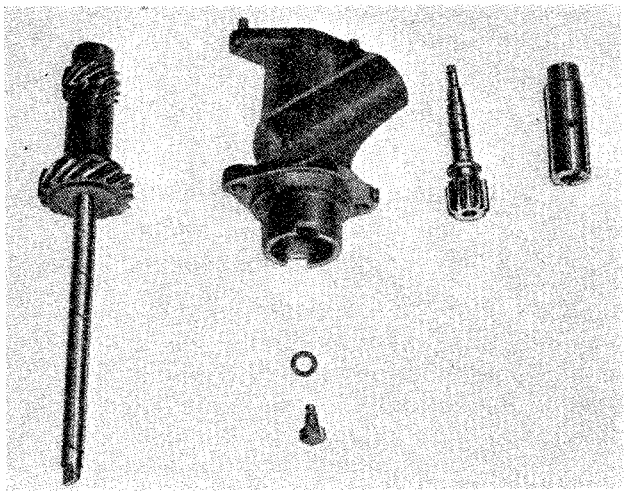

Fig. 15 **Exploded view of Distributor and Tachometer Drive Details.**

The main bearings are of the precision type, bi-metal steel backed. No hand fitting is required and in no circumstances should the bearing caps be filed with a view to taking up wear. The filing of bearing caps will make them unserviceable for future use when new bearings are ultimately used.

Where excessive bearing wear has occurred the only satisfactory cure is to replace worn

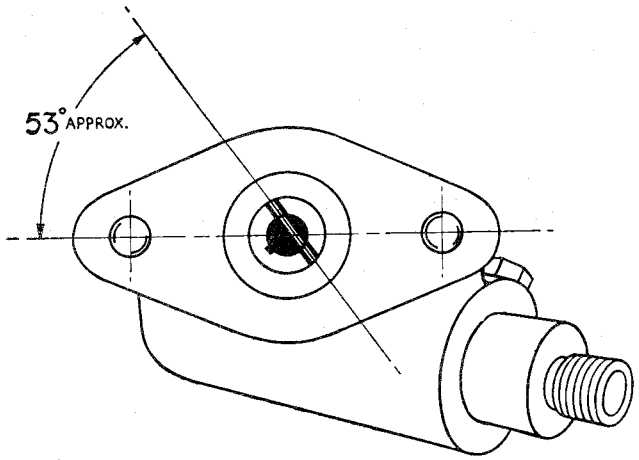

Fig. 16 **Position of Slot in Distributor Boss when No. 1 cylinder is at T.D.C. on compression stroke.**

bearings ensuring first, however, that the crankshaft journals and pins are in good order and that there is no question of a regrind being necessary. Where a crankshaft journal is worn, scored or tapered in excess of .002″ regrinding is necessary.

When a regrind is found to be necessary a decision will have to be made as to the suitable undersize bearings which will meet the particular case. The reduced diameter of journal to suit the various undersize bearings may be calculated by subtracting —.020″, —.030″ or —.040″, the sizes of bearings available from the original dimensions on page 1.

BI

(a) Main Bearing Clearance

The crankshaft journal diameter and the internal dimension of the bearings is given on page 1. The clearance new for the main bearings is .001″—.0025″, if the worn clearance exceeds .006″ or if the journals have become scored, the crankshaft will have to be reground and undersized bearings fitted. The crankshaft should be measured with a micrometer gauge and if the reading is less than 2.477″ (for a crankshaft that has not previously been ground) the shaft is due for reconditioning.

With regard to the main bearings, when the worn internal dimensions exceed 2.483″ (for the standard size bearings) replacements should be fitted undersized to suit the amount which has to be removed from the undersizes available, *viz*: —.010″, —.020″, —.030″ and —.040″.

(b) Crankshaft End Float

The float specified for the crankshaft is .004″—.006″ when new, which should be measured as shown in Fig. 17. Where, after the fitting of new thrust washers, end float is below .004″ the steel face of the thrust washers should be rubbed down on a piece of emery cloth placed on a surface plate as shown in Fig. 18. Do not reduce the white metal bearing surface.

The illustration shows the end float being measured by the feeler gauge method. An alternative method is the use of a Dial Test Indicator which will give a more positive reading if the dial is at "zero" when the crankshaft is at the limit of its float.

After a considerable mileage, wear may occur on the face of the crankshaft abutting the thrust washers. It may be necessary to fit oversize thrust washers,

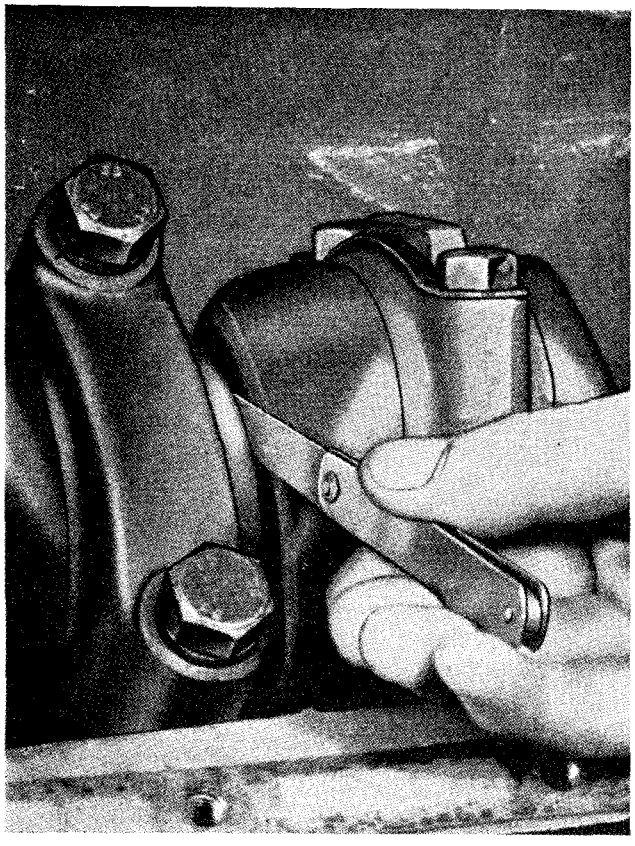

Fig. 17 **Measuring Crankshaft End Float. This operation can be carried out with a Dial Test Indicator.**

and although this may rarely happen, oversize thrust washers +.005″ may be obtained by a special order on the Spares Department under their normal detail number specifying that the oversize thrust washers are required.

5. CONNECTING ROD BEARINGS (Fig. 8)

The connecting rod, a molybdenum manganese steel stamping, is provided with a phosphor bronze small end bush and the precision type lead indium bronze steel backed bearing at the big end. Like the main bearings, no hand fitting is necessary and in no circumstances should the bearing caps be filed to take up wear.

Where excessive journal wear has occurred the only satisfactory cure is to replace the bearings ensuring first, however, that the crankshaft journals and pins are in good order. Where a journal or pin is worn,

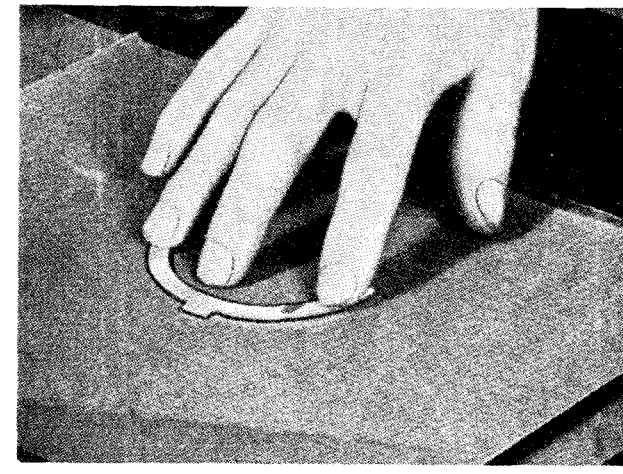

Fig. 18 **Reducing the thickness of a Thrust Washer. This must only be carried out on the Steel Side.**

scored or tapered in excess of .0020″ regrinding is necessary.

When a regrind is found to be necessary a decision will have to be made as to the most suitable undersize bearings which will meet the particular case. The reduced diameter of the pin to suit the various undersize bearings may be calculated by subtracting —.0100″, —.0200″, —.0300″ or —.0400″ from the original size as listed on page 1. The small end bushes, dimensions given on page 2, should be pressed into the rods and subsequently reamed to $\frac{7}{8}$″ ±.0005″. A gudgeon pin selected to give a clearance of .0002″ at 68°F. This clearance will be indicated by a light finger push fit, with the piston warmed by immersion in hot water. The connecting rod centres are 6.250″ ± .002″ and there is no offsetting of the rod in relation to the bearing housings. The connecting rod cap is located in relation to the rod by means of dowel bush, as shown in Fig. 6.

Before installing a connecting rod it should be checked for alignment after first removing the bearing shells. The rod should be checked for bend, in which the piston will not be perpendicular to the crankpin, or if the gudgeon pin is not on the same plane as the crank pin the rod is twisted, see Fig. 19. Appropriate action should be taken to deal with the various causes of misalignment with a suitable bending bar. The connecting rod aligning fixture shown in Fig. 19 is obtained from Messrs. V. L. Churchill and Company Limited.

PISTON ASSEMBLY AND CYLINDER SLEEVES

The piston and cylinder bore dimensions are given on page 2. As indicated in this list of tolerances and limits, three sizes of pistons are used in conjunction with suitable bore dimensions. The three sizes of pistons and cylinder sleeves are indicated by the stamping of F, G or H on the crown of each piston and the upper flange of each cylinder sleeve as shown in Fig. 20.

Piston ring dimensions and clearances are also given on page 2. Where the worn clearance between the piston skirt and the cylinder sleeve bore exceed .007″ at the top and .005″ at the bottom reboring or replacement becomes necessary if a satisfactory repair job is to be executed.

The connecting rod should be fitted to the piston assembly with its bearing cap towards the split portion of the piston skirt

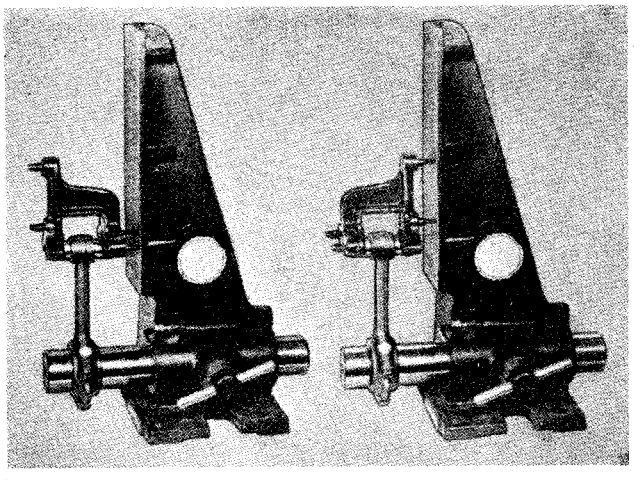

Fig. 19 **The Churchill Fixture No. 335. Left-hand examining for "twist." Right-hand examining for "bend."**

and then should be assembled into the cylinder sleeves with the gudgeon pin in diametrical relation to pairs of opposite flats on the upper flanged faces of the cylinder sleeves. When assembling the sleeve and piston into the cylinder block, position the bearing cap of the connecting rod towards the camshaft side of the engine, or away from the point of maximum thrust. When cases of light wear occur and cause piston knock, an improvement can be effected by withdrawing the sleeve and rotating this 90° and so employ the alternate pair of flats as shown in Fig. 20.

The importance of using cylinder sleeve retainers to prevent relative movement of these parts is stressed.

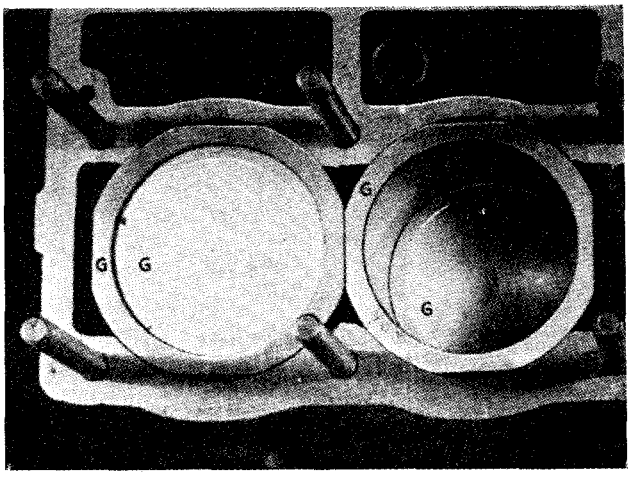

Fig. 20 **The Identification Letters stamped on the Piston Crown and the Cylinder Sleeves. Note also the flats on the outer periphery.**

When the sleeves are installed in the block the flanged face should stand proud of the cylinder block by .003″ minimum—.0055″ maximum, and checked as shown in Fig. 5.

7. FIGURE OF EIGHT JOINTS (Fig. 4)

These joints are between the lower flanged face of the cylinder sleeves and the machined recesses in the cylinder block. They are metal and the plastic coating ensures that they afford a good water tight joint. Failure to do so will mean that water will leak from the cylinder block water jacket into the sump.

It is essential that these joints are handled and stored with great care to prevent damage to the plastic coat.

These joints are fitted one to each pair of cylinder sleeves. Before fitting, the sleeves and block should be thoroughly cleaned with a wire brush to ensure all scale and foreign matter is removed, and a light coating of "Wellseal" jointing compound applied to both sleeves and block. Extreme cleanliness is essential.

Sinking of the cylinder sleeves is prevented by the use of these metal joints. The sleeves should stand .003″ to .0055″ above the face of

the cylinder block and a routine check should be made whenever the combustion head is removed. Should the cylinder sleeve(s) be below the specified limits new figure of eight joints should be fitted.

8. CAMSHAFT AND TIMING GEARS

The camshaft is of cast iron, having chilled faces for the cams and journals. With the camshaft a cast iron flanged front bearing is used, the other three journals making direct contact with the cylinder block.

In the near future it is proposed to fit four Vandervel bi-metal bearings to accommodate the camshaft A recognition of an engine so fitted with these bearings will be that three setscrews retaining the three rearmost bearings will be clearly visible on the left-hand side of the cylinder block. The front bearing is pressed into the front bearing sleeve.

The camshaft is driven by a double roller silent chain which engages with a sprocket on the crankshaft and one spigotted on the

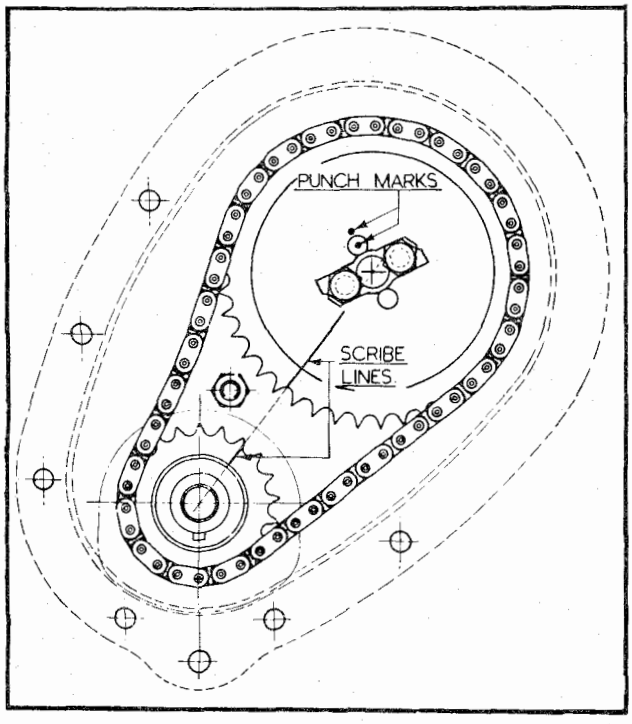

Fig. 21 Showing Wheel Markings for Valve Timing. Note the Keyway in the Crankshaft Sprocket pointing downward.

end of the camshaft and secured by two bolts.

Four holes are provided in the camshaft timing gear, which are equally spaced but offset from a tooth centre. When the chain wheel is fitted at 90° to its initial position, which location we will identify as position "A", a $\frac{1}{2}$ tooth of adjustment is obtained. If on the other hand the wheel is turned "back to front" from position "A" a $\frac{1}{4}$ tooth of adjustment is obtained, whilst a 90° movement in the reversed position will give $\frac{3}{4}$ of a tooth variation from that given by position "A."

When the timing has been correctly set the faces of the two gears are marked with a scribed line drawn radially in such a manner that if the lines were produced outwards on the respective gears they would pass through the centres of the two gears.

In addition, to avoid any possibility of the camshaft position being incorrect, a centre punch mark is made on the end of the camshaft through an unoccupied bolt hole and on the face of the timing gear adjacent to the setscrew hole ; Fig. 21 shows the marking of the timing wheels.

The helical gear for the distributor and tachometer drive and the cam for operating the fuel pump are integral parts of the camshaft.

End float of the camshaft is taken between the flange on the front camshaft bearings and the rear face of the timing wheel.

This end float can be increased by reducing the length of the front bearing sleeve by rubbing the rearmost end on a sheet of emery cloth placed on a surface plate, to decrease the end float it will be necessary to replace the front bearing.

After grinding operations on the camshaft have been completed it is degreased, bonderized and whilst still warm immersed in a solution of "Dag" (colloidal graphite). This process considerably improves the bearing surfaces and gives additional wearing properties.

9. TO REMOVE CAMSHAFT

The camshaft may be removed from the engine while the unit is still in the chassis and the following procedure is used.

(a) Remove the front cowl and radiator as described in "Removal of Engine," page 28.

(b) Remove the cylinder head as described in "Decarbonising" and "Valve Grinding," page 25. Immediately after removal of the cylinder head,

sleeve retainers (Churchill Tool No. S.138) should be applied as shown in Fig. 22.
In the event of sleeve movement, new figure of eight washers should be fitted. Remove push rods and tappets.

(**c**) Disconnect tachometer drive. Remove distributor assembly complete with pedestal by removing the two securing nuts at the crankcase. Do not slacken clamp bolt. Remove distributor and oil pump helical driving gear.

(**d**) Check that the petrol has been turned off, remove petrol pipe and pump. (See "Fuel" Section P.)

(**e**) Loosen off dynamo and remove fan and fan assembly by withdrawing four bolts and the extension bolt.

(**f**) Remove the timing cover by withdrawing the seven setscrews, four bolts and one nut. Note the timing markings on the gear wheels and camshaft; this will assist in the re-assembly (see Fig. 21).

(**g**) Release the locking plate and withdraw the two setscrews. The timing chain can be lifted off the chain wheel and both components moved clear.

(**h**) The front camshaft bearing is next removed by withdrawing the two setscrews and locking washers. The bearing can be lifted away.

(**i**) The camshaft can now be drawn forward out of the cylinder block.

10. REFITTING CAMSHAFT

Re-assembly is the reverse procedure to the removal. It is considered desirable to describe certain operations as follows:—

(**a**) When resetting the valve timing, the engine should be set with Nos. 1 and 4 pistons at T.D.C. In this position the crankshaft timing wheel keyway is pointing vertically downwards, as shown in Fig. 21.
Rest the camshaft chainwheel on the camshaft spigot and turn the chainwheel about the camshaft until the identification punch mark on the end of the camshaft can be seen through the punch marked hole in the chainwheel. Secure the chainwheel to the camshaft leaving the two bolts finger tight.
Turn the camshaft chainwheel until the scribe line thereon aligns with the scribe line on the crankshaft sprocket. **Without moving** the camshaft remove the camshaft chainwheel and when removed fit the timing chain to this wheel and the one on the crankshaft in such a manner that the scribe lines remain aligned. Reposition the camshaft chainwheel and check by simulating pressure of the chain tensioner that the timing marks have retained their positions and re-adjust if necessary. Tighten bolts to correct torque loading and turn over tabs of locking plates.

(**b**) When refitting the oil pump and distributor driving helical gear, ensure that No. 1 piston is at T.D.C. on the compression stroke. In this position the correct engagement of the helical gear should allow the Woodruffe key to be positioned towards the front of the engine, pointing approximately towards the dipstick (Fig. 16). It may be found that the oil pump, shaft will not engage with the pump for the tongue and slot of these components are out of line. The engine will need to be turned over slowly until the shaft engages with the pump. Continue to turn the engine until the offset slot in the distributor drive boss attains the position as illustrated in Fig. 16. Disengage the helical gear and remove it from the housing. Turn the engine over until No. 1 piston attains the T.D.C. position on the compression stroke and replace the

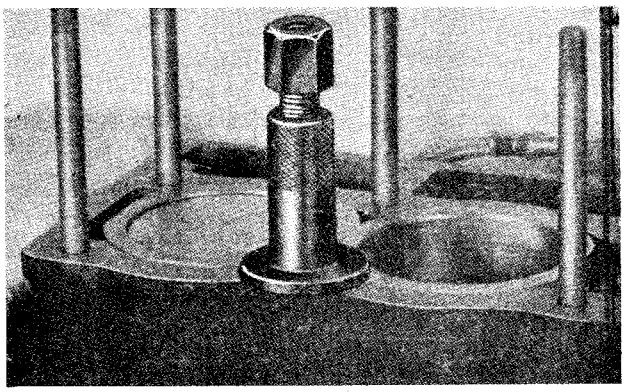

Fig. 22 Showing one of the two Cylinder Sleeve Retainers required to prevent movement.

helical gear when the shaft will engage with the oil pump.

(c) Having refitted the cylinder head and rocker shaft it is advisable to apply oil to the ground surfaces where the rockers contact the valves, as these points do not immediately receive a supply of oil.

11. TO SET VALVE CLEARANCES

All adjustments should be made when the engine is cold.

(a) Remove the rocker cover from the engine.

(b) Turn the engine over by hand until the valves of any cylinder are on the point of rock. Note the number of this cylinder.

(c) Continue turning the engine for another complete revolution, this will ensure that the tappets of this cylinder are at the base of the cam (Fig. 23).

(d) Holding the ball pin in the rocker arm with a screwdriver, loosen the lock nut.

(e) Pressing down on the screwdriver to eliminate any slackness in the valve gear.

(f) Turn the screwdriver until a feeler gauge of .010″ for inlet valve or .012″ for exhaust valve will pass between the toe of the rocker and the tip of the valve stem. The ball pin or screwdriver is turned anti-clockwise to increase the gap and clockwise to decrease the gap.

(g) Holding the screwdriver steady, tighten the lock nut. Still applying pressure to the heel of the rocker check the gap and adjust if necessary.

(h) Repeat with the second valve of that cylinder.

(i) Having noted the number of this cylinder continue with the remaining three in the firing order 1, 3, 4, 2, by turning the engine half a revolution before making adjustments.

(j) Replace the rocker cover pressing, ensuring first that the cork seal is in sound condition and second, when placing the cover in position, that the right-hand side does not foul the combustion head securing nuts. Failure to observe either of these points may result in a serious loss of oil.

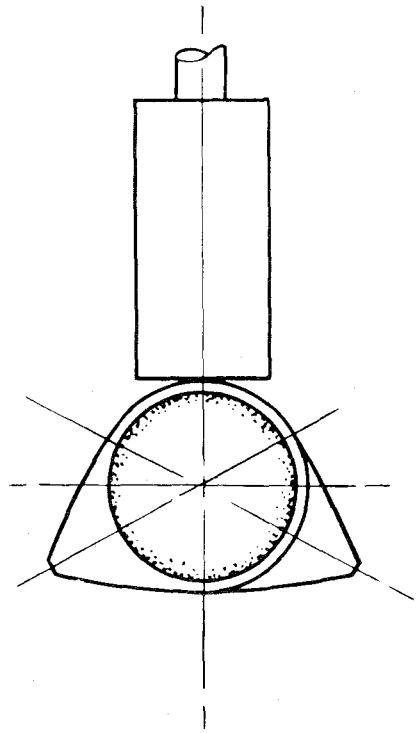

Fig. 23 **Tappet on base or concentric position of cam.**

12. TO SET VALVE TIMING IN THE ABSENCE OF TIMING WHEEL MARKINGS

It is assumed that, for the purpose of this instruction, the cylinder head and valve gear are in position and the crankshaft sprocket is keyed to the crankshaft but the camshaft chainwheel has yet to be fitted. The following procedure is recommended:

(a) Set valve rocker clearances for Nos. 1 and 4 cylinders to .015″ which is the valve timing clearances.

(b) Turn crankshaft until Nos. 1 and 4 pistons are at T.D.C.
This position may be found by placing the keyway in the crankshaft vertically downwards.

(c) Rotate the camshaft until the exhaust valve and inlet valve of No. 4 cylinder are at the point of balance in which the tappets will be in the position shown in Fig. 24. In this position the exhaust valve will just be about to close and the inlet just commencing to open. From the timing diagram, Fig. 25, it will be observed that the inlet valve opens at 15° B.T.D.C. and the exhaust valve closes at 15° A.T.D.C. 15° before or after T.D.C. is equivalent to .081″

(2.06 mm.) piston travel or 1.5″ (3.81 cm.) measured round the flywheel adjacent to the starter teeth.

(**d**) Offer up the camshaft chainwheel to the camshaft itself but without moving this shaft and adjust its engagement with the chain until a pair of holes in the chainwheel exactly match a pair in the shaft. It may be necessary to turn this wheel back to front to match these holes.

(**e**) Having attained the correct position of the chainwheel relative to the shaft, encircle the wheel with the timing chain.

(**f**) Without moving either crankshaft or camshaft, position the loop of the chain round the crankshaft sprocket in such a manner that the holes in the chainwheel match those in the camshaft.

(**g**) The camshaft chainwheel is now secured to the camshaft by two bolts and locking plates, the bolts are not locked until a final check has been made.

(**h**) A final check can be made when the engine is on a bench by marking the rear of the cylinder block opposite the T.D.C. mark on the flywheel with Nos. 1 and 4 cylinders at T.D.C.

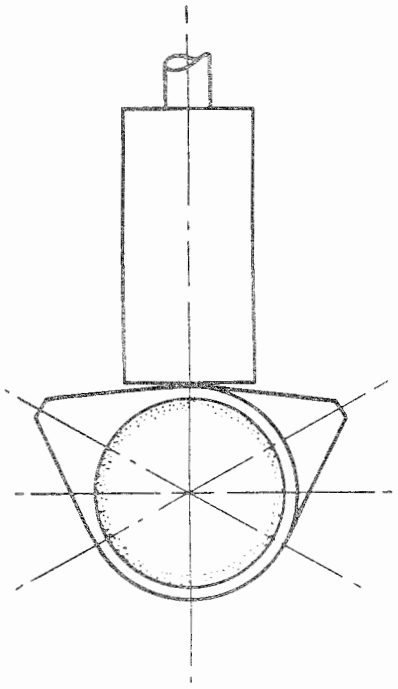

Fig. 24 **The Valve Tappet is at Point of Balance.**

The flywheel is then moved a $\frac{1}{4}$ turn anti-clockwise (viewed from the front of the engine) and then turned

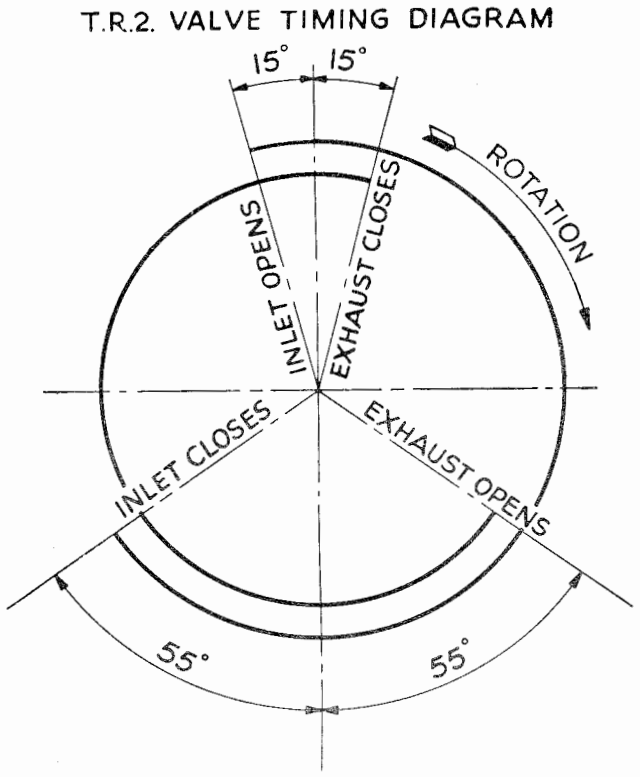

Fig. 25 **The TR2 Valve Timing Diagram.**

slowly in a clockwise direction. As the flywheel is turned clockwise, insert a .010″ feeler gauge between the valve stem and the rocker of No. 4 cylinder inlet valve until a slight resistance is felt, that is when the valve begins to open. At this stage the movement of the flywheel should be stopped; with a pencil mark the flywheel opposite the mark previously made on the cylinder block.

Remove the feeler gauge from the inlet valve.

Turn the flywheel clockwise until the feeler gauge can be inserted between the valve stem and the rocker of No. 4 cylinder exhaust valve, after which the flywheel is turned to T.D.C. Proceed to turn the flywheel slowly clockwise and at the same time putting a slight pull on the feeler gauge. The turning of the flywheel should be stopped at a point where the feeler gauge can be removed and this indicates that the exhaust valve has closed. A second mark of the pencil is now made on the flywheel opposite the mark on the cylinder block. With a rule measure the distance from the T.D.C. mark on the flywheel to each of the pencil marks.

If the timing is correct the two dimensions will be identical. Having finally proved the valve timing, the chainwheel locking tabs may be turned up.

(i) The timing gears are now marked with a scribe line as shown in Fig. 21.

(j) Fit the timing chain tensioner and secure with plain washer and split pin. Replace timing cover.

(k) The rocker clearances are now set to their working clearances of .012″ exhaust valve and .010″ for inlet valves (see page 22). When the car is used for high speed work the valve clearances for all valves is .013″.

13. IGNITION AND DISTRIBUTOR TIMING

See also "Engagement of Oil Pump and Distributor Driving Gear". (Page 16.)

It is important that the "Distributor and Tachometer Gear Assembly" is fitted with an end float of .003″ to .007″.

This can be measured in the following manner :—

(a) Measure and note the thickness of a $\frac{1}{2}$″ washer and assemble it with the distributor-tachometer driven gear to the oil pump driving shaft.

(b) Install this assembly in the cylinder block with the washer between the gear and the shaft bearing in the cylinder block. Ensure that the shaft is engaged in the oil pump.

(c) Over the gear assembly fit the distributor adapter.

(d) Utilising feeler gauges, ascertain the distance between the distributor adapter and its mating face on the cylinder block.

(e) When this measurement is compared with the thickness dimension of the washer the difference will represent the amount of "end float" or "interference".

Example

Thickness of washer	.060″
Distance between faces	.055″

The distance, being less than the washer, gives the gear assembly an "end float" of .005″.

Conversely

Thickness of washer	.060″
Distance between faces	.065″

The distance being greater than the washer, gives the gear assembly an "interference" of .005″. It will be necessary to fit shims or packings under the distributor adapter to obtain the correct end float.

Assuming the first instance to be the case, it will be necessary to add one packing of .002″ thickness to bring the end float to top limit. For the second instance it will be first necessary to "zero" the interference, *i.e.*, .005″ and add sufficient packings to obtain the correct end float. The packing necessary in this case is .011″ for a middle limit end float.

(f) Remove the gear assembly, shaft and washer from the cylinder block.

(g) Turn the engine until the piston of No. 1 cylinder is at T.D.C. on compression stroke, in this position both valves will be closed.

(h) Fit the Woodruffe key to the oil pump driving shaft and insert the shaft in the block to engage the oil pump with its tongue. Rotate the shaft until the key is at right angles to the camshaft and points away from the engine.

(i) Position and lower the distributor-tachometer driven gear on the drive shaft until the keyway and the key engage. Continue a downward motion turning the gear clockwise to effect engagement with the driving gear on the camshaft. Caution must be exercised to prevent dislodging the Woodruffe key.

(j) When correctly engaged the offset slot in the gear assembly will be aligned with No. 1 pushrod sealing tube and the offset towards the rear of the engine. Similar to Fig. 16.

(k) Assemble the distributor adapter together with the necessary packings to obtain the correct end float. Secure with nuts and locking washers.

(l) Fit the distributor body with the rotor arm pointing to No. 1 push rod tube.

(m) Adjust the points to .015″ and with the contact points just commencing to separate the vernier adjuster on the third marking of its scale, secure the body to the adapter bracket with the nut and lock washer with a plain washer, under the lock washer.

(n) Advance the vernier a further 1 division, which is equivalent to advancing the ignition 4° on the flywheel B.T.D.C.

(o) Fit the distributor cover, connect the plug leads to the correct plugs (Fig. 26). The plugs having had their gaps set to .032". Fit the H.T. and L.T. leads to the ignition coil.

14. TO DECARBONISE

We recommend the removal of the cylinder head for decarbonising after the first 5,000 miles. Attention after this running period has the advantage of allowing the initial casting stresses to resolve themselves and permits the consequent valve seat distortion to be counteracted by valve grinding. Failure to carry out this initial valve grinding is a frequent cause of excessive petrol consumption of new cars. Subsequent attention will not normally be required until further considerable amount of running has been done—normally after about 15,000 miles.

The above mentioned figures only take into consideration a car which is used under normal conditions. If the car is being used for competition and high speed work valve grinding is done as and when necessary.

The procedure recommended for decarbonising is as follows :—

(a) Disconnect the battery lead and plug leads from plugs.

(b) Drain the cooling system.

(c) Disconnect the fuel pipe clip, the top water and by-pass hoses and remove the thermo gauge bulb from the thermostat housing, then remove the latter from the cylinder head by withdrawing the two bolts.

(d) Remove the two rocker cover securing nuts and lift off the rocker cover.

(e) Remove the rocker shaft assembly by loosening off the four pedestal nuts progressively, allowing the assembly to rise as a unit.

(f) Remove the heater hose from the water shut-off cock at the rear of the cylinder head. (Where heater is fitted.)

(g) Disconnect the throttle and choke controls, the suction pipe and fuel feed pipe from the carburettors. Whilst there is no need to remove the carburettors this can be effected at the carburettor and manifold joints. (See "Fuel" Section P.)

(h) Remove the ten cylinder head nuts and lift the head from the block. **Do not** attempt to break the seal of the cylinder head by turning the engine as this will disturb the cylinder sleeves.

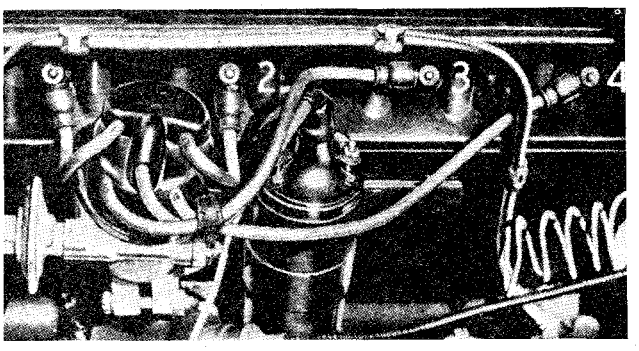

Fig. 26 **Plug Lead Attachment Sequence.**

(i) Immediately the combustion head has been removed, place cylinder liner retainers in position (Fig. 22) and check the projection of the cylinder sleeves above the face of the cylinder block (Fig. 5). The flange of the cylinder sleeves should stand proud by .003" minimum to .0055" maximum. If the cylinder sleeves have sunk below .003" new figure of eight joints will need to be fitted. (See page 19.)

Inspect also for cylinder sleeve movement and if any is suspected the cylinder sleeves and pistons will have to be removed and new figure of eight joints fitted.

Remove the push rods.

15. VALVE GRINDING

Lay the cylinder head on a bench so that the valve heads are supported, this will ensure that when pressure is exerted on the valve spring cap this spring will compress and the cotters easily removed.

The valves are numbered from the front of the engine and their positions perpetuated.

The carbon should be cleaned off with a blunt instrument and finally cleaned with a petrol moistened rag.

Grind the valves into their appropriate seating, where valve faces are badly pitted they should either be renewed or replaced. No attempt should be made to grind a badly pitted valve into its seating or this will be unduly reduced.

When the necessity of recutting a valve seat

arises, it is important that the valve guides are concentric with the seats themselves. Where a valve guide is badly worn it should be replaced before the seat is recut.
While refacing valves, only remove sufficient metal to clean up the face, otherwise if too much is removed the edge will tend to curl up in service.
Where valve seats are badly worn or pitted they should be recut with an 89° cutter utilising a pilot of the same diameter as the valve stem. Should the valve seating become embedded in the cylinder head as shown in Fig. 27, it will first become necessary to employ a 15° cutter, to provide a clearance for the incoming or outgoing gases, following this with a cutter of 44½°. This work should be carried out after the cylinder head has been cleaned.
The valve and guide data is given on pages 3 and 4.

16. REMOVAL OF CARBON

Remove the spark plugs, clean, set and test ready for replacement. If for any reason such as badly burnt or broken electrodes, and damaged insulation the plug should be replaced. For normal motoring Champion L10S ½″ reach; for high speed motoring L11S ½″ reach is recommended and the gap is to be set at .032″. The normal life of a spark plug is 10,000 miles.
Clean the carbon from the cylinder head, finally wipe the chambers clean. Scrape the valve ports clean, exercising great care not to damage the valve seats. When the head is clean of carbon blow out with a compressed air line and wipe with a rag moistened with petrol. Ensure that the contact face is perfectly clean and flat.
Before cleaning the carbon from the tops of the pistons, smear a little grease around the top of the two bores and raise the piston almost to the top. Fill the other two bores and tappet chambers with non-fluffy cloth; this will safeguard against any carbon chips entering the lower extremities of the engine. It is suggested that the piston crowns are cleaned, utilising a stick of lead solder, which will not scratch the piston crown, in such a manner that the carbon deposit on the vertical wall of the piston and that deposit formed in each cylinder bore above the maximum travel point of the top piston ring is not disturbed. This carbon helps to insulate the piston rings from the heat generated during combustion and provides a secondary oil seal.
The use of emery cloth or other abrasive for polishing is not recommended as particles of such abrasive may enter the bores and engine after re-assembly, causing serious damage.
Having cleaned two pistons, brush and blow away the carbon chippings, taking care not to allow any to drop into the cylinder block. Lower the clean pistons in their bores and wipe away the grease, remove the cloth stuffing from the other two piston bores and grease the tops. After greasing the tops of the cylinder bore raise these pistons and fill the remaining two bores with the rag. Repeat the cleaning operation. On completion of the piston cleaning, wipe and blow away the carbon chips and clear the block face, particularly around the cylinder sleeves and the tops of these

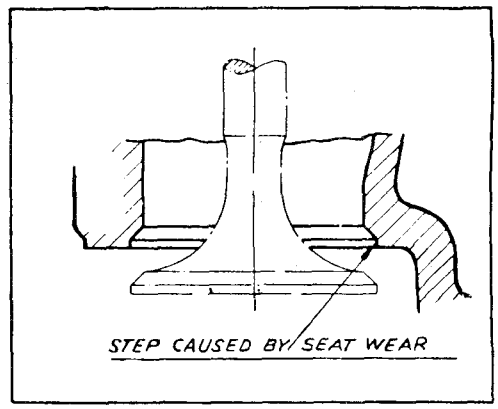

Fig. 27 A " Pocketed " Valve Seating.

sleeves. Clean the grease from the cylinder bores and remove the cloth stuffing from the bores and tappet chambers.
The valve springs should be examined for damage and their length compared with new springs. If any doubt exists as to the condition they should be replaced. The exhaust valve is fitted with an auxiliary inner spring, making three springs in all. It should be noted that the close-coiled end of these springs is fitted nearest the cylinder head.
Ensure that the cylinder block and head faces are perfectly flat and clean, it should only be necessary then to apply a coating of grease to the cylinder gasket. Should it be decided to use a sealing compound, one of the non-setting type must be used for on future occasions when the head is removed, the

cylinder sleeves may be disturbed because of their adherence to the gasket.

When refitting the cylinder head nuts, tighten them gradually in the sequence shown in Fig. 28 in order to produce an even pressure on the gasket and prevent undue strain in the cylinder block casting. It will be necessary to recheck the nut tightness when cold to 100—105 lbs. ft. Before tightening down the rocker shaft pedestals, screw back each adjusting screw and ensure that the ball ends of these screws engage correctly in the push rods. Failure to attend to this procedure can result in damage to the push rods. Smother the rocker gear with oil, particularly where the rockers bear on the valves.

Before replacing the rocker cover ensure that the cork joint is undamaged and shellaced to the cover, otherwise oil may leak through the joint.

After the first 500 miles the cylinder head nuts should be checked for tightness with the engine hot.

17. LOW COMPRESSION KIT—PART No. 502227

This kit was introduced for those owners who experienced difficulty in obtaining fuels of a high octane value.

The kit comprises of:—

8 Push Rods (longer than those normally fitted).
1 Combustion Head Gasket.
1 Low Compression Plate.
1 " Corgasyl " Combustion Head Gasket.

(**a**) Prepare the engine unit as for decarbonisation (see page 25.) No attempt should be made to break the combustion head seal by turning the crankshaft—this action will only disturb the cylinder liners on their lowermost seatings and water leakage will result. When the head has been removed fit liner retainers (Fig. 22) and check that the liners stand proud of the cylinder block .003" to .0055" (see page 19.)

(**b**) Apply a light coating of " Wellseal " jointing compound to both sides of the low compression plate and gaskets.

(**c**) Fit the copper cylinder head gasket (smooth face downwards), followed by the low compression plate and steel " Corgasyl " gasket; this may be fitted either side up.

(**d**) Fit the longer push rods and lower the combustion head into position. Omitting the plain washers, tighten the combustion head nuts (Fig. 28) to the correct torque (100 to 105 lbs. ft.).

(**e**) Screw back the ball pins in the rockers and then fit shaft assembly to the combustion head and tighten nuts to 24—26 lbs. ft.

Adjust valves for clearance. (See page 22.)

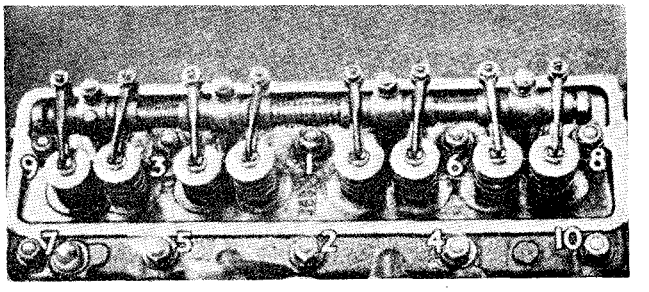

Fig. 28 Cylinder Head nut tightening sequence

(**f**) Reconnect fuel pipe, carburettor/distributor suction pipe, throttle and choke cables to carburettors.

(**g**) Replace rocker cover, ensuring first that the seal is in good order, also the thermostat housing, thermo gauge bulb.

(**h**) Refit heater hose (if heater is fitted), by-pass hose, top radiator hose. Replenish cooling system with coolant.

(**i**) Reconnect fuel pipe at pump. Connect battery lead.

NOTE—After the first 500 miles the cylinder nuts should be checked for tightness with the engine hot.

18. THE "PUROLATOR MICRONIC" OIL FILTER—TYPE 17F. 5102 (Fig. 29)

The Purolator Micronic filter consists of a plastic impregnated paper element which removes the finest particles of abrasive which invariably find their way into the engine. A filter of this type will stop not only the smaller microm sized particles of abrasive, but ensures a supply of clean oil to the engine at all times. The only attention which the filter needs is to see that the element is changed at periods not exceeding 8,000 miles. It is essential that this operation is carried out at specified periods

B

to ensure maximum filtration. To renew the element proceed as follows :—

(**a**) Clean the outside of the filter casing.

(**b**) Unscrew the centre bolt and remove the filter casing and element.

NOTE—The paper element, its perforated outer cover and element tube forms a complete element assembly.

Ensure that the top seal is retained in position in the groove in the filter head.

(**c**) Withdraw the element and clean the inside of the casing.

(**d**) Insert a new element into the filter casing.

(**e**) Fit the filter and new element to the filter head ensuring that the spigot formed on the head enters the centre tube of the element squarely. Tighten the centre bolt sufficiently to ensure an oil-tight joint. (14-16 lbs. feet.)

(**f**) Run the engine for a few minutes and inspect the filter for leaks. If leakage is noted between the filter casing and the head, the centre bolt must be unscrewed and the casing and element withdrawn. A new top seal should then be fitted. If leakage occurs at the bottom of the filter, withdraw the casing and element, remove the circlip from the centre bolt and withdraw the bolt from the casing ; collect the element support, bolt seal, washer and spring. Ease the remaining seal out of the bottom of the casing and fit a new seal in its place. Insert the centre bolt and fit the spring, the washer, a new bolt seal and the element support on to the part, fit circlip into its groove in the bolt. Place the element inside the casing and offer up the assembly to the filter head, screw the centre bolt home. A certain quantity of oil will be lost due to the removal of the filter casing, and the sump should be topped up after assembly of the filter.

The filter casing should not be disturbed until element renewal is required. To do this invites the hazard that the accumulated dirt on the outside of the filter may be allowed to contaminate the inside ; thus being carried into the bearings when the engine is re-started.

Do no attempt to reset the pressure relief valve which is incorporated in the filter head. This is the main engine pressure relief valve and is set at the works to a predetermined figure.

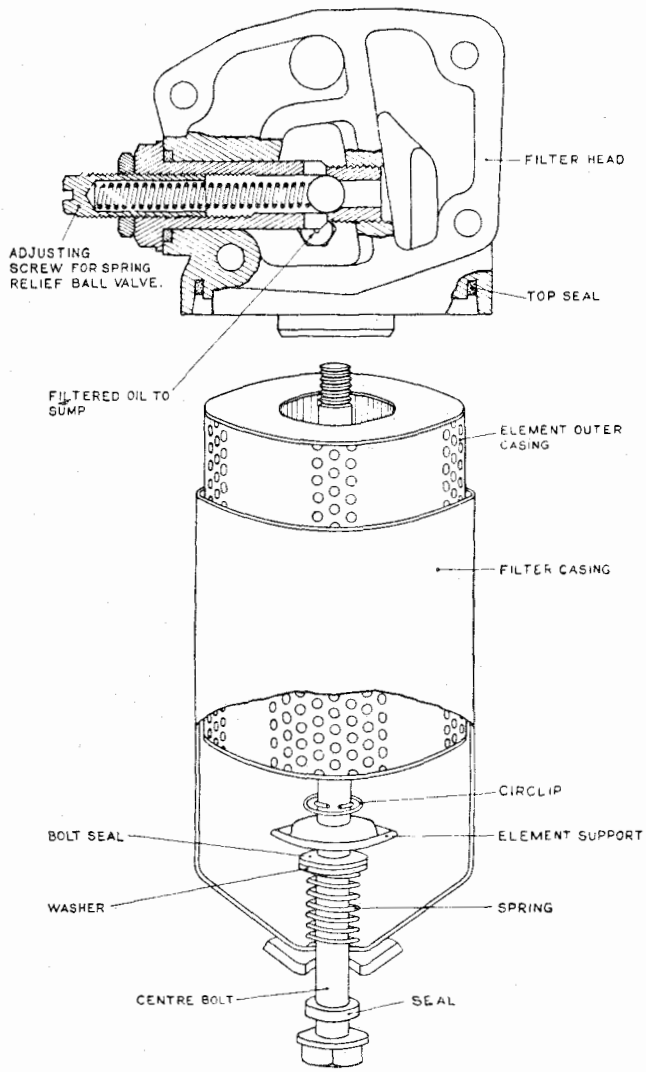

Fig. 29 **The Purolator Oil Filter.**

19. REMOVAL OF ENGINE AND GEARBOX AS A UNIT

(**a**) Disconnect the battery. Turn off petrol at shut-off cock.

(**b**) The bonnet is removed by removing four hinge nuts, two at each hinge.

(**c**) Drain off the cooling fluid by opening the taps, one at the base of the radiator

and the second situated below the inlet and exhaust manifold in the cylinder block.

(**d**) Drain off the oil from the engine and gearbox.

(**e**) Disconnect the head and side light cables at their snap connectors. Remove the bolts from the top brackets and the bolt in the centre of the cowling, this holds the bonnet lock connecting cable, release cable control at one side. Remove the twelve setscrews (six per side) situated under the wheel arches. Remove the starting handle bracket and the steady rods from under the cowling and finally the nut and bolt from the steady plate.

(**f**) To remove radiator disconnect top and bottom hoses, release the tie rods at the top and the bolts one either side at the base of the unit.

(**g**) Disconnect the lever linkages at the foremost carburettor; disconnect the inner and outer cables of the choke control and the fuel feed pipes at their banjo unions. Remove the carburettors from the manifold by undoing the four nuts—two at each flange.

(**h**) Remove the horns from their brackets by first removing the four fixing bolts (two to each horn). There is no need to disconnect the horns from their cables. Disconnect dynamo leads and remove dynamo from its bracket and remove fan belt.

(**i**) Remove front chassis cross tube by removal of three nuts and bolts at each flange.

(**j**) Remove the three nuts and washers at the exhaust flange and break the joint.

(**k**) Disconnect the flexible fuel pipe at the petrol tap, the oil pressure gauge pipe, starter motor cable, L.T. lead at the coil, the tachometer drive at distributor pedestal and withdraw the water temperature gauge bulb.

(**l**) To remove the seats, first remove the cushions and unscrew the sixteen nuts (eight to each seat) thus releasing the frame from the runners; it can then be lifted out.

(**m**) Free the rubber gear lever grommet by the removal of three self-tapping screws from the gearbox cover pressing and remove the latter by unscrewing the thirteen setscrews, hidden by the trim and floor covering.

(**n**) Remove the gear lever with grommet by loosening the locknut and unscrewing the lever.

(**o**) Remove the speedometer drive, the overdrive cable at the snap connector and the starter motor by removing two nuts and bolts.

(**p**) Drain the clutch hydraulic system. Disconnect the bundy tubing at the flexible hose at the left-hand side chassis member whilst holding the hexagon on the hose. Still holding the hexagon remove the hose securing nut and shakeproof washer; the flexible hose can now be withdrawn from its bracket.

(**q**) Uncouple the propeller shaft by removing the four nuts and bolts securing the two flanges. Remove the two nuts holding the gearbox to the chassis frame.

(**r**) Remove the four nuts and bolts (two each side) securing the engine mountings to the chassis.

(**s**) Fit slings to engine and lift out in a "nose up" position, as shown in Fig. 31.

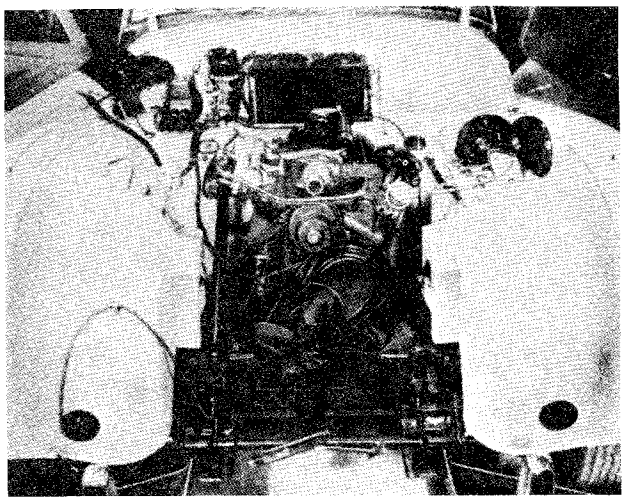

Fig. 30 The front of Car prepared for Engine and Gearbox Removal.

20. DISMANTLING ENGINE

It is sound policy to clean the exterior of the engine and gearbox before commencing to dismantle.

(i) Detach gearbox by removing the nine nuts and bolts from the clutch bell housing.

(ii) Remove the clutch from the flywheel by withdrawing the six securing bolts.

(iii) Remove the flywheel by unlocking the tab washers and withdrawing the four bolts.

(iv) To remove the fuel pump, first disconnect the pipe to the carburettors and then remove the nuts and lock washers from the studs. It will be noticed that the rearmost stud accommodates the oil pressure gauge pipe clip.

(v) Remove rocker cover, together with oil filler cap.

(vi) Remove suction pipe from distributor and sparking plug leads, H.T. and L.T. leads at the ignition coil. Avoid loosening clamping bolt and remove distributor from pedestal, secured by two nuts with locking and plain washers. Lift out distributor and tachometer driving shaft assembly.

(vii) Remove the ignition coil.

(viii) From the front of thermostat housing remove the nut holding the clip for the fuel and suction pipes; these two pipes are strapped together and can be lifted away. Remove the by-pass hose from the thermostat housing to the water pump housing after undoing the two hose clamps. Withdraw thermostat housing as a unit following the removal of the two bolts and lock washers securing it to the combustion head.

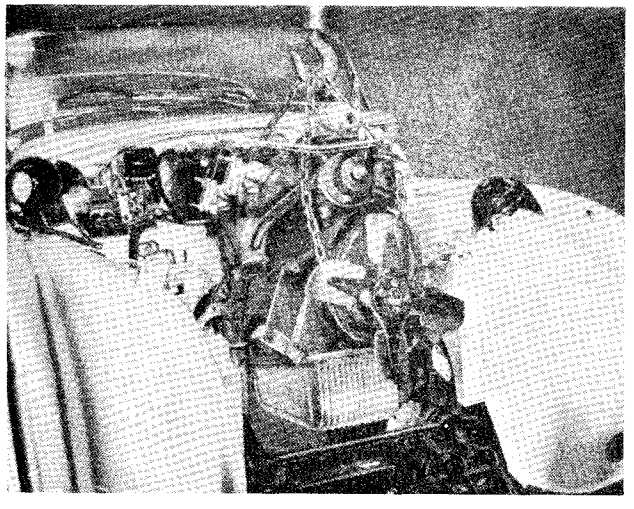

Fig. 31 The Engine and Gearbox being removed from the Chassis. Note the "nose up" attitude.

(ix) Remove water pump impeller after withdrawing one bolt and two nuts.

(x) Remove the water pump housing which is held by two bolts and spring washers.

(xi) Proceed to remove oil filter assembly by first removing the cap nut holding the oil pressure pipe banjo to the filter. This pipe can now be detached. The remaining three bolts can then be removed and the filter assembly taken away.

(xii) Remove dynamo bracket and pedestal.

(xiii) Remove fan assembly by withdrawing four bolts, followed by the extension bolt; the hub and hub extension can now be withdrawn from the crankshaft.

(xiv) Remove timing cover and packing, remove chain tensioner after withdrawal of split pin and washer. Observe the markings on the camshaft chainwheel and crankshaft sprocket which should correspond to Fig. 21 when No. 1 piston is at T.D.C. of compression stroke.

(xv) Release the tabs of the locking plate and withdraw the two bolts to release camshaft chainwheel, the chain can now be freed from the crankshaft sprocket. Camshaft chainwheel and chain can now be lifted away and the crankshaft sprocket and Woodruffe key removed from the crankshaft, followed by the shims.

(xvi) Lift rocker shaft assembly by removal of the four pedestal nuts.

(xvii) Remove the inlet and exhaust manifolds by removing eight nuts and six clamps.

(xviii) Remove combustion head by removal

of ten nuts and washers and lift out the push rods and tappets.

(**xix**) The camshaft can be withdrawn by first removing two bolts securing the front bearing, then the bearing and finally the camshaft.

(**xx**) Remove the nineteen sump securing bolts and remove the sump. Care should be taken not to damage the oil pump filter.

(**xxi**) Remove oil pump from inside cylinder block by unscrewing the three nuts and washers.

(**xxii**) Remove the front engine plate from the block by removing the five attachment bolts, and discard the packing.

(**xxiii**) Remove the bearing caps, bottom halves of the shell bearings and thrust washers by releasing the tabs of the locking plates and withdrawing the bolts. Remove also the big end bearing caps and bottom halves of the shell bearings by releasing the locking plates and withdrawing the bolts.

(**xxiv**) Lift out the crankshaft and collect the upper halves of the shell bearings.

(**xxv**) Collect the upper halves of the big end shell bearings and withdraw the connecting rods and pistons from cylinder block. The cylinder sleeves may be tapped out gently from below.

21. RE-ASSEMBLY OF ENGINE

When the engine is completely dismantled the following procedure is suggested for re-assembly.

The cylinder block and combustion head should be examined for leakage at the various core plugs. If these do show signs of leakage they must be renewed, their seatings thoroughly cleaned and new plugs fitted with jointing compound.

The main and big end journals of the crankshaft should be checked for wear against the dimensions listed on page 1.

Wear in excess of .0025″ on the crank pins and the journals should be met by regrinding, but where the bearing alone is seriously worn (in excess of .003″) its replacement should suffice.

The bores of the sleeves should be measured and if more than .010″ in excess of the dimensions quoted on page 2 they should be renewed. It should be noted that maximum wear occurs at the top of the bore.

The camshaft and camshaft bore should also be dimensionally examined. Journal wear in excess of .003″ will necessitate a replacement shaft, whilst wear in the cylinder block bores of more than .0035″ will entail a replacement block.

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It is intended in the very near future to introduce replaceable camshaft bearings for all journals. At the time of going to press full details are not available and this matter will be dealt with in an issue of "Service Information."

The combustion head should be examined and due attention paid to valve guides, valve seats, valve springs and the valves themselves. Valve guides should be replaced if they are more than .003″ oversize their original dimensions quoted on page 3.

Valve seats should be ground in, or if "pocketed" (Fig. 27), new seats should be shrunk in.

Valve springs should be thoroughly examined for cracks and dimensions compared with those quoted on page 5.

Valves should be examined to ensure that their stems are prefectly straight and the faces recut.

The block and the head should be thoroughly cleaned or blown out by compressed air to ensure that all foreign matter has been removed. Bolts, setscrews and nuts are to be tightened to the torque loadings given in General Data Section.

All joint washers, gaskets, locking washers, lock plates and split pins must be renewed

(**i**) Check that the two halves of the rear oil seal bear the same number (Fig. 32).

These are machined as a mated pair and failure to observe this instruction may result in oil leakage. Shellac the top half of the oil seal and attach it loosely to the cylinder block by its four bolts and lock washers. Shellac and similarly fit the lower half of the oil seal to the rear bearing cap. Ensuring that the crankshaft mandrel is clean (Fig. 33), lay it in the rear bearing housing (without the shell bearings).

Fit the bearing cap and tighten down sufficiently to nip the mandrel. Tighten the eight bolts to secure the oil seal to the cylinder block and bearing cap (torque loading of 8—10 lbs. ft). Remove bearing cap from block.

(**ii**) Fit the upper half of the main bearings to the cylinder block; thoroughly clean and lubricate; place the crankshaft in position.

(**iii**) Fit the lower halves of the main bearings to the bearing caps, and lubricate.

(**iv**) Thread the two top halves of the thrust washers at the side of the centre main bearing between the crankshaft and the cylinder block.
It is essential that the white metal side is toward the crankshaft.
Fit the thrust washers, one either side, to the centre bearing cap (Fig. 34) and lightly secure with the two bolts and lock washers to cylinder block. Fit the two remaining caps to the cylinder block with two bolts and two lock washers each.

(**v**) Commencing from the front of the engine, tighten the bearings cap bolts to the correct torque (see "General Data"). On tightening the rear bearing

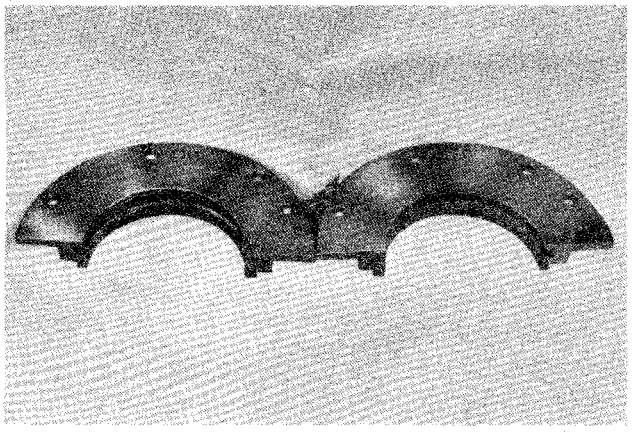

Fig. 32 **Rear Oil Seal for Crankshaft. These are a mated pair and should not be separated.**

cap, tap the oil seal lightly so that the joint between the two halves is flush.
In the absence of a crankshaft mandrel the oil seal attachment bolts will still be loose at this juncture. They should now be tightened to a torque loading of 8—10 lbs. ft. The bearing cap must

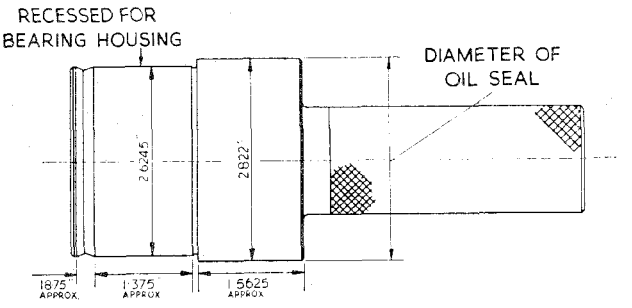

Fig. 33 **Crankshaft Mandrel for centring the Rear Oil Seal.**

be tightened down so that the oil seal division is flush.

(**vi**) Check the crankshaft end float by the use of the feeler gauges or by using the dial indicator gauge as shown in Fig. 17. Should the end float determined be greater than .006", thicker thrust washers may be fitted; when the float is less than .004", thinner washers are needed or the existing ones should be rubbed down on emery paper (Fig. 18).

(**vii**) Fit the front main bearing sealing block and tighten down the two cheese-headed bolts using a substantial screwdriver. Check that the face of the block is flush with the face of the cylinder block.
Plug the two cavities, one either end of the sealing block, with the sealing pad coated with shellac.

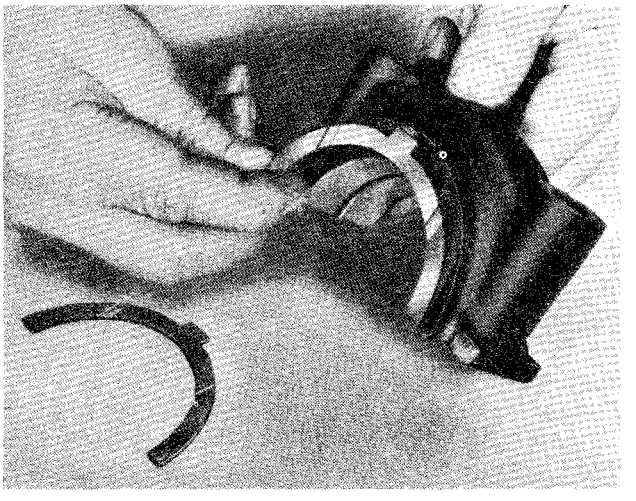

Fig. 34 **Fitting the Lower Thrust Washer to the Centre Bearing Cap.**

(**viii**) After dipping the felt packing strip into shellac force it into the recesses

either side of the rear main bearing cap with the aid of a $\frac{3}{16}$" square brass drift (Fig. 35). Two lengths about 9" long are necessary. Completely fill the groove and cut the felt off $\frac{1}{64}$" proud of the cylinder block face. It is suggested that the felt strip is cut into approximately $\frac{3}{4}$" lengths for easy insertion.

(**ix**) Check the connecting rods for alignment in the Churchill Tool No. 335 or a similar tool. Press the Clevite bush into the small end of the connecting rod and ream out whilst in position using the Churchill Tool No. 6200A and reamer; dimensions are to be found on page 2. Assemble the piston to the connecting rods so that the split of the skirt faces the cap side of the rod (Fig. 7). It is suggested that the pistons be first submerged in hot water for a few moments and the gudgeon pin should then be a light push fit. Secure the gudgeon pin with circlips, one either side. Dry the piston and rod assemblies thoroughly.

(**x**) Fit the piston rings to the pistons, the two compression rings are uppermost with one oil scraper ring below. Lubricate freely. Move the rings so that their gaps are 180° removed from one another; failure to observe this point may lead to increased oil consumption. Wire brush the exterior of the cylinder liners to ensure that they are free from scale and all loose dirt on their machined surfaces. With the assistance of a piston ring compressor fit the piston assemblies to the cylinder sleeves bearing the same letter as the piston.

(**xi**) Arrange the piston and connecting rod assemblies now in their cylinder sleeves, so that the numbers stamped on the rods and caps run consecutively, *i.e.*, 1, 2, 3, 4. Turn these assemblies upside down in pairs, 1 and 2, 3 and 4, with the flat of the liner adjacent to one another. The bearing caps are now all uppermost and must be turned face one way. Remove the bearing caps and fit the shell bearings to rods and caps. Fit one figure of eight packing, using a light coating of "Wellseal" jointing compound on the flanged faces of each

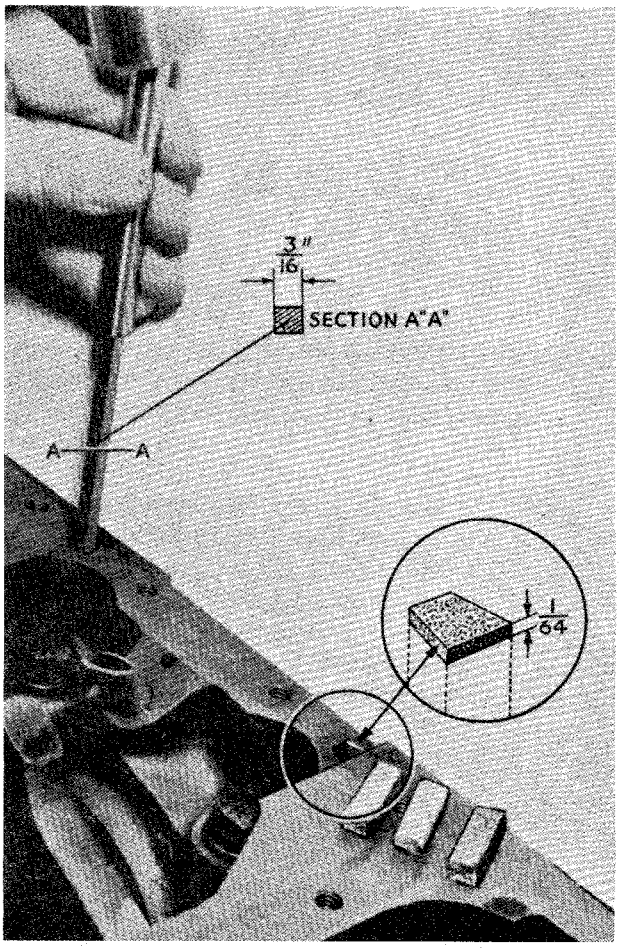

Fig. 35 **Sealing Rear Main Bearing Cap.**

pair of cylinder sleeves and on the mating faces in the cylinder block after ensuring that all components have been thoroughly cleaned of all loose deposits and the machined surfaces in which the cylinder sleeves spigot are clean and free from burrs, the sleeves with their respective piston assemblies can now be fitted to the block.

(**xii**) Locate the cylinder sleeves and piston assemblies in the cylinder block so that the cap of the connecting rod is adjacent to the camshaft side of the engine. The assembly which bears the number 1 on its connecting rod is fitted to the foremost position. The sleeves should stand .003" to .0055" proud of the cylinder block face (Fig. 5).

(**xiii**) It is essential that means are employed to prevent the cylinder sleeves from moving in the block. Messrs. V. L. Churchill & Co. Ltd. have manu-

factured special retainers for this purpose (Fig. 22) and it is suggested that these are employed. Until this is done the piston assemblies must not be moved, for any movement will be transferred to the sleeve and damage the figure of eight washers. If damage is undetected, water leakage will result. An alternate method is to insert the cylinder sleeves **alone** into the block, clamp them with the Churchill sleeve retainers to ensure no further movement and then fit the piston assemblies similarly as described in paras. (**x**) and (**xi**).

(**xiv**) Having the sleeve retainers in position, the connecting rods may be fitted to the crankshaft, Nos. 1 and 4 cylinders, followed by 2 and 3 cylinders. The caps are fitted to their respective rods and in such a manner that the tubular dowel will sink into its recess and their identification numbers coincide. It should be noted that the bearing cap, because of this dowel, can only be fitted one way round. The cap is secured by two bolts and a locking plate. Tighten the bolts to the correct torque loading and turn over the tabs of the locking plates.

(**xv**) Push the oilite bush into the centre of the crankshaft at its rear end and tap the flywheel locating dowel into position in the flange.

(**xvi**) Fit flywheel located by the dowel so that the arrow marked on its periphery lines up with the centre of the cylinder block with Nos. 1 and 4 pistons at T.D.C. Secure flywheel with the four setscrews and two locking plates, then turn over the tabs of the locking plates when the setscrews have been tightened to their correct torque loading.

(**xvii**) Utilising jointing compound affix the front plate packing and locating the engine plate on the two dowels secure with the five bolts and locking washers. Fit the engine mountings secured by two nyloc nuts.

(**xviii**) To the forward end of the crankshaft fit the sprocket locating shims, the Woodruffe key and the sprocket wheel.

(**xix**) Lubricate the camshaft and feed into the cylinder block and secure the front bearing with two setscrews. Check the end float as described on page 17. Rest the camshaft chainwheel on the camshaft spigot and turn the chainwheel about the camshaft until the identification punch mark on the end of the camshaft can be seen through the punch marked hole in the chainwheel. Secure the chainwheel to the camshaft leaving the two setscrews finger tight. If a replacement chainwheel is being fitted, see "12. To set Valve Timing in the Absence of Markings" (page 22). Check the alignment of the chainwheel with that of the sprocket on the crankshaft, taking into consideration the end float of the camshaft. The alignment can be adjusted by altering the thickness of the shim between the crankshaft sprocket and the abutment on the crankshaft.

(**xx**) Turn the camshaft chainwheel until the scribe line thereon lines up with the scribe line on the crankshaft sprocket. **Without moving** the camshaft remove the chainwheel and when removed fit the timing chain to this wheel and the one on the crankshaft. Reposition the camshaft chainwheel and check by simulating pressure of the chain tensioner that the timing marks have retained their positions and re-adjust if necessary. Tighten bolts to correct torque loading and turn over tabs of locking plates. Lubricate tappets and place in tappet chambers.

(**xxi**) Fit the chain tensioner to its pin and secure with washer and split pin. Screw in timing cover support bolt to the engine plate and fit the oil deflector to the crankshaft so that the raised edge faces the timing cover.

(**xxii**) Press the oil seal with its lip inwards into the timing cover and fit this cover with its packing to the engine plate utilising one nut, eleven bolts with four nuts.
NOTE—See that the short earth bonding strip from engine to chassis frame is attached under the head of the bolt

which aligns with L.H. rubber mounting attachment nut.

(**xxiii**) The machined faces on the combustion head and the upper flanges of the cylinder sleeves, which contact the combustion head gasket, should be lightly coated with " Wellseal " sealing compound. A substitute compound, which retains its plasticity, may be used if " Wellseal " is not available. This sealing is necessary to ensure a proper life for the gasket.

(**xxiv**) Assemble the valves and springs to the combustion head (see " To Decarbonise," page 25) and fit the assembly to the block, tightening the ten nuts and washers down as shown in Fig. 28. Fit push rods in the chambers.

(**xxv**) Assemble the rocker shaft as follows : To the rocker shaft fit No. 4 rocker pedestal in such a manner that the oil-feed holes coincide and secure with setscrew. To the shorter end of the shaft, fit No. 8 rocker, a double coil spring washer and a collar. Secure the collar to the shaft with a mills pin. On the longer end of the shaft feed the remaining rockers, springs and pedestals (see Fig. 36). After fitting No. 1 rocker, fit the double coil spring and collar securing the latter with a mills pin.

(**xxvi**) Loosen the ball pins and fit rocker shaft assembly to combustion head securing the pedestals to the studs with four nuts and spring washers. Before exerting any pressure on the nuts it is recommended that the adjusting pins are slackened off to prevent them coming into too hard a contact with the push rods. Tighten down the nuts progressively to the correct torque loading (see "General Data" Section A).

(**xxvii**) Adjust valve clearances. See "11. To Set Valve Clearances" (page 22).

(**xxviii**) Fit the oil pump assembly and packing secured by three nuts and lockwashers to the inside of the cylinder block.

(**xxix**) Fit the sump and packing to the cylinder block and secure with nineteen bolts and lock washers. The shorter bolt is fitted through the front flange of the sump into the sealing block. The rearmost bolt on the left-hand side accommodates the breather pipe clip and the bolt in front of this accommodates the clutch slave cylinder stay. When an aluminium sump is fitted, two packings are used, one either side of the tray.

B

(**xxx**) Fit the breather pipe to the cylinder block and secure the clip to the sump plate by the bolt, nut and lock washer with a distance piece between the two plates.

(**xxxi**) Fit ignition coil to side of cylinder block with two nuts and lock washers.

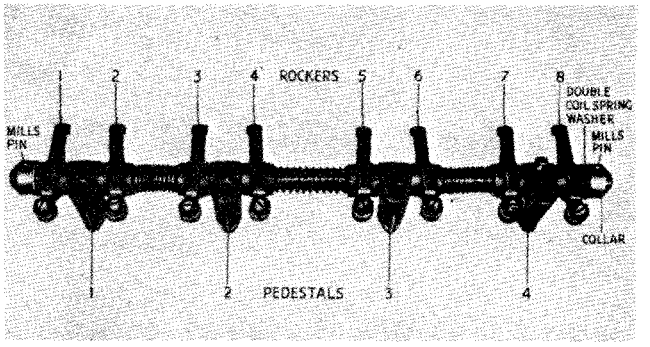

Fig. 36 **The Rocker Gear Assembly.**

(**xxxii**) Fit distributor and adapter as described in "13. Ignition and Distributor Timing" (page 24).

(**xxxiii**) To the pulley hub and hub extension assemble the fan pulley in such a manner that the T.D.C. indicating hole in the pulley is diametrically opposite the key way in the pulley hub centre ; secure with six nuts and bolts locked in pairs with locking plates. On later production cars with engine numbers after T.S. 4145E the locking plate and nut was replaced by a plain washer and nyloc nut.

(**xxxiv**) Fit the Woodruff key to the crankshaft, offer up the pulley assembly and

secure with the extension bolt. Shims are placed behind the head of this bolt, which incorporates the starting handle dogs, to provide the correct relation with the starting handle and the engine compressions. This position is obtained with Nos. 1 and 4 pistons at T.D.C. and the dog faces corresponding to "10 minutes to 4 o'clock" (Fig. 37).

(**xxxv**) To the fan assembly fit the split rubber bushes (four front and four to the rear) and slide into the bushes the four metal sleeves. Place on top of the rubber bushes four larger diameter plain washers, the lockwasher for the starting dog extension bolt followed by the balance piece placed in such a manner that the drilled holes coincide with the drill spot on the hub extension To the securing bolts fit the locking plates and smaller diameter plain washers and feed through the holes in the fan blade assembly, and offer up the hub assembly to the crankshaft and secure, finally turning over the tab washers.

(**xxxvi**) Using a new joint washer and sealing compound, offer up the water pump housing to the cylinder block and secure with two bolts and lock washers and tighten to the correct tightening torque. Affix a joint washer to the housing with sealing compound and offer up the water pump impeller. This is secured by two nuts with lock washers and a bolt with lock washer, the purpose of this bolt is twofold, it secures the impeller to the housing and the housing to the cylinder block. Attach the adjusting link with a bolt and tab washer to the right-hand side of the water pump housing but leave the bolt finger tight at this juncture.

(**xxxvii**) Fit the "U" dynamo bracket to cylinder block utilising three setscrews and lock washers. Fit the dynamo pedestal to the front engine plate and secure with nyloc nut ; offer up dynamo and secure finger-tight to the pedestal with a setscrew and lock washer and to the bracket at the rear by nut and bolt with lock washer. Secure the front of the dynamo by its second fixing point to the adjusting link (already attached to the water pump) utilising one setscrew with a plain washer either side of the dynamo.

(**xxxviii**) Fit the fan belt and adjust to give $\frac{3}{4}$" play either side of a centre line. Tighten up all nuts and bolts securely including the bolt of the adjusting link and turn up tab of tab washer.

(**xxxix**) Fit thermostat housing and packing to combustion head and secure with two bolts and lock washers, leaving finger tight at this juncture. Connect

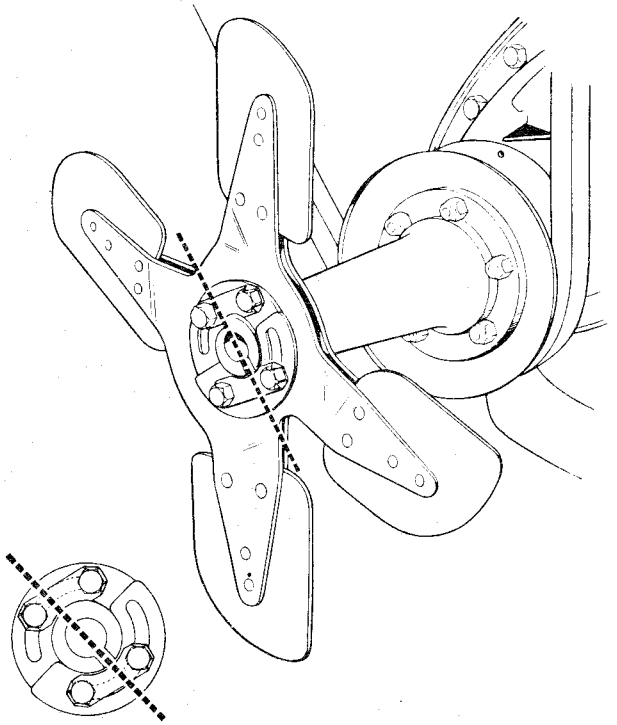

Fig. 37 **Setting the Hand Starter Dog at "ten minutes to four". Note also the hole in fan pulley and pointer on timing cover, which when aligned bring Nos. 1 and 4 pistons to T.D.C.**

the water pump and thermostat housing with the by-pass hose and tighten hose clips.

(**xl**) Assemble the inlet manifold to the exhaust manifold leaving the two nuts finger tight. Position the manifold gaskets on the eight studs fitted in the cylinder head. Fit the manifold assembly to the cylinder head, positioning the four short clamps on the upper row of studs and the longer pair on the two inner studs of the bottom row. Fit the eight nuts and spring washers and

tighten to 20—24 lbs. ft. Finally tighten the two nuts attaching the inlet to the exhaust manifold to 16—18 lbs. ft..

(**xli**) Fit the Purolator oil filter with packing to left-hand side of cylinder block. It is located by a tubular stud and secured by three bolts with lock washers. The tubular stud accommodates the oil pressure gauge pipe. This part is fitted to the stud with a copper washer either side of the banjo connection and secured by a cap nut. The pipe is also attached by a clip to the rear stud of the fuel pump.

(**xlii**) Fit fuel pump and packing and secure with two nuts and lock washers. The rearmost stud of this mounting also accommodates the clip steadying the oil pressure pipe.

(**xliii**) Connect fuel pipe from pump, clipping it to the thermostat housing, also the suction tube to the distribution union. The latter, a narrow section tube, is strapped to the fuel pipe.

(**xliv**) Apply oil to the rocker arms and valve tops. Ensure that the rocker cover seal is in position and is in good order and secure cover to top of engine by the two nyloc nuts, each bearing on a fibre and plain washers. Ensure that the rocker cover does not foul the cylinder head nuts at the right-hand side of the engine.

(**xlv**) Offer up the clutch driven plate and housing to flywheel, ensuring first that they are in good condition and the release levers of the housing are correctly adjusted. (See "Clutch" Section.) Settle the housing on the two dowels and secure the flywheel with six set-screws and lock washers, centralising the clutch driving plate with a dummy constant pinion shaft or mandrel.

(**xlvi**) Ascertain that the gearbox, clutch release bearing and clutch operating shaft are in working order before assembling to engine. Offer the gearbox up to the engine, locating it on two dowels and three studs, and secure with six bolts, nuts and lock washers, and three nuts and washers on the studs.

(**xlvii**) The engine and gearbox can be fitted to the chassis with the use of a derrick or moveable crane. Allow the rear extension of the gearbox to be lower than the sump and by slowly lowering the whole unit the mounting points can be found ; utilise a rope sling fitted as shown in Fig. 31.

(**xlviii**) The attachment of the engine and gearbox to the chassis is the reversal of the detachment procedure.

(**xlix**) The engine and the gearbox must be refilled with oil and the radiator with water before the car is used.

22. IGNITION SYSTEM

Notes on Sparking Plugs

(**a**) When sparking plugs are removed from the engine, remove their gaskets with them. Place the plugs and gaskets in a suitable holder, identifying each plug with the cylinder number. The tray shown in Fig. 38 is a simple construction with holes drilled to admit the upper ends of the plugs. Place a new plug of the proper type beside the others to afford a comparison of relative condition of the plugs in use, to the new plug.

(**b**) Look for signs of oil fouling, indicated by wet, shiny, black deposit on the insulator (Fig. 39). Oil pumping is caused by worn cylinders and pistons or gummed-up rings. On the suction stroke of the piston, oil vapour from the crankcase is forced up past the worn rings, where it fouls the plugs and causes sticking valves, with resultant waste of petrol. On the compression stroke, the mixture of oil and petrol vapour is forced past the rings into the crankcase again, contaminating the oil and turning it black with carbon. Carbon deposists in the combustion chamber are formed from burning oil vapour and cause " pinking."

(**c**) Next, look for petrol fouling indicated by a dry fluffy, black deposit (Fig. 40). This is caused by many things—faulty carburation, ignition system, defect in battery, distribution coil or condenser, broken or worn-out cable.

The important thing is for the petrol consumption to be improved. If plugs show suitability for further use, proceed to clean and test.

(**d**) In preparing for cleaning, remove plug gaskets, and in doing so ascertain their

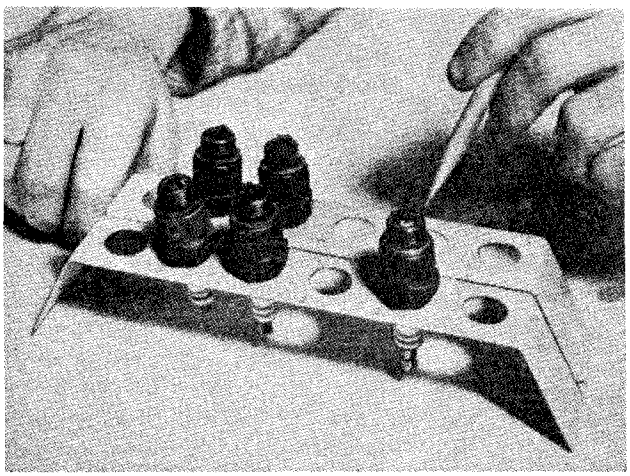

Fig. 38 Sparking Plugs in a tray ready for comparison.

condition. Note the gaskets illustrated in Fig. 41. Upper left shows a gasket not properly compressed. A large proportion of the heat from the insulator is dissipated to the cylinder head by means of the copper gasket between the plug and the cylinder head. Plugs not down tight can be easily overheated, throwing them out of the proper heat range, causing pre-ignition, short plug life and bringing about so-called " pinking." Don't tighten plugs too much—but be reasonably sure a good seal is made between plug and cylinder head. Lower left shows a gasket on which the plug was pulled down too tight, or had been too long in service. Note the distorted condition. Note evidence of blow-by, also a cause of plug over-heating and resulting dangers. Upper right shows a reasonably compressed gasket giving the plug adequate seal and a good path for heat dissipation. All may be compared with the new gasket, at lower right. If gaskets are at all questionable they should be replaced by new gaskets.

Fig. 39 Oil fouling indicated by a wet shiny black deposit on the Insulator.

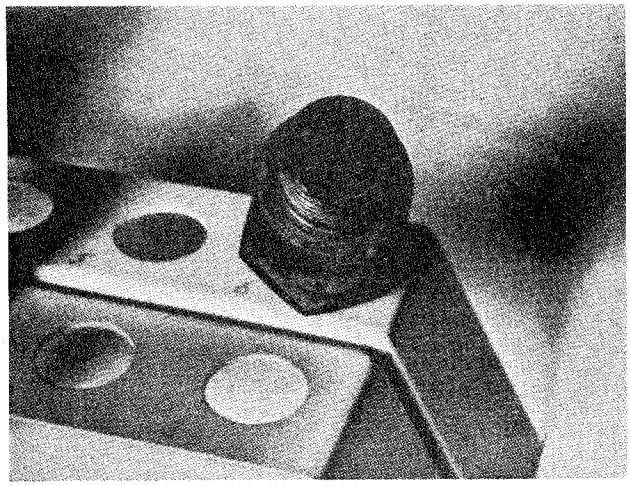

Fig. 40 Petrol fouling indicated by a dry fluffy black deposit on the Insulator.

(**e**) Occasionally a blistered insulator or baldy burned electrode may be noted when examining plugs (Fig. 42). If the plug is the type normally recommended for the engine and was correctly installed, *i.e.*, down tight on the gasket—the condition may have been brought about by a very " lean " mixture, or overheated engine. It is well to remember that plugs operating in the condition described above are often the cause of poor engine performance and extravagant petrol con-

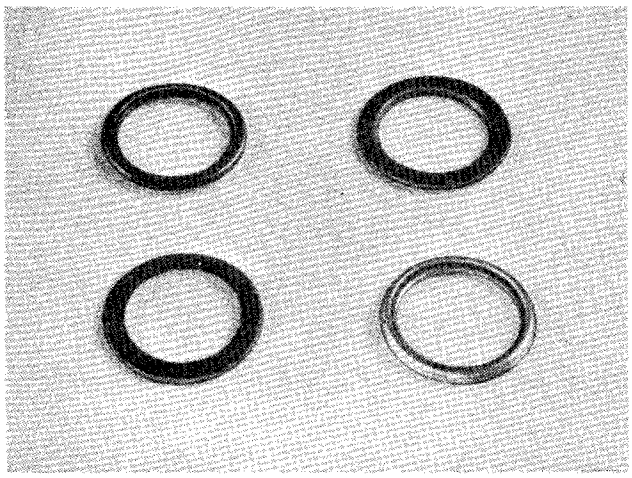

Fig. 41 Sparking Plug Gaskets in various conditions.

sumption. It may be, however, that a plug of a " colder " type is required.

(**f**) After cleaning, examine plugs for cracked insulators or insulator nose worn away through continued previous cleaning. In this case we should recommend that the plugs have passed their point of useful life and new plugs should be installed. Look for a deposit on the insulator, under side electrode, which may accumulate heat and act as a " hot spot " in service.

(**g**) After cleaning and blowing surplus abrasive out of shell recesses and off plug threads by means of " blow out " nipple—examine threads for carbon accumulation. Use a wire brush to remove carbon and clean the threads. A wire buffing wheel may also be utilised ; however, use reasonable care in both operations in order not to injure electrode or insulator tip. The threaded section of plug shell is often neglected in plug cleaning, even though, like the gaskets, these threads form a means of heat dissipation. When threads are coated with carbon, it retards the even flow of heat to the cooling medium, thereby causing overheating. (When installing plugs, this simple procedure will ensure no binding of threads and avoid unnecessary use of plug spanner.) Screw the plug down by hand as far as possible, then use spanner for tightening only. Always use a box spanner to avoid possible fracture of the insulator.

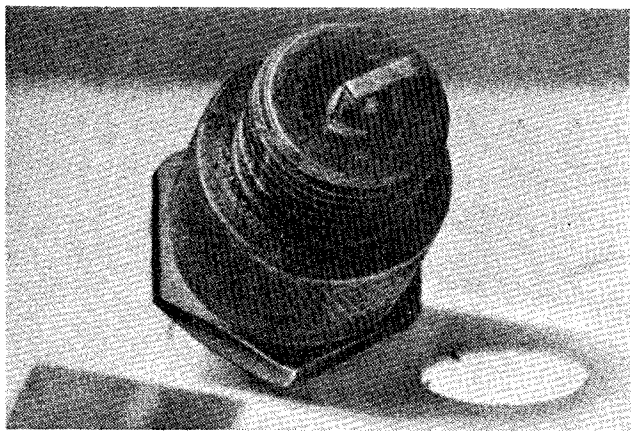

Fig. 42 A Blistered Insulator.

Fig. 43 Champion Series "700" Cleaner and Tester Unit.

(**h**) Next, we are ready for resetting the electrodes (Fig. 44). Remember that electrode corrosion and oxides at gap area vitally affect spark efficiency. The cleaner can remove the oxides and deposits from the insulator, but because of gap location, the cleaner stream cannot always reach this area with full effect, also, the tenacious adhesion of corrosion, etc., would require too much subjection to clean blast for removal. Therefore, when plugs are worthy of further use, it is sometimes good practice to dress the gap area, on both centre and side electrodes, with a small file before resetting to correct gap.

Resetting of electrodes should be part of service during useful life of the

plugs. However, the strains of intense heat, pressure, mechanical shock, electrical and chemical action, during miles of service, wreak such havoc on the electrodes that molecular construction is affected. Plugs reach a worn out condition and resetting can serve a good purpose only for a time.

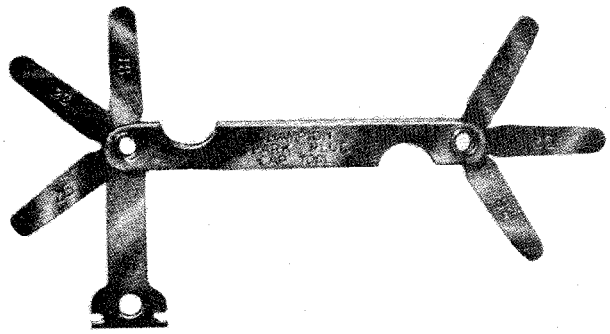

Fig. 44 **The Champion Spark Plug Gap Tool.**

When gaps are badly burned, it is indicative the plug is worn to such an extent that further use is unwarranted and wasteful. When resetting, bend the side wire only, never bend centre electrode as this may split the insulator tip.

(i) Inspect for leakage after testing, by applying oil around the terminal (Fig. 45). Leakage is indicated by the presence of air bubbles, the intensity of which will serve to show degree of leakage. Leakage throws the plug out of its proper heat range, as the hot gas escaping has a " blow torch " effect on the plug, causing compression loss, pre-ignition, rapid electrode destruction and overheating of the insulator tip.

(j) New gaskets have been fitted to the plugs and the general improvement in appearance is apparent now that the plugs are ready to be installed in the engine (Fig. 46). It requires no imagination to know that improved engine performance, better petrol consumption and satisfaction will result. The use of the stand (as illustrated) is evidence of your careful handling of the plugs.

(k) The top half of the insulator is often responsible for causes of poor plug

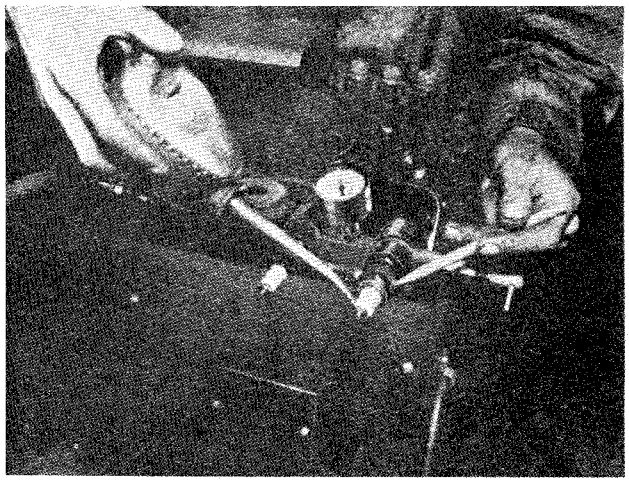

Fig. 45 **Testing for Leaks.**

performance (Fig. 47), namely, paint splashes, accumulation of grime and dust; cracked insulators caused by slipping spanner, or overtightening of terminals. Examine for cracked insulators at shoulder and terminal post. Remove grime and dust. Recommend inspection, cleaning and testing every 3,000 miles (Fig. 48).

Clean and replace sparking plugs periodically as necessary. The correct gap for the TR2 plugs should provide

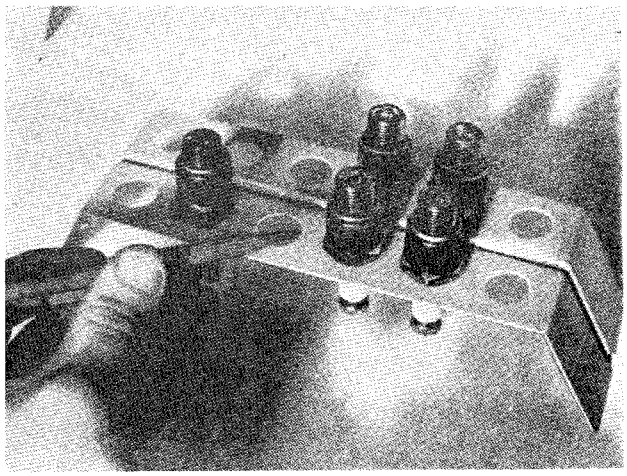

Fig. 46 **Sparking Plugs ready to fit to Engine. Note the New Gaskets and the use of the Stand.**

a gap of .032″, the Champion L10S ½″ reach plug being specified for normal road work, the L11S for high speed work. The normal efficient life of a sparking plug is 10,000 miles, after which, if full efficiency and economy is desired, the plugs should be replaced by new ones of the type specified.

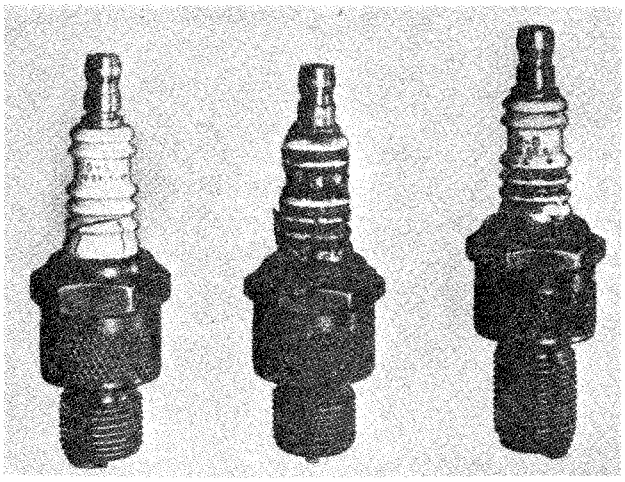

Fig. 47 **Sparking Plugs in various conditions.**

The distributor cap and rotor should be periodically examined for cracks which will allow electrical leakages.

The contact breaker points should be examined each 5,000 miles, when normal lubrication of this part of the car is recommended, and where these have become burnt or pitted, they should, if possible, be squared up with a piece of carborundum stone, so that when the points are closed they fit flush against each other. If the points have become seriously worn they should be replaced by new items. The points should be properly set to provide a gap of .014″ to .016″ when fully open.

B

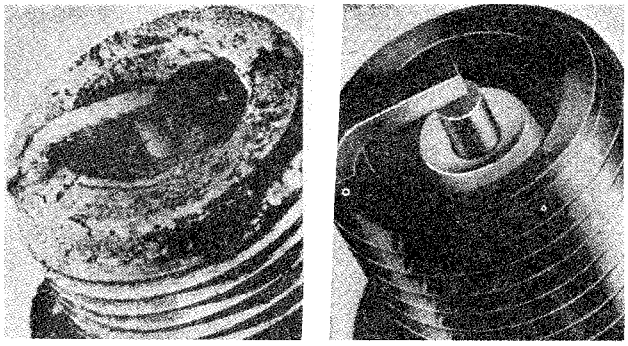

Fig. 48 **An unretouched photograph of a CHAMPION Sparking Plug after 25,000 miles of service, compared with a new plug. The weak spark given by the former can readily be imagined and amply justifies our recommendation that to save petrol, plugs should be changed before such a stage of wear, as that shown in the photograph is reached.**

The condenser wiring and the low and high tension circuits should be ensured, as should the automatic advance and retard mechanism. Similarly the coil should be ensured.

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23. ENGINE NOISES

(a) Main Bearing Knock

This knock can usually be identified by its dully heavy metallic note which increases with frequency as the engine speed and load rises. A main bearing knock is particularly noticeable when the engine is running very slowly and consequently unevenly, it is more pronounced with advanced ignition.

When this bearing knock is experienced it can be explained by one of the following faults and should be treated accordingly.

(i) Unsuitable grade of oil or badly diluted oil supply.

(ii) Low oil pressure.

(iii) Insufficient oil in sump.

(iv) Excessive bearing clearance caused by worn journal and/or bearings.

(b) Crankshaft End Float

When a knock is being caused by the development of end float, it will be found most noticeable when the engine is running at idling speeds. This knock can temporarily be eliminated by operating the clutch.

(c) Big End Bearing Knock

A big end bearing knock is lighter in note than that experienced with a main bearing. It will be evident at idling speeds and will increase with engine speed.

The best test for this noise is to detach the lead from each sparking plug in turn and reconnecting the lead whilst flicking the throttle open. On re-connection of the lead, a light thud will be audible where the bearing looseness or correcting misalignment exists, further investigation can be carried out to that particular rod or rods.

In addition to the knock being caused by excessive bearing clearance it is sometimes caused by :—

(i) Unsuitable grade of oil or badly diluted supply.

(ii) Insufficient supply of oil.

(iii) Low oil pressure.

(d) Small End Knocks

As the gudgeon pin used in this model is able to float in the piston and the bearing in the connecting rod, a knock may arise owing to slackness in the small end bush or the piston bosses. The knock will make itself audible under idling conditions or at road speeds between 20—30 m.p.h. (32—48 km.p.h.).

To test for a gudgeon pin knock, cut out each cylinder one at a time by disconnecting the plug leads. The offending gudgeon pin will be identified by the fact that a double knock is caused when the disconnection of the plug lead is made.

With complaints of this nature, the following possible causes should be examined.

(i) A too tight gudgeon pin.

(ii) A gudgeon pin slack in the connecting rod bush or piston boss (see page 2 for gudgeon pin clearance).

(iii) Misalignment of connecting rod allowing connecting rod bush to foul the piston bosses.

(e) Piston Knock (Piston Slap)

This will increase with the application of load up to 30 m.p.h. (48 km.p.h.) but only in very bad cases will it continue to be audible over that speed. In some cases piston knock will only be evident when the engine is started from cold and will disappear as the engine warms. In such cases it is suggested that the engine is left untouched.

A suggested method of locating the offending piston is to engage a gear and with the hand brake hard on, just let the clutch in sufficiently to apply a load with the engine at a moderate speed.

By detaching a spark plug lead and thus putting a cylinder out of action, it is possible to cut out the knock and so determine the offending piston.

Faults in the engine components listed hereafter often contribute to piston

knock (piston slap) and should therefore be examined.

(i) Excessive clearance between piston and cylinder sleeve due to fair usage or to an unsuitable replacement part.

(ii) Pistons or rings striking ridge at the top of the sleeve after fitting a replacement. Such ridges should be removed before replacement parts are fitted.

(iii) Collapsed piston.

(iv) Broken piston ring grooves or excessive clearance in grooves (see page 2).

(v) Connecting rod misalignment.

(f) Noisy Valve Rockers or Tappets

Noise due to valve rockers can be identified fairly easily owing to the fact that these are operated by the camshaft which revolves at half engine speed, the noise will seem to be slower than other engine noises. Valve rocker noise has a characteristic clicking sound which increases in volume as the engine speed rises.

Where rocker noise is caused by excessive tappet clearance, it can be eliminated by the insertion of a feeler gauge between the stem of the valve and the rocker toe whilst the engine is idling.

When this complaint is experienced and is found to be caused by incorrect tappet clearance the rockers should be adjusted as described on page 22.

Push rod noise may be caused by worn or rough rocker ball pins or push rod cups and can be cured by replacing the worn or damaged parts.

(g) Ignition Knock (Pinking)

An ignition knock is recognised by its metallic ringing note, usually occurring when the engine is labouring or accelerating.

The knock can be caused by either detonation or pre-ignition. Detonation is the result of a rapid rise in pressure of the explosive mixture, thus causing the last portion of the charge in the cylinder to be spontaneously ignited, resulting in this striking the cylinder wall with a ringing sound; this noise being familiar to motorists as "pinking."

Pre-ignition may arise as a result of detonation owing to heat generated thereby but may also be caused by sharp edges or points in the combustion space, and where it arises should be treated accordingly.

When "ignition knock" is audible, the following possible causes should be investigated.

(i) Excessive carbon deposits in head and on piston crowns.

(ii) Incorrect or faulty spark plugs causing incandescence.

(iii) Sharp edges or pockets in combustion space.

(iv) Engine overheating.

(v) Too weak carburettor mixture, causing delayed combustion.

(vi) Unsatisfactory grade of fuel.

(vii) Too early ignition timing.

(viii) Faulty automatic advance and retard mechanism due to incorrect or weak centrifugal control springs.

(ix) Hot engine valves due to incorrect seating width, insufficient valve rocker clearances, valve edges thinned by excessive refacing. Valve of unsuitable material.

(h) Back Firing into Carburettor

It is in order that with a cold engine back firing into the carburettors may occur, but this should cease when the engine attains normal working temperature.

If back firing still persists in spite of warming up, the following possible causes should be investigated.

(i) Incorrect ignition timing.

(ii) Incorrect wiring of sparking plugs.

(iii) Centrifugal or suction advance and retard mechanism not functioning correctly.

(iv) Incorrect valve timing.

(v) Poor quality fuel.

(vi) Mixture is too weak or excessively rich.

(vii) Pre-ignition due to various causes.

(viii) Air leak into induction system giving rise to a weak mixture.

(ix) Valves, particularly inlet, not seating correctly.

(x) Defective cylinder head gasket.

(i) Excessive Oil Consumption

Excessive oil consumption is usually associated with a very worn engine, but can arise as a result of external leakages and due to other factors with comparatively new engines.

If excessive oil consumption is established, before commencing to dismantle the engine a check for external leakage should be carried out.

When an engine is burning oil it will be indicated by the emission of bluish grey smoke from the exhaust when the engine is " raced up " after a period of idling.

A check for external leakage can be conveniently carried out by spreading paper on the ground under the forward part of the car, and running the engine at a moderate speed for a few minutes.

In this way it is possible to locate the position of leaks which, without the engine running, would not be evident. External leaks are caused by one or more of the following :—

(i) Cracked sump or poor sump packing.

(ii) Flange faces of sump not true.

(iii) Drain plug loose or defective packing washer.

(iv) Defective filter packing, poor joint faces or loose attachment bolts.

(v) Oil pressure pipe line leaking.

(vi) Defective petrol pump packing, poor joint faces or attachment nuts loosened.

(vii) Defective rocker cover packing, poor joint faces or attachment nuts loosened.

(viii) Defective front engine plate packing or poor joint faces.

(ix) Timing cover oil seal defective.

(x) Timing cover cracked, defective packing or loose mounting bolts.

(xi) Leakage round camshaft welch plug.

(xii) Unsuitable grade of oil or excessively diluted, arduous driving conditions, excessively high pressure or crankcase temperatures.

(xiii) Excessive clearance between piston and sleeve or incorrect replacements, damaged rings, rings stuck in grooves, insufficient piston ring end gap, piston rings exercising insufficient radial pressure.

(xiv) Excessive diameter and axial clearance due to wear associated with the possibility of oval and worn crankpins.

(xv) Excessive diameter clearance in main bearings and/or worn journals. (See page 1 for dimensions and clearances.)

(j) Low Oil Pressure

The correct oil pressure is 40—60 lbs. per sq. in. for top gear for road speeds between 30 — 40 m.p.h. (48 — 64 km.p.h.). With complaints of low oil pressure the following possible causes should be investigated :—

(i) Insufficient oil in sump.

(ii) Unsuitable grade of oil or a very badly diluted supply.

(iii) Suction oil filter restricted by dirt in sump.

(iv) Oil pump loose on mountings.

(v) Very badly worn or damaged oil pump. (See " Oil Pump " on page 13.)

(vi) Oil release valve in exterior oil filter head out of adjustment, dirt on valve seating, broken or weak release valve spring. Filter loose on bracket, damaged joint packing, poor joint faces.

(vii) Loose connections on pressure gauge pipe or defective pipe line and/or flexible connections.

(viii) Incorrect oil pressure gauge.

(ix) Worn engine bearings and/or crankshaft journals and pins.

(k) High Oil Pressure

(i) Using too heavy a grade of oil.

(ii) Faulty adjustment of oil relief valve, too heavy a relief valve springs.

(iii) Faulty oil pressure gauge.

B

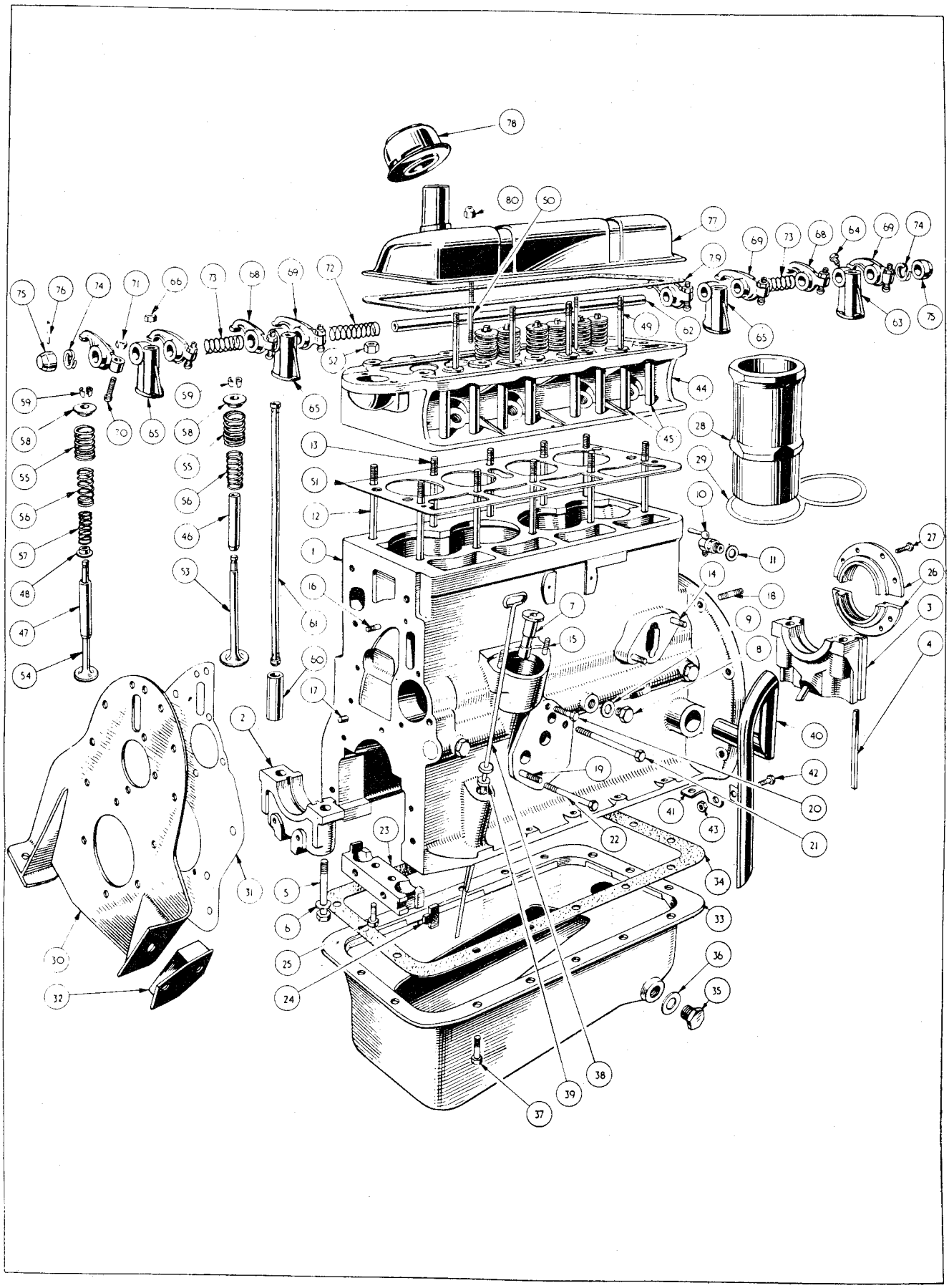

Fig. 49 Exploded view of Engine. Cylinder Block Details.

NOTATION FOR FIG. 49

Exploded view of Cylinder Block Details

Ref. No.	Description
1	Cylinder Block.
2	Front Bearing Cap.
3	Rear Bearing Cap.
4	Rear Bearing Cap Felt Packing.
5	Bearing Cap Bolts.
6	Spring Washer for Bearing Cap Bolts.
7	Oil Pump Drive Bush.
8	Oil Gallery Blanking Screw.
9	Washer for Blanking Screws.
10	Drain Tap.
11	Washer for Drain Tap.
12, 13	Combustion Head Studs.
14	Petrol Pump Studs.
15	Distributor Studs.
16	Front Engine Plate Stud.
17	Front Engine Plate Locating Dowel.
18	Gearbox Stud.
19	Oil Filter Stud.
20, 21, 22	Oil Filter Attachment Bolts.
23	Front Bearing Sealing Block.
24	Sealing Block Pads.
25	Screw for Sealing Block.
26	Rear Oil Seal (always a mated pair).
27	Setscrews for Rear Oil Seal.
28	Cylinder Sleeve.
29	Figure of Eight Joint.
30	Front Engine Plate.
31	Engine Plate Joint Washer.
32	Engine Front Mounting.
33	Oil Sump.
34	Joint Washer for Oil Pump.
35	Oil Drain Plug.
36	Washer for Drain Plug.
37	Oil Sump Bolts.
38	Dipstick.
39	Felt Washer for Dipstick.

Ref. No.	Description
40	Breather Pipe.
41	Breather Pipe Clip.
42	Breather Pipe Clip Bolt.
43	Nut for Pipe Clip Bolt.
44	Combustion Head.
45	Push Rod Sealing Tubes.
46	Inlet Valve Guide.
47	Exhaust Valve Guide.
48	Exhaust Valve Guide Collar.
49	Rocker Pedestal Stud.
50	Rocker Cover Stud.
51	Combustion Head Gasket.
52	Combustion Head Securing Nut.
53	Inlet Valve.
54	Exhaust Valve.
55	Outer Valve Spring.
56	Inner Valve Spring.
57	Auxiliary Exhaust Valve Spring.
58	Valve Spring Collars.
59	Split Cones.
60	Valve Tappet.
61	Push Rod.
62	Rocker Shaft.
63	Rocker Pedestal (with oil passage drilled).
64	Rocker Pedestal Screw.
65	Rocker Pedestal.
66	Rocker Pedestal Attachment Nut.
68	No. 1 Rocker.
69	No. 2 Rocker.
70	Ball Pin.
71	Ball Pin Locking Nut.
72	Rocker Centre Spring (coil).
73	Rocker Intermediate Spring (coil).
74	Rocker Outer Spring (flat coil).
75	Shaft End Collars.
76	Mills Pins for Shaft End Collars.
77	Rocker Cover.
78	Oil Filler Cap.
79	Rocker Cover Joint.
80	Nyloc Nuts.

B

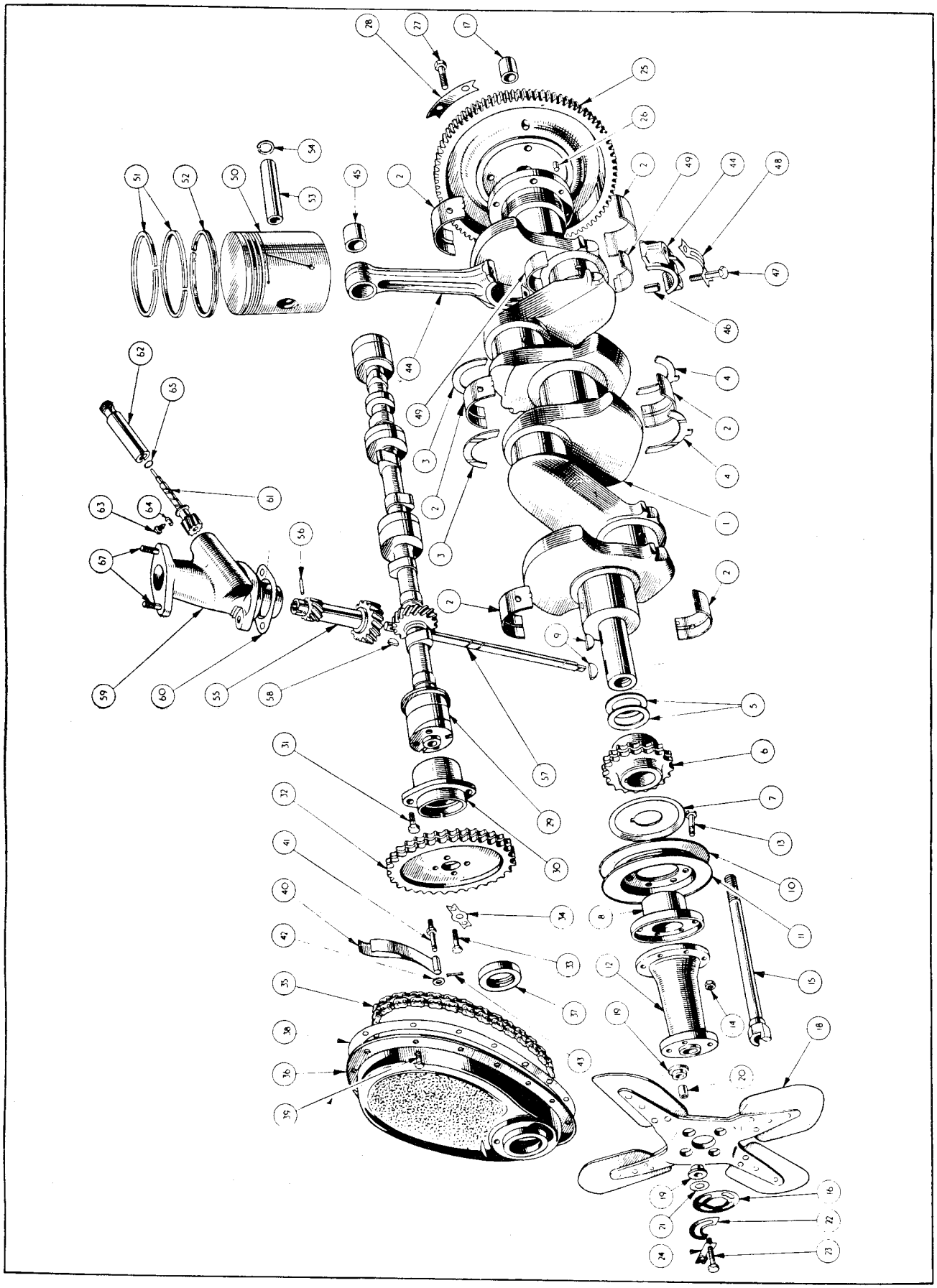

Fig. 50. Exploded view of Engine. Crankshaft Details.

NOTATION FOR FIG. 50

Exploded View of Crankshaft Details.

Ref. No.	Description	Ref. No.	Description
1	Crankshaft.	34	Chain Wheel Bolt Locking Plate.
2	Crankshaft Main Bearings.	35	Timing Chain.
3	Top Thrust Washers.	36	Timing Cover.
4	Lower Thrust Washers.	37	Crankshaft Oil Seal.
5	Sprocket Locating Shims.	38	Timing Cover Joint Washer.
6	Crankshaft Sprocket (Timing Chain).	39	Timing Cover Attachment Bolt.
7	Oil Deflector.	40	Chain Tensioner.
8	Fan Pulley Hub.	41	Chain Tensioner Fulcrum Pin.
9	Woodruffe Keys.	42	Washer for Chain Tensioner Pin.
10	Rear Half of Fan Pulley.	43	Split Pin for Chain Tensioner Pin.
11	Front Half of Fan Pulley.	44	Connecting Rod.
12	Fan Pulley Hub Extension.	45	Small End Bearing.
13	Fan Pulley Bolt.	46	Hollow Dowel.
14	Nyloc Nut for Fan Pulley Bolt.	47	Connecting Rod Bolt.
15	Extension Bolt with Starter Dog Head.	48	Lock Plate for Connecting Rod Bolts.
16	Lock Washer for Extension Bolt.	49	Connecting Rod Bearing.
17	Constant Pinion Pilot Bush.	50	Piston.
18	Cooling Fan Assembly.	51	Compression Ring.
19	Rubber Bushes.	52	Oil Scraper Ring.
20	Metal Sleeves for Rubber Bushes.	53	Gudgeon Pin.
21	Plain Washer.	54	Circlip for Gudgeon Pin.
22	Balance Piece.	55	Distributor and Tachometer Driving Gear.
23	Fan Attachment Bolt.	56	Mills Pin.
24	Locking Plate for Fan Attachment Bolts.	57	Oil Pump Drive Shaft.
25	Flywheel.	58	Woodruffe Key.
26	Flywheel Locating Dowel.	59	Distributor Pedestal.
27	Flywheel Attachment Bolt.	60	Pedestal Joint Washer.
28	Flywheel Bolt Locking Plate.	61	Tachometer Drive Gear.
29	Camshaft.	62	Bearing for Tachometer Drive Gear.
30	Front Camshaft Bearing.	63	Locating Screw for Bearing.
31	Camshaft Bearing Attachment Bolt.	64	Lock Washer for Locating Screw.
32	Camshaft Chain Wheel.	65	Oil Seal.
33	Chain Wheel Securing Bolt.	67	Distributor Stud.

FAULT LOCATION

SYMPTOM.	CAUSE.	REMEDY.
Difficulty in Starting Engine.	1. Fault in fuel supply.	(a) Check tank and leaking unions. (b) Clean fuel line, pump and carburettor. (c) Check fuel pump cam lever for bend, weak diaphragm or spring failure. (d) Check carburettor float level. (e) Flooding caused by damaged float or dirty needle and valve.
	2. Sluggish starter motor.	(a) Check battery strength and connection. (b) Dirty bushes. (c) Motor needing overhaul.
	3. Failure of starter pinion to engage with flywheel.	(a) Dirty or bent shaft. (b) In and out of mesh clearance too great.
	4. Faulty ignition.	(a) Condensation on plugs, leads or distributor cap. (b) Plugs dirty or have wrong gap. (c) Dirty or incorrectly set distributor points. (d) Cracked distributor or broken wire. (e) Defective coil or faulty condenser.
Stalling Engine	1. Incorrect carburation.	(a) Dirty jets, mixture and throttle control setting. (b) Air leaks in manifold joints.
	2. Incorrect ignition timing.	Reset timing.
	3. Poor compression.	Decarbonise engine and check for sticking or badly seating valves.
Lack of Power.	1. Choked silencer and/or tail pipe.	Examine the components for carbon deposits.
	2. Binding brakes.	Check brake mechanism.
	3. Slipping clutch.	Check adjustment then overhaul if necessary.

FAULT LOCATION (CONTINUED)

SYMPTOM	CAUSE	REMEDY
	4. Incorrect ignition settings.	Check type of plug and spark gap, distributor gap, condenser, seized automatic advance mechanism. Incorrect timing.
	5. Incorrect tappet clearance.	Adjust tappets.
	6. Poor compression.	Check individual compressions with three spark plugs fitted and a compression gauge in the fourth cylinder, throttle set at tick-over using 20 S.A.E. oil and operating the electric starter. Average reading should be 120 lbs. per sq. in. Grind in valves if necessary.
Engine Misfiring.	1. Faulty carburation.	(a) Incorrect float level. (b) Dirty jets. (c) Badly fitting throttle valve or air leaks in joints and manifold connections. (d) Dirty or clogged air filter.
	2. Faulty ignition.	(a) Incorrect ignition timing. (b) Defective plugs or leads. (c) Defective ignition coil or distributor condenser.
	3. Valve condition.	Valves sticking in their guides.

BI

Service Instruction Manual

C

COOLING SYSTEM

SECTION C

COOLING SYSTEM

INDEX

ILLUSTRATIONS

COOLING SYSTEM

1. DESCRIPTION

The cooling system is pressurised and thermostatically controlled, with an impeller pump to ensure efficient circulation of water at all times. The **capacity** is 13 pints or 14 when a heater is fitted. Careful consideration has been given to points where adequate cooling is necessary, such as sparking plugs and valve guides, etc.

To assist cooling when the car is stationary or travelling at low speeds a $12\frac{1}{2}$" diameter four bladed fan attached to the crankshaft draws air through the radiator.

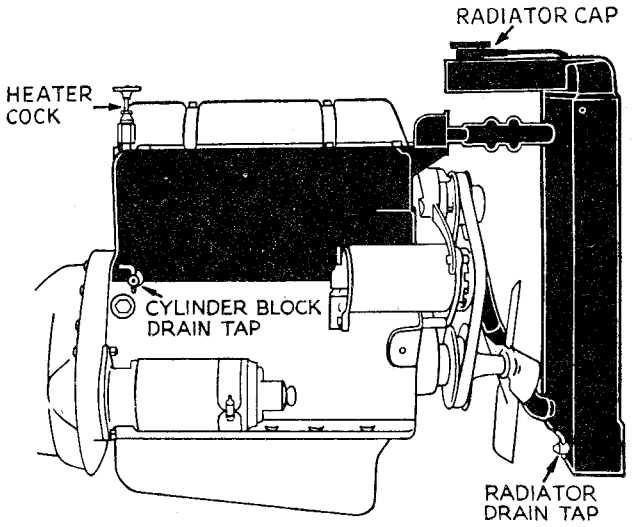

Fig. 1 **Draining of Cooling System.**

2. TO DRAIN THE COOLING SYSTEM

(**a**) Open the bonnet and remove the radiator filler cap, this is necessary as the system is pressurised. If a heater is fitted ensure that the water shut-off cock is open.

(**b**) Open both drain taps (Fig. 1), one situated at the lower extremity of the radiator block and a second in the right hand side of the cylinder block below No. 4 inlet and exhaust manifold.

3. FAN BELT ADJUSTMENT

Fan belt adjustment is effected by repositioning the dynamo as follows :—

(**a**) Loosen the three dynamo attachments.

(**i**) The nyloc nut and bolt at the rear, attaching it to the dynamo bracket.

(**ii**) The bolt attaching the lower portion of the front flange to the dynamo fulcrum.

(**iii**) The bolt securing the upper portion of the flange to the adjusting link.

(**b**) By moving the dynamo to or away from the engine the fan belt is loosened or tightened respectively. When the belt has $\frac{3}{4}$" "play" in its longest run suitable adjustment is provided.

(**c**) Tighten the adjusting link bolt, followed by the two lower attachments.

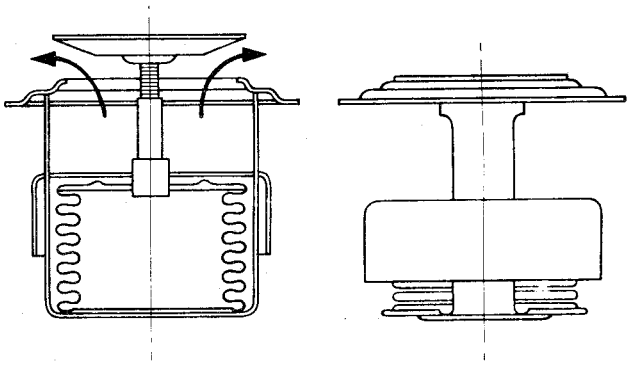

Fig. 2 **The Thermostat in the "Open" and "Closed" condition.**

4. THE THERMOSTAT (Fig. 2)

This is fitted in the cooling system to control the flow of water **before** the engine has reached its normal working temperature.

When the engine is started from cold, water is circulated around the cylinder block by action of the water pump impeller through matched apertures in the impeller pump housing and the cylinder block. The water circulates round the block and cylinder head into the thermostat housing. If the water has not reached a temperature of 158°F. the thermostat will remain closed and the water will pass into the by-pass passage and down to the impeller pump housing to be recirculated through the block by the rotation of the impeller, being driven by a belt at twice crankshaft speed (Fig. 3).

When the water temperature rises above 158°F. (70°C.) the thermostat will commence to open and allow the water to pass into the radiator. This new circulation of water allows the impeller pump to draw water

from the lower part of the radiator. The thermostat is fully open at 197°F. (92°C.)

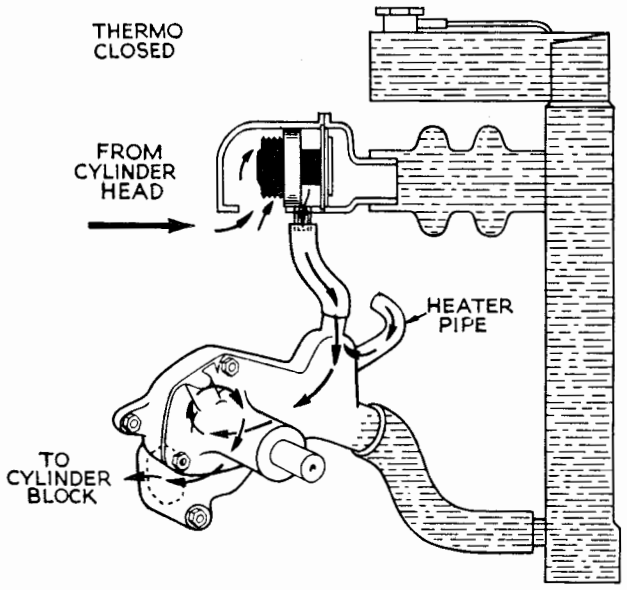

Fig 3 **Circulation of Water before the Thermostat has opened.**

and at this stage the by-pass is sealed off, this sealing off avoids loss of cooling efficiency when it is most required (Fig. 4).

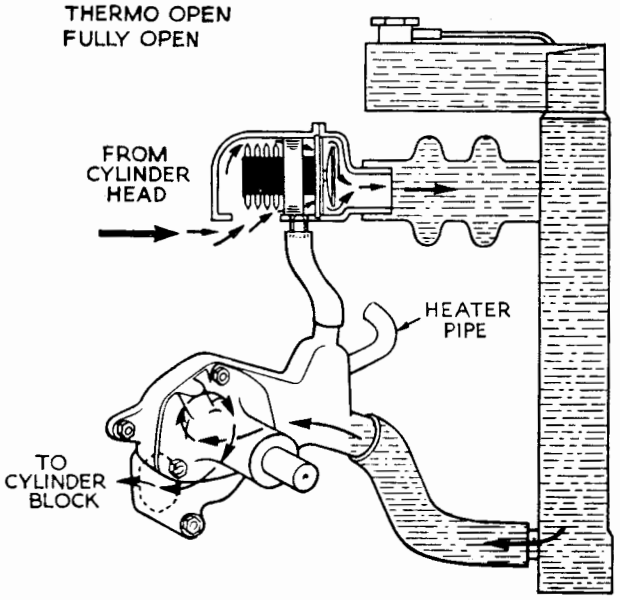

Fig. 4 **Circulation when the Thermostat is open.**

The radiator temperature for normal motoring should not exceed 185°F. (85°C.).

NOTATION FOR FIG. 5

Ref. No.	Description	
1	Thermostat Housing.	Up to Commission No. TS.1201
2	Studs for Top Plate.	
3	Studs for Outlet Cover.	
4	Thermostat.	
5	Outlet Cover.	
6	Outlet Cover Joint Washer.	
7	Nut for securing Outlet Cover.	
8	Lock Washer for Nut	
9	Top Plate.	
10	Top Cover Joint Washer.	
11	Nut for securing Top Plate	
12	Lock Washer for Nut.	
13	Thermo Housing Joint Washer.	
14	Thermostat Housing.	From Commission No. TS.1201
15	Studs for Outlet Cover.	
16	Thermostat.	
17	Outlet Cover.	
18	Outlet Cover Joint Washer	
19	Nut for securing Outlet Cover.	
20	Lock Washer for securing Nut.	
21	Thermo Housing Attachment Bolt.	
22	Top Hose.	
23	Supergrip Hose Clip	
24	By-Pass Hose.	
25	Supergrip Hose Clip.	
26	Lower Hose.	
27	Lower Hose Connecting Pipe.	
28	Supergrip Hose Clip.	

5. TO REMOVE THE THERMOSTAT HOUSING (with thermostat) (Fig. 5)

(a) Drain the cooling system. See page 1.

(b) Disconnect the top and by-pass hoses.

(c) Loosen the nuts of the thermostat cover, and remove the lower nut to release the petrol pipe clip.

(d) Remove the thermo gauge capillary tube by withdrawing the gland nut at the left hand side.

(e) The thermostat housing can be removed by withdrawal of the two bolts attaching it to the combustion head.

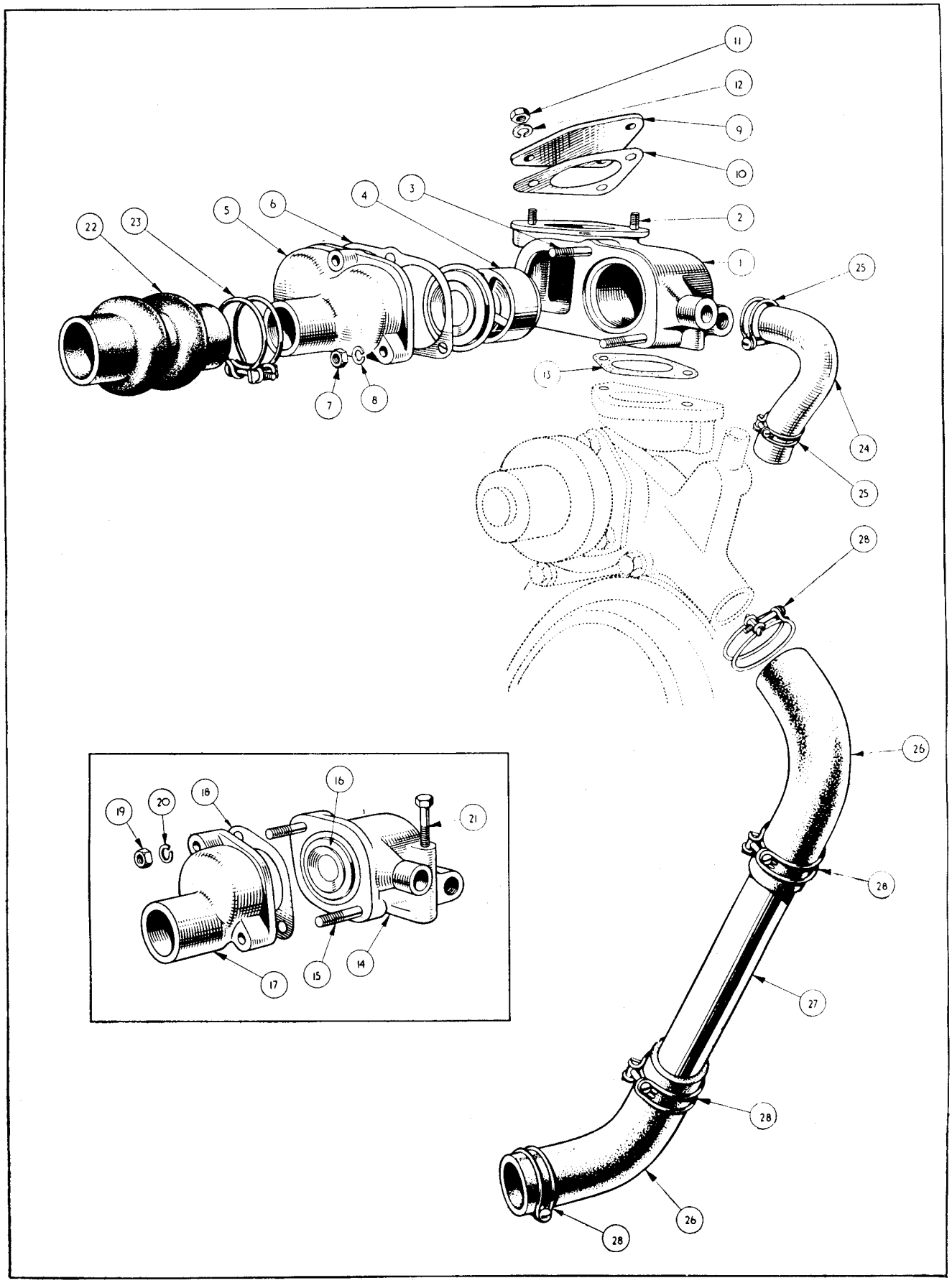

Fig. 5 **Exploded details of Thermostat Housings (the housing in the insert is that fitted to current production cars). Cooling System hoses are also shown.**

(f) The thermostat can be removed from housing by removing the remainder of the front cover nuts (already loosened in para. c) but **after** the removal of the joint washer.

6. TO REPLACE THERMOSTAT HOUSING

The replacement is the reversal of the removal but care should be taken concerning the following points.

(a) That the contact surfaces of the housing and the cover are perfectly clean and do not bear traces of the old joint washer. Failure to observe this point may lead to water leakages.

(b) The thermostat is fitted to the housing first and followed next by the joint washer. In no circumstances should the joint washer be fitted first.

7. TO REMOVE THE THERMOSTAT ONLY (Fig. 5)

(a) Drain the cooling system. See page 1.

(b) Disconnect the top hose.

(c) Withdraw the thermostat housing front cover by removing the three nuts and lock-washers. Remove the petrol pipe clip on the lower right hand stud.
On cars from Commission No. TS.1201 onwards there are only two front cover attachment studs. The lower one accommodating the petrol pipe clip.

(d) Remove the joint washer **before** removing the thermostat.

8. TO REPLACE THERMOSTAT

The replacement is the reversal of the removal but care should be taken concerning the following the points.

(a) That the contact surfaces of the housing and the cover are perfectly clean and do not bear traces of the old joint washer. Failure to observe this point may lead to water leakages.

(b) The thermostat is fitted to the housing first and followed next by the joint washer. In no circumstances should the joint washer be fitted first.

9. TESTING THE THERMOSTAT

Remove the thermostat from its housing as described on page 2. It should be tested in water, at a suitable temperature employing a thermometer to ascertain that the valve does commence to open at the correct temperature 158°F. There is no need to check the temperature at which the valve is fully open as this follows automatically.

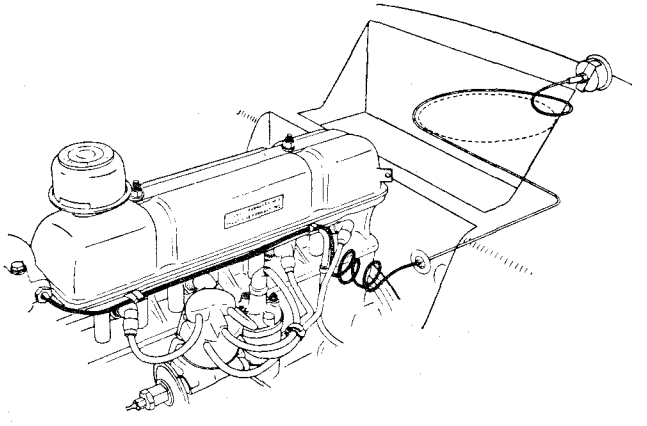

Fig. 6 **The run of the Water Temperature Capillary Tube. The dotted circle indicates the position of the heater.**

10. WATER TEMPERATURE GAUGE

The capillary of this instrument is secured in the thermostat housing by a gland nut and a dial on the instrument panel registers the temperature of the water on the engine side of the thermostat.

Care should be taken that the tubing is not "kinked" for this is liable to fracture the capillary tube thus rendering the instrument unserviceable. Fig. 6 illustrates a suitable "run" for the capillary tube.

11. TO TEST WATER TEMPERATURE GAUGE

When doubt exists concerning the accuracy of the gauge readings, the efficiency of the instrument can be checked by immersing the capillary tube in hot water and checking the gauge reading with that of an accurate thermometer also immersed in the same water adjacent to the bulb.

To effect this test it is merely necessary to remove the gland nut at the left hand side of the thermostat housing.

The instrument is not adjustable or repairable and when a test shows inaccuracies or damage on inspection it will be necessary to replace the complete instrument.

12. THE RADIATOR

The radiator is of the finned pipe type and is secured to the chassis and body of the car at four points. The upper extremity is attached by two nuts and bolts with lock washers to the steady rods, which are in turn secured to the body of the car by jam nuts. The lower attachment is by two pointed shanked bolts with $\frac{1}{8}$" thick composition packings between the radiator brackets and the chassis frame at either side.

The radiator is pressurised, a relief valve being incorporated in the radiator cap. The spring loaded rubber valve is lifted off its seating when the pressure in the cooling system exceeds 4 lbs. per sq. inch letting the excess pressure escape through the overflow pipe.

To relieve the vacuum when the system cools a small spring-loaded relief valve is incorporated in the centre of the pressure valve unit which will open to admit atmospheric pressure.

The overflow pipe is a rubber tube and is attached to the filler pipe, clipped at the right hand steady attachment, and after running downward it is clipped to the lower right hand wing valance.

13. TO REMOVE RADIATOR

(**a**) Remove the front cowling as described in the Body Section.

(**b**) Drain the cooling system as described on page 1.

(**c**) Remove top and bottom hoses and overflow pipe from radiator.

(**d**) Remove the nuts and bolts from the two steady rods, one either side at the top of the radiator.

(**e**) Remove the two bolts and lock washers from the brackets at the sides of the block. The packing between bracket and chassis frame can be removed **after** the radiator has been lifted.

14. TO REPLACE RADIATOR

The replacement of the radiator is the reversal of the removal.

15. FLEXIBLE HOSE CONNECTIONS (Fig. 5)

Four hoses are used in the system and all are moulded rubber with a fibre insert. They are secured to their mating parts by " Supergrip " hose clips.

The smaller diameter curved hose is the by-pass hose for the thermostat—water pump housing connection, the larger diameter straight corrugated hose connects the thermostat housing to the radiator.

The two large diameter curved hoses are assembled to a metal connecting pipe so that their ends are 90° removed from one another. This assembly connects the water pump housing to the radiator outlet.

The overflow pipe is attached to the filler pipe, clipped at the top right hand upper corner of the radiator and again on its run down at a point on the wing valance just above the chassis frame.

16. THE WATER PUMP ASSEMBLY (Fig. 7)

This assembly is attached to the cylinder block by three bolts of unequal length. The longer bolt is situated in the upper right hand position and its purpose is two-fold. In addition to attaching the pump assembly to the cylinder block it also secures the bearing housing to the pump body. The head of this bolt is trapped by the belt pulley and the bolt cannot be removed until this pulley is first removed. The two remaining bolts are of equal length and are situated in the lower extremities of the impeller body.

17. TO REMOVE THE WATER PUMP BEARING HOUSING (Fig. 7)

(**a**) Loosen the two lower dynamo attachments, remove the upper fixing bolt with the two plain washers and then remove the fan belt.

(**b**) Loosen the two nuts and the bolt securing the bearing housing to the pump body progressively until the bearing housing can be lifted away with its joint washer.

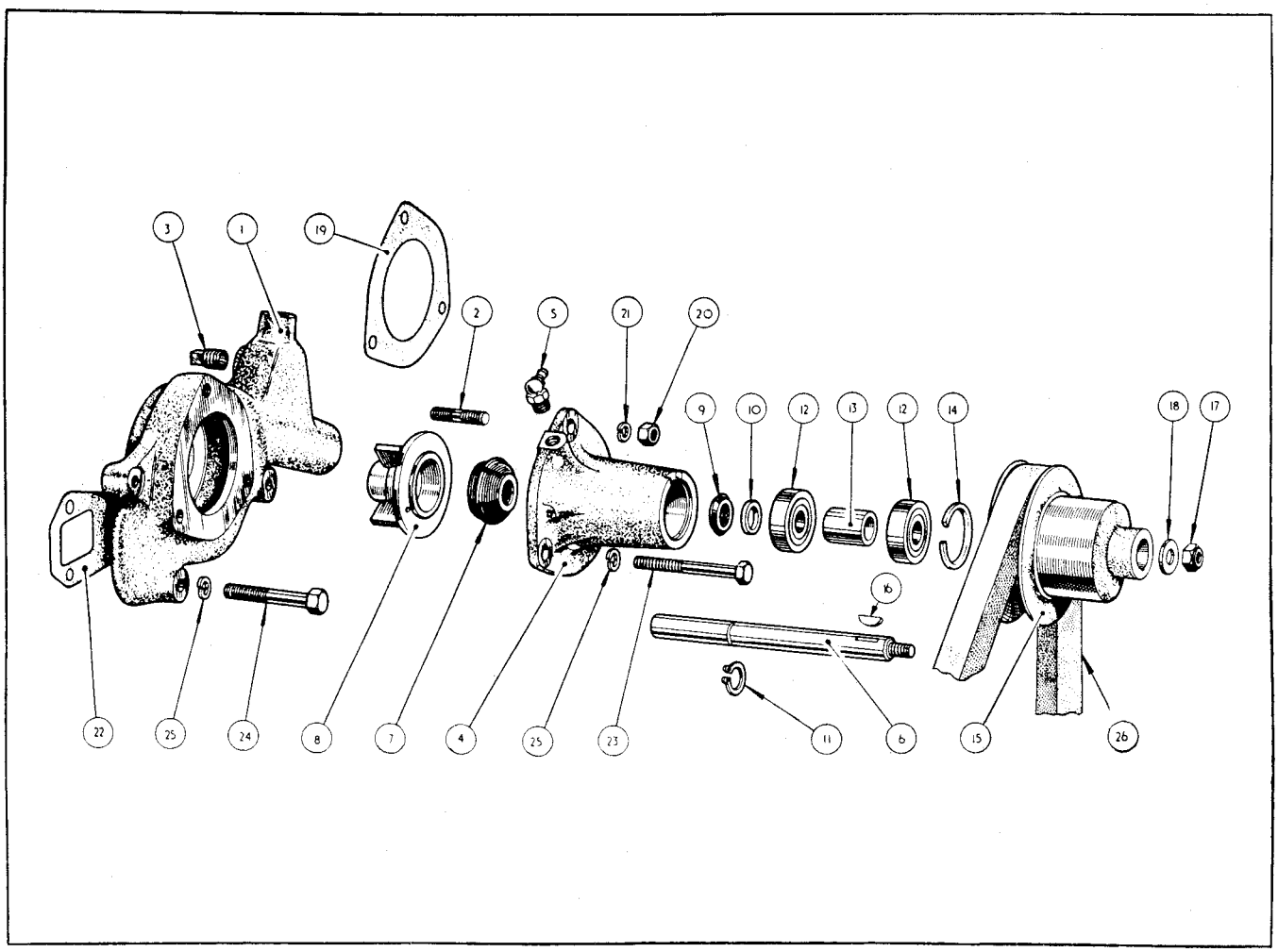

Fig. 7 **Exploded details of Water Pump Housing Assembly.**

NOTATION FOR WATER PUMP HOUSING ASSEMBLY (Fig. 7)			
Ref. No.	Description	Ref. No.	Description
1.	Water Pump Body.	15.	Water Pump Pulley.
2.	Bearing Housing Attachment Stud.	16.	Woodruffe Key.
3.	Plug (removed when heater is fitted).	17.	Nyloc Nut.
4.	Bearing Housing.	18.	Plain Washer.
5.	Grease Nipple.	19.	Water Pump Joint Washer.
6.	Spindle.	20.	Nut.
7.	Water Pump Seal.	21.	Lock Washer.
8.	Impeller.	22.	Water Pump Housing Joint Washer.
9.	Synthetic Rubber Spinner.	23.	Bearing Housing to Cylinder Block Attachment Bolt.
10.	Abutment Washer.	24.	Pump Housing to Cylinder Block Attachment Bolt.
11.	Circlip.	25.	Lock Washer.
12.	Bearings.		
13.	Distance Collar.		
14.	Circlip.		

(c) It will be noted that the bolt is trapped between the bearing housing and the pulley. Mark the position of the bolt on the bearing housing so that during assembly it can be returned to its original position.

18. TO REPLACE THE WATER PUMP BEARING HOUSING

(a) The replacement of this assembly is the reversal of the removal, but the following points should be noted.

(b) The attachment bolt must be fitted before the fan pulley is attached to the shaft. Looking at the pulley end of the assembly with the grease nipple positioned at 11 o'clock, the bolt will occupy the hole at approximately 7 o'clock.

(c) Ensure that the contact surfaces of both components are perfectly clean and a replacement joint washer is used. Failure to observe this point may lead to water leaks.

19. TO DISMANTLE THE BEARING HOUSING ASSEMBLY

(a) Remove nyloc nut and washer from the belt pulley spindle.

(b) Withdraw pulley with the Churchill Universal puller tool No. 6312 and remove the Woodruffe key from its key way.

(c) Utilising the Churchill Tool No. FTS. 127 remove the impeller and rubber seal as shown in Fig. 8.

(d) Remove the bearing locating circlip and gently tap out bearing and spindle assembly.

(e) The bearings and spacer can now be pressed off the spindle, the washer, circlip and synthetic rubber bearing seal can also be removed at this juncture.

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20. TO ASSEMBLE THE BEARING HOUSING ASSEMBLY

The assembly is the reversal of the dismantling but the following points must be observed :—

(a) On fitting the bearings to the spindle, ensure that the grease seal incorporated in these bearings face *away* from one another.

(b) The attachment bolt must be fitted before the fan pulley is attached to the shaft. Looking at the shaft end of the assembly with the grease nipple at 11 o'clock, the bolt will occupy the position at 7 o'clock.

(c) The impeller must be a tight fit on the spindle and if it appears to have lost its interference fit with the spindle a replacement must be fitted. It must be pressed on as shown in Fig. 9 and soft

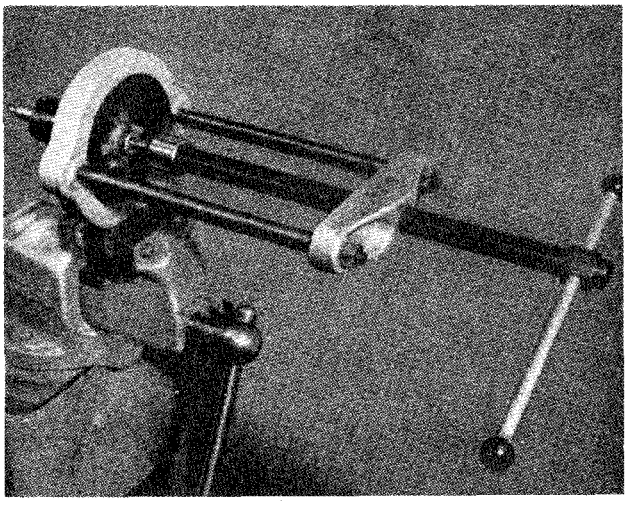

Fig. 8 **Utilising the Churchill Tool No. FTS 127 to remove the Water Pump Impeller.**

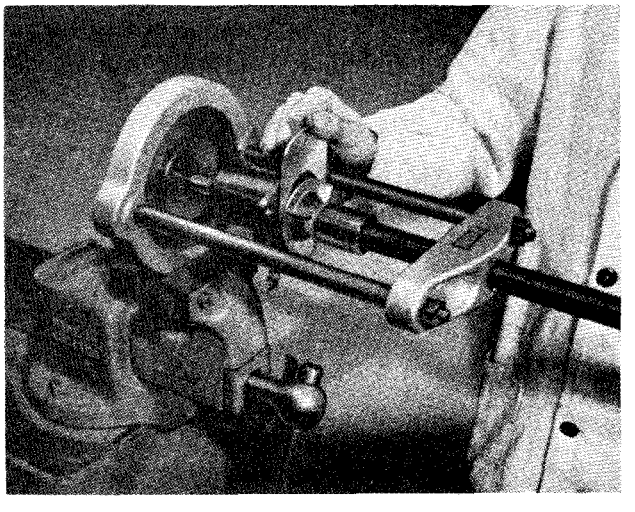

Fig. 9 **Fitting the Impeller, utilising the Churchill Tool No. FTS 127.**

solder run round the end face to ensure a water-tight joint (Fig. 10).

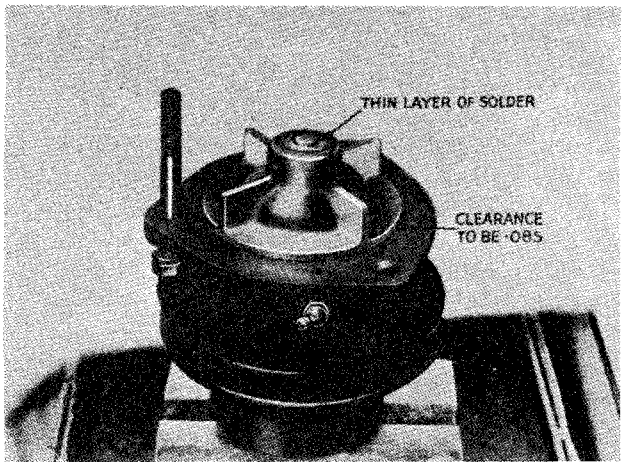

Fig. 10 **Showing the correct clearance between Water Pump Impeller and Bearing Housing.**

21. RECUTTING THE WATER PUMP SEALING FACE

When servicing the water pump it is sometimes necessary to re-cut the water seal abutment face. The Churchill Tool No. 6300 and bush S.126 is designed for this operation (Fig. 11) and carried out as follows :—

(**a**) The bearing housing is dismantled as described on page 7.

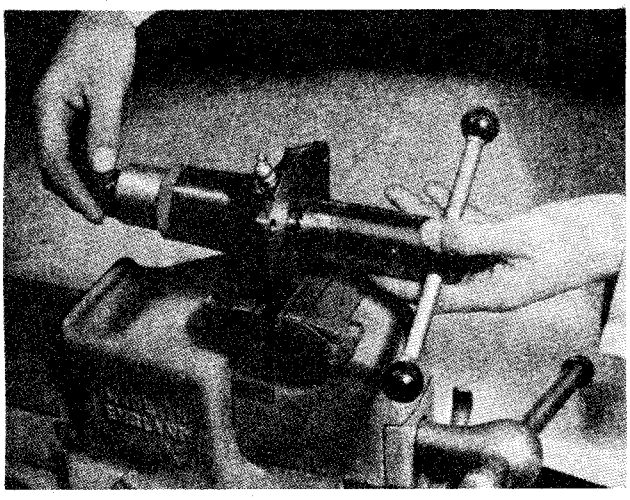

Fig. 11 **Refacing Water Seal Face with Churchill Tool No. 6300 and Bush S.126.**

(**b**) Feed the pilot shaft of the Churchill Tool No. 6300 in from the seal seating of the bearing housing. On to the protruding end of the pilot feed the bush S.126, followed by the tool bearing and knurled nut (Fig. 11).

(**c**) Turn the knurled nut until the cutter contacts the seal face and turn the tool round by the tommy bar, apply firm and steady pressure.

(**d**) Tightening the knurled nut slightly continue to turn the tool until the seal face is free from score lines and has attained a polished surface.

(**e**) Whilst carrying out this operation it will be necessary to remove the tool and clean the cutter with a blast from a compressed air line. Do not remove more than .030″ from the seal surface, if the score marks are not removed at this figure a replacement bearing housing should be fitted.

22. TO REMOVE WATER PUMP BODY (When bearing assembly has been removed)

(**a**) Disconnect the by-pass hose, also the heater pipe if the car is so fitted.

(**b**) Remove dynamo adjusting link which is secured to the pump body by a set-screw locked by a tabwasher.

(**c**) Remove the remaining two bolts securing the pump body to the cylinder block.

(**d**) Remove the body complete with its joint washer.

23. TO REPLACE WATER PUMP BODY

The replacement is the reversal of the removal, but care should be taken concerning the following point.

That the contact surfaces of the housing and the cover are perfectly clean and do not bear traces of the old joint washer. Failure to observe this point may lead to water leakages.

24. THE FAN ASSEMBLY

The fan is built up on a hub and hub extension, then balanced as a unit. When this operation has been completed the balancing plate is drilled right through and the drill allowed to touch the hub extension.

If, for any reason, the fan is dismantled all that is necessary on re-assembly is to line up the component parts so that the drill holes are all in line with the dimple in the hub extension and the re-assembled unit is in

balance. Only when replacement parts are fitted will it be necessary to re-balance the unit.

The hub extension is attached to the hub, the latter being keyed to the crankshaft by six nyloc nuts and bolts and the whole assembly is secured to the crankshaft by the extension bolt, the head of which acts as the starting handle dog and on re-assembly it will be necessary to place sufficient shims under the head of the extension bolt to bring it into such a position that when the starting handle is in use compression is felt just after the handle has left B.D.C. as shown in Fig. 37 in Engine Section.

25. TO REMOVE THE FAN ASSEMBLY FROM ENGINE UNIT

(**a**) Remove the front cowling as described in the Body Section " N ".

(**b**) Remove the radiator as described on page 5.

(**c**) Scribe a mark on the balancing plate and fan assembly to ascertain the front of these components for re-assembly.

(**d**) Turn back the tabs of the locking plates and withdraw the four bolts together with lock plates, plain washers, the balance plate (if one is fitted) and the extension bolt locking plate. The fan assembly, together with split rubber bushes, metal sleeves and larger diameter plain washer can now be removed.

(**e**) Remove the extension bolt and shims from the hub extension.

(**f**) By tapping the front flange of the hub extension remove the hub extension, hub and fan belt pulley from the crankshaft. Collect Woodruffe key.

(**g**) By releasing the tabs of the locking plates the nuts and bolts can be removed. On engines after Engine No. TS.4145E nyloc nuts and plain washers were fitted in place of lock plates and plain nuts. The hub extension can be removed and the hub withdrawn from the pulley pressings.

26. TO FIT FAN ASSEMBLY TO ENGINE UNIT

(**a**) Fit the Woodruffe key to the crankshaft and slide on the hub and hub extension assembled as described in operations **a, b** and **c** of " To assemble fan for balancing," hereafter.

(**b**) Fit the two shims under the head of the extension bolt and insert through the centre of hub extension and tighten until the abutment of the starting dog jaws, incorporated in the head of the extension bolt, assume a " 10 to 4 o'clock " position to ensure correct relationship with compression when the starting handle is in use.

(**c**) On to one pair of fan securing bolts feed one lock plate followed by one plain washer per bolt.

(**d**) Offer up the fan assembly in such a manner that the hole in the web is over the dimple in the hub extension face. Fit the extension bolt locking plate with the larger diameter plain washer between it and the rubber bushes. Secure the extension bolt locking plate with the bolts built up as described in operation (**c** above) utilising the two tappings opposite those with the $\frac{5}{32}$" drill hole.

(**e**) The remaining pair of bolts are made up in a similar manner to those already mentioned, but with the balancer fitted. These bolts are assembled to the remaining tappings in the hub extension. Before tightening, the balancer is moved until the hole aligns with those in the fan assembly ; after tightening the tabs of the locking plates are turned over.

(**f**) Replace the radiator and hoses.

(**g**) Replace the front cowling as described in the Body Section.

27. TO ASSEMBLE FAN FOR BALANCING

Check that the four fan blades riveted to the fan webs are free from movement. If for any reason replacement parts have been fitted the fan unit should be re-balanced. The dimple in hub extension face should be filled in with solder to avoid confusion during re-assembly.

(**a**) Place the two pulley pressings together, the flatter one with the drilled hole uppermost and the second pressing on top; feed the hub through the pressings with its keyway lowermost. It is necessary that this procedure is followed for it ensures a visual check of setting the engine at T.D.C. on Nos. 1 and 4 cylinders.

(**b**) Position the six bolts and secure the hub extension with the nyloc nuts. On early production cars, nuts and locking plates were used.

(**c**) Insert the rubber bushes in the fan assembly and locate the metal sleeves through the centres of these bushes.

(**d**) Feed the four fan attachment bolts through the larger diameter plain washers and metal sleeves of the fan assembly and secure the latter to the hub extension.

(**e**) Using a jig, ascertain the lighter side of the assembly and fit the balancer to that side. This can be moved to obtain perfect balance.

(**f**) When the balanced condition is attained a $\frac{5}{32}$" drill hole should be put through the thinner edge of the balancer and fan assembly webs until it makes a small dimple in the face of the hub extension. Withdraw the four bolts and remove fan assembly from hub extension.

28. ANTI-FREEZE PRECAUTIONS

During frosty weather it is necessary to protect the engine from damage and this can be effected by draining the cooling system by opening the tap at the lowermost portion of the radiator, and the second tap at the right hand side of the cylinder block.

In severe frosty weather an anti-freeze additive to the cooling system is strongly recommended, for it is possible for the lower portion of the radiator to become frozen, even when the car is being driven, restricting the circulation of the water as well as causing possible damage to the radiator itself. Before adding the anti-freeze compound thoroughly flush out the radiator and cylinder block, and ascertain that all hoses and connections are in perfect condition. Check also that the cylinder head nuts are tight, for if due to leaks, any anti-freeze solution finds its way into the cylinder bores serious damage may result.

The anti-freeze solution itself does not usually evaporate, thus apart from leakage, it should only be necessary to top up with water as the level in the radiator head drops.

This Company uses and recommends Smiths "Bluecol", and for protection from various degrees of frost the following proportions are recommended.

Degrees of Frost (Fahrenheit)	15	25	35
Proportion (per cent)	10	15	20
Amount of Bluecol (pints)	2	3	4

Water capacity 13 pints, 14 pints with heater. Other reputable anti-freeze compounds are available and the compound chosen should be used in accordance with the manufacturer's instructions.

It is a very wise precaution when using anti-freeze in the cooling system to employ some method of indicating the fact for the enlightenment of repairers who may be called upon to carry out adjustments or the replacement of parts.

SERVICE DIAGNOSIS.

OVERHEATING.

This difficulty may arise owing to one or more of the causes listed below :—

CAUSE	REMEDY
Ignition timing too late or auto advance and retard mechanism or suction not operating correctly.	Check ignition timing, automatic advance and retard mechanism and the suction pipe for the carburettor.
Fan belt slipping.	Adjust to give belt $\frac{3}{4}$" play by moving dynamo outwards along adjusting link.
Insufficient water in cooling system.	Check all joints for leaks including combustion head gasket
Radiator and/or cylinder block restricted by the accumulation of sludge, dirt or other solid matter.	Flush out system with a detergent and refill, using clean, softened or soft water.
Thermostat not operating correctly.	Remove and test as described on page 4.
Weak mixture caused by incorrect carburettor setting or air leaks in induction manifold.	Check carburettor manifold and carburettor joints, ensure tightness of manifold.
Initial tightness after an engine overhaul or insufficient clearance of replacement parts during an overhaul.	If due to the former, run-in engine most carefully and overheating should disappear. If overheating is caused by the latter it will not disappear, it can even get worse. The engine should be examined for badly fitting parts.
Overheating from bad lubrication, incorrect oil level or incorrect grade of oil. The use of certain brands of anti-freeze compound which have a lowering effect on the boiling point during warm weather.	Check oil level, grade and circulation, flushing system and refilling if necessary. Smiths " Bluecol " has a tendency to raise the boiling point.

Service Instruction Manual

D

CLUTCH

SECTION D

CLUTCH

INDEX

ILLUSTRATIONS

CLUTCH

1. GENERAL DATA

Model A 6 G 9″.
Hydraulically operated from twin bore master cylinder which incorporates the brake master cylinder.
Ball bearing release bearing.
Clearance between ball bearing release bearing and release levers—.0625″.
Nine, 120—130 lb. cream thrust springs.
Single dry plate with six springs. All six springs cushion the driving torque, whilst three (grey in colour) cushion the over run.
Free travel on clutch pedal = .820″.
Clearance between piston rod and master cylinder piston = .030″.
End float in Slave Cylinder fork assembly = .079″.
Height of release lever tip from face of flywheel = 1.895″.
Long portion of hub towards Gearbox.

2. TOOL DATA

Borg and Beck Gauge Plate No. CG.192.
Land Thickness = .330″ (see page 13).

Churchill Tool Spacers	No. 3
Churchill Tool Adapters	No. 7
Churchill Tool base plate position	D

3. CLUTCH OPERATION

The clutch is hydraulically operated and has a twin bore master cylinder (see Brake Section "R", for full explanation) attached to the bulkhead under the bonnet and a slave cylinder secured to the gearbox bell housing by a support plate, these are connected together by a length of Bundy-tubing and a flexible hose.

When pressure is applied to the foot pedal of the master cylinder it is transmitted through the pipe line to the slave cylinder. The piston of this cylinder operates a rod attached to the lever of the clutch operating shaft, a fork mounted on the latter engages in an annular groove of the release bearing mounting sleeve and moves the release bearing into engagement with the release levers.

4. TWIN BORE MASTER CYLINDER

The unit consists of an integrally cast body with a common fluid reservoir for the two identical bores, one connected to the brakes and the second to the clutch. Each bore

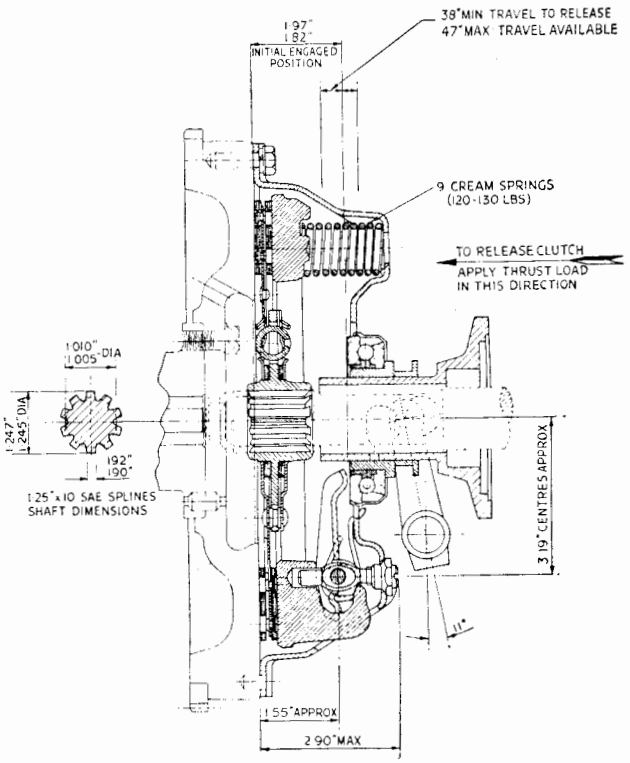

Fig. 1 **Sectional view of Clutch.**

accommodates a piston having a main cup loaded on to its head by a return spring. In order that the cup shall not tend to be drawn into the holes in the piston head, a piston washer is interposed between the main cup and the piston head.

Unlike the brake cylinder bore, with that for the clutch, there is no check valve fitted at the delivery end of the return spring and this spring uses the body as an abutment.

The absence of this check valve precludes the risk of residual line pressure which would tend to keep the release bearing in contact with the release levers, causing excessive wear on the bearing and possible clutch slip.

5. CLUTCH SLAVE CYLINDER

The slave cylinder is mounted on a support plate which is attached by the two lower bell housing bolts to the left-hand side of the engine unit. A steady bracket, attached at its forward end to the engine unit by one of the sump bolts, forms the slave

cylinder and plate upper attachment by means of a jam nut and a nyloc nut. The lower attachment being effected by nut and bolt with washer. A return spring is fitted to a plate on the clevis pin of the fork assembly to the lower portion of the support plate.

The inner assembly of the slave cylinder is made up of a coil spring, cup filler, rubber cup and a piston. The piston moves in the highly polished bore when hydraulic pressure is applied through the pipe line.

6. THE CLUTCH OPERATING SHAFT

This shaft is carried in the bell housing in two " Oilite " bushes, it is positioned by a fixing screw, the shank of which locates the reduced diameter portion of the shaft. A short coil spring is placed between the shaft lever and the bell housing which steadies the shaft and prevents rattle.

Mounted on the shaft is the release bearing operating fork, being secured thereto by a tapered pin, the shank of which passes into the shaft, whilst its head is locked to the fork by a short length of wire.

The shaft is lubricated by grease nipples and over-lubrication must be avoided (see page 4).

7. THE RELEASE BEARING

This is a ball bearing housed in a cover. A sleeve pressed into the inner race of this bearing, is grooved externally to accommodate the pins of the clutch operating fork mounted on its shaft in the bell housing of the gearbox. The sleeve, pressed into the bearing, moves on an extension of the front gearbox cover which ensures its correct angular engagement with the three release levers.

The ball bearing is grease packed during its manufacture and does not require re-greasing.

8. COVER ASSEMBLY

This assembly consists of a steel pressing to which the component parts are assembled, being attached with the Driven Plate Assembly to the flywheel.

NOTATION FOR CLUTCH ASSEMBLY (FIG. 2)

Ref. No.	Description
1	Clutch Cover.
2	Pressure Plate.
3	Thrust Springs.
4	Release Lever Eye Bolt.
5	Release Lever Pin.
6	Release Lever.
7	Release Lever Strut.
8	Anti-Rattle Spring.
9	Adjusting Nut.
10	Driven Plate Assembly.
11	Driven Plate Facings.
12	Ball Bearing, Release Bearing and Pressed-in Sleeve.
13	Clutch Operating Fork.
14	Taper Pin.
15	Clutch Operating Shaft.
16	Spring on Operating Shaft.
17	Grease Nipple (one each end of shaft).
18	Shaft Locating Bolt.
19	Locking Washer for Locating Bolt.
20	Slave Cylinder Body.
21	Bleed Screw.
22	Cup Filler Spring.
23	Cup Filler.
24	Rubber Cup.
25	Piston.
26	Rubber Boot.
27	Small Circlip for Rubber Boot.
28	Large Circlip for Rubber Boot.
29	Fork Assembly Rod.
30	Fork End.
31	Clevis Pin.
32	Clevis Pin Spring.
33	Fork End Locking Nut.
34	Clutch Shaft Return Spring.
35	Anchor Plate for Return Spring.
36	Slave Cylinder Support Bracket.
37	Lower Attachment Bolt.
38	Nut.
39	Lock Washer.
40	Slave Cylinder Stay.
41	Nyloc Nut.

The cover assembly contains a cast iron pressure plate loaded by nine cream thrust springs (120—130 lbs.). Mounted on the pressure plate are three release levers which pivot on floating pins retained by eye bolts. Adjusting nuts are screwed on the eye bolts, which pass through the cover pressing these nuts being secured by staking.

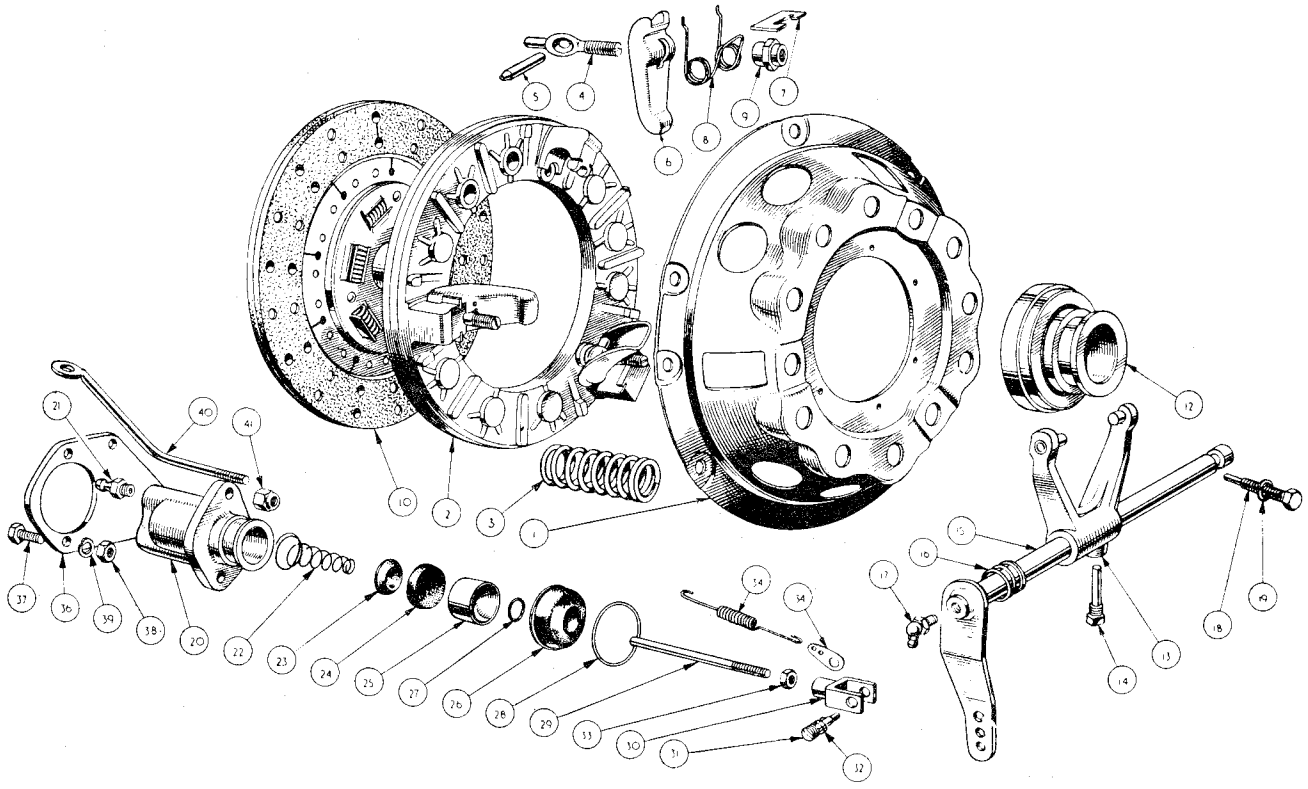

Fig. 2 **Exploded details of Clutch Assembly with Slave Cylinder.**

Struts are interposed between the lugs on the pressure plate and the outer ends of the release levers. Anti-rattle springs are fitted between the release levers and the cover pressing.

9. DRIVEN PLATE ASSEMBLY

This is the Borglite spring type, having a splined hub and a disc adapter fitted with nine cushioned segments which carry two facings attached by rivets.

The hub flange and disc adapter are slotted to carry six springs (3 red, 3 grey) positioned by a retaining plate which is secured to the disc adapter by stop pins. This flange is drilled to carry three steel balls positioned by the two friction plates located by tabs in holes in the hub flange.

A spacer is fitted between the disc adapter and one friction plate and another spacer is fitted between the retaining plate and the second friction plate.

10. MAINTENANCE

It is essential that the master cylinder is at least half full of Lockheed Brake Fluid at all times, and should be checked every 5,000 miles (8,000 kms.).

Only Lockheed Brake Fluid should be used in this system. This fluid has been selected as it has no injurious effects on the rubber seals and flexible hoses used.

Before removing the filler cap, wipe the top of the master cylinder and the cap clean with a non-fluffy material. Cleanliness is particularly important and every precaution should be taken to ensure no dirt or foreign matter is allowed to enter the system. Failure to observe this point may lead to blockages; damage to the highly polished bores and pistons, resulting in expensive replacements.

Ensure also that the breather hole in the filler cap is not restricted and that the sealing washer and pipe lines are in good order.

11. BLEEDING THE HYDRAULIC SYSTEM

Bleeding is only necessary when a portion of the system has been disconnected or if the level of the fluid has been allowed to fall so low that air has been allowed to enter the system. If bleeding is carried out for the latter reason the brake system will need to be bled also, as they share the same reservoir.

(**a**) Fill the reservoir with Lockheed Brake Fluid and keep at least half full throughout the operation. Failure to observe this point may lead to air being drawn into the system and the operation of bleeding will have to be repeated.

(**b**) Attach a length of rubber piping to the bleed screw and allow the free end to be submerged in a little Lockheed Brake Fluid contained in a *clean* glass jar, open the bleed port by giving the screw one complete turn.

(**c**) Depress the clutch pedal with a slow full stroke and before the pedal reaches the end of its travel the bleed screw is tightened sufficiently to seat it.

(**d**) Repeat the operation (**c**) until air bubbles cease to appear from the end of the tube.

(**e**) Ensure that there is sufficient fluid in the reservoir, at least half full, and replace cap first, ensuring that its seal is in good order and its vent is unobstructed.

12. GREASING OF THE CLUTCH OPERATING SHAFT

Hand grease gun lubrication should be used when greasing this shaft. Two strokes of the gun to each nipple after 5,000 miles (8,000 kms.) of running will provide adequate lubrication

Over lubrication, from generous use of pressure lubricating may lead to grease finding its way on to the clutch facing.

13. ADJUSTING THE CLUTCH

The adjustment connection between pedal and master cylinder is set on initial assembly and should not need re-adjustment.

During complete overhauls or the repair of accidental damage the master cylinder may have to be disturbed. Its replacement is dealt with in the Brake Section "R" and the adjustment is described in this section below.

The clutch pedal will provide no sensitive indication of loss of release bearing clearance ($\frac{1}{16}$") consequent upon wear of the facings. Adjustment at the slave cylinder fork assembly must therefore be checked periodically, at whatever intervals the operating conditions may dictate. The adjusting sequence is described below.

The adjustment is said to be correct when there is .079" end float in the slave cylinder fork assembly.

14. ADJUSTING THE MASTER CYLINDER

It is important to provide .030" free travel of the push rod before it reaches the piston. This clearance is necessary to ensure that the piston will return to its stop in its cylinder and thus prevent the possibility of the lip of the main cup covering the by-pass port. If such a condition were to exist the excess fluid drawn into the cylinder during the return stroke of the piston will find no outlet and pressure will build up in the system causing the clutch to "slip".

(**a**) Loosen the jam nut of the clutch pedal stop at the forward end of the master cylinder support bracket.

(**b**) Turn the adjuster screw inwards and testing the push rod eliminate all end float. Tighten jam nut finger tight, holding adjuster screw.

(**c**) Unscrew the adjuster together with the jam nut until a .030" feeler can be placed in between the jam nut and the master cylinder bracket.

(**d**) Holding adjuster screw, lock jam nut to the bracket.

15. ADJUSTING THE SLAVE CYLINDER

(**a**) Unlock the jam nut on the slave cylinder fork assembly.

(**b**) Turn the rod until ALL end float is just eliminated.

(**c**) Hold the push rod and turn the jam nut until a .079" feeler gauge will pass in between the nut and the fork end.

(d) Screw the rod together with the jam nut to the fork and lock. Check by moving the fork assembly and readjust if necessary.

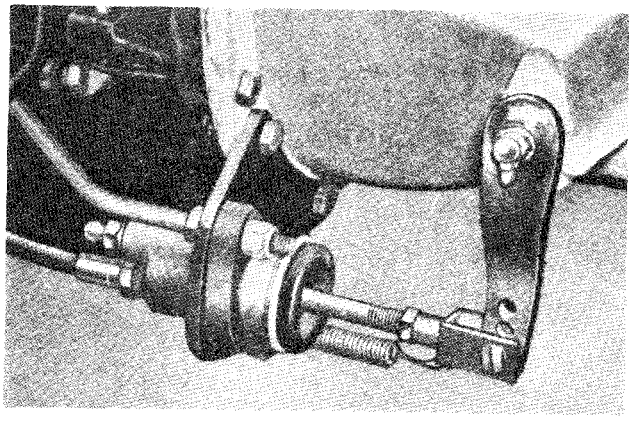

Fig. 3 The Slave Cylinder and support bracket.

16. TO REMOVE THE FLEXIBLE HOSE

(a) Drain the hydraulic system.

(b) Holding the hexagon of the flexible hose, withdraw the Bundy tubing by first removing the union nut.

(c) Still holding the hexagon of the flexible hose, remove the locking nut and shake proof washer.

(d) Withdraw the flexible hose from its bracket and disconnect it from the slave cylinder.
Ensure that its whole length is turned whilst unscrewing as any twist will impair the life of the hose.

17. TO FIT THE FLEXIBLE HOSE

Ensure that all connections are perfectly clean. Dirt being allowed to enter the system may cause blockages, or damage to the highly polished bores and pistons resulting in expensive replacements.

(a) Utilising a new copper gasket, attach and secure the flexible hose to the lower port of the slave cylinder.

(b) Feed the hose into the bracket welded on the left hand chassis member. Griping the hexagon of the hose with a spanner set the hose in such a manner that it will have a free run, away from all obstructions and rubbing contacts.

(c) Still holding the hexagon of the hose secure it to the chassis bracket with the shakeproof washer and lock-nut.

(d) Insert the Bundy tubing into its housing and check that it is correctly seated before securing with the union nut.

(e) Bleed the clutch system as described on page 4.

18. REMOVAL OF THE SLAVE CYLINDER (with fork-rod assembly) Fig. 3.

D

(a) Remove the flexible hose as described on this page.

(b) Unhook the spring from the slave cylinder support plate. Remove the split pin and the clevis pin exercising care not to mislay the spring between the fork and the clutch shaft lever. Remove the spring attachment plate.

(c) Remove the nyloc nut from the slave cylinder stay and the nut, bolt and lock washer from the lower cylinder fixing point and withdraw slave cylinder from its support plate.

(d) Withdraw the fork assembly from the slave cylinder together with the rubber boot by first removing the wire clip from the exterior of the boot and slave cylinder.

19. TO REPLACE SLAVE CYLINDER

(a) Seat the slave cylinder in the support bracket with the bleed screw uppermost.

(b) Secure at the uppermost point by a nyloc nut on the threaded end of the stay and at the lowermost point with nut, bolt and lock washer.

(c) Fit the small coil spring and spring anchor plate either side of the clutch operating lever, followed by the fork assembly. Secure with the clevis pin and lock with split pin.

(d) Attach the return spring to the spring anchor plate of the fork end assembly and anchor the other end to the slave cylinder support bracket.

(e) Fit the flexible hose as described on this page.

(f) Adjust the clutch at the fork end assembly as described on page 4.

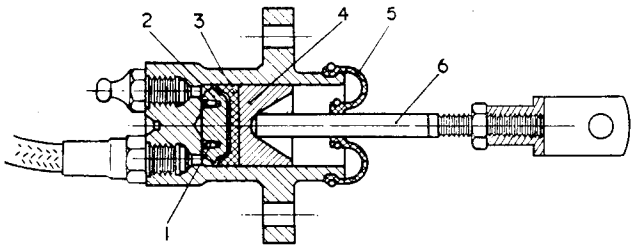

Fig. 4 **Sectional View of Slave Cylinder. 1 Spring. 2 Cup Filler. 3 Rubber Cup. 4 Piston. 5 Rubber Boot. 6 Fork assembly.**

20. DISMANTLING THE SLAVE CYLINDER (Fig. 4)

(**a**) Remove the slave cylinder assembly from its mounting as described on page 5. Remove bleeder screw.

(**b**) Remove the wire circlip from the rubber boot and ease the rubber boot from the alloy body.

(**c**) The rubber boot can be removed from the fork end assembly by first removing the wire circlip. The assembly can now be drawn through the rubber.

(**d**) By applying low air pressure through one of the tapped holes the piston can be removed from the cylinder bore followed by the rubber cup, the cup filler and spring.

(**e**) The components should be washed in Lockheed Brake Fluid and any component that shows excess wear should be replaced. Particular attention must be paid to the cylinder bore and piston.

21. ASSEMBLY OF THE SLAVE CYLINDER

(**a**) Give the component parts a liberal coating of Lockheed Brake Fluid and also the bore of the cylinder.

(**b**) Assemble the spring to the cup filler and insert both, spring first, into the bore of the cylinder.

(**c**) Fit the rubber cup, lip first, into the bore, exercising great care that the edges do not curl up inside the bore. After assembly it will be noticed that the flat surface of the rubber cup is uppermost and will accommodate the piston.

(**d**) Slide the piston into the cylinder, flat side first, the piston may be assisted in the travel by the rod of the fork end assembly.

(**e**) Insert the push rod of the fork assembly into the rubber in such a manner that the push rod end is nearer to the lips of the boot. Secure the rubber boot to the rod with a small circlip.

(**f**) Fit the fork end assembly and rubber boot to the slave cylinder body and secure with the large wire circlip.

(**g**) Fit the bleed screw to one of the ports in the slave cylinder body.

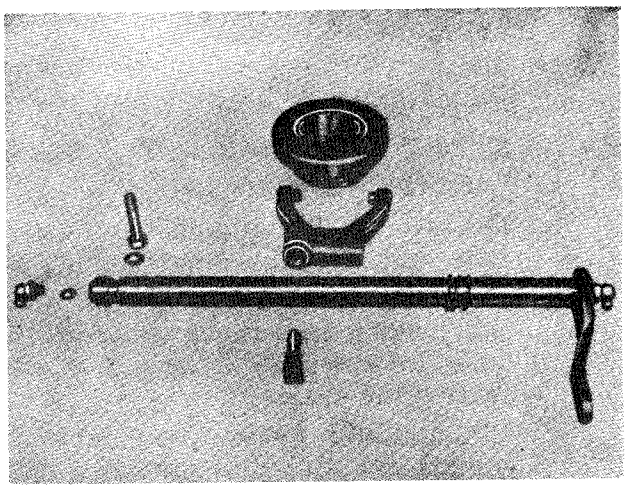

Fig. 5 **The Clutch Operating Shaft Assembly.**

22. TO REMOVE RELEASE BEARING AND CLUTCH OPERATING SHAFT (Fig. 5)

(**a**) Remove the gearbox from the car as described in the Gearbox Section "E".

(**b**) Break and remove the wire locking the taper pin to the clutch bearing operating fork, remove taper pin.

(**c**) Withdraw the release bearing and sleeve from the front end cover of the gearbox.

(**d**) Remove grease nipple and fibre washer from right hand end of clutch operating shaft.

(**e**) Withdraw the shaft locating bolt and lock washer from right hand side of bell housing.

(**f**) Holding the clutch operating fork withdraw the shaft from the left.

(**g**) Remove spring and grease nipple with fibre washer from lever end of shaft.

NOTE—To effect the removal of the shaft from cars prior to Commission No. TS. 411, there is no necessity to remove the grease nipple (operation **d**) and the shaft locating bolt (operation **e**) is situated on the left hand side of the bell housing.

23. TO REPLACE CLUTCH OPERATING SHAFT AND RELEASE BEARING

The replacement of the clutch operating shaft and release bearing is the reversal of the removal. It will be found, however, that light pressure will be necessary to compress the spring on the operating shaft to insert and tighten the shaft locating bolt.

When fitting the ball bearing release bearing, locate the pegs of the operating fork in the groove of the bearing. Secure the operating fork to the shaft with the taper pin and lock the head with wire.

24. REMOVAL OF THE CLUTCH FROM FLYWHEEL WITH GEARBOX REMOVED

(**a**) Slacken the six holding bolts, in the outer rim of the cover pressing, a turn at a time by diagonal selection until the thrust spring pressure is relieved.

(**b**) Remove the six bolts and lift away the cover assembly and driven plate assembly from the two locating dowels.

(**c**) Inspect the two dowels in the flywheel for looseness and burrs and replace if necessary.

25. REPLACEMENT OF CLUTCH TO FLYWHEEL (Fig. 6)

(**a**) Place the driven plate assembly on the flywheel with the larger portion of the splined hub towards the gearbox. Centralise this plate with the Churchill Tool No. 20S. 72 or the splined portion of a constant pinion shaft.

(**b**) Fit the cover assembly over the driven plate and locate it on the two dowels in the face of the flywheel.

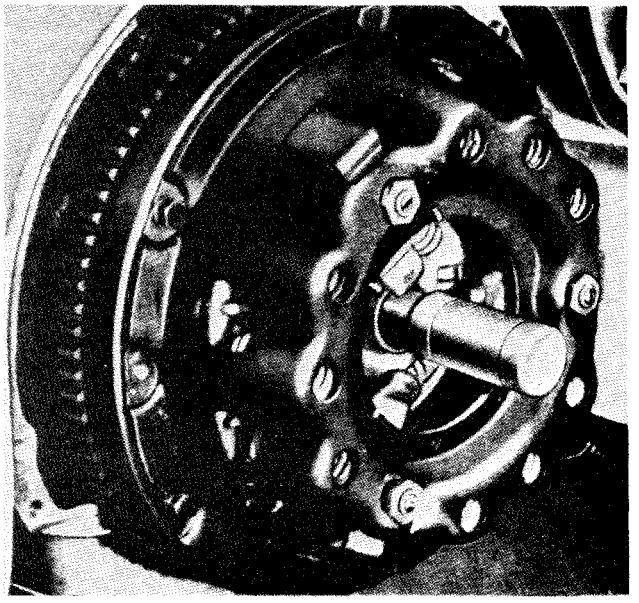

Fig. 6 **Showing Constant Pinion Mandrel in position. Churchill Tool No. 20S.72.**

(**c**) Secure the cover assembly to the flywheel with six bolts and lock washers, tightening them a turn at a time by diagonal selection to the correct tightening torque, 20 lbs. ft.

(**d**) Remove the driven plate centraliser only when the cover assembly is attached to the flywheel.

It is essential that the driven plate assembly is central at all times during the assembly of the cover to flywheel. Failure to observe this point may lead to difficulty in attaching the gearbox, for the constant pinion shaft may not have a free passage to the pilot bearing bush in the rear end of the crankshaft.

26. DISMANTLING THE COVER ASSEMBLY USING THE CHURCHILL FIXTURE No. 99A (Fig. 7)

(**a**) Before dismantling the clutch, suitably mark the following parts so that they can be re-assembled in the same relative positions to each other and so preserve the balance of the clutch cover assembly.

(**i**) Cover pressing.

(**ii**) Lugs on the pressure plate.

(**iii**) Release levers.

DI

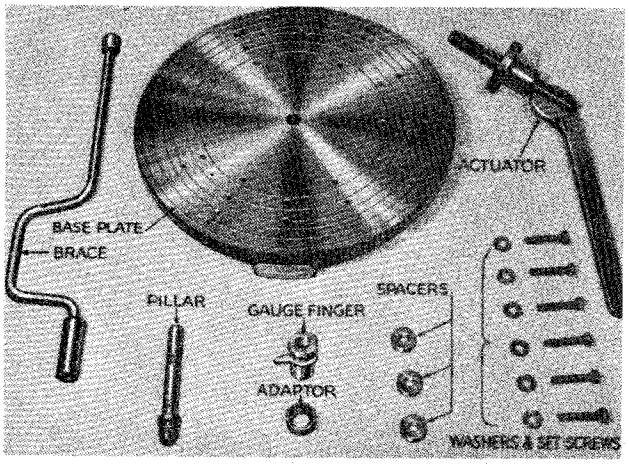

Fig. 7 **Clutch Assembly Fixture (Churchill Tool No. 99A) as used with 9″ clutch.**

(**b**) Determine from the code card in the Churchill Fixture No. 99A, the reference numbers of the adapter, the spacers, and the spacers position letter on the Churchill base plate. For this clutch they are 7, 3 and D respectively.

(**c**) Clean the top of the base plate and place the three number 3 spacers (Fig. 8) on the positions marked " D ".

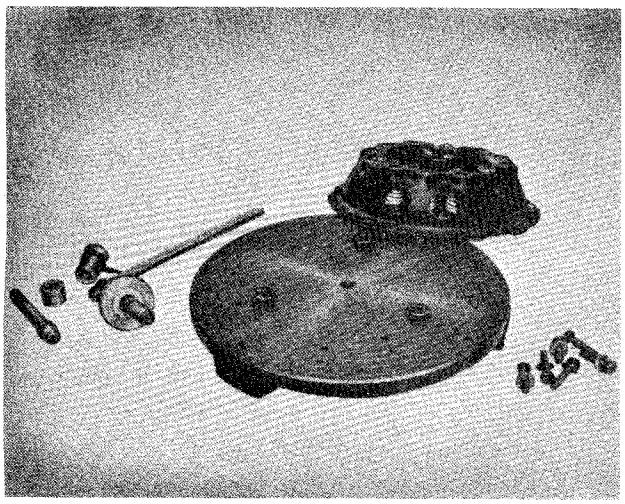

Fig. 8 **Spacers in position on Base Plate.**

(**d**) Place the cover assembly on the baseplate so that the release levers are situated directly above the spacers and the bolt holes in the rim of the cover pressing are in line with the tapped holes in the base plate.

(**e**) Screw the actuator into the centre hole, and press the handle down to clamp the cover housing to the base plate.

(**f**) Insert through the cover pressing six bolts and secure cover assembly to base plate (Fig. 9). Remove the actuator.

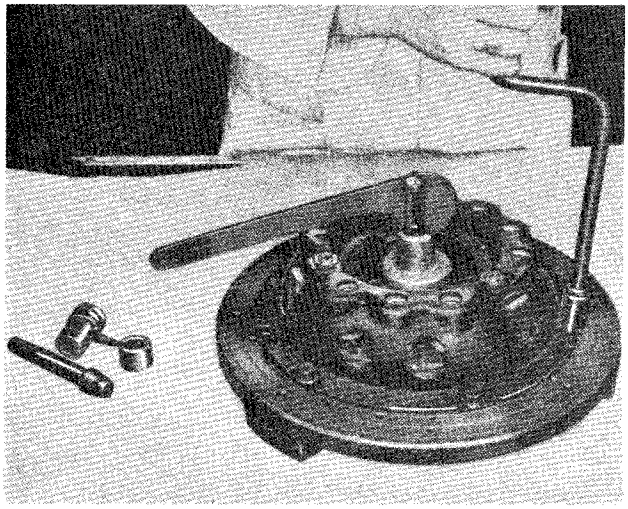

Fig. 9 **Securing Cover assembly to Base Plate.**

(**g**) Remove the three adjusting nuts, considerable torque will be necessary as the staking of these nuts has to be overcome.

(**h**) Remove the bolts clamping cover assembly to base plate by diagonal selection to release load on springs (Fig. 10).

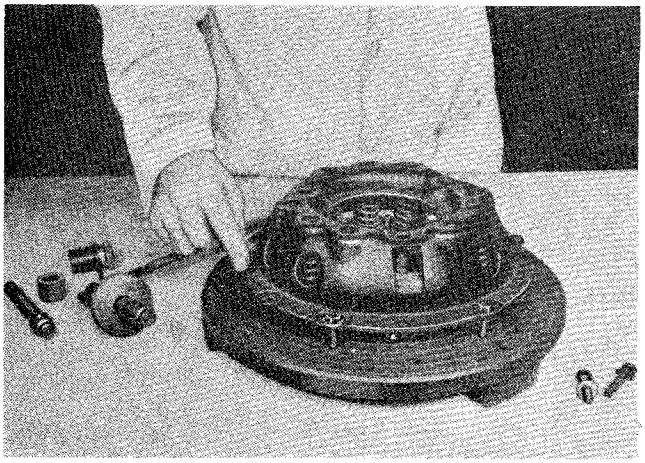

Fig. 10 **Adjusting nuts have been removed, cover securing bolts being removed.**

(**i**) Take off cover pressing and remove the nine thrust springs and anti-rattle springs.

(j) Lift up inner end of release lever and disengage the strut. Repeat procedure for 2nd and 3rd levers.

(k) Gripping the tip of the release lever and the eye bolt lift out the assembly from the pressure plate. Repeat procedure for 2nd and 3rd levers.

(l) Remove the eye bolts from release levers and take out pins. Remove the struts from pressure plate.

27. ASSEMBLY OF COVER PLATE ASSEMBLY USING THE CHURCHILL FIXTURE No. 99A

Before assembling a smear of Lockeed Expander Lubricant or Duckham's Keenol K.O. 12 should be applied to the release lever pins, contact faces of the struts, eye-bolt seats in the cover pressing, drive lug sides on the pressure plate and the plain end of the eye bolts.

Assembly is to be made with strict regard to the markings on certain parts and so ensure that the unit remains in balance.

(a) Place strut in position in lug of pressure plate.

(b) Assemble pin to eye bolt and feed threaded portion through release lever.

(c) By holding the strut in the pressure plate to one side, feed the plain end of the eye bolt (assembled to release lever) into the pressure plate (Fig. 11).

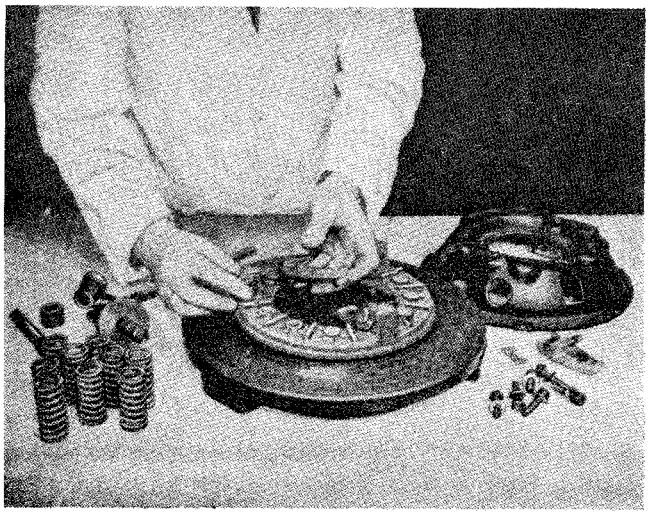

Fig. 11 Fitting Release Levers to Pressure Plate.

(d) Place the strut into groove in the outer end of the release lever.

(e) Repeat operations (a) to (d) for the remaining two release levers.

(f) Place the pressure plate and the assembled release levers, with the latter over the spacers, on the base plate of the Churchill Fixture.

(g) Place the cover pressing over the pressure plate laying on the base allowing the lugs to protrude through the cover. Should the holes in the cover pressing fail to line up with those in the base plate the cover and pressure plate must then be turned to allow alignment. Remove the cover pressing without disturbing the position of the pressure plate. Fit the anti-rattle springs.

(h) Place springs on their seats on the pressure plate, followed by cover pressing (Fig. 12).

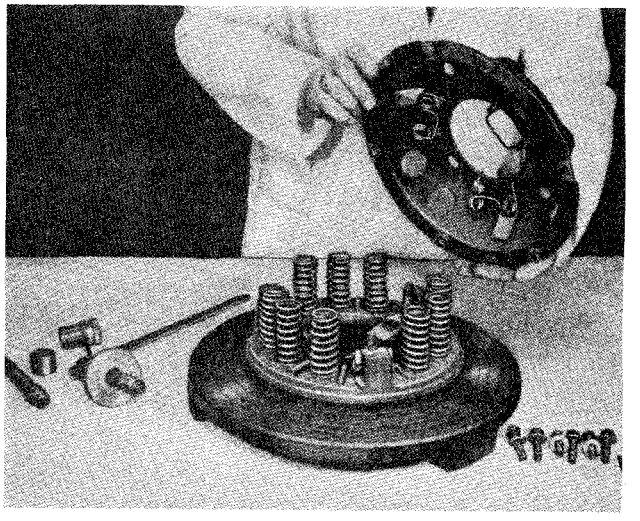

Fig. 12 Cover pressing with anti-rattle springs fitted ready for final assembly.

(i) Insert bolts through cover pressing into base plate. Tighten bolts by diagonal selection, checking that the pressure plate lugs protrude through the cover and the anti-rattle springs contact the release levers.

(j) Screw on adjuster nuts until their heads are flush with the tops of the eye bolts.

(k) Fit the actuator into the centre hole of the base plate and pump handle up and down half a dozen times to settle the assembled mechanism, remove actuator.

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(l) Secure pillar firmly into centre of base plate. Place on No. 7 adapter, recessed side downward, followed by gauge finger.

(m) Screw the adjusting nuts to raise or lower the release levers sufficiently to just contact the finger gauge (Fig. 13).

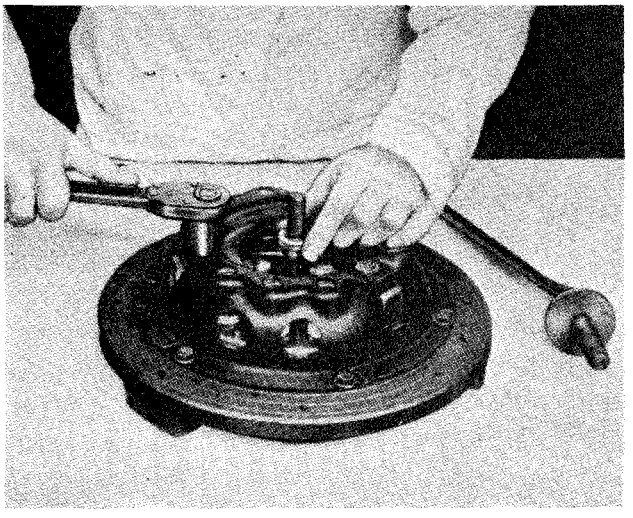

Fig. 13 **Adjusting the release levers.**

(n) Exchange the finger gauge and pillar for the actuator and operate the clutch a dozen or so times. Check again with finger gauge and make any adjustments necessary.

(o) Lock the adjusting nuts by peening over the collars into the cuts of the eye bolts.

(p) Remove cover assembly from base plate and it is ready to be fitted to the flywheel (with the driven plate assembly).

28. DISMANTLING THE COVER ASSEMBLY (Fig. 14) WITHOUT CHURCHILL FIXTURE

In the event of the Churchill Fixture not being available the following method is suggested.

This method utilises a fly or hydraulic press and suitable size wooden blocks ; two blocks on which to stand the pressure plate and allow the cover pressing downward movement. Before dismantling the cover assembly suitably mark the following parts so that they can be re-assembled in the same relative positions to each other and so preserve the balance of the cover assembly :—

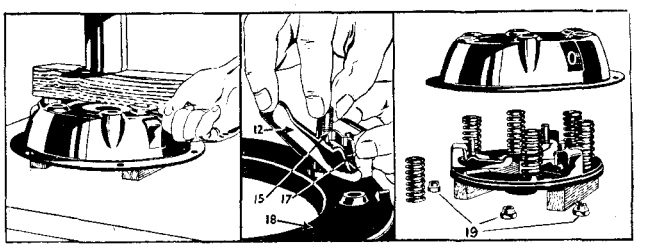

Fig. 14 **Dismantling the Cover Assembly utilising a ram press. 12 Release Lever. 15 Eye Bolt. 17 Strut. 18 Pressure Plate. 19 Adjusting Nuts.**

(i) Cover pressing.

(ii) Lugs on the pressure plate.

(iii) Release levers.

(a) Lay the assembly on the bed of the press with the pressure plate resting on the two wooden blocks so arranged that the cover pressing is free to move downwards when pressure is applied.

(b) Lay another wooden block on top of the cover pressing in such a manner that it will contact the ram of the press and will also move downward between the release levers.

(c) Lower the ram of the press sufficiently to bring the cover pressing in contact with the bed of the press. Secure the ram and remove the three adjusting nuts, considerable torque will be necessary as the staking of these nuts has to be overcome.

(d) Release the pressure of the press slowly to prevent the thrust springs from flying out.

(e) Remove the cover pressing and collect the component parts.

29. TO ASSEMBLE COVER ASSEMBLY WITHOUT CHURCHILL FIXTURE

Before assembly note the markings on the various components and return them to their original positions. Grease the components slightly at their contact faces with Lockheed Expander Lubricant or Duckham's Keenol K.O. 12.

(a) Fit the pins to the eye bolts and locate these parts within the release levers. Hold the threaded end of the eye bolt and the inner end of the lever as close together as possible and, with the other hand, engage the strut within the slots in a lug on the pressure plate and the other

end of the strut push outwards to the periphery of the pressure plate. Offer up the lever assembly, first engaging the eye bolt shank within the hole in the pressure plate, then locate the strut in the groove of the release lever. Fit the remaining levers in a similar manner.

(**b**) Place the pressure plate on the wooden blocks on the base of the press and position the thrust springs on the bosses on the pressure plate.

(**c**) Place the cover pressing, with the anti-rattle springs fitted, over the pressure plate ensuring that the lugs protrude through the cover slots.

(**d**) Arrange a wooden block across the cover and apply pressure to compress the whole assembly. Screw the adjusting nuts on to the eye bolts sufficiently so that pressure can be released.

30. INSPECTION OF COVER ASSEMBLY

Before re-assembling the clutch unit the parts should be cleaned and inspected. Any components which show considerable wear on its working surface should be replaced. The thrust springs and anti-rattle springs should be checked against new ones of the correct strength, and any found to be obviously weak should be replaced. The anti-rattle springs should be assembled to the cover pressing. The working face of the cast iron pressure plate should also be inspected and if the ground face is deeply scored or grooved it should be either re-ground or replaced by a new plate.

If any parts are changed or a new pressure plate fitted, it is essential it should be statically balanced.

31. ADJUSTING THE RELEASE LEVERS

In service, the original adjustments made by the clutch manufacturer, will require no attention and re-adjustment is only necessary if the cover assembly has been dismantled.

There are three methods by which the release levers may be adjusted.

(**i**) Churchill No. 99A Clutch Fixture.

(**ii**) Borg and Beck No. CG 192 gauge plate. (If available).

(**iii**) In the absence of the above the Driven Plate Assembly may be used.

(**a**) **Churchill No. 99A Clutch Fixture.** Both this Company and the Clutch manufacturers recommend this method. Details can be found on page 9.

(**b**) **Borg and Beck No. CG 192 Gauge Plate method (Fig. 15).**

(**i**) Utilising the actual flywheel lay the Gauge Plate in the position normally taken by the driven plate assembly. Mount the cover plate

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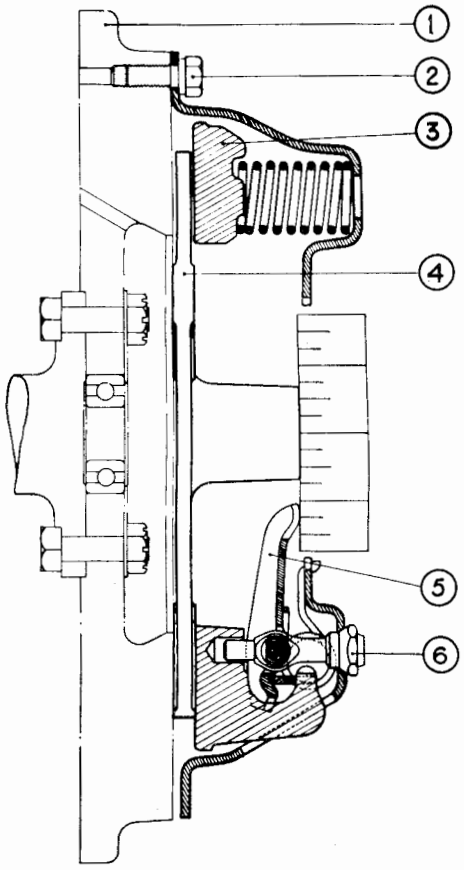

Fig. 15 **Adjusting the Release Levers utilising the Borg and Beck Gauge plate No. CG 192.**

Notation for Fig. 15.

Ref. No.	Description
1	Flywheel.
2	Cover assembly attachment bolts.
3	Pressure plate.
4	Borg and Beck gauge plate No. CG 192.
5	Release lever.
6	Adjusting nut.

assembly on the flywheel so that the ground lands of the gauge plate are situated under the release levers.

(ii) Turn the adjusting nuts to bring the release lever tips to contact a short straight edge resting upon the boss of the gauge plate.

(iii) Having made preliminary setting, operate the mechanism several times in order to settle the mechanism. The press used for assembling the cover assembly will perform this operation.

(iv) Carry out a check with the straight edge and re-adjust if necessary. Lock the adjusting nuts.

(c) **Utilising the Driven Plate Assembly.**

This method of setting the levers is not highly accurate and should only be used when the Churchill Fixture or the Borg and Beck Gauge Plate No. CG 192 are not available.

The draw back to this method is that although the driven plate is produced to close limits, it is difficult to ensure absolute parallelism. Although the error in the plate is small it becomes magnified at the lever tip due to lever ratio.

(i) Utilising the actual flywheel, lay the driven plate in position and clamp the cover plate assembly over it. The driven plate can be centralised by the Churchill Tool No. 20S. 72 (or similar tool).

(ii) By turning the adjusting nut adjust the height of the lever tips to 1.895″ from the flywheel face utilising a suitable depth gauge.

(iii) Operate the Clutch by using a small press several times in order to settle the mechanism.

(iv) Check the height of the release lever tips and re-adjust if necessary.

(v) Slacken the cover assembly and turn the drive plate 90°. Reclamp the cover assembly to the flywheel and check the height of the release lever tips as a safeguard against any lack of truth in the driven plate.

32. CONDITION OF CLUTCH FACINGS

The possibility of further use of the driving plate assembly is sometimes raised, because the clutch facings have a polished appearance after considerable service. It is perhaps natural to assume that a rough surface will give a higher friction value against slipping, but this is not correct.

Since the introduction of non-metallic faces of the moulded asbestos type, in service, a polished surface is a common experience, but it must not be confused with a glazed surface which is sometimes encountered due to conditions discussed hereafter.

The ideal smooth polished condition will provide a normal contact, but a glazed surface may be due to a film or a condition introduced, which entirely alters the frictional value of the facings. These two conditions might be simply illustrated by the comparison between a polished wood and a varnished surface. In the former the contact is still made with the original material, whereas in the latter instance, a film of dried varnish is interposed between the contact surfaces.

The following notes give useful information on this subject.

(a) After the clutch has been in use for some little time, under perfect conditions, with the clutch facings working on a true and polished or ground surface of correct material, without the presence of oil, and with only that amount of slip which the clutch provides for under normal condition, then the surface of the facings assumes a high polish, through which the grain of the material can be clearly seen. This polished facing is of a mid-brown colour and is then in perfect condition, the co-efficiency of friction and the capacity for transmitting power is up to a very high standard.

NOTE : The appearance of Wound or Woven type facings is slightly different but similar in character.

(b) Should oil in small quantities gain access to the clutch in such a manner as to come in contact with the clutch facings it will burn off, due to the heat generated by slip which occurs during normal starting conditions. The burning off of the small amount of lubricant, has the effect of gradually darkening

the clutch facings, but providing the polish on the facing remains such that the grain of the material can be clearly distinguished, it has very little effect on clutch performance.

(**c**) Should increased quantities of oil or grease attain access to the facings, one or two conditions or a combination of the two, may arise, depending on the nature of the oil etc.

(**i**) The oil may burn off and leave on the surface facings a carbon deposit which assumes a high glaze and causes slip. This is very definite, though very thin deposit, and in general it hides the grain of the material.

(**ii**) The oil may partially burn and leave a resinous deposit on the facings, which frequently produce a fierce clutch and may also cause a "spinning" clutch due to a tendency of the facings to adhere to the flywheel or pressure plate face.

(**iii**) There may be a combination of 1 and 2 conditions, which is likely to produce a judder during clutch re-engagement.

(**d**) Still greater quantities of oil produce a black soaked appearance of the facings, and the effect may be slip, fierceness or judder in engagement etc., according to the conditions. If the conditions under (**c**) or (**d**) are experienced, the clutch driven plate assembly should be replaced by one fitted with new facings, the cause of the presence of oil removed and the clutch cover housing assembly and flywheel thoroughly cleaned.

33. RECONDITIONING OF DRIVEN PLATE ASSEMBLY

Whilst a much more satisfactory result is obtained by the complete replacement of this assembly, circumstances may force the renewal of the clutch facings. The aftermentioned notes will prove useful.

(**a**) Ensure that the metal components of the assembly are in good condition and pay particular attention to the following:—

(**i**) Uneven spline wear.

(**ii**) Cracked segments.

(**iii**) Springs are not broken.

(**iv**) Test the drive and over run.

(**b**) Drill out the rivets securing the facings to the plates.

(**c**) Rivet the new facings onto the plate assembly. It is suggested that an old flywheel is used as an anvil and the rivets supported by short pieces of $\frac{3}{16}$" dia. mild steel rod.

(**d**) Mount the driven plate assembly on a mandrel between the centres of a lathe and check for "run out" with a dial test indicator set as near to the edge of the assembly as possible.

Where the run-out exceeds .015" locate the high spot and true the assembly by prizing over in the requisite direction. Care must be taken not to damage the facings.

NOTE : When offering up the driven plate assembly to the flywheel, the LONGER side of the splined hub must be nearer to the gearbox.

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IMPORTANT

The Borg and Beck Gauge Plate No. CG 192.

Mention of this Gauge Plate is made on Pages 1 and 11, but this plate can no longer be purchased. It is possible however that some dealers have an existing gauge of this type and for this reason instruction as to its use is included.

SERVICE DIAGNOSIS.

SYMPTOM	CAUSE	REMEDY
1. Drag or Spin.	(*a*) Oil or grease on the driven plate facings.	Fit new facings.
	(*b*) Misalignment between the engine and gearbox shaft.	Check over and correct the alignment.
	(*c*) Improper pedal adjustment not allowing full movement to release bearing.	Correct pedal adjustment.
	(*d*) Warped or damaged pressure plate or clutch cover.	Renew defective part.
	(*e*) Driven plate hub binding on splined shaft.	Clean up splines and lubricate with small quantity of high melting point grease such as Duckham's Keenol.
	(*f*) Pilot or operating shaft bearings binding.	Renew or lubricate bearings.
	(*g*) Distorted driven plate due to the weight of the gearbox being allowed to hang in clutch plate during erection.	Fit new driven plate assy. using a jack to take the overhanging weight of the gearbox.
	(*h*) Broken facings of driven plate.	Fit new facings.
	(*j*) Dirt or foreign matter in the clutch.	Dismantle clutch from flywheel and clean the unit, see that all working parts are free. **Caution.** Never use petrol or paraffin for cleaning out clutch.
	(*k*) Air in hydraulic line or insufficient fluid.	Bleed or replenish.
2. Fierceness or Snatch.	(*a*) Oil or grease on driven plate facings.	Fit new facings and ensure isolation of clutch from possible ingress of oil or grease.
	(*b*) Misalignment.	Check over and correct the alignment.
	(*c*) Binding of clutch pedal mechanisms.	Free and lubricate journals.
	(*d*) Worn out driven plate facings.	New facings required.
3. Slip.	(*a*) Oil or grease on the driven plate facings.	Fit new facings and eliminate cause of foreign presence.
	(*b*) Improper pedal adjustment indicated by lack of the requisite .820″ free or unloaded foot pedal movement—.030″ at master cylinder, .079″ at slave cylinder.	Correct pedal adjustment and/or clearances.
4. Judder.	(*a*) Oil, grease or foreign matter on the driven plate facings.	Fit new facings and eliminate cause of foreign presence.
	(*b*) Misalignment.	Check over and correct alignment.

SYMPTOM	CAUSE	REMEDY
	(*c*) Pressure plate out of parallel with flywheel face in excess of of permissible tolerance. (*d*) Contact area of friction facings not evenly distributed. Note that friction facing surface will not show 100% contact until the clutch has been in use for some time, but the contact area actually showing should be evenly distributed round the friction facings. (*e*) Bent splined shaft or buckled driven plate. (*f*) Unstable or ineffective rubber engine mountings.	Re-adjust levers in plane and, if necessary, fit new eyebolts. This may be due to distortion, if so fit new driven plate assembly. Fit new shaft or driven plate assembly. Replace and ensure elimination of endwise movement of power unit.
5. Rattle.	(*a*) Damaged driven plate, *i.e.*, broken springs, etc. (*b*) Worn parts in release mechanism. (*c*) Excessive back lash in transmission. (*d*) Wear in transmission bearings. (*e*) Bent or worn splined shaft. (*f*) Ball release bearing loose on operating sleeve.	Fit new parts as necessary.
6. Tick or Knock.	(*a*) Hub splines badly worn due to misalignment. (*b*) Worn pilot bearing.	Check and correct alignment, then fit new driven plate. Pilot bearing should be renewed.
7. Fracture of Driven Plate.	(*a*) Misaligment distorts the plate and causes it to break or tear round the hub or at segment necks in the case of Borglite type. (*b*) If the gearbox during assembly be allowed to hang with the shaft in the hub, the driven plate may be distorted, leading to drag, metal fatigue and breakage.	Check and correct alignment and introduce new driven plate. Fit new driven plate assembly and ensure satisfactory re-assembly.
8. Abnormal Facing Wear.	Usually produced by overloading and by the excessive slip starting associated with overloading.	In the hands of the operator.

Service Instruction Manual

E

GEARBOX

SECTION E

GEARBOX

INDEX

GEARBOX

ILLUSTRATIONS

GEARBOX

Dimensions and Tolerances

PARTS AND DESCRIPTION	DIMENSIONS NEW	CLEARANCE	REMARKS
Constant Pinion Shaft			
Spigot External Diameter	.494″ .492″	.0058″ to .0085″	
Crankshaft Bush Internal Diameter	.5005″ .4998″		
Mainshaft			
Spigot External Diameter	.6875″ .6870″	.0005″ to .0017″	
Internal Diameter of Constant Pinion Bush	.6887″ .6880″		
Mainshaft Bushes			
Diameter of Mainshaft	1.2488″ 1.2481″	.0007″ to .0026″	
Internal Diameter of 2nd Gear Bush	1.2507″ 1.2495″		
Internal Diameter of 3rd Gear Bush	1.2495″ 1.2488″	.0000″ to .0014″	
Mainshaft Bush Float			
Length of 2nd Gear Bush (measured without flange)	1.162″ 1.160″	.004″ to .008″	End float of .004″ to .006″ obtained by selective assembly.
Length of 2nd Gear	1.156″ 1.154″		
Length of 3rd Gear Bush	1.225″ 1.223″	.004″ to .008″	End float of .004″ to .006″ obtained by selective assembly.
Length of 3rd Gear	1.219″ 1.217″		
Overall Float of Bushes			
Overall Length of Mainshaft Bushes	2.511″ 2.505″		2nd gear bush has .124″—.122″ flange.
Thickness of 2nd Gear Thrust Washer	.122″ .120″		
Thickness of 3rd Gear Thrust Washer	.124″ .122″		
Overall Float of Bushes		.000″ .015″	End float of .007″ to .012″ obtained by selective assembly.

GEARBOX

Dimensions and Tolerances

PARTS AND DESCRIPTION	DIMENSIONS NEW	CLEARANCE	REMARKS
Countershaft			
External Diameter of Countershaft	.7913″ .7908″		
Internal Diameter of Countershaft Gear	.8983″ .8978″		
Needle Roller Diameter	.119″		
Countershaft Gear End Float			
Internal Width of Casing	6.771″ 6.769″		
Affected Length of 1st Countershaft Gear	2.2487″ 2.2473″		
Width of Constant Gear	1.3132″ 1.3118″		
Width of Third Gear	1.1882″ 1.1868″		
Width of Second Gear	.7607″ .7593″		
1st Thrust Washer Thickness	.068″ .066″		
Rear Thrust Washer Thickness	.107″ .105″		
Distance Piece	1.0817″ 1.0803″		
Overall Width of :—			
Countershaft Gears and Two Thrust Washers	6.7675″ 6.7565″		
Overall Float of Countershaft Gears	.0015″ .0145″		Select parts to provide .006″—.010″ end float.
Reverse Idler Shaft			
Diameter of Shaft	.5618″ .5613″	.0007″ to .0012″	
Internal Diameter of Bushes	.5625″		

GEARBOX

Dimensions and Tolerances

PARTS AND DESCRIPTION	DIMENSIONS NEW	CLEARANCE	REMARKS
Gearbox Top Cover			
Selector Shaft External Diameter	.4985″ .4972″	.0010″	
Bore in Cover for Selector Shaft.	.5005″ .4995″	to .0033″	
Gear Synchronisation and Loading Details			
2nd Speed Synchro Axial Load for Release		25 to 27 lbs.	
3rd and Top Synchro Axial Load for Release		19 to 21 lbs.	
Gap between Baulk Ring Dog Teeth and Cone Dog Teeth on Mainshaft Synchro Gears		.035″ to .040″ Engaged. .060″ to .075″ Free.	
Selector Rod Loading			
Selector Rod Axial Load for Release		1st and 2nd 3rd and TOP Reverse	32 to 34 lbs. 17 to 20 lbs. 21 to 23 lbs.
Load required at Gear Change Knob to Select :—			
1st and 2nd Gear		7 to 9 lbs.	
3rd and TOP Gear		4 to 6 lbs.	
Reverse Gear		6 to 7 lbs.	

NOTE : To convert lbs. to Kgs. divide by 2.204.
„ „ ins. to Millimetres multiply by 25.4.

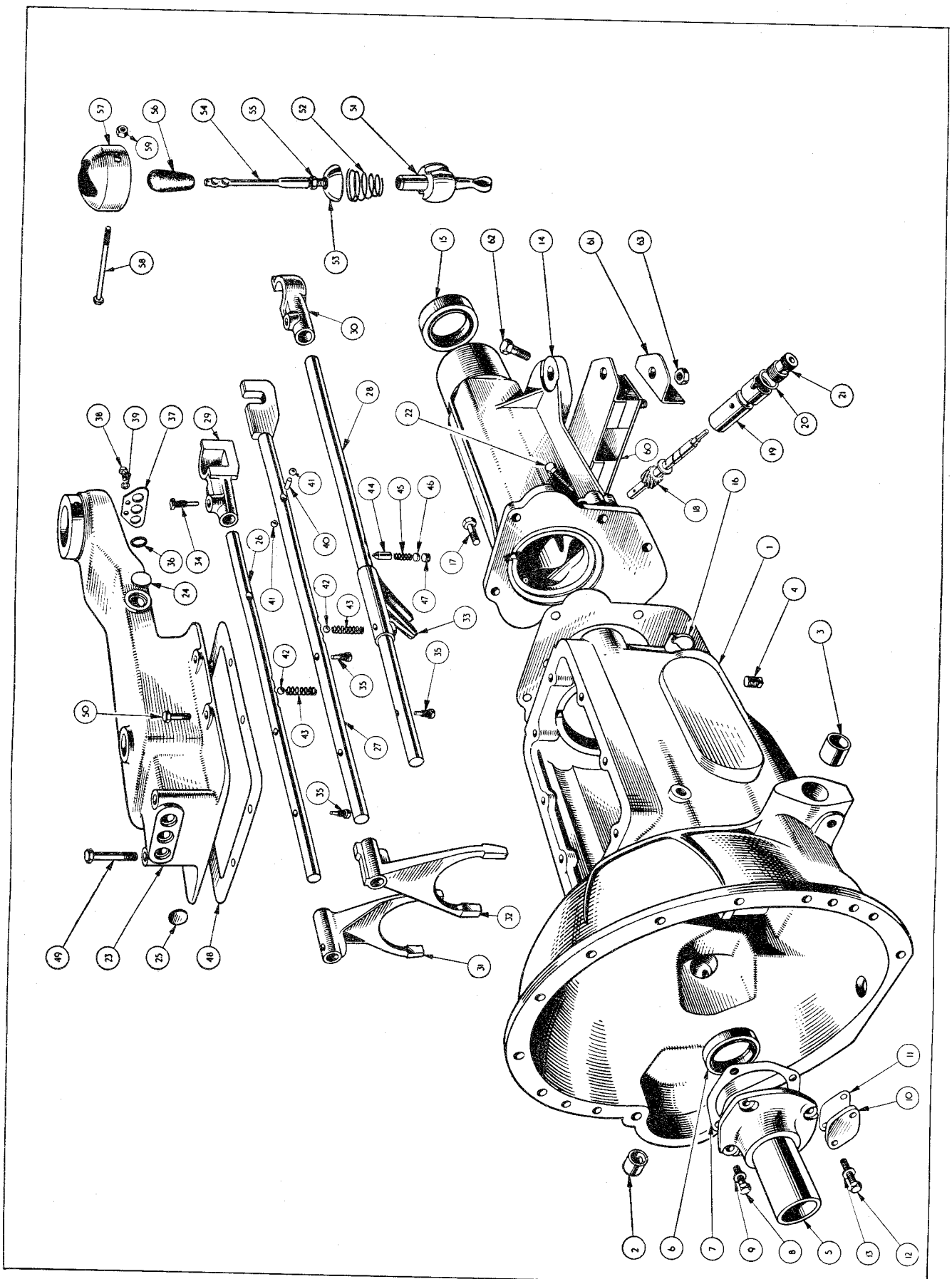

Fig. 1 Exploded view of Gearbox Casing, Extension Housing, Top Cover and Selector Mechanism.

NOTATION FOR FIG. 1

Ref. No.	Description
1	Clutch and Gearbox Casing.
2	Bush for Clutch Shaft.
3	Bush for Clutch Shaft.
4	Drain Plug.
5	Front End Cover.
6	Oil Seal.
7	Joint Washer.
8	Setscrew for Cover.
9	Plain Washer for 8.
10	Countershaft Cover.
11	Joint Washer.
12	Setscrew.
13	Plain Washer.
14	Gearbox Extension.
15	Oil Seal.
16	Joint Washer.
17	Extension Attachment Bolt.
18	Speedometer Drive.
19	Speedometer Bearing.
20	Washer.
21	Screwed Adaptor.
22	Locating Screw.
23	Top Cover.
24	Core Plug.
25	Selector Shaft Welch Washer.
26	Selector Shaft (1st and 2nd Gear).
27	Selector Shaft (Top and 3rd Gear).
28	Reverse Selector Shaft.
29	1st/2nd Gear Selector.
30	Reverse Gear Selector.
31	1st/2nd Selector Fork.
32	3rd/Top Selector Fork.
33	Reverse Selector.
34	Taper Screw.
35	Stop Screw.
36	Sealing Ring.
37	Cover Plate.
38	Setscrew for Cover Plate.
39	Lock Washer.
40	Interlock Roller 3rd/Top.
41	Interlock Balls.
42	Selector Shaft Ball.
43	Spring for Ball.
44	Reverse Shaft Plunger.
45	Spring for Plunger.
46	Distance Piece.
47	Plug.
48	Joint Washer.
49	Attachment Bolt (long). } Top cover.
50	Attachment Bolt (short). }
51	Ball End.
52	Spring.
53	Spring Retainer.
54	Lever Assembly.
55	Lever Locknut.
56	Knob.
57	Cap.
58	Bolt.
59	Nyloc Nut.
60	Rear Mounting.
61	Steady Bracket.
62	Bolt.
63	Nut.

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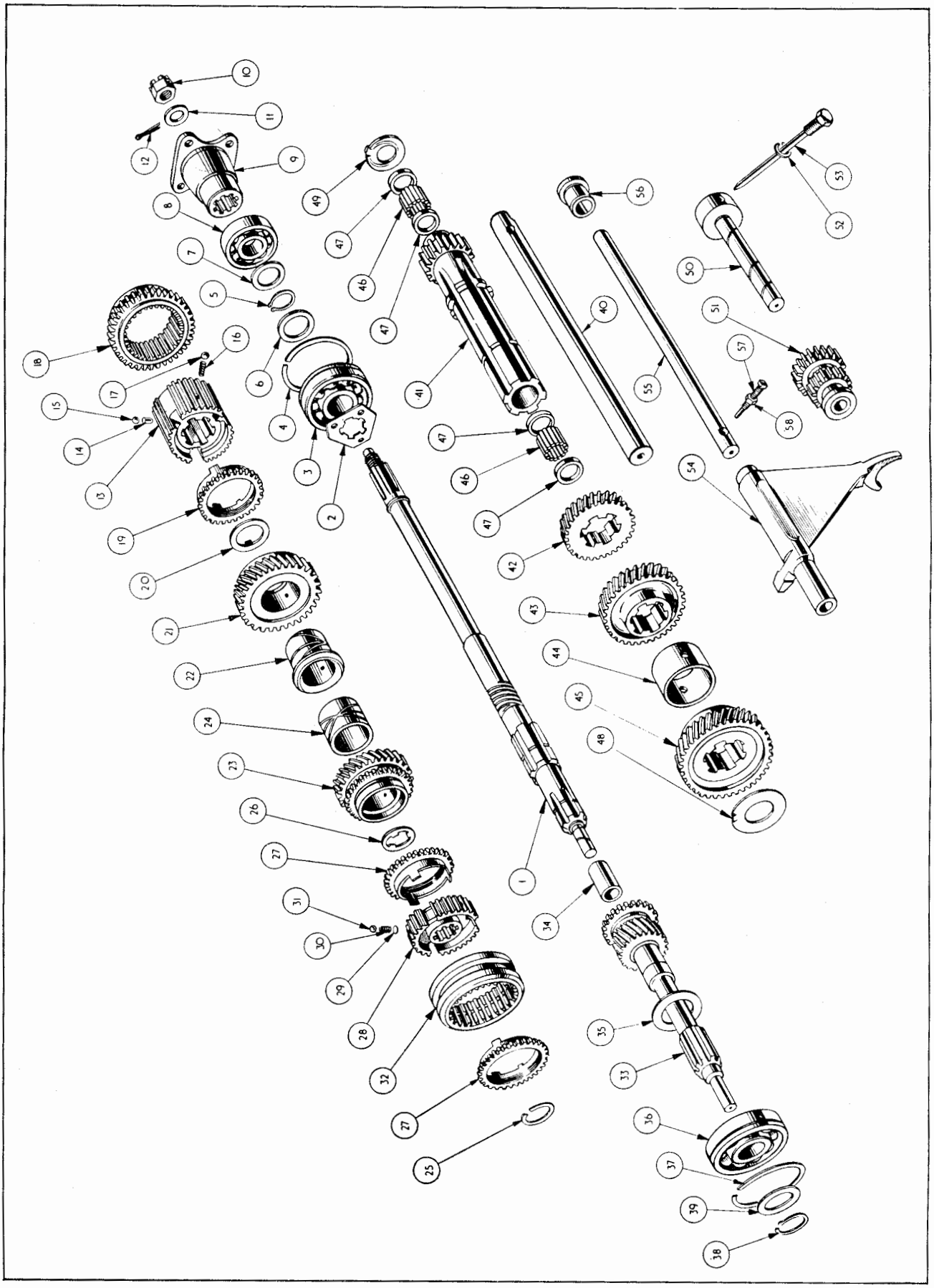

Fig. 2. Exploded view of Gears.

NOTATION FOR FIG. 2			
Ref. No.	Description	Ref. No.	Description
1	Mainshaft.	30	Synchro Spring.
2	Triangular Washer.	31	Synchro Ball.
3	Centre Bearing (Interchangeable with 36).	32	3rd and TOP Gear Sychronising Sleeve.
4	Outer Circlip for Centre Bearing (Interchangeable with 37).	33	Constant Pinion Shaft.
5	Circlip for Centre Bearing.	34	Constant Pinion Bush.
6	Washer for Centre Bearing.	35	Oil Thrower.
7	Washer for Rear Bearing.	36	Ball Bearing.
8	Rear Bearing.	37	Outer Circlip for Constant Pinion Bearing.
9	Driving Flange.	38	Circlip.
10	Slotted Nut.	39	Washer between Bearing and Circlip.
11	Plain Washer.	40	Countershaft.
12	Split Pin.	41	1st Speed Countershaft Gear.
13	1st Gear Synchro Hub.	42	2nd Speed Countershaft Gear.
14	Interlock Plunger.	43	3rd Speed Countershaft Gear.
15	Interlock Ball.	44	Distance Piece Countershaft Gear.
16	Synchro Spring.	45	Constant Gear.
17	Synchro Ball.	46	Needle Rollers.
18	1st Gear Synchronising Sleeve.	47	Retaining Ring for 46.
19	2nd Speed Synchronising Cup.	48	Front Thrust Washer.
20	Washer.	49	Rear Thrust Washer.
21	2nd Gear.	50	Reverse Spindle.
22	2nd Speed Bush.	51	Reverse Wheel.
23	3rd Speed Gear.	52	Lock Washer.
24	3rd Speed Bush.	53	Countershaft Retaining Screw.
25	Circlip.	54	Reverse Operating Fork.
26	Washer.	55	Operating Rod.
27	3rd and TOP Gear Synchronising Cup.	56	Bush on rear end of Rod.
28	3rd and TOP Gear Synchronising Hub.	57	Rod Retaining Screw.
29	Synchro Spring Shim.	58	Locknut.

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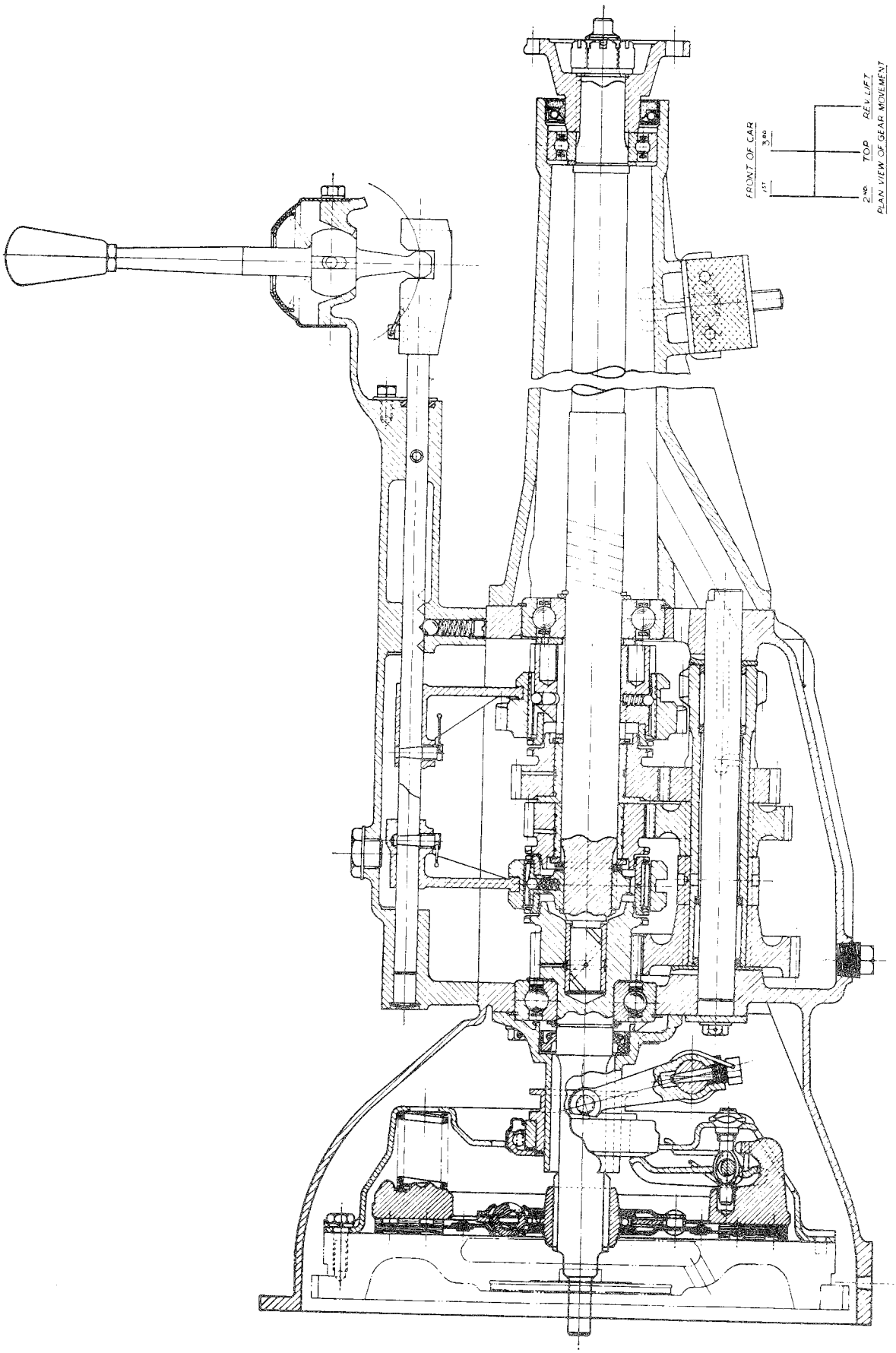
GEARBOX



Sectional view of Gearbox.

Fig. 3

GEARBOX

Description

Four forward speeds with gear synchronisation on 2nd, 3rd and Top and one Reverse ratio actuated by a compound gear which is disengaged when in Neutral or in any of the forward gears.

1. OPERATION

A remote control lever is carried in a turret formed in the rear end of the top cover, which is at a point approximately halfway down the rear extension housing. The selector forks are mounted on three selector shafts which are carried in the gearbox top cover and both cover and shafts extend rearwards to the control lever turret where gear selection is made by conventional "H" gate movement.

2. RATIOS

	Gearbox	Overall
Overdrive Top	0.82	3.03
Top	1.00	3.70
Third	1.325	4.90
Second	2.00	7.40
First	3.38	12.50
Reverse	4.28	15.80

3. BEARINGS

(a) **Constant Pinion Shaft**
Bearing (S.M.Co. Part No. 58391):
Fischer Ball Bearing No. MS12 S.G.
Hoffman Ball Bearing No. MS12 K.

(b) **Mainshaft Centre**
Bearing (S.M.Co. Part No. 58391):
As for Constant Pinion Shaft.

(c) **Mainshaft Rear**
Bearing (S.M.Co. Part No. SP75 G.):
Fischer Ball Bearing No. 6206.
Hoffman Ball Bearing No. 130.

(d) **Countershaft Cluster**
Front: 24 needle rollers retained by means of two retaining rings (press fit).
Rear: 24 needle rollers retained by means of two retaining rings (press fit).

4. MOUNTING

Unit assembly with engine which is two point mounted to the chassis at front, the gearbox being mounted on a silent block under the gearbox extension housing to the chassis cross member.

5. OIL CAPACITY

1½ pints (0.8 litres) from dry.
With Overdrive 3½ pints (2.0 litres).
For recommended grades of oil refer to Lubricant Recommendations in the "General Data" Section.

6. NUT AND BOLT DATA AND TIGHTENING TORQUES

For these particulars refer to "General Data" Section.

NOTE—For details regarding Special Tools, please refer to Section "Q" of this Manual.

7. TO REMOVE GEARBOX LEAVING ENGINE IN POSITION

(a) Disconnect battery lead.

(b) Remove both seats by withdrawing sixteen nuts, eight from beneath each seat cushion.

(c) Remove gear lever and grommet, after slackening the locknut and unscrew gear lever from its ball end.

(d) Withdraw floor centre section and carpet after the withdrawal of sixteen setscrews located round the edges of the pressing. Similarly remove the "U" plate (R.H. side) secured with two P.K. screws.

(e) Disconnect the propeller shaft at the front end by withdrawing the four bolts and nyloc nuts.

(f) Disconnect speedometer cable from gearbox by unscrewing the knurled collar from its adaptor.

(g) Remove clutch slave cylinder with its mounting bracket after withdrawing two nuts and bolts from the bell housing and one sump bolt securing the steady rod. The slave cylinder push rod can be removed from the clutch operating shaft after the withdrawal of the split pinned clevis pin from the operating fork to which is attached the clutch return spring.

(**h**) Disconnect the two wires from their terminals on the solenoid if an Overdrive is fitted.

(**i**) Remove gearbox mounting after the withdrawal of two nuts by jacking up the unit, using a block of wood between jack and sump to avoid damage.

(**j**) Remove starter motor bolts and slide starter motor forwards clear of the bell housing.

(**k**) Remove nuts and bolts from bell housing and withdraw gearbox (Fig. 4).

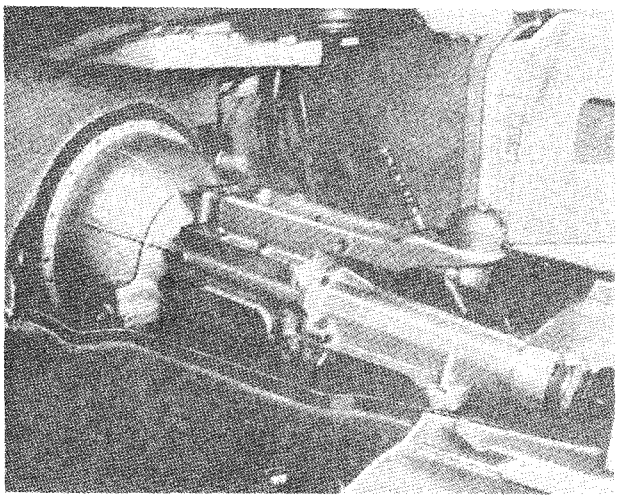


Fig. 4 Gearbox Unit ready for withdrawal.

TO REPLACE GEARBOX

Carry out the above procedure in reverse, but it is advisable before doing so to check the alignment of the clutch unit with a suitable mandrel (Fig. 5). If this is found to be incorrect slacken the clutch cover assembly bolts until the mandrel slides in freely, then re-tighten the bolts.

8. TO DISMANTLE

(**a**) Remove eight setscrews from the top cover assembly and withdraw complete with selector mechanism. To dismantle top cover assembly see page 18.

(**b**) Remove top cover paper joint.

(**c**) Break locking wire on clutch operating fork positioning setscrew and withdraw.

(**d**) Remove clutch operating shaft positioning bolt and grease nipple with fibre washer from R.H. of clutch shaft.

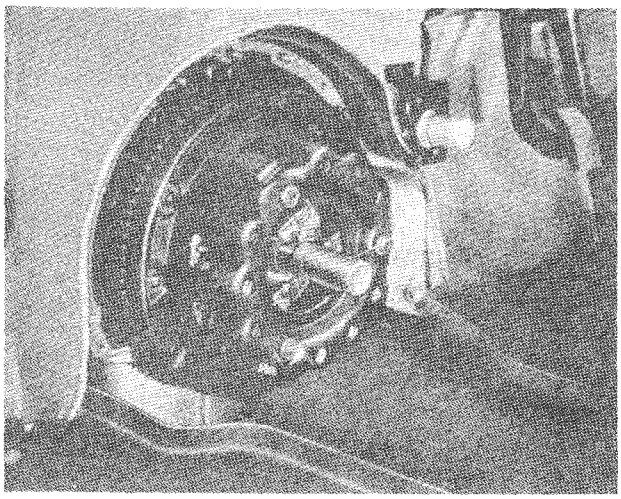


Fig. 5 Aligning Clutch Floating Plate with Mandrel. Churchill Tool No. 20S. 72.

Then withdraw operating shaft, coil spring, operating fork, clutch throwout bearing and sleeve.

(**e**) Detach the speedometer drive after removal of the special securing setscrew.

(**f**) Withdraw propeller shaft coupling, having first removed split pin, nut and plain washer.

(**g**) Remove gearbox extension and paper joint after the withdrawal of six securing setscrews and spring washers Fig. 6. The oil seal and ball race will remain in position in the housing but can easily be tapped out with a suitable drift.

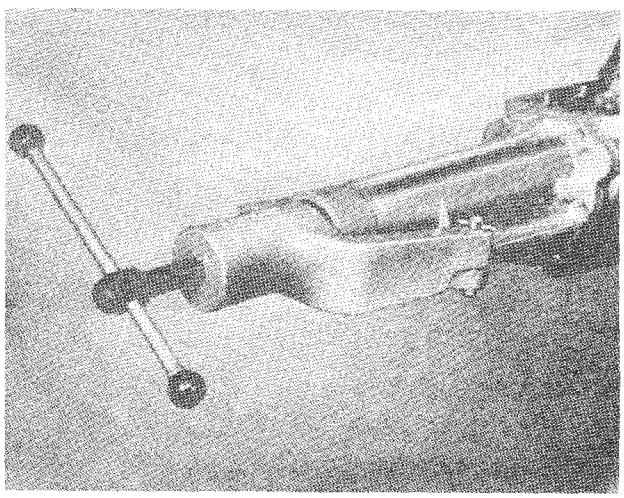


Fig. 6 Showing the removal of Gearbox Extension with Churchill Tool No. 20S. 63.

(**h**) Withdraw the countershaft locating setscrew as shown in Fig. 7.

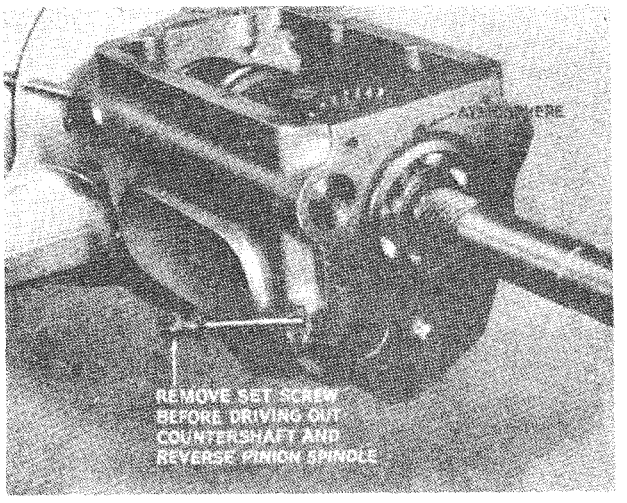


Fig. 7 **Countershaft and Reverse Locating Setscrew partially withdrawn.**

(**i**) After removal of the countershaft front end cover plate which is secured by two wired setscrews, plain washers and lead linger drive out the countershaft using a suitable tube as shown in Fig. 8, to retain the 48 needle rollers in position maintaining contact throughout between the tube and countershaft.

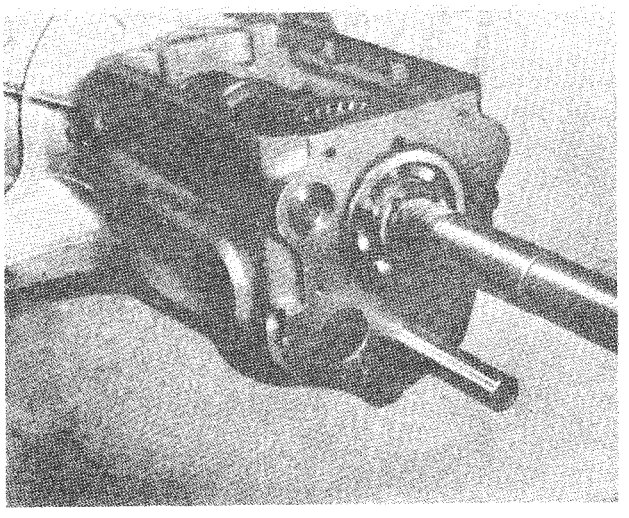


Fig. 8 **Showing Needle Roller Retainer Tube Tool No. 20SM68 being used to drive out Countershaft.**

(**j**) Remove the gearbox front end cover and paper joint after cutting the wire in the setscrew heads and withdrawing them complete with their plain washers and lead linger.

(**k**) Extract the constant pinion shaft assembly as shown in Fig. 9, and remove

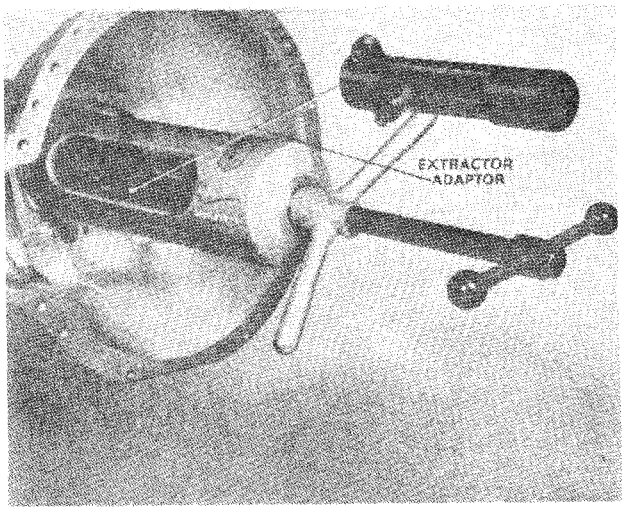


Fig. 9 **Extracting Constant Pinion Shaft Assembly with Churchill Tool No. 20SM66A.**

the mainshaft spigot bush located in the pinion itself. The further dismantling of this assembly necessitates the removal of the small circlip and thrust washer which fit against the inner ring of the ball race. After extraction of ball race in the fixture shown in Fig. 10, the oil thrower may be withdrawn, but owing to probable damage to this thrower during the dismantling operation a new one may be required when re-assembling the unit.

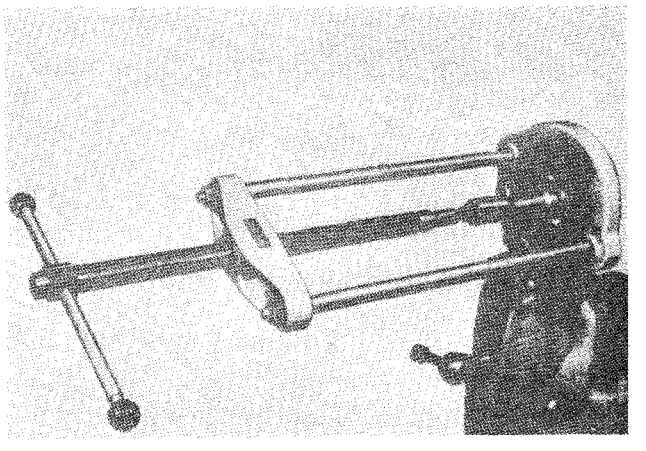


Fig. 10 **Extraction of Constant Pinion Ball Race with Churchill Press No. S4221 and Adapter from Set S.4615.**

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(l) Tap the mainshaft towards the rear with a soft metal drift, as shown in Fig. 11, sufficiently to clear the bearing

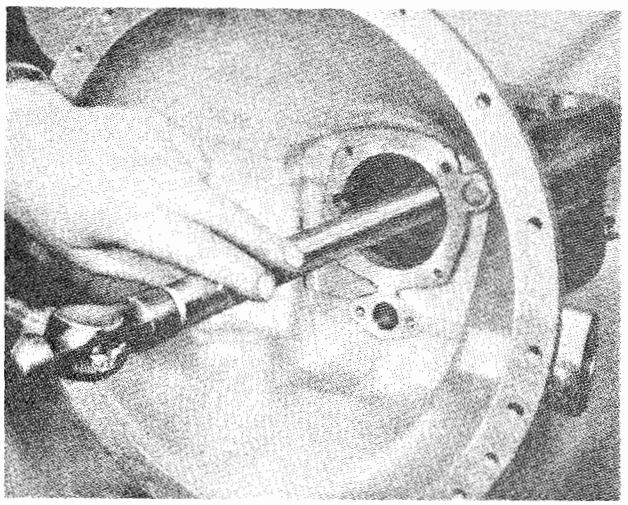

Fig. 11 Driving Mainshaft to rear with Tool No. 20SM1 to free Centre Main Bearing.

from the casing. Next tilt the shaft sufficiently to enable the third and top synchro unit to be withdrawn as shown in Fig. 12. Note the position

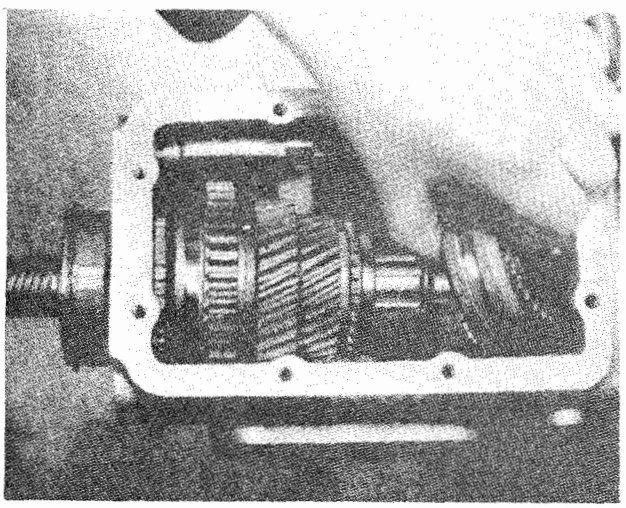

Fig. 12 Removing Top and Third Synchro Unit.

of the short boss on the synchro hub is towards the mainshaft circlip.

(m) Remove mainshaft circlip with the special extractor shown in Fig. 13. The extraction of this circlip is made somewhat difficult by the adjacent thrust washer which has three lugs,

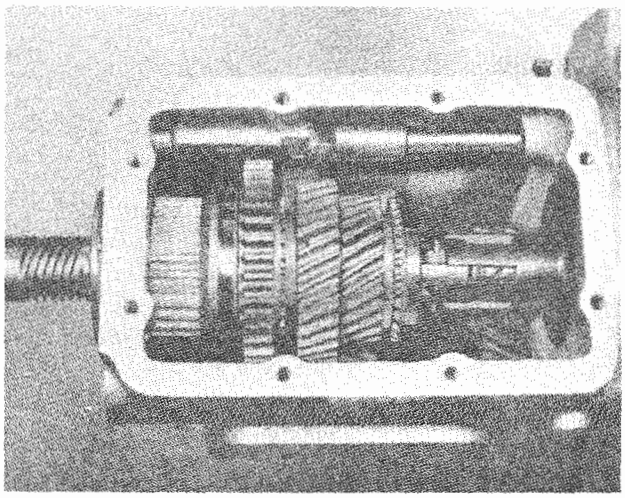

Fig. 13 Showing the removal of the Mainshaft Circlip with Churchill Tool No. 20SM69.

equally spaced, and engaging alternate splines on the mainshaft. Quite apart from the necessity to engage the three available splines with the full length prongs, in some cases it may be necessary to tap the circlip round on these prongs, to free it from its recess before it can be withdrawn. A new circlip should always be used when re-assembling.

(n) Withdraw thrust washer, third mainshaft constant gear and bush, second mainshaft constant gear and bush, thrust washer with three lugs to fit splines and the second speed synchro unit which also incorporates the first mainshaft gear. The mainshaft can now be withdrawn.

(o) Remove the small seeger circlip and thrust washer which locates the ball race on the mainshaft and extract the race as shown in Fig. 14. The triangular washer can then be removed from behind the race.

(p) After removal of the lock nut and locating screw the reverse selector shaft and bronze selector fork can be withdrawn. A steel selector shaft insert located at the rear of the casing and a welch plug at the front can easily be removed.

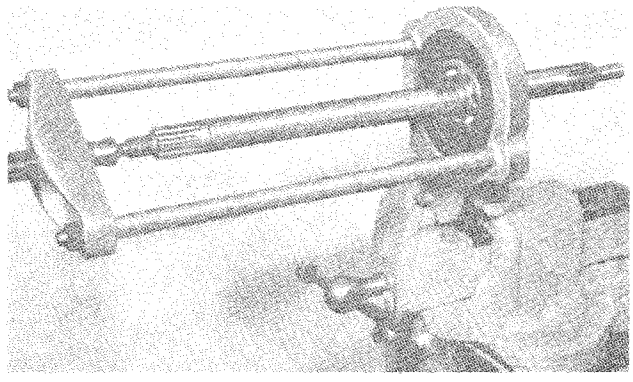

Fig. 14 **Removing Mainshaft Centre Bearing with Churchill Press No. S4221 and adapter from Set No. S4615.**

(q) Lift out the reverse pinion (compound gear) after tapping out its spindle through the rear of the casing, the retaining setscrew having been removed in a previous operation (h).

(r) The countershaft assembly can now be lifted out of the casing with the needle roller retaining tube still locating the 24 rollers at each end of the countershaft in their respective recesses. Lay aside the two phosphor bronze thrust washers for re-assembly.

(s) The countershaft gears and distance sleeve can now be removed from the splined portion of the countershaft, noting their position for re-assembly.

(t) If it is desired to examine the needle rollers they can be removed by withdrawing the retaining tube. Note the correct number of 48 for re-assembly (24 at each end) and the needle roller retaining rings can be tapped out with a suitable drift.

9. TO ASSEMBLE

(a) Thoroughly clean out the casing and examine for cracks, ball race housings for wear or other damage.

(b) Fit needle roller retaining rings if necessary, as shown in Fig. 15. Fit 24 needle rollers at each end of the countershaft ensuring first that the locating rings are in position. The chamfer on each retainer ring should be placed towards the bottom of the bore in the case of the inner ones, outwards for the outer ones. The rollers should

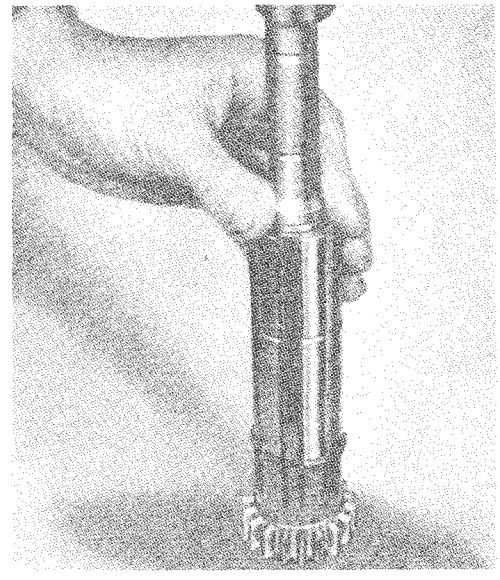

Fig. 15 **Fitting Needle Roller Retainer Rings with Churchill Tool No. 20SM68.**

be retained in grease and counted after installation to ensure that they have not become displaced before fitting the retainer tube.

(c) Assemble countershaft, noting correct position for the gears, observed in operation (s) when dismantling (see also Fig. 3).

(d) Install the countershaft assembly, positioning the thrust washers on the casing with grease. The correct end float for the countershaft gears should be between .006"—.010". If there is insufficient end float the distance piece should be reduced as necessary by rubbing it down on a sheet of emery cloth placed on a surface plate. Where too much end float exists new thrust washers and/or distance piece should be fitted.

(e) Fit reverse pinion (compound gear) with smaller gear towards front of box, having first ensured that there is no tooth damage or wear in bushes; leave the fitting of the locating setscrew until the countershaft has been assembled in its normal fitted position.

(f) Install the reverse selector shaft and bronze selector fork position with setscrew and tighten lock nut. The selector shaft steel insert and welch plug can now be fitted.

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(**g**) (**i**) Install the triangular washer on its splines on the mainshaft.

(**ii**) Press ball race on to mainshaft with Churchill fixture as shown in Fig. 16. Then fit the thrust washer

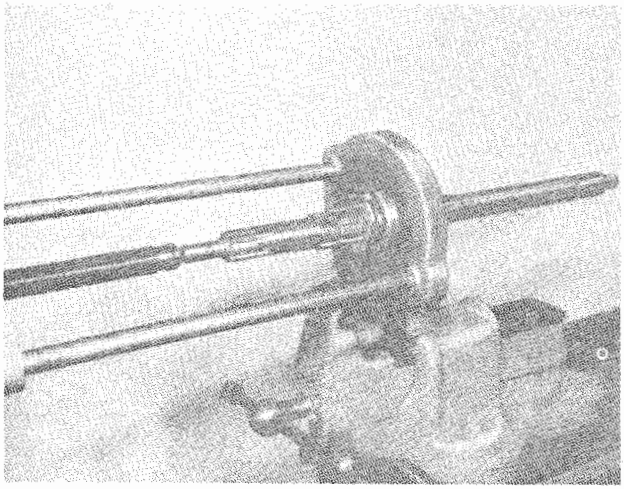

Fig. 16 Fitting Mainshaft Centre Bearing with Churchill Press No. S4221 and Adapter from Set No. S4615.

and small seeger circlip. A large circlip should be fitted into the annular groove in the outer ring of the bearing.

(**h**) Before the mainshaft is assembled into the gearbox the following points should be checked :

(**i**) The 2nd speed constant gear float on its bush (.004″—.006″).

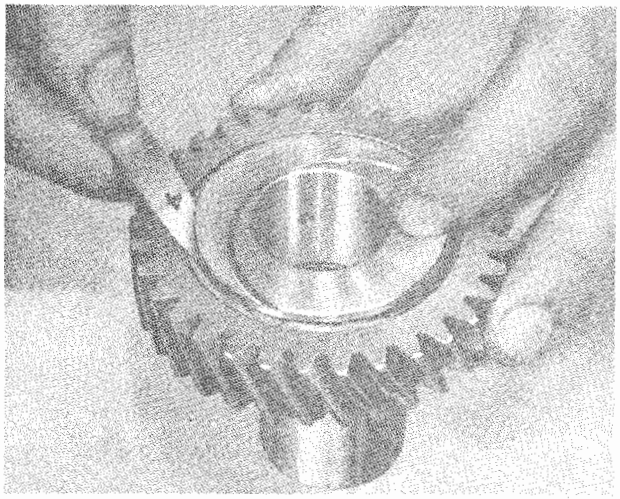

Fig. 17 Checking Second Mainshaft Constant Gear for End Float.

(**ii**) The 3rd speed constant gear float on its bush (.004″—.006″). (**i**) is checked as in Fig. 17, and (**ii**) as in Fig. 18.

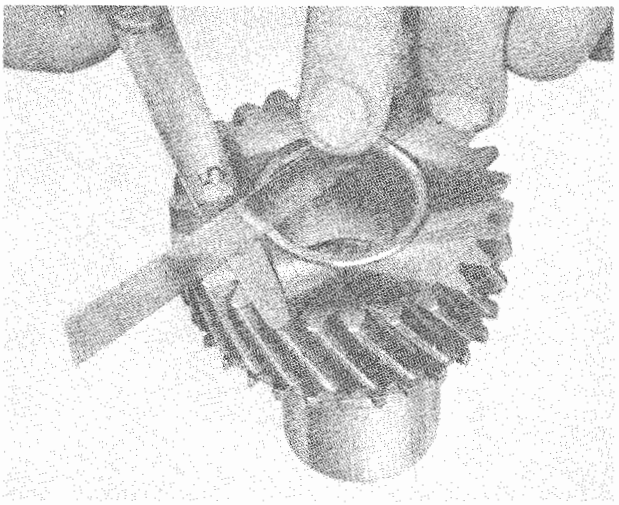

Fig. 18 Checking Third Gear Mainshaft Constant Gear for End Float.

(**iii**) Overall bush float on mainshaft (.007″—.012″).
To check gear bush end float, fit 2nd speed mainshaft gear thrust washer, ensuring that its three lugs engage in the mainshaft splines, 2nd and 3rd mainshaft gear bushes and 3rd mainshaft gear thrust washer fitted with oil scroll towards the bush. Install the original circlip and measure float with a feeler gauge as shown in Fig. 19.

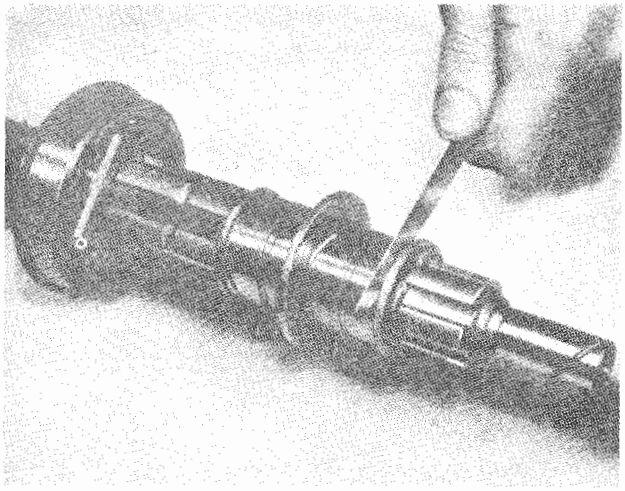

Fig. 19 Checking Mainshaft Gear Bush Overall Float.

(iv) Axial release loading of 2nd speed synchro unit 25—27 lbs.

(v) Axial release loading of 3rd and top speed synchro unit 19—21 lbs.

(iv) and (v) can be checked as shown in Fig. 20. If it is found to be in-

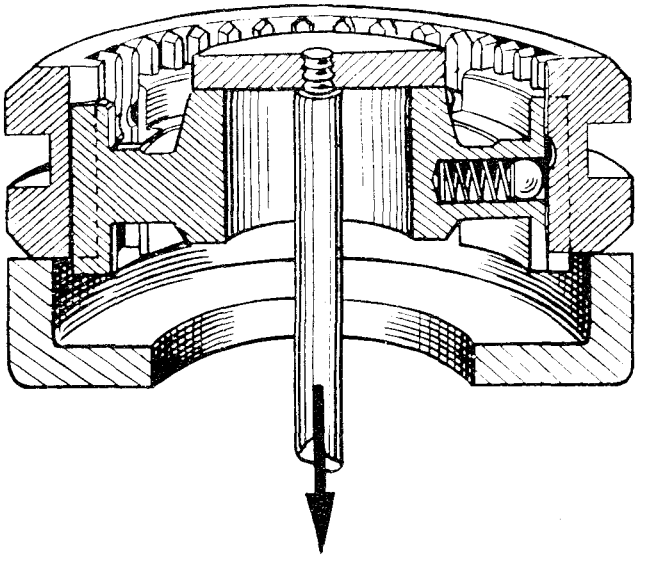

Fig. 20 **Fixture which can be readily manufactured to test Synchro Axial loading.**

correct, steel shims can be added or removed from below the axial release loading springs to increase or decrease respectively the axial release load as required.

(i) After completion of checks the mainshaft circlip, thrust washers and constant gear bushes can be removed. The mainshaft can then be installed into the gearbox casing, and assembled as follows :

(i) Second speed synchro unit incorporating the first mainshaft gear.

(ii) Thrust washer with three lugs to fit splines.

(iii) Second mainshaft constant gear and bush.

(iv) Third mainshaft constant gear, bush and thrust washer fitted with oil scroll towards gear.

(v) New mainshaft circlip as shown in Fig. 21.

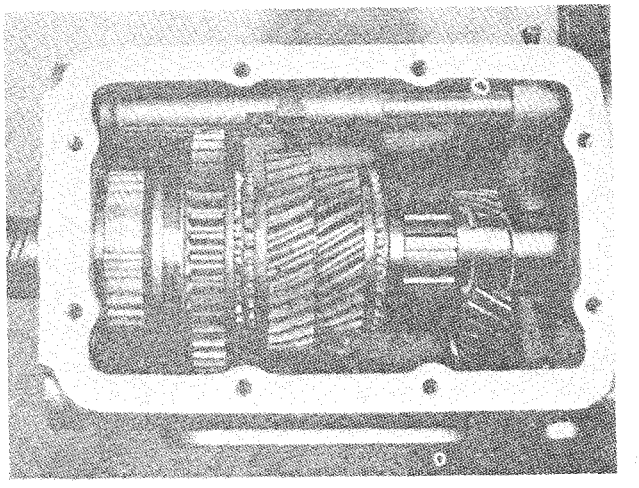

Fig. 21 **Fitting Mainshaft Circlip with Churchill Tool No. 20SM. 46.**

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(vi) Third and top speed synchro unit with the short boss of the synchro hub towards the mainshaft circlip or rear of gearbox as shown in Fig. 3. The mainshaft and ball race can then be driven into the gearbox casing, positioning the gap of the circlip on the outer ring of the bearing in line with the atmosphere hole in the casing as shown in Fig. 7.

(j) Assemble oil thrower on to constant pinion shaft and press ball race on the shaft as shown in Fig. 22, ensuring that this goes right home and that in

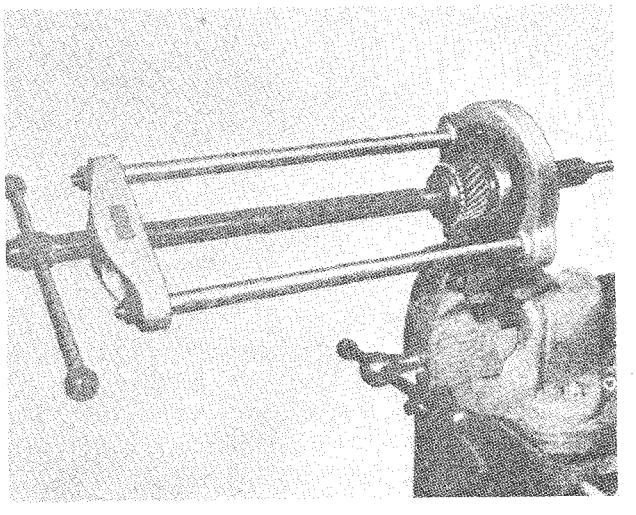

Fig. 22 **Fitting Bearing on to Constant Pinion Shaft with Churchill Press No. S4221 and Adapter from Set No. S4615.**

this position with the correct thrust washer fitted, the small seeger circlip fits properly into its recess. When passing this circlip along the ground portion of the constant pinion shaft, take care not to score the shaft as such damage may cause subsequent leakage of oil. Fit larger circlip into the annular groove in the outer ring of the ball race.

(**k**) Fit Oilite spigot bush into constant pinion, placing the internally bevelled portion of it towards the mainshaft.

(**l**) Drive the constant pinion shaft and bearing into the gearbox casing, positioning the gap in the circlip on the outer ring of the bearing in line with the oil hole in the casing.

Utilising a feeler gauge, measure the distance between the dog teeth of all the mainshaft synchro gears, and the dog teeth of their respective baulk rings. (Fig. 23).

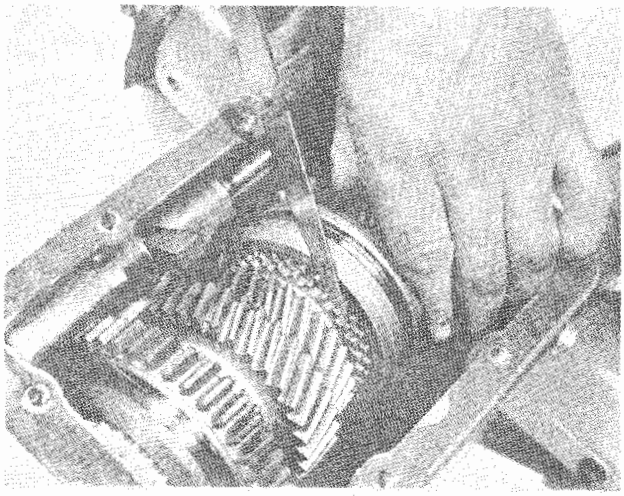

Fig. 23 Measuring the gap between Baulk Ring teeth and Cone.

Move the outer synchro sleeve towards the gear being measured thus forcing the baulking ring on to its cone. In this position the dimension should be between .035″ and .040″ for new components and .005″ to .010″ less for components which have been run-in.

(**m**) Utilise a pilot to align thrust washers and countershaft gear assembly as

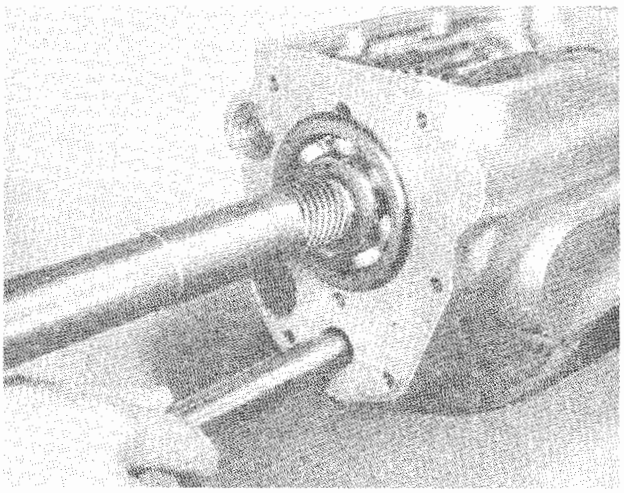

Fig. 24 Inserting Churchill Tool No 20S. 77 preparatory to driving out needle roller retaining tube.

shown in Fig. 24, driving out needle roller retaining tube, subsequently ejecting the pilot tool with the actual countershaft. It is important when carrying out this operation that the pilot tool should maintain contact with the retaining tube or countershaft, as appropriate, throughout the operation, alternatively there is danger that the needle rollers may leave their recess.

(**n**) Install locating setscrew through countershaft, and reverse spindle, first checking the alignment of the holes in the reverse gear spindle and countershaft.

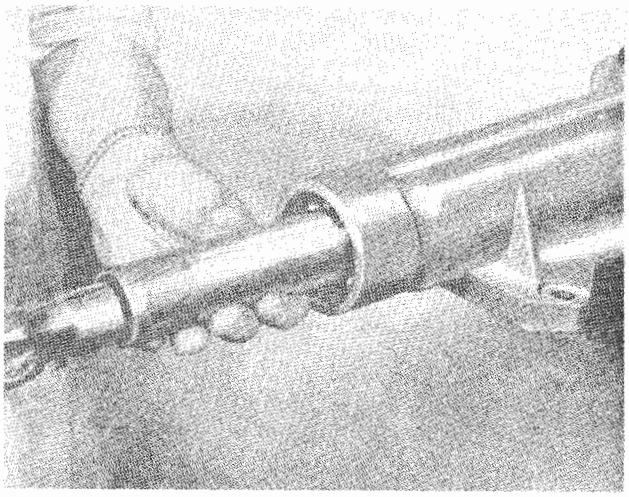

Fig. 25 Fitting Extension Ball Bearing and Thrust Washer with Churchill Tool No. 20S. 87.

(o) Fit countershaft front end cover plate and paper joint securing with two setscrews and washers using lead linger and wiring as necessary.

(p) Assemble gearbox extension and paper joint, securing with six setscrews and washers, using lead linger and wiring as necessary.

(q) Install thrust washer and ball race into gearbox extension with suitable tool as shown in Fig. 25.

(r) Locate gearbox extension oil seal as shown in Fig. 26.

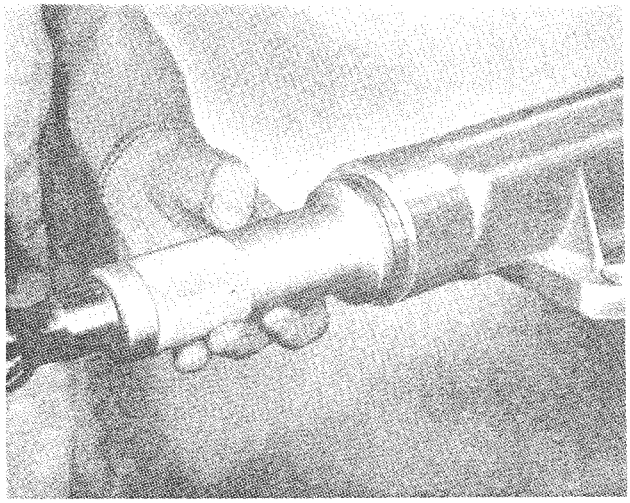

Fig. 26 Fitting Extension Housing Oil Seal with Churchill Tool No. 20S. 87.

(s) Fit plain washer, slotted nut as shown in Fig. 27, tightening to 85—100 lbs. ft., and install split pin.

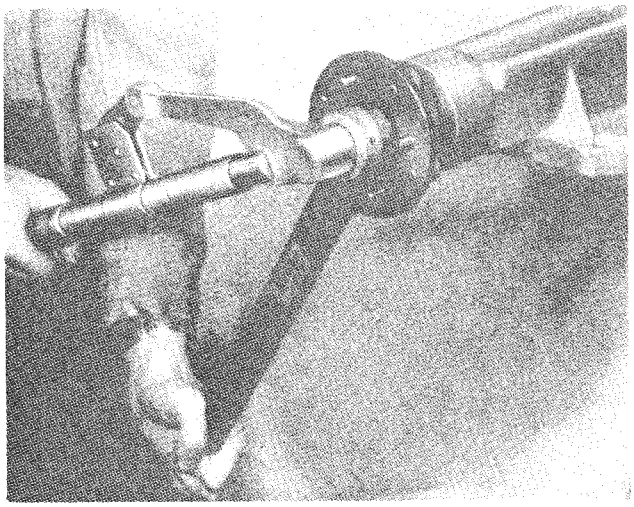

Fig. 27 Tightening Driving Flange Securing Nut with torque spanner and Churchill Tool No. 20SM. 90.

(t) Install speedometer driving gear and accommodating bush, securing with special setscrew.

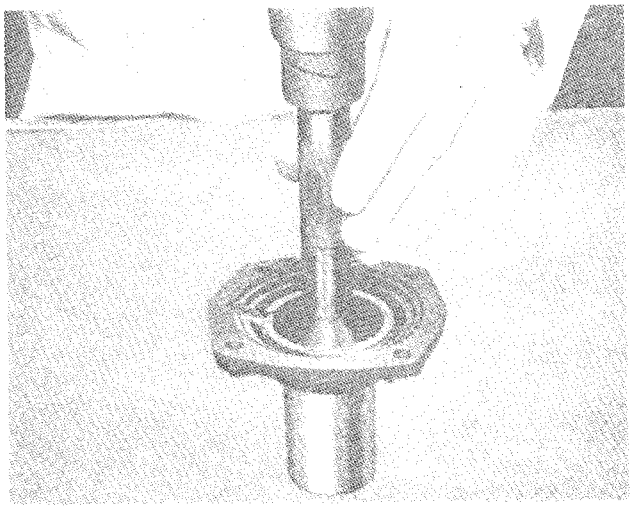

Fig. 28 Fitting Front Cover Oil Seal with Tool No. 20SM. 73.

(u) Fit front cover, having installed oil seal as shown in Fig. 28, utilising fitting tool to protect oil seal (see Fig. 29).

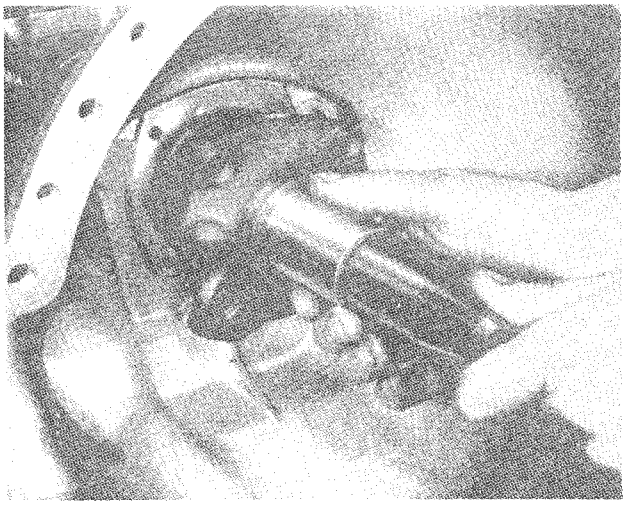

Fig. 29 Assembling Front Cover, utilising Churchill Tool No. 20SM. 47 to protect Seal Face.

Fit four setscrews and plain washers with lead linger after positioning the slot in the face of the front cover horizontally at 9 o'clock and wire setscrew heads.

(v) Assemble clutch throw-out bearing and sleeve and install with clutch operating shaft coil spring and clutch operating fork, positioning both with special securing setscrews, wire locking the latter. Install grease nipple with fibre washer into R.H. end of clutch operating shaft.

(w) Fit top cover assembly with selector mechanism, paper joint, securing with eight setscrews.

10. TO DISMANTLE TOP COVER ASSEMBLY

(a) Remove oil level dipstick.

(b) Ensure that the selector mechanism is in the neutral position.

(c) Remove change speed lever positioning bolt, nyloc nut and setscrew. This enables the change speed lever complete with knob, cap, spring retainer, spring and ball end to be removed as an assembly. Further dismantling requires the removal of the knob and/or the removal of the screwed change speed lever ball end.

(d) Remove 1st and 2nd speed selector shaft wire locked stop screw and $\frac{3}{8}$" dia. positioning ball, spring and retaining screw, then 1st and 2nd speed bronze selector fork wire locked positioning setscrew, and slide selector shaft rearwards clear of the casting to enable the selector fork to be removed.

(e) Remove reverse selector fork and shaft, carrying out procedure as in (d) except that the shaft is positioned by a plunger spring, distance piece and retaining screw instead of the ball, spring and retaining screw.

(f) Remove 3rd and top speed selector shaft and fork, carrying out the procedure as in (d).

N.B. It is important that no attempt is made to move more than one selector shaft at a time otherwise damage will be caused to the selector shaft bores by the interlock mechanism consisting of two $\frac{3}{8}$" dia. ball bearings located in the top cover casting either side of the 3rd and top speed selector shaft, and the .185" dia. interlock roller made of key steel which makes contact with these balls being installed, in a hole drilled transversely through the 3rd and top speed selector shaft. (See Fig. 1.)
The interlock roller and steel balls can easily be shaken or pushed out of position if it is desired to examine them.

(g) Further dismantling of the selector shafts only requires the removal of the selector shaft end pieces on the 1st and 2nd and reverse rods, they are located by a wired setscrew; on the 3rd and top they are silver soldered together.

(h) Remove the two setscrews and spring washers from the oil sealing ring cover plate, enabling the plate and three rubber sealing rings at the end of the selector shaft bores to be removed.

(i) The three 16G pressing selector shafts welch plugs located at the front of top cover and the two 14G pressing welch plugs either side of top cover can easily be removed with a suitable drift.

(j) The threaded plug located on the top cover can also be removed.

TO ASSEMBLE, carry out the reverse procedure to that of dismantling, but for ease of assembly install the $\frac{3}{8}$" dia. interlock mechanism balls after the 3rd and top speed selector shaft has been fitted but before the reverse and 1st and 2nd selector shafts.

Important.
Whilst fitting the selector shafts make sure that the selector shaft or shafts already fitted are in the neutral position.

INSTALLATION OF OVERDRIVE

1. DISMANTLING

Remove the detachable floor pressing from around the gearbox. Remove the four bolts connecting the propeller shaft to the gearbox flange. Disconnect the speedometer drive from the gearbox. Remove the bottom nuts of rear mounting and jack up engine sufficiently to allow removal of rear mounting. Remove the starter motor. Remove the clevis pin from the lever on the clutch operating shaft.

Remove the bolts from around the bell housing and detach the gearbox from the engine.

The gearbox should now be dismantled and the various gears and ball races examined for possible damage. Any parts which are damaged or suspect in any way should be replaced.

The mainshaft originally fitted will be replaced by the special one supplied. To ensure the future life of the Overdrive Unit it is advisable to fit a new mainshaft bearing.

2. ASSEMBLY OF GEARBOX

Proceed to re-assemble in the following manner after ensuring that the gearbox has been drilled as shown in Fig. 31.

(**a**) Fit 1st and reverse idler pinion and shaft with the smaller gear pointing forward and the hole in the shaft in line with the securing bolt.

(**b**) Fit the reverse selector fork and shaft with the tapered hole forward. Secure in position by fitting the tapered bolt and locknut.

(**c**) With heavy grease, assemble the needle rollers into the 1st countershaft gear (24 each end) and slide in a needle retaining tube to retain the rollers during assembly.

(**d**) With heavy grease, position the front thrust washer with the lip of the washer engaged with a recess in the gear case.

(**e**) Slide the small, or 2nd speed gear, on to the 1st countershaft gear, following this by the 3rd speed gear with the boss pointing forward. Next slide on the distance piece and finally the constant speed gear with the boss towards the distance piece.

(**f**) Position the completed countershaft gear assembly in the bottom of the gear case and slide into position the rear thrust washer.

(**g**) For checking purposes the countershaft should be fitted. The countershaft gears (when new) have an end float of .006″—.010″.

(**h**) After checking, the countershaft should be removed by pushing the needle retaining tube into the countershaft gears and forcing the layshaft out, after which the gears will drop to the bottom of the gearbox casing.

(**i**) Fit the triangular washer, ball race, distance washer and circlip to the new mainshaft. Gripping the mainshaft in the protected jaws of a vice, assemble the gears on this shaft up to the main locating circlip, ensuring that the recess for this is free for its eventual entry by checking with half the circlip previously used (a new one will be required when re-assembling). When a new 2nd or 3rd mainshaft gear is to be fitted, ensure that .004″—.006″ end float of the gears is permitted by the length of their bushes, when in their fitted position.

Having ensured that the synchro units are perfectly free on their splines, check the overall float of the constant mesh assemblies by removing the 2nd and 3rd speed constant gears, but leaving their respective bushes in position with the hardened steel thrust washers and the half circlip.

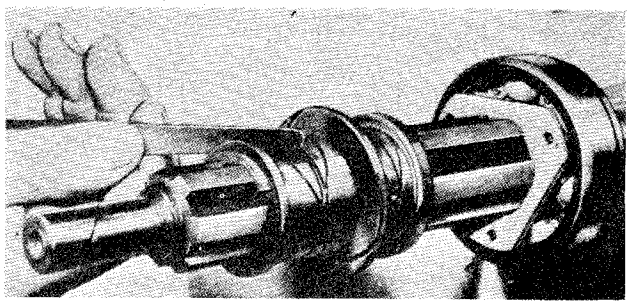

Fig. 30 Checking overall float of mainshaft bushes with feeler gauge.

The end float can then be checked with a set of feeler gauges as shown in Fig. 30. The correct float should be between .007″ and .012″.

(j) Remove the mainshaft details remaining on the shaft and begin the final assembly.

Feed the shaft into the casing and assemble the 2nd gear synchro unit, the hardened steel thrust washer which must be located on the splines, the 2nd constant gear with its bush, the 3rd constant gear with bush, the front hardened steel thrust washer and finally fit the main locating circlip with a special sleeved tool.

(k) Withdraw the gearbox mainshaft, with the gears so far assembled, sufficiently towards the rear to enable the assembly to be tipped upwards, thus permitting the 3rd and top synchro unit to be fitted.

(l) Tap the mainshaft assembly into position and fit the constant pinion assembly.

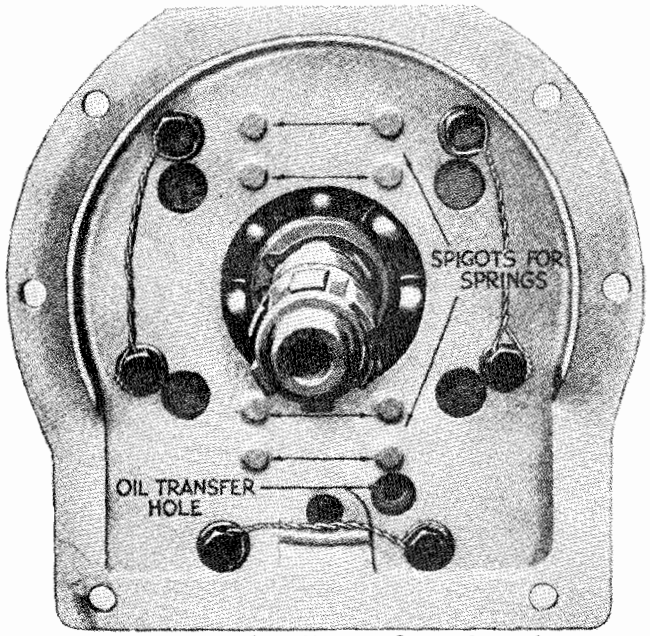

Fig. 31 Showing the oil transfer hole and method of wiring bolts. The Gearbox casing has to be drilled on early models whereas all present production are already drilled.

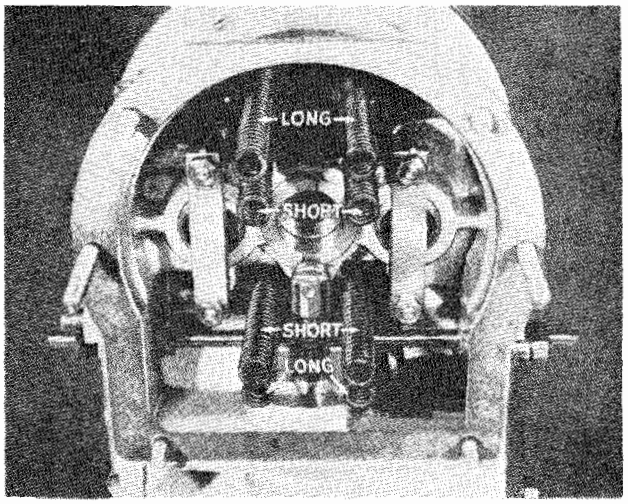

Fig. 32 Showing correct location of four springs.

3. FITTING THE OVERDRIVE UNIT

(a) Locate the paper washer on the gearbox casing with grease, fit the overdrive adapter plate and wire the six securing bolts, as shown in Fig. 31. The correct positioning of the wiring is important to ensure proper working clearance for the assembled overdrive unit. Ensure that the oil transfer hole is free (see Fig. 31).

(b) Ensure that the eight springs in the overdrive unit are correctly located, as shown in Fig. 32, that is, the long springs on the outside and the short springs nearer the centre.

(c) After placing a paper joint on the adapter plate, fit the gearbox assembly

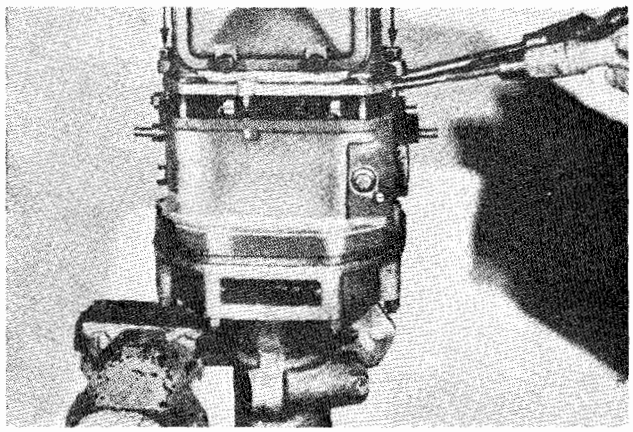

Fig. 33 Method of fitting Gearbox to Overdrive Unit.

to the overdrive unit, holding the latter vertically in the vice as shown in Fig. 33. After engaging top gear, turn the constant pinion until the splines in the overdrive unit mesh with those of the mainshaft. The eight springs are now located on their spigots and a nut and washer fitted to each long stud.

These two nuts are now evenly tightened until the pump roller is nearing the pump driving cam. The driving cam should have been assembled on the gearbox mainshaft splines so that the least amount of eccentricity is nearest to the pump roller. It is necessary to depress the pump plunger with a screwdriver to allow the pump roller to pass over the cam. The nuts are now finally tightened.

CAUTION. Do not use undue force in tightening the nuts on the long studs. There are two sets of splines in the overdrive unit and unless these are in line, it is impossible to tighten the overdrive unit home on to the adapter plate face.

The overdrive valve setting should now be checked.

4. VALVE CHECKING

On the R.H. of the overdrive unit and pinned to the valve operating shaft, is a valve setting lever with a $\frac{3}{16}$" diameter hole. In the casting adjacent to this lever is another $\frac{3}{16}$" diameter hole. Actuate the solenoid with a 12 volt battery and while the plunger is drawn into the solenoid and if the valve adjustment is correct, it should be possible to insert a $\frac{3}{16}$" diameter pin through the valve setting lever and into the casting (see Fig. 34).

If this is not possible then the valve must be re-adjusted in the following manner.

5. VALVE ADJUSTMENT (Fig. 35)

Remove the cover plate by unscrewing three cheese headed bolts. Slacken off the clamping bolt on the solenoid lever.

Rotate the valve setting lever until its $\frac{3}{16}$" diameter hole coincides with the $\frac{3}{16}$" diameter hole in the casting. Insert a $\frac{3}{16}$" diameter pin through the hole in the

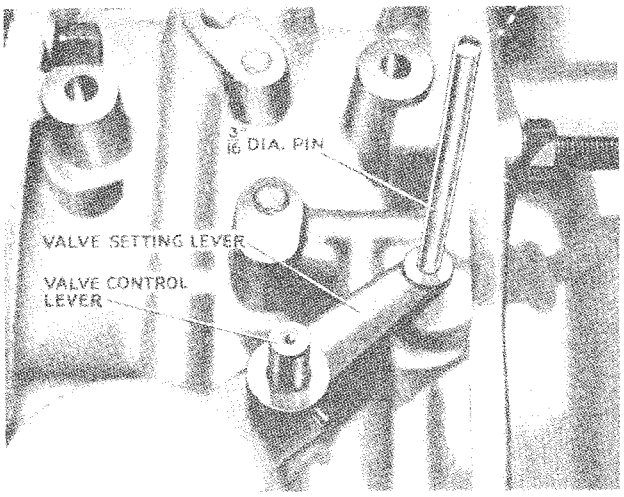

Fig. 34 Method of setting Valve Operating Levers.

setting lever and into the casting thus locking the valve operating shaft.

Actuate the solenoid with a 12 volt battery and while the plunger is drawn into the solenoid, tighten the clamping bolt on the solenoid lever and at the same time ensure that opposite end of the solenoid lever is against the head of the actuating bolt. Repeat the first check and if satisfactory, refit the cover plate.

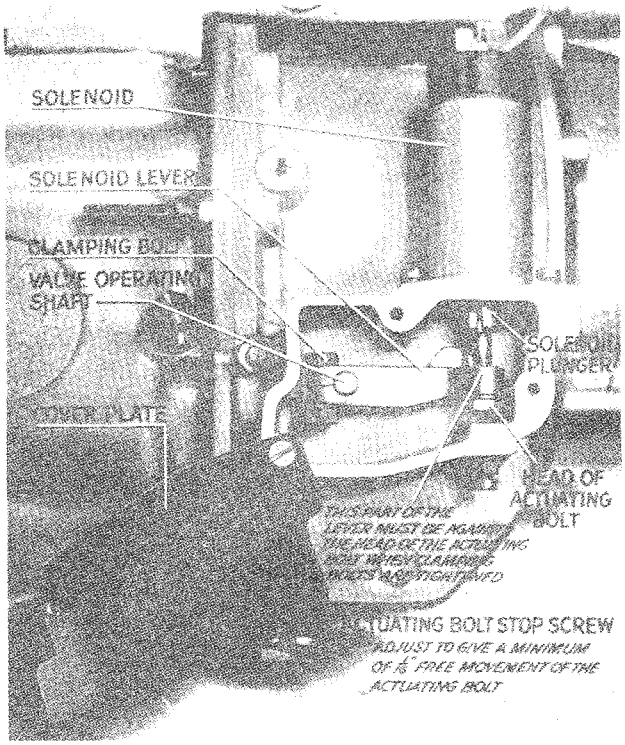

Fig. 35 Setting Solenoid Lever.

6. FITTING THE ISOLATOR SWITCH

On the lid of the gearbox, and situated near the dipstick, is a plug with a 16 mm. dia. thread. This plug should be removed and replaced by an isolator switch type SS10/1, which is supplied (see Fig. 36). See page 24 for multi-gear overdrive.

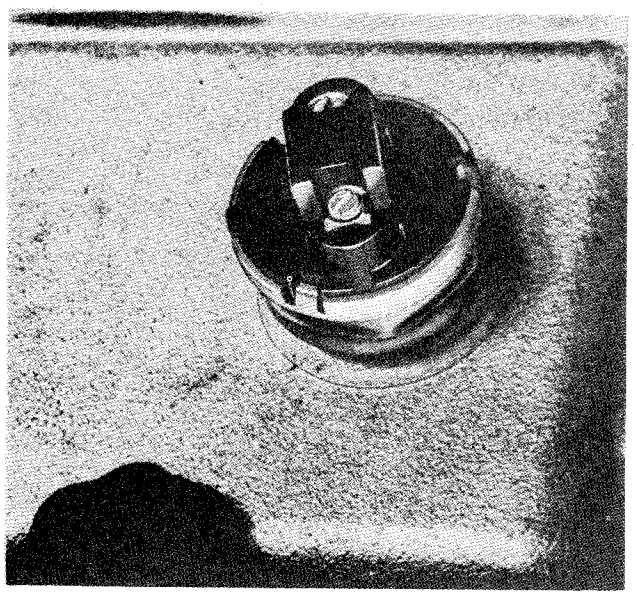

Fig. 36 Showing the position of the Isolator Switch on the Gearbox Cover.

7. THE OPERATING SWITCH

L.H. Drive Cars. Two holes are pierced in the facia panel on the L.H. side of the speedometer and covered with fabric. The fabric should be pierced through the extreme L.H. hole and the operating switch fitted. The remaining hole is used for a heater switch when fitted.

R.H. Drive Cars. Two holes are pierced in the facia panel on the R.H. side of the speedometer and covered with fabric. The fabric should be pierced through the extreme R.H. hole and the operating switch fitted (see Fig. 37).
The remaining hole is used for a heater switch when fitted.

The Relay. Reference to Fig. 38 shows the fitted position of the relay.

Wiring. The feed wire to the terminal marked " W1 " on the relay is taken from

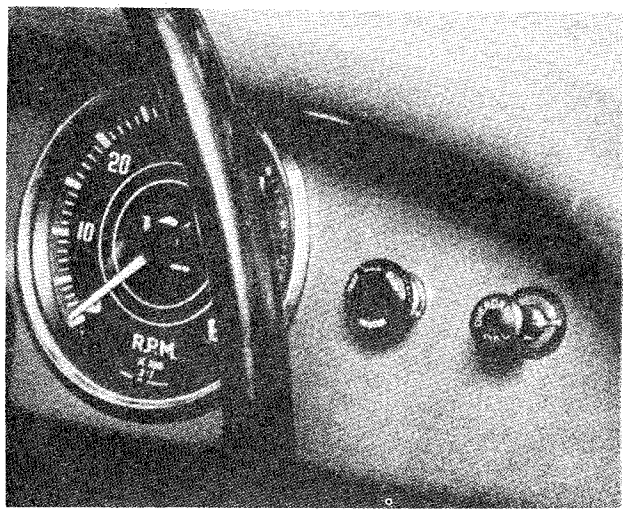

Fig. 37 Showing the position of the Overdrive Control.

the " live " side of the starter switch on the facia panel (see Fig. 39).

NOTE—The terminal on the starter switch is " live " only when the ignition is switched " ON."
A wire is connected from " W2 " on the relay to a terminal of the operating switch on the facia panel. The remaining terminal

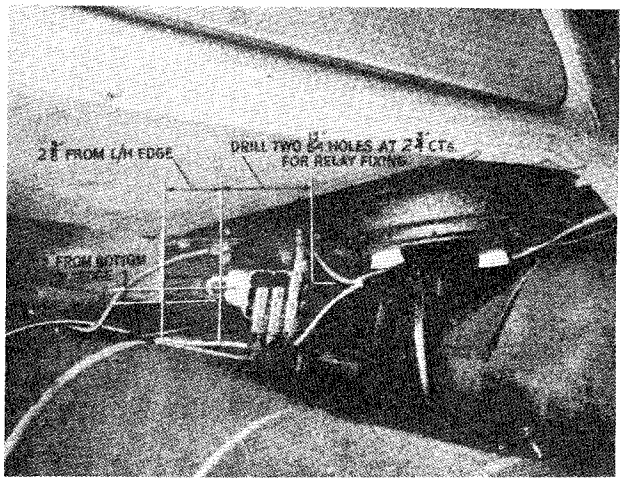

Fig. 38 Instructions for fitting the Relay Switch.

of the operating switch is connected through a snap connecter to a terminal on the isolating switch situated on the gearbox lid. The remaining terminal of the isolating switch is earthed to one of the bolts securing

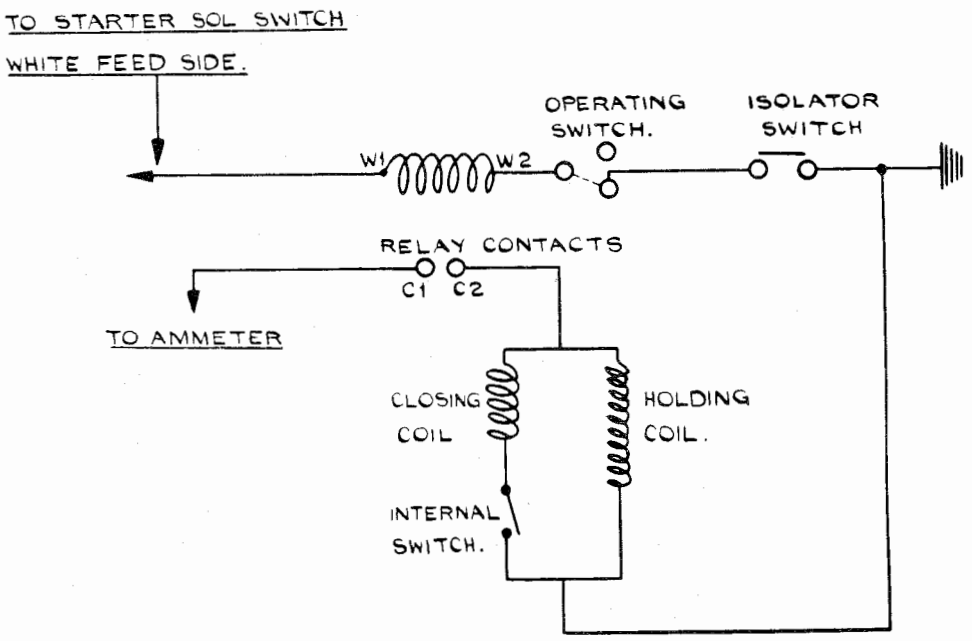

Fig. 39 **Overdrive Control Circuit.**

the gearbox lid. A second feed wire is connected from the negative side of the ammeter to " C1 " on the relay.

To complete the wiring, a wire is connected from " C2 " on the relay through a snap connecter to the solenoid.

Built into the solenoid are two coils, a closing coil and a holding coil. These two coils are connected in parallel with an internal switch connected in series with the closing coil.

When the solenoid is energised, both coils are in circuit until the plunger reaches a pin which operates the internal switch. This switch switches out the closing coil and allows the holding coil to remain in circuit.

The closing current of 15 amperes is of a very short duration. The holding current should be less than one ampere. Fig. 39 shows the theoretical wiring diagram.

SUPPLEMENTARY INSTRUCTIONS FOR INCORPORATING OVERDRIVE ON "SECOND" AND "THIRD" GEARS

1. The incorporation of Overdrive on "Second" and "Third" gears has necessitated the following engineering alterations :—

(a) Increasing the diameter of the clutch operation pistons in the overdrive unit from $1\frac{1}{8}$" to $1\frac{3}{8}$".

(b) Re-designing the gearbox top cover assembly to permit the selection of overdrive in other gears.

2. OVERDRIVE UNIT

To enable the unit to transmit the maximum available torque in the lower gears, it is necessary to use larger clutch operating pistons than those fitted previously.

From Chassis No. TS.5980 onwards, all Triumph Sports Cars, which have been equipped with overdrive, have been fitted with the re-designed unit, Part No. 301991 : Serial No. 22/1374/— incorporating the larger pistons.

NOTE. A small number of cars with chassis numbers prior to TS.5980 have been fitted with the re-designed overdrive unit.

To establish whether or not a re-designed unit has been fitted, remove the gearbox floor covering and a brass plate can be seen bearing a serial number. The old unit number is 22/1275/—, and the re-designed unit number is 22/1374/—.

Unit Exchange
The Spares Department of The Standard Motor Company Ltd., in conjunction with Messrs. Laycocks, operate an exchange system whereby the old unit can be exchanged for the later type at a cost fixed by the Spares Division of The Standard Motor Company Ltd.

3. GEARBOX TOP COVER ASSEMBLY Fig. 41

To permit the selection of overdrive in "Second" and "Third" as well as "Top" a new top cover assembly has been designed and the Part No. is 502411.

The new cover assembly has been fitted to Chassis No. TS.6280 and all subsequent Sports Cars.

NOTE. A limited number of cars prior to Chassis No. TS.6280 were fitted with the new cover assembly and can be recognised by the two isolator switch bosses, Fig. 41.

Modification of Top Cover Assembly. To modify the old top cover assembly, thus permitting the selection of overdrive in 2nd, 3rd and top gears necessitates the fitting of certain new parts. The new parts required are detailed under "Top Cover Conversion Pack" on page 27.

Top Cover Assembly—Fig. 40—Dismantling. Proceed as follows :—

(a) Remove the dipstick and ensure that the selector mechanism is in the "Neutral" position.

(b) Disconnect the wires from the isolator switch, where fitted, and remove the top cover assembly from the gearbox.

(c) Remove the change speed lever by :—
(i) Unscrewing and removing the $\frac{1}{4}$" UNF setscrew (1) which secures the retaining cap to the top cover casting.

(ii) Unscrewing the nyloc nut (2) from the pivot bolt.