DATSUN

SPORTS CAR

MODEL SP(L) 311

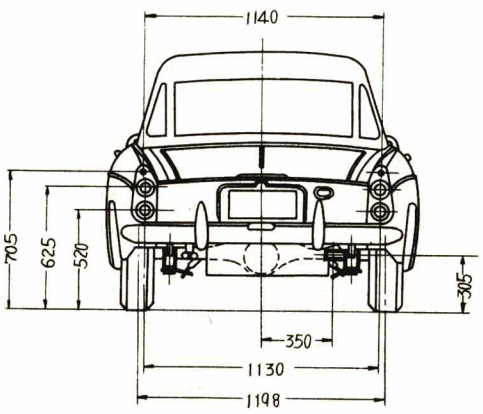
Service Manual

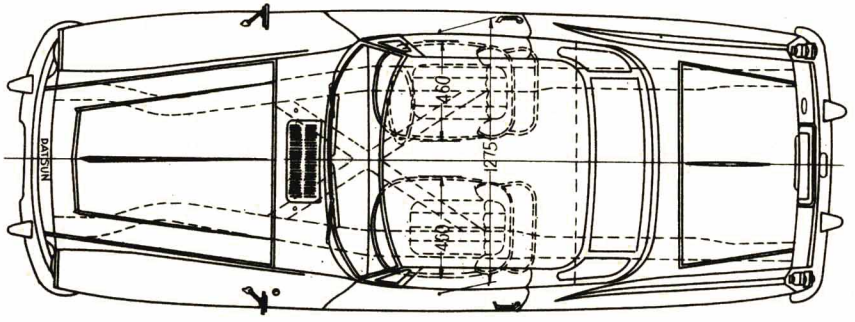
NISSAN MOTOR CO., LTD.

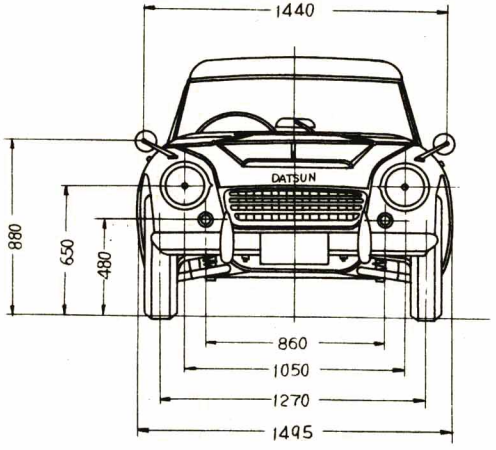
TOKYO, JAPAN

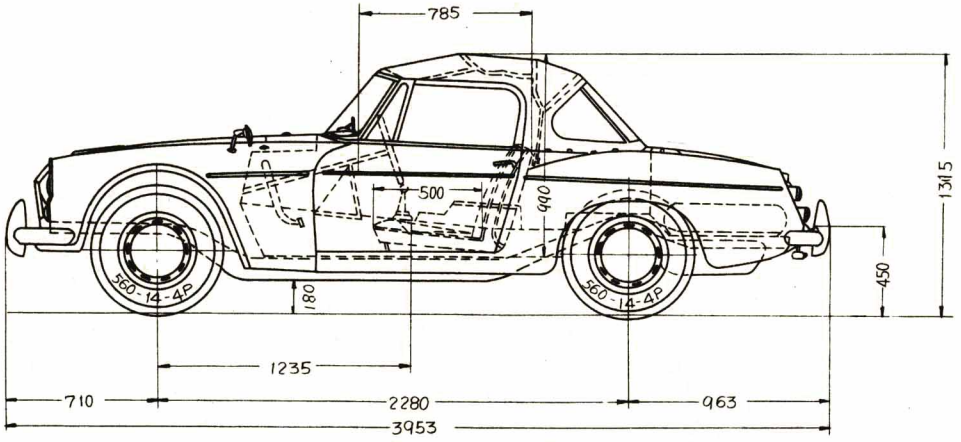
NEW DATSUN SPORTS CAR MODEL SP(L)311-U

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.

CONTENTS

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/cm² (r.p.m.)		50/4000 (711.2 lb/in²)
	Max. Mean Effective kg/cm² (r.p.m.)		10.6/4000 (150.8 lb/in²)
	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 Clearance	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
			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 87.5x290 - 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 75x100x1.6 LOWER 25x100x2.3

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.

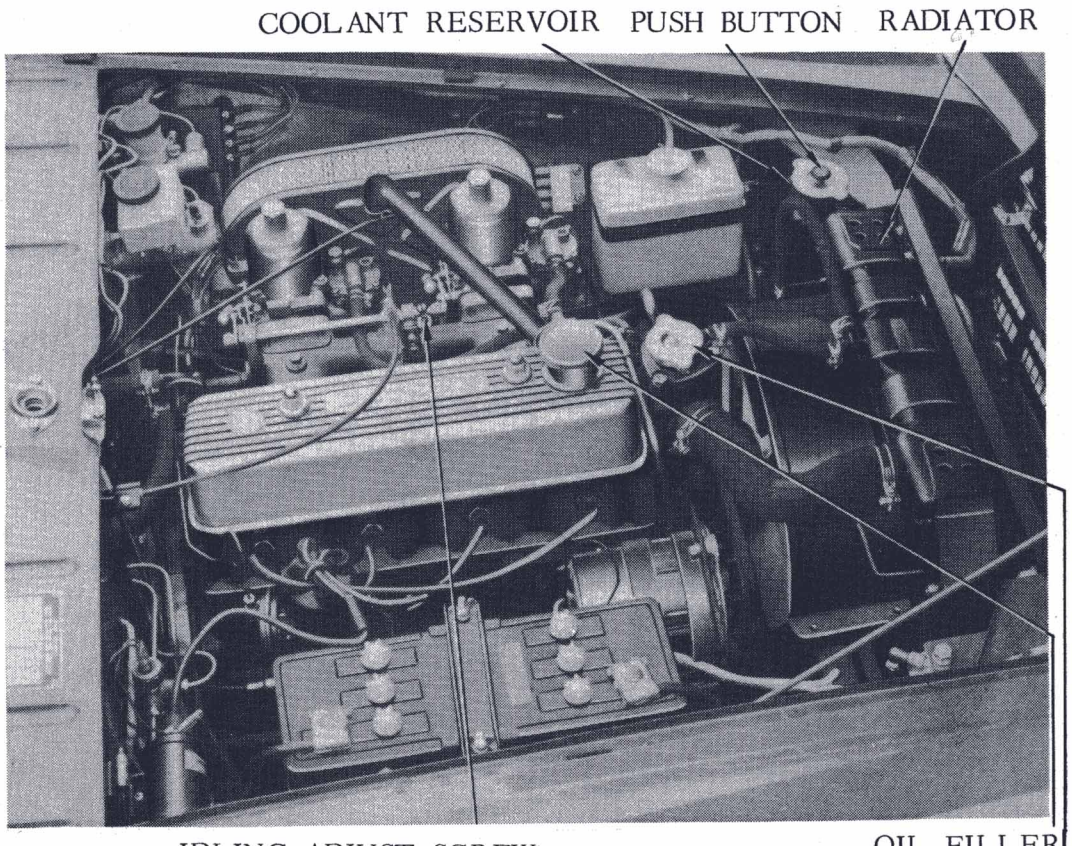
This standardizing the screw threads for R type engine (1600 cc) has been adopted by the international standardzation organization I.S.O. from E/# R-40001.

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

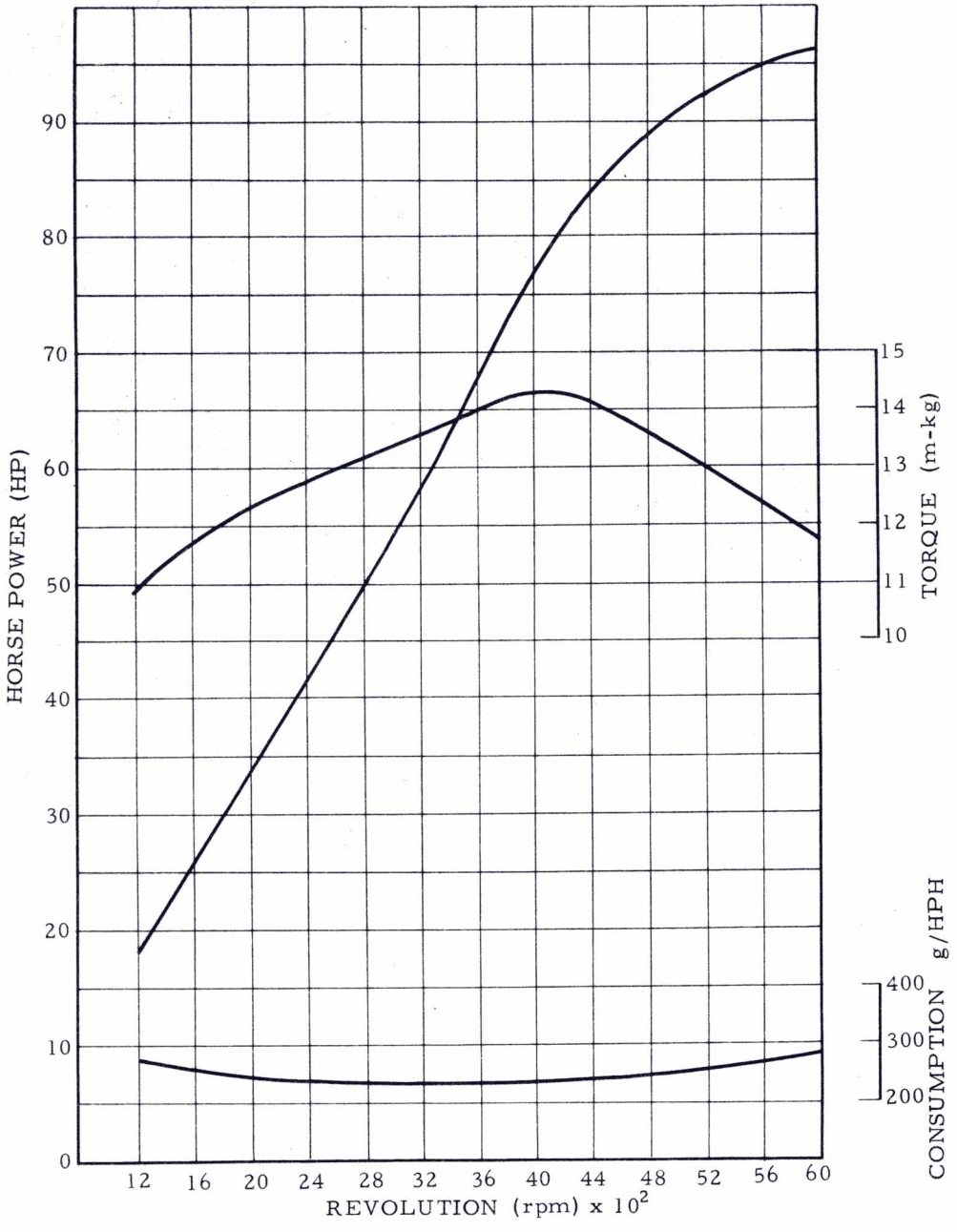
Stud and cap nut rocker cover	5/16" → M8 x 1.25
Bolt or stud manifold	5/16" → M8 x 1.25
Stud water outlet	3/8" → M10 x 1.5
Stud adjust bar	3/8" → M10 x 1.25
Plug heater outlet hole	5/8" → M16 x 1.5
Stud or bolt rocker bracket	7/16" → M10 x 1.5
Stud or bolt manifold fix	5/16" → M8 x 1.25
Stud carburetor 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



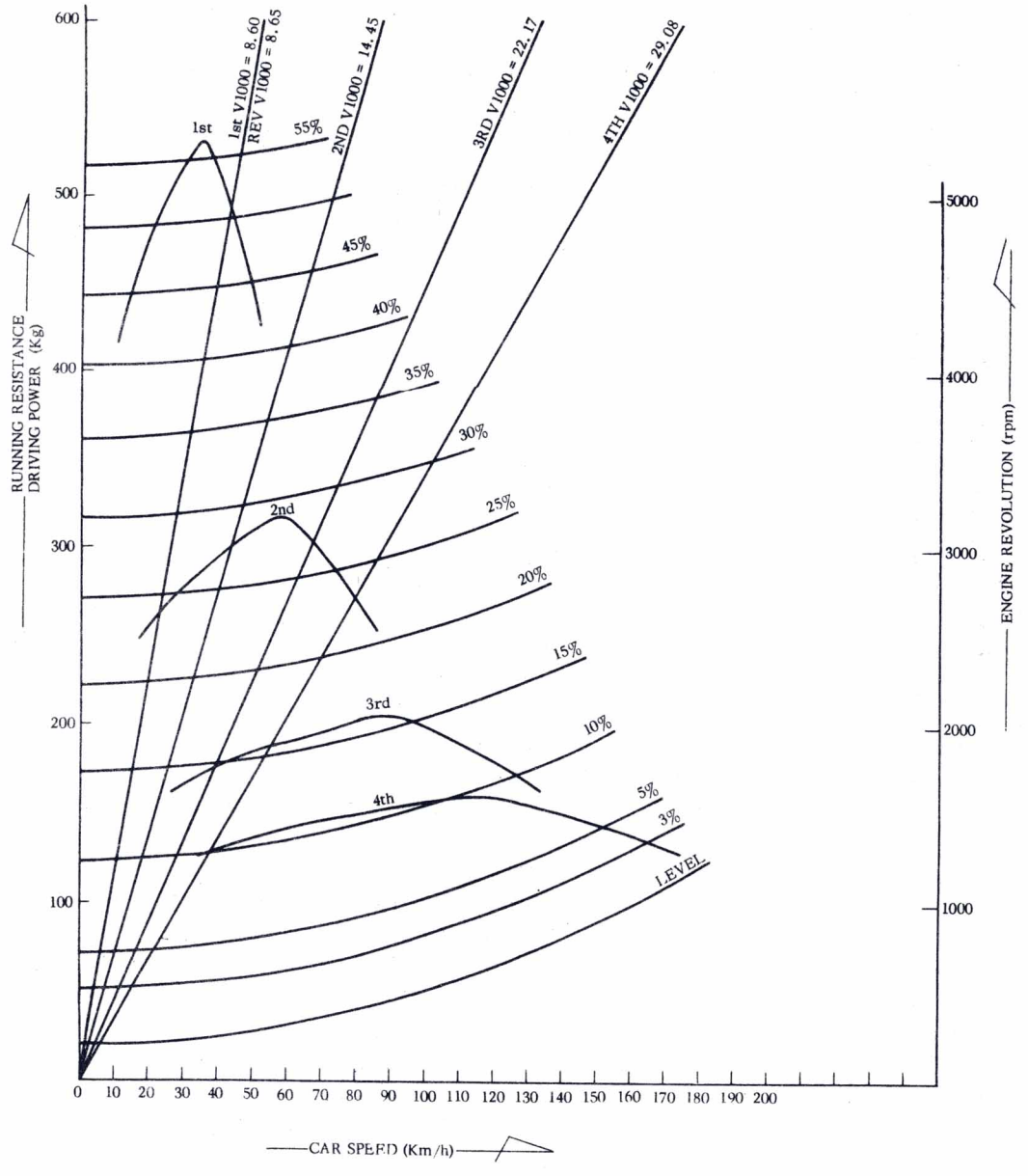
Engine	R type
Cylinder	4
Valve	Overhead
Displacement	1595 cc
Bore x stroke mm	87.2 x 66.8
Max. HP SAE B.H.P./r.p.m.	96/6000
Max. torque kg/rpm	14.3/4000 (103 ft. lbs)
Compression ratio	9.0
Compression pressure kg/cm^2(r.p.m.)	12.7/320 (180.6 lb in^2)

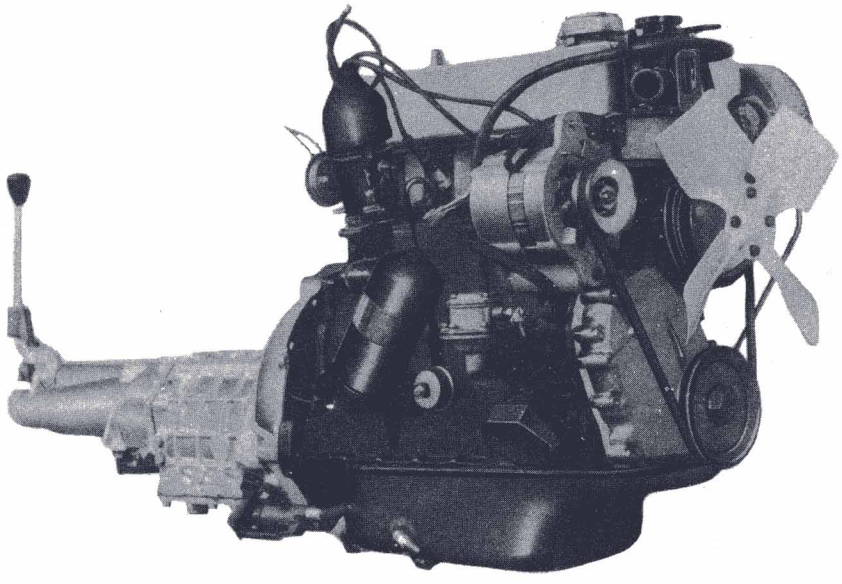
MODEL R ENGINE PERFORMANCE CURVE



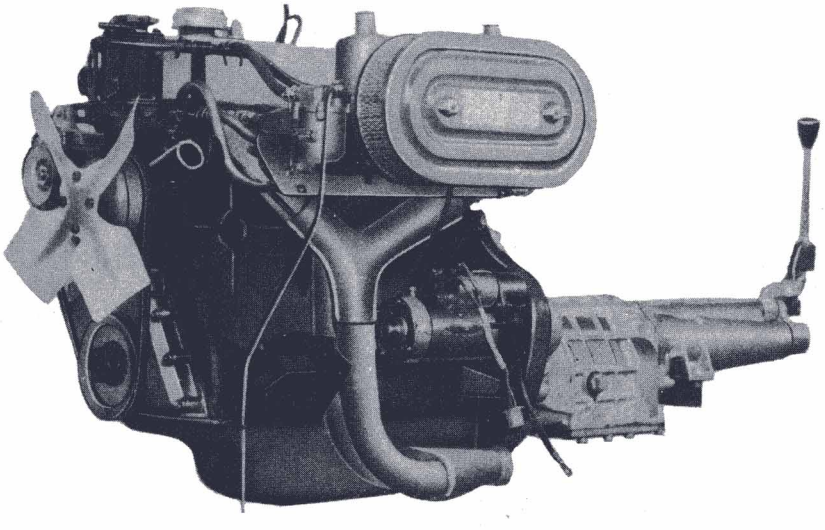
MODEL SP(L)311-U
RUNNING PERFORMANCE CURVE

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	$\tan\theta = 0.573$ ($\sin\theta = 0.$
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.

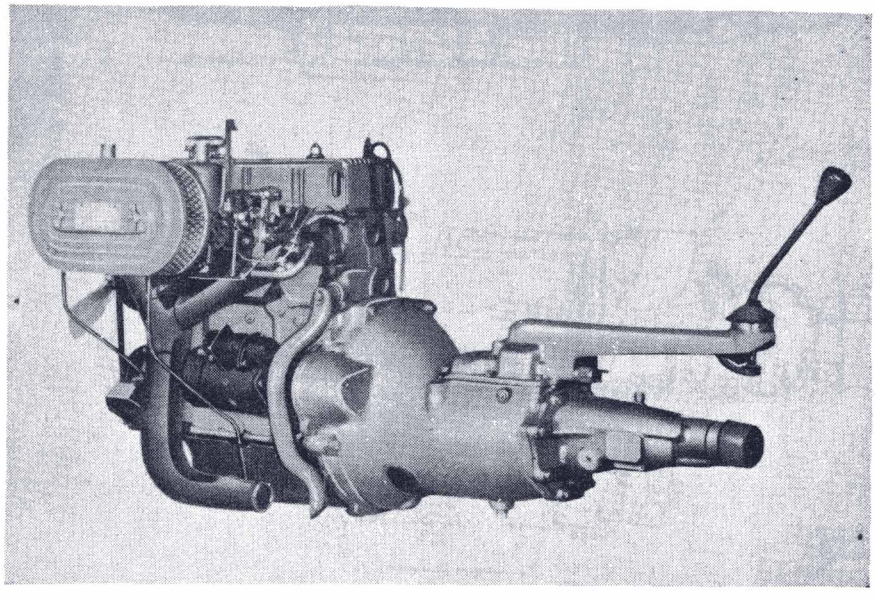


Fig. 1 R type engine (left side)

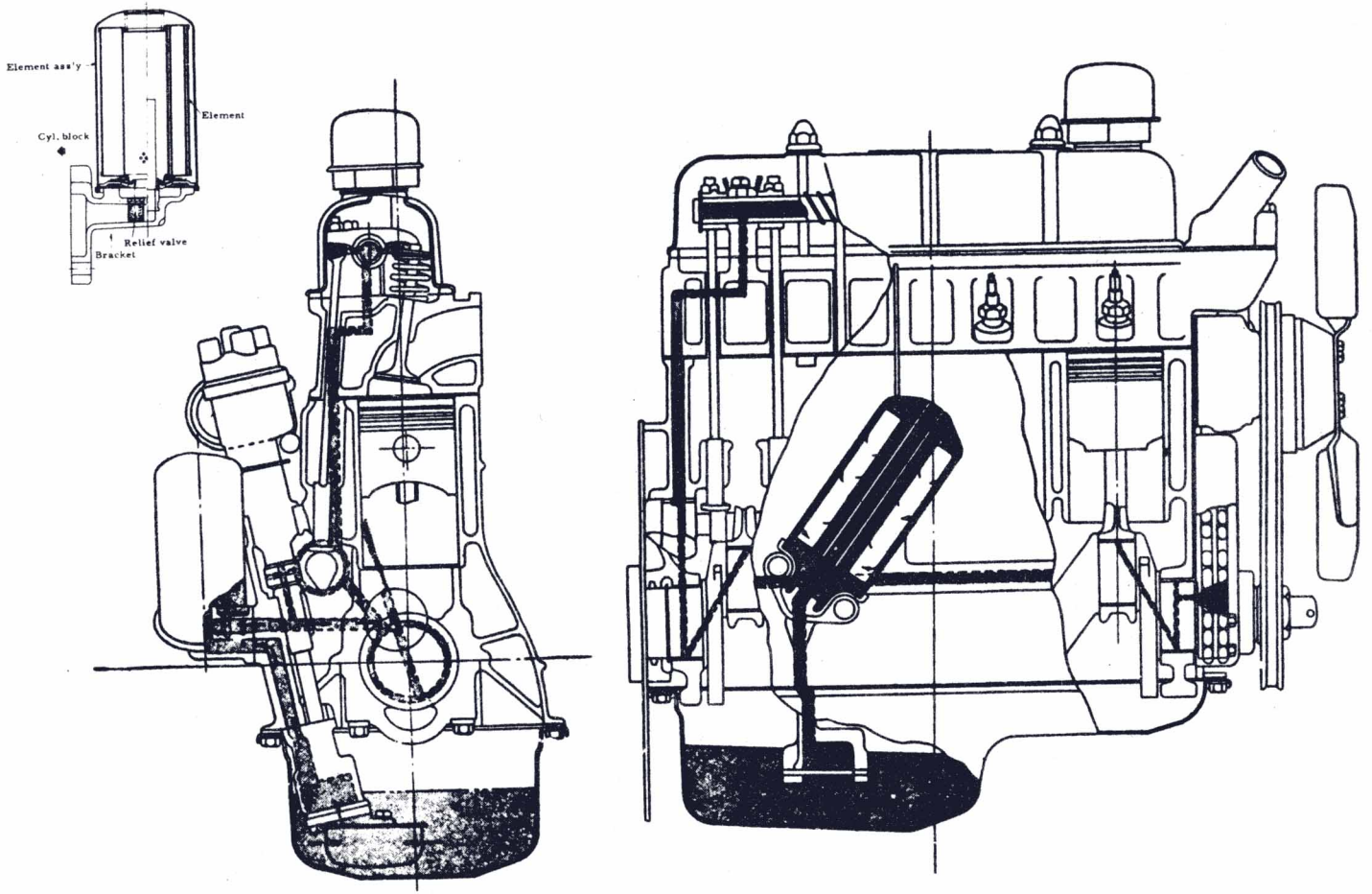


Fig. 2 Oil lubrication system

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.

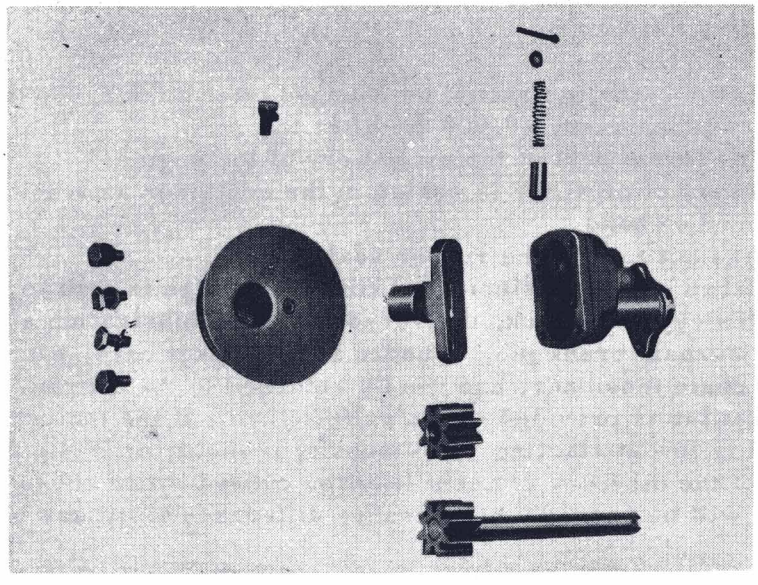


Fig. 4

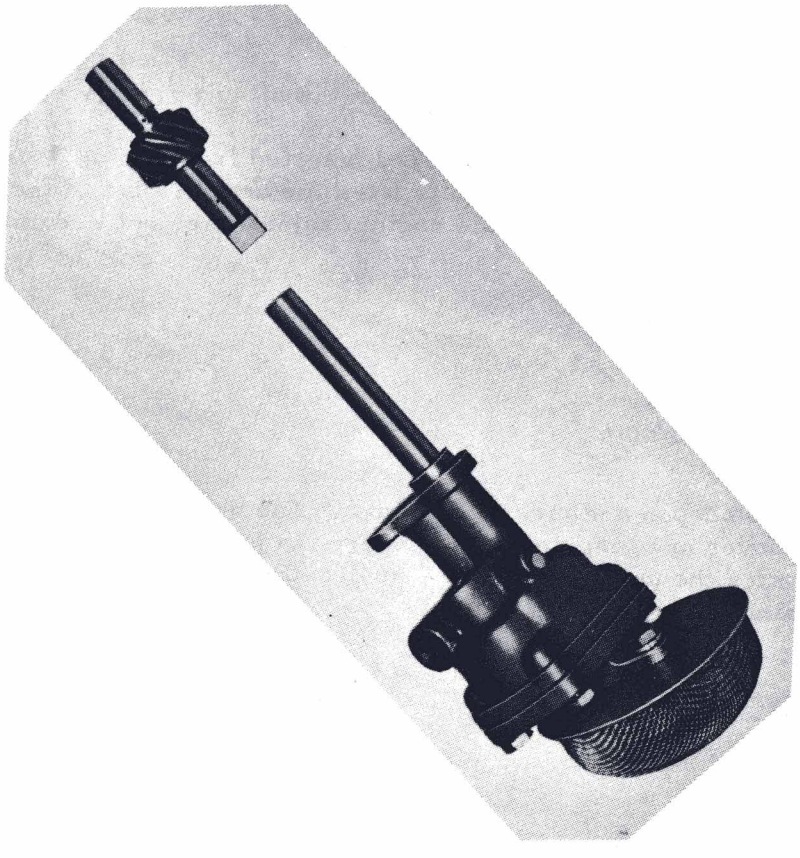


Fig. 5

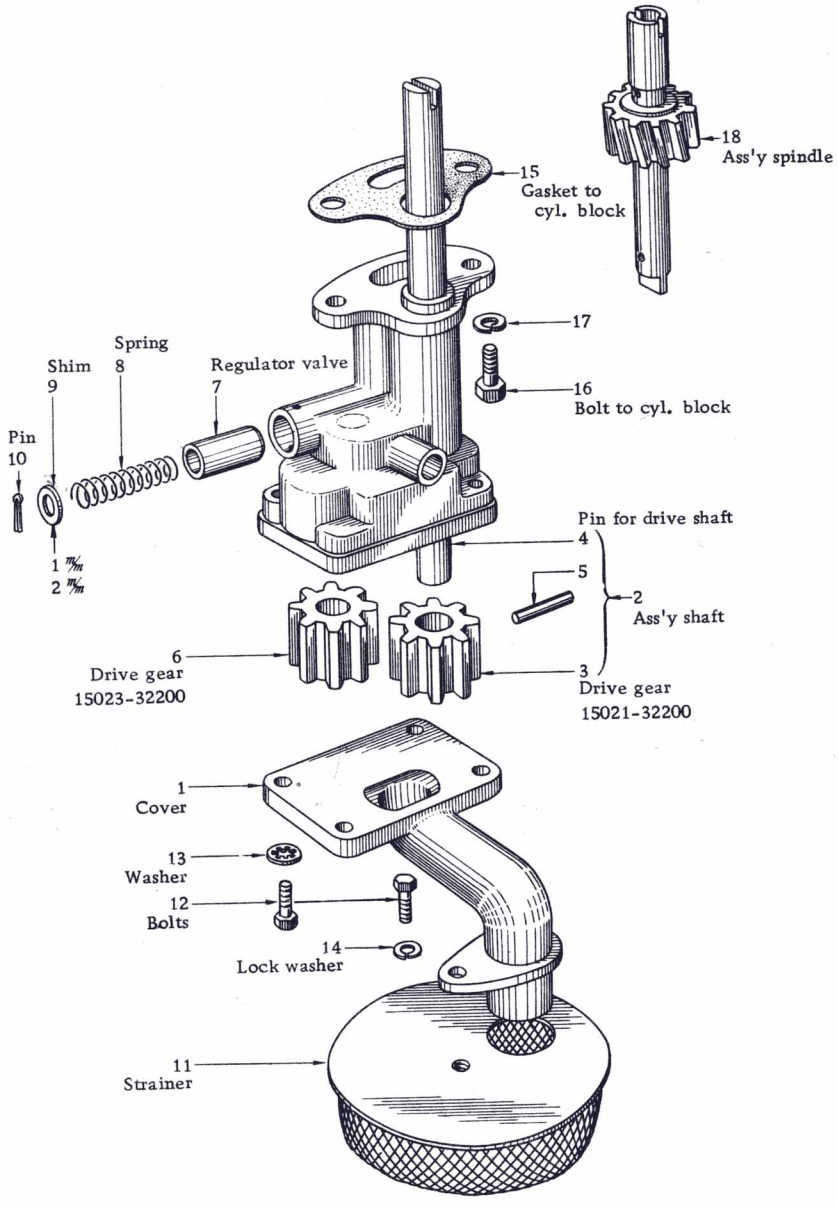
Refitting the Oil Pan

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

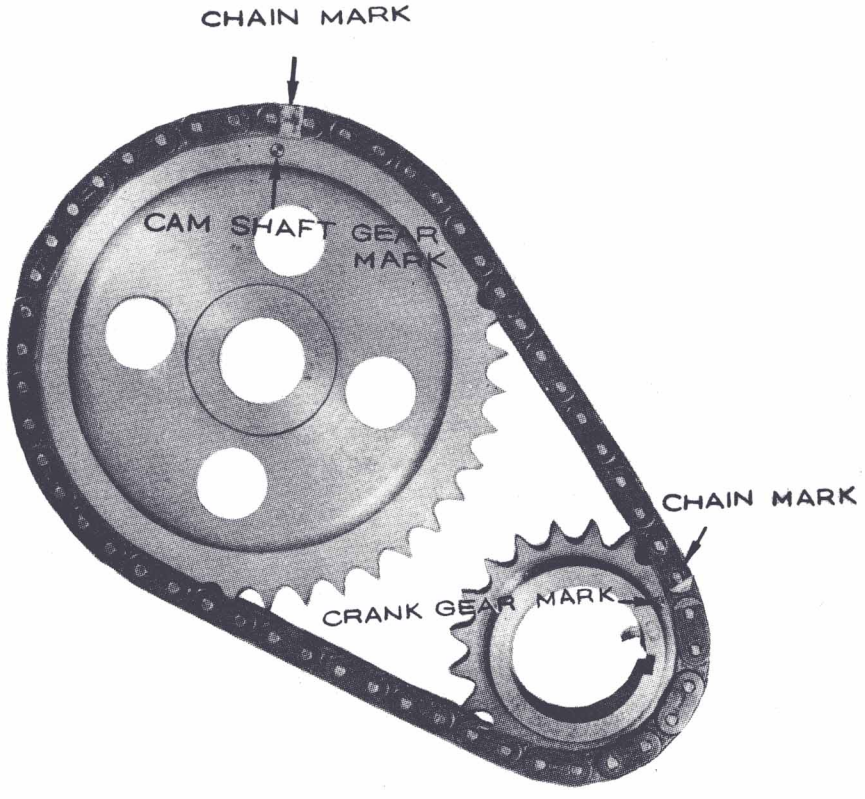


Fig. 2 Position of refitting gears with the chain

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.

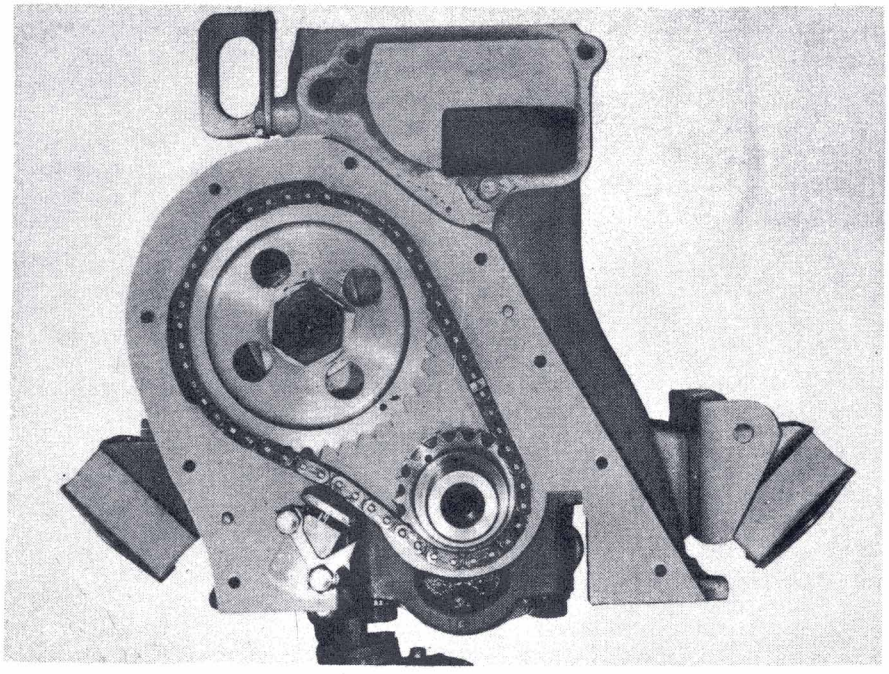


Fig. 3

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.

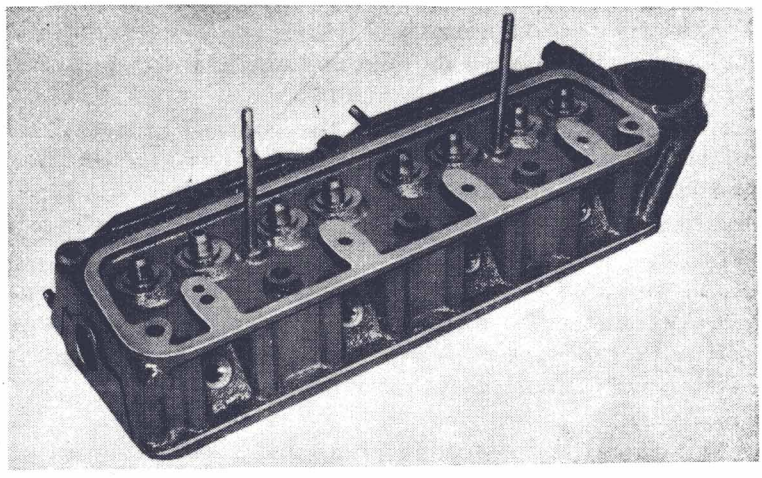


Fig. 1

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)

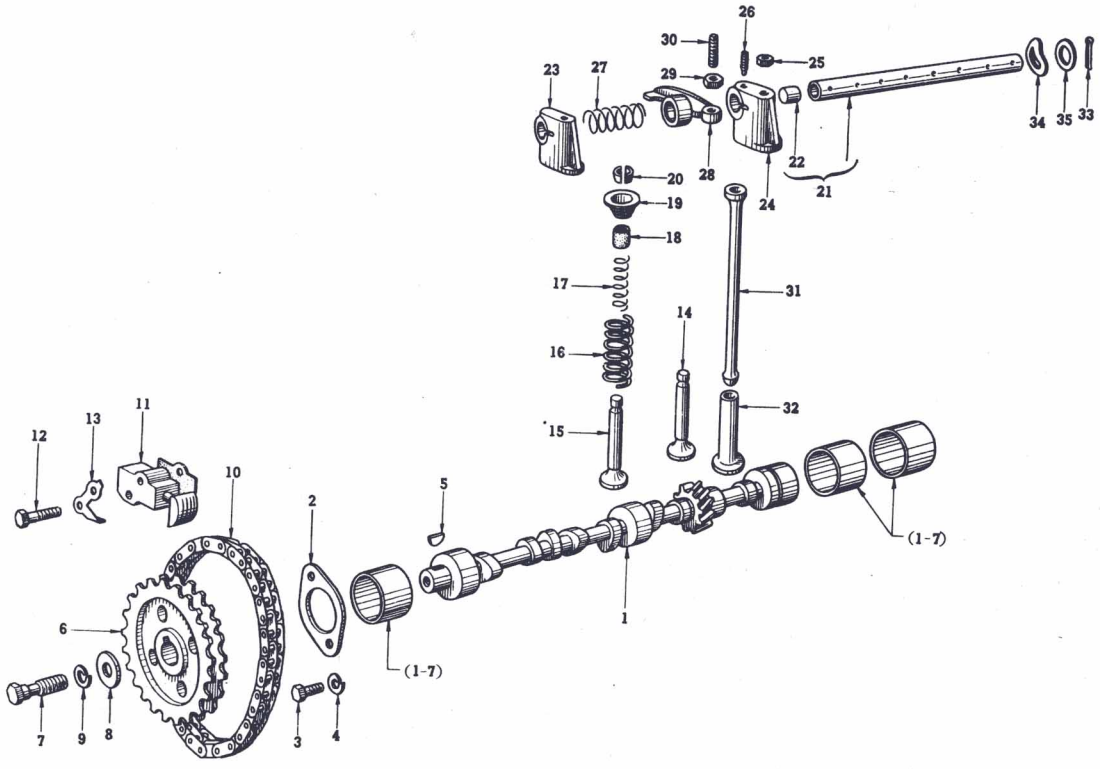
Refitting the Cylinder Head

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.

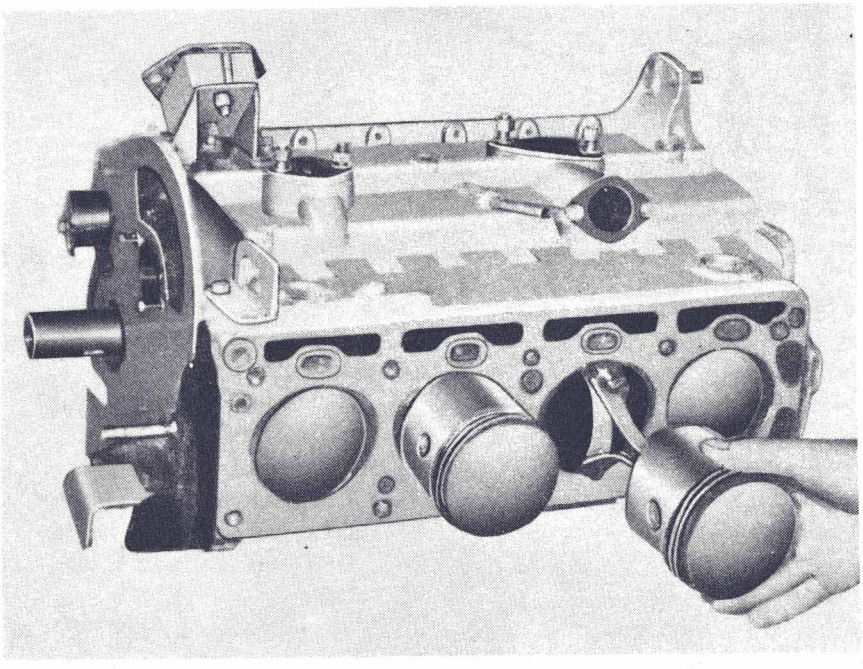


Fig. 2

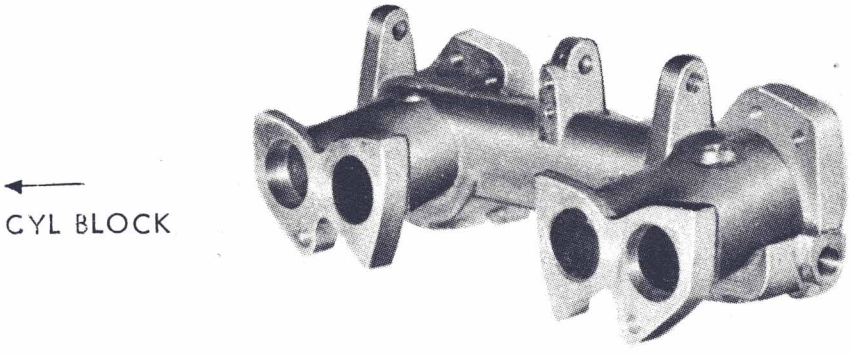


Fig. 3 Intake manifold

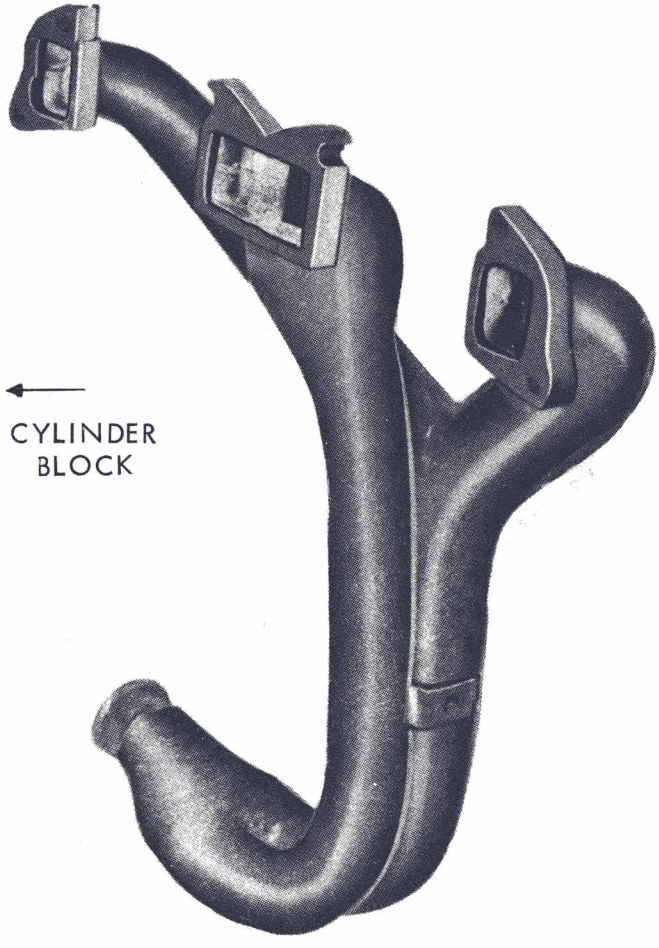
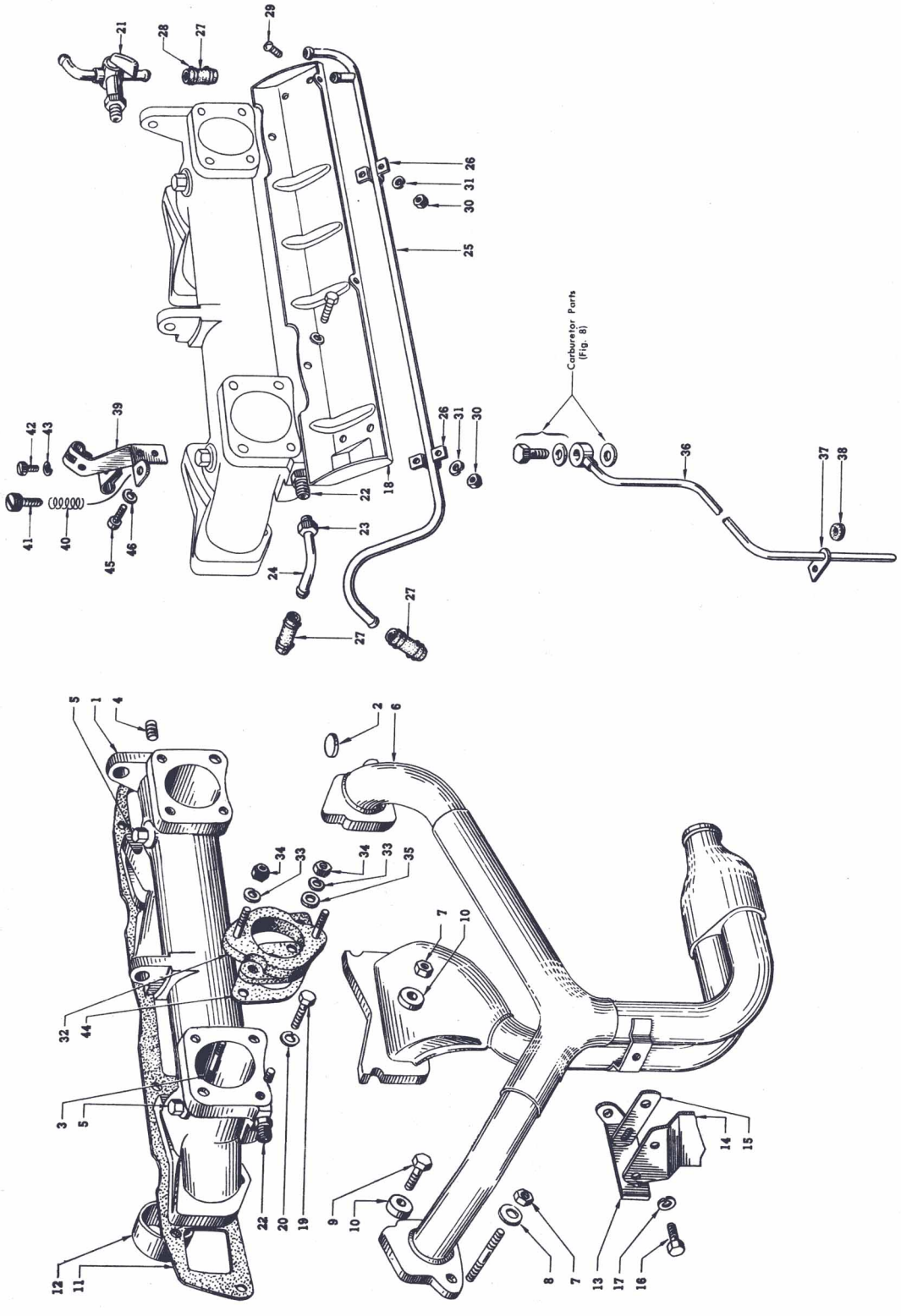


Fig. 4 Exhaust manifold


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 } to fix heat shield plate
20. Washer-lock }
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 } to fix water tube clamp
31. Washer-lock }
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.

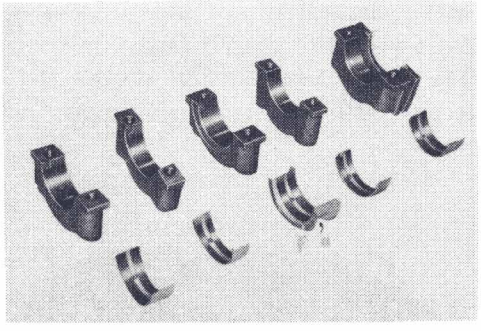
CONNECTING ROD

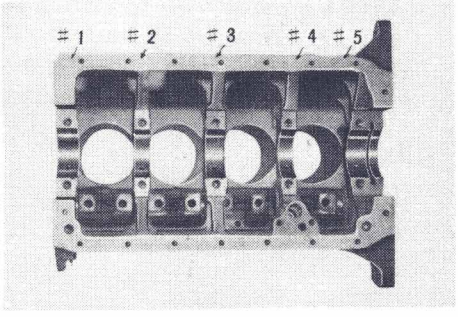
Material	Steel forging	
Length, center to center	152.45 mm	
Big end bearing:		
Material	Thinwall, steel backed clevite metal F 770	
Width	24.1 - 23.9 mm	0.9488 - 0.9409 in.
Thickness	1.500 - 1.508 mm	0.0591 - 0.0594 in.
Diameter of big end housing	55.000 - 55.013 mm	2.1653 - 2.1658 ins.
Big end width	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.

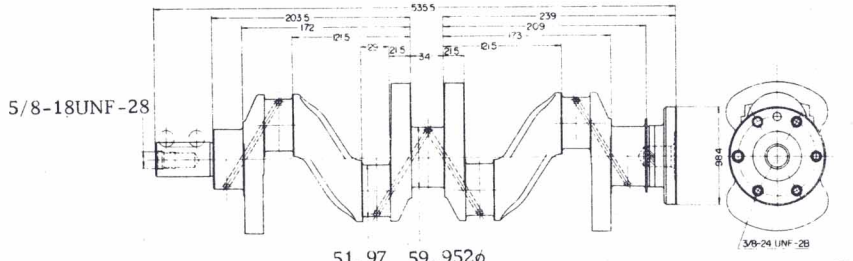
CRANKSHAFT

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







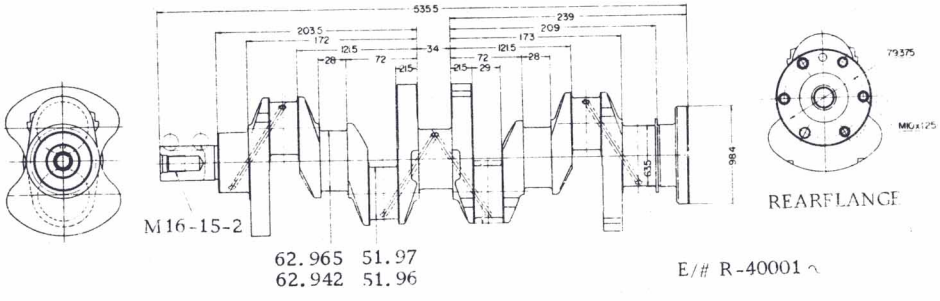


Fig. 4-2

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.

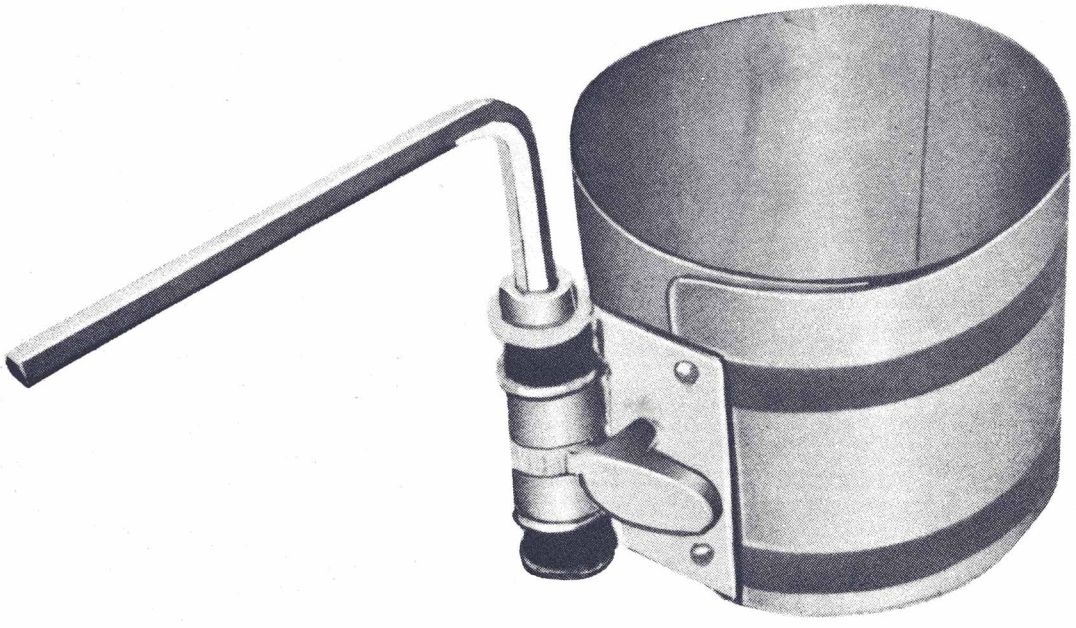


Fig. 5

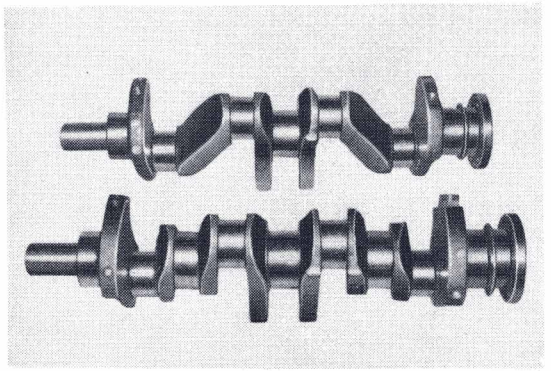


Fig.6 Piston & crank shaft

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.

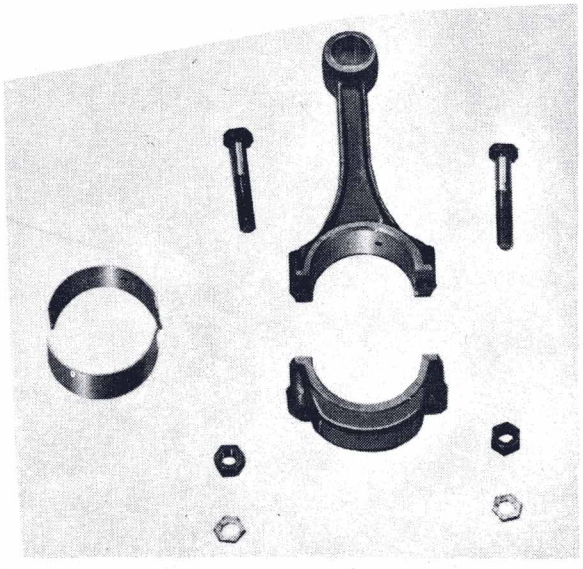


Fig.7

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

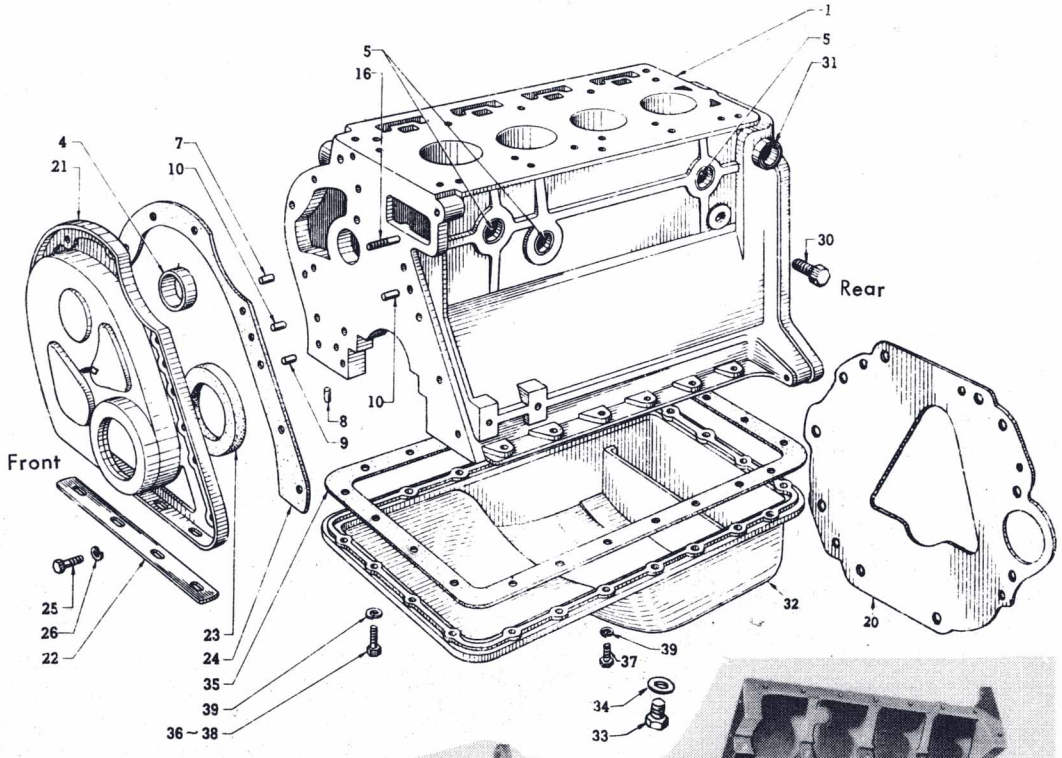
Cylinder bore taper	Less than 0.0008 in.
Difference of each cylinder bore	Less than 0.0008 in.
Over size piston available	0.010, 0.020, 0.030, 0.040 in. 0.25, 0.50, 0.75, 1.00 mm
Cylinder head surface warpage limit	0.1 mm, 0.004 in.
Torque wrench setting:	
Cylinder head bolts	6.2-6.9 kgm 45-50 ft. lbs.
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.)

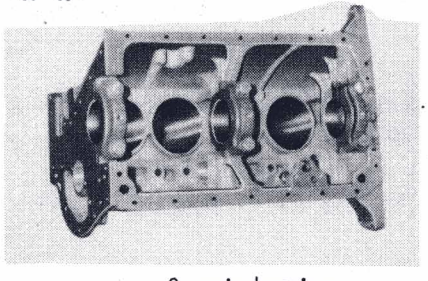
PISTON

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

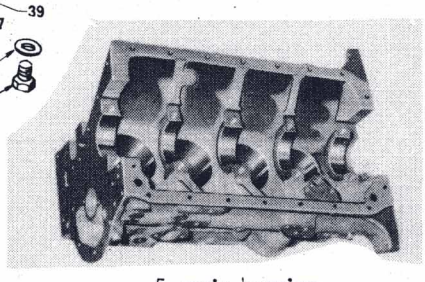
Standard size (12010-14611)					
	1	2	3	4	5
R Engine	79.975 79.966mm	79.985 79.976mm	79.995 79.986mm	80.005 79.996mm	80.015 80.006mm

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





3 main bearing

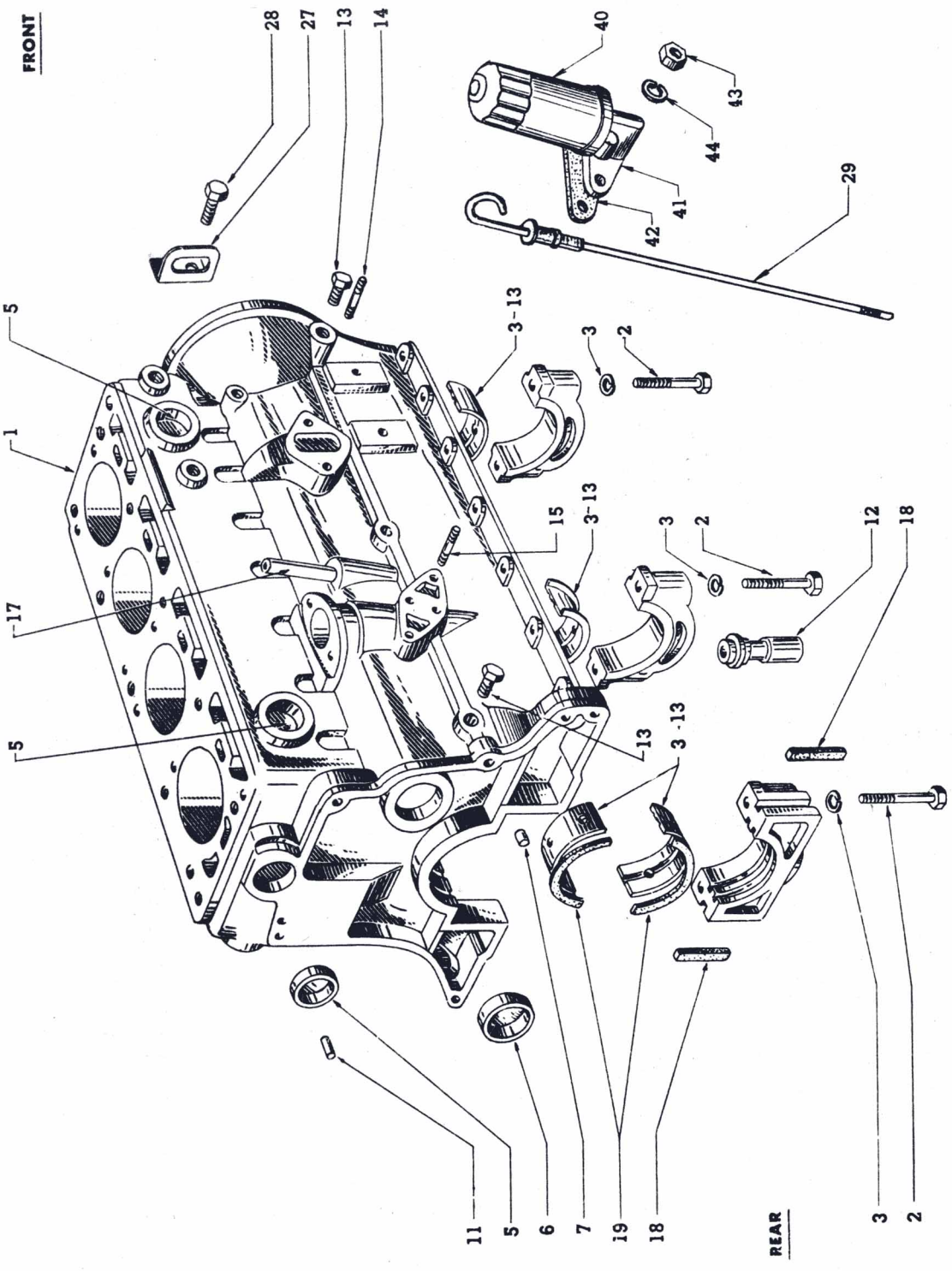


5 main bearing

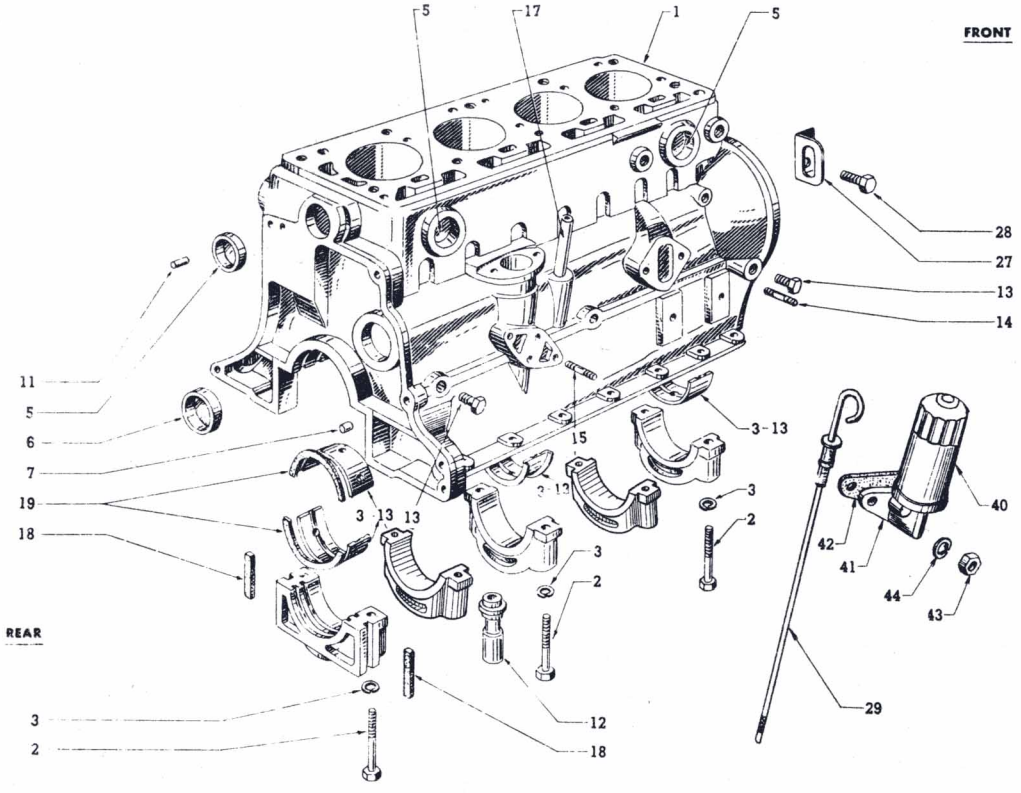
3 main bearing	5 main bearing
E/# ~ 40000	E/# 40001 ~
11010-74000	11010-74700

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

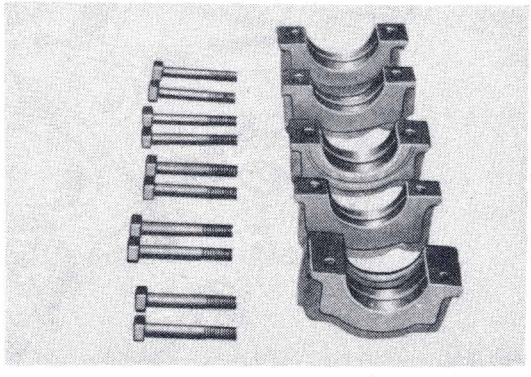
CYLINDER BLOCK(A)



CYLINDER BLOCK(B)



1. Ass'y-block, cylinder
2. Bolt } to fix bearing
3. Washer-lock } 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
44. Washer-lock } 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.)

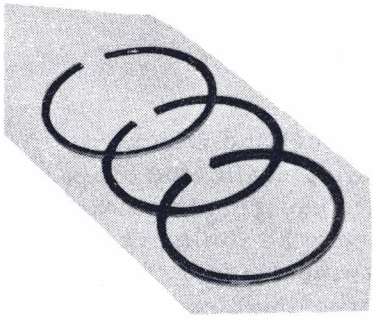
PISTON RINGS

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.

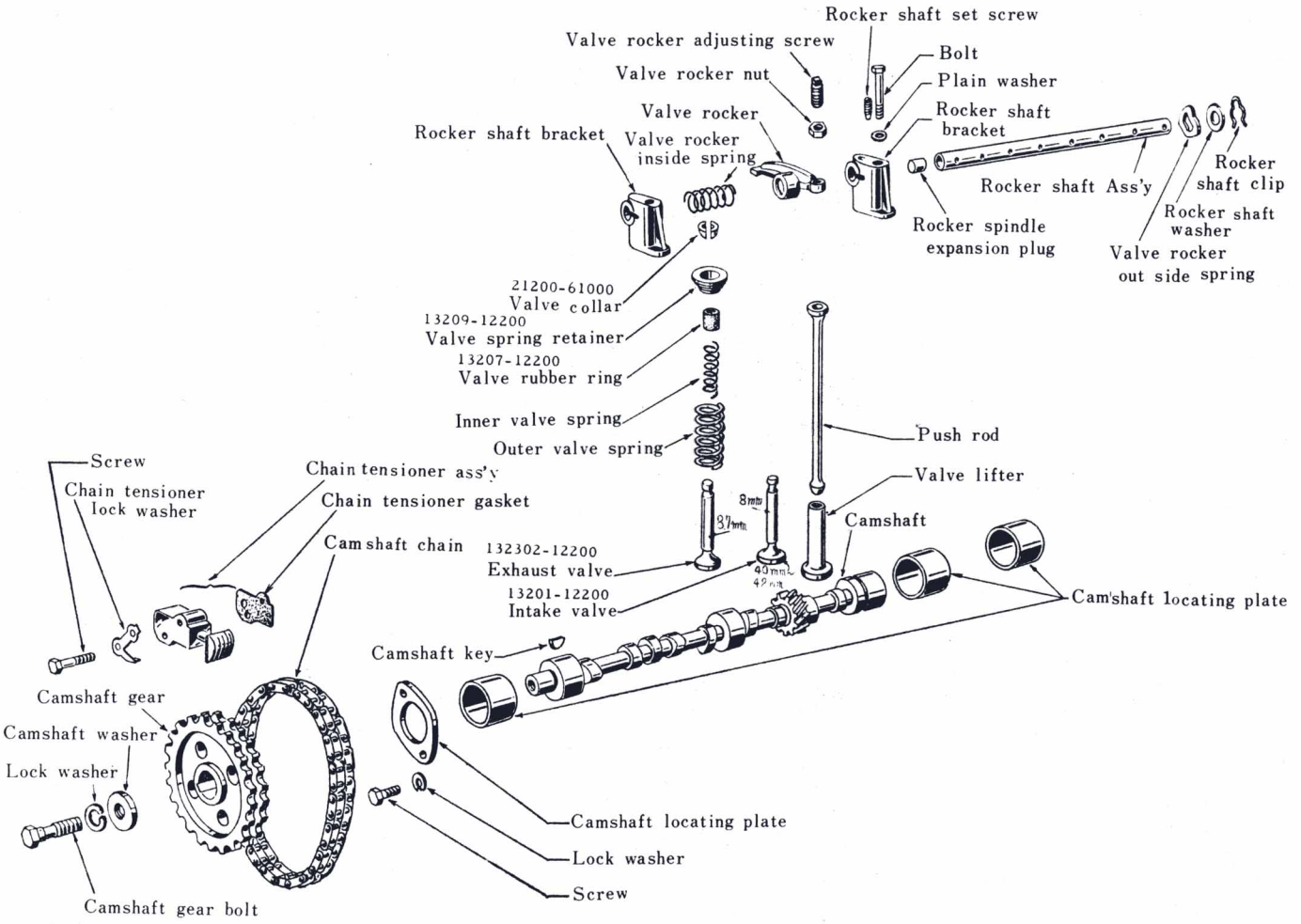
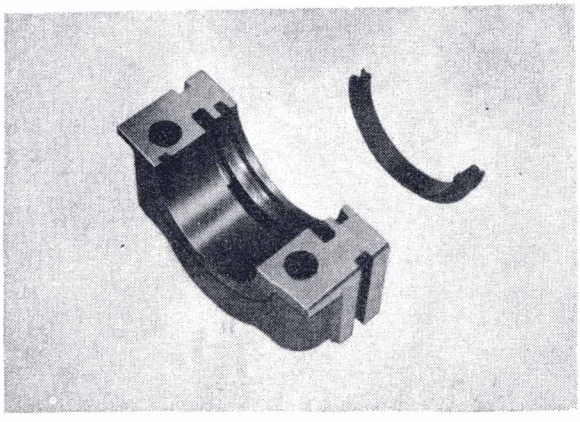
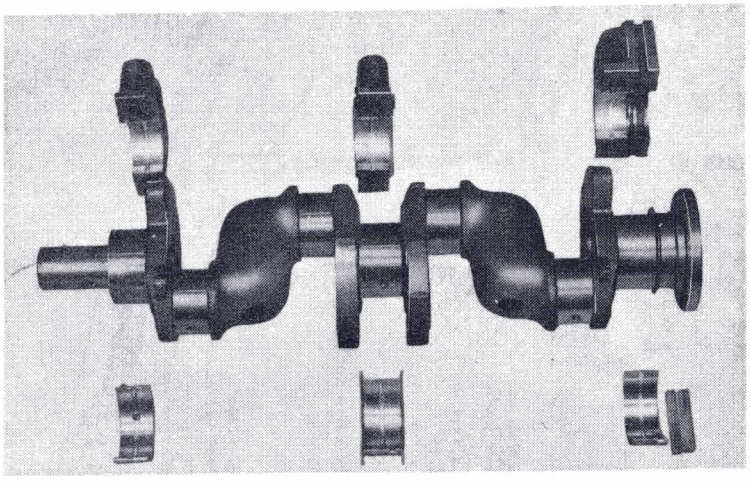


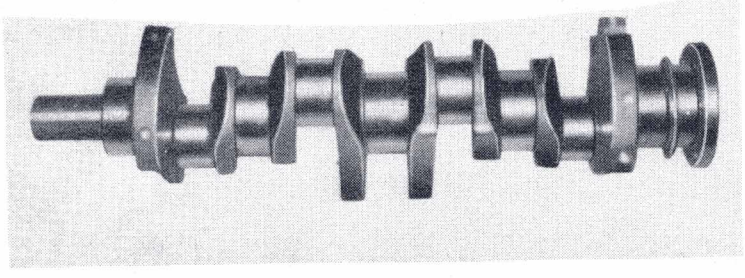
Fig. 10 Camshaft & valve gear



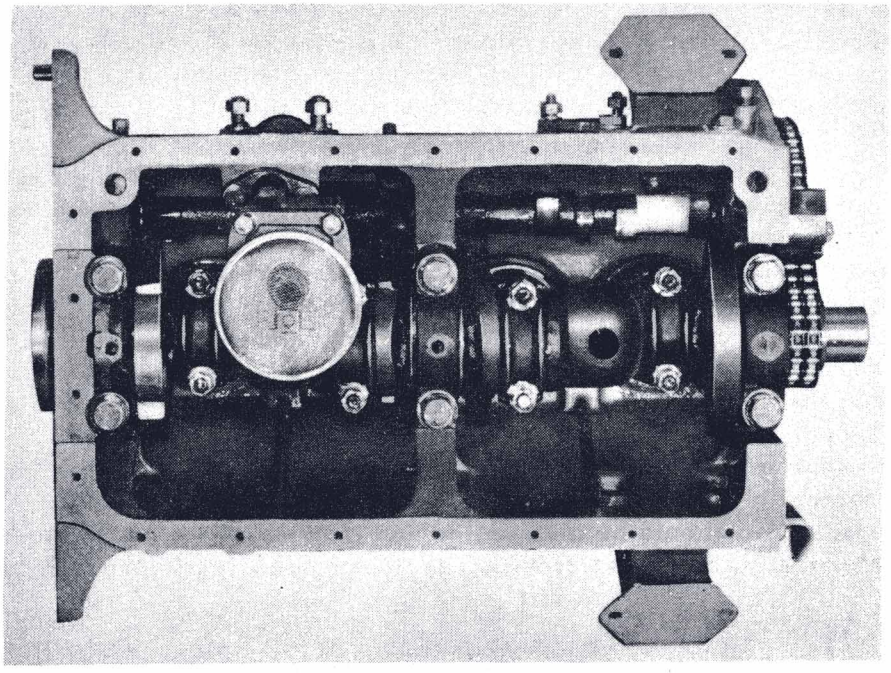
Remove all traces of dirt and oil from the housings and throughly dry them with a non-fluffy rag. Make sure that the oil ways are clear. When fitting the bearing caps ensure that they are replaced the right-way round. Each cap is marked, and the marks should face the camshaft side of the engine.



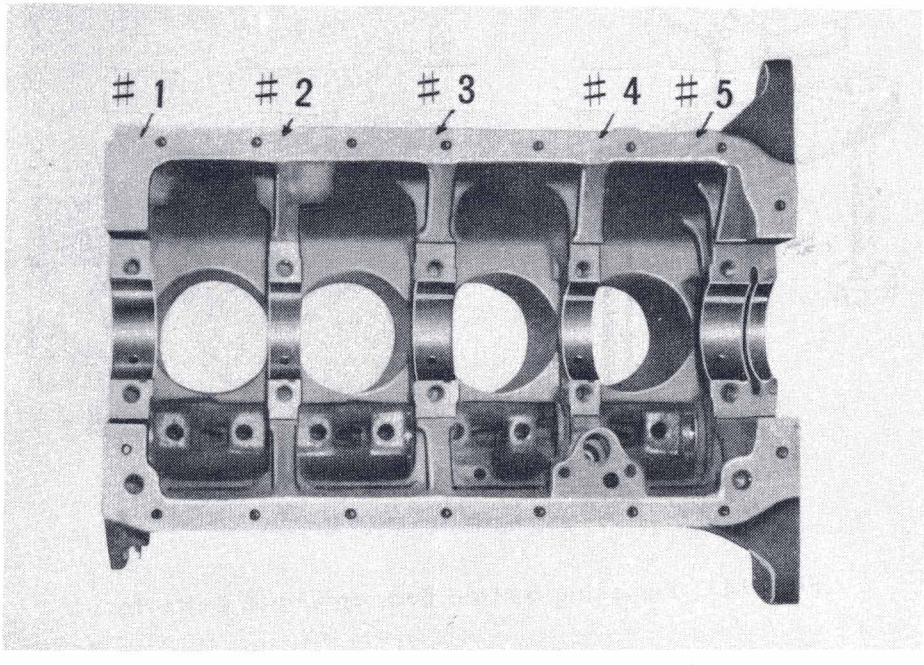
Crank shaft for 3 bearing



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.).

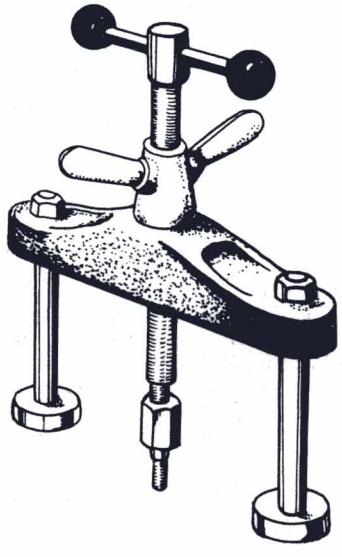
When refitting the main bearing caps tighten the center one first. After each cap is tighten rotate the crankshaft to ascertain that it revolues freely.

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.



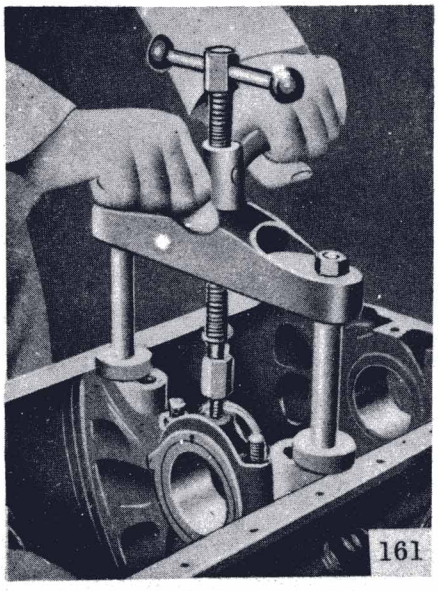


Fig. 14 Removing a Main Bearing Cap & Extractor

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.

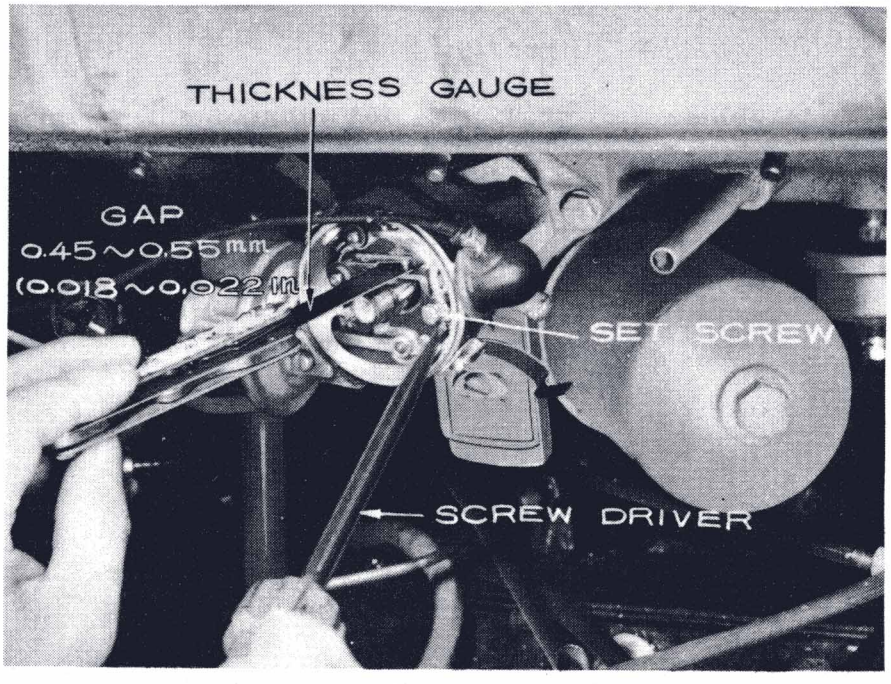


Fig. 15 Adjusting the Point Gap

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.

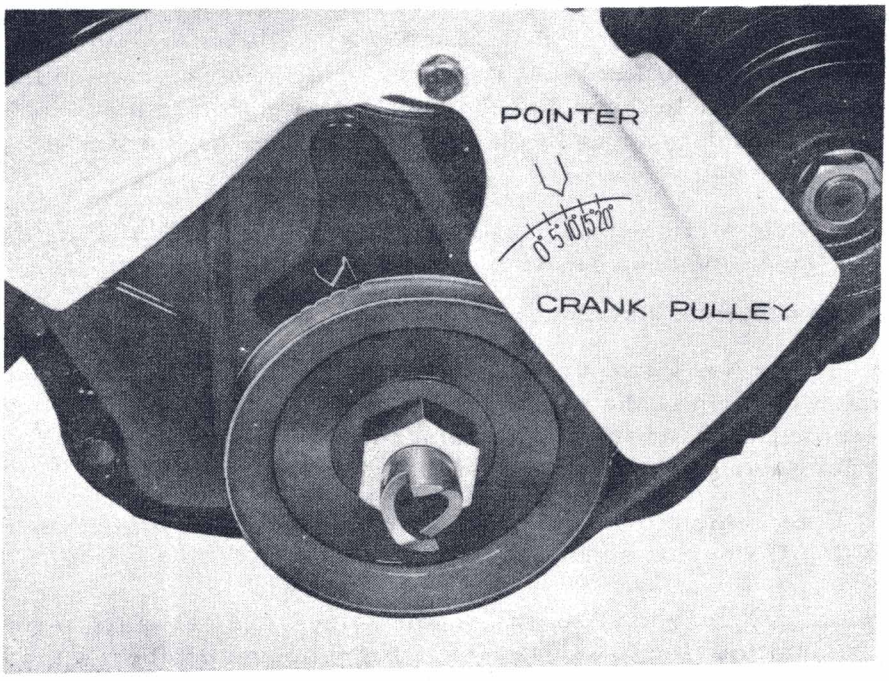


Fig. 1 Checking the Ignition timing

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 coresponding 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)

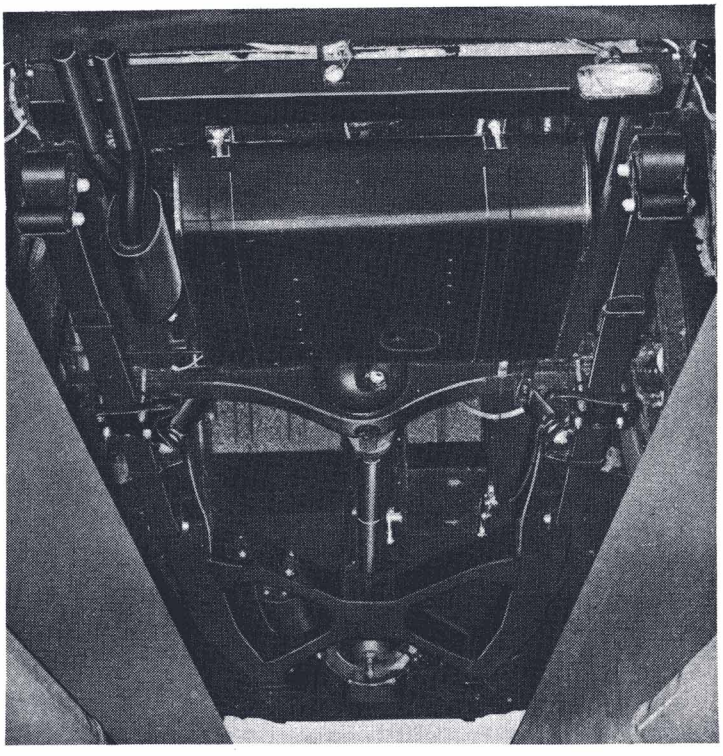


Fig. 1

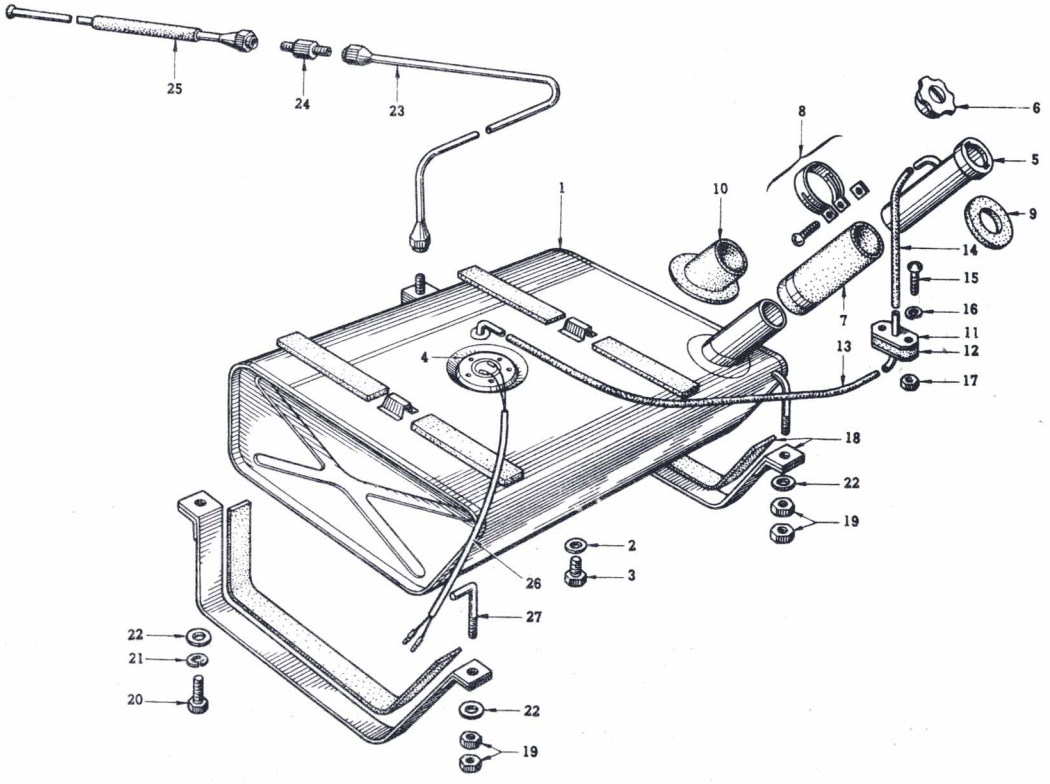


Fig. 2 Fuel tank (43 ℓ)

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 operation 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.

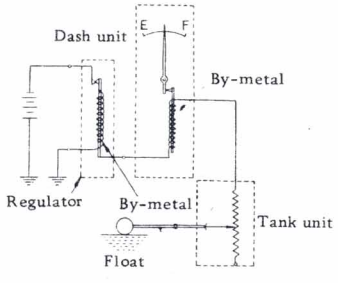


Fig. 3
Wiring of fuel gauge

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)

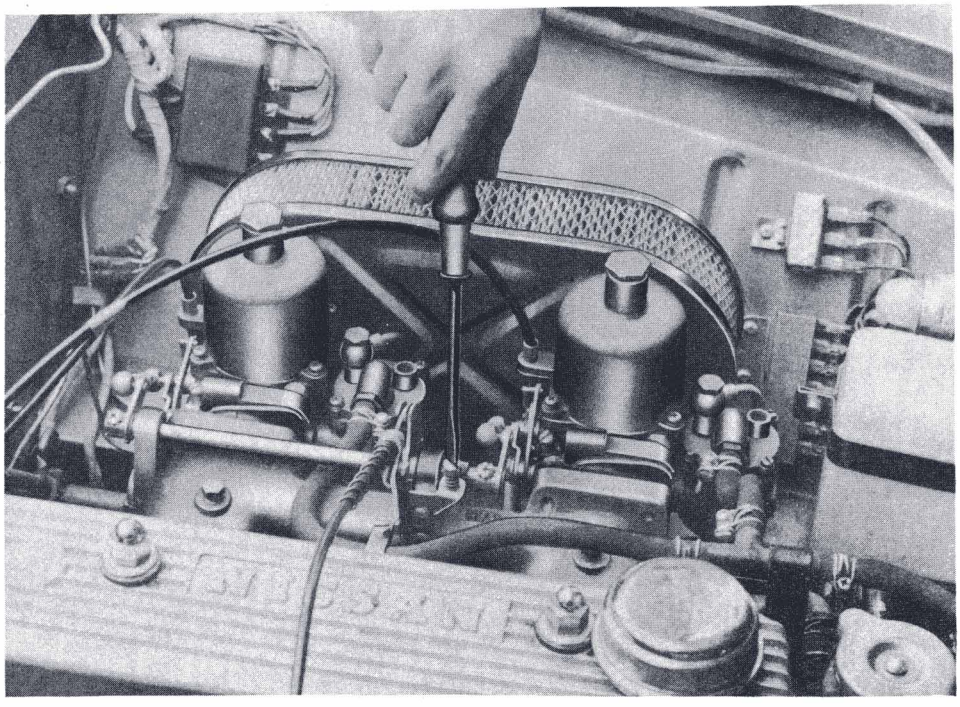


Fig. 1

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.

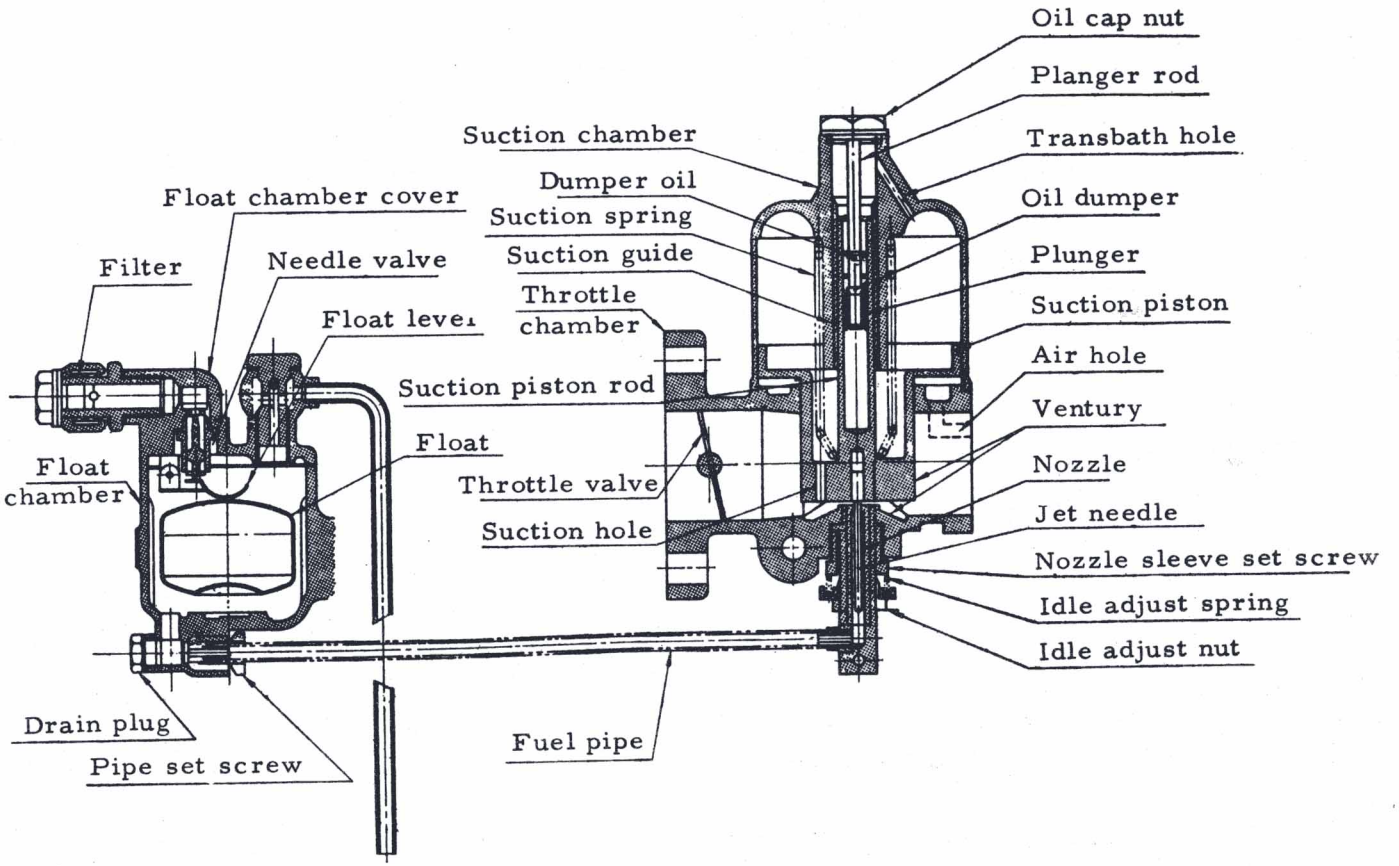


Fig. 2 Sectional View of Carburetor

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.

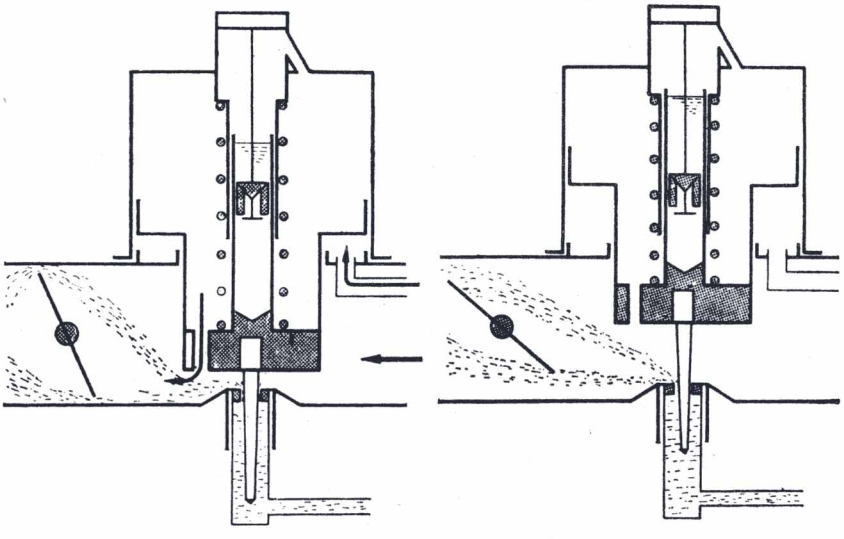
In order to heighten acceleration, the oil damper is provided within the suction piston rod and prevents the piston from an abrupt opening.

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

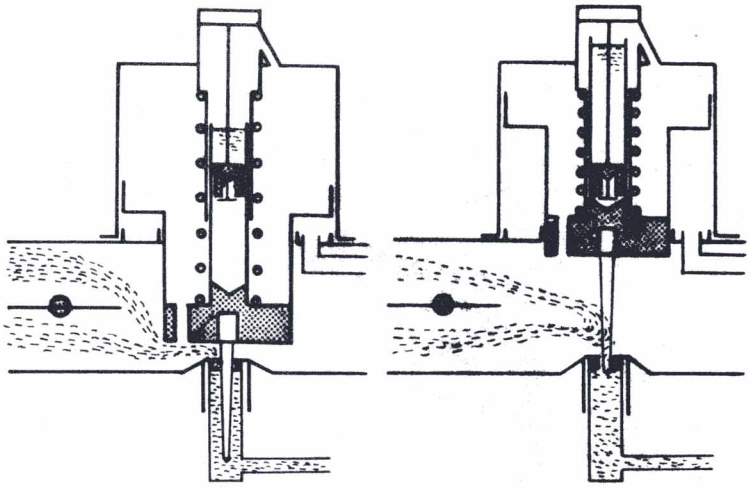


Fig. 4

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.

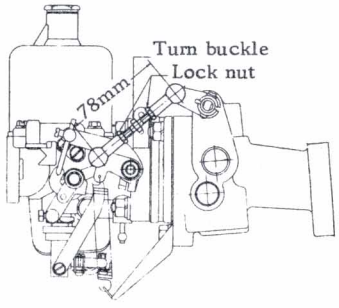
(2) Fix the con. rod on the Rear side at 70mm with the lock nut. (Over all length 86 +0mm, -2mm).

(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.

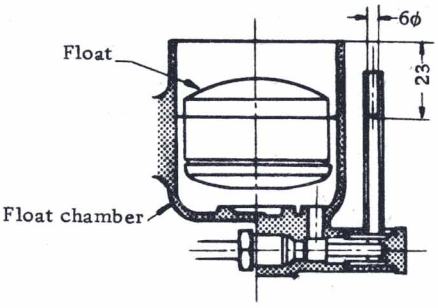
(4) Further return the throttle adjust screw of the Front side carburetor and slow down revolution, then the stable idling driving can be obtained.

(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

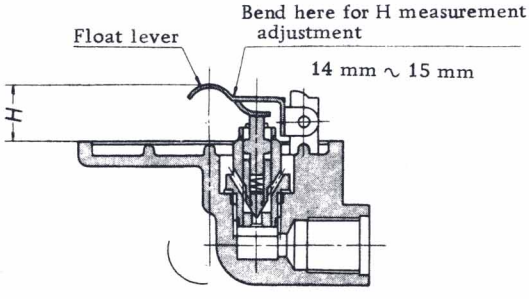


Fig. 5 Adjusting float level

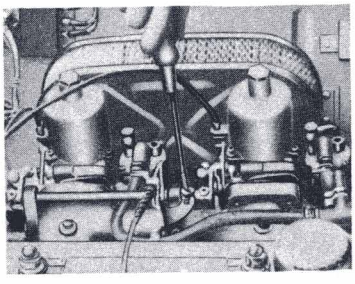
(1) Remove 4 ea of the set screw of the float chamber cover, the float chamber cover and the float lever can be removed together.
Put the float chamber cover on a stand with the float lever upside.

(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.

Adjustment of Starting Linkage Opening (Refer to the Figure)



IDLING ADJUST SCREW FOR THE DUAL CARBURETORS

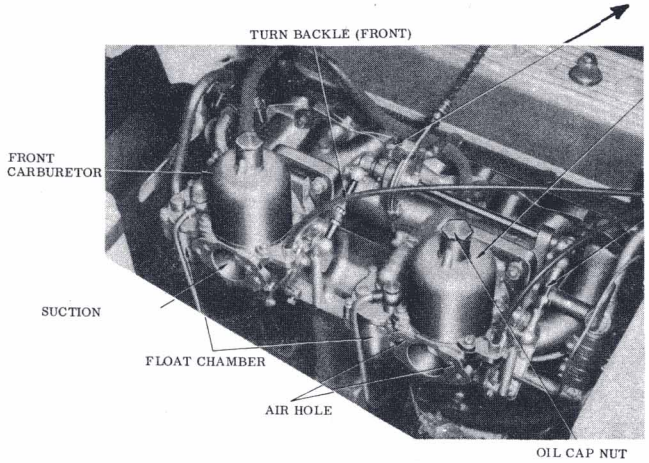
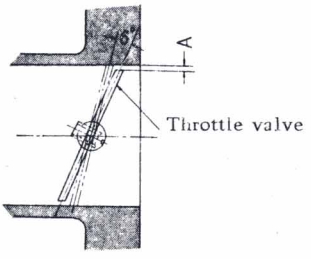
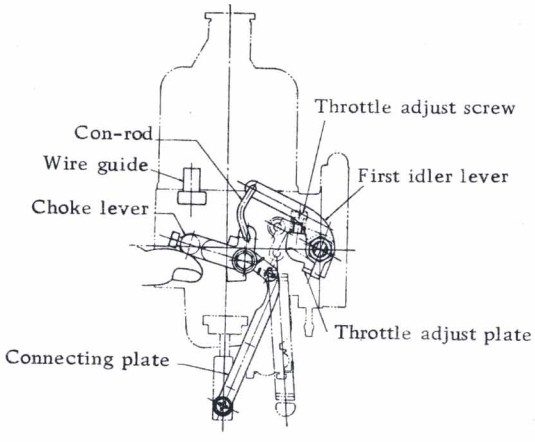


Fig. 6 Adjustment for Openning degree at connecting

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.





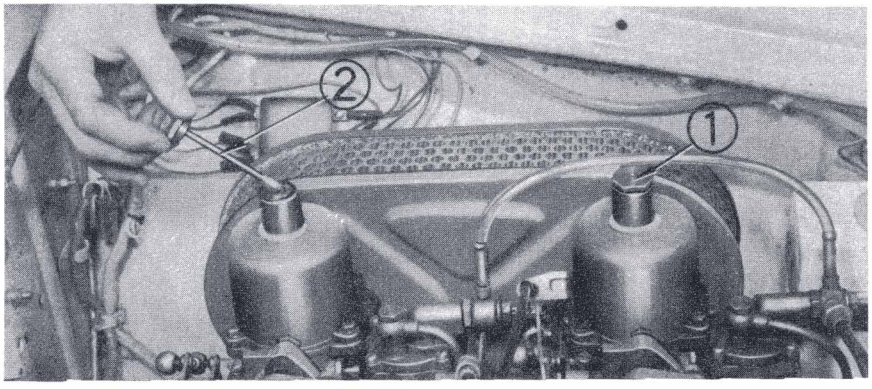
Inspection of Damper Oil

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.

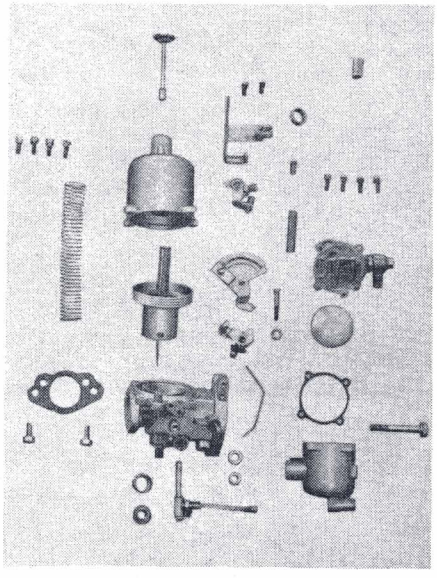


Fig. 8 Knock Down of Suction Piston & Suction Chamber

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.

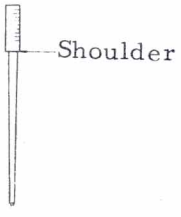


Fig. 9 Jet needle

(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.

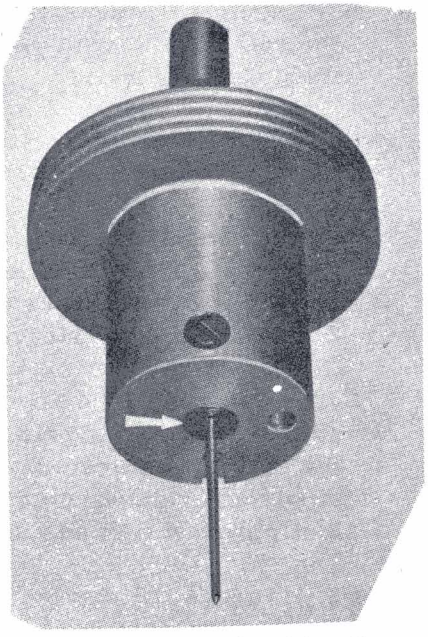


Fig. 10 Setting Jet Needle

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.

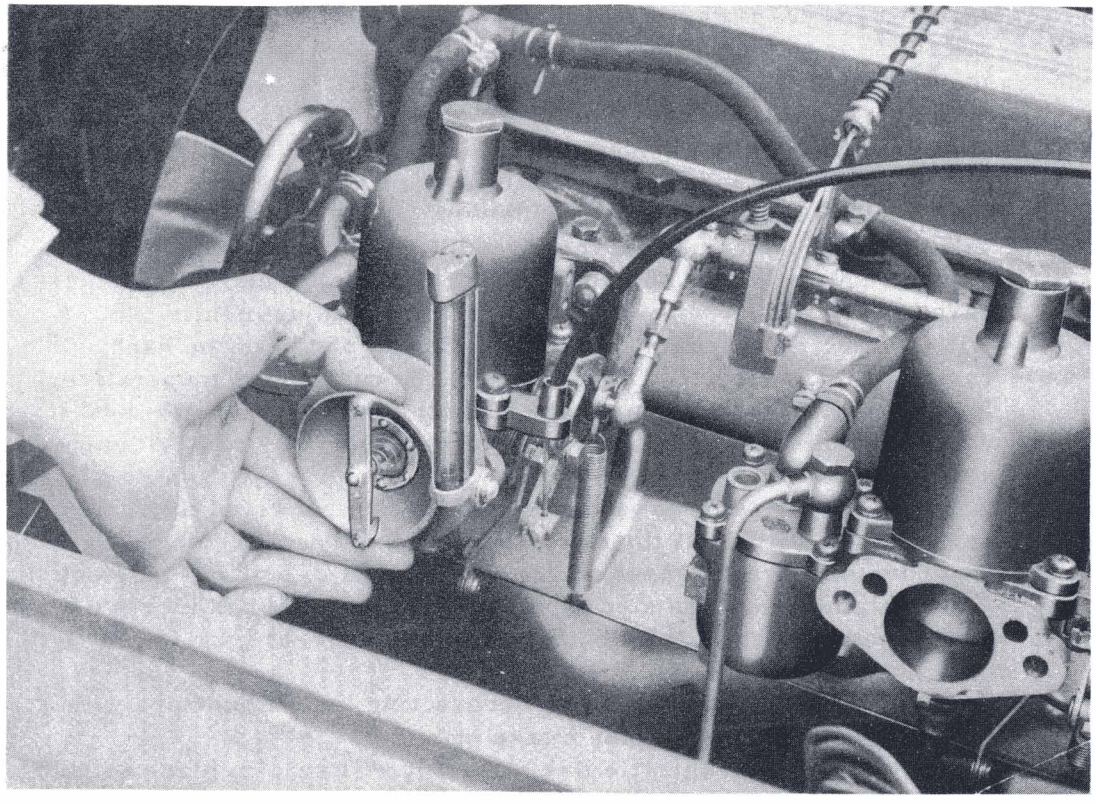
(5) Turn the front throttle adjusting screw anti-clockwise until engine reaches about 500 RPM.

(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.

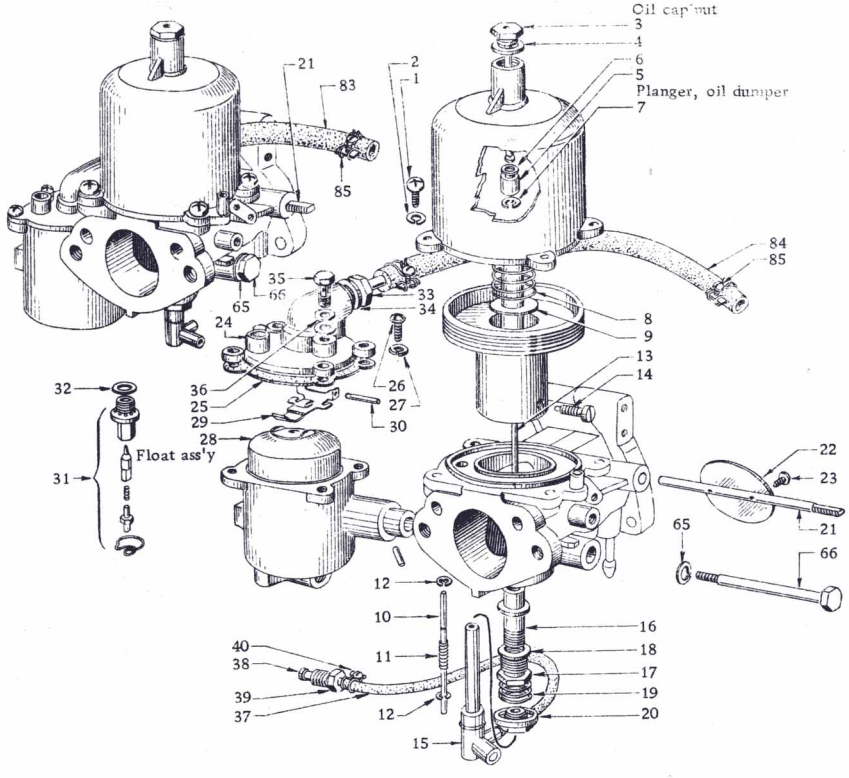
(9) Set the rear carburetor throttle adjusting screw so it is on the top.



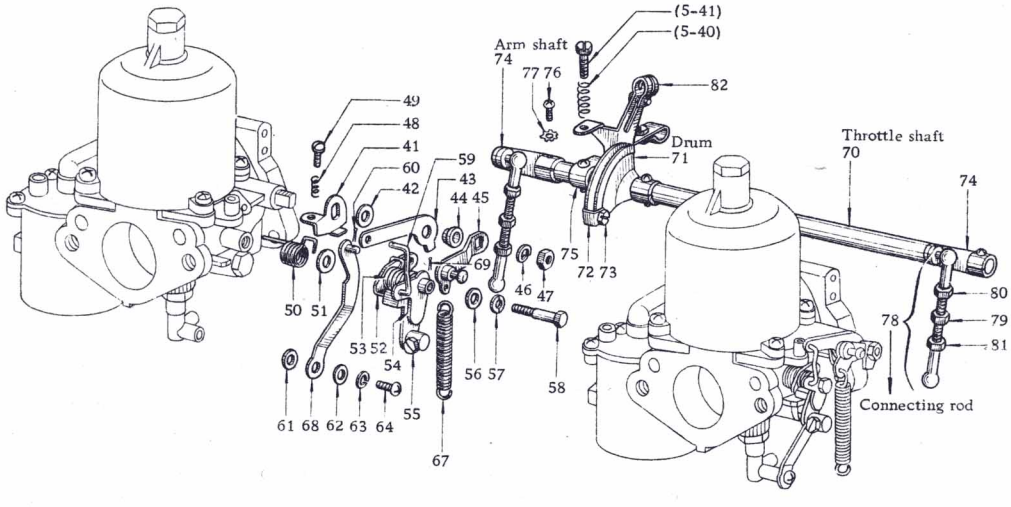
Method ©

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.

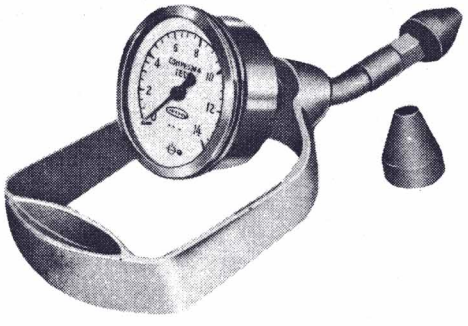


Fig. 1
Measuring compression pressure by means of a compression gauge

(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.

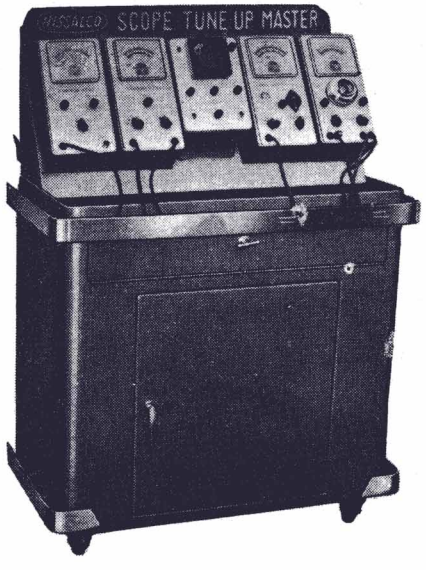


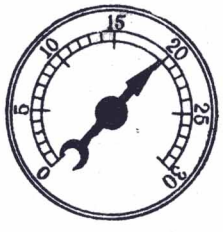
Fig. 2
Motor master tester available for 4, 6 and 8 cylinder engine

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.)	$70 \pm 2\%$
High Speed Running (2, 000 r. p. m.)	$85\ ^{+5}_{-2}\ \%$

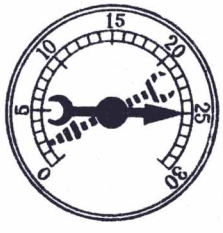
Engine Trouble Shooting

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.



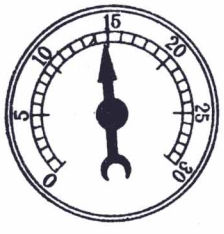
(1)

Normal condition
Settles between 18~20 in.



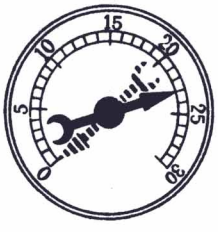
(2)

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)

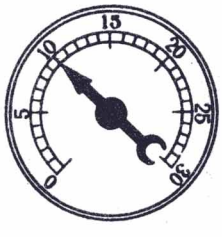
When indicator drops by about 2 in., valves leak. (Faulty seating of valves.)

(8)

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

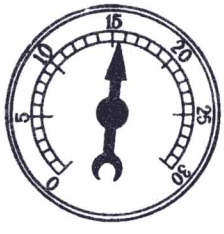
(9)

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.



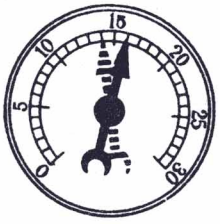
(10)

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



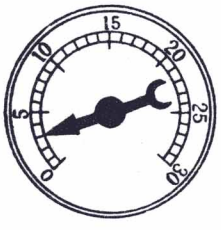
(11)

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



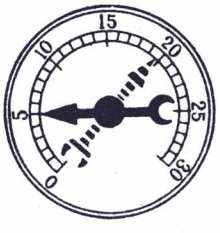
(12)

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



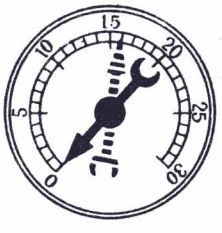
(13)

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.

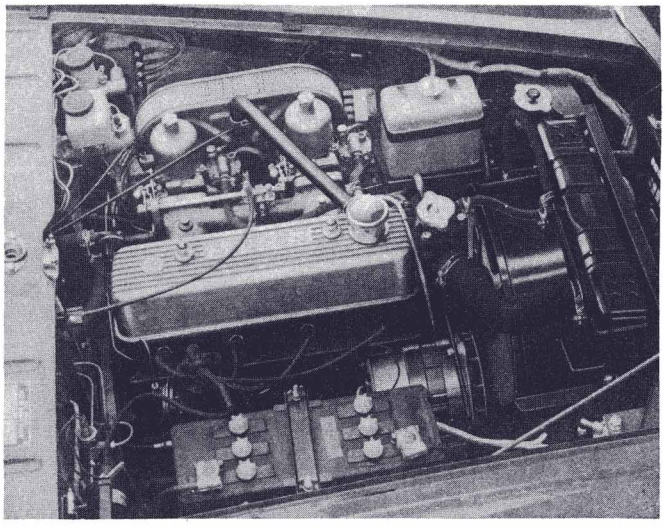


Fig. 1

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.

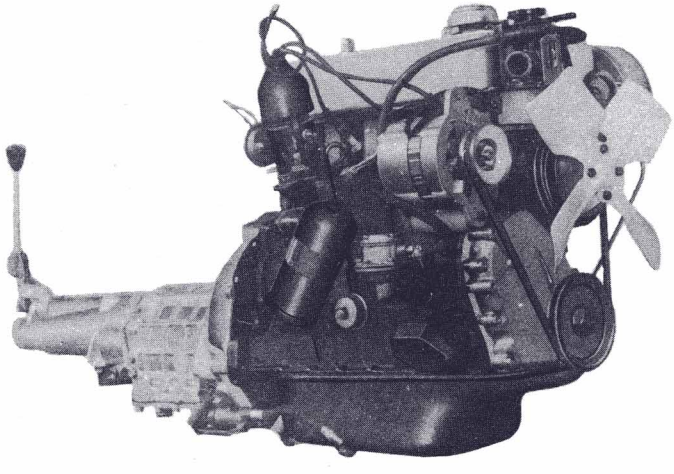


Fig. 2

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.

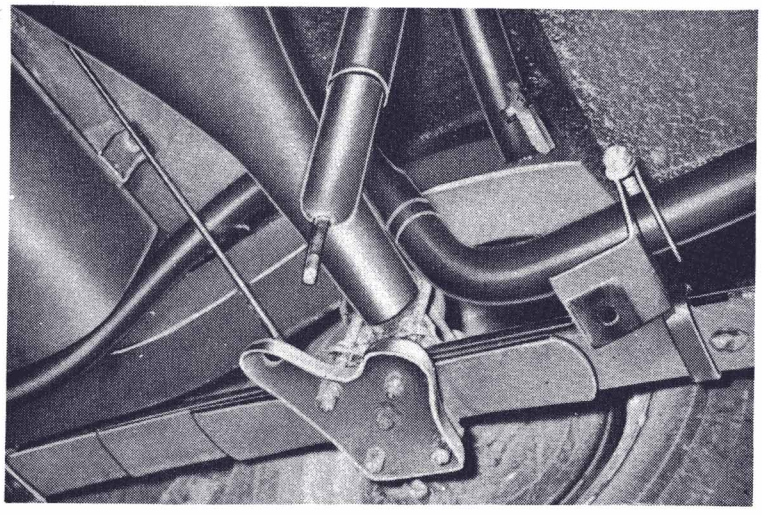


Fig. 3

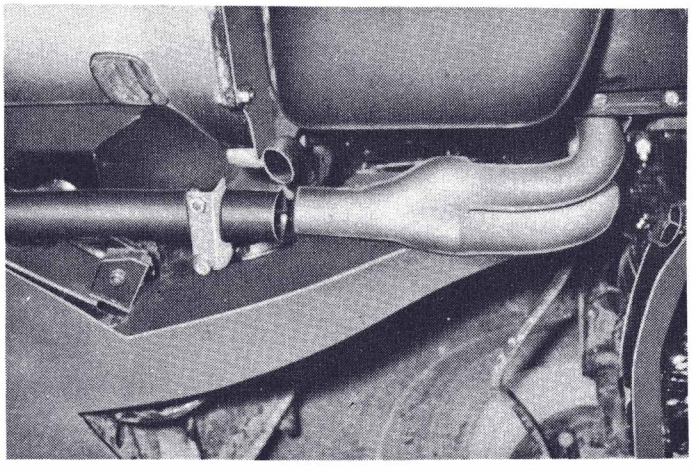


Fig. 4

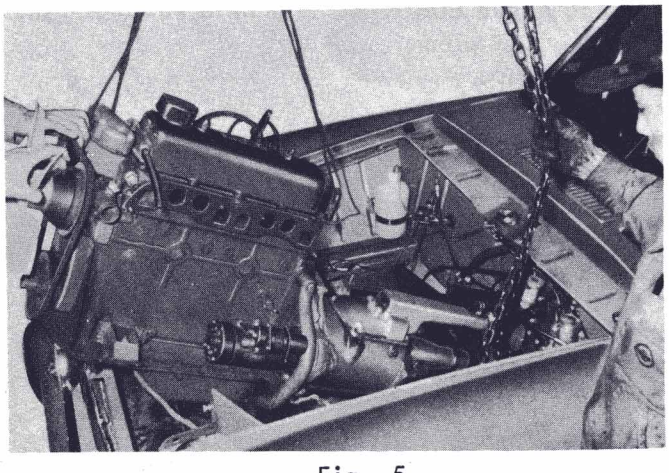


Fig. 5

COOLING SYSTEM

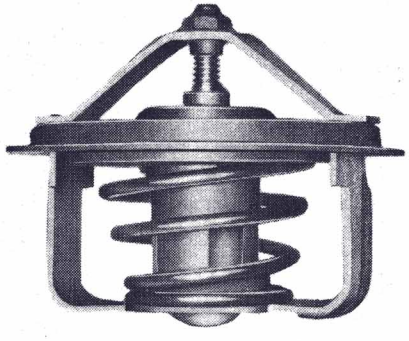
RADIATOR

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

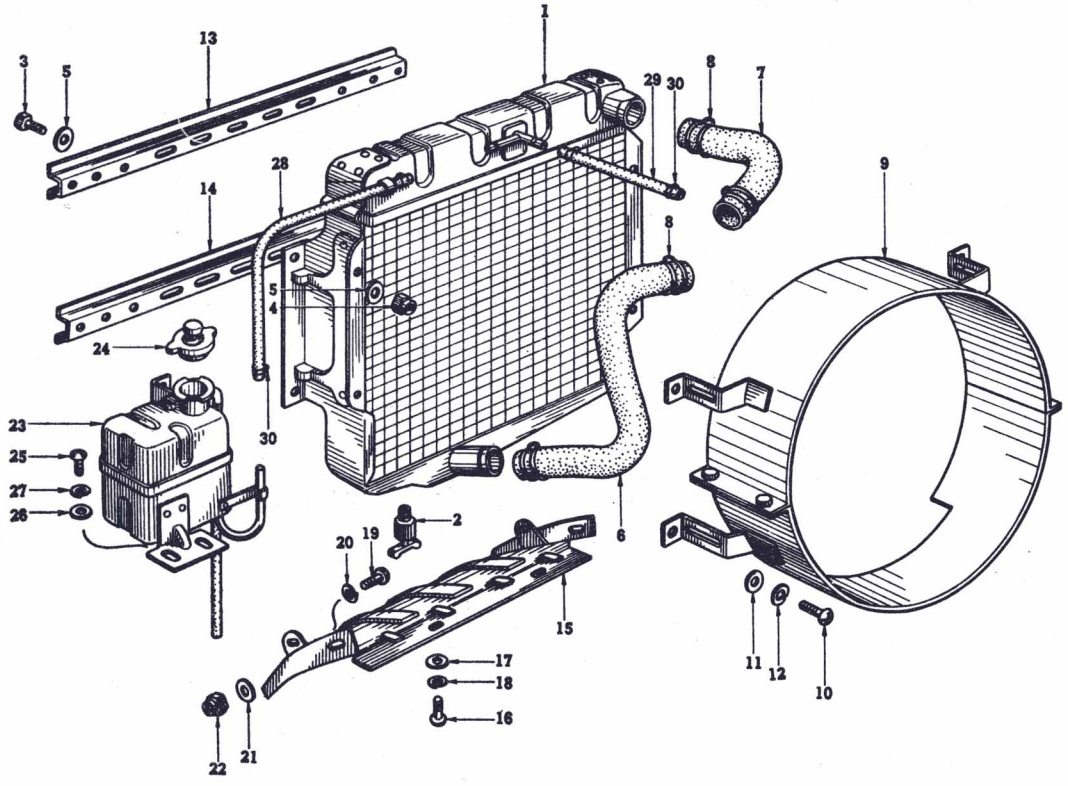
An efficient cooling system is of major importance to ensure the satisfactory running of the engine and it is therefore necessary to pay paticular attention to its maintenance. Attention is especially drawn to the procedure for winter months, if damage is to be avoided.



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 wafer 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.

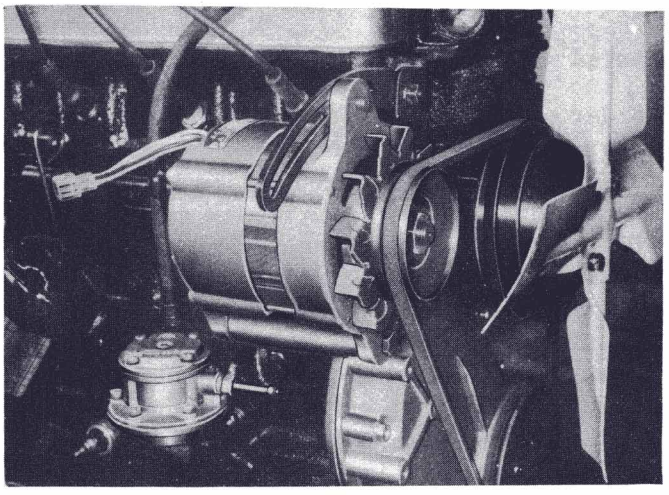


Fig. 2
Fan belt adjustment

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.)

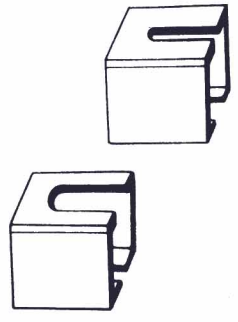
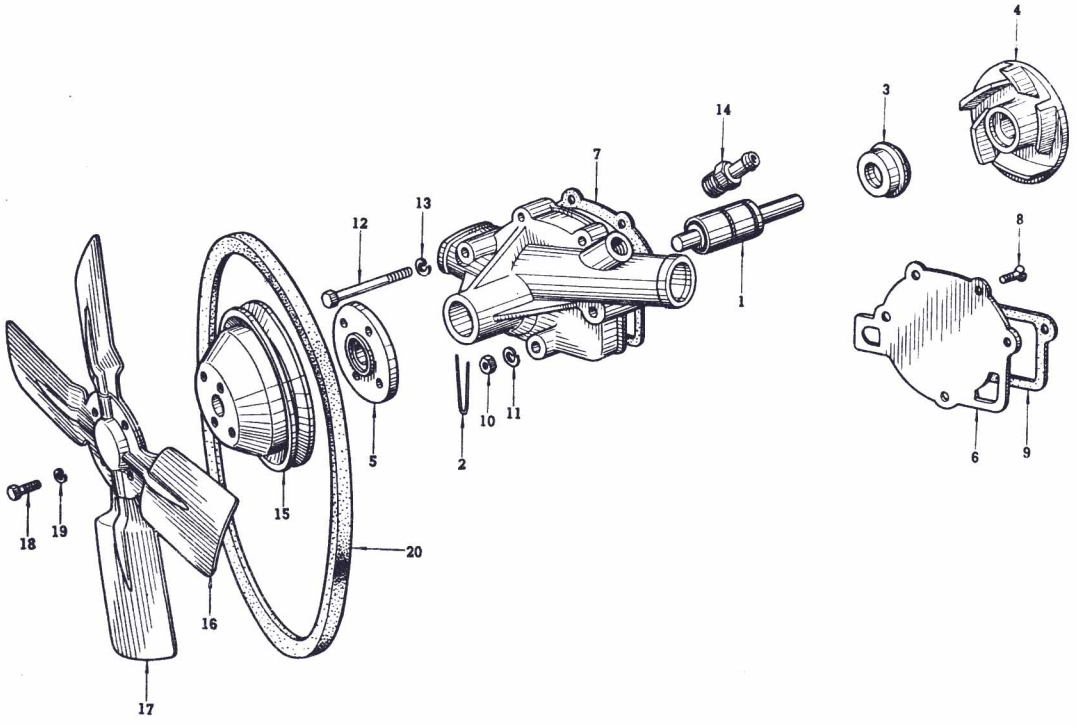


Fig. 3

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

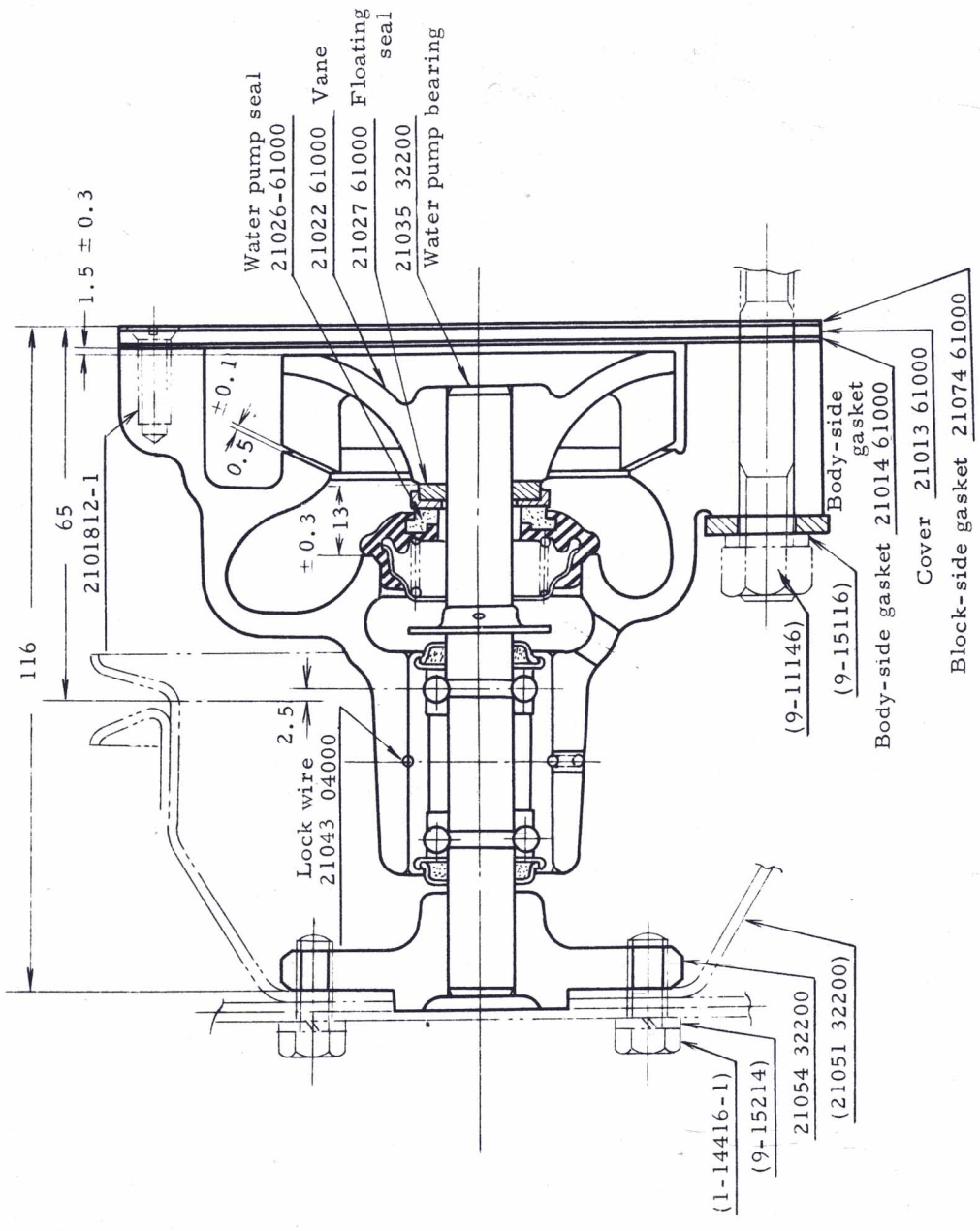
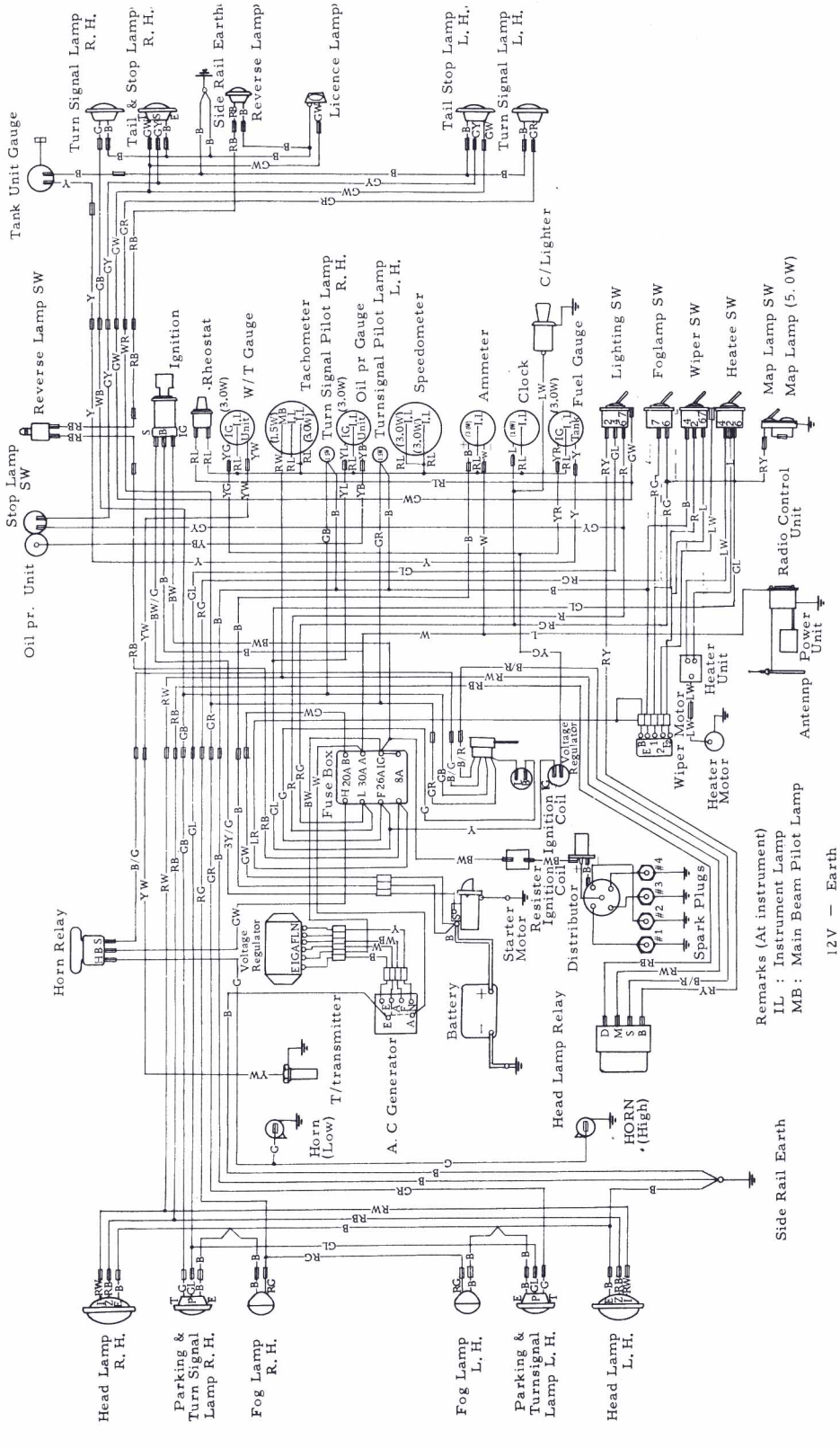


Fig. 5

Sectional view of the water pump

ELECTRICAL SYSTEM

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

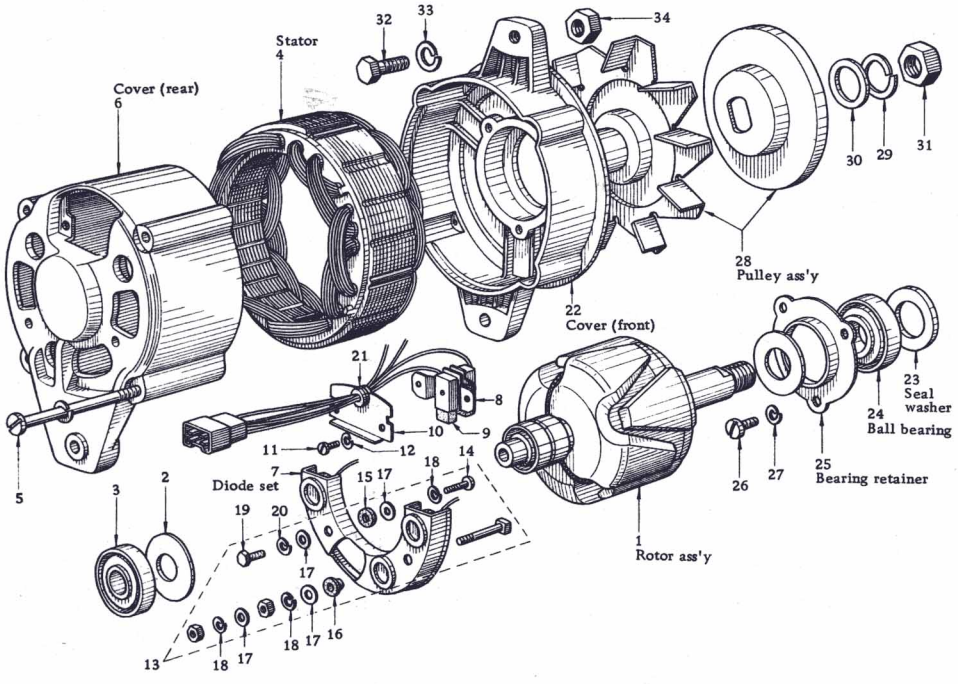
	Primary side	Secondary side
Adjust, valve	14 ~ 15V	14 ~ 15V
Dynamo revolution	4000 rpm.	4000 rpm.
Load	Battery + resisting load 21.5 A approx.	Battery

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
33. Washer-lock
34. Nut

} alternator to bracket fix

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 (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

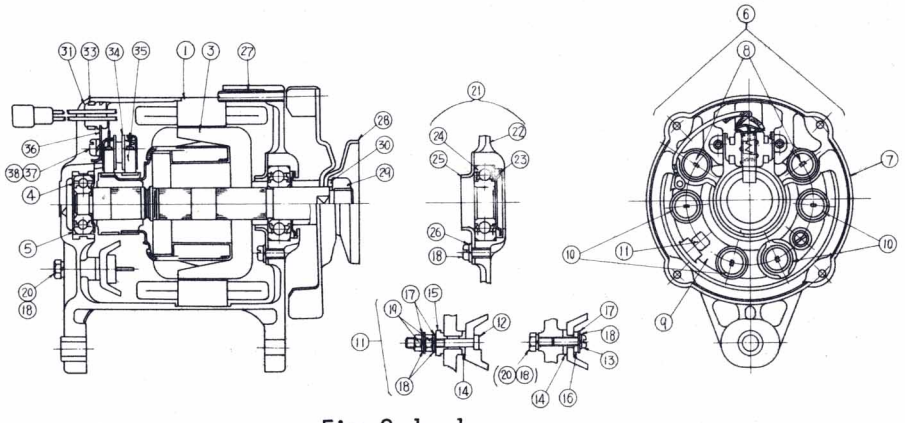
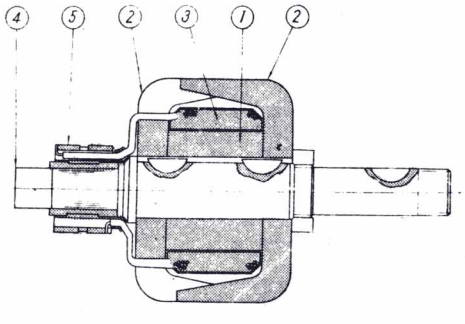


Fig.2-1. 1

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.



Sectional View of Rotor

Fig.2-1. 2

① Field core

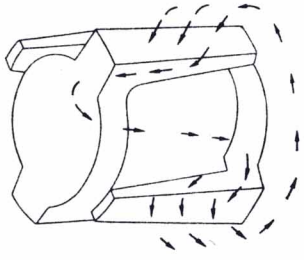
② Field segment

③ Field coil

④ Shaft

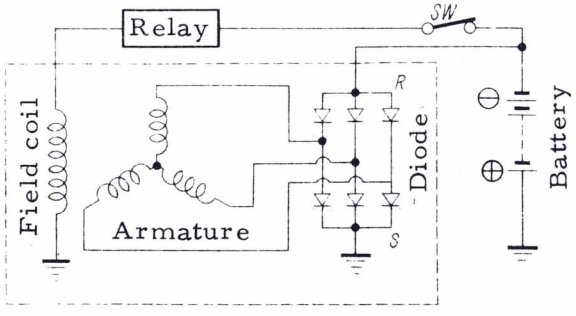
The clip ring pressed in the shaft is soldered at both ends of the field coil to pass magnetic current.

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

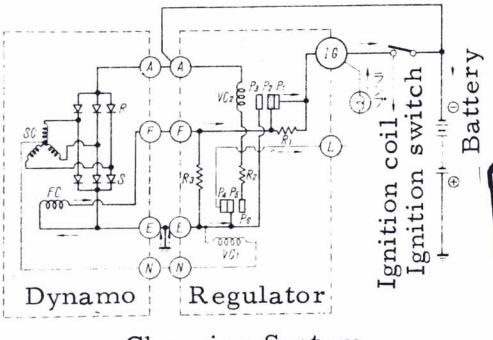
Fig. 2-1. 3



Connection within Dynamo

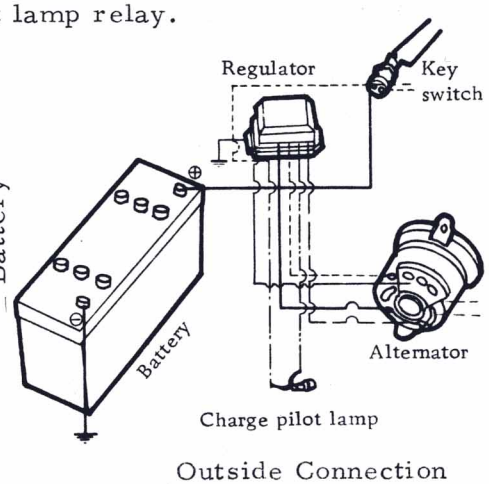
Fig. 2-1. 4

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.

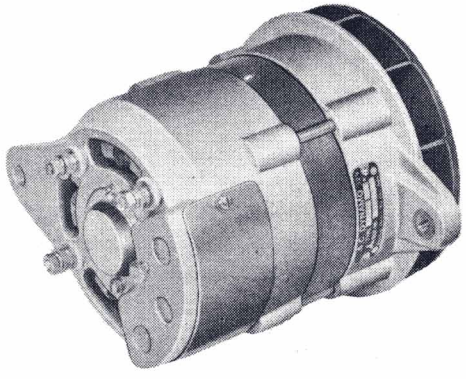
This is because the diode is used and when the voltage to add to it is so low, large proportional resistance shows up and current does not flow through the field coil unless the dynamo makes very high revolution.

Disassembly and Assembly

A. Disassembly

The dynamo is disassembled in the following order.

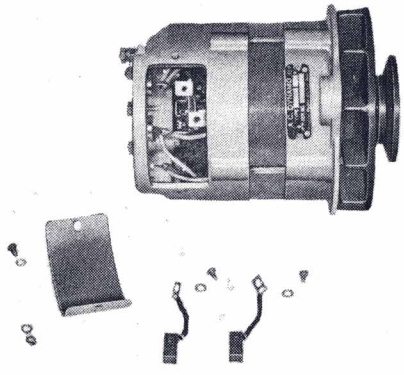
a)



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

Fig.2-2. 1

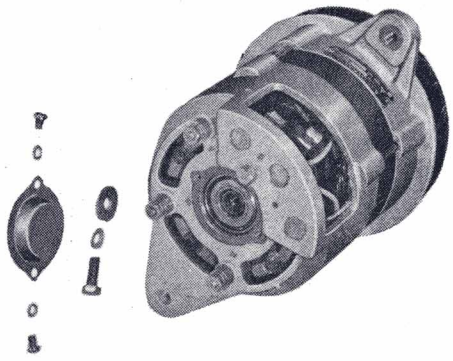
b)



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

Fig.2-2. 2

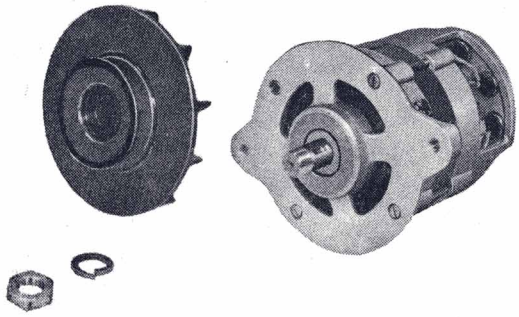
c)



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

Fig.2-2. 3

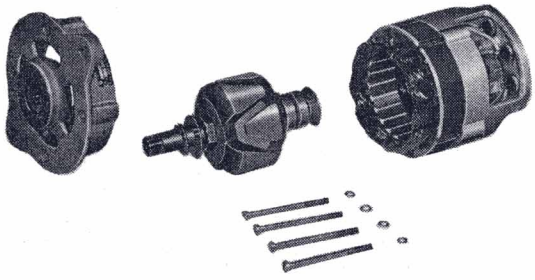
d)



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.

Fig.2-2. 4

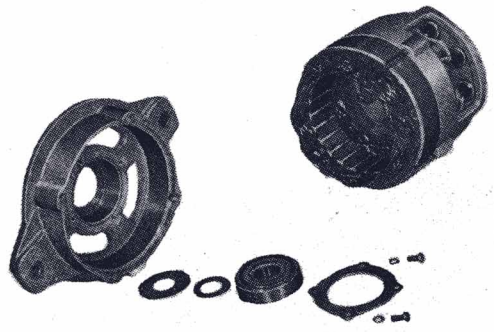
e)



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.

Fig.2-2 .5

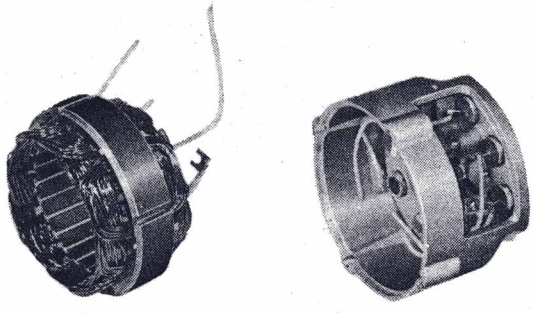
f)



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)

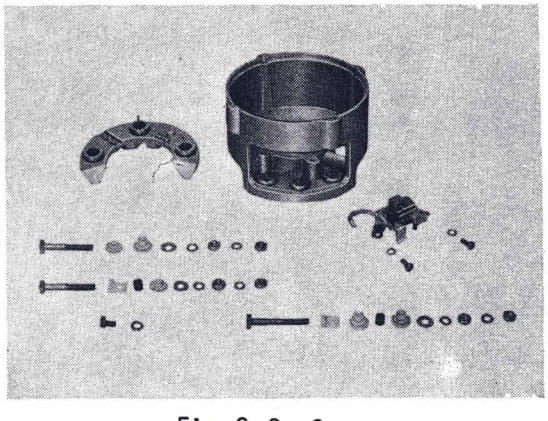


Remove the rear cover and stator.
Separate the silicon diode, 3 ea. from the stator coil lead wire, 3 ea. by melting soldering with an electric iron.
Slacken N terminal bolt on the rear cover side and remove the clip terminal, then the rear cover and the stator can be separated.

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.

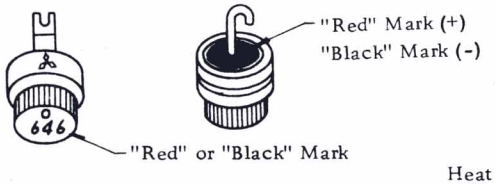


Fig. 2-2. 9

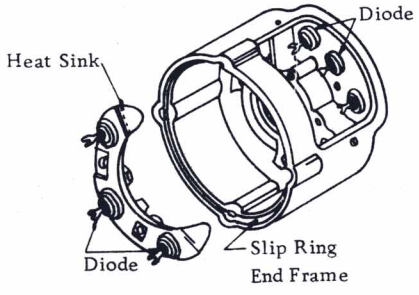
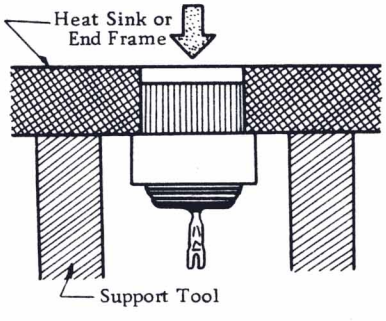


Fig. 2-2. 10 Exploded view

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.

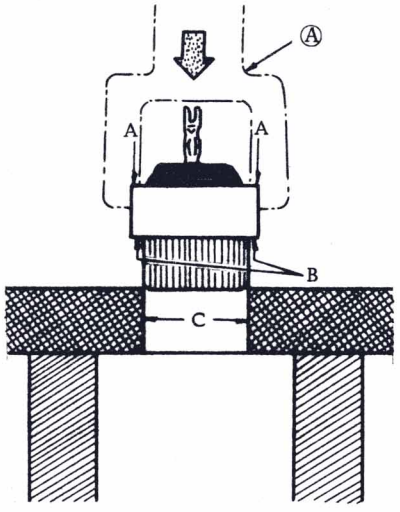


Fig. 2-2. 12

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.)

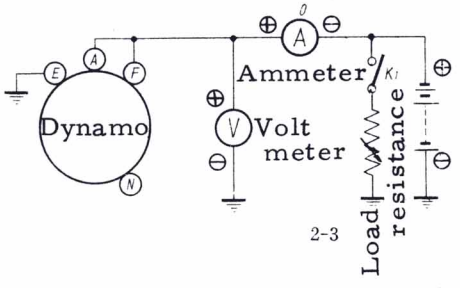


Fig. 2-3. 1

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

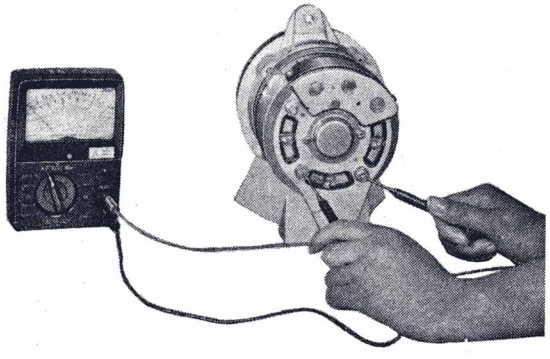


Fig. 2-3. 2

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.

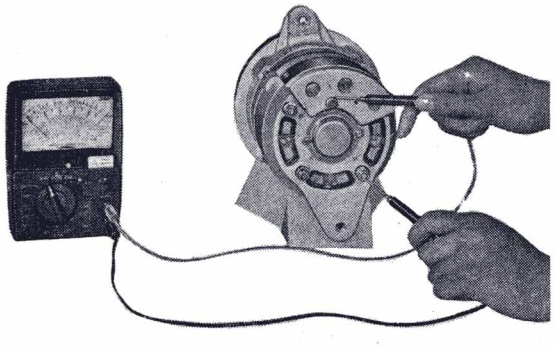


Fig. 2-3. 3

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.

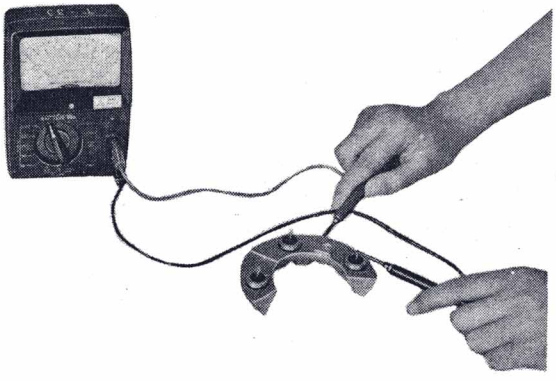


Fig. 2-3. 4

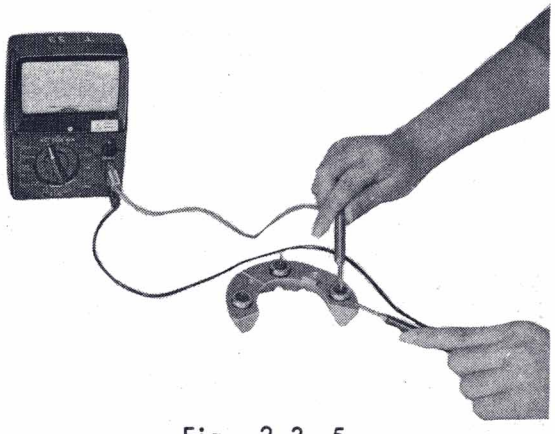


Fig. 2-3. 5

D. Inspection of Diode with Lamp.

a) Simple Inspection

Check positive diodes

Test Method	Test	Lamp	Method
	Connection	Lamp	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	Lamp	Method
	Connect ion	Lamp	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.

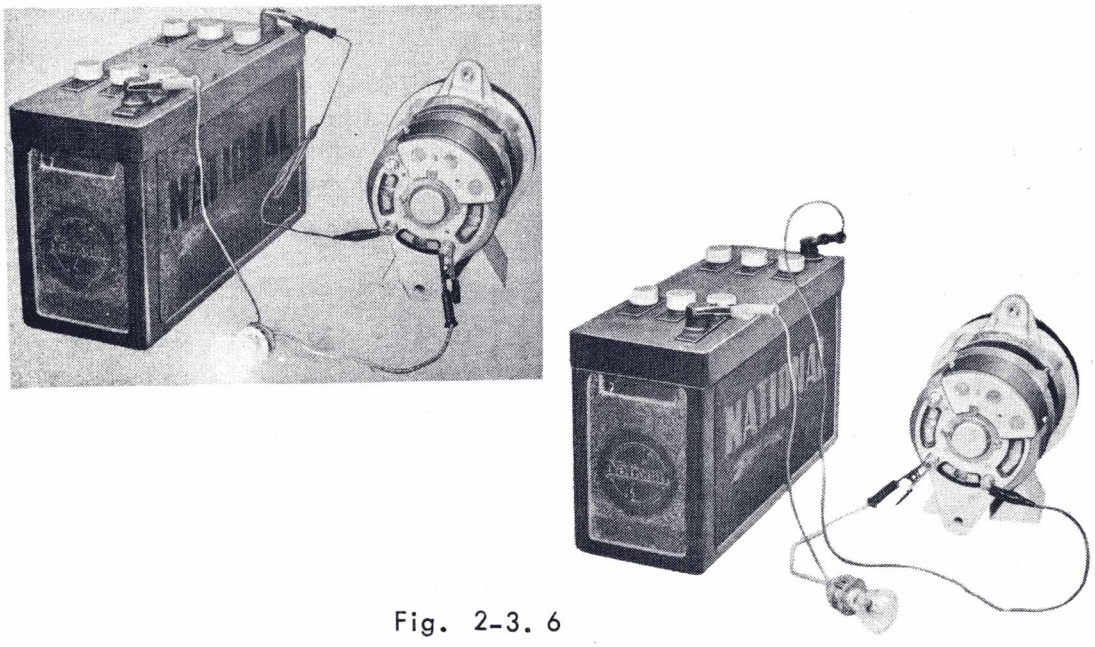


Fig. 2-3. 6

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.

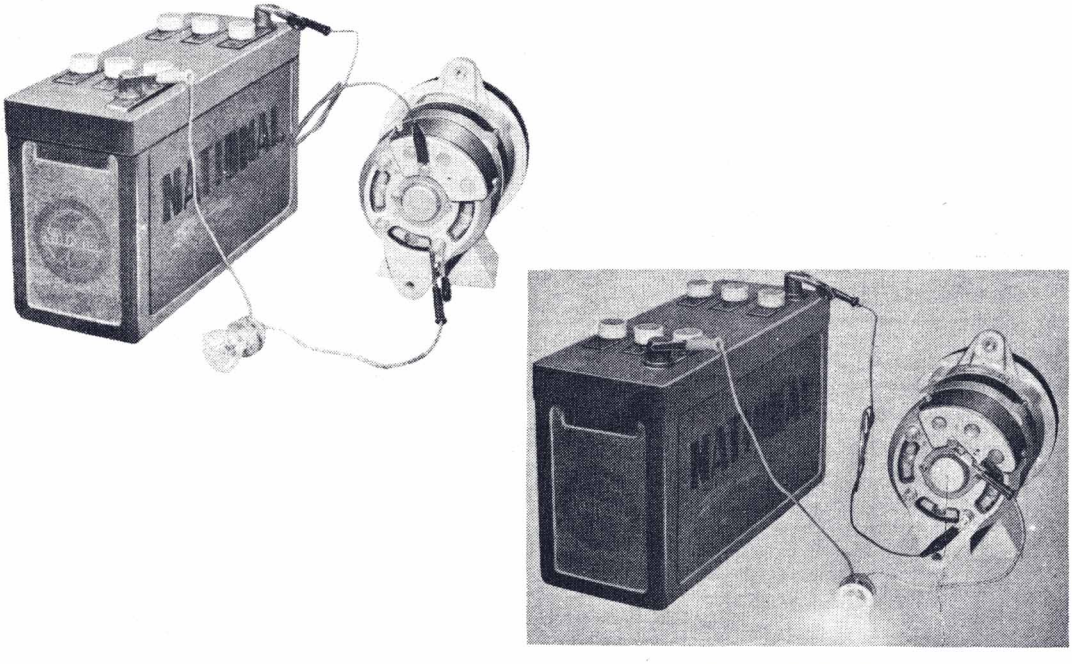


Fig. 2-3. 7

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

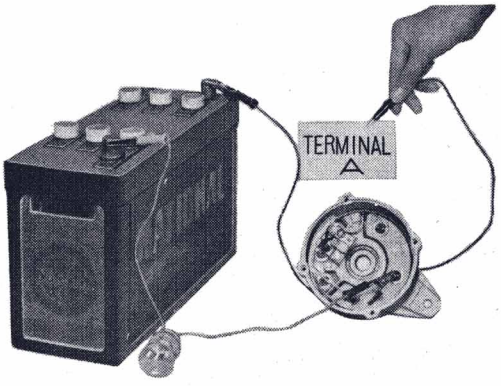


Fig. 2-3. 8

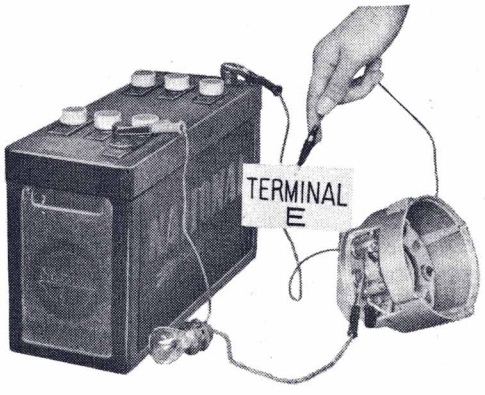


Fig. 2-3. 9

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

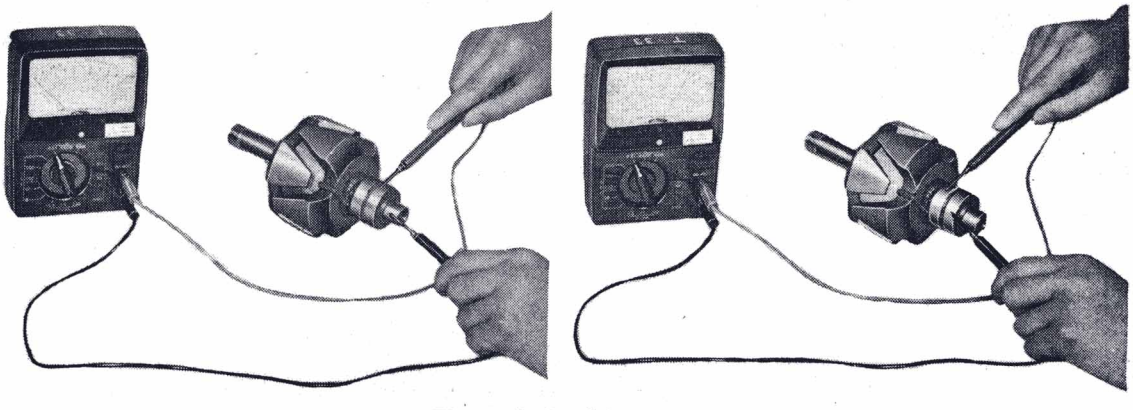


Fig. 2-3. 10

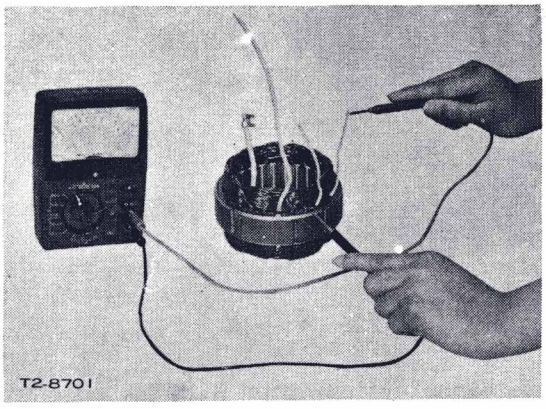
As shown in Fig. 3. 10, put the tester between the slip ring of rotor and if there are 6 ~ 7 Ω , it is all right. Make sure there is no conduction between the rotor slip ring and the shaft.

F. Ball Bearing

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

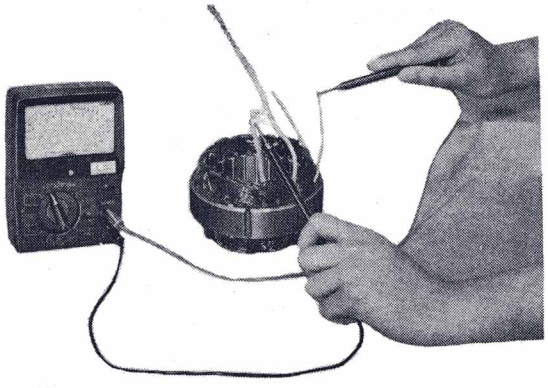
G. Inspection of Stator (Armature)

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.

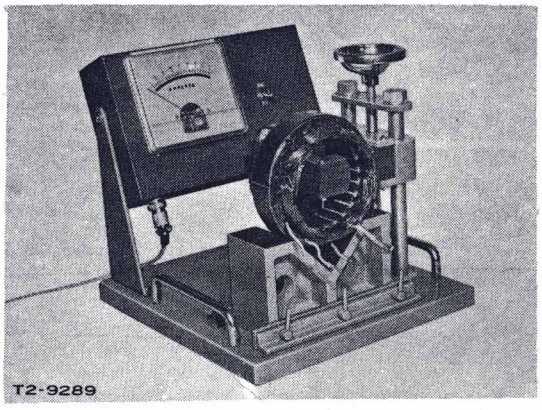


Fig. 2-3. 13

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

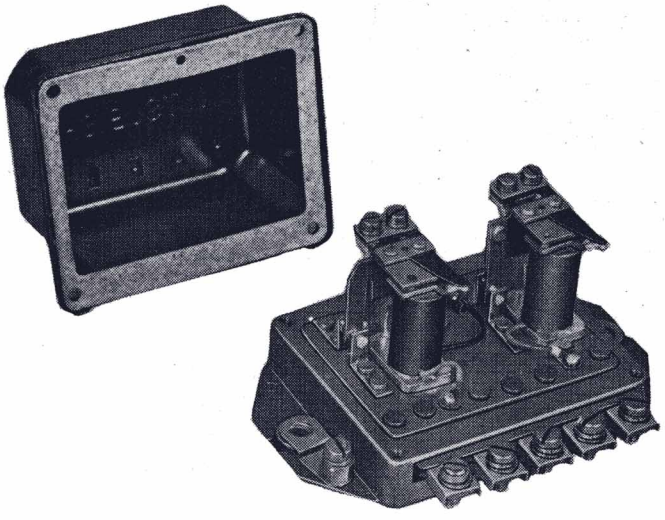


Fig. 3-1. 1

(2) Operation of Constant Voltage Relay

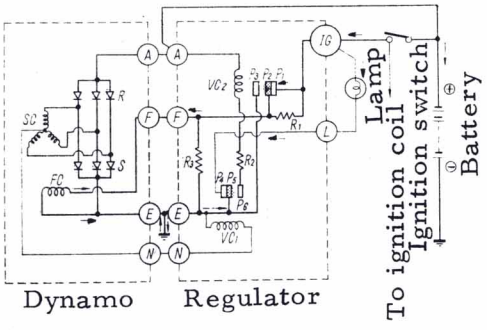


Fig. 3-1. 2

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.

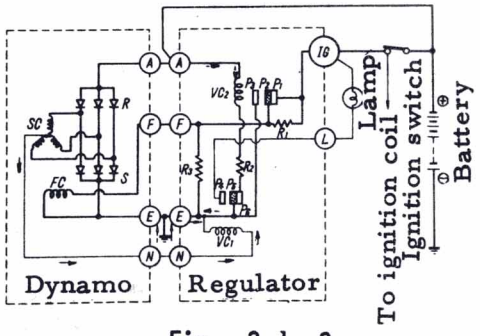


Fig. 3-1. 3

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.

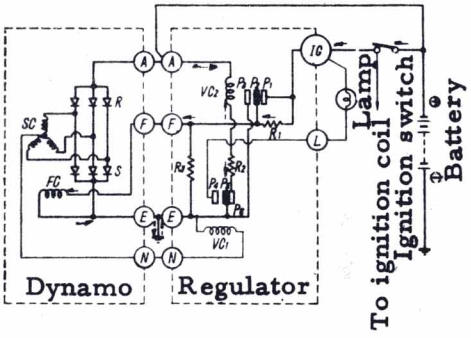


Fig. 3-1. 4

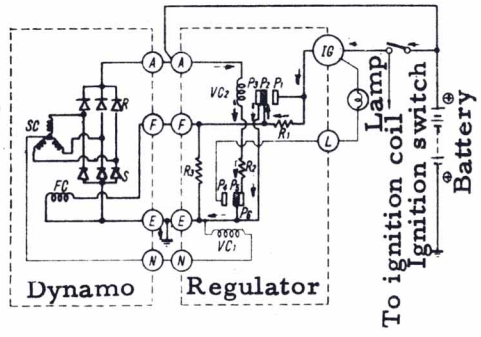


Fig. 3-1. 5

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.

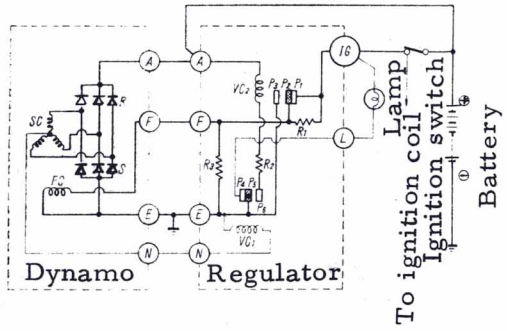


Fig. 3-1. 6

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

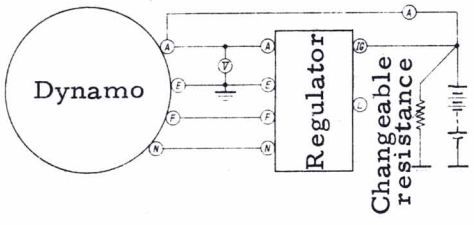


Fig. 3-2. 1

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

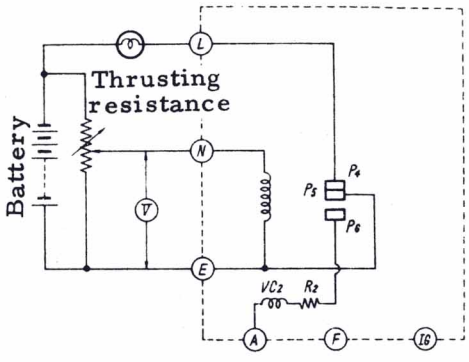


Fig. 3-2. 2

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

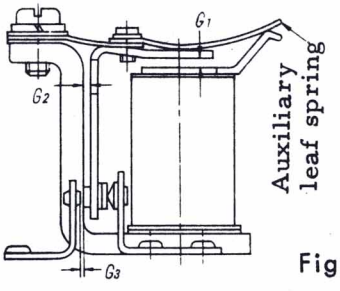


Fig. 3-2. 3

(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

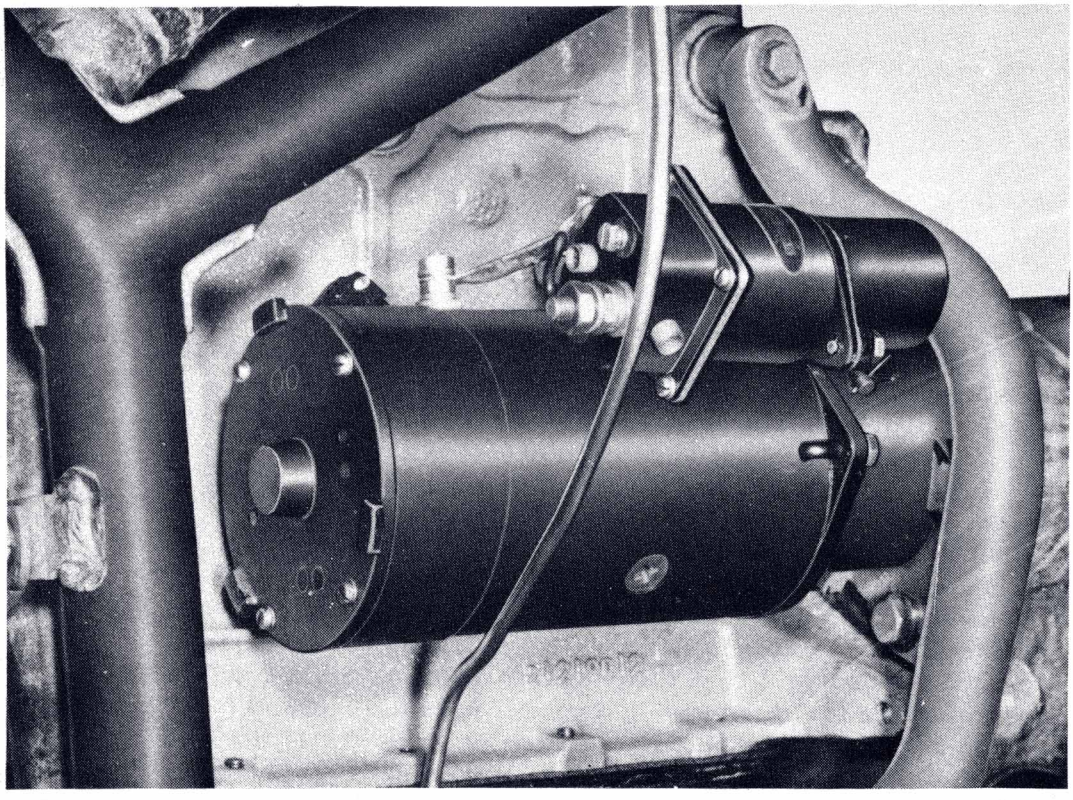
Type	S114-91A (23300 36901)
Voltage	12 volts
Output	(1.4 HP)
Starting current (Voltage)	Less than 500 amps. (9.5 Volts.)
Lock torque	Over 0.9 kg-m
Type of pinion gear	Bendex type
Number of tooth on pinion gear	9
Number of tooth on rign gear	120
Amendment limit of short dimension of shaft dia. (pinion 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.

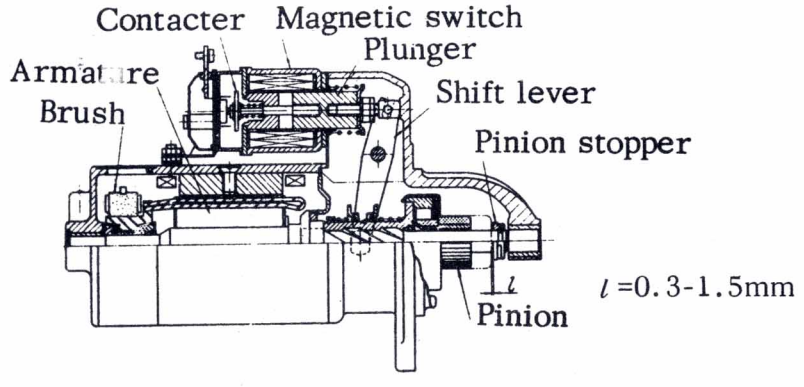


Fig. 1 Sectional view of magnetic shift type

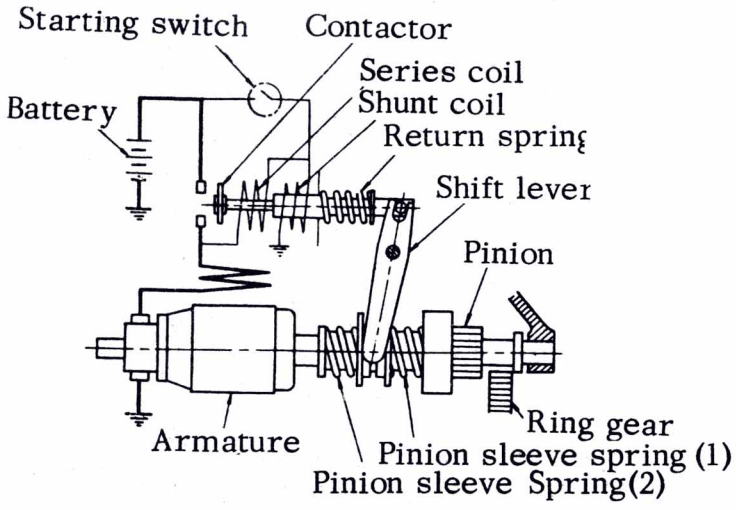


Fig. 2 View of starter system

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.

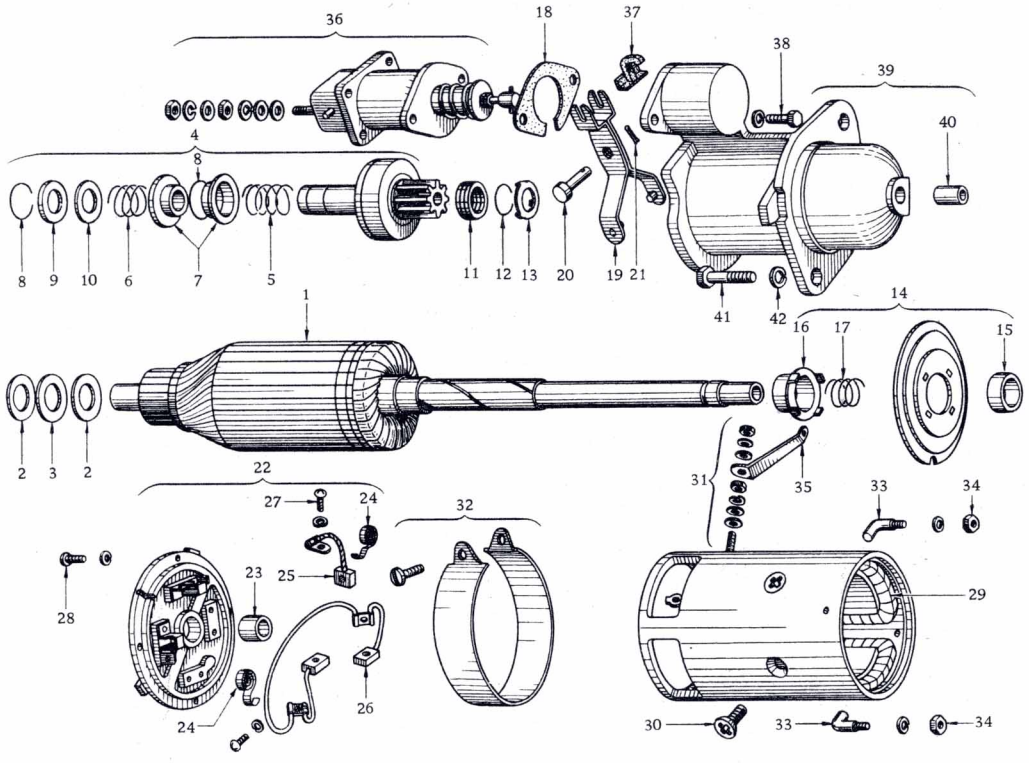
(2) The two stay bolts on the starter rear cover (front end when mounted on the engine) are removed.

(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.

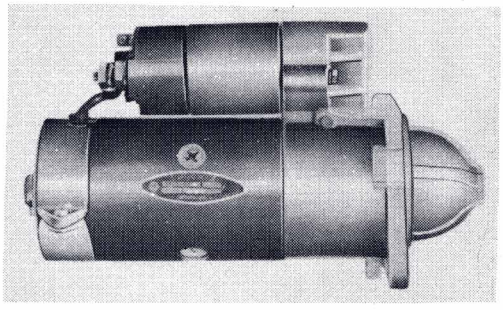
(5) The armature and the front cover are taken out together.

(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.

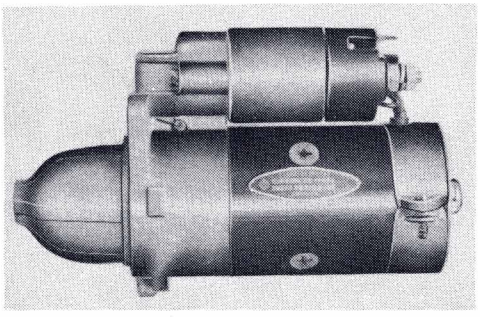


1. Ass'y-armature
2. Washer-thrust
3. Washer-thrust
4. Ass'y-pinion & clutch
5. Spring-pinion sleeve (No. 1)
6. Spring-pinion sleeve (No. 2)
7. Sleeve-pinion
8. Clip-sleeve pinion
9. Stopper-spring sleeve
10. Washer-pinion
11. Stopper-pinion
12. Clip-stopper, pinion
13. Washer-stopper, pinion
14. Ass'y-bearing,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

Fig. 3 Component of starter motor

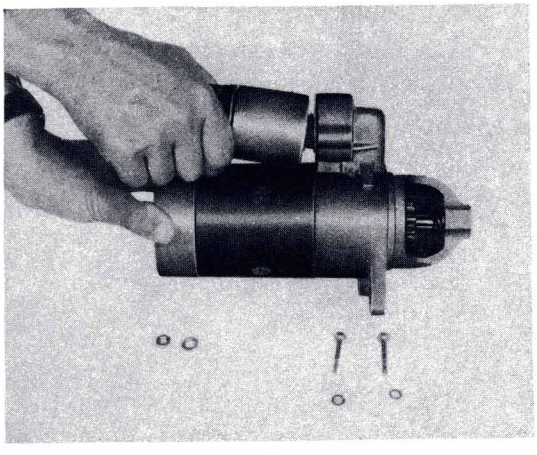


S114-91A type (Aluminum die cast)
Weight=5.4 kg

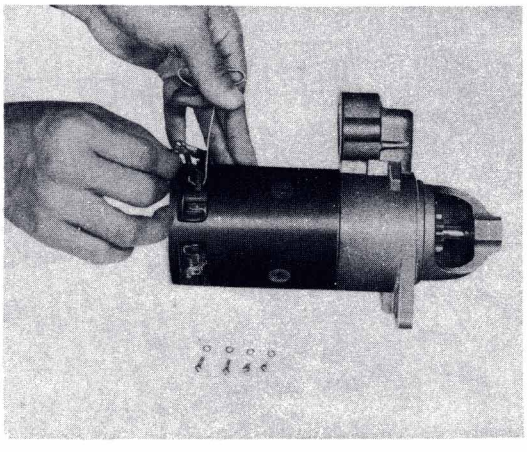


S114-71 type (Cast iron)
Weight=6.8 kg

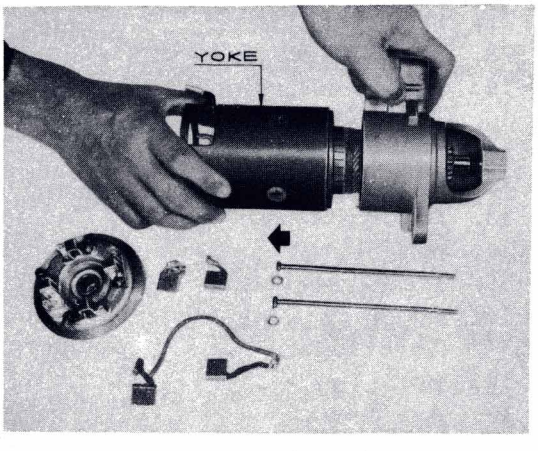
Diassembling order



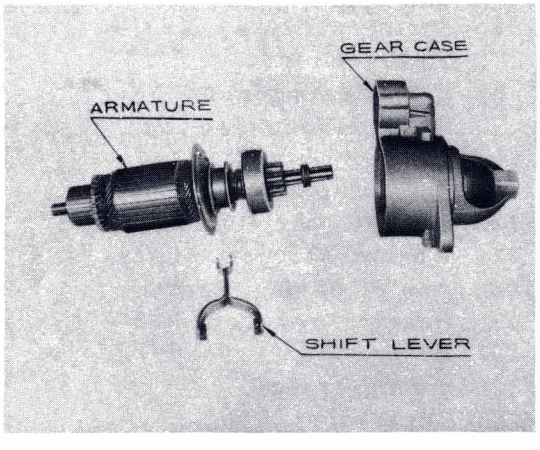
Remove the magnetic switch



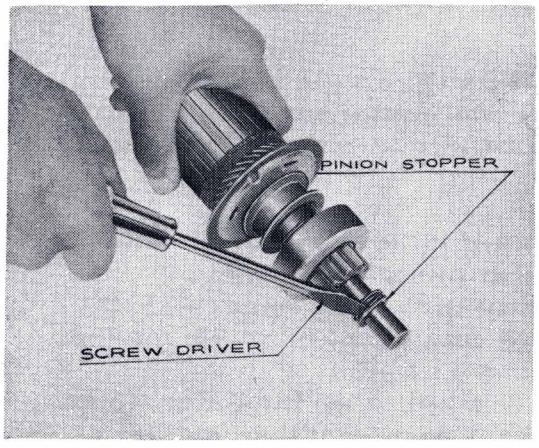
Draw out the brushes from body after removing fixed screws



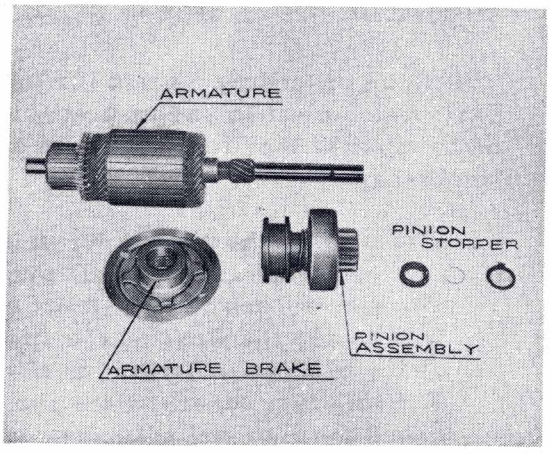
Draw out the yoke from the gear case



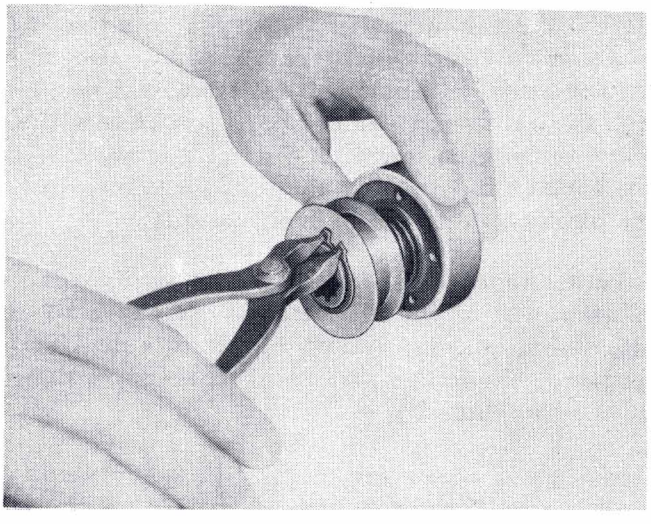
Separate for the armature and gear case



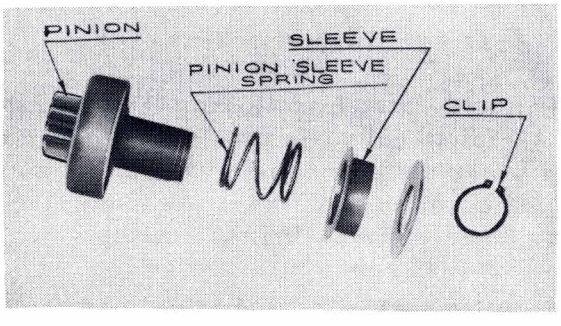
Take off the pinion stopper



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 corrosion 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-

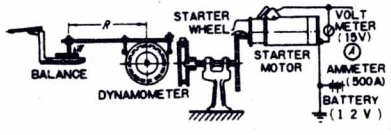


Fig. 4
Torque testing apparatus

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.

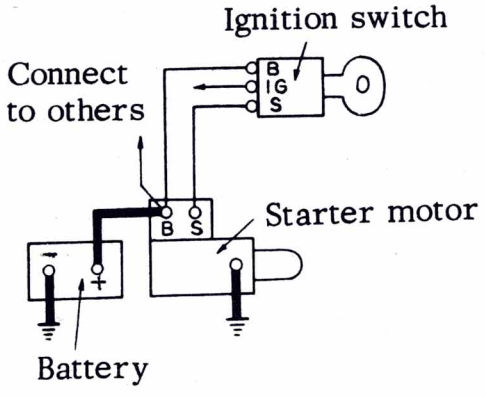


Fig. 5 Magnetic starter circuit

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

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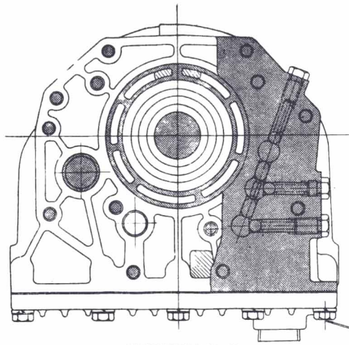
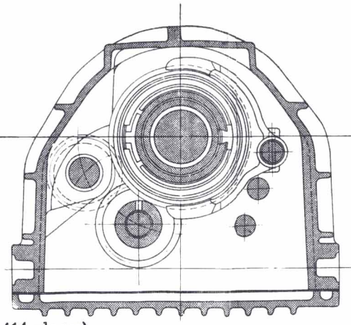
SECTIONAL VIEWS OF TRANSMISSION

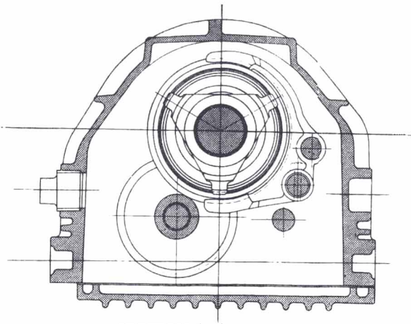


SECTION C-C

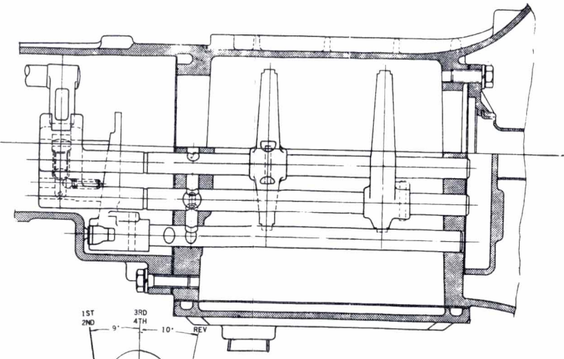
T=1.2∼1.4 kg-m (14 places)

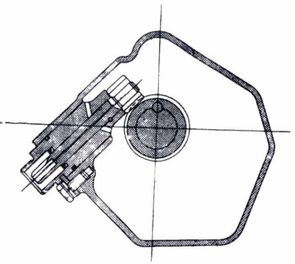


SECTION B-B

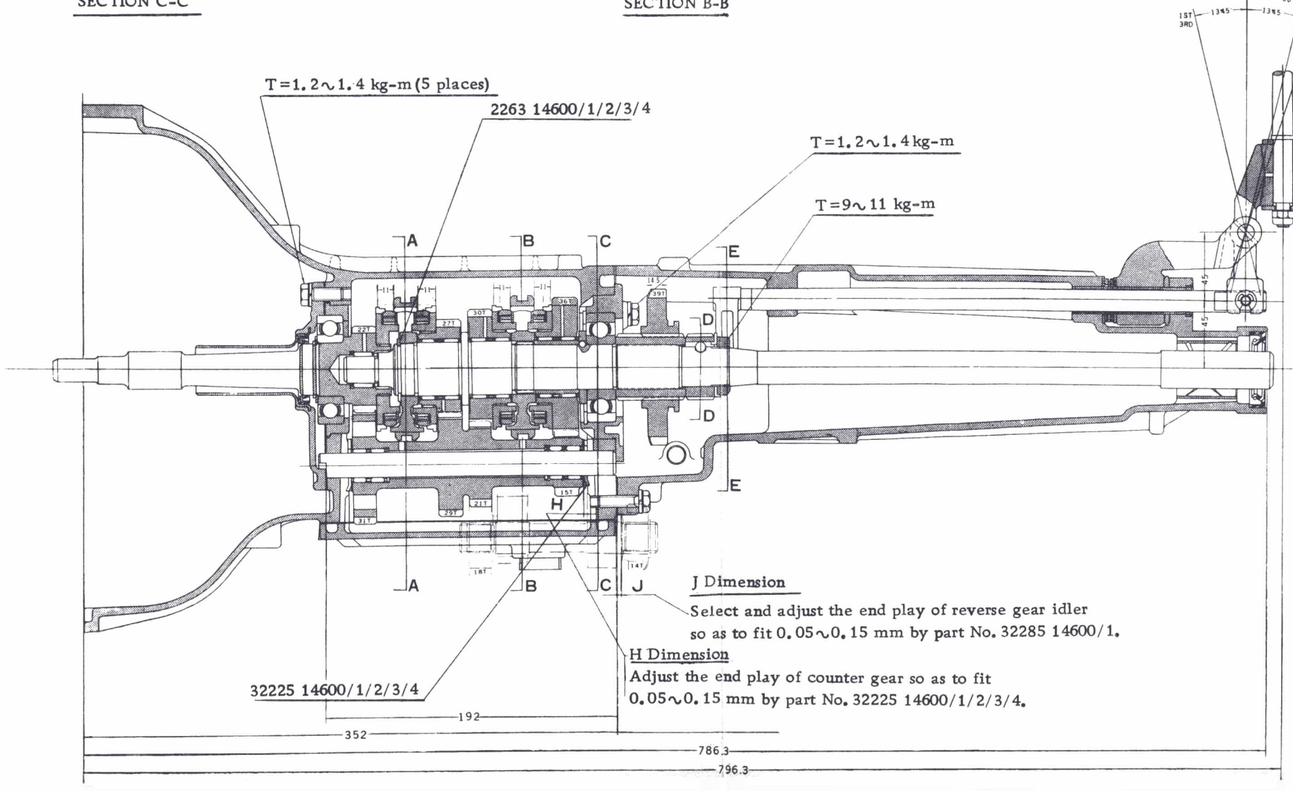


SECTION A-A





SECTION D-D

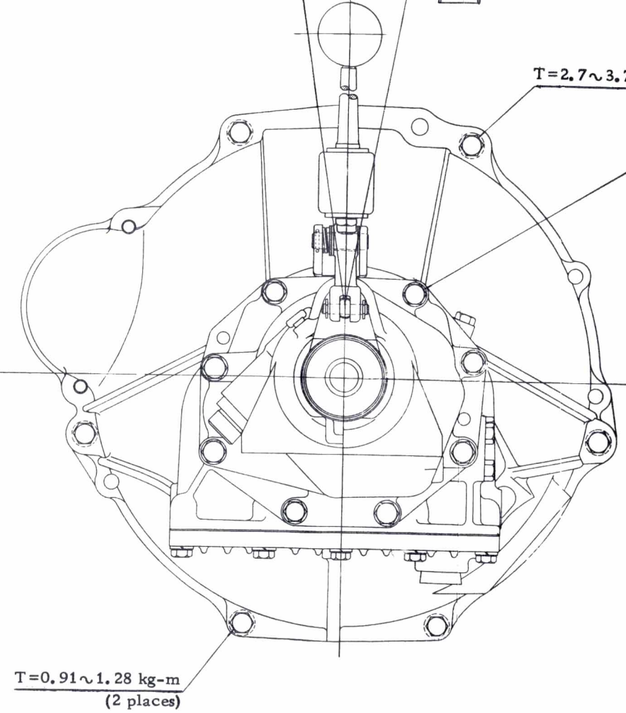


J Dimension

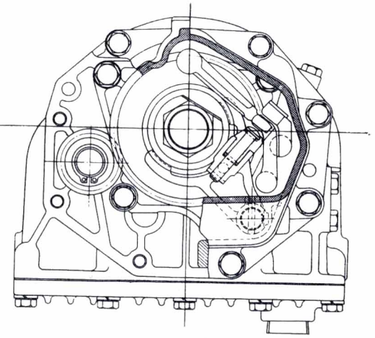
Select and adjust the end play of reverse gear idler so as to fit 0.05∼0.15 mm by part No. 32285 14600/1.

H Dimension

Adjust the end play of counter gear so as to fit 0.05∼0.15 mm by part No. 32225 14600/1/2/3/4.



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



SECTION E-E

T = Tightening Torque

TRANSMISSION

GENERAL DATA

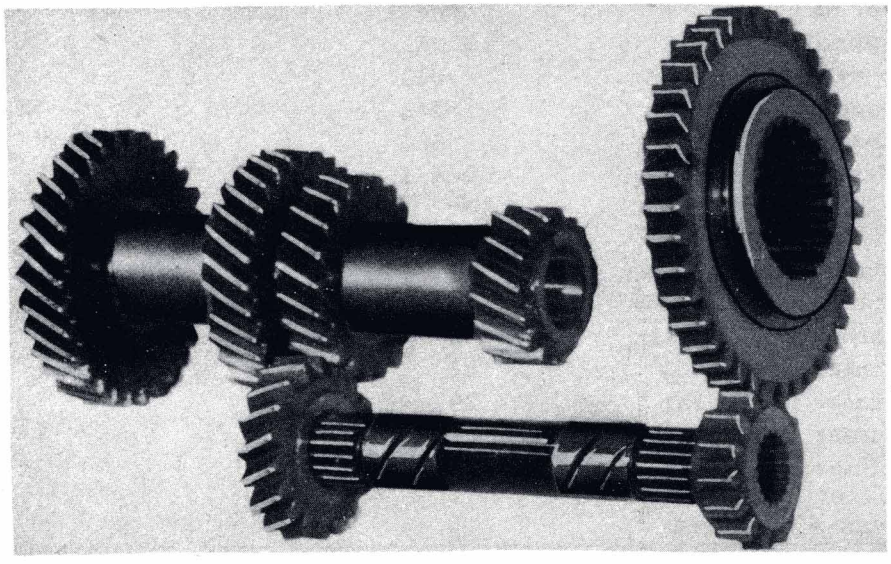
Model	4 stages for forward, 1 stage for reverse remote controled
Type of gear	Synchro-meshed for speed # 2. 3 & 4 Synchro-meshed helical gear type
Speed #1	3.382
Speed #2	2.013
Speed #3	1.312
Speed #4	1.000
Reverse	3.364
No. of tooth of gear	
Main drive gear	22
Main shaft 3rd gear	27
Main shaft 2nd gear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

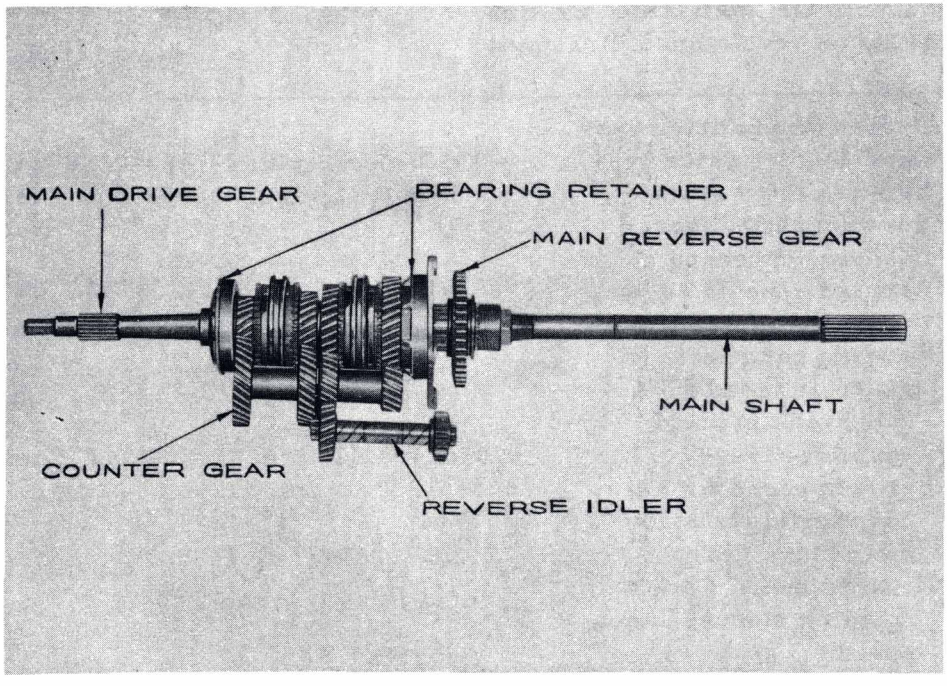
BACKLASH OF VARIOUS GEARS

(Play on revolutional direction)

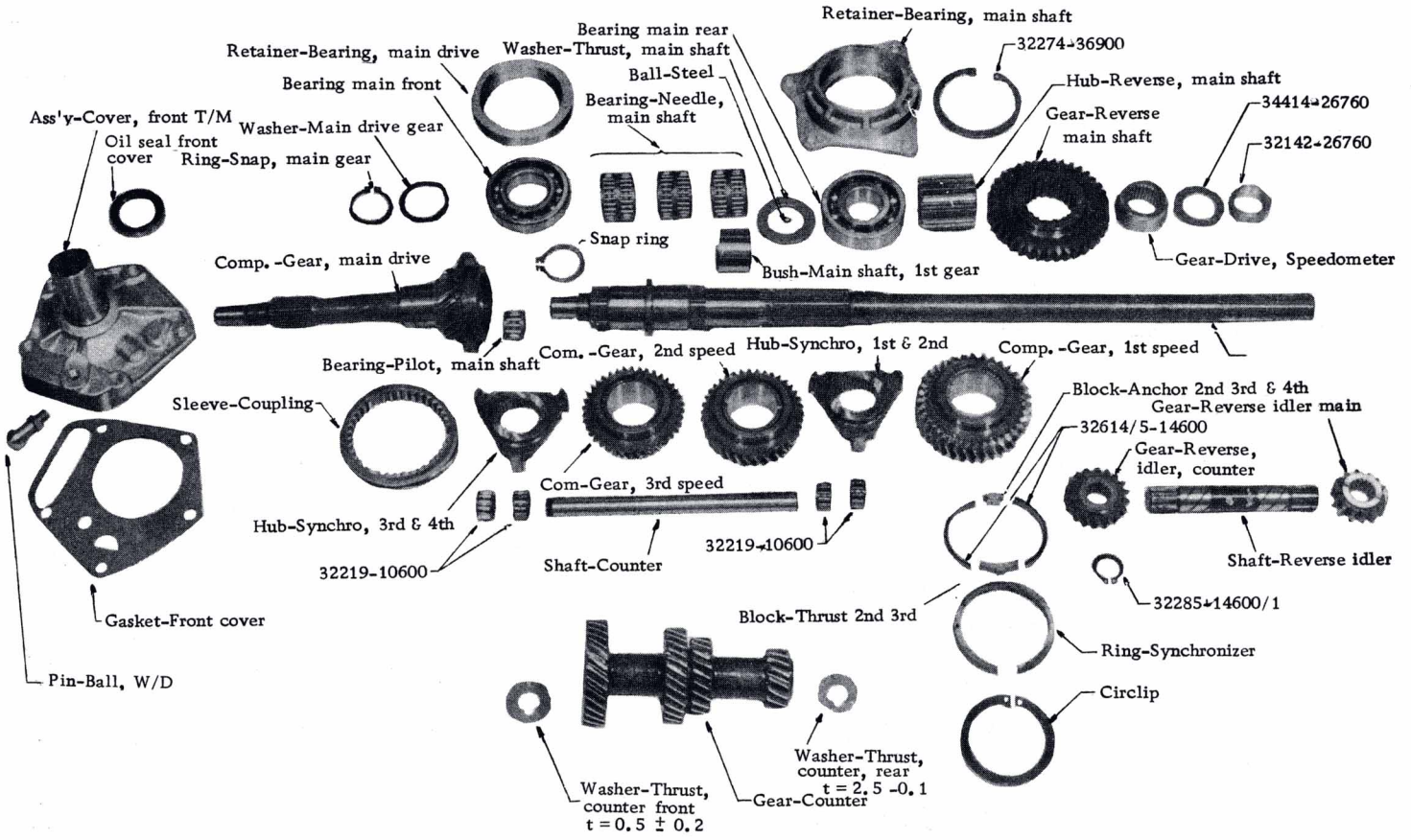
Between main drive gear and counter drive gear	0. 075-0. 125 mm	(0. 003-0. 005 in.)
Between third gears	0. 075-0. 125 mm	(0. 003-0. 005 in.)
Between second gears	"	(")
Between low gears	"	(")
Between speed # 3 & 4 Synchronizers and main	0. 03-0. 12 mm	(0. 0014-0. 0048 in.)
Between peripheral gears of 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.)

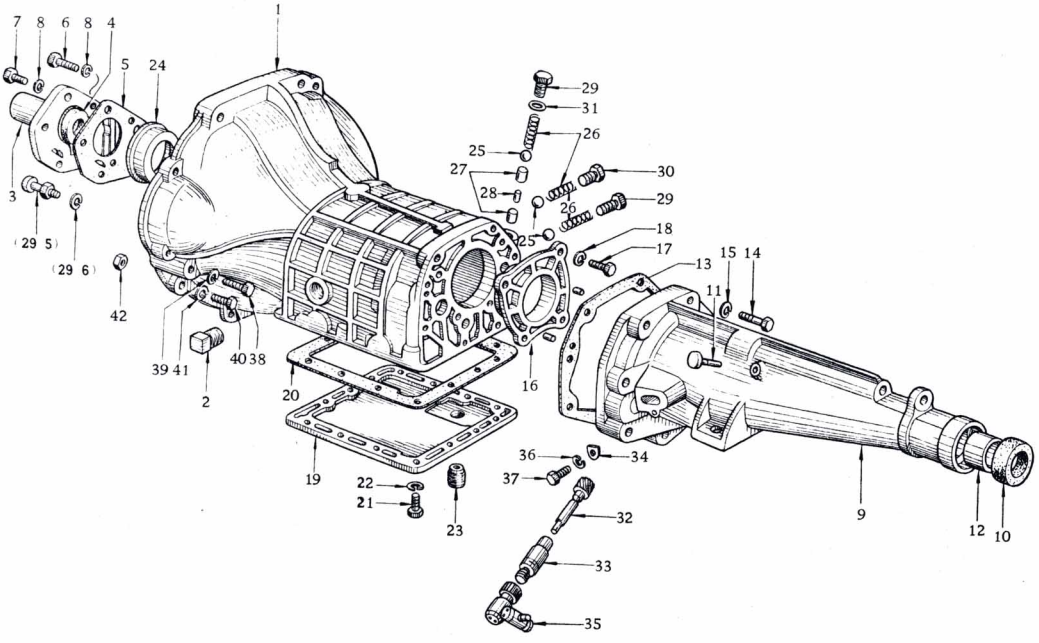




Reverse Idler & Main Shaft Reverse Gear



Component of Transmission Cace



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 } 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 } to fix rear extension
16. Retainer-bearing, main shaft
17. Bolt
18. Washer-spring } to fix bearing retainer
19. Cover-bottom, transmission case
20. Gasket-bottom cover
21. Bolt
22. Washer-spring } 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 } 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

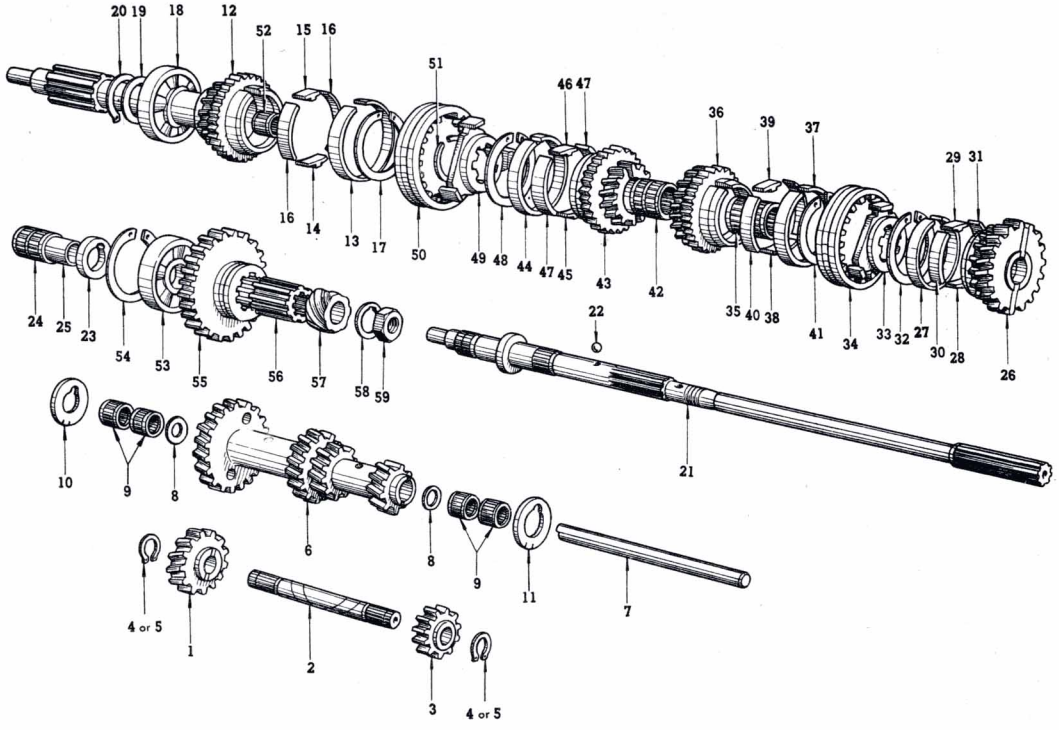
Before driving the drive shaft from its position, tilt the counter gears, now in the bottom of the case, to clear the drive shaft gear. Using a long drift, inserted through the main shaft opening, drive the drive shaft forward, complete with bearing and circlip, from the case.

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

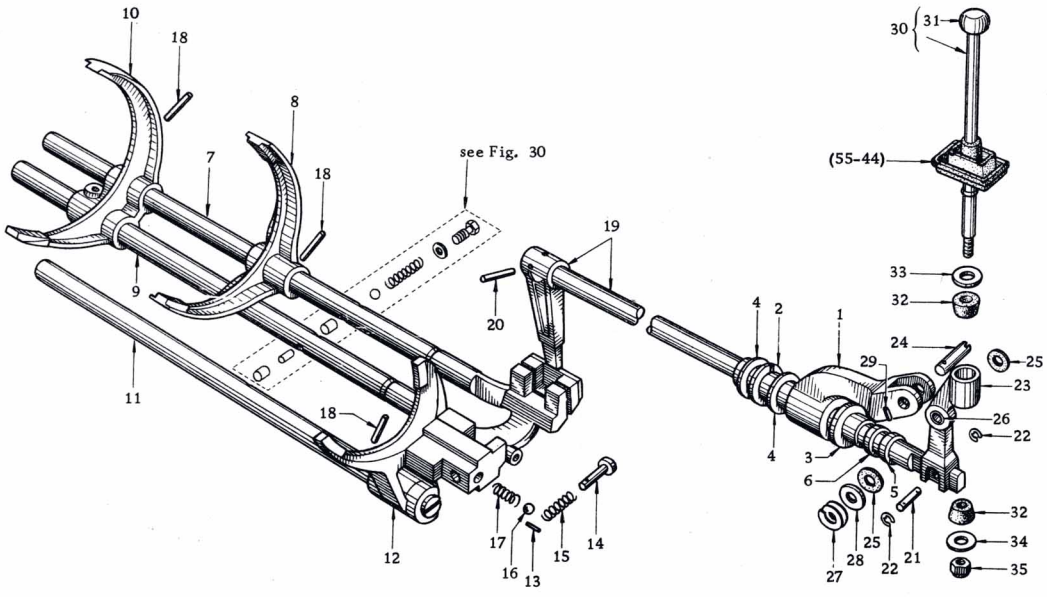
The ball journal bearing should now be drifted on to the shaft, with its spring ring away from the geared end. Position the geared end of the drive shaft in a dummy 3rd and 4th speed coupling sleeve, put the washer over the bearing, tighten the nut and lock it in position.

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

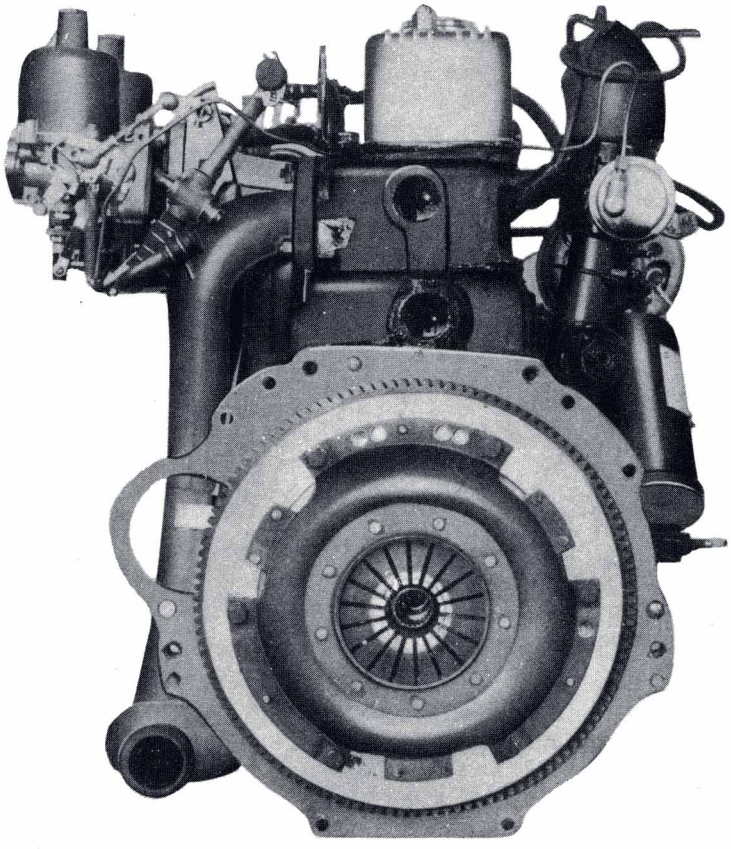


Fig. 1

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.

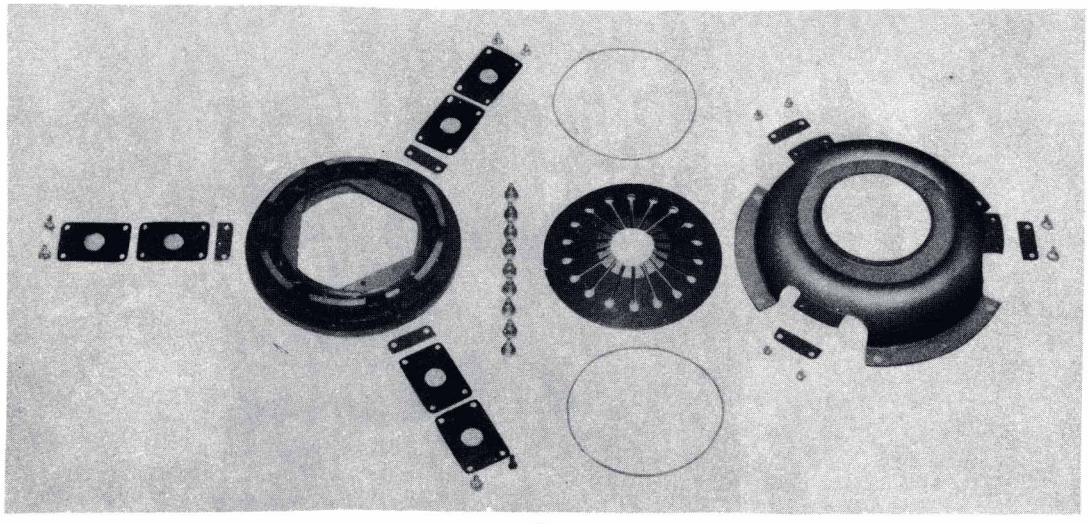


Fig. 2

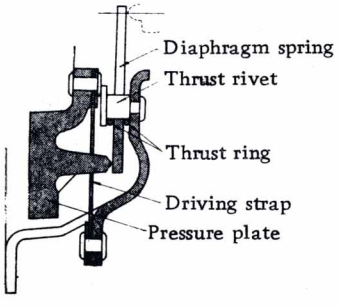


Fig. 3

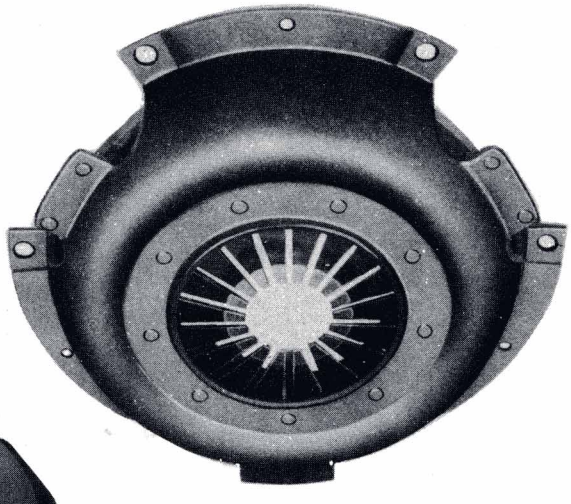


Fig. 4

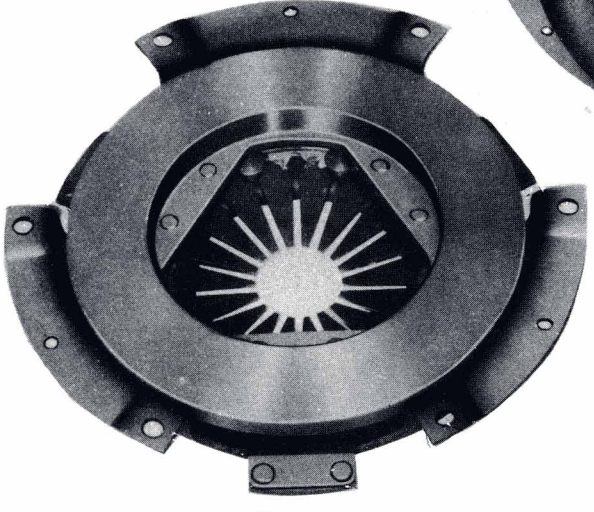


Fig. 5

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.

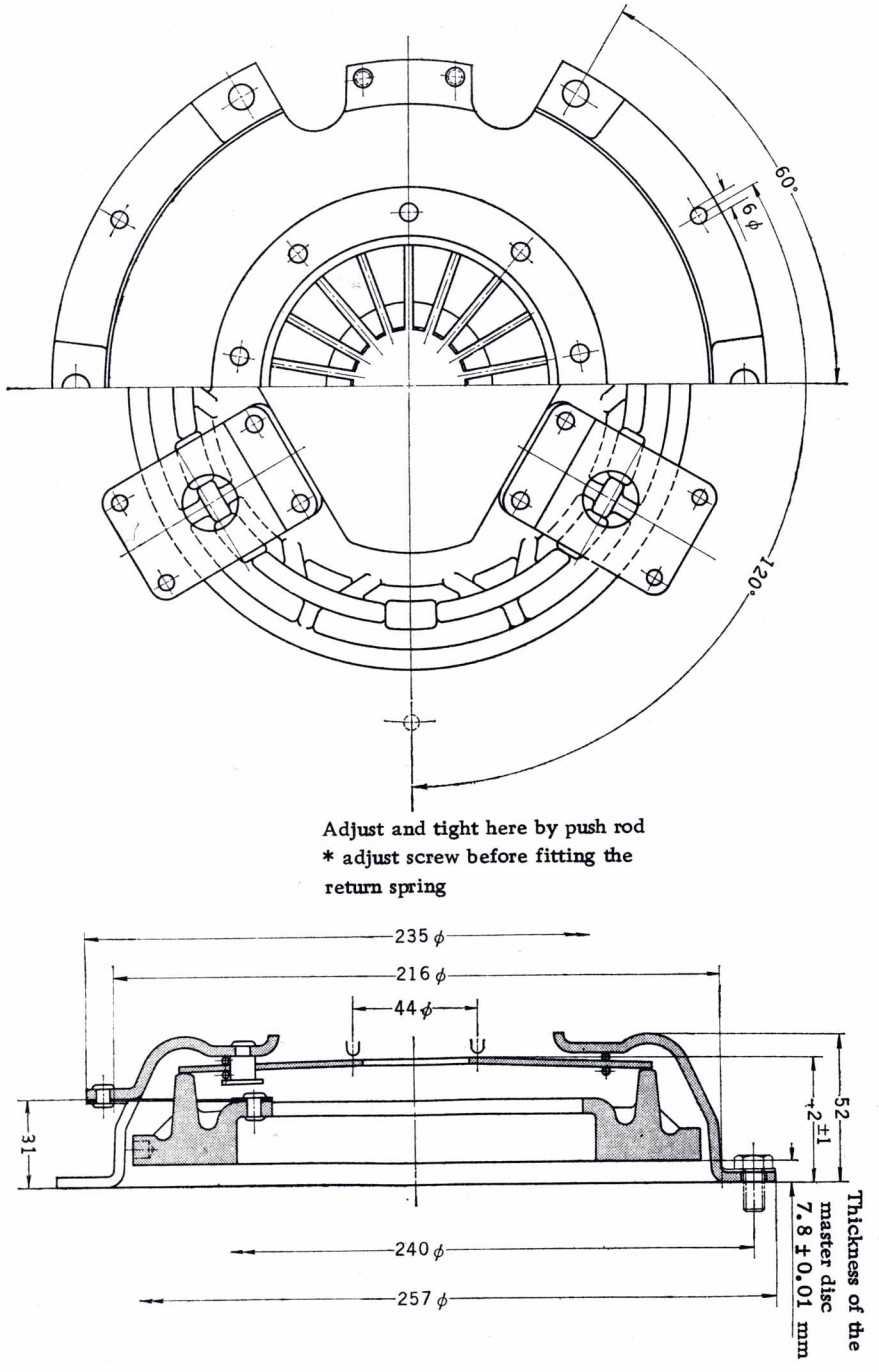


Fig. 6 Sectional view of the clutch

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) (Outside)	 36° 16' 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

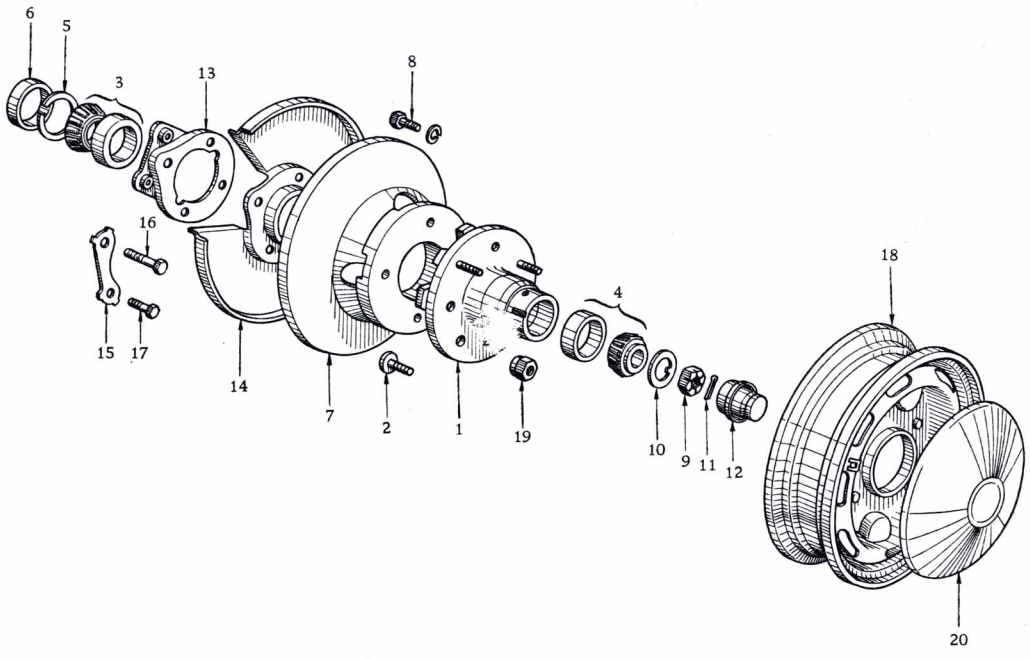
Dismantling of the front hub, first jack the car until the wheel is clear of the ground and then place blocks under independent suspension spring plate. Lower the car on to the blocks. Remove the wheel and the screw. If the drum appears to bind on the brake shoes, the shoe adjusters should be slackened.

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.

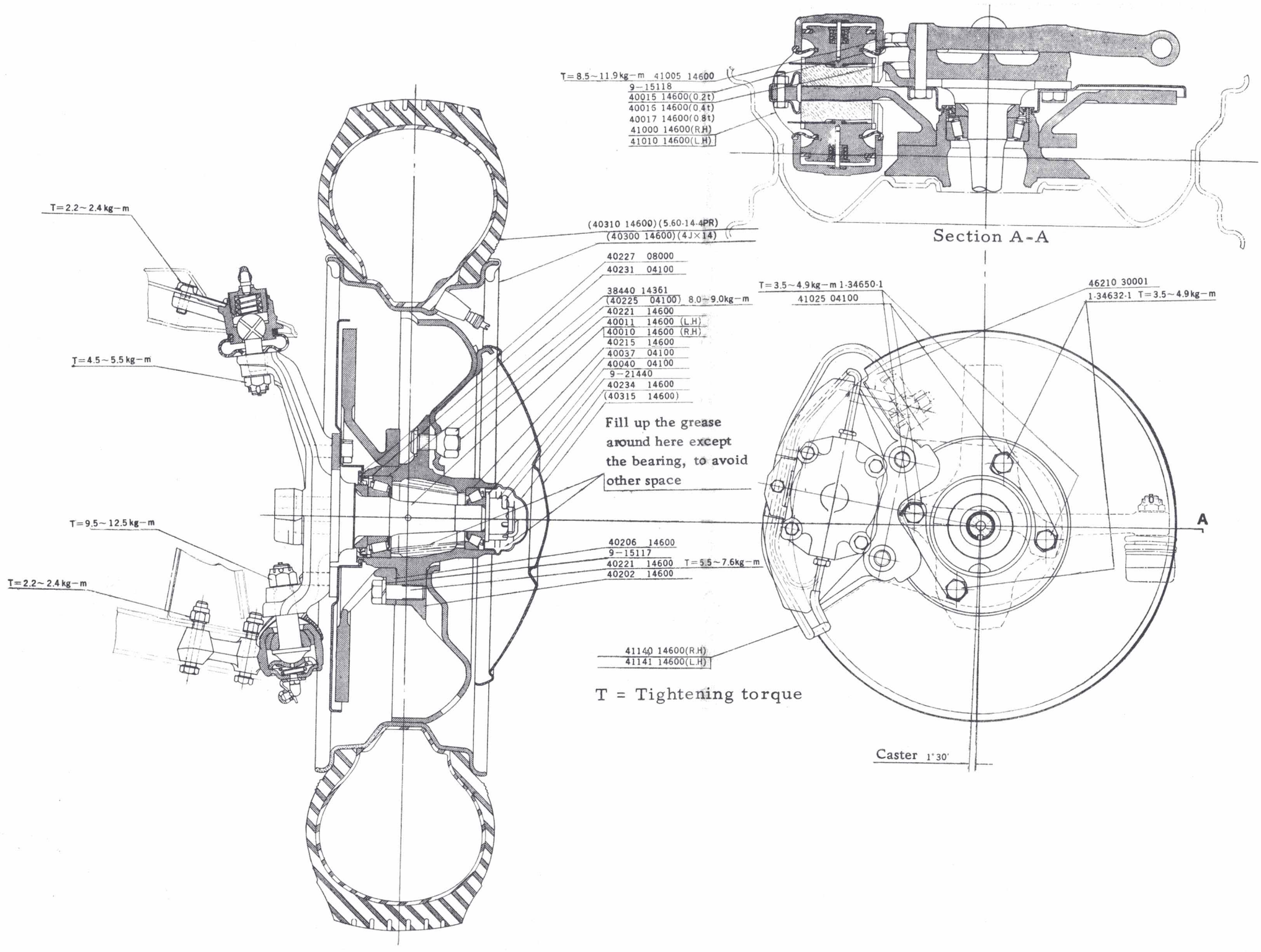
When assembling the hub the inner bearing race should first be inserted into the hub. Pack the hub with recommended grease. Replace the hub oil seal over the inner bearing. Renew the seal if it is damaged any way.



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

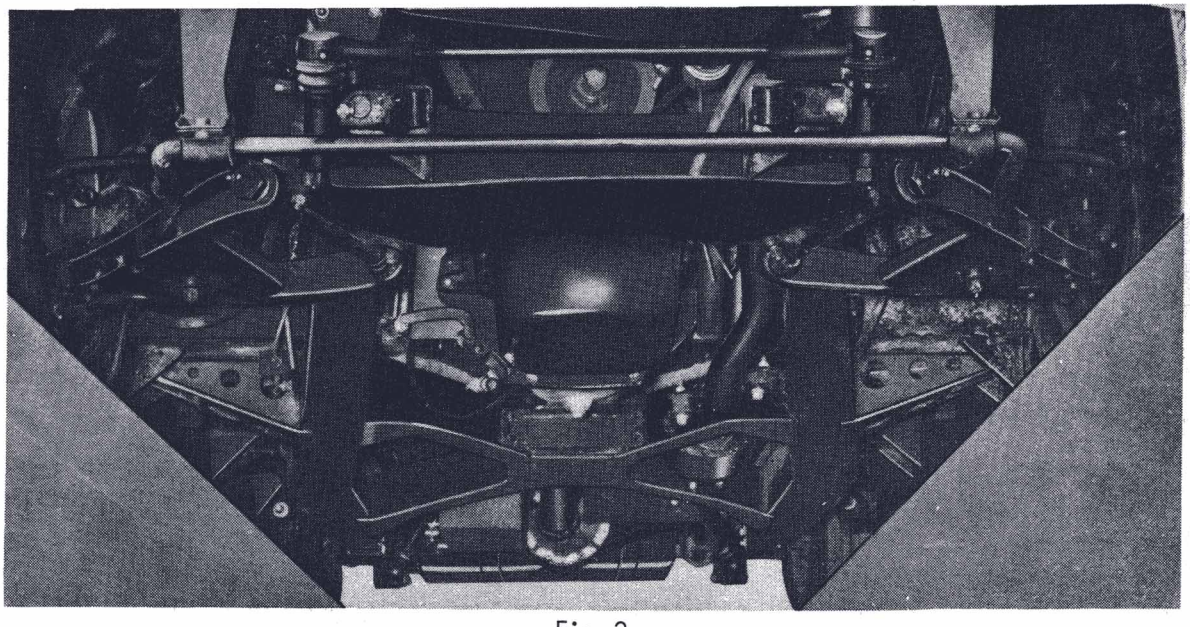


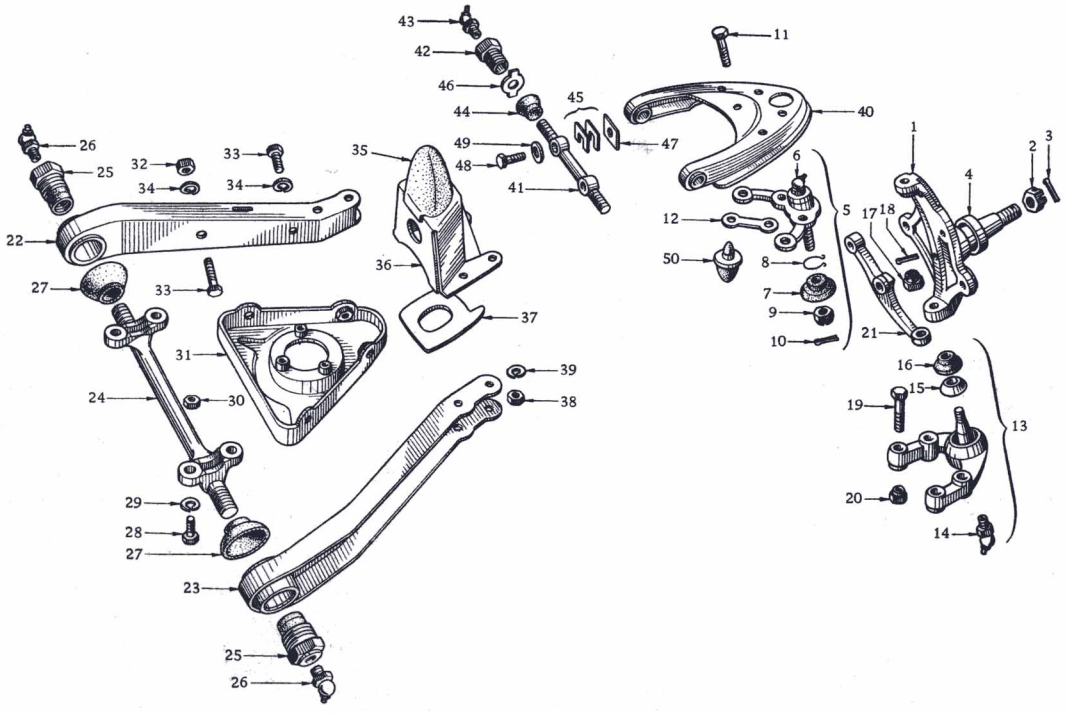
Fig.2

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.

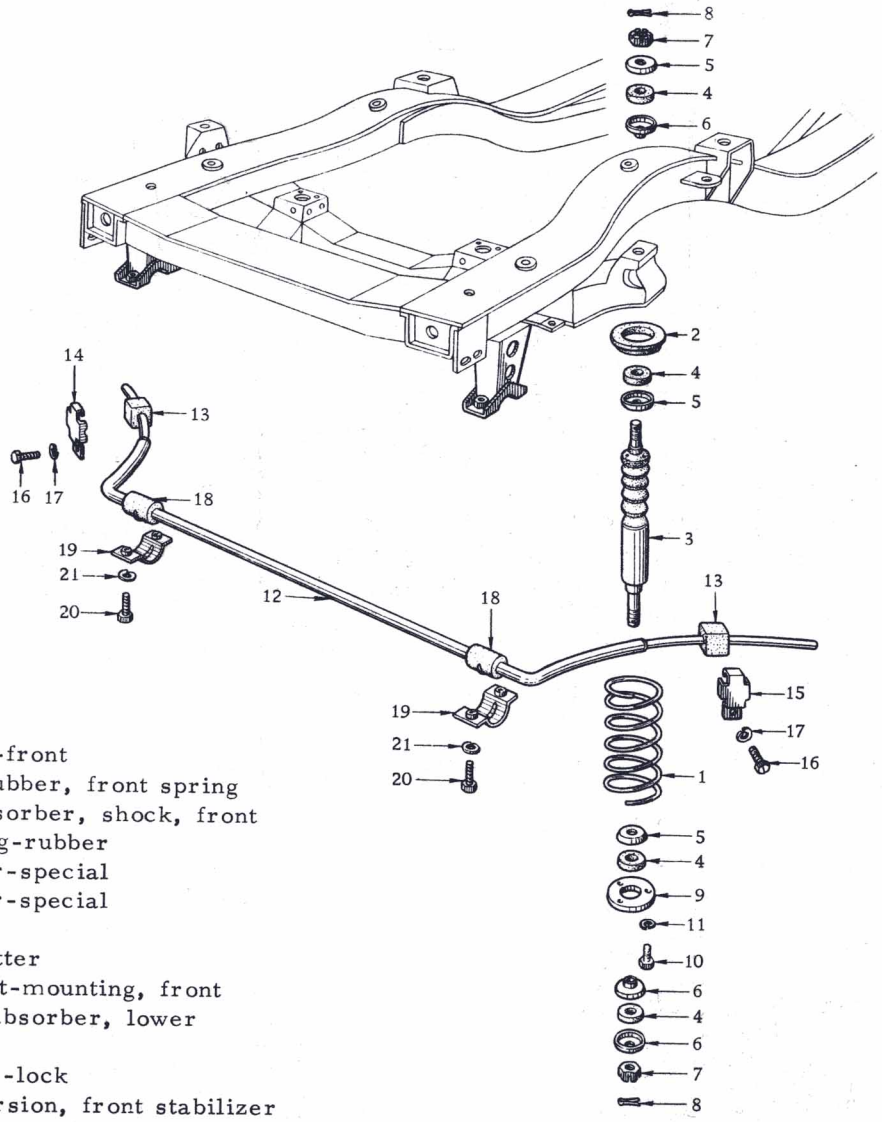
Camber adjusting shims			
Parts No.	54542	04100	1 mm.
	54543	04100	2 mm.
	54544	04100	4 mm.

Caster adjusting shims			
Parts No.	54545	04100	(Front)
	54546	04100	(Rear)



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

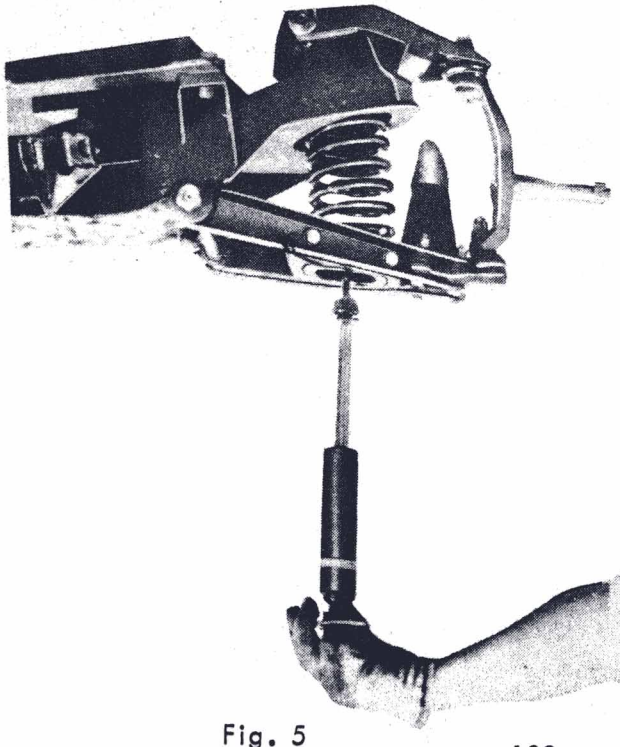


Fig. 5

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.

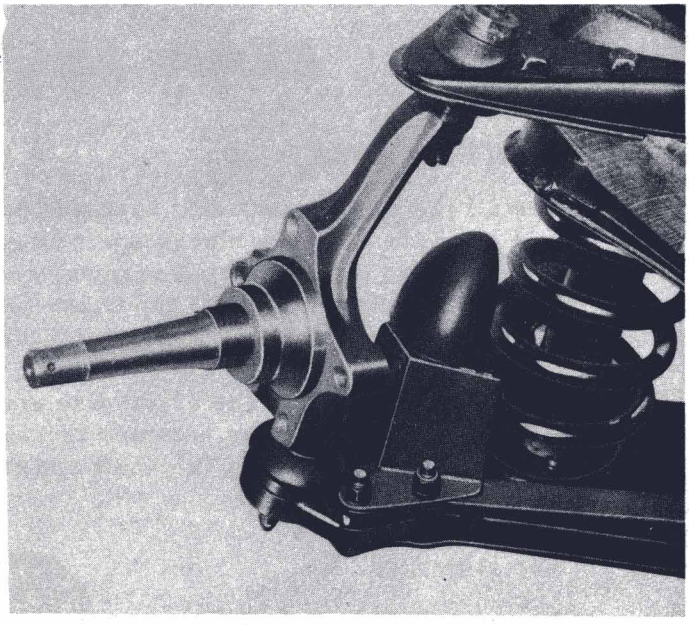


Fig. 6

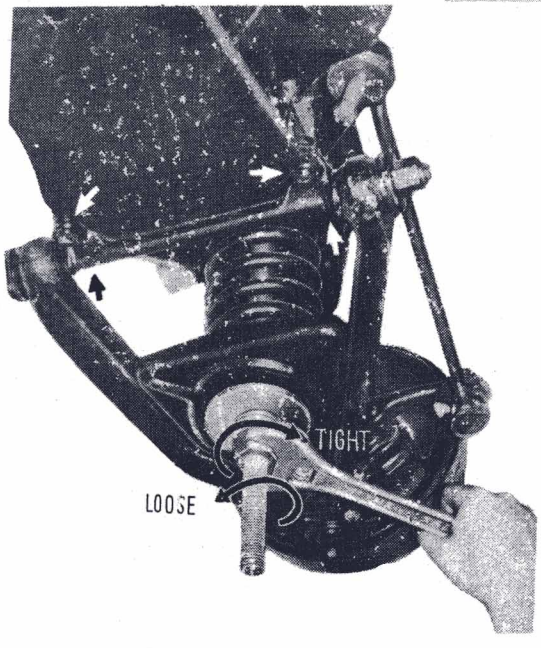


Fig. 7 Refitting the coil spring

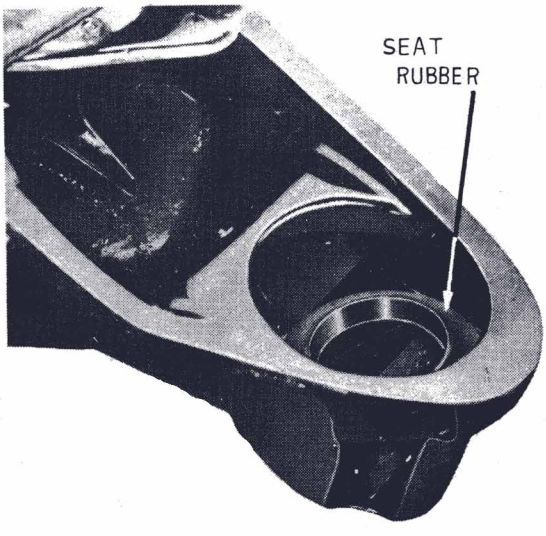


Fig. 8 Seat rubber

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.

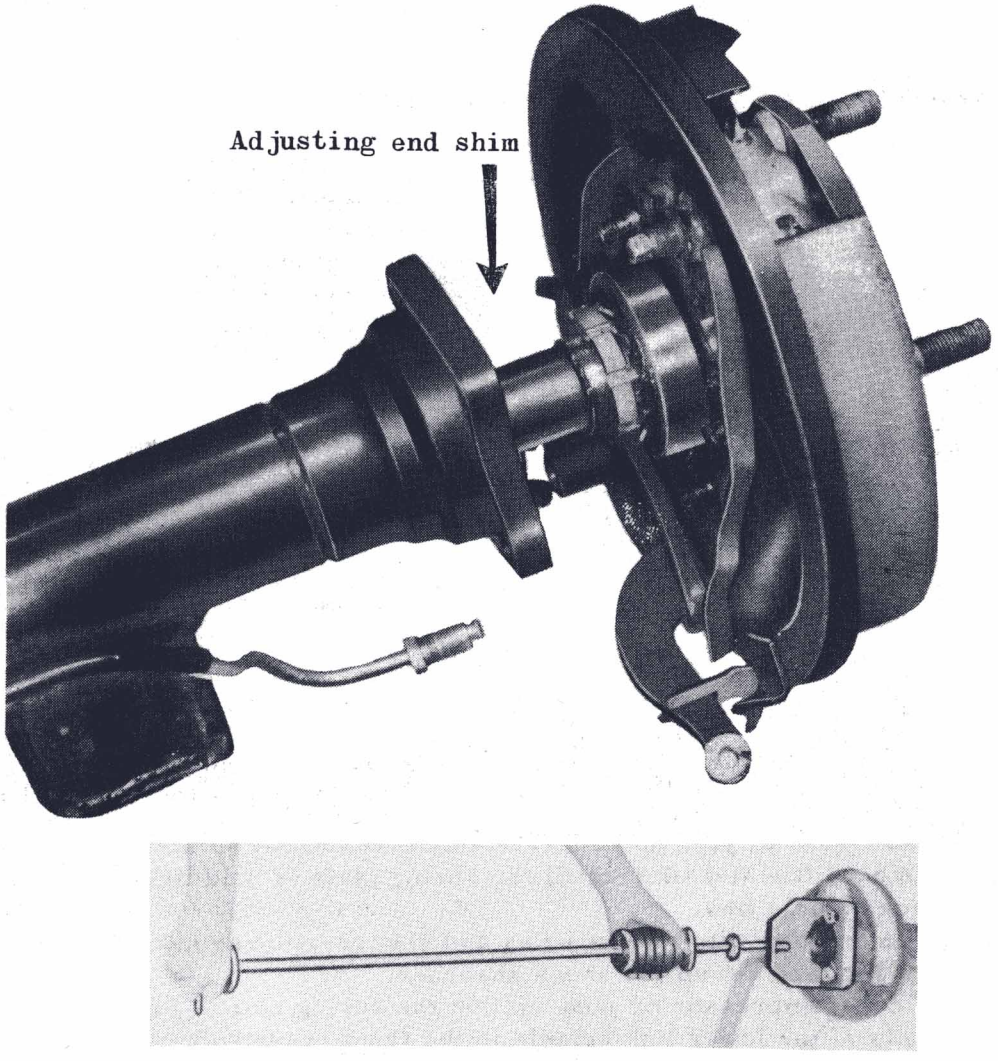
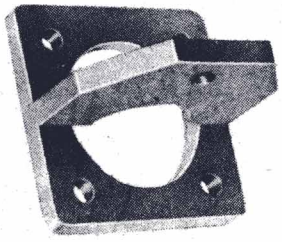


Fig. 1 Removal of axle shaft and disc assembly

SERVICE SPECIAL TOOLS

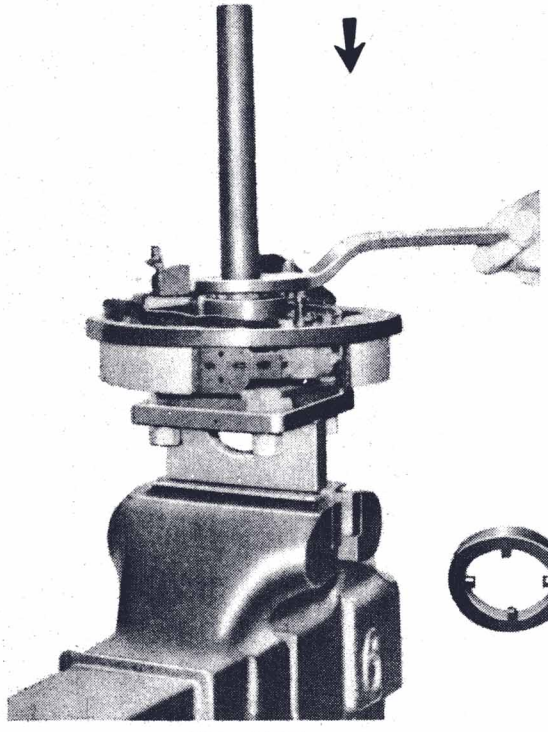


DT-4679
Special Stand

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

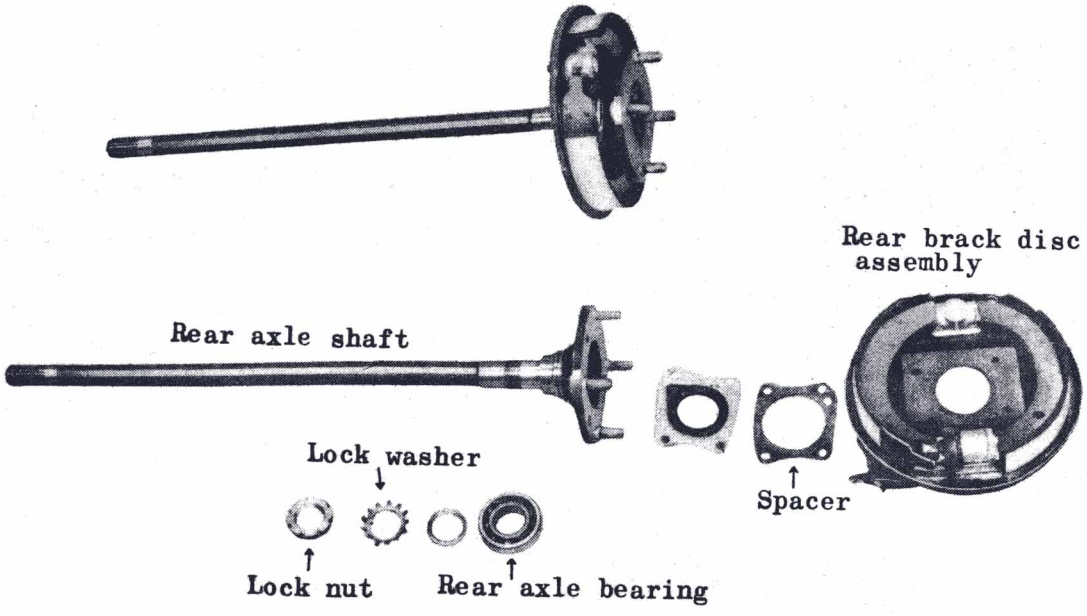


Fig. 3 Rear axle shaft & brake disc assembly

Order of Rear Axle Shaft & Brake Disc Assembly

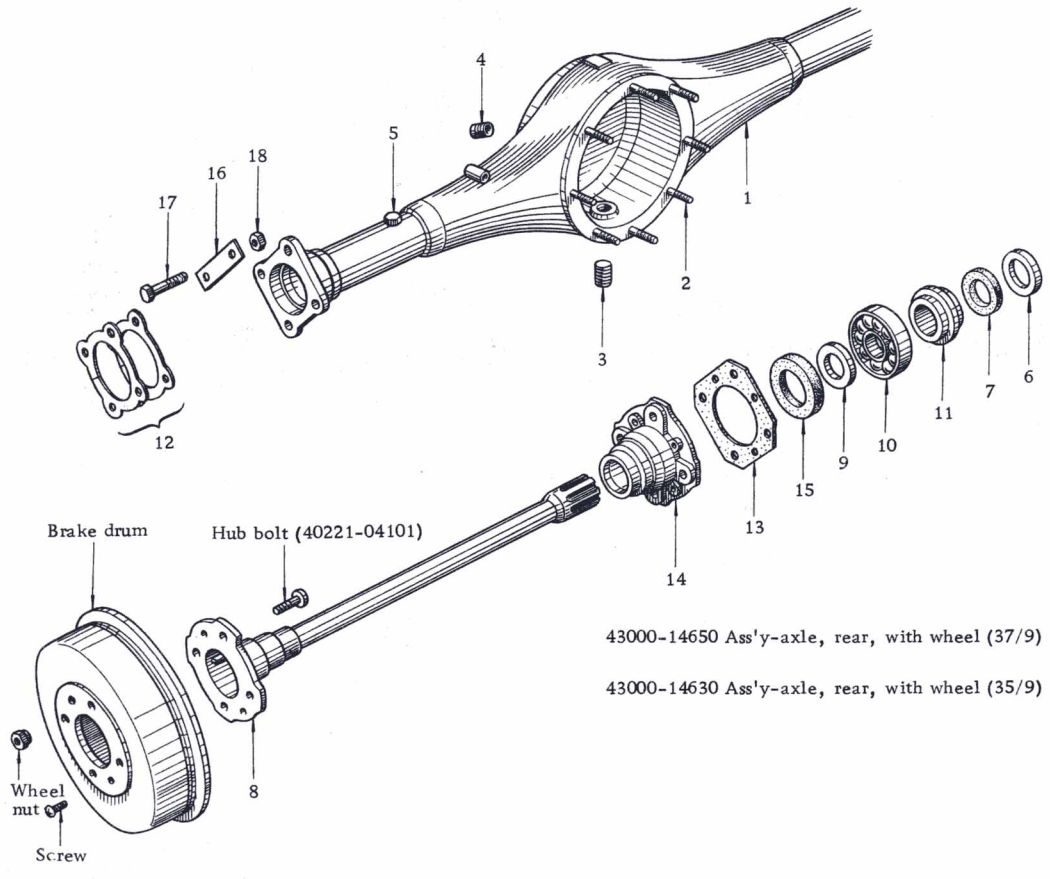
The rear axle bearing with the brake disc assembly is replaceable in one operation by pressing into place. When fitting the axle shaft it should be compressed into the abtment shoulder of the case end after inserting the end shim between its flange and hub. (Part No. 43036-04100)

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.



43000-14650 Ass'y-axle, rear, with wheel (37/9)

43000-14630 Ass'y-axle, rear, with wheel (35/9)

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.

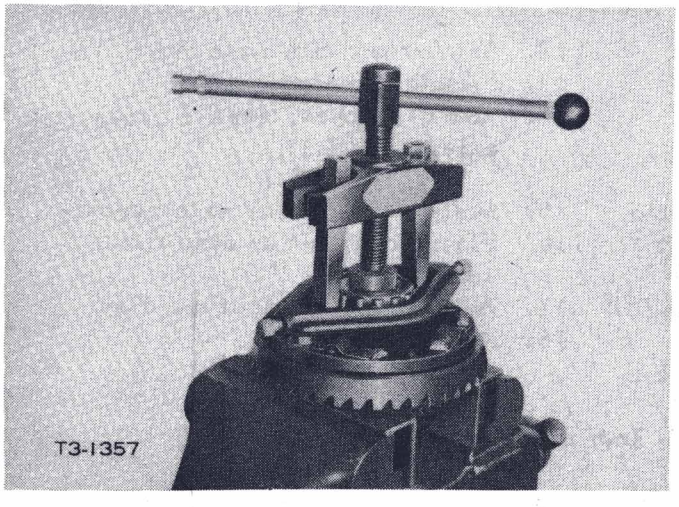


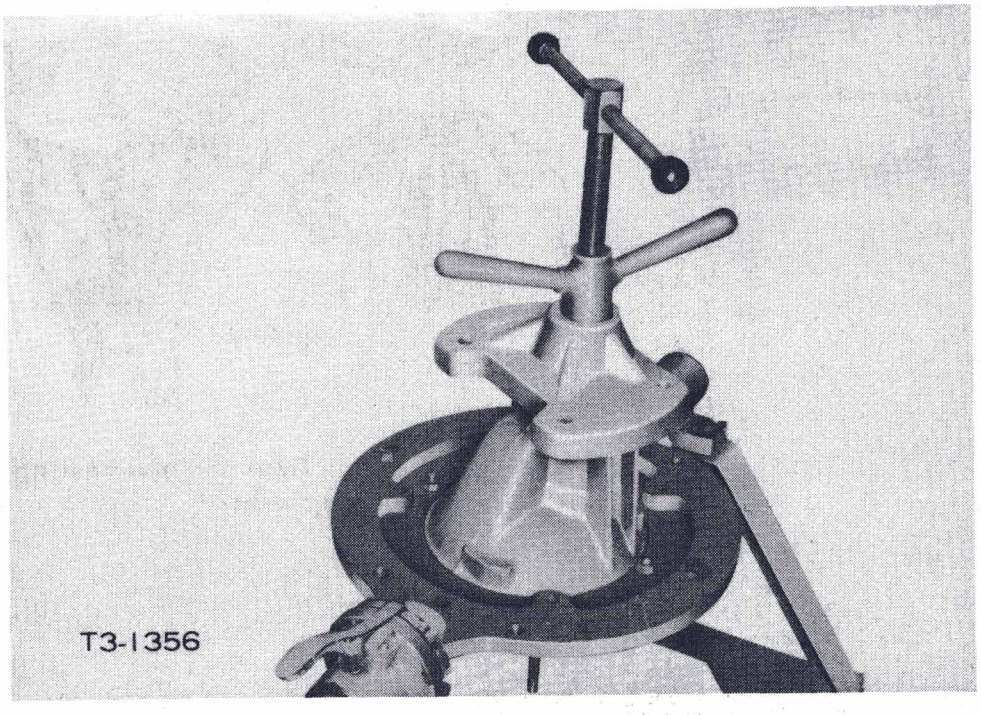
Fig. 5 Using of side bearing puller (DT4686)

(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.

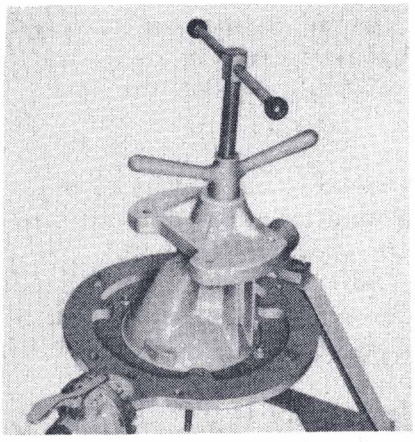
(10) Take out the drive pinion of gear carrier by striking out lightly to the backwards the front end (at the side of conpanion flange) of drive pinion with the drift of soft metal. Thus, the pinion would be taken out together with the inner lace of rear bearing and roller, distance piece, and the adjusting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

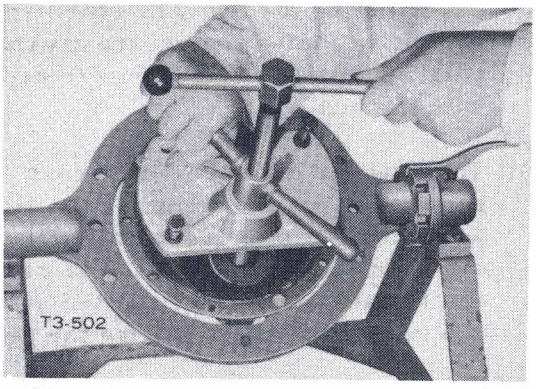
(11) Pull out the rear bearing inner race of the drive pinion.
As illustrated in Fig. No. 6 the drive pinion rear bearing inner lace replacer and the adapter should be employed in this case. The adapter in the round form is for fixing and the other for taking off. It is easy to handle with the vice fixing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

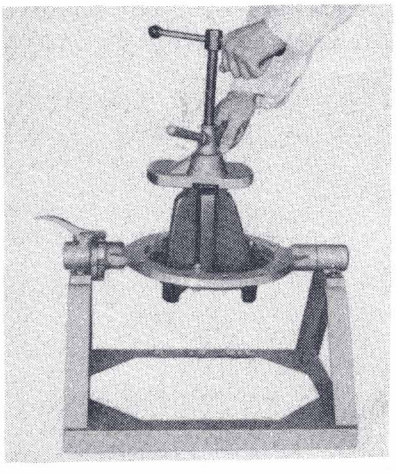


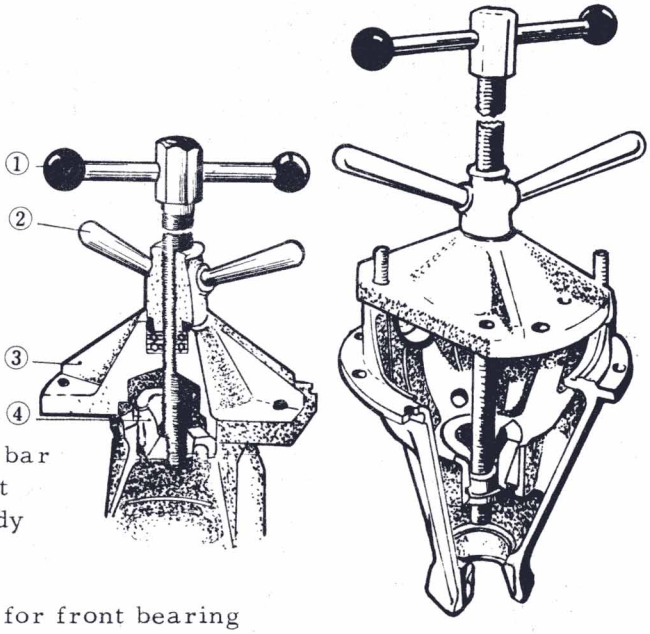
Tool No. DT4782, DT4631 & DT4689

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

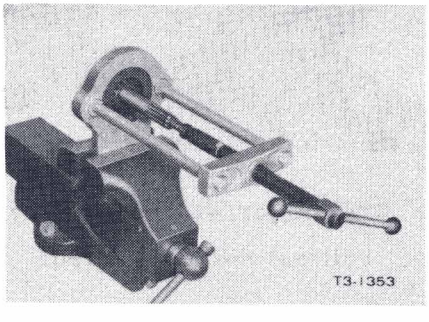


Fig. 5 Inner race replacer

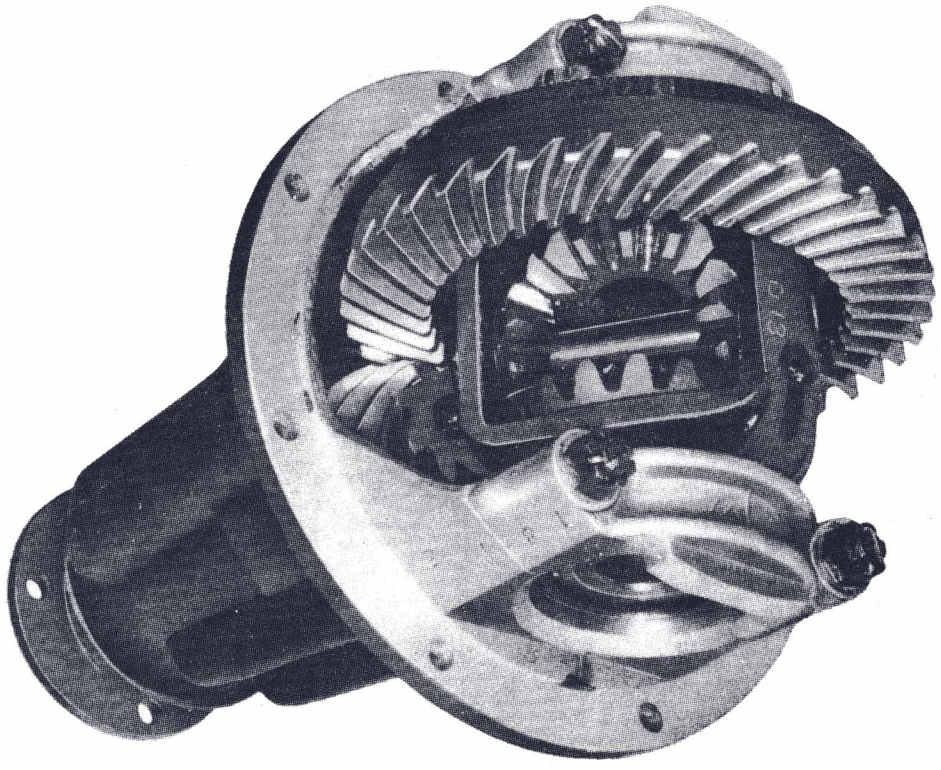
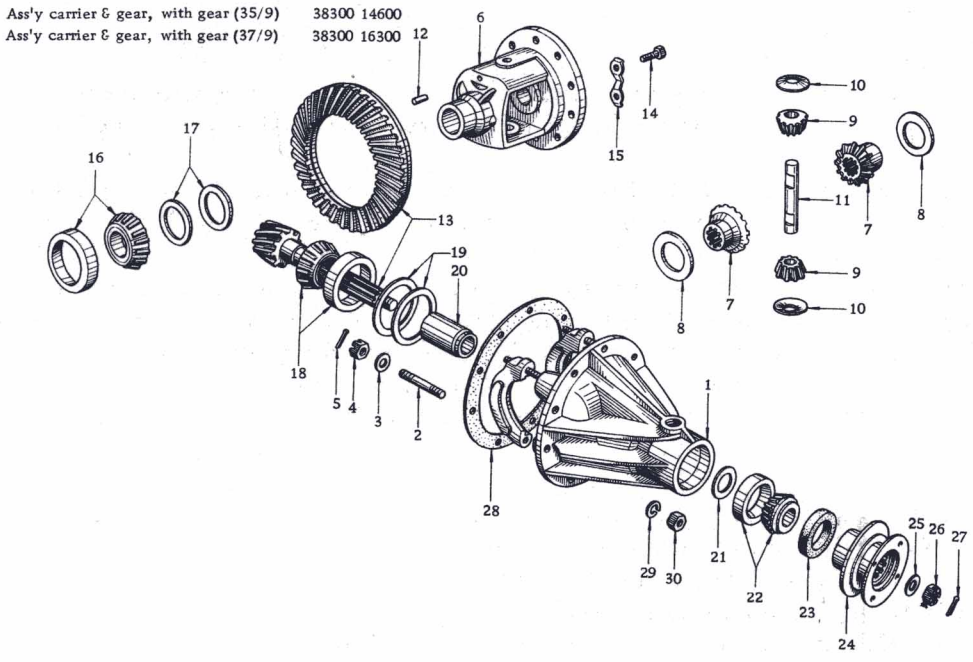


Fig.10

(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 backlash 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.

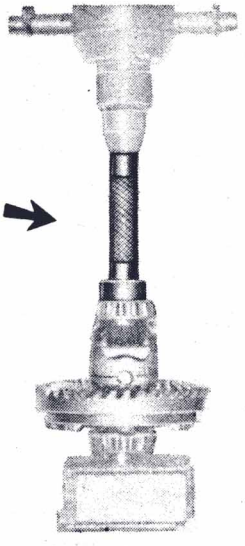


Fig. 11

(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.

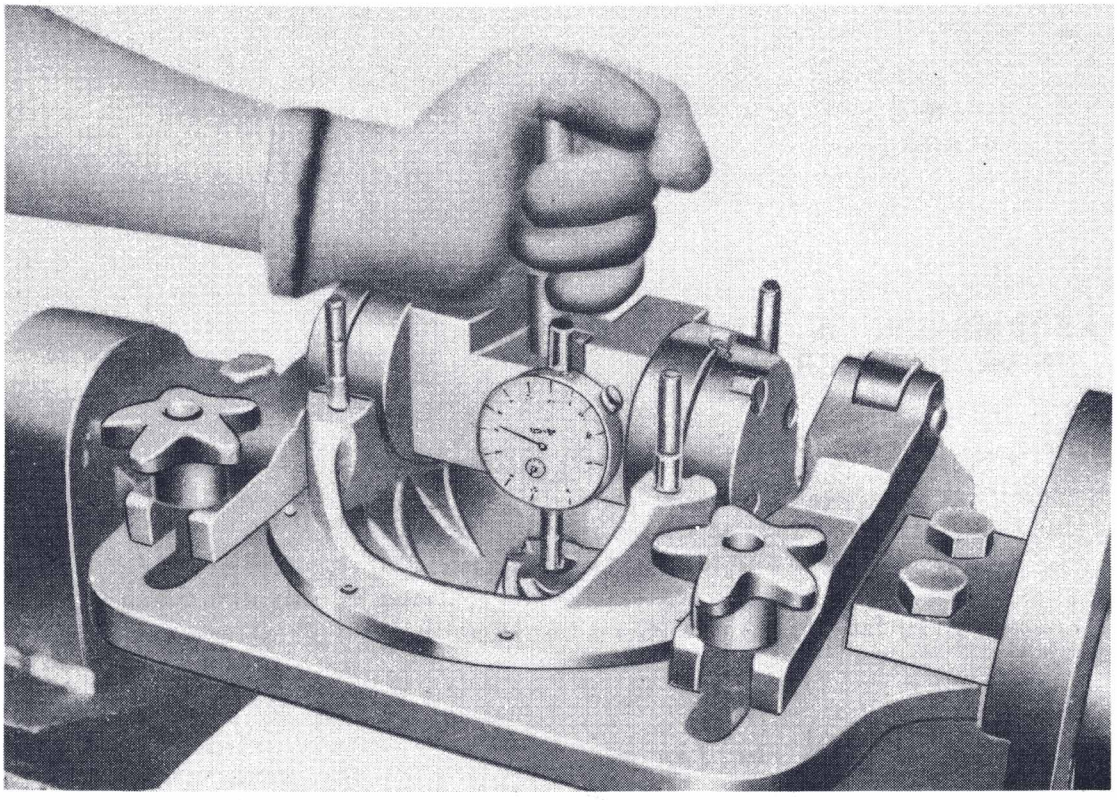


Fig. 9 Adjustment of pinion height

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 disassembling, 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,

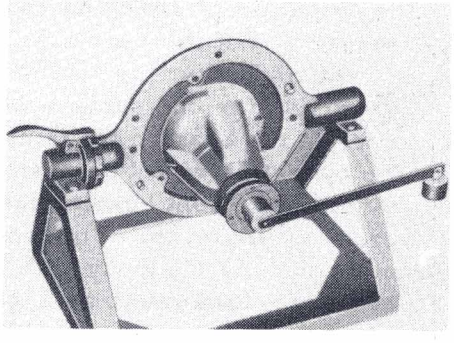


Fig. 10

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.

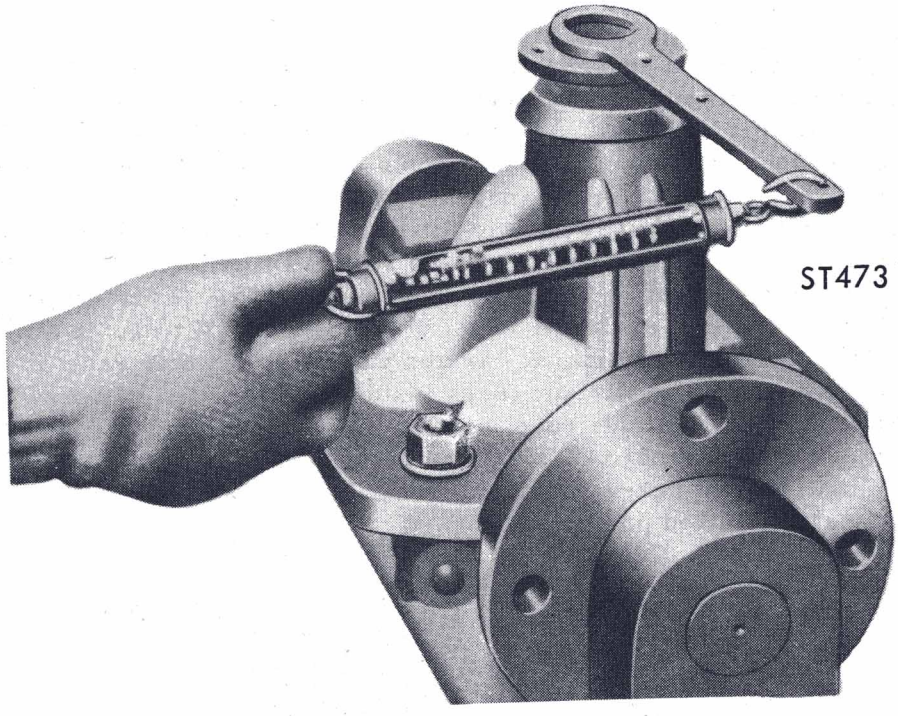


Fig. 11

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

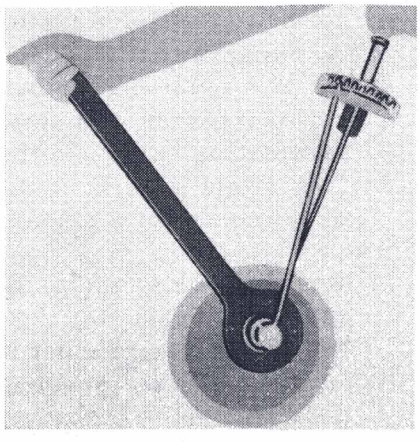


Fig. 12

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 *

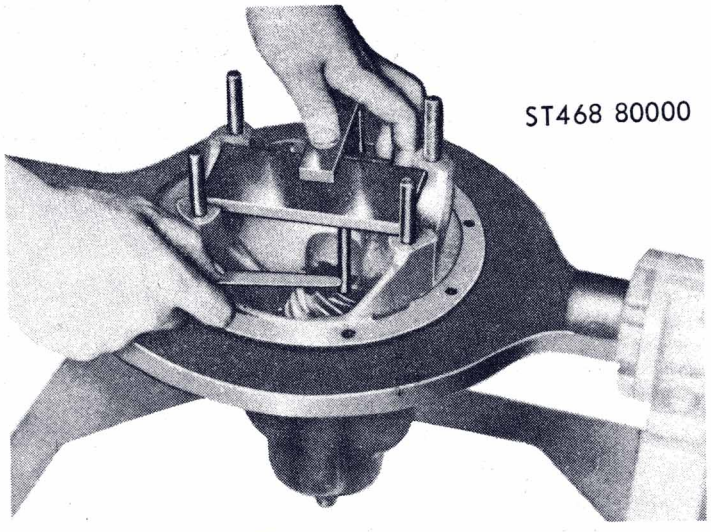


Fig. 13

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.

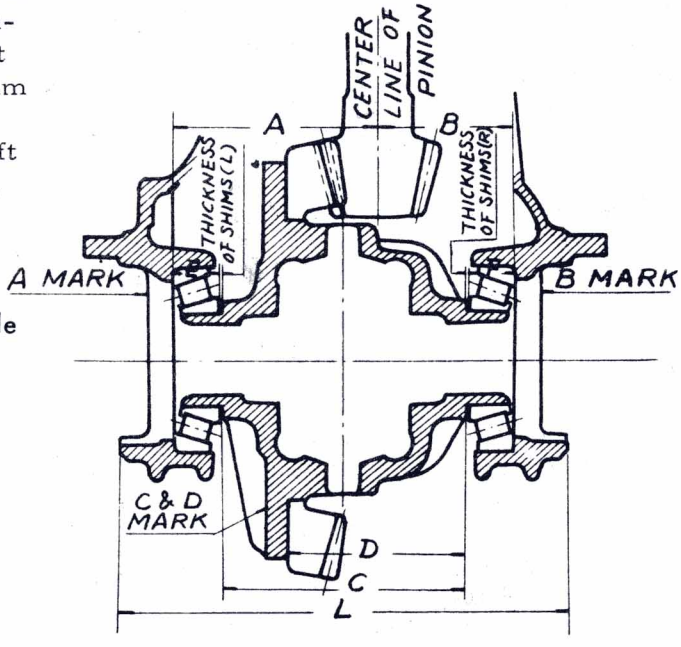


Fig. 14

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)

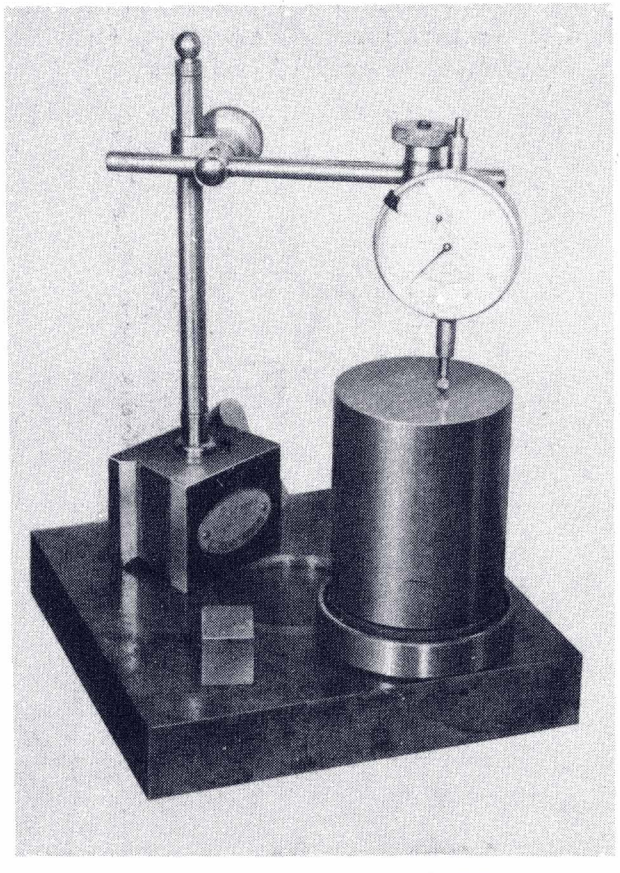


Fig. 15

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

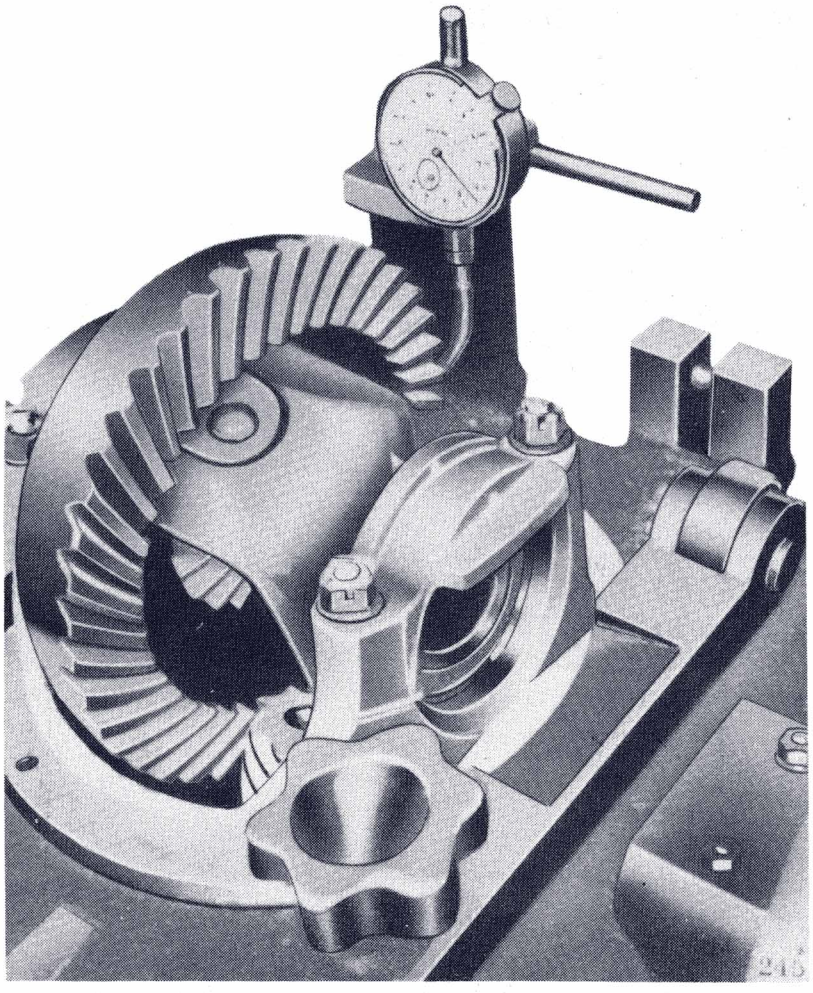


Fig. 16

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.

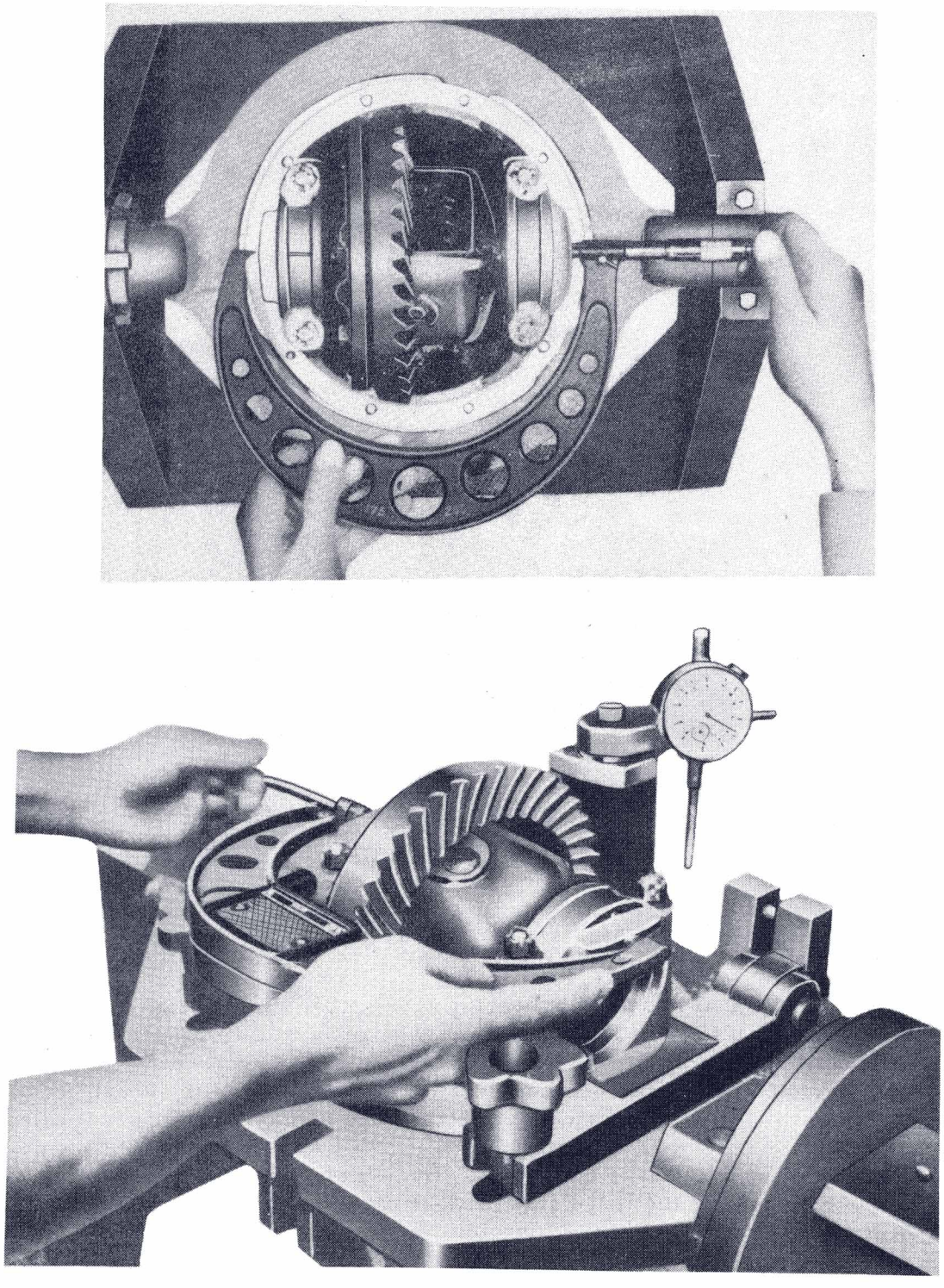
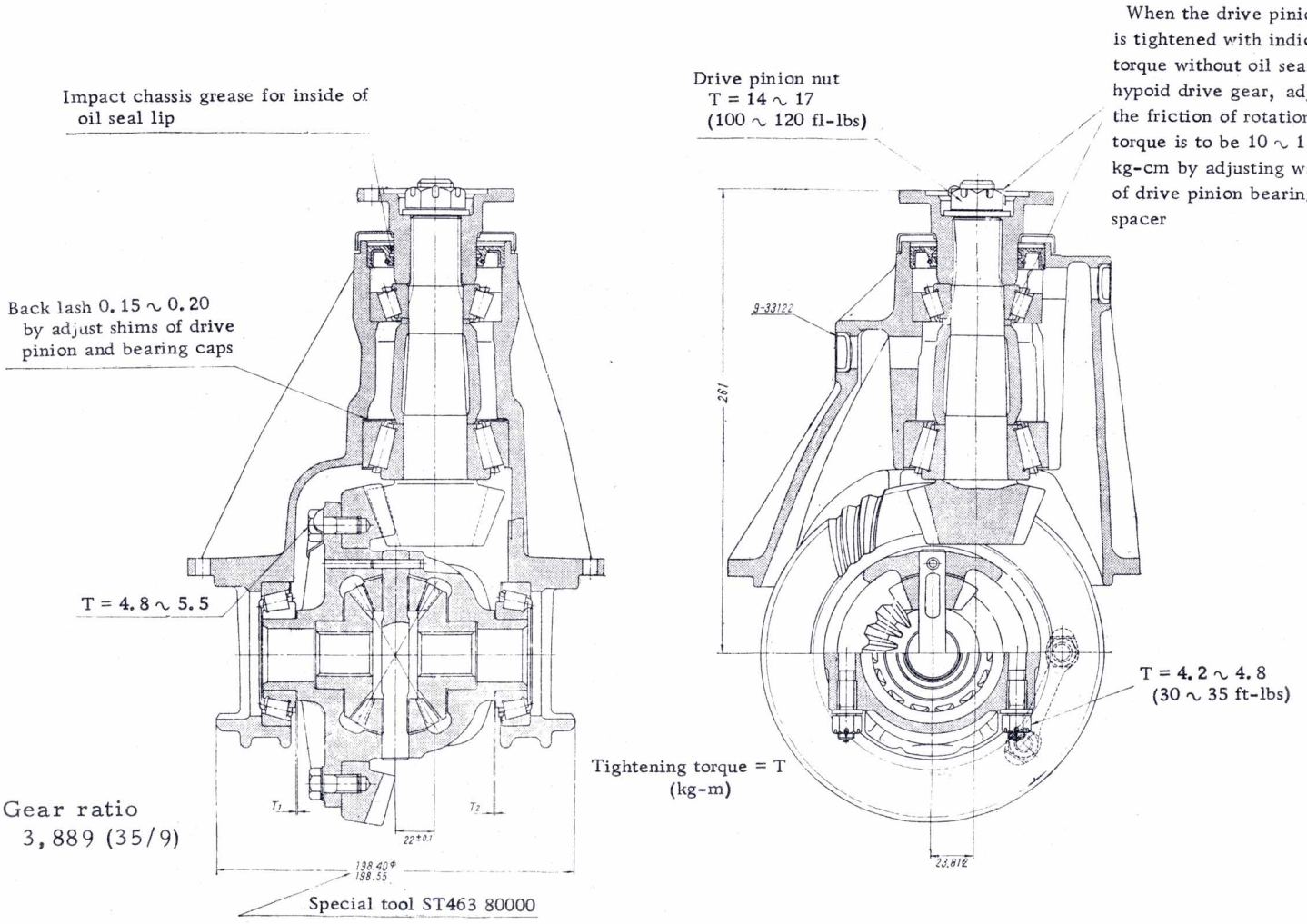


Fig. 17 Using the differential side bearing cap gauge

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.

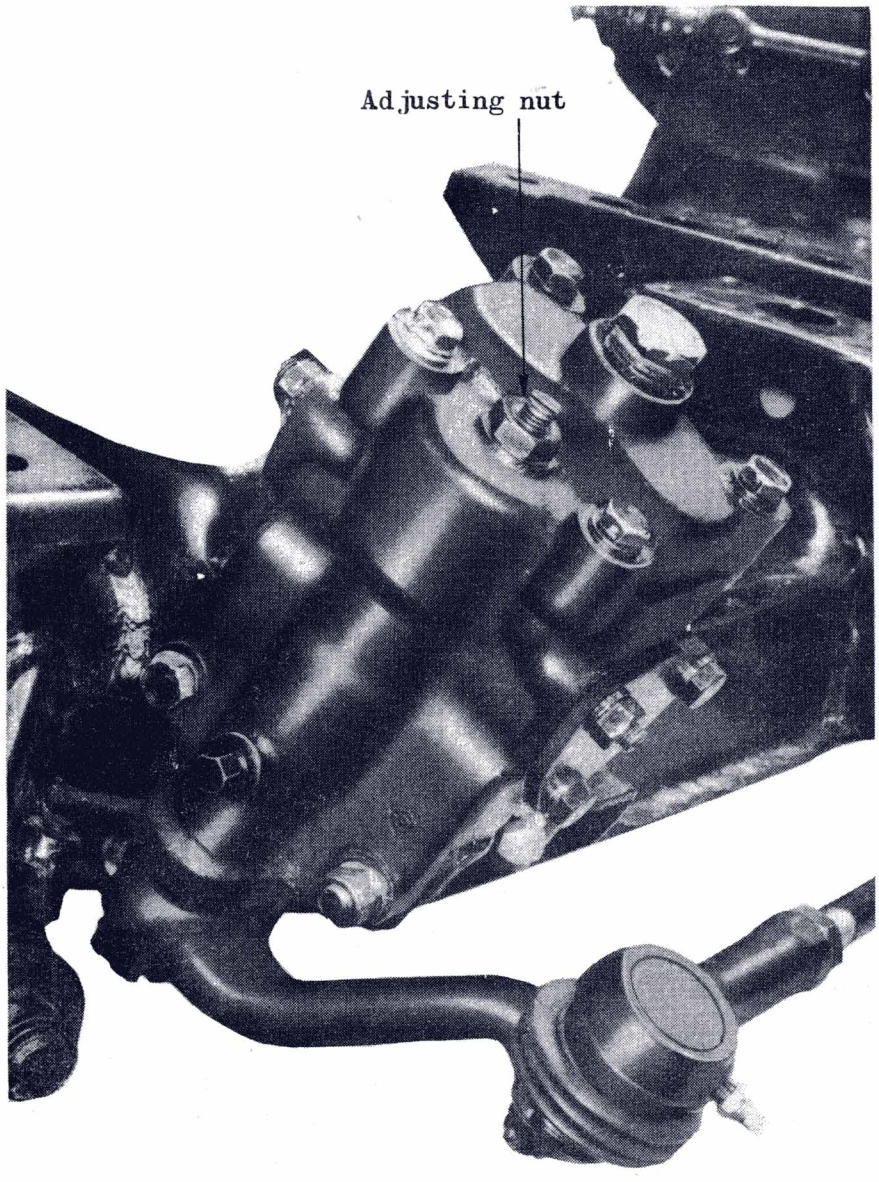


Fig. 1 Steering gear box

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.

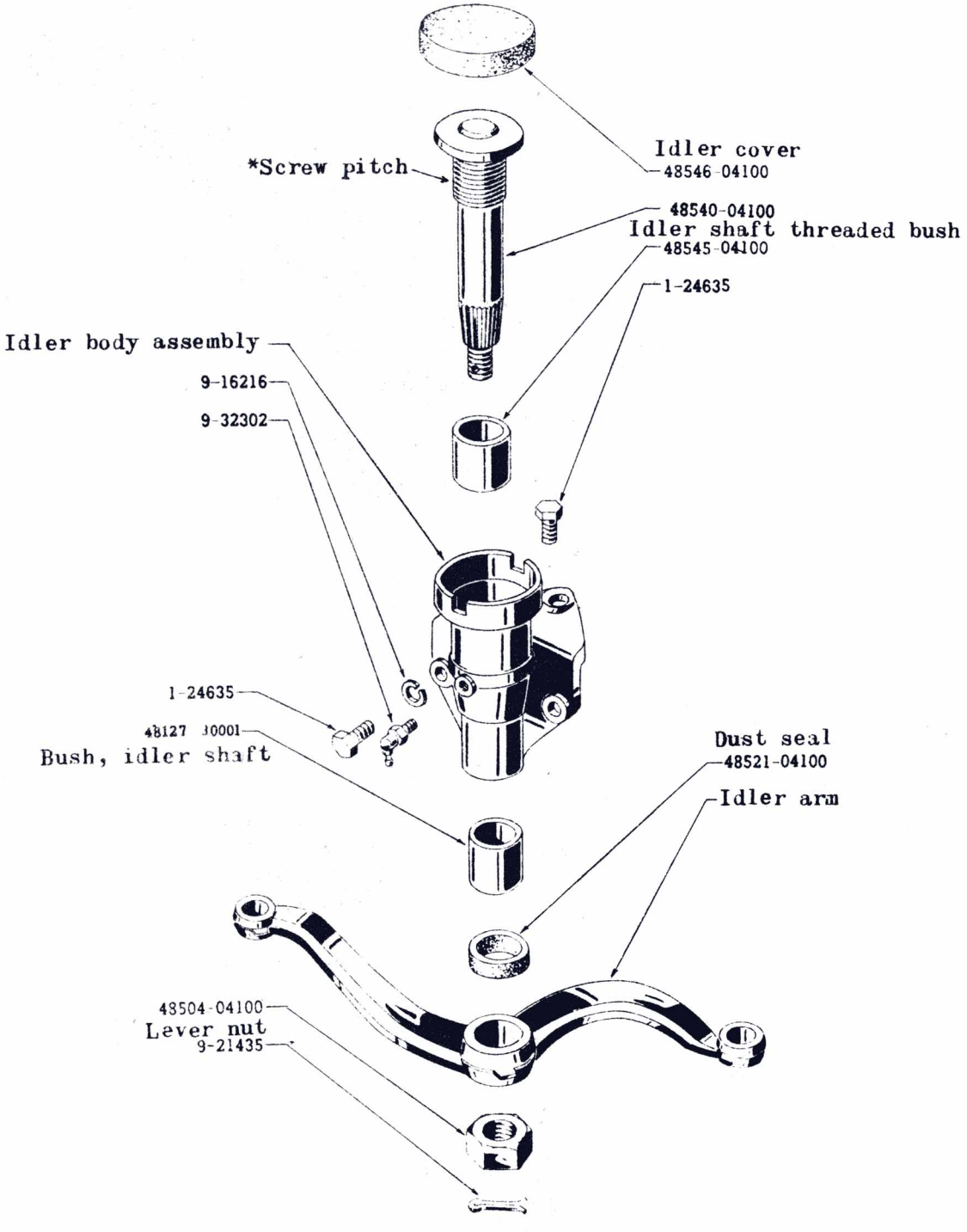
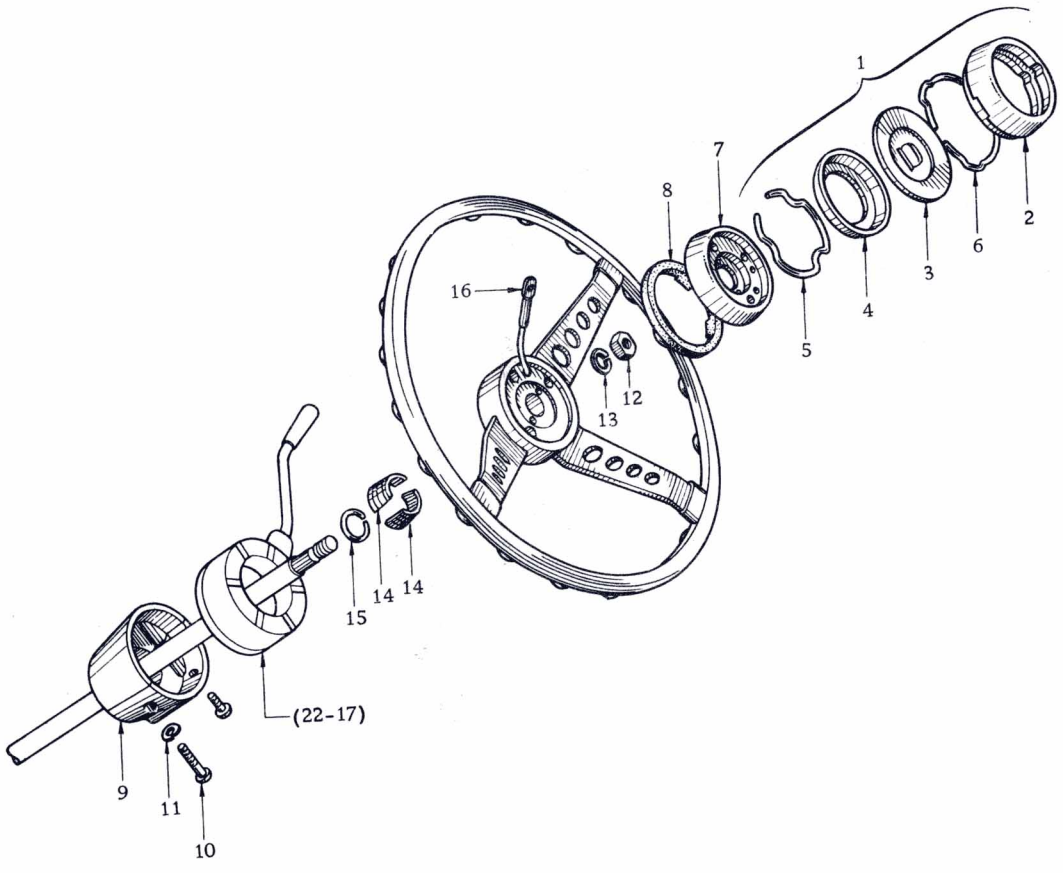


Fig. 2 Idrer & arm



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

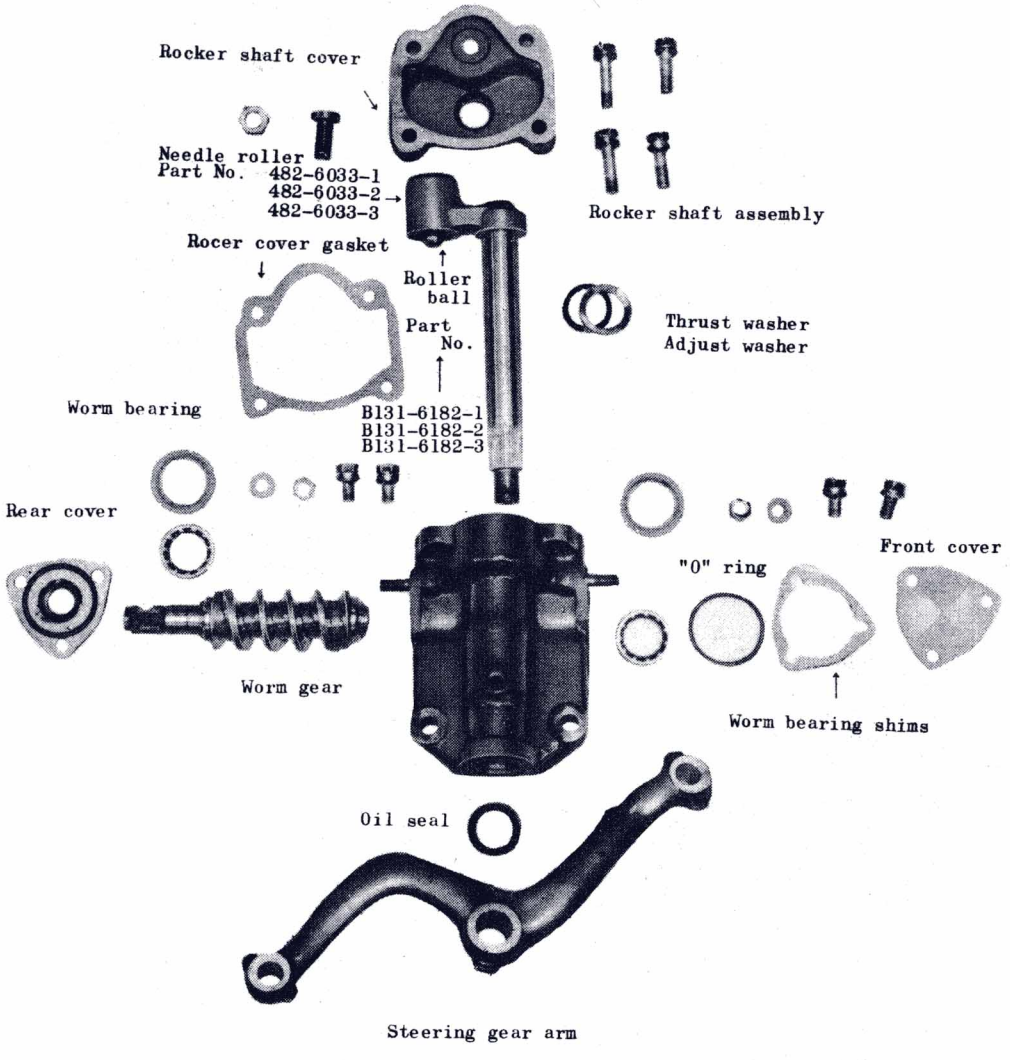
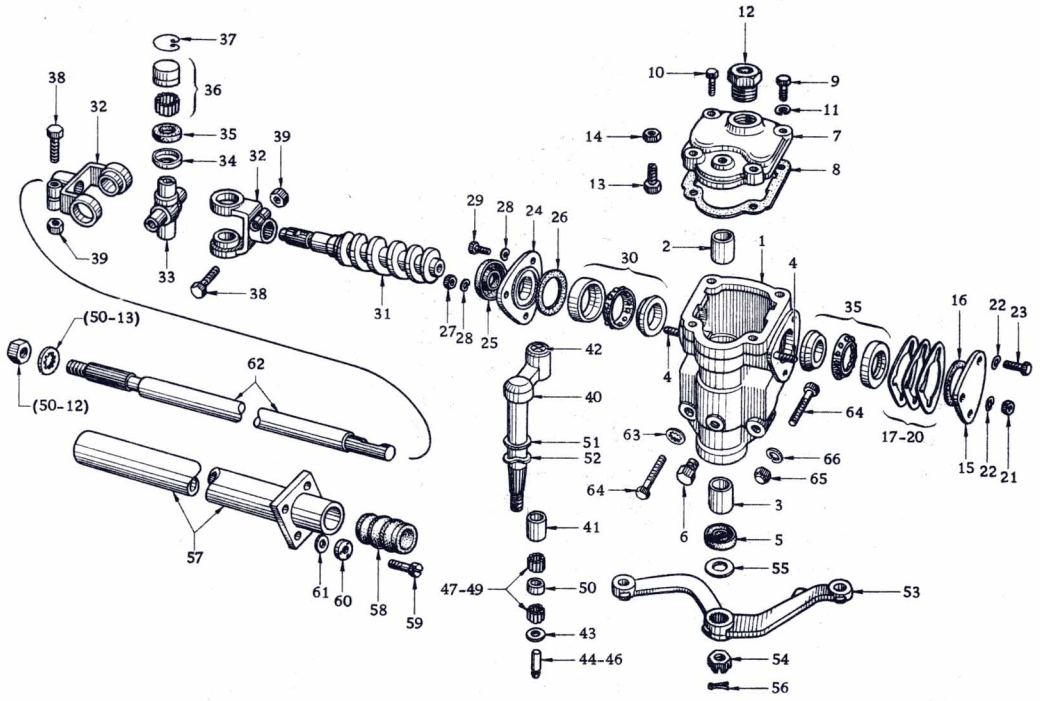


Fig. 4 Components of the steering gear case

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

(21-23) 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

(27-29) to fix rear cover

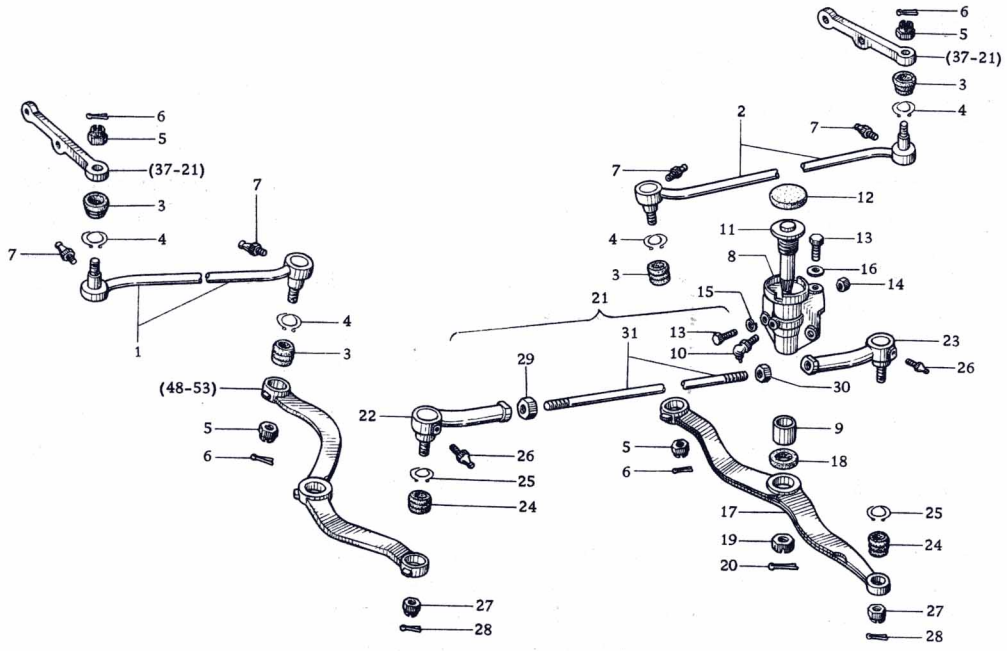
30. Ass'y-bearing, worm
31. Gear-worm
32. Yoke-universal joint
33. Journal
34. Retainer-oil seal, bearing
35. Seal-oil, bearing
36. Ass'y-bearing
37. Ring-snap
38. Bolt
39. Nut
40. Ass'y-shaft, rocker
41. Race-needle roller
42. Plug-ball roller
43. Cover-needle roller
44. Ball-roller (12.998 ϕ)
45. Ball-roller (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

(59-61) to fix jacket to dash board

62. Comp.-column, steering
63. Washer-lock
64. Bolt
65. Nut

(63-65) to fix steering gear

66. Washer-lock



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.

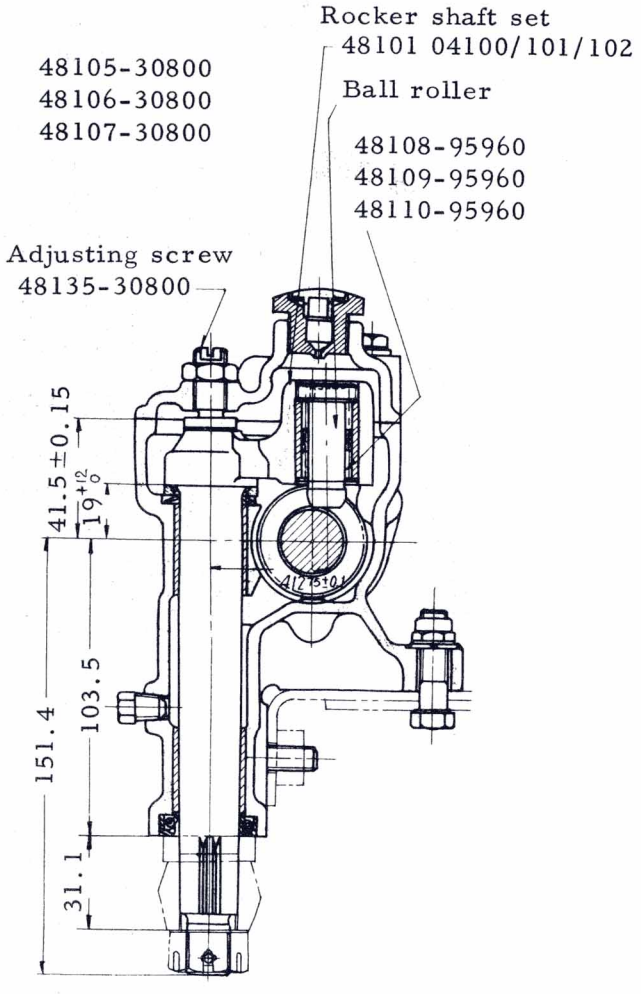


Fig. 6 Section of steering geer housing

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 left lock.

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.

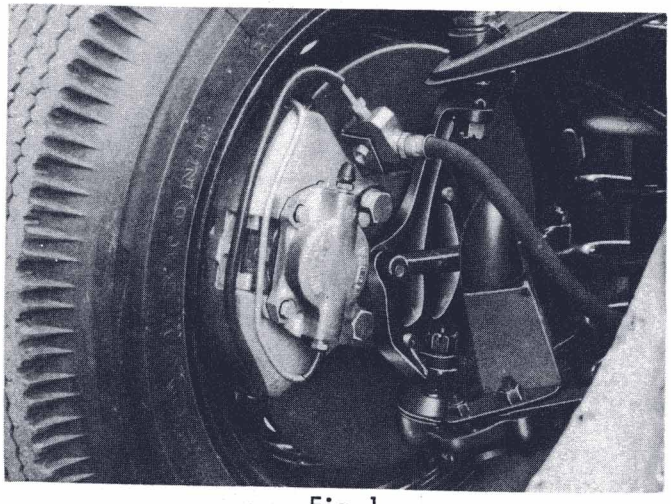


Fig. 1

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)	53.98 (2 1/8 in.)
Rear (mm)	20.64 (13/16 in.)
Pedal ratio	3.9
Friction pad	TEXTAL TP 9L

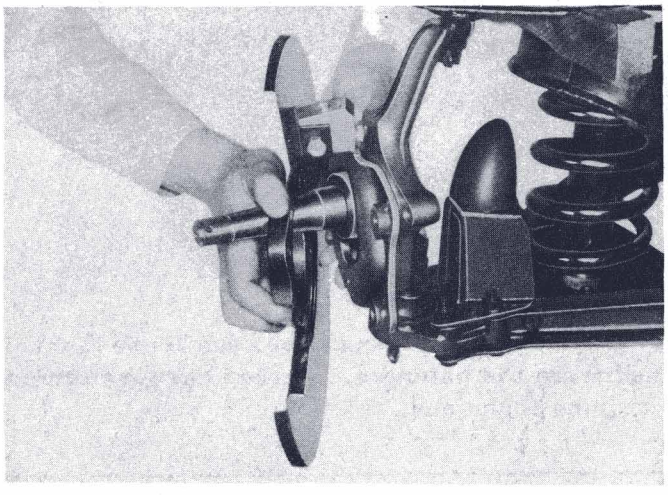


Fig. 2

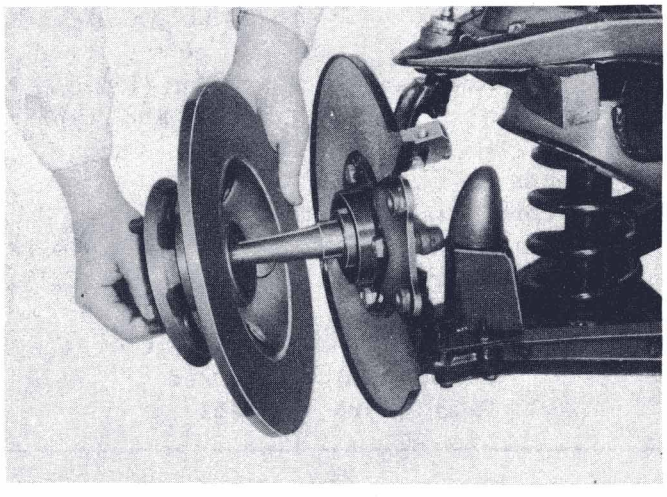


Fig. 3

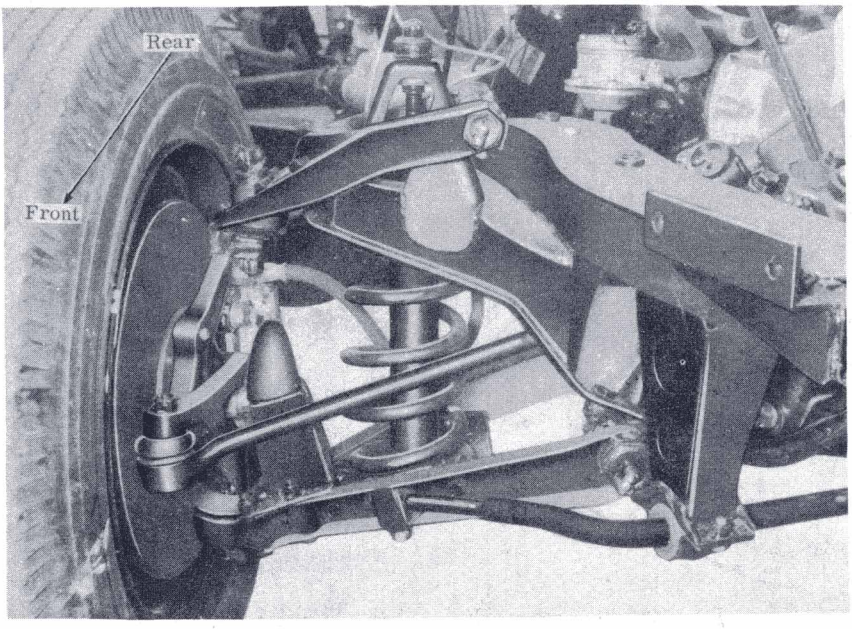


Fig. 4

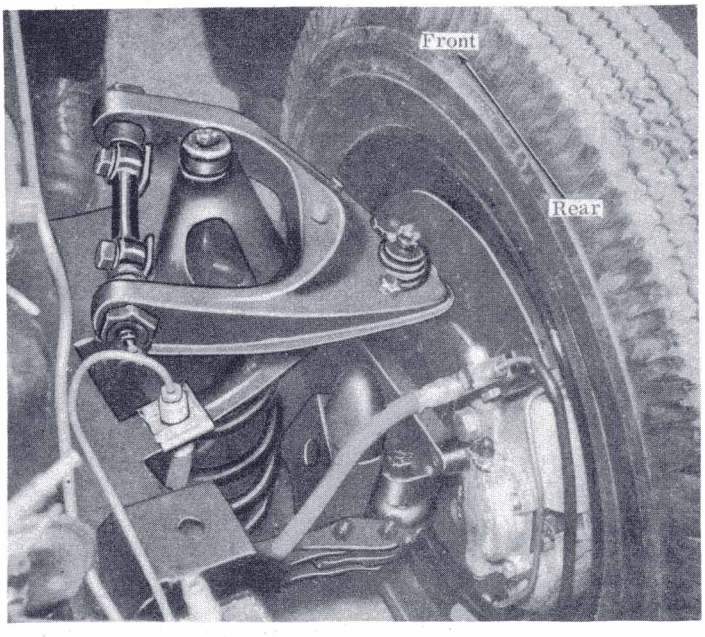
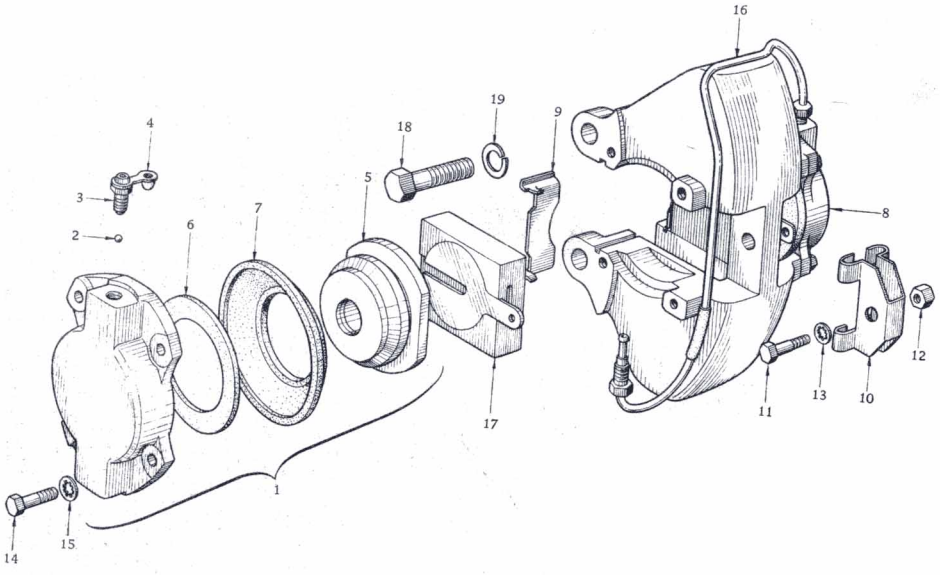


Fig. 5 Front axle



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
12. Nut
13. Washer
} to fix keep plate
14. Bolt
15. Washer
} to fix cylinder
16. Ass'y-tube, bridge (R.H.)
17. Ass'y-pad
18. Bolt
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.

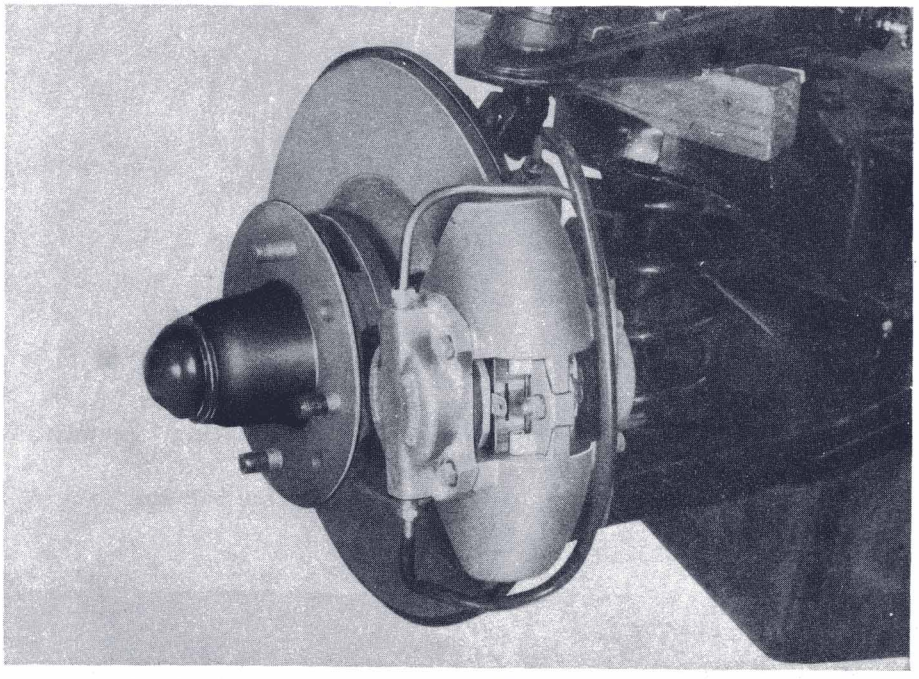


Fig. 7

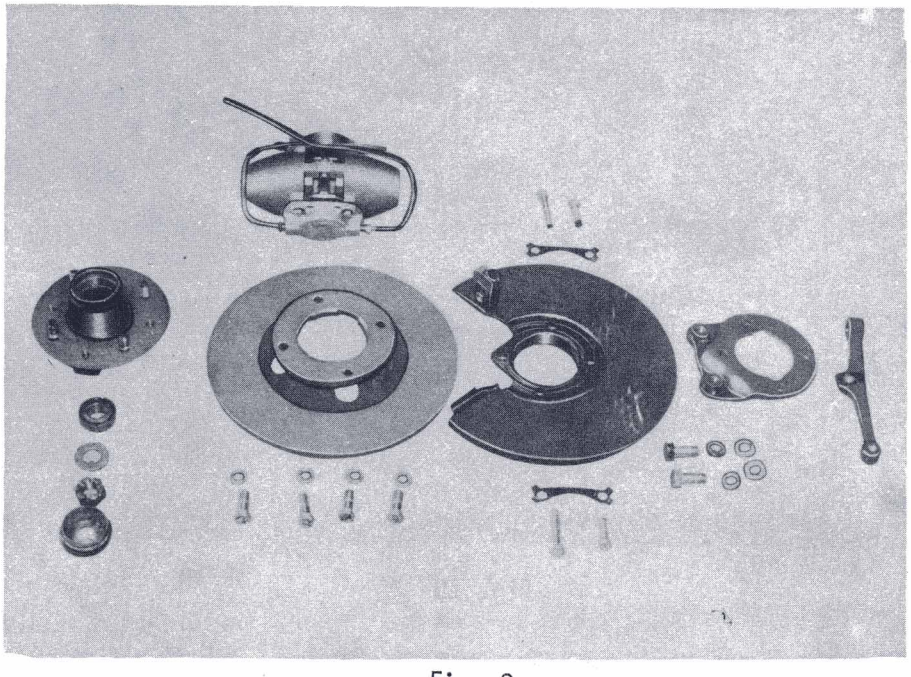


Fig. 8

Components of the Calliper

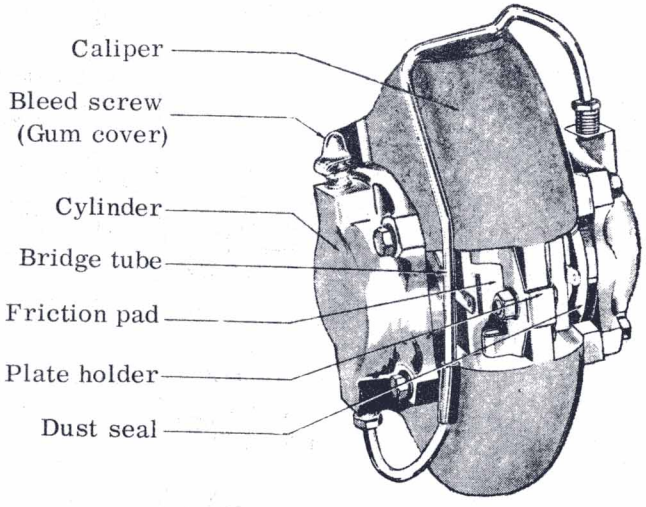


Fig. 9

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.

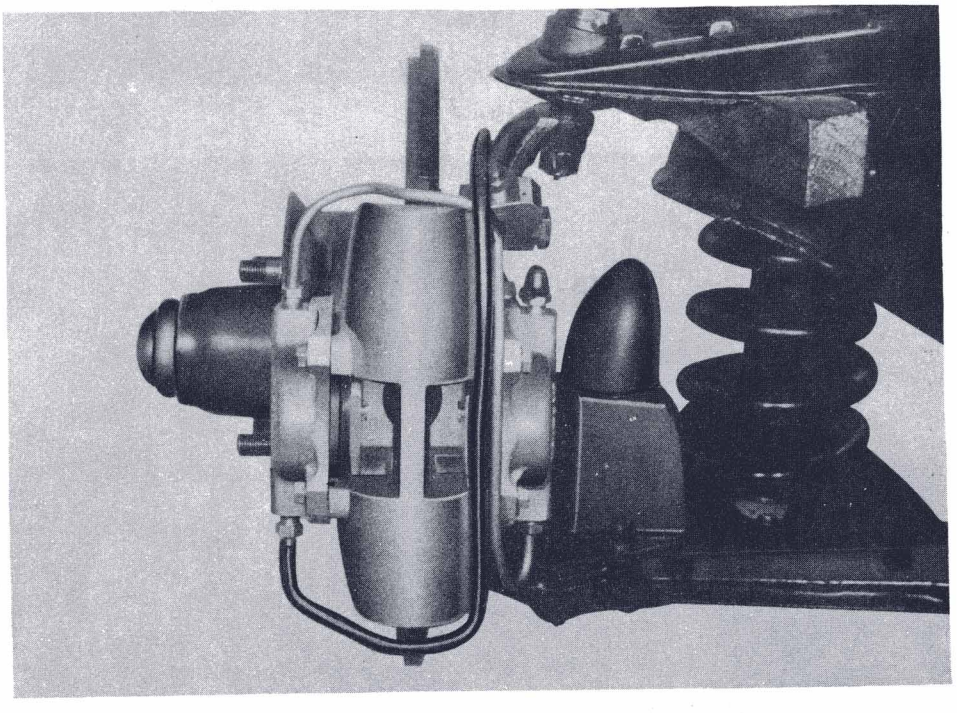


Fig. 10

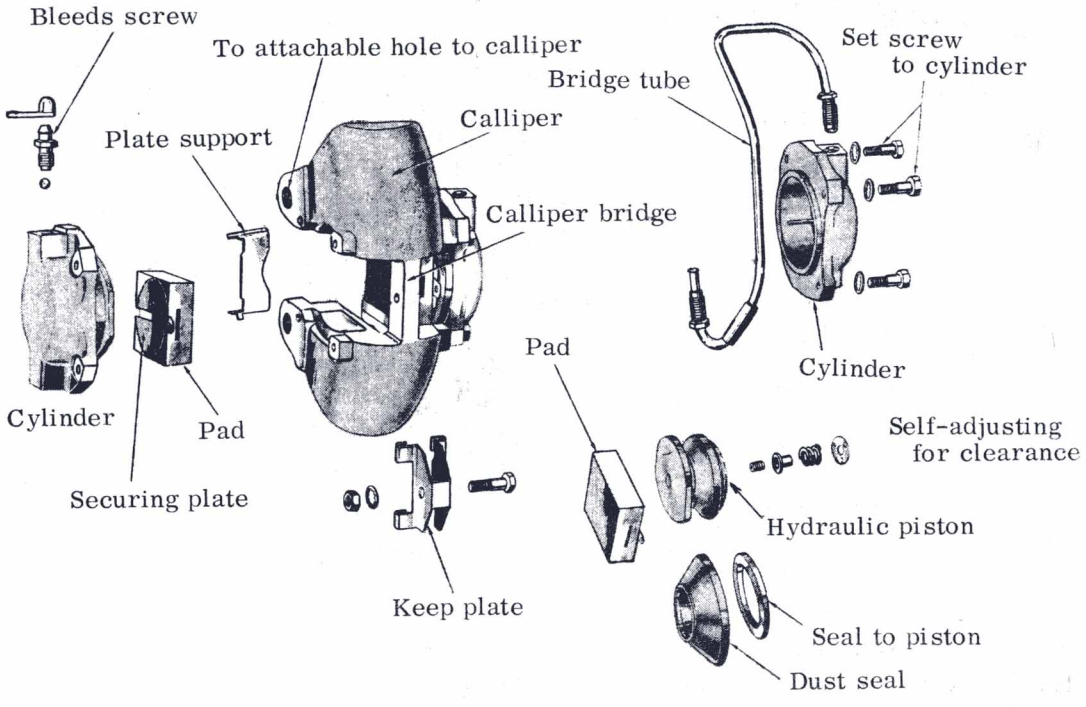

Bleeds screw
To attachable hole to calliper
Bridge tube
Set screw to cylinder
Plate support
Calliper
Calliper bridge
Cylinder
Pad
Securing plate
Keep plate
Pad
Cylinder
Self-adjusting for clearance
Hydraulic piston
Seal to piston
Dust seal

Fig. 11

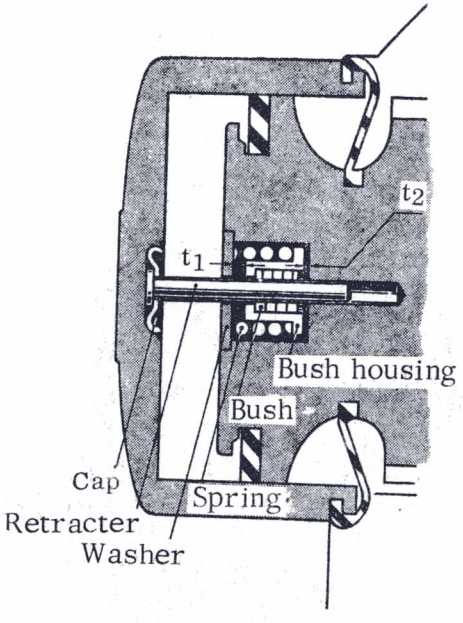

t2
t1
Bush housing
Bush
Cap
Spring
Retracter
Washer

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.

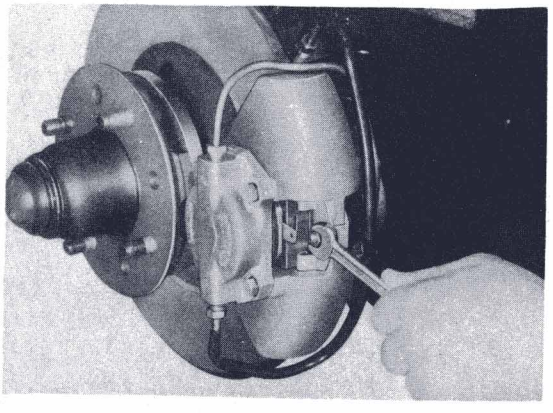


Fig. 13

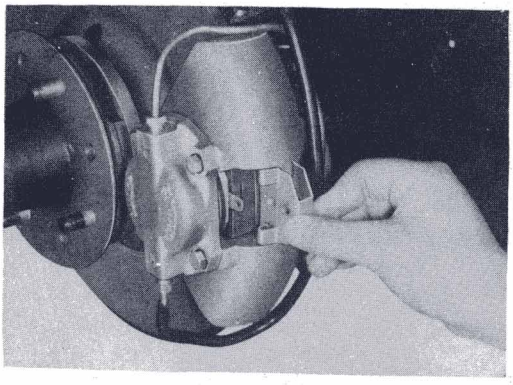


Fig. 14

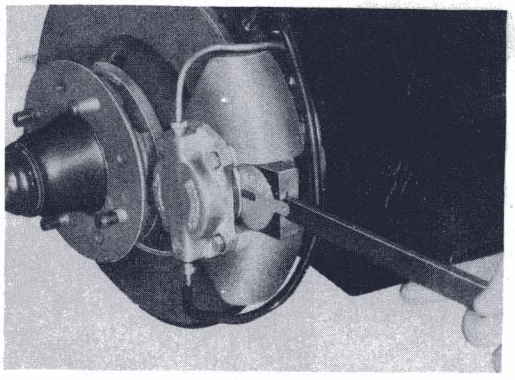


Fig. 15

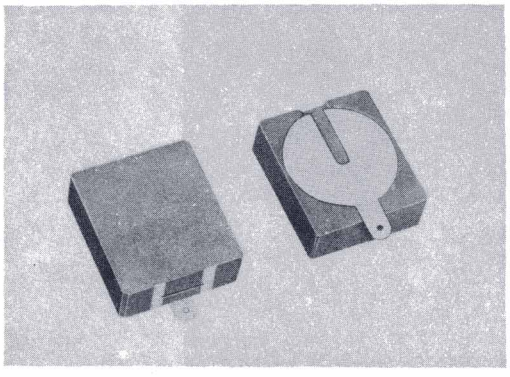


Fig. 16

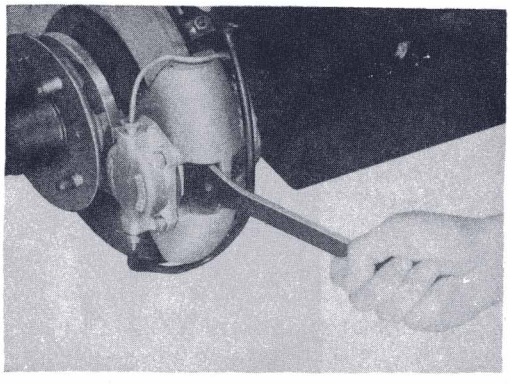


Fig. 17

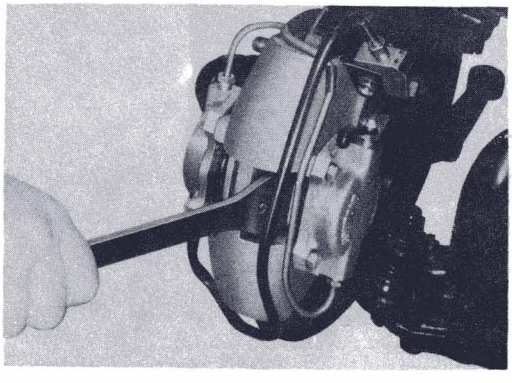


Fig. 18

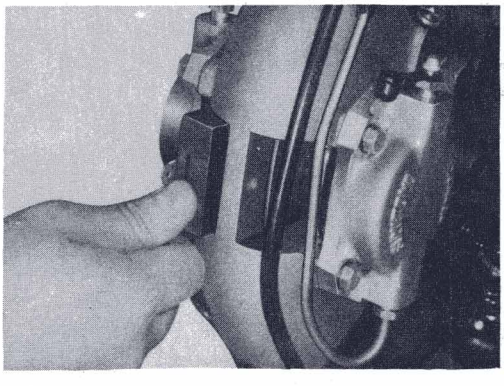


Fig. 19

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.

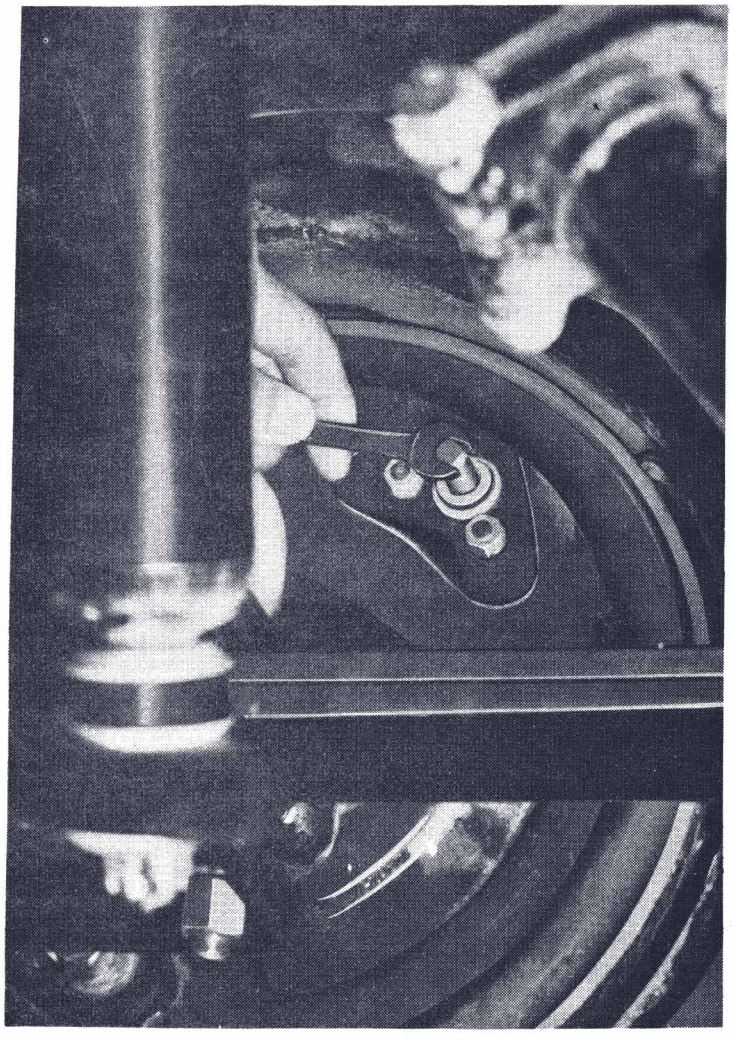
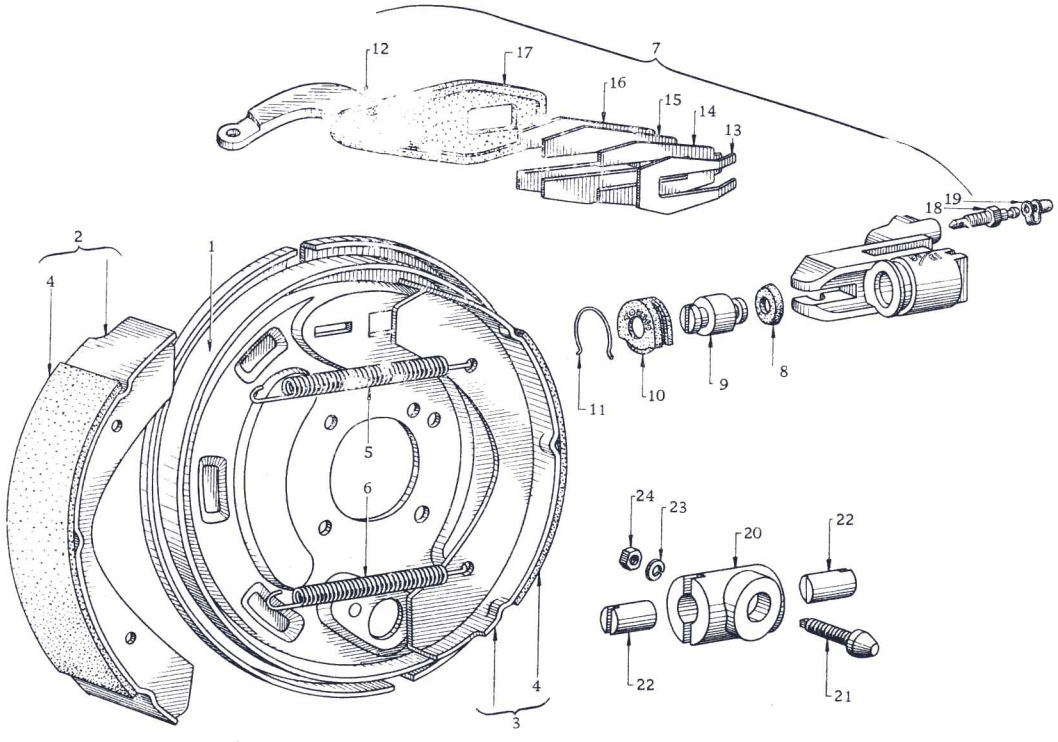


Fig. 20 Adjusting brake shoe

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.

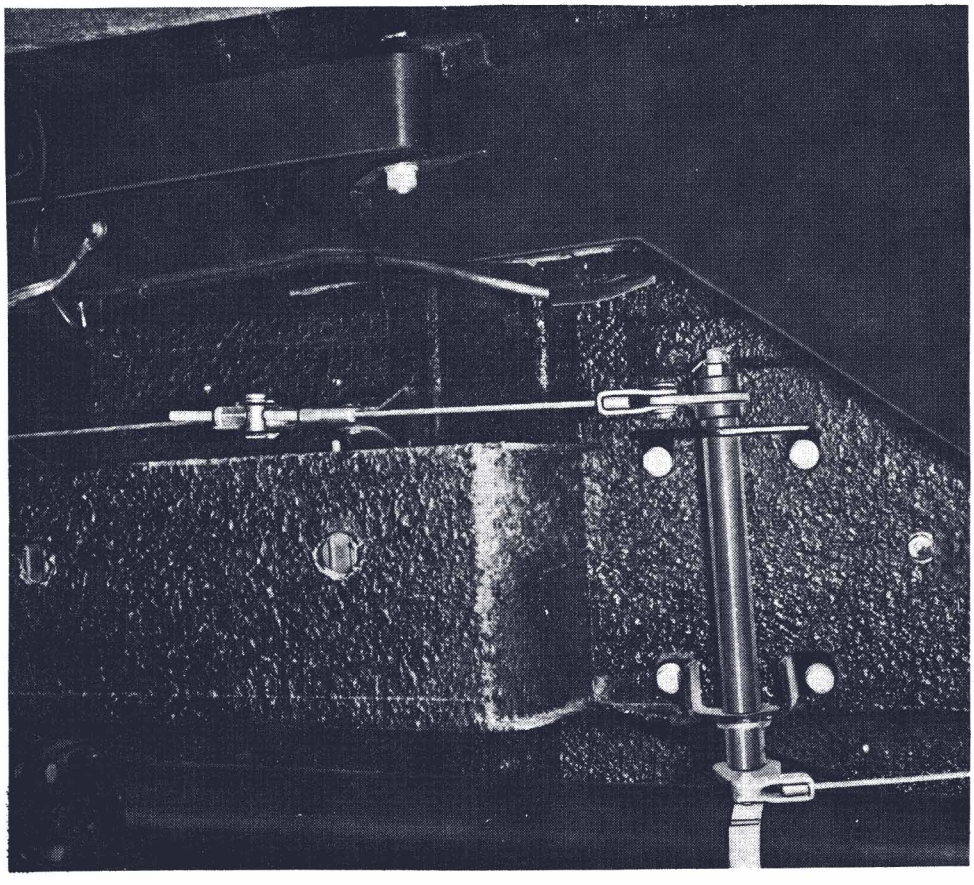


Fig. 22

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.

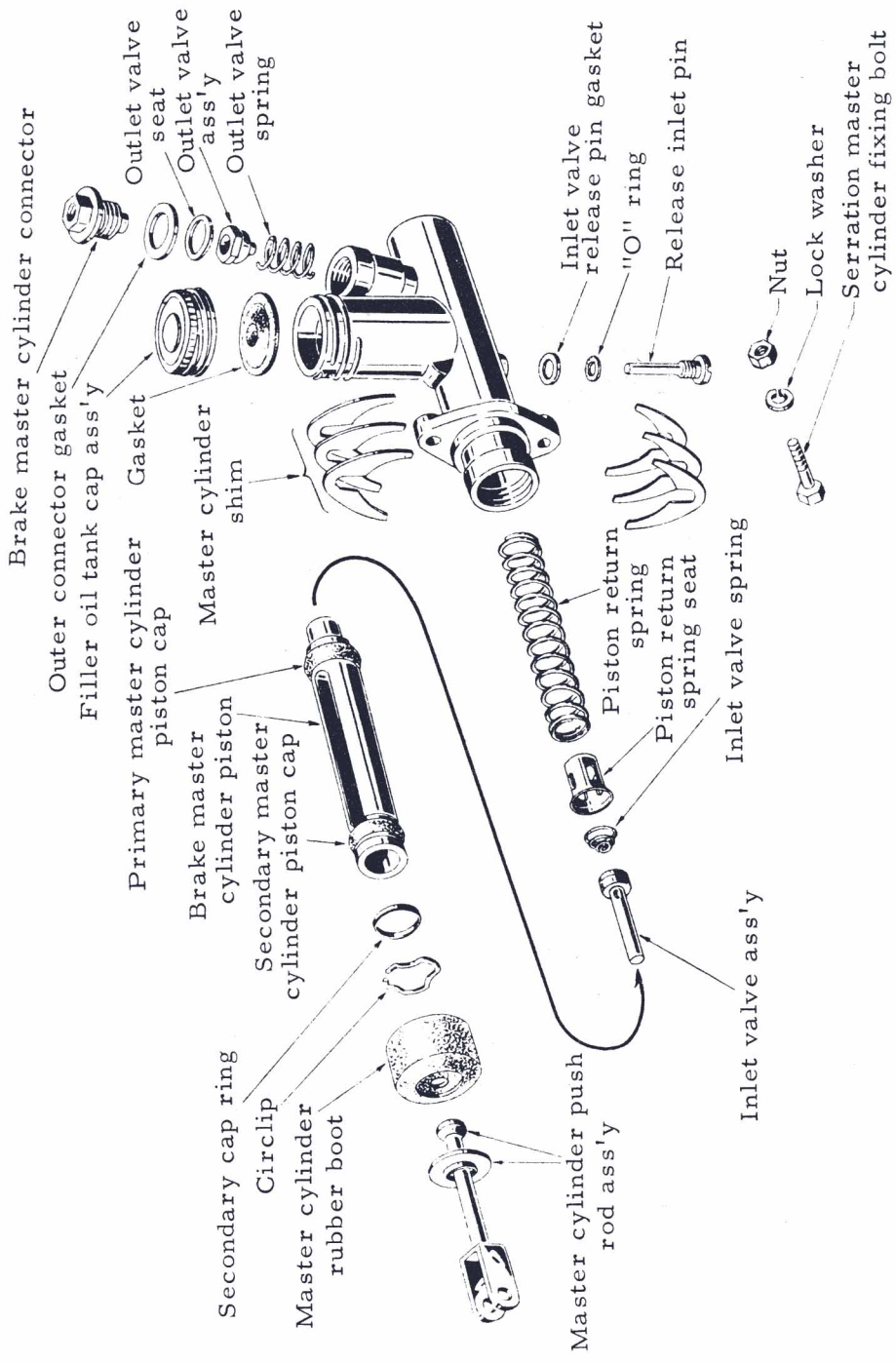


Fig. 23 Brake master cylinder

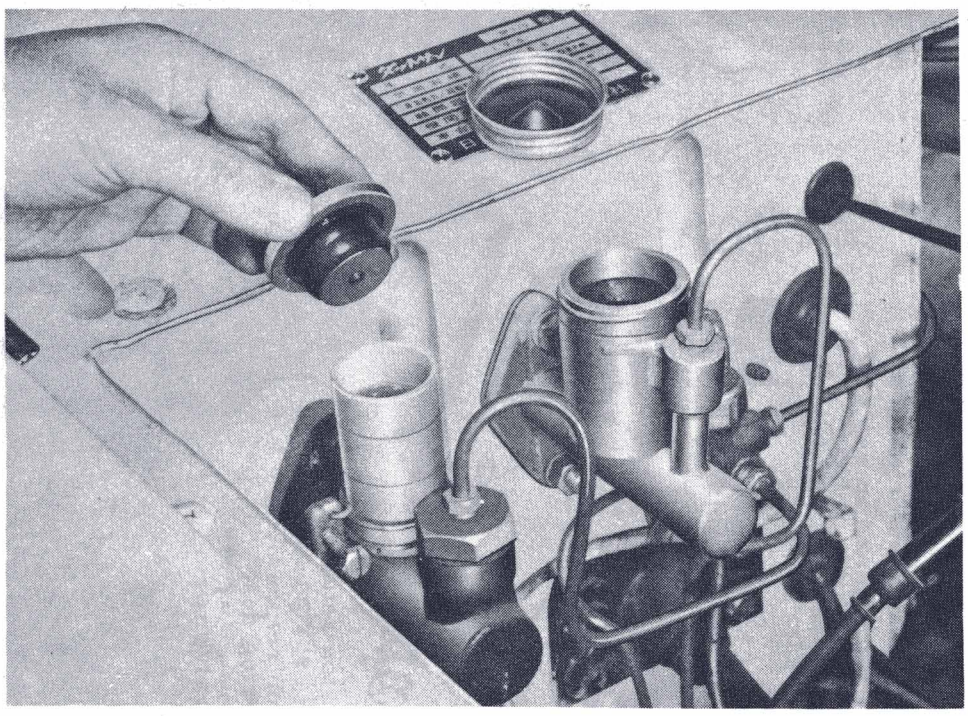


Fig. 24

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 extent 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.

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