DATSUN

SPORTS CAR

1600 AND 2000 MODELS THROUGH 1970

HANDBOOK AND SERVICE MANUAL

Detailed Step-by-Step Instructions
on Maintenance and Repair

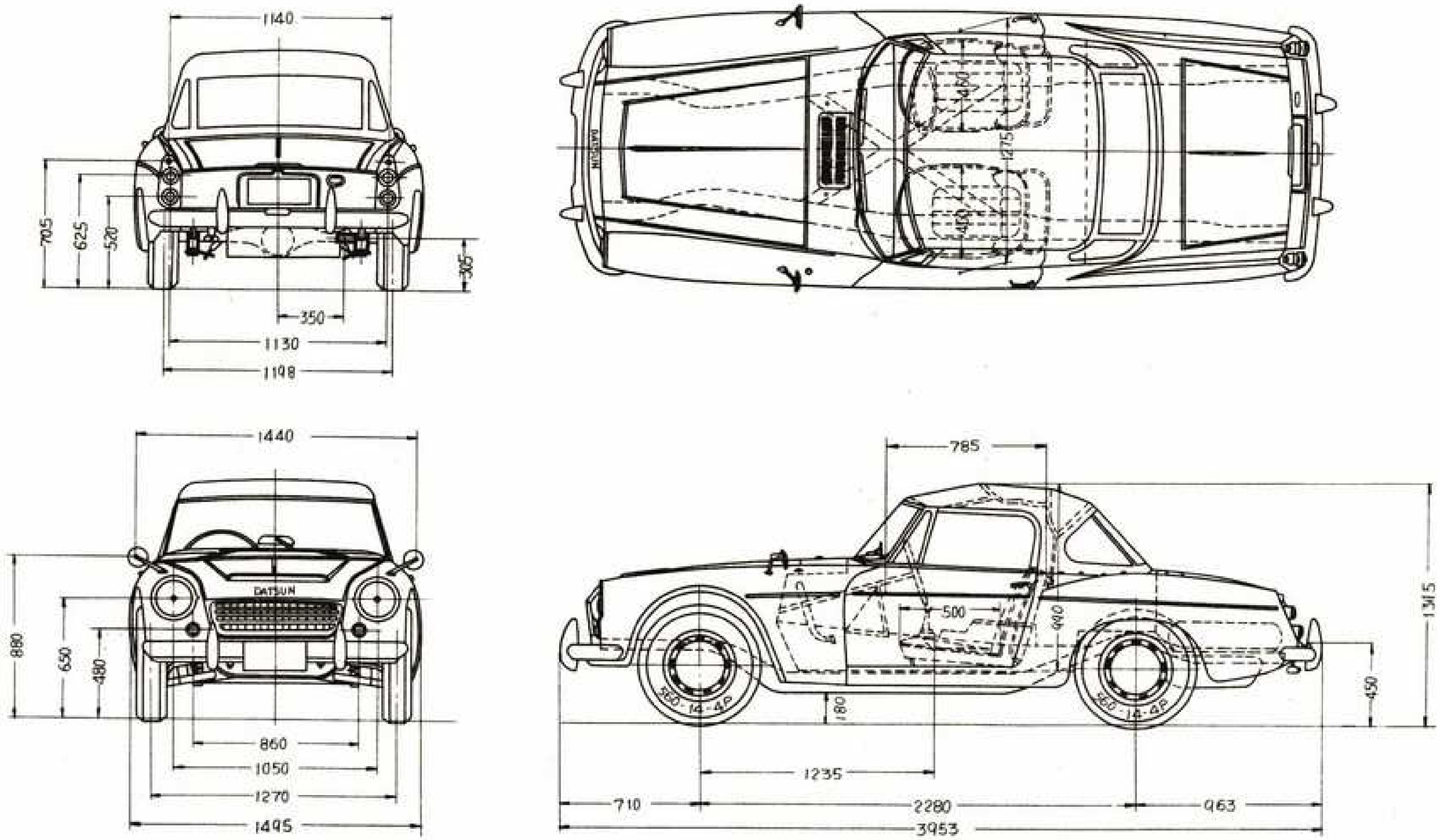
Emission Control System

Complete Specifications

Troubleshooting

NEW DATSUN SPORTS CAR MODEL SP(L)311-U

GENERAL VIEW OF MODEL SP(L)311



INTRODUCTION

This manual has been complied for pourpose of assisting our distributors and dealers for effective service and maintainance of the *New Model SP(L)311.* Each assembly of the major components is described in detail. In addition, comprehensive instructions are given for complete dismantling, assembling, and inspection of these assemblies.

It is emphasised that only genuine Spare Parts should be used as replacements.

SPECIFICATIONS

Item			Model: SP(L)311-U
Dimensions (mm)	Vehicle Overall Length		3,953 (155.6 in.)
	Vehicle Overall Width		1,495 (58.9 in.)
	Vehicle Overall Height		1,300 (51.6 in.)
	Interior size of cargo space	Overall Length	750 (29.52 in.)
		Overall Width	1,275 (50.2 in.)
		Overall Height	990 (39.0 in.)
	Tread	Front	1,275 (50.2 in.)
		Rear	1,200 (47.24 in.)
	Wheel Base		2,280 (89.8 in.)
	Min. Road Clearance		145 (5.71 in.)
	Floor Height		313 (12.3 in.)
	Overhang to the Front End (Without Bumper)		620 (24.4 in.)
	Overhang to the Rear End (Without Bumper)		885 (34.84 in.)
	Frame Overhang to the Front End		525 (20.7 in.)
	Frame Overhang to the Rear End		830 (32.68 in.)
Tire Size	Front		5,60 - 14 - 4P
	Rear		5,60 - 14 - 4P
Weight (kg)	Vehicle Weight kg (lbs.)		920 (2028.3 lb.)
	Seating Capacity		2
	Max. Payload		
	Vehicle Gross Weight		1010 (2226.6 lb.)
	Distribution of Vehicle weight without load	Front	555 (1,223.5 lb.)
		Rear	455 (1,003.0 lb.)

Weight (kg)	Chassis Weight kg (lbs.)	495 (1091.2 lb.)
	Distribution (Front) kg (lbs.)	340 (749.5 lb.)
	Distribution (Rear)	155 (341.91 lb.)
	Height of Gravity Center mm(in.)	470 (18.50 in.)
Performance	Max. Speed km/h (m/h)	170 (106)
	Fuel Consumption by Paved Flat read with Max. load km/ℓ	12
	Grade Abilisty Sin θ	0.497
	Min. Turning Radius m	4.9 (16.08 ft.)
	Brake Stopping Distance (50 km/h)	13.5(m)(44.3 ft)
Engine	Model	R type
	Manufacturer	NISSAN
	Classification	GASOLINE
	Cooling System	WATER FORCED CIRCULATION
	No. of Cylinder & Arrang	4 in line
	Cycle	4
	Combustion Chamber	WEDGE TYPE
	Valve Arrangement	OVER HEAD
	Bore x Stroke mm	87.2 x 66.8 (3.433 x 2.630 in.)
	Displacement ℓ	1.595 (97.32 cu.in.)
	Compression Ratio	9.0
	Compression Pressure kg/cm^2 (r.p.m.)	12.7/320 (180.6 lb in^2)

Engine		Max. Exploding Pressure kg/cm^2 (r.p.m.)	50/4000 (711.2 lb/in^2)
		Max. Mean Effective kg/cm^2 (r.p.m.)	10.6/4000 (150.8 lb/in^2)
		Max. Power B.H.P/r.p.m. (SAE)	96/6000
		Max. Torque m-kg/r.p.m. (SAE)	14.3/4000 (103 ft.lb.)
		Length x Width x Height mm	635 x 650 x 623 (25 x 25.6 x 24.5 in.)
		Weight kg	155 (341.7 lb.)
		Position of Engine	FRONT
		Type of Piston	AUTO THERMIC TYPE
		Material of Piston	LO - EX
	No. of Piston Ring	Pressure	2
		Oil	1
	Valve Timing	Intake Open	20° B.T.D.C.
		Intake Close	56° A.B.D.C.
		Exhaust Open	58° B.B.D.C.
		Exhaust Close	18° A.T.D.C.
	Valve Clear-ance	Intake mm	0.43 (0.0169 in.)
		Exhaust mm	0.43 (0.0169 in.)
Ignition System		Starting Method	MAGNETIC STARTING SYSTEM
		Ignition Method	BATTERY COIL TYPE
		Ignition Timing B.T.D.C./r.p.m.	16°/600
		Firing Order	1 - 3 - 4 - 2

Ignition System	Ignition Coil	Type	Coil : Resistor C6R-50 :5650R-1500 (HU-13Y : RA-16)
		Manufacturer	HITACHI (HANSHIN)
	Distributor	Type	D407-51
		Manufacturer	HITACHI
		Ignition Timing Advance System	VACUUM & GOVERNOR
	Spark Plug	Type	B-6E (L-45)
		Manufacturer	NIHON TOKUSHU TOGYO (HITACHI)
		Thread mm	14 (0.551 in.)
		Gap mm	0.7 ~ 0.8 (0.027 ~ 0.031 in.)
Fuel System	Carburetor	Type & No.	HJB38W-3 2 each
		Manufacturer	HITACHI
		Throttle Valve Bore mm	38 (1.496 in.)
		Venturi Size mm	VARIABLE
		Air Draught	SIDE DRAFT
	Air Cleaner	Type & No.	PAPER TYPE 1 each
		Manufacturer	TSUCHIYA
	Fuel Pump	Type	DIAPHRAGM
		Manufacturer	SHOWA, KYOSAN
	Fuel Tank	Capacity of Fuel Tank ℓ	43 (11.36 U.S. gal)
Lubricating System	Lubricating Method		FORCED PRESSURE TYPE
	Oil Pump Type		GEAR TYPE

Lubricating System	Oil Filter Filter	FULL FLOW TYPE
	Oil Pan Capacity ℓ (U.S.gal.)	4.1 (1.083)
Cooling System	Type	WATER COOLING CLOSED TYPE
	Radiator	CORUGATED FIN & TUBE TYPE
	Capacity of Cooling Water	8ℓ(2.11 U.S.gal.)
	Type of Water Pump	CENTERIFUGAL TYPE
	Thermostat	PELLET TYPE
Battery	Type of No.	N41 1 each
	Voltage V	12
	Capacity A.H.	40
Generator	Type	AC300/12 x R
	Manufacturer	MITSUBISHI
	Generating Method	ALTERNATOR
	Voltage V	12
	Capacity kw	0.3
	Voltage Regulator	RL-2B
Starter	Type	S114-71 (MP1.0/1.2YR)
	Manufacturer	HITACHI (MITSUBISHI)
	Voltage & Power V-HP	12V - 1.4
Removing Device	Engine-Transmission Mechanism	ENGINE-CLUTCH TRANSMISSION
	Clutch — Type	SINGLE DRY DISC HYDRAULIC OPERATION

Transmitting Device	Clutch	Number of Plate	(FACING) 2
		Outdia. x India x Thickness mm	200 x 130 x 3.5 (7.87x5.12x0.138 in.)
		Total Friction Area cm^2	364 (56.42 in.^{2})
	Transmission	Type	4 FORWARD, 1 REVERSE SYNCHRO-MESHED ON 1ST, 2ND, 3RD, 4TH
		Operating Method	FLOOR GEAR SHIFT
		1st	3.382
		2nd	2.013
		3rd	1.312
		4th	1.000
		Reverse	3.365
Propeller Shaft	Length x Outdia x India. mm		760 x 63 x 59.8 (29.92x2.48x2.35 in.)
	Type of Universal Joint		SPICER TYPE
Final Gear	First Gear	Type of Gear	HYPOID
		Gear Ratio	3.889 (OPTION 4.111)
		Speedometer	16/5 (17/5)
Diff. Gear	Housing Type		BANJO
	Type of Number of Gear		STRAIGHT BEVEL PINION 2 each
Steering System	Type of Gear		CAM AND LEVER
	Gear Ratio		14.8
	Steering Angle In and Out.		36°16', 28°20'
	Steering Wheel Dia.		400 (15.75 in.)
Running Device	Wheel Arrangement		2 FRONT, 2 REAR
	Front Axle		WISH BONE BALL JOINT TYPE

Running Device	Toe-in		mm	2 ~ 3
	Camber			1°25'
	Caster			1°30'
	Inclination Angle of King Pin			6°35'
	Type of Rear Axle			SEMI-FLOATING TYPE
System of the Brake	Master Brake	Type: Front		DISC
		Type: Rear		LEADING TRAILING
		Lining Dimension (Front)	mm	47.5x16.7x53.98 (1.87x0.66x2.125 in.)
		Lining Dimension (Rear)		40 x 4.5 x 215 (1.57x0.18x8.46 in.)
		Total Braking Area (Front)	cm^2	102.6 (15.9 $in.^2$)
		Total Braking Area (Rear)		351 (54.4 $in.^2$)
		Dia. of Disc (Front)	mm	284 (11.18 in.)
		Dia. of Drum (Rear)	mm	228.6 (90 in.)
	Oil Brake	Inner Dia. of Master Cyl.	mm	19.05 (0.75 in.)
		India. of Wheel Cyl. (Front)	mm	53.98 (2.125 in.)
		India. of Wheel Cyl. (Rear)	mm	20.64 (0.813 in.)
		Max. Oil Pressure	kg/cm^2	137 (1948.6 $lb/in.^2$)
	Parking Brake	Type		MECHANICAL FOR REAR WHEEL
		Lining Dimension	mm	40 x 4.5 x 215
		Total Braking Area	cm^2	351
		India. of Drum	mm	228.6
	Front			INDEPENDENT COIL SPRING

Suspension	Coil Spring Size Length x Width x Thickness - No.	12.7 x 87.5 x 290 - 6
	Rear	PARALLEL SEMI ELLIPTIC
	Spring Size Length x Width x Thickness - No.	1200 x 60 x 6 - 2 5 - 2
	Shock Absorber (Front)	TELESCOPIC DOUBLE ACTION
	Shock Absorber (Rear)	TELESCOPIC DOUBLE ACTION
	Stabilizer (Front)	TORSION BAR TYPE
	Stabilizer (Rear)	
Frame	Type	X MEMBER
	Section	BOX TYPE
	Dimension Height x Width x Thickness mm	UPPER 75 x 100 x 1.6 LOWER 25 x 100 x 2.3

PORTION USED INCH SIZE SCREWS OR BOLTS

1) Screw for cylinder head fixing bolt (but bolt head is mm size)
2) Connecting rod bolt and nut
3) Stud and nut of cartridge oilfilter
4) Drain plug for water (but bolt head is mm size)
5) Ex. manifold (Ex. tube fixing stud and nut)
6) Others ...... screws except engine unit

	Altered portion to mm size	
	Applied metric type from E/# 040001	Used screw threads of inch type E/# ~ 40000
Maine bearing cap	M12 x 1.75	1/2 - 13UNC
Fly wheel (crankshaft)	M10 x 1.25	3/8 - 16UNC
Fly wheel (clutch cover)	M8 x 1.25	5/16 - 24UNF
Oil pan	M6 x 1.0	1/4 - 20UNC
Rocker cover	M8 x 1.25	5/16 - 18UNC (Stud) 5/16 - 24UNF (Nut)
Front cover	M8 x 1.25	1/4 - 20UNC
Manifold fixing	M8 x 1.25	5/16 - 24UNF
Carburator fixing	M8 x 1.25	5/16 - 18UNC (Stud) 5/16 - 24UNF (Nut)
Water pump fixing bolt	M8 x 1.25	5/16 - 18UNC
Water pump fixing stad	M10 x 1.25	3/8 - 24UNF
Fan blade	M6 x 1.0	1/4 - 28UNF
Air cleaner fixing (support)	M8 x 1.25	5/16 - 18UNF
Air cleaner fixing (manifold)	M8 x 1.25	5/16 - 18UNC
Water out-let	M8 x 1.25	5/16 - 18UNC
Starter motor fixing	M10 x 1.5	3/8 - 24UNF
Distributor fixing	M6 x 1.0	1/4 -20UNC
Fuel pump	M8 x 1.25	5/16 - 24UNF
Oil filter fixing	M10 x 1.25	3/8 - 24UNF
Oil pump fixing (block)	M8 x 1.25	5/16 - 18UNC
Oil pump (body ~ cover)	M6 x 1.0	1/4 - 20T x 14L
Oil pump (Strainer ~ suction pipe)	M6 x 1.0	1/4 - 20T x 25L
Valve rocker bracket	M10 x 1.5	7/16 - 20UNF
Chain tensioner	M6 x 1.0	1/4 - 20UNC
Cam shaft gear	M10 x 1.5	3/8 - 16UNC
Crank pulley bolt	M16 x 1.5	5/8 - 18UNF
Generator bracket	M8 x 1.25	5/16 - 24UNF
Transmission fixing	M10 x 1.5	3/8 - 24UNF

In connection with the alteration of the screw threads from inch type to metric type, the crank shaft supporting ribs for R type engine is altered from 3 bearings method to 5 bearings method.

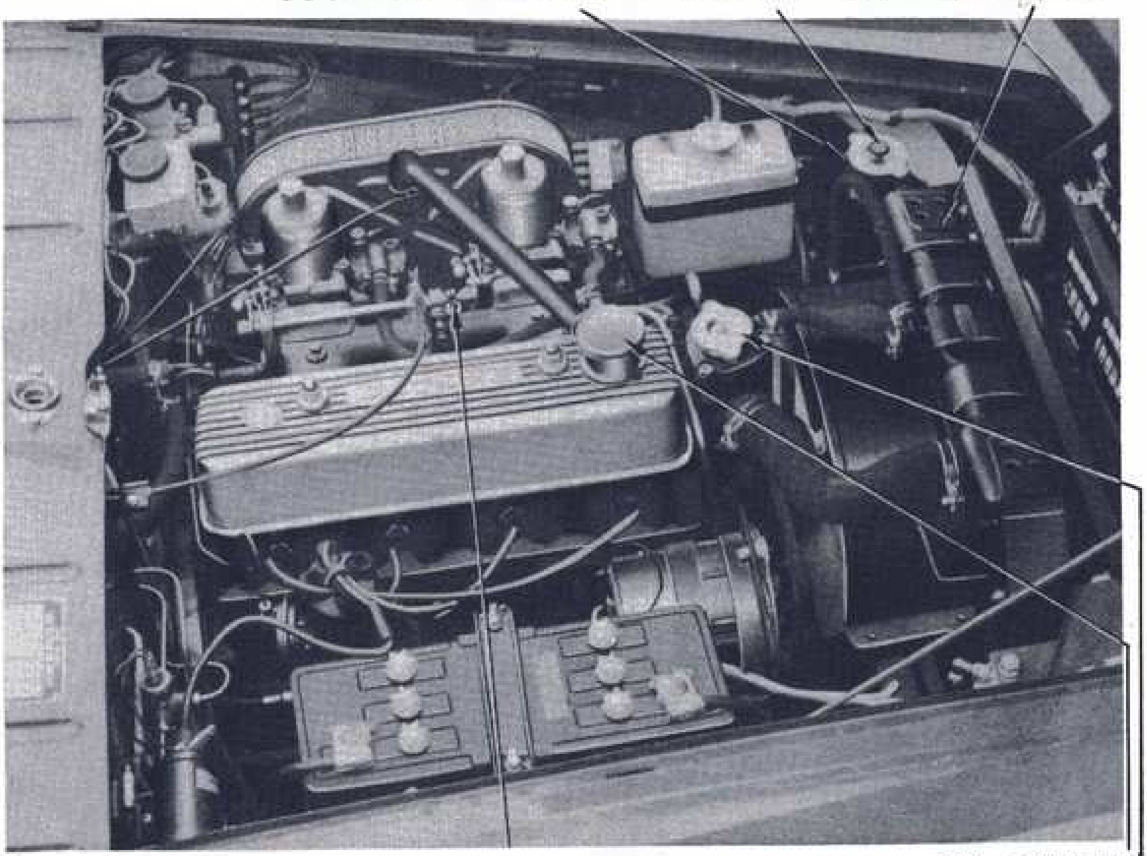
This standardizing the screw threads for R type engine (1600 cc) has been adopted by the international standardzation organization I.S.O. from E/# R-40001.

Inch		Metric		
3/8"	→	M10	x	1.25
Nominal size (inch)		Nominal size (mm)		Pitch (mm)

Screw threads	1/4" → 6 mm 5/16" → 8 mm 3/8" → 10 mm 7/16" → 10 mm (Exception: Cylinder head bolt) 1/2" → 12 mm
Bolts front cover to block	1/4" → M8 x 1.25
Spring washer	1/4" → 8
Stud cover to oil pan	1/4" → M6
Bolt clutch cover to flywheel	5/16" → M8 x 1.25
Bolt flywheel to crankshaft	3/8" → M10 x 1.25
Bolt drive plate fix	3/8" → M10 x 1.25
Stud and nut or bolt	5/16" → M8 x 1.25
Washer	5/16" → 8 mm
Stud and nut	3/8" → M10 x 1.25
Washer	3/8" → 10 mm
Stud and nut water pump	3/8" → M10 x 1.25
Bolt water pump to block	5/16" → M8 x 1.25
Bolt (and nut) alternator to bracket	5/16" → M8 x 1.25
Bolt (and nut) bracket to block	3/8" → M10 x 1.5
Nut adjust bar to cylinder head	3/8" → M10 x 1.25
Bolt or nut support to cylinder block	1/4" → M6 x 1.0
Screw fixing distributor to support	1/4" → M6 x 1.0
Pan head eccentric advance screw	1/4" → M6 x 1.0
Ass'y sleeve speedoneter pinion (R-Sports)	7/8" → M22 x 1.5
The clearance hole of distributor support is changed	7.5mm dia. → 7.0mm dia.
Bolt starter motor fix	3/8" → M10 x 1.5
Bolt cover to body	1/4" → M6 x 1.0
Bolt oil pump to block	5/16" → M8 x 1.25
Bolt camshaft gear	3/8" → M10 x 1.5
Screw set	1/4" → M6 x 1.0
Washer camshaft gear	10mm dia. → 10.5mm dia.
Clearance hole of locating plate	7mm dia. → 6.6mm dia.
Screw set chain tensioner	1/4" → M6 x 1.0
Bolt bracket to cylinder block	3/8" → M10 x 1.5
Bolt T/M case to engine block	3/8" → M10 x 1.5
Bolt and nut T/M case to engine rear plate	3/8" → M10 x 1.5

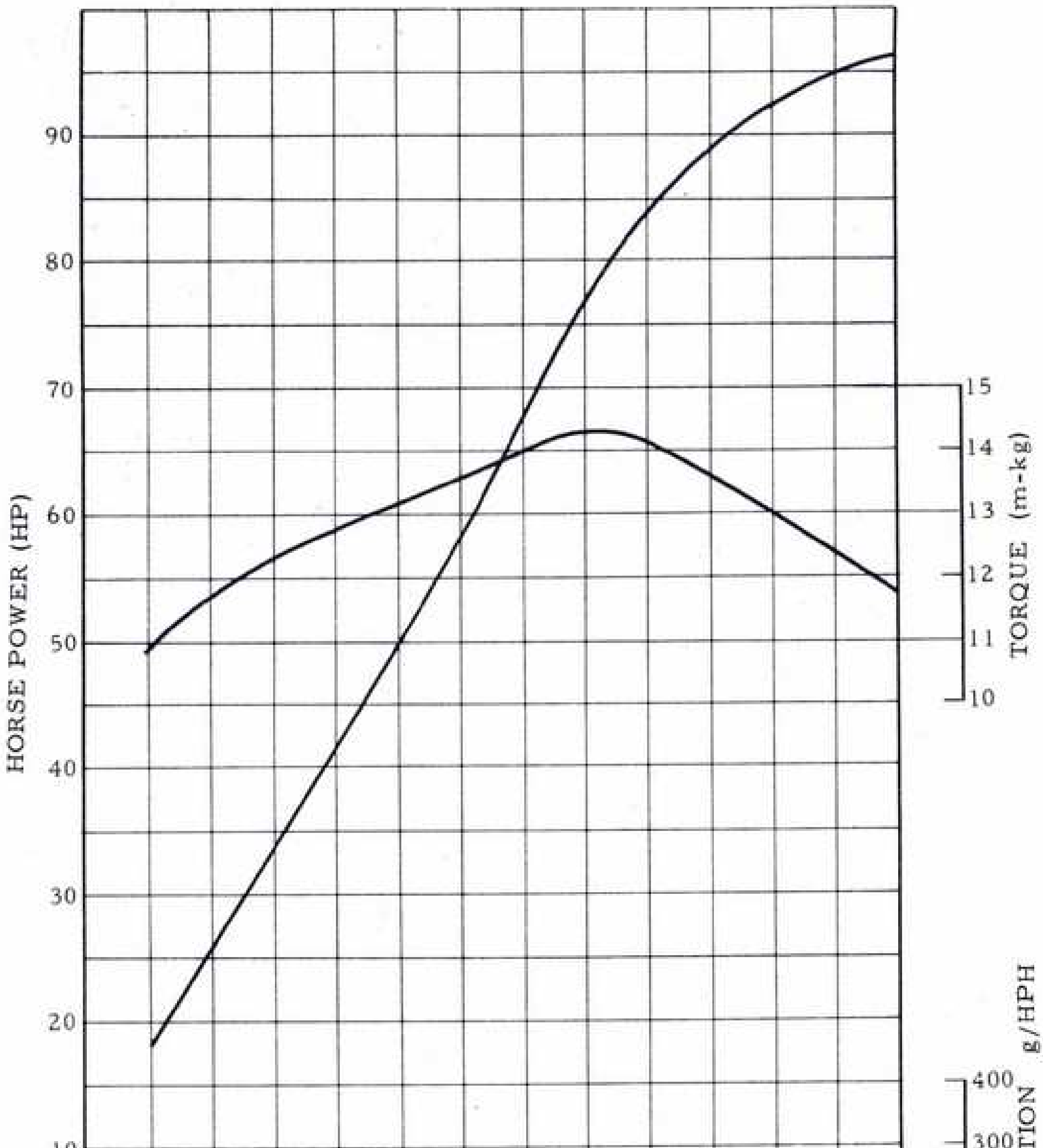
Stud and cap nut rocker cover	5/16" → M8 x 1.25
Bolt or stud manifold	5/16" → M8 x 1.25
Stud water outlet	3/8" → M10 x 1.5
Stud adjust bar	3/8" → M10 x 1.25
Plug heater outlet hole	5/8" → M16 x 1.5
Stud or bolt rocker bracket	7/16" → M10 x 1.5
Stud or bolt manifold fix	5/16" → M8 x 1.25
Stud carburetor fix	5/16" → M8 x 1.25
Stud and nut carburetor to manifold	5/16" → M8 x 1.25
Bolt air cleaner to carburetor (R)	5/16" → M8 x 1.25
Bolt air cleaner to carburetor (R)	5/16" → M8 x 1.25
Bolt water outlet to cylinder head .... (R-Sports)	3/8" → M10 x 1.5
Stud water outlet to cylinder head .... (R)	3/8" → M10 x 1.5
Stud and nut bracket (R)	7/16" → M10 x 1.5
Screw set rocker shaft (No. 4)	5/16" → M8 x 1.25
Screw threads of valve rocker R/L	7/16" → M10 x 1.25
Adjust screw and nut valve rocker	7/16" → M10 x 1.25
In connection with the change of the rocker bracket bolt, its clearance hole of the rocker bracket is changed ...	11.8mm dia. → 10.8mm dia.
Bolt fan	1/4" → M6 x 1.0

ENGINE



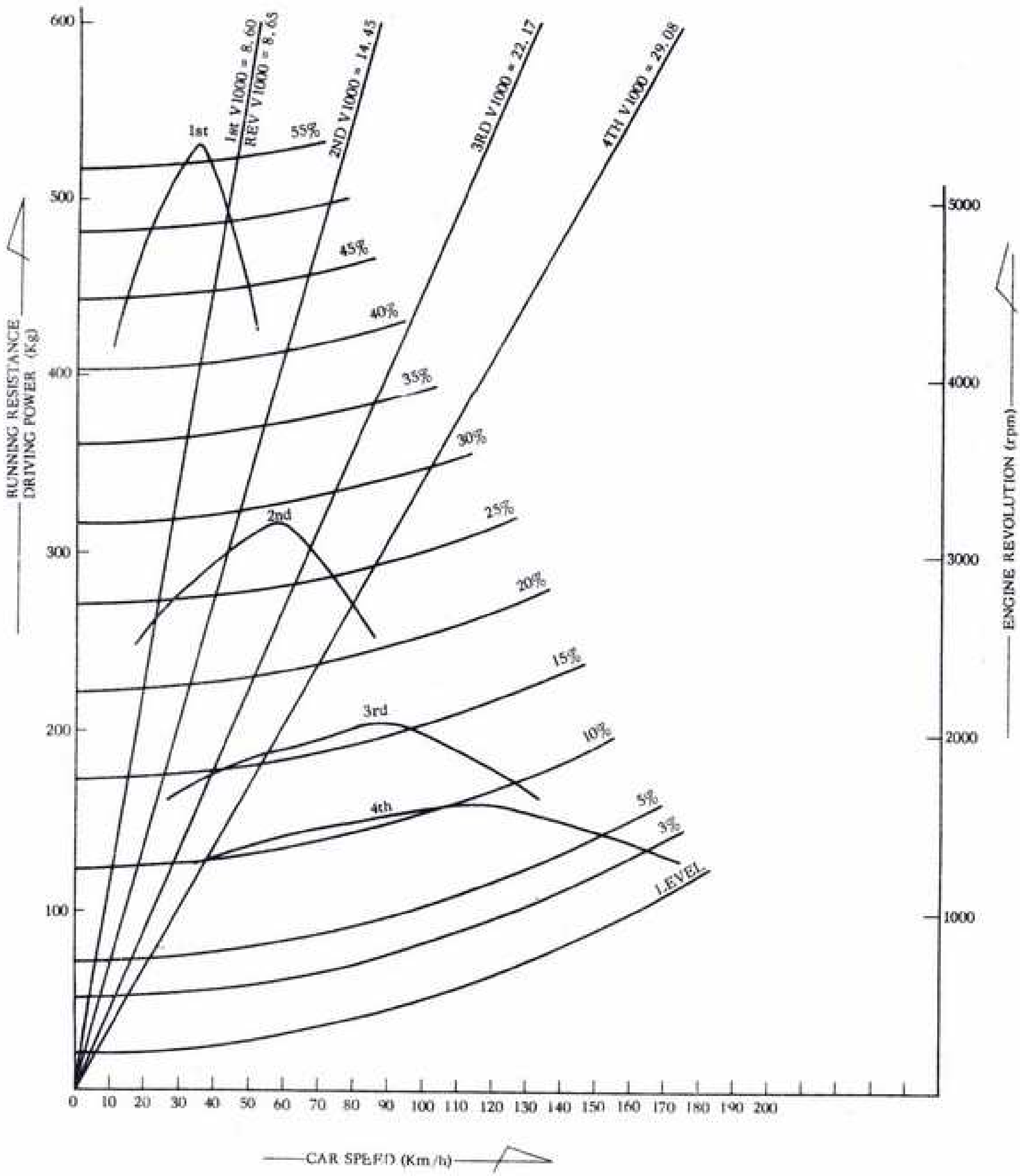
Engine	R type
Cylinder	4
Valve	Overhead
Displacement	1595 cc
Bore x stroke mm	87.2 x 66.8
Max. HP SAE B.H.P./r.p.m.	96/6000
Max. torque kg/rpm	14.3/4000 (103 ft. lbs)
Compression ratio	9.0
Compression pressure kg/cm^2(r.p.m.)	12.7/320 (180.6 lb in^2)

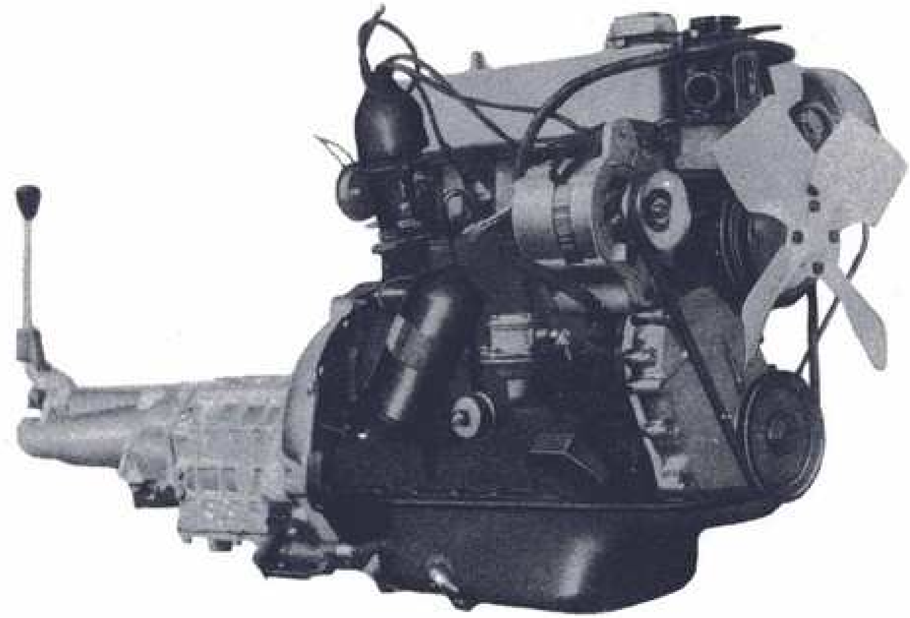
MODEL R ENGINE PERFORMANCE CURVE



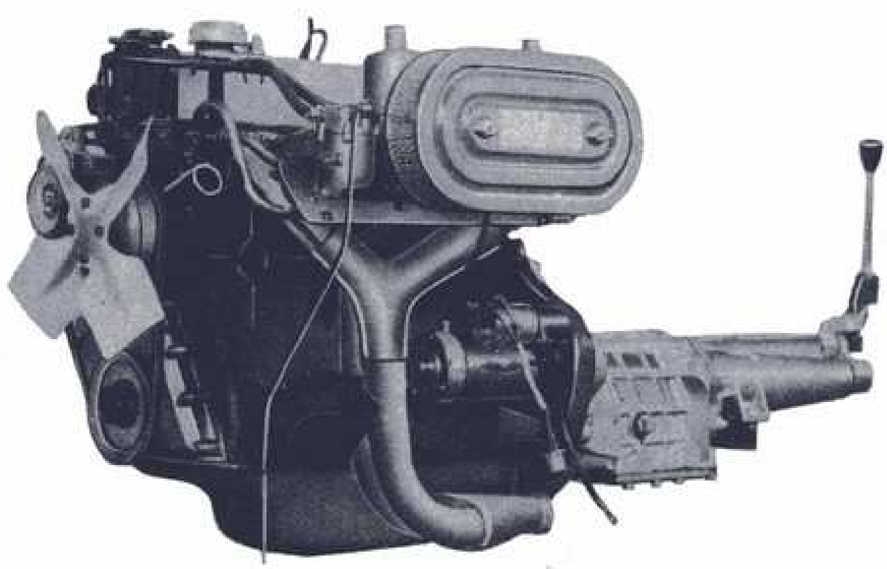
MODEL SP(L)311-U
RUNNING PERFORMANCE CURVE

Final Gear Ratio	3.889
1st Speed Ratio	3.382
2nd Speed Ratio	2.013
3rd Speed Ratio	1.312
4th Speed Ratio	1.000
Gross Vehicle Weight	1030 kg
Max. Grade Ability	tan θ = 0.573 (sin θ =0.-
Max. Torque	14.3 mkg/400 rpm
Max. BHP (SAE)	96 HP. 6000 rpm





ENGINE-RIGHT SIDE



ENGINE-LEFT SIDE

LUBRICATION

Circulation

Pressure lubrication is used throughout the unit and is provided by gear pump nondraining.

The oil pump is bolted under the crankcase, and is driven from the camshaft gear by a short vertical shaft. Oil drawn into the pump through the strainer and is delivered through internal oil ways.

The flow then passes through drillings in the crankshaft. The connecting rod lends are drilled for jet lubrication to the cylinder walls. From the rear camshaft bearing the oil passes upward through a drilling in the cylinder block and the rear rocker shaft bracket, to lubricate the rockers, and then drains back into the oil pan via the push rod aperatures.

Oil from the center camshaft bearing enters a gallery on the left-hand side of the engine and lubricates the tappets through individual drillings.

As the camshaft rotates, groove in the front journal register with a small hole in the camshaft locating plate thus all owing a small amount of oil to pass into the timing case during each revolution of the camshaft to provide lubrication for the timing chain and gears.

From the timing case the oil returnes via a drain hole back to the oil pan.

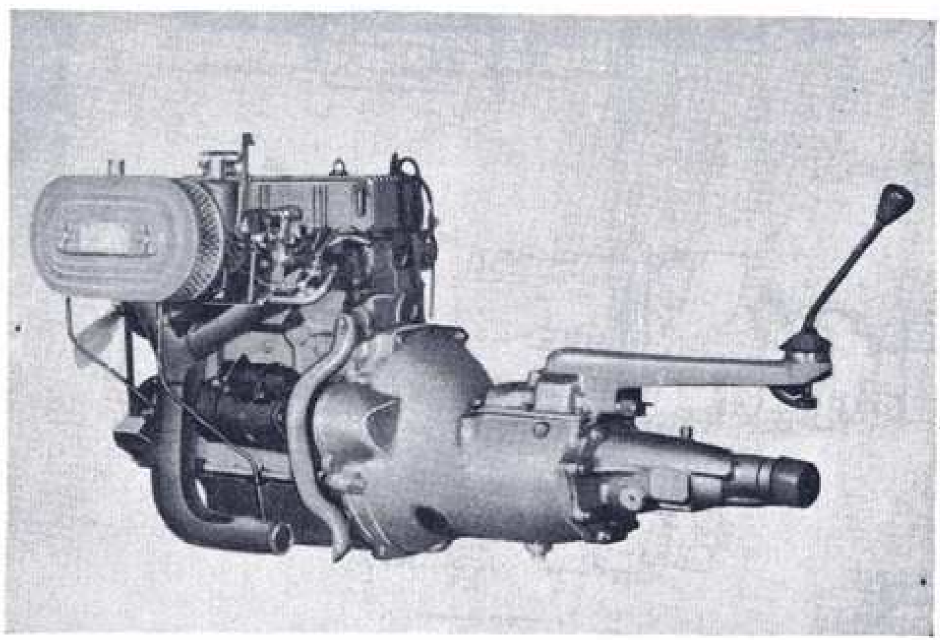


Fig. 1 R type engine (left side)

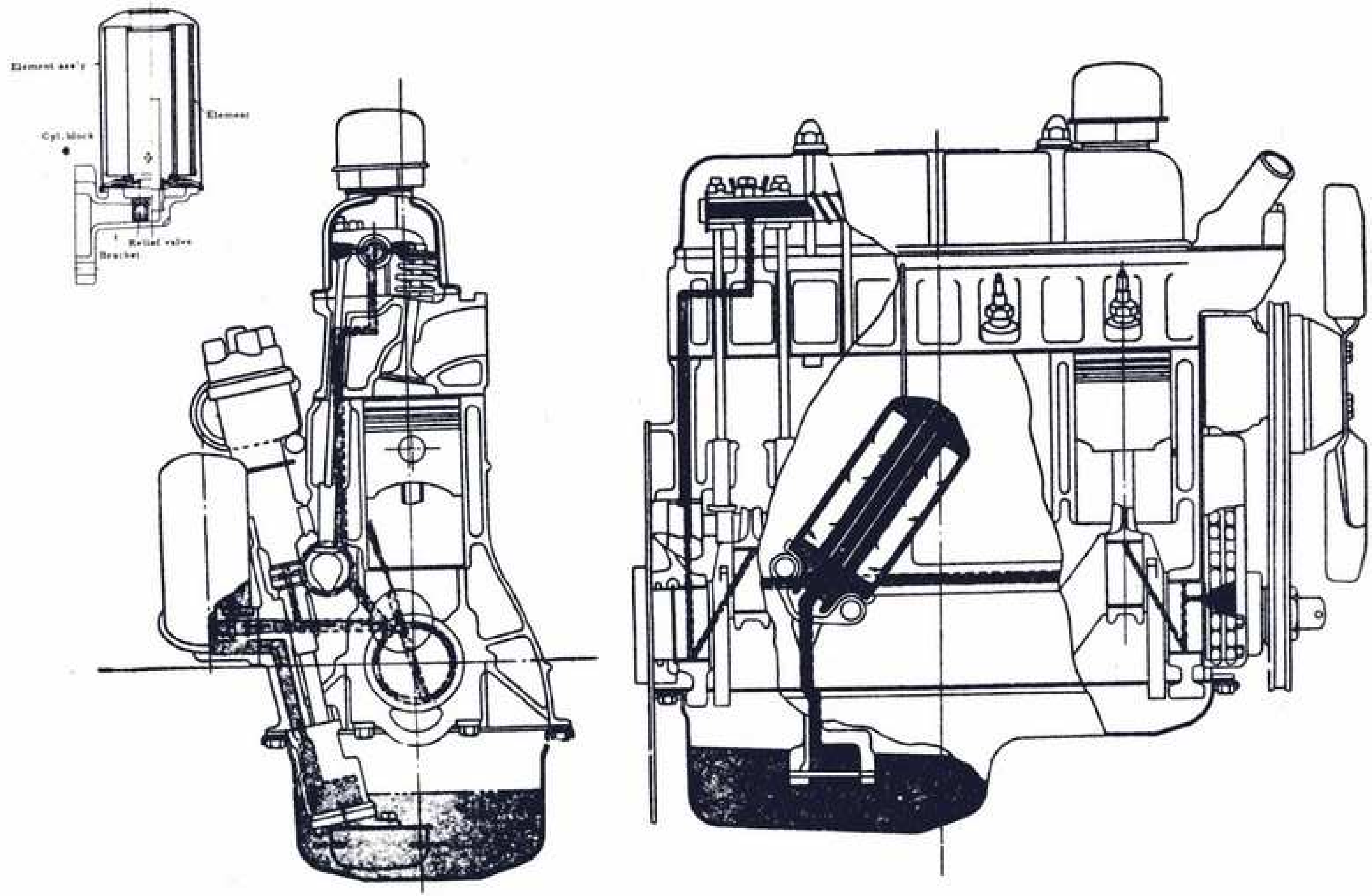


Fig. 2 Oil lubrication system

This illustrates the flow of oil from the oil pan through the oil pump to the main gallery, bearing and overhead rocker arm.

Removing the Filter

A new filter cartridge should be changed after first 2,000 miles (3,000 km) and then every 10,000 km after this.

The filter forms part of the oil gallery of the engine.

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.

The filtered oil in the element of filter cartridge is sent to the oil passage in the cylinder block, delivered to all the lubrication system, crankshaft journal, crank pin, cylinder bore, locker arm, camshaft journal and chain tensioner, and finally returned to the oil pan.

The oil filter is provided with a relief valve. If the temperature of lublicant oil is low at starting, oil viscosity is hight, or if the filtration resistance of the oil filter element is large caused by its choke up, the relief valve will be opened with pressure difference to bypass oil.

Removing the Oil Pan

The sump capacity is 4.1 litres. Drain the oil and replace the drain plug.

Remove the set screw bolts which are inserted from the underside of the securing flange, and the lower bolts from the bottom edge of the bell housing. Lower the oil pan from the engine, taking care not to damage the joint washers in the process.

Removing the Oil Pump

Remove the oil pan and pick up strainer. The bolts securing the oil pump bottom cover are long enough to secure the pump to the crankcase. Fig. 4 illustrates the pump in explosed form. Unscrew the bolts and remove the pump with its drive shaft.

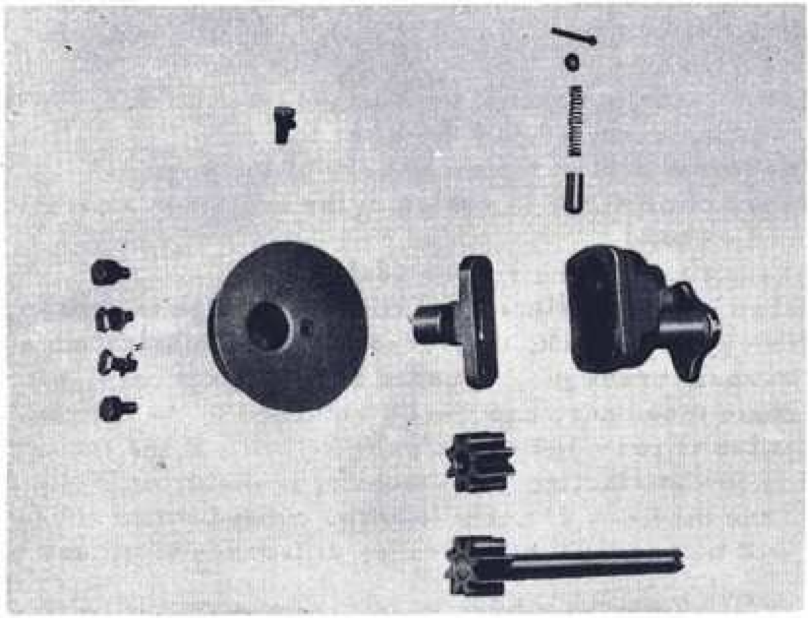


Fig. 4

Fig. 5

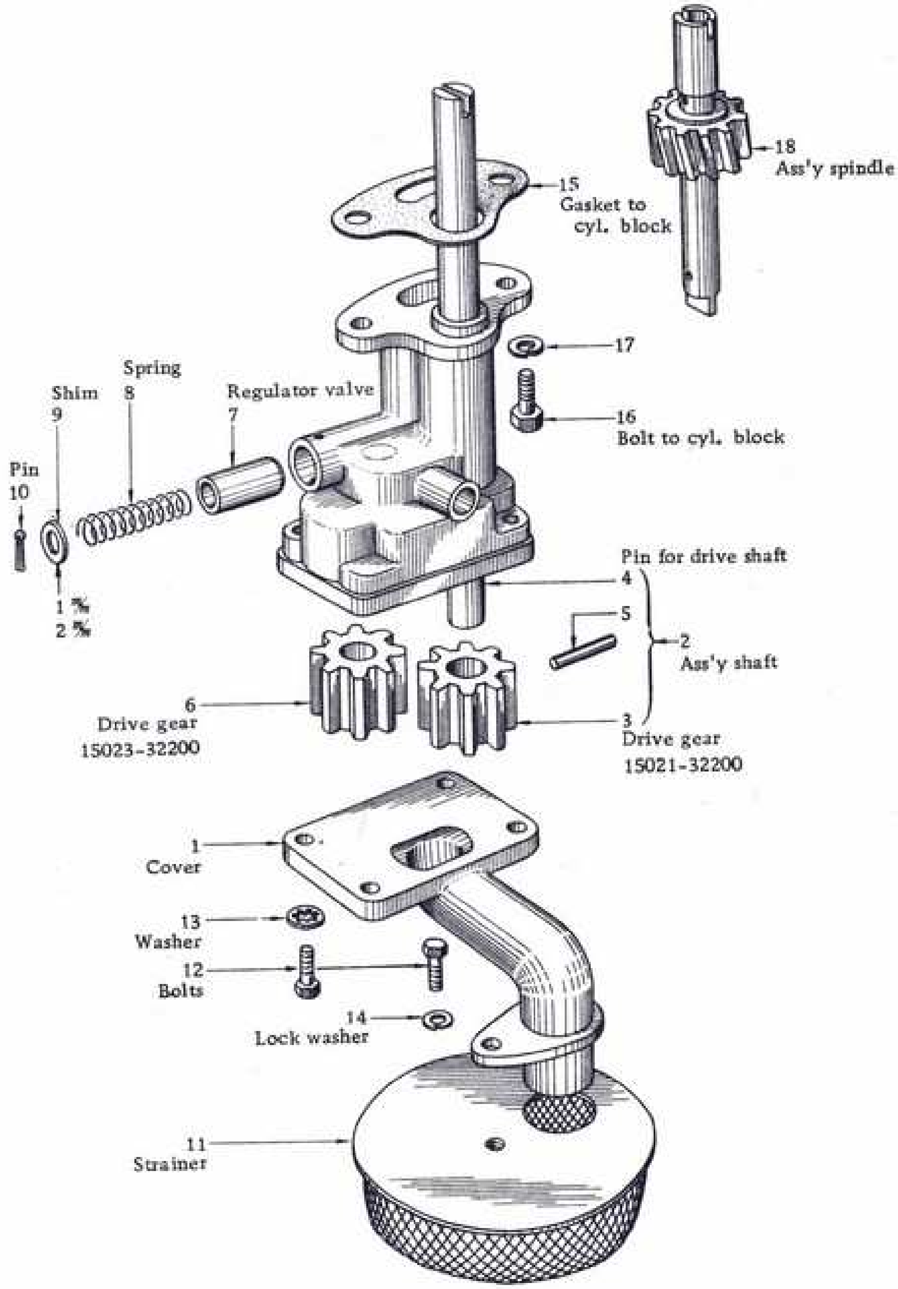
Refitting the Oil Pan

Clean out the oil pan by washing it with gasoline, the care to remove any traces of the sediment before refitting the oil pan to the engine. Pay paticular attention to the oil pan and crankcase joint faces, and remove any traces of old jointing material. Examine the joint washer and renew it if necessary. The old joint washer can be used again if it is sound, but it is advisable to fit a new one. Smear the faces of the joint with grease and fit the joint washer. Lift the oil pan into position and insert the setscrews into the flange tighting them up evenly.

Reassembling the Oil Pump

OIL PUMP

Performance test	22 ltr (5. 8 US. Gal.) minute at 2000 rpm (pump) Pressure 4 kg/cm^2(5. 89 lb/in^2) Engine oil SAE 20, temperature 70°C (158°F) Regulator valve locked Vacuum 3. 94 in Hg (100 mm Hg)
Gear back lash	0. 25-0. 3 mm (0. 010-0. 012 in)
Clearance between gear & cover	0. 04-0. 11 mm (0. 0016-0. 0043 in)



1.	Cover-oil pump	10.	Pin-cotter (3 ϕ)
2.	Ass'y-shaft, oil pump	11.	Ass'y-strainer, oil
3.	Gear-drive, oil pump	12.	Bolt
4.	Shaft-oil pump	13.	Washer
5.	Pin-drive shaft	14.	Washer-lock
6.	Gear-drive, oil pump	15.	Gasket-oil pump to cylinder block
7.	Valve-oil regulator	16.	Bolt } to fix oil pump
8.	Spring-valve, oil regulator	17.	Washer-block } to cylinder block
9.	Shim-oil regulator (1 m/m)	18.	Ass'y-spindle, driving, oil pump

Fig.6 Oil pump & stainer

SERVICE OPERATIONS WITH ENGINE IN POSITION

Removing Starting Nut and Pulley

Remove the radiator. Slacken the dynamo attachment bolts and remove the fan belt.

Bend back the tab on the bolt locking washer. Unscrew the starting nut by using heavy duty "Shock type" spanner.

A few sharp blows in an anti-clockwise direction will slacken the nut.

Pull off the crankshaft pulley.

Removing the Timing Cover

The timing cover is secured by set-screw bolts, each having a shakeproof washer.

The spring washers are immediately below the bolt heads.

Take out the set-screw bolts, remove the cover and its joint washer. Care should be taken not to damage the washer when breaking the joint. If damage does occur fit a new washer, cleaning of the faces of the joint surfaces beforehand.

Removing the Timing Gear

The timing chain is endless, and it is necessary to remove both the crankshaft and camshaft gears together. Before doing this, notice the timing marks on both gears and their relationship to each other.

Draw off both the gears a little at a time, first removing the crankshaft gear retaining nut.

As the gears are withdrawn care must be taken not to lose the packing washers from behind the crankshaft gear. Between the camshaft gear teeth, is a rubber ring which acts as a tensioner, and ensures silent operation of the chain drive. Examine the felt washer and renew it if oil has been lost by seepage.

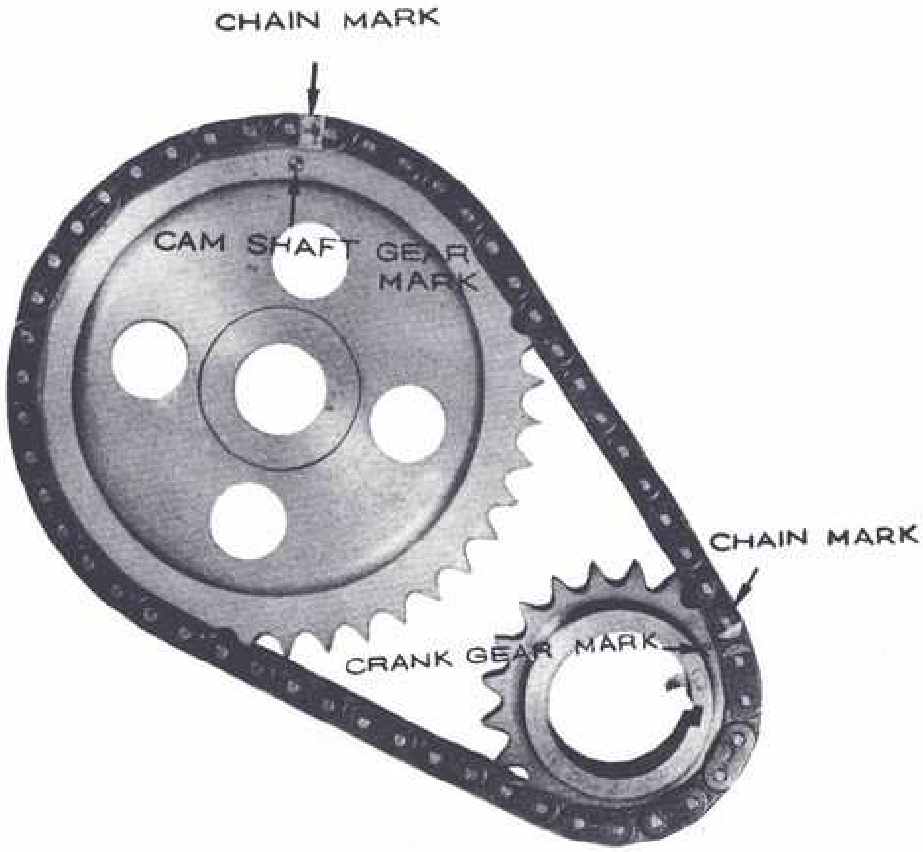


Fig. 2 Position of refitting gears with the chain

Refitting the Timing Gear

Replacing the components of the timing gear is largely a reversal of the dismantling process, but special attention should be paid to the following points.

Turn the engine crankshaft until the keyway is at T.D.C. and the camshaft with its keyway.

Fit the crankshaft and camshaft gears into their respective shafts finding the key ways against each position of key as shown in Fig. 2. Ensure the timing marks are opposite along in line.

Place the gears into position, ensuring that the keys are present in keyways on the shafts. Ensure again that the timing marks on the gears are opposite to each other and in line.

The same number of shims taken from front of the crankshaft must be replaced unless a new crank or camshaft has been fitted. In this case the alignment of the gear faces and measuring the alignment with a feeler gauge. To adjust the alignment it will be necessary to vary the number of shims.

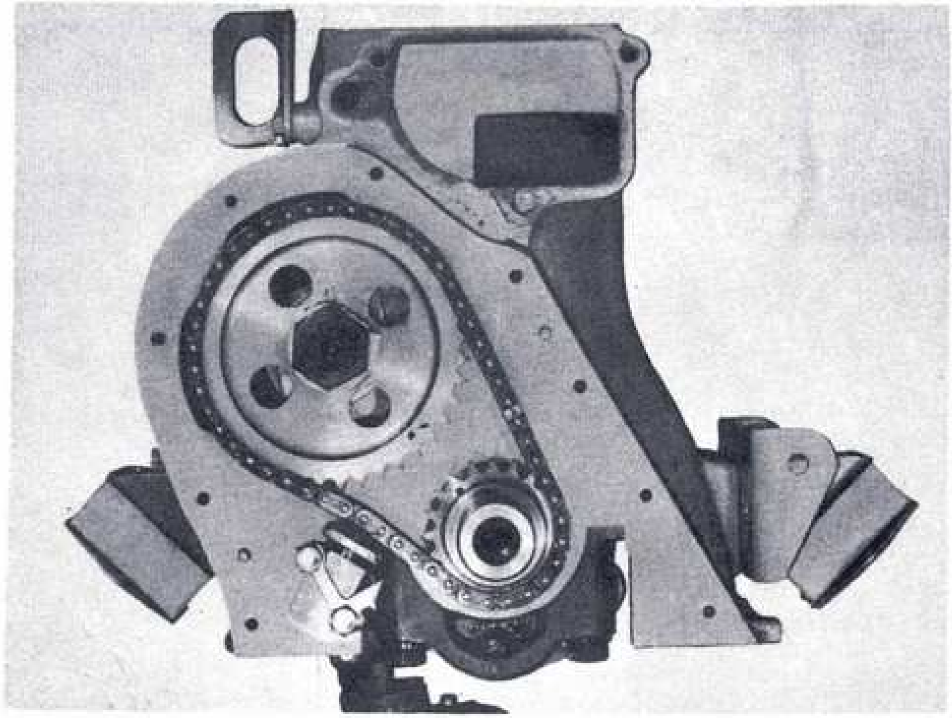


Fig. 3

Valve Rocker Cover Removal

Remove the air cleaner. Unscrew the cap nuts securing the engine lifting brackets. Remove the rocker cover and the cork joint washer.

Removing the Rocker Assembly

Drain the colling system. If anti-freeze is in use, use a clean container for the fluid if it is to be used again.

It is necessary to drain the system and slacken the cylinder head bolts, because four of the rocker shaft fixing bolts also secure the cylinder head.

If the cylinder head bolts are not slackened distonation may result and allow water to find its way from the coooling system into the cylinders and pump.

Notice that under the right-hand rear rocker stud nut is a special locking plate. Completely unscrew the rocker-shaft blacket nuts and remove the rocker assembly. Complete with brackets and rockers.

VALVE

Material:		
Inlet	Chrome steel	
Exhaust	Unilloy 2112	
Valve timing:		
Inlet opens	20° B.T.D.C.	
Inlet closes	56° A.B.D.C.	
Exhaust opens	58° B.B.D.C.	
Exhaust closes	18° A.T.D.C.	
Valve clearance Inlet & Exhaust	0.43 mm	(0.017 in) Hot
	0.525 mm	(0.0207 in) Cold
Dowel angle	50° - 54°	
Head diameter:		
Inlet valve	42 mm	(1.57 in)
Exhaust valve	32 mm	(1.26 in)
Valve seat angle inlet & exhaust	45°	
Valve face angle inlet & exhaust	44°30'	
Valve length (overall)	109 mm	(4.30 in)
Lift	8.5 mm	(0.335 in)

Dismantling the Assembly

To dismantle the rocker shaft assembly first remove the grub screw and locking plate from the rear rocker bracket.

Remove the split pins, flat washers and spring washers from each end of the shaft. Slide the rockers, brackets and springs from the shaft. Unscrew the plug from the end of the shaft and clean out the oil way.

The two end rockers may be dismantled without the whole rocker assembly being drawn out. This may be achived by truning the engine by hand until No.1 push rod reaches its lowest position.

Unlock the tappet adjusting screw and screw it back as far as it will go.

Withdraw the split pin, flat and spring washers and slide the rocker off the shaft.

Sometimes the valve spring will have to be slightly compressed by levering a screwdriver under No.2 rocker, thus allowing the end rocker to slide off the shaft easily. Repeat the procedure for No.8 rocker.

Reassembling the Rocker

On reassembly tighten the pedestal bracket securing nuts a little at a time working diagonally from nut to nut, left nut of No. 1 pedestal bracket, right nut of No. 2, left of No. 3 and so on returning from the left nut of No. 4 bracket and repeating the process until they are all tight. If the rocker assembly has been completely stripped down and rebushed, the oil holes will have to be redrilled and the bushes reamed down to size before assembly on the shaft.

The rockers and spring must be replaced in their original position on the ends of the shaft. Remember to replace the rocker shaft locating screw and lock plate.

Replace the spring and flat washers with the split pins on the ends of the shaft. Replace the rocker cover and gasket. The vent pipe should be at the front of the engine. Secure the cover by means of the two cap nuts, ensuring that the rubber bushed and engine lifting plates are in position. If the rocker cover gasket or the rubber bushes are found to be faulty, they must be renewed otherwise oil leaks will result.

Push Rod Removal

If the valve rocker assembly has already been removed all that remains is for the push rods to be lifted out. They may on the other hand be taken out without detaching the rocker assembly.

Remove the air cleaner and rocker cover.

Slacken all the tappet adjusting screws to their full extent; then using a screwdriver, with the rocker shaft as a fulcrum, depress the valve spring, slide the rocker side ways and lift out the push rod.

All but the end push rods can be withdrawn in this way. These will have to be withdrawn after the removal of the two end rockers from the shaft. When replacing push rods ensure that the ball ends register in the tappet cups. From here onwards, reassembly is a straightforward reversal of the dismantling process.

Adjusting Valve Rocker Clearances

Remove the air cleaner and rocker cover.

There should be a clearance of 0. 43 mm (0. 017 in.) between the face of the rocker and the base of the valve stem. Whilst checking the clearances it is important to maintain pressure with a screwdriver on the tappet adjusting screw to disperse the film of oil from the push rod cup. Failure to follow this procedure will result in a wrong reading being taken.

Turn the engine over by hand (Starting handle) until the push rod stops falling, the valve is fully closed.

To adjust, insert a screwdriver in the adjusting screw slot and slaken the lock nut. Then insert 0.017 in. feeler gauge between the face of the rocker and the valve stem. Raise or lower the adjusting screw until the correct clearance is obtained.

Tighten the lock nut and recheck the clearance.

It is important to note that while the clearance is being set, the tappet of the valve being adjusted must be on the back of the cam, opposite to its peak.

ROCKER MECHANISM

TAPPETS

Type	Maushroom
Diameter	12.673-12.684 mm(0.4988-0.4993 in)
Hole diameter for tappet	12.700-12.718 mm(0.4990-0.5006 in)
Tappet length	57 mm (2.24 in)

ROCKER MECHANISM

Push rod:		
Overall length	196.6-197.4mm	(7.74-7.77 in)
run-out (at center of rod)	Not to exceed 0.2 mm	(0.008 in)
Diameter	7.1 mm	(0.27 in)
Rocker shaft: length	398 mm	(15.67 in)
Rocker shaft diameter		(0.7865-0.7874 in)
Rocker arm hole diameter	20.020-20.033mm	(0.7882-0.7887 in)
Arm & shaft clearance	0.020-0.054 mm	(0.0008-0.0021 in)
Arm lever ratio	1.46 1	

CYLINDER HEAD

Removing the Cylinder Head

Drain the cooling system by opening the radiator and cylinder block drain taps.

One is situated inlet tube at the backside of the radiator and other at the rear right-hand side of the engine. If anti-freeze mixture is in use it should be drained into a suitable container and retained for future use.

Disconnect the negative cable from the battery by extracting the terminal screw and removing the lug from the battery terminal post.

Slacken both the retaining clips on the hose connecting the radiator to the thermostat housing and remove the hose.

Extract the thermostat housing securing nuts and remove the housing and thermostat.

Remove the aircleaner, carburetor, rocker cover and the inlet and exhaust manifolds.

Detach the high tension cables and remove the sparking plugs, also disconnect the water temperature gauge connection from the thermostat housing.

Take off the rocker assembly not forgetting to slacken the external cylinder head bolts at the same time.

Withdraw the push rods keeping them in the order of removal.

The cylinder head can now be lifted off the cylinder block. To facilitate breading the cylinder head joint, tap each side of the head with a hammer using a piece of wood interposed to take the blow. Do not use excessive force. When lifting the head a direct pull should be given so that the head is pulled evenly up the studs. Remove the cylinder head gasket.

Decarbonizing

Remove the cylinder head. With the valves still in position remove the carbon from the combustion chambers and the valve faces. Leaving the valves in position for this operation ensures that damage cannot be caused to the seats by the wire brush which should be used for the removal of carbon.

If the exhaust valve heads are coated with a very hard deposit this may be removed by using a chisel shaped piece of hardwood.

Remove the valves, and using the wire brush clean out the carbon from the in let and exhaust ports.

Blow out all traces of carbon dust with compressed air or type pump, and finally clean the ports with gasoline and dry them out. The carbon should now be removed from the piston crowns. Rotate the engine until the piston to be worked on is at T.D.C. Protect the other cylinder bore from the entry of carbon particles by pushing a non-fluffy rag into them.

Using a chisel shaped piece of hardwood. Carefully remove the carbon from the piston crowns. A ring of carnon should be left round the periphery of each piston, and the deposit round the top of the cylinder bore should not be touched. An indication as to when decarbonisation is required is generally given by an all round loss of power. Cars used mainly on short runs will require this attention more often than those used for long runs.

Removal and Replacement of a Valve

Whilst the cylinder head is removed the valves can be taken out. To do this compress the valve spring with the special valve spring compressor.

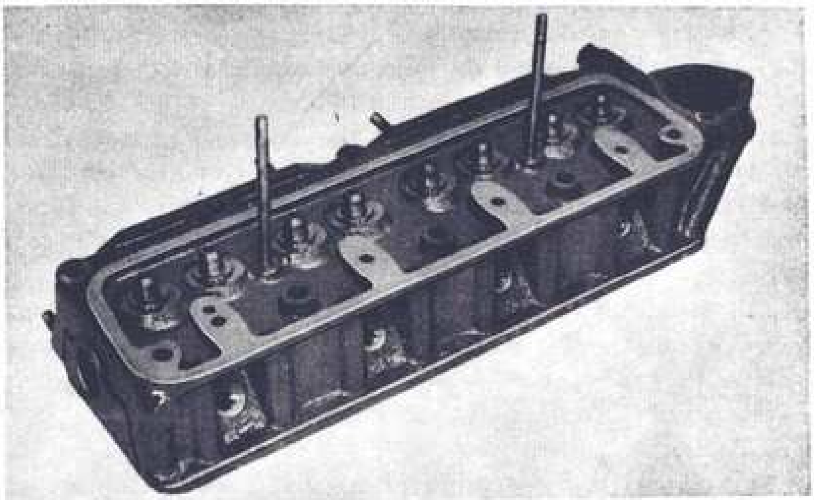


Fig. 1

Valve Grinding

Before replacement of the cylinder head the valves and their seats should be examined for signs of pitting or burnt patches and distortion.

If these conditions are present, the valve seats must be recut before attempting to grind in the valves, whilst distorted valve heads should be trued or the valve renewed. Only the minimum amount of metal should be removed in the trueing process.

When grinding a valve onto its sealing, the valve face should be smeared lightly with grinding paste and then lapped in with a suction type grinding tool. The valve must be ground to its seat with a semi rotary motion. A light coil spring interposed between the valve head and the port will assist considerably when lifting the valve in order to rotate the face to a different position. This should be done frequently to spread the grinding compound evenly.

It is necessary to continue the grinding process until an even matted surface is produced on the seating and the valve face.

On completion, the valve seats and ports should be throughly cleaned with gasoline soaked rag, and dried, and the subjected to a compressed air blast. The valves should be washed in gasoline and all traces of grinding compound removed.

VALVES

Valve head diameter			
	Intake valve	42 mm	(1.66 in)
	Exhaust valve	32 mm	(1.26 in)
Valve seat angle inlet & exhaust		45°	
Valve face angle inlet & exhaust		44° 30'	
Valve length (overall)		109 mm	(4.30 in)
Lift		8.5 mm	(0.335 in)

Reset the valve clearances, and finally check them when the engine is not hot or cold. The cylinder head bolts may pull down slightly more after the engine has attained its normal working temperature, in which case the valve clearances will have to be checked again and reset if necessary.

Refit the inlet and exhaust manifolds.

Fit the carburetor and reconnect the control linkage. Refit the ignition advance suction pipe to the connection on the carbureter, but do not at this stage refit the air cleaner or it will have to be removed later to check the valve clearances. Replace the rocker cover taking care to fit the cork gasket correctly.

Place the thermostat and its housing in position and secure with the three nuts. Reconnect the water temperature gauge wire and fit the radiator hose to the thermostat housing. Connect the cables to the battery. Ensure that the radiator and cylinder block drain tapes are closed, and refill the radiator.

Clean and adjust the sparking plugs and refit them, clipping on the hightension leads. The firing order of the engine is 1-3-4-2. Replace the clip which secures part of the electrical whiring harness to the side of the head.

The ignition can now be switched on and the engine started. When the normal operating temperature has been reached switch off and remove the rocker cover so that the valve clearances may be recheked. Replace the rocker cover and fit the air cleaner when the final check has been made.

Whilst the engine is running check that the water hose connections and fuel line unions do not leak. Tighten them if necessary.

OVER SIZE VALVES (STEM) AVAILABLE

		Intake Valve	Stem diameter
Standard		13201 12900	8.7 mm (0.34 in)
Over size	0.2 mm (0.008 in)	13201 12901	8.9 mm (0.35 in)
	0.4 mm (0.016 in)	13202 12902	9.1 mm (0.36 in)
		Exhaust Valve	Stem diameter
Standard		13202 12200	8.7 mm (0.34 in)
Over size	0.2 mm (0.008 in)	13202 12201	8.9 mm (0.35 in)
	0.4 mm (0.016 in)	13202 12202	9.1 mm (0.36 in)

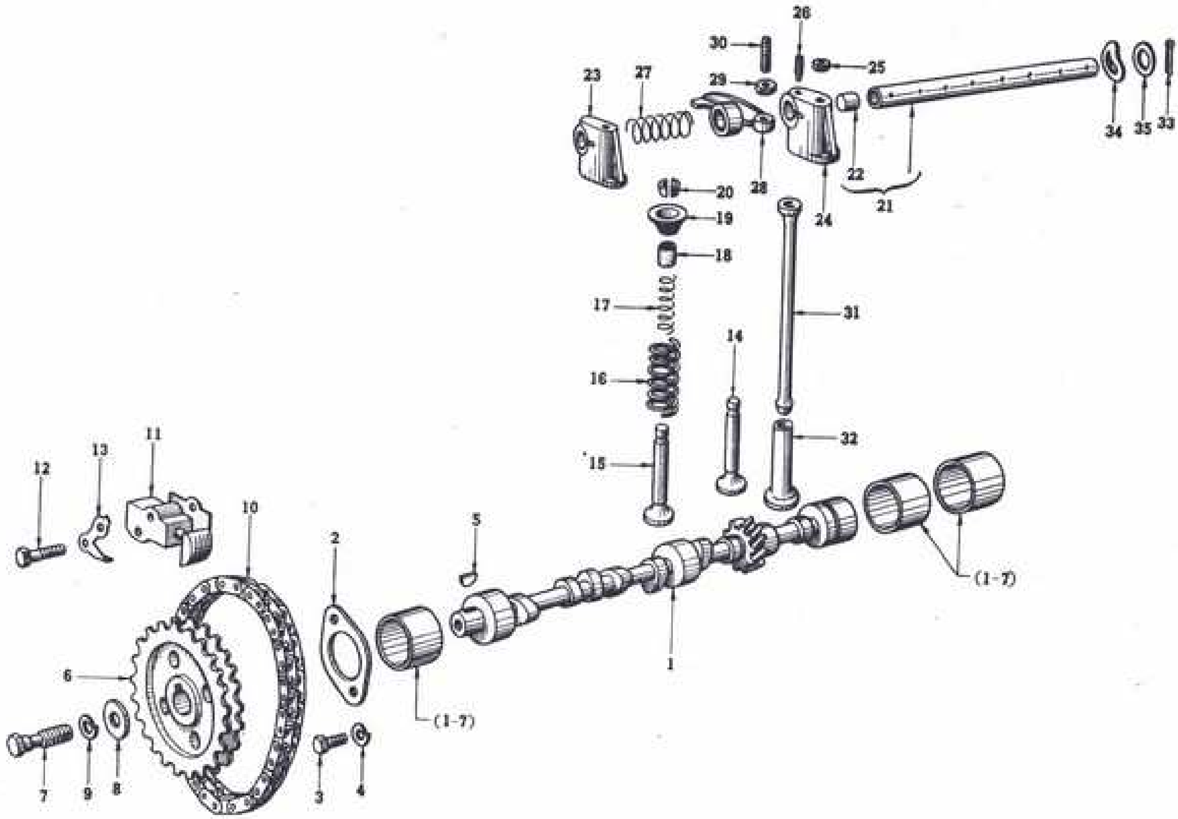
Refitting the Cylinder Head

Ensure that the cylinder head and cylinder block joint faces are clean.

The cylinder head gasket is marked "Top" so that it will be placed head in correctly. Place the gasket into position and lower the cylinder into place. Fit the seven cylinder head securing nuts finger tight.

Insert the push rods, replaceing them in the positions from which they were taken.

Screw back all the tappet adjusting screws. Replace the rocker assembly and screw down the securing nuts finger tight. Evenly tighten the cylinder head bolts a little at a time, finally pulling them down with a torque wrench set to 45-50 lbs. ft. (6.2-6.9 kgm).



1. Camshaft
2. Plate-locating, camshaft
3. Screw-set
4. Washer-lock
5. Key-camshaft
6. Gear-camshaft
7. Bolt-camshaft gear
8. Washer-camshaft gear
9. Washer-lock
10. Chain-camshaft
11. Ass'y-tensioner, chain
12. Screw
13. Washer-lock
14. Valve-intake (standard size)
15. Valve-exhaust (standard size)
16. Spring-valve, outer
17. Spring-valve, inner
18. Ring-rubber, valve
19. Retainer-valve spring
20. Collet-valve
21. Ass'y-shaft, rocker
22. Plug-expansion, rocker shaft
23. Bracket-rocker shaft
24. Bracket-rocker shaft (tapped)
25. Nut
26. Screw-set, rocker shaft
27. Spring-inside, valve rocker
28. Rocker-valve (R.H.)
29. Nut-valve rocker
30. Screw-adjust, valve rocker
31. Rod-push
32. Lifter-valve
33. Pin-split, valve rocker shaft
34. Spring-outside, valve rocker
35. Washer-rocker shaft

Removing and Replacing the Tappets

Remove the cylinder head assembly and withdraw the push rod, keeping them in their respective positions so that they will be replaced on the same tappets.

Take out the camshaft from engine block, then push out the tappet from the top of the cylinder block with one of push rods, also keeping them in same locations.

Assembly is a reversal of above procedure. It may be necessary to insert the tappets from inside of cylinder block keeping upside down or lay down.

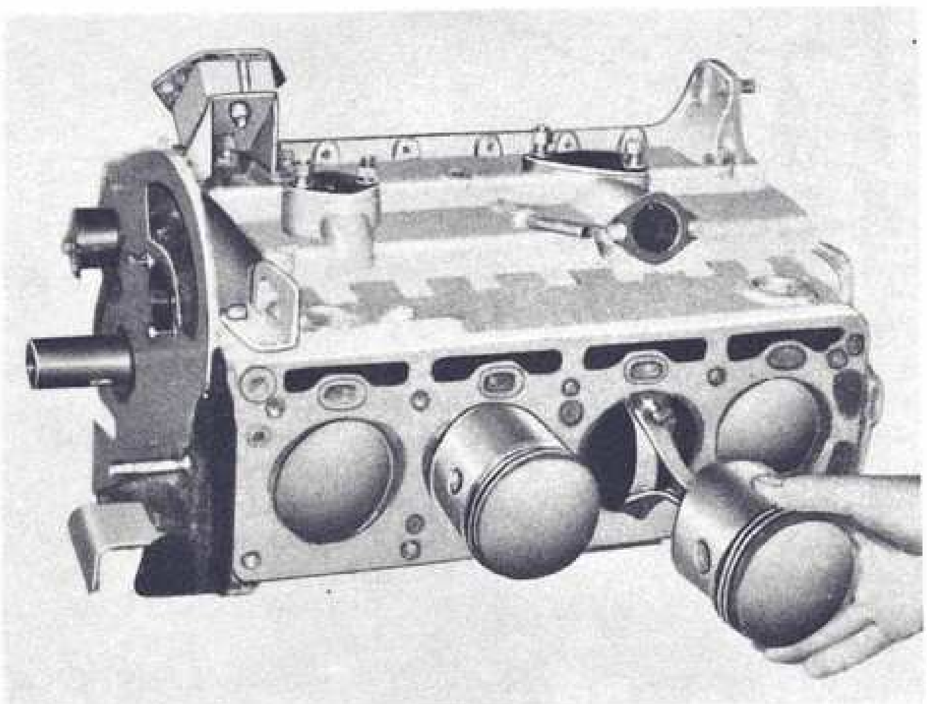


Fig. 2

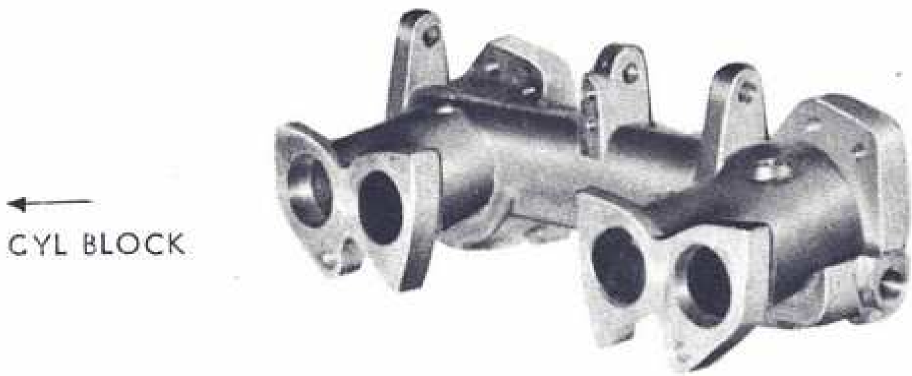


Fig. 3 Intake manifold

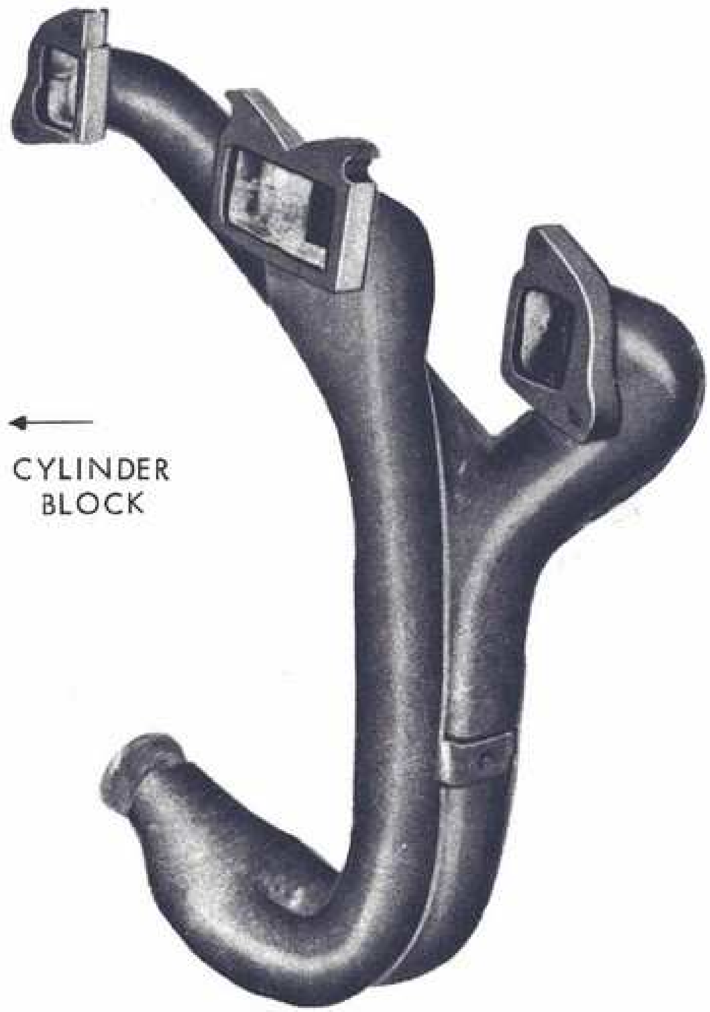
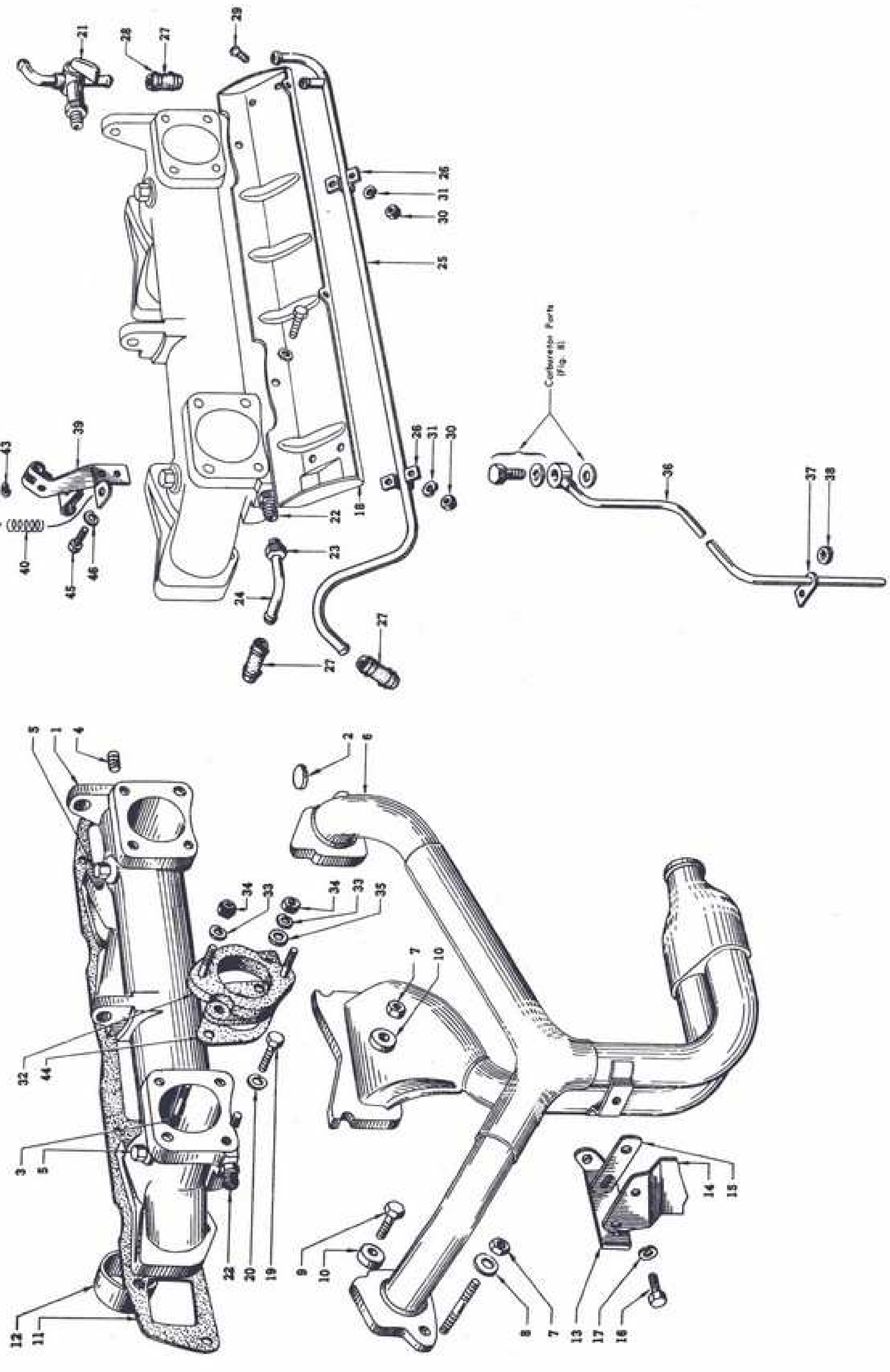


Fig. 4 Exhaust manifold


Carburetor Parts (Fig. 8)

1. Manifold-intake
2. Plug-welch (25ϕ)
3. Stud (to fix carburetor)
4. Plug-taper thread
5. Plug
6. Ass'y-manifold exhaust
7. Nut
8. Washer-plain
9. Screw
10. Yoke-manifold
11. Gasket-manifold to cylinder head
12. Coller-intake manifold
13. Support-exhaust manifold
14. Insulator-exhaust manifold
15. Bar-exhaust manifold
16. Bolt
17. Washer-lock
18. Plate-heat shield, carburetor
19. Bolt
20. Washer-lock

    (19–20) to fix heat shield plate

21. Cock-three way
22. Connector
23. Nut-manifold to cylinder head
24. Tube-manifold to cylinder head
25. Tube-manifold to water pump
26. Clamp-water tube
27. Hose-water
28. Clamp-hose
29. Screw
30. Nut
31. Washer-lock

    (29–31) to fix water tube clamp

32. Insulator-carburetor
33. Washer-lock
34. Nut
35. Washer-plain
36. Ass'y-tube, over flow, carburetor
37. Bracket-drain tube
38. Rubber-ferrule
39. Ass'y-bracket, accelerator wire & tube
40. Spring-adjust screw
41. Screw-throttle adjust
42. Screw
43. Washer-lock
44. Gasket-insulator, carburetor
45. Screw
46. Washer-lock

Piston and Connecting Rod Removal

Drain the colling water from the engine and radiator. Drain and remove the oil pan from the engine, then disconnect and remove the oil strainer. Take out the pal nuts and cap nuts from the big ends and withdraw the caps. When used parts are replaced after dismantling, it is essential they are fitted into their original positions.

To ensure correct refitting mark the caps and connecting rods on the sides to identify then together.

The piston and connecting rods must be withdrawn upwards through the cylinder bores.

Release the connecting rod from the crankshaft side and slowly push the piston and rod upwards through the cylinder bore with the wooden bar.

Note: It may be necessary to remove the ring of carbon or lip from the top of the cylinder bore with a hand scraper to avoid risk of piston ring breakage.

Remove the assembly from the top of the cylinder block.

Check the crankpins for ovality with a pair of micro meter calipers, and examine the bearing surface for scoring, either defect will necessitate the removal of the crankshaft for regrinding.

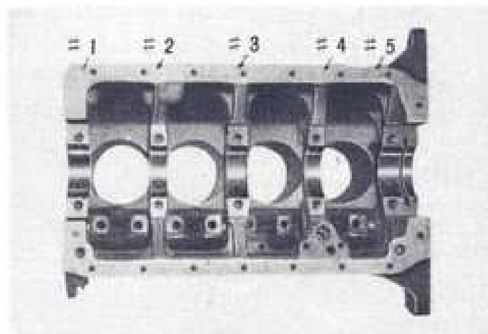
CONNECTING ROD

Material	Steel forging	
Length, center to center	152.45 mm	
Big end bearing:		
Material	Thinwall, steel backed clevite metal F 770	
Width	24.1 - 23.9 mm	0.9488 - 0.9409 in.
Thickness	1.500 - 1.508 mm	0.0591 - 0.0594 in.
Diameter of big end housing	55.000 - 55.013 mm	2.1653 - 2.1658 ins.
Big end width	28.75 - 28.80 mm	1.1319 - 1.1339 in.
End play	0.2 - 0.3 mm	0.008 - 0.012 in.
Clearance crank pin and bearing	0.023 - 0.052	0.001 - 0.002 in.
Piston pin housing (reamed in position)	22.010 - 21.997 mm	0.8663 - 0.8662 in.

CRANKSHAFT

Material	Steel forging	62.941 - 62.96 mm
Diameter of journals	See Fig. 4-2	
Diameter of crank pin	51.961 - 51.974 mm	62.941 - 62.96 mm
End play	0.05 - 0.15 mm	62.941 - 62.96 mm
Main bearing clearance	0.025 - 0.068 mm	62.941 - 62.96 mm
Deflection (RUN-OUT) at intermediate journal	0.03 mm	62.941 - 62.96 mm

Part Name	E # R40001	E/# 40000
Cap main bearing #1	12282 78200	12282 38700
Cap main bearing #2, #4	12284 78200	-
Cap main bearing #3	12283 78200	12283 38700
Cap main bearing #5	12286 78200	12286 38700
Ass'y-crankshaft (R)	12200 74710	12200 14600
Oil seal crankshaft rear	12279 61000	12279 32200



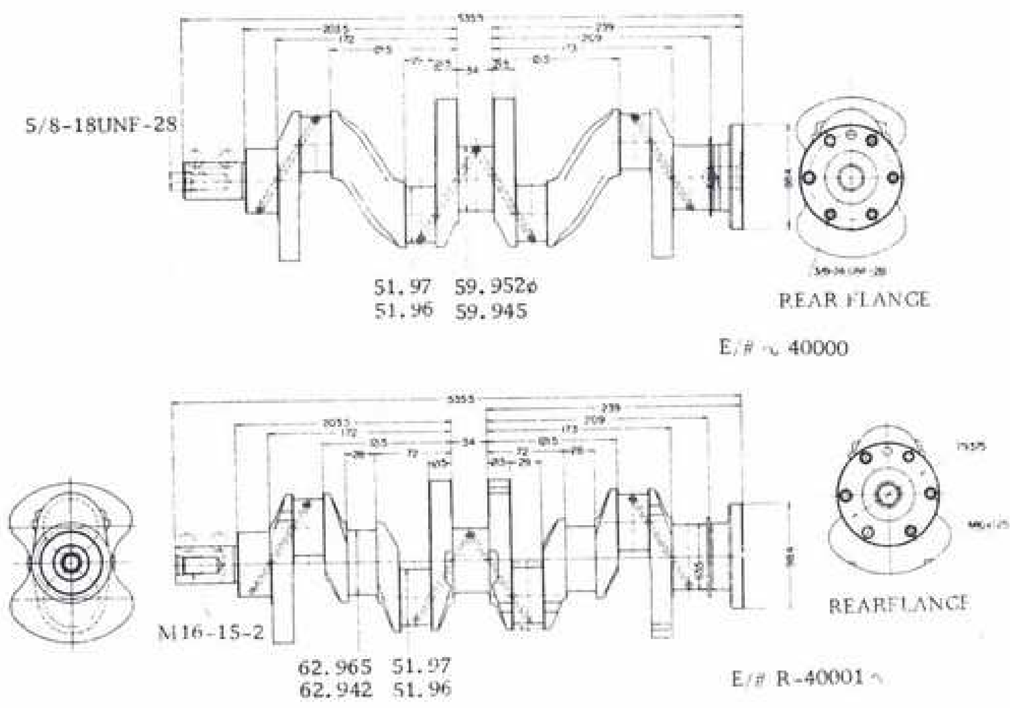


Fig. 4-2

MAIN BEARINGS

Material	Thinwall, steel backed, clevite metal F 770 (upper & lower)	
Number of bearings	3	
Width:		
Front and rear	28 mm	5
Center	33.90 - 33.95 mm	5
Bearing thickness	1.827 - 1.835 mm	5

The shell bearing are removable by hand. The bearings are require no "bedding in" it is being only necessary to ensure that the housings are scrupulously clean and dry, and to place the bearings into position with the tangs located in their corresponding slots. Always renew bearings if they are scored or damaged in any way, or following the regrinding of the crankshaft bearing surfaces. In the latter case undersize bearings will be required and the kinds of sizes available are S.T.D, 0.25, 0.50, 0.75 and 1.00.

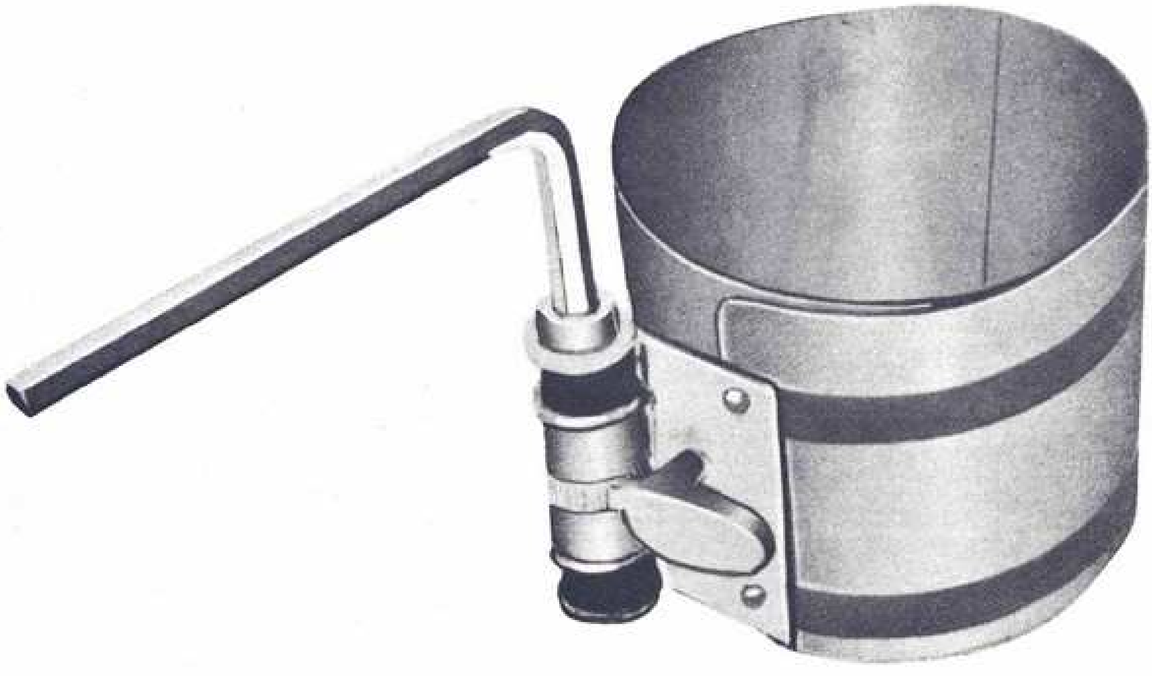
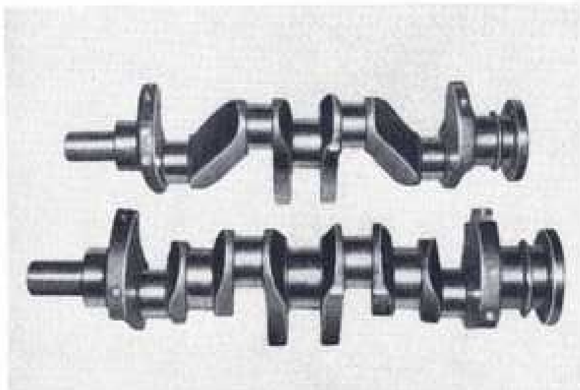


Fig. 5



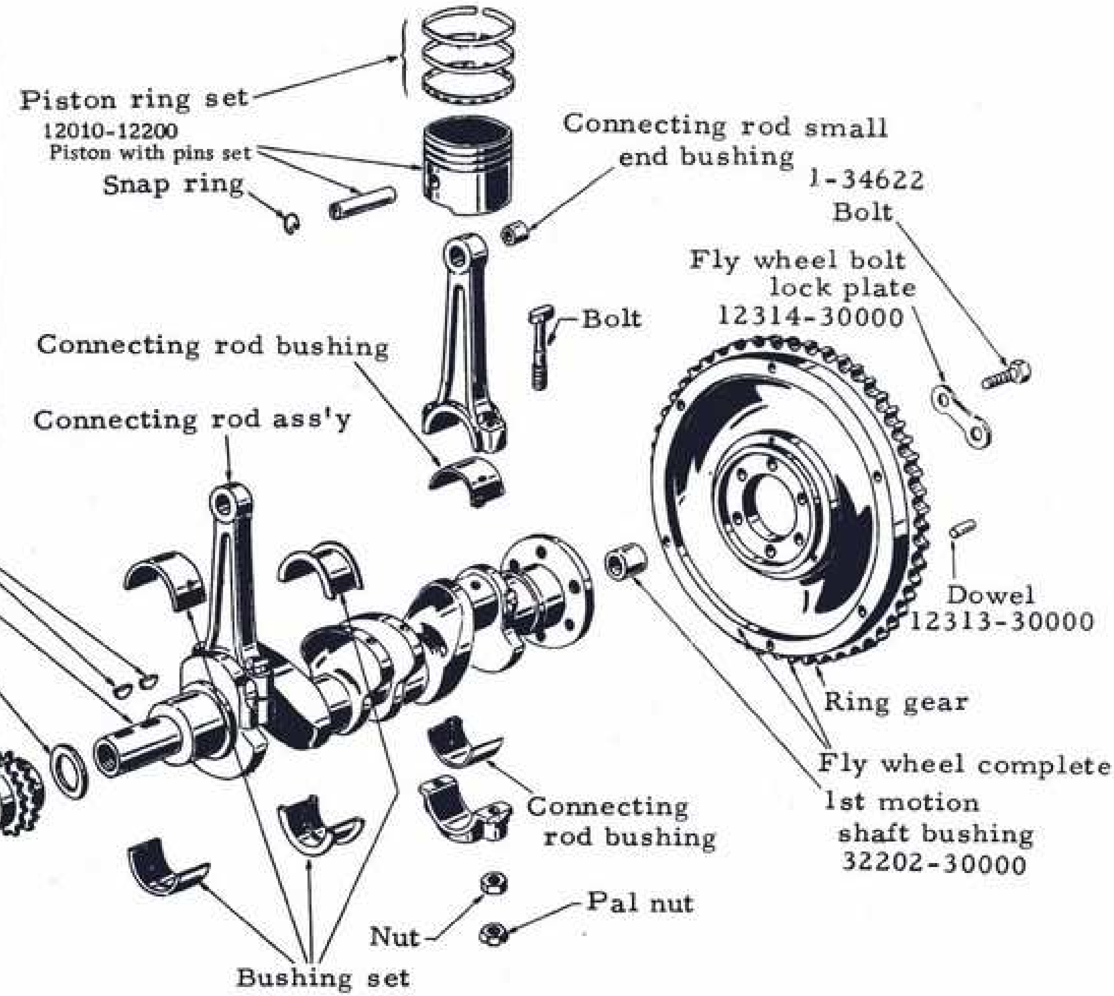



Fig.6 Piston & crank shaft

PISTON

Replacing Pistons and Connecting Rods

Insert each piston and connecting rod assembly into the cylinder from which in was taken; it is essential that the split in the skirt of the piston is positioned towards the camshaft.

Compress, the piston rings with inserting piston using tool (Fig. 3), and gently tap the crown of the piston with the wooden end of a hammer handle, until the piston is clear of the piston ring clamp.

Now push the piston down the cylinder block until the big end of the connecting rod just protrudes through the bottom of the cylinder bore, then position upper half bearing shells.

Note:-Each upper & lower bearing has the oil holes, there by ensuring sufficient and it is of the greatest importance that the corresponding oil hole in the bearing shell registers with the oil way to provide an unobstructed passage.

Pull the connecting rod onto the crankpin taking care not to injure the bearing surface. Insert the shell into the connecting rod cap; position the cap and the locking washers. Insert the setscrews and tighten with a torque wrench to 35 - 45 lbs. /ft. (4. 8-6. 2 kgm).

Finally set with the pal nut. Check the connecting rod big end for side clearance(7/1000 in.) and see that the shell bearings are not binding on the crankpin when rotating the crankshaft. If it is difficult to turn, undo the big end and examine the shell and seat for dirt or grit. Before reassembling always apply a little clean oil to the piston surfaces and into the cylinder bore. Never file the connecting rod caps or their mating surfaces as this creates ovality in the bearing.

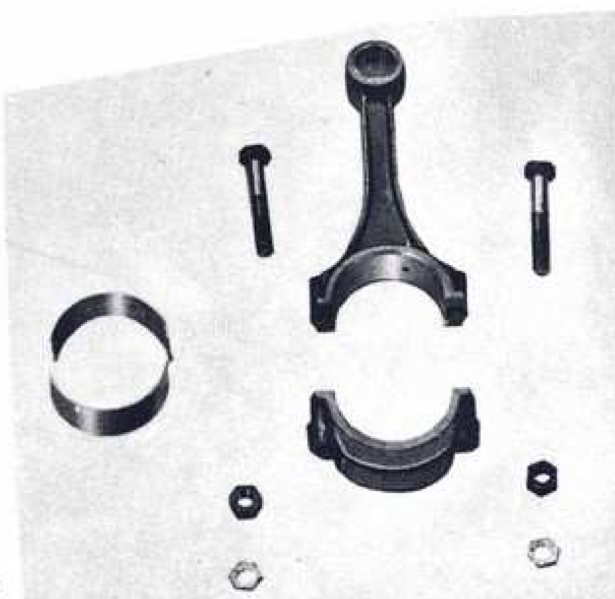


Fig.7

Removing a Piston

Remove the clamping bolt from the small end of the connecting rod and push out the gudgeon pin.
The gudgeon pin is a push fit in piston at 30°-40°C. When reassembling, ensure the gadgeon pin is positioned in the connecting rod so that its groove is in line with the clamp screw hole. Check that the spring washer fitted under the head of the pitch bolt is not damaged.

CYLINDER BLOCK (11010-14600)

Grade Number & Dimensions STD. Bore					
Grade No.				4	5
R Engine	87.200 80.008mm	80.010 80.019mm	80.020 80.029mm	80.030 80.039mm	80.040 80.049mm

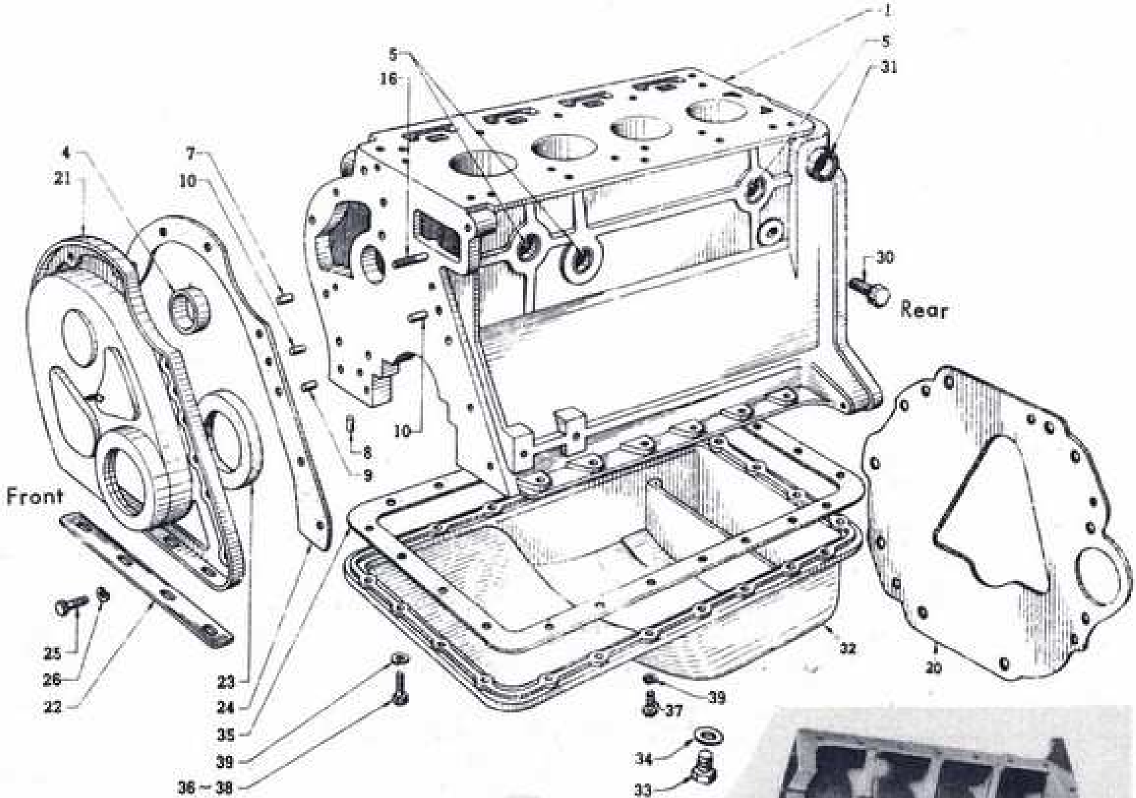
Cylinder bore taper	Less than 0.0008 in.
Difference of each cylinder bore	Less than 0.0008 in.
Over size piston available	0.010, 0.020, 0.030, 0.040 in. 0.25, 0.50, 0.75, 1.00 mm
Cylinder head surface warpage limit	0.1 mm, 0.004 in.
Torque wrench setting:	
Cylinder head bolts	6.2-6.9 kgm 45-50 ft. lbs.
Rocker bracket nuts	4.15-4.84 kgm 30-35 ft. lbs.
Connecting rod bolts	4.8-6.2 kgm (35-45 ft. lbs.)
Main bearing cap	9.75-11.06 kgm (71-81 ft. lbs.)

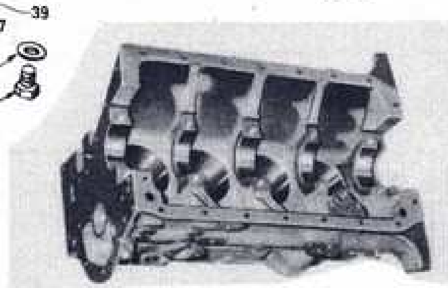
PISTON

Material	LO-EX Aluminum Alloy
Diameter of piston skirt:	Measured at right angles to the piston pin.

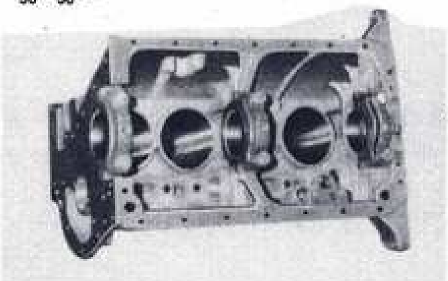
Standard size (12010-14611)					
	1	2	3	4	5
R Engine	79.975 79.966mm	79.985 79.976mm	79.995 79.986mm	80.005 79.996mm	80.015 80.006mm

Over size avilable (12010-14613 → 12010-14618)	0.010, 0.020, 0.030, 0.040, 0.050, 0.060 ins. (0.25) 0.50, 0.75, 1.00, 1.25, 1.50 mm
Clearance: Cyld. wall and piston	0.025-0.043 mm, 0.001-0.0017 in.
Checking by feeler gauge	1-2 kg. with 0.04mm feeler gauge (2.2-4.4 lbs. with 0.0015 in. feeler gauge)
Allowable difference of gross weight with connecting rod	Within 5 gram





5 main bearing

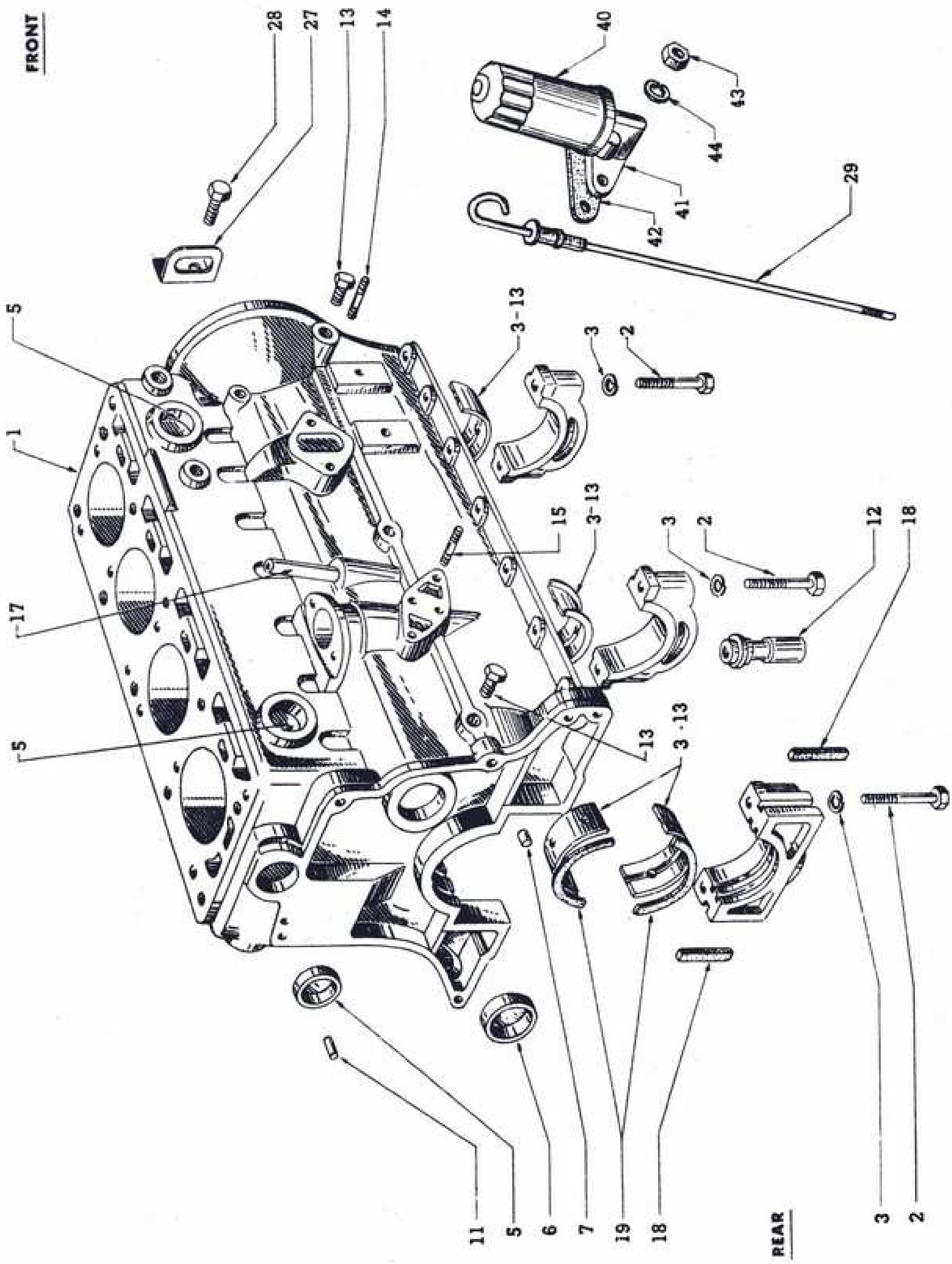


3 main bearing

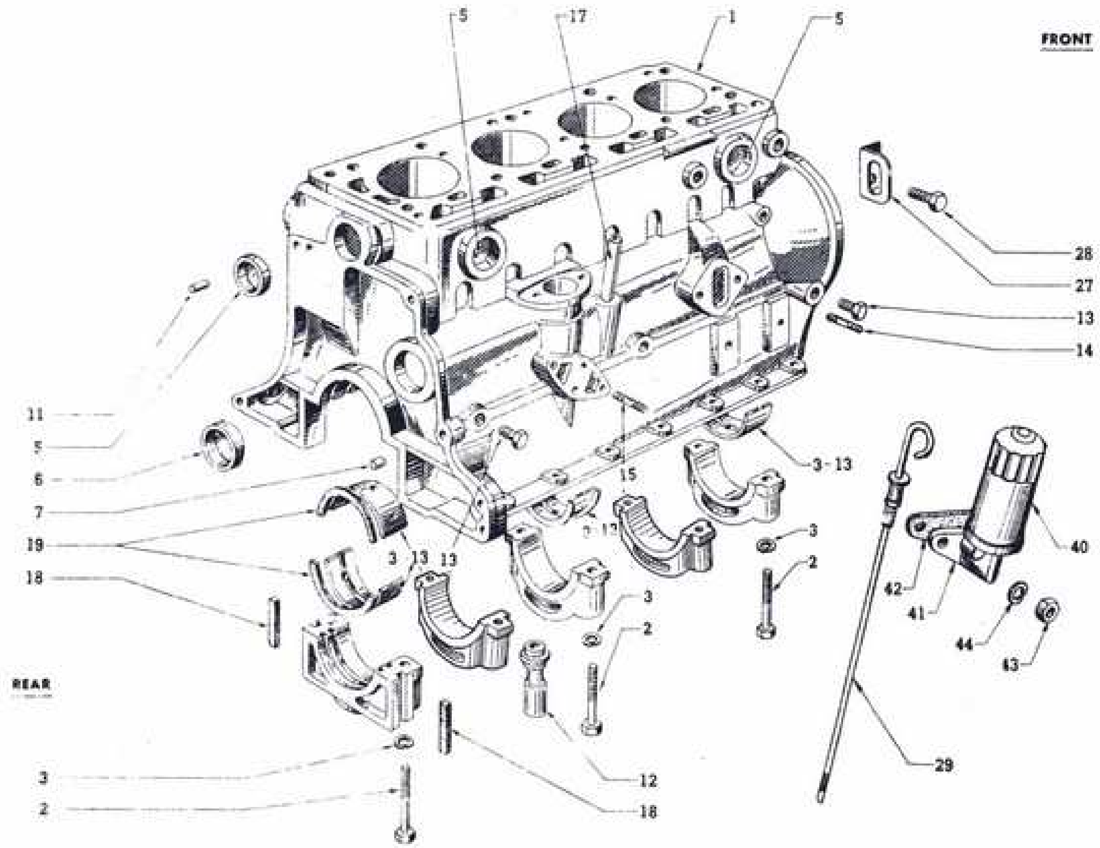
3 main bearing	5 main bearing
E/# ~ 40000	E/# 40001 ~
11010-74000	11010-74700

1. Ass'y-block, cylinder
4. Set-bush, camshaft (standard size)
5. Plug-welch (35ϕ)
7. Plug-crank case oil gallary
8. Plug-blind (6.5ϕ)
9. Jet-oil, chain tensioner
10. Dowel-timing chain case
16. Stud (fixing water pump)
20. Plate-engine, rear
21. Ass'y-cover, timing chain
22. Plate-tapping, timing chain cover
23. Seal-oil, timing chain cover
24. Gasket-timing chain cover
25. Bolt
26. Washer-lock
30. Plug-drain
31. Plug-welch
32. Ass'y-oil pan
33. Plug-drain
34. Washer-drain plug
35. Gasket-oil pan
36. Bolt
37. Bolt
38. Bolt
39. Washer-lock

CYLINDER BLOCK(A)



CYLINDER BLOCK(B)



1. Ass'y-block, cylinder
2. Bolt } to fix bearing cap
3. Washer-lock } to fix bearing cap
5. Plug-welch (35o)
6. Plug-taper (44.425o)
7. Plug-crank case oil gallery
11. Dowel
12. Bush-driving spindle oil pump
13. Plug-thread (oil gallery)
14. Stud (fixing fuel pump)
15. Stud (fixing oil filter)
17. Guide-oil level gauge
18. Seal-oil, rear bearing cap side
19. Seal-oil, crank shaft rear end
27. Slinger-engine front
28. Bolt
29. Ass'y-gauge, oil level
40. Ass'y-element, oil filter
41. Ass'y-bracket, oil filter
42. Gasket-oil filter
43. Nut } to fix oil filter bracket to cylinder block
44. Washer-lock } to fix oil filter bracket to cylinder block

CYLINDER BLOCK (C)

PISTON PIN

Type	Full floating (Snap rings at both end of pin in piston)	
Pin fit (to piston pin hole)	Thumb fit at 30° - 40°C, 86° - 104°F	
Diameter	21.987 - 22.000 mm	0.8657 - 0.8661 in.
Length	73 mm	2.874 in.
Fit clearance (pin and connecting rod)	TIGHT 0.01 mm LOOSE 0.018 mm	TIGHT 0.0004 in. LOOSE 0.0007 in.

PISTON AND BORES

There should be a clearance of 0.0010-0.0016 in. (0.025-0.040 mm.)

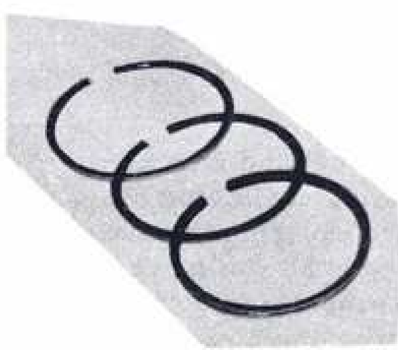
PISTON RINGS

The top piston ring gap should be 0.010-0.016 in. (0.25-0.40 mm.) when checked in the cylinder bore. The clearance of the second and oil control compression rings in their grooves should amount to 0.006-0.012 in. (0.15-0.30 mm).

If the piston rings do not travel to the end of the cylinder bores a "lip" is eventually formed due to wear. This may be checked with a dial gauge and must be removed. If this is not done there will be a tendency to noicy operation or a fractured ring, caused by the top piston ring striking the lip. Piston and rings are available in. 0.010 in. (0.254 mm.) 0.020 in. (0.508 mm.) 0.030 in. (0.762 mm.) 0.040 in. (1.016 mm.) and 0.050 in. (1.270 mm.), oversizes.

The piston rings should always be fitted from the crown of the piston and never pushed upwards over the skirt. Before fitting the rings, remove any carbon deposit from the grooves in the piston.

When fitting, note that the second compression is tapered type and oil control ring is slot type processed by chromium plating.



Withdrawing Camshaft

The camshaft is positioned by a locating plate held by three screws and shakeproof washers. Note the position of the small lubricating oil hole in the locating plate when replacing should be to the right of the engine.

End.play of 0.08-0.28 mm (0.003-0.011 in) is controlled by the thickness of the locating plate, and can be checked with a dial indicator set against the camshaft gear.

Before withdrawing the camshaft the distributor and its driving spindle push rods, will have to be removed. Remove the oil pump and its drive shaft, and take off the timing cover and gears. The engine front mounting plate is now accessible and may be removed by withdrawing the setscrew and locking plates. The dynamo swinging link must be removed.

Take out the setscrews securing the camshaft locating plate, when the camshaft can be withdrawn from the cylinder block.

CAMSHAFT BEARINGS

White metal bearings, with steel lining are used for the camshaft. They can be taken out renewed when necessary, it being usual to do this when the cylinder block is being reconditioned.

The bearings can be removed by drifing them out of their housings.

When fitting new bearings care must be taken to line up the oil holes with the corresponding holes in the cylinder block.

Tap the new bearings into position and ream them to give a running clearance of 0.001-0.002 in. (0.025-0.051 mm.)

Refitting the Camshaft

This is a reversal of the intructions for removal. Care should be taken however, to align and engage the drive pin in the rear end of the camshaft with the slot in the oil pump drive shaft.

Main Bearing Caps

Remove the flywheel and clutch.

Take off the timing chain, the oil pan and the engine rear plate. Unlock and remove the bolts securing the main bearing caps of the cylinder block, also the bolts securing the timing chain cover at front of cylinder block.

When fitting new bearings no scraping is required as they are machined to give the correct running clearance of 0.001-0.0027 in. (0.03-0.07 mm.).

Handle the new bearings carefully so as not to damage the fine surface finish.

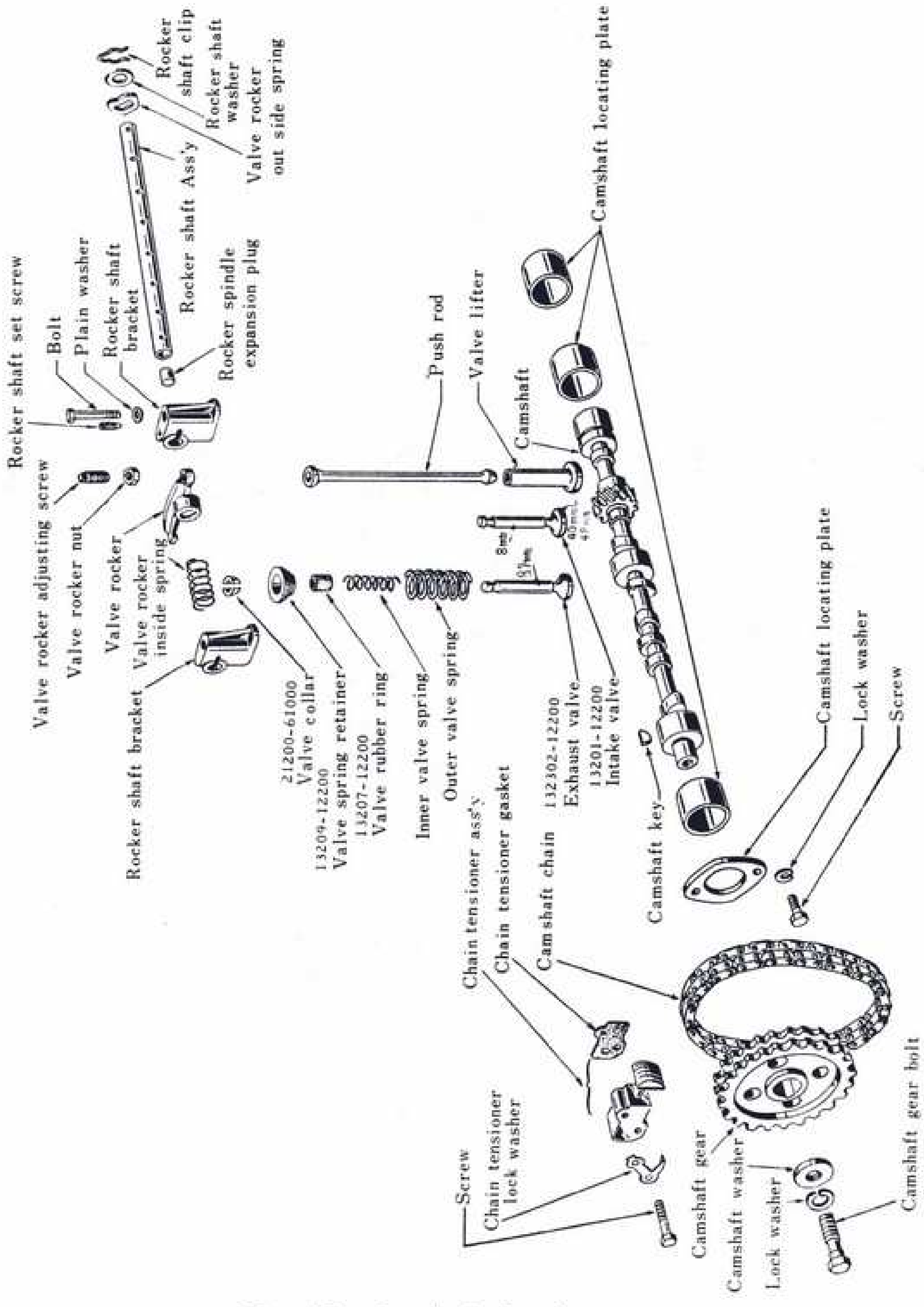
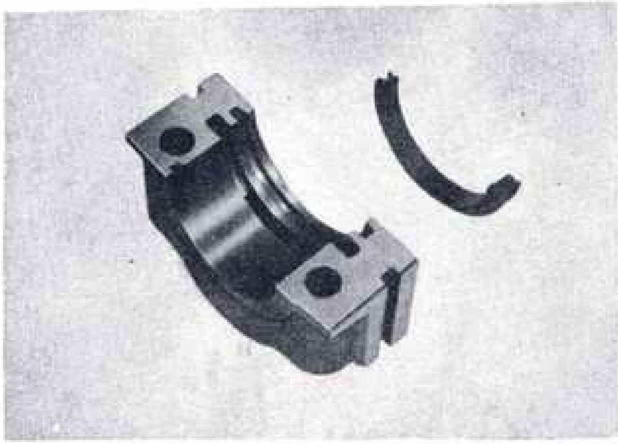
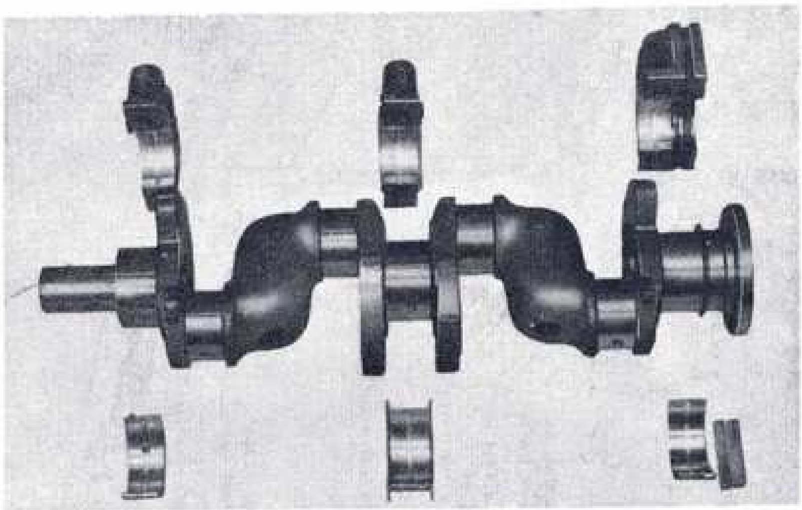


Fig. 10 Camshaft & valve gear

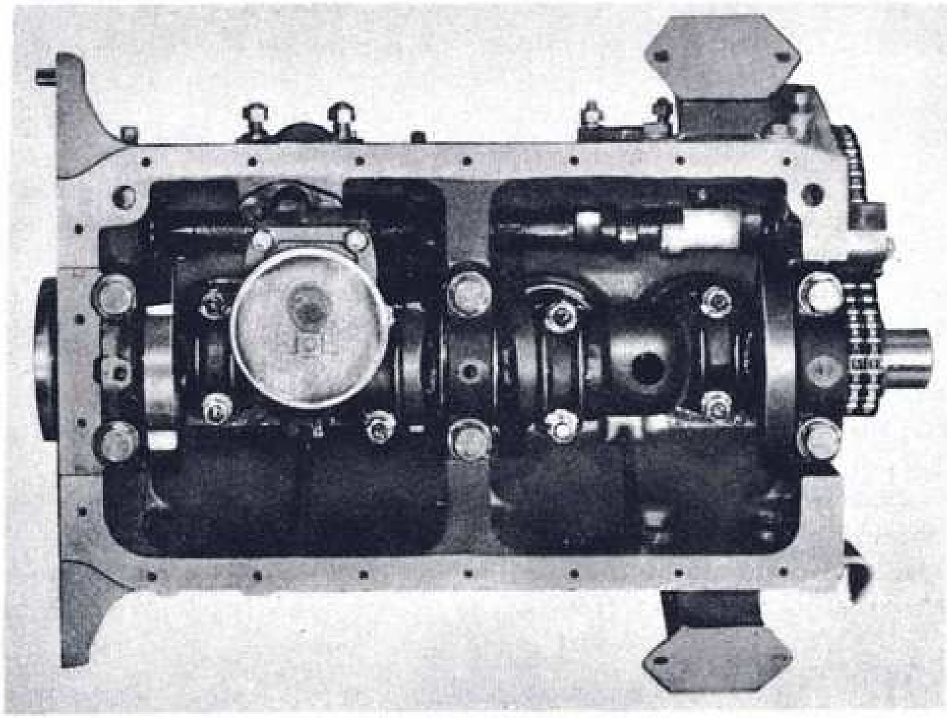


Remove all traces of dirt and oil from the housings and throughly dry them with a non-fluffy rag. Make sure that the oil ways are clear. When fitting the bearing caps ensure that they are replaced the right-way round. Each cap is marked, and the marks should face the camshaft side of the engine.

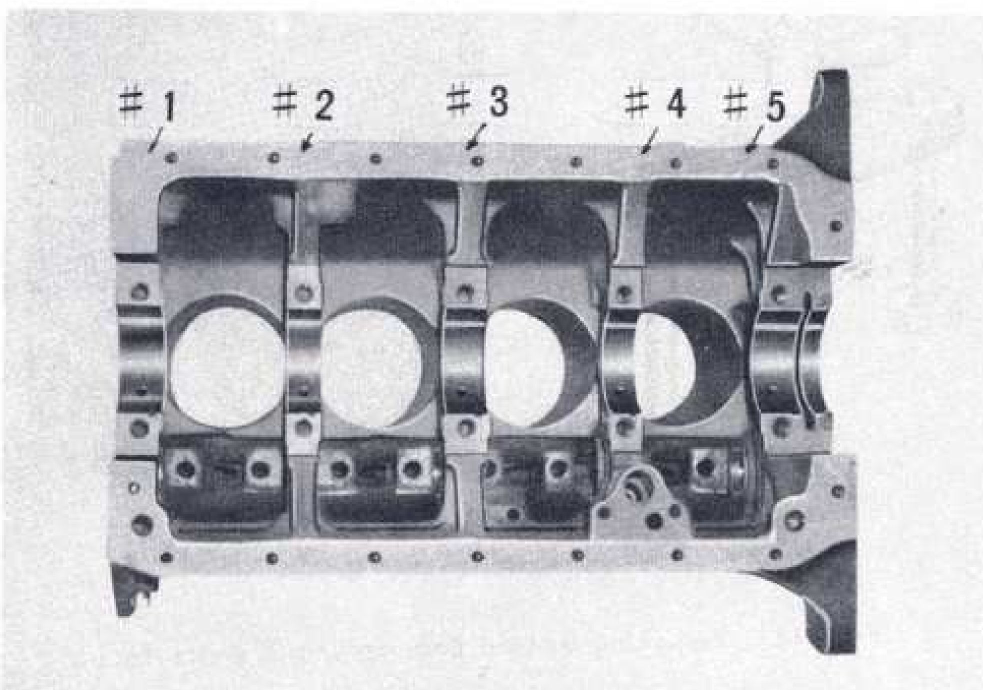


Crank shaft for 3 bearing

Crank shaft for 5 bearing



3 main bearing ribs



5 main bearing ribs

CAUTION

Never file the bearing caps to take up excessive play as this will cause ovality.

Always cover the bearing surfaces with engine oil when they are replaced.

Do not forget to refit the thrust washer. The main bearing caps are held in position by set screws and lock washers. Pull the set-screw up tight with a torque wrench set to a loading of 75-80 lbs. /ft(10. 36-11. 05 kgm.).

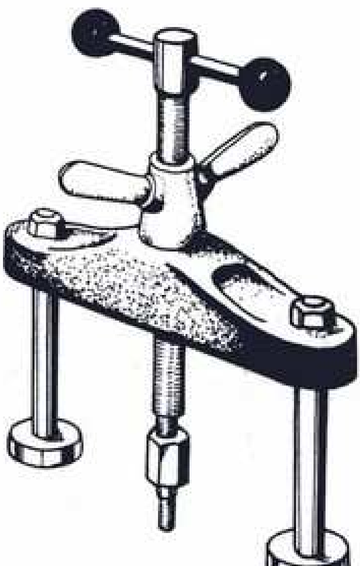
When refitting the main bearing caps tighten the center one first. After each cap is tighten rotate the crankshaft to ascertain that it revolues freely.

If it is tight remove the last cap tightened, and examine the bearing and its seating for foreign matter.

Check the crankshaft end play by means of a dial gauge. This should be 0. 002 in-0. 006 in(0. 05 mm-0. 15 mm).

If a bearing has "run", it is essential to clean out all oilways in the crankshaft and block. Wash out the engine sump and the strainer.

The oil pump should be dismantled and cleaned. Ensure that no particles of bearing, metal are left within the engine lubrication system.



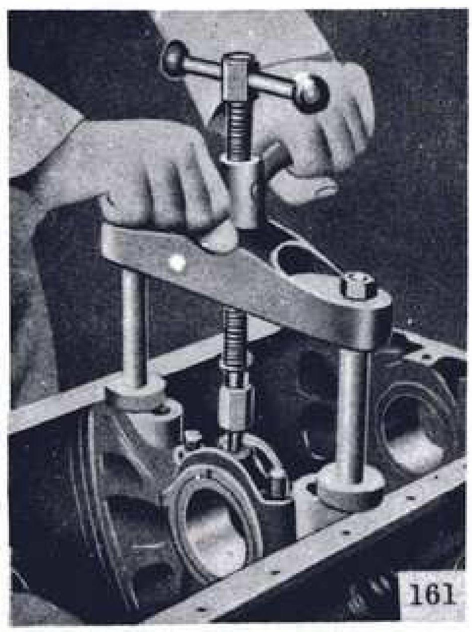


Fig. 14 Removing a Main Bearing Cap & Extractor

Adjusting the Breaker Points

To adjust the breaker points, turn the engine crankshaft with the crank handle until the breaker is fully open. Then loosen the breaker point fixing screw. Next, by turning the adjusting screw, move the plate until a feeler gauge of 0.45 to 0.55 mm. (0.018 to 0.022 ins.) thickness slides easily between the breaker points. Then tighten the fixing screw securely.

Finally, check the gap once more, then reinstall thr rotor. The interior and exterior of the cap is wiped clean with a soft, dry piece of cloth, extra attention being paid to the areas between the terminals. Clean the center electrode on the inside of the cap also.

The vacuum type timing advancer is functioning properly, can be determined by the inspection pointer located at the diaphragm if, as the engine is being run, this pointer moves when the engine speed is suddenly changed, the advancer is satisfactory.

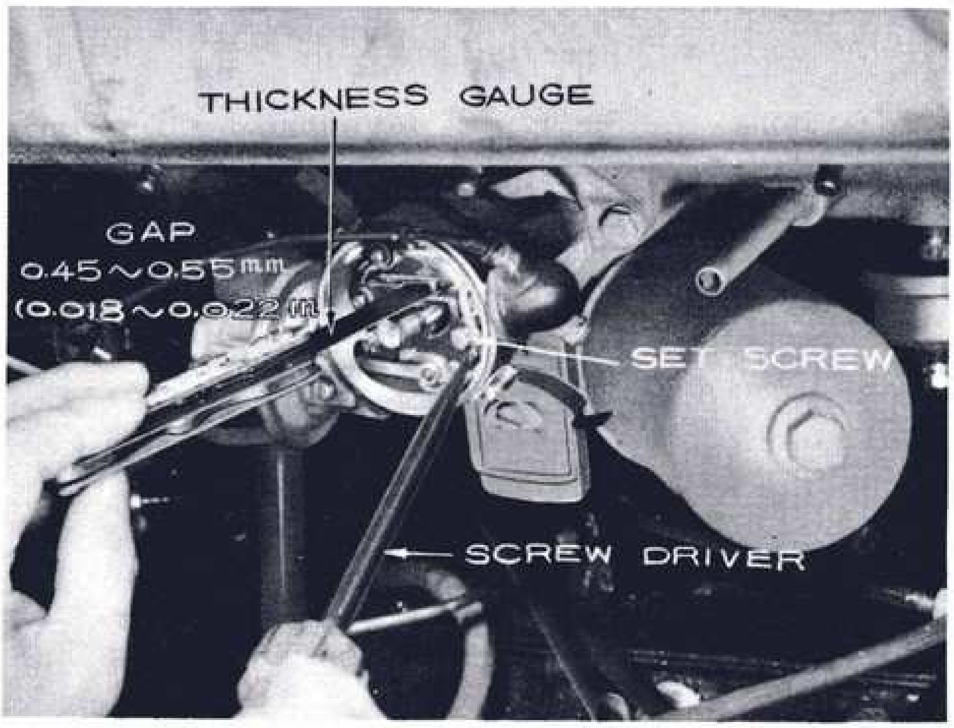


Fig. 15 Adjusting the Point Gap

ADJUSTING THE IGNITION TIMING

The ignition timing is adjusted to 10 degrees before top dead center with the engine stopped as shown in Fig.   With this adjustment, the automatic timing advancer of the distributor advances the ignition timing even further at the time the engine starts to rotate, and the timing is maintained constantly at valves suitable for the rotational speed.

With the engine stopped, adjust so that the distributor breaker point just breaks when the piston of the No. 1 cylinder is in its 10 degrees before top dead center position for compression. If a timing lamp is used, the standard ignition timing is 16 degrees before top dead center at idling (600 rpm) speed.

In the case of marks which are not evenly spaced, pointers indicate 10 deg., 15 deg. and 20 deg., positions before top dead center.

DISTRIBUTOR

Type	D407-51
Ignition timing (Idling)	B.T.D.C. 16° with timing light, engine 600 rpm
	(Adjust timing angle by the kinds of gasoline octane value.)
Ignition timing advance	Automatic advance by the centrifugal weight and vacuum timing control.
Automatic advance	Governor start advance at 400-550 rpm Maximum advance angle 14° - 16° at 1800 rpm
Vacuum advance	Start advance at 4.7-5.5 in.(120-140mm)Hg. Maximum advance angle at crank shaft 9-12° at 12.6 in. (320 mm) Hg.
Firing order	1 3 4 2
Point gap	0.45-0.55 mm 0.018-0.022 in. 50°-54° Hitachi, 56°-61° Mitsubishi
Contact arm spring tension	500-650 gram 18.6-23 oz.
Capacity of condenser	0.20-0.24 mfd. 0.20-0.24 mfd.

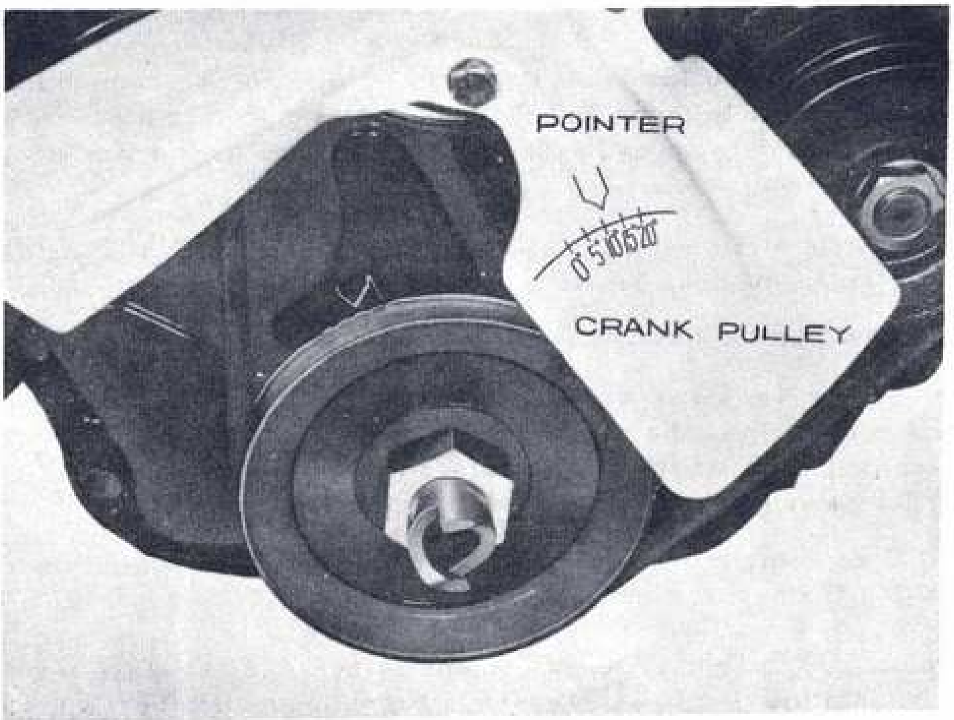


Fig. 1 Checking the Ignition timing

Adjustment is made by the following procedure.

1. First adjust the distributer to the correct gap as described previously.

2. Turn the crankshaft gradually until the top dead center mark (Fig. 1) on the pulley perifery coincides with the mark for 12 deg. before top dead center on the timing gear cover as the crankshaft approaches its position somewhat before that corresponding to the end of the compression stroke of the No. 1 piston. Stop the crankshaft in this position. The compression stroke of the No. 1 piston can be determined if the spark of the No. 1 cylinder is removed, the hole plugged with a finger, and the crankshaft turned. With the crankshaft in the previously mentioned position, the No. 1 piston is in its position of 10 deg. before top dead center of compression.

3. Next, inserting the driving shaft of the distributor at an angle to the engine, engage the gear on its lower and with the gear on the camshaft. During this assembly place the slot of the distributor drive of the upper end of the shaft somewhat to the left. At this time, the smaller of the semi-circles is placed toward the front.

4. Adjusting the direction of the rotor so that it engages the drive shaft slot, mount the distributor to the engine. At the same time, the breaker must be in its position when it is just begining to open. If these conditions do not coincide, they are made to do so by

slightly turning the distributor body only. To determine the position when the breaker point is just begining to open, turn on the ignition key; hold the end of the No. 1 spark cord about 1/4 inch away from the cylinder head; and turn the body until spark jumps across the gap.

The off-set slot position of the drive shaft when the No. 1 piston is in its compression top dead center position is shown here.

5. Next put the distributor cap on and clamp it securely with the clip.

6. To the No. 1 spark plug connect the cord from the terminal to which the arm of the rotor is pointing. Thereafter connect the terminal cords to their spark plugs in the counter-clock-wise order so as to obtain a 1-3-4-2 firing order.

7. Upon completion of the wiring, cover the distributor with a rubber cap. The engine should now start properly.

Ordinarily, the pointer of the octane selector is set at its zero reading during the ignition timing adjustment. If the octane number of the fuel being used is low and the engine knocks, the pointer is adjusted to the right(R) to the optimum advance angle. Conversely, if the octane number is high the pointer is adjusted to the left (A). One unit of calibration of the selector corresponds to 2 deg. of the distributor angle and to 4 deg. of the crankshaft angle.

When a timing lamp is used, the standard setting is 12 deg. before top dead center with the engine idling (600 -620). In any case, the optimum adjustment is that in which a slight knocking is heard when, with the car running at low speed in "HIGH" (TOP) gear, acceleration is applied suddenly.

FUEL SYSTEM

The fuel tank has a capacity of 43 litres and is situated at the rear of the luggage compartment.

The fuel pump, operated off the camshaft draws fuel from the tank and forces it into the carburetor float chamber. A large and efficient air cleaner filters the air supply to the carburetor.

FUEL SYSTEM

GASOLINE TANK

Capacity	43 ltr	(12 US. Gal)

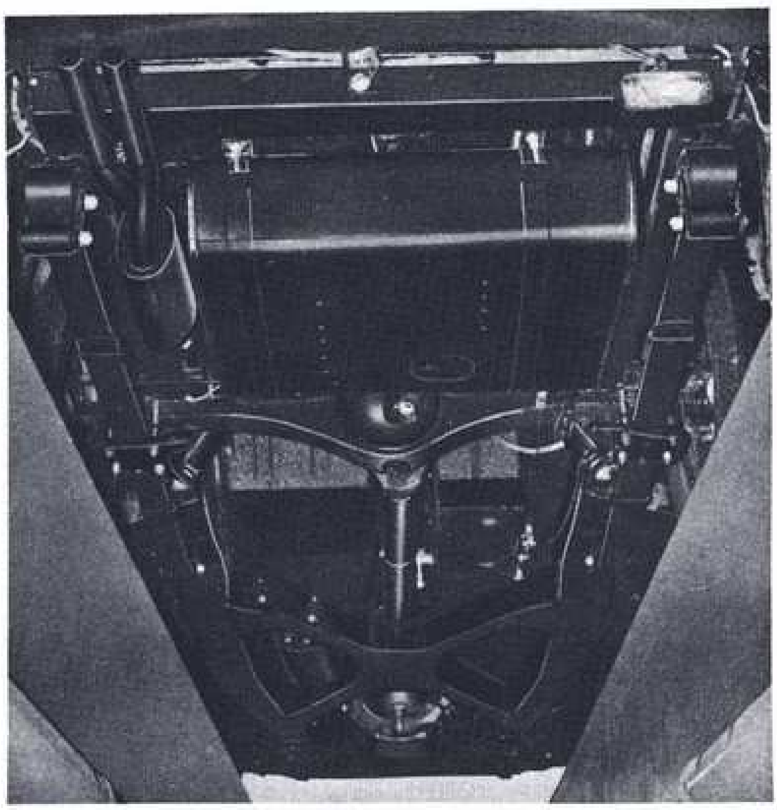


Fig. 1

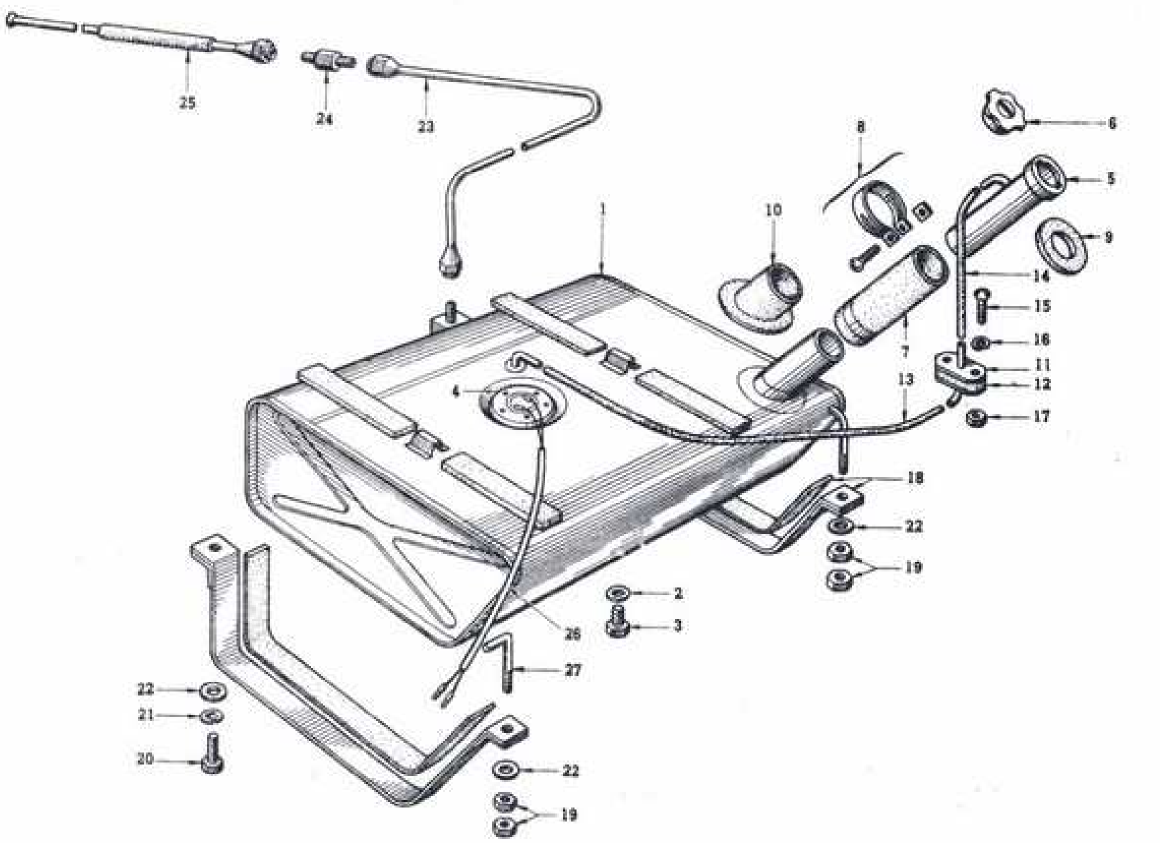


Fig. 2 Fuel tank (43 ℓ)

1. Ass'y-tank, fuel
2. Gasket-drain seat
3. Plug-drain, fuel tank
4. Gauge-unit, fuel tank
5. Ass'y-tube, inlet, fuel tank
6. Ass'y-cap, filler
7. Hose-fuel tank (inlet tube to filler)
8. Clamp-hose
9. Grommet-rubber
10. Grommet-rubber
11. Ass'y-tube, ventilation, middle
12. Packing-ventilation tube
13. Hose-ventilation tube, lower
14. Hose-ventilation tube, upper
15. Screw
16. Washer-lock
17. Nut
18. Ass'y-band, fuel tank mounting
19. Nut
20. Bolt
21. Washer-lock
22. Washer-plain
23. Tube-fuel tank to connector
24. Connector
25. Tube-connector to strainer
26. Ass'y-cable, fuel tank gauge unit
27. Bolt-band, gas tank

Situated on the top face of the tank is the gauge unit. To remove, withdraw the set screws which secure the unit to the tank not foregetting to disconnect the electrical lead beforehand. Care must be taken not to strain or bend the float lever as this may seriously effect subsequent gauge readings. Remember this also applies when refitting the unit.

Examine the joint washer to ensure that it is in position and undamage. This is essential as the joint between the tank and gauge unit must be fuel tight.

When Gasoline Fails to Reach Gasoline Strainer

If the fuel fails to reach the gasoline strainer when there is some fuel left in the gasoline tank and the operaticn of fuel pump is known to be satisfactory, check the following points.

(When it is difficult to confirm the delivery of fuel at the strainer, loosen the connector at the fuel intake of the carburetor.)

(1) Check to see if gasoline pipe is clogged with dust and dirt. This can be easily checked by disconnecting the connector of the pipe and blowing with compressed air toward the direction of the tank. Then from the tank end blow the pipe again and clean the pipe.

In many cases the tip of gasoline intake pipe of tank unit is clogged with dust and water.

Therefore, together with cleaning of the pipe, the interior of the tank should be cleaned by removing the drain plug at the bottom of the tank.

Check to see if the gasoline pipe of the tank unit is so bent as to fail to reach the fuel surface.

The standard position of the bottom end of the pipe is about 3/4 in. apart from the bottom in order to prevent its sucking up sediments on the tank bottom.

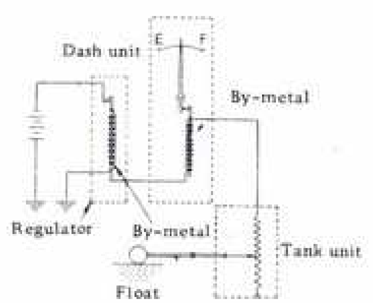


Fig. 3
Wiring of fuel gauge

If not normal, remove tank unit and adjust the bend of the pipe.

Check to see if the vent hole of the filler cap is clogged with dust and dirt, not supplying air to the tank.

According to the degree of vacuum within the tank, fuel cannot be drawn up even by the operation of fuel pump.

So be sure to clean the air vent of the cap.

If you should lose the cap and substitute a wooden plug for it, a measure which is sometimes witnessed, the condition inside of the tank becomes the same as though it were sealed up. Always use only the standard cap.

Operation and Repairs Fuel Gauge

As shown in Fig. 3, the fuel gauge consists of the dash unit and tank unit.

The dash unit, which is installed on the instrument panel, has two by-metal, that magnetic forces control the movement of a keeper (iron piece) with a hand (indicator).

On the tank unit, a contact arm slides over a resistance in response to the float level.

As shown in Fig. 3 if the ignition switch is turned on when the tank is empty, electic current will flow from the battery through the ammeter into tank unit, and then through the contact arm to the ground.

The coil is then magnetized, attracts the iron piece, and the indicator points to Empty.

As the float is raised and the contact arm moves, tank unit increases resistance in the circuit and thus the current which traveled through coil then flows, this time, both contact arm and coil, and finally to the ground.

The magnetic power of the coil can be balanced, with the indicator deflecting in the direction of Full.

Troubles with Fuel Gauge and their Remedies

When something is wrong with the readings of the fuel gauge, first disconnect the wiring at the unit and, turning on the ignition switch, ground and unground the terminal end of the said wiring to the body of the car.

If the indicator of the dash unit swings slowly between E and F, the wiring between the dash unit and the said terminal end is in good condition, with the defect existing either in tank unit itself or in poor ground of this unit.

In the test mentioned in the preceeding section, if the indicator does not swing but it moves (moves to E) when the dash unit end of the wiring from the tank unit is grounded, the wiring between the dash unit and tank unit is defective.

Therefore rewiring or repairing is required.

If, when indicator fails to swing but sparking is observed when the wiring connecting the battery with the terminal on the dash unit is disconnected at the dash unit end and grounded, it proves the wiring is satisfactory, and the trouble is in the dash unit itself.

If sparking does not occur, the wiring, which is thus indicated to be out of order, should be repaired or replaced.

Incorrect readings of the indicator probably means that the height of the float of the tank unit is in error.

In this case, adjust the height of the float by bending the rod.

Trouble with the unit are difficult to repair so it should be replaced by a new unit.

In checking the tank unit, be sure to insert a fuel gauge in the circuit between the battery and the unit.

TWIN CARBURETOR(HJB38W TYPE)

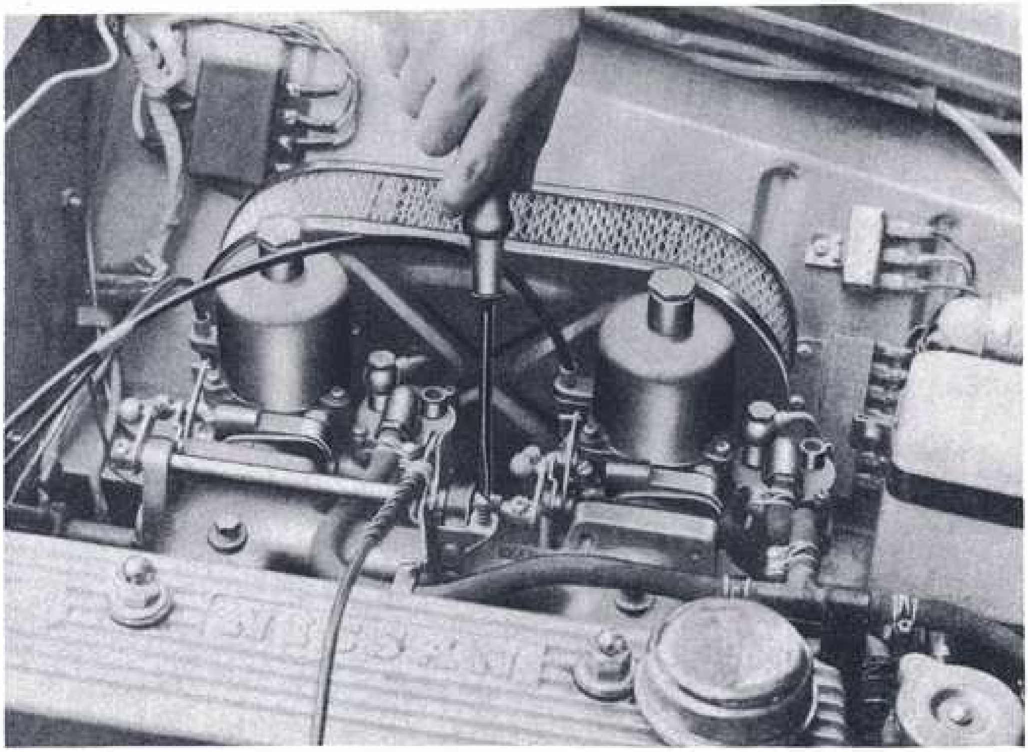


Fig. 1

1 STRUCTURE AND FUNCTION

Float Chamber

Fuel sent from the fuel pump gets into the float chamber passing through the needle valve. The fuel in the float chamber always keeps a constant level by operation of the needle valve and the float. The needle valve is made of special steel with high hardness and endures long time use without wear.

Venturi Control System

The suction chamber is installed on the upper side of the throttle chamber, in which the suction piston operates vertically.

On the top of the suction piston, load of the venturi down flow is transmitted through the suction hole and the underside of it passes to the open air through the air hole and the air cleaner.

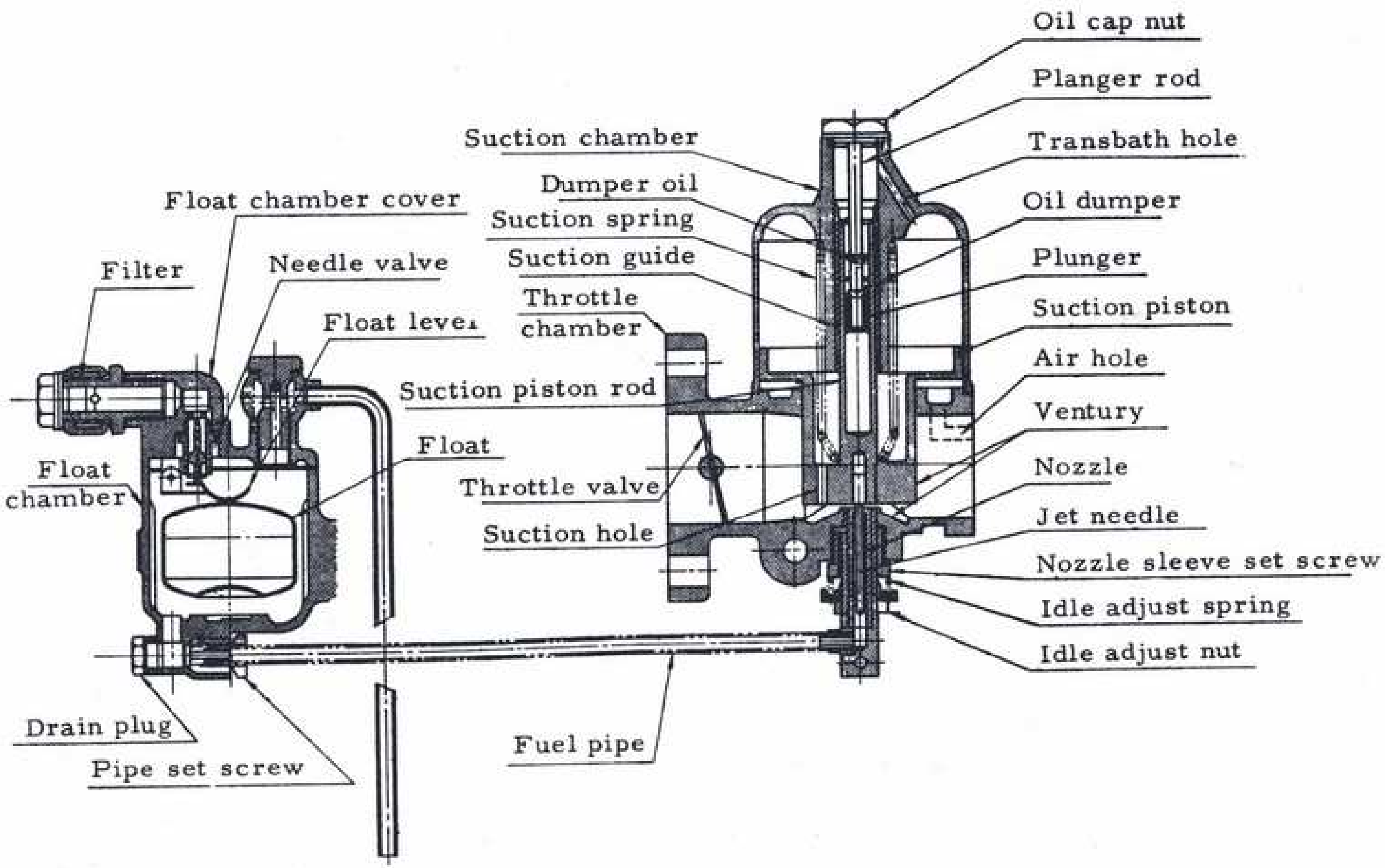


Fig. 2 Sectional View of Carburetor

The suction piston automatically makes vertical movement by the balance of the load works on the top and weight of it and strength of the suction spring.

When the throttle valve is widely opened and much air is sucked in, the load on the top of the suction piston increases and makes the venturi wedely open. When the air is little, the load is small, then the venturi also opens little.

Weight of the suction piston and strength of the suction spring are selected so as the venturi opening will meet with any running conditions of the engine.

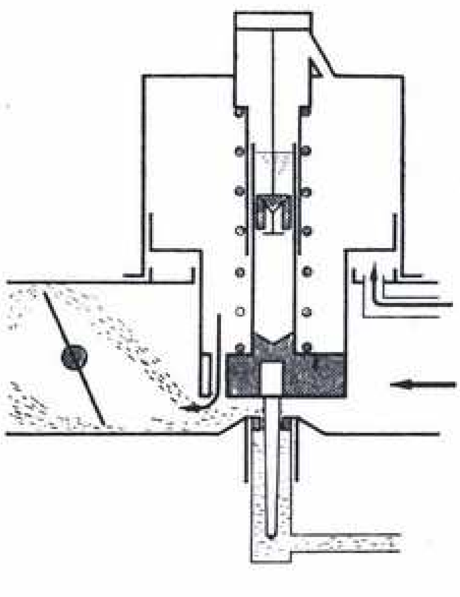
In order to heighten acceleration, the oil damper is provided within the suction piston rod and prevents the piston from an abrupt opening.

Fuel Measuring System

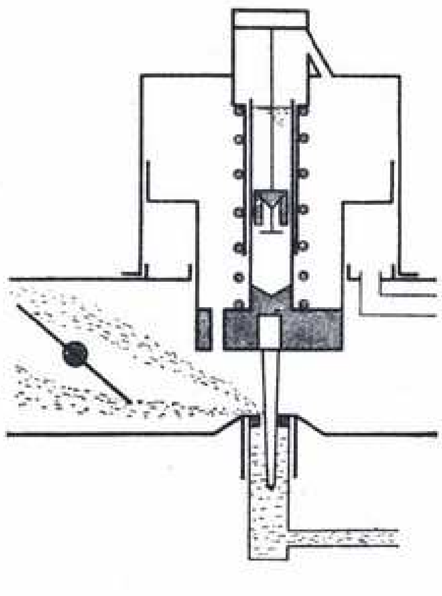
Fuel sent from the float chamber spouts into the venturi through the gap between the nozzle and the jet needle by the pressure generated at the venturi.

The jet needle is installed underside the suction piston amd moves vertically in the nozzle together with the suction piston. The jet needle is tapered so that the gap between the nozzle and the jet needle varies and automatically changes flow of fuel. Form of the jet needle is determined so as to satisfy every condition of movement.

Operation of the suction piston and measurement of fuel at each condition, idling through full open, high speed are shown below.



Low speed operation



Medium low speed operation

Fig. 3

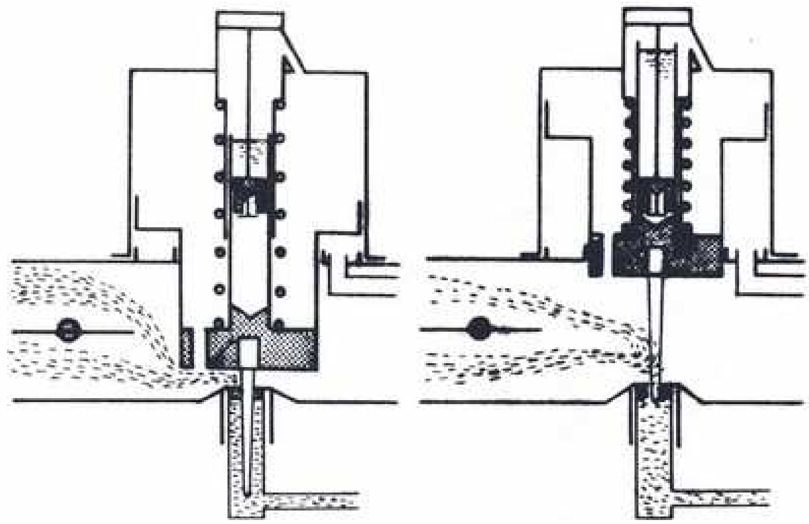


Fig. 4

Full open low speed operation. Full open high speed operation

Starting Device

When the choke button is pulled out, the starter lever moves and pulls down the nozzle, then the gap between the nozzle and the jet needle is opened widely and dense fuel flows in. The throttle valve opens automatically about 6° with the synchronized linkage.

2 ADJUSTMENT AND HANDLING

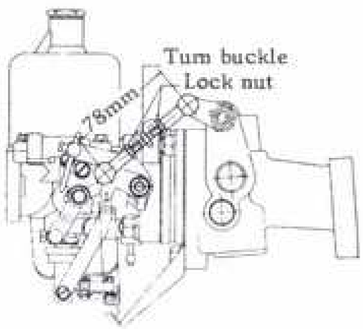
Adjustment of Linkage Movement of Throttle Shaft and Full Close of Throttle Valve

As 2ea of the carburetor are used in parallel, when full close of the throttle valves are not in accord, this will affect on consumption of fuel. The throttle shaft on the front side in the forward direction (Front side) and that on the back side (Rear side) drive at the same time with the auxiliary shaft provided on the engine side. The throttle shaft has the throttle lever respectively and is connected with the lever of auxiliary shaft with the connecting rod.

(1) To adjust full close of the throttle valves of the carburetors on Front and Rear sides, release completely the throttle adjust screws on both sides making them free of the stopper and change length of the connecting rod for the auxiliary shaft on one side.

(2) Fix the con. rod on the Rear side at 70mm with the lock nut. (Over all length 86 +0mm, -2mm).

(3) Turn the turn buckle of the con. rod on the Front side and adjust length of the con. rod on the Front side so as the throttle valves on both sides are in full close.
(4) When the throttle valves on Front and Rear sides are in full close, load upon the turn buckle disappears, which can be felt by the hand, When the con. rod on the Front side is too long and the return spring on the Rear side is too short, the return spring on the Front side works, this can be felt on the turn buckle.
(5) When full close adjustment has been finished on both sides, fix the turn buckle on the Front side with the lock nut.
(6) Connect the throttle wire with the drum.



Adjustment of Idle

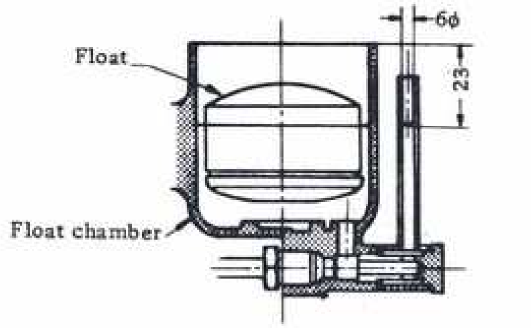
Slow adjustment is conducted with the throttle adjust screw and the idle adjust nut after the engine has been warmed up.

(1) Tighten completely the idle adjust nuts of the carburetors on the Front and Rear sides, then return three turns and tighten 2-3 turns the throttle adjust screw of the carburetor on the Front side and make starting. Release the throttle adjust screw of the carburetor on the Rear side so as the end of it is free from the stopper and do not move it till the last.
(2) Return the throttle adjust screw slowly, then the engine revolution slows gradually down and stop it just before the engine revolution becomes stagnant.
(3) After that, release or retighten the idle adjust nuts of the carburetors on the Front and Rear sides the same turns and stop them when the engine revolution is the most speedy and smooth.
(4) Further return the throttle adjust screw of the Front side carburetor and slow down revolution, then the stable idling driving can be obtained.
(5) At last, tighten the throttle adjust screw of the Rear side carburetor until its end makes contact with the stopper. Becareful not to screw in too much and further open the throttle valve. Adjustment of idling will affect consumption of fuel and acceleration.

Adjustment of Float Level

To measure the float level, remove the drain plug and insert the level gauge with the inside diameter 6mm and conduct idling driving. If the fuel level shown on the glass tube stands at 22 ~ 24mm from the top of the float chamber, it is the normal level.

When the level gauge is not available the following steps are taken for adjustment.



Measuring float level

(1) Remove 4 ea of the set screw of the float chamber cover, the float chamber cover and the float lever can be removed together. Put the float chamber cover on a stand with the float lever upside.

(2) Push up the float lever with the finger and slowly down and stop it when the float lever seat just contact with the valve stem.

(3) In this case, dimension (H) between the contact point of the float lever and float and the fitting point of the float chamber cover is to be 14 ~ 15mm as the standard.

(4) When the dimension is not right, bend the point shown in the figure for adjustment.

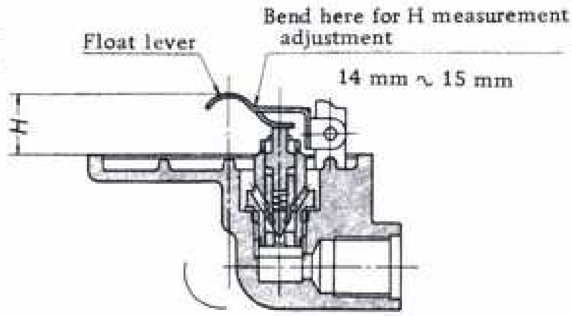
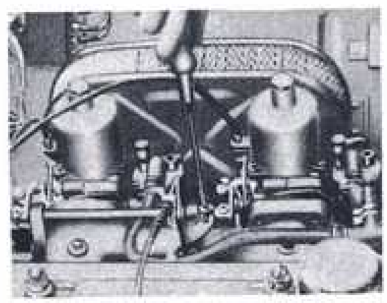
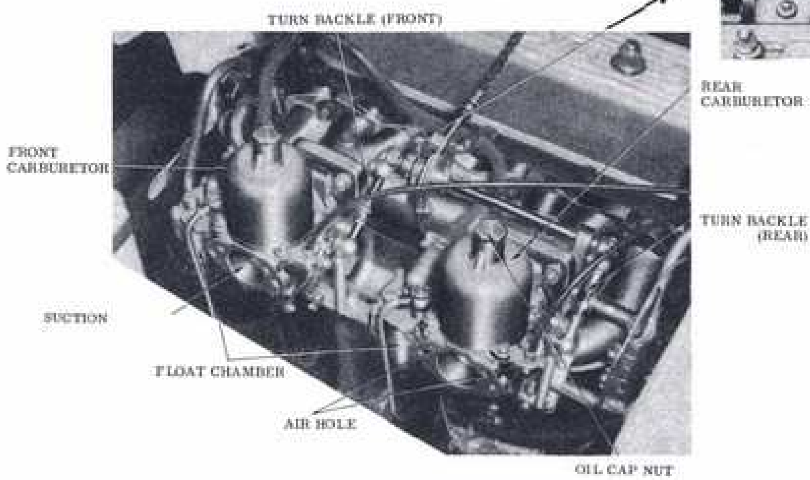


Fig. 5 Adjusting float level

Adjustment of Starting Linkage Opening (Refer to the Figure)



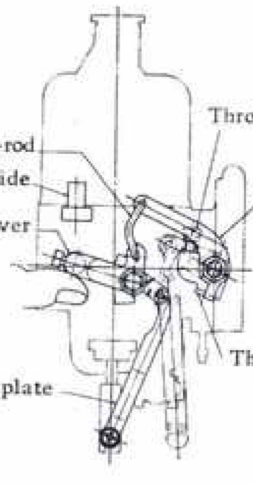


IDLING ADJUST SCREW FOR THE DUAL CARBURETORS

Fig. 6 Adjustment for Openning degree at connecting

Pull the choke button, then the starter lever moves and the nozzle is pulled down, while the throttle valve automatically opens with linkage at around 6°, the most suitable opening for starting.

When resetting, fit the line marked on the con. rod (c) to the arrow marked on the 1st idle lever post, then the starting linkage opening can be adjusted.



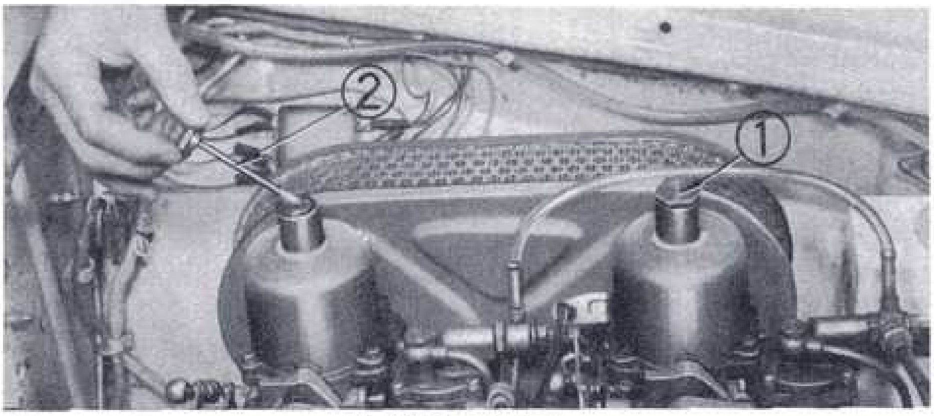
Inspection of Damper Oil

When the carburetor is installed to the engine or the engine is overhauled, check the damper oil without fail and add it if necessary.

If the damper oil is short, this affects acceleration and other movements, so that periodical inspection, every 2 ~ 3 months or about 3,000 km, is necessary and add it when necessary.

To add the oil, remove the oil cap nut. Use the motor oil SAE #20 as the damper oil. Do not use those #30 up.

To check the damper oil level, remove the oil cap nut and if the oil level stands at 5mm or more from the grooves on the plunger rod, it is normal, however if the level is lower, add the oil. Be careful not to bend the rod when the oil cap nut is removed.



1. Oil cap nut
2. Plunger rod

Fig. 7 Inspecting damper oil

Periodical Inspection of Suction Chamber and Suction Piston

For normal operation of the suction piston to control the venturi area, it is necessary to conduct periodical maintenance for the suction piston and the suction chamber, as dust in the air is sucked in to some extent and accumulated on the piston.

To check movement of the suction piston without removing it from the engine, the following steps are taken.

(1) Remove the oil cap nut.

(2) Push up the lifter with the finger, the end of lifter will make contact with the underside of larger diameter of the suction piston at about 1.5mm. Push up the lifter further, it will make a stop with the stopper.

(3) When the lifter is free of the finger, it returns with load of the lifter spring, then the suction piston also comes down and the stop pin at its front end hits against the fixed side of the venturi. This is known by the sound.

If the piston moves smoothly up and down like that, it can be said to be in a good operative condition. This also assures that centering is good as explained in the following chapter.

To check bend of the plunger rod of oil cap nut, remove the air cleaner with the oil cap nut as it is, push up the suction piston by the finger and drop it freely. When push up, the finger will feel fairly heavily by action of the oil damper, but it will come down freely without action of the oil damper. If so, it can be said to be in a good condition. Conduct overhaul every 6 months.

3 DISASSEMBLY AND ASSEMBLY

The float chamber for HJB38 carburetor is of the same structure as ordinary carburetors, however, the venturi and fuel control systems are made up particularly of high precision parts, so that close attention must be paid for disassembly and assembly.

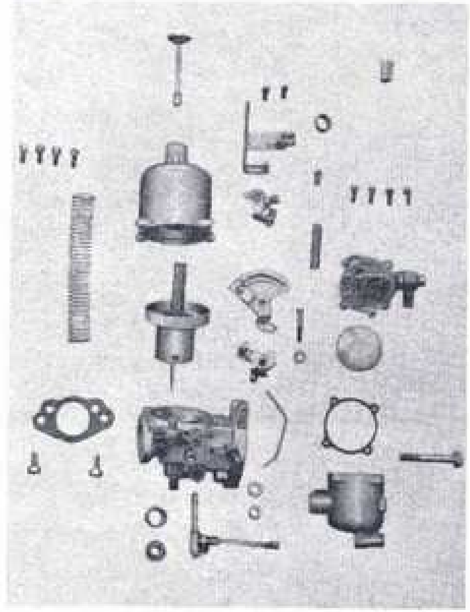


Fig. 8 Knock Down of Suction Piston & Suction Chamber

Disass'y and Ass'y of Suction Piston and Suction Chamber

(1) Remove 4 ea of the set screw and separte the suction chamber.

(2) Remove the suction spring, nylon packing and the suction piston from the inside.

(3) The removed suction chamber and suction piston must be put on clean cloth placed on the level top of a desk. Do no make scratches on the inside of suction chamber and on the outside diameter of the suction piston. Do not bend the jet needle underside the suction piston.

(4) Do not separate the jet needle out of the suction piston if possible. When it is necessary to disassemble unavoidably, loosen the jet needle set screw by using the pliers within 2mm from the shoulder of the jet needle taking care of not making scratches and slowly pull it out, twisting so as not to bend it.

(5) Incorrect setting of the jet needle in the suction piston results in malfunction of idling and other performances. Proper setting of the jet needle is as follows.
Set the jet needle so as its shoulder is on the same level with the underside of the suction piston small diameter as shown. Put a level plate at the small diameter and accord it to the shoulder of jet needle and fix the set screw.

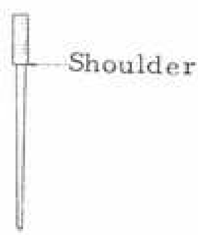


Fig. 9 Jet needle

(6) Clean the suction chamber and suction piston with fresh gasoline and flow them with air to eliminate oil and dust.

(7) When the suction chamber and suction piston have been cleaned, add 1 ~ 2 drops of thin oil to the piston rod and assemble them.
If oil sticks to the inside of suction chamber and the large diameter of suction piston, it will be the cause of trouble.

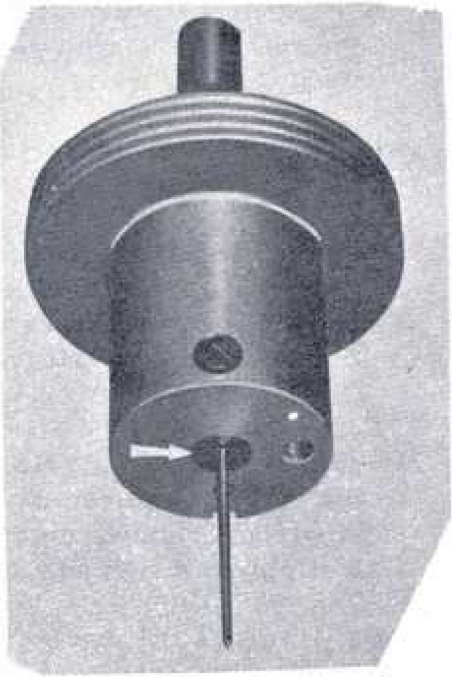


Fig. 10 Setting Jet Needle

Disassembly and Assembly of Nozzle

(1) Disassembly of Nozzle
Disassembly of the nozzle is simple, but the nozzle sleeve, washer and nozzle sleeve set screw are hard to reassemble, so that do not knock down these items of possible.

A. Remove the starter return spring and the pins, 4 ϕ and 5 ϕ (the con. rod is also removed for F side carburetor), and then the starter lever. Next, loosen the clip and remove the fuel pipe, then the nozzle can be taken off. In this case, every care must be taken not to injure or bend the jet needle remained.

B. Remove the idle adjust nut and idle adjust spring.

C. Remove the nozzle sleeve set screw and take off the washer and nozzle sleeve.
The fuel measuring jet of nozzle is the most important part of the carburetor and processing of the nole is carried on very prudently and strict inspection is conducted. Clean the nozzle with fresh gasoline and blow it with dry air.

(2) Reassembly of Nozzle

A. Set the suction piston and suction chamber first. Set the jet needle in the suction piston and remove the oil cap nut and do not add damper oil.

B. Insert the nozzle until it hits the nozzle sleeve, when close the suction piston in full up to the position the stop pin hits the fixed side venturi.

C. Move the nozzle sleeve and determine the postition of it so as the jet does not hit the jet needle.

D. In this state, push up the suction piston by the finger and drop it slowly. If the suction piston stop pin drops smoothly until it hits against the fixed side venturi with a slight sound, tighten the nozzle sleeve set screw somewhat firmly.

E. Remove the nozzle, set the idle adjust spring and idle adjust nut in the nozzle sleeve, then insert the nozzle, insert the fuel pipe connected with the float chamber to the nozzle nipple and tighten the clip in full. Be careful not to twist the fuel pipe and tighten the clip at the swollen part of the nipple.

F. Install the starter lever with the pins, 4ϕ and 5ϕ (the con. rod is also installed on the F side) and finally install the starter spring.

G. When assembly has been completed, make sure whether the suction piston drops smoothly.

(3) Disassembly of Float Chamber
Follow the order of disassembly described in the chapter, adjustment of float level.

(4) Disassembly and Assembly of Linkage
Do not deform each parts in processing. After the reassembly as the synchronized linkage is to operate smoothly.

4 INSTRUCTIONS FOR BALANCING TWIN HITACHI HJB-38-W VARIABLE VENTURI SIDE DRAFT CARBURETOR

Method Ⓐ

(1) Remove air cleaner.
(2) Disconnect throttle connections of both carburetors.
(3) On the front carburetor (nearest radiator) set idle screw so that tachometer reading is 500 RPM. If you do not have an instrument for balancing multiple carburetors, use a length of plastic hose, 1/2 inch diameter, and place at open horn of carburetor, and at your ear. Listen to sound of air entering carburetor.

(4) Move to second carburetor and follow same procedure of listening to air entering this carburetor. If the sound is exactly the same as the front carburetor, then they are synchronized. If not, then adjust the idle screw until they have the same sound.

(5) Now if reading of the tachometer has changed, you must move both idle screws until you have both carburetors hissing the same tone and the RPM is not more than 650.
You have now synchronized the throttle opening of dual carburetors.

(6) We will now proceed to adjust and synchronize the fuel flow of both carburetors. Start with the front carburetor adjustment.
With the engine running at 600 RPM, lift the piston of the back carburetor 1/2 inch. (This will make the carburetor inoperative.) If engine stalls, then you must richen the front carburetor until it will keep the engine running as if it were firing only two cylinders, rough but a steady beat.
Now repeat this same procedure or lifting the piston on the front carburetor, and adjust the mixture of the back carburetor.

(7) You have now synchronized your air fuel ratio in both carburetors. You may find when this step is completed that RPM has increased on your tachometer; if so, go back to step and correct your idle to 600 RPM.

(8) Next, adjust your throttle linkage connecting the carburetors with the throttle shaft mounted on the intake manifold.
Adjust the length of throttle link so that it will snap in place without changing RPM on the front carburetor.
Do this same operation with the link to the back carburetor.
Your engine should now run smoothly, providing the rest of your engine is properly tuned, such as valves, points, plugs, condenser, and ignition timing properly set.

Method Ⓑ

(1) Warm engine to normal operating temperatures.

(2) Turn the idle adjusting screw clockwise until closed, then turn the screw about three turns.

(3) Turn the front carburetor throttle adjusting screw clockwise 2 or 3 turns.
Back off on the rear carburetor adjusting screw so it is off the stop.

(4) Then start engine.

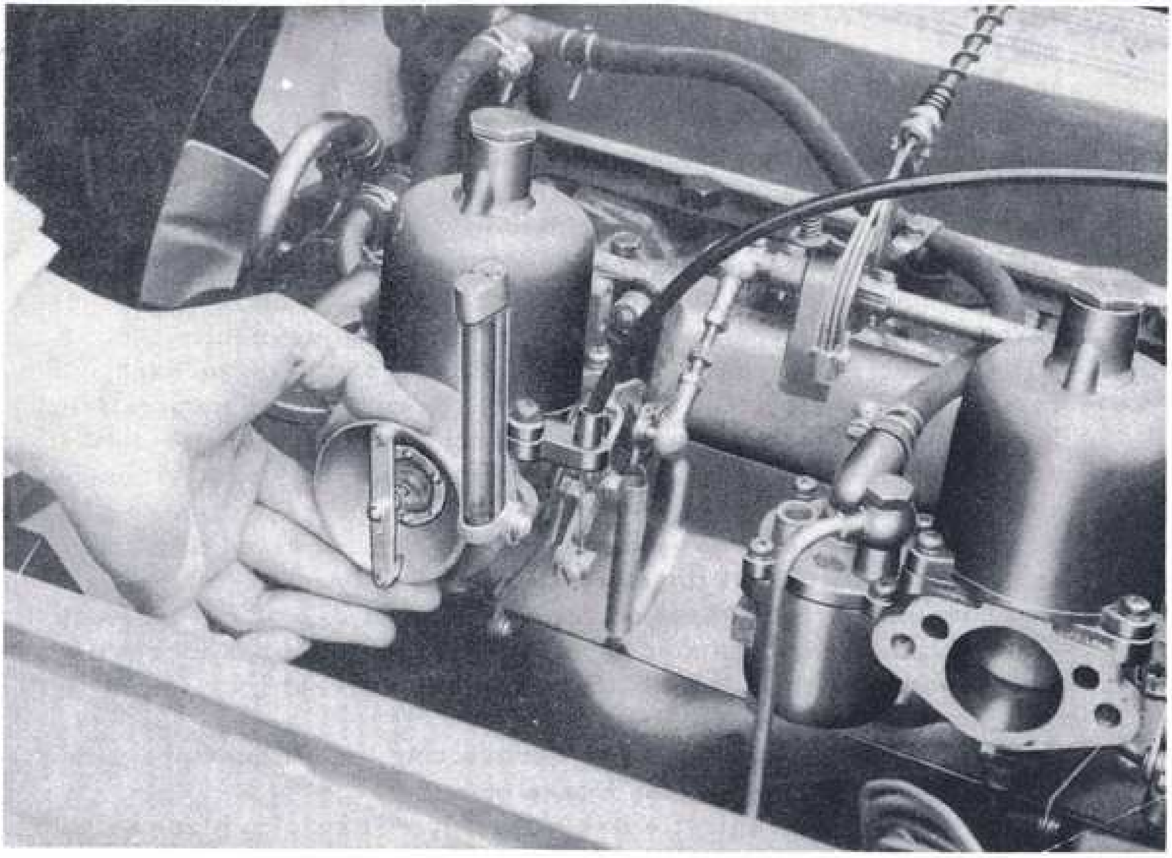
(5) Turn the front throttle adjusting screw anti-clockwise until engine reaches about 500 RPM.

(6) Turn the idle adjusting screw turns either left or right until engine runs evenly.

(7) If the rotation of engine is too fast, slightly adjust the front throttle adjusting screw until engine about 600 RPM.

(8) Normally a slight alteration of the idle adjust screw is again necessary.

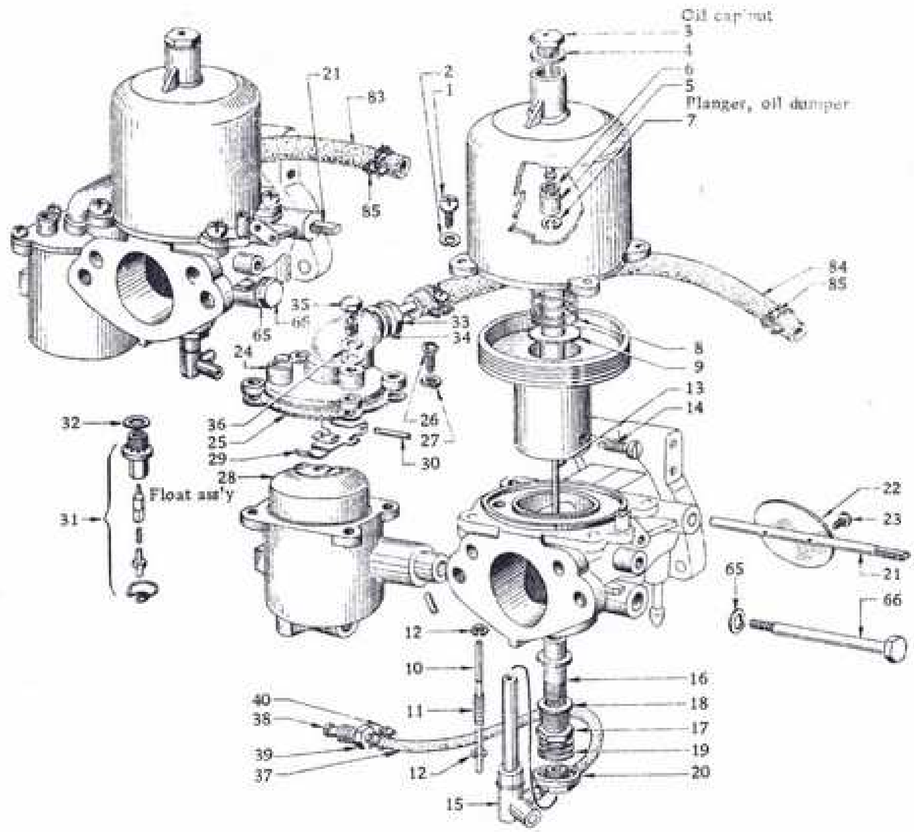
(9) Set the rear carburetor throttle adjusting screw so it is on the top.



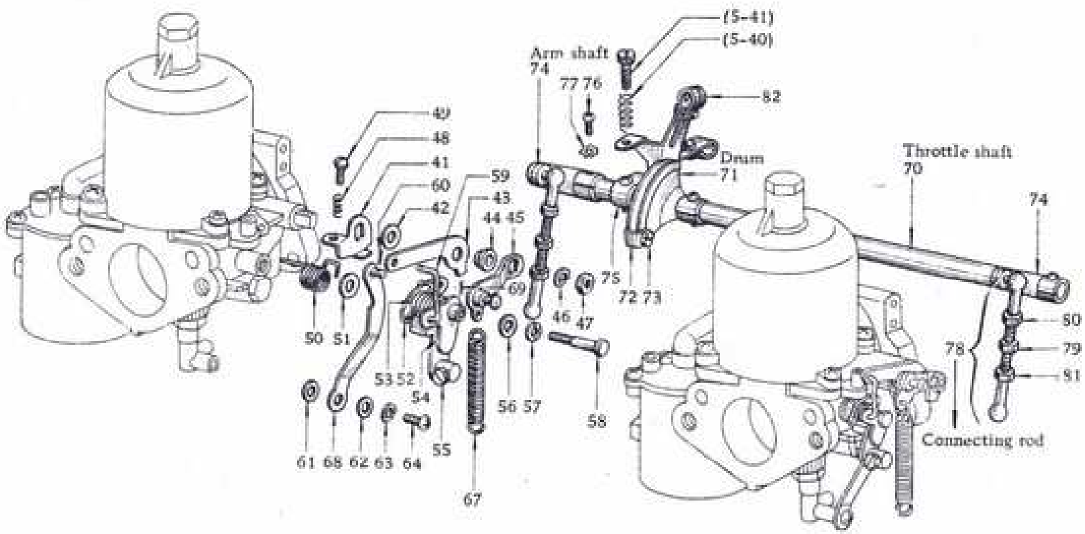
Method ©

If you have an instrument for balancing multiple carburetors.

(1) Warm engine to normal operating temperatures.
(2) Remove air cleaner; disconnect linkage.
(3) Place an instrument for balancing over throat of one carburetor. (Adjust the screw of air flow control.)
(4) With the adjusting screw in open position, gradually turn down until float in transparent tube rises to, or near, any graduating mark line. (Tube to be kept vertical while in operation.)
(5) Without changing position of the adjust screw, place the same on remaining carburetor, adjusting each carburetor "throttle-stop-screw" to bring float to approximately same level as the above 4.
If the idling speed is too fast, back off the throttle stop screw on one carburetor adjust an instrument for balancing to that carburetor, then rebalance the other carburetors. Then carefully reconnect linkage. Then the engine speed is increased just enough so the carburetor control arms do not touch the stop screws, then locking the accelerating control at a point that will not affect the linkage to the carburetor.
The linkage may then be checked and adjusted by using an instrument for balancing multiple carburetors in the same manner as for adjusting the idling screws.



Carbureteor (HJB 38W 3 type)



Accelerator

1. Screw
2. Washer-spring
3. Nut-oil cap
4. Packing
5. Plunger-oil damper
6. Washer-oil damper
7. Ring-"C"
8. Spring-suction
9. Packing-nylon, 12.5 ϕ
10.. Lifter-piston
11. Spring-piston lifter
12. Ring-"E"
13. Jet-needle
14. Screw-set, jet needle
15. Nozzle
16. Sleeve-nozzle
17. Screw-set, nozzle sleeve
18. Washer-10 ϕ
19. Spring-idle adjust screw
20. Nut-idle adjust
21. Shaft-throttle
22. Valve-throttle
23. Screw-valve
24. Cover-float
25. Gasket-float chamber
26. Screw-set, 5 ϕ
27. Washer-spring
28. Ass'y-float
29. Lever-float
30. Shaft-float lever
31. Ass'y-valve, needle
32. Washer-10 ϕ
33. Nipple-fuel
34. Packing-12 ϕ
35. Screw-set, nipple
36. Packing-10 ϕ
37. Pipe-fuel
38. Sleeve
39. Nut-sleeve
40. Clip
41. Plate-throttle adjust
42. Washer-8 ϕ
43. Lever-idle first
44. Sleeve-"A"
45. Lever-throttle
46. Washer
47. Nut-8 ϕ
48. Spring-throttle adjust screw
49. Screw-throttle adjust
50. Spring-starter return
51. Washer-5 ϕ
52. Plate-connecting, "B"
53. Spring-connecting
54. Lever-choke
55. Bolt
56. Washer-7 ϕ
57. Washer-spring
58. Bolt-5 ϕ
59. Rod-connecting
60. Pin-cotter
61. Washer-4 ϕ
62. Sleeve-"C"
63. Washer-spring
64. Screw-4 ϕ
65. Washer-spring
66. Bolt
67. Spring-throttle
68. Plate-connecting, "A"
69. Pin-cotter
70. Shaft-throttle
71. Ass'y-drum, throttle
72. Clip-throttle wire
73. Screw
74. Arm-shaft
75. Arm-throttle adjust screw
76. Screw
77. Washer-tooth
78. Ass'y-rod, connecting
79. Turn-backle, connecting rod
80. Nut
81. Nut
82. Bracket-accelerator wire & tube
83. Tube-flexible, fuel pump to carburetor (front)
84. Tube-flexible, fuel pump to carburetor (rear)
85. Clamp-tube

5 CAUSES AND REMEDY FOR TROUBLE

For troubles in the carburetor, causes and remedy for them are listed as follows. When the engine is in disorder, there may be the cause in the electric system, not in the carburetor. In such a case, check the electric system first and then adjust the carburetor.

Trouble	Cause	Remedy
Overflow:	Leak, deform of float	Replace
	Dust on needle valve seat	Clean
	Slack of needle valve	Retighten
	Defective seat of needle vavle	Grind or replace
	Excessive pressure of fuel pump	Repair
	Sucking air in fuel pump	Repair
Excessive consumption of fuel:	Overflow	See the above
	Malfunction of suction piston	Preceding para.
	Defect in nozzle return	Adjust
	Wear of jet needle	Replace
	Wear of nozzle jet	Replace
	Incorrect slow-adjust	Adjust
	Incorrect fitting of jet needle	Adjust
	Incorrect adjustment of throttle valve linkage	Adjust
Want of power	Throttle valve not full open	Adjust
	Malfunction of suction piston	Preceding para.
	Defect in nozzle return	Adjust
	Clog in nozzle or fuel line	Clean
	Incorrect fitting of jet needle	Adjust
	Clog in needle valve	Clean
	Malfunction of fuel pump	Adjust
Defect in idle:	Malfunction of suction piston	Preceding para.
	Defect in nozzle return	Adjust
	Wear of jet needle	Replace
	Incorrect adjust of idle adjust nut	Adjust
	Wear of throttle shaft	Replace
	Air leak due to defective packing between manifold and carburetor	Replace gasket
	Incorrect adjust of throttle valve linkage	Adjust
	Slack in throttle lever linkage	Adjust or repair

Breathing	Malfunction of suction piston	Preceding para.
	Incorrect adjust of idle	Adjust
	Shortage in damper oil or use of inferior oil	Add. replace
	Incorrect fitting of jet needle	Adjust

Do not start:	Overflow	Preceding para.
	Fuel not feed	Check pump Check fuel pipe Check needle valve
	Incorrect adjust of idle	Adjust
	Malfunction of suction piston	Preceding para.

Malfunction of suction piston:	Deposit of dust or oil	Clean
	Adhesion of suction chamber and suction piston due to deform	Repair or replace
	Incorrect centering of nozzle	Adjust
	Bend of jet needle	Replace
	Bend of plunger rod	Repair

ADJUSTMENT & INSPECTION OF ENGINE

The engine must always be operated in the best possible condition, and for this purpose, periodic inspection and adjustment must be maintained in a certain order while in use as well as after overhaul.

Order of Inspection and Adjustment of Engine

(1) Check the cooling water: water level and extent of filthiness.

(2) Inspect the battery: all connections, level of electrolyte, specific gravity of electrolyte and voltage.

(3) Inspect the oil: amount, filthiness, classification and viscosity.

(4) Cleaning of spark plugs and adjustment of their gaps.

(5) Measurement of compression pressure of cylinders.
The standard compression pressure of the engine is approx. 182 lbs. per. sq. in. (12.7 kg/cm^2) at 320 r.p.m.
Measurement of pressure is made in the following manner: (see Fig. 1)
First, warm up the engine (temperature of cooling water, 70-80°C) then remove all spark plungs and pull out the throttle knob all the way (that is in the carburetor, the throttle valve and choke valve are fully opened); press a compression gauge against each spark plug hole, and running the starter motor with a fully charged battery, read the maximum pressure obtained within 5-8 rotations of the motor. This measurement must be made as quickly as possible.
It the compression pressure of any one cylinder differs by 10 lb. /sq. in. or more from that of another, the cause must be investigated.

Fig. 1
Measuring compression pressure by means of a compression gauge

(6) Check and adjust the distributor:
If the breaker contact points have defective contact surfaces, dress them abd adjust the gap to 0. 45-0. 55 mm.

Also turn the cam of the distributor clockwise and check to see if the governor can carry out advancing function.

(7) Adjust ignition timing correctly.
By utilizing a power timing light, the function of the governor can be checked together with the ignition timing (illumination of crank pulley will enable to inspect the conditions of running and advancing of the timing.)
(B. T. D. C. 12°/550 rpm)

(8) Inspection of fuel pump and gasoline strainer.

(9) Adjust the slow setting of carburetor.

(10) Checking operation of generator.
Check the generating condition and functioning of the cutout relay by means of indications of the ammeter.

(11) Adjustment of slack in fan belt.

(12) Adjustment of valve tappet clearance.

Diagnosing of Engine by Means of Vacuum Gauge and Combustion Tester

In diagnosing the engine, the condition of each cylinder can be assumed by measuring its compression.

For employment of a vacuum gauge, connect it to the engine intake manifold and refer to Fig. 2.

The use of a master motor tester as showing in Fig. is convenient.

When a combustion tester is used, install a special intake (pick-up) in the exhaust tube, and after the engine has been started, analyze by means of a special gauge, the combustion gas which flows through the connecting hose into the tester, and judge the combustion condition according to the mixture ratio of fuel and air. When measurement is to be made in rainyor cold weather, use an auxiliary condenser between the pick up and the meter, otherwise, the excessive moisture in the exhaust gas will damage the functioning of the meter if permitted to enter it.

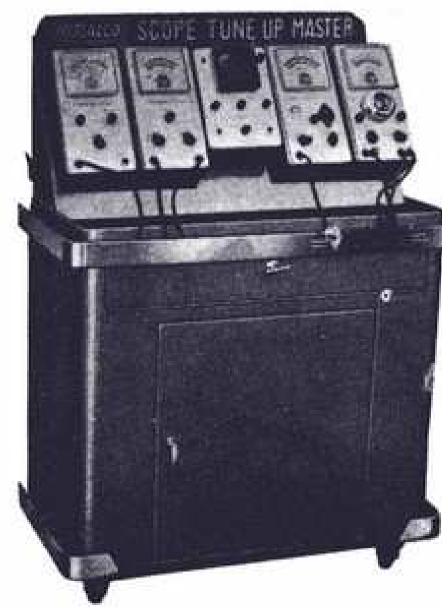


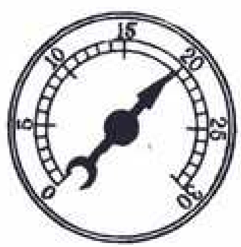
Fig. 2
Motor master tester available for 4, 6 and 8 cylinder engine

When a tester is to be used, make adjustments according to the following table.

Conditions (Without load)	Suitable Weight Ratio of Mixture
Low Speed Running (600 r. p. m.)	70 ± 2%
High Speed Running (2, 000 r. p. m.)	85^{+5}_{-2} %

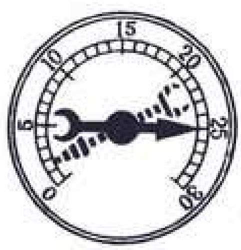
Engine Trouble Shooting

Fig. 3 is intended to be of assistance in the systematic analysis and isolation of symptoms of engine troubles so that the defective points may be accurately traced and economically repaired.



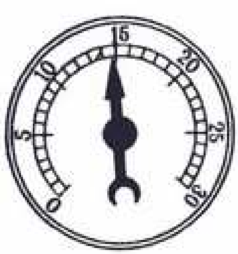
(1)

Normal condition
Settles between 18~20 in.



(2)

Normal condition
When indicator fluctuates between a range of 0~25 in. as engine is raced, rings and valves are in good conditions.



(3)

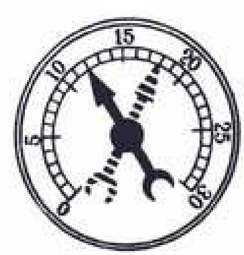
Even if indicator settles, if reading is low rings or oil are in faulty condition.

(4)

When above (3) condition exists, indicator will swing to 0 in. if engine is raced.

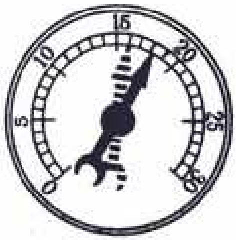
(5)

When indicator sometimes drops by 4 in., or so, valve sticking exists.



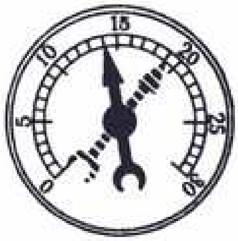
(6)

When indicator drops by several inches at certain time, valves are burnt.



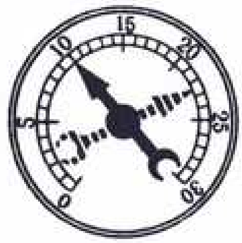
(7)

When indicator drops by about 2 in., valves leak. (Faulty seating of valves.)



(8)

When indicator oscillates actively between 14 and 18 in., valve stem guide is worn out.

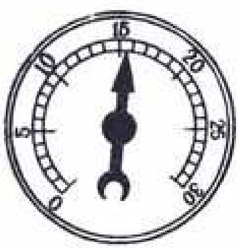


(9)

When, with a slight speeding up, indicator moves between 10~22 in., and with increase of speed, the range becomes larger, valve springs are weak.

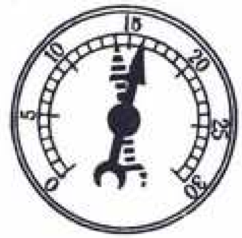
(10)

When indicator remains still between 8~15 in., it is because either valve timing is retarded or valve clearances are not correct.



(11)

When indicator settles between 14~17 in., ignition timing is retarded.

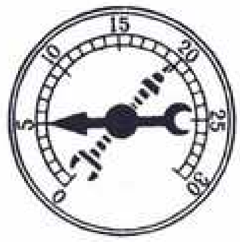


(12)

When indicator moves slowly between 14~16 in., it is because either electrode gaps of plugs are too narrow, or breaker point is defective.

(13)

When indicator points to 5 in. or below, there is leakage at intake-manifold or gasket of carburetor. (Faulty clamping of gasket.)



(14)

When indicator oscillates regularly between 5~19 in., there is leakage at cylinder head gasket. (Faulty clamping of gasket.)

(15)

When indicator first rises high, drops down to zero, and then returns to 16 in., muffler is clogged.

(16)

When indicator moves slowly between 13~17 in., carburetor is poorly adjusted.

Fig. 3 Diagnosing engine by means of a vacuum gauge

REMOVING & REFITTING

Experience has shown that it is much easier to remove the engine and transmission as a single unit than to detach the engine by itself.

To remove the engine and transmission upwards, proceed as follows:

Completely drain the cooling system and the transmission, disconnect and remove the battery and its supporting tray.

Remove the upper and lower radiator hoses by undoing the retaining clips.

To allow the engine and transmission to be drawn forward, the radiator must be removed by undoing the four securing bolts.

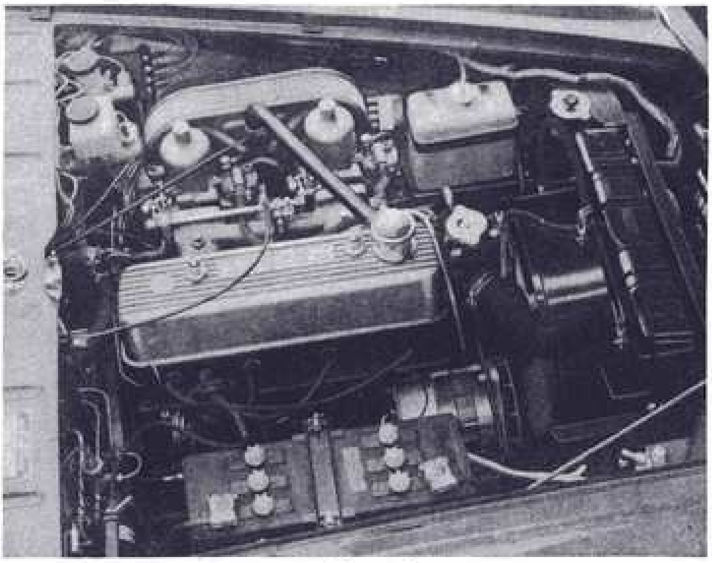


Fig. 1

Disconnect the capacitor lead at the distributor, also the high tension and switch wires at the coil.

Take off the dynamo lead and disconnect the starter motor cable at the motor end.

Remove the oil gauge and water, temperature gauge leads from their terminals and choke controls must be disconnected from the carburator. Disconnect the fuel pipe from the fuel pump.

Next, remove the exhaust remove the manifold assembly from engine block upward.

Pipe from the manifold after taking off the shock absorber.

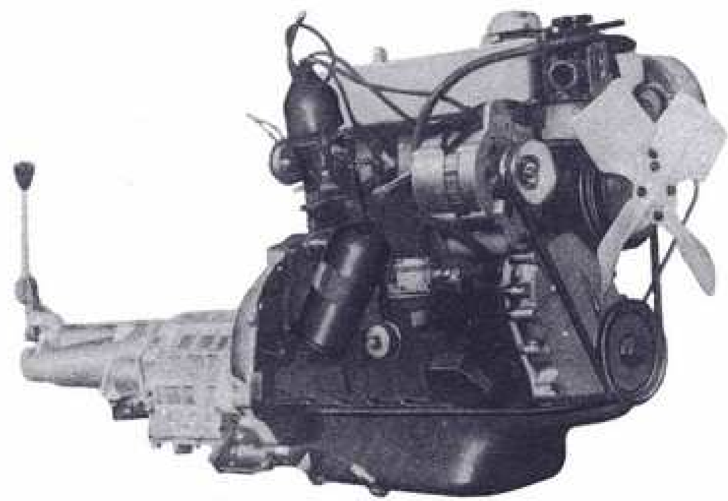


Fig. 2

Disconnect the earth strap from the starter motor. Remove change lever from transmission.

Disconnect the speedometer cable from the transmission. Uncouple the propeller shaft pinion franges at rear axle and draw the shaft out of the transmission.

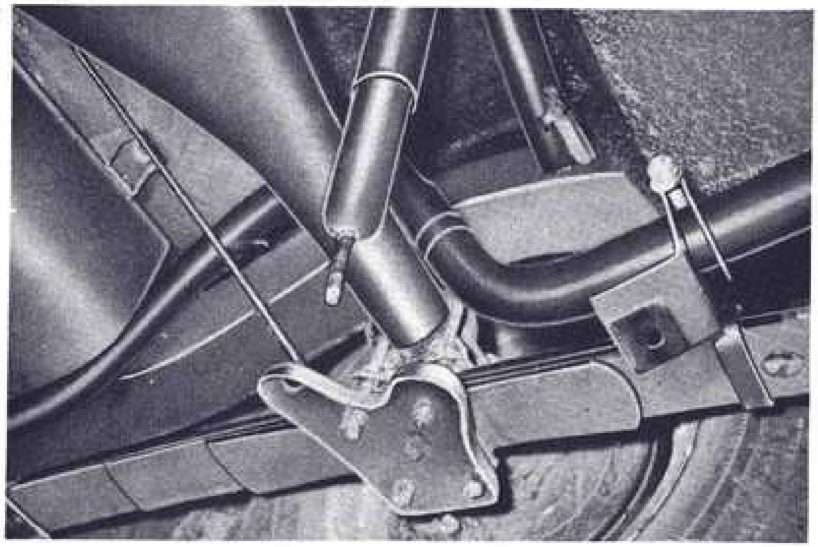


Fig. 3

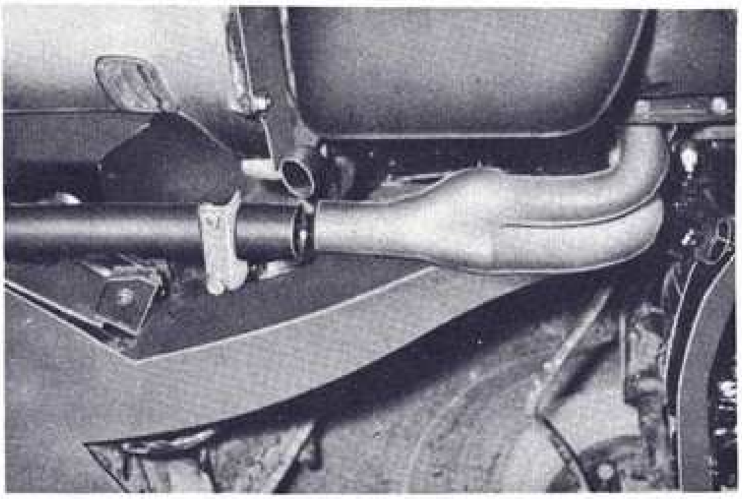


Fig. 4

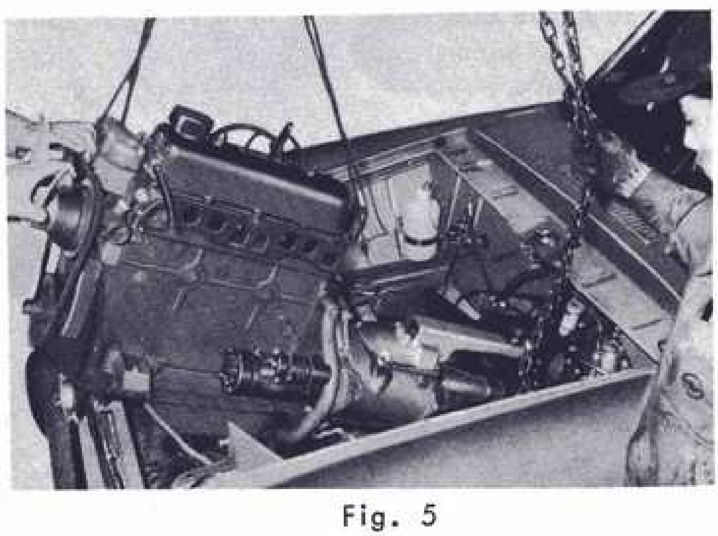


Fig. 5

COOLING SYSTEM

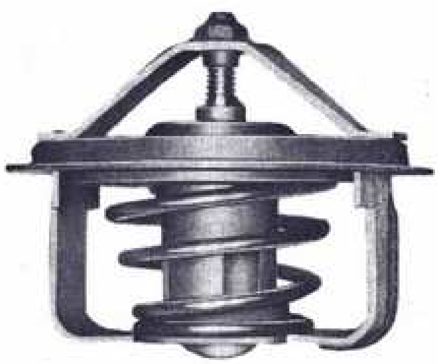
RADIATOR

Type	Maccord closed type
Pressurised	0.3-0.4kg/cm^2 0.4-0.6 lb/in^2
Total capacity of cooling water	6.5 ltr. (1.7) US. Gal

THERMOSTAT

Type	Wax pellet type	
Start to open temperature	72 ± 1.5°C	161.6 ± 3°F
Fully open temperature	80 ± 1.5°C	176 ± 3°F
Valve lift	9.5mm	0.374 in

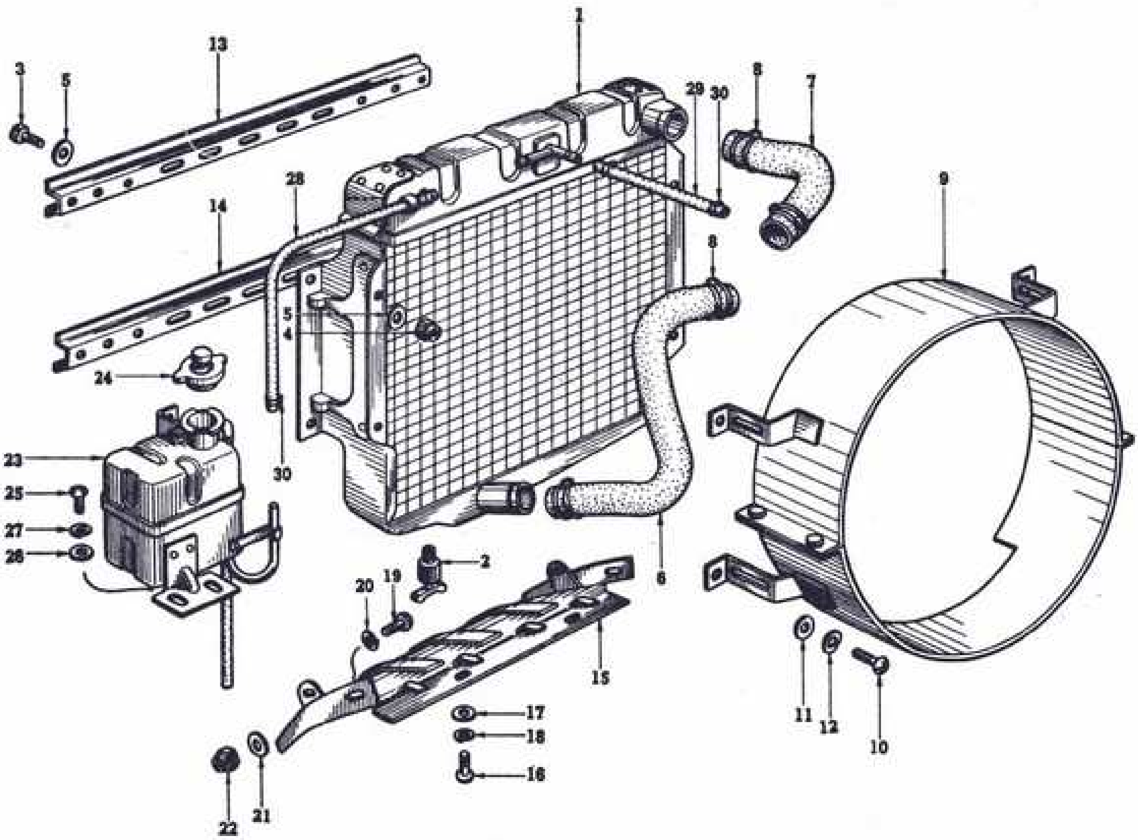
An efficient cooling system is of major importance to ensure the satisfactory running of the engine and it is therefore necessary to pay paticular attention to its maintenance. Attention is especially drawn to the procedure for winter months, if damage is to be avoided.



Description

The cooling system is maintained by water pump circulation, combined with an efficient fan cooled radiator and thermostat.

The system is pressurised and the relief valve, incorporated in the radiator filler cap, controls the pressure at approximately 0.4kg. per sq. cm. Do not remove the ifller cap if the temperature of the coolant is above boiling point or if the engine is running. Topping-up should only be required occasionally to replace water lost through the overflow pipe. Top-up when the engine is cold, and if possible use clean soft water.



1. Ass'y-radiator
2. Cock-drain
3. Bolt
4. Nut
5. Washer-plain
6. Hose-radiator to water pump
7. Hose-radiator to cylinder head
8. Clamp-hose
9. Shroud-radiator
10. Screw-machine
11. Washer-plain
12. Washer-lock
13. Ass'y-channel, radiator core support (upper)
14. Channel-radiator core support (lower)
15. Guide-air
16. Screw
17. Washer-plain
18. Washer-lock
19. Bolt
20. Washer-spring
21. Washer-spring
22. Nut-hex.
23. Ass'y-tank, reservoir
24. Ass'y-cap, pressure
25. Screw
26. Washer-plain
27. Washer-lock
28. Hose-radiator to reservoir tank
29. Hose-breather, radiator
30. Clamp-hose

Fig. 1 Radiator mounting

Fill to within 1/2" of the bottom of the filler plug well. Overfilling when the engine is cold may cause water to flow through the overflow pipe. The capacity of the system is approximately 8.4 litres.

Thermostat

In order to ensure maximum efficiency, it is essential to keep the engine operating temperatures within certain limits. To assist this a bellows type thermostat is fitted, being located in the water outlet at the front of the cylinderhead. The device consists of metallic bellows, filled with a volatile liquied, which controls a mushroom valve. When the engine is cold this valve is closed and on starting the engine the flow of water to the radiator is temporarily restricated.

Due to this, the temperature of the water in the cylinder head and cylinder jackets will quickly rise, thus ensuring rapid warming up. The heat so generated will gradually expand the bellows so opening the valve, and ultimatelly permitting a full flow of water to the radiator.

The thermostat itself is detachable; therfore, should the occasion arise, it can be removed from its housing and the hose reconnected to avoid laying up the car. Should the thermostat be tight, there are two tapped holes on the top which may be utilized to ease if from casting. When the system has been completely emptied, it is essential to allow air to escape through the thermostat valve and then finally top-up. The thermostat opening is set by the manufacturer and cannot be altered. It opens at a temperature of $72 \pm 1.5^{o}C$. During decarbonising it is policy to test this opening by immersing the thermostat in water raised to the requisite temperature. The valve should open under these conditions, but if it fails to open a new unit should be fitted.

Overheating

Overheating may be caused by a slack fan belt, excessive carbon deposit in the cylinders, running with the ignition too far retarded, incorrect carburetor adjustment, failire of the water to circulate or loss of water.

Fan Belt Adjustment

The fan is driven from the crankshaft by a "V" belt, this also driving the dynamo.

A new belt can be fitted by first loosening the clamp bolts(Fig. 2), which hold the dynamo in position, and moving the dynamo towards the engine. Slide the belt over the fan and onto the fan pulley.

Adjustment is then made by bringing the dynamo away from the engine. The belt should be sufficiently tight to prevent slip, yet the belt should have 10 to 15 mm. slace between the generator and crankshaft pulley when the midspan is pushed firmly.

As the drive is taken on the "V" of the pulleys it is not necessary to have the fan belt tight; to do so may cause excessive wear to the dynamo and water pump bearings. After the correct tension has been obtained, securely lock the dynamo in position again.

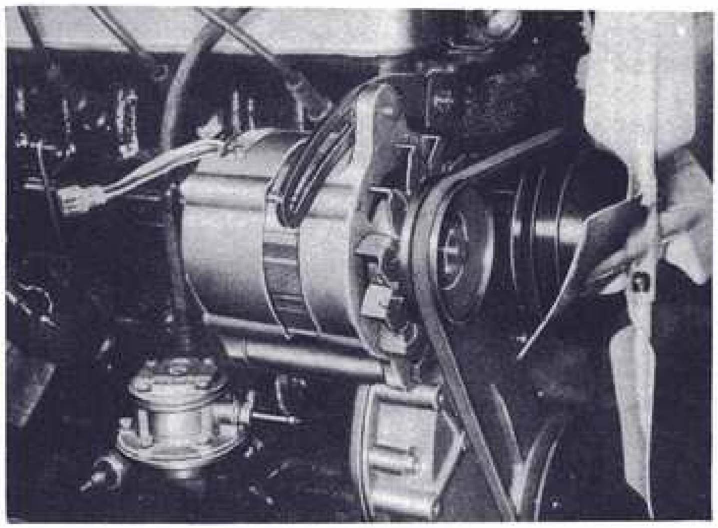


Fig. 2
Fan belt adjustment

Frost Precautions

Freezing may occur first at the bottom of the radiator or in the lower hose connections.

Ice in the hose will stop water circulation and may cause boiling. A muff can be used to advantage, but care must be taken not to run with the muff fully closed, or boiling will result. When frost is expected or when the car is to be used in a very low temperature, make sure that the strength of the solution is, in fact, up to the strength advised by the manufacturers. The strength of the solution must be maintained by topping-up with antifreeze solution as necessary. Excessive topping-up with water reduces the degree of protection afforded. Solution must be made up in accordance with instructions applied with the container.

Relations of freezing temperatures of alchol-water and glycerine mixtures ratio.

Top-up when the system is cold.

If the cooling system has to be drained, run the mixture into a clear container and use again.

Protection by Draining

On cars where antifreeze is not used the following precautions must be taken during frosty water to obviate any damage due to freezing of the cooling system.

When heavy frost is imminent, the cooling system must be completely drained. It is not sufficient merely to cover the radiator and engine with rugs and musfs. There are two drain cocks one on the left hand side of the cylinder block and the other at the base of the radiator block. Both taps must be opened to drain the system and the car must be on level ground while draining.

The drain taps should be tested at frequent intervals by inserting a piece of wire to ensure that they are clear. This should be done immediately the taps are opened, so that any, obstruction freed by the wire may be flushed out by the water. The draining should be carried out when the engine is hot.

When completely drained the engine should be run for a timed minute to ensure that all water has been cleaned from the system.

A suitable notice should be then affixed to the radiator, indicating that the water has been drained.

Flushing the Radiator

To ensure efficient circulation of the coolant and to reduce the formation of scale and sediment in the radiator, the system should be periodically flushed with clear running water, preferably before putting in antifreeze in the winter and again when taking it out in the spring. The water should be allowed to run through until it comes out clear from the drain taps. At intervals a stiff piece of wire should be inserted into the taps during draining to ensure that they are not becoming clogged with sediment.

This method of radiator flushing may serve well, but in cases where the "furring" up is excessive the operator will find it more efficient practice to remove the radiator completely and flush in the reverse way to the flow, turn the radiator upside down and let the water flow in through the bottom hose connection and out of the top connection.

WATER PUMP

After draining the water from the radiator, remove the pump unit from the cylinder block by taking off the fan belt and releasing the setbolts with spring washers and hinge bolts to dynamo.

Removing the Pump Shaft Assembly

Disconnect the fan blades, pulley and cover.

The shaft and ball bearings is combined with one unit.

Put the pulley hub on the bench.

First, press or knock the shaft end with a drift (hard bar) and draw out the pulley hub on the U type bench.

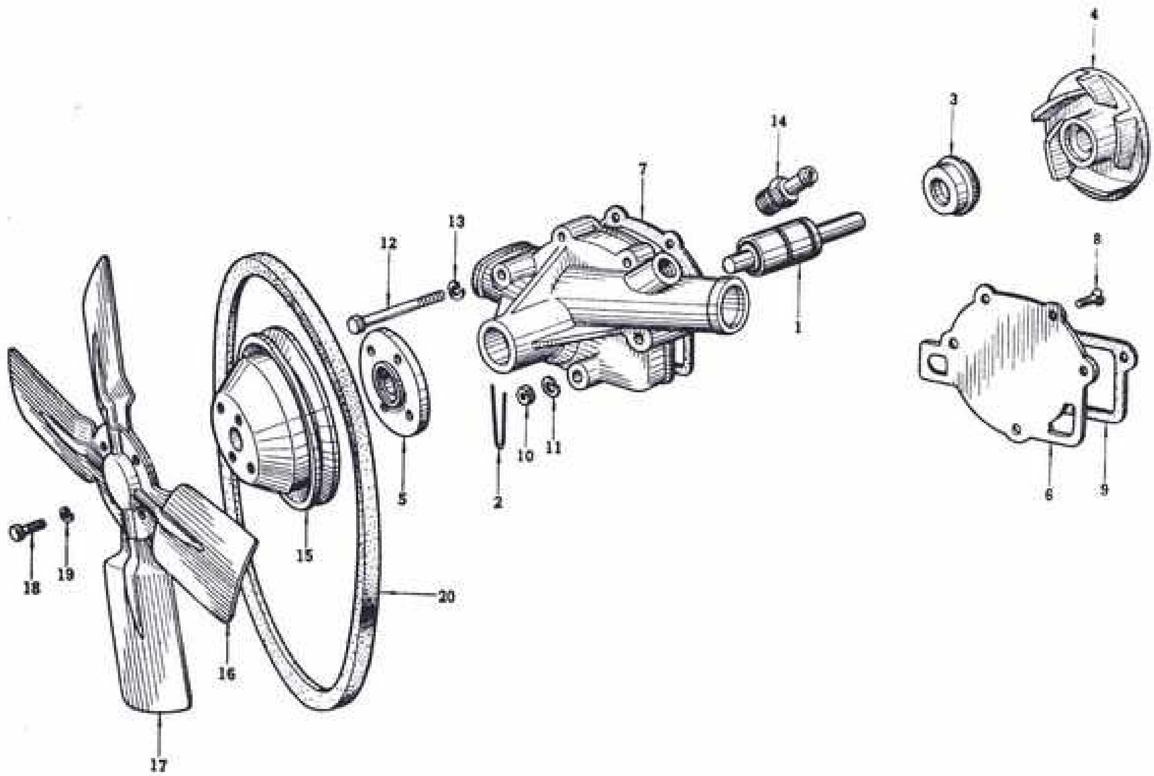
Take out the set pin from the slit which locked the shaft assembly to the pump body. (See Fig.)

Fig. 3

Next, turn the body upside down and press out the shaft assembly from the vane side on the U type bench.

The shaft and ball bearing assembly can be drewout from the body.

Thus take out the vane, floating seal and seal which remained in the pump body.



1. Bearing-water pump
2. Wire-lock
3. Ass'y-seal, water pump
4. Vane-water pump
5. Hub-water pump pulley
6. Cover-water pump
7. Gasket-water pump cover
8. Screw
9. Gasket-water pump, block side
10. Nut
11. Washer-lock
12. Bolt
13. Washer-lock
14. Connector-cylinder head to water pump
15. Pulley-fan & water pump
16. Blade-fan, front
17. Blade-fan, rear
18. Bolt
19. Washer-lock
20. Belt-fan

Fig. 4 Water pump

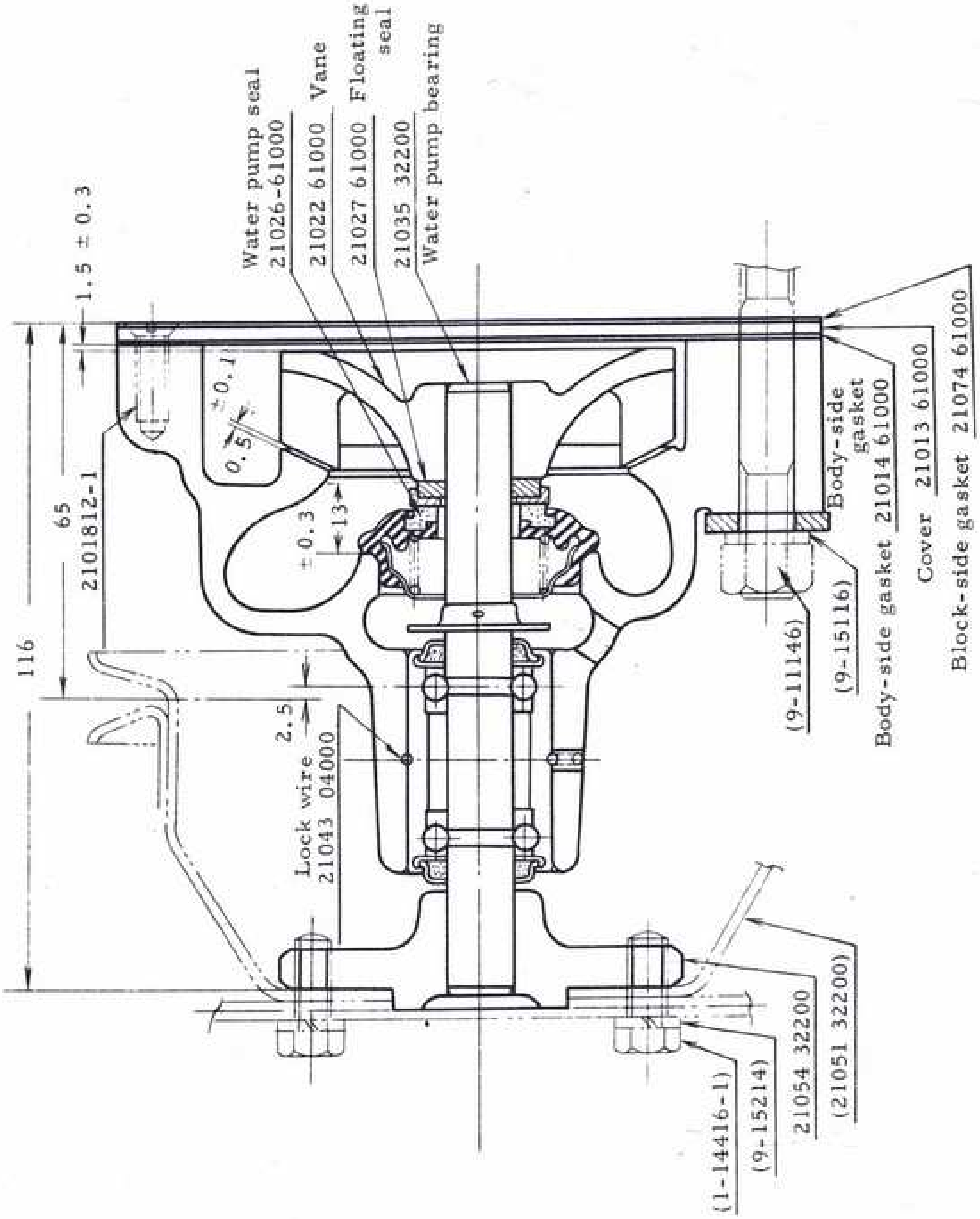
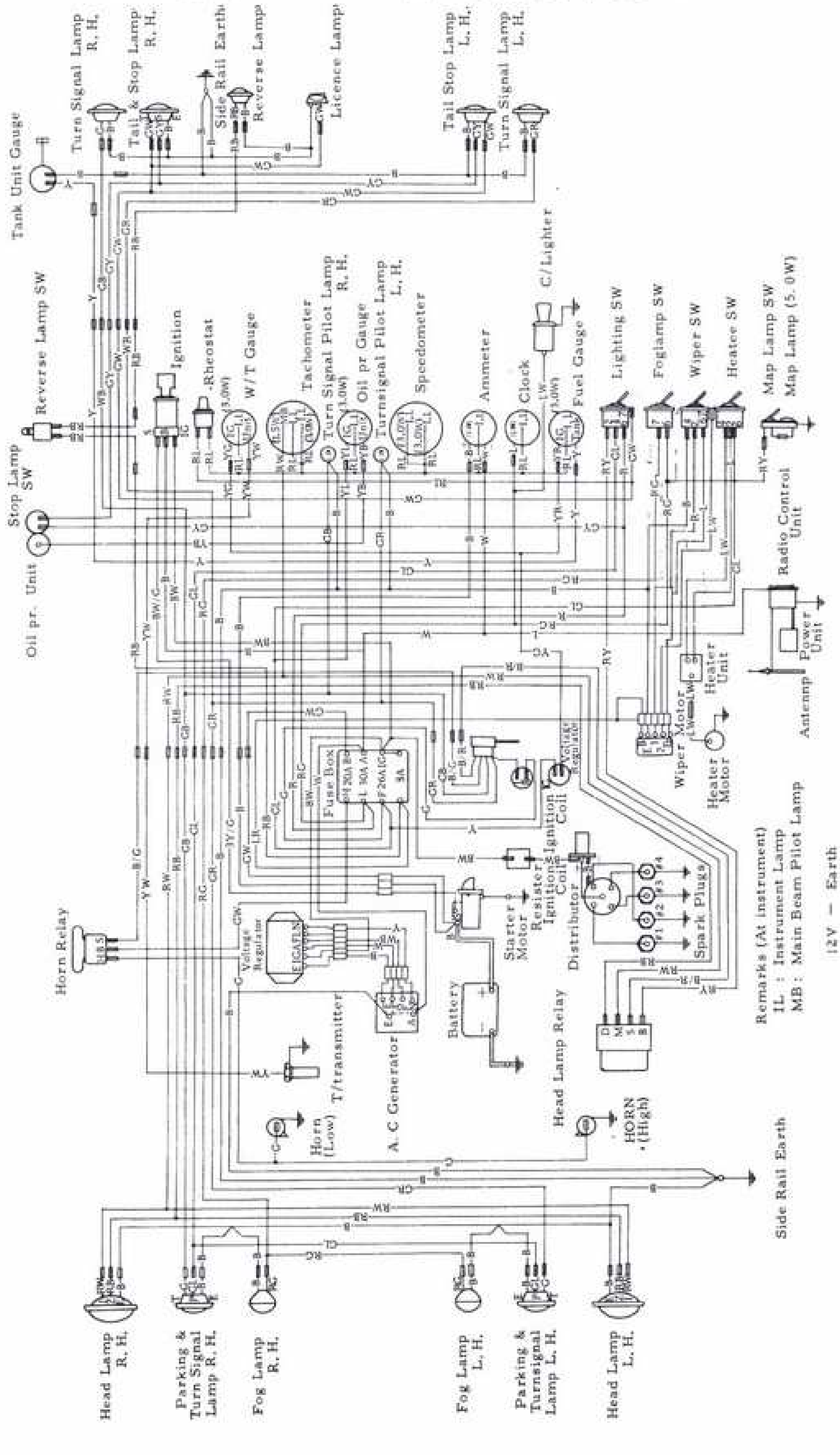


Fig. 5

Sectional view of the water pump

WIRING DIAGRAM SP(L)311



SPECIFICATION

Alternator	Mitsubishi Denki (23100-14602)
Model	AC300/12X2R
Nominal output	12V - 300W
Constant	Successive
Pole	Side ground (minus)
Constant revolution	2500 rpm.
No load minimum revolution	1000 rpm. down 14V (normal temp.)
Output current	2500 rpm. 14V 24.5A up (normal temp.) 2500 rpm. 14V 21.5A up (high temp.)
Pulley ratio	1 : 1.73
Regulator	Mitsubishi Denki Co. (23500 - 1402)
Model	RL-2B3
Type	Tirrill type (leaf spring)
Element	Constant voltage relay. Pilot lamp relay.
Constant voltage relay	3 contact point type

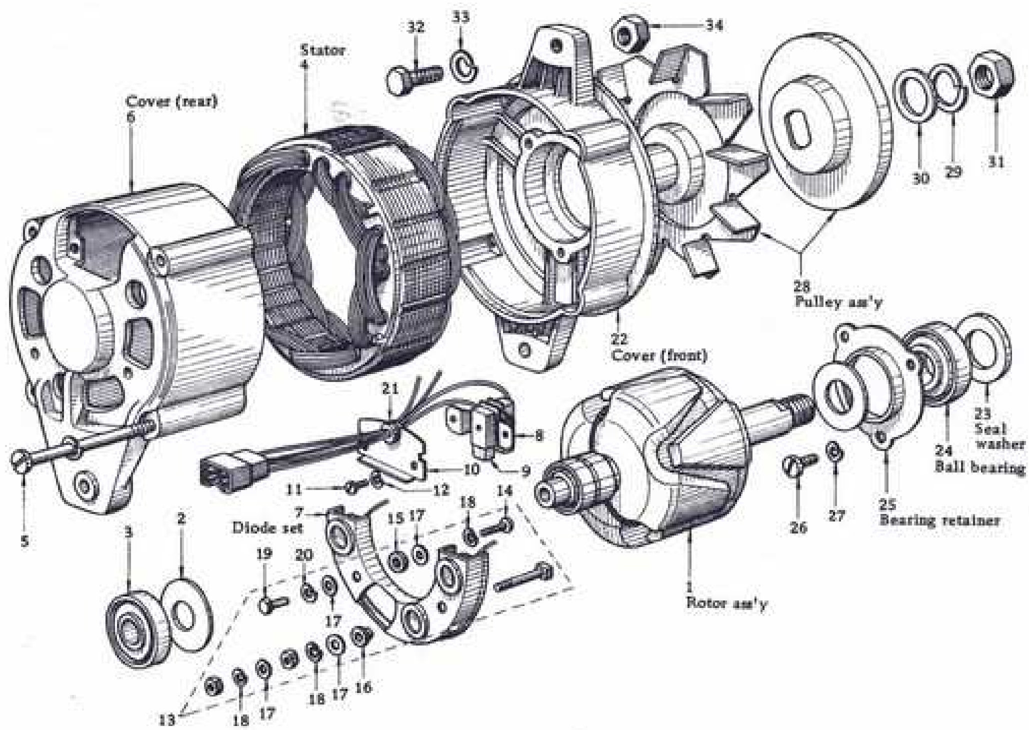
	Primary side	Secondary side
Adjust, valve	14 ~ 15V	14 ~ 15V
Dynamo revolution	4000 rpm.	4000 rpm.
Load	Battery + resisting load 21.5 A approx.	Battery

NOTE: Use battery charged in full.

Pilot lamp relay (3 contact point type)

Put-off voltage	Put-on voltage
4.2 ~ 5.2V	0.5 ~ 3V

MOJOR COMPONENTS OF ALTERNATOR FOR SP 311



1. Ass'y-rotor
2. Washer-seal
3. Bearing-ball
4. Ass'y-stator
5. Bolt-through
6. Ass'y-cover, rear
7. Ass'y-diode, set
8. Ass'y-holder, brush
9. Ass'y-brush
10. Cover-brush
11. Screw-4 ϕ x 10
12. Washer-spring
13. Ass'y-terminal
14. Screw
15. Insulator
16. Insulator
17. Washer
18. Washer-spring
19. Bolt-terminal (E)
20. Washer-spring
21. Grommet
22. Ass'y-cover, front
23. Washer-seal
24. Bearing-ball
25. Retainer-bearing
26. Screw
27. Washer-spring
28. Ass'y-pulley
29. Washer-spring
30. Washer-plain
31. Nut
32. Bolt — alternator to
33. Washer-lock — bracket fix
34. Nut

GENERATOR

Construction and Feature

Different from the DC generator, the AC generator turns the magnetic pole and fixes the armature making it generates 3-phase alternate current, and rectifies all waves with the silicon diode, (+) (-) each three, that are built within, and takes out as direct current.

1	Starter	11	A Terminal Ass'y	20	Terminal bolt	29	Nut
3	Roter	12	Hex bolt	21	Front bracket	30	Spring washer (T)
4	Seal washer	13	Round head	22	Front bracket	31	Grommet
5	Ball bearing	14	Insulator (5)	23	Seal washer	33	Clip
6	Rear bracket Ass'y	15	Insulator (5)	24	Ball bearing	34	Brush holder
7	Rear bracket Ass'y	16	Filter washer	25	Bearing retainer	35	Brush
8	Diode (-)	17	Washer	26	Round head	36	Brush cover
9	Diode Ass'y	18	Spring washer (5)	27	Through bolt	37	Spring washer
10	Diode (+)	19	Stopper nut	28	Pulley Ass'y	38	Round head

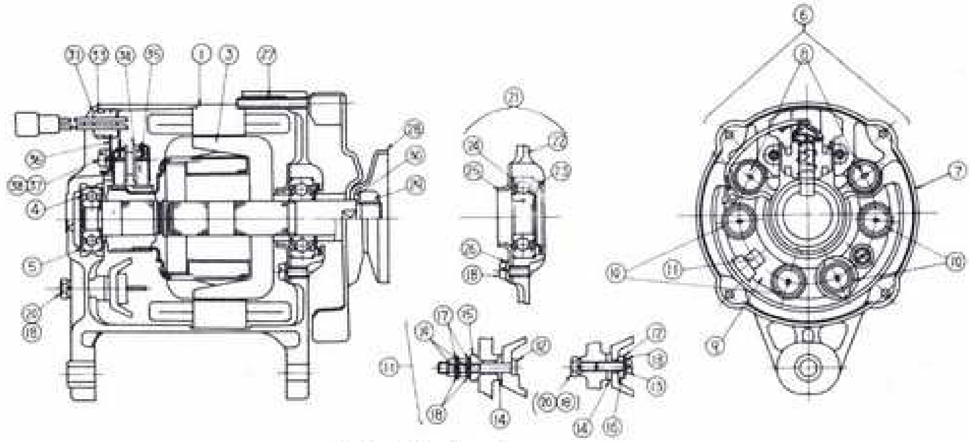
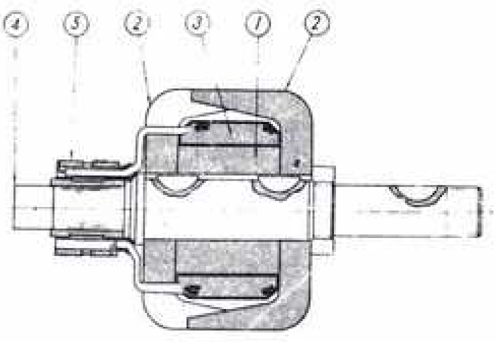


Fig.2-1. 1

The sealed ball bearings are used to support the rotor. Clearance between the brush and brush holder is also made so as to prevent it from dust. Thus the AC generator will increase milage without maintenance. Each 3 diodes are pressed in the rear cover and the diode base respectively.



① Field core

② Field segment

③ Field coil

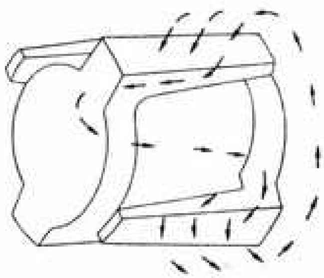
④ Shaft

Sectional View of Rotor

Fig.2-1. 2

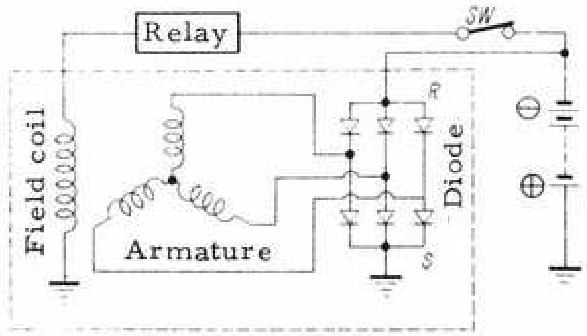
The clip ring pressed in the shaft is soldered at both ends of the field coil to pass magnetic current.

The pole of rotor makes out the magnetic circuit as shown in Fig. 1. 3 and all the poles are magnetized by doughnut coil.



Magnetic Circuit

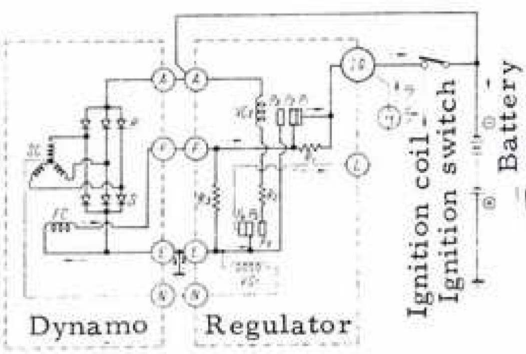
Fig. 2-1. 3



Connection within Dynamo

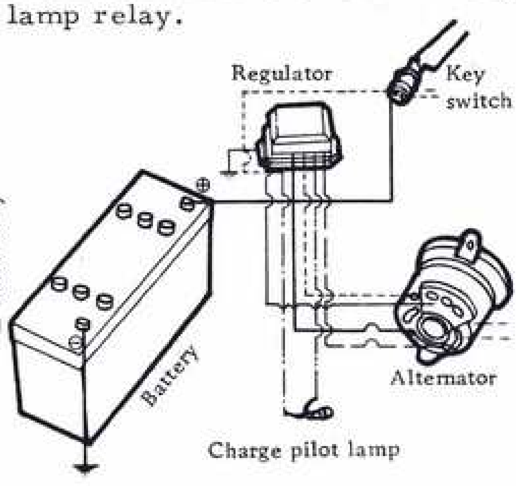
Fig. 2-1. 4

The armature is of a three phase Y connection type and the silicon diode rectifies all waves. It pulls out the neutral point and adds voltage having conducted 3 phase half wave rectification in the circuit of relay and controls the voltage coil of the pilot lamp relay.



Charging System

Fig. 2-1. 5



Outside Connection

Fig. 2-1. 6

When the ignition switch is put on, the battery current flows in the arrow marked direction passing through the dynamo E terminal, brush slip ring, field coil, slip ring, brush, dynamo F terminal, relay F terminal and IG terminal and completes the field circuit. It in difficult for the dynamo to stand up only by residual magnetism of the field core, so that magnetization is necessary until voltage rises to suit charging after the engine has started.

This is because the diode is used and when the voltage to add to it is so low, large proportional resistance shows up and current does not flow through the field coil unless the dynamo makes very high revolution.

Disassembly and Assembly

A. Disassembly

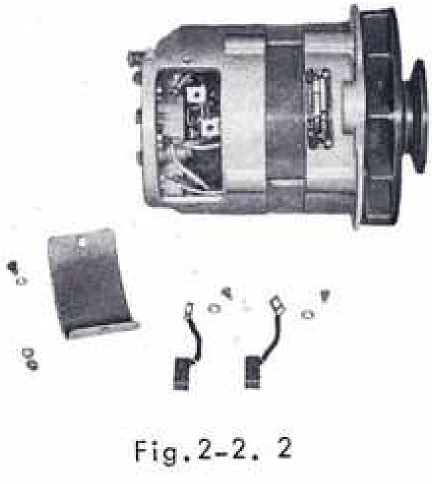
The dynamo is disassembled in the following order.

a)

* The completed
The parenthesized is the part number for SP311.

Fig.2-2. 1

b)



Remove the brush cover and pull off the brush, 2 ea.

Fig.2-2. 2

c)

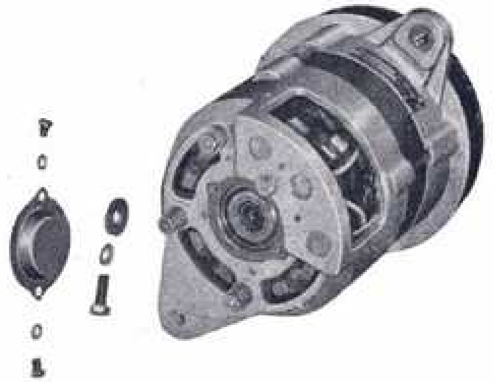


Fig.2-2. 3

Remove the cover of bearing and take off the hex. bolt of shaft.

d)

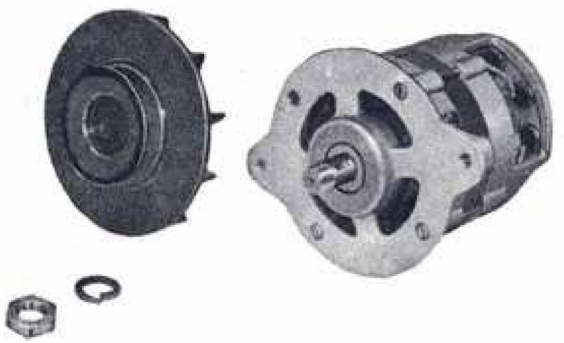


Fig.2-2. 4

Remove the hex. nut of pulley and pull off the pulley and the half-moon key. Be careful not to injure the fan when the nut is removed.

e)

Fig.2-2 .5

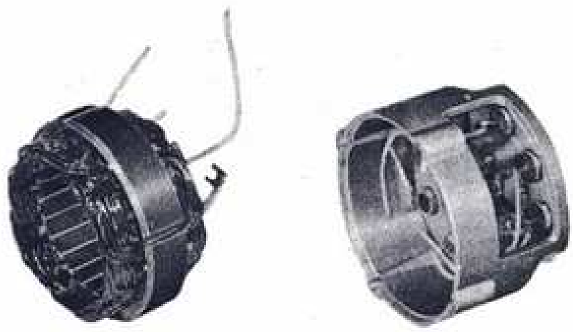
Remove the through bolt tightening bolt front cover and rear cover, pull off the front cover and rotor.
Use a hammer of wood or plastic if necessary.

f)

Remove the ball bearing from the front cover. Remove the bolt or tightening the bearing plate and or pull off the bearing with such as a hand press. Slacken N terminal bolt on the rear cover side and remove the clip terminal, then the rear cover and the stator can be separated.

Fig.2-2. 6

g)

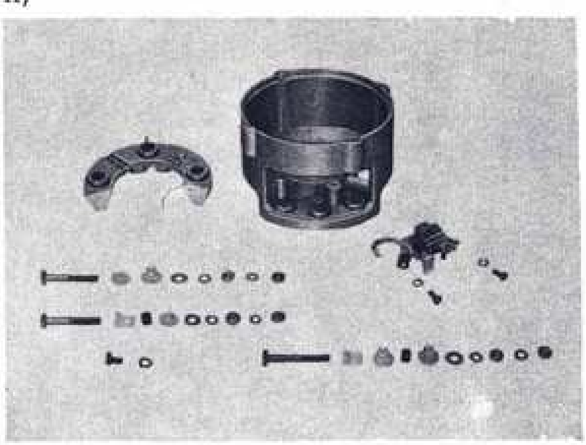


Remove the rear cover and stator. Separate the silicon diode, 3 ea. from the stator coil lead wire, 3 ea. by melting soldering with an electric iron.
Slacken N terminal bolt on the rear cover side and remove the clip terminal, then the rear cover and the stator can be separated.

Fig.2-2. 7

NOTE: When temperature within diode gear up over 150°C the diode will lose functioning, so that use the electric iron, 100 ~ 200W, for around 2 seconds at the soldered portions..

h)



Remove the diode set and brush holder from the rear cover, when be careful not to lose small parts such as screws, washers and bushings.

Fig.2-2. 8

B. Assembly

Assembly is done in the reverse sequence of disassembly.

Always make sure the polarity of alternator or regulator before replacing the diode either positive or negative. The polarity of alternator or regulator is usually marked on the name plate or label which is attached to each model.

In case the alternator or regulator shows the positive ground, the red coloured diode should be mounted in the frame of slip ring end and the black coloured diode in the heat sink.

Fig. 2-2. 9

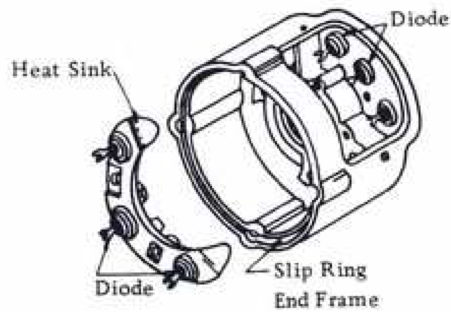
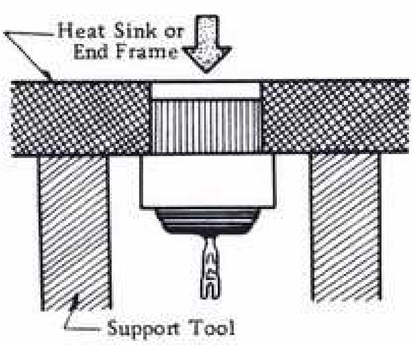


Fig. 2-2. 10 Exploded view

Removal

To remove a diode, use a suitable tool to support the end of the frame, or heat sink, and push the diode out by using an arbor press as shown the below.



Press out so as not to injure the mounting bore of the frame or the heat sink.

Fig. 2-2. 11

Installation

Support the heat sink or end frame with a suitable tool and then press the diode in the heat sink and end frame by using the tool shaped Ⓐ which fits over the outer diode edge A portion.

Press down perfectly the diode in the mounting bore of C portion to the lower edge of B portion of the diode.

Checking the replaced diodes.

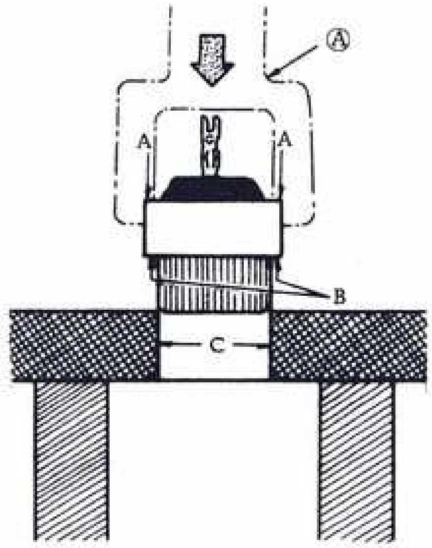


Fig. 2-2. 12

Inspection of Troubles

A. Inspection of Output

For inspection of output, remove the dynamo from the vehicle and connect wiring as shown in Fig. 3. 1 and drive it with motor. (For inspection of output of dynamo without removing it from the vehicle, refer to "Inspection of AC generator" to be published later.)

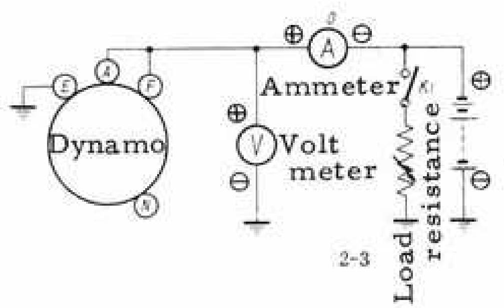


Fig. 2-3. 1

NOTE:

Use the battery charged in full up to the normal capacity.

Through the wiring shown in Fig. 3. 1, magnetic current flows from the battery to the field coil of dynamo. In this state, raise revolution of dynamo 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. 1000 rpm. 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 dynamo. Observe thus increasing output current as revolution of dynamo 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 dynamo or the relay is in disorder. See the charging current by inserting the ammeter between A terminal of relay and the battery.

Disconnect wire passing from the dynamo 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.

B. Short Circuits on Diode "-" Side

It can be judged as the pilot lamp does not flare even if the key switch is turned on. Actually a trouble such as "diode open" is very rare and short circuits at the polar line are also rare. Ordinarily, there are many cases of "+" side short circuits.

C. Inspection of Diode with Tester.

a) Simple Inspection

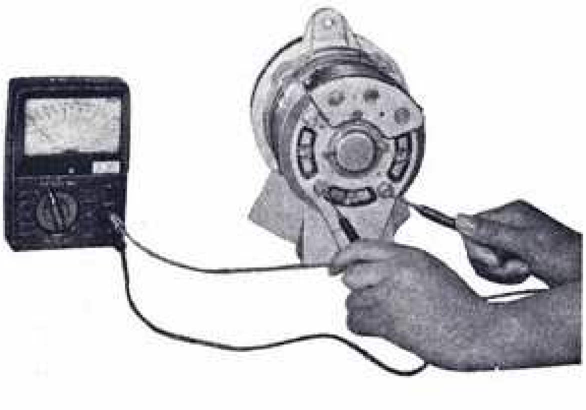


Fig. 2-3. 2

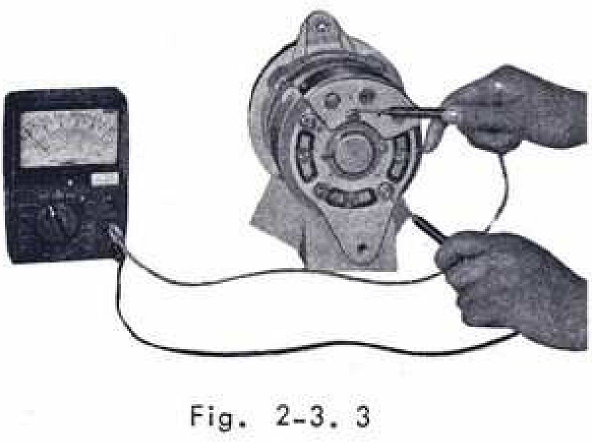


Fig. 2-3. 3

Check between the terminals, A - N as shown in Fig. 3. 2. Set the dial of tester for conductivity and put the tester needles at both terminals alternately. When one shows low resistance and the other shows pretty high resistance, the 3 diodes in the diode set are all right.

Check between the terminals, A - E same as above. When the same result is obtained, 3 diodes are also all right.

However, when there is no disorder found in this simple test and the dynamo output is somewhat lower than the standard, 1 ~ 2 diodes are often in opening, when one by one checking will be necessary.

b) Separate Inspection

Check resistance with the tester between the diode base commonly used for 2 diodes and lead wire on the rear cover - 2 times changing the poles. When one side shows low resistance and the other shows high resistance, there is no disorder. If both sides are low, there will be short circuit and both sides are high there will be open.

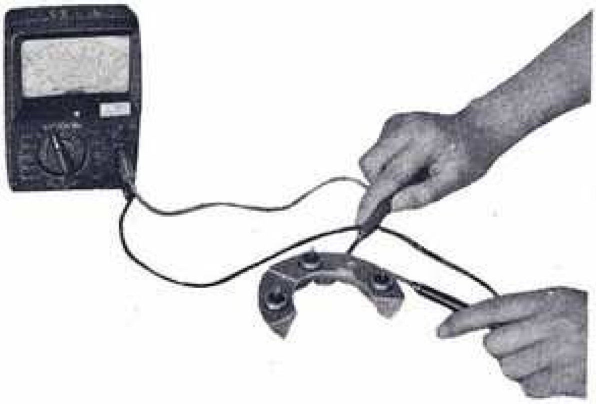


Fig. 2-3. 4

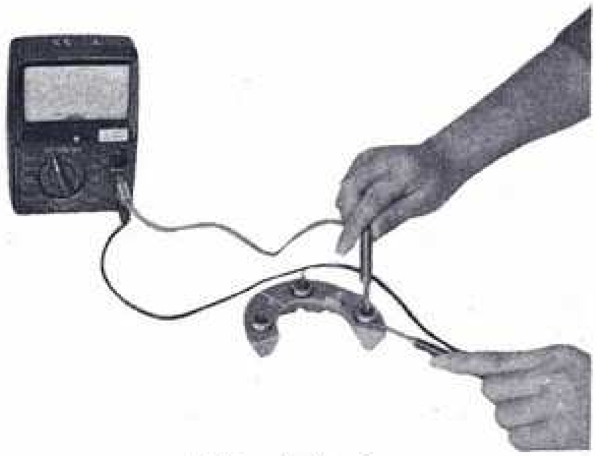


Fig. 2-3. 5

D. Inspection of Diode with Lamp.

a) Simple Inspection

Check positive diodes

Test Method	Test Connection	Lamp Lamp	Method Result
Should be conductive Ⓐ to Ⓑ	Connect ⊕ to Ⓐ and ⊖ to Ⓑ	Light	Good
		No Light	Defective
Should be non-conductive Ⓑ to Ⓐ	Connect ⊖ to Ⓐ and ⊕ to Ⓑ	No Light	Good
		Light	Defective

Check negative diodes

Test Method	Test Connection	Lamp Lamp	Method Result
Should be non-conductive Ⓐ to Ⓑ	Connect ⊖ to Ⓐ and to Ⓑ	Light	Good
		No Light	Defective
Should be conductive Ⓑ to Ⓐ	Connect ⊖ to Ⓑ and ⊕ to Ⓐ	Light	Defective
		No Light	Good

The soldering for the lead wires should be performed in less than 20 seconds, as the excessive heat may damage the diodes.

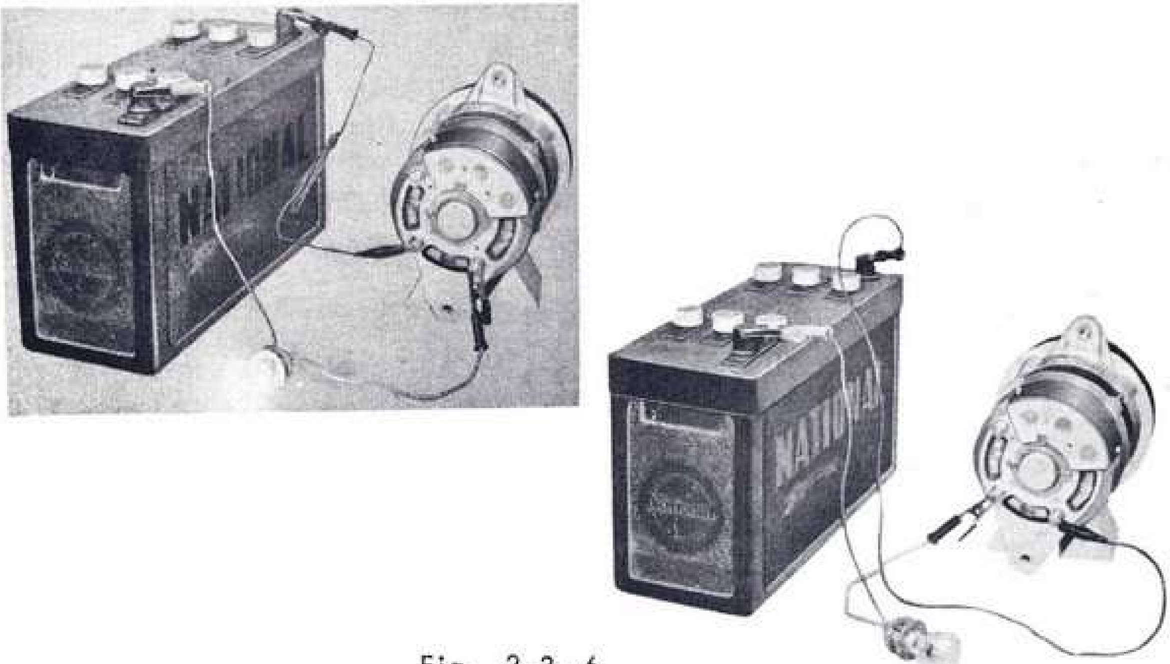


Fig. 2-3. 6

Check between the terminals, A - N, as shown in Fig. 3. 6. Connect with the lamp (12V) in straight and put both ends at A and N terminals alternately. On one side the lamp flares and on the other the lamp is off, when 3 diodes of the diode set are all right.

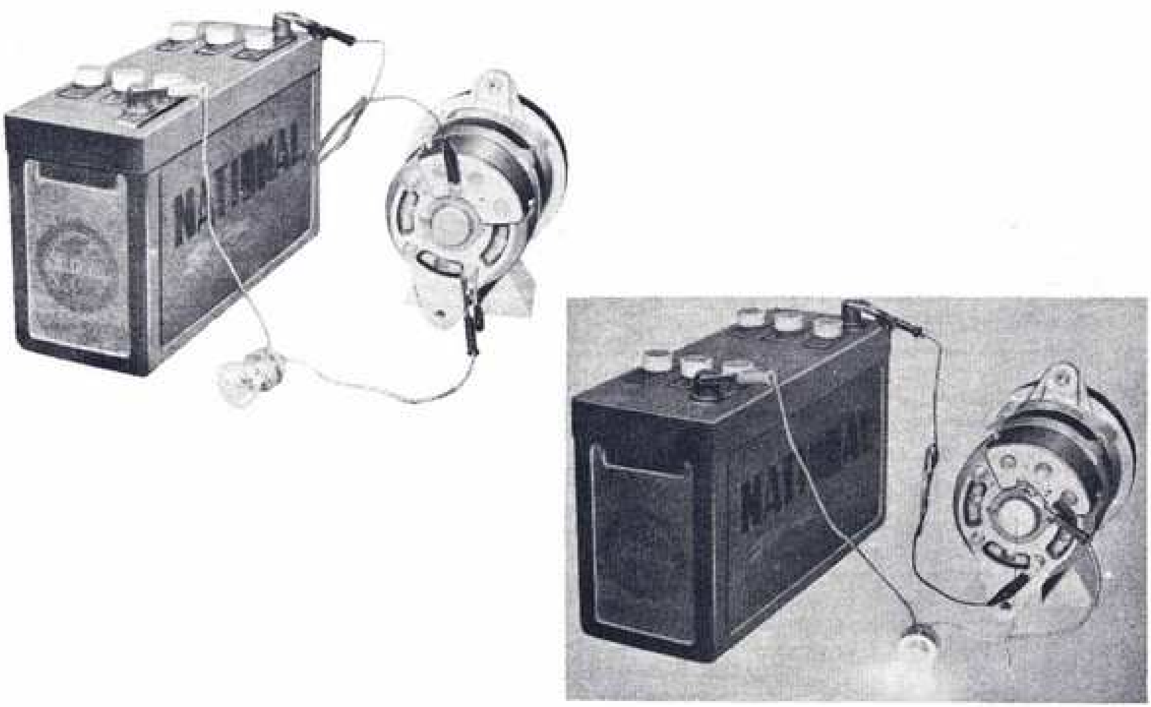


Fig. 2-3. 7

The same step is taken between the terminals, N - E. When the same result is obtained, 3 diodes pressed in the cover are all right. However, if the simple test is all right, but when the dynamo output is lower than the standard, 1 ~ 2 diodes may often be opening, so that one by one check will be necessary.

b) Separate Inspection

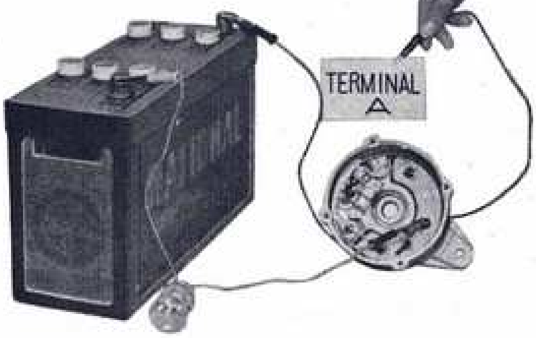


Fig. 2-3. 8

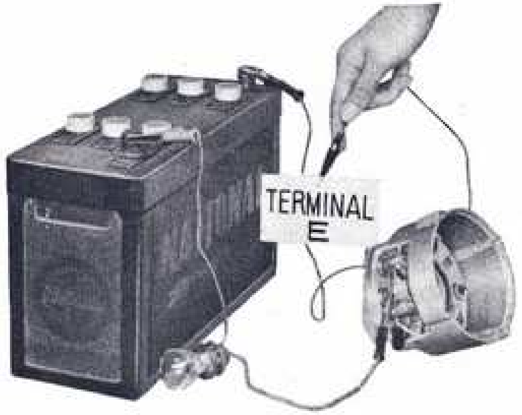


Fig. 2-3. 9

Check between the lead wire and the diode set common with the other 2 diodes or the rear cover with the lamp and battery. It is all right if one side flares and the other is off. If both sides flare, there is short circuit and both sides are off, there is open.

E. Inspection of Field Coil

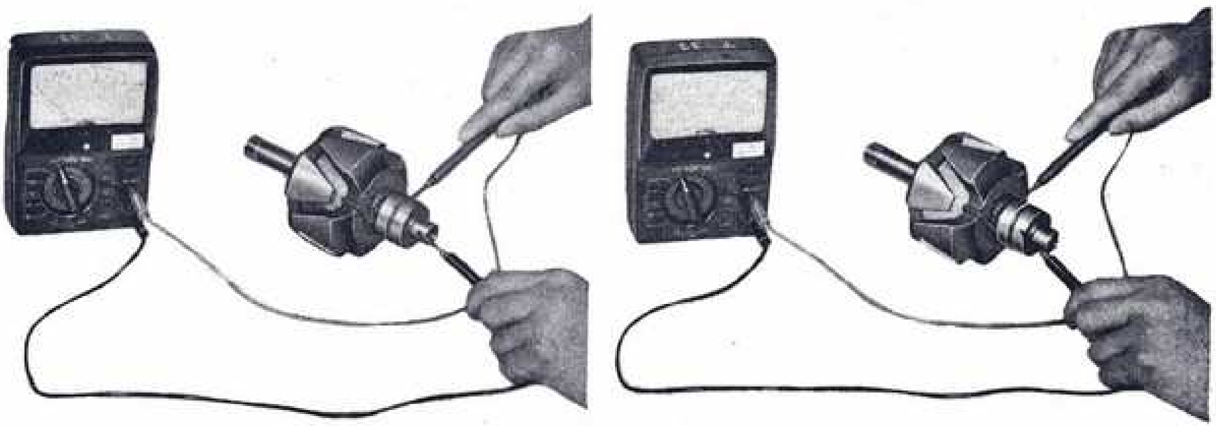


Fig. 2-3. 10

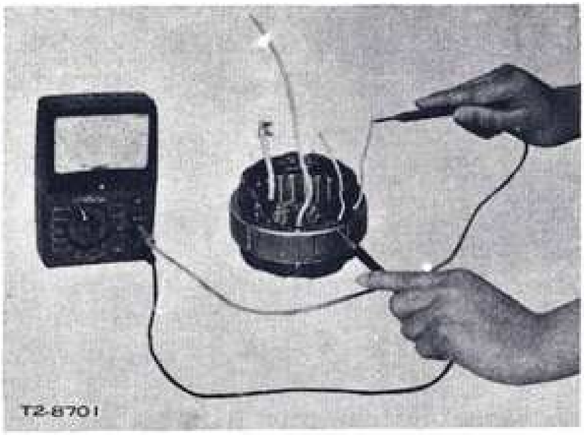
As shown in Fig. 3. 10, put the tester between the slip ring of rotor and if there are 6 ~ 7 Ω, it is all right. Make sure there is no conduction between the rotor slip ring and the shaft.

F. Ball Bearing

Both sides sealed ball bearing is used, so lubrication is not necessary.

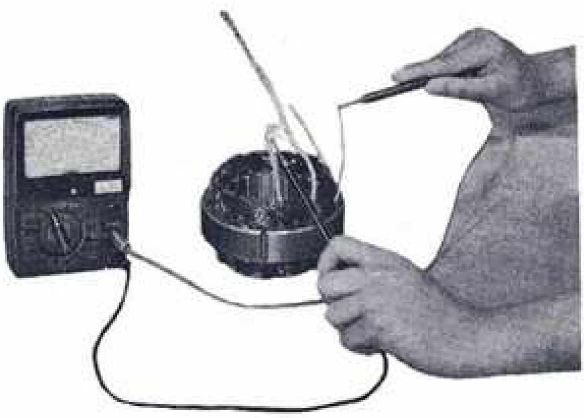
G. Inspection of Stator (Armature)

a) Conduction Test



If the terminal connected to the diode is not conductive with the stator core, that is all right.

Fig. 2-3. 11



If each terminal of the coil and the terminal connected to N terminal are not conductive, that is all right.

Fig. 2-3. 12

b) Layer Test

Connect the tester cord to 100V wire, put the stator on the test stand and make the tester one turn reading the ammeter. If there is short circuit on the coil, swings of the ammeter abruptly increase and if there is no trouble, there will be no change.

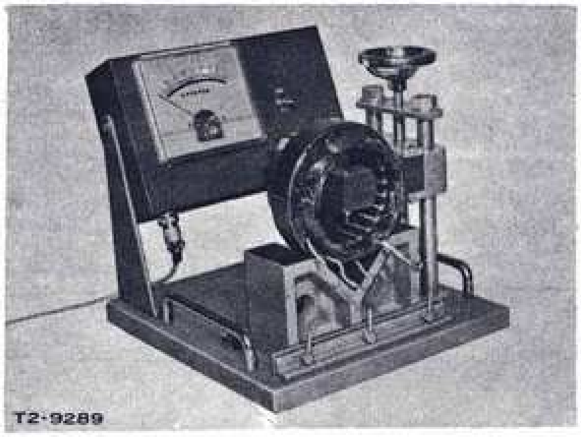


Fig. 2-3. 13

H. Inspection of Brush

Wipe with clean cloth when oil or dust is on the contact surface of the brush and slip ring.

Same as in case of DC generator, replace the brush when wear of it reached to the wear limit.

REGULATOR

Construction and Operation

(1) Construction

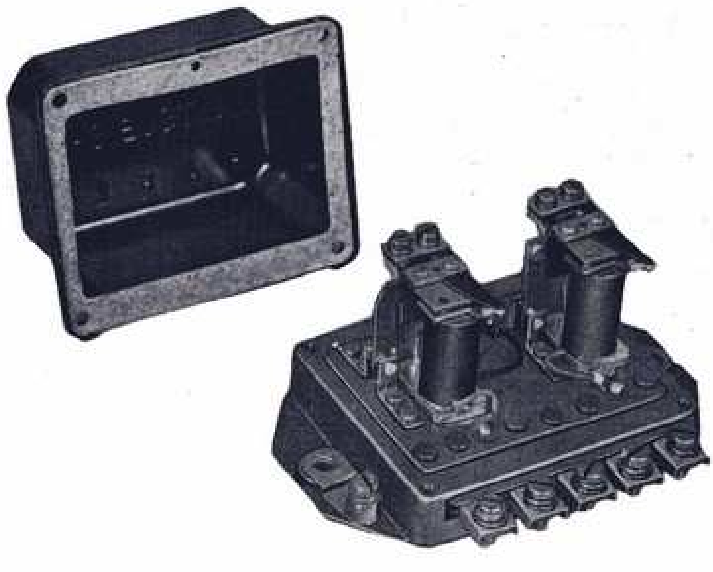


Fig. 3-1. 1

(2) Operation of Constant Voltage Relay

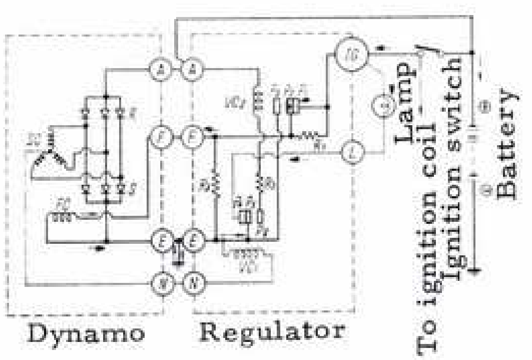


Fig. 3-1. 2

When the ignition switch is on, carrent from the battery passes through the dynamo E terminal, field coil, contact points P_2, P_1 and the dynamo is magnetized.

While it also frows the regulator E terminal, contact points P_5, P_4 and the lamp flares.

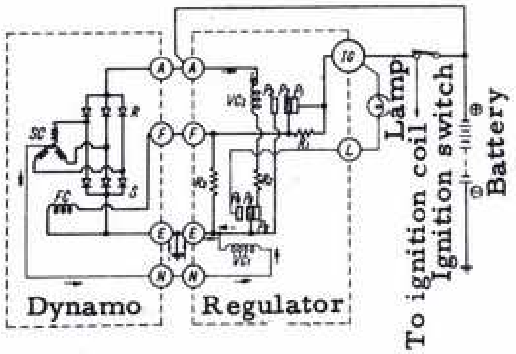


Fig. 3-1. 3

When the engine starts and the dynamo is driven, three phase alternate current generates on the stator coil, passing through the three phase all wave rectifier (diode) and changes to direct current between the terminal A - E for charging.

At the N terminal, voltage, half of that between A - E, generates and passes through the circuit, N terminal, VC_1, coil, E terminal and with action of the VC coil, the movable contact point P_5 leaves from P_4 and makes contact with P_6, so that the lamp is off and it passes through the circuit, E terminal, contact points P_5, P_6, resistance R_2, VC_2 coil and A terminal, then the VC_2 coil animated and prepares to vibrate the movable contact point P_2 of the constant voltage relay.

When the dynamo revolution gets higher, the contact point P_2 separates from P_1 with electric magnetism of the VC_2 coil and the field current from the circuit of the dynamo E terminal, field coil, F terminal and resistance R_1 and when the contact point P_2 contacts with P_1, the current flows through the circuit of dynamo E terminal, field coil, F terminal, contact points P_2, P_1. This is repeated according to vibration of the contact point P_2 and the dynamo terminal voltage is kept evenly and continues charging.

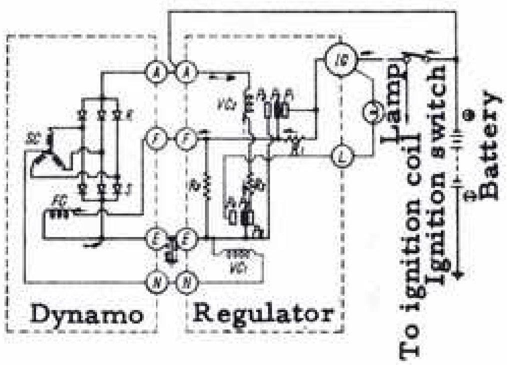


Fig. 3-1. 4

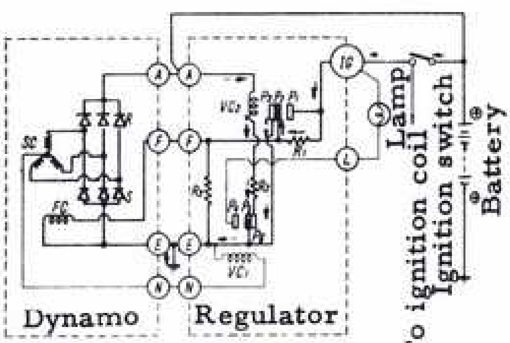


Fig. 3-1. 5

When the dynamo revolution gets still higher, the movable piece is drawn and the movable contact point P_2 sticks to P_3, so that current almost does not flow the field and the generated voltage of dynamo goes down. As the result, the contact point P_2 separates from P_3 and the current from through the dynamo E terminal, field coil, F terminal, resistance R_1 and voltage goes up again. At such a high speed, with open and close of the contact points, P_2 and P_3, the dynamo terminal voltage is always kept evenly.

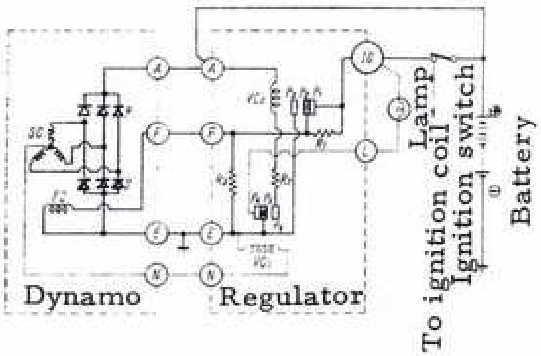


Fig. 3-1. 6

The operation of this time is called a high speed operation and the adjust voltage is colled a secondary voltage.

When the dynamo revolution goes down and charging capacity reduces, the voltage between the terminals, N - E, also lowers.

As the result, the electric magnetism of VC_1 coil weakens and the contact point P_5 fixed with the movable piece can not continue contact with P6 and changes to P_4 side and lights the lamp indicating non generation.

When the ignition switch is turned off to stop the engine, the lamp goes out and the current to the field coil is suspended.

(3) Operation of Pilot Lamp Relay

As shown in Fig. 3-1. 2, this is made up with the contact points, P_4, P_5 and P_6. The contact point P5 is on the movable side and usually makes contact with P_4. Between the terminals, N - E, the movable piece is drawn when voltage half of the battery is added and P_5 fixed to the movable piece separates from P_4 and makes contact to P_6. When the voltage between N - E terminals is conspicuously reduced, P_5 makes contact with P_4 again.

The voltage between N - E terminals necessary for P_5 to make contact with P_6 is "Put-off voltage" and that P_5 changes from P_6 to P_4 is "Put-on voltage".

Adjustment

(1) Check Adjust Value of Constant Voltage Relay

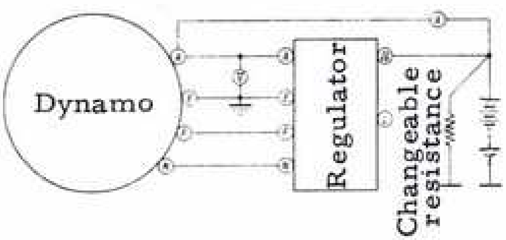


Fig. 3-2. 1

Connect the battery almost charged in full as shown, and make the dynamo revolution with 4000 rpm.

When the voltage of this time is 14 ~ 15V, it is all right.

(2) Check Voltage of Put-off, Put-on Pilot Lamp Relay

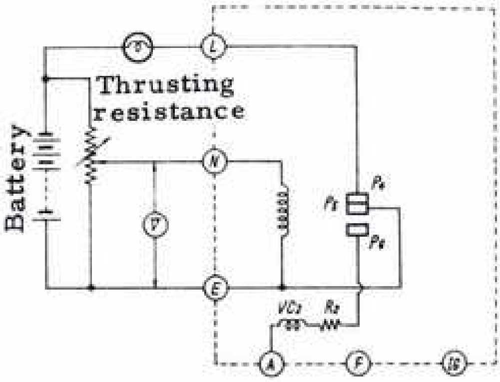


Fig. 3-2. 2

First, put on the lamp with connection as shown in Fig. 2. 2 and read the voltage between N - E by putting off the lamp moving the volt split point of the rubbing resistance. This is a put-off voltage.

From this state, mave the rubbing resistance volt-plit point and lower the voltage and read the voltage when the lamp frares.

This is a put-on voltage.

If the put-off voltage is 4.2 ~ 5.2V and the put-on voltage is 0.5 ~ 0.3V, it is all right.

(3) Adjustment of Gap (Constant Voltage, Pilot Lamp Relay)

The voltage adjust values of the constant voltage relay and the pilot lamp relay must be as shown in Fig. 2 · 3.

	Gap		
	G_1	G_2	G_3
Constant Voltage Relay	0.8 ~ 1.0	0.7 ~ 0.9	0.3 ~ 0.4
Polot Lamp Relay	0.8 ~ 1.2	0.8 ~ 1.1	0.8 ~ 1.1

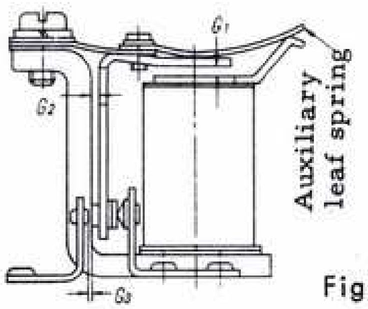


Fig. 3-2. 3

(4) Adjustment of Voltage

Put-off voltage of the constant voltage relay and pilot lamp relay.

Adjust the voltage by bending the stopper up and down. Bend upward to heighten adjust value and bend downward to lower adjust value.

14 ITEMS ON HANDLING

Prohibition	Reason
(1) When mounting on vehicle, polish the contact points on both sides removing point, rust or oil.	
(2) Make sure the engine side pitch and dynamo side pitch of the front cover are well fitted together.	
(3) Be attentive to the belt tension.	
(4) Regulator is sealed with lead. If the seal is removed during the claim period, the claim will invalid.	
(5) If the earth is not correctly set, the adjust value will change.	
(6) Connect the dynamo and battery with full attention.	When the battery poles are connected in reverse, large current flows from battery to dynamo, resulting in damages of diode or lead wire.
(7) Make sure the whole circuit is completely composed.	
(8) Change wiring with full attention.	When after the engine started the dynamo is magnetized from the ignition switch, so that incorrect wiring will result in hampering magnetization and then generation.
(9) Do not use the high voltage tester such as megger.	As diode is built in, the diode will be damaged with high voltage.
(10) Engine room must be kept in the condition of standard usage.	Because there is diode which will deteriorate or be damaged with temperature higher than the normal.

(11) Do not separate the battery terminal (dynamo A terminal) during driving vehicle.	Separation of the terminal causes serge voltage within battery and damages diode.
(12) When cleaning with steam cleaner, do not expose dynamo to steam directly. When washing with water, dynamo must be free from reckless pour of water.	If the diode is moistened, the performance will be lowered.
(13) When the battery is quickly charged with the quick charger, the lead wire ore regulator A terminal (dynamo A terminal) should be disconnected.	Serge voltage of the quick charger will also damage diode.
(14) Put the key switch off when the engine is in a stop except when porticularly needed.	When the key switch is on, magnetic current always flows on the field coil and might damage the dynamo and often causes over discharge of battery.

TROUBLE SHOOTING LIST

Trouble & Cause	Remedy
5- 1 Over-discharge of battery	
1. Slackness of fan belt	Adjust
2. Earth or breakage of stator coil	Repair or replace
3. Breakage of rotor coil	Replace
4. Mal-contact of brush and slip ring	Replace brush, clean holder
5. Mal-function of diode	Replace as a set.

6. Adjust voltage of constant voltage relay is low.	Readjust
7. Mal-contact of low speed side contact point of constant voltage relay.	Polish contact point.
8. Adherence of high speed side contact point.	Replace
9. Shortage or unfitness of electrolyte.	Add distilled water, check S.G.
10. Mal-function of battery pole. (short circuit)	Replace or repair
11. Mal-contact of battery terminal	Clean, retighten terminal
12. Mal-contact or breakage between ignition switch and relay IG terminal.	Repair
13. Mal-contact or breakage between regulator F terminal and dynamo F terminal.	Repair
14. Excessive electric load.	Chect power consumed
5- 2 Over-charge of battery	
1. Constant voltage relay adjust voltage is too high.	Readjust
2. Constant voltage relay coil breakage or rare short.	Replace
3. Constant voltage relay coil straight resistance breakage.	Replace
4. Constant voltage relay low speed side contact point adherence.	Replace
5. Constant voltage relay high speed side contact point mal-contact.	Polish contact point
6. Breakage or rare short of pilot lamp relay.	Replace
7. Mal-contact of pilot lamp relay contact point.	Polish contact point
8. Mal-function of regulator earth.	Adjust
9. Mal-contact or breakage between regulator N terminal and dynamo N terminal.	Repair
5- 3 Noises of Dynamo	
1. Mal-function of bearing.	Replace
2. Mal-function of diode.	Replace diode as a set.
3. Earth or rare short of stator coil.	Replace

STARTER MOTOR

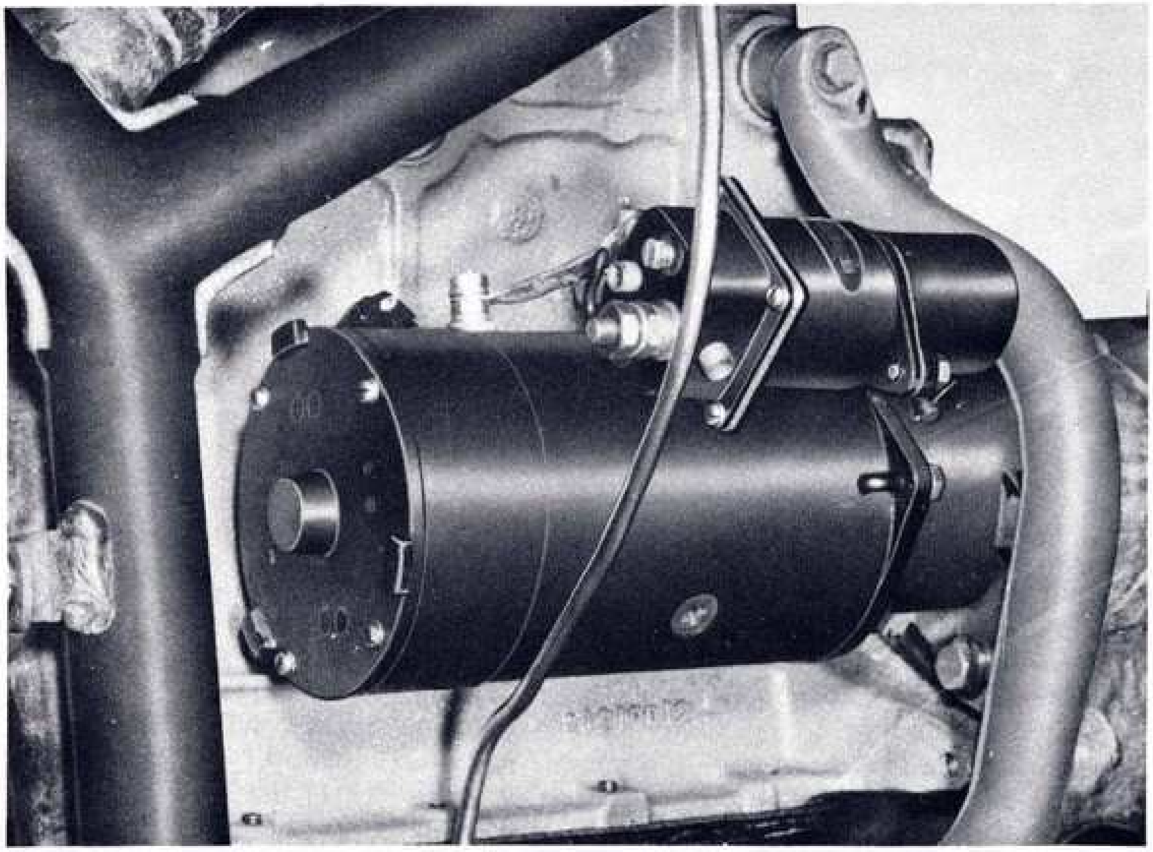
Type	S114-91A (23300 36901)
Voltage	12 volts
Output	(1.4 HP)
Starting current (Voltage)	Less than 500 amps. (9.5 Volts.)
Lock torque	Over 0.9 kg-m
Type of pinion gear	Bendex type
Number of tooth on pinion gear	9
Number of tooth on rign gear	120
Amendment limit of short dimension of shaft dia. (pinion side)	0.1mm (0.004 in)
Amendment limit of short dimension of shaft dia. (rear end)	0.1mm (0.004 in)
Gap between shaft and bush (pinion side)	0.038-0.095mm (0.0015-0.0038 in)
Amendment limit dittoed gap	0.2mm (0.008 in)
Gap between shaft and bush (rear end)	0.03-0.076mm(0.0012-0.0030in)
Amendment limit dittoed gap	0.2mm (0.008 in)
Gap between shaft and bush (rear end)	0.03-0.76mm(0.0012-0.0030in)
Amendment limit dittoed gap	0.2mm (0.008in)
Amendment limit of deflection on shaft	0.1mm (0.004 in)
Outer dia. of commutator	33mm
Amendment limit of short dimension	2mm (0.08 in)
Dittoed degree of real circle	0.05mm (0.002 in)
Dittoed limit of polarized wear	0.4mm (0.016in)
Bush length	14mm (0.551 in)
Amendment limit	9.5mm (0.374 in)
Brush spring tension	0.8kg (0.017 lb.)

Construction and Operation

The starter motor is a 1.4 horsepower sliding inertia type electric motor for use in starting. The motor when mounted on the engine is on the front right side of the transmission with its pinion gear directly opposite to the ring gear. The construction of the starter motor is similar to that of the generator but differs only in that its armature shaft extends out backwards with a pinion group installed on the end as shown in Fig. 1 & 2.

The connection diagram for the starter is shown in Fig. 3.

The starter switch is a key type combined with the ignition switch. By turning switch to the right direction, the relay on the magnetic switch move to permit current to flow to the starter and cause the armature to start turning suddenly. After advancing about 14mm., the pinion completes the meshing into the ring gear and drives it with a powerful torque. The direction in which the pinion moves is from the shaft towards the starter bracket, thus reducting the bending torque.



After the engine starts and its speed becomes greater than the no-load speed of the starter, the pinion is kicked back to unmesh and return to its former position.

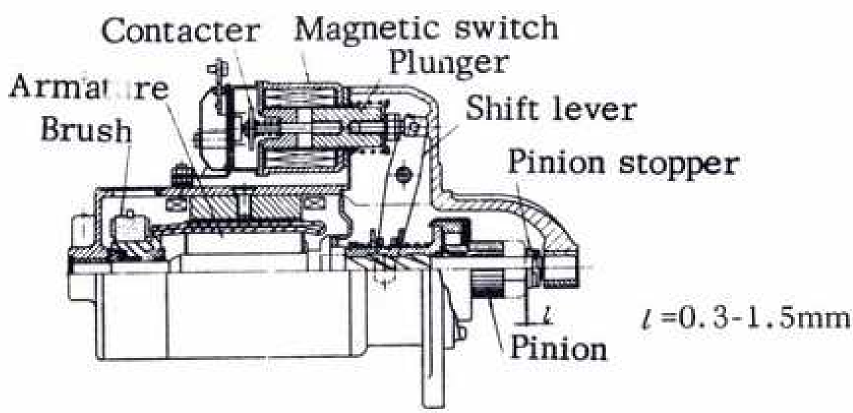


Fig. 1 Sectional view of magnetic shift type

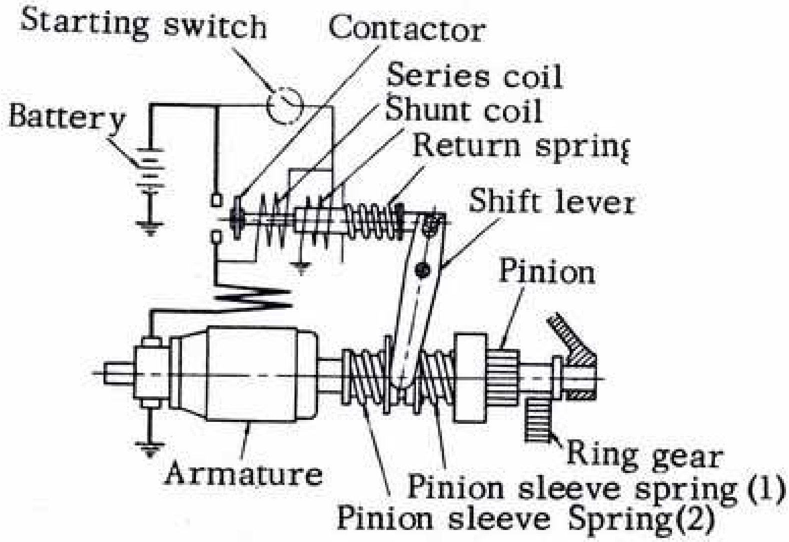


Fig. 2 View of starter system

Optional Precautions

The instructions to be observed when starting the engine are as follows:

(1) The starter should be securely mounted on the engine and should not show any looseness.

(2) The starter switch should be operated properly and should be released immediately when the engine starts.
Excepting in extremely cold weather, the engine should normally start within 10 seconds.

(3) The starter switch should not be operated when the engine is running. If the engine fails to start, allow time for the pinion to come to rest before turning the starter switch again.

(4) When the engine fails to start after turning the starter key for over 10 seconds, do not continue turning the key time after time but try to save the battery. In this case, check for the cause of the trouble and correct so that the engine will start.

Checking While in Operation

(1) With a fully charged battery and with the lamps lighted, the starter switch is used. If the lamps become dim, especially when the engine does not start, the current is flowing through the starter motor coil but for some reason the armature is not turning. Careful check should be made since the starter pinion may be locked in the flywheel ring gear and unable to return, a trouble usually caused by turning on the starter while the engine is still running.

(2) When the starter switch is turned up and the starter motor fails to turn although the lights remain bright, the switch should first be checked. If the switch is in satisfactory condition, then the condition of all the terminal and ground connections of the battery, starter switch and starter are checked.
If the starter motor runs but its movement is sluggish, it indicates either a high resistance due to loose connection in the starter circuit or a badly discharged battery.

(3) If after the above troubles are corrected and the starter fails to operate occasionally and shoes defective performance, it is due to internal defects so in this case, it should be dismantled and checked.

Dismantling and Disassembling

(1) The starter can be dismantled easily by removing the two stud nuts mounting the starter on the engine.

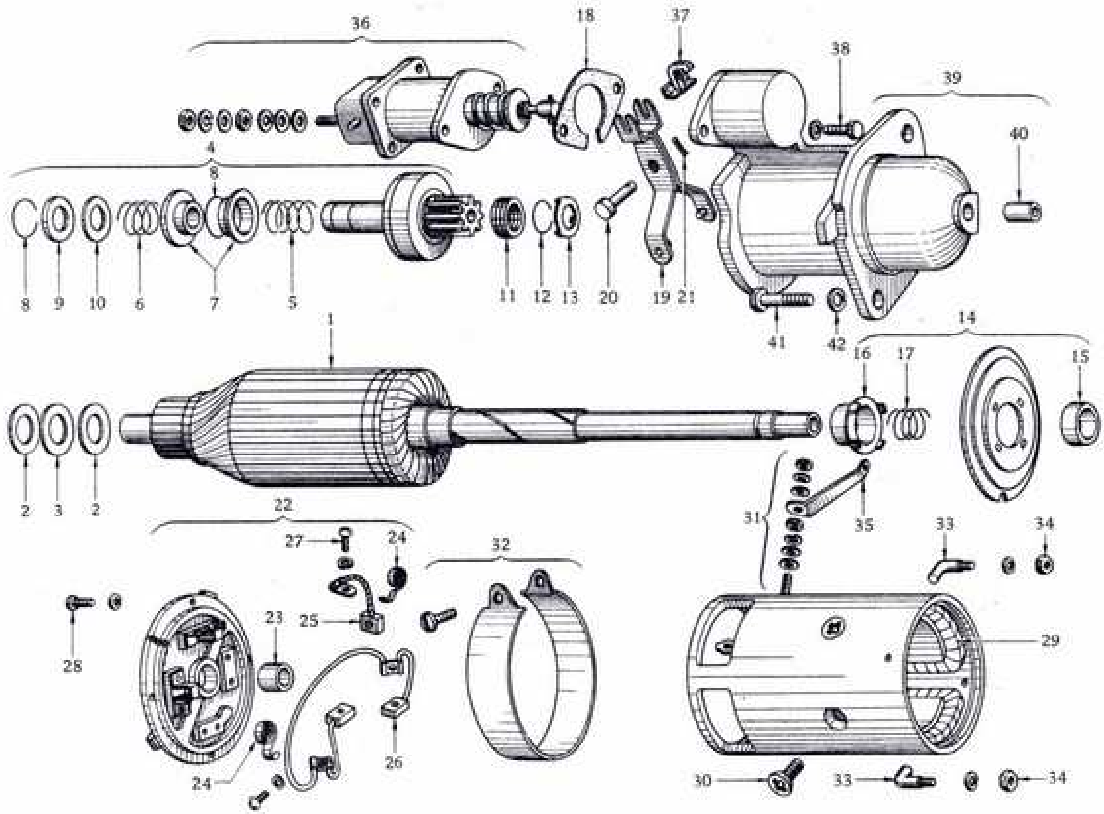
(2) The two stay bolts on the starter rear cover (front end when mounted on the engine) are removed.

(3) After removing the band cover, the brushes and lead wires are removed.

(4) By properly protecting and holding the starter body, the armature shaft is pulled out.

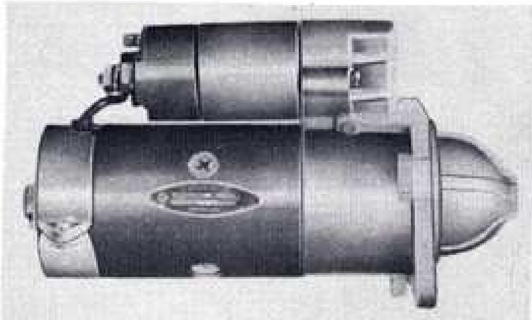
(5) The armature and the front cover are taken out together.

(6) To remove the pinion group from the armature shaft, the cotter pin on the end of the shaft is pulled out and by removing the pinion nut, the pinion group is removed.

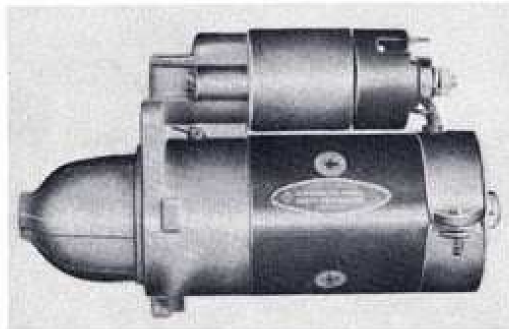


1.	Ass'y-armature	22.	Ass'y-cover, rear
2.	Washer-thrust	23.	Bearing-metal
3.	Washer-thrust	24.	Spring-brush
4.	Ass'y-pinion & clutch	25.	Brush (-)
5.	Spring-pinion sleeve (No. 1)	26.	Brush (+)
6.	Spring-pinion sleeve (No. 2)	27.	Screw (3 ϕ)
7.	Sleeve-pinion	28.	Screw (4 ϕ)
8.	Clip-sleeve pinion	29.	Ass'y-coil, field
9.	Stopper-spring sleeve	30.	Screw-set, pole core
10.	Washer-pinion	31.	Ass'y-terminal
11.	Stopper-pinion	32.	Ass'y-cover, brush
12.	Clip-stopper, pinion	33.	Bolt-joint
13.	Washer-stopper, pinion	34.	Nut
14.	Ass'y-bearing, center	35.	Plate-connecting
15.	Bearing-metal, center	36.	Ass'y-switch, magnetic
16.	Brake	37.	Cover-dust
17.	Spring-brake	38.	Bolt (5 ϕ)
18.	Cover-dust	39.	Ass'y-case, gear
19.	Ass'y-lever, pinion shaft	40.	Bearing-metal
20.	Pin-lever, shift	41.	Bolt } to fix
21.	Pin-cotter	42.	Washer-lock } starter motor

Fig. 3 Component of starter motor

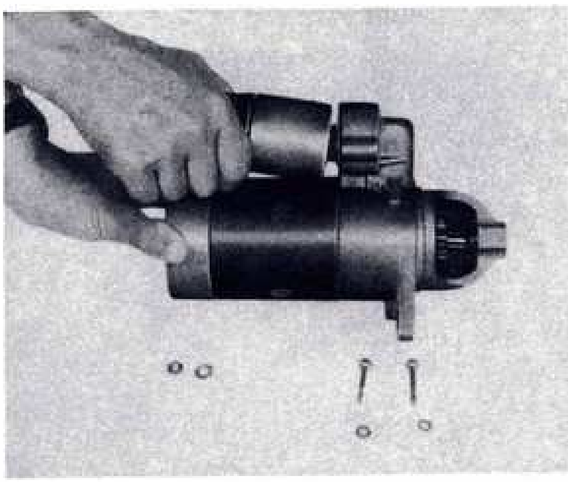


S114-91A type (Aluminum die cast)
Weight=5.4 kg

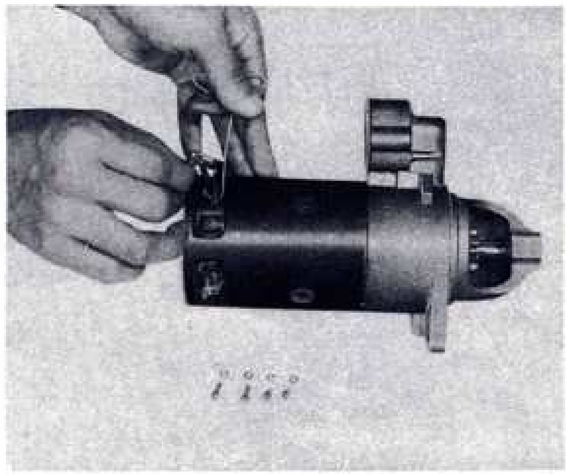


S114-71 type (Cast iron)
Weight=6.8 kg

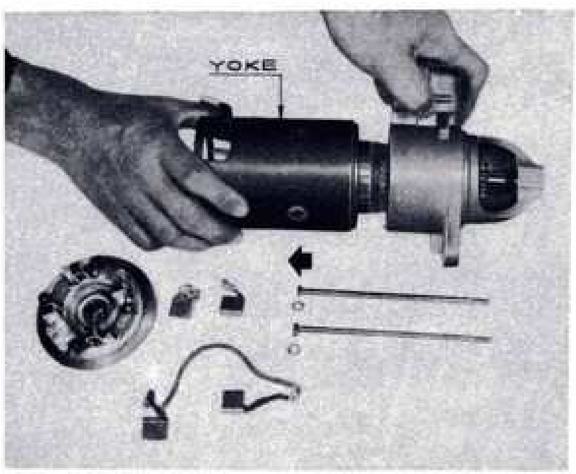
Diassembling order



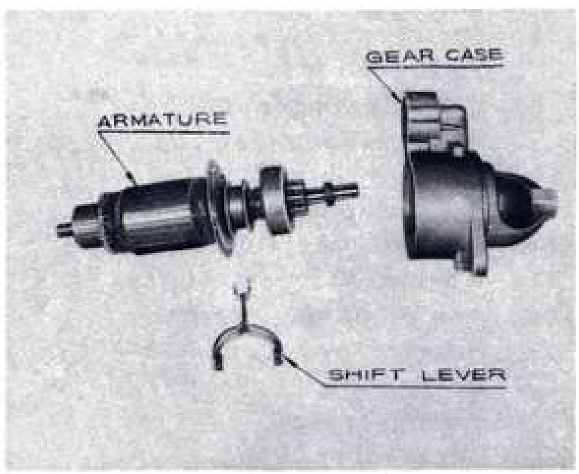
Remove the magnetic switch



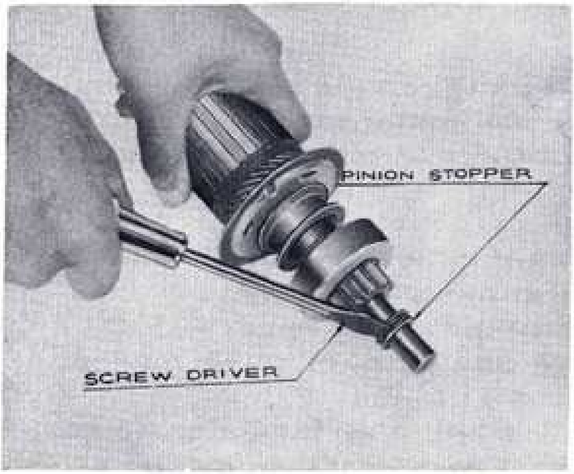
Draw out the brushes from body after removing fixed screws



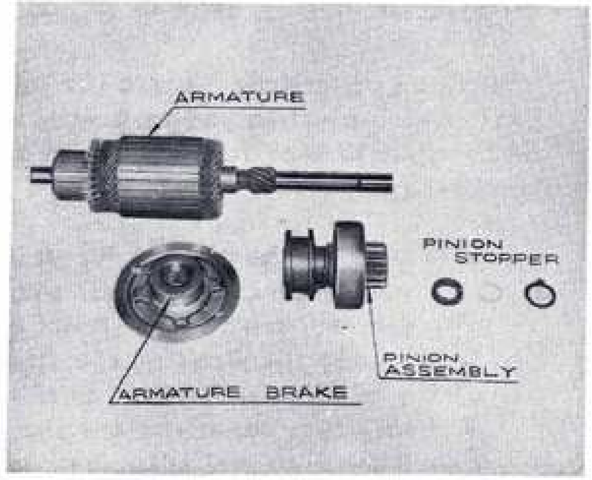
Draw out the yoke from the gear case



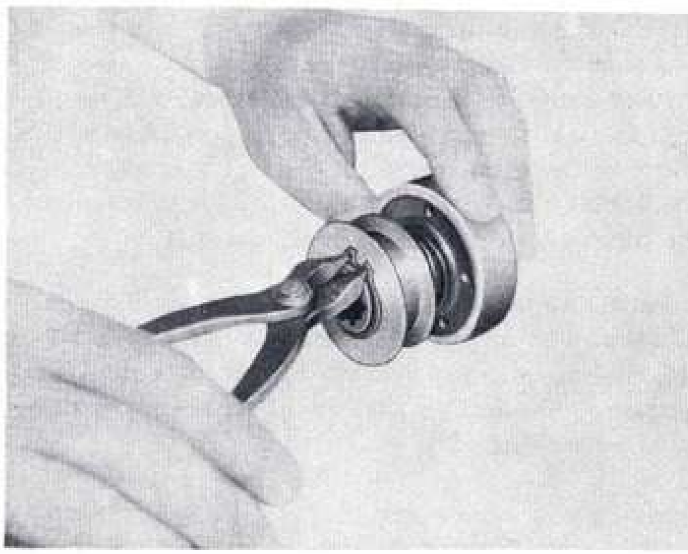
Separate for the armature and gear case



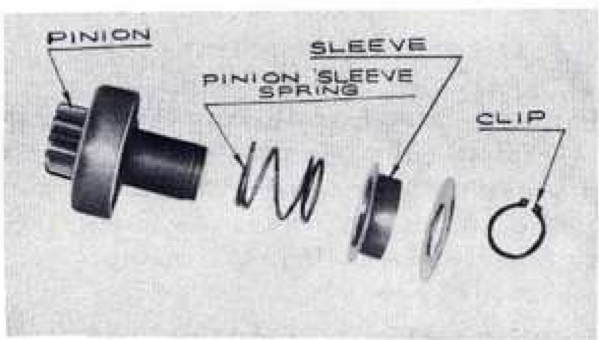
Take off the pinion stopper



Disassemble the srmature



Remove the pinion clip



Components of pinion

Assembling will be done in reverse order of these course.

Inspection and Repairing Parts

The same procedure as that for the generator parts is followed, the parts being cleaned and inspected after which determinations are made as to whether they can be reused or if repairs or replacements are necessary.

(1) The pinion is inspected for defects and if the tooth face is worn or the tooth edge is demaged, the pinion should be replaced. Worn or broken teeth will not only make the gear mesh poorly but will hasten the wear on the opposing gear and also, poorly meshing gears will cause bending in the armature shaft. For this last reason, care should be taken, when inspecting, to also check the flywheel and take remedial measures if the ring gear is cound worn or damaged. When the pinion is found defective, replaced the entire pinion group.

(2) When inspecting the armature, check the armature to core gap, shaft to bushing clearance, bending in shaft, etc., in the same manner as that for the generator and are corrected to the specified limits, or the armature is replaced. Special attention should be given to the clearance between the armature and the core to see that they are not contacing, and corrósion found on the outside surface of the armature or the inner surface of the core should be removed by polishing, and the surfaces painted with rust preventive oil.

(3) The armature is inspected and repaired in accordance with the procedures outlined for the generator. Especially to improve or correct the brush contacing condition, the brushes are reseated. At the same time, the brush and brush spring are checked and are corrected or replaced.

(4) The insulation on the wires are carefully inspected and wires found with weak or damaged insulation should be replaced.

(5) An armature found with one part especially damaged by buring should be strictly tested by the insulation test.

Assembling and Testing Starter

Reassembling is performed by following the reverse procedure for disassembling. All frictional parts are lubricated with mobile oil (SAE 30) while the bearings are coated with a small amount of grease circuit in the magnetic switch and causes the main circuit S_2 in the magnetic circuit to close. Releasing the starter switch opens the magnetic circuit which also opens S_2.

(1) Causes for magnetic switch failling to operate can be divided into electrical and mechanical sources.
Causes for electrical troubles.

(A) Current failure in magnetic circuit.

When the starter switch in pressed and the current falls to pass through the magnetic circuit, most of the trouble is due to broken soldered connection between the magnetic coil wire add the magnetic switch body.

(B) Defective contact in main circuit S_2.

When the magnetic circuit is satisfactory and S_2 is closing but only a small current flowing due to high contact resistance, and the opposite case of switch S_1 opening but S_2 remaines closed.
In either case, the trouble lies in the faulty moving of the core or roughness of the contacing point surface. Therefore polished the surface well, then the operation will become satisfactory.
Causes for mechanical troubles.

Failure to operate is caused in many cases by the guide shaft on the moving core of the magnetic switch main circuit S_2 sticking against the cover hole. Correction can be made in this case by loosening the cover screws (4 pieces) and retightening them so that the shaft moves freely.

(2) Precaution.
In removing nuts from the magnetic switch main circuit terminals when installing or removing cables, the lower nut of the double nuts should be kept in a tightened state while unscrewing. If the lower nut is loose, the terminal bolt may turn together and ground the terminal to the cover and cause damage.

Starter Troubles, Their Causes and Remedies

The following is a list of troubles which can be determined from the state the starter is installed on the engine.

(1) Starter fails to turn.
The engine is checked to see if it can be cranked by hand.
If it cannot be cranked, the enigne is at fault and should be checked.
If it can be cranked easily, the starter including the wiring should be checked and corrections made accordingly.
Is the battery run down? Check the specific gravity of the battery fluid to see if it is over 1.240 and recharge or replace the battery as found necessary.
All loose battery and ground cables should be cleaned and properly tightened.
(Magneto grease or Gargoyle (BRB No. 1). All cord connections are carefully tightened and special attention given to the condition of insulation.
The assembly check is made by testing the starter as a single unit using a fully charged bat-

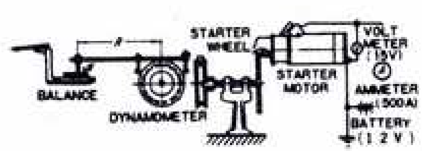


Fig. 4
Torque testing apparatus

tery. Tests are made with a starter motor tester or with the apparatus shown in Fig. 4 by which braking torque is measured. In this case, the normal value should be 0.9m-kg.
To test the starter motor when installed on the engine, the engine is first warmed up. Then with the throttle valve in fully closed position the starter is actuated.
In addition, if a starter motor tester is used, performance tests can be made easily and accurately.

Construction of Magnetic Switch and Instructions

The magnetic switch is an apparatus when the engine is being started by shift lever, serves to close the circuit between the battery and the starter motor, and permits a large current to flow and actuate the starter motor.
After starting or when the engine is stopped, the switch serves to keep the circuit open. The principles of operation can be seen from Fig. 5. Closing the starter switch S_1 allows the current to flow through the magnetic.

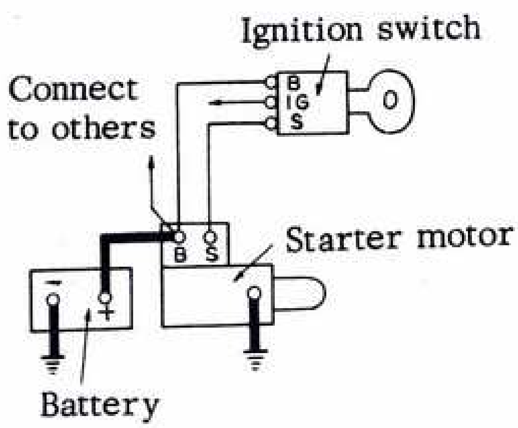


Fig. 5 Magnetic starter circuit

If there is trouble in the magnetic circuit, it should be corrected.
For improperly contacting starter brushed, the brushes together with the armature should be checked, and correctiobs or replacement made as found necessary.

If all of the above checks with their corresponding repairs have been made and the starter still fails to operate, the trouble can be assumed to be in the starter itself so that it should be removed from the engine and checked.

This is exceedingly rare but care should be taken to see that the starter pinion is not locked into the flywheel ring gear. Cases like this

TRANSMISSION

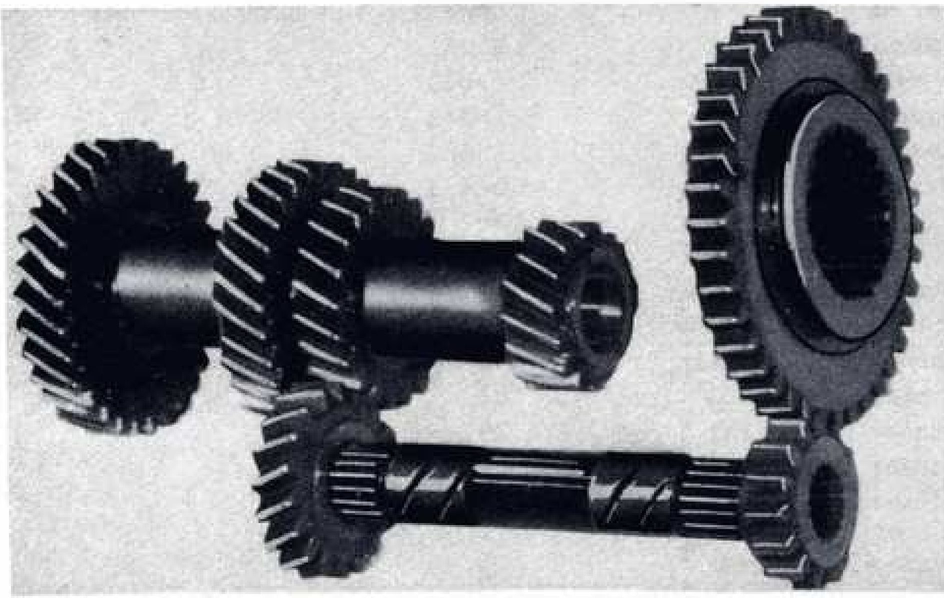
GENERAL DATA

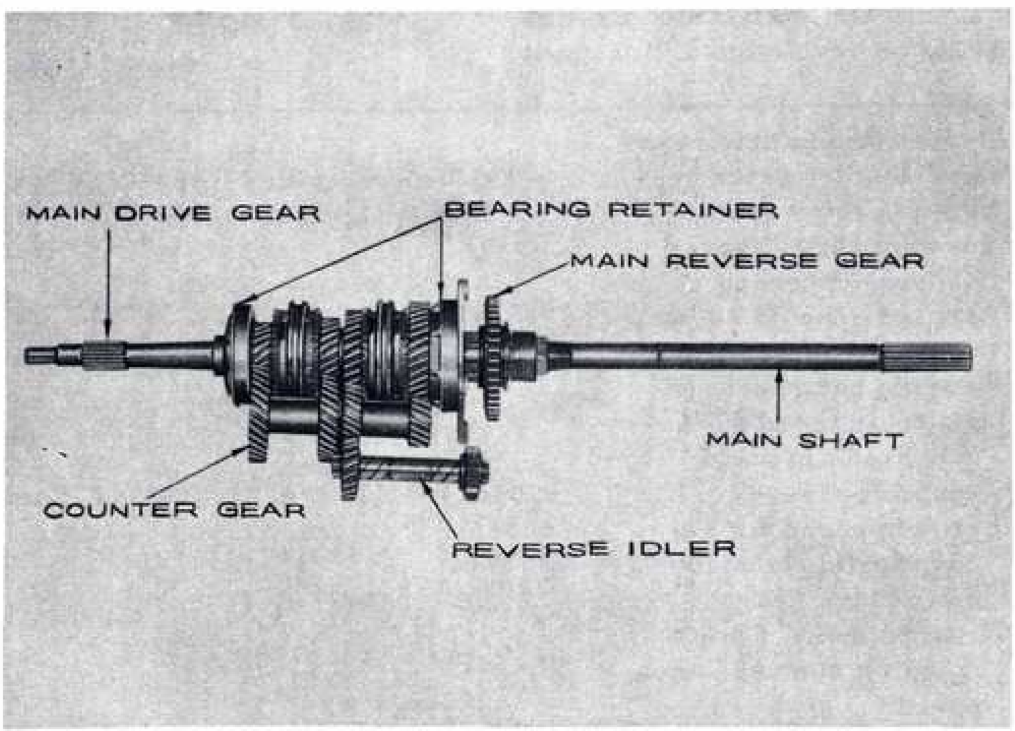
Model	4 stages for forward, 1 stage for reverse remote controled Synchro-meshed for speed # 2.3 & 4
Type of gear	Synchro-meshed helical gear type
Speed #1	3.382
Speed #2	2.013
Speed #3	1.312
Speed #4	1.000
Reverse	3.364
No. of tooth of gear	
Main drive gear	22
Main shaft 3rd gear	27
Main shaft 2nd gear	30
Main shaft 1st gear	36
Counter drive gear	31
Counter third gear	29
Counter second gear	21
Counter first gear	15
	14
Reverse idler gear	18

BACKLASH OF VARIOUS GEARS
(Play on revolutional direction)

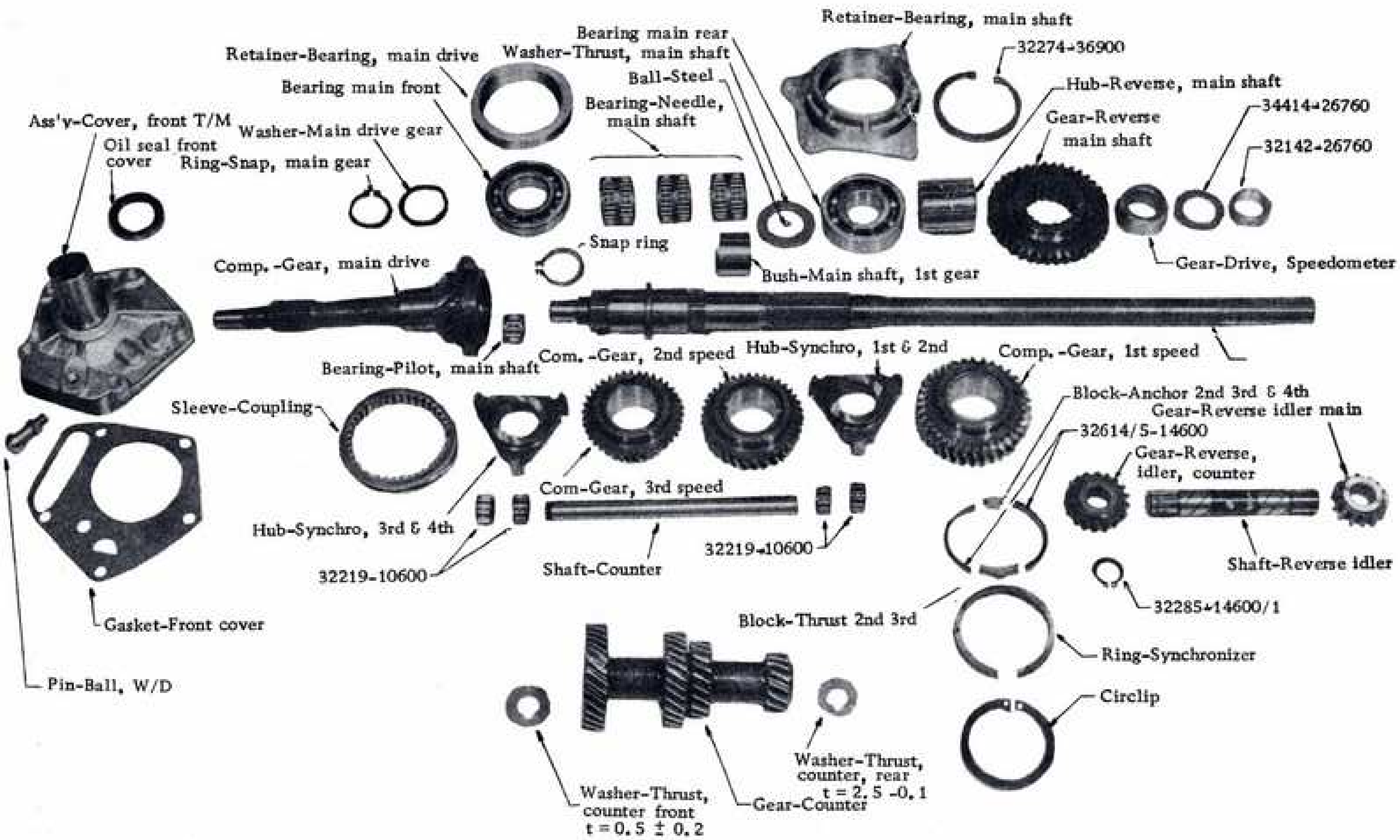
Between main drive gear and counter drive gear	0.075-0.125 mm	(0.003-0.005 in.)
Between third gears	0.075-0.125 mm	(0.003-0.005 in.)
Between second gears	"	(")
Between low gears	"	(")
Between speed # 3 & 4 Synchronizers and main	0.03-0.12 mm	(0.0014-0.0048 in.)
Between peripheral gears of speed # 3 & 4 synchronizers and coupling sleeve	0.075-0.125 mm	(0.003-0.005 in.)
Between speed # 3 & 4 coupling sleeves and main drive gear	"	(")
Between speed # 3 & 4 coupling sleeves and speed # 3 gear	"	(")

Between speed # 2 synchronizer and main shaft spline	0. 003-0. 12 mm	(0. 0014-0. 0048 in.)
Between # 2 synchronizer and speed # 1 gear	0. 075-0. 125 mm	(0. 003-0. 005 in.)
Between speed # 1 gear and speed # 2 gear	0. 075-0. 125 mm	(0. 003-0. 005 in.)



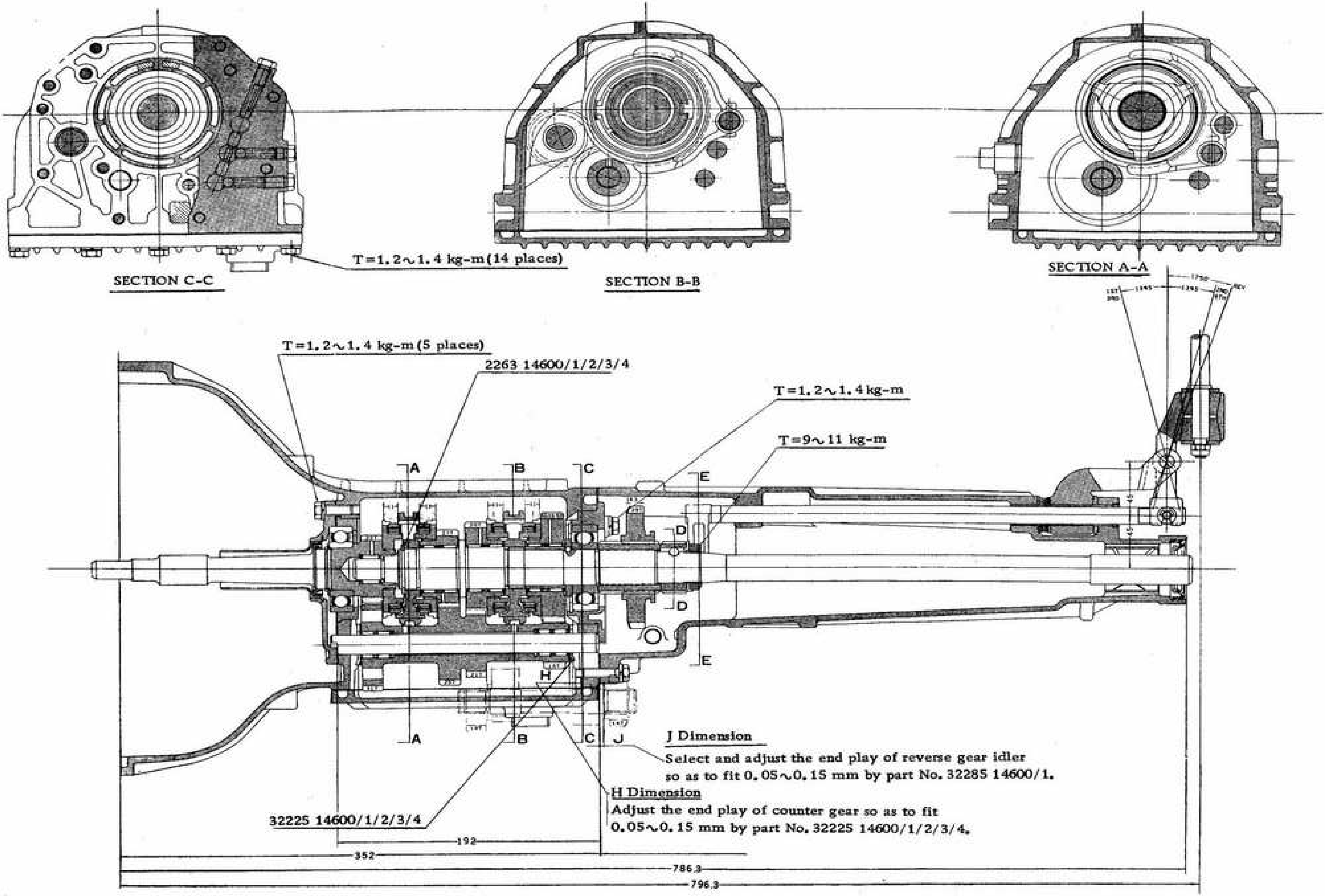


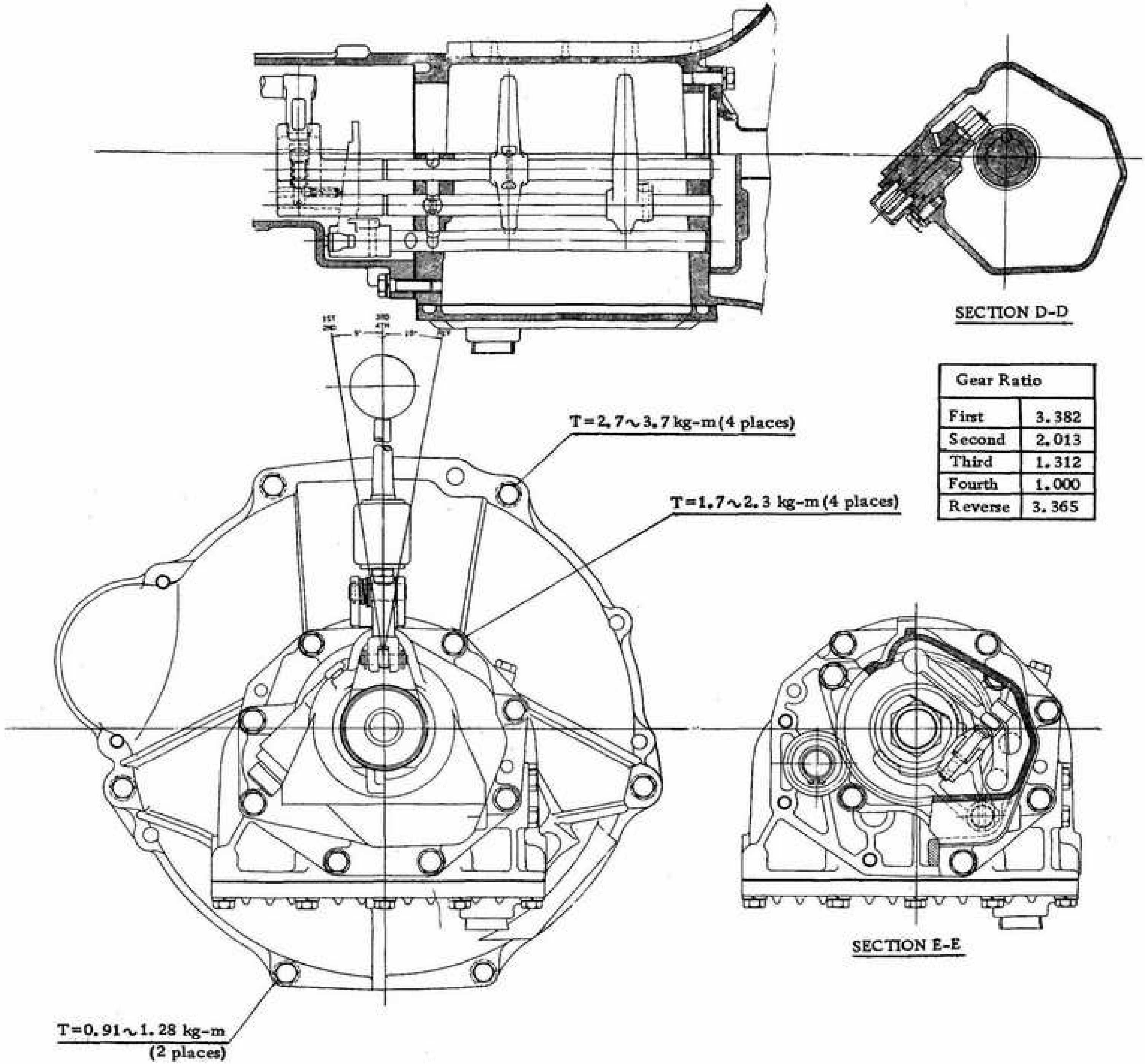
Reverse Idler & Main Shaft Reverse Gear



Component of Transmission Cace

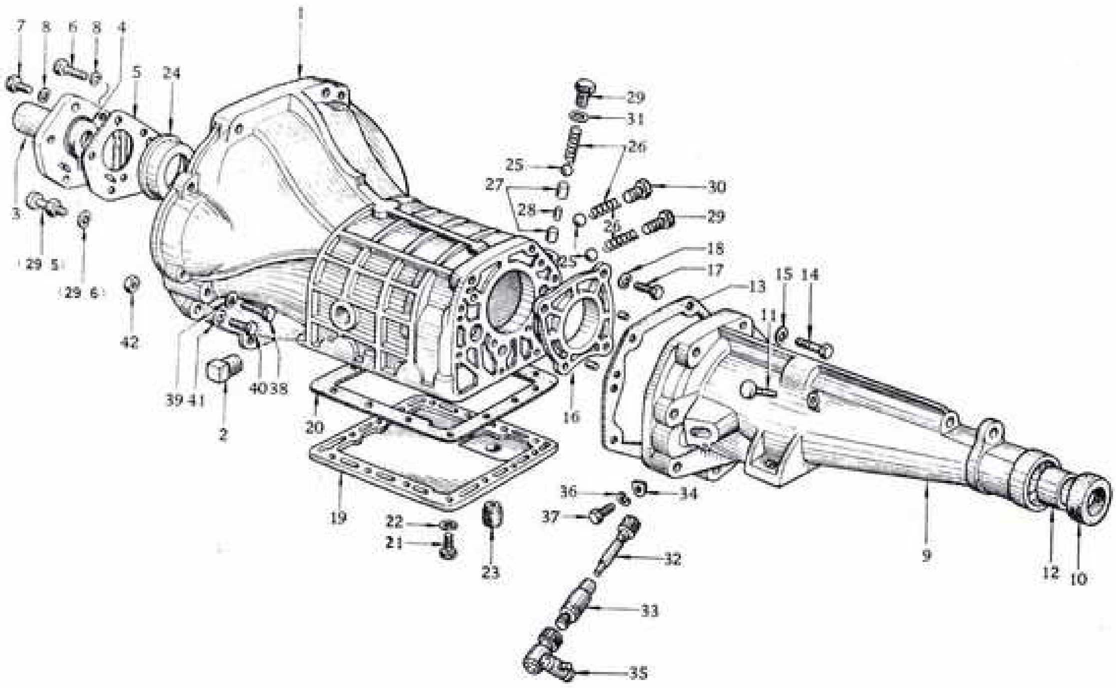
SECTIONAL VIEWS OF TRANSMISSION





Gear Ratio	
First	3.382
Second	2.013
Third	1.312
Fourth	1.000
Reverse	3.365

T = Tightening Torque



1. Ass'y-transmission
2. Plug-taper thread
3. Cover-front, transmission case
4. Seal-oil, front cover
5. Gasket-front cover
6. Bolt
7. Bolt
8. Washer-spring (6–8: to fix front cover)
9. Ass'y-extension, rear
10. Seal-oil, rear extension
11. Ass'y-breather
12. Bush-striking rod
13. Gasket-rear extension
14. Bolt
15. Washer-spring (14–15: to fix rear extension)
16. Retainer-bearing, main shaft
17. Bolt
18. Washer-spring (17–18: to fix bearing retainer)
19. Cover-bottom, transmission case
20. Gasket-bottom cover
21. Bolt
22. Washer-spring (21–22: to fix bottom cover)
23. Ass'y-plug, drain
24. Retainer-bearing, main drive
25. Ball-checking
26. Spring-checking ball
27. Plunger-inter lock
28. Pin-inter lock
29. Plug-checking ball
30. Plug-checking ball
31. Washer-plain
32. Ass'y-pinion, speedometer (17 t)
33. Ass'y-sleeve, speedometer pinion
34. Plate-lock, speedometer sleeve
35. Adapter-speedometer pinion
36. Washer-spring
37. Bolt
38. Bolt
39. Washer-spring
40. Bolt
41. Washer-spring
42. Nut (37–42: to fix transmission)

Transmission case

DISASSEMBLING THE CASE

First drain the oil from the transmission by removing the drain plug. The drain plug is situated beneath the case at the left-hand side.

Clutch Withdrawal Lever

Bend back the lock washer, remove the nut its spring washer, and screw the bolt out of the bracket. The leg of the clutch withdrawal support bracket on the steering part of the car is threaded; do not therefore, try to knock the bolt out, or the threaded in the support bracket will be stripped. Screw the bolt out. Detach the rubber dust cover around the withdrawal lever from within the clutch housing.

Removel of Control Lever

Twist the cap on the lower portion of the control lever as illustrated in Fig. 2 counter-clockwise with a slight downward pressure.

Removel of Shift Rod & Shift Fork

Remove the cover from the transmission by detaching 6 bolts.

Reverse Gear

A lug, which is an integral part of the main casting locates the forward end of the reverse gear shaft. To secure the shaft in position, a setpin is screwed through the lug locating in the shaft. The setpin is locked by a tab washer. Straighten the tab washer, release the setpin, then tap forward and remove the reverse gear shaft. Lift out the reverse gear.

Countor Shaft & Gear

Using soft metal dirt, drive the counter shaft forward and out of case, when the counter gear cluster and two thrust washers will drop to the bottom of the case.

These gears can only be lifted from the casting when the main and drive shafts together with their respective gears, have been removed.

To remove the cage of needle roller bearing within the counter gear cluster.

Main Shaft

The main shaft can now be withdrawn from the transmission casing. To remove the gears from the main shaft first slide off the third and fourth speed synchronizer assembly, then with a piece of wire inserted through the hole in the gear cone, depress the small spring loaded plunger which locates the splined washer at the forward end of the main shaft, turning the washer into line with the splines. The third and second speed constant mesh gears, together with their common phosphor bronze sleeve, can now be pulled over the steel plunger and so clear of the main shaft. As the phosphor bronze sleeves and their common driving washer are a tight fit on the shaft, the shaft should be immersed in warm oil in order to expand the sleeves so that they will slide off the shaft, when the second speed gear can be removed. Take out the steel plunger and spring.

Next remove the splined washer separating the second speed constant mesh gear assembly from the first gear unit, and then slide the first gear assembly free of the main shaft. To release the speedometer wheel from the main shaft, straighten the tab washer and unscrew its securing nut, then slide the speedometer wheel off the shaft. Do not lose the key. Take off the distance piece, and the main shaft bearing, can be separated from its housing after the nut has been prised from the shaft.

If it is desired to dismantle the fourtheand third speed coupling sleeve, or the first speed gear, these can be pressed clear of their splined synchronizers, but care must be taken to retrieve the three balls and springs in each assembly. Take out the main shaft front needle roller bearings from the end of the drive gear shaft.

Rear Oil Seal

This oil seal is situated in the end of the rear cover and should not be dismantled unless suspected of leaking. It is almost impossible to take off the seal without damaging it; consequently a new oil seal should be fitted if the old one has been moved. It will be seen that the oil seal housing is pinched into position. This can be removed by using a punch and hammer.

Drive Gear Shaft

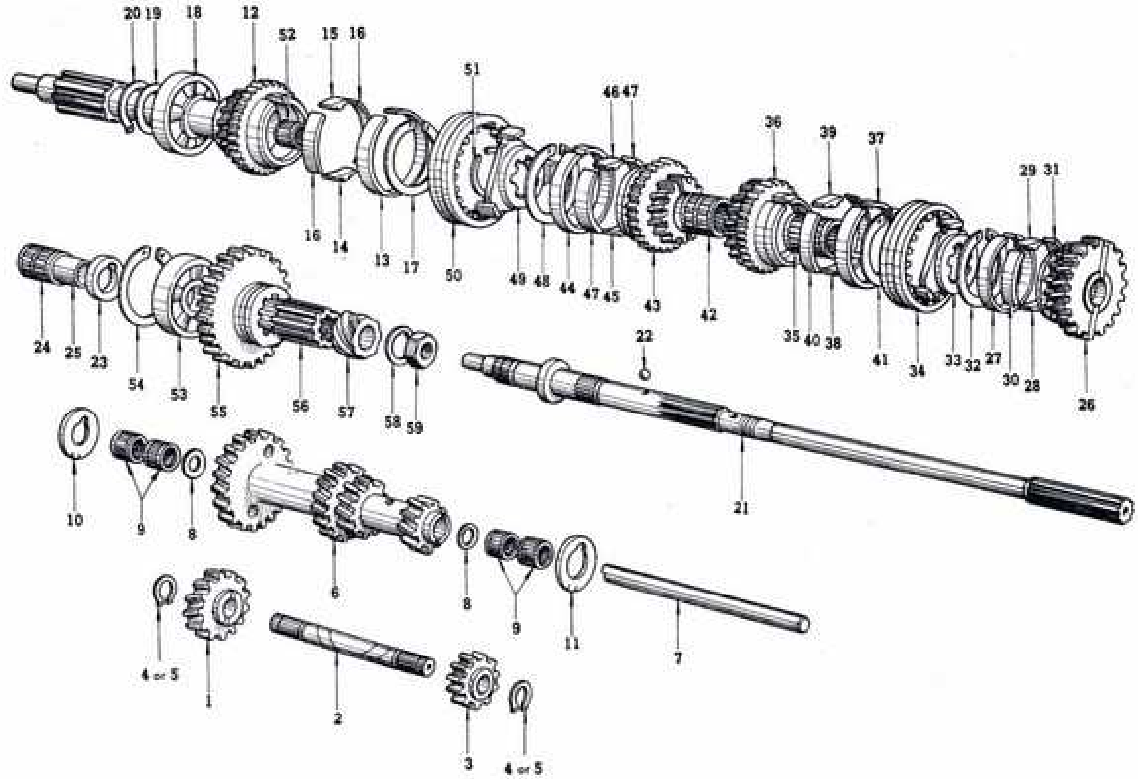
Before driving the drive shaft from its position, tilt the counter gears, now in the bottom of the case, to clear the drive shaft gear. Using a long drift, inserted through the main shaft opening, drive the drive shaft forward, complete with bearing and circlip, from the case.

The counter gears may now be removed from the case.

To remove the bearing from shaft, knock back the tab locking washer and unscrew the shaft nut. This nut has a left-hand thread.

The bearing can now be driven from the shaft, preferably by resting the circlip of the outer race on the jaws of an open vice and driving the shaft downward.

Use a hide or lead hammer for the operation, as great case must be exercised to prevent the end of the gear shaft from spreading.



1. Gear-reverse idler counter
2. Shaft-reverse idler
3. Gear-reverse idler, main
4. Ring-snap, reverse idler
5. Ring-snap, reverse idler
6. Gear-counter
7. Shaft-counter
8. Ring-counter shaft
9. Ass'y-bearing, needle
10. Washer-thrust, counter, front
11. Washer-thrust, counter rear
12. Comp.-gear, main drive
13. Ring-synchronizer
14. Block-thrust, 2nd, 3rd & 4th
15. Block-anchor, 2nd, 3rd & 4th
16. Band-brake, 2.5
17. Circlip
18. Bearing-main drive gear
19. Washer-main drive gear
20. Ring-snap, main drive gear
21. Shaft-main
22. Ball-steel (5/32)
23. Washer-thrust, main shaft
24. Bearing-needle, main shaft
25. Bush-main shaft, 1st gear
26. Comp.-gear, 1st speed, main shaft
27. Ring-synchronizer
28. Block-thrust, 1st
29. Block-anchor, 1st
30. Band-brake, 2.5
31. Band-brake, 2.2
32. Circlip
33. Hub-synchronizer, 1st & 2nd speed
34. Sleeve-coupling
35. Bearing-needle, main shaft
36. Comp.-gear, 2nd speed, main shaft
37. Ring-synchronizer
38. Block-thrust, 2nd, 3rd & 4th
39. Block-thrust, 2nd, 3rd & 4th
40. Band-brake, 2.5
41. Circlip
42. Bearing-needle, main shaft
43. Comp.-gear, 3rd speed, main shaft
44. Ring-synchronizer
45. Block-thrust, 2nd 3rd & 4th
46. Block-anchor, 2nd, 3rd & 4th
47. Band-brake, 2.5
48. Circlip
49. Hub-synchronizer, 3rd & 4th speed
50. Sleeve-coupling
51. Ring-snap, synchronizer, hub
52. Bearing-pilot, main shaft
53. Bearing-main shaft
54. Ring-snap, main shaft bearing
55. Gear-reverse, main shaft
56. Hub-reverse, main shaft
57. Gear-drive, speedometer
58. Washer-lock, main shaft
59. Nut-main shaft

Transmission gears

ASSEMBLING THE TRANSMISSION

Synchromesh Sub-Assembly

During manufacture 2nd speed gear, the third and fourth speed coupling sleevs are each paired with their respective synchronizers.
Only mated pairs of these parts should therefore fitted.

Counter Shaft Gears

First locate the two thrust washers to the counter gears, ensuring that the larger washer is at the front, and then place the gear cluster in the gear case.

Check that there is end play for the cluster gears of between 0. 04 - 0. 06 mm. (0. 0015- 0. 0023), and remedy if necessary by fitting a thicker or thinner rear washer.

Thickness of front thrust washer

3. 91-3.'96 mm (0. 154-0. 156 in.)

Thickness of rear thrust washer

3. 96-3. 91 mm (0. 156-0. 154 in.)
4. 013-3. 988 mm (0. 1580-0. 1569 in.)
4. 089-4. 064 mm (0. 161-0. 160 in.)
4. 166-4. 140 mm (0. 164-0. 163 in.)
0. 04-0. 06 mm (0. 0015-0. 0023 in.)

Temporarily replace the counter shaft with a thin rod which will permit the gear cluster to remain out of mesh with the main and drive shaft gears.

Drive Gear Shaft

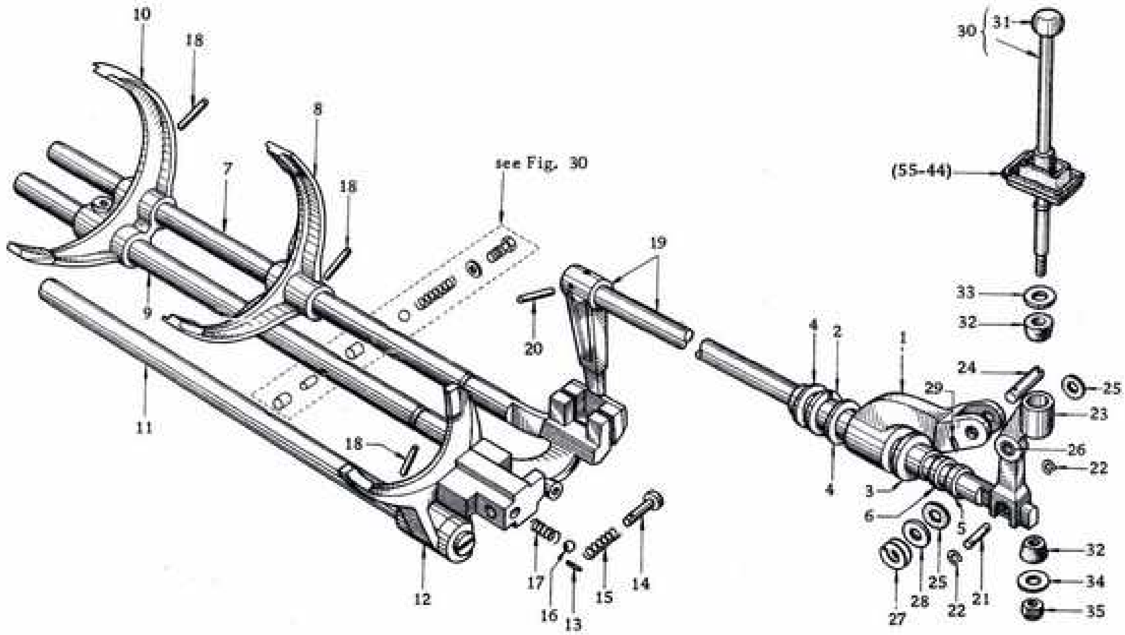
The ball journal bearing should now be drifted on to the shaft, with its spring ring away from the geared end. Position the geared end of the drive shaft in a dummy 3rd and 4th speed coupling sleeve, put the washer over the bearing, tighten the nut and lock it in position.

Smear grease in the end of the shaft, where the main shaft locates, then load the 18 needle rollers so that they adhere in position by means of the grease.

Turn the gear casing to ensure that the counter teeth are below the drive shaft bearing housing. Failure to do this will result in damage to both the counter gear and drive shaft geared ends.

The drive shaft can now be drifted into position from the clutch housing end.

Ensure that the spring ring resisters properly in the racess on the gear case.



1. Arm-control
2. Spring-striking
3. Washer-thrust, control arm
4. Washer-thrust, control arm
5. Cap-ring. "O"
6. Ring-"O", striking rod
7. Comp.-rod, fork, 1st & 2nd
8. Fork-shift, 1st & 2nd
9. Rod-fork, 3rd & 4th
10. Fork-shift, 3rd & 4th
11. Rod-fork, reverse
12. Fork-shift, reverse
13. Pin-roller
14. Pin-reverse fork
15. Spring-return, reverse pin
16. Ball-check, reverse fork
17. Spring-check, reverse fork
18. Pin-retaining
19. Ass'y-rod, striking
20. Pin-retaining
21. Pin-striking rod
22. Ring "C"-stiking pin
23. Bracket-lever, control
24. Pin-control arm
25. Washer-control pin
26. Bush-control pin
27. Spring-control
28. Washer-thrust, control pin
29. Pin-retaining
30. Ass'y-lever, control
31. Knob-control lever
32. Rubber-control lever
33. Washer-control lever, upper
34. Washer-control lever, lower
35. Nut-self locking

Transmission control

Main Shaft

Press the main shaft center bearing complete with housing on to the shaft from the rear. The bearing must be pressed firmly against the shoulder of the center splined portion of the shaft.

Lightly oil the shaft forward of the bearing and refit the first speed wheel assembly with the synchronizer pointing forward.

Refit the thrust washer on to the shaft followed by the baulking ring.

The phosphor bronze sleeve which carries the second speed is a tight fit on the shaft; there it must be first immersed in warm oil and then slid into position on the shaft. Fit the second speed wheel over the sleeve, then the driving washer and the second bronze sleeve which carries the third speed wheel. The two sleeves are locked together by the driving washer. Now position the third gear over its sleeve. Place the spring and plunger into the hole in the main shaft and slide the splined washer. Depress the plunger with a piece of wire through the hole in the third speed, and slide the sprined washer over the plunger. Then turn the washer for the plunger to engage with a groove in the washer.

The gears are now assembled on the main shaft and there should be end movement for the first speed gear between the center bearing and the keyed washer at the rear of the second speed gear. Assemble the two baulking rings to the third and top speed synchronizer and coupling sleeve.

When fitted to the shaft, the large boss of the inner splines of the synchronizer must face towards the front of the box. Also note that in each case the pointed ends of the baulking ring lugs face inwards to the synchronizers. Slide the third and fourth synchronizers slightly forward on the shaft to clear the counter gears and then carefully guide the main shaft assembly into the gear casing. When the housing surrounding the main shaft bearing is flush with the gear casing, the counter shaft gear cluster should be raised into mesh with the gears and counter shaft oiled and fitted into position. The lipped end must be flush with the gear casing.

FRONT THRUST WASHER	THICKNESS
32264 26761	3.975-4.001 mm (0.1564-0.1575 in.)
32265 26761	4.026-4.051 mm (0.1585-0.1595 in.)
32266 26761	4.077-4.102 mm (0.1605-0.1614 in.)

Reverse Gear

Refit the reverse gear into the gear casing with the large gear to the rear. Oil the reverse gear shaft before inserting and secure the shaft with locating pin and tab washer.

CLUTCH

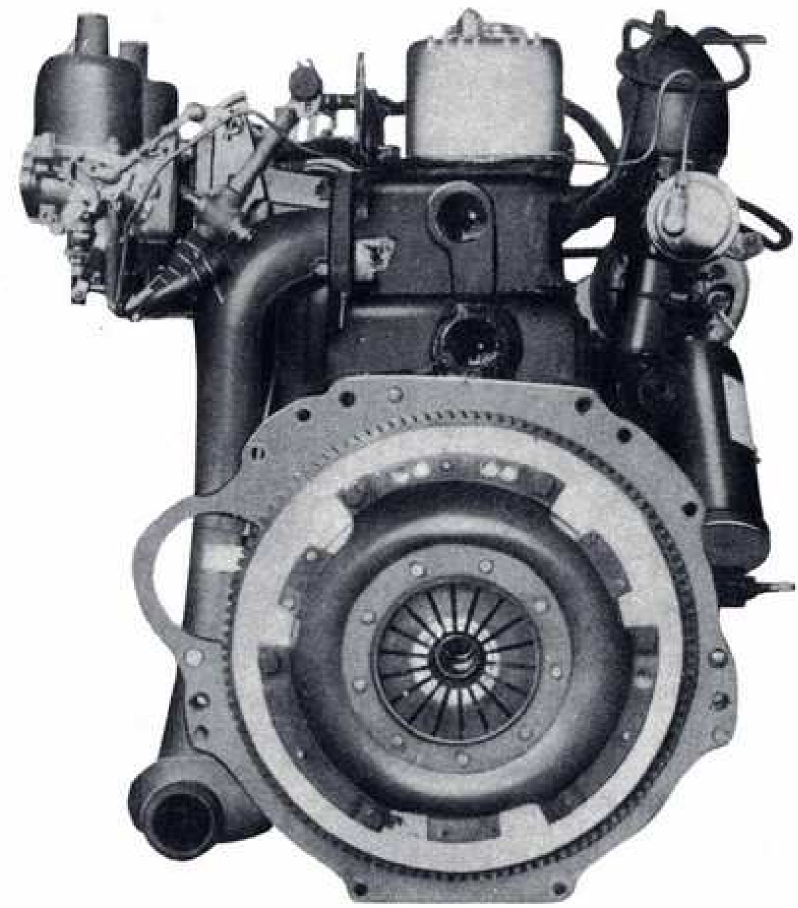


Fig. 1

The clutch mechanism is hydralically operated and consists of a pressure plate, a disc plate, a diaphram spring and cover assembly.

The exploded view in following figure shows each of the parts.

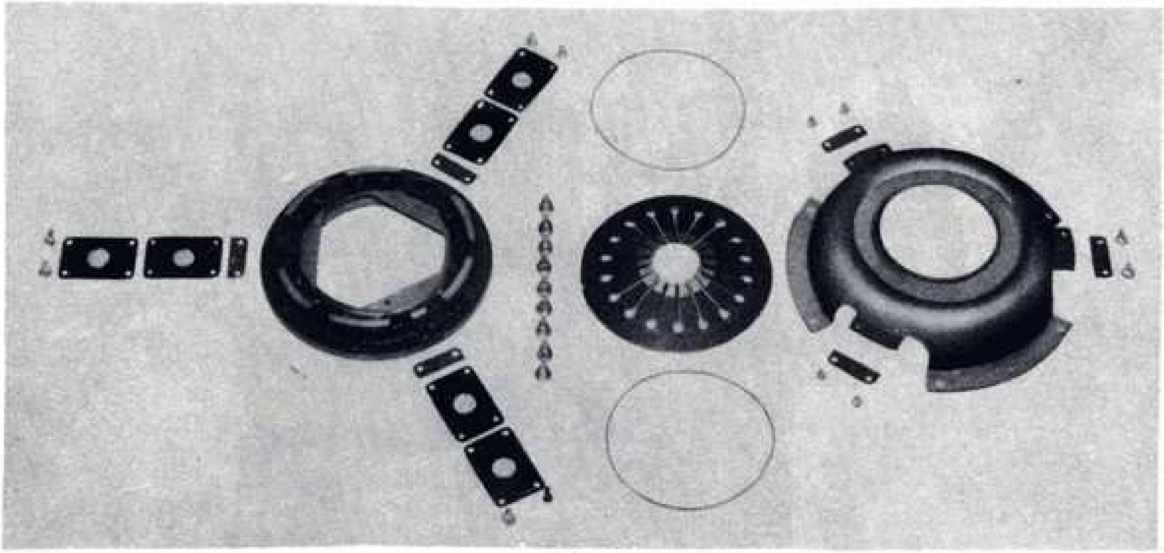


Fig. 2

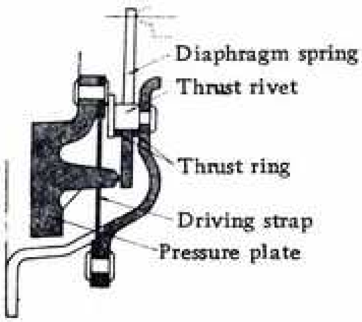


Fig. 3

Fig. 4

Fig. 5

The cover is bolted to the fly wheel and encloses a disc plate, pressure plate.

The hydraulic system comprises a master cylinder coupled to a operating cylinder which operates the clutch release mechanism.

Clutch Cover

The disc plate comprises a splined hub connected to a flexible steel plate by a spring mounted.

The annular friction facings are riveted to the plate and damper springs are assembled around the hub to absorb power shocks and torsional vibration.

The diaphragm spring is interposed between two annular rings which provide fulcrum points for the diaphragm when it is fixed.

The rings and the diaphram are located and secured to the cover by nine equally spaced rivets. Three clips that engage the outer edge of the diaphragm are bolted to the pressure plate.

The bolts pass through three straps which are riveted to the inside of the cover, the straps prevent the diaphragm and the pressure plate from rotating in relation to the cover. A release plate having an annular thrust is fitted to the outer face of the diaphram and retained by a circlip.

The release bearing is graphite and mounted in a cup which fits into the fork of the clutch withdrawal lever. The cup is held in position by the spring retainers.

Removing

Looson each of the bolts securing the clutch assembly to the flywheel be slackening them a turn at a time until spring pressure is released.

The clutch cover can now be disengaged from the dowels on the flywheel and the assembly removed.

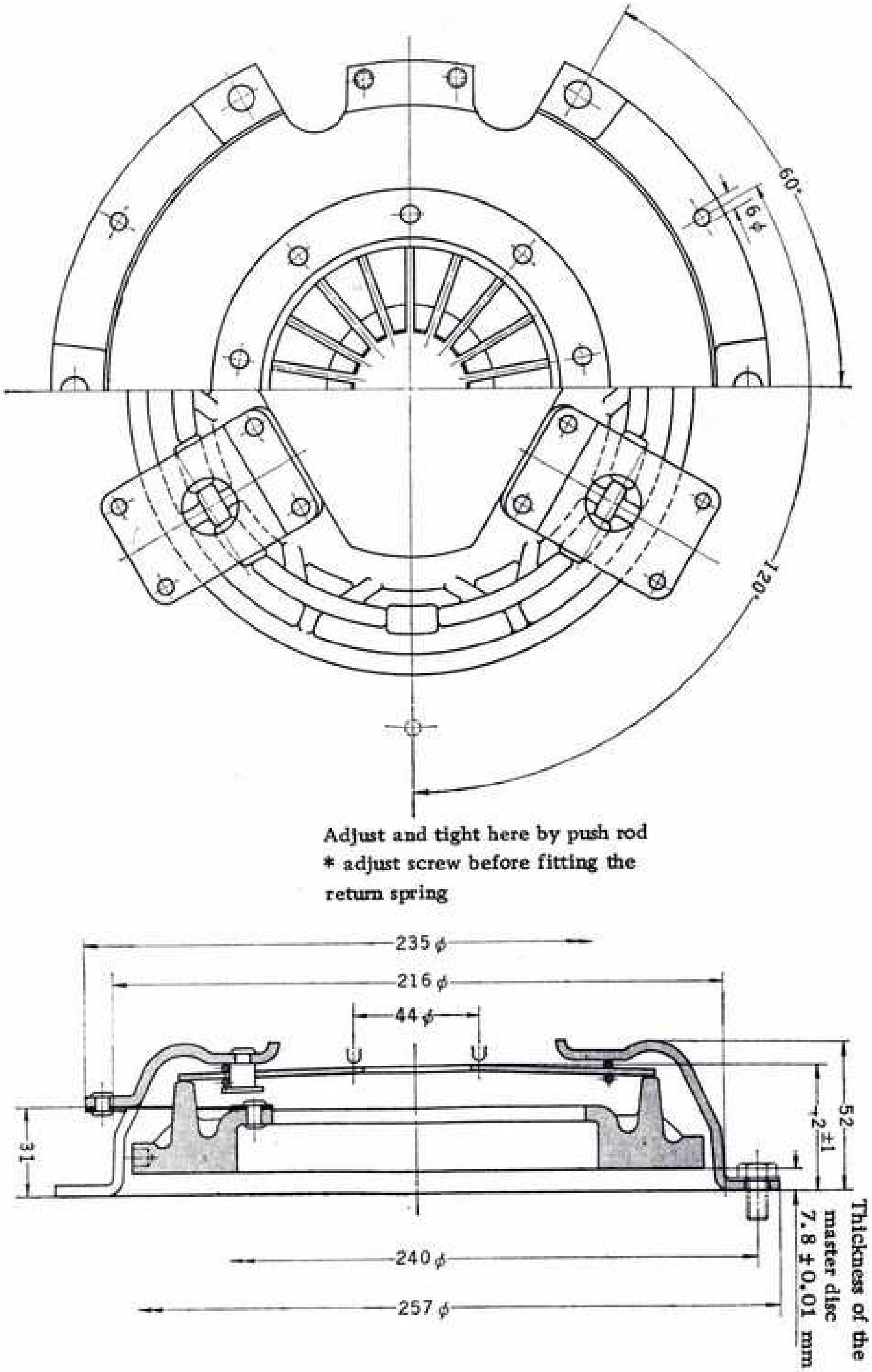


Fig. 6 Sectional view of the clutch

FRONT AXLE

Type	Independent suspention with double wishbones, coil spring telescopic shock absorbers: Stabilizing bar.
Toe-in	2 - 3 mm
Camber	1°25'
Caster	1° 30'
Angle of inclimation of swivel axle	6°35' (Ball joint type)
Tread:	1.270 mm
Turning angle of front wheel (Inside)	36° 16'
(Outside)	28°20'
Min. turning radius	4.90 meters (16 feets)
Camber shim:	Standard 6 mm (Adjusting shim 1 mm, 2 mm, 4 mm)
Caster shim:	Front & Rear 1.2 mm

DISASSEMBLING THE FRONT HUB

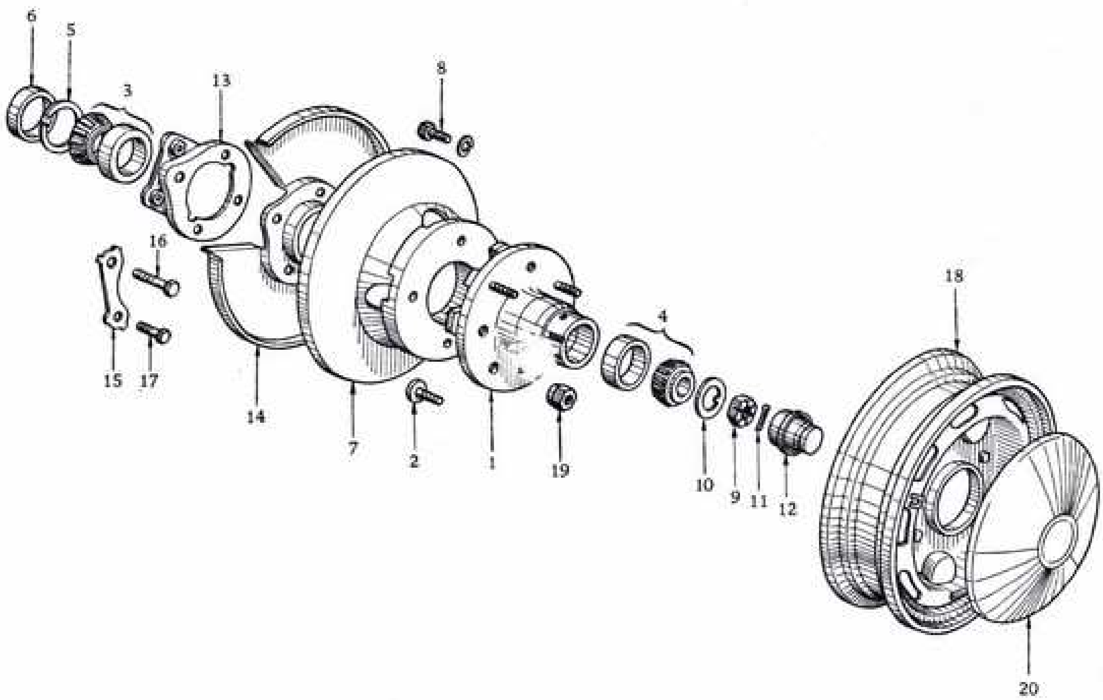
Dismantling of the front hub, first jack the car until the wheel is clear of the ground and then place blocks under independent suspension spring plate. Lower the car on to the blocks. Remove the wheel and the screw. If the drum appears to bind on the brake shoes, the shoe adjusters should be slackened.

Lever off the hub cap, and then extract the split pin from the spindle nut.

Using a box spanner remove the spindle nut and ease flat washer under the nut, clear of the axle thread by carefully using a narrow rod into small holes, in turn, in each side of the spindle and tapping the race lightly. With the hub removed, outer bearing can be dismantled, and by inserting a drift through the inner bearing and tapping the out bearing clear of the hub.

The inner bearing and oil seal can then be removed by inserting the drift from the opposite side of the hub.

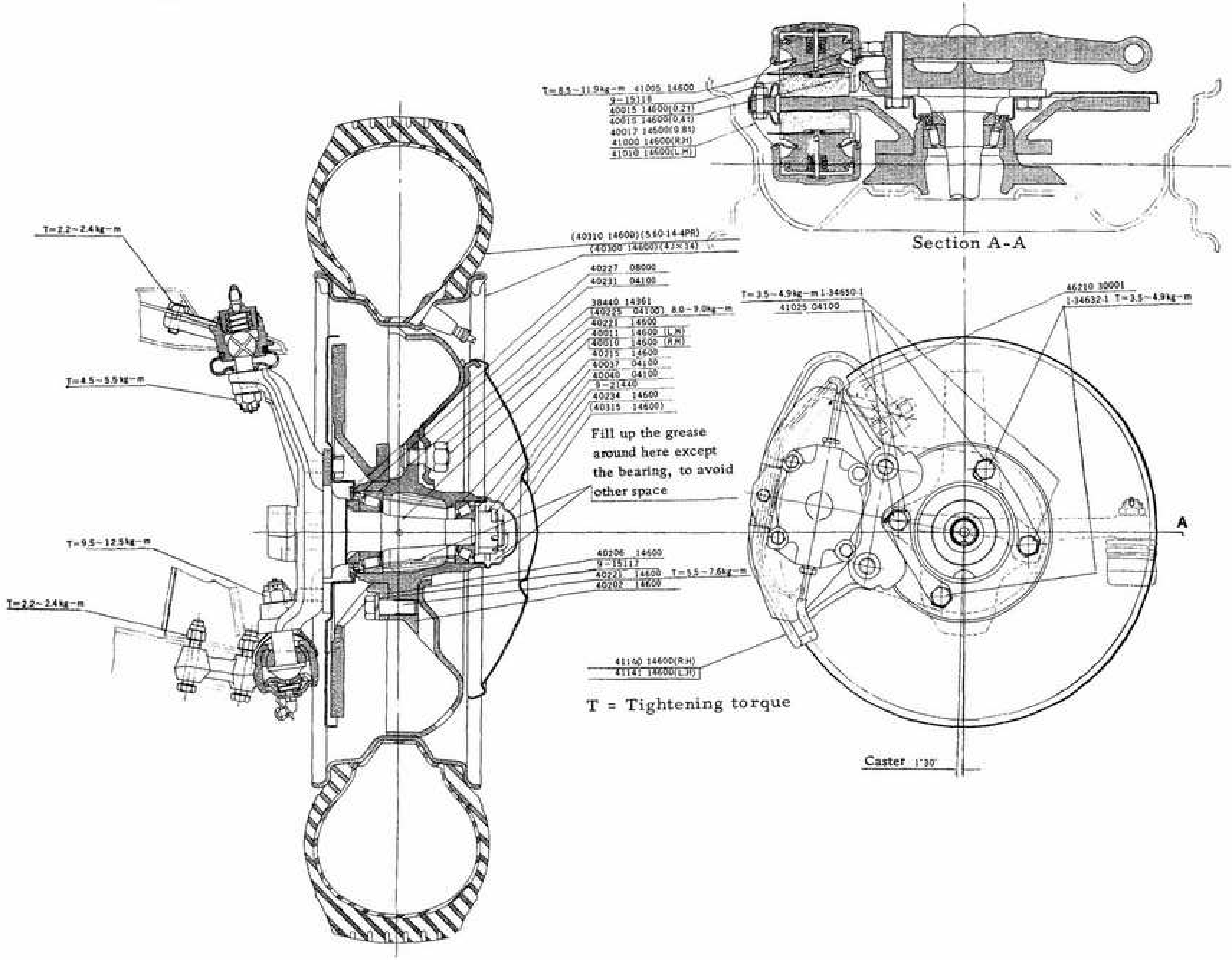
When assembling the hub the inner bearing race should first be inserted into the hub. Pack the hub with recommended grease. Replace the hub oil seal over the inner bearing. Renew the seal if it is damaged any way.



1. Ass'y-hub, road wheel, front
2. Bolt-hub, road wheel
3. Bearing-front wheel, inner
4. Bearing-front wheel, outer
5. Spacer-oil seal, front hub
6. Seal-oil, front hub
7. Rotor-disc brake
8. Bolt-hub rotor fix
9. Nut-knuckle spindle
10. Washer-front wheel bearing
11. Pin-cotter
12. Cap-hub, front wheel
13. Adapter-caliper (R.H.) (L.H.)
14. Plate-baffle (R.H.) (L.H.)
15. Plate-lock
16. Bolt
17. Bolt
18. Ass'y-wheel, road
19. Nut-road wheel
20. Ass'y-cover, road wheel

Fig. 1 Front hub & road wheel

SECTIONAL VIEWS OF THE FRONT AXLE & DISC BRAKE



The hub can now be replaced on the spindle. Gently tap the hub into position until the inner race bear against the shoulder on the spindle.

Place the spindle flat washer into position and screw the nut down finger tight. Spin the wheel and examine the resistance. Tighten the nut.

A slightly increased resistance to the spinning of the wheel will then be noticed. The bearings are now preloaded and the split pin should be inserted to lock the nut. Tap the hub cap to the hub after packing the cap with grease.

Replace the brake drum and secure with machin screws. It is important that the drum is fully home before this screws is tightened and if necessary, the drum should be pressed in position by tightening two wheel nut.
Refit the wheel and nuts are best finally tightened when the car is off the facking blocks, but readjust the brake shoes if necessary before the car is lowered to the ground.

INDEPENDENT FRONT SUSPENSION

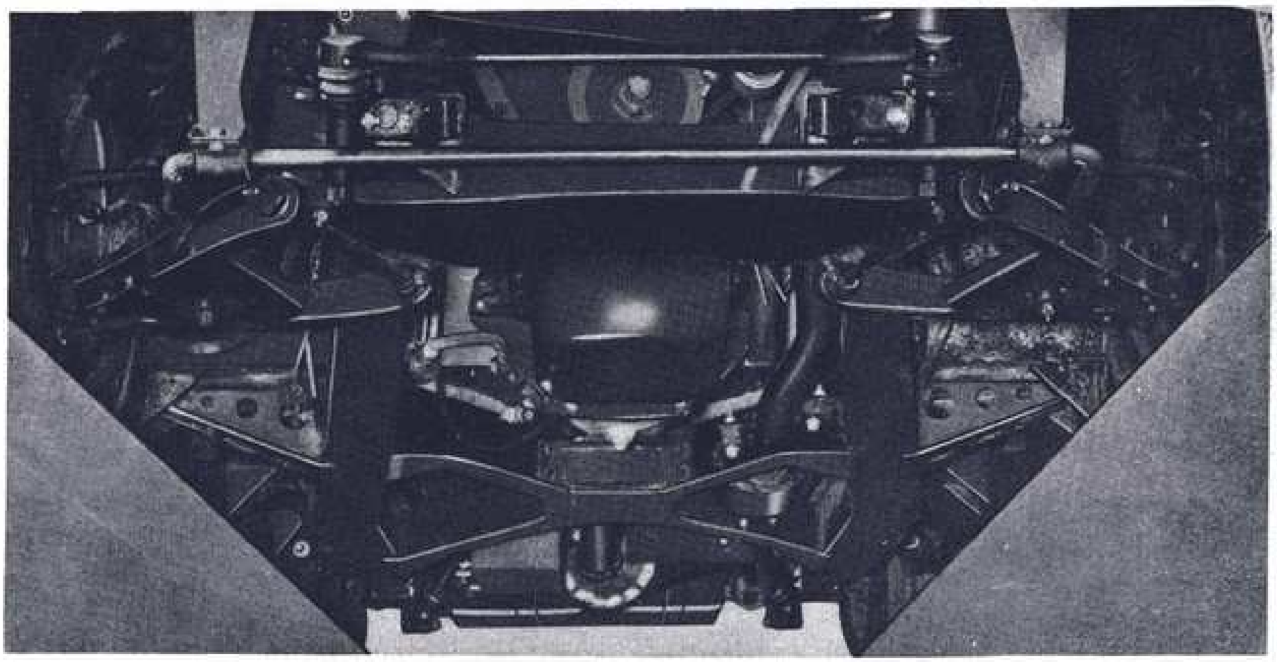
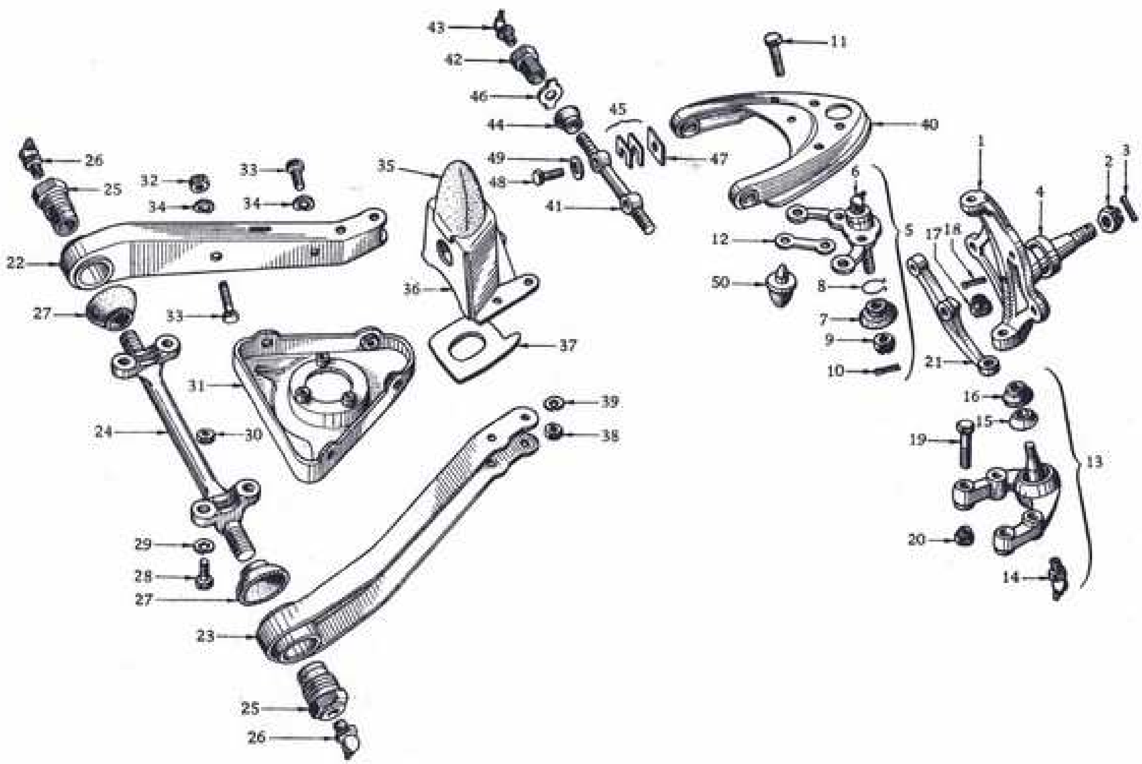


Fig.2

The dependent front suspension is known as the wishbone type, since the top upper and lower bottom linkages roughly conform to the shape of a wishbone.

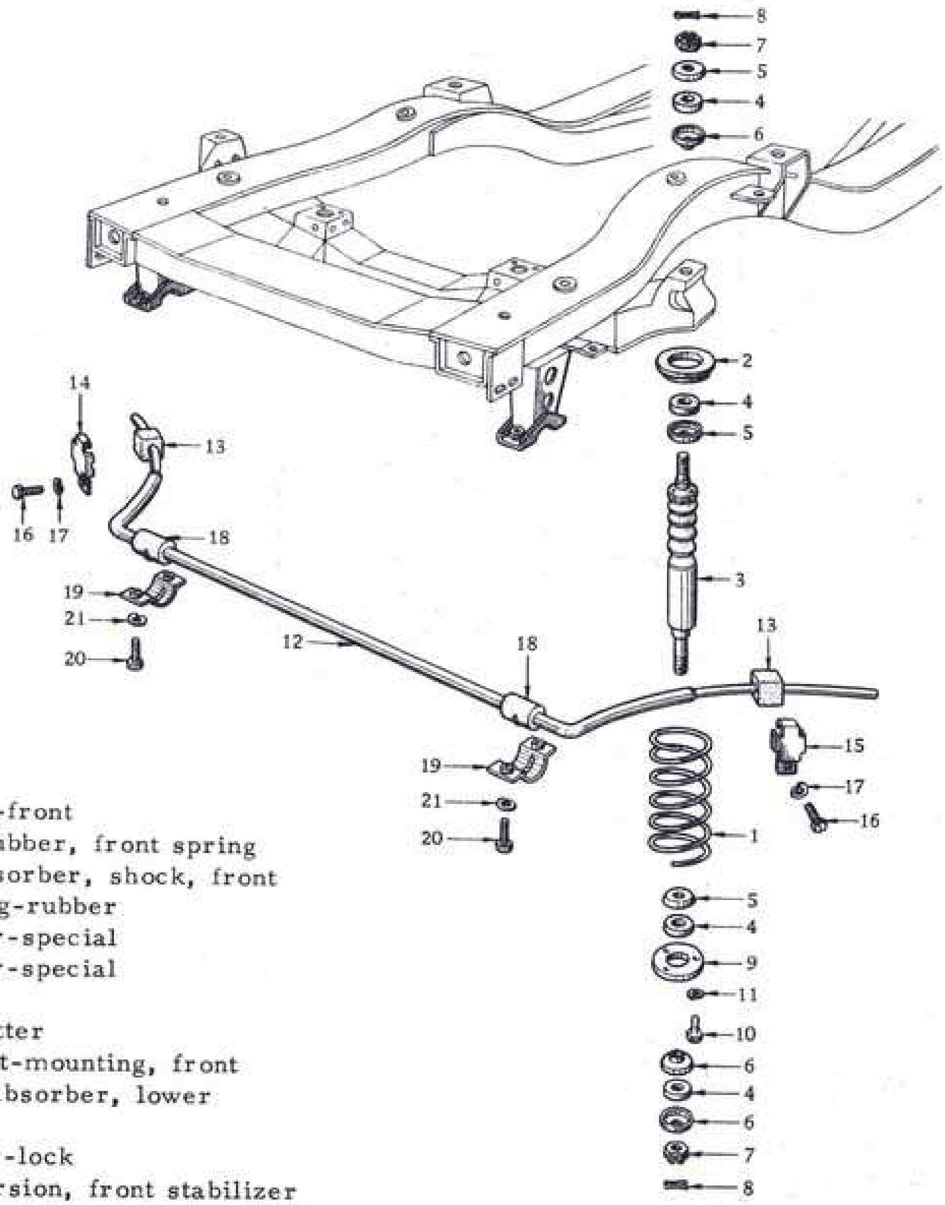
Between these two wishbones is the coil spring, held under compression between the upper spring seat and lower spring plate which is secured to the lower wishbone by four bolts. At the swivel axle end, the upper and lower linkages are jointed by the ball joints.
The upper spindle bracket is bolted to the front suspension member with caster shims and the lower spindle is connected to the lower bracket of the suspension member.

Camber adjusting shims				Caster adjusting shims			
Parts No.	54542	04100	1 mm.	Parts No.	54545	04100	(Front)
	54543	04100	2 mm.		54546	04100	(Rear)
	54544	04100	4 mm.				



1. Ass'y-spindle, knuckle, with nut (R.H.)
   (L.H.)
2. Nut
3. Pin-cotter
4. Collar-front spindle
5. Ass'y-joint, ball, front suspension (upper)
6. Nipple-grease
7. Cover-dust, upper ball joint
8. Clamp-dust cover
9. Nut
10. Pin-cotter
11. Bolt
12. Plate-lock
13. Ass'y-joint, ball, front suspension (lower)
14. Nipple-grease
15. Cover-dust, inner
16. Cover-dust, outer (rubber)
17. Nut
18. Pin-cotter
19. Bolt
20. Nut
21. Arm-knuckle (R.H.)
    (L.H.)
22. Ass'y-link, lower, front suspension, front (L.H.)
23. Ass'y-link, lower, front suspension, rear
24. Spindle-lower link, front suspension
25. Ass'y-bushing, lower link, front suspension
26. Nipple-grease
27. Seal-dust, lower link bush
28. Bolt
29. Washer-lock
30. Nut
31. Ass'y-seat, front spring, lower (R.H.)
    (L.H.)
32. Nut
33. Bolt
34. Washer-lock
35. Ass'y-bumper, rebound, front suspension
36. Ass'y-bracket, rebound, front suspension (R.H.)
    (L.H.)
37. Spacer-rebound bumper
38. Nut-plain
39. Washer-lock
40. Ass'y-link, upper, front suspension
41. Spindle-upper link, front suspension
42. Ass'y-bushing, upper link, front suspension
43. Nipple-grease
44. Seal-dust, upper link bush
45. Shim-camber, A (1.0 t)
    B (2.0 t)
    C (4.0 t)
46. Washer-lock
47. Shim-caster, rear (1.2 t)
48. Bolt
49. Washer-lock
50. Bumper-rubber, rebound, front suspension

Fig. 3 Swivel axle



1. Spring-front
2. Seat-rubber, front spring
3. Kit-absorber, shock, front
4. Bushing-rubber
5. Washer-special
6. Washer-special
7. Nut
8. Pin-cotter
9. Bracket-mounting, front shock absorber, lower
10. Screw
11. Washer-lock
12. Bar-torsion, front stabilizer
13. Bushing-rubber, front stabilizer, lower link side
14. Clip-front stabilizer, link side (R.H.)
15. Clip-front stabilizer, link side (L.H.)
16. Screw
17. Washer-lock
18. Bushing-rubber, front stabilizer, frame side
19. Retainer-bush, front stabilizer, frame side
20. Bolt
21. Washer-lock

Fig.4 Front suspension

BALL JOINTS AND BUSHES OF THE SWIVEL AXLE

Wear of the swivel ball joint, or wear of the screw bushes of links, or both, may be checked by jacking the front of the car and endeavouring to rock the wheel by grasping opposite points of the tire in a horizontal position. If any movement can be detected between the upper and lower swivel joints and the swivel axle assembly, the ball joints or the screw bushes are worn and must be stripped for examination.

Front Coil Spring

Between the upper and lower links is the coil spring, held under compression between the top spring seat and lower spring plate which is secured to the lower link by four bolts.

Through the center of coil spring the telescorp type shock absorber which is connected to the top spring seat and lower spring plate with bolt.

The rubber bearing bushes or screw bushes may in time deteriorate and need renewing.

Excessive side ways movement in either of these bearings would denote softening of the rubber bushes or screw bushes.

The screwed bushes or the ball joints may develop excess free play due to wear of either of these parts. This assembly can best be checked when the suspension has been dismantled.

Removing the Coil Spring

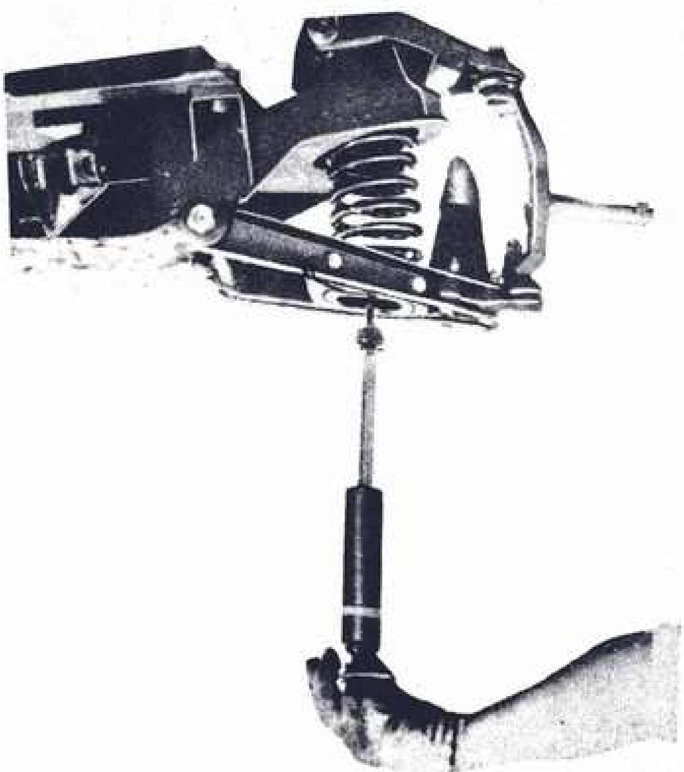


Fig. 5

Method ① Lift the side or front bumper of the car concerned and place blocks under the body unscrew nut of the shock absorber at the top and take out it from down side after unscrew lower small flange of it from lower spring plate.

Fit the service tool DT-4672 and screw up the spring compressure nut.

In the absence of the said service tool DT-4672 a suitable jack will be required to release the compression from the coil spring.

Compressing the coil spring, unscrew the four bolts of lower link spindle which located under the suspension member.

Remove these bolts and release the compression from the coil spring.

When the coil spring is fully extended, take out it.

Method ② Removing the coil spring with seat plate.

Unscrew the four bolts securing the bottom spring plate to the suspension lower links. Remove these bolts and release the compression from the coil spring. When the coil spring with seat plate can be driven out.

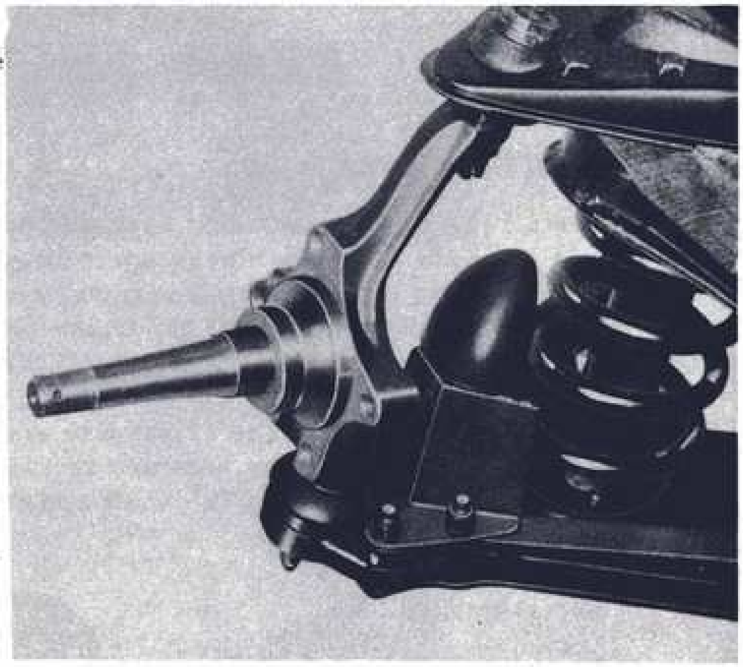


Fig. 6

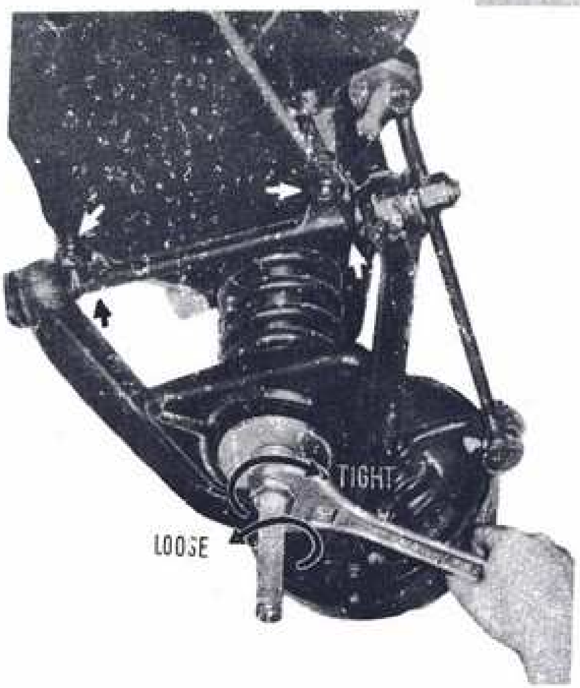


Fig. 7 Refitting the coil spring

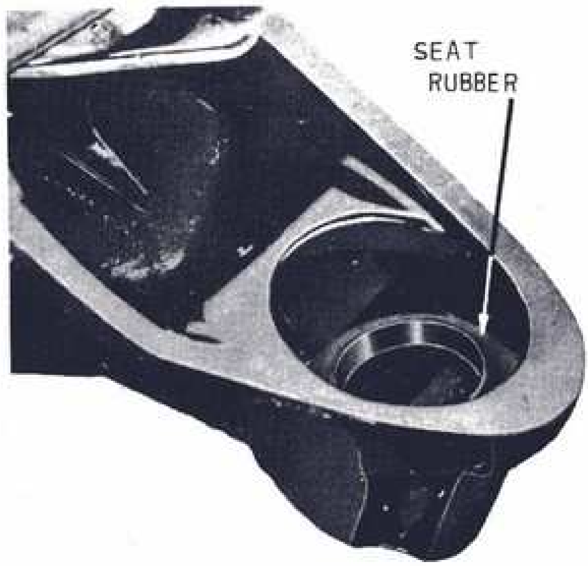


Fig. 8 Seat rubber

Offer the coil spring plate with the coil into position, tighten the nut of service tool DT-4672 or jack up with available tool and lift up the coil spring with plate each a little at a time untill the spring plate is held tightly against the suspension spindle link.

Fit two short bolts into the nut holes and secure with regular nuts gradually. Insert and set up the shock absorber.

Use the coil compressor or jack against the spring plate. Screw up the screw bolts of the lower link spindle to the front suspension member and then secure the bolts of the lower spindle. Release the compression by loosing the compressor nut or the jack screw down.

REAR AXLE

Axle Shaft Removal

Choke all the wheels not being operated upon, jak up the car.

Lower the axle on to the blocks and remove the wheel using a screw driver unscrew the drum locating screws, release the hand brake and tap the drum off with the mallet. If the brake linings should hold the drum when the hand brake is released, slack off the brake shoe adjuster a few notches.

Take off the fix bolts of the brake disc and remove the axle shaft as shown Fig. 1 Tap with swing hammer holding the wheel studs bolt with the rear axle shaft stand draw out the shaft and disc assembly by gripping it outside of the disc.

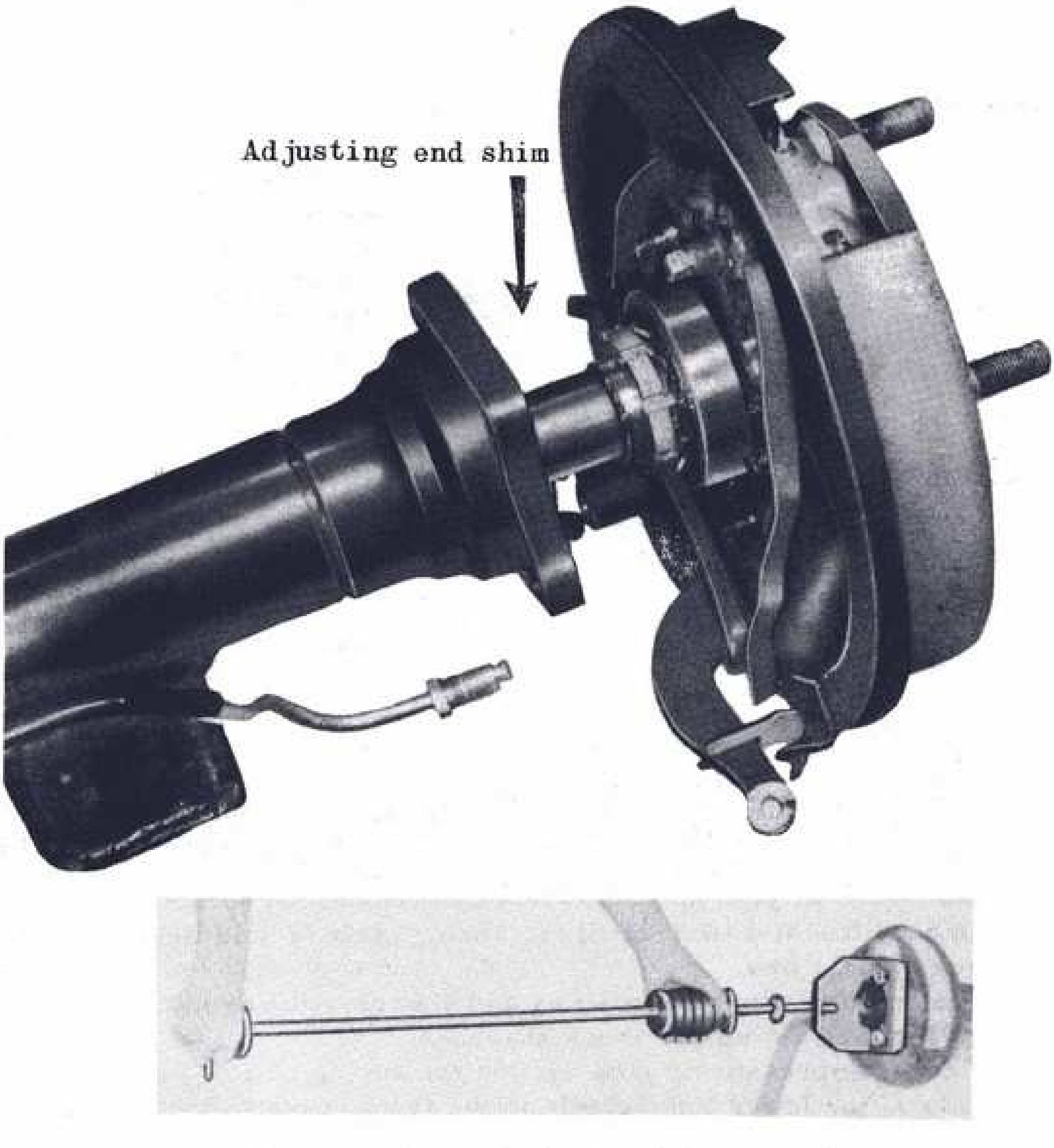
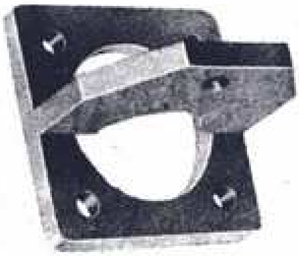
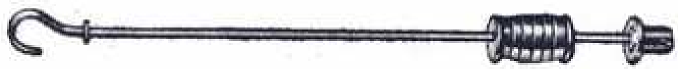


Fig. 1 Removal of axle shaft and disc assembly

SERVICE SPECIAL TOOLS



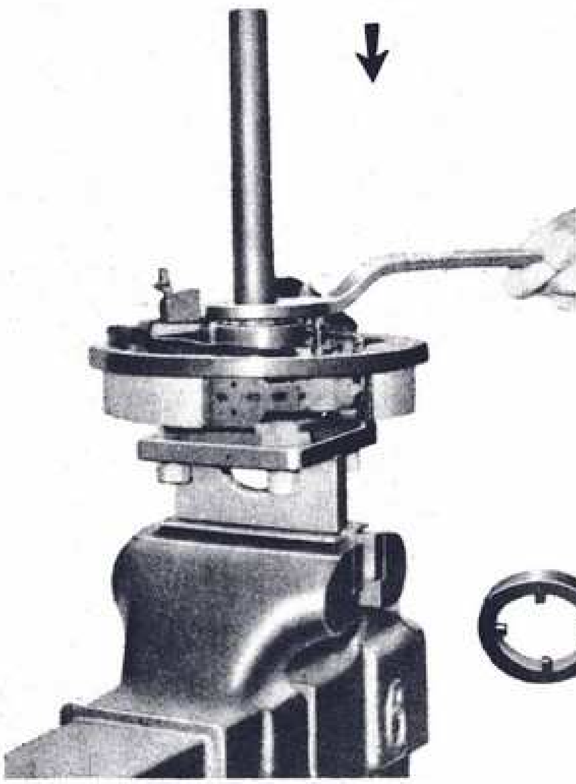
DT-4679
Special Stand



DT-4678
Swing Hummer

Disassembly and Assembly of Axle Shaft

When replacing the differential axle shaft do not forget the adjusting washer between the top of the axle flange and the brake disc assembly so as to keep the end play of the axle shafts.



DT-4680
Rear axle shaft bearing lock wrench

Rear axle shaft bearing lock nut wrench

Fig. 2

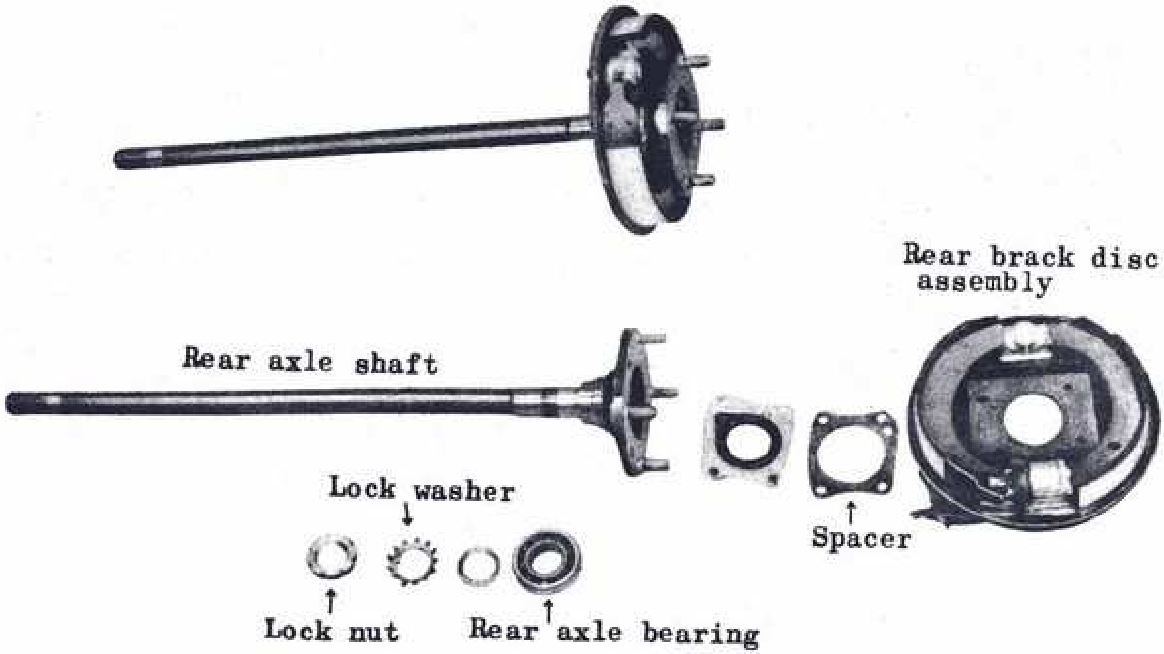


Fig. 3 Rear axle shaft & brake disc assembly

Order of Rear Axle Shaft & Brake Disc Assembly

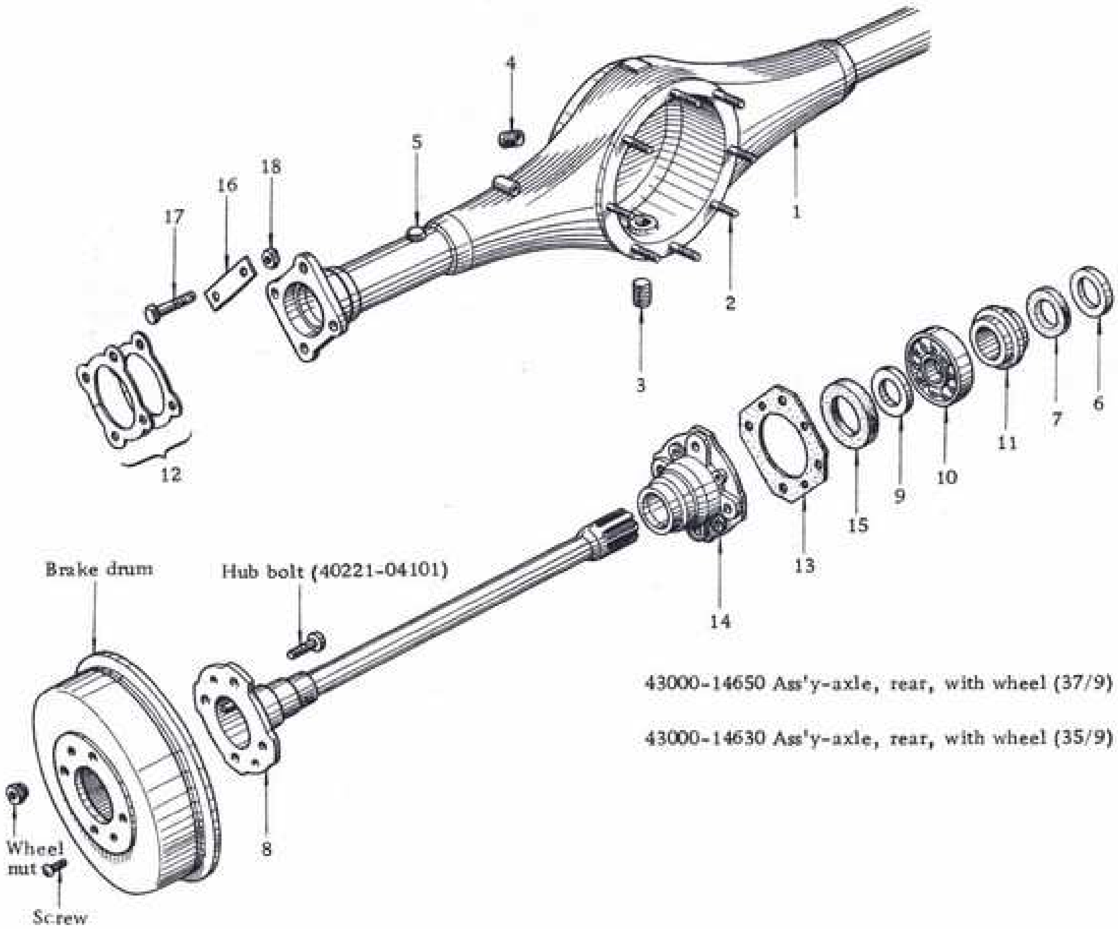
The rear axle bearing with the brake disc assembly is replaceable in one operation by pressing into place. When fitting the axle shaft it should be compressed into the abtment shoulder of the case end after inserting the end shim between its flange and hub. (Part No. 43036-04100)

The following points must be taken into consideration.

i. Nominated hypoid gear oil No. MP90 must be used.
(In wamer district than 32°C use MP#140)

ii. It is prohibited to use any other kinds of gear oil or any oil of different viscocity. The same brand must always be selected.

The standard capacity of oil is about oil 0.93 ℓ. The method of feeding oil should be done by taking off the feeler plug at the rear cover of the housing and fill in full up to the feeding hole.



1. Comp.-case, rear axle
2. Stud-gear carrier
3. Ass'y-plug, drain
4. Plug-taper
5. Ass'y-breather
6. Spacer-oil seal, rear axle
7. Seal-oil, rear axle shaft
8. Shaft-rear axle
9. Spacer-rear axle bearing
10. Bearing-rear axle
11. Collar-bearing, rear axle
12. Shim-rear axle case end
13. Packing-grease catcher
14. Ass'y-catcher, grease, rear axle axle case (R.H.)
(L.H.)
15. Seal-grease, rear axle bearing
16. Plate-lock, brake disc fixing bolt
17. Bolt-fixing, rear brake disc
18. Nut

Fig. 4 Rear axle case & shaft

Dismounting & Disassembling of Differential Gear Carrier

(1) Take off and drain out the gear oil.

(2) At the time of dismounting the gear carrier, pull out the both left and right axle shaft with the disc of the brake assembly.

(3) Take off the joint flange from the side of propeller shaft.

(4) Pull off the nuts of the housing and dismount forward the carrier ass'y.

(5) Take off the side bearing cap of carrier and pry with a lever the differential gear case and the bearing.

(6) Dismount the differential side bearing.
As illustrated in Fig. 5 with the aid of side bearing puller, pull out the bearing. The puller should be handled with care in catching the hedge of bearing inner lace which is hard to hook.
Both the left and right bearing should be arranged separately.

(7) Dismount the differential drive gear. (Ring gear) by loosening the 8 vixing screws on the differential gear case, and spreading out the lock washer. Loosen them in a diagonal line considering to keep from the gear bending.

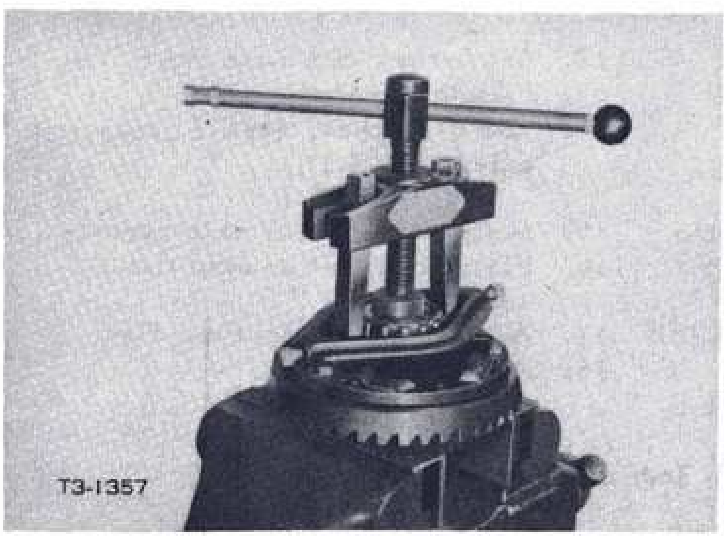


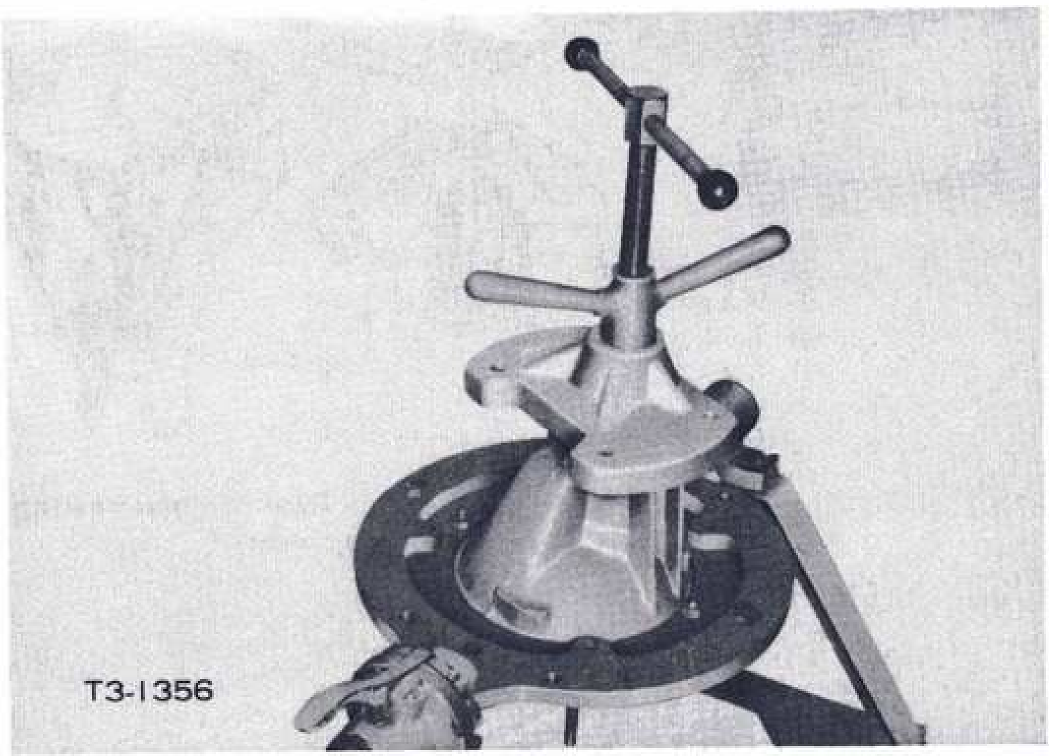
Fig. 5 Using of side bearing puller (DT4686)

(8) Take out the differential pinion as well as the side gear. The pinion mate shaft should first be pulled out by striking out the pinion mate shaft locking pin which is fixed on the differential case from left side (from the side of ring gear fixed) to the right before pulling out the pinion, side gear and the thrust washer.
The gear as well as the thrust washer should be arranged separately as left and right, front and rear.

(9) After taking the out nut of the carrier, pull put the companion flange. The drive pinion flange wrench should be employed, setting its four points in the holes of flange to keep it from moving, take off the nuts with the box wrench.

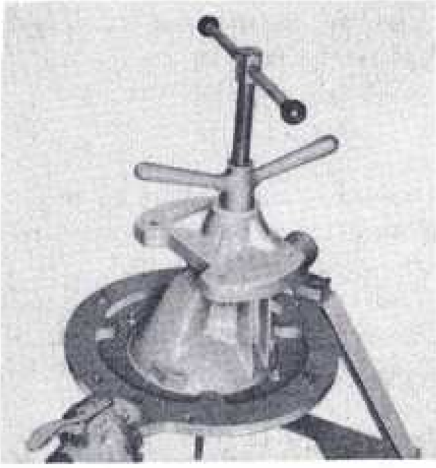
(10) Take out the drive pinion of gear carrier by striking out lightly to the backwards the front end (at the side of conpanion flange) of drive pinion with the drift of soft metal. Thus, the pinion would be taken out together with the inner lace of rear bearing and roller, distance piece, and the adjusting shim and the oil seal, outer lace and pinion of front and rear bearing as well as the pinion adjusting shim left in the carrier.

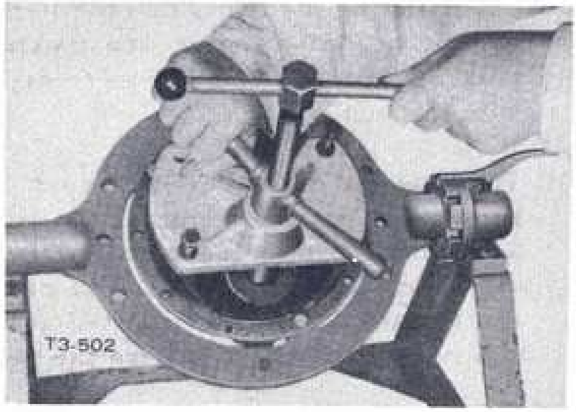
(11) Pull out the rear bearing inner race of the drive pinion. As illustrated in Fig. No. 6 the drive pinion rear bearing inner lace replacer and the adapter should be employed in this case. The adapter in the round form is for fixing and the other for taking off. It is easy to handle with the vice fixing one end of replacer.

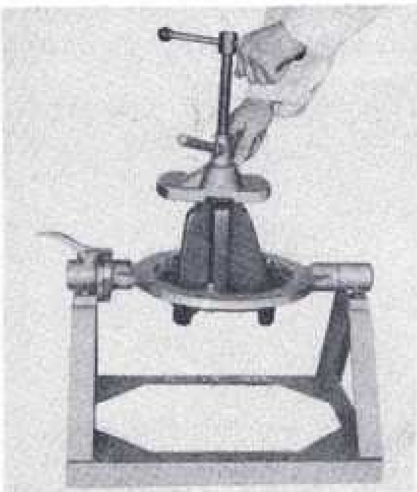


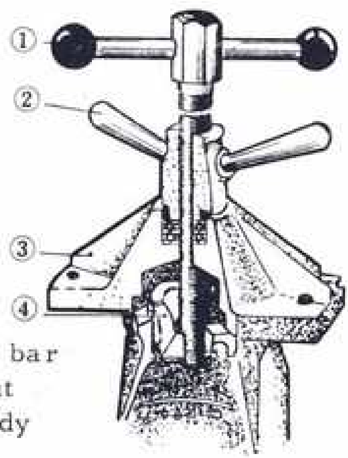
Tool No. DT4782, DT4631 & DT4689

Fig. 6 Pull out the bearing race









① Tommy bar
② Wing nut
③ Tool body
④ Cone

Adapter for front bearing outer race

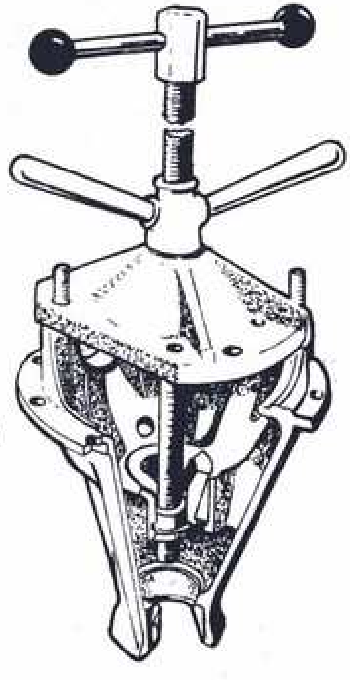


Fig. 4 Drive pinion front and rear bearing outer race replacer

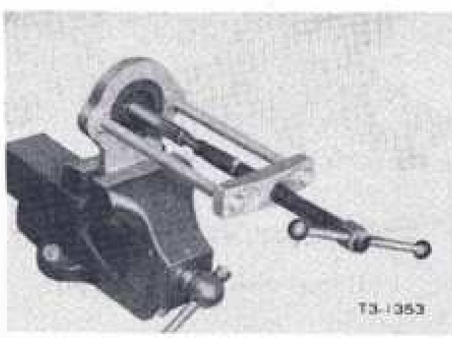


Fig. 5 Inner race replacer

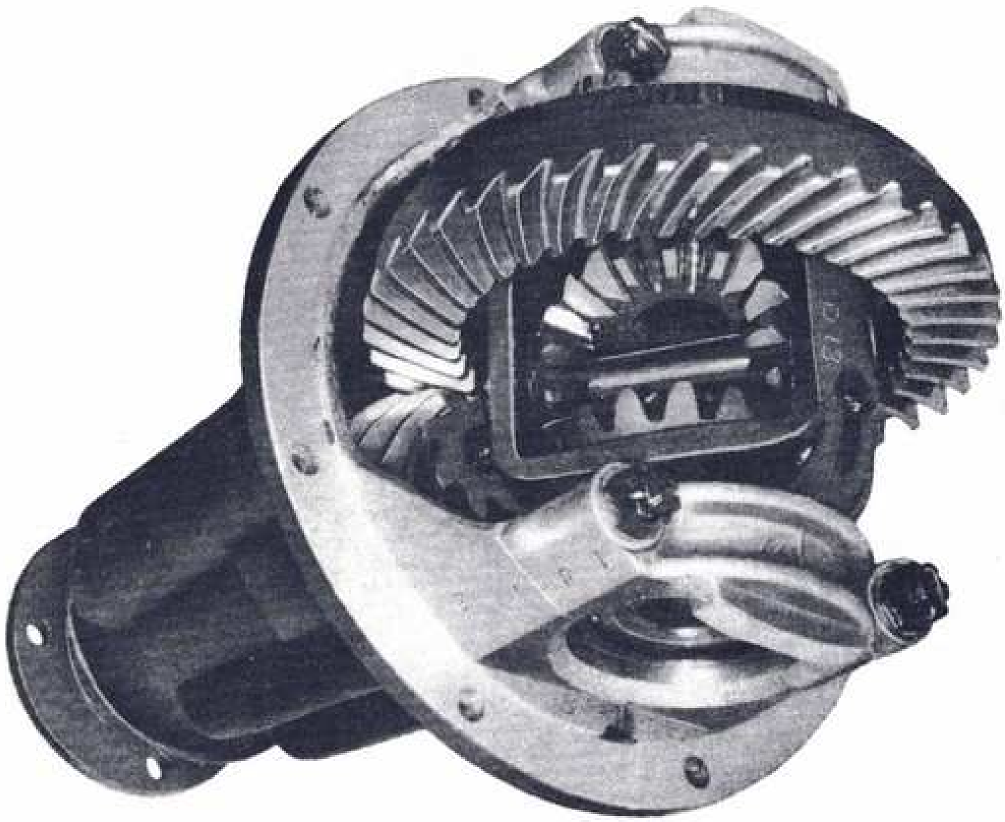
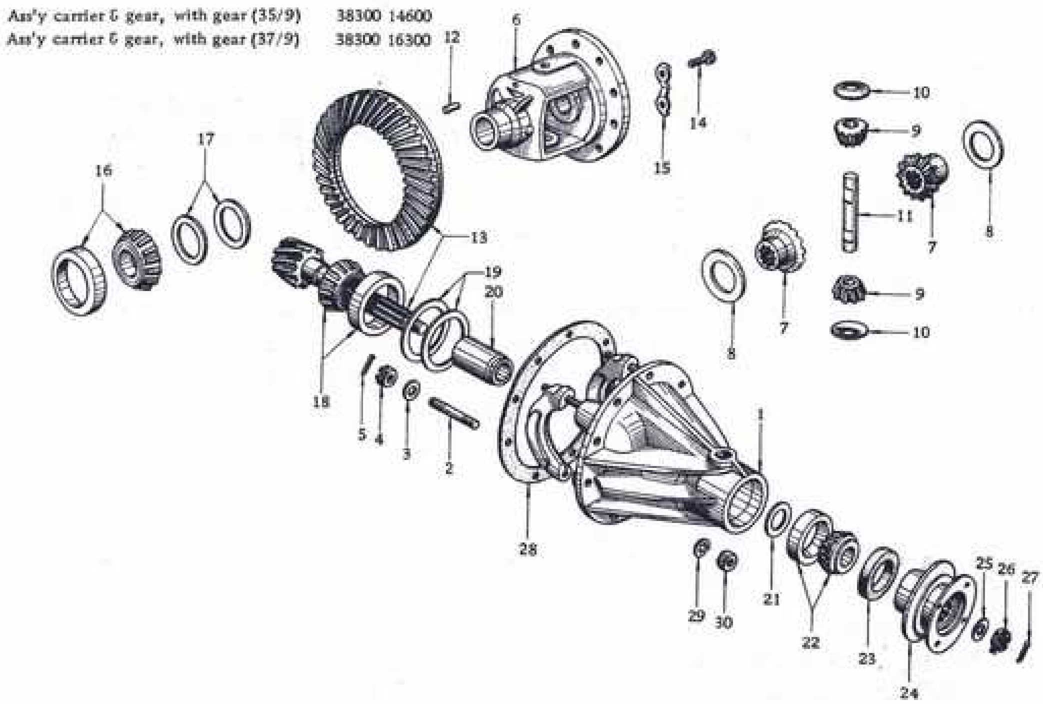


Fig.10

(12) Taking out the rear bearing outer race of gear carrier.
The drive pinion bearing outer race replacer as illustrated in Fig. 9 should be employed in this case. In other upon the stud so as to make the screw at the center of carrier, and set the adapter at the lower frim of the race.
Supporting the tommy bar (1) and screw up till the corn (7) closely touches the adapter, then screw the wing nut to take out the rear outer race.

(13) To pull out the front bearing outer race from the gear carrier, set the tool body (3) as illustrated in Fig. 9 pull it out with adapter (B) in the way of rear race.



1. Ass'y-carrier, gear
2. Stud-differential bearing cap
3. Washer-plain
4. Nut
5. Pin-cotter
6. Case-differential gear
7. Gear-side
8. Washer-thrust, side gear (t=0.76 ~ 0.81)
9. Gear-pinion mate
10. Washer-thrust, pinion mate
11. Shaft-pinion mate
12. Pin-pinion mate
13. Set-gear, hypoid drive (37:9) (35:9)
14. Bolt-drive gear
15. Strap-lock, bolt
16. Bearing-side
17. Shim-adjusting, drive gear (0.75 t)
18. Bearing-drive pinion, rear
19. Shim-adjusting, drive pinion (0.75 t)
20. Spacer-drive pinion bearing (59.25 m/m)
21. Washer-adjust, drive pinion bearing
22. Bearing-drive pinion, front
23. Seal-oil, drive pinion
24. Ass'y-flange, companion
25. Washer-plain
26. Nut
27. Pin-cotter
28. Gasket-gear carrier
29. Washer-lock
30. Nut

Fig. 7 Gear carrier & gear

INSPECTION & REPAIRING OF DISASSEMBLED PARTS

Every parts after they are disassembled should be cleaned and cleaned by the compressed air before making an inspection and adjustment.

(1) Each bearing should be inspected in every unit of ass'y in regard with the defect and defacement before deciding to re-use them.

(2) The axle shaft should be inspected in respect of the crank and the defacement oi spline measuring the shake with the gauge by holding the both end. The difference over 0.4mm should be adjusted within 0.8mm or replaced. The clearance between the end of rear axle case and brake disc should be adjusted with the adjusting end shim. (Part No. 43036-04100)

(3) Every gear should be inspected as to the locking condition defacement or any defects on the surface to see if they can be re-used.
In case of insufficient standard back lash, deformation or damage found, replacement is necessary.
Specially the drive pinion and drive gear should be replaced in a set whenever the locking condition gets worse and the defacement is already in progress, because it would cause the noise in later operation and be difficult to adjust even with proper adjustment is made.

The perfect driving condition at the surface of drive pinion gear should be about from 2/3mm to 3/4mm in un unloaded driving while the gear surface should start to touch from tip to full surface in an ordinary loaded driving.

The inspection of this condition can be made as it is.

If it is hard to inspect them as it is, do otherwise by cleaning the both surface with the rugs before disassembling and paint thinly and evenly with the mixed with thin oil on the gear surface (drive side) then turn the pinion with hand to print the track of it on the gear. Which shows the situations of considerably worn out gear.

In case of unloaded test, it is perfect that the gears contact for about three quarter at the center of 1/4 of whole gear length from too (interior tip end of the gear) on the pitch line.

(4) Lock the side gear with pinion together with respective thrust in the gear case.
In case of the back lash over 0.2mm and the clearance between the side gear and thrust washer exceeds 0.5mm replace the thrust washer.
The else worn out parts should also be replaced.
The contact when ring gear is too close to pinion center in case of back-lash should be adjusted closely or it gives mush noise.

(5) Put the drive gear (ring gear) on the buoy block as it is fixed in the differential gear case, and measure with the dial indicator. Revolve the drive gear to turn around the differential gear case as the bearing do not move on the buoy block. Measure the shake at the rear side of gear by the scale and the shake should be within 0.5mm. In mounting the gear, clean well the fitting face and rear face (measured face) of it and fix correctly, then there should not be any shaking.

ASSEMBLING, ADJUSTMENT

Assembling Differential Gear

(1) Assemble the pinion and side gear in the differential case. Every parts should be cleaned and oiled with new gear oil, then the pinion mate side gear and the thrust washer should be assembled by the mentioned inspection and selection before pushing in the pinion mate to shaft. Inspection should be made again in the clearance of between the washer or the backlash. Adjustment must be made in case any abnormal, is found. Strike in the pinion shaft locking pin from the right side of the case (opposite side of drive gear) and must be fixed by setting well the striking hole of it after putting it to the required piston so as the pin should not loosen.

(2) Fix the drive gear (Ring gear) with the differential case. The drive gear as well as the drive pinion should be well inspected or they must be replaced as a set whenever the replacement is required. Otherwise, they would not properly lock after assembling is complected. In mounting in the case, the fitting surface must specially be cleaned and fixed with 8 set screws as well as lock washer bend the washer with sureness after the drive gear shake is adjusted. In tightening up the screw, it should be set and supported by vice or any other setting tools so as not to damage it and screw up in a diagonal line with a wrench which fit correctly with the head of the screws. The standard screwing torque for this is 25 ft/lbs. to 30 ft/lbs. Screw in for sure, striking lightly the head of screw by one quarter pound hammer.

Fig. 11

(3) Mount the side bearing in the differential case.
Press in the both side of the bearing by using the drift.
It is important in this case to assemble by putting the side bearing adjusting shim to give the bearing a proper preload in fixing with the carrier .

ASSEMBLING & ADJUSTMENT BY GEAR CARRIER ASS'Y

It is to deside the assembling & adjustment of gear which is must important in an rear axle ass'y and should be carried in accordance with the exact sample shown by the manufacturer.

The construction and mechanism must well be comprehended referring to Fig. 9 & 11 and the adjustment & repairing exactly according to the condition of practical use based on the adjustment by exact calculation.

The preparation for the mounting the drive pinion in the gear carrier

(1) If the drive gear, drive pinion, and bearing are to the re-used as they are as a result of disassembling and inspection, they should be assembled in on order of disassembling at the previous condition of adjusting shim.
In case any item should be replaced or required to re-use even if any item is worm out prepare the various shim as mentioned later because the position of drive pinion to be fixed with carrier must be adjusted by the adjusting shim between the carrier and pinion rear bearing outer race.

(2) There are few numbers with 0 & + or - besides set number marked by an electric pen on the tip head surface of drive pinion. They show the manufacturing variation in a figure at the unit of 0.001 in. (0.025mm) to decide the thickness of adjusting shim for adjustment of standard position (The standard pinion height is 51.0mm from axle center as shown in Fig. 9 & 11.
If the figure is difficult to discriminate due to the corrosion, scrape off the oxidize substance on the surface by a some what narrow grind stone with care not to scrape off even the mark.

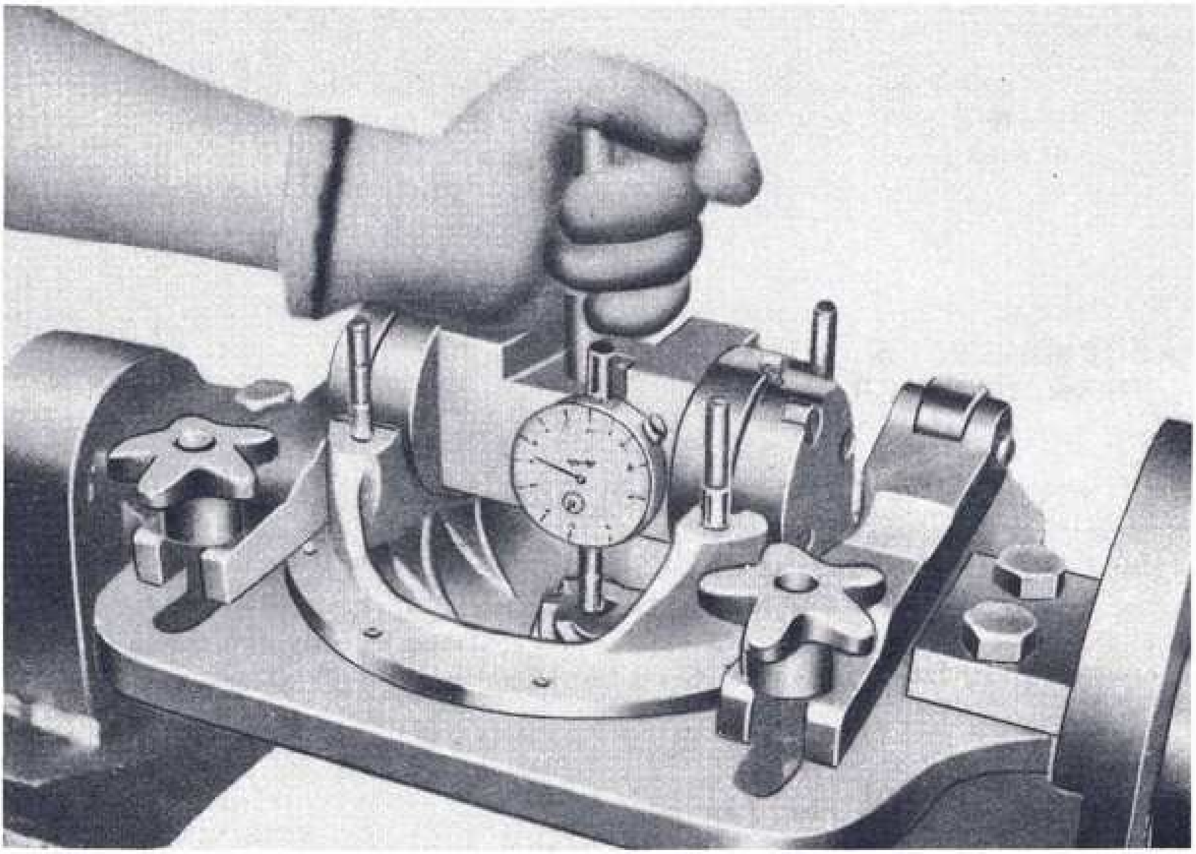


Fig. 9 Adjustment of pinion height

Adjust to the direction of on arrow in accordance with the pinion mark.

(3) The thickness of drive pinion adjusting shim are arranged as following.

The use of the adjusting shim will be explained in the following paragraph of adjustment. Supposing the drive gear and the drive pinion were replaced as a new set and the height of drive pinion previonsly used was right, prepare the shim of thickness which equals to the difference of figures on the new and this pinion. Deduct the previously used shim in case it is plus, increase in case of minus and have the general idea of required thickness of the shim for assembling to prepare.

Part Name	Part No.	Thickness	Standard Leaf No.
Drive pinion adjusting shim	38153-25660	0.75mm (0.030 in.)	1 - 0
	38154-25660	0.25mm (0.010 in.)	2
	38155-25660	0.125mm (0.005 in.)	2 - 1
	38156-25660	0.075mm (0.003 in.)	2 - 1

It is convenient to inspect the condition before disassembling in a way as mentioned later in the measurement of pinion height.
Besides the condition of defacement on the carrier, the pinion bearing must be taken into consideration though it will be explained in detail later.

Fixing and Adjustment of Drive Pinion

(1) Drive pinion rear bearing outer race should be mounted in the carrier. In this case, after inserting the properly selected adjusting shim as previously mentioned between the carrier and bearing race, mount the outer race by the special tool of drive pinion front, rear bearing outer race replacer.
For adjustment of previously mentioned pinion height, the shim at the rear side of this outer race is increased or decreased, and the race also must be taken off in each time for this adjustment, there fore the tools must be handled properly to avoid such a situation as to make the bearing hole of carrier in on oval. Referring to Fig. 3 for handling method of tool, set the adaptor ring (A) on the corn (7) to guide the body of tool at the small hole of carrier put the rear outer race on the corn (8) as the bearing surface faces inside at the tip end of screw and put the split adaptor inside race. At the same time, supporting it by the bar, twist up the corn (7) till the adaptor and race come to the setted position then screw up the wing nut (2) so as the race be housed properly at the setted position.

(2) Mount the front bearing outer race in the carrier.
For mounting the front outer race, take off at first the adapter (A) from the front end of the carrier and fix the tool at the side of stud in opposite side, tighten the screw as to be the center of carrier as shown in Fig. 3 Then mount it by using adaptor (C) as in a way of mounting the rear outer race.
The race is scarcely necessary to be taken off unless damaged.

(3) Mount the rear bearing inner race and roller to the drive pinion.
By using the round adapter attached to the drive pinion rear bearing inner race replacer which was employed at dis-assembling, press in the drive pinion. This might as well be done in pressing in by the use of a certain drift.

(4) Mount the drive pinion in the carrier and adjust by measuring the position.
The pinion height must be adjusted as mentioned in the previous paragraph,

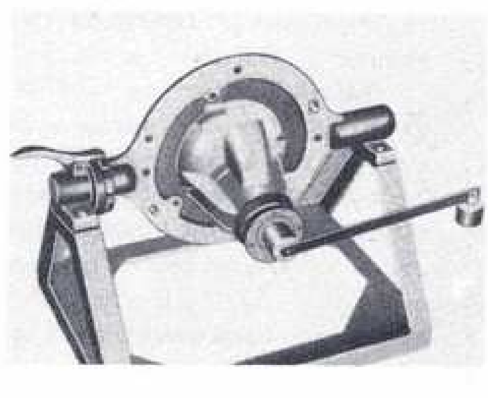


Fig. 10

by mounting temperarily the pinion in the carrier and the bearing be given a regular pre-load. On the other hand the bearing of drive pinion should be newly oiled after the pinion is inserted from the inside of the carrier, the inserted end of pinion should be locked with front bearing corn and tightened up by the pinion nut fixing with the companion flange till the regular revolving torque is required. As this is not yet at the final assembling the bearing spacer (distance piece), bearing adjusting shim and oil seal are not mounted.

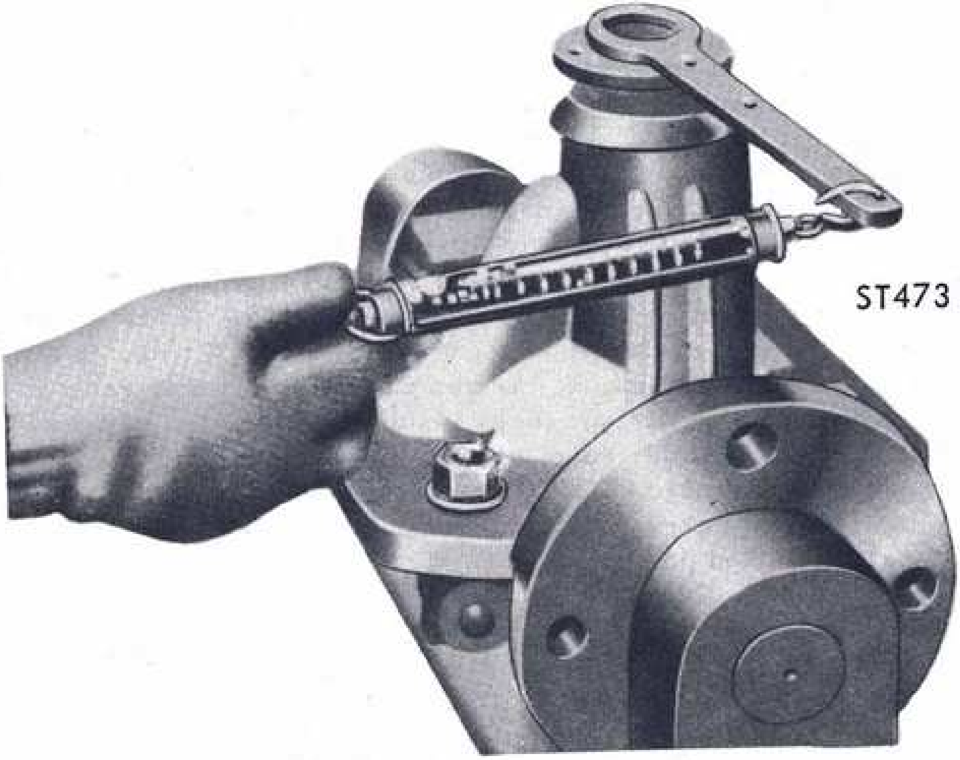


Fig. 11

At the time of inserting the front bearing, as pushing in the inner race by pulling out the drive pinion from the rear side of the carrier.

At the time of inserting the front bearing, as pushing in the inner race by pulling out the drive pinion from the rear side of the carrier. Put the rear side of the carrier downward and set the tool under it, then supporting the end surface of drive pinion, press in the bearing by using the drift. The operation would be easier by using the drive pinion front bearing inner race inserter as shown in. Tighten up the pinion nut by turning it slowly with hands with the use of pre-load gauge as Fig. 6 to the degree that support the bearing preload at 7-10kg cm. When the drive pinion is mounted in the previously mentioned condition it is necessary

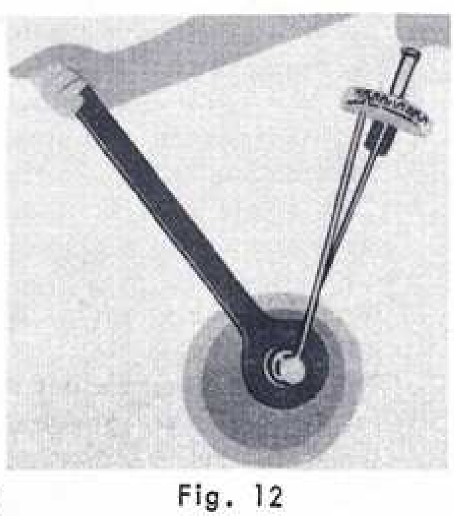


Fig. 12

to measure the height of rear surface of the pinion whether it is higher or lower than the standard. Make use of the special drive pinion arrangement gauge. The standard height of the pinion is 51.0mm. from the bottom of the side bearing fixed with the carrier. The fixing position can be measured by setting an arc of circle on both sides of arrangement gauge at the position of side bearing and insert the thickness gauge in the clearance between the tip of gauge bar and the pinion such as to push in by scraping of the carrier in diagonal, otherwise preload and the pinion height of the bearing would come out of order and tend to cause an unexpected trouble in future.

(5) The formal adjustment of the drive pinion, bearing and pre-load.
After the fixing position of drive pinion is decided as mentioned in the previous paragraph, take off the pinion nut & companion flange to mount again the drive pinion bearing spacer (distance piece) and nut. Tighten up the nut as Fig. 11 by using torque wrench at the regular torque of 100-120ft./per lbs. The preload supportedly the bearing in this case is different according to the condition of the bearing adjusting shim inserted. The more of the shim inserted, much the play of pinion to the direction of axle is increased. The less of the shim inserted, the more the bearing tightened by the previously mentioned nuts and cause it to be burned if left and turned as it is.
Therfore, for readjustment of the bearing preload in this case, it must be adjusted by increasing or decreasing the number of four kinds of *

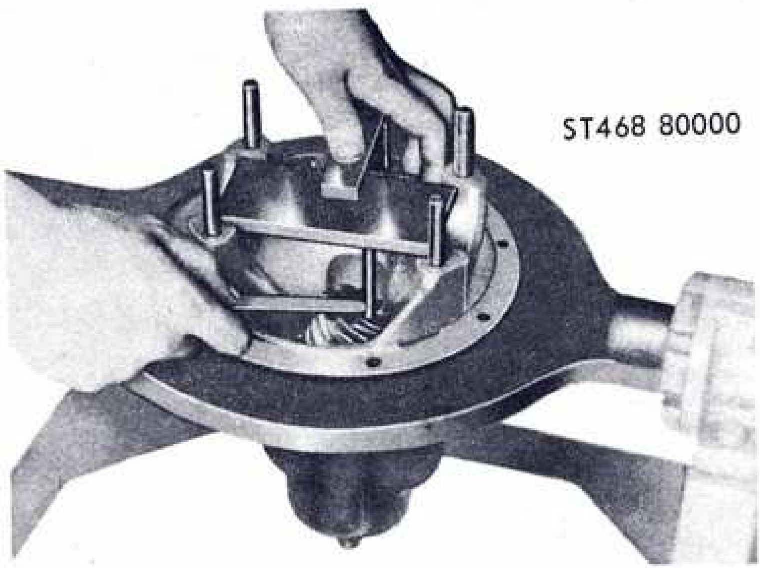


Fig. 13

Remarks

When measuring the height of the pinion head, set the semi-circular side portions of the gauge on the side bearing seats; insert a feeler gauge into the clearance between the tip of the gauge center rod and the pinion head, and adjust the pinion. The gauge rod is made 0.2mm(8/100 in.) shorter than the standard measurment(51mm). Therefore, adjustment is made by selecting a feeler gauge in accordance with the plus or minus valve marked on the pinion head.

* adjusting shim as shown in the following list and measuring with the use of the drive pinion bearing preload gauge as Fig. so as to make the revolving torque of pinion at 7-10 kg/cm if there should not by any error in the pinion with the head mark at 0 and the clearance should be sealed at 0.2mm (0.008 in.) by the feeler gauge, thus pinion is regarded as at the correct position because the height of the gauge is made shorter for 0.2mm than the standard size (51.0mm).
If it is necessary to adjust the pinion height, take off the drive pinion as well as pinion rear bearing outer race from the carrier to adjust by increasing or decreasing the number of the adjusting shim.
In other words, read the mark on the head of the drive pinion, before adjusting by increasing or decreasing the number of drive pinion adjusting shim (110-5093-6) to insert the feeler gauge which is deducted for the number of mark from 0.008 in. in case of minus side added for the number of mark to 0.008 in. in case of plus.
For instance, the mark shows +2, adjust the position of drive pinion by deducting the number of shim so as to make the clearance at 0.008 in. + 0.002 in. = 0.010 in. It is necessary to give the bearing a right preload. At the time of pushing the outer race into the carrier, it must be done in a right way, otherwise.
Specially when the old bearing is to be used again in assembling, the adjustment should be made at the lower torque than standard in accordance with the conditions of practical use so as not to give it an over preload.

(6) When the former adjustment of preload of the bearing is completed as in the previous paragraph, inspect the pinion height again.
Unless any thing wrong is found, loosen the pinion nut, take off the flange, insert the new oil seal in the rear of the rear of the carrier and formerly fix the flange, washer and pinion nut. The nut should be tightened up at the standard torque. In case the cotter pin hole fitted, the adjustment should be made not by tightening the nut, but by filling the washer.

Mounting the Differential Gear Ass'y in the Carrier

(1) Mount the complete unit of differential gear in the carrier and fix the bearing cap. There is a engrayed mark on the side of cap which should be fitted with mark on the leg of bearing housing when mounting.
It is important to note that the fixing part of the cap of each bearing housing is machimerly finished up.
The differential gear case is inserted by the bearing adjusting shim with the side bearing as explained in (3) of (A) and by housing in the bearing housing of carrier, the bearing must be given the regular preload.
The screwing torque of the fixing nut of the side bearing cap is at 35-40 ft/lbs. and should be equally locked with fixing cotter pin.

So far, only the differential unit is mounted and the drive gear is locked with the drive pinion, therefore, the following adjustment must be made to acquire the regular side bearing preload & the gear back lash.

(2) Adjustment of side bearing preload & back lash.

To give the right preload on the side bearing of differential gear case and in pressing the bearing in the differential gear case and in pressing the bearing in the differential case adjust by inserting inside the bearing adjusting shim of thickness calculated in accordance with the following method of computation.

There is a marked numberal of adjusting basis on the bearing housing of the gear carrier and differential case. The numberal is the manufacturing variation in a unit of 1/1000 in., against each standard measurement of A.B.C.D. in Fig. 9. To measure the width of the side bearing on left and right, use the standard gauge (20.0mm thickness) and dial gauge on a flat board. In this case, place the load on the bearing with the aid of weight block for about 2.5 kg to acquire the steady figures.

Calculate the manufacturing variation on minus side against the each stan standard measurement of 20.0mm on the unit basis of 1/1000 and assume each of them as E & F. Take the left side bearing, for example. When the measured width is 19.8 m, it is -0.2mm. (-0.008 in.) against the standard measurement and the E is, by excluding the minus sign, 0.008in. The thickness of the shim is acquired by opplying the numerals to the following method of computation.

It may as well be assembled by using the shim of thickness which is in accordance with above method of computation. The left and right bearing must be well pressed in, otherwise the preload changes.

Measure the backlash of the drive pinion & ring gear as Fig. by using the dial indicator to make sure that it is within 0.1mm-0.2mm (0.004"-0.008").

If it is much, move to left taking off the right shim, for adjustment.

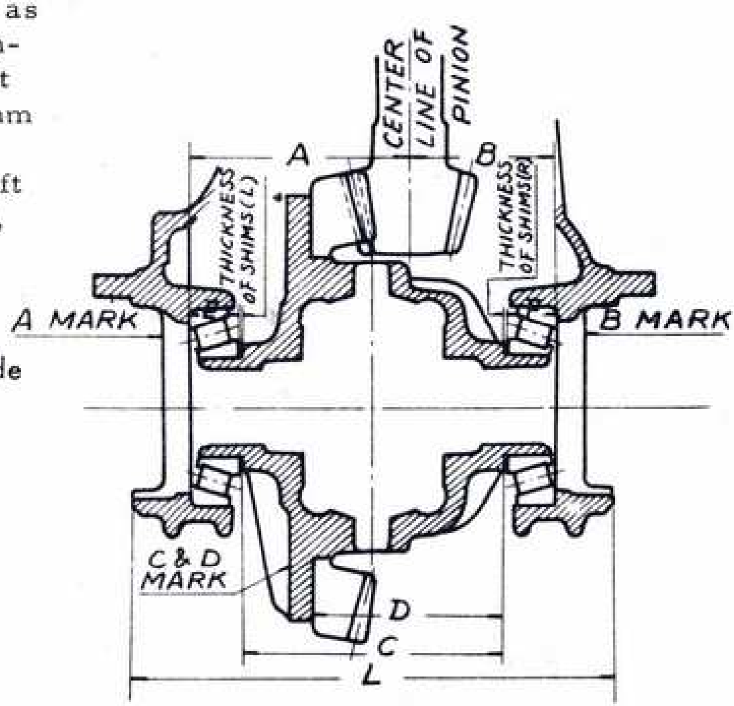


Fig. 14

Thickness of shim on left side

Left Side

T_1=A-C+D+E+7

Thickness of Shim on right side

Right Side

T_2=B-D+6

B-D+F+(0.150)

Example of calculation:

A = +1 F = 8 (0.2 mm/0.025mm = 8)
B = +2 F = 10 (0.25mm/0.025mm = 10)
C = -1

(Left) T_1 = A-C+D+E+7 = 0.025mm x 20 = 0.5mm
(1-(-1)+3+8+7)

(Right)T_2= B-D+F+6 = 0.025mm x 15 = 0.375 mm
(2-3+10+6)

T_1 = A D - C 0.007 E
=0.001"+0.002"-0.002"
+0.007"+0.008" =
0.016" ... (Thickness of left side shim)

T_2 = B - D 0.006" + F
=0.002"-0.003"+0.006"+0.010"
=0.015" (thickness of right side shim)

The numeral marked by the electric pen on the side of the drive gear shows that of the recommended back lash besides the set number .
For example, (b-6) means the back lash of 0.006 in. (0.25mm x 6=0.15mm)

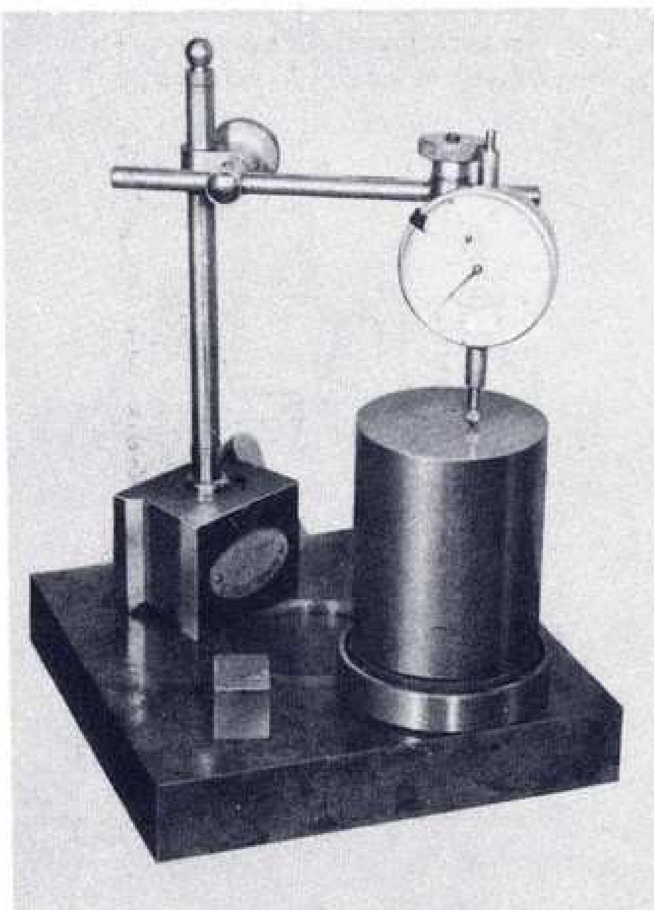


Fig. 15

1. Dial gauge
2. S.T.D. gauge (20.0mm thickness)
3. Weight block
4. The bearing measured.

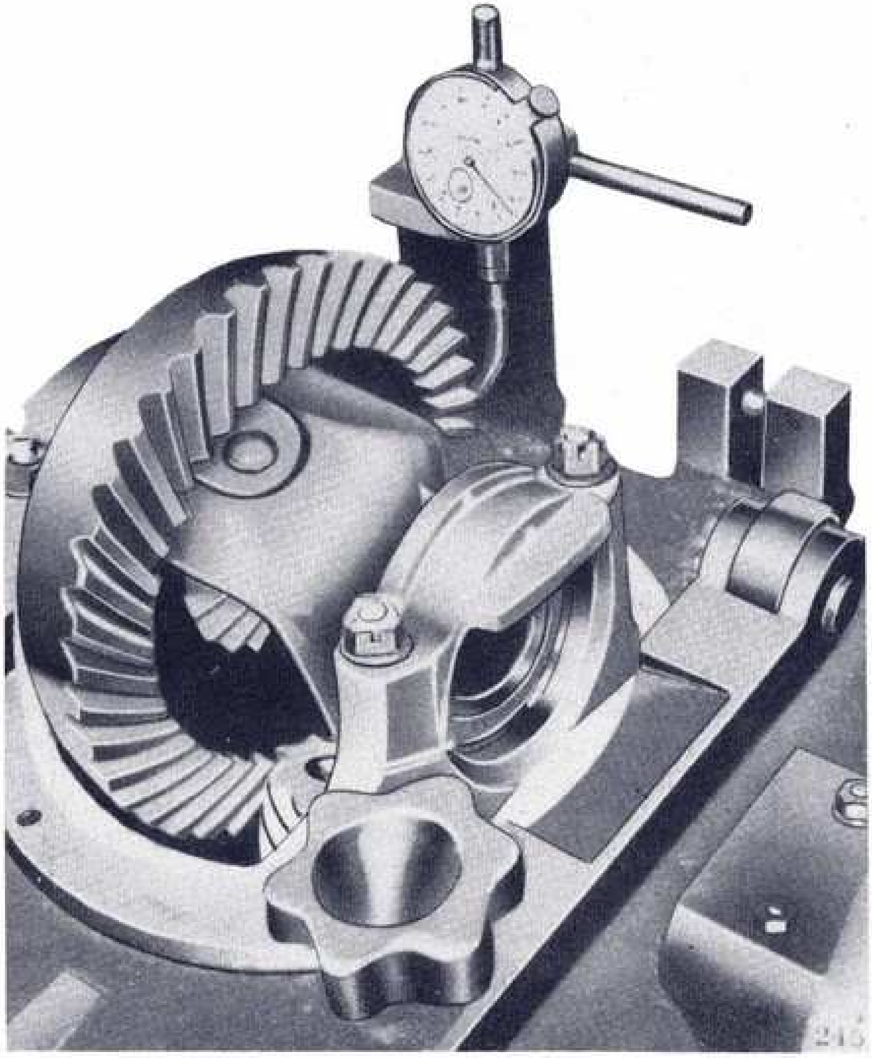


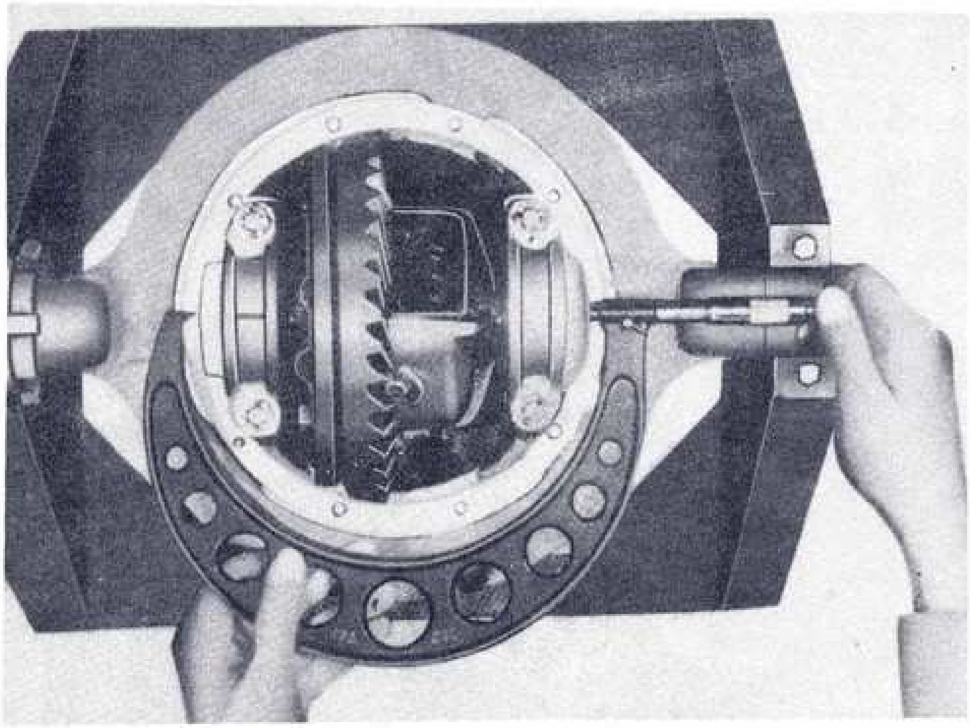
Fig. 16

Measurement of backlash for the drive pinion & ring gear

If it is necessary to use the bearing again at the time of repairing, the thickness of each shim of left & right must be reduced for 0.001"-0.003" on the basis of 80% or 60% against standard preload in accordance with the practical condition of use, because over preload is given to the beari with the shim of thickness calculated from above method of computation.

Thus the adjustment is completed. By way of precaution, measure with michrometer of the large size the L measurement which is within 198.40 - 198.55mm as Fig. 12 (Service No. tool ST463-80000).
If it is insufficient, add an additional shim of 0.002 ins. left and right. In this case, the said michrometer, Fig. 12 or special gauge should be employed for scaling.

The shake of the back of drive gear which has been fixed with the carrier should be measured by dial indicator to condirm that is within 0.05mm.



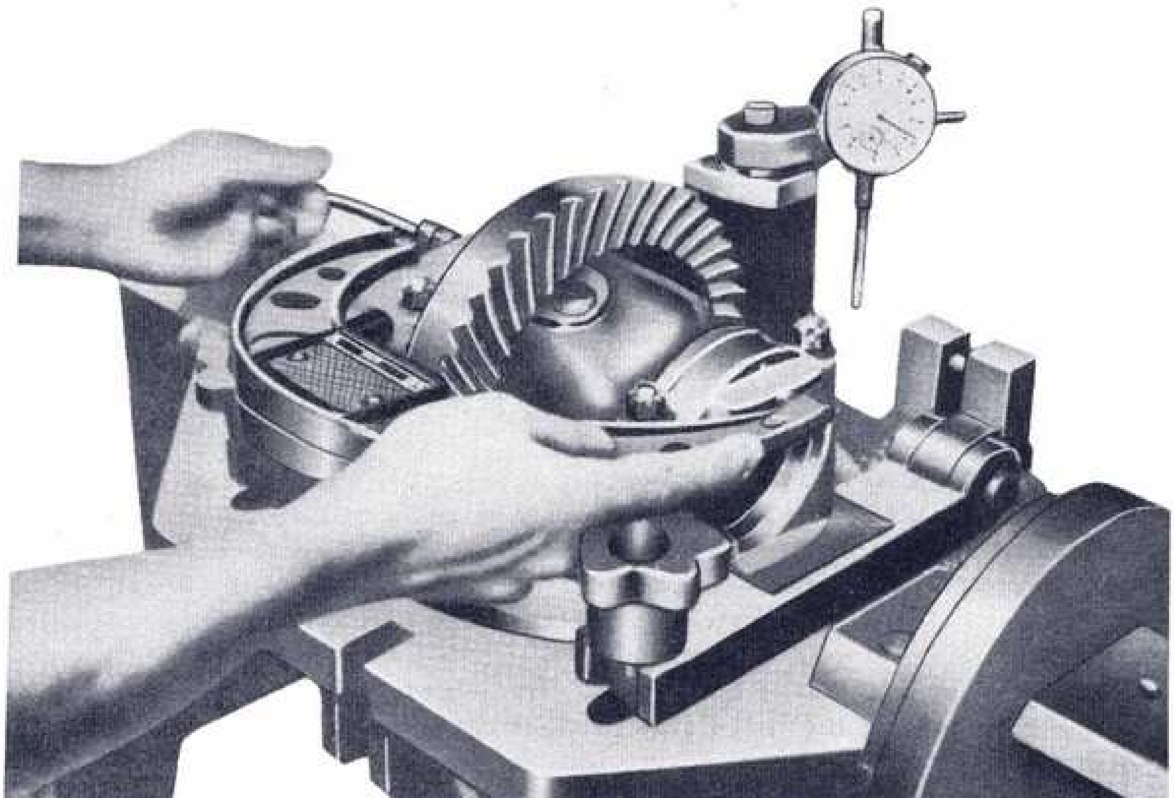
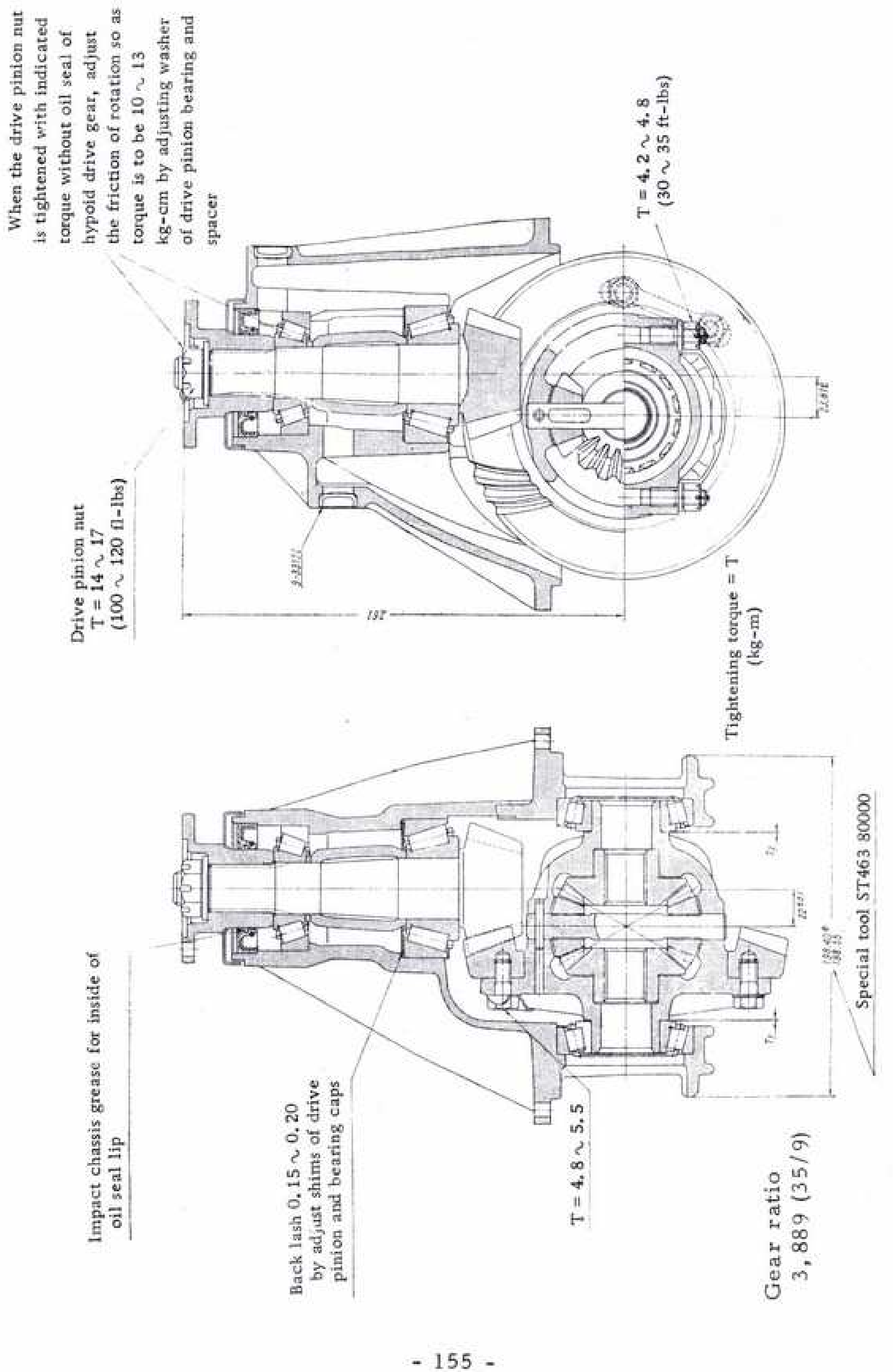


Fig. 17 Using the differential side bearing cap gauge

SECTIONAL VIEWS OF DIFFERENTIAL GEAR



Mounting the gear carrier Ass'y on the Rear Axle Housing

Interior of the axle housing should be cleaned well. The carrier packing should also be replaced with new one. Mount the gear carrier ass'y without mistaking its upper side with down side and through 8 studs, then fix with the lock washer & nut. The nut must be tightened in a diagonal line so as not to cause the oil leaks.

When it is mounted on the vehicle, feed the gear oil immediately. The oil of the designated gypoid gear oil No. 90 should be feed. Feed the oil till it comes up to the down side of the feeding hole.

STEERING

The steering tube revolves a cam, which engages in turn with a taper peg fitted to a rocker shaft within roller bearing. This assembly is enclosed in an oil tight casing which carries two ball bearings at either end of the cam.

When the steering wheel is turned the tube revolves the cam, which in turn, causes the taper peg to remove over a predetermined arc, thus giving the rocker shaft its desired motion, connected to the rocker shaft is a steering side and cross rod lever, that links up with the steering linkage. The steering is of the three cross rod connecting the side and cross rod lever to the gear arm on the idler shaft. Two shorter side rod, one on either side, connect the steering gear arm to the steering gear and idler arms respectively.

Side Cross Rods

The side cross rods are held in position by a castllated nut and split pin at each end.

To remove the tube, withdraw the split pin and release the nut at each end of the rod and then carefully tap the rods clear of the levers to which they are connected.

Removing the Steering Gear Arm

These are secured to the steering gear rocker shaft and idler shaft respectively by a nut and split pin each. Normaly these levers need not be removed for any general maintenance. The only occasion requiring their removal would be when damage has occurred, under which circumstances the steering box or idler should also be removed for inspection when the arm concerned can be withdrawn once the steering gear box or idler has been removed to the work bench.

The gear arm should be with drawn from the shaft concerned using a suitable extractor. The gear arm must not be hammered from its shaft.

Removing the Idler

After the side and cross rods diconnected the idler can be detached from the body. It is secured by three bolts to the front suspention member.

Holding, the idler body on the bench and take off rubber cover.

Unscrew the idler shaft out of the body.

STEERING GEAR

Type of gear	Cam & Lever
Gear ratio	14.8 : 1
Outer dia. of front & rear edge at the position of bearing insert	18 mm
Inner dia. of worm bearing (F. & R.) :	18 - 0.009 m
Dimension for fittable tightness of worm bearing:	0.009 mm.
Worm adjusting shim:	0.762 mm, 0.254 mm, 0.127 mm 0.005 mm
Thickness of standard shim	1.5 mm
Turning weight at the steering column:	0.12 mm-0.25 kg. at the inside of wheel.
Dia. of shaft:	22 mm
Bushing, Out dia.	25.2 mm
In dia.	22.227-22.250 mm
Clearance of shaft:	0.017-0.060 mm
Thickness of thrust washer	3.2 ± 0.05 mm
Off-set at center of worm & roller	4.7 ± 0.1 mm
Dia. of steering wheel:	400 mm
Play of steering at around of wheel	25-35 mm
Dia. of the shaft:	22 mm
Bushing (Lower)	
Outer dia.	25.5 mm
In dia.	22.227-22.250 mm
Clearance for shaft:	0.017-0.060 mm
Standard:	Gear oil MP#90 (Hypoid gear oil) In warmer district than 32°C use MP#140 if colder less than -12° C use MP380.
Capacity:	0.25ℓ

Steering Gear Housing Removal

Removing the horn bottom from the steering wheel, unscrew the universal joint lock bolt at the extremity of the gear housing, then disconnect higher up the column from the universal joint.

First disconnect ball stud nut and draw out from the end of steering gear arm.

Unscrew the bolts secured to front suspension member. Thus, the steering gear housing assembly should be removed from position.

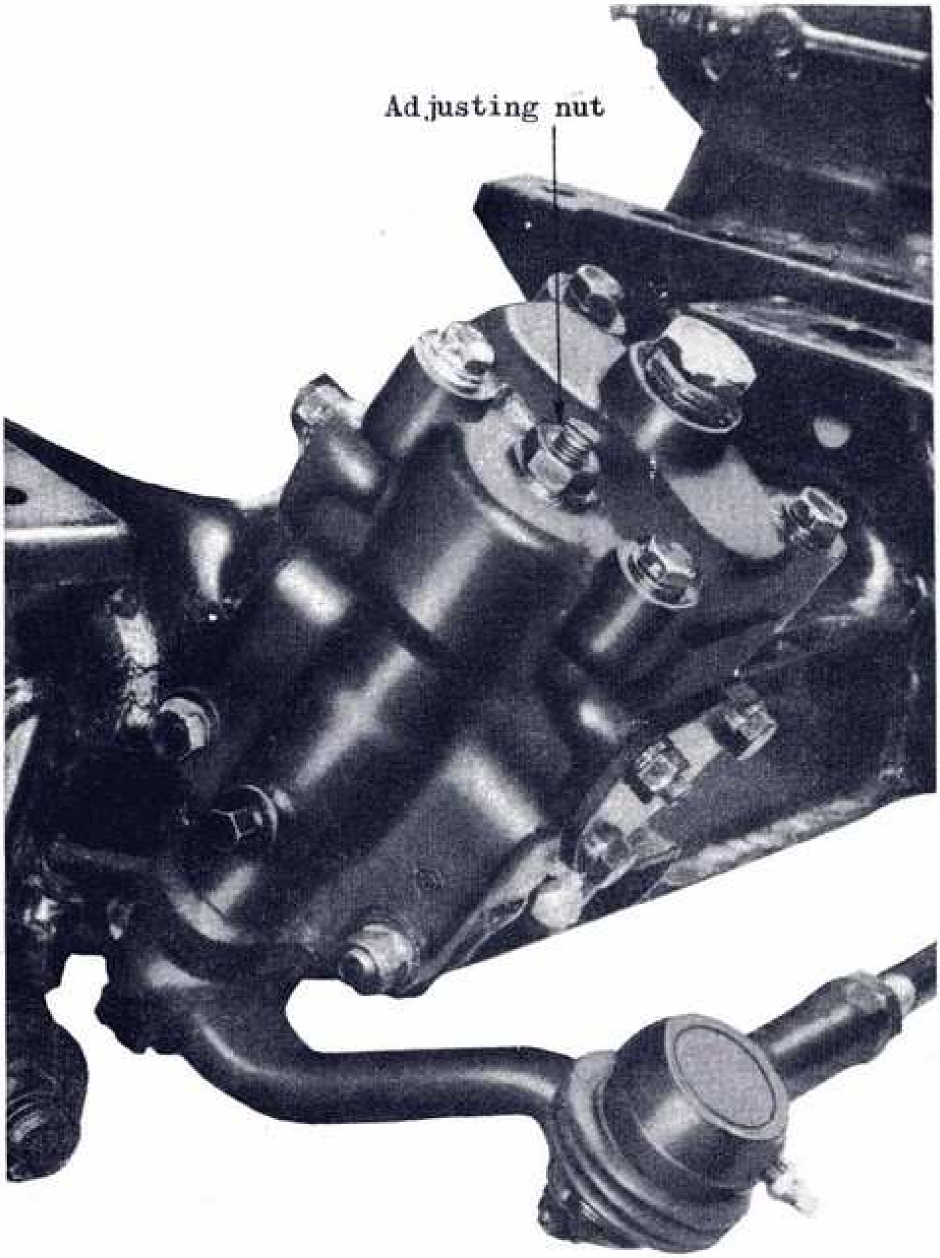


Fig. 1 Steering gear box

Disassembly

Supporting the hausing on the suitable bench leaving the rocker shaft free. Remove the rocker shaft cover after extracting the four setscrews.

Tapped out the rocker shaft using a soft metal drift. Disconnect coupling assembly from worm gear shaft. A ball roller is situated within needle rollers fitted in the ball plug of the shaft and care should be exercised that the rollers do not fall out it a ball roller is removed. It should only be removed if showing an appreciable amount of wear. Disconnect the three setpins secwring the front cover in position, and release this cover with shims.

Take off rear cover same way.

The complete unit should now be up-ended with the steering housing uppermost.

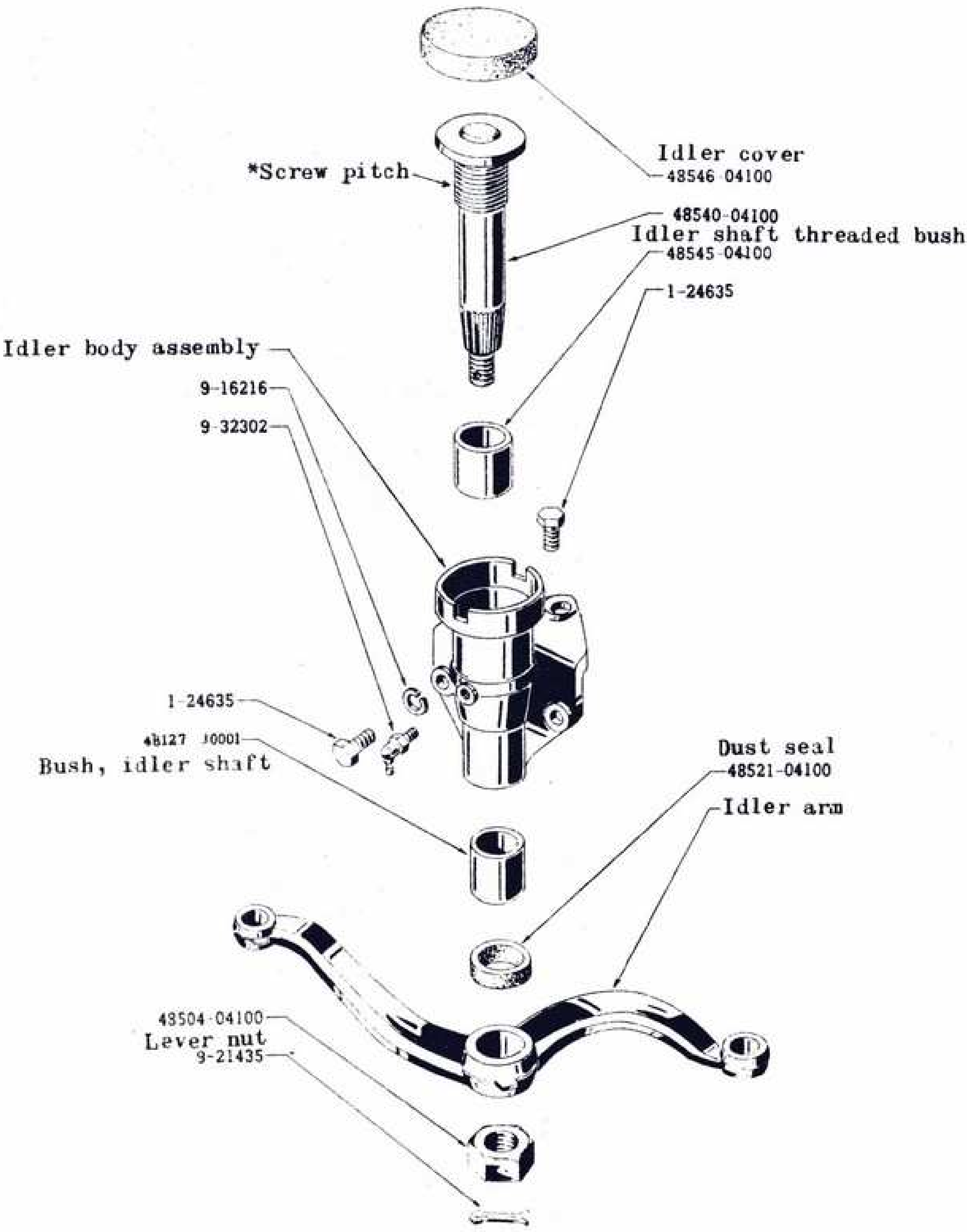
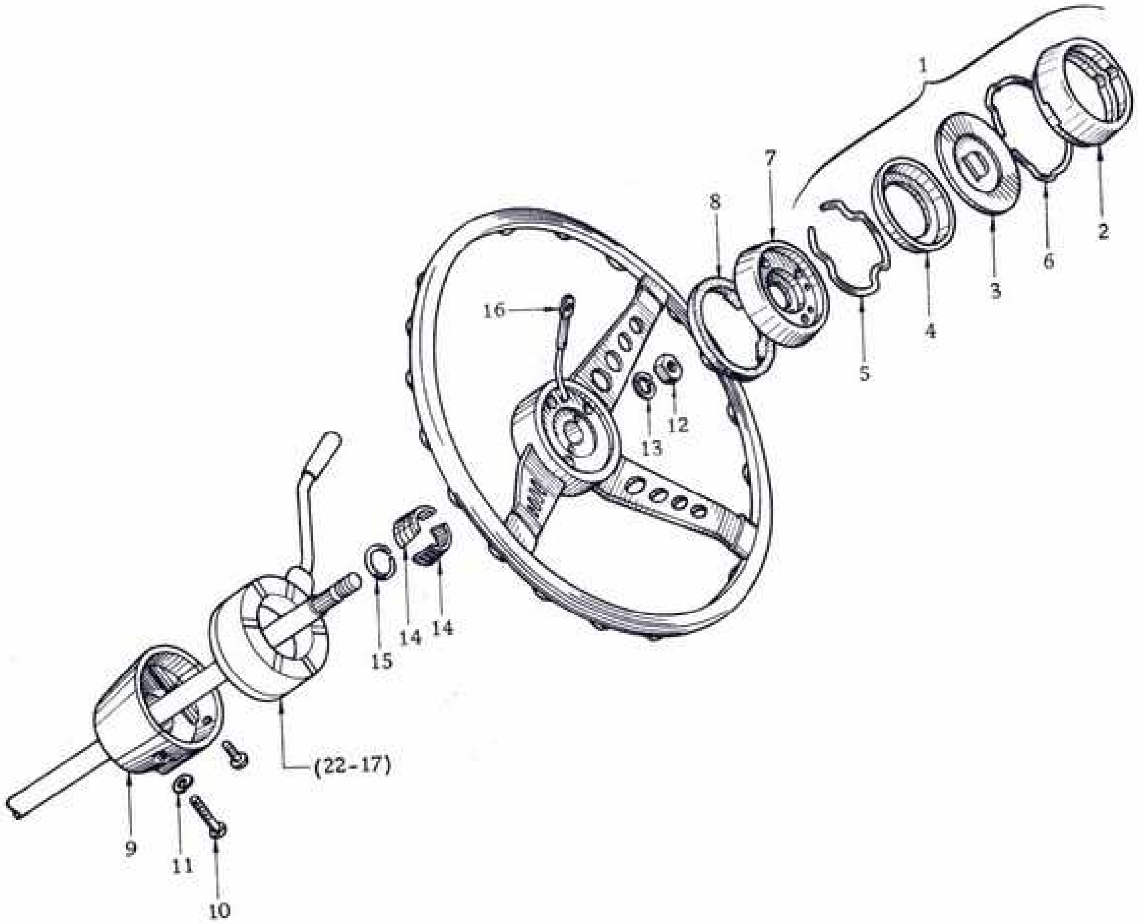


Fig. 2 Idrer & arm



1. Ass'y-button, horn
2. Retainer-horn button, upper
3. Button-horn
4. Cap-horn button
5. Spring-button lock
6. Spring-retainer lock
7. Ass'y-switch, horn
8. Spring-horn button
9. Set-shell, steering column
10. Screw
11. Washer-lock
12. Nut-steering wheel fixing
13. Washer-lock
14. Collar-steering wheel fixing
15. Wire
16. Comp. -cord, horn upper

Fig. 3 Steering wheel

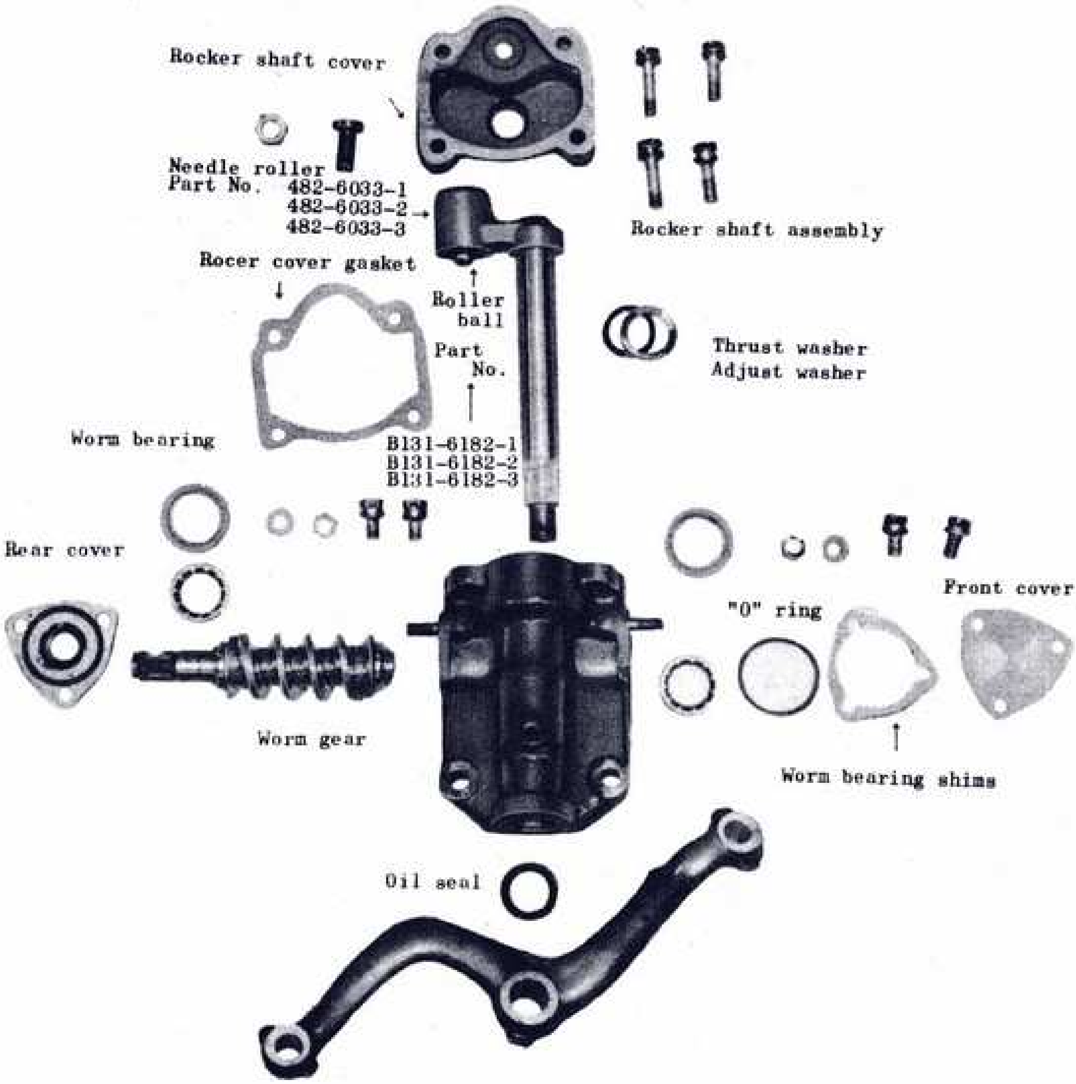
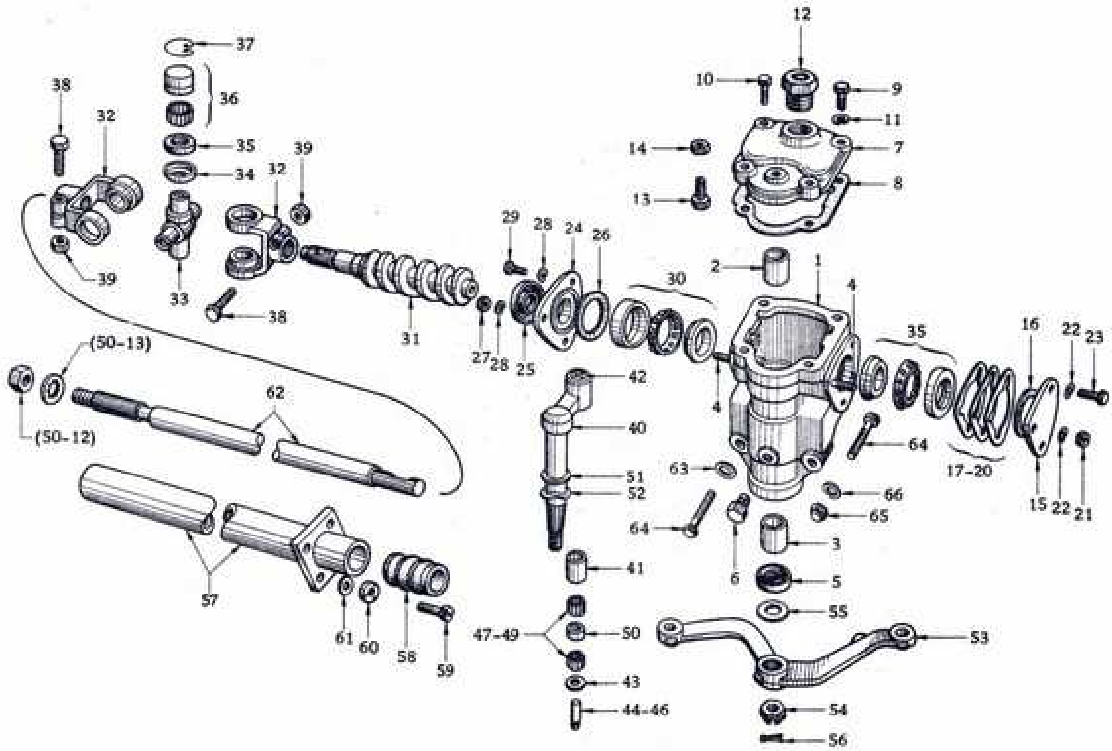


Fig. 4 Components of the steering gear case

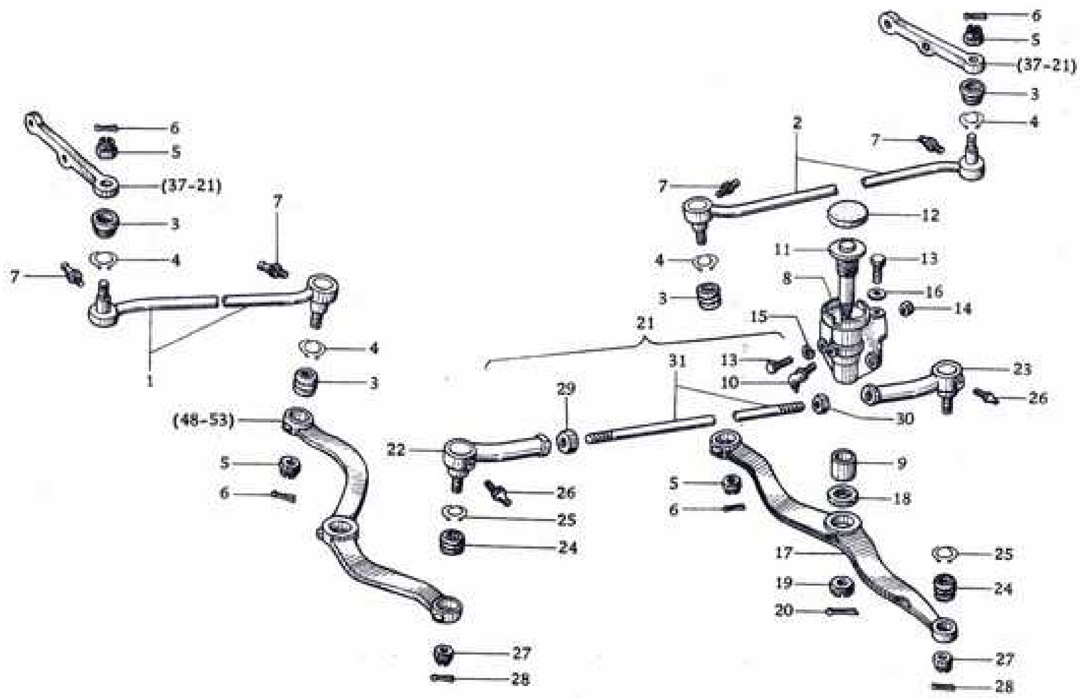
By bumping the end of the worm gear against a wooden block, tap out on the floor, the worm gear with rear bearing will be displaced. The complete inner assembly can then be withdrawn from the housing through the open end of it.

Then with the steering wheel held to prevent it from turning, endeavour to turn the side rod and gear arm. Should the steering wheel have a tendency to lift, it may be assumed that there is excess end play in the worm gear.



1. Comp.-housing, steering
2. Bushing-idler shaft
3. Bushing-idler shaft
4. Stud-bushing, front
5. Seal-oil, rocker shaft
6. Plug-drain
7. Cover-rocker shaft
8. Gasket-rocker shaft cover
9. Bolt
10. Bolt
11. Washer-lock
12. Ass'y-plug, filler
13. Screw-rocker shaft adjust
14. Nut-lock
15. Cover-housing, shaft adjust
16. Ring-"O", housing cover
17. Shim-worm bearing (0.762 t)
18. Shim-worm bearing (0.254 t)
19. Shim-worm bearing (0.127 t)
20. Shim-worm bearing (0.050 t)
21. Nut
22. Washer-lock
23. Bolt } to fix front cover
24. Cover-housing, rear
25. Seal-oil, worm shaft
26. Ring-"O", housing cover
27. Nut
28. Washer-lock
29. Bolt } to fix rear cover
30. Ass'y-bearing, worm
31. Gear-worm
32. Yoke-universal joint
33. Journal
34. Retainer-oil seal, bearing
35. Seal-oil, bearing
36. Ass'y-bearing
37. Ring-snap
38. Bolt
39. Nut
40. Ass'y-shaft, rocker
41. Race-needle roller
42. Plug-ball roller
43. Cover-needle roller
44. Ball-roller (12.998 ϕ)
45. Ball-roller (12.993 ϕ)
46. Ball-roller (12.988 ϕ)
47. Roller-needle (2.540 ϕ)
48. Roller-needle (2.543 ϕ)
49. Roller-needle (2.546 ϕ)
50. Spacer-needle roller
51. Washer-thrust, rocker shaft
52. Washer-thrust, shaft adjusting
53. Arm-steering gear
54. Nut
55. Washer
56. Pin-cotter
57. Comp.-jacket, steering column
58. Ass'y-bush, column
59. Bolt
60. Washer-lock
61. Washer-plain } to fix jacket to dash board
62. Comp.-column, steering
63. Washer-lock
64. Bolt
65. Nut } to fix steering gear
66. Washer-lock

Steering gear



1. Ass'y-rod, side (R.H.)
2. Ass'y-rod, side (L.H.)
3. Seal-dust, ball socket
4. Clamp-dust, seal
5. Nut
6. Pin-cotter
7. Nipple-grease
8. Comp.-body, idler
9. Bushing-idler socket
10. Nipple-grease
11. Comp.-shaft, idler
12. Cover-idler (rubber)
13. Bolt
14. Nut
15. Washer-lock
16. Washer-lock
17. Arm-idler
18. Seal-dust, rocker shaf
19. Nut-steering lever
20. Pin-cotter
21. Ass'y-rod, cross
22. Ass'y-socket, cross rod (R.H.)
23. Ass'y-socket, cross rod (L.H.)
24. Seal-dust (rubber)
25. Clamp-dust seal
26. Nipple-grease
27. Nut-slotted
28. Pin-cotter
29. Nut
30. Nut-cross rod, locking
31. Bar-cross rod

Fig. 5 Steering linkage

Assembling

Reassembly of the gear housing is merely a reversal of the dismantling procedure however, adjusting shims should be fitted behind the front cover so that there is no end play on the column, but at the same time they should not be preloaded, otherwise damage to the ball races may ensue.

When the rocker shaft is dropped into position, ensure that it is a good fit in its housing and that the oil seal at the rear cover of the housing is making good contact.

Before refitting the rear and front cover screw back the adjusting nut.

Ensure that all joint are oil tight.

Adjusting the gear

The adjusting screw in the cover should be slackened by releasing the lock nut and unscrewing the screw a few turns.

Then the adjusting screw should be down until there is no free movement in the straight a head position of the gear and adjustment secured by lock nut. Final adjustment should be made once the gear has been reassembled to the housing. It should be noted that as wear in use is normally greater in the straight ahead position than on lock, provision is made for this in the disign of the cam, and it will be found that there is a slight end play towards each lock.

The steering gear housing should be filled with recommended gear oil through the filler plug situated at the rocker shaft cover and then a final test made to ensure that the movement is free from lock.

Assembly order of Steering Column and Coupling

When replacing steering column, reverse the removal procedure, but care should be excercised to see that at the steering column end insert lock bolt the fixed position which fittable hole to the universal joint.

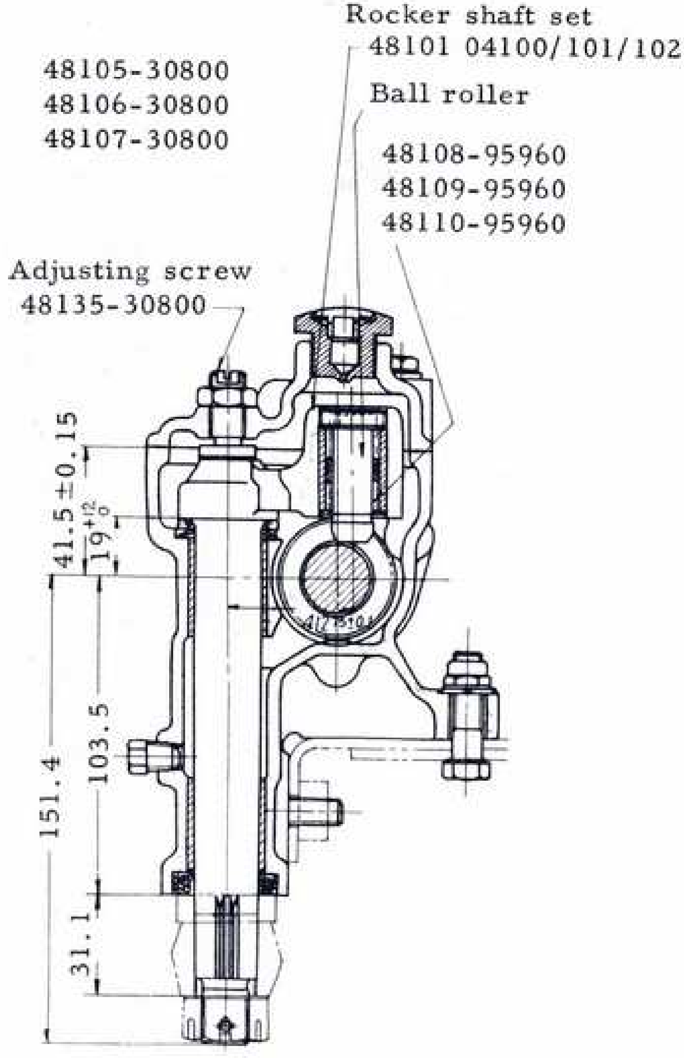


Fig. 6 Section of steering geer housing

Steering Faults

Loose steering is invariably attributed end play of the worm gear through steering column, which can be rectified by the removal of shimes located behind the gear housing front cover, as already mentiond. To check for this end play, disconnect ball joint stud at the end of cross rod from gear arm and turn the steering partly to the right or léft lock.

SAFETY STEERING COLUMN

CONTENTS

DESCRIPTION

The steering shaft mounted on the 510 series, SPL311-U and SRL311-U is a collapsible type which collapses and absorbs the collision energy when the driver collide on the steering wheel.

The construction of the collapsible steering is described in Figure ST-1.

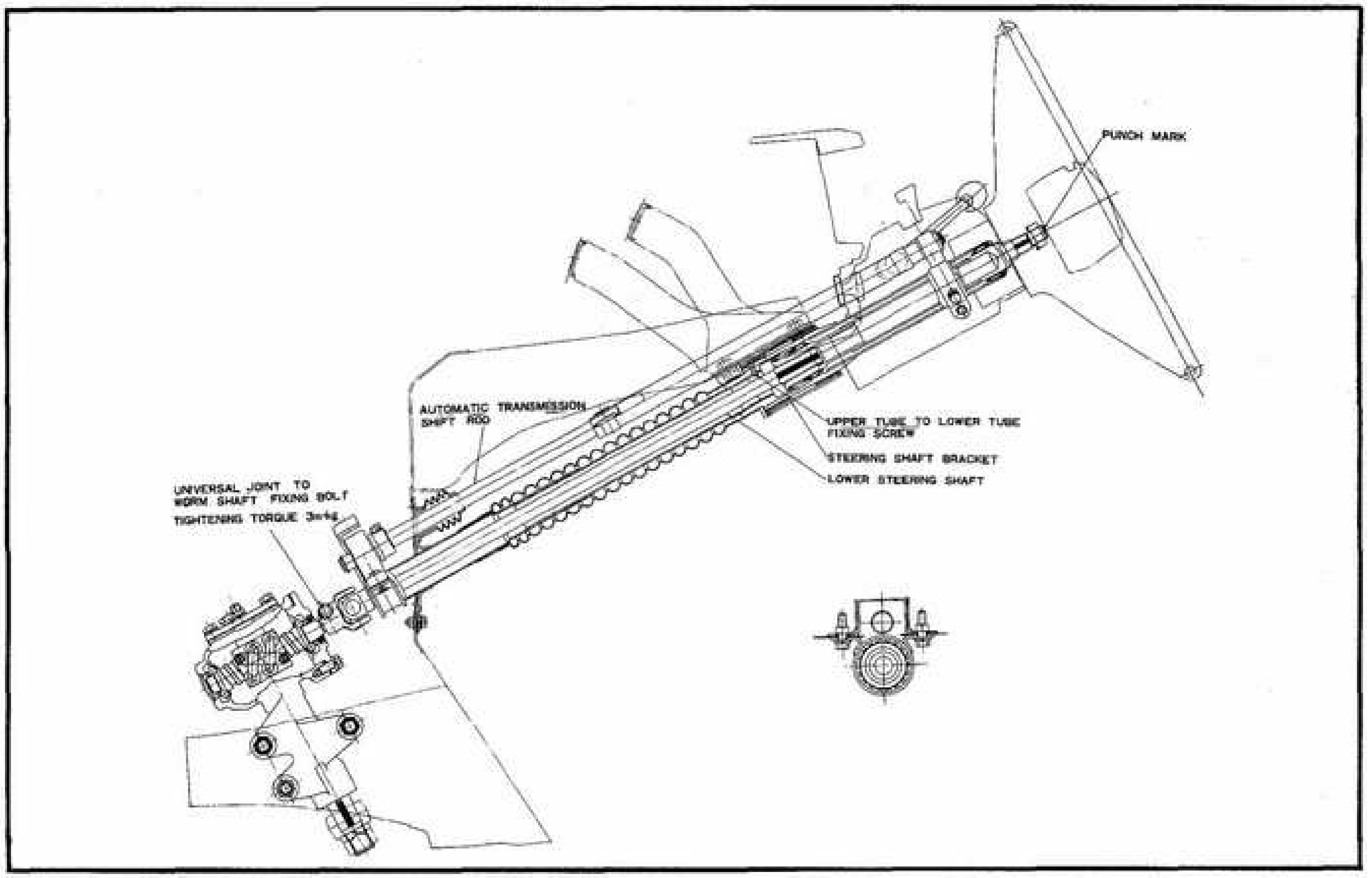


Fig. ST-1 Construction of the collapsible steering mounted on the 510 series

REMOVAL AND INSTALLATION

The procedure for removal is the same to an ordinary type steering, however the gear housing and steering column shaft can be divided at the universal joint, therefore the removal is rather easy. (The procedure for an ordinary type steering is described in the section ST of the SERVICE MANUAL DATSUN CHASSIS AND BODY-MODEL 510 SERIES.)

1. Remove the horn ring, the steering wheel and the shell cover.

2. Remove the directional and lighting switch.

3. Remove the cotter pin and separate shift rod (Automatic transmission only).

4. Remove the bolt fixing the universal joint to the worm shaft.

5. Hold the lower steering shaft by a wire rope to prevent slipping this shaft off.

6. Remove the bolts fixing the jacket tube flange to the fire wall panel.

7. Remove steering column shaft bracket attaching bolts.

8. Then pull out assembly steering column shaft toward driver's seat.

Installation is the reversal procedure for removal.

Tightening torque of universal joint nut should be 3 m-kg (21.7 ft-lb).

DISASSEMBLY AND ASSEMBLY

1. Remove the holding wire.

2. Pull out the lower steering shaft.

3. Remove the control linkage (Automatic transmission only).

4. Slip off the steering shaft bracket.

5. Remove three screws fixing the upper tube to the lower tube, then separate the upper tube and the lower tube.

Assembly is the reversal for disassembly procedure.

Note: When lower steering shaft spline is inserted into upper steering shaft spline, the slit of universal joint must coinside with punch mark located on upper end of upper steering shaft (See Fig. ST-2).

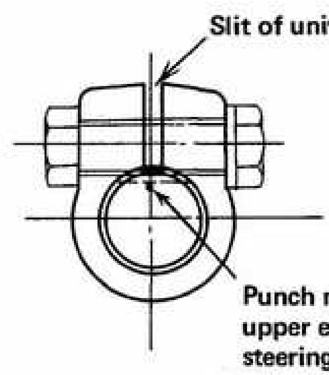


Fig. ST-2 Coinsideing the slit with punch mark

BRAKES

Disc Brake for Front Wheel

The disc brake of Dunlop MKII type is adopted for the front wheel.
Reference to the rear wheel, the leading trailing shoe is used for drum of the wheel.
This disc brake consist of a flat disc (roter), caliper assembly, and carrier adapter etc.

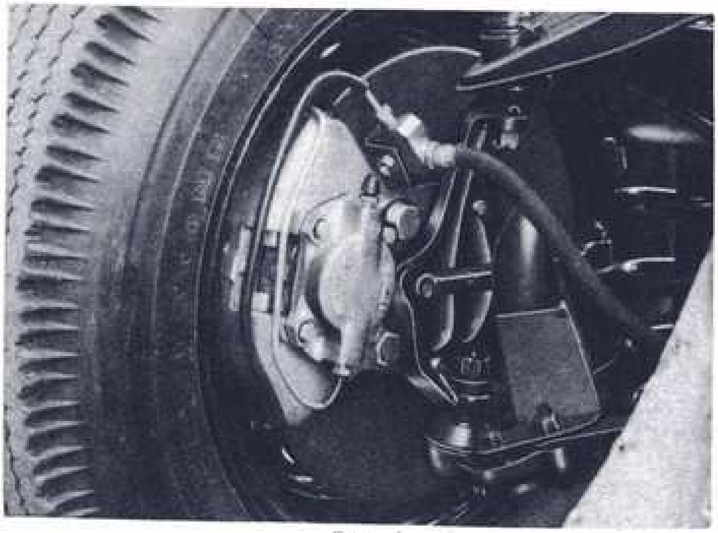


Fig. 1

This MKII type is made of the transferee, Smitomo Electric Industry Co., which obtained from the patentee, Dumlop corporation as to all the patent for manufacturing technique.

		New Model
Type	Front	Disc (Dunlop MKII type)
	Rear	Drum (Leading & trailing shoe type)
Lining dimension (Width x Thickness x Length - Nos.)		
	Front (mm)	47.5 x 16.7 x 53.98 - 4
	Rear (mm)	40 x 4.5 x 215 - 4
Total braking area		
	Front (mm)	102.6
	Rear (mm)	351

Roter (disc) Outer dia. Front (mm)	284 (11.1 in.)
Drum inner dia. Rear (mm)	228.6 (9 in.)
Master cylinder Inner dia. (mm)	19.05 (3/4 in.)
Wheel cylinder Front (mm) Rear (mm)	 53.98 (2 1/8 in.) 20.64 (13/16 in.)
Pedal ratio	3.9
Friction pad	TEXTAL TP 9L

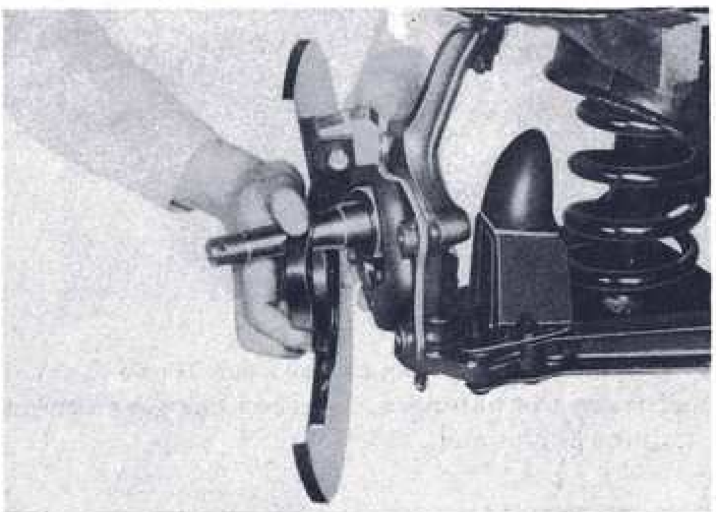


Fig. 2

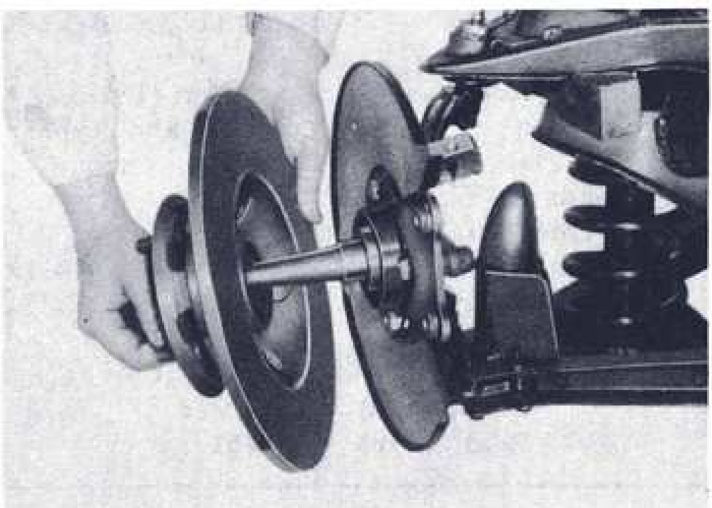


Fig. 3

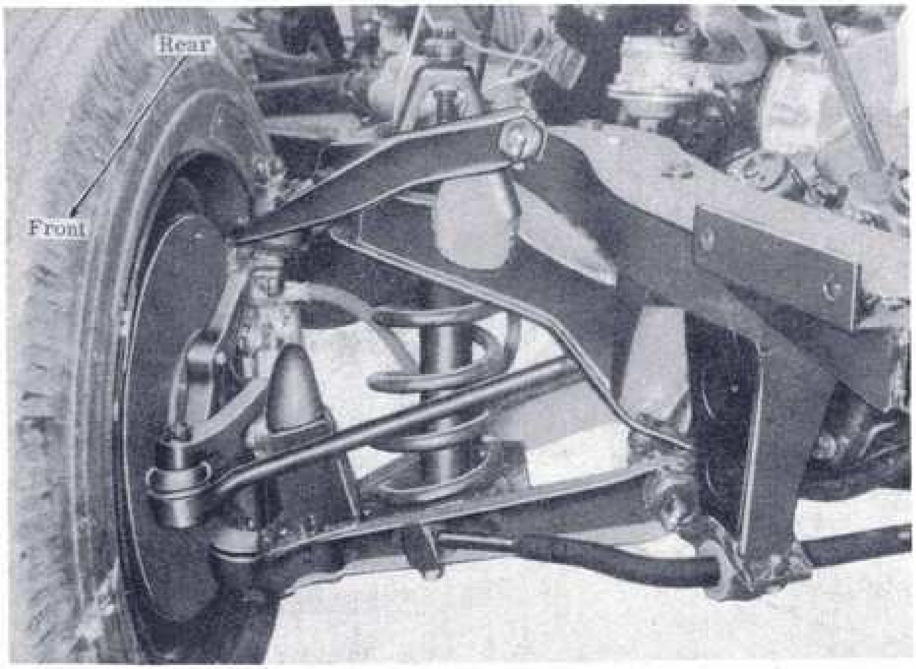


Fig. 4

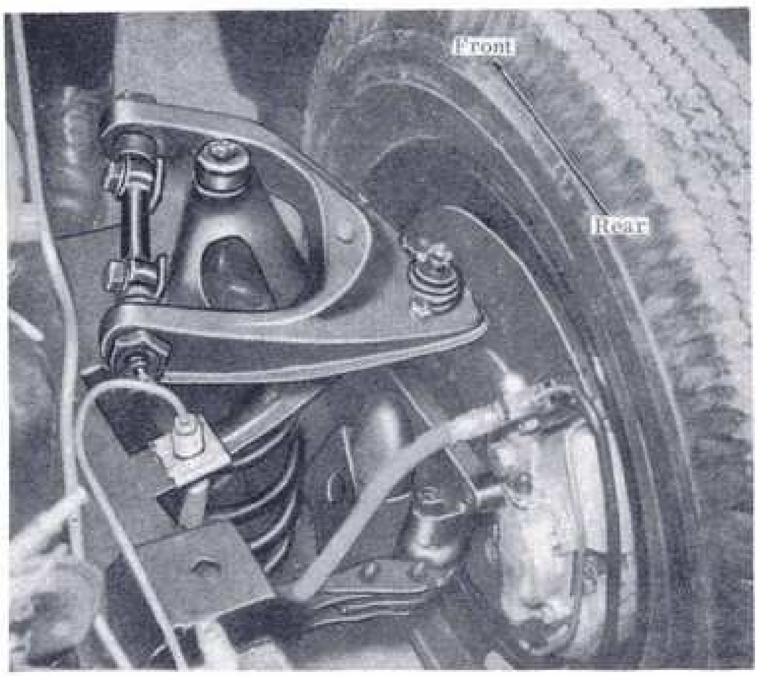
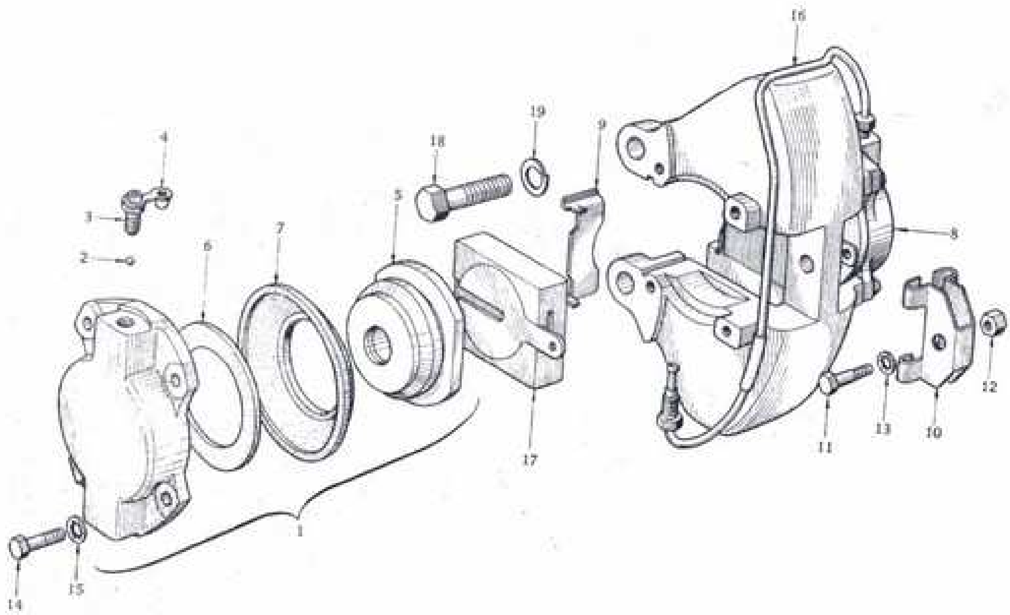


Fig. 5 Front axle



1. Ass'y-cylinder, inner
2. Ball-13/16
3. Screw-bleeder
4. Cap-bleeder
5. Ass'y-piston
6. Packing-piston
7. Cover-dust
8. Ass'y-cylinder, outer
9. Plate-support
10. Plate-keep
11. Bolt } to fix keep plate
12. Nut } to fix keep plate
13. Washer } to fix keep plate
14. Bolt } to fix cylinder
15. Washer } to fix cylinder
16. Ass'y-tube, bridge (R.H.)
17. Ass'y-pad
18. Bolt } to fix caliper
19. Washer } to fix caliper

Fig. 6 Front brake

The Disc Brake Unit

The brake unit consists of a calliper settled in two halves which are held together by the bolts.

Each front wheel brake unit comprises a hub-mounted disc rotating with the wheel and a braking unit rigidly attached to the swivel axle.

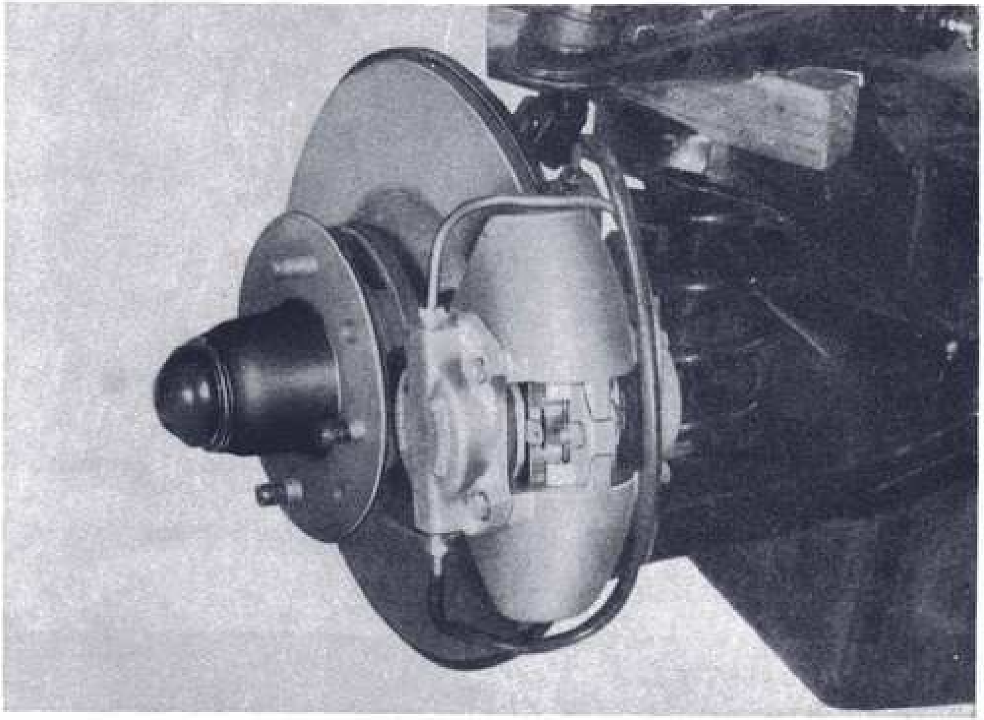


Fig. 7

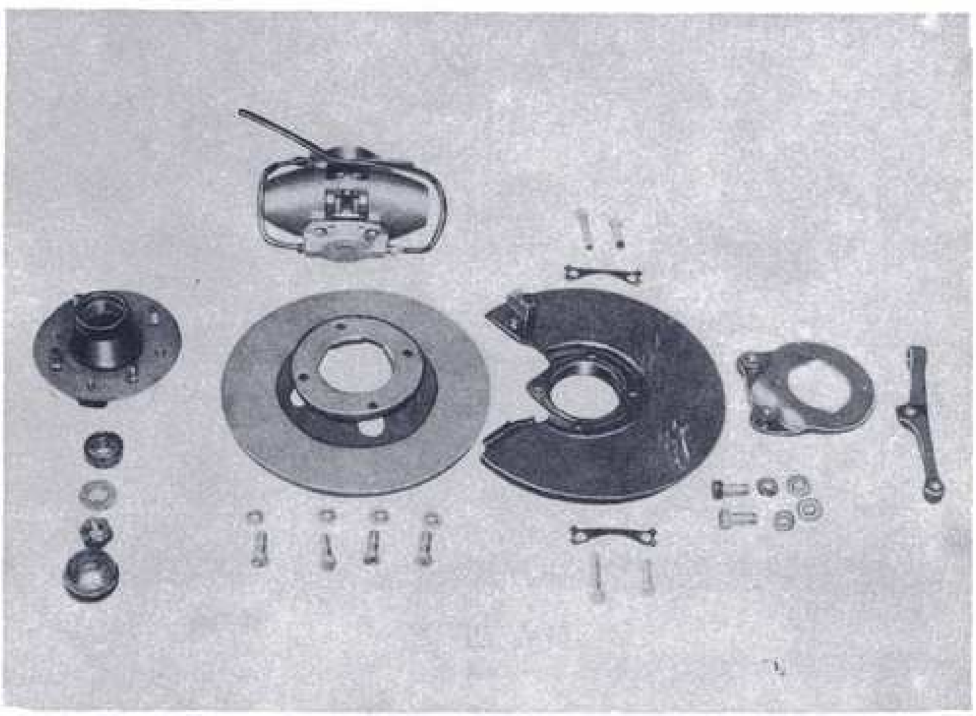


Fig. 8

Components of the Calliper

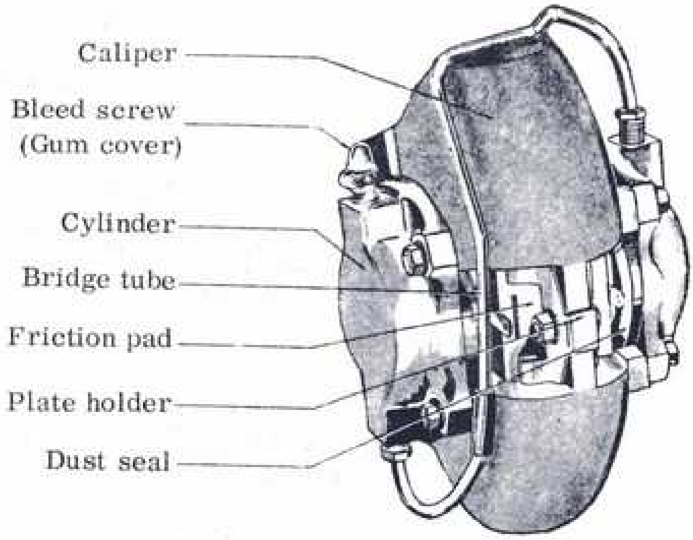


Fig. 9

A cylinder in each calliper half houses a self-adjusting hydraulic piston, a fluid seal, a dust seal, and a seal retainer.

Each piston is located on a guide post securely held in the back of each cylinder.

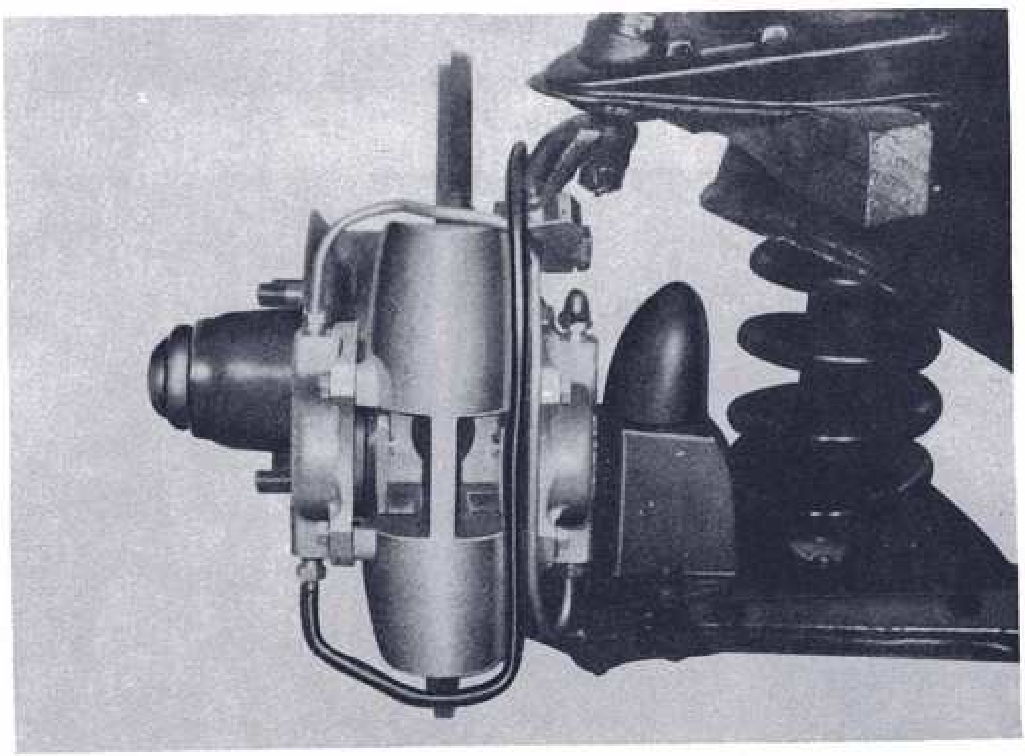


Fig. 10

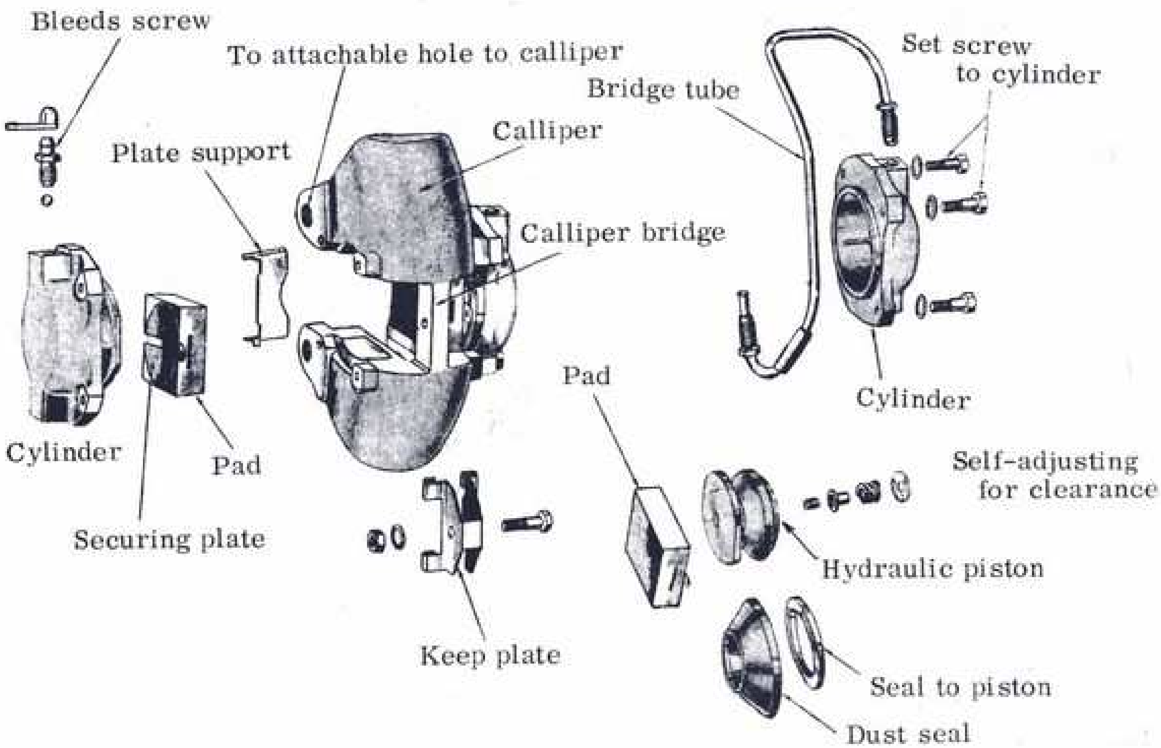

Bleeds screw
To attachable hole to calliper
Bridge tube
Set screw
to cylinder
Calliper
Plate support
Calliper bridge
Cylinder
Pad
Cylinder
Pad
Securing plate
Self-adjusting
for clearance
Hydraulic piston
Keep plate
Seal to piston
Dust seal

Fig. 11

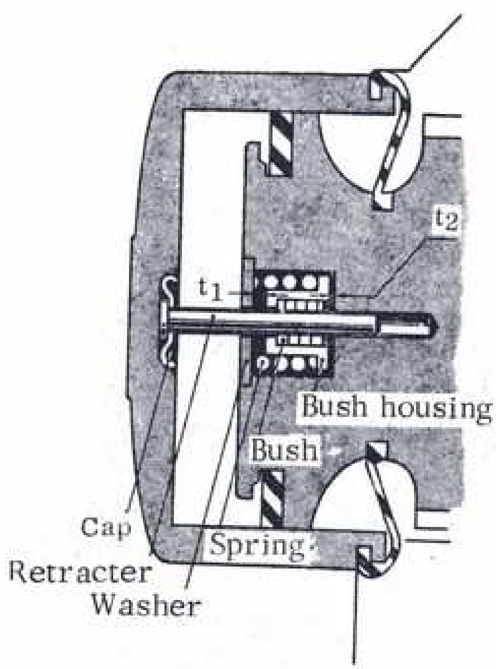

t_2
t_1
Bush housing
Bush
Cap
Spring
Retracter
Washer

Fig. 12

The friction pad assemblies are fitted adjacent to the pistons by the securing plate and are retained in position by a support plate and bolted with the keep plate.

Fluid pressure generated in the master cylinder enters mounting half of each calliper and passes through internal fluid ports into the rim half. An even pressure is therefore exerted on both hydraulic pistons, moving them along the cylinder bores until the friction pad assemblies contact the disc.

In order to compensate for wear of the pads the pistons move progressively for wear of the pads the pistons move progressively along each corresponding guide post, and the friction stops, which grip the posts, provide a positive datum to which the pistons return. The movement of the piston deflects the fluid seal in the cylinder bore, and on releasing the pressure the piston moves back into its original position thus providing the required clearance for the friction pads.

Removing Disc Friction Pads

Apply the hand brake jack up the car, and remove the road wheel.

Unscrew the bolt of keep plate, take out the keep plate from the calliper bridge.

Withdraw the brake friction pads out of the calliper with a tool by a hole of it.

When the lining material has worn down to a minimum permissible thickness of 6 mm the friction pads must be renewed.

Throughly clean the exposed end of each piston and ensure that the recesses which are provided in the calliper to receive the friction pads are free from rust and grit.

Before fitting new friction pads the calliper pistons, which will be at their maximum adjustment must be returned to the base of the bores, using a suitable tool insert the friction pads.

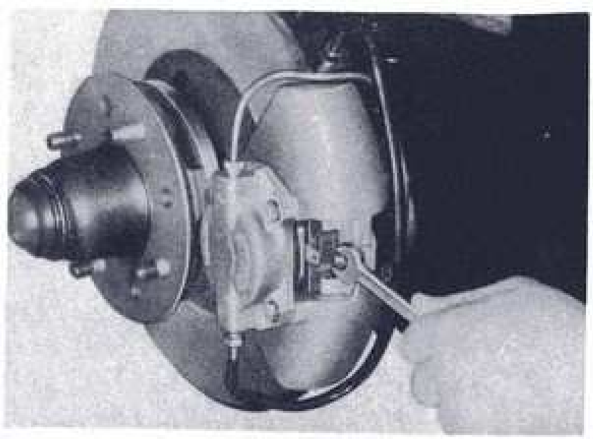


Fig. 13

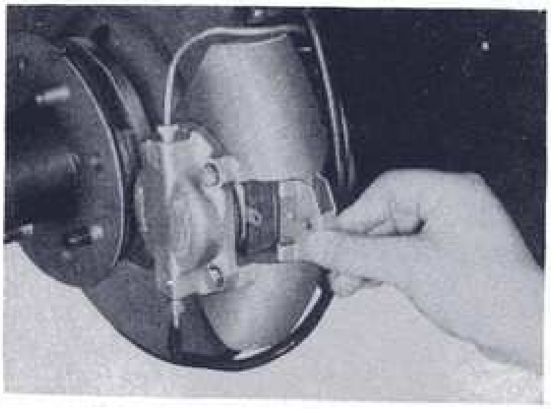


Fig. 14

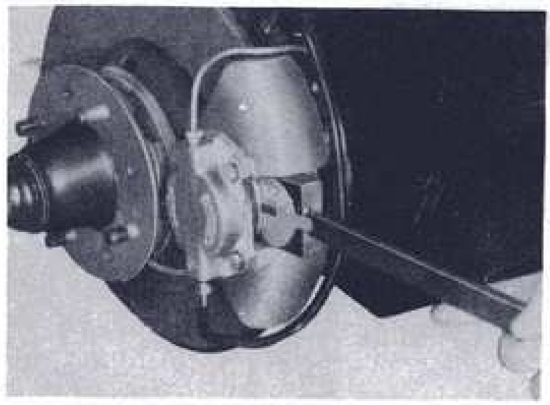


Fig. 15

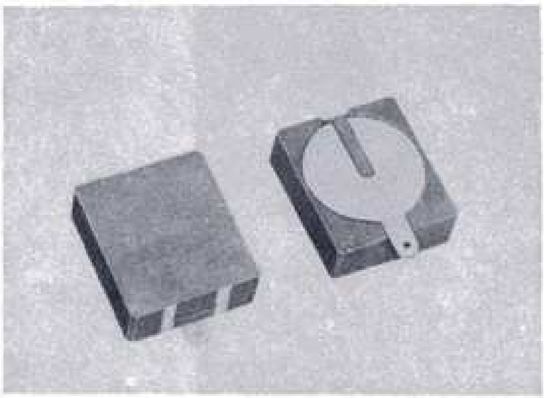


Fig. 16

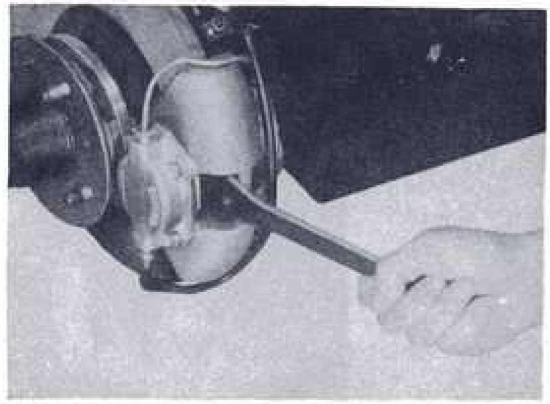


Fig. 17

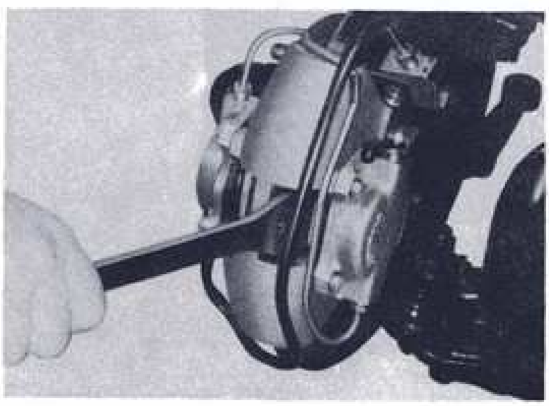


Fig. 18

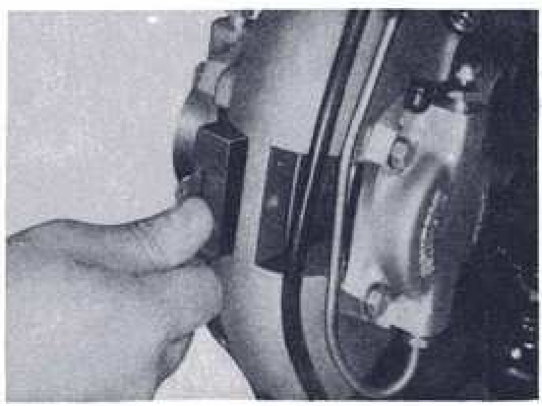


Fig. 19

Note: The level of the fluid in the master cylinder supply tank will rise during this operation and it may be necessary to siphon off any surplus fluid to prevent it from overflowing.

REAR BRAKES (LEADING TRAILING TYPE)

The rear brake shoes are not fixed but are allowed to slide and centralise with the same effect as in the front brakes. They are hydraulically operated by wheel cylinder and independent hand brake mechanism.

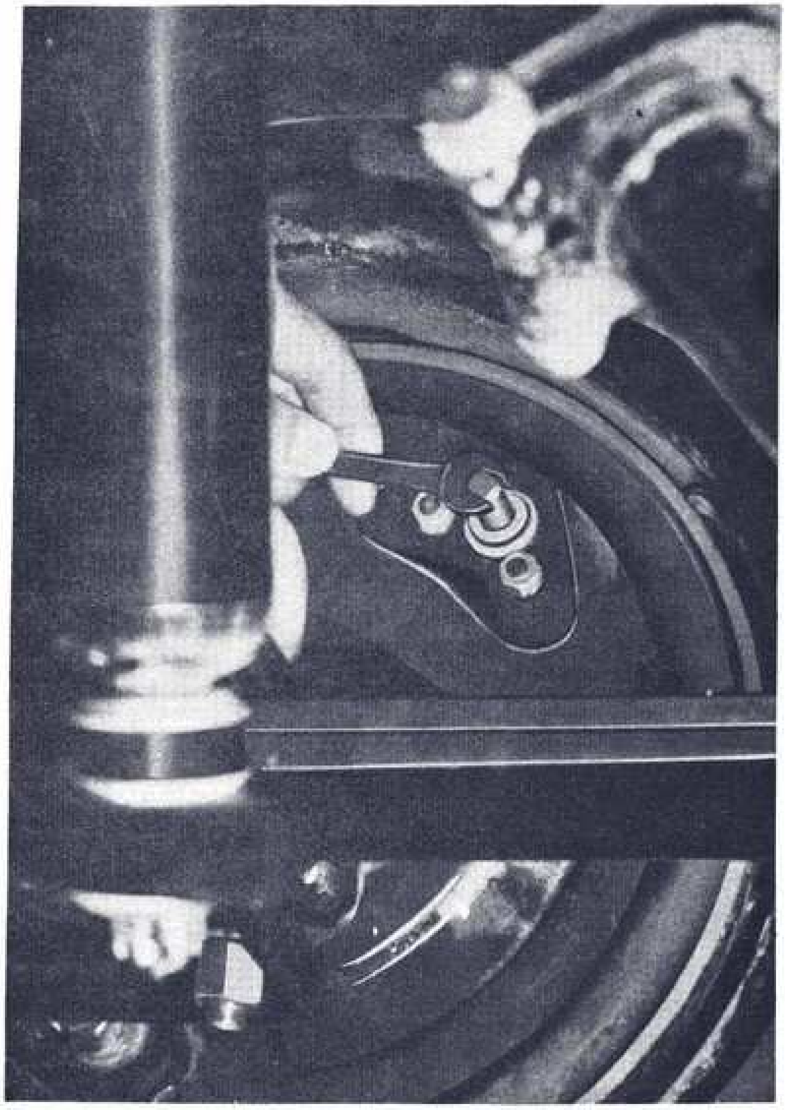
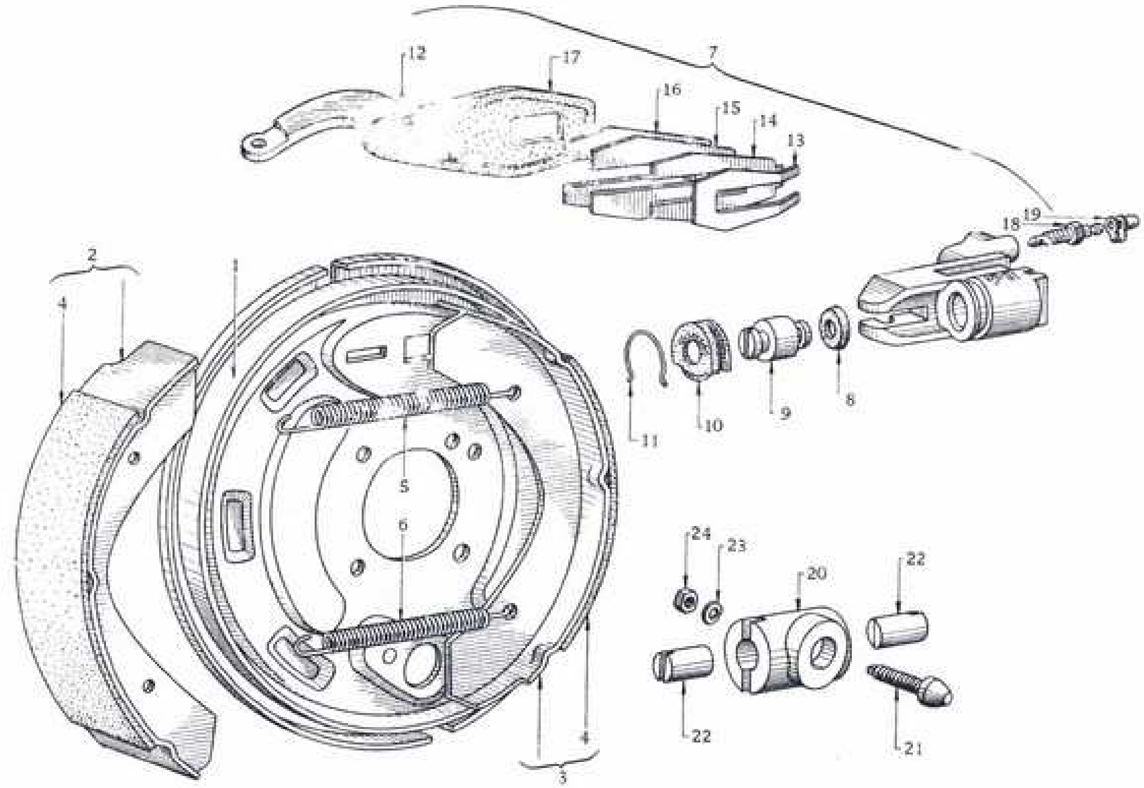


Fig. 20 Adjusting brake shoe

Adjustment for the rear brake shoes is by means of the adjuster bolt which located at the outside of brake disc. This precaution should be taken to eliminate the possibility of brake shoe drag due to mis-adjusted parking brakes. Turn the bolt to screw direction tightly and then turn back screw 2 ~ 3 notchs.



1. Ass'y-disc, rear brake (R.H.)
   (L.H.)
2. Ass'y-shoe, rear brake, fore
3. Ass'y-shoe, rear brake, after
4. Lining-brake
5. Spring-return, brake shoe, cylinder side
6. Spring-return, brake shoe, sdjuster side
7. Ass'y-cylinder, rear wheel (13/16")(NABCO)
8. Cup-piston
9. Piston-cylinder, rear wheel
10. Cover-dust, A
11. Ring-snap
12. Ass'y-lever
13. Shim-adjusting, A
14. Shim-adjusting, B
15. Plate-A
16. Plate-B
17. Cover-dust, B
18. Screw-bleeder
19. Cap-bleeder
20. Ass'y-housing, brake shoe adjuster
21. Wedge-adjuster
22. Tappet-adjuster
23. Washer-lock
24. Nut

Fig. 21 Rear brake

HAND BRAKE

The hand brake operates on the rear wheels only and is applied by a pull-up type of lever situated along-side the driver's seat. The cable from the control is attached to the toggle lever connected with the rear brake disc. The hand brake linkage is set when leaving the works and should not require any attention under normal maintenance. Only when a complete overhaul is necessary should the hand brake linkage require reseting.

When this is correct the rear shoes should be locked to the drums, the brake control just slightly applied and the wire rope set with the slackness just removed, by means of a nut at the center rod of the equalizer drag link.

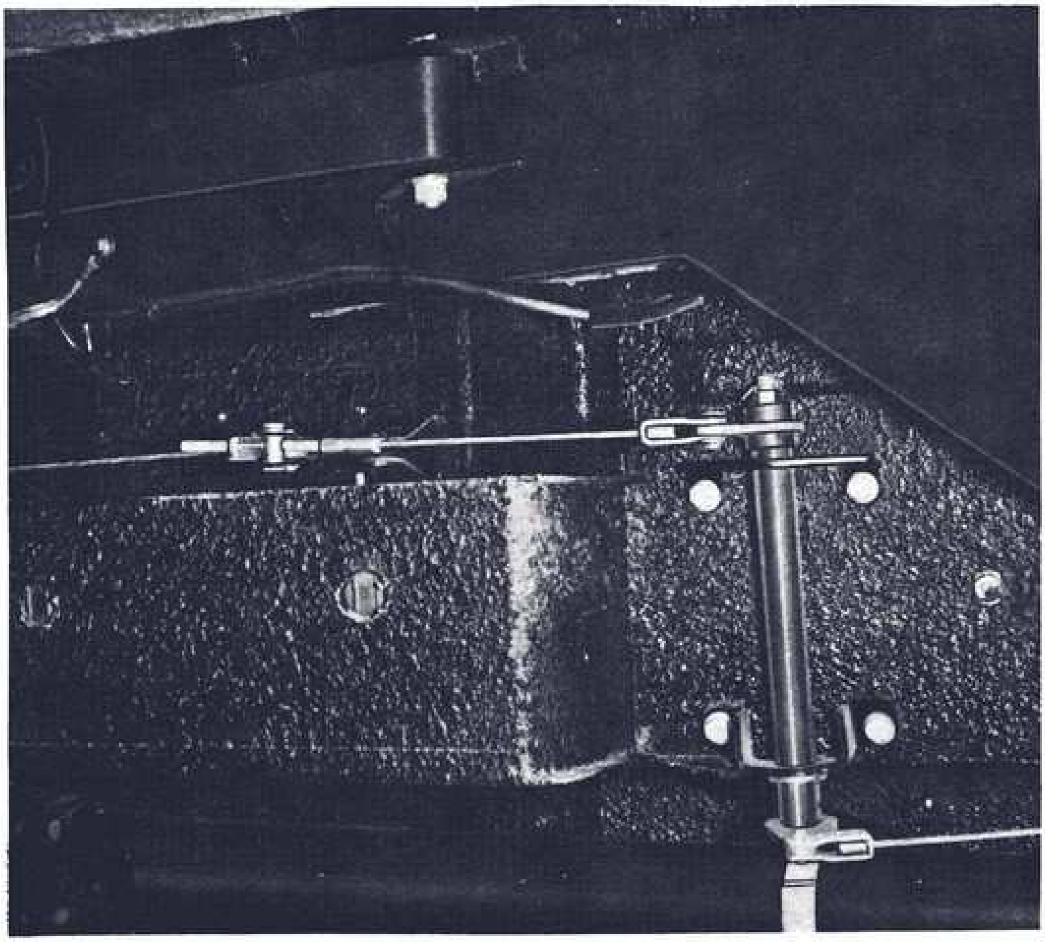


Fig. 22

MASTER CYLINDER

This is consists of an alloy body with a polished, finished bore, and reservoir with cap.

The inner assembly is made of the push rod, stoper plate ring, piston, secondery cap, return spring, let out valve and check valve seat.

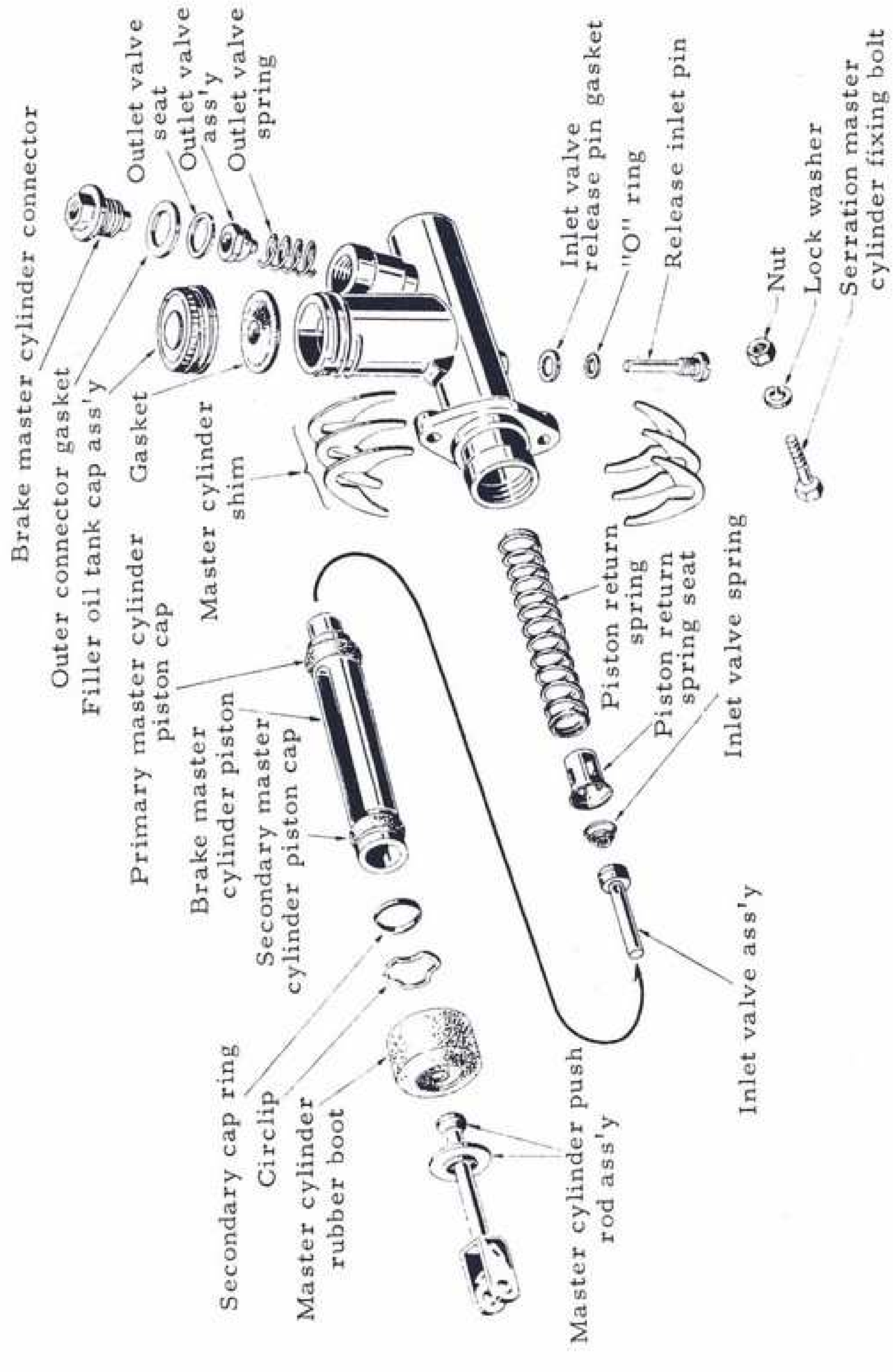


Fig. 23 Brake master cylinder

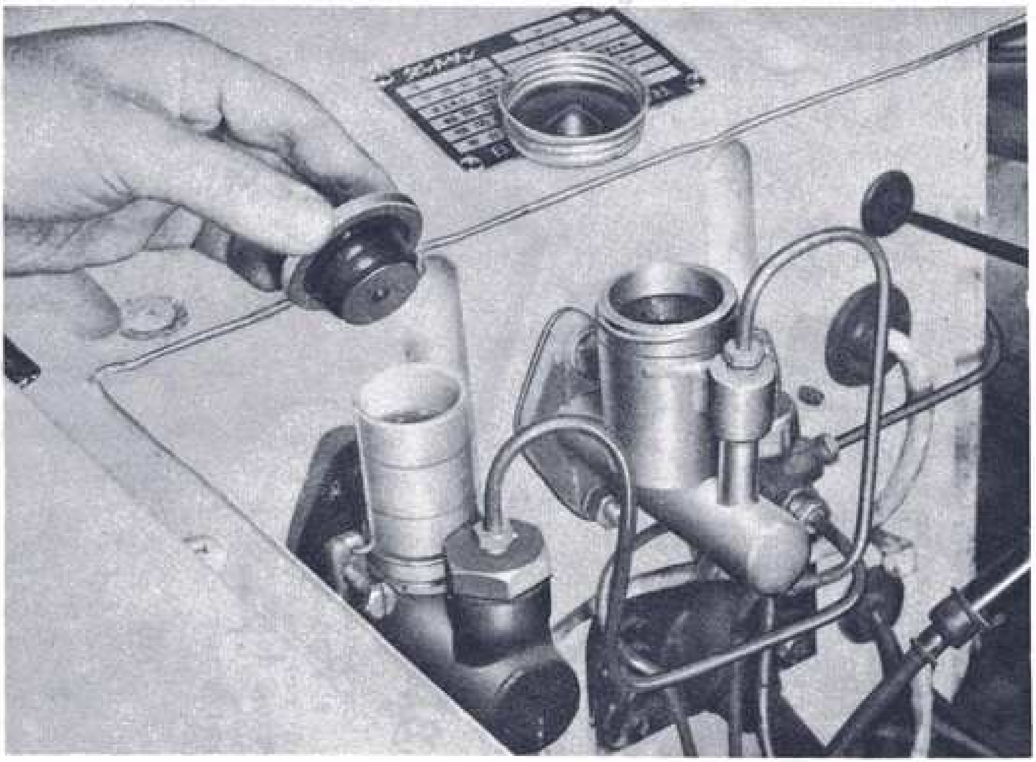


Fig. 24

The open end of the cylinder is protected by a rubber boot as shown Fig. disassembling the Brake Master cylinder.

Disconnect the pressure pipe union from the cylinder and remove the securing bolts, when the master cylinder and fluid reservoir may withdrawn complete from the car. Remove the filler cap and drain out fluid. Pull back the rubber boot and remove the stopper ring with a pair of long-nosed pliers. The push rod assembly can then be removed. When the push rod has been removed the piston with the secondary cap will be exposed, therefore remove the piston assembly complete.

The assembly can be separated by taking out other small parts.

Examine all parts, especially the rubber primary cap, for wear or distortion and replace with new parts where necessary.

Bleeding the Hydraulic System

Bleeding is necessary any time a portion of the hydraulic system has been disconnected or if the level of the brake fluid has been allowed to fall so low that air has entered the master cylinder.

With all the hydraulic connections secure and the supply tank topped up with the fluid, remove the cap from the bleed valve and fit the bleed tube the bleed valve, immersing the free end of the tube in a clean jar containing a little brake fluid.

Unscrew the bleed valve cap about three-quarters of a turn and then operate the brake pedal with a slow full stroke until the fluid entering the jar is completely free of air bubbles. Then, during a downstroke of the brake pedal, tighten the bleed screw cap sufficiently to seat, remove bleed tube.

This process must now be repeated for each of the other wheel cylinder

Always keep a careful check on the supply tank during bleeding since it is most important that a full level is maintained.

Should air reach the master cylinder from the supply tank, the whole of the bleeding operation must be repeated.

After bleeding top up the supply tank to its correct level of approximately three-quaters full. Never use fluid that has been bleed from a brake system for topping up the supply tank, as this brake fluid may be to some exte aerated. Such fluid must be allowed to stand for at least one day before it is used again. This will allow the air bubbles in the fluid time to disperse. Great cleanliness is essencial when dealing with any part of the hydraulic system, and especially so where the brake fluid is concerned.

Dirty fluid must never be added to the system.

DOUBLE SAFETY BRAKES

CONTENTS

DESCRIPTION

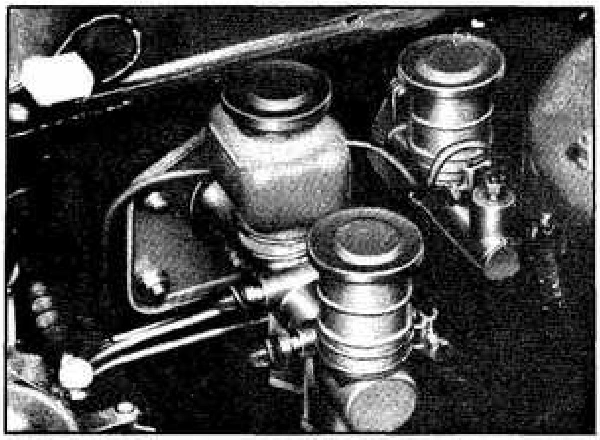


Fig. BR-1 Datsun 510

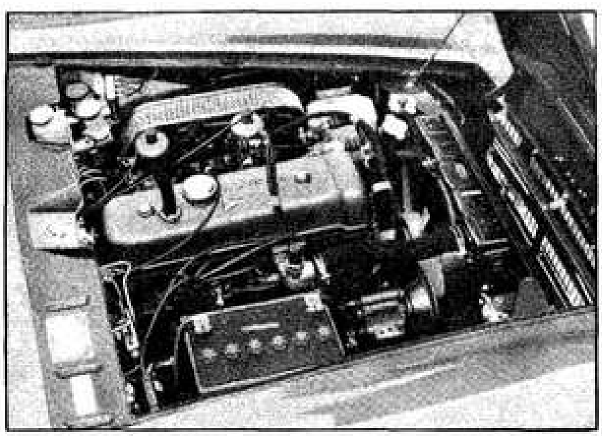


Fig. BR-2 Datsun Sports SR311

All Datsun 510 models and Datsun Sports SR311 & SP311 models are equipped with a tandem type master cylinder as a safety feature. Front and rear brakes are applied independently by this master cylinder and even when one brake fails to operate caused by the leak of brake fluid, the remaining brake can be operated securely and the car stops safely.

In this double safety brake system, a warning light switch for warning the brake line pressure difference is installed between the front and rear brake pipings.

MASTER CYLINDER-DOUBLE SAFETY BRAKE

Description

The master cylinder is the compensating type. In the Double-safety brake system type master cylinder, failure in one part of the brake system does not result in failure of the entire hydraulic brake system. Failure in the front brake system will leave the rear brake system still operative or failure in the rear brake system will leave the front brake system operative.

A double hydraulic master cylinder with two outlets, two residual check valves, two fluid reservoirs, and two hydraulic pistons (a primary and secondary) is operated in tandem by a single hydraulic push rod.

With the master cylinder fluid reservoirs filled and the front and rear brake system bled, there is a solid column of fluid on the forward side of both the primary and the secondary pistons.

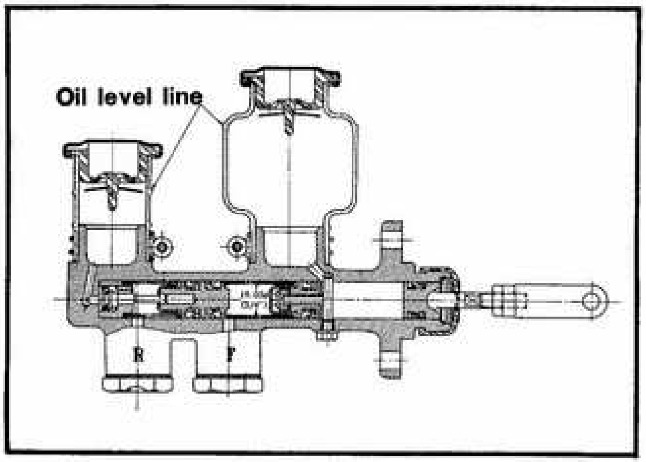


Fig. BR-3 Sectional view of master cylinder (Datsun 510)

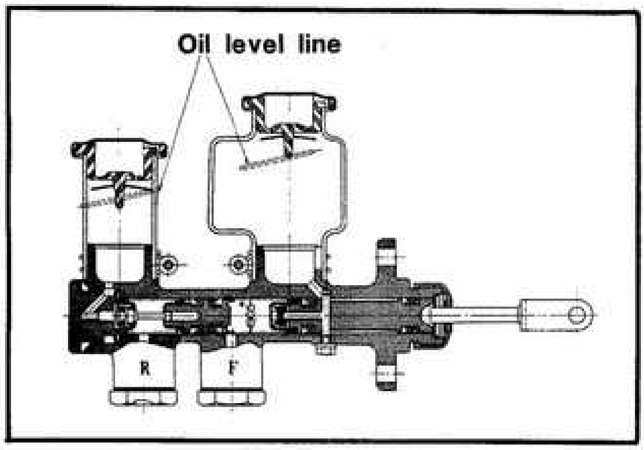


Fig. BR-4 Sectional view of master cylinder (Datsun Sports SR311)

Upon application of the brakes through movement of the brake pedal, fluid is displaced by the pistons into the wheel cylinders to activate both front and rear brakes. Upon release of the brakes, fluid returns from the wheel cylinder through the residual check valves to the master cylinder bore.

The dual system differs from the single system in operation when hydraulic failure occurs in either the front brake system or the rear brake system. Should hydraulic failure occur in the rear brake system, fluid under pressure continues to be displaced by the front brake system as in the conventional type master cylinder

Removal

1. Remove the clevis pin of the push rod connecting with the brake pedal and disconnect the brake master cylinder from the pedal.

2. Detach the fluid line by unscrewing the union nuts, using blanking plugs to prevent dirt entering the line.

3. Withdraw the master cylinder after unscrewing the two fixing nuts securing the master cylinder to the dash board.

4. Empty the contents of the fluid reservoir into a clean container.

Disassembly

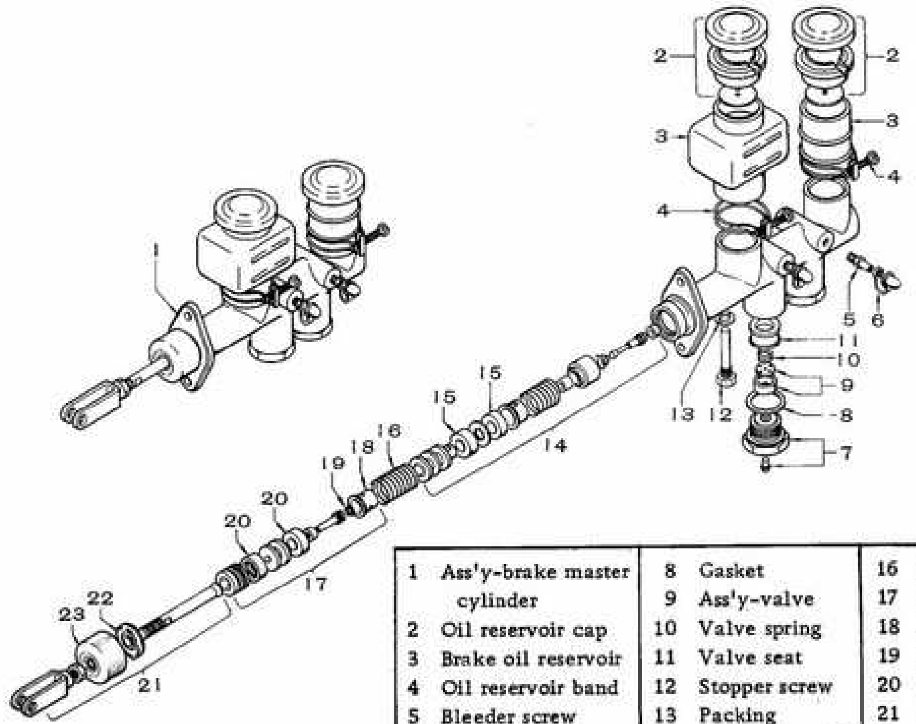
1. Remove the piston stopper screw.

2. Remove the dust cover and take out the snap ring from the groove at the bore opening.

3. Remove the push rod and stopper plate. All other parts are ready to be disassembled.

Note: When removing, be careful not to damage the piston and cups.

4. Remove the valve caps and take out the front and rear residual check valves.



1	Ass'y-brake master cylinder	8	Gasket	16	Cylinder spring
2	Oil reservoir cap	9	Ass'y-valve	17	Ass'y-piston (B)
3	Brake oil reservoir	10	Valve spring	18	Ass'y-valve inlet
4	Oil reservoir band	11	Valve seat	19	Inlet valve spring
5	Bleeder screw	12	Stopper screw	20	Piston cup
6	Bleeder screw cap	13	Packing	21	Ass'y-push rod
7	Valve cap	14	Ass'y-piston (A)	22	Stopper ring
		15	Piston cup	23	Dust cover

Fig. BR-5 Exploded view of master cylinder

Inspection and repair

Clean all parts and thoroughly check them for wear, damage and other abnormal condition. If any abnormal conditions should be detected on them, replace them with new ones.

Note: Rubber parts should always be cleaned with alcohol or brake fluid since they are vulnerable to mineral oil such as gasoline and kerosene.

1. Check cylinder and piston for abnormal one side wear and damage and replace if necessary.

2. Check all springs for weakness and damage and replace it if necessary.

3. When the master cylinder is overhauled, it is recommendable to replace cups and valves even if apparently they are in satisfactory conditions, and must be replaced if deformed due to swelling, wear and ageing.

4. Damaged dust cover, oil reservoir and cap should be replaced.

Assembly

Assembly can be accomplished in the reverse order of disassembly, but the following points should be observed.

1. Prior to assembly piston cup should be soaked in brake fluid. Install piston cup taking care it is correctly faced.

2. Coat brake fluid to cylinder and piston, and assemble them.

Installation

Installation is a reversal of the removal procedure, but the following operation should be added.

1. Adjust the pedal height.

2. Bleed the master cylinder and hydraulic lines.

BRAKE LINE PRESSURE DIFFERENTIAL WARNING LIGHT SWITCH

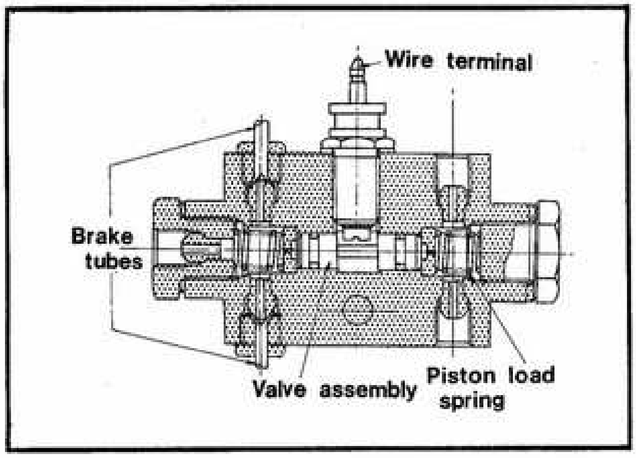


Fig. BR-6 Sectional view of warning light switch

A warning light is located on the instrument cluster to warn the driver when a pressure differential of 13 to 17 kg/cm^2 (185 to 242 lb/in^2) exist between the front and rear brake system.

A hydraulically actuated warning light switch is positioned in the engine compartment. Both front and rear brake systems are connected to this switch assembly.

When a pressure differential of 13 to 17 kg/cm^2 (185 to 242 lb/in^2) occurs between the front and rear brake system, the valves will shuttle toward the side with the low pressure. The valve contacts with the switch terminal and the ground circuit for the warning light is completed lighting the light.

The hydraulic brake problem must then be corrected and bleed the brakes.

Check the warning light switch assembly for a proper operation. Check the switch assembly for fluid leakage.

DO NOT ATTEMPT TO REPAIR SWITCH FOR ANY REASON: REPLACE COMPLETE SWITCH ASSEMBLY.

BRAKE PIPING

With the adoption of the tandem type brake master cylinder, the brake line pressure differential warning light switch is installed between the front brake piping and the rear brake piping. So, the brake piping parts of the front brake system are quite different from the standard brake system.

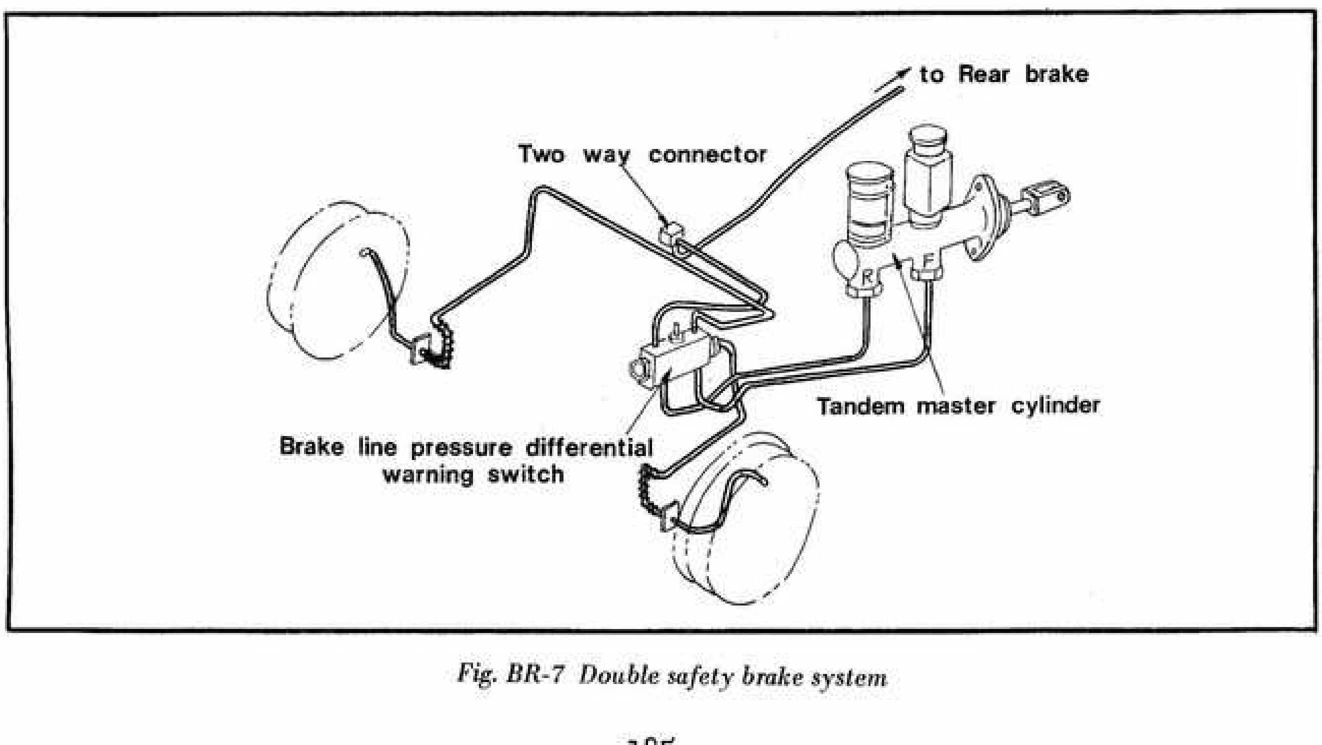


Fig. BR-7 Double safety brake system

U20 ENGINE
AND
5-SPEED TRANSMISSION
FOR
DATSUN SPORTS 2000

NISSAN

NISSAN MOTOR CO., LTD.

TOKYO, JAPAN

FOREWORD

The service procedure and Specifications Contained in this manual are outlined for MODEL U20 ENGINE & FS5C71A TRANSMISSION equipped in DATSUN SPORTS 2000 MODEL SR311 Series.

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 specifications and adjustments contained in this manual were in effect at the time of publication. Nissan Motors reserves the right to change specifications or design without notice or incurring obligation.

CONTENTS

GENERAL INFORMATION

SPECIFICATIONS

	Item \ Model		Unit	SP(L)311-(U)	SR(L)311-(U)
DIMENSIONS	Vehicle Overall Length		mm (in)	3, 955 (155.70)	
	Vehicle Overall Width		mm (in)	1, 495 (58.900)	
	Vehicle Overall Height		mm (in)	1, 300 (51.574)	
	Interior size of cargo space	Overall Length	mm (in)	750 (29.524)	
		Overall Width	mm (in)	1, 275 (50.200)	
		Overall Height	mm (in)	990 (38.976)	
	Tread	Front	mm (in)	1, 275 (50.196)	
		Rear	mm (in)	1, 200 (47.244)	
	Wheel Base		mm (in)	2, 280 (89.800)	
	Min. Road Clearance		mm (in)	145 (5.708)	
	Floor Height				
	Overhang to the Ront End (Without Bumper)		mm (in)	620 (24.400)	
	Overhang to the Rear End (Without Bumper)		mm (in)	885 (34.842)	
	Frame Overhang to the Front End		mm (in)	525 (20.700)	
	Frame Overhang to the Rear End		mm (in)	830 (32.677)	
TIRE SIZE	Front & Rear			5.60S14-4PR	5.60S14-4PR (Option 6.45H14-4PR)
WEIGHT	Vehicle Weight		kg (lb)	900 (1, 984)	910 (2, 006)
	Seating Capacity			2	
	Max. Payload				

	Item \ Model			SP(L)311-(U)	SR(L)311-(U)	
WEIGHT	Vehicle Gross Weight			1010 (2, 227)	1020 (2, 249)	
	Distribution of Vehicle weight without load	Front	kg (lb)	505 (1, 113)	515 (1, 135)	
		Rear	kg (lb)	395 (800)		
	Distribution Vehicle weight with load	Front	kg (lb)	555 (1, 224)	565 (1, 246)	
		Rear	kg (lb)	455 (1, 003)		
	Chassis Weight		kg (lb)	495 (1, 091)	505 (1, 113)	
	Distribution (Front)		kg (lb)	340 (749)	350 (771)	
	Distribution (Rear)		kg (lb)	155 (342)		
	Height of Gravity Center		mm (in)	470 (18. 503)		
PERFORMANCE	Max. Speed		km/h (m/h)	170 (106)	SOLEX CARB. 205 (127. 4)	SU CARB. 190 (118. 1)
	Fuel Consumption by Paved Flat Road with Max. load (presumptive)		km/ℓ (US. MPG)	12 (28. 23)	8 (18. 823)	10 (23. 53)
	Grade Ability Sin θ			0. 497	0. 560	0. 527
	Min. Turning Radius		m (ft)	4. 9 (16. 08)		
	Brake Stopping Distance (50 km/h)			13. 5 (44. 3)		
ENGINE	Model			R	U20	
	Make			Nissan		
	Clasification of Fuel			Gasoline		
	Cooling System			Water Forced Circulation		
	No. of Cylinder & Arrange			4 in line		
	Cycle			4		
	Combustion Chamber			Wedge Type		
	Bore × Stroke		mm (in)	87. 2 × 66. 8 (3. 433 × 3. 267)	87. 2 × 83 (3. 433 × 3. 267)	

GENERAL INFORMATION

		Item \ Model	SP(L)311-(U)	SR(L)311-(U)	
ENGINE		Displacement ℓ (cu. in)	1.595 (97.32)	1.982 (120.92)	
ENGINE		Compression Ratio	9.0	9.5	
ENGINE		Compression Pressure kg/cm2 (lb/in2)/r.p.m.	9.0	9.5	
ENGINE		Max. Exploding Pressure kg/cm2 (lb/in2)/r.p.m.	50 (711.2)/4000	54 (766.26)/5600	
ENGINE		Max. Mean Effective Pressure kg/cm2 (lb/in2)/r.p.m.	10.6 (150.8)/4000	11.5 (163.1)/4800	
ENGINE		Max. Power B.H.P./r.p.m. (SAE)	96/6000	SOLEX CARB 150/6000	SU CARB 135/6000
ENGINE		Max. Torque m-kg (ft-lb)/r.p.m. (SAE)	14.3 (103)/4000	19.1 (138)/ 14800	18.2 (132)/ 14400
ENGINE		Length × Width × Height mm (in)	635 × 650 × 623 (25 × 25.6 × 24.5)	692 × 641 × 670 (27.24 × 25.23 × 26.37)	
ENGINE		Weight kg (lb)	155 (342)	160 (353)	
ENGINE		Position of Engine	FRONT		
ENGINE		Type of Piston	AUTO THERMIC TYPE		
ENGINE		Material of Piston	LO-EX		
ENGINE	No. of Piston Ring	Pressure	2		
ENGINE	No. of Piston Ring	Oil	1		
ENGINE	VALVE TIMING	Intake Open B.T.D.C.	20°	SOLEX CARB. 30°	SU CARB. 18°
ENGINE	VALVE TIMING	Intake Close A.B.D.C.	56°	70°	58°
ENGINE	VALVE TIMING	Exhaust Open B.B.D.C.	58°	70°	58°
ENGINE	VALVE TIMING	Exhaust Close A.T.D.C.	18°	30°	18°
ENGINE	Valve Clearance	Intake mm (in)	0.43 (0.0169)	0.2 (0.007874)	
ENGINE	Valve Clearance	Exhaust mm (in)	0.43 (0.0169)	0.3 (0.011811)	

		Item \ Model	SP(L)311-(U)	SR(L)311-(U)	
IGNITION SYSTEM		Ignition Method	BATTERY-COIL TYPE		
		Ignition Timing B.T.D.C./r.p.m.	16°/600	SOLEX CARB. 20°/700	SU CARB. 16°/700
		Firing Order	1-3-4-2		
	IGNITION COIL	Type	C6R-50 (HV-13Y)		
		Make	HITACHI (HANSHIN)		
	DISTRIBUTOR	Type	D407-51		
		Make	HITACHI		
		Ignition Timing Advance System	Vacuum & Governor	Governor	Vacuum & Governor
	SPARK PLUG	Type	B-6E (L-45)		
		Make	NGK (HITACHI)		
		Thread mm (in)	14 (0.551)		
		Gap mm (in)	0.7 ~ 0.8 (0.027 ~ 0.031)		
FUEL SYSTEM	CARBURETOR	Type	HJB38W	44PHH	HJG46W
		Manufacturer	HITACHI	MIKUNI	HITACHI
		Throttle Valve Bore mm (in)	38	44	46
		Venturi Size mm (in)	Variable	OUTER 37 (1.456) INNTER 10 (0.3937)	Variable
		Main Jet		#180	
		Pilot Jet		# 60	
		Pump Jet mm (in)		0.30 (0.01181)	
	Air Cleaner	Type & No.	PAPER TYPE		
		Make	TSUCHIYA		

GENERAL INFORMATION

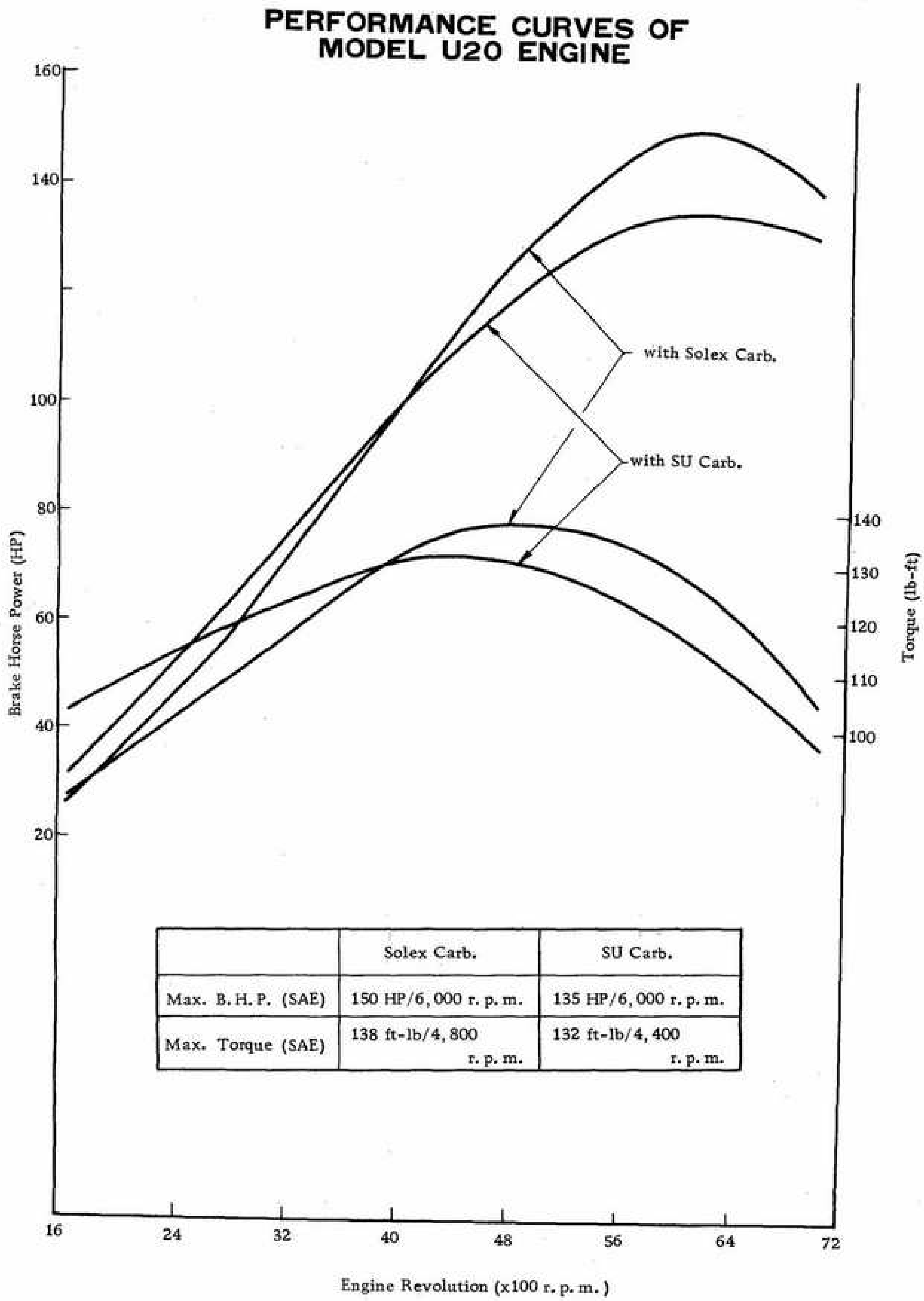
<table>
<tr><th colspan="3">Item \ Model</th><th>SP(L)311-(U)</th><th colspan="2">SR(L)311-(U)</th></tr>
<tr><td rowspan="3">FUEL SYSTEM</td><td rowspan="2">FUEL PUMP</td><td>Type</td><td colspan="3">DIAPHRAGM</td></tr>
<tr><td>Make</td><td colspan="3">SHOWA, KYOSAN</td></tr>
<tr><td>Fuel Tank</td><td>Capacity of Fuel Tank ℓ (U.S.gal.)</td><td colspan="3">43 (11.36)</td></tr>
<tr><td rowspan="4">LUBRICATING SYSTEM</td><td colspan="2">Lubricating Method</td><td colspan="3">FORCED PRESSURE TYPE</td></tr>
<tr><td colspan="2">Oil Pump Type</td><td colspan="3">GEAR TYPE</td></tr>
<tr><td colspan="2">Oil Filter</td><td colspan="3">FULL FLOW TYPE</td></tr>
<tr><td colspan="2">Oil Pan Capacity ℓ (U.S.gal.)</td><td>4.1 (1.083)</td><td>SOLEX CARB.
7.1 (1.875)</td><td>SU CARB.
4.1 (1.083)</td></tr>
<tr><td rowspan="5">COOLING SYSTEM</td><td colspan="2">Type</td><td colspan="3">PRESSURIZED WATER COOLING
SEALED TYPE</td></tr>
<tr><td colspan="2">Radiator</td><td colspan="3">CORRUGATED FIN & TUBE TYPE</td></tr>
<tr><td colspan="2">Capacity of Coolant ℓ (U.S.gal.)</td><td>8 (2.11)</td><td colspan="2">8.5 (2.245)</td></tr>
<tr><td colspan="2">Type of Water Pump</td><td colspan="3">CENTERIFUGAL TYPE</td></tr>
<tr><td colspan="2">Thermostat</td><td colspan="3">PELLET TYPE</td></tr>
<tr><td rowspan="3">BATTERY</td><td colspan="2">Type</td><td colspan="3">2SMB (or CORVAIR)</td></tr>
<tr><td colspan="2">Voltage V</td><td colspan="3">12</td></tr>
<tr><td colspan="2">Capacity A.H.</td><td>50 (40 ... For R/H Car)</td><td colspan="2">50</td></tr>
<tr><td rowspan="6">GENERATOR</td><td colspan="2">Type</td><td>AC300/12 × 2R</td><td colspan="2">$AS2030A_2$</td></tr>
<tr><td colspan="2">Make</td><td colspan="3">MITSUBISHI</td></tr>
<tr><td colspan="2">Generating Method</td><td colspan="3">ALTERNATOR</td></tr>
<tr><td colspan="2">Voltage V</td><td colspan="3">12</td></tr>
<tr><td colspan="2">Capacity Kw</td><td colspan="3">0.3</td></tr>
<tr><td colspan="2">Voltage Regulator</td><td colspan="3">$RL2220B_5$</td></tr>
<tr><td rowspan="2">Starter</td><td colspan="2">Type</td><td>S114-91</td><td colspan="2">$ME\text{-}Y_2R$</td></tr>
<tr><td colspan="2">Make</td><td>HITACHI</td><td colspan="2">MITSUBISHI</td></tr>
</table>

Item \ Model			SP(L)311-(U)	SR(L)311-(U)
Starter	Voltage & Power V-HP		12-1.4	
CLUTCH	Type		SINGLE DRY DISC WITH DIAPHRAGM SPRING	
	Number of Plate		(FACING) 2	
	Outer dia.×Inner dia.×Thickness mm (in)		200 × 130 × 3.5 (7.87 × 5.12 × 0.138)	
	Total Friction Area cm^2 (in^2)		364 (56.42)	
TRANSMISSION	Type		F4C63L	FS5C71A
	Operating Method		Direct Floor Shift	
	Gear Ratio	1st	3.382	2.957
		2nd	2.013	1.858
		3rd	1.312	1.311
		4th	1.000	1.000
		5th		0.852
		Reverse	3.365	2.922
	Lubricant Capacity ℓ (U.S.gal.)		2.2 (0.58)	2.6 (0.68)
Propeller Shaft	Length × Outer dia. × Thickness mm (in)		760 × 63 × 59.8 (29.92×2.48× 2.35)	838 × 63.5 × 1.6 (32.99×24.99×0.06299)
	Type of Universal Joint		63H	63H
FINAL GEAR	FIRST GEAR	Type of Gear	HYPOID GEARS	
		Gear Ratio	3.889 (OPTION 4.111)	3.700
		Speedometer	16/5 (17/5)	18/6
DIFF. GEAR	Housing Type		BANJO	
	Type and Number of Gear		STRAIGHI BEVEL PINION 2 EACH	
	Lubricant Capacity ℓ (U.S.gal.)		0.93 (0.25)	
STEERING SYSTEM	Type of Gear		CAM AND LEVER	
	Gear Ratio		14.8	
	Steering angle In and Out.		36°16', 29°20'	

GENERAL INFORMATION

Item			Model	SP(L)311-(U)	SR(L)311-(U)
Steering System	Steering Wheel Dia.		mm (in)	400 (15.75)	
Steering System	Lubricant Capacity		ℓ (U.S.gal.)	0.25 (0.07)	
RUNNING DEVICE	Wheel Arangement			2 FRONT, 2 REAR	
RUNNING DEVICE	Front Axle			WISH BONE BALL JOINT TYPE	
RUNNING DEVICE	Toe-in (Unladen)		mm (in)	2 ~ 3 (0.0787 ~ 0.1181)	
RUNNING DEVICE	Camber (Unladen)			1°25'	
RUNNING DEVICE	Caster (Unladen)			1°30'	
RUNNING DEVICE	Inclination Angle of King Pin			6°35'	
RUNNING DEVICE	Type of Rear Axle			SEMI-FLOATING TYPE	
BRAKE SYSTEM	HYDRAULIC BRAKE	Type	Front	DISC	
			Rear	LEADING TRAILING	
		Lining Dimension (Front) Width × Thickness × Length	mm (in)	47.5 × 16.7 × 53.98 (1.87 × 0.66 × 2.125)	
		Lining Dimension (Rear) Width × Thickness × Length	mm (in)	40 × 4.5 × 215 (1.57 × 0.18 × 8.46)	
		Total Braking Area (Front)	cm^2 (in^2)	102.6 (15.9)	
		Total Braking Area (Rear)	cm^2 (in^2)	351 (54.4)	
		Dia. of Disc (Front)	mm (in)	284 (11.18)	
		Dia. of Drum (Rear)	mm (in)	228.6 (90)	
		Inner Dia. of Master Cyl.	mm (in)	19.05 (0.75)	
		In Dia. of Wheel Cyl. (Front)	mm (in)	53.98 (2.125)	
		In Dia. of Wheel Cyl. (Rear)	mm (in)	19.05 (0.75)	
		Max. Oil Pressure	(lb/in^2) kg/cm^2	137 (1948.6)	
	PARKING BRAKE	Type		MECHANICAL FOR REAR WHEEL	
		Lining Dimension	mm	40 × 4.5 × 215	

		Item \ Model		SP(L)311-(U)	SR(L)311-(U)
SYSTEM OF THE BRAKE	PARKING BRAKE	Total Braking Area	cm^2 (in^2)	351 (54.4)	
		In Dia. of Drum	mm (in)	228.6 (90)	
SUSPENSION		Front		INDEPENDENT WITH COIL SPRING	
		Coil Spring Size Wire Dia. × In.Dia. of Coil × Free Length - No.	mm (in)	12.7 × 87.5 × 290 - 6 (0.499 × 3.44 × 11.41 - 6)	
		Rear		PARALLEL SEMI FLLIPTIC	
		Spring Size Length × Width × Thickness - No.	mm (in)	$1200 \times 60 \times \frac{6-2}{5-2}$ (47.2 × 2.36 × 0.23)	
		Shock Absorber (Front)		TELESCOPIC DOUBLE ACTION	
		Shock Absorber (Rear)		TELESCOPIC DOUBLE ACTION	
		Stabilizer		FORSION BAR TYPE FOR FRONT	
		Torque Rod		At the Rear Right Side of Frame	
FRAME		Type		X MEMBER	
		Section		BOX TYPE	
		Dimension Height × Width × Thickness	mm	UPPER 75 × 100 × 1.6 LOWER 25 × 100 × 2.3	

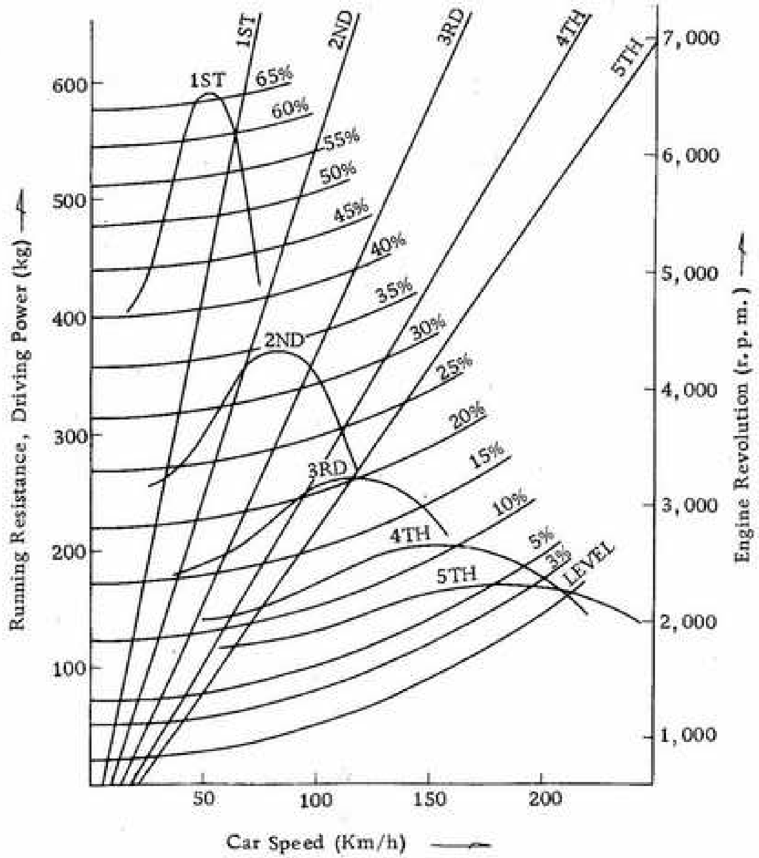


	Solex Carb.	SU Carb.
Max. B. H. P. (SAE)	150 HP/6, 000 r. p. m.	135 HP/6, 000 r. p. m.
Max. Torque (SAE)	138 ft-lb/4, 800 r. p. m.	132 ft-lb/4, 400 r. p. m.

MODEL SR(L)311-U RUNNING PERFORMANCE CURVES

(U20 Engine with Solex Carburetor)

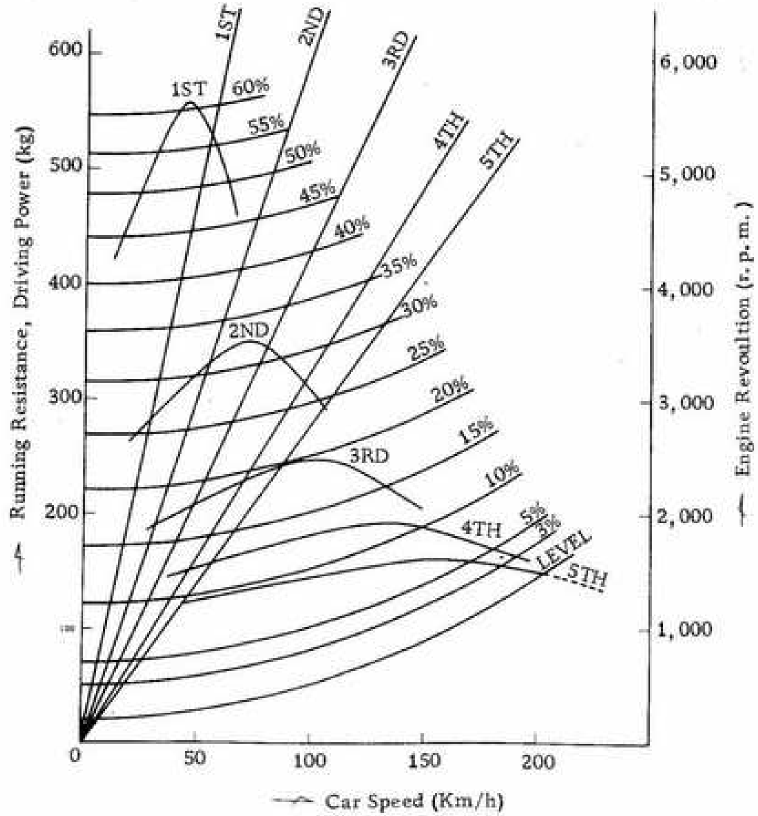
Final gear ratio	3.700 (37/10)
1st speed ratio	2.957
2nd speed ratio	1.858
3rd speed ratio	1.311
4th speed ratio	1.000
5th speed ratio	0.852
Max. grade ability	Tan θ =0.675 (Sin θ =0.560)
Max. Torque (SAE)	19.1 m-kg (138.0 ft-lb)
Max. B.H.P. (SAE)	150 HP/6,000 r.p.m.



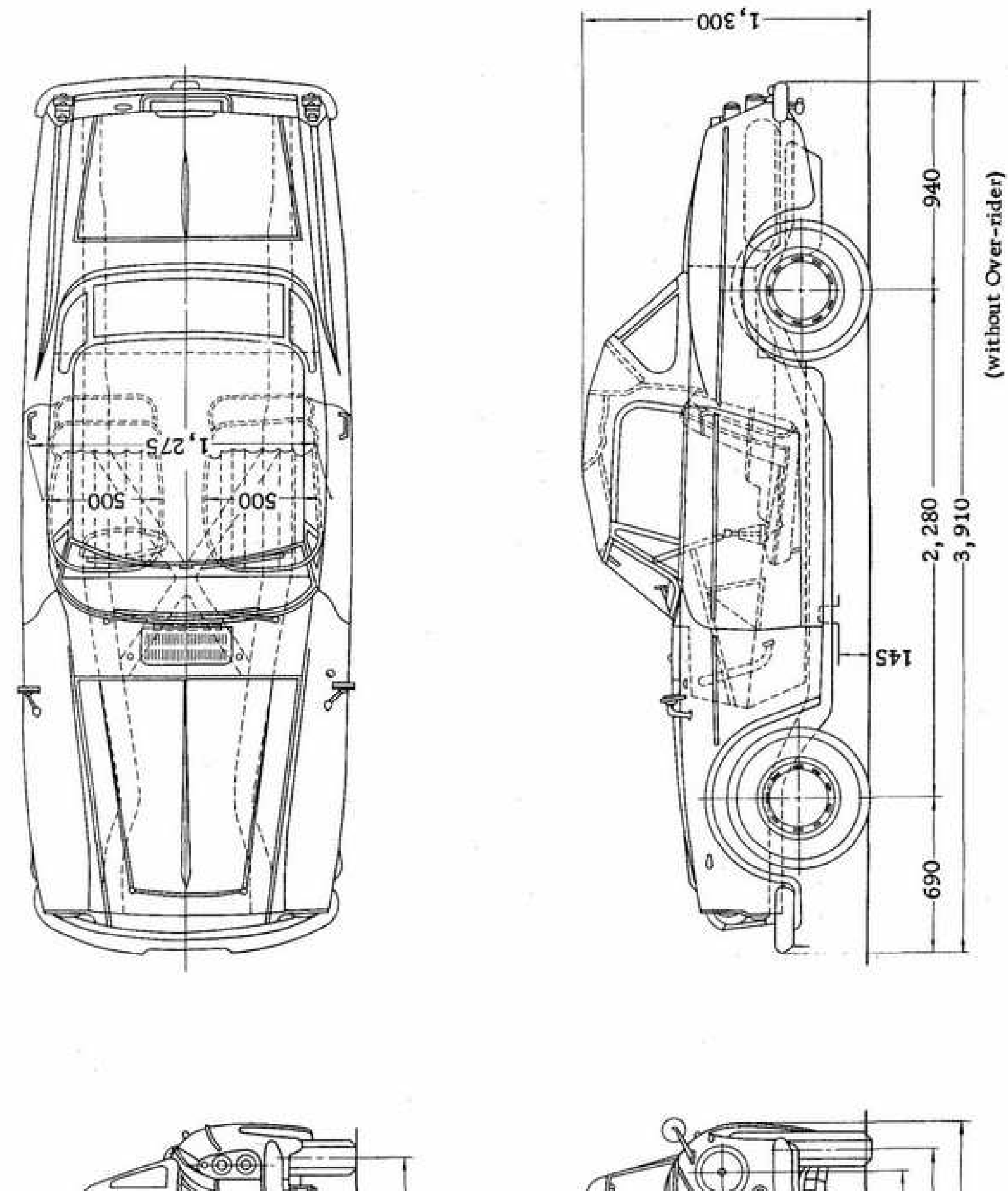
MODEL SR(L)311-U RUNNING PERFORMANCE CURVES

(U20 Engine with SU Carburetor)

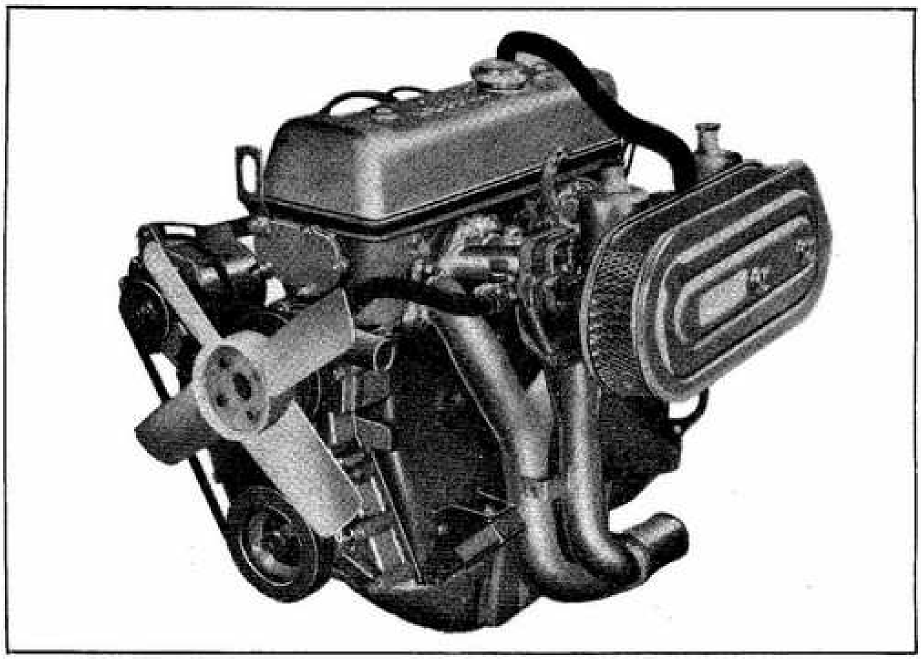
Final speed ratio	3.700 (37/10)
1st speed ratio	2.957
2nd speed ratio	1.858
3rd speed ratio	1.311
4th speed ratio	1.000
5th speed ratio	0.852
Max. grade ability	Tan θ =0.620 (Sin θ =0.527)
Max. Torque (SAE)	18.2 m-kg (131.6 ft-lb)
Max. B.H.P. (SAE)	135 HP/6,000 r.p.m.

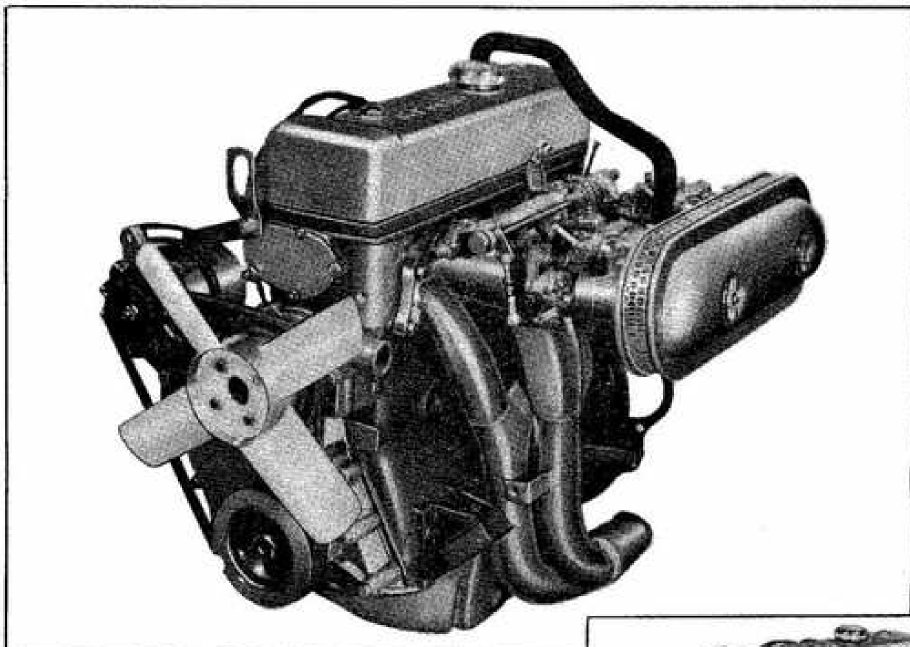


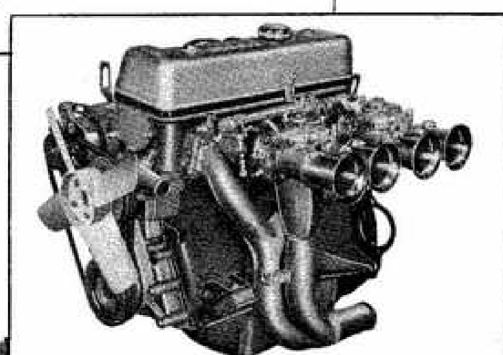
GENERAL VIEWS OF DATSUN SPORTS 2000

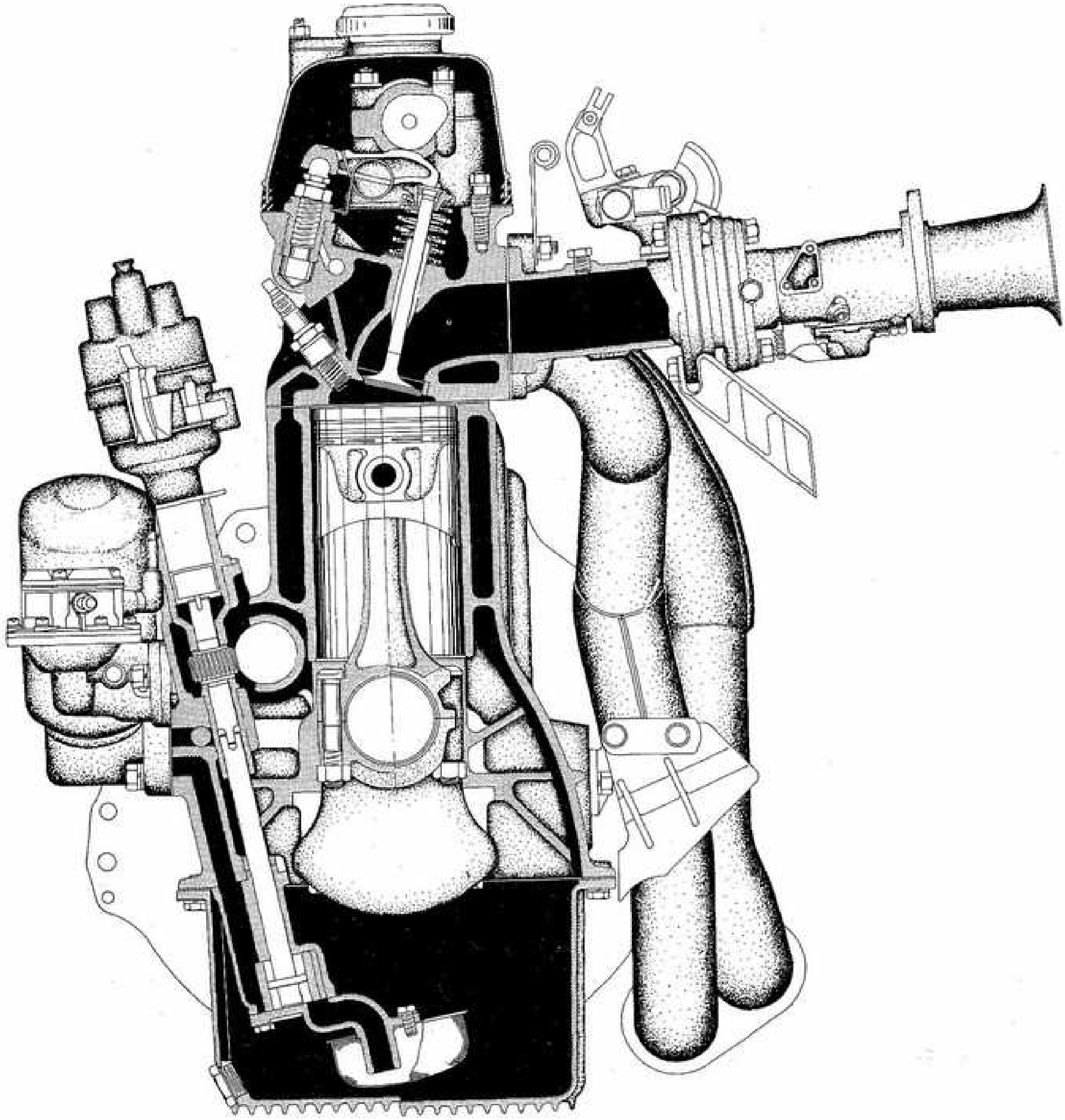


ENGINE

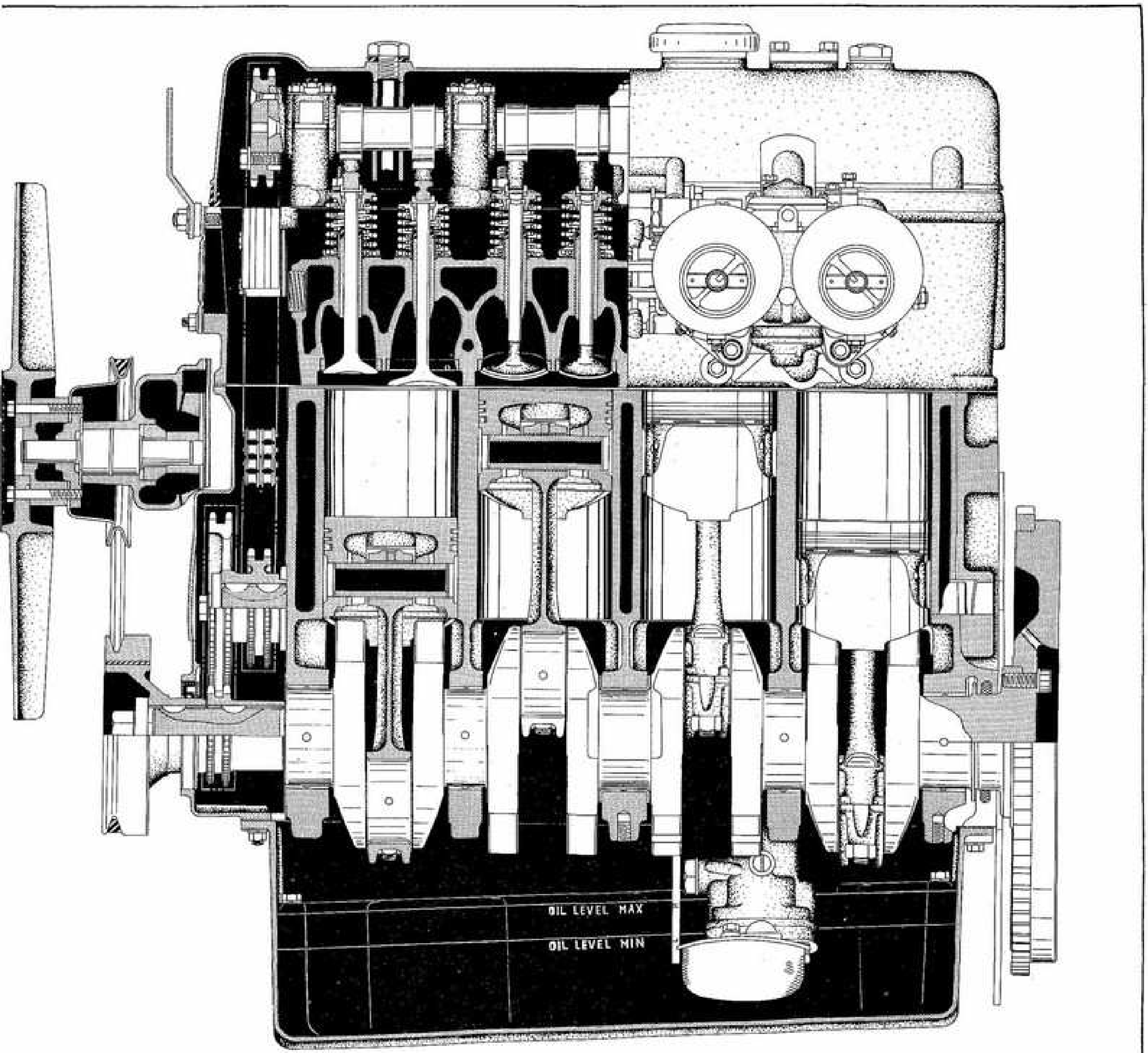








ENGINE MECHANICAL



GENERAL DESCRIPTION

U20 engine is a 1982 cc in line overhead camshaft four-cylinder engine and has 87.2 mm (3.4331 in.) bore and 83 mm (3.2677 in.) stroke with a compression ratio of 9.5 : 1.

This engine uses SU type dual carburetor as standard equipment and Solex type dual carburetor as optional. When the optional carburetor (Solex type) is to be equipped, change Air cleaner, Intake Manifold, Camshaft and Oil Pan at the same time.

Cylinder Block

The cast iron cylinder block has a vertical row of four cylinders. Five main bearings support the crankshaft. Bearing caps fit in recesses in the block which assure accurate alignment and facilitate assembly.

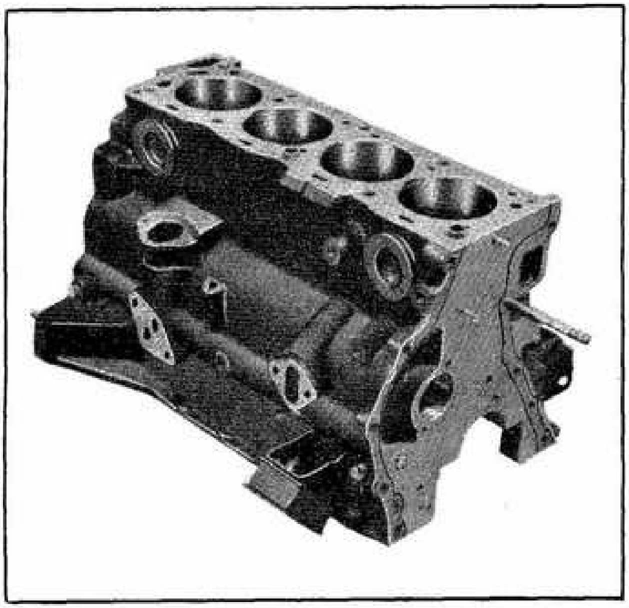


Fig. EM-1

Crankshaft

The crankshaft is made of forged steel and is supported by five main bearings.

Main bearings are lubricated from oil holes which intersect the main oil gallery which runs parallel to the cylinder bores.

Crankshaft has eight balance weights and dynamically balanced.

A slip-on vibration damper on the forward end of the crankshaft dampens any engine torsional vibrations.

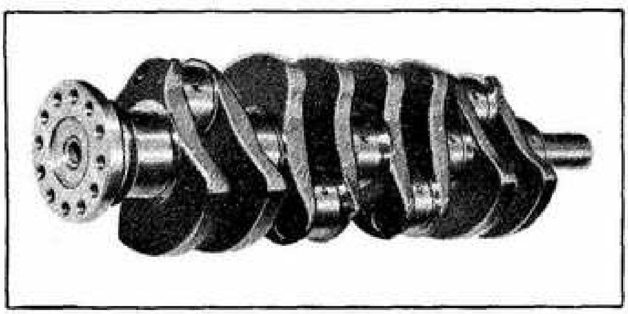


Fig. EM-2

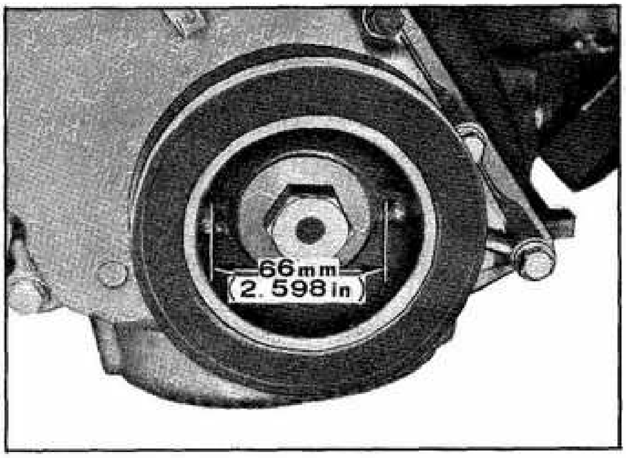


Fig. EM-3

Pistons and Connecting Rods

New-design light-weight pistons are of cast aluminum slipper-skirt type. Top and second rings are compression rings and of tapered face type. All piston rings are hard chromium plated.

Connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent 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.

Connecting rod bolts are fitted tightly to connecting rods.

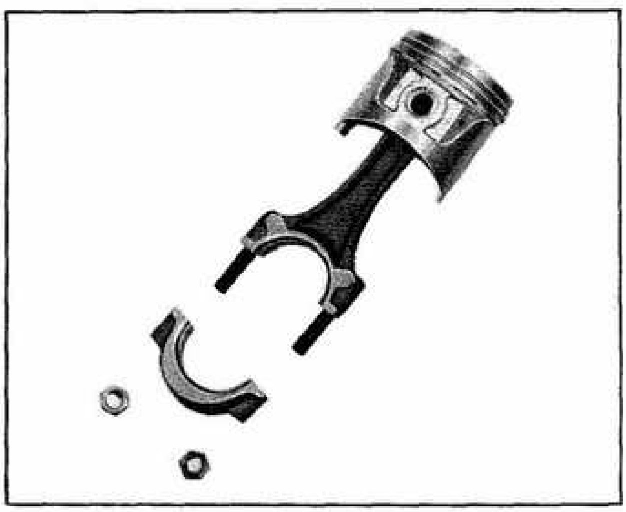


Fig. EM-4

Cylinder Head

Cylinder head is made of aluminum and is tightened to cylinder block with ten special steel bolts.

Cylinder head is press-fitted with valve guides and valves arranged in line with the top of the valves tilted inboard slightly to the manifold side.

Combustion chambers are fully contour machined with a new and improved wedge shape.

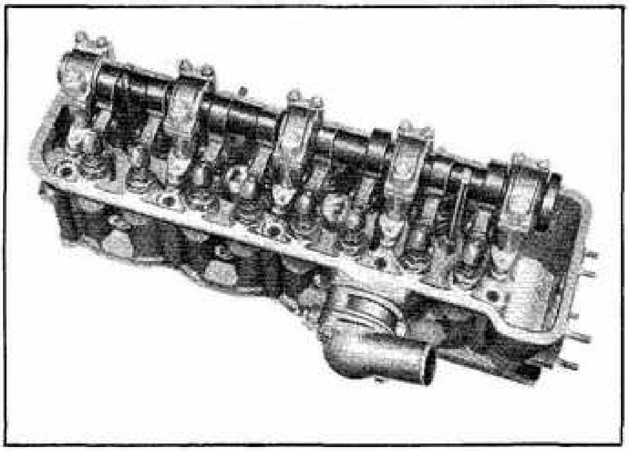


Fig. EM-5

Jackshaft

Jackshaft is made of special cast iron and supported by three bearings.

This shaft drives the distributor drive gear and fuel pump.

Camshaft over the cylinder head is driven by timing chains through this jackshaft.

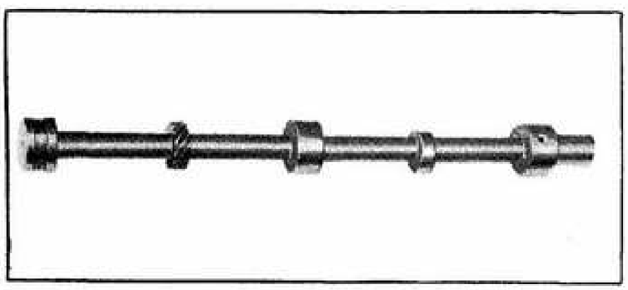


Fig. EM-6

Camshaft

Camshaft is made of special cast iron and located inside the rocker cover.

Five aluminum brackets support this camshaft.

These bearings can be separated to upper and lower parts, so replacement of camshaft is possible with the engine in vehicle.

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

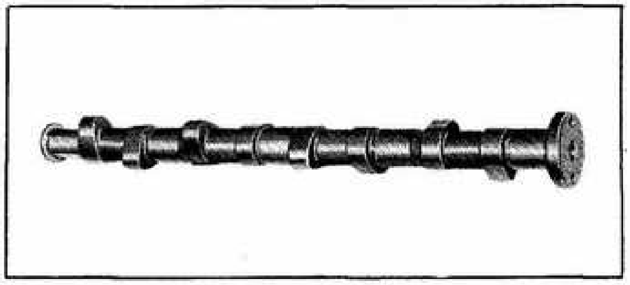


Fig. EM-7

Concentric passages drilled in the front and rear part of the camshaft form the galleries which supplies oil to each cam lobe through an oil hole drilled in the base circle of each lobe.

These holes supply lubrication to the cam pad surface of the rocker arm and to the valve tip end.

Lubrication is supplied to the front oil gallery from 1st and 3rd camshaft bearings and to the rear oil gallery from 3rd and 5th camshaft bearings.

Camshaft Drive

Camshaft is driven by two double row roller chains driven by crankshaft through jackshaft.

Crankshaft chain driven by crankshaft sprocket drives the jackshaft sprocket-front and jackshaft. Nextly, Camshaft chain driven by jackshaft sprocket-rear drives the camshaft sprocket and camshaft.

The "tension" of each chain is controled by the upper and lower chain tensioners which are operated by spring and oil pressure.

The contacting surface of chain tensioner is made of special anti-oil, heat proof hard rubber.

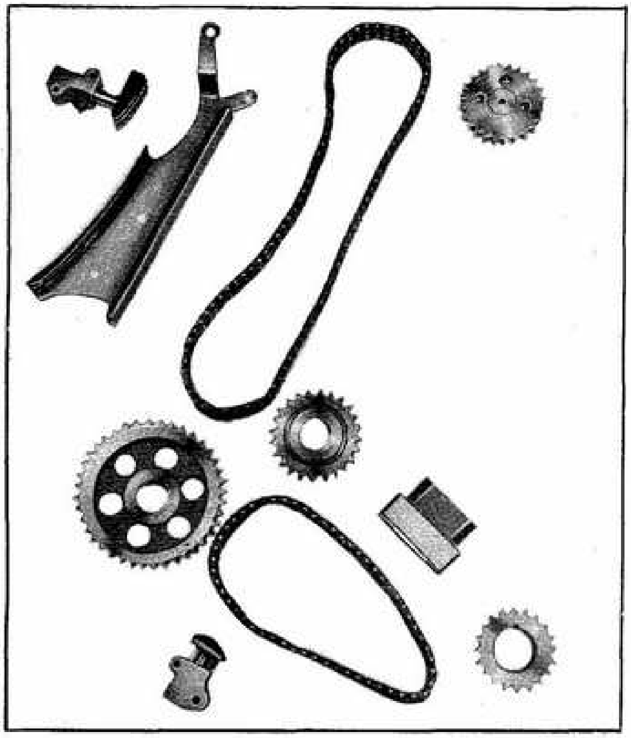


Fig. EM-8

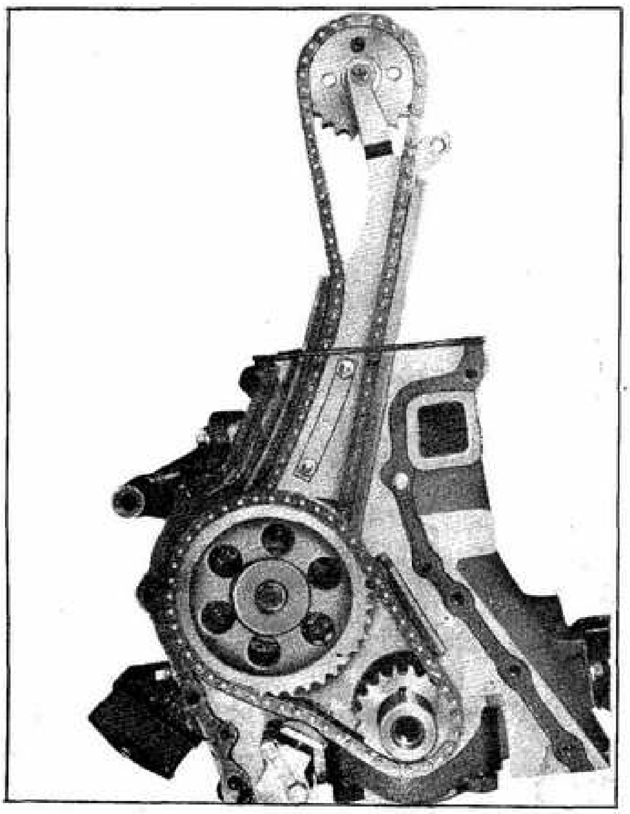


Fig. EM-9

Manifold

The "over under" design of the two part inlet and three-part exhaust manifolds is arranged to provide a hot exhaust gases to warm cold incoming fuel mixtures.

Dual intake manifold with individual inlet tube permits a single passage to feed each cylinder. Individual exhaust ports are utilized to provide improved breathing.

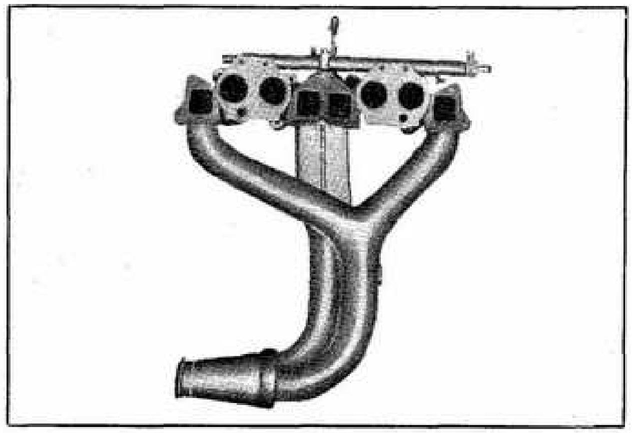


Fig. EM-10

SERVICE OPERATIONS

ENGINE IN VEHICLE

Engine-Remove and Install

To remove Engine off the vehicle, it is more efficient to remove it together with Transmission as attached to Engine.

1. Mark hinge location on Hood and remove Hood from hinges.

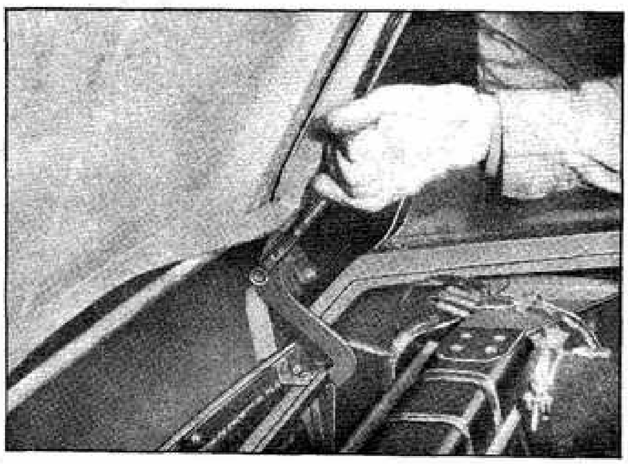


Fig. EM-11

2. Drain cooling system.
3. Disconnect battery cables at Battery.
4. Remove Battery.
5. Disconnect engine wire harness and engine to frame ground straps.

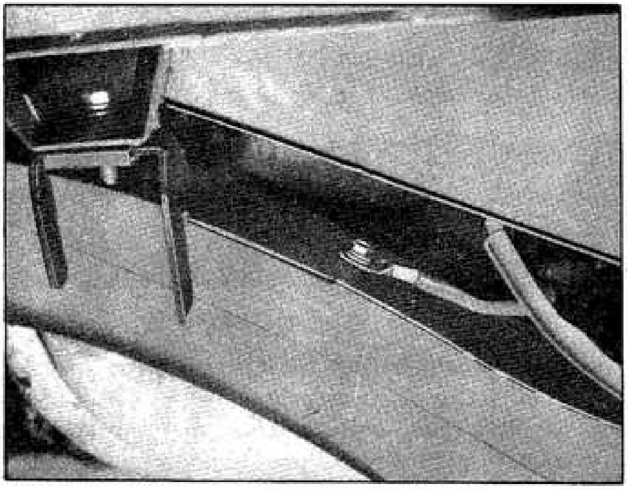


Fig. EM-12

6. Disconnect Tachometer cable.
7. Disconnect High tension cables.
8. Disconnect Radiator and heater hoses at engine attachment.

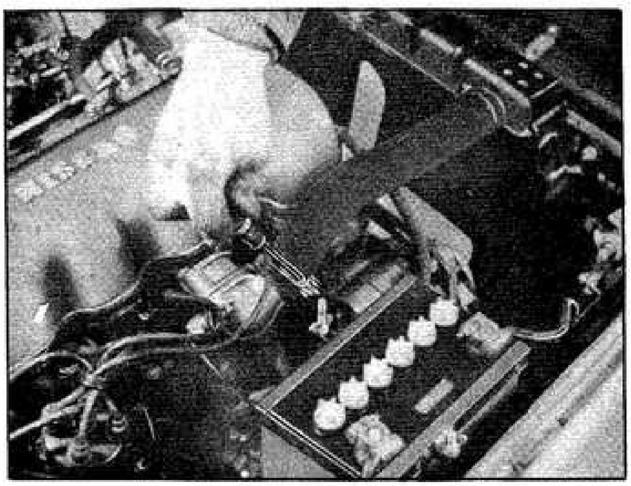


Fig. EM-13

9. Remove Screws attaching Radiator shroud to Radiator.
10. Remove Radiator.

Fig. EM-14

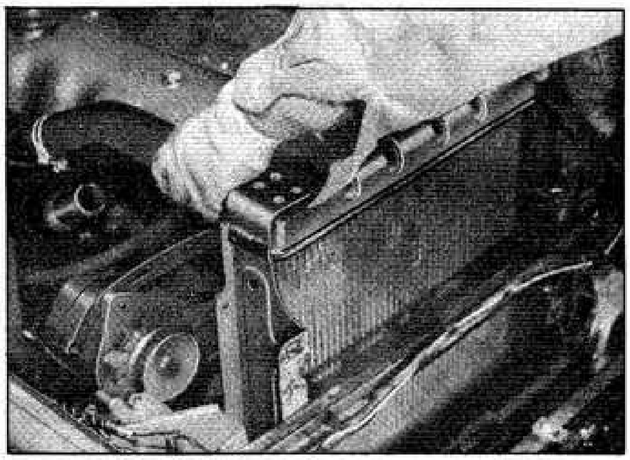


Fig. EM-15

11. Remove Radiator shroud.
12. Disconnect Accelerater control linkage.

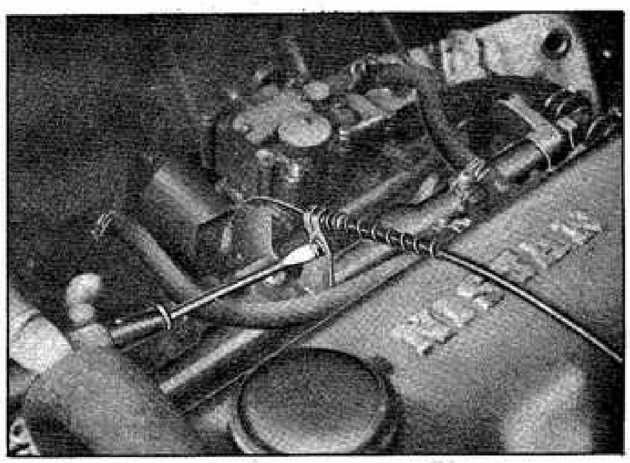


Fig. EM-16

13. Disconnect fuel lines at Fuel pump.

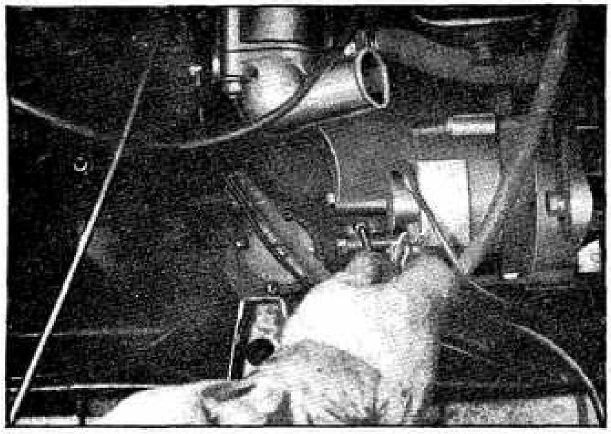


Fig. EM-17

14. Disconnect Exhaust pipe from Manifolds.

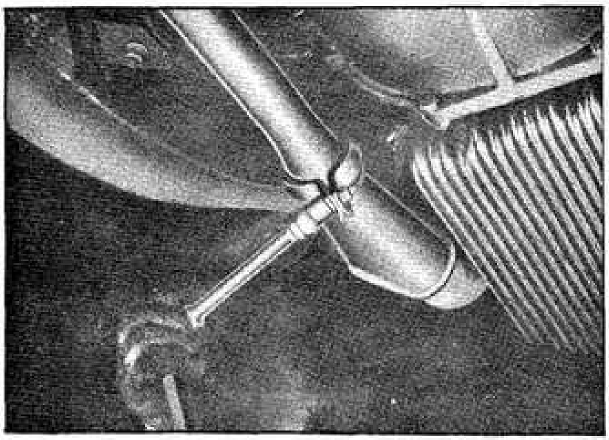


Fig. EM-18

15. Disconnect Speedometer cable.

16. Remove Clutch operating cylinder.

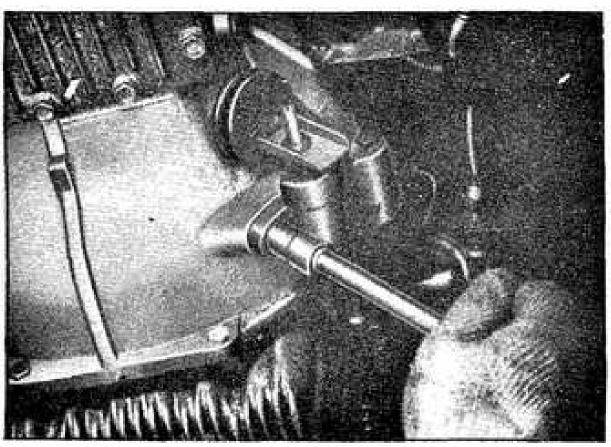


Fig. EM-19

17. Disconnect Propeller shaft from Differential gear case.

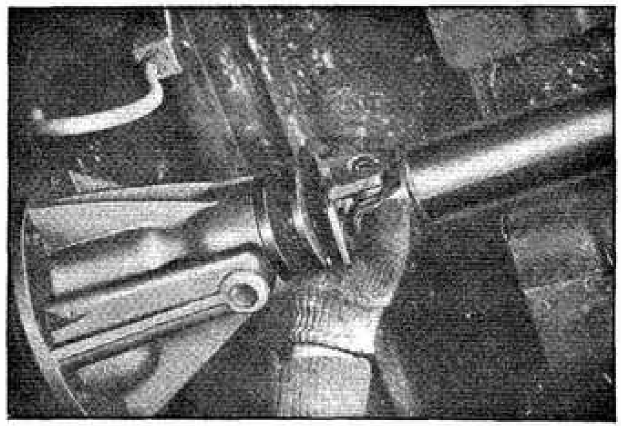


Fig. EM-20

18. Remove Propeller shaft from Rear extension flange of Transmission.

19. Remove two bolts securing Rear engine mounting to Frame cross member bracket.

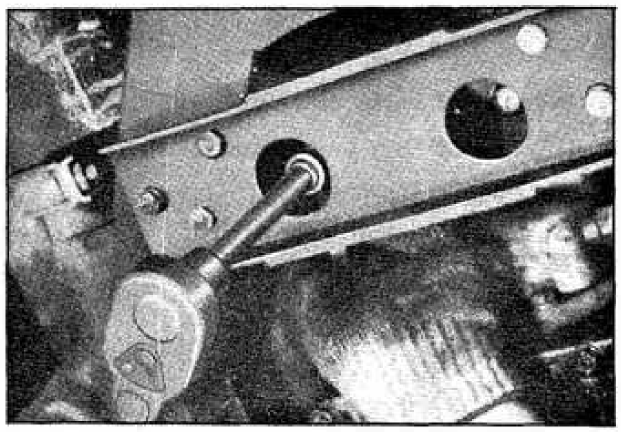


Fig. EM-21

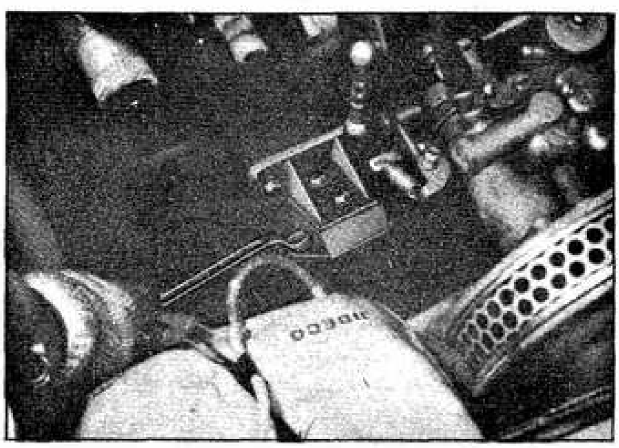


Fig. EM-22

20. Remove all bolts securing Front engine mountings to Frame brackets.
21. Using a suitable lifting equipment, raise Engine.
22. Disconnect Starter wires.

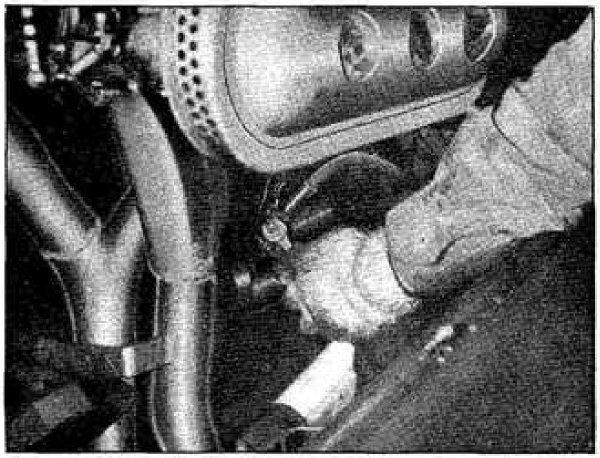


Fig. EM-23

23. Remove Engine.

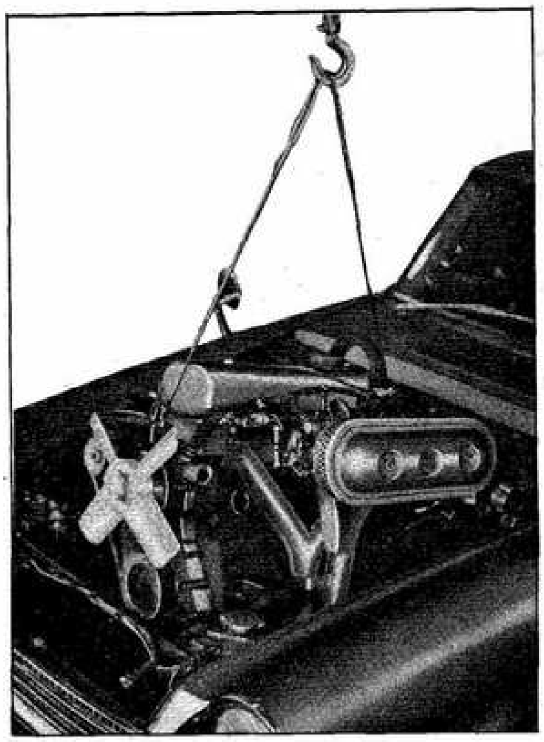


Fig. EM-24

Replacement is a reversal of the removal procedure.

Engine Mounting

Resilient rubber mounting cushions support the engine and transmission at three points. A cushion is located at each side on the center line of the engine, with the rear supported by a cushion between the transmission extension housing and the engine rear support cross-member.

Removal or replacement of any cushion may be accomplished by supporting the weight of the engine or transmission at the area of the cushion.

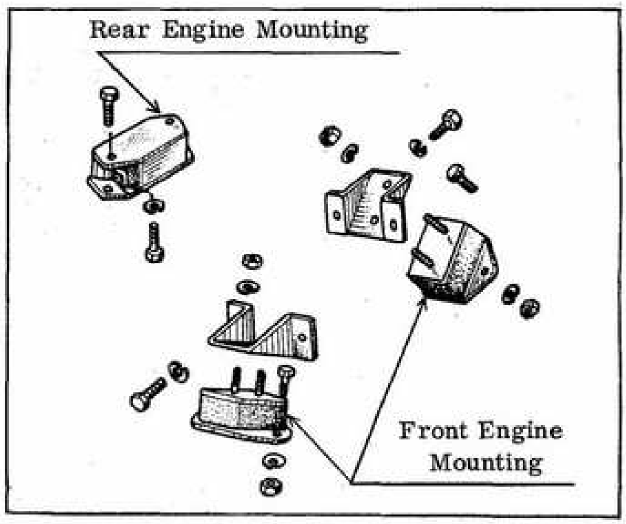


Fig. EM-25

Service Operations with Engine in Vehicle

Following service operations are possible with Engine in Vehicle.

As for other operations it is advisable to put Engine on a suitable engine stand after removing Engine from Vehicle.

1. Air Cleaner-Remove And Replace
2. Carburetors-Remove And Replace
3. Intake And Exhaust Manifold-Remove And Replace
4. Camshaft-Remove And Replace
5. Cylinder Head-Remove And Replace
6. Fan And Water Pump-Remove And Replace
7. Oil pan and Oil pump-Remove And Replace

THE SIDE OF ENGINE

Carburetor-Remove and Replace

1. Disconnect Exhaust emission control hose.
2. Remove Air cleaner.

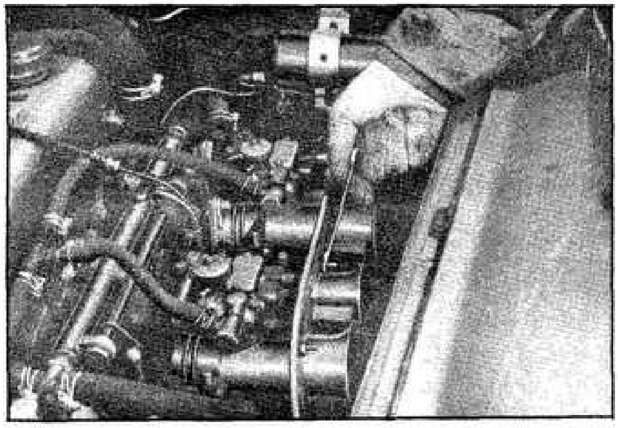


Fig. EM-26

3. Disconnect Throttle cable at bell crank and disconnect connecting rod from throttle shaft.

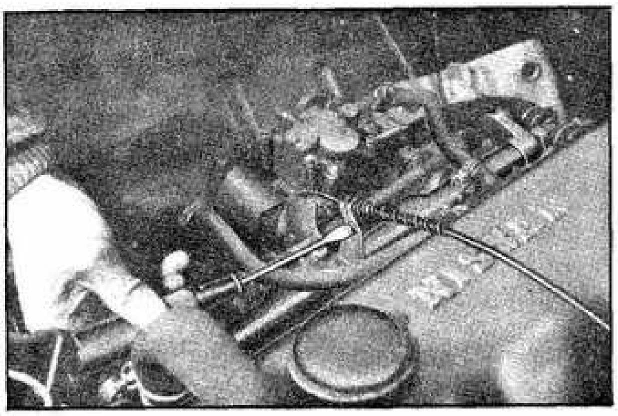


Fig. EM-27

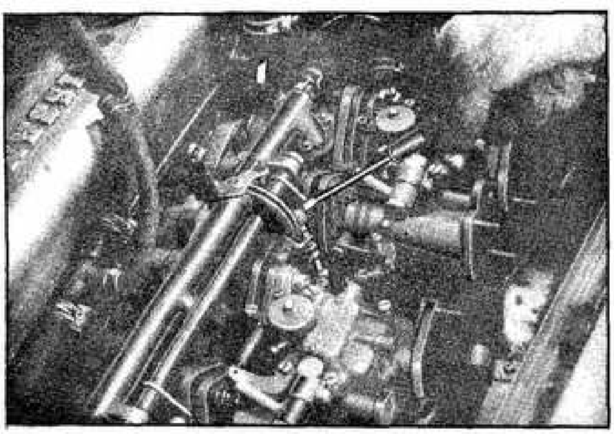


Fig. EM-28

4. Disconnect Fuel and vacuum lines from carburetor. (As for Solex type, there is no vacuum line.)

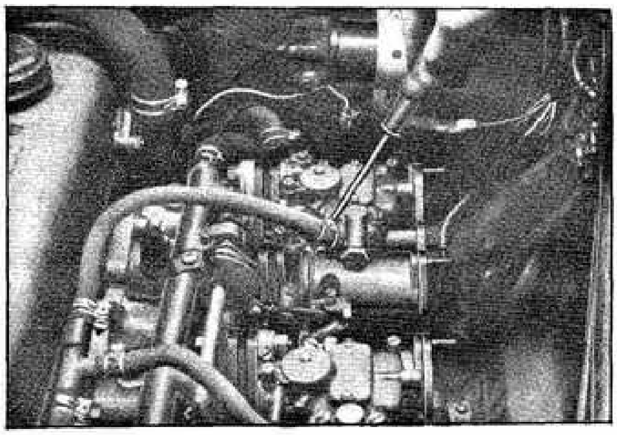


Fig. EM-29

5. Remove Carburetors by removing insulator to carburetor stud nuts (eight nuts).

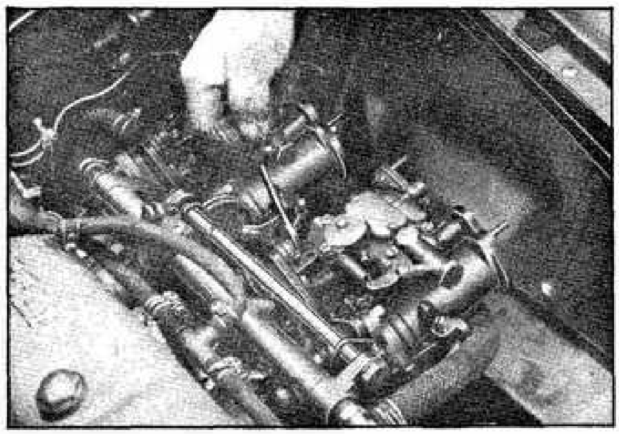


Fig. EM-30

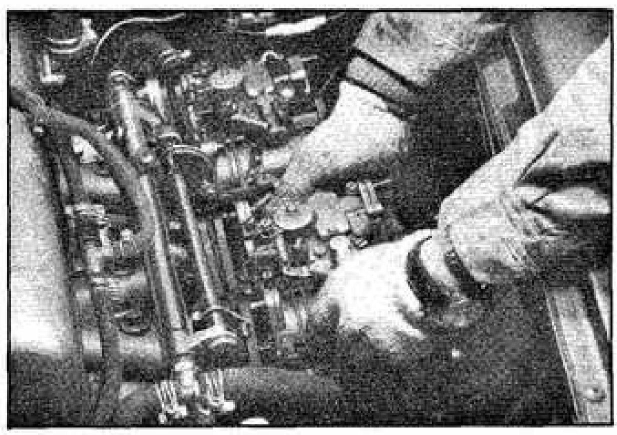


Fig. EM-31

Replacement is a reversal of the above procedure.

Intake and Exhaust Manifold-Remove and Replace

Remove

1. Remove Air cleaner and Carburetors as previously mentioned.

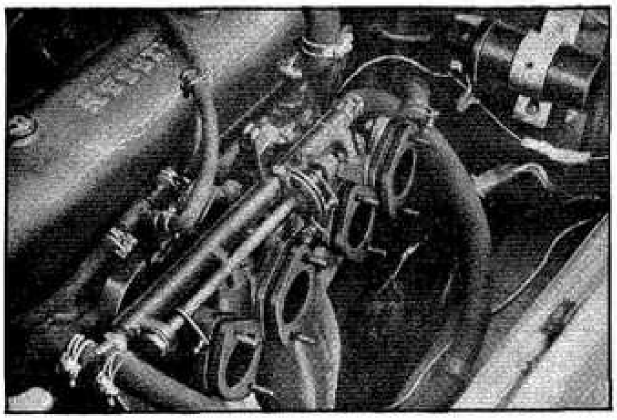


Fig. EM-32

2. Remove Intake manifold to Cylinder head stud nuts.

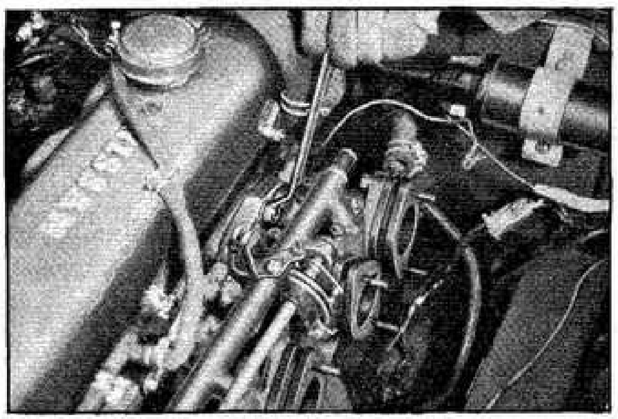


Fig. EM-33

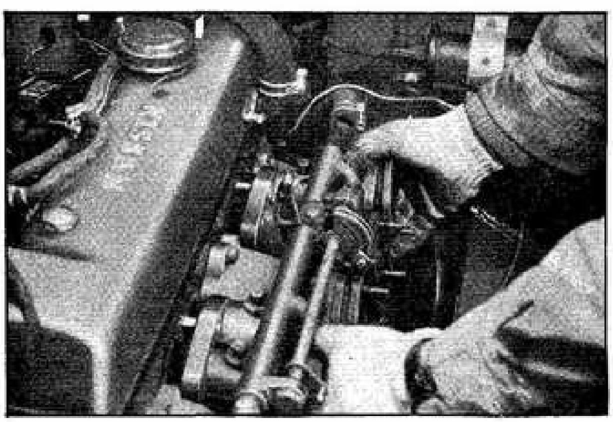


Fig. EM-34

3. Remove Intake manifold.
4. Remove Stud nuts and one manifold to bracket bolt.
5. Remove Exhaust manifold.

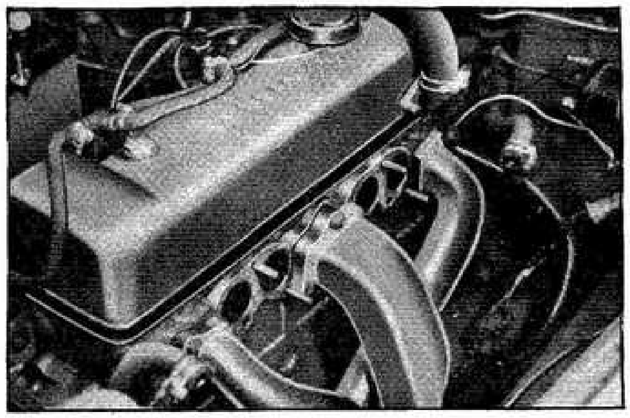


Fig. EM-35

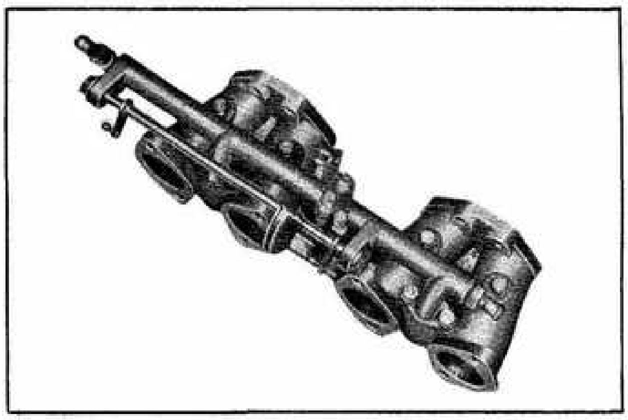


Fig. EM-36

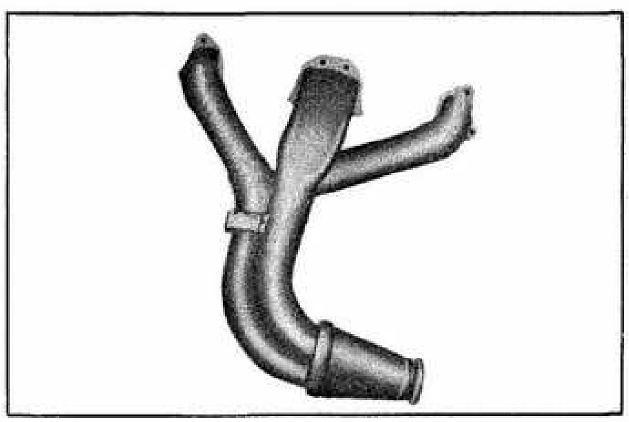


Fig. EM-37

Replace

1. Clean Gasket flanges on Cylinder head and Manifold.
2. Check for cracks on Manifold.
3. Position new gasket over manifold studs on Cylinder head and carefully install Exhaust manifold in position, making sure the gasket is in place.
4. Install nuts and clamps while holding manifold in place and tighten nuts to 1.4 ~ 2.8 kg-m (10.1 ~ 20.2 ft-lb.).
5. Reverse steps 1-3 of removal procedure to complete installation.

THE TOP OF ENGINE

Camshaft and Rocker Arm-Remove and Replace

1. Remove Rocker Arm Cover.
2. Disconnect Camshaft sprocket at Camshaft front end and support Camshaft sprocket temporarily with a screw to Camshaft chain guide as shown in Fig. EM-38.

Fig. EM-38

3. Remove all camshaft bearing caps.

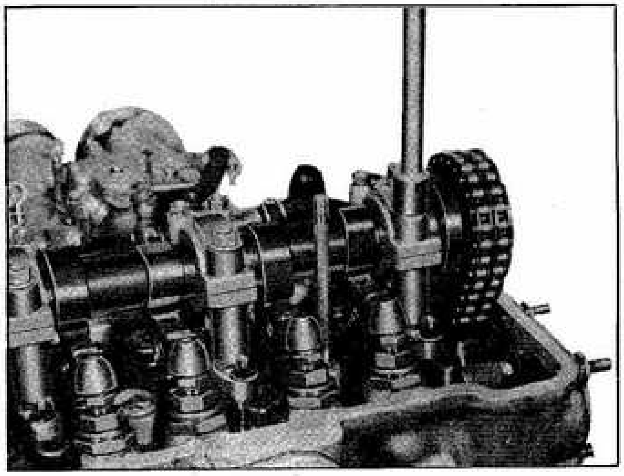


Fig. EM-39

4. Remove Camshaft.

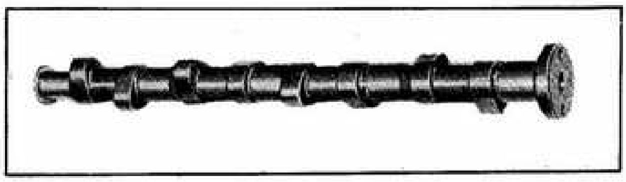


Fig. EM-40

5. Remove all rocker arms.

   On replacement it is more effective to install Rocker arms by pressing down Valve springs after the installation of Camshaft.

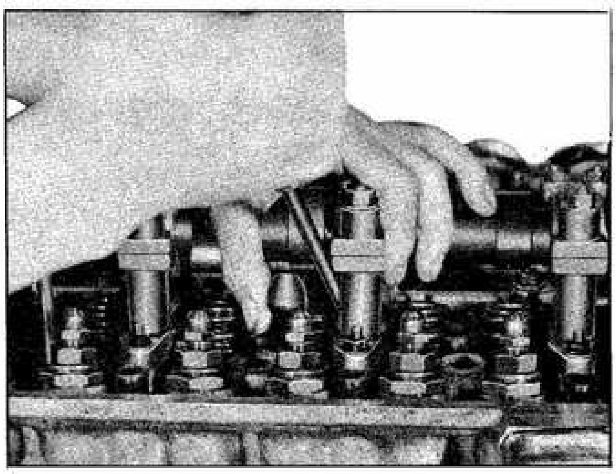


Fig. EM-41

Inspect Camshaft condition

Camshaft Bend

(Measure Center Journal with Both end journals supported).... less than 0.01 mm (0.0004 in.)

Camshaft Journal to Bearing Clearance (at room temperature)

No.1 ~ No.4 Journal ... 0.023 ~ 0.052 mm (0.0009 ~ 0.0020 in.)

No.5 Journal .... 0.021 ~ 0.047 mm (0.0008 ~ 0.0019 in.)

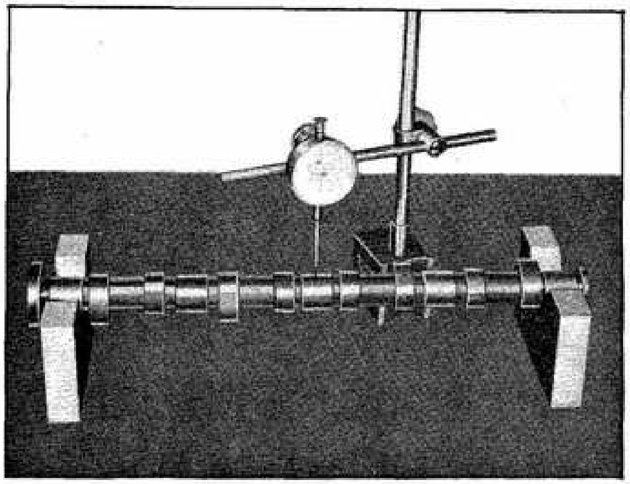


Fig. EM-42

After installation, Camshaft End play must be checked.

Camshaft End Play .... 0.1 ~ 0.3 mm (0.0039 ~ 0.0118 in.)

Tightening torque of Camshaft bearing cap nuts is 1.8 kg-m (13.0 ft-lb.) for Large nuts and 0.7 kg-m (5.1 ft-lb.) for Small nuts. Tightening torque of Camshaft sprocket to Camshaft bolts is 1.8 kg-m (13.0 ft-lb.). Tightening torque of Rocker arm cover bolts is 0.6 ~ 0.7 kg-m (4.3 ~ 5.1 ft-lb.).

Caution: Never remove Lower 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 boring.

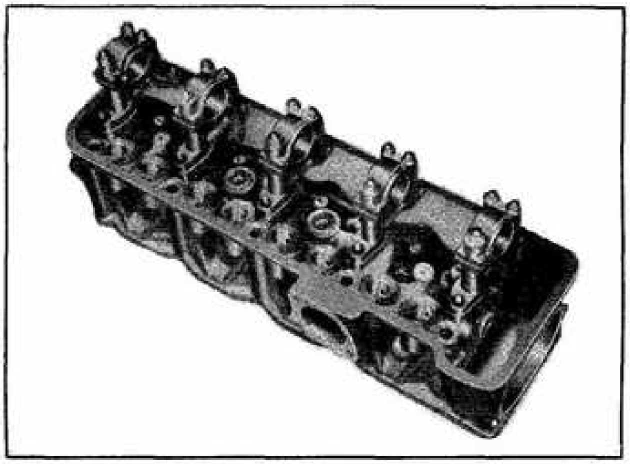


Fig. EM-43

Cylinder Head-Remove and Replace

Remove

1. Disconnect Radiator and Heater hoses.
2. Remove Air Cleaner.
3. Disconnect Fuel and vacuum lines at carburetors.
4. Remove Intake manifold and Carburetors as an assembly.
5. Remove Exhaust manifold.
6. Remove Rocker arm cover assembly.
7. Disconnect Camshaft sprocket at camshaft front end, and support camshaft sprocket temporarily to chain guide with a screw.
8. Remove Cylinder head front plate.
9. Remove Upper chain tensioner.
10. Remove two nuts securing Cylinder Head to Timing Chain Cover.

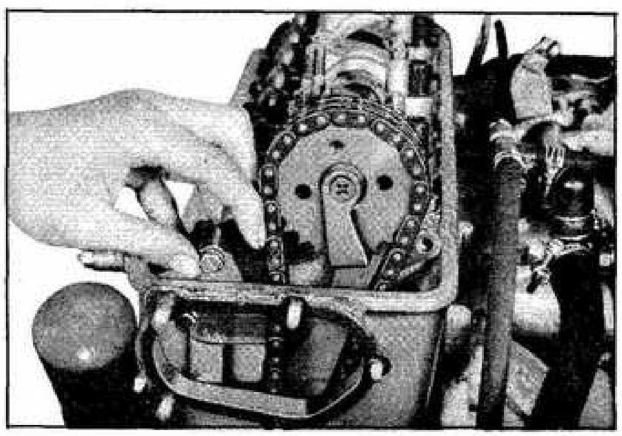


Fig. EM-44

11. Remove Cylinder head bolts, Cylinder head and Gasket.

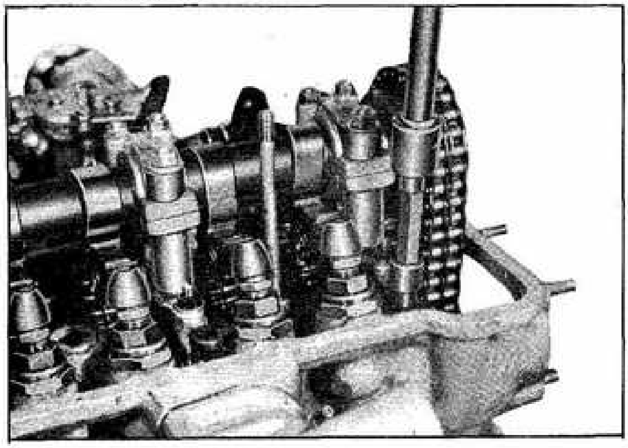


Fig. EM-45

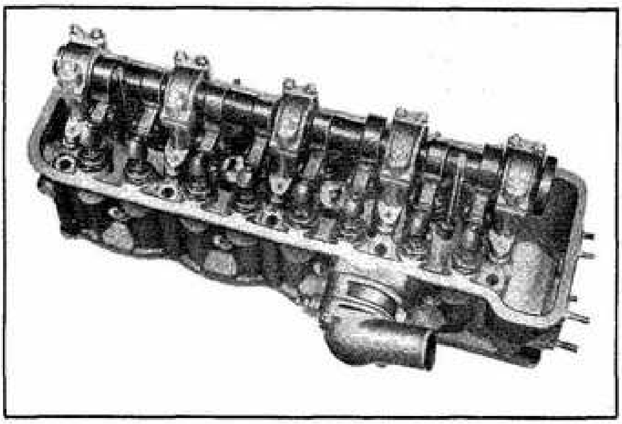


Fig. EM-46

12. Clean Gasket surfaces of cylinder head and block.

Replace

1. Place a new cylinder head gasket in position over dowel pins in cylinder block.

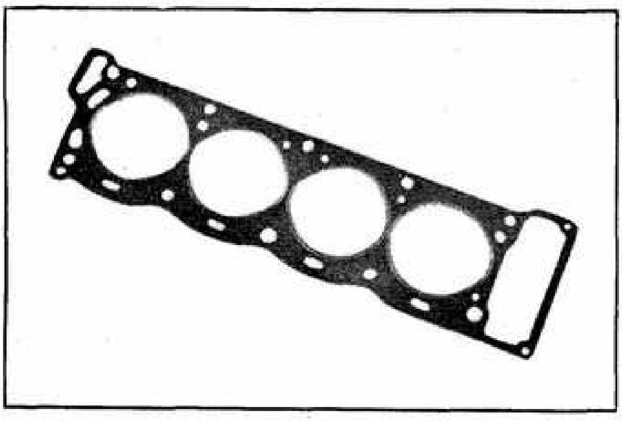


Fig. EM-47

2. Carefully guide Cylinder head into place over dowel pins and gaskets.
3. Start all bolts in threads.
4. Tighten Cylinder head at first round to 6.0 kg-m (43.3 ft-lb.) with a torque wrench. Follow the sequence shown in Fig. EM-48. The final torque should be 9.0 kg-m (65.1 ft-lb.)

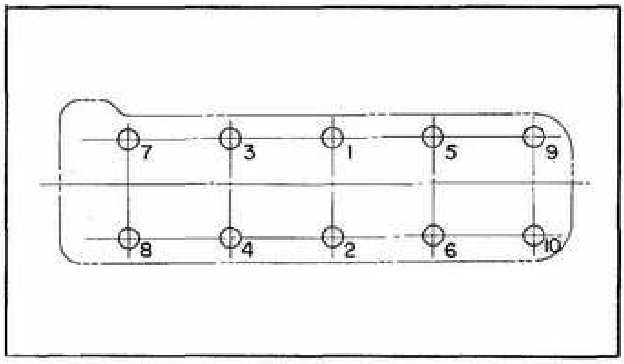


Fig. EM-48 Cylinder Head Bolt Tightening Order

5. Reverse steps 1-9 removal to complete installation procedure using new gasket and seals as required.

Cylinder Head and Valves-Recondition

Disassemble

1. Remove Cylinder head and Gasket as previously described. Place Cylinder head on two blocks of wood to prevent damage.
2. Remove Rocker arms and Camshaft.
3. Remove Lash adjusters.

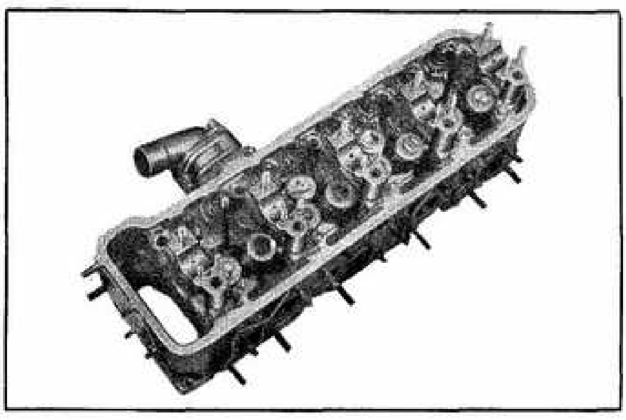


Fig. EM-49

4. Using Valve Lifter, compress the valve springs and remove valve keys.
   Remove spring caps, springs and spring seats with oil seals.

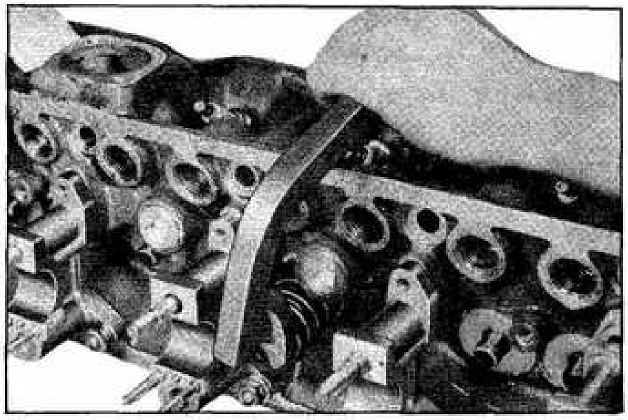


Fig. EM-50

5. Remove Valves from bottom of cylinder head and place them in a rack in their proper sequence so they can be assembled in their original positions.

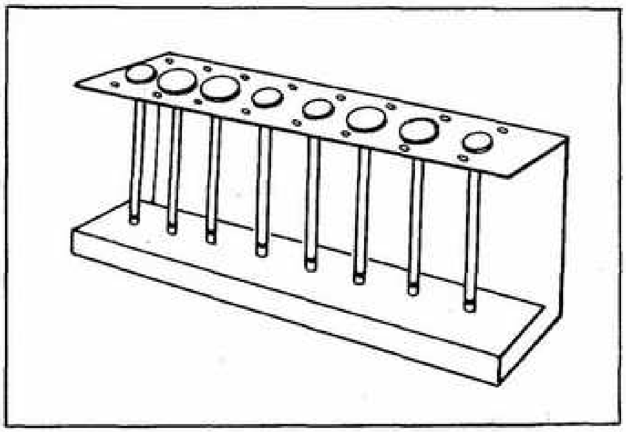


Fig. EM-51

Clean and Inspect

1. Clean all carbon from combustion chambers and valve ports.
2. Thoroughly clean the valve guides.
3. Clean all carbon and sludge from rocker arms.
4. Clean valve stems and heads on a buffing wheel.
5. Clean carbon deposits from head gasket mating surfaces.

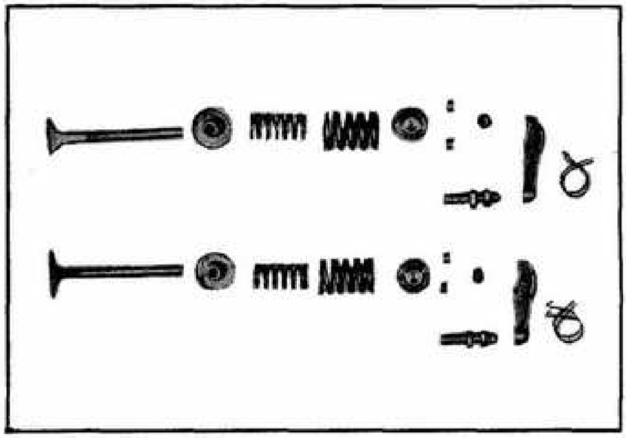


Fig. EM-52

6. Wash all parts in cleaning solvent and dry them thoroughly.
7. Inspect Cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks to the water chamber.
8. Inspect Valves for burned heads, cracked faces or damaged stems.
9. Check fit of valve stems in their respective bores.

Fitting Valve Stems to Guides

The valve stem to guide clearance is 0.015 ~ 0.043 mm (0.0006 ~ 0.0017 in.) for intake valves and 0.045 mm ~ 0.073 mm (0.0018 ~ 0.00029 in.) for exhaust valves.

Wear limit of clearance is 0.15 mm (0.0059 in.).

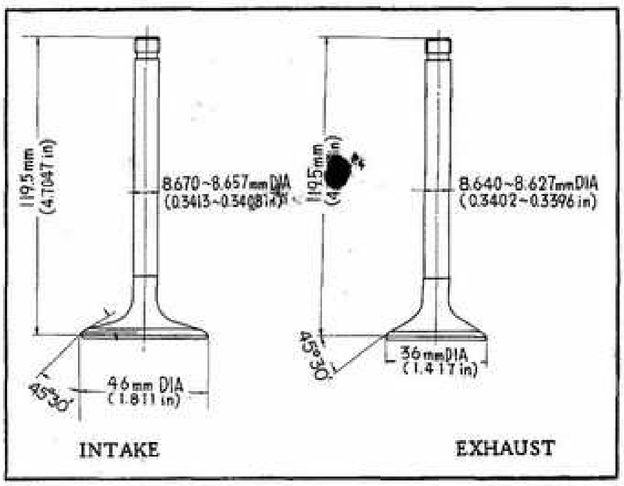


Fig. EM-53

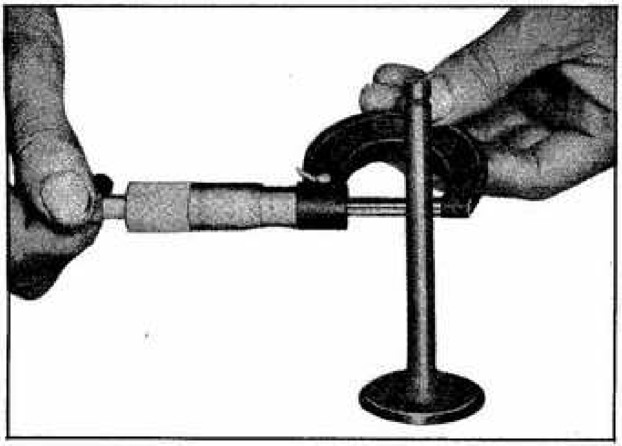


Fig. EM-54

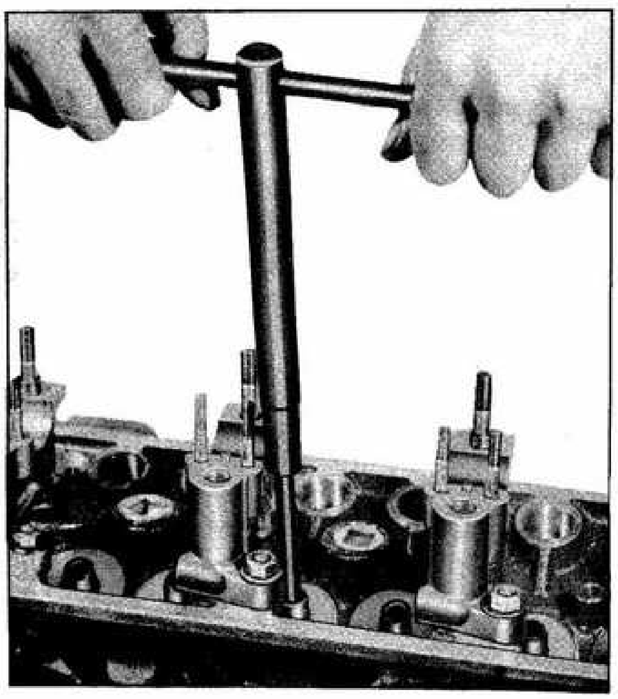


Fig. EM-55

The intake and exhaust valve stem diameters are shown in Fig. EM-53. Valve guides with 0.25 mm (0.0098 in.) oversize diameter are available. The same valve stem to guide clearance applies for oversize valve guides.

Reamers are required to enlarge valve guide holes to fit the valve stems.

When reamer is turned through valve guide, it will size the hole to fit valve stem according to above limits.

Valve Guides-Remove and Replace

Remove

1. Rest Cylinder head with its machined face upwards on a suitable stand.
2. Drive a valve guide downwards from the combustion space with a suitable-sized drift.

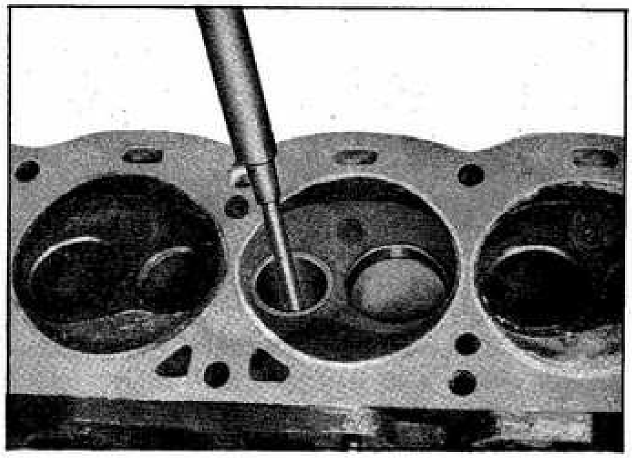


Fig. EM-56

Replace

1. Heat the cylinder head to a temperature of 150 ~ 160°C (302 ~ 320° F).

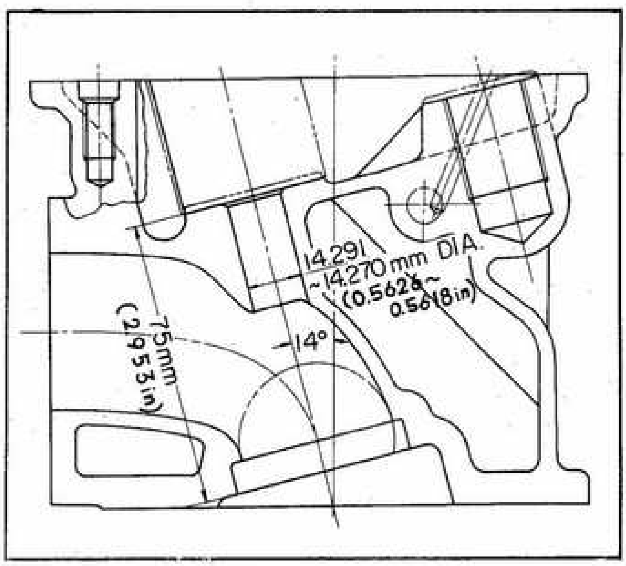


Fig. EM-57 Sectional View of Cylinder Head

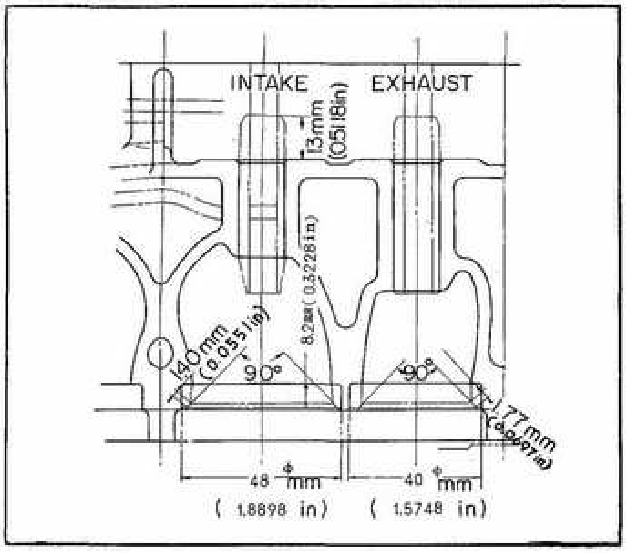


Fig. EM-58 Sectional View of Cylinder Head

2. Rest the cylinder head with its machined face downwards on a clean surface.

3. Press the new valve guide in from the top of the cylinder head.

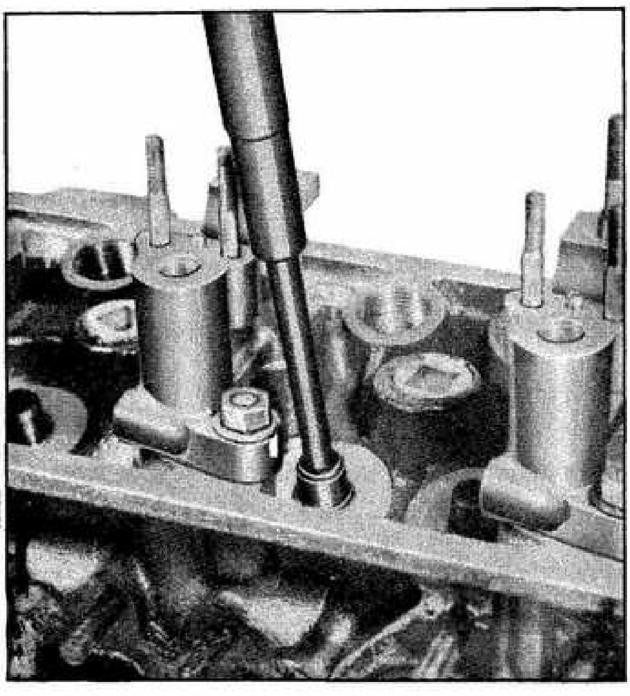


Fig. EM-59

The exhaust valve guides must be inserted with the end having the small chamfer at the top and the intake valve guides should have their taper ends at the bottom.

The valve guides should be driven into the combustion space until they are 13 ± 0.1 mm (0.512 ± 0.004 in.) above the machined surface of the spring seat.

Interference fit of valve guide into Cylinder head is 0.022 ~ 0.050 mm (0.0009 ~ 0.0020 in.) for both intake and exhaust valve guides.

Valve Seat Inserts-Remove and Replace

Remove

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.

Replace

1. Check the valve recess diameter.

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

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

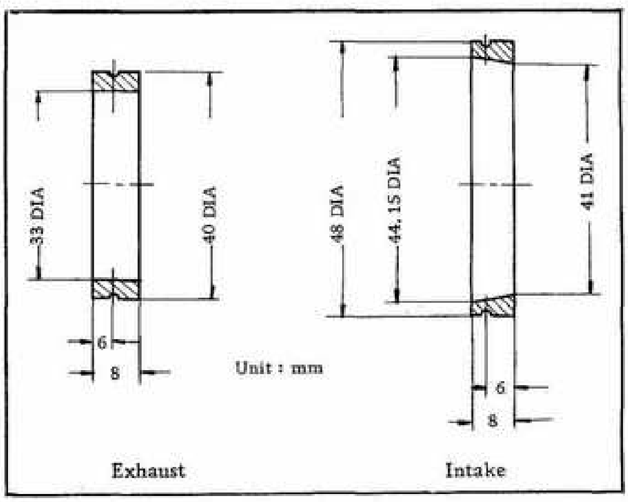


Fig. EM-60 Valve Seat Insert

4. Heat the cylinder head to a temperature of 150 ~ 160°C (302 ~ 320°F).

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

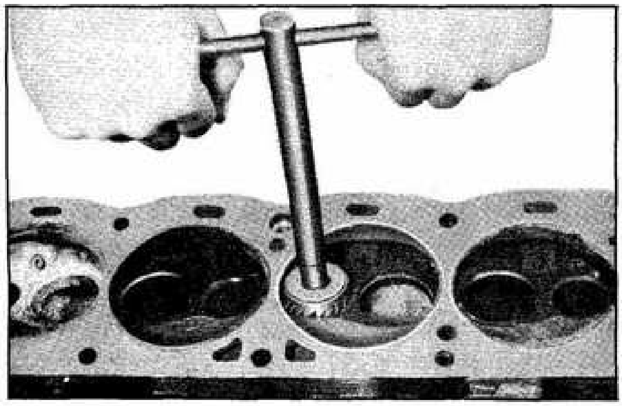


Fig. EM-61

6. The valve seats newly fitted should be cut or ground at an angle of 45° to a width of 1.40 mm (0.055 in.) for Intake and 1.77 mm (0.069 in.) for Exhaust.

   Interference fit of Valve seat into Cylinder head valve recess.

   Intake .... 0.081 ~ 0.113 mm (0.0032 ~ 0.0044 in.)
   Exhaust .... 0.064 ~ 0.096 mm (0.0025 ~ 0.0038 in.)

Valves and Seats-Recondition

Valves should be ground on a special bench grinder designed specifically for this purpose and valve seats should be ground with reputable power grinding equipment having stored of the correct seat angle and a suitable pilot which pilots in the valve stem guide.

1. The seating of the cylinder head must be machined to the dimensions given in Fig. EM-58. Each valve seat insert should have an interference fit of 0.081 ~ 0.113 mm (0.0032 ~ 0.0044 in.) for Intake and 0.064 ~ 0.096 mm (0.0025 ~ 0.0038 in.) for Exhaust and must be pressed as previously mentioned. After fitting, grind or machine the new seating to the dimensions given in Fig. EM-62.

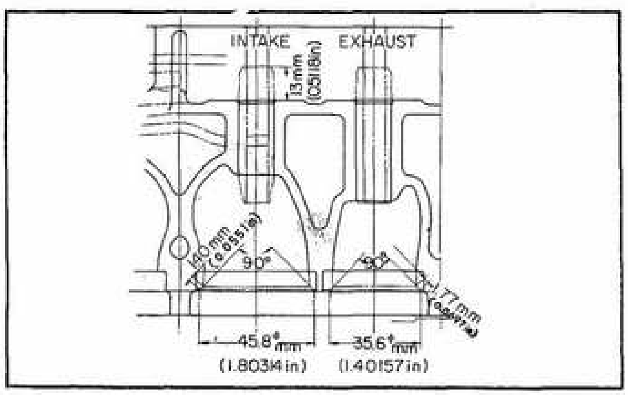


Fig. EM-62 Sectional View of Cylinder Head

2. The intake valve seat angle is 45° with a face angle of 45°30'. The exhaust valve has a seat angle of 45° with a face angle of 45°30'. This will provide hairline contact between valve and seat to provide positive sealing and reduce build up of deposits on seating surfaces.

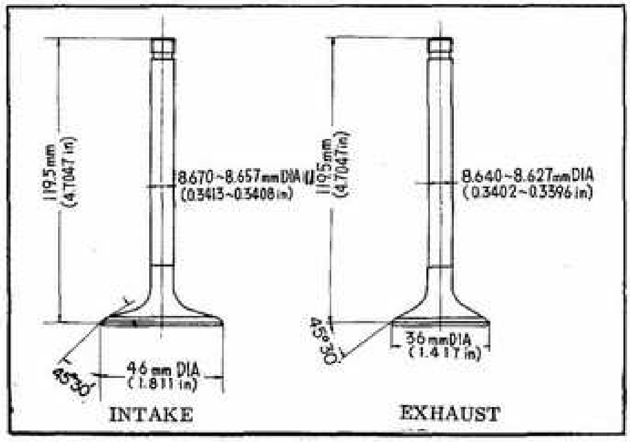


Fig. EM-63

3. Valves may be refaced until remaining margine is down to 0.5 mm (0.0196 in.) then the valve must be replaced.
   The valve stem tip when worn can be resurfaced and rechamfered. However, never remove more than 0.5 mm (0.0196 in.).

Valve Spring

Whenever valve springs are removed, they should be tested according to the specifications listed below.

Use valve spring tester and replace all springs not within specifications.

	Outer Spring	Inner Spring
Free Length	49.7 mm (1.96 in.)	48.4 mm (1.91 in.)
Valve Closed	41.2 mm at 32.3 kg (1.62 in. at 71.1 lb.)	39.2 mm at 13.3 kg (1.54 in. at 29.3 lb.)
Valve Open	29.6 mm at 76.4 $^{+2.0}_{-4.0}$ kg (1.17 in. at 168.1 $^{+4.41}_{-8.82}$ lb.)	27.6 mm at 29.9 + 1.8 kg (1.09 in. at 65.8 ± 3.96 lb.)

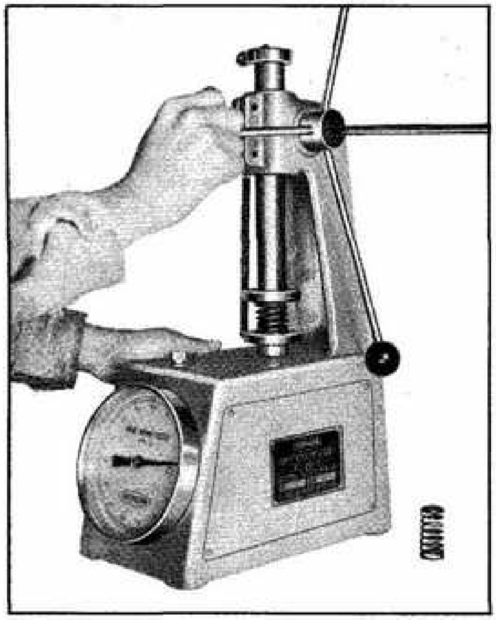


Fig. EM-64

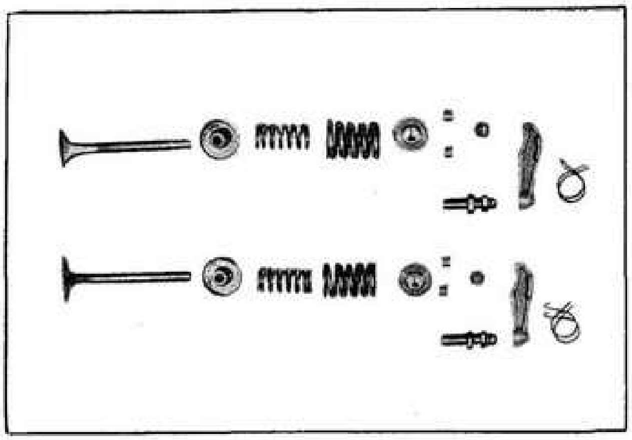


Fig. EM-65

Reassemble

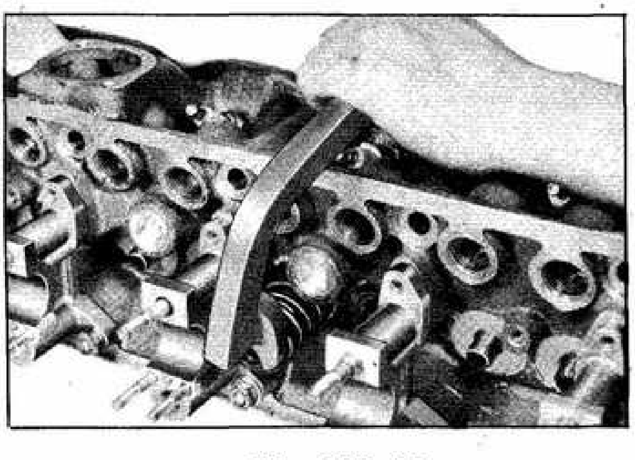


Fig. EM-66

1. Starting with No. 1 cylinder place exhaust valve in the port and place valve spring seat with lip-seal and valve spring and cap in position.
   Then using suitable spring compressor, compress spring and insall valve keys.
   See that the keys seat properly in valve stem groove.
2. Assemble remaining valves, valve spring seats, valve springs, spring caps and valve keys in cylinder head.

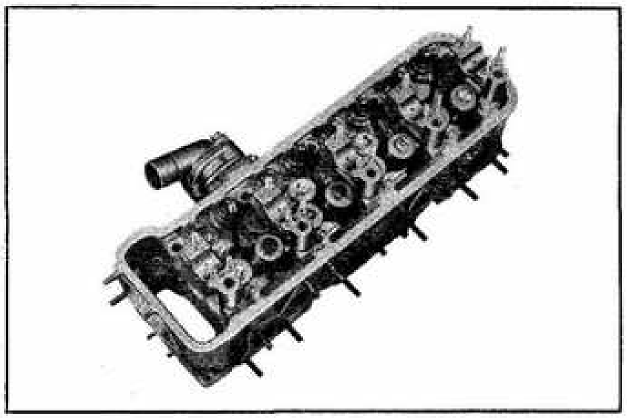


Fig. EM-67

3. Assemble Lash adjusters.
4. Install Camshaft.
5. Install Camshaft bearing caps and tighten Large nuts (M8) to 1.8 kg-m (13.0 ft-lb.) and Small nuts (M6) to 0.7 kg-m (5.1 ft-lb.).
6. Check End play. {0.1 ~ 0.3 mm (0.0039 ~ 0.0118 in.) }.
7. Install Rocker arms by pressing down the valve springs.

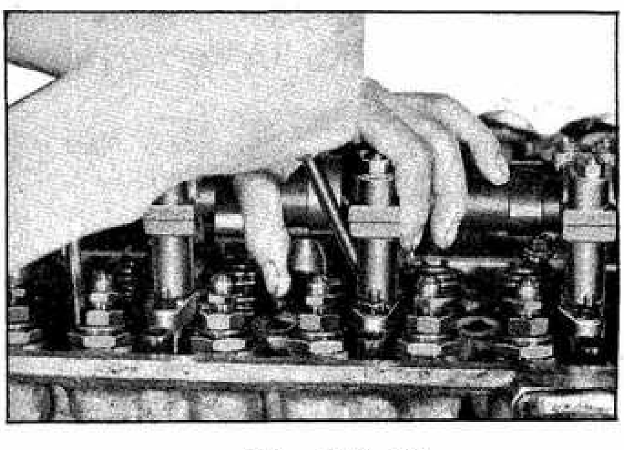


Fig. EM-68

Valve Rocker Clearance-Adjust

If the engine is to give its best performance and the valves are to retain their maximum useful life, it is essential to maintain the correct valve clearance.

Provision for adjusting the valve clearance is made in the rocker arm by an adjustable screw and lock nut.

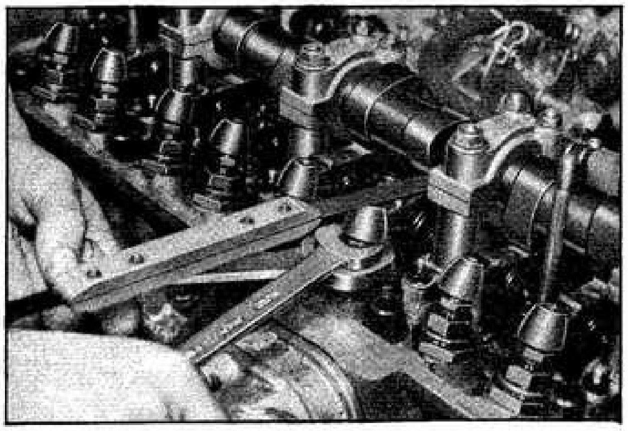


Fig. EM-69

The rocker adjusting screw is released by slackening the hexagon lock nut with a end wrench while holding the screw against rotation with a end wrench.

The valve clearance can then be set by carefully rotating the rocker screw while checking the clearance with a feeler gauge. This screw is the re-locked by tightening the hexagon lock nut while again holding the screw against rotation.

Caution: Do not adjust the valve clearance with Engine running because the rocker arms and valves are forcibly lubricated from Camshaft oil gallery.

Valve Rocker Clearance (Hot)
Exhaust Valve ...... 0.3 mm (0.0079 in.)
Intake Valve .... 0.2 mm (0.0118 in.)

THE FRONT OF ENGINE

Water Pump-Remove and Replace

1. Remove Upper radiator shroud.

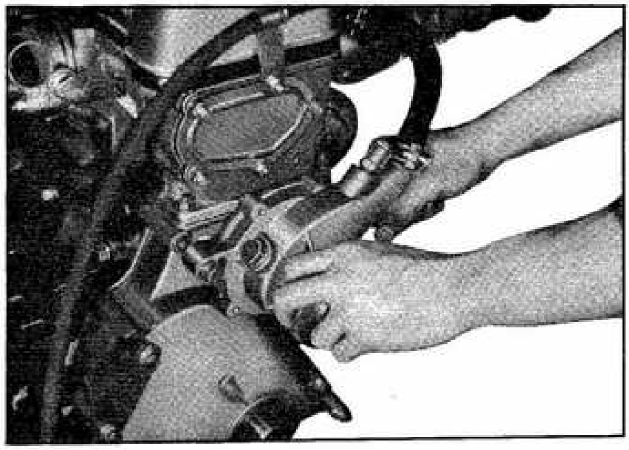


Fig. EM-70

2. Loosen Alternator at adjusting bracket and pivot bolt and remove Fan belt from Fan pulley.
3. Remove Fan, Fan pulley and Spacer.
4. Remove four screws securing Water pump to the front of Engine.
5. Remove Water pump.

Replacement is a reversal of the above procedure.

Vibration Damper-Remove and Replace

1. Loosen Alternator at adjusting bracket and pivot bolt and remove Fan belt from Vibration Damper.

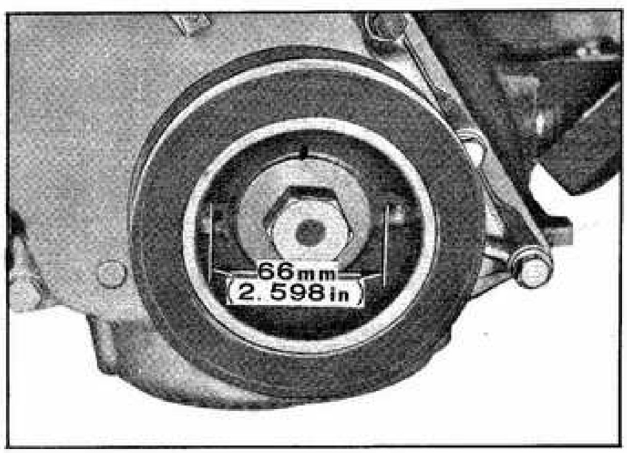


Fig. EM-71

2. Remove Crank Pulley Bolt from Crankshaft.
3. Remove Vibration Damper with Special Tool.

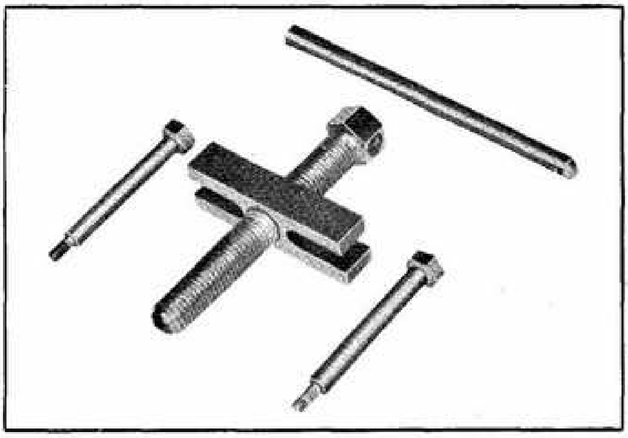


Fig. EM-72

Replacement is a reversal of the above procedure.

Vibration Damper is not repairable in the field. It is only serviced as a complete assembly.

Tighten Crank Pulley Bolt to 20 kg-m (144.6 ft-lb.) torque. A loose Vibration Damper or damage to the damper cushion may be misdiagnosed as loose engine bearings.

Timing Chain Cover-Remove and Replace

1. Remove Alternator.
2. Remove Cylinder head, Intake and Exhaust manifold.

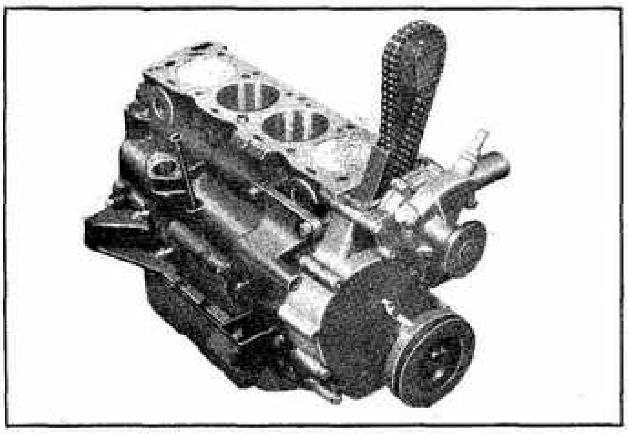


Fig. EM-73

3. Remove Fan, Fan pulley and Fan belt.
4. Remove Vibration Damper.
5. Remove Water pump.

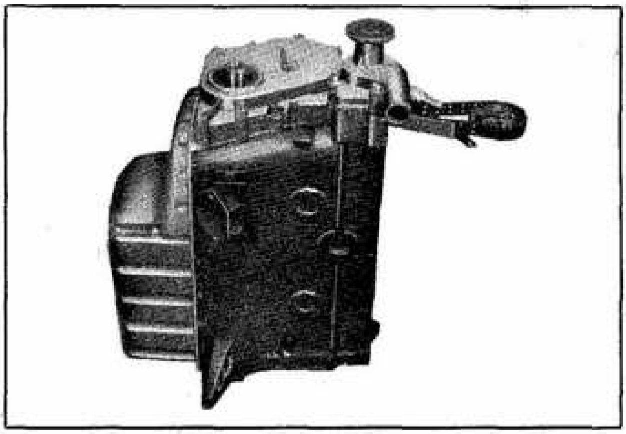


Fig. EM-74

6. Remove all screws securing Oil pan to Timing chain cover and Cylinder Block.
7. Remove Oil pan.
8. Remove Timing chain cover.

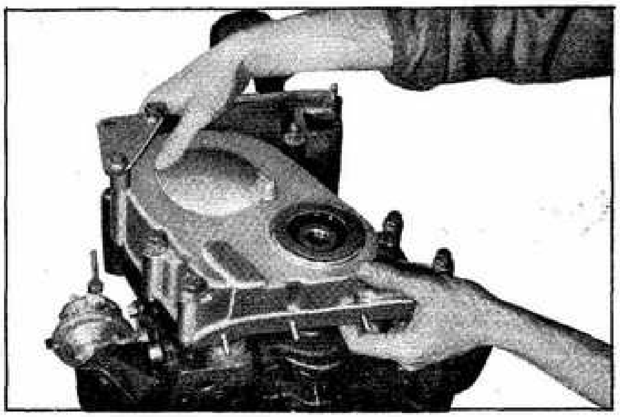


Fig. EM-75

Replacement is a reversal of the above procedure.

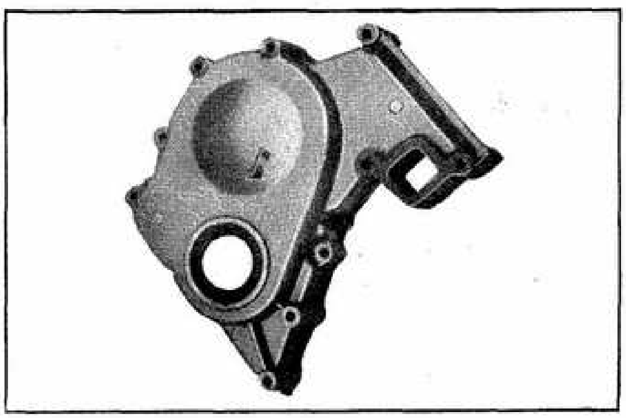


Fig. EM-76

Timing Chains and Sprockets-Remove and Replace

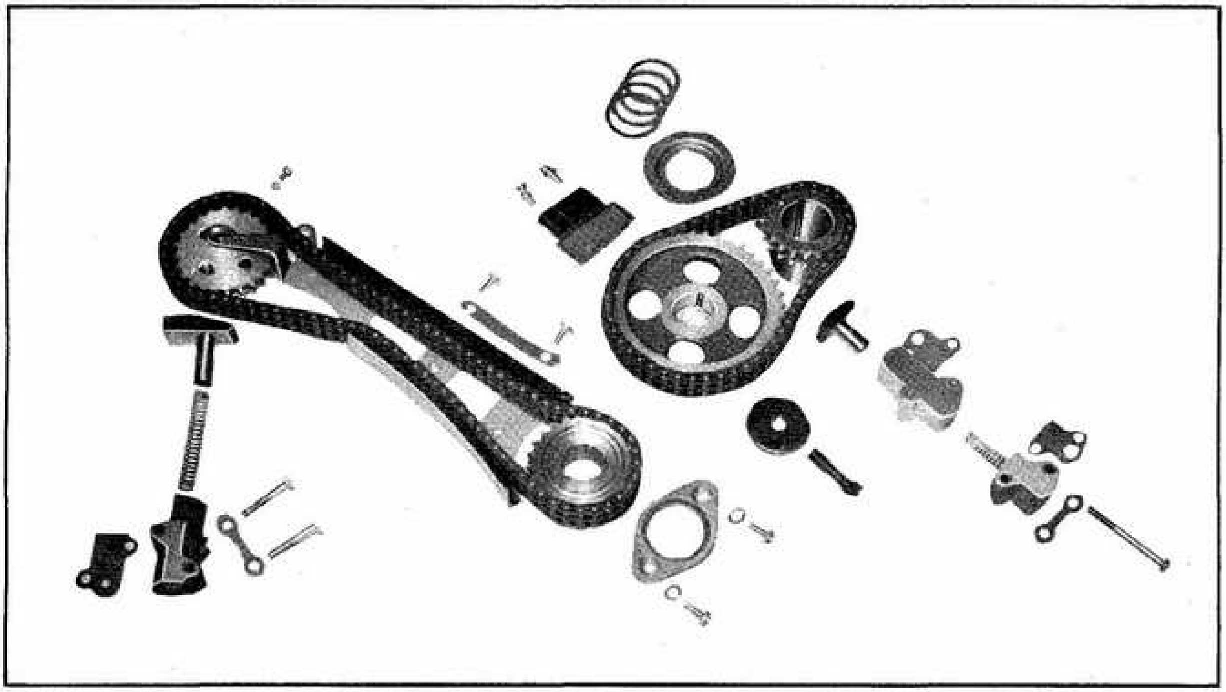


Fig. EM-77

Removing Timing Chains

1. Remove Timing chain cover as previously mentioned.

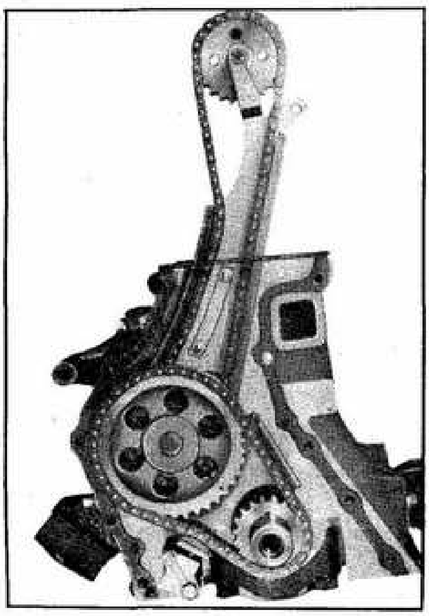


Fig. EM-78

2. Remove Lower chain tensioner.

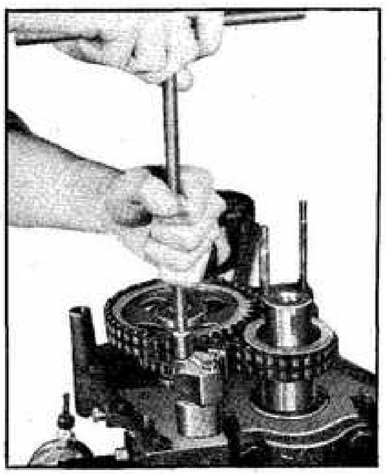


Fig. EM-79

3. Remove Jackshaft chain with Crankshaft sprocket and Jackshaft sprocket-Front.

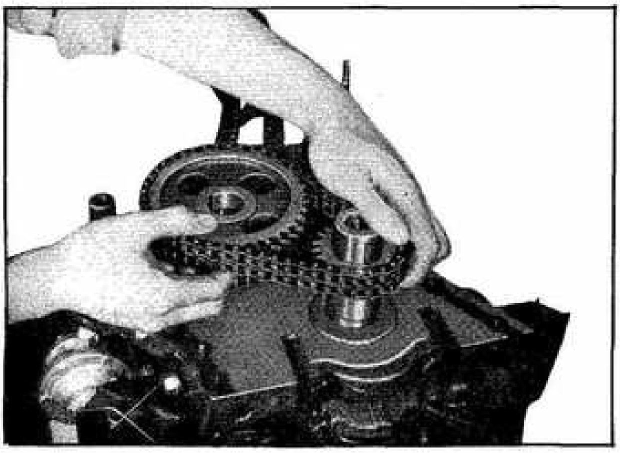


Fig. EM-80

4. Remove Camshaft sprocket and install small screw securing Camshaft sprocket to Timing chain guide into its original place of Camshaft sprocket.

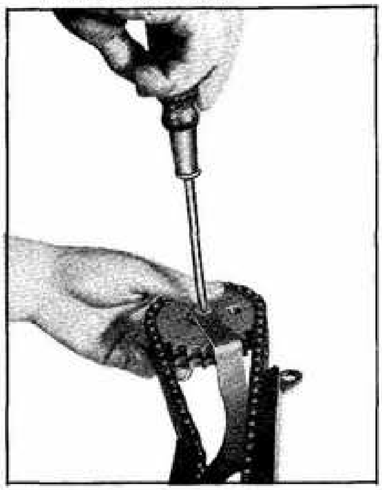


Fig. EM-81

5. Remove Camshaft chain.
6. Remove Jackshaft sprocket-Rear.

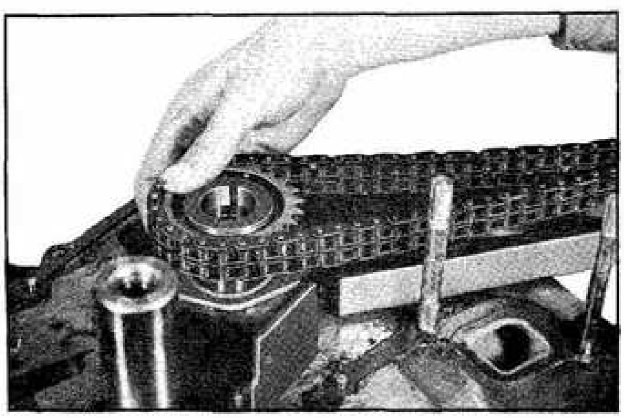


Fig. EM-82

7. Remove all Timing chain guides.

Replacement is a reversal of the above procedure.

Align the timing marks according to the following procedure.

Tighten Screw-Jackshaft Front sprocket to Jackshaft to 4.5 ~ 5.0 kg-m (32.5 ~ 36.2 ft-lb.) torque.

Aligning Timing Marks

Valve timing is determined by the relation between Crankshaft sprocket and Jackshaft sprocket and the relation between Jackshaft sprocket and Camshaft sprocket.

To obtain the correct valve timing, assemble Timing chains and Sprockets as follows.

1. Place Camshaft sprocket and Jackshaft sprocket-Rear into Camshaft chain, aligning the timing marks of Sprockets with those of Timing chain.

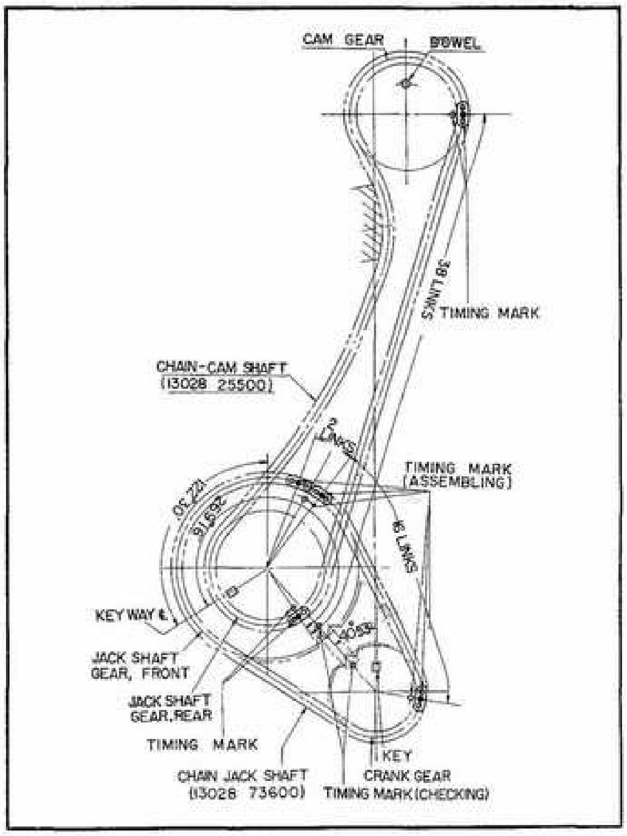


Fig. EM-83

2. Keeping Sprockets in this position engage Jackshaft Sprocket Keyway with the key on Jackshaft.

3. Support Camshaft sprocket temporarily to Chain guide with a screw.
4. Place Jackshaft sprocket-Front and Crankshaft sprocket into Jackshaft chain, aligning the timing marks of Sprockets with those of Timing chain as shown in Fig. EM-83.

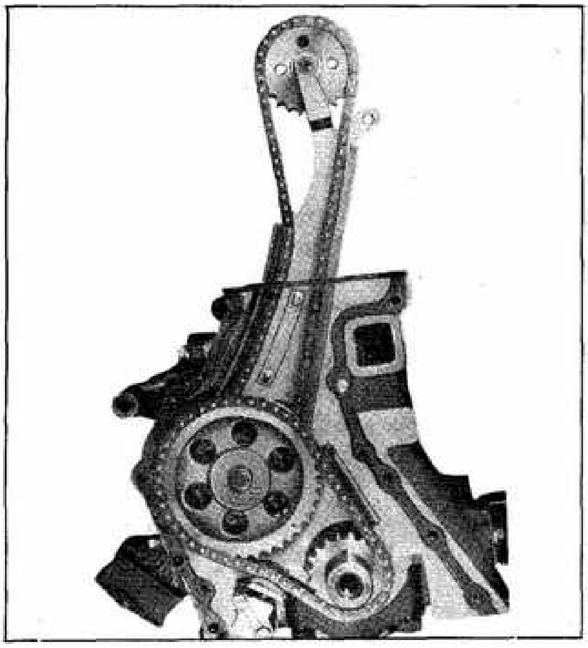
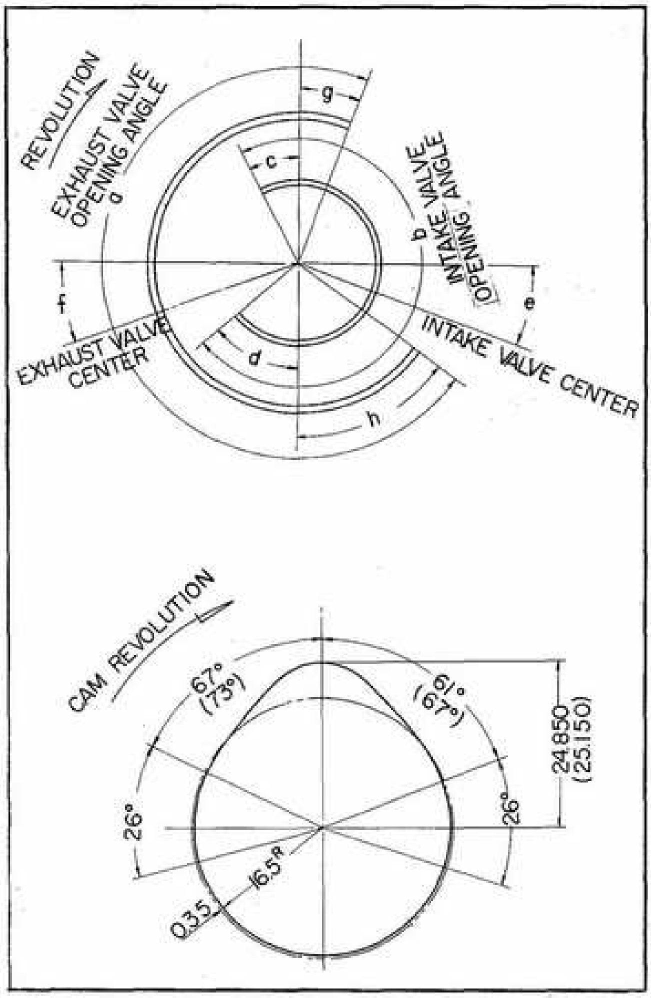


Fig. EM-84

5. Install Timing chain and Sprocket assembly engaging each keyway with the keys on Jackshaft and Crankshaft.
Push the sprockets onto the shafts as far as they will go and secure Jackshaft sprocket with the lock washer and bolt. Tighten to 4.5 ~ 5.0 kg-m (32.5 ~ 36.2 ft-lb.) torque.

Unit: degree

	FOR SU	FOR SOLEX
a	256	280
b	256	280
c	18	30
d	58	70
e	20	20
f	20	20
g	18	30
h	58	70



( ) shows for Solex Carburetor

Fig. EM-85 Valve Timing Diagram

To check the assembly, rotate Crankshaft until the key on Crankshaft is on the highest position (No.1 Piston is on its T.D.C.). In this case, the "O" marks on Jackshaft and Crankshaft sprockets must be on a line drawn through the center line of each shaft.

Timing Chain Tensioner-Remove and Replace

Upper Tensioner

1. Remove Rocker arm cover.
2. Remove Cylinder head front cover plate.

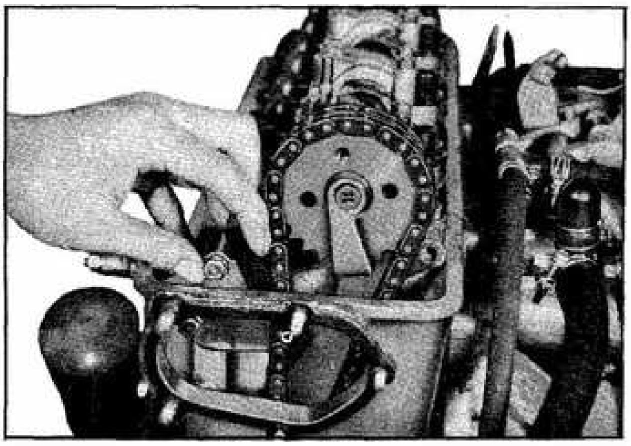


Fig. EM-86

3. Remove two screws securing Chain tensioner to Cylinder head.
4. Remove Chain tensioner and Spacer plate.

Replacement is a reversal of the above procedure. Use new gaskets.

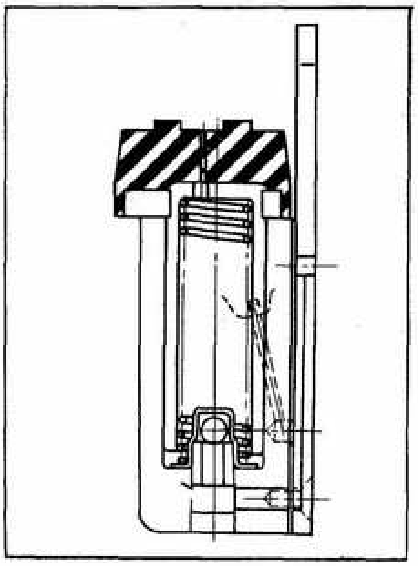


Fig. EM-87

Lower Tensioner

1. Remove Timing chain cover as previously mentioned.
2. Remove two screws securing Chain tensioner to Cylinder block
3. Remove Chain tensioner.

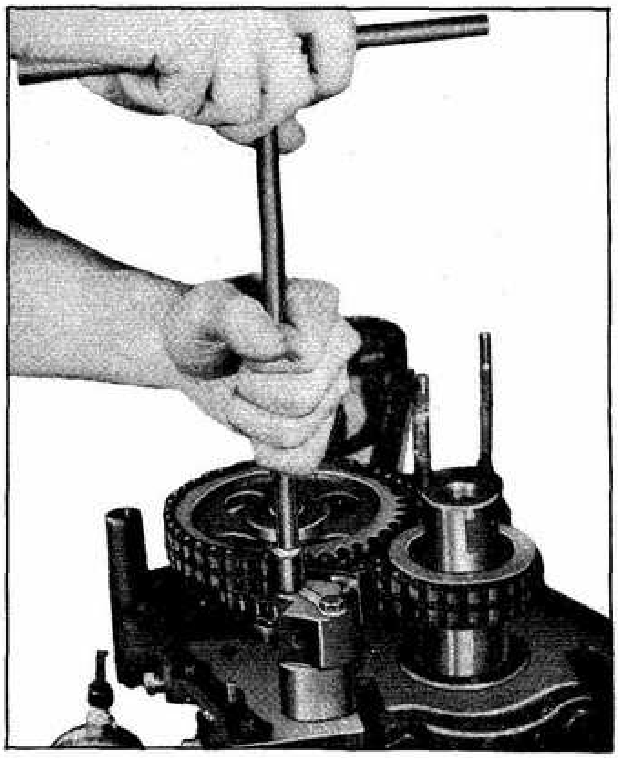


Fig. EM-88

Replacement is a reversal of the above procedure. Use new gaskets.

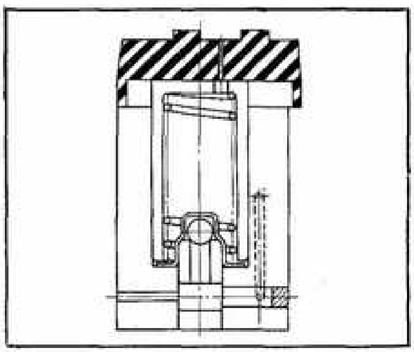


Fig. EM-89

THE REAR OF ENGINE

Flywheel-Remove and Replace

1. Remove Clutch assembly by unscrewing the six bolts and spring washers securing Clutch cover to Flywheel. Release the bolts a turn at a time to avoid the distortion of the cover flange. Three dowels locate Clutch cover on Flywheel.

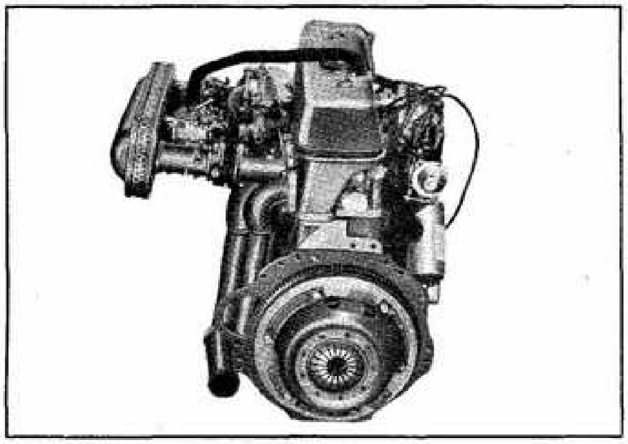


Fig. EM-90

2. Unlock and remove the twelve bolts securing Flywheel to Crankshaft and remove Flywheel.

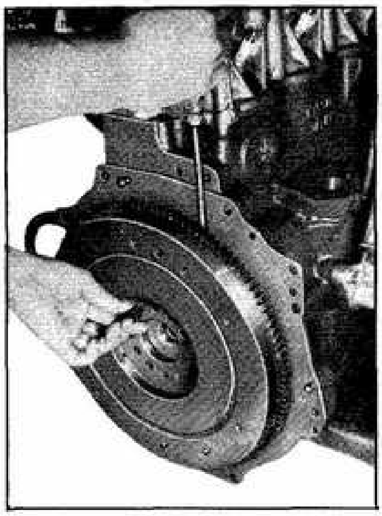


Fig. EM-91

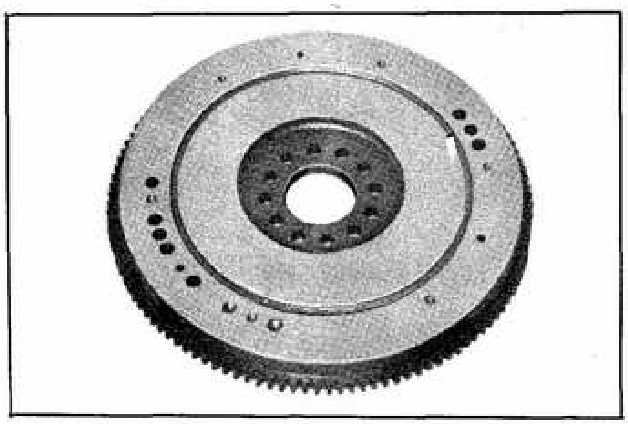


Fig. EM-92

Replacement is a reversal of the above procedure.

Tighten Flywheel bolts to 8 kg-m (57.8 ft-lb.) torque.
Tighten Clutch cover-Flywheel bolts to 2.5 ~ 3.5 kg-m (18.1 ~ 25.3 ft-lb.) torque.

Starter ring gear can be replaced by placing Flywheel in an arbor press with steel blocks equally spaced around the gear and pressing Flywheel through.

To install new Starter ring gear, firstly heat it to 200 ~ 300°C (390 ~ 570°F) to expand the inside diameter so that it can be pressed over Flywheel.

THE BOTTOM OF ENGINE

Oil Pan-Remove and Replace

1. Drain Engine Oil.
2. Unscrew Bolts and Nuts securing Oil pan to Cylinder block and Timing chain cover.

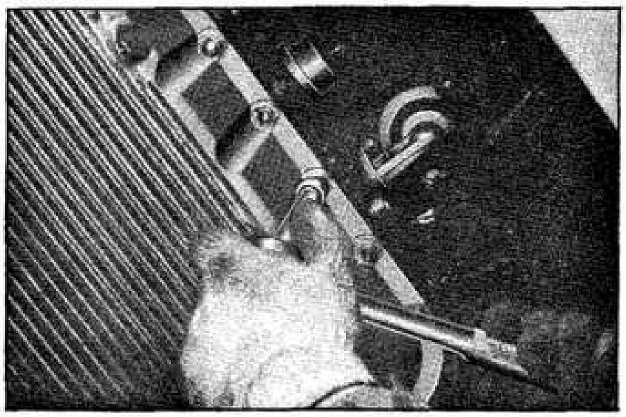


Fig. EM-93

3. Remove Oil Pan.

Fig. EM-94

When installing Oil pan, replace the old gasket to the new one.

Tighten Oil pan bolts and nuts to 0.5 kg-m (3.6 ft-lb.) torque.

Oil Pump-Remove and Replace

Oil pump is driven by the distributor drive shaft.

However, Oil pump removal or replacement will not affect Distributor timing as Distributor drive gear remains in mesh with Jackshaft gear.

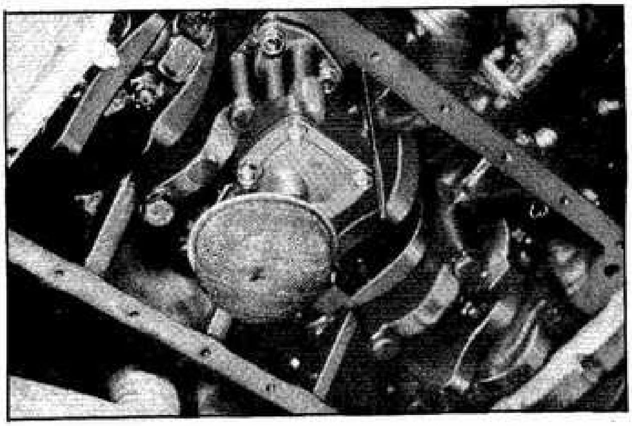


Fig. EM-95

1. Remove Oil pan as previously mentioned.
2. Unscrew the bolt and stud nut securing Oil pump to Cylinder block and remove Oil pump.

When refitting Oil pump, use a new Gasket.

Tighten Oil pump to Cylinder block bolts and nuts to 0.8 ~ 1.0 kg-m (5.8 ~ 7.2 ft-lb.) torque.

THE INSIDE OF ENGINE

Connecting Rod and ?iston Assembly-Remove and Replace

Remove

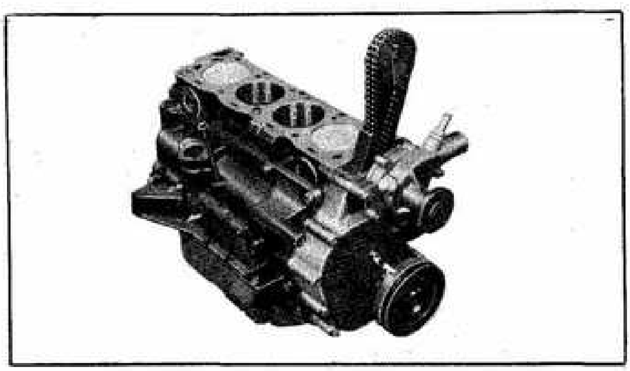


Fig. EM-96

1. Remove Cylinder head, Intake and Exhaust manifolds as previously mentioned.
2. Remove oil pan.
3. Check Connecting rod and Piston for cylinder number identification and if necessary, mark them.
4. Remove Big End Bearing caps.

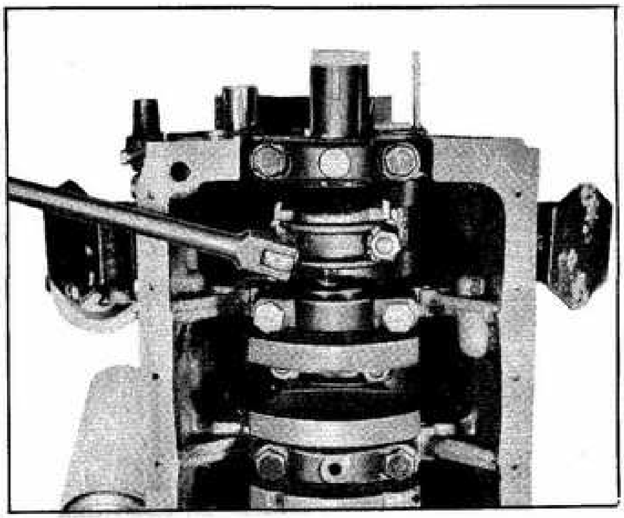


Fig. EM-97

5. Carefully remove Connecting rod and Piston assembly by pushing out and refit the bearing cap.

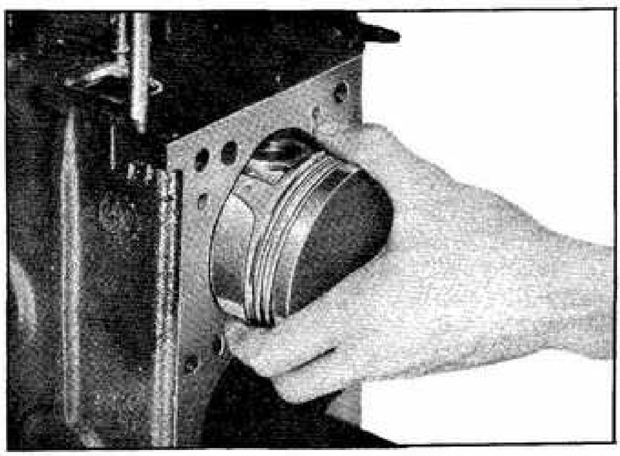


Fig. EM-98

Connecting Rod and Piston-Disassemble and Reassemble

1. Remove Piston rings using suitable piston ring remover.

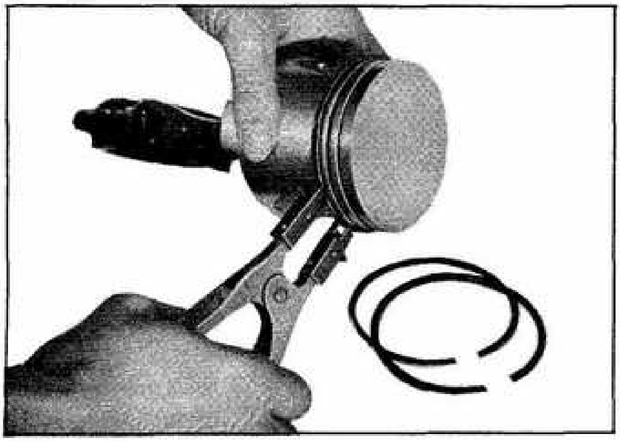


Fig. EM-99

2. Remove Piston pin snap rings.

Fig. EM-100

3. Push out Piston pin and take off Connecting rod.

Assembling is a reversal of the above procedure.

Connecting rod to piston pin fitting should be a thumb push fit.

Clean and Inspect

1. Clean carbon, varnish, and gum from piston surfaces, including underside of piston head. Clean ring grooves, and oil holes in oil ring groove, using suitable cleaning tool and solvent.

2. Clean piston pin, rod, cap, bolts and nuts in suitable solvent. Reinstall cap on connecting rod to assure against subsequent mixing of caps and connecting rods.

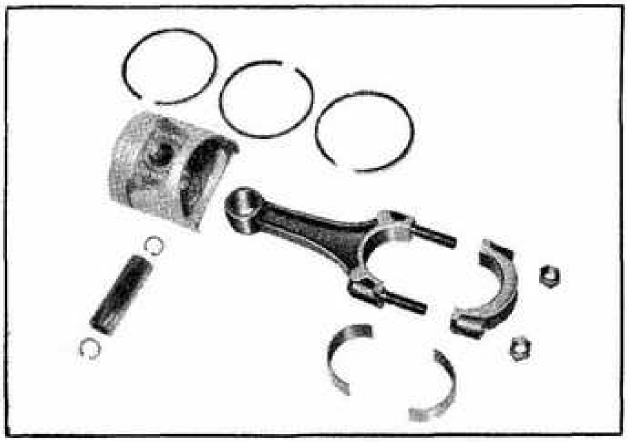


Fig. EM-101

3. Carefully examine piston for rough or scored bearing surfaces; cracks in skirt or head; cracked, broken, or worn ring lands; and scored, galled, or worn piston bosses. Damaged or faulty pistons should be replaced.

4. Inspect piston pin for scoring, roughness, or uneven wear and proper fit.

Piston Pin-Fit

The piston pin is a push fit into Connecting rod and Piston at room temperature.

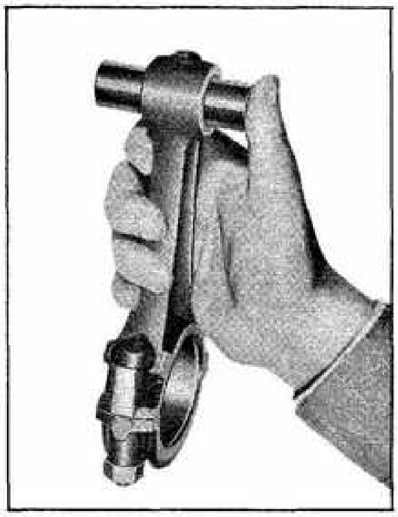


Fig. EM-102

Check the wear of the bushing at the connecting rod small end.

When fitting the pin, all parts must be free of nicks and burrs.

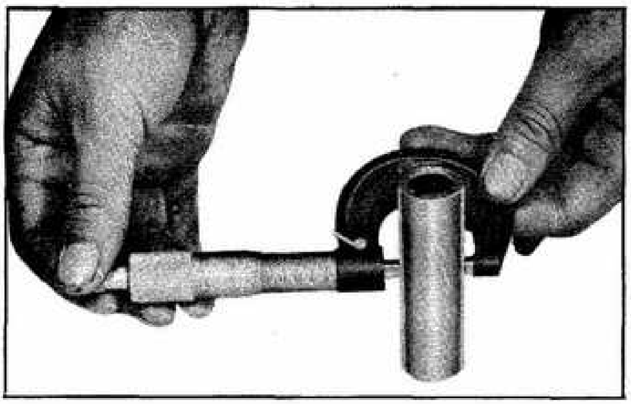


Fig. EM-103

The piston pin to piston pin hole clearance is 0.006 ~ 0.012 mm (0.0002 ~ 0.0005 in.).

The piston pin to connecting rod bushing clearance is 0.025 ~ 0.035 mm (0.0010 ~ 0.0014 in.).

Cylinder Bores-Inspect

Inspect Cylinder bores for out-of-round or excessive taper, with an accurate cylinder gauge at top, middle and bottom of bore.

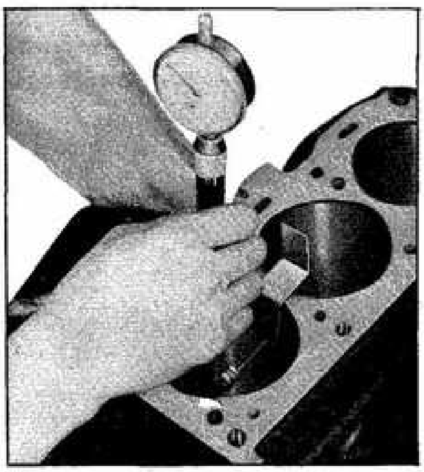


Fig. EM-104

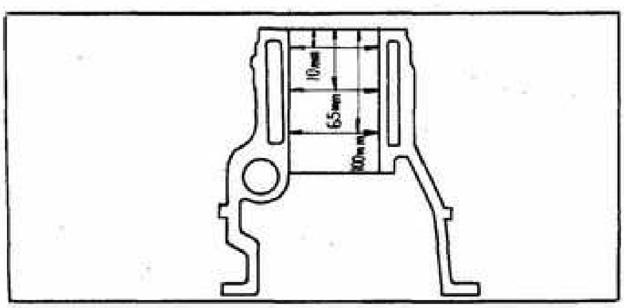


Fig. EM-105

Measure Cylinder bore parallel and at right angles to the center line of Engine to determine out-of-round.

Variation in measure from top to bottom of Cylinder indicates the taper in Cylinder.

The standard diameter of Cylinder bores is $87.200 \frac{+0.050}{0}$ mm ($3.4331 \frac{+0.0020}{0}$ in.).

Cylinder Bore Grade List (Production Use)

Standard Bore 87.200 mm DIA. (at 20°C)

Unit: 1/1000 mm

Grade Mark	1	2	3	4	5
Cylinder Grade	0~10	10~20	20~30	30~40	40~50

Cylinder Out-of-round 0.015 mm (0.0006 in.)
Cylinder Taper 0.02 mm (0.0008 in.)

Boring and Honing

If a piston in excess of 0.25 mm (0.01 in.) oversize is to be installed, cylinder should be bored, rather than honed, to effect a true bore.

When honing to eliminate the possibility of honing taper into the cylinder when installing 0.25 mm (0.01 in.) oversize, full strokes of the hone in cylinder should be made in addition to checking measurement at top, middle and bottom of bore repeatedly.

When boring, always be sure crankshaft is out of way of boring cutter when boring each cylinder.

Crankshaft bearings and other internal parts must be covered or taped to protect them during boring or honing operation. When taking final cut with a boring bar, leave 0.025 mm (0.001 in.) on the diameter for finish honing to give required piston to cylinder clearance specifications.

By measuring the piston to be installed at sizing points and adding the mean of clearance specification, the finish hone cylinder measurement can be determined. It is important that both block and piston be measured at normal room temperature, 20°C (68°F).

After final honing and before piston is checked for fit; each cylinder bore must be thoroughly cleaned.

Use soapy water solution and wipe dry to remove all traces of abrasive. If all traces of abrasive are not removed, rapid wear of new rings and piston will be result.

Piston-Fit and Replace

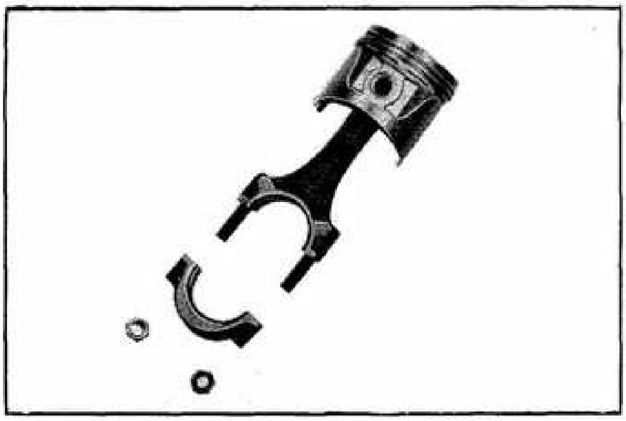


Fig. EM-106

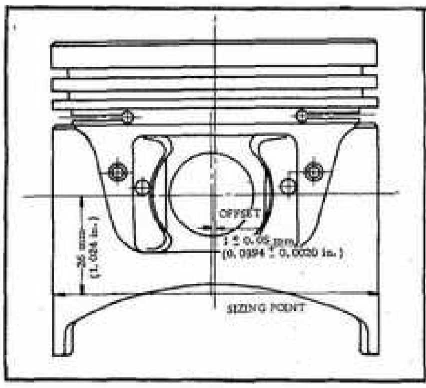


Fig. EM-107

Fig. EM-108

Pistons should be fitted in bores by actually measuring fit. Clearance between Piston and Cylinder bore should be 0.030 mm to 0.050 mm (0.0012 ~ 0.0020 in.)

This clearance can be checked easily by using a feeler gauge 0.04 mm (0.0016 in.) and a spring scale as shown in Fig. EM-108.

Extracting Force .... 0.5 ~ 1.5 kg (1.10 ~ 3.31 lb.)

If Cylinder bores have been reconditioned or if Pistons are being replaced, reconditioning of Bores and fitting of Pistons should be closely coordinated.

If Bore has been honed, it should be washed thoroughly with hot, soapy water and stiff bristle brush.

Using a cylinder checking gauge, measure Cylinder bore crosswise of block to find smallest diameter. Record smallest diameter of each bore.

Measure Piston skirt perpendicular to Piston pin hole and at sizing point indicated in Fig. EM-107.

Make sure the micrometer is in full contact.

As Pistons are measured they should be marked for size identification and measurements recorded.

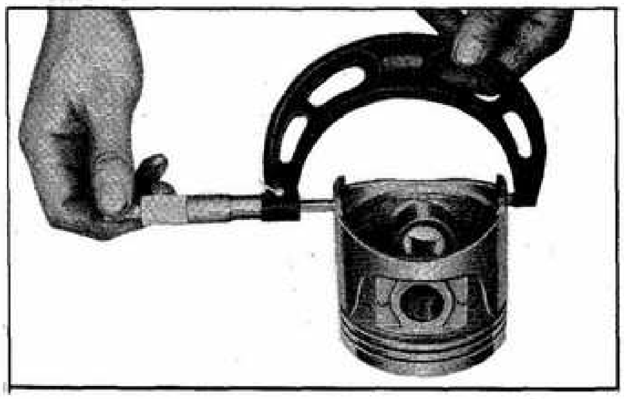


Fig. EM-109

If there is excessive clearance between Cylinder bore and Piston which was installed in that bore, a new Piston should be used.

After all measurements have been made, match new Pistons with Cylinders where they will fit with proper clearance. Honing Cylinder bore may be necessary to effect a proper fit. When properly mated, mark Pistons with Cylinder numbers they fit so they will not become mixed.

Piston Grade List (Production Use)

Unit: 1/1000 mm

Grade Mark	①	②	③	④	⑤
Piston Grade	0 ~ 10	10 ~ 20	20 ~ 30	30 ~ 40	40 ~ 50

ref. Standard Piston Dia. for production use

$87.160 \frac{+0.050}{0}$ mm ($3.4315 \frac{+0.0020}{0}$ in.)

Proper diameter of Piston is determined by adding above values to the standard diameter of Piston.

Piston For Service — Unit: mm

Piston size	Outside Diameter (H)
STD	87.180 ~ 87.230
25 Oversize	87.410 ~ 87.460
50 Oversize	87.660 ~ 87.710
75 Oversize	87.910 ~ 87.960
100 Oversize	88.160 ~ 88.210
150 Oversize	88.660 ~ 88.710

Connecting Rod Alignment

Whenever new rings are installed or new pistons and piston pins are replaced, it is necessary to align the connecting rods and pistons as assemblies to insure true operation in the cylinder bore.

Misaligned rods will cause uneven piston and ring wear which will result in oil consumption. The connecting rod should be inspected for a twisted or bent condition.

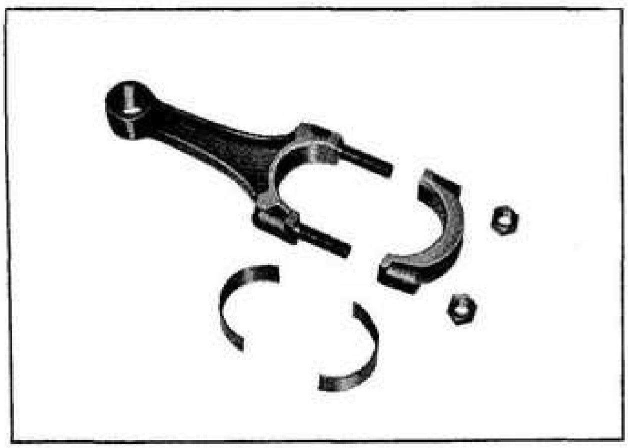


Fig. EM-110

Connecting Rod Bend should be smaller than 0.04 mm (0.0016 in.) per 100 mm (3.94 in.) length.

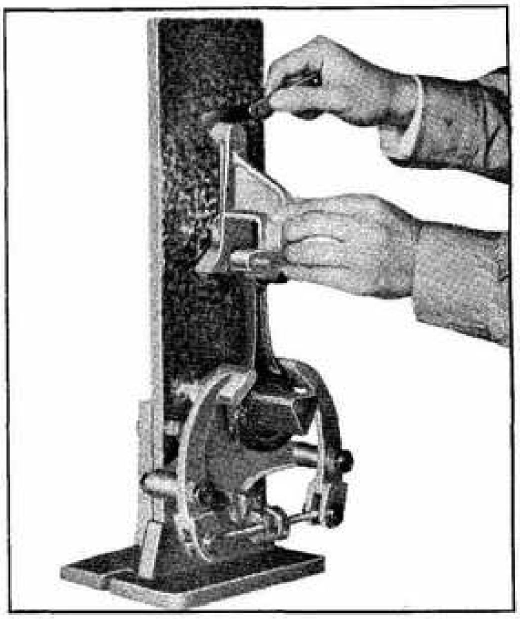


Fig. EM-111

Piston Rings-Remove and Replace

If no special piston ring expander is available, use a piece of thin steel such a smoothly ground hacksaw blade or a disused feeler gauge.

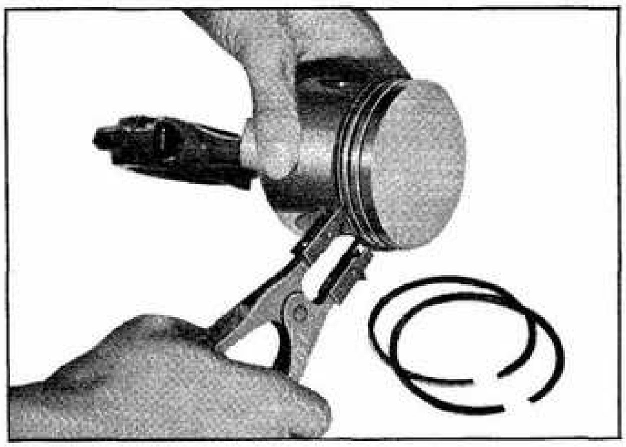


Fig. EM-112

1. Raise one end of the ring out of its groove. Insert the steel strip around Piston, applying slight upward pressure to the raised portion of the ring until it rests on the land above the ring grooves. It can then be eased off Piston.
2. Do not remove or replace the rings over

Piston skirt, but always over the top of Piston.

3. Before fitting new rings, clean the grooves in Piston to remove any carbon deposit. Care must be taken not to remove any metal, or sideplay between the ring and groove will result, with consequent excessive oil consumption and loss of gastightness.
4. Cylinder bore glazing should be removed before fitting new rings to a worn bore.
5. When refitting the rings, note that the taper of the compression rings is different between the top and second rings and each ring marked with the letter for correct assembly.

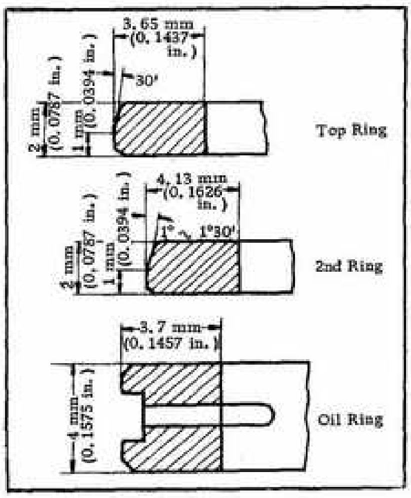


Fig. EM-113

Piston Ring Oversize

Top Ring, Second Ring and Oil Ring

Ring Size Mark	STD	25	50	75	100	150
Outside Diameter	87.200 mm (3.4331 in.)	87.450 mm (3.4429 in.)	87.700 mm (3.4527 in.)	87.950 mm (3.4626 in.)	88.200 mm (3.4724 in.)	88.700 mm (3.4921 in.)

Ring Side Clearance and Ring Gap Checks

New rings must be tested in Cylinder bore to ensure that the ends do not butt together. Ring gap and side clearance should be checked while installing rings as follows:

1. Check pistons to see ring grooves and oil return holes have been properly cleaned.
2. Place ring down at bottom of ring traveled part of cylinder bore in which it will be used. Square ring in bore by pushing it into position with head of piston.
3. Measure gap between ends of ring with feeler gauge. Gaps should be as follows.

Top Compression Ring .... 0.25 ~ 0.40 mm (0.0098 ~ 0.016 in.)
Second Compression Ring ...... 0.15 ~ 0.30 mm (0.0060 ~ 0.0118 in.)
Oil Ring .... 0.14 ~ 0.29 mm (0.0055 ~ 0.0114 in.)

Incorrect ring gap indicates that wrong size rings are being used. If rings are selected according to the size of the bore, they should have proper gap. It should not be necessary to alter ring gap by filing.

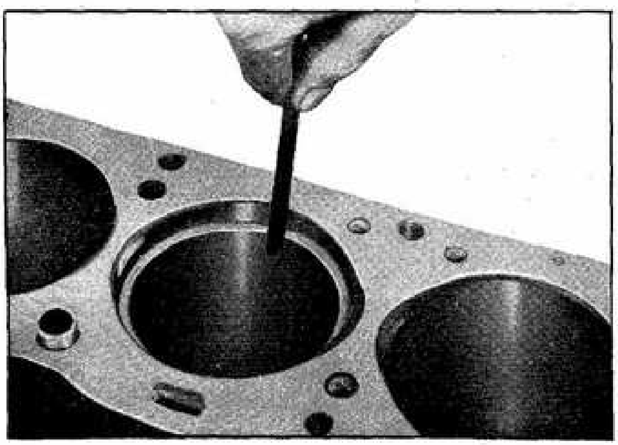


Fig. EM-114 Ring Gap

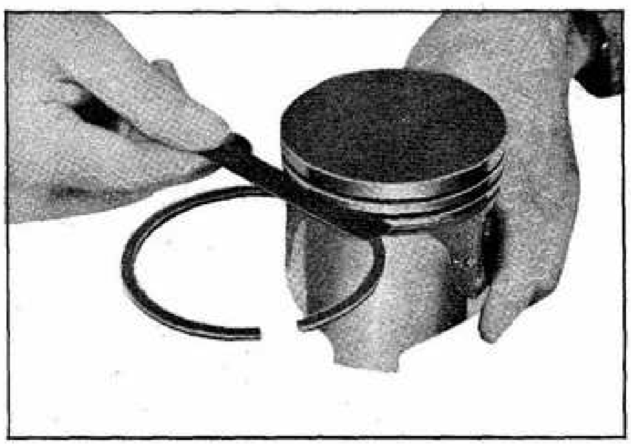


Fig. EM-115 Ring Side Clearance

4. Install rings on piston using suitable ring installing tool to prevent breakage or fracture of rings, or damage to pistons.

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

Top Compression Ring	0.040 ~ 0.073 mm (0.0016 ~ 0.0029 in.)
Second Compression Ring	0.030 ~ 0.063 mm (0.0012 ~ 0.0025 in.)
Oil Ring	0.025 ~ 0.063 mm (0.0010 ~ 0.0025 in.)

Connecting Rod and Piston Assembly-Replace

1. Using suitable piston ring compressor, insert Connecting Rod and Piston assembly into Cylinder so marking in top of Piston is facing front of Engine.

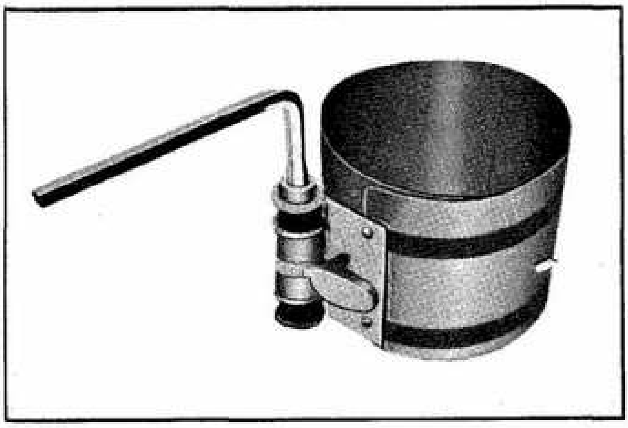


Fig. EM-116

2. From beneath Engine, pull Connecting rod with bearing into place against Crankpin.

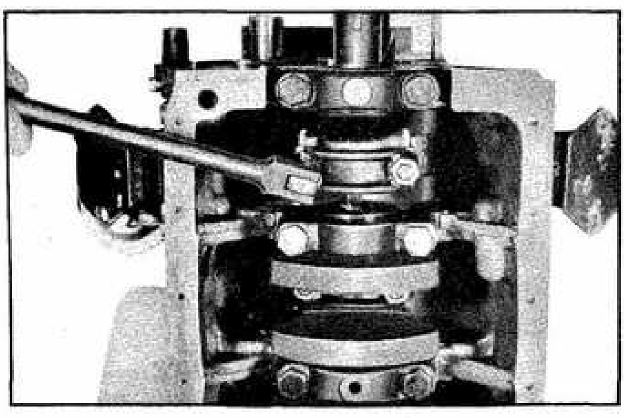


Fig. EM-117

3. Install Bearing Cap. Tighten cap nuts to 9 kg-m (65.1 ft-lb.).
4. Check Crankshaft rotation.
5. Install remaining Connecting rod and Piston assembly.
6. Check End play of Connecting rod big end.

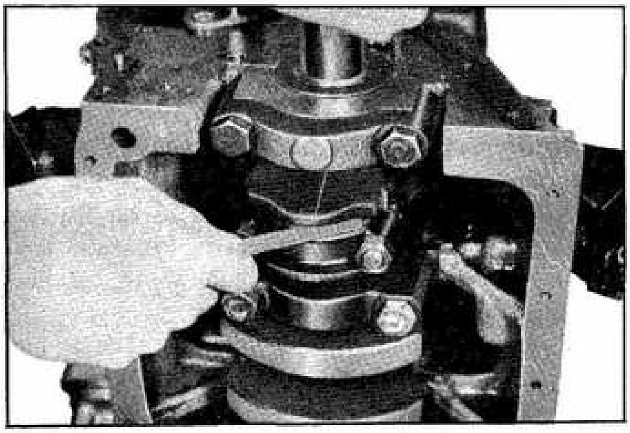


Fig. EM-118

7. Reversal procedure 1-2 of connecting rod and Piston assembly removal to complete installation procedure.

   End play of Connecting rod big end should be 0.2 ~ 0.3 mm (0.008 ~ 0.011 in.).

Connecting Rod Bearing-Remove and Replace

1. Remove oil pan.
2. Rotate Crankshaft as necessary to bring crankpin carrying bearing to be replaced straight toward bottom of block.
3. Remove Bearing cap.

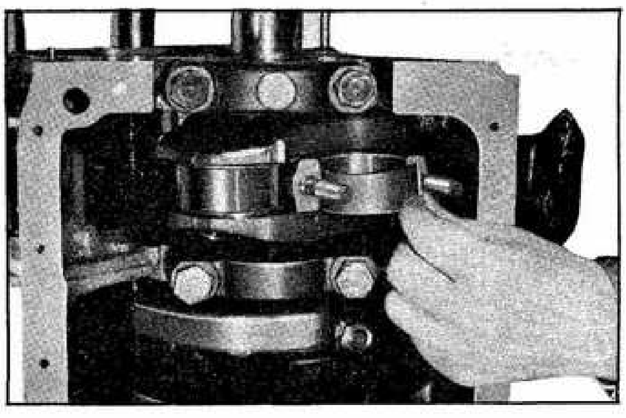


Fig. EM-119

4. Push Piston and rod assembly up far enough to remove upper bearing.
5. Remove Bearings from cap and rod.
6. Inspect Crankpin for damage, out-of-round and taper.

Replacement is a reversal of the above procedure. Check clearance with Plastigage as outlined below.

Connecting Rod Bearing Clearance

To determine the amount of bearing clearance, use a piece of Plastigage in the bearing cap. Then tighten the cap to torque specifications to compress the gauge. Remove the bearing cap and calibrate the width, of the plastigage with the scale furnished.

If the bearing clearance is excessive, a new standard or undersize bearing insert should be installed.

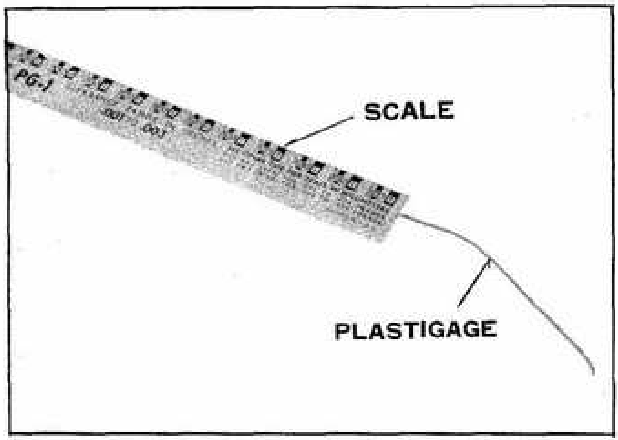


Fig. EM-120

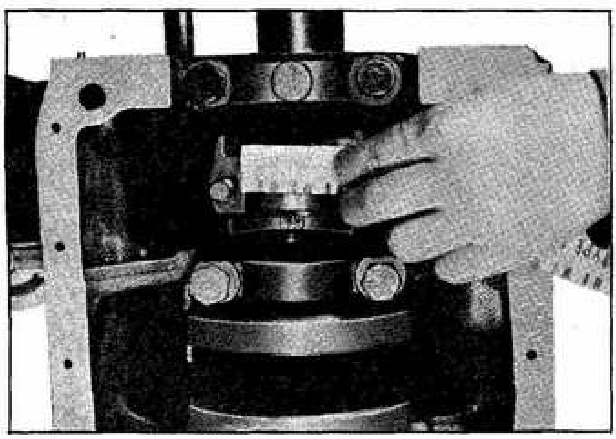


Fig. EM-121

The correct connecting rod bearing clearance is 0.034 ~ 0.086 mm (0.0013 ~ 0.0034 in.) at normal room temperature.

It is important that the connecting rod bearing cap bolt nuts be tightened to 9 kg-m (65.1 ft-lb.).

Jackshaft-Remove and Replace

1. Remove Cylinder Head and Oil pan.
2. Remove Timing chain cover, Timing chains and Sprockets.
3. Withdraw Distributor and Drive Gear.
4. Remove Fuel pump.
5. Take out the two set screws and shockproof washers which secure Jackshaft locating plate to Cylinder block and withdraw Jackshaft.

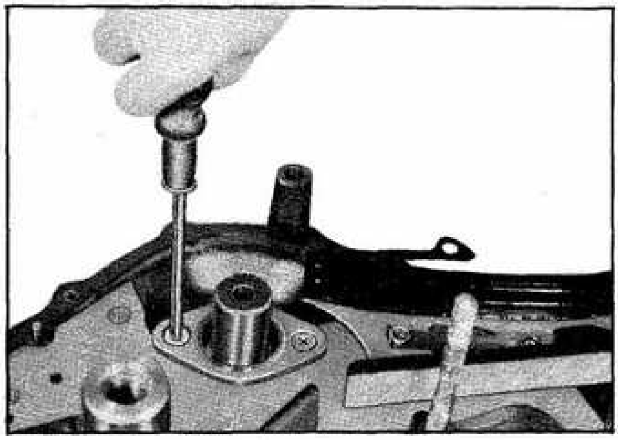


Fig. EM-122

Replacement of Jackshaft is a reversal of the above procedure.

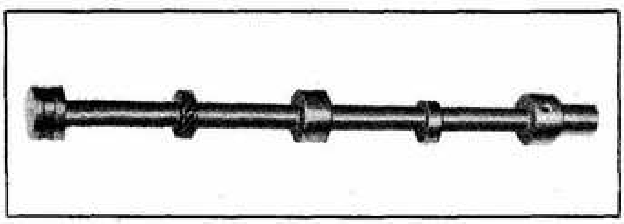


Fig. EM-123

Inspect the bend of Jackshaft and the bearing clearances.

Jackshaft Bend should be smaller than 0.02 mm (0.0008 in.), measuring as shown in Fig. EM-124.
Bend Limit is 0.05 mm (0.0020 in.).

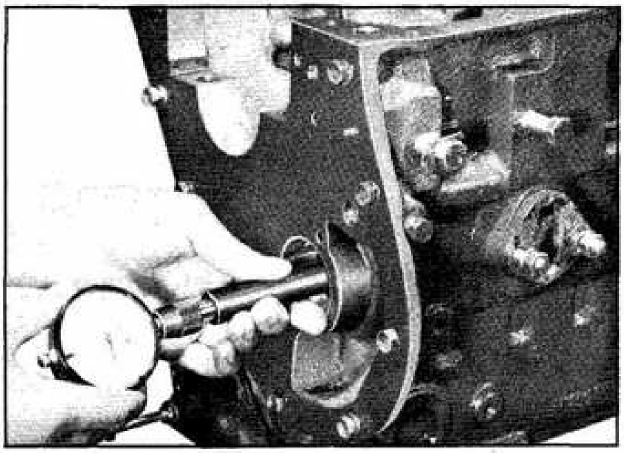


Fig. EM-124

Bearing Clearance
Front and Rear .... 0.025 ~0.087 mm
(0.00098 ~ 0.00342 in.)
Center .... 0.038 ~0.100 mm
(0.00150 ~ 0.00394 in.)

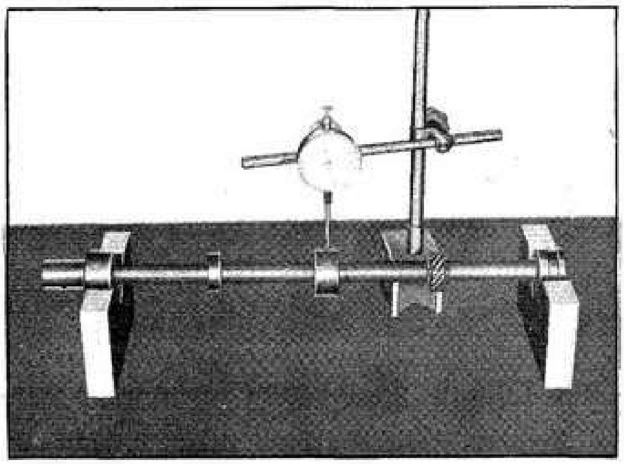


Fig. EM-125

Distributor Drive Gear-Refit

1. Turn Engine until No.1 Piston is at T.D.C. on its compression stroke. When the valves on No.4 Cylinder are "rocking" (i.e. exhaust just closing and inlet just opening), No.1 Piston is at the top of its compression stroke. If Engine is set so that the long notch in Crankshaft pulley is in line with the pointer on Timing chain cover, No. 1 Piston is exactly at T.D.C.

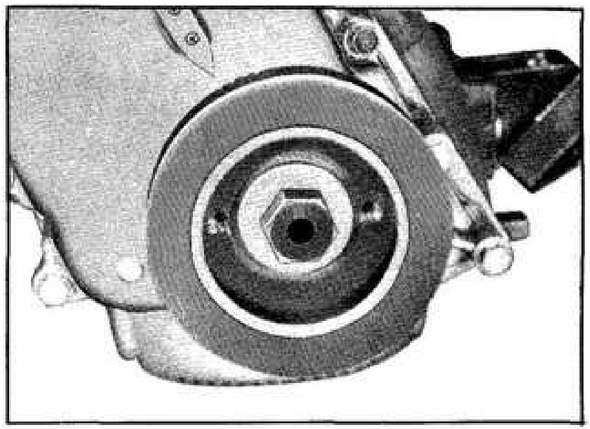


Fig. EM-126

2. Insert Drive gear shaft of Distributor at an angle to Engine, engaging the gear of Drive gear shaft with the gear on Jackshaft.

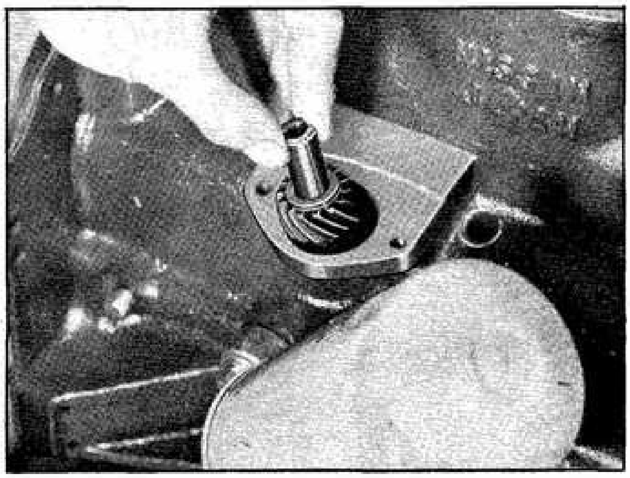


Fig. EM-127

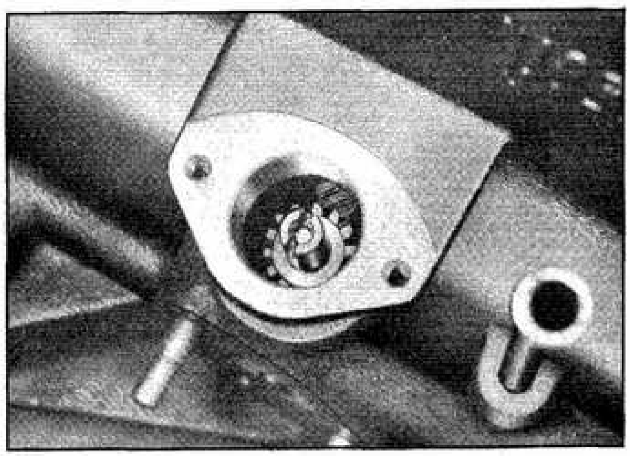


Fig. EM-128

During this assembly place the drive gear with the slot on its head just forward the vertical and finish by turning Drive gear shaft clockwise until its in 11 : 25 o'clock position.
At this time, the smaller of the semi-circles must be placed toward the front.

Crankshaft-Remove, Inspect and Replace

Remove

1. Remove Engine from vehicle.
2. Remove Transmission and Clutch from engine.
3. Mount Engine on a suitable stand.
4. Remove Fan, Fan pulley and Water pump.
5. Remove Cylinder head ass'y.
6. Remove Vibration damper.
7. Remove Oil pan, Oil pump and Timing chain cover.
8. Remove Chain tensioner and Crank Timing chain and Sprockets.

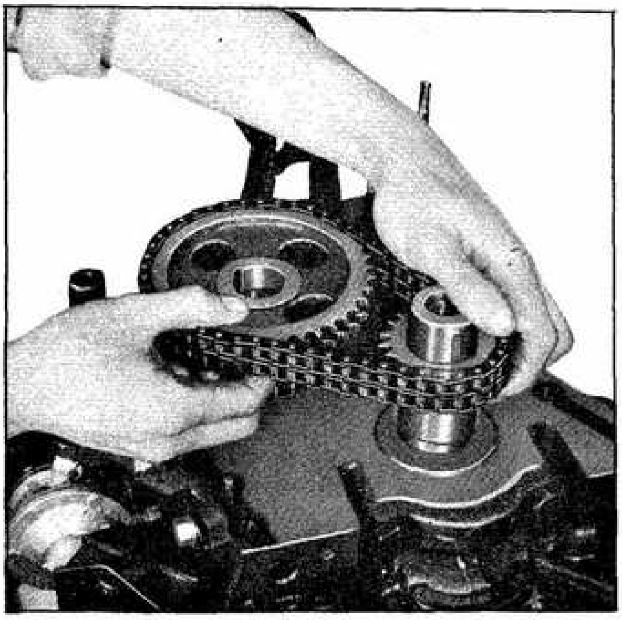


Fig. EM-129

9. Remove Flywheel.

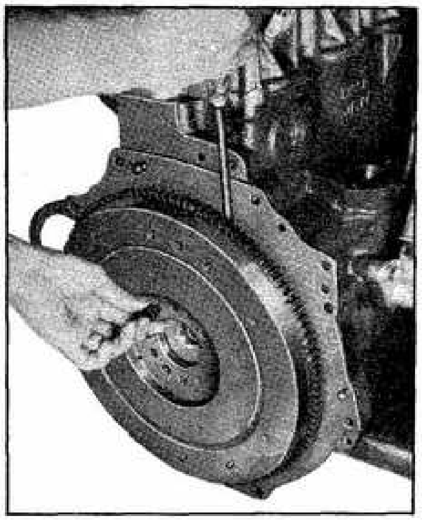


Fig. EM-130

10. Remove Connecting rod bearing caps with bearings and identify each for re-installation.
11. Remove Connecting rod and Piston assemblies.

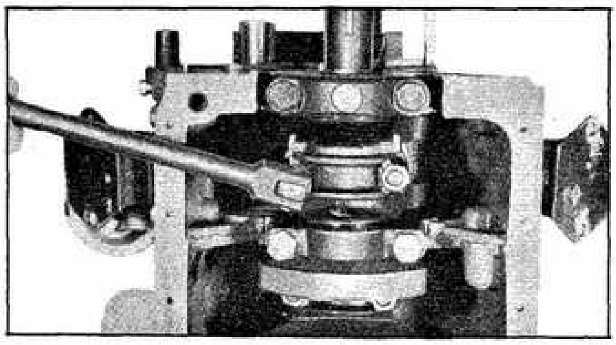


Fig. EM-131

12. Remove Main bearing caps with bearings and identify for reinstallation.

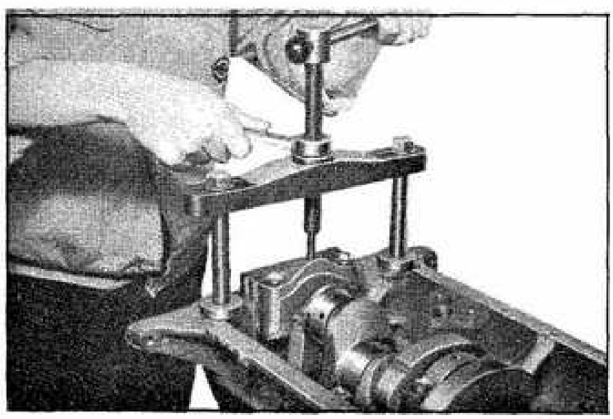


Fig. EM-132

13. Remove crankshaft.

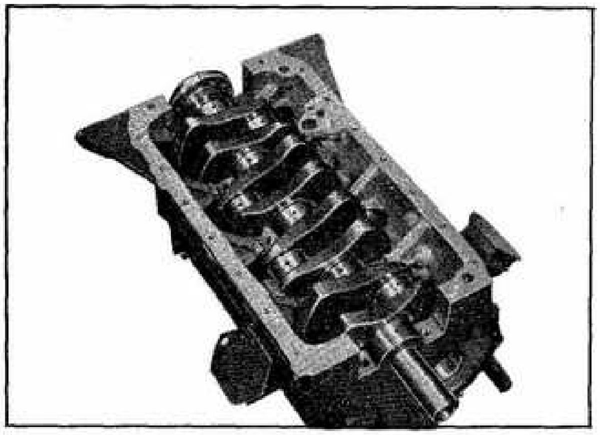


Fig. EM-133

Inspect

Inspect Crankshaft for wear and crack.

Check the bend of Crankshaft and the out-of round or excessive taper of Crankshaft main journal and Crankpin.

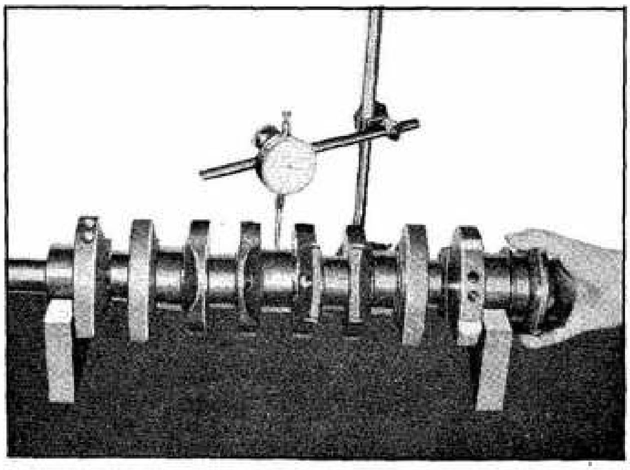


Fig. EM-134

Journal out-of-round ... less than 0.005 mm (0.0002 in.)

Crank Pin out-of-round ..... less than 0.005 mm (0.0002 in.)

Crankshaft Bend

Measure No. 2, 3, 4 Journal with No. 1 & 5 Journal supported	... less than 0.03 mm (0.0012 in.)

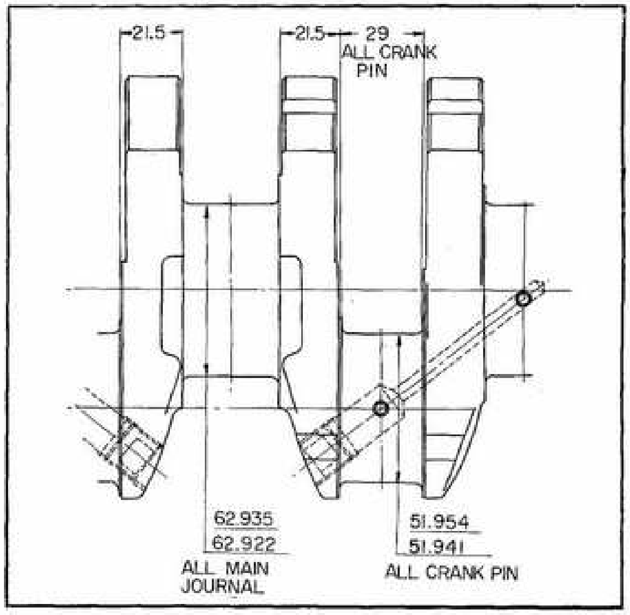


Fig. EM-135

Replace

1. With upper bearings installed, position Crankshaft in block.
2. Using new seals in rear main bearing cap install main bearing caps, but do not tighten cap bolts.

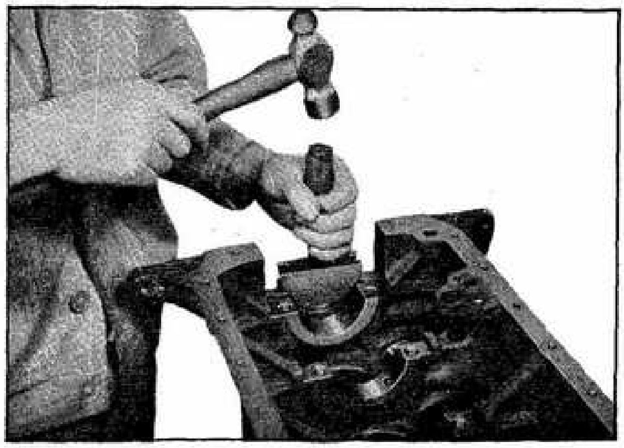


Fig. EM-136

3. Install Connecting rods (with upper bearings installed) and pistons into place.
4. Install Rod bearing caps (with bearings), but do not tighten nuts.
5. With a rubber mallet hit both ends of Crankshaft to center thrust bearing.

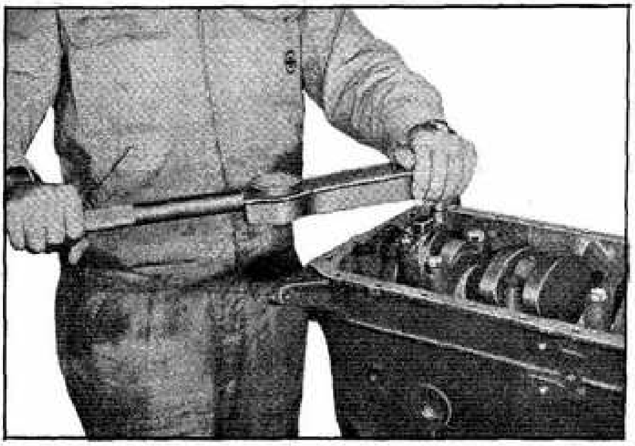


Fig. EM-137

6. Tighten Main bearing caps to 9 kg-m (65.1 ft-lb.) torque.
7. Check Crankshaft Free End Play.

   Crankshaft Free End Play should be 0.05 ~ 0.18 mm (0.002 ~ 0.007 in.) and the wear limit of End play is 0.3 mm (0.012 in.).

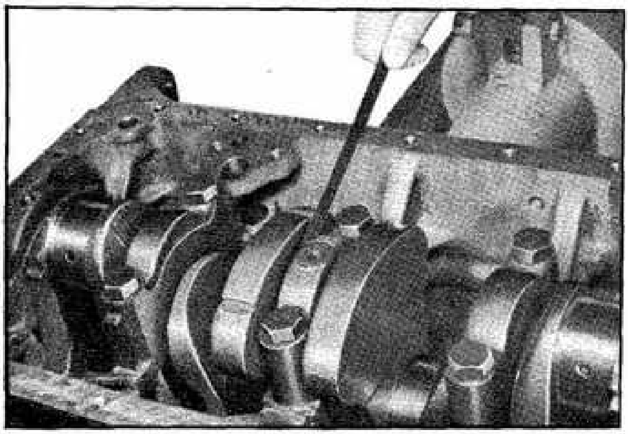


Fig. EM-138

8. Tighten Connecting rod bearing caps to 9 kg-m (65.1 ft-lb.) torque.
9. Install key from old crankshaft keyway in new crankshaft.
10. Install Timing chain and Sprockets.
11. Install Lower chain tensioner.
12. Install Timing chain cover.
13. Install Oil pump, Oil pan and Gasket.
14. Install Cylinder head ass'y.
15. Install Vibration damper and Water pump.
16. Install Fan pulley and Fan.
17. Attach Clutch and Transmission to Engine.
18. Install Complete assembly in Vehicle.

Main Bearings-Remove and Replace

The main bearings are of precision insert type and do not utilize shims for adjustment. If the clearances are found to be excessive, a new standard or undersize bearing insert, both upper and lower halves, will be required.
Main Bearings can be removed and replaced without removing Crankshaft as following.

Remove

1. Remove Oil pan.
2. Remove the bearing cap of the bearing to be replaced.
3. Loosen all of the other bearing caps.
4. Insert a small pin in the crankshaft oil hole. The head of this pin should be large enough so that it will not fall into the oil hole, yet thinner than the thickness of the bearing.

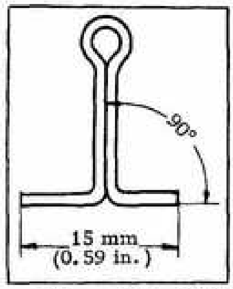


Fig. EM-139

5. With the pin in place, rotate the shaft so that the upper half of the bearing will rotate in the direction of the Crankshaft rotation. This will roll upper bearing shell out of Engine.

Replace

1. Oil new upper bearing shell and insert plain end of shell between crankshaft and indented or notched side. Rotate the bearing into place.
2. Install new bearing shell in bearing cap.
3. Tight all main bearing caps to 9.0 kg-m (65.1 ft-lb.) torque except the one replaced.
4. Check bearing clearance using Plastigage method as outlined below.
5. Install Oil pan using new gaskets and seals.

Main Bearing Clearance

The standard clearance can be accurately checked by the use of Plastigage.

Remove the bearing cap and wipe the oil from the bearing insert.

Place a piece of Plastigage across the full width of the bearing insert.

Install the bearing cap and tighten to 9.0 kg-m (65.1 ft-lb.) torque. Then remove the bearing cap and with the graduated scale, which is printed on the plastigage envelope, measure the width of the flattened plastigage at its widest point.

The correct main bearing clearance is 0.020 ~ 0.072 mm (0.0008 ~ 0.0028 in.).

The main bearing journal diameter is 62.942 ~ 62.955 mm (2.4780 ~ 2.4785 in.).

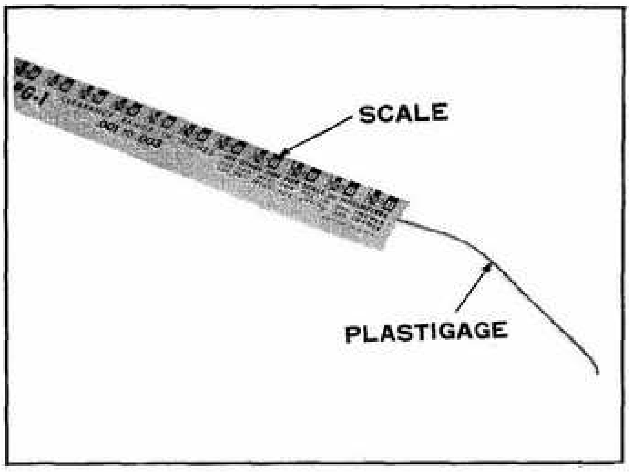


Fig. EM-140

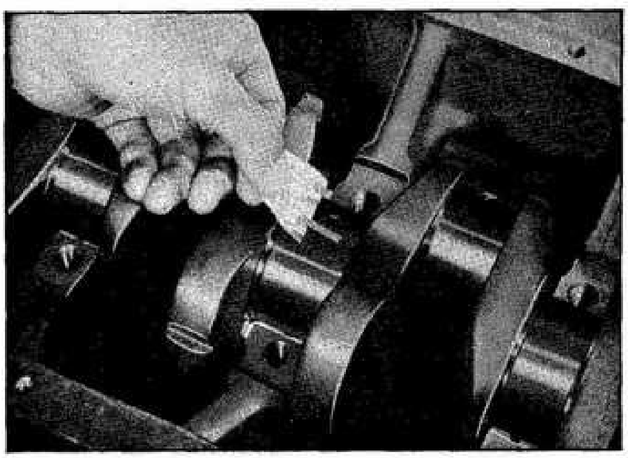


Fig. EM-141

Rear Main Bearing Oil Seal-Remove and Replace

Although the usual practice is to remove the crankshaft when the upper half of the seal is to be replaced, it is possible to do the job without removing the crankshaft.

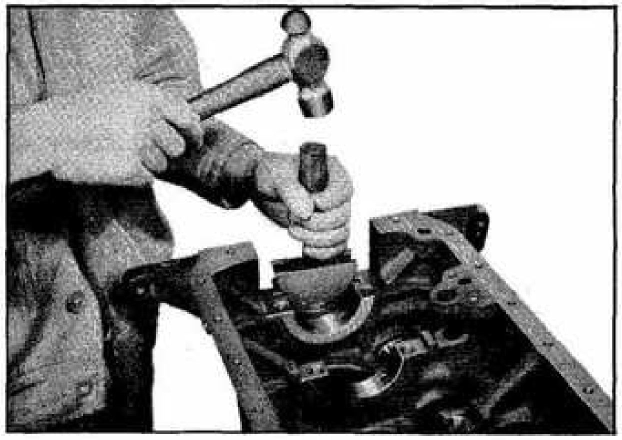


Fig. EM-142

1. Remove oil pan.
2. Remove Rear bearing cap using tool ST446 30000.

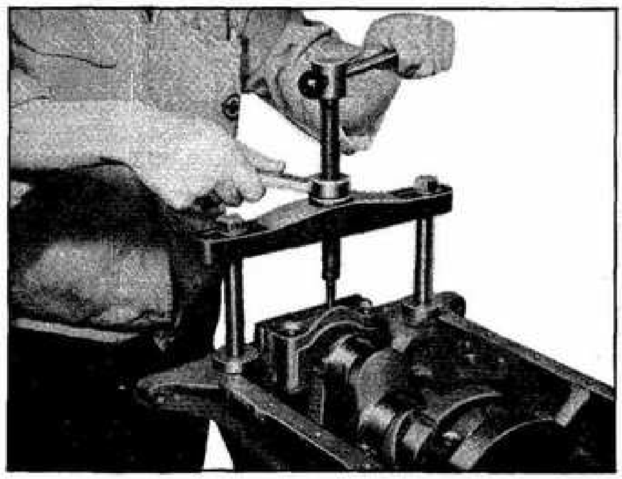


Fig. EM-143

3. Remove oil seal from groove of bearing cap and side oil seals, using a small screw-driver.
4. Place new seals in position so that both ends protrude above the cap. Tap the seal down into position with a smooth rounded tool. Then cut off the protruding ends of the seal.

5. To replace the upper half of seal, use needle-nose pliers to grasp the end of the seal which is most accessible. Pull the seal upward while rotating the crankshaft slowly in the direction that the seal is being removed.
6. To install the new seal, fasten a length of wire or strong string such as fishing line securely to one end of the new seal. Coat the seal with engine oil.
7. Pass the free end of the wire or string up over the crankshaft.
8. Then exert a firm, steady pull on the wire or string and at the same time rotate the crankshaft slowly in the direction of the pull.
9. When the installation is completed, trim the ends of the seal flush with the engine block.
10. Install Bearing cap and tighten it 9.0 kg-m (65.1 ft-lb.) torque.
11. Install Oil pan.

SERVICE DATA

GENERAL SPECIFICATION

Model	U20
Cylinder Arrangement	4 in line
Displacement	1982 c.c. (120.9 cu.in.)
Bore and Stroke	87.2 × 83 mm (3.4331 × 3.2677 in.)
Valve Arrangement	(S) OHC
Max. Brake Horsepower (HP/r.p.m)	Solex 150/6000 (SAE) SU 135/6000 (SAE)
Max. Gross Torque {kg-m (ft-lb.)/r.p.m.)}	Solex 19.1 (138)/4800 (SAE) SU 18.2 (132)/4400 (SAE)
Firing Order	1-3-4-2
Engine Idle R.P.M.	700 R.P.M.
Compression Ratio	9.5
Engine Idle Manifold - Inches of Mercury at Specified Engine Idle R.P.M. (Sea Level)	Solex 230 ~ 260/700 SU 460 ~ 480/700
Oil Pressure (Hot at 2,000 r.p.m)	2.0 kg/cm^2 (28.38 lb/in^2) at all temperature

TIGHTING TORQUE

Cylinder Head Bolts	1st- 6.0, 2nd- 8.7, final- 9.0 kg-m	(1st-43.4, 2nd-62.9, final-65.1 ft-lb.)
Connecting Rod Big End Nuts	9.0 kg-m	(65.1 ft-lb.)
Flywheel Fix Bolts	8.0 kg-m	(57.8 ft-lb.)
Main Bearing Cap Bolts	9.0 kg-m	(65.1 ft-lb.)
Camshaft Bearing Cap Nuts	M-8 1.8 kg-m	(13.0 ft-lb.)
	M-6 0.7 kg-m	(5.1 ft-lb.)
Camshaft Gear Nuts	1.8 kg-m	(13.0 ft-lb.)
Oil Filter Nuts	2.1 ~ 2.7 kg-m	(15.2 ~ 19.5 ft-lb.)
Oil Pan	0.5 kg-m	(3.6 ft-lb.)
Oil Pump	0.8 ~ 1.0 kg-m	(5.8 ~ 7.2 ft-lb.)
Crank Pulley Bolt	20 kg-m	(144.6 ft-lb.)
Jackshaft Sprocket Screw	4.5 ~ 5.0 kg-m	(32.5 ~ 36.2 ft-lb.)
Rocker Cover	0.6 ~ 0.7 kg-m	(4.3 ~ 5.1 ft-lb.)

SPECIFICATIONS

a) VALVE MECHANISM

Valve Clearance (Hot)	In. 0.2 mm	(0.0079 in.)
	Ex. 0.3 mm	(0.0118 in.)
Wear Limit of Dittoed Clearance	0.35 mm	(0.0138 in.)
Valve Head Dia. - Intake	$46^{+0.2}_{0}$ mm	($1.81^{+0.0079}_{0}$ in.)
- Exhaust	$36^{+0.2}_{0}$ mm	($1.42^{+0.0079}_{0}$ in.)
Valve Stem Dia. - Intake	$8.7^{-0.043}_{-0.030}$ mm	($0.343^{-0.0017}_{-0.0012}$ in.)
Valve Stem Dia. - Exhaust	$8.7^{-0.073}_{-0.060}$ mm	($0.343^{-0.0029}_{-0.0024}$ in.)
Valve Length - Intake	120.8 mm	(4.76 in.)
- Exhaust	120.8 mm	(4.76 in.)
Valve Lift	Solex 11.6 mm	(0.46 in.)
	SU 11.2 mm	(0.44 in.)
Valve Spring Free Length - Outer	49.7 mm	(1.96 in.)
- Inner	48.4 mm	(1.91 in.)
Valve Spring Loaded Length - Outer	29.6 mm/$76.4^{+2.0}_{-4.0}$ kg	(1.17 in./$168.1^{+4.41}_{-8.82}$ lb.)
- Inner	27.6 mm/29.9 ±1.8 kg	(1.09 in./65.8 ± 3.96 lb.)
Valve Spring Assembled Height - Outer	41.2 mm/32.3 kg	(1.62 in./71.1 lb.)
- Inner	39.2 mm/13.3 kg	(1.54 in./29.3 lb.)
Valve Spring Effective Turns - Outer		4.25
- Inner		5.5
Valve Spring Wire Dia. - Outer	4.6 mm	(0.18 in.)
- Inner	2.95 mm	(0.116 in.)
Valve Spring Coil Dia. - Intake	35.0 mm	(1.38 in.)
- Exhaust	24.2 mm	(0.95 in.)
Valve Guide Length - Intake	55.0 mm	(2.17 in.)
- Exhaust	55.0 mm	(2.17 in.)
Valve Guide Height From Head Surface	13.0 ± 0.1 mm	(0.512 ± 0.004 in.)
Valve Guide Inner Dia. - Intake	8.685 ~ 8.700 mm	(0.3419 ~ 0.3425 in.)
- Exhaust	8.685 ~ 8.700 mm	(0.3419 ~ 0.3425 in.)
Valve Guide Outer Dia. - Intake	14.313 ~ 14.326 mm	(0.5635 ~ 0.5640 in.)
- Exhaust	14.313 ~ 14.326 mm	(0.5635 ~ 0.5640 in.)
Valve Guide to Stem Clearance - Intake	0.015 ~ 0.043 mm	(0.0006 ~ 0.0017 in.)
- Exhaust	0.045 ~ 0.073 mm	(0.0018 ~ 0.0029 in.)
Valve Seat Width - Intake	1.40 mm	(0.055 in.)
- Exhaust	1.77 mm	(0.069 in.)
Valve Seat Angle - Intake		45°
- Exhaust		45°
Valve Seat Interference Fit - Intake	0.081 ~ 0.113 mm	(0.0032 ~ 0.0044 in.)
- Exhaust	0.064 ~ 0.096 mm	(0.0025 ~ 0.0038 in.)
Valve Guide Interference Fit - Intake	0.022 ~ 0.050 mm	(0.0009 ~ 0.0020 in.)
- Exhaust	0.022 ~ 0.050 mm	(0.0009 ~ 0.0020 in.)

b) CAMSHAFT AND TIMING CHAIN

Camshaft End Play .... 0.1 ~ 0.3 mm (0.0039 ~ 0.0118 in.)
Camshaft Robe Lift .... Solex 8.3 mm (0.327 in.)
SU 8.0 mm (0.315 in.)
Camshaft Journal Dia. - 1st .... 29.964 ~ 29.977 mm (1.1800 ~ 1.1802 in.)
- 2nd .... 29.964 ~ 29.977 mm (1.1800 ~ 1.1802 in.)
- 3rd .... 29.964 ~ 29.977 mm (1.1800 ~ 1.1802 in.)
- 4th .... 29.964 ~ 29.977 mm (1.1800 ~ 1.1802 in.)
- 5th .... 24.966 ~ 24.979 mm (0.9830 ~ 0.9834 in.)
Camshaft Bend (Measure Center journal with Both end journals supported) .... less than 0.01 mm (0.0004 in.)
Camshaft Journal to Bearing Clearance .... No.1~4 0.023 ~ 0.052 mm (0.0009 ~ 0.0020 in.)
No.5 0.021 ~ 0.047 mm (0.0008 ~ 0.0019 in.)

Camshaft Bearing Inner Dia. - 1st .... $30^{+0.016}_{0}$ mm ($1.18^{+0.0006}_{0}$ in.)
- 2nd .... $30^{+0.016}_{0}$ mm ($1.18^{+0.0006}_{0}$ in.)
- 3rd .... $30^{+0.016}_{0}$ mm ($1.18^{+0.0006}_{0}$ in.)
- 4th .... $30^{+0.016}_{0}$ mm ($1.18^{+0.0006}_{0}$ in.)
- 5th .... $25^{+0.013}_{0}$ mm ($0.98^{+0.0005}_{0}$ in.)

c) ROCKER ARM LEVER RATIO .... Approximately 1.4 : 1

d) CONNECTING ROD

Center Distance .... 144 ± 0.03 mm (5.67 ± 0.001 in.)
Bearing Length .... 24 ± 0.1 mm (0.94 ± 0.0039 in.)
Bearing Thickness .... STD 1.493 ~ 1.506 mm (0.0588 ~ 0.0593 in.)
Big End End Play .... 0.2 ~ 0.3 mm (0.008 ~ 0.012 in.)
Connecting Rod Bearing Clearance .... 0.034 ~ 0.086 mm (0.0013 ~ 0.0034 in.)
Connecting Rod Bend .... Less than 0.04 mm per 100 mm length (0.0016 in. per 3.94 in.)

e) CRANKSHAFT AND MAIN BEARING

Journal Dia. .... 62.942 ~ 62.955 mm (2.4780 ~ 2.4785 in.)
Journal Taper & Out-of-Round .... Less than 0.005 mm (0.0002 in.)
Crankshaft Free End Play .... 0.05 ~ 0.18 mm (0.002 ~ 0.007 in.)
Wear Limit of Dittoed Play .... 0.3 mm (0.012 in.)
Crank Pin Dia. .... 51.941 ~ 51.954 mm (2.0449 ~ 2.0454 in.)
Crank Pin Taper & Out-of-Round .... Less than 0.005 mm (0.002 in.)
Main Bearing Thickness .... STD 1.822 ~ 1.835 mm (0.0717 ~ 0.0722 in.)
Main Bearing Clearance .... 0.020 ~ 0.072 mm (0.0008 ~ 0.0028 in.)
Wear Limit of Dittoed Clearance .... 0.12 mm (0.0047 in.)
Crankshaft Bend .... Less than 0.03 mm (0.0012 in.)

f) JACKSHAFT

Journal Dia. - 1st	45.434 ~ 45.447 mm	(1.7887 ~ 1.7892 in.)
- 2nd	43.877 ~ 43.910 mm	(1.7274 ~ 1.7287 in.)
- 3rd	41.218 ~ 41.231 mm	(1.6228 ~ 1.6233 in.)
Jackshaft Free End Play	0.08 ~ 0.28 mm	(0.0031 ~ 0.0110 in.)

g) PISTON

Piston Dia. - STD	87.180 ~ 87.230 mm	(3.4323 ~ 3.4342 in.)
Oversize 1	87.410 ~ 87.460 mm	(3.4413 ~ 3.4433 in.)
Oversize 2	87.660 ~ 87.710 mm	(3.4512 ~ 3.4531 in.)
Oversize 3	87.910 ~ 87.960 mm	(3.4610 ~ 3.4630 in.)
Oversize 4	88.160 ~ 88.210 mm	(3.4709 ~ 3.4728 in.)
Oversize 5	88.660 ~ 88.710 mm	(3.4905 ~ 3.4925 in.)
Ellipse Difference	0.39 ~ 0.42 mm	(0.0154 ~ 0.0165 in.)
Ring Groove Width - Top	$2.0^{+0.050}_{+0.030}$ mm	($0.079^{+0.0020}_{+0.0012}$ in.)
- Second	$2.0^{+0.040}_{+0.020}$ mm	($0.079^{+0.0157}_{+0.0008}$ in.)
- Oil	$4^{+0.040}_{+0.015}$ mm	($0.157^{+0.0157}_{+0.0006}$ in.)
Piston to Bore Clearance	0.030 ~ 0.050 mm	(0.0012 ~ 0.0020 in.)
Piston Pin Hole Off-Set	1 ± 0.05 mm	(0.03937 ± 0.0020 in.)

h) PISTON PIN

Pin Dia.	$22^{-0.013}_{0}$ mm	($0.866^{-0.0005}_{-0}$ in.)
Pin Length	$72.6^{-0.1}_{0}$ mm	($2.858^{-0.0039}_{-0}$ in.)
Piston Pin to Piston Clearance	0.006 ~ 0.012 mm	(0.0002 ~ 0.0005 in.)
Piston Pin to Connecting Rod Bushing Clearance	0.025 ~ 0.035 mm	(0.0010 ~ 0.0014 in.)

i) PISTON RING

Ring Height - Comp. Top	$2^{-0.023}_{-0.010}$ mm	($0.079^{-0.0009}_{-0.00039}$ in.)
2nd	$2^{-0.023}_{-0.010}$ mm	($0.079^{0.0009}_{-0.0009}$ in.)
- Oil	4 -0.010 mm	(0.157 -0.0009 in.)
Side Clearance - Comp. Top	0.040 ~ 0.073 mm	(0.0016 ~ 0.0029 in.)
2nd	0.030 ~ 0.063 mm	(0.0012 ~ 0.0025 in.)
- Oil	0.025 ~ 0.063 mm	(0.0010 ~ 0.0025 in.)
Ring Gap - Comp. Top	0.25 ~ 0.40 mm	(0.0098 ~ 0.016 in.)
2nd	0.15 ~ 0.30 mm	(0.0060 ~ 0.0118 in.)
- Oil	0.14 ~ 0.29 mm	(0.0055 ~ 0.0114 in.)

j) CYLINDER BLOCK

Cylinder Bore Out-of-Round	0.015	mm	(0.0006 in.)
Cylinder Bore Taper	0.02	mm	(0.0008 in.)
Block Head Surface Flatness	Less than 0.1	mm	(0.0039 in.)

k) CYLINDER HEAD

Head Surface Flatness	Less than 0.1	mm	(0.0039 in.)

LUBRICATION SYSTEM

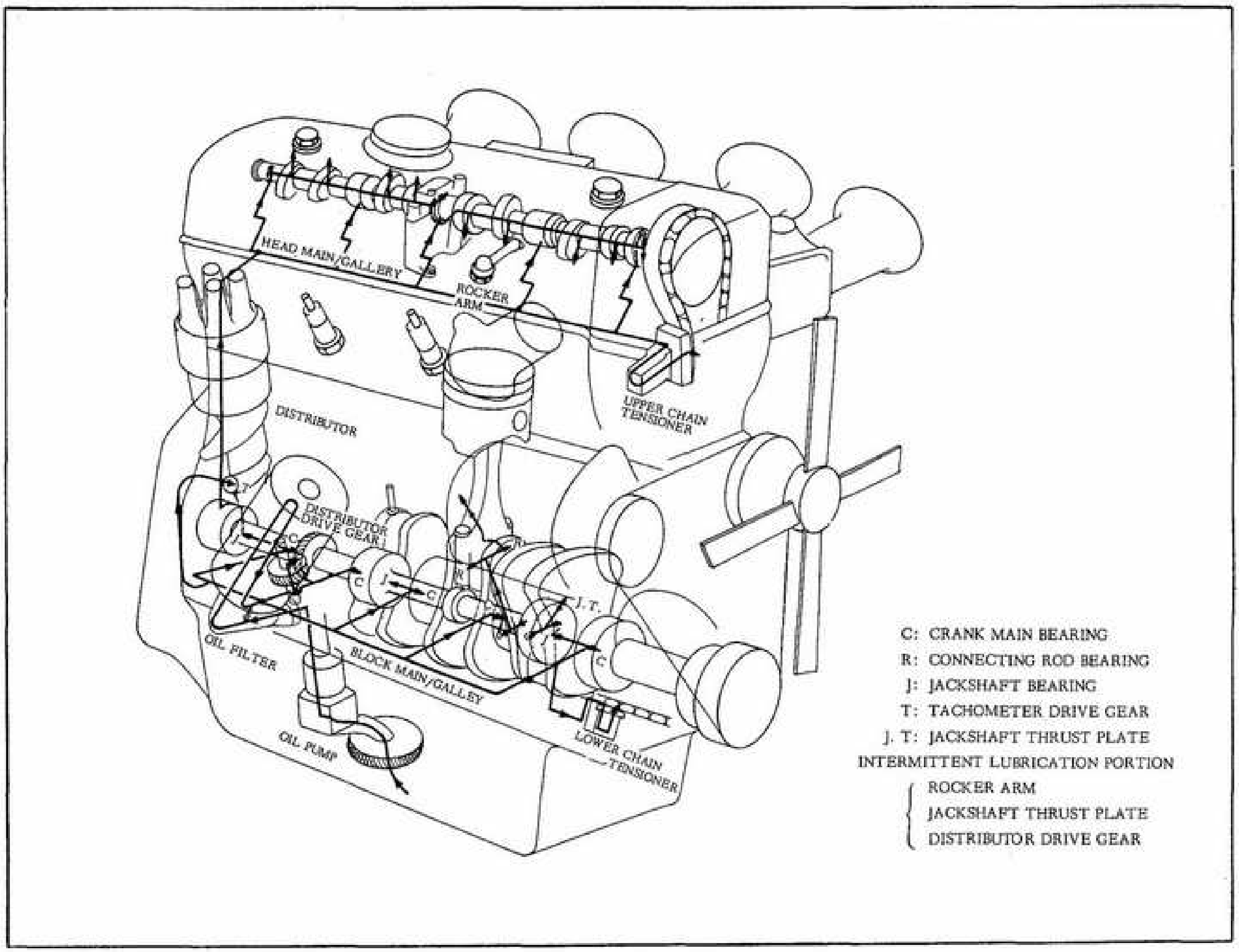


Fig. EL-1 Lubrication Circuit

The lubrication system is the full pressure type, except to the piston pins.

Pressure is supplied by a gear type, positive pressure pump mounted on a boss adjacent to the number four main bearing location.

Lubrication Circuit

Oil drawn through the inlet screen and tube to the inlet side of the oil pump is driven between the gears and pump body, to the pressure outlet portion of the oil pump where it is routed through an oil gallery to the inlet side of the full flow oil filter and then into the main oil gallery.

Each main bearing and Jackshaft bearing is supplied with lubrication from the main oil gallery.

Holes drilled in each crankshaft throw direct lubrication to the connecting rod bearings. Oil throw off from jet holes on connecting rods lubricates the cylinder walls and piston pins.

Oil from the lubrication system enters the lower chain tensioner and holds the pad against the chain by its pressure and spring. Lubrication is supplied to the crankshaft timing chain through a small channel in the slipper pad.

Furthermore lubrication is supplied to the cylinder head main oil gallery through the Jackshaft rear end bearing location and five camshaft bearings on the cylinder head are fed directly from this gallery.

Rocker arm and Valve lubrication is supplied intermittently by a flow of oil through the oil gallery in the camshaft and the small channel at the base circle portion of each cam.

To this oil gallery lubrication is supplied through the No. 1, No. 3 and No. 5 camshaft bearing locations as shown in Fig. EL-1.

From the front end of the cylinder head main gallery Oil is supplied to the upper chain tensioner and lubricates the camshaft timing chain through a hole in the slipper pad of the chain tensioner.

Oil Pressure

Engine Revolution \ Temperature	at 80°C (176°F)	at 100°C (212°F)	at 110°C (230°F)
Idling 700 r.p.m.	1 kg/cm^2 (14.19 lb/in^2)	0.7 kg/cm^2 (9.93 lb/in^2)	0.6 kg/cm^2 (8.51 lb/in^2)
2,000 r.p.m.	3.9 kg/cm^2 (55.34 lb/in^2)	2.6 kg/cm^2 (36.89 lb/in^2)	2.2 kg/cm^2 (31.22 lb/in^2)
2,400 r.p.m.	4.6 kg/cm^2 (65.27 lb/in^2)	3.2 kg/cm^2 (45.41 lb/in^2)	2.8 kg/cm^2 (39.73 lb/in^2)
6,000 r.p.m.	5.2 kg/cm^2 (73.79 lb/in^2)	4.8 kg/cm^2 (68.11 lb/in^2)	4.6 kg/cm^2 (65.27 lb/in^2)

Oil Pump

The oil pump ass'y is installed to bottom of the cylinder block by a bolt and a stud nut and driven by the distributor drive shaft ass'y.

The oil pump is the gear type. A slot provided at the top of the drive gear is engaged with a dog clutch at the lower end of the distributor drive shaft ass'y and the oil pump is thus operated by a gear on Jackshaft through the distributor drive shaft ass'y.

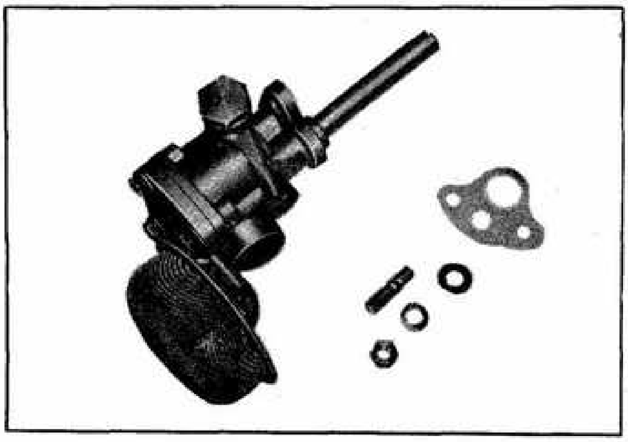


Fig. EL-2

Disassembly

1. Remove the Oil pump from the engine.
2. Remove four bolts and spring washers securing Oil pump cover to Oil pump body.
3. Remove Oil pump cover and detach Oil strainer.
4. Extract Oil pump drive gears and drive shaft.
5. Remove Relief valve cap screw and Relief valve.

   Assembling is a reversal of the above procedure.

Oil Pressure Relief Valve

The oil pressure relief valve is not adjustable. In the released position, the valve permits oil to by-pass through a passage in the pump cover to the inlet side of the pump.

The Valve should be examined to ensure that the relief spring has not lost its tension.

Tightening torque
- Bolts-Pump cover to Body ... 0.8 ~ 1.0 kg-m (5.8 ~ 7.2 ft-lb.)
- Bolts-Pump cover to Oil strainer ..... 0.8 ~ 1.0 kg-m (5.8 ~ 7.2 ft-lb.)
- Cap Nut-release valve .... 3.0 ~ 3.5 kg-m (21.69 ~ 25.31 ft-lb.)

Oil Pressure at Idling (700 r.p.m.) ..... Over 0.5 kg/cm^2 (7.10 lb/in^2) at all temperature

Relief Valve Spring Free Length .... 62.3 mm (2.453 in.)

Relief Valve Spring Pressure Length .... 31.9 mm (1.256 in.)

Opening Pressure ... 4.5 kg/cm^2 (63.86 lb/in^2)

Gear Side Clearance .... 0.04 ~ 0.11 mm (0.0016 ~ 0.0043 in.)

Tip Clearance-Gear to Pump Cover .... 0.150 ~ 0.230 mm (0.0060 ~ 0.0091 in.)

Gear Backlash .... 0.3 ~ 0.4 mm (0.0118 ~ 0.0157 in.)

Oil Filter

A full flow oil filter mounted on the lower right-hand side of the engine is accessible through the hood opening.

A by-pass valve incorporated in the filter mounting boss provides a safety factor in the event the filter becomes inoperative as a result of dirt or sludge accumulation.

Oil filter removal tool will facilitate removal at the recommended mileage intervals.

Apply a thin film of oil to the new filter gasket before installing.

Operate engine at first idle and check for leaks.

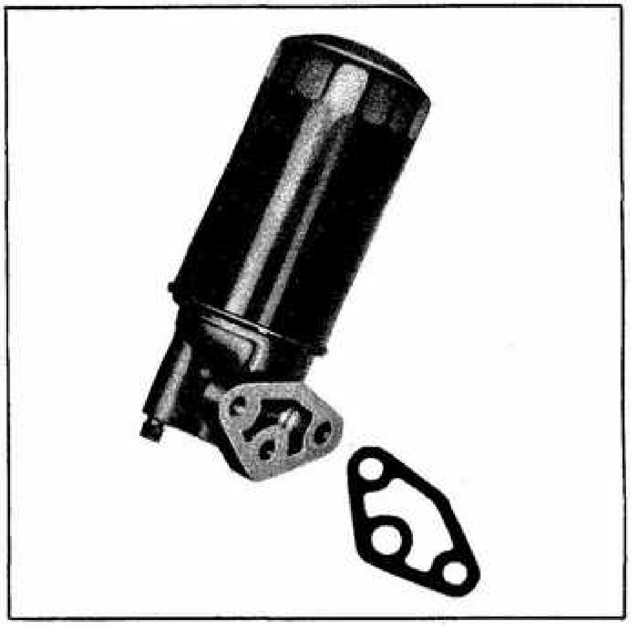


Fig. EL-3

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FUEL SYSTEM

AIR CLEANER

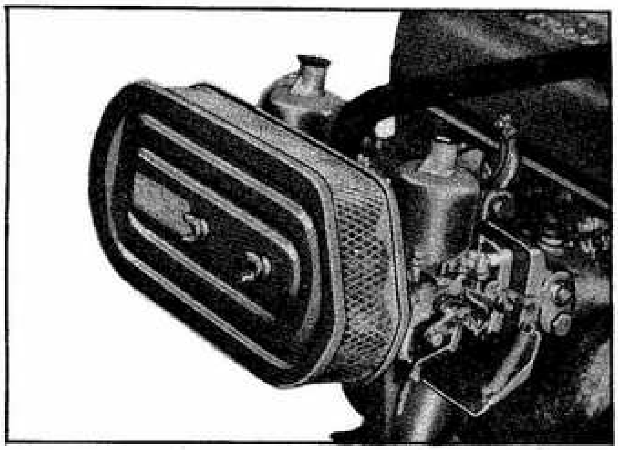


Fig. EF-1 For SU Caburetor

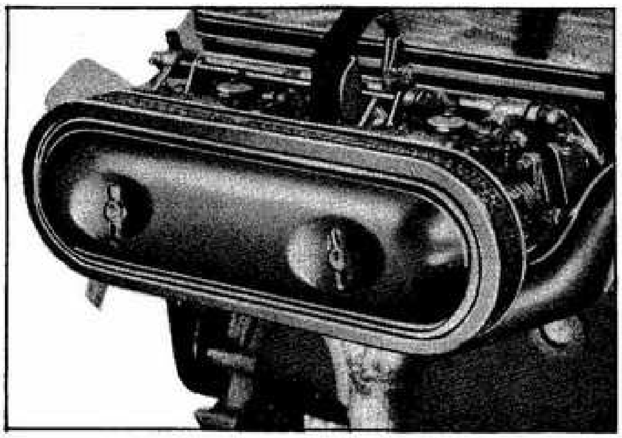


Fig. EF-2 For Solex Caburetor

The replaceable element type air cleaner is used as standard equipment.

The air cleaner is necessary to protect the fuel system as well as the working parts of the engine from abrasive clogging action of dust, dirt, and sediment normally present in the combustion air supply.

The air is taken into the air cleaner from the circumference. The air cleaner body is so designed to reduce to a very low level the noise of vibration periods emitted through the carburetor by the intake air rushing through to the intake system. The air cleaner also acts as a flame arrester in the event of a backfire through the carburetor.

In order for the air cleaner to function properly, it must be served periodically. A dirty element will restrict air flow to the carburetor and create an overly rich mixture condition and excessive fuel consumption as well as become unable to filter dust and dirt and thereby cause abnormal wear to the working parts of the engine.

Every 3,000 km (2,000 mile), remove the element and shake out accumulated dirt. Do not wash. Use compressed air and carefully blow out element in reverse direction of normal air flow. Install a new element every 40,000 km (24,000 mile).

More frequent cleaning and replacement is advisable when the vehicle is operated in dusty areas or unpaved roads. Accumulated dirt restricts air flow, reducing fuel economy and performance.

FUEL PUMP AND FUEL STRAINER

Function and Structure

The fuel pump, which is of the diaphragm type, is mechanically driven by the eccentric part of Jackshaft in the engine.

And the fuel strainer, separated from the fuel pump, is located at the front right side of the engine compartment.

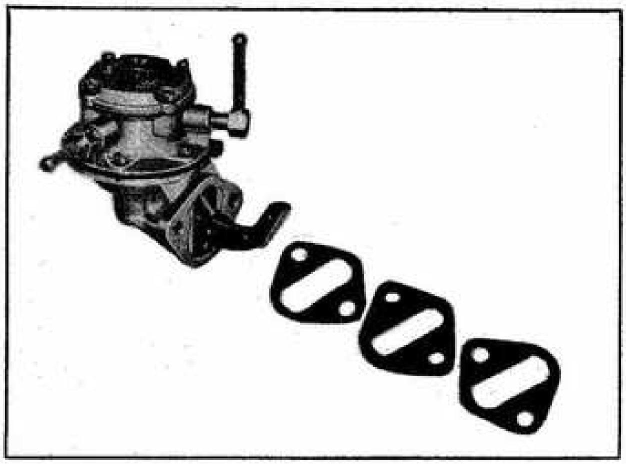


Fig. EF-3

The fuel pump draws gasoline from the tank through the fuel strainer and delivers it under pressure to the carburetor.

The fuel pump rocker arm is activated by an eccentric on the engine jackshaft and the diaphragm goes down against diaphragm spring and then is pushed up again by its spring.

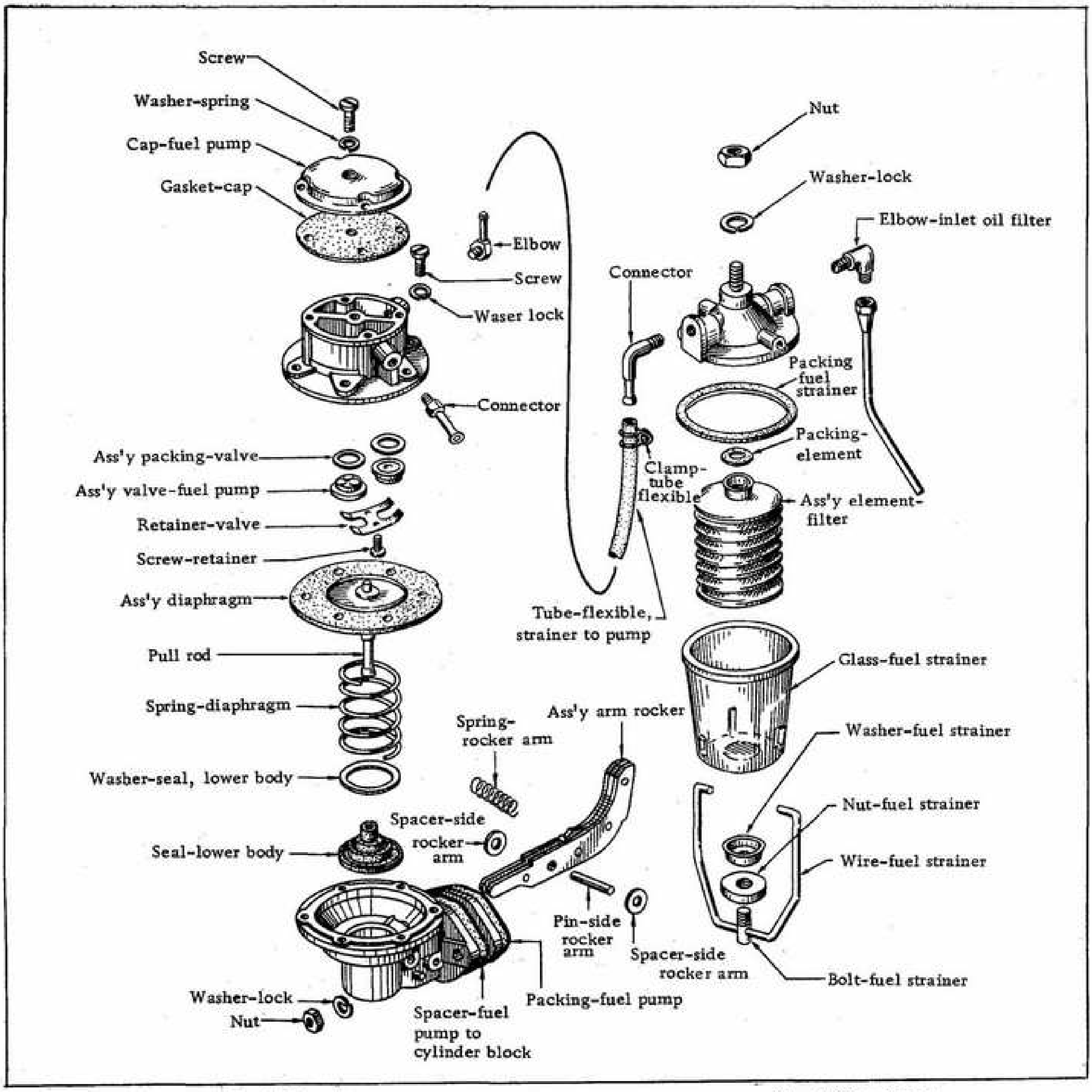
By this movements of the diaphragm and the functioning of the valves at the inlet and outlet of the pump chamber, gasoline is drawn up from the tank to the carburetor.

If the float chamber of the carburetor contains enough gasoline and the needle valve is closed, . gasoline is not allowed into the carburetor.

Thus gasoline is stored in the pump chamber and due to its pressure, the diaphragm is kept down and cannot return.

Under this condition, the rocker arm works in vain, as the rod remains low.

The rocker arm spring serves to prevent noise, keeping the rocker arm pushed against the eccentric of the engine jackshaft.



Fuel Pump *Fuel Strainer*

Fig. EF-4

Fuel Pump-Disassemble and Assemble

Disassemble

Remove Fuel pump assembly by unscrewing two attaching nuts and disassemble in the following order.

1. Separate Upper body and Lower body by unscrewing six body set screws.
2. Take off Cap and Cap gasket by removing Cap screws.
3. Unscrew Elbow and Connector.
4. Take off Valve retainer by unscrewing two valve retainer screws and two Valves are easily taken out.
5. To remove Diaphragm, Diaphragm spring, Lower body seal washer and Lower body seal out of Lower body, press down Diaphragm against force of Diaphragm spring and meantime incline Diaphragm so that a rectangular part in the lower end of Pull rod is unhooked from Rocker arm link.
6. Dirve out Rocker arm pin by using a press or hammer.

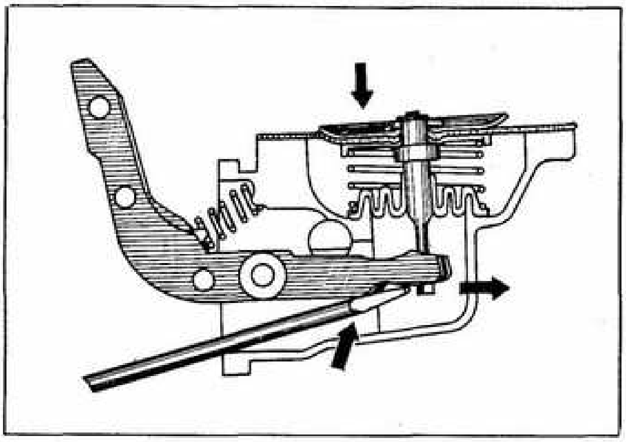


Fig. EF-5 Pull Rod Removal

Inspect

1. Check Upper body and Lower body for crack.
2. Check Valve assembly for wear of Valve and Valve spring. Blow Valve assembly by breath to examine function.
3. Check Diaphragm for small hole, crack and wear.
4. Check Rocker arm for wear at the portion to contact with Jackshaft.
5. Check Rocker arm pin for wear since the worn pin may cause oil leakage.
6. Check all other components for any abnormalities and change with new part depending on the condition.

Assemble

Assembly is a reversal of the disassembly procedure. In case of reassembly and reinstallation, following points should be noted.

1. Use new gaskets.
2. Lubricate Rocker arm, Rocker arm link, Rocker arm pin and Lever pin before installation.
3. To test the function, position Fuel pump assembly about 1 m (3 ft.) above fuel level with a pipe connecting Fuel pump and Fuel strainer and operate Rocker arm by hand. If the fuel is drawn up soon after Rocker arm is released, function of the pump is sufficient.

Fuel Pump Tests

Always check Fuel pump while it is mounted on the engine and be sure there is gasoline in the tank.

Capacity test; 800 cc (0.211 U.S.gal.) of fuel in one minute or less at 700 r.p.m. engine speed.

Vacuum test; at least 500 mm (21.6 in.) Hg (vacuum at 700 r.p.m. engine speed).

IMPORTANT: Fuel line from pump to carburetor must be disconnected so pump will operate at full capacity.

Pressure test; Connect a pressure gauge to a "T" fitting at the carburetor. The length of the hose on pressure gauge should not exceed 15 cm (6 in.).

Vent pump by allowing it to pump fuel for a few seconds unrestricted through the line into a container. This procedure is necessary to remove air and vapor that may be trapped in the pump.

Pressure specification is 0.24 kg/cm^2 to 0.30 kg/cm^2 (3.41 lb/in^2 to 4.26 lb/in^2) at 700r.p.m. engine speed.

SU TYPE TWIN CARBUETOR

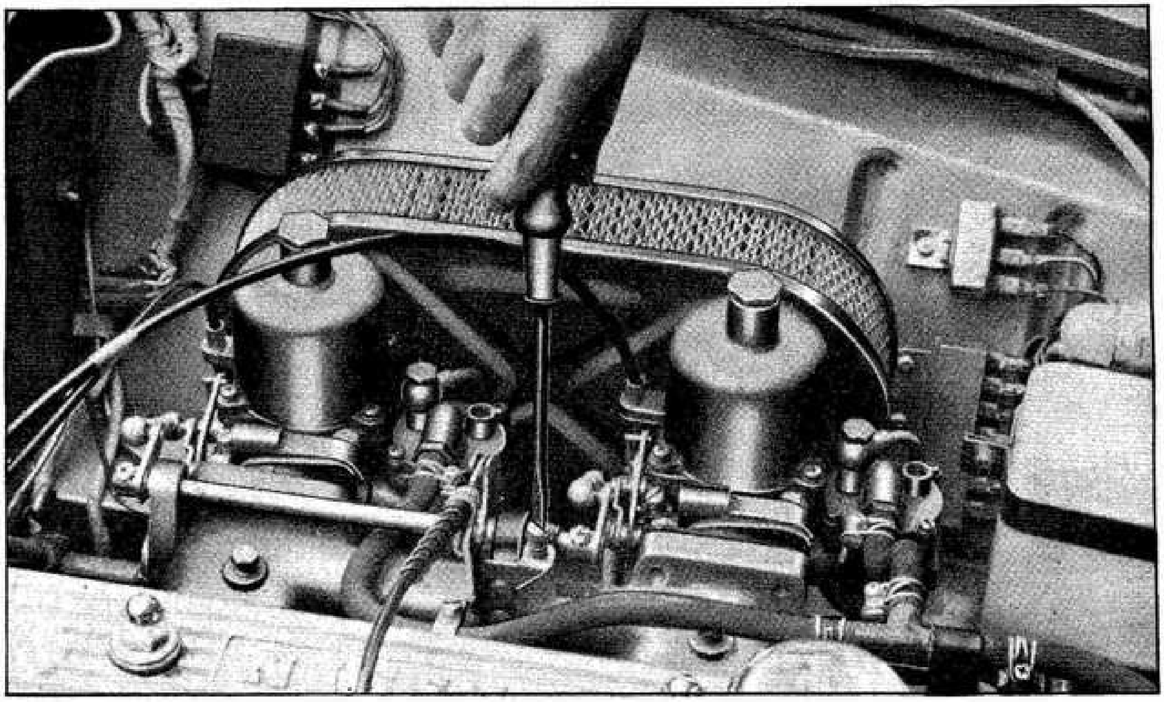


Fig. EF-6

STRUCTURE AND FUNCTION

Float Chamber

Fuel supplied from the fuel pump flows into the float chamber passing through the needle valve. The fuel level in the float chamber is always kept at a constant level by the operation of the needle valve and the float. The needle valve is made of special steel with high hardness and endures long time use without wear.

Venturi Control System

The suction chamber is installed on the upper side of the throttle chamber, in which the suction piston operates vertically.

Onto the top of the suction piston, vacuum of the venturi is transmitted through the suction hole, while atmospheric pressure acts on the lower side of the piston through the air hole to air cleaner.

The suction piston automatically makes vertical movement stabilized at a vacuum controlled by the weight of the piston, strength of the suction spring and the area of the large and small dia. of piston.

When the throttle valve is wide opened for high speed throttle position, the vacuum on the top of the suction piston increases and raises the venturi to wide open. When the air flow is little, the vacuum is low, then the venturi also opens little.

Weight of the suction piston and stength of the suction spring are selected so as the venturi opening will meet with any running conditions of the engine.

In order to produce rapid acceleration, oil damper is provided within the suction piston rod to restrict the speed of lift of piston on snap throttle opening.

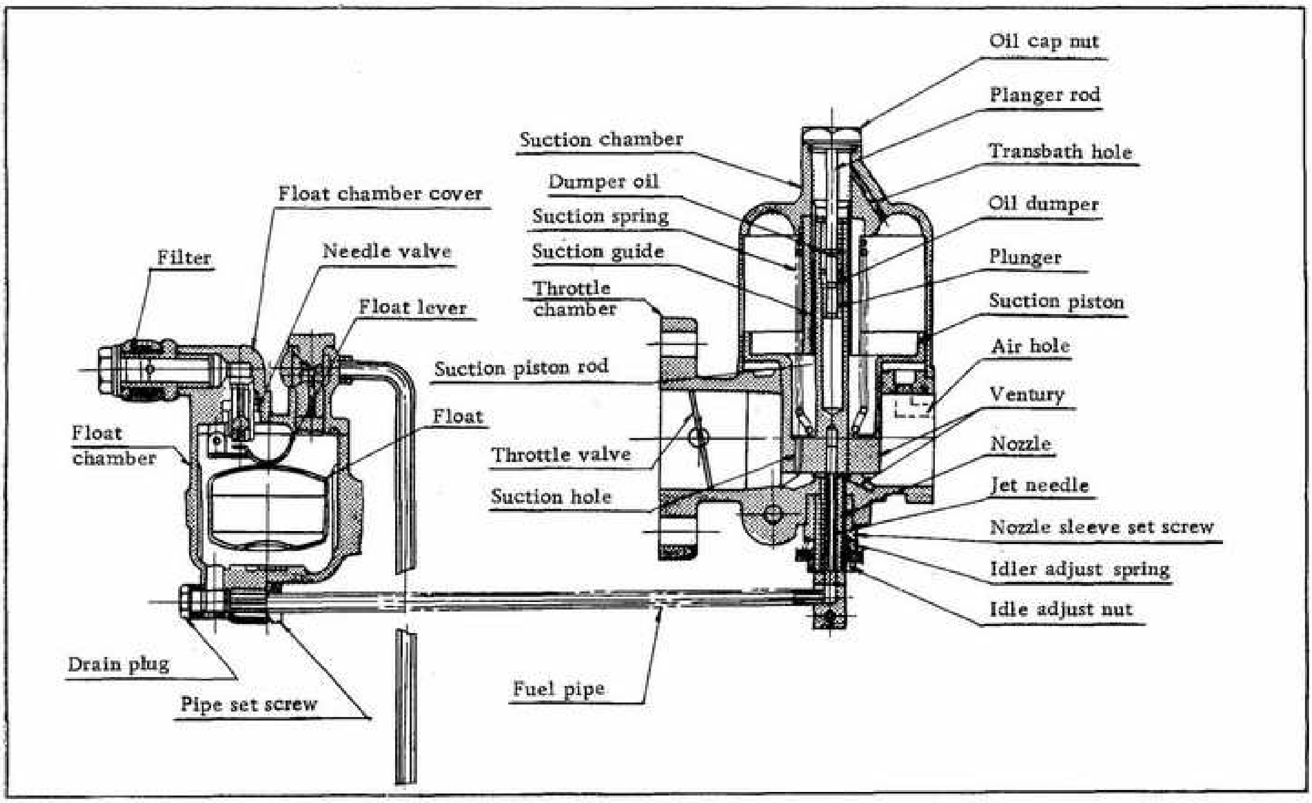
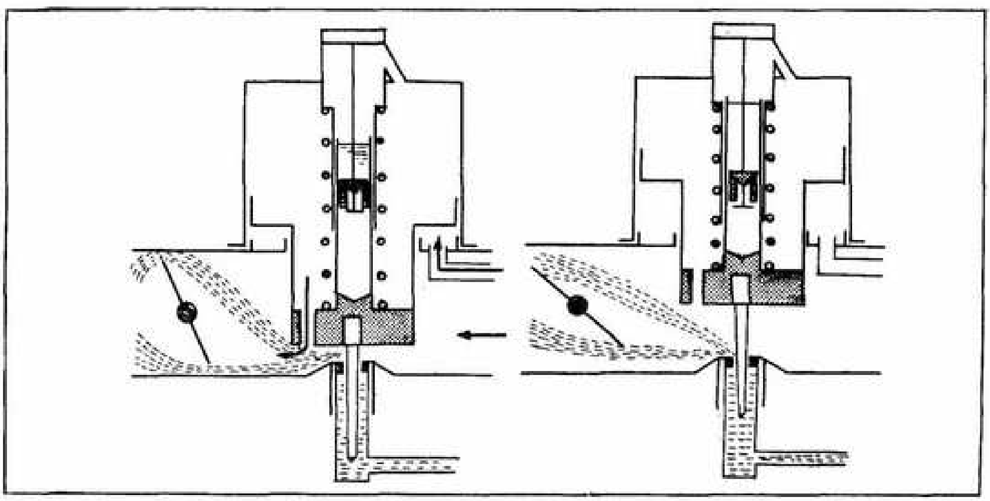


Fig. EF-7 Sectional View of Carburetor

Fuel Measuring System

Fuel supplied from the float chamber flows into the venturi through the gap between the nozzle and the jet needle by the vacuum generated at the venturi.

The jet neddle is fixed to the base of the suction piston and moves vertically in the nozzle together with the suction piston.

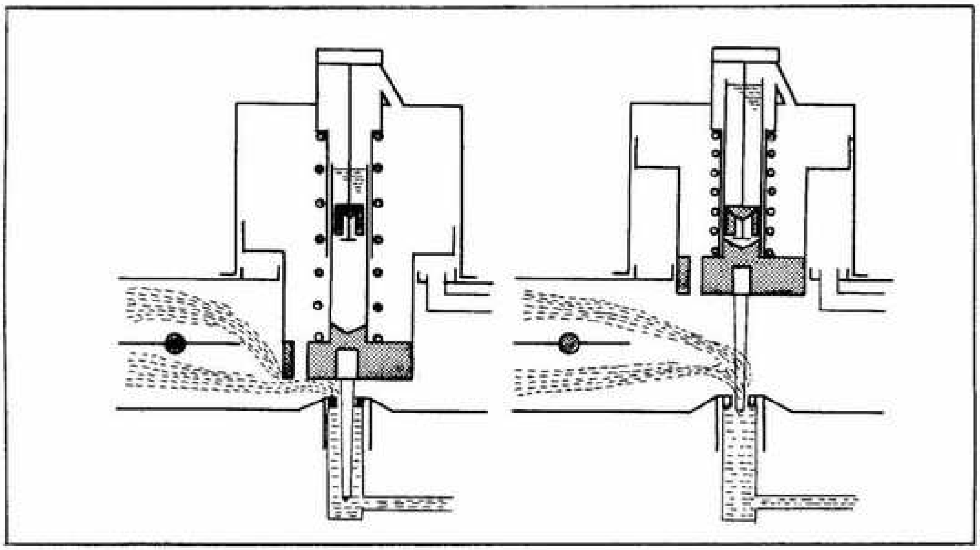


Idling Speed *Medium-Low Speed*

Fig. EF-8

The jet needle is tapered so that the gap between the nozzle and the jet needle varies and automatically changes flow of fuel. Form of the jet needle is determined so as to satisfy every condition of movement.

Operation of the suction piston and measurement of fuel at each condition, idling through full open, high speed are shown below.



Full Open High Speed *Full Open Low Speed*

Fig. EF-9

Starting Device

When the choke button is pulled out, the starter lever moves and pulls down the nozzle, then the gap between the nozzle and the jet needle is opened widely and rich fuel flows in. The throttle valve opens automatically about 6° with the synchronized linkage.

ADJUSTMENT AND HANDLING

Adjustment of Linkage Movement of Throttle Shaft and Fuel Close of Throttle Valve

Two carburetors are used in parallel, both throttle must be set and correctly synchronized, otherwise this will affect on consumption of fuel. The throttle shaft on the front side (F side) and that on the rear side (R side) operate at the same time with the auxiliary shaft provided on the engine side. Each throttle shaft has the throttle lever respectively and is connected to the lever of auxiliary shaft with adjustable connecting rod.

(1) To adjust full close of throttle valves of the carburetors on F and R sides, unscrew the both throttle adjust screws until the throttles are completely closed and change length of the connecting rod for the auxiliary shaft on one side.

(2) Fix the connecting rod on the R side to 70 mm (2.7559 in.) with the lock nut. (Overall length 84 ~ 86 mm).

(3) Turn the F side turn buckle of the connecting rod and adjust length so that the throttle valves on both sides are full closed.

(4) When the throttle valves on F and R sides are full closed, load upon the turn buckle disappears, which can be felt by the hand. When the connecting rod on the F side is too long and the return spring on the R side is too short, the return spring on the F side works, this can be felt on the turn buckle.

(5) When full close adjustment has been finished on both sides, lock the turn buckle on the F side with the lock nuts.

(6) Connect the throttle wire to the drum.

Idle Speed Adjustment

Slow running adjustment is conducted with the throttle adjust screw and the idle adjust nut after the engine has been warmed up.

(1) Tighten completely the idle adjust nuts of the carburetors on the F and R sides, then return three turns. Tighten 2-3 turns the throttle adjust screw of the carburetor on the F side and start engine.
Unscrew the throttle adjust screw of the carburetor on the R side so as the end of it is clear from the stopper and do not move it till the last.

(2) Return the F throttle adjust screw slowly, then the engine revolution slows gradually down and stop it just before the engine revolution becomes irregular.

(3) After that, screw in or out the idle adjust nuts of the carburetors on the F and R sides the same turns and stop them when the engine revolution is the most fastest and smooth.

(4) Further return the throttle adjust screw of the F side carburetor and slow down revolution, then the stable idling driving can be obtained.

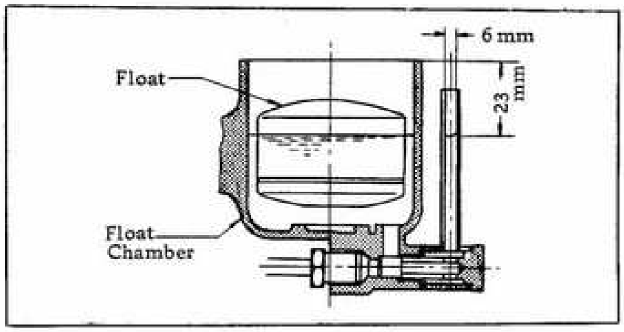
(5) Lastly screw in the throttle adjust screw of the R side carburetor to the point when the engine speed start to increase. Be careful not to screw in too much and further open the throttle valve. Adjustment of idling will affect consumption of fuel and acceleration.

Adjustment of Float Level

To measure the float level, remove the drain plug and insert the level gauge with the inside diameter 6 mm and conduct idling running of engine. If the fuel level shown on the glass tube stands at 22 ~ 24 mm (0.8661 ~ 0.9449 in.) from the top of the float chamber, it is the normal level.

When the level gauge is not available the following steps are taken for adjustment.

(1) Remove 4 ea of the set screw of the float chamber cover, the float chamber cover and the float lever can be removed together. Put the float chamber cover on a stand with the float lever upside.



Measuring Float Level

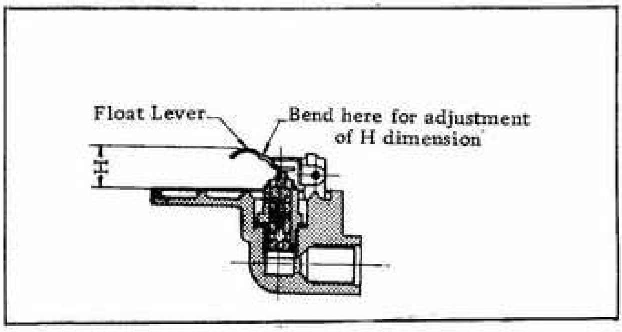


Fig. EF-10 Adjusting Float Level

(2) Lift the float lever with the finger and slowly lower down and stop it when the float lever seat just contact with the valve stem.

(3) In this case, dimension (H) between the contact point of the float lever and float and the fitting point of the float chamber cover is to be 14 ~ 15 mm (0.5512 ~ 0.5905 in.) as the standard.

(4) When the dimension is not right, bend the point shown in the figure for adjustment.

Adjustment of Starting Linkage Opening

Pull the choke button, then the starter lever moves and the nozzle is pulled down, while the throttle valve automatically opens 6° with linkage the most suitable opening for starting.

When resetting, fit the line marked on the connecting rod (c) to the arrow marked on the fast idle lever post, then the starting linkage opening can be adjusted.

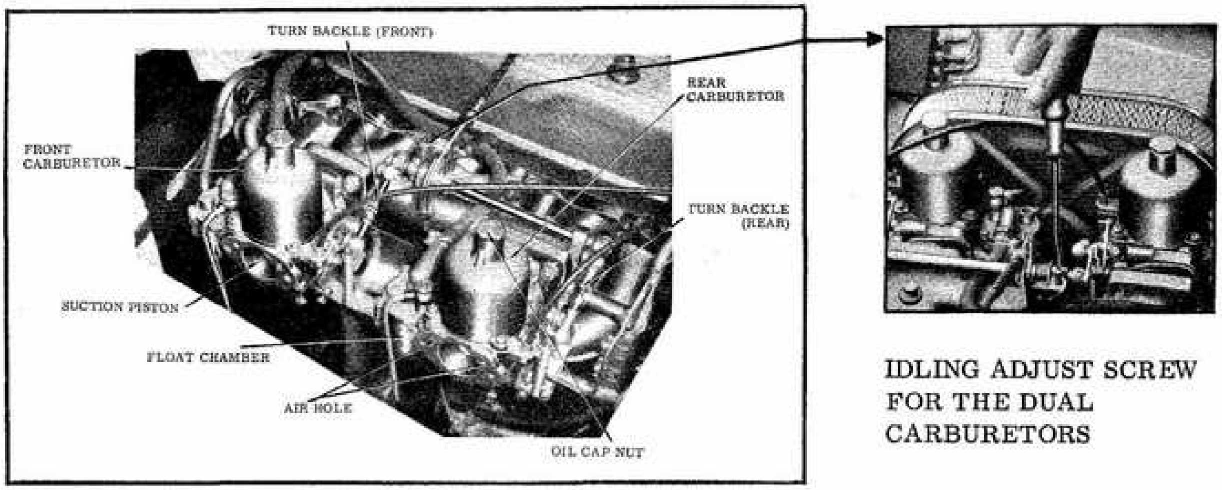


Fig. EF-11 Adjustment for Opening Degree at Connecting

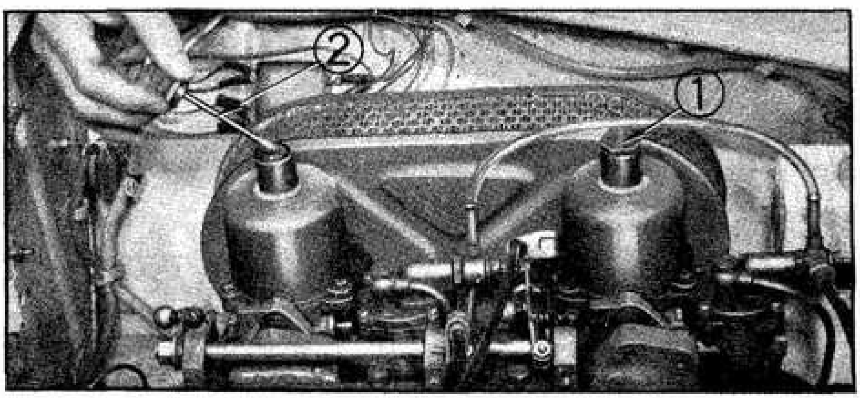
Inspection of Damper Oil

When the carburetor is installed to the engine or the engine is overhauled, check the damper oil without fail and add it if necessary.

If the damper oil is short, this affects acceleration and other movements, so that periodical inspection, every 2 ~ 3 months or about 3, 000 km (2, 000 mile), is necessary and add it when necessary.

To add the oil, remove the oil cap nut. Use the motor oil SAE#20 as the damper oil. Do not use those #30 up.

To check the damper oil level, remove the oil cap nut and if the oil level stands at 5 mm (0.1968 in.) or more from the grooves on the plunger rod, it is normal, however if the level is lower, add the oil. Be careful not to bend the rod when the oil cap nut is removed.



① Oil cap nut
② Plunger rod

Fig. EF-12 Inspecting Damper Oil

Periodical Inspection of Suction Chamber and Suction Piston

For normal operation of the suction piston to control the venturi area, it is necessary to conduct periodical maintenance for the suction piston and the suction chamber, as dust in the air is sucked in to some extent and accumulated on the piston.

To check movement of the suction piston without removing it from the engine, the following steps are taken.

(1) Remove the oil cap nut.

(2) Push up the lifter with the finger, the end of lifter will make contact with the underside of larger diameter of the suction piston at about 1.5 mm (0.0591 in.). Push up the lifter further, it will make a stop with the stopper.

(3) When the lifter is free of the finger, it returns with load of the lifter spring, then the suction piston also comes down and the stop pin at its front end hits against the fixed side of the venturi. This is known by the sound. If the piston moves smoothly up and down like that, it can be said to be in a good operative condition. This also assures that centering is good as explained in the following chapter.
To check bend of the plunger rod of oil cap nut, remove the air cleaner with the oil cap nut as it is, push up the suction piston by the finger and drop it freely. When push up, the finger will feel fairly heavily by action of the oil damper, but it will come down freely without action of the oil damper. If so, it can be said to be in a good condition. Conduct overhaul every 6 months.

DISASSEMBLY AND ASSEMBLY

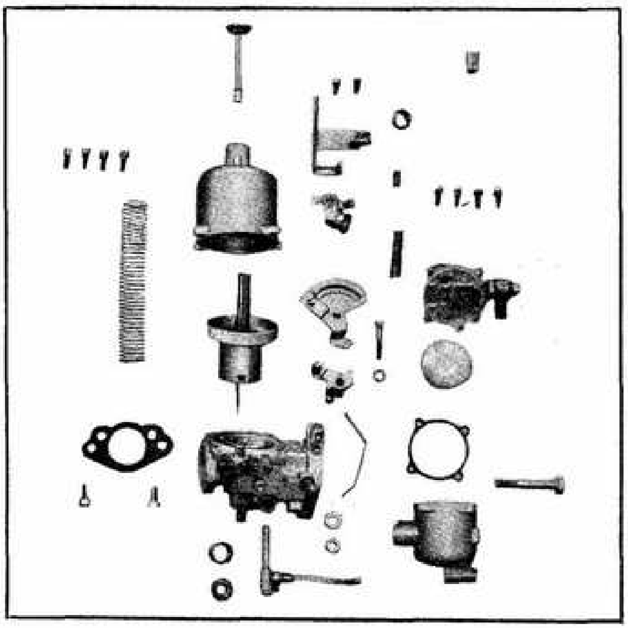


Fig. EF-13 Suction Piston & Suction Chamber

The float chamber for HJG-46W carburetor is of the same structure as ordinary carburetors, however, the venturi and fuel control systems are made up particularly of high precision parts, so that close attention must be paid for disassembly and assembly.

Suction Piston and Suction Chamber-Disassemble and Assemble

(1) Remove 4ea. of the set screw and separate the suction chamber.

(2) Remove the suction spring, nylon packing and the suction piston from the inside.

(3) The removed suction chamber and suction piston must be put on clean cloth placed on the level top of a desk. Do not make scratches on the inside of suction chamber and on the outside diameter of the suction piston. Do not bend the jet needle underside the suction piston.

(4) Do not remove the jet needle out of the suction piston if possible. When it is necessary to disassemble unavoidably, loosen the jet needle set screw then using plier within 2 mm (0.0787 in.) from the shoulder of the jet needle taking care of not making scratches and slowly pull it out, twisting so as not to bend it.

(5) Incorrect setting of the jet needle in the suction piston results in malfunction of idling and other performances.
Proper setting of the jet needle is as follows. Set the jet needle so as its shoulder is on the same level with the underside of the suction piston small diameter as shown. Put a level plate at the small diameter and accord it to the shoulder of jet needle and fix the set screw.

Fig. EF-14 Jet Needle

(6) Clean the suction chamber and suction piston with clean gasoline and flow them with air to eliminate oil and dust.

(7) When the suction chamber and suction piston have been cleaned, add 1 ~ 2 drops of thin

oil to the piston rod and assemble them. If oil sticks to the inside of suction chamber and the large diameter of suction piston, it will be the cause of trouble.

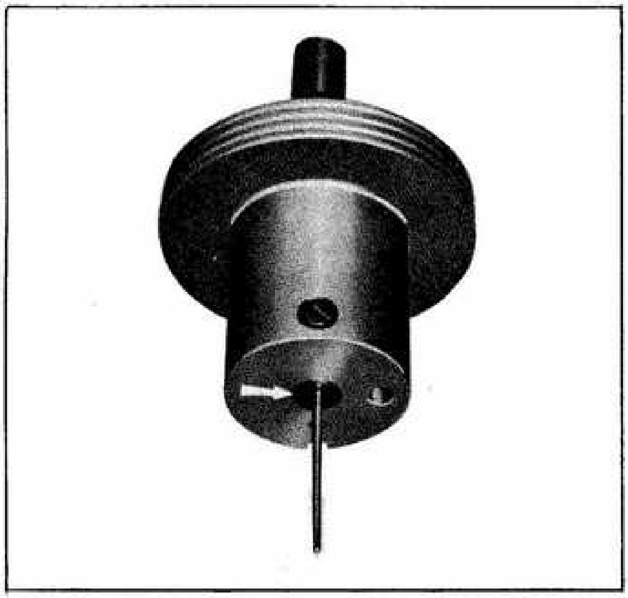


Fig. EF-15 Setting Jet Needle

Nozzle-Disassemble and Assemble

(1) Disassembly of Nozzle
Disassembly of the nozzle is simple, but the nozzle sleeve, washer and nozzle sleeve set screw are hard to reassemble, so that do not disassemble these items if possible.

A. Remove the starter return spring and the pins, 4 and 5 mm Dia. (the connecting rod is also removed for F side carburetor), and then the starter lever. Next, loosen the clip and remove the fuel pipe, then the nozzle can be taken off. In this case, every care must be taken not to injure or bend the jet needle remained.

B. Remove the idle adjust nut and idle adjust spring.

C. Remove the nozzle sleeve set screw and take off the washer and nozzle sleeve. The fuel measuring jet of nozzle is the most important part of the carburetor and processing of the hole is carried on very precisely and very strict inspection is conducted. Clean the nozzle with clean gasoline and blow it with dry air.

(2) Reassembly of Nozzle

A. Set the suction piston and suction chamber first (with the jet needle in the suction piston). Remove the oil cap nut and do not add damper oil.

B. Place the suction piston in full down position and then insert the nozzle until it hits the nozzle sleeve.

C. Move the nozzle sleeve and determine the position of it so as the jet does not hit the jet needle.

D. In this state, push up the suction piston by the finger and drop it slowly. If the suction piston stop pin drops smoothly until it hits against the venturi with a slight sound, tighten the nozzle sleeve set screw firmly.

E. Remove the nozzle, set the idle adjust spring and idle adjust nut in the nozzle sleeve, then insert the nozzle, insert the fuel pipe connected with the float chamber to the nozzle nipple and tighten the clip. Be careful not to twist the fuel pipe and tighten the clip at the swollen part of the nipple.

F. Install the starter lever with the pins, (the connecting rod is also installed on the F side) and finally hook the starter spring.

G. When assembly has been completed, make sure whether the suction piston drops smoothly.

(3) Disassembly of Float Chamber
Follow the order of disassembly described in the section, Adjustment of Float Level.

(4) Disassembly and Assembly of Linkage.
Do not deform each parts in processing. After the reassembly the synchronized linkage is to operate smoothly.

INSTRUCTIONS FOR BALANCING TWIN HITACHI HJG-46W VARIABLE VENTURI SIDE DRAFT CARBURETOR

Method Ⓐ

(1) Remove air cleaner.

(2) Disconnect throttle connections of both carburetors.

(3) On the front carburetor (nearest radiator) set idle screw so that tachometer reading is 600 r.p.m. If you do not have an instrument for balancing multiple carburetors, use a length of plastic hose, 1/2 inch diameter, and place at open horn of carburetor, and at your ear.
Listen to sound of air entering carburetor.

(4) Move to second carburetor and follow same procedure of listening to air entering this carburetor. If the sound is exactly the same as the front carburetor, then they are synchronized. If not, then adjust the idle screw until they have the same sound.

(5) Now if reading of the tachometer has changed, you must move both idle screws until you have both carburetors hissing the same tone and the r.p.m. is not more than 750 r.p.m.
You have now synchronized the throttle opening of dual carburetors.

(6) We will now proceed to adjust and synchronize the fuel flow of both carburetors. Start with the front carburetor adjustment.
With the engine running at 700 r.p.m., lift the piston of the rear carburetor 1/2 inch. (This will make the carburetor inoperative.) If engine stalls, then you must richen the front carburetor until it will keep the engine running as if it were firing only two cylinders, rough but a steady best.
Now repeat this same procedure or lifting the piston on the front carburetor, and adjust the mixture of the rear carburetor.

(7) You have now synchronized your air fuel ratio in both carburetors. You may find when this step is completed that r.p.m. has increased on your tachometer; if so, go back to step and correct your idle to 700 r.p.m.

(8) Next, adjust your throttle linkage connecting the carburetors with the throttle shaft mounted on the intake manifold.
Adjust the length of throttle link so that it will snap in place without changing r.p.m. on the front carburetor.
Do this same operation with the link to the rear carburetor.

Your engine should now run smoothly, providing the rest of your engine is properly tuned, such as valves, points, plugs, condenser, and ignition timing properly set.

Method Ⓑ

(1) Warm engine to normal operating temperatures.

(2) Turn the idle adjusting nut clockwise until closed, then return the nut about three turns.

(3) Turn the front carburetor throttle adjusting screw clockwise 2 or 3 turns.
Back off on the rear carburetor adjusting screw so it is off the stopper.

(4) Then start engine.

(5) Turn the front throttle adjusting screw until engine reaches about 600 r.p.m.

(6) Turn the idle adjusting screw turns either left or right until engine runs evenly.

(7) If the rotation of engine is too fast, slightly adjust the front throttle adjusting screw until engine speed is about 700 r.p.m.

(8) Normally a slight alteration of the idle adjust screw is again necessary.

(9) Set the rear carburetor throttle adjusting screw so it seats on the stopper.

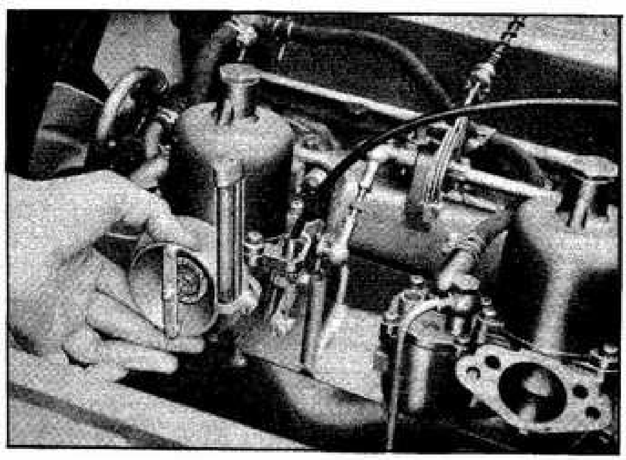


Fig. EF-16 Carburetor Balancing

Method ©

If you have an instrument for balancing multiple carburetors.

(1) Warm engine to normal operating temperatures.

(2) Remove air cleaner; disconnect linkage.

(3) Place an instrument for balancing over throat of one carburetor.
(Adjust the screw of air flow meter.)

(4) With the adjusting screw in open position, gradually turn down until float in transparent tube rises to, or near, any graduating mark line. (Tube to be kept vertical while in operation.)

(5) Without changing position of the adjust screw, place the same on remaining carburetor, adjusting each carburetor "throttle-stop-screw" to bring float to approximately same level as the above item (4).

If the idling speed is too fast, back off the throttle stop screw on one carburetor adjust an instrument for balancing to that carburetor, then rebalance the other carburetor. Then carefully reconnect linkage. Then the engine speed is increased just enough so the carburetor control arms do not touch the stop screws, then locking the accelerating control at a point that will not affect the linkage to the carburetor.

The linkage may then be checked and adjusted by using an instrument for balancing multiple carburetors in the same manner as for adjusting the idling screws.

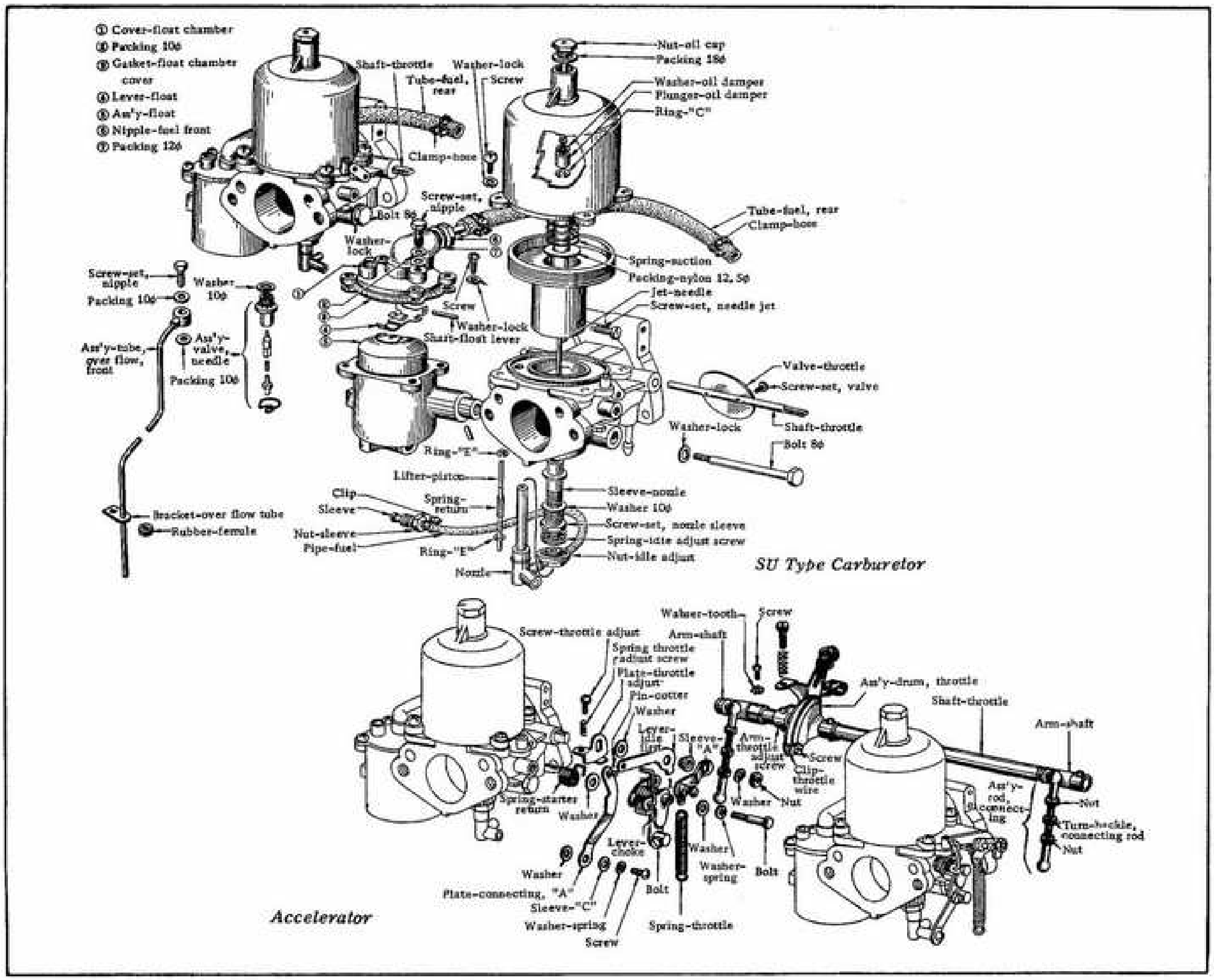


Fig. EF-17 Carburetor Component Parts

CAUSES AND REMEDY FOR TROUBLE

For troubles in the carburetor, causes and remedy for them are listed as follows. When the engine is in disorder, there may be the cause in the electric system, not in the carburetor. In such a case, check the electric system first and then adjust the carburetor.

Trouble	Cause	Remedy
Overflow:	Leak, deform of float	Replace
	Dust on needle valve seat	Clean
	Slack of needle valve	Retighten
	Defective seat of needle valve	Grind or replace
	Excessive pressure of fuel pump	Repair
	Sucking air in fuel pump	Repair
Excessive consumption of fuel:	Overflow	See the above
	Malfunction of suction piston	See last item
	Defect in nozzle return	Adjust
	Wear of jet needle	Replace
	Wear of nozzle jet	Replace
	Incorrect slow-adjust	Adjust
	Incorrect fitting of jet needle	Adjust
	Incorrect adjustment of throttle valve linkage	Adjust
Want of power:	Throttle valve not full open	Adjust
	Malfunction of suction piston	See last item
	Defect in nozzle return	Adjust
	Clog in nozzle or fuel line	Clean
	Incorrect fitting of jet needle	Adjust
	Clog in needle valve	Clean
	Malfunction of fuel pump	Adjust
Defect in idle:	Malfunction of suction piston	See last item
	Defect in nozzle return	Adjust
	Wear of jet needle	Replace
	Incorrect adjust of idle adjust nut	Adjust
	Wear of throttle shaft	Replace
	Air leak due to defective packing between manifold and carburetor	Replace gasket
	Incorrect adjust of throttle valve linkage	Adjust
	Slack in throttle lever linkage	Adjust or repair
Breathing:	Malfunction of suction piston	See last item
	Incorrect adjust of idle	Adjust
	Shortage in damper oil or use of inferior oil	Add. replace
	Incorrect fitting of jet needle	Adjust

Do not start:	Overflow	See preceding item
	Fuel not feed	Check pump
		Check fuel pipe
		Check needle valve
	Incorrect adjust of idle	Adjust
	Malfunction of suction piston	See last item
Malfunction of suction piston:	Deposit of dust or oil	Clean
	Adhesion of suction chamber and suction piston due to deform	Repair or replace
	Incorrect centering of nozzle	Adjust
	Bend of jet needle	Replace
	Bend of plunger rod	Repair

SOLEX 44PHH TYPE DUAL CARBURETOR

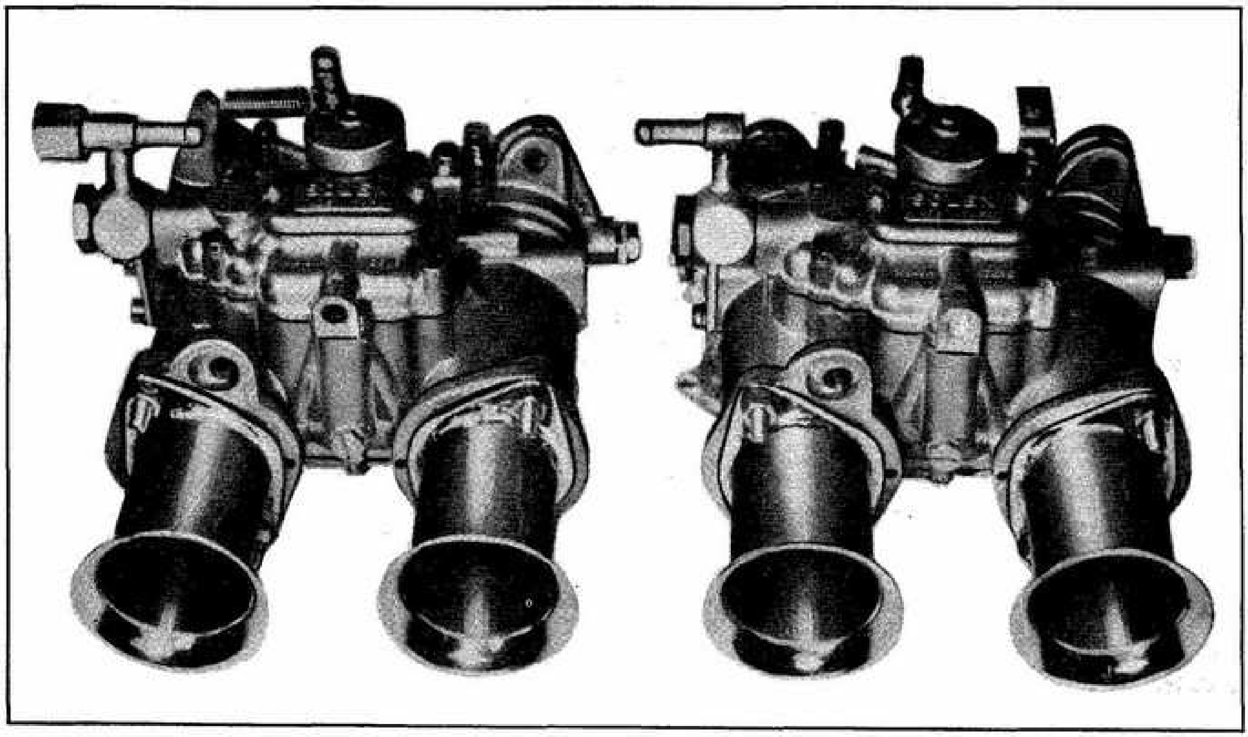


Fig. EF-18

GENERAL DESCRIPTION

Type 44PHH Carburetor is a Solex Carburetor developed for mounting on, in addition to general motor vehicles, sports cars and racing cars requiring rugged and high performances.

Its outstanding features are as follows:

1-1 Twin-bodies carburetor

So-called Twin-Chalk Carburetor, with two suction ports embodied in one Carburetor compactly.

1-3 High in suction coefficient

Starter is employed for the starting system instead of chalk valve to improve suction coefficient.

1-2 Strong against inclination

Designed to let it full maintain its performances even at excessive inclinations of the fuel level (from lateral turning of the car to quick acceleration). To be more concrete, Float hinge is installed at a position free from lowering in performances even at sharp lateral turnings by installing Jets at the center part and making Float the twin bodies type.

1-4 Exchangeable venturies and air funnel

Venturies and Air funnel are exchangeable, allowing this Carburetor to be a universal type usable on any types of Engines.

1-5 Easy to adjust

Major Jets are installed concentrated at the center, and can be easily exchanged by removing the Jet chamber cover.

1-6 Equipped with membrane type accelerator pump

Free from causing defective operation due to wear or sticking, unlike the piston type pump.

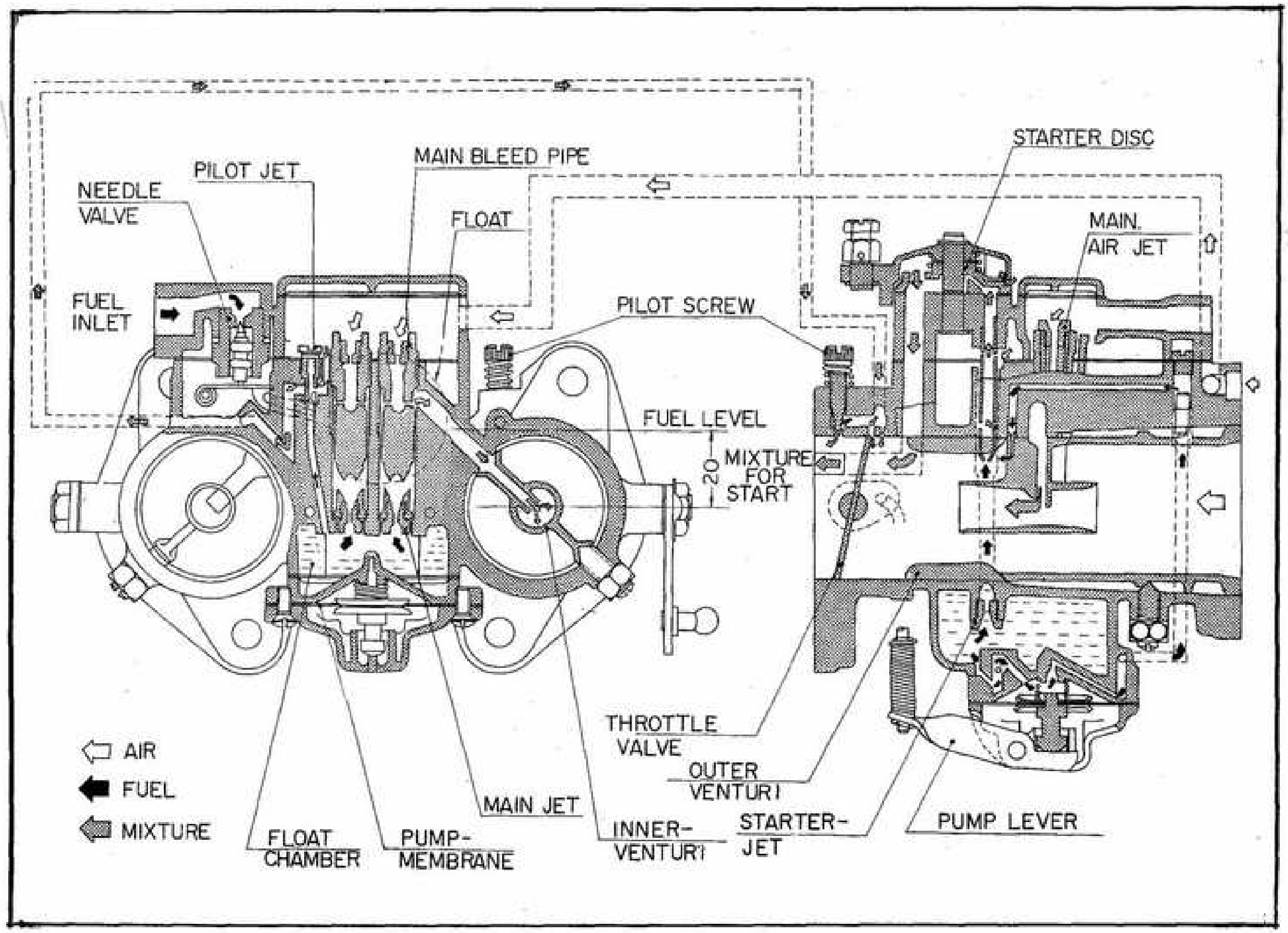


Fig. EF-19 44PHH Fuel Flow Chart

CONSTRUCTION AND FUNCTION

As Solex 44PHH TYPE Carburetor is a twin-bodies type, all functional parts are installed in twin, except for Float Chamber, Accelerator Pump and Starter Device which are installed one each and deliver the fuel equally to both suction ports.

The construction is mainly devided into the following five system, that is, Slow-running System, Main System at the middle and high speed running, Float system for maintaining the fuel level at the regular height, Accelerator Pump and Starter System for starting Engine in a cold condition.

Float System

This system is the device for maintaining the fuel level at the regular height when Engine is running and is composed of the functional parts, Float ② and Needle Valve ①. The construction is shown in Fig. EF-20. The fuel flows from Fuel tank by way of Fuel Pump and flows into Float Chamber ③ through Needle Valve ①. If a certain amount of the fuel is filled in Float Chamber ③, Float ② will be floated and the float valve will contact closely with the valve seat by the buoyancy of Float, cutting off the fuel flow and as the result the fuel level is always maintained to the regular height.

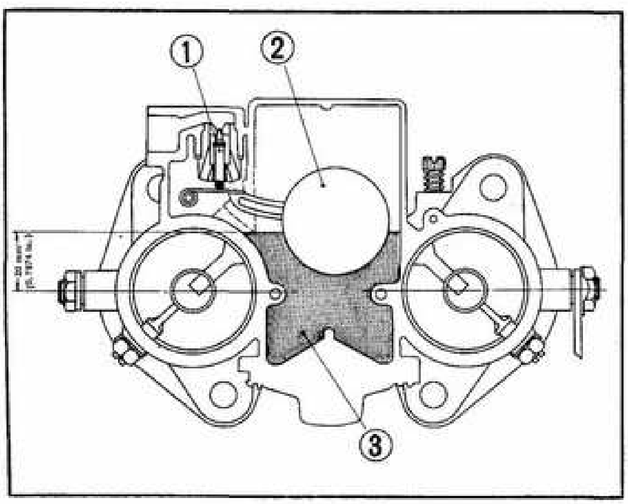


Fig. EF-20

Note: 1) The fuel level is set up to be 20 mm (0.7874 in.) above the center of Main Bore when the fuel pressure is 0.25 kg/cm^2 (3.55 lb/in^2).
As the Fuel level moves up and down with the change of the fuel pressure as shown in Fig. EF-21, be careful not to give a higher fuel pressure than needed which will cause a over-flow of the fuel.

2) Adjust the fuel level by a suitable packing. A standard packing has a 1 mm (0.0394 in.) thickness and 0.5 mm (0.0197 in.) and 1.5 mm (0.0591 in.) packings are available for adjusting.

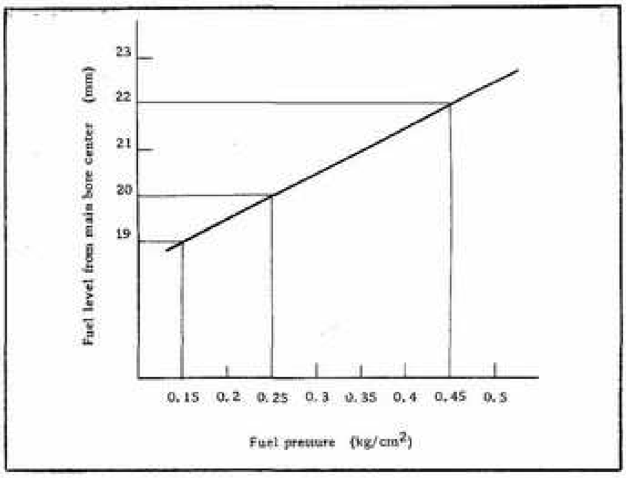


Fig. EF-21

Slow-Running System

This Slow-Running System supplies the mixture for Idling, Slow and Middle Speed running.

This system is composed of such functional parts as Pilot Jet ⑤, Pilot Air Jet ⑥, Pilot Outlet ⑦, Pilot Screw ⑧, By-pass ⑨, etc.

These functional parts are combined suitably to make a mixture of the optimum density and supply this optimum mixture to Engine.

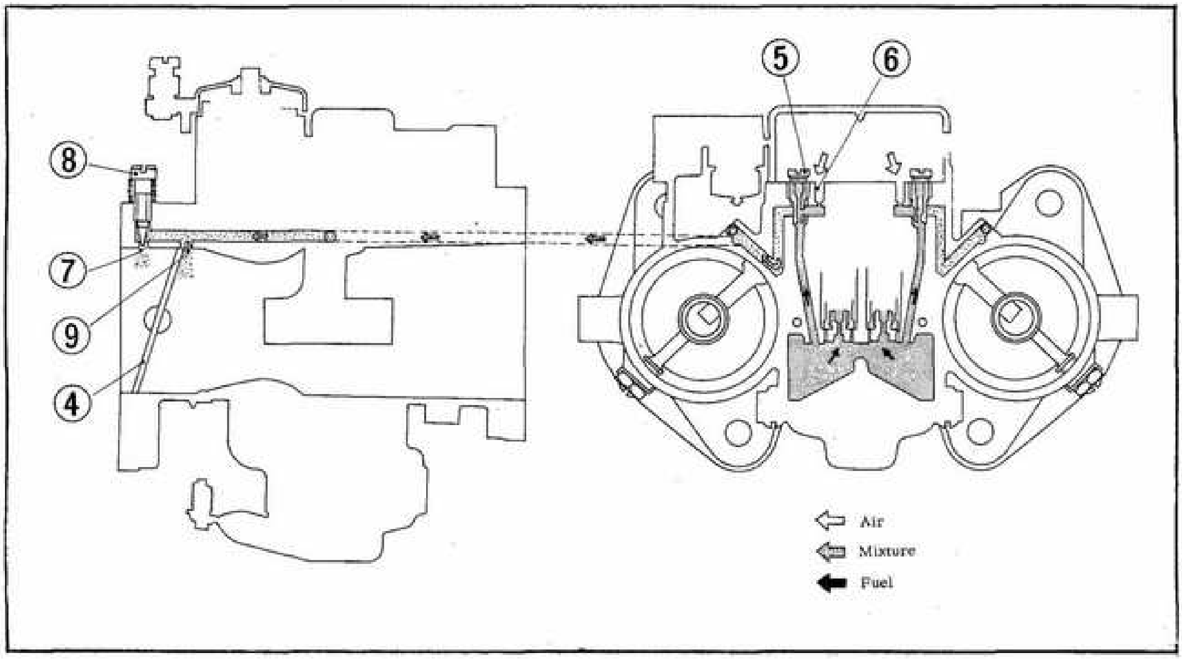


Fig. EF-22

The function of main parts are as follows,

1) Pilot Jet ⑤
This jet will measure the fuel quantity which should be sprayed out from Pilot Outlet ⑦ and By-pass ⑨.

2) Pilot Outlet ⑦ And Pilot Screw ⑧
Pilot Screw ⑧ is screwed into Pilot Outlet ⑦ section and adjust the density of the mixture for idling, varing the opening of Pilot Outlet ⑦ by the tapered end of Pilot Screw.

3) By-pass ⑨

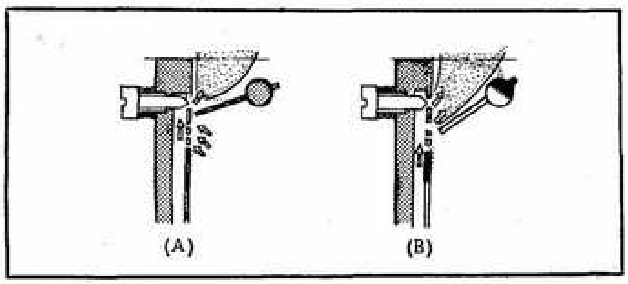


Fig. EF-23

By-pass ⑨ is composed of several small holes.

When the opening of Throttle Valve ④ is small as shown in Fig. EF-23(A) (Idling). The air will be sucked from these holes and make thin the density of the fuel, promoting the vaporization of the fuel.
When the opening of Throttle Valve becomes bigger as shown in Fig. EF-23(B) (Slow-Middle speed running), then the mixture will jetted out from By-pass holes as well as Pilot Outlet.

4) Pilot Air Jet ⑥
This jet measures the air quantity which is to be mixed with the fuel measured by Pilot Jet ⑤.

The opening of Throttle Valve for idling is very small, so the negative pressure of Engine will operate only on the engine side of Throttle Valve and the pressure to the vicinity of By-pass ⑨ will be nearly atmospheric pressure.
The negative pressure of Engine operates on Pilot Outlet ⑦.
The fuel measured in Pilot Jet ⑤ is mixed with the air measured in Pilot Air Jet ⑥ and furthermore mixed again with the air from By-pass, the fuel becomes a well-vaporized mixture of the rather thick density and flows into Pilot Outlet ⑦.

The mixture which flows into Pilot Outlet ⑦ is controled by Pilot Screw ⑧ and sprayed into Main Bore and, mixed with the air flows through Main Bore, the mixture will gain a optimum density and finally supplied to Engine.

In Slow and Middle speed running, it is not enough with the fuel only from Pilot Outlet ⑦ and the mixture from By-pass ⑨ will supplement the shortage.

That is, at first, the negative pressure operates only on Pilot Outlet ⑦ and after Throttle Valve opens more widely than as shown in Fig. EF-23(B), the negative pressure will operate also on the vicinity of By-pass ⑨ and the mixture will be jetted from By-pass holes, too.

As mentioned above, at first only Pilot Outlet ⑦ operates and No. 1 By-pass (nearest hole to Throttle Valve) and No. 2 By-pass operate successively according to the opening of Throttle Valve and as the mixture increase in proportion to the increase of the intake air, the mixture is always kept in a condition of the optimum density.

Main System

Main System supplies the fuel when the high power is needed such as in Middle and High speed running, Acceleration and Climing the hill.

The system is composed of such functional parts as Main Jet ⑩, Main Air Jet ⑫, Jet Block ⑬ and Inner Venturi ⑪.

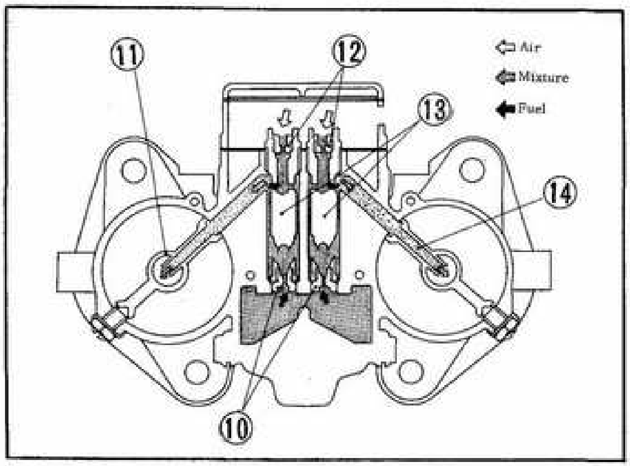


Fig. EF-24

1) Main Jet ⑩
   This jet is used for measuring the fuel needed in Middle and High speed running, Acceleration and Climing.

2) Main Air Jet ⑫
   This jet is used for measuring the air which will be mixed with the fuel measured in Main Jet ⑩.

When the engine revolution goes up and the opening of Throttle Valve exceeds 10%, then the speed of air-flow will be quickened and the negative pressure at Main Nozzle ⑭ grows up and the fuel began to be jetted from Main Nozzle ⑭

That is, the fuel measured in Main Jet ⑩ is mixed with the air measured in Main Air Jet ⑫ After the fuel becomes a well-vaporized mixture of the rather thick density, the mixture is sprayed into Main Bore and, mixed with the air flow through Main Bore, will gain a optimum density and finally will be supplied to Engine.

Accelerator Pump

When Accelerator pedal is pressed down sharply, the fuel to the Main system cannot follow the increase of the air flow and the mixture will thin its density temporarily.

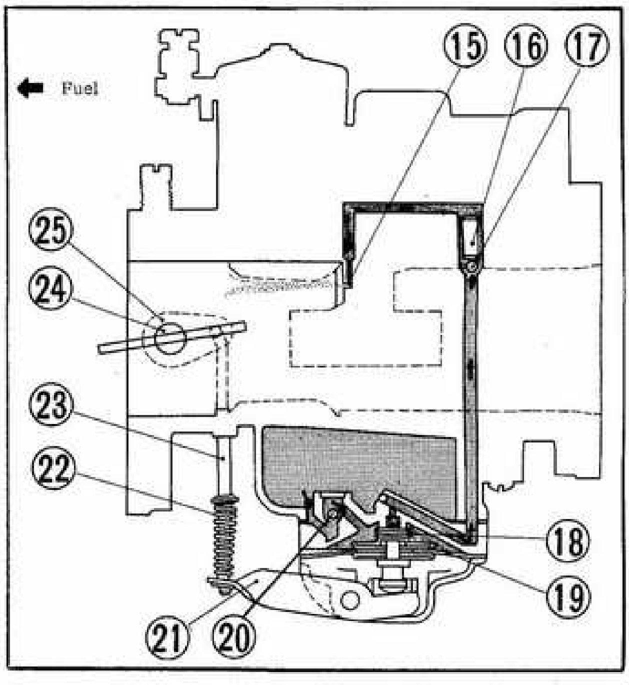


Fig. EF-25

This Accelerator Pump is the device for jetting the fuel to prevent the temporary thinning of the mixture and to improve the follow-up performance of Carburetor.

The construction is like that Rod Lever ㉕ is connected to Throttle Shaft ㉔ and to this Rod Lever ㉕, Pump Rod ㉓ and Pump Lever ㉑ are connected.

When Accelerator Pedal is pressed, Diaphragm ⑲ will be pushed up by way of Rod Lever ㉕ - Pump Rod ㉓ - Pump Lever ㉑.

The fuel in the pump chamber will flow toward Pump Jet ⑮ by the movement of Diaphragm ⑲.

That is, the fuel is devided to two passages and pushes up respective Outlet Check Ball ⑰ and Pump Weight ⑯ and finally is jetted into respective cylinder from Pump Jets ⑮ provided at respective Inner Venturi.

The working range of this pump is just from the opening of Throttle Valve to the 30% opening of that valve.

NOTE: Three holes are provided for Rod setting at the end of Pump Rod ㉓ and the hole at the middle is the standard for setting. When the increase of the fuel jet is required, use the upper hole.

Starter System

This carburetor employs Starter Device instead of Choke valve to increase the suction efficiency.

Starter Device is composed of the functional parts, Starter Jet ㉗ Starter Pipe ㉖ and Starter Disk ㉚.

Pull the Starter button of Dash-board, and Starter Disk ㉚ will be rotated and Fuel and Air passages will open. After Engine is started, Fuel will flow into Starter Pipe ㉖, being measured at Starter Jet ㉗. Some bleed holes are provided in Starter Pipe. A small quantity of air from these holes will be mixed with the fuel and promote the vaporizing of the fuel which will flow into Starter Disk ㉚.

The mixture which flows into Starter Disk ㉚ will be mixed again with the air and gain the optimum density and, after devided into two, flow into each cylinder.

In this Starter Device Throttle Valve will operate as Choke Valve of the conventional type carburetor, so if you press down the Accelerator pedal when starting, the negative pressure operating to Fuel Jet ㉘ will be reduced and the lack of the fuel supply will be result.

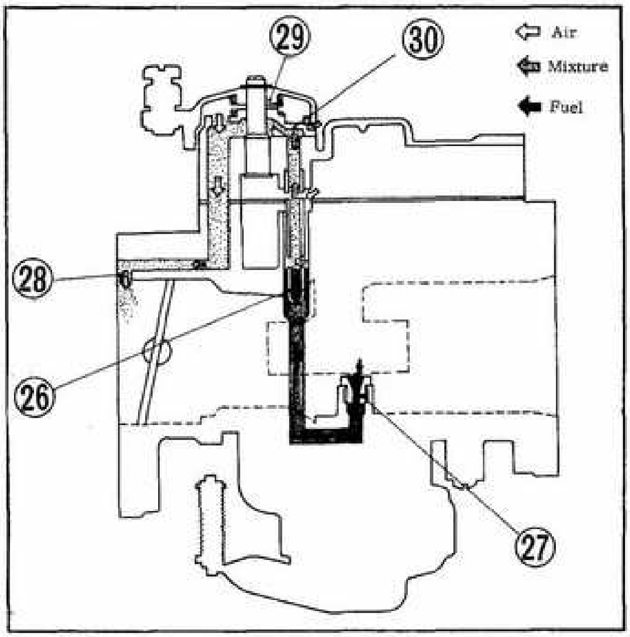


Fig. EF-26

ADJUSTMENT

Idling

Start adjusting after Engine is fully warmed up. Also, be sure to start adjusting after confirming that Throttle valves of all Carburetors are opened in uniform degree. For this, adjust all Throttle valves so that they can fully close under the condition of all Throttle stop screws being loosened. Then, return each Pilot screws for about one round from total close, screw Throttle stop screw in a little and let Engine start. Then, after setting Engine r.p.m. to about the required idling r.p.m. (different for each engines) by Throttle stop screws, set it to the highest r.p.m. by opening and closing each Pilot screws for about 1/4 rounds separately. After obtaining a little higher Engine r.p.m. by doing so, set it to the required Idling (700 r.p.m.) again by Throttle stop screws. Repeat this operation 2-3 times, and the required idling can be obtained.

Medium and High Speed

First, decide Venturies. The size of Venturies depends on the Engine capacity or Engine r.p.m. for maximum power. For racing cars largely requiring high speeds, larger Venturies is required; but, for general motor vehicles, it is recommended to employ Venturies of smaller diameter, instead of larger ones, and increase torque at total-open low-speeds, for easy car running. Therefore, it is necessary to choose two sizes of Venturies, one for normal operation and the other for high output, and to decide, for each of them, the most optimum Main jet, Main air jet, etc. Make rough adjustment by Main jet, and fine adjustments by Main air jet. It is necessary to decide the size of Air funnel, at the same time.

Accelerator Pump

Accelerator pump works for 30% of the Throttle valve opening, by Accelerator pedal pushing, beginning from the position where the pedal is first pushed down. It is important that Pump lever is contacting the Membrane when Throttle valve is opened full. Failing Pump lever to close full and leaving opening there will result in no acceleration at Pedal pushing.

Inspecting and Adjusting Fuel Level

Inspecting

Inspect the fuel level with the carburetor in engine.

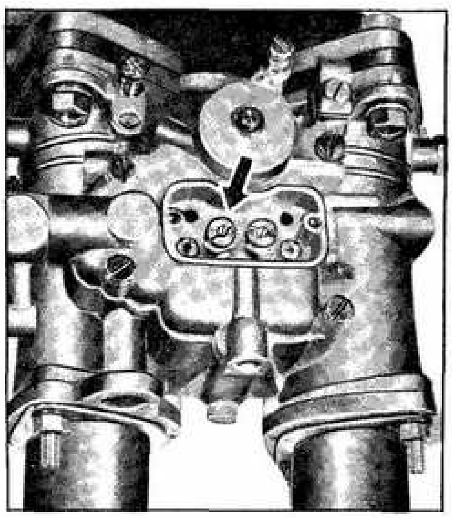


Fig. EF-27

1) Remove Jet Chamber Cover.
2) Remove Jet Block.
3) Insert the fuel level meter into the hole after Jet Block removed.
4) Close the hole on the fuel level meter with a finger and draw up the meter slowly.
5) Read the fuel level on the fuel level meter.

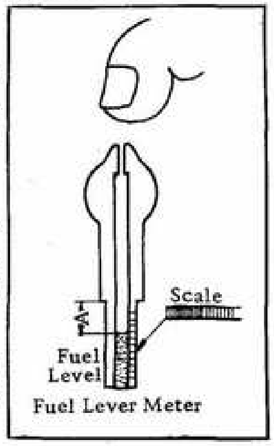


Fig. EF-28

6) If the dimension "A" of the fuel level meter is 18 ± 1 mm (0.7087 ± 0.0394 in.), the fuel level is normal, that is, the fuel level is 20 mm (0.7874 in.) above the center of Main Bore when the fuel pressure is 0.25 kg/cm^2 (3.55 lb/in^2).

Adjusting

If you find the fuel level is wrong, adjust as follows.

1) Adjust by replacing the packing of Needle Valve.
2) The fuel level varies 2 mm (0.0787 in.) with the packing of 0.5 mm (0.0197 in.) thickness.
   That is, if a packing of 0.5 mm is added, the fuel level will be lowered by 2 mm, and if removed, the level will be raised by 2 mm.
3) Standard packing is 1.0 mm (0.0394 in.) thickness and for adjusting, 0.5 mm (0.0197 in.) and 1.5 mm (0.0591 in.) packings are available.

DISASSEMBLING AND ASSEMBLING

Remove Carburetor From Engine

(1) Remove Air cleaner or Air funnel.

(2) Disconnect fuel lines. (Do this carefully, when Exhaust manifold is scorched.)

(3) Remove Throttle wire or Throttle links.

(4) Loosen Starter wire fastening bolts.

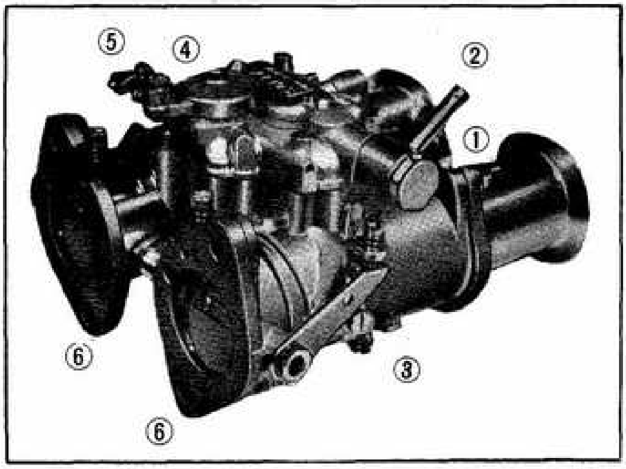


Fig. EF-29

(5) Remove Starter cable.

(6) Remove Carburetor from Intake manifold.

There shall be no scratches on the tight face of Fuel joint and packings.

Clean Filter (wire gauge) by compressed air, and tighten Joint bolts securely so as to keep it free from dust depositing.
(Use 19 mm wrench.)

*Caution

Put Cover on the Intake manifold or Suction ports removed of Carburetor with a piece of cloth to prevent foreign substances from entering them.

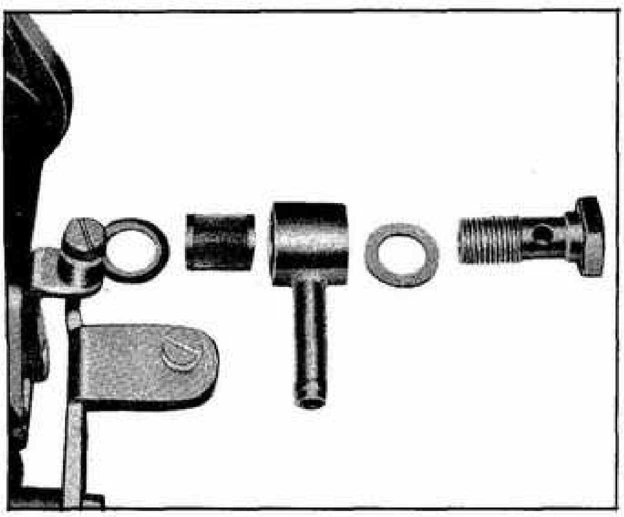


Fig. EF-30

Float Chamber-Remove and Replace

(1) Loosen four screws, and Float chamber cover can be removed.

(2) Remove Float chamber cover carefully not to damage Float chamber packing.

(3) Float can be removed as one unit.

There is no fear of Float to puncture as it is made of foamed material.

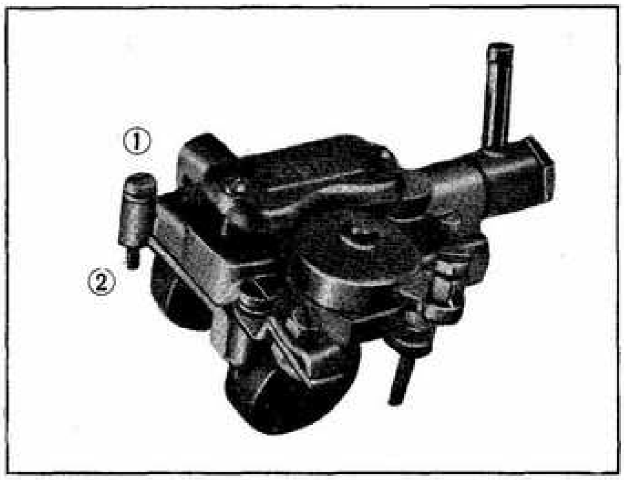


Fig. EF-31

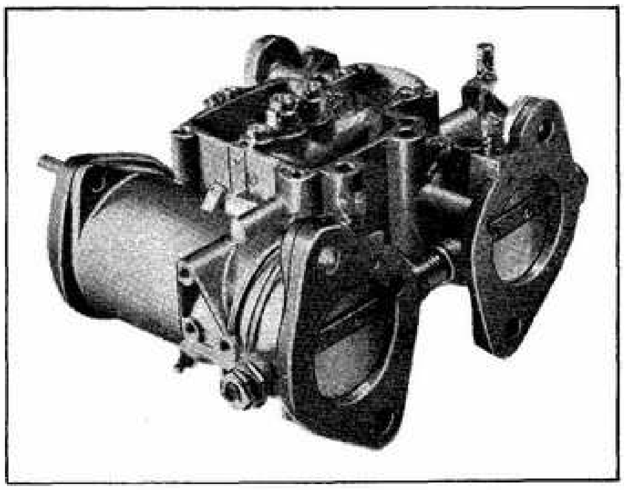


Fig. EF-32

*Caution

It is strictly prohibited to bend (3) Float arm. Especially be careful not to bend it to give change to the fuel level, which is liable to change the carburetor performance.

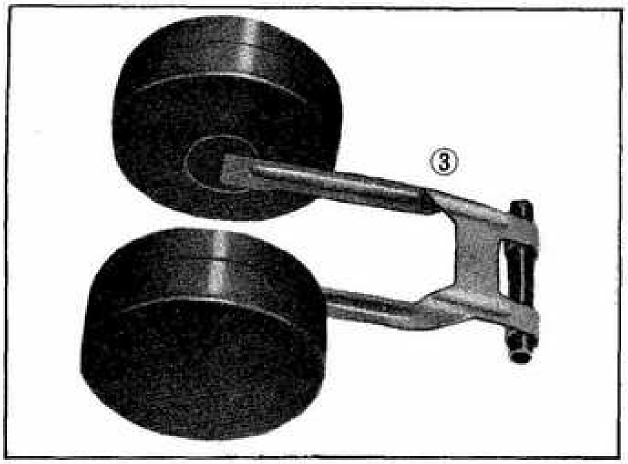


Fig. EF-33

Needle Valve-Remove and Replace

(1) Remove Needle valve(14 mm socket wrench). Engraving (Example: 1.8) shows the diameter of Needle valve in millimeter.

(2) The standard thickness of the packing of Needle valve is 1 mm (0.0394 in.), at which the fuel level is to be standard 20 mm (0.7874 in.) above the center of Main bore when Carburetor being in horizontal condition.
The allowable error is ±1 mm (0.0394 in.).
The fuel level can be changed by adjusting the thickness of the packing as follows:

Make packing thinner ----- fuel level rise.

Make packing thicker --- fuel level lower.

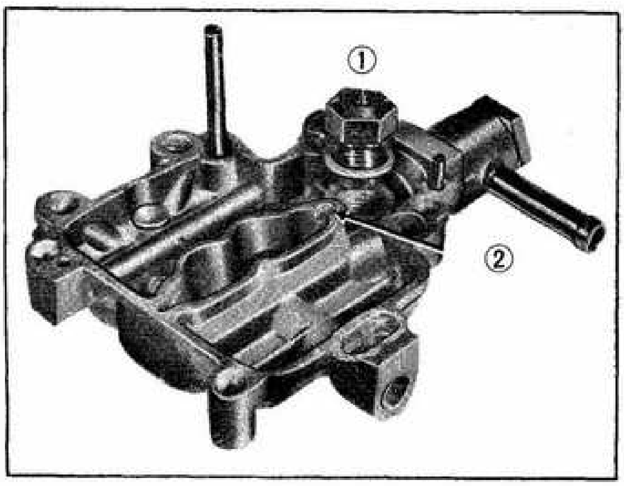


Fig. EF-34

After removing Needle valve, remove Fuel joint and clean it by compressed air.

Check for scratches on the tight surface and fix it, paying attention not to let dust enter.

Jets-Remove and Install

After removing Jet chamber cover.

(1) Remove Main Air jet (MAJ).

(2) Pull Jet block out.

(3) Remove Main jet (MJ) in a manner as illustrated in Fig. EF-36, with screw driver, supporting the head with 10 mm open end wrench.

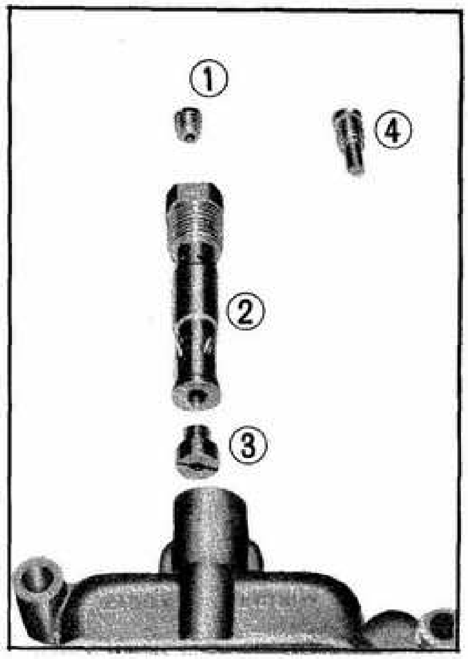


Fig. EF-35

*Caution:

Clean Jets by gasoline and remove foreign substances off by compressed air.

Do not work into the jet holes with wire, etc.

(4) Remove Pilot jet.
(For the working of each jets, refer to Page 74.)

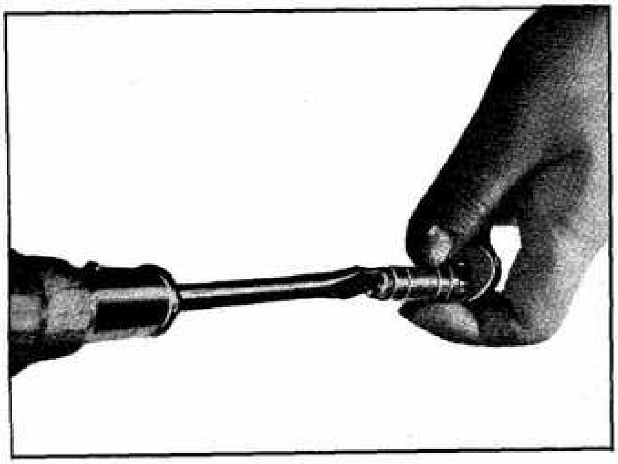


Fig. EF-36

Accelerator Pump-Disassemble and Assemble

(1) Pull Cotter pin out, and remove Washer and Spring.

(2) Remove 6 small screws, and parts (3)-(7) can be removed separately.

(5) Assemble Membrane return spring and Membrane in the correct directions.

(6) Pump body has Check ball inside; confirm working condition of the Pump body by swinging it and listening to the sound of Check ball.

(7) When assembling, confirm that Tight surface, packing, etc. of each part are free from scratches and securely tighten with 6 small screws.
Excess fuel discharged from the Pump goes through Check valve to effect one-way flow of the Fuel.
Remove Float chamber cover

and,

(8) Remove Plug screw, and

(9) Pump weight will come into view, and under it,

(10) Check ball is provided.

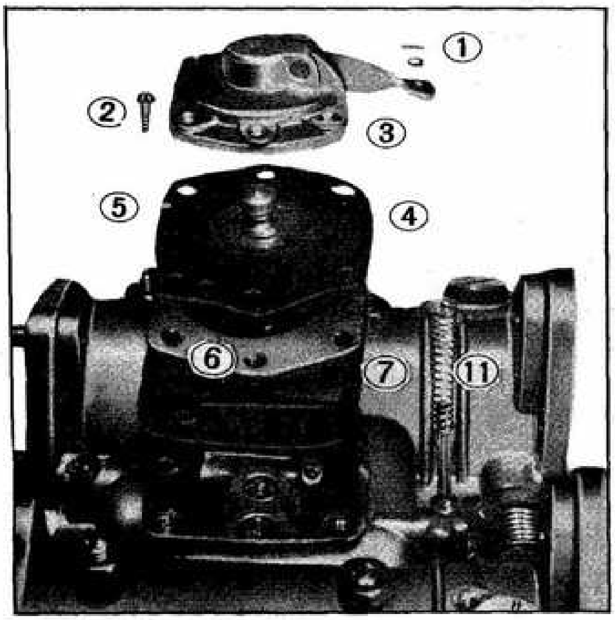


Fig. EF-37

(3) Lever of Pump cover shall be workable smoothly.

(4) Membrane shall be free from scratches or pin holes.

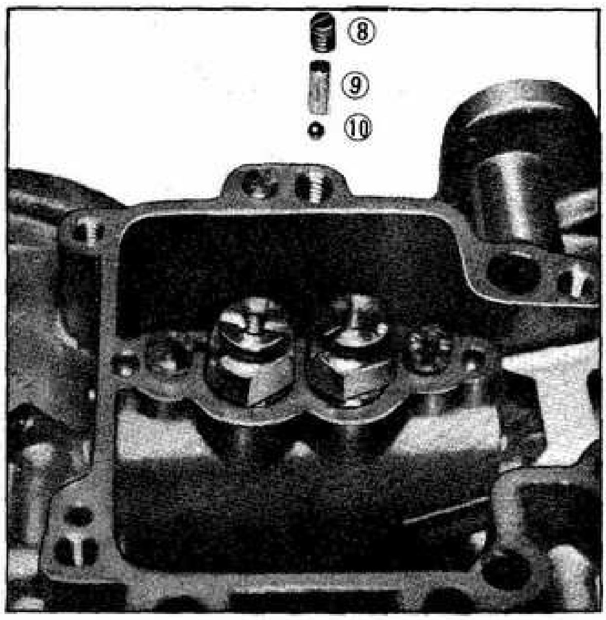


Fig. EF-38

Confirm the surfaces of Ball and Seat part are free from scratches.

Insert Cotter pin into the endmost hole of Pump rod (11) and the discharge of Accelerating pump will decrease (Cotter pin hole at three points.

Starter Pump-Disassemble and Assemble

Remove:

(1) Snap ring,

(2) Starter cover,

(3) Starter disk,

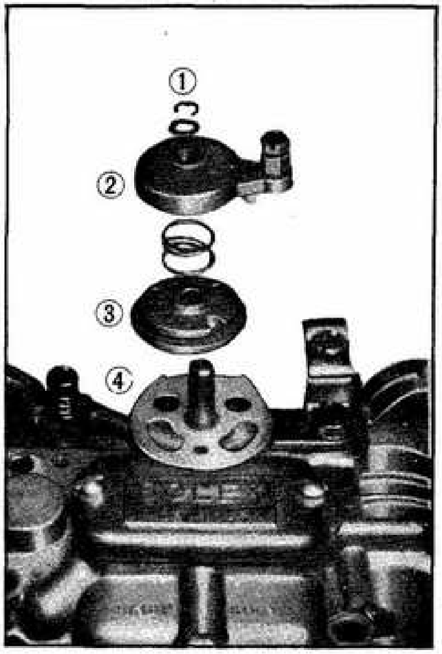


Fig. EF-39

(4) Rubbing surfaces of Starter disk and Carb. body shall be free from scratches.

Scratches or dust will cause leak and un-smooth operation at idling time.

(5) Starter jet (S.J.) is common to Air jet.

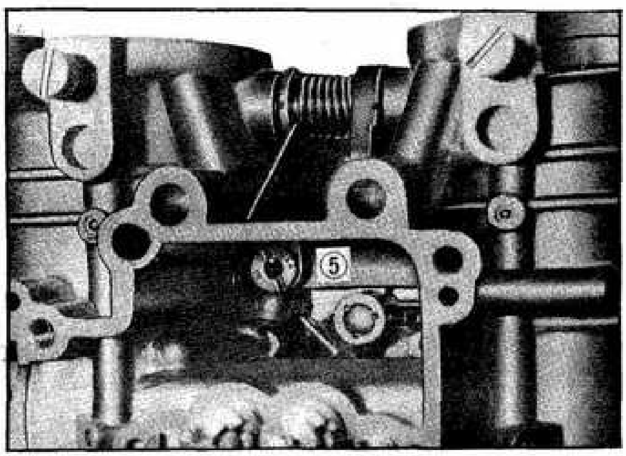


Fig. EF-40

Adjust improper starting and first idling by this Jet.

* This Jet has nothing to do with the output, but is effective only at Stater working time.

Throttle Valve Shaft-Disassemble and Assemble (No.1)

Though Throttle Valve shaft can be disassembled as follows, do not disassemble it without any proper reason.

(1) Remove Nut as illustrated in Fig. EF-41 using 12 mm end wrench and 14 mm wrench paying attention not to cause torsion to the Throttle valve shaft.

The set screw of Throttle valve is caulked at its tip to prevent it from loosening and falling down. So, remove the caulked part using file, etc. as illustrated in the figure and remove the Screw.

When assembling, tighten using a new screw and caulk its tip. Loosened screw will surely cause trouble.

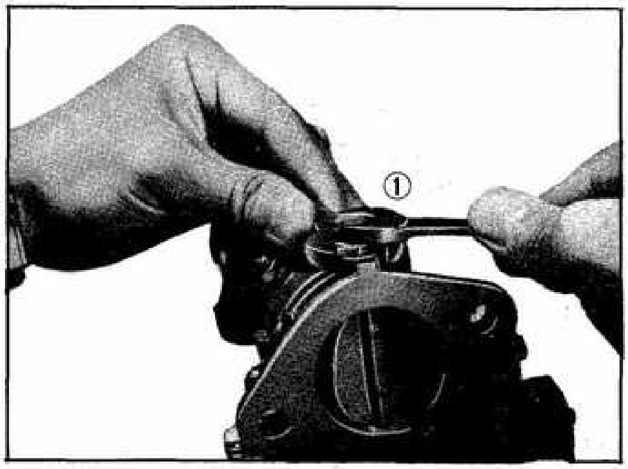


Fig. EF-41

* In repairing, be sure not to give scratches to the inside surface of Throttle valve (the cause of unstable slow-running).

Further, when fixing Throttle valve, assemble it seeing to it that Valves of both Bores will totally close at the same time (the cause of unstable slow-running).

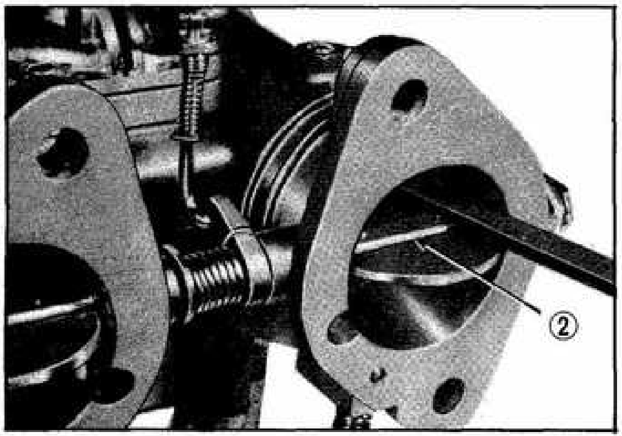


Fig. EF-42

Throttle Valve Shaft-Disassemble and Assemble (No.2)

After removing Throttle valve and Nut:

(1) Remove Snap spring.

(2) Pull Snap pin out.
Then,

(3) Shaft can be pulled out.

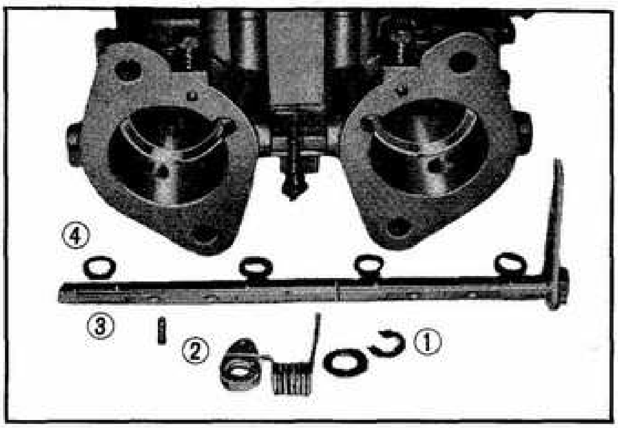


Fig. EF-43

* Caution

1) It is strictly prohibited to bend Shaft.
Especially be careful in pulling out or inserting Shaft as Shaft is liable to bend.
Even a small bend will cause unsmooth working and trouble.

2) Be careful not to lose Dust seal (4) at fixing, as it is easily lost. Lack of Dust seal may accelerate wear and may also cause defective Slow-running.

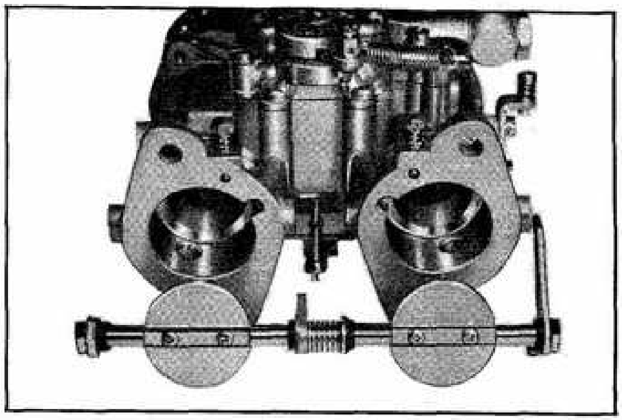


Fig. EF-44

Cleaning and Adjustment of Slow-Running

(1) Pull Pilot jet out in advance.

(2) Remove Pilot screw.
The tip of Pilot screw (P.S.) is in a taper condition and fits to the Pilot outlet hole (P.O.) on the Body side.

(3) There are provided 2 ~ 3 by-pass holes on the passage from P.O. to P.J. which are liable to clog very often.

(4) Clean each holes completely by compressed air.

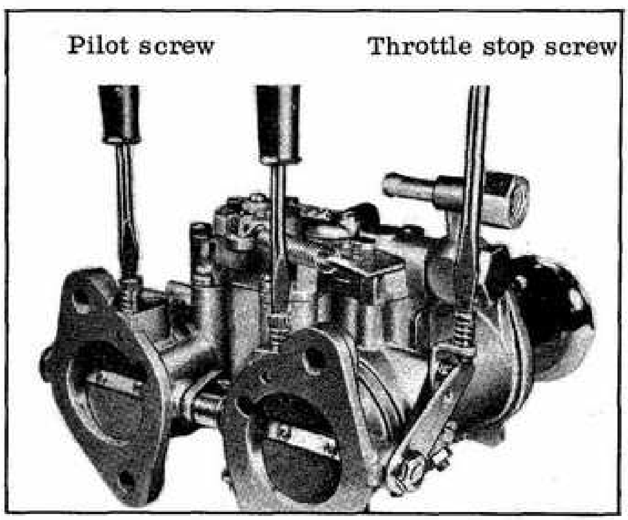


Fig. EF-45

(5) Check the tip of Pilot screw for carbon deposit and remove it.

Exchanging of Outer and Inner Venturi

(1) Loosen 10 mm nut and Remove Air funnel.

(2) Loosen the three nuts.

(3) Remove Inner Venturi.

(4) Remove Outer Venturi.

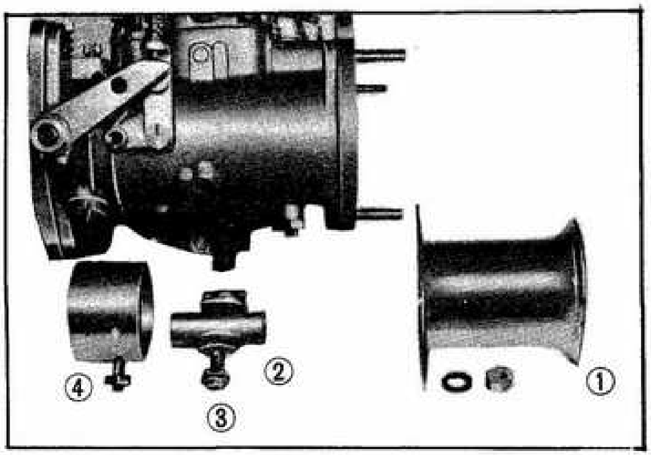


Fig. EF-46

Caution in replacing and assembling:

1. Insert seeing to it that the side of the outer Venturi having inner diameter engraving comes to the cleaner side, and fix Screw seeing to it that the tip of Lock screw fits to the recess of Venturi.
2. Fix Inner Venturi seeing to it that the side having Pump nozzle hole [example: very small hole 0.4 mm DIA (0.0157 in. DIA)] comes to the Suction side and be sure to put packing in and tighten screw tightly.
3. Tighten each nuts fully as they are liable to loosen by Engine vibration.

Each Jets

(1) Main air jet
Jet to regulate air supply only. The larger No., the larger jet diameter.
Example: #185 means 1.85 mm DIA (0.0628 in. DIA); the larger this number, the thinner mixture.

(2) Main Jet
Jet to regulate fuel supply; the larger No., the larger Jet diameter; But the jet No. is decided by the flow instead of by drilled hole diameter. So, the larger this No., the thinner mixture.

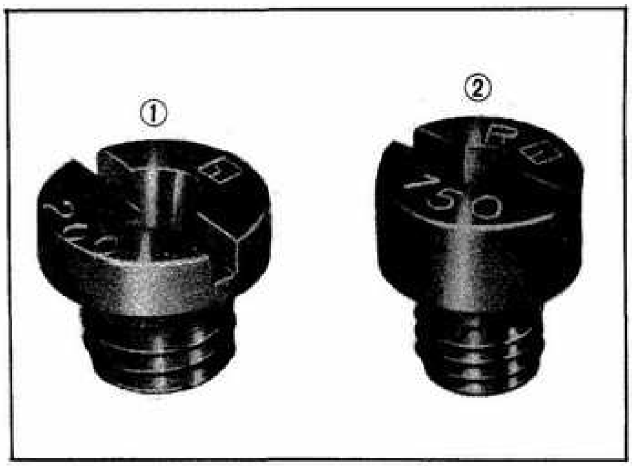


Fig. EF-47

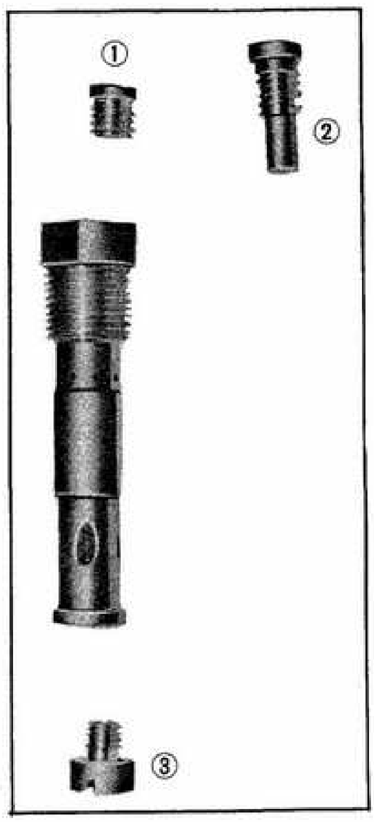


Fig. EF-48

(3) Pilot jet is to regulate the mixture of the Throw system, and the larger its No., the larger jet diameter and thinner mixture.

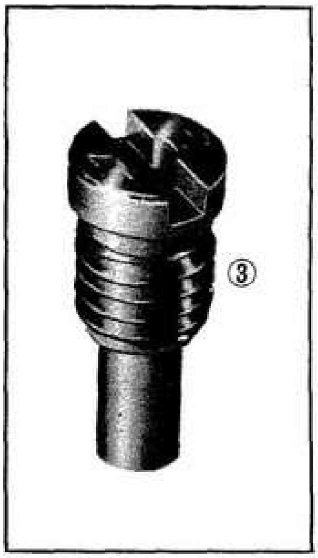


Fig. EF-49

INSTRUCTION FOR BALANCING RIGHT-LEFT (FRONT-REAR) CARBURETORS

(1) Set Pilot screw to the specified number of returnings (1 $\frac{1}{4}$ rounds). (Tighten P.S. to make idling mixture thinner and loosen it to make mixture thicker.)

(2) After Throttle stop screw has struck the Throttle Lever, tighten for another round.

After warming up the Engine:
Balance each cylinder,

(3) Using Flow meter,

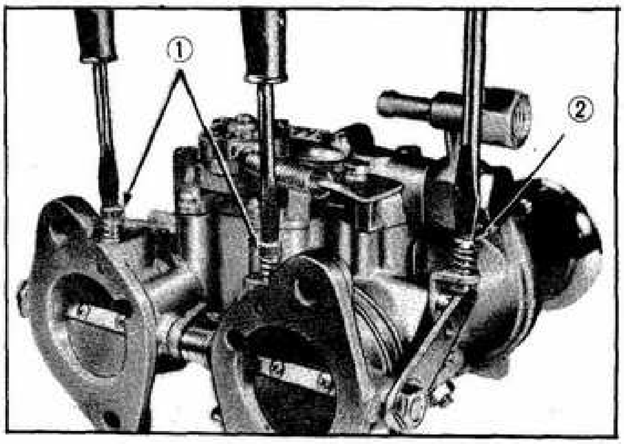


Fig. EF-50

(4) By Joint screw or (2) Stop screw so as to make negative pressure of each cylinders uniform.

After that, adjust, by Pilot screw, so that the Engine attains the highest r.p.m., and, then, make it again to the required idling r.p.m. by Stop screw.

Caution:

(2) Throttle stop screw is for opening Throttle valve.
Tighten it to open Valve and increase r.p.m.

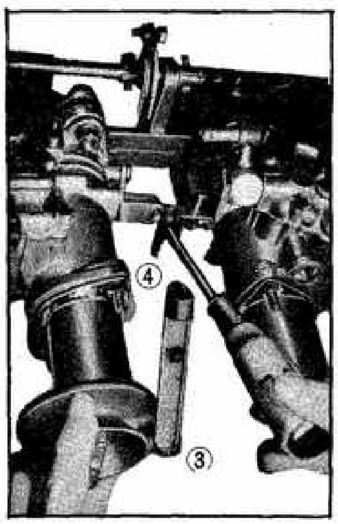
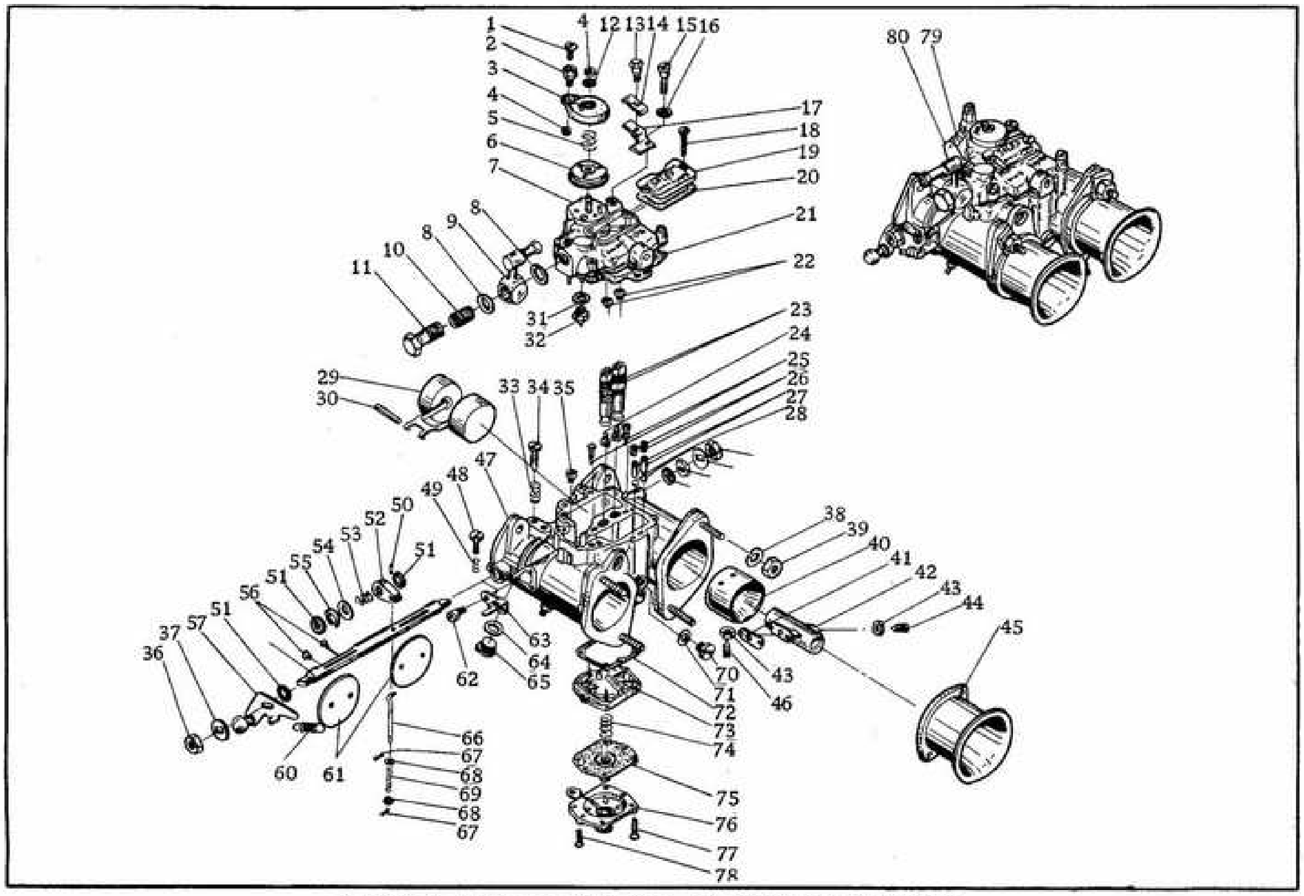


Fig. EF-51



Exploded View of Solex 44 PHH Carburetor

1.	Cable fixing bolt	28.	Ball	55.	Snap ring
2.	Cable fixing collar	29.	Float	56.	Fixing screw; throttle
3.	Starter cover	30.	Spindle; float	57.	Throttle lever comp.
4.	Snap ring	31.	Washer, 12ϕ	58.	Throttle spindle
5.	Starter spring	32.	Needle valve comp.	59.	Nut fixing collar
6.	Starter disk	33.	Volume control screw screw spring	60.	Throttle spring
7.	Float chamber cover	34.	Volume control screw	61.	Throttle butterfly
8.	Washer, 12ϕ	35.	Starter jet	62.	Spring washer screw
9.	Fuel pipe comp.	36.	Nut	63.	Bracket; slow running screw
10.	Filter comp	37.	Washer	64.	Washer
11.	Banjo bolt	38.	Spring washer	65.	Plug screw
12.	Washer, 6ϕ	39.	Nut	66.	Pump control rod
13.	Spring washer bolt	40.	Outer venturi	67.	Split pin
14.	Clip; cable bracket	41.	Gasket-inner venturi	68.	Washer; pump control
15.	Spring washer screw	42.	Inner venturi	69.	Spring; pump control
16.	Washer, 5.3ϕ	43.	Nut	70.	Plug screw
17.	Starter bracket	44.	Fixing screw	71.	Washer
18.	Fixing screw: jet chamber cover	45.	Air funnel	72.	Gasket; pump cover
19.	Jet chamber cover	46.	Fixing screw	73.	Pump cover
20.	Gasket; jet chamber cover	47.	Main body assembly	74.	Pump spring
21.	Gasket; float chamber cove.	48.	Slow running adjustment screw	75.	Diaphragm assembly
22.	Main air jet	49.	Volume control screw spring	76.	Pump cover assembly
23.	Jet block	50.	Stopper pin	77.	Fixing screw
24.	Main jet	51.	Dust proof ring	78.	Fixing screw
25.	Pilot jet	52.	Pump intermediate lever	79.	Starter spring
26.	Plug	53.	Throttle spring	80.	Starter spring bracket
27.	Pump weight	54.	Thrust washer		

COOLING SYSTEM

GENERAL DESCRIPTION

RADIATOR

Type	Corrugated fin and tube type
Pressurised	0.9 kg/cm^2 (0. (12.8 lb/in^2)
Total capacity of cooling water	... 8.5 ltr. (2.245 U.S.gal.)

THERMOSTAT

Type	Wax pellet type
Start to open temperature	82°C (179.6°F)
Fully open temperature	95°C (203.0°F)
Valve lift	at least 8 mm (0.315 in.)

An efficient cooling system is of major importance to ensure the satisfactory running of the engine and it is therefore necessary to pay paticular attention to its maintenance.
Attention is especially drawn to the procedure for winter months, if damage is to be avoided.

The cooling system is maintained by water pump circulation, combined with an efficient fan cooled radiator and thermostat.

The system is pressurised and the relief valve, incorporated in the radiator filler cap, controls the pressure at approximately 0.9 kg per sq.cm. Do not remove the filler cap if the temperature of the coolant is above boiling point or if the engine is running. Topping-up should only be required occasionally to replace water lost through the overflow pipe. Top-up when the engine is cold, and if possible use clean soft water.

The capacity of the system is approximately 8.5 litres (2.245 U.S.gal.).

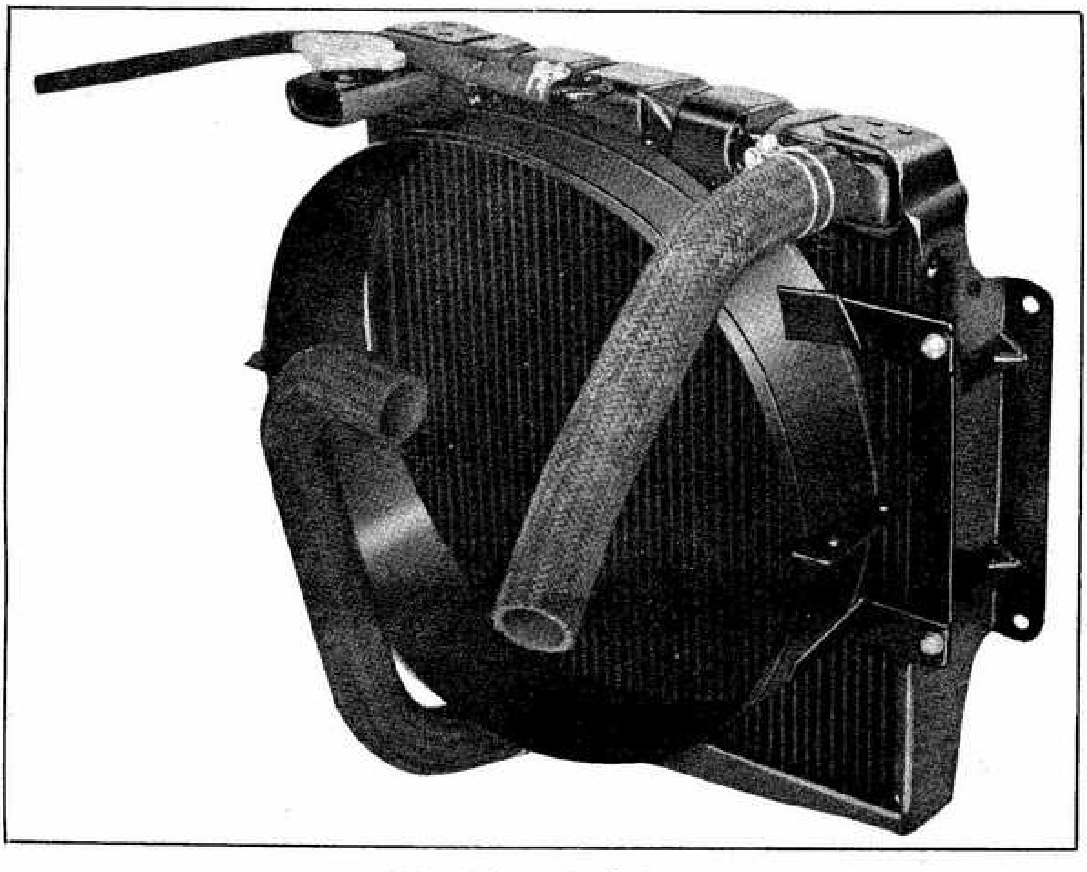


Fig. CO-1 Radiator

Thermostat

In order to ensure maximum efficiency, it is essential to keep the engine operating temperatures within certain limits. To assist this a wax pellet type thermostat is fitted, being located in the water outlet at the front of the cylinder head. The device consists of metallic pellet and rubber sleeve filled with the wax, which controls a valve. When the engine is cold this valve is closed and on starting the engine the flow of water to the radiator is temporarily restricted.

Due to this, the temperature of the water in the cylinder head and cylinder jackets will quickly rise, thus ensuring rapid warming up. The heat so generated will gradually press up the piston by shrinkage of so opening the valve, and ultimatelly permitting a full flow of water to the radiator.

The thermostat itself is detachable; therefore, should the occasion arise, it can be removed from its housing and the hose reconnected to avoid laying up the car. Should the thermostat be tight, there are two tapped holes on the top which may be utilized to ease if from casting. When the system has been completely emptied, it is essential to allow air to escape through the thermostat valve and then finally top-up. The thermostat opening is set by the manufacturer and cannot be altered. It starts to open at a temperature of 82°C. The thermostat can be easily tested by immersing it in water raised to the requisite temperature. The valve should open under these conditions, but if it fails to open a new unit should be fitted.

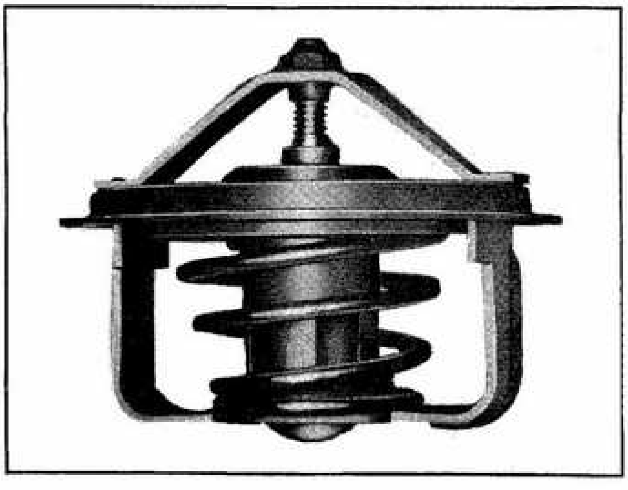


Fig. CO-2

Overheating

Overheating may be caused by a slack fan belt, excessive carbon deposit in the cylinders, running with the ignition too far retarded, incorrect carburetor adjustment, failure of the water to circulate or loss of water.

Fan Belt Adjustment

The fan is driven from the carnkshaft by a "V" belt, this also driving the alternator.

A new belt can be fitted by first loosening the clamp bolts (Fig. CO-3), which hold the alternator in position, and moving the alternator towards the engine. Slide the belt over the fan and onto the fan pulley.

Adjustment is then made by bringing the alternator away from the engine. The belt should be sufficiently tight to prevent slip, yet the belt should have 15 to 20 mm (0.6 ~ 0.8 in.) slack between the alternator and crankshaft pulley when the midspan is pushed firmly.

As the belt fits in the "V" shape groove of the pulleys it is not necessary to have the fan belt excessively tight; to do so may cause excessive wear to the alternator and water pump bearings. After the correct tension has been obtained, securely lock the alternator in position again.

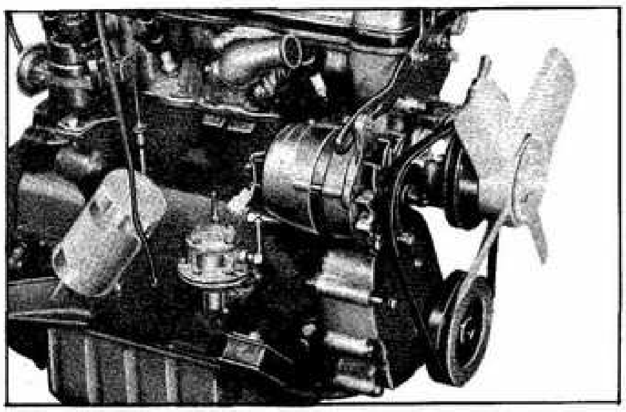


Fig. CO-3 Fan Belt Adjustment

Frost Precautions

Freezing may occur first at the bottom of the radiator or in the lower hose connections.

Ice in the hose will stop water circulation and may cause boiling. A muff can be used to advantage, but care must be taken not to run with the muff fully closed, or boiling will result.

When frost is expected or when the car is to be used in a very low temperature, the anti-freeze liquid should be used to prevent the breakage of the cooling system parts due to freezing.
Anti-freeze liquid must be made up in accordance with instructions applied with the container.

When the warmer season comes and the usage of anti-freeze liquid is no longer required, replace it with ordinary water, otherwise the over heat trouble is sometimes caused.

Protection by Draining

On cars where anti-freeze is not used the following precautions must be taken during frosty water to prevent any damage due to freezing of the cooling system.

When heavy frost is imminent, the cooling system must be completely drained. It is not sufficient merely to cover the radiator and engine with rugs and muffs. There are two drain cocks one on the left hand side of the cylinder block and the other at the base of the radiator block. Both taps must be opened to drain the system and the car must be on level ground while draining.

The drain taps should be tested at frequent intervals by inserting a piece of wire to ensure that they are clear. This should be done immediately the taps are opened, so that any, obstruction freed by the wire may be flushed out by the water. The draining should be carried out when the engine is hot.

When completely drained the engine should be run for a few minutes to ensure that all water has been cleaned from the system.

A suitable notice should be then paid to the radiator, indicating that the water has been drained.

Flushing the Radiator

To ensure efficient circulation of the coolant and to reduce the formation of scale and sediment in the radiator, the system should be periodically flushed with clean running water, preferably before putting in anti-freeze in the winter and again when taking it out in the spring. The water should be allowed to run through until it comes out clear from the drain taps. At intervals a stiff piece of wire should be inserted into the taps during draining to ensure that they are not becoming clogged with sediment.

This method of radiator flushing may serve well, but in cases where the "furring" up is excessive the operator will find it more efficient practice to remove the radiator completely and flush in the reverse way to the flow, turn the radiator upside down and let the water flow in through the bottom hose connection and out of the top connection.

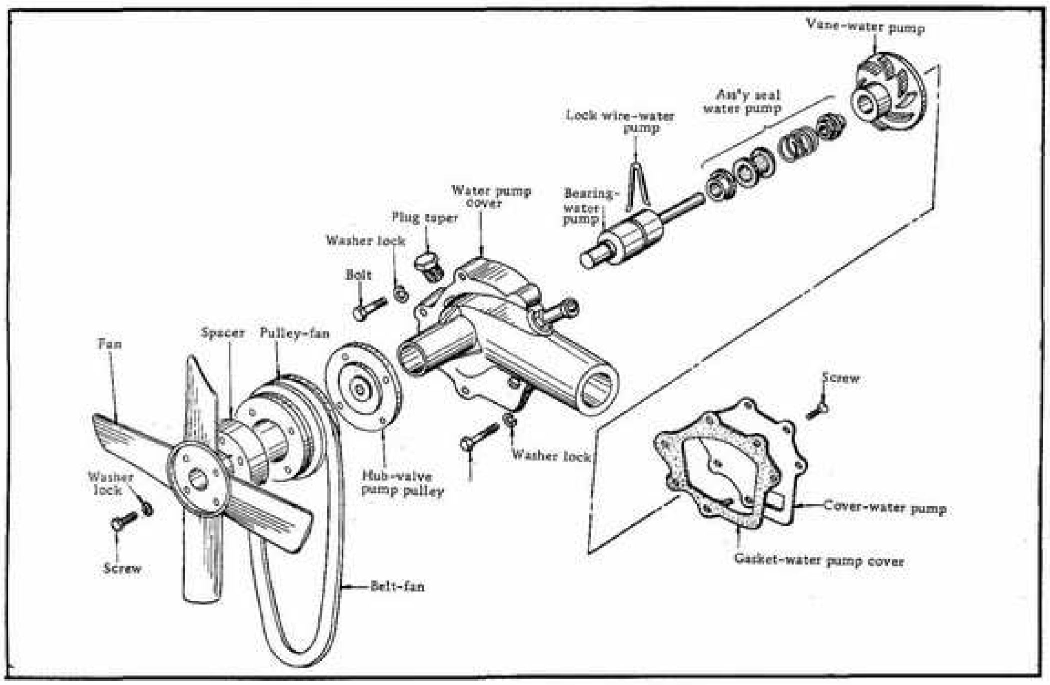
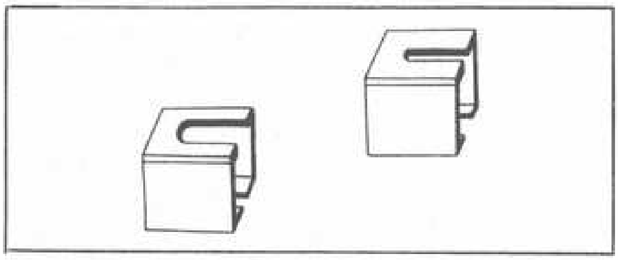


Fig. CO-4 Water Pump

After draining the water from the radiator, remove the pump unit from the cylinder block by taking off the fan belt and removing the set bolts with spring washers.

The shaft and ball bearing assembly can be drawn out from the body.

Thus take out the vane, floating seal and seal which remains in the pump body.



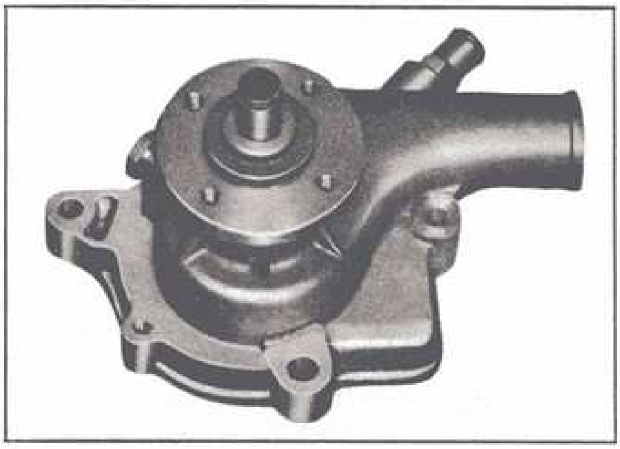


Fig. CO-5

Removing the Pump Shaft Assembly

Disconnect the fan blades, pulley and cover.

The shaft and ball bearings is combined with one unit.

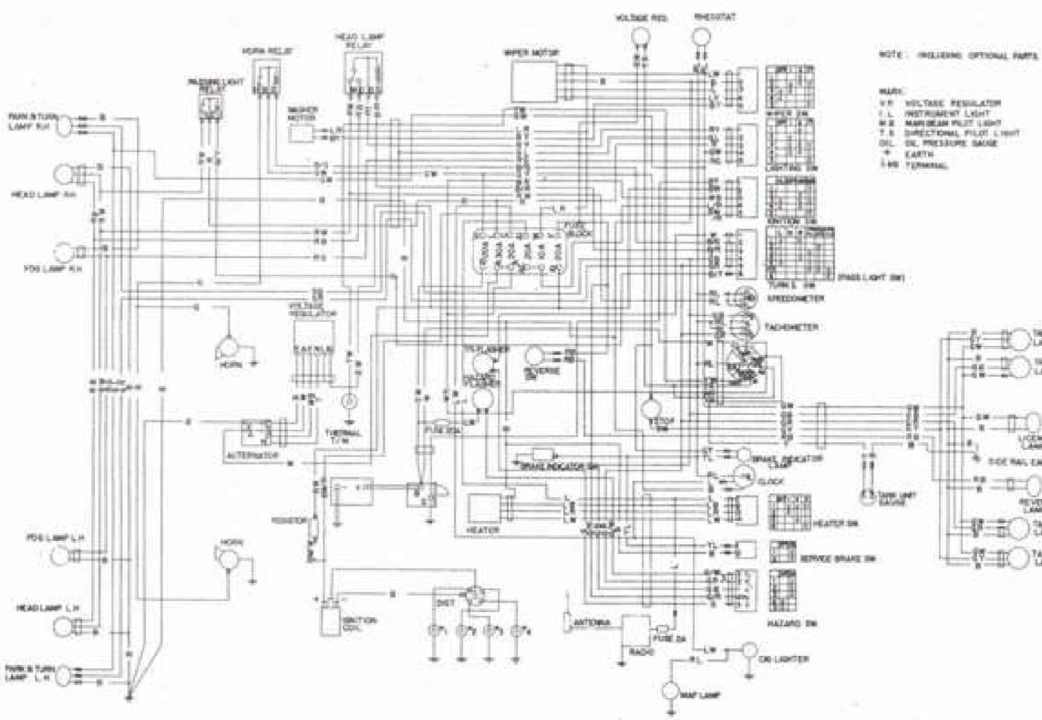
Put the pulley hub on the bench.

First, press or knock the shaft end with a drift (hard bar) and draw out the pulley hub on the U type bench.

Take out the set pin from the slit which locked the shaft assembly to the pump body.

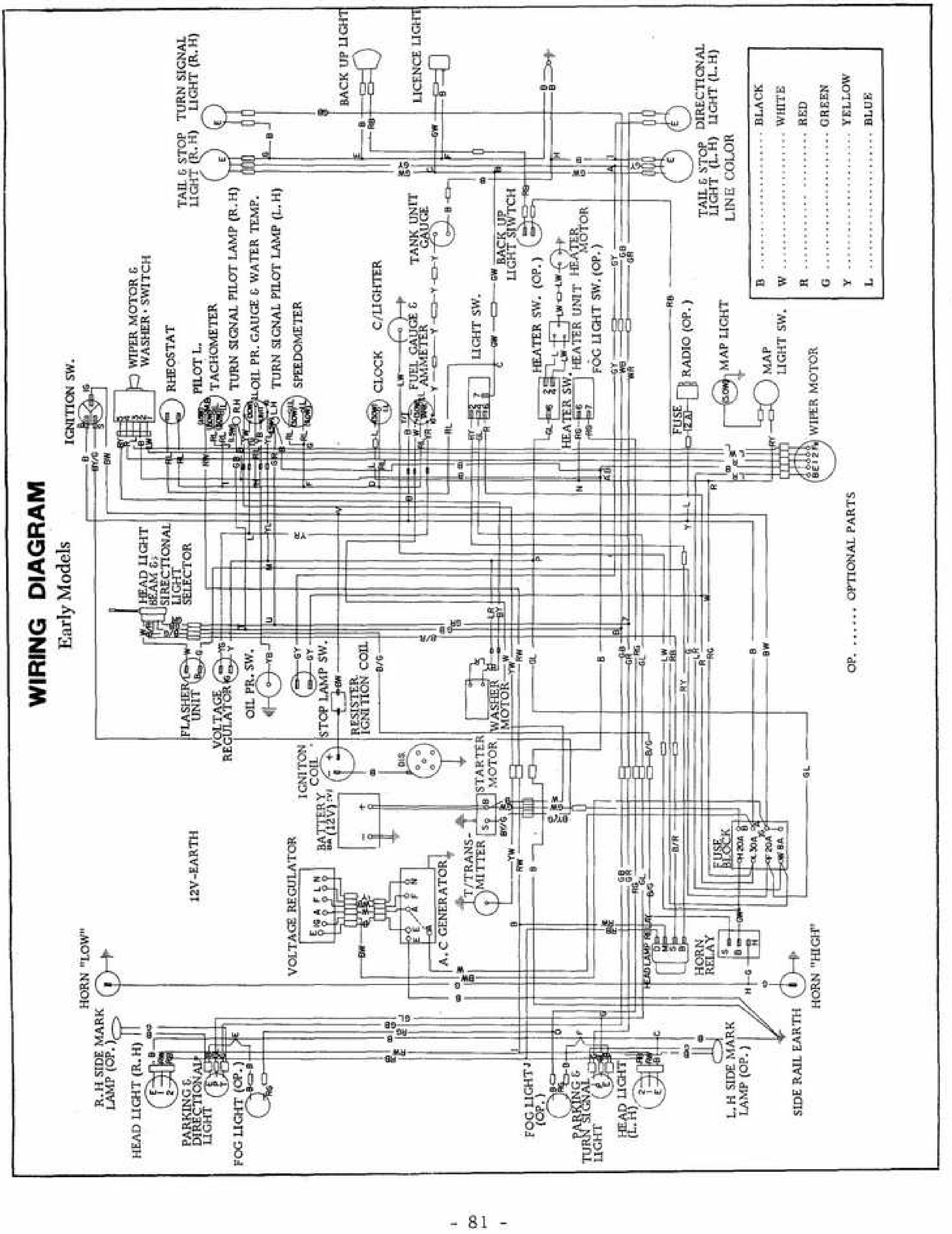
Next, turn the body upside down and press out the shaft assembly from the vane side on the U type bench.

ENGINE ELECTRICAL SYSTEM



WIRING DIAGRAM SPL311-U & SRL311-U

Later Models


WIRING DIAGRAM
Early Models
12V-EARTH
TURN SIGNAL LIGHT (R.H)
TAIL & STOP LIGHT (R.H)
BACK UP LIGHT
LICENCE LIGHT
DIRECTIONAL LIGHT (L.H)
TAIL & STOP LIGHT (L.H)
LINE COLOR
B BLACK
W WHITE
R RED
G GREEN
Y YELLOW
L BLUE
IGNITION SW.
WIPER MOTOR & WASHER SWITCH
RHEOSTAT
PILOT L.
TACHOMETER
TURN SIGNAL PILOT LAMP (R.H)
OIL PR. GAUGE & WATER TEMP.
TURN SIGNAL PILOT LAMP (L.H)
SPEEDOMETER
CLOCK
C/LIGHTER
FUEL GAUGE & AMMETER
TANK UNIT GAUGE
LIGHT SW.
BACK UP LIGHT SWITCH
HEATER SW. (OP.)
HEATER MOTOR
HEATER UNIT
FOG LIGHT SW. (OP.)
RADIO (OP.)
FUSE
MAP LIGHT
MAP LIGHT SW.
WIPER MOTOR
OP. .... OPTIONAL PARTS
HEAD LIGHT BEAM & DIRECTIONAL LIGHT SELECTOR
FLASHER UNIT
VOLTAGE REGULATOR
OIL PR. SW.
STOP LAMP SW.
RESISTER IGNITION COIL
WASHER MOTOR
IGNITON COIL
DIS.
BATTERY (12V)
STARTER MOTOR
T/TRANSMITTER
VOLTAGE REGULATOR
A.C GENERATOR
FUSE BLOCK
HEAD LAMP RELAY
HORN RELAY
HORN "LOW"
HORN "HIGH"
R.H SIDE MARK LAMP (OP.)
HEAD LIGHT (R.H)
PARKING & DIRECTIONAL LIGHT
FOG LIGHT (OP.)
FOG LIGHT (OP.)
PARKING & TURN SIGNAL LIGHT
HEAD LIGHT (L.H)
L.H SIDE MARK LAMP (OP.)
SIDE RAIL EARTH

GENERATOR

SPECIFICATION

Alternator	Mitsubishi Denki
Model	$AS2030A_2$
Nominal output	14V - 30A
Pole	Negative ground
Revolution	1000 ~ 12000 r.p.m.
No load minimum revolution	Less than 1050 c.p.m. (14V, normal temp.)
Output current	23A (14V, 2500 r.p.m., normal temp.)
Pulley ratio	1 : 1.94
Regulator	Mitsubishi Denki
Model	$RL\text{-}2220B_5$
Type	Tirrill type (leaf spring)
Element	Constant voltage relay
Constant voltage relay	3 contact point type
No load regulating voltage	13.5 ~ 14.5V/4000 r.p.m.

Note: Use battery charged in full.

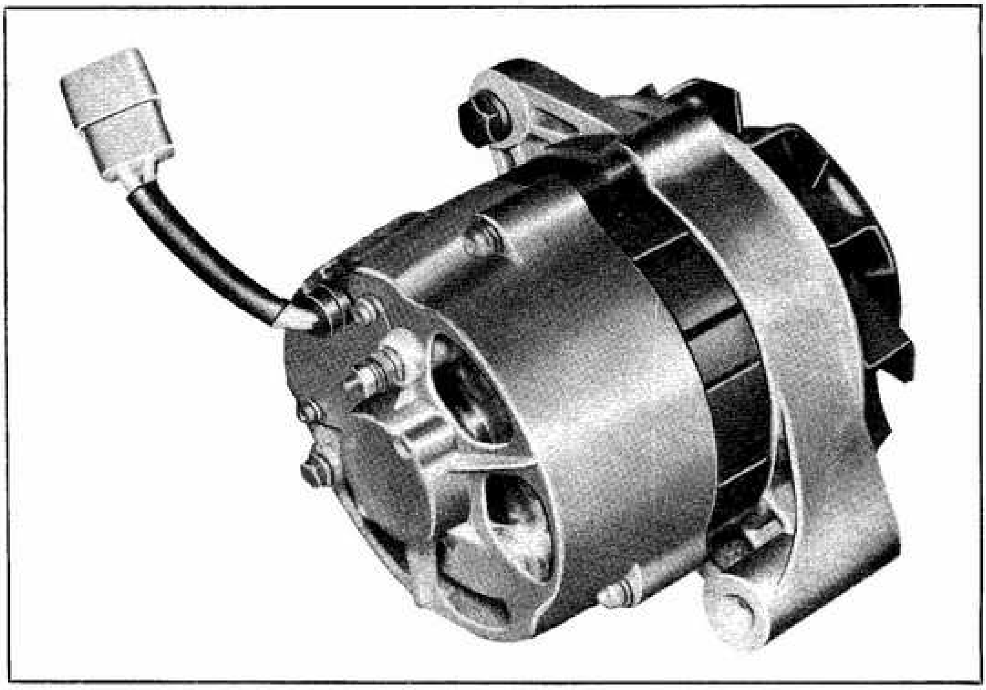


Fig. EE-1

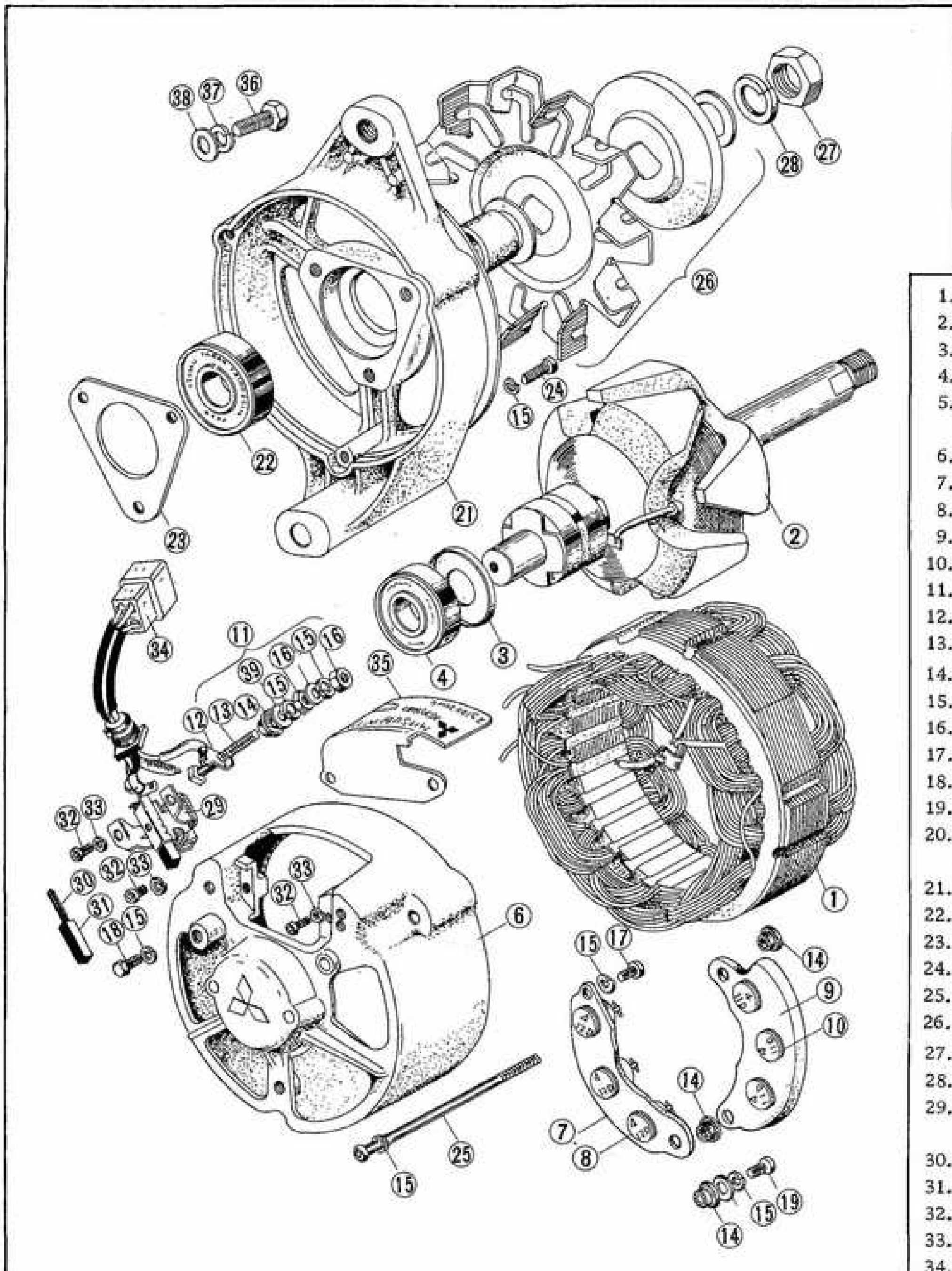


Fig. EE-2

1.	Ass'y-stator
2.	Ass'y-rotor
3.	Seal washer
4.	Ball bearing
5.	Ass'y-rear bracket (Inc. No. 6 ∿ 19 & No. 39)
6.	Rear bracket
7.	Ass'y-diode set
8.	Negative diode
9.	Ass'y-diode set
10.	Positive diode
11.	Ass'y-terminal
12.	Connector
13.	Square bolt
14.	Insulator
15.	Spring washer
16.	Nut
17.	Screw
18.	Terminal bolt
19.	Screw
20.	Ass'y-front bracket (Inc. No. 21 ∿ 24 & No. 15)
21.	Front bracket
22.	Ball bearing
23.	Bearing retainer
24.	Screw
25.	Through bolt
26.	Ass'y-pulley
27.	Nut
28.	Spring washer
29.	Ass'y-brush holder (Inc. No. 30, 31)
30.	Brush spring
31.	Brush
32.	Screw
33.	Spring washer
34.	Ass'y-connector
35.	Brush cover
36.	Bolt
37.	Spring washer
38.	Washer
39.	Washer

CONSTRUCTION AND FEATURE

Different from the DC generator, Alternator turns the magnetic pole and fixes the armature making it generates 3-phase alternate current, and rectifies all waves with the silicon diodes (+) (-) each three, and takes out as direct current.

1	Stater	11	A Terminal Ass'y	20	Terminal bolt	29	Nut
3	Roter	12	Hex bolt	21	Front bracket	30	Spring washer (7)
4	Seal washer	13	Round head	22	Front bracket	31	Grommet
5	Ball bearing	14	Insulator (5)	23	Seal washer	33	Clip
6	Rear bracket Ass'y	15	Insulator (5)	24	Ball bearing	34	Brush holder
7	Rear bracket Ass'y	16	Filter washer	25	Bearing retainer	35	Brush
8	Diode (-)	17	Washer	26	Round head	36	Brush cover
9	Diode Ass'y	18	Spring washer (5)	27	Through bolt	37	Spring washer
10	Diode (+)	19	Stopper nut	28	Pulley Ass'y	38	Round head

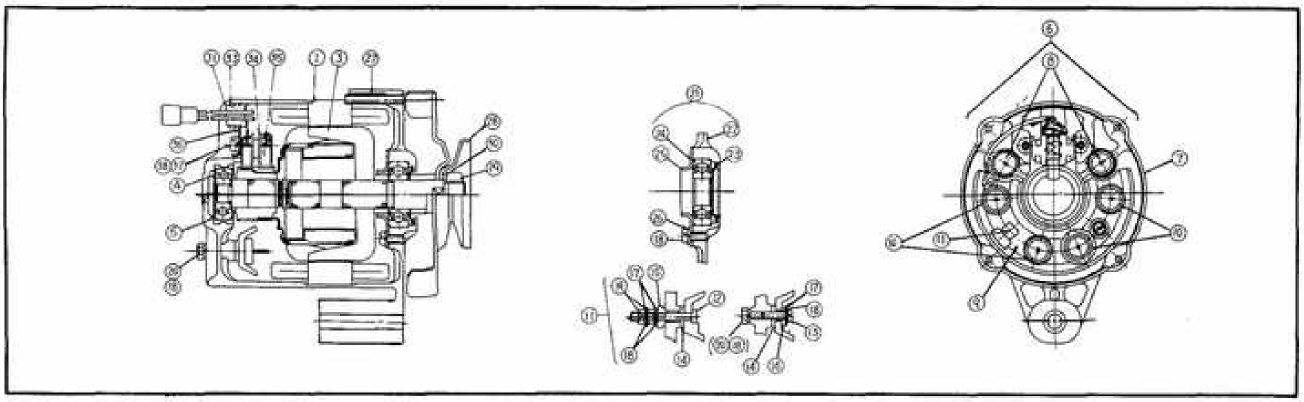


Fig. EE-3

The sealed ball bearings are used to support the rotor. Clearance between the brush and brush holder is also made so as to prevent it from dust. Thus Alternator will increase milage without maintenance. Each 3 diodes are pressed in the rear cover and the diode base respectively.

The clip ring pressed in the shaft is soldered at both ends of the field coil to pass magnetic current.

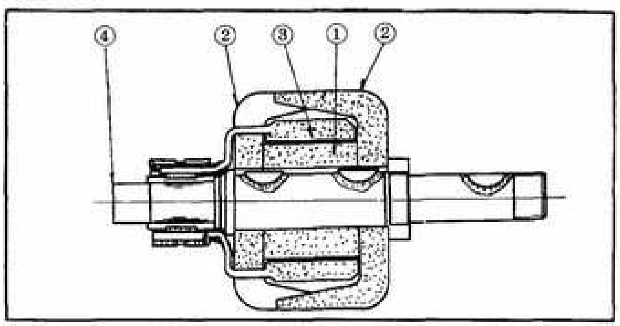


Fig. EE-4 Sectional View of Rotor

① Field core
② Field segment
③ Field coil
④ Shaft

The pole of rotor makes out the magnetic circuit as shown in Fig. EE-5 and all the poles are magnetized by doughnut coil.

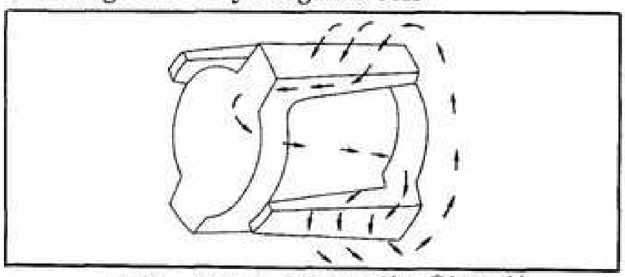


Fig. EE-5 Magnetic Circuit

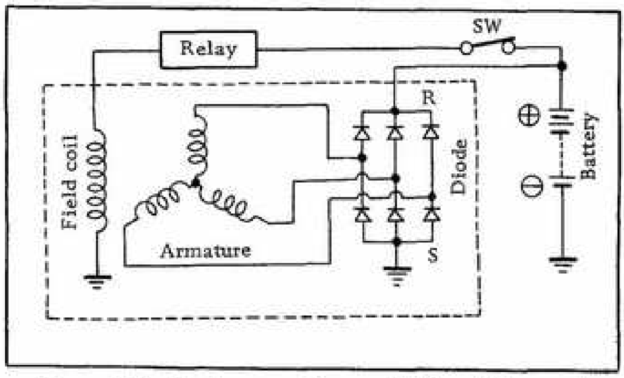


Fig. EE-6 Connection within Alternator

The armature is of a three phase Y connection type and the silicon diode rectifies all waves. It pulls out the neutral point and adds voltage having conducted 3 phase half wave rectification in the circuit of relay.

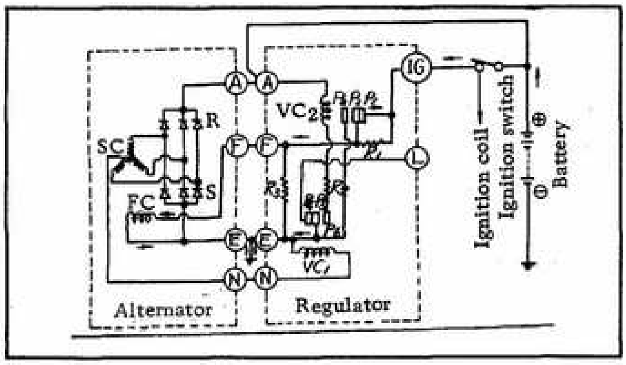


Fig. EE-7 Charging System

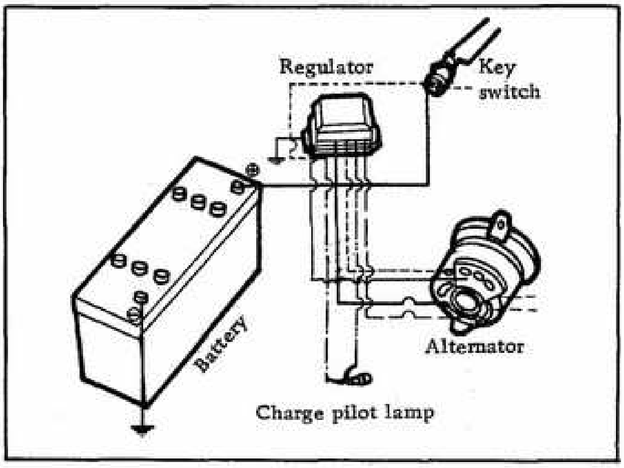


Fig. EE-8 Outside Connection

When the ignition switch is put on, the battery current flows in the arrow marked direction passing through Alternator E terminal, brush slip ring, field coil, slip ring, brush, Alternator F terminal, relay F terminal and IG terminal and completes the field circuit. It is difficult for Alternator to stand up only be residual magnetism of the field core, so that magnetization is necessary until voltage rises to suit charging after the engine has started.

This is because the diode is used and when the voltage is so low, large proportional resistance comes up and current does not flow through the field coil unless Alternator makes very high revolution.

DISASSEMBLY AND ASSEMBLY

Disassembly

Alternator is disassembled in the following order.

1) Remove Complete assembly from Engine.

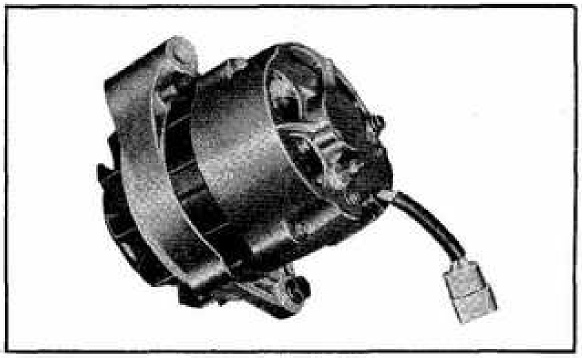


Fig. EE-9

2) Remove Brush cover by unscrewing each setscrew.

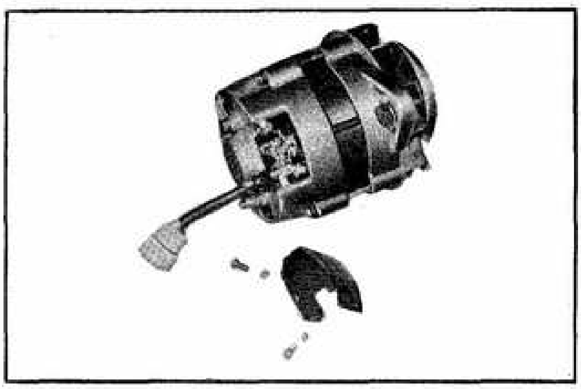


Fig. EE-10

3) Unscrew three through bolts and separate Rotor from Stator by hitting Front Bracket lightly with a mallet.

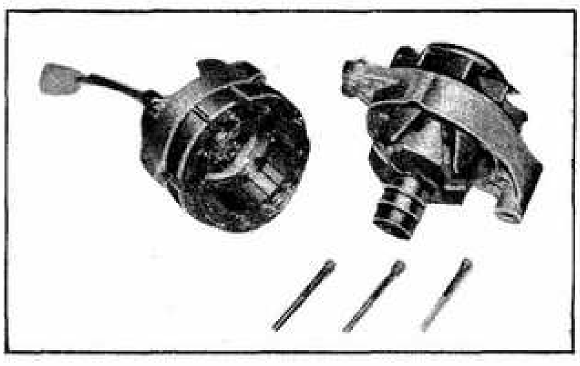


Fig. EE-11

EMISSION CONTROL SYSTEM

FOREWORD

So this manual supplements the SERVICE MANUAL; Datsun Sedan, Datsun Sports, Datsun Pick-up, and L16, U20 Engine.

Since proper maintenance and service are most essential to satisfy the federal air pollution control standard and safety standard by keeping their cars in the best condition, this manual should be carefully studied.

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

CONTENTS

GENERAL DESCRIPTION

There are two types of emissions that must be controlled. These are the crankcase emissions and the exhaust emissions. Crankcase emissions are controlled by use of the Positive Crankcase Ventilation System. Exhaust emissions are controlled by two types, the Nissan Air Injection System (N.A.I.S.) and Nissan Engine Modification System (N.E.M.S.).

Periodic inspection and required servicing of these systems should be carried out at the recommended intervals to assure a cleaner, better performing, longer-lasting engine and almost complete elimination of air pollution.

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.

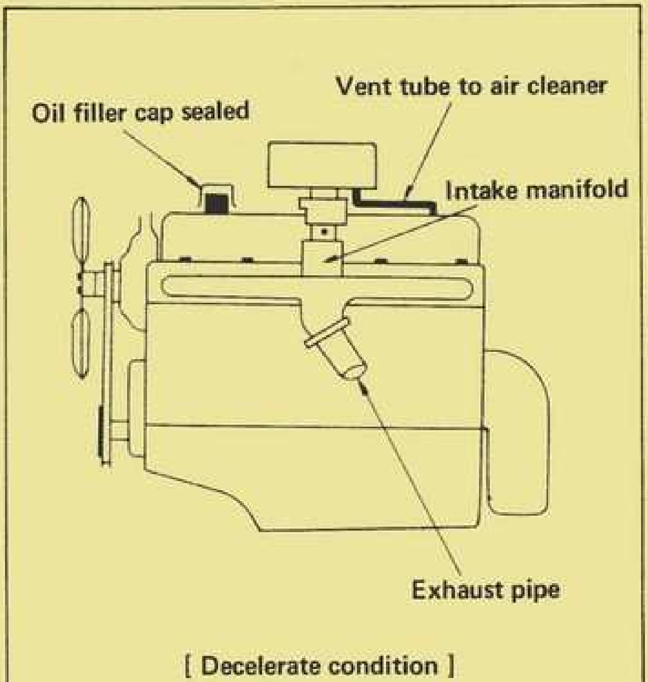


Fig. EC-1 Tube-to-air cleaner device

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.

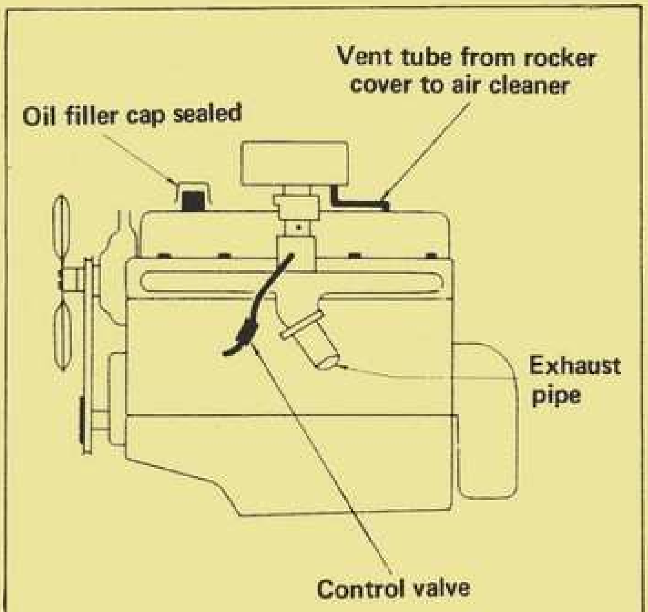


Fig. EC-2 Combination system

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

4) Vise Rotor carefully not to injure the fan. Remove Pulley nut, Pulley rim, Fan and Spacer.

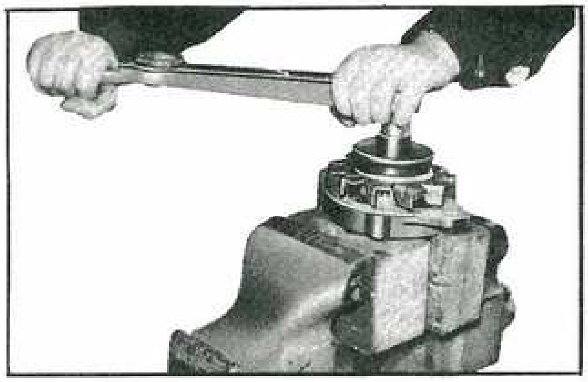


Fig. EE-12

5) Remove Rotor from Front Bracket.

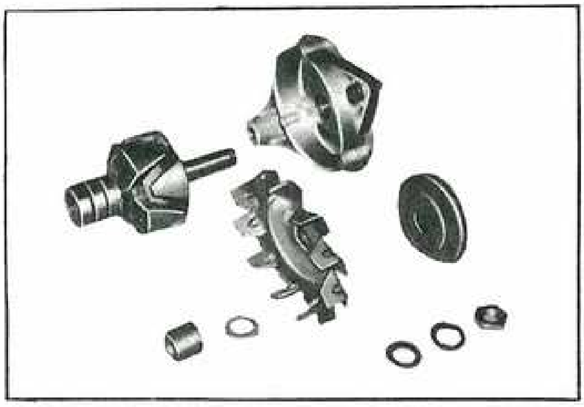


Fig. EE-13

6) Remove Bearing retainer by unscrewing three set screws and push out Bearing, using a arbor press.

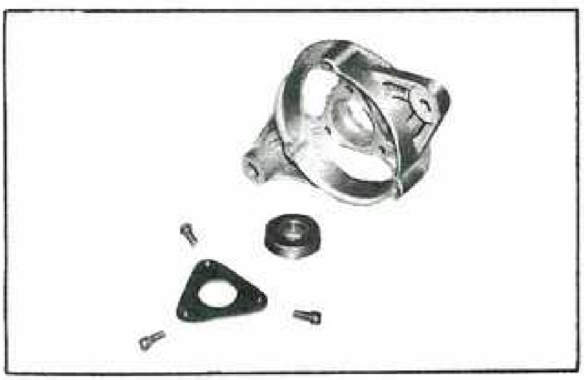


Fig. EE-14

7) Separate Rear Bracket from Stator. Disconnect Negative diode (3 each) from the stator coil lead wire (3 each) and each lead wire between diodes by melting solder with an soldering iron.

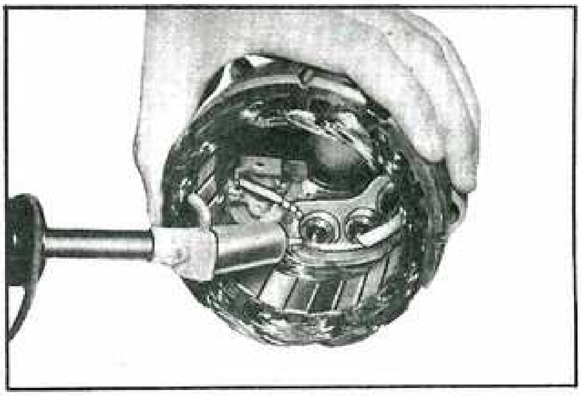


Fig. EE-15

8) Disconnect N terminal lead wire by melting solder, then Rear Bracket and Stator can be separated.

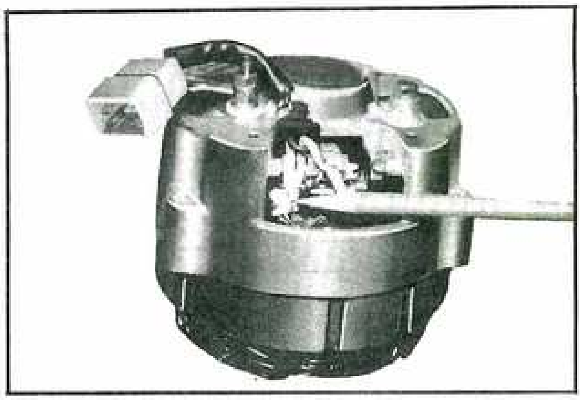


Fig. EE-16

NOTE: When temperature within diode goes up over 150°C the diode will lose its function, so use the electric iron, 100 ~200W, for around 2 seconds at the soldered portions.

9) Remove Diode set and Brush holder from Rear Bracket by disconnecting Lead wire between Positive diode set and Connector. Be careful not to lose small parts such as screws, washers and bushings.

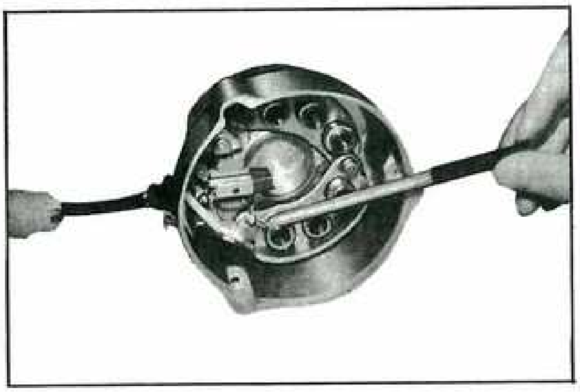


Fig. EE-17

10) Disassemble Brush Holder
Dissolder lead wire F (black/white color), lead wire E (black color) and Brush holder wires (negative & positive), using a soldering iron.

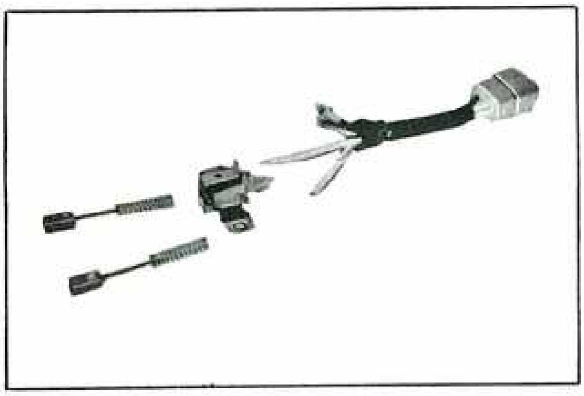


Fig. EE-18

11) All disassembled parts are shown in Fig. EE-19.

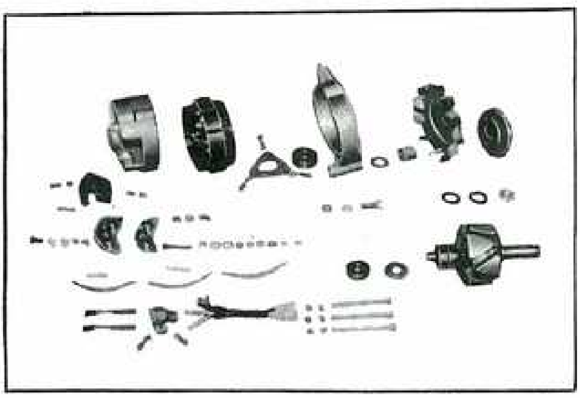
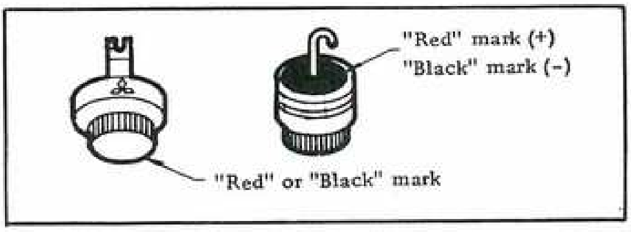


Fig. EE-19

Assembly

Assembly is a reversal of disassembly procedure.

Always make sure the polarity of alternator or regulator before replacing the diode either positive or negative. The polarity of Alternator or Regulator is usually marked on the name plate or label which is attached to each mdoel.



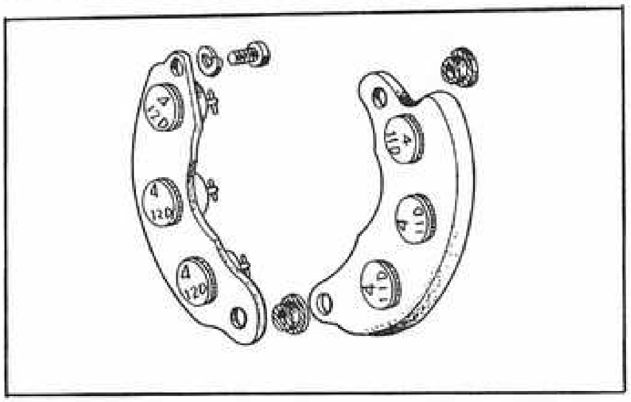


Fig. EE-20 Diode Set Exploded View

Diode Removal

To remove a diode, use a suitable tool to support the end of the frame, or heat sink, and push the diode out by using an arbor press as shown the below.

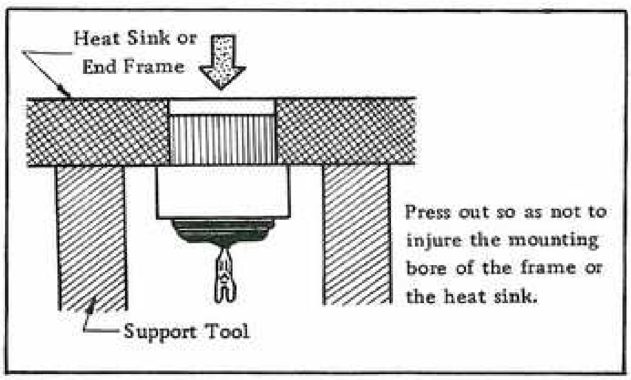


Fig. EE-21

Diode Installation

Support the heat sink or end frame with a suitable tool and then press the diode in the heat sinks by using the tool shaped Ⓐ which fits over the outer diode edge A portion.

Press down perfectly the diode in 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 lb.).

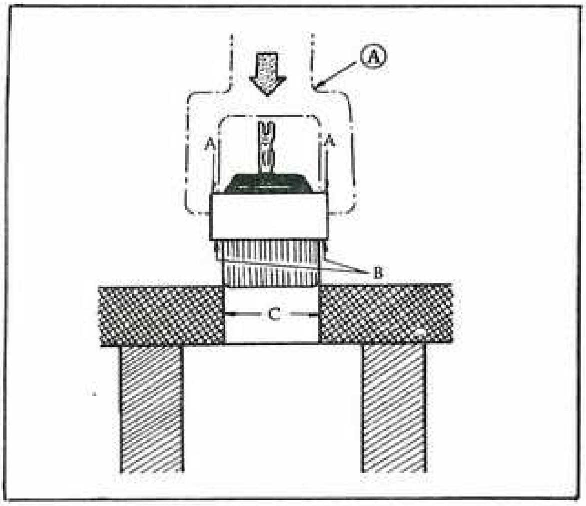


Fig. EE-22

INSPECTION AND REPAIR

Inspection of Output

For output inspection, remove Alternator from the vehicle and connect wiring as shown in Fig. EE-23 and drive it with motor.

Through the wiring shown in Fig. EE-23, magnetic current flows from the battery to the field coil of Alternator. In this state, raise revolution of 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. 1000 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 Alternator. Observe thus increasing output current as revolution of 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 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 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.

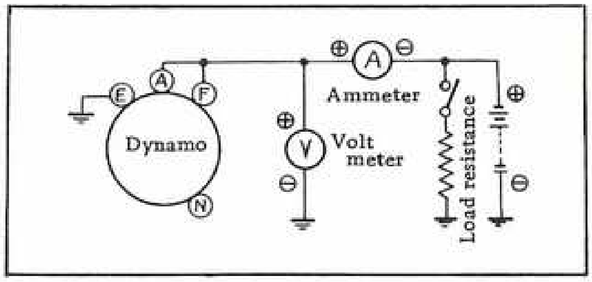


Fig. EE-23

NOTE: Use the battery charged in full up to the normal capacity.

Rotor Inspection

1) Conduction Test of Field Coil

   As shown in Fig. EE-24, 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.

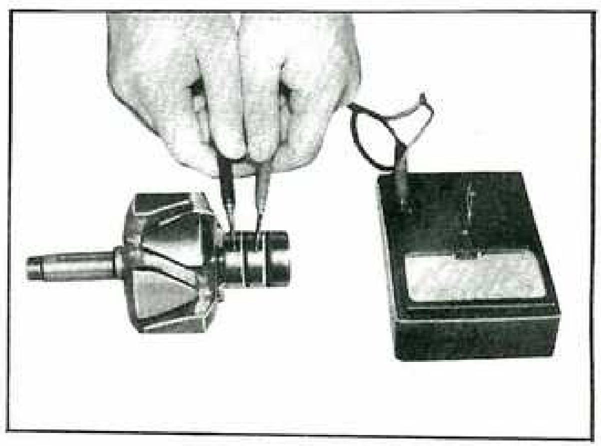


Fig. EE-24

2) Ground Test of Field Coil
Check the conduction between Slip ring and Rotor shaft. If the conduction exist, replace Rotor assembly because in this case, Field Coil or Slip ring must be grounded.

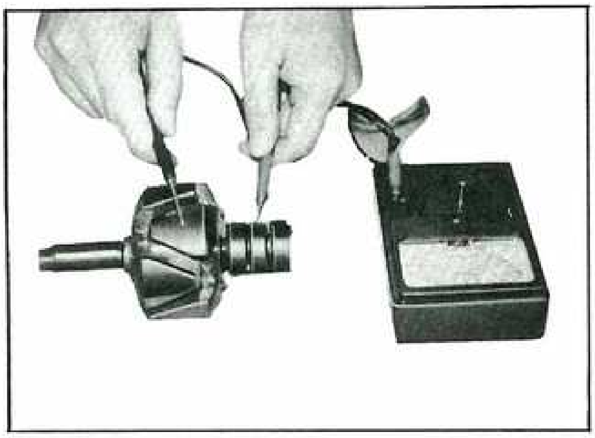


Fig. EE-25

3) Inspection of Rotor Eccentricity
Check the eccentricity of Rotor as shown in Fig. EE-26, using a dial gauge.
Repair or replace if the eccentricity is over 0.10 mm (0.0039 in.).

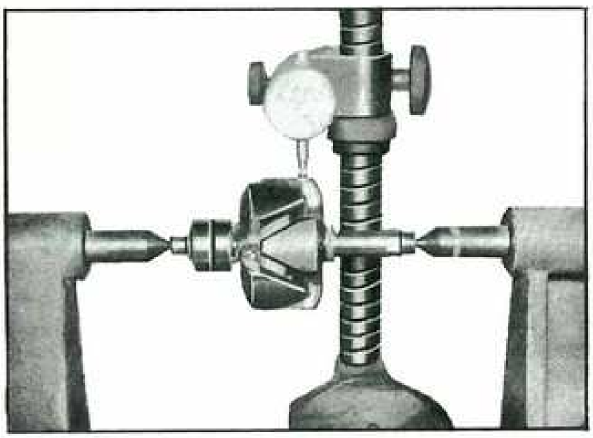


Fig. EE-26

Inspection of Stator(Armature)

1) Conduction Test
If the neutral wire of Stator which is to be connected to N terminal (yellow) is conductive with each lead wire of Armature Coil, the condition is all right.

Fig. EE-27

2) Ground Test
If each lead wire of Armature Coil (including neutral wire) is not conductive with Stator Core, the condition is all right.

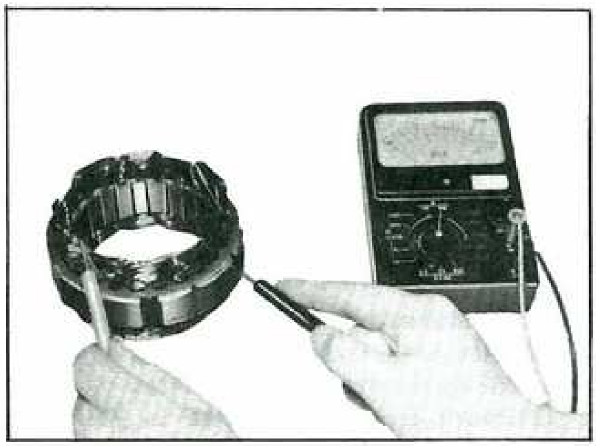


Fig. EE-28

Inspection of Diode (Using Lamp and Battery)

1) Positive Side Diode
Connect Battery negative terminal with Connector A terminal (white color) and Battery positive terminal with Connector N terminal (yellow color) as shown in Fig. EE-29.
Lamp in the circuit will light.

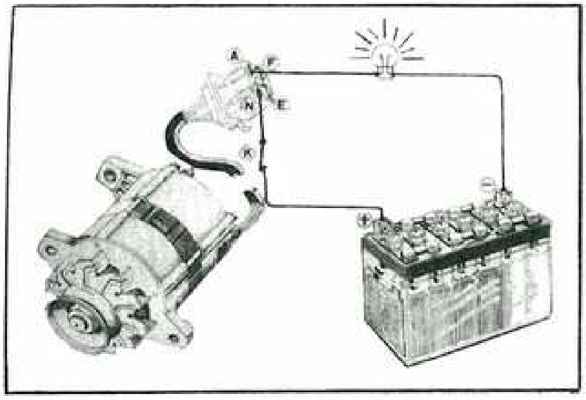


Fig. EE-29

Nextly, if Lamp does not light when the connection is made reversely as shown in Fig. EE-30, the positive side diode is in good working condition.

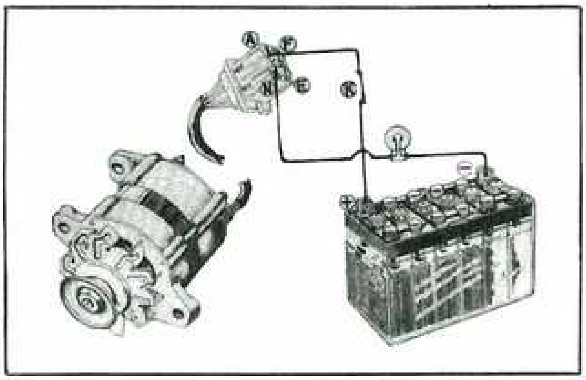


Fig. EE-30

2) Negative Side Diode
Connect Battery negative terminal with Connector N terminal (yellow) and Battery positive terminal with Connector E terminal (black) as shown in Fig. EE-31.
Lamp in the circuit will light.

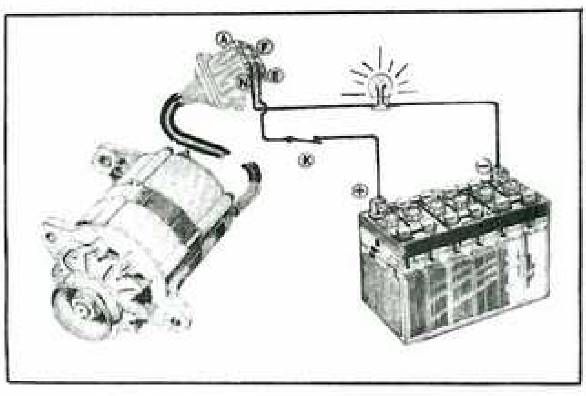


Fig. EE-31

Nextly, if Lamp does not light when the connection is made reversely as shown in Fig. EE-32, the negative side diode is in good working condition.

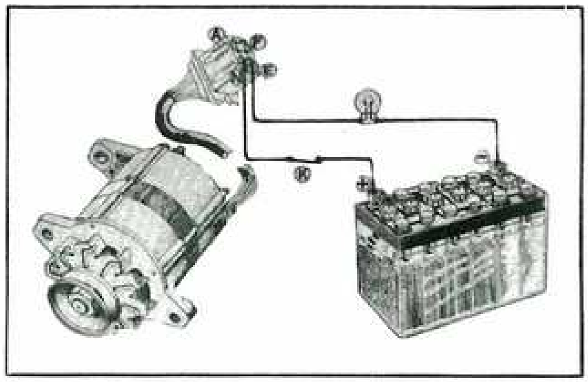


Fig. EE-32

Inspection of Diode with Tester

There are two kinds of diodes as shown in Fig. EE-33. Each diode can be descriminated its polarity by the color of the printed mark or letter on each diode.

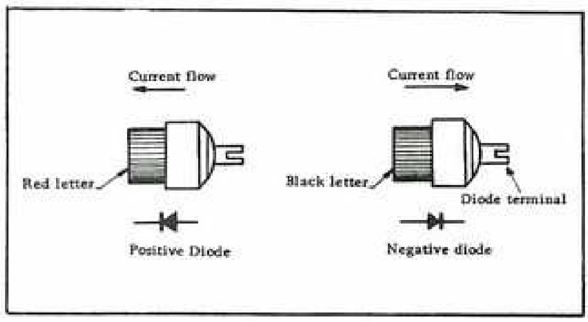


Fig. EE-33

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.

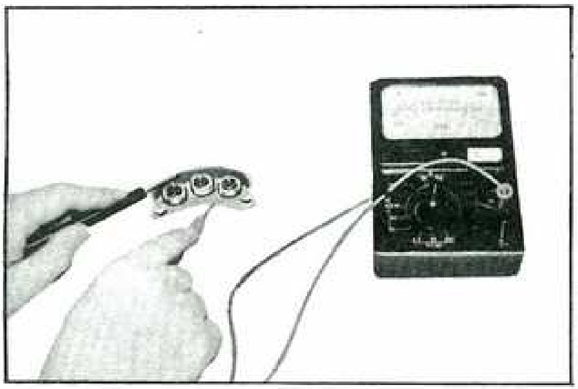


Fig. EE-34 Positive Diode

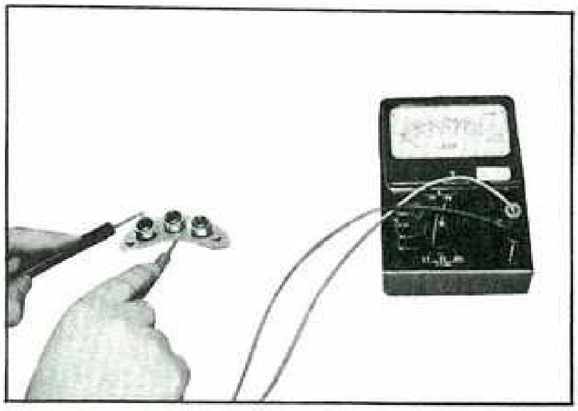


Fig. EE-35 Negative Diode

Inspection of Brush

Check the movement of Brush and if the movement is unsmooth, check Brush holder and clean it.

The standard length of Brush is 13 mm (0.512 in.). If Brush wore off smaller than 6 mm (0.236 in.), replace the brush to new one.

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 2 mm (0.0787 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 lb.). If the pressure is smaller than 0.2 kg (0.44 lb.), replace it.

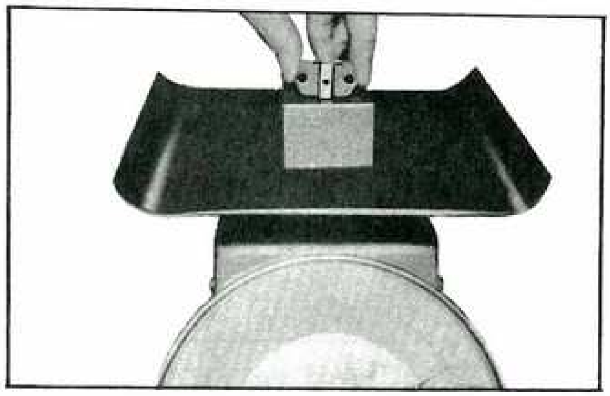


Fig. EE-36

TROUBLE AND REMEDIES

Trouble & Cause	Remedy
Over-discharge of battery	
1. Slackness of fan belt.	Adjust
2. Ground or breakage of stator coil.	Repair or replace
3. Breakage of rotor coil.	Replace
4. Malcontact of brush and slip ring.	Replace brush, clean holder
5. Malfunction of diode.	Replace as a set
6. Adjust voltage of constant voltage relay is low.	Readjust
7. Shortage or unfitness of electrolyte.	Add distilled water, check S.G.

8. Malfunction of battery pole. (short circuit)	Replace or repair
9. Malcontact of battery terminal.	Clean, retighten terminal
10. Malcontact or breakage between ignition switch and relay IG terminal.	Repair
11. Malcontact or breakage between regulator F terminal and dynamo F terminal.	Repair
12. Excessive electric load.	Check power consumed
Over-charge of battery	
1. Constant voltage relay adjust voltage is too high.	Readjust
2. Constant voltage relay coil breakage or rare short.	Replace
3. Constant voltage relay coil straight resistance breakage.	Replace
4. Breakage or rare short of pilot lamp relay.	Replace
5. Malcontact of pilot lamp relay contact point.	Polish contact point
6. Malfunction of regulator earth.	Adjust
7. Malcontact or breakage between regulator N terminal and dynamo N terminal.	Repair
Noises of Alternator	
1. Malfunction of bearing.	Replace
2. Malfunction of diode.	Replace diode as a set
3. Earth or rare short of stator coil.	Replace

REGULETOR

CONSTRUCTION AND OPERATION

(1) Construction

1.	Cover
2.	Packing
3.	Screw
4.	Spring washer
5.	Constant voltage relay
6.	Pilot lamp relay
7.	Connector

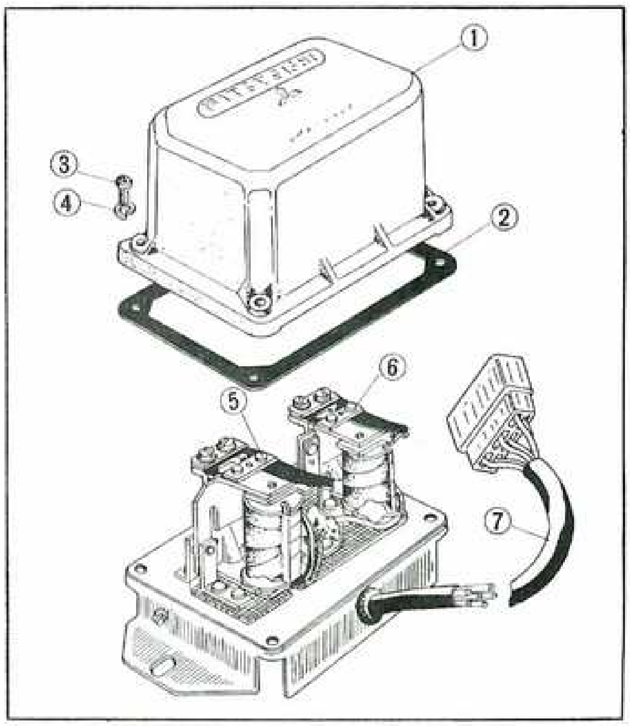


Fig. EE-37

(2) Operation of Constant Voltage Relay

When the ignition switch is on, current from the battery passes through Alternator F terminal, field coil, contact points P_2, P_1 and Alternator is magnetized.

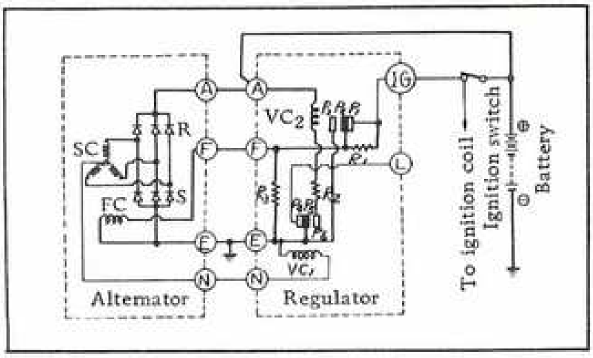


Fig. EE-38

When the engine starts and Alternator is driven, three phase alternate current generates on the stator coil, passing through the three phase all wave rectifier (diode) and changes to direct current between the terminal A-E for charging.

At the N terminal, voltage, half of that between A-E, generates and passes through the circuit, N terminal, VC_1, coil, E terminal and with action of the VC coil, the movable contact

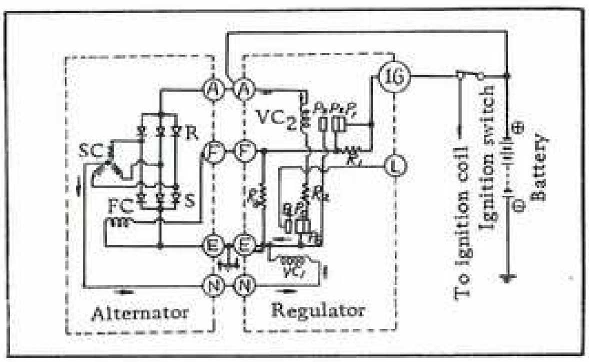


Fig. EE-39

point P_5 leaves from P_4 and makes contact with P_6, so that the lamp is off and it passes through the circuit, E terminal, contact points P_5, P_6, resistance R_2, VC_2 coil and A terminal, then the VC_2 coil animated and prepares to vibrate the movable contact point P_2 of the constant voltage relay.

When Alternator revolution gets higher, the contact point P_2 separates from P_1 with electric magnetism of the VC_2 coil and the field current from the circuit of Alternator E terminal, field coil, F terminal and resistance R_1 and when the contact point P_2 contacts with P_1, the current flows through the circuit of Alternator E terminal, field coil, E terminal, contact points P_2, P_1. This is repeated according to vibration of the contact point P_2 and Alternator terminal voltage is kept evenly and continues charging.

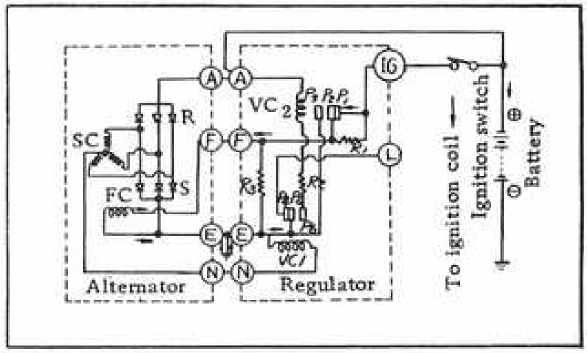


Fig. EE-40

When Alternator revolution gets still higher, the movable piece is drawn and the movable contact point P_2 sticks to P_3, so that current almost does not flow the field and the generated voltage of Alternator goes down. As the result, the contact point P_2 separates from P_3 and the current from through Alternator E terminal, field coil, F terminal, resistance R_1 and voltage goes up again. At such a high speed, with open and close of the contact points, P_2 and P_3, Alternator terminal voltage is always kept evenly.

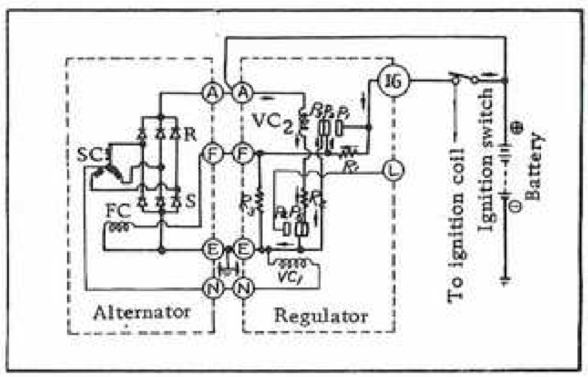


Fig. EE-41

The operation of this time is called a high speed operation and the adjust voltage is called a secondary voltage.

When Alternator revolution goes down and charging capacity reduces, the voltage between the terminals, N-E, also lowers.

As the result, the electric magnetism of VC_1 coil weakens and the contact point P_5 fixed with the movable piece can not continue contact with P_6 and changes to P_4 side and lights the lamp indicating non-generation.

When the ignition switch is turned off to stop the engine, the lamp goes out and the current to the field coil is suspended.

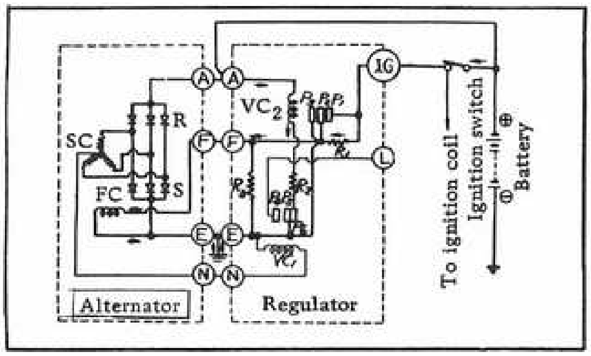


Fig. EE-42

ADJUSTMENT

(1) Check Adjusted Voltage of Constant Voltage Relay

Connect the battery almost charged in full as shown, and raise Alternator revolution to 400 r.p.m.

When the voltage of this time is 13.5 ~ 14.5 V, it is all right.

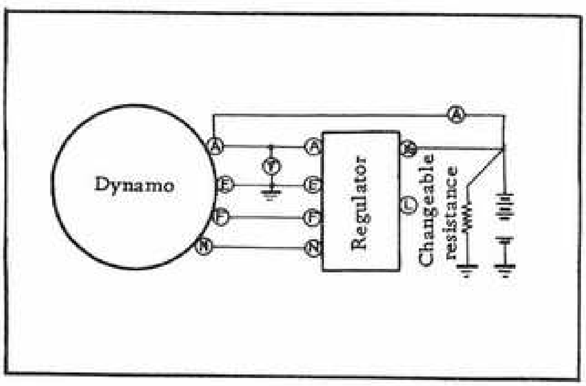


Fig. EE-43

(2) Adjustment of Gap (Constant Voltage, Pilot Lamp Relay)

The voltage adjust values of the constant voltage relay and the pilot lamp relay must be as shown in Fig. EE-44.

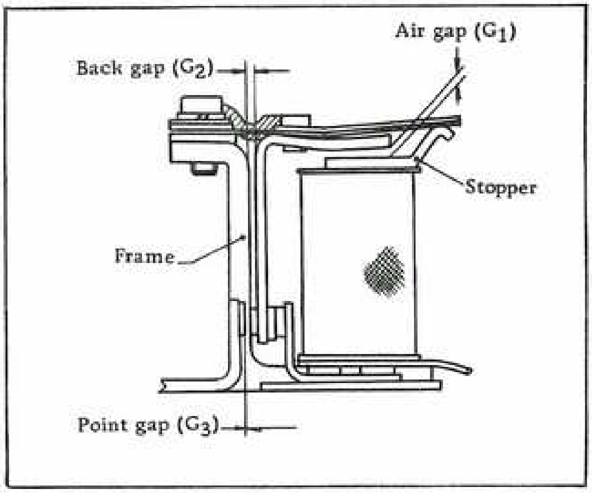


Fig. EE-44

	G_1	G_2	G_3
Constant Voltage Relay	0.8 ~ 1.2	0.8 ~ 1.1	0.3 ~ 0.4
Pilot Lamp Relay	0.9 ~ 1.2	0.75 ~ 1.1	0.75 ~ 1.1

Back Gap

Measure the gap with Pin gauge or thick-

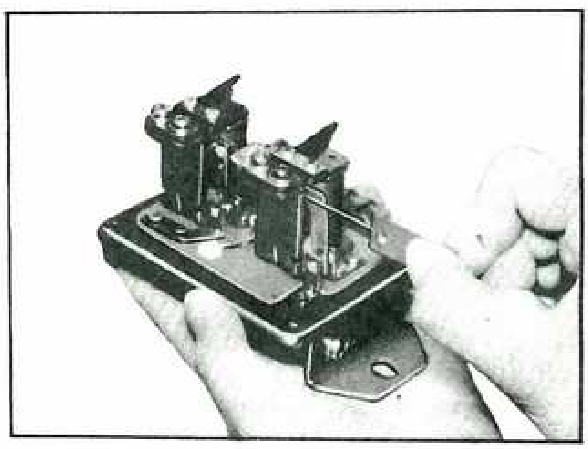


Fig. EE-45

ness gauge. Adjust the gap by releasing the fixing screw of Auxiliary spring if the gap is out of specification.

Air Gap

Check the gap with Pin gauge and adjust as shown in Fig. EE-46 and Fig. EE-47, if required.

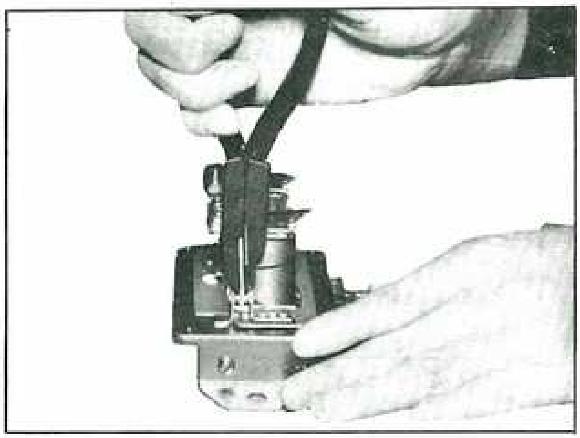


Fig. EE-46

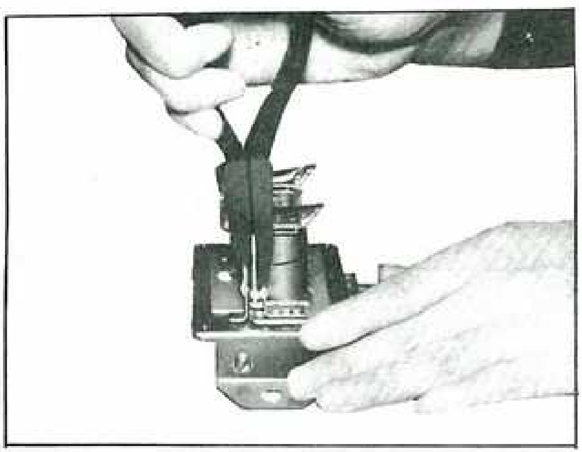


Fig. EE-47

Point Gap

Check the gap and adjust the gap by bending the constant base in the right or left direction.

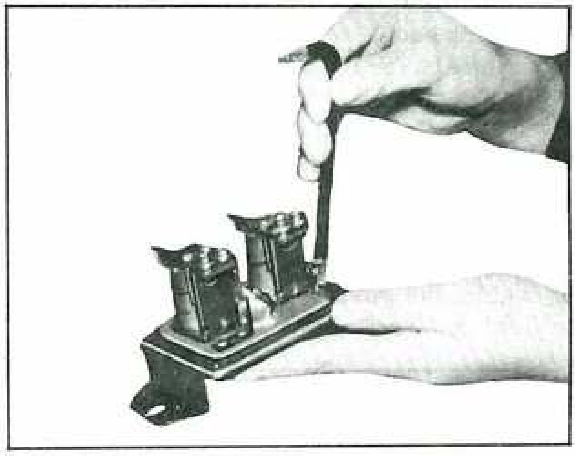


Fig. EE-48

(3) 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.

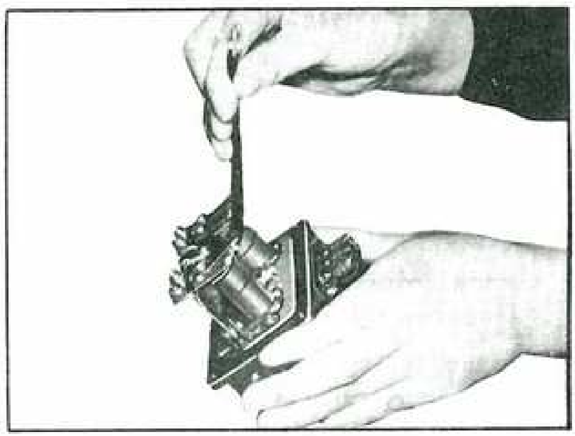


Fig. EE-49

STARTING MOTOR

SPECIFICATION

Type	MITSUBISHI ME-Y_2R
Voltage	12 volts
Output	1.0 kw
Starting Current (Voltage)	Less than 500 Amps. (6 volts)
Lock torque	Over 1.0 kg-m (7.23 ft-lb)
No Load Current (Voltage)	Less than 60 Amps. (11 volts)
No Load Starter Revolution	Less than 6,000 r.p.m.

Shift type of Pinion Gear	Magnetic Shift
Number of tooth on pinion gear	9
Number of tooth on ring gear	120
Weight	5.5 kg (12.13 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 "Ign" position. This starting motor utilizes an enclosed over-running clutch type and the compound motor as described following. The magnetic switch is mounted at the upper side of the yoke.

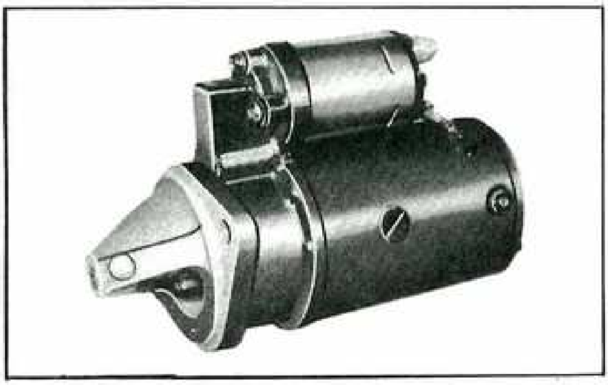


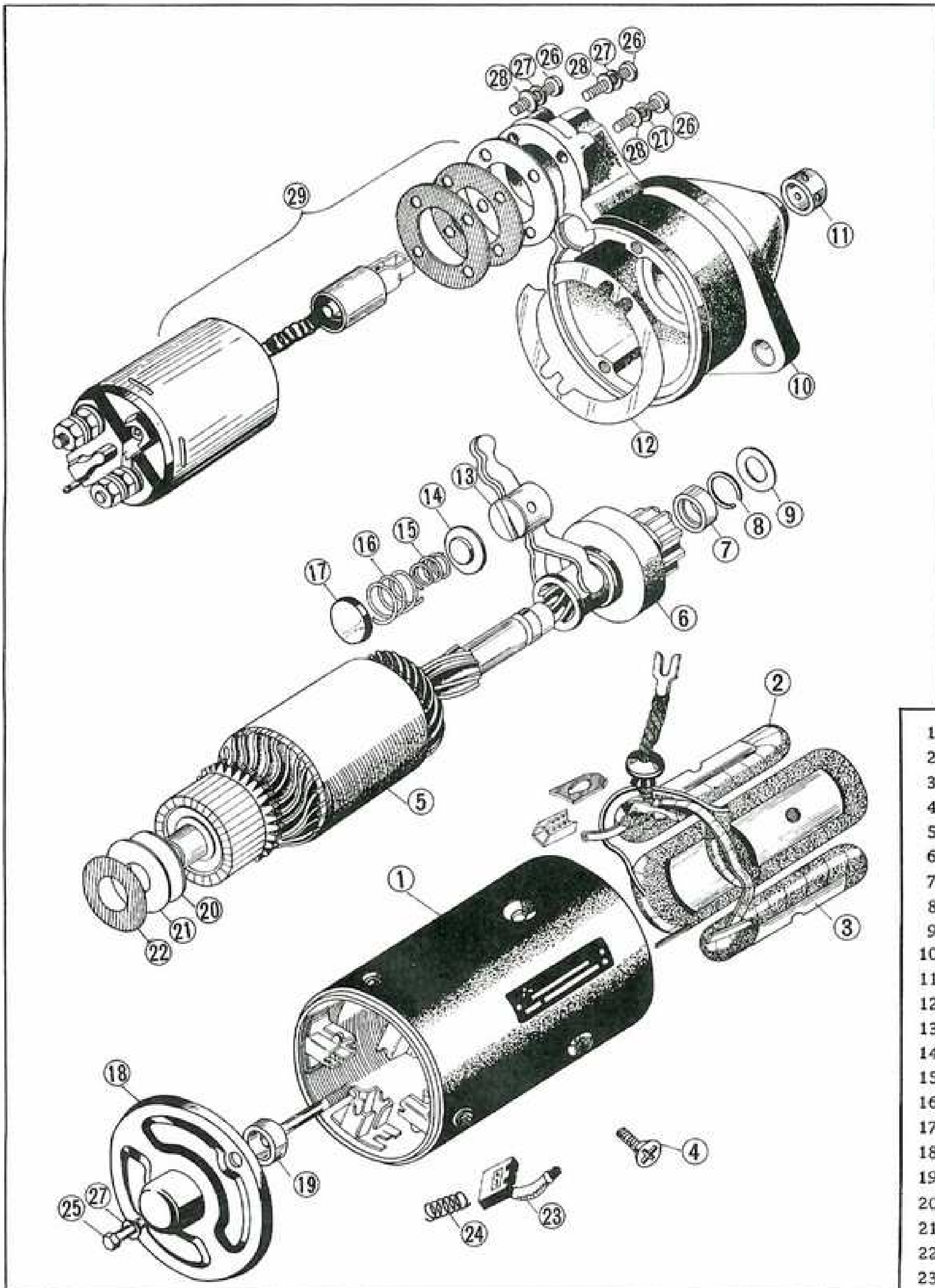
Fig. EE-50

OPERATION

When the ignition switch is turned on to "start" position, (cf. Fig. EE-52) current flows through the "current" and "potential" 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 B and M.

Closing of the contact B and M causes the motor to crank the engine and also cuts out the "current" coil of the solenoid, the magnetic pull of the "potential" 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 "Ign" position, the "current" coil demagnetizes against the "potential" coil, then a return spring actuates the plunger to return to the original position, consequently stops the motor. More positive meshing and demeshing of the pinion and 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 permits the pinion to over-run the armature after the engine has started.



1.	Yoke Ass'y
2.	Field coil
3.	Pole core
4.	Screw
5.	Armature
6.	Over running clutch
7.	Stopper ring
8.	Ring
9.	Washer
10.	Front bracket
11.	Pinion case metal
12.	Shim
13.	Shift lever Ass'y
14.	Lever spring cap
15.	Lever spring (A)
16.	Lever spring (B)
17.	Lever spring seat
18.	Rear cover
19.	Rear cover metal
20.	Washer
21.	Washer
22.	Insulating washer
23.	Brush
24.	Brush spring
25.	Through bolt
26.	Screw
27.	Spring washer
28.	Washer
29.	Switch Ass'y

Fig. EE-51

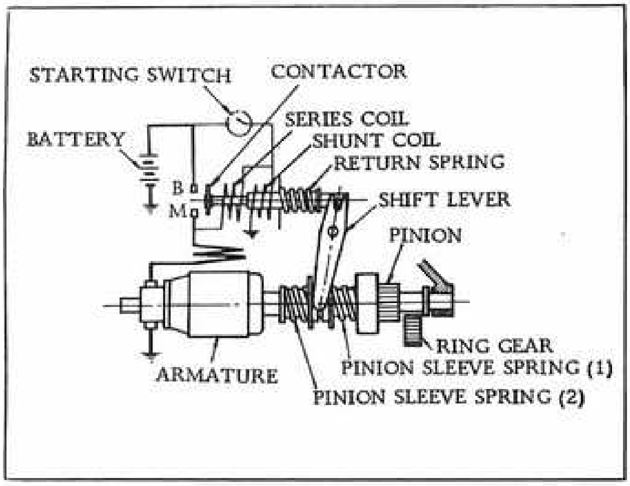


Fig. EE-52 Starting Motor Circuit

CONSTRUCTION

Field Coil;

The field coil is mounted on yoke by the pole core and pole core screws and located inside the yoke.

Armature; (include over-running clutch)

The armature is retained into yoke assembly by the rear cover and gear case bush so that it permits the armature to high speed revolution. The armature shaft includes drive mechanism such as over-running clutch assembly.

Magnetic Switch Assembly;

The magnetic switch is mounted on the gear case by four screws. The plunger and the over-running clutch is mechanically connected by the shift lever and operate simultaneously.

Over-running Clutch Assembly;

The main parts of drive mechanism are over-running clutch assembly and this starting motor uses over-running clutch as mentioned above.

The over-running clutch consists of the pinion, the roller and the thrust spline.

Brush and Brush Holder;

The brushes and brush springs are installed in the brush holders inside the yoke.

REMOVAL

1. Disconnect the battery ground cable. Disconnect the black with yellow tracer wire from the magnetic switch terminal, and black battery cable from the magnetic "battery" terminal.
2. Remove two bolts securing the starting motor to engine end plate. Pull starter assembly forward and remove starting motor.

DISASSEMBLY

1. Remove the nut securing the connecting plate to the magnetic switch "M" terminal. Remove three bolts securing Mangetic switch and remove Magnetic switch assembly.

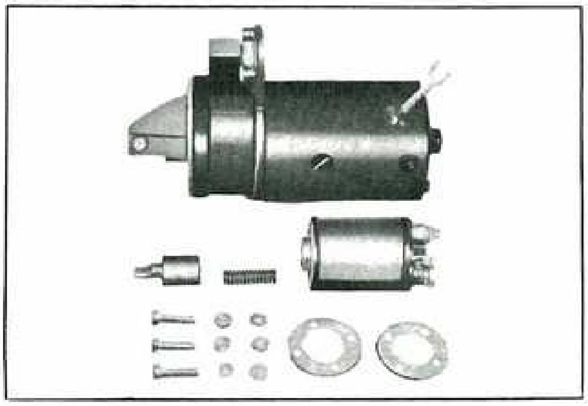


Fig. EE-53 Removing Magnetic Switch Ass'y

2. Remove two through bolts and Brush cover assembly.
3. Remove Yoke assembly by hitting lightly with a wooden mallet.

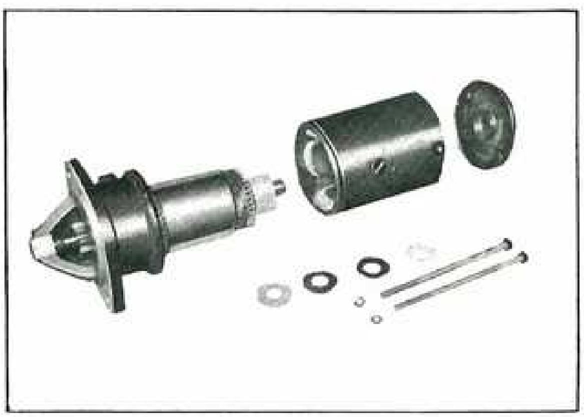


Fig. EE-54 Separating Yoke Ass'y and Armature Ass'y

4. Withdraw Armature assembly and Shift lever.

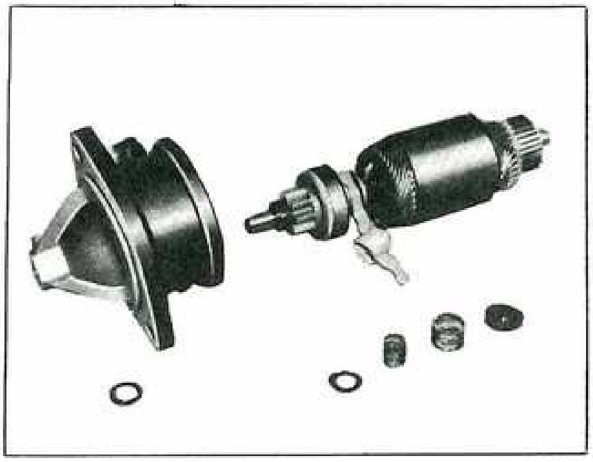


Fig. EE-55 Removing Armature Ass'y and Shift Lever

5. Remove Pinion stop ring located at the end of the armature shaft. To remove Stop ring, firstly push Stop ring to the Clutch side and then, after removing Snap ring, remove Stop ring with Over-running clutch. Withdraw Over-running clutch assembly from the armature shaft.

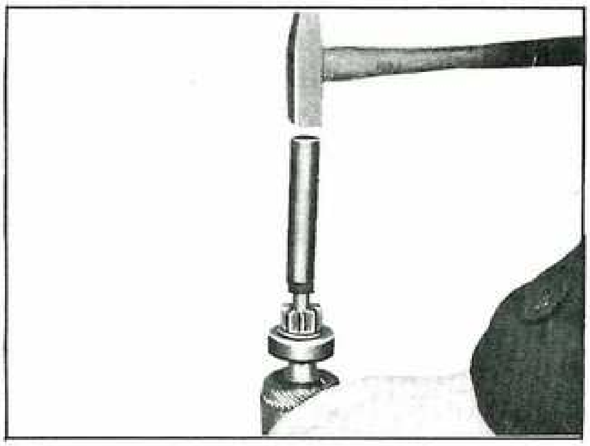


Fig. EE-56 Removal of Over-running Clutch Ass'y

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

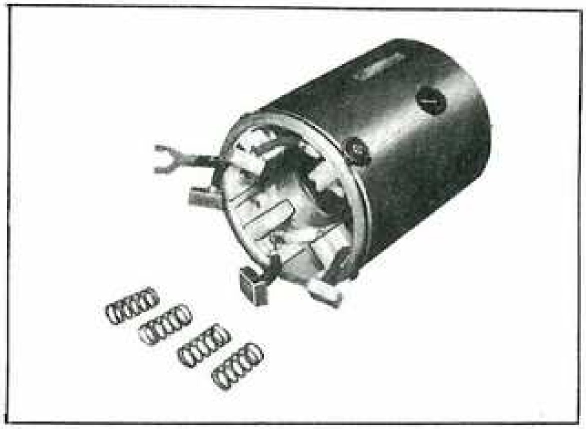


Fig. EE-57

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 to see if these are damaged or worn excessively, they should be replaced as necessary.

1. Terminal

Check for damage and wear, and replace if necessary.

2. 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 Negative brush holder.

If no conductance is read, the field circuit or coil is open.

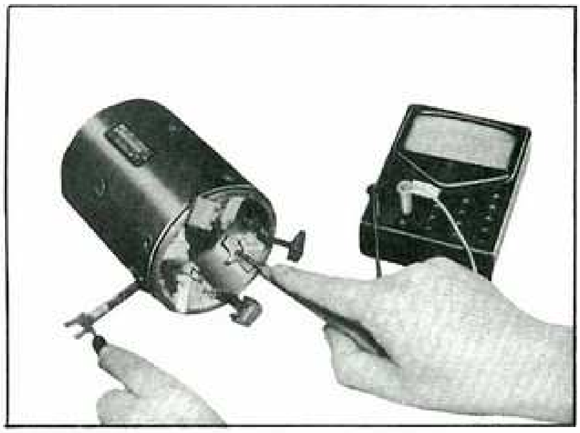


Fig. EE-58 Field Coil Test for Continuity

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-59 Field Coil Tester 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.

3. 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 7.5 mm (0.2953 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 may be cleaned.

4. Brush Spring Tension

Check the brush spring tension by a contact pressure gauge. Take the gauge reading when the new or replaced brush separate from the commutator. The reading should be 0.95 kg (20.94 lbs.). Replace the spring if the tension is lower than 0.5 kg (11.02 lbs.).
Gauge reading should be done when the brush height from holder is 1.5 mm (0.059 in.)

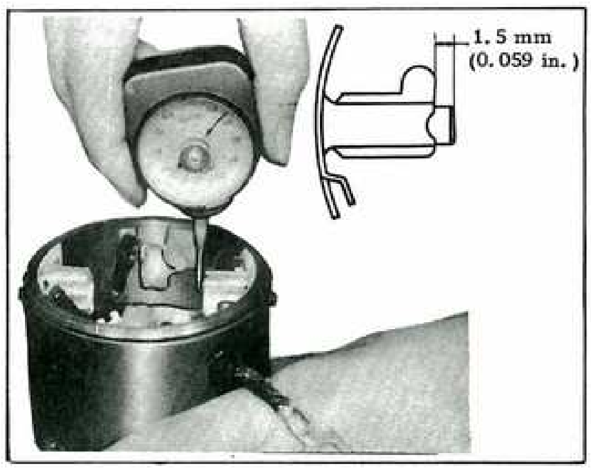


Fig. EE-60 Inspection of Brush Spring Tension

5. Armature Assembly

Check external appearance of the armature and the commutator.

a. Measure the armature shaft for bend by a dial gauge. Replace the armature shaft if the bend exceeds 0.1 mm (0.004 in.).

b. Inspect the commutator. If the surface of the commutator is rough, it must be sanded lightly with a No. 500 emery paper.
The commutator may be checked also for out-of-round.

If the out-of-round is more than 0.2 mm (0.0078 in.), or the depth of the insulating mica is less than 0.2 mm (0.0078 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 (0.0019 in.). Insulating mica should be also under cut so that the depth of it is from 0.5 mm to 0.8 mm (0.0196 to 0.0315 in.).
The wear limit of the commutator diameter in 2 mm (0.0787 in.). If the commutator is beyond repair, replace it.

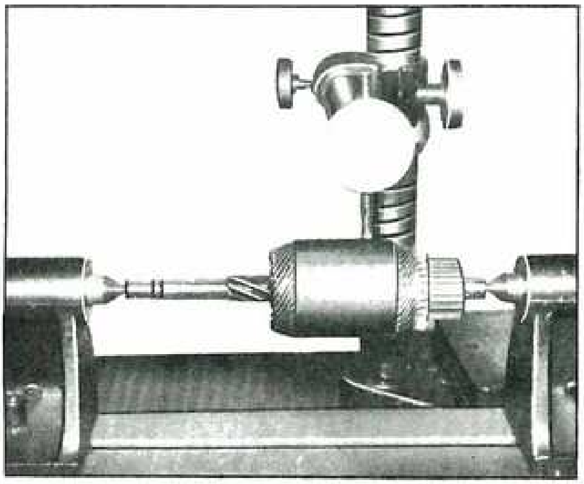


Fig. EE-61 Inspection of Armature Shaft for Bend

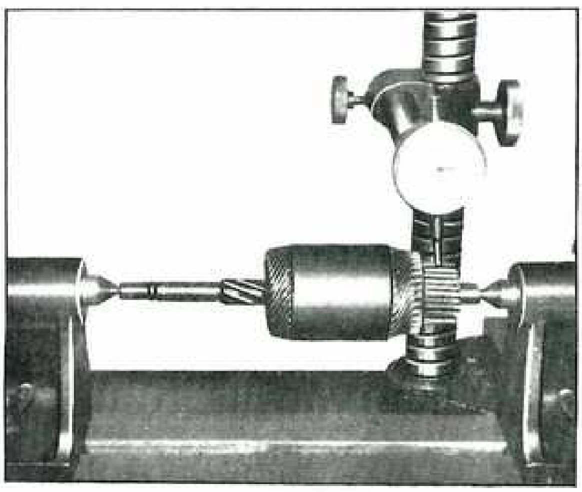


Fig. EE-62 Inspection of Commutator

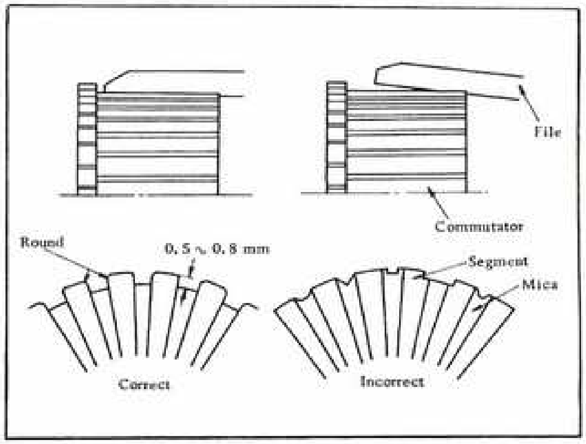


Fig. EE-63 Undercutting Insulating Mica

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

d. 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-64

e. Check armature for shorts by placing on growler and with back saw blade over armature core, rotate armature.
If saw blade vibrates, armature is rare shorted.

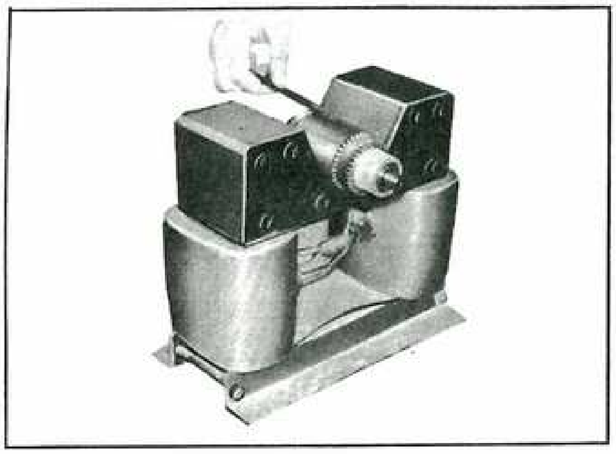


Fig. EE-65 Armature Test for Short

f. 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.

Fig. EE-66 Armature Test for Continuity

6. Over-Running Clutch Assembly

Inspect the pinion assembly and screw sleeve. Screw sleeve must be freely slide along the armature shaft splined. If scratchs 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.

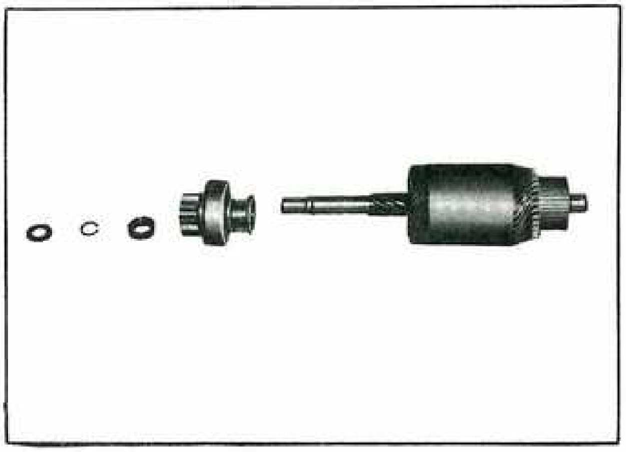


Fig. EE-67 Over-running Clutch Ass'y

7. 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 conductive the brush holder is shorted to ground. Replace an insulator or brush holder.

8. 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 (0.0078 in.), replace the metal. Press in a new bearing and adjust the clearance to 0.050 ~ 0.104 mm (0.0020 ~ 0.0041 in.). The bearing metal should be so pressed in that the end of the bearing metal would be equal to gear case end plane.

9. Magnetic Switch Assembly

Inspect the magnetic switch contacts. If a rough welding be found on the contact is 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, pinion and center bearing.

STARTING MOTOR 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.

1. 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".

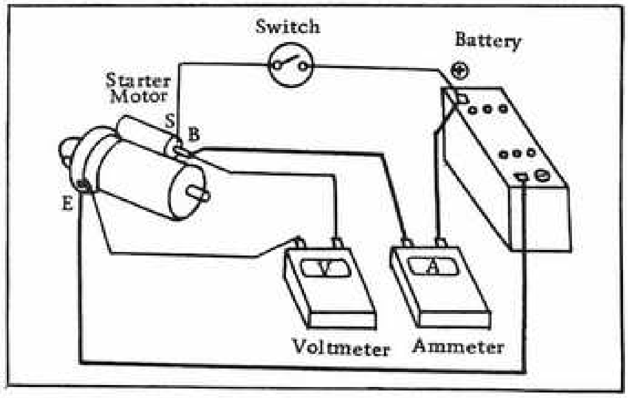


Fig. EE-68 No-load Test

2. Torque Test

Torque testing equipment should be used to the motor will develop rated torque. 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 across the starting motor (+) and (-) and Torque are shown in Fig. EE-69.

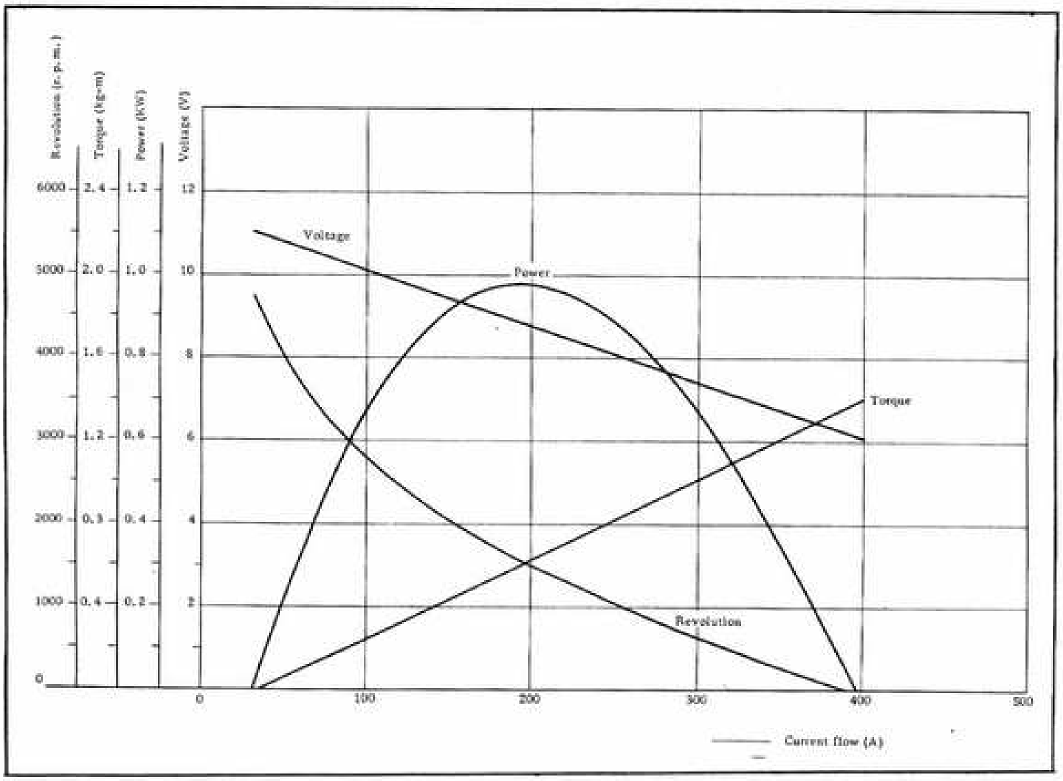


Fig. EE-69 Performance Curves

3. Diagnosis of Test

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

a. Tight, dirty or worn bearings.
Bent armature shaft or loosen field probe.

b. Shorted armature
Check armature further.

c. 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 conductive, remove other two brushes and check fields and armature separately to determine whether it is the fields or armature that is grounded.

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

a. A grounded or open field coil
Inspect the connection and trace the circuit by a circuit tester.

b. The armature coil do 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.

c. 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 burn the commutator bar.

C. 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 B-c.

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

4. Magnetic Switch Assembly Test

If the starting motor check is "OK". Check the magnetic switch assembly. Connect jumper cables between the "positive" battery terminal and the starting motor "B" terminal, the "negative" battery terminal and the ground side of

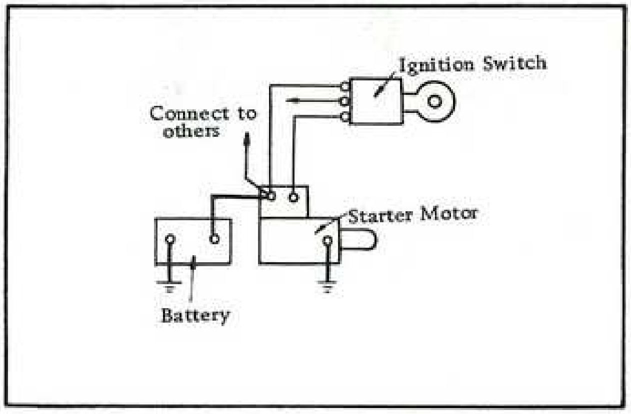


Fig. EE-70

starting motor, and the "positive" battery terminal and the starting motor "S" terminal (Connect ignition switch in series).

Measure the gap "ℓ" between Pinion front edge and Pinion Stopper.

If the gap is off the standard, adjust the gap by adjusting the dimension "L" of Magnetic Switch to the standard dimension.

Cap-Pinion Face to Pinion Stopper	0.5 ~ 2.0 mm (0.0197 ~ 0.0787 in.)
"L" dimension	27.5 ~ 28 mm (1.0837 ~ 1.1024 in.)

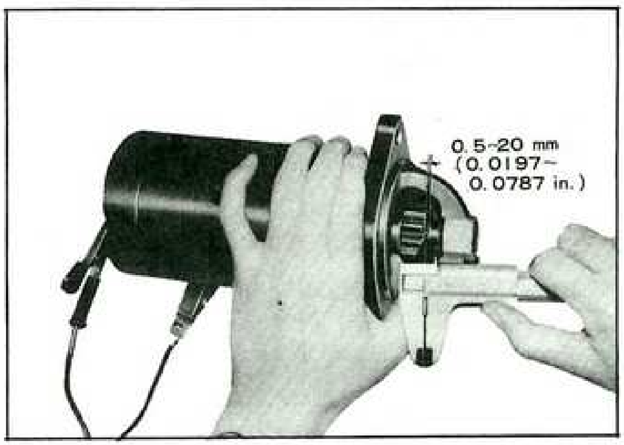


Fig. EE-71

Fig. EE-72

5. Diagnosis of Test

A. With the ignition switch on to "start" position, the motor does not operate.

Poor contact of the magnetic switch would be the cause of trouble.

B. With the ignition switch on to "start" position, the plunger moves to push and pull the pinion. Open potential coil would be the cause of trouble.

C. With the ignition switch on to "start" position, the plunger does not move to pull the pinion but the motor operates by manual pulling the pinion. Open current coil would be the cause of trouble.

D. With the ignition switch turned off, the motor does not stop. Defective terminals would be the cause of trouble.

E. Low no-load speed with low torque loose connection of the terminals would be cause of trouble.

SERVICE DATA

Armature Shaft Diameter (Pinion side)	$11 {}^{-0.050}_{-0.077}$ mm	($0.4331 {}^{-0.0020}_{-0.0030}$ in. Dia.)
Armature Shaft Diameter (Rear end)	$14.2 {}^{-0.050}_{-0.077}$ mm	($0.5591 {}^{-0.0020}_{-0.0030}$ in. Dia.)
Amendment Limit of Shaft Dia.	0.1 mm	(0.0039 in.)
Amendment Limit of Shaft Bent	0.1 mm	(0.0039 in.)
Clearance between Shaft and Bush	0.050 ~ 0.104 mm	(0.0020 ~ 0.0041 in.)
Amendment Limit of Dittoed Clearance	0.2 mm	(0.0079 in.)
Outer Diameter of Commutator	39 mm	(1.5354 in.)
Wear Limit of Commutator Dia.	2 mm	(0.0787 in.)
Brush Length	14 mm	(0.5512 in.)
Wear Limit of Dittoed Length	6.5 mm	(0.2559 in.)
	(Remaining Brush should be move than 7.5 mm)	(0.2953 in.)
Brush Spring Tension	0.95 kg	(2.094 lb.)
Front Bracket Metal Inner Diameter	$11 {}^{+0.027}_{0}$ mm	($0.4331 {}^{+0.0011}_{0}$ in.)
Rear Cover Metal Inner Diameter	$14 {}^{+0.027}_{0}$ mm	($0.5591 {}^{+0.0011}_{0}$ in.)

TROUBLE DIAGNOSIS AND CORRECTIONS

Troubles	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.
Nosiy 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 and 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 operate 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 it turned off.	Defective solenoid switch.	Repair or replace the solenoid switch.
	Defective gear teeth.	Replace the defective gear.

DISTRIBUTOR

SPECIFICATION

TYPE & MAKE	D407-52 HITACHI
Ignition Timing .... (B.T.D.C.)	Solex 20°/700 r.p.m. SU 16°/700 r.p.m.
Rotaling Direction	Counter-Clockwise
Advance Starting .... R.P.M.	800 ~ 1100 r.p.m. (Engine revolution)
Dwell Angle	49° ~ 55°
Condenser Capacity	0.20 ~ 0.24 μF

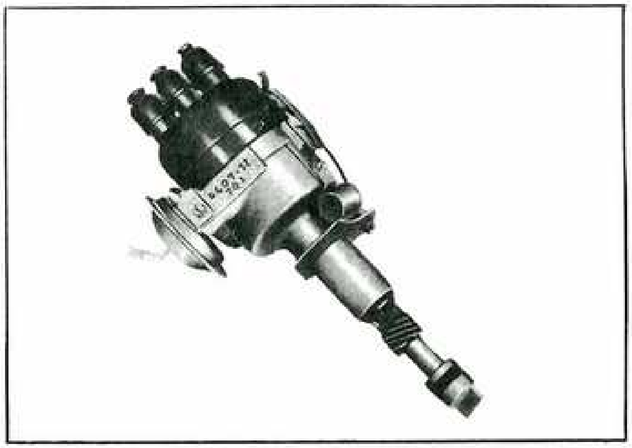


Fig. EE-73

CONSTRUCTION AND OPERATION

Fig. EE-74 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. Fig. EE-75 shows structure of its typical product.

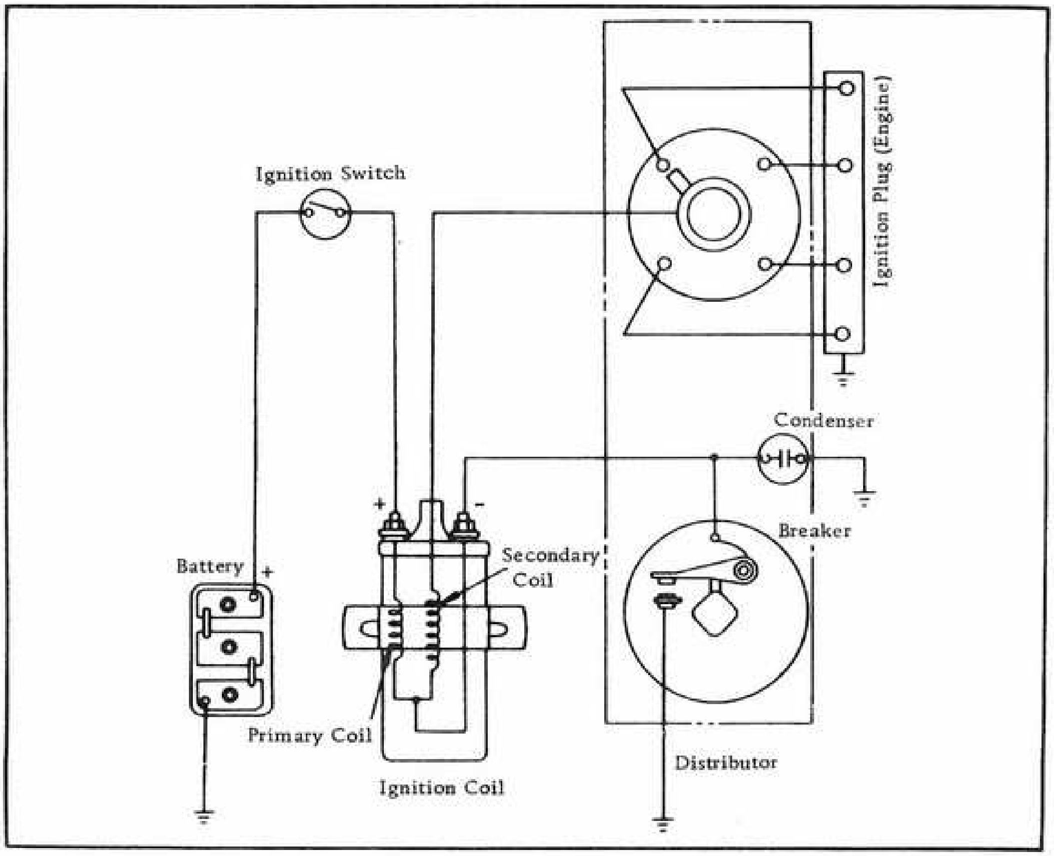


Fig. EE-74

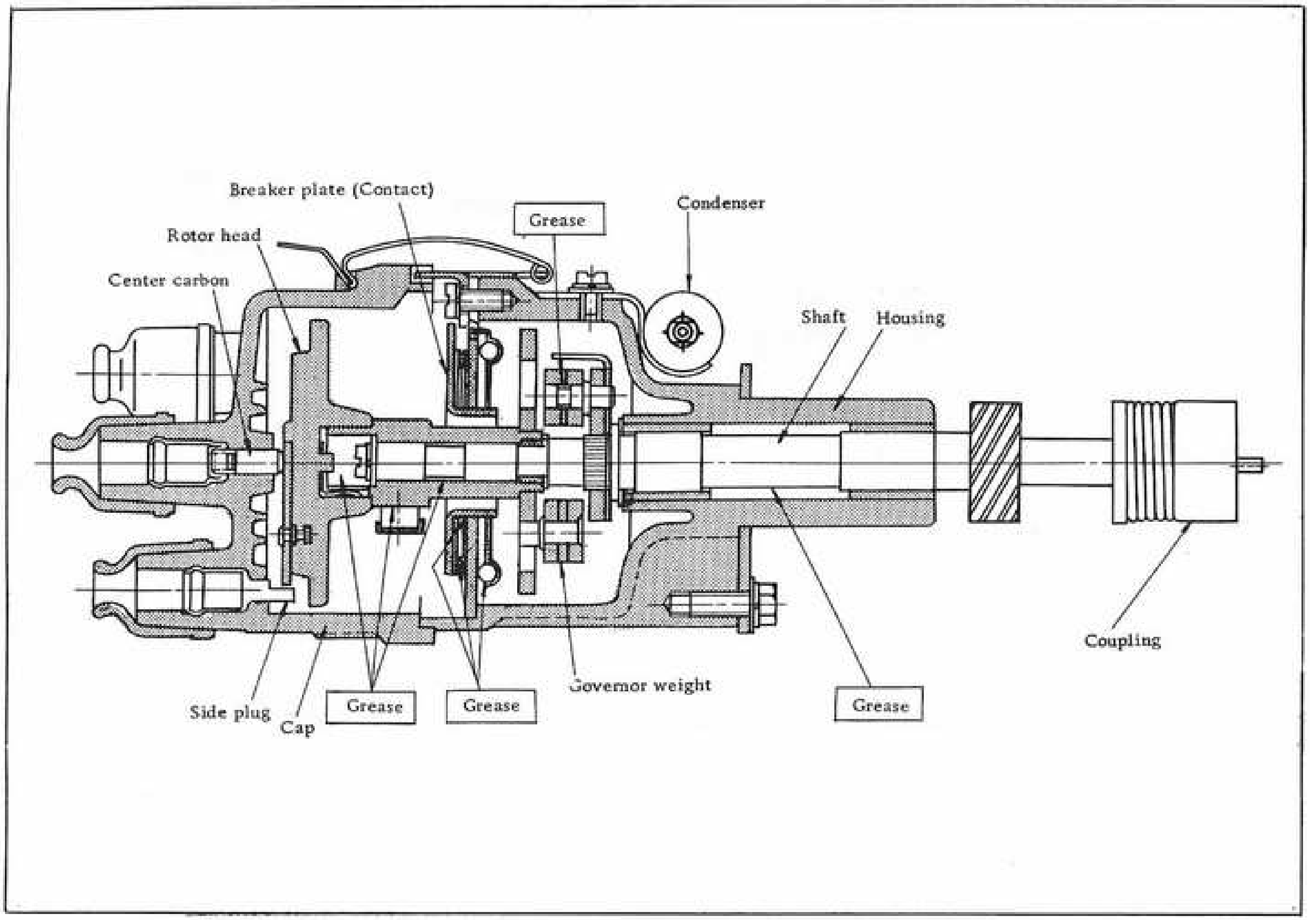


Fig. EE-75

High Tension Voltage Part

Cap and rotor head are main parts of high tension voltage distributor. Cap is made of synthetic resine durable to high tension voltage. There is a center carbon in the center of the cap, through which high tension voltage generated at the secondary part of the ignition coil runs to rotor head.

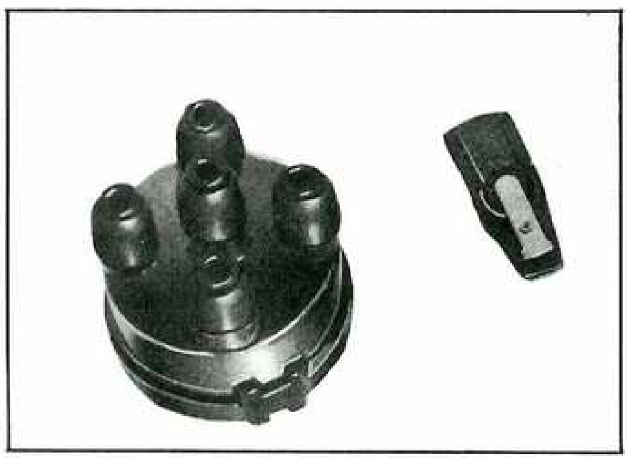


Fig. EE-76

Rotor head is set in cam head to lead high tension voltage sent from center carbon to side plug. Material is same as that used for cap.

Switch On-Off Part

Switch on-off part consists of cam, contact arm, contact point and condenser. Cam is shaped square and has same number of angles as that of engine cylinder, point is opened when the top draws near. Fig. EE-78 shows cam assembly which possesses timing lever to adjust advance automatically by putting weight pin in the rectangular hole of the lever.

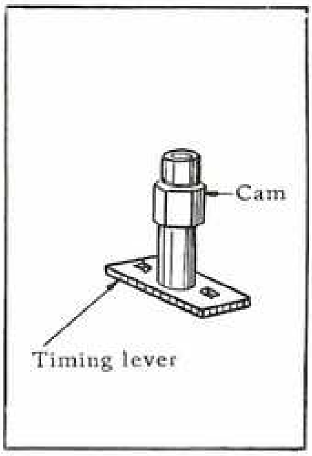


Fig. EE-77

Fig. EE-78

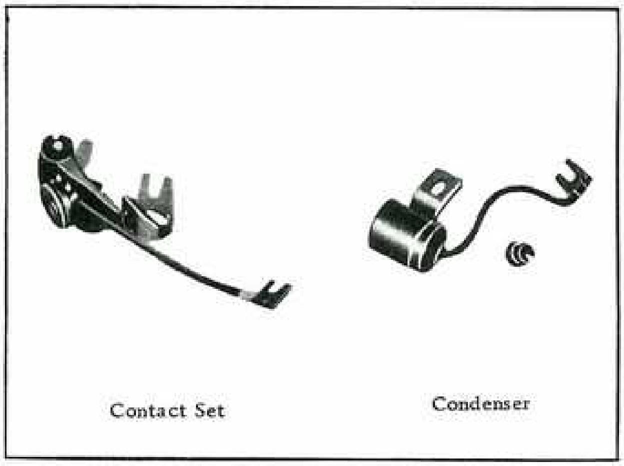


Fig. EE-81 *Fig. EE-82*

Contact set is a combination of contact arm and contact point. As shown by Fig. EE-79, contact arm has an arm and consists of point, heel (lever slide) pivot receiver and spring. Standard pressure at point is 0.50-0.65 kg (1.102 ~ 1.433 lb.) and when the pressure is too high, heel wears rapidly and when too low, ignition timing becomes bad, thus causing engine trouble in either case.

As shown by Fig. EE-80, contact point possesses point setting pad which is connected with arm pivot and has oblong hole for adjustment. As shown by Fig. EE-74, condenser is connected to point in parallel and not only prevent point from damage by absorbing Arc between points

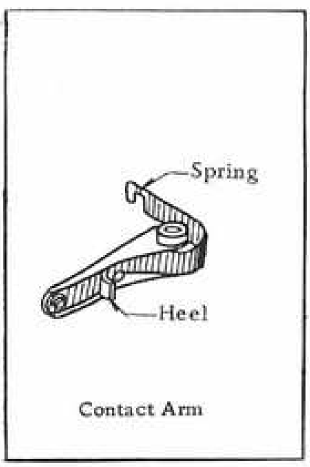


Fig. EE-79

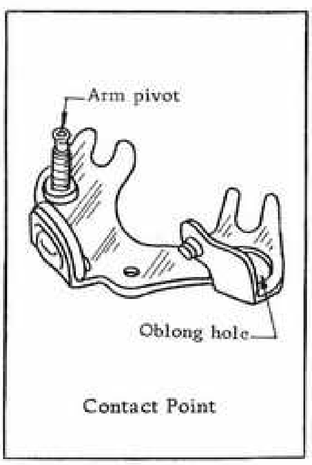


Fig. EE-80

but also increase secondary voltage by switching off quickly primary electric current.

This condenser contains small and light MP condenser capable of self-recovery at the time of puncture. Fig. EE-82 shows the picture of MP condenser.

Centrifugal Advance Mechanical Part

When sparking is made to mixed gas in the cylinder of engine, usually it takes time to make explosion instantly and make complete burning by getting required pressure inside cylinder. Becuase of time required for burning, ignition must be made to the mixed gas by sparking shortly before the piston comes to the upper dead point. This timing, however differs by rotation frequency. Centrifugal advancing device is to hasten ignition timing according to rotation velocity, as explained in the following. Refer to Fig. EE-83. When the shaft rotates unclockwise, weight opens automatically by centrifugal power with weight pivot as its center. However due to existence of spring, it keeps balance at the place where spring tension and centrifugal power equals. Pin B is knocked in weight and kept inside of the oblong hole of timing lever so that timing lever, (i.e., cam) advances as the weight moves.

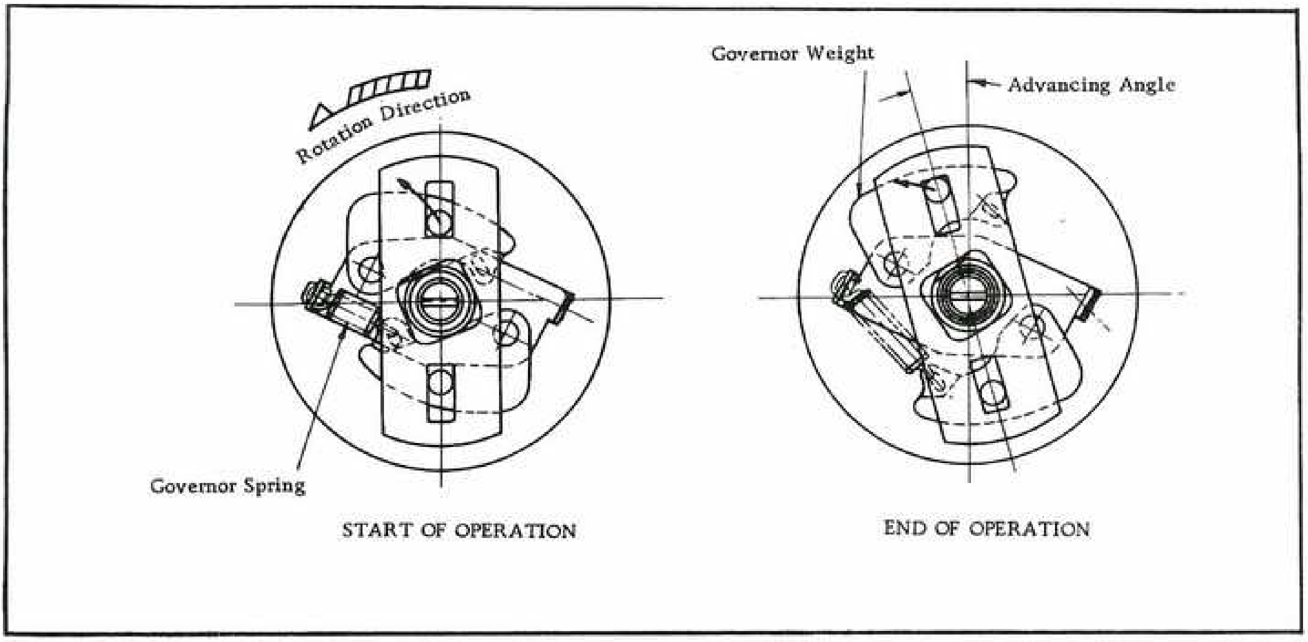


Fig. EE-83 Centrifugal Advance Mechanism

Vacuum Advance Mechanical Part

When mixing ratio is fixed, only centrifugal advance will do. However, in actuality, it varies by the load, so that adjustment is required in ignition timing. In case load is small, manifold load is considerably large and burning time is long. Quickening of ignition timing is required. In case load is large, on the other hand, manifold load is small and burning time is small. Decrease in advance is required.

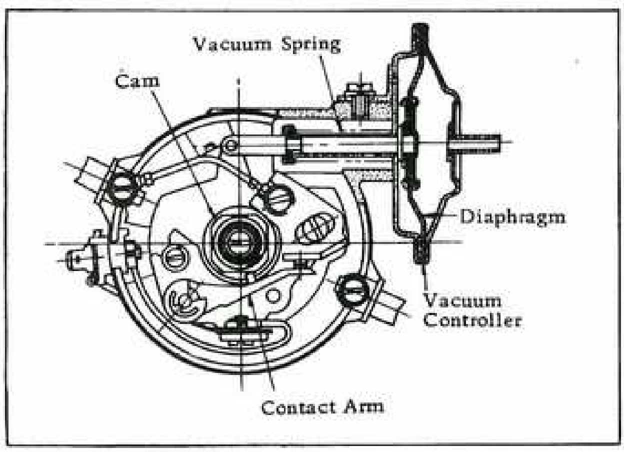


Fig. EE-84 Vacuum Advance Mechanism

Fig. EE-84 shows vacuum advance mechanism. Vacuum room and atomospheric room are divided by oil-proof diaphragm. The former is led by pipe to the vicinity of completely closed area of throttle valve. When vacuum increases, diaphragm moves toward right and rod turns whole breaker, thus advancing the distributor to that extent.

Note: In case Solex type carburetor is used, vacuum controler terminal is to be covered by vinyle cover since vacuum advance becomes unnecessary.

CHECKING AND ADJUSTMENT

Cap & Rotor Head

Cap & 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 & 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 - 0.55 mm. In case size is off the standard, adjustment is required by loosening point screws (1) & (2) (Fig. EE-85). 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 thick.

As for those with tungsten point, point gap must be checked at every 4,000 km run. Adjust it to size required in case it is off the standard. 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 heel. 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. First loosen by 1 - 1.5 time 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 Fig. EE-85.

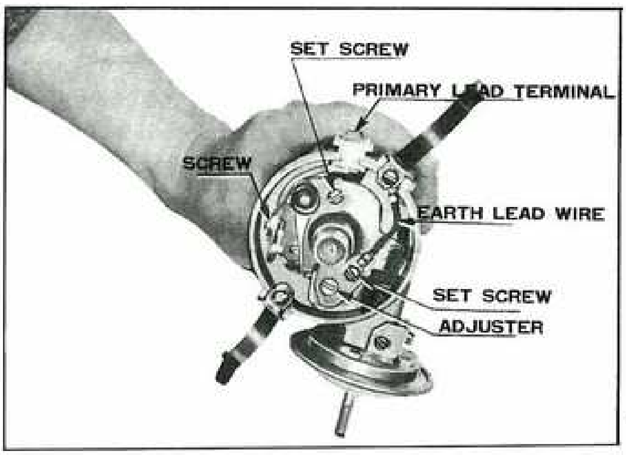


Fig. EE-85 Breaker

As shown by Fig. EE-86, hold the contact point by fingers and pull out toward you elevating it a little. Then both contact point and contact arm can be disconnected together.

Further, when stopper is disconnected, contact arm can easily be taken off from stem bar. When new contact set is connected, do simply just in opposite order. Apply slightly Grease on both arm pivot receiver and surface of cam.

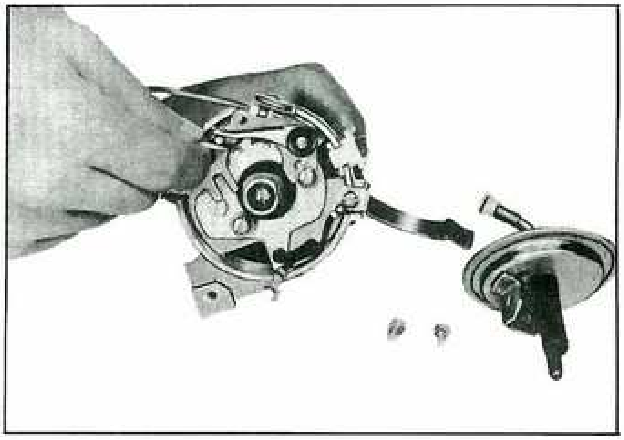


Fig. EE-86

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 arm swings largely instantly and gradually moves back to the infinite. In case the arm 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

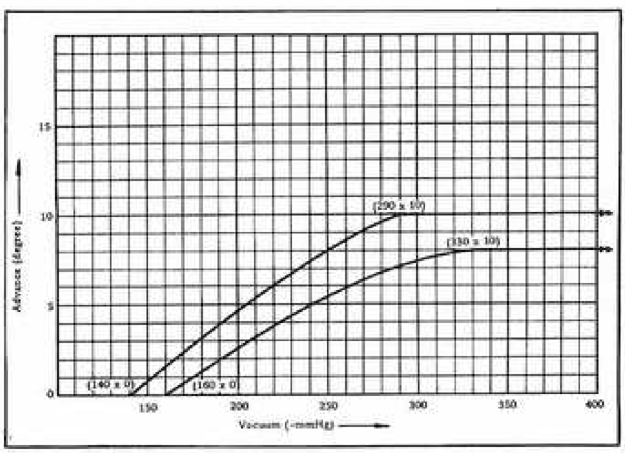


Fig. EE-87 Vacuum Advance Characteristic

Check whether or not vacuum advance mechanism operate by operation indicator attached to vacuum advance mechanism.
Followings are the causes considered for non-operation.

(1) Leakage of air due to incomplete fasening of vacuum inlet.

(2) Leakage due to defective diaphragm.

(3) Fixed side and moving side of breaker plate is fixed.

Solution for (1) is to make complete fastening and (2) is to replace it with a new one.

Solution for (3) is as follows:

(a) As shown by Fig. EE-88, moving side of breaker plate is supported by three steel balls for each up and down side. Do these balls work smoothly?

(b) Moving side of breaker plate is to rotate with pivot receiver of fixed side as a center. 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.

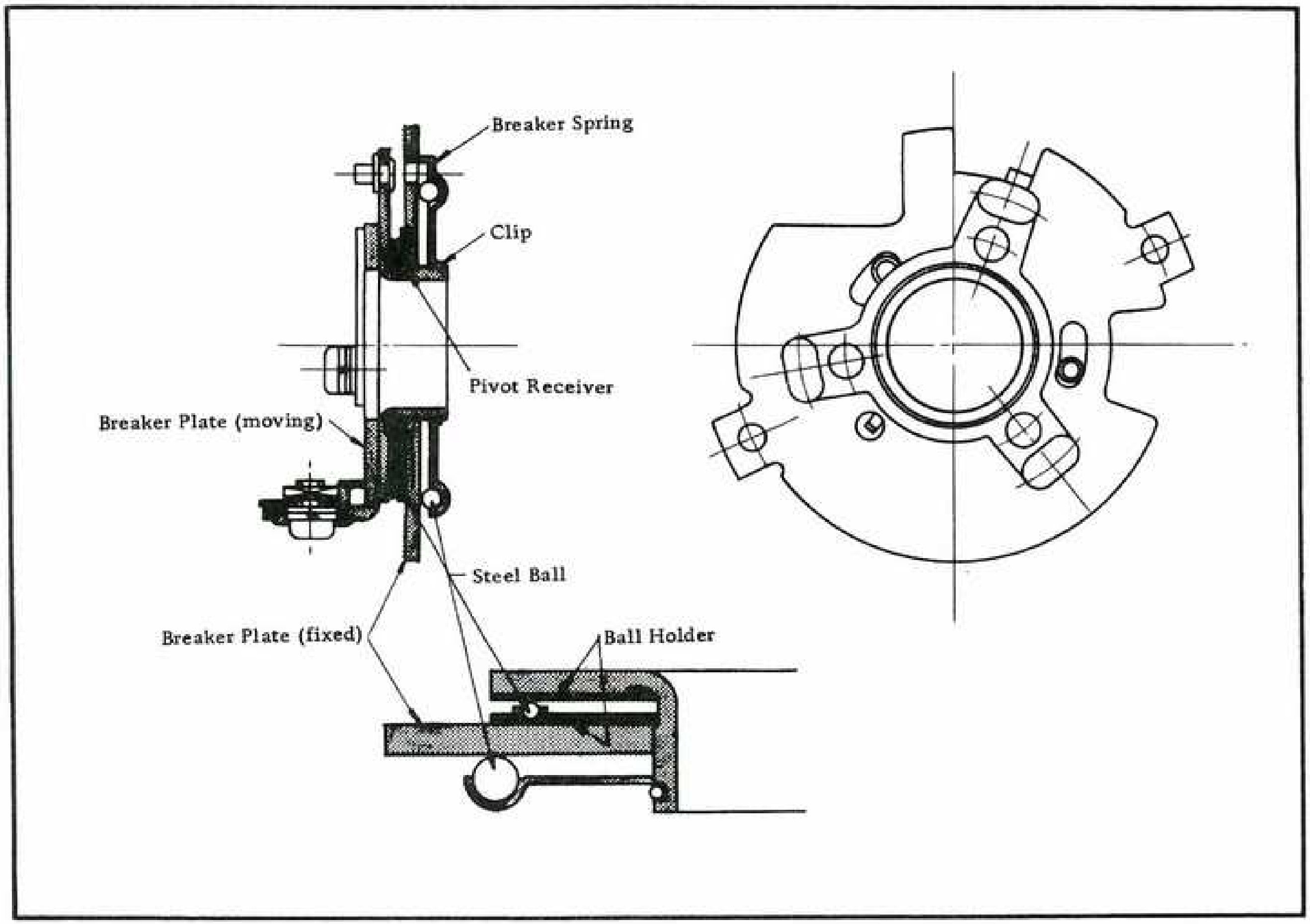


Fig. EE-88 Breaker Plate Collecting Part Mechanism

Centrifugal Advance Mechanism 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 characteristic, causes conceivable are defectiveness or unusual wearing-out of driving part or others. So don't 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.

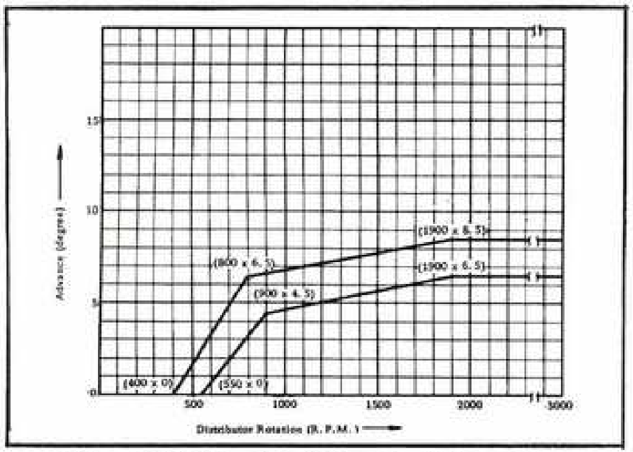


Fig. EE-89 Centrifugal Advance Characteristic

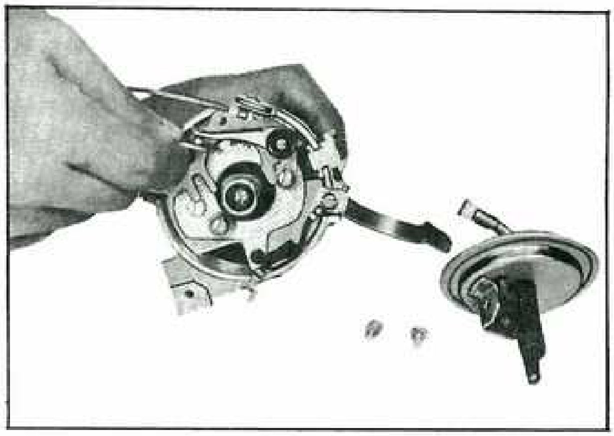


Fig. EE-90 Disassembly of Vacuum Controller

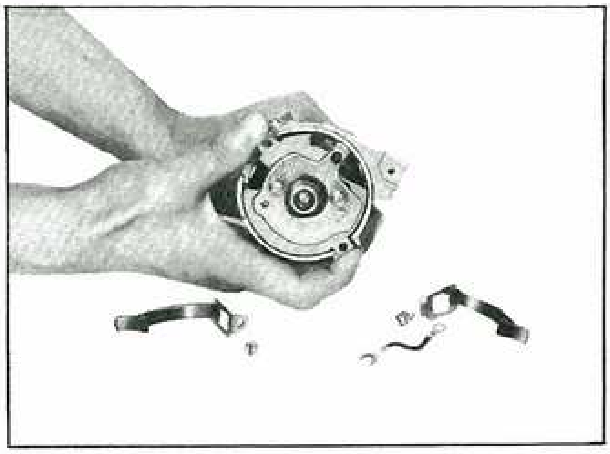


Fig. EE-91 Disassembly of Contact Breaker Plate

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-90).

(3) Take off contact breaker (Fig. EE-90).
Reffer to page 111 when contact set is to be disconnected.

(4) When contact breaker is disassembled, take off clip in Fig. EE-88 to disconnect breaker plate (fixed) putting down breaker plate moving.
Be careful not to lose steel balls between breaker spring and breaker plate as well as those between breaker plates.

(5) Pull roll pin and disconnect coupling to pull out whole rotation part. However before pulling out, put counter mark on coupling and shaft or remember well relation between coupling direction and setting groove of cam rotor head. (Fig. EE-92).

(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 well the relation with ignition timing.

(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) Fig. EE-93 shows complete disassembly.

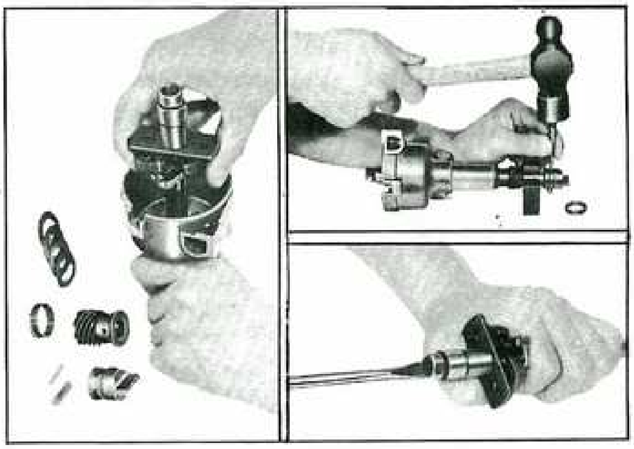


Fig. EE-92 Disassembly of Coupling Shaft and Cam

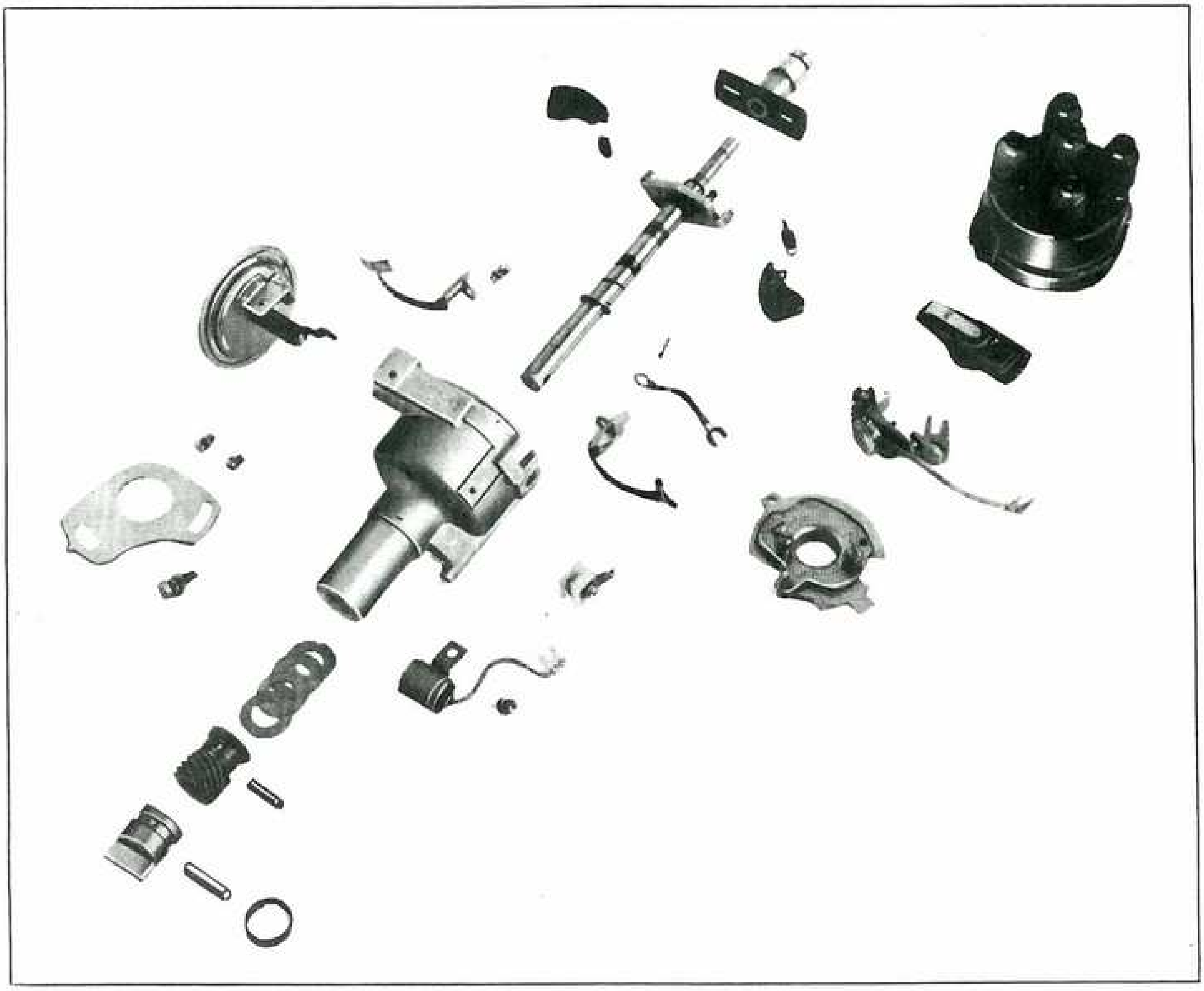


Fig. EE-93 Exploded View of Distributor

Assembly

In case of reassembly do it in just reverse way of disassembly. Pay attention to fastening and setting of coupling to cup particularly.

Refer to Fig. EE-94 at the time of replacement and reassembly of governor spring and cam.

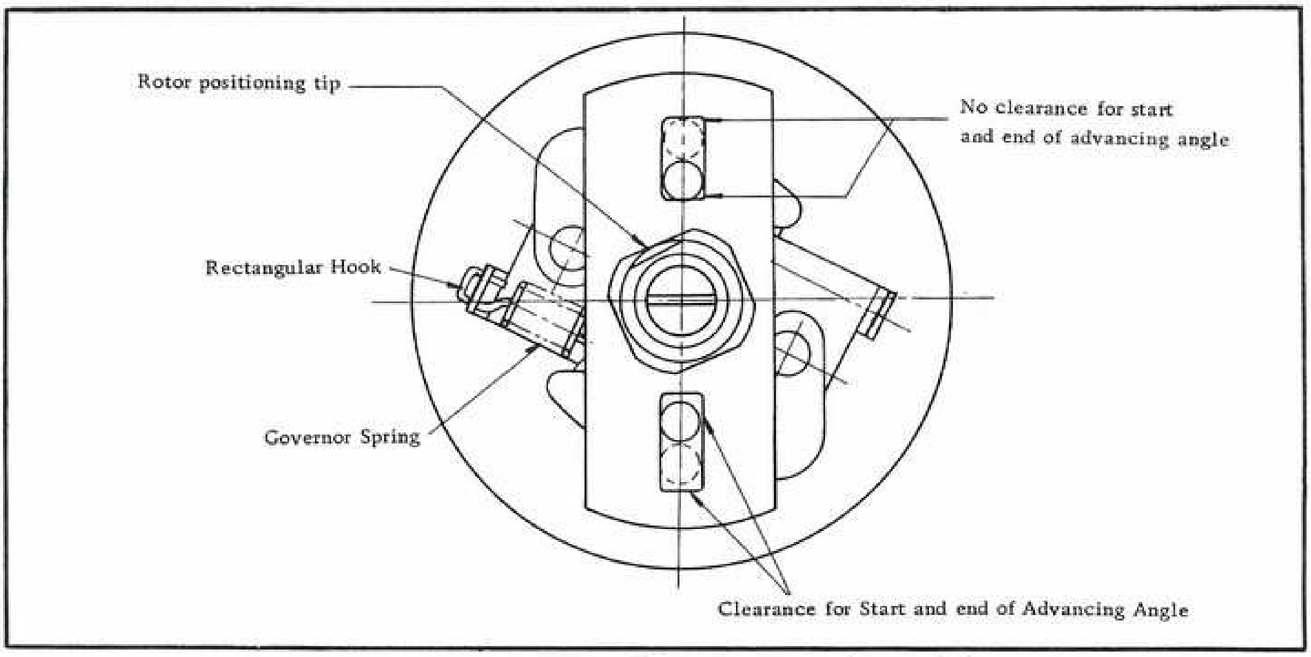


Fig. EE-94 Setting of Governor Spring and Cam

At the time of assembly, rotor head positioning tip at cam is to be set to governor spring side (rectangular hook). Then weight pin for governor spring (3) 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.

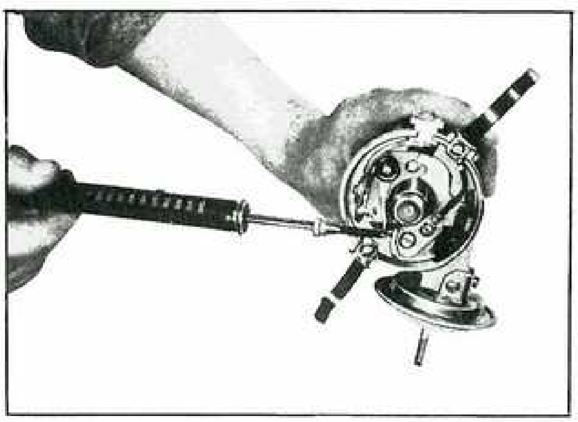


Fig. EE-95 Point Pressure Test

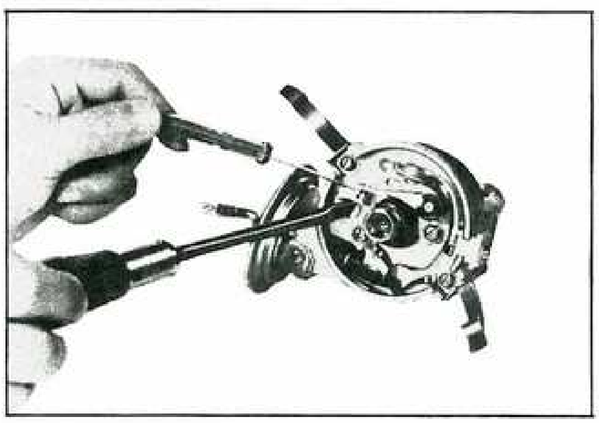


Fig. EE-96 Point Gap Measure

SERVICE DATA

Point Gap	0.45 ~ 0.55 mm	(0.0157 ~ 0.0196 in.)
Point Pressure	0.50 ~ 0.65 kg	(1.10 ~ 1.43 lb.)
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.)
Ammendment 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 ~ 0.0036 in.)
Weight Pivot Diameter	$5^{-0.010}_{-0.028}$ mm	($0.1575^{-0.0004}_{-0.0010}$ in.)
Weight Hole Diameter	$5^{+0.018}_{0}$ mm	($0.1575^{+0.0007}_{0}$ in.)
Clearance between Pivot and Hole	0.01 ~ 0.046 mm	(0.0004 ~ 0.0025 in.)

TRANSMISSION

MODEL FS5C71A TRANSMISSION

GENERAL DESCRIPTION

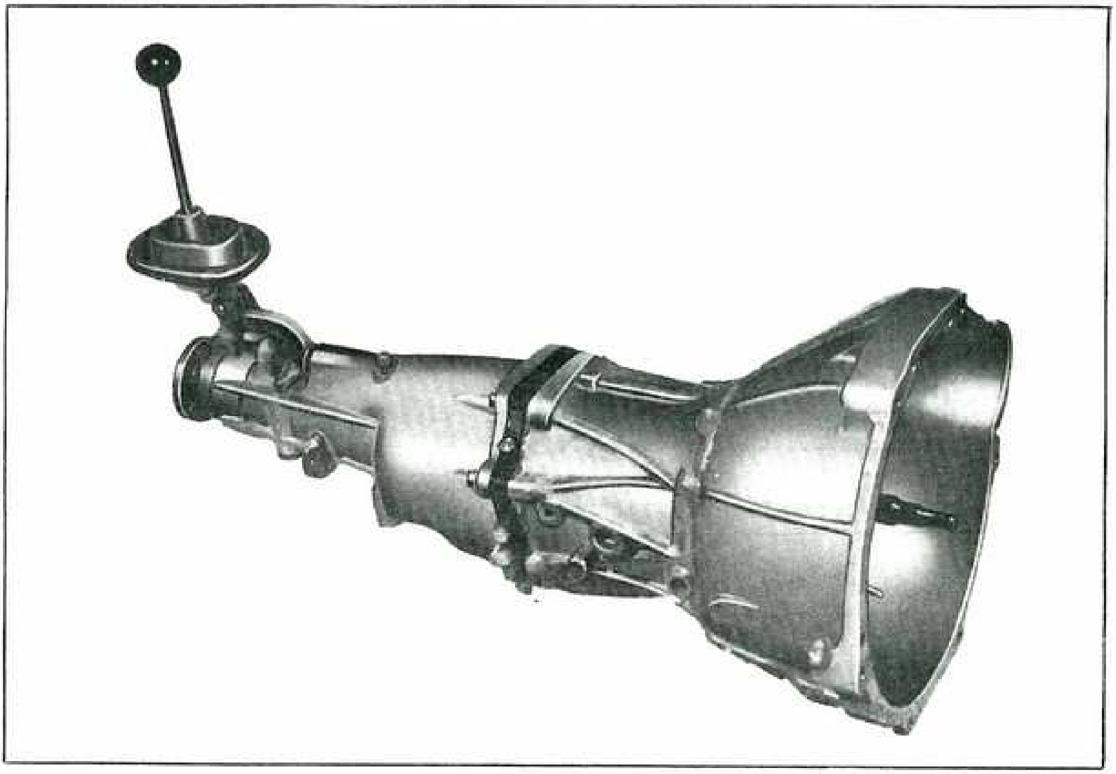


Fig. TM-1

TYPE FS5C71A transmission has 5 stage with over drive gear and divided type.

The clutch housing, gear case and rear extention can be easily divided, moreover, as the gear assembly is fixed to the gear case with the adaptor, the gear assembly can be easily taken out from the gear case.

The front cover of the transmission is constructed in a body to the clutch housing and the synchronizing method is servo type.

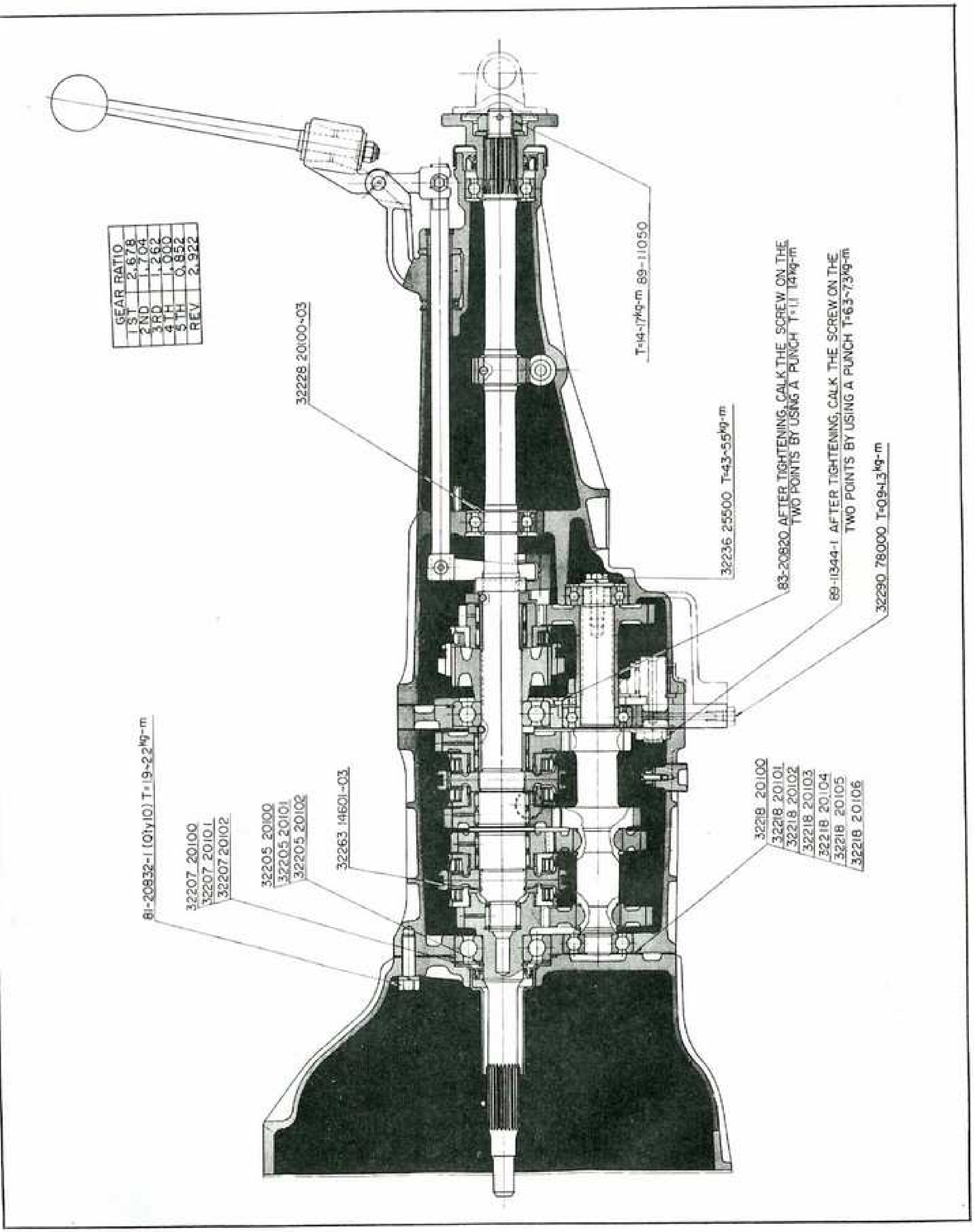

GEAR RATIO
1ST 2.678
2ND 1.704
3RD 1.262
4TH 1.000
5TH 0.852
REV 2.922
T=14-17kg-m 89-11050
32228 20100-03
32236 25500 T=4.3-5.5kg-m
83-20820 AFTER TIGHTENING, CALK THE SCREW ON THE TWO POINTS BY USING A PUNCH
89-11344-1 AFTER TIGHTENING, CALK THE SCREW ON THE TWO POINTS BY USING A PUNCH T=6.3~7.3kg-m
32290 78000 T=0.9~1.3kg-m
32218 20100
32218 20101
32218 20102
32218 20103
32218 20104
32218 20105
32218 20106
81-20832-1 (Q'ty 10) T=1.9~2.2kg-m
32207 20100
32207 20101
32207 20102
32205 20100
32205 20101
32205 20102
32263 14601-03

Fig. TM-2

SERVICE OPERATION

DISMOUNT AND DISASSEMBLE

Inspect Transmission Oil

1) Check the transmission oil level before disassembly with the vehicle at normal flat condition.
The oil level and the oil condition can be used as a factor for judging the cause of the trouble.

2) As the drain plug has magnet, the condition of its gathering the iron particles will be a reference factor for analyzing the trouble.

3) Check the impurities or dirts obtained at screening the drained oil before disassembly.

4) Record the place of leakage if any found before disassembly on the followings.

   a) Oil leakage at oil seal.

   b) Oil leakage at packings.

Dismount Ass'y Transmission

Transmission can not be dismount with Engine in the car.

So to dismount and mount transmission assembly, remove Engine and Transmission as a unit from the car.

Refer to Engine-Remove and Replace procedure.

Detach Rear Extension, Clutch Housing and Gear Case

1) Drain Gear Oil.

2) Disconnect Striking Rod from Control Lever.

3) Pull up Split Pin and release nut and remove Companion Flange from Rear Extension.

4) Release fixing bolts and detach Rear Extension, disengaging Striking Rod from Fork Rods.

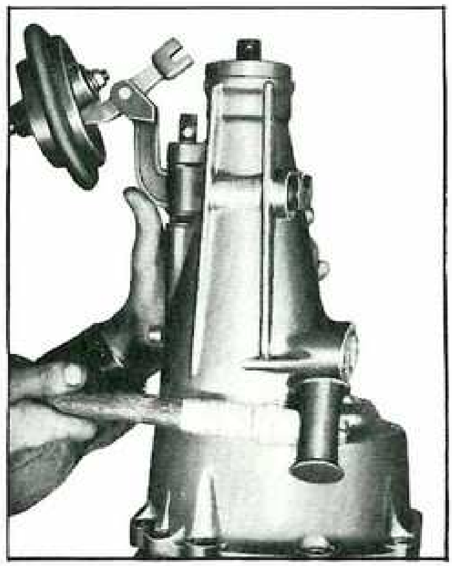


Fig. TM-4

5) Remove Oil Seal and Bearing, if required.

6) Remove Select Spring Plug and take out Select Spring & Select Pin, if required.

7) Pull out Striking Rod and remove "O" ring Cap and Bush-Striking, then remove Control Arm, if required.

8) Release fixing bolts and detach Clutch Housing from Gear Case.

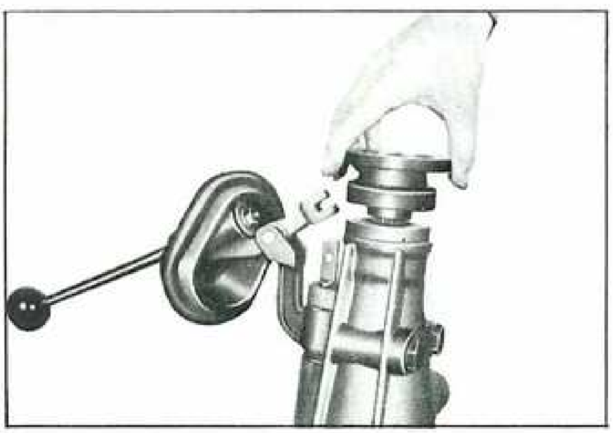


Fig. TM-3

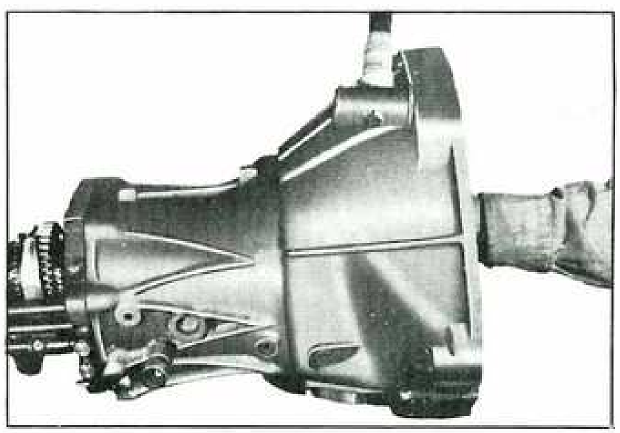


Fig. TM-5

9) Remove Stopper Ring on Main Drive Gear Bearing and detach Gear Ass'y from Transmission Gear Case.

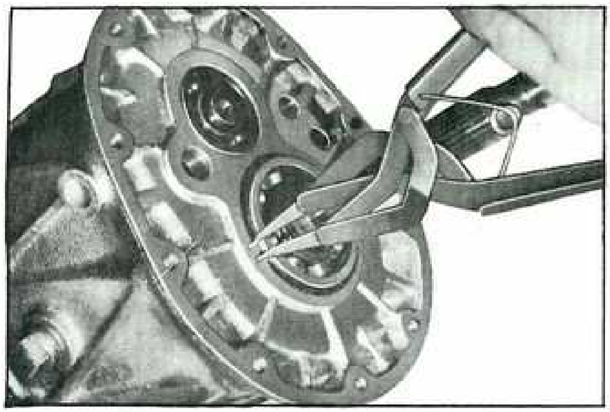


Fig. TM-6

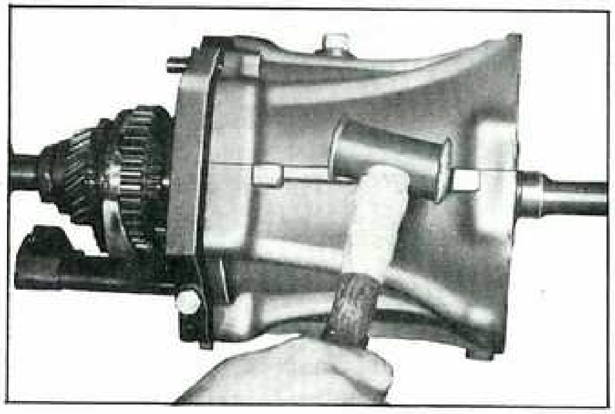


Fig. TM-7

Disassemble Gear Ass'y

1) Push out all Retaining Pins from Forks and Fork Rods, using a suitable drift.

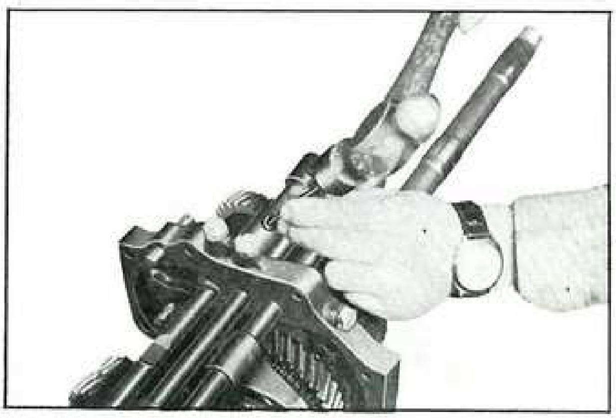


Fig. TM-8

2) Remove Checking Plugs and take out Checking Springs and Steel Balls.

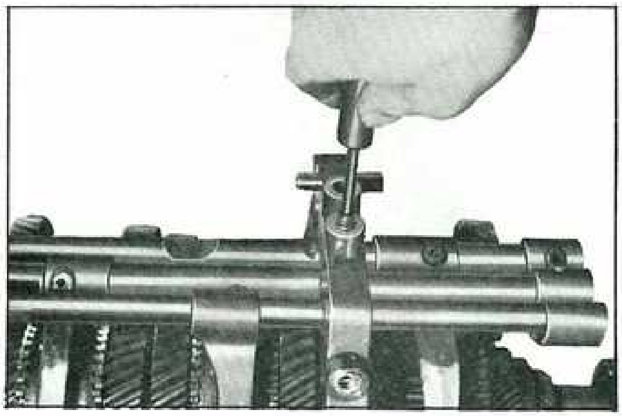


Fig. TM-9

3) Remove 1st-2nd, 3rd-4th & Reverse-5th Rods and four Check Balls.

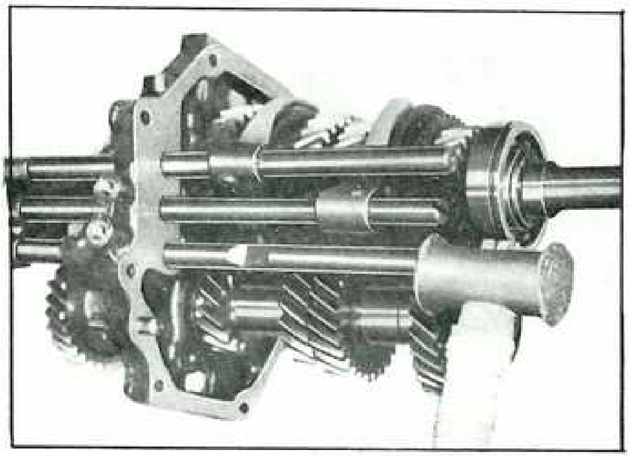


Fig. TM-10

4) Vise Adapter Plate on a suitable stand.

5) Remove Snap Rings on Main Shaft rear end and Speedometer Drive Gear rear end. Then, pull out Speedometer Gear.

6) Remove two Snap Rings and pull out Bearing-Main Shaft Over Drive.
Remove a remaining Snap Ring.

7) Stretch Lock Plate and release Nut-Main Shaft.
Remove Nut, Lock Plate and Thrust Washer.

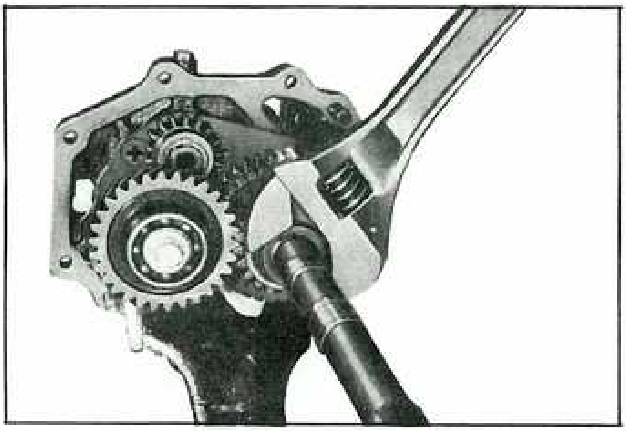


Fig. TM-11

8) Remove Bolt and Washer from Counter Shaft rear end and Pull out Bearing and Gear-Counter Shaft Over Drive together.

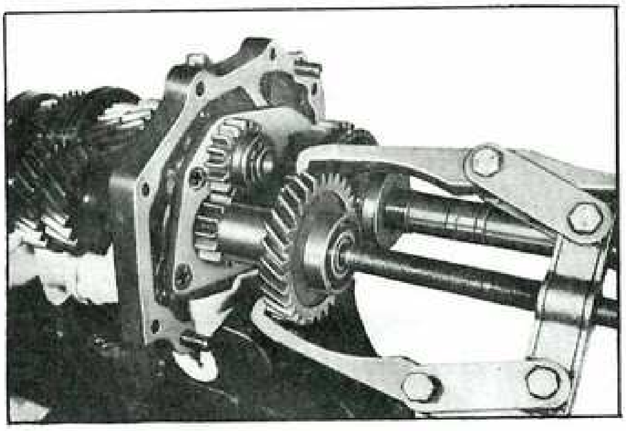


Fig. TM-12

9) Remove Over Drive Gear Ass'y, Needle Roller Bearing and Bushing.

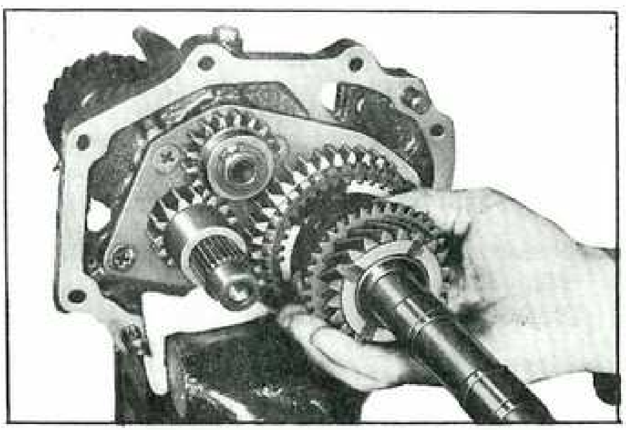


Fig. TM-13

10) Remove Reverse Gear Idler by removing Snap Ring.

11) Pull out Reverse Gear-Main Shaft and Reverse Gear-Counter Shaft.

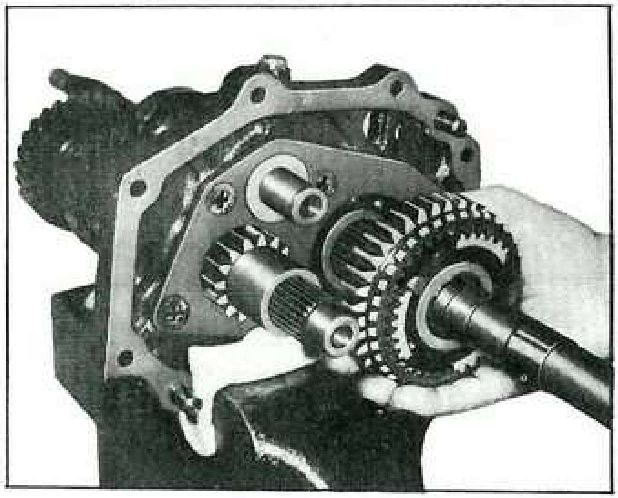


Fig. TM-14

12) Remove Main Shaft Bearing Retainer to Adapter Plate Screws and detach Bearing Retainer.

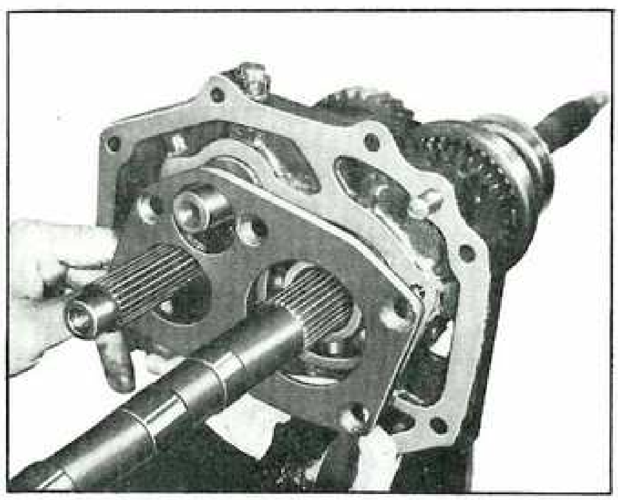


Fig. TM-15

13) Remove Counter Shaft and Main Shaft Assembly together, hitting lightly the outer races of Both Bearings.

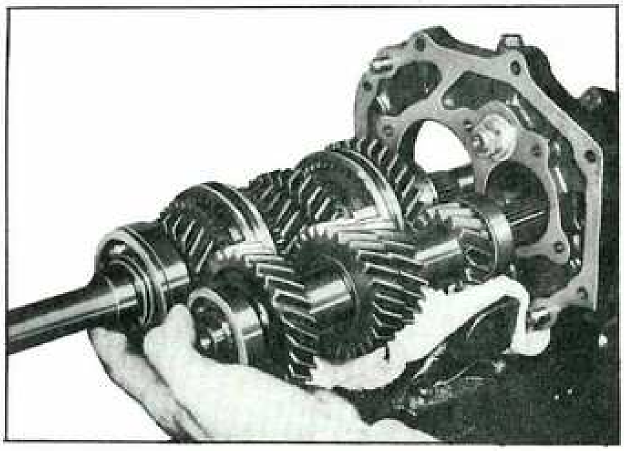


Fig. TM-16

Disassemble Main Shaft

1) Remove Main Shaft Bearing and Thrust Washer.

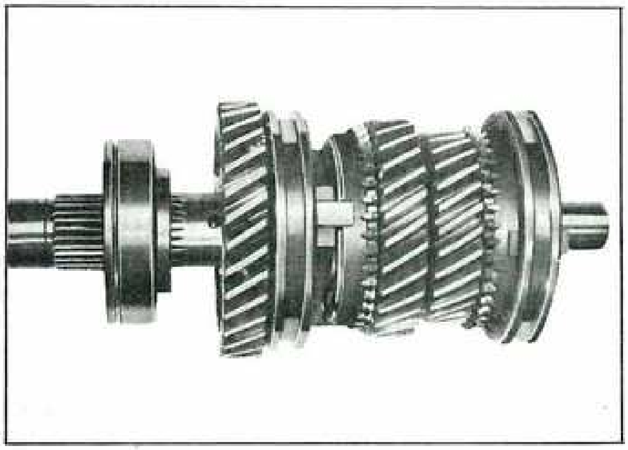


Fig. TM-17

2) Remove 1st Gear Ass'y, Needle Roller Bearing and Bushing.
3) Pull out Hub-Synchronizer and Coupling Sleeve.
4) Remove 2nd Gear Ass'y and Needle Roller Bearing.

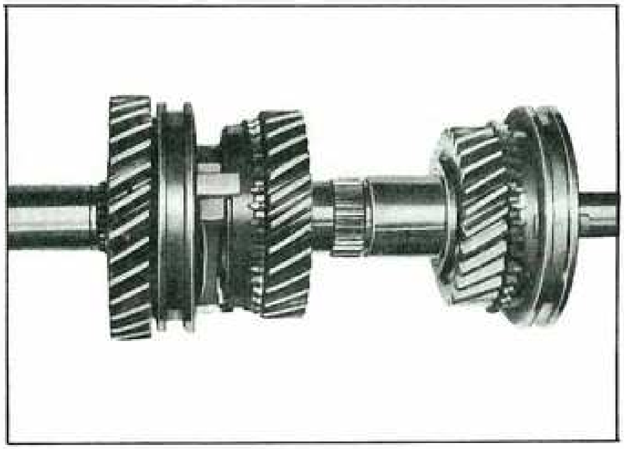


Fig. TM-18

5) Remove Snap Ring on Main Shaft front end and pull out Hub Synchronizer & Coupling Sleeve.

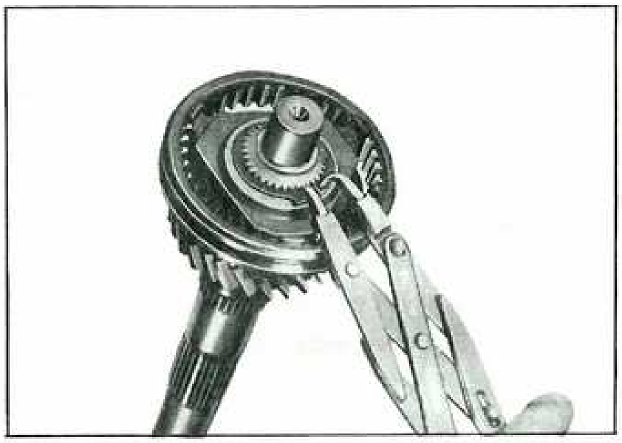


Fig. TM-19

6) Remove 3rd Gear Ass'y and Needle Roller Bearing.

Inspect and Replace Disassembled Parts

1) Check Oil Seals and "O" Rings for wear, damage, hardening of Oil Seal Lip and Outside condition.
   Replace them, if they are damaged.
2) Check Bearings and replace if they are damaged.
3) Check Gears and replace if they are damaged.

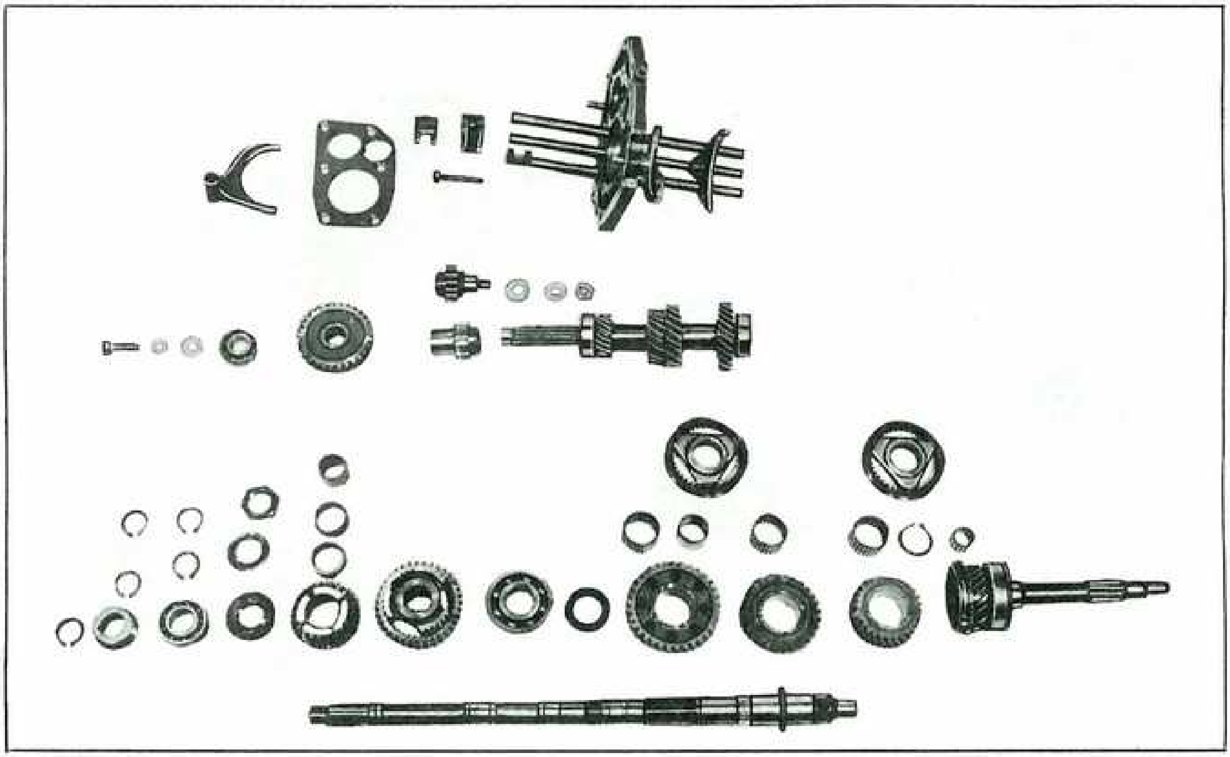


Fig. TM-20

ASSEMBLE AND MOUNT

Clean and Replace Each Part

1) Clean every part with clean solvent and lubricate with the transmission oil.
2) Remove the old gasket throughly and clean the trace of the sealing compound by thinner or carbon tetrachrolide.
   Coat the new gasket with the specified compound.
3) Replace Oil seals with new ones. Apply the multi-purpose grease to the lip of the oil seal.
4) Replace damaged snap rings with new ones.

Subassembling of Main Parts

1) *Assemble Synchronizer ring to each gear.*
   1. Place each gear on a flat place.
   2. Install Synchronizer ring into the inside of Clutch gear on each gear.
   3. Install Thrust block to each gear.
   4. Install Anchor block to each gear.

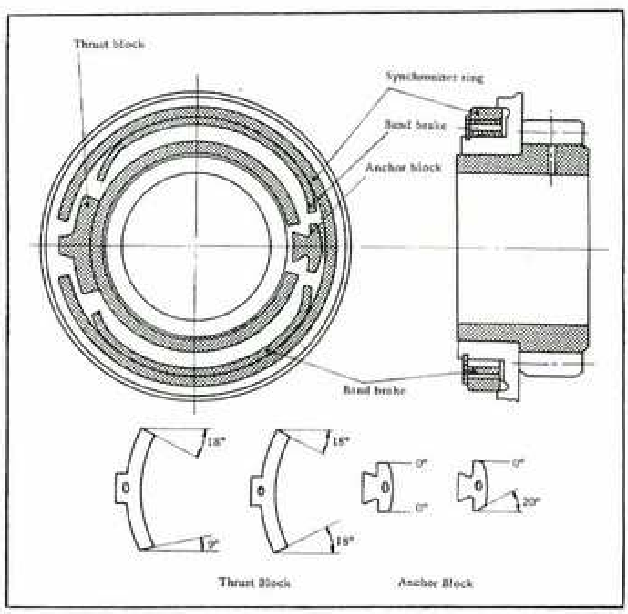


Fig. TM-21

	1st	2nd	3rd	M/D	O.D
Synchronizer ring	32611 14600	32611 14600	32611 14600	32611 14600	32316 20100
Thrust block	32617 14601 18"-9"	32612 14601 18"-18"	32612 14601	32612 14601	32362 20100 18"-18"
Anchor block	32618 14601 0"-20"	32613 14601 0"-0"	32613 14601	32613 14601	32363 20100 0"-0"
Band brake	32614 14604 2.5t 32615 14600 2.2t	32614 14600 2.5t	32614 14600	32614 14600	32364 20100 2.5t
Circlip	32616 14600	32616 14600	32616 14600	32616 14600	32366 20100

5. Install Brake band as shown in Fig. TM-21.
6. Install Circlip into the groove of each gear.

2) Install Reverse Idler Shaft to Adapter Plate.

1. Press Reverse Idler Shaft into Adapter Plate, with a suitable drift, setting the set-screw hole location.
2. Install Set-screw, smearing with some adhesive compound for sealing.
3. Install Washer, Spring washer and Nut into Reverse shaft and tighten to 6.3 ~ 7.3 kg-m (45.55 ~ 52.78 ft-lb) torque.

3) Rear Extension-Assemble

1. Install "O" rings on both ends of Control Arm.

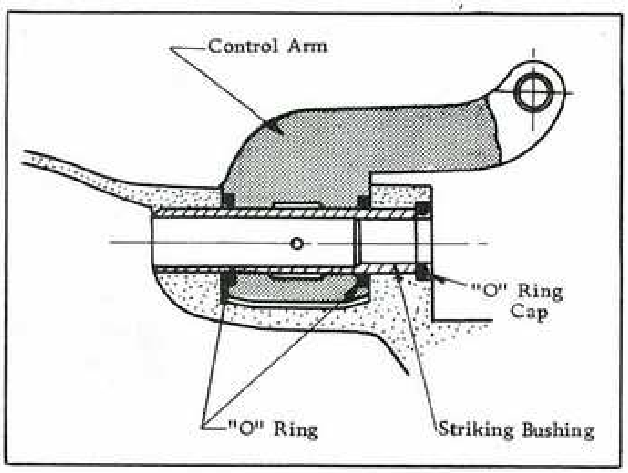


Fig. TM-22

2. Install Control Arm into Rear Extension and press in Striking Bushing by a suitable drift.
3. Install "O" ring and Retainer into Striking bushing rear end.
4. Install Control lever bracket into Control arm and insert control lever pin with washers.
5. Retain Control lever pin with Retaining pin.

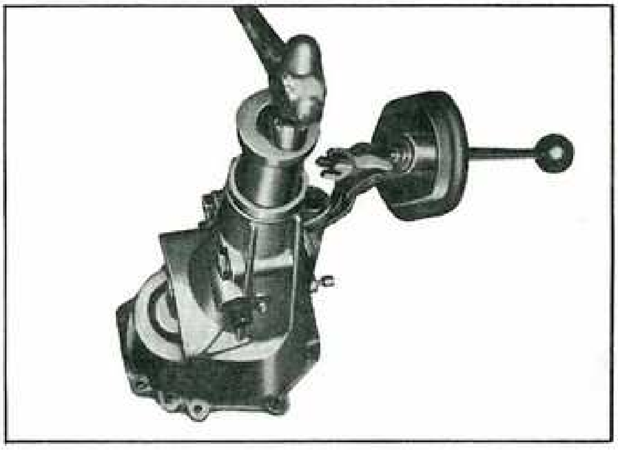


Fig. TM-23

6. Press Rear Extension Bearing into Rear Extension, using a drift.
7. Install Oil Seal.

4) Main Shaft-Assemble

1. Install Needle roller bearing and 3rd Gear Assembly into Main Shaft front end.

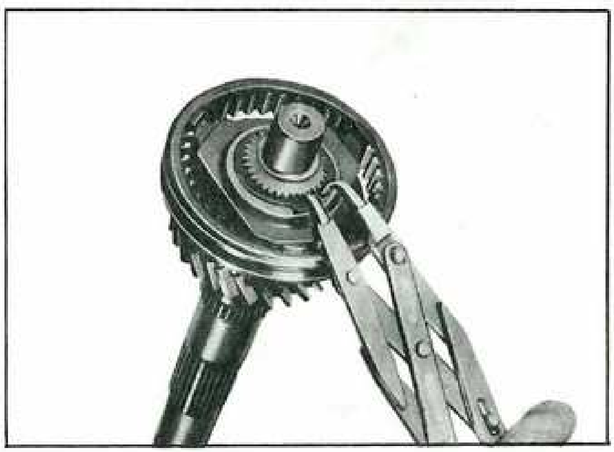


Fig. TM-24

2. Install Synchronizer Hub and retain with Snap Ring.
3. Install Coupling Sleeve.
4. Install Needle roller bearing and 2nd Gear Assembly into Main Shaft from the rear end.
5. Press Synchronizer Hub into Main Shaft with a suitable drift.
6. Install Coupling Sleeve into 1st & 2nd Synchronizer Hub.
7. Press 1st speed gear bushing into Shaft.
8. Install Needle roller bearing and 1st Gear assembly.
9. Install Thrust washer and Lock ball.
10. Press in Main Shaft Bearing, using a suitable drift.

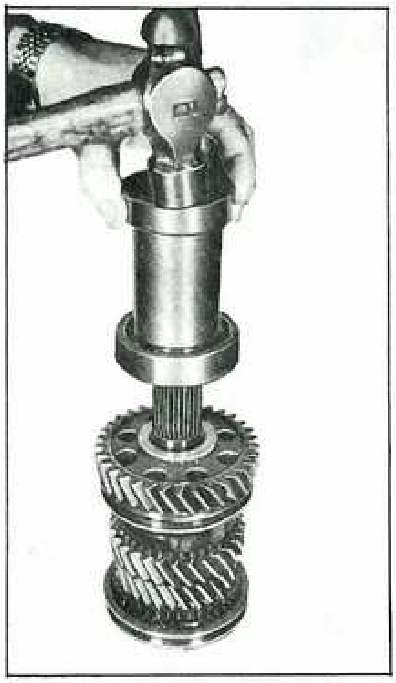


Fig. TM-25

5) Counter Shaft-Assemble

Press Counter Shaft Bearings into both ends of Counter Shaft, using a suitable drift.

Fig. TM-26

Assemble Gear Ass'y

1) Vise Adapter Plate on a suitable stand.
2) Assemble Main Shaft Ass'y, Main Drive Shaft Ass'y and Counter Shaft Ass'y together into Adapter Plate.

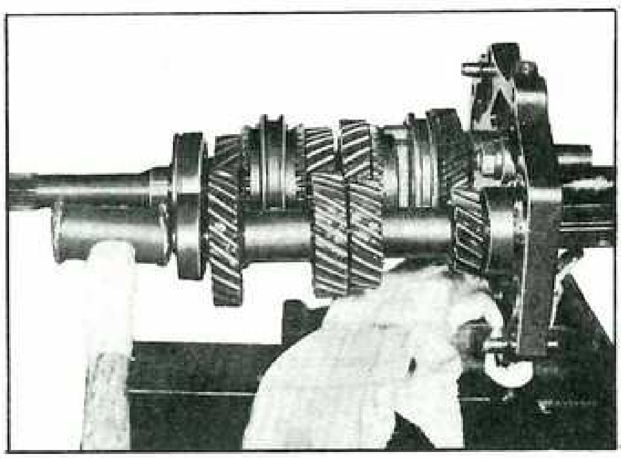


Fig. TM-27

3) Install Counter Shaft Bearing Ring at the rear end of Counter Shaft Bearing and Stopper Ring at Main Shaft Bearing.

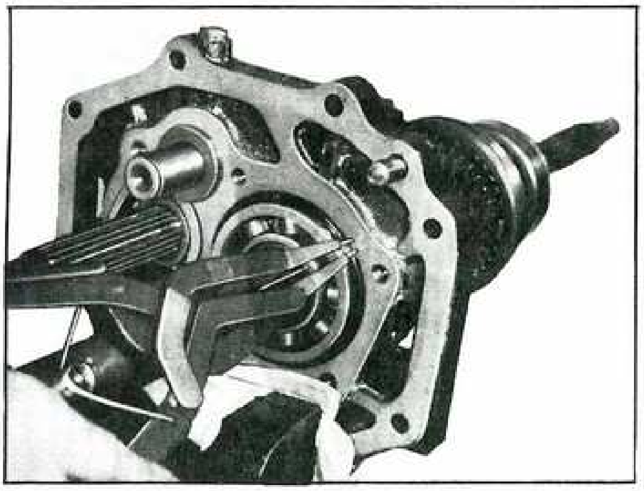


Fig. TM-28

4) Install Main Shaft Bearing Retainer. Tighten Screws to 1.1 ~ 1.4 kg-m (7.95 ~ 10.12 ft-lb) torque.

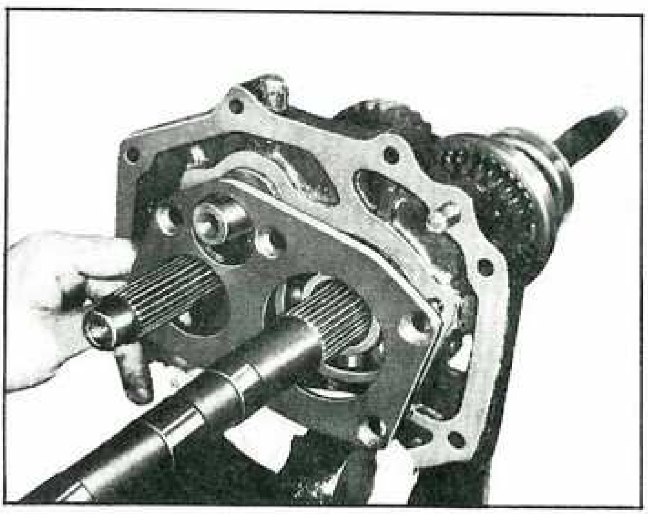


Fig. TM-29

5) Install Hub Synchro-Over Drive and Reverse Gear into Main Shaft, using a suitable drift.

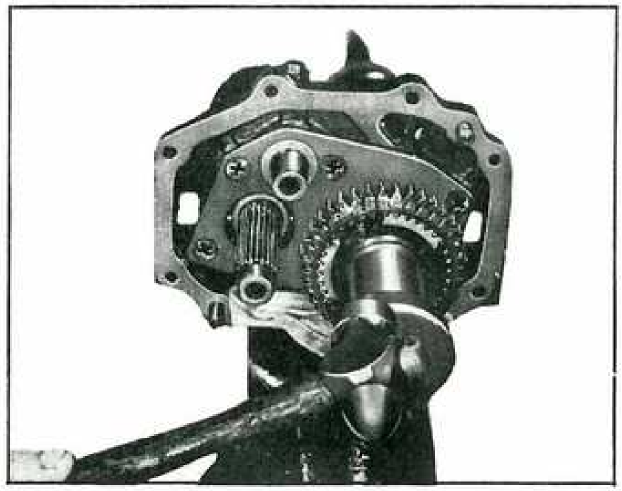


Fig. TM-30

6) Press Reverse Gear into Counter Shaft, using a drift.

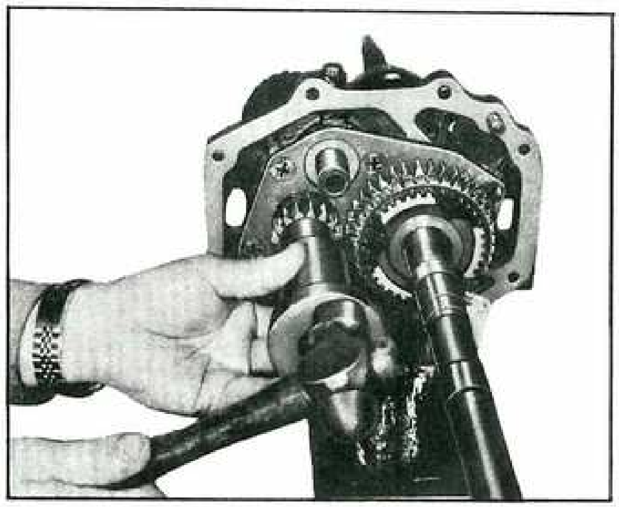


Fig. TM-31

7) Install Needle Roller Bearing, Reverse Idler Gear and Thrust Washer into Reverse Idler Shaft.
Retain with Snap Ring.

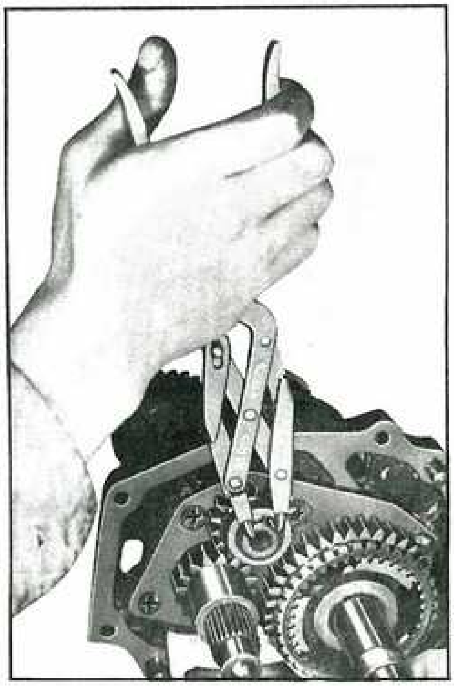


Fig. TM-32

8) Install Bushing-Main Shaft Over Drive, using a suitable drift.

9) Install Needle Roller Bearing and Over Drive Gear Assembly.

10) Press Over Drive Gear-Counter Shaft into Counter Shaft.

11) Press Bearing-Counter Shaft Over Drive into the rear end of Counter Shaft.

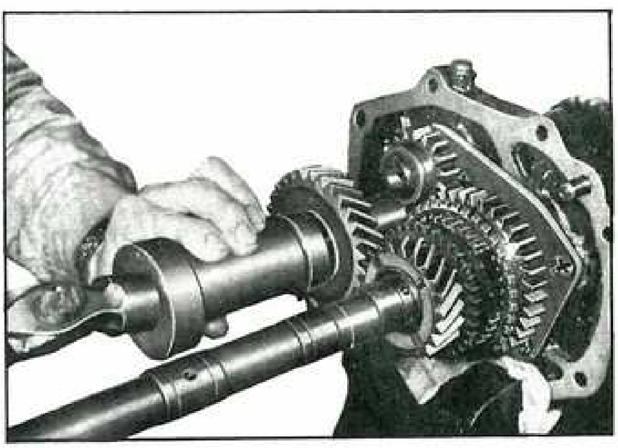


Fig. TM-33

12) Install Washer, Spring Washer and Bolt into Counter Shaft.

13) Tighten Bolt-Counter Shaft to 4.3 ~ 5.5 kg-m (31.09 ~ 39.77 ft-lb) torque.

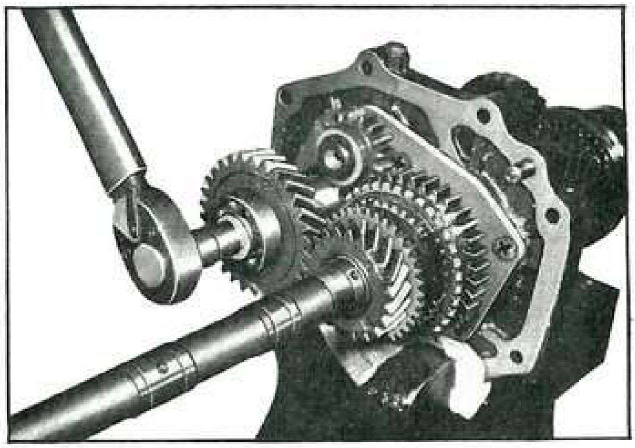


Fig. TM-34

14) Install Lock Ball and Thrust Washer.

15) Install Lock Plate and Nut. Do not tighten.

16) Tighten Nut-Main Shaft to 17 ~ 20 kg-m (122.9 ~ 144.6 ft-lb) torque, and turn over the lock plate to lock the nut.

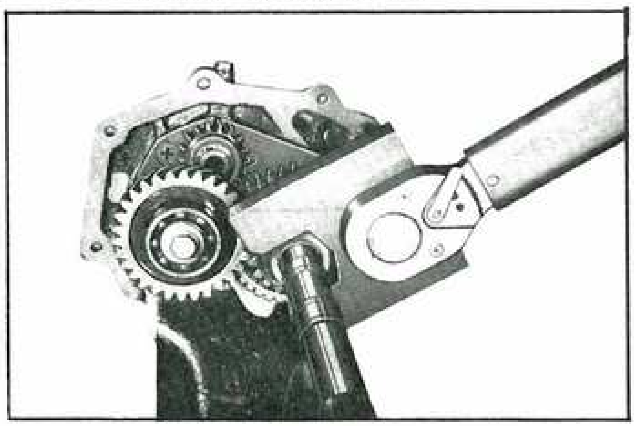


Fig. TM-35

17) Install Snap ring into the groove.

18) Press Over Drive bearing into Main shaft and retain with Snap ring in order.

19) Install Snap ring, Steel ball, Speedometer gear and Snap ring.

20) Install Reverse fork and insert Fork rod-reverse & Over drive with bracket.

21) Match Fork rod hole with the hole of Reverse Fork and insert Retaining pin.

22) Install two steel balls into Check ball hole.

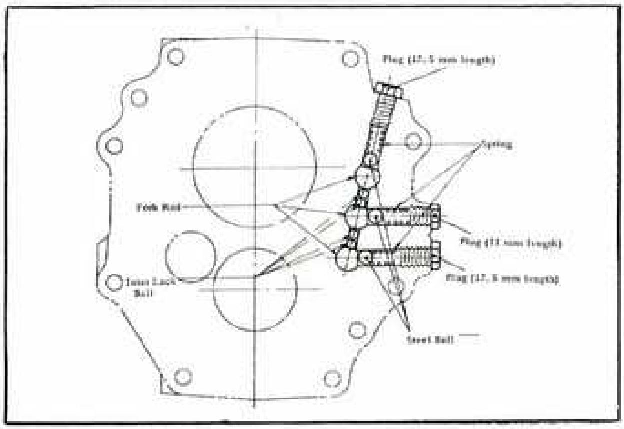


Fig. TM-36

23) Install Fork-3rd & 4th and insert Fork rod with bracket.

24) Insert Retaining pin.

25) Install two steel balls into Check ball hole.

26) Install Fork-1st & 2nd and insert Fork rod with bracket.

27) Insert Retaining Pin.

28) Install two steel balls into Check ball hole. into each check ball hole and screw in Checking plugs, smearing with the adhesive compound.

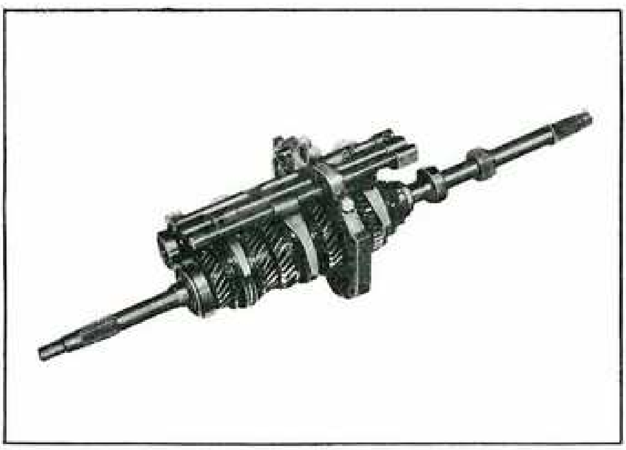


Fig. TM-37

29) Tighten Checking plugs to 2.2 ~ 3.0 kg-m (15.91 ~ 21.69 ft-lb) torque.

30) Check the end plays of Gears.
End play of Main Shaft Gears should be 0.1 ~ 0.2 mm (0.0039 ~ 0.0079 in.).

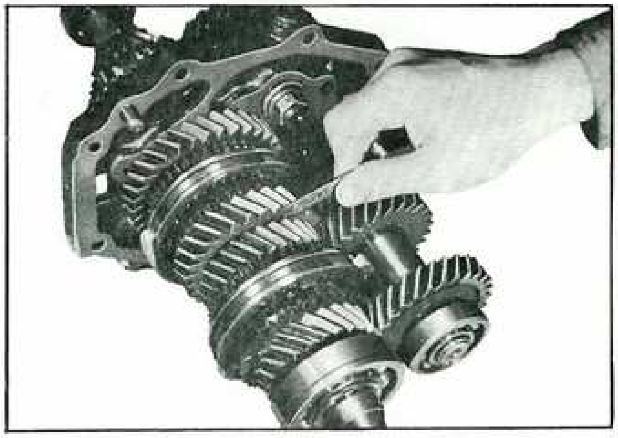


Fig. TM-38

Assemble Gear Ass'y, Gear Case, Clutch Housing and Rear Extention

1) Install Gear Ass'y into Gear Case, using a new gasket.

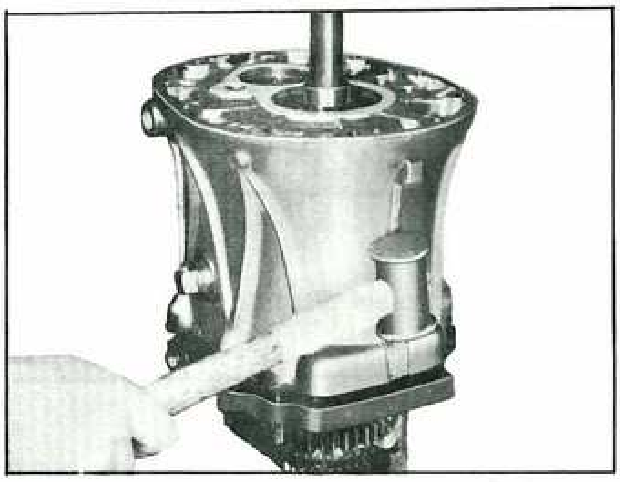


Fig. TM-39

2) Measure the depth from Gear case face to Bearing face and select a suitable shim. Available Counter Shaft Bearing Shims are

0.4 mm (0.0158 in.), 0.5 mm (0.0197 in.),

0.6 mm (0.0236 in.), 0.7 mm (0.0276 in.),

0.8 mm (0.0315 in.), 0.9 mm (0.0354 in.),

1.0 mm (0.0394 in.).

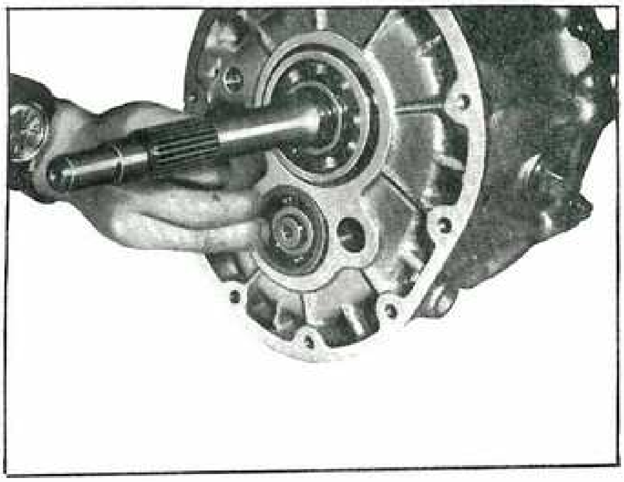


Fig. TM-40

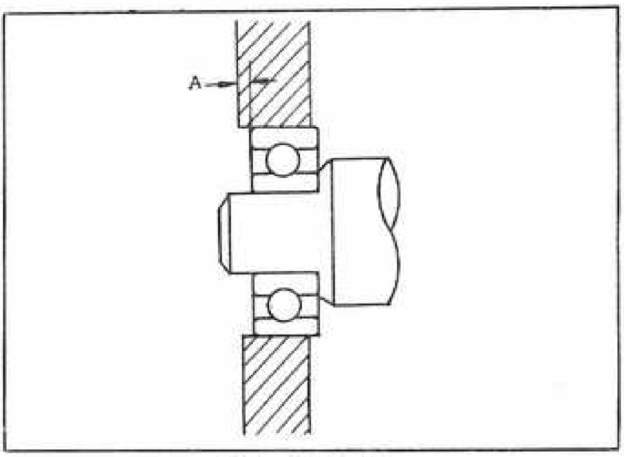


Fig. TM-41

3) Select a suitable Main Drive Gear Bearing Ring.

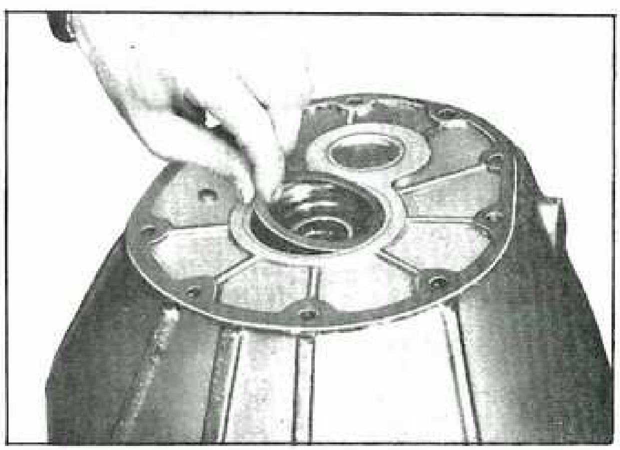


Fig. TM-42

o Install a Stopper Ring into Main Drive Gear Bearing and Press in Bearing until Stopper Ring contacts with Gear Case Face.

o Measure the height (B) of Bearing face from gear case face.

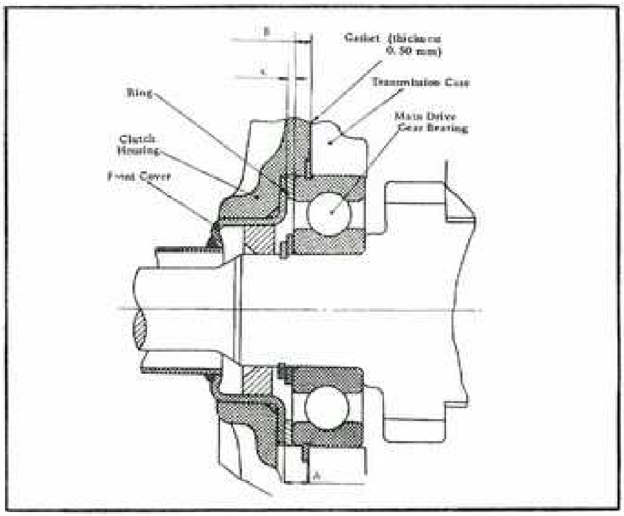


Fig. TM-43

o Measure the depth (A) of Front cover rear flange face from Clutch housing face.

Standard dimension:

A = 6.0 ~ 6.2 mm (0.2362 ~ 0.2441 in.)
B = 4.70 ~ 5.00 mm (0.1850 ~ 0.1969 in.)

o Select Main Drive Bearing Ring (thickness C) such as will satisfy the following equation.
A - B - C = -0.20 mm ~ +0.20 mm (-0.0079 in. ~ +0.0079 in.).
Three kinds of Main Drive Bearing Rings are avairable {C = 1.2 mm (0.0472 in.), 1.4 mm (0.0551 in.) & 1.6 mm (0.0630 in.)}.

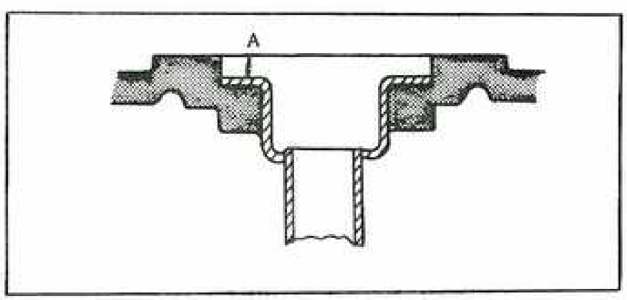


Fig. TM-44

4) Install Clutch housing, using a new gasket.

5) Install Clutch housing to Transmission bolts and spring washers.

6) Tighten to 1.9 ~ 2.2 kg-m (13.74 ~ 15.91 ft-lb) torque.

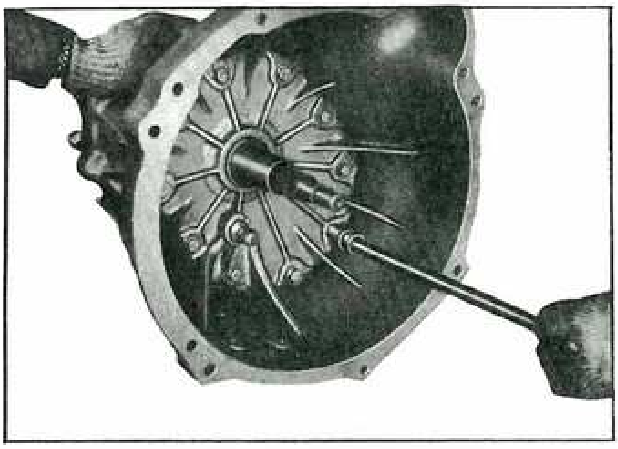


Fig. TM-45

7) Install Rear Extension Ass'y, engaging Striking Rod with Fork Rod. Use a new gasket.

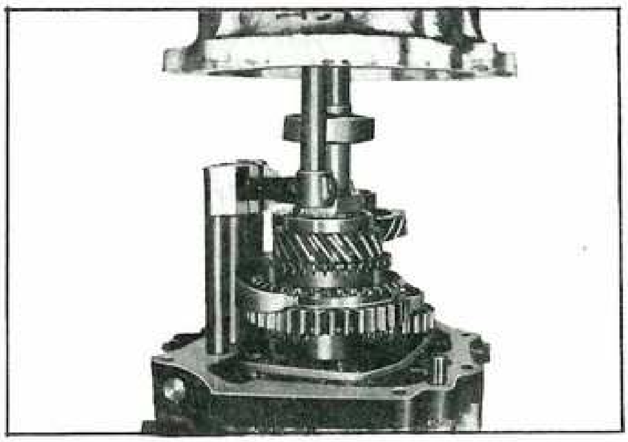


Fig. TM-46

8) Install eight bolts and spring washers. Tighten bolts to 1.5 ~ 2.2 kg-m (10.85 ~ 15.91 ft-lb) torque.

9) Install Companion Flange Ass'y.

10) Install Plane Washer and Nut. After tightening to 14 ~ 17 kg-m (101.2 ~ 122.9 ft-lb) torque, retain with Cotter pin.

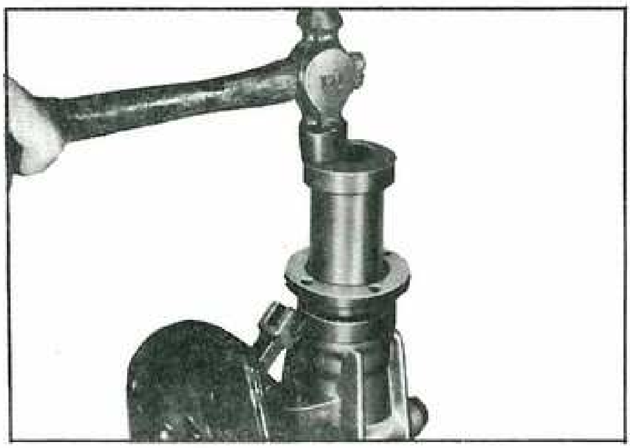


Fig. TM-47

11) Connect Striking Rod with Control Lever.

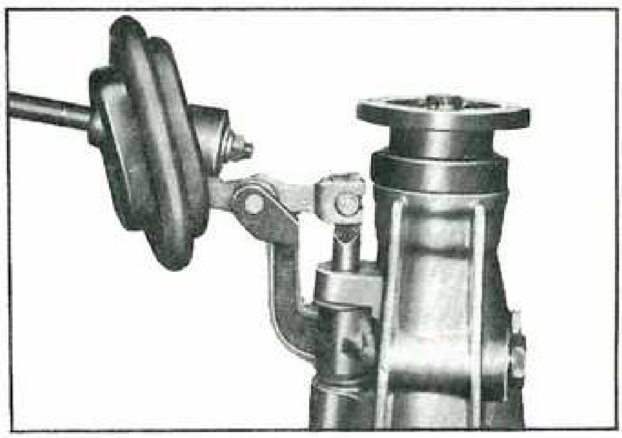


Fig. TM-48

SERVICE DATA

GENERAL SPECIFICATION

Model		FS5C71A
Control Type		Floor Shift
Synchro Type		Servo Type
Gear Ratio		1st = 2.957
		2nd = 1.858
		3rd = 1.311
		4th = 1.000
		5th = 0.852
		Rev. = 2.922

Number of Teeth

Main Shaft	Drive gear	23
	3rd gear	28
	2nd gear	29
	1st gear	34
	Rev. gear	36
	O.D. gear	21
Counter Shaft	Driven gear	28
	3rd gear	26
	2nd gear	19
	1st gear	14
	Rev. gear	15
	O.D. gear	30
Reverse Idler Gear		17
Speedometer	Drive gear	6
	Driven gear	18

TIGHTENING TORQUE

Reverse Idler Shaft Nut	6.3 ~ 7.3 kg-m (45.55 ~ 52.78 ft-lb)
Reverse Idler Shaft Set-Screw	1.1 ~ 1.3 kg-m (7.95 ~ 9.40 ft-lb)
Main Bearing Retainer Screws	1.1 ~ 1.4 kg-m (7.95 ~ 10.12 ft-lb)
Counter Shaft Overdrive Bearing Bolt	4.3 ~ 5.5 kg-m (31.09 ~ 39.77 ft-lb)
Main Shaft Rear Nut	17 ~ 20 kg-m (122.9 ~ 144.6 ft-lb)
Check Ball Plugs	2.2 ~ 3.0 kg-m (15.91 ~ 21.69 ft-lb)
Rear Extension Fitting Bolts	1.5 ~ 2.2 kg-m (10.85 ~ 15.91 ft-lb)
Companion Flange Nut	14 ~ 17 kg-m (101.2 ~ 122.9 ft-lb)
Clutch Housing to Gear Case Bolts	1.9 ~ 2.2 kg-m (13.74 ~ 15.91 ft-lb)
Speedometer Sleeve Lock Plate Bolt	0.5 ~ 0.6 kg-m (3.62 ~ 4.34 ft-lb)
Clutch Housing to Engine Bolt	Large 2.7 ~ 3.7 kg-m (19.52 ~ 26.75 ft-lb) Small 1.1 ~ 1.4 kg-m (7.95 ~ 10.12 ft-lb)

DECIMAL EQUIVALENTS

1/64	.015625	33/64	.515625
1/32	.03125	17/32	.53125
3/64	.046875	35/64	.546875
1/16	.0625	9/16	.5625
5/64	.078125	37/64	.578125
3/32	.09375	19/32	.59375
7/64	.109375	39/64	.609375
1/8	.125	5/8	.625
9/64	.140625	41/64	.640625
5/32	.15625	21/32	.65625
11/64	.171875	43/64	.671875
3/16	.1875	11/16	.6875
13/64	.203125	45/64	.703125
7/32	.21875	23/32	.71875
15/64	.234375	47/64	.734375
1/4	.25	3/4	.75
17/64	.265625	49/64	.765625
9/32	.28125	25/32	.78125
19/64	.296875	51/64	.796875
5/16	.3125	13/16	.8125
21/64	.328125	53/64	.828125
11/32	.34375	27/32	.84375
23/64	.359375	55/64	.859375
3/8	.375	7/8	.875
25/64	.390625	57/64	.890625
13/32	.40625	29/32	.90625
27/64	.421875	59/64	.921875
7/16	.4375	15/16	.9375
29/64	.453125	61/64	.953125
15/32	.46875	31/32	.96875
31/64	.484375	63/64	.984375
1/2	.5	1	1.

MAINTENANCE LOG

DATE	TYPE OF SERVICE	COST	REMARKS

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.

EXHAUST CONTROL SYSTEM

CONTENTS

DESCRIPTION

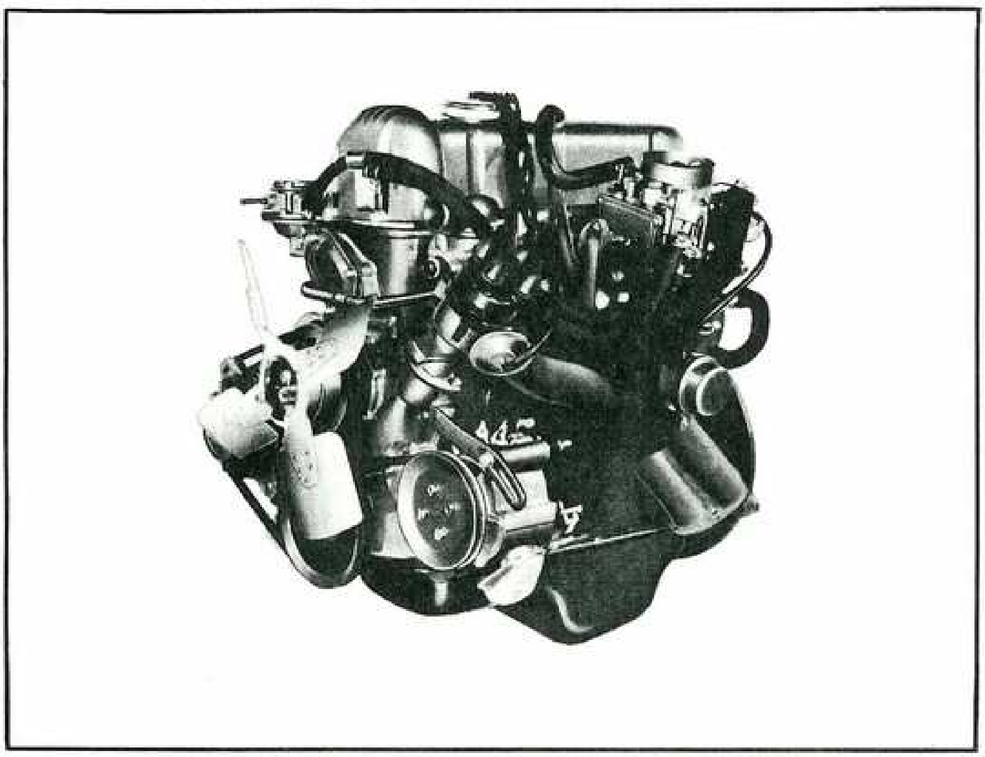


Fig. EC-3 97.4 C.I.D. (Model L16) engine

Nissan Motor has two types of emission control systems for Datsun vehicles.

The N.A.I.S. with which Datsun Sports Cars, Sedans, and Station Wagons are equipped is designed to reduce air pollution, caused by engine exhaust tailpipe gases, by "treating" the unburned hydrocarbons and carbon monoxide as they are expelled from the combustion chambers into the exhaust manifolds. A sealed bearing pump, driven by the engine, compresses, distributes and injects clean filtered air into the exhaust port of each cylinder. Here the clean air combines with the unburned hydrocarbons and carbon monoxide at high temperatures in a chemical reactions, producing a "treated" exhaust, below the maximum allowable level for air pollution. The elements of the N.A.I.S. include an air cleaner, a belt-driven air injection pump, a check valve, an anti-backfire valve, and related connecting tubes and hoses. A special calibrated carburetor and distributor are also used with the air injection system.

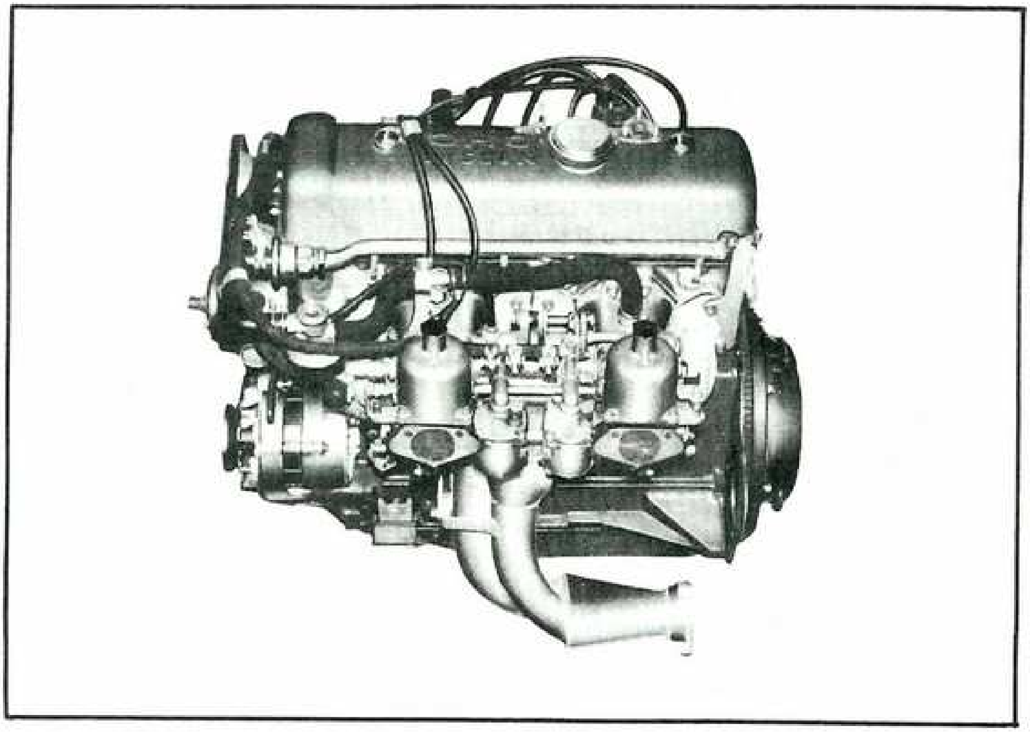


Fig. EC-4 120.9 C.I.D. (Model U20) engine

The N.E.M.S. with which Datsun Pick-ups and Patrols are equipped, is also designed to continuously control carburetion and ignition timing at the best settings for performance and combustion during all driving conditions (the primary purpose of this systems is to reduce emission at idle and in the deceleration range). These adjustments keep hydrocarbons and carbon monoxide in the exhaust below the maximum allowable level. Some special components are used in this system. The carburetor is specially calibrated to provide leaner mixtures at idle and during low speed operation. The distributor is designed to give retarded timing at idle. The intake and exhaust manifold are designed for quicker vapourization. A fuel cut-off device ---- solenoid valve, throttle valve switch, clutch switch, vacuum switch, and transmission neutral switch ---- is provided on Datsun Pick-ups to cut-off the fuel supply during deceleration. A vacuum control valve is specially installed on Datsun Patrols for the distributor advance mechanism.

NISSAN AIR INJECTION SYSTEM

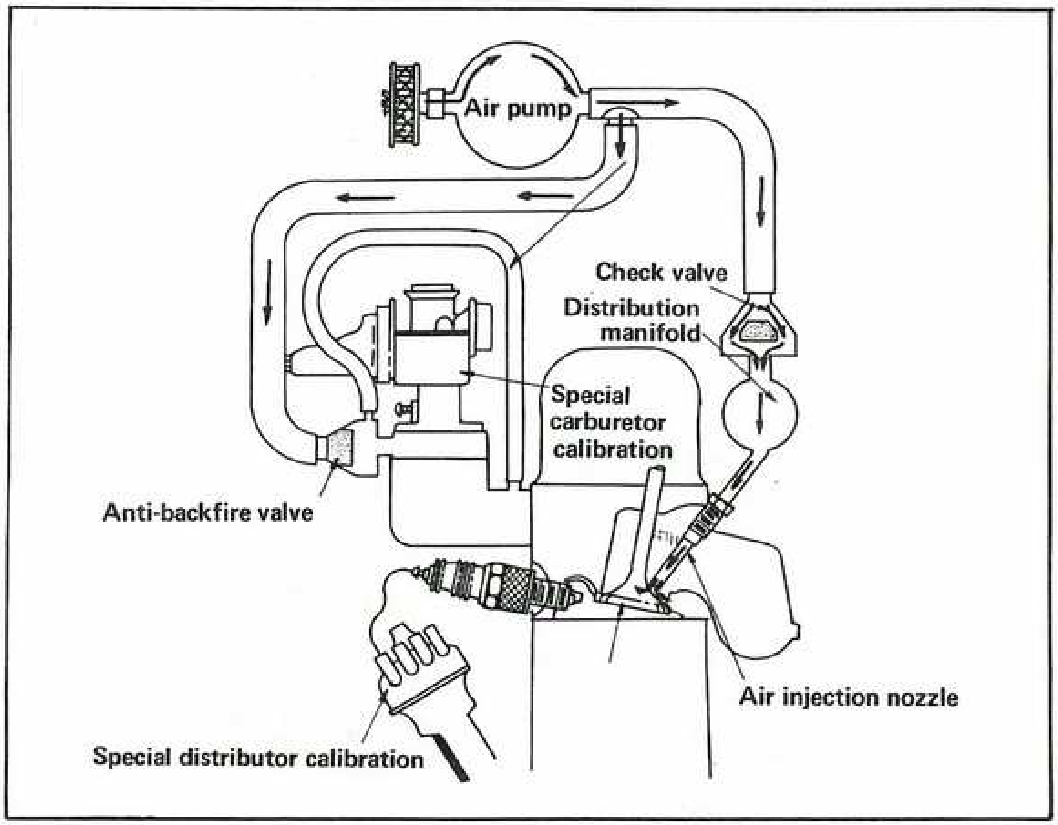


Fig. EC-5 Nissan air injection system

N.A.I.S. is basically an air injection system combined with engine modifications to increase its effectiveness.

The basic elements of the system are:

1. Engine-driven air pump
2. Air injection into each exhaust port
3. Engine modifications
4. Recommended annual maintenance

The application of this system to the engines produced by Nissan Motor Co. are 97.4 C.I.D. (Model L16) Datsun Sedan and Station Wagon engines equipped with 2 barrel carb, and 97.3 C.I.D. (Model R16), 120.9 C.I.D. (Model U20) Sports Car engines equipped with SU type twin carburetors.

The air injection pump receives clean air by means of a hose, connected to a fitting on the underside of the carburetor air cleaner. As for the Datsun Sports Car the air injection pump will have a separate air cleaner.

This rotary vane type pump has been designed to draw the air in and compress it to produce maximum air flow with quiet operation. A fresh air line from the air injection pump is routed so that it goes to a check valve, which prevents exhaust gas from entering the air pump in the event exhaust manifold pressure is greater than air injection pressure, or in the case of an inoperative pump. The compressed fresh air is injected through an injection nozzle to the exhaust ports.

An anti-backfire valve has been installed to eliminate "popping" in the exhaust system when the throttle is closed at a high speed "coast". Controls which have been incorporated to assure reliable system operation include an anti-backfire valve and a check valve.

Engine-driven air pump

The air injection pump is a positive displacement vane-type which is permanently lubricated and requires no periodic maintenance.

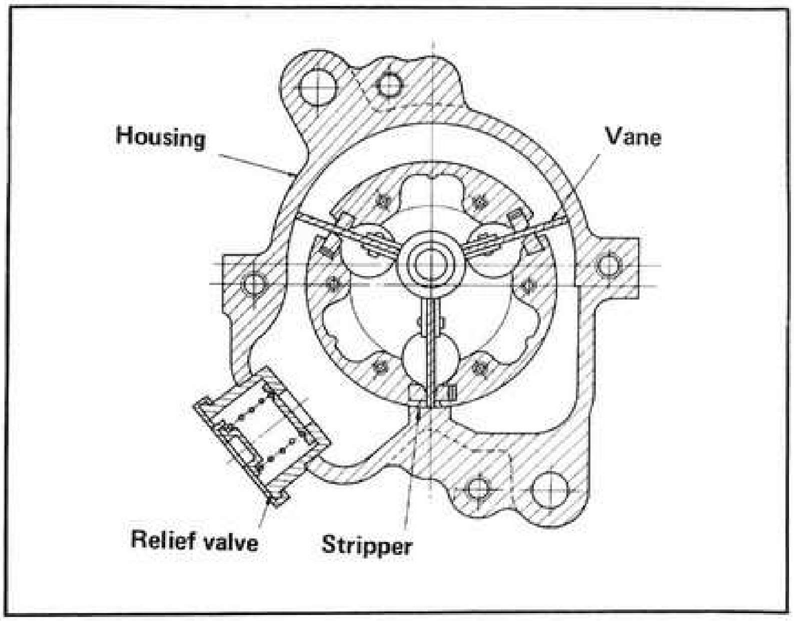


Fig. EC-6 Sectional view of air pump

The die-cast aluminum air pump assembly attached to the front of the engine is driven by an air pump drive belt. A rotor shaft, drive hub, relief valve, and intake and exhaust tubes are visible on the pump exterior. A rotor, vanes, carbon shoes, and shoe springs make up the rotating unit of the pump. The rotor located in the center of the pump is belt driven. The vanes rotate freely around the off-center pivot pin, and follow the circular-shaped pump bore. The vanes produce three chambers in the housing; intake, compression, and exhaust. Each vane completes a pumping cycle in every revolution of the rotor. Air is drawn into the intake cavity through a tube connected to the air cleaner. The air is sealed between the vanes and moved into a smaller cavity, the compression area.

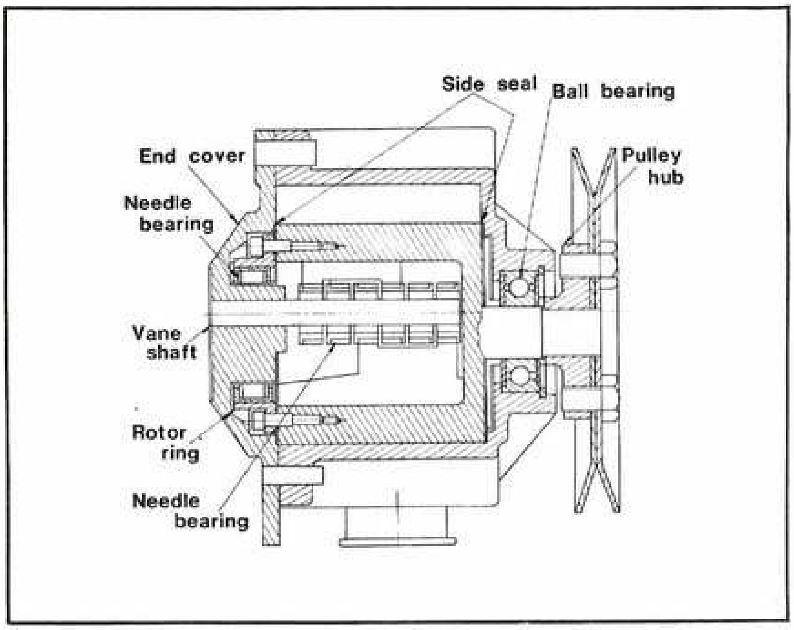


Fig. EC-7 Sectional view of air pump

After compression, the vanes pass the exhaust cavity. The vanes then pass the stripper, a section of the housing that separates the exhaust and intake cavities. Continuing the cycle, the vane again enters the intake cavity to repeat its pumping cycle. The relief valve, located in the exhaust cavity, encloses a pre-loaded spring, a seat, and a pressure-setting plug. Its function is to relieve the exhaust air flow if the pressure exceeds a pre-set value. Metering grooves, machined into the housing wall, located in both the intake and exhaust cavities; provide a quiet transition from intake to compression to exhaust.

Carbon shoes support the vanes from slots in the rotor. The shoes are designed to permit sliding of the vanes and to seal the rotor interior from the air cavities. Leaf springs which are behind the follower-side of the shoes compensate for shoe wear and vane articulation. Air leaking into the rotor is exhausted through two small holes in the end cover. The rotor is further sealed by flexible carbon seals which are attached to each end. The plates also seal off the housing and end cover to confine the air to the pump cavities. Air that leaks by the front carbon seal is exhausted through a small hole in the housing.

Completing the rotating unit is a steel ring bolted to the rotor end. This ring prevents the rotor from spreading at high r.p.m., and also positions and holds the rear bearing and the carbon seal.

The front and rear bearings which support the rotor are of two types. The front bearing uses ball bearings and the rear bearing uses needle bearings. The hub bearings are the needle bearing type. All bearings have been greased for life.

Air injection into each exhaust port

The fresh air from the air pump is injected into the individual exhaust ports of the cylinder head in the vicinity of the exhaust port.

Pressurized air is transmitted through hoses and air distribution manifold.

A schematic of the exhaust port is shown in Figure EC-8, 9.

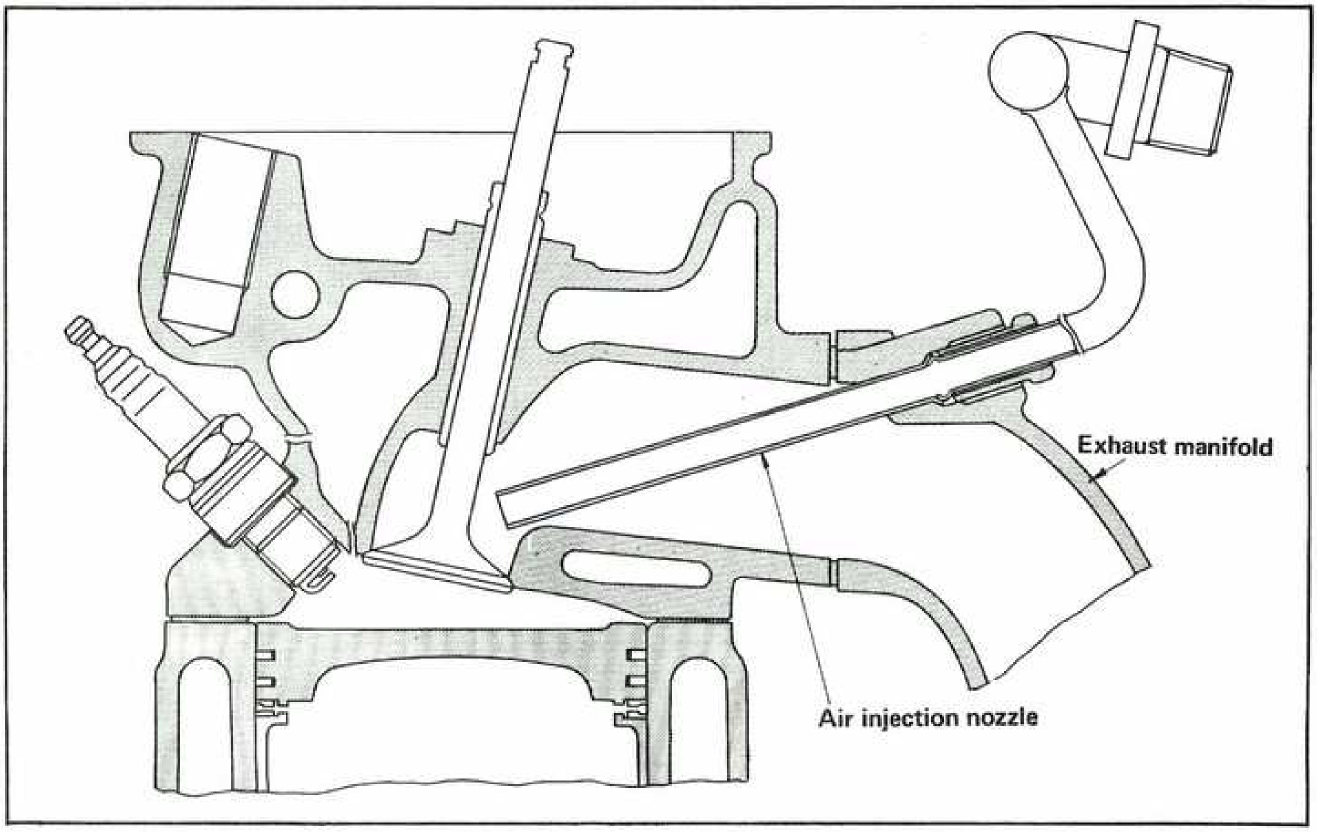


Fig. EC-8 Air injection into exhaust port - L16 engine

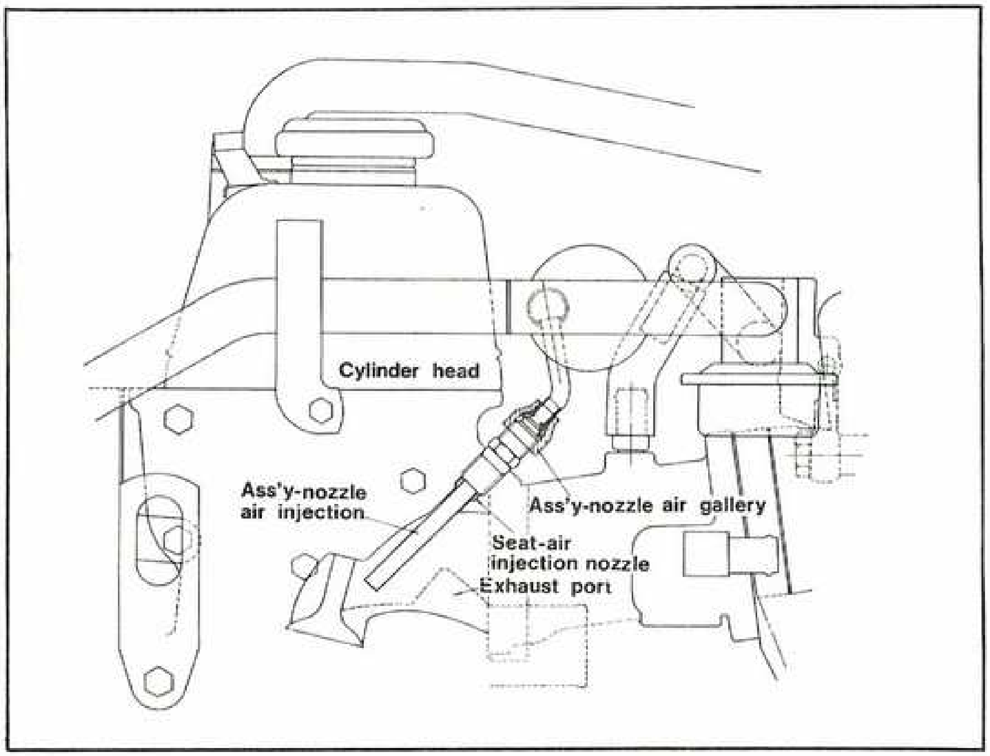


Fig. EC-9 Air injection into exhaust port-U20 engine

In addition to air injection, certain controls have been incorporated to assure reliable system operation as follows.

Anti-backfire valve

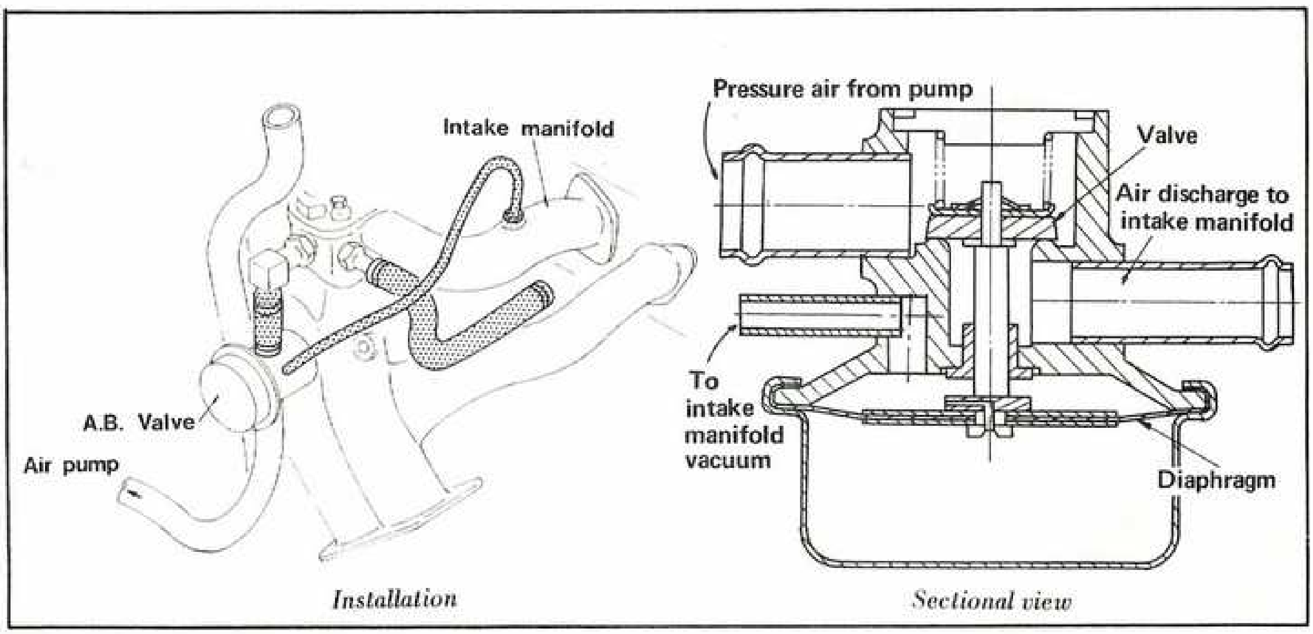


Fig. EC-10 Anti-backfire valve

This valve is controlled by intake manifold vacuum and is required to prevent exhaust system backfires during deceleration. During deceleration, the mixture in the intake manifold is too rich to burn and ignites when combined with the injected air in the exhaust manifold.

The anti-backfire valve is used to provide a gulp of air into the intake manifold thereby making the air mixture leaner to prevent backfire.

A schematic of the anti-backfire valve is shown in Figure EC-10.

The anti-backfire valve inlet is connected to the air pump discharge line and outlet to the intake manifold.

By burning this rapidly evaporated fuel within the cylinder, some contribution to emission reduction can also be expected.

If the valve does not work properly, the fuel mixture will back up through it, meet the fresh air and, at high temperature, backfire will result.

Check valve

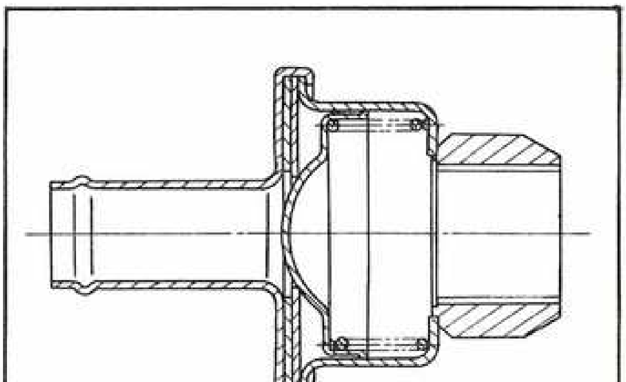


Fig. EC-11 Sectional view of check valve

Check valve is set between the air pump and the air injection nozzle. It prevents a back flow of exhaust gas. Normally, it passes air into the air distribution manifold in the air injection system. When exhaust manifold pressure exceed air injection pressure, as it will at high speed or when the air pump drive belt fails, the air injection nozzle is in the path of the exhaust gases, and the exhaust manifold pressure will exceed air injection pressure, backing up exhaust gas, which is prevented from entering the system by the check valve which closes it off.

Air pump relief valve

The air pump relief valve is mounted in the discharge cavity of the air pump and accomplishes the following functions without affecting the exhaust emission control system's effectiveness:

Hold the increase in maximum exhaust gas temperatures to a minimum.

Minimize horsepower losses resulting from air injection into the exhaust system.

Protect the pump against excessive back pressures.

Engine modifications

The air injection system includes some engine modifications necessary to reduce exhaust hydrocarbons and carbon monoxided concentrations.

Combustion chamber improvement

The combustion chamber is designed to provide an open chamber.

Carburetor

In consideration of air injection effectiveness, engine performance, fuel economy and drive feeling, all engines for this system are equipped with special calibrated carburetors with narrow to tolerance for fuel flow.

Ignition distributor

The ignition distributor used with the Air Injection System is provided with a different advance curve from that used on engines without an exhaust emission control system.

Idle ignition timing is retarded by about 10 degrees; these settings will vary between engines.

Idle speed

The idle speed is set at a higher r.p.m. for all engines.

These settings will vary between engines but typical specifications are 650 r.p.m. for automatic transmission equipped vehicles and 700 r.p.m. for manual transmission equipped vehicles. (Refer to the page EC(A)-33.)

Carburetor idle mixture

On cars equipped with the Air Injection System, slightly rich adjustment of the idle mixture is required.

Cooling system

A modified engine cooling system will be used due to increased engine heat rejection at idle caused by retarded ignition timing.

Cooling system changes such as larger fans, higher fan speeds are incorporated.

Thermal modulator

A thermal modulator is used on 120.9 C.I.D. (Model U20) engine. This provides full vacuum advance at idle when the cooling system temperature becomes too high (approximately 220° F).

The advanced timing reduces the cooling requirements and increases engine speed at idle, and so extremely high temperatures in cooling system can be avoided.

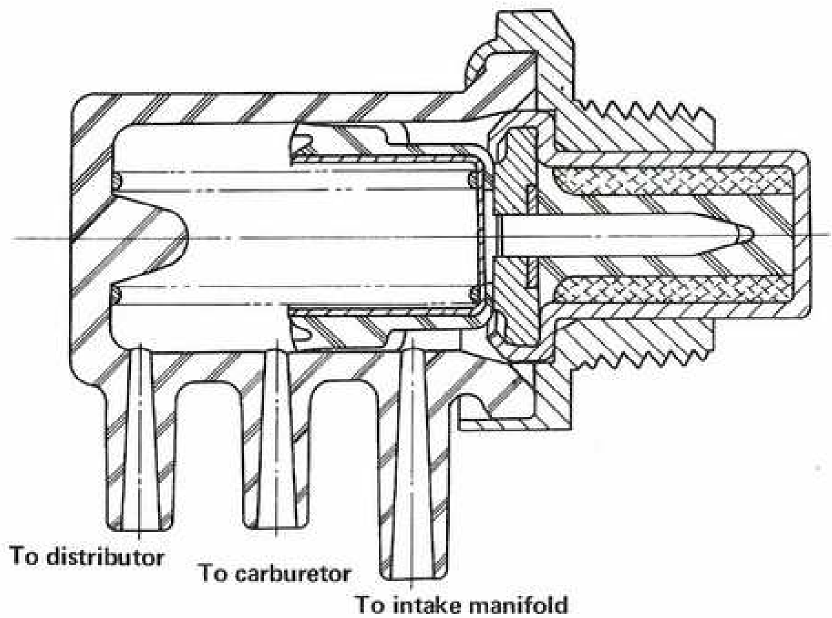


Fig. EC-12 Sectional view of thermal modulator

Thermostatic fan clutch

The larger fans increase fan noise.

A thermostatic fan clutch is used on Air Injection equipped cars. When the air temperature of the radiator's back side rises to some predetermined temperature, the thermostatic fan clutch is activated.

Normally this clutch slips and therefore reduces fan noise and fuel consumptions.

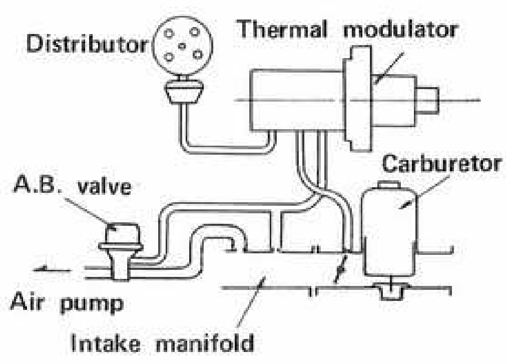


Fig. EC-13 Schematic of thermal modulator

Hot air type air cleaner (optional)

For Datsun Sedan and Station Wagon 97.4 C.I.D. (Model L16) engines, the heated air systems are designed to warm the air entering the carburetor when the underhood temperature is low. Under this condition the carburetor can be calibrated to effectively reduce exhaust emission without affecting engine performance and to provide fuel economy and eliminate carburetor icing.

Spark plug

Projected electrode type spark plugs are employed on all of Nissan's emission controlled engines.

Crankcase ventilation system

Datsun Sedan and Station Wagon 97.4 C.I.D. (Model L16) engine utilizes a crankcase emission control valve of the tapered-plunger type.

This valve was shown to be capable of operating longer with much less clogging.

The Datsun Sports Car 97.3 C.I.D. (Model R16) and 120.9 C.I.D. (Model U20) engines are equipped with conventional sealed crankcase ventilation systems.

Recommended annual maintenance

For the continued proper performance of the Nissan Air Injection System, annual maintenance must be performed.

The details of annual maintenance are described in chapter 'MAINTENANCE'.

REMOVAL AND DISASSEMBLY PROCEDURE

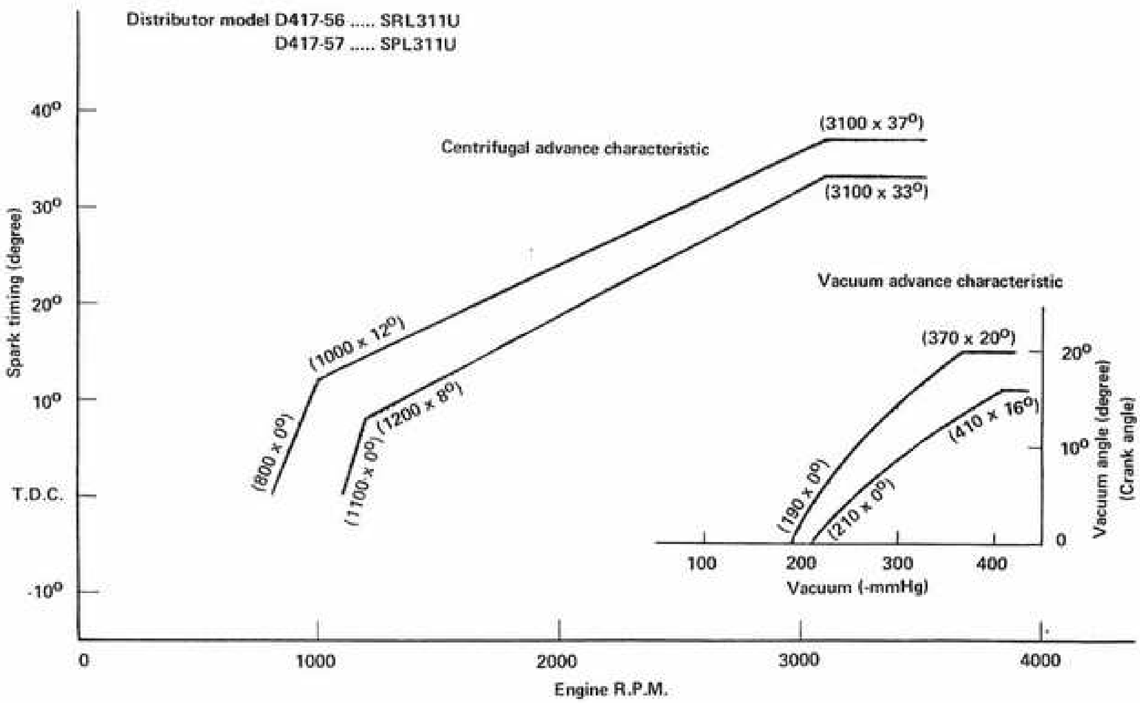
The exhaust emission control system should not be removed generally and fully inspection must be done prior to removal.

Air pump

Removal

1. Disconnect hoses from air pump housing cover.

Note: Pages EC(A)-12 through EC(A)-15 removed since they do not refer to the Datsun Sports Cars.



Distributor advance characteristic - Datsun Sports Car (Model U.R engine)

2. Remove bolt securing air pump to belt adjusting bar.
3. Remove bolt securing air pump to mounting bracket and remove air pump drive belt.
4. Remove air pump assembly from car.

Periodic service

Since the bearings in the pump have permanent type lubrication, no periodic maintenance is required. Every 3, 000 miles, the belt tension should be inspected and adjusted.

Note: Mask the two holes in the end cover when washing the car with steam cleaner.

Disassembly of air pump

1. Remove four pulley drive hub bolts and remove pulley from hub.
2. Clamp air pump drive hub in a vise, as shown in Figure EC-21 and remove four housing end cover bolts.

Note: Never clamp on the aluminum housing.

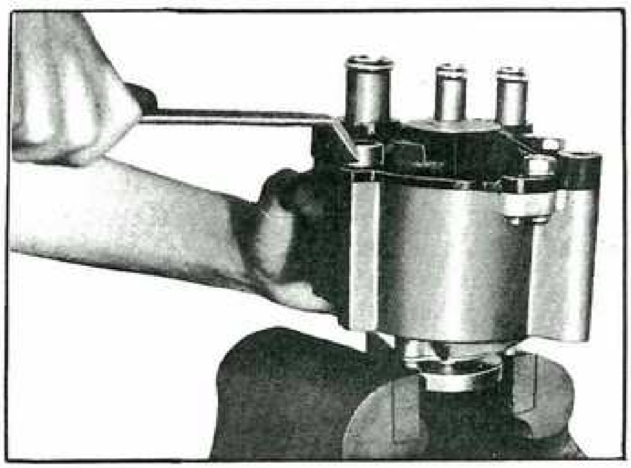


Fig. EC-21 Removing end cover

3. Remove housing end cover by carefully tapping on vicinity of large dowel pin with plastic hammer and lifting straight up.
4. Scribe rotor ring and side of rotor to assure proper reassembly and then remove six screws that retain rotor ring to rotor, using hexagon wrench (special tool: STECP 20000).

Note: Generally manufacture already gives coincidence marks on both rotor ring and rotor.

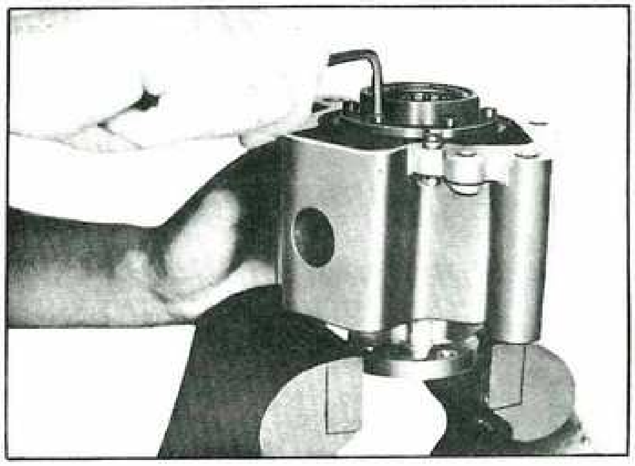


Fig. EC-22 Removing rotor ring

5. Remove rotor ring and side carbon seal from rotor.
6. If it is necessary to replace rear bearing, it may be pressed out of rotor ring on a press using support for disassembling rotor ring (special tool: STECP 20001) and attachment for pushing needle bearing (special tool: STECP 20002).

Note: Support rotor ring carefully to avoid distrotion

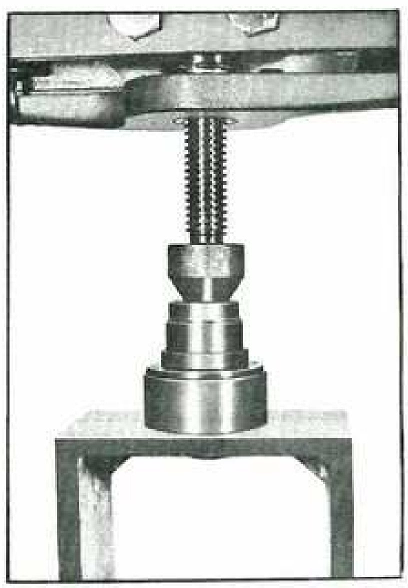


Fig. EC-23 Removing rear rotor bearing

7. Remove vanes from rotor.
8. Remove three sets of carbon shoes and three shoe springs using pair of tweezers or needle nose pliers.

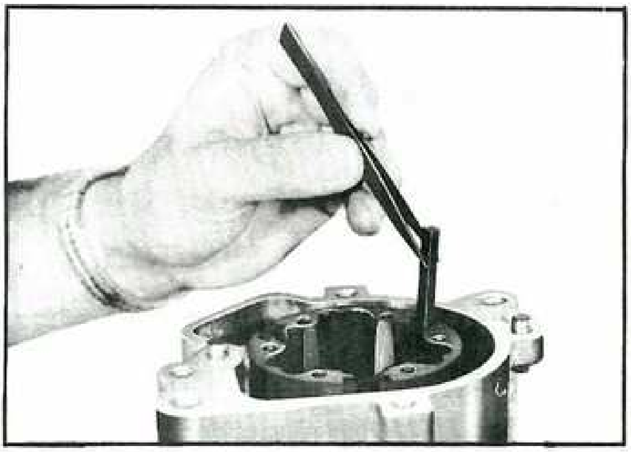


Fig. EC-24 Removing carbon shoe

9. If it is necessary to replace the relief valve, use bridge for pulling out relief valve (special tool: STECP 20004) and standard puller.

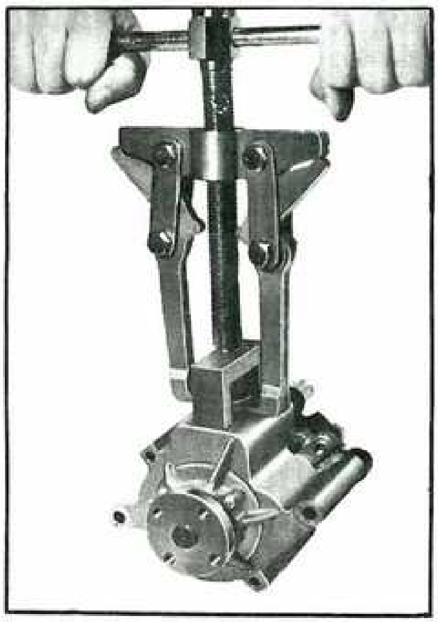


Fig. EC-25 Removing relief valve

10. No further disassembly should be attempted.

Cleaning-inspection-lubrication

Cleaning

Clean rear bearing and vane hub bearings in petroleum solvent.

Clean carbon dust from pump houisng and rotor assembly with an air hose.

Note: Do not use cleaning solvent on pump housing and rotor assembly.

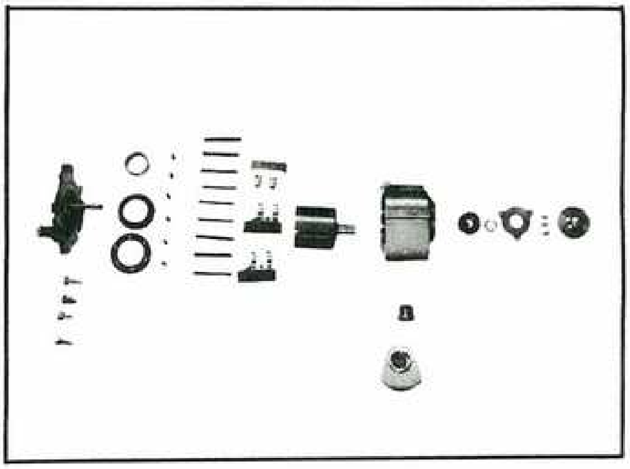


Fig. EC-26 Air pump components

Inspection

Inspect all parts for chipping, scoring, wear and roughness.

All damaged parts must be replaced to ensure quiet and efficient operation. If especially side carbon seal is scored, replace with new one.

Carbon dust may be present in the housing and is usually an indication of normal wear.

Lubrication

The rear bearing and vane hub bearings must be lubricated with a high melting point grease such as ESSO ANDOK 260 or its equivalent. Work grease into each bearing to insure adequate lubrication.

Note: Bearings for service are already packed with high melting point grease.

Assembly of air pump

1. Place air pump housing in a vise, clamping pump drive hub between jaws.
2. Assemble vanes correctly on dummy shaft 9.5 ϕ (special tool: STECP 20005).

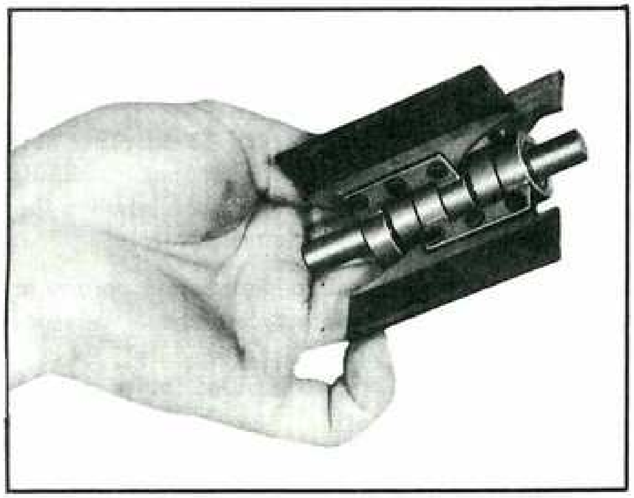


Fig. EC-27 Vane assembly

3. Place vanes into rotor, making sure that one vane is against housing stripper. Do not remove dummy shaft at this time.

Note: a. Pack in vane hub bearing with high melting point grease such as ESSO ANDOK 260.

b. Installation of a new vane set in air injection pump may result in vanes chirping or squeaking during initial operation. The vanes may require five to ten miles wear-in running time. In the event a slight squeaking still persists the vehicle should be run through two or three full throttle shift points. In most cases five to ten miles will be sufficient for wear-in.

4. Insert one carbon shoe on each side of every vane.

Note: Each carbon shoe must the positioned so that chamfered end of shoe faces to vane.

5. Insert three shoe springs into the deeper of shoe slots.

Note: When springs are properly positioned, they will be flush or below rotor surface. The curved portion of spring will be aginst the shoe and ends will be against wall of shoe slot.

6. If rear bearing was removed, a new bearing may be pressed into rotor ring using attachment for pressing in needle bearing (special tool: STECP 20003). The bearing should be about 0.8 mm (0.0315 in.) below rotor ring surface.

Note: Press only on lettered end bearing surface and support rotor ring to prevent its distortion.

7. Position new carbon seal on rotor ring so that holes line up.
8. Position rotor ring so that scribe marks on rotor ring and side of rotor line up.
9. Apply thread locking material to six rotor ring retaining screws and tighten them to 30 to 50 kg-cm (2.2 to 3.6 ft-lb).
10. Remove dummy shaft from vanes and start housing end cover assembly into position, indexing vane shaft into vane bearings. Do not force cover on as this will distort vane bearings and/or vane bearing alignment.
11. Seat end cover to housing and starting with bolt adjacent to large dowel torque four end cover bolts to 100 to 130 kg-cm (7.2 to 9.4 ft-lb). Remove from vise.
12. Insert relief valve into housing mounting hole. With protective plate over valve tap

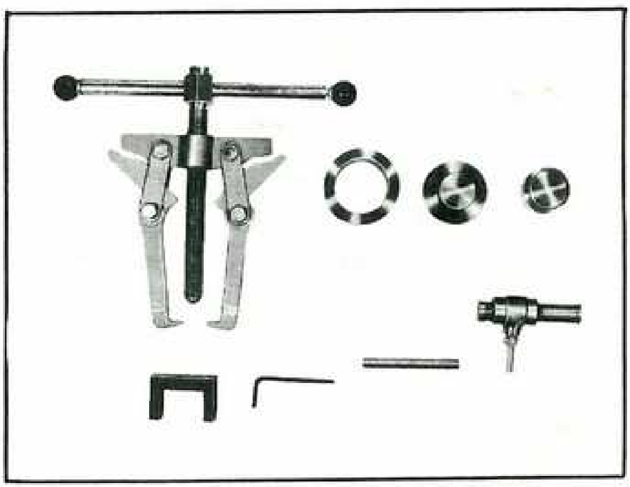


Fig. EC-28 Special tool

with hammer until valve shoulders on housing.

Note: **Care must be observed to prevent distortion of air pump housing.**

13. Set silencer to relief valve by hand.

Installation of air pump

Installation of air pump is reversal of procedure given for removal noting following points.

Adjust the belt tension so that it has about 1/2 in. of slack under thumb pressure.

Note: **Do not pry on the die cast pump housing.**

Drive pulley

1. Loosen the air supply pump adjusting bar nut and bolt to relieve the belt tension.

2. Remove the drive pulley attaching bolts.

Anti-backfire valve

The removal of the anti-backfire valve requires disconnecting the hoses. No further disassembly should be done. After installation check the valve operation and inspect all hoses and hose connections for leak.

Check valve

1. Disconnect the air supply hose.

2. Remove the check valve from the air gallery pipe holding the flange of air gallery pipe with a wrench.

Note: **a. Take care not to damage the air gallery pipe.**
b. No further disassembly should be done.

3. Installation of check valve is reversal of procedure given for removal.

Note: **Tightening torque 9.0~10.5 kg.m (65~76 ft.lb.)**

4. After installation check the valve, hoses and hose connections for air leakage.

Air gallery pipe and injection nozzles

It is very difficult to remove the air gallery from the exhaust manifold on Datsun Sedan and Station Wagon, or, from the injection nozzle on Datsun Sports without bending the pipe. Which could result in fractures or leakage. Therefore the removal of the air gallery pipe and injection nozzle should be done only when they are damaged.

Datsun Sedan and Station Wagon

1. Lubricate around the screwed portion of the air injection nozzle with engine oil.

2. Remove the screwed plug connecting air gallery to injection nozzle (exhaust manifold) using a pipe wrench. And then remove the air gallery from the exhaust manifold.

Note: **a. Apply engine oil to the screwed portion in several times during the above sequence work.**
b. Take care not to damage other correct parts.

3. Insert a hard wire with hooked tip through the injection nozzle and hook nozzle with it, and then remove.

4. Check the air gallery and nozzle for fractures or leakage. Clean the air injection nozzle with wire brush.

5. At the time of installation, the air injection nozzles must be correctly positioned into the exhaust manifold.

6. Tighten the screwed plug connecting the air gallery to injection nozzle (exhaust manifold) to a torque of 5.0 ~ 6.0 kg. m (36 ~ 43 ft. lb.).

7. Check the engine running.

Datsun Sports

1. Lubricate around the connecting portion of the air injection nozzle and air gallery with engine oil.

2. Hold the air injection nozzle hexagon head with a wrench and unfasten the flare screw connecting the air gallery to injection nozzle. Remove the air gallery.

Note: **a. Apply engine oil to the screwed portion in several times during the above sequence work.**
b. Take care not to damage other correct parts.

3. Unfasten the air injection nozzle from the cylinder head applying the engine oil to the screwed portion several times.
4. Check the air gallery and nozzle for fractures or leakage. Clean the air injection nozzle with wire brush.
5. At the time of installation, assemble the nozzle seat on the injection nozzle and tighten the air injection nozzle to a torque of 5.7 ~ 7.6 kg.m (41 ~ 55.0 ft.lb.).
6. Hold the air injection nozzle hexagon head with a wrench and tighten the flange screw of the air gallery to a torque of 5.0 ~ 6.0 kg.m (36 ~ 43 ft.lb.).
7. Check the cylinder head, air injection nozzle and air gallery for leaks with the engine running.

DIAGNOSIS AND TESTING

Diagnosis-general exhaust system

A preliminary "Diagnosis Guide" is included below as an aid in trouble shooting the exhaust emission control system.

Trouble	Possible cause
Excessive backfire in exhaust system	.Anti-backfire valve vacuum line collapsed, plugged, disconnected or leaking. (N.A.I.S.) .Defective or mulfunctioning anti-backfire valve resulting in insufficient air delivery to the intake manifold or air delivery not timed to engine requirement. (N.A.I.S.) .Improper carburetor fuel mixture adjustment. (N.A.I.S. & N.E.M.S.)
Air supply hose baked or burned	.Defective check valve on air distribution manifold. (N.A.I.S.)
Rough engine idle	.Improper carburetor adjustment-idle speed, idle fuel mixture, choke setting, etc. (N.A.I.S. & N.E.M.S.) .Improper initial ignition timing. (N.A.I.S. & N.E.M.S.) .Intake vacuum leak at the anti-backfire valve vacuum line or air inlet hose. (N.A.I.S.) .Anti-backfire valve defective or stuck open. (N.A.I.S.)
Engine surges at all speeds	.Anti-backfire valve defective or stuck open. (N.A.I.S.) .Improper carburetor adjustment-idle speed, idle fuel mixutre, choke setting, etc. (N.A.I.S. & N.E.M.S.)
Engine stop	.Defective cut-off valve. (N.E.M.S.) .Trouble in the electric circuit-transmission neutral switch, throttle valve switch, clutch switch, vacuum switch. (N.E.M.S.)
Noisy air pump drive belt	.Drive belt improperly adjusted. (N.A.I.S.) .Seized or failing air pump. (N.A.I.S.) .Misaligned or defective pulleys. (N.A.I.S.)

Diagnosis-air pump

On car

Noise - external cause

Air injection pump is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increase.

If excessive noise is heard, the following steps should be taken:

1. Check pump to see that it rotates and check belt for proper tension.
2. Check hoses to insure that they are not loose, leaking or touching other parts of car.
3. Check relief valve for escaping air.

Noise - internal cause

1. Vane noise
   A chirping or squeaking noise is most commonly associated with vanes rubbing in housing bore. Vane chirping is most noticeable at low speed and is heard intermittently.
   Additional wear-in time may eliminate this condition. If additional wear-in time does not eliminate chirp, pump must be disassembled, vanes and carbon shoes replaced.
2. Bearing noise
   A rolling sound indicates bearing noise. This sound will be noticeable at all speeds, but does not necessarily indicate bearing failure. However, if noise increases to objectionable level, bearing may have to be replaced.

Off car

1. With pump removed from car, rotate drive hub in jerks three-quarters of turn forward and one-quarter of turn backward. If roughness or bumps are felt, remove rear cover.
2. Inspect carbon seal. This seal should not show holes caused by wear or be broken or cracked. Such condition commonly results from rear and/or vane bearing failure.
   A failed seal must be replaced.
3. With rear rotor ring and carbon seal removed, pull out vanes. Vane bearing failure is also indicated by absence of grease or caked grease. Inspect vane shaft to confirm this bearing failure. All corners of vanes should be square. Broken edges require vanes be replaced.
4. Remove carbon shoes and inspect surface contacting vane. Small grooves in shoes are normal, chipped or broken shoes require replacement. Broken shoes indicate improper assembly of shoe springs. Damaged shoes must be replaced and springs must be properly installed.
5. Carbon dust may be present on vanes and in housing. This is indication of normal wear, not failure. Remove carbon dust by blowing air on parts in question.

Troubles	Possible cause	Remedies
Inoperative pump	Trouble in pump.	Replace with new pump.
	Excessive slackness of drive belt.	Adjust drive belt tension to specified data.
Insufficient delivering air	Damaged vane hub bearing.	Replace defective parts.
	Worn vane.	Replace worn parts.
	Worn carbon shoe	Replace worn parts.
	Worn side seal	Replace worn parts.

Air leakage	Leakage from hoses, connectors or clamps. Leakage from relief valve.	Ammend or tighten. Replace if necessary. Replace relief valve.
Abnormal noise	Stick of air pump. Slackness of drive belt. (in accelerating) Leakage from hoses, connectors or clamps.	Replace with new assembly. Adjust drive belt tension. Retighten or replace.

Testing

The following procedures are recommended for checking and/or verifying that the various components of the exhaust emission control system are operating properly. The engine and all components must be at normal operating temperatures when the test are performed. Prior to performing any extensive diagnosis of the exhaust control system, it must be determined that the engine as a unit is functioning properly. (Disconnect the anti-backfire valve vacuum sensing hose and air supply hose at the intake manifold connections. Plug the manifold connector to preclude leakage. Plug the anti-backfire valve vacuum sensing hose to close the passage the intake manifold-N.A.I.S.). After checking the engine normal operation, reinstall all the N.A.I.S. or N.E.M.S. parts.

Check valve test

This test can be performed at the same time as the air pump test.

a) Operate the engine until it reaches normal operating temperature.

b) Inspect all hoses and hose connectors for obvious leaks and correct as necessary before checking the valve operation.

c) Disconnect air supply hose at the check valve.

d) Visually inspect the position. of the valve plate inside the valve body. It should be lightly positioned against the valve seat away from the air distributor manifold.

e) Insert a probe into the valve connection on the check valve and depress the valve plate.

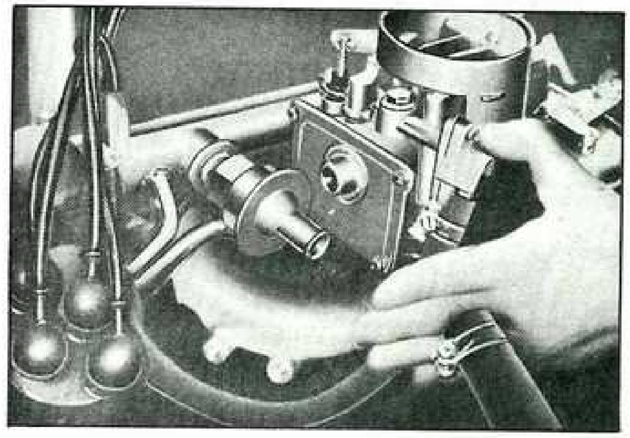


Fig. EC-29 Check valve test

It should freely return to the original position, against the valve seat, when released.

f) Leave the hose disconnected and start the engine. Slowly increase the engine speed to 1,500 r.p.m. and watch for exhaust gas leakage at the check valve. There should not be any exhaust leakage. The valve may flutter or vibrate at idle speeds, but this is normal due to the exhaust pulsations in the manifold.

g) If the check valve does not meet the recommended conditions, replace it.

Anti-backfire valve test

a) Operate the engine until it reaches normal operating temperature.

b) Inspect all hoses and hose connections for obvious leaks, and correct as necessary before checking the anti-backfire valve operation.

c) Accelerate the engine, in neutral, allowing the throttle to close rapidly. The valve is operating satisfactorily when no or a few exhaust system backfire occurs.

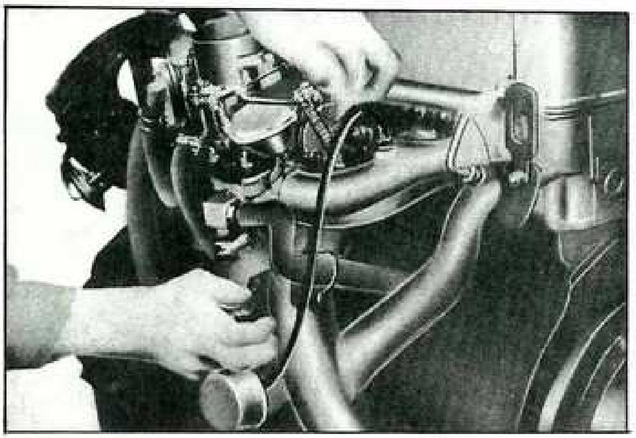


Fig. EC-30 Anti-backfire valve test

d) If a further check is necessary, disconnect the air hose to intake manifold at the anti-backfire valve. Insert a suitable plug in the hose and fasten it securely.

e) Open and close the throttle valve rapidly, if air flow is felt for one to two seconds (for two to three seconds for L16 engine) by a finger at the anti-backfire valve outlet to the intake manifold, the valve functioning properly. If air flow is not felt or air flow is felt continuously more than two seconds (more than three seconds for L16 engine), the valve should be replaced.

f) Connect the air hose to intake manifold and disconnect the air inlet hose from the air pump at the anti-backfire valve.

If engine idle speed changes excessively, the valve function is not proper and it should be replaced.

Thermal modulator test

a) Remove the vacuum tube at the distributor.

b) Connect a vacuum gauge to the distributor vacuum tube open end.

c) Operate the engine until it reaches normal operating temperature.

d) Observe the pressure produced at the vacuum gauge.

e) If the vacuum pressure should be less than 3.937 inHg at idle, thermal modulator is functioning properly. If not, check the vacuum leakage from the plunger in the thermal modulator. Replace if necessary.

Air pump test

a) Operate the engine until it reaches normal operating temperature.

b) Inspect all hoses and hose connections for leaks and correct as necessary before checking the air supply pump.

c) Check the air pump belt tention and adjust to specifications.

d) Install a tachometer on the engine. Start the engine and slowly increase the engine speed to 1,500 r.p.m. Check the air pump in the following order.

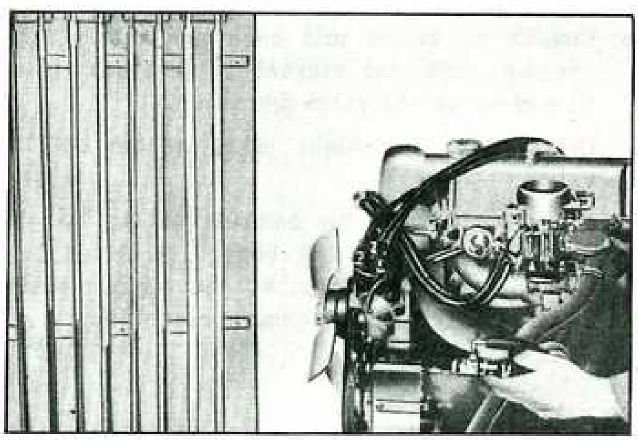
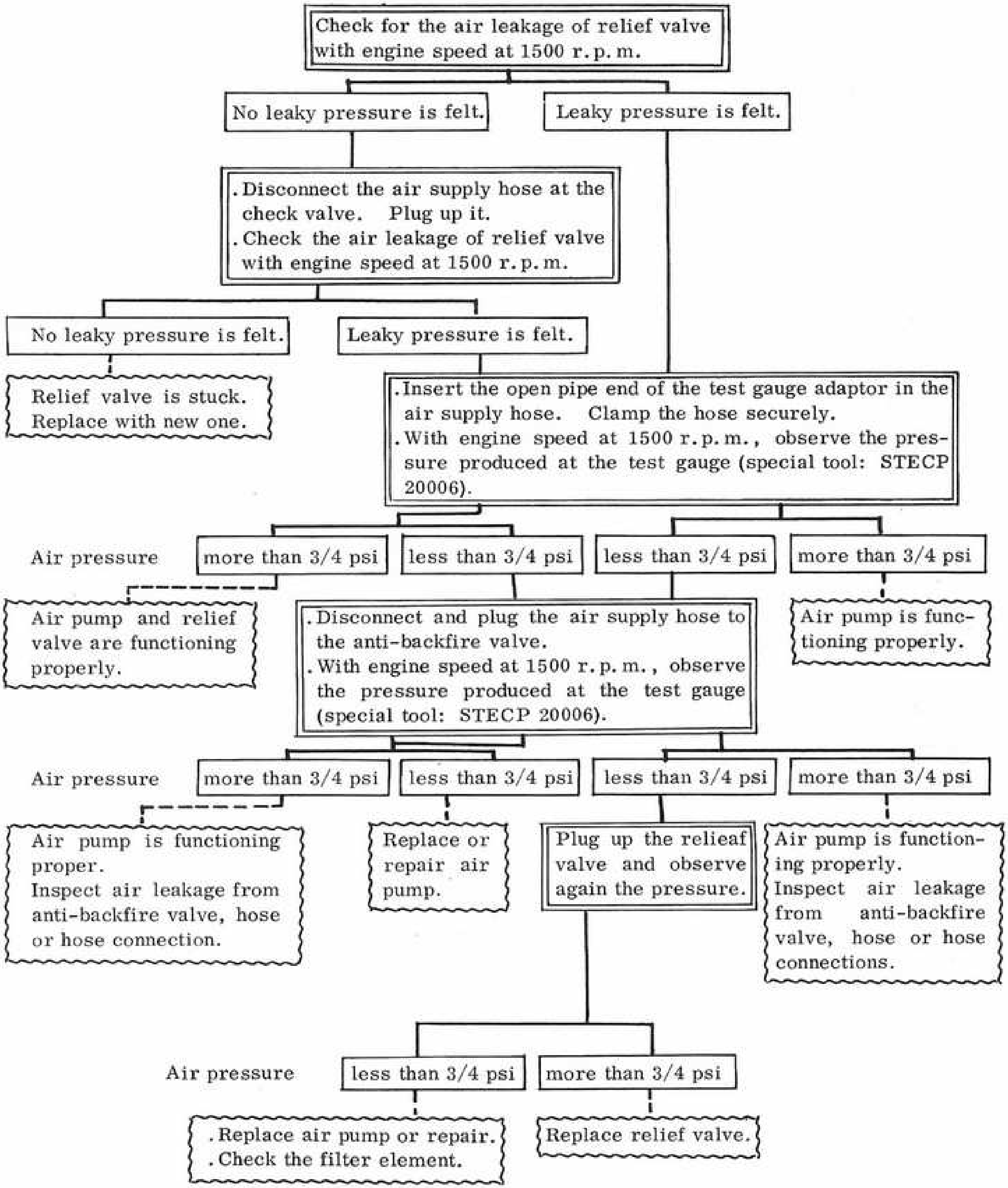


Fig. EC-31 Air pump test



AIR PUMP TEST

Note: Pages EC(A)-25 through EC(A)-29 removed since they do not refer to the Datsun Sports Cars.

Diagnosis and adjustment

of distributor vacuum

control valve

Distributor vacuum control valve

a) Connect a tachometer to the engine and warm engine up to the normal operating temperature.

b) Connect a vacuum gauge (0-30 in. mercury) to the distributor vacuum tube. The tee fitting should have the same inside diameter as the distributor vacuum tube.

c) Clamp the closed vacuum tube that connects the vacuum valve to manifolds vacuum.

d) Remove the distributor vacuum tube at the distributor and clamp the tube closed.

e) Set the basic ignition timing to manufactures specifications (0° T. D. C.).
The idle speed must be at the specifies r. p. m. before the timing is adjusted.

f) Adjust carburetor to obtain the specifies engine speed and exhaust emission level. The distributor vacuum must be below 4 in. of mercury at idle.

g) Remove the clamps from the vacuum tubes and reconnect-vacuum tube to the distributor. Remove vacuum valve cover.

h) Speed engine up to 2,000 r. p. m. in neutral and hold speed for approximately 5 seconds. Release throttle and observe distributor vacuum.
When the throttle is released, the distributor vacuum should increase to above 16 inches of mercury and remain there for a minimum of 1 second.
The distributor vacuum must fall below 4 inches of mercury within 3 seconds after the throttle is released.

i) Adjust valve if necessary. Turning the adjusting screw counter-clockwise will increase the time the distributor vacuum remains above 4 inches of mercury after the throttle is released. One turn of the adjusting screw will change the valve setting by approximately 1/2 inch of maecury. If the valve cannot be adjusted to the specifications described in step no. h) replace valve.

MAINTENANCE

To make certain that exhaust emissions are maintained at a low level, it is recommended that inspection be basically made every 12 months or every 12,000 miles. Whichever occurs first. Best engine operation and minimum exhaust emissions will be obtained with regular inspections and recommended services at these interval.

General maintenance

1. Carburetor check

Check the choke setting and adjust to specifications as required.

Proper carburetor idle mixture adjustment is imperative for best exhaust emission control.

Refer to the article given in "Setting ignition timing and adjusting idle speed and mixture".

2. Distributor check

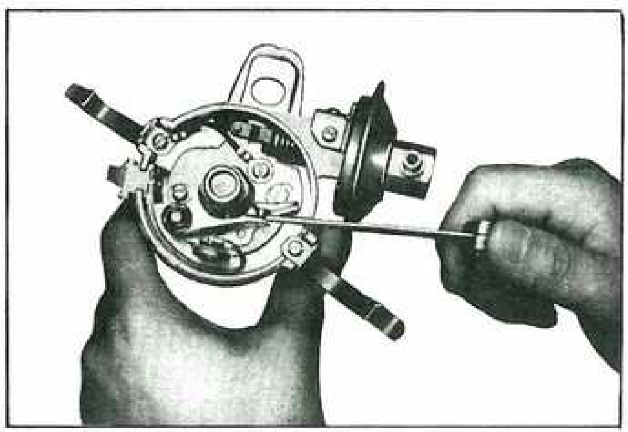


Fig. EC-40 Distributor check

Check the distributor cam dwell angle and point condition and adjust to specifications or replace as required. Check the ignition timing and adjust it to the specification.

Clean and apply distributor grease to the cam and wick.

Breaker points should be replaced at intervals not to exceed 12,000 miles.

3. Spark plug test

Fig. EC-41 Spark plug check

Remove and clean plugs in a sand blast cleaner. Inspect each spark plug. Make certain that they are of the specified heat range. Inspect insulator for cranks and chips. Check both center and ground electrodes. If they are badly worn, replace with new spark plugs. File center electrode flat. Set the gap to 0.0315 ~ 0.0355 in. using the proper adjusting tool. Spark plug should be replaced every 12,000 miles.

4. High tension cable test

Use an ohmmeter to check resistance on secondary cables. Remove cable from spark plug and install the proper adaptor between cable and spark plug. Remove the distributor cap from the distributor with secondary cables attached. Do not remove the cables from the cap.

Connect the ohmmeter between the spark plug adaptor and the corresponding electrode inside the cap. If resistance is more than 15,000 ohms, remove the cable from cap and check cable resistance only. If resistance is still more than 15,000 ohms, replace cable assembly.

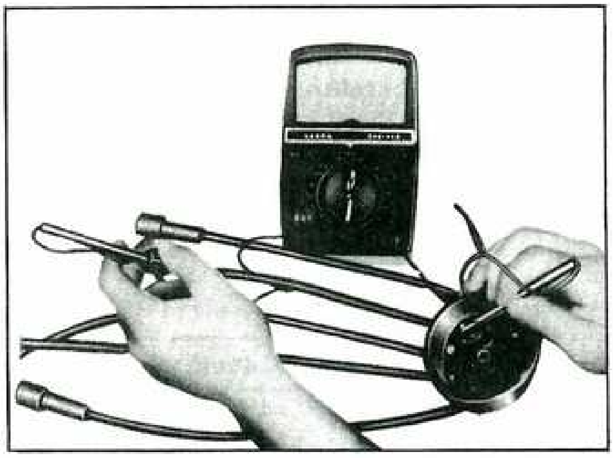


Fig. EC-42 High tension cable test

5. Battery check

Test the battery specific gravity with an accurate hydrometer. Specific gravity should be at least 1,220 or more with temperature corrections. Add mineral free water as required to bring fluid upto proper level.

Clean battery posts and cable terminals. After tightening clamps, coat the battery posts and clamps with light grease to retard correction.

6. Positive crankcase ventilation system

With engine running at idle, remove the ventilator hose from the crankcase, 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 it necessary.

7. Air cleaner element

1) Air pump air cleaner element (Datsun Sports car only)

Clean and inspect the air pump air cleaner element every 6,000 miles. If it is damaged it must be replaced.
Change the element every 12,000 miles.

2) Carburetor air cleaner element

The paper element has been specially treated, therefore, there is no need to clean it. But it should be replaced every 24,000 miles.
As for oil bath type air cleaner installed on Datsun Patrol, clean the element and change oil every 2,000 miles.

Periodic recommended maintenance

Periodic inspection and required servicing of these system should be carried out at the recommended intervals to assure a cleaner, better performing, longer-lasting engine and almost complete elimination of air pollution.

Note: Page EC(A)-33 remove since it does not refer to the Datsun Sports Cars.

1. N.A.I.S.

Item	Interval
1. Engine	
Check ignition timing.	every 3,000M
Check engine idling.	3,000
Engine tune-up.	12,000
Check spark plugs.	3,000
Replace spark plugs.	12,000
Check high tension cables.	12,000
Check for pitting and wear of distributor breaker points.	3,000
Replace distributor breaker points.	12,000
Apply grease to distributor rotor shaft.	12,000
Apply grease to distributor cam and wick.	12,000
Replace carburetor air cleaner element.	24,000
Clean pump air cleaner element.	6,000
Replace pump air cleaner element.	12,000
2. Crankcase emission control	
Check hoses and hose connections for leaks.	12,000
Check for proper function of crankcase ventilation control valve.	12,000
3. Exhaust emission control	
Check for proper function of air pump.	12,000
Check for proper function of relief valve.	12,000
Check for proper function of check valve.	12,000
Check for proper function of anti-backfire valve.	12,000
Check air gallery and nozzle connections for leaks.	12,000
Check hoses and hose connections for leaks.	12,000
Check air pump belt tension.	3,000

2. N.E.M.S.

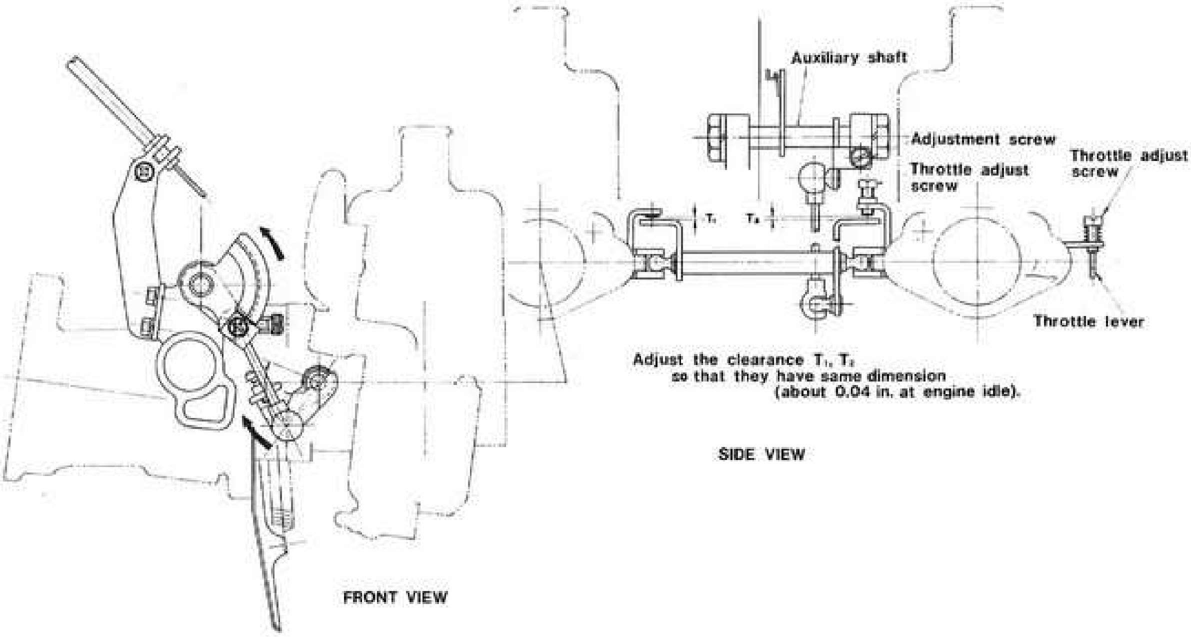


Fig. SE-12 120.9 C.I.D. (Model U20) engine SU type carburetor throttle valve shaft interlock and throttle valve full closing adjustment

SETTING IGNITION TIMING & ADJUSTING IDLE SPEED MIXTURE

Engine tune-up must be done according to Nissan Specifications with necessary equipments recommended.

But the following procedures are recommended to Datsun Sedans, Station Wagons, Pick-ups and Datsun Sports.

Datsun Sports Model SPL311-U

Throttle valve close adjustment must be carefully done since the fuel consumption will increase and engine output will be lost if each throttle valve of both carburetors arranged in parallel are not closed simultaneously.

1. Inspect damper oil in the carburetors. Top up if necessary.

2. Remove the air cleaner.

3. Ensure the proper function of suction pistons by lifting them up by finger.

4. Connect ignition tachometer and timing light.

5. Start the engine and warm up thoroughly.

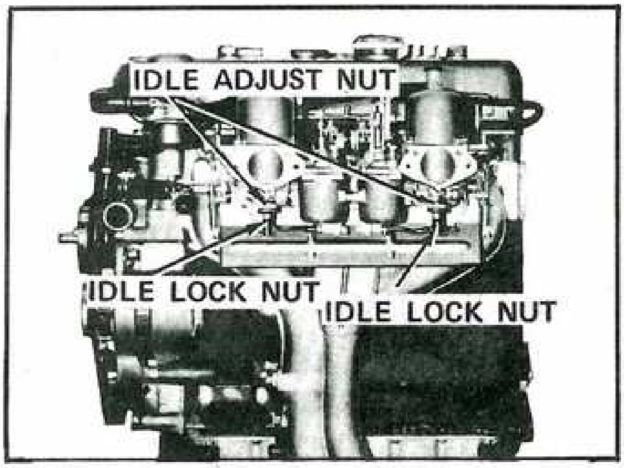


Fig. EC-43 Adjusting idle speed mixture

6. Loosen the throttle adjust screws on front and rear side carburetor so that the tip of them does not touch the stoppers.

7. Screw in the idle adjust nuts on front and rear side carburetor half a turn from completely loosening position where they will touch the idle lock nuts.

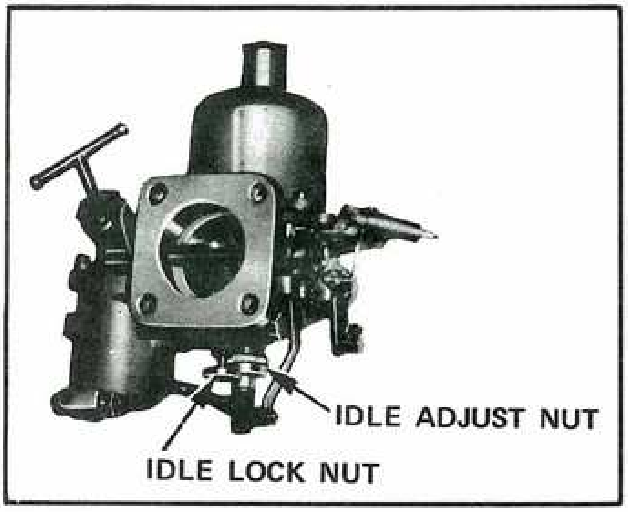


Fig. EC-44 SU type carburetor

Note: Do not touch the idle lock nuts except for carburetor overhaul, because they have precisely calibrated at the factory.

8. Set the front side connecting rod L length to the standard measurement (about 2.76 in.). Set the engine speed at 800 ~ 1,000 r.p.m. by screwing in the throttle adjust screw on the auxiliary shaft. With a flow meter, adjust the length of rear side connecting rod so that the air inlet volume on front and rear side will be uniform.

10. Lower engine speed to 700 r.p.m. by turning back the throttle adjust screw on the auxiliary shaft carefully. Then screw in the throttle adjust screws on front and rear side carburetor so that the tip of them will touch the stoppers. Ensure the flow meter float positions are even for both front and rear carburetors.

11. Set the ignition timing to 0° T.D.C.

12. If the engine speed changes, adjust the engine speed at 700 r.p.m. by turning the throttle adjust screws on front and rear side carburetor simultaneously by same turns. Timing should remain at 0° T.D.C. at 700 r.p.m.

13. If you set idle speed and mixture by measuring the percentage of the carbon monoxide in the exhaust gas with CO meter, the following procedure should be done after above item 12.

a) Adjust the percentage of the carbon monoxide to 6.0 ± 1.0%, AT THE AIR PUMP DISCONNECTED, by turning idle adjust nuts on front and rear side carburetor simultaneously by same turns (2.0 ± 0.2%; with the air pump connected).

b) If the engine speed changes, adjust the engine speed and ignition timing at 0°T.D.C. at 700 r.p.m. by turning the throttle adjust screws on front and rear side carburetor simultaneously by same turns.

Datsun Sports Model SRL311-U

1. Inspect damper oil in the carburetors. Top up if necessary.

2. Remove the air cleaner.

3. Ensure the proper function of suction pistons by lifting them up by finger.

4. Connect the ignition tachometer and timing light.

5. Start the engine and warm up thoroughly.

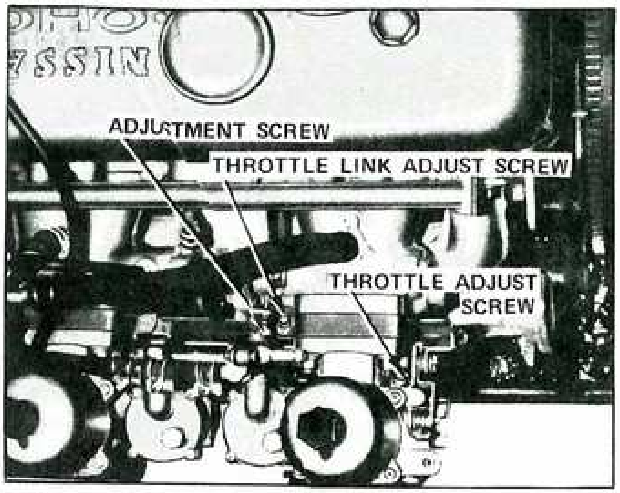


Fig EC-45 Location of adjusting screws

6. Screw in the idle adjust nuts on front and rear side carburetor half a turn from completely loosening position where they will touch the idle lock nuts.

Note: Do not touch the idle lock nuts except for carburetor overhaul, because they have precisely calibrated at the factory.

7. Turn back the throttle adjust screw on the throttle link and set the engine speed at 700 r.p.m. by adjusting the throttle adjust screws on front and rear side carburetor with a flow meter so that the throttle valve opening are even.

8. Set the ignition timing at 0° T.D.C.

9. If the engine speed changes, adjust the engine speed at 700 r.p.m. by turning the throttle adjust screws on front and rear side carburetor simultaneously by same turns. Timing should remain at 0° T.D.C. at 700 r.p.m.

10. Set the engine speed at 800 ~ 1,000 r.p.m. by screwing in the adjustment screw on the auxiliary shaft. With a flow meter, adjust the throttle adjust screw on the throttle link so that the air inlet volume on front and rear side carburetor will be uniform.

11. Back off (loosen) the adjustment screws on the auxiliary shaft and set the engine speed at 700 r.p.m.

12. If you set idle speed and mixture by using CO meter further the following procedure should be done after above item 11.

a) Adjust the percentage of the carbon monoxide to 6.0 ± 1.0%, AT THE AIR PUMP DISCONNECTED, by turning idle adjust nuts of front and rear side carburetor simultaneously by same turns (2.0 ± 0.2%; with the air pump connected).

b) If the engine speed changes, adjust the engine speed and ignition timing at 0°T.D.C. at 700 r.p.m. by turning the throttle adjust screws on front and rear side carburetor simultaneously by same turns.

Note: Refer to Figure SE-12.

SERVICE DATA AND SPECIFICATIONS

SPECIFICATIONS

Vehicle	**Name**	**Datsun Sports**	
	Model	SPL311U	SRL311U
Engine	Model	R16	U20
	Number of cylinders	4 in line	4 in line
	Type of cylinder head	O.H.V.	S.O.H.C.
	Displacement, bore x stroke	97.3 cu.in., 3.43 in. x 2.63 in.	120.9 cu.in., 3.43 in. x 3.27 in.
	Nominal compression ratio	9.0	9.5
	Rated brake horse power	96 HP at 6000 r.p.m.	135 HP at 6000 r.p.m.
	Recommended fuel grade	Premium	←
Transmission	Type	F4C63L	FS5C71A
	Gear ratio 1st	3.382	2.957
	2nd	2.013	1.858
	3rd	1.312	1.311
	4th	1.000	1.000
	5th	—	0.852
	Rev.	3.365	2.922
Final gear ratio		3.889	3.700
Curb weight		2,083.7 lb.	2,094.8 lb.
Type of crankcase emission control		Sealed type	←
Type of exhaust emission control		Nissan Air Injection System	
Carburetor	Make	HITACHI	←
	Model	HJB38W-5	HJG46W-5
	Type	SU type side draft	←
	Bore	1.495 in. dia. (38 mm dia.)	1.805 in. dia. (46 mm dia.)
	Suction piston lift	1.400 in. dia. (29 mm dia.)	1.337 in. dia. (34 mm dia.)
	Jet	0.092 in. dia. (2.34 mm dia.)	0.100 in. dia. (2.54 mm dia.)
	Metering needle	M-39	N-17
	Suction spring	#23 (0.106 ~ 0.232 lb.)	#32 (0.247 ~ 0.402 lb.)
	Fast idle	6°	4.5° throttle opening at full choke
	Float chamber inclination	0°	8°
	V.C. hole	from rear carb.	from front carb.

Alternator	Make	MITSUBISHI	←
	Model	AC300/12 x_2 R	AS2030A$_2$
	Capacity	12V-300W	12V-300W
Distributor	Make	HITACHI	←
	Model	D417-57	D417-56
Spark plug	Model	NGK BP-6E	←
Air pump	Model	ECP200-2	ECP200-3
	Capacity	200 cc/rev.	←
Air pump pulley ratio		130 : 137 (=0.95)	←
Relief valve opening pressure		2.6 psi. (1.8 mAq.)	←
Anti-backfire valve	Type	Gulp type	←
	Model	AV54-1B	←
	Duration time	1.5 ~ 1.8 sec. at 19.7 inHg (500 mHg)	←
	Orifice	0.236 in. dia. (6 mm dia.)	←
Check valve	Type	CV27-2	←
	Opening pressure	0.590 inAq. (0.15 mAq.)	←
Cooling fan	Outer dia. x blade no.	13.78 in. dia. (350 mm dia.) x 7	←
Fan clutch	ON temperature	62 ± 3° C (143.6 ± 5.4° F)	←
	OFF temperature	50 ± 2.5° C (122 ± 4.5° F)	←
Thermal modulator ON temperature		–	102 ± 1.7° C (220 ± 3.0° F)
Tune up data	Basic timing	0° T.D.C.	←
	Idle R.P.M.	700 r.p.m.	←
	Distributor dwell angle	49 ~ 55° at 0.02 in. of point gap	
	Spark plug gap	0.0315 in. ~ 0.0355 in.	
	Choke setting	Manual	←
	CO percent setting	2.0 ± 0.2% (at the air pump connected)	
	Idle fuel mixture (with Combustion Analyzer)	12.0 ~ 12.5 (at the air pump disconnected)	

TIGHTENING TORQUE

Bolt-air pump bracket to cylinder block	1.0 ~ 1.3 kg.m (7.2 ~ 9.4 ft.lb.)
Bolt-air pump to adjust bar	2.2 ~ 2.5 kg.m (15.9 ~ 18.1 ft.lb.)
Bolt-air pump to bracket	2.2 ~ 2.5 kg.m (15.9 ~ 18.1 ft.lb.)
Bolt-adjust bar to front cover	1.0 ~ 1.3 kg.m (7.2 ~ 9.4 ft.lb.)
Screwed plug connecting air gallery to exhaust manifold (Datsun Sedan & Station Wagon)	5.0 ~ 6.0 kg.m (36.2 ~ 43.4 ft.lb.)
Air injection nozzle to cylinder head (Datsun Sports)	5.7 ~ 7.6 kg.m (41.2 ~ 55.0 ft.lb.)
Flange screw connecting air gallery to injection nozzle (Datsun Sports)	5.0 ~ 6.0 kg.m (36.2 ~ 43.4 ft.lb.)
Check valve to air gallery (Datsun Sedan & Station Wagon)	9.0 ~ 10.5 kg.m (65.1 ~ 75.9 ft.lb.)

AIR PUMP DRIVE BELT SLACKNESS	0.5 in. UNDER THUMB PRESSURE

APPENDIX for EMISSION CONTROL SYSTEM

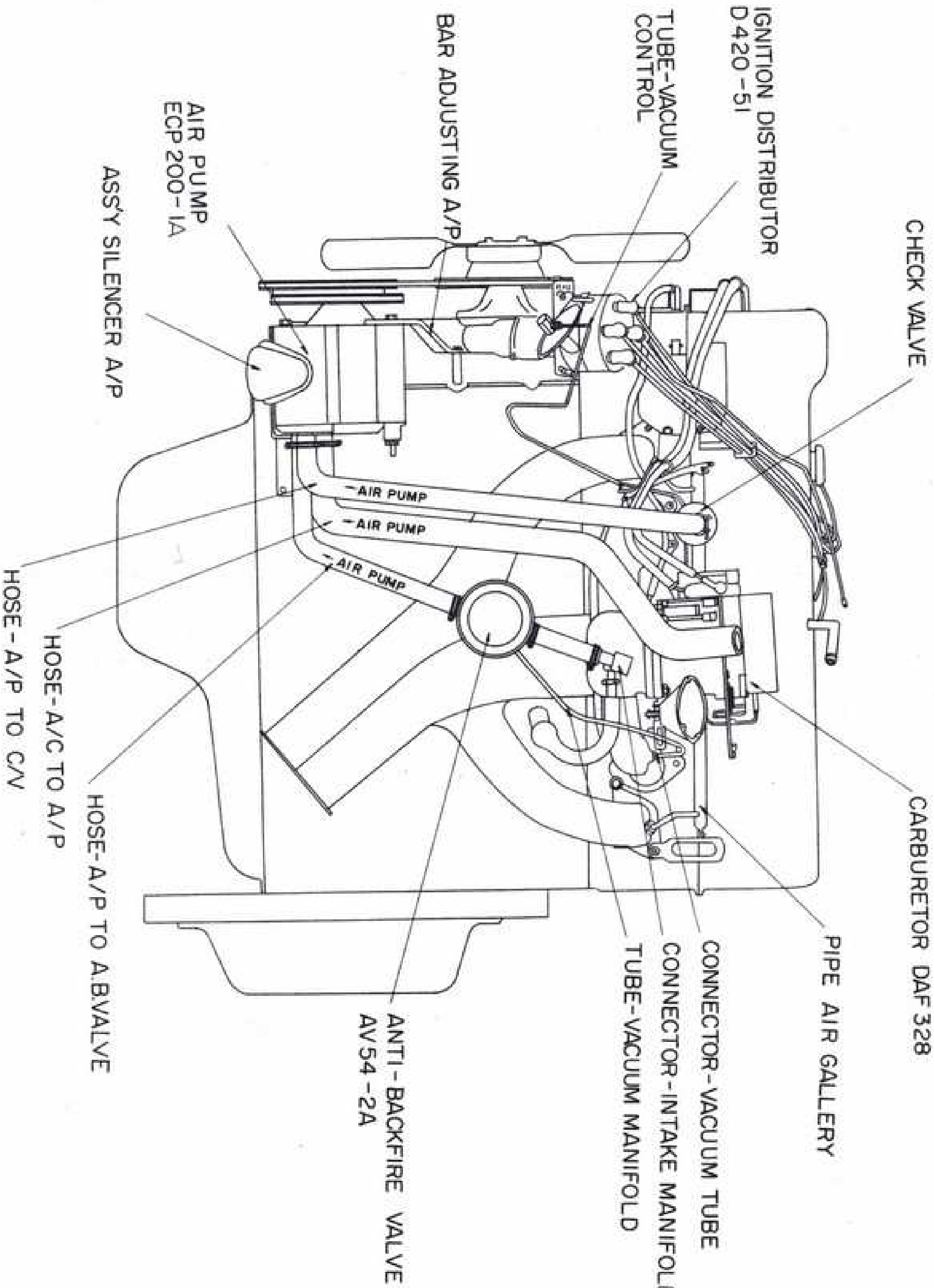


Fig. SE-5 General view 97.4 C.I.D. (Model L16) engine

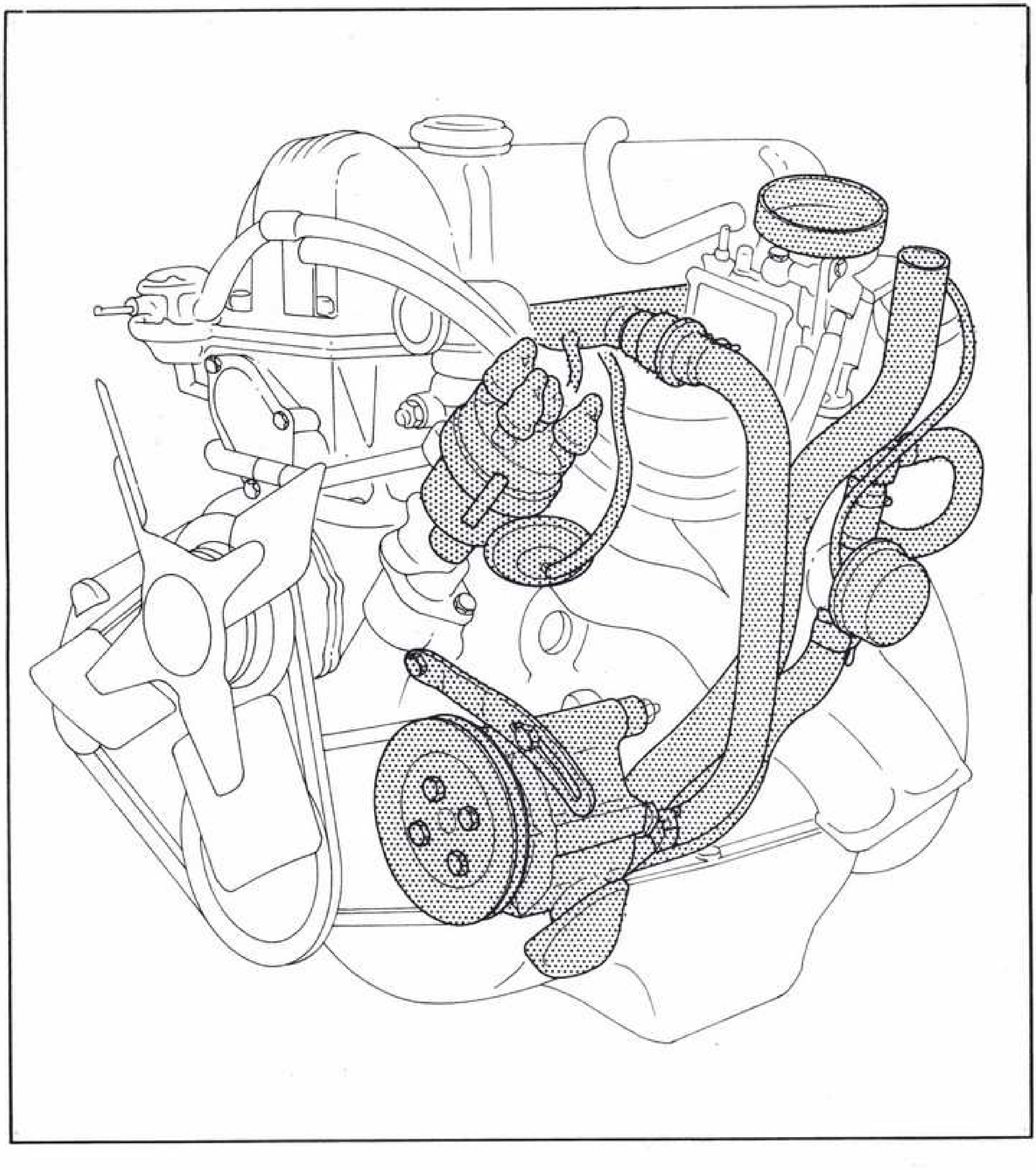


Fig. SE-6 Air injection installation -97.4 C.I.D. (Model L16) engine

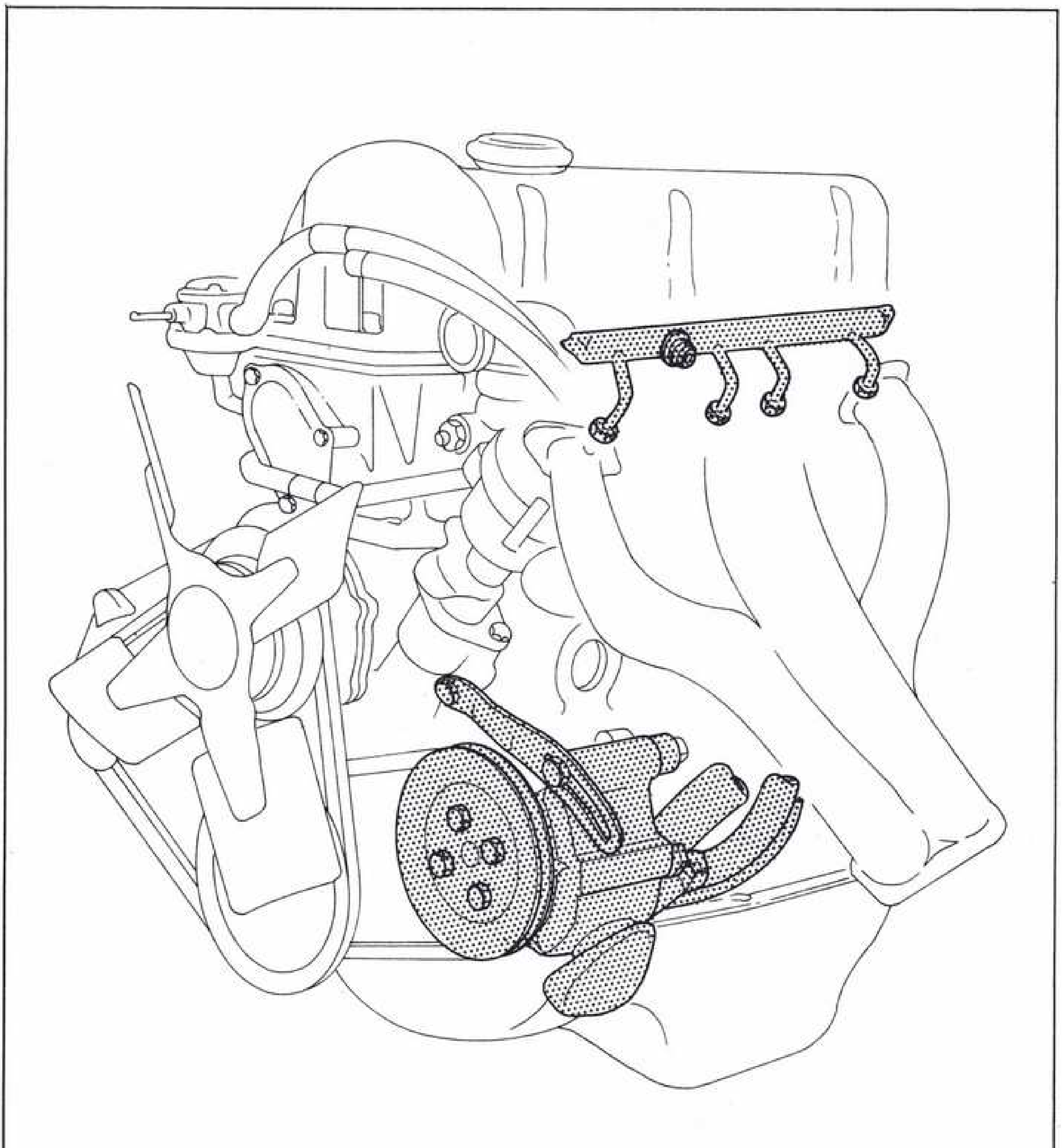


Fig. SE-7 Air pump and air gallery installation -97.4 C.I.D. (Model L16) engine

SPECIAL TOOLS for EMISSION CONTROL SYSTEM

Special tools and standard tools necessary to perform recommended emission control maintenance are as follows:

SPECIAL TOOLS

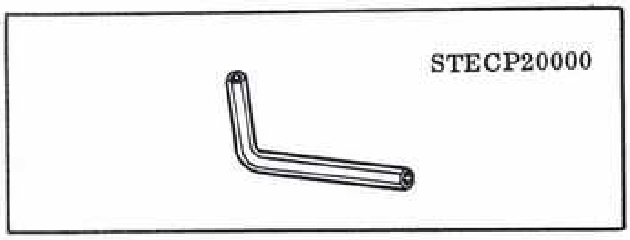


Fig. SE-13 Hexagon wrench

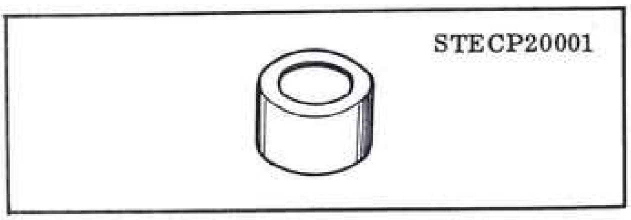


Fig. SE-14 Support for disassembling rotor ring

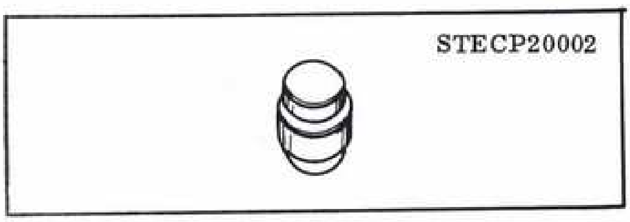


Fig. SE-15 Attachment for pushing needle bearing

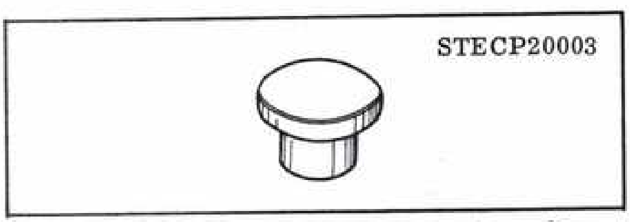


Fig. SE-16 Attachment for pressing in needle bearing

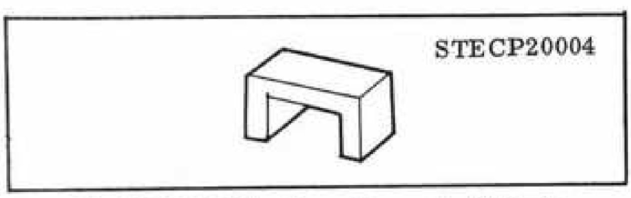


Fig. SE-17 Bridge for pulling out relief valve

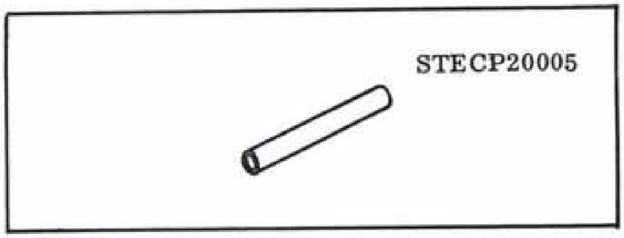


Fig. SE-18 Dummy shaft

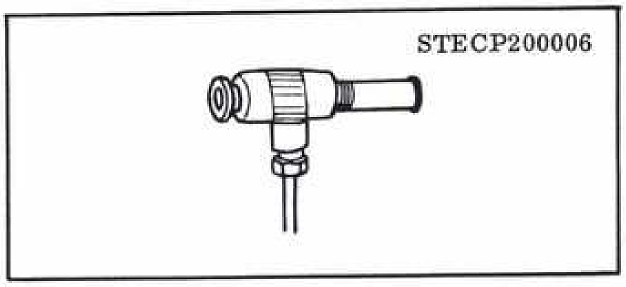
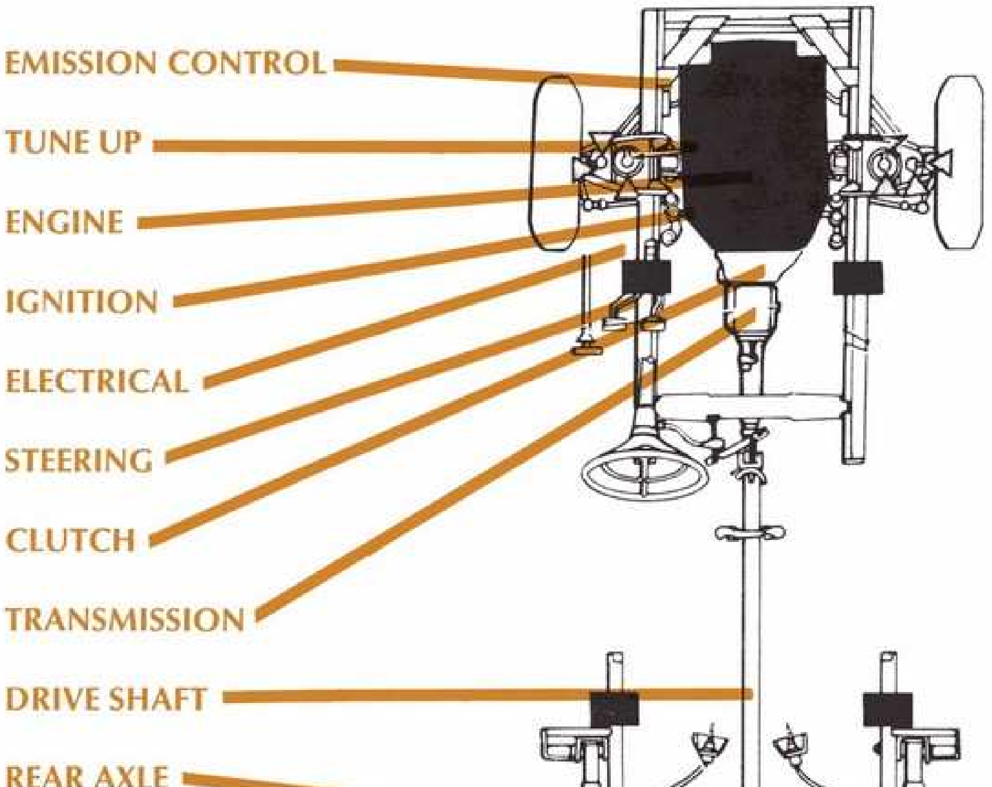


Fig. SE-19 Air pump test gague adaptor

STANDARD TOOLS

1. Ignition timing light
2. Tachometer
3. Vacuum gauge
4. Pressure gauge
5. Carburetor flow meter
6. Ammeter
7. Voltage meter
8. Ohmmeter
9. Compression tester
10. Engine exhaust combustion analyzer (or CO meter)
11. Ignition analyzer oscilloscope
12. Cam angle dwell meter
13. Distributor advance tester

COMPLETE SERVICE/REPAIR INFORMATION



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