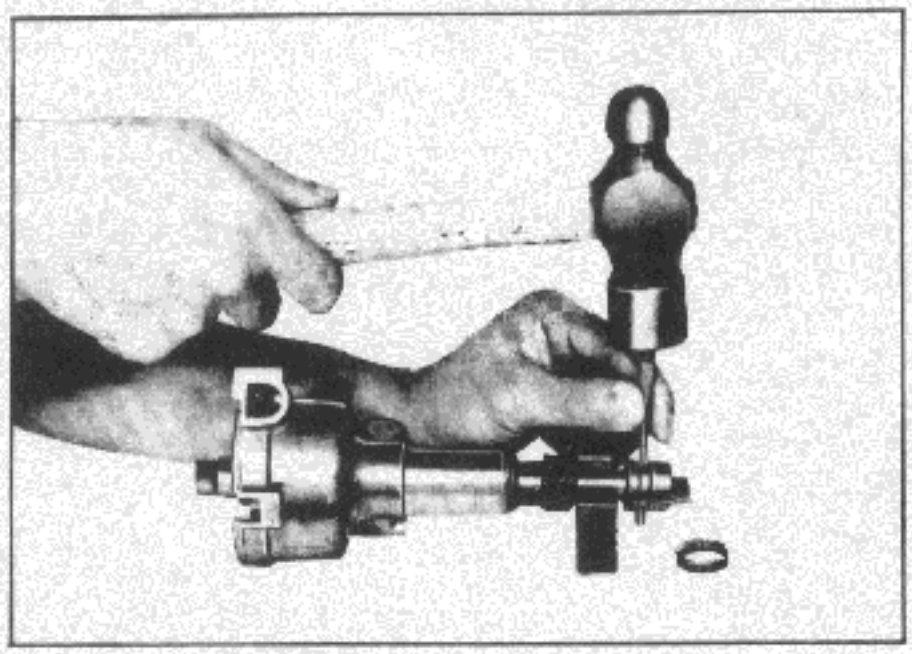


Fig. EE-102 Removal of knock pin

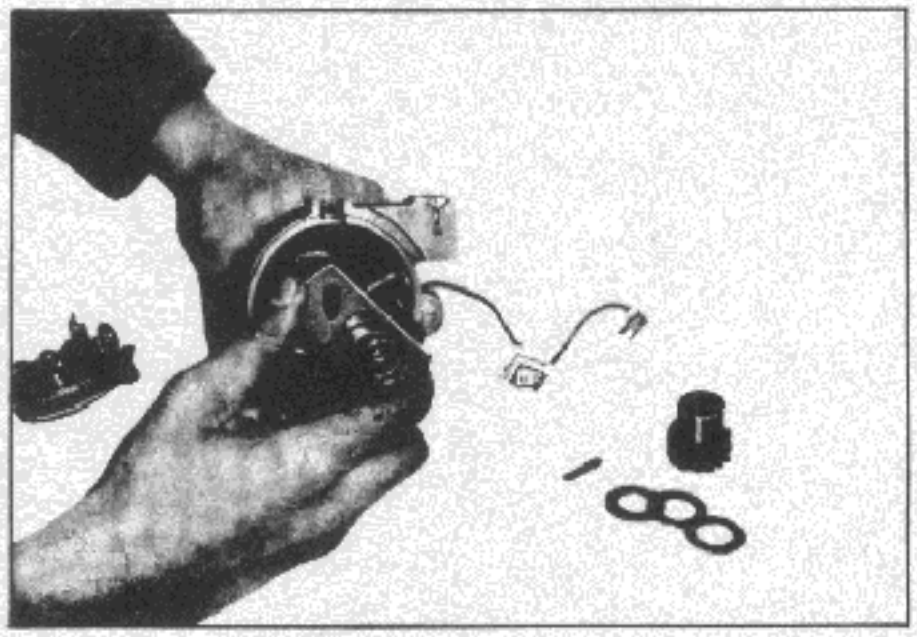


Fig. EE-103 Removal of rotation part

6. When cam is disconnected, take off set screw first since shaft head is fastened by screw to hold cam down. In this case also, put counter mark on cam and shaft or remember the relation with ignition timing.

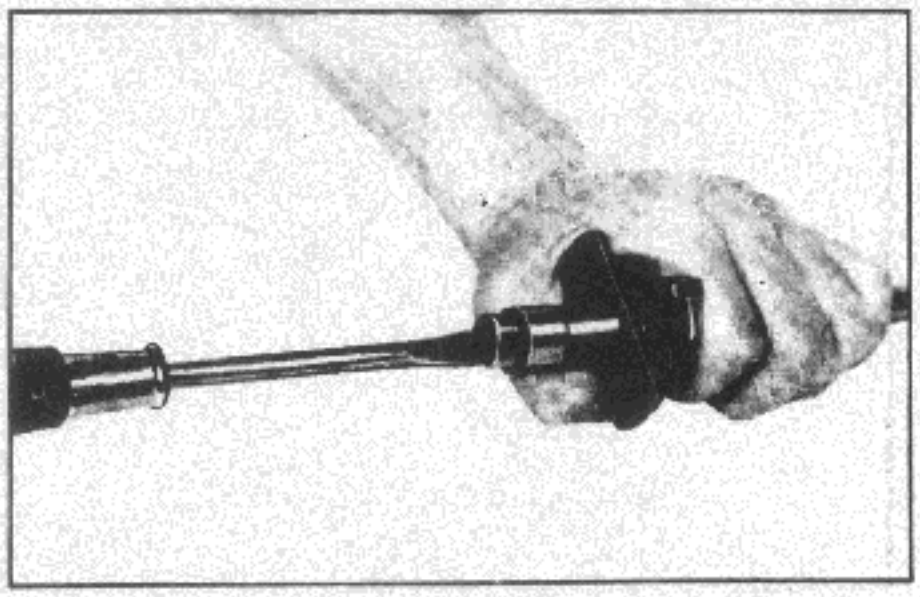


Fig. EE-104 Removal fo cam

7. When governor weight and spring are disconnected, be careful not to stretch or deform the governor spring. When disassembly is completed, apply grease to weight pivot.

8. Figure EE-105 shows the exploded view.

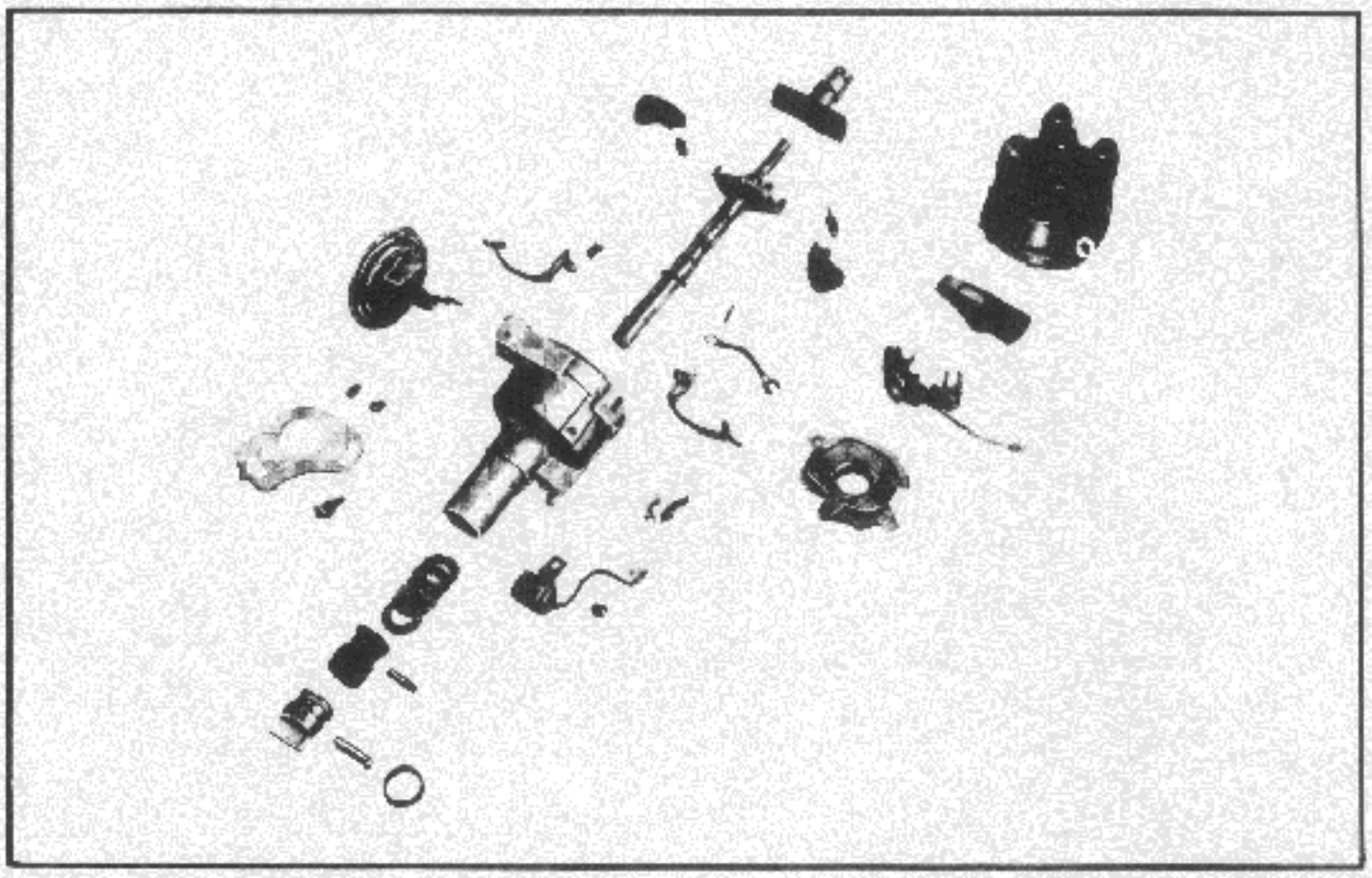
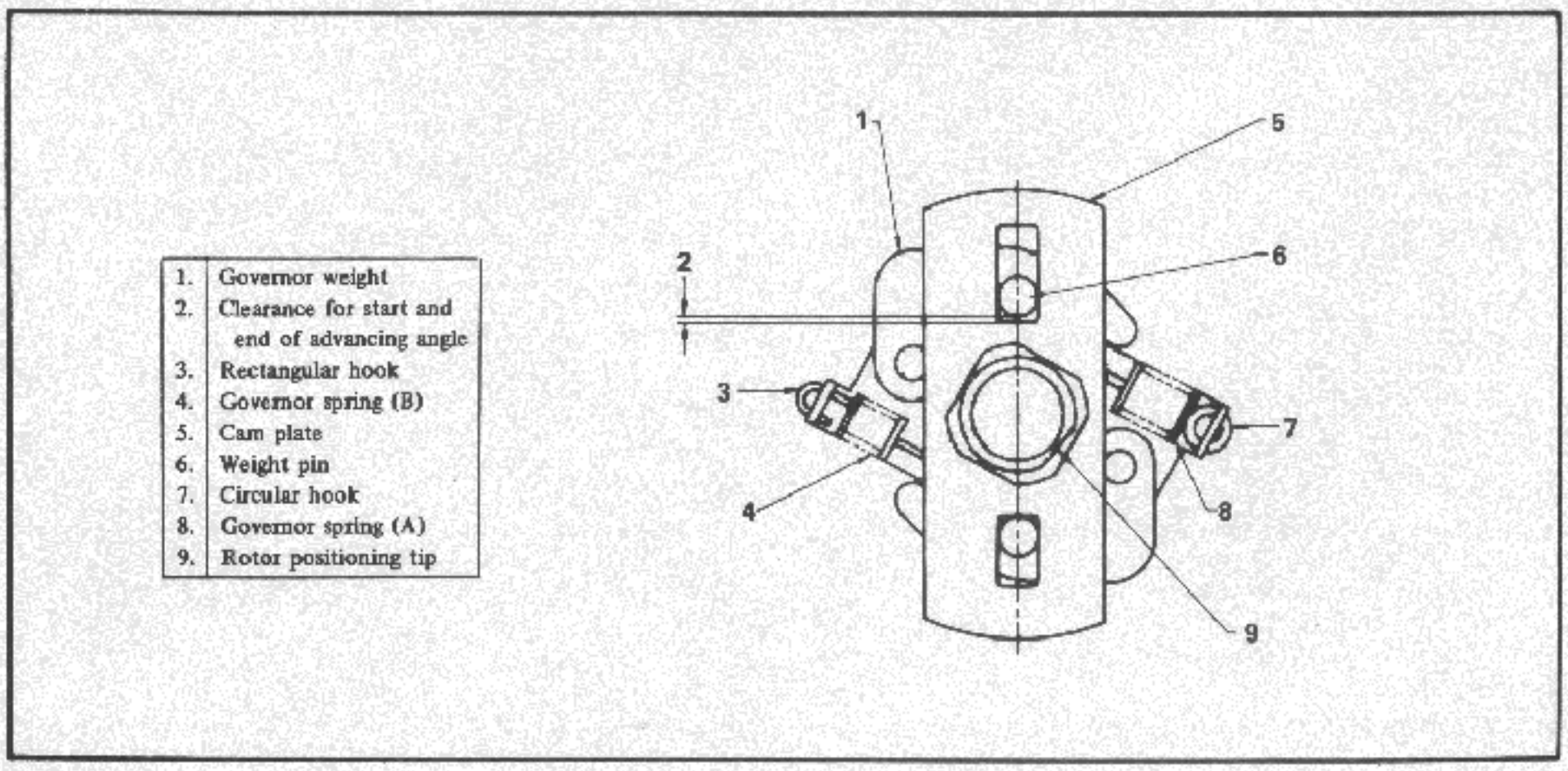


Fig. EE-105 Exploded view (D410-58, D409-54)

Assembly

In case of reassembly do it in just reverse way of disassembly.

Refer to Figure EE-106 at the time of replacement and reassembly of governor spring and cam.



1.	Governor weight
2.	Clearance for start and end of advancing angle
3.	Rectangular hook
4.	Governor spring (B)
5.	Cam plate
6.	Weight pin
7.	Circular hook
8.	Governor spring (A)
9.	Rotor positioning tip

Fig. EE-106 Setting of governor spring and cam

At the time of assembly, rotor head positioning tip at cam is to be set to governor spring circular hook side. Then weight pin for governor spring (A) with circular hook comes in long rectangular hole. It leaves clearance at the start and end of advancing. Meanwhile, weight pin on opposite side comes in short rectangular hole. It does not leave clearance either at the start and end of advancing. When assembly is completed, set it to engine after checking advance characteristic and confirming performance. Be sure to make adjustment of ignition timing after this.

Adjustment must be made to let off the distributor point at degree position of upper dead point of first cylinder compression of engine.

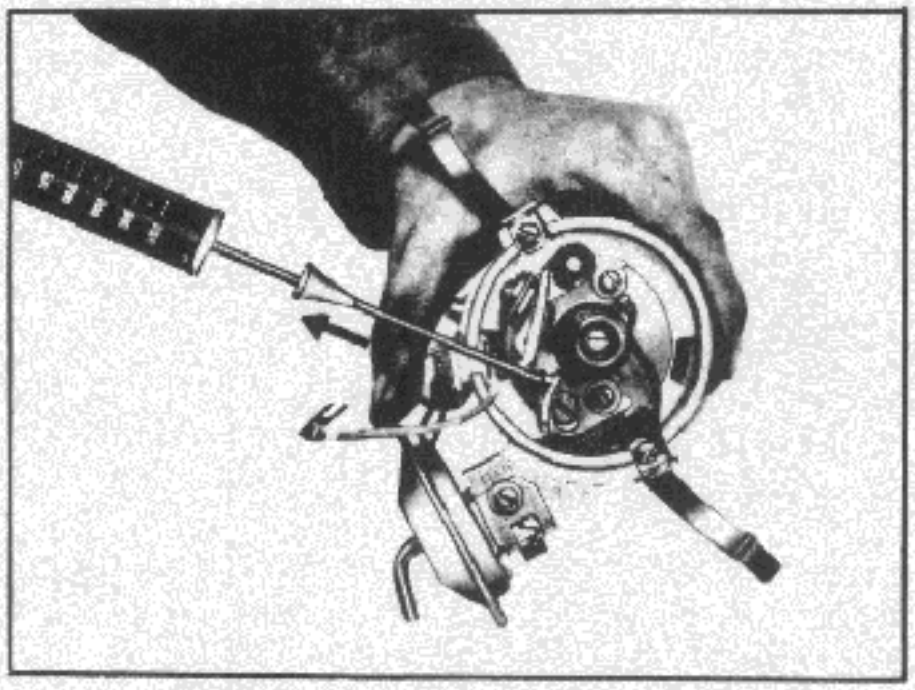


Fig. EE-107 Point pressure test

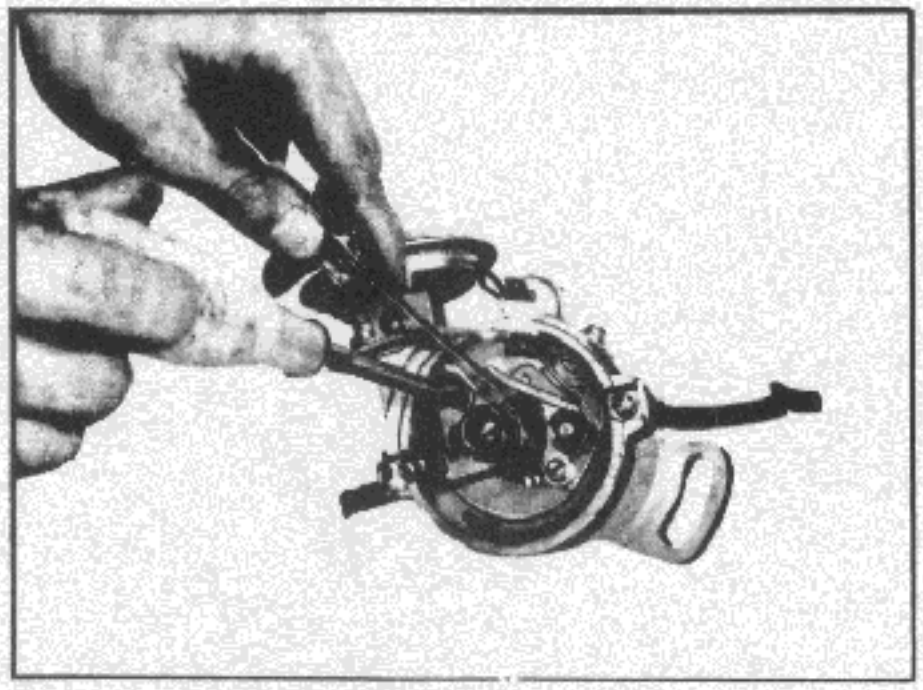


Fig. EE-108 Point gap measure

SERVICE DATA

≪ All distributors ≫

Point gap	0.45 ~ 0.55 mm (0.0177 ~ 0.0217 in.)
Point pressure	0.50 ~ 0.65 kg (1.10 ~ 1.43 lbs.)
Shaft diameter (lower part)	$12.45\ ^{-0.010}_{-0.020}$ mm ($0.4902\ ^{-0.0004}_{-0.0008}$ in.)
Housing inner diameter	$12.45\ ^{+0.018}_{0}$ mm ($0.4902\ ^{+0.0007}_{0}$ in.)
Clearance between shaft and housing	0.010 ~ 0.038 mm (0.0004 ~ 0.0015 in.)
Amendment limit of clearance	0.08 mm (0.0031 in.)
Shaft diameter (upper part)	$8\ ^{-0.005}_{-0.014}$ mm ($0.3150\ ^{-0.0002}_{-0.0006}$ in.)
Cam inner diameter	$8\ ^{+0.015}_{0}$ mm ($0.3150\ ^{+0.0006}_{0}$ in.)
Clearance between shaft and cam	0.005 ~ 0.029 mm (0.0002 ~ 0.0011 in.)
Weight pivot diameter	$5\ ^{-0.010}_{-0.028}$ mm ($0.1969\ ^{-0.0004}_{-0.0010}$ in.)
Weight hole diameter	$5\ ^{+0.018}_{0}$ mm ($0.1969\ ^{+0.0007}_{0}$ in.)
Clearance between pivot and hole	0.01 ~ 0.046 mm (0.0004 ~ 0.0018 in.)

IGNITION COIL

SPECIFICATIONS

Item \ Make / Model	HITACHI	
	C14-51	C6R-50
Applied engine	L16, L13	L20, L16 (SSS)
Primary voltage -V	12	12
Spark gap -mm (in.)	more than 6 (0.2362)	more than 6 (0.2362)
Primary resistance at 20° C -Ω	3.2~4.1	2.1~2.7
Secondary resistance at 20° C -KΩ	11.2~16.8	11.2~16.8
Resistor -Ω		1.6

DESCRIPTION

The ignition coil is a pitch type coil. On L20 and L16 (with Twin Carb.) engine, the coil equiped with resistor is adopted for good spark performance at high revolution. The number of turns in primary winding results in a higher inductance in this winding, which makes it possible for this coil to provide a higher secondary voltage output throughout the speed range.

For optimum starting performance, the resistor is by-passed during cranking, thereby connecting the ignition coil directly to battery. This provides full battery voltage available at coil and thus keeps ignition voltage as high as possible during cranking. The resistor is by-passed automatically through the ignition and starting switch when switch is in the "start" position.

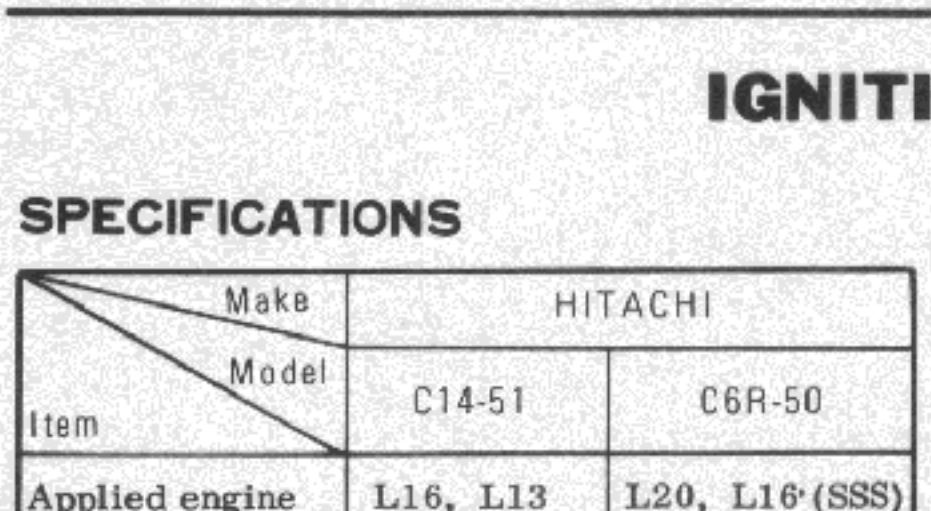


Fig. EE-109 C14-51

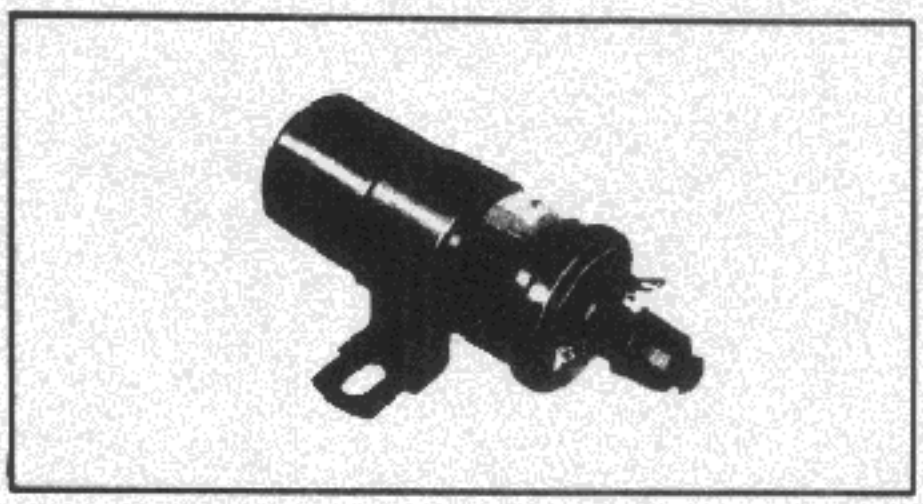
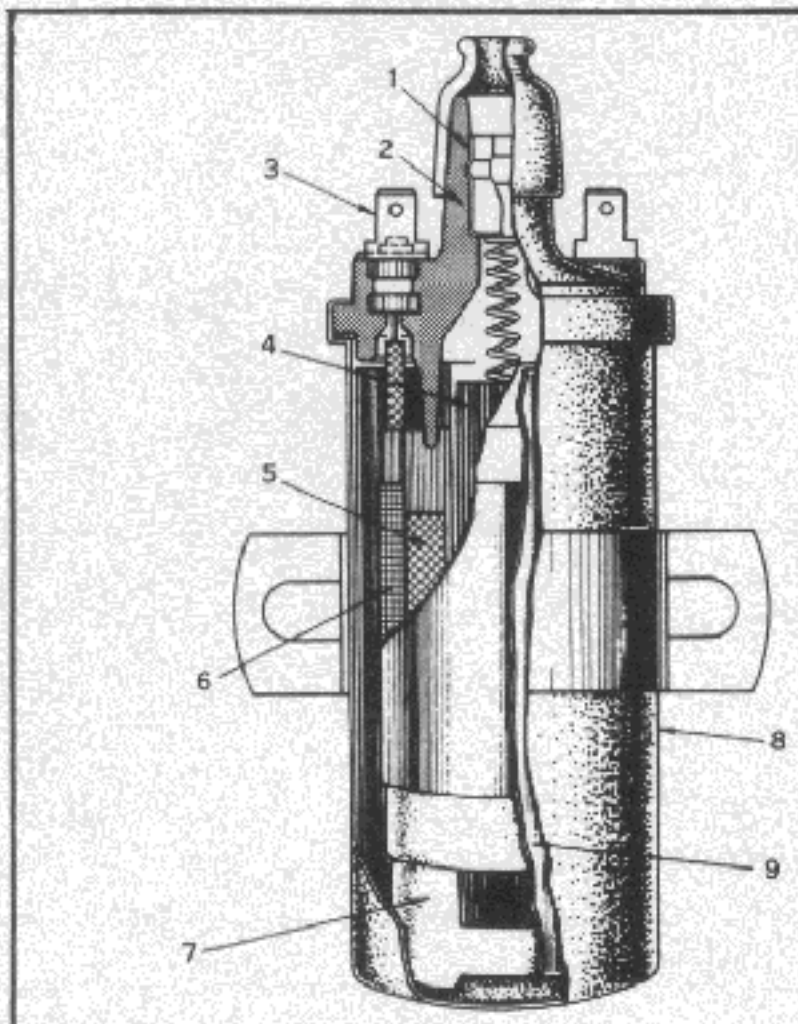


Fig. EE-110 C6R-50



1.	Primary terminal
2.	Cap
3.	Secondary terminal
4.	Inside iron core
5.	Secondary coil
6.	Primary coil
7.	Insulator
8.	Case
9.	Outside iron core

Fig. EE-111 Construction

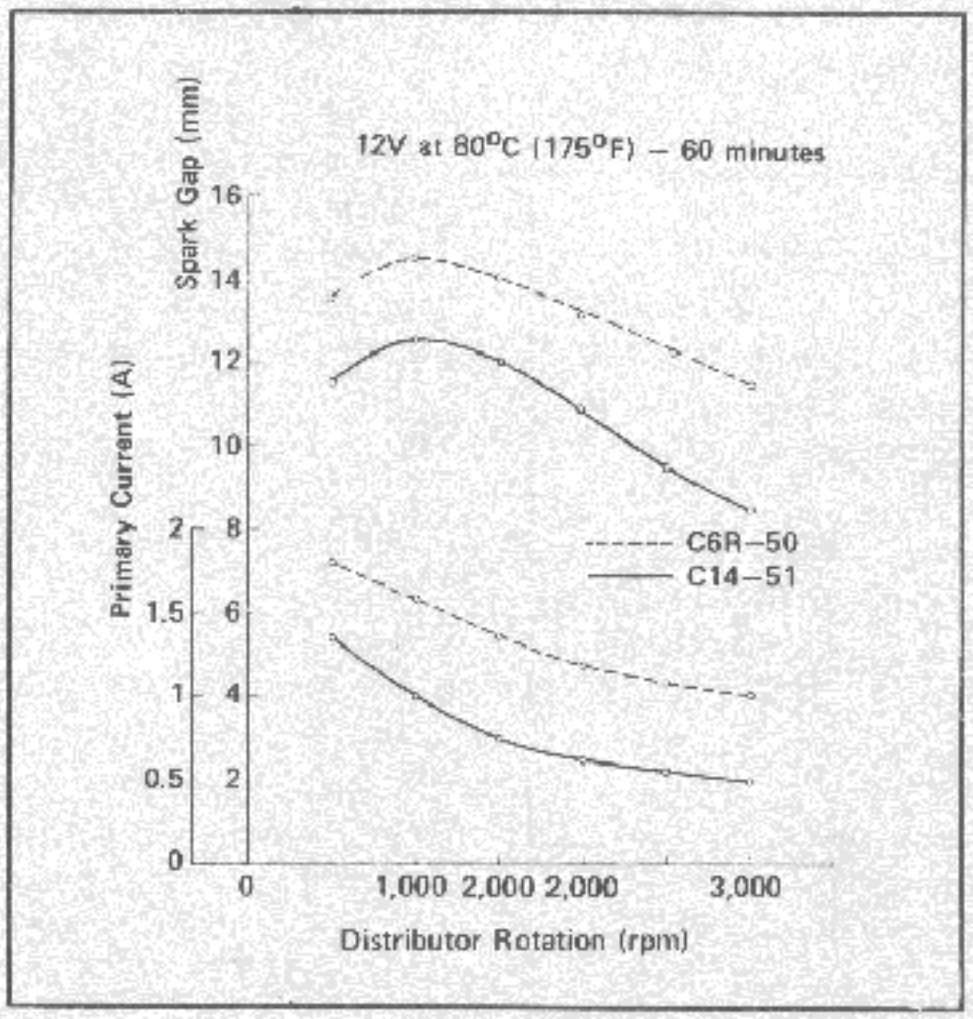


Fig. EE-112 Characteristic curve

SPARK PLUGS

CONTENTS

SPECIFICATIONS AND SERVICE DATA

Item \ Make / Model	NGK BP-6E
Applied engine	L20, L16, L13
Size (screw diameter × reach) -mm (in.)	14 × 19 (0.55 × 0.75)
Plug gap -mm (in.)	0.8~0.9 (0.031~0.035)
Torque -kg-m (ft-lb.)	1.5~2.0 (11.0~15.0)

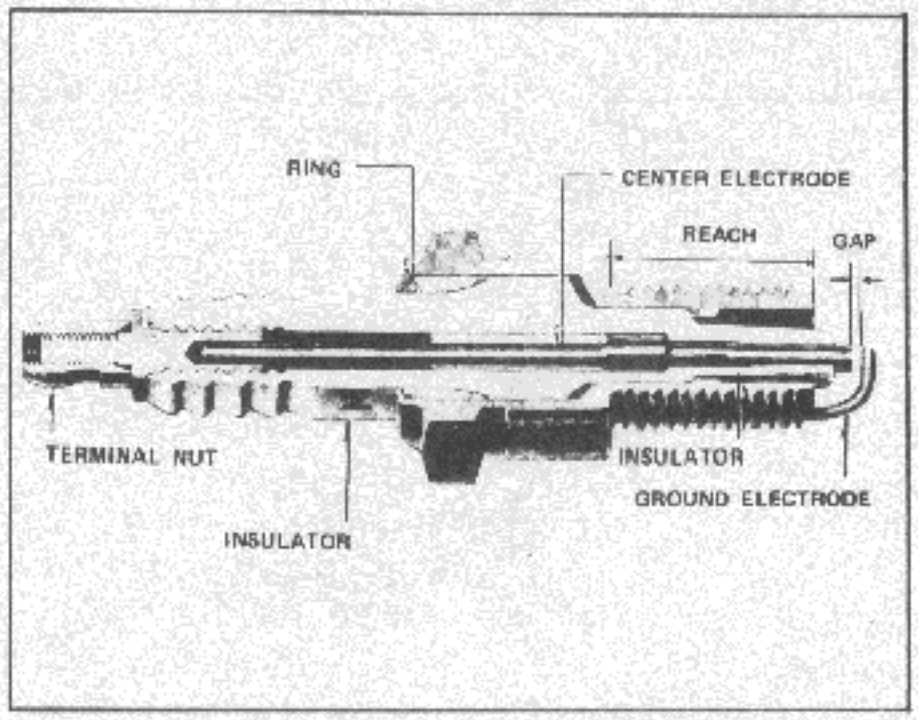


Fig. EE-113 Cross section of spark plug

PERIODIC SERVICE

Periodically (actual time depending on operating conditions) plugs should be removed for cleaning, inspection and regapping.

INSPECTION

Spark plug life is affected to a large extent by operating conditions and plug life varies accordingly. To insure peak performance, spark plugs should be checked, cleaned and regapped every 12 months or 20,000 km (12,000 miles).

Worn or dirty plugs may give satisfactory operation at idling speed, but under operating conditions they frequently fail. Faulty plugs are evident in a number of ways such as wasting gas, power loss, loss of speed, hard starting and general poor engine performance.

Spark plug failure, in addition to normal wear may be due to dirty or leaded plugs, excessive gap or broken insulator.

Dirty or leaded plugs may be evident by black carbon deposits, or red, brown, yellow or blistered oxide deposits on the plugs. The black deposits are usually the result of slow-speed driving and short runs where sufficient engine operating temperature is seldom reached.

Worn piston rings, faulty ignition, over-rich carburetion and spark plugs which are too "cold" will also result in carbon deposits. Red or brown oxide deposits and a consequence of the use of leaded fuel, usually result in spark plug failure under severe operating conditions. The oxides have no adverse effect on plug operation as long as they remain in a powdery state. But, under high speed or hard pull, the powder oxide deposits melt and form a heavy glaze coating on the insulator which, when hot, acts as a good electrical conductor, allowing current to follow the deposits and short out the plug.

Excessive gap wear on plugs of low mileage, usually indicates the engine is operating at high speeds or loads that are consistently greater than normal or that a plug which is too "hot" is being used. In addition, electrode wear may be the result of plug overheating, caused by combustion gases leaking through the threads and gasket, due to insufficient compression of the spark plug gasket, dirt under the gasket seat. Too "lean" carburetion will also result in excessive electrode wear.

Broken insulators are usually the result of improper installation or carelessness when regapping the plug. Broken upper insulators usually result from a poor fitting wrench or an outside blow. The cracked insulator may not make itself evident immediately, but soon oil or moisture will penetrate the fracture. The fracture is usually just below the crimped part of shell and may not be visible.

Broken lower insulators usually result from carelessness when regapping and generally are visible. In fairly rare instances, this type of break may result from the plug operating too "hot" such as encountered in sustained periods of high-speed operation or under extremely heavy loads. When regapping a spark plug, to avoid lower insulator breakage, always make the gap adjustment by beanding the ground side electrode. Spark plugs with broken insulators should always be replaced.

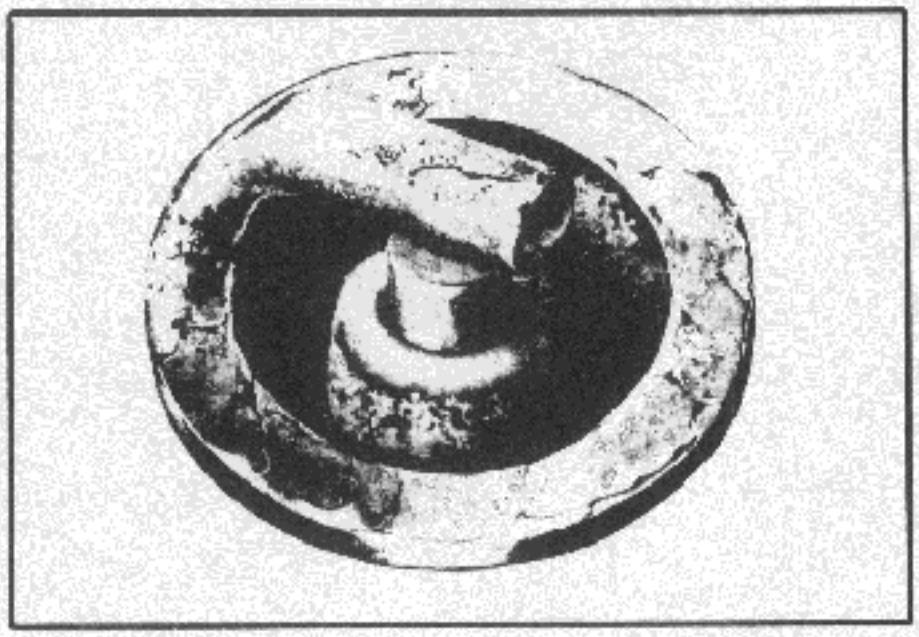


Fig. EE-114 Normal

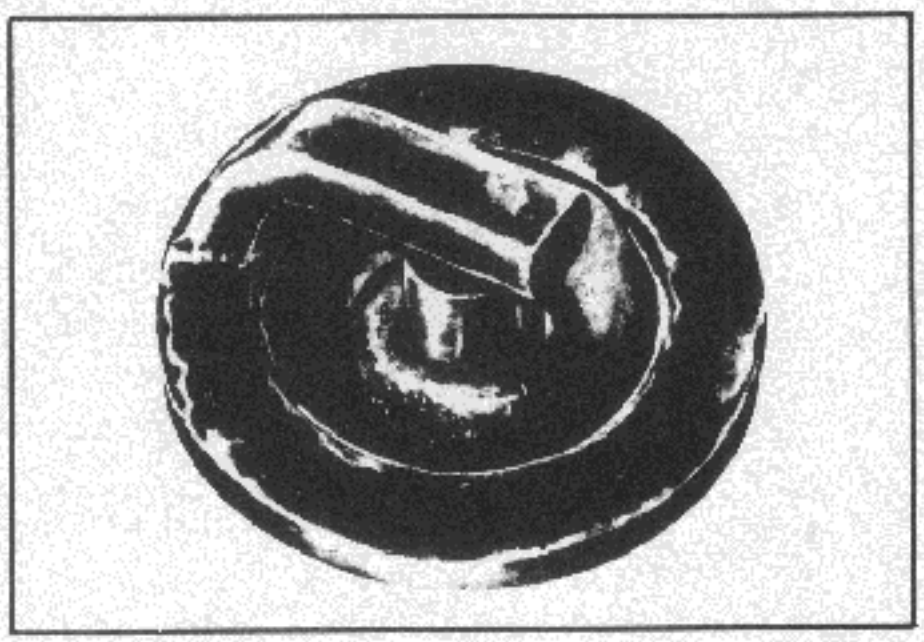


Fig. EE-115 Wet

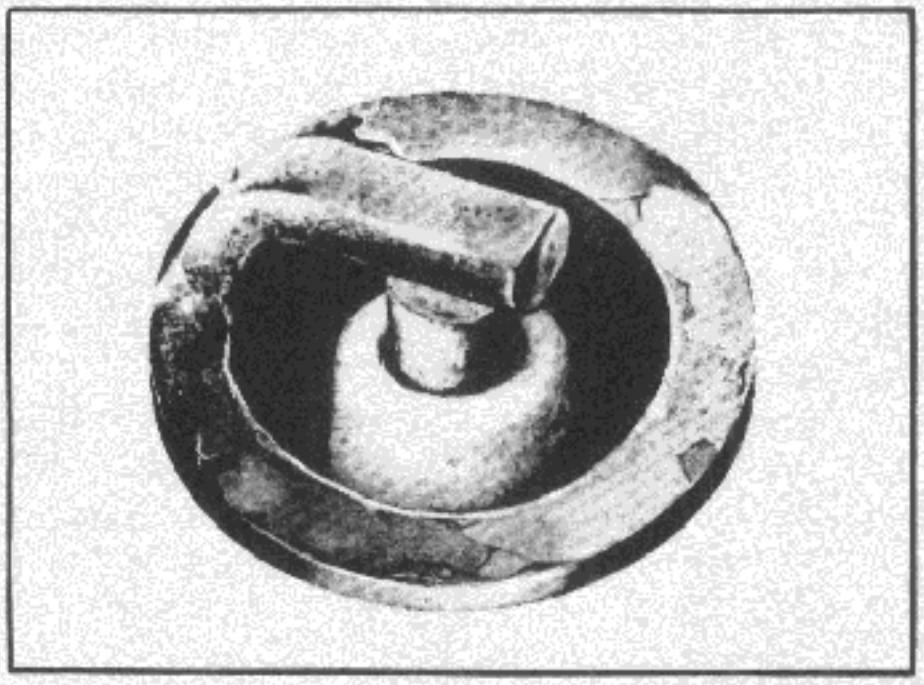


Fig. EE-116 Overheating (1)

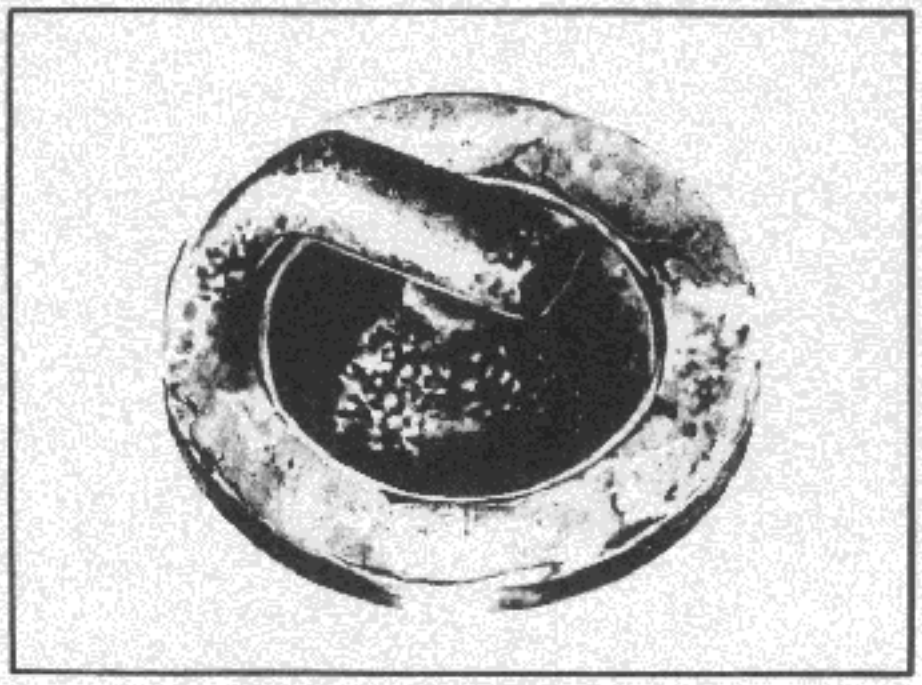


Fig. EE-117 Overheating (2)

Fig. EE-118 Overheating (3)

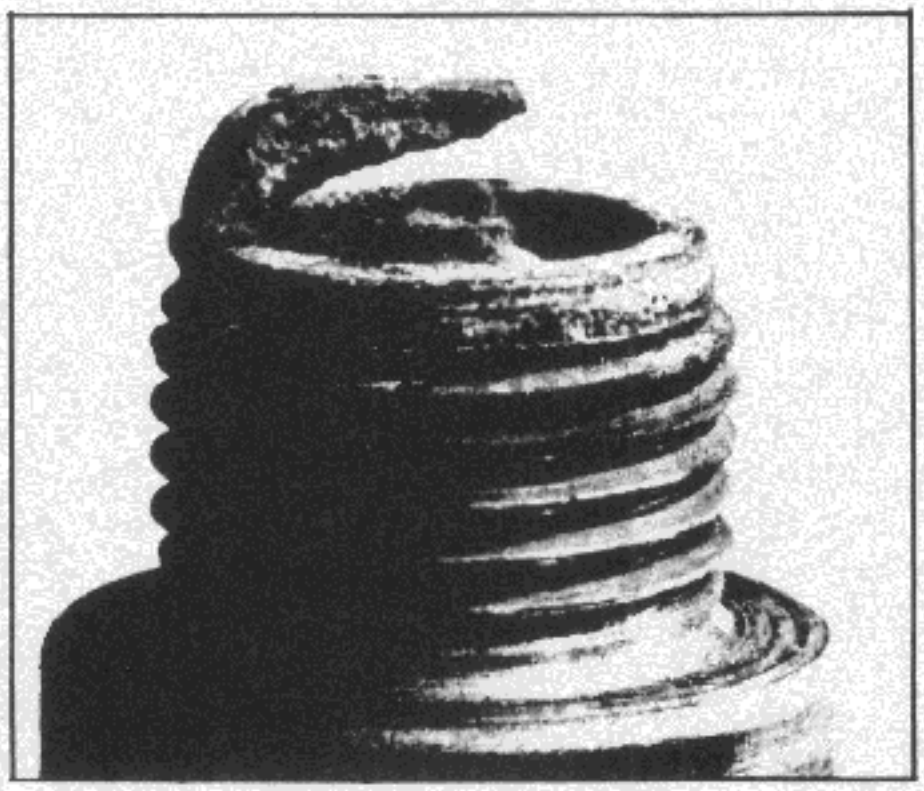


Fig. EE-119 Life

CLEANING AND REGAP

Clean spark plugs thoroughly using an abrasive-type cleaner. All spark plugs must be of the same make and number or heat range. Use a round feeler gauge to adjust the spark plug gaps.

Note: Before adjusting gap, file center electrode falt. In adjusting spark plug gap, never bend center electrode which extends through porcelain center. Always make adjustments by bending ground side electrode.

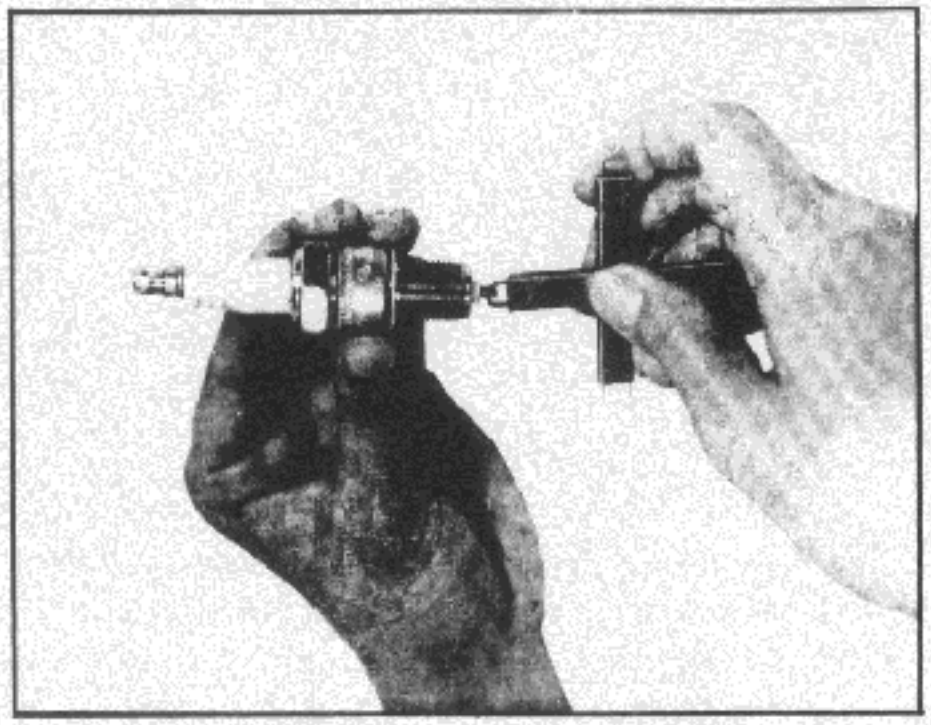


Fig. EE-120 Measuring spark plug gap

TROUBLE DIAGNOSES AND CORRECTIONS

1. When the engine does not start

If there is no trouble in the fuel system, the ignition system should be checked. This can be easily done by detaching the high tension cord from spark plugs, start the engine by the starting motor and observe the condition of the sparks that occur between the high tension cord and cylinder block. After checking this, use the proper countermeasures.

Spark gap	Trouble location	Causes	Remedies
No sparks at all	Distributor	Defective insulation of condenser.	Replace.
		Breakage of lead-wire on low tension side.	Repair.
		Defective insulation of cap and rotor head.	Replace.
		Point does not open or close.	Repair.
	Ignition coil	Wire breakage or short circuit of coil.	Replace with new one.
	High tension code	Wire coming off.	Repair.
		Defective insulation.	Replace.
1~2 mm (0.0394 ~0.0787 in.) or irregular	Distributor	Point gap too wide.	Correct.
		Oil sticking on point.	Clean.
		Point burnt too much.	Replace.
		Layer short-circuit.	Replace with good one.
Less than 6 mm (0.2362 in.)	Spark plugs	Electrode gap too wide.	Correct or replace.
		Too much carbon.	Clean or replace.
		Broken neck of insulator.	Replace.
		Expirty of plug's life.	Replace.

2. When the engine rotates but does not run smoothly.

In this case, causes are many and varied and it is difficult to point to the right cause, but considering the ignition system only, pay special attention to the following points.

Troubles	Trouble location	Causes	Remedies
Engine misses	Distributor	Dirty point.	Correct.
		Improper point gap.	Correct.
		Leak of electricity of cap and rotor head.	Clean or replace.
		Defective insulation of condenser.	Replace.
		Defective insulation of lead wire of condenser.	Correct.
		Defective arm.	Oil the shaft.
		Defective spring of arm.	Correct or replace.
		Near-breakage of lead wire.	Correct.
		Worn out and shaky breaker plate.	Correct.
		Worn out and shaky distributor shaft.	Correct.
	Ignition coil	Layer short circuit or use of inferior quality.	Replace with good one.
	High tension code	Deterioration of insulation and leak of electricity.	Replace.
	Spark plugs	Dirty.	Clean or replace.
		Electricity leak at the upper porcelain insulater.	Clean.
Engine cause knocking very often	Distributor	Improper and advance timing.	Correct the fitting.
		Coming off or breakage of governor spring.	Correc or replace.
		Worn out a pin or a hole ofgovernor portion.	Replace.
	Spark plugs	Burnt too much.	Replace.
Engine does not give enough power	Distributor	Improper and retarded timing.	Correct the fitting.
		Defective function of governor.	Correct.
		Dirty point.	Correct.
		Point gap too narrow.	Correct.
	Spark plugs	Dirty.	Clean.

SERVICE MANUAL

MODEL L SERIES ENGINE

NISSAN

SECTION SE

SERVICE EQUIPMENT

ENGINE TOOLS

ST49010000
ST44830000 (L20)

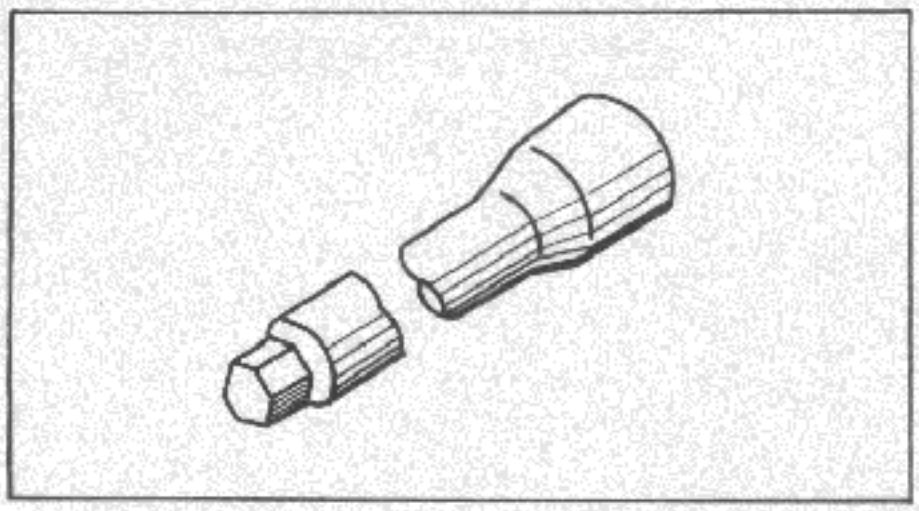


Fig. SE-1 Cylinder head bolt wrench

ST49080000

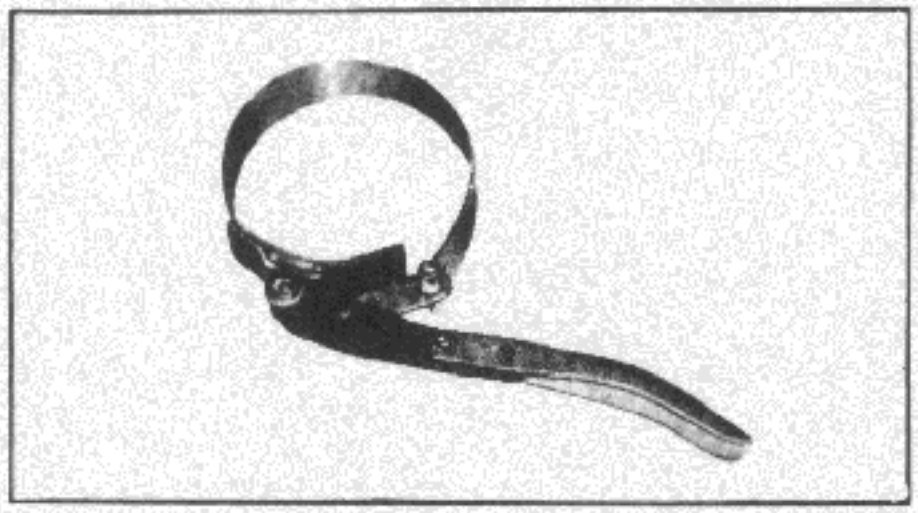


Fig. SE-4A Oil filter wrench

ST4463000D
ST44630000 (L20)

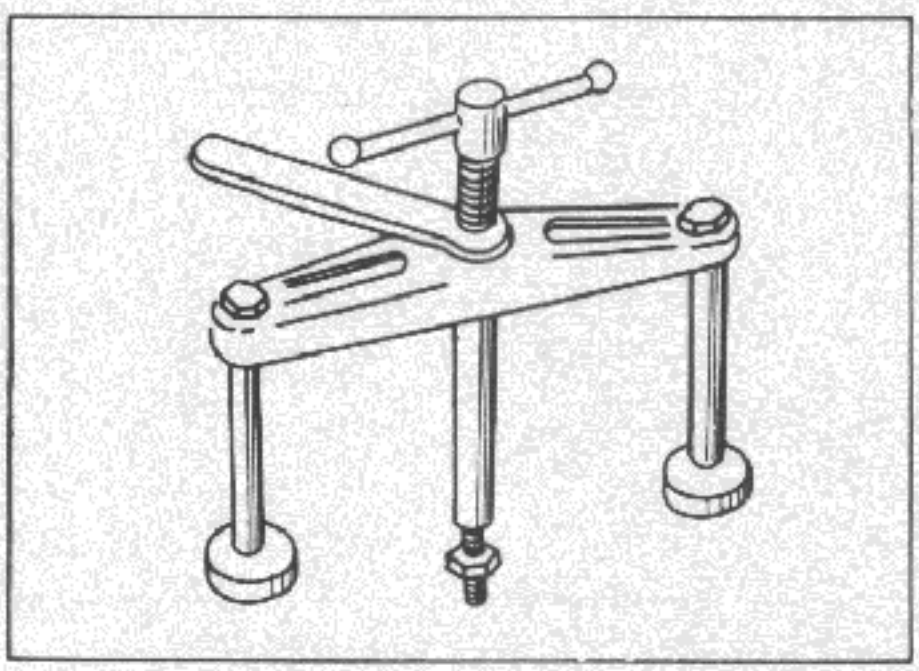


Fig. SE-2 Main bearing cap puller assembly

ST44850000 (L20)

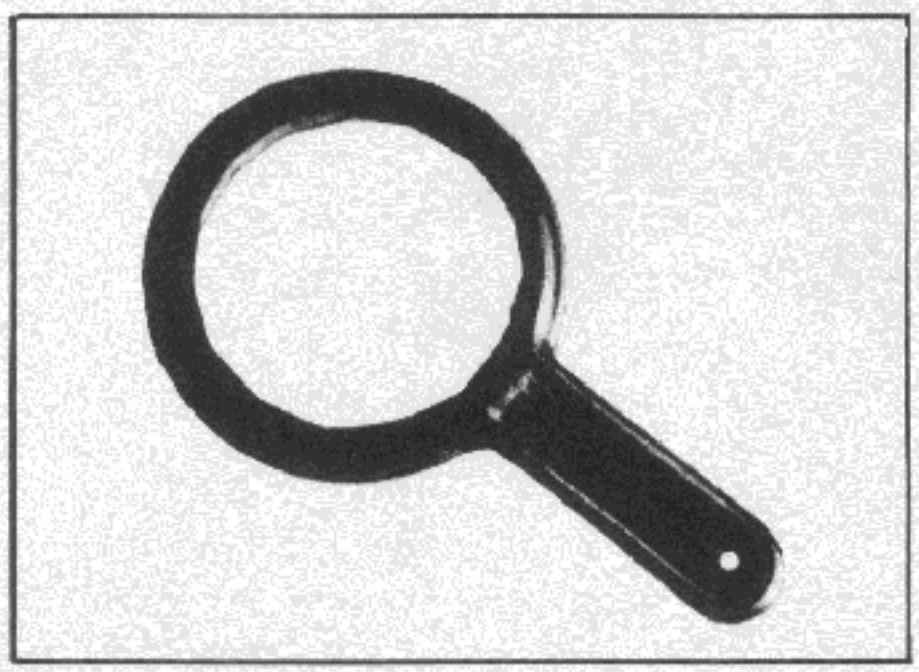


Fig. SE-4B Oil filter wrench

ST4484000D
ST44840000 (L20)

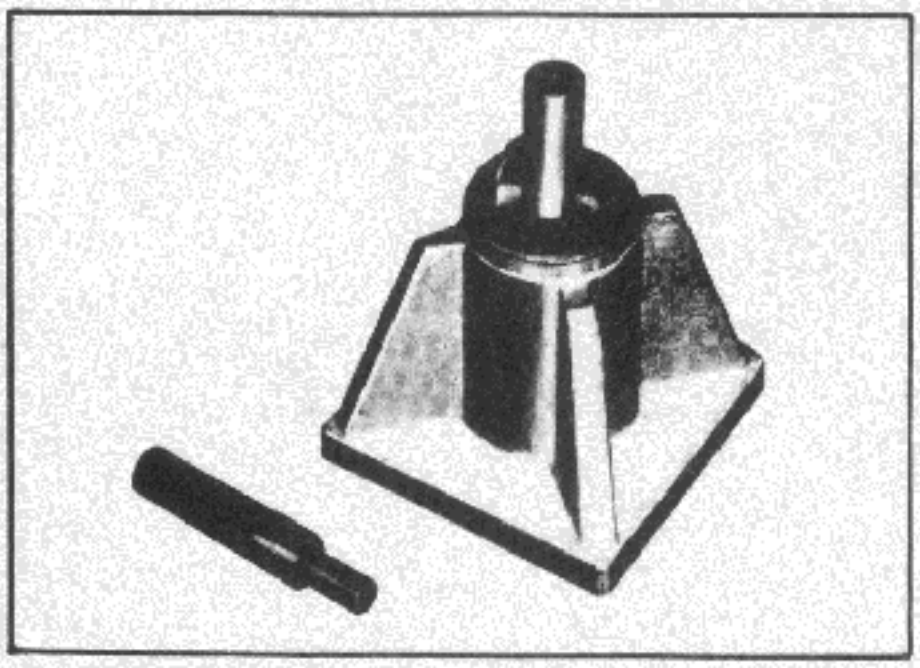


Fig. SE-3 Piston pin press stand assembly

ST47450000

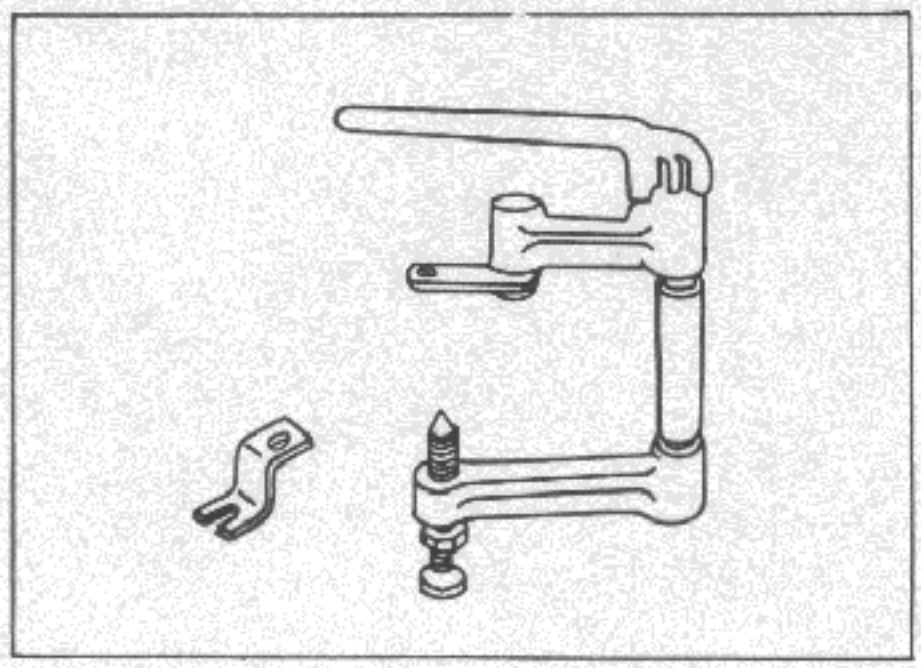


Fig. SE-5 Valve lifter assembly

ST49350000

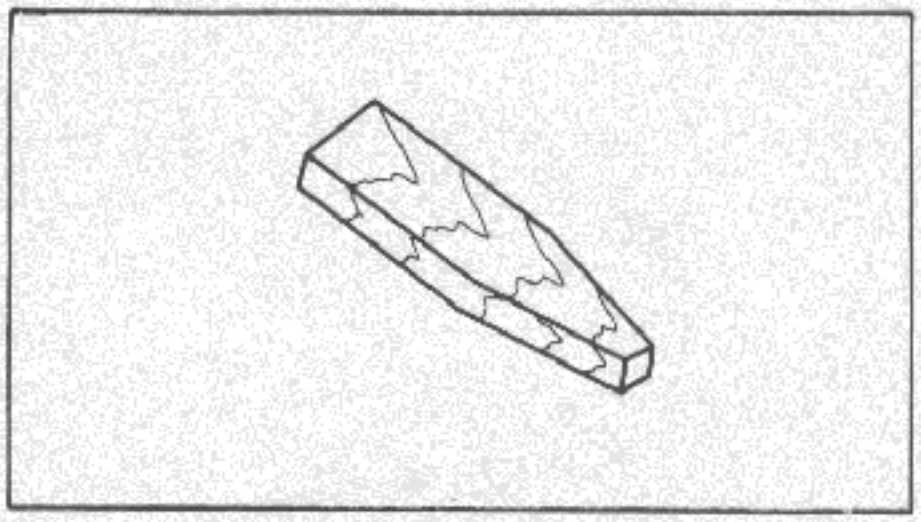


Fig. SE-6 Chain stopper

ST44800000

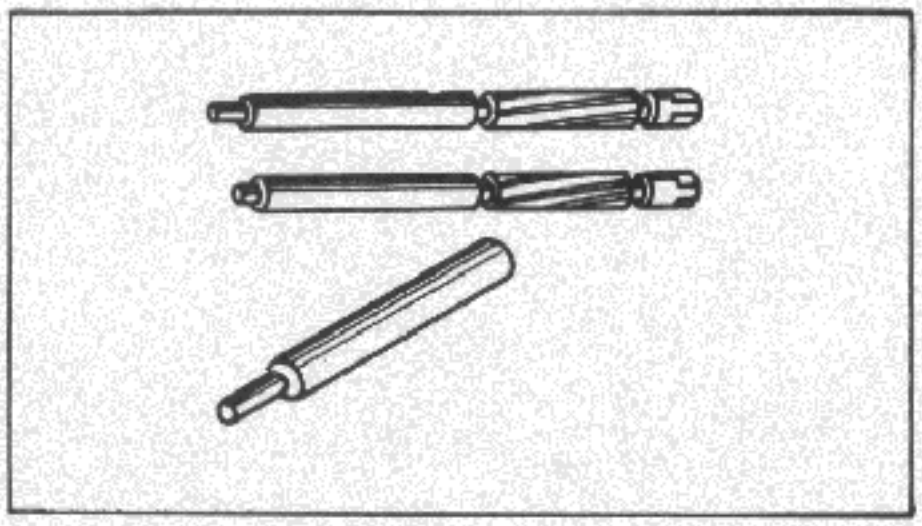


Fig. SE-9 Valve guide reamer set

ST44820000

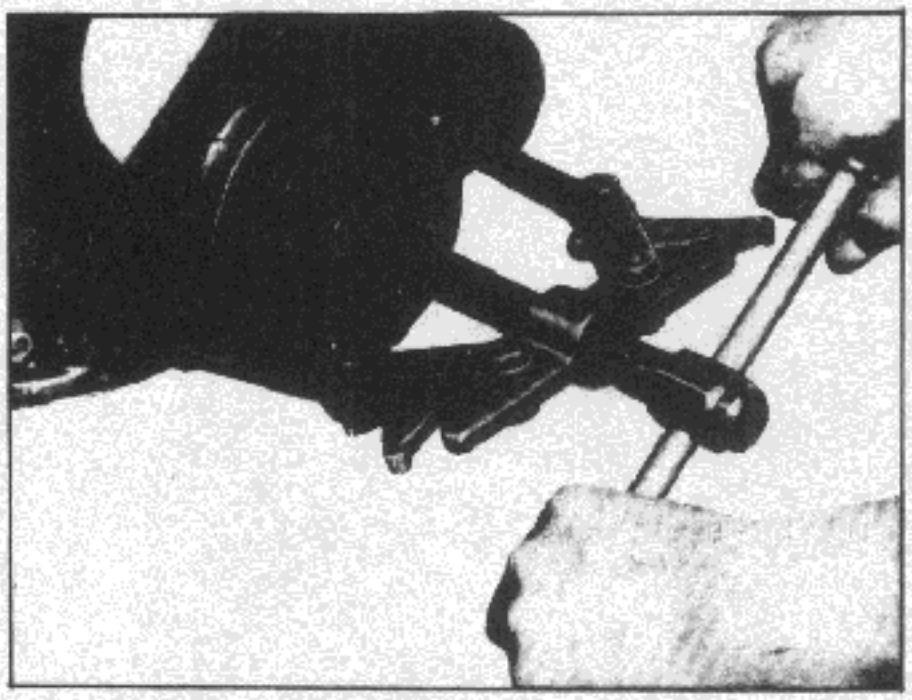


Fig. SE-7 Crankshaft gear pulley puller

ST49410000
ST44810000 **(L20)**

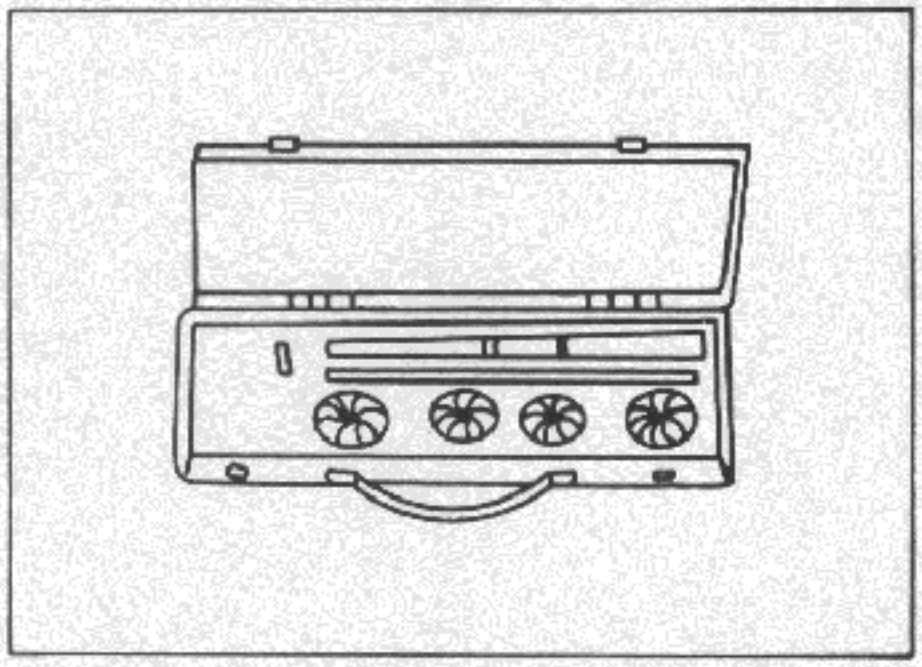


Fig. SE-10 Valve seat cutter set

ST20850000

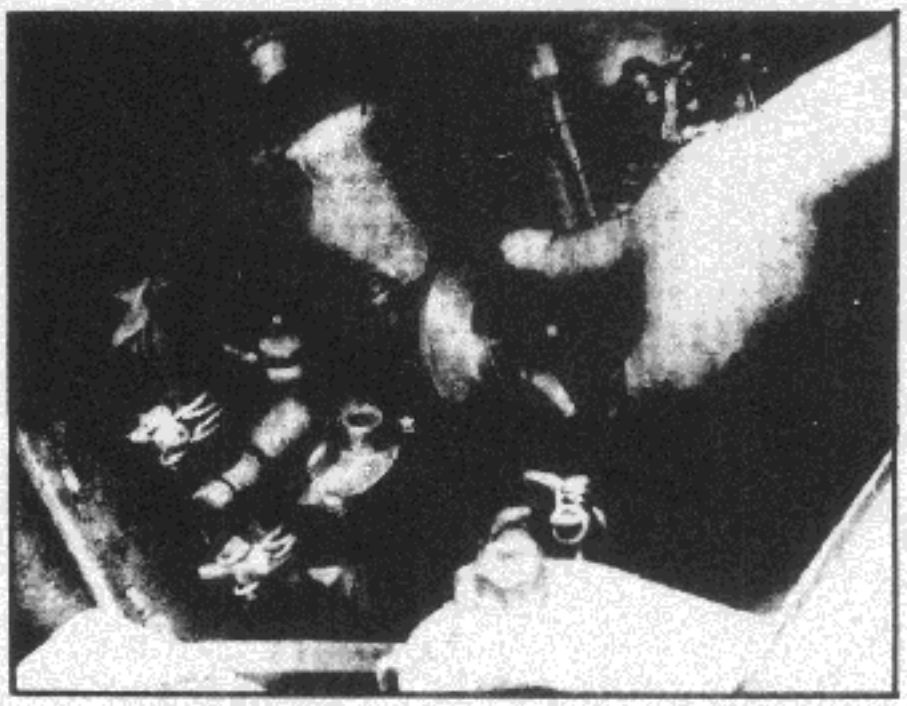


Fig. SE-8 Carburetor balancer

ST37200510
ST37200L20 **(L20)**

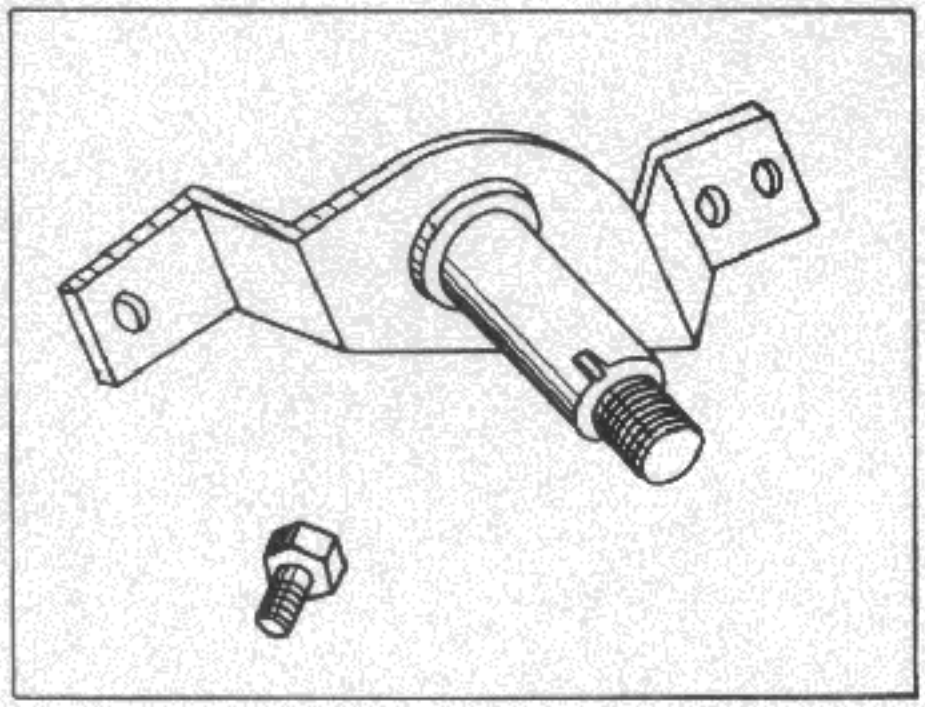


Fig. SE-11 Engine attachment

ST49440000

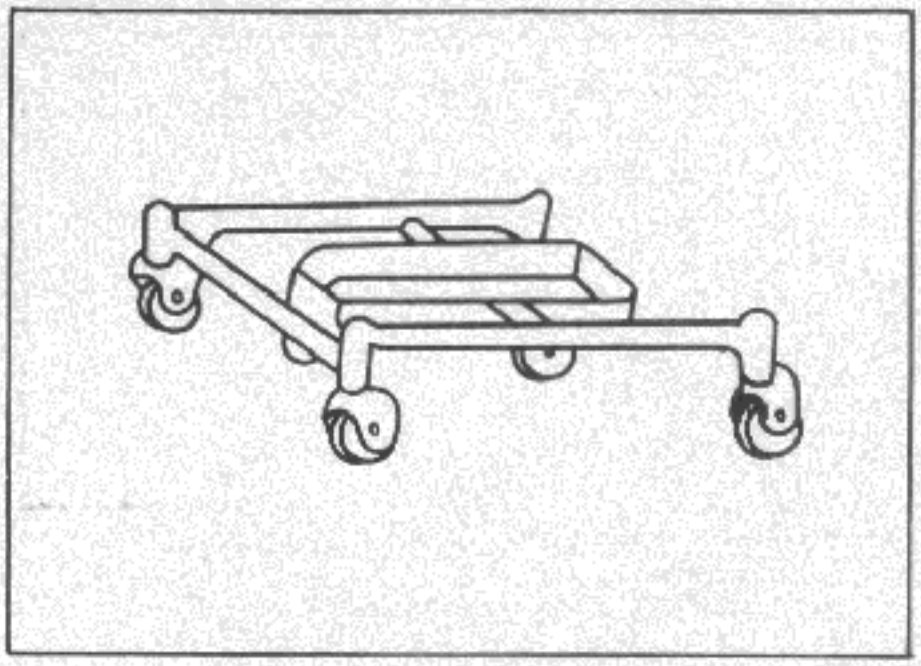


Fig. SE-12 Engine carrier

ST37100000

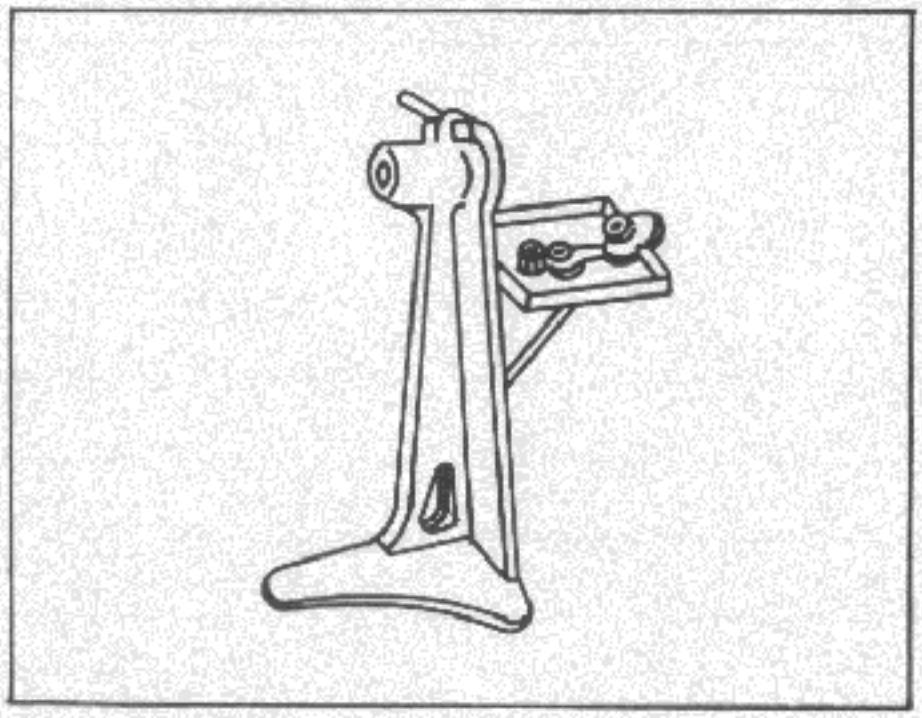


Fig. SE-14 Engine stand

ST49370000
ST47810000 (L20)

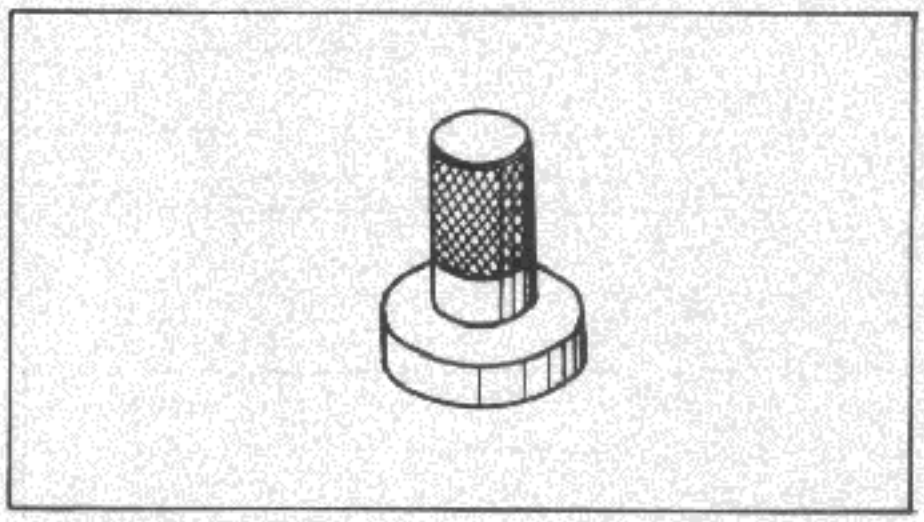


Fig. SE-13 Crankshaft oil seal drift

ST44870000

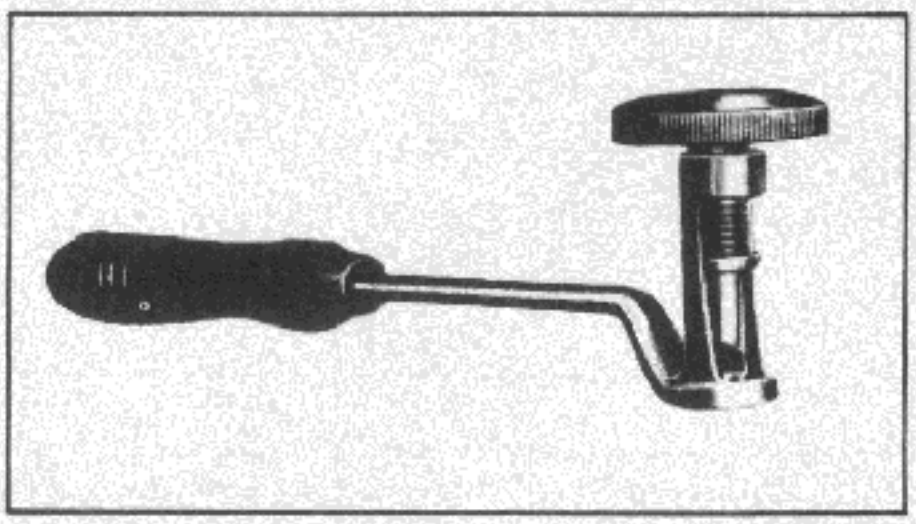


Fig. SE-15 Valve tappet adjust wrench

NISSAN