

SERVICE MANUAL

DATSUN

MODEL 410 SERIES



NISSAN MOTOR CO., LTD.

**OTEMACHI BLDG., OTEMACHI, CHIYODA-KU,
TOKYO, JAPAN**

**CABLE ADDRESS : "NISMO" TOKYO
PHONES : (21) 5281-9**



DATSUN BLUEBIRD MODEL P (L) 410

INTRODUCTION

This manual has been compiled for purpose of assisting *DATSON* distributors and dealers for effective service and maintenance of the *Model P/L410*. 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 *DATSON Spare Parts* should be used as replacements.

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SPECIFICATION

MAJOR SPECIFICATION

Name and Model of Vehicle		Datsun P410	Classification	S	
Name of Manufacturer		NISSAN MOTOR CO., LTD.			
Name of Chassis and Model		Datsun P410	Kind of Vehicle	Passenger 4-wheel	
Vehicle Weight	kg	885	Name of Vehicle	Datsun	
Seating Capacity		5	Series of Vehicle	P410	
Vehicle Gross Weight	kg	1,160	Engine Model	E1	
Overall Length	mm	3,990	Total Piston Displacement	1,189	
Overall Width	mm	1,490	Fuel	Gasoline	
Overall Height	mm	1,415			
Interior size of room Space	Length	1,685	Wheel Base	mm	2,380
	Width	1,240	Overhang to the end of Rear Body	950	
	Height	1,130	Cargo Space, of-sec	mm	
Distribution of Vehicle Weight Without Load	Front	505	Tire Size	Front	5.60-13-4P
	Rear	380		Rear	5.60-13-4P
Distribution of Vehicle Weight With Load	Front	600	Proportion of Tire With Load	Front	95.2
	Rear	560		Rear	88.9
Proportion of Front Tire with Load		51.7	Max. Inclination Angle	Front	46°
				Rear	46°
Tread	Front	1,206			
	Rear	1,198			

COMPARISON WITH MAJOR SPECIFICATION OF MODEL P410

ITEM	MODEL	P410	
DIMENSIONS (mm)	Vehicle Overall Length	3,995	
	Vehicle Overall Width	1,490	
	Vehicle Overall Height	1,415	
	Interior Size of Cargo Space	Overall Length	1,685
		Overall Width	1,240
		Overall Height	1,130
	Tread	Front	1,206
		Rear	1,198
	Wheel Base	2,380	
	Min. Road Clearance	175	
	Floor Height		
	Overhang to the Front End (Without Bumper)	605	
	Overhang to the Rear End (Without Bumper)	950	
	Frame Overhang to the Front End		
Frame Overhang to the Rear End			
TIRE SIZE	Front	5.60-13-4P	
	Rear	5.60-13-4P	
WEIGHT (kg)	Vehicle Weight	915	
	Seating Capacity	5	
	Max. Payload		
	Vehicle Gross Weight	1,160 (1,190)	
	Distribution of Vehicle Weight Without Load	Front	505(525)
		Rear	380(390)
	Distribution of Vehicle Weight With Load	Front	610(615)
		Rear	560(575)
	Chassis Weight		
	Distribution (Front)		
Distribution (Rear)			
Height of Gravity Center	mm	565	
PERFORMANCE	Max. Speed	km/h (m/h)	128(80 m/h)
	Flat Road W2 Max Load	km/g	18
	Grade Ability Sin θ		0.34

ITEM		MODEL	P410
PERFORMANCE	Min. Turning Radius	m	5.0
	Brake Stopping Distance (50 km/h)		13.7
ENGINE	Model		E1
	Manufacturer		Nissan
	Classification		Gasoline Engine
	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	73 x 71
	Displacement	ℓ	1,189
	Compression Ratio		8.2
	Compression Pressure	kg/cm ² (r. p. m.)	11.5/350
	Max. Exploding Pressure	kg/cm ² (r. p. m.)	48/3,600
	Max. Mean Effective	kg/cm ² (r. p. m.)	9.3/3,600
	Max. Power B.H.P. /r.p.m. (SAE)		60/5,000
	Max. Torque	m-kg/r p.m.	9.3/3,600(SAE) (69.7 ft-lb)
	Full Road SR/PS-h		210/2,000
	Length x Width x Height	mm	589 x 582 x 690
	Weight	kg	138
	Position of Engine		Front
	Type of Piston		Split Skirt
	Material of Piston		LO-EX
	No. of Piston Ring	Pressure	
Oil			1
Valve Timing	Inlet Open		14° B. T. D. C.
	Inlet Close		50° A. R. D. C.
	Outlet Open		52° B. T. D. C.
	Outlet Close		12° A. B. D. C.
Valve Clearance	Intake		0.35
	Exhaust		0.35
IGNITION SYSTEM	Starting Method		Magnetic Starting System
	Ignition Method		Battery Coil Type

ITEM		MODEL	P410		
ENGINE	Ignition Timing B. T. D. C. /r. p. m.		10°/600		
	Firing Order		1-3-4-2		
	Ignition Coil	Type	C14-50 (1N-12F)		
		Manufacturer	Hitachi, Hanshin		
	Distribution	Type	D-409-1, TVB-4BL (1 ea.)		
		Manufacturer	Hitachi, Mitsubishi		
		Ign. Timing Advance System	Vacuum or Governor		
	Spark Plug	Type	L4S, B-6E		
		Manufacturer	Hitachi, Nihonrokushutoku		
		Thread	m	14	
		Gap	mm	0.7 ~ 0.8	
	Carburetor	Type & No.	2D-3DCE 1 ea.		
		Manufacturer	Nihonkikaki		
		Throttle Valve Bore	mm	28	30
		Venturi Size	mm	21-8	25-14-7
		Main Jet	mm	#96	#115
		Slow Jet	mm	#48	#48
		Pump Jet	mm	#60	
		Power Jet	mm	#55	
		Air Draught		Down	Down
Air Cleaner	Type & No.	Paper Filter 1 ea.			
	Manufacturer	Tsuchiya			
Fuel Pump	Type	Diaphragm			
	Manufacturer	Showa, Kyosan			
Fuel Tank	Capacity of Fuel Tank	41ℓ(10.8 U.S. gallon)			
LUBRICATION SYSTEM	Lubricating Method		Forced Pressure Type		
	Oil Pump Type		Trocod Type Teth		
	Oil Filter		Paper Filter		
	Oil Pan Capacity	ℓ (U.S. gal.)	2.9 (0.8)		
COOLING SYSTEM	Type		Water Cooling Closed Type		
	Radiator		Maccord Closed Type		
	Capacity of Cooling Water		ℓ	4.7	
	Type of Water Pump		Centrifugal Type		
	Thermostat		Beller Type		

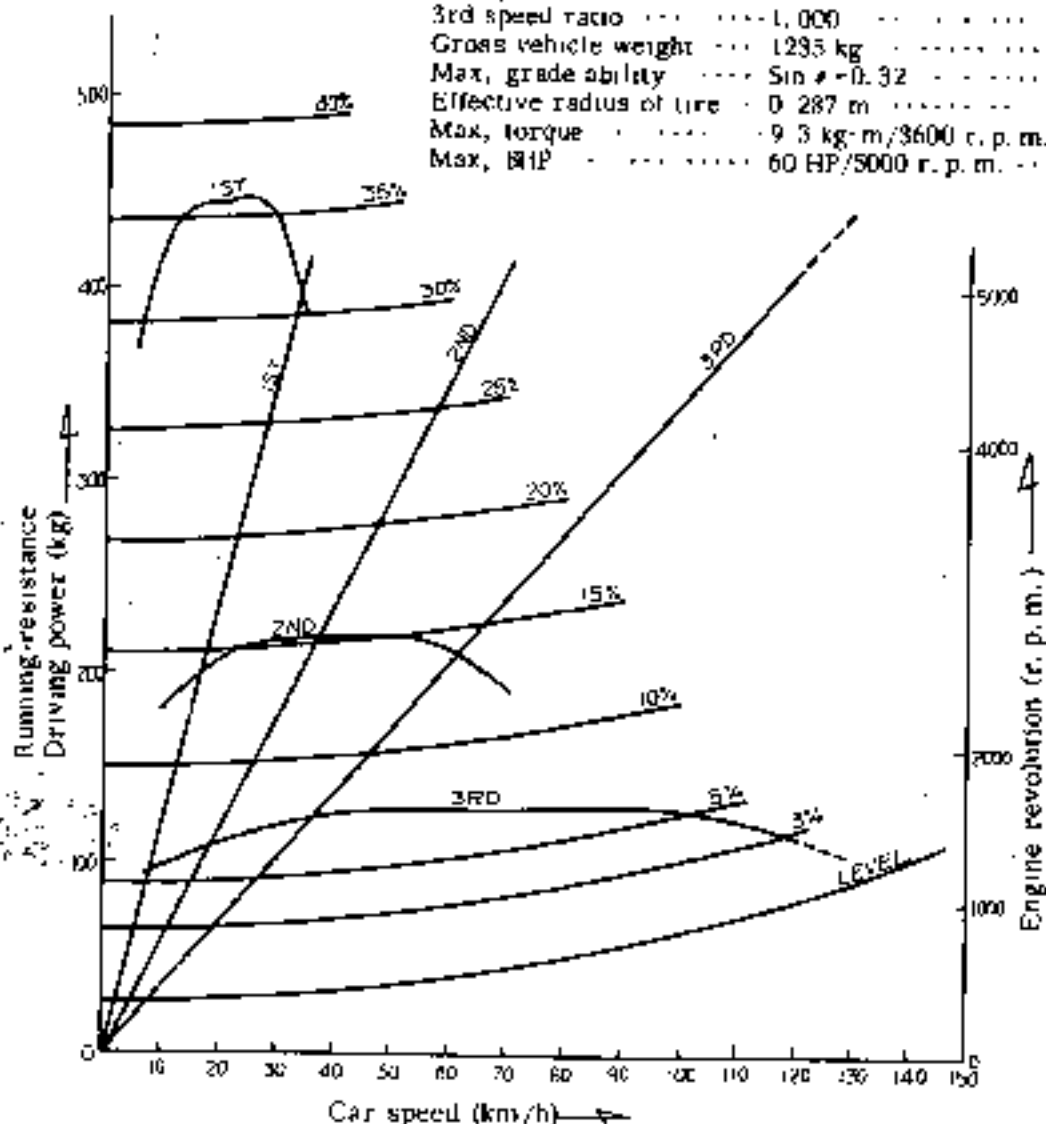
ITEM		MODEL	P410	
BATTERY	Type of No.		ZSMB, 14M2	
	Voltage V		12	
	Capacity A. H.		40	
GENERATOR	Type		AC300-12AIR	
	Manufacturer		Mitsubishi	
	Generating Method		Alternator	
	Voltage V		12	
	Capacity	kw		0.3
	Voltage Regulator			RI-A2
STARTER	Type		S114-72	
	Manufacturer		Hitachi	
	Voltage & Power V-HP		12-1.4	
RUNNING DEVICE	Engine-Transmission Mechanism		Engine-Clutch Transmission	
TRANSMITTING DEVICE	Clutch	Type	Single Dry Disc Hydraulic Operation	
		Number of Plate	1 (facing 2)	
		Outdia. x In dia. x Thickness	200 x 130 x 3.5 mm	
		Total Friction Area	163 cm ²	
	Transmission	Type	Sync. Framed on 2nd Top & 1 Reverse	Sync. Framed on 2nd 3rd & 4th 4 Forward 1 Reverse 1010-019
		Operating Method	Remote Control	Floor Shift
		1st	3.518	3.945
		2nd	1.725	2.402
		3rd	1.000	1.490
		4th		1.000
Reverse	4.125	5.159		
PRE-PELLER SHAFT	Length x Outdia. x In dia.		1,237 x 68.9 x 65.3 mm	
	Type of Universal Joint		Spicer	
FINAL GEAR	Final Gear	Type of Gear	Hypoid	
		Gear Ratio	4.375	
DIFF. GEAR	Housing Type		Banjo	
	Type of Number of Gear		Straight Bevel Pinion (2)	

ITEM		MODEL	P410
STEERING SYSTEM	Type of Gear		Cam & Lever
	Gear Ratio		14.8
	Steering Angle Out		28°36'
	Steering Wheel Dia. mm		405
RUNNING DEVICE	Wheel Arrangement		2 Front & 2 Rear
	Front Axle		Wish Bone Ball Joint Type
	Toe-In mm		3
	Camber		1°30'
	Caster		1°30'
	Inclination Angle of King Pin		6°30'
	Type of Rear Axle		Semi-Floating Type
BRAKE SYSTEM	Master Brake	Type	2 Leading (Front) Leading Trailing (Rear)
		Lining Dimension (Front)	40 x 4.5 x 215
		Lining Dimension (Rear)	40 x 4.5 x 215
		Total Braking Area (Rear) cm ²	228.6
		India. of Drum (Front)	25.40
		India. of Drum (Rear)	23.81
	Oil Brake	Inner Dia. of Master Cyl. mm	22.22
		India. of Wheel Cyl. (Front) mm	25.40
		India. of Wheel Cyl. (Rear) mm	23.81
		Max. Oil Pressure kg/cm ²	115
	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
SUSPENSION	Front		Independent Suspension with Double Wish Bones, Coil Springs
	Coil Spring Size Length x Width x Thickness - No.		14 x 94 x 325. 5 - 8

ITEM	MODEL	P410
SUSPENSION	Rear	Parallel Semi-Elliptic
	Spring Size Length x Width x Thickness - No.	1200 x 60 x $\frac{6}{5} - \frac{2}{2}$
	Helping Spring	mm
	Shock Absorber (Front)	Telescopic Double Action
	Shock Absorber (Rear)	Telescopic Double Action
	Stabilizer (Front)	Torsion Bar Type
	Stabilizer (Rear)	Torsion Bar Type
FRAME	Type	
	Section	
	Dimension Height x Width x Thickness mm	

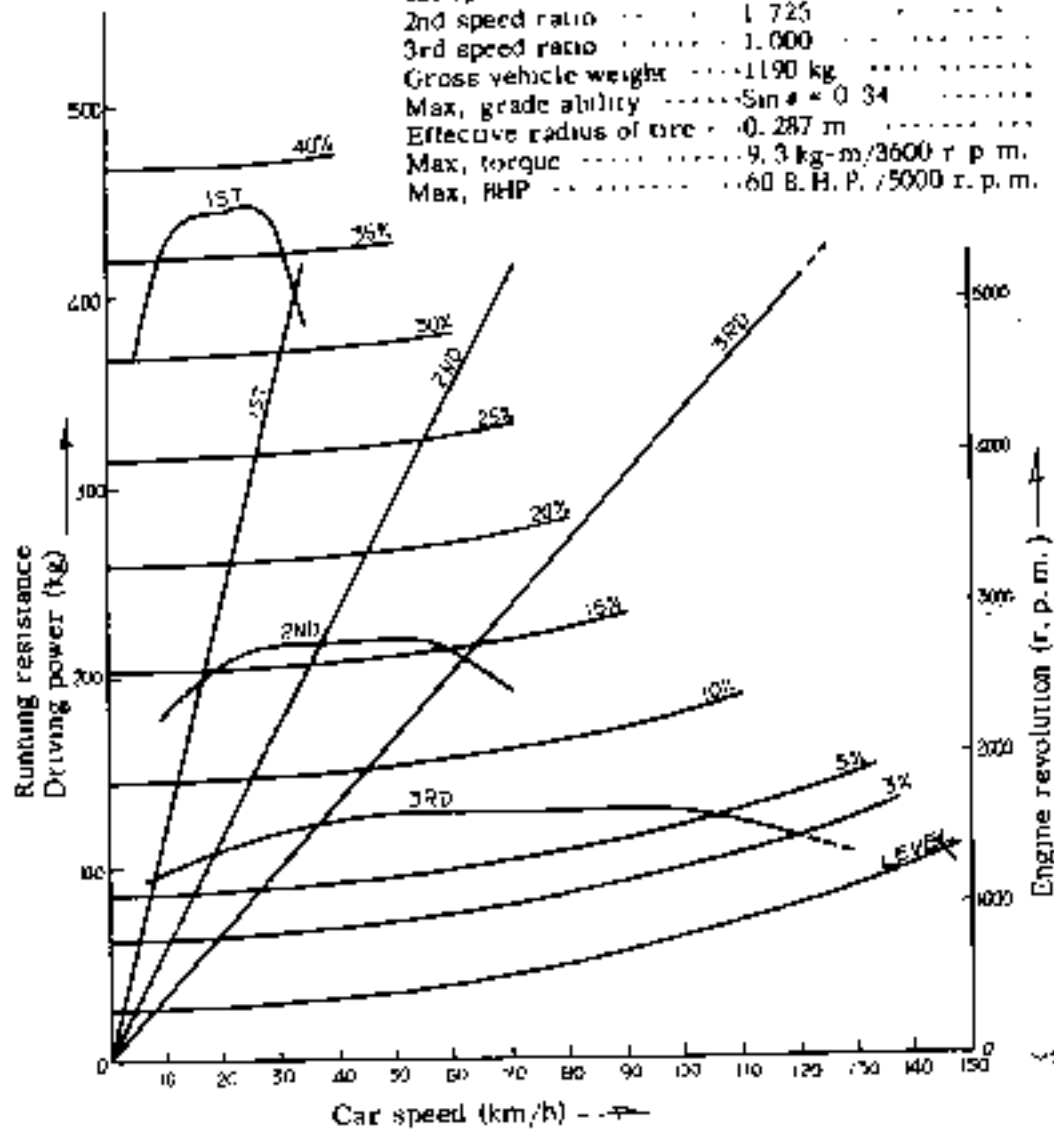
MODEL WP410 RUNNING PERFORMANCE CURVE

Final gear ratio 4.375
 1st speed ratio 3.518
 2nd speed ratio 1.725
 3rd speed ratio 1.000
 Gross vehicle weight 1295 kg
 Max. grade ability $\sin \theta = 0.32$
 Effective radius of tire 0.287 m
 Max. torque 9.3 kg-m/3600 r. p. m.
 Max. HP 60 HP/5000 r. p. m.

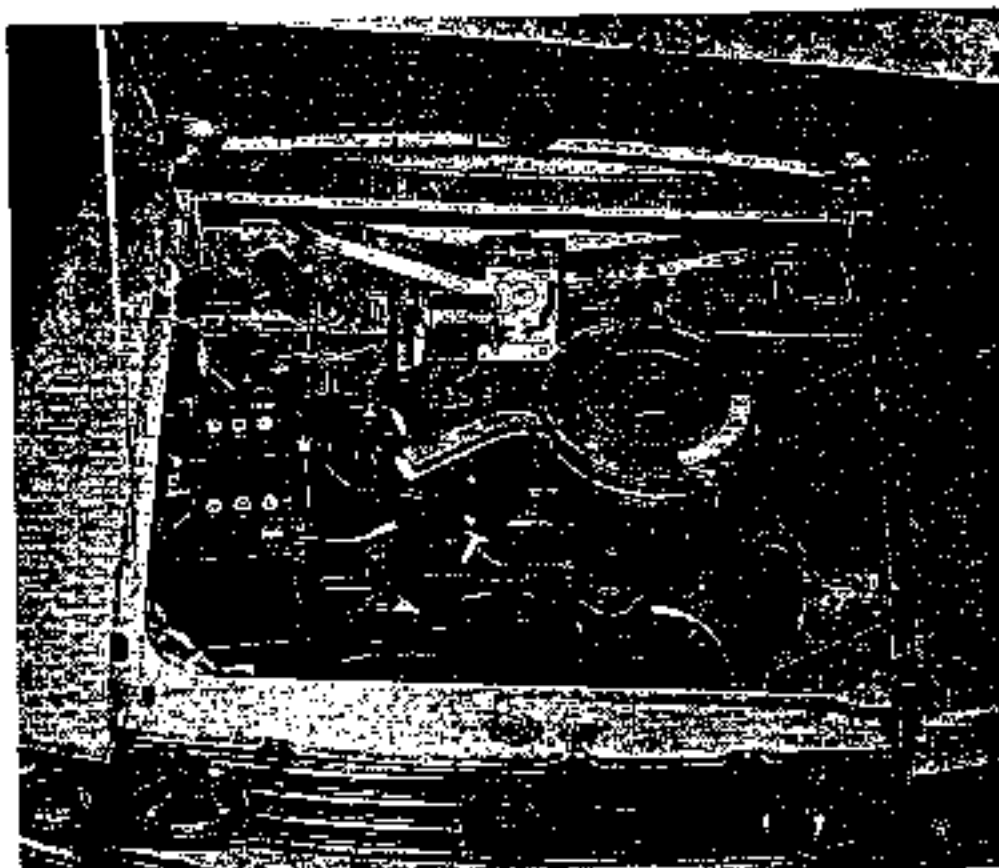


MODEL P410 RUNNING PERFORMANCE CURVE

Final gear ratio 4.375
 1st speed ratio 3.518
 2nd speed ratio 1.725
 3rd speed ratio 1.000
 Gross vehicle weight 1190 kg
 Max. grade ability $\sin \theta = 0.34$
 Effective radius of tire 0.287 m
 Max. torque 9.3 kg-m/3600 r.p.m.
 Max. BHP 60 B.H.P. / 5000 r.p.m.



ENGINE



ENGINE

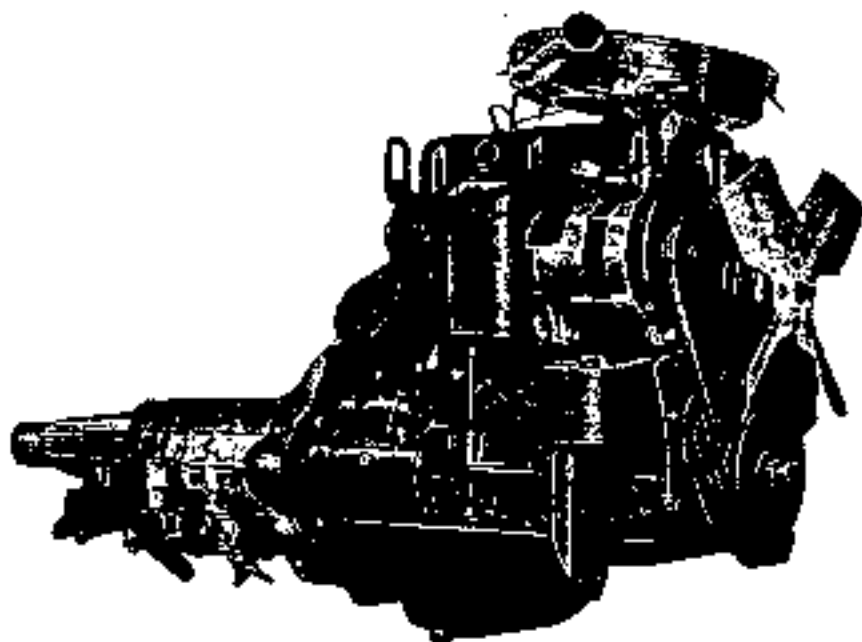
The engine is of monobloc construction, and is fitted with overhead valves operated by rockers and push rods from the camshaft. Oil seals are fitted to the valves. Three steel backed bearings support the camshaft which is chain driven.

The oil pump and distributor are driven from the camshaft, each component having its own drive shaft.

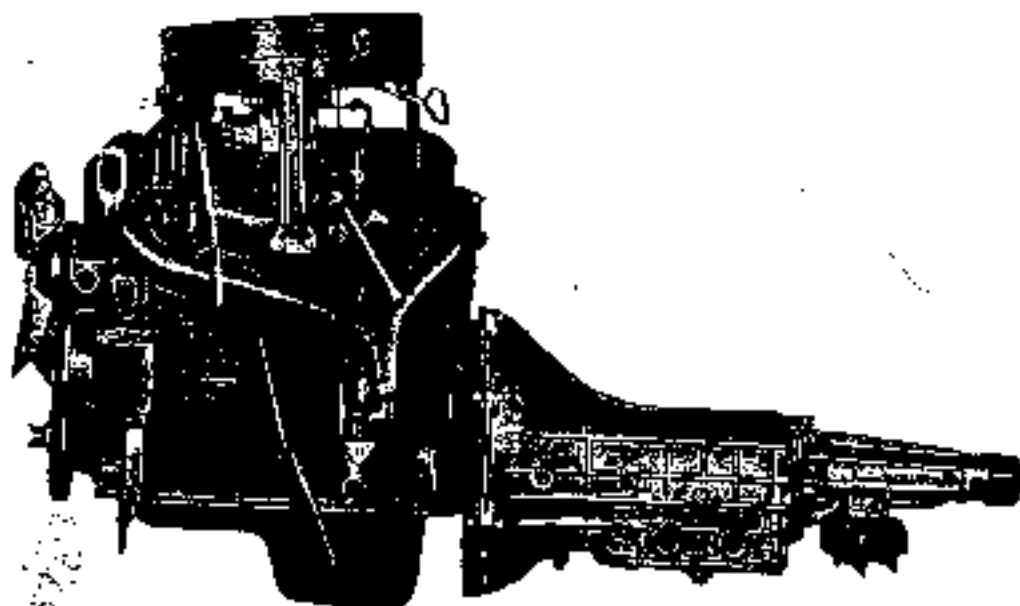
The pistons are each fitted with two compression rings and a slotted oil control ring. Bearings of the thin shell preformed type are fitted to the connecting rod big ends and to the main bearings. A counter-balanced crankshaft is fitted. The end thrust on this component is taken by special washers at the center main bearing. The centrifugal water pump and cooling fan are driven by the dynamo belt.

GENERAL SPECIFICATIONS

No. of Cylinder	4
Bore	73.025 mm. (2.875 in.)
Stroke	71 mm. (2.796 in.)
Volume	1,189 cc.
Max. brake horse power	60 HP. at 5000 r. p. m.
Torque	9.3 kg-m at 3600 r. p. m.
Firing order	1-3-4-2
Valve arrangement	Overhead valve, push rod type
Compression pressure	163 lbs. per sq. in. (11.5 kg/cm ²) at 350 r. p. m.
Compression ratio	8.2 : 1



ENGINE-RIGHT SIDE



ENGINE-LEFT SIDE

COOLING SYSTEM

An efficient cooling system is of major importance to ensure the satisfactory running of the engine and it is therefore necessary to pay particular attention to its maintenance.

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 0.4 kg. per sq. cm. Do not remove the filler cap if the temperature of the coolant is above boiling point or if the engine is running. Topping-up should only be required occasionally to replace water lost through the overflow pipe. Top-up when the engine is cold, and if possible use clean soft water.

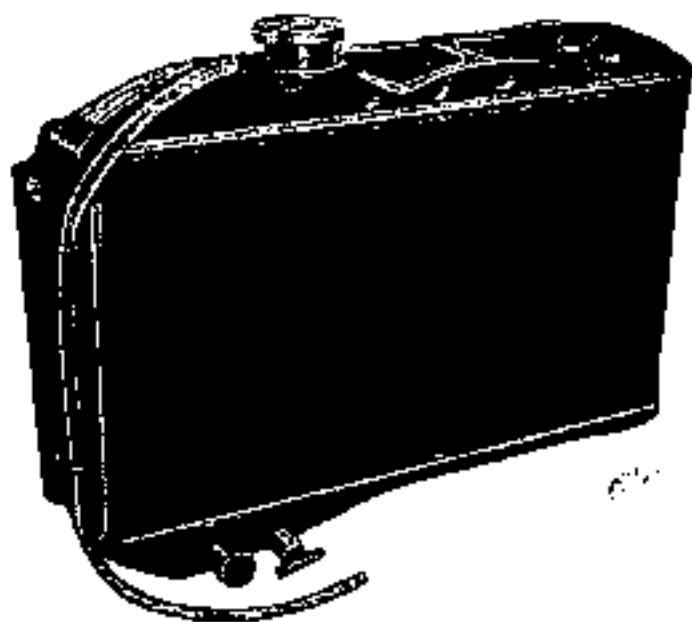


Fig. 1 Radiator

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 5.2 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 cylinder-head. The device consists of metallic bellows, filled with a volatile liquid, 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 restricted.

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

The thermostat itself is detachable, therefore, should the occasion arise, it can be removed from its housing and the hose reconnected to avoid laying up the car. Should the thermostat be tight, there are two tapped holes on the top which may be utilized to ease it 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 $76.5^{\circ} \pm 1.5^{\circ}\text{C}$.

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.



Fig. 2 Pellet Thermostat

Overheating

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

Fan Belt Adjustment

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

A New belt can be fitted by first loosening the clamp bolts (Fig. 3), 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 alternator away from the engine. The belt should be sufficiently tight to prevent slip, yet the belt should have 10 to 15 mm slack between the generator and crankshaft



Fig. 3 Fan Belt Adjustment

pulley when the midspan is pushed firmly

After the correct tension has been obtained, securely lock it in position again.

Front 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 anti-freeze solution as necessary. Excessive topping-up with water reduces the degree of protection afforded. Solution must be made up in accordance with instructions supplied with the container.

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 anti-freeze is not used the following precautions must be taken during frosty weather 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 mats. 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 anti-freeze in the winter and again when taking it out in the spring. The water should be allowed to run through until it comes out clear from the drain taps. At intervals a stiff piece of wire should be inserted into the taps during draining to ensure that they are not becoming clogged with sediment.

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

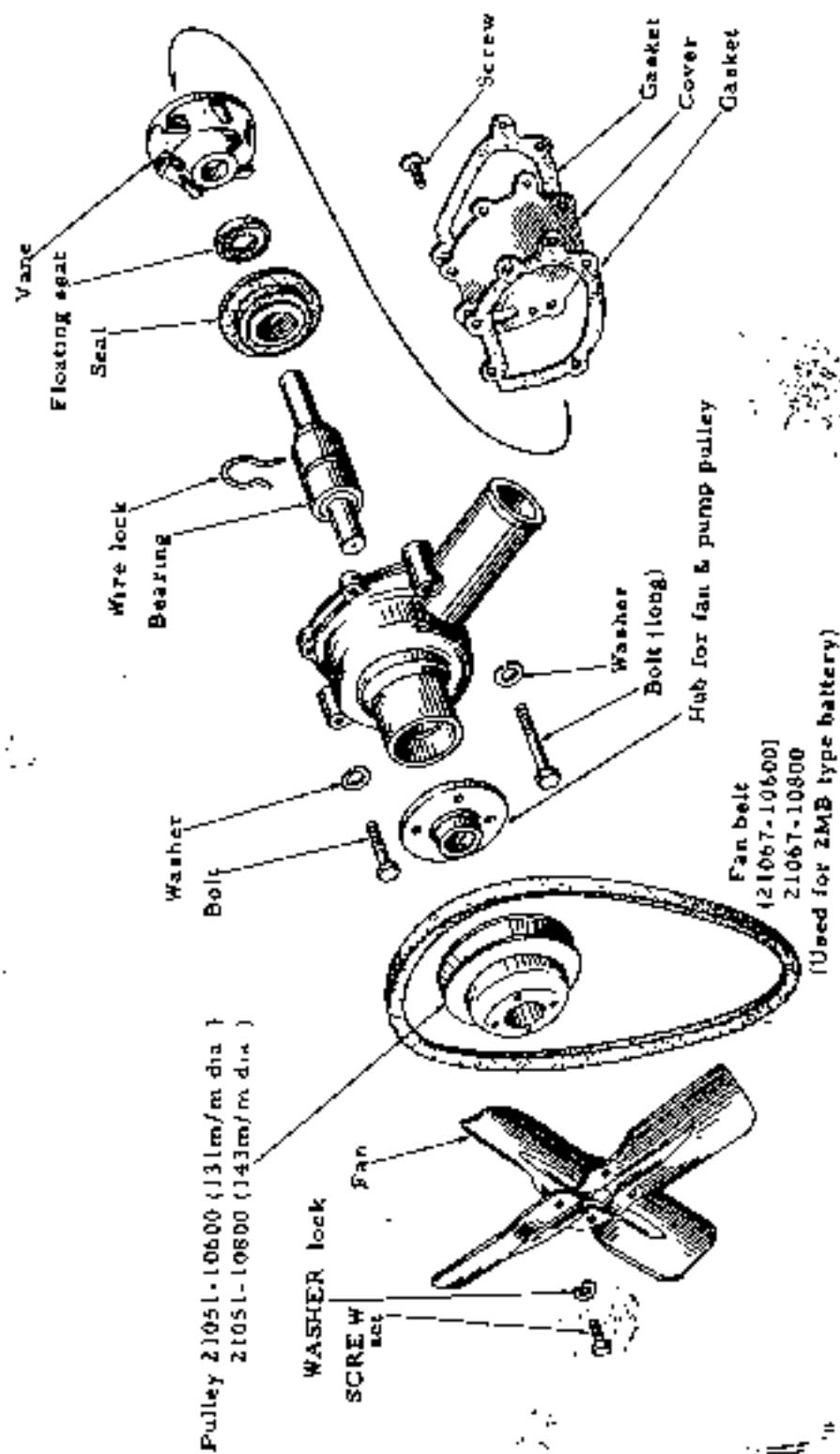


Fig. 5 WATER PUMP

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 lunge 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 1**)

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

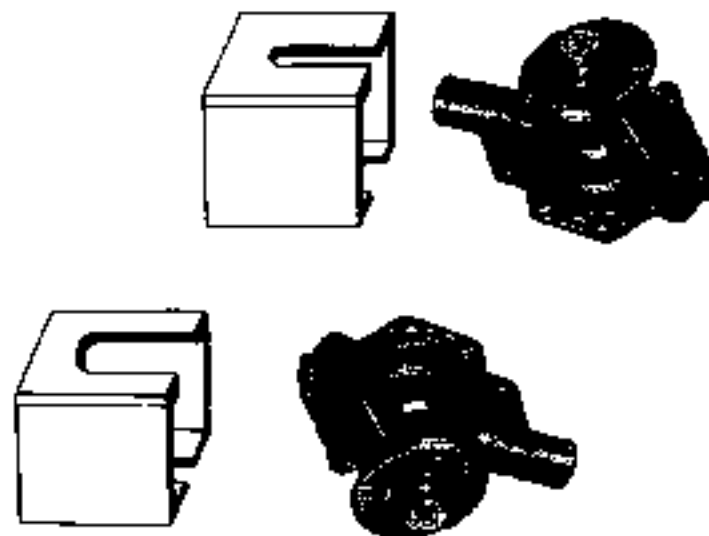


Fig. 4

The shaft and ball bearing assembly can be drew out from the body
Thus take out the vane, floating seal and seal which remained the pump body.

Reassembly

The reassembling of the pump is a reversal of the disassembly procedure, but a care should be taken to ensure that the shaft assembly is fitted correctly for a slit (a hole of set ring) with a groove of shaft so as to insert and set the said ring correctly.

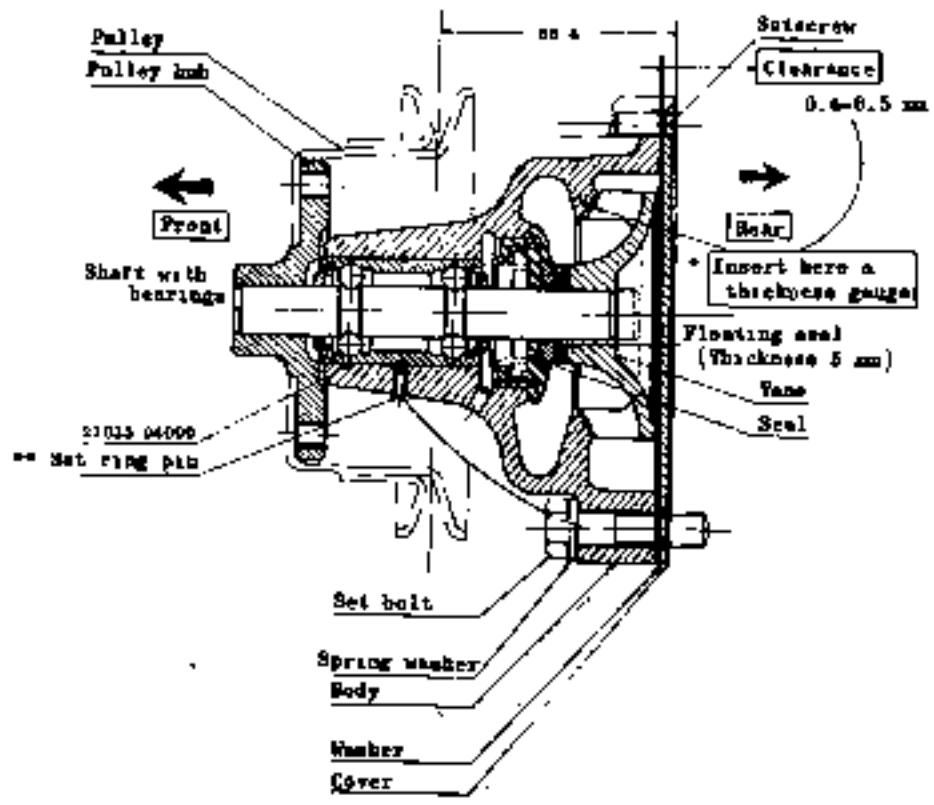


Fig. 6
Section View of the Water Pump



Fig. 7

Adjusting the Clearance the Vane End and Body

First, press down the shaft fitting with a groove line to insert the set pin.

Inserting thickness gauge (thickness 0.4-0.5 mm) between the vane end on the U block bench. Take out the thickness gauge and find out good condition. Screw up with the cover and cork washer.

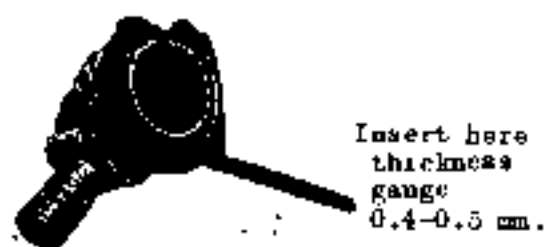
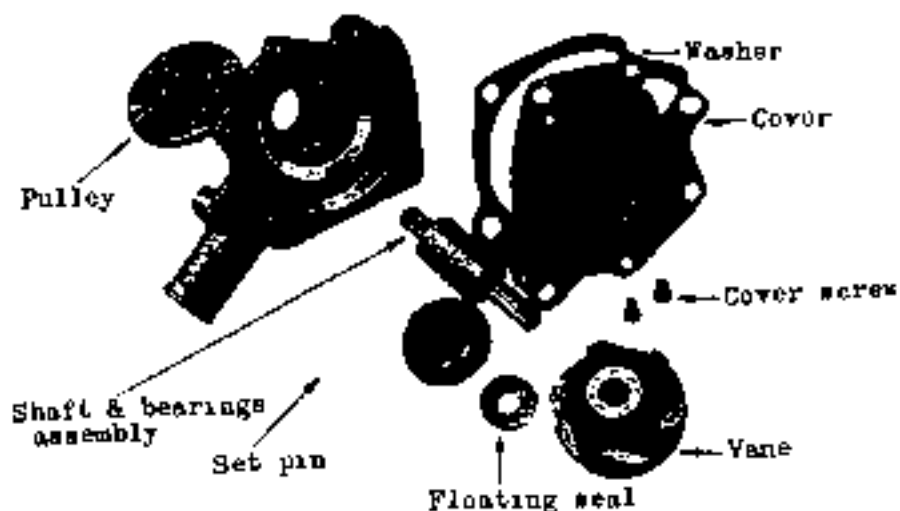


Fig. 8

LUBRICATION

Circulation

Pressure lubrication is used throughout the unit and is provided by an eccentric non-draining oil pump. The oil pump is bolted into the left hand side of the crankcase, and is driven from the camshaft gear by a short vertical shaft.

Oil is drawn into the pump via the filter and is delivered through internal oilways to the non-adjustable relief valve which is situated at the rear left-hand side of the crankcase.

From the relief valve the oil passes into the main oil gallery on the right-hand side of the engine. The flow then passes via connecting oilways to the main, big end and cam shaft bearings through drillings in the crankshaft. The connecting ends are drilling in the cylinder block and the rear rocker shaft bracket, to lubricate the rockers, and then drains back into the engine sump via the push rod apertures. 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, two grooves in the front journal register with a small hole in the camshaft thrust plate thus allowing a small amount of oil to pass into the timing case twice during each revolution of the camshaft to provide lubrication for the timing chain and gears. From the timing case the oil returns via a drain hole back to the engine sump. The filter therefore forms part of the main oil gallery and as such is filled with oil under pressure.

A proportion of the oil enters the element through holes in the casing, and passes through the element into the annular space round the center bolt.

This space is sealed top and bottom so that the oil can only escape through a small hole into the hollow center bolt and from this point back into the sump.



Fig. 1

Draining Oil Pan

The oil pan is a metal pressing, with the drain plug.

On new and reconditioned engines the sump must be drained and refilled with new oil after the first 1,000 km, and subsequently at intervals of 5,000 km.

Drain the oil when the engine is hot since warm oil flows freely and takes with it any sludge or sediment which may have accumulated.

Never use petrol or paraffin for flushing purposes. Such cleaning mediums are never completely dispersed from the engine lubrication system and will remain

to contaminate any fresh oil. This may cause premature bearing failure.

Oil Pressure

The normal operating oil pressure is 60 lb. per sq. in.

The warning light which is embodied in the instrument panel light if the oil pressure drops below 8 lb. sq. in., under these circumstances do not attempt to run the engine or serious damage may result.

Refilling

When refilling the sump do not pour the oil in too quickly, as it may overflow from the filler orifice and mislead the operator as to the quantity of lubricant in the engine.

Before testing the level of the oil, ensure that the vehicle is as near level as possible. Always wipe the dip-stick clean with a non-fluffy cloth before taking the reading. It should be remembered that time must be allowed for new oil to reach to sump before reading the dipstick.

Check for Low Oil Pressure

Check the level of oil in the engine sump by means of the dip-stick and top up if necessary. If the warning light is still on after refilling the sump, switch off and ascertain that the gauge strainer in the sump is clean and not choked with sludge, also that no air leakage exists at the strainer union on the suction side of the oil pump being defective, remove the unit and rectify the fault.

Oil Release Valve

The oil release valve should be examined.

If the engine bearings are worn the oil pressure will be reduced. A complete bearing overhaul and the fitting of replacement parts is the only remedy, necessitating the removal of the engine from the chassis.

Removing the By-pass Filter

A new filter element should be fitted every 15,000 km.

The filter forms part of the main oil gallery of the engine. To remove the filter it is only necessary to unscrew the center bolt when the bowl can be removed from



Fig. 2 Oil Release Valve

- ① Sealing
- ② Spring
- ③ Screw Plug
- ④ Washer

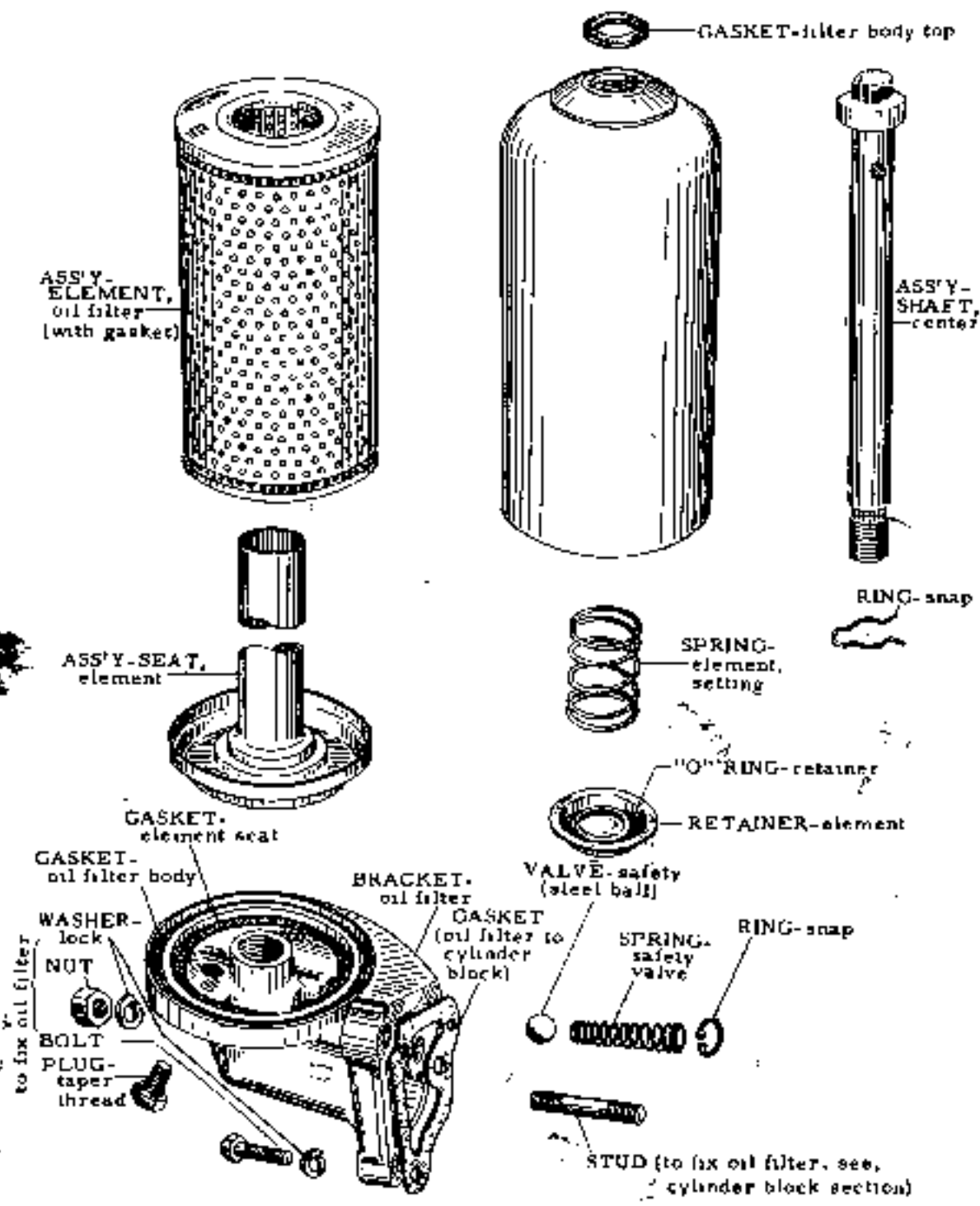


Fig. 3 OIL FILTER

the crankcase, complete with the element. Take care not to lose the rubber sealing ring. Remove the element and note the assembly of the components.

Wash out the bowl with petrol, so that it is clean. It is important to thoroughly dry the bowl to obviate any contamination of the lubricating oil.

Replacing the Filter

With the center bolt, the washer and the spring together with the collar in position in the bowl, insert a new element. Place the distance piece over the center bolt with the flanged end towards the element. The bowl of filter must now be filled with oil. Offer up the complete assembly to the engine and secure into position by means of the center bolt.

Removing the Oil Pan

The sump capacity is 3.1 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 Strainer

With the sump lowered it is possible to remove the oil strainer through which oil is drawn into the oil pump. To remove the strainer undo the union connecting the oil pick-up to the pump and unscrew the securing bolts.

The strainer may be dismantled for cleaning purpose by removing the delivery pipe flange bolts.

Notice that there are the dowel pins to the cover which must be positioned correctly when refitting.

Removing the Oil Pump

Remove the oil pan and pick up strainer. Three of the five bolts securing the oil pump bottom cover are long enough to secure the pump to the crankcase.

Fig. 4 illustrates the pump in exploded form. Unscrew the long bolts and remove the pump with its drive shaft.

Dismantling the Oil Pump

Remove the setscrews and spring washers which secure the cover to the body and take off the cover. On tilting the body upside down the inner rotor with its drive shaft, and the outer rotor will slide out.

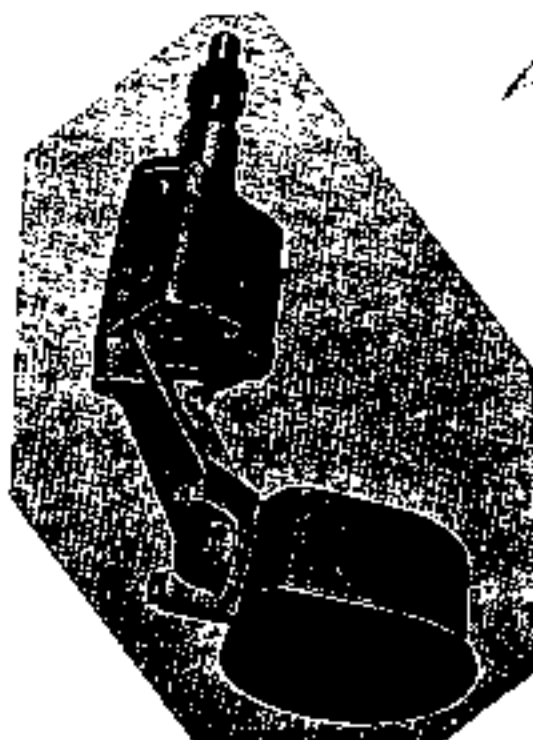


Fig. 4

Refitting the Sump

Clean out the sump by washing it in paraffin, the care to remove any traces of the paraffin before refitting the oil pan to the engine. Pay particular attention to the oil pan and crank case 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 righting them up evenly.

Reassembling the Oil Pump

The outer rotor Fig. 4, has a chamfered edge. It is of great important that this chamfer be towards the base of the body. Failure to assemble in this way will result in the cover is rightened down. Insert the slotted end of the drive shaft into the body and bring the rotors into mesh.

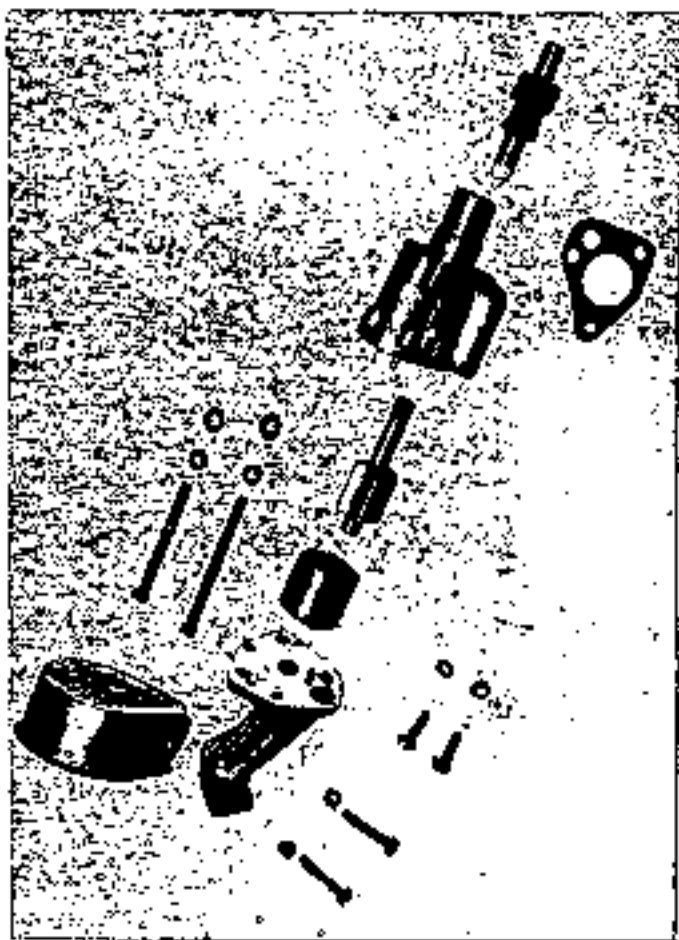


Fig. 5 Oil Pump

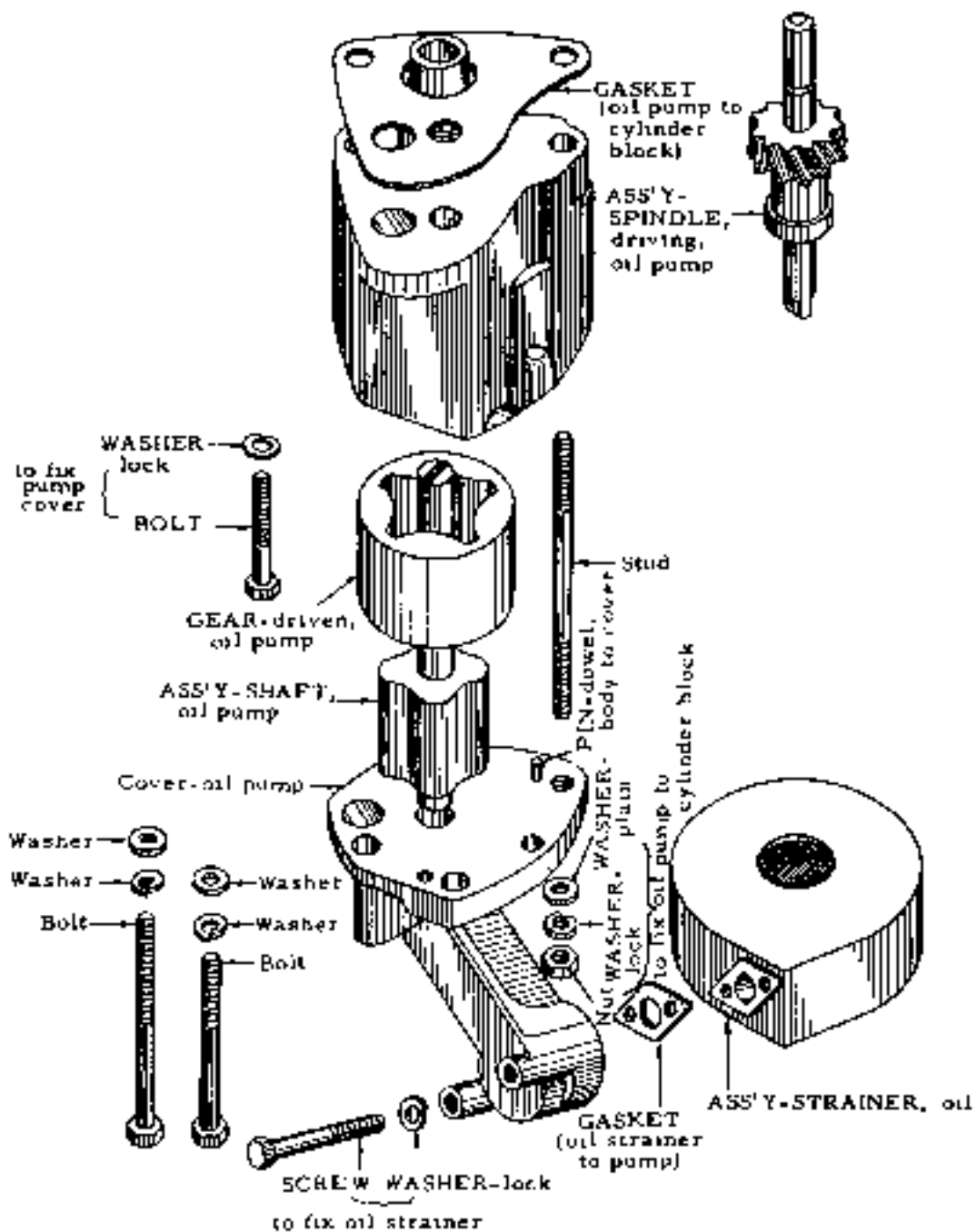


Fig. 6 OIL PUMP

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 starting dog nut locking washer. Unscrew the starting dog nut by using heavy duty "Shock type" spanner.

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

Pull off the crankshaft pulley.

Removing the Timing Cover

The timing cover is secured by set-screw bolts, each having a shakeproof washer and a special plain-washer. Note that the special washer is of elongated shape and is fitted next to the timing cover flange.

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.

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.

Fit the crankshaft and camshaft gears into their respective shafts. Ensure the timing marks are opposite and in line.

Turn the engine crankshaft until the keyway is at T. D. C. and the camshaft with its keyway in approximately the one o'clock position.

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

The same number of packing washers taken from behind the crankshaft gear 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 packing washers.

Fit the oil thrower behind the crankshaft gear so that its concave face is towards the front of the car, and check that the felt washer is in position.

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 cooling 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 nuts, because four of the rocker shaft fixing nuts also secure the cylinder head.

If the cylinder head nuts are not slackened distortion may result and allow water to find its way from the cooling 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 bracket nuts and remove the rocker assembly. Complete with brackets and rockers.

Dismantling the Assembly

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

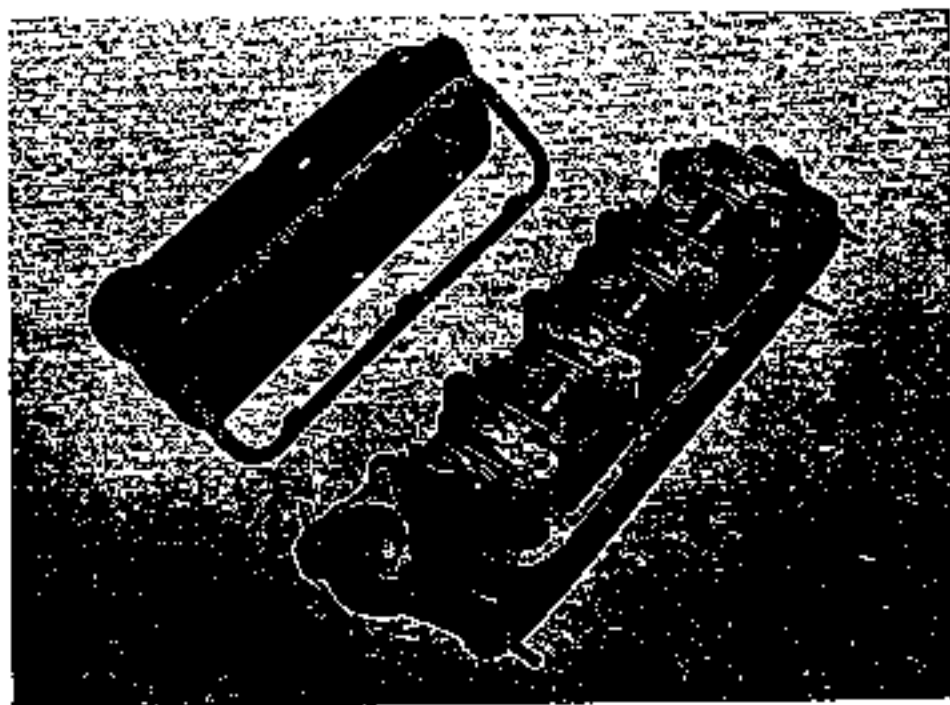


Fig. 1 Cylinder Head

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 achieved by turning the engine by hand until No. 1 push rod reaches its lowest position.

Unblock 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 bushes 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 straight forward reversal of the dismantling process.

Adjusting Valve Rocker Clearances

Remove the air cleaner and rocker cover.

There should be a clearance of 0.014 in. (0.35mm) 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.

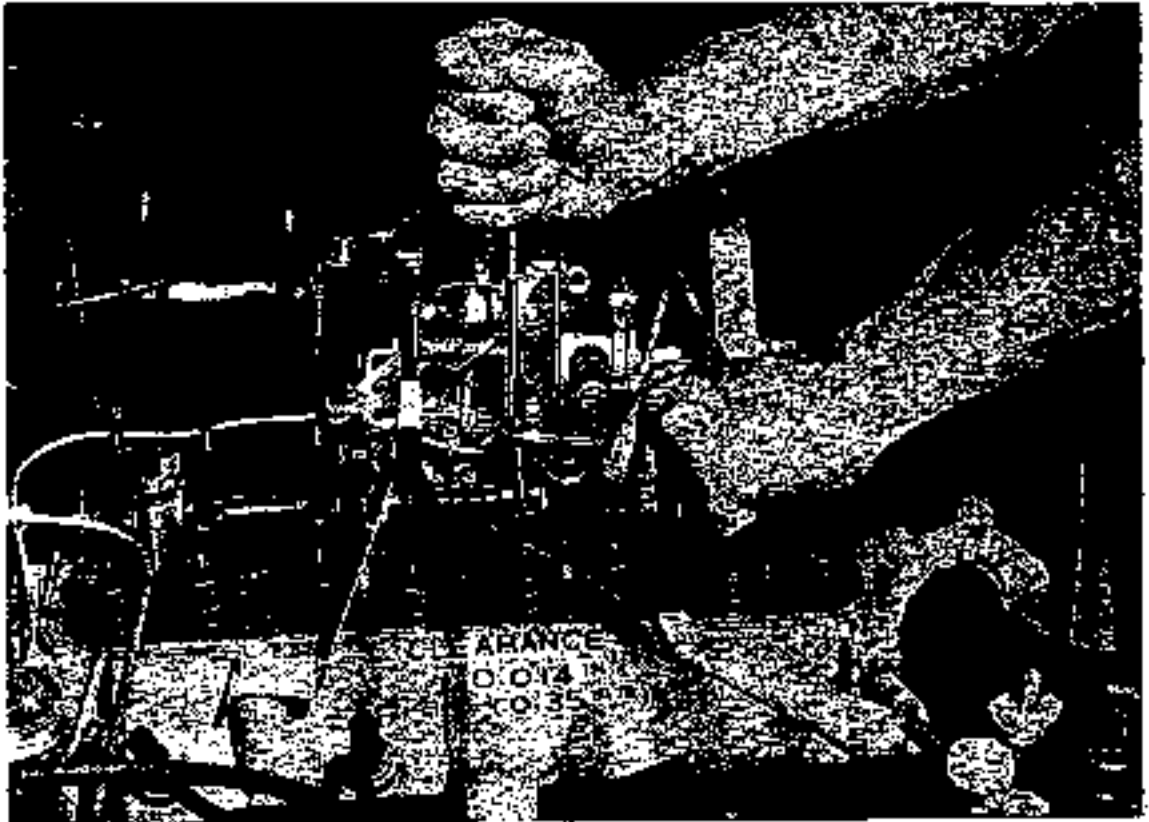


Fig. 2 Adjusting the Rocker Clearance

To adjust (Fig. 2) insert a screw driver in the adjusting screw slot and slacken the lock nut. Then insert .014 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

Rocker shaft - Length - Outer diameter	355.63 mm (14 1/32 in.) 15.850 - 15.875 mm (0.624 - 0.625 in.)
Rocker arm bush - Type - Outer diameter (before mounting) - Inner diameter (Reamer-finished dimension after mounting) - Thickness before reamer finishing - Clearance	White metal with steel lining 19.075 - 19.101 mm (0.751 - 0.752 in.) 15.888 - 15.901 mm (0.625 1/2 - 0.626 in.) 1.644 - 1.727 mm (0.065 - 1/2 - 0.068 in.) 0.013 - 0.051 mm (0.0001/2 - 0/002 in.)
Rocker arm - Bore - Lever ratio	19.012 - 19.37 mm (0.748 1/2 - 0.749 1/2 in.) 25.003 to 35.719 mm (63/64 to 1 13/32 in.)

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 air cleaner, 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 nuts 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 breaking 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.

Decarbonising

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 inlet 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 carbon 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 require 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 as shown in Fig. 1.

Removal

Remove the two cap retaining collars. Release the valve spring, the valve spring cap, valve oil seal (inlet valve only) and its retainer. Withdraw the valve from the guide.

Keep the valves in their relative positions when removed from the engine, to ensure replacement in their original valve guides.

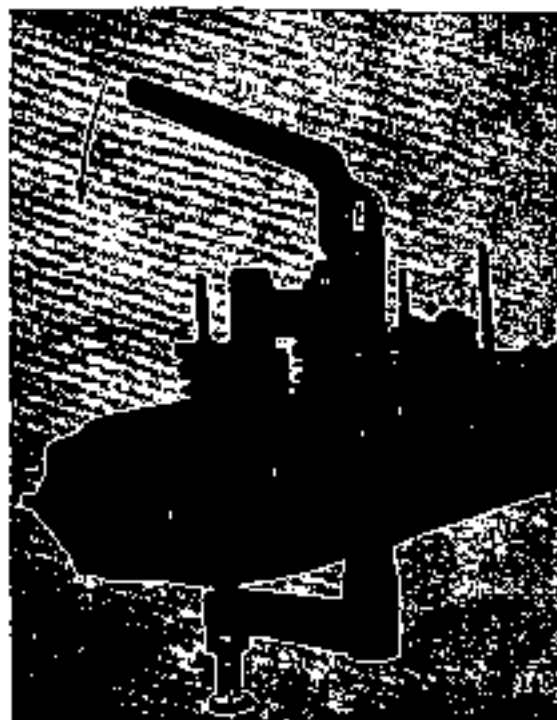


Fig. 1 Valve Spring Compressor.

Replacement

Note that the diameter of the exhaust valve heads are smaller than the inlet valve. To replace the valves, insert each valve into its guide and replace the spring, oil seal and retainer. Fit oil seal chamfered side down words. The oil seals are more easily fitted if they have been soaked in engine oil for a short period before use. The oil seal is used for the intake valve only.

Replace the valve spring and compress the valve spring.

Refit the cap retainers and secure them by means of the valve cotter. Remove the compressor.

Free length mm	Inner Sp. 50 mm	Outer Sp. 52 mm
Length to use and loaded mm-kg.	36.9-13.1 \pm 0.7	38.9-29 \pm 1.5
Turning Nos. of coil	8.5	6.5
Effective turn of coil	6.5	4.5
Dia. of coil wire	5.6 \pm 0.2 mm	8.5 \pm 0.2 mm
Diameter of coil	24 mm	33.7 mm

VALVE SPRING

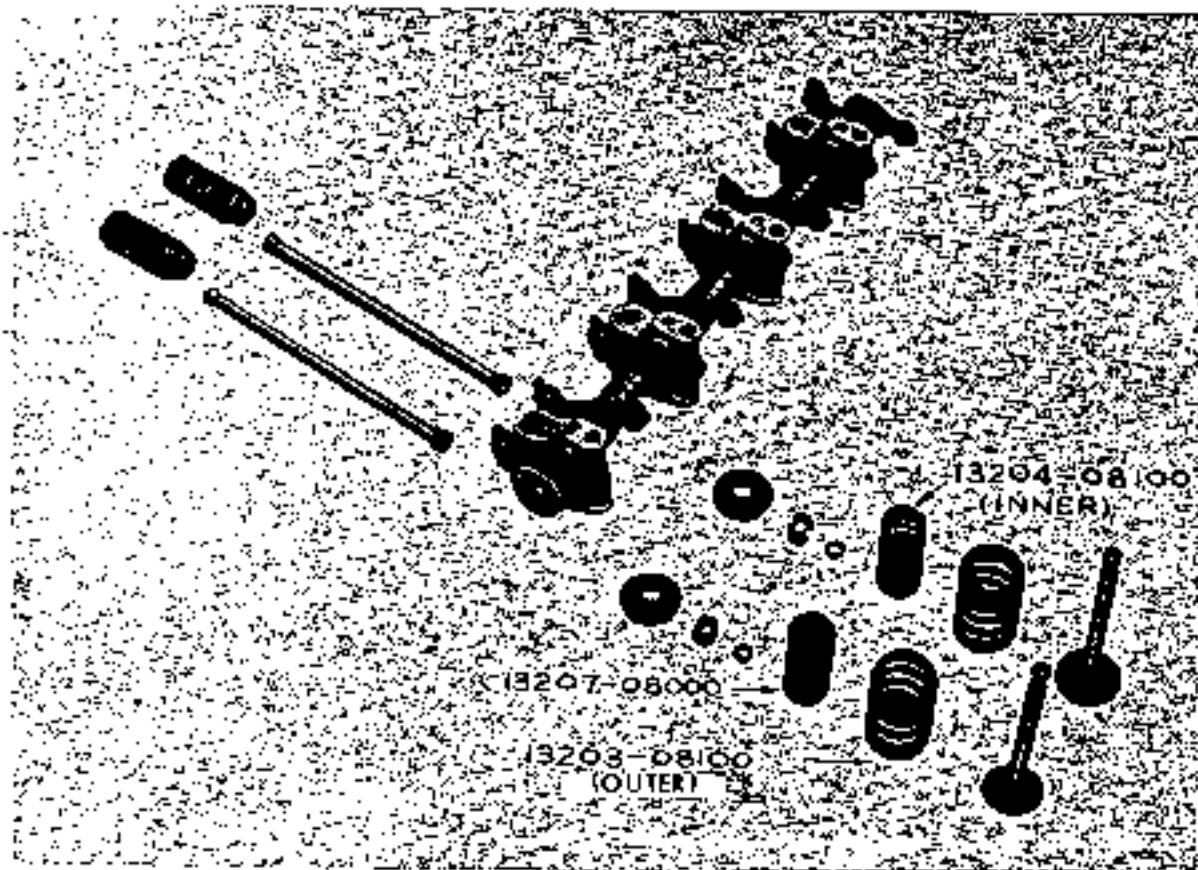


Fig. 2 Valve Spring & Valve Ass'y

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 turning process.

When grinding a valve onto its seating, 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 matt surface is produced on the seating and the valve face.

On completion, the valve seats and ports should be thoroughly 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	34.798-34.935 mm (1.370-1.375 in.)
Exhaust valve	30.023-30.150 mm (1.182-1.187 in.)
Valve seat width	1.63±0.015 mm
Valve stem outer diameter (both intake and ex.)	8.6805-8.6932 mm (0.341 3/4- 0.342 1/4 in.)
Overall length	
Intake valve	109.54 mm (4-5/16 in.)
Ex. valve	108.74 mm (4-9/32 in.)

VALVE GUIDE

Length Intake valve	47.63 mm (1-7/8 in.)
Exhaust valve	57.94 mm (2-9/32 in.)
Outer diameter (both intake and exhaust)	14.313-14.440 mm (0.5635-0.5685 in.)
Inner diameter (both intake and exhaust)	8.733-8.860 mm (0.3438-0.3443 in.)
Inner diameter at guide inlet to insert (both intake and exhaust)	14.3 mm (0.5634 in.)
Clearance of valve stem and guide (both intake and exhaust)	0.0394-0.0648 mm (0.0015-0.0025 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 head into place. Fit the cylinder head securing nuts finger tight.

Insert the push rods, replacing 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 eleven cylinder head nuts a little at a time in the order given in Fig. 3, finally pulling them down with a torque wrench set to 45 lbs./ft.

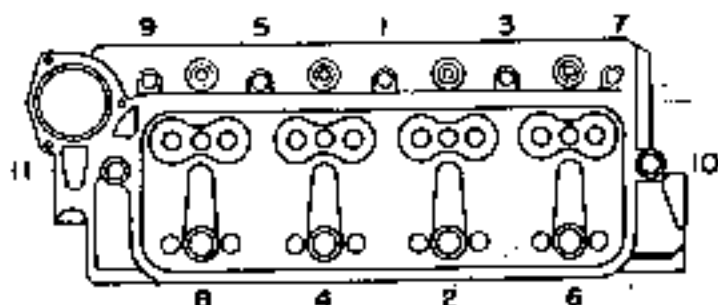


Fig. 3 The Order of Tightening the Cylinder Head Nuts

Reset the valve clearances, and finally check them when the engine is not hot or cold. The cylinder head nuts 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 carburettor, 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 high tension leads. The firing order of the engine is 1-3-4-2. Replace the clip which secures part of the electrical wiring 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 rechecked. 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.

Removing and Refitting Valve Guides

Remove the cylinder head.

Remove the appropriate valve and spring.

Rest the cylinder head with its machined face downwards on a clean surface and drive the guide downward into the combustion space with a drift.

This should take the form of a hardened steel punch. (See Fig 5)

When fitting new valve guides, these should be driven in from the top of the cylinder head.

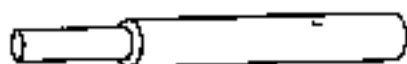


Fig. 5 *Hardened Steel Punch*

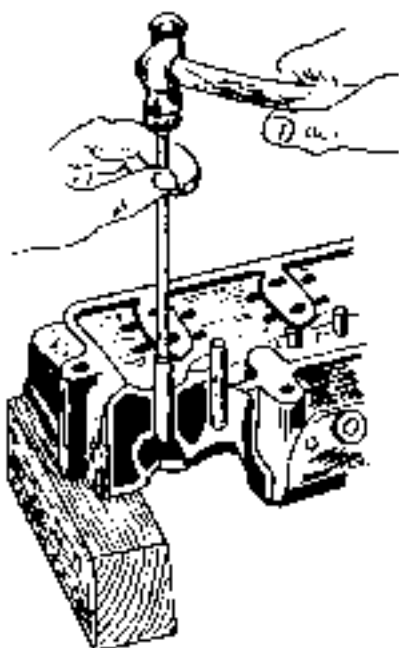


Fig. 4 *Renewing a Valve Guide*

Renewing a Valve Spring in Position

In an emergency a new valve spring can be fitted without removing the cylinder head. When doing this, the applicable piston must be brought to its T. D. C. position to eliminate any possibility of the valve falling into the cylinder.

Remove the spark plug from the cylinder concerned. Hold the valve onto its seating with the aid of a suitable tool such as a bent screwdriver which will pass through the sparking plug orifice, and locate on the valve head. By using the rocker shaft, as a fulcrum point, the spring can be compressed with two screwdrivers or a fork ended bar.

Withdraw the valve cutters and renew the valve spring.

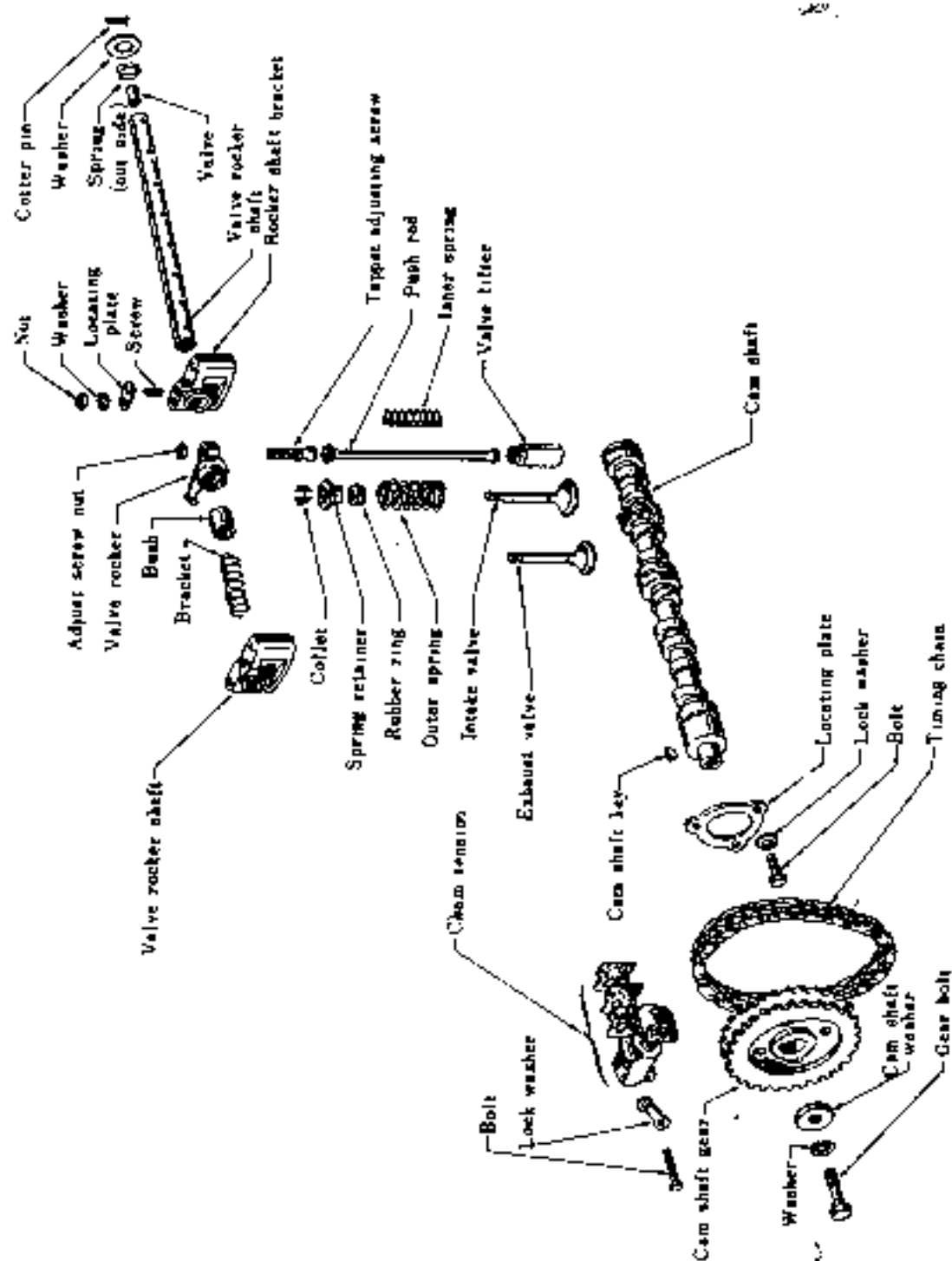


FIG. 6 CAMSHAFT & VALVE GEAR

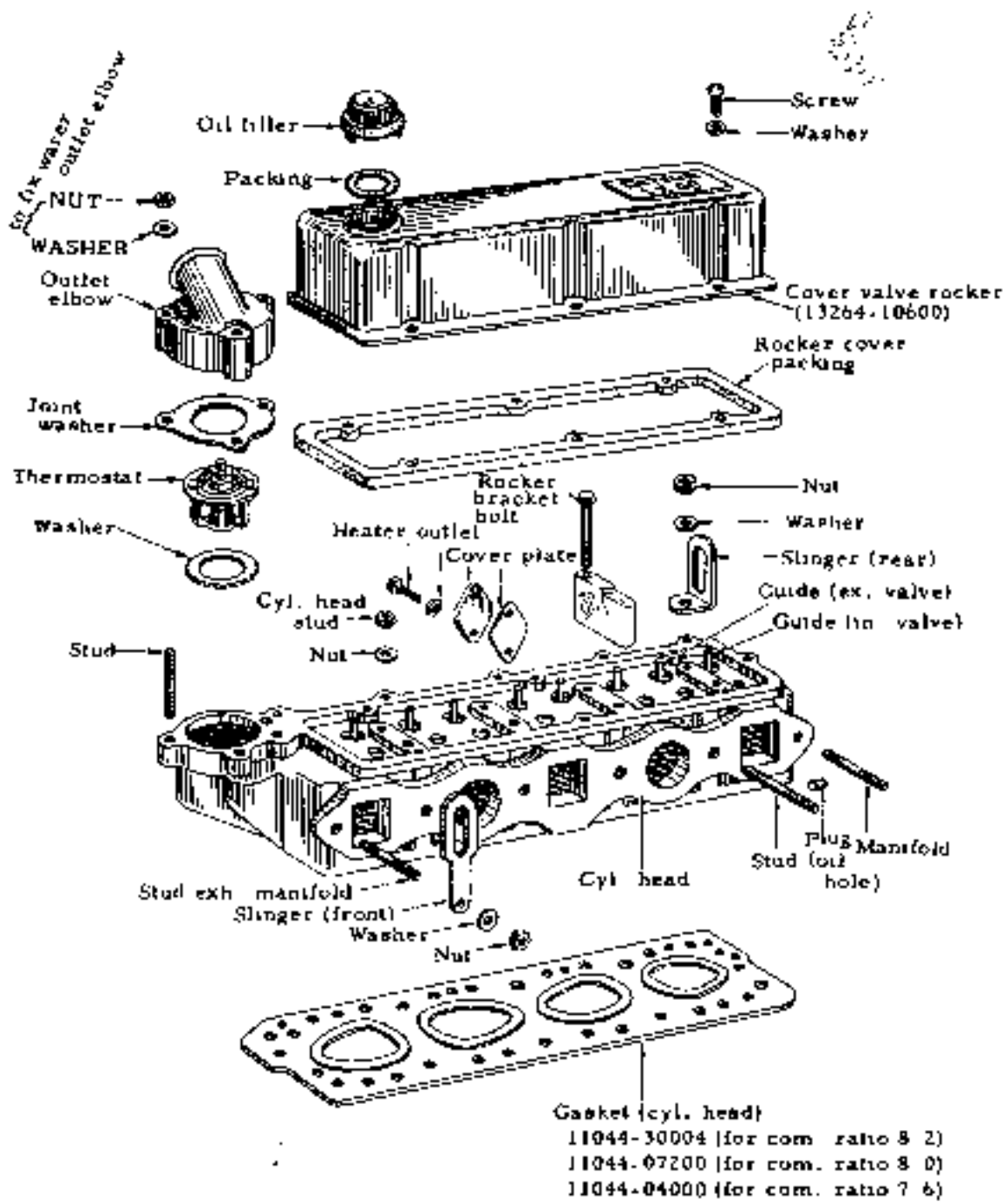


Fig. 7 CYLINDER HEAD

Removing and Replacing the Tappets

Remove the carburetor and the rocker cover, then take off the manifolds.

Disconnect the high-tension leads from the spring plugs, remove the rocker assembly and withdraw the push rods, keeping them in their respective positions so that they will be replaced onto the same tappets.

Remove the tappet covers and lift out the tappets, also keeping them in same locations (Fig. 8).

New tappet should be fitted by selective assembly so that they fall into the guides under their own weight when lubricated.

Assembly is a reversal of the above procedure, but care should be taken to see that tappet cover joints are oil tight, and that the rockers are adjusted to give the correct valve clearance.

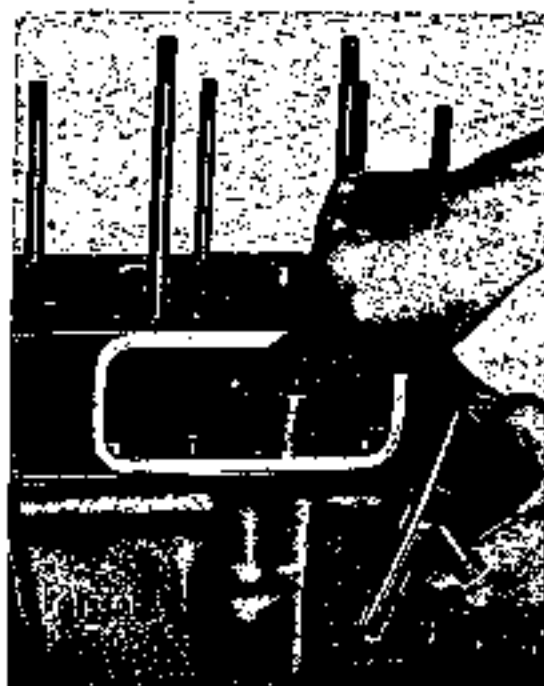


Fig. 8 Removing a Tappet

Piston and Connecting Rod Removal

Drain the cooling water from the engine and radiator. Drain and remove the sump from the engine, then disconnect and remove the oil strainer. Take out the sec screws and rock washers from the big-ends and withdraw the caps. It will be noted that the caps are off-set; 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 them together. The piston and connecting rods must be withdrawn upwards through the cylinder bores.

Release the connecting rod from the crankshaft and slowly push the piston and rod upwards through the cylinder bore.

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 micrometer calipers, and examine the bearing surface for scoring, either defect will necessitate the removal of the crankshaft for regrinding.

CONNECTING ROD

Distance between center of large end and small end	144 ± 0.03 mm
Large end bearing Type	Clevite (F500)
Overall length	25.273-25.527 mm (0.995-0.005 in.)
Thickness	1.8288-1.8352 mm (0.072-0.0725 in.)
Outer diameter	51.346 mm (2.015 in.)
Width of large end	26.8 mm (1.055 in.)
End play of large end	0.203-0.305 mm (0.008-0.012 in.)
Finishing dimension of inner diameter of small end bush Standard	17.450-17.462 mm (0.6870-0.6875 in.)

CRANKSHAFT

Clearance of bearing periphery to cylinder block hole	-0.013-0.050 mm
Material	White metal (Block side) Clevit metal (Cap side)
Clearance of bearing inner diameter and crank journal	0.0127-0.0508 mm (0.0005-0.0020 in.)
Diameter of main journal	50.183-50.825 mm (2.0005-2.001 in.)
End play of crankshaft	0.051-0.076 mm (0.002-0.003 in.)
Crank pin diameter Standard	47.640-47.652 mm (1.875-1.876 in.)
Difference of crank pin diameter	Less than 0.012 mm (0.00048 in.)
End play when flywheel was installed	Less than 0.05 mm (0.002 in.)

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 0.010, 0.020, 0.030 and 0.040 etc.

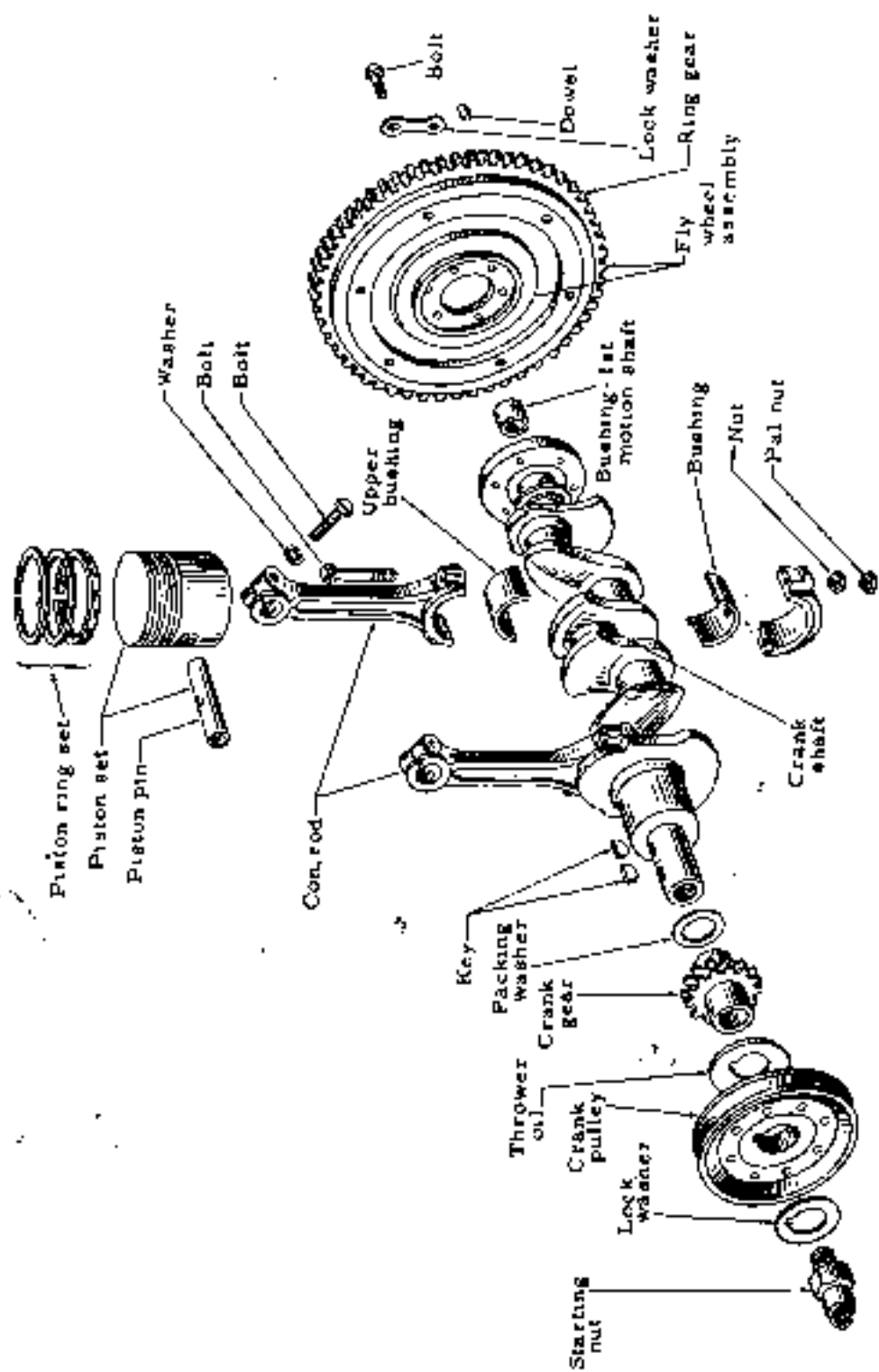


Fig. 9 PISTON & CRANK SHAFT



Fig. 10 Crank Shaft

PISTON

Replacing Pistons and Connecting Rods

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

Compress the piston rings with inserting piston using tool (Fig. 11), 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.

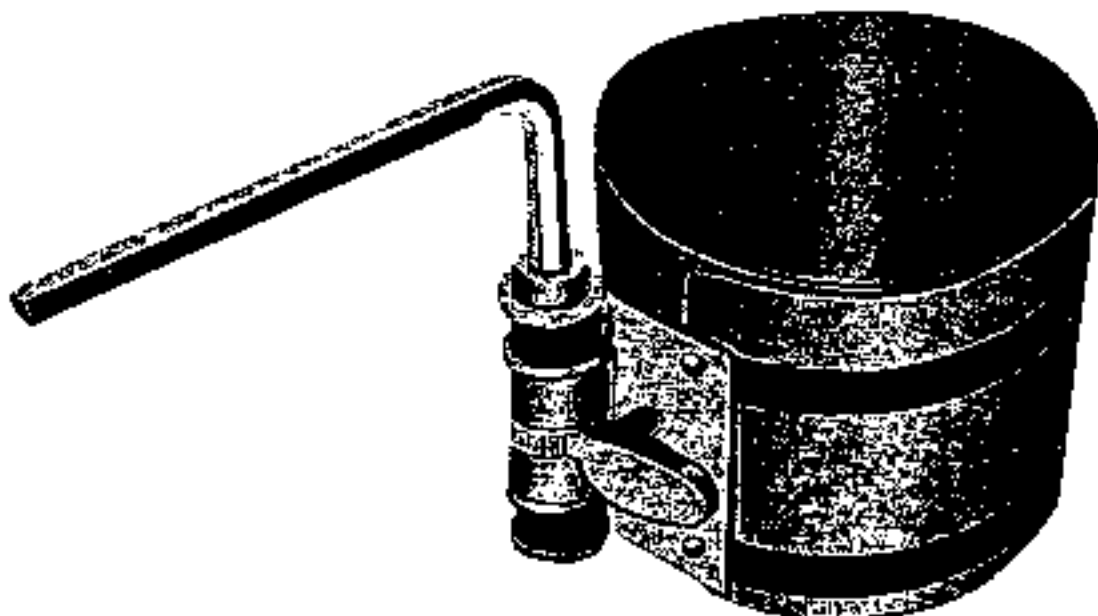


Fig. 11 Piston Adapter

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 two 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 21.7-24.6 lbs./ft.

Finally knock back the lock washers.

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.

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 70°F. (21.1°C.)

When reassembling, ensure the gudgeon 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 pinch bolt is not damaged.

PISTON PIN

Diameter	17.447-17.452 mm (0.6869-0.6871 in.)
Over size $5/1000$ in.	17.574-17.579 mm (0.6919-0.6921 in.)
$10/1000$ in.	17.701-17.706 mm (0.6969-0.6971 in.)
$15/1000$ in.	17.828-17.833 mm (0.7019-0.7021 in.)
Length	64.20-64.45 mm (2.568-2.578 in.)
Clearance of pin and pin hole	Degree to be able to push it by finger at 20°C.
Clearance of pin and connecting rod bush hole	0.003-0.010 mm (0.0001-0.0004 in.)

PISTON AND BORES

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

PISTON RINGS

The piston ring gap should be 0.008-0.013 in. (0.203-0.330 mm) when checked in the cylinder bore. The clearance of the compression rings in their grooves should amount to 0.0015-0.0035 in. (0.038-0.089 mm) and the oil control ring 0.0016-0.0036 in. (0.041-0.092 mm)

Because 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 noisy 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), and 0.040 in. (1.016 mm) oversizes. The piston rings

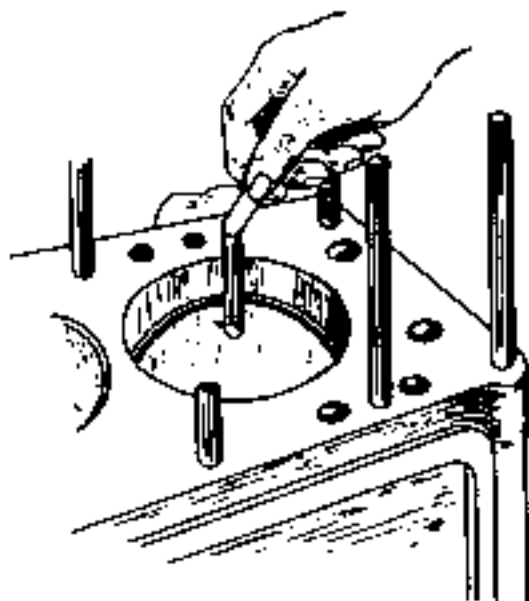


Fig. 12

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 slat type processed by chromium plating.

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.

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 on the engine.

The throttle and choke controls must be disconnected from the carburetor. Disconnect the fuel pipe from the fuel pump.

Next, remove the exhaust pipe from the manifold.

From below the vehicle, remove the gear change selector rod from the lever on the transmission casing.

Disconnect the earth strap from the starter motor. Remove the hand brake control rod supporting from transmission.

Disconnect the speed-meter cable from the transmission. Uncouple the propeller shaft pinion fringes at rear axle and draw the shaft out of the transmission.

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

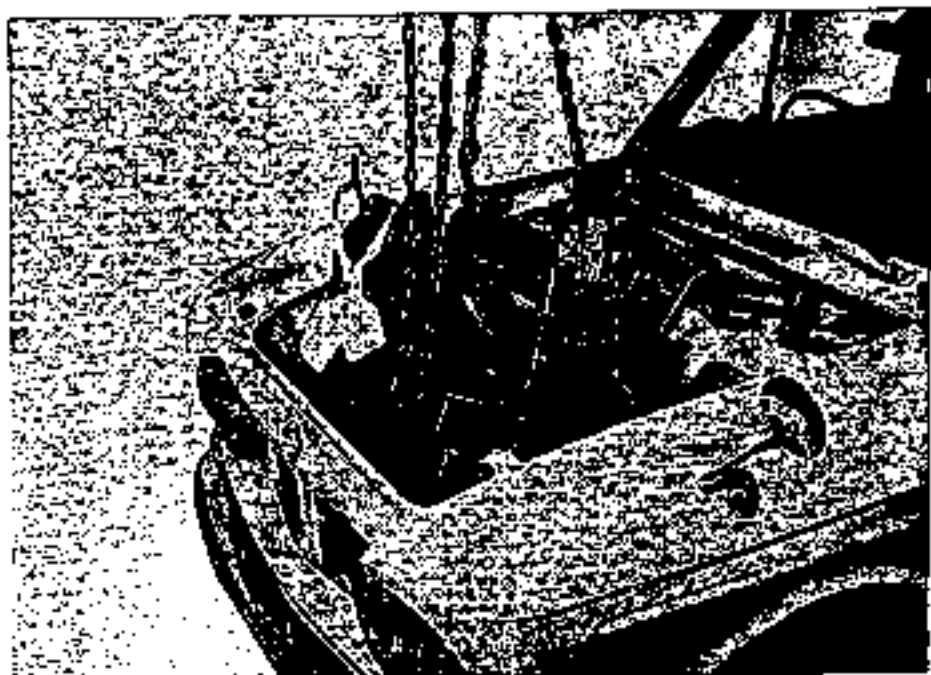


Fig 1

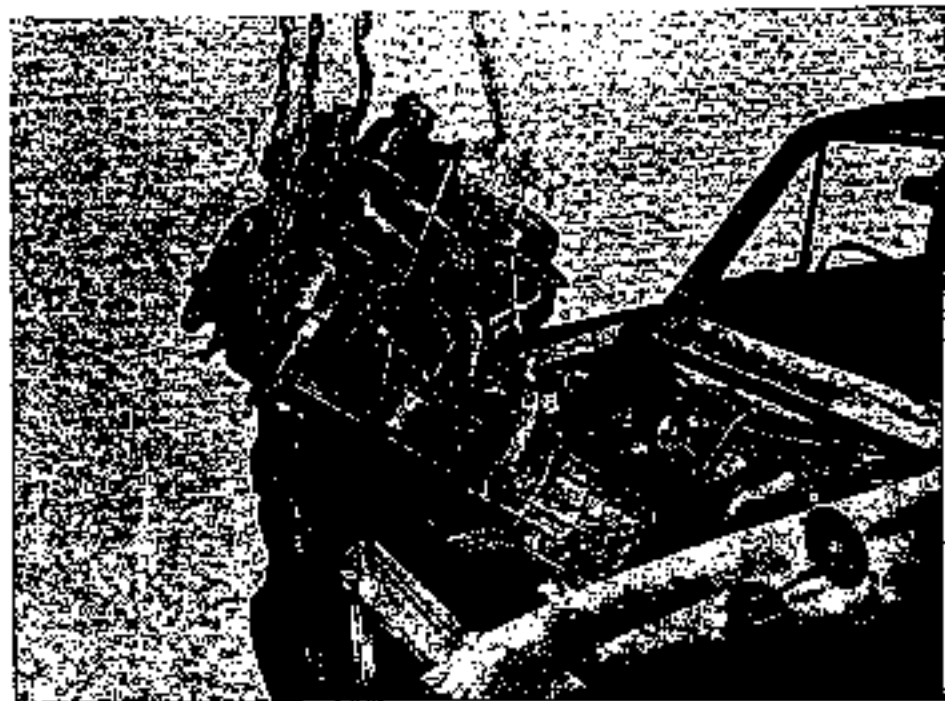


Fig 2

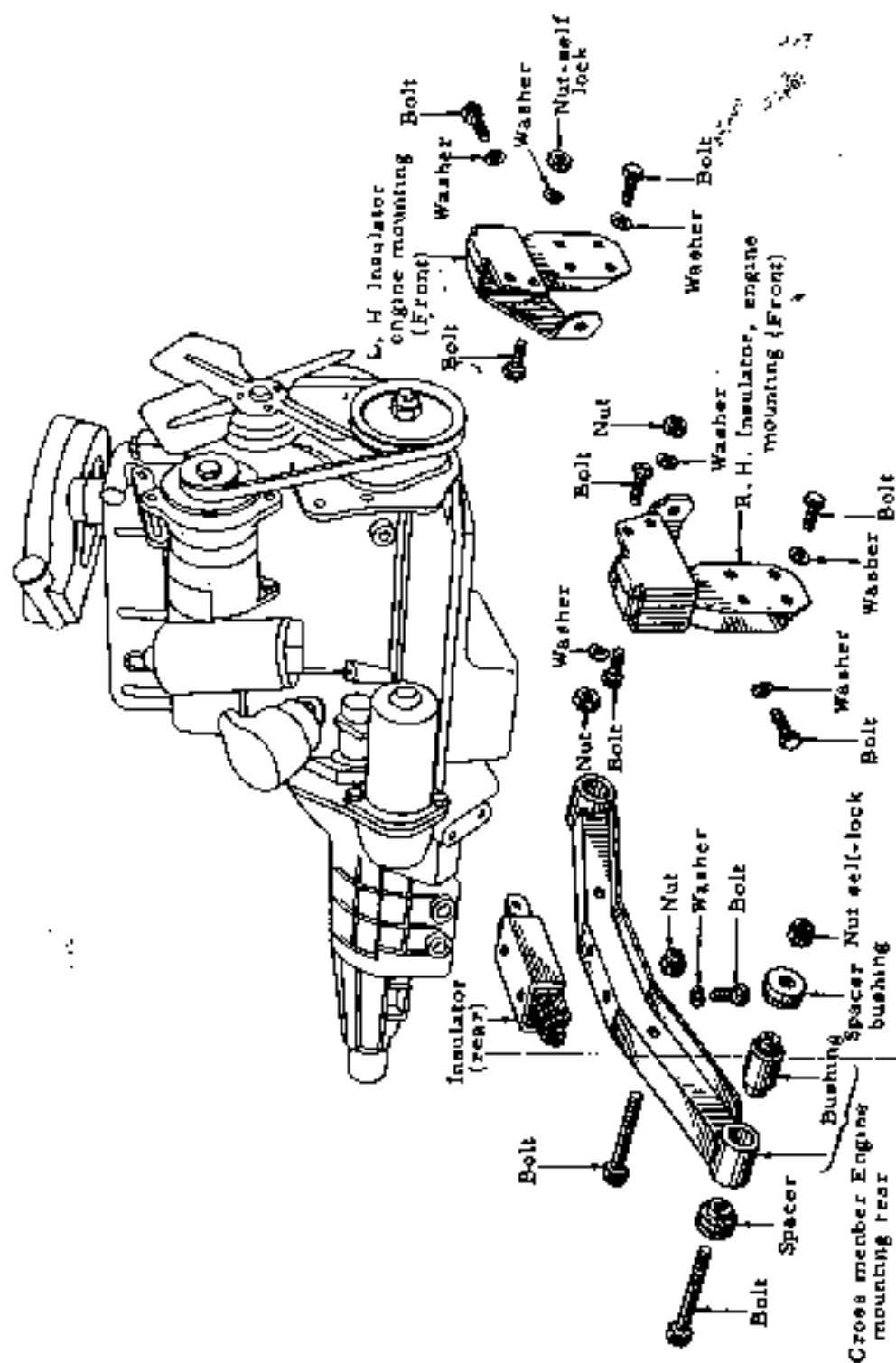


Fig. 3 ENGINE MOUNTING

OPERATION WITH THE ENGINE REMOVED

The following operations are best performed with the engine removed from the car.

Although it may be found possible to carry out certain attentions with the engine in position, it is more convenient to do the work on the bench.

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 0.003-0.007 in. (0.076-0.178 mm) 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, and tappet, 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 drifting 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 instructions for removal. Care should be taken however, to align and engage the drive pin at the rear end of the camshaft with the slot in the oil pump drive shaft.

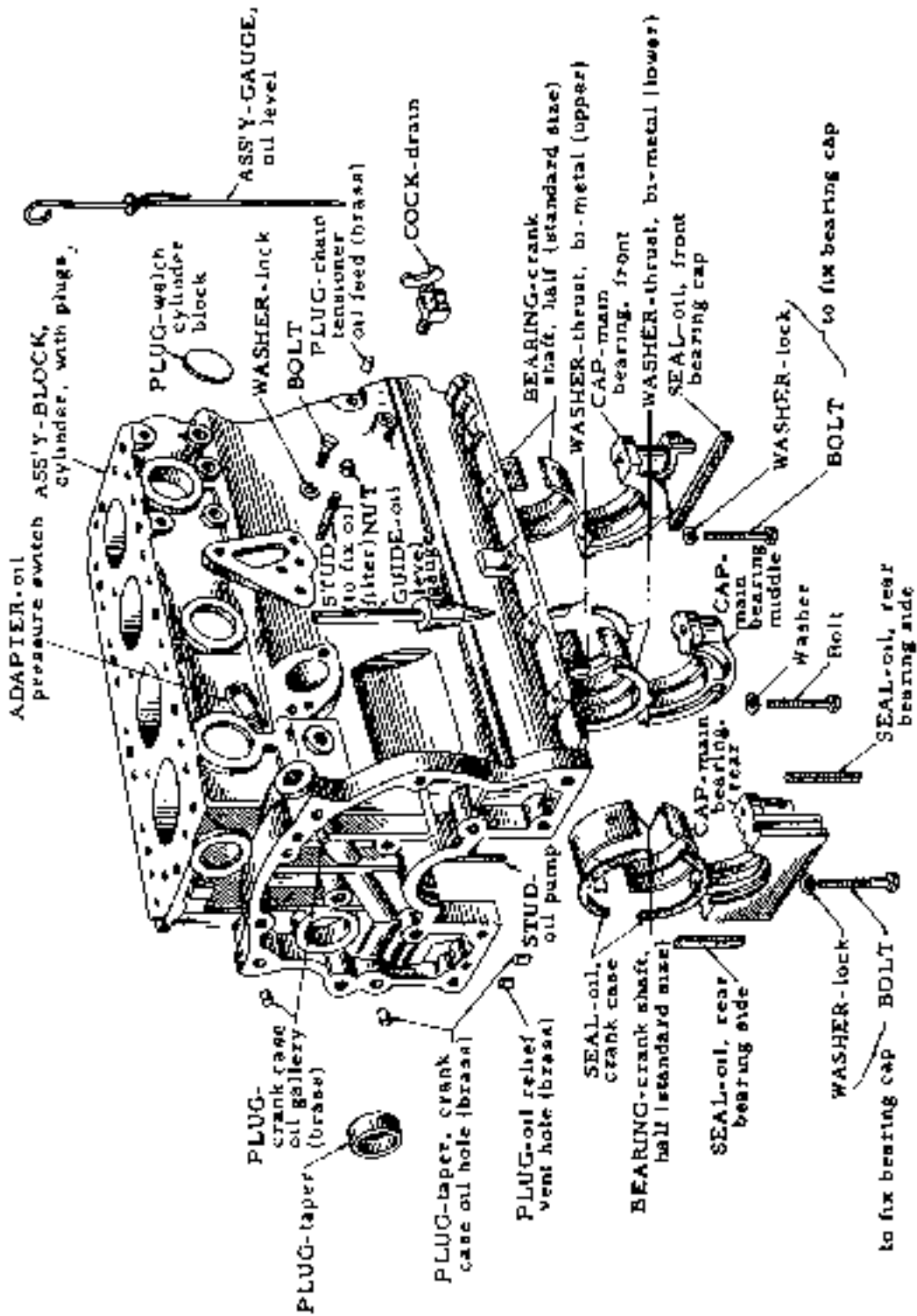


Fig. 2 CYLINDER BLOCK (B)

Main Bearing Caps

Remove the flywheel and clutch.

Take off the timing chain, the sump and strainer, and the engine rear mounting plate. Unlock and remove the bolts securing the main bearing caps to the cylinder block, also the two bolts securing the front cap to the engine front bearer plate.

Note that a thrust washer is fitted on each side of the centre main bearing to take the crankshaft end thrust. These thrust washers each consist of two semi-circular halves, one half having a lug, which is located in a recess in the detachable half of the bearing, the other being plain.

When fitting new bearings no scraping is required as they are machined to give the correct running clearance of 0.0005-0.002 in. (0.0127-0.0508 mm).

Ensure that the locating rings are properly engaged in their recesses.

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

Remove all traces of dirt and oil from the housings and thoroughly 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 punch marked, and the marks should face the crankshaft side of the engine.

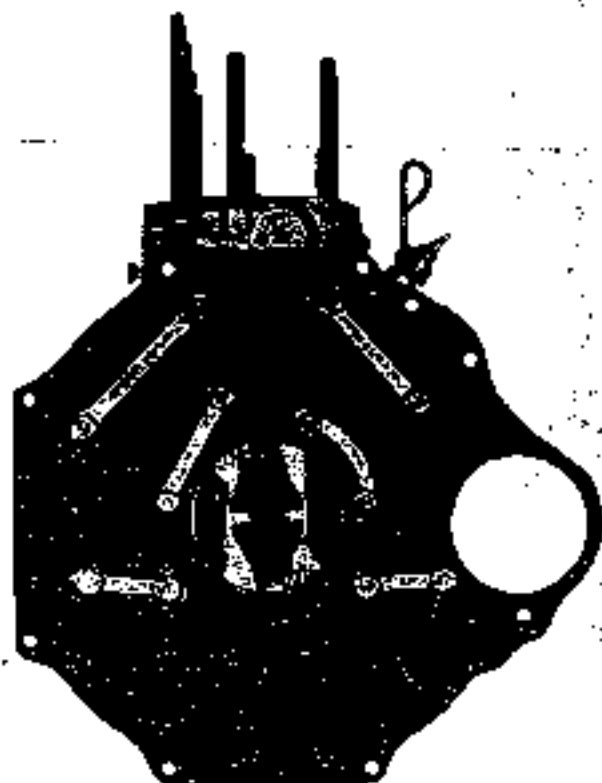


Fig. 3 Engine (Rear Side)

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.

The main bearing caps are held in position by set screws and lock washers. Pull the set-screws up tight with a torque wrench set to a loading of 75-80 lb. /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 revolves 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. (0.051 mm).

If a bearing has "run", it is essential to clean out all oil-ways 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.

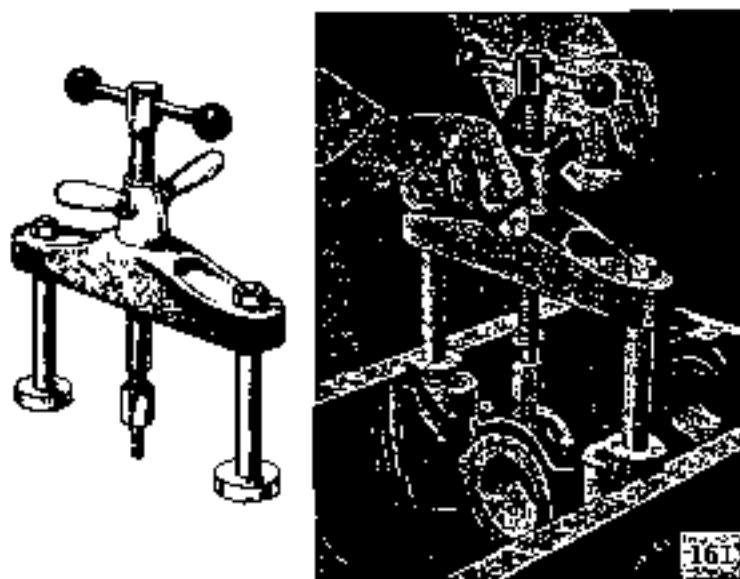


Fig. 4 Removing a Main Bearing Cap & Extractor

BRAKER POINT AND IGNITION TIMING ADJUSTMENT DISTRIBUTOR

Type	Hitachi D406-D1
Ignition timing standard	10° before top dead center at 600 r. p. m.
Apparatus of automatic advance	Governor type
Advance starting vacuum pressure	100~120 mm-Hg
Advance angle by vacuum pressure of 340 mm-Hg	12°~18°(Crankshaft) 6°~9°(Distributor)
Number of revolution at the start of advance angle	450 r. p. m.
Max. advance angle at crankshaft	11°~15° at 2400 r. p. m.
Rotating direction of cam	Counterclockwise
Firing order	1-3-4-2
Point gap	0.45-0.55 mm (0.018-0.022 in.)
Dowel angle	50°-55°
Contact arm spring pressure	0.5-0.65 kg
Condenser capacity	0.20-0.24 mfd.

Inside the distributor is a braker point as shown in Fig. 2 This braker makes and brakes contact several thousand times in one minute. Each time this braker brakes contact, a spark is generated in one of the spark plugs. Therefore, the maintenance of this braker must not be treated lightly. Also, because the time during which the ignition coil current flows varies with the gap between these braker points, see that this gap is maintained at the standard value, which is 0.45 mm. (0.018 to 0.022 in.)

The braker points must be kept free of grease and oil. If the points should become burnt or blackened, they are cleaned with a fine honing stone or crocus cloth after which they should be wiped clean with a piece of cloth which has been dampened with gasoline.

If the points are badly burnt, they must be replaced. Braker points must always be replaced as sets.

Adjusting the Braker Points

To adjust the braker points, turn the engine crankshaft with the crank handle until the braker is fully open. Then loosen the braker point fixing screw. Next, by turning the adjusting screw, move the plate until a feeler gauge of 0.45 to 0.55

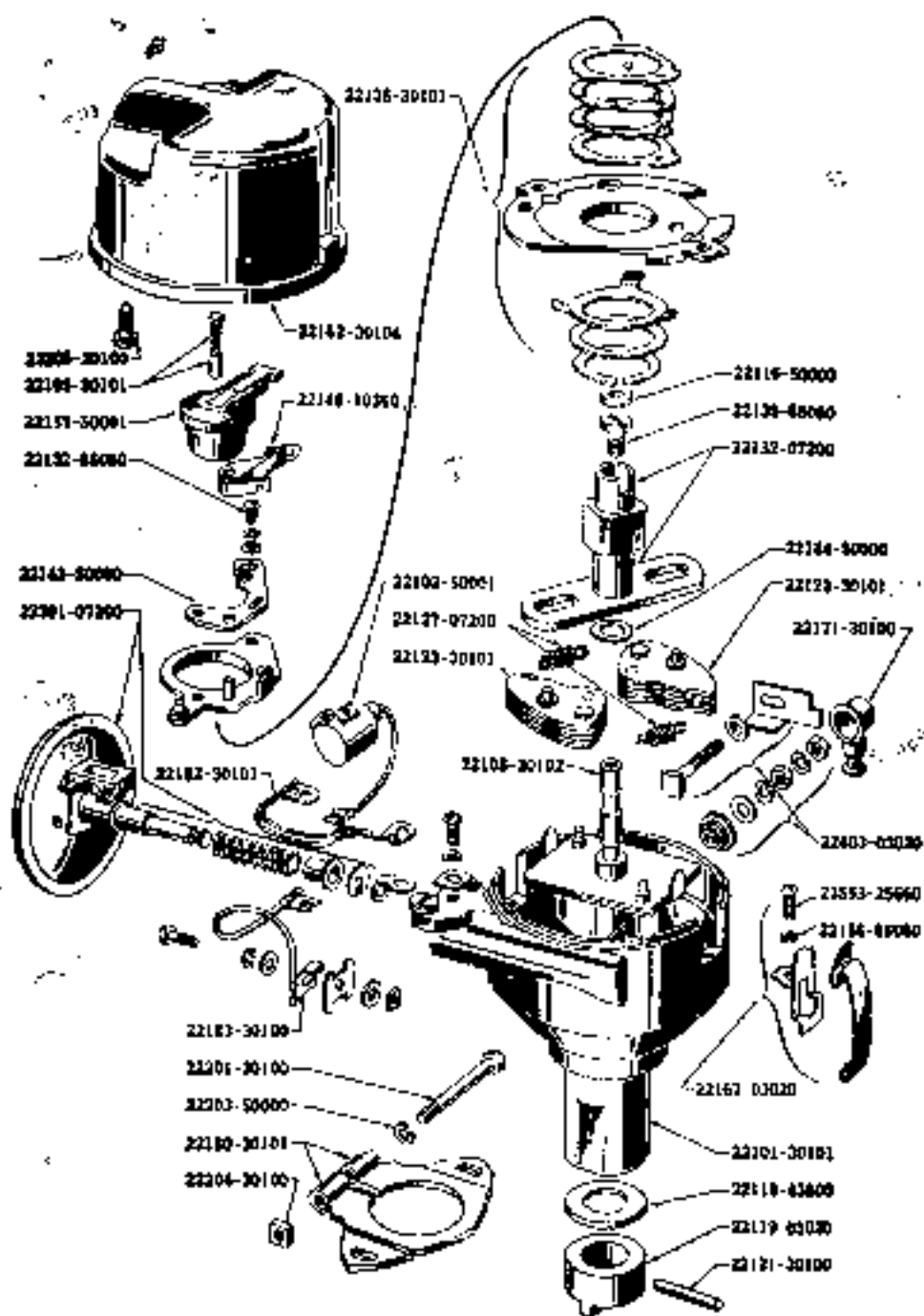


Fig. 1 DISTRIBUTOR

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 the 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.

Whether or not 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.

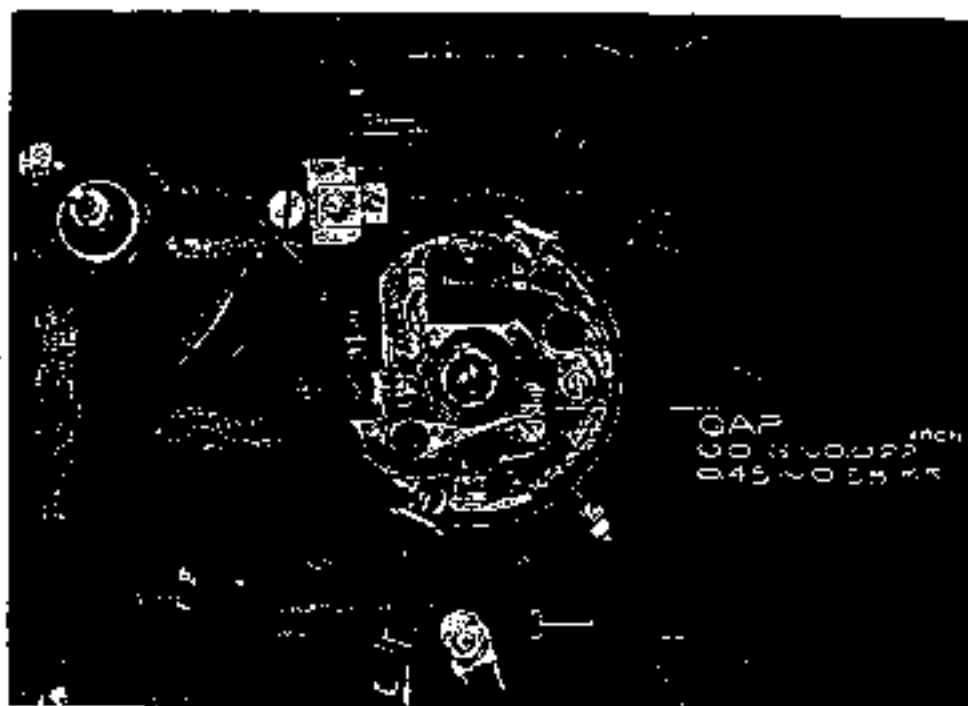


Fig. 2 Adjusting the Point Gap

ADJUSTING THE IGNITION TIMING

The ignition timing is adjusted to 10 degrees before top dead center with the engine stopped as shown in Fig. 3. 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 15 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. Adjustment is made by the following procedure.

1. First adjust the distributor to the correct gap as described previously.
2. Turn the crankshaft gradually until the top dead center mark (Fig. 3) on the pulley periphery coincides with the mark for 10 deg. before top dead center on the timing gear cover as the crankshaft approaches its position somewhat before that corresponding to the end of the compression stroke of the No. 1 piston. Stop the crankshaft in this position. The compression stroke of the No. 1 piston can be determined if the spark plug 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.

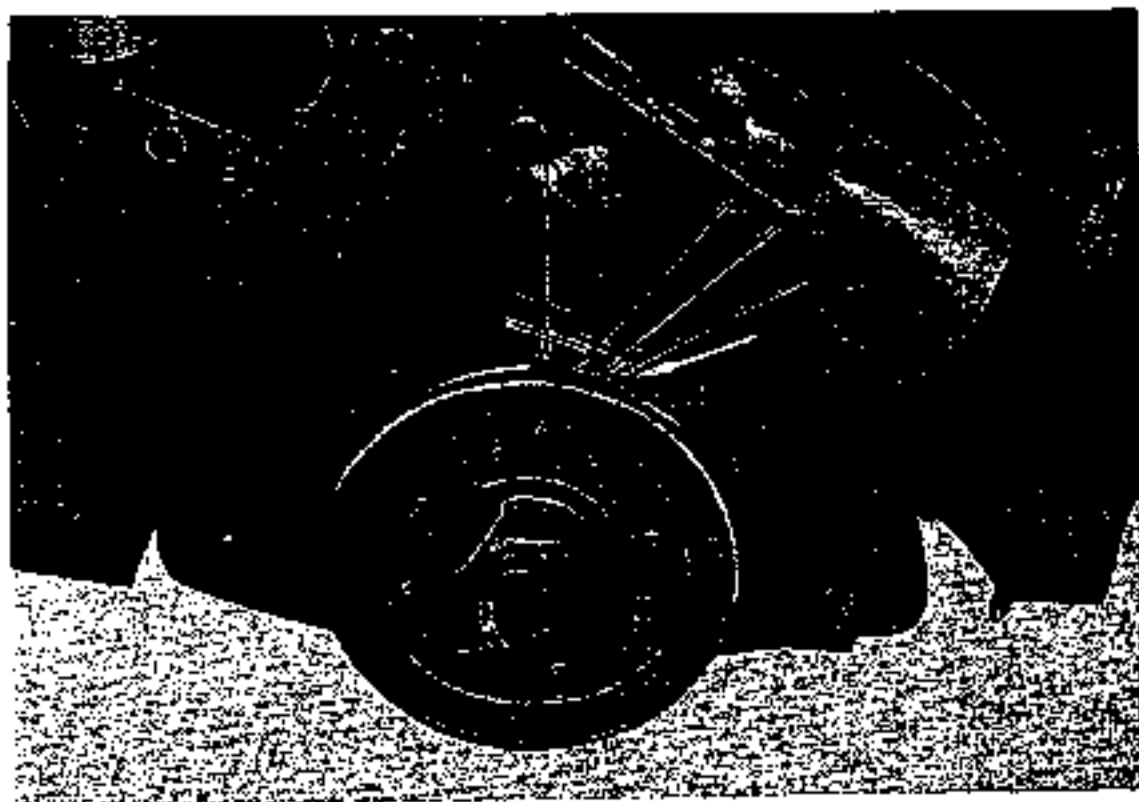


Fig. 3 Checking the Ignition Timing

3. Next, inserting the driving shaft of the distributor at an angle to the engine, engage the gear on its lower end 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 as shown in Fig. 5. At this time, the smaller of the semi-circles is placed toward the front.

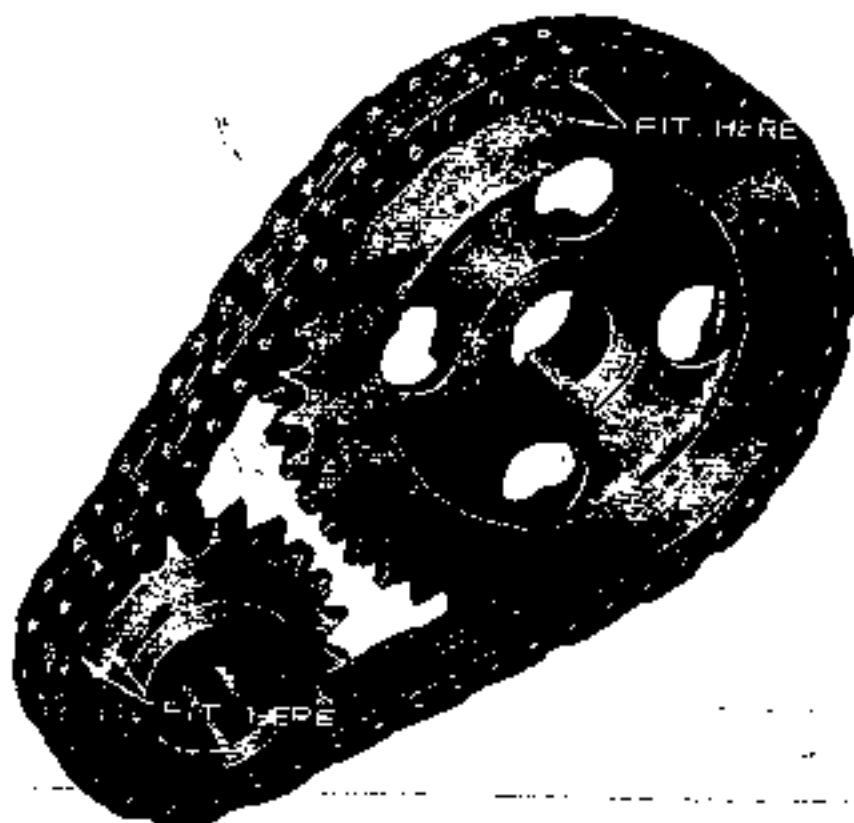


Fig. 4 Setting of Timing Gear Mark

4. Adjusting the direction of the rotor so that it engages the drive shaft slot, mount the distributor to the engine. During this assembly the directions of the distributor and rotor must be as shown in Fig. 5. At the same time, the breaker must be in its position when it is just beginning 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 beginning 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 axis 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.

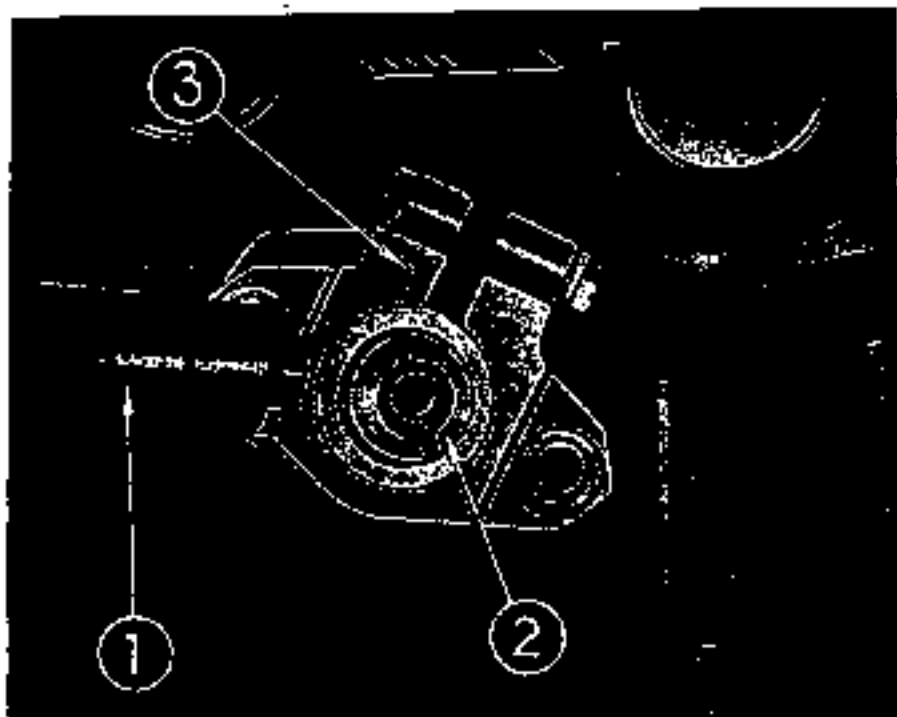


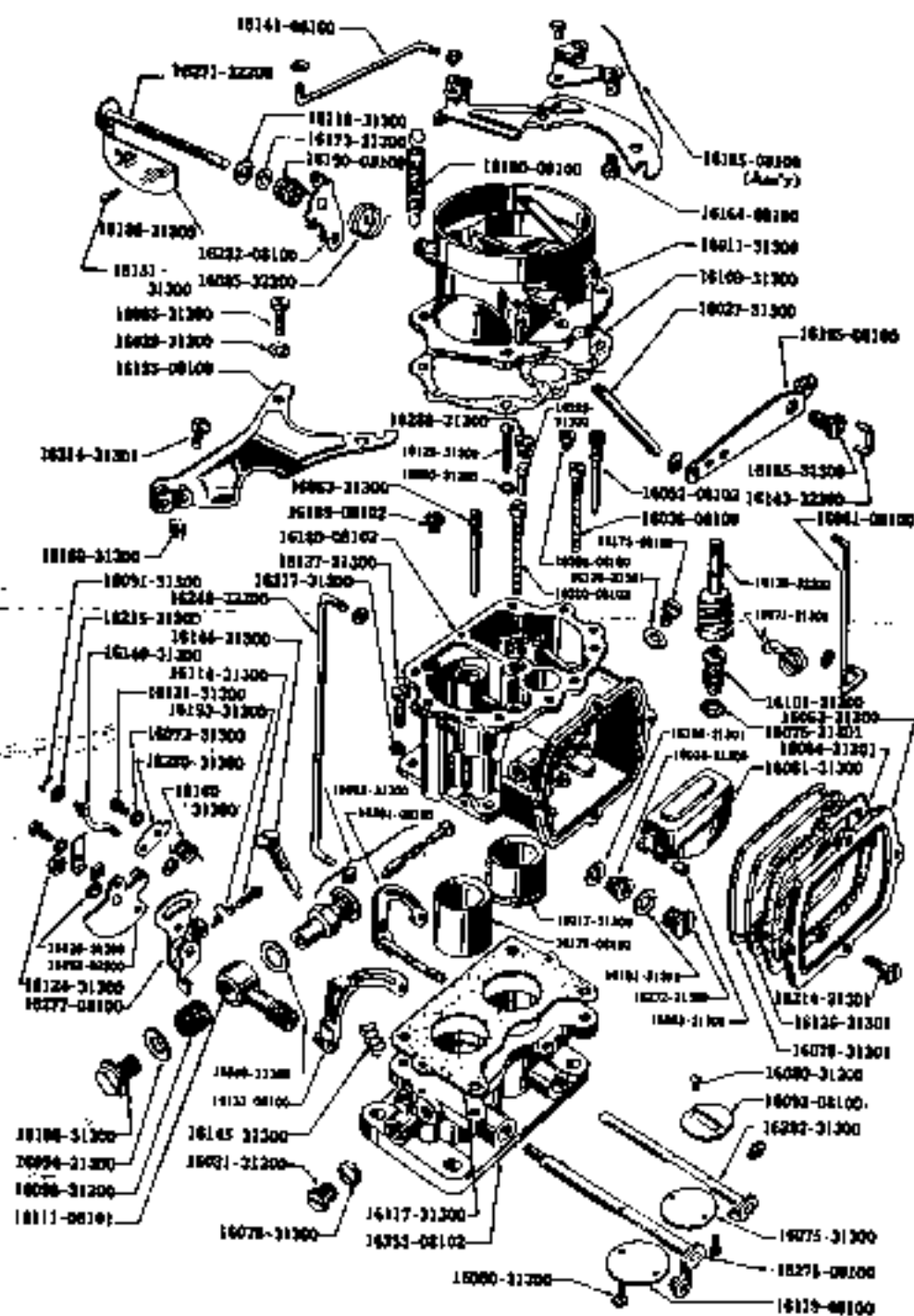
Fig. 5 Assembly Angle of Drive Shaft

- ① Distributor shaft
- ② Distributor drive shaft
- ③ Distributor fixing plate

Conversely, if the octane number is high the pointer is adjusted in 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 15 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 CARBURETOR



CARBURETOR

SPECIFICATIONS

2D - 30CF Type	Primary	Secondary
Bore diameter	28 mm	30 mm
Venturi diameter	21-8 mm	25 - 14 - 7 mm
Main jet	#96	#115
Main air bleed	#80	#60
Slow jet	#48	#48
Slow air First	#100	#120
Slow air Second	#220	
Emulsion hole or	#60 x 10	#60 x 14
Slow economizer	#20 x 2	
Power jet	#55	
Power valve	Begins to open when the primary throttle valve is at 45° opening.	
Floar level	19 mm below the upper surface of the float chamber body.	

The carburetor has the function of atomizing the fuel, mixing it in suitable ratio to air and supplying the mixture to the engine.

It is therefore an important part which can influence the performance of the engine.

The Model 2D-30C carburetor is a highly efficient carburetor of two barrel two step and down draft type having the following special features.

Construction and Operation

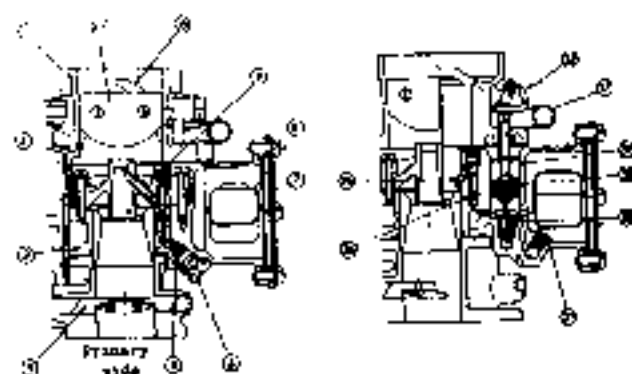


Fig. 1

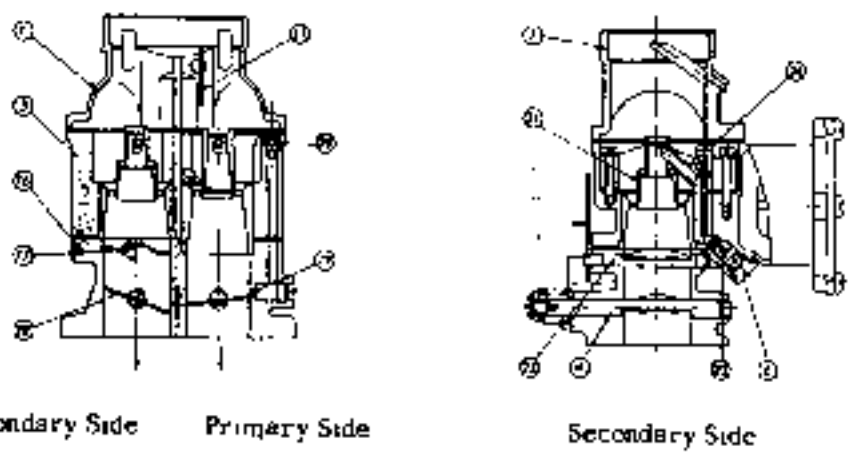


Fig. 2

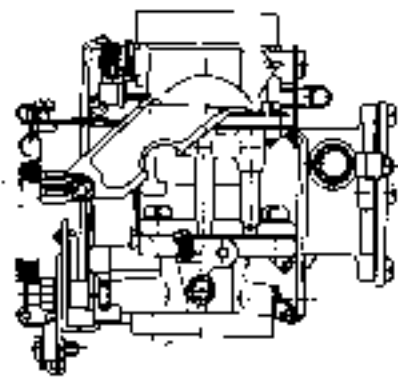


Fig. 3

- | | |
|-------------------------|-----------------------------|
| ① Body assembly | ⑮ Auxiliary throttle valve |
| ② Ventury | ⑯ Throttle valve |
| ③ Float chamber | ⑰ By-pass hole |
| ④ Throttle shaft | ⑱ Slow jet |
| ⑤ Main jet | ⑲ Ventury |
| ⑥ Main jet carrier | ⑳ Auxiliary valve shaft |
| ⑦ Float chamber cover | ㉑ Main jet |
| ⑧ Float | ㉒ Main air bleed |
| ⑨ Main air bleed | ㉓ Pump injector |
| ⑩ Air vent pipe | ㉔ Out-let valve |
| ⑪ Choke valve | ㉕ Inlet check valve |
| ⑫ Choke control link | ㉖ Power valve |
| ⑬ Connecting rod | ㉗ Pump piston |
| ⑭ Choke wire blocker | ㉘ Air vent hole |
| ⑰ Throttle wire blocker | ㉙ Pump piston return spring |
| ⑱ Lower body | ㉚ Connecting rod |

Main Carburetting System

The fuel flowing out of the passage at the bottom of the float chamber passes through the primary main jet and then mixed with the air coming from the main air bleed to be minute drops and inject into the venturi through the main nozzle.

When the throttle valve is widely open and the engine requires dense mixture gas, the accelerating pump opens its power valve, from where the fuel also flows into the main system.

The power valve begins to operate when the throttle valve opens 45° from full closed position.

Slow Speed System

Passing through the main jet, the fuel passage separate from main line and flows through the slow jet, slow air bleed first, slow economizer, slow air bleed second and inject from the by-pass holes and idle holes.

Accelerating System

Mechanical accelerating pump synchronized with the throttle valve is adapted. When throttle valve is open, the piston rod is pushed up with the linkage, which pushed up the piston through the dumper spring. When the piston is coming down, the inlet check valve closes the out-let check valve opens and the fuel within the pump is blown out from the pump jet by the compressed dumper spring and hits against the side wall of the small venturi to be minute drops, compensating transient sparseness of the fuel. A jetting amount of the fuel can be varied with the two holes provided on the pump arm, that is, the inserting positions of the connecting rod.

Starting System

The choke valve is provided with the spring and installed eccentrically on the normal carburetting device and synchronized with the throttle valve. When the choke is fully closed, the throttle valve opens about 14° from a full close. This is the best condition to start operation. The synchronization of the choke valve and the throttle valve can be exactly maintained often the engine has started firing.

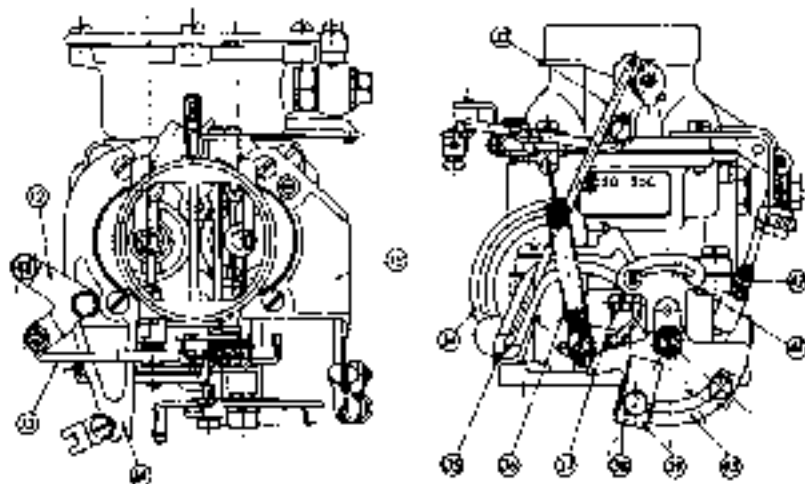


Fig. 4

- ① Choke control link
- ② Connecting rod
- ③ Choke wire bracket
- ④ Throttle wire bracket
- ⑤ Starting cam-rod
- ⑥ Auxiliary lever
- ⑦ Starting throttle lever
- ⑧ Spring
- ⑨ Throttle adjusting screw
- ⑩ Cam-rod
- ⑪ Throttle wire clamp
- ⑫ Throttle lever
- ⑬ Scale
- ⑭ Idle adjust screw

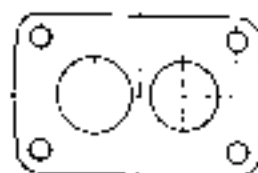


Fig. 5

POWER CARBURETTING FUNCTION

Main Carburetting System

Same as the normal carburetting function the fuel flowing out of the passage at the bottom of the float chamber passes through the secondary main jet and become minute drops mixing with the air coming from the main air bleed and is blown into the venturi through the main nozzle.

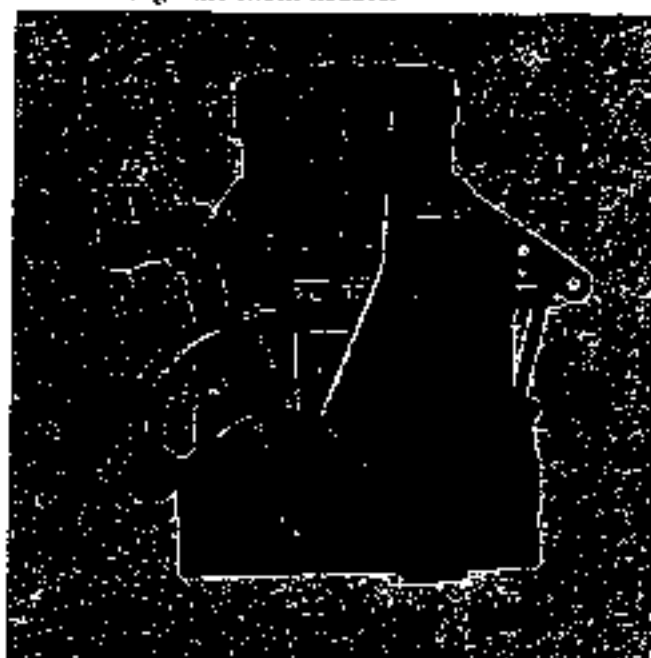


Fig. 6 Carburetor (Model - RRH 2D 30C)

When the throttle valve of the normal carburetor is widely opened and the engine produces high power, the throttle valve of the power carburetor begins to open by the unsynchronized linkage.

However, at the top of the power carburetor throttle valve is an auxiliary valve which is not open at a slow speed with a heavy load due to the load of the

counter weight connected to the valve shaft even when the throttle valve is open. When the engine change to still higher revolutions, the auxiliary valve open against the load of the counter weight and the power carburetor starts operation for high power. When the normal carburetor throttle valve is in a full open, the power carburetor throttle valve is also to be in a full open.

Float Chamber

The float chamber is provided, cover of which is made of glass of facilitate for inspecting inside condition through the marked line of cover of it. Adjustment of the float level can be done from outside by adding or subtracting the needle valve carrier gasket after removing the float needle valve installed at the inlet connector.

As ventilation within the float chamber is of a air vent method and pressure within the venturi and the float chamber is always constant no matter how suctional resistance of the air cleaner varies, fuel consumption can be always economically maintained.

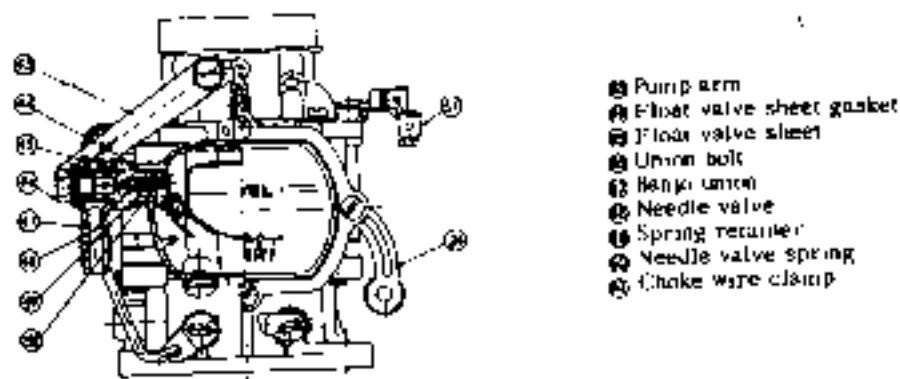


Fig. 7 Float Chamber

Adjusting Fuel Level

Float level is shown on the float chamber cover with the line, 19 mm below the body top to which fuel is to be adjusted. Adjusting the float level is done by adding or subtracting the gasket of float valve seat (needle valve carrier).

Addition or subtraction of 2 numbers gasket make the float level up or down about 1 mm.

Accelerating Linkages

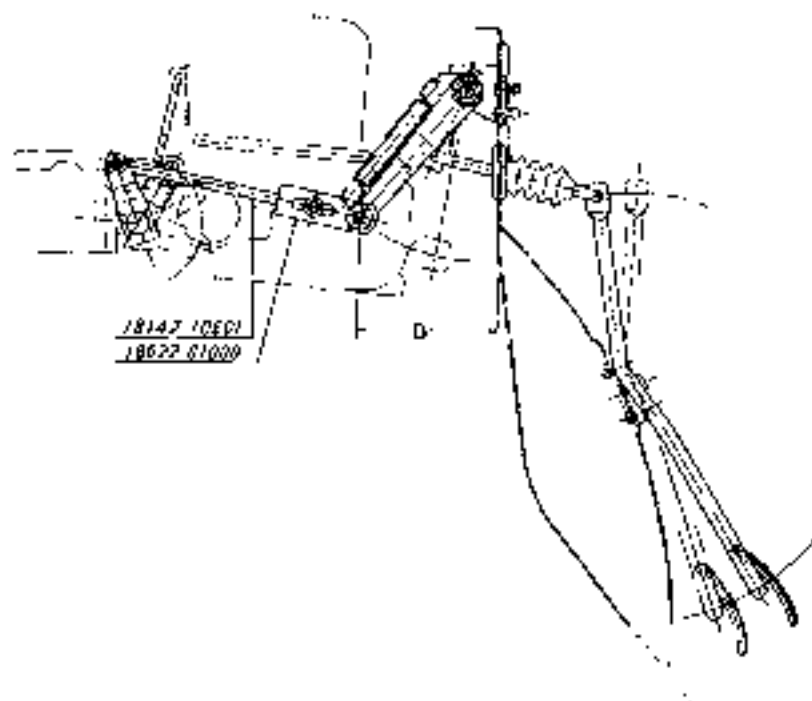


Fig. 8

Dimensions of 'D' is adjusted to 86.5 mm by rod and adjusting plate. The nut must tighten surely after fixing the dimension of 'D'.



① Rod ② Adjusting plate ③ Nut

Fig. 9

FUEL SYSTEM

The fuel tank has a capacity of 41.0 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.

THE GASOLINE TANK

Draining the Fuel

The fuel tank is drained by turning the wrench operated drain cock.

Fuel Tank Gauge Unit

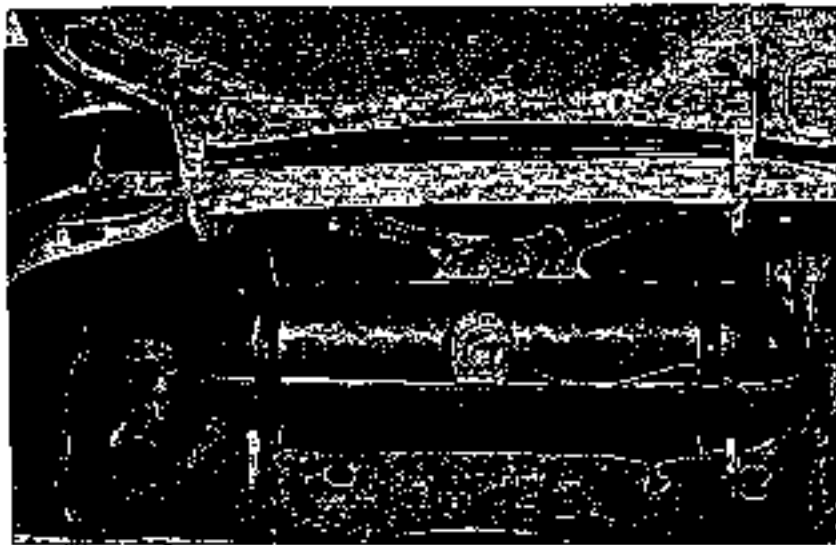


Fig. 1 Fuel Tank Securing

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 forgetting 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 undamaged. This is essential as the joint between the tank and gauge unit must be fuel tight.

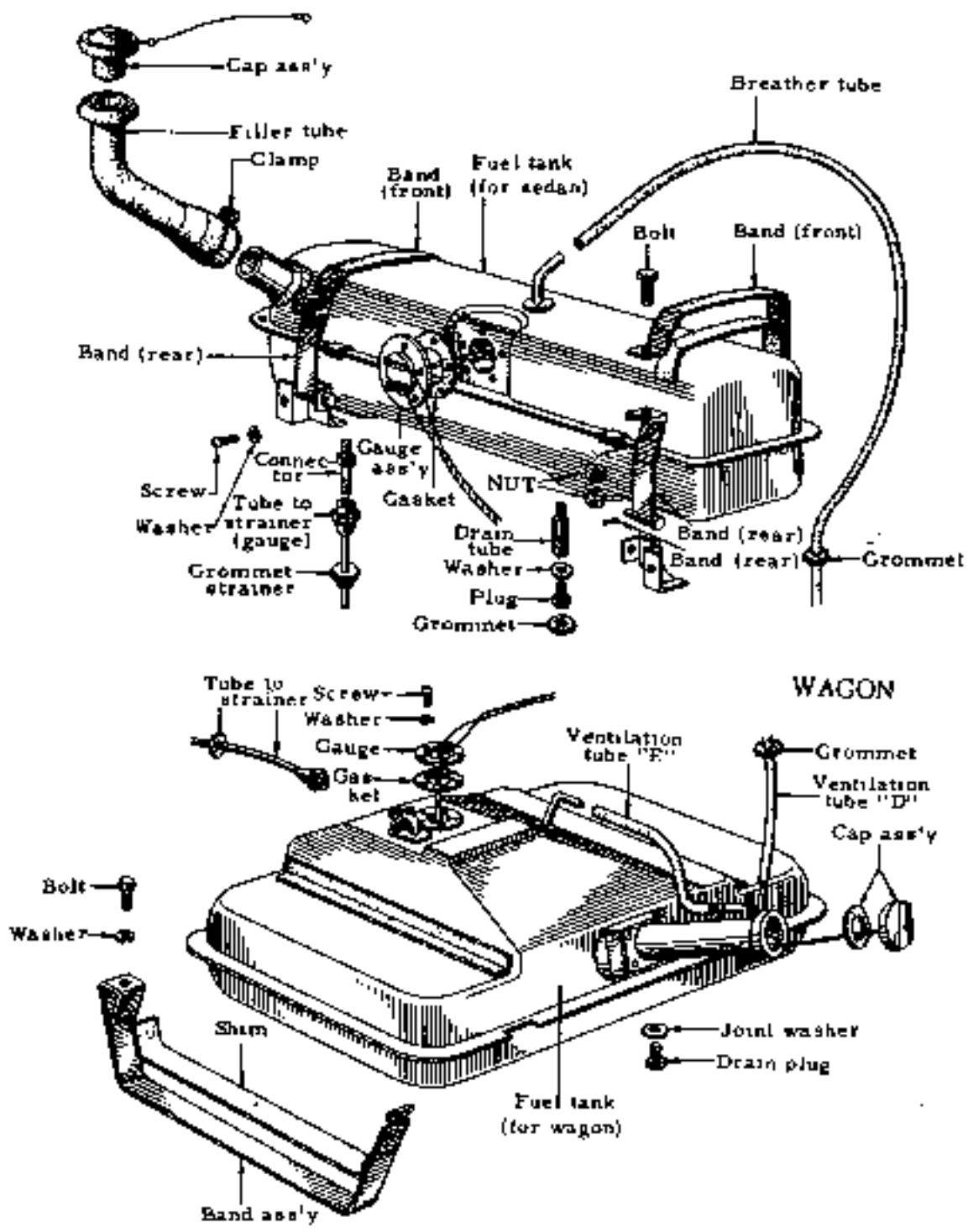


Fig. 2 FUEL TANK MOUNTING

Troubles and Repairs of Gasoline Tank

(A) When Fuel Leaks from Gasoline Tank

When a crack, distortion or damage is found in the tank, repair or replace it.

To make repairs, put marks with chalk at the leaking points and, even after the fuel in the tank has been drained out, blow with compressed air through the tank to force out stagnant gasoline vapor completely. Repairs should be done only when the tank is completely dry.

Leakage is ordinarily mended by soldering. When welding is necessary, the above precaution must be strictly observed. Otherwise, there will be danger of explosion.

(B) 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.)

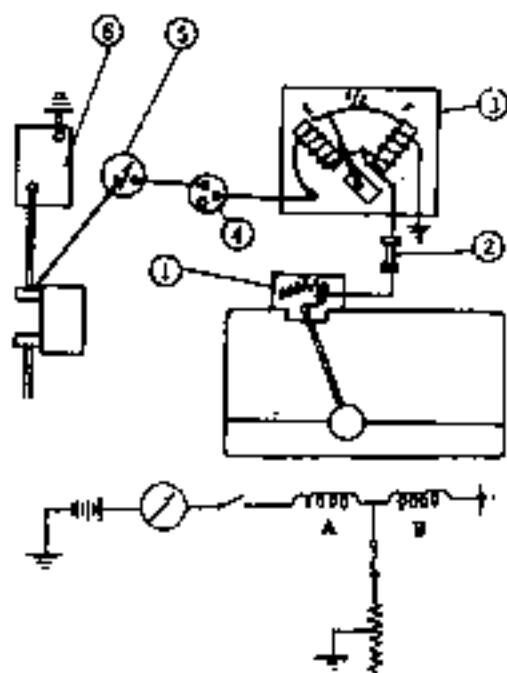


Fig. 3 Wiring of Fuel Gauge

- | | |
|--------------|-------------------|
| ① Fuel gauge | ⑤ Ignition switch |
| ② Fuse | ⑥ Ammeter |
| ③ Fuel gauge | ⑦ Battery |

(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 pipe is about $3/4$ in. apart from the bottom in order to prevent its sucking up sediments on the tank bottom.

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

Check too 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 of 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 coils that cross each other at right angles, whose 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, electric current will flow from the battery through the ammeter into coil A, and then through the contact arm to the ground.

Coil A is then magnetized, attracts the iron piece, and the indicator points to E.

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 A then flows, this time, both contact arm and coil B, and finally to the ground.

As both A and B coils are so wound as to have their magnetic poles in the same direction, the iron piece will locate to the direction where the magnetic power of the two coils can be balanced, with the indicator deflecting in the direction of F.

That is, this is a gauge of electric resistance control type. E signifies Empty level and F, Full level.

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 un-ground the terminal end of the said wiring to the body of the car.

If the indicator of the dash unit swings actively 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 preceding 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.

Troubles 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.

FUEL STRAINER

Instructions for Disassembly

To remove the bowl from the body, loosen the strainer nut and remove the wire to a side. Take off the bolt, nut and washer from the wire and remove bowl, gasket and screen.

The strainer body is made of aluminum alloy. Take good care not to break threads of each connection.

Pay attention not to tighten the strainer nut so excessively that the gasket and bowl are broken.

When installing the strainer assembly, the strainer bracket should be cleaned sufficiently. Dust and dirt on the bracket surface prevent plug from keeping air-tight.

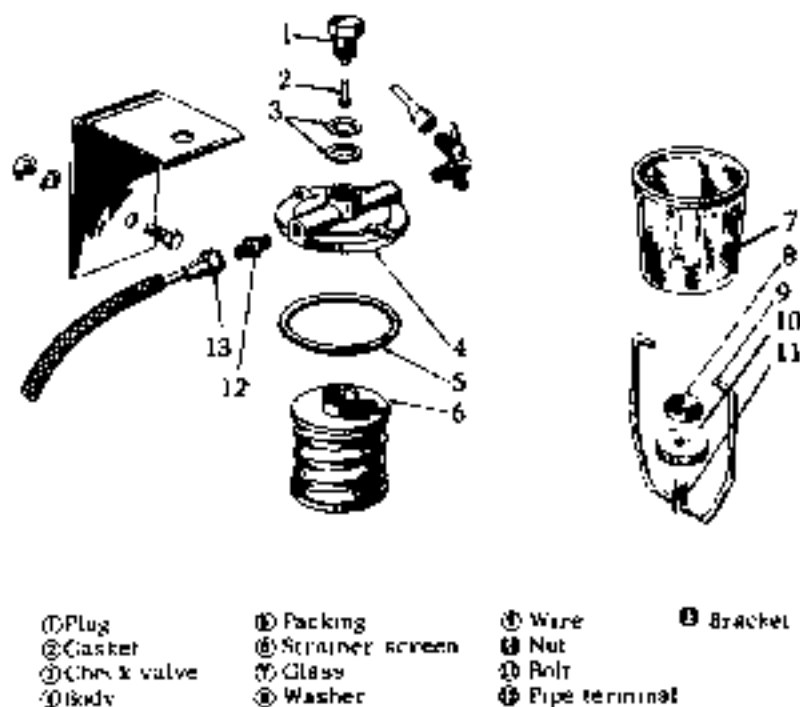


Fig. 4 Fuel Strainer Assembly

FUEL PUMP

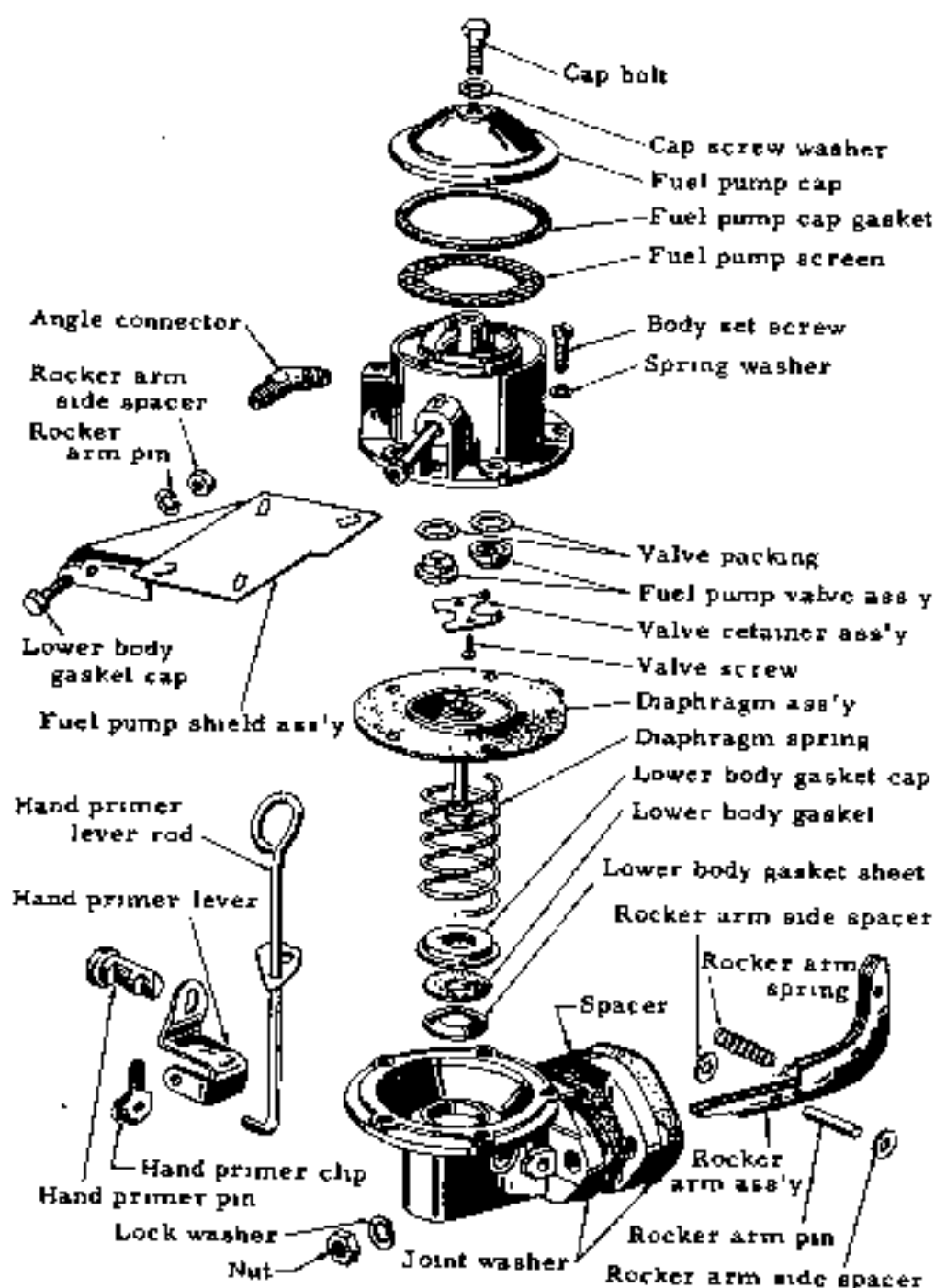


Fig. 5 COMPONENT OF FUEL PUMP

FUEL PUMP

Type	Diaphragm pump
Method driven	Driven by camshaft
Diaphragm spring	
Free length	36.5 ± 0.1 mm
Length in use and tension	18 mm - 1.6 ± 0.1 kg
Rocker arm spring	
Free length	30 mm
Valve spring	
Free length	9.5 mm
Thickness of valve	1.6 mm
Performance	
Max. quantity discharged	1300 cu. cm. per minute at 1000 r. p. m. of cam, 500 mm. in suction height
Max. pressure discharged	110-130 mm. in mercury column
Max. degree of suction vacuum	More than 400 mm. in mercury column
Hand primer quantity discharged	60 cu. cm. (at 20 strokes)

The fuel pump, which is of the diaphragm type, is mechanically driven by the eccentric part of the camshaft of the engine.

It draws gasoline from the tank and delivers it under pressure to the carburetor.

Even when the engine is not running, fuel can be delivered under pressure by moving the hand primer up and down.

By the rotation of camshaft, rocker arm is pushed and pull rod of diaphragm is pulled down.

At the same time, diaphragm goes down against diaphragm spring and then is pushed up again by its spring.

By the movements of the diaphragm and functioning of the valves at the inlet and outlet of the pump chamber, gasoline is drawn up from the tank to the carburetor.

If the float chamber of the carburetor contains enough gasoline and the needle valve is closed, gasoline is not allowed into the carburetor.

Thus gasoline is stored in the pump chamber and due to its pressure, the diaphragm is kept down and cannot return.

Under this condition, the rocker arm works in vain, as the rod remains low.

The rocker arm spring serves to prevent noise, keeping the rocker arm pushed against the eccentric of the camshaft.

Disassembling & Inspection

Checking with fuel pump installed on engine.

Switch off and stop the engine. Disconnect the fuel pipe at the inlet union of the carburetor, and then turn the engine with the crank handle.

Now the gasoline should be ejected vigorously from the tip of the pipe once every two rotations of the crankshaft.

To test the function of the pump alone, operation of the hand primer and checking the fuel ejection is enough.

Removal from engine

Fuel pump can be easily removed by disconnecting the inlet and outlet unions and loosening the 2 attachment nuts.

Inspection prior to disassembling

Prior to disassembling of the removed pump, measure the distance between the rocker arm and flange of the lower body by means of a scale and see if the rocker arm, rocker link and pins are worn.

Method of disassembling

First wipe dirt off the outer surface of the pump and put marks on both the upper and lower bodies, to make their reassembling easy.

It is easily separated into two when the five screws around the upper body are loosened.

Take great care not to damage the diaphragm during this disassembly.

Checking & Repairs of Parts

Wash the disassembled parts well in gasoline then inspect them.

Replace the diaphragm if any damage, impregnation by gasoline.

Replace a valve assembly if any wear or faulty operation is detected.

Even if repairs are unavoidably required, the limit for repairs of warp or wear of the valve is 0.001 in.

When the surface of the valve seat or valve is found irregular, remove the valve seat of the outlet and dress the surface with a fine oilstone.

In case of irregularity of the seat surface of the inlet valve, which cannot be taken off from the body, recondition it with a cutter and grinding tool.

When the surface of the valve is faulty, place some very fine grinding compound on the surface of a flat piece of glass plate and grind it lightly with the tip of a finger. The standard thickness of the valve is 1.6 mm.

The hole of the joint parts of diaphragm shaft and link may be worn to some extent. This is not serious, but when serious eccentric wear, crack, or breakage is found, the part must be replaced.

As a remedial measure, such wear can be compensated for at the time of dismantling and reassembling of the body, by inserting a packing made of thick paper between the lower body and diaphragm to raise the relative position of diaphragm shaft with respect to the lower body.

The rocker arm should be replaced when its contact face with the cam and that with the link and its pin hole are seriously worn.

When its re-employment by reconditioning is unavoidable, add material to the rocker arm and link by welding and finish them with a file, but this cannot last long and is no more than a temporary measure.

Renew the arm pin when it is found worn excessively.

The diaphragm spring, arm spring seldom become faulty, but when weakened, replace them always with standard ones.

If the diaphragm spring is too strong, it results in overflow of the float chamber of the carburetor.

The tension of the spring must not be strengthened or weakened arbitrarily by hand.

Check to see if there is any warp on the joint surfaces of the cap and body, and, after disassembling is over, renew the gasket to keep its air-tightness.

Reassembling & Installing

Employ standard springs for the various uses as stated before.

Install valves precisely for close contact with their respective seats.

In screwing in of upper and lower bodies and diaphragm, fit them together according to the marks which were put before the disassembling and align one screwing hole to its mate, and then screw in at the position where the diaphragm is fully pulled down with the rocker arm pushed towards the side of the body by pressure.

Do not screw in tight one by one since it causes warping. Instead, clamp all the screws round loosely and uniformly.

Then tighten them diagonally and lastly re-tighten all of them in order to make sure.

As a general rule, gaskets should be replaced by new ones.

Installation on the engine is done in the reverse order to that for disassembly.

Be sure to set the rocker arm so that it is contacting the eccentric of camshaft properly, not the rear side or to one side. Replace the gasket between the cylinder block and pump with a new, standard one.

Checking Function

When repairs of the pump is over, or before it is installed on the engine, make a check to see

When a vacuum gauge is connected to the pump inlet port and the pump is mounted on a tester, the rocker arm is activated by the eccentric of the camshaft revolving at 1000 rpm. Then the gauge pressure should rise to higher than 400 mm. of mercury column, and, even if operation is discontinued, this condition should remain for more than 3 seconds.

When a gauge or tester is not available, test in the following way

Close the inlet port and outlet port with finger tips. Then, after operating the rocker arm several times, suddenly release the fingers. The pump is in good conditions if, 3 to 5 seconds thence, there can be heard strong inlet and outlet noise respectively.

The pump is mechanically fit for use when, by connecting a hose to the inlet port, it is able to draw up gasoline from a height of more than 0.5 m. After installing the pump, test its functions during operation.

(A) Connect the gasoline pipe on the inlet port side only. Leave that on the outlet port side as it is, and turn the engine 6 to 7 rotations by means of the crank handle and make sure that there is sure outflow of gasoline from the outlet port.

(B) Connect the gasoline pipe to the outlet port side and tighten all the piping joints. Then turn the engine again several times to see if there is any leakage of air or gasoline from each connection.

ADJUSTMENT AND 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. 163 lbs. per. sq. in. at 350 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 plugs 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.

If the compression pressure of any one cylinder differs by 10 lb./sq. in. or more from that of another, the cause must be investigated.

- (6) Check and adjust the distributor:

If the breaker contact points have defective contact surfaces, dress them and 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., 20*)

- (8) Inspection of fuel pump and gasoline strainer.

- (9) Adjust the slow setting of carburetor.



Fig. 1 Compression Gauge

(10) Checking operation of generator.

Check the generating condition and functioning of the cut-out relay by means of indications of the ammeter.

(11) Adjustment of slack in fan belt.

(12) Adjustment of valve tappet clearance.

(13) Road test.

While driving in 3rd. speed at about 25 km./hr., suddenly step on the accelerator. If only a slight knocking results, the ignition timing is correct. Slow speed adjustment is made so that the speed is about 15 km./hr., when driving in 3rd speed.

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 shown in Fig. 2 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 rainy or cold weather, use an auxiliary condenser between the pick up and the meter, otherwise, the excessive moisture in the exhaust gas will damage the functioning of the meter if permitted to enter it.

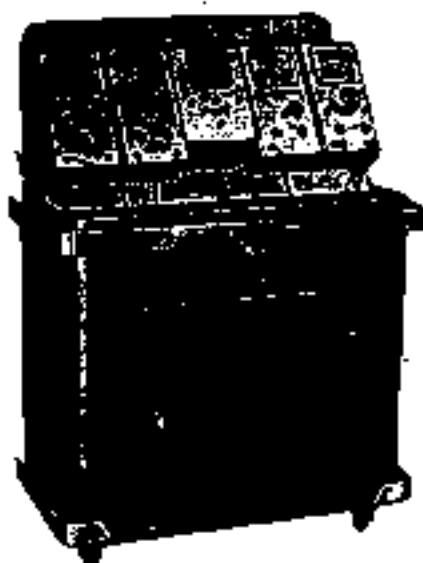


Fig. 2 Motor Master Tester Available for 4, 6 and 8 Cylinder Engine

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

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

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.



- (6)
When indicator drops by several inches at certain time, valves are burnt.



- (2)
Normal condition
When indicator fluctuates between a range of 0-25 in. as engine is raced, rings and valves are in good conditions.



- (7)
When indicator drops by about 2 in., valves leak. (Faulty seating of valves.)



- (3)
Even if indicator settles, if reading is low rings or oil are in faulty condition.



- (8)
When indicator oscillates actively between 14 and 18 in., valve stem guide is worn out.



- (4)
When above (3) condition exists, indicator will swing to 0 in. if engine is raced.



- (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.



- (5)
When indicator sometimes drops by 4 in. or so, valve sticking exists.



- (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



(14)
When indicator oscillates regularly between 5-19 in., there is leakage of cylinder head gasket. (Faulty clamping of gasket.)



(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.



(15)
When indicator first rises high, drops down to zero, and then returns to 15 in., muffler is clogged.

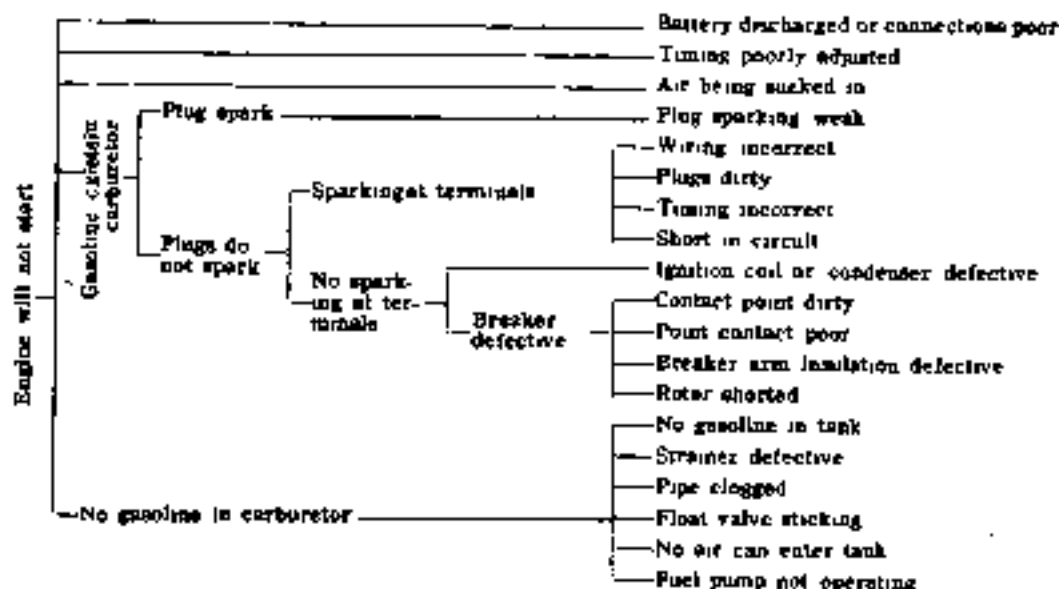


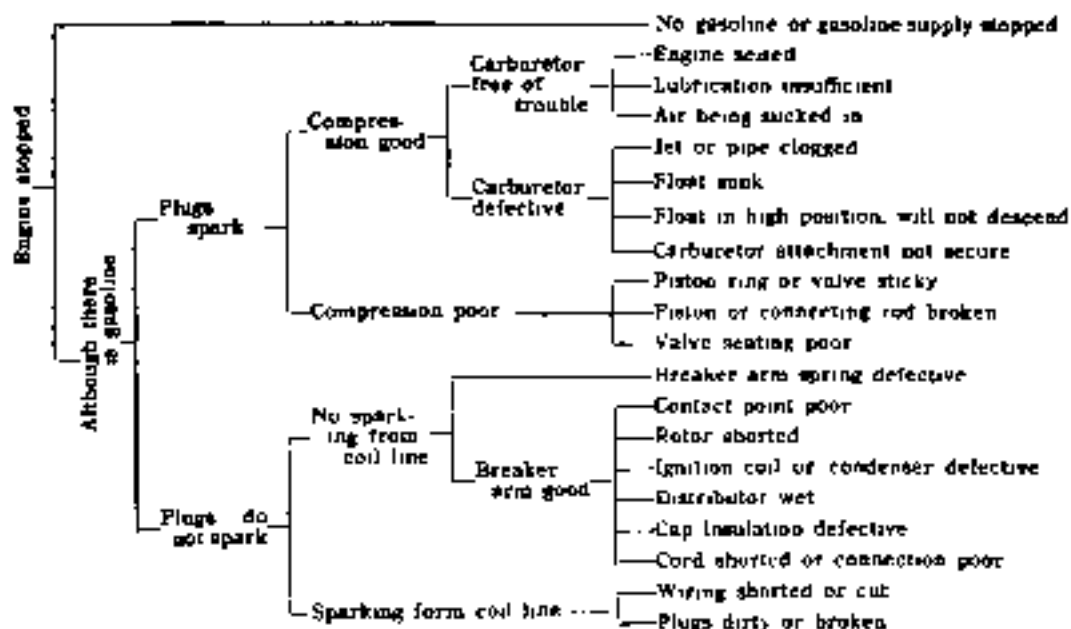
(13)
When indicator points to 6 in. or below, there is leakage at intake manifold or gasket of carburetor. (Faulty clamping of gasket.)



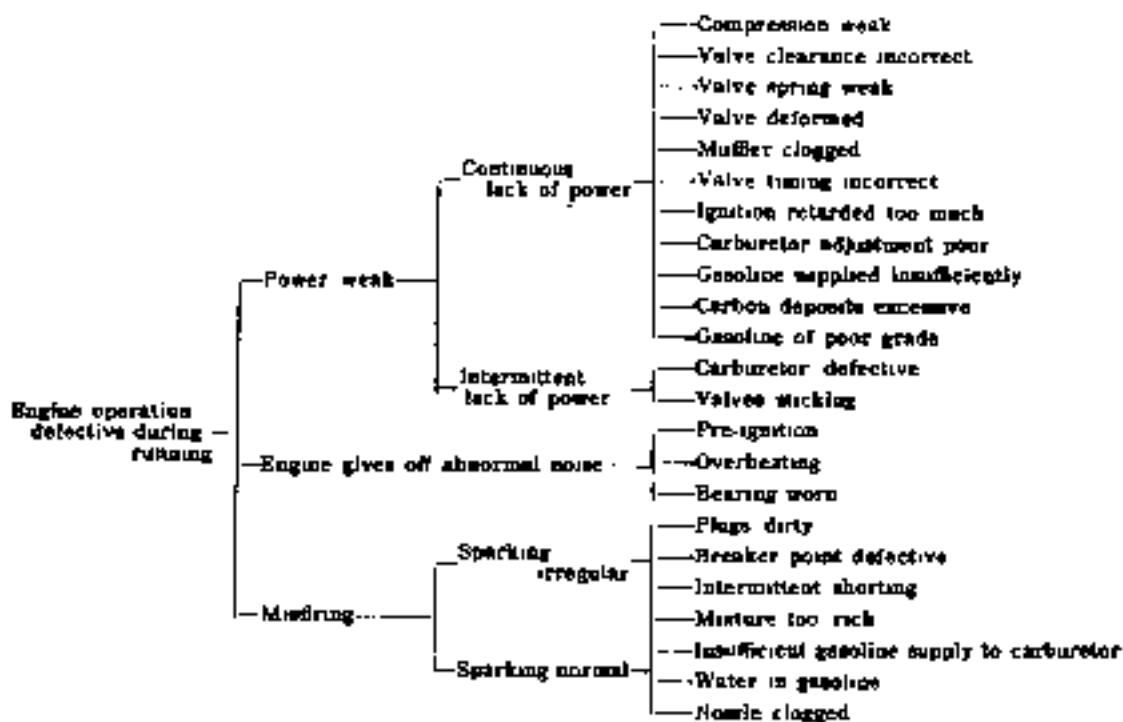
(16)
When indicator moves slowly between 13-17 in., carburetor is poorly adjusted.

Fig. 3 Diagnosing Engine by means of a Vacuum Gauge.





(A) Trouble Shooting Chart



(B) Trouble Shooting Chart

CLUTCH

GENERAL DATA

Type	Single dry disc plate
Construction of disc	With coil spring
Outer dia. of facing	200 mm
Inner dia. of facing	130 mm
Thickness of facing	3.5 mm
Gross friction area	363 cm ²
Thickness of disc ass'y	8.6 ~ 9.1 mm when releasing 7.3 ~ 8.1 mm when depressing
Disc run-out	Less than 0.5 mm
Backlash at splines part	0.05 ~ 0.15 mm (0.002 ~ 0.006 in.)
*Operating method	Oil pressure
*Inner dia. of master cylinder	15.85 mm (5/8 in.)
*Inner dia. of operating cylinder	19.05 mm (3/4 in.)
*Operating liquid	Genuine super brake oil
Return spring, withdrawal wire dia.	1.6 mm
Free length	87 mm
Length in used & tension	136 mm/5 kg

PRESSURE SPRING

Free length	49 mm ± 1.5
Compressed length	Less than 25 mm
Turn numbers	7.8
Power of comp. in full	About 300 kg
Wire diameter	3.3 mm
Length in use and load	29.2 - 37.5 ± 2 kg

RELEASE BEARING

Construction	Ball bearing type
Height of release plate	*From flywheel face to rear end of plate 50.5 ± 0.2 mm
Release plate run-out	Less than 0.03 (0.0012 in.)

*If use master disc (7.8 mm L 0.5 mm height), height of release lever is 50.5 ± 0.2 mm.

DRIVEN PLATE ASSEMBLY

This is the flexible type in which the splined hub is indirectly attached to a disc, which transmits the power and the over-run through a number of coil springs held in position by retaining wires.

Two friction linings are riveted to the disc.

COVER ASSEMBLY

The cover assembly consists of pressed steel cover, and a cast iron pressure plate located by six pressure springs.

Mounted on the pressure plate are three release levers.

Adjusting nuts are screwed on the bolts of pressure plate. Retainers of pressure spring insert to the clutch cover holes and anti-rattle springs load release levers.

RELEASE BEARING

The release bearing consists of a carbon bearing shrink into a bearing cup, the cup bearing located by the operating fork and the release bearing retainer spring.

RUNNING ADJUSTMENT

Owing to the hydraulic design of the clutch controls no adjustment is necessary to the clutch pedal.

Removing the Clutch

To gain access to the clutch it is first necessary to remove the transmission complete from the engine.

Once the transmission unit is free, a turn at a time by diagonal selection until the spring pressing is relieved.

Then remove the screws completely and lift the clutch assembly away from the flywheel. Finally, remove the driven plate assembly.

The release levers are correctly set on assembly. Interference with this setting, unless new parts have to be fitted, will throw the pressure plate out causing judder.

Dismantling, Assembling & Gauging

By using service tool the clutch can be quickly dismantled, reassembled and adjusted to a high degree of accuracy.

The tool comprises the following parts, base plate centre pillar, spacing washers, distance pieces, light finger actuating mechanism, setscrews, speed brace and metal box. As this tool is universal, a chart indicating the particular parts to be used for particular types of clutch will be found on the inside of the lid of the box.

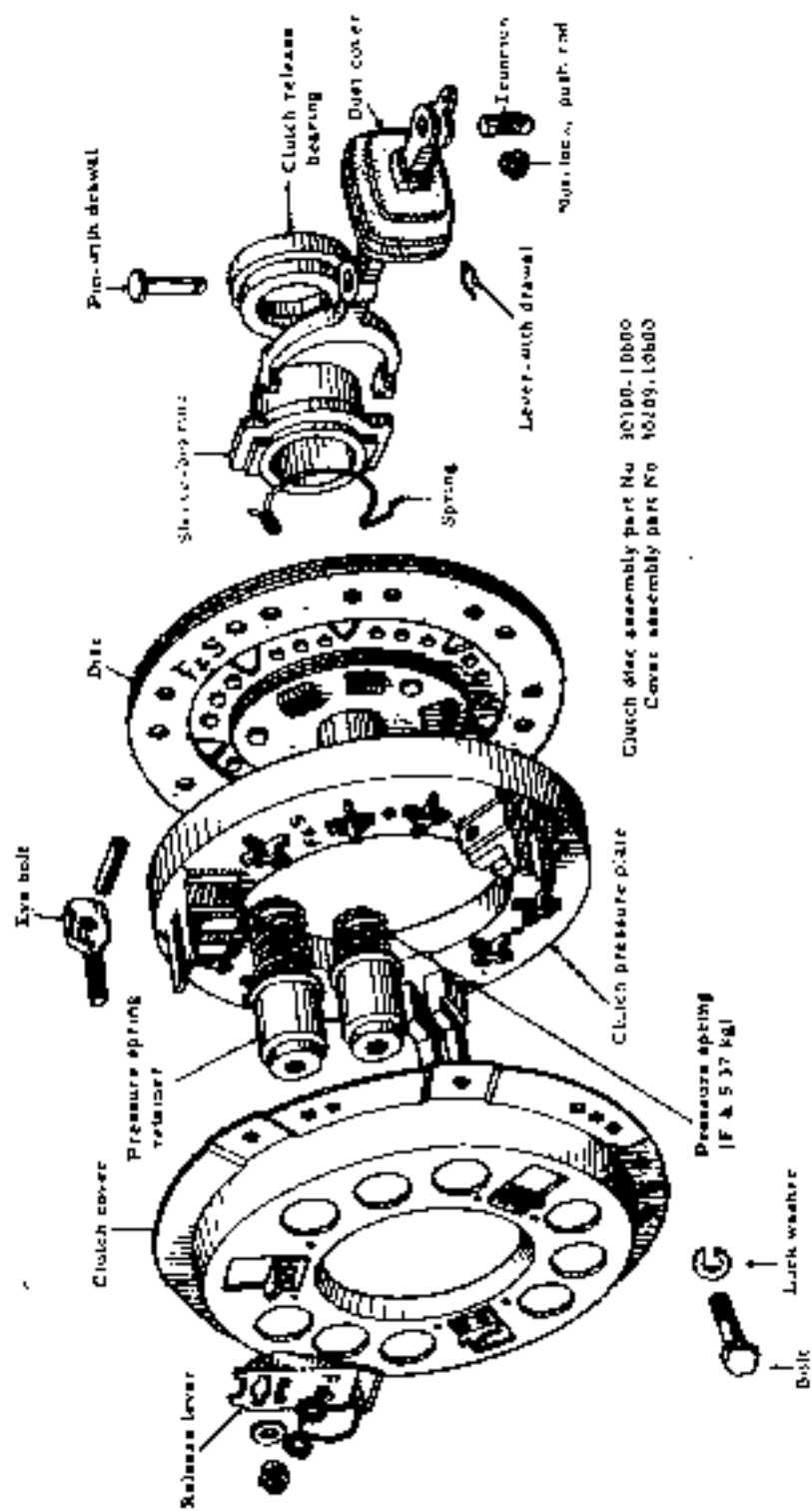


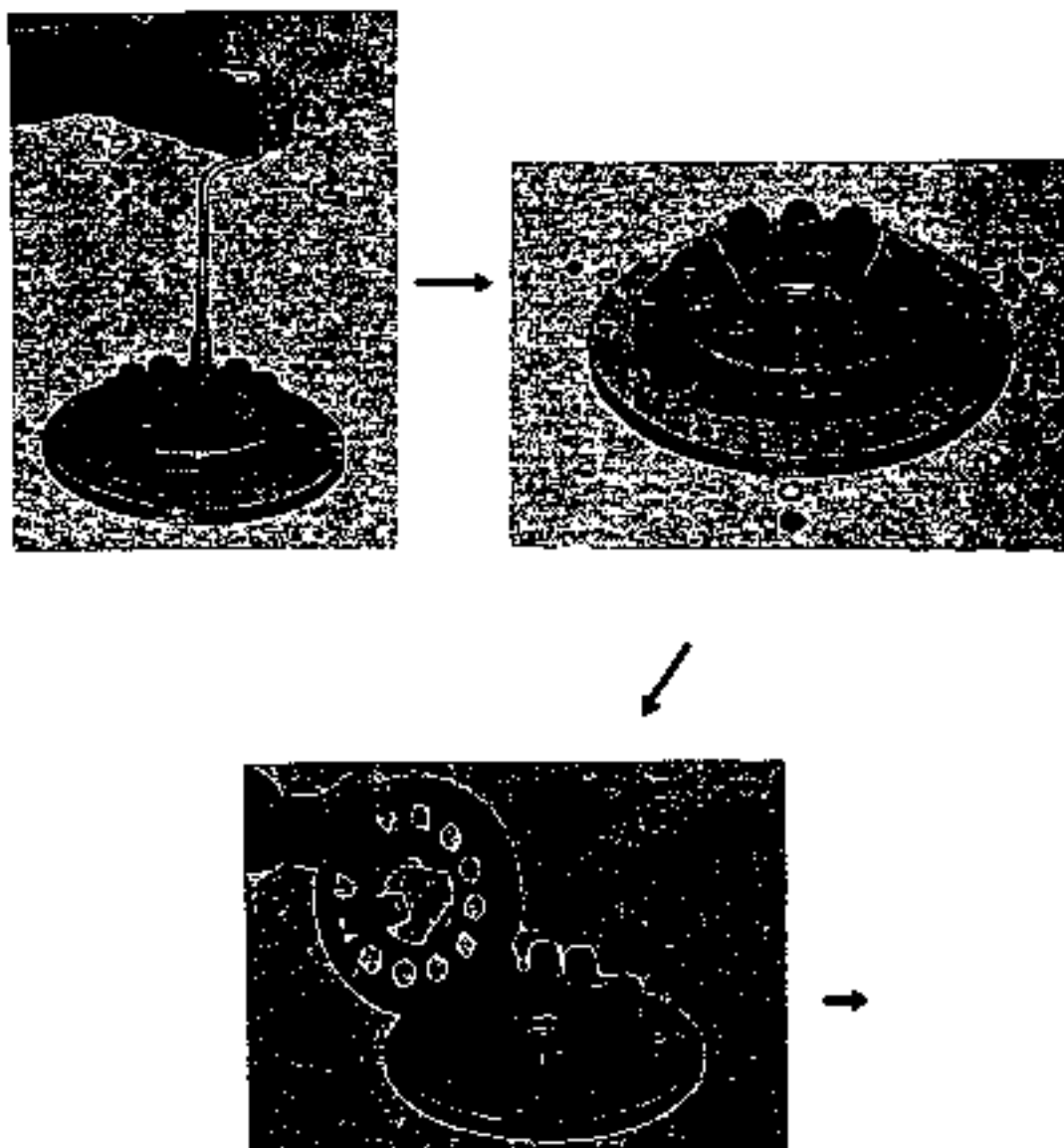
Fig. 2 CLUTCH

Dismantling

Place the clutch cover assembly on the three spring so that the holes in the cover coincide with the capped holes in the plate, insert the set-screws provided and tighten them, a little at a time, by diagonal selection until the cover is firmly attached to the base plate at all possible points. This is most important if the best results are to be achieved.

Mark the cover, pressure plate lugs and release levers with a centre punch so that the parts can be reassembled in their relative position in order to maintain the balance of the clutch.

Detach the release lever plate from the eye-bolts and remove the three lock nuts and adjusting nuts



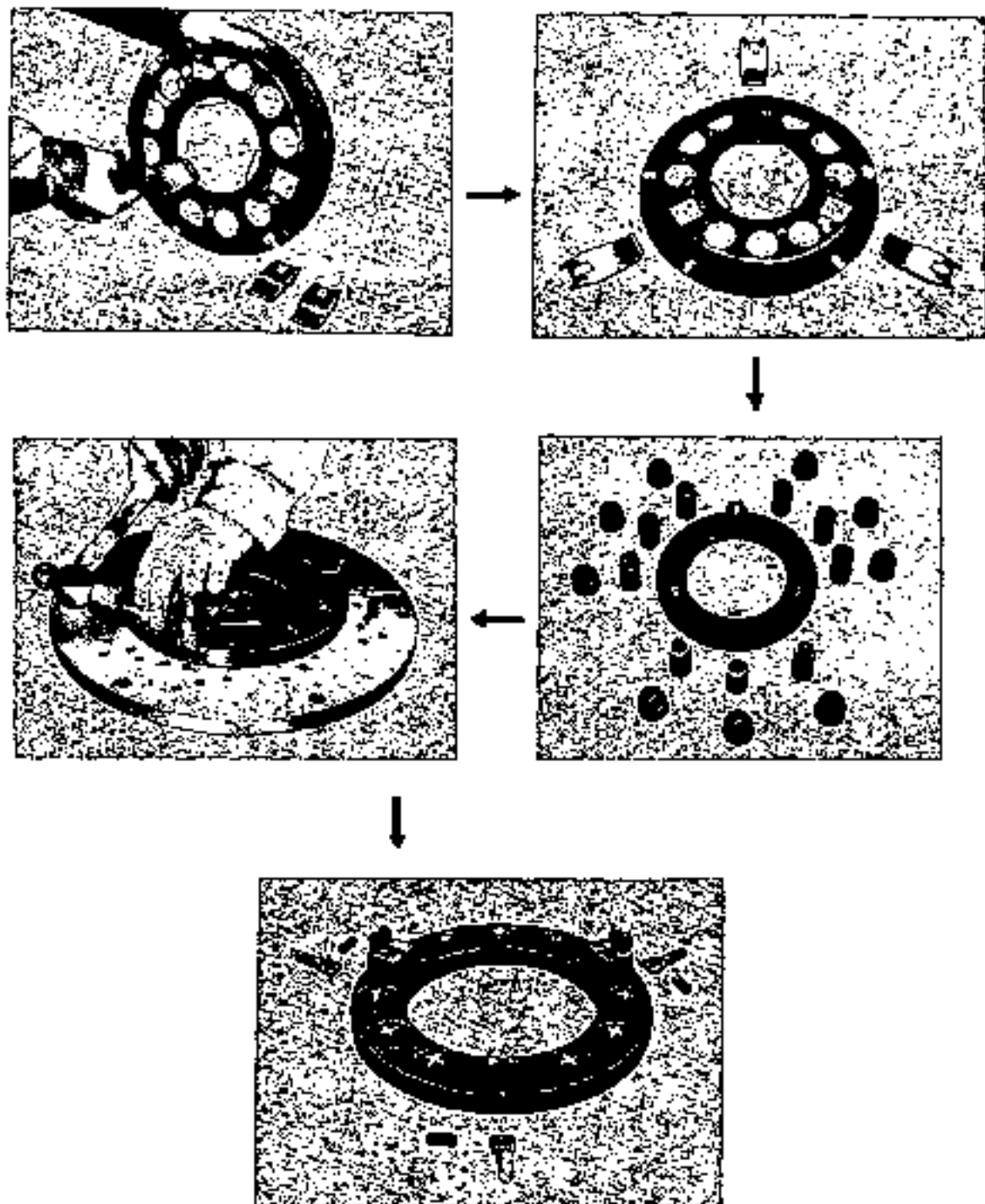


Fig. 4 Disassembling

Slowly release the pressure on the springs, unscrewing by diagonal selection, the set-screws securing the cover to the base plate. The clutch can then be lifted to expose all components for inspection.

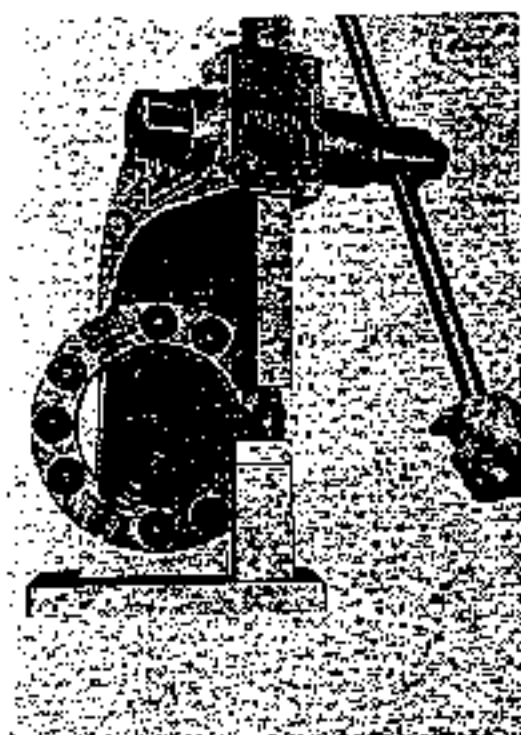
The release levers, and springs should be examined for wear and distortion. Renew these parts if necessary, bearing in mind that the pressure springs must only be renewed in sets. Clean all parts and lubricate the bearing surfaces of the levers, sparingly with grease.



Fig. 5

Assembling

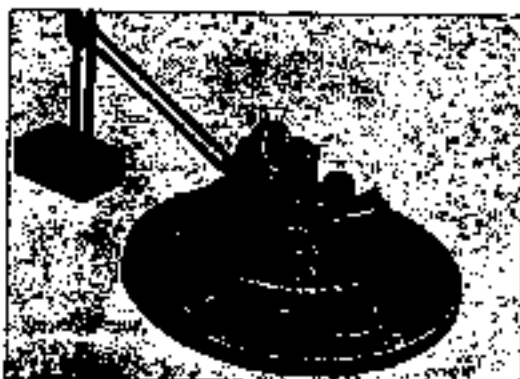
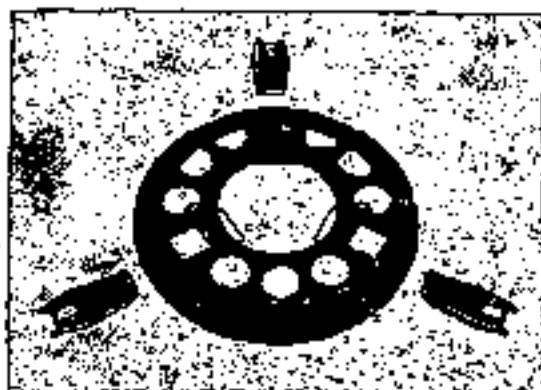
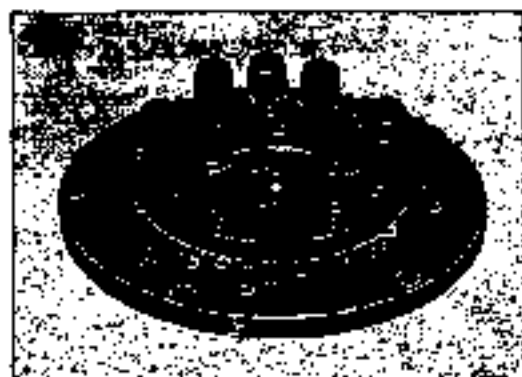
Press the pin into the eye-bolt hole through the lug on the pressure plate as shown.

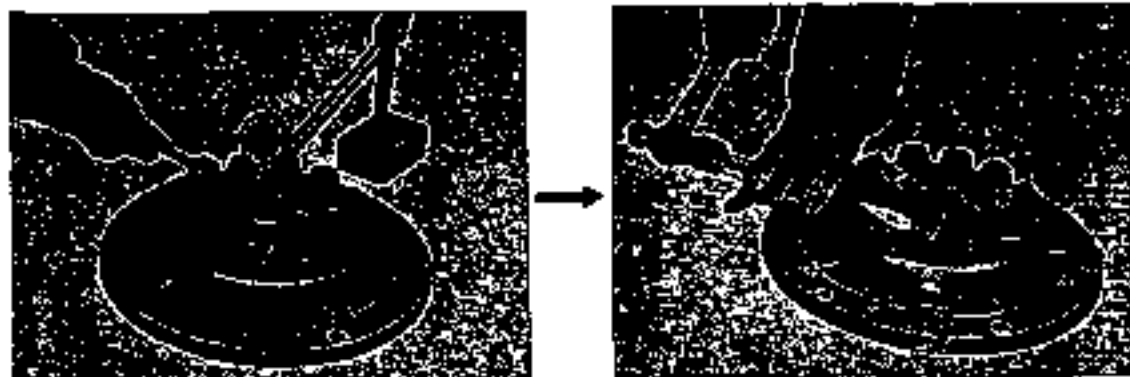


Place the pressure plate on the base plate with the pressure springs in position on the pressure plate and put the pressure spring retainers on it. Cover and set the clutch cover assembly on the base plate.

Compress the pressure springs by screwing down the cover to the base plate by using the special set screw placed through each hole in the cover.

Tighten the screws, a little at a time, by diagonal selection to prevent distortion to the cover. Set the release lever on the eye-bolt with lock nuts inserting for lug at the edge of pressure plate.





Gauging

Screw the nuts into the bolts and proceed as follows. Screw the centre pillar into the base plate and slip the distance piece over the pillar followed by the cam-shaped height finger. Adjust the height of the release levers by screwing or unscrewing the bolt nuts until the height finger, when rotated, just contact the highest point on the tip of the release levers.

Replace the height finger and pillar by the clutch actuating mechanism (See inset Fig. 5) and actuate the clutch several times by operating the handle.

This will enable the parts to settle down on their knife edges.

Replace the height finger and distance piece and readjust the height of the release levers checked for "run out" as near the edge as possible as, if the error is more than 0.02 in. press over the high spots until it is true within this figure. It is important to keep friction facings free from oil or grease.

Finally repeat the procedure to make quite sure the release levers are seating properly and gauge again. Secure the lock nuts and fix the release lever

Release the setscrews, and remove the clutch assembly from the base plate

Refacing the Driven Plate

If a new complete clutch driven plate is not available new linings may be fitted to the old driven plate in the following manner.

Each rivet should be removed by using drill. The rivets should not be punched out. Rivet one new facing in position, then if the correct tool is not available, use a blunted center punch to hold the rivet shanks securely against the plate. The second facing should then be riveted on the opposite side of the plate with the clear holes over the heads already formed in fitting the first facing. The plate should then be mounted on a mandrel between centers and checked for "run out" as near the edge as possible. If the wabbing is more than 0.02 in. press over high spots until it is true within this figure. It is important to keep friction facings free from oil or grease.

Refitting the Clutch

Place the driven plate on the flywheel with the longer chamfered splined end of the driven plate hub towards the transmission.

The driven plate should be centralised by a dummy drive shaft which fits the splined bore of the driven plate hub and the pilot bearing of the flywheel.

The clutch cover assembly can now be secured to the flywheel by means of the holding screws, rightening them a turn at a time by diagonal selection.

There are two dowels in the flywheel to locate in the clutch cover. Remove a dummy shaft after these screws are fully tightened. (35 lb/ft = 4.84 kg-m.)

Refit the release bearing and transmission case. The weight avoid strain on the drive shaft and distortion of the driven plate assembly.

DESCRIPTION OF CLUTCH CONTROL

The clutch is operated from a master cylinder by means of a suspended pedal.

A cylinder mounted on the clutch bell housing is coupled to the clutch operating shaft.

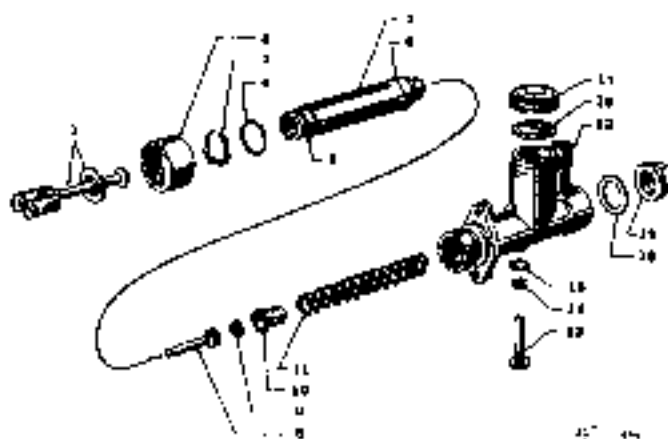


Fig. 6 Components of the Master Cylinder

- | | |
|--------------------------------|--|
| ① Push rod assembly | ⑩ Piston return spring |
| ② Master cylinder rubber boots | ⑪ Clutch master cylinder body assembly |
| ③ Stopper ring | ⑫ Let-in valve release pin |
| ④ Piston secondary cup ring | ⑬ Ring |
| ⑤ Secondary cup | ⑭ Gasket |
| ⑥ Primary cup | ⑮ Filler cap gasket |
| ⑦ Master cylinder piston | ⑯ Cap |
| ⑧ Let-in valve assembly | ⑰ End plug gasket |
| ⑨ Let-in valve spring | ⑱ End plug |
| ⑫ Return spring seat | |

When pressure to the clutch pedal is applied the piston of the master cylinder displaces the fluid in the cylinder and via a pipe line, in turn, moves the piston of the cylinder, pushing against the lever of the clutch shaft.

The Master Cylinder

The master cylinder consists of an alloy body with a polished finish bore, and reservoir with cap. The inner assembly is made up of the push rod, ring, stopper ring, piston, cups, spring seat, spring, valve and valve spring.

The end of cylinder is protected by a rubber boot.

Dismantling the Clutch Master Cylinder

Disconnect the pressure pipe union from the cylinder and remove the securing bolts, then the master cylinder can be withdrawn complete from the car.

Remove the filler cap and drain out the fluid. Pull back the rubber boot and remove the stopper ring with a pair of long nosed pliers. The push rod and ring can then be removed, and unscrew the release pin.

When the push rod has been removed the piston with caps attached will be exposed, remove the piston assembly complete.

The assembly can be separated by lifting the spring seat edge over the shouldered end of the piston. Depress the piston return spring allowing the valve assembly to slide through the elongated hole of the spring seat thus releasing the tension, on the spring.

Examine all parts, especially the gasket, cylinder bore and piston cups, for wear or distortion and replace the new parts where necessary.

Assembling

Smear the assembly well with the recommended brake fluid, and insert the assembly into the bore of the cylinder, and first, easing the piston cups lips in the bore.

Replace the push rod, with the secondary cup ring, into the cylinder followed by the stopper ring which engages into the groove machined in the cylinder body.

Replace the rubber boot and secure the unit by means of the two bolts on the flange and refit the pressure pipe union into the cylinder.

The Operating Cylinder

This cylinder is of simple construction, consisting of the body, piston, piston with cup, spring and bleed screw, the open end of the cylinder being protected by a rubber dust cover. The cylinder is mounted under side of the starting motor.

Dismantling

Remove the rubber dust cap from the bleed screw attach a bleed tube, open the bleed screw three-quarters of a turn and pump the clutch pedal until all the fluid has been drained into a clean container.

Unscrew the flexible pipe union and adjustable push rod. The operating cylinder can now be removed. Remove the rubber cover and if compressed air line is available, blow out the piston from the side union.

Examine all parts, especially the seal, and replace if worn or damaged.

Assembling

Place the seal into the stem of the piston, with the back of the seal against the piston, replace the springs with the small end on the stem, smear well with the recommended fluid and insert into the cylinder. Replace the dust cover and mount the cylinder in position, making sure the push rod enters the hole in the rubber boot. Secure the cylinder with the bolt, and screw in the pipe union. Adjust the push rod by the screw driver at top of withdrawal lever with the adjustable rod of

operating cylinder to give the end play $2.5 - 3.0$ mm

Bleeding the Clutch System

Remove the bleed screw dust cap at the operating cylinder, open the bleed screw approximately three-quarters of a turn and attach a tube immersing the open end into a clean receptacle containing a small amount of brake fluid. Fill the master cylinder reservoir with the recommended fluid and by using slow, full strokes, pump the clutch pedal until the fluid entering the container is free from air bubbles. On a down stroke of the pedal, screw up the bleed screw, remove the bleed tube and replace the dust cap.

When the clutch pedal is depressed, the force is transmitted to the ball bearing, and the surface pushed the release plate. Effectual stroke of the pedal is 128 mm leaving 30 mm surplus in stroke (95 mm until the clutch disengages). When there is undue surplus or shortness in stroke, readjust the pedal position with the adjust shim.

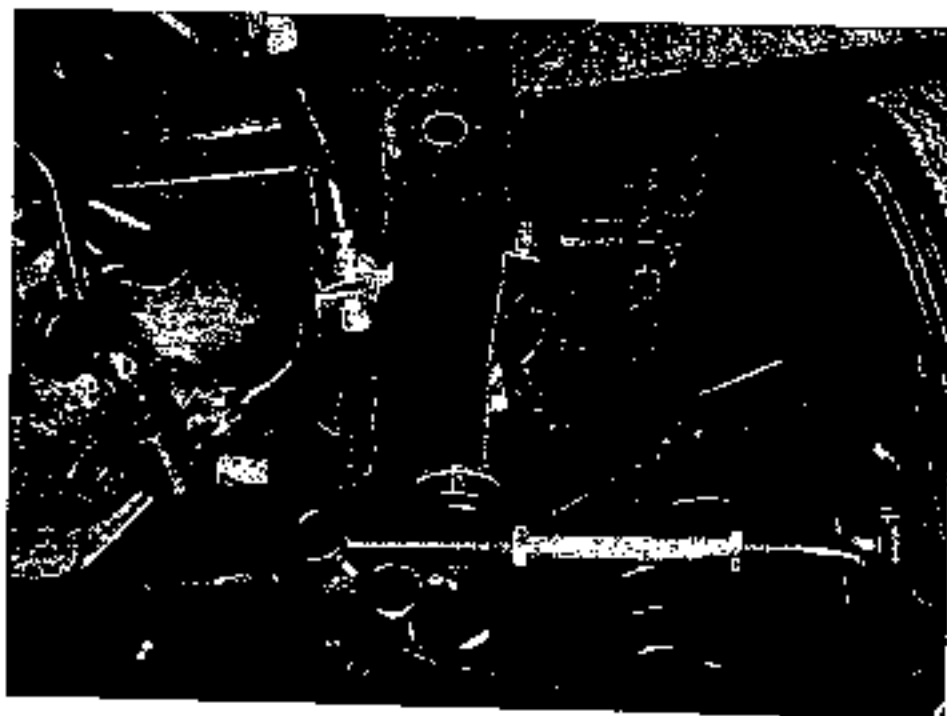


Fig. 7

TRANSMISSION

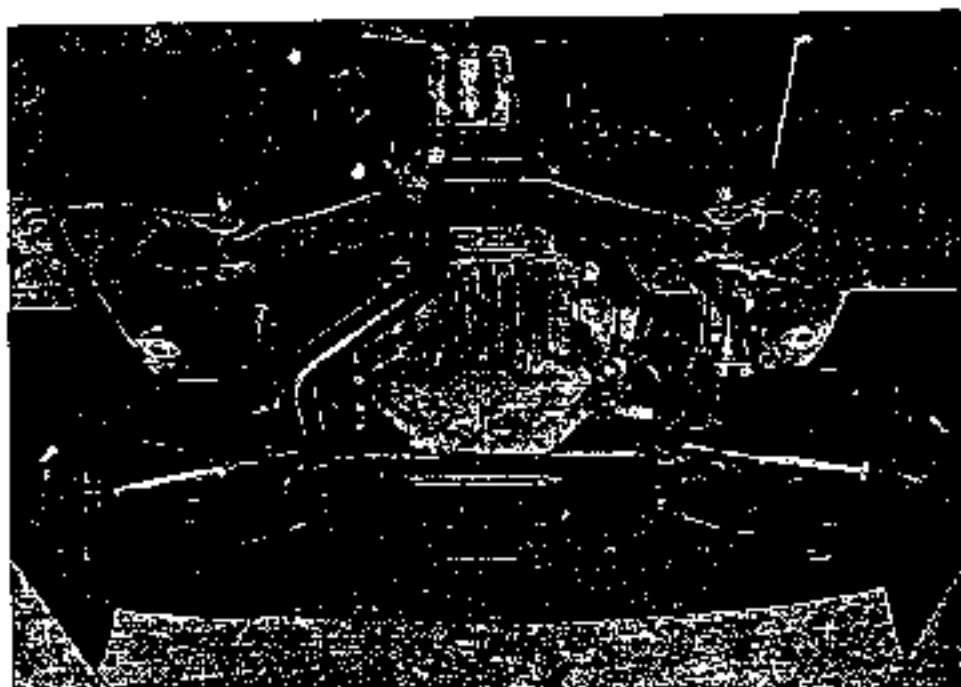


Fig. 1

Model	3 stage for forward, 1 stage for reverse Remote control Full-synchromesh on forward gears.	4 stage for forward, synchromesh on for speed
Type of gear	Synchromeshed helical gear type	#2nd, 3rd & 4th gear
Ratio #1	3.518	3.94
Ratio #2	1.725	2.40
Ratio #3	1.000	1.49
Ratio #4		1.00
Reverse	4.125	5.159

DISASSEMBLE THE TRANSMISSION CASE

First drain the oil from the transmission by removing the drain plug. The drain plug is situated beneath the case.

Disconnect the propeller shaft, starting motor, clutch lever and shift levers.

Shift Lever (Remote Control)

The shift lever is positioned on the right-hand side of the case of transmission, if the car has right-hand steering wheel, and on the left-hand side, if it has left-hand steering wheel.

Shift Lever (Floor Gear Shift Lever)

The shift lever is located on the right-hand or left-hand side of driver's seat.

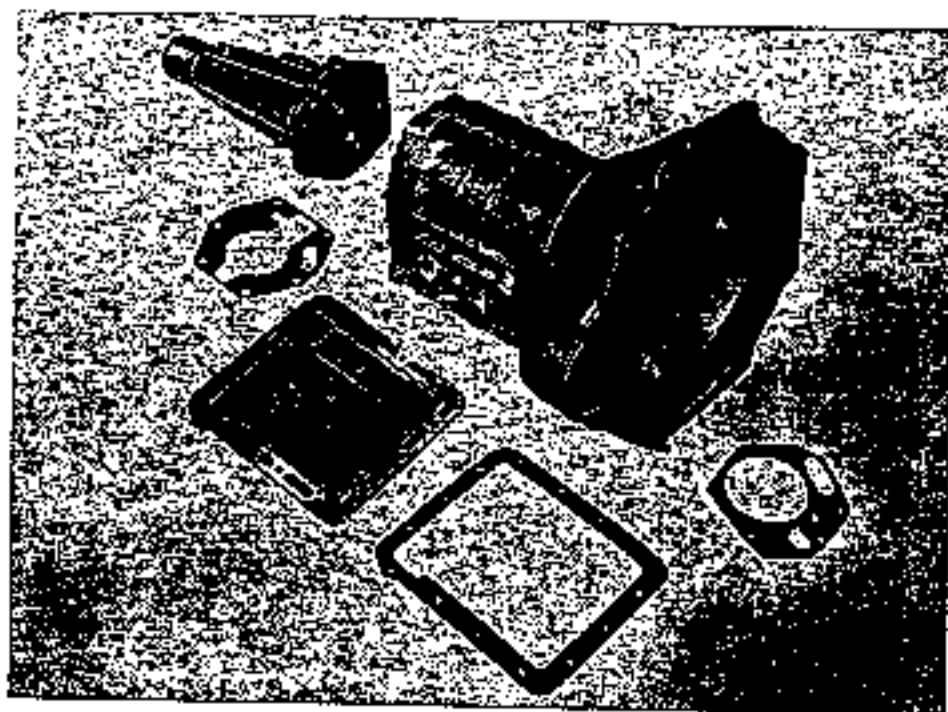


Fig. 2

TRANSMISSION CASE

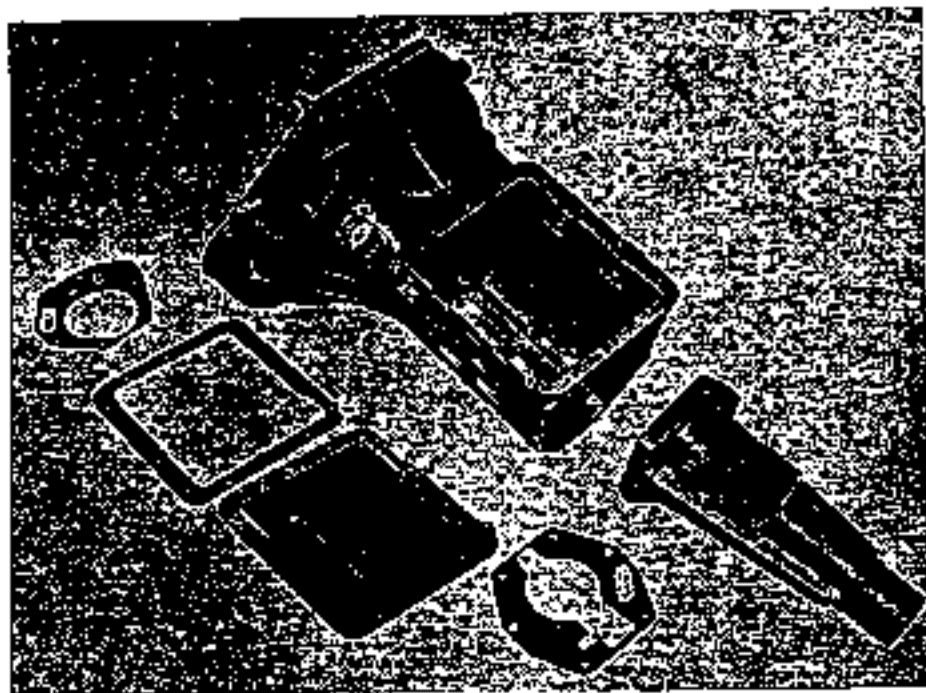


Fig. 3

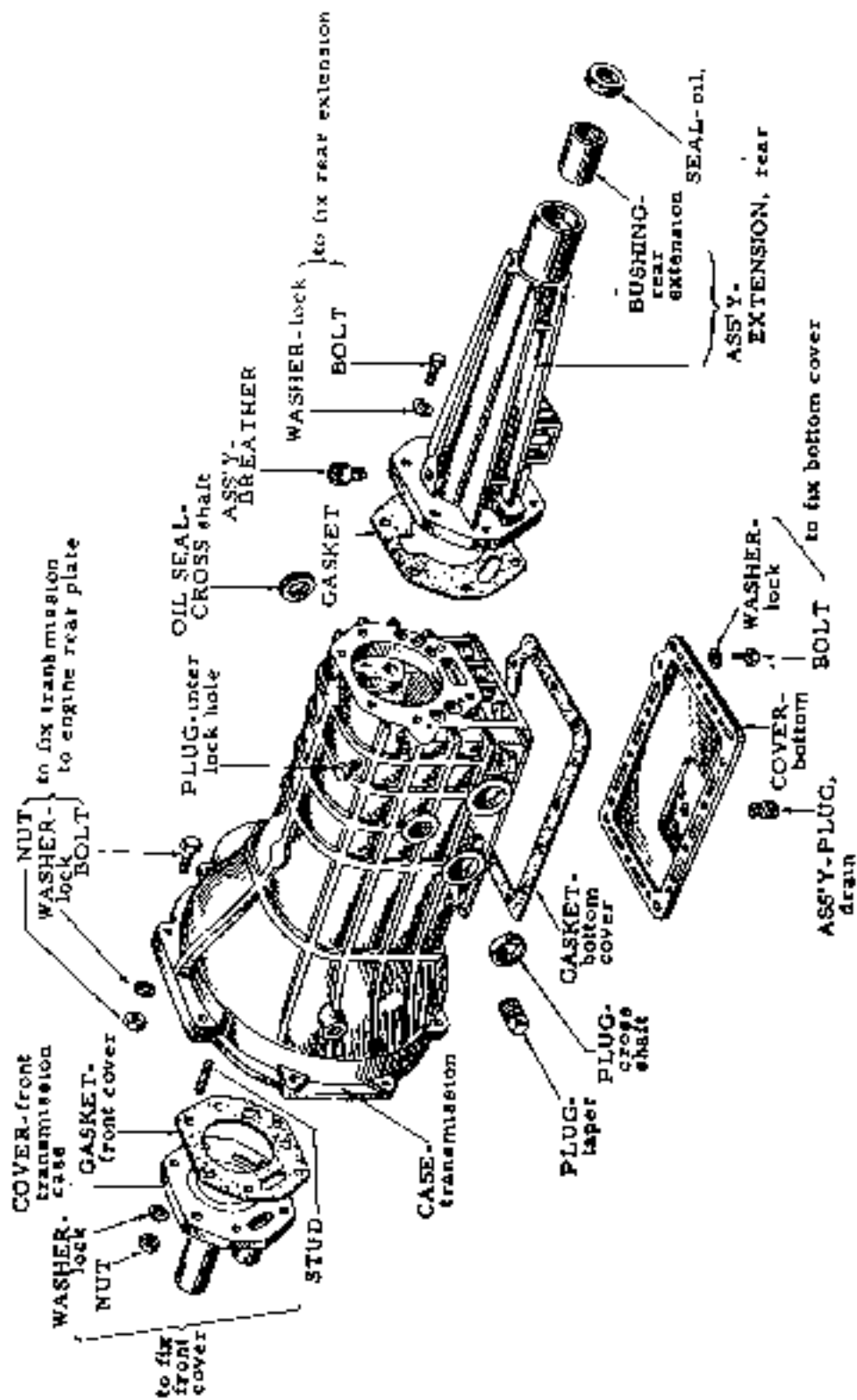


FIG.4 TRANSMISSION CASE & REAR EXTENSION

DISASSEMBLY

Front Bearing Retainer

Release the front bearing retainer situated within the clutch housing by removing the nuts.

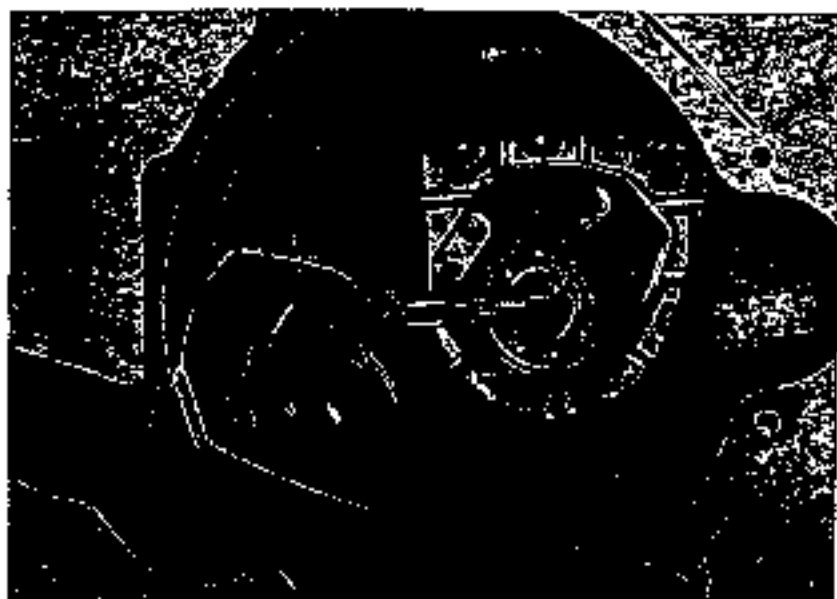
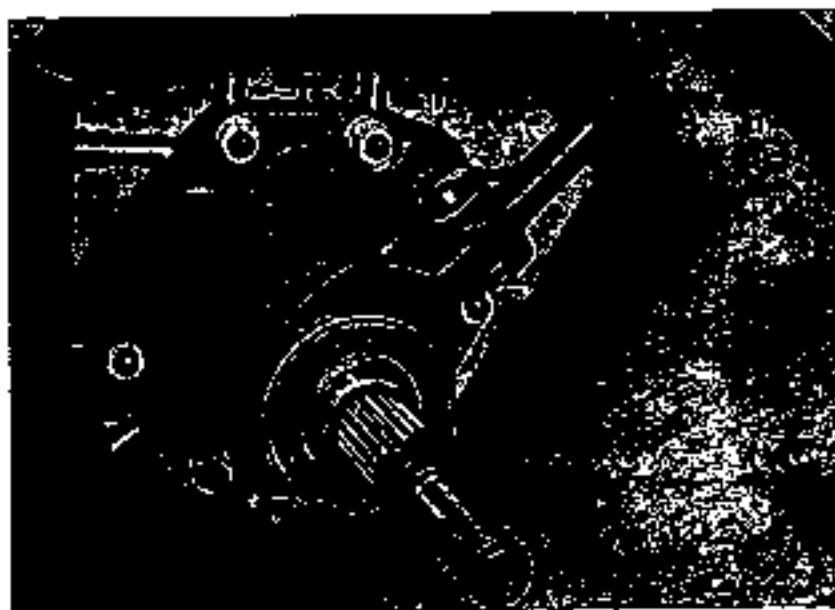


Fig. 5 Bearing Retainer

Cover of Transmission

Holding the cover in position are 14 set-nuts, all of which must be removed when the cover can be taken off.

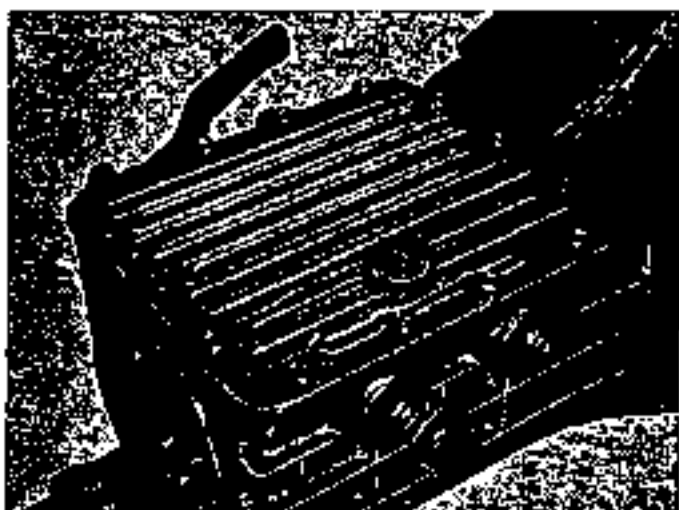


Fig. 7 Bottom Cover

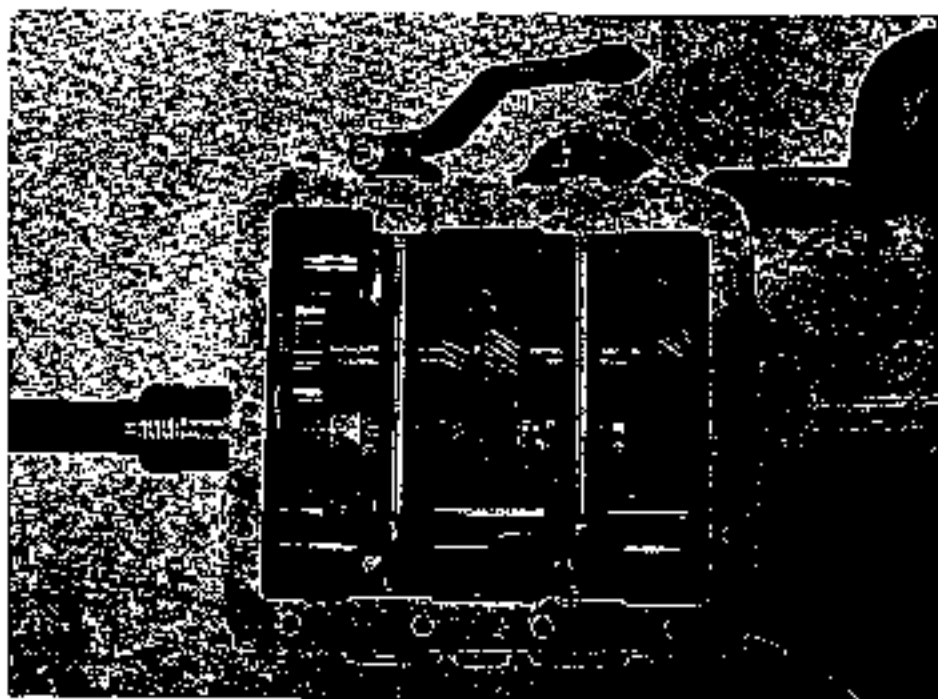


Fig. 8 View of Inside of Transmission



Fig. 9 Take Out the Ring

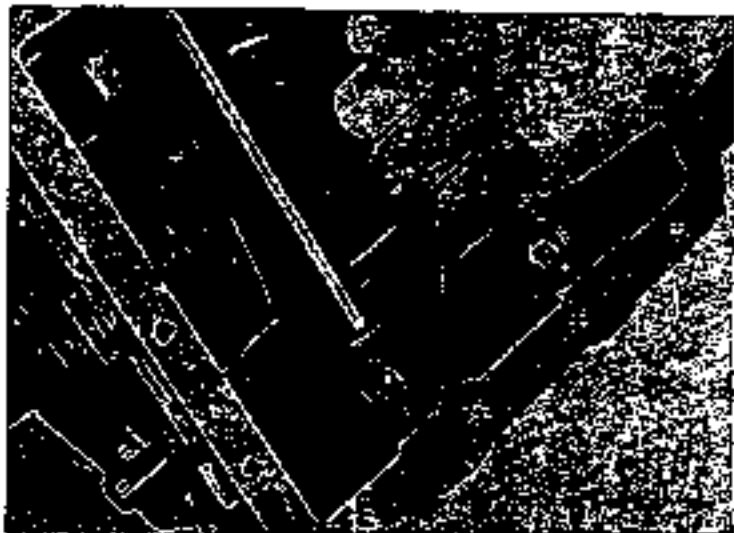


Fig. 10 Take Off the Pin & Nut

Counter Shaft & Gear

Using a soft and long metal drift, drive out the counter shaft forward. When the counter gear cluster and two thrust washers will drop in the case. These gear cluster can only be lifted from the case.

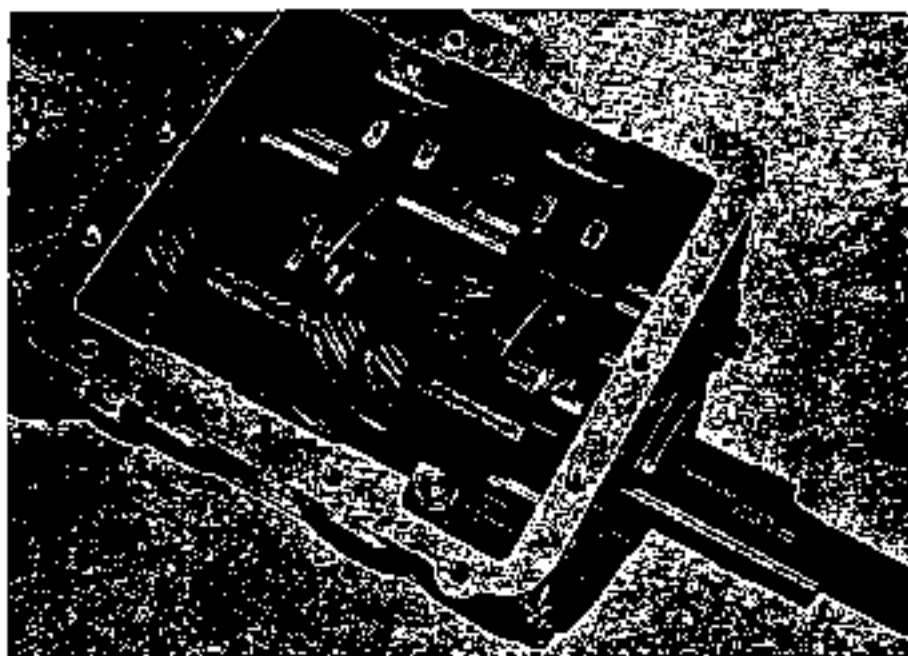


Fig. 11 Counter Shaft Removal



Fig. 12 Pull Out the Retaining, Fork Pin

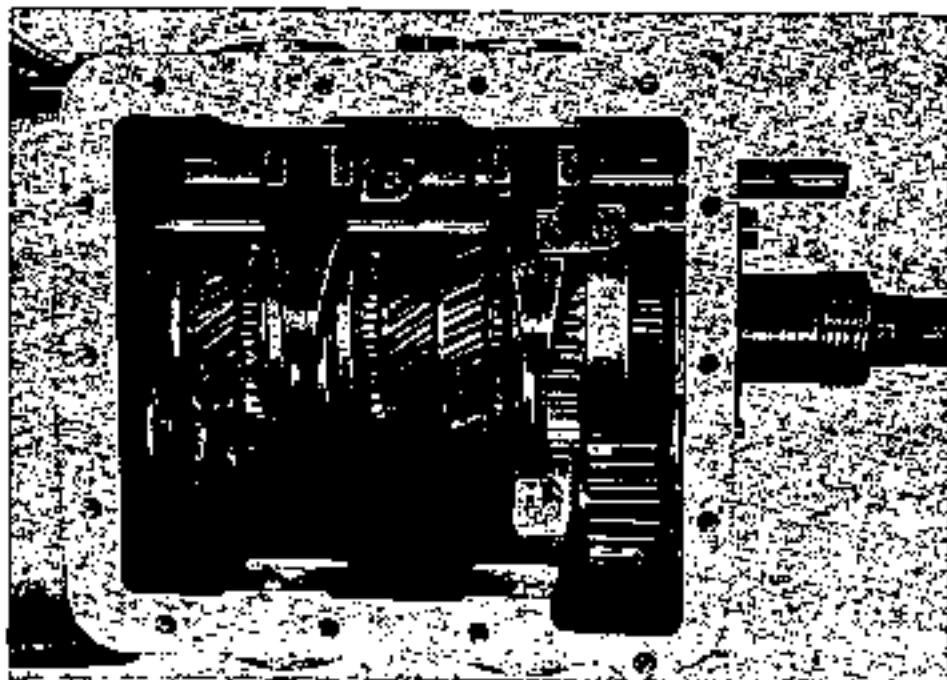


Fig. 13-A Pull Out the Fork Rods

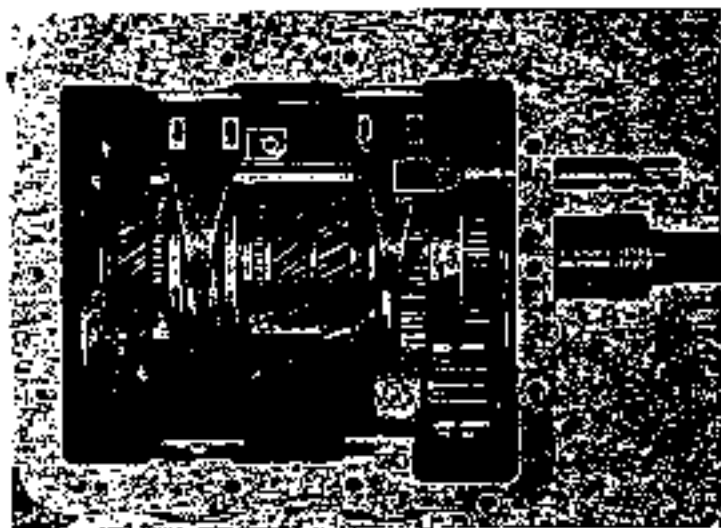


Fig. 13-B Pull Out the Fork Rods

Revers 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 set bolt is screwed through the lug locating in the shaft of reverse gear.

Release the lock washer, then screw out. Lift out the reverse gear shaft.



Fig. 14-A Pull Out the Reverse Gear Shaft



Fig. 14-B Pull Out the Reverse Gear Shaft
Main Drive Shaft

Tapped out the main drive gear assembly.

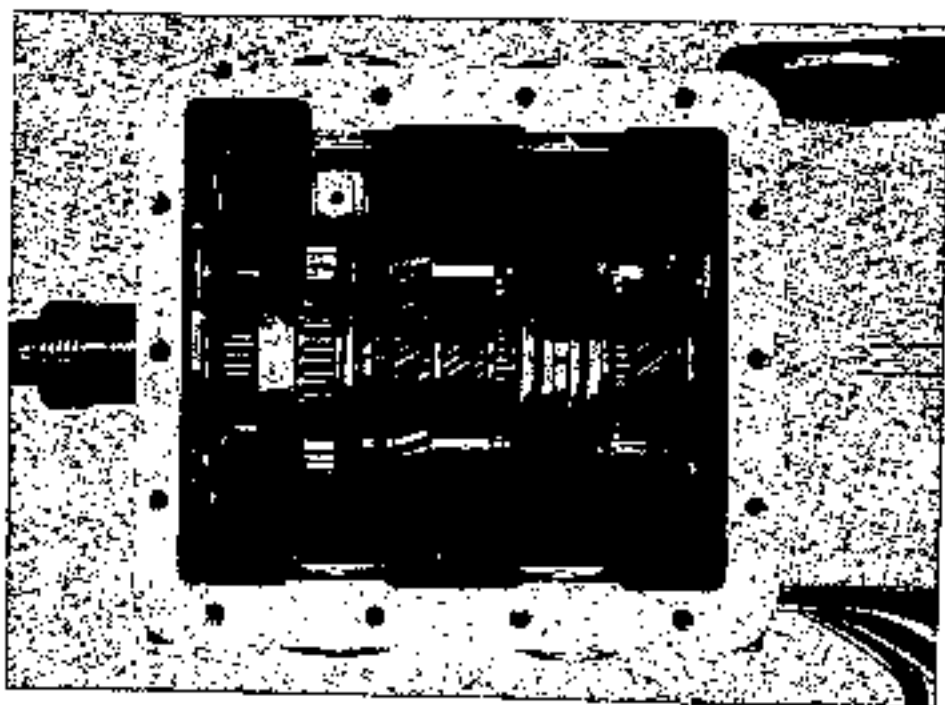


Fig. 15-A Removal of Main Drive Gear Shaft

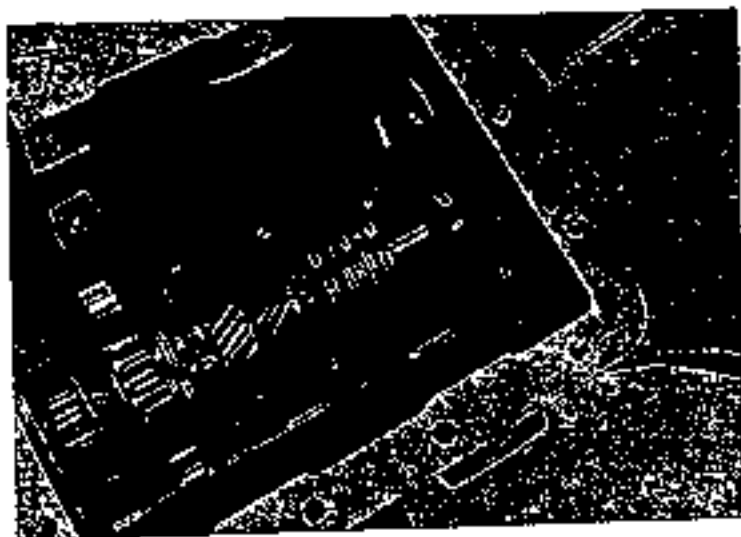


Fig. 15-B Removal of Main Drive Gear Shaft

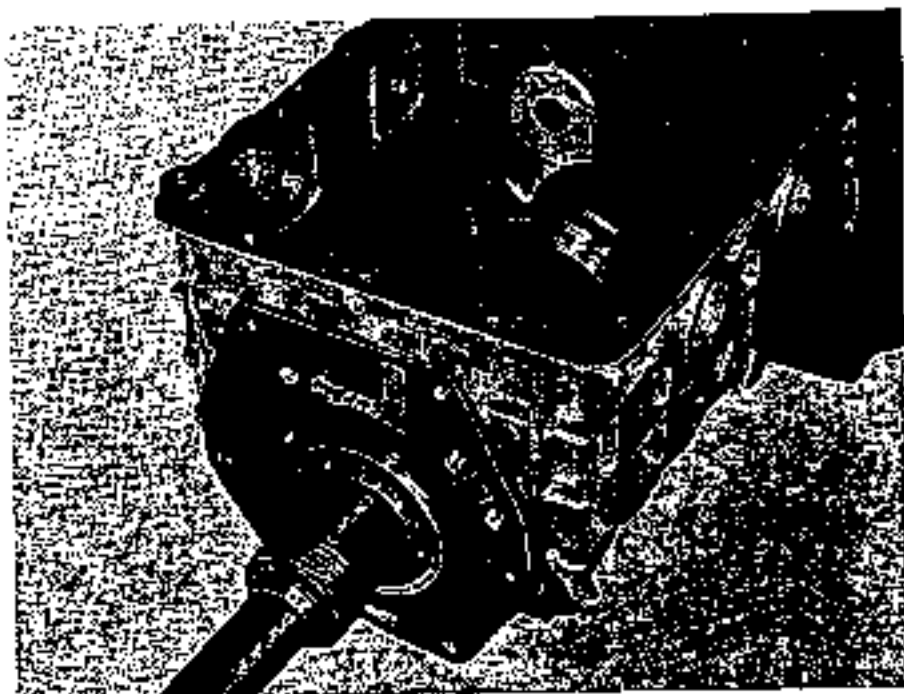


Fig. 16-A Main Shaft Removal

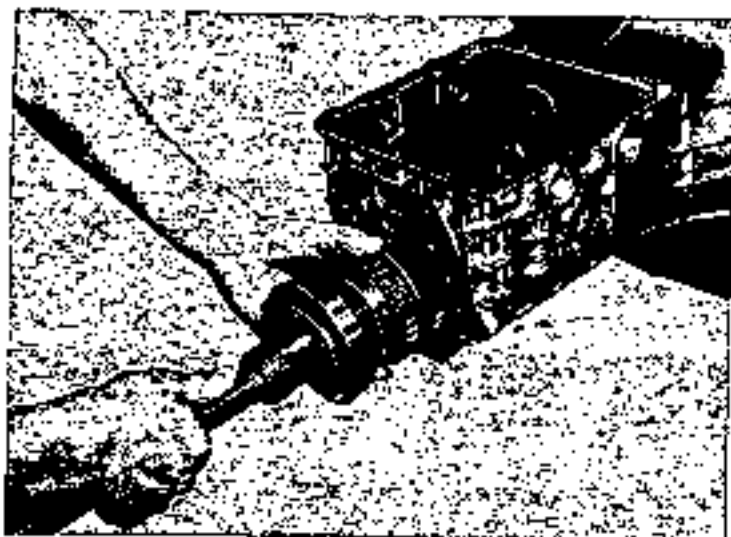


Fig. 16 -B Main Shaft Removal

Main Shaft

Roll out the rear bearing and the speed gear sleeve by the bearing puller from the main shaft rear side.



Fig. 17

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 set pin is screwed through the lug locating in the shaft. The set key is locked out side of the case.

Release the set pin, then tap forward and remove the reverse gear shaft. Lift out the reverse gear.

Rear Oil Seal

This oil seal is situated in the end of the rear bearing retainer and should not be dismantled unless suspected of leaking. It is almost impossible to take off the seal without damage it; consequently a new oil seal should be fitted if the old one has been removed.

This can be removed by using a punch and hammer.

Main Shaft

Counter cluster gear in the case. Insert the first gear to the main shaft together with second and third gear assembly from rear hole and fit the first and reverse fork shifter over the first gear.

Fit the shift fork of the second and third gears assembly on the hub of synchronizer.

Depress the main shaft bearing to the end of the case.

Change the dummy shaft to counter gear with the said shaft.

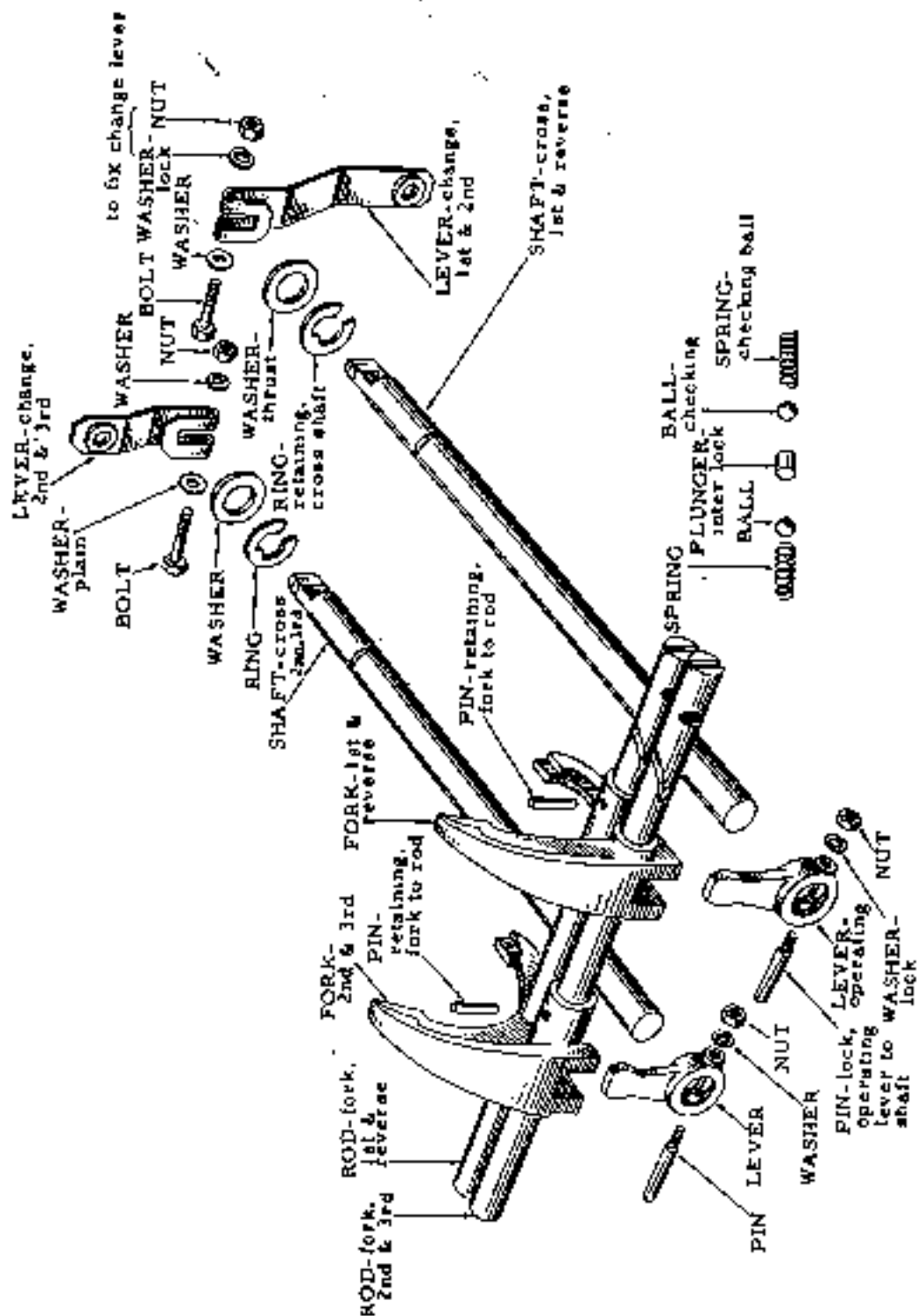


FIG.18 TRANSMISSION FORK & ROD

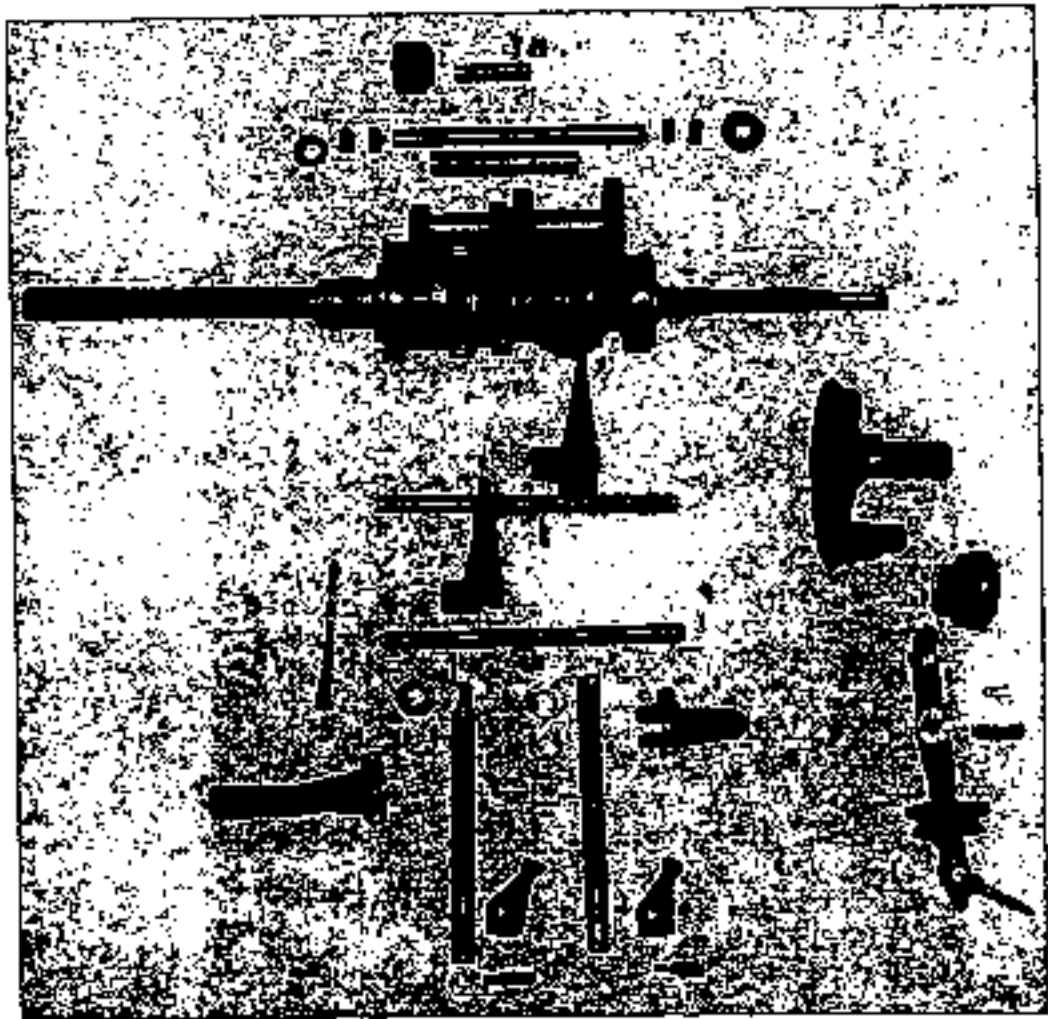


Fig. 19 ASSEMBLY ORDER OF
TRANSMISSION GEAR & CASE

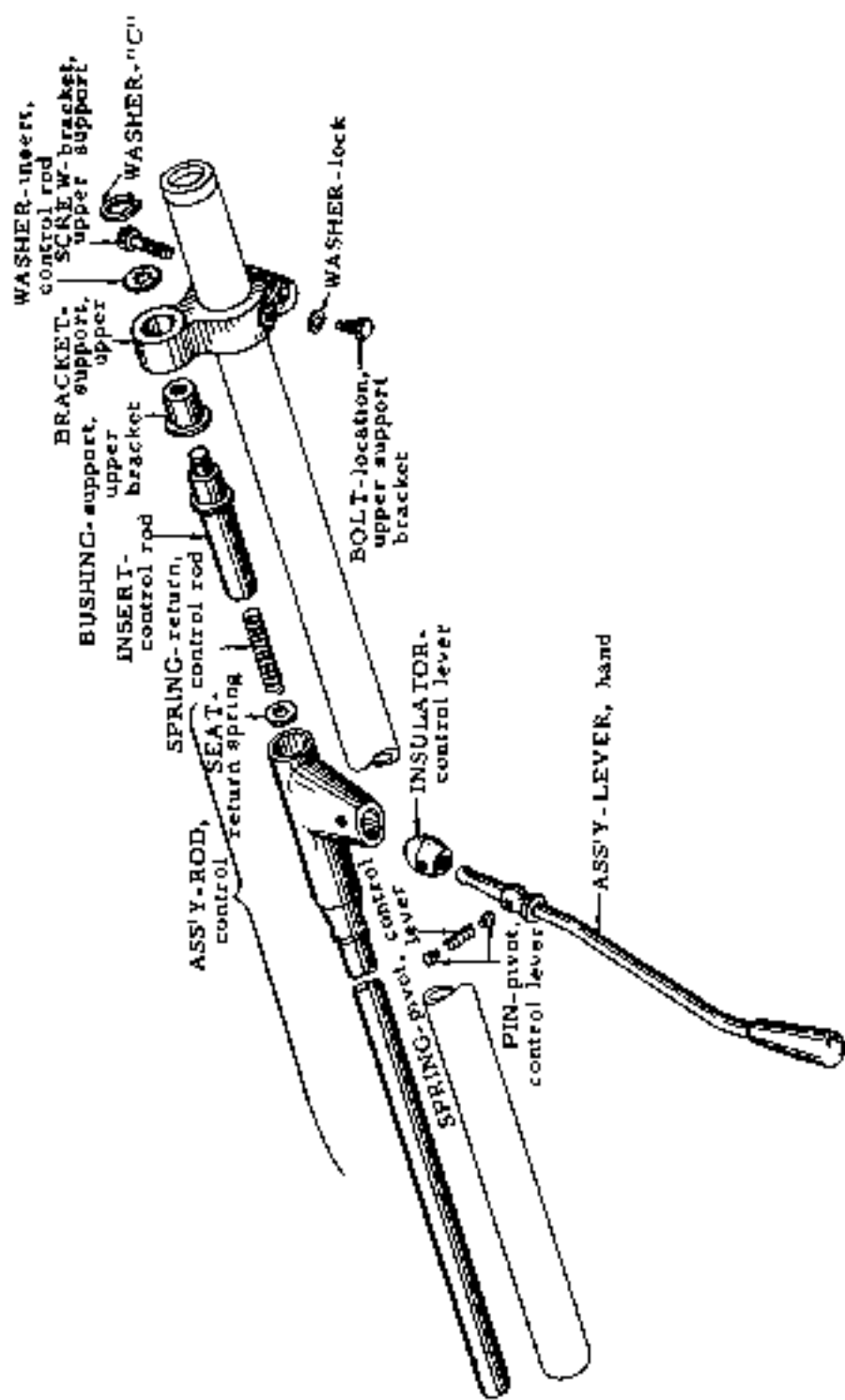


FIG.20 REMOTE CONTROL

DISASSEMBLE THE TRANSMISSION CASE

FOR 4 STAGE FLOOR SHIFT

Removal of Control Lever

Twist the cap on the lower portion of the control lever counterclockwise with a slight downward pressure.

Removal of Shift Rod & Shift Fork

Remove the cover from the transmission by detaching six bolts.

Reverse Gear

A lug, which is an integral part of the main casing locates the forward end of the reverse gear shaft. To secure the shaft in position, a setting screw is locked by a tab washer. Straighten the tab washer, release the setting screw, then tap forward and remove the reverse gear shaft. Set out the reverse gear.

Counter Shaft & Gear

Using soft metal drift, drive out 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 casing when the main and drive shafts together with their respective gears, have been removed.

To remove the needle roller bearing within the counter gear cluster it is necessary to break the retaining circlips before driving out the bearing with a suitable piece of metal tubing.

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 fourth and 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 jamming 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.

ASSEMBLING THE TRANSMISSION

The 2nd speed gear, the 3rd and 4th speed coupling sleeves are each paired with their respective synchronizers. Only mated pairs of these parts should therefore fitted.

Reverse Gear

Refit the reverse gear into the gear case with the large gear to the rear.

Oil the reverse gear shaft before inserting and secure the shift with locating screw and lock washer.

Counter Shaft Gears

First put 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 between 0.04 mm and 0.12mm (0.0015~0.0046), and remedy if necessary by fitting a thicker or thinner rear washer.

Thickness of front thrust washer,

<u>Part No.</u>	<u>Thickness</u>
32224-26760	3.9I 3.96T

Thickness of rear thrust washer;

<u>Part No.</u>	<u>Thickness</u>
32226 26760	3.9T
32227 26760	4.0I
32228 26760	4.1I
32229 26760	4.2T

Replace the counter shaft with a thin temporary 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 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 race on the gear case.

Main Shaft

Press the main shaft center bearing complete with housing on to the shaft from the rear.

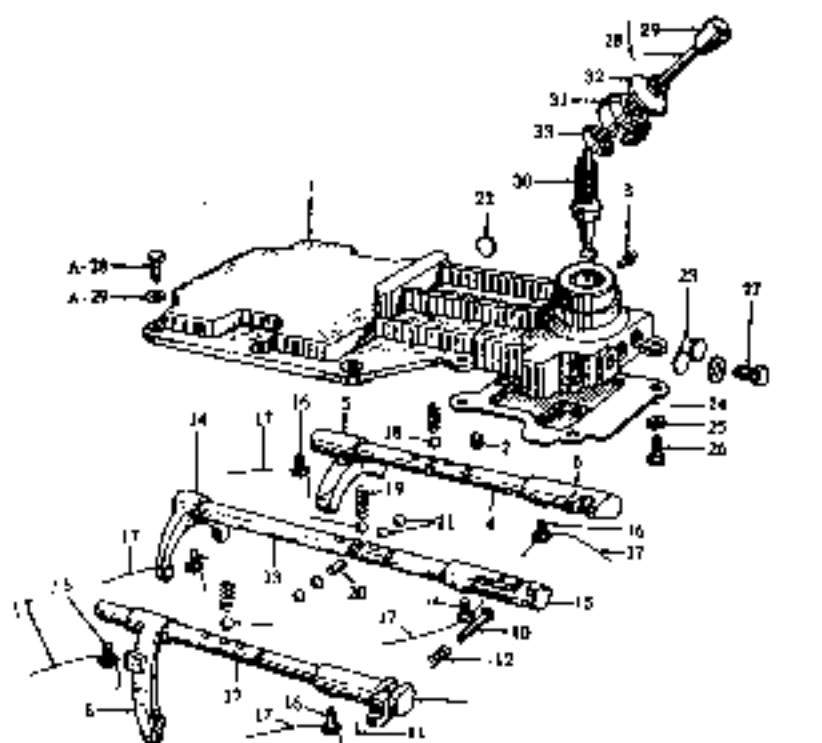
The bearing must be pressed firmly against the shoulder of the center splined portion of the shaft. Lightly smear oil the shaft forward of the bearing and refit the first speed wheel assembly with the synchronizer pointing forward.

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, therefore it must be first immersed in warm oil and then slid into position on the shaft. Fit 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 splined washer over the plunger. Then turn the washer for the plunger to engage with a groove in the washer.

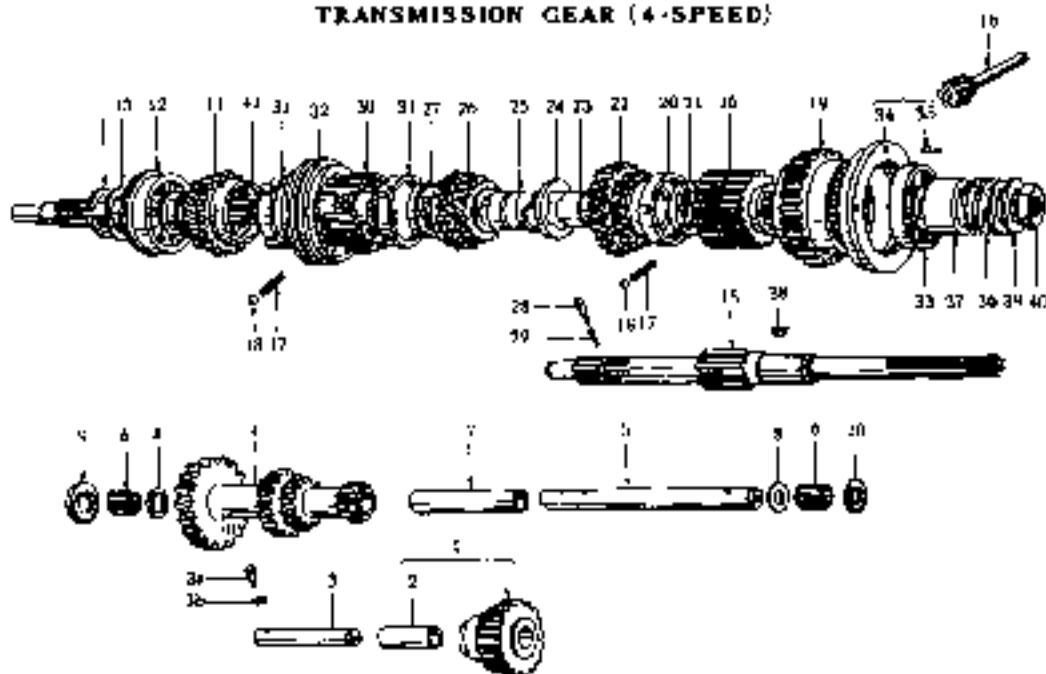
The gear are now assembled on the main shaft.

TRANSMISSION FORK & ROD (4-SPEED)



- | | | | | |
|---------------------------|----|-----------------------------|----|--------------------------|
| Apply-cover, transmission | 13 | Ball-fork, 3rd & 4th speed | 25 | Washer-lock |
| Apply-cover, transmission | 14 | Fork-3rd & 4th speed | 26 | Bolt |
| 1 | 15 | Brakes-rod, 3rd & 4th speed | 27 | Plug |
| 2 | | Ball-checking | 28 | Ass'y-lever, control |
| 3 | | Spring-poppet pin | 29 | Knob-control lever |
| 4 | 16 | Screw-pat | 30 | Spring-lever, control |
| 5 | 17 | Wire-lock | 31 | Cap-cover, transmission |
| 6 | 18 | Bolt-checking | 32 | Box-rubber |
| 7 | 19 | Spring-poppet, shift rod | 33 | Semi-lever spring |
| 8 | 20 | Pin-interlock | | SCREW-stop, reverse fork |
| 9 | 21 | Ball-interlock | | NOE-plate |
| 10 | 22 | Plug-weld | | |
| 11 | 23 | Plug-weld | | |
| 12 | 24 | Plate-dial | | |

TRANSMISSION GEAR (4-SPEED)



- | | |
|--------------------------------------|---|
| 1 Axly gear, reverse | 18 Ball-synchronizer hub |
| 2 Bushing, reverse gear | 19 Gear-mainshaft |
| 3 Shaft-reverse gear | 20 Ring-hub, 2nd speed |
| Screw-set reverse gear | 21 Washer-thrust, main shaft rear |
| Washer lock | 22 Gear-2nd speed |
| 4 Gear-counter | 23 Bushing-2nd speed gear |
| 5 Shaft-counter | 24 Washer-thrust, main shaft |
| 6 Roller-needle | 25 Bushing-3rd speed gear |
| 7 Countershaft spacer | 26 Gear-3rd speed |
| 8 Ring-retainer, needle roller | 27 Washer-hub, main shaft, front (3 V) |
| 9 Washer-thrust, counter front | 28 Washer-thrust, main shaft, front (4 V) |
| 10 Washer-thrust, counter rear (3 V) | 29 Washer-thrust, main shaft, front (4 V) |
| Washer-thrust, counter, rear (4 V) | 30 Washer-thrust, main shaft, front (4 V) |
| Washer-thrust, counter, rear (4 V) | 31 Washer-thrust, main shaft, front (4 V) |
| 11 Gear-main drive | 32 Peg-locking |
| 12 Bearing-main drive gear | 33 Spring-locking peg |
| 13 Spacer-take up (1.5T) | 34 Hub-synchronizer, 3rd & 4th speed |
| 14 Ring-snap, main drive gear (1.5T) | 35 Ring-hub, 3rd & 4th speed |
| Ring-snap, main drive gear (1.5T) | 36 Sleeve-synchronizer, 3rd & 4th speed |
| Ring-snap, main drive gear (1.7T) | 37 Bearing-main shaft |
| 15 Shaft-main | 38 Axly-roller, main shaft bearing |
| 16 Hub-synchronizer | 39 Peg-locking |
| 17 Spring-synchronizer hub | 40 Gear-drive, speedometer (5T) |
| | Gear-drive, speedometer (4T) |
| | 41 Pin-dimension, main shaft |
| | 42 Key-woodruff |
| | 43 Washer-lock |
| | 44 Nut-main shaft |
| | 45 Bearing-main shaft pilot |

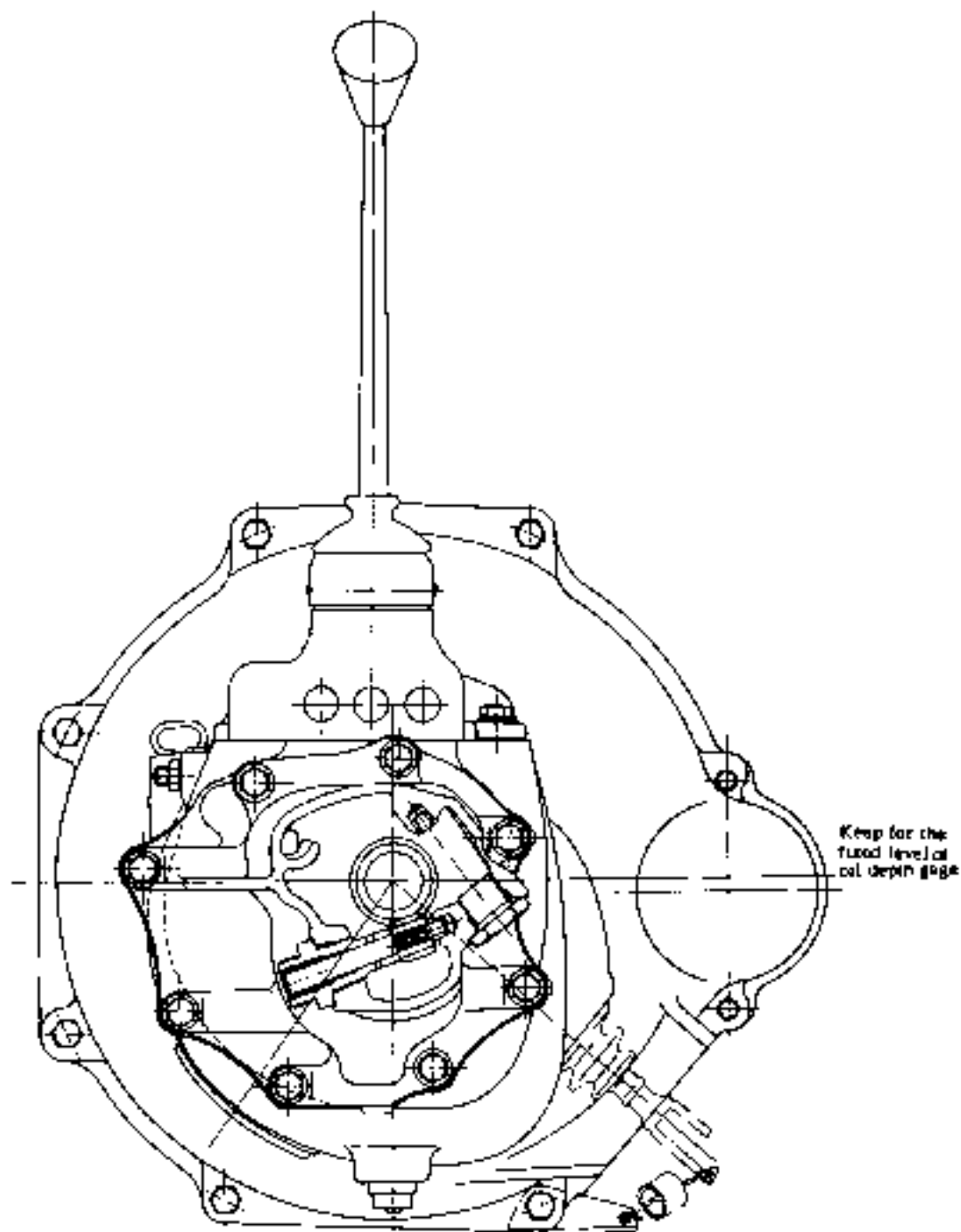
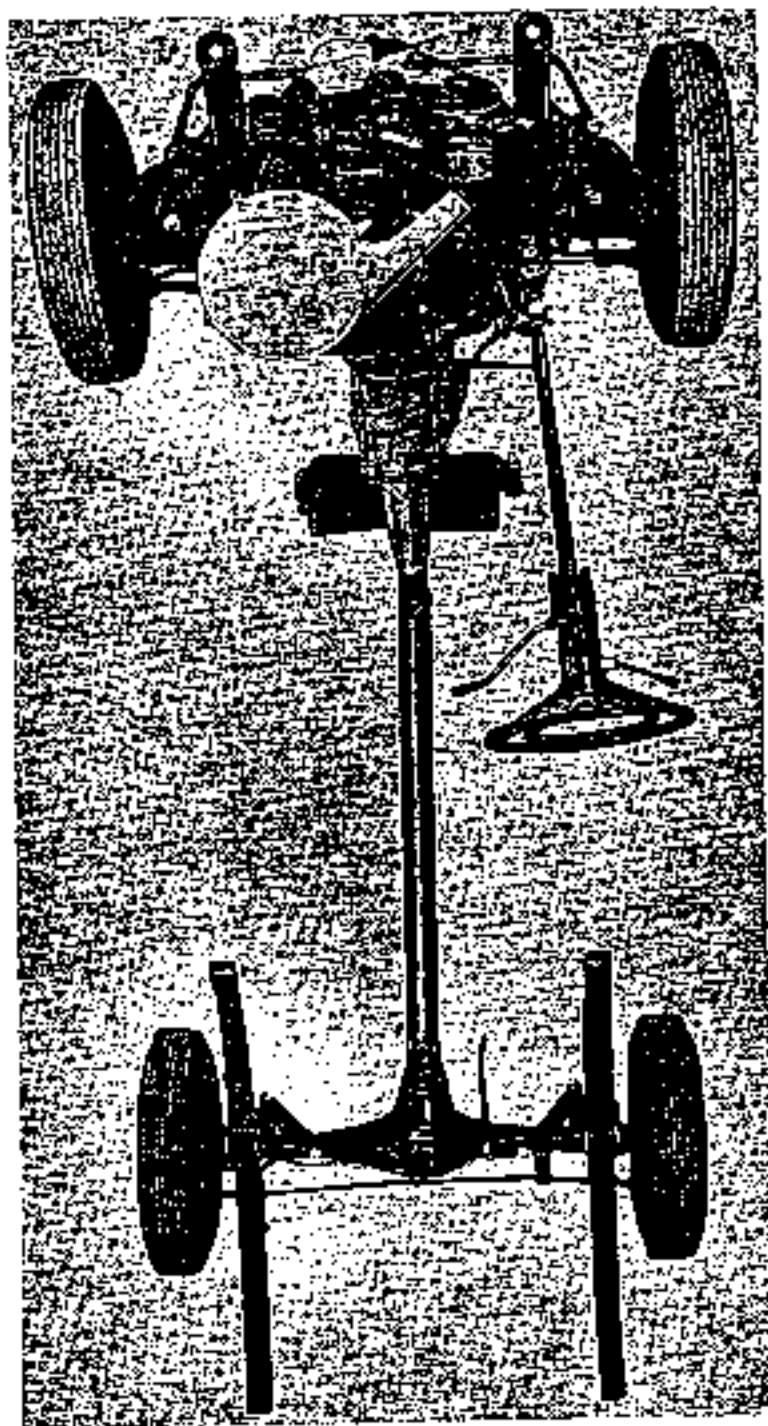
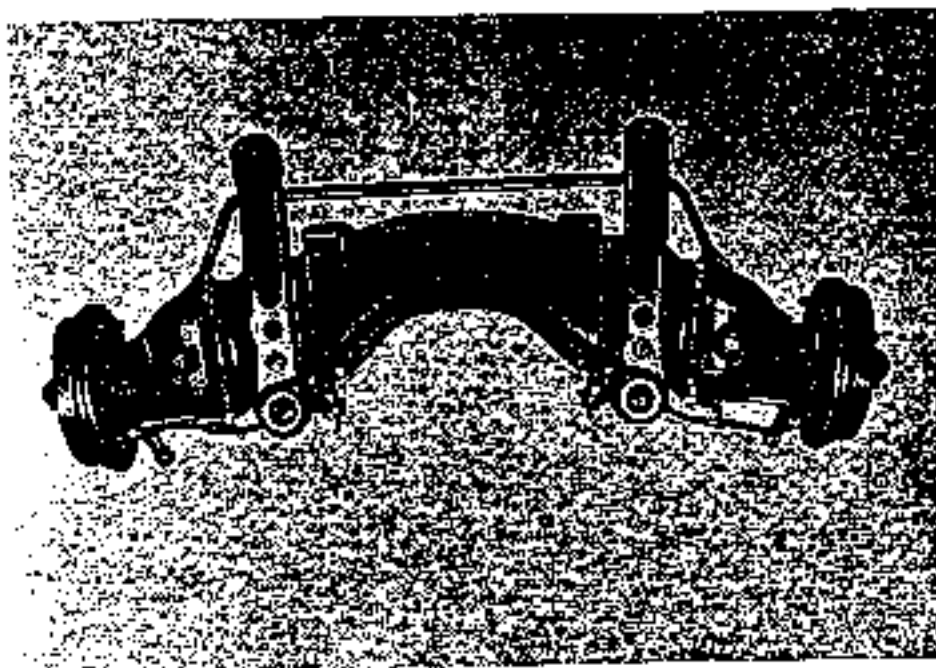


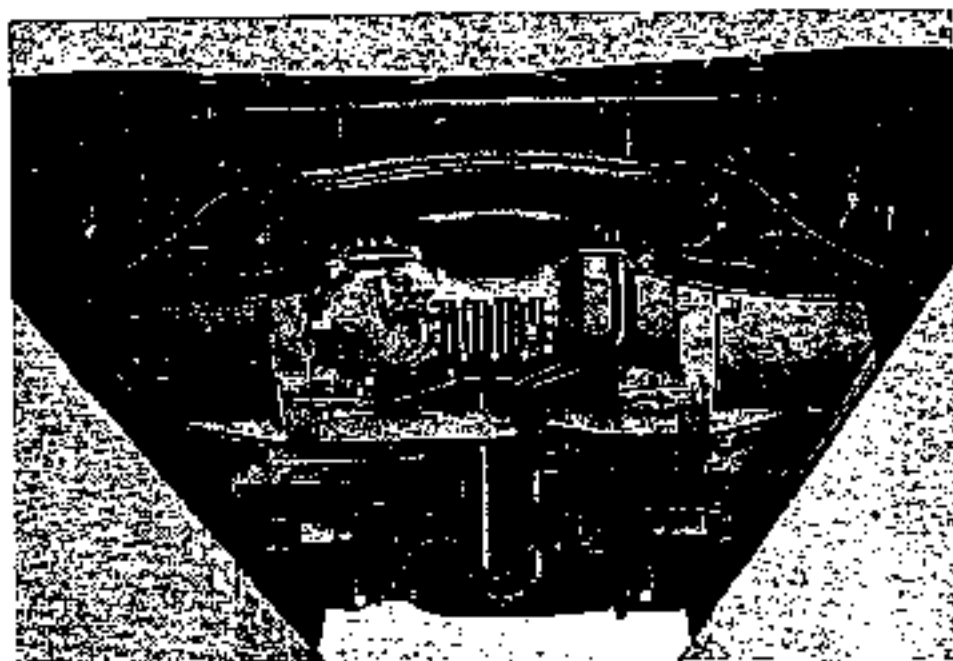
FIG. B TRANSMISSION
(4 Speed shift gear type)



FRONT AXLE



INDEPENDENT FRONT SUSPENSION



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 and lower which is secured to the lower suspension member 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.

Adjust for	Change the number of Shims*		Camber	Caster
	Front side	Back side		
Both Camber & Caster	-1		-0°01'	+0°29'
		-1	+0°16'	-0°31'
	+1		+0°02'	-0°31'
		+1	-0°04'	+0°29'
Camber only	+1	+1	-0°15'	
	+2	+2	-0°27'	
	-1	-1	+0°15'	
	-2	-2	+0°27'	

* , a thickness of each shim. - 1 m/m

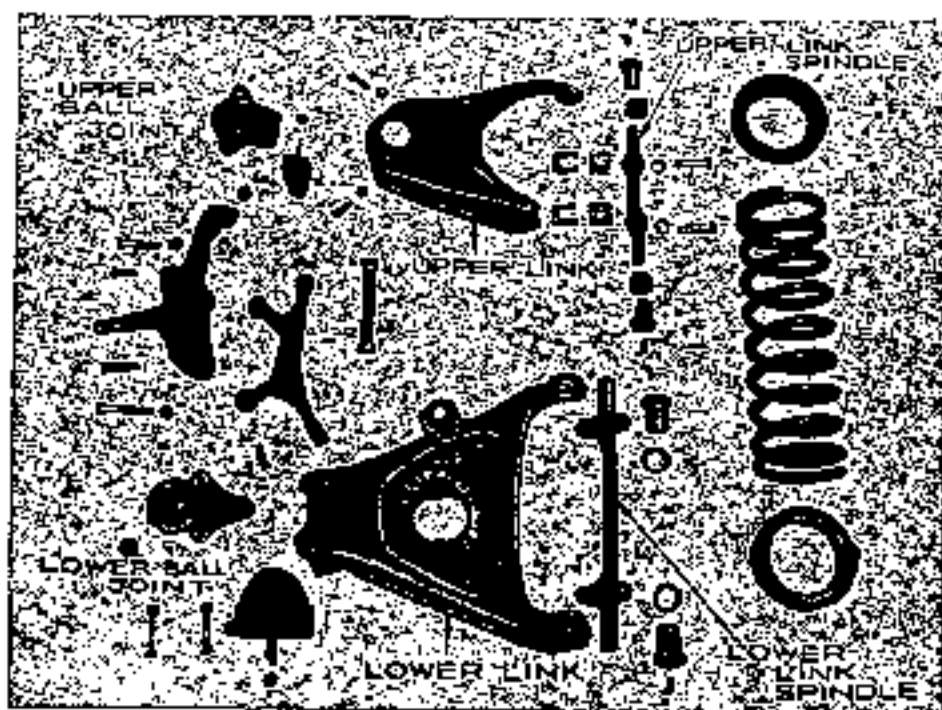
Camber adjusting shims

Parts No.	54542	04100	1 mm
	54543	04100	2 mm
	54544	04100	4 mm
Standard adjustment	Camber	1°30'	R/L difference within 40'
	Caster	1°30'	R/L difference within 40'

BALL JOINTS AND BUSHES OF THE SWIVEL AXLE

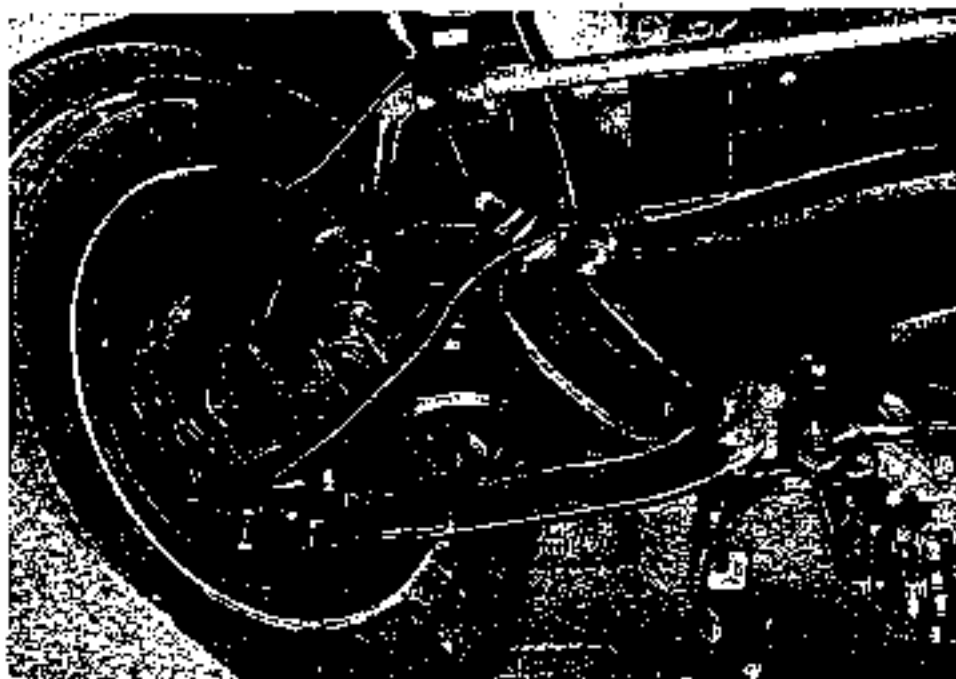
Wear of the swivel ball joint, or wear of the screw bushes of links, or both, may be checked by jacking the front of the car and endeavouring to rock the wheel by grasping opposite points of the tyre in a horizontal position. If any movement can be detected between the upper and lower swivel joints and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

Front Coil Spring



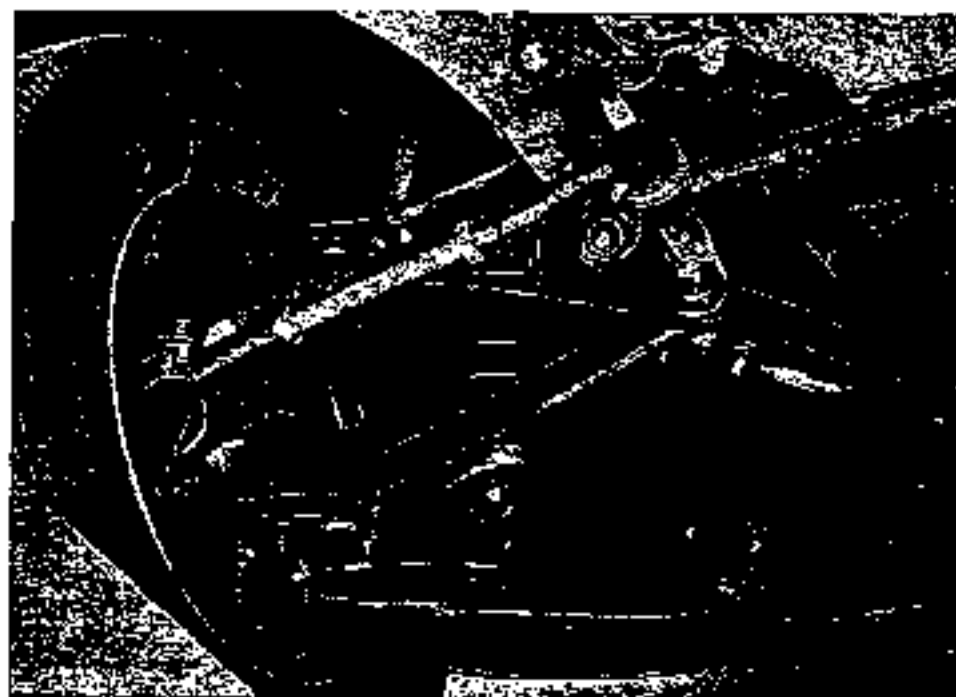
Between the upper and lower links is the coil spring, held under compression of it which is secured by nuts of the lower and upper ball joints.

Through the center of coil spring the telescopic type shock absorber which is connected to the top spring seat and lower link with nuts of the lower and upper.



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FRONT SUSPENSION



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.

Disassembling Order of Front Suspension

- 1) Remove shock absorber.
- 2) Compress the coil spring by tool.
- 3) Disconnect lower ball joint and rebound bumper from lower link.
- 4) Release the coil spring by loosing the nut of tool.
- 5) When the coil spring is fully extended, take out it.
- 6) Disconnect upper link spindle from suspension member (if need to inspect for).

Removing the Coil Spring

METHOD (A)

(1) Unscrew nut of the shock absorber at the top and take out it from down side after unscrew lower flange of it from lower link.

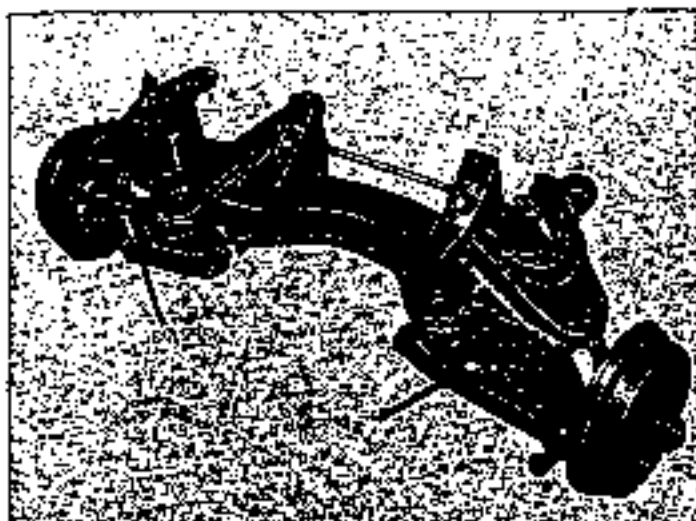
Fit the service tool and screw up the spring compressor nut.

In the absence of the service tool a suitable tool will be required to release the compression from the coil spring.

Compressing the coil spring, unscrew the 3 nuts of lower ball joint which located under the edge of lower link.

Remove these nuts and release the compression from the coil spring by loosing of nut of tool.

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



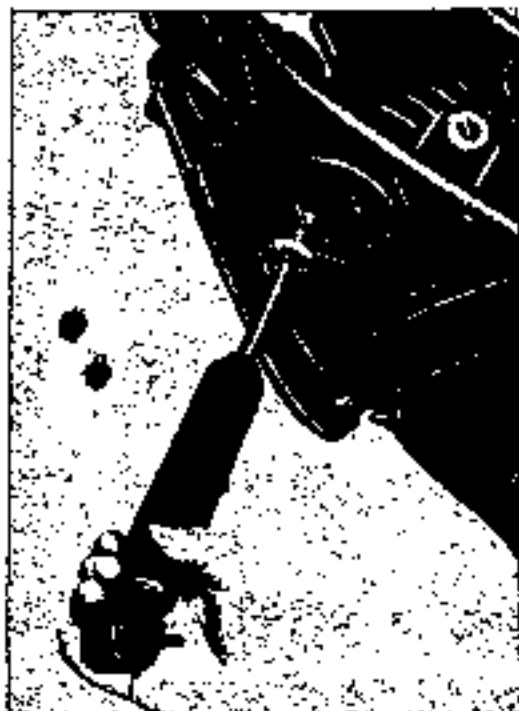
Front Suspension Assembly



*Detachment of Shock Absorber
from Suspension*



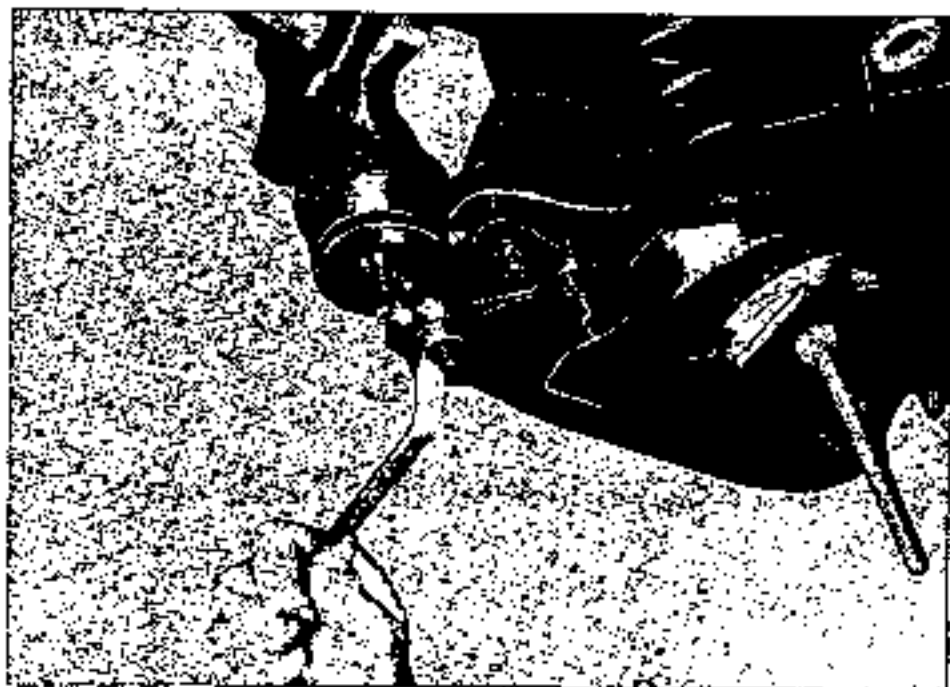
*Detachment of Shock
Absorber from Suspension*



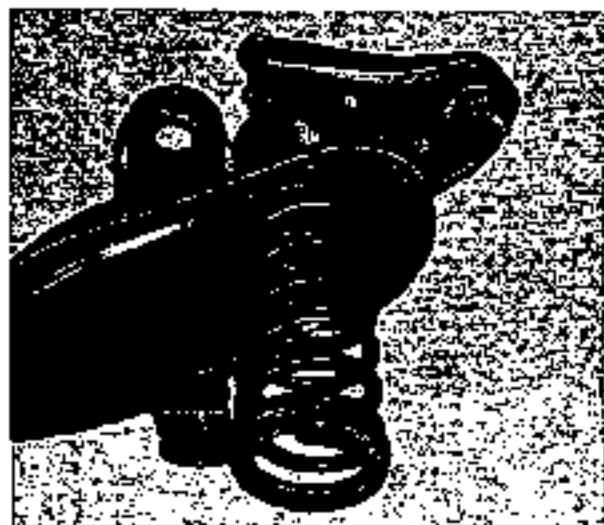
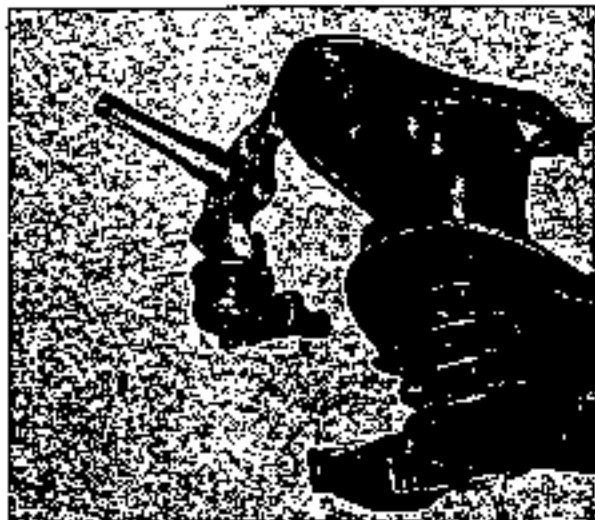
Remove Shock Absorber



*Detachment of Rebound
Bumper*



Releasing the Nuts of Lower Ball Joints



METHOD (B)

Unscrew the four bolts of lower spindle which is secured to the suspension member. Remove these bolts and release the compression from the coil spring. When the lower link with spindle can be driven out.

Refitting the Coil Spring

Use the coil compressor or jack against the lower link. 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 loosening the compressor nut or the jack screw down.

Set up the shock absorber by the double nut of upper side and the bolts of lower side.

METHOD (C)

Replacing Order of Upper Link

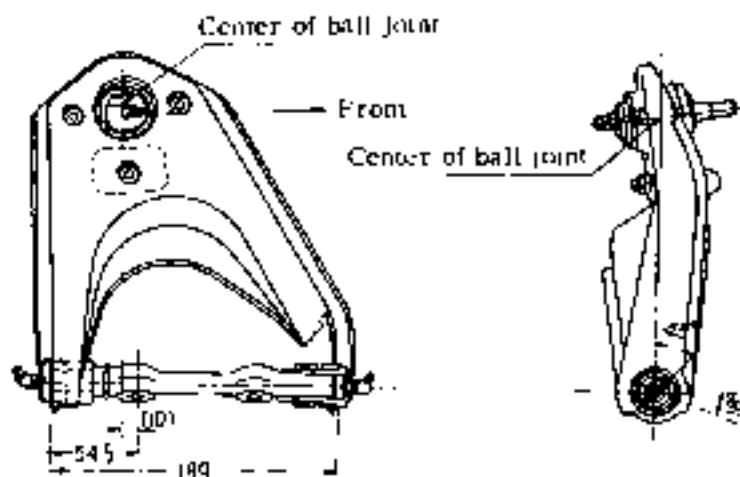
- 1) Prepare to remove front wheel.
- 2) Jack up and support front suspension lower link.
- 3) Remove wheel.
- 4) Disconnect upper ball joint and rebound bumper from upper link.
- 5) Detach upper link and spindle from suspension member.
- 6) Disassemble upper link spindle from upper link by unscrewing link bushings.
- 7) Reassemble upper link spindle and bushings to upper link of replacing reinforced part carefully following undermentioned instruction.
- 8) Reassemble whole parts back again to complete unit.
- 9) Check and adjust front wheel alignment.

Instruction

- 1) Don't hold spindle tight against link when screwing-in bushings (Because the pitch of threads of spindle, inner and outer screw of bushing and link sleeve are all same).
- 2) Apply ample grease on to the inner screw of bushing and spindle.
- 3) Pay careful attention not to damage the thread when screwing-in the bushing. Tighten-up bushing against link sleeve by the torque of 19 ~ 20 kg·m (137 ~ 145 ft·lbs).
- 4) Friction resistance torque between spindle and bushing should be within 0.5 kg·m (3.6 ft·lbs) when assembled.
- 5) Adjust the relative position of spindle and link as shown in the figure by turning

the spindle

- 6) Align the direction of grease nipples as shown in the figure.
- 7) Lubricate bushings with grease completely until extra grease will come out from dust seal.



Tightening Torque

Nuts fixing upper ball joint and rebound bumper to the upper link is 2.4 ~ 2.6 kgm (17.4 ~ 18.8 lb./ft.).

Bolt fixing upper link spindle 4.7 ~ 5.0 kgm (34 ~ 36, 2 lb./ft.).

Nut fixing lower link spindle 4.0 ~ 4.5 kgm (29 ~ 32, 5 lb./ft.).

Front Wheel Alignment

Toe-in	3 mm (1/8 in.)
Caster	1°30' ±
Camber	1°30' ±
King-pin inclination angle	6°30'

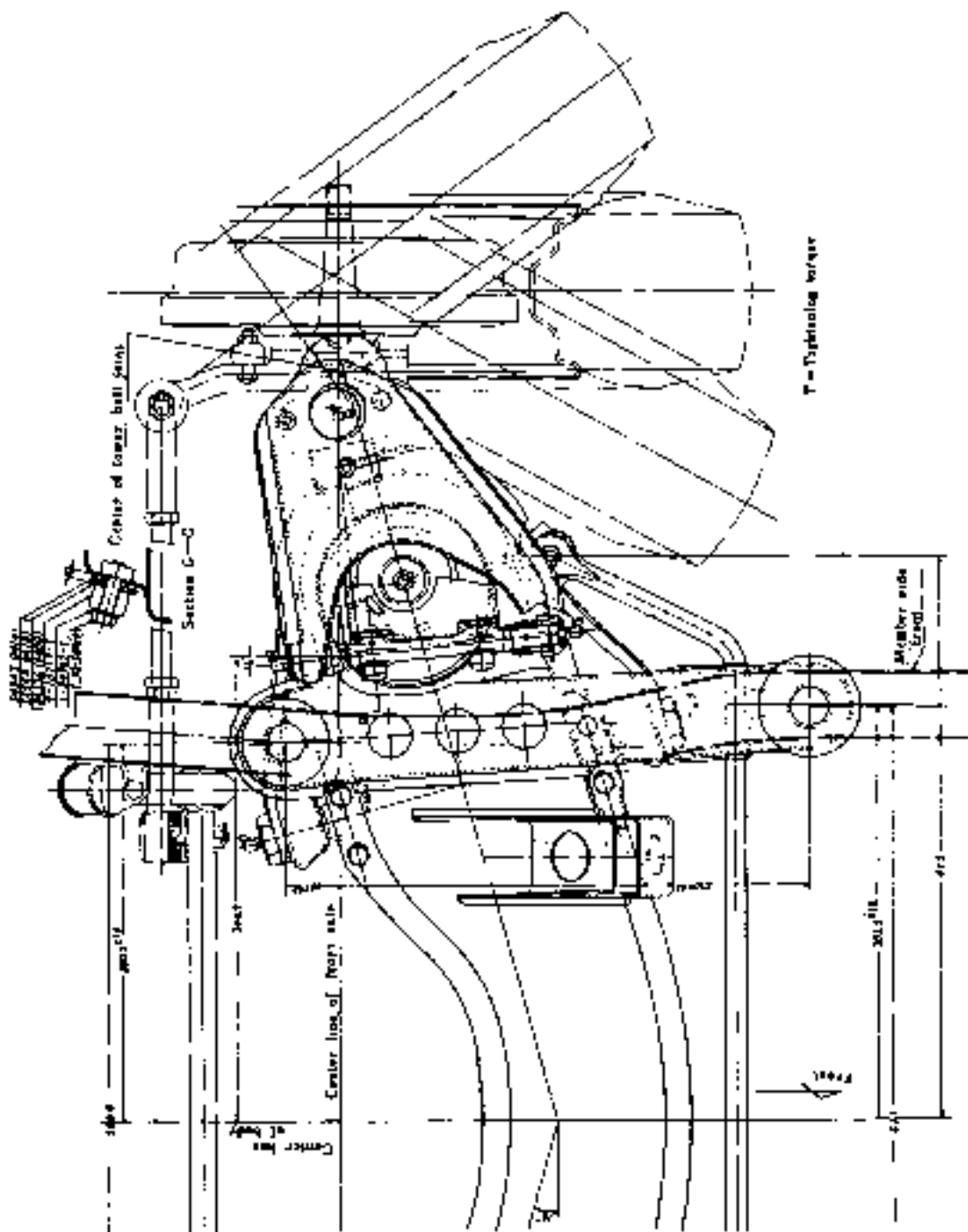
1.0 = 0.020

Adjust camber with adjusting shim at upper bush spindle fixing portion.
Adjust caster with the same shim or by turning upper link spindle only 1/2 one turn.

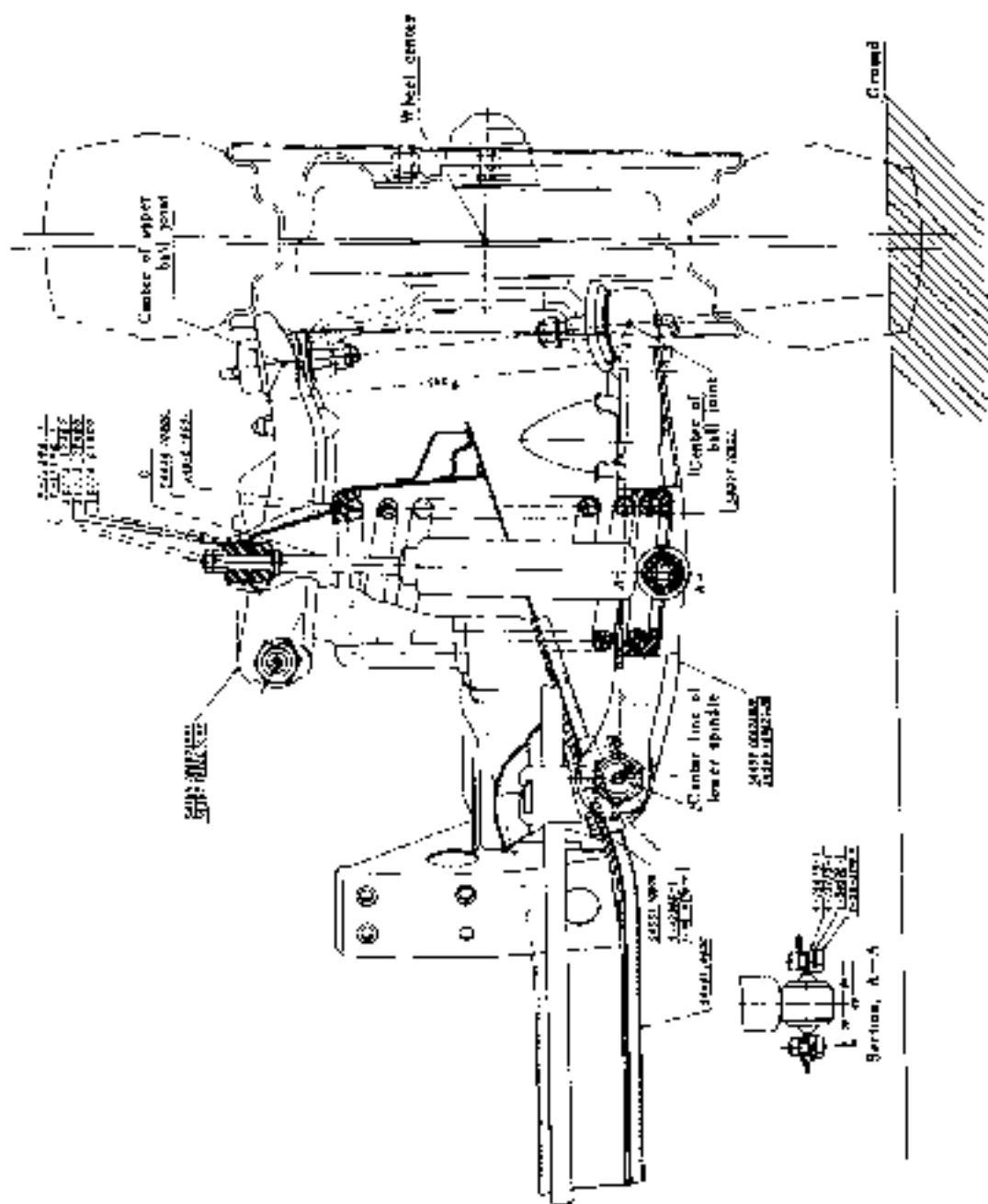
Turning of upper spindle **		
Caster Only	-360° (One turn)	-0°32'
	-180° (Half turn)	-0°18'
	+180°	+0°13'
	+360°	+0°27'

** + , clockwise (See from back side)

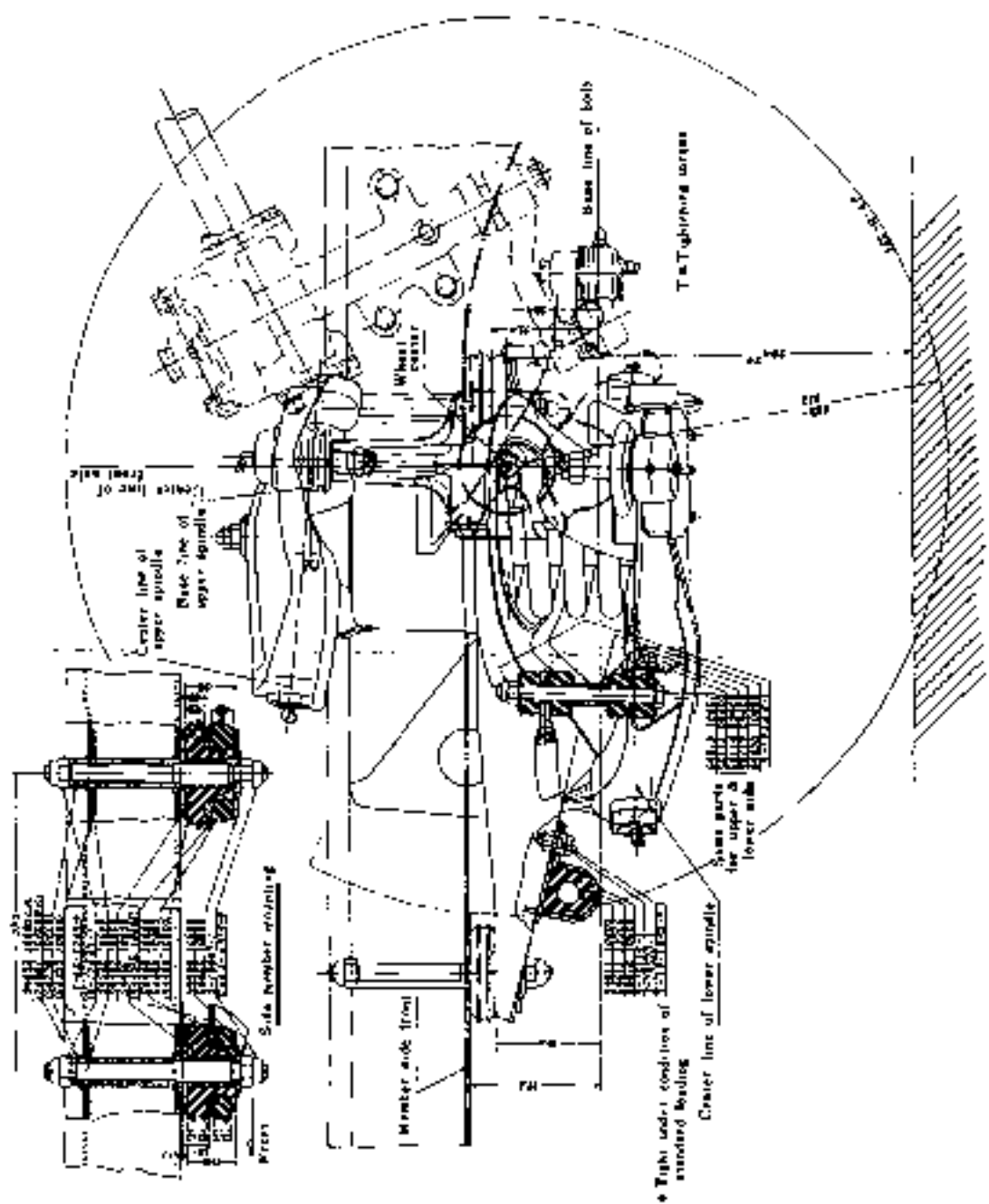
- , Counterclockwise (See from back side)



FRONT SUSPENSION(A)

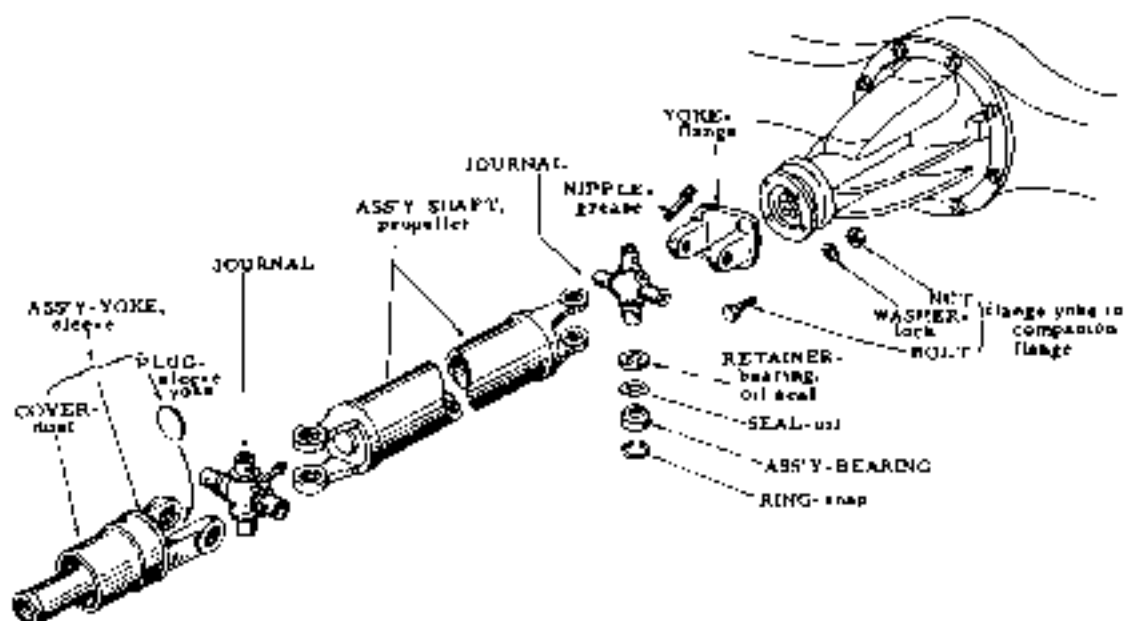


FRONT SUSPENSION(B)



FRONT SUSPENSION(C)

PROPELLER SHAFT & UNIVERSAL JOINTS



PROPELLER SHAFT & UNIVERSAL JOINTS

Fore and aft movement of the rear axle and other components is allowed for by a sliding spline between the front end of the propeller shaft and the rear of the transmission case. Each universal joint consists of a center spider, four needle roller bearings and two yokes.

Back lash of sleeve yoke spline	0.1 mm (0.004 in.)
Amendment limit of dittoed backlash	0.5 mm (0.02 in.)
Outer diameter of universal joint journal	14.728-14.725 mm (0.580-0.579 in.)
Inner dia. of bearing race	19.515-19.530 mm (0.768-0.769 in.)
Number of roller of bearing needle	22 for each bearing
Diameter x length on dittoed bearing needle roller	2.38 mm x 10.3 mm
Run-out of shaft	Less than 0.4 mm (0.015 in.)
Tighting torque of companion flange nuts	15 - 18 ft-lbs.
Outer dia. ;	68.9 mm
Inner dia. ;	65.3 mm
Length (between 1237 mm front & rear joint)	Parts No. 37000 11600 (Comp. shaft with joint)

Lubrication

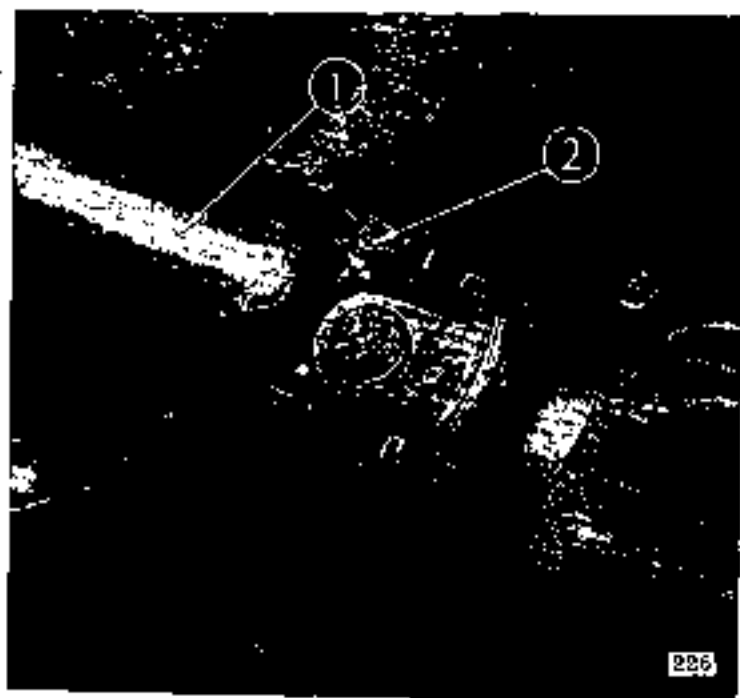
-An oil nipple is fitted to each center spider for lubricating the bearings.

The central oil chamber is connected to the four oil reservoirs and to the needle roller bearings assemblies, Fig.

The needle roller bearings are filled with oil on assembly. Oil from the transmission.

Lubricates the sliding splined joint between propeller shaft and the transmission.

Before refitting the propeller shaft to the transmission case, smear the splines with the oil.



1 Propeller shaft
2 Universal joint nipple

Lubricating a universal joint of the propeller shaft

Removal

Remove the rear propeller shaft flange from the pinion flange of the rear axle by taking out the securing nuts, bolts and lock washers.

Place a clean tray under the rear end of the gear box to collect any surplus oil that may drain off. The operator should now take the weight of the propeller shaft and then draw the splined end out of the transmission.

Dismantling

Clean away the paints from all the snap rings and bearing faces, to ensure easy extraction of the bearings.

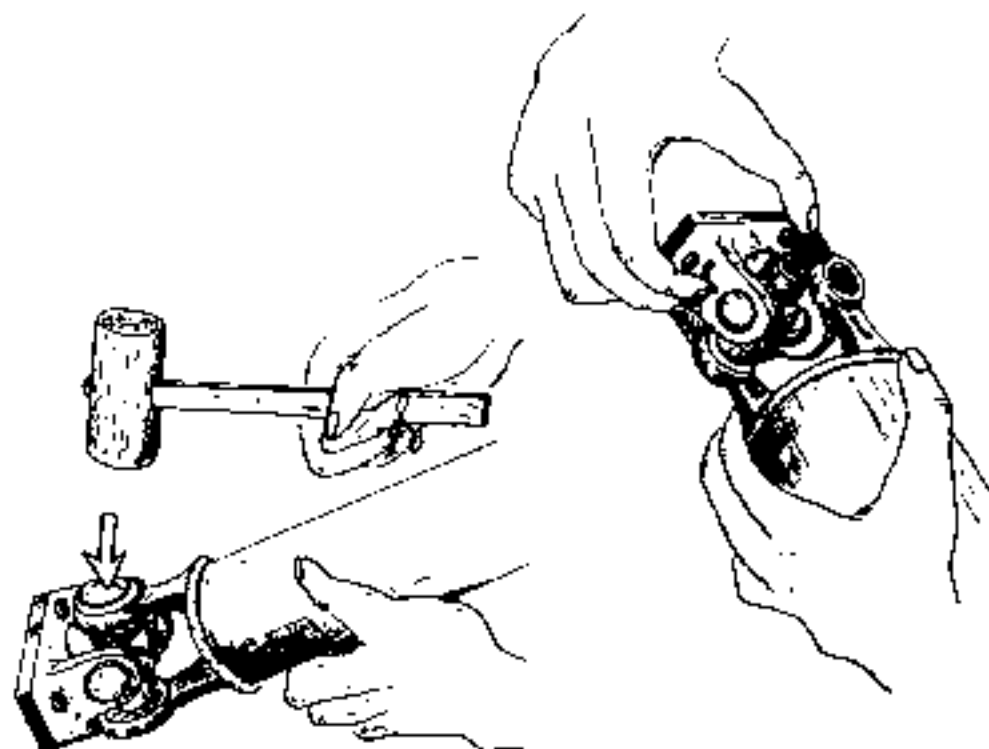
Remove the snap rings by pressing these ends together and prise out with screw driver. If the ring does not come out, tap the bearing face lightly to relieve the pressure against the ring.

Hold the splined end of the shaft in one hand and tap the radius of the yoke with a lead or copper hammer, when the bearing will begin to emerge.

If difficulty is experienced, use a small bar to tap the bearing from the inside, taking care not to damage the race itself, being careful not to lose any of the needles.

Repeat this operation the other bearing and the splined yoke can be removed from the spider.

The same procedure can be utilized to detach the other spider from its yoke.



EXAMINATION & CHECKING FOR WEAR

When the propeller shaft has been in use for a long time, the parts most likely to show signs of wear are the bearing races and the spider journals.

The complete assembly should be renewed if looseness or stress marks are observed, as no oversize journals or bearings are provided. It is essential that bearing races are a light drive fit in the yoke trunnions.

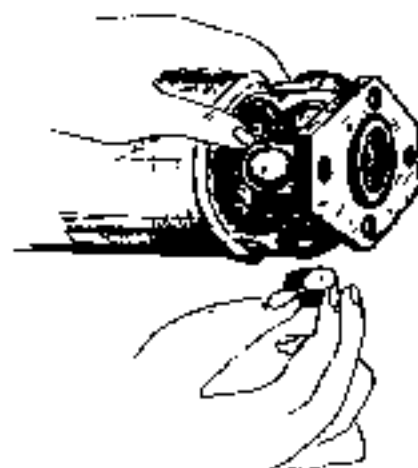
Any ovality in the trunion bearing holes indicates the fitting of new yokes.

The straightness of the shaft is

determined by measuring the off-center deflection of the shaft in rotation with

a dial gauge applied both ends. If the

deflection exceeds clearance limit, (less than 0,4 mm) correct or replace the shaft.



Reassembling

See that the drilled holes in the journals are cleaned out and filled with oil.

Assemble the needle rollers in the bearing races and fill with the oil. Should difficulty be experienced in assembly, smear the walls of the races with petroleum jelly

to retain the needle rollers (22, Nos.) in place. Insert the spider in the yoke and tap the bearing in position with a foot nosed drift smaller in diameter than the hole in the yoke. It is essential that the bearing races are a light drive fit in the yoke trunnions. Repeat this operation for the other bearings.

The spider journal shoulder should be coated with shellac prior to fitting the retainers to ensure a good seal.

If the joint appears to bind, tap lightly with a wooden mallet which will relieve any pressure of the bearings on the end of the journals. It is advisable to renew cork washers and washer retainers on spider journals, using a tubular drift.

Replacing the Shaft Assembling

Smear the propeller shaft splines with oil and slide the splines into mesh with those of transmission main shaft.

Wipe the rear companion flange and flange yoke faces clean to ensure that the pilot flange registers properly and the joint faces bed evenly all around and securely lock them in position. It is advisable to use new lock in position. It is advisable to use new lock washers.

Axle Shaft Removal

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

Lower the axle on to the blocks and remove the wheel using a screw driver un-screw 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 six bolts of the brake disc and remove the axle shaft as shown Fig. 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.

To rear
axle
case

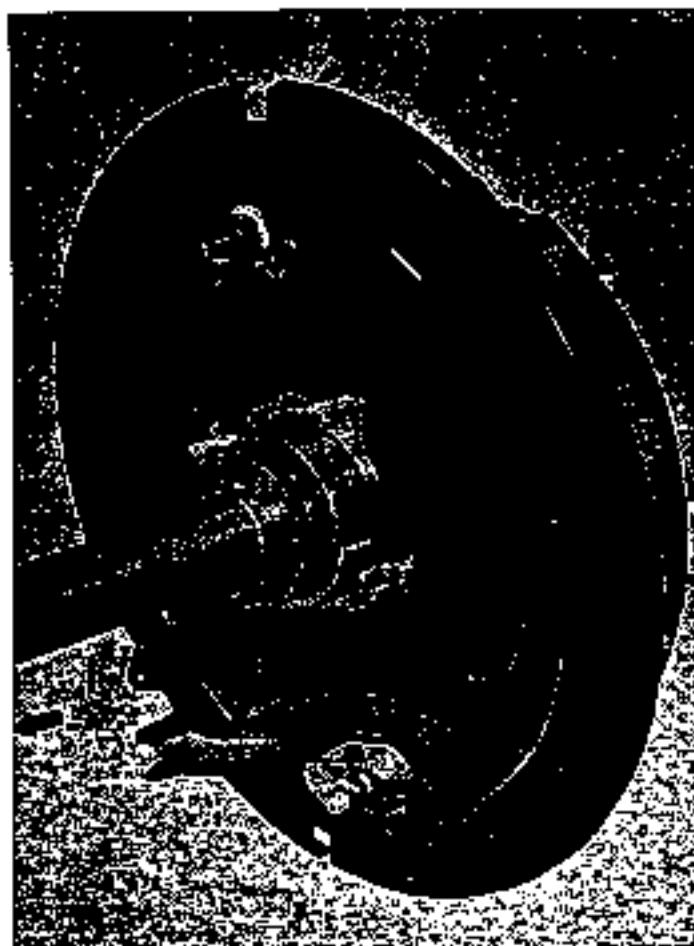


Fig. 3 Remove of Axle Shaft and Disc Assembly

SERVICE SPECIAL TOOLS



*DT-4679
Special Stand*

Fig. 4

*DT-4678
Swing Hammer*

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.

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 shoulder of the case end after inserting the end slum between its flange and hub. (Part No. 43036-04100).

The following points must be taken into consideration.

1. Nominated Hypoid gear oil No. MP90 must be used.
(In warmer district than 32°C use MP#140)
2. It is prohibited to use any other kinds of gear oil or any oil of different viscosity. 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.

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 ledge of bearing inner race 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 fixing 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.

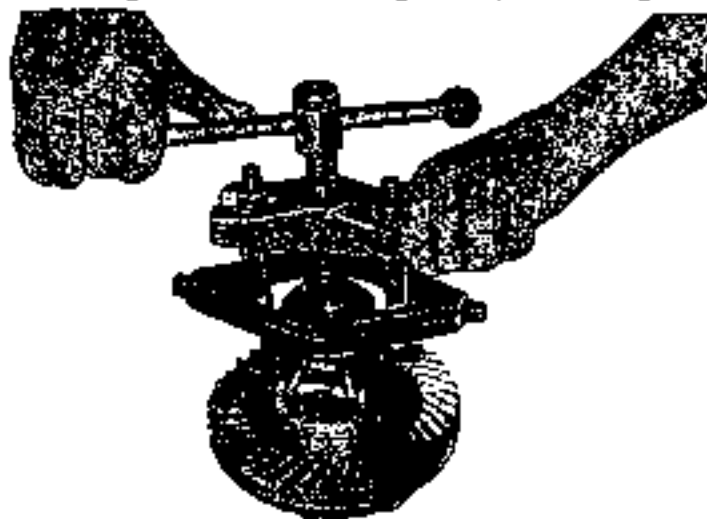
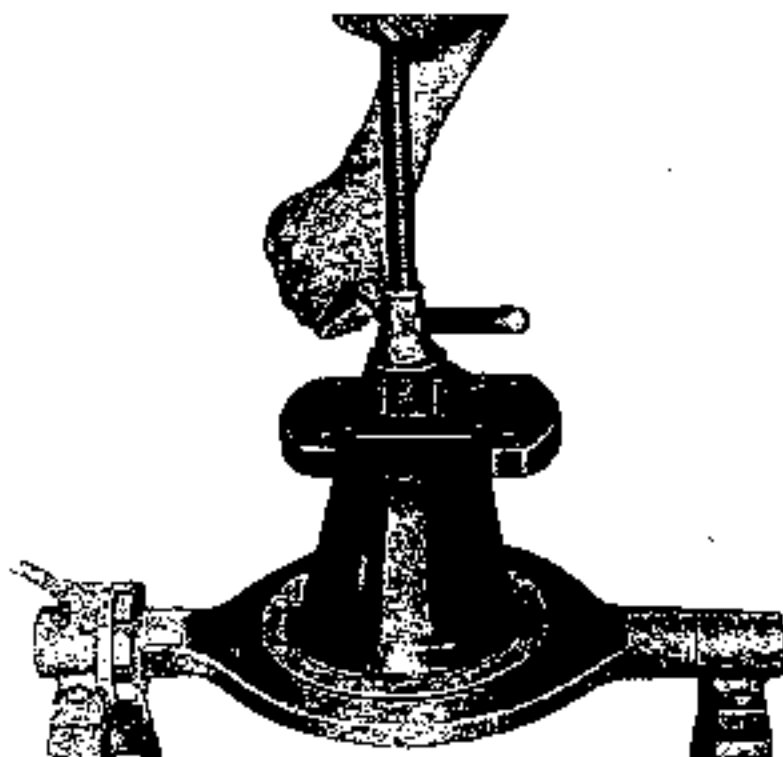


Fig 5 Using of Side Bearing Puller (DT-4686)

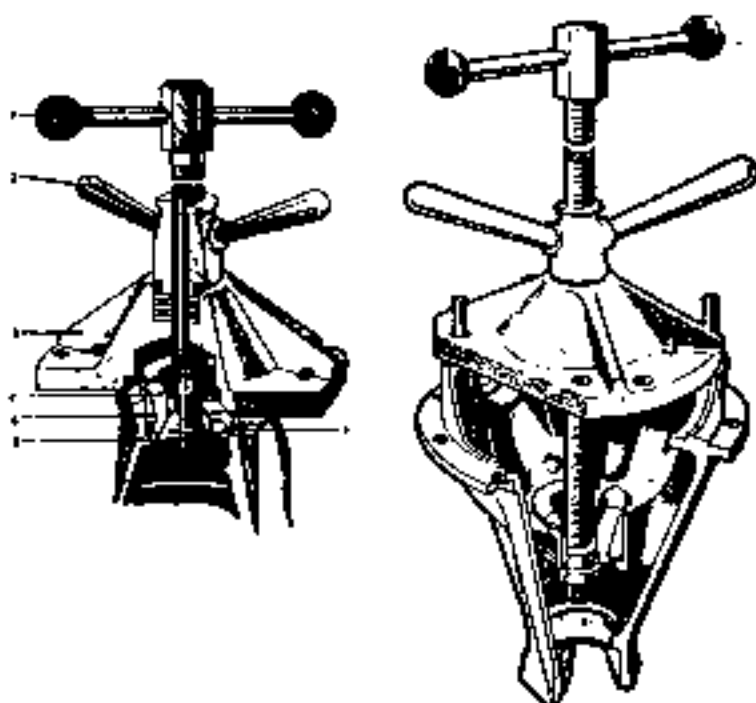
- 8) Take out the differential pinion as well as the side gear. The pinion mate shaft should first be pulled out by striking out the pinion mate shaft locking pin which is fixed on the differential case from left side (from the side of ring gear fixed) to the right before pulling out the pinion, side 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 out 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 companion flange) of drive pinion with the drift of soft metal. Thus, the pinion would be taken out together with the inner race of rear bearing and roller, distance piece, and the adjusting shim and the oil seal, outer race 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 race replace and the adaptor should be employed in this case. The adapter in the 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.
- 12) Taking out the rear bearing outer race of gear carrier.

The drive pinion bearing outer race replacer as illustrated in Fig. 6 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 frum 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.



Tool No. DT4782, DT4631 & DT4689 Fig. 5 Pull out the Bearing Race



- 13) To pull out the front bearing outer race from the gear carrier, set the tool body (3) as illustrated in Fig. 7 pull it out with adapter (B) in the way of rear race.

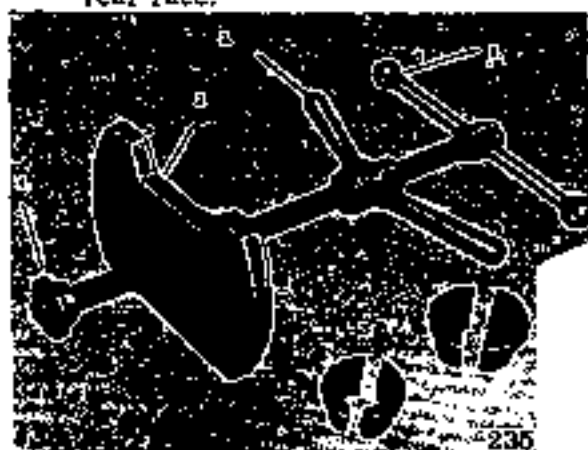


Fig. 7

- 1 Tommy bar
- 2 Wing nut
- 3 Tool body
- 4 Cone

(Adaptor for Front Bearing Outer Race)

Drive Piston Front and Rear Bearing Outer Race Replacer

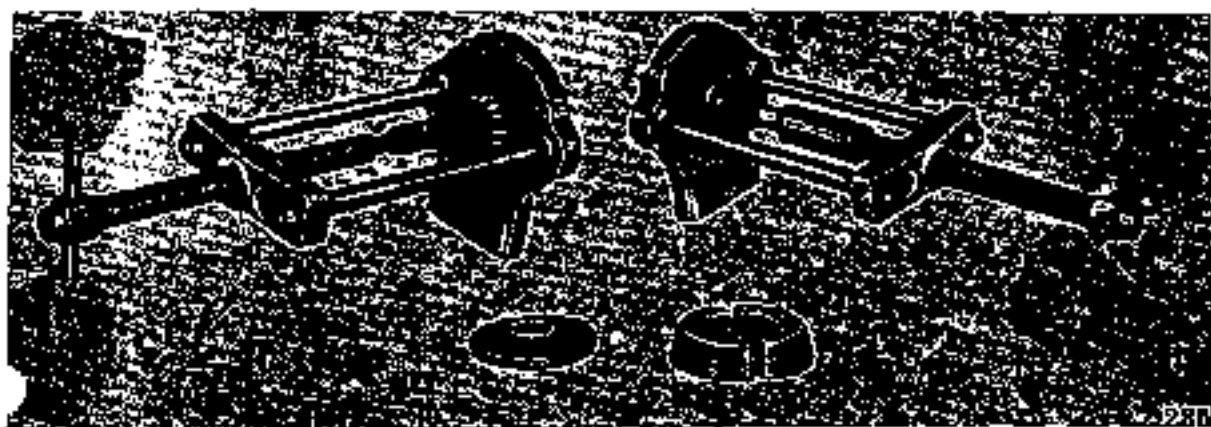
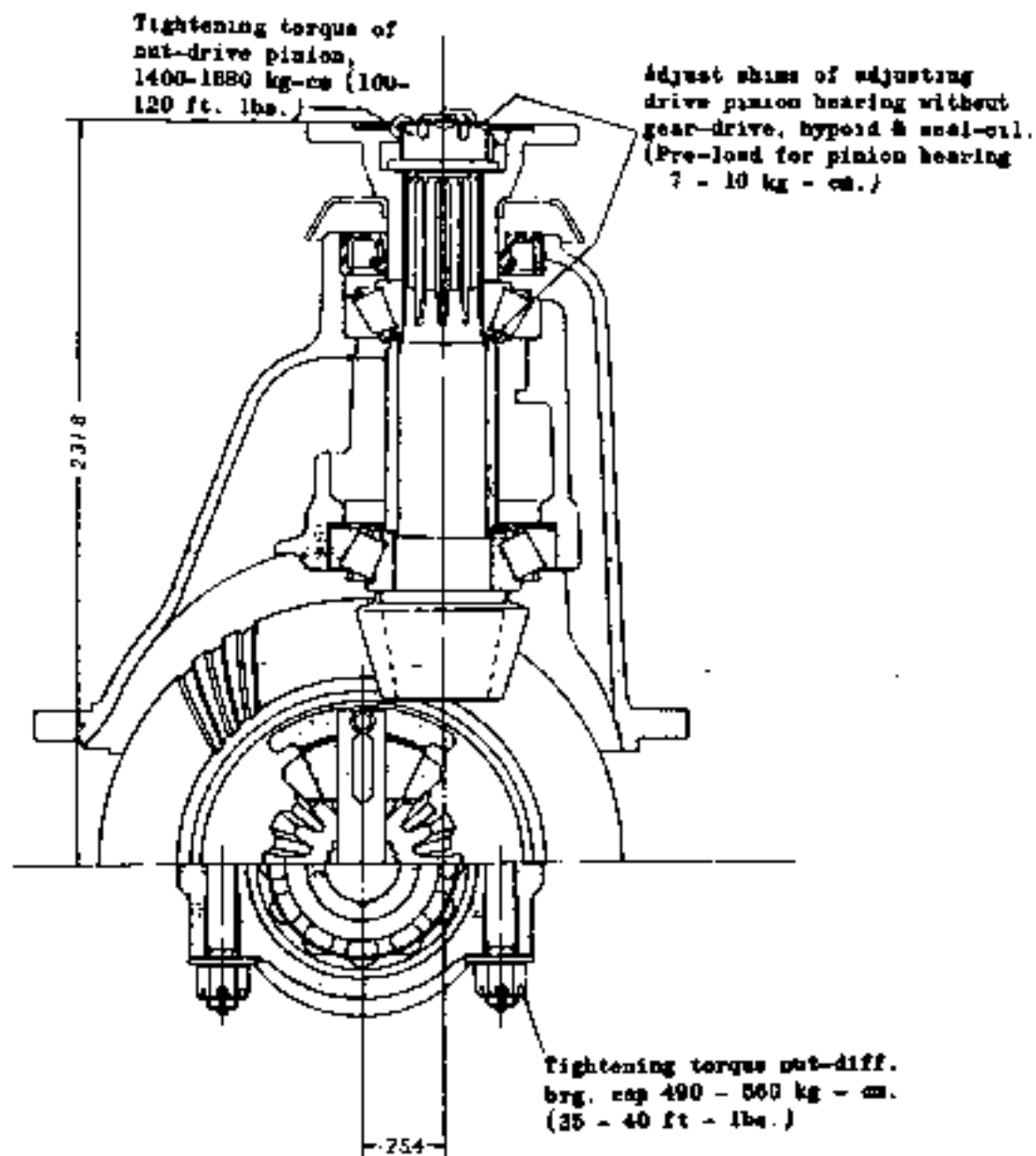


Fig. 8 *Inner Race Replacer*

FIG. 9 SECTION OF DIFFERENTIAL CASE



Gear ratio:

Transmission 3 gear ...	
Change	4.375 (35/8)
4 gear change	4.111 (37/9)
Optional	4.625 (37/8)

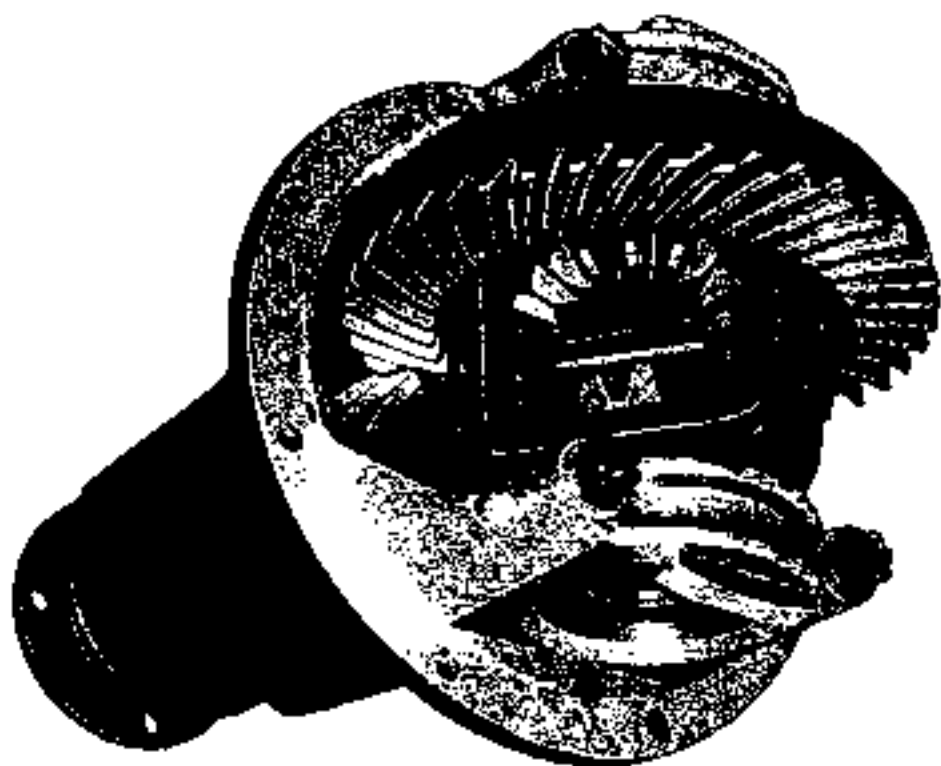


Fig. 10

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 regard with the defect and defacement before deciding to re-use them.
- 2) The axle should be inspected in respect of the crack and the defacement of spline measuring the shake with the gauge by holding the both end. The difference over 0.4 mm should be adjusted with 0.8 m/m 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 $2/3$ mm to $3/4$ mm in 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 rags 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 0.2 mm and the clearance between the side gear and thrust washer exceeds 0.5 mm replace the thrust washer.
The else worn out parts should also be replaced.
The contact when ring gear is too close to pinion center in case of back-lash should be adjusted closely or it gives much 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 0.5 mm. 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 completed.
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.
- 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.

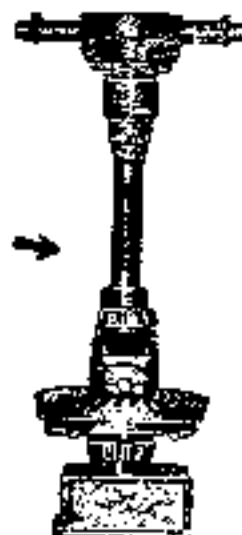


Fig. 12

ASSEMBLING & ADJUSTMENT BY GEAR CARRIER ASS'Y

It is to decide the assembling & adjustment of gear which is very 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. 19 & 21 and the adjustment & repairing exactly according to the condition of practical use based on the adjustment by exact calculation.

(A) The Preparation for Mounting the Drive Pinion in the Gear Carrier

- (1) If the drive gear, drive pinion, and bearing are to be reused as they are as a result of disassembling and inspection, they should be assembled in an order of disassembling at the previous condition of adjusting shim. In case any item should be replaced or required to reuse even if any item is worn 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.

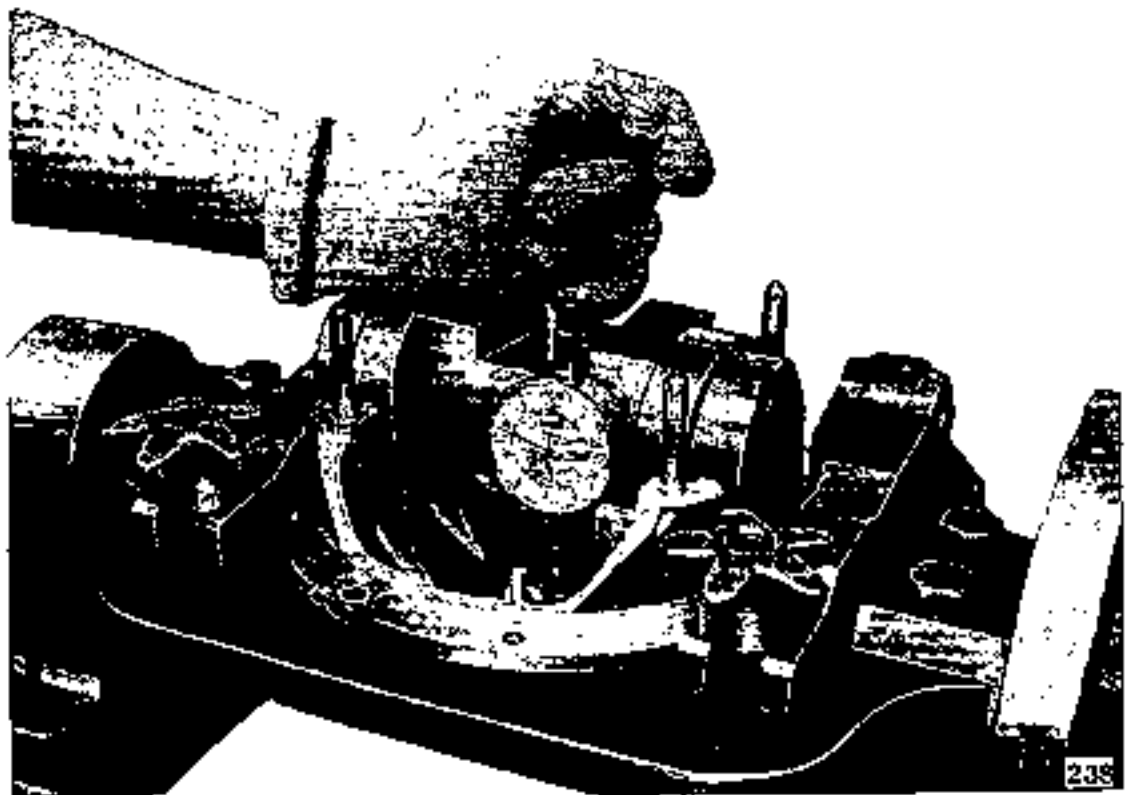


Fig. 13 Adjustment of Pinion Height

They show the manufacturing error in a figure at the unit of 0.001 in. (0.025 mm) to decide the thickness of adjusting shim for adjustment of standard position. (The standard pinion height is 51.0 mm from axle center as shown in Fig. 13&17.)

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.

Adjust to the direction of an 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 previously 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.

Parts Name	Part No.	Thickness	Standard Leaf No.
Drive pinion adjusting shim	38153 25660	0.75 mm (0.030 in.)	1 - 0 1 - 0
"	38154 25660	0.25 mm (0.010 in.)	2
"	38155 25660	0.125 mm (0.005 in.)	2 - 1
"	38156 25660	0.075 mm (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 detachment on the carrier, the pinion bearing must be taken into consideration though it will be explained in detail later.

(B) 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, therefore the tools must be handled properly to avoid such a situation as to make the bearing hole of carrier in an oval. Referring to Fig. 8 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 surfaces 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 the (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 adaptor (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 Fig. 14 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 adaptor 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 by mounting temporarily the pinion in the carrier and the bearing be given a regular preload. 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.

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 preload gauge as Fig. 15 to the degree that support the bearing preload at 7-10 kg-cm.

When the drive pinion is mounted in the previously mentioned condition it is necessary 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 51.0 mm from the bottom of the side bearing fixed with the carrier.



Fig. 14

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.

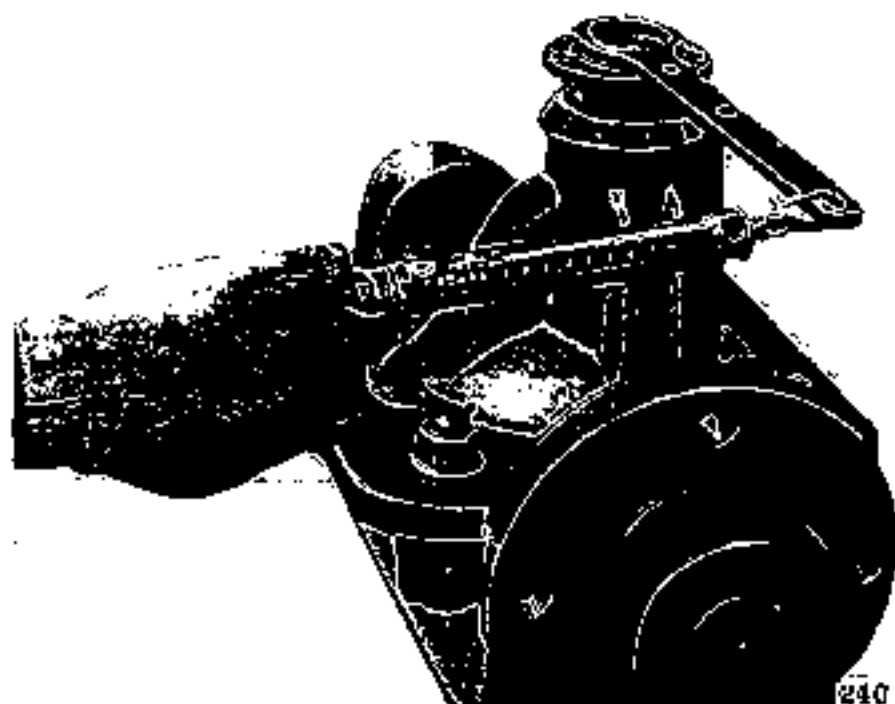


Fig. 15

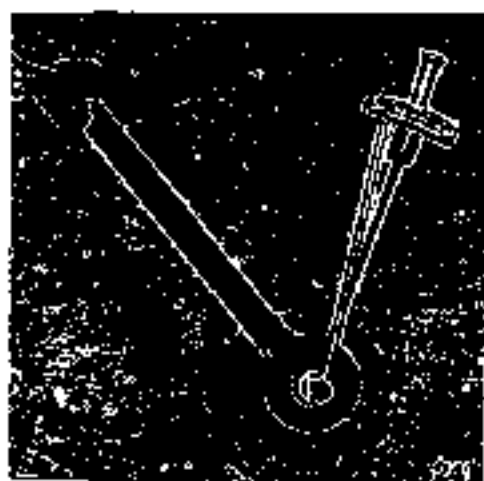


Fig. 16

- (5) The formal adjustment of the drive pinion, bearing and preload. 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. 16 by using the torque wrench at the regular torque of 100-120 ft/per lbs. The preload supported by 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. Therefore, for readjustment of the bearing preload in this case, it must be adjusted by increasing or decreasing the number of four kinds of adjusting shim as shown in the following list and measuring with the use of the drive pinion bearing preload gauge as Fig. 15 so as to make the revolving torque of pinion at 7-10 kg/cm if there should not be 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 0.2 mm than the standard size (51.0 mm).

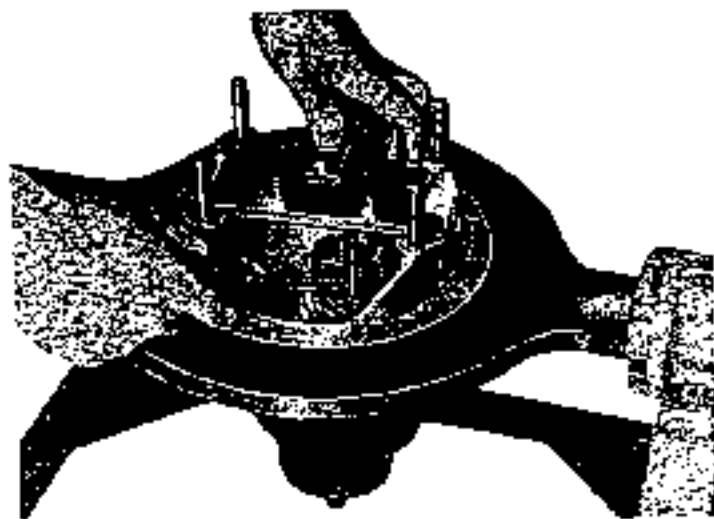


Fig. 17

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 0.2 mm (8/1000 in.) shorter than the standard measurement (51 mm).

Therefore, adjustment is made by selecting a feeler gauge in accordance with the plus or minus value marked on the pinion head.

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-S093 5) 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. = 0.001 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 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.

(C) Mounting the Differential Gear Ass'y in Carrier

- (1) Mount the complete unit of differential gear in the carrier and fix the bearing cap. There is a engraved 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 machinerly 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 case adjust by inserting inside the bearing adjusting shim of thickness calculated in accordance with the following method of computation.

There is a marked numeral of adjusting basis on the bearing housing of the gear carrier and differential case. The numeral is the manufacturing error in a unit of 1/1000 in. against each standard measurement of A, B, C, D, in Fig.

To measure the width of the side bearing on left and right, use the standard gauge (20.0 mm 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 error on minus side against the each standard measurement of 20.0 mm 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 mm it is -0.2 mm (-0.008 in.) against the standard measurement and the E is, by excluding the minus sign, 0.008 in.

The thickness of the shim is acquired by applying 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. 20 by using the dial indicator to make sure that it is within 0.1 mm-0.2 mm (0.004"-0.008"). If it is much, move to left by taking off the right shim, for adjustment.

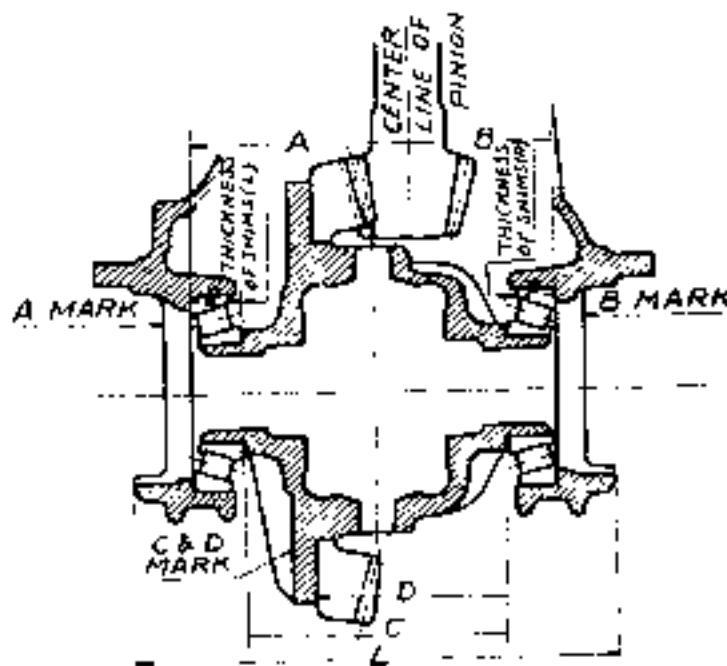


Fig. 18

Thickness of Shim on Left Side	Thickness of Shim on Right Side
Left Side $T_1 = A - C + D + E + 7$	Right Side $T_2 = B - D + F$ $B - D + F + (0.150)$

Example of calculation:

$A = +1$	$E = 8 (0.2 \text{ mm} / 0.025 \text{ mm} = 8)$
$B = +2$	$F = 10 (0.25 \text{ mm} / 0.025 \text{ mm} = 10)$

(Left) $T_1 = A - C + D + E + 7 = 0.025 \text{ mm} \times 20 = 0.5 \text{ mm}$
 $(1 - (-1) + 3 + 8 + 7)$

(Right) $T_2 = B - D + F + 6 = 0.025 \text{ mm} \times 15 = 0.375 \text{ mm}$
 $(2 - 3 + 10 + 6)$

$$T_1 = A + D - C + 0.07 + E$$

$$= 0.001'' + 0.002'' - 0.002'' + 0.007'' + 0.008'' = 0.016''$$

(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 beside the set number. For example, (b-6) means the back lash of 0.006 in ($0.025 \text{ mm} \times 6 = 0.15 \text{ mm}$).



- 1 Dial gauge
- 2 S.T.D. gauge (20 mm thickness)
- 3 Weight block
- 4 The bearing measured

Fig. 19

After the Operation

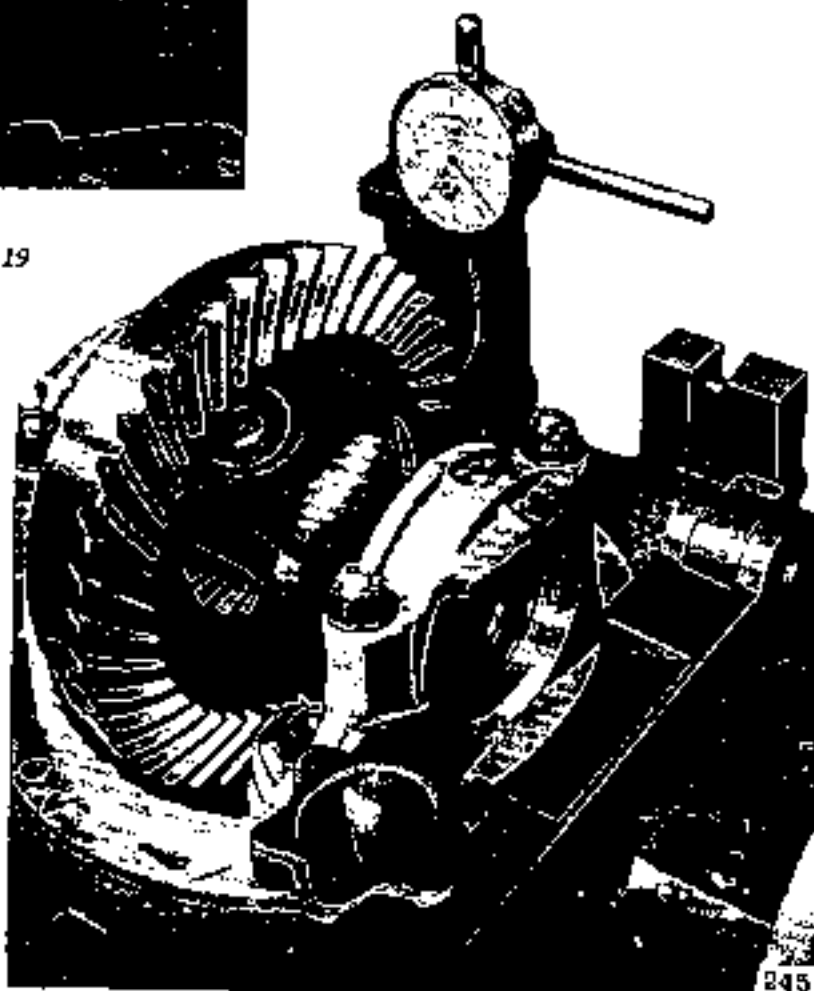


Fig. 20 Measurement of Backlash for the Drive Pinion & Ring Gear

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 bearing with the shim of thickness calculated from above method of computation.

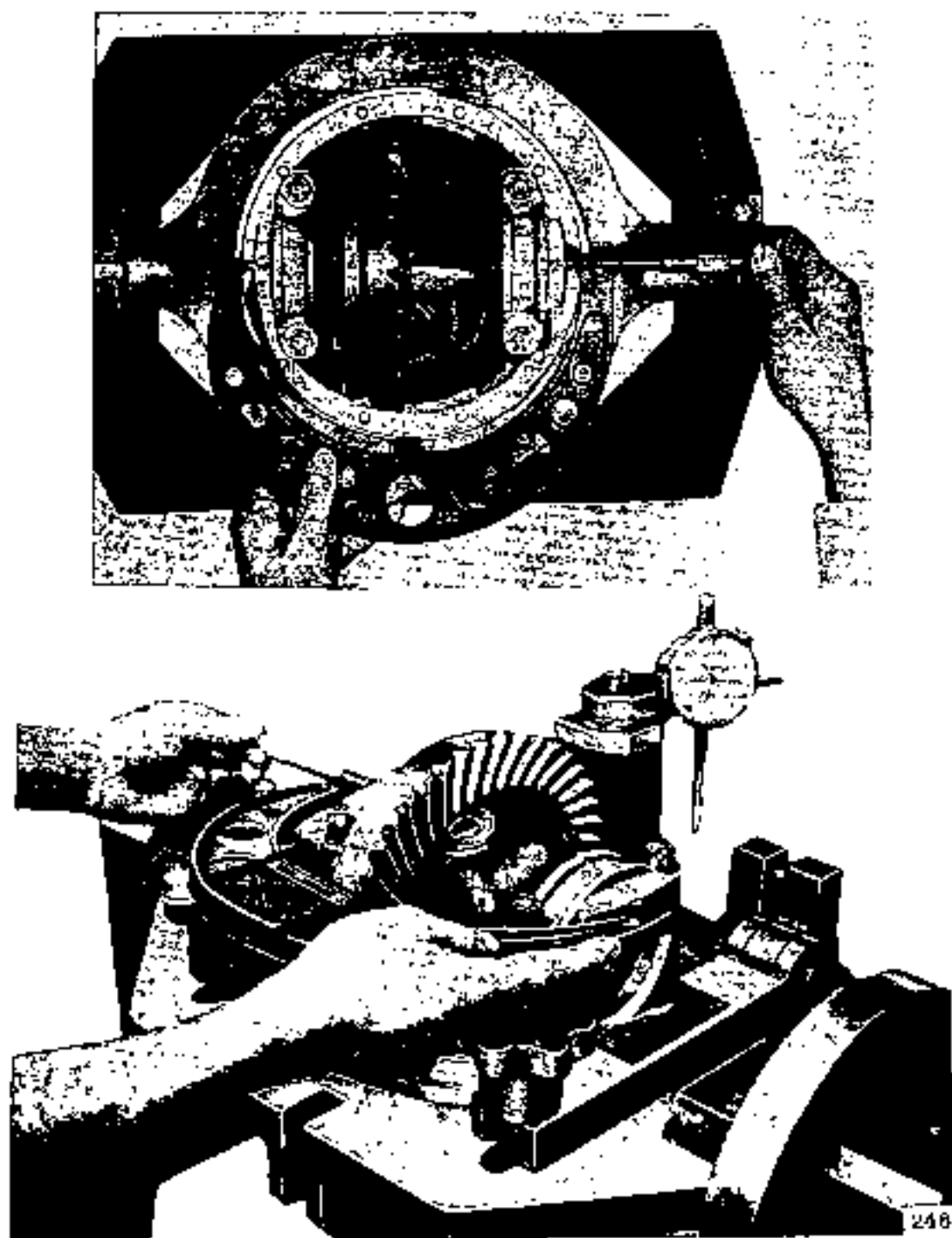


Fig. 21 Using the Differential Side Bearing Cap Gauge

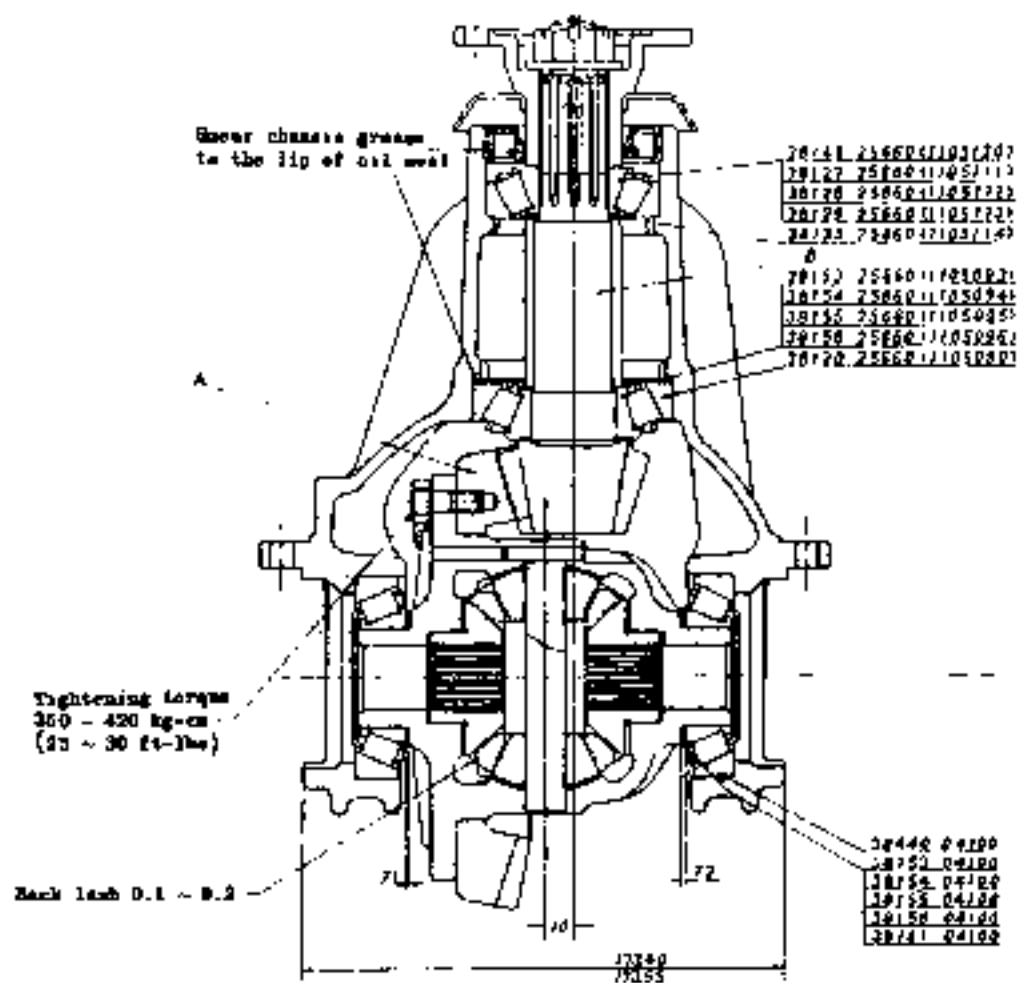


FIG. 22 CARRIER

Thus the adjustment is completed. By way of precaution, measure with micrometer of the large size the L measurement which is within 173.40 - 173.55 mm as Fig. 21 (Service No. tool DT-4685). If it is insufficient, add an additional shim of 0.002 in. (0.05 mm) left and right. In this case, the said micrometer, Fig. 21 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 confirm that is within 0.05 mm.

Mountin the Gear Carrier Ass'y on the Rear Axle Housing

Interior of the axle housing should be cleaned well

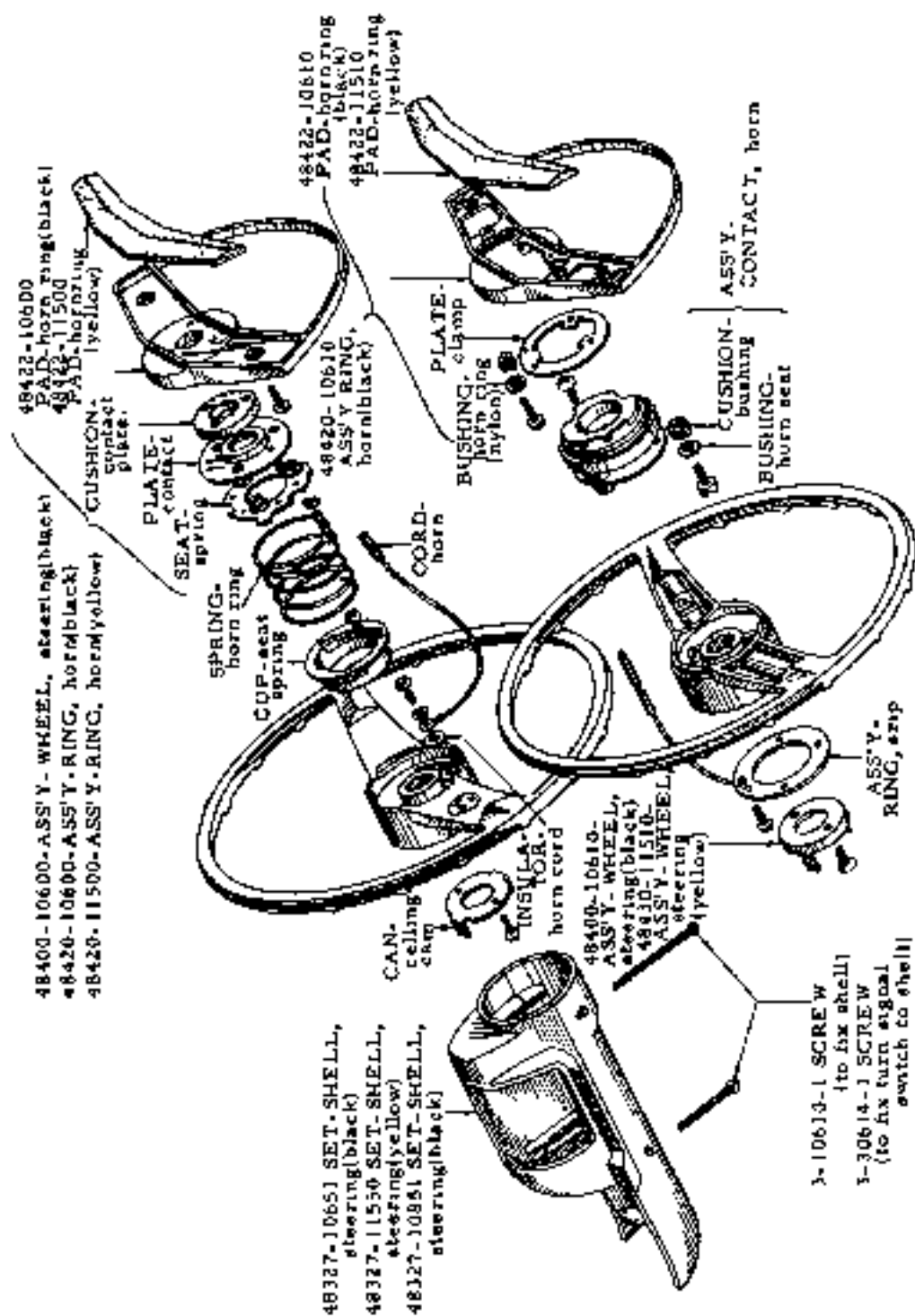
The carrier packing should also be replaced with new one.

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 hypoid gear oil No. 90 should be feed

Feed the oil till it comes up to the down side of the feeding hole.

STEERING



STEERING WHEEL

STEERING

STEERING

Type of gear	Cam and Lever
Gear Ratio	14.8 : 1
Adjustment	Adjusting screw and nut
Diameter of steering wheel	405 mm
Turning circle	5,000 mm

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 revolve over a predetermined arc, thus giving the rocker shaft its desired motion, connected to the rocker shaft is a steering side 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 rods, one on either side, connect the steering gear arm to the steering gear and idler arms respectively.

Side Cross Rods

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

To remove the rod, 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. Normally 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 withdrawn from the shaft concerned using a suitable extractor. The gear arm must not be hammered from its shaft.

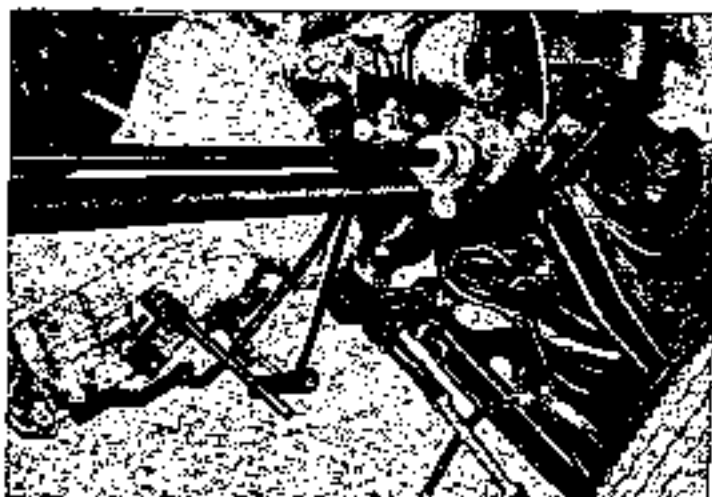


Fig. 1-1 Steering Gear



Fig. 1-2 Steering Gear

Removing the Idler

After the side and cross rods disconnected the idler can be detached from the body. It is secured by two bolts to the front suspension member.

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

Unscrew the idler shaft out of the body.

Steering Gear Housing Removal

Removing the horn ring assembly from the steering wheel, unscrew the column lock, then disconnect higher up the column jacket from the housing.

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.

Disassembly

Supporting the housing 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. 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 if a ball roller is removed. It should only be removed if showing an appreciable amount of wear. Disconnect the three nuts of the front cover in position, and release this cover with shims.

Take off column jacket way.

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

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 pre-loaded, 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 joints 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 ahead 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 design 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.

Steering Faults

Loose steering is invariably attributed end play of the worm gear through steering column, which can be rectified by the removal of shims located behind the gear housing front cover, as already mentioned. 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.

BRAKE

GENERAL DATA

Type - Foot brake Hand brake	Hydraulic expansion, 2 shoes for 4 wheels Mechanical, internal expansion, rear 2 wheels braked
Lining - Width x Thickness x Length	40 x 4.5 x 215 mm (Same for Front & Rear)
Area of surface (cm ²)	95 (Front & Rear)
Brake drum dia. (Front & Rear)	228.6 mm (Same for Front & Rear)
Master cylinder bore Inner dia.	22.22 mm
Wheel cylinder bore Inner dia.	Front wheels 25.40 mm Rear wheels 23.81 mm

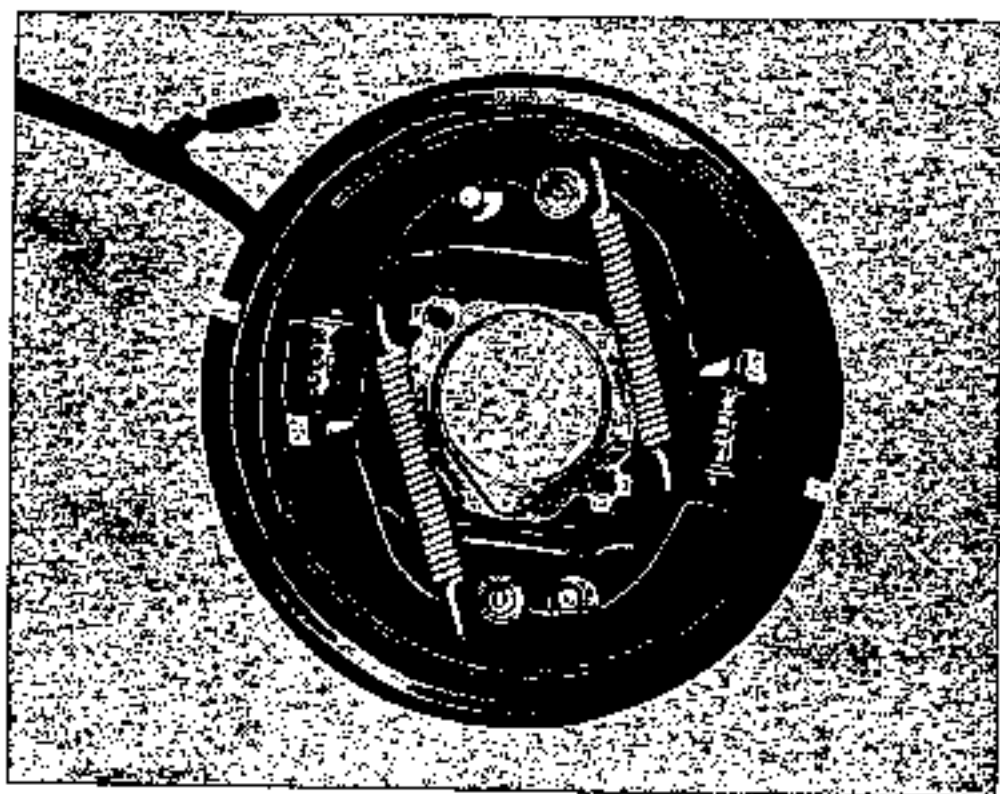


Fig 1 Front Brake Flange
(brake disc)

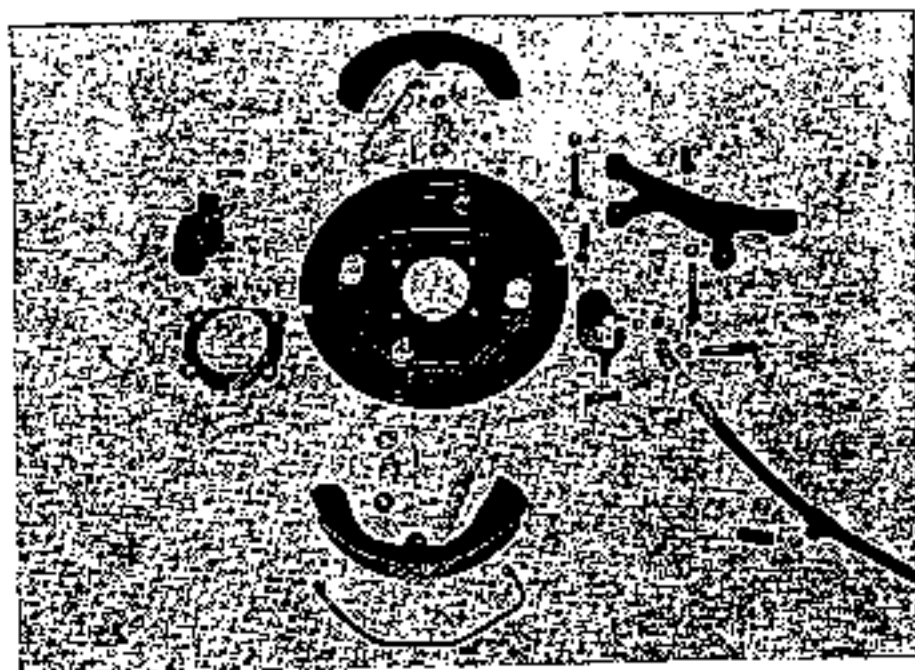


Fig. 2 Front Brake (Out Side)

The brake on all four wheels are hydraulically operated by foot pedal application, directly coupled to a master cylinder in which the hydraulic pressure of the brake operating fluid is originated. A supply tank cast integrally with the master cylinder provides a reservoir by which the fluid is replenished, and a pipe line consisting of tube, flexible hose and union, inter connected the master cylinder and wheel cylinders.

The pressure generated in the master cylinder by application with the foot pedal is transmitted with the equal and undiminished force to all wheel cylinders simultaneously.

This moves the pistons out wards, which in turn expand the brake shoe thus producing automatic equalisation, and efficiency in direct proportion to the effort supplied at the pedal.

When the pedal is released the brake shoe spring return the shoe which then return the wheel cylinder pistons, and therefore the fluid back into the pipe lines and master cylinder. An independent mechanical linkage actuated by a hand brake, mounted drivers seat side. This is positioned on the right-hand side of seat if the car has right-hand steering, and on the left-hand side if it has left-hand steering. Operated the rear wheels by mechanical expanders attached to rear wheel cylinder bodies.

FRONT BRAKE

The front brakes are constructed by the two leading system with each two wheel cylinder.

The shoes are allowed to slide and centralize automatically during the actual braking operation which distributes the braking force strongly over the lining area ensuring high efficiency the brake disc caused by adjuster housing against the friction of the brake linings of front and rear shoes and even lining wear.

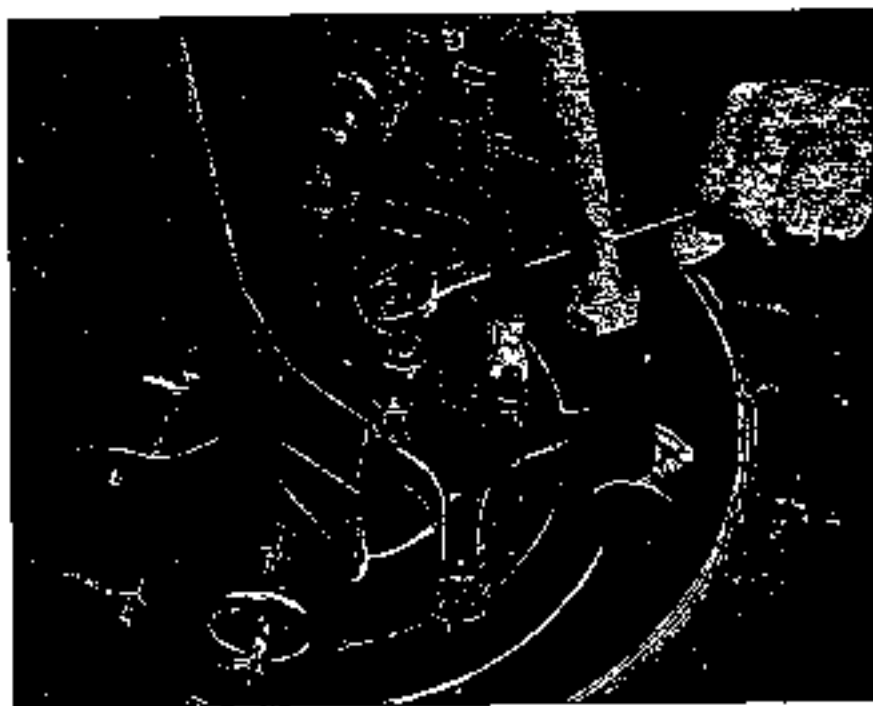
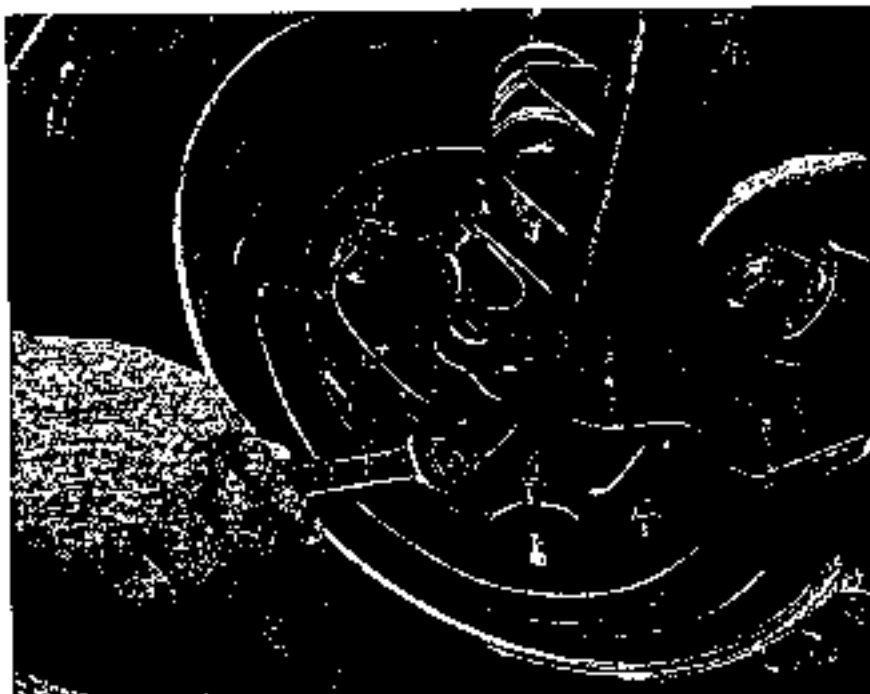
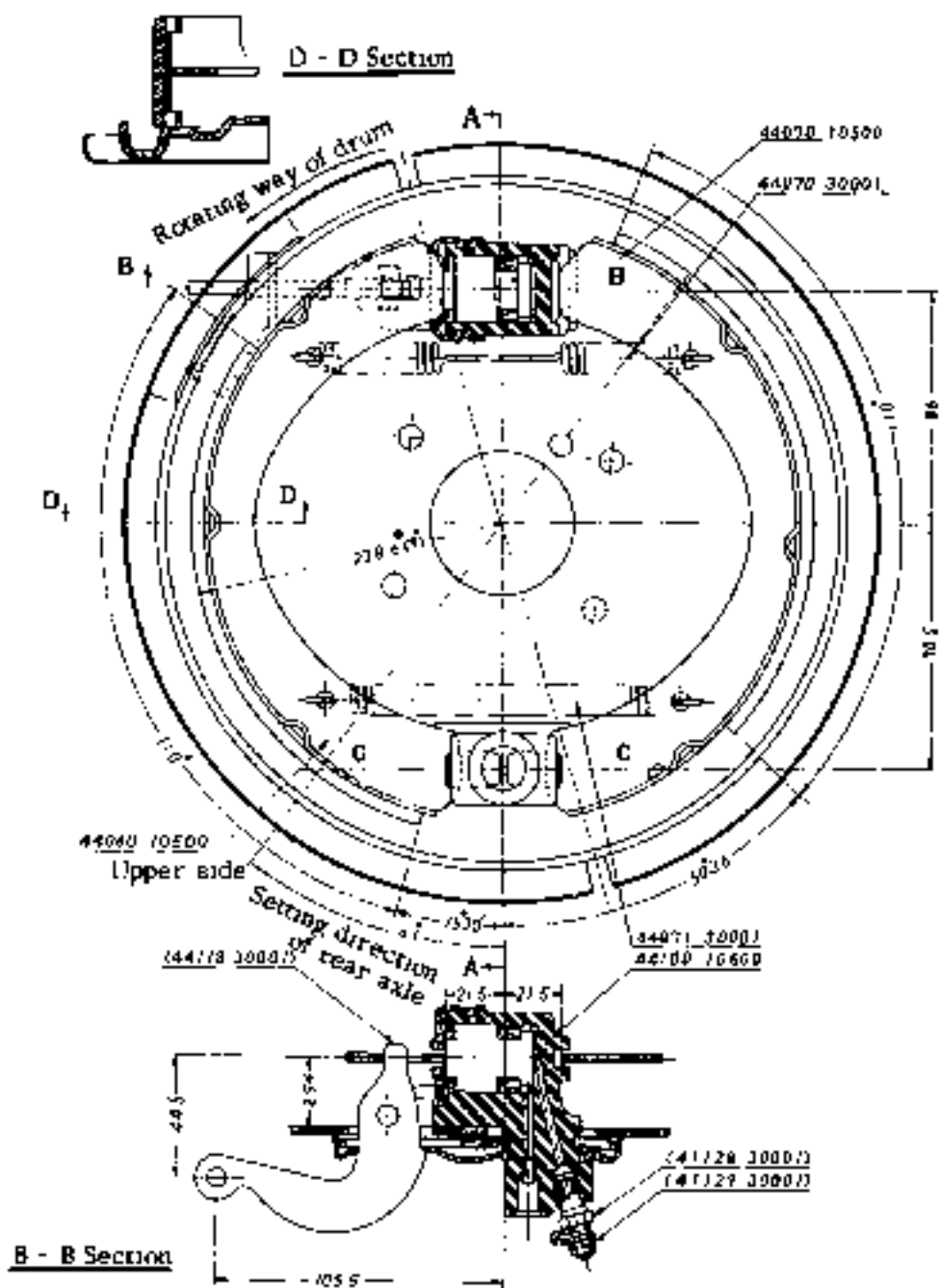


FIG. 4 ADJUSTING OF FRONT BRAKE



Adjustment of brake shoe

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 notches until the wheel drum turns just free from the shoe

FIG. 7 REAR BRAKE (NO. 1)

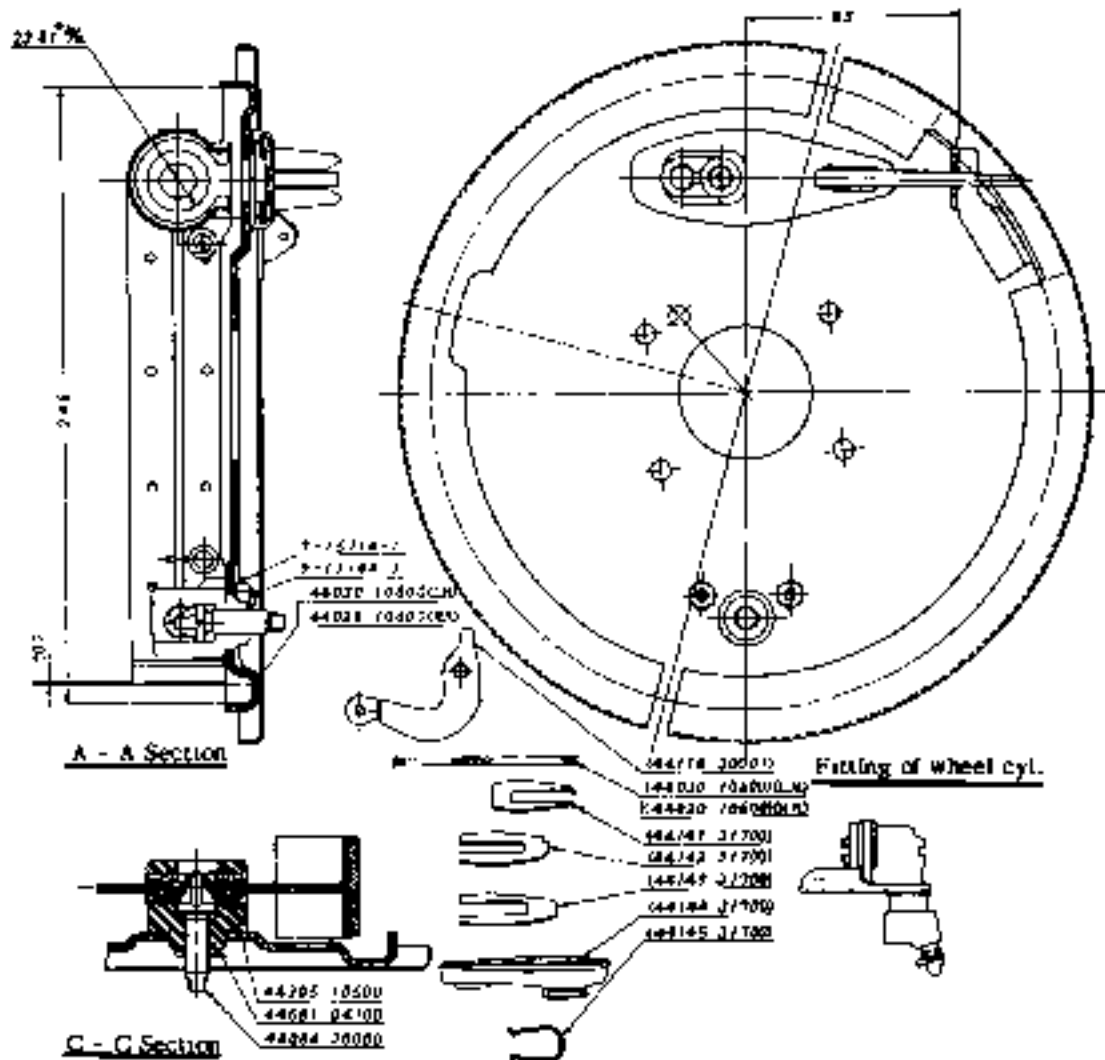


FIG.8 REAR BRAKE (NO. 2)

Adjustment for the front brake shoe is by means of the teeth of the gear which located at the lower position of the brake disc.

Remove the dust cover of the uni-servo housing. Tap the adjuster housing and insert a screw driver through adjusting hole and engage the teeth on the wheel. Turn the adjusting nut down direction until the shoe becomes locked on the brake drum, then turn back it upward direction until the shoes becomes just free notches.

REAR BRAKES

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

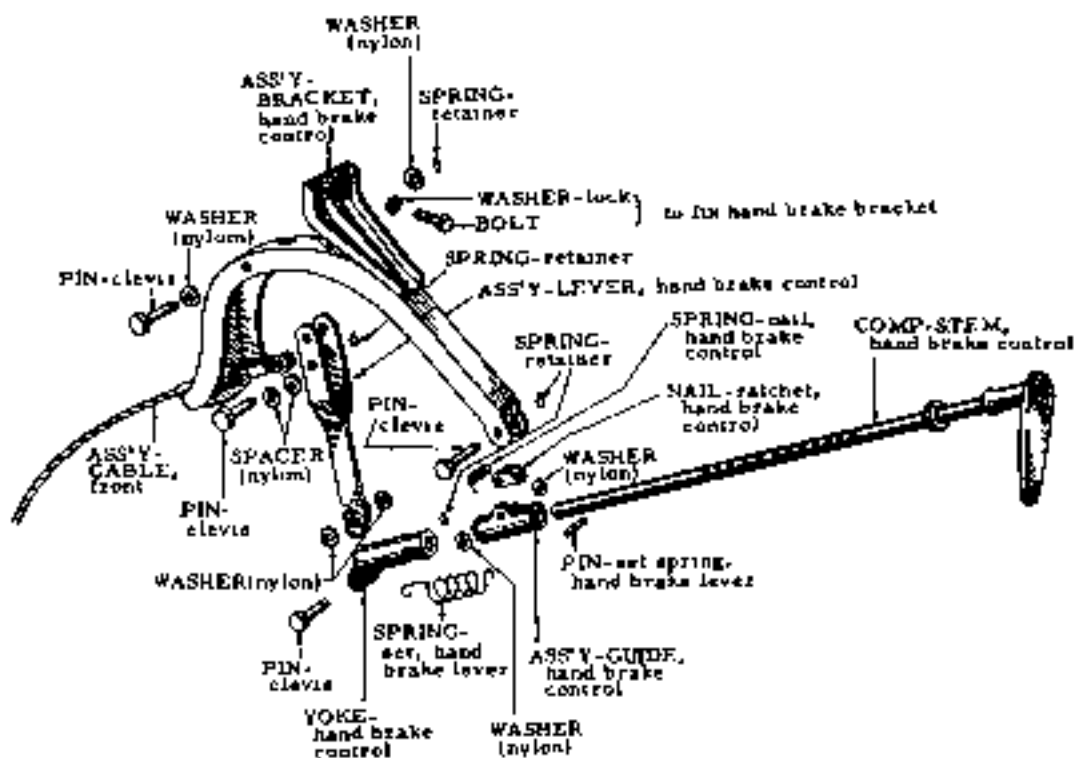


Fig. 9 Hand Brake Control



Fig 10 Adjusting Brake Shoe

Adjustment for the rear brake shoes is by means of the screw 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 notches until the wheel drum turns just free from the shoe.

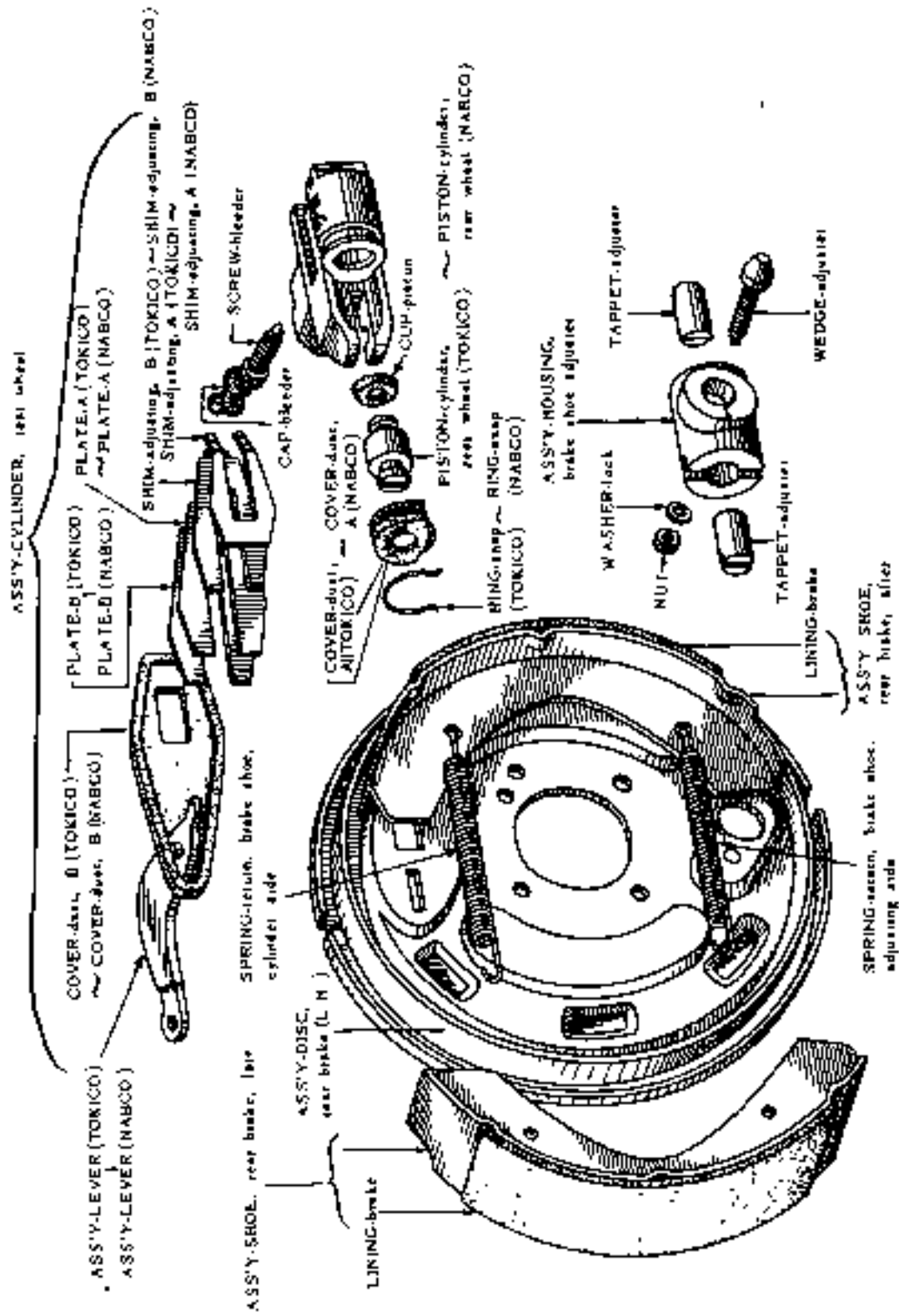


FIG. 11 REAR BRAKE (L.H.)

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 resetting.

When this is correct the rear shoes should be locked to the drums, the hand 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.

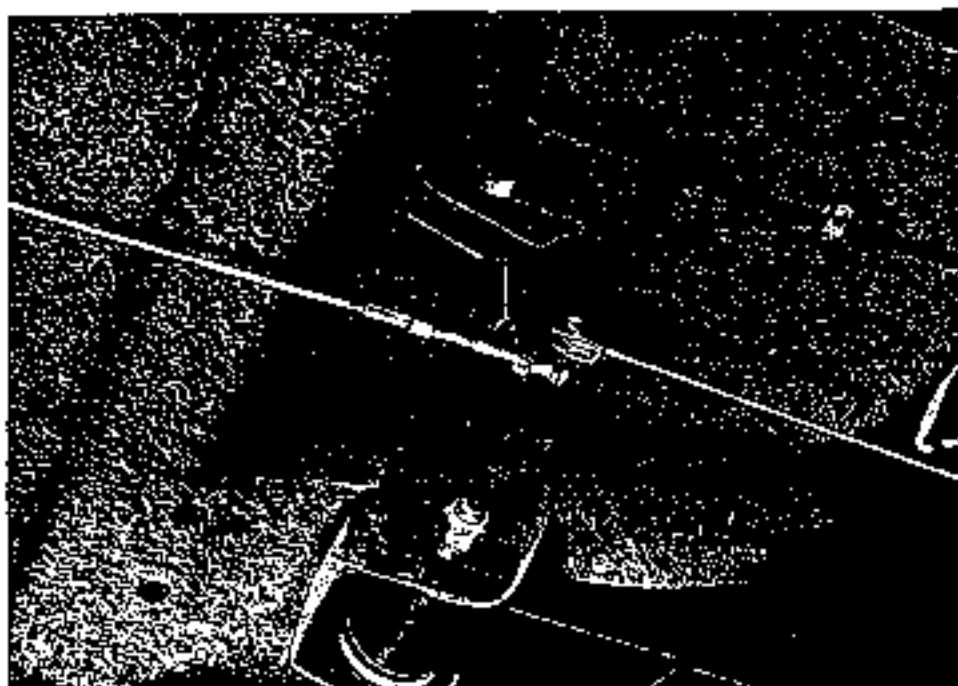


Fig. 12 Adjusting Nut

MASTER CYLINDER

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

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

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



BRAKE

CLUTCH

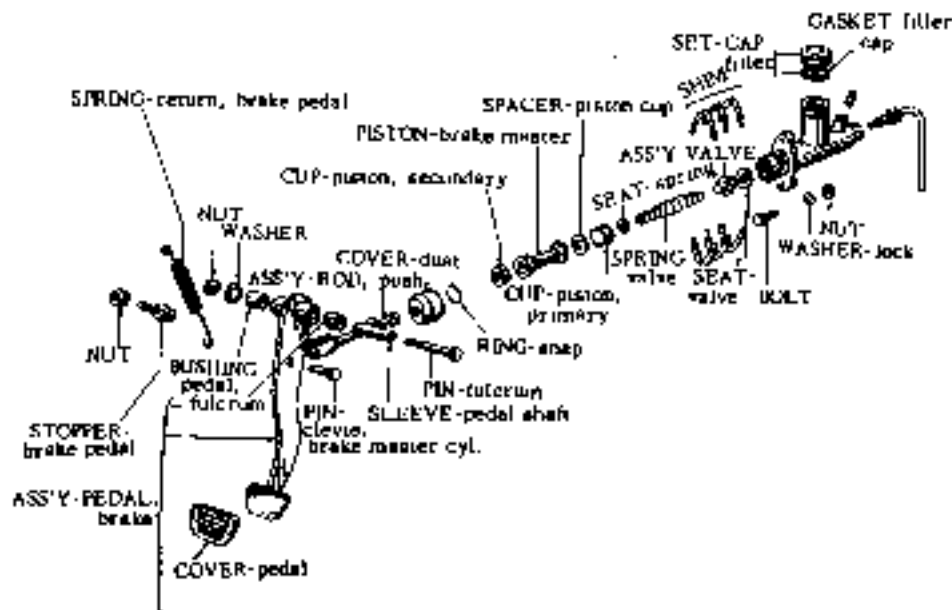


Fig. 13 Brake Master Cylinder

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

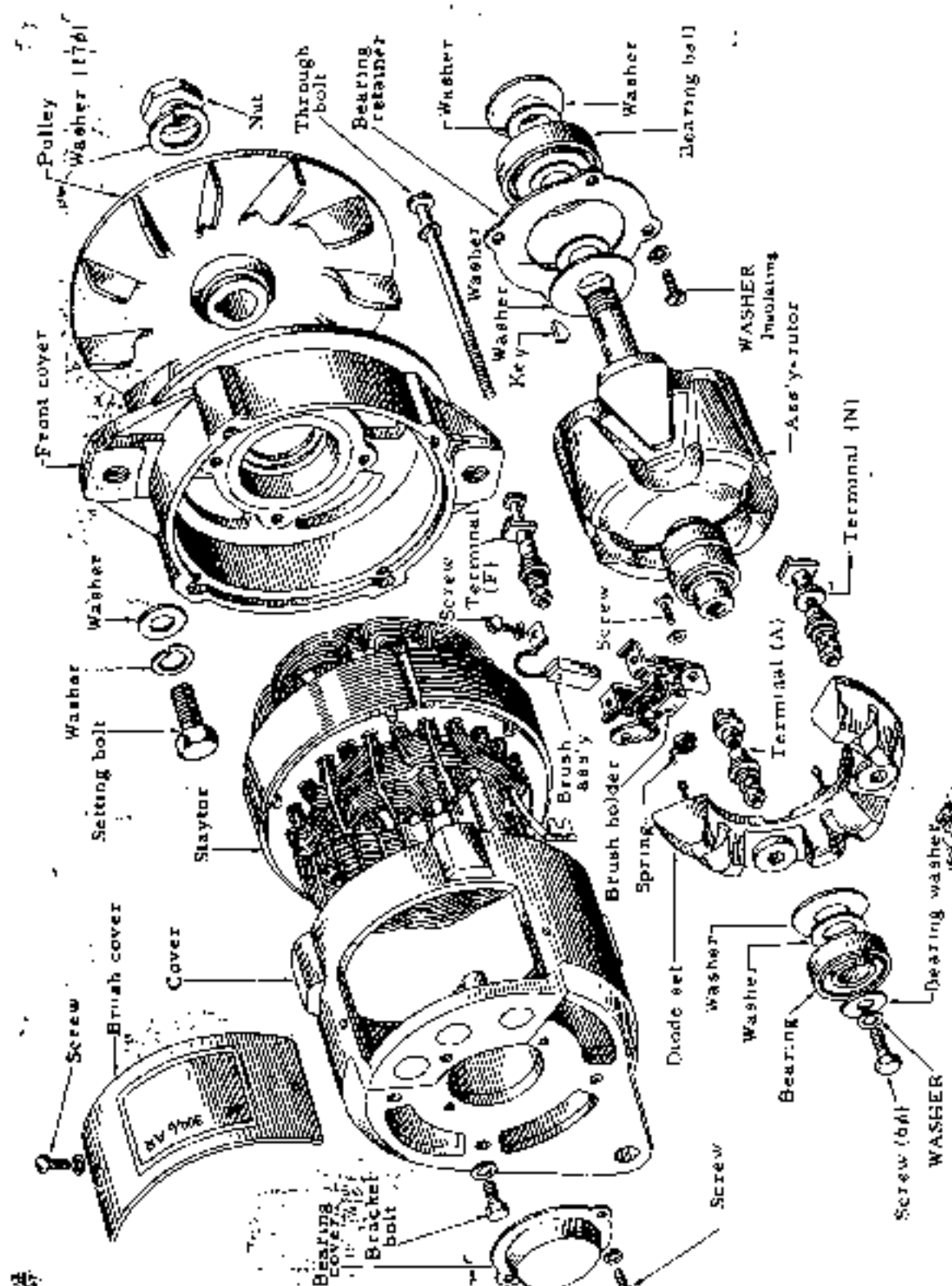


FIG. 1 ALTERNATOR (MITSUBISHI)

ALTERNATOR

Alternator	Mitsubishi Denki Co
Model	AC300/12AIR
Nominal output	12V - 300W
Constant	Successive
Pole	+ side ground
Constant revolution	2,500 r. p. m.
No load minimum revolution	1,000 r. p. m. down 14V (normal temp.)
Output current	2,500 r. p. m. 14V 24.5A up (normal temp.) 2,500 r. p. m. 14V 21.5A up (high temp.)
Pulley ratio	1 : 1.75
Regulator	Mitsubishi Denki Co. (23500 - 12200)
Model	RL - A2
Type	Terrill type (leaf spring)
Element	Constant voltage relay, Pilot lamp relay.
Constant voltage relay	3 contact point type

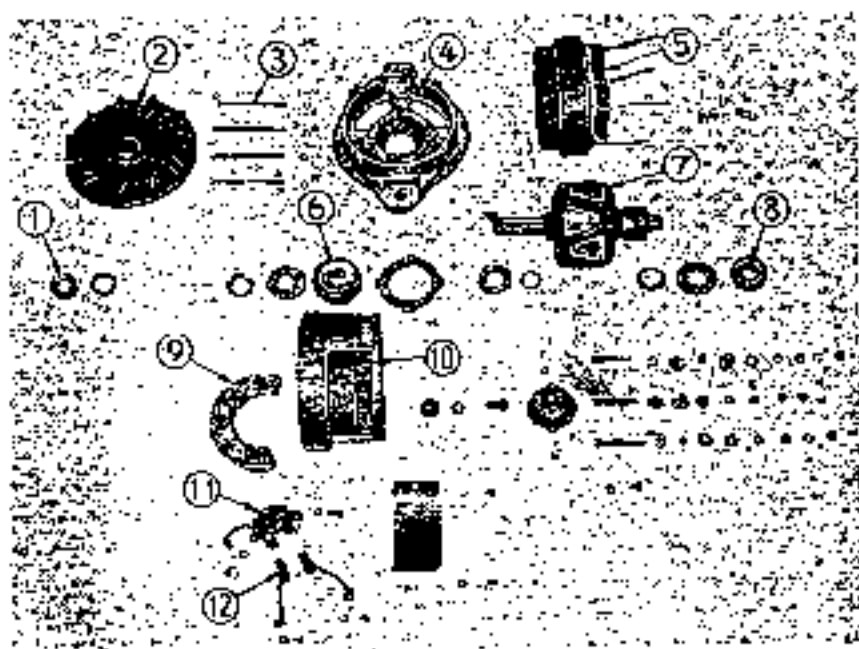
	Primary side	Secondary side
Adjust, valve	14 ~ 15V	14 ~ 15V
Dynamo revolution	4,000 r. p. m.	4,000 r. p. m.
Load	Battery + resisting load 21.5A approx.	Battery

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

MAJOR COMPONENTS OF ALTERNATOR



	Part No	Part Name	Q'ty	Remarks
	23100 61200	Alternator ass'y	1	
	23500 12200	Regulator ass'y	1	
1	23153 12210	Nut 17φ	1	
2	23151 12210	Pulley	1	
3	23131 12210	Through bolt	4	
4	23118 12210	Front cover ass'y	1	
5	23102 12210	Stator ass'y	1	
6	23120 12210	Ball bearing	1	
7	23108 12210	Rotor ass'y	1	with slip ring
8	23129 12210	Ball bearing	1	
9	23230 12210	Diode set	1	
10	23183 12210	Rear cover	1	
11	23133 12210	Brush holder	1	
12	23135 12210	Brush	2	
	23127 12211	Rear cover with diode set, etc.		Diode set, brush holder, brush, brush spring, ball bearing, each terminal.
	21067 10800	Fun belt	1	

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.

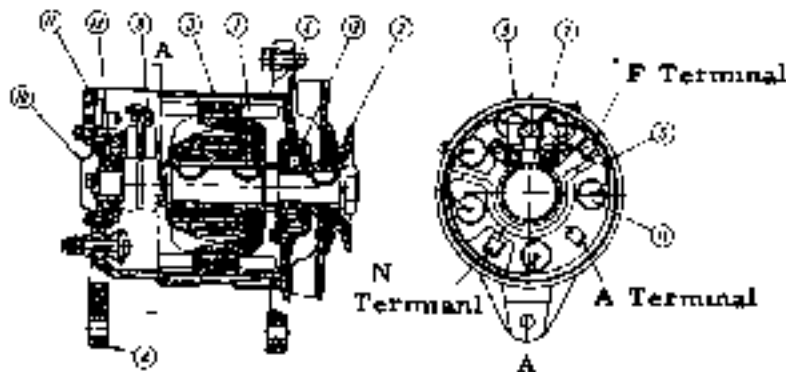


Fig. 1-1. Sectional View of Dynamo

- | | | |
|----------------------|----------------|-----------------|
| ① Rotor ass'y | ⑤ Diode set | ⑩ Brush cover |
| ② Pulley with fan | ⑥ Front cover | ⑪ Bearing cover |
| ③ Starter (armature) | ⑦ Brush holder | ⑫ Diode |
| ④ Rear cover | ⑧ Brush | |

The sealed ball bearings ③, ④ 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.

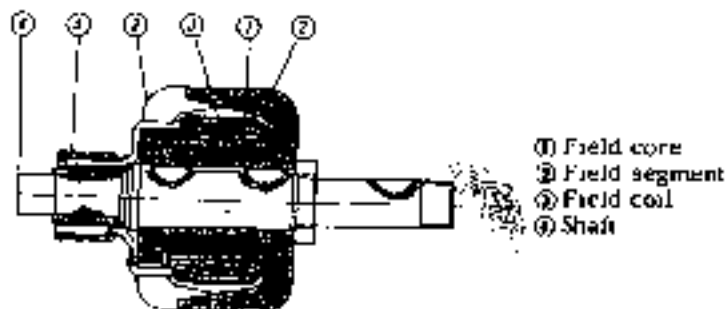


Fig. 1-1 Sectional View of Rotor

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.

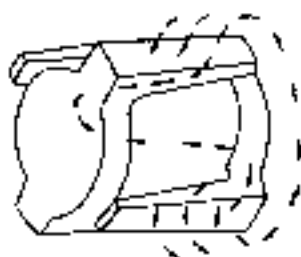


Fig. 1-3 Magnetic Circuit

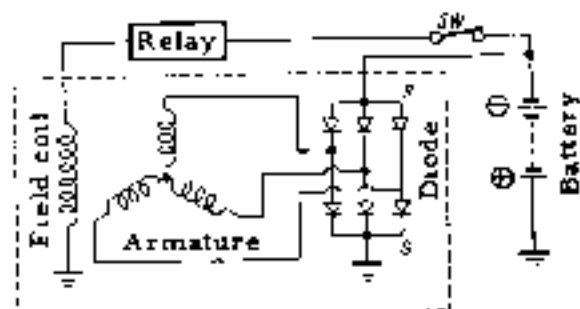


Fig. 1-4 Connection within Dynamo

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.

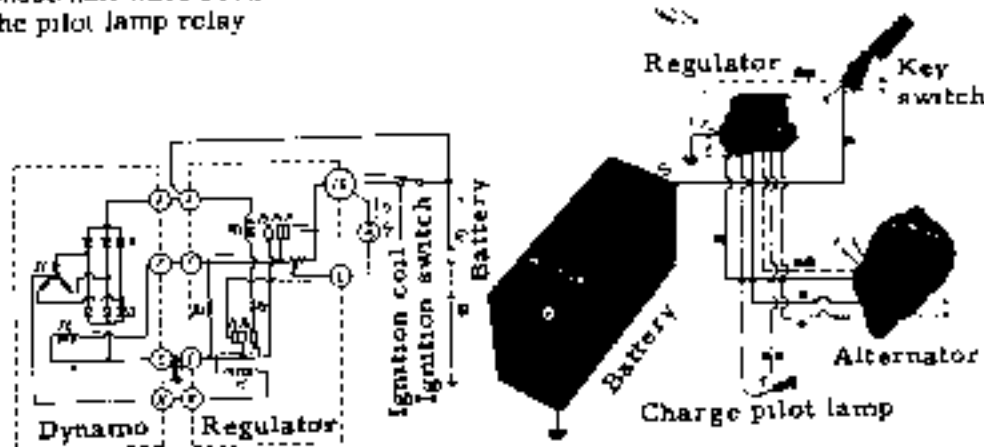


Fig. 1-5 Charging System

Fig. 1-6 Outside Connection

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 is 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.

Thus 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)



Fig. 2-1

* The completed (23100 61200).
The parenthesized is the part
number for SP310.

b)



Fig. 2-2

Remove the brush cover
(23107 12210) and pull off the
brush, 2 ea (23135 61200)

c)



Fig. 2-3

Remove the cover (23130 12210)
of bearing (23129 12210, JIS
#62022 7ZC*) and take off the
hex. bolt of shaft.

d)

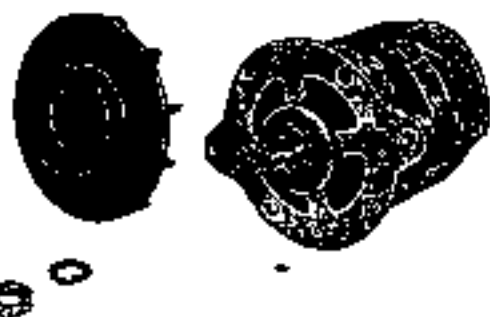


Fig. 2-4

Remove the hex. nut (23153 12210) of pulley (23151 61200) and pull off the pulley and the half-moon key (23195 12210). Be careful not to injure the fan when the nut is removed.

c)



Fig. 2-5

Remove the through bolt (23131 12210) tightening bolt front cover (23118 12210) and rear cover (23183 12210), pull off the front cover and rotor (23108 12210). Use a hammer of wood or plastic if necessary.

f)



Fig. 2-6

Remove the ball bearing from Front cover. Remove the bolt (23352 09610) tightening the bearing plate (23123 12210) 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.

g)



Fig. 2-7

Remove the rear cover and stator (23102 12210). Separate the silicon diode, 3ea from the stator coil lead wire, 3ea 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.

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.

n)



Fig. 2-8

Remove the diode set and brush holder (23133 12210) from the rear cover, when be careful not to lose small parts such as screws, washers and bushings.

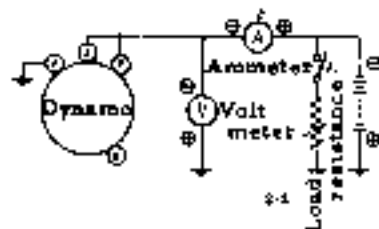
B. Assembly

Assembly is done in the reverse sequence of disassembly.

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.)



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

Fig. 3-1

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 (2A approx.) to the field coil and read the revolution. Correct revolution is approx. 1,000 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 P 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)

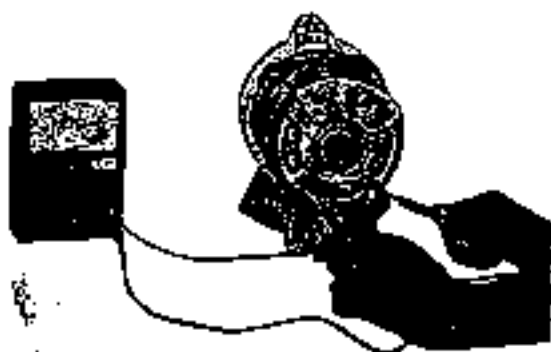


Fig. 3-2

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.

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



Fig. 3-3

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.

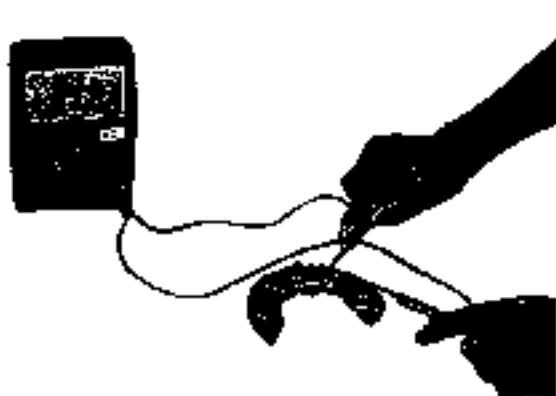


Fig. 3-4

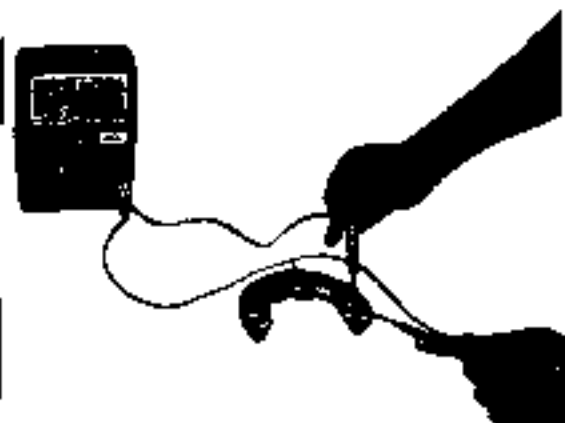


Fig. 3-5

D. Inspection of Diode with Lamp

a) Simple Inspection

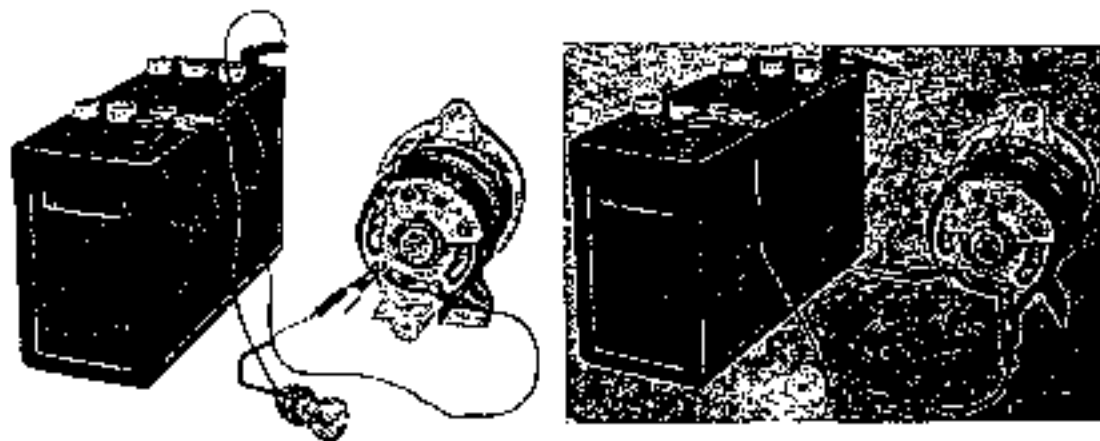


Fig. 3-6

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.

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.

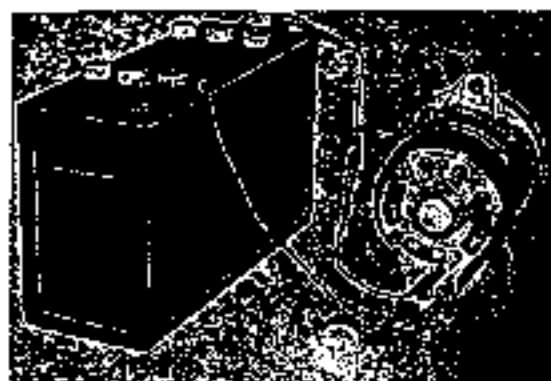
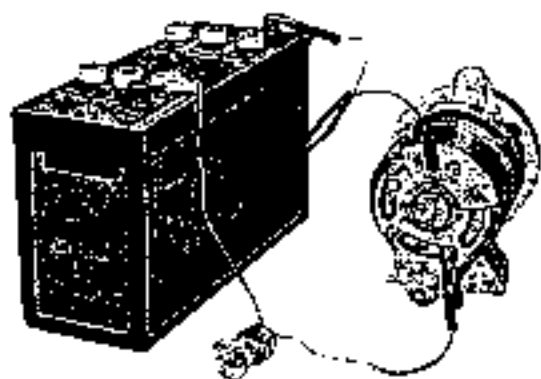


Fig. 3-7

b) Separate Inspection

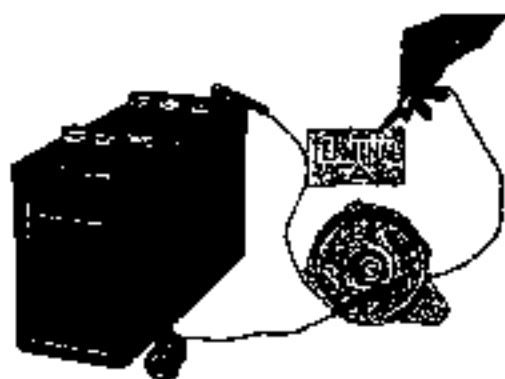


Fig. 3-8



Fig. 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

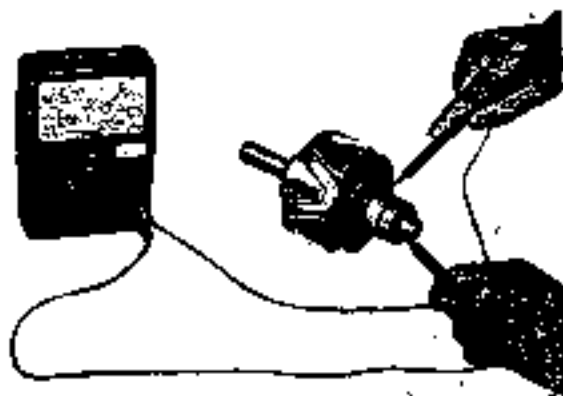
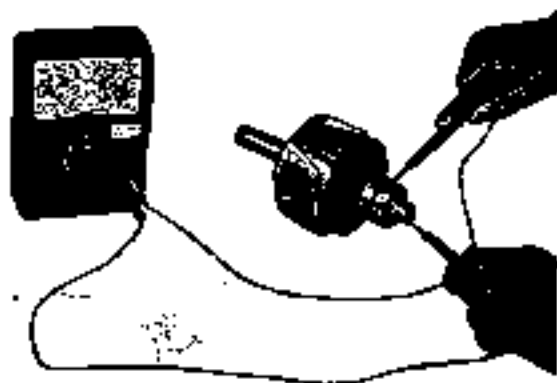


Fig. 3-10

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

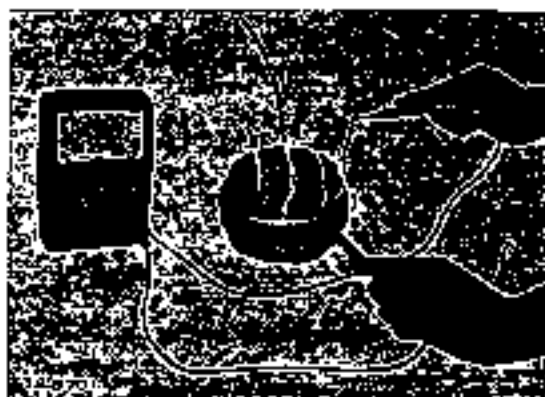


Fig. 3-11

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



Fig. 3-12

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

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.

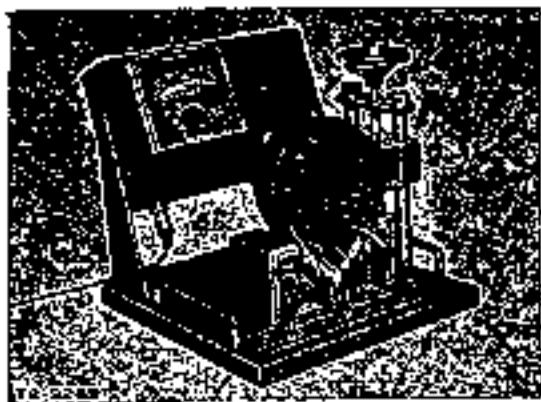


Fig 3-13

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

1. Constution and operation

(1) Construction

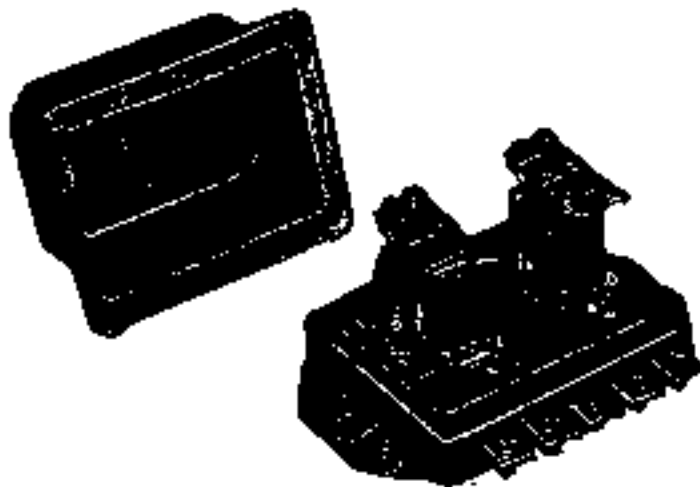


Fig 4-1

(2) Operation of Constant Voltage Relay

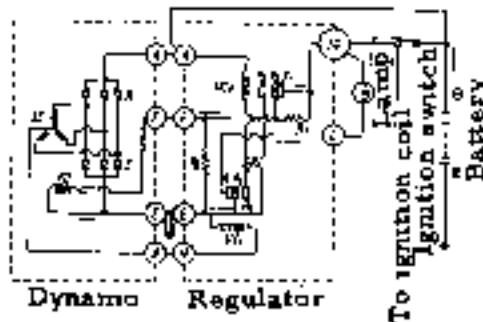


Fig 4-2

When the ignition switch is on, current 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 flows the regulator F terminal, contact points P_3, P_4 and the lamp glows.

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_3 leaves from P_4 and makes contact with P_0 , so that the lamp is off and it passes through the circuit, E terminal, contact points P_3, P_2 , resistance R_2 , VC_2 coil and A terminal, then the VC_2 coil animated and

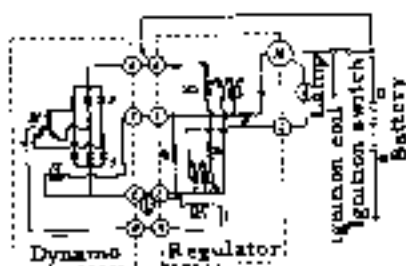


Fig. 4-3

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_4 , P_3 . This is repeated according to vibration of the contact point P_2 and the dynamo terminal voltage is kept evenly and continues charging.

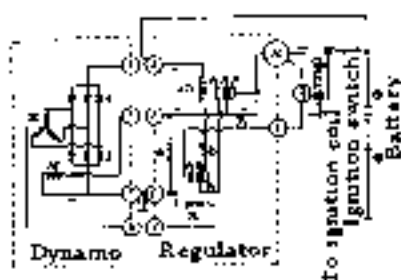


Fig. 4-4

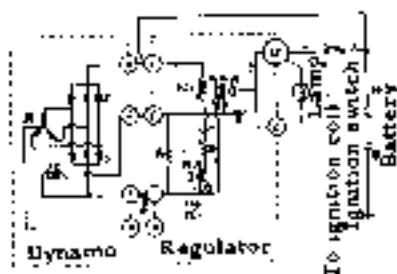


Fig. 4-5

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_4 and P_3 , the dynamo terminal voltage is always kept evenly.

The operation of this time is called a high speed operation and the adjust voltage is called 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_3 fixed with the movable piece can not continue contact with P_4 and changes to P_4 side and lights the lamp indicating non generation.

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

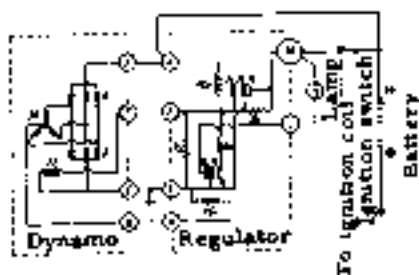


Fig. 4-6

(3) Operation of Pilot Lamp Relay

As shown in Fig 4-2, this is made up with the contact points, P_4 , P_5 and P_6 . The contact point P_5 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".

2. Adjustment

(1) Check Adjust Value of Constant Voltage Relay

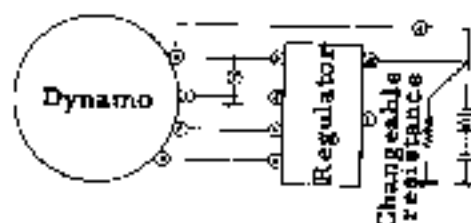


Fig. 4-7

Connect the battery almost charged in full as shown, and make the dynamo revolution with 4,000 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

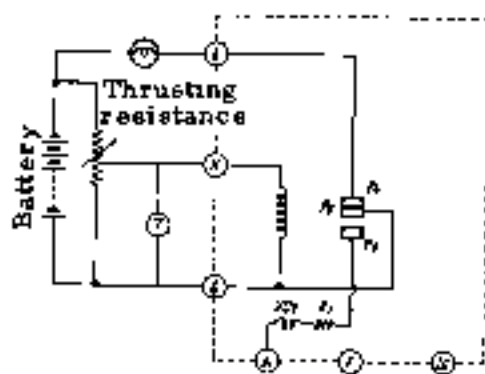


Fig 4-8

First, put on the lamp with connection as shown in Fig 4-8 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, move the rubbing resistance volt-split point and lower the voltage and read the voltage when the lamp freres

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. 4-9.

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

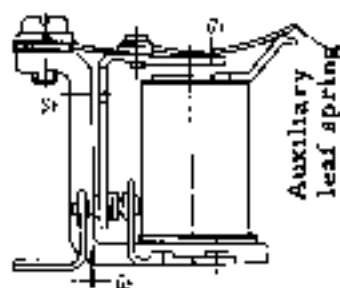


Fig 4-9

(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 paint, 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 be 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 surge 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.
- (13) When the battery is quickly charged with the quick charger, the lead wire or regulator A terminal (dynamo A terminal) should be disconnected.
- (14) Put the key switch off when the engine is in a stop except when particularly needed.

If the diode is moistened, the performance will be lowered.

Surge voltage of the quick charger will also damage diode.

When the key switch is on, magnetic current always flows on the field coil and might damage the dynamo and often cause over discharge of battery

TROUBLE SHOOTING LIST

Trouble & Cause	Remedy
5- 1 Over-discharge of battery. <ol style="list-style-type: none"> 1. Slackness of fan belt 2. Earth or breakage of stator coil 3. Breakage of rotor coil 4. Mal-contact of brush and slip ring 5. Mal-function of diode 6. Adjust voltage of constant voltage relay is low. 7. Mal-contact of low speed side contact point of constant voltage relay 8. Adherence of high speed side contact point. 9. Shortage or unfitness of electrolyte. 10. Mal-function of battery pole. (short circuit) 11. Mal-contact of battery terminal 12. Mal-contact or breakage between ignition switch and relay IG terminal 13. Mal-contact or breakage between regulator F terminal and dynamo F terminal. 14. Excessive electric load. 	<p style="text-align: center;">Adjust</p> <p style="text-align: center;">Repair or replace</p> <p style="text-align: center;">Replace</p> <p style="text-align: center;">Replace brush, clean holder</p> <p style="text-align: center;">Replace as a set.</p> <p style="text-align: center;">Readjust</p> <p style="text-align: center;">Polish contact point.</p> <p style="text-align: center;">Replace</p> <p style="text-align: center;">Add distilled water, check S.G.</p> <p style="text-align: center;">Replace or repair</p> <p style="text-align: center;">Clean, retighten terminal</p> <p style="text-align: center;">Repair</p> <p style="text-align: center;">Repair</p> <p style="text-align: center;">Check power consumed</p>
5- 2 Over-charge of battery <ol style="list-style-type: none"> 1. Constant voltage relay adjust voltage is too high. 2. Constant voltage relay coil breakage or rare short. 3. Constant voltage relay coil straight resistance breakage. 4. Constant voltage relay low speed side contact point adherence. 	<p style="text-align: center;">Readjust</p> <p style="text-align: center;">Replace</p> <p style="text-align: center;">Replace</p> <p style="text-align: center;">Replace</p>

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	S114-72
Voltage	12 volts
Output	(1.0 HP)
Starting current (volts)	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 ring gear	120
Amendment limit of short dimension on shaft dia. (pinion side)	0.1 mm (0.004 in.)
Amendment limit of short dimension of shaft dia. (rear end)	0.1 mm (0.004 in.)
Gap between shaft and bush (pinion side)	0.038-0.095 mm (0.0015-0.0038 in.)
Amendment limit dittoed gap	0.02 mm (0.008 in.)
Gap between shaft and bush (rear end)	0.03-0.076 mm (0.0012-0.0030 in.)
Amendment limit dittoed gap	0.2 mm (0.008 in.)
Amendment limit of deflection on shaft	0.1 mm (0.004 in.)
Outer dia. of commutator	
Amendment limit of short dimension	2 mm (0.08 in.)
Dittoed degree of real circle	0.05 mm (0.002 in.)
Dittoed limit of polarized wear	0.4 mm (0.016)
Bush length:	
Amendment limit	9 mm (0.36 in.)
Brush spring pressure	0.9 kg 0.1

Construction and Operation

The starter motor is a 1.0 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 gear 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.

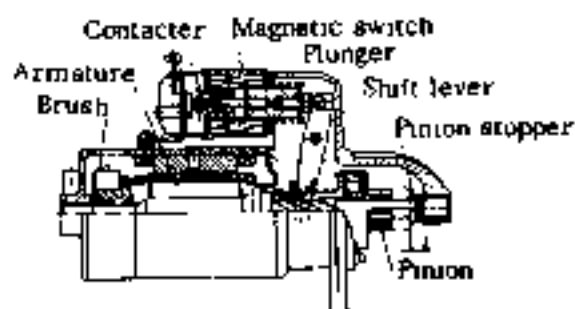


Fig. 1 Magnetic Shift Type

After advancing about 14 mm, 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 end of the shaft towards the starter bracket, thus reducing the bonding 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.

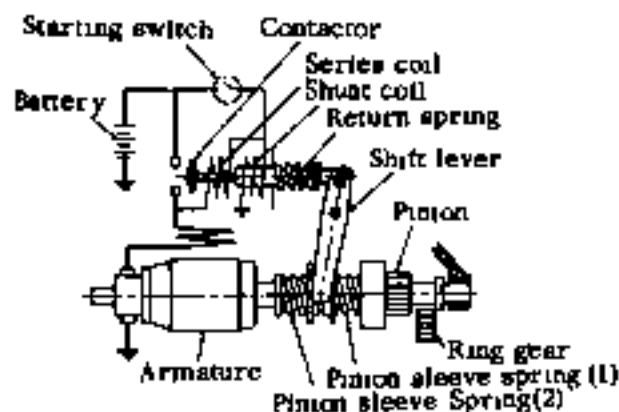


Fig. 2 A View of Starter System

Operational 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 release immediately when the engine starts.

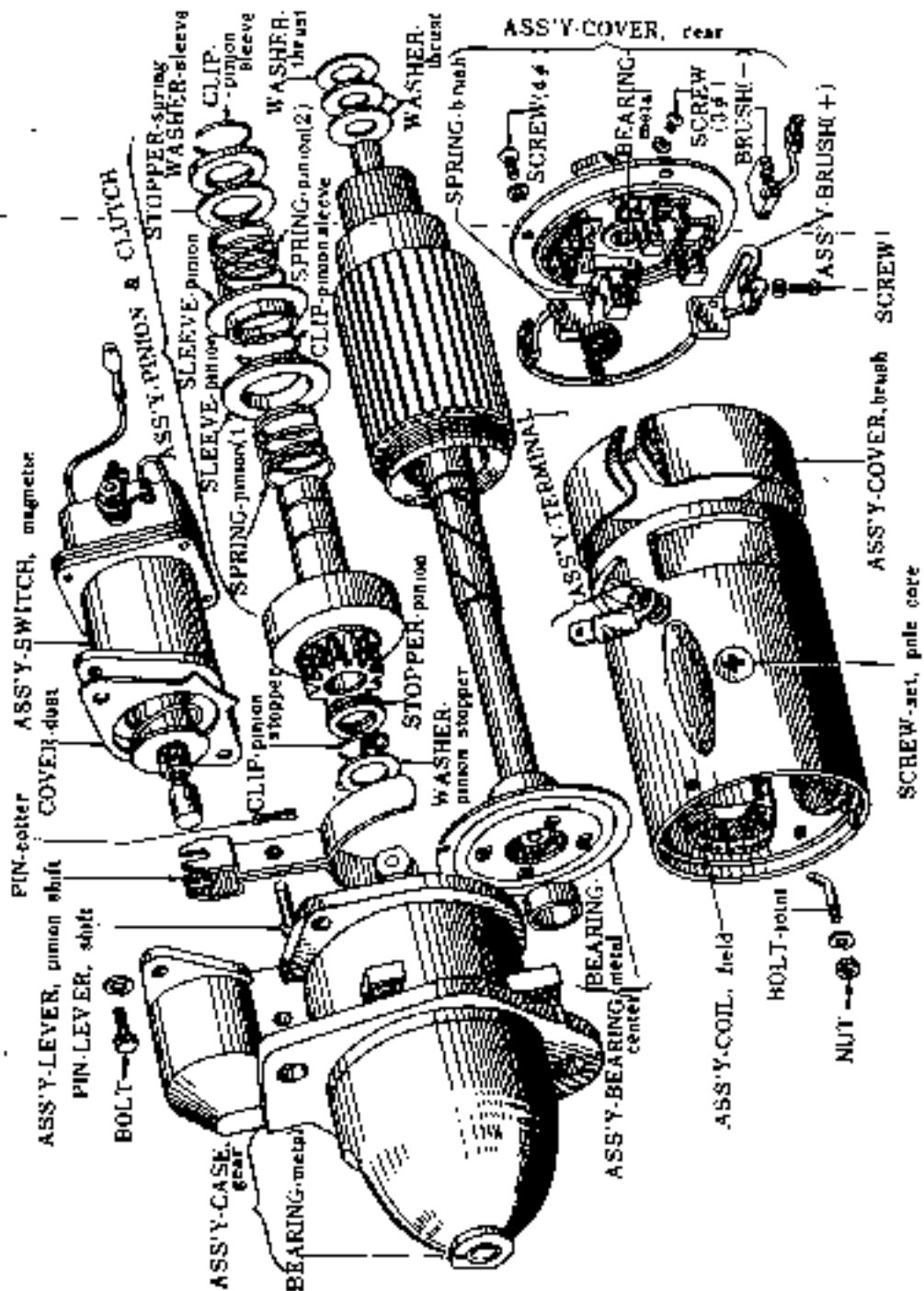


FIG. 3 STARTER MOTOR (HITACHI)

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 shows defective performance, it is due to internal defects so that 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.

Inspecting 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 damaged, 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 found 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 contacting, 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 contacting condition, the brushes are reseted. At the same time, the 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 burning 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_4 .

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

(A) Current failure in magnetic circuit.

When the starter switch is pressed and the current fails to pass through the magnetic circuit, most of the trouble is due to broken soldered connection between the magnetic coil wire and the magnetic switch (+) terminal, and defective ground connection from the coil wire to the magnetic switch body.

(B) Defective contact in main circuit S_2 .

When the magnetic circuit is satisfactory and S_4 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 remains closed. In either case, the trouble lies in the faulty moving of the core or roughness of the contacting 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_1 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 engine 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 battery. 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 0.9 m.-kg.



Fig. 4 Torque Testing Apparatus

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.

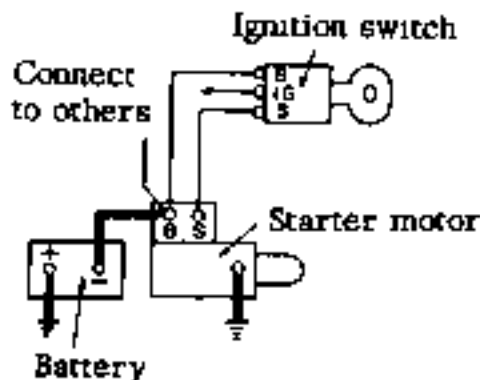


Fig 5 Magnetic Starter Circuit

If there is trouble in the magnetic circuit, it should be corrected.

For improperly contacting starter brushes, the brushes together with the armature should be checked, and corrections 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 are usually caused by badly worn gears meshing improperly and if the defect is not too severe, it can be remedied by placing the gear shift lever into fourth speed and rocking the car back and forth to free the gears. If this trouble is frequently repeated, the starter should be dismantled from the engine for checking and repairs.

- (1) Starter turns but its turning power is weak and fails to start the engine. If the trouble is due to a run down battery, loose terminals, troubles in magnetic shift switch, worn and sticking brushes, dirty and damaged commutator, etc., the checking, and repairs are made in the same manner as described in the preceding chapters. If the outer surface of the armature is rubbing against the core, the starter should be dismantled, disassembled and repaired. Besides the above, there is the case of the pinion meshing improperly. If the trouble is due to the gear teeth being badly worn, the gears should be replaced but if it is due to the screw guide on the pinion shaft being dirty and not allowing the pinion to advance smoothly and causing improper meshing, the shaft should be cleaned and oiled.

- (2) Starter exceeding noisy when in operation.

The flywheel ring gear is checked and if the teeth are deformed, they should be repaired or the gear replaced.

Rattling noise caused by loose starter mounting bolts are corrected by re-tightening the bolts.

Noise caused by brushes improperly contacting the armature required correcting as this condition not only produces noise but will hasten wear on both parts.

Noises made by the armature rubbing against the core while in operation is caused by too large a clearance between the armature shaft and the bushing so the worn parts should be replaced. Wear between the shaft and bushing is due to lack of oil so that attention should be given to proper lubrication. Lubricate once every half year using good grade of machine or mobile oil and lubricate the parts through the oil nipples. The amount of oil required is about 0.5 cc. for each bracket.