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SERVICE MANUAL

DATSUN

SPORTS CAR

MODEL SP(L) 310

NISSAN

NISSAN MOTOR CO., LTD.
TOKYO, JAPAN

P/N 99999–20006

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NISSAN MOTOR CO., LTD.

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

CABLE ADDRESS : "NISMO" TOKYO
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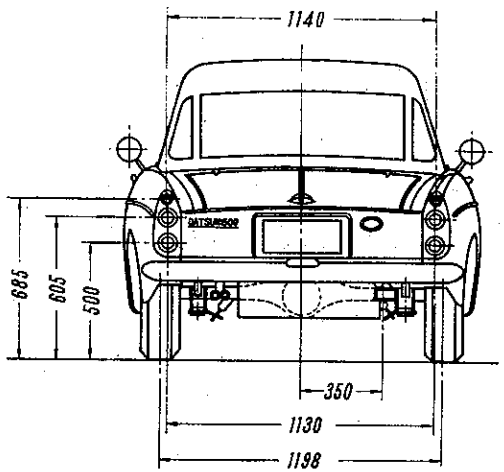
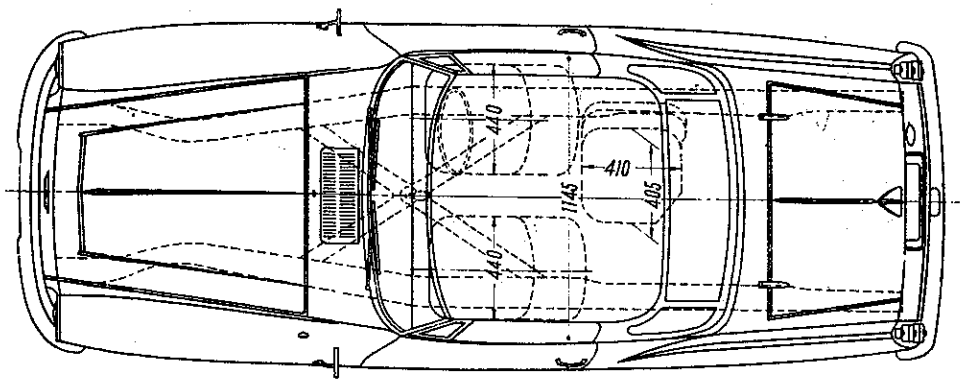
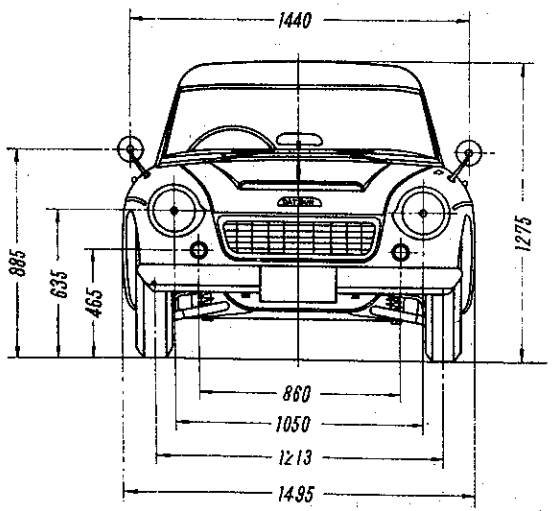
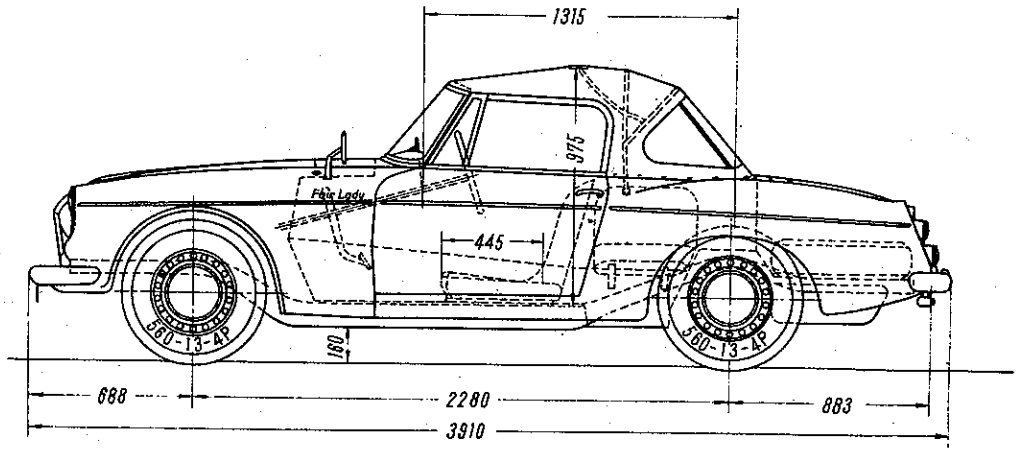
MODEL SP(L)310 GENERAL VIEW

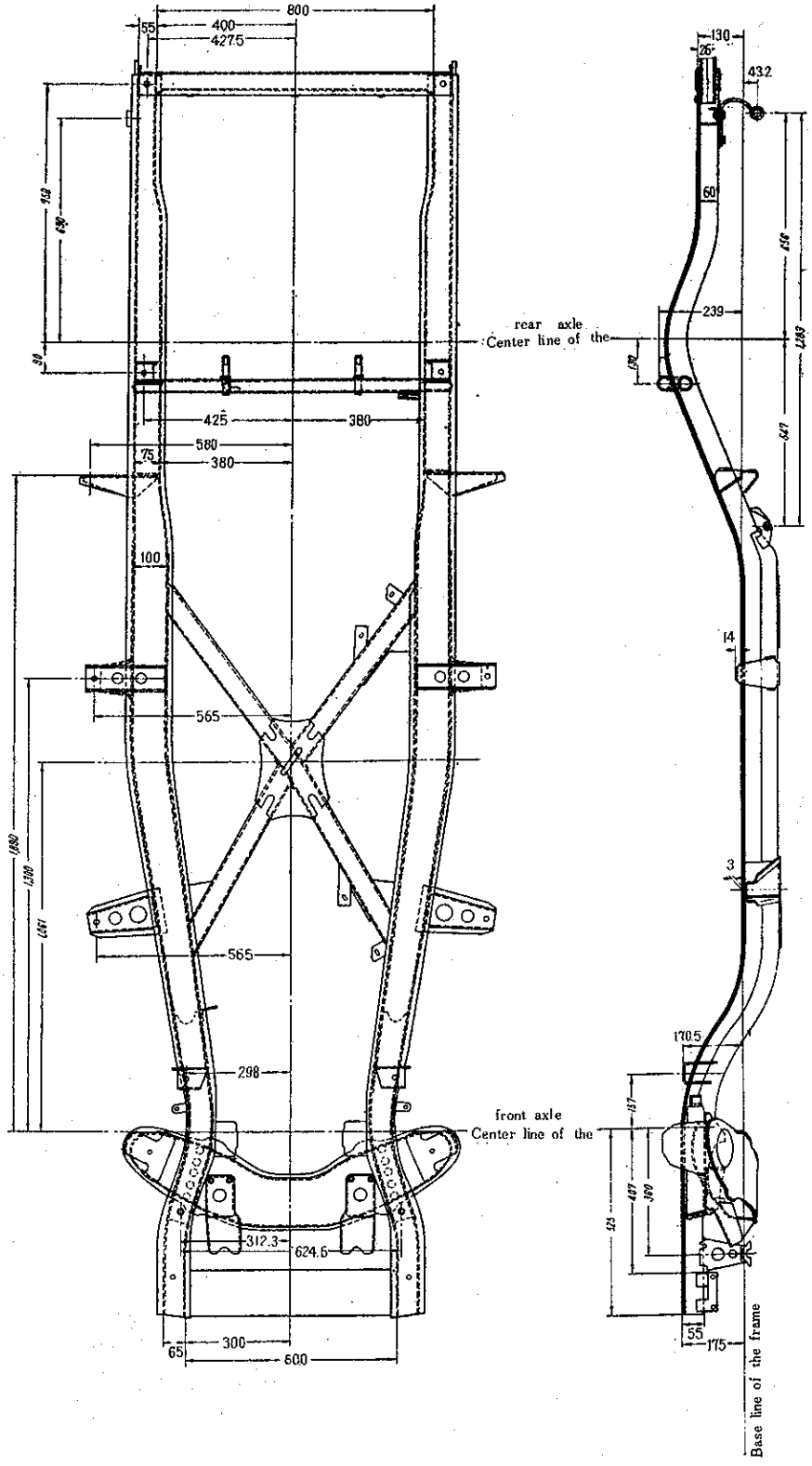








MAIN DIMENSION OF SP310 FRAME



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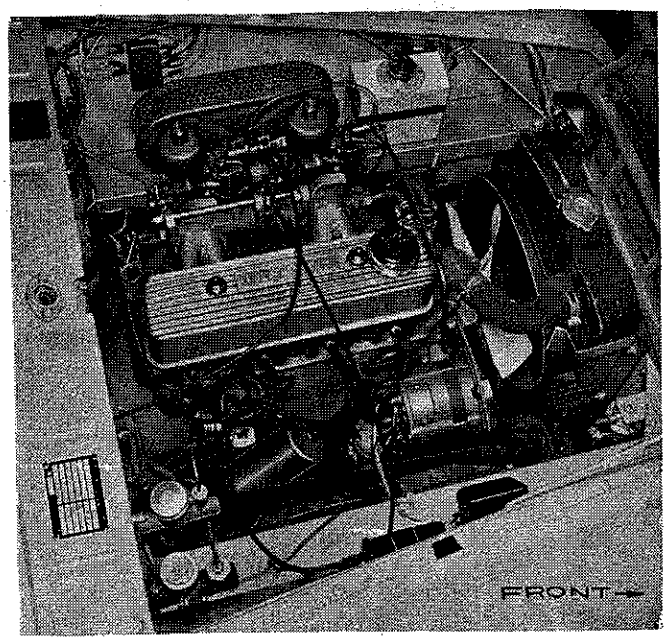
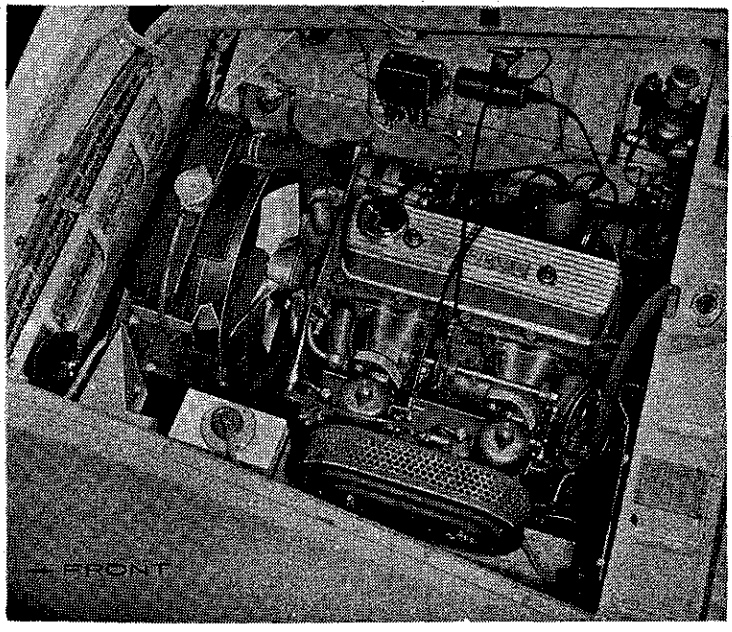
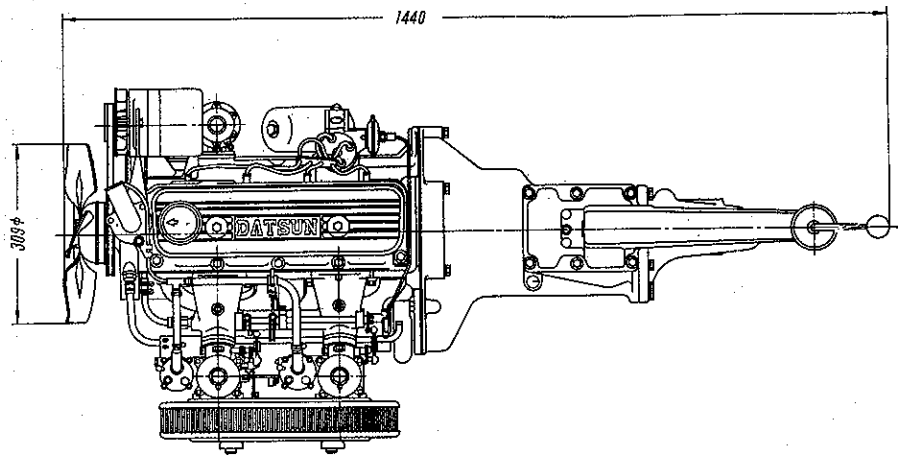
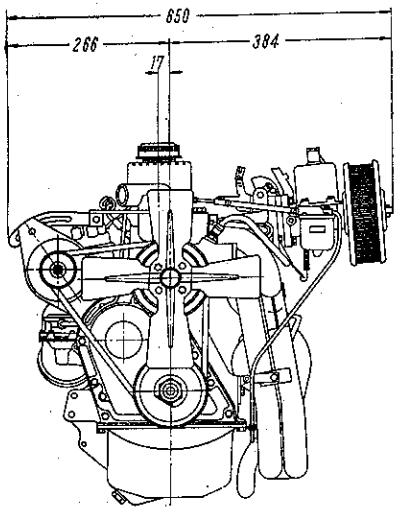
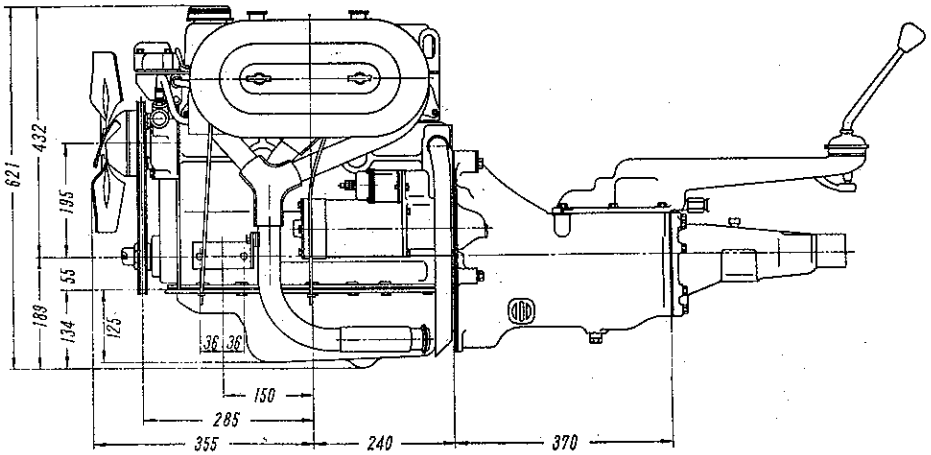




DIMENSION OF THE ENGINE WITH TRANSMISSION







SPECIFICATIONS

NEW MODEL SP(L)310
DIMENSIONS AND WEIGHT

Overall length	3,953mm (155.6 in.)
Overall width	1,495mm (58.9 in.)
Overall height	1,275mm (50.2 in.)
Wheel base	2,280mm (89.8 in.)
Tread front	1,213mm (47.8 in.)
Tread rear	1,198mm (47.1 in.)
Vehicle weight	905Kg (1991 lb.)
Seating capacity	3 Persons
Min. road clearance	160mm (6.3 in.)
Gross vehicle weight	1,070Kg (2365 lb.)

PERFORMANCE

Max. speed	155 Km/h	(96 mile/h)
Max. grade ability (sin ϕ)	0.460	
Min. turning radius	4.9 m	(16.0 ft.)
Brake distance at 50 Km/h	14.3 m	(46.8 ft.)

ENGINE

Model G; Gasoline engine; Water cooled four cycle O.H.V.: Four cylinder in line; Bore 80mm (3.15 in.); Stroke 74mm (2.91 in.); Max. brake horse power 85 HP at 5,600 r.p.m. (S.A.E.); Max. torque 12.7 m-Kg (92 ft-lb.) at 4,400 r.p.m. (S.A.E.); Compression radio 9.0 : 1

FUEL SYSTEM

HITACHI HJB-38W-1 x 2; Variable venturi, side draft type twin carburetors. Mechanical type diaphragm pump; Paper element type air cleaner; Fuel tank capacity 43.1 (11.3 US gal.)

LUBRICATION SYSTEM

Pressure feed with full flow type oil filter; Gear type pump; Oil pan capacity 4 (0.8 US gal.)

IGNITION SYSTEM

Coil and distributor with automatic mechanical and vacuum controls.

COOLING SYSTEM

Pressurized radiator; Centrifugal pump; Pellet type thermostat and fan; Cooling water capacity 6.51 (1.7 US gal.)

ELECTRIC SYSTEM

12 volt 40 A.H. capacity battery; 300 watt alternator with Tirrill's voltage regulator; 1.4 HP magnetic shift starter.

CLUTCH

Single dry disc with cushioning springs; Dia. 20.3 mm (8 in.).

TRANSMISSION

4 speed forward and 1 reverse; Synchromesh on 2nd, 3rd and 4th gear; Gear ratio, 1st 3.515, 2nd 2.140, 3rd 1.328, 4th 1.000, reverse 4.597; Floor gear shift.

REAR AXLE

Semi floating axle; Hypoid bevel gear, ratio 3.889.

FRONT SUSPENSION

Independent wishbones, coil springs with hydrauric double action type shock absorbers.

REAR SUSPENSION

Semi-elliptic leaf type spring; 4 leaves with hydrauric double action shock absorbers.

STEERING

Cam and lever type gear, ratio 14.8 : 1 ; Steering wheel 3 spokes 400 mm (15.7 in.) diameter.

BRAKE

Hydrauric; Two leading shoe on front; Leading and trailing shoe on rear; Brake drum dia. 228.6mm (9 in.); Brake lining area 702 square cm. (109 square in.) ; Parking brake mechanically operated on rear wheels only.

WHEELS AND TIRES

Steel disc wheels; 5.60 - 13 - 4P tires.

LAMPS

Two head lamps (sealed beam); Two front parking and turn signal lamps; Two tail lamps and stop lamps; Twin rear turn signal lamps; Rear license lamp; Map lamp; Reverse lamp.

INSTRUMENT

Speedometer with milage recorder; Tachometer; Combined meter (Fuel meter, Thermometer, Oil pressure warning pilot lamp, Main beam warning lamp); Instrument panel also includes ignition and starter switch, lighting switch, choke control knob and windshield wiper switch.

FRAME

Pressed steel box section with X member.

BODY WORK

Two door 3 seater, open type with canvas top; All steel body fully upholstered with vinyl leather; Floor carpet; Safety glass windshield; Roll up type door lass; Plastic rear window; Adjustable bucket type front seats; Anchorage for fitting safety belt; Ash tray and glove box on instrument panel; Fresh air control; Door lock with key; Bumper over rider, front and rear; Spare wheel housed in trunk room; Mid point side jacking.

EQUIPMENTS

Windshield wiper; Windshield wahser; Cigarette lighting; Double horn; Inside and outside back mirrors; Tonneau cover.

OPTION & EQUIPMENTS

Heater, Radio. Plastic hard top (Fiber glass reinforced)

* These specifications are subject to change without notice.

ENGINE

Draining the Oil

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

On new and reconditioned engines the oil 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 accumulatted.

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 1 kg/cm^2/550 rpm(14.22 lb/in^2/550 rpm) at idling speed, and 3-4 kg/cm^2/2000 rpm(42.6-56.8lb/in^2/2000 rpm).

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 dipstick 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

The oil pressure gage is installed at the instrument panel. The ignition switch is turned on and when the engine started firing and the oil pressure increase normally as before mentioned.

Should it keep normal pressure during the engine running, it is result of the oil pressure down too low or the shortage of oil in the oil pan. Check the level of oil in the oil pan by means of the level gage and top up if necessary. If the pressure is still too low after refilling the oil, switch

off and ascertain that the strainer is clean and not choked with sludge, also that no air leakage exists at the strainer union on the suction side of the pump.

In the case of oil pump being defective, remove the unit to rectify the fault.

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.

LUBRICATION

Circulation

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

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

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

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

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

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

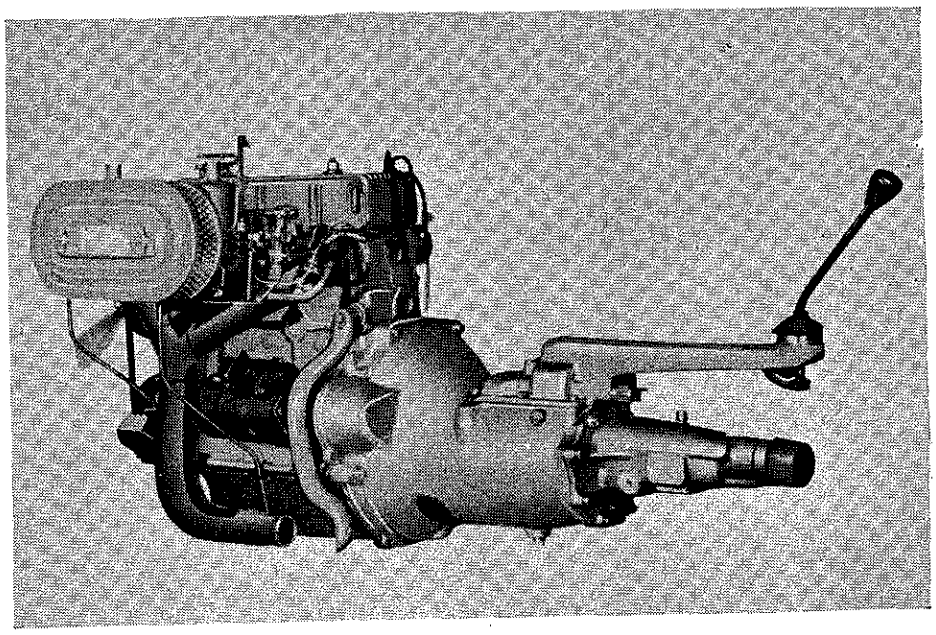


Fig. 1 G type engine (left side)

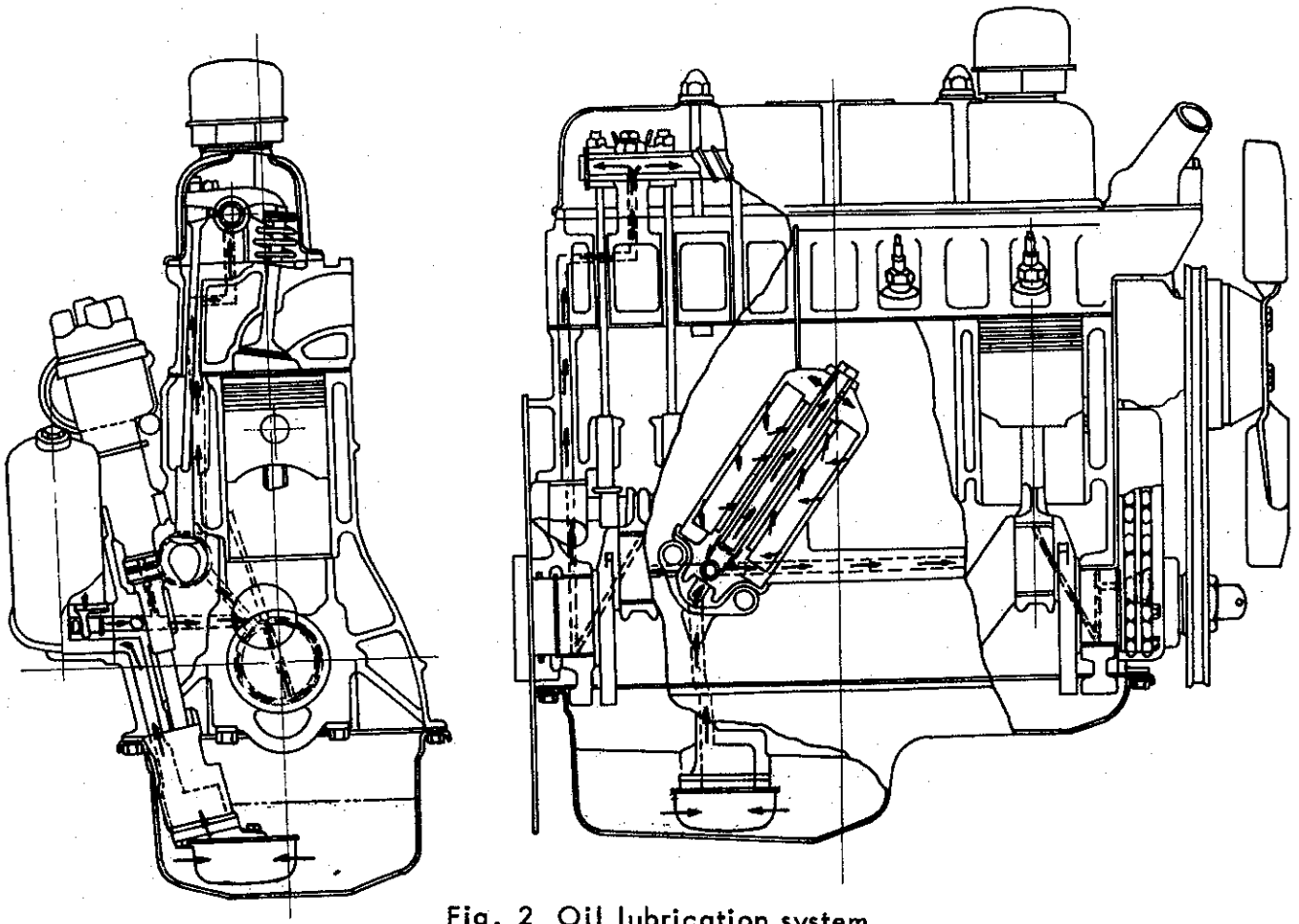


Fig. 2 Oil lubrication system

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

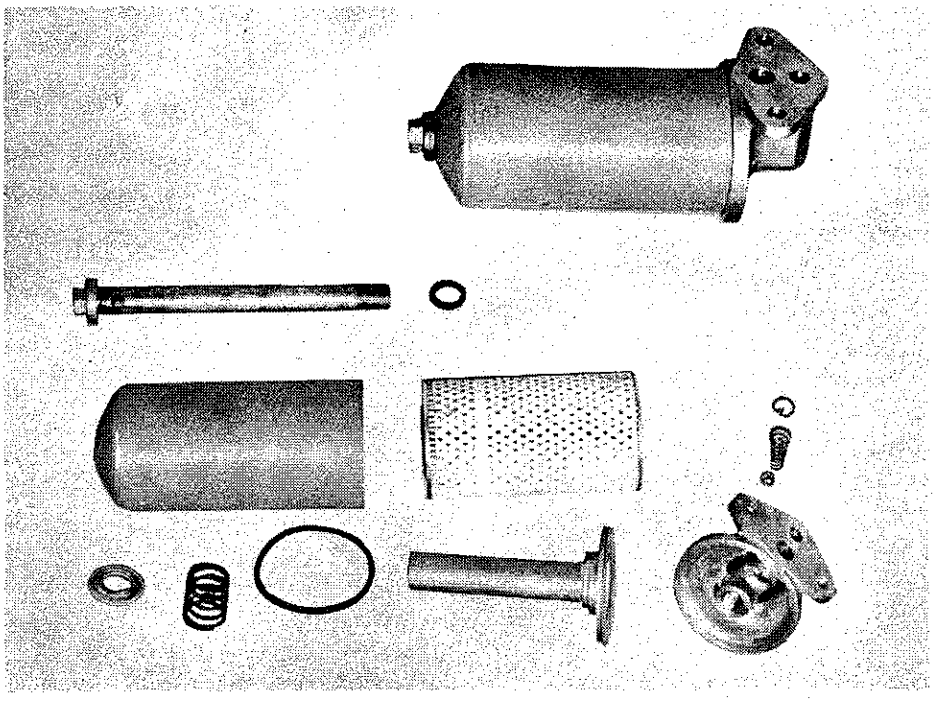


Fig. 3 Component of oil filter

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 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 pettol, 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.

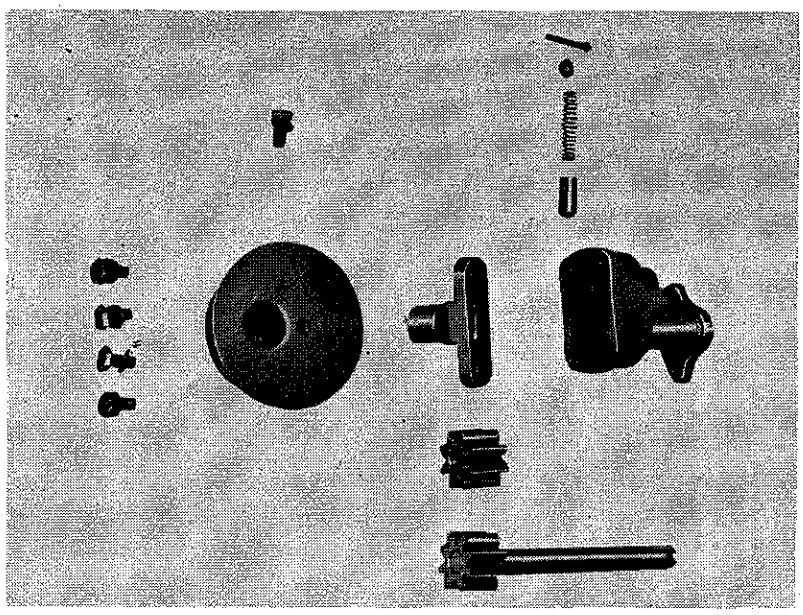


Fig. 4

Removing the Oil Pump

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

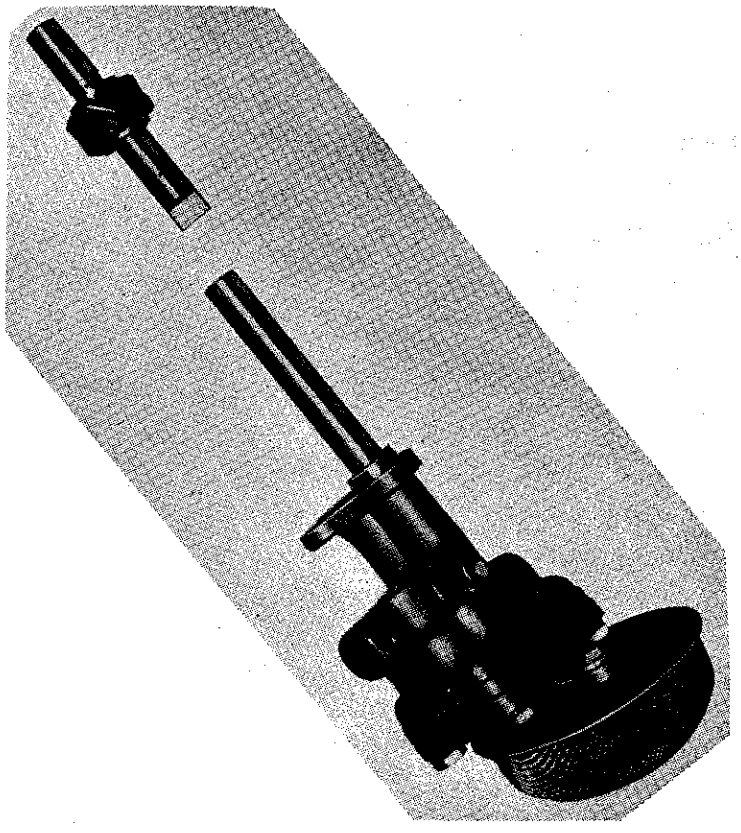


Fig. 5

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 drive gear and its drive shaft with a gear.

Refitting the Oil Pan

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

Reassembling the Oil Pump

OIL PUMP

Performance test	22 ltr (5.8 US. Gal.) minute at 2000 rpm (pump) Pressure 4 kg/cm^2(5.89 lb/in^2) Engine oil SAE 20, temperature 70°C (158°F) Regulator valve locked Vacuum 3.94 in Hg (100 mm Hg)
Gear back lash	0.25-0.3 mm (0.010-0.012 in)
Clearance between gear & cover	0.04-0.11 mm (0.0016-0.0043 in)

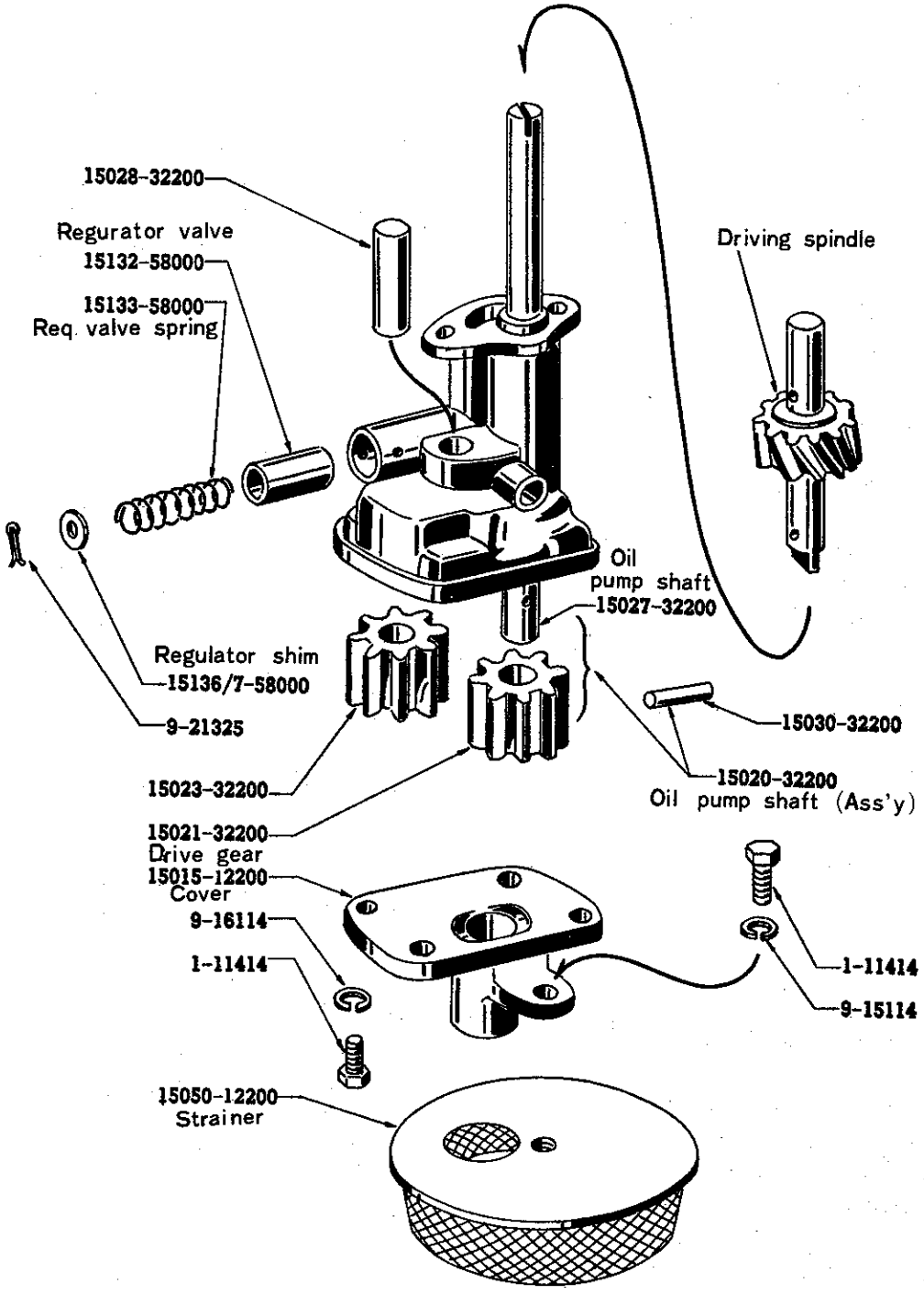


Fig. 6 Oil pump & strainer assembly

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

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

Pull off the crankshaft pulley

Removing the Timing Cover

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

The spring washers are immediately below the bolt heads.

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

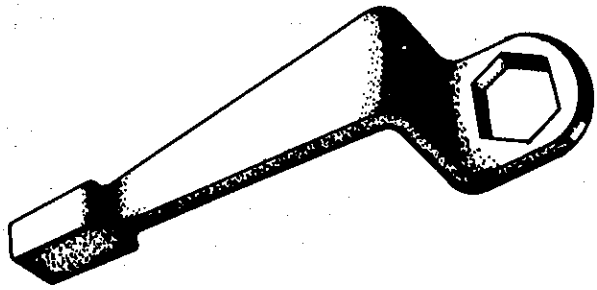


Fig. 1

Heavy duty "shock type" spanner

Removing the Timing Gear

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

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

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

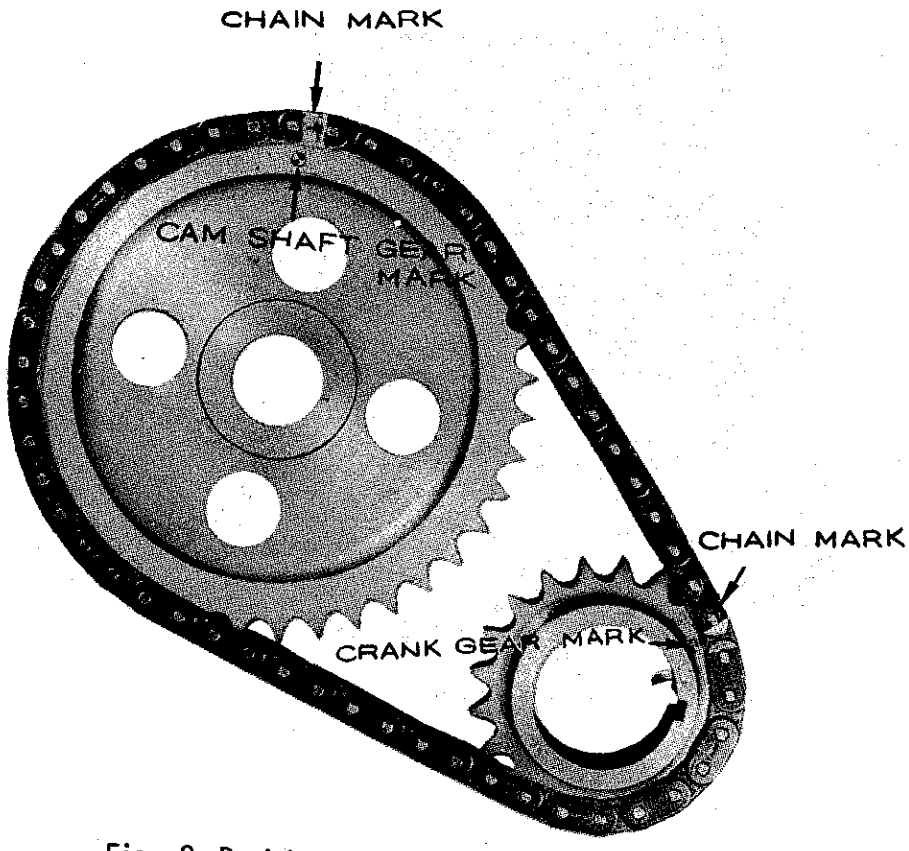


Fig. 2 Position of refitting gears with the chain

Refitting the Timing Gear

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

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

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

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

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

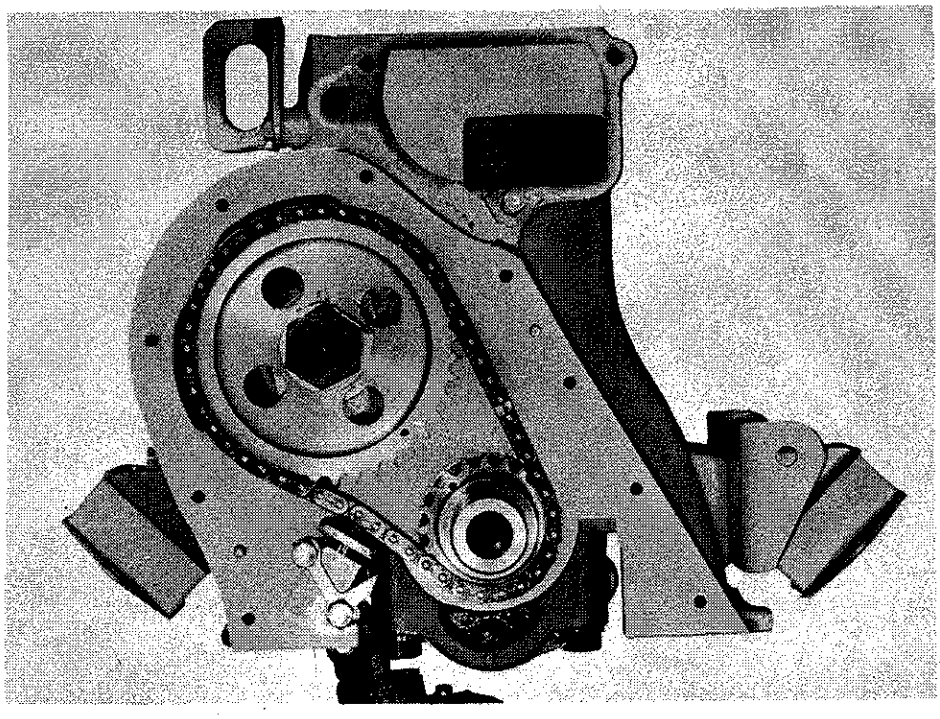


Fig. 3

Valve Rocker Cover Removal

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

Removing the Rocker Assembly

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

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

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

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

VALVE

Material:			
	Inlet	Chrome steel	
	Exhaust	Unilloy 2112	
Valve timing:			
	Inlet opens	20° B. T. D. C.	
	Inlet closes	56° A. B. D. C.	
	Exhaust opens	58° B. B. D. C.	
	Exhaust closes	18° A. T. D. C.	
Valve clearance Inlet & Exhaust		0. 43 mm	(0. 017 in) Hot
		0. 525 mm	(0. 0207 in) Cold
Dowel angle		50° - 54°	
Head diameter:			
	Inlet valve	42 mm	(1. 57 in)
	Exhaust valve	32 mm	(1. 26 in)
Valve seat angle inlet & exhaust		45°	
Valve face angle inlet & exhaust		44° 30'	
Valve length (overall)		109 mm	(4. 30 in)
Lift		8. 5 mm	(0. 335 in)

Dismantling the Assembly

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

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

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

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

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

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

Reassembling the Rocker

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

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

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

Push Rod Removal

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

Remove the air cleaner and rocker cover.

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

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

Adjusting Valve Rocker Clearances

Remove the air cleaner and rocker cover.

There should be a clearance of 0.43 mm (0.017 in.) between the face of the rocker and the base of the valve stem. Whilst checking the clearances it is important to maintain pressure with a screwdriver on the tappet adjusting screw to disperse the film of oil from the push rod cup. Failure to follow this procedure will result in a wrong reading being taken.

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

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

Tighten the lock nut and recheck the clearance.

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

ROCKER MECHANISM

TAPPETS

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

ROCKER MECHANISM

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

CYLINDER HEAD

Removing the Cylinder Head

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

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

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

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

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

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

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

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

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

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

Decarbonizing

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

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

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

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

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

Removal and Replacement of a Valve

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

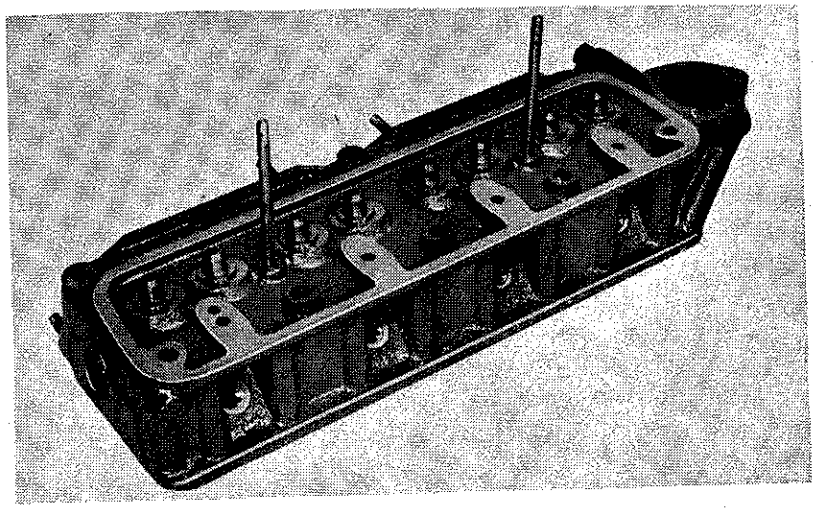


Fig. 1

Valve Grinding

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

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

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

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

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

VALVES

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

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

Refit the inlet and exhaust manifolds.

Fit the carburetor and reconnect the control linkage. Refit the ignition advance suction pipe to the connection on the carburetter, 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 whiring harness to the side of the head.

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

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

OVER SIZE VALVES(STEM) AVAILABLE

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

Refitting the Cylinder Head

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

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

Insert the push rods, 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 cylinder head bolts a little at a time, finally pulling them down with a torque wrench set to 45-50 lbs. /ft. (6.2-6.9 kgm).

Removing and Replacing the Tappets

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

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

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

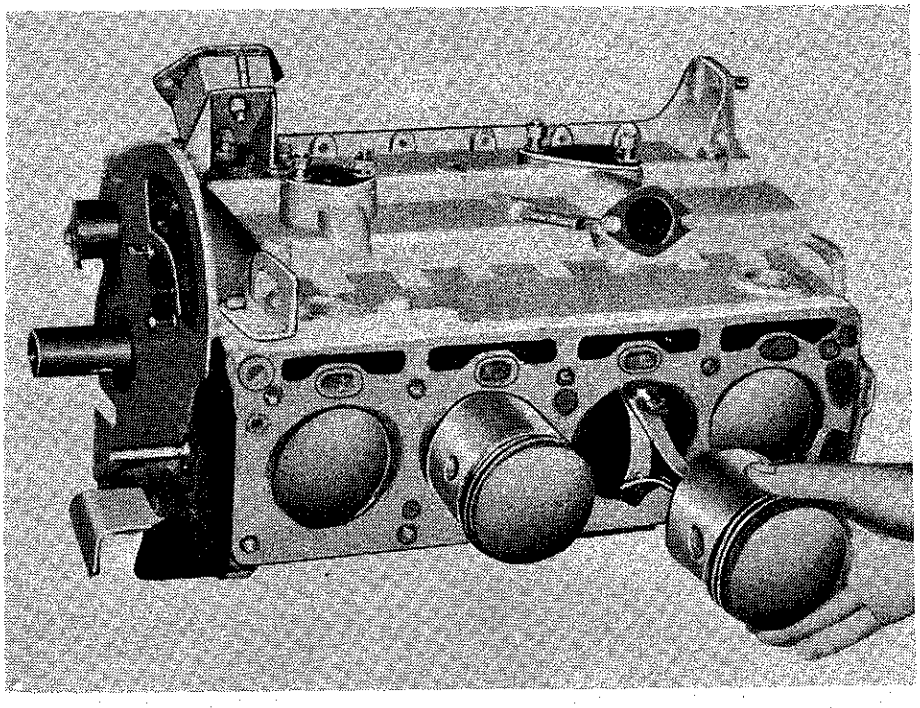


Fig. 2

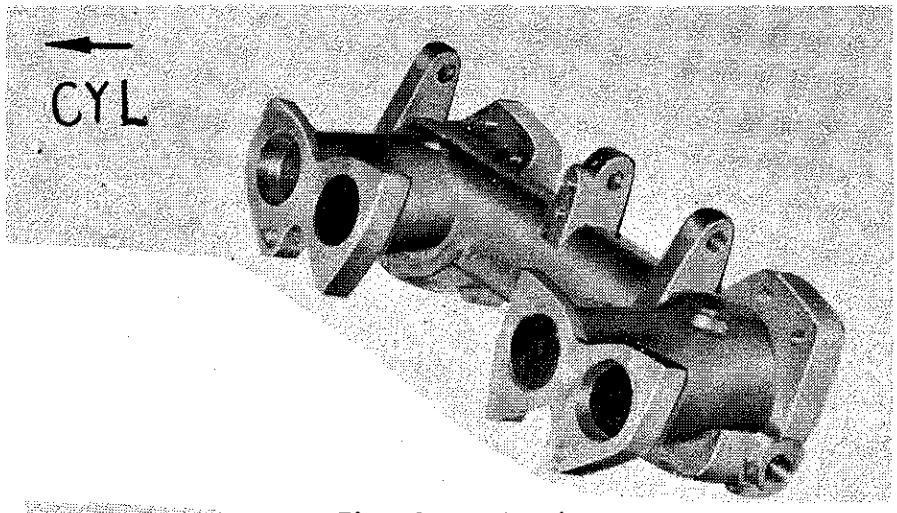


Fig. 3 Intake manifold

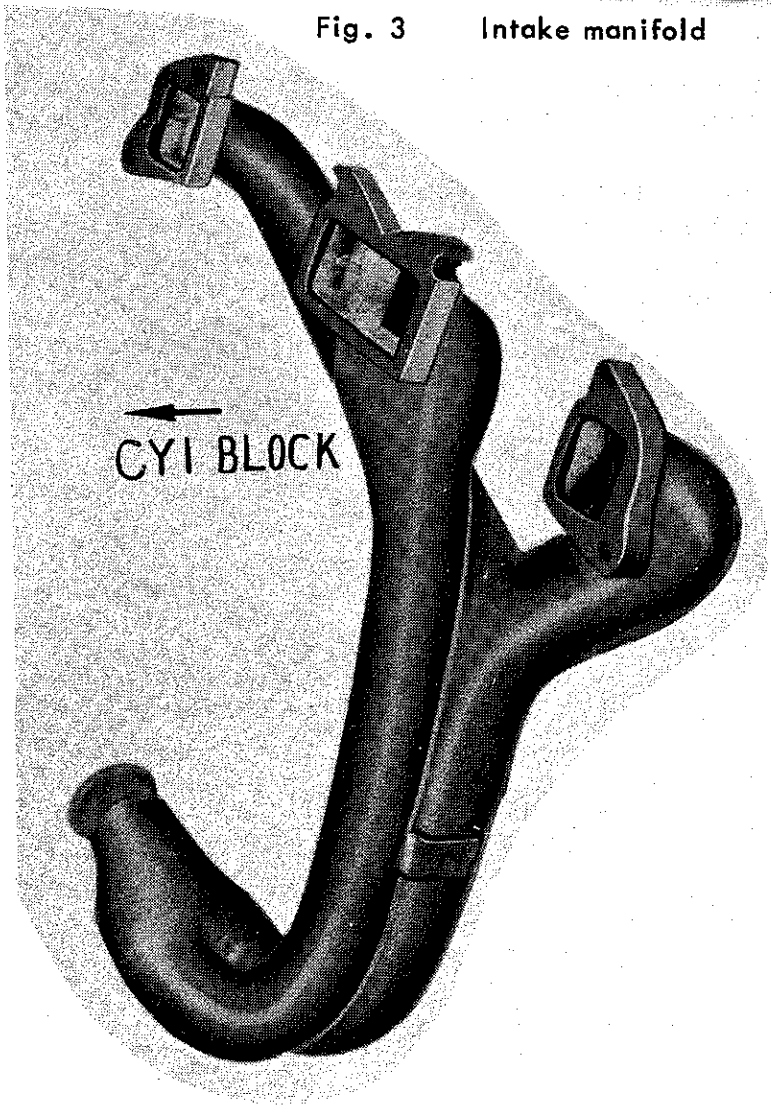


Fig. 4 Exhaust manifold

Piston and Connecting Rod Removal

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

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

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

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

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

Remove the assembly from the top of the cylinder block.

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

CONNECTING ROD

Material	Steel forging	5.699 ins.
Length, center to center	144 mm	
Big end bearing:		
Material	Thinwall, steel backed clevite metal	
Width	24.1 - 23.9 mm	0.9488 - 0.9409 in.
Thickness	1.500 - 1.508 mm	0.0591 - 0.0594 in.
Diameter of big end housing	55.000 - 55.013 mm	2.1653 - 2.1658 ins.
Big end width	28.75 - 28.80 mm	1.1319 - 1.1339 in.
End play	0.2 - 0.3 mm	0.008 - 0.012 in.
Clearance crank pin and bearing	0.023 - 0.052	0.001 - 0.002 in.
Piston pin housing (reamed in position)	22.010 - 21.997 mm	0.8663 - 0.8662 in.

CRANKSHAFT

Material	Steel forging	
Diameter of journals	59.945 - 59.952 mm	2.3598 - 2.3602 in.
Diameter of crank pin	51.961 - 51.974 mm	2.0457 - 2.0463 in.
End play	0.05 - 0.15 mm	0.002 - 0.006 in.
Main bearing clearance	0.025 - 0.068 mm	0.001 - 0.0027 in.
Deflection (RUN-OUT) at intermediate journal	0.03 mm	0.0012 in.

MAIN BEARINGS

Material	Thinwall, steel backed, white metal (upper) Clevite metal (lower)	
Number of bearings	3	
Width:		
Front and rear	28 mm	1.102 ins.
Center	33.90 - 33.95 mm	1.3027 - 1.3366 ins.
Bearing thickness	1.827 - 1.835 mm	0.0719 - 0.0725 ins.

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.

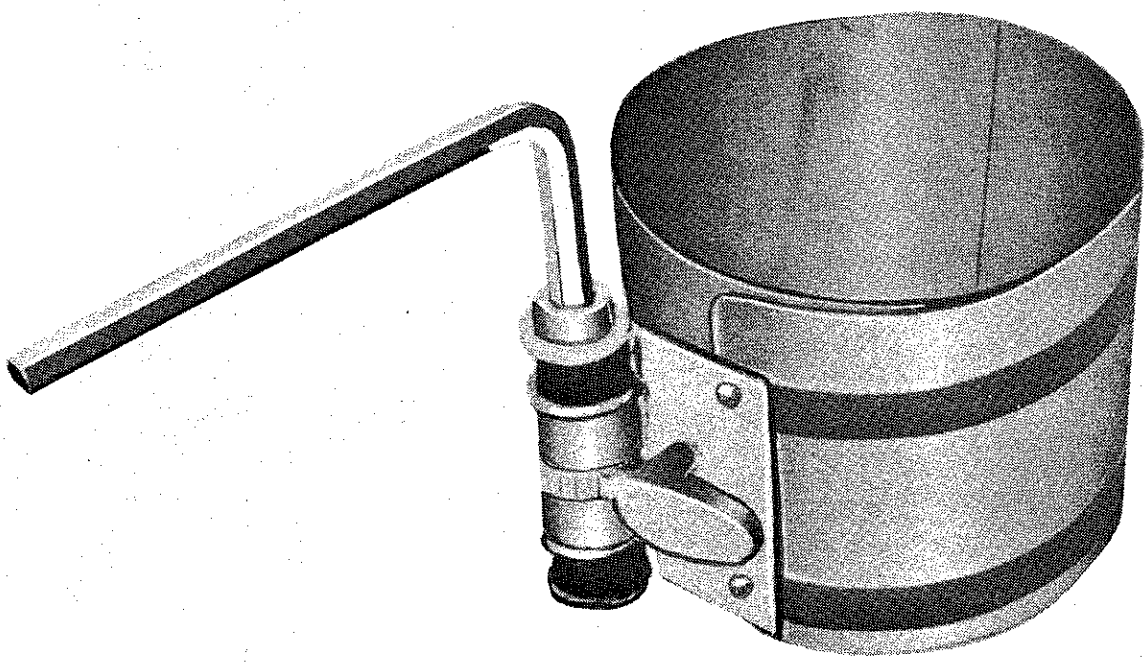


Fig. 5

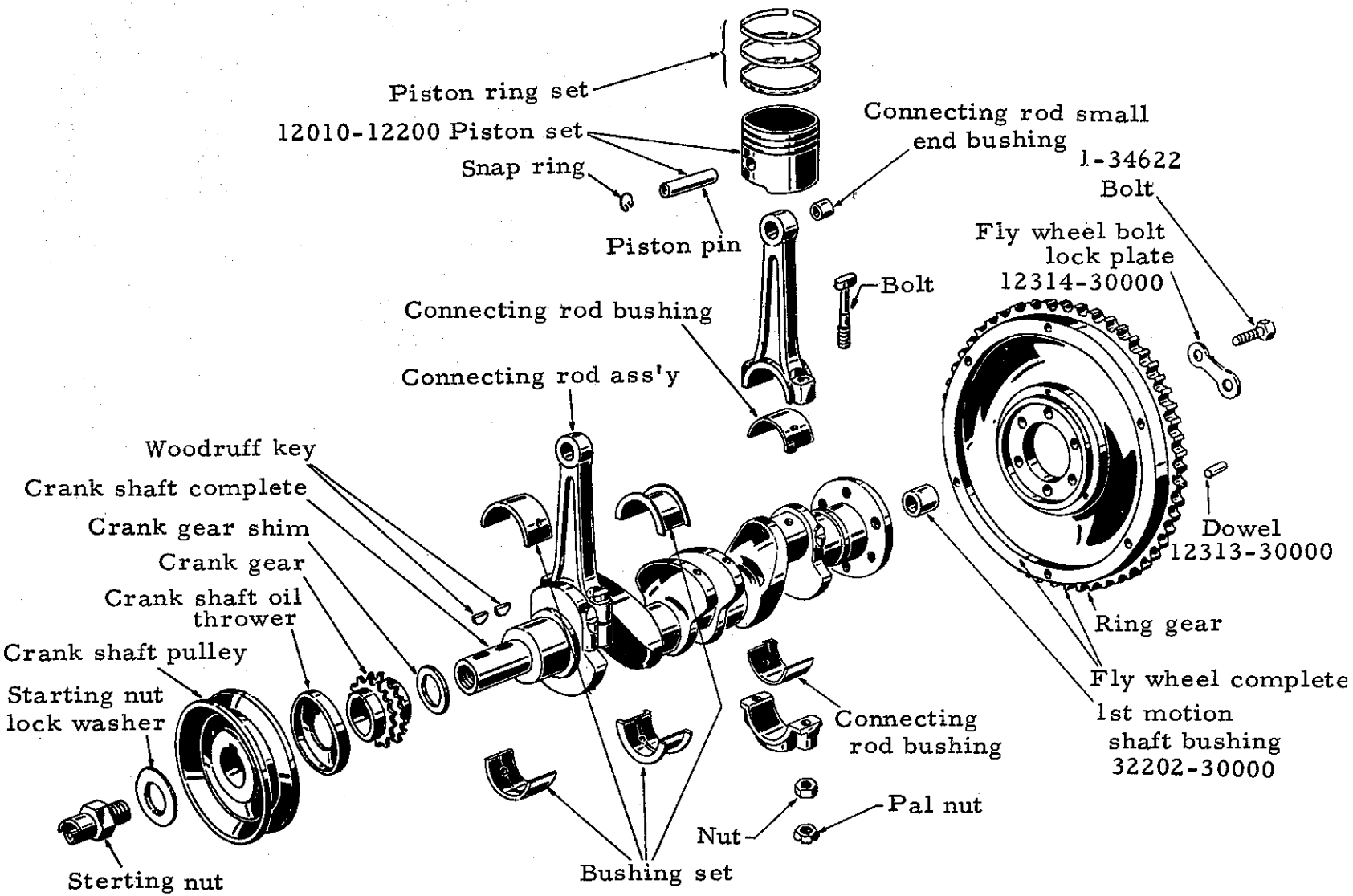


Fig.6 Piston & crank shaft

PISTON

Replacing Pistons and Connecting Rods

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

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

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

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

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

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

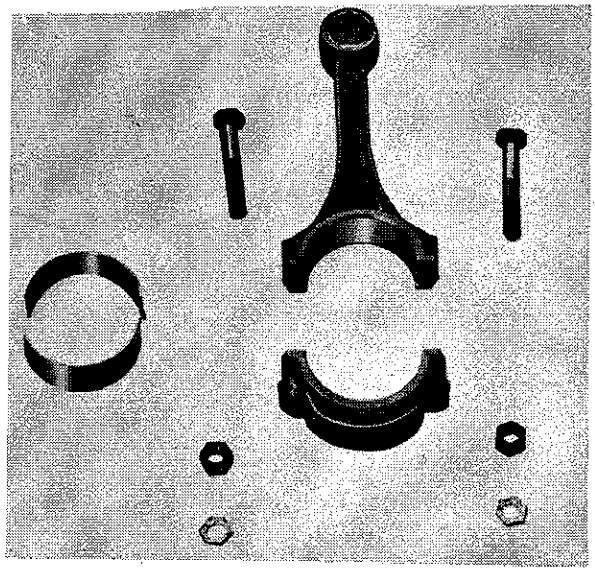


Fig.7

Removing a Piston

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

CYLINDER (11010-37000)

Grade Number & Dimensions STD. Bore					
Grade No.	1	2	3	4	5
G Engine	3.1496 in. 3.1499 in. 80.000 mm 80.008 mm	3.1500 in. 3.1503 in. 80.010 mm 80.019 mm	3.1504 in. 3.1507 in. 80.020 mm 80.029 mm	3.1508 in. 3.1511 in. 80.030 mm 80.039 mm	3.1512 in. 3.1515 in. 80.040 mm 80.049 mm

Cylinder bore taper	Less than 0.0008 in.
Difference of each cylinder bore	Less than 0.0008 in.
Over size piston available	0.010, 0.020, 0.030, 0.040 in. 0.25, 0.50, 0.75, 1.00 mm
Cylinder head surface warpage limit	0.1 mm, 0.004 in.

Torque wrench setting:		
Cylinder head bolts	6.2-6.9 kgm	45-50 ft. lbs.
Rocker bracket nuts	4.15-4.84 kgm	30-35 ft. lbs.
Connecting rod bolts	4.8-6.2 kgm	(35-45 ft. lbs.)
Main bearing cap	9.75-11.06 kgm	(71-81 ft. lbs.)

PISTON

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

Standard size (12010-12200)					
Grade No.	1	2	3	4	5
G Engine	3.1485 in. 3.1482 in. 79.975 mm 79.966 mm	3.1489 in. 3.1486 in. 79.985 mm 79.976 mm	3.1493 in. 3.1490 in. 79.995 mm 79.986 mm	3.1497 in. 3.1494 in. 80.005 mm 79.996 mm	3.1501 in. 3.1498 in. 80.015 mm 80.006 mm

Over size avilable (12010-12201 →)	0.010, 0.020, 0.030, 0.040, 0.050, 0.060 ins. (0.25) 0.50, 0.75, 1.00, 1.25, 1.50 mm
Clearance: Cyld. wall and piston	0.025-0.043 mm, 0.001-0.0017 in.
Checking by feeler gauge	1-2 kg. with 0.04mm feeler gauge (2.2-4.4 lbs. with 0.0015 in. feeler gauge)
Allowable difference of gross weight with connecting rod	Within 5 gram

Diameter of piston pin hole	21.987-22.000 mm	0.8656-0.8661 in.
Piston pin hole off set	1.05-0.96 mm	0.0414-0.0374 in.
Width of ring grooves,		
Compressing	2.030-2.055 mm	0.0800-0.0809 in.
Oil control	4.015-4.040 mm	0.1580-0.1591 in.

PISTON PIN

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

PISTON RINGS

Type of rings:	Top ring: Ductile cast iron 2nd ring: Tapered type Oil control ring: Slot type chrome plated		
Ring width:			
Compression	1.977-1.990 mm		0.0779-0.0787 in.
Oil control	3.977-3.990 mm		0.1565-0.1570 in.
Ring clearance in groove:			
Compression	0.040-0.078 mm		0.0016-0.003 in.
Oil control	0.025-0.063 mm		0.0010-0.0024 in.
Ring gap in bore:			
Compression No. 1	0.25-0.40 mm		0.010-0.016 in.
Compression No. 2	0.15-0.30 mm		0.006-0.012 in.
Oil control	0.15-0.30 mm		0.006-0.012 in.
Ring tension:			
Compression No. 1	1.8	0.2 kg	4 ± 0.44 lb
Compression No. 2	1.95	0.2 kg	4.33 ± 0.44 lb
Oil control	2.1	0.2 kg	4.67 ± 0.44 lb

PISTON AND BORES

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

PISTON RINGS

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

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

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

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

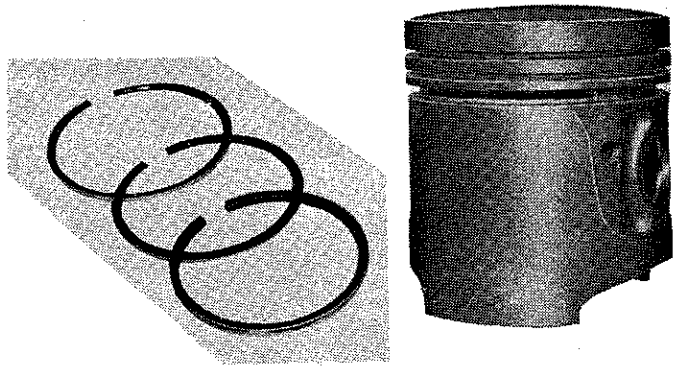


Fig. 8

Withdrawing Camshaft

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

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

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

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

CAMSHAFT BEARINGS

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

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

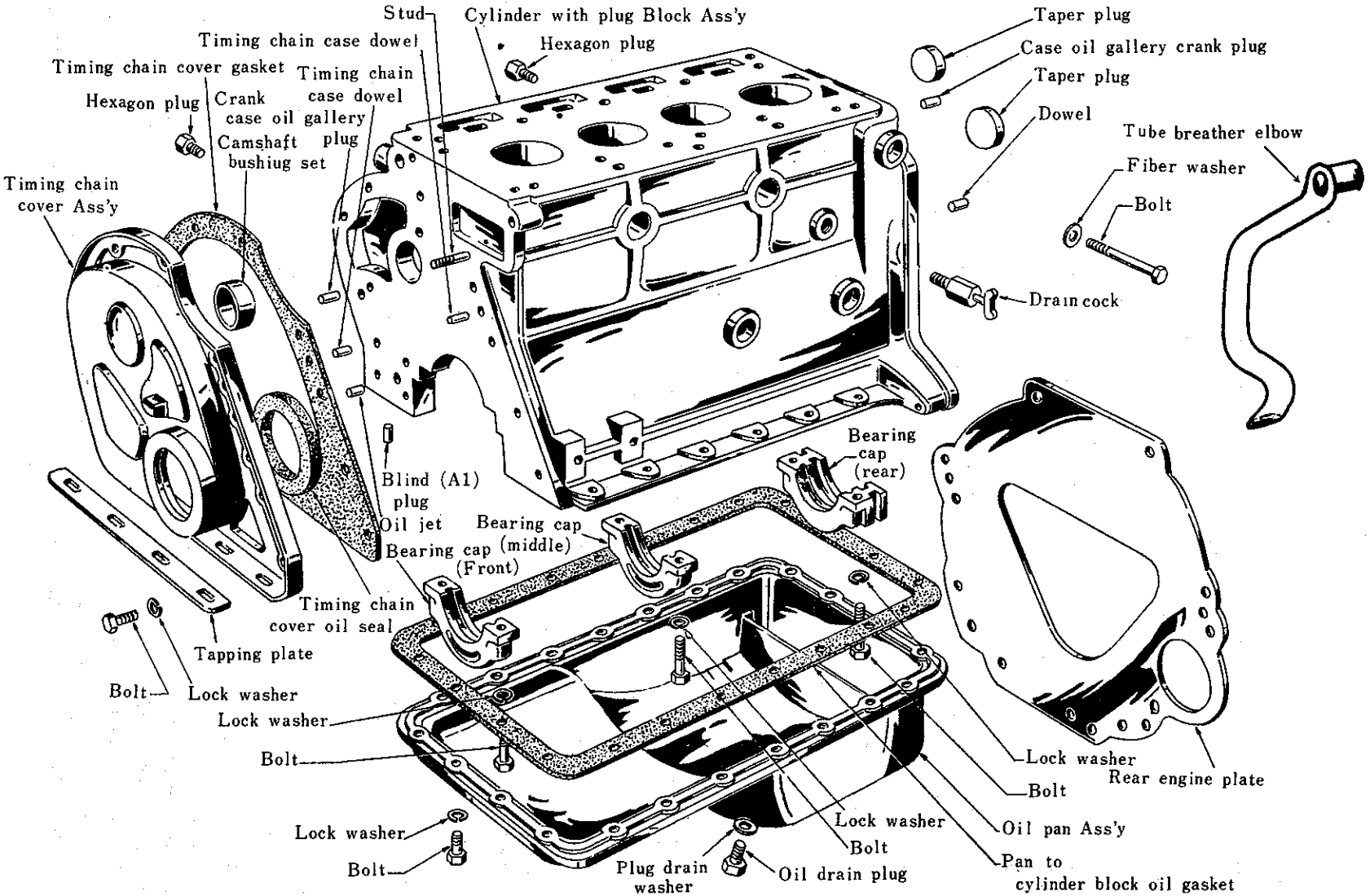


Fig. 9 Cylinder block

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

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

Refitting the Camshaft

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

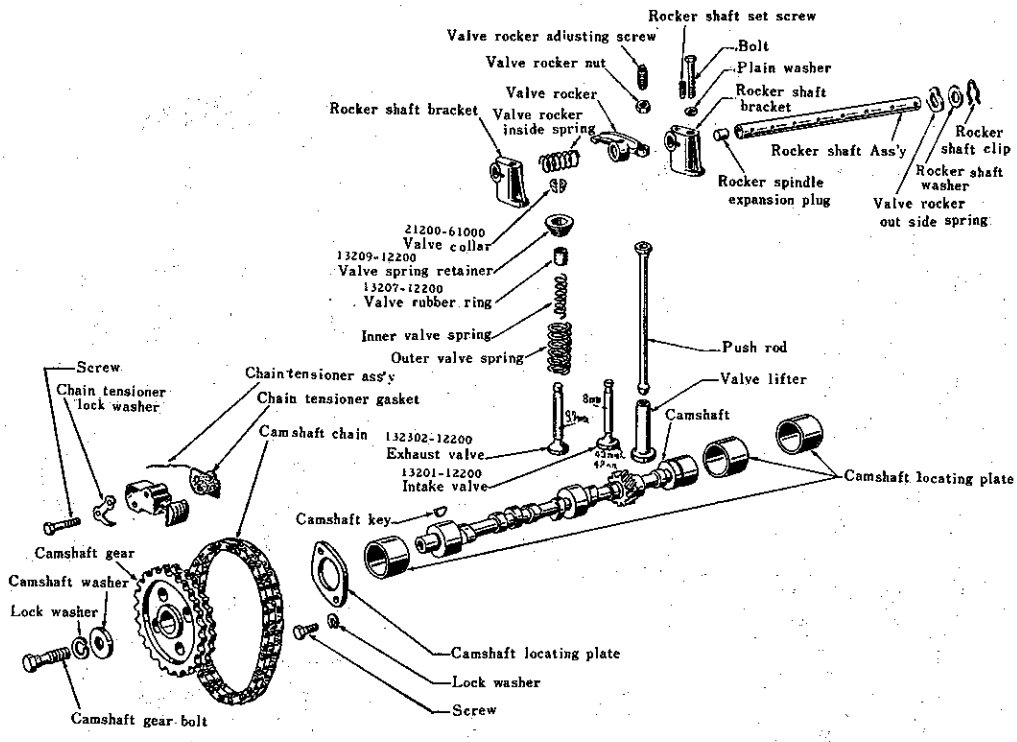


Fig. 10 Cameshaft & valve gear

Main Bearing Caps

Remove the flywheel and clutch.

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

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

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

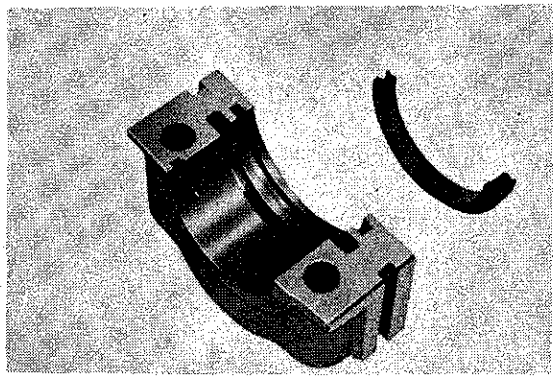


Fig. 11

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

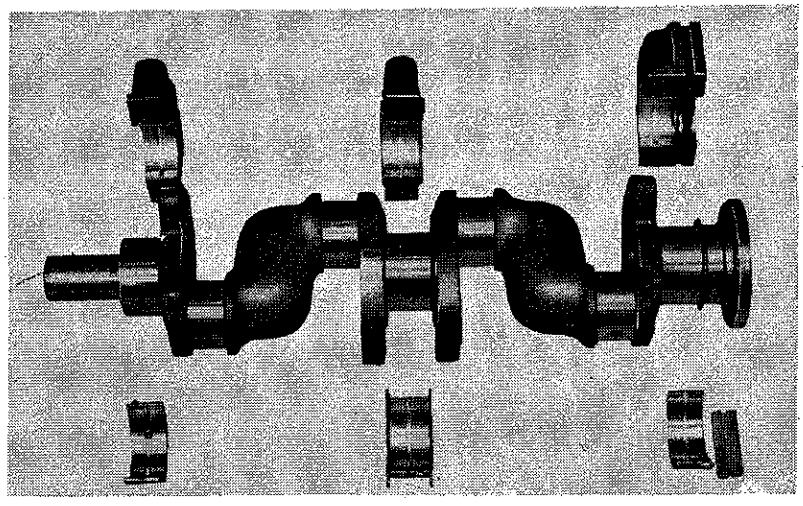


Fig. 12

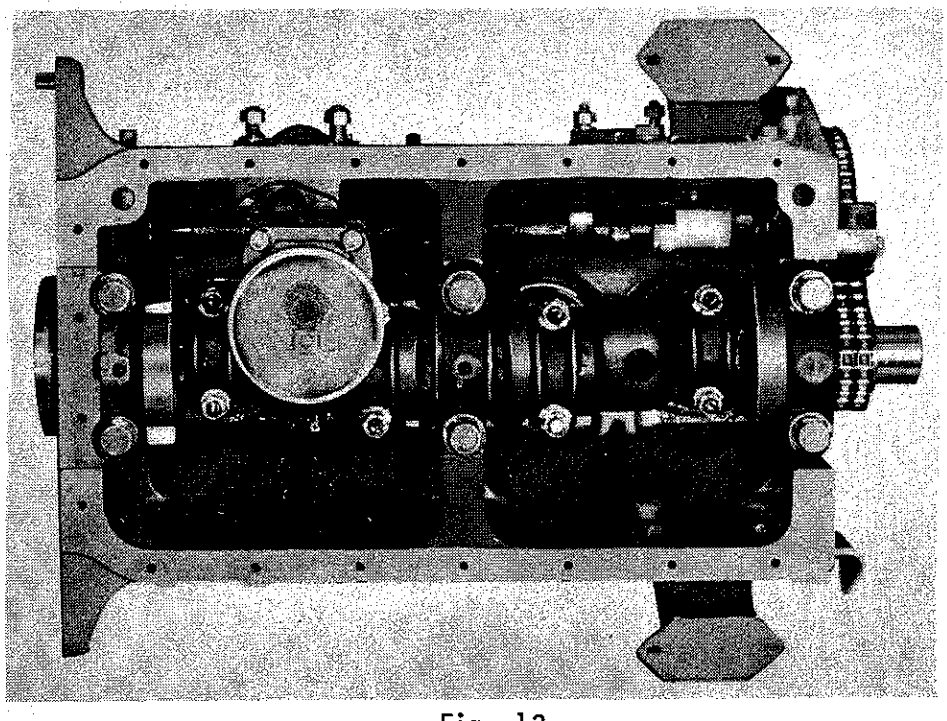


Fig. 13

CAUTION

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

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

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

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

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

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

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

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

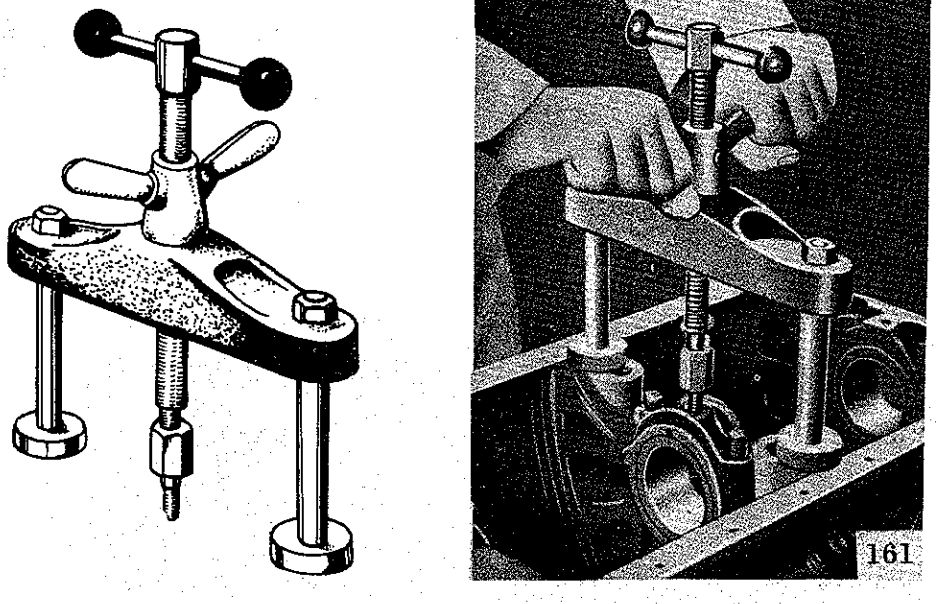


Fig. 14 Removing a Main Bearing Cap & Extractor

Adjusting the Brake Points

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

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

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

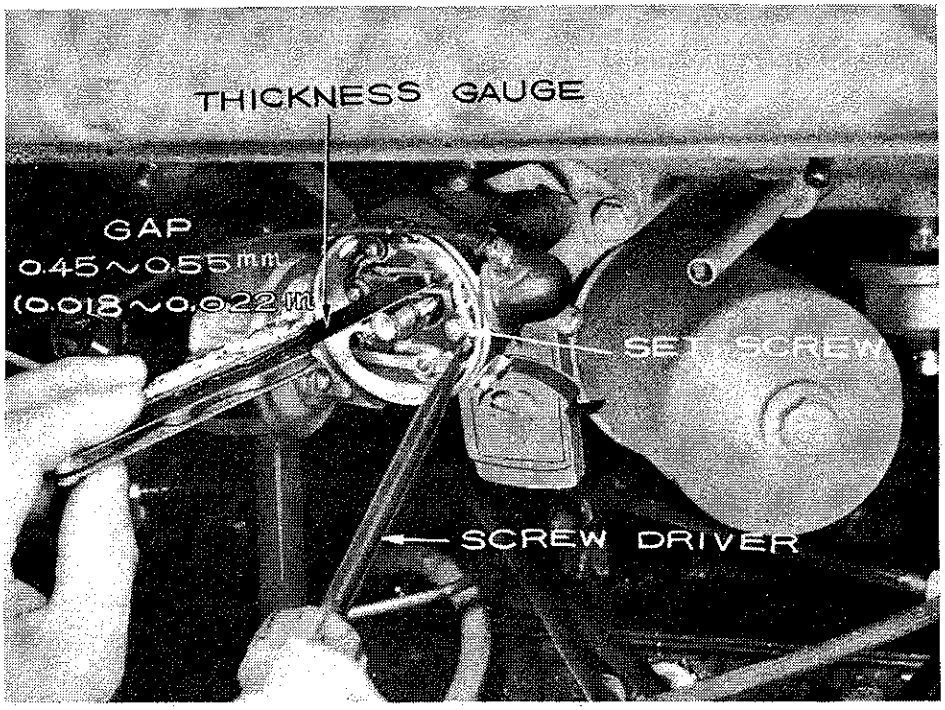


Fig. 15 Adjusting the Point Gap

ADJUSTING THE IGNITION TIMING

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

With the engine stopped, adjust so that the distributor breaker point just breaks when the piston of the No. 1 cylinder is in its 10 degrees before top dead center position for compression. If a timing lamp is used, the standard ignition timing is 12 degrees before top dead center at idling (600 rpm) speed.

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

DISTRIBUTOR

Type	D415-08
Ignition timing (Idling)	B.T.D.C. 16° with timing light, engine 600 rpm (Adjust timing angle by the kinds of gasoline octane value.)
Ignition timing advance	Automatic advance by the centrifugal weight and vacuum timing control.
Automatic advance	Governor start advance at 400-550 rpm Maximum advance angle 14° - 16° at 1800 rpm
Vacuum advance	Start advance at 4.7-5.5 in.(120-140mm)Hg. Maximum advance angle at crank shaft 9-12° at 12.6 in. (320 mm) Hg.
Firing order	1 3 4 2
Point gap	0.45-0.55 mm 0.018-0.022 in. 50°-54° Hitachi, 56°-61° Mitsubishi
Contact arm spring tension	500-650 gram 18.6-23 oz.
Capacity of condenser	0.20-0.24 mfd. 0.20-0.24 mfd.

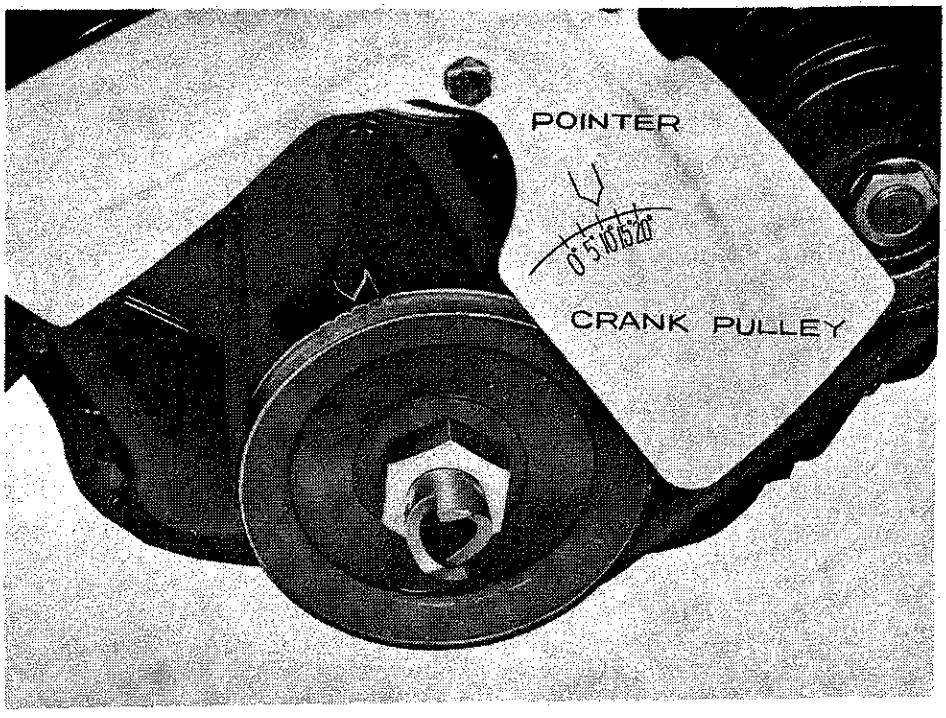


Fig. 1 Checking the Ignition timing

Adjustment is made by the following procedure.

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

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

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

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

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

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

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

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

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

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

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

FUEL SYSTEM

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

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

FUEL SYSTEM

GASOLINE TANK

Capacity	43 ltr	(12 US. Gal)

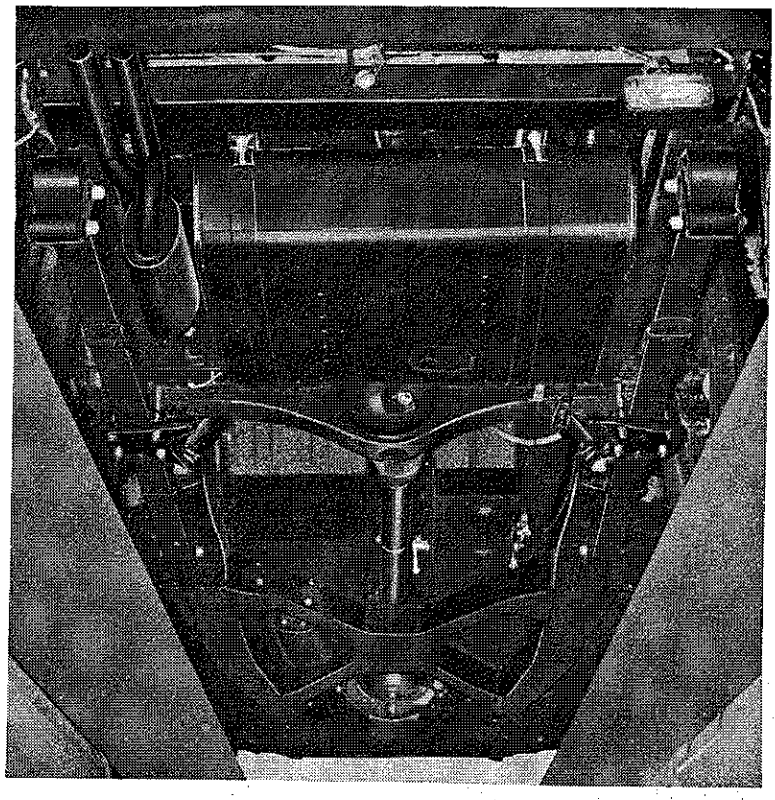


Fig. 1

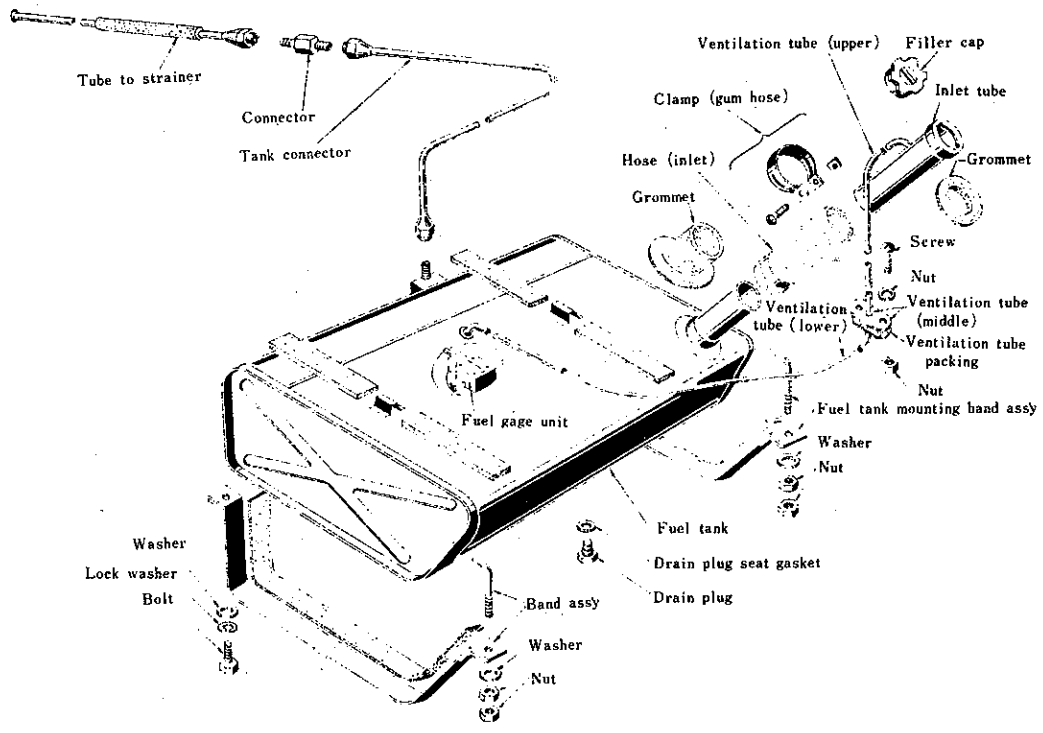


Fig. 2 Fuel tank (43 ℓ)

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

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

TROUBLES & REPAIRES 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 exposition.

(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.)

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

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

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

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

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

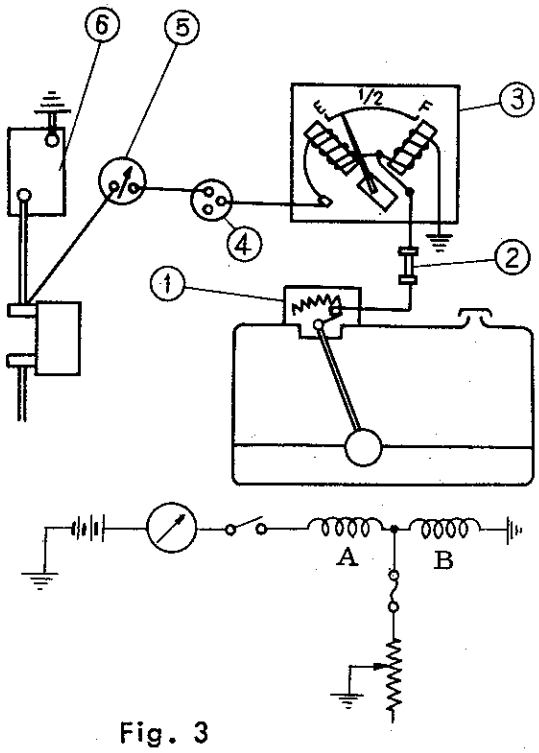


Fig. 3
Wiring of fuel gauge

(1) Unit gauge (4) Ignition switch
(2) Fuse (5) Ammeter
(3) Fuel gauge (6) Battery

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

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

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

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

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

Operation and Repairs 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, electic 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 rotate 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 unground 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 preceeding section, if the indicator does not swing but it moves (moves to E) when the dash unit end of the wiring from the tank unit is grounded, the wiring between the dash unit and tank unit is defective.

Therefore rewiring or repairing is required.

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

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

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

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

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

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

TWIN CARBURETOR (HJB38W TYPE)

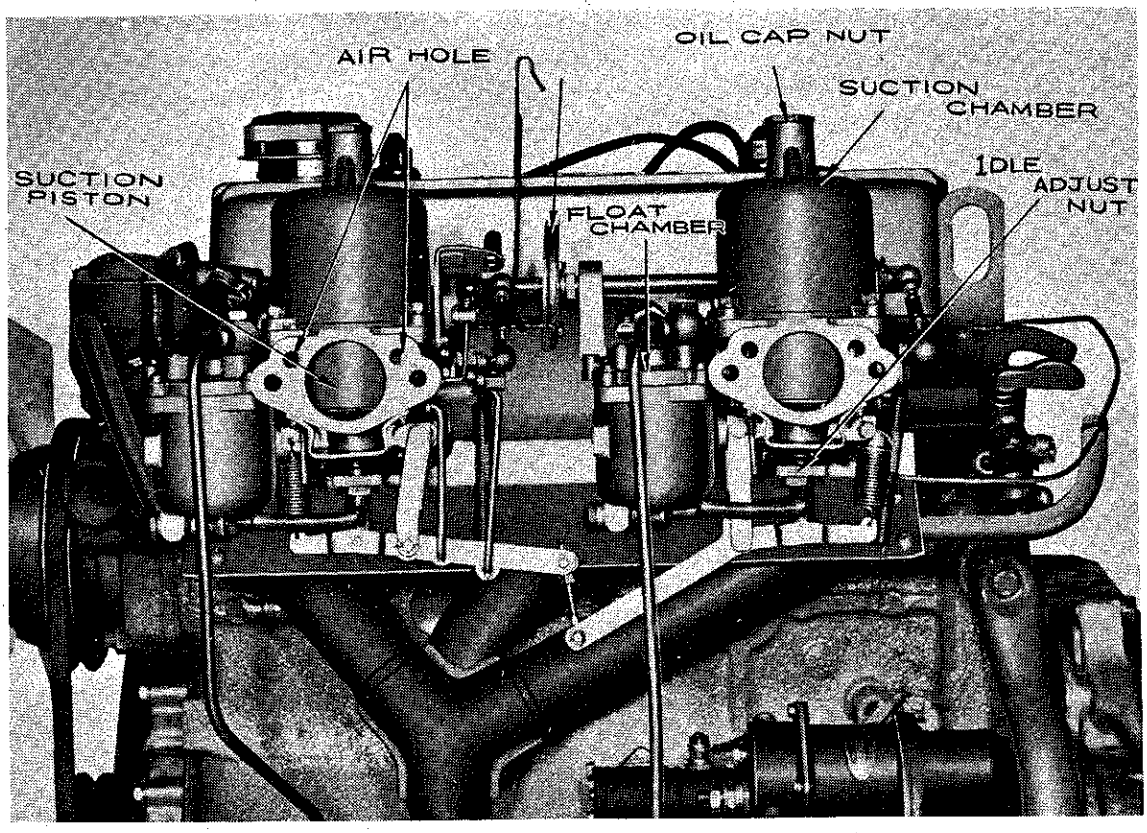


Fig. 1

1 STRUCTURE AND FUNCTION

Float Chamber

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

Venturi Control System

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

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

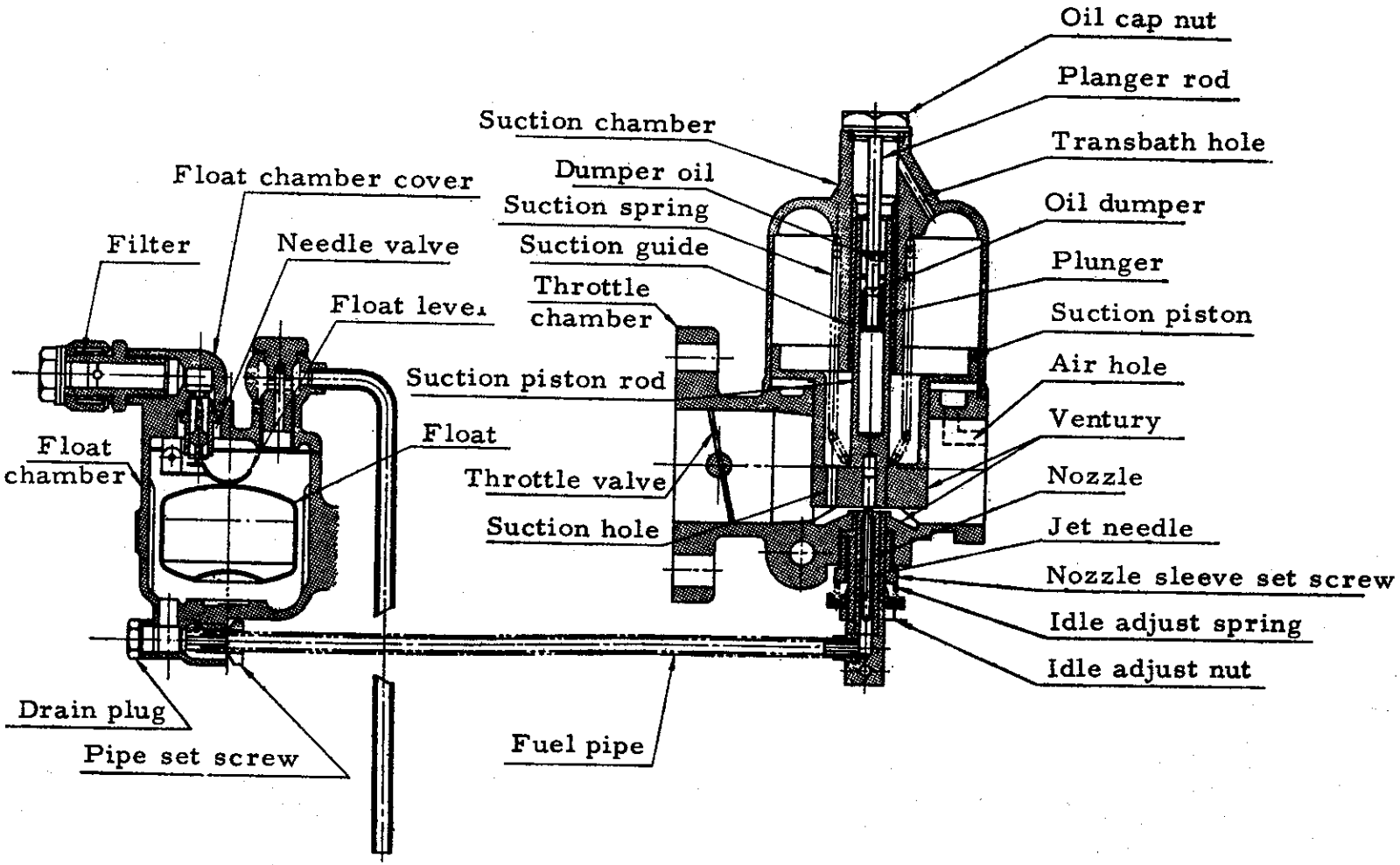


Fig. 2 Sectional View of Carburetor

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

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

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

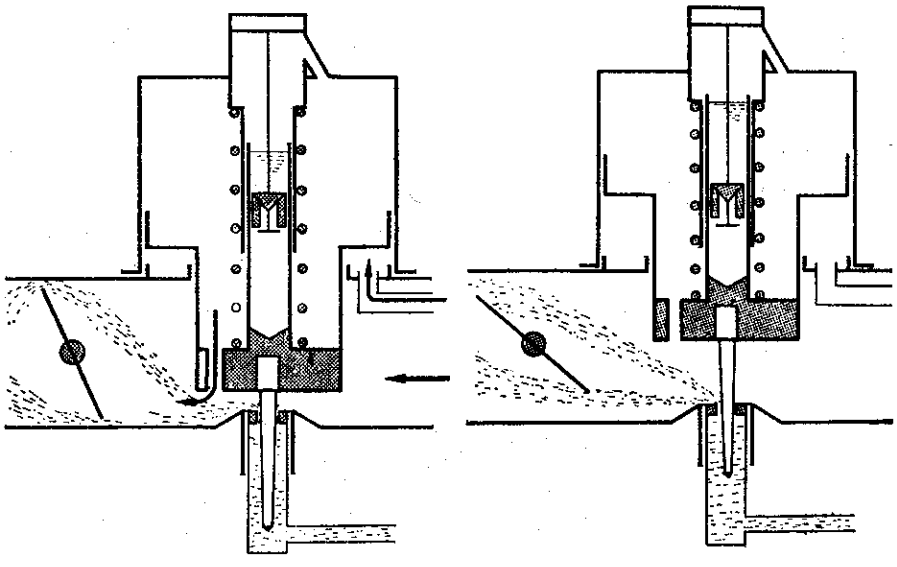
In order to heighten acceleration, the oil damper is provided within the suction piston rod and prevents the piston from an abrupt opening.

Fuel Measuring System

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

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

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



Low speed operation Medium low speed operation

Fig. 3

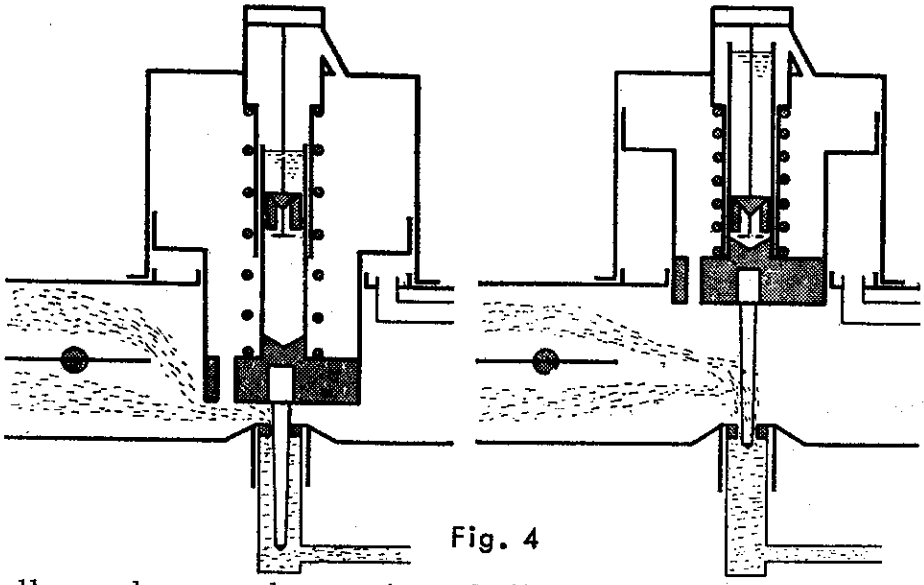


Fig. 4

Full open low speed operation. Full open high speed operation

Starting Device

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

2 ADJUSTMENT AND HANDLING

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

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

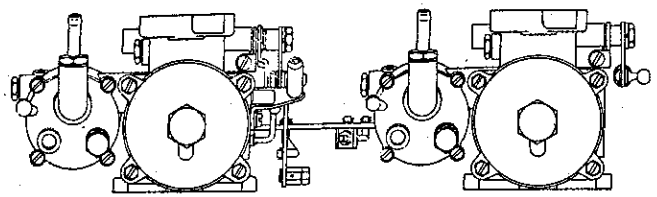
(1) To adjust full close of the throttle valves of the carburetors on F and R sides, release completely the throttle adjust screws on both sides making them free of the stopper and change length of the connecting rod for the auxiliary shaft on one side.

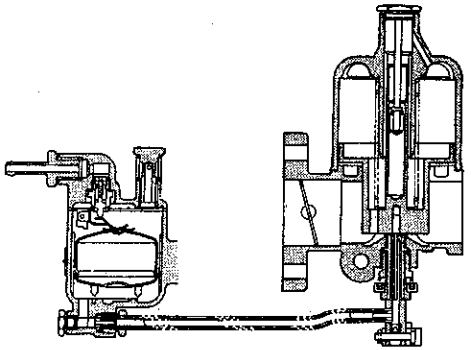
(2) Fix the con. rod on the R side at 70mm with the lock nut. (Over all length 86 +0mm, -2mm).

(3) Turn the turn buckle of the con. rod on the F side and adjust length of the con. rod on the F side so as the throttle valves on both sides are in full close.

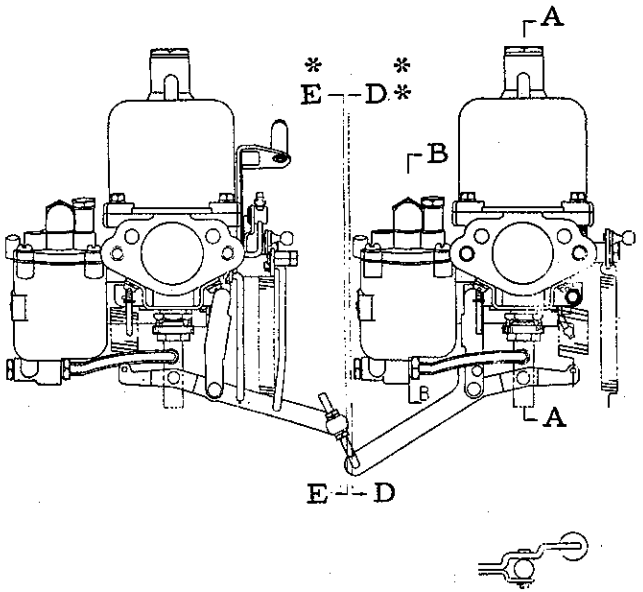
(4) When the throttle valves on F and R sides are in full close, load upon the turn buckle disappears, which can be felt by the hand. When the con. rod on the F side is too long and the return spring on the R side is too short, the return spring on the F side works, this can be felt on the turn buckle.

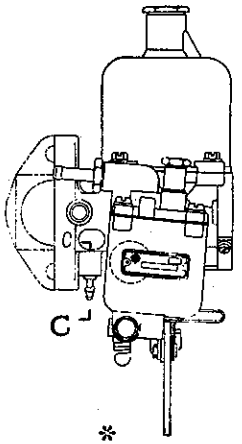
TWIN CARBURETOR (HJB 38W—1 TYPE)



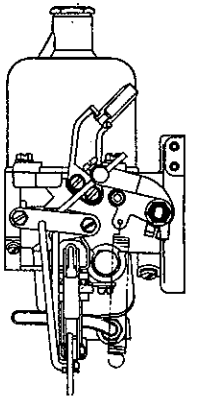


Section B - B Section A - A





*D - D



*E - E

Section C - C

(5) When full close adjustment has been finished on both sides, fix the turn buckle on the F side with the lock nut.
(6) Connect the throttle wire with the drum.

Adjustment of Idle

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

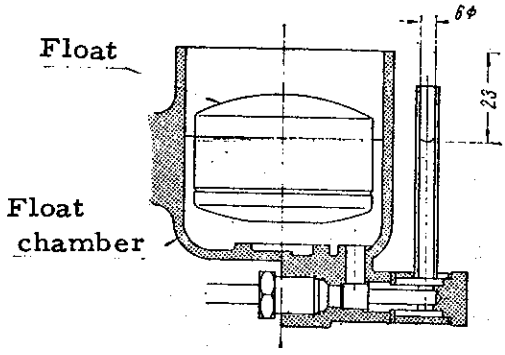
(1) Tighten completely the idle adjust nuts of the carburetors on the F and R sides, then return three turns and tighten 2-3 turns the throttle adjust screw of the carburetor on the F side and make starting. Release the throttle adjust screw of the carburetor on the R side so as the end of it is free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

Adjustment of Float Level

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

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

(1) Remove 4 ea of the set screw of the float chamber cover, the float chamber cover and the float lever can be removed together.
Put the float chamber cover on a stand with the float lever upside.
(2) Push up the float lever with the finger and slowly down and stop it when the float lever seat just contact with the valve stem.



Measuring Float Level

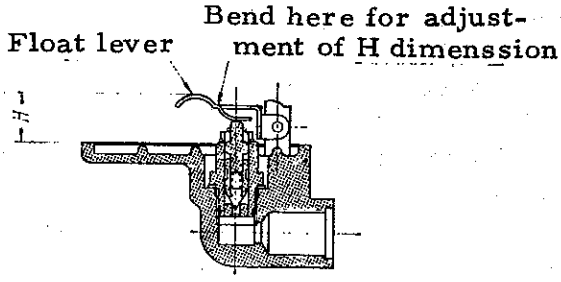


Fig. 5 Adjusting Float Level

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

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

Adjustment of Starting Linkage Opening (Refer to the Figure)

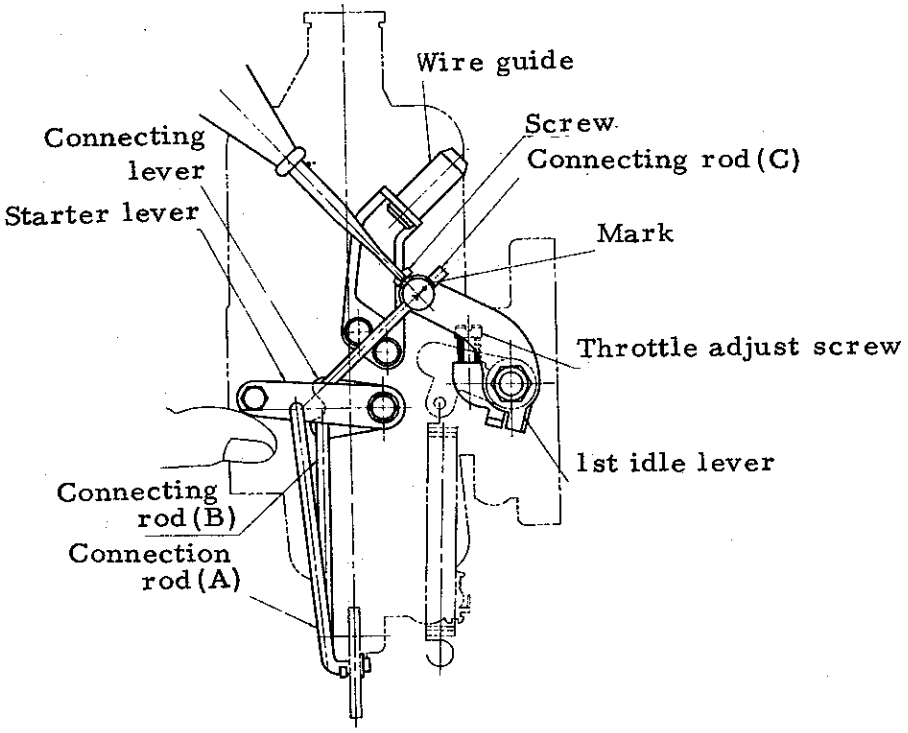


Fig. 6 Adjustment for Openning degree at connecting

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

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

Inspection of Damper Oil

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

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

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

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

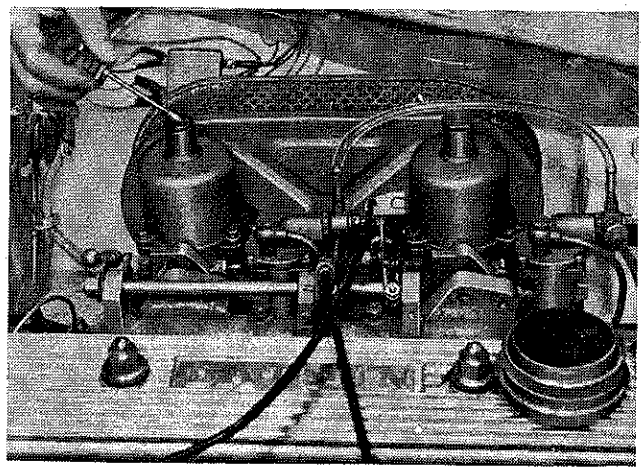


Fig. 7 Inspecting Damper Oil

1 Oil cap nut
2 Plunger rod
3 Oil filler neck

Periodical Inspection of Suction Chamber and Suction Piston

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

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

(1) Remove the oil cap nut.

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

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

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

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

3 DISASSEMBLY AND ASSEMBLY

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

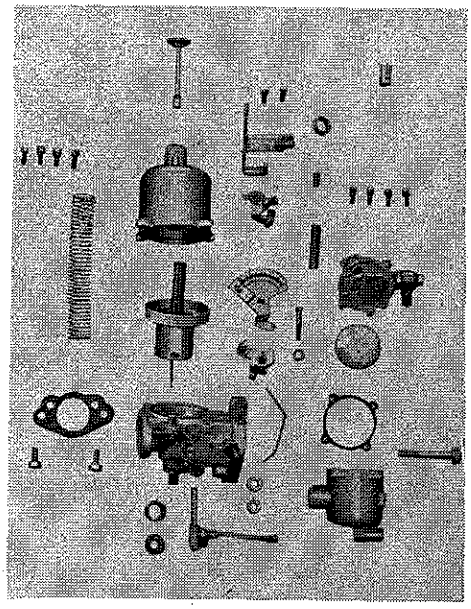


Fig. 8 Knock Down of Suction Piston & Suction Chamber

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

(1) Remove 4 ea of the set screw and separte the suction chamber.
(2) Remove the suction spring, nylon packing and the suction piston from the inside.
(3) The removed suction chamber and suction piston must be put on clean cloth placed on the level top of a desk. Do no make scratches on the inside of suction chamber and on the outside diameter of the suction piston. Do not bend the jet needle underside the suction piston.
(4) Do not separate the jet needle out of the suction piston if possible. When it is necessary to disassemble unavoidably, loosen the jet needle set screw by using the pliers within 2mm from the shoulder of the jet needle taking care of not making scratches and slowly pull it out, twisting so as not to bend it.
(5) Incorrect setting of the jet needle in the suction piston results in malfunction of idling and other performances. Proper setting of the jet needle is as follows.
Set the jet needle so as its shoulder is on the same level with the underside of the suction piston small diameter as shown. Put a level plate at the small diameter and accord it to the shoulder of jet needle and fix the set screw.

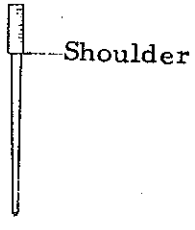


Fig. 9 Jet needle

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

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

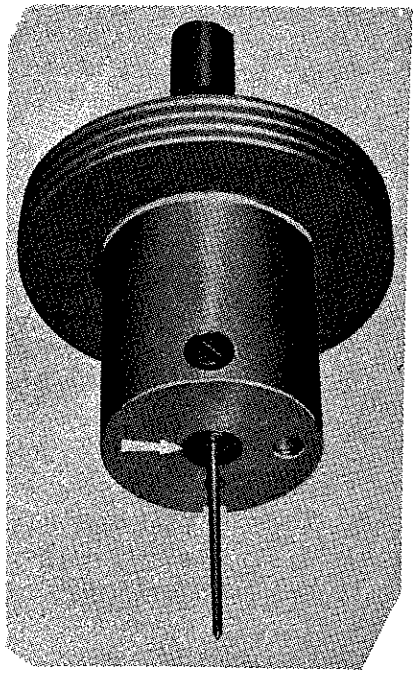


Fig. 10 Setting Jet Needle

Disassembly and Assembly of Nozzle

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

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

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

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

(2) Reassembly of Nozzle

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

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

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

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

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

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

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

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

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

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

Method

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

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

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

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

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

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

5 CAUSES AND REMEDY FOR TROUBLE

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

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

Do not start:	Overflow	Preceding para.
	Fuel not feed	Check pump
		Check fuel pipe
		Check needle valve
	Incorrect adjust of idle	Adjust
	Malfunction of suction piston	Preceding para.
Malfunction of suction piston:	Deposit of dust or oil	Clean
	Adhesion of suction chamber and suction piston due to deform	Repair or replace
	Incorrect centering of nozzle	Adjust
	Bend of jet needle	Replace
	Bend of plunger rod	Repair

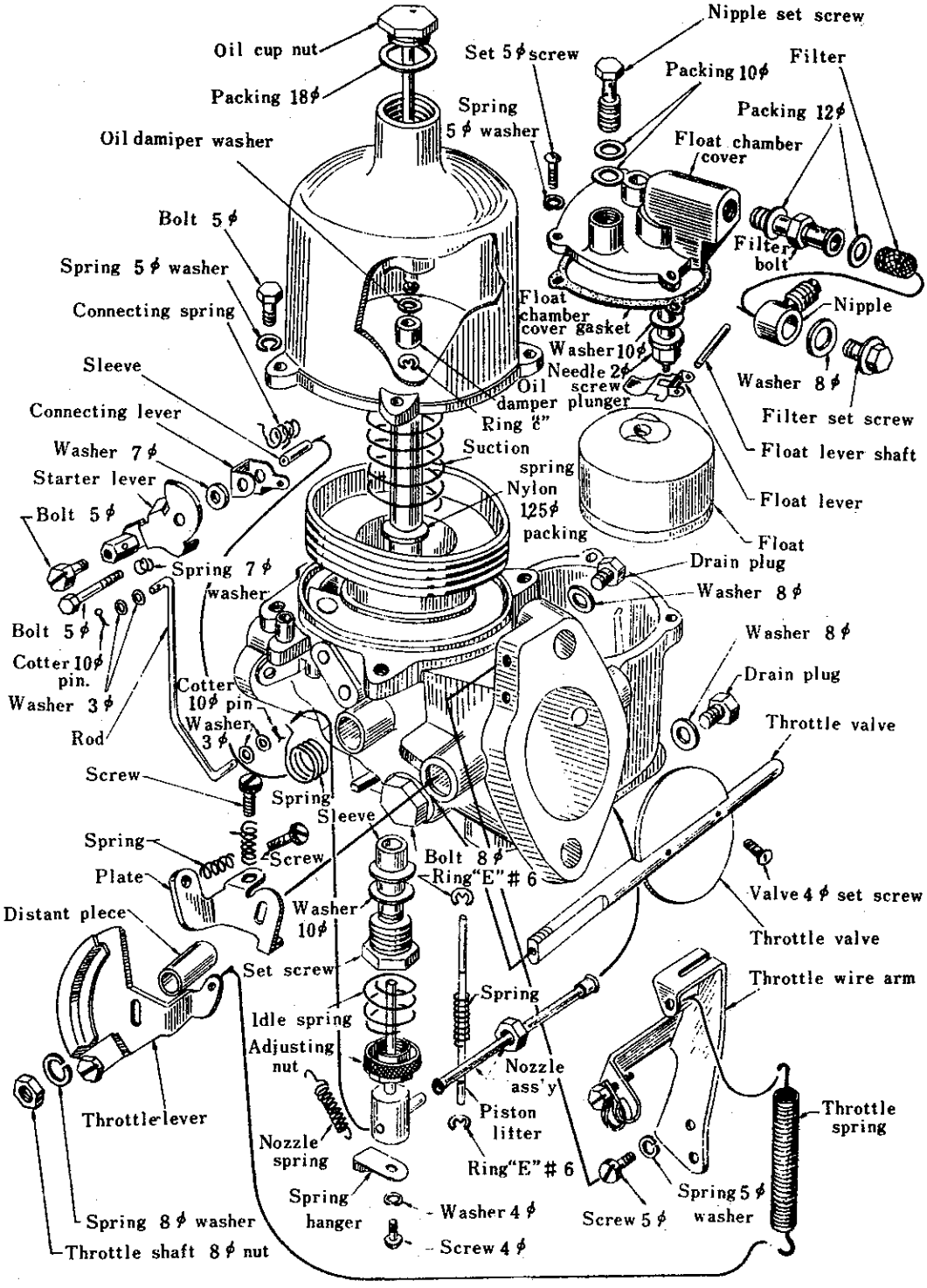


Fig.9 Key to tne Carburetor Components

ADJUSTMENT & INSPECTION OF ENGINE

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

Order of Inspection and Adjustment of Engine

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

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

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

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

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

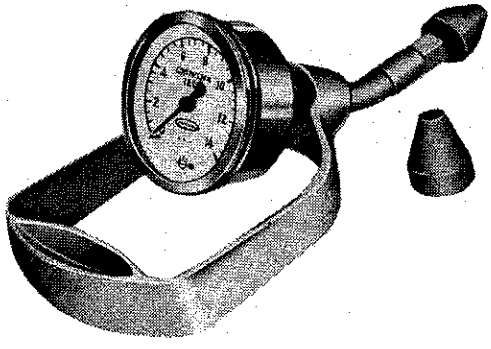


Fig. 1
Measuring compression pressure by means of a compression gauge

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

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

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

(8) Inspection of fuel pump and gasoline strainer.

(9) Adjust the slow setting of carburetor.

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

(11) Adjustment of slack in fan belt.

(12) Adjustment of valve tappet clearance.

Diagnosing of Engine by Means of Vacuum Gauge and Combustion Tester

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

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

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

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

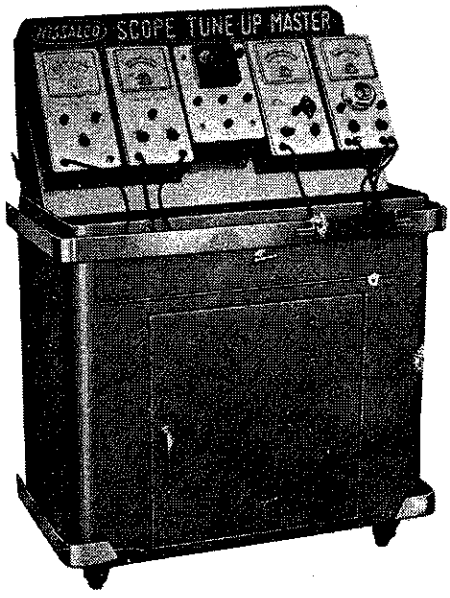


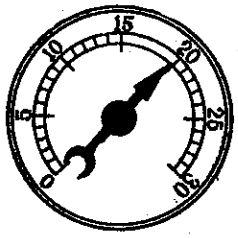
Fig. 2
Motor master tester available for 4, 6 and 8 cylinder engine

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

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

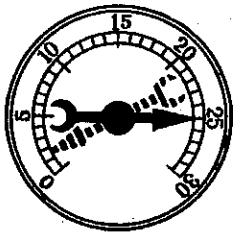
Engine Trouble Shooting

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



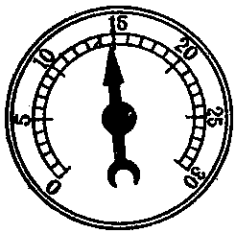
(1)

Normal condition
Settles between 18~20 in.



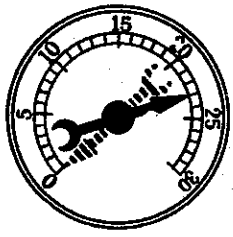
(2)

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



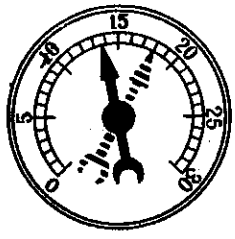
(3)

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



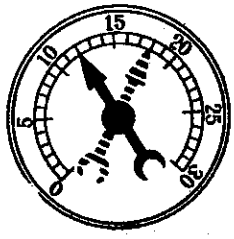
(4)

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



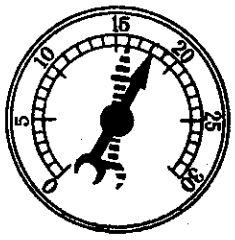
(5)

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



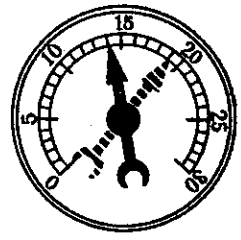
(6)

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



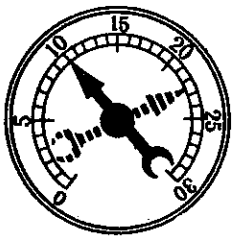
(7)

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



(8)

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

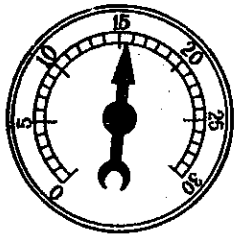


(9)

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

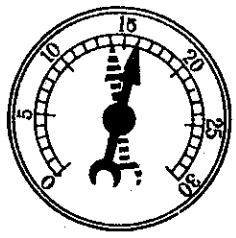
(10)

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



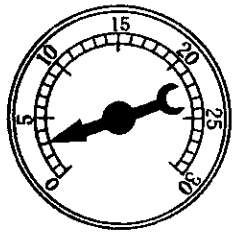
(11)

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



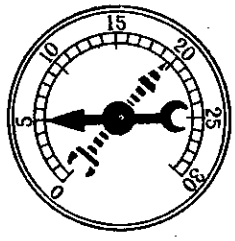
(12)

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



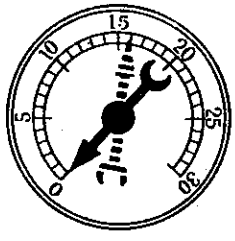
(13)

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



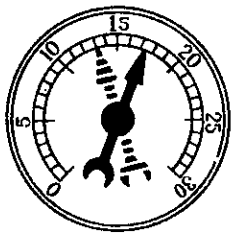
(14)

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



(15)

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



(16)

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

Fig. 3 Diagnosing engine by means of a vacuum gauge

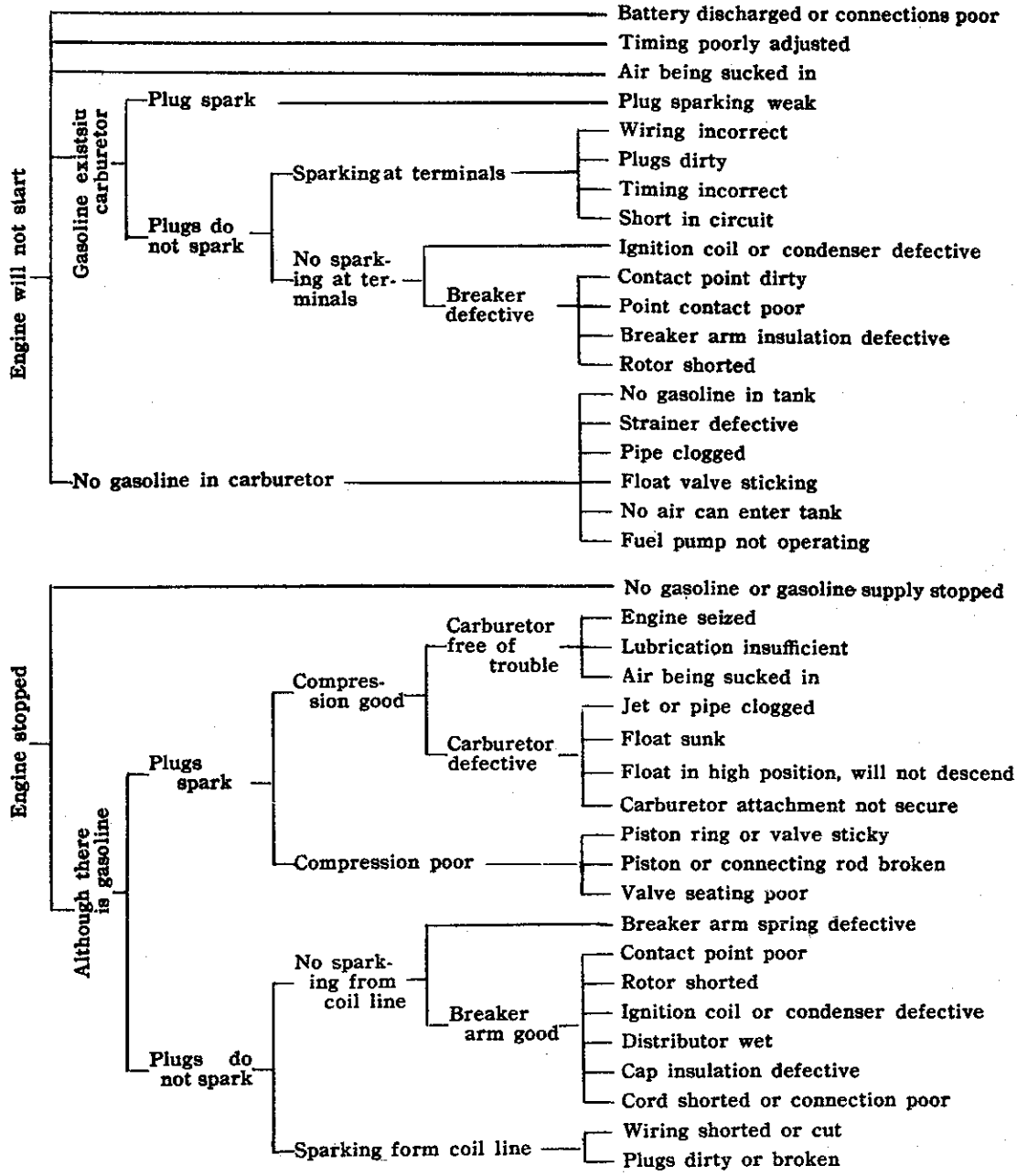


Fig. 4 (A) Trouble shooting chart

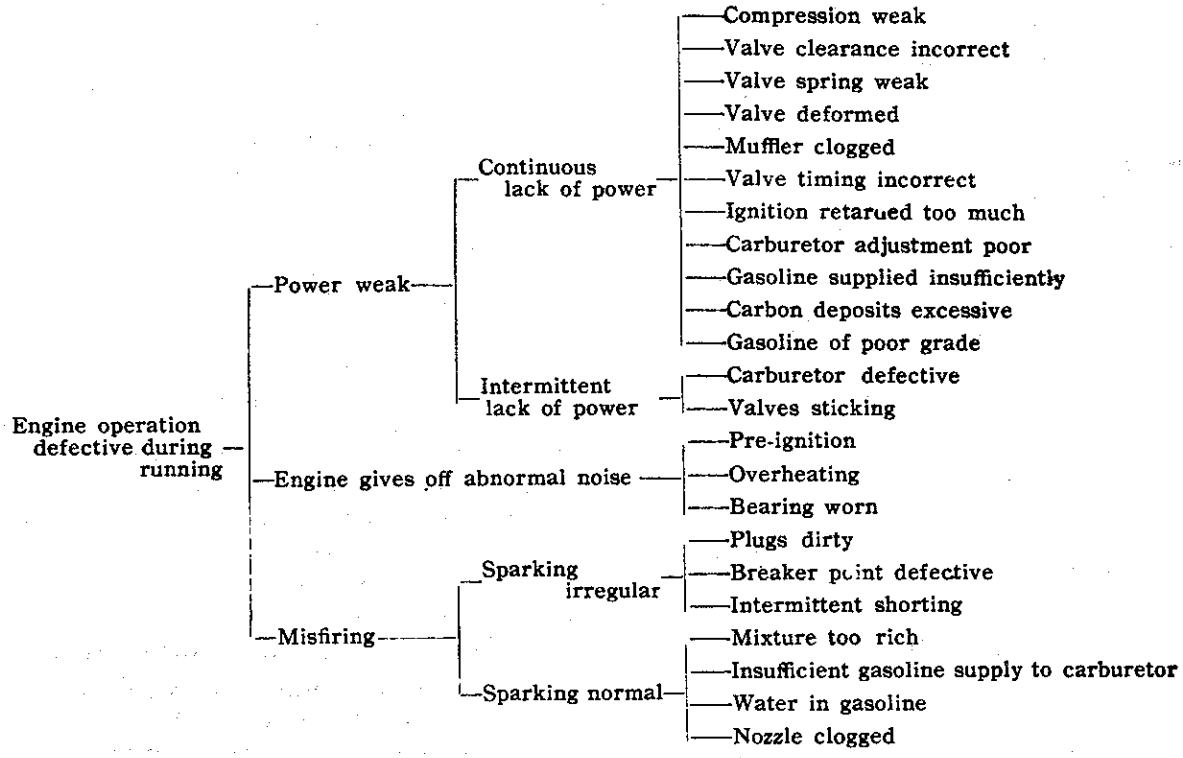


Fig. 4 (B) Trouble shooting chart

REMOVING & REFITTING

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

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

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

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

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

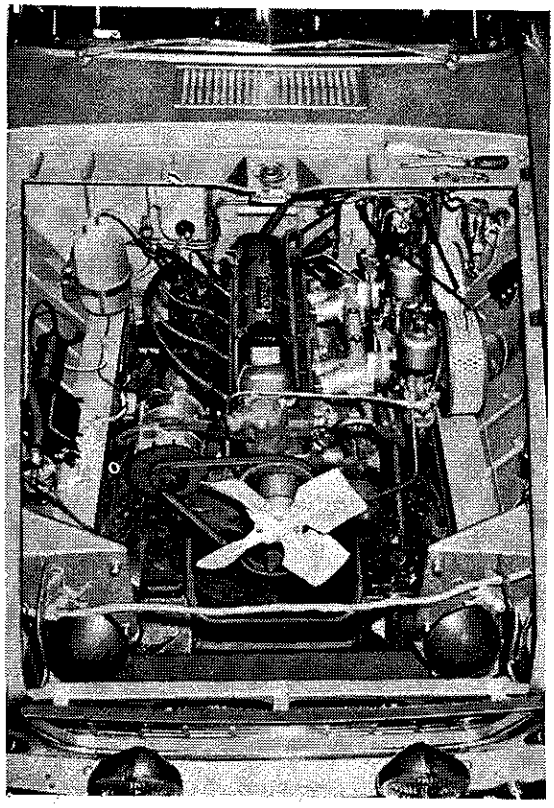


Fig. 1

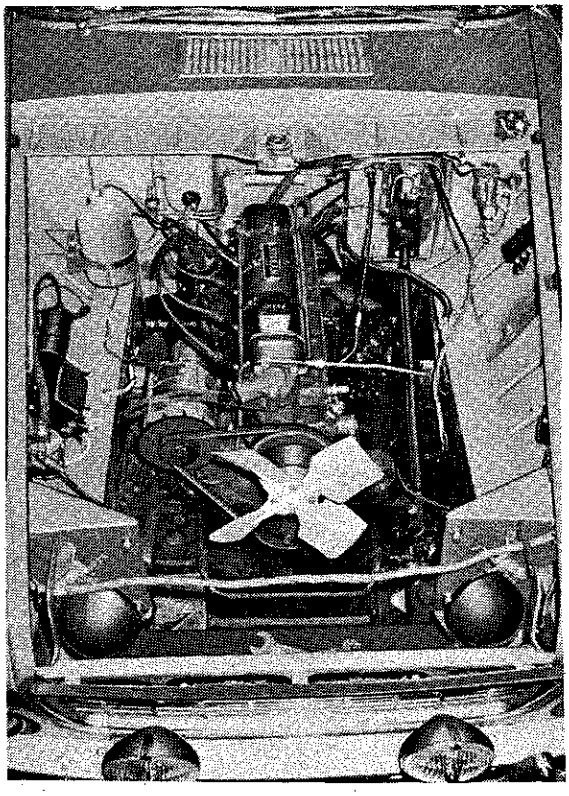


Fig. 2

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

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

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

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

Pipe from the manifold after taking off the shock absorber.

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

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

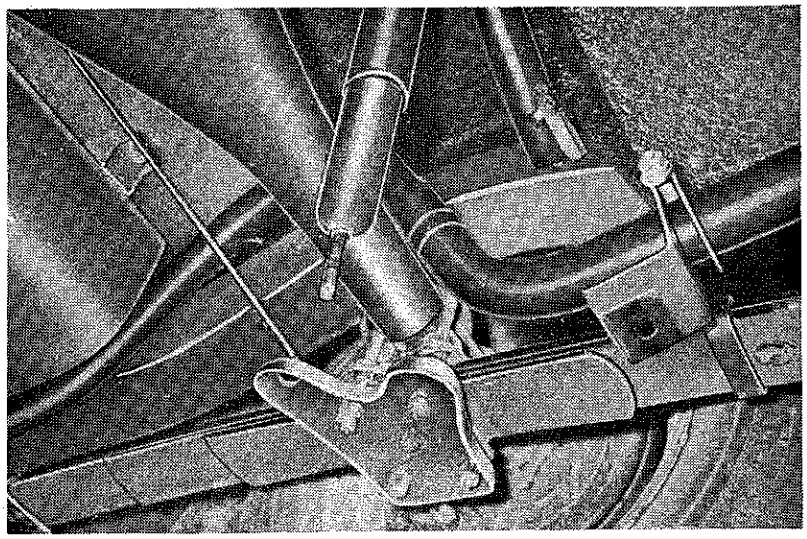


Fig. 3

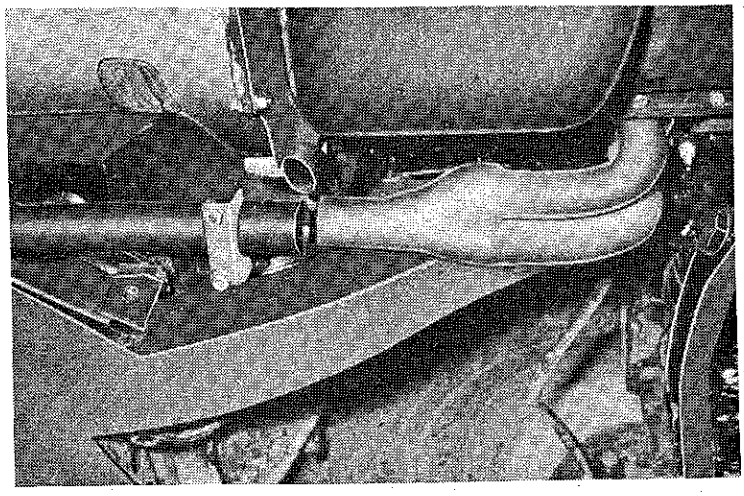


Fig. 4

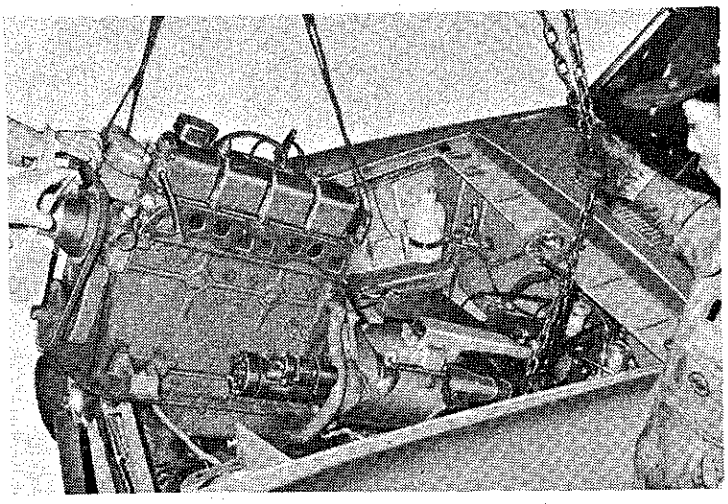


Fig. 5

COOLING SYSTEM

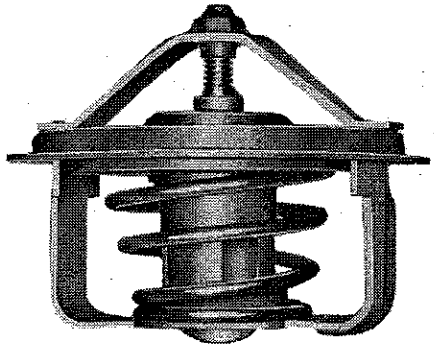
RADIATOR

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

THERMOSTAT

Type	Wax pellet type	
Start to open temperature	72 ± 1.5°C	161 6 ± 3°F
Fully open temperature	80 ± 1.5°C	176 ± 3°F
Valve lift	9.5mm	0.374 in

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



Description

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

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

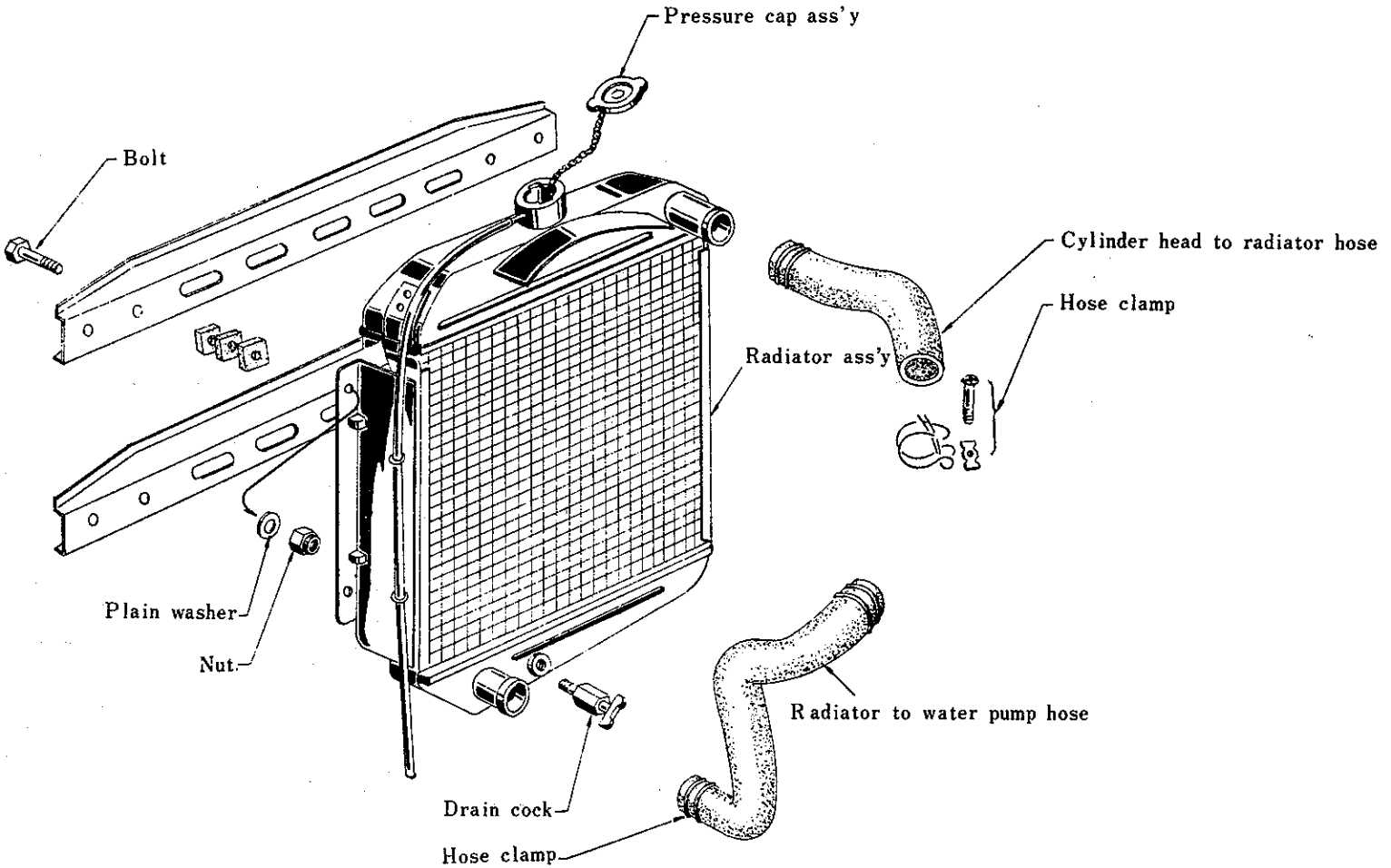


Fig. 1 Radiator mounting

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

Thermostat

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

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

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

Overheating

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

Fan Belt Adjustment

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

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

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

As the drive is taken on the "V" of the pulleys it is not necessary to have the fan belt tight; to do so may cause excessive wear to the dynamo

and water pump bearings. After the correct tension has been obtained, securely lock the dynamo in position again.

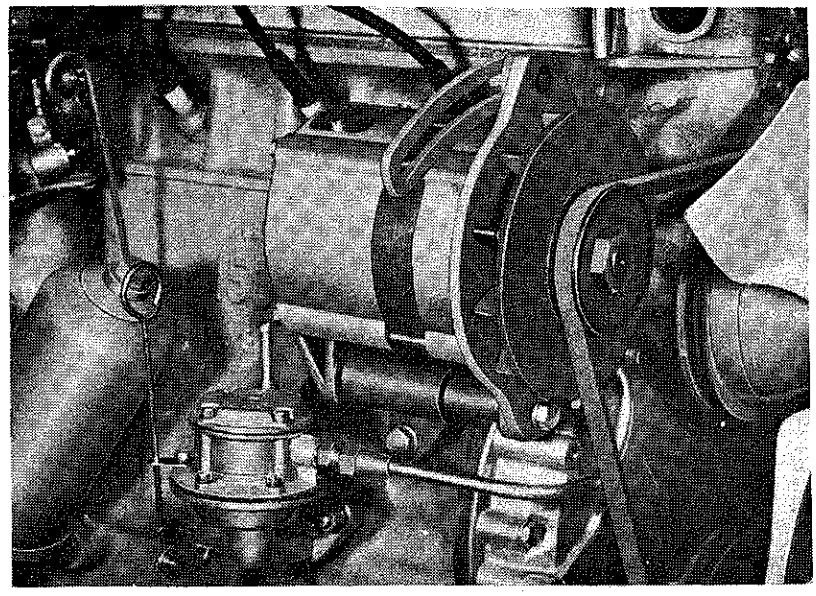


Fig. 2
Fan belt adjustment

Frost Precautions

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

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

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

Top-up when the system is cold.

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

Protection by Draining

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

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

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

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

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

Flushing the Radiator

To ensure efficient circulation of the coolant and to reduce the formation of scale and sediment in the radiator, the system should be periodically flushed with clear running water, preferably before putting in 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.

WATER PUMP

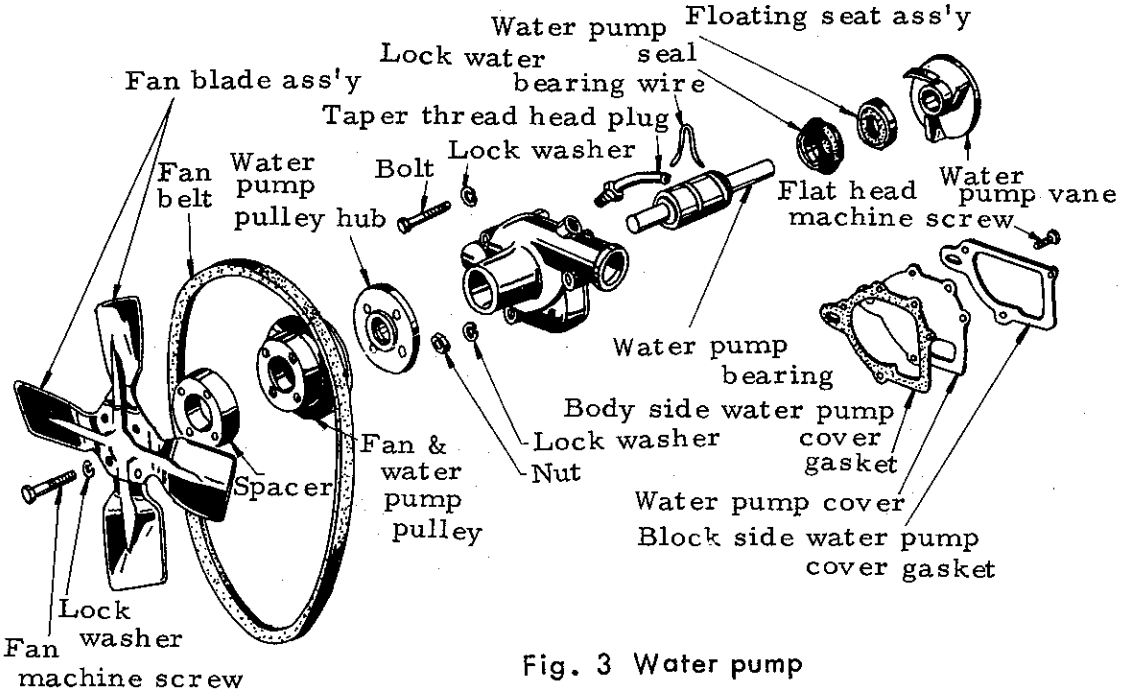


Fig. 3 Water pump

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

Removing the Pump Shaft Assembly

Disconnect the fan blades, pulley and cover.

The shaft and ball bearings is combined with one unit.

Put the pulley hub on the bench.

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

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

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

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

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

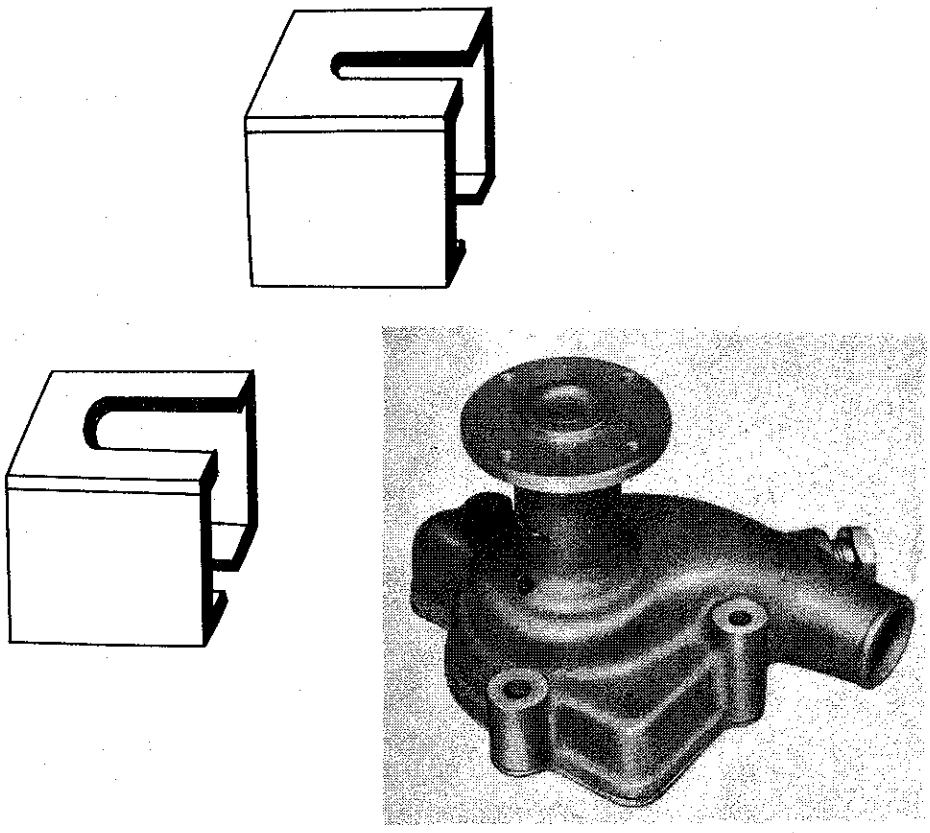


Fig. 4

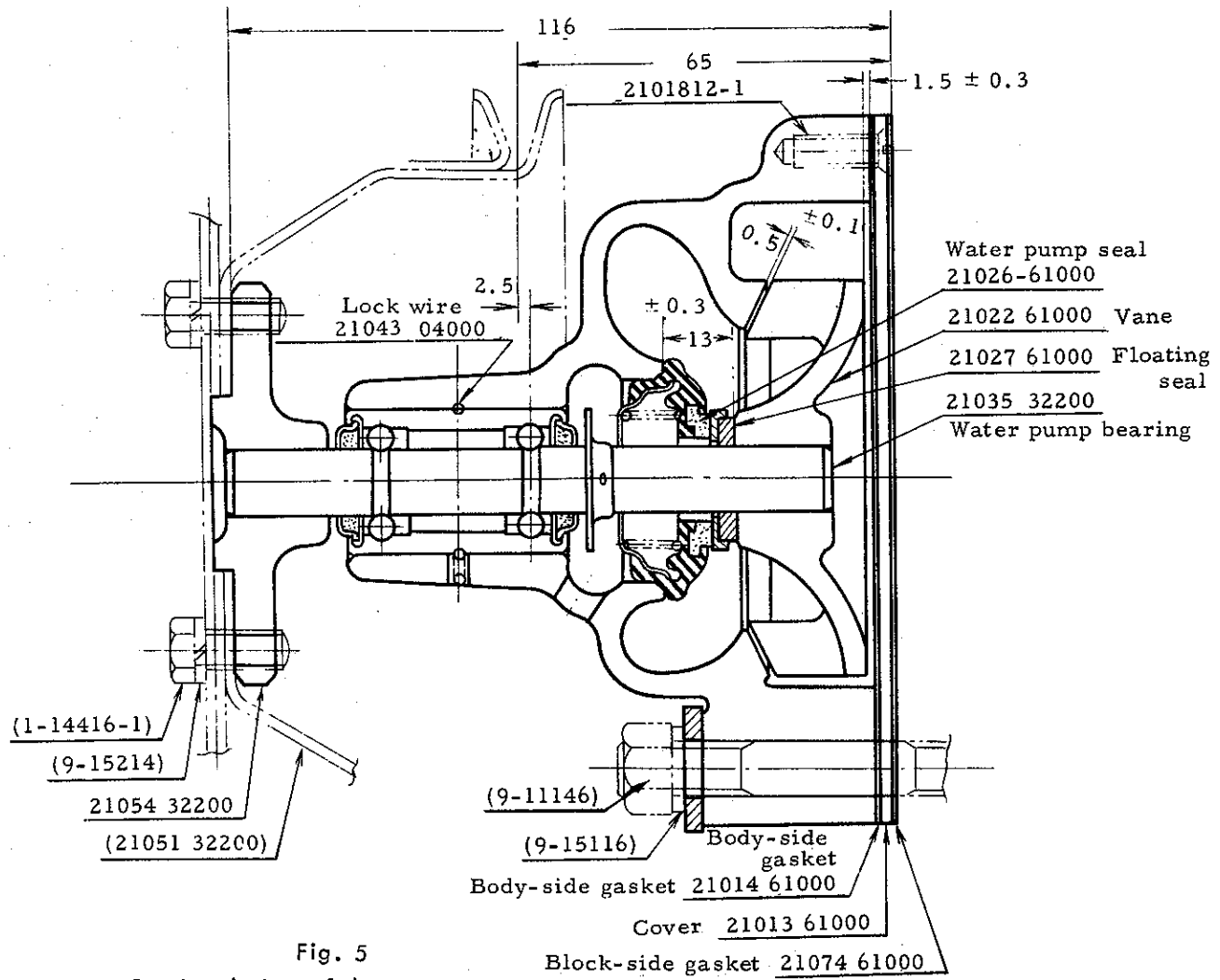
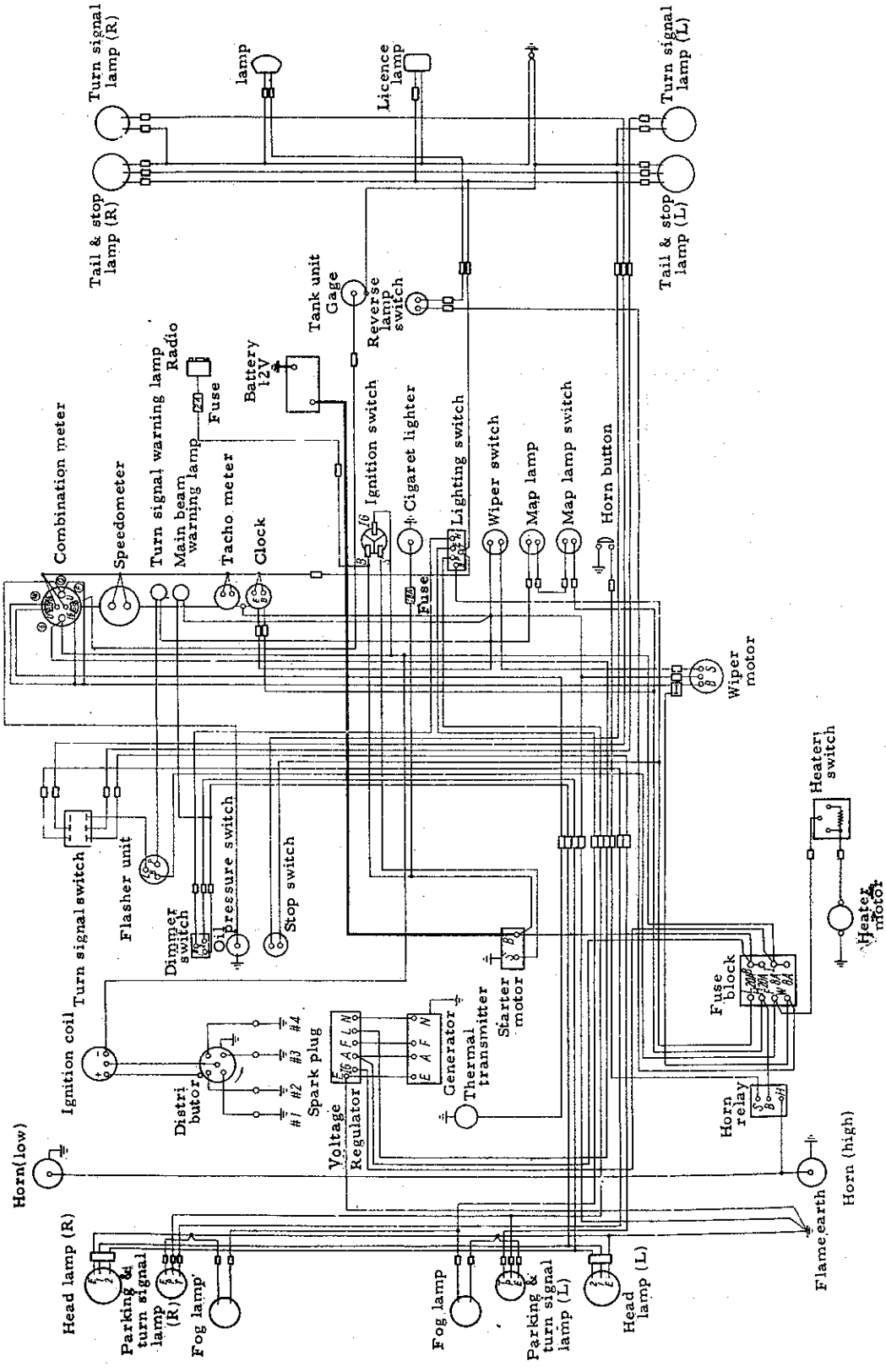


Fig. 5
Sectional view of the water pump

ELECTRICAL SYSTEM

ELECTRIC WIRING DIAGRAM



BATTERY

Voltage	12V		
Capacity	50AM (20H)		
Earth			
Specific gravity of electrolyte		1,280	at 20°C
Level of electrolyte		10 mm.	Above electrode

The CEDRIC is equipped with one of the above makes of batteries meeting the specifications of the Japanese Standard Type battery. The interior construction consists of 6 cells each having a terminal voltage of 2 volts, the voltage produced between the (+) and (-) terminals being 12 volts, and when installed on the car, the (-) terminal is made the ground.

The battery when installed on the car is located on the right side of the engine room which makes it easy to inspect when the hood is raised. However, there is a tendency to be lax in servicing the battery. Improper care will not only shorten the life of the battery itself but will lower the performance of the car so that care should be taken to always maintain the battery in the best of condition. The construction of the battery together with the chemical action caused by charging and discharging are shown in Fig. 1 .

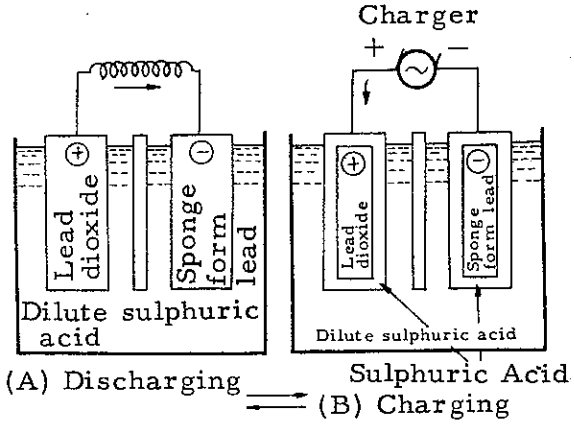


Fig. 1
Chemical action of battery

The construction is exceedingly simple, consisting of ebonite cells filled with electrolyte in which are placed chocolate colored positive plates and gray colored negative plates with wooden separaters inserted in between the plates.

When a load is placed between the positive and negative terminals, the battery will discharge due to the chemical action of the active substances, i. e. , lead dioxide in the positive plates, sponge form lead in the negative plates, and dilute sulphuric acid in the electrolyte, occurring within the battery as shown in Fig. 1. In this case, the lead dioxide and the sponge form lead react with the dilute sulphuric acid, the lead portion and the sulfate portion combining to form a lead sulfate film on the surfaces of both the positive and the negativeplates.

Thus, as the discharging continues, the sulphuric acid in the electrolyte becomes more dilute, the specific gravity drops, and the discharge capacity becomes less. If, at this time, a charger is placed between the positive and negative terminals and current forced to flaw in the opposite direction to that of discharging the lead sulfate covering the plates will be decomposed to increase the density of the dilute sulphuric acid, raise the specific gravity and restore the battery to its former state. The above is an outline of the discharging and charging principles of the battery. It is requested that these principles be thoroughly understood before servicing the battery.

Servicing

(1) External inspection

Rust or corrosion on battery terminals

Damage in battery case

Damage in battery posts and improper contact

It is feasible to check the above points without removing the battery from the car. Care should be taken to keep the battery clean at all times so that any abnormal corrosion of the connections, overflowing of the battery fluid, and other visible troubles can be quickly detected and the cause determined.

(2) Battery electrolyte

Fluid level

Since the battery fluid gradually decreases due to the loss of water caused by evaporation and electrolytic action, the vent plugs in each cell are removed and the fluid level checked. It is important to maintain the fluid level at about 20 to 24 mm. above the battery plates. If the fluid level becomes low, the specific gravity will rise due to fluid becoming concentrated, the paste in the exposed part of the plate will become severely concentrated through oxidation, the battery performance will be lowered together with difficulty in recovery and shortening of the battery life. The fluid level should be checked about twice a week during summer (or in hot regions) and about once a week during winter (or in cold regions), and the fluid replenished if found low. If visual caps are used, the fluid can be observed directly from the top without the necessity of removing the vent plugs. As shown in Fig. 2 the plug center will apear colored if the fluid level is normal and appear white if the level is low.

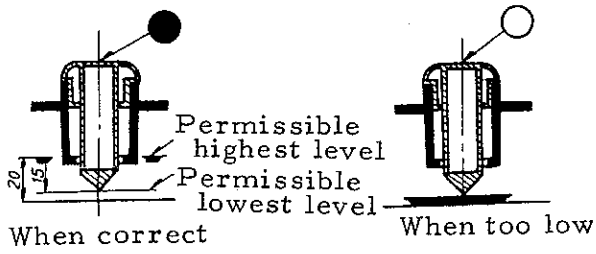


Fig. 2
Checking fluid level through vent plug

Replenishing fluid.

The battery fluid is replenished with distilled water provided the lose is due to water only and not to battery troubles or overflowing. Dilute sulphuric acid is not used is this case. If distilled water is not obtainable, water from city mains or other clean water may have to be used. As city water, in many cases contains iron or purifying agents, a filter such as puric should be used.

After replenishing the battery fluid, the battery should be charged at least 20 minutes in order to allow the fluid to mix thoroughly. This procedure should be specially observed in cold regions due to the fact that if the replenished fluid is slow to stand without mixing, there is a danger of the water separating to the top and freezing. If the fluid level becomes low due to leakage caused by overflowing from vent plug or from damages in battery, the trouble should be corrected first and the fluid replenished or replaced with dilute sulphuric acid made up to the same specific gravity as that in the cell. When the fluid becomes exceedingly dirty, it should be replaced since there are impurities mixed in the fluid. The density of the replenishing or replacing fluid is determined by the specific gravity determination procedure described in the following chapter. A slightly lower specific gravity of 1.260 is used instead of the normal 1.280 (at 20°C). After replenishing, the battery is wiped to remove all traces of spillage and the vent plug crewed in tightly. The plug is cleaned at this time to allow the gas to escape freely from the vent hole.

Specific Gravity

The specific gravity of the battery fluid varies with the state of battery charge; and, when the battery is fully charged, the specific gravity should normally be from 1.270 to 1.290 (at 20°C). By measuring the specific gravity of the battery fluid with a hydrometer.

The state of battery charge can be determined.

The specific gravity is read at the upper part of the graduation as shown in the illustration. The specific gravity varies with the temperature so that the temperature of the fluid is measured and with the use of the following conversion factor, corrections are made to the condition at 20°C in order to determine the actual state of battery charge. If the specific gravity falls below 1.220, the battery should be charged at once until the fully charged state of 1.280 is reached.

Specific gravity when fully charted

1.280 at 20°C

Temperature conversion factor for 1°C:

-0.0007

For each 1°C rise in temperature, the specific gracity decreases 0.0007 and reversely, a drop in temperature increases the specific gravity correspondingly.

The reason for using a fluid having specific gravity of 1.260 for replenishing or replacing as mentioned above is to take into consideration the

fluid becoming concentrated due to charging and lowering of fluid level in making the fully charged specific gravity about 1.280. Even if a specific gravity of 1.280 is shown when the fluid is at the normal level of about 22 mm. above the top of the plates, the fluid level, when it becomes even with the top of the plates, will concentrate the fluid to a specific gravity of over 1.310.

If the specific gravity becomes higher than 1.30, caution should be taken since the life of the battery will be shortened rapidly.

(3) Terminal voltage at each cell.

By the above method of determining specific gravity, the state of battery charge can be determined, but the following methods can also be used to determine the condition of the battery charge.

An tester is used to determine the voltage drop by contacting both terminals of the cell and permitting a large current to flow through the tester.

A battery tester is used to measure the terminal voltage of each cell. By the values measured, the condition of the battery charge can be determined.

A method frequently used to determine the state of battery charge is to place a wire or metal tool across the battery terminals to permit a spark to fly, and making the determination by observing the strength of the spark. This method should absolutely be avoided as there is danger of igniting the gas generated from the battery of nearby combustible fumes. The previously described methods and the following chart should be used instead, to determine the condition of the battery.

Although the internal performance of a battery can be easily determined by making a discharge test with a battery tester, frequent use is not recommended as it will lower the capacity of the battery. It is necessary that tests be made in accordancd with the following chart and within 15 seconds.

Terminal voltage	Specific gravity (20°C)	Battery condition
Under 1.75	Under 1.140	Complete discharge
1.80	1.140	Impossible to use
1.85	1.170 - 1.190	1/4 charged
1.95	1.200 - 1.220	1/2 charged
2.00	1.230 - 1.250	3/4 charged
Over 2.10	1.260 - 1.280	Fully charged

Determining Repairability

The above completes the instructions on correct use and maintenance of the battery. If the battery is overdischarged, the plates inside the cells will become warped and the surface of the plates will be covered with white lead sulphate.

This will plug the many small holes in the wooden separators to increase internal resistance and cause the voltage drop which will make recharging difficult. It will be necessary in this case to repair or replace the plates in the battery.

Charging

Whenever the battery has been repaired, and when the battery fluid has been replaced, and also while the battery is in use and the voltage drops due to large electrical consumption, the generator installed on the car is unable to maintain sufficient charging. In such cases, the battery fluid is replenished or replaced if in faulty condition and the battery charged by connecting it to a battery charger.

(1) Instructions on normal charging procedures.

The fluid level is checked to see that it is about 22 mm. above the top of the plates (on visible type plugs, it should be up to the normal level indication).

Note: The vent plugs on all cells should be removed while charging.

The terminals should be polished to remove all dirt and fluid adhering to the surface.

The (+) of the battery terminal is connected to the (+) direct current terminal of the charger and the (-) terminal of the battery to the (-) terminal of the charger. The charging is made with a current of 6 to 8 amperes.

As the charging progresses, the battery voltage rises so that the charging current beings to decrease while small bubbles appear and the specific gravity starts rising.

If the charging is continued as is, the charging current being small will make the charging time very long so that the voltage should be adjusted from time to time in order to maintain a steady charging current of 6 to 8 amperes. When the charging progresses so that the voltage in each cell becomes higher than 2.5 volts and the specific gravity over 1.280, gas will be given off vigorously and the fluid will presnet a milkey appearance.

When this condition is reached, the charging current is reduced to about 4 amperes and the charging continued until the specific gravity becomes constant. That is, the charging is continued until three consecutive readings of the terminal voltage and the specific gravity (Corrected to temperature) taken every hour shows a contant value, the charging being made by passing a 20-hour rate current through the battery.

If the temperature should rise higher than 45°C during charging, the current is reduced to one-half or the charging is discontinued for a while until the temperature drops.

The above is the constant current charging method generally used. Initial charging is made by using a low current and long charging time but for ordinary recharging, a current described above is used and the charging completed in about 12 to 16 hours.

The point to be observed in charging is determining the time when the charging should be discontinued. The completion time must be such that there is no overcharging or undercharging. If overcharged more than necessary, the charging current will be used up in decomposing the water in the battery fluid, and not only will the loss be great but this will hasted the aging of the plates due to temperatur rise. Efficient charging is attained when the charging is made with the least possible amount of gas being generated. Gas begins to be generated at the time the battery voltage begins its sudden rise from around 2. 3 to 2. 4 volts. Therefore, if the electrical source voltage is maintained at 2. 3 to 2. 4 volts, the battery voltage will be unable to rise higher and the battery can be charged with the least amount of gas being generated. This is the constant voltage charging method, in which an exceedingly large amount of current flows at the start but as the charging progresses, the current decreases, and, when the battery voltage becomes equal to the electrical source voltage, there will be practically no current flowing. However, to adjust the specific gravity after completing the charge, it is necessary to use the constant current charging for this purpose.

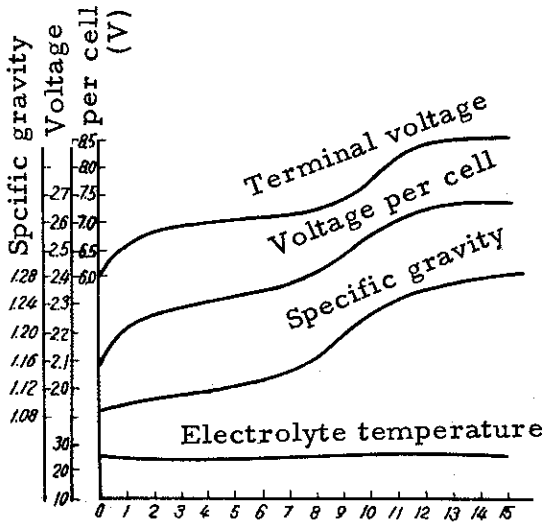


Fig. 3 Constant current charging characteristics

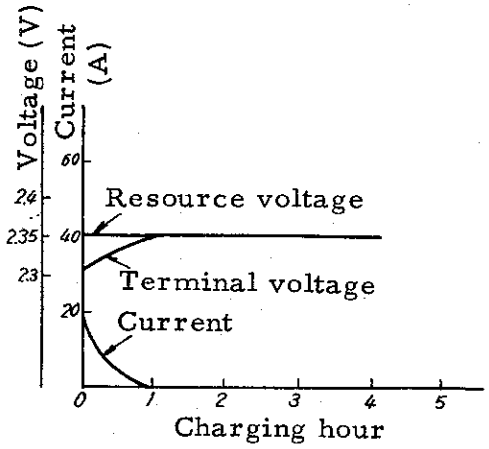


Fig. 4 Constant voltage charging characteristics

(2) Instructions on quick charging

For charging without the necessity of removing the battery from the car and for making the charge in a short time, the quick charger is used. In using the quick charger, there is a tendency to pass a large current to hasten the charging time, but in order to protect the plates and also the life of the battery, the specified current should not be exceeded and the charging current made as small as possible.

Storing Instructions

(1) Even if the battery is not being used, it will self discharge. Therefore, a battery which has not been in use for a long period of time should be checked for its state of charge. If the battery is not to given a full charge at the start and a light maintaining charge every month thereafter.

(2) If the battery is not removed from a car which is to be stored, the ground terminal on the battery should be disconnected in order to prevent discharging and fire hazards.

(3) If the battery alone is to be stored, it should be kept in a cool place and away from direct sunlight.

(4) When battery fluid overflows and adheres to the surface of the battery, the acid should be neutralized by wiping with alkali solution and the surface wiped to keep it in dry condition.

SPECIFICATIONS

Alternator	Mitsubishi Denki Co. (23100-12200)
Model	AC300/12AR x 2R
Nominal output	12V - 300W
Constant	Successive
Pole	+ side ground
Constant revolution	2500 rpm.
No load minimum revolution	1000 rpm. down 14V (normal temp.)
Output current	2500 rpm. 14V 24.5A up (normal temp.)
	2500 rpm. 14V 21.5A up (high temp.)
Pulley ratio	1 : 1.73
Regulator	Mitsubishi Denki Co. (23500-12200)
Model	RL-A1
Type	Tirrill type (leaf spring)
Element	Constant voltage relay. Pilot lamp relay.
Constant voltage relay	3 contact point type

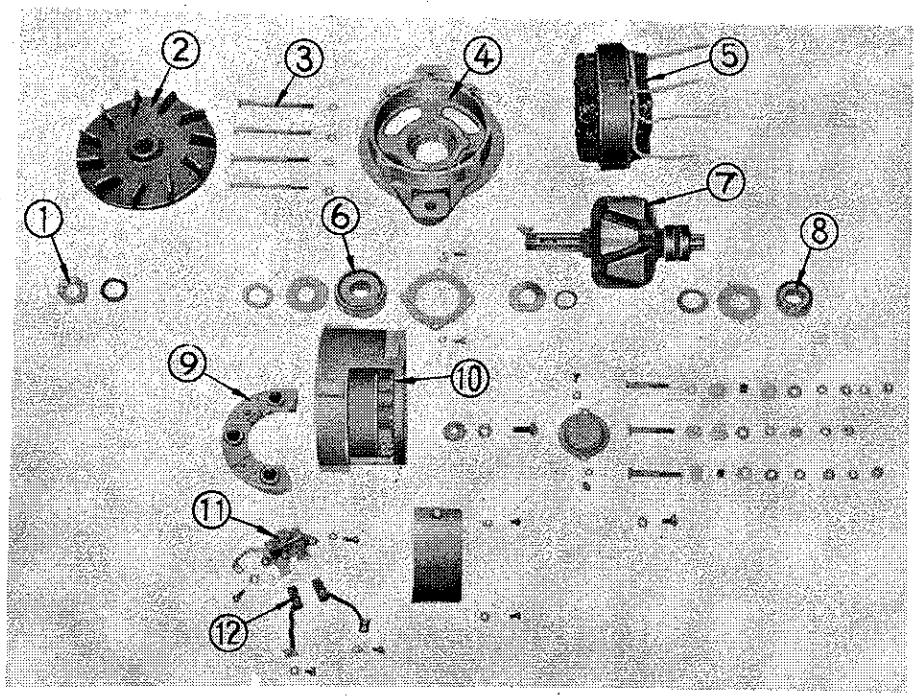
	Primary side	Secondary side
Adjust, valve	14 ~ 15V	14 ~ 15V
Dynamo revolution	4000 rpm.	4000 rpm.
Load	Battery + resisting load 21.5A approx.	Battery

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 FOR SP310

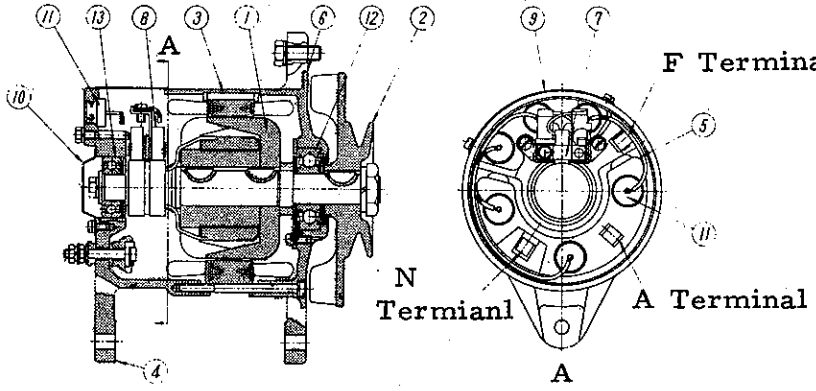


	Part No.	Part Name	Q'ty	Remarks
	23100-12200	Alternator ass'y	1	
	23500-12200	Regulator ass'y	1	
	23153-12210	Nut ϕ17	1	
1	23151-12210	Pulley	1	
2	23131-12210	Through bolt	4	
3	23118-12210	Front cover ass'y	1	
4	23102-12210	Stator ass'y	1	
5	23120-12210	Ball bearing	1	
6	23108-12210	Rotor ass'y	1	with slip ring
7	23129-12210	Ball bearing	1	
8	23230-12210	Diode set	1	
9	23183-12210	Rear cover	1	
10	23133-12210	Brush holder	1	
11	23135-12210	Brush	2	
12	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

1 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.

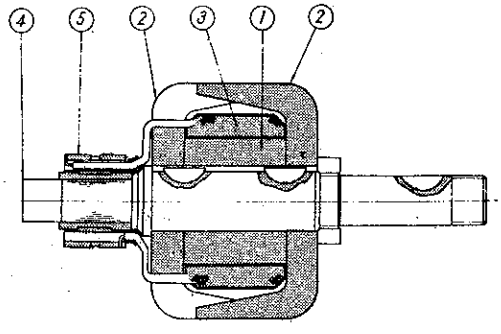


Sectional View of Dynamo

Fig. 2-1. 1

① Rotor ass'y	⑤ Diode set	⑨ Brush cover
② Pulley with fan	⑥ Front cover	⑩ Bearing cover
③ Stator (armature)	⑦ Brush holder	⑪ Diode
④ Rear cover	⑧ Brush	

The sealed ball bearings ⑫ ⑬ are used to support the rotor. Clearance between the brush and brush holder is also made so as to prevent it from dust. Thus the AC generator will increase milage without maintenance. Each 3 diodes are pressed in the rear cover and the diode base respectively.



① Field core

② Field segment

③ Field coil

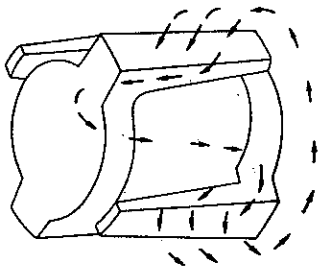
④ Shaft

Sectional View of Rotor

Fig. 2-1. 2

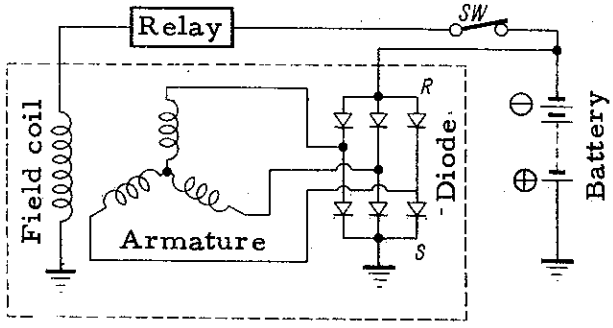
The clip ring pressed in the shaft is soldered at both ends of the field coil to pass magnetic current.

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



Magnetic Circuit

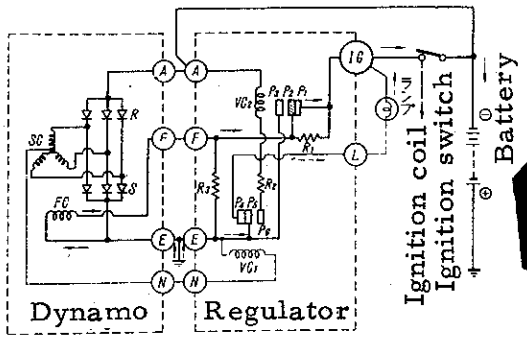
Fig. 2-1. 3



Connection within Dynamo

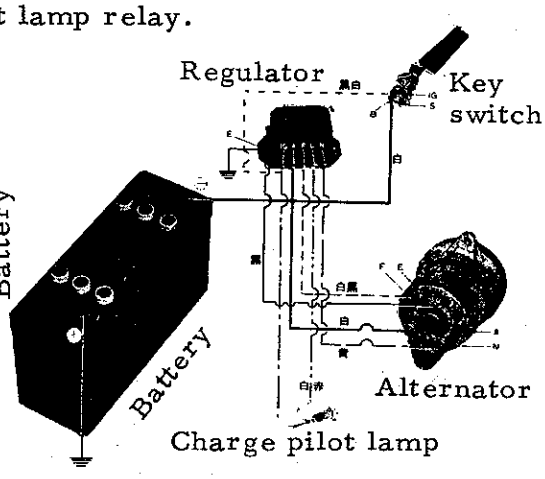
Fig. 2-1. 4

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



Charging System

Fig. 2-1. 5



Outside Connection

Fig. 2-1. 6

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

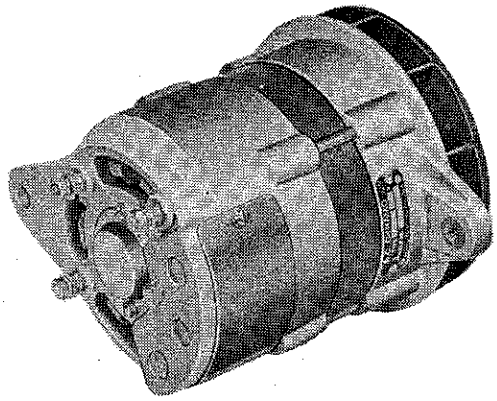
This is because the diode is used and when the voltage to add to it is so low, large proportional resistance shows up and current does not flow through the field coil unless the dynamo makes very high revolution.

2 DISASSEMBLY AND ASSEMBLY

A. Disassembly

The dynamo is disassembled in the following order.

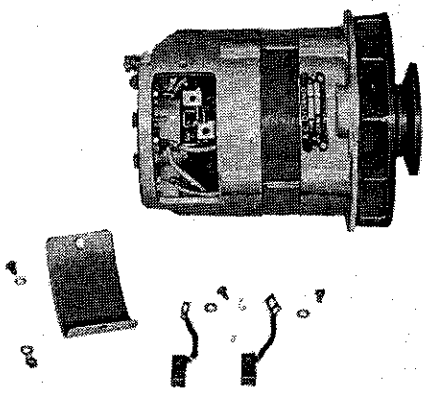
a)



* The completed (23100-12200) The parenthesized is the part number for SP310.

Fig. 2-2. 1

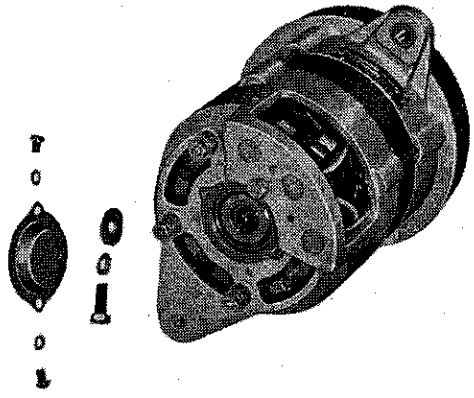
b)



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

Fig. 2-2. 2

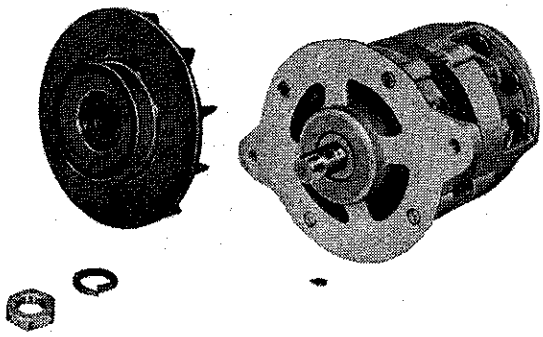
c)



Remove the cover (23130-12210) of bearing (23129-12210, JIS #62022 ZZC_3) and take off the hex. bolt of shaft.

Fig. 2-2. 3

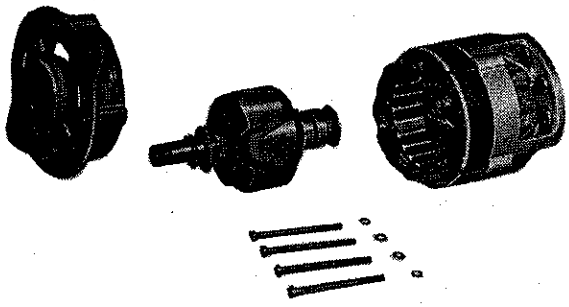
d)



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

Fig. 2-2. 4

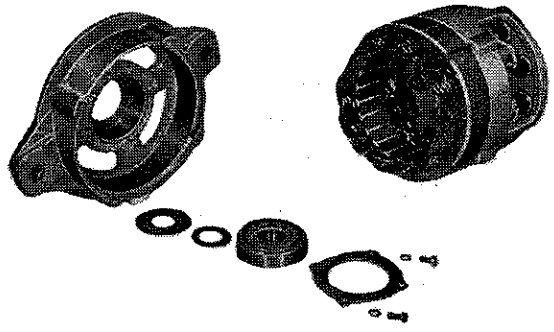
e)



Remove the throu bolt (23131-12210) tightening bolt front cover (23118-12210) and rear cover (23127-12211), pull off the front cover and rotor (23108-12210). Use a hammer of wood or plastic if necessary.

Fig. 2-2. 5

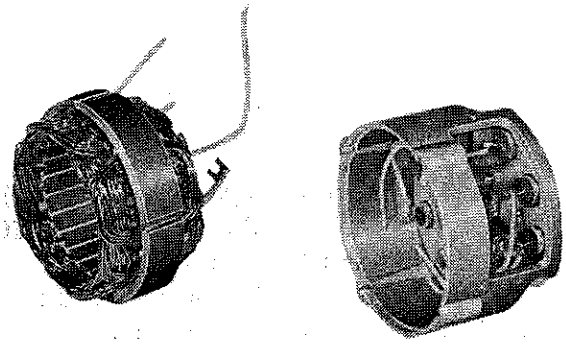
f)



Remove the ball bearing From Front cover. Remove the bolt or (23352-09610) tightening the bearing plate (23123-12210) and tor pull off the bearing with such as a hand press.
Slacken N terminal bolt on the rear cover side and remove the clip terminal, then the rear cover and the stator can be separated.

Fig. 2-2. 6

g)

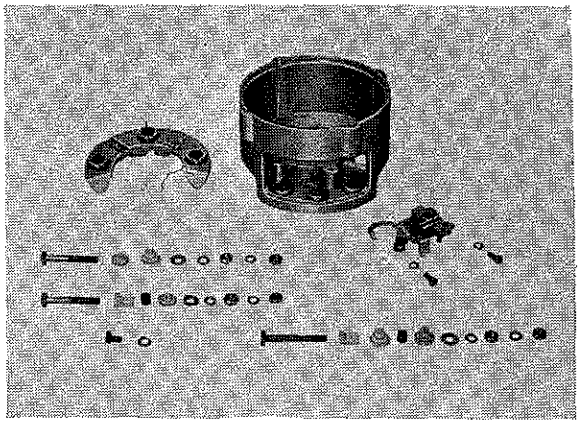


Remove the rear cover and stator (23102-12210). Separate the silicon diode, 3ea. from the stator coil lead wire, 3ea. by melting soldering with an electric iron.
Slacken N terminal bolt on the rear cover side and remove the clip terminal, then the rear cover and the stator can be separated.

Fig. 2-2. 7

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

h)



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

Fig. 2-2. 8

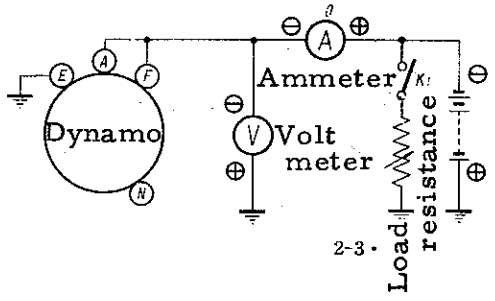
B. Assembly

Assembly is done in the reverse sequence of disassembly.

3 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. 2-3. 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 (2 A approx.) to the field coil and read the revolution. Correct revolution is approx. 1000 rpm. without load.

Next, increase load resistance to the maximum and almost stop flowing of load current, and put off the switch. Then, raising the load current slowly, increase revolution of dynamo. Observe thus increasing output current as revolution of dynamo increases. If there is no large difference from the specification, it is correct.

No matter how the battery is over-charged or discharged, if the charging current is small, first make sure either the dynamo or the relay is in disorder. See the charging current by inserting the ammeter between A terminal of relay and the battery.

Disconnect wire passing from the dynamo F terminal to the relay F terminal at the relay F terminal and make the removed lead wire short circuits at the relay A terminal, when if the charging current highly increases, the relay is in disorder.

B. Short Circuits on Diode "-" Side

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

C. Inspection of Diode with Tester.

a) Simple Inspection

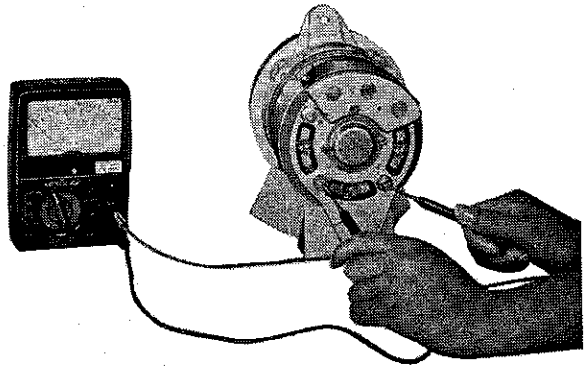


Fig. 2-3. 2

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

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

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

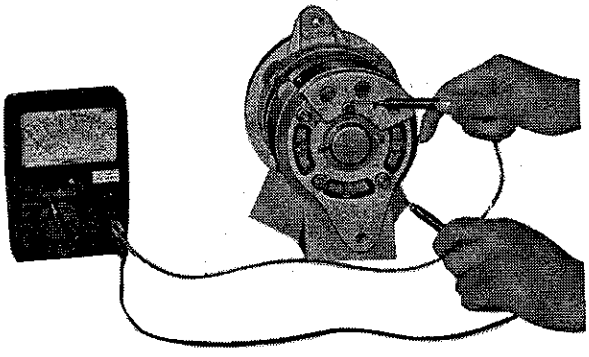


Fig. 2-3. 3

b) Separate Inspection

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

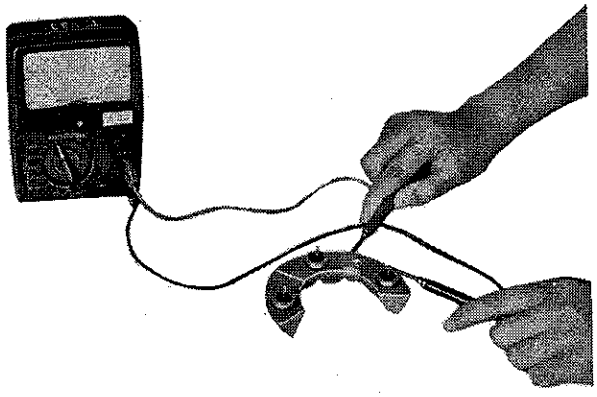


Fig. 2-3. 4

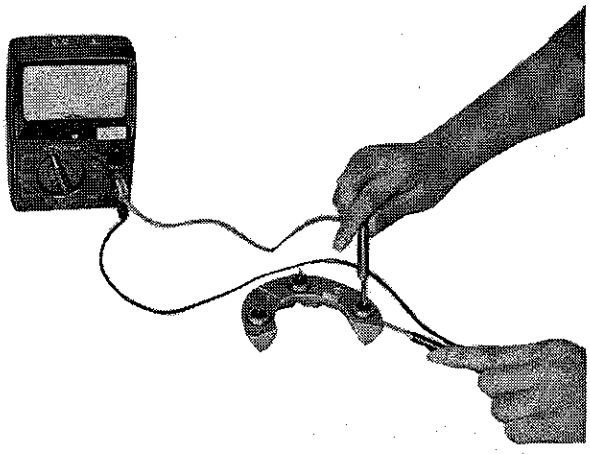


Fig. 2-3. 5

D. Inspection of Diode with Lamp.

a) Simple Inspection

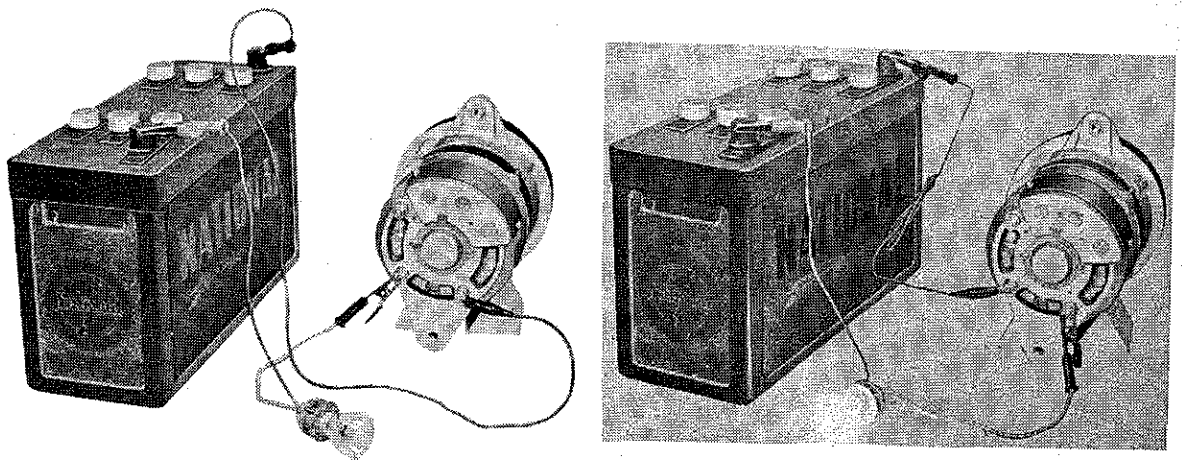


Fig. 2-3. 6

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

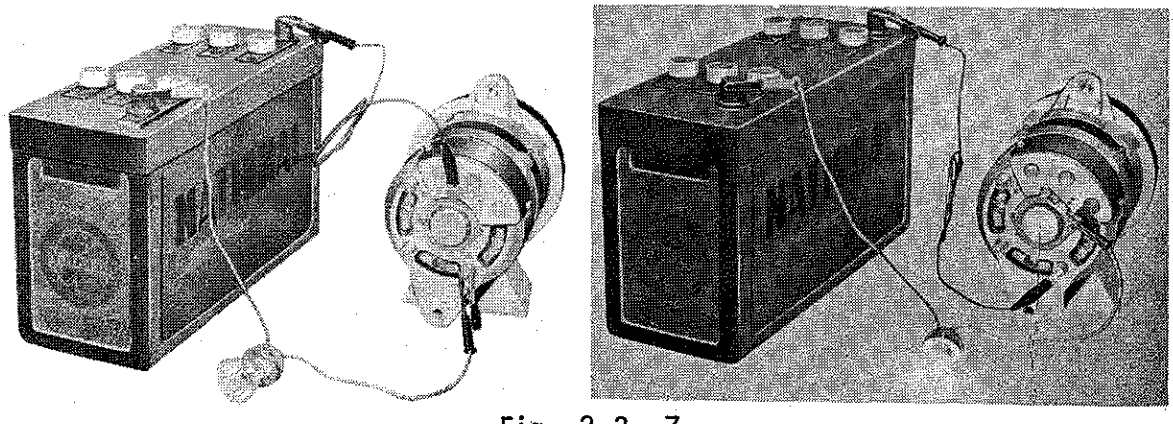


Fig. 2-3. 7

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

b) Separate Inspection

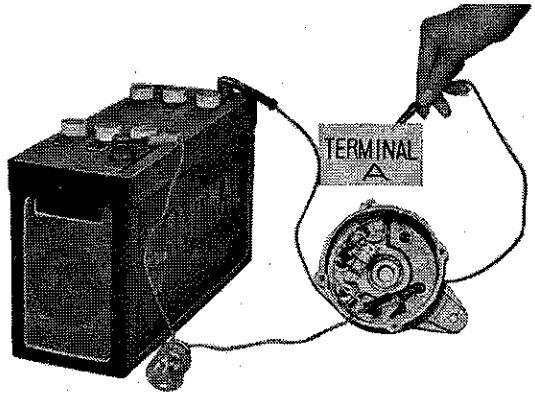


Fig. 2-3. 8

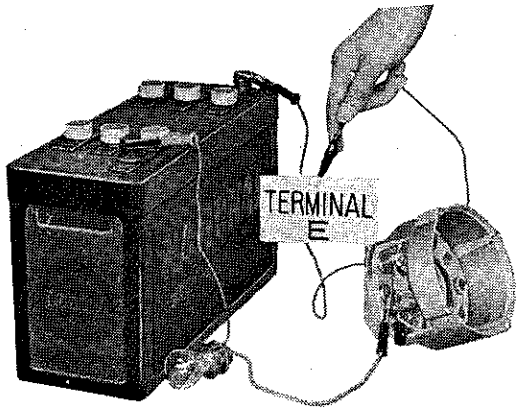


Fig. 2-3. 9

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

E. Inspection of Field Coil

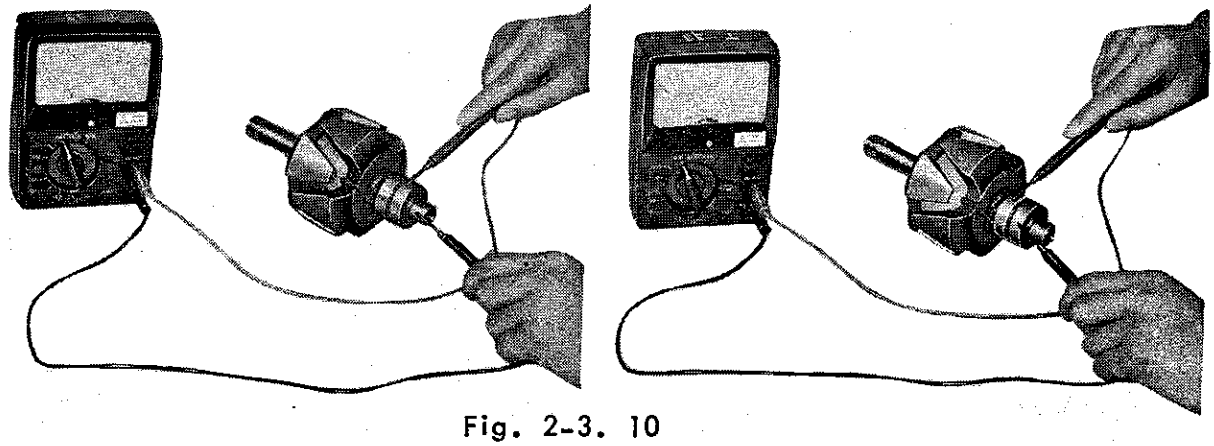


Fig. 2-3. 10

As shown in Fig. 3. 10, put the tester between the slip ring of rotor and if there are 6~7Ω, 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

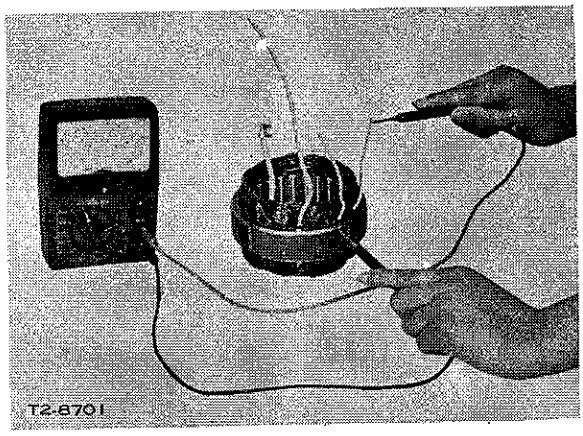


Fig. 2-3. 11

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

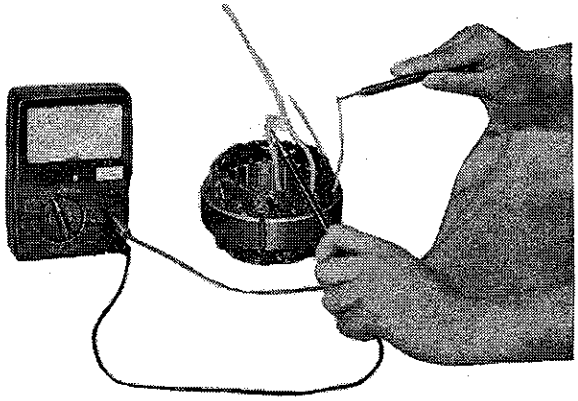


Fig. 2-3. 12

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.

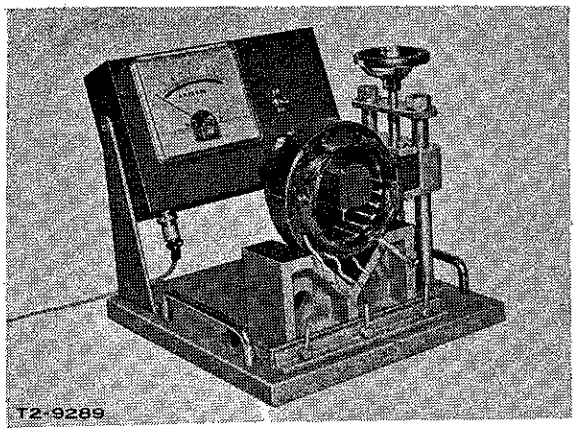


Fig. 2-3. 13

H. Inspection of Brush

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

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

REGULATOR

1 Construction and Operation

(1) Construction

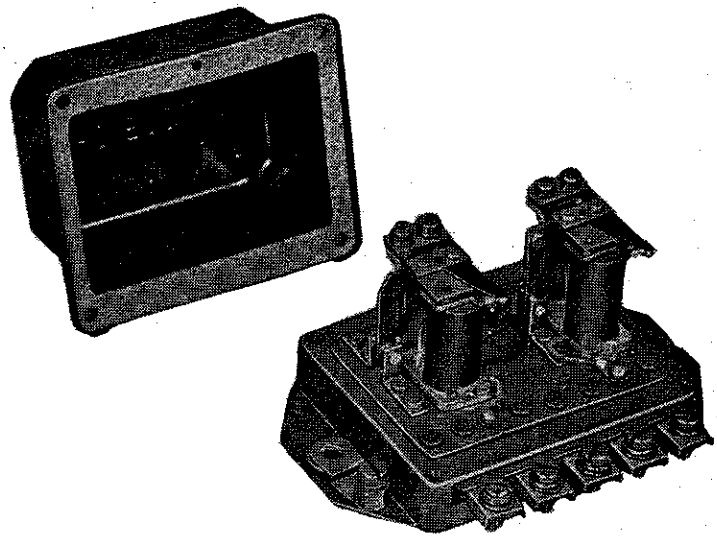


Fig. 3-1. 1

(2) Operation of Constant Voltage Relay

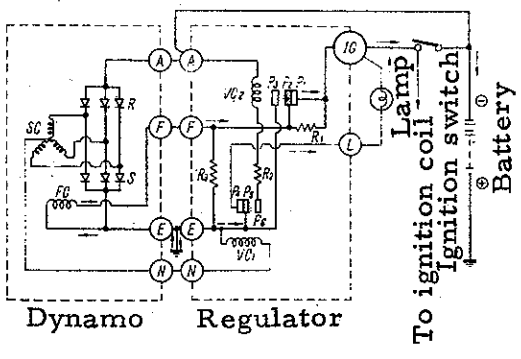


Fig. 3-1. 2

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

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

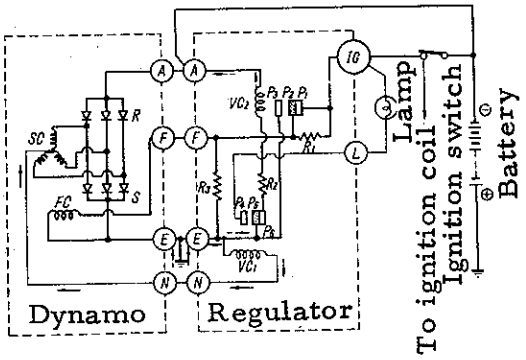


Fig. 3-1. 3

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

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

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

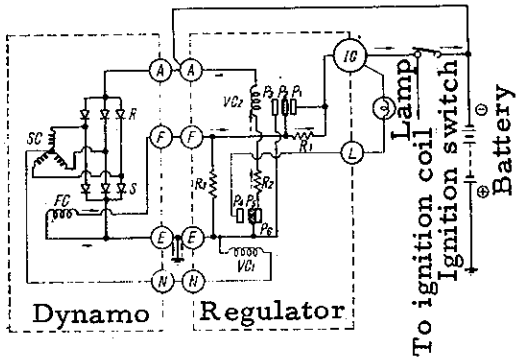


Fig. 3-1. 4

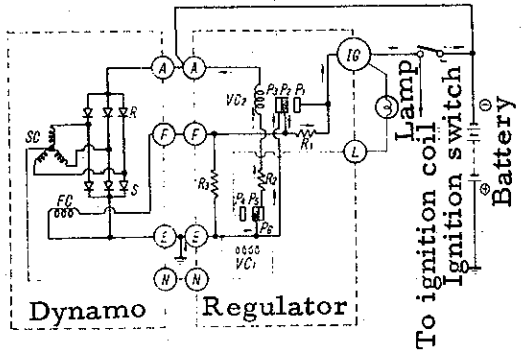


Fig. 3-1. 5

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

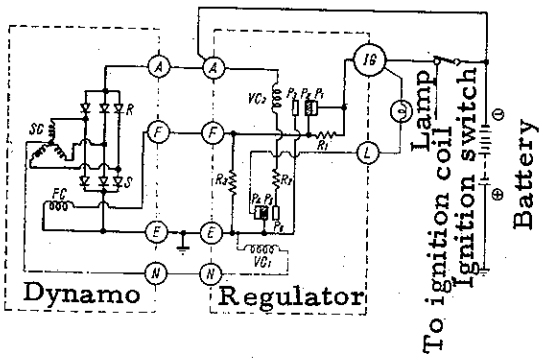


Fig. 3-1. 6

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

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

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

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

(3) Operation of Pilot Lamp Relay

As shown in Fig. 3-1. 2, this is made up with the contact points, P_4, P_5 and P_6. The contact point 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

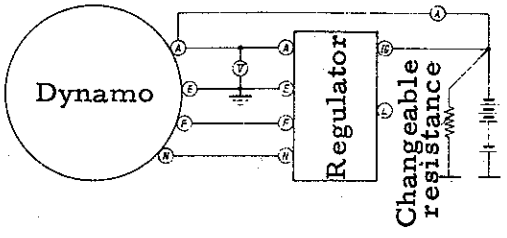


Fig. 3-2. 1

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

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

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

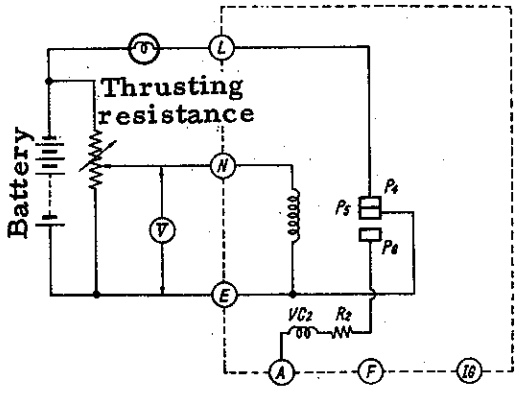


Fig. 3-2. 2

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

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

This is a put-on voltage.

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

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

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

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

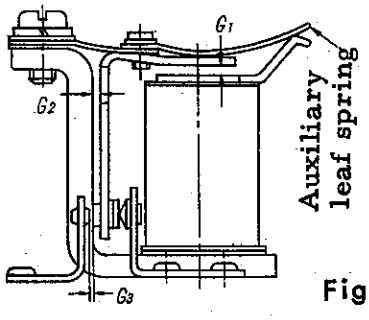


Fig. 3-2. 3

(4) Adjustment of Voltage

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

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

14 ITEMS ON HANDLING

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

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

TROUBLE SHOOTING LIST

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

9. Mal-contact or breakage between regulator N terminal and dynamo N terminal.	Repair
5- 3 Noises of Dynamo	
1. Mal-function of bearing.	Replace
2. Mal-function of diode.	Replace diode as a set.
3. Earth or rare short of stator coil.	Replace

STARTER MOTOR

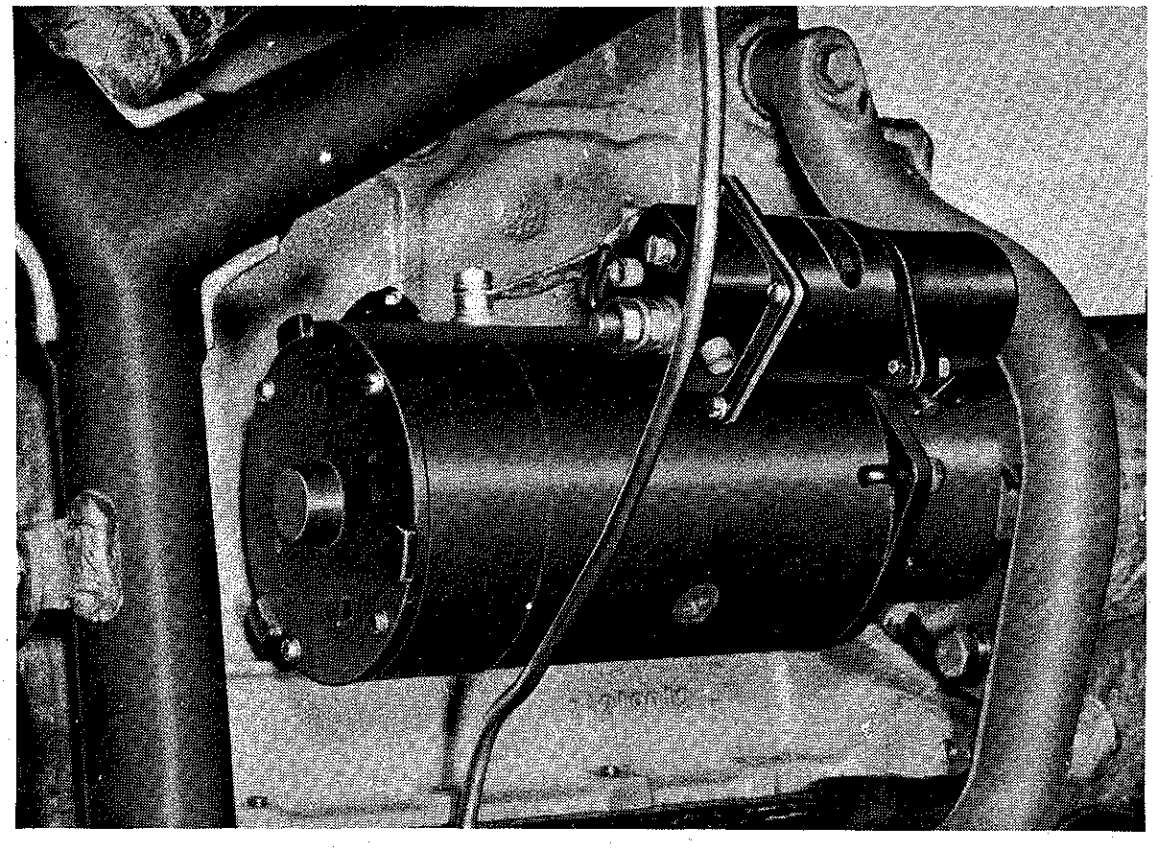
Type	S114-71A
Voltage	12 volts
Output	(1.4 HP)
Starting current (Voltage)	Less than 500 amps. (9.5 Volts.)
Lock torque	Over 0.9 kg-m
Type of pinion gear	Bendex type
Number of tooth on pinion gear	9
Number of tooth on rign gear	120
Amendment limit of short dimension of shaft dia. (pinion side)	0.1mm (0.004 in)
Amendment limit of short dimension of shaft dia. (rear end)	0.1mm (0.004 in)
Gap between shaft and bush (pinion side)	0.038-0.095mm (0.0015-0.0038 in)
Amendment limit dittoed gap	0.2mm (0.008 in)
Gap between shaft and bush (rear end)	0.03-0.076mm(0.0012-0.0030in)
Amendment limit dittoed gap	0.2mm (0.008 in)
Gap between shaft and bush (rear end)	0.03-0.76mm(0.0012-0.0030in)
Amendment limit dittoed gap	0.2mm (0.008in)
Amendment limit of deflection on shaft	0.1mm (0.004 in)
Outer dia. of commutator	
Amendment limit of short dimension	2mm (0.08 in)
Dittoed degree of real circle	0.05mm (0.002 in)
Dittoed limit of polarized wear	0.4mm (0.016in)
Bush length	14mm (0.551 in)
Amendment limit	9.5mm (0.374 in)
Brush spring pressure	0.8kg (0.017 lb.)

Construction and Operation

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

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

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



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

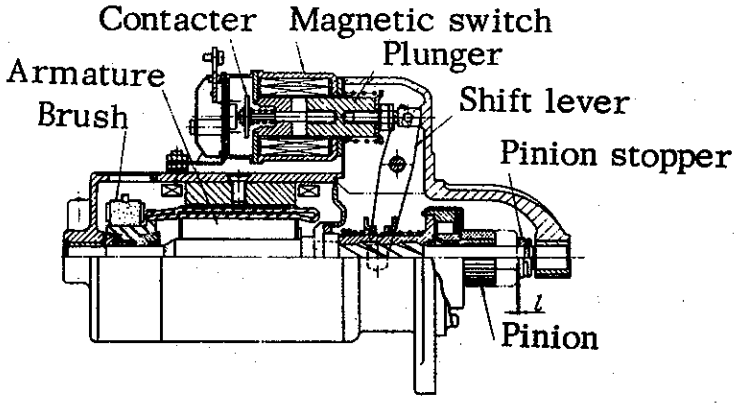


Fig. 1 Sectional view of magnetic shift type

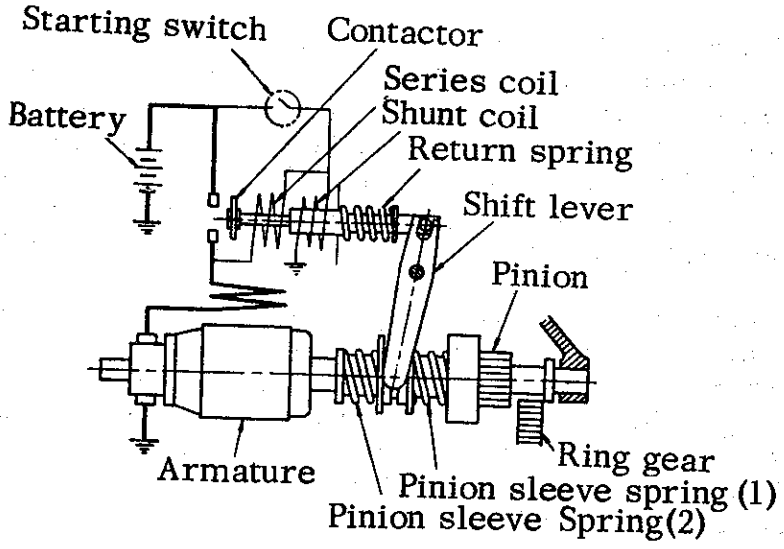


Fig. 2 View of starter system

Optional Precautions

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

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

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

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

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

Checking While in Operation

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

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

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

Dismantling and Disassembling

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

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

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

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

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

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

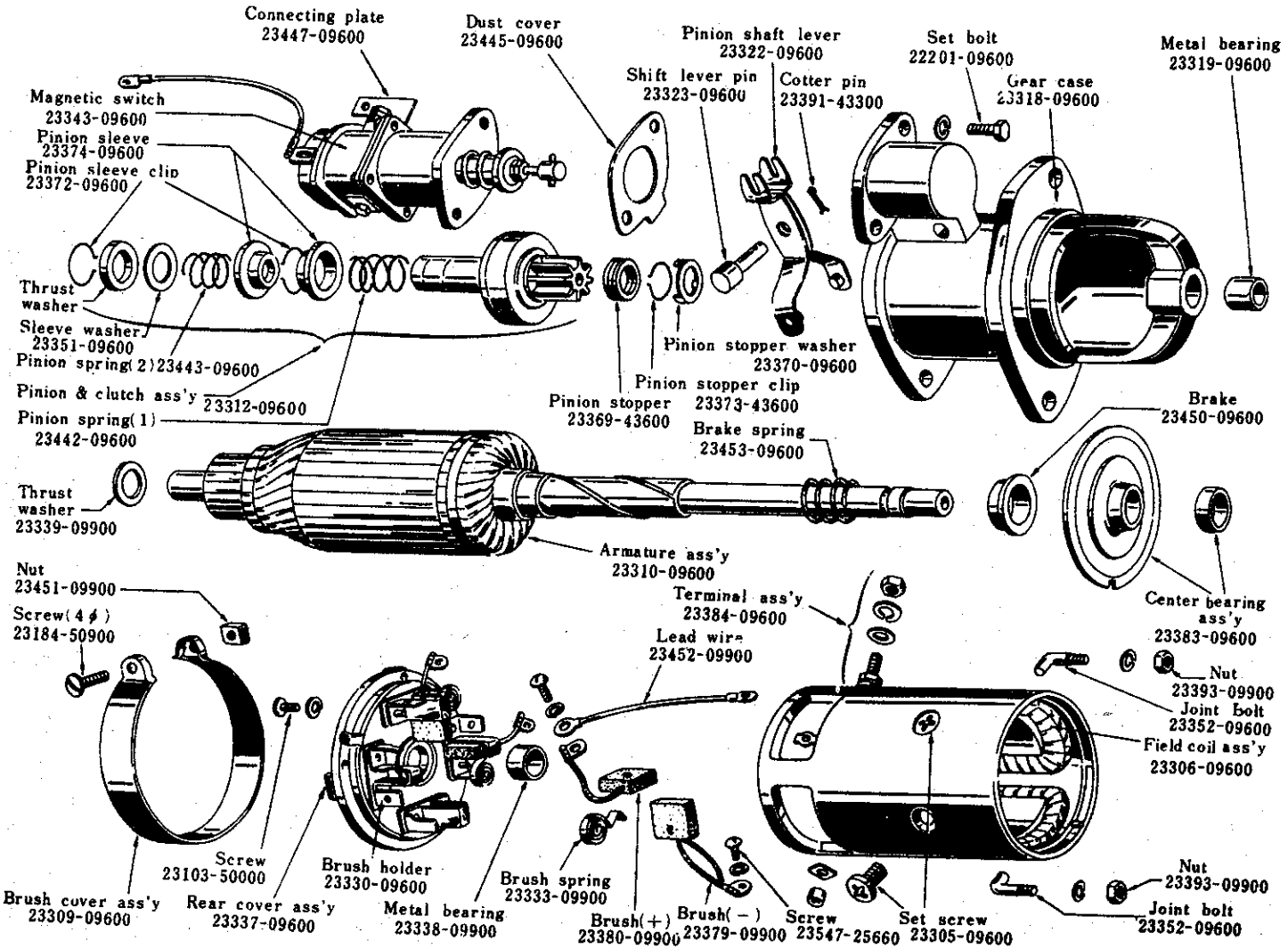


Fig. 3 Components of starter motor

Inspection and Repairing Parts

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

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

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

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

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

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

Assembling and Testing Starter

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

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

(A) Current failure in magnetic circuit.

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

(B) Defective contact in main circuit S_2.

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

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

(2) Precaution.

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

Starter Troubles, Their Causes and Remedies

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

(1) Starter fails to turn.

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

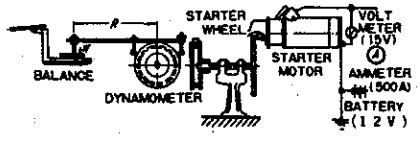


Fig. 4
Torque testing apparatus

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

Construction of Magnetic Switch and Instructions

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

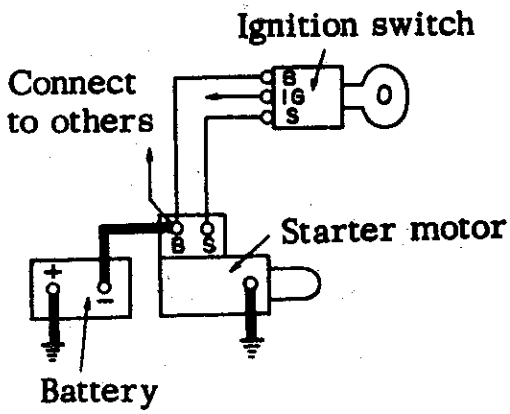


Fig. 5 Magnetic Starter Circuit

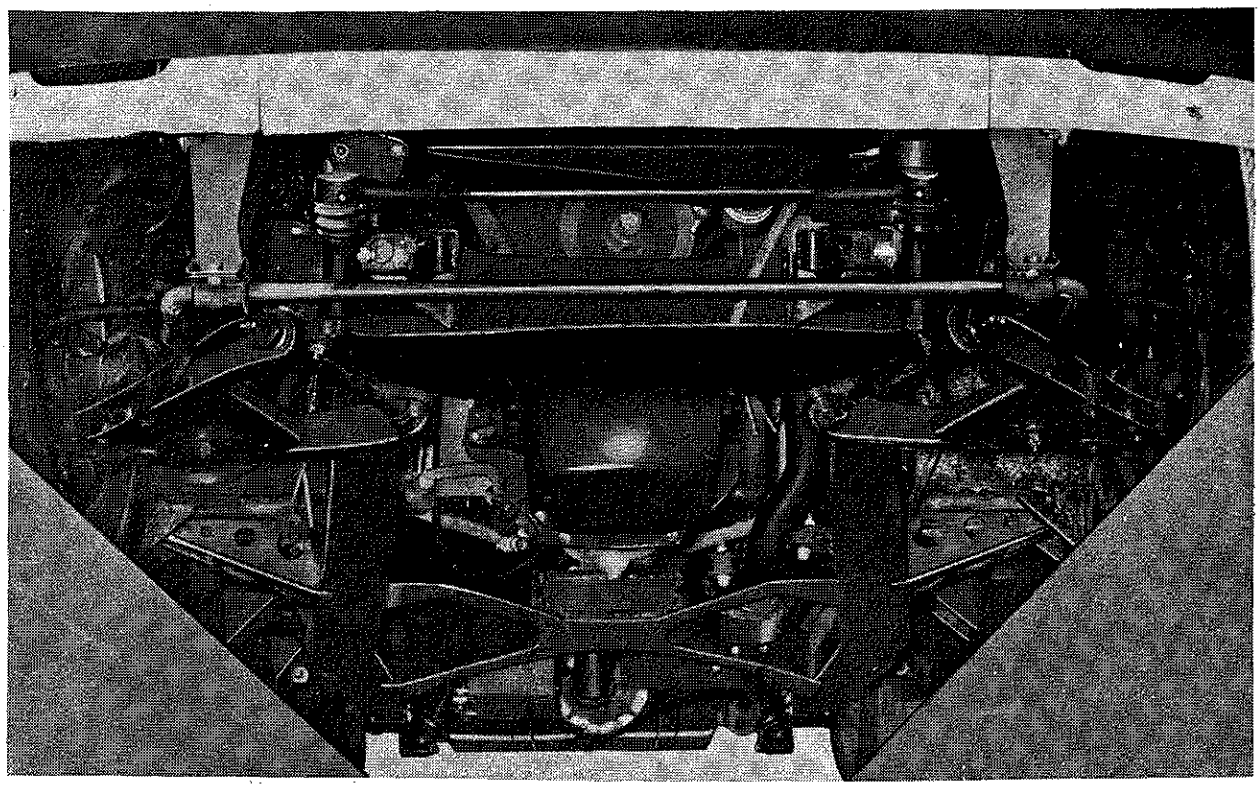
If there is trouble in the magnetic circuit, it should be corrected.
For improperly contacting starter brushed, the brushes together with the armature should be checked, and correctiobs or replacement made as found necessary.
If all of the above checks with their corresponding repairs have been made and the starter still fails to operate, the trouble can be assumed to be in the starter itself so that it should be removed from the engine and checked.
This is exceedingly rare but care should be taken to see that the starter pinion is not locked into the flywheel ring gear. Cases like this

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 dismanted from the engine for checking and repairs.

(2) 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.

(3) 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 retightening the bolts.
Noises caused by brushes improperly contacting the armature requires 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 replace.
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.

CONSTRUCTION OF CHASSIS



CLUTCH

GENERAL DATA

Type	Single dry disc plate
Method of operation	Hydraulic
Clutch master cylinder bore	15.875 mm (5/8 in)
Clutch operating cylinder bore	19.05 mm (3/4 in)
Number of facings	2
Facing size	203 x 146 x 3.2 mm (8 x 5.7 x 0.125 in)
Total friction area	312 sq cm (48.4 sq in)
Thickness of disc ass'y:	
Free	Less than 8.45 mm (0.333 in)
Compressed	Less than 7.15 mm (0.282 in)
Pressure plate spring:	
Free length	55 mm (2.17 in)
Fitted length & load	39.6 mm at 79±2 kg (1.56 in. at 173.8±4.4 lb)
Release bearing	Angular contact ball bearing (40 TNK 20)
Height of release plate	52±0.2 mm (2.05±0.01 in)
Release plate run-out	0 03 mm (0.001 in)
Flywheel facing run-out	0.05 mm (0.002 in)
Clutch pedal play	12-20 mm (0.6-0.8 in)
Clutch pedal hight	160±5 mm (6.3±0.2 in) at center of pat from toe board.

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 springs.

Mounted on the pressure plate are three release levers which pivot on floating pins retained by eye-bolts. Adjustment nuts are screwed on the eye-bolts and secured by staking. Struts are interposed between the lugs on the pressure plate and the outer end of release levers.

Anti-rattle springs load the release levers, and retainer spring connect the release lever plate.

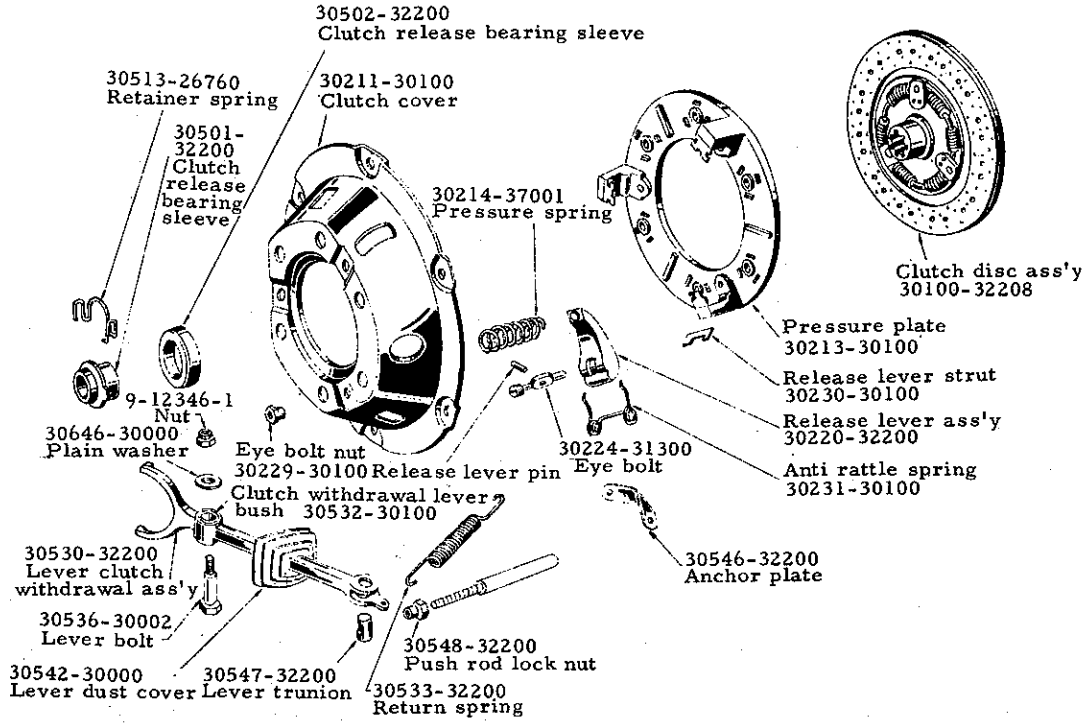


Fig. 1 Clutch

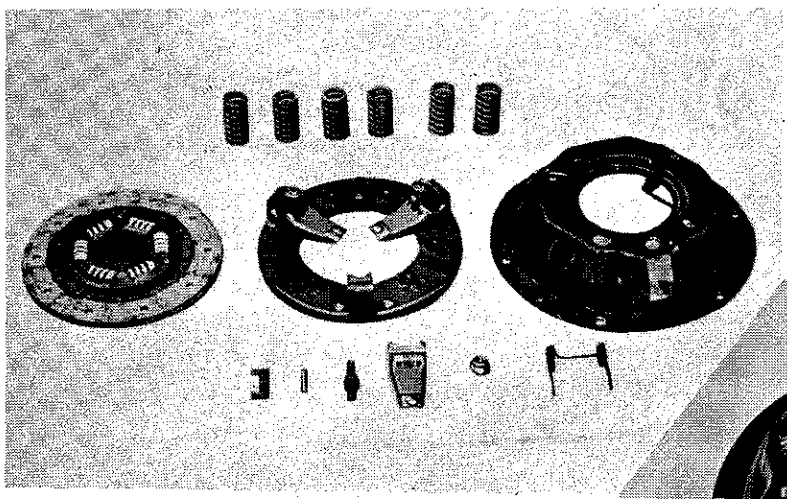


Fig. 2

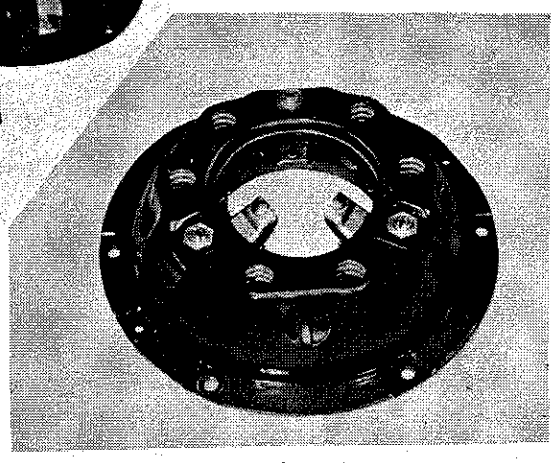


Fig. 3

RELEASE BEARING

The release bearing consists of sealed type ball bearing it located by the operating fork and the release bearing retainer spring.

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 relived.

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 throuw the pressure plate out causing judder.

Dismantling, Assembling & Gauging

By using service tool (Fig. 5) the clutch can be quickly dismantled, reassembled and adjusted to a high degree of accuracy.

The tool comprises the following parts; base plate center pillar, spacing washers, distance pieces, hight finger actuating mechanism, setscrews, speed brace and metal box. As this tool is universal, a chart indicating the paticular parts to be used for paticular types of clutch will be found on the inside of the lid of the box. (Tool No. 4799)

Dismantling

With the clutch assembly, select three spacing washers (Fig. 5 inset) and place them over the code letter "B" on the

1. Release lever height indicator.
2. Distance piece
3. Center pillar
4. Clutch cover
5. Set screw
6. Pressure plate
7. Thrust spring
8. Spacing washer
9. Base plate
10. Lock nut
11. Adjusting screw
12. Release lever

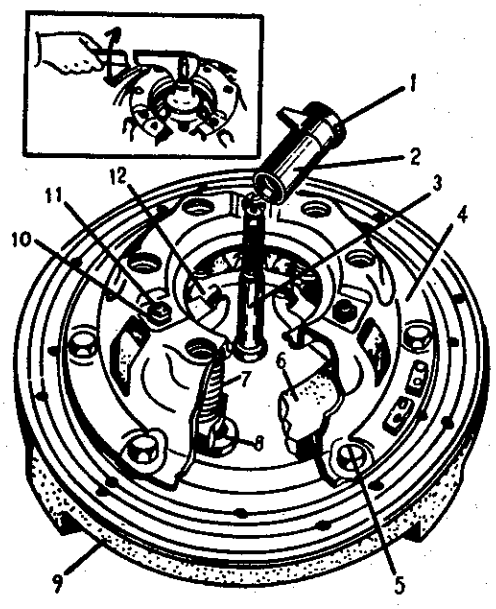


Fig. 4

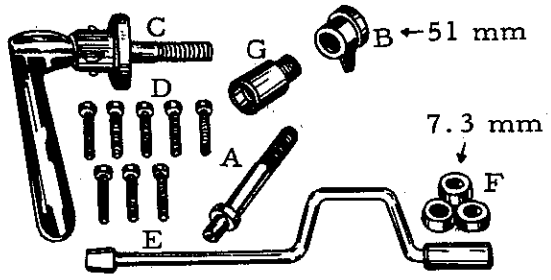
Now place the clutch assembly on the three spring washer so that the holes in the cover coincide with the tapped holes in the plate, insert the setscrews provided and tighten them, a little at a time, by diagonal selection until the cover is firmly attached to the base plate at all possible points. This 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 retaining springs and remove the three eye-bolt nuts or adjusting nuts.

Slowly release the pressure on the springs, unscrewing by diagonal selection, the setscrews securing the cover to the base plate. The clutch can be lifted to expose all components for inspection. The release levers, eye-bolts, struts and springs should be examined for wear and distortion. Renew these parts if necessary, bearing in mind that the thrust springs must only be renewed in sets.

Clean all parts and lubricate the bearing surfaces of the levers eye-bolts, etc., sparingly with grease.



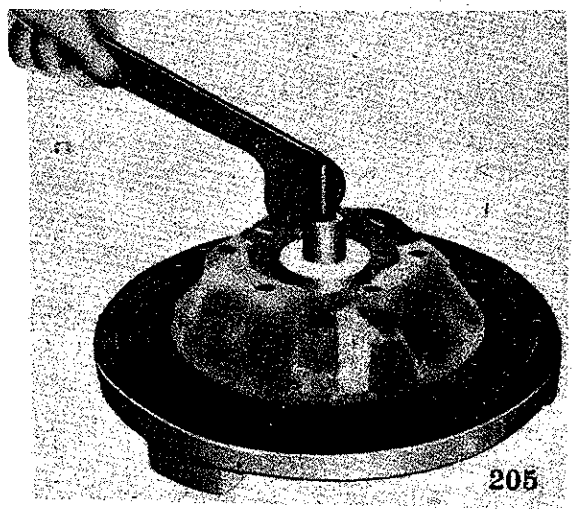


Fig. 5 Assembling tool

Assembling

Place the pressure plate over the three spacing washers on the base plate, with the thrust springs in position on the pressure plate (see Fig. 6). Assemble the release lever, eye-bolt and pin holding the threaded end of the eye-bolt the inner end of the lever as close together as possible. with the other hand, insert the strut in the slots on the pressure plate lug sufficiently to allow the plain end of the eye-bolt to be inserted in to the hole in the pressure plate.

Move the strut upward into the slot in the pressure plate lug and over the ridge on the short end of the lever and drop it into the groove formed in the latter.

Fit the other two levers in a similar manner. Place the cover over the assembled parts, ensuring that the anti-rattle springs are in position, and that the tops of the thrust springs are directly under the seats in the cover. In addition the machined portions of the pressure plate lugs must be directly under the slots in the cover through which they have to pass.

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 screw, a little at a time, by diagonal selection to prevent distortion to the cover.

The eye-bolts and pressure plate lugs must be guided through the holes in the cover at the same time.

Finally repeat the procedure to make quite sure the release levers are seating properly and gauge again. Secure the eye-bolt nuts and fit the release lever plate on the tips of the release levers, then secure by means of the three retaining springs.

Release the setscrews, a little at a time, by diagonal selection, and remove the clutch assembly from the base plate.

Gauging

Screw the nuts into the eye-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 eye-bolt nuts until the height finger, when rotated, just contact the heighest point on the tip of the release levers.

Replace the height finger and pillar by the clutch actuating mechanism (see 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.

Refacing the Driven Plate

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

Each rivet should be removed by using a 3.5 mm. diameter drill. The rivets should not be punched out. Rivet one new facing in position, then if the correct tool is not available, use a bluntended center punch to roll the rivet shanks securely against the plate. The second facing should then be reveted on the opposite side of the plate with the clearance 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 wabbling 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 chambered 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, tightening 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 ft lbs = 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 suspened pedal.

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

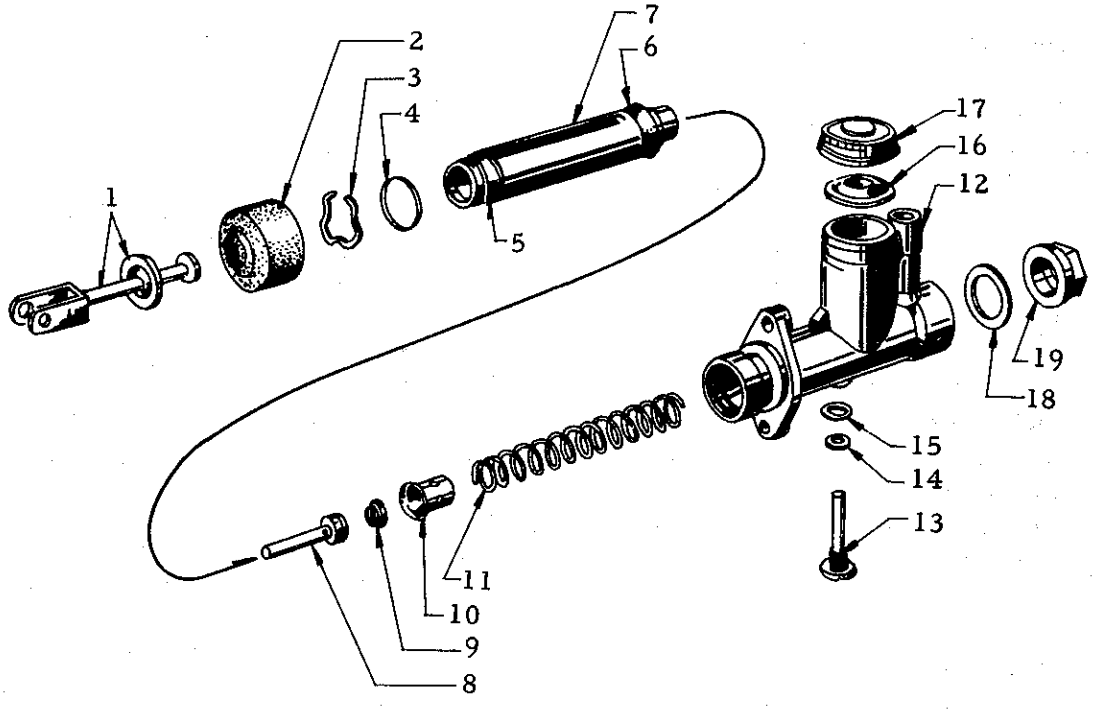


Fig. 1 Components of the master cylinder

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

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 and may 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 cups 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

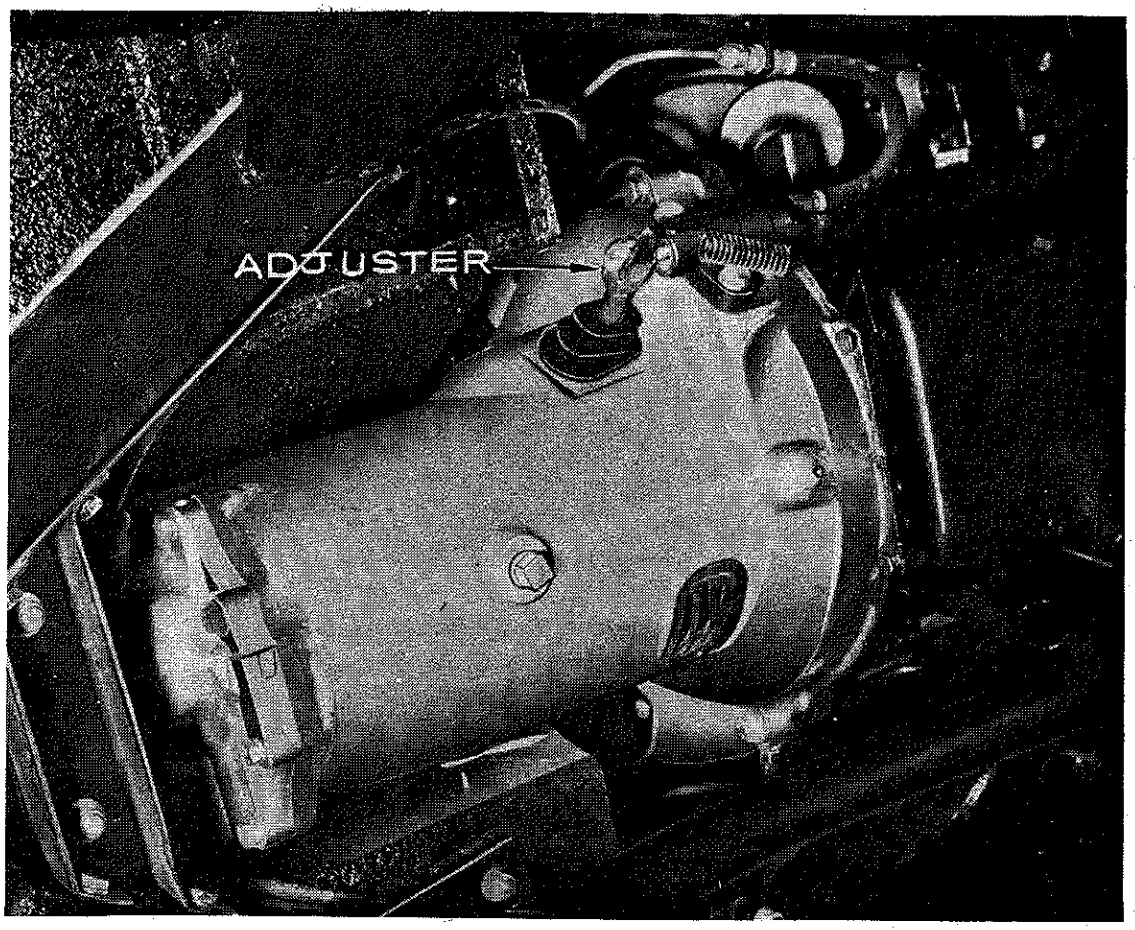
Smear the assembly well with the recommended brake fluid, and insert the assembly into the bore of the cylinder end with piston cups lips in the bore.

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.



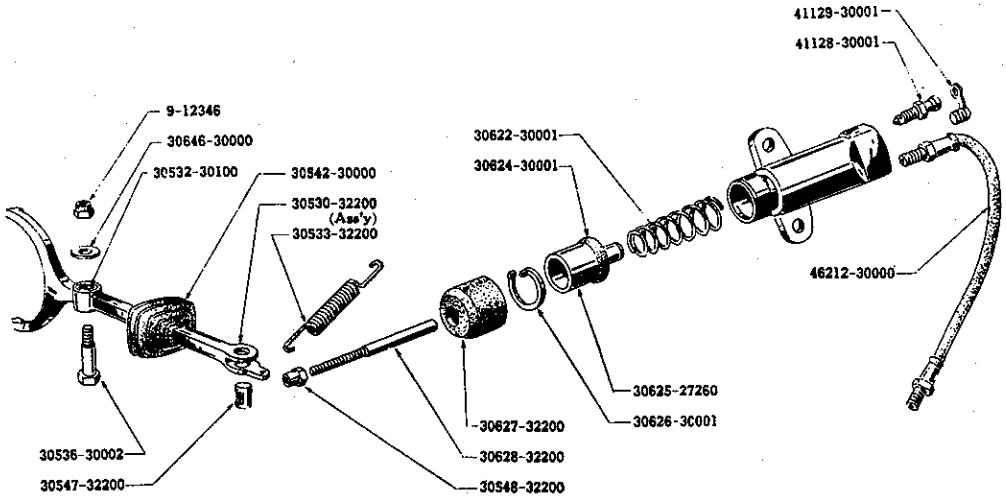


Fig. 2 Clutch operating

Dismantling

Remove the rubber dust cap from the bleed screw attach a bleed tube, open the bleed screw three-quarter 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 of 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 pinch bolt, and screw in the pipe union.

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 bearing, and the surface pushes the release plate.

TRANSMISSION

GENERAL DATA

Model	4 stages for forward, 1 stage for reverse remote controled
	Synchro-meshed for speed # 2. 3 & 4
Type of gear	Synchro-meshed helical gear type
Speed #1	3.515
Speed #2	2.140
Speed #3	1.328
Speed #4	1.000
Reverse	4.597
No. of tooth of gear	
Main drive gear	21
Main shaft 3rd gear	25
Main shaft 2nd gear	31
Main shaft 1st gear	28
Counter drive gear	29
Counter third gear	26
Counter second gear	20
Counter first gear	11
Reverse idler gear	13
Reverse idler gear	17

BACKLASH OF VARIOUS GEARS

(Play on revolutional direction)

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

Between speed #2 synchronizer and main shaft spline	0.003-0.12 mm (0.0014-0.0048 in.)
Between #2 synchronizer and speed #1 gear	0.075-0.125 mm (0.003-0.005 in.)
Between speed #1 gear and speed #2 gear	0.075-0.125 mm (0.003-0.005 in.)

MAIN DRIVE GEAR AND SHAFT

Inner diameter of bearing at rear end of main drive gear	20.485-20.503 mm (0.8064-0.8072 in.)
Outer dia. of bearing at front end of main shaft	14.460-14.448 mm (0.5693-0.5688 in.)
Main shaft pilot bearing	Needle roller bearing
No. of needles of needle roller bearing	18
Dia. x height of dittoed bearing	3 mm x 28 mm (0.118 in. x 1.102 in.)
Inner dia. of 3rd gear bearing hole	33.388-33.401 mm (0.3144-1.3149 in.)
Outer dia. of 3rd gear bush (before pressing in)	33.312-33.325 mm (1.3114-1.3119 in.)
Play of periphery of 3rd gear bush	0.06-0.09 mm (0.0023-0.0035 in.)
Amendment limit of dittoed play	0.15 mm (0.0059 in.)
Inner dia. of 2nd gear bearing hole	33.388-33.401 mm (1.3144-1.3149 in.)
Outer dia. of 2nd gear bush	33.312-33.325 mm (1.3114-1.3119 in.)
Gap at periphery of 2nd gear bush	0.06-0.09 mm (0.0023-0.0035 in.)
Amendment limit of dittoed gap	0.15 mm. (0.0059 in.)
Thickness of front thrust washer on main shaft	3.975-4.001 mm (0.1564-0.1575 in.)
"	4.026-4.051 mm (0.1585-0.1595 in.)
"	4.077-4.102 mm (0.1605-0.1614 in.)
Thickness of interlocking ring on 2nd & 3rd gear bush	3.937-3.962 mm (0.1549-0.1559 in.)
Thickness of gear thrust washer on main shaft	4.826-4.801 mm (0.1900-0.1890 in.)
End play of 2nd & 3rd gear	0.12-0.16 mm (0.0048-0.0062 in.)

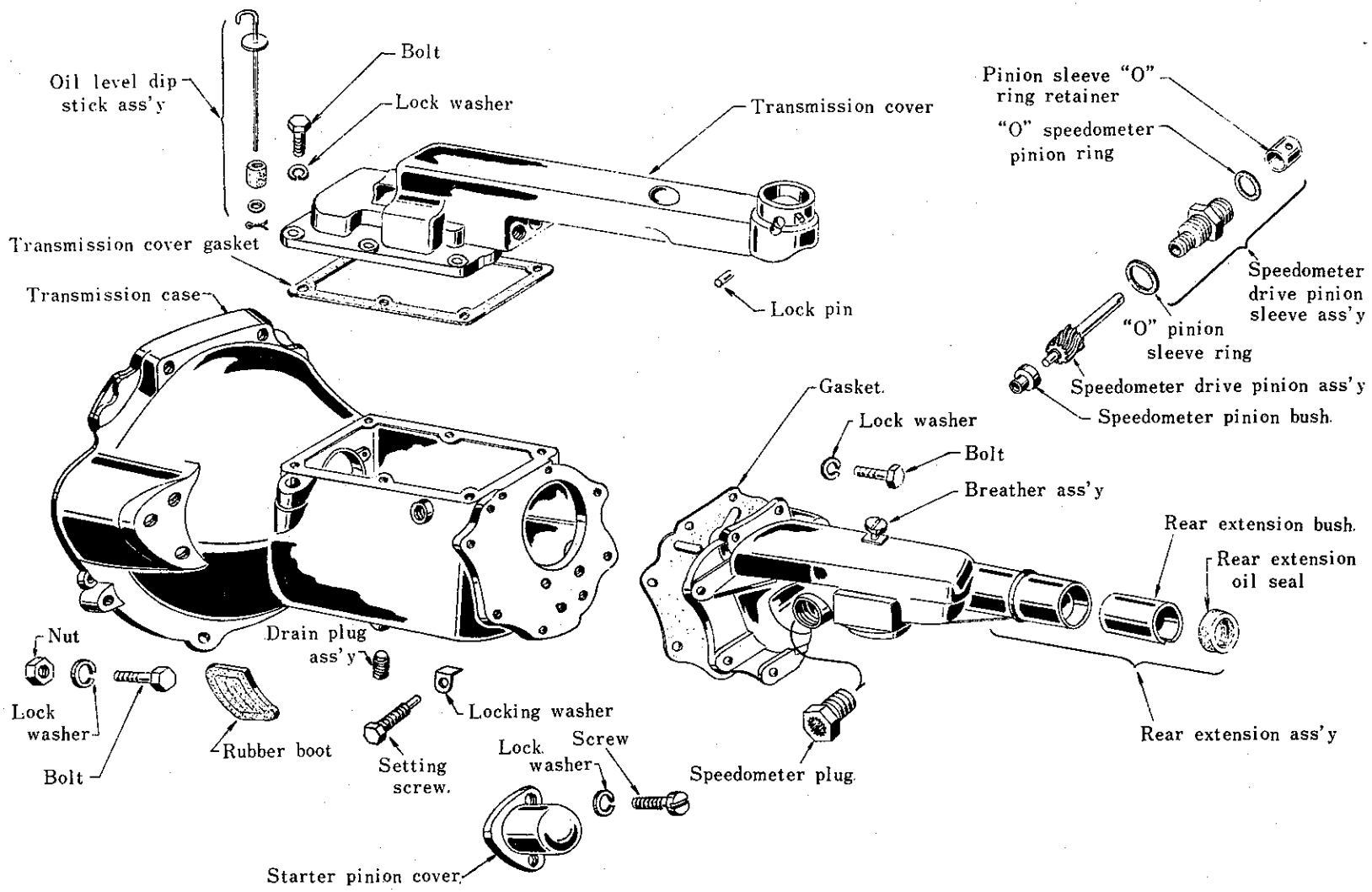
Amendment limit of dittoed play	0.25 mm (0.01 in.)
Synchronizer spring	
Free length	127 mm (0.49 in.)
Outer diameter	6.7 mm (0.25 in.)
Coil diameter	0.8 mm (0.03 in.)
Tension	2 kg. at 8 mm.
Outer dia. of synchronizer locating hole	9/32 in. (7.144 mm.)

COUNTER GEAR

Inner dia. at gear bearing	22.420-22.433 mm (0.8826-0.8831 in.)
Outer dia. of shaft	16.391-16.401 mm (0.6452-0.6456 in.)
Type of bearing	Needle roller bearing
No. of needles	20 x 2 (front & rear)
Dia. x length	3 mm. x 23.8 mm (0.118-0.936 in.)
Thickness of front thrust washer	3.91-3.96 mm (0.154-0.156 in.)
Thickness of rear thrust washer	3.96-3.91 mm (0.1560-0.1540 in.)
	4.013-3.988 mm (0.1580-0.1569 in.)
	4.089-3.140 mm (0.161-0.160 in.)
	4.166-4.140 mm (0.164-0.163 in.)
End play	0.04-0.06 mm (0.0015-0.0023 in.)
Amendment limit of dittoed play	0.10 mm. (0.004 in.)

REVERSE GEAR

Inner dia. of bush	14.338-14.376 mm (0.564-0.566 in.)
Outer dia. of reverse shaft	14.249-14.262 mm (0.561-0.5614 in.)
Gap between shaft & bush	0.076-0.127 mm (0.003-0.005 in.)



Transmission case

DISASSEMBLING THE CASE

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

Clutch Withdrawal Lever

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

Removel of Control Lever

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

Removel of Shift Rod & Shift Fork

Remove the cover from the transmission by detaching 6 bolts.

Reverse Gear

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

Countor Shaft & Gear

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

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

To remove the 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.

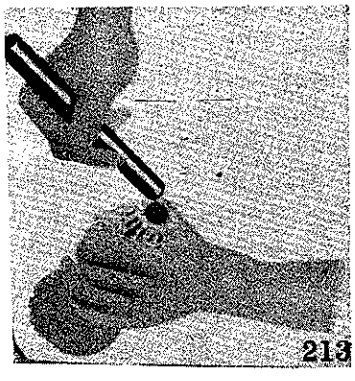


Fig. 1

Main Shaft

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

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

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

Rear Oil Seal

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

Drive Gear Shaft

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

The counter gears may now be removed from the case.

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

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

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

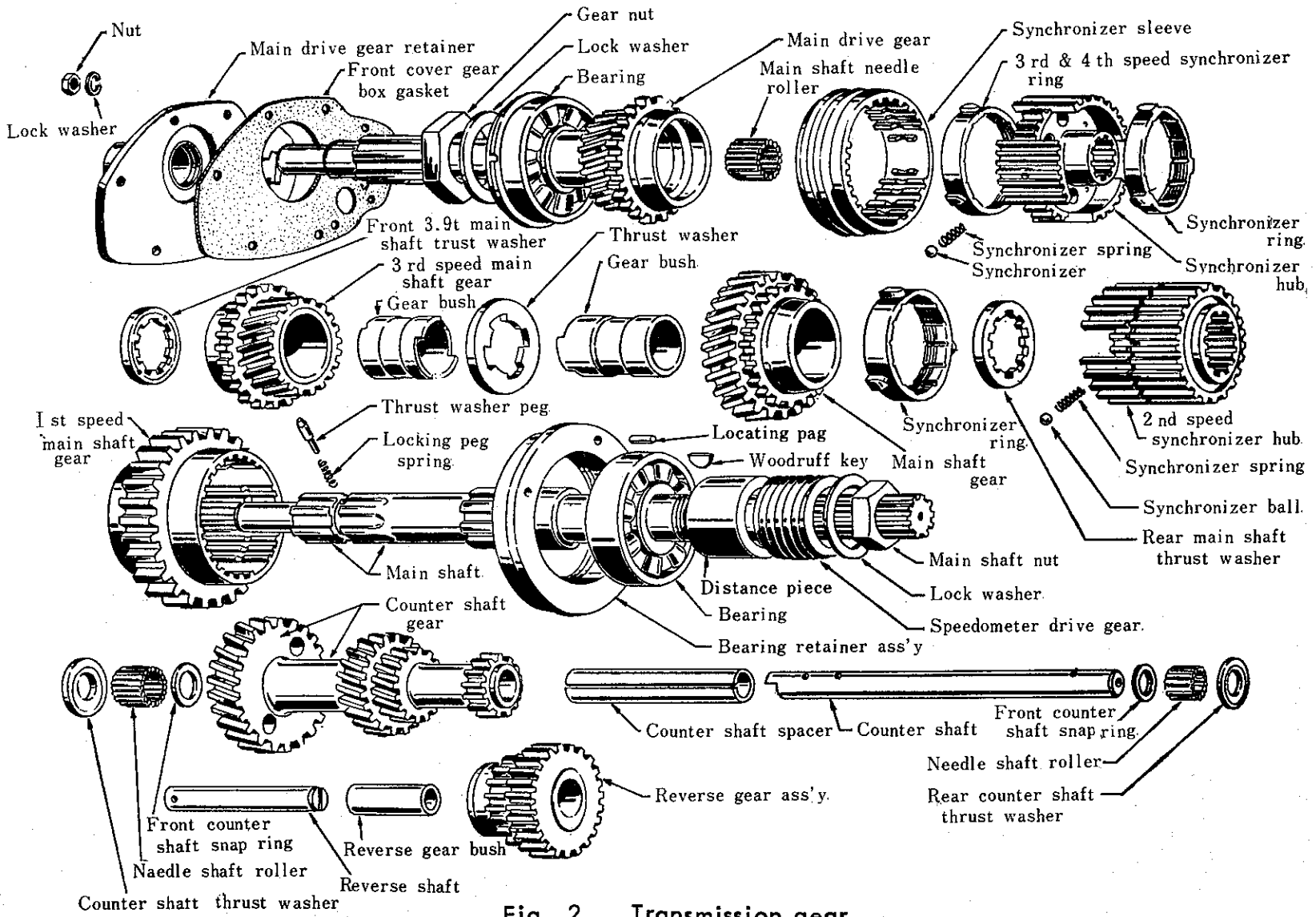


Fig. 2 Transmission gear

ASSEMBLING THE TRANSMISSION

Synchromesh Sub-Assembly

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

Counter Shaft Gears

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

Check that there is end play for the cluster gears of between 0.04 - 0.06 mm. (0.0015- 0.0023), and remedy if necessary by fitting a thicker or thinner rear washer.

Thickness of front thrust washer

3.91-3.96 mm (0.154-0.156 in.)

Thickness of rear thrust washer

3.96-3.91 mm (0.156-0.154 in.)
4.013-3.988 mm (0.1580-0.1569 in.)
4.089-4.064 mm (0.161-0.160 in.)
4.166-4.140 mm (0.164-0.163 in.)
0.04-0.06 mm (0.0015-0.0023 in.)

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

Drive Gear Shaft

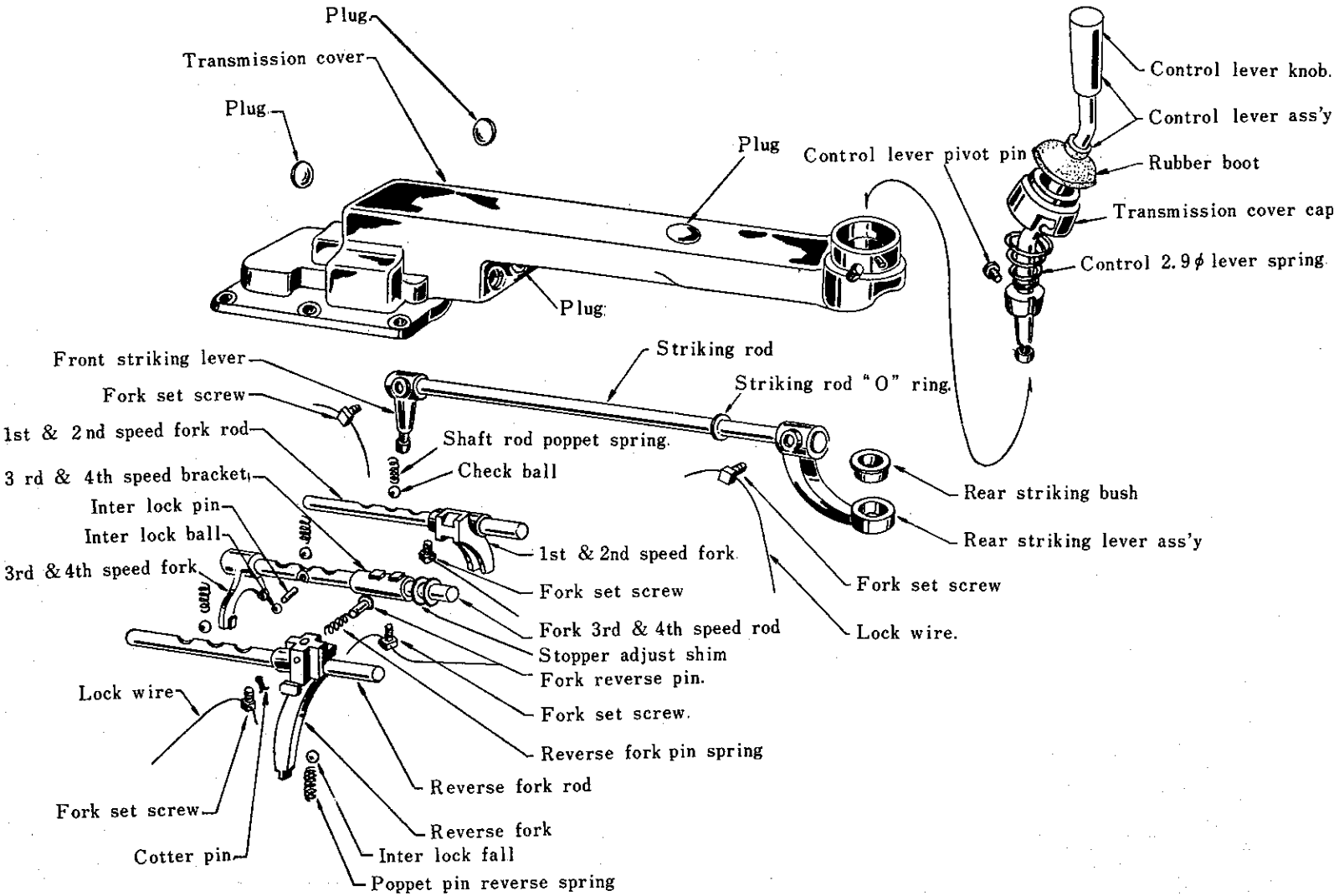
The ball journal bearing should now be drifted on to the shaft, with its spring ring away from the geared end. Position the geared end of the drive shaft in a dummy 3rd and 4th speed coupling sleeve, put the washer over the bearing, tighten the nut and lock it in position.

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

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

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

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



Transmission fork & rod

Main Shaft

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

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

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

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

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

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

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

Reverse Gear

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

PROPELLER SHAFT & UNIVERSAL JOINTS

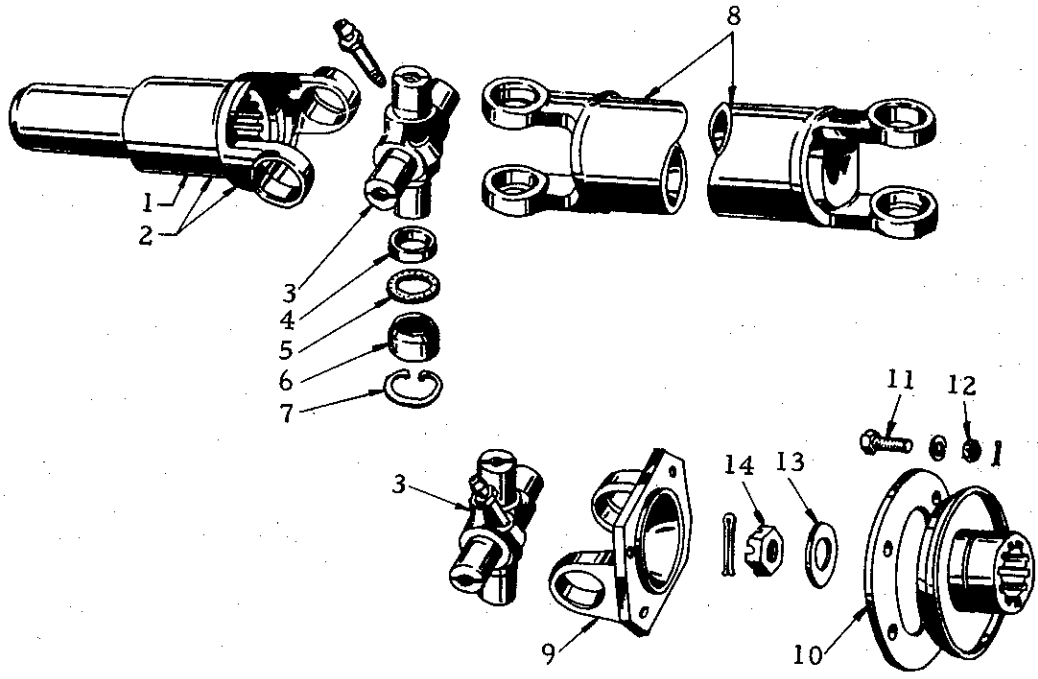


Fig. 1 Propeller shaft & joint

(1) Dust cover
(2) Sleeve yoke
(3) Journal
(4) Oil seal bearing retainer
(5) Oil seal
(6) Bearing assembly
(7) Snap ring
(8) Propeller shaft assembly
(9) Flang yoke
(10) Companion flange
(11) Bolt
(12) Nut
(13) Plane washer
(14) Drive pinion nut
(15) Cotter pin

PROPELLER SHAFT & UNIVERSAL JOINTS

Dimensions:	Length x Outside diameter x Inside diameter 920 x 63.5 - 60.325	
Universal joint:		
Journal diameter	14.7ϕ	0.579 in
Bearing race inside diameter	19.5ϕ	0.769 in
Number of needle (roller) bearings	22	
Needle bearing outer diameter	2.4ϕ	0.095 in

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 bearing assemblies. (Fig. 1)

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

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

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

Removal

Remove the rear propeller shaft flange from the pinion flange of the near 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

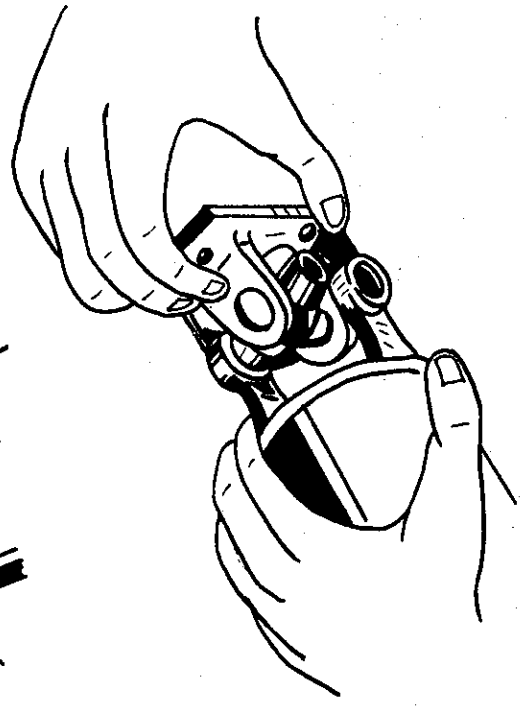
Clean away the paints from all the snap rings and bearing faces, to ensure easy extracition of the bearings.

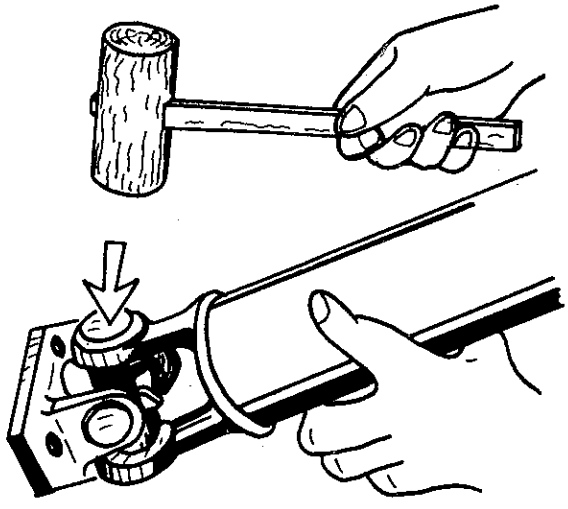
Remove the snap rings by pressing these ends together and prise out with screw driver. If the ring done not come out, tap the bearing face lightly to relieve the pressure against the ring.

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

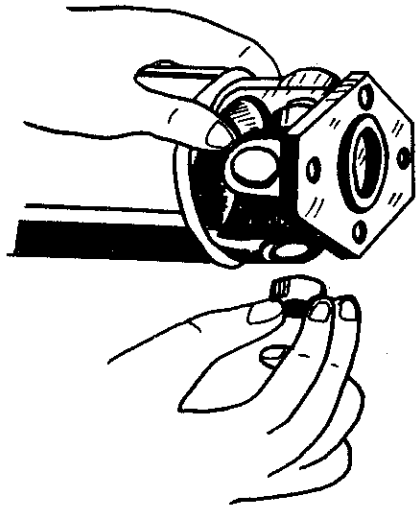
If difficulty is experienced, use a small bar to tap the bearing from the inside, taking care not to damage the race itself, being careful not to loss any of the needles.

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 trunions.

Any ovality in the trunion bearing holes indicates the fitting of newyokes.

The straightness of the shaft is determined by measuring the offcenter 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

Inspect that the drilled holes in the hournals 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 relive any pressure of the bearings on the end of the journals. It is advisable to renew cork washers and washer retainers on speder journals, using a tublar drift.

Replacing the Shaft Assmbling

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.

FRONT AXLE

Type	Independent suspention with double wishbones, coil spring telescopic shock absorbers: Stabilizing bar.
Toe-in	2 - 3 mm
Camber	1° 26'
Caster	1° 30'
Angle of inclimation of swivel axle	6° 34' (Ball joint type)
Tread:	1.213 mm
Turning angle of front wheel (Inside) (Outside)	 36° 16' 28° 20'
Min. turning radius	4.90 meters (16 feets)
Camber shim:	Standard 6 mm (Adjusting shim 1 mm, 2 mm, 4 mm)
Caster shim:	Front & Rear 1.2 mm
Tightening torque: Upper ball joint nut Lower ball joint nut Spring plate nut	 15 - 18 ft-lbs. 16 - 20 ft-lbs. 25 - 30 ft-lbs.
Upper arm spindle to cross member	35 - 42 ft-lbs.
Lower link spindle bolt	25 - 30 ft-lbs.
Nut upper ball stud with knuckle spindle	43-51 ft-lbs. (6.6-7.0 kg-m)
Nut lower ball stud with knuckle spindle	80-90 ft-lbs. (11.0-12.5 kg-m)
Tightening of spindle nut	Tighten it at 30 ft-lb. and turn it 1/8 revolution back.
Coil dia. x Center dia. x Free length - Effective coil Numbers	12.7 x 87.5 x 290 - 6
Part No.	54010 10500 (SP310-U SPL310)
S. Constant	9.5 kg/m

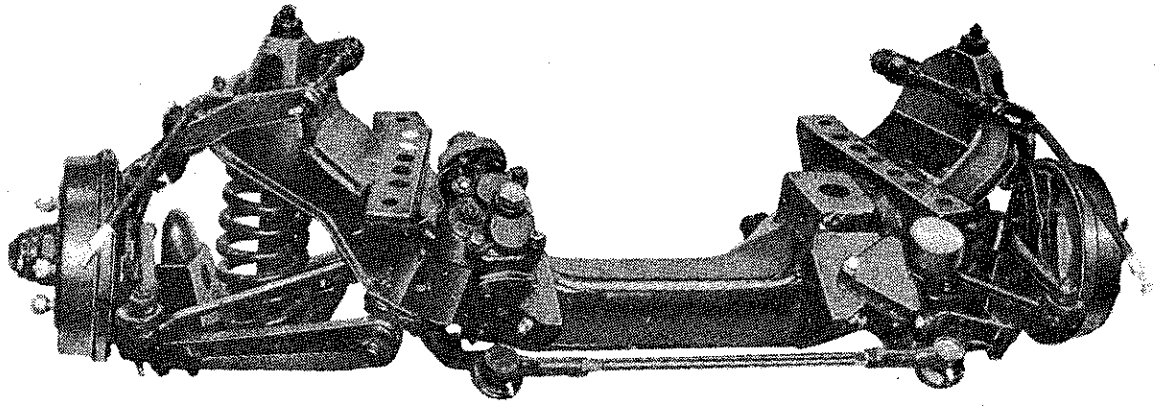


Fig. 1 Front axle

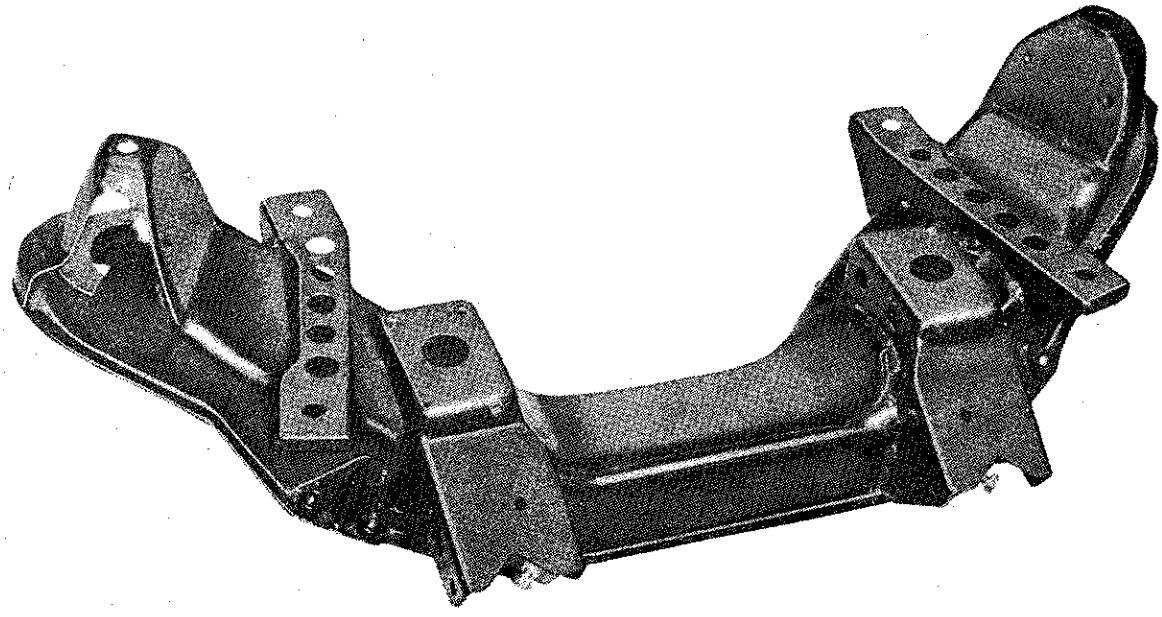


Fig. 2 Front suspension member

DISASSEMBLING THE FRONT HUB

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

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

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

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

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

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

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

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

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

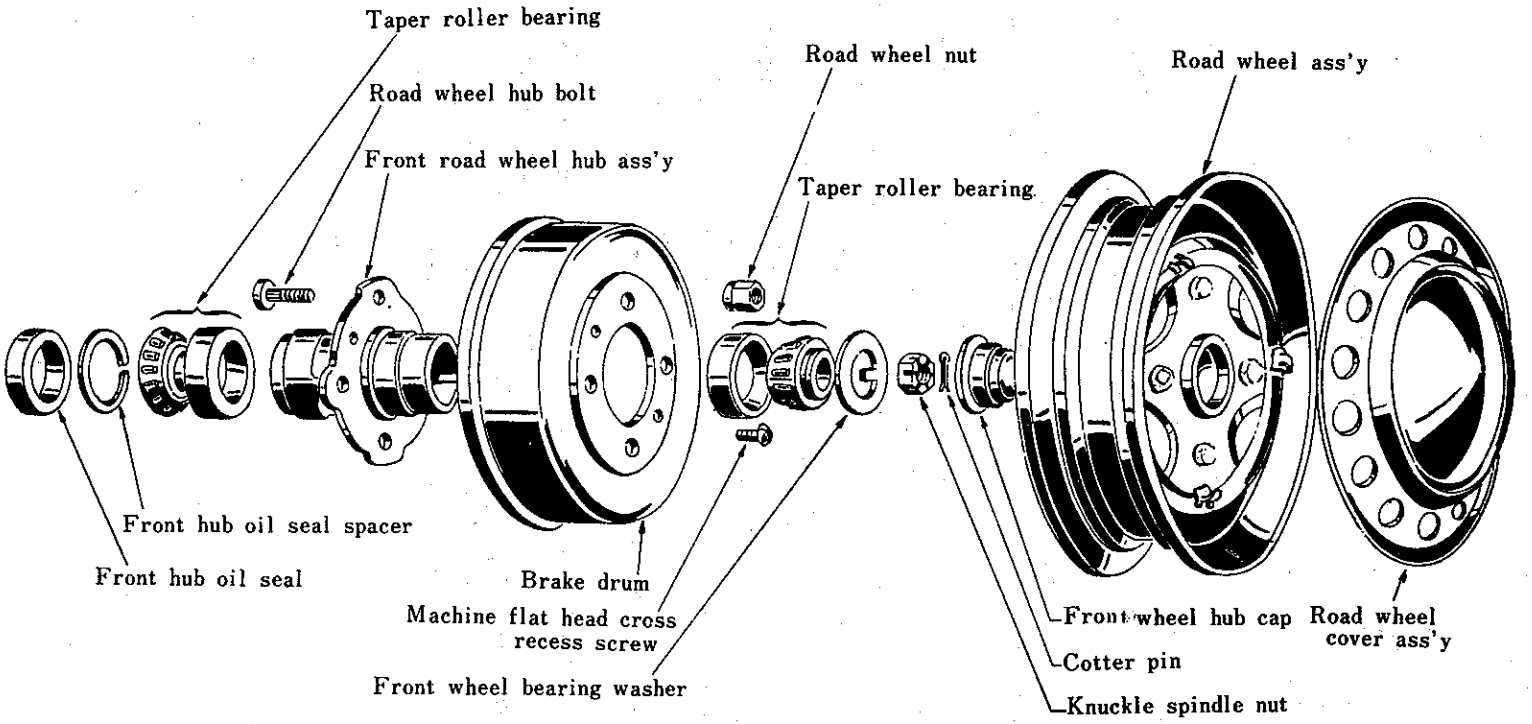


Fig. 3 Front drum & wheel

INDEPENDENT FRONT SUSPENSION

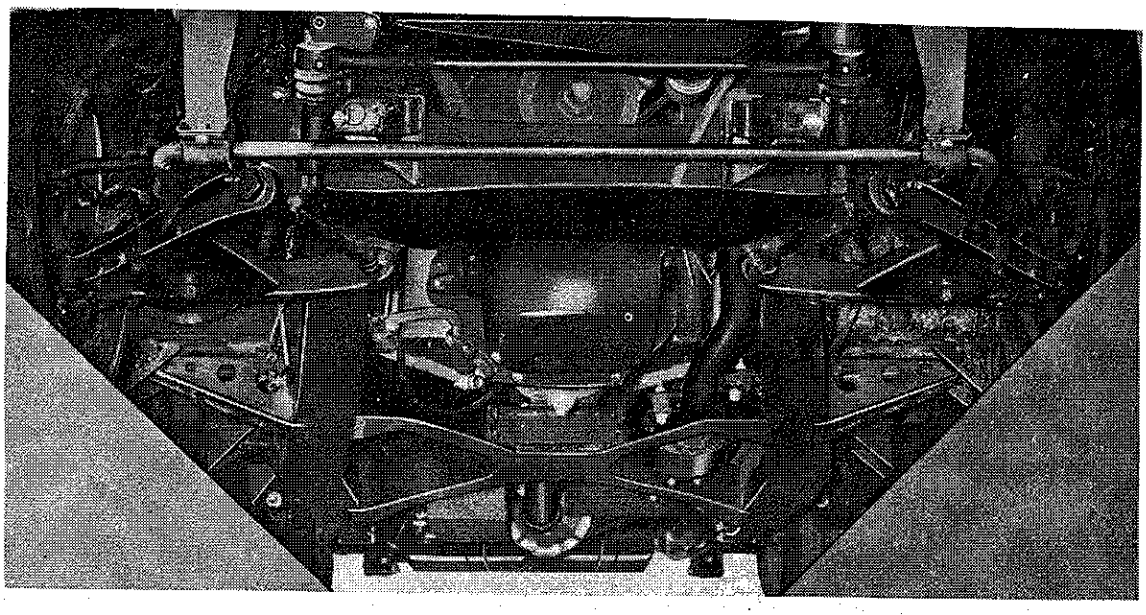


Fig. 1

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

Between these two wishbones is the coil spring, held under compression between the upper spring seat and lower spring plate which is secured to the lower wishbone by four bolts. At the swivel axle end, the upper and lower linkages are jointed by the ball joints.

The upper spindle bracket is bolted to the front suspension member with caster shims and the lower spindle is connected to the lower bracket of the suspension member.

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

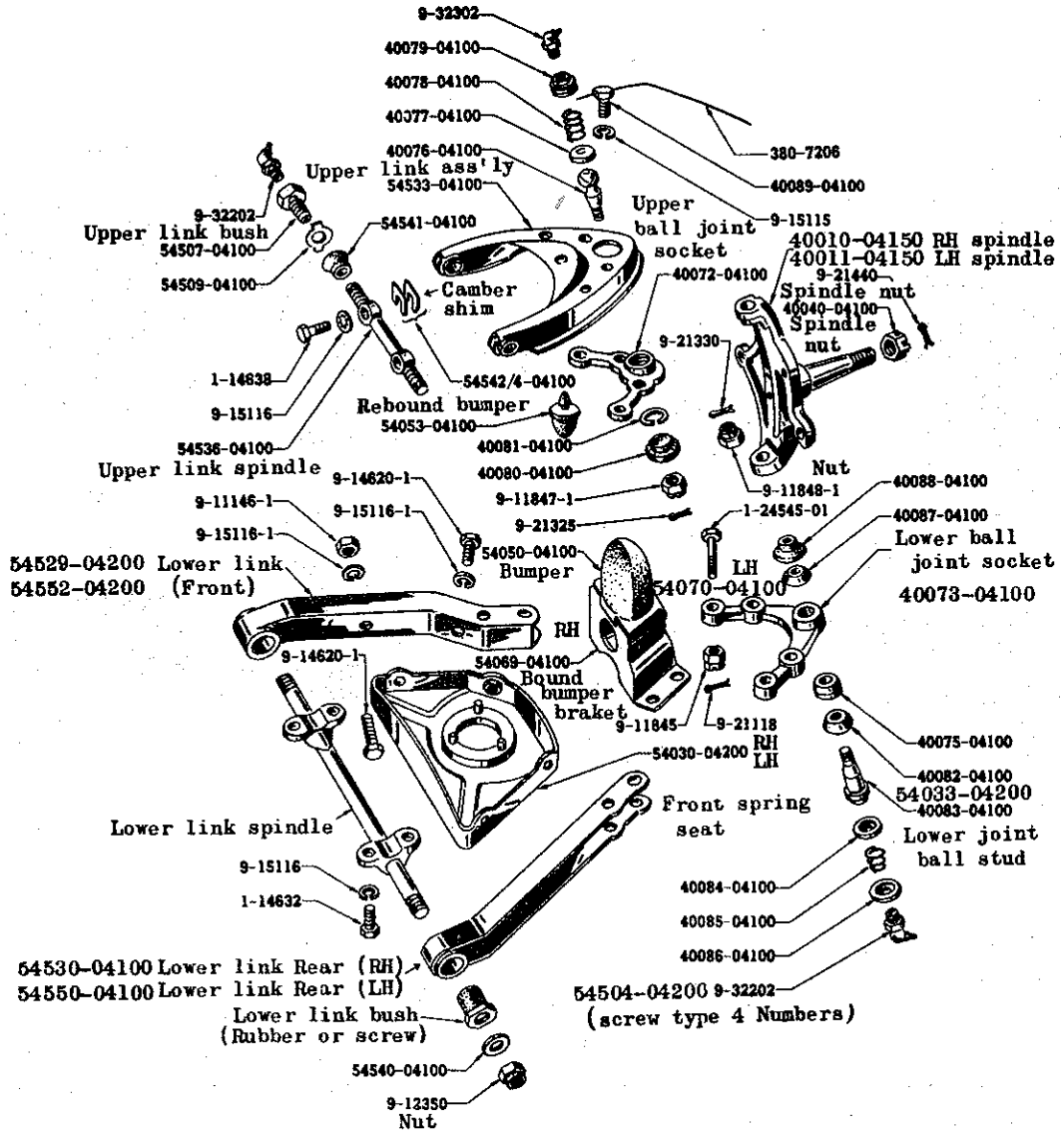


Fig. 2 Front suspension

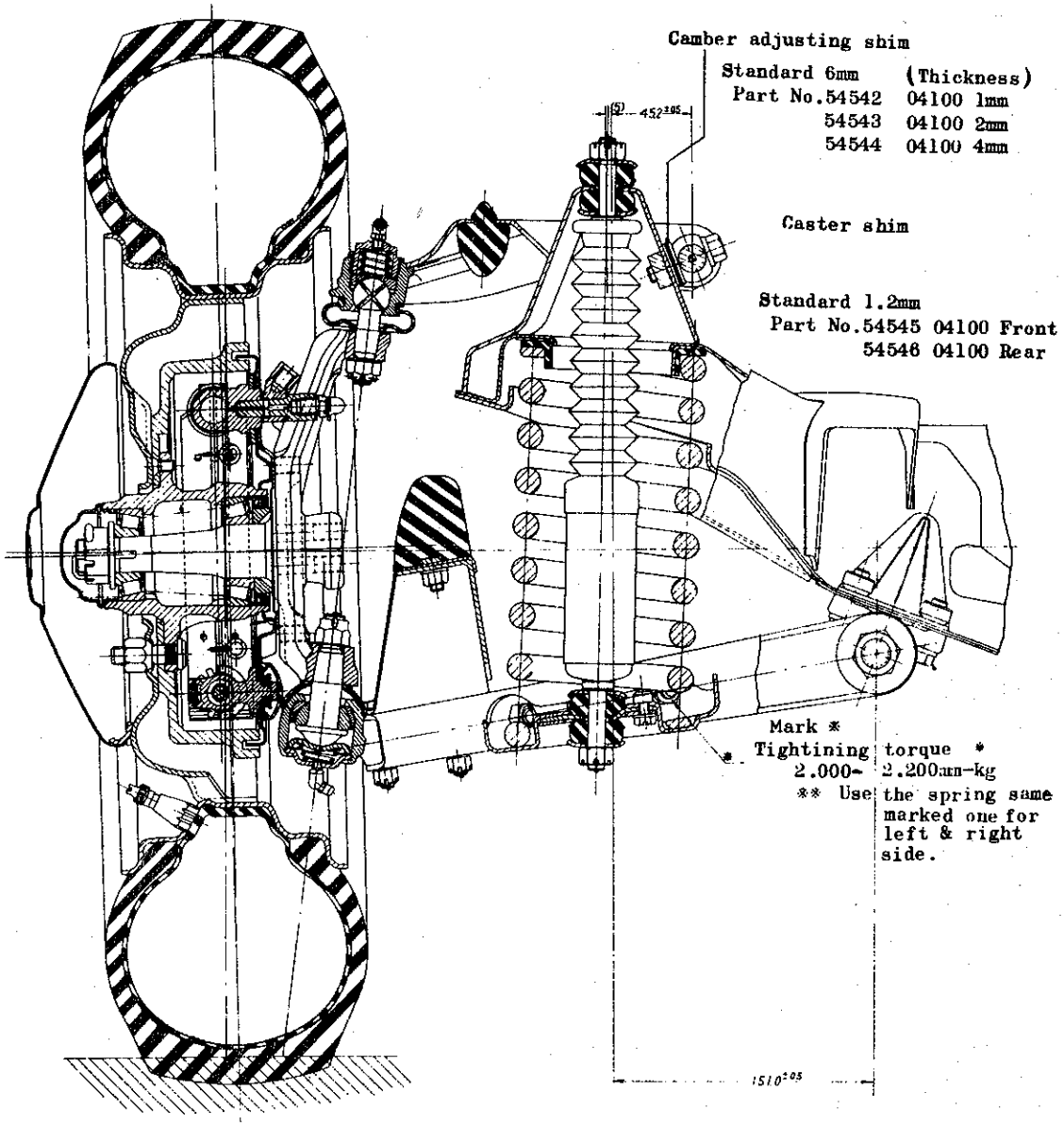


Fig. 3 Section of front suspension

BALL JOINTS AND BUSHES OF THE SWIVEL AXLE

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

Front Coil Spring

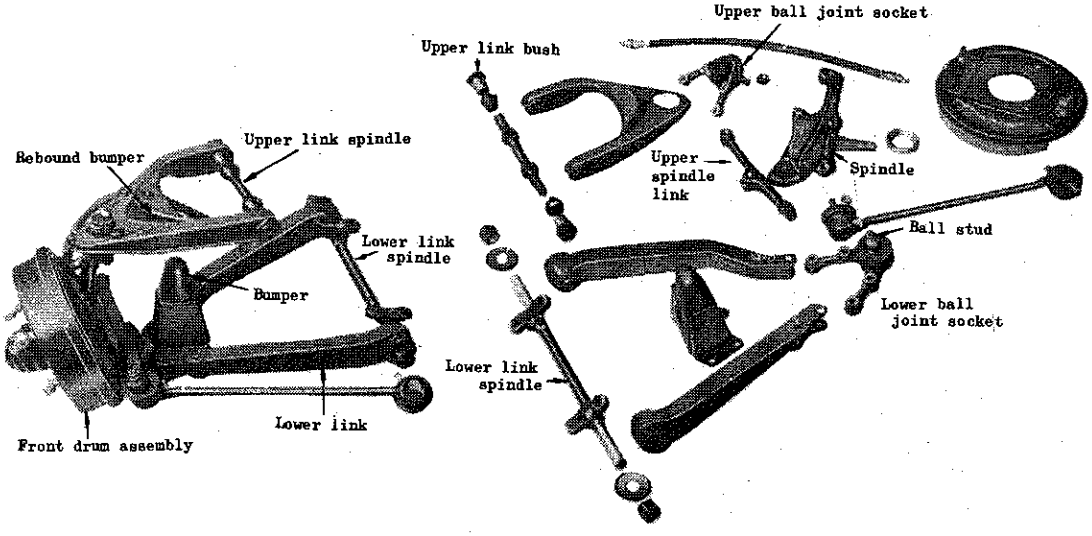


Fig. 4 Front suspension member

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

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

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

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

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

Removing the Coil Spring

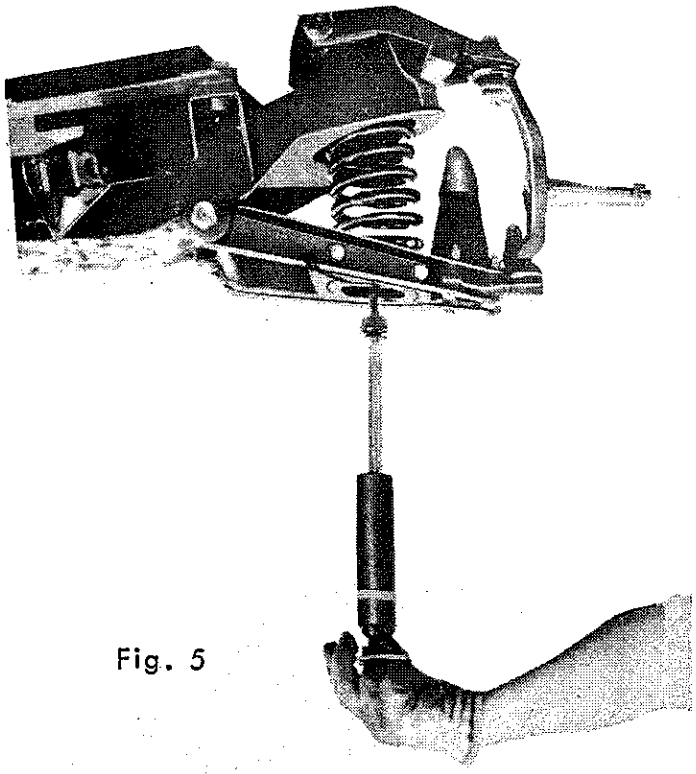


Fig. 5

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

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

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

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

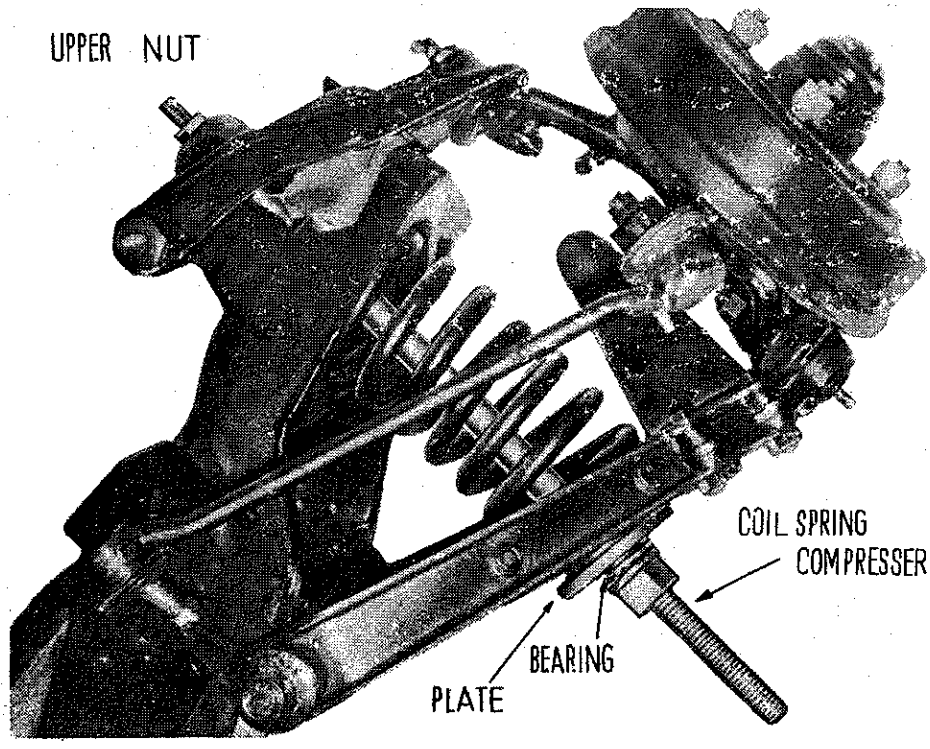


Fig. 6

Remove these bolts and release the compression from the coil spring.
When the coil spring is fully extended, take out it.

Method ② Removing the coil spring with seat plate.

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

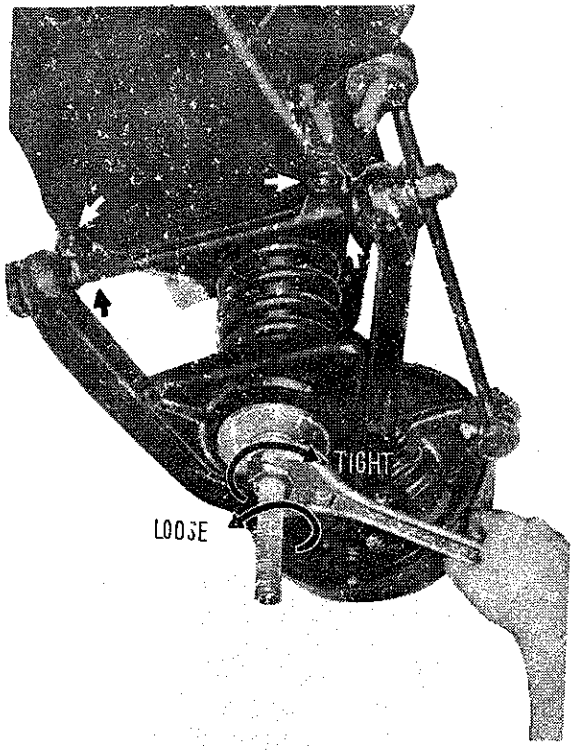


Fig. 7 Refitting the coil spring

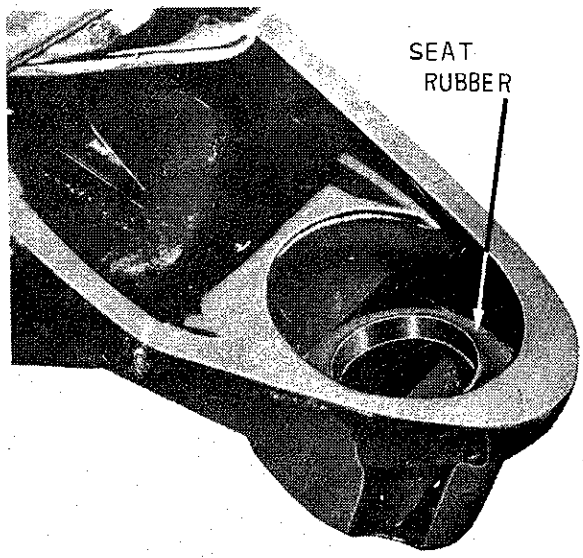


Fig. 8 Seat rubber

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

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

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

REAR AXLE

Axle Shaft Removal

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

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

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

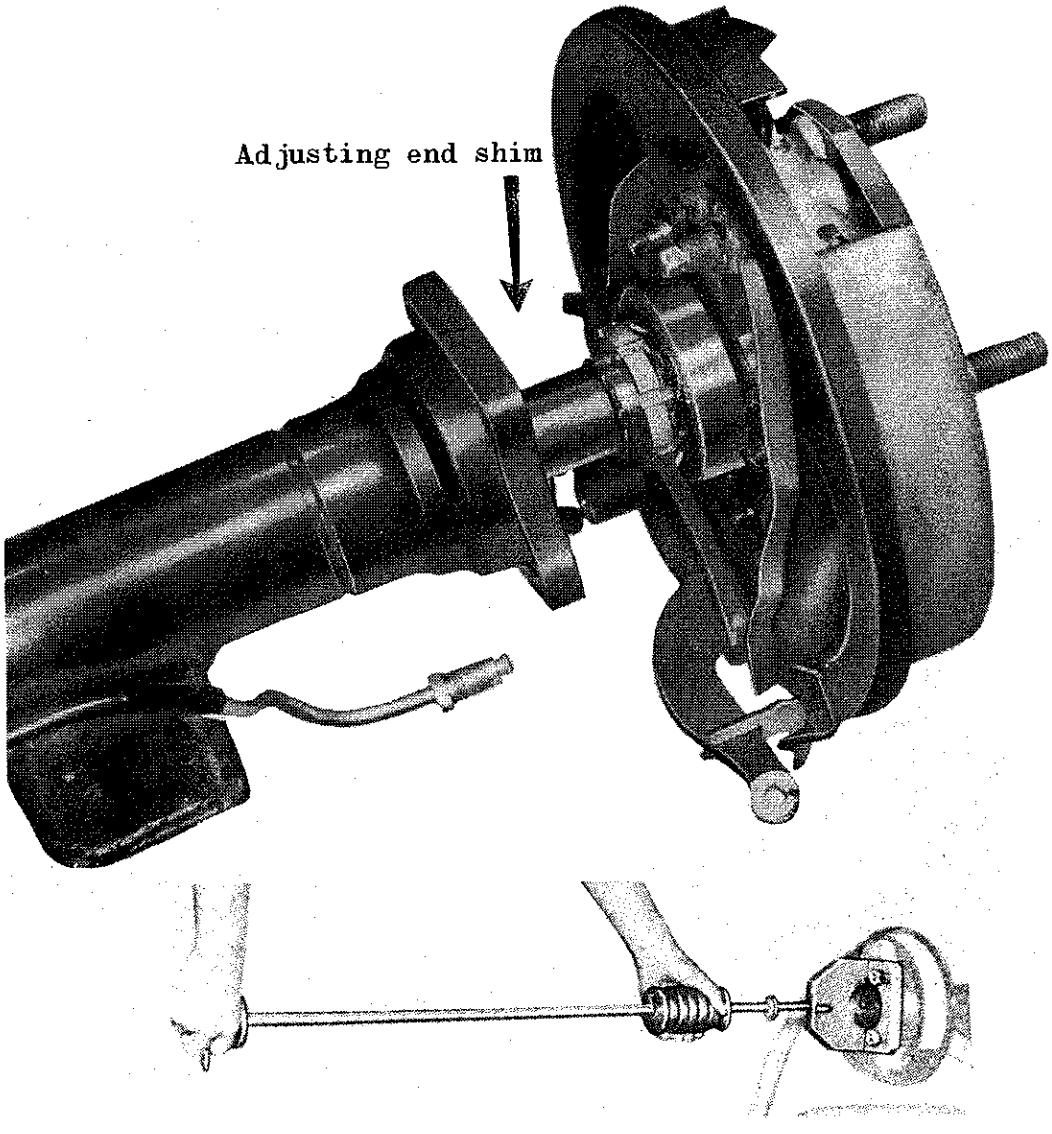
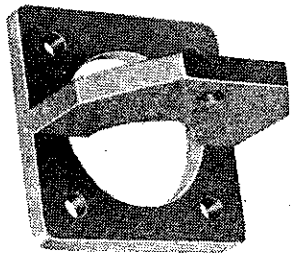


Fig. 1 Removal of axle shaft and disc assembly

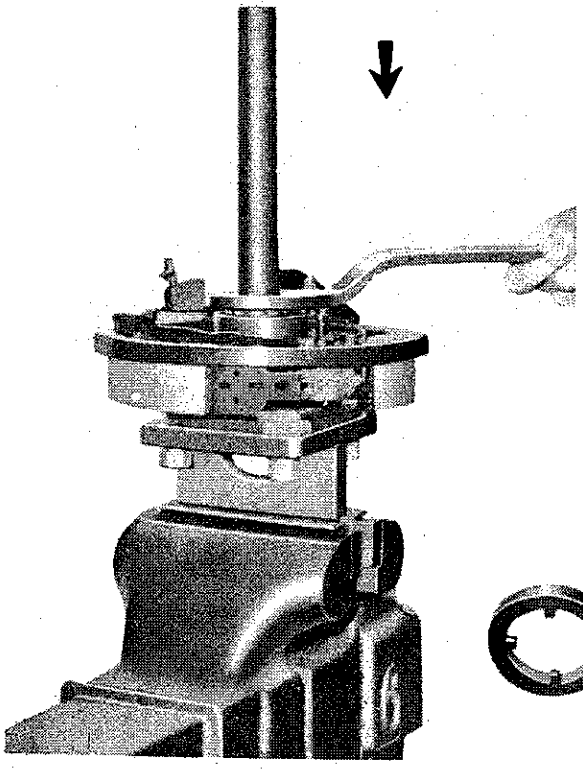
SERVICE SPECIAL TOOLS



DT-4679
Special Stand

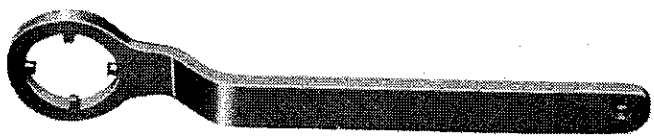
DT-4678
Swing Hummer

Disassembly and Assembly of Axle Shaft



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

DT-4680
Rear axle shaft bearing lock wrench



Rear axle shaft bearing lock nut wrench

Fig. 1

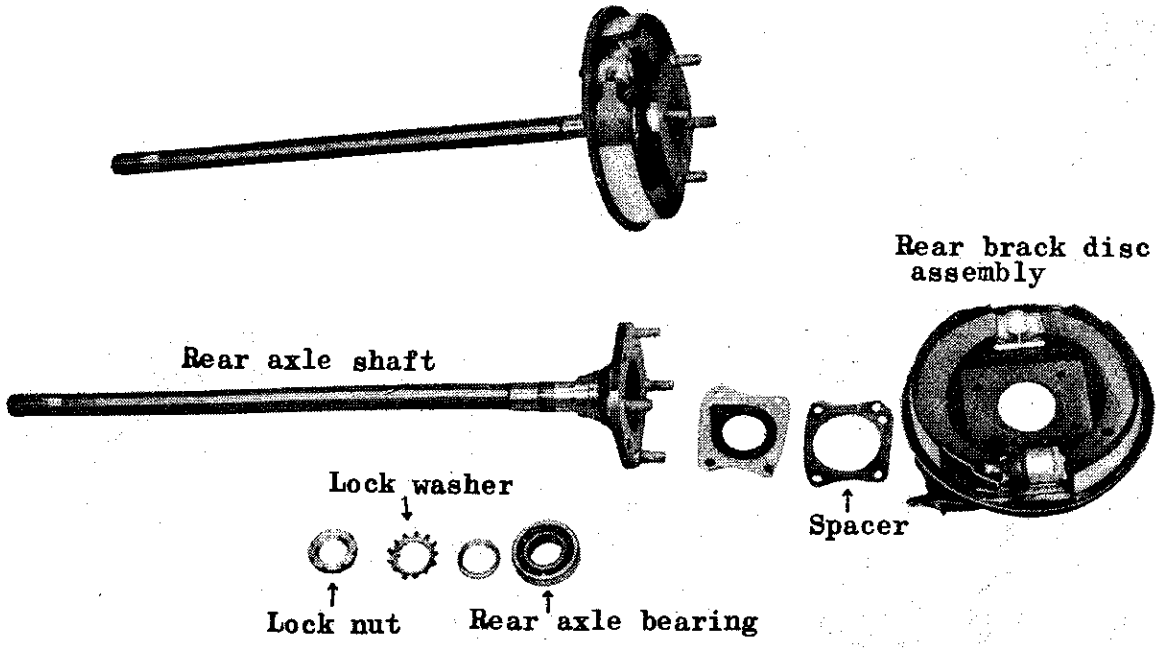


Fig. 2 Rear axle shaft & brake disc assembly

Order of Rear Axle Shaft & Brake Disc Assembly

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

The following points must be taken into consideration.

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

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

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

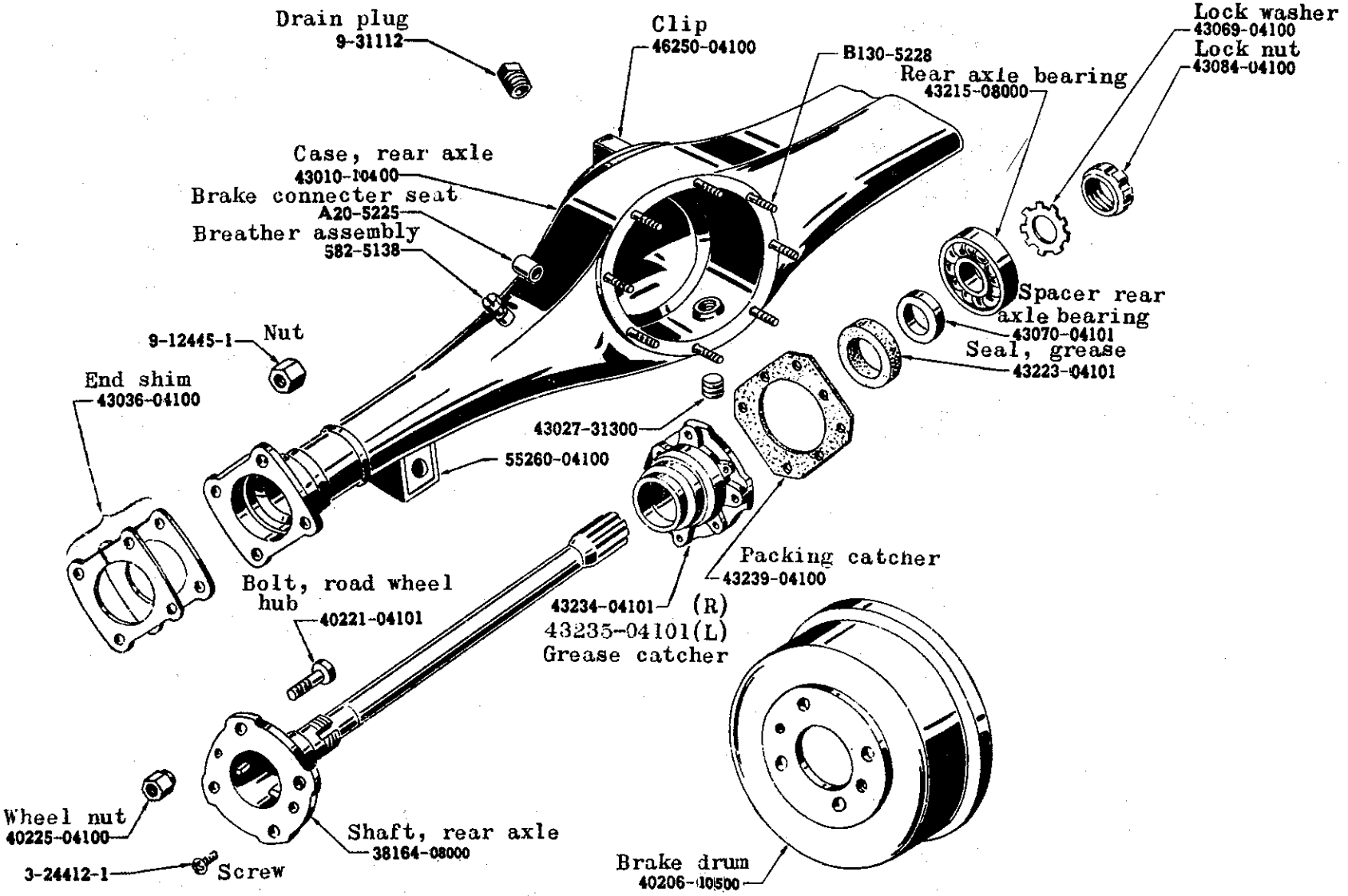


Fig. 3 Rear axle

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. 1 with the aid of side bearing puller, pull out the bearing. The puller should be handled with care in catching the hedge of bearing inner lace which is hard to hook.
Both the left and right bearing should be arranged separately.

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

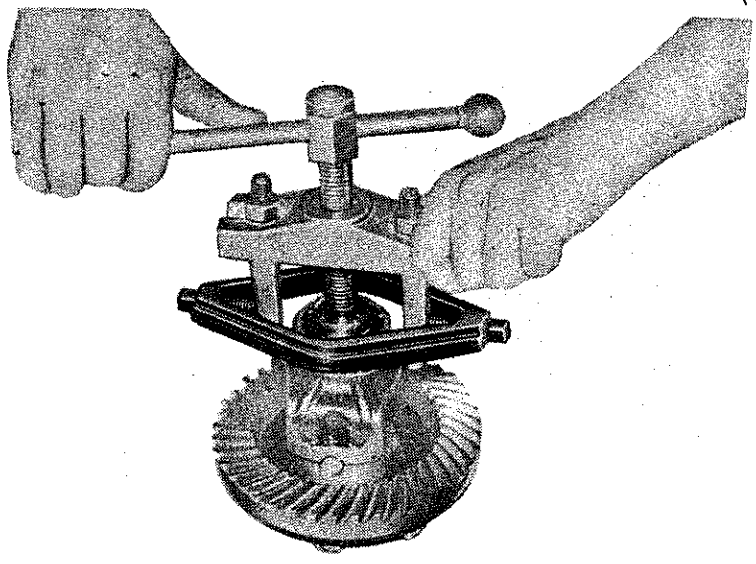


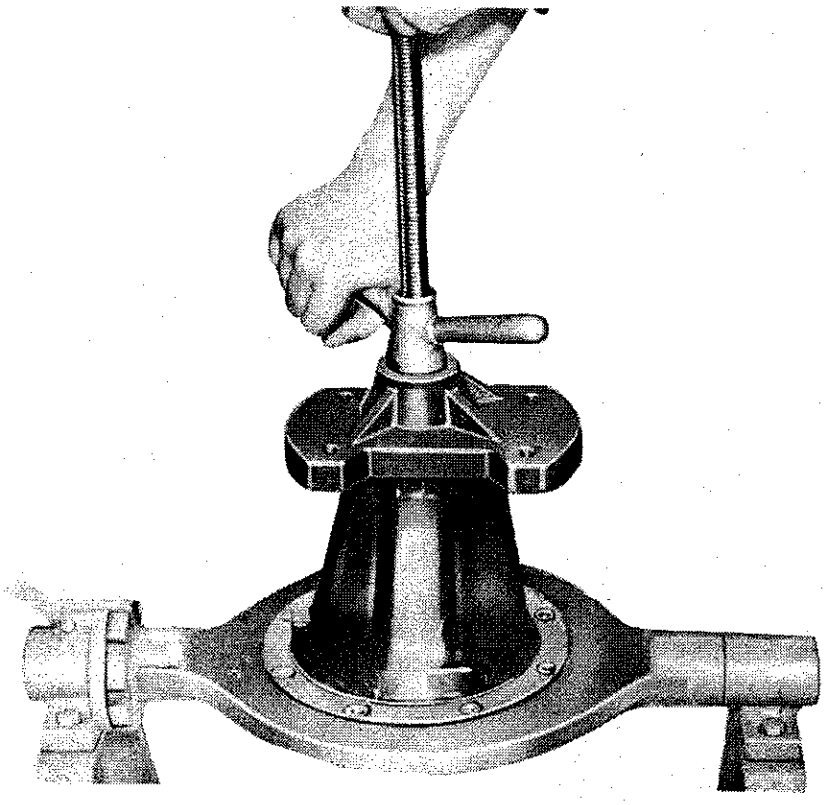
Fig. 1 Using of side bearing puller (DT4686)

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

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

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

(11) Pull out the rear bearing inner race of the drive pinion.
As illustrated in Fig. No. 2 the drive pinion rear bearing inner lace replacer and the adapter should be employed in this case. The adapter in the round form is for fixing and the other for taking off. It is easy to handle with the vice fixing one end of replacer.



Tool No. DT4782, DT4631 & DT4689

Fig. 2 Pull out the bearing race

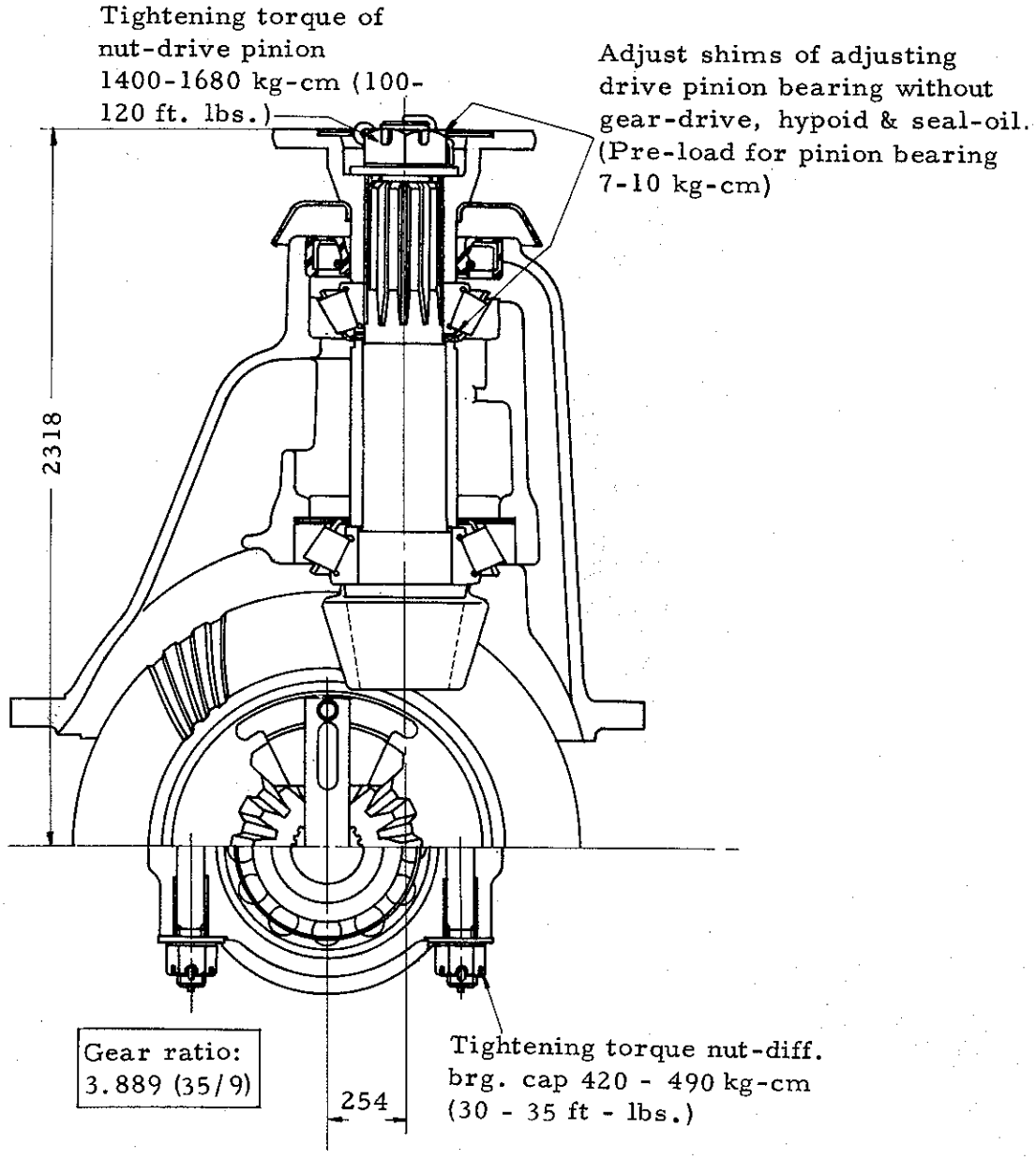
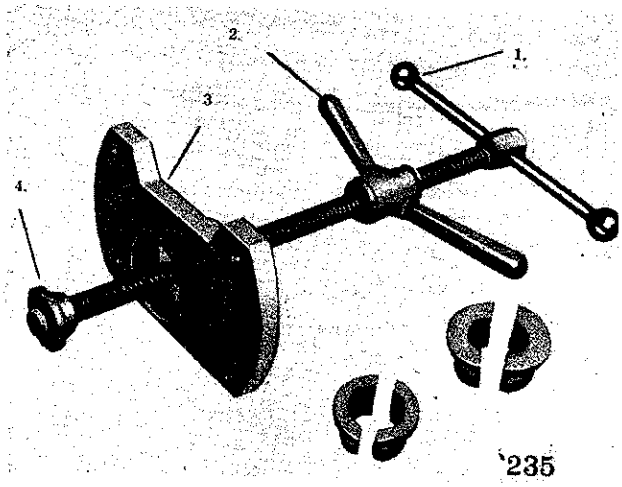
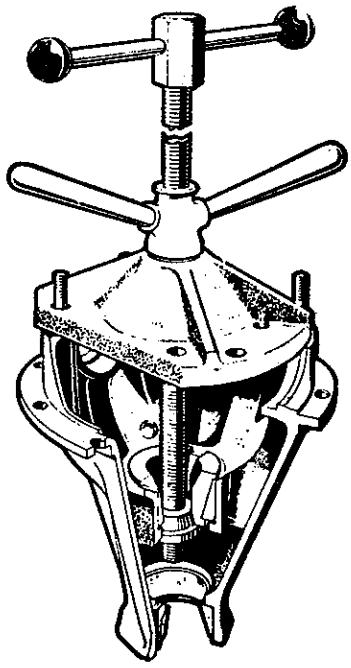


Fig. 3 Section of differential case





1. TOMMY BAR
2. WING NUT
3. TOOL BODY
4. CONE ADAPTOR FOR FRONT BEARING OUTER RACE

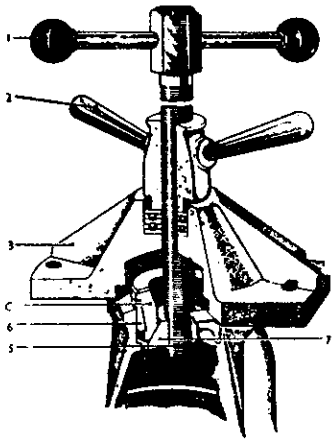


Fig. 4 Drive pinion front and rear bearing outer race replacer

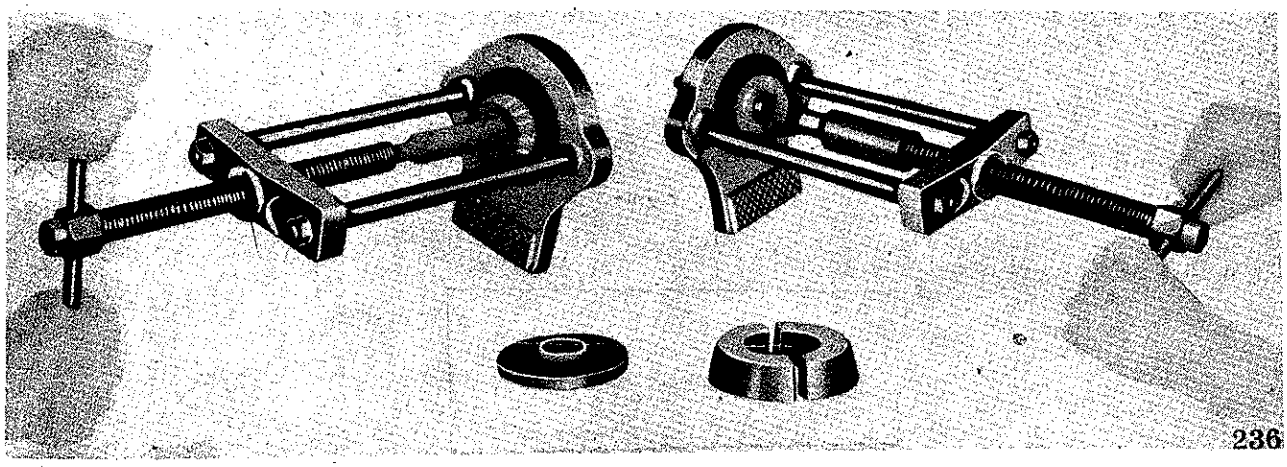


Fig. 5 Inner race replacer

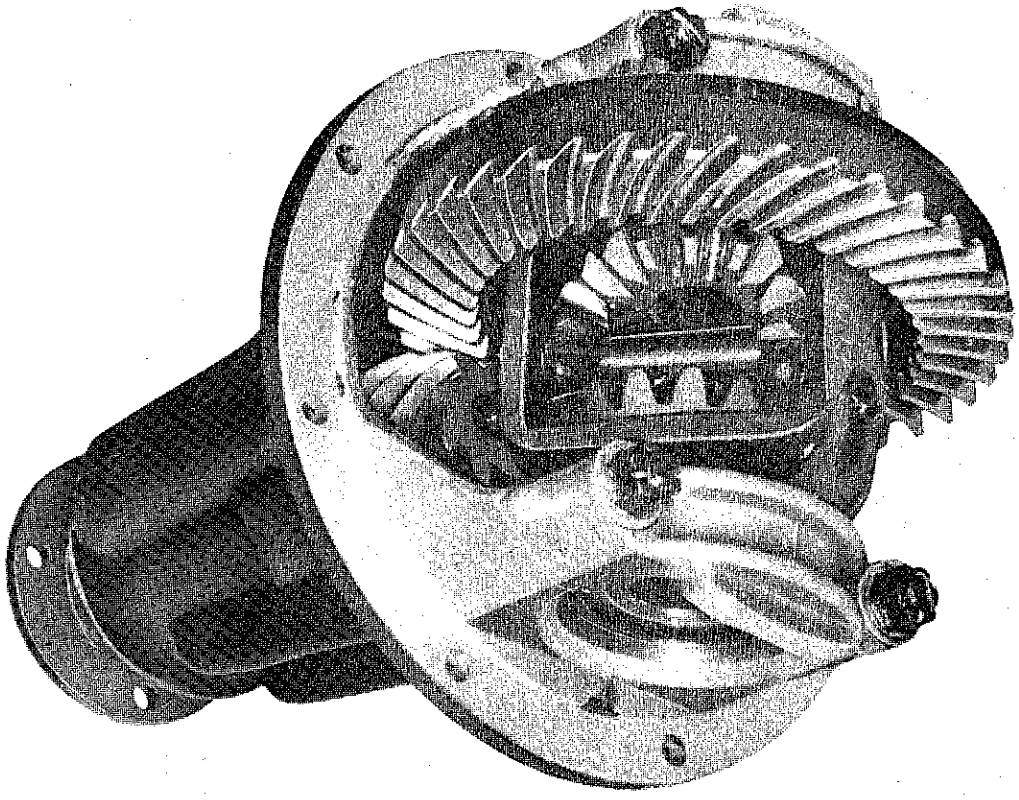


Fig. 6

(12) Taking out the rear bearing outer race of gear carrier.
The drive pinion bearing outer race replacer as illustrated in Fig. 5 should be employed in this case. In other upon the stud so as to make the screw at the center of carrier, and set the adapter at the lower frim of the race.
Supporting the tommy bar (1) and screw up till the corn (7) closely touches the adapter, then screw the wing nut to take out the rear outer race.

(13) To pull out the front bearing outer race from the gear carrier, set the tool body (3) as illustrated in Fig. 5 pull it out with adapter (B) in the way of rear race.

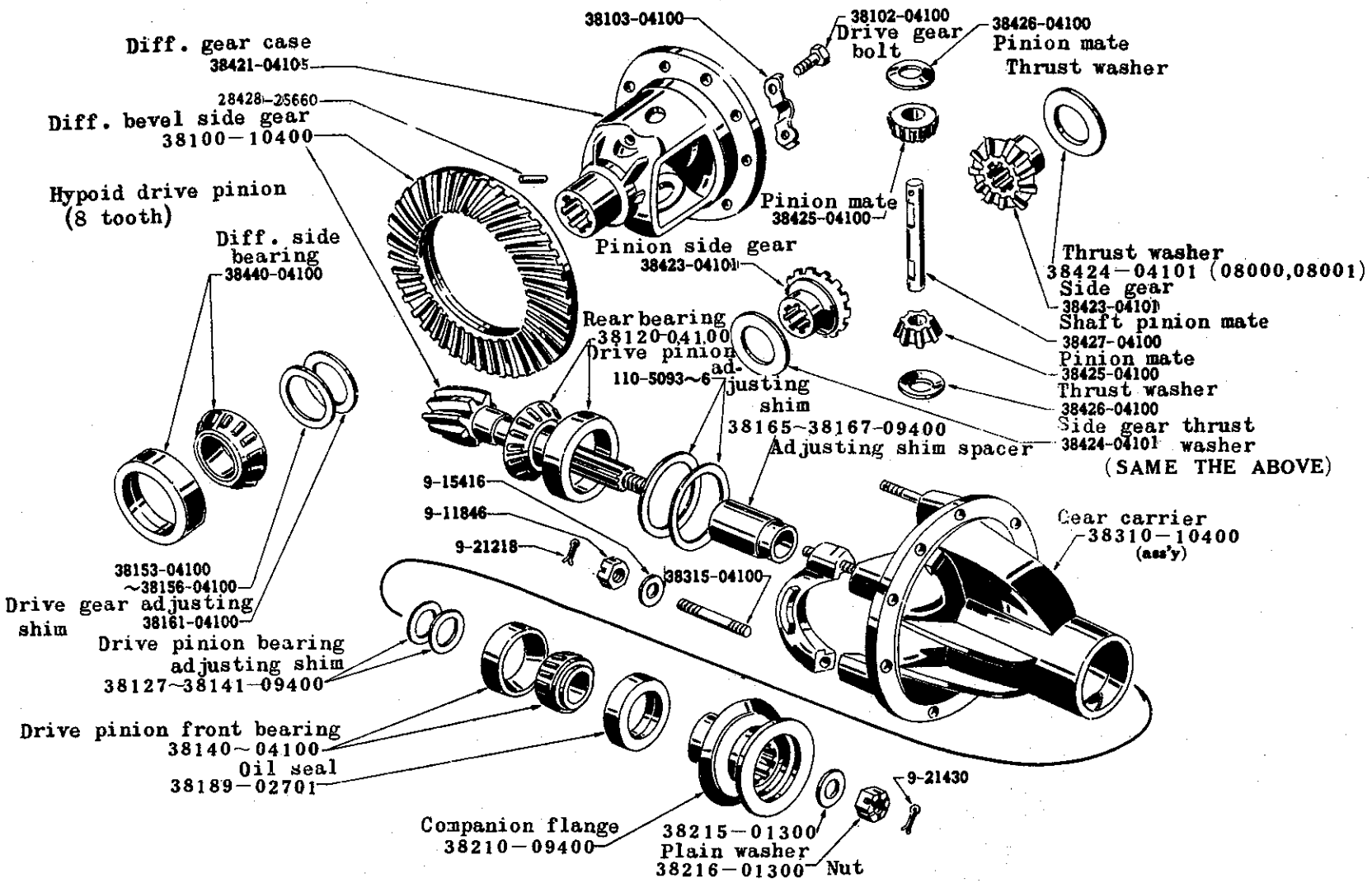


Fig. 7 Rear axle (38300-10400)

INSPECTION & REPAIRING OF DISASSEMBLED PARTS

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

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

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

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

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

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

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

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

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

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

ASSEMBLING, ADJUSTMENT

Assembling Differential Gear

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

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

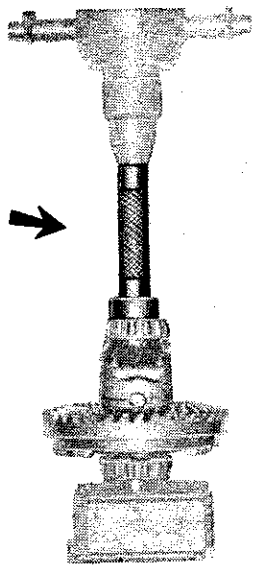


Fig. 8

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

ASSEMBLING & ADJUSTMENT BY GEAR CARRIER ASS'Y

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

The construction and mechanism must well be comprehended referring to Fig. 5 & 9 and the adjustment & repairing exactly according to the condition of practical use based on the adjustment by exact calculation.

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

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

(2) There are few numbers with 0 & + or - besides set number marked by an electric pen on the tip head surface of drive pinion. They show the manufacturing error in a figure at the unit of 0, 001 in. (0.025mm) to decide the thickness of adjusting shim for adjustment of standard position (The standard pinion height is 51.0mm from axle center as shown in Fig. 5 & 8.
If the figure is difficult to discriminate due to the corrosion, scrape off the oxidize substance on the surface by a some what narrow grind stone with care not to scrape off even the mark.

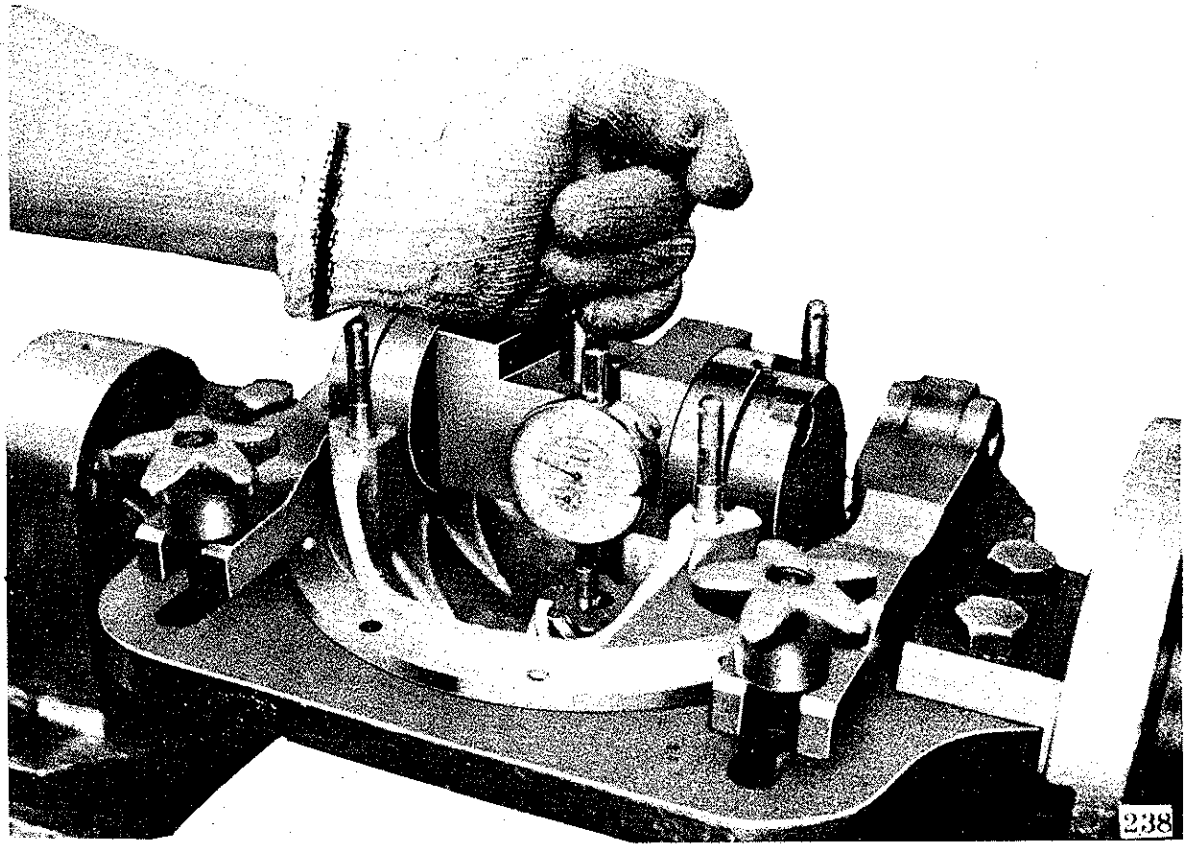


Fig. 9 Adjustment of Pinion Height

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

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

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

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

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

Fixing and Adjustment of Drive Pinion

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

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

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

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

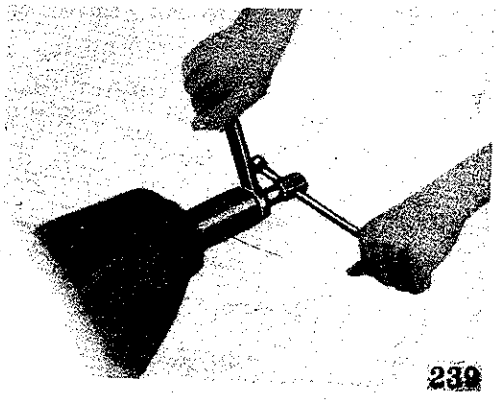


Fig. 10

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

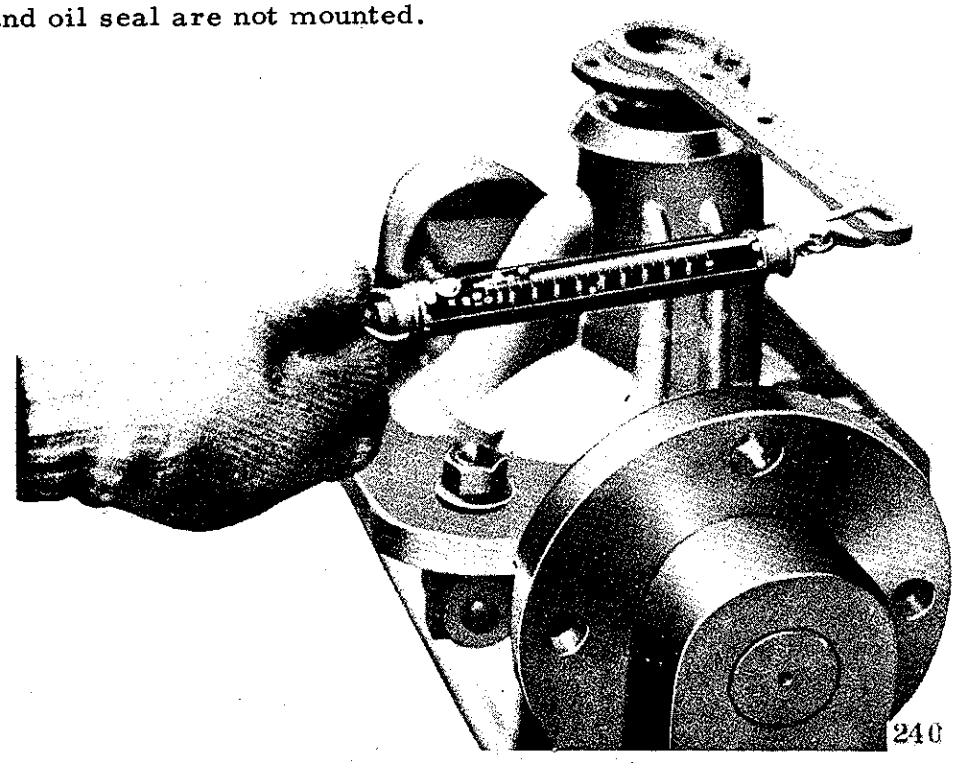


Fig. 11

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

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

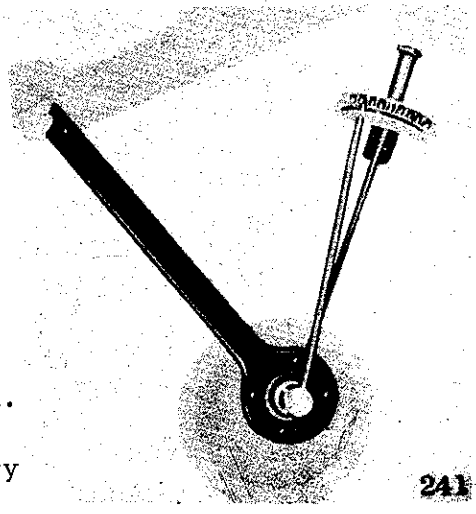


Fig. 12

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

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

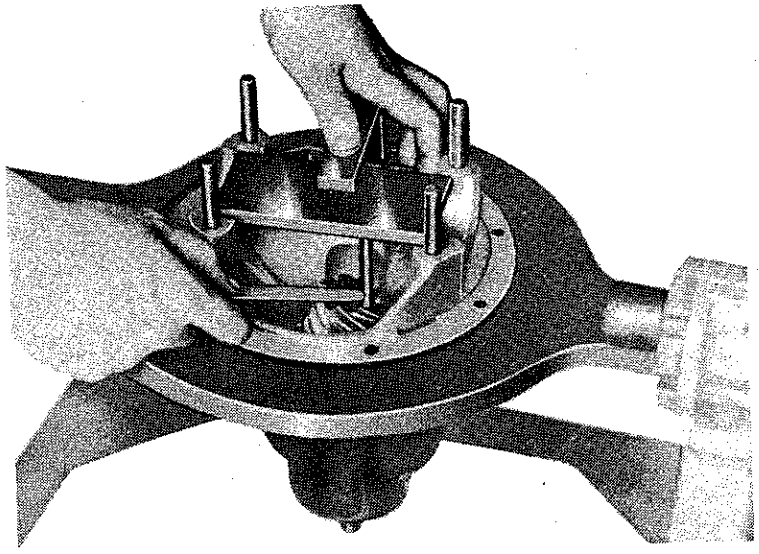


Fig. 13

Remarks

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

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

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

Mounting the Differential Gear Ass'y in the Carrier

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

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

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

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

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

Calculate the error on minus side against the each standard measurement of 20.0mm on the unit basis of 1/1000 and assume each of them as E & F. Take the left side bearing, for example. When the measured width is 19.8 m, it is -0.2mm. (- 0.008 in.) against the standard measurement and the E is, by excluding the minus sign, 0.008 in.

The thickness of the shim is acquired by opplying the numerals to the following method of computation.

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

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

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

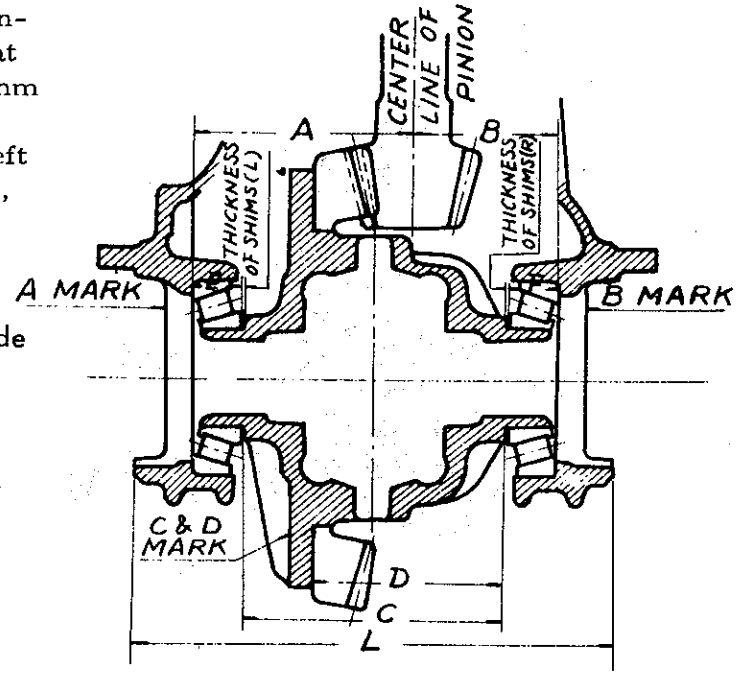


Fig. 14

Thickness of shim on left side

Left Side

T_1=A-C+D+E+7

Thickness of Shim on right side

Right Side

T_2=B-D+6

B-D+F+(0.150)

Example of calculation:

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

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

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

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

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

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

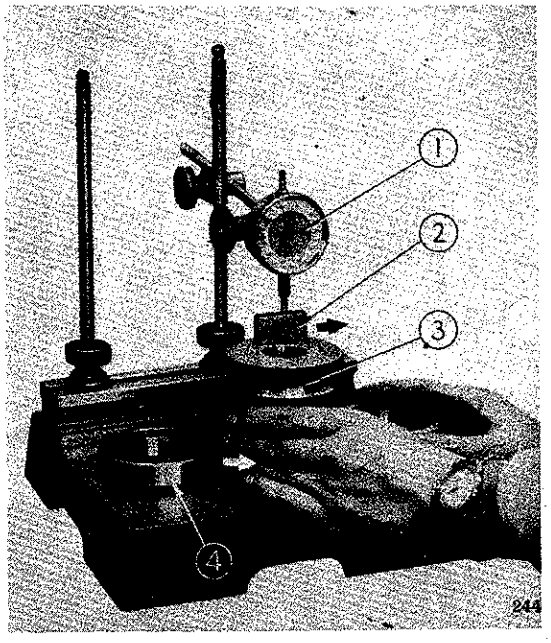


Fig. 15

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

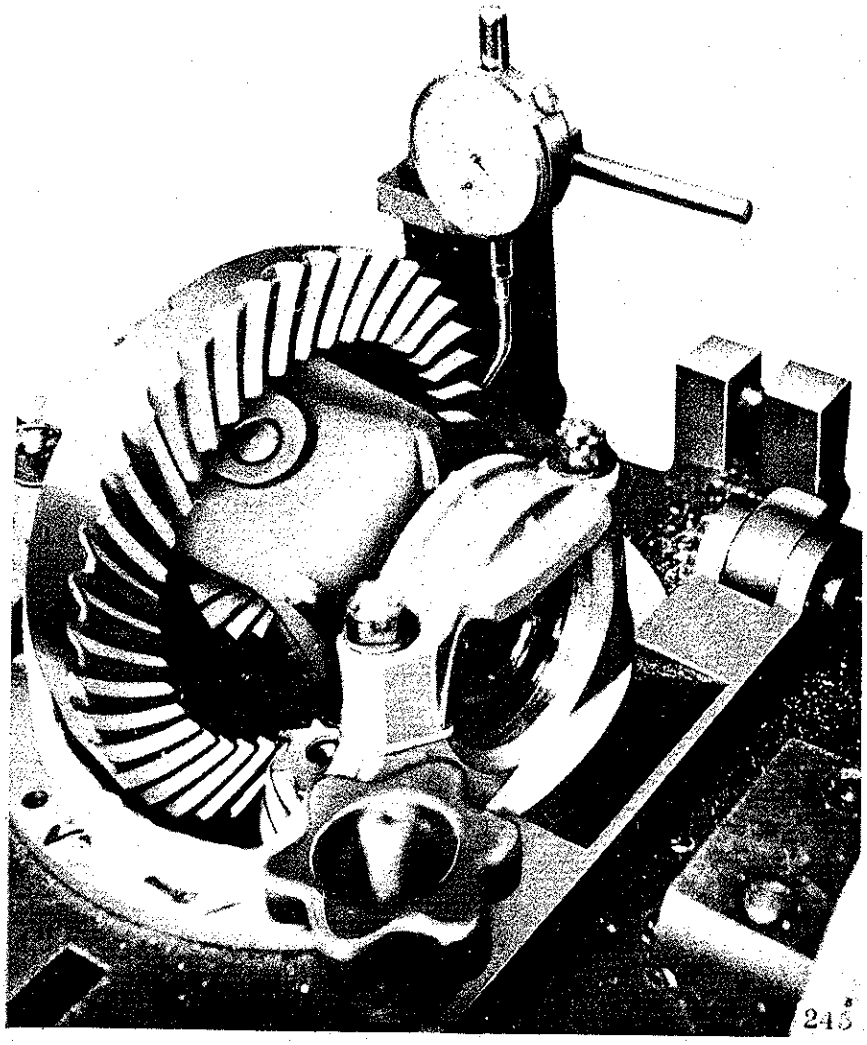


Fig. 16

Measurement of backlash for the drive pinion & ring gear

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

Thus the adjustment is completed. By way of precaution, measure with michrometer of the large size the L measurement which is within 173, 40 - 173, 55mm as Fig. 12 (Service No. tool TD-4685).
If it is insufficient, add an additional shim of 0, 002 ins. left and right.
In this case, the said michrometer, Fig. 12 or special gauge should be employed for scaling.

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

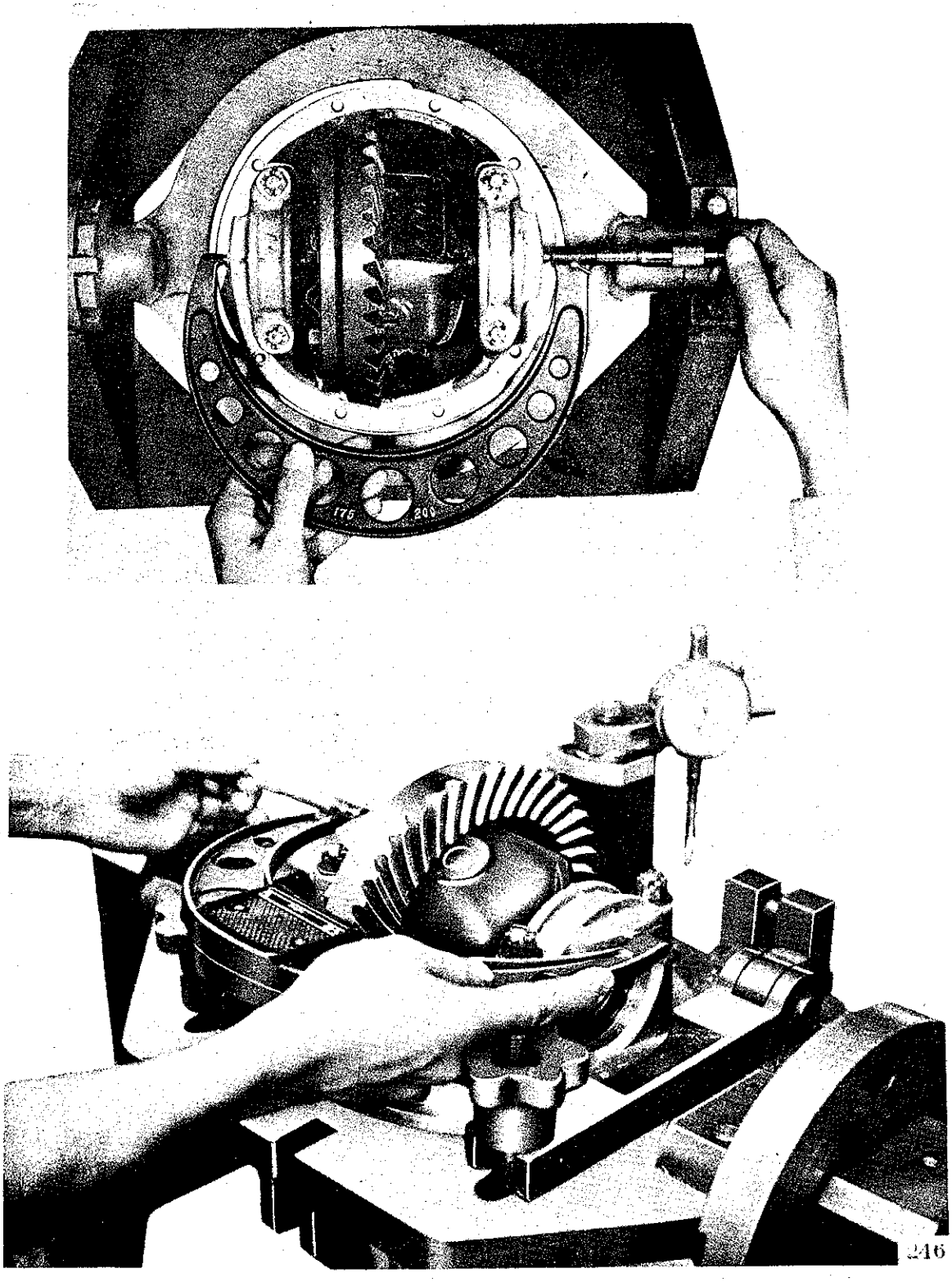


Fig. 17 Using the differential side bearing cap gauge

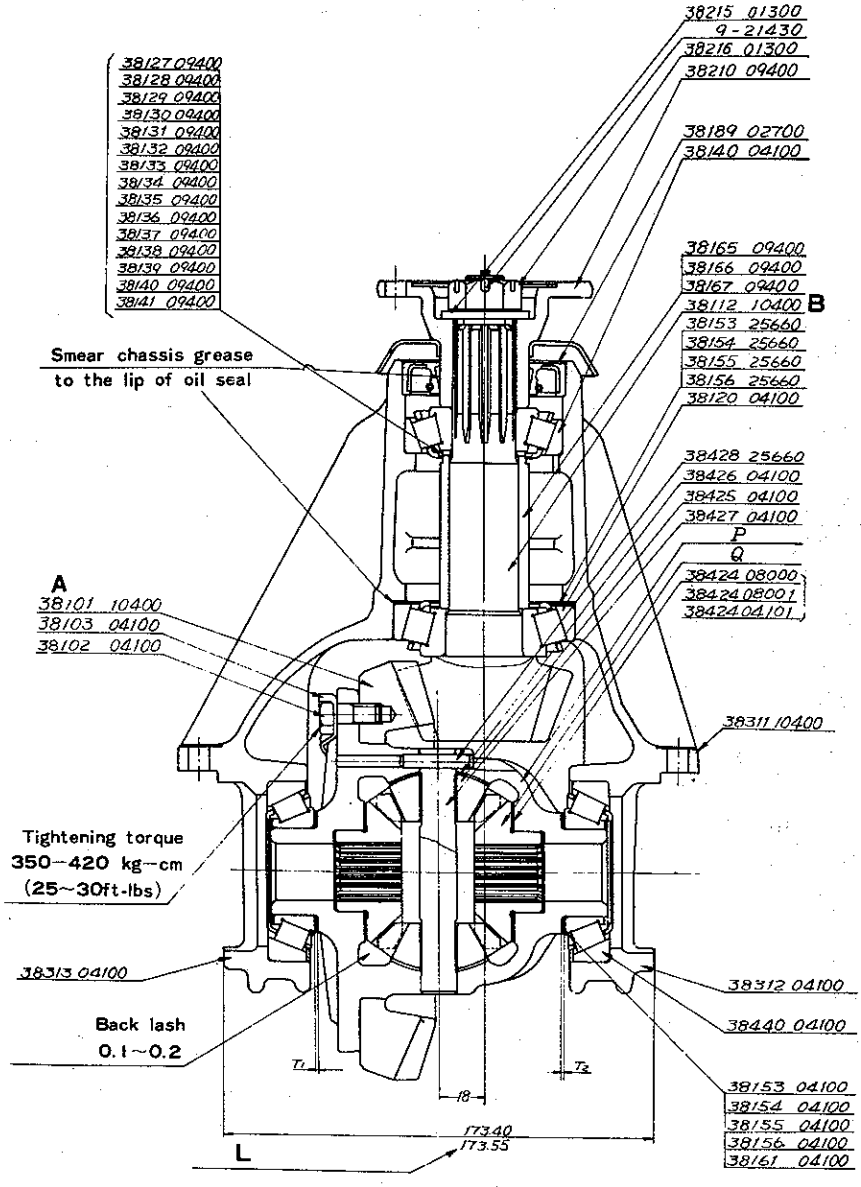


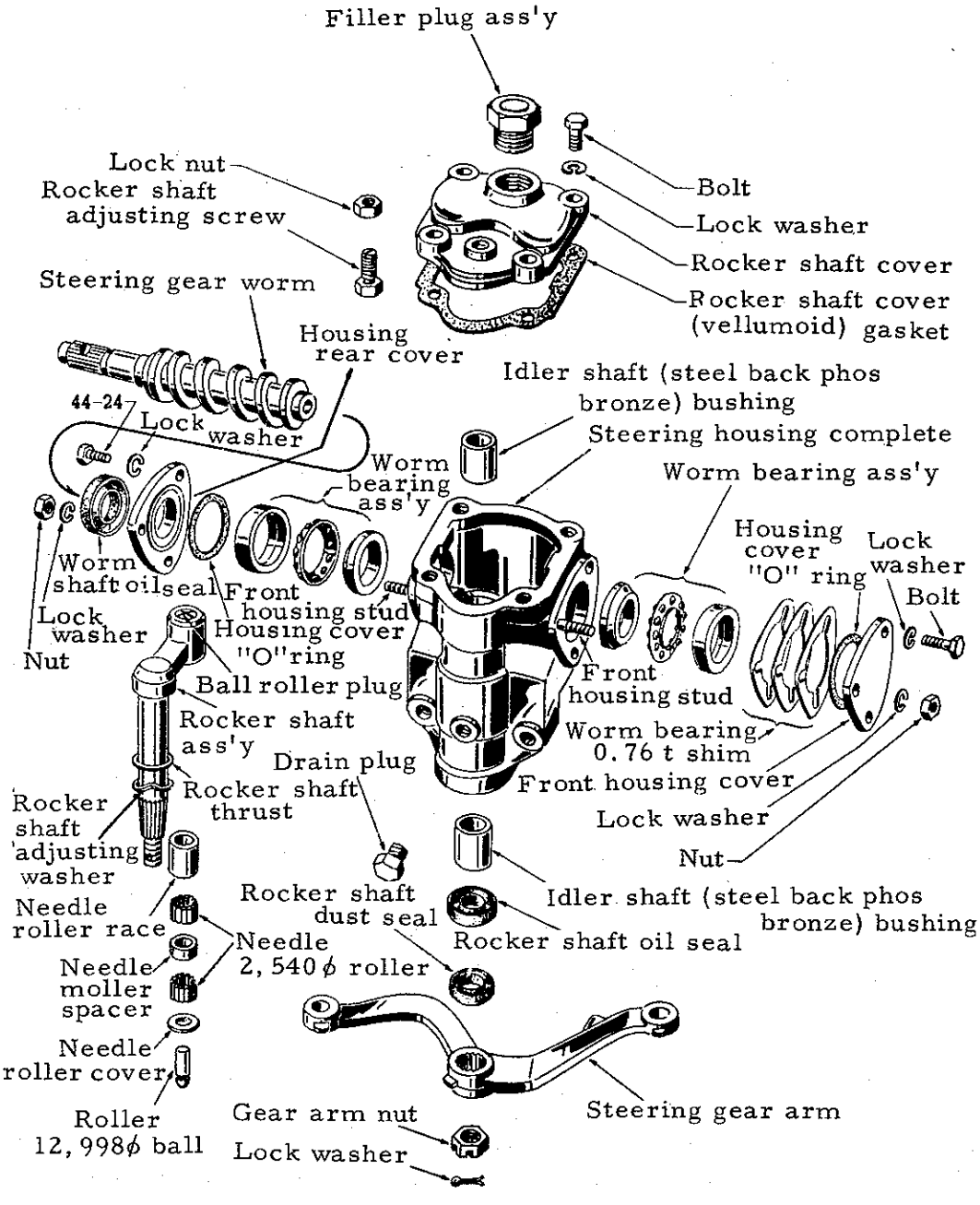
Fig. 18 Carrier

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

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

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

STEERING


Filler plug ass'y
Lock nut
Rocker shaft adjusting screw
Steering gear worm
Bolt
Lock washer
Rocker shaft cover
Rocker shaft cover (vellumoid) gasket
Housing rear cover
Idler shaft (steel back phos bronze) bushing
Steering housing complete
44-24
Lock washer
Worm bearing ass'y
Worm bearing ass'y
Housing cover "O" ring
Lock washer
Bolt
Worm shaft oil seal
Front housing stud
Lock washer
Housing cover "O" ring
Nut
Ball roller plug
Front housing stud
Rocker shaft ass'y
Worm bearing 0.76 t shim
Drain plug
Front housing cover
Rocker shaft thrust
Lock washer
Rocker shaft adjusting washer
Nut
Idler shaft (steel back phos bronze) bushing
Needle roller race
Rocker shaft dust seal
Rocker shaft oil seal
Needle 2, 540 ϕ roller
Needle moller spacer
Needle roller cover
Steering gear arm
Roller 12, 998ϕ ball
Gear arm nut
Lock washer

STEERING

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

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

Side Cross Rods

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

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

Removing the Steering Gear Arm

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

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

Removing the Idler

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

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

Unscrew the idler shaft out of the body.

STEERING GEAR

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

Steering Gear Housing Removal

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

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

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

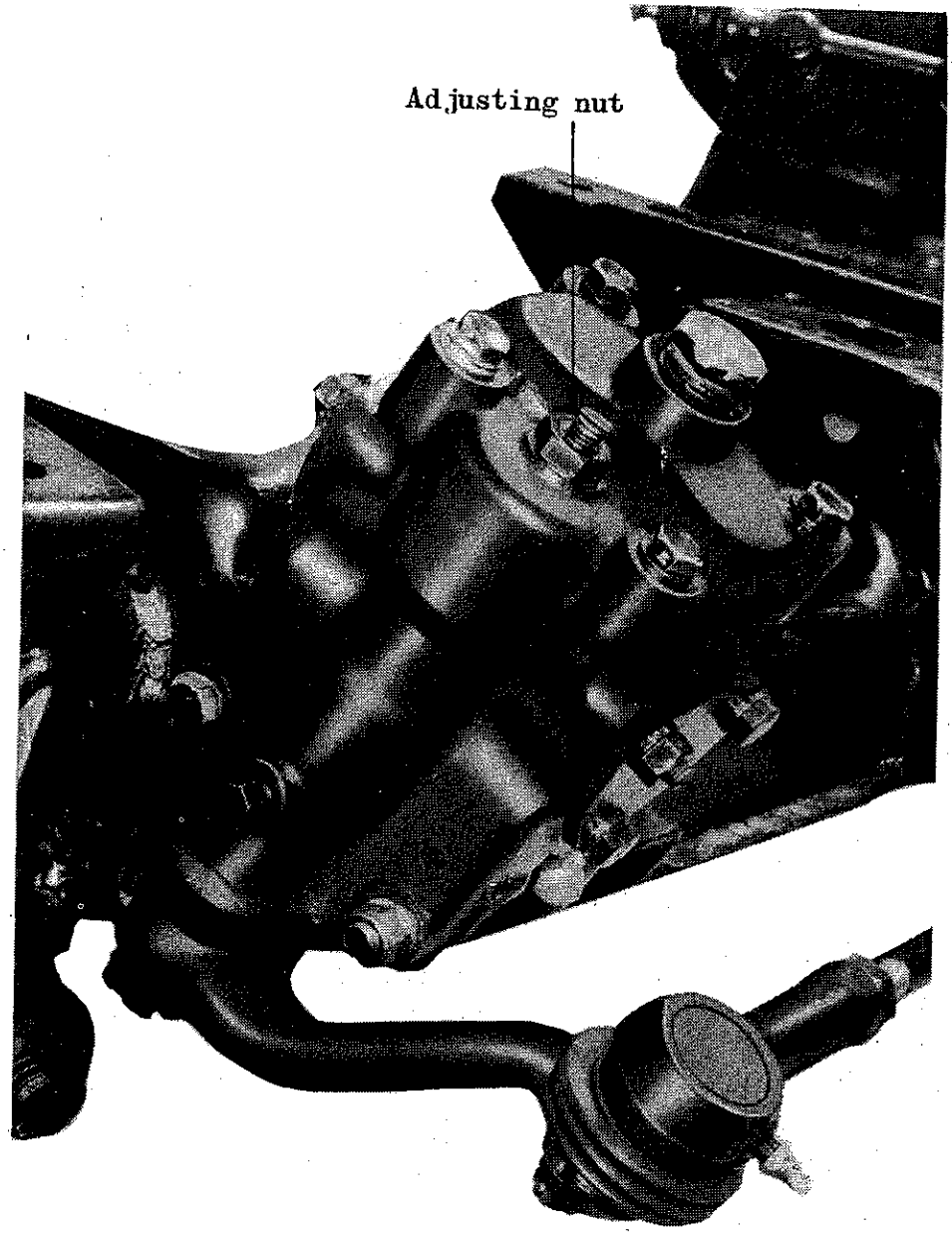


Fig. 1 Steering gear box

Disassembly

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

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

Take off rear cover same way.

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

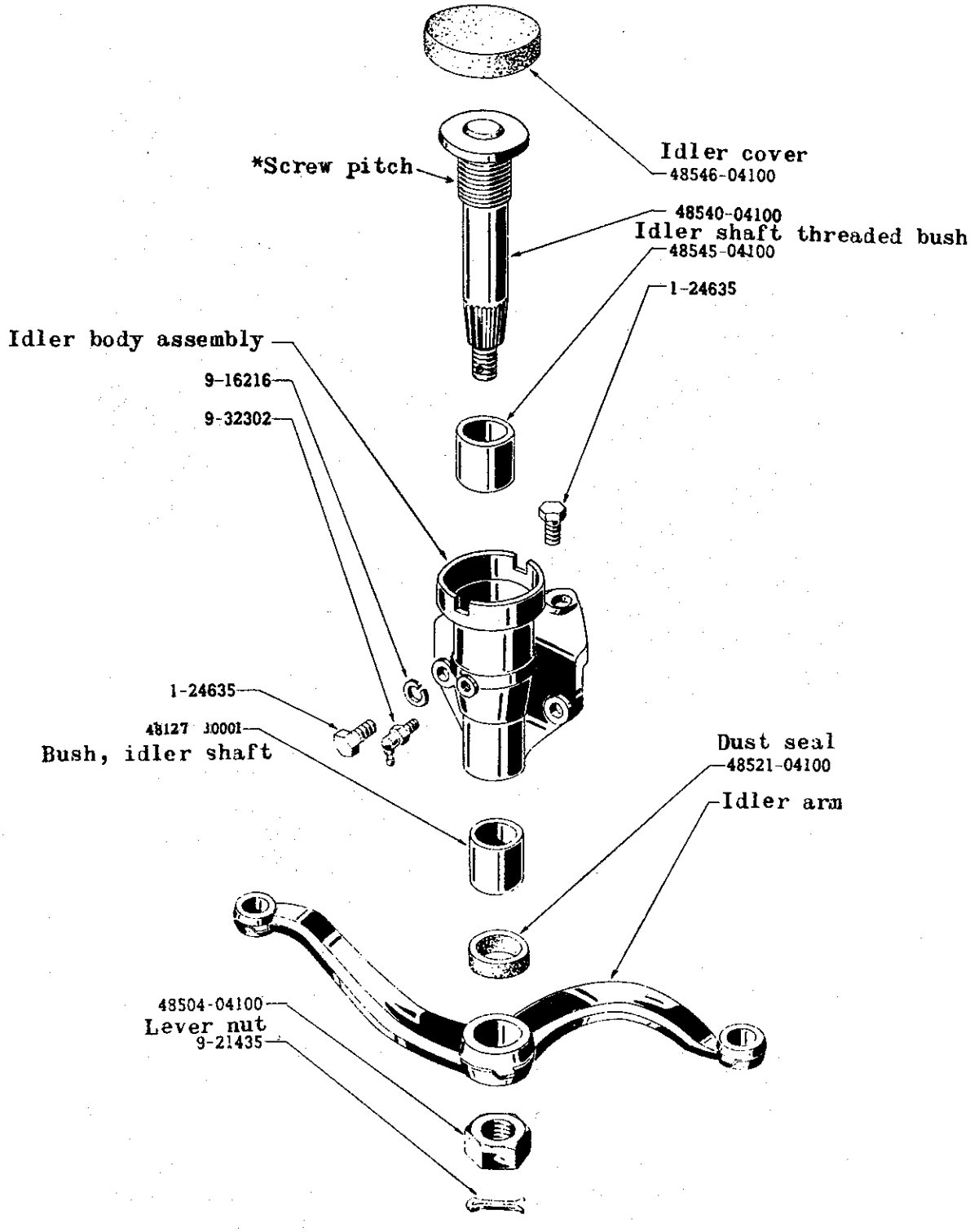


Fig. 2 Idrer & arm

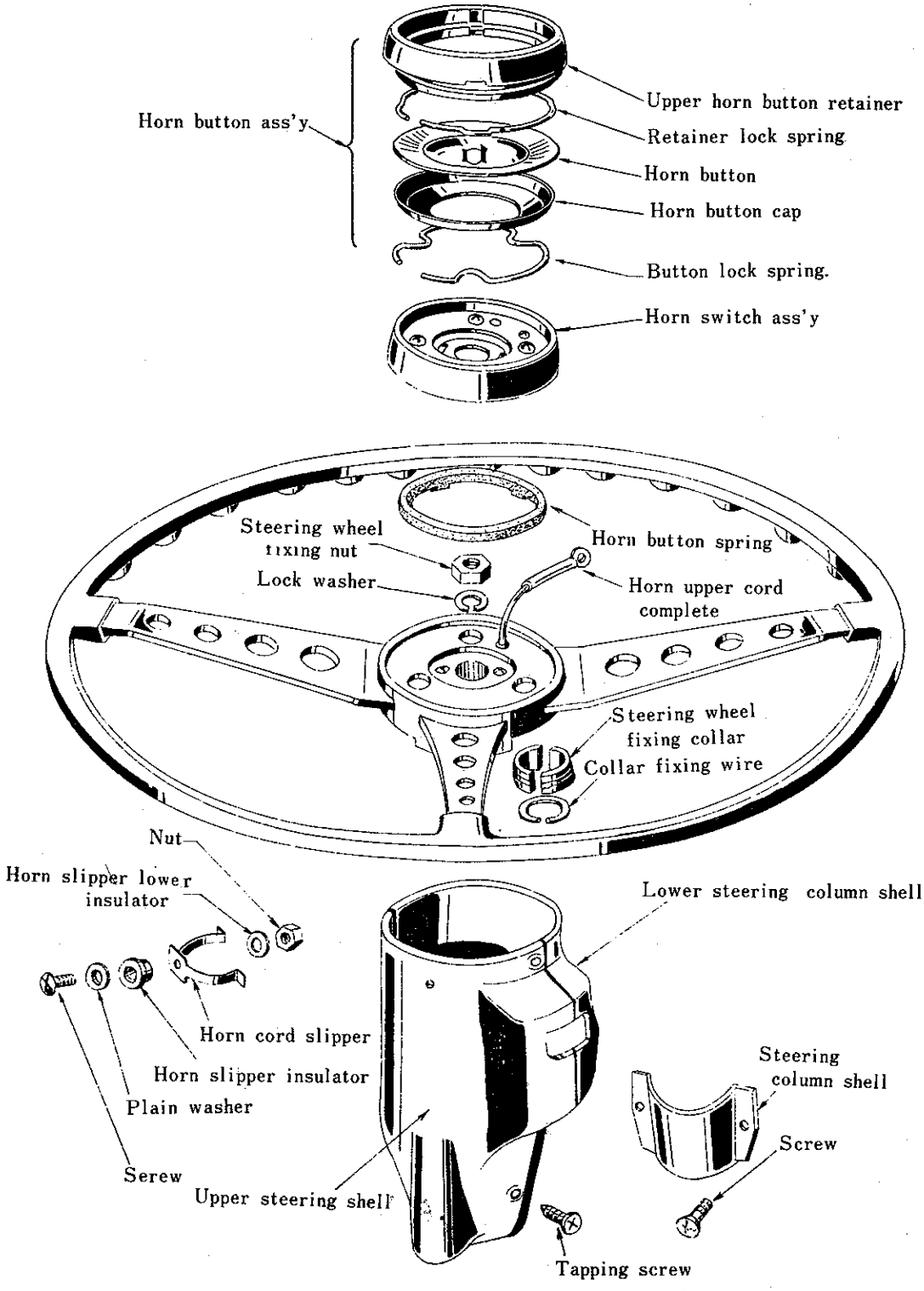


Fig. 3 - Steering wheel

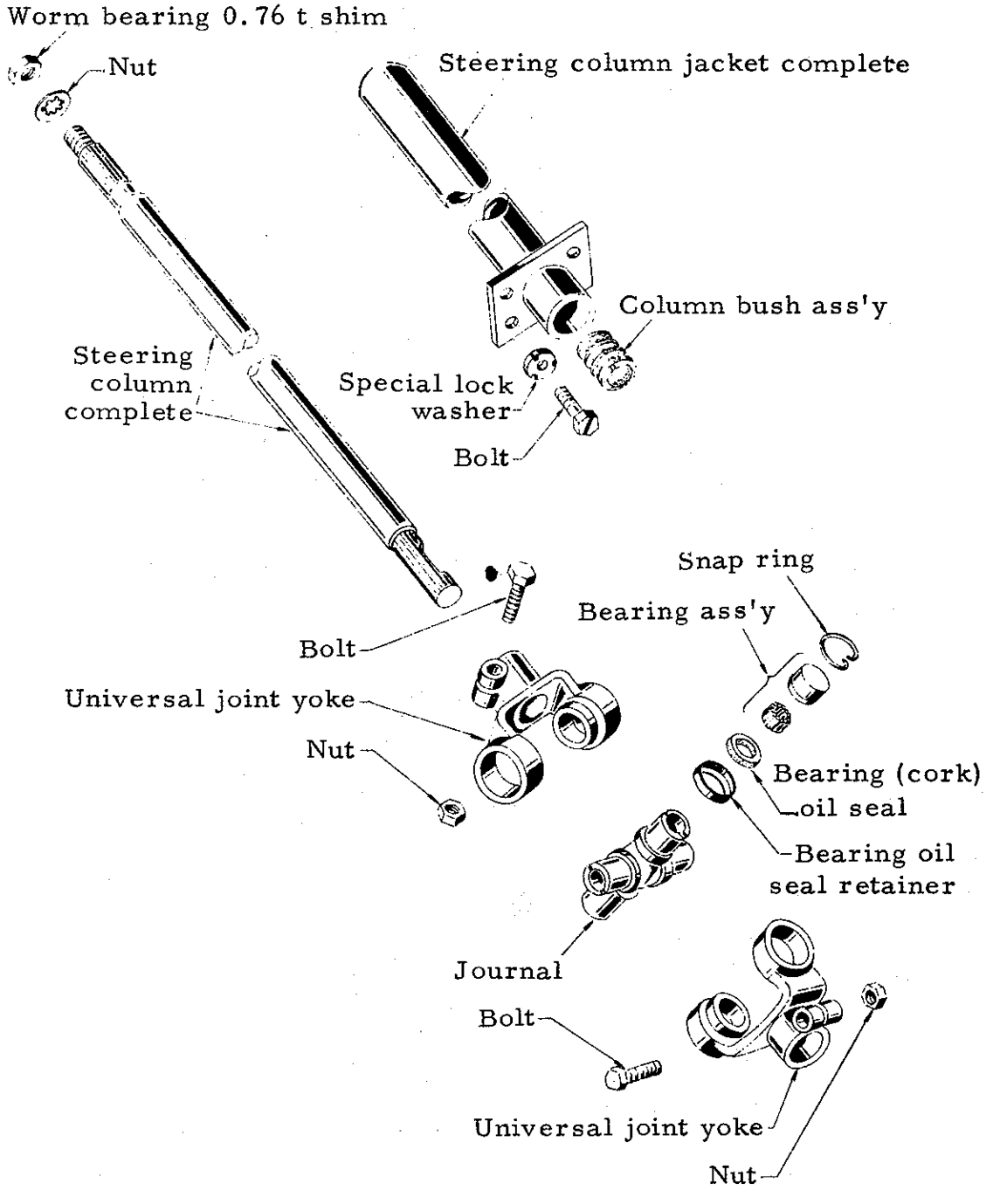


Fig. 4 Steering column & coupling

COMPONENTS OF THE STEERING GEAR CASE

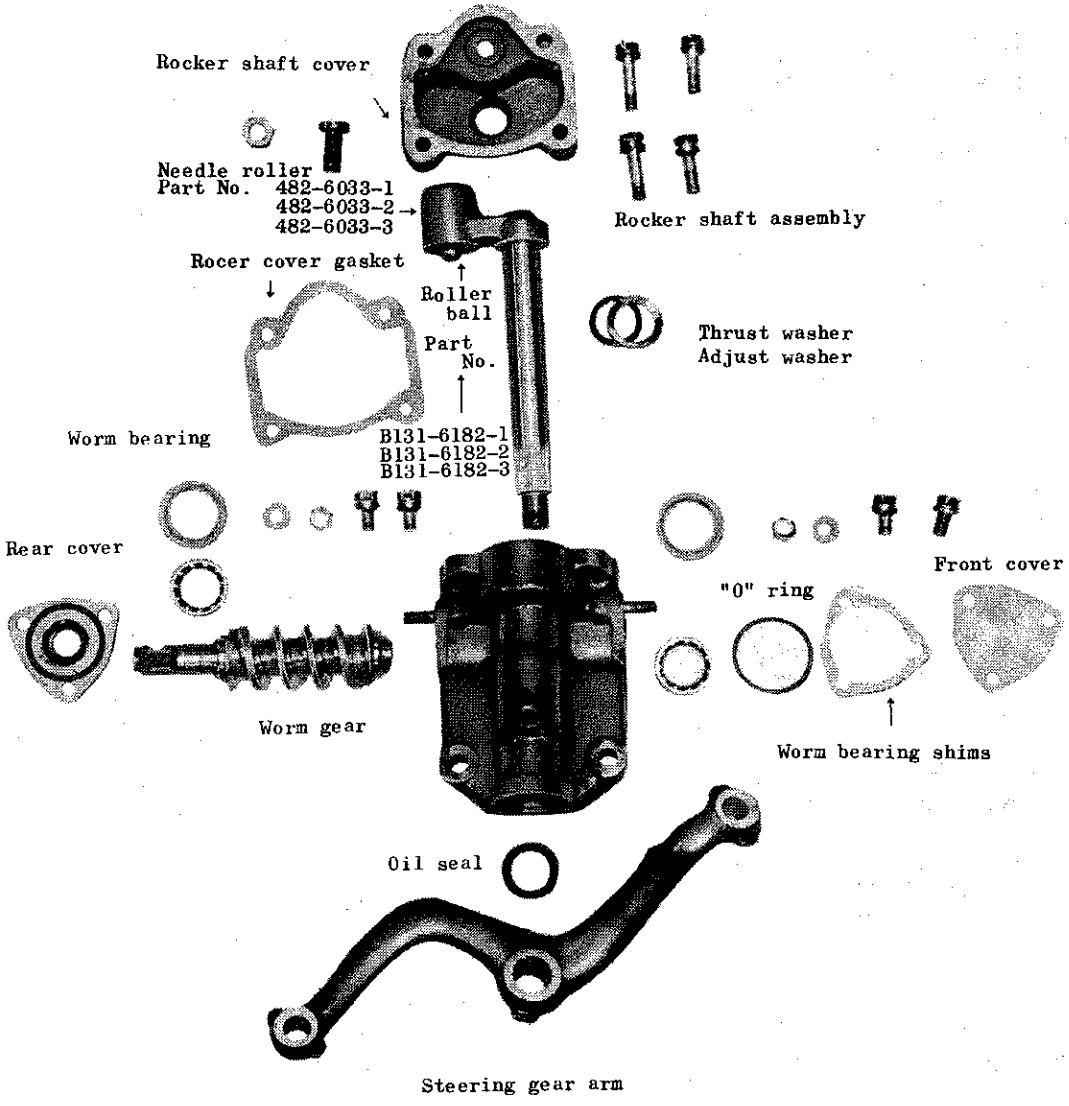


Fig. 5 Components of the steering gear case

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

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

Assembling

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

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

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

Ensure that all joint are oil tight.

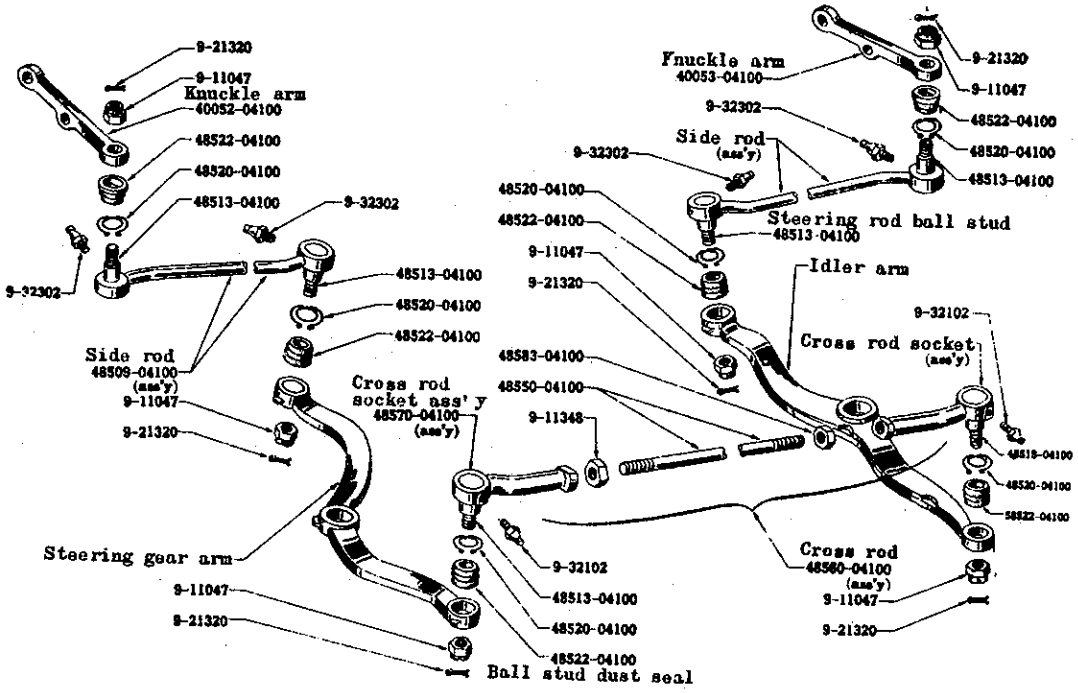


Fig. 6 Steering linkage

Adjusting the gear

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

Then the adjusting screw should be down until there is no free movement in the straight a head position of the gear and adjustment secured by lock nut. Final adjustment should be made once the gear has been reassembled to the housing. It should be noted that as wear in use is normally greater in the

straight ahead position than on lock, provision is made for this in the disign of the cam, and it will be found that there is a slight end play towards each lock.

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

Assembly order of Steering Column and Coupling

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

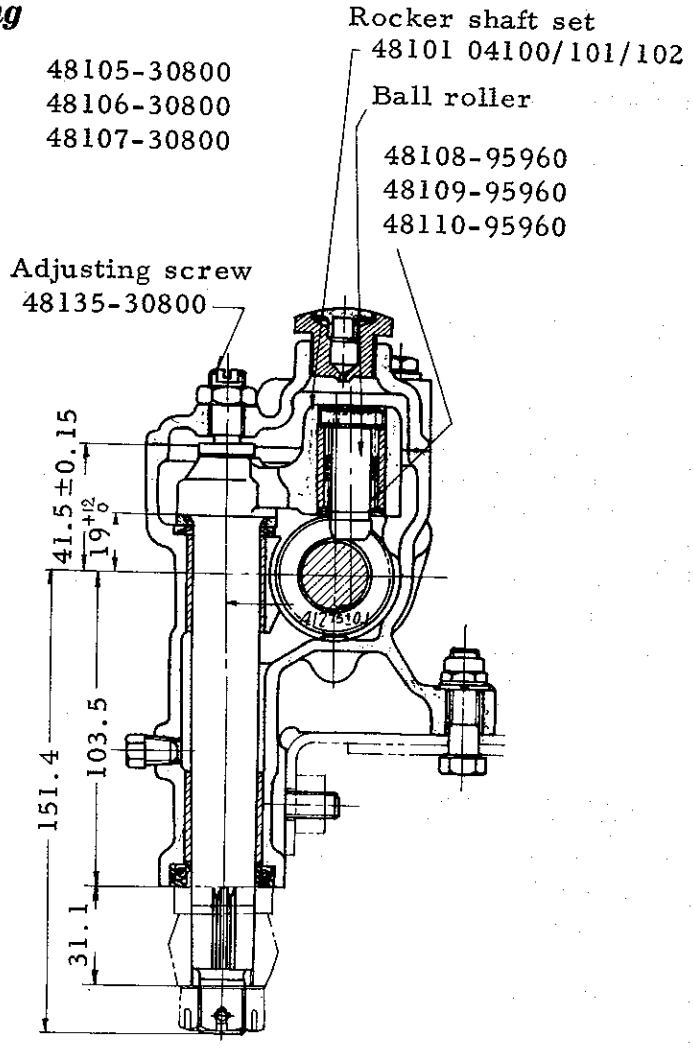


Fig. 7 Section of steering geer housing

Steering Faults

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

BRAKE

Front	2 - leading	
Rear	Leading trailing	
Type operated by foot	Four wheels braking by oil pressure	
operated by hand	Mechanical braking for rear wheels	
Inner dia. of master cylinder	22.22 (7/8")	
Inner dia. of wheel cylinder	Front wheel	Rear wheel
	25.40 (1")	23.81 (15/16")

BRAKE DRUM

Inner dia. of drum (both front & rear)	228.6
Degree of rear circle of drum	Less than 0.05 mm (0.002 in.)
Amendment limit of dittoed degree	0.20 mm (0.008 in.)
Allowable limit of inner dia. of drum	0.80 x 2 mm

BRAKE SHOE

Lining dimension (front) Length x width x thickness	Front	215mm x 140mm x 4.5mm
	Rear	215mm x 40mm x 4.5mm
Whole area for braking	Front	351cm^2
	Rear	351cm^2
Front (2 Leading type)	Expand up to the tight position (Light H way) by adjuster cam and then turn back it little by little till the drum run freely.	
Rear (Lead trailing)	Screw up to the tight position (Right H way) by adjuster and then return back 2 3 notches.	

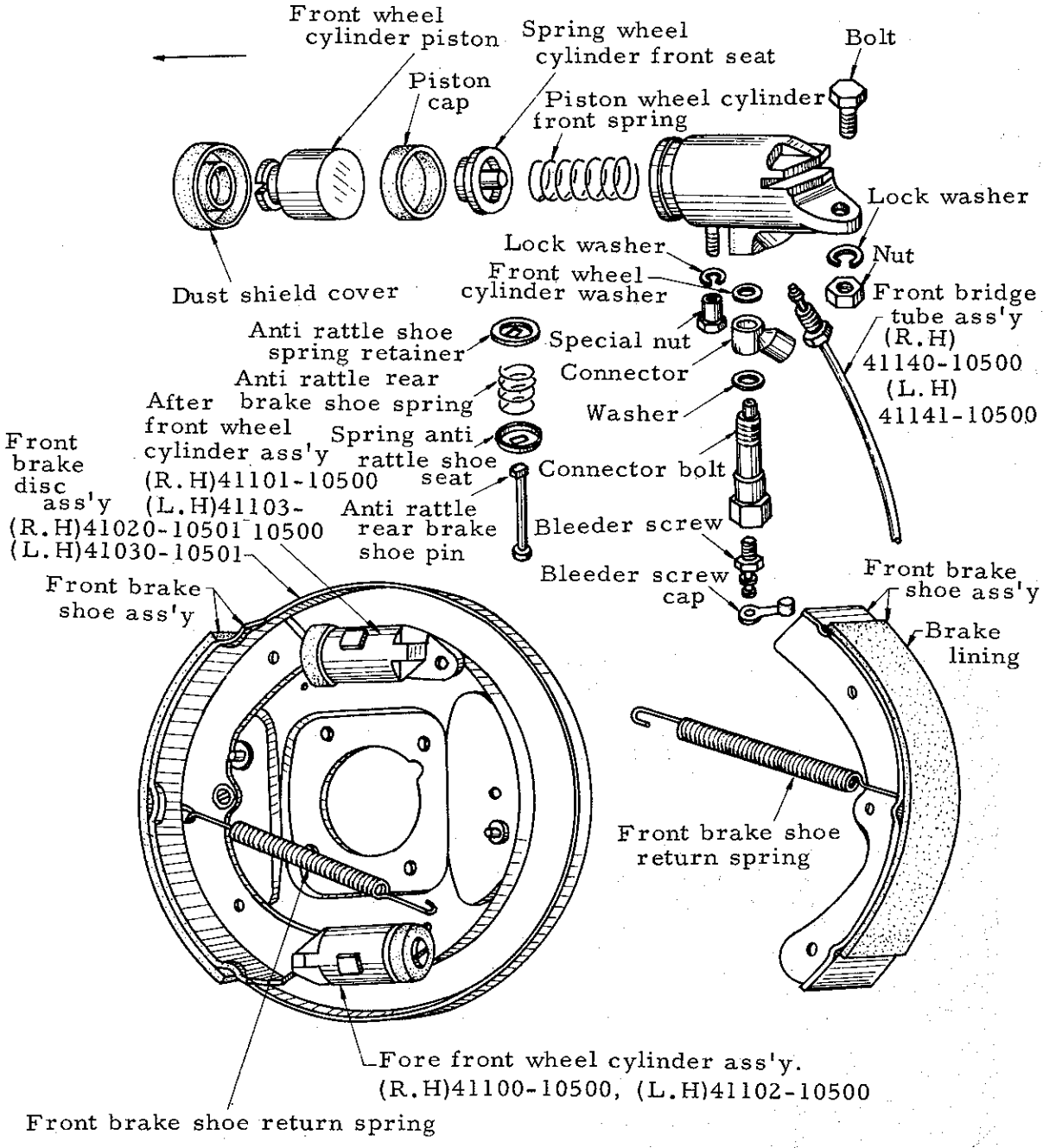


Fig. 1 Component of front brake

The brakes 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 shoes thus producing automatic equalisation, and efficiency in direct proportion to the effort supplied at the pedal.

When the pedal is released the brake shoe springs return the shoes 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 hand brake, mounted drivers seat side. This is positioned on the right-hand side of seat if the car has left-hand steering, and on the left-hand side if it has right-hand steering. Operates the rear wheels by mechanical expanders attached to rear wheelcylinder bodies.

FRONT BRAKES

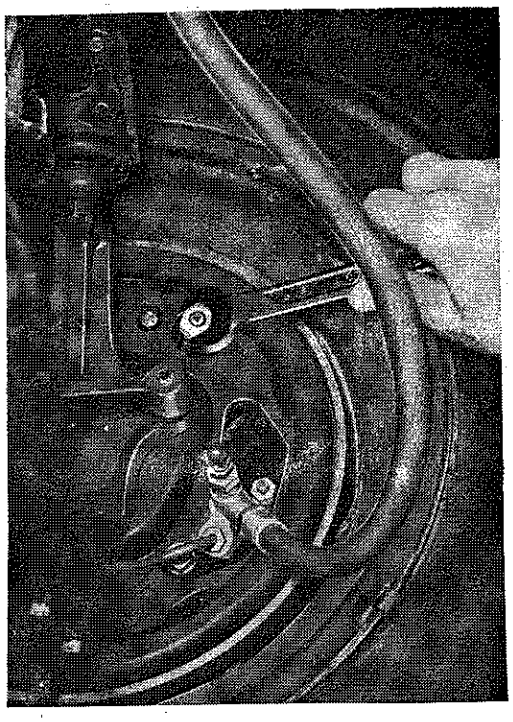


Fig. 2 Adjusting of front brake

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

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

Adjustment for the front brake shoes is by means of the bolt of adjuster which located at outside of the brake disc, adjuster turn the adjusting bolt to the left direction until the shoe becomes locked on the brake drum, then turn back it upward direction little by little until the shoe becoms just free on the brake drum.

REAR BRAKES (LEADING TRAILING TYPE)

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

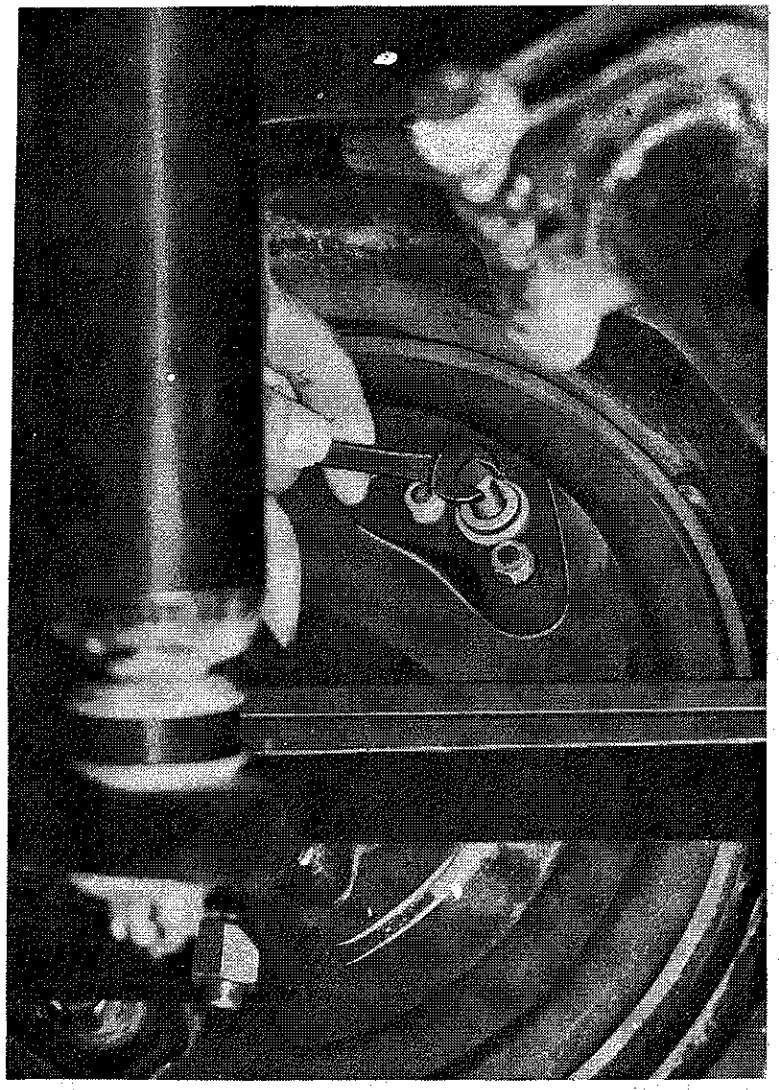


Fig. 3 Adjusting brake shoe

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

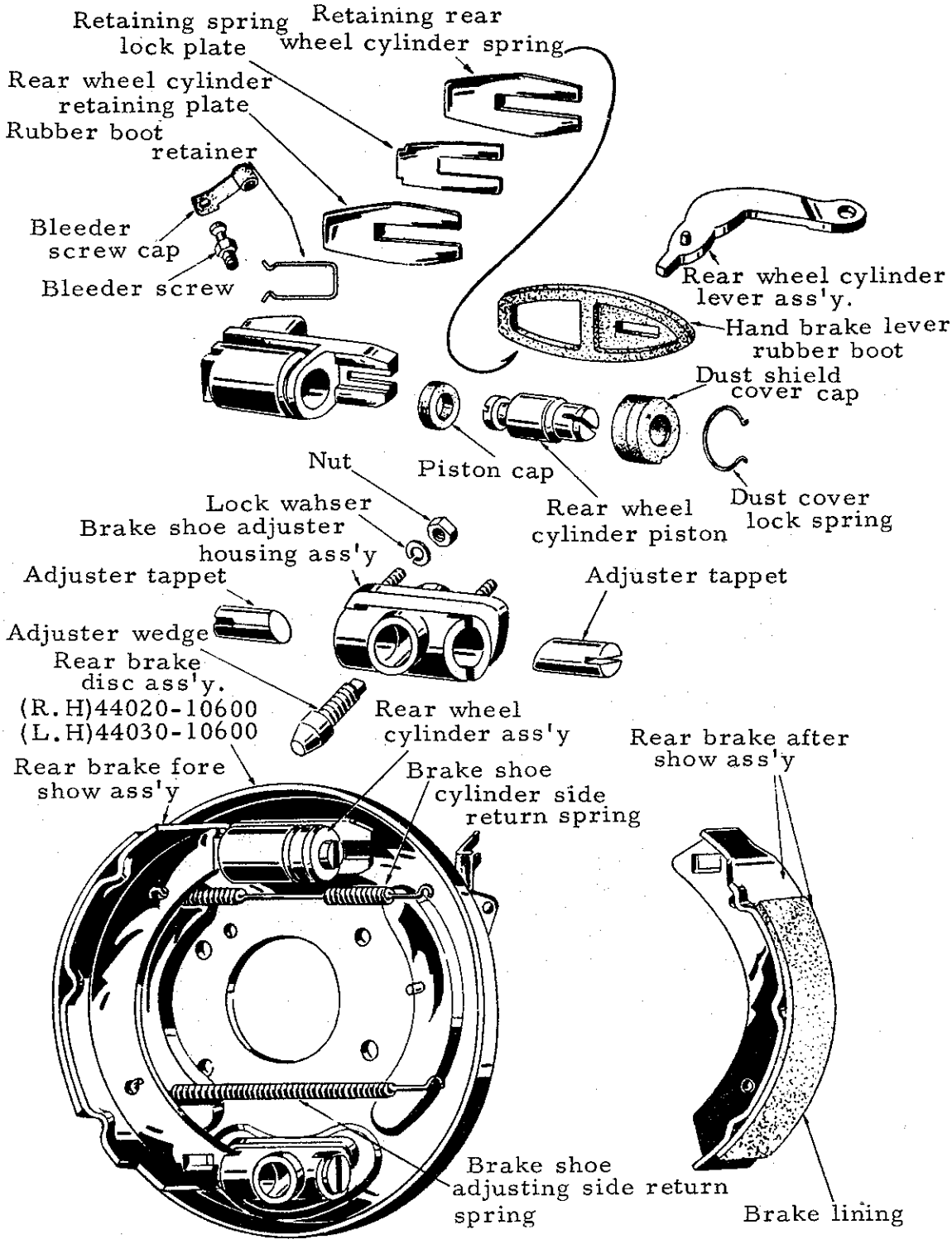


Fig. 4 Components of rear brake

HAND BRAKE

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

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

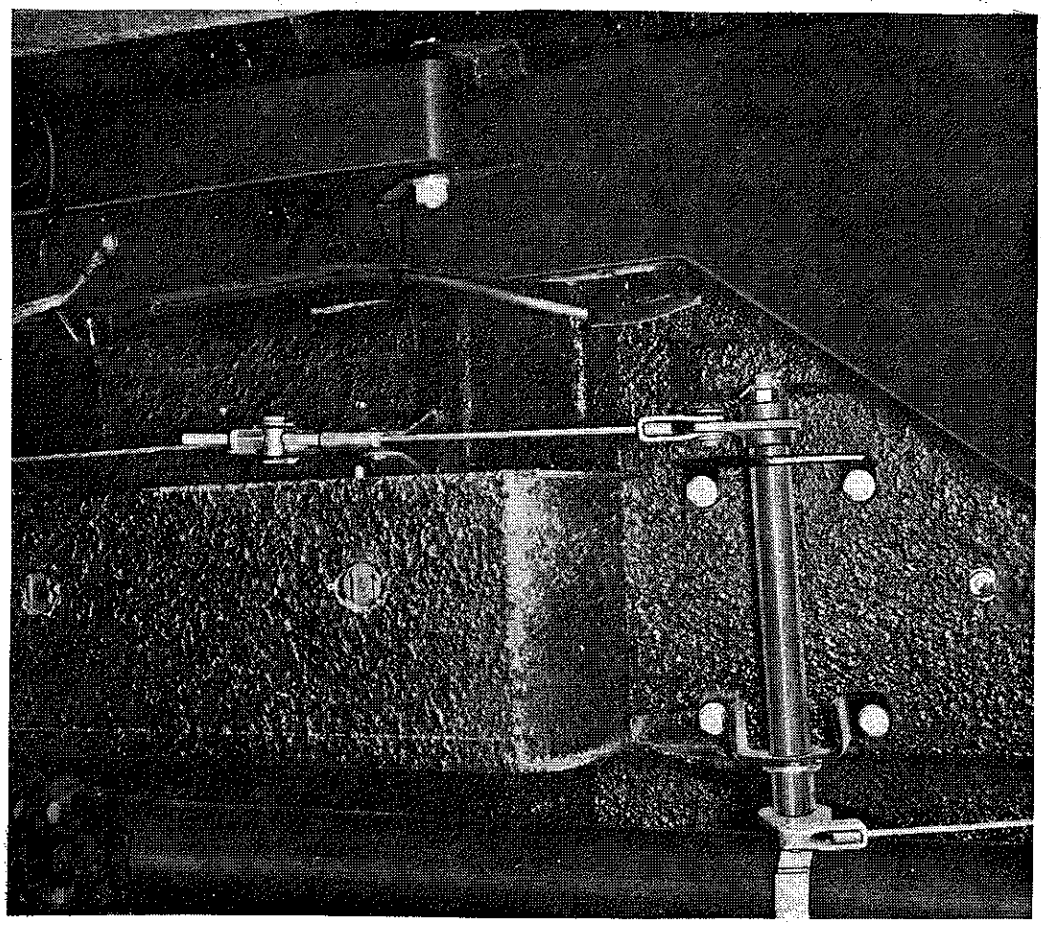


Fig. 5

MASTER CYLINDER

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

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

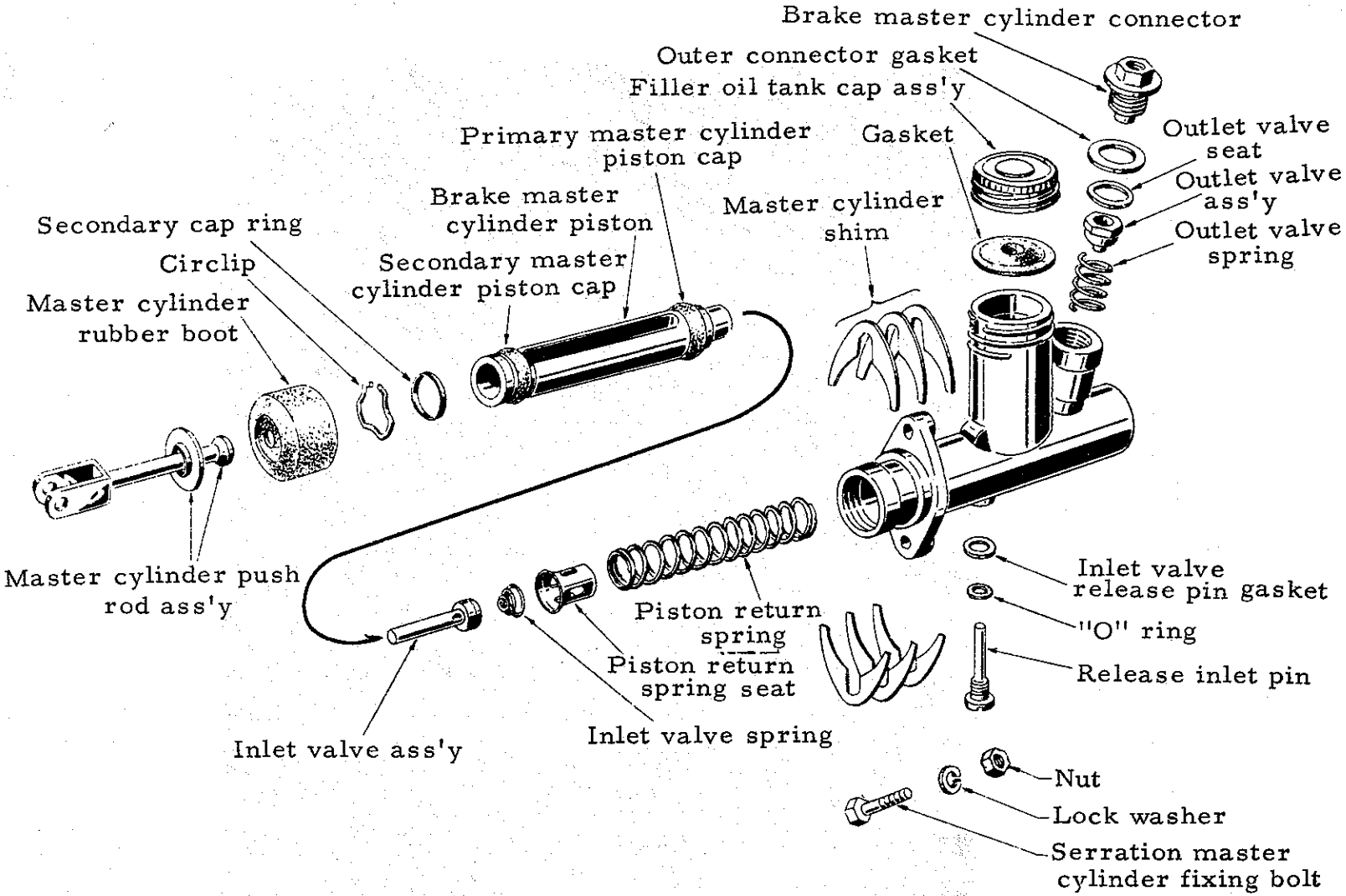


Fig. 6 Brake naster cylinder

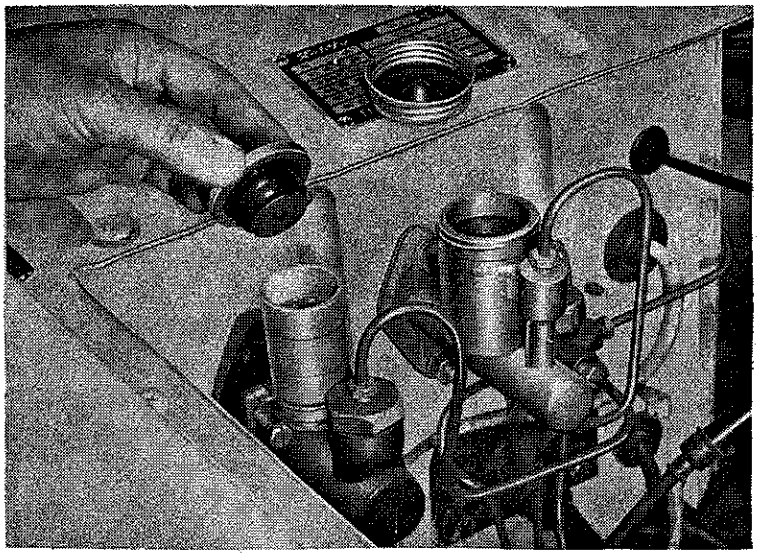


Fig. 7

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

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

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

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

Bleeding the Hydraulic System

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

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

Unscrew the bleed valve cap about three-quarters of a turn and then operate the brake pedal with a slow full stroke until the fluid entering the

jar is completely free of air bubbles. Then, during a downstroke of the brake pedal, tighten the bleed screw cap sufficiently to seat, remove bleed tube.

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

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

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

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

Dirty fluid must never be added to the system.