



Autobooks

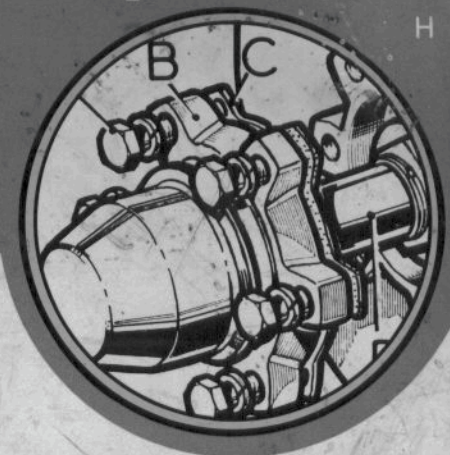
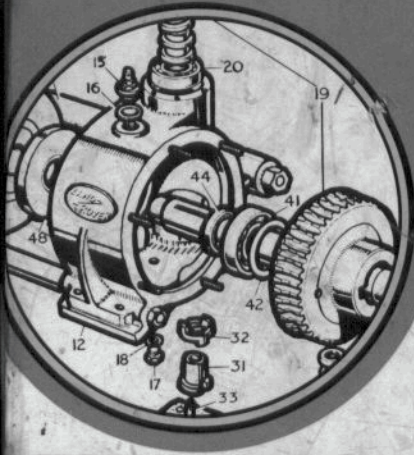
Land-Rover 2, 2A, 3

Land-Rover Series 2, 2¼ Litre, Petrol
Land-Rover Series 2A, Petrol, Diesel
Land-Rover Series 3, Petrol, Diesel

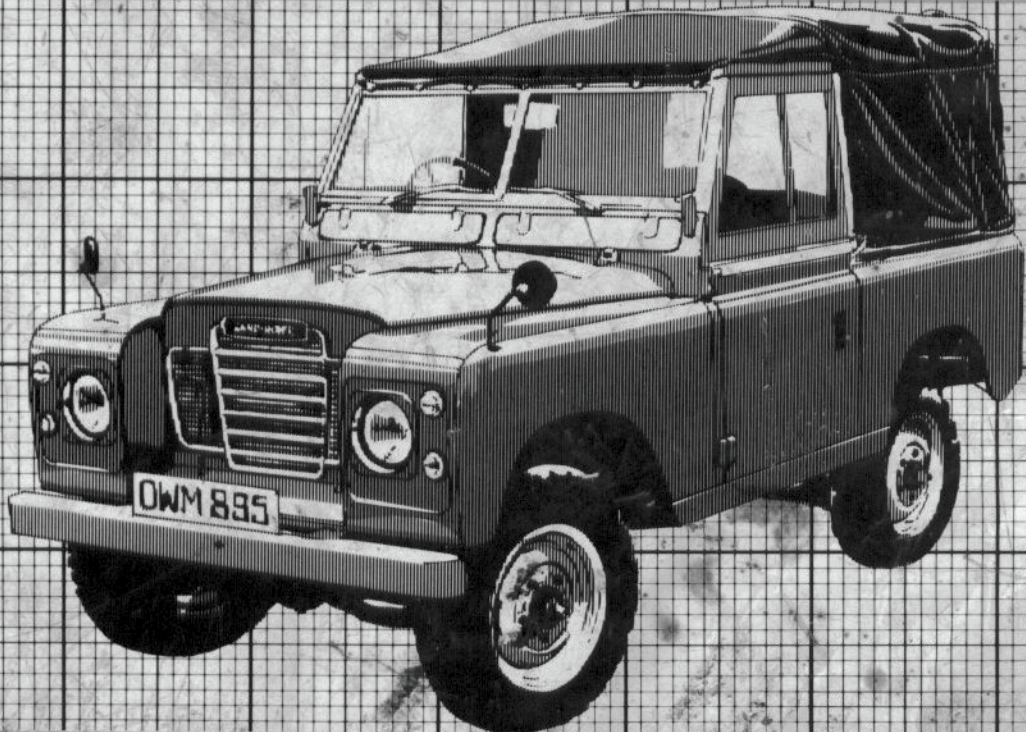
1959-78

OWM 895

Owners Workshop Manual



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Land-Rover 2, 2A, 3 1959-78 Autobook

By the Autobooks Team of Writers and Illustrators

Land-Rover Series 2, 2½ Litre, Petrol 1959-61

Land-Rover Series 2A, Petrol, Diesel 1961-71

Land-Rover Series 3, Petrol, Diesel 1971-78

Chapter 1 Introduction 1

Chapter 2 The Land-Rover 2 11

Chapter 3 The Land-Rover 2A 21

Chapter 4 The Land-Rover 3 31

Chapter 5 The Land-Rover 3 31

Chapter 6 The Land-Rover 3 31

Chapter 7 The Land-Rover 3 31

Chapter 8 The Land-Rover 3 31

Chapter 9 The Land-Rover 3 31

Chapter 10 The Land-Rover 3 31

Chapter 11 The Land-Rover 3 31

Chapter 12 The Land-Rover 3 31

Chapter 13 The Land-Rover 3 31

Chapter 14 The Land-Rover 3 31

Appendix 1 31

Appendix 2 31

Appendix 3 31

Appendix 4 31

Appendix 5 31

Appendix 6 31

Appendix 7 31

Appendix 8 31

Appendix 9 31

Appendix 10 31

Appendix 11 31

Appendix 12 31

Appendix 13 31

Appendix 14 31

Appendix 15 31

Appendix 16 31

Appendix 17 31

Appendix 18 31

Appendix 19 31

Appendix 20 31

Appendix 21 31

Appendix 22 31

Appendix 23 31

Appendix 24 31

Appendix 25 31

Appendix 26 31

Appendix 27 31

Appendix 28 31

Appendix 29 31

Appendix 30 31

Appendix 31 31

Appendix 32 31

Appendix 33 31

Appendix 34 31

Appendix 35 31

Appendix 36 31

Appendix 37 31

Appendix 38 31

Appendix 39 31

Appendix 40 31

Appendix 41 31

Appendix 42 31

Appendix 43 31

Appendix 44 31

Appendix 45 31

Appendix 46 31

Appendix 47 31

Appendix 48 31

Appendix 49 31

Appendix 50 31

Appendix 51 31

Appendix 52 31

Appendix 53 31

Appendix 54 31

Appendix 55 31

Appendix 56 31

Appendix 57 31

Appendix 58 31

Appendix 59 31

Appendix 60 31

Appendix 61 31

Appendix 62 31

Appendix 63 31

Appendix 64 31

Appendix 65 31

Appendix 66 31

Appendix 67 31

Appendix 68 31

Appendix 69 31

Appendix 70 31

Appendix 71 31

Appendix 72 31

Appendix 73 31

Appendix 74 31

Appendix 75 31

Appendix 76 31

Appendix 77 31

Appendix 78 31

Appendix 79 31

Appendix 80 31

Appendix 81 31

Appendix 82 31

Appendix 83 31

Appendix 84 31

Appendix 85 31

Appendix 86 31

Appendix 87 31

Appendix 88 31

Appendix 89 31

Appendix 90 31

Appendix 91 31

Appendix 92 31

Appendix 93 31

Appendix 94 31

Appendix 95 31

Appendix 96 31

Appendix 97 31

Appendix 98 31

Appendix 99 31

Appendix 100 31

Autobooks

The AUTOBOOK series of Workshop Manuals is the largest in the world and covers the majority of British and Continental motor cars, as well as the majority of Japanese and Australian models.

Whilst every care has been taken to ensure correctness of information it is obviously not possible to guarantee complete freedom from errors or omissions or to accept liability arising from such errors or omissions.

CONTENTS

Acknowledgement

Introduction

Chapter 1	The Petrol Engine	9
Chapter 2	The Diesel Engine	27
Chapter 3A	The Petrol Fuel System	41
Chapter 3B	The Diesel Fuel System	55
Chapter 4	The Ignition System	63
Chapter 5	The Cooling System	69
Chapter 6	The Clutch	75
Chapter 7	The Gearbox and Transfer Gearbox	81
Chapter 8	Propeller Shaft, Rear Axle and Rear Suspension	95
Chapter 9	Front Suspension, Differential and Hubs	101
Chapter 10	The Steering Gear	109
Chapter 11	The Braking System	117
Chapter 12	The Electrical Equipment	131
Chapter 13	The Bodywork	149
Chapter 14	Optional Equipment	155
Appendix		179

CHAPTER 1

THE PETROL ENGINE

- 1:1 Description
- 1:2 Working on the engine in situ
- 1:3 Removing the engines
- 1:4 Removing and replacing the cylinder head
- 1:5 Decarbonization and attention to the valves
- 1:6 Removing the timing gear and camshaft
- 1:7 Replacing the timing gear and camshaft
- 1:8 Servicing the oil pump and filters
- 1:9 Removing the clutch and flywheel
- 1:10 The pistons and connecting rods
- 1:11 The crankshaft and main bearings
- 1:12 Reassembling a stripped engine
- 1:13 Emission control equipment
- 1:14 Fault diagnosis

1:1 Description

The Autobook covers the Land Rover normal control Series 2, 2A and 3 models. Petrol engines of 2½ litres and 2.6 litres are available to choice and in this Chapter both engines are dealt with. The same basic techniques are applicable to working on either engine but constructional details are varied. These are clearly described where necessary.

The 2½ litre engine has a conventional cylinder block and head of cast iron with overhead inlet and exhaust valves. It is a rugged four-cylinder unit with a three bearing crankshaft. Two compression ratios are available, either 7:1 or 8:1; the former gives 77 bhp at 4250 rev/min and the latter 81 bhp. A chain driven camshaft with a chain tensioner provides the means of operation for the valve gear. **FIG 1:1** shows the engine in part section.

The 2.6 litre engine is a six-cylinder of unusual layout. The cylinder block is of cast iron with an inclined top face which carries the aluminium alloy cylinder head. Overhead inlet and side exhaust valves are fitted, both operated from a chain driven camshaft. A hydraulic chain tensioner maintains the chain tension. The crankshaft is carried in seven main bearings and incorporates a torsional vibration damper. This engine is also available with either one

of two compression ratios, 7:1 or 7.8:1. The former gives 90 and the latter 95 bhp at 4500 rev/min. **FIG 1:2** shows the engine in part section.

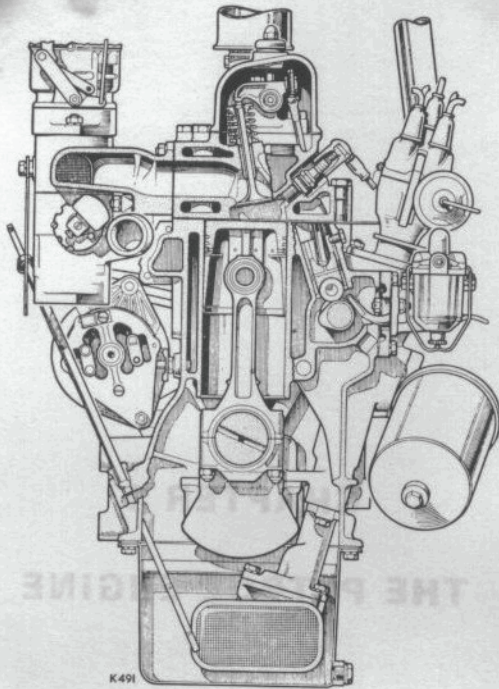
1:2 Working on the engine in situ

The only operation which entails the removal of either engine from the chassis is for removal of the crankshaft; even the rear main bearing oil seal can be replaced without moving the engine. Obviously, work on the flywheel or clutch will involve gearbox removal and most operations at the front of the engine demand the removal of the radiator grille panel and radiator. If a major overhaul is contemplated, time can be saved if the engine is removed, therefore instructions for this are given in the next Section.

1:3 Removing the engines

(a) 2½ litre:

- 1 Remove the bonnet panel, air cleaner, radiator and grille panel. Disconnect the battery.
- 2 Remove the front floor by undoing the locknuts below the four wheel drive and transfer gearlever knobs then unscrewing the knobs to allow the floor plates to be unscrewed and lifted up.



Cross-section view of engine

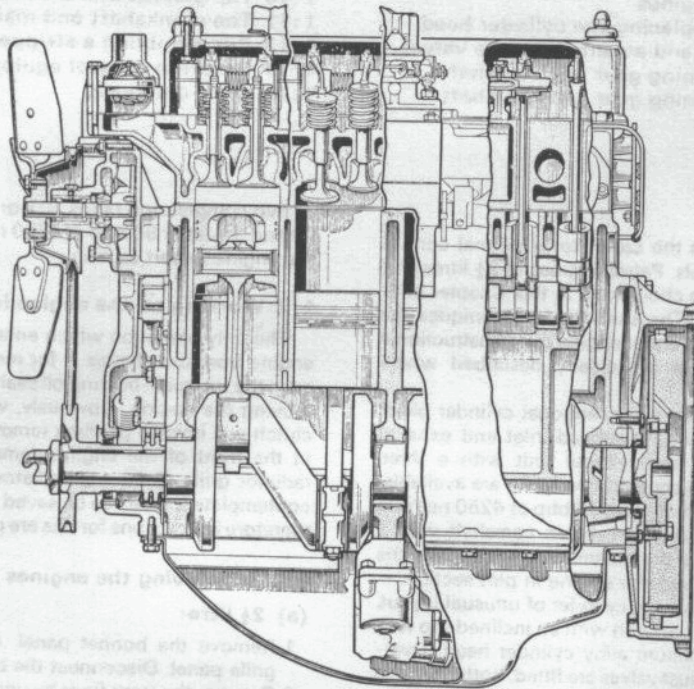
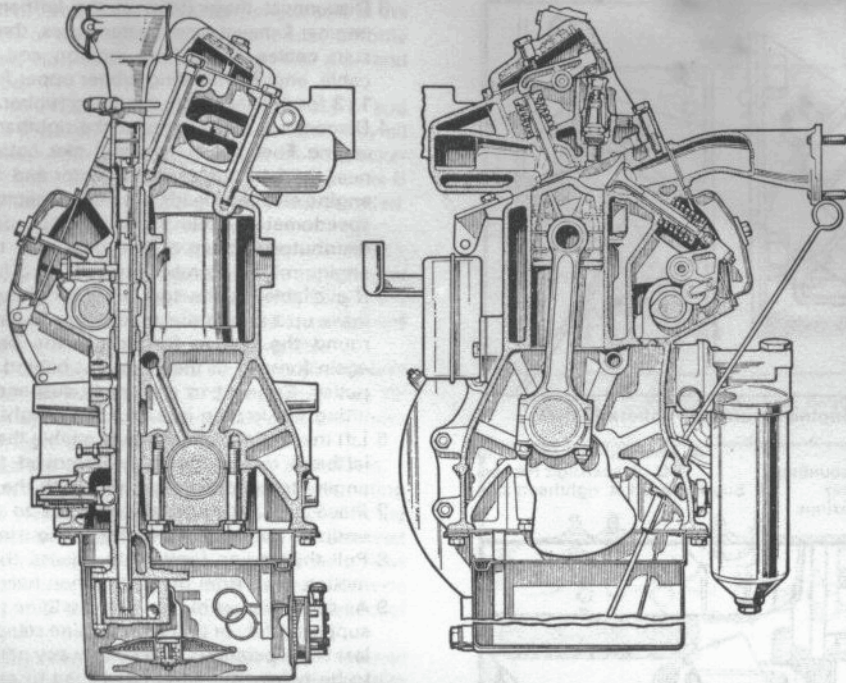


FIG 1:1 The 2 1/2 litre engine



Cross-section view of engine

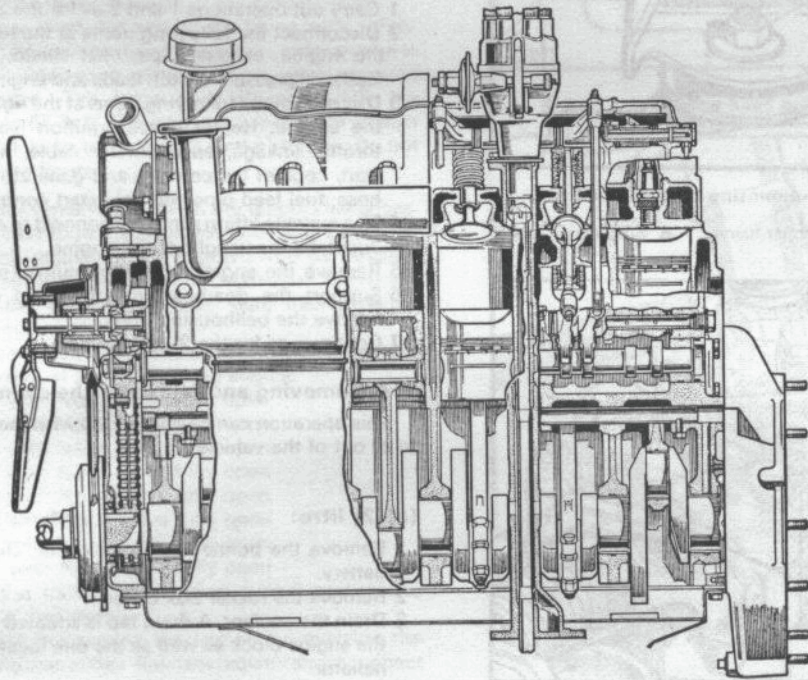


FIG 1:2 The 2.6 litre engine

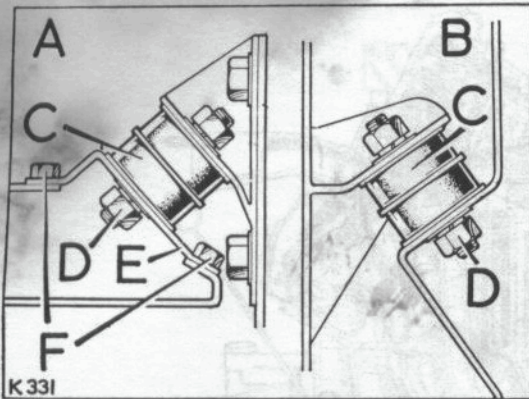


FIG 1:3 Engine mounting rubbers 2½ litre

Key to Fig 1:3
 B Righthand side mounting
 D Lower centre fixing
 F Support bracket fixings
 A Lefthand side mounting
 C Suspension rubbers
 S Support bracket, righthand side

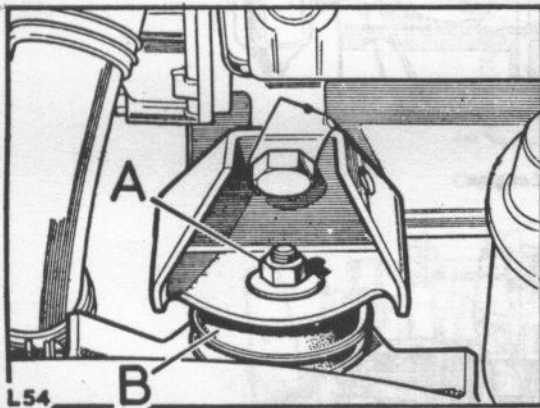


FIG 1:4 Engine mounting rubbers, 2.6 litre

Key to Fig 1:4 A Upper fixing B Suspension rubber

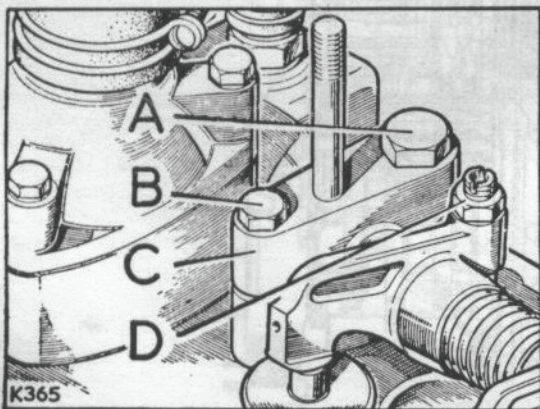


FIG 1:5 Rocker shaft mounting, 2½ litre

Key to Fig 1:5
 B Shaft to bracket bolt
 C Rocker bracket
 D Tappets
 A Bracket to engine bolt

- 3 Disconnect these items at the lefthand side of the engine: Exhaust pipe, heater hoses, throttle link, cold start cables, leads from ignition coil, engine earth cable, engine mounting rubber upper fixing. See FIG 1:3 for details of this mounting rubber.
- 4 Disconnect these items at the righthand side of the engine: Fuel pipe at the pump inlet, battery lead at clip near the fuel pump, starter motor and dynamo leads, engine electrical leads at snap connectors, release the speedometer cable from its clip, disconnect the distributor vacuum pipe if necessary then undo the engine mounting rubber upper fixing (see FIG 1:3).
- 5 If available, fit the special Rover lifting sling or else make up a substantial rope sling and pass it under and round the engine forward of the bellhousing and again forward of the sump but behind the crankshaft pulley. Connect to a properly suspended and tested lifting tackle then just take the weight of the engine.
- 6 Lift the engine sufficiently to enable the righthand and lefthand mountings to be removed then lower the engine to maintain alignment with the gearbox.
- 7 Place packing under the gearbox to support it then undo all the bolts round the bellhousing.
- 8 Pull the engine forward to release the gearbox first motion shaft from the clutch then hoist away.
- 9 As soon as possible lower the engine to the floor and support safely or bolt to an engine stand. During these last two operations never allow any part of the person to be below the suspended load in case of a tackle failure.

(b) 2.6 litre:

- 1 Carry out operations 1 and 2 as for the 2½ litre engine.
- 2 Disconnect the following items at the lefthand side of the engine, exhaust pipe, heat shield, starter motor leads, oil pressure switch leads and engine earth cable.
- 3 Disconnect the following items at the righthand side of the engine: Heater hoses, ignition leads from coil, throttle linkage, speedometer cable, leads for cold start, coolant temperature and generator, brake servo hose, fuel feed pipe and cold start control cable.
- 4 Fit a suitable lifting sling and connect to a lifting tackle. Just take the weight of the engine.
- 5 Remove the engine front mountings (see FIG 1:4).
- 6 Support the gearbox on substantial packing then remove the bellhousing bolts.
- 7 Continue as for the 2½ litre engine.

1:4 Removing and replacing the cylinder head

This operation can be conducted with the engine either in or out of the vehicle.

(a) 2½ litre:

- 1 Remove the bonnet and air cleaner. Disconnect the battery.
- 2 Remove the rocker box cover.
- 3 Drain the coolant. A drain tap is situated at the side of the engine block as well as the one located below the radiator.
- 4 Disconnect or remove the following components at the righthand side of the engine: The distributor vacuum pipe, plug and coil high-tension leads, plugs, fan shroud, oil gallery pipe and coolant bypass hose.

5 Disconnect or remove the following components at the lefthand side of the engine: Top coolant hose, throttle linkage, cold start cables at carburetter, fuel pipe and exhaust pipe.

6 Now refer to **FIG 1:5**. Slacken the locknuts D and screw back the tappet adjusting screws until they all clear the pushrods. Undo bolts A and lift the rocker shaft clear of the cylinder head. Do not release bolts B unless the shaft and rockers are to be dismantled. Remove the assembly to a clean place.

7 Lift out the pushrods one at a time and identify them 1 to 8 from the front of the engine so that they can be replaced in the tappet seats from whence they were taken. Eight numbered holes in a strip of cardboard is a convenient and simple way of doing this.

8 Slacken the cylinder head bolts evenly in the reverse order to that shown in **FIG 1:6** until they can be screwed out by hand and removed. Lift off the cylinder head and discard the gasket.

To replace the cylinder head proceed as follows:

1 Make sure all components and particularly their mating surfaces are clean. Examine the threaded holes in the cylinder block into which the head bolts are screwed and see that no water or carbon is lying in them. This can cause a bolt to bottom instead of pulling down on the head thus leading to a mysterious epidemic of blown gaskets.

2 Smear a little clean oil on the cylinder block face and both sides of a new head gasket. Fit the gasket with the word 'PETROL' uppermost, and replace the head. Assemble the head bolts finger tight.

3 Replace the pushrods making sure that they are located in the spherical seats of the tappet slides.

4 Fit the rocker shaft and just nip the fixing bolts lightly.

5 Tighten all the cylinder head bolts in the order shown in **FIG 1:6**. Tighten each a little at a time, working round the sequence. The large bolts, $\frac{1}{2}$ inch UNF, are tightened to 65 lb ft (8.9 mkg) torque and the smaller $\frac{3}{8}$ inch UNF bolts to 18 lb ft (2.4 mkg) torque. Do not exceed these figures.

6 It will be convenient now to set the tappet clearances. All valves, inlet and exhaust are set to .01 inch (.25 mm). Screw each adjusting screw down into its pushrod until the feeler gauge is just held between the rocker foot and the end of the valve stem then lock the adjusting nut.

7 Set the clearances in the following order, commencing at No. 1 valve at the front of the engine:

Set No. 1 with No. 8 valve fully open

Set No. 3 with No. 6 valve fully open

Set No. 5 with No. 4 valve fully open

Set No. 2 with No. 7 valve fully open

Set No. 8 with No. 1 valve fully open

Set No. 6 with No. 3 valve fully open

Set No. 4 with No. 5 valve fully open

Set No. 7 with No. 2 valve fully open

8 Replace the rocker cover using a new gasket and tighten the nuts evenly.

9 Continue to reassemble the engine by reversing the dismantling operations. Refill the radiator and reconnect the battery.

10 Allow the engine to run up to proper operating temperature then remove the sparking plugs and rocker cover and check the cylinder head bolts for

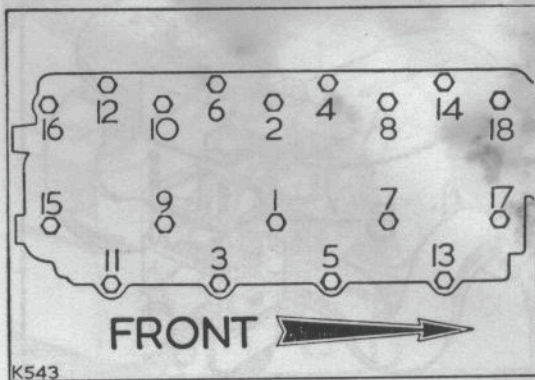


FIG 1:6 Cylinder head bolt sequence, 2½ litre

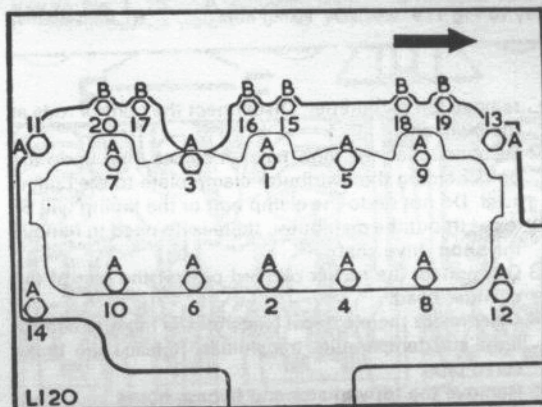


FIG 1:7 Cylinder head bolt sequence, 2.6 litre

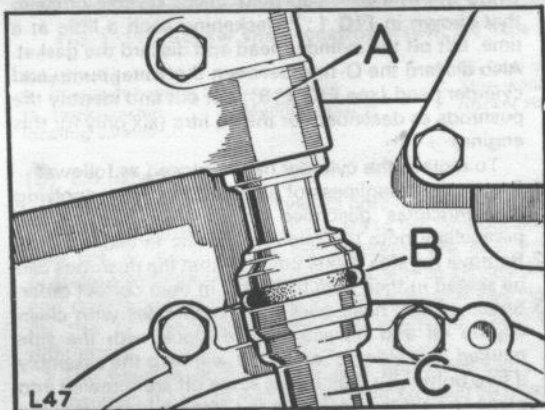


FIG 1:8 Seal between head and pump, 2.6 litre

correct torque loading as they may have slackened slightly.

(b) 2.6 litre:

1 Remove the bonnet, disconnect and remove the air cleaner, disconnect the battery, drain the radiator and

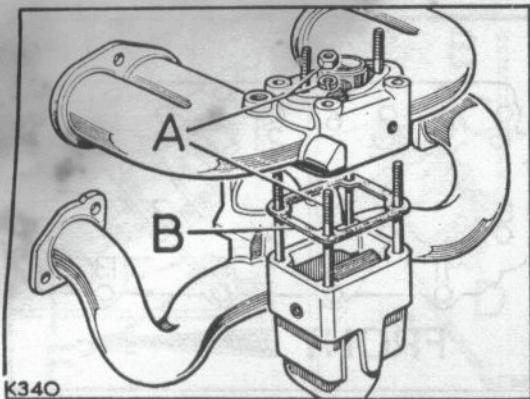


FIG 1:9 Separating the manifolds, 2½ litre

Key to Fig 1:9 A Fixing nuts B Joint washer

remove the carburetter. Disconnect the control rods at the bellcrank.

- 2 Disconnect all the high-tension cables then undo the bolts holding the distributor clamp plate to the crankcase. Do not undo the clamp bolt or the timing will be lost. Lift out the distributor; there is no need to remove the short drive shaft.
- 3 Disconnect the rocker oil feed pipe at the rear of the cylinder head.
- 4 Disconnect the electrical leads for the mixture control light and temperature transmitter. Release the brake servo pipe.
- 5 Remove the top radiator and bypass hoses.
- 6 Remove the rocker cover from the head and slacken all the tappet screws.
- 7 Undo the cylinder head bolts in the reverse order to that shown in FIG 1:7 slackening each a little at a time. Lift off the cylinder head and discard the gasket. Also discard the O-ring between the water pump and cylinder head (see FIG 1:8). Lift out and identify the pushrods as described for the 2½ litre (six only for this engine).

To replace the cylinder head proceed as follows:

- 1 Ensure the cleanliness of all components by applying the principles described for the 2½ litre engine, particularly note the reference to the threaded holes.
- 2 Remove the side rocker cover so that the pushrods can be seated in their cam followers in their correct order.
- 3 Smear a new head gasket on both sides with clean engine oil and replace on the block with the side marked 'this side up' on top. It will help the assembly if two bolts with their heads sawn off are screwed into place to hold the gasket on the sloping block until the head is in place. Cut slots in these two bolts so that they can be unscrewed with a screwdriver.
- 4 Replace the head and fit all the bolts. Connect the bypass hose or new O-seal as necessary at the same time.
- 5 Tighten the head bolts each a little at a time in the sequence shown in FIG 1:7. The bolts marked 'A' are tightened to 50 lb ft (7 mkg) torque and those marked 'B' to 30 lb ft (4 mkg).

- 6 Adjust the tappets making sure that the screws are located in the pushrod ends. Screw the adjusting screws down until a .006 inch (.15 mm) feeler gauge is just held between the rocker foot and the end of the inlet valve stem then lock the locknut.
- 7 Set the clearances in the following order, commencing at No. 1 valve at the front of the engine.
 - Set No. 1 with No. 6 valve fully open
 - Set No. 2 with No. 5 valve fully open
 - Set No. 3 with No. 4 valve fully open
 - Set No. 4 with No. 3 valve fully open
 - Set No. 5 with No. 2 valve fully open
 - Set No. 6 with No. 1 valve fully open
- 8 Refit the side and top rocker covers using new gaskets then continue to reassemble the engine by reversing the dismantling procedure. Refill the radiator and reconnect the battery.
- 9 Run the engine up to operating temperature and recheck the torque loading of the cylinder head bolts, tighten where necessary.

1:5 Decarbonization and attention to the valves (a) 2½ litre:

Instructions for removing the cylinder head were given in Section 1:4. To decarbonize the engine and service the valve gear proceed as follows:

- 1 Attend to the cylinder block first. Plug all the water ways with pieces of rag or twists of newspaper of sufficient size so that they will not be pushed into the jacket and forgotten. This is vital. Examine the threaded holes in the block face and clean away any carbon or dry out any water. Blow into them to finally clean them then put plugs of rag in as described for the waterways. With a flat scraper clean the top face of the block thoroughly then bring two pistons to top dead centre and scrape off the carbon. Use care during this operation so that the piston crowns are not damaged. A blunt penknife is the best tool to use. Under no circumstances use emerycloth or any abrasive to polish up the pistons or block. Turn the engine over to bring up the other two pistons and repeat the cleaning process. Wipe the bores free of carbon as the engine is turned. Do this several times. Cover the block with a piece of clean rag and attend to the head and rocker gear.
- 2 Unbolt the carburetter from the manifold and place to one side. The manifold can be separated if necessary by undoing the vertical bolts after it is removed from the cylinder head. This will be necessary if trouble is suspected with the mechanical 'hot spot' operation. Refer to FIG 1:9. If the 'hot spot' bi-metallic spring has broken or the butterfly is hard to move, undo the screw in the counterweight and pull the counterweight, spring and adjusting plate from the spindle. Free the spindle or replace the spring then reassemble the components in the reverse order to dismantling. The adjusting plate has several serrations which correspond to a setscrew fitted in the side of the manifold (see FIG 1:10). Remove the screw then turn the adjusting plate so that the counterweight is only just supported by the spring. Replace the screw in the nearest serration. Fit the halves of the manifold together using a new joint washer but do not tighten the bolts until the manifold assembly is refitted to the cylinder head.

- 3 Remove the thermostat housing from the cylinder head.
- 4 Using a suitable spring compressor remove all the valves and springs from the head keeping them in sets identified to the position in the head from which they were removed.
- 5 Plug all the waterways and oil passages in the head then remove all the carbon by the use of scrapers and wire brushes. Be careful not to score the valve seat faces.
- 6 Clean and polish the valves. It is permissible to spin the valves in an electric drill and use emerycloth for this but again, do not damage the seating face.
- 7 Wipe the valves and valve guide bores clean and dry and then try each valve in its guide. The clearance between the inlet valve and its guide should not exceed .003 inch (.07 mm) and the exhaust .004 inch (.096 mm). If the clearance is excessive check the valve stems for wear. Usually the guides will need replacing. If so, use piloted drifts and drive the guides out of the head. Fit new guides, again using piloted drifts and lubricate the guides and cylinder head bores before fitting. Special Rover drifts must be used both for removal and replacement. The tool part numbers are: Inlet removal, No. 274400, inlet replacement No. 601508 and exhaust removal No. 274401, exhaust replacement No. 600959.

8 After fitting new guides the seats in the head must be recut to 30 deg. for the inlets and 45 deg. for the exhausts.

9 Examine the valve faces, if a noticeable ridge or distinct pitting is seen the valves must be refaced. This can only be done at a service station and should not be attempted if by so doing the valve will be brought to a knife edge.

10 If the valves can be reset by lapping, smear a little abrasive paste on the face, insert in the head and oscillate to and fro using a suction cup tool. Every few strokes raise the valve and advance it half a turn or so to distribute the paste. Continue until a clear grey band shows all round the valve face and the head seating. Carefully clean away all abrasive paste and when all the valves are completed destroy any rag which may be contaminated.

11 Check that the valve springs are an interference fit between the inner and outer; if not they must be renewed.

12 Clean all the components then lubricate the valve stems with engine oil and insert them in their guides. With the aid of the spring compressor replace the springs, caps and collets. Use new oil seals on each valve.

13 Complete the head assembly by fitting the thermostat and manifolds. Note that either a one piece or two piece joint washer is available for the manifold to head joint. Use whichever type was fitted originally. If the two piece type is fitted the raised rings on the washers must go towards the head. Tighten the head to manifold bolts hard then tighten the vertical bolts holding the manifolds together to 17 lb ft (2.3 mkg). Note that the two piece joint washers fit the inlet manifold only. The exhaust manifold is in metal to metal contact with the head.

14 Reassemble the engine as described in **Section 1:4** making sure that all pieces of rag or paper are removed from the waterways and oilways.

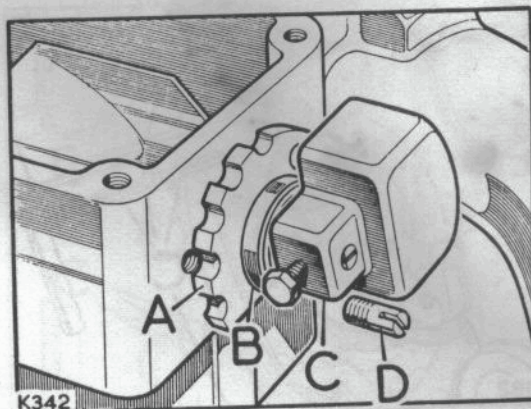


FIG 1:10 Adjusting the hot spot, 2½ litre

Key to Fig 1:10 A Adjusting plate B Bi-metal spring
C Counterbalance weight D Setscrew

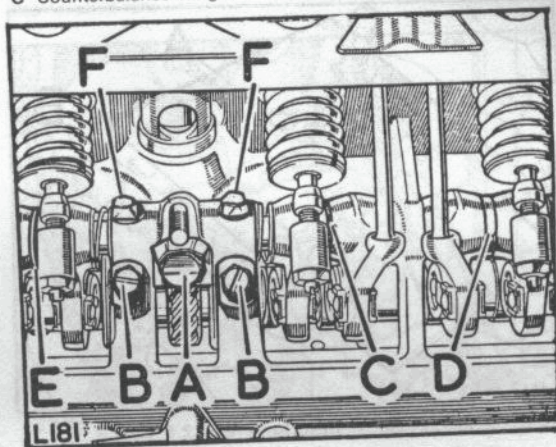


FIG 1:11 Rocker shaft locating screw, 2.6 litre

Key to Fig 1:11 A Oil feed bolt
B Camshaft bearing locating screws C Thin washer
D Thick washer E Medium washer F Rocker shaft
locating screws

(b) 2.6 litre:

This engine has the inlet valves only in the head, therefore although the exhaust valves are in the cylinder block they will be dealt with in this Section. The inlet valve operation and most of the work necessary to service them and decarbonize the head is common to that described for the 2½ litre engine with the following important differences.

- 1 The head is of light alloy and the valve seats are inserted. If a valve seat is badly burnt it must be ground away until it can be broken out and a new one pressed in. The head must be heated to 150°F before doing this.
- 2 The seat insert must be recut to a 30 deg. angle.
- 3 Replace the valve guides if the clearance between a new valve stem and the guide exceeds .003 inch (.07 mm). Heat the head to 150°F before removing or replacing guides. Use drift part No. 27440 to remove the guides and drift part No. 600959 to replace them.

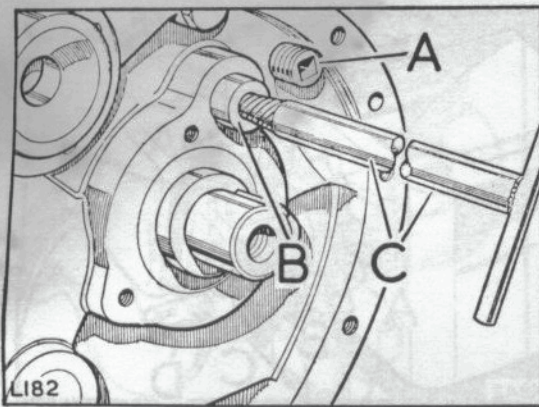


FIG 1:12 Rocker shaft extractor, 2.6 litre

Key to Fig 1:12 A Plug B Shaft C Extractor

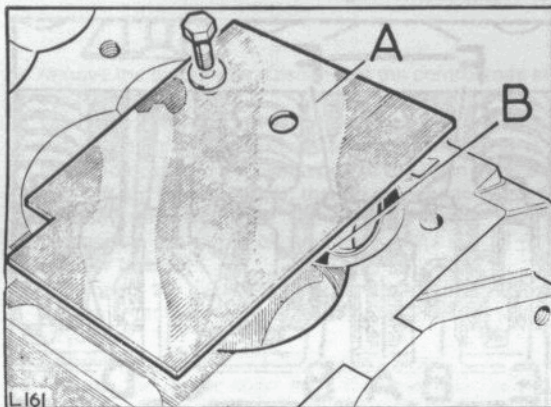


FIG 1:13 Protection plate, 2.6 litre

Key to Fig 1:13 A Plate B Insert

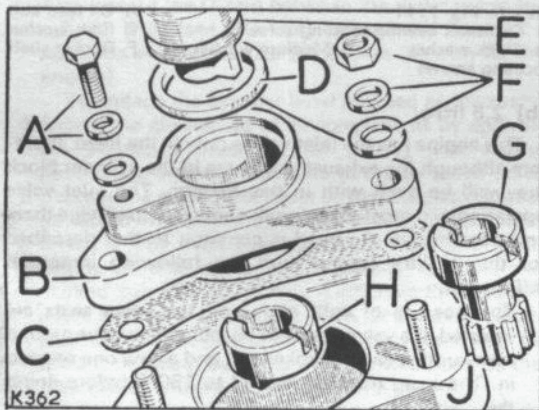


FIG 1:14 Distributor removal, 2½ litre

Key to Fig 1:14
 A Distributor fixings
 B Distributor adaptor C Joint washer D Cork washer
 E Distributor F Adaptor fixings G Top drive shaft, early engines
 H Drive shaft coupling, later engines
 J Vertical drive gear housing

- 4 Do not fit the O-rings to the valve guides until the valves are finally assembled. Pulling a valve out through the O-ring will destroy it.

To service the exhaust valves:

- 1 Remove all carbon from the block and pistons using the methods described for the 2¼ litre engine.
- 2 Remove the exhaust manifold and gaskets then the side rocker cover and its joint washer.
- 3 Slacken each tappet screw right off and turn the engine until the rocker is on the low point of the cam. Commencing at No. 1 exhaust valve, insert the spring compressor and release the valve. Identify each set of valve components with the position in the engine from which they were removed. Be careful not to lose any of the split collets.
- 4 Clean up the valves and seats then check the fit of the valve and the guides. If the clearance between a new valve and the guide exceeds .003 inch (.07 mm) a new guide should be fitted. If the seats are burnt beyond regrinding they must also be renewed.
- 5 To renew valve guides or seats the side rocker shaft must first be removed. Proceed as follows:
 - (a) Remove the timing gear as detailed in Section 1:6.
 - (b) Remove the end plug from the front end of the rocker shaft.
 - (c) Remove the rocker shaft locating screws F (see FIG 1:11) and the oil feed bolt A.
 - (d) The shaft is in halves and can now be pulled out from the front and rear of the engine using the extractor part No. 262749. Lift the rockers, spacers and springs away, carefully noting their position ready for reassembly.

After the valve guides or seats have been attended to, the side rocker shaft can be replaced by reversing the dismantling procedure. It will be best to refit the rear half of the shaft first. Make sure the locating bolt holes are in line with the holes in the block. The extractor can be screwed into the shaft as a means of turning it into position. FIG 1:12 shows the extractor in place in the shaft.

- 6 To remove a valve seat insert, first grind the insert with a cutting wheel to reduce its thickness as much as possible. Fit a protection plate over the cylinder block (see FIG 1:13) and break the insert out by using a chisel through the hole in the plate. The insert is very hard and fragments may fly off.
- 7 Drift the exhaust valve guide out by using drift part No. 274401 and driving it downwards.
- 8 Pull the new insert into place by using tool part No. 530625 then fit the protection plate again and leave in place for a few minutes in case the insert shatters. It is a wise precaution to wear goggles and keep all spectators away when working on these valve seat inserts. There is no need to heat the block or freeze the insert prior to fitting.
- 9 Lubricate a new valve guide and drift into position using drift, part No. 600959.
- 10 The valve seat insert must now be ground to 45 deg. on its seating face using a power driven grinder. The insert is too hard to cut by hand tools.
- 11 Clean up or renew the valves then lap them into the seats using the minimum of fine abrasive paste as described for the 2¼ litre engine.

- 12 Thoroughly clean all the components, lubricate the valve stems, then assemble to the cylinder block and fit the springs, caps and collets with the aid of the spring compressor.
- 13 At this point the tappets should be adjusted to .01 inch (.25 mm) clearance. Start at No. 1 cylinder and set each tappet in exactly the same sequence as described earlier for the inlet valves, i.e., No. 1 tappet with No. 6 valve fully open etc.
- 14 Replace the side rocker cover and continue to reassemble the engine as described in **Section 1:4**.

1:6 Removing the timing gear and camshaft

(a) 2½ litre:

It is not difficult to remove the camshaft and fit a replacement but any attention to the camshaft bearings will be beyond the resources of an average private owner since special line boring or reaming equipment of a most expensive nature is essential. If the bearings are unserviceable the whole engine block should be stripped and sent to a Rover service agent equipped to carry out this work.

- 1 Dismantle the engine as described in **Section 1:4** but in addition remove the radiator and grille panel.
- 2 Remove the external oil filter and mounting.
- 3 Remove the distributor and its drive gear. **FIG 1:14** shows the method of removal for the distributor. Once this is lifted out, undo the grub screw (C in **FIG 1:15**) and remove the gear using a pair of small round nose pliers.
- 4 Remove the engine front cover by first slackening the generator fixings and removing the fan belt. Take off the generator adjusting link to gain access to the cover bolts then remove the starter dog and driving pulley. A solid spanner and a sharp tap with a heavy hammer will start the dog unscrewing. Separate the bypass pipe from the thermostat housing, then undo all the cover fixing bolts including those at the sump flange and lift off the cover. Clean the cover and examine the crankshaft oil seal. If this is to be renewed, carefully lever the old seal out and press the new one in. Apply a smear of jointing compound to the outside of the seal and press it in with the garter spring facing inwards (towards the engine block when assembled).
- 5 Undo the bolt (B in **FIG 1:16**) and remove the chain tensioner ratchet and spring. Compress the piston spring by hand and unbolt the tensioner from the block. Dismantle it and clean all components in clean fuel. Replace if undue wear is evident. Make sure the ball valve and seating are clean and in good condition. **FIG 1:17** shows the tensioner in detail.
- 6 Remove the chain vibration damper (E in **FIG 1:18**).
- 7 Remove the tappet locating bolts (D in **FIG 1:18**), then hook the tappet slides and rollers out. Lastly remove the tappet guides as shown in **FIG 1:19**.
- 8 Lift off the timing chain, undo the bolt in the centre of the camshaft sprocket and pull the sprocket from the shaft. Use an extractor for this, do not lever the sprocket away from the block. Remove the thrust plate then pull the camshaft gently forwards and out of the block supporting it along its length to prevent the cam lobes from scoring the bearings.

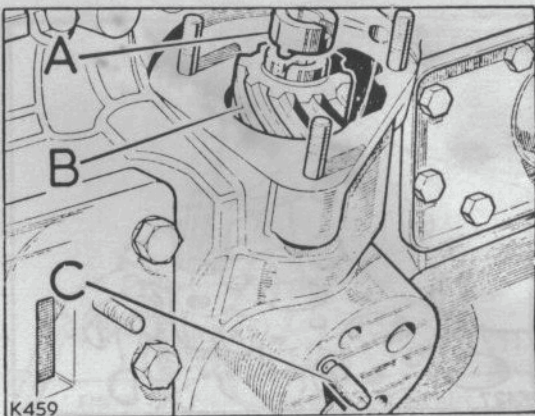


FIG 1:15 Distributor removal, 2½ litre

Key to Fig 1:15
 B Vertical drive gear assembly
 filter location face

A Drive shaft coupling
 C Locating screw in oil

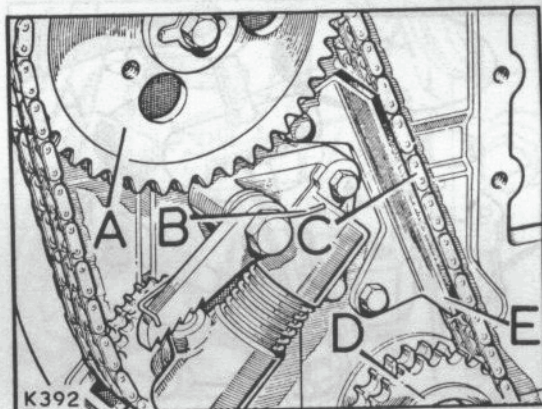


FIG 1:16 Chain tensioner in position, 2½ litre

Key to Fig 1:16
 A Camshaft wheel B Ratchet spring
 C Timing chain D Crankshaft wheel E Vibration damper

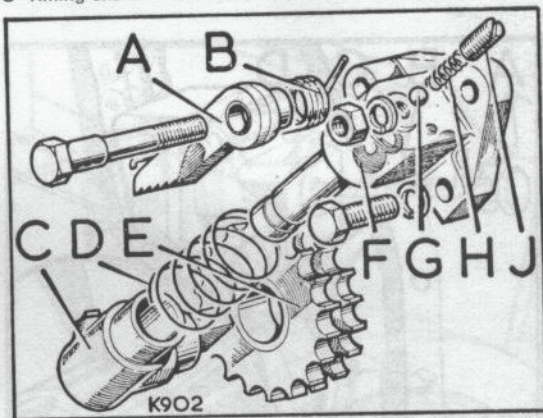


FIG 1:17 Details of chain tensioner, 2½ litre

Key to Fig 1:17
 A Ratchet B Ratchet spring
 C Cylinder D Chain tensioner spring E Idler wheel
 F Piston G Non-return valve H Spring J Plug

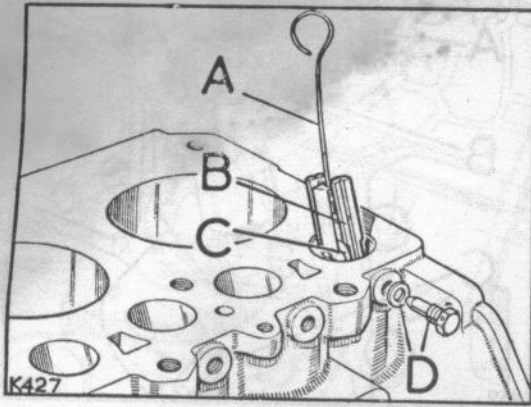


FIG 1:18 Removing tappets, 2½ litre

Key to Fig 1:18 A Hook B Slide C Roller
D Locating bolt

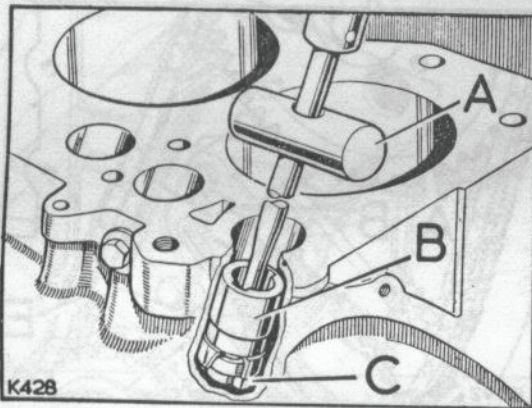


FIG 1:19 Removing tappet guides, 2½ litre

Key to Fig 1:19 A Special tool B Guide C Adaptor

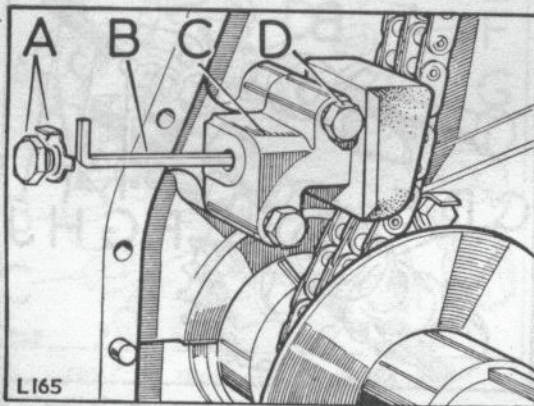


FIG 1:20 Chain tensioner, 2.6 litre

Key to Fig 1:20 A Plug and washer B Allen key
C Tensioner D Fixing bolts

(b) 2.6 litre:

This engine, unlike the 2½ litre, will allow renewal of the camshaft bearings but it must be noted that the rear-most bearing can only be serviced when the engine is out of the chassis and the flywheel housing is removed.

- 1 Dismantle the engine as described in Sections 1:4 and 1:5 (removal of side rocker shaft) but in addition remove the radiator and grille panel.
- 2 Remove the generator, fan belt, fan blades, distance piece and fan pulley. Undo the starter dog and remove the driving pulley. Undo the bolts and lift off the front cover then remove the oil thrower from the crankshaft. Clean up the cover and if necessary replace the crankshaft oil seal as described for the 2½ litre engine.
- 3 Refer to FIG 1:20 and remove plug A from the chain tensioner. With an ⅛ inch (3 mm) Allen key, B, turn the adjuster clockwise until the spring loading is removed. Unbolt the tensioner and remove from the engine.
- 4 Undo the bolt in the centre of the camshaft chainwheel and with a suitable extractor, pull the wheel from the camshaft and lift off the timing chain. Remove the camshaft thrust plate.
- 5 Remove the distributor as described in Section 1:4. Refer to FIG 1:11. The bolt marked A must be removed and the distributor vertical drive gear assembly withdrawn upwards.
- 6 Refer to FIG 1:11 and remove the bolts 'B'.
- 7 Screw a bolt with a piece of plate or mild steel strip to make a handle to grip with, into the front end of the camshaft and gently pull the camshaft forward until the bearings are just clear of their housings. Lift the bearings off the shaft keeping them in their correct pairs as indicated by the numbers stamped on the end face. Continue to extract the shaft, supporting it along its length to prevent damage.

1:7 Replacing the timing gear and camshaft

(a) 2½ litre:

- 1 Replace the camshaft taking great care not to score the bearings as the shaft passes through them. Fit the thrust plate but do not bend up the locking tabs. Fit the chainwheel and see that the end float of the shaft lies

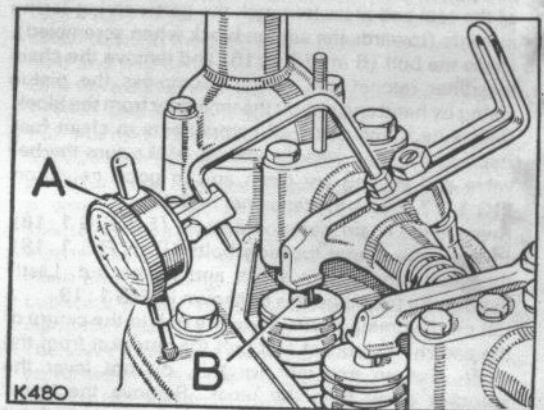


FIG 1:21 Checking valve opening, 2½ litre

Key to Fig 1:21 A Dial gauge B No. 1 exhaust valve

between .0025 to .0055 inch (.06 to .13 mm). If not, select another thrust plate or grind one down. When correct, bend up the thrust plate bolt locking tabs.

2 Replace the tappet assemblies, cylinder head, pushrods and rocker shaft.

3 Retime the camshaft as follows:

(a) Note that there are two methods of timing, one is by marks on the flywheel and the other by a pointer on the timing cover. The flywheel type is described first.

(b) Remove the coverplate from the flywheel housing and turn the flywheel in the direction of engine rotation until the EP mark is in line with the pointer. Temporarily fit the chainwheel to the camshaft.

(c) See that No. 1 cylinder exhaust valve is fully closed and has .010 inch (.25 mm) tappet clearance.

(d) Fit a clock gauge as shown in FIG 1 :21 then turn the chainwheel until the gauge shows the exact point when the valve is fully open. Fit the chain so that there is no slack on the driving side. If there is slack, refit the chainwheel in another position on the splines, recheck that the valve position has not altered and try the chain on again. When correct, lock the chainwheel to the camshaft.

(e) To retime the camshaft if the engine has the pointer on the timing cover proceed as follows:

Rotate the crankshaft until the keyway for the crankshaft wheel is exactly vertical.

(f) Fit the camshaft chainwheel as shown in FIG 1 :22 then replace the chain with no slack on the driving side and tighten the chainwheel fixing bolt.

4 Refit the timing chain tensioner as shown in FIG 1 :16 then refit and adjust the vibration damper E, so that there is a maximum of .010 inch (.25 mm) clearance between it and the chain.

5 To assist in fitting the front cover, temporarily remove the stud from the cylinder block front face. Smear the new joint washers on both faces with grease and bolt the cover to the cylinder block. Replace the stud. Fit the bypass pipe to the thermostat housing. Replace the crankshaft pulley and starter dog. Tighten the dog to 150 lb ft (20.5 mkg). FIG 1 :23 shows the front cover assembly in detail.

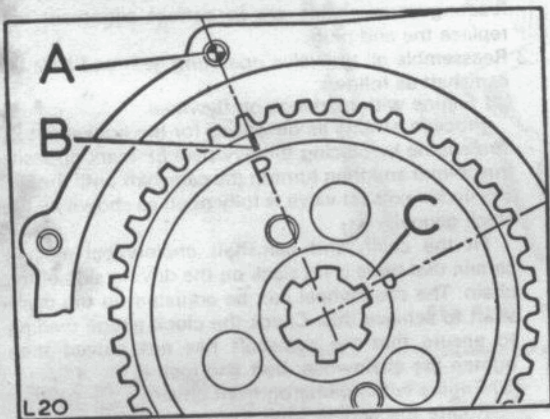


FIG 1 :22 Camshaft chainwheel marking, 2½ litre

Key to Fig 1 :22
B Groove marked 'P'

A Tapped hole in cylinder block
C Fit spline P to camshaft key

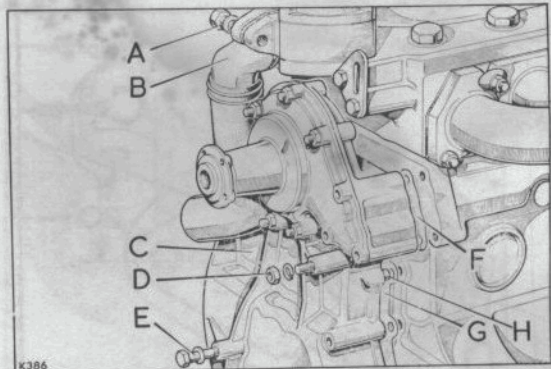


FIG 1 :23 Front cover assembly, 2½ litre

Key to Fig 1 :23 A Bypass pipe bolt B Bypass pipe
C Front cover D Generator link fixing E Front cover fixings
F Joint washer G Joint washer H Locating dowels, 2 off

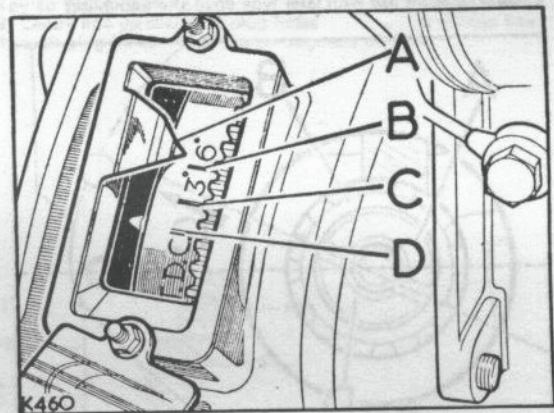


FIG 1 :24 Flywheel timing marks, 2½ litre

Key to Fig 1 :24 A Pointer B 6 deg. mark C 3 deg. mark
D TDC mark

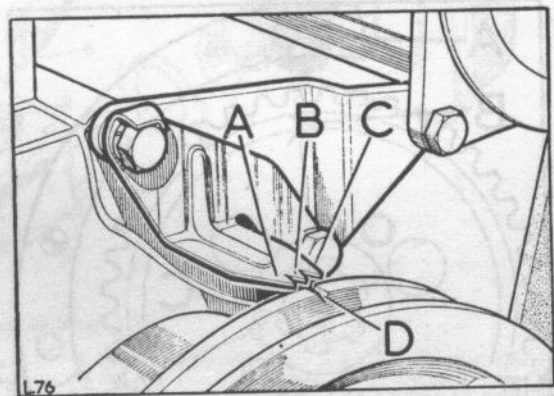


FIG 1 :25 Front cover timing marks, 2½ litre

Key to Fig 1 :25 A 6 deg. point B 3 deg. point
C TDC point D Pulley mark

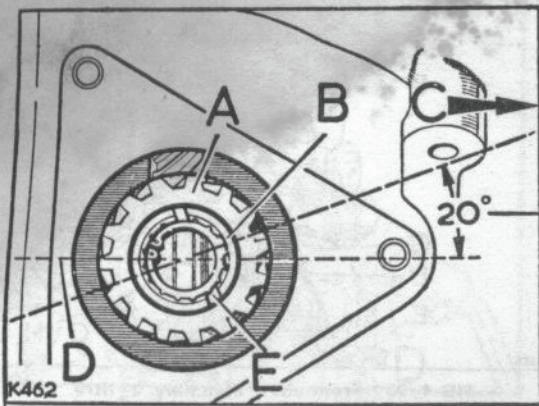


FIG 1:26 Fitting vertical drive gear, 2½ litre

Key to Fig 1:26
 A Vertical drive gear
 B Master spline for locating drive shaft, early engines C To front of engine
 D Line parallel with engine centre line
 E Offset slot for use with later type drive shaft coupling

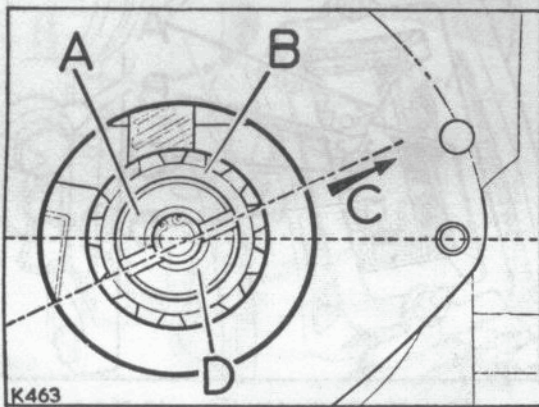


FIG 1:27 Fitting drive coupling, 2½ litre

Key to Fig 1:27
 A Top drive coupling
 B Vertical drive gear C No.1 cylinder D Narrow segment

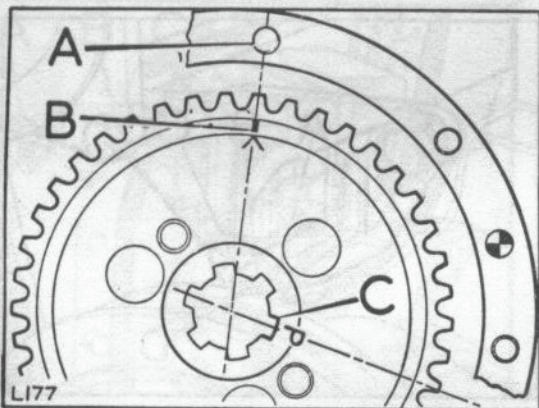


FIG 1:28 Front cover timing marks, 2.6 litre

Key to Fig 1:28
 A Tapped hole in cylinder block
 B Groove in line with tapped hole C Fit chainwheel spline P on to camshaft key

- 6 Continue to rebuild the engine by reversing the dismantling procedure.
- 7 Retime the distributor as follows referring to Technical Data of the Appendix to obtain the correct timing figures:

Rotate the engine until the appropriate timing marks are in alignment (see FIG 1:24 or 1:25) and both valves of No. 1 cylinder are closed. Insert the vertical drive shaft assembly as shown in FIG 1:26, locate the small hole in the drive gear bush through the oil filter location face and fit the grub screw (see FIG 1:15). Fit the short drive shaft coupling as shown in FIG 1:27. Replace the distributor with the vacuum unit facing to the rear making sure the shaft key engages the slot in the short drive shaft, and set the octane selector so that the fourth line from the left of the calibration markings is against the face of the distributor body. If all is well the contacts should just be separating. Slight adjustment can be made by loosening the clamp bolt. Check that the rotor arm is pointing to No. 1 cylinder. The exact timing point can be checked when the battery is reconnected. Put a 12-volt bulb between the distributor low-tension terminal and earth. Switch the ignition on and turn the engine two revolutions in the direction of rotation. The bulb should light when the timing pointer comes into alignment with the appropriate mark.

- 8 Refit the external oil filter, replace the radiator and refill with coolant.

(b) 2.6 litre:

The camshaft bearings must be fitted dry. See that the correct pairs of bearings are assembled together and that the locating holes in the bearings are in alignment with the holes in the cylinder block.

- 1 Insert the camshaft just far enough to allow the skew gear to pass through the intermediate housing webs then assemble the bearings to the camshaft. Put a distance piece temporarily between the middle pair of bearings so that it can be pulled out when the shaft is home. Squirt oil down the locating holes then fit the retaining bolts. Fit the camshaft thrust plate ensuring that the shaft has .0045 to .0065 inch (.11 to .16 mm) end float.
- 2 Refit the side rocker shafts making sure that the locating screw holes are in correct alignment and replace the end plug.
- 3 Reassemble all the valve operating gear and time the camshaft as follows:

(a) Engine with markings on flywheel.

Proceed exactly as described for the equivalent 2½ litre engine by placing the flywheel EP mark opposite the pointer and then turning the camshaft until the No. 1 cylinder exhaust valve is fully open as shown by the clock gauge.

Fit the chain and camshaft chainwheel making certain that there is no slack on the driving side of the chain. The chainwheel can be adjusted on the camshaft to achieve this. Check the clock gauge reading to ensure that the camshaft has not moved then tighten the chainwheel bolt and lock it.

(b) Engine with pointer on front cover.

Rotate the engine until the crankshaft keyway is exactly vertical.

Fit the chainwheel and chain as shown by FIG 1:28 ensuring that there is no slack on the driving

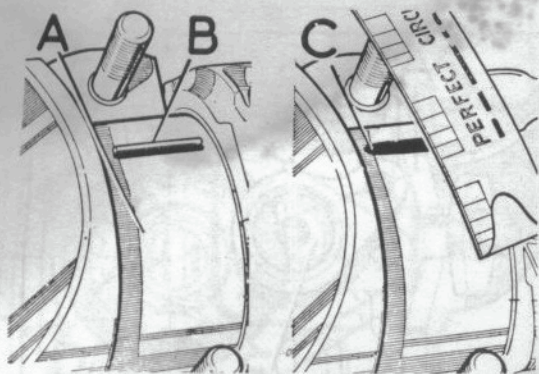


FIG 1:31 Checking big-end clearance, 2½ litre

Key to Fig 1:31

B Initial position of 'Plastigage' C Flattened 'Plastigage'.
A Journal
Measure width against scale on 'Plastigage' packet

side of the chain. Replace the camshaft chainwheel bolt, tighten and lock up.

- 4 Bolt the chain tensioner to the engine then with the Allen key turn the sleeve clockwise until the head of the tensioner moves forward against the chain. Never turn the sleeve anticlockwise. Replace the plug after removing the Allen key.
- 5 Replace the front cover, smearing grease on both faces of the new joint washer.
- 6 Fit the crankshaft pulley, tightening the starter dog to 200 lb ft (27.5 mkg). Replace the fan blades and dynamo. Adjust the dynamo belt tension to between $\frac{7}{16}$ to $\frac{1}{4}$ inch (8 to 11 mm) free movement.
- 7 Turn the engine in the direction of rotation until the TDC mark on the flywheel or crankshaft pulley is opposite the pointer with both valves of No. 1 cylinder closed. Insert the distributor drive shaft and gear so that the short drive shaft eventually is positioned as shown by FIG 1:29. Fit the locating bolt.
- 8 Replace the distributor, engaging the key in the shaft with the slot in the drive shaft. Check that the rotor arm is in the No. 1 cylinder firing position and the distributor vacuum unit faces the front of the engine.
- 9 Rotate the engine forward two turns until the appropriate timing mark for the fuel to be used is in alignment with the pointer (flywheel or crankshaft pulley as applicable). Slacken the pinch bolt on the distributor clamp and rotate the distributor body until the points are just opening on the leading side of the cam. A test lamp can be used to obtain the exact point of break. Tighten the pinch bolt and replace the distributor cap.
- 10 Reverse the dismantling procedure for the assembly of the remaining items then refill the radiator and reconnect the battery.

1:8 Servicing the oil pump and filters

(a) 2½ litre:

The oil pressure at 2000 rev/min with a warm engine should be between 45 and 65 lb/sq inch. Any pressure much lower than this may denote trouble with the pump but there are many other possible causes including worn engine bearings. If it is decided to strip the pump this can be done quite easily.

- 1 Drain the oil from the sump then remove the sump bolts and lower away. Clean the crankcase and sump joint faces.
- 2 Remove the two bolts holding the pump and pull the pump from the engine complete with its drive shaft. This will not upset the distributor timing.
- 3 Refer to FIG 1:30 and strip and clean all the components.
- 4 Inspect the relief valve ball seating. If this is pitted it is possible to lap it in by the use of a spare ball soldered to a piece of tubing rotated by a hand drill. Use coarse abrasive paste to start with and finish with fine paste. Wash thoroughly afterwards.
- 5 Check and replace the gears if the end float exceeds .005 inch (.12 mm) for the steel gear and .006 inch (.15 mm) aluminium gear. Use a steel straightedge across the pump body and check with feeler gauges.
- 6 Measure the radial clearance between the gear teeth and the body again using feeler gauges. This must not exceed .004 inch (.10 mm).
- 7 The backlash between the gears must not exceed .012 inch (.28 mm).
- 8 Reassemble the pump in the reverse order to dismantling giving all moving parts a smear of clean oil. See that the plain portion of the drive gear bore is uppermost and use a little jointing cement between the pump body and shaft housing.
- 9 Reassemble to the engine; tighten the bolts using new locking tabs. Replace the sump and refill with clean oil.
To renew the external oil filter, first place a receptacle below it to catch the oil which will drain out. Undo the hexagon at the base of the filter chamber and remove the chamber and filter. Discard the element and sealing ring. Wipe the chamber clean, fit a new element and sealing ring and replace on the housing. Tighten the hexagon.

(b) 2.6 litre:

The oil pressure at 2000 rev/min with a warm engine should be between 40 and 50 lb/sq in.

- 1 To remove the pump first drain the oil then remove the sump.
- 2 At the side of the crankcase just forward of the starter motor will be seen a hexagon with a domed housing. Wipe all dirt away from around this then unscrew carefully. This is the oil pressure relief valve and is not adjustable. Be careful not to lose the steel ball and spring when the hexagon housing comes free.
- 3 Immediately above this relief valve is another setbolt and locknut. This locates the oil pump and when it is removed the pump can be withdrawn downwards.
- 4 Dismantle the pump by undoing the four bolts in the cover then wash all the components and examine for wear. The replacement dimensions for end float, backlash and radial clearance are the same as those given for the 2½ litre engine. Replace where necessary and rebuild the pump by reversing the dismantling process.
- 5 Replace the pump in the cylinder block and refit the locating bolt and the oil pressure relief valve.
- 6 Refit the sump using a new joint washer and refill with oil.

The external oil filter is serviced in the same way as the one fitted to the 2½ litre engine. The only small

difference is that the bolt holding the filter element chamber is at the top of the chamber not the bottom.

1:9 Removing the clutch and flywheel

On either engine, this operation can be carried out without removing the engine from the vehicle. See **Chapter 6** for the method of removing the clutch.

(a) 2½ litre:

To remove the flywheel once the clutch is taken off, release the locking tags and unscrew the setbolts. The flywheel is held by these eight bolts and a dowel. Once the bolts are removed the flywheel can be pulled off the crankshaft.

If the flywheel face which contacts the clutch friction plate is scored it can be refaced by removing up to .030 inch (.76 mm) of metal. Do not exceed this amount and make sure that the clutch bolts and dowels were removed first so that the refacing extends right across the flywheel face.

To renew the starter ring gear, grip the flywheel vertically in a vice then drill a $\frac{1}{8}$ inch (4 mm) hole through the ring at the root of a tooth so as to weaken the ring. Place a heavy cloth or sack over the gear then drive a chisel down from the root of the tooth into the hole thus breaking the gear. The cloth will prevent any pieces flying off unexpectedly.

Heat a new starter ring to between 220°C to 225°C (light straw colour) and then lay it on the flywheel. Have the square edge of the teeth against the flywheel flange. Allow to cool slowly and thus contract and grip the flywheel. Do not hasten the cooling.

The flywheel can be reassembled to the crankshaft once the ring has cooled. Make sure that the crankshaft boss and the flywheel register are clean. Tighten the bolts to 60 to 65 lb ft (8.5 to 9 mkg) and bend up the locking tabs. The flywheel must not run out of true more than .002 inch (.05 mm) at the edge of the friction plate surface.

(b) 2.6 litre:

To remove and service the flywheel of this engine proceed in all respects as for the 2½ litre engine.

1:10 The pistons and connecting rods

(a) 2½ litre:

1 Strip the engine as described in **Sections 1:4** and **1:5** enough to remove the cylinder head. This can be done either in or out of the chassis. Drain the oil and remove the sump. All work on the pistons can now proceed without removing the engine.

2 Turn the crankshaft to bring two pistons to bottom dead centre. Mark the caps and connecting rods so that they can be replaced in the right order in the engine and the right way round. Undo the two big-end nuts and remove the cap and bearing shell from each rod. Push the connecting rod and piston up the bore and remove from the top of the engine. Keep the components in their related sets including the bolts and nuts. Turn the crankshaft half a turn and repeat for the other two pistons.

3 If the engine is to be rebored, new pistons and correctly gapped rings will be supplied. If not, check the piston, ring and connecting rod as follows:

(a) Remove the rings carefully by using either the special pliers or the three legged device obtainable at any good accessory shop. In emergency cut three strips of tinplate about .5 inch wide and work these under the ring and move round until they are parallel to the length of the piston and spaced at 120 degrees from each other. Slip the ring up and off.

(b) Clean all carbon from the piston being careful not to damage the grooves. Examine carefully for cracks or damage. Any area of heavy bearing showing on the sides of the piston denotes a bent connecting rod. Check and renew if necessary.

(c) Check the gudgeon pin fit in the piston and rod. There should be not more than .0005 inch (.012 mm) clearance between the pin and the rod and an interference fit in the piston. In practical terms this means that with the components cold and dry the pin will just slide into the connecting rod bush but to enter the piston the latter must be heated to 55°C (132°F). On series III models the gudgeon pin is a hand fit in the piston at room temperature. Note that if the piston crown is marked with an X, the pin must be withdrawn and fitted at that side.

(d) To check the big-end fit on the crankpin, assemble the components with a piece of 'Plastigage' as shown in **FIG 1:31**. Full instructions for the use of 'Plastigage' are given on the packet. Tighten the big-end nuts to 35 lb ft (4.9 mkg) for bolts with machine cut threads or 25 lb ft (3.5 mkg) for rolled thread bolts. The latter are identifiable by a drill centre at the threaded end. The clearance between the bearings and crankpin must not exceed .0025 inch (.063 mm) or be less than .001 inch (.025 mm). The end float between the big-end and crankpin webs should lie between .007 to .012 inch (.20 to .30 mm).

(e) Push each piston ring into an unworn part of the cylinder bore and check the gap. This must be between .015 to .020 inch (.38 to .5 mm) for all rings. Use a piston to push the ring down so that it seats squarely in the bore.

(f) The side clearance between the rings and piston grooves should be .0018 to .0038 inch (.046 to .097 mm) for compression rings and .0015 to .0035 inch (.038 to .089 mm) for scraper rings.

4 Reassemble the pistons and connecting rods using new gudgeon pin circlips. It is important that if there is an X on the piston crown that this goes towards the front of the engine. The oil spray hole in the rod always faces the camshaft. Fit the compression rings with the word 'Top' or 'T' uppermost. The scraper ring can be fitted either way up.

5 Smear a little clean oil on the cylinder bore and on the outside of the piston. Assemble the piston ring clamp to the piston first making sure that the ring gaps are spaced at 120 degrees. Enter the assembly from the top face of the cylinder block and push the piston gently through the clamp and into the bore. Refit the big-end bearing securing the cap with new nuts, tightening them to the torque given in paragraph 3 (d).

6 Rebuild the engine as described in previous Sections.

(b) 2.6 litre:

All work on the pistons and connecting rods in this engine can be undertaken with the engine in the chassis.

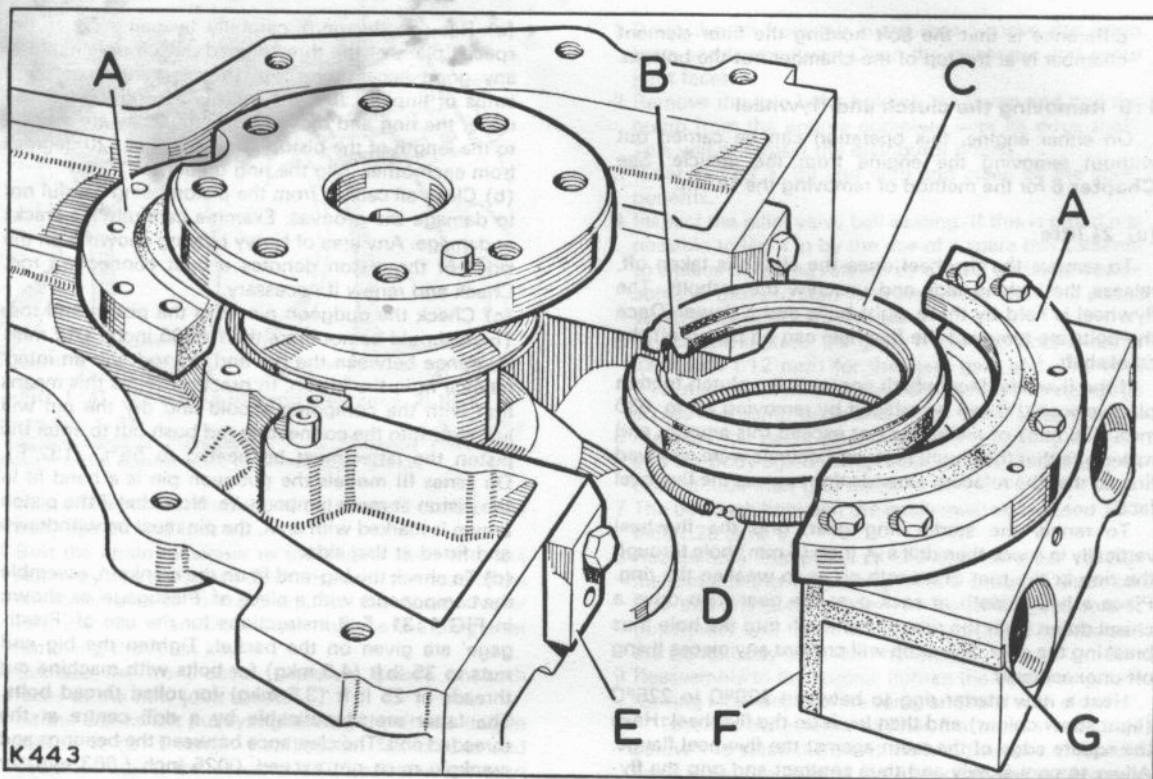


FIG 1:32 Rear main bearing oil seal

Key to Fig 1:32 A Retainer halves B Split line of seal to be towards top of engine when fitted C Split oil seal
 D Garter spring, hook and eye to be midway between split and hinge of oil seal when fitted E Guides, part No. 270304, for rear main bearing cap T-seals F Trim these edges before fitting cap to prevent seal from folding G Trim these ends when cap is fitted to allow $\frac{1}{32}$ inch (.8 mm) protrusion

Strip the engine as described previously and remove the connecting rods and pistons from the top of the cylinder bores as described for the 2½ litre engine. The note concerning withdrawing the gudgeon pin from the side of the piston marked X applies here. Check the components exactly as described for the 2½ litre engine. The compression ring gap should be between .015 to .020 inch (.38 to .5 mm) and the scraper ring .015 to .033 inch (.38 to .8 mm).

The ring to piston groove clearance should be between .002 to .004 inch (.05 to .10 mm). Gudgeon pin and big-end clearances are also the same as for the 2½ litre engine.

When reassembling the engine use new gudgeon pin circlips and fit the connecting rod ensuring that the oil spray hole is to the same side as the bore number stamped on the piston crown. If no bore number is marked, fit the rod so that the oil spray hole is away from the camshaft. This is opposite to the instruction for the 2½ litre engine. Use a piston ring clamp to assist the rings to enter the bore but due to the sloping face of the cylinder block, careful work with the fingers is necessary to get the rings in without damage. Fit new big-end cap nuts tightening them to 20 lb ft (2.8 mkg). Continue to assemble the engine as described in previous Sections.

1:11 The crankshaft and main bearings

(a) 2½ litre:

To remove the crankshaft the engine must be removed from the vehicle as described in **Section 1:3**. Secure the engine safely on an engine stand or on blocks on the floor. Drain the oil and remove the sump, oil pump, timing cover, timing chain, clutch, flywheel and flywheel housing. Undo the big-end nuts and remove the caps keeping them in order. Push the pistons and rods a little way up the bores out of the way unless the cylinder head is off and it is intended to remove the pistons as well.

Now continue as follows:

- 1 Undo the main bearing cap bolts and remove the bearing caps keeping them in order of removal.
- 2 Lift the crankshaft away and remove the oil seal from the rear of the crankshaft. Remove the oil seal retainer halves from the rear of the crankcase and the rear main bearing face.
- 3 To check the crankshaft bearing fit, first thoroughly clean and dry all the components then lay the shaft back in the crankcase with the shell bearing top halves

in position. Refit the bearing caps and bottom bearing shells using a piece of Plastigage between each journal and bearing as described for checking big-end clearance. At the same time refit the thrust bearings. Tighten the bearing cap bolts to 85 lb ft (11.75 mkg) then release and measure the Plastigage. The clearance should be between .001 and .0025 inch (.02 to .06 mm). Outside these limits the shaft should be ground under-size and the equivalent new bearing shells fitted. Remove all traces of the Plastigage and replace the bearings. Nip up the bolts then lever the shaft forwards and back to check the end float. This should be between .002 to .006 inch (.05 to .15 mm). If it is greater, over-size thrust washers can be fitted but make sure that the shaft remains centralized. The thrust washers must not be different one from the other by more than .003 inch (.08 mm).

4 The crankshaft is replaced by reversing the dismantling procedure but pay special attention to the instructions which follow for renewing the rear main bearing oil seal. During all these operations great care must be taken to exclude all dirt and grit. Make very sure that the oilways in the crankshaft are absolutely clean before putting the shaft back. Any grinding dust left here will ruin a bearing in no time.

5 Assemble all the bearing top halves to the crankcase, apply a very slight smear of oil and then fit the thrust washers. Lay the shaft in the bearings and replace the front and centre lower bearing shells and bearing caps. Tighten the bolts finger tight. Rotate the shaft. Now refer to FIG 1 : 32. Carefully hook the garter spring D round the shaft as shown. Do not stretch it. Move it up against the oil thrower flange. Apply Silicone Grease MS4 to the shaft and both sides of the oil seal lip. Place the oil seal over the shaft with the recess towards the spring and oil thrower flange. This is clearly shown in FIG 1 : 32. Gently fit the spring into the seal recess then move the seal to its running position on the shaft. Apply Hylomar PL32M sealing compound to the seal diameters of the two retaining plates 'A'. Do not use trichlorethylene to degrease these plates. Wipe clean with a dry cloth before applying the Hylomar. Bolt the crankcase retaining plate to the crankcase, compressing the seal to assist assembly. Tighten the top three bolts hard but leave the two nearest the split line finger tight. See that the split in the oil seal remains vertically towards the cylinder head. Bolt the other retainer to the main bearing cap in the same way. Fit the T-seals to the sides of the cap and just take their sharp edges off at positions F and G (see FIG 1 : 32). The two guides 'E' are worth making up to assist the seals to slide into the crankcase. Apply the silicone grease to the T-seals. Now fit the bearing cap assembly complete with bearing shell, and pull down until within $\frac{1}{32}$ inch (.8 mm) of right home. Check that the seal has entered the retainer without damage. If all is well continue to pull the cap down and tighten the bolts to 85 lb ft (11.75 mkg). Repeat for the centre and front bearing caps. Tighten the four bolts, two in each seal retainer, left slack. See that the shaft rotates freely.

6 Continue to rebuild the engine as described in earlier Sections.

(b) 2.6 litre:

The instructions given for the 2½ litre engine apply exactly to this engine, with the following minor exceptions.

- 1 The bearing clearance should be between .0006 and .002 inch (.015 and .05 mm).
- 2 Tighten the bearing cap bolts to 75 lb ft (10 mkg).

1 : 12 Reassembling a stripped engine

In the previous Sections full instructions have been given for the reassembly of each major unit including timing procedures. No difficulty should be experienced in reassembling an engine if the operations are worked through in sequence. Utter cleanliness is essential; clean out all oil galleries and drillings using lint free rag or pipe cleaners. Be careful not to leave a piece of rag stuck in an oilway.

Always use new locking tabs or washers and gaskets. Do not exceed the stated torque figures for bolts and nuts as bolts can be easily stretched and weakened.

1 : 13 Emission control equipment

Crankcase ventilation:

Crankcase fumes are vented into the induction system to be burnt with the fuel/air mixture in the normal combustion process.

A number of different layouts are employed according to model and market, but the principle remains the same. Maintenance is confined to the following filter cleaning and replacement at specified mileages.

The engine breather filter (see FIG 1 : 33) contains a gauze which should be washed in clean petrol, dried and dipped in clean oil. Shake off surplus oil and refit.

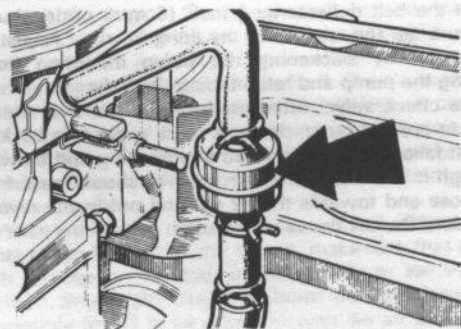
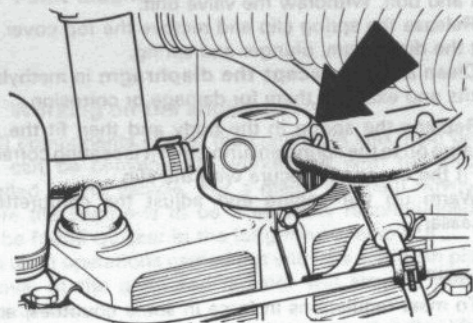


FIG 1 : 33 Engine breather filter (above) and crankcase ventilation flame trap (below)

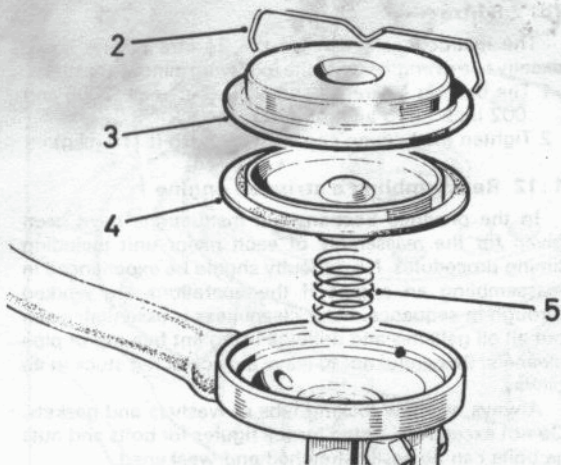


FIG 1:34 Crankcase emission valve

Key to Fig 1:34 2 Clip 3 Cover 4 Diaphragm
5 Spring

A flame trap is incorporated in the breather hose on some models (see FIG 1:33). Unclip the hose from each end of the flame trap and renew the assembly complete.

The crankcase emission valve which is shown in FIG 1:34 should be removed for inspection and cleaning from time to time.

Disconnect the two hosepipes and remove the securing nut and bolt. Withdraw the valve unit.

Release the spring clip and remove the top cover. Lift out the diaphragm, plunger and spring.

Clean all parts **except the diaphragm** in methylated spirits and examine them for damage or corrosion.

Replace the spring in the body and then fit the diaphragm on to the spring ensuring that it is seating correctly.

Fit the cover and secure with the clip.

Warm up the engine and adjust the carburetter if necessary.

Air pump:

To meet regulations in force in some countries, an air pump is fitted which delivers air to the exhaust manifold through an air rail. Air pump drive belt tension is correct when the belt deflects by $\frac{1}{2}$ inch (6 mm) under thumb pressure at the centre of its longest run. Adjust, if necessary, by slackening the pump mounting bolts, moving the pump and retightening the bolts.

The check valve, fitted at the air rail end of the air hose to prevent pump damage in the event of a backfire or belt failure, can be checked by removing and blowing through it. Do not use an air line. Air should pass from the hose end towards the air rail and not in the reverse direction. Renew the valve if faulty.

Checking and repairing the air pump, if necessary, will have to be entrusted to a suitably equipped service station.

1:14 Fault diagnosis

(a) Engine will not start

- 1 Battery discharged
- 2 Starter jammed in mesh or defective
- 3 Ignition faults
- 4 Carburetter fault
- 5 Lack of fuel
- 6 Incorrect 'hot spot' adjustment

(b) Engine starts but stops at once

- 1 Faulty electrical connection
- 2 Lack of fuel

(c) Engine will not idle

- 1 Incorrect carburetter setting
- 2 Fuel pump faulty
- 3 Ignition timing incorrect or ignition fault
- 4 Burnt valve
- 5 Blown cylinder head gasket
- 6 Choked exhaust system

(d) Engine misfires on acceleration

- 1 Faulty distributor contact breaker
- 2 Coil or capacitor faulty
- 3 Defective sparking plug
- 4 Carburetter air leak or punctured diaphragm

(e) Engine misfires

- 1 Air leak in exhaust system
- 2 Defective valves
- 3 Ignition timing retarded
- 4 Carburetter air leak
- 5 Valve timing incorrect

(f) Engine knocks

- 1 Ignition too far advanced
- 2 Slack tappets
- 3 Worn bearings
- 4 Excessive carbon

(g) Engine runs erratically

- 1 Incorrect ignition timing
- 2 Faulty fuel pump
- 3 Sparking plug defective
- 4 Stuck valve or incorrect tappet clearance
- 5 Leaking exhaust system

(h) Lack of power

- 1 Incorrect ignition timing
- 2 Low compression, worn cylinders or burnt valves
- 3 Binding brakes
- 4 Clutch slip

CHAPTER 2

THE DIESEL ENGINE

- 2:1 Description
- 2:2 Working on the engine in situ
- 2:3 Removing the engine
- 2:4 Removing the cylinder head
- 2:5 Servicing the cylinder head and valves
- 2:6 Decarbonizing
- 2:7 Replacing the cylinder head
- 2:8 Removing the timing gear and camshaft
- 2:9 Replacing the timing gear and camshaft

- 2:10 Timing the injection pump
- 2:11 Servicing the oil pump and filters
- 2:12 Removing and replacing the clutch and flywheel
- 2:13 The pistons and rods
- 2:14 The crankshaft and main bearings
- 2:15 Reassembling a stripped engine
- 2:16 Fault diagnosis

2:1 Description

This engine is offered as an alternative to the petrol engines described in **Chapter 1**. **FIG 2:1** shows a sectional view. It provides 62 bhp at only 4000 rev/min and is a long lasting, powerful unit. The compression ratio is 23:1 and fuel is injected into the cylinders by C.A.V. Pintaux injectors. The pistons are of light alloy with a swirl inducing recess in the crown. Overhead valves are driven from a camshaft situated high up on the side of the engine which is in turn driven by chain and jockey wheel from the crankshaft. A distributor type rotary fuel pump is fitted and the fuel system has four fuel filters to ensure cleanliness of the delivery to the injectors.

A high capacity, spur gear oil pump is driven from the engine camshaft. This pump has a strainer submerged in the oil sump and an external fullflow filter unit with a replaceable element.

To assist in starting from cold, heater plugs are fitted to each cylinder. Operation of these is controlled by the starting key which has a 'heater plug' position. The key is held at this position for about 10 seconds before turning on to the starter motor position.

The high compression ratio of diesel engines makes heavy demands on the starter and a heavy duty pre-engaged type is fitted. To cope with the current requirements heavy duty batteries are provided.

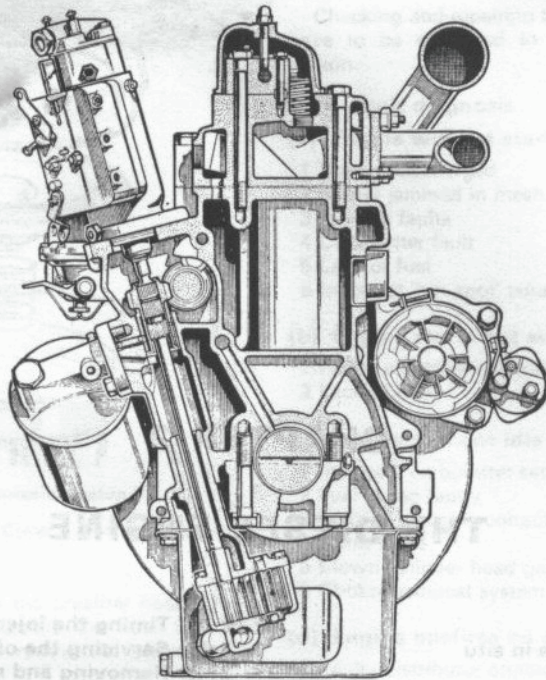
2:2 Working on the engine in situ

All components except the crankshaft and main bearings can be conveniently worked on with the engine installed in the vehicle. For a major overhaul however, where the engine is to be extensively reconditioned, it will be found quicker in the long run to remove it.

In most operations carried out with the engine in place, removal of the grille and radiator will simplify matters considerably.

For the operator who has no access to suitable lifting tackle the following operations are possible without removing the engine: Decarbonization and attention to the valves, renewal of the hot plugs, injectors and pushrod tubes, camshaft and tappet renewal, pistons, big-end bearing renewal, rocker shaft overhaul. The oil pump and strainer can also be worked on from below as can the clutch and flywheel if the gearbox is removed. Accessories such as the water pump, thermostat, starter, dynamo, injection pump and vibration damper, where fitted, are all easily accessible.

When working on the engine in the vehicle, if the engine is being run for test or any reason, make sure that an oil bath air cleaner, if fitted, is fixed safely in the vertical position. Should the cleaner be loose and tip sideways, it is possible for oil to be drawn in with the air and act as excess fuel. The engine will then overspeed out of control and serious damage can result.



Cross-section view of engine

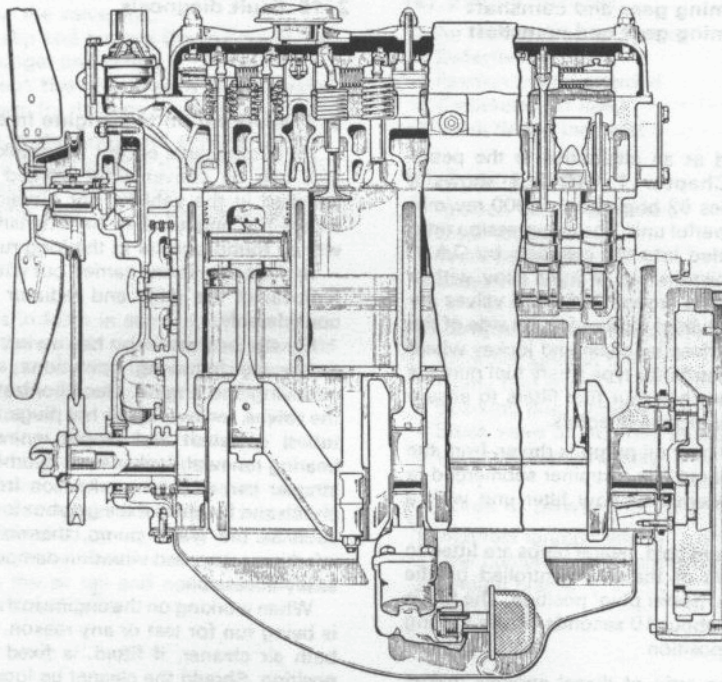


FIG 2:1 Sectional view of engine

2:3 Removing the engine

- 1 Remove the spare wheel from the bonnet, if fitted, disconnect the bonnet support stay, then lift the bonnet as high as possible and slide sideways out of the hinges.
- 2 Disconnect the air cleaner and hose.
- 3 Disconnect the battery leads and remove the battery.
- 4 Drain the coolant by undoing one tap below the radiator and one at the lefthand side of the cylinder block.
- 5 Disconnect the front lamp leads at the snap connectors and earth terminal. Now pull the wiring clear to the front of the engine.
- 6 Detach the top radiator hose at the header tank and the bottom hose from the water pump. Undo the fan blades and allow them to rest on the cowl. Remove them when the radiator and grille panel is removed.
- 7 Remove the bolts securing the front apron then the bolts securing the grille to the front crossmember and wings. Lift the radiator, grille panel and headlamps assembly upwards and forwards clear of the vehicle.
- 8 Loosen the bolts securing the front exhaust pipe and disconnect the exhaust pipe from the manifold.
- 9 Disconnect the heater pipes, if fitted, at the engine side of the dash.
- 10 Disconnect the wiring from the starter motor, generator, oil pressure warning switch and the glow plug (heater) lead from the resistance on the dash.
- 11 Disconnect the fuel pipe to the fuel pump and the fuel pipe from the spill pipe to the fuel filter. Plug all ports and lay the pipes away in a clean place to avoid the ingress of dirt.
- 12 Remove the accelerator rod then the cut-off cable from the steady bracket on the engine and from the lever on the injection pump.
- 13 If available, fit the Rover engine sling to the engine or otherwise make up a suitable rope sling to pass beneath the engine. With a suitably safe tackle just take the strain of the weight of the engine. Check any improvised sling for proper location.
- 14 Remove the front floor and gearbox cover from the body.
- 15 From below the vehicle, support the weight of the gearbox on substantial wooden blocks; do not use house bricks.
- 16 Remove the nuts and washers securing the gearbox to the flywheel housing.
- 17 Remove the engine front supports and gently pull it forward to clear the gearbox input shaft. Make sure all is clear then carefully hoist the engine from the vehicle.
- 18 At this point it is convenient to drain the oil from the sump before mounting the engine on a stand or supporting it on the floor for further work.

2:4 Removing the cylinder head

This operation can be performed with the engine either in or out of the vehicle. If in the vehicle, remove the bonnet, disconnect the battery and drain the coolant. Now proceed as follows:

- 1 Remove the air cleaner and flexible pipe complete.
- 2 Unscrew the dome nuts securing the rocker cover and lift the cover clear.
- 3 Remove the rocker shaft pedestal securing bolts, then

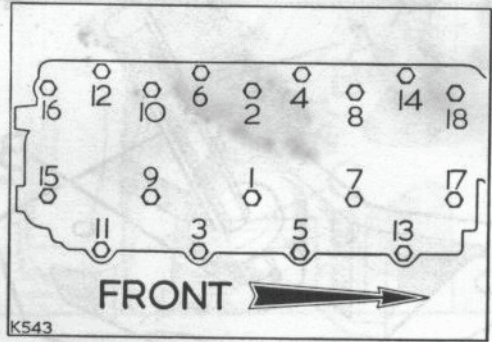


FIG 2:2 Cylinder head bolt sequence

Key to Fig 2:2 $\frac{1}{2}$ inch bolts 90 lb ft (12.5 mkg)
 $\frac{3}{8}$ inch bolts 18 lb ft (2.4 mkg)

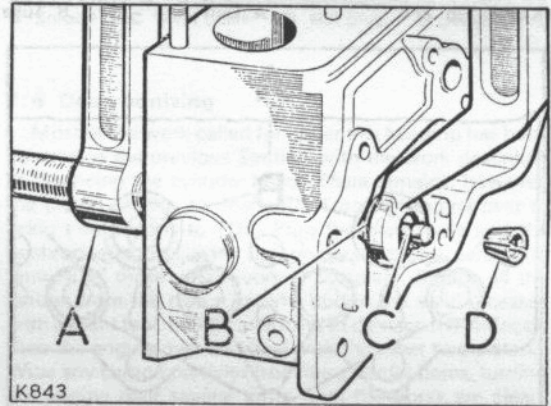


FIG 2:3 Removing the valves

Key to Fig 2:3 A Compressor tool B Spring C Valve D Split collets

fit the inverted rocker cover to the rocker bracket studs and remove the assembly using the top cover as a retainer.

- 4 Withdraw the pushrods keeping them in their correct order for refitting.
- 5 Disconnect the pipes from the main fuel filter; the pipe from the filter to the injection pump must be removed completely to prevent distortion.
- 6 Remove the bolts securing the filter to the support bracket of the engine, detach the heater plug earth lead and withdraw the filter.
- 7 Disconnect the fuel 'bleed back' pipe from the injector nozzle and from the union nut on the main fuel return pipe. Remove the fuel pipes, injection pump to nozzles. Fit blanking plugs or caps to the injection pump outlet unions, to the fuel lift pump outlet, to the fuel return pipe union and to the injector nozzle inlet and outlet unions.
- 8 Remove the injector nozzle securing nuts and remove the nozzle assemblies.
- 9 Disconnect the leads and take out the heater plugs.
- 10 Remove the top coolant hose and the thermostat bypass hose.

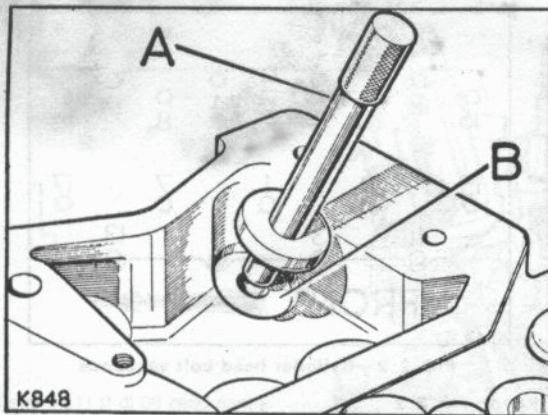


FIG 2:4 Removing pushrod tubes

Key to Fig 2:4 A Drift B Tube

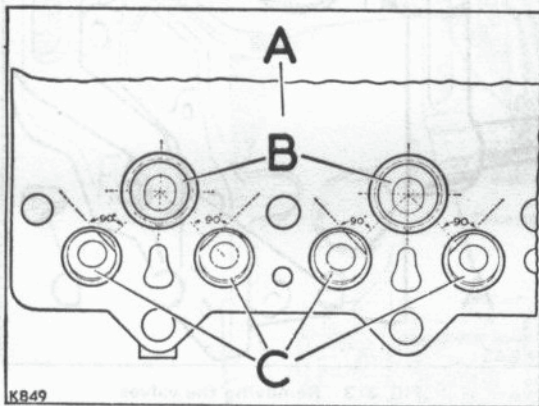


FIG 2:5 Position of pushrod tubes

Key to Fig 2:5 A Head B Hot plug C Pushrod tubes

- 11 Disconnect the oil feed pipe from the rear of the cylinder head, righthand side, and the front exhaust pipe from the manifold.
- 12 Loosen the cylinder head bolts evenly in the reverse order to that shown in FIG 2:2 then remove them completely and lift the head clear.
- 13 Remove the inlet and exhaust manifolds and the thermostat if necessary.

2:5 Servicing the cylinder head and valves

- 1 Remove the valves with a valve spring compressor as shown in FIG 2:3. Lay out the valves, springs, caps and collets so that if it is desired to refit them they will be in order of removal.
- 2 Clean all carbon from the cylinder head using a blunt scraper, make sure no carbon particles fall into the waterways by plugging these with rag or screws of newspaper. Be sure all these plugs are removed at the proper time. This operation is important because it is possible for a piece of hard carbon to fall from a waterway when the head is being replaced and lodge on the head gasket thereby spoiling the seal.

3 Clean all carbon from the valves but do not touch the seating face. Try the valves in their guides. If the clearance between the valve stem and the guide exceeds .004 inch (.096 mm), the parts are worn. Measure the valve stem; inlet valve stems should measure .3112 —.0005 inch (7.90 —.013 mm) and exhaust valves .3415 —.0005 inch (8.67 —.013 mm). If the valves are within these limits yet slackness is apparent between the valve and guide, new guides must be fitted.

- 4 Drift the guides from the head using Rover drifts, part Nos. 274400 and 274401, inlet and exhaust respectively. Remove and scrap the seals.
- 5 To fit new guides it is necessary to use drifts, part Nos. 600959 for the exhausts and 601508 for the inlets. Early type guides with internal oil seal grooves have three packing washers under the exhaust guide head and two packing washers under the inlet guide head. Later type guides for external oil seals do not require packing washers. Lubricate the outside diameter of a guide with engine oil and carefully drift into position.
- 6 If new guides have been fitted it will be necessary to recut the valve seats in the cylinder head to ensure concentricity with the guide. Remove the hard surface of the existing seating with a piece of emerypaper, then recut the seats to an angle of 45 deg. both inlet and exhaust. Special cutting tools, Rover part Nos. 274413 and 274414 inlet and exhaust, are available for this operation.

When cutting the seats do not apply excessive pressure to the tool as this may cause it to judder and ruin the seat.

- 7 If the old valves are to be used again check them for concentricity of the seat to the stem by applying a little engineers blue to the cylinder head seating and then refitting the valve and rotating it one turn. Marking all round the valve shows all is well. If not, the safest course is to fit a new valve. The old valve can be refaced on a valve truing machine provided this does not reduce the face to a knife edge.
- 8 The new or reground valves should be lapped into their seats using grinding paste. Smear a little paste on the valve face, insert it in the cylinder head and by applying a suction cup tool to the valve, oscillate the valve back and forth several times, raise the valve from its seat move it forwards a third of a turn and repeat the grinding process. Do this three or four times, pausing to re-distribute the paste, then remove the valve being careful not to touch the ground surface. If a grey band of contact shows all round the valve face and the cylinder head seat, all is well and the process can be repeated on the next valve. If contact is not obtained, repeat the grinding and again examine the faces. If proper contact is not obtained this time re-examine the valve for truth and the cylinder head seat for concentricity with the valve guides. Do not carry on grinding interminably. Wipe all traces of grinding paste from the head with clean rag, being careful to destroy this rag and anything else which may be contaminated with abrasive once the lapping is completed. Wash the valves in petrol and wipe dry.
- 9 To assemble the valves, first fit a new rubber seal to each valve guide, smear a little engine oil on the valve stem and insert it in the guide. Replace the springs,

caps and cotters with the aid of the spring compressor. Note that the springs are an interference fit in each other. If they are slack they must be scrapped. A red stripe is painted on springs suitable for the later type guides with external oil seals. It is recommended that the whole assembly, comprising exhaust valves, guides and springs is fitted in place of the earlier types, although later type springs can be fitted provided the packing washers are removed.

Pushrod tubes:

Leaks sometimes develop at these thereby necessitating renewal. Proceed as follows:

- 1 Drift out the defective tubes as shown in FIG 2:4 using Rover drift, part No. 274399. When the tubes are removed they are scrap.
- 2 Fit new tubes complete with sealing rings by pressing them into the head from the head face. Smear them well with Silicone MS4 compound beforehand. Ensure that the chamfers on the tubes and in the cylinder head are in full contact and that the flat on the tube is at right angles to a line drawn between the centre of the pushrod tube and the centre of the hot plug (see FIG 2:5).

Injector shrouds:

In order to renew the injector shrouds it is necessary to remove the hot plugs. FIG 2:6 clearly shows the construction.

- 1 Remove the hot plugs by inserting a copper drift through the injector shroud aperture and tap evenly round the inside of the hot plug.
- 2 If the injector shrouds are tight, drift them out towards the injector bore, then carefully clean the combustion chamber.
- 3 The hole in the side of the shroud is for manufacturing purposes only but can be used as a guide when fitting new ones.
- 4 Smear a little engine oil on the new shroud and insert in the cylinder head with the hole pointing towards the centre of the head. Drift into position using tool part No. 274399.
- 5 Replace the hot plugs by tapping gently with a hide-faced hammer. Check with a dial indicator to see that they do not protrude more than .001 inch (.025 mm) above the head face and are not recessed below the face more than .002 inch (.05 mm). If the plugs are loose in the head retain them temporarily with a little grease.

The rocker shaft-

- 1 To strip the shaft, remove all the components and lay them out in order as shown in FIG 2:7.
- 2 If necessary press the bushes from the rockers and press new ones in. Make sure the oil holes are in alignment. Ream the new bushes to .53 + .001 inch (13.5 + .02 mm).
- 3 To reassemble the shaft, fit an intermediate bracket to the shaft and engage locating screw (26 in FIG 2:7). Continue to assemble as shown in FIG 2:7 noting particularly that the rockers are 'handed'.

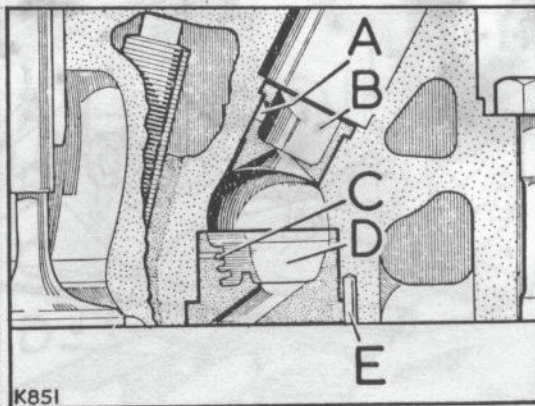


FIG 2:6 View of injector shroud and hot plug

Key to Fig 2:6 A Hole positioned towards head centre line B Shroud C Swirl holes D Hot plug E Locating peg

2:6 Decarbonizing

Most of the work called for under this heading has been covered in the previous Section with the work described in 'Servicing the cylinder head'. There remains, however, the piston crowns to deal with. Turn the engine over to bring two pistons to TDC. Plug the waterways and the pushrod apertures with rag or paper, being careful to remove all these when work is complete. Scrape all the carbon from the piston crowns and in the swirl recesses with a blunt tool, being careful not to damage the surfaces. Turn the engine over and deal with the other two pistons. Wipe any carbon particles from the cylinder bores, turning the engine over several times until the bores are clean. On no account use abrasive paper in an attempt to polish the pistons.

2:7 Replacing the cylinder head

- 1 Obtain a new gasket, and coat both sides sparingly with a jointing cement such as Hylomar SQ32M. Place the gasket on the cylinder block with the word 'Diesel' uppermost. Carefully place the cylinder head assembly on the gasket and loosely fit all the cylinder head bolts except those which hold the rocker shaft pedestals.
- 2 Replace the pushrods in their original positions making sure that their lower ends are correctly located in the tappets.
- 3 Locate the rocker shaft assembly on the cylinder head ensuring that the pushrods are seating on the rocker adjusting screws. Fit the pedestal bolts but do not tighten at this stage.
- 4 Now tighten all the cylinder head bolts in the order shown in FIG 2:2. All the $\frac{1}{2}$ inch bolts must be tightened to 90 lb ft (12.5 mkg) whilst the $\frac{5}{8}$ inch bolts must be tightened to 18 lb ft (2.4 mkg). Work round the sequence a little at a time trying to keep the pressure as even as possible.
- 5 Do not turn the engine over until all excess slack is eliminated from the tappets. Check each rocker for movement and take up the slack, turn the engine over half a turn and again check the tappets. Do this several

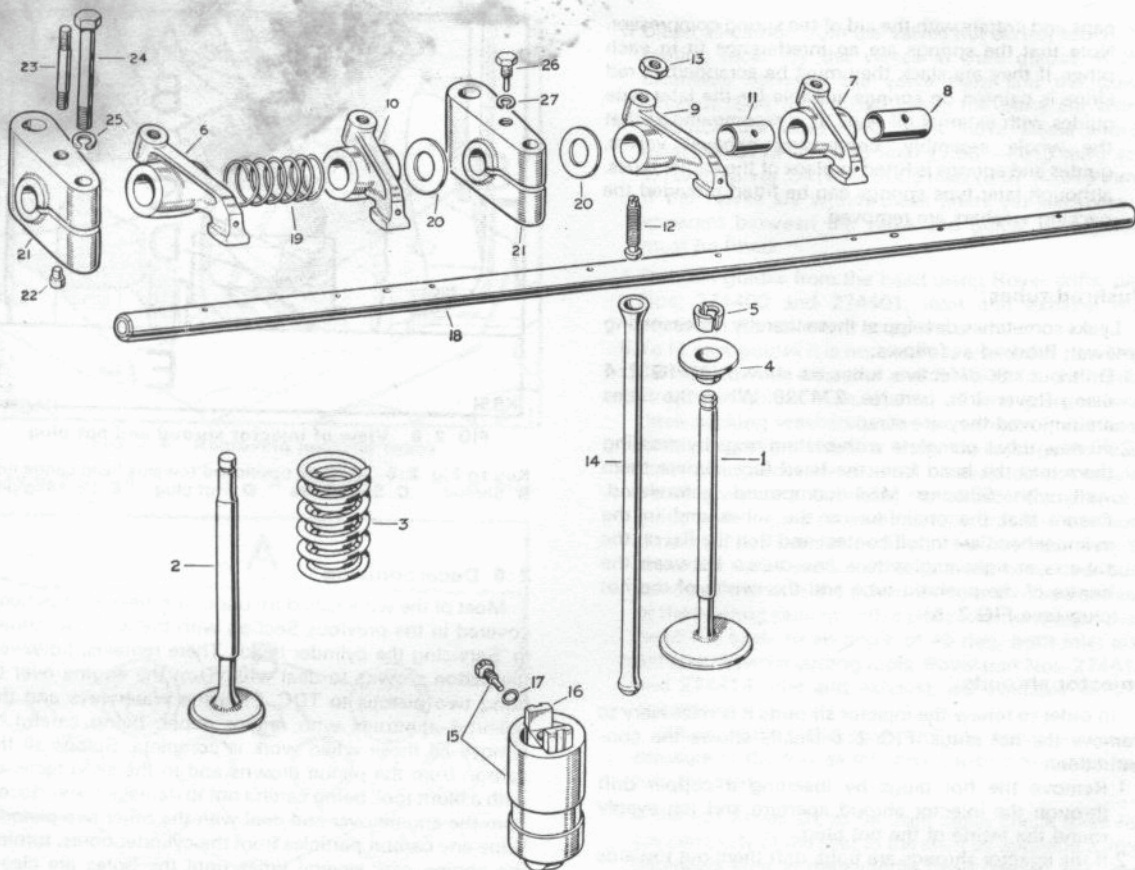


FIG 2:7 Rocker shaft arrangement

Key to Fig 2:7

1 Inlet valve	2 Exhaust valve	3 Valve spring, inner and outer	4 Valve spring cup
5 Split cone for valve, halves	6 Valve rocker, exhaust lefthand	7 Valve rocker, exhaust righthand	8 Bush for exhaust valve rocker
9 Valve rocker, inlet lefthand	10 Valve rocker, inlet righthand	11 Bush for inlet valve rocker	12 Tappet adjusting screw
13 Locknut for tappet adjusting screw	14 Tappet pushrod	15 Tappet, tappet guide, roller and setbolt assembly	16 Tappet
17 Copper washer for tappet guide setbolt	18 Valve rocker shaft	19 Spring for rocker shaft	20 Washer for rocker shaft
21 Rocker bracket	22 Locating dowel for rocker bracket	23 Stud for rocker bracket	24 Setbolt ($\frac{7}{16}$ UNF x 2 inch long) (fixing rocker bracket to cylinder head)
25 Spring washer (fixing rocker shaft at bracket)	26 Locating screw (for rocker shaft at bracket)		

times. This is important because excess slack can allow the pushrod to lift out of the spherical seat and on to the tappet slide. Further movement will then damage the pushrod.

6 The tappets can now be adjusted to their proper running clearance. This is .010 inch (.25 mm) with the engine hot or cold. Turn the crankshaft in the direction of rotation until No. 8 valve from the front of the engine is fully open. Check the clearance for No. 1 valve as shown in **FIG 2:8** using a feeler gauge, spanner and screwdriver. The complete sequence for setting tappets is as follows:

- Set No. 1 tappet with No. 8 valve fully open
- Set No. 3 tappet with No. 6 valve fully open
- Set No. 5 tappet with No. 4 valve fully open
- Set No. 2 tappet with No. 7 valve fully open
- Set No. 8 tappet with No. 1 valve fully open
- Set No. 6 tappet with No. 3 valve fully open
- Set No. 4 tappet with No. 5 valve fully open
- Set No. 7 tappet with No. 2 valve fully open

7 Complete the reassembly of the head by replacing the rocker cover and refitting the heater plugs. The injectors must also be replaced. Proceed as follows: Smear a new copper joint washer with grease and fit one to each injector. Insert a new corrugated sealing washer into each injector nozzle recess in the head with its raised portion upwards (see **FIG 2:9**). Locate the injectors in the head and tighten the clamping nuts to 6 to 8 lb ft (.8 to 1.0 mkg). Do not overtighten. Connect the injector feed pipes and spill pipes and tighten all the pipe unions. Tighten the heater plugs to 25 lb ft (3.4 mkg).

8 Replace the manifolds using new gaskets where required and complete the assembly by reversing the dismantling process.

2:8 Removing the timing gear and camshaft

To obtain access to the camshaft it is necessary to remove the timing cover and chain. If the engine is installed

in the vehicle, first remove those items which are in the way. Refer to **Section 2:3** and carry out operations 1 to 9. If the engine is out of the vehicle ignore **Section 2:3**. From here onwards the situation of the engine does not affect the work.

Remove the cylinder head as described in **Section 2:4** being careful to store all the injection equipment in a dustproof place. Now proceed as follows:

- 1 Slacken the generator mounting brackets and remove the fan belt.
- 2 Remove all the pipes from the injection pump and disconnect the throttle and cut-off controls. Blank off all the pump apertures either with the proper aluminium plugs or with adhesive tape to prevent the ingress of foreign matter.
- 3 Undo the securing nuts and washers then lift the pump upwards and clear of the engine.
- 4 The rear tappet chamber cover and fuel lift pump can now be removed as one unit. Take off the forward tappet chamber cover and oil filler pipe.
- 5 Undo the bolts retaining the water pump and remove the pump and joint washer.
- 6 Unscrew the starter dog and pull off the vibration damper (if fitted); remove the key. The starter dog will probably be jammed tight. To remove it, use a ring spanner and strike the handle sharply with a hammer.
- 7 The tappet assemblies must now be removed complete. First remove the guide locating bolts from the side of the cylinder block then with a piece of hooked wire lift out the roller and brass slide. Do not allow the guide to move or the roller may fall into the camshaft chamber. Keep the assemblies in order. Refer to the instructions given in **Chapter 1** for the 2½ litre petrol engine. The construction is the same.
- 8 The vertical drive shaft gear can be lifted out as shown in **FIG 2:10** after removing the locating screw from the external filter adaptor joint face. The split bush may be removed by tapping to release the dowels. Do not remove the aluminium plug in the gear unless absolutely necessary. A new plug must always be fitted if the old one is removed. This assembly is similar to the one described in **Chapter 1** for the 2½ litre petrol engine.
- 9 Undo the bolts and lift off the timing case front cover. The timing gear will appear as shown in **FIG 1:16, Chapter 1**. Remove the tensioner ratchet securing bolt and withdraw the ratchet and spring. Compress the tensioner spring, undo the securing bolts and lift off the tensioner. The timing chain will now be slack enough to lift off. Undo the bolt in the centre of the camshaft chainwheel. The chainwheel may pull off the shaft easily but a special puller may be necessary. This can be made up from a piece of mild steel with three bolts in it. The two outer ones are screwed into the holes in the wheel and the centre one is then tightened against the end of the shaft thus pulling the wheel free. If the wheel is very tight put a piece of brass on the end of the shaft to avoid damaging the thread.
- 10 The thrust plate bolts must now be removed and the thrust plate lifted away. The camshaft will now be free to come forward out of the engine. Do this very gently, supporting the shaft through the side apertures so that the intermediate bearings are not damaged.

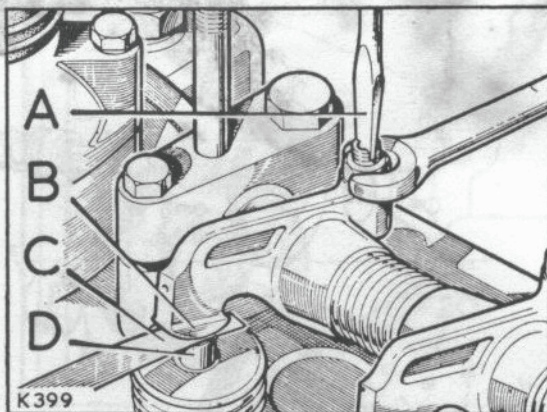


FIG 2:8 Setting the tappet clearance

Key to Fig 2:8 A Screwdriver B Rocker
C Feeler gauge D Valves

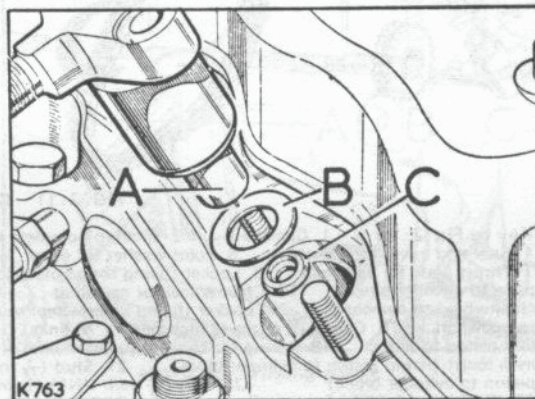


FIG 2:9 Fitting fuel injectors

Key to Fig 2:9 A Injector B Copper washer
C Steel washer, raised position uppermost

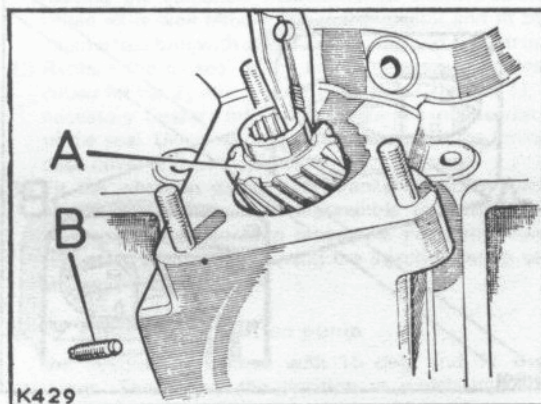


FIG 2:10 Removing the vertical drive shaft gear

Key to Fig 2:10 A Gear
B Locating screw housed in tapping at oil filter face

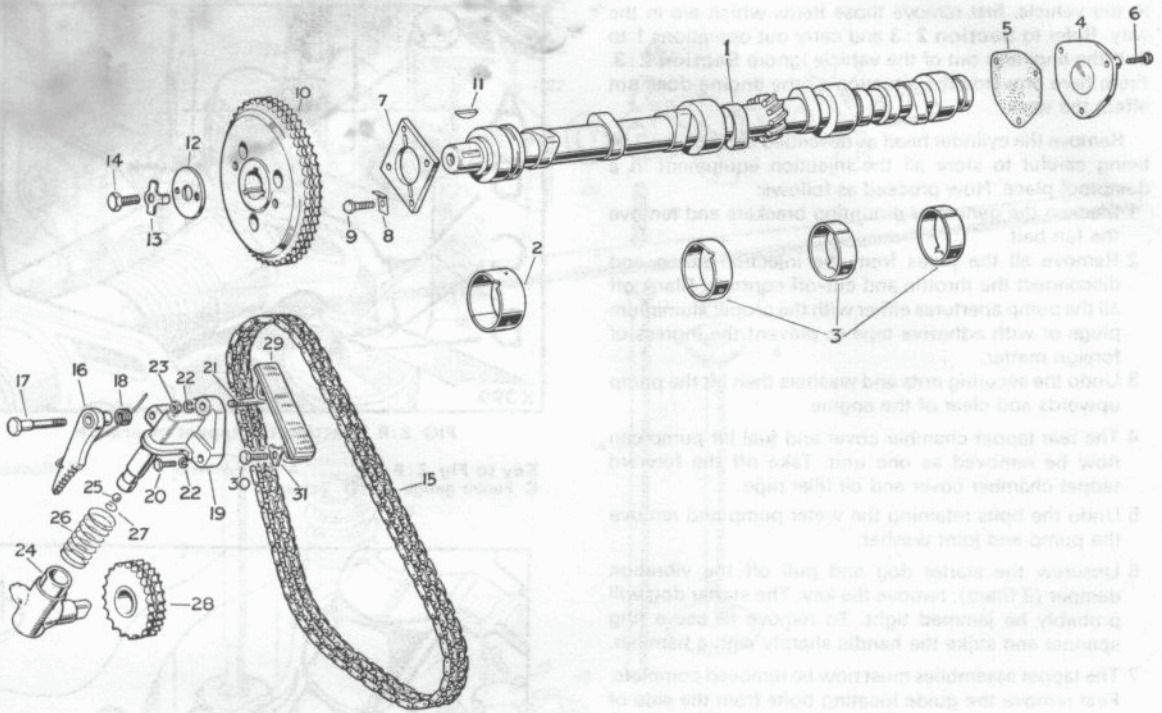


FIG 2:11 Camshaft components

Key to Fig 2:11 1 Camshaft 2 Bearing complete for camshaft, front 3 Bearing complete for camshaft, centre and rear
 4 Rear end cover for camshaft 5 Joint washer for cover 6 Setbolt ($\frac{1}{2}$ inch UNF x $\frac{7}{8}$ long) (fixing cover to block) spring washer
 7 Thrust plate for camshaft 8 Locker (fixing thrust plate to cylinder block) 9 Setbolt ($\frac{1}{2}$ inch UNF x $\frac{3}{4}$ inch long) (fixing thrust plate to cylinder block) 10 Chainwheel for camshaft 11 Key locating camshaft chainwheel 12 Retaining washer (fixing to chainwheel to camshaft) 13 Locker (fixing chainwheel to camshaft) 14 Setbolt ($\frac{3}{8}$ inch UNF x $\frac{7}{8}$ inch long) (fixing chainwheel to camshaft) 15 Camshaft chain ($\frac{3}{8}$ inch pitch x 78 links) 16 Ratchet for timing chain adjuster 17 Special bolt fixing ratchet and piston to block 18 Spring for chain adjuster ratchet 19 Piston for timing chain adjuster 20 Setbolt ($\frac{5}{16}$ inch UNF x $1\frac{1}{2}$ inch long) (fixing piston to cylinder block) 21 Stud ($\frac{5}{16}$ inch UNF) (fixing piston to cylinder block) 22 Spring washer (fixing piston to cylinder block) 23 Nut ($\frac{5}{16}$ inch UNF) (fixing piston to cylinder block) 24 Cylinder for timing chain adjuster
 25 Steel ball ($\frac{3}{32}$ inch) for non-return valve 26 Spring for chain tensioner 27 Retainer for steel ball 28 Idler wheel for timing chain 29 Vibration damper for timing chain 30 Setbolt ($\frac{1}{4}$ inch UNF x $\frac{1}{2}$ inch long) (fixing damper to cylinder block)
 31 Locking plate (fixing damper to cylinder block)

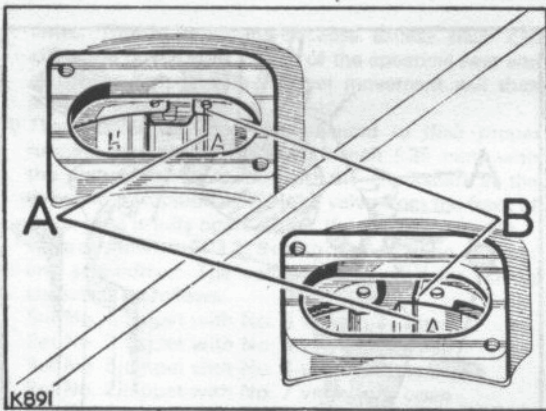


FIG 2:12 Early type pump, timing marks

Key to Fig 2:12 A Mark on pump rotor B Scribed mark or circlip straightedge

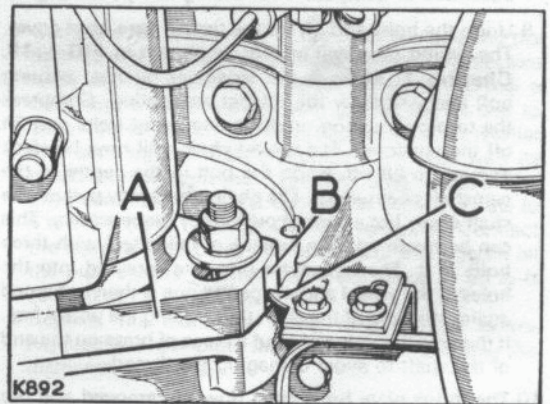


FIG 2:13 Later type pump, timing marks

Key to Fig 2:13 A Flange B Timing mark C Pointer

2:9 Replacing the timing gear and camshaft

Refer to FIG 2:11. This shows all the component parts quoted in this Section.

It is possible to replace bearings but these are supplied undersize when new and have to be line reamed in position. The tools needed are specialized and expensive therefore this is definitely a job for a Rover service station.

If a new camshaft is being fitted make sure that it is marked 'DIESEL' between No. 1 and 2 cams.

To reassemble the timing gear proceed as follows:

- 1 Smear a little clean engine oil on all the camshaft bearing surfaces then introduce it carefully into the engine. Support it until it is home in the rear bearing.
- 2 Fit the thrust plate and tighten the bolts but do not bend up the locking tags until the end float has been checked. Use a dial indicator and see that the shaft has between .0025 and .0055 inch (.06 to .13 mm) of float. If it is not within these limits, fit a new thrust plate. Bend up the locking tags.
- 3 Check the tappet assemblies for wear and replace where necessary. Smear each guide with oil and replace in the block making sure that the locating hole in the guide lines up with the screw hole in the block. Gently lower the roller into the guide, do not drop it in. Make sure the chamfer on the inside diameter faces to the front of the engine. Replace the tappet slide, also with the word 'FRONT' towards the front of the engine. Screw the locating bolt in with the fingers to make sure that it enters the hole in the guide. Continue until all the tappets are assembled. Tighten the locating bolts and then wire them together in pairs using 20 SWG iron wire.
- 4 Clean and examine the tensioner, replace any worn components, lubricate with engine oil and reassemble.
- 5 If the rubber on the chain vibration damper is grooved, fit a new damper.
- 6 Fit the camshaft chainwheel to the shaft but do not fit the bolt at this stage.
- 7 Replace the cylinder head, pushrods and rockers as described in Section 2:7.
- 8 Turn the crankshaft in the direction of rotation until the E.P. mark on the flywheel is in line with the timing pointer.
- 9 Fit a dial indicator to No. 1 cylinder exhaust valve, as shown in FIG 1:21, Chapter 1. Turn the camshaft in the direction of rotation until the cam has nearly fully opened No. 1 exhaust valve. Note the indicator reading and mark the chainwheel and timing case at this position. Turn the camshaft further onwards until the indicator again shows the same reading. Make another mark on the chainwheel exactly between the other two marks. This is the place where the valve is fully open. Turn the camshaft back until the centre mark on the wheel is opposite the mark on the timing case.
- 10 Fit the chain vibration damper then fit the chain with no slack on the driving side. It may be necessary to remove and reposition the chainwheel to obtain this condition. Do not turn the camshaft; watch the dial indicator as a check.
- 11 Refit the tensioner assembly and ratchet. Allow the jockey wheel to take up the slack in the chain.
- 12 Turn the crankshaft back against the direction of rotation half a turn then slowly turn forwards to the E.P.

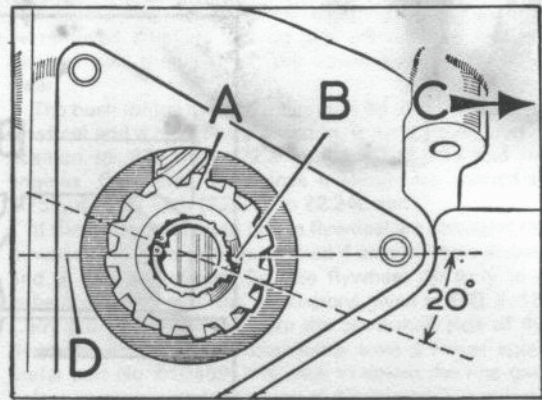


FIG 2:14 Setting the vertical drive gear

Key to Fig 2:14 A Drive gear B Master spline at 20 deg. angle to engine centre line C Front of engine D Line parallel with engine centre line

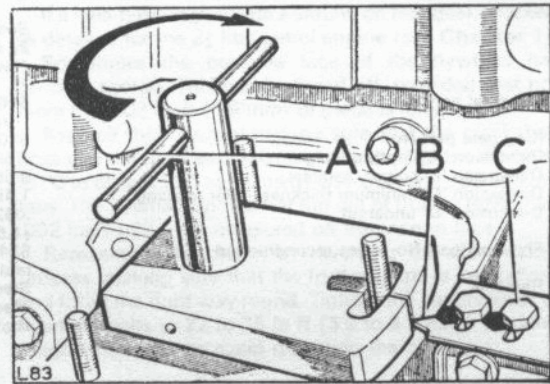


FIG 2:15 Timing gauge

Key to Fig 2:15 A Gauge in position B Pointer C Bolts retaining pointer

- mark. Check the dial indicator reading to see that No. 1 exhaust valve is fully open. If not, repeat item 10 by moving the camshaft chainwheel to another spline. When all is well remove the dial indicator and fit the chainwheel bolt with a new locking tag and tighten up.
- 13 Replace the oil seal in the timing case cover as described for the 2½ litre petrol engine (see Chapter 1), if necessary. Smear a little engine oil on the inner surface of the seal. Using all new joint washers, fit the timing case cover and bolt up evenly.
 - 14 Fit the vibration damper (or crankshaft pulley) and starter dog. Continue to reassemble the engine by reversing the dismantling procedure. For instructions regarding refitting and timing the injection pump see the next Section.

2:10 Timing the injection pump

The flywheel is marked with 15 deg. and 16 deg. markings. These give the position at which injection begins.

Early pumps have internal timing marks (see FIG 2:12), while the later type pump has an external mark (see FIG 2:13).

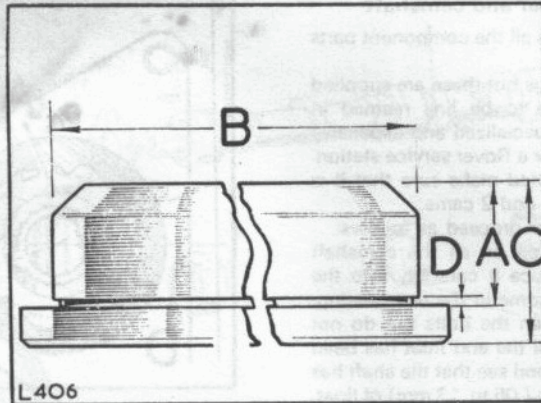


FIG 2:16 Flywheel reconditioning

Key to Fig 2:16	A	B	C	D
	Depth of spigot	Spigot diameter	Minimum thickness after refacing	Undercut
				<i>Series 2A</i>
				<i>2½ litre Diesel models</i>
				<i>(Multi-purpose, two and four dowel accommodation)</i>
				<i>Series 2A</i>
				<i>2½ litre Diesel models</i>
				<i>(Four dowel hole type)</i>
Flywheel part No.				566852 (Will replace 516082 and 546519)
Ring gear part No.				568431
Dimension 'A' depth of spigot ....	.750 inch (19.0 mm)			—
Dimension 'B' spigot diameter	9.562 inch (242.9 mm)			—
Dimension 'C' minimum thickness after refacing	1.454 inch (36.9 mm)			1.454 in (36.9 mm)
Dimension 'D' undercut ....	.062 inch x .031 inch (1.60 x .80 mm) deep			—
Flywheel part No. when reconditioned	524638 (Can be replaced by 549544)			Non available
Remarks	Steel flywheel. Machine from crankshaft flange side			Cast iron flywheel. Detachable ring gear fitted as original equipment. No machining necessary other than for refacing.

The 16 deg. mark is for the early type pump and the 15 deg. mark is for the later type pump.

Proceed to set the timing with the greatest precision and care possible.

- 1 Turn the crankshaft forwards until No. 1 piston is ascending on the compression stroke. Turn on slowly and align the appropriate timing mark with the pointer. If the crankshaft is turned too far do not turn back. Continue turning forwards until No. 1 piston is again on the compression stroke then again align the mark and pointer. Always look squarely at the pointer so that no errors of vision occur. These can put the timing out by as much as 2 deg.
- 2 Mesh the driving gear assembly with the camshaft so that the master spline is approximately 20 deg. from the centre line of the engine (front end, see FIG 2:14). Lock the split bearing bush in position with the grub screw.
- 3 Remove the inspection cover on the injection pump (early type) and rotate the spindle in the direction of rotation until the line marked 'A' on the driving plate, lines up with the mark on the timing ring (see FIG 2:12).

- 4 Fit the pump to the engine. With a mirror look through the pump inspection aperture and make the final adjustment by turning the pump body to align the timing ring with the 'A' mark. While doing this hold the pump drive plate and thus the skew gear against the drive side of the camshaft gear so that backlash does not upset the positioning.
- 5 Check the timing by turning the engine forwards until the 'A' mark on the pump driven plate aligns with the mark on the timing ring. If not, repeat the timing operation. Checking by this method will magnify any error. If correct, lock up all the pump fixings and replace the inspection cover.
- 6 If a later type pump with the external timing mark is being fitted, the special timing gauge part No. 605836 is essential. Set the engine flywheel to the 15 deg. mark then insert the drive gear as described earlier and illustrated in FIG 2:14. Insert the timing gauge, as shown in FIG 2:15 and twist in a clockwise direction to remove any backlash. Hold in this position, slacken the bolts (see FIG 2:15) and adjust the pointer B to align with the mark on the gauge. Tighten the bolts C. Remove the gauge and drop the short

drive shaft in locating it on the master spline. Rotate the pump shaft to line up with the master spline on the short drive shaft then fit the pump to the engine. Rotate the pump body until the timing mark (see **FIG 2:13**) lines up with the pointer then tighten the pump fixings. Check the timing by rotating the engine as described for the earlier type pump.

2:11 Servicing the oil pump and filters

If low oil pressure is traced to a defective pump it is best to fit an exchange pump if possible, rather than to attempt to recondition the pump. However, some improvement may be made by fitting new gears if the gear chamber is undamaged.

To remove the pump, drain off the engine oil and remove the sump. Undo the two securing bolts and lower the pump complete with driving shaft down and away from the engine. Lift out the driving shaft, unscrew the securing nut and take off the filter gauze assembly (see **FIG 1:30, Chapter 1**). Undo the bolts holding the upper casing to the lower body, tap them gently apart and remove the gears. The idler gear spindle may be removed if necessary. Unscrew the relief valve plug and release the spring, plunger and ball.

Wash all the parts in clean petrol and dry off. Assemble the gears in the gear chamber and check the radial clearance between the tips of the gear teeth and the chamber wall. This must not exceed .004 inch (.10 mm). Lay a straight-edge across the gear chamber face and measure the end float of the gears with feeler gauges. This should be between .002 and .005 inch (.0508 to .127 mm). If these clearances are exceeded, try fitting new gears. If this does not correct the measurement, a new pump is needed.

To assemble the pump, lubricate the gears and place in the gear chamber. Smear a little jointing compound between the gear chamber face and the upper body and bolt together. Fit the relief valve ball, plunger, spring and plug. Insert the longer end of the splined shaft into the pump and locate in the driving gear.

With the inlet port facing to the rear of the engine, offer the pump and driving shaft up into place and fit and tighten the securing bolts. Fit a new tabwasher and seal to the filter gauze pipe, position the filter square with the sump bottom and tighten the nut. Bend up the tab on the washer.

Refit the sump and refill with oil.

To renew the external oil filter element, place a drip tray beneath the filter housing and unscrew the bolt at the base of the filter housing, then unscrew the bolt at the base of the filter container. Withdraw the container and discard the element. Wash the container in petrol, wipe dry, then fit new inner and outer sealing rings, insert a new element then replace and bolt up the container.

2:12 Removing and replacing the clutch and flywheel

For this operation the engine must either be out of the vehicle or the gearbox must be removed as described in **Chapter 7**.

Mark the clutch coverplate and flywheel so that the plate can be refitted in its correct position on reassembly.

Undo the bolts holding the coverplate to the flywheel, working diametrically opposite each time and easing off the pressure gradually. Lift off the coverplate and driven (friction) plate. Note which way round the driven plate

was assembled. The flywheel retaining bolts can now be removed after the locking tags are released and the flywheel will then pull off the dowel and can be lifted clear.

The bush for the primary pinion can be drifted out of the flywheel and a new one pressed in. It must be reamed in position to .878 inch (22.3 mm) on Series II and IIA engines. On Series III engines it should be reamed to .8755 to .8757 inch (22.237 to 22.242 mm).

If the starter gear teeth on the flywheel are damaged the flywheel will have to be machined if an early type engine and a ring gear fitted. Set the flywheel up truly in a lathe and machine to the dimensions given in **FIG 2:16**. Carry out the machining from the crankshaft side of the flywheel. A ring gear is obtainable from a Rover agent under part No. 510489. It is wise to obtain the ring gear before commencing machining as dimension 'B' has been changed in later engines from 9.624 inch (244.44 mm) to 9.562 inch (242.9 mm). The ring gear is held to the flywheel by the clutch cover bolts. Make sure these are in good condition.

If a later type engine with a shrunk on ring gear, proceed as detailed for the 2½ litre petrol engine (see **Chapter 1**).

Sometimes the pressure face of the flywheel has become scored. This can be faced off, provided that not more than .03 inch (.76 mm) of metal is removed.

Replace the flywheel making sure that the crankshaft boss and the flywheel register are clean. Tighten the bolts to 60 to 65 lb ft (8.5 to 9.0 mkg) and lock with new locking tabs. The flywheel should not run out of true by more than .002 inch (.05 mm) measured on the friction face.

Reassemble the clutch by reversing the dismantling process, making sure that the friction plate is centralized and fitted the right way round. Tighten the clutch cover to flywheel bolts to 22 to 25 lb ft (3.0 to 3.5 mkg) working diagonally round to avoid distorting the cover.

2:13 The pistons and rods

These can be removed with the engine either in or out of the chassis.

Proceed to gain access to them by removing the sump and cylinder head as described in earlier Sections.

Turn the crankshaft until two big-ends are at BDC. Undo the big-end cap nuts and remove the cap. The cap will be numbered on one face to correspond with numbering on the rod. This identifies the crankpin (1 to 4) and shows which way round the caps must be refitted. Push the connecting rod up the bore and extract the piston and rod from the top of the cylinder block. Repeat for the other pistons and rods.

With the piston and rod assembly removed from the engine, remove the gudgeon pin circlips from the piston and push the gudgeon pin out towards the side marked 'X' on the piston crown.

Check the fit of the little-end bush on the gudgeon pin. There should be a maximum of .001 inch (.025 mm) clearance with the pin cold and dry. In practice, the pin should slide in without any perceptible side shake. If renewal of the bush is necessary, press out the old bush by using a vice and a distance piece. The new bush can be pressed in by the same method making sure that the oil holes are in alignment. Ream the bush carefully to size on a proper jig. There must be no make-shift methods used or the piston will not be in proper alignment with the rod.

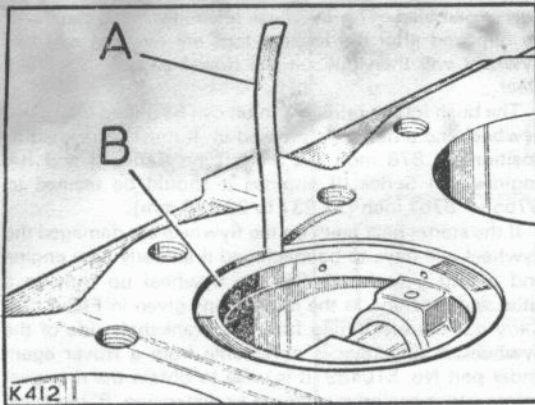


FIG 2:17 Checking piston clearance

Key to Fig 2:17
B Piston in cylinder bore

A Feeler gauge

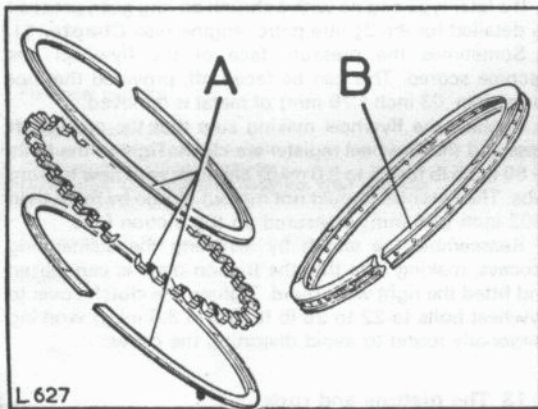


FIG 2:18 Scraper rings

Key to Fig 2:18 A Later type. Fit above gudgeon pin only
B Early type. Fit above or below gudgeon pin

Check that the connecting rod or cap has not been filed by bolting the rod and cap together without bearings then slackening one nut right off. There must be no clearance between the cap and rod at this side.

Check the connecting rod big-end bearing nip by assembling the rod and cap with the bearing shells which it is intended to use. Tighten the bolts then slacken one nut right off. There should now be a clearance of between .002 and .004 inch (.05 to .1 mm) on this side. This can be adjusted by selective assembly of the bearing shells as these are available in slightly varying thicknesses. Do not file the rod or cap.

The pistons must be cleaned of all carbon and oil deposit if it is intended to use them again. Clean the crown thoroughly paying particular attention to the swirl recess. Remove the piston rings by slipping an old feeler gauge under one end and working the ring over it and on to the land of the piston. Alternatively a simple three-legged device can be purchased cheaply at any accessory shop which makes this operation easy. Clean all carbon from the ring groove using a piece of a broken

ring as a scraper. Do not remove any metal from the piston while doing this.

Examine the piston skirt for heavy marking. If this has occurred at top and bottom on opposite sides, suspect a bent connecting rod and check accordingly.

The fit of the piston in the cylinder bore must be checked. In the absence of a more accurate method, insert a long length of .004 inch (.10 mm) feeler gauge stock in the bore and insert the piston as shown in FIG 2:17. The piston must be upside down and the gudgeon pin axis must be in line with the crankshaft. If the piston and bore are fit for further service the piston should become a tight fit when the bottom of the skirt enters the bore.

Check the piston ring gaps by entering each ring in the bore and then square it up by pushing a piston down behind it. Make sure the ring is in an unworn part of the bore when checking. The top ring must have a gap of .014 to .019 inch (.35 to .5 mm), the second and third compression rings .010 to .015 inch (.25 to .4 mm) and the early type one-piece scraper ring the same as the second and third rings. Later type three-piece scraper rings .015 to .045 inch (.4 to 1.14 mm). The side clearance in the groove should lie between .0025 to .0045 inch (.06 to .11 mm) for all rings, except late type scraper rings which must have .0015 to .0025 (.04 to .064 mm).

When fitting rings to the piston make sure that the second and third compression rings are fitted with the side marked 'T' uppermost. The top ring and the scraper can be fitted either way up.

It will be seen that the pistons have a second scraper ring groove at the bottom of the skirt. This is not used.

The later type three-piece scraper ring can be fitted as a replacement for the earlier one-piece ring but it must never be fitted in the groove below the gudgeon pin. Assemble it to the piston by first winding in one rail followed by the expander with its ends butted in line with the gudgeon pin. Take great care that the ends do not overlap. See that the coloured paint on each end of the expander is visible when the ring is fitted. Fit the second rail, positioning its gap approximately 1 inch (25.4 mm) to the left of the butted ends of the expander. FIG 2:18 shows the two types of scraper ring.

Check the gudgeon pin fit in the piston. With the pin cold and dry it should be an interference fit but capable of being fitted by hand pressure when the piston is warmed. On Series III models the gudgeon pin should be a hand fit in the piston at room temperature.

To reassemble the pistons and connecting rods, first fit the rings, correctly gapped as described earlier in this Section. Then fit the connecting rod to the piston with the oil spray hole in the rod on the same side as the V-shaped swirl recess in the piston crown. Push the gudgeon pin home from the side of the piston marked 'X' and secure with two new circlips. Never re-use circlips in pistons. Make sure they have seated in their grooves properly.

Fit a ring compressor to the piston and insert the piston and rod assembly in the cylinder bore from the top face of the block. The swirl recess in the piston crown must face the camshaft side of the engine. Gently tap the piston down through the compressor and into the bore using a piece of soft wood. Fit the big-end bearing shells and big-end caps and tighten the nuts to 25 lb ft (3.5 mkg). All components should be lightly lubricated with engine oil before assembly.

Complete the reassembly of the engine by replacing the sump and cylinder head. Refill the sump with engine oil.

2:14 The crankshaft and main bearings

For attention to these components the engine must be removed from the vehicle. The cylinder head, sump, timing chain, connecting rods, oil pump, flywheel and clutch must be taken off and the engine secured with the crankshaft uppermost.

To remove the shaft, undo all the bearing cap bolts and remove the caps; make sure that all are properly marked for reassembly. If the bearing shells are likely to be replaced keep them with their appropriate bearings. Lift out the shaft.

This crankshaft can not be reconditioned for diesel engines. If the shaft journals are worn oval or scored a new crankshaft of standard size should be fitted.

Remove the rear oil seal retainer halves from the crankcase and rear main bearing.

Before fitting the new shaft or replacing the old one, make sure that everything is clean and dry. Pay particular attention to the oilways in the shaft. Wash them through with petrol from a good force feed gun and dry off with compressed air.

First check the main bearing nip. Fit the shells to the crankcase and bearing caps then bolt up to a torque of 100 lb ft (13.8 mkg). Slacken one bolt right off and with a feeler gauge see that between .004 to .006 inch (.1 to .15 mm) clearance exists between the cap and crankcase on the side which has the slackened bolt. Do this to each bearing. The clearance can be adjusted by selective assembly of bearing shells as they are available in slightly varying thicknesses.

When the nip has been correctly adjusted, remove the bearing caps and fit new standard size thrust bearings to each side of the centre main bearing. Lay the crankshaft in place but do not lubricate at this stage.

Refit the bearing caps and shells and bolt up evenly. Check that the crankshaft will turn freely by hand. It should resist rotation when a .0025 inch (.06 mm) shim paper is placed between any bearing shell and crankshaft journal. Adjust by selective assembly of bearing shells.

Using a dial indicator check the crankshaft end float. It should lie between .002 and .006 inch (.05 and .15 mm). If not, fit suitable oversize thrust bearings. Make sure that the crankshaft remains central by not allowing the variation in thrust bearing thickness at either side to exceed .003 inch (.07 mm). Remove the crankshaft. The rear main bearing oil seal is fitted in exactly the same way as the seal for the petrol engines. Refer to **Chapter 1** for details.

Tighten the bearing bolts hand tight and rotate the shaft to make sure it is free. If correct, then proceed to pull the bolts on all the main bearings up to 100 lb ft (13.8 mkg) gently and evenly, rotating the shaft from time to time to check for freedom of movement.

When the engine has run for a while oil leakage can sometimes occur past the neoprene seals in the sides of the rear main bearing cap. To avoid having to strip the engine completely, remove the sump and with a square section drift, ram the neoprene seals up in their grooves as far as they will go. Insert a short piece of seal in each groove leaving the new piece protruding below the cap face by $\frac{1}{2}$ inch (.8 mm). Replace the sump and pull the sump bolts up tight.

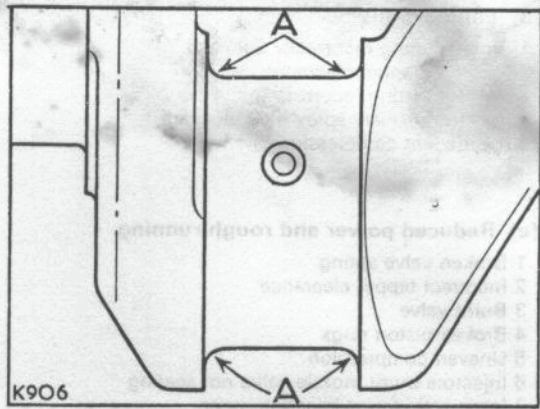


FIG 2:19 Crankshaft journal radius

Key to Fig 2:19

A Radius .150 inch (3.8 mm)

2:15 Reassembling a stripped engine

All dismantling and reassembly operations have been given in preceding Sections, so it is simply a matter of taking the various operations in the proper sequence. Before starting work a complete set of gaskets, special washers, circlips, splitpins and locking tags must be obtained. Never attempt to replace any of these items once used. Make sure that all oilways are clear and clean and have their running surfaces lubricated with engine oil as assembly proceeds.

Commence by fitting the crankshaft, connecting rods, pistons and flywheel. It is necessary to fit the flywheel at this stage as the markings on its periphery will be needed to time the camshaft and injection pump. Fit the camshaft and the oil pump then bolt the sump on. Turn the engine right way up and fit the tappets then the cylinder head, pushrods and rocker gear. Time the camshaft and fit the chain, tensioner and rocker gear. Replace the water pump and timing cover. Press the pulley on to the crankshaft and lock with the starter dog. Fit the clutch and the injection pump.

The engine can now be replaced in the vehicle and the thermostat, water pump, generator, heater plugs, injectors and piping added. Replace the rocker cover after the tappet clearances have been set.

2:16 Fault diagnosis

(a) Engine will not start

- 1 Incorrect starting procedure
- 2 Starter motor defective
- 3 Batteries discharged
- 4 Heater plug circuit broken
- 5 Foreign matter in fuel system
- 6 Supply of fuel to injectors restricted
- 7 Insufficient compression
- 8 Injector setting incorrect
- 9 Injector auxiliary spray hole blocked

(b) Engine stalls

- 1 Slow-running incorrectly adjusted
- 2 Incorrect tappet clearance
- 3 Injector setting incorrect
- 4 Injector auxiliary spray hole blocked
- 5 Insufficient compression

(c) Reduced power and rough running

- 1 Broken valve spring
- 2 Incorrect tappet clearance
- 3 Burnt valve
- 4 Broken piston rings
- 5 Uneven compression
- 6 Injectors burnt, nozzle valve not seating
- 7 Incorrectly timed injection pump
- 8 Fuel supply restricted
- 9 Injectors loose in cylinder head
- 10 Fuel pump delivery insufficient

(d) Engine overheats

- 1 Defective cooling system
- 2 Defective lubrication system
- 3 Defective injectors
- 4 Incorrect injection pump timing
- 5 Restricted fuel supply

(e) Low oil pressure

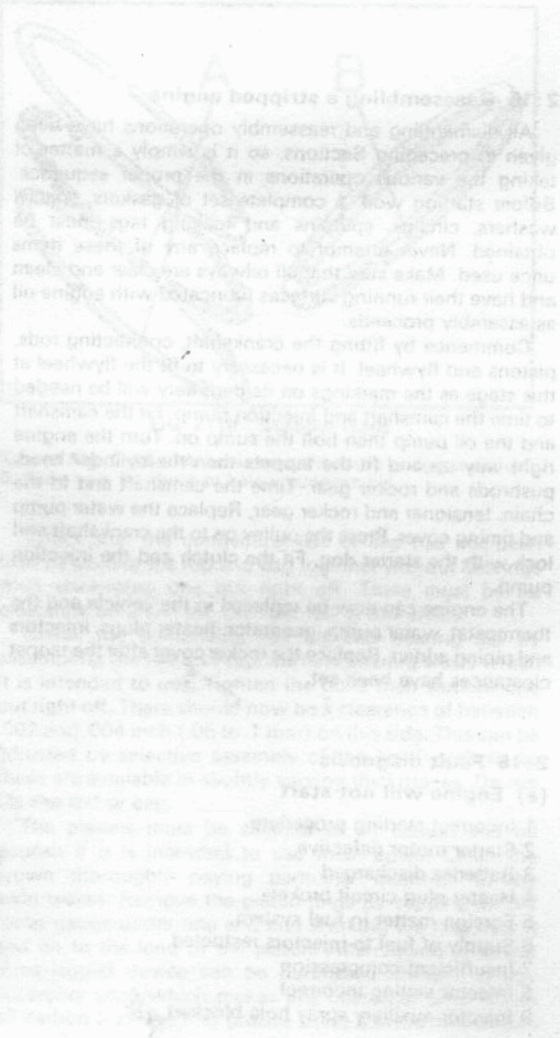
- 1 Defective pump
- 2 Relief valve not seating
- 3 Worn bearings
- 4 Wrong grade or insufficient oil

(f) Black smoke from exhaust

- 1 Defective injector
- 2 Injection pump wrongly timed

(g) White vapour from exhaust (hot engine)

- 1 Coolant leaking into combustion chamber





CHAPTER 3A

THE PETROL FUEL SYSTEM

- 3A :1 Description
- 3A :2 The fuel pumps
- 3A :3 The carburetters
- 3A :4 The air cleaner

- 3A :5 Evaporative loss control
- 3A :6 Exhaust emission control
- 3A :7 Setting the throttle control
- 3A :8 Fault diagnosis

3A :1 Description

Four types of carburettor are fitted to the petrol engine vehicles described in this book. The 2½ litre engines are fitted with either a Solex or Zenith type, while the 2.6 litre models have the Stromberg or SU. Note that the Stromberg is made by the Zenith Co. and carries their name. Reference to the illustrations in this Chapter will make clear the type of carburettor with which a particular vehicle is equipped. The 2½ litre engines have a mechanical fuel pump and the 2.6 litre has the electric pump. Both are illustrated and described. The fuel filter is incorporated in the design of the mechanical pump, but the electric pump feeds a separate filter in the engine compartment.

3A :2 The fuel pumps

(a) Mechanical:

In this Section refer to **FIG 3A :1**, noting particularly that components for the early and later type pumps are shown.

To dismantle the pump proceed as follows:

- 1 Undo the retainer 11 and remove the sediment bowl 10, gasket 9 and filter 8.
- 2 Mark the top and bottom halves of the body then undo the screws 2, and separate the parts.
- 3 Remove the valve retainer 6 and pull out the valves 5. **Particularly note which way up each one is fitted.** On later models the valves are staked into the body. Scrape away the staking to remove the valves.

- 4 Ease the diaphragm 12 from the rim of the lower body then depress it slightly in the centre and turn either way through 90 deg. when it will be pushed clear by spring 13.

- 5 Prise out the oil seals 14, 15 or 27, 28.

- 6 To release the rocker arm 24, remove pin 21, or 30. The later pin is held by the retainers 31.

Inspect all parts carefully and wash in clean fuel. Obtain a service kit and renew the diaphragm, oil seals and sediment bowl gasket. If the valves are suspect these should also be replaced.

To rebuild the pump carry out the following operations:

- 1 Replace the rocker arm and pivot pin. If a late type pump, peen the retainers into the pump body.
- 2 Fit new oil seals and peen the housing flange over the retainer in at least three places.
- 3 Hold the pump body with the rocker arm downwards and the diaphragm return spring in place. Position the diaphragm over the spring with the flattened end of its rod in line with the slot in the link. Push downwards then turn to engage with the link.
- 4 Replace the valves.
- 5 Put the top cover over the lower body, aligning the marks made when dismantling. Fit the screws but do not tighten. By means of the priming lever, depress the diaphragm fully; now tighten all the screws. If this is properly done the diaphragm edges will be flush with

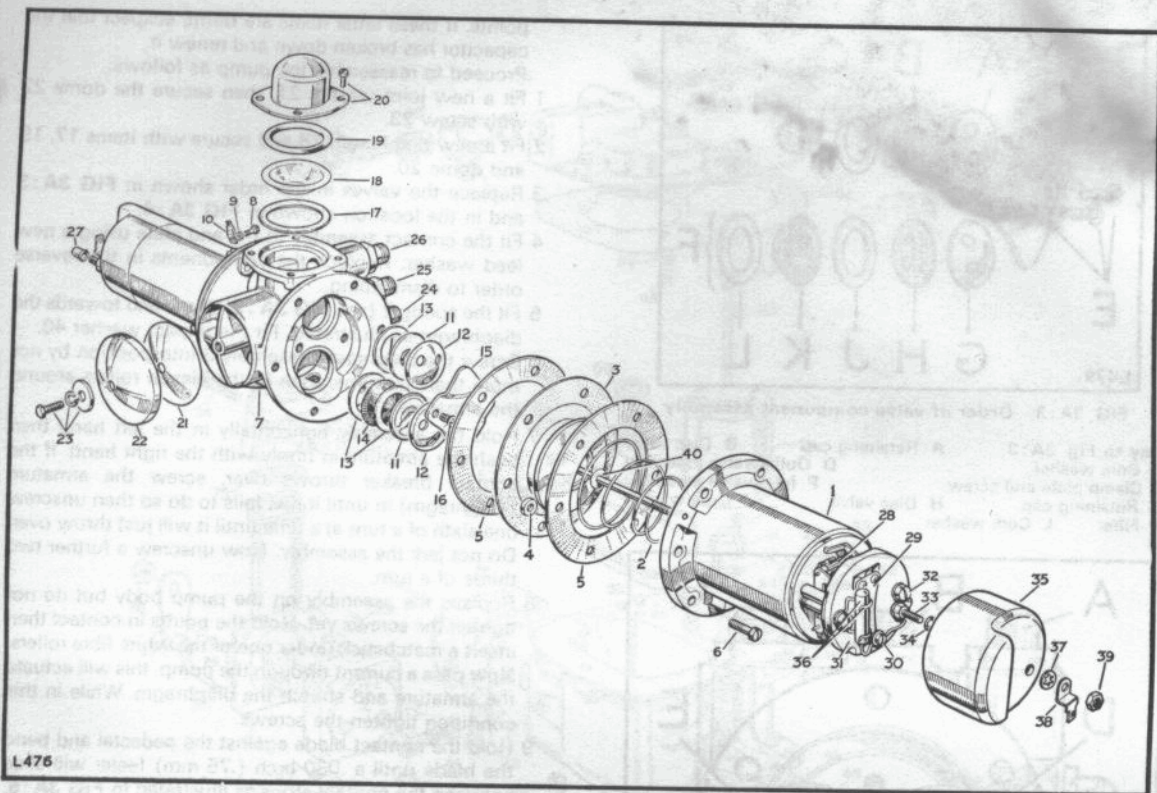


FIG 3A:2 Electric fuel pump

- | | | | | | |
|------------------------------------|----------------------------|--------------------------------------|--------------------------------------|-----------------------------------|---------------------------------------|
| Key to Fig 3A:2 | 1 Magnet housing | 2 Spring for armature | 3 Diaphragm | 4 Roller | 5 Joint washer |
| 6 Securing screw, body to housing | 7 Body | 8 Special screw (earth connection) | 9 Spring washer (earth connection) | 10 Lucar blade (earth connection) | 11 Melinex valve assembly |
| 12 Valve cap | 13 Sealing washer | 14 Fuel filter sealing ring | 15 Clamp plate | 16 Clamp plate screws | 17 Sealing ring for outlet air bottle |
| 18 Diaphragm for outlet air bottle | 19 Rubber | 20 Outlet air bottle, dome and screw | 21 Joint washer for inlet air bottle | 22 Cover for inlet air bottle | 23 Securing screw and washers |
| 24 Union, main fuel supply | 25 Union, main fuel supply | 26 Union for outlet pipe | 27 Nylon protection cap | 28 Contacts rocker assembly | 29 Spring blade contact |
| 30 Anchor screw | 31 Moulded end plate | 32 Retaining screw for end plate | 33 Terminal screw | 34 Composition washer | 35 End cover |
| 36 Condenser and clip | 37 Shakeproof washer | 38 Lucar blade | 39 Nut | 40 Impact washer for armature | |

the pump joint faces. If not, slacken the screws and repeat the operation.

- Replace the filter and sediment bowl, using the new gasket. Do not overtighten the retainer nut.

To test the pump, immerse it in a bath of clean paraffin and operate the rocker arm several times. Empty the pump then place a finger over the inlet port. Operate the rocker arm again for several strokes then remove the finger. A distinct suction sound should be heard. Repeat for the outlet side. This time, air pressure should be felt for 2 or 3 seconds after the rocker arm has stopped operating. Again hold the finger over the outlet and build up pressure; immerse the pump in the paraffin and look for air bubbles round the diaphragm joint.

(b) Electric, double entry:

In this Section refer to FIG 3A:2; both ends of the pump are similar so the overhaul instructions apply to each.

To dismantle this pump, proceed as follows:

- Remove the end cover 35.

- Mark the magnet housing 1 and body 7 then remove the screws 6 and gently pull the components apart.
- Unscrew the diaphragm 3 in an anticlockwise direction, taking care not to lose the eleven rollers 4.
- Remove the diaphragm complete with spring and gaskets.
- Remove the contact 29, then the terminal screw 33 and nut.
- Remove the end plate 31 and capacitor 36.
- Remove the contact pivot pin from the mechanism.
- Remove the lead washer and terminal screw from the end cover. If the main body and valves require attention continue as follows:
- Remove the outlet air bottle dome 20 and items 17, 18 and 19, keeping them in order for reassembly.
- Remove items 23, 22 and 21 from the inlet air bottle.
- Remove the clamp plate 15 and gently ease out the valve assemblies, keeping them carefully in order for reassembly.

Inspect all components for damage and renew all diaphragms, gaskets and if necessary, the contact

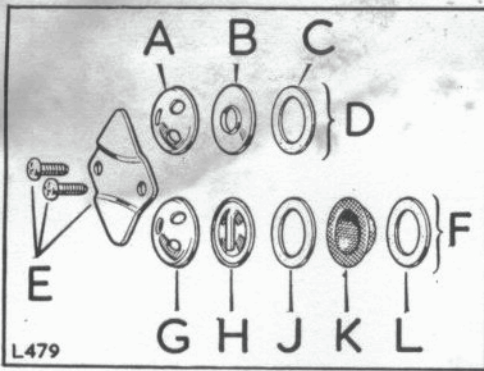


FIG 3A:3 Order of valve component assembly

Key to Fig 3A:3
 A Retaining cap B Disc valve
 C Cork washer D Outlet valve assembly
 E Clamp plate and screw F Inlet valve assembly
 G Retaining cap H Disc valve J Cork washer
 K Filter L Cork washer

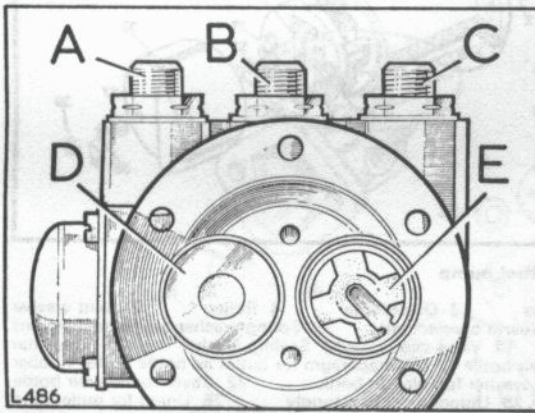


FIG 3A:4 Location of valves

Key to Fig 3A:4
 A Outlet B Righthand inlet
 C Lefthand inlet D Outlet valve E Inlet valve

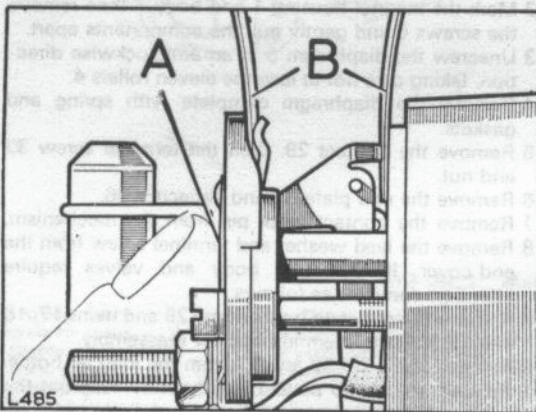


FIG 3A:5 Checking contacts

Key to Fig 3A:5
 A Contact blade
 B Gauges, .030 inch (.75 mm) minimum clearance

points. If these latter items are burnt, suspect that the capacitor has broken down and renew it.

Proceed to reassemble the pump as follows:

- 1 Fit a new joint washer 21, then secure the dome 22 with screw 23.
- 2 Fit a new diaphragm 18 and secure with items 17, 19 and dome 20.
- 3 Replace the valves in the order shown in FIG 3A:3 and in the location shown in FIG 3A:4.
- 4 Fit the contact assembly to the end plate using a new lead washer. Replace the components in the reverse order to dismantling.
- 5 Fit the spring 2 (see FIG 3A:2), large end towards the diaphragm as illustrated. Fit the impact washer 40.
- 6 Screw the diaphragm assembly 3 into position by not more than six turns, then fit the eleven rollers around the armature.
- 7 Hold the assembly horizontally in the left hand then push the armature in firmly with the right hand. If the contact breaker throws over, screw the armature (diaphragm) in until it just fails to do so then unscrew one sixth of a turn at a time until it will just throw over. Do not jerk the assembly. Now unscrew a further two thirds of a turn.
- 8 Replace the assembly on the pump body but do not tighten the screws yet. Hold the points in contact then insert a matchstick under one of the white fibre rollers. Now pass a current through the pump, this will actuate the armature and stretch the diaphragm. While in this condition tighten the screws.
- 9 Hold the contact blade against the pedestal and bend the blade until a .030 inch (.75 mm) feeler will slide between the contact stops as illustrated in FIG 3A:5. Refit the cover.

To test the pump see that it will lift fuel (either petrol or paraffin) 3 feet from a supply tank, priming itself promptly. Block the outlet; the action should cease for at least 15 seconds.

3A:3 The carburetters

(a) 2½ litre engine, Solex carburetter

In this Section refer to FIG 3A:6.

To dismantle the carburetter, remove components in the following order:

- 1 Detach the cover 61, removing elbow 72 if necessary.
- 2 Remove the joint washer 62.
- 3 Unscrew the valve 59 and remove complete with washer 60.
- 4 Remove the screw 14, then detach chamber 2 from body 1. Remove gasket 18.
- 5 Make light marks on the throttle butterfly and choke wall then remove the two screws from the spindle, remove the butterfly and withdraw the throttle spindle.
- 6 Remove screws 30 and detach the starter unit.

Note that this may or may not have the heater assembly 23 fitted.

- 7 Remove the float 56 from the body then items 41, 34, 49, 50, 39, 53, 51, 36 and 47 in that order.
- 8 Detach the accelerator pump by removing the screws 33.

Inspect all parts for damage, particularly the throttle spindle bore for ovality and the float for punctures. If either of these are found renew the parts concerned. Do not clean out any jets or fuel passages with wire or metal

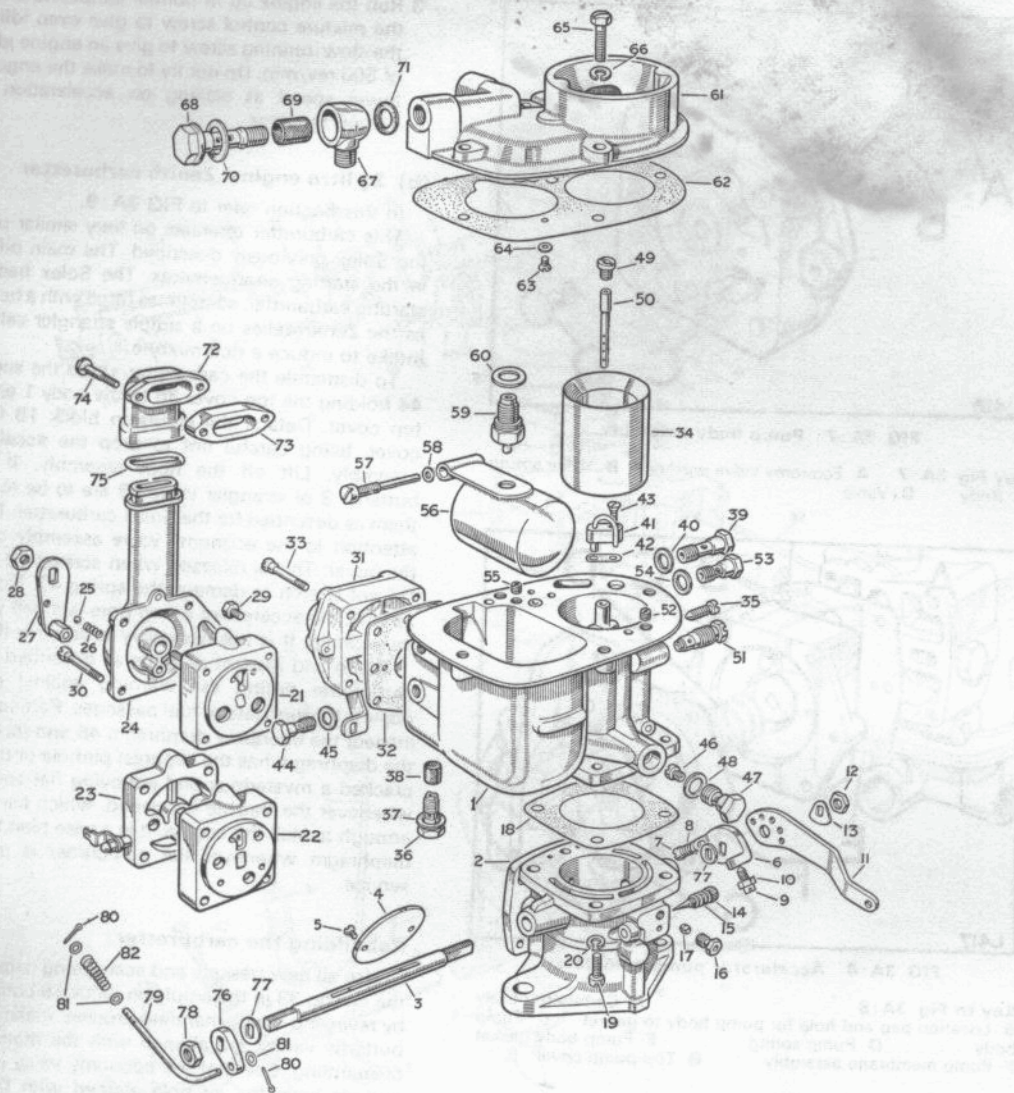


FIG 3A:6 Solex carburetter

- Key to Fig 3A:6**
- | | | | |
|---|--|--|--------------------------------------|
| 1 Carburetter body | 2 Throttle chamber | 3 Spindle for throttle | 4 Butterfly for throttle |
| 5 Special screw fixing butterfly | 6 Throttle abutment plate | 7 Special screw for slow-running adjustment | 8 Spring for slow-running adjustment |
| 9 Special screw for throttle stop | 10 Locknut for throttle stop | 11 Throttle lever | 12 Nut fixing throttle lever |
| 13 Lockwasher for nut | 14 Special screw for mixture control | 15 Spring for mixture control | 16 Screwed union for suction pipe |
| 17 Olive for suction pipe | 18 Joint washer for throttle chamber | 19/20 Fixing chamber to carburetter body | |
| 21 Starter body and valve, without starter heater element | 22 Starter body and valve complete with starter heater element | | |
| 23 Heater element for starter | 24 Cover for starter | 25 Ball for starter valve | 26 Spring for starter valve |
| 27 Lever for starter | 28 Nut fixing starter lever | 29 Special bolt fixing starter cable | 30 Special screw fixing starter body |
| 31 Accelerator pump complete | 32 Joint washer for pump | 33 Special screw fixing pump | 34 Choke tube |
| 35 Special screw fixing choke tube | 36 Non-return valve | 37 Fibre washer for valve | 38 Filter gauze for non-return valve |
| 39 Jet, accelerator pump | 40 Fibre washer for jet | 41 Pump injector | 42 Joint washer for pump injector |
| 43 Special screw fixing injector | 44 Economy jet (blank) | 45 Joint washer for blank jet | 46 Main jet |
| 47 Main jet carrier | 48 Fibre washer for carrier | 49 Correction jet | 50 Emulsion tube |
| 51 Pilot jet | 52 Jet air bleed | 53 Starter jet, petrol | 54 Fibre washer for jet |
| 55 Economy jet | 56 Float | 57 Spindle for float | 58 Copper washer for spindle |
| 59 Needle valve complete | 60 Fibre washer for valve | 61 Top cover for carburetter | 62 Joint washer for top cover |
| 63/64 Joint washer to top cover fixings | 65/66 Top cover to body fixings | 67 Banjo union | 68 Special bolt for union |
| 69 Filter gauze for union | 70 Large fibre washer | 71 Small fibre washer | 72 Elbow for top cover |
| 73 Distance piece, elbow to top cover | 74 Screw fixing elbow to top cover | 75 Rubber sealing washer, elbow to starter cover | 76 Lever for accelerator pump rod |
| 77 Special washer for lever | 78 Nut fixing lever to spindle | 79 Control rod for accelerator pump | 80 Splitpin for control rod |
| 81 Plain washer for control rod | | | |

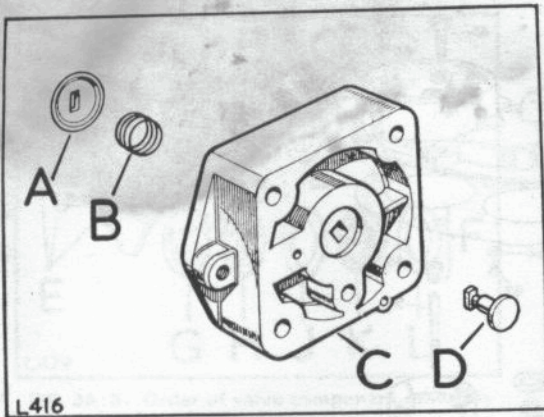


FIG 3A:7 Pump body assembly

Key Fig 3A:7 A Economy valve washer B Valve spring
C Body D Valve

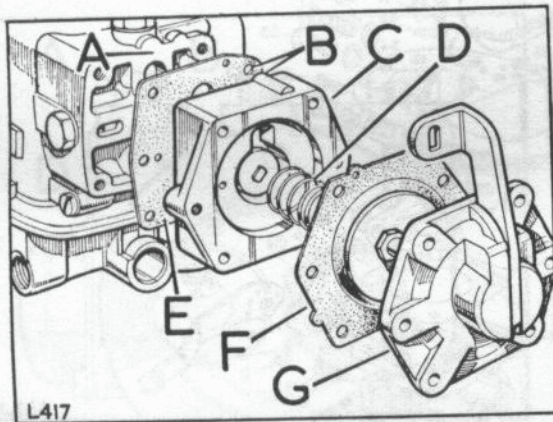


FIG 3A:8 Accelerator pump complete

Key to Fig 3A:8 A Carburettor body
B Location peg and hole for pump body to gasket C Pump body
D Pump spring E Pump body gasket
F Pump membrane assembly G Top pump cover

tools. Nothing more than an air jet should be necessary. Examine the accelerator pump diaphragm for pin holes and renew if any are present. Use all new seals and gaskets when rebuilding.

Rebuilding the carburetter:

This is a reversal of the dismantling procedure but refer to FIG 3A:7 to see that the economy valve is held in place by turning washer A through 90 deg. FIG 3A:8 shows the complete accelerator pump assembly. When replacing the butterfly, see that the marks made when dismantling are in alignment.

Tuning the carburetter for slow-running:

- 1 Set the mixture control screw one and a half turns from fully in.
- 2 Screw the slow-running throttle stop screw one turn further in after contacting the abutment.

3 Run the engine up to normal temperature then adjust the mixture control screw to give even idling. Adjust the slow-running screw to give an engine idling speed of 500 rev/min. Do not try to make the engine idle at a lower speed as stalling on acceleration is almost certain to occur.

(b) 2½ litre engine, Zenith carburetter

In this Section refer to FIG 3A:9.

This carburetter operates on very similar principles to the Solex previously described. The main difference lies in the starting arrangements. The Solex had a separate starting carburetter, sometimes fitted with a heater, whereas the Zenith relies on a simple strangler valve in the air intake to induce a rich mixture.

To dismantle the carburetter, undo the screws 43 and 44 holding the top cover 36 to the body 1 and lift off the top cover. Detach the emulsion block 19 from the top cover, being careful not to drop the accelerator pump assembly. Lift off the float assembly. If the throttle butterfly 3 or strangler valve 58 are to be removed, mark them as described for the Solex carburetter. Pay particular attention to the economy valve assembly on the top of the cover. This is released when screws 49 are removed. Do not stretch or damage the spring 47. Note that at the base of the accelerator pump bore is a ball valve retained by a circlip. It is not necessary to remove this.

Clean and inspect all parts as described for the Solex carburetter noting the warning against poking metal objects through jets or fuel passages. Particularly carefully inspect the economy diaphragm 45 and its gaskets 46. If the diaphragm has the slightest pinhole or the gaskets are cracked a mysterious and annoying flat spot will appear whenever the throttle is opened, which can become bad enough to stall the engine. It is a wise plan to replace this diaphragm whenever the carburetter is given a major service.

Rebuilding the carburetter:

Use all new gaskets and seals being careful to position the O-ring 33 in the emulsion block 19 correctly. Proceed by reversing the dismantling process, making sure that the butterfly valves are aligned with the marks made when dismantling. See that the economy valve diaphragm and gaskets have the air hole aligned with the hole in the carburetter cover. FIG 3A:10 shows the assembly in detail. Set the float level as follows: Position the float assembly and emulsion block on the top cover held upside down as shown in FIG 3A:11. The dimension 'C' must be adjusted by bending the tongue E not by altering the float carrier arms. Check the fast-idle interconnection by closing the strangler valve (58 in FIG 3A:9), fully and then seeing if a .040 inch (1.25 mm) diameter drill can just pass between the throttle butterfly edge 3 and the choke tube. Bend link 7 until this condition exists. On Series III models use a .055 inch (1.40 mm) drill for this test.

Tuning the carburetter for slow-running:

Adopt the methods recommended for the Solex carburetter, i.e. adjustment of the throttle stop screw and mixture control screw.

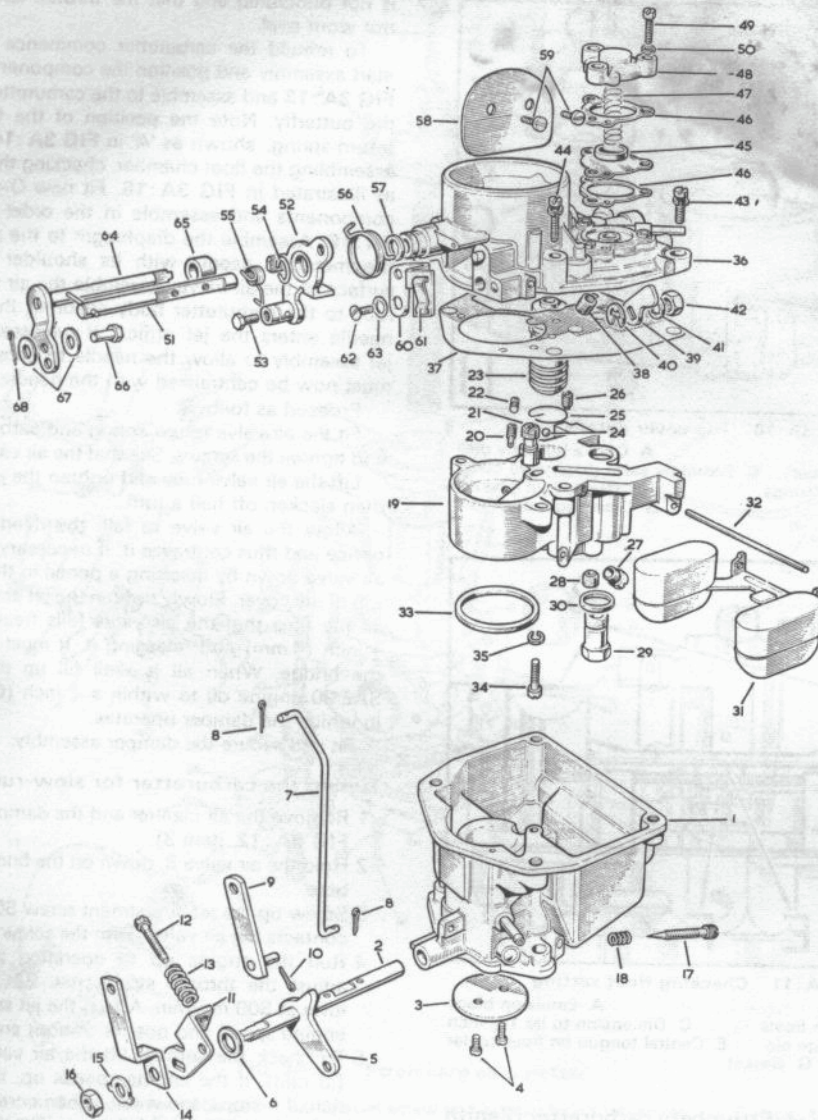


FIG 3A:9 Zenith carburettor

- Key to Fig 3A:9
- | | | | |
|---|--|--|---|
| 1 Carburettor main body | 2 Throttle spindle | 3 Butterfly for throttle | 4 Special screw fixing butterfly |
| 5 Floating lever on throttle spindle | 6 Plain washer on spindle for floating lever | 7 Interconnecting link, throttle to choke | 8 Splitpin fixing link to levers |
| 9 Relay lever, throttle to accelerator pump | 10 Splitpin fixing relay lever to floating lever | 11 Throttle stop and fast-idle lever | 12 Special screw for throttle stop |
| 13 Spring for throttle stop | 14 Throttle lever | 15 Lockwasher for throttle levers | 16 Special nut for throttle levers |
| 17 Volume control screw | 18 Spring for control screw | 19 Emulsion block | 20 Pump jet |
| 21 Pump discharge valve | 22 Plug for pump jet | 23 Piston for accelerator pump | 24 Ball for piston |
| 25 Circlip for piston | 26 Slow-running jet | 27 Main jet | 28 Enrichment jet |
| 29 Needle valve | 30 Special washer (2 mm) | 31 Float | 32 Spindle for float |
| 33 O-ring, emulsion block to body | 34 Special screw (fixing emulsion block to body) | 35 Spring washer (fixing emulsion block to body) | 36 Top cover for carburettor |
| 37 Gasket for top cover | 38 Ventilation screw (3.0) for choke | 39 Internal pump lever | 40 Retaining ring for pump lever |
| 41 Shakeproof washer (fixing pump lever) | 42 Special nut (fixing pump lever) | 43 Screw and spring washer, long (fixing top cover to main body) | 44 Screw and spring washer, short (fixing top cover to main body) |
| 45 Diaphragm for carburettor | 46 Gasket for diaphragm | 47 Spring for diaphragm | 48 Cover for diaphragm |
| 49 Screw (fixing diaphragm cover) | 50 Spring washer (fixing diaphragm cover) | 51 Spindle and pin for choke lever | 52 Lever and swivel for choke |
| 53 Small spring for choke lever | 54 Circlip fixing choke lever to top cover | 55 Special screw fixing butterfly | 56 Large spring for choke lever |
| 57 Plain washer for choke spindle | 58 Butterfly for choke | 59 Special screw fixing butterfly | 60 Bracket and clip for choke cable |
| 61 Clip for choke bracket | 62 Special screw (fixing choke bracket to top cover) | 63 Shakeproof washer (fixing choke bracket to top cover) | 64 Spindle and lever for accelerator pump |
| 65 Spacing washer for pump spindle | 66 Pin (fixing relay lever to pump lever) | 67 Plain washer (fixing relay lever to pump lever) | 68 Splitpin (fixing relay lever to pump lever) |

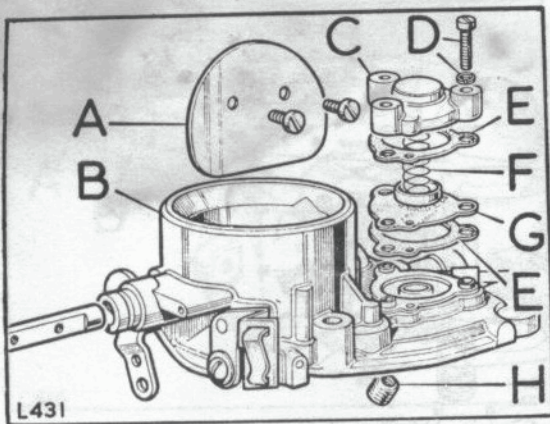


FIG 3A:10 Top cover details

Key to FIG 3A:10
 A Choke butterfly disc
 B Carburettor top cover
 C Economy valve diaphragm cover
 D Diaphragm cover fixings
 E Diaphragm gaskets
 F Diaphragm assembly
 H Ventilation jet

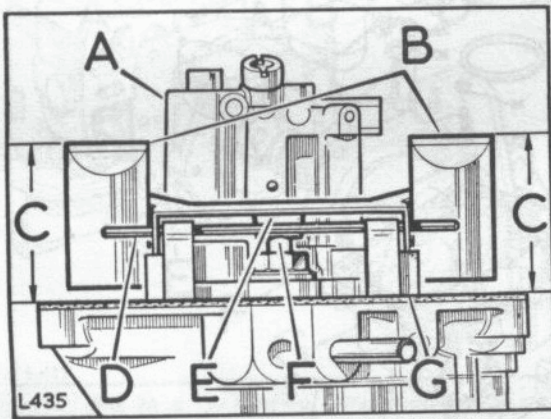


FIG 3A:11 Checking float setting

Key to FIG 3A:11
 A Emulsion block
 B Highest points on floats
 C Dimension to be $1\frac{1}{8}$ inch (33 mm)
 D Hinge pin
 E Central tongue on float carrier
 F Needle valve
 G Gasket

(c) 2.6 litre engine, Stromberg carburettor (Zenith type 175CA2S):

In this Section refer to FIG 3A:12.

This carburettor operates on very different principles from those described so far. It is known as a variable choke device since the manifold depression controls the position of the air valve and fuel metering needle.

To dismantle this carburettor, first remove the damper 3, top cap 1, spring 12 and diaphragm air valve assembly 8, 9 and 10. If necessary undo screw 17 and pull out needle 16. Undo the screws 61 and 62 and lift off the float chamber 59. Unscrew the jet assembly from the body. This assembly consists of items 47 to 56 inclusive. These can be dismantled for cleaning if necessary. Remove the float. Detach the throttle butterfly 20 and the cold start unit, items 35 to 46.

Clean and examine all components, being careful to use only clean rag to clean the diaphragm. See that the float

is not punctured and that the throttle spindle bores are not worn oval.

To rebuild the carburettor commence with the cold start assembly and position the components as shown in FIG 3A:13 and assemble to the carburettor body then fit the butterfly. Note the position of the throttle control return spring, shown as 'A' in FIG 3A:14. Continue by assembling the float chamber, checking the float position as illustrated in FIG 3A:15. Fit new O-rings to the jet components and assemble in the order shown in FIG 3A:16. Assemble the diaphragm to the air valve and fit the metering needle with its shoulder level with the surface of the air valve. Assemble the air valve very carefully to the carburettor body ensuring that the metering needle enters the jet orifice. If necessary unclamp the jet assembly to allow the needle to enter easily. The jet must now be centralized with the needle.

Proceed as follows:

Fit the air valve return spring and carburettor top cover and tighten the screws. See that the air valve moves easily.

Lift the air valve fully and tighten the jet assembly fully then slacken off half a turn.

Allow the air valve to fall, the needle will enter the orifice and thus centralize it. If necessary, gently push the air valve down by inserting a pencil in the dashpot at the top of the cover. Slowly tighten the jet assembly, checking all the time that the air valve falls freely by raising it a $\frac{1}{4}$ inch (6 mm) and releasing it. It must drop firmly onto the bridge. When all is well fill up the dashpot with SAE.20 engine oil to within a $\frac{1}{4}$ inch (6 mm) of the rod in which the damper operates.

Fit and secure the damper assembly.

Tuning the carburettor for slow-running:

- 1 Remove the air cleaner and the damper assembly (see FIG 3A:12, item 3).
- 2 Hold the air valve 8, down on the bridge in the throttle bore.
- 3 Screw up the jet adjustment screw 55, until the jet 47, contacts the air valve. Turn the screw back three turns.
- 4 Run the engine up to operating temperature then adjust the throttle stop screw 22, until the engine idles at 500 rev/min. Adjust the jet screw 55, until the engine speed and note is smooth and regular.
- 5 To check the setting, lift the air valve 8, by $\frac{3}{8}$ inch (.8 mm). If the engine speeds up, the mixture is too rich, if it stops, too weak. When correct the speed will remain constant or fall very slightly. To enrich the mixture, unscrew the jet screw 55; to weaken it, screw the screw into the body.
- 6 When the adjustment is correct replace the damper and air cleaner.
- 7 The fast-idle (choke) adjustment is made by operating the choke fully and adjusting screw 29 in lever 28 until the engine runs at 1000 to 1200 rev/min. Push the choke in and check that screw 29 now clears lever 42.

(d) 2.6 litre engine, SU carburettor:

In this Section refer to FIG 3A:17.

This carburettor operates on a similar principle to the Stromberg in that variations in manifold depression raise and lower the air valve and fuel metering needle. The same care must be taken to centralize the jet.

To dismantle the carburettor remove oil cap and damper

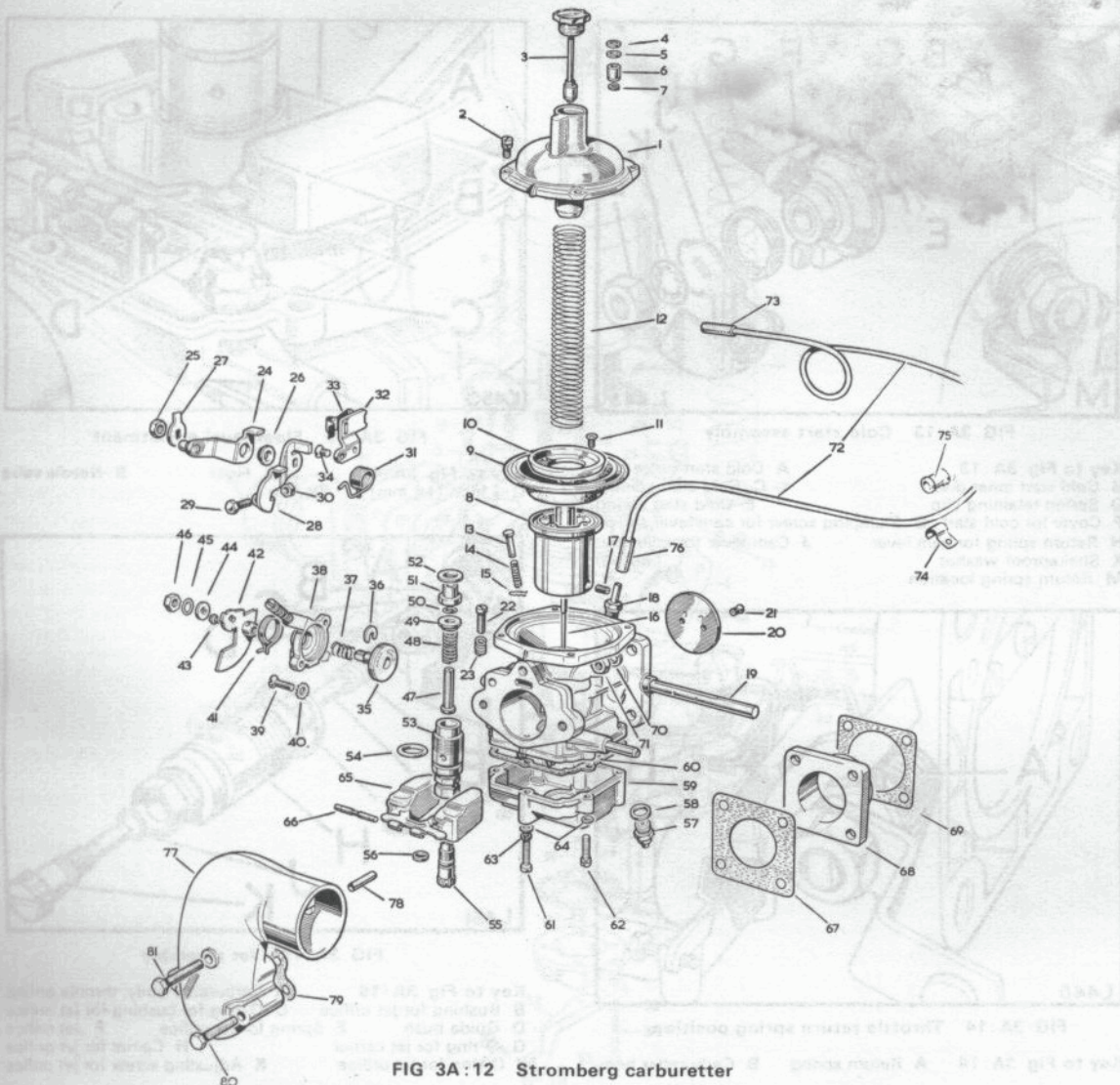


FIG 3A:12 Stromberg carburetter

- Key to Fig 3A:12**
- | | | |
|--|--|---|
| 1 Top cover for carburetter | 2 Special screw and washer fixing top cover | 3 Damper and oil cap assembly |
| 4 Special washer, upper | 5 Special washer, lower | 6 Bush for damper |
| 7 Retaining ring, for damper | 8 Air valve, shaft and diaphragm assembly | 9 Diaphragm |
| 10 Retaining ring for diaphragm | 11 Special screw fixing retaining ring | 12 Return spring for air valve |
| 13 Lifting pin for air valve | 14 Spring for lifting pin | 15 Spring clip for lifting pin |
| 16 Metering needle | 17 Locking screw for metering needle | 18 Ignition adaptor |
| 19 Throttle spindle | 20 Butterfly for throttle | 21 Special screw fixing butterfly |
| 22 Throttle stop screw | 23 Spring for stop screw | 24 Throttle lever |
| 25 Special nut (fixing throttle levers) | 26 Special washer (fixing throttle levers) | 27 Tabwasher (fixing throttle levers) |
| 28 Throttle stop and fast-idle screw | 29 Special screw for throttle stop | 30 Locknut for throttle stop |
| 31 Throttle return spring | 32 Bracket and clip for choke cable | 33 Clip for choke bracket |
| 34 Special screw fixing choke bracket | 35 Cold start spindle | 36 Special washer for starter spindle |
| 37 Cold start spring | 38 Cover for cold start | 39 Special screw (fixing cover) |
| 40 Shakeproof washer (fixing cover) | 41 Return spring for cam lever | 42 Cam lever for cold start |
| 43 Clamping screw for cam lever swivel | 44 Spacing washer (fixing cam lever to cold start spindle) | 45 Shakeproof washer |
| 46 Special nut (fixing cam lever to cold start spindle) | 47 Jet orifice | 48 Spring for jet orifice |
| 49 Guide bush for jet orifice | 50 O-ring for jet orifice | 51 Bush for jet orifice |
| 52 Special washer for jet orifice | 53 Carrier for jet orifice | 54 O-ring for carrier |
| 55 Adjusting screw for jet orifice | 56 O-ring for adjusting screw | 57 Needle valve |
| 58 Washer for needle valve | 59 Float chamber | 60 Gasket for float chamber |
| 61 Special screw, long (fixing float chamber) | 62 Special screw, short (fixing float chamber) | 63 Plain washer (fixing float chamber) |
| 64 Plain washer (fixing float chamber) | 65 Float and arm | 66 Spindle for float |
| 67 Joint washer for carburetter | 68 Adaptor for carburetter | 69 Joint washer for adaptor |
| 70 Spring washer (fixing carburetter and adaptor to cylinder head) | 71 Nut ($\frac{7}{16}$ inch UNF) (fixing carburetter and adaptor to cylinder head) | 72 Suction pipe, carburetter to distributor |
| 73 Rubber sleeve, suction pipe to adaptor | 74 Clip for suction pipe (on engine) | 75 Rubber grommet for clip (on engine) |
| 76 Rubber sleeve, suction pipe to carburetter | 77 Air inlet elbow assembly | 78 Adaptor for top breather hose |
| 79 Joint washer for inlet elbow | 80 Setbolt ($\frac{5}{16}$ inch UNC x $2\frac{1}{2}$ inch long) (fixing elbow to carburetter) | 81 Setbolt ($\frac{5}{16}$ inch UNC x 3 inch long) (fixing elbow to carburetter) |

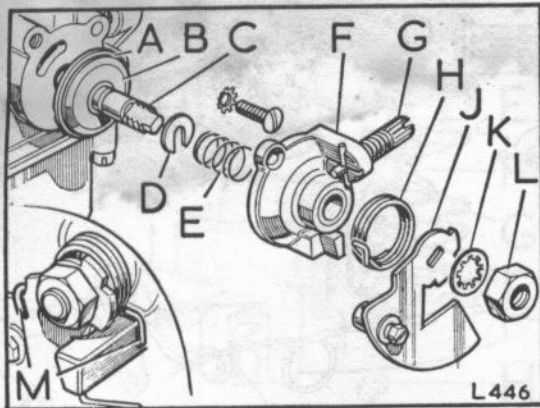


FIG 3A:13 Cold start assembly

Key to Fig 3A:13
 A Cold start outer disc
 B Cold start inner disc
 C Cold start spindle
 D Spring retaining clip
 E Cold start spring
 F Cover for cold start
 G Clamping screw for cam lever swivel
 H Return spring for cam lever
 J Cam lever for cold start
 K Shakeproof washer
 L Locknut
 M Return spring location

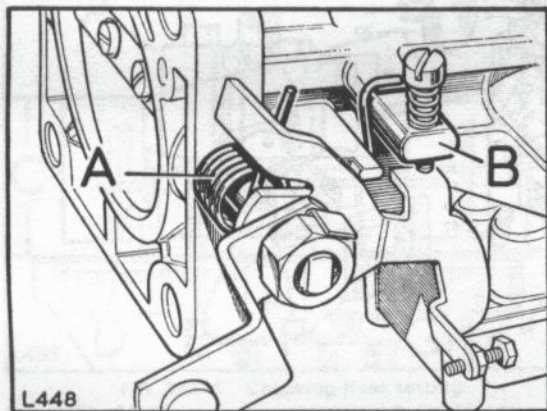


FIG 3A:14 Throttle return spring position

Key to Fig 3A:14 A Return spring B Carburettor body

rod 15, then undo screws 10 and remove the suction chamber and piston 9 as a unit. Gently ease the piston from the chamber and remove spring 11 and washer 12.

Slacken screw 14 and remove the metering needle 13. Remove the union 46 and gauze filter from the float chamber lid then undo cap nut 45 and remove banjo 42. The lid 37 and washer 38 will now lift off. Take out the float and then release the pin 41. This will free the fork 40 and the needle valve 39 can be released.

Now release screws 34 and the float chamber can be separated from the carburettor body. The spring 19, jet 18 and jet housing 20 can now be removed. Undo screw 18 and take out jet bearing 17. Remove items 29 to 32. Remove return spring lever 65, then carefully mark the butterfly 22 as illustrated in FIG 3A:18. Close the split ends of the screws 23, remove them, push the butterfly out of the slot and slide the spindle 21 out of the body. Prise the gland assemblies, items 25 to 28 from each side

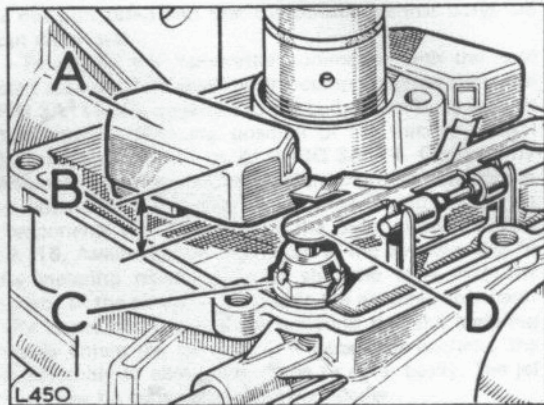


FIG 3A:15 Float level adjustment

Key to Fig 3A:15 A Float B Needle valve
 C $\frac{3}{8}$ inch (16 mm) D Tag

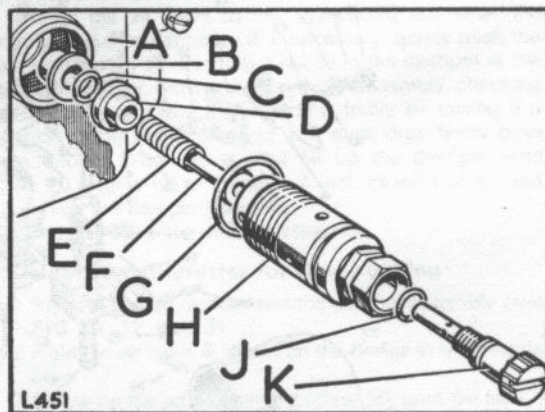


FIG 3A:16 Jet assembly

Key to Fig 3A:16 A Carburettor body, throttle orifice
 B Bushing for jet orifice C O-ring for bushing for jet orifice
 D Guide bush E Spring for jet orifice F Jet orifice
 G O-ring for jet carrier H Carrier for jet orifice
 J O-ring for jet orifice K Adjusting screw for jet orifice

of the body and all the necessary dismantling is completed.

Clean and inspect all the components paying particular attention to the diaphragm surrounding the jet, the throttle spindle bores and all joint faces. Obtain a set of gaskets and seals then proceed to rebuild the carburettor as follows:

- 1 Insert the throttle into the body from left to right as viewed from the air intake. Assemble the new gland components as shown in FIG 3A:19 using a piece of tube to tap the retainer 'E' home.
- 2 Remove the spindle and reinsert from right to left. Assemble a new gland in the opposite side of the body.
- 3 Assemble the butterfly to the alignment marks made when dismantling. Insert the two screws but only tighten just enough to hold the butterfly. Snap the butterfly shut to centralize it then tighten the two screws. When satisfied that the butterfly is completely closing the bore when the spindle is rotated, spread

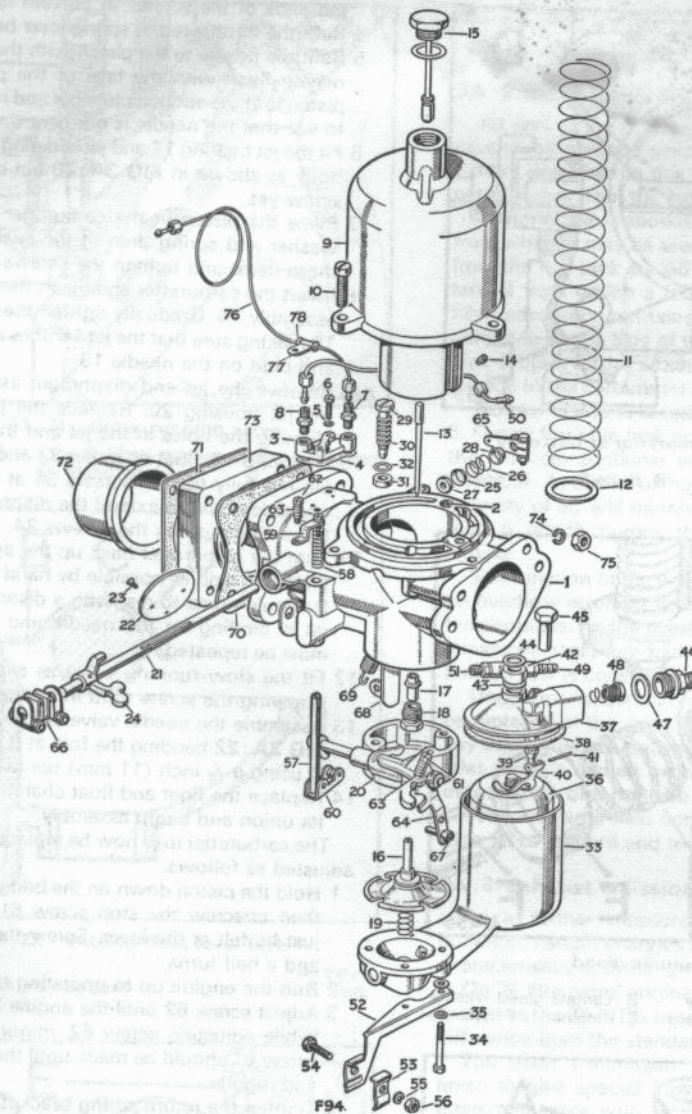


FIG 3A:17 SU carburetter

Key to Fig 3A:17

- | | | |
|---|--|---|
| 1 Carburetter body | 3 Adaptor, ignition and weakening device | 4 Gasket for adaptor |
| 5 Shakeproof washer (fixing adaptor) | 6 Screw (fixing adaptor) | 7 Union for ignition pipe |
| 9 Suction chamber and piston complete | 10 Special screw fixing suction chamber | 8 Union for economizer pipe |
| 12 Thrust washer for suction chamber | 13 Needle, SS | 11 Spring for piston (yellow) |
| 17 Jet bearing | 18 Jet screw | 19 Jet spring |
| 23 Screw for throttle butterfly | 24 Throttle stop | 25 Gland washer for throttle spindle, langite |
| 27 Gland washer for throttle spindle, langite | 28 Retainer cap for gland washer | 29 Slow-running adjusting valve |
| 30 Gland spring for slow-running | 31 Gland washer for slow-running, rubber | 32 Brass washer for slow-running |
| 33 Float chamber | 34 Bolt (fixing float chamber) | 35 Shakeproof washer (float chamber) |
| 37 Lid for float chamber | 38 Joint washer for float chamber lid | 39 Needle valve and seat |
| 42 Banjo (on float chamber) | 43 Fibre washer for banjo (on float chamber) | 40 Lever for float |
| 45 Cap nut fixing banjo (on float chamber) | 46 Double-ended union for carburetter | 41 Pin for lever |
| 48 Filter and spring for carburetter body | 49 Economizer union for rubber tube | 47 Washer for union |
| 51 Union for economizer pipe | 57 Sliding rod, roller and cam shoe | 58 Spring for sliding rod |
| 62 Top stop screw | 63 Spring for stop screw | 59 Top plate |
| 68 Bracket for throttle return spring | 69 Throttle return spring | 70 Joint washer for carburetter |
| 72 Liner for manifold | 73 Distance piece for carburetter | 74 Spring washer (fixing carburetter and distance piece to cylinder head) |
| 75 Nut ($\frac{1}{8}$ inch UNF) (fixing carburetter and distance piece to cylinder head) | 76 Suction pipe complete | 77 Clip for suction pipe on engine |
| 78 Rubber grommet for clip on engine | | |

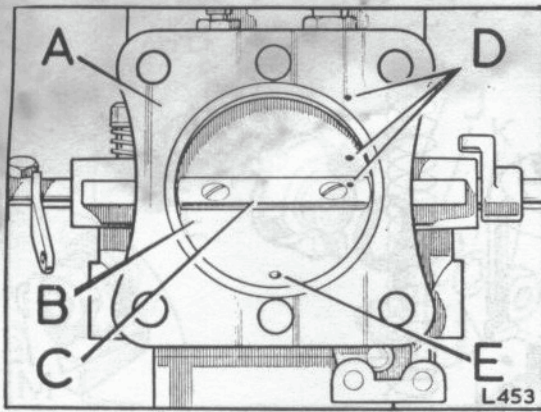


FIG 3A:18 Alignment marking of butterfly

Key to Fig 3A:18 A Body B Butterfly C Spindle
D Marks E Hole in butterfly

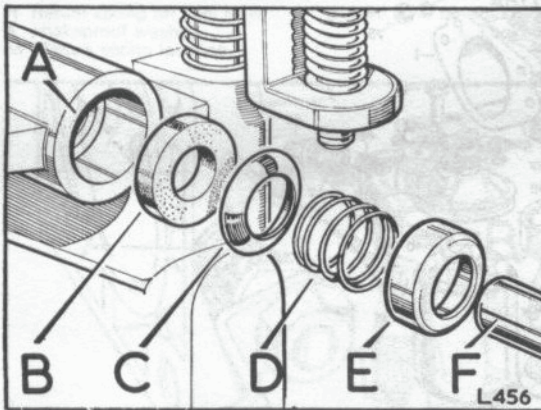


FIG 3A:19 Spindle gland

Key to Fig 3A:19 A Body B Langite gland washer
C Brass gland washer D Spring E Retainer F Spindle

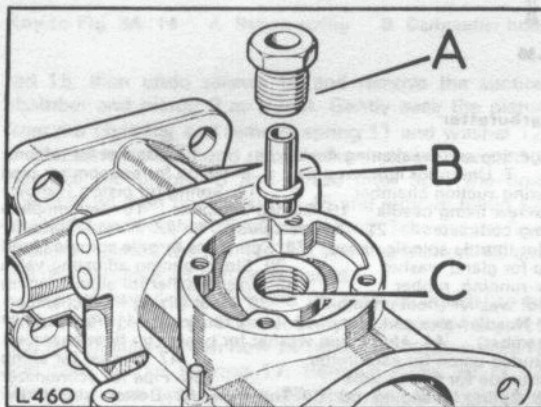


FIG 3A:20 Fitting jet bearing

Key to Fig 3A:20 A Jet screw B Jet bearing
C Body

- the ends of the screws to prevent loosening.
- 4 Refit the throttle return spring lever but do not tighten.
 - 5 Refit the needle to the piston with the shoulder on the needle flush with the face of the piston. Insert the piston into the suction chamber and rotate it, watching to see that the needle is not bent.
 - 6 Fit the jet bearing 17 and jet securing screw 18 into the body as shown in FIG 3A:20 but do not tighten the screw yet.
 - 7 Place the piston in the carburettor body, replace the washer and spring then fit the suction chamber over these items and tighten the screws.
 - 8 Invert the carburettor and insert the jet and diaphragm assembly 16. Gradually tighten the jet securing screw 18 making sure that the jet 16 does not move off centre and bind on the needle 13.
 - 9 Remove the jet and diaphragm assembly 16 then fit the jet housing 20. Replace the jet and diaphragm, aligning the holes in the jet and the jet housing.
 - 10 Fit spring 19, float chamber 33 and choke bracket 52. Do not fully tighten screws 34 at this stage. Operate choke lever 64 to extend the diaphragm to its furthest travel then tighten the screws 34.
 - 11 Turn the carburettor back up the right way and lift the piston as high as possible by hand then allow it to fall. It should come to rest with a distinct 'click'. If not the jet is binding on the needle and operations 8 to 10 must be repeated.
 - 12 Fit the slow-running valve as shown in FIG 3A:21 screwing the screw right in at this stage.
 - 13 Assemble the needle valve and float fork as shown in FIG 3A:22 bending the fork at B to obtain dimension D using a $\frac{1}{16}$ inch (11 mm) bar as a gauge.
 - 14 Replace the float and float chamber lid complete with its union and banjo assembly.

The carburettor may now be replaced on the engine and adjusted as follows:

- 1 Hold the piston down on the bridge in the throttle bore then unscrew the stop screw 61 until free play can just be felt at the lever. Screw the screw back in one and a half turns.
- 2 Run the engine up to operating temperature.
- 3 Adjust screw 62 until the engine idles at 500 rev/min. While adjusting screw 62, minor movements of stop screw 61 should be made until the engine note is even and regular.
- 4 Tighten the return spring bracket 65.

To check this adjustment, lift the piston $\frac{1}{2}$ inch (.8 mm). If the engine speed rises, the mixture is too rich, if it falls greatly, too weak. When correct the speed will remain constant or fall only slightly. Move screw 61 to correct the mixture if necessary.

3A:4 The air cleaner

(a) 2½ litre engine:

Remove the air cleaner intake elbow from the carburettor, release the fixing strap and lift out the cleaner complete with hose and elbow.

Dismantle the cleaner by releasing the clips (A in FIG 3A:23), drain the oil from the container B and withdraw the wiremesh unit C. Wash all components in clean petrol and allow to dry. Refill with clean oil and reassemble by reversing the dismantling process.

Replace on the engine and tighten all fixings.

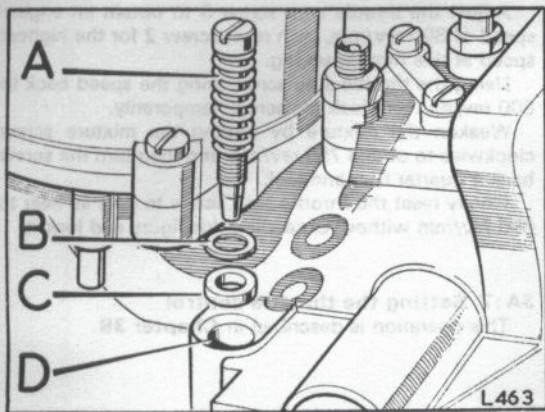


FIG 3A:21 Slow-running valve

Key to Fig 3A:21 A Slow-running screw and spring
B Brass washer C Gland washer D Body

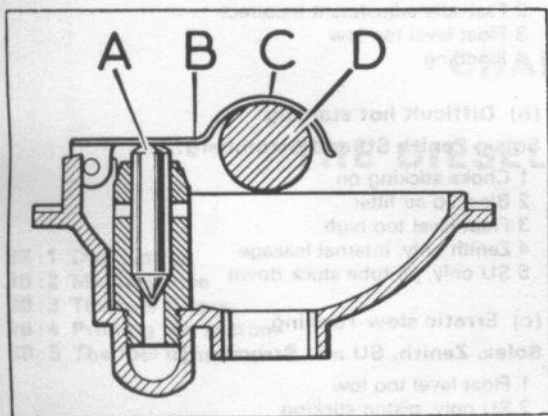


FIG 3A:22 Setting float level fork

Key to Fig 3A:22 A Valve C Fork
B Point at which fork may be bent
D $\frac{7}{16}$ inch (11 mm) bar

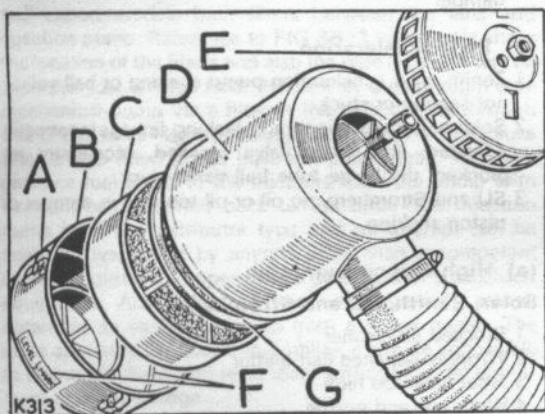


FIG 3A:23 Air cleaner

Key to Fig 3A:23 A Clips B Oil container
C Wire mesh unit D Air cleaner body E Intake cap
F Level mark G Washer

(b) 2.6 litre engine:

Proceed exactly as for the 2 $\frac{1}{4}$ litre engine.

3A:5 Evaporative loss control

As part of the measures taken to reduce the pollution caused by noxious emissions into the atmosphere, the system described in this section is designed to eliminate petrol fumes from the storage tank.

The principle is shown diagrammatically in FIG 3A:24 from which it may be seen that the evaporative emissions from the fuel tank are led by the pipe 2 into an expansion tank 3 from which a further pipe 4 leads to a charcoal filled adsorption container 1 situated in the engine compartment. At the side of this container there is an air inlet pipe 5 open to the atmosphere, and from the top a pipe 6 leads to the carburettor air cleaner through a flame trap.

Normal fuel tank breathing is through the air inlet pipe 5. Fumes from the tank or expansion chamber are fed into the charcoal container where they are adsorbed on the charcoal. At times of high vacuum in the inlet tract a quantity of air will be inhaled through the pipe 6 and air inlet 5 which purges the trapped emissions into the engine.

The function of the expansion tank is simply to provide an overflow reservoir for fuel expanding in high ambient temperatures. As the overflow pipe is at the bottom of the expansion tank, any fuel here will run back to the main tank as fuel is consumed.

Under normal conditions the charcoal container should be replaced at the specified maintenance intervals, but if any liquid fuel has entered, shown by weeping at the air inlet pipe, it should be replaced immediately. **Do not attempt to cleanse the container.**

When fitting a new container note that the open inlet pipe faces inboard and towards the rear.

3A:6 Exhaust emission control

As a further measure towards the elimination of pollution, certain changes have been made to carburation characteristics and the ignition timing procedure.

On 2 $\frac{1}{4}$ litre petrol engines a modified Zenith carburettor known as the 36 IVE is used and has a number of points of difference from the standard model.

The main enrichment jets have a cadmium plated finish to give special flow characteristics. They are not interchangeable with similar size jets having a natural finish.

In order to weaken the excessively rich mixture drawn into the engine on overrun with closed throttle, a vacuum operated 'throttle prop' device is fitted. Under the high manifold depression obtaining at these times a trigger valve, connected to the inlet manifold by a pipe, is operated and relays the depression to a vacuum servo which in turn operates a rod link to the throttle butterfly and opens it by a small amount.

This condition is maintained until the manifold depression drops when the trigger valve closes and the throttle is allowed to return to its closed position.

A fuel cut-off valve, solenoid operated, which cuts off the idle bypass and progression chambers when the ignition is switched off, is fitted to prevent running-on. This has been found of advantage as the idle speed has been increased to 750 to 800 rev/min to increase the airflow under closed throttle conditions.

The fuel cut-off is preset and must not be adjusted.

An additional fuel filter is fitted between the carburettor and the pump on the righthand side of the engine. This is a sealed unit and the complete unit must be renewed at the stipulated maintenance intervals.

The accelerator pump linkage is set in its maximum position with the throttle relay lever in the hole in pump lever nearest to the pump spindle.

Slow-running adjustment:

This must be carried out when the ignition timing is correctly set as described in **Section 4:7**. Refer to **FIG 3A:25**.

Bring the engine up to normal working temperature, then unlock the mixture screw 2, turn it gently by hand until it is fully in, then screw back three quarters of a turn.

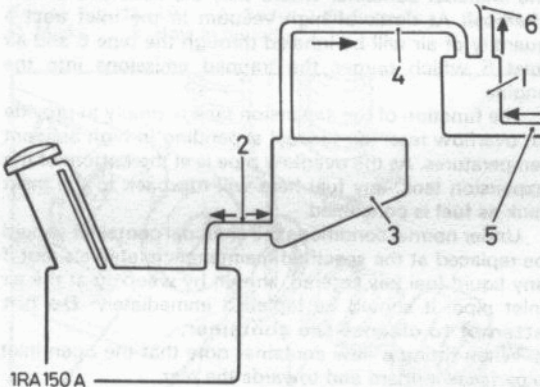


FIG 3A:24 Evaporative loss control

Key to Fig 3A:24 1 Charcoal container 2 Pipe
3 Expansion tank 4 Pipe 5 Air inlet 6 Pipe to carburettor

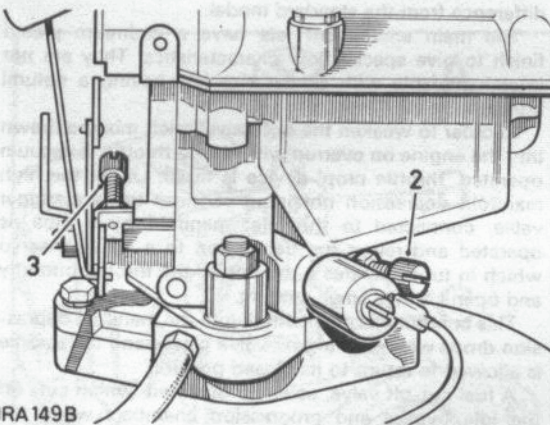


FIG 3A:25 Slow-running adjustment, Zenith 35 IVE

Key to Fig 3A:25 2 Mixture control screw
3 Throttle stop screw

Adjust the throttle stop screw 3 to obtain an engine speed of 800 rev/min, then reset screw 2 for the highest speed at this throttle setting.

Using the throttle stop screw bring the speed back to 800 rev/min and lock the screw, temporarily.

Weaken the mixture by turning the mixture screw clockwise to obtain 750 rev/min and then turn the screw back a quarter turn and lock.

Finally reset the throttle stop screw to give as near to 800 rev/min without exceeding this figure and lock it.

3A:7 Setting the throttle control

This operation is described in **Chapter 3B**.

3A:8 Fault diagnosis

(a) Difficult cold starting

Solex, Zenith, SU and Stromberg:

- 1 Insufficient choke
- 2 Fast-idle adjustment incorrect
- 3 Float level too low
- 4 Flooding

(b) Difficult hot starting

Solex, Zenith SU and Stromberg:

- 1 Choke sticking on
- 2 Blocked air filter
- 3 Float level too high
- 4 Zenith only, internal leakage
- 5 SU only, jet tube stuck down

(c) Erratic slow-running

Solex, Zenith, SU and Stromberg:

- 1 Float level too low
- 2 SU only, piston sticking
- 3 Solex and Zenith only, incorrect setting
- 4 SU and Stromberg, incorrect jet setting
- 5 All types, air leaks
- 6 SU and Stromberg, no oil or too thick an oil in the damper

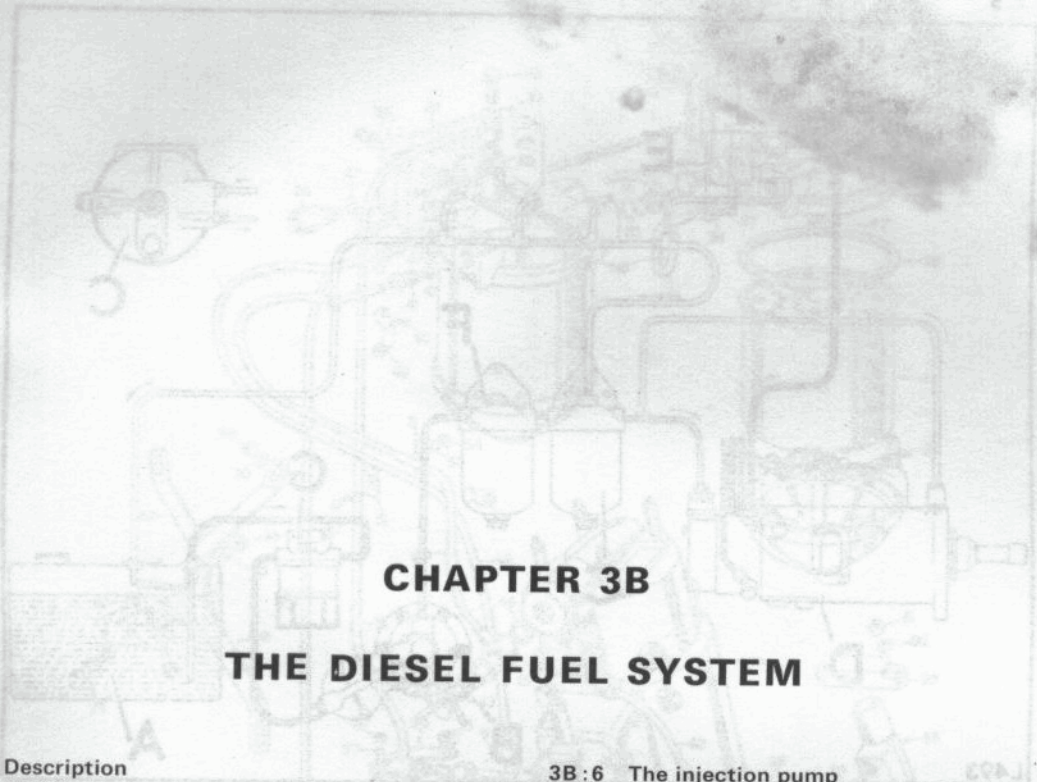
(d) Poor acceleration

- 1 Zenith only, acceleration pump sticking or ball valves not seating or stuck
- 2 Solex only, pump diaphragm leaking, linkage incorrectly adjusted, non-return valve blocked, accelerator jet blocked, discharge tube ball valve stuck.
- 3 SU and Stromberg, no oil or oil too thin in damper or piston sticking.

(e) High fuel consumption

Solex, Zenith, SU and Stromberg:

- 1 Blocked air cleaner
- 2 Wrongly adjusted carburettor
- 3 Float level too high
- 4 Worn jets and needle
- 5 Choke sticking on
- 6 SU and Stromberg only, wrong type of needle
- 7 Solex and Zenith only, accelerator linkage wrongly adjusted



CHAPTER 3B

THE DIESEL FUEL SYSTEM

- 3B:1 Description
- 3B:2 Maintenance
- 3B:3 The fuel filters
- 3B:4 Priming the system
- 3B:5 The fuel lift pump

- 3B:6 The injection pump
- 3B:7 The injector nozzle assemblies
- 3B:8 The air filter
- 3B:9 Setting the throttle controls
- 3B:10 Fault diagnosis

3B:1 Description

Great care must be taken when dealing with direct injection fuel systems to eliminate dirt and grit. For this reason all Diesel Land Rovers are fitted with at least three, and export models four, filters between the tank and injection pump. Reference to **FIG 3B:1** will clearly show the location of the filters and also the pipe layout. It will be seen that fuel is lifted from the tank by a diaphragm type mechanical pump via a filter in the tank thence through one of two more filters to the injection pump. A fine gauze filter is also fitted in the injection pump head. The high pressure fuel is led to the injectors from the pump with overspill being carried back to the tank. The injection pump is of the distributor type and no attempt can be made to overhaul it by anyone other than a competent service engineer equipped with a great deal of specialized equipment. Any failure of this unit invariably means obtaining an exchange pump from a Rover dealer. The same applies to the nozzle assemblies; it is quite impossible to dismantle these and reset them without special equipment and knowledge.

3B:2 Maintenance

No maintenance is required by either the injection pump or nozzles. Maintenance of the system must be

confined to keeping the filters clean. In this connection if the main filter element sludges up in an unreasonably short time this is due to an excess of wax in the fuel and the supplier should be consulted. Never draw fuel from a storage tank at its lowest point, impurities will always collect here.

Remember that the engine must never be run even for a few moments without coolant. The injectors will overheat and be ruined.

3B:3 The fuel filters

Reference to **FIGS 3B:2** and **3B:3** will clearly show the layout of the filters and other pipes and components. Particularly note that the early layout has a bowl filter on the lift pump while the later layout has a sedimentor.

(a) Lift pump bowl filter:

To clean this filter, undo the nut holding the glass bowl up to the casting, swing the retainer aside and lower the bowl. Clean the bowl and filter gauze and refit. Use a new cork gasket between the bowl and casting.

(b) Main filter, early type:

Refer to **FIG 3B:4**.

To renew the element proceed as follows:

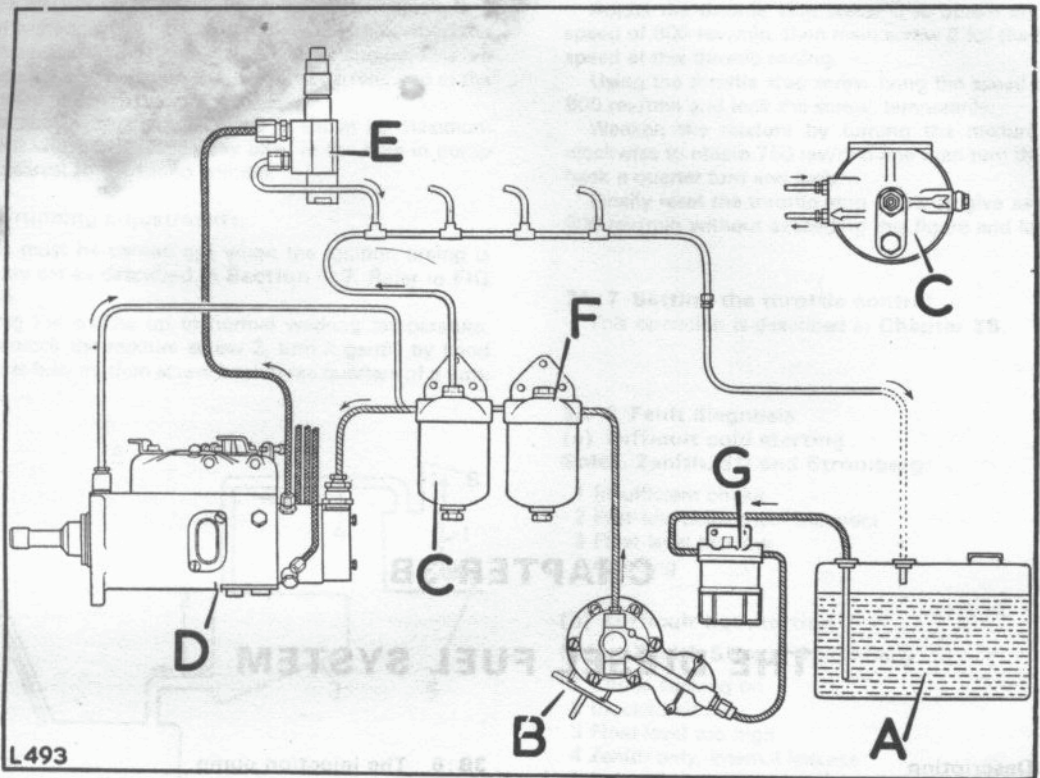


FIG 3B:1 Diagram of fuel system

Key to Fig 3B:1 A Fuel tank B Fuel pump C Main filter D Injection pump E Injection nozzle
 F Additional filter (early export models) G Sedimentor (latest export models) // // // // // Low pressure delivery
 xxxxxxx High pressure delivery - - - - - Excess fuel spillback

- 1 Slacken plug N and allow the fuel to drain into a suitable container.
- 2 Disconnect the bleed back pipe from the top of the filter.
- 3 Support the container J and undo cap nut B.
- 4 Remove container J and oil seals C and F.
- 5 Discard the element then wash the container thoroughly in clean fuel. See that the centre spindle is clean and that the drain hole in the plug N is clear.
- 6 Renew ring K if any doubts exist about its condition. Renew seals C and F.
- 7 Fit a new element and replace the container J tightening cap nut B.
- 8 Reconnect pipes, tighten the drain plug N and prime the system.

(c) Main filter, late type:

Refer to FIG 3B:5.

The late type filter can be identified by the black nylon fuel pipes and the fact that it is attached to the dash, not the engine. The filter element forms part of the filter body, thus the engine cannot be run without an element in position.

To renew the element, support the holder C and undo

bolt A. Discard the element and wash the holder C in clean fuel. Renew the rubber washers in the top of the filter and in the element holder C.

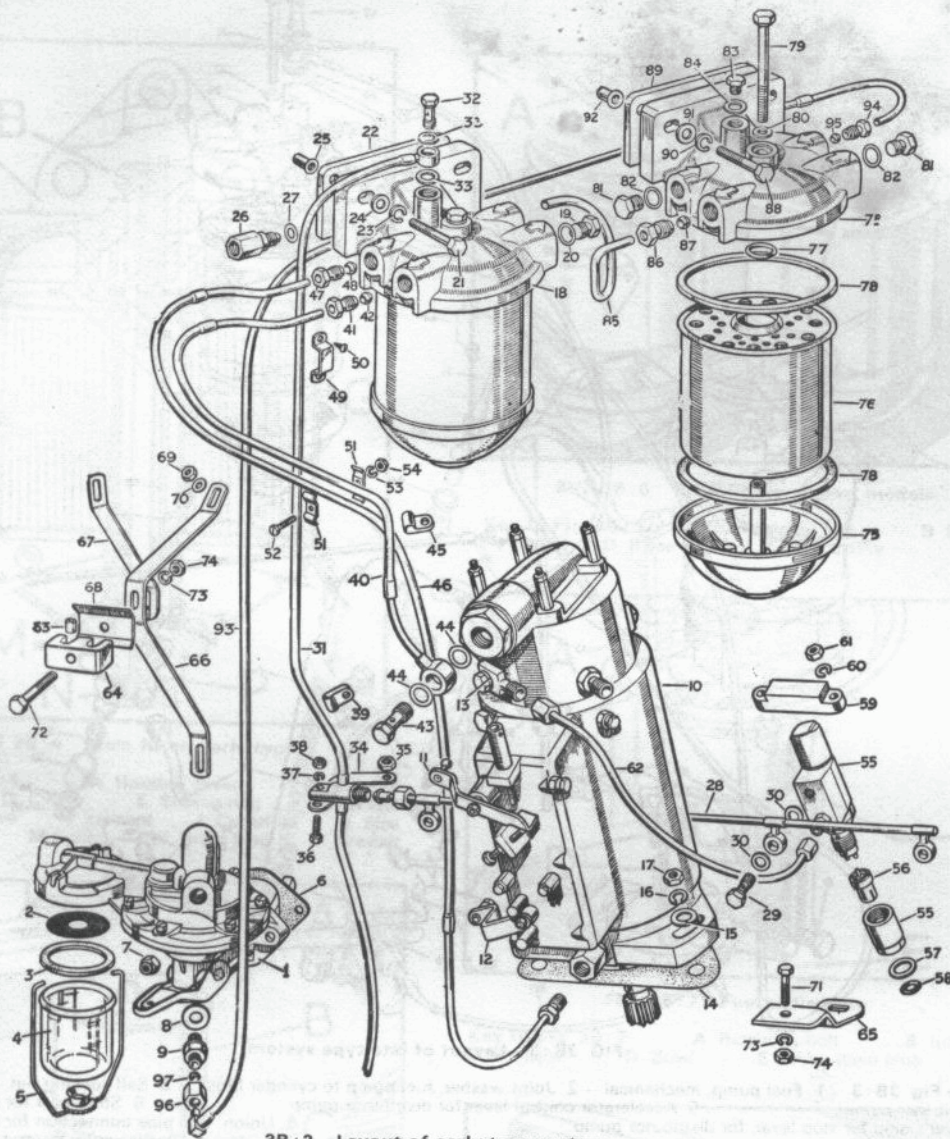
Push a new element on to the filter top spigot with the perforations in the element to the top. Fit holder C and tighten bolt A. Prime the system.

An additional main filter is mounted beside the filter just described if the vehicle is intended for export. FIG 3B:6 shows the layout. A paper element is fitted but the instructions for renewing it are identical to those given for the main filter, late type.

(d) Sedimentor:

Latest vehicles are fitted with a sedimentor which removes the larger droplets of water and foreign matter from the fuel. This device is illustrated at FIG 3B:7. Occasionally slacken drain plug E, allow water to escape and tighten the plug when clean fuel emerges. Priming the system is not necessary after doing this.

To clean the unit, first disconnect pipe B and support it above the supply tank level. Support bowl D and undo bolt A. Clean all parts in petrol. Fit new seals and replace the bowl and element. Tighten bolt A and connect pipe B. Prime the system as described in Section 3B:4.



3B:2 Layout of early type system

- Key to Fig 3B:2
- | | | | |
|---|---|--|--|
| 1 Fuel pump, mechanical | 2 Filter for sediment bowl | 3 Washer for sediment bowl | 4 Sediment bowl |
| 5 Retainer | 6 Joint washer | 7 Self-locking nut | 8 Joint washer for mechanical pump inlet and outlet |
| 9 Union for mechanical pump inlet and outlet | 10 Distributor pump | 11 Accelerator control lever for distributor pump | 12 Stop lever for distributor pump |
| 13 Joint washer for injection pipe, distributor pump end | 14 Joint washer | 15/17 Distributor pump to cylinder block fixings | 18 Fuel filter |
| 19 Plug for filter | 20 Joint washer | 21/25 Filter to dash fixings | 22 Filter to dash fixings |
| 23 Filter to dash fixings | 24 Filter to dash fixings | 26 Non-return valve for filter | 27 Joint washer |
| 28 Leak-off pipe | 29 Banjo bolt (fixings, leak-off pipe to injector) | 30 Washer (fixings, leak-off pipe to injector) | 31 Fuel pipe, spill return to tank |
| 32 Banjo bolt (fixing spill return pipe to filter) | 33 Joint washer (fixing spill return pipe to filter) | 34 Bracket for leak-off pipe | 35 Locknut fixing bracket to injector stud |
| 36/38 Spill return pipe to bracket on injector stud fixings | 37 Clip | 39 Clip | 40 Fuel pipe, filter to distributor pump |
| 41 Nut (fixing pipe to filter) | 42 Olive (fixing pipe to filter) | 43 Banjo bolt (fixing pipe to distributor pump) | 44 Joint washer (fixing pipe to distributor pump) |
| 45 Clip, fixing pipe to distributor pump | 46 Fuel pipe, distributor return to filter | 47 Nut (fixing pipe to non-return valve at filter) | 48 Olive (fixing pipe to non-return valve at filter) |
| 49 Clip | 50 Drive screw (fixing distributor pump feed and return pipes together) | 51 Double pipe clip (fixing distributor pump feed and return pipes together) | 52/54 Pipes and clips fixings |
| 55 Injector | 56 Nozzle | 57 Copper joint washer for injector | 58 Steel joint washer for injector |
| 59 Injector to cylinder head fixings | 60/61 Injector to cylinder head fixings | 62 Injector pipe to No. 2 cylinder | 63 Damper for injector pipe |
| 64 Shroud | 65 Bracket for shroud | 66 Support strap for shroud | 67 Steady strap for shroud |
| 68 Backplate for shroud | 69/70 Fixings, straps to injector studs | 71/74 Fixings, shroud and dampers to backplate, strap and support bracket | 72 Small seal for element* |
| 73 Small seal for element* | 74 Small seal for element* | 75 Fuel filter* | 76 Element* |
| 77 Small seal for element* | 78 Large seal for element* | 79 Special centre bolt for filter* | 80 Washer for centre bolt* |
| 81 Plug for fuel filter* | 82 Joint washer* | 83 Plug for fuel filter, top, leak-off* | 84 Joint washer for leak-off plug* |
| 85 Transfer pipe, extra filter to basic filter* | 86 Nut (fixing pipe to filter)* | 87 Olive (fixing pipe to filter)* | 88/92 Filter to dash fixings* |
| 89 Filter to dash fixings* | 90 Filter to dash fixings* | 91 Filter to dash fixings* | 92 Filter to dash fixings* |
| 93 Fuel pipe, pump to filters* | 94 Nut (fixing pipe to filter)* | 95 Olive (fixing pipe to filter)* | 96 Nut (fixing pipe to filter)* |
- * Additional fuel filter

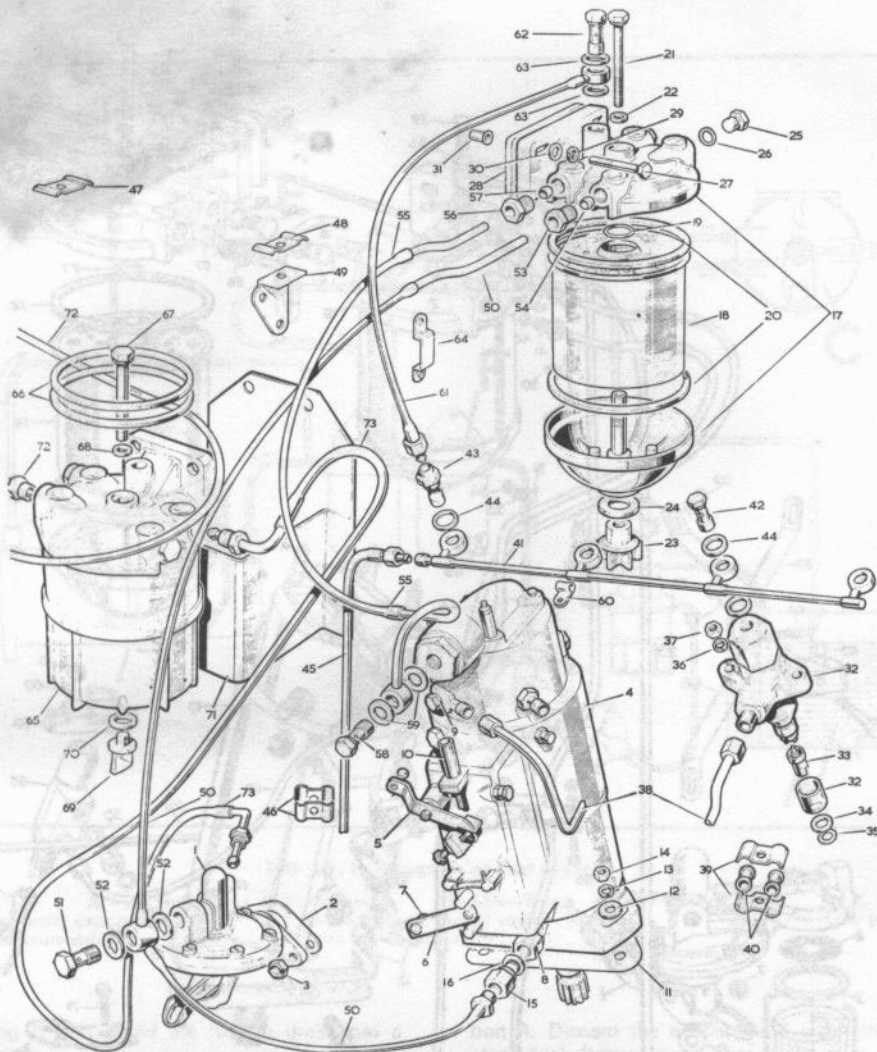


FIG 3B:3 Layout of late type system

- | | | |
|--|--|--|
| 1 Fuel pump, mechanical | 2 Joint washer, fuel pump to cylinder block | 3 Self-locking nut, fixing fuel pump |
| 4 Distributor pump | 5 Accelerator control lever for distributor pump | 6 Stop lever for distributor pump |
| 7 Swivel clamp for stop lever, for distributor pump | 8 Union, fuel pipe connection for distributor pump | 10 Sleeve for control lever stop screw |
| 9 Joint washer for injector pipe, distributor pump end | 11 Joint washer for distributor pump | 12 Plain washer (fixing distributor pump to cylinder block) |
| 13 Spring washer (fixing distributor pump to cylinder block) | 14 Nut ($\frac{1}{2}$ inch UNF) (fixing distributor pump to cylinder block) | 15 Non-return valve for distributor pump |
| 16 Joint washer for non-return valve | 17 Fuel filter | 18 Element for fuel filter |
| 19 Small seal for element | 20 Large seal for element | 21 Special centre bolt for filter |
| 22 Washer for centre bolt | 23 Nylon drain plug for filter | 24 Rubber seal for drain plug |
| 25 Plug for filter | 26 Joint washer for plug | 27 Bolt ($\frac{1}{2}$ inch UNF x $1\frac{1}{2}$ inch long) (fixing filter to dash) |
| 28 Distance plate (fixing filter to dash) | 29 Spring washer (fixing filter to dash) | 30 Plain washer (fixing filter to dash) |
| 31 Rivnut ($\frac{1}{2}$ inch UNF) (fixing filter to dash) | 32 Injector complete | 33 Nozzle for injector |
| 34 Copper joint washer for injector | 35 Steel joint washer for injector | 36 Spring washer (fixing injectors to cylinder head studs) |
| 37 Nut ($\frac{1}{8}$ inch UNF) (fixing injectors to cylinder head studs) | 38 Injector pipe to No. 2 cylinder | 39 Clamping plate for injector pipe grommet |
| 40 Grommet for injector pipe | 41 Spill rail pipe complete | 42 Banjo bolt for No. 1, 2 and 3 injectors (fixing spill rail pipe to injectors) |
| 43 Banjo union for No. 4 injector (fixing spill rail pipe to injectors) | 44 Joint washer for banjo bolt (fixing spill rail pipe to injectors) | 45 Fuel pipe, spill return to tank |
| 46 Double clip, clamping feed and return pipes together | 47 Double clip, fixing feed and return pipes to chassis sidemember | 48 Double clip for feed and return pipes |
| 49 Bracket for clip | 50 Fuel pipe, mechanical pump and distributor pump to filter | 51 Banjo bolt (fixing fuel pipe to mechanical pump) |
| 52 Joint washer (fixing fuel pipe to mechanical pump) | 53 Nut (fixing pipe to filter) | 54 Olive (fixing pipe to filter) |
| 55 Fuel pipe, filter to distributor pump | 56 Nut (fixing pipe to filter) | 57 Olive (fixing pipe to filter) |
| 58 Banjo bolt (fixing pipe to distributor pump) | 59 Joint washer (fixing pipe to distributor pump) | 60 Clip, fixing fuel pipe to distributor pump |
| 61 Fuel pipe filter to spill rail at No. 4 injector | 62 Banjo bolt (fixing fuel pipe to filter) | 63 Joint washer (fixing fuel pipe to filter) |
| 64 Double clip, fixing fuel pipes to bulkhead | 65 Sedimentor | 66 Seal for sedimentor |
| 67 Special centre bolt for sedimentor | 68 Washer for centre bolt | 69 Drain plug for sedimentor |
| 70 Rubber seal for drain plug | 71 Mounting bracket for sedimentor | 72 Fuel pipe, tank to sedimentor |
| 73 Fuel pipe, sedimentor to mechanical pump | | |

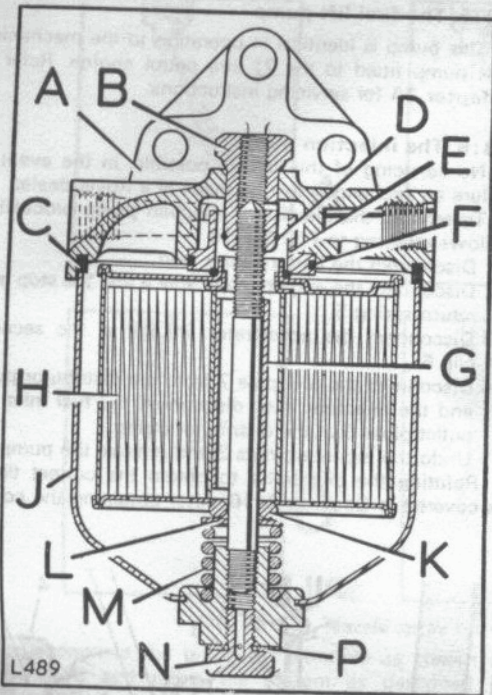


FIG 3B:4 Main filter, early type

Key to FIG 3B:4
 A Housing cover B Cap nut
 C Oil seal D Circlip E Sealing ring F Oil seal
 G Location sleeve H Element J Container K Seal
 L Plain washer M Spring N Drain plug P Washer

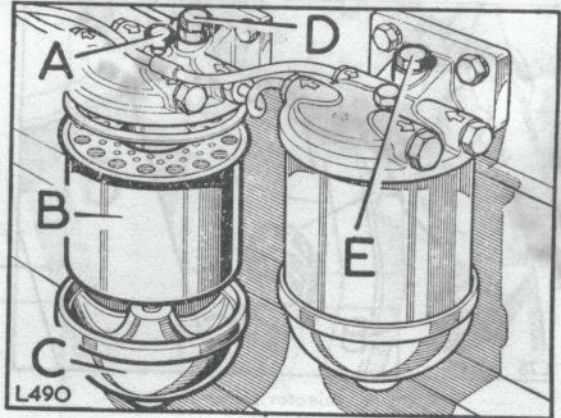


FIG 3B:6 Twin filters, export models

Key to FIG 3B:6
 A Retaining bolt B Element
 C Holder D Bleed pipe E Vent screw

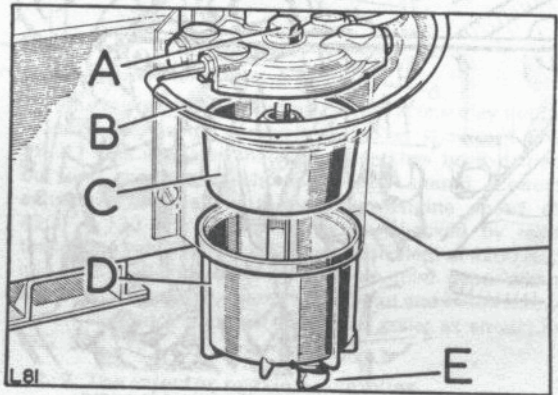


FIG 3B:7 Fuel sedimentor

Key to FIG 3B:7
 A Retaining bolt B Inlet pipe
 C Element D Bowl E Water drain plug

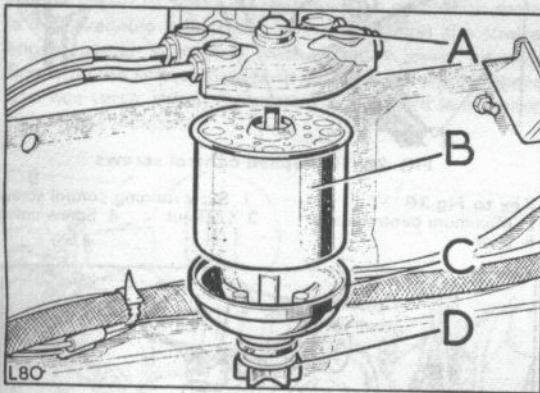


FIG 3B:5 Main filter, late type

Key to FIG 3B:5
 A Retaining bolt B Element
 C Holder D Water drain plug

3B:4 Priming the system

When any disconnection has been made in the system or if the tank level has run low, the system must be primed as follows:

(a) Early type filter:

- 1 Slacken the air vent screw (B in FIG 3B:8), on the top of the engine filter then operate the hand priming

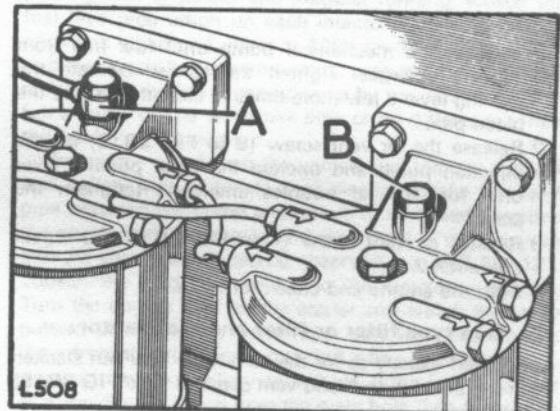


FIG 3B:8 Filter air vent

Key to FIG 3B:8
 A Bleed pipe B Air vent screw

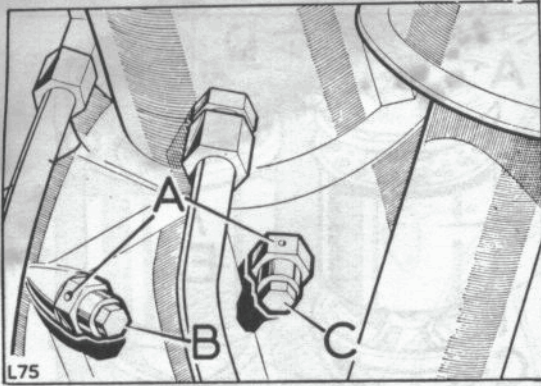


FIG 3B:9 Injector pump air vents

Key to Fig 3B:9
 B Distributor air vent C Distributor control cover air vent

A Fuel orifice

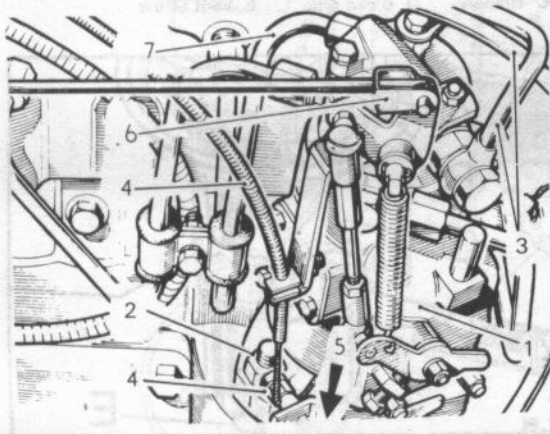


FIG 3B:10 Removing the injector pump

Key to Fig 3B:10 1 Distributor pump 2 Mounting nuts
 3 Fuel pipes 4 Engine stop cable 5 Stop lever return spring
 6 Accelerator linkage 7 Injector fuel pipe

3B:5 The fuel lift pump

This pump is identical in operation to the mechanical fuel pump fitted to the 2½ litre petrol engine. Refer to Chapter 3A for servicing instructions.

3B:6 The injection pump

No servicing of this unit is possible, in the event of failure an exchange must be made at a Rover dealer.

To remove the distributor injection pump proceed as follows referring to FIG 3B:10.

- 1 Disconnect the battery earth lead.
- 2 Disconnect the engine stop cable 4 and the stop lever return spring 5.
- 3 Disconnect the accelerator linkage at the securing clip 6.
- 4 Disconnect the fuel pipe 7 from the distributor pump and the injectors. Also disconnect the fuel inlet and outlet pipes 3 at the distributor pump.
- 5 Undo the mounting nuts 2 and remove the pump.

Refitting the distributor to obtain the correct timing is covered in Section 2:10. After obtaining the correct

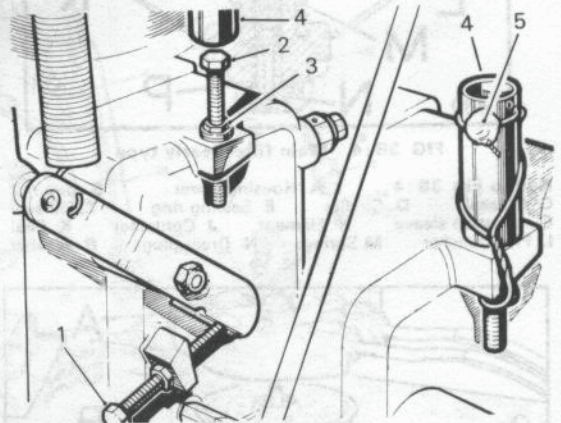


FIG 3B:11 Speed control screws

Key to Fig 3B:11 1 Slow running control screw
 2 Maximum control screw 3 Locknut 4 Screw collar
 5 Seal

lever on the mechanical pump until fuel free from bubbles emerges. Tighten the screw. Operate the priming lever a few more times to clear the air into the bleed pipe.

- 2 Release the air vent screw (B in FIG 3B:9) on the injection pump and operate the hand priming lever until fuel free of bubbles emerges. Retighten the screw.
- 3 Release air vent screw (C in FIG 3B:9) and repeat operation 2.
- 4 Start the engine and check for leaks.

(b) Late type filter or filter and sedimentor:

Proceed exactly as for the early type filter but slacken both the bleed pipe A and vent screw B (see FIG 3B:8) in turn.

Ensure that the fuel lift pump lever is on the bottom of the cam otherwise the hand priming lever may be ineffective and prevent priming of the system.

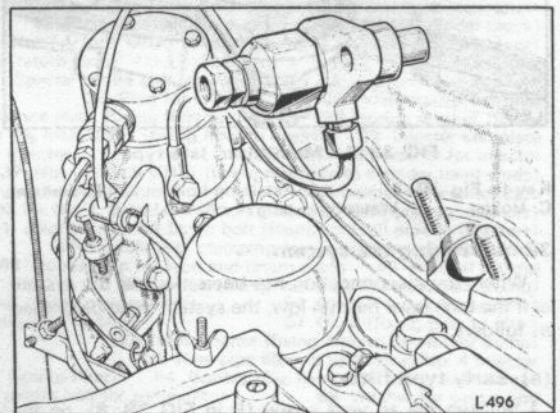


FIG 3B:12 Testing a nozzle assembly

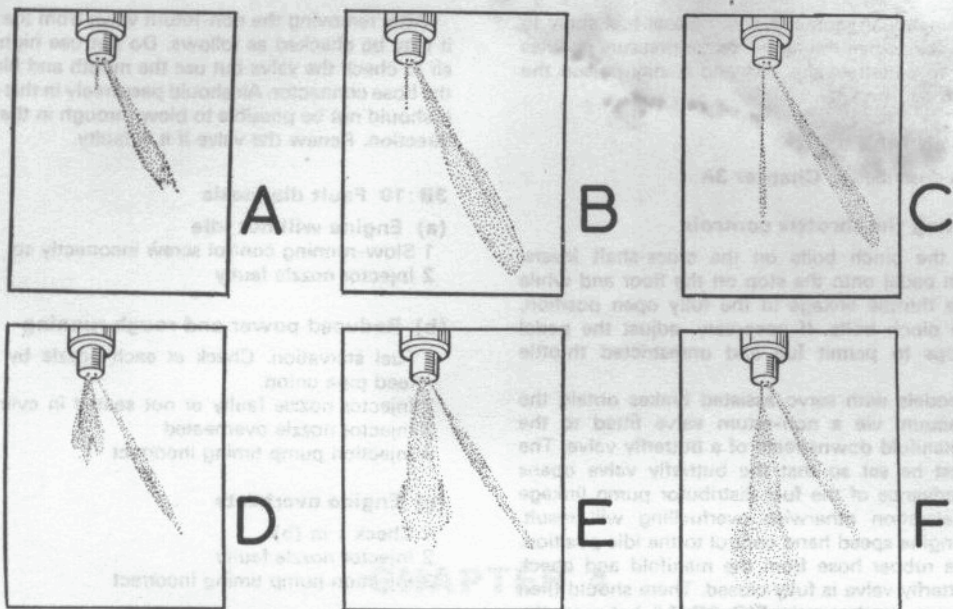


FIG 3B:13 Nozzle spray forms, starting to running conditions, A to F

timing reconnect the pipes and controls as shown in FIG 3B:10 and prime the system as described in Section 3B:4.

When fitting a new or exchange distributor pump the slow running and maximum control screw will require setting. The slow running screw may be supplied loose and should be fitted as shown in FIG 3B:11.

Adjust the slow running control screw to obtain an engine speed of 590 ± 20 rev/min. If a revolution meter is not available adjust the screw to obtain the lowest engine speed consistent with smooth, even running. Screwing the screw inwards to increase the engine speed and vice versa. When the correct adjustment is obtained tighten the locknut.

Adjustment of the maximum control screw may not be required. Where the screw is sealed as shown in FIG 3B:11 this indicates that adjustment has been carried out and the setting should not be altered. Correct adjustment will allow a maximum engine speed of 4200 ± 20 rev/min. This may be checked by road testing the vehicle, the road speed equivalent of 4200 rev/min being 48 mile/hr (77 km/hr) in third gear. When adjustment is correct tighten the locknut and fit the screw collar. Wire lock and seal the screw collar as shown in FIG 3B:11.

3B:7 The injector nozzle assemblies

These assemblies cannot be serviced by the private owner but it is possible to check and test them on the vehicle so as to isolate any particular defective one.

To make a quick check if a nozzle is suspected of causing loss of power and irregular running; loosen the fuel feed pipe union on each injector in turn whilst the engine is idling and again at 1000 rev/min.

If the nozzle has been operating properly there will be a reduction in rev/min accompanied by obvious roughness but a faulty nozzle will make little or no difference when the feed pipe is loosened.

To test the nozzles on the vehicle first remove the fuel spill gallery pipe complete then disconnect the fuel feed pipe between the pump and nozzle to be tested. Remove the nozzle from the engine and reconnect to the pump so that the spray pattern can be observed (see FIG 3B:12). Loosen the feed pipe unions to the remaining nozzles. Turn the engine over on the starter and watch the spray pattern of the nozzle under test. Very little fuel should issue from the main spray hole but a fine spray should be ejected from the auxiliary spray hole. If the fuel is ejected as a liquid jet or issues from the main hole then the nozzle must be replaced by an overhauled exchange assembly.

FIG 3B:11 shows the development of nozzle spray forms from starting to running conditions.

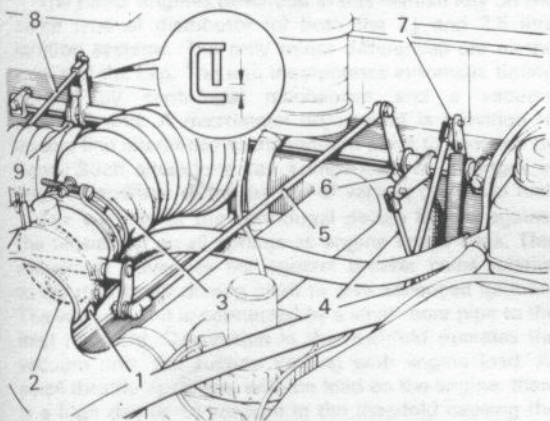


FIG 3B:14 Diesel models with servo-assisted brakes

Key to Fig 3B:14 1 Non-return valve 2 Butterfly valve
3 Rubber hose 4 Hand throttle 5 Manifold butterfly linkage
6 Pinch bolt 7 Accelerator linkage 8 Distributor pump linkage
9 Pinch bolt

It is extremely dangerous to allow diesel fuel spray to contact the skin, since the high injector pressure enables the fuel oil to penetrate the skin and it may poison the blood which can be fatal.

3B:8 The air filter

This was described in **Chapter 3A**.

3B:9 Setting the throttle controls

Slacken the pinch bolts on the cross-shaft levers. Depress the pedal onto the stop on the floor and while holding the throttle linkage in the fully open position, tighten the pinch bolts. If necessary, adjust the pedal limiting stops to permit full and unrestricted throttle opening.

Diesel models with servo assisted brakes obtain the required vacuum via a non-return valve fitted to the induction manifold downstream of a butterfly valve. The linkage must be set so that the butterfly valve opens slightly in advance of the fuel distributor pump linkage during acceleration otherwise overfueling will result. Move the engine speed hand control to the idle position. Remove the rubber hose from the manifold and check that the butterfly valve is fully closed. There should then be a clearance as shown in **FIG 3B:14** between the front arm of the cross-shaft lever and the fuel distributor pump link. If necessary slacken the pinch bolt and move the lever to obtain this clearance.

After removing the non-return valve from the manifold it may be checked as follows. Do not use high pressure air to check the valve but use the mouth and blow down the hose connector. Air should pass freely in this direction. It should not be possible to blow through in the opposite direction. Renew the valve if it is faulty.

3B:10 Fault diagnosis

(a) Engine will not idle

- 1 Slow-running control screw incorrectly set
- 2 Injector nozzle faulty

(b) Reduced power and rough running

- 1 Fuel starvation. Check at each nozzle by loosening feed pipe union.
- 2 Injector nozzle faulty or not seated in cylinder head.
- 3 Injector nozzle overheated
- 4 Injection pump timing incorrect

(c) Engine overheats

- 1 Check 1 in (b)
- 2 Injector nozzle faulty
- 3 Injection pump timing incorrect

(d) Black smoke from exhaust

- 1 Injector nozzle faulty
- 2 Injection pump timing incorrect



CHAPTER 4

THE IGNITION SYSTEM

- 4:1 Description
- 4:2 Routine maintenance
- 4:3 Ignition faults
- 4:4 Removing and dismantling distributor
- 4:5 Timing the ignition
- 4:6 Sparking plugs
- 4:7 Emission control
- 4:8 Fault diagnosis

4:1 Description

The petrol engines described in this manual rely on the same type of distributor for both the 2½ and 2.6 litre ignition systems. The only minor differences are to the cam and the cap. The unit incorporates automatic timing control by centrifugal mechanism and a vacuum operated unit. A micrometer adjustment is provided to enable fine alterations to the ignition point to be made by hand. Such alterations can compensate for changes in engine condition or for the use of various grades of fuel.

The weights of the centrifugal device fly out against the tension of small springs as engine speed rises. This movement advances the contact breaker cams relative to the distributor driving shaft to give advanced ignition. The vacuum unit is connected by a small-bore pipe to the inlet manifold. Depression in the manifold operates the vacuum unit, the suction varying with engine load. At small throttle openings, with no load on the engine, there is a high degree of vacuum in the manifold causing the vacuum unit to advance the ignition. When hill-climbing on large throttle openings, the much reduced vacuum ensures that the unit will retard the ignition. The various elements of the two automatic controls can be seen in FIG 4:1 as items 8, 9 and 10.

4:2 Routine maintenance

Refer to FIG 4:1 and remove distributor cap 2. Pull rotor 5 squarely off the end of cam spindle 13. Now lubricate the cam spindle. Add only a few drops of oil to the recess and do not remove the screw. There is clearance provided for the oil to make its way downwards.

Squirt a few drops of oil to lubricate the centrifugal advance mechanism, but take great care to avoid letting oil get onto the contact breaker plate or the points 6. Smear a little grease or engine oil on the cam. Apply the tiniest drop of oil to the contact breaker pivot.

Adjusting the contact breaker points:

Refer to FIG 4:2 and slacken screw C. Adjust the points to the correct gap of .014 to .016 inch (.35 to .40 mm) as measured with a feeler gauge. It will be necessary to turn the engine until one of the cams has opened the points to the fullest extent so that the gap is measured at the position of maximum opening. Do not alter the gap unless it varies considerably from the suggested setting.

Cleaning the contact points:

If the contact points are dirty or pitted they must be cleaned by polishing them with a fine carborundum

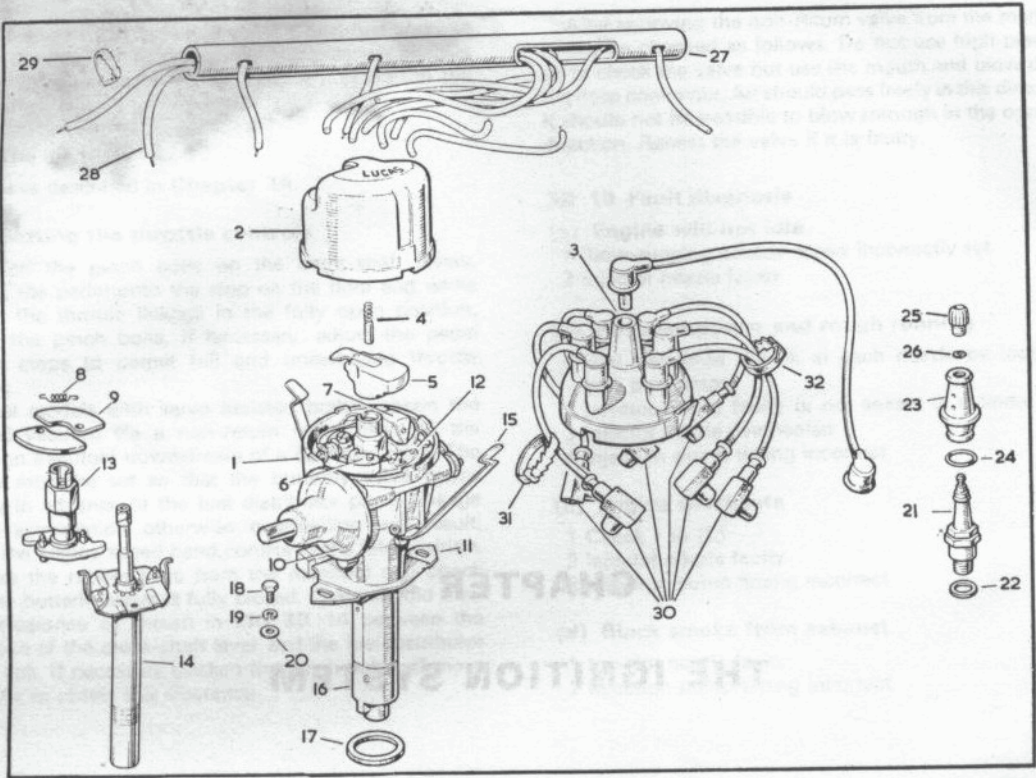


FIG 4:1 Exploded view of distributor

Key to Fig 4:1 1 Distributor body 2 Distributor cap, early type 3 Distributor cap, latest type 4 Brush and spring for cap 5 Rotor arm 6 Contact points 7 Condenser 8 Auto advance spring, set 9 Auto advance weight 10 Vacuum unit 11 Clamping plate 12 Base plate for contact breaker 13 Cam 14 Shaft and action plate 15 Clip for cover 16 Driving dog washer (Fixing distributor to cylinder block) 17 Cork washer for distributor housing 18 Setbolt ($\frac{1}{8}$ in UNF x $\frac{3}{16}$ in long) (Fixing distributor to cylinder block) 19 Spring 20 Plain washer (Fixing distributor to cylinder block) 21 Sparking plug 22 Washer for plug 23 Cover for sparking plug 24 Rubber sealing ring for plug cover 25 Cable nut 26 Washer for cable nut 27 Ignition wire carrier 28 Sparking plug lead set 29 Cable cleat securing No. 1 plug lead and coil leads

stone, taking care to keep the faces flat and square. Afterwards wipe away all dust with a cloth moistened in fuel. The contacts may be dismantled to assist cleaning. If the moving contact is removed from its pivot, check that it is not sluggish. If it is tight, polish the pivot pin with a strip of fine emerycloth, clean off all dust and apply a tiny spot of oil to the top of the pin. If a spring testing gauge is available the contact breaker spring should have a tension of 20 to 24 oz measured at the points.

4:3 Ignition faults

If the engine runs unevenly, set it to idle at a fast speed. Taking care not to touch any metal part of the sparking plug leads, pull off the insulated sleeves thereby disconnecting each plug in turn. Disconnecting a plug which is firing properly will make the uneven running more pronounced. Disconnecting a plug in a cylinder which is not firing will make no difference.

Having located the faulty cylinder, hold the lead carefully to avoid shocks so that the metal end is about $\frac{3}{16}$ inch away from the cylinder head. A strong regular spark shows that the fault might lie with the sparking plug.

Remove and clean it, or alternatively substitute it with a new plug.

If the spark is weak and irregular, check that the lead is not perished or cracked. If it appears to be defective, renew it and try another test. If there is no improvement, remove the distributor cap and wipe the inside clean and dry. Check the carbon brush 4 in FIG 4:1. It should protrude from the moulding and be free to move against the pressure of the internal spring. Examine the surface inside the cap for signs of 'tracking', which can be seen as a thin black line between the electrodes or to some metal part in contact with the cap. This is caused by sparking and the only cure is to fit a new cap.

Testing the low-tension circuit:

Before carrying out electrical tests, confirm that the contact breaker points are clean and correctly set. Then proceed as follows:

- 1 Disconnect the thin cable from the CB terminal on the coil and from the side of the distributor. Connect a test lamp between the two terminals. Turn the engine over slowly. If the lamp lights when the contacts close and

goes out when they open, the low-tension circuit is in order. If the lamp fails to light, the contacts are dirty or there is a break or loose connection in the low-tension wiring.

- 2 If the fault lies in the low-tension circuit, switch on the ignition and turn the crankshaft until the contact points are fully open. Refer to the wiring diagrams in Technical Data and check the circuit with a 0-20 voltmeter. If the circuit is in order the meter should read approximately 12 volts.
- 3 Battery to control box terminal A. Connect the voltmeter between terminal A and earth. No reading indicates a faulty cable or loose connection.
- 4 Control box. Connect the meter between the other auxiliary terminal A1 and earth. No reading indicates a broken or loose connection.
- 5 Control box auxiliary terminal D to terminal IGN on ignition switch. Connect the meter between terminal IGN and earth. No reading indicates a damaged cable or loose connection.
- 6 Ignition coil. Disconnect the cable from terminal CB and connect the meter between this terminal and earth. No reading indicates a fault in the primary winding of the coil and a replacement coil must be fitted. If the reading is correct, remake the connection to the coil.
- 7 Ignition coil to distributor. Disconnect the thin cable from the side terminal on the distributor and connect the meter between the end of this cable and earth. No reading indicates a damaged cable or loose connections.
- 8 Contact breaker and capacitor. Connect the meter across the contact breaker points. No reading indicates a faulty capacitor.

Capacitor:

The best method of testing a capacitor (condenser) is by substitution. Disconnect the original capacitor and connect a new one between the low-tension terminal on the side of the terminal distributor and to earth.

If a new capacitor is needed, fit one complete with bracket, but if necessary unsolder the original bracket and solder it on the new capacitor using as little heat as possible. Capacitor capacity is .18 to .22 microfarad.

4:4 Removing and dismantling distributor

Use FIG 4:1 for reference. Before removing the distributor turn the crankshaft until the rotor arm 5 is pointing to the brass segment in the cap which is connected to No. 1 cylinder plug lead at the front of the engine. This will provide a datum for replacement. Provided the pinch bolt in clamp plate 11 is not loosened, the distributor can be removed and replaced without disturbing the ignition timing. Do not turn the crankshaft after this.

- 1 Remove cap 2 and disconnect the cable from the low-tension terminal. Disconnect the suction pipe from vacuum unit 10. Remove the bolts securing the clamp plate 11 to the housing in the crankcase and withdraw the distributor.
- 2 Pull off the rotor arm. Remove the nut which holds assembly 6 and lift off the insulating bush, terminal tags, moving contact and spring assembly and the washer. The fixed contact plate can then be lifted off.

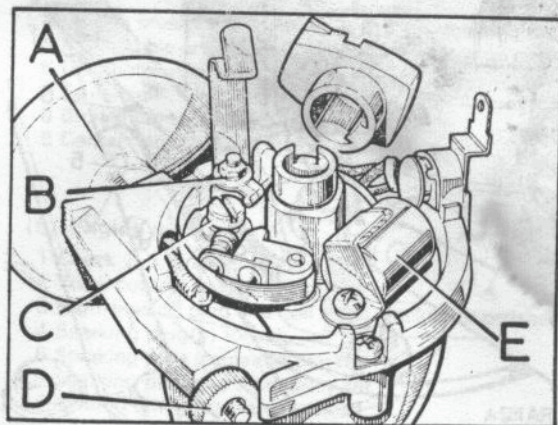


FIG 4:2 The contact breaker

Key to Fig 4:2 A Micrometer scale B Terminal screw
C Contact adjustment screw D Micrometer adjusting nut E Capacitor

- 3 Remove the two screws securing the base plate and unhook the flexible link coming from the vacuum unit.
- 4 Before further dismantling, note the relative positions of the rotor arm driving slot at the top of item 13 and the driving dog 16 which is offset and can only engage its driving spindle in one position. Then, when the cam assembly is fitted to the centrifugal weights during reassembly, the timing will not be 180 deg. out.
- 5 Take out the cam retaining screw recessed in the rotor arm housing on the end of the spindle. Remove the springs 8 and lift off the cam. Take out the weights 9.
- 6 To release the vacuum unit remove the circlip at the adjusting nut end. Unscrew the knurled nut, remove the friction spring and withdraw the unit from the body.
- 7 Check all parts for wear, and service the cap and contact breaker by following the instructions in Section 4:2. If the shaft 14 is slack in the body, drive out the parallel pin, pull off dog 16 and withdraw the spindle. Press out the old bush. Immerse the new bush in thin engine oil for 24 hours and press it into the body.

Reassembly is the reverse of dismantling but note the following points:

- 1 Lubricate the parts of the centrifugal advance mechanism, the distributor shaft and that part of the shaft which accepts the cam, with thin engine oil.
- 2 Turn the vacuum control adjusting nut to its halfway position. Engage the cam driving pins with the centrifugal weights so that, when seen from above, the small offset of the driving dog is on the right and the driving slot for the rotor arm is at the six o'clock position.
- 3 Fit the distributor in its housing and turn the rotor arm until the driving dog engages. Provided the crankshaft has not been turned the rotor arm should finish up pointing to No. 1 cylinder segment in the cap. Replace the plug leads in the firing order of 1, 3, 4, 2 or 1, 5, 3, 6, 2, 4 (2½ or 2.6 litre engine). Distributor rotation is anticlockwise when viewed from above. If the clamping plate has been moved, resulting in lost timing, refer to the next Section.

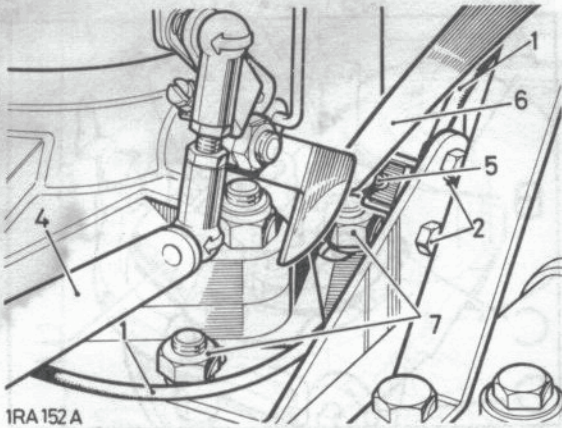


FIG 4:3 Throttle controlled vacuum switch adjustment

Key to Fig 4:3

- 2 Switch retaining bolts
- 5 Switch plunger
- 7 Bracket mounting nuts

- 1 Vacuum pipes
- 4 Throttle linkage
- 6 .030 inch feeler gauge

4:5 Timing the ignition

If the engine has been dismantled and the ignition timing disturbed refer to **Chapter 1** for retiming instructions for both the 2½ and 2.6 litre engines (see **Section 1:7(a)** and **(b)**).

4:6 Sparking plugs

Inspect, clean and adjust sparking plugs regularly. The inspection of the deposits on the electrodes is particularly useful because the type and colour of the deposit gives a clue to conditions inside the combustion chamber, and is therefore most helpful when tuning.

Remove the sparking plugs by loosening them a couple of turns and then blowing away loose dirt from the plug recesses with compressed air or a tyre pump. Store them in the order of removal.

Examine the gaskets. If they are about half their original thickness they may be used again.

Examine the firing end of the plugs to note the type of deposit. Normally, it should be powdery, and range from brown to greyish tan in colour. There will also be slight wear of the electrodes, and the general effect is one which comes from mixed periods of high-speed and low-speed driving. Cleaning and resetting the gap is all that will be required. If the deposits are white or yellowish they indicate long periods of constant-speed driving or much low-speed driving. Again, the treatment is straightforward.

Black, wet deposits are caused by oil entering the combustion chamber past worn pistons, rings or down valve stems. Sparking plugs of a type which run hotter may help to alleviate the problem, but the cure is an engine overhaul.

Dry, black, fluffy deposits are usually the result of running with a rich mixture. Incomplete combustion may also be a cause and this might be traced to defective ignition or excessive idling.

Overheated sparking plugs have a white, blistered look about the centre electrode and the side electrode may be badly eroded. This may be caused by poor cooling, wrong ignition timing, or sustained high speeds with heavy loads.

Have the sparking plugs cleaned on an abrasive-blasting machine and tested under pressure after attention to the electrodes. File these until they are clean, bright, and parallel. Set the electrode gap to .025 inch. Do not try to bend the centre electrode. The spark plug gap for Series III models should be .029 to .032 inch.

Before replacing the plugs clean the threads with a wire brush. Do not use a wire brush on the electrodes. If it is found that the plugs cannot be screwed in by hand, run a tap down the threads in the cylinder head. Failing a tap, use an old sparking plug with crosscuts down the threads. Finally tighten the plugs to a torque of 30 lb ft. If a torque wrench is not available, tighten with a normal box spanner through half a turn.

Sparking plug leads:

To fit new leads, insert the cable after smearing the socket with silicone grease to prevent water from entering. Push the lead right home and then secure it with the screw. To fit the high-tension cable to the ignition coil slip the knurled terminal over the cable first. Then bare about ¼ inch of the wires and thread them through the brass washer removed from the old cable. Fan out the wires over the face of the washer to hold it in place. Screwing the terminal nut into the coil socket will hold the cable firmly.

4:7 Emission control

A special distributor provides retarded ignition at low engine speeds while retaining the normal advance facility at higher speeds. However, when the throttle is shut from high engine speeds a retarded setting is needed and is achieved by fitting a throttle controlled vacuum switch.

Refer to **FIG 4:3**. The switch is inserted in the vacuum line between the inlet manifold and the distributor retard capsule. A throttle operated cam governs the switch progressively from open to closed.

At the open position (switch plunger out) the switch closes off the vacuum line, opens the distributor capsule to atmosphere and allows the ignition to advance.

At the closed position (switch plunger in) the switch opens the vacuum line to the capsule and the ignition is retarded.

Adjusting the vacuum switch:

First ensure that the throttle linkage is fully in the idle position, then push the switch plunger fully in and hold.

Measure the clearance between the plunger and the cam on the throttle linkage. This must be .03 inch (.76 mm).

If necessary, adjust by loosening the mounting bracket nuts and moving the switch and bracket complete in the required direction.

Ignition timing

To ensure compliance with any exhaust emission regulations it is essential that the timing is set dynamically. This requires the use of a tachometer and a stroboscopic lamp. The static timing may be used as an initial setting, but this is not acceptable as a final setting. The timing mark for the engine appears on the crankshaft pulley.

Make sure that the vacuum switch is correctly set and that all pipes are sound and correctly fitted. Connect a stroboscopic lamp to No. 1 sparking plug in accordance with the makers instructions.

Set the engine idle speed to as near 800 rev/min as possible without exceeding this figure. Set the vernier adjustment on the distributor to the fully advanced position.

Slacken the distributor clamp bolt and carefully rotate the distributor to synchronise the light at 6 deg. ATDC. Secure the clamping bolt and check the timing.

4:8 Fault diagnosis

(a) Engine will not fire

- 1 Battery discharged
- 2 Distributor contact points dirty, pitted or maladjusted
- 3 Distributor cap dirty, cracked or 'tracking'

- 4 Carbon brush inside distributor cap not touching rotor
- 5 Faulty cable or loose connection in low-tension circuit
- 6 Distributor rotor arm cracked
- 7 Faulty coil
- 8 Broken contact breaker spring
- 9 Contact points stuck open

(b) Engine misfires

- 1 Check 2, 3, 5 and 7 in (a)
- 2 Weak contact breaker spring
- 3 High-tension plug and coil leads cracked or perished
- 4 Sparking plug(s) loose
- 5 Sparking plug insulation cracked
- 6 Sparking plug gap incorrectly set
- 7 Ignition timing too far advanced

CHAPTER 5

THE COOLING SYSTEM

5.1 Description

- 5.1.1 Water-cooled cooling system, all-round
- 5.1.2 The water pump, Petrol and Diesel engines

5.4 The thermostat

5.5 Fault diagnosis

5.1 Description

All the engines covered by this manual have a water-cooled cooling system. The cooling system is a closed circuit in which the water is pumped by a centrifugal pump. The water in the system flows from the bottom tank of the radiator and passes it through the passage block of the engine block and cylinder head and it reaches a thermostat valve which allows cool water passing to the top of the radiator. The water in the radiator is cooled by the air which flows over it as the engine is running. The thermostat valve, on cooling, will close, and the water will flow only to the radiator tank, and the passage of the water to the engine will be stopped. The passage of the water to the engine is provided by the action of the pump.

The thermostat valve, in our engines, has two positions. The thermostat valve, in the closed position, the water will flow only to the radiator and the water will be cooled by the air which flows over it as the engine is running. The thermostat valve, in the open position, the water will flow to the engine and the water will be cooled by the air which flows over it as the engine is running.

The thermostat valve, in our engines, has two positions. The thermostat valve, in the closed position, the water will flow only to the radiator and the water will be cooled by the air which flows over it as the engine is running. The thermostat valve, in the open position, the water will flow to the engine and the water will be cooled by the air which flows over it as the engine is running.

It is essential to know that the thermostat valve does not open at the correct working temperature. The thermostat valve, in the closed position, the water will flow only to the radiator and the water will be cooled by the air which flows over it as the engine is running. The thermostat valve, in the open position, the water will flow to the engine and the water will be cooled by the air which flows over it as the engine is running.

5.2 Maintenance of engine cooling system

It is a good idea to inspect the cooling system of the engine and that the thermostat valve is in the correct level in the radiator. The thermostat valve, in the closed position, the water will flow only to the radiator and the water will be cooled by the air which flows over it as the engine is running. The thermostat valve, in the open position, the water will flow to the engine and the water will be cooled by the air which flows over it as the engine is running.

Adjust the belt tension of the water pump. The thermostat valve, in the closed position, the water will flow only to the radiator and the water will be cooled by the air which flows over it as the engine is running. The thermostat valve, in the open position, the water will flow to the engine and the water will be cooled by the air which flows over it as the engine is running.

NOTES

1. The first part of the report is devoted to a description of the experimental apparatus and the method of measurement. It is found that the rate of reaction is independent of the concentration of the reactants and is proportional to the square of the concentration of the catalyst.

2. The second part of the report is devoted to a discussion of the results obtained. It is shown that the rate of reaction is independent of the concentration of the reactants and is proportional to the square of the concentration of the catalyst. This is in agreement with the proposed mechanism.

3. The third part of the report is devoted to a discussion of the mechanism of the reaction. It is proposed that the reaction proceeds via a two-step process in which the first step is rate-determining.

4. The fourth part of the report is devoted to a discussion of the effect of temperature on the rate of reaction. It is found that the rate of reaction increases with increasing temperature, in agreement with the Arrhenius equation.

5. The fifth part of the report is devoted to a discussion of the effect of the concentration of the catalyst on the rate of reaction. It is found that the rate of reaction increases with increasing concentration of the catalyst, in agreement with the proposed mechanism.

6. The sixth part of the report is devoted to a discussion of the effect of the concentration of the reactants on the rate of reaction. It is found that the rate of reaction is independent of the concentration of the reactants, in agreement with the proposed mechanism.

7. The seventh part of the report is devoted to a discussion of the effect of the concentration of the catalyst on the rate of reaction. It is found that the rate of reaction increases with increasing concentration of the catalyst, in agreement with the proposed mechanism.

8. The eighth part of the report is devoted to a discussion of the effect of the concentration of the reactants on the rate of reaction. It is found that the rate of reaction is independent of the concentration of the reactants, in agreement with the proposed mechanism.

9. The ninth part of the report is devoted to a discussion of the effect of the concentration of the catalyst on the rate of reaction. It is found that the rate of reaction increases with increasing concentration of the catalyst, in agreement with the proposed mechanism.

10. The tenth part of the report is devoted to a discussion of the effect of the concentration of the reactants on the rate of reaction. It is found that the rate of reaction is independent of the concentration of the reactants, in agreement with the proposed mechanism.

11. The eleventh part of the report is devoted to a discussion of the effect of the concentration of the catalyst on the rate of reaction. It is found that the rate of reaction increases with increasing concentration of the catalyst, in agreement with the proposed mechanism.

12. The twelfth part of the report is devoted to a discussion of the effect of the concentration of the reactants on the rate of reaction. It is found that the rate of reaction is independent of the concentration of the reactants, in agreement with the proposed mechanism.

13. The thirteenth part of the report is devoted to a discussion of the effect of the concentration of the catalyst on the rate of reaction. It is found that the rate of reaction increases with increasing concentration of the catalyst, in agreement with the proposed mechanism.

14. The fourteenth part of the report is devoted to a discussion of the effect of the concentration of the reactants on the rate of reaction. It is found that the rate of reaction is independent of the concentration of the reactants, in agreement with the proposed mechanism.

15. The fifteenth part of the report is devoted to a discussion of the effect of the concentration of the catalyst on the rate of reaction. It is found that the rate of reaction increases with increasing concentration of the catalyst, in agreement with the proposed mechanism.

16. The sixteenth part of the report is devoted to a discussion of the effect of the concentration of the reactants on the rate of reaction. It is found that the rate of reaction is independent of the concentration of the reactants, in agreement with the proposed mechanism.

17. The seventeenth part of the report is devoted to a discussion of the effect of the concentration of the catalyst on the rate of reaction. It is found that the rate of reaction increases with increasing concentration of the catalyst, in agreement with the proposed mechanism.

18. The eighteenth part of the report is devoted to a discussion of the effect of the concentration of the reactants on the rate of reaction. It is found that the rate of reaction is independent of the concentration of the reactants, in agreement with the proposed mechanism.

19. The nineteenth part of the report is devoted to a discussion of the effect of the concentration of the catalyst on the rate of reaction. It is found that the rate of reaction increases with increasing concentration of the catalyst, in agreement with the proposed mechanism.

20. The twentieth part of the report is devoted to a discussion of the effect of the concentration of the reactants on the rate of reaction. It is found that the rate of reaction is independent of the concentration of the reactants, in agreement with the proposed mechanism.



CHAPTER 5

THE COOLING SYSTEM

5:1 Description

- 5:2 Maintenance of cooling system, all models
- 5:3 The water pump. Petrol and Diesel engines

5:4 The thermostat

- 5:5 Fault diagnosis

5:1 Description

All the engines covered by this manual have the same type of pressurized cooling system. The natural thermo siphon action of the water is augmented by a centrifugal impeller mounted at the cylinder block end of the fan spindle. The impeller receives water from the bottom tank of the radiator and passes it through the cylinder block. From here it rises into the cylinder head until it reaches a thermostat valve which prevents cold water passing to the top tank of the radiator. The water is then re-circulated through the engine until it is hot enough to open the thermostat valve, thus giving a quick warm up. The hot water in the top tank of the radiator falls through the finned core where it is cooled. The passage of the cooling air past the core is assisted by the action of the fan.

A spring-loaded valve in the radiator filler cap pressurizes the system and so increases the temperature at which the water boils. Note that early models are pressurized to 10 lb/sq inch (.7 kg/sq cm) and later models to 9 lb/sq inch (.6 kg/sq cm). As the coolant temperature falls a vacuum is created and a valve opening at 1 lb/sq inch (.07 kg/sq cm) is incorporated in all filler caps.

On early 2½ litre petrol and diesel engines the thermostat is a bellows type while later engines have the wax filled unit. Both are fully open at 185°F (85°C). The 2.6 litre petrol engine has the wax type which is set to be fully open at 190°F (87.8°C).

It is essential to note that the diesel engine must not be run, even for a few seconds, without coolant in it. Lacquer formation on the injectors would ruin them almost at once. The wisest precaution to take if the diesel cooling system is drained is to disconnect the batteries so that the heater plugs and starter motor are inoperative; failing this, at least attach a label to a prominent place in the driving cab stating that the system has been drained and the engine must not be started until it is refilled.

5:2 Maintenance of cooling system, all models

It is a good plan to inspect the cooling system at the same time that the oil level is checked. See that the water level in the radiator reaches the bottom of the filler neck, that the hoses are not cracked or perished, the drain taps are properly closed and that no water leaks are visible. Check the fan belt tension; on 2¼ litre petrol and diesel engines there should be $\frac{5}{16}$ to $\frac{7}{16}$ inch (8 to 11 mm) slack between the fan and crankshaft pulleys and the same on the 2.6 litre petrol engine. To adjust the tension, slacken the generator pivot bolts and the bolt on the adjusting link, move the generator as necessary then tighten the bolts.

Adjust the belt tension of models fitted with an alternator in place of the generator to the following figures. For the 2½ litre engine the belt should deflect .25 to .375 inch (6.5 to 9.5 mm) midway between the fan and alternator pulleys. For the 2.6 engine fitted with an alternator deflection is the same as for the earlier models.

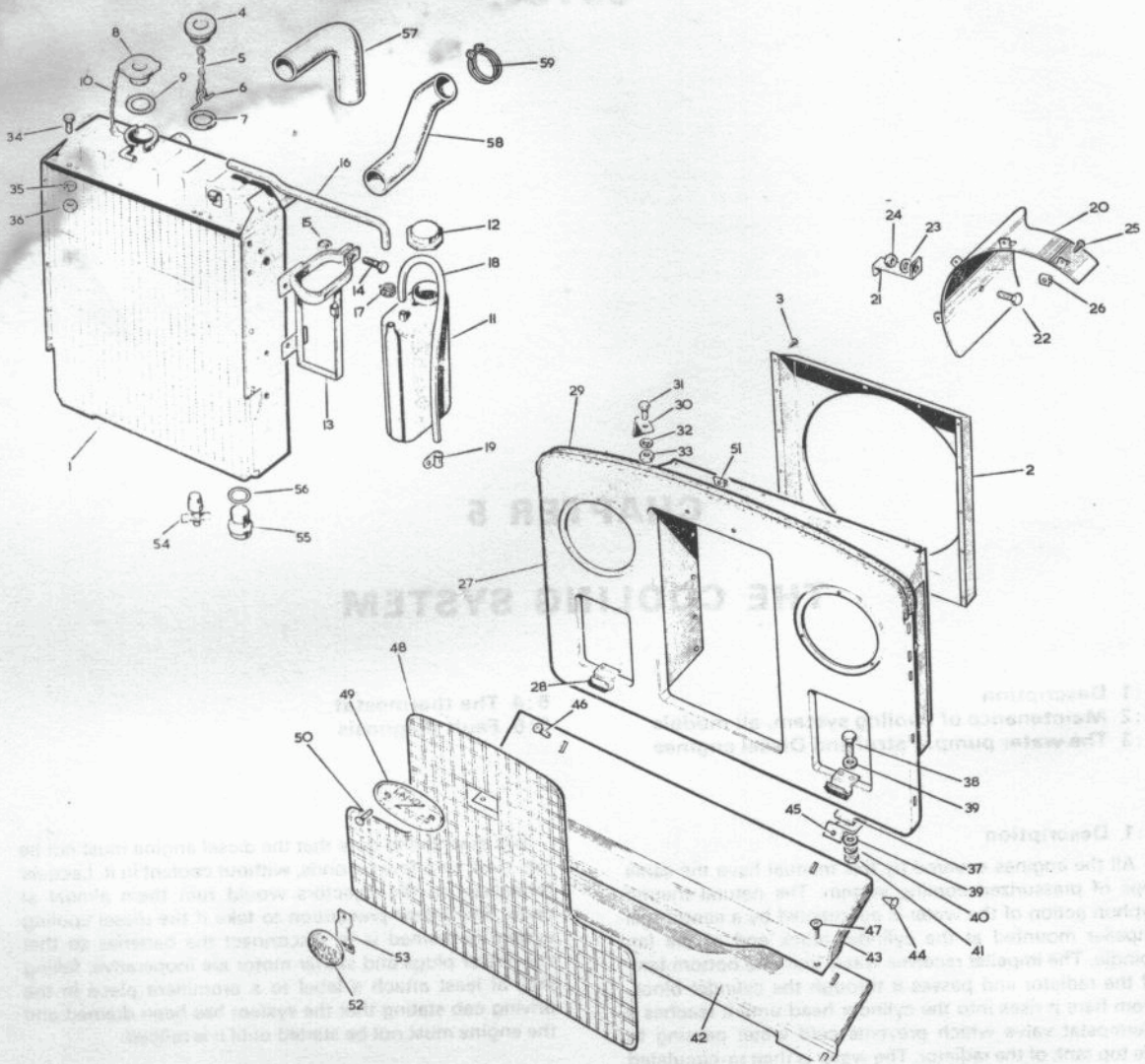


FIG 5:1 Radiator and grille assembly

Key to Fig 5:1 1 Radiator block assembly 2 Fan cowl 3 Drive screw for cowl 4 Filler cap 5 Filler cap chain 6 Retainer for chain 7 Filler cap joint washer 8 Filler cap with overflow bottle provision 9 Joint washer 10 Chain for filler cap for chain 11 Overflow bottle for radiator 12 Cap for overflow bottle 13 Carrier bracket for overflow bottle 14 Bolt ($\frac{1}{2}$ in UNF x $\frac{3}{8}$ in long) (Clamping bottle to carrier) 15 Self-locking nut ($\frac{1}{2}$ in UNF) (Clamping bottle to carrier) 16 Hose, radiator to overflow bottle 17 Clip, fixing hose 18 Flexible pipe, overflow bottle outlet 19 Clip, fixing outlet pipe 20 Shroud for fan cowl 21 Steady strip for shroud 22 Bolt ($\frac{1}{2}$ in UNF x $\frac{3}{8}$ in long) (Fixing steady strip to shroud) 23 Spring washer (Fixing steady strip to shroud) 24, 25, 26 Shroud fixings 27 Radiator grille panel complete 28 Support clip for grille mesh 29 Bonnet rest strip, 35 in long 30 Protection plate for headlamp 31 Bolt ($\frac{1}{2}$ in UNF x $\frac{3}{8}$ in long) (Fixing plate to grille panel) 32 Spring washer (Fixing plate to grille panel) 33 Nut ($\frac{1}{2}$ in UNF) (Fixing plate to grille panel) 34 Bolt ($\frac{1}{2}$ in UNF x $\frac{3}{8}$ long) (Fixing radiator block to grille panel) 35 Spring washer (Fixing radiator block to grille panel) 36 Nut ($\frac{1}{2}$ in UNF) (Fixing radiator block to grille panel) 37 Rubber buffer (Fixing grille panel and front apron bracket to chassis frame) 38 Bolt ($\frac{1}{2}$ in UNF x $1\frac{1}{2}$ in long) (Fixing grille panel and front apron bracket to chassis frame) 39 Plain washer (Fixing grille panel and front apron bracket to chassis frame) 40 Spring washer (Fixing grille panel and front apron bracket to chassis frame) 41 Nut ($\frac{3}{8}$ in UNF) (Fixing grille panel and front apron bracket to chassis frame) 42 Front apron panel (Alternatives) 43 Front apron panel (Alternatives) 44 Rubber buffer for front apron panel 45 Securing bracket for panel 46 Fixings, apron panel to brackets 47 Fixings, apron panel to chassis 48 Grille for radiator 49 'Land Rover' nameplate 50 Drive screw (Fixing nameplate and grille to grille panel) 51 Spire nut (Fixing nameplate and grille to grille panel) 52 'Diesel' badge, where applicable 53 Fixing bracket for badge—Rivet (Fixing bracket and badge to grille)—Lockwasher (Fixing bracket and badge to grille) 54 Drain tap for radiator 55 Drain plug for radiator 56 Joint washer for plug 57 Hose for radiator, top 58 Hose for radiator, bottom 59 Radiator hose clips

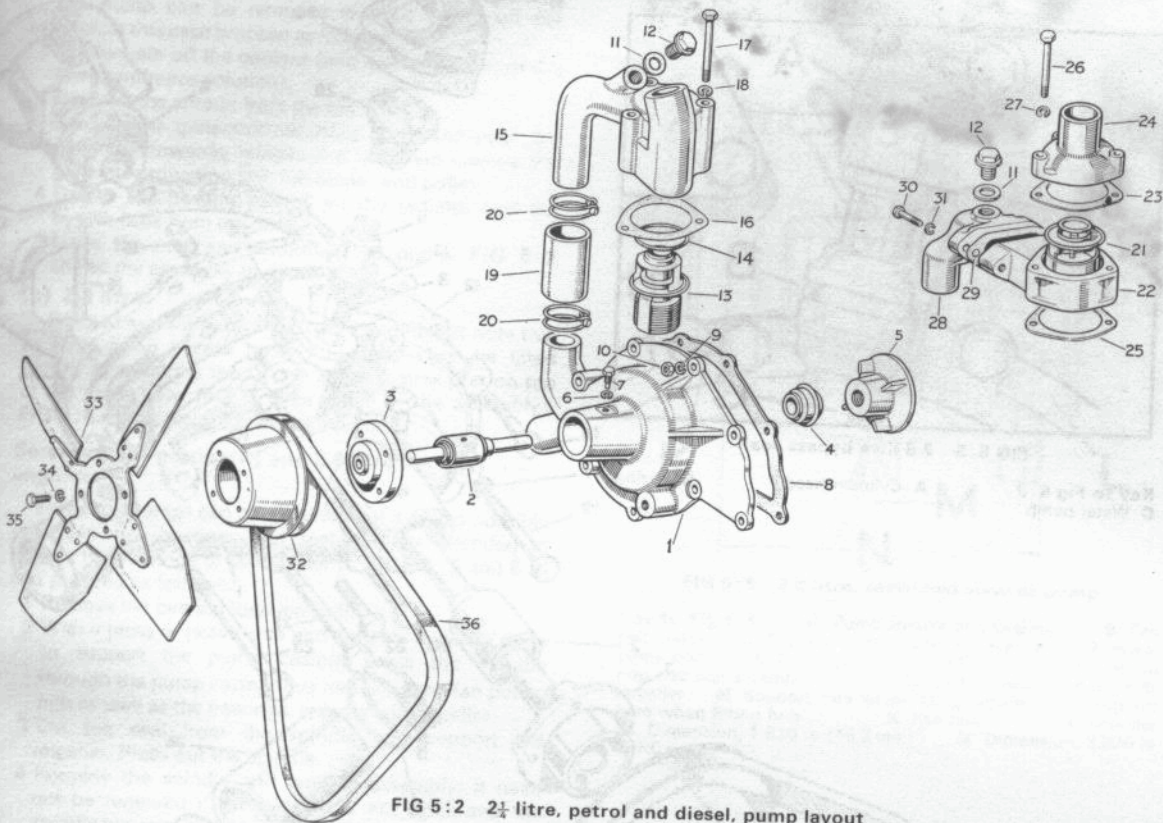


FIG 5:2 2½ litre, petrol and diesel, pump layout

- Key to Fig 5:2**
- | | | | | |
|--|---|--|---|--|
| 1 Water pump casing | 2 Pump spindle and bearing | 3 Hub for fan | 4 Carbon ring and seal unit | 5 Impeller |
| 6 Spring washer (Locating bearing casing) | 7 Special setbolt (Locating bearing casing) | 8 Joint washer for water pump | 9 Spring washer (Fixing water pump to front cover) | 10 Nut (Fixing water pump to front cover) |
| 11 Joint washer (For heater return in water outlet pipe) | 12 Plug (3/8 in BSP) (For heater return in water outlet pipe) | 13 Thermostat | 14 O-ring, thermostat to water outlet pipe | 15 Water outlet pipe, thermostat to radiator |
| 16 Washer for outlet pipe | 17 Setbolt (1/4 in UNF x 2 1/2 in long) (Fixing outlet pipe to cylinder head) | 18 Spring washer (Fixing outlet pipe to cylinder head) | 19 Hose for bypass pipe | 20 Clip for hose |
| 21 Thermostat | 22 Thermostat housing, lower | 23 Joint washer for thermostat housing, upper | 24 Water outlet pipe, thermostat to radiator | 25 Joint washer for thermostat housing and outlet pipe to cylinder head |
| 26 Setbolt (1/2 in UNF x 2 1/2 in long) (Fixing thermostat housing and outlet pipe to cylinder head) | 27 Spring washer (Fixing thermostat housing and outlet pipe to cylinder head) | 28 Thermostat bypass pipe | 29 Joint washer for bypass pipe | 30 Setbolt (1/4 in UNF x 1 in long) (Fixing bypass pipe to thermostat housing) |
| 31 Spring washer (Fixing bypass pipe to thermostat housing) | 32 Fan pulley | 33 Fan blade | 34 Spring washer (Fixing fan blade and pulley to hub) | 35 Setbolt (1/4 in UNF x 2 in long) (Fixing fan blade and pulley to hub) |
| | 36 Fan and dynamo belt | | | |

Flushing the system:

The cooling system should be drained and flushed at least once or twice a year in the following manner:

- 1 Remove the radiator cap and open the drain taps. Allow the coolant to drain away.
- 2 Place a hose in the radiator filler and fill the system, adjust the flow to equal that draining from the taps.
- 3 Run the engine for a few minutes.
- 4 Stop the engine, close the taps and refill the system to the bottom of the radiator filler neck.

Frost precautions:

Only high quality inhibited glycol based solutions should be used as antifreeze. For temperatures from -32°C use one part of antifreeze to two parts of water. See the Technical Data Section for the capacities of the various cooling systems. To add the antifreeze, first

check that all the cooling system connections are in good order; antifreeze has a much more 'searching' action than plain water. Drain and flush the system then half-fill with clean water, add the antifreeze and top up with water. Run the engine until the thermostat opens and the solution circulates through the radiator core. If possible always use soft water in the cooling system. In hard water areas, distilled or rain water should be used.

5:3 The water pumps

Petrol engines:

(a) 2½ litre:

FIG 5:1 shows the layout and this applies to the diesel engine as well. The later type semi-sealed system is illustrated.

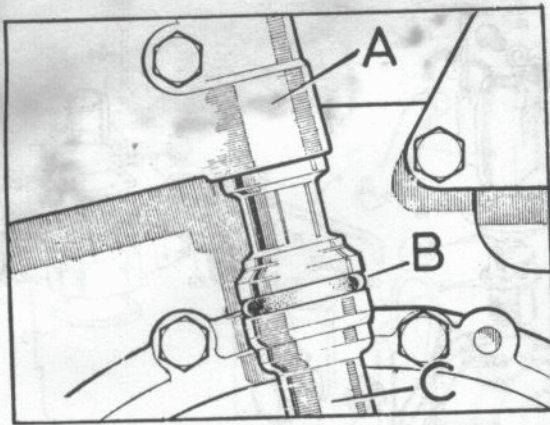


FIG 5:3 2.6 litre bypass seal

Key to Fig 5:3
C Water pump

A Cylinder head

B O-ring

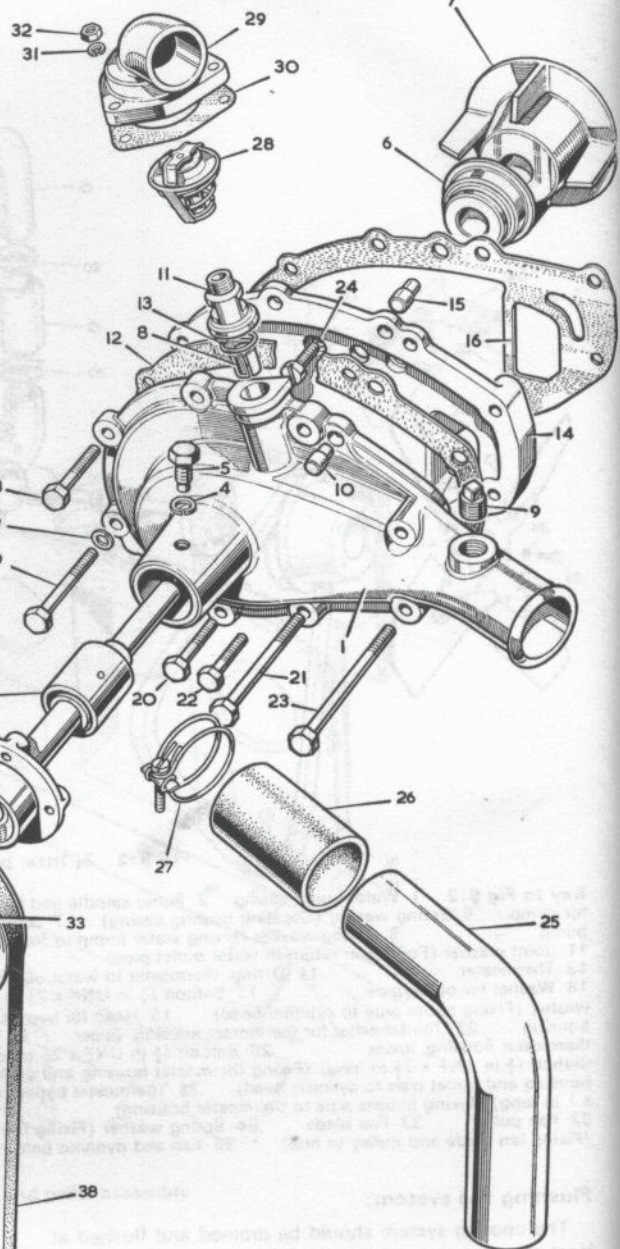


FIG 5:4 2.6 litre petrol engine, pump layout

Key to Fig 5:4 1 Water pump assembly 2 Spindle and bearing complete 3 Hub for fan blade 4 Spring washer (Locating bearing in casing) 5 Special setbolt (Locating bearing in casing) 6 Carbon ring and seal 7 Impeller for pump 8 Tube for thermostat bypass 9 Plug ($\frac{3}{8}$ in BSP) for heater adaptor hole in casing 10 Dowel for water pump casing 11 Connector, bypass to water pump 12 Joint washer for water pump 13 Rubber seal, pump to cylinder head 14 Adaptor for water pump 15 Dowel for adaptor 16 Joint washer for adaptor 17 Spring washer* 18 Setbolt ($\frac{1}{2}$ in UNF x 1 in long)* 19 Setbolt ($\frac{1}{2}$ in UNF x $1\frac{3}{8}$ in long)* 20 Setbolt ($\frac{1}{2}$ in UNF x $1\frac{1}{8}$ in long)* 21 Setbolt ($\frac{1}{2}$ in UNF x $2\frac{1}{2}$ in long)* 22 Setbolt ($\frac{1}{2}$ in UNF x $\frac{7}{8}$ in long)* 23 Setbolt ($\frac{1}{2}$ in UNF x $2\frac{1}{2}$ in long) 24 Special 'Wedgelok' screw 25 Inlet pipe for water pump 26 hose, water inlet pipe to pump 27 Clip, hose to pump 28 Thermostat, wax type 29 Outlet pipe to radiator 30 Joint washer for water outlet pipe 31 Spring washer (Fixing pipe to cylinder head) 32 Nut ($\frac{1}{2}$ in UNF) (Fixing pipe to cylinder head) 33 Pulley for fan 34 Fan blade 35 Distance piece for fan blade 36 Spring washer (Fixing pulley and blade to hub) 37 Setbolt ($\frac{1}{2}$ in UNF x $1\frac{1}{2}$ in long) (Fixing pulley and blade to hub) 38 Fan belt

*Fixing water pump and adaptor to block

The pump can be removed without taking off the radiator; in this case proceed as follows:

- 1 Partly drain off the coolant (into a clean container if it is an antifreeze solution).
- 2 Remove the shroud from the fan cowl.
- 3 Slacken the generator mounting bolts and push the generator inwards, remove the belt then remove the generator adjusting link, fan blades and pulley.
- 4 Detach the bottom hose from the radiator and the bypass hose from the pump.
- 5 Undo the nuts and withdraw the pump. FIG 5:2 shows the assembly in detail.

(b) 2.6 litre:

Proceed exactly as for the 2½ litre engine but note that as there is no bypass hose, the pump must be tilted slightly to compress the O-ring at the bypass port on top of the pump (see FIG 5:3 for detail of the assembly). FIG 5:4 shows the complete pump unit.

Servicing the pumps, 2½ and 2.6 litre petrol engines:

Exchange pumps can be obtained but it is also possible to obtain new bearings and seals. If it is intended to replace the bearings or seals, refer to FIGS 5:5 and 5:6 and proceed as follows:

- 1 Remove the bearing location bolt.
- 2 With a press or heavy vice and suitable distance rings to support the pump casing, press the spindle through the pump casing thus removing the fan pulley hub as well as the bearings, spindle and impeller.
- 3 Cut the seal from the spindle and support the impeller. Press out the spindle.
- 4 Examine the spindle and bearing assembly; it need not be renewed if the bearing is not slack and the spindle not excessively corroded. This may be the case where a defective seal causing a water leak has been the reason for stripping the pump. Clean any corroded part of the spindle and paint with chlorinated rubber primer or good quality aluminium paint. If a steel deflector washer is fitted to the spindle, check that there is .018 inch (.46 mm) clearance between it and the bearing face.
- 5 Put a few drops of thick oil in the location hole in the bearing.
- 6 Press the spindle and bearing assembly into the front of the pump body with the longer end of the spindle leading. Locate with the setbolt and washer.
- 7 Support the spindle and press on the fan pulley hub to the dimensions shown in FIGS 5:5 or 5:6 as appropriate.
- 8 Turn the pump over and support the spindle at the front. Press the impeller onto the spindle, again referring to FIG 5:5 or 5:6 as appropriate.

Replacing the pumps:

This is a reversal of the removal process but be sure to use all new joint washers. It will be found easier to fit the belt if it is engaged in the fan pulley groove before the fan and pulley are bolted to the pump spindle.

The 2½ litre diesel engine:

Removal, servicing and replacement of this pump follow the same general lines as those described for the 2½ litre petrol engine. Reference to FIG 5:6 will show that the pump itself is identical to that used on the 2½ litre petrol engine.

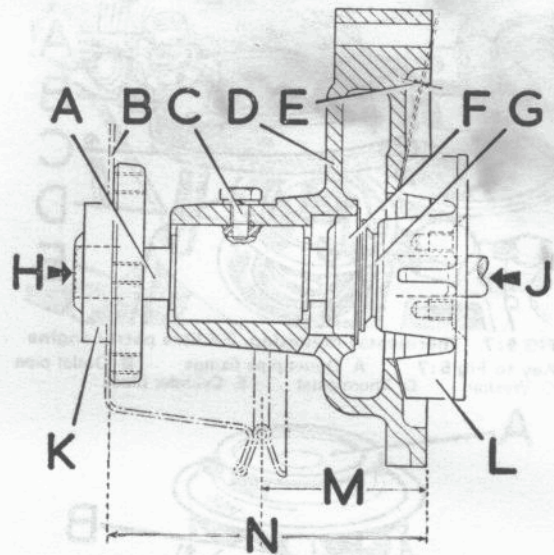


FIG 5:5 2.6 litre, sectioned view of pump

Key to Fig 5:5 A Pump spindle and bearing B Fan belt pulley C Bearing location bolt and washer D Water pump body E Dimension, .025 in (0.63 mm) F Carbon ring and seal assembly G Carbon seal faced towards impeller H Support here when fitting impeller J Support here when fitting hub K Fan hub L Impeller M Dimension, 1.820 in (46.2 mm) N Dimension, 3.820 in (97.0 mm)

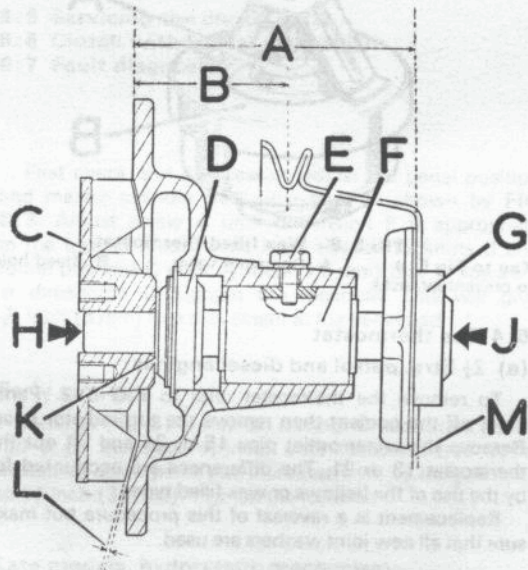


FIG 5:6 2½ litre, sectioned view of pump

Key to Fig 5:6 A Dimension, 3.510 in (89.15 mm) B Dimension, 1.930 in (49.0 mm) C Impeller D Carbon ring and seal assembly E Locating bolt F Pump spindle and bearing assembly G Fan hub H Support here when fitting hub J Support here when fitting impeller K Carbon seal faced toward impeller L Dimension, .025 in (.63 mm) M Fan belt pulley

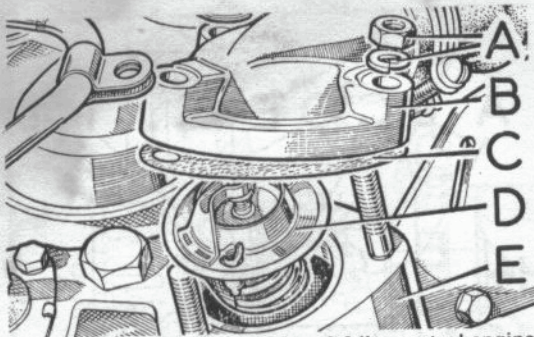


FIG 5:7 Thermostat mounting, 2.6 litre petrol engine
Key to Fig 5:7 A Outlet pipe fixings B Outlet pipe
 C Washer D Thermostat E Cylinder block

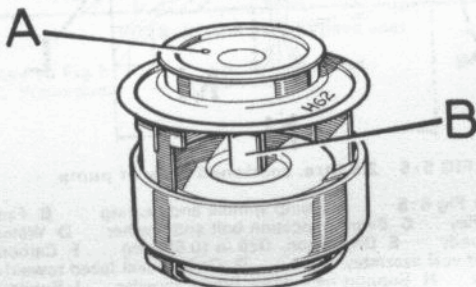


FIG 5:8 Bellows type thermostat
Key to Fig 5:8 A Bleed hole to prevent air locks
 B Operating valve

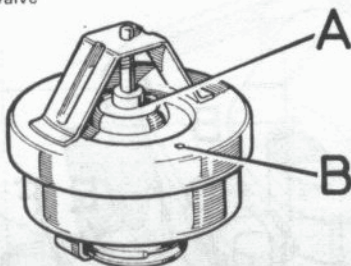


FIG 5:9 Wax filled thermostat
Key to Fig 5:9 A Operating valve B Bleed hole
 to prevent air locks

5:4 The thermostat

(a) 2½ litre, petrol and diesel engines:

To remove the thermostat refer to FIG 5:2. Partly drain off the coolant then remove the top radiator hose. Remove the water outlet pipe 15 or 24 and lift out the thermostat 13 or 21. The differences are accounted for by the use of the bellows or wax filled types.

Replacement is a reversal of this procedure but make sure that all new joint washers are used.

(b) 2.6 litre petrol engine:

To remove the thermostat refer to FIG 5:7. Proceed as for the 2½ litre engines by partly draining the coolant, removing the top hose and the outlet pipe 13. The thermostat D will then lift out. Replacement is a reversal of the removal process but make sure that all new joint washers are used.

To test a thermostat:

Obtain a container of water which can be heated to near boiling point. Support the thermostat in the water so that it does not touch the bottom or sides of the container. Raise the water temperature and with the aid of a thermometer check the opening point of the thermostat. For the 2½ litre petrol and diesel engines the temperature should be:

Bellows type:

Commence to open between 161°F (71.7°C) and 168°F (75.6°C).

Wax type:

Commence to open between 159°F (70.6°C) and 167°F (75°C).

For the 2.6 litre petrol engine the temperature should be:

Commence to open between 161°F (71.7°C) and 170°F (76.7°C).

For the 2.6 litre Series III petrol engine the temperature should be:

Commence to open between 75°C and 80°C.

If the opening point is much different to these figures the unit must be renewed. Similarly, a thermostat which remains open even when cold must also be renewed.

FIGS 5:8 and 5:9 show the difference between the bellows type and the wax filled thermostat.

5:5 Fault diagnosis

(a) External leakage

- 1 Loose hose clips
- 2 Defective hose
- 3 Damaged radiator
- 4 Defective water pump seal
- 5 Loose core plug
- 6 Damaged gasket

(b) Internal leakage

- 1 Defective cylinder head gasket
- 2 Cracked cylinder bore
- 3 Loose cylinder head bolts

(c) Poor circulation

- 1 Restriction in system, collapsed hose
- 2 Insufficient coolant
- 3 Inoperative water pump
- 4 Slack fan belt
- 5 Inoperative thermostat

(d) Overheating

- 1 Poor circulation
- 2 Dirty oil and sludge in engine
- 3 Choked radiator core
- 4 Incorrect ignition or injection pump timing
- 5 Incorrect valve timing
- 6 Low oil level
- 7 Tight engine
- 8 Choked exhaust system
- 9 Binding brakes
- 10 Excessive idling

(e) Overcooling

- 1 Defective thermostat

CHAPTER 6

THE CLUTCH

- 6:1 Description
- 6:2 Adjustment of pedal travel
- 6:3 Bleeding the hydraulic system
- 6:4 Servicing the hydraulic system

6:1 Description

The clutch unit is a Borg and Beck single dry plate type operated by a hydraulic mechanism. Early vehicles are equipped with a coil spring cover unit but later vehicles have the diaphragm spring cover. This latter unit cannot be overhauled and in the event of failure must be exchanged for a new one at a Rover Service Agent. The latest vehicles are also fitted with a hydrostatic operating mechanism which requires no adjustment throughout the life of the clutch. Instructions for setting this mechanism are included in this Chapter.

6:2 Adjustment of pedal travel

This operation should be carried out regularly if the early non-hydrostatic mechanism is fitted to ensure that all the free play is not taken up, thereby allowing spring pressure to load the release bearing giving rise to clutch slip as the friction plate wears. It must also be done whenever the clutch unit or any parts of the mechanism are removed and overhauled. This applies to both early and late type mechanisms. FIG 6:1 illustrates the early mechanism and FIG 6:2 the later (hydrostatic) mechanism.

- 6:5 Servicing the clutch unit
- 6:6 Clutch withdrawal mechanism
- 6:7 Fault diagnosis

First check and if necessary adjust the pedal position and master cylinder free movement as shown by FIG 6:3. Adjust screw A until dimension E is appropriate to the type of mechanism. Now slacken locknuts B and rotate pushrod C until $\frac{1}{8}$ inch (1.5 mm) play is apparent at dimension D; tighten the locknuts. This will give $\frac{5}{16}$ inch (8 mm) free movement at the pedal pad.

Early models:

Refer to FIG 6:4, slacken locknut C and rotate pushrod B on the slave cylinder until the pedal free travel measured at the pedal pad increases from $\frac{1}{2}$ inch (8 mm) to $1\frac{1}{2}$ inch (38 mm). Tighten the locknut.

Late models, hydrostatic mechanism:

Hold the cranked operating lever on the clutch cross-shaft down to ensure that all backlash in the mechanism is absorbed. Refer to FIG 6:5. Slacken nut E and turn nut D until dimension C is obtained. Lock nut E. Never loosen nut D on the shaft B, it must always be hard against the end of the thread.

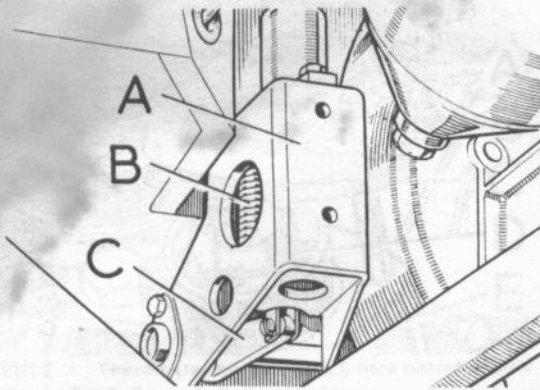


FIG 6:1 Early type mechanism

Key to Fig 6:1 A Support bracket B Return spring
C Straight operating lever

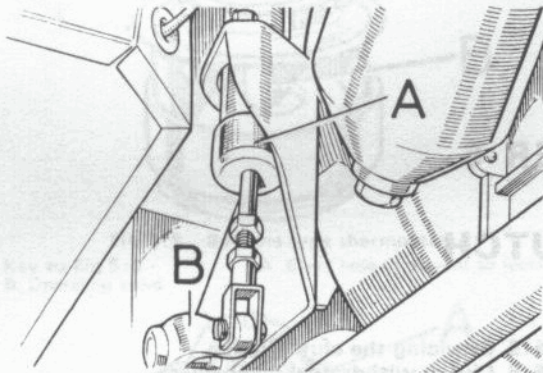


FIG 6:2 Later type mechanism

Key to Fig 6:2 A Slave cylinder B Cranked operating lever

Note that with this hydrostatic mechanism the pedal free travel remains at $\frac{5}{16}$ inch (8 mm). Any 'riding' of the clutch will cause rapid wear as the mechanism begins to operate immediately this small amount of free play disappears.

6:3 Bleeding the hydraulic system

During this operation maintain the level of fluid in the reservoir by adding Castrol Girling Brake and Clutch Fluid, Crimson, as work proceeds. If the reservoir is integral with the master cylinder, keep the fluid level up to the marking on the side of the reservoir; if the reservoir is separate from the master cylinder keep the fluid level above the top of the inner reservoir.

Remove the front floor or gearbox tunnel to gain access to the slave cylinder then attach a length of rubber or plastic tubing to the bleed screw as shown in FIG 6:6. Immerse the lower end of the tubing in a glass jar containing a little clean fluid. Slacken the bleed screw and pump the clutch pedal, pausing at the end of each stroke. When no more bubbles appear from the tubing, tighten the bleed screw at the beginning of a downwards stroke of the pedal. Remove the tubing and replace the floor. Do not re-use fluid bled from the system.

6:4 Servicing the hydraulic system

(a) The master cylinder

Removal of the master cylinder is a straightforward disconnecting operation but it is a little more difficult on lefthand steering vehicles than righthand steering ones. On lefthand steering vehicles the lefthand front wing

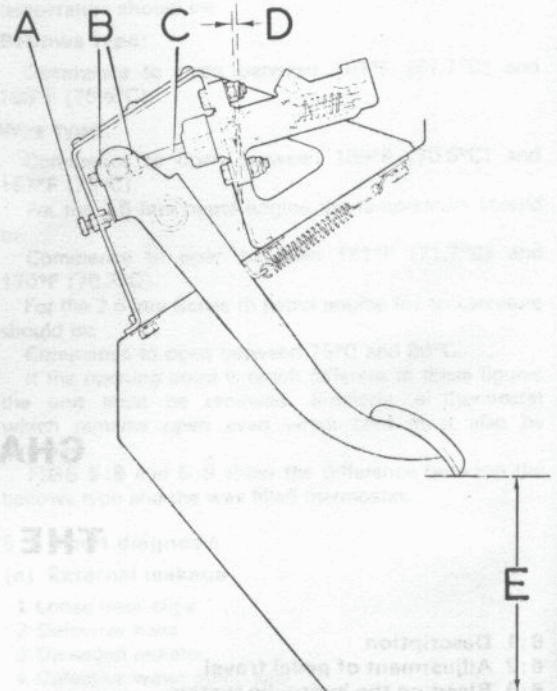


FIG 6:3 Pedal and master cylinder settings

Key to Fig 6:3 A Pedal position setting bolt B Master cylinder pushrod locknuts C Master cylinder pushrod D Free play $\frac{1}{16}$ in (1.5 mm) E Models with non-hydrostatic clutch mechanism: $6\frac{1}{2}$ in (158 mm) Models with hydrostatic clutch mechanism: $5\frac{1}{2}$ in (140 mm)

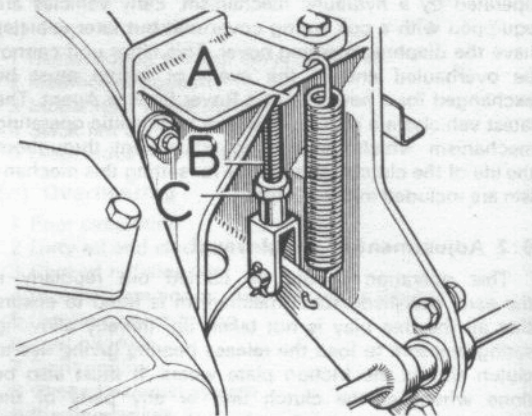


FIG 6:4 Slave cylinder adjustment, early type

Key to Fig 6:4 A Slave cylinder B Pushrod
C Locknut

must be removed and also the whole pedal bracket and its fixings. This allows the clutch pedal, bracket and master cylinder to come out as one assembly. On righthand steering vehicles it is only necessary to remove the top cover from the pedal bracket before undoing the bolts holding the master cylinder and releasing the pushrod from the pedal trunnion. When the hydraulic pipes are released take great care to prevent dirt entering them. It is best to wrap adhesive tape right over the end until ready for reassembly.

For overhauling the master cylinder a kit of seals and rubbers is obtainable. Note that it does not matter whether or not the master cylinder has an integral or separate reservoir. The internal components are identical. In all operations connected with hydraulic components exercise the most scrupulous cleanliness. Cover the bench with newspaper and discard it as it becomes soiled. Wipe the external surfaces of components as clean as possible before dismantling, then wash everything in Girling cleaning fluid or clean new hydraulic fluid after dismantling. Inspect the surfaces of the cylinder bore and the piston for wear, scores or discolouration. If any of these are present, scrap the component.

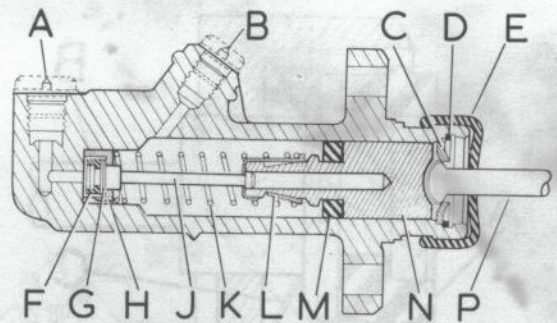


FIG 6:7 Sectioned view of master cylinder

Key to FIG 6:7 A Inlet port B Outlet port C Spring washer D Circlip E Dust cover F Valve seal G Spring washer H Valve spacer J Valve stem K Return spring L Spring retainer M Piston seal N Piston P Pushrod

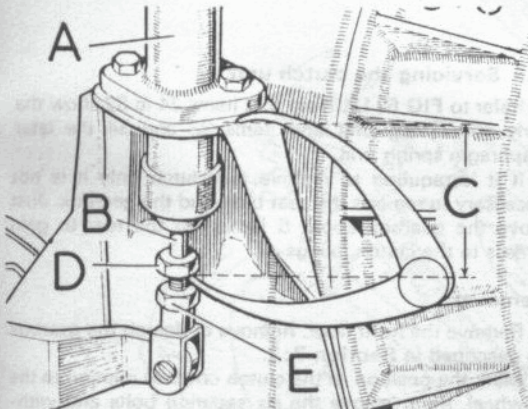


FIG 6:5 Slave cylinder adjustment, later type

Key to FIG 6:5 A Slave cylinder B Pushrod C 2 1/2 in (73.4 mm). Check dimension with calipers as shown D Nut must be at end of pushrod thread E Locknut for pushrod

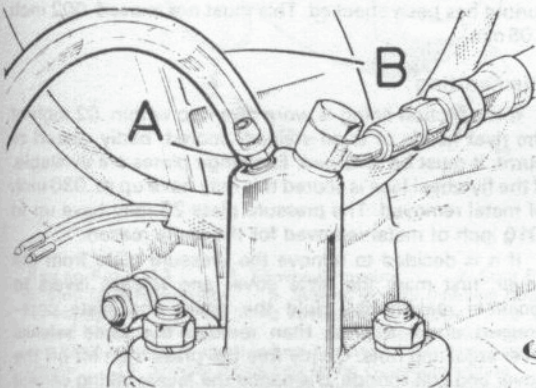


FIG 6:6 Bleeding the hydraulic system

Key to FIG 6:6 A Bleed screw B Tubing

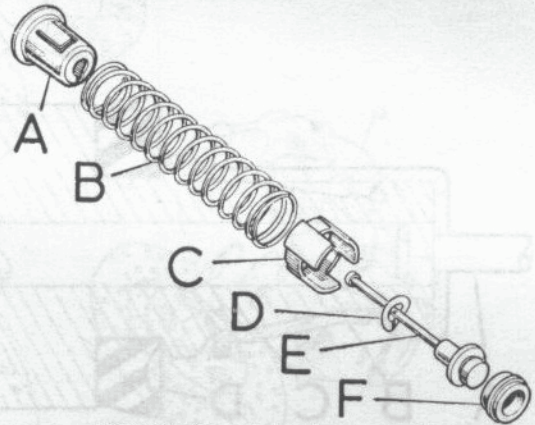


FIG 6:8 Complete valve assembly

Key to FIG 6:8 A Spring retainer B Spring C Valve spacer D Spring washer E Valve stem F Valve seal

Refer to FIG 6:7. Pull off dust cover E, release circlip D and then extract pushrod P and washer C. Very gently tap the casting on a piece of soft wood until the piston N and all the valve components slip out of the cylinder bore. Raise prong L on the spring retainer and pull away from the piston. Slip the valve stem J from the keyhole slot in L and the valve assembly can be dismantled.

Discard all the rubber components then clean and inspect the remainder. If all is well proceed to rebuild as follows:

- 1 Smear all the seals with Castrol Girling rubber grease and lubricate all other sliding surfaces with clean hydraulic fluid.
- 2 Fit the valve assembly as shown in FIG 6:8 paying particular attention to the detail given in FIG 6:9.
- 3 Replace the valve stem through the keyhole in the retainer, fit the piston seal as shown in FIG 6:10, then replace the retainer, locking the prong under the piston head.
- 4 Slide the piston and valve assembly into the previously lubricated cylinder and fit the pushrod, washer and circlip.

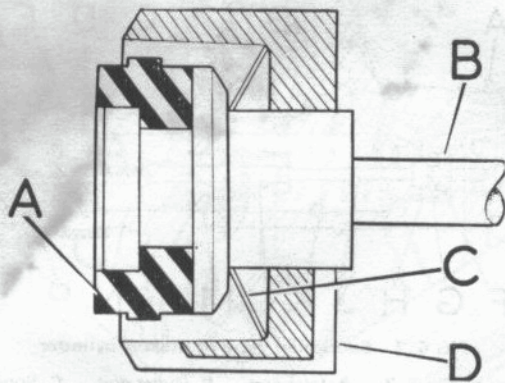


FIG 6:9 Valve seal detail

Key to Fig 6:9 A Valve seal washer B Valve stem C Spring D Valve spacer

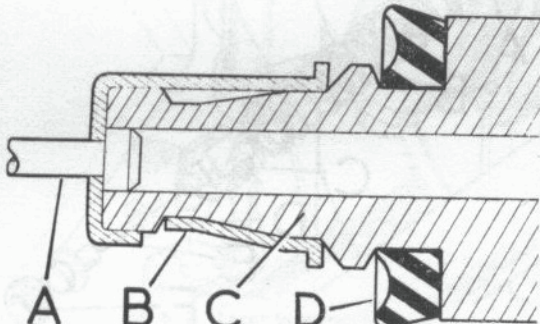


FIG 6:10 Piston seal detail

Key to Fig 6:10 A Valve stem B Prong engaged C Piston D Seal

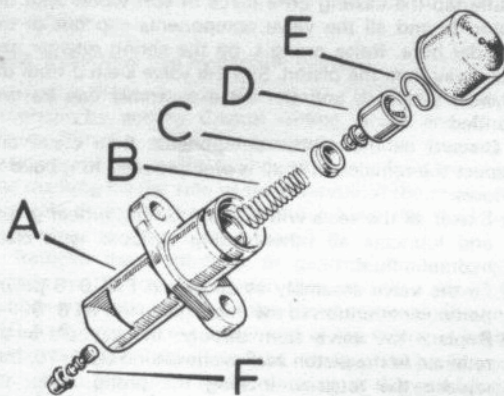


FIG 6:11 View of slave cylinder

Key to Fig 6:11 A Cylinder B Spring C Piston seal D Piston E Circlip F Bleed nipple

5 Liberally smear the inside of the dust cover with rubber grease and refit to the cylinder.

Replace the cylinder on the vehicle by reversing the dismantling procedure. Connect the hydraulic pipes and refill the system with fluid. Bleed the system as described in Section 6:3.

(b) The slave cylinder:

Removal of the slave cylinder only involves undoing the holding bolts, disconnecting the pushrod and the hydraulic pipe. The remarks concerning cleanliness apply with equal force to this component.

To strip the slave cylinder, refer to FIG 6:11. Pull off the rubber dust cover and remove circlip E. The components can be gently jarred out of the body.

Clean and examine the unit as described for the master cylinder. Assemble the unit with new seals in the order shown in FIG 6:11. Note that the smaller end of the spring goes towards the piston.

Replace the unit on the vehicle by reversing the dismantling process and then carry out the bleeding operation (see Section 6:3).

6:5 Servicing the clutch unit

Refer to FIG 6:12. Note that items 24 to 32 show the early coil spring unit and items 33 and 34 the later diaphragm spring unit.

If it is required to remove the clutch only it is not necessary to remove the seat base and the gearbox. Just move the gearbox about 5 inches to the rear to gain access to the clutch fixings.

Removal:

Remove the front floor. Remove or detach the gearbox as described in Section 7:2.

Mark the position of the clutch cover in relation to the flywheel, then remove the six securing bolts and withdraw the clutch assembly. The clutch plate is released during this operation.

Remove the flywheel securing bolts and lift off.

When refitting the flywheel to the crankshaft, tighten up the bolts to 60 to 65 lb ft but do not lock until the runout has been checked. This must not exceed .002 inch (.05 mm).

Dismantling:

If the friction lining is worn down to within .02 inch of the rivet heads or is oil stained, scored, badly glazed or burnt, it must be renewed. Exchange plates are available. If the flywheel face is scored this may have up to .030 inch of metal removed. The pressure plate 25 may have up to .010 inch of metal removed for the same reason.

If it is decided to remove the pressure plate from the cover, first mark the plate cover and release levers to facilitate reassembly. Hold the cover and plate compressed under a press then remove the three release lever adjusting nuts. Gently free the press then lift off the cover and coil springs. Dismantle the levers taking careful note of the sequence of lever, eyebolt, pin and anti-rattle spring so that they will be reassembled in the proper order.

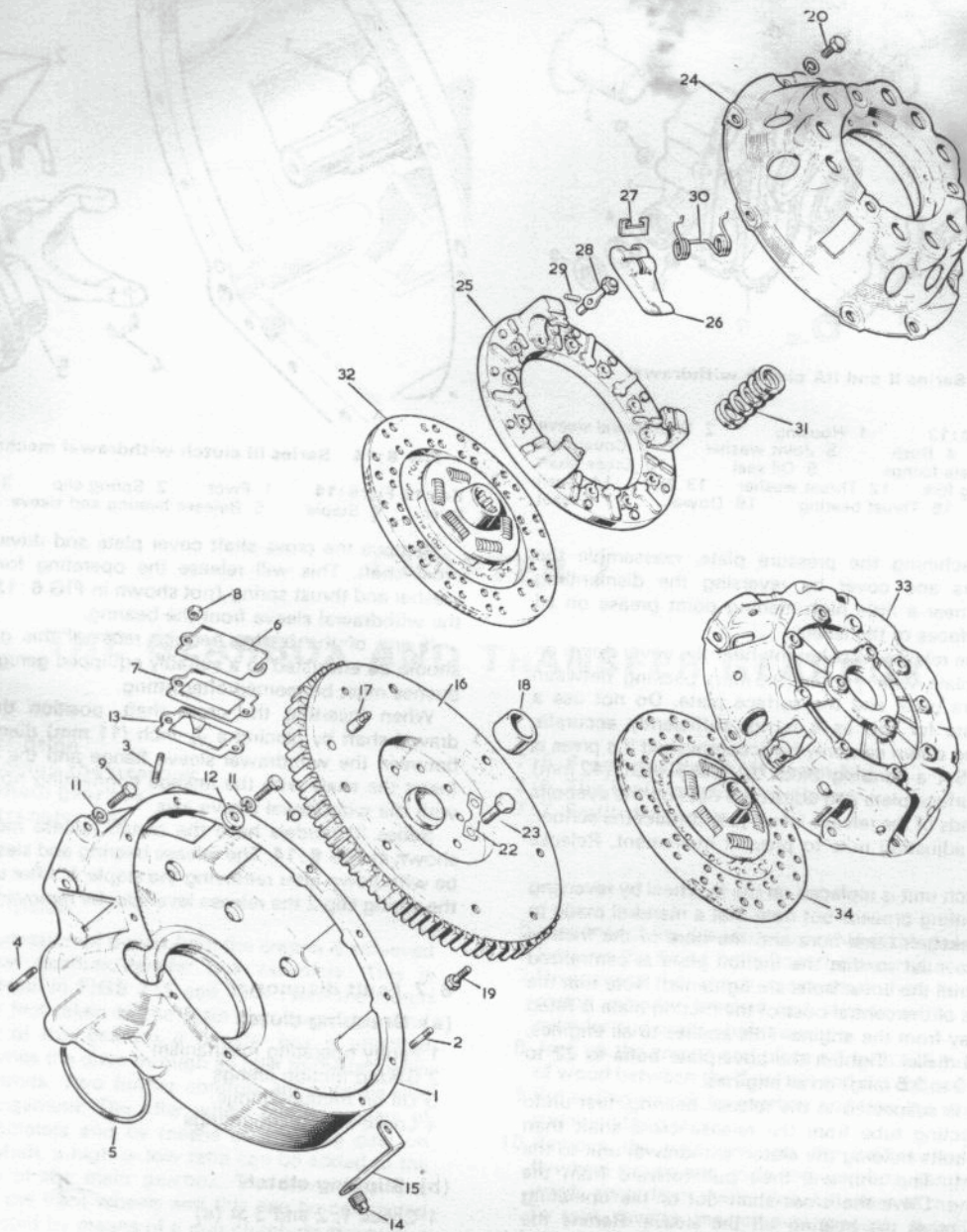


FIG 6:12 Clutch assembly

Key to Fig 6:12

1 Flywheel housing	2 Stud fixing flywheel housing to bellhousing	3 Stud fixing inspection cover
4 Stud for starter motor	5 Sealing ring for flywheel housing	6 Inspection coverplate (early type engines)
7 Joint washer	8 Nut fixing coverplate	9 Bolt
10 Bolt	11 Spring washer	12 Plain washer
13 Indicator for engine timing (early type engines)	14 Drain plug for housing	15 Stowage bracket for drain plug. On later engines the plug is stowed in a blind tapping in the flywheel housing
16 Flywheel assembly	17 Dowel locating clutch coverplate	18 Bush for primary pinion
19 Special fitting bolt fixing clutch coverplate	20 Setbolt	21 Spring washer
22 Locker	23 Special setbolt	24 Coverplate for coil spring type clutch
25 Pressure plate	26 Release lever	27 Strut for release lever
28 Eyebolt and nut for release lever	29 Pin for release lever	30 Anti-rattle spring for release lever
31 Clutch coil spring (9 off)	32 Clutch driven plate	33 Diaphragm spring type clutch, fitted to 2.6 litre engines and later 2½ litre Diesel engines. Optional equipment on 2½ litre petrol engines
34 Clutch driven plate		

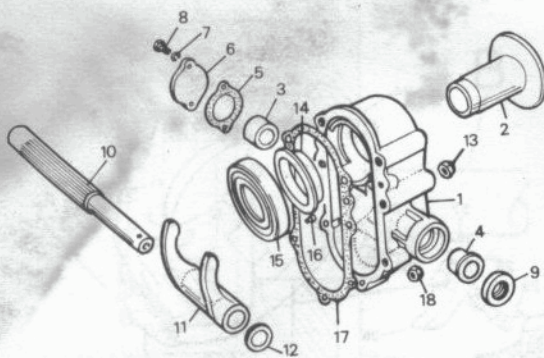


FIG 6:13 Series II and IIA clutch withdrawal mechanism

Key to Fig 6:13
 1 Housing 2 Withdrawal sleeve
 3 Bush 4 Bush 5 Joint washer 6 Coverplate
 7-8 Coverplate fixings 9 Oil seal 10 Cross-shaft
 11 Operating fork 12 Thrust washer 13 Nut 14 Bush for sleeve
 15 Thrust bearing 16 Dowel 17 Gasket
 18 Nut

After machining the pressure plate, reassemble the plate, levers and cover by reversing the dismantling process. Smear a little high melting point grease on all bearing surfaces of the levers.

To set the release lever height; hold the cover down on a surface plate with $\frac{3}{8}$ inch (9.5 mm) packing between the pressure plate and the surface plate. Do not use a friction plate for this as it is not sufficiently accurate. This holding down can only be accomplished if a press is available. Set a scribing block to 1.655 inch (42 mm) from the surface plate and adjust the nuts on the eyebolts until the ends of the release levers just contact the scribe. Stake the adjusting nuts to prevent movement. Release the press.

The clutch unit is replaced on the flywheel by reversing the dismantling process but note that a mandrel made to fit the crankshaft bush bore and the bore of the friction plate is essential so that the friction plate is centralized and held until the cover bolts are tightened. Note that the longer side of the central boss of the friction plate is fitted facing away from the engine. This applies to all engines, petrol and diesel. Tighten the coverplate bolts to 22 to 25 lb ft (3.0 to 3.5 mkg) on all engines.

If wear is suspected in the release bearing, first undo the connecting tube from the release cross-shaft then undo the bolts holding the clutch withdrawal unit to the bellhousing. The unit will then pull forward from the bellhousing. Drive the cross-shaft out of the operating fork then press the bearing off the sleeve. Renew the bearing and reassemble by reversing the dismantling process. Always fit a new oil seal to the cross-shaft and a new joint washer between the unit and the bellhousing, otherwise oil can leak from the gearbox. Tighten the $\frac{1}{2}$ inch BSF nuts to 10 lb ft (1.4 mkg) and the $\frac{5}{16}$ inch BSF nuts to 15 lb ft (2.0 mkg) holding the unit to the bellhousing.

6:6 Clutch withdrawal mechanism

On series II and IIA units this mechanism is incorporated with the primary pinion cover of the gearbox. Removal of the assembly is dealt with in **Section 7:3**.

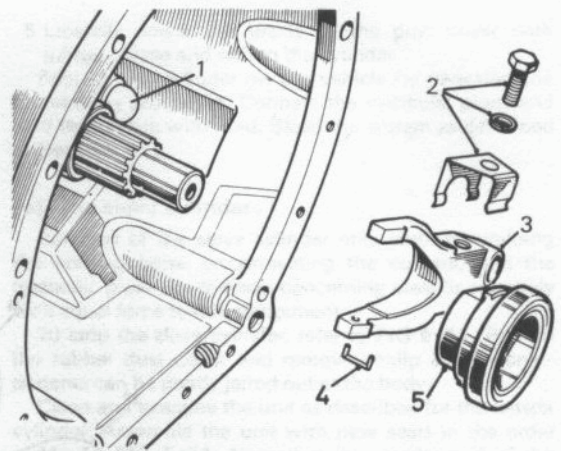


FIG 6:14 Series III clutch withdrawal mechanism

Key to Fig 6:14
 1 Pivot 2 Spring clip 3 Release lever
 4 Staple 5 Release bearing and sleeve

Remove the cross-shaft cover plate and drive out the cross-shaft. This will release the operating fork thrust washer and thrust spring (not shown in **FIG 6:13**). Press the withdrawal sleeve from the bearing.

If any of the bushes require renewal this operation should be entrusted to a suitably equipped garage as the bushes must be reamed after fitting.

When inserting the cross-shaft, position the withdrawal shaft by placing a $\frac{7}{8}$ inch (11 mm) diameter bar between the withdrawal sleeve flange and the housing. Insert the shaft with the linkage connecting hole in line with the withdrawal sleeve axis.

Series III models have the clutch release mechanism shown in **FIG 6:14**. The release bearing and sleeve 5 can be withdrawn after removing the staple 4. After unbolting the spring clip 2 the release lever can be removed.

6:7 Fault diagnosis

(a) Grabbing clutch

- 1 Faulty operating mechanism
- 2 Glazed friction linings
- 3 Oil on friction linings
- 4 Loose engine mountings

(b) Slipping clutch

- 1 Check 1, 2 and 3 at (a)
- 2 Worn linings
- 3 Broken coil springs

(c) Dragging clutch

- 1 Check 1, 2 and 3 at (a)
- 2 Crankshaft bush binding on pinion shaft
- 3 Distorted clutch cover

(d) Clutch judder

- 1 Check 1, 2, 3 and 4 at (a)
- 2 Worn transmission shafts

CHAPTER 7

THE GEARBOX AND TRANSFER GEARBOX

- 7:1 Description
- 7:2 Removing the gearbox
- 7:3 The main gearbox
- 7:4 The transfer box

- 7:5 Front output shaft assembly
- 7:6 The main gearchange lever
- 7:7 Fault diagnosis

7:1 Description

The transmission of power from the engine is achieved by a unique gearbox/transfer box assembly. This is shown in detail in **FIGS 7:1** and **7:2**. From the clutch the drive is first taken to the main four speed gearbox. At the rear of this gearbox a transfer box is attached which transmits the drive through an idler to the propeller shaft drive units. Two further controls are possible due to this arrangement. The idler wheel has two gears of different diameters and by means of a sliding gear on the output shaft, a high or low ratio can be added to the four speeds of the main gearbox. The forward output shaft drives the front wheels and this can be connected or disconnected by means of a dog clutch on the output shaft, to give 2 or 4 wheel drive.

The main gearbox on Series III models differs from earlier models incorporating synchromesh on all four forward gears.

7:2 Removing the gearbox

- 1 Remove the front floor and front seat base.
- 2 Remove the drain plugs from the main and transfer gearboxes and drain the oil.
- 3 Disconnect both propeller shafts.
- 4 Release the handbrake expander rod from the relay levers then remove the lever and relay mechanism.

- 5 Disconnect the speedometer cable at the gearbox.
- 6 Remove the fixing bolts from the two rear mountings.
- 7 Disconnect the clutch cross-shaft then release the clutch cylinder bracket and withdraw the bracket, cylinder and cross-shaft assembly.
- 8 Jack up the engine and place a 1 inch (25 mm) block of wood between the flywheel and the chassis.
- 9 Put a sling round the gearbox and take the strain on a suitable lifting tackle.
- 10 Remove the nuts securing the bellhousing to the flywheel cover and slide the gearbox gently backwards away from the engine. Lift clear of the vehicle. To refit, reverse the removal process. It will be of help to engage top gear so that the primary pinion can be turned by rotating the transmission brake drum. By this means the primary pinion shaft can be slowly rotated to align with the clutch driven plate splines.

7:3 The main gearbox

Reference should be made to **FIGS 7:3**, **7:4** and **7:5**.

To dismantle the main gearbox :

- 1 Drain the oil from the main and transfer gearboxes.
- 2 Remove the main gearchange lever assembly then the reverse stop hinge.

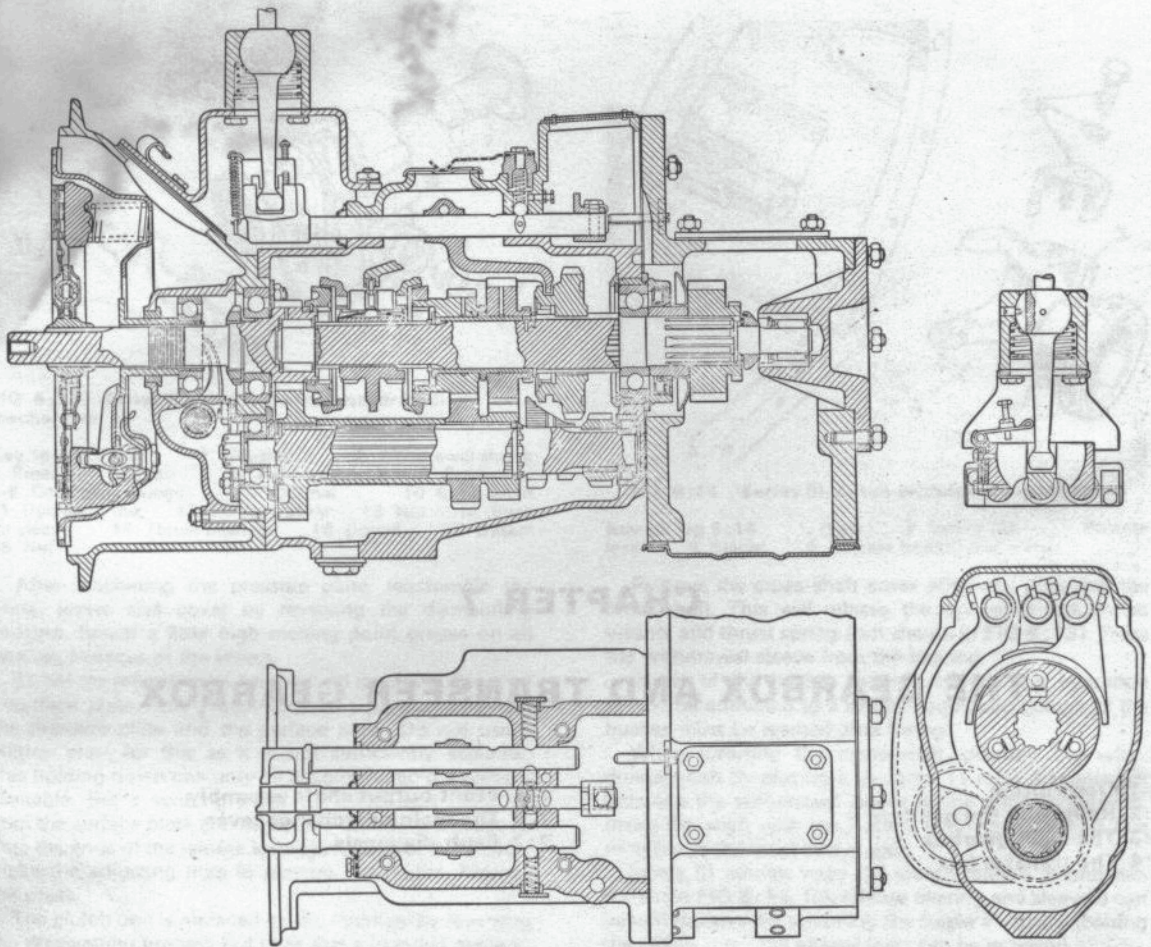


FIG 7:1 Cross-section of gearbox unit: elevation

- 3 Remove the transfer box and front output shaft housing complete.
- 4 Remove the connecting tube from the clutch cross-shaft and the grommets from the bellhousing apertures.
- 5 Remove the primary pinion cover from the bellhousing. On series II and 11A models this cover houses the clutch withdrawal mechanism.
- 6 Remove the oil filler cap.
- 7 Remove the plug 14 (see FIG 7:3), withdraw the spring and pack the hole with grease. This prevents the selector ball falling into the box when the cover 7 is removed.
- 8 Refer to FIG 7:5. Remove the plates 17 and 18 then remove the selector springs 15 and 16 and the two balls 14.
- 9 Refer to FIG 7:3. Remove plate 10 and the bolts which hold the cover 7 to the transfer box casing.
- 10 Remove the cover 7 and detach the selector ball in the cover from the grease holding it in place. Remove the locking plungers 13 (see FIG 7:5). Undo the nut 28 and bolt 27 and remove the second speed gear stop 10 (see FIG 7:5). This stop is not fitted on Series III gearboxes.
- 11 Remove the selector shafts on series II and IIA models as follows. Select first gear by moving the centre selector to the rear; remove the reverse gear selector by lifting and turning the selector shaft one quarter of a turn to the left. Move the first/second selector to neutral and lift it out, repeat for the third/fourth selector. The selectors can now be removed from their shafts by undoing the pinch bolts. On series III models proceed as follows. Select third gear by moving the righthand selector to the rear; lift, turn and withdraw the third/fourth selector shaft. Withdraw the first/second selector shaft followed by the reverse selector shaft.
- 12 Remove the transfer gearlever from the side of the bell housing. So that the layshaft cannot rotate engage fourth and second gears simultaneously. Remove the nut or bolt from the front of the layshaft. Remove the nut 47 from the rear of the mainshaft after undoing the tab washer. Then remove the tab washer, shim washer if fitted, transfer gear 45 and oil thrower 43.
- 13 Remove the bellhousing noting the position of the two special fixing nuts which are fitted diagonally opposite one another. Tap the layshaft out of its

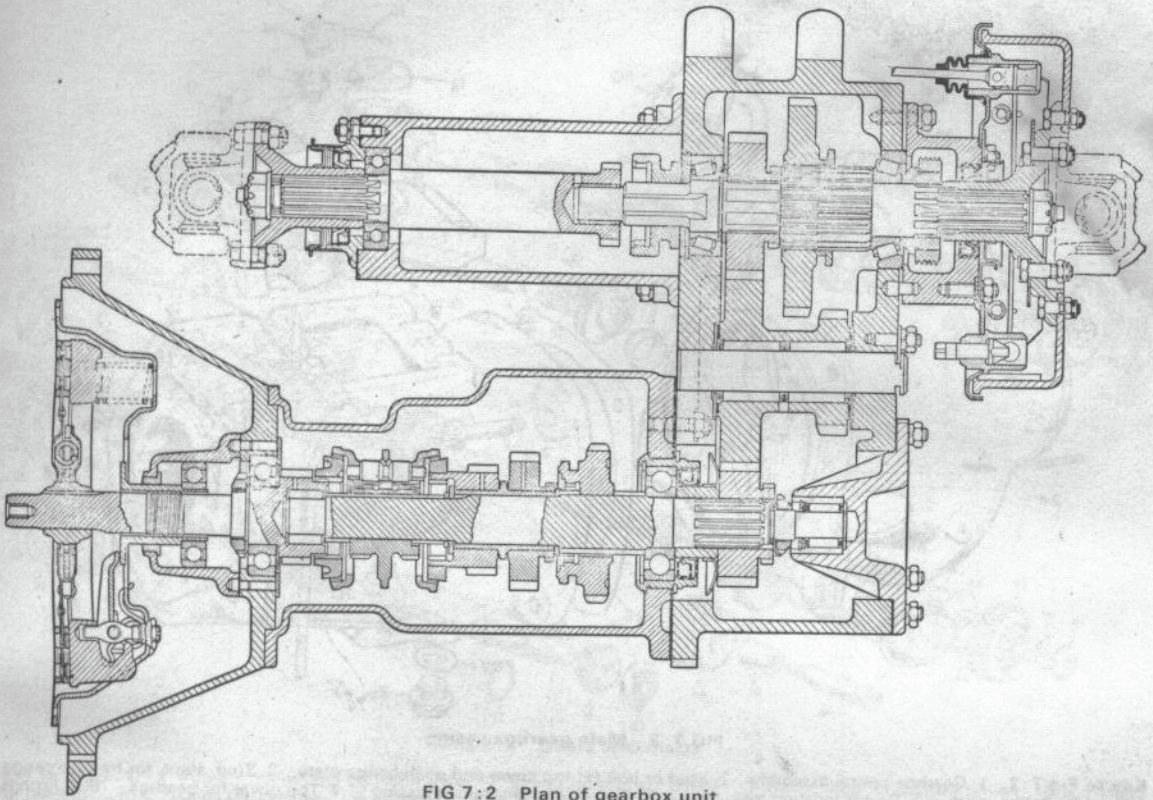


FIG 7:2 Plan of gearbox unit

- bearing when removing the bellhousing so that it remains in the gearbox. Remove the primary pinion from the bellhousing. On series II and IIA models this is secured by the nut 5 which has a lefthanded thread. On series III models the pinion is secured by a circlip on the shaft.
- 14 Remove the constant gear 1 from the layshaft.
 - 15 Remove the fixings for the main and layshaft bearings in the bellhousing, items 6, 30 and 31 and press out the bearings.
 - 16 Remove the synchronizing clutch unit 34 from the mainshaft then withdraw the complete layshaft.
 - 17 On series II and IIA models the layshaft can be dismantled. Remove the distance sleeve 22, the gears 18 and 16. Remove the splintering 17. Press off the rear bearing 33 and the first speed gear 14. The gears on series III models are integral with the layshaft.
 - 18 Drive the mainshaft forward out of the gearbox.
 - 19 Remove the first speed gear 15. The rear part of the series III mainshaft is dismantled as follows, referring to FIG 7:6. Remove the thrust washer 1, first speed gear 2 and bush 4. Withdraw the rear cone of the synchronizer assembly 3 followed by the synchronizer assembly 5 and the synchronizer front cone.
 - 20 Prise out the spring ring 21 and discard it. Remove the thrust washer 20 and the gear 18. Remove the sleeve 19 and gear 16. Remove the pegs 11 and 12 and the thrust washer 13.
 - 21 Take out the circlip 41 and tap out the housing 38 from the rear thus releasing the peg 39. Remove the

oil seal 42 and the circlip 40 and the bearing 37 can be pressed out of the housing.

- 22 Warm the gearbox and position it with the rear face upwards. Tap the rear face with a mallet. The inner race of the layshaft bearing should fall out. On some gearboxes two holes are provided so that the race can be drifted out. The reverse idler gear and shaft should be removed while the gearbox is warm by driving the shaft out to the rear.
- 23 The first/second speed synchronizer fitted to series III models should be dismantled while the assembly is enclosed in a cloth so that no parts are lost. The parts are shown in exploded form in FIG 7:7.

To rebuild the main gearbox:

- 1 Wash all components and inspect thoroughly. Discard any gears heavily pitted or marked. Discard any slack or rough bearing, likewise any shaft with the splines damaged. Note that the constant, second and third speed gears are only supplied as mated pairs. Use all new circlips.
- 2 Drive a new layshaft outer bearing element into the rear of the casing. The casing may need warming first. Note that the lipped edge must be to the rear.
- 3 Check the fit of the reverse gear on its shaft. If necessary have the bush renewed by a Rover agent. Warm the casing before driving the shaft home.
- 4 Press the mainshaft rear bearing 37 into its housing 38 and secure with circlip 40. Press the oil seal 42 into the other end of the housing, knife edge inwards.

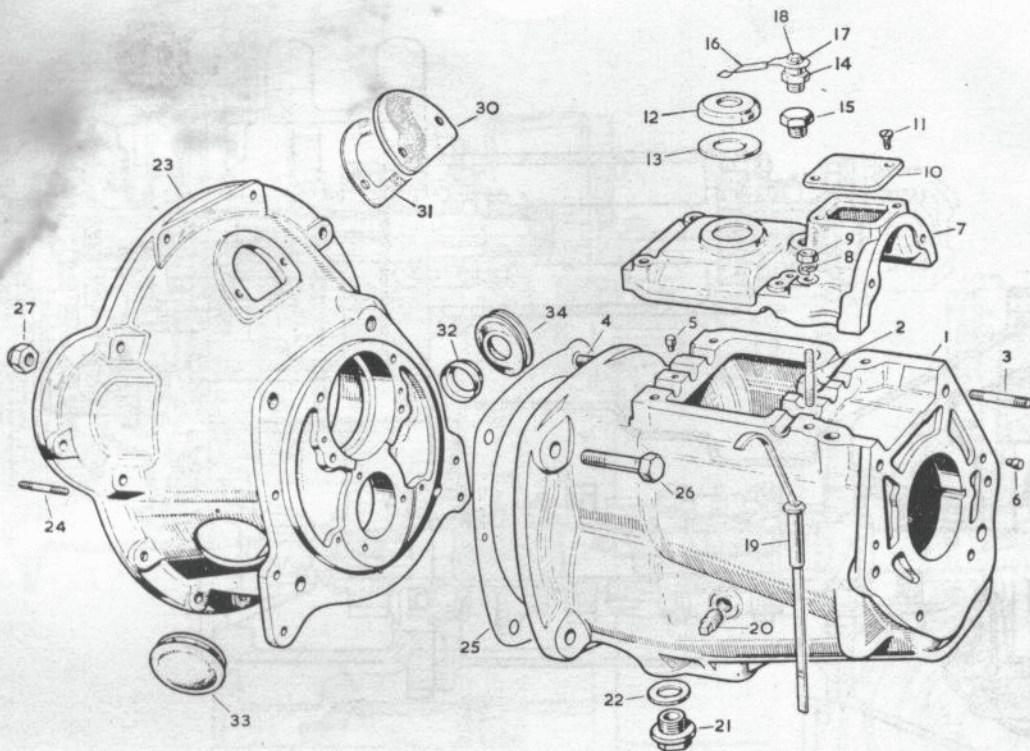


FIG 7:3 Main gearbox casing

Key to Fig 7:3 1 Gearbox casing assembly 2 Stud or bolt for top cover and gearchange plate 3 Stud, short, for transfer casing 4 Stud for bellhousing 5 Dowel locating top cover 6 Dowel locating transfer casing 7 Top cover for gearbox 8-9 Fixings for top cover, used with stud 10 Inspection coverplate for selectors 11 Setscrew fixing coverplate 12 Oil filler cap (early gearboxes) 13 Joint washer for cap (early gearboxes) 14 Plug for retaining spring and cap (early gearboxes) 15 Plug retaining selector spring (late gearboxes) 16 Retaining spring for cap (early gearboxes) 17-18 Fixings for spring (early gearboxes) 19 Oil level dipstick (early gearboxes) 20 Oil lever filler plug 21 Drain plug for gearbox 22 Washer for plug 23 Bellhousing assembly 24 Stud for withdrawal race housing 25 Joint washer, bellhousing to gearbox 26-27 Fixings for gearbox casing 30 Top cover for bellhousing 31 Rubber seal for top cover 32 Centre for dust cover (early gearboxes) 33 Grommet for bellhousing hole 34 Grommet for bellhousing shaft

- 5 Smear the outer diameter of the bearing housing with jointing compound and push the complete bearing housing into the casing and secure with circlip 41. (Fit peg 39 first).
- 6 Replace the thrust washer 13; do not fit peg 12 at this stage. Slide on sleeve 19, slot to the rear, together with the second speed gear 16, cone to the rear. Place the third speed gear 18 on the sleeve and secure with the thrust washer 20 and the old spring ring 21.
- 7 Press the third speed gear 18 hard against the sleeve shoulder when the end float of gear 16, measured between the gear and the shoulder should be .004 to .007 inch (.10 to .18 mm). The end float of gear 18 should be the same when gear 16 is pressed hard against the sleeve shoulder. If the end float is insufficient a new sleeve is needed; if excessive, the end of the sleeve may be rubbed down.
- 8 Remove the spring ring, take off the gear then replace the sleeve, thrust washer and old spring ring. The sleeve should have an end float of .001 to .008 inch (.03 to .20 mm). Various thicknesses of thrust washer are available to achieve this.
- 9 When the end floats are correct, fit the peg 11, thrust washer 13, peg 12, gears 16 and 18 on sleeve 19 and

slide sleeve 19 on the mainshaft, large slot to the rear. Slide washer 20 on the shaft with its groove in line with the small slot in sleeve 19. Secure with a new spring ring.

- 10 On series II and IIA models slide gear 15 onto the mainshaft and then press the shaft through the rear bearing. On series III models proceed as follows. Refer to FIG 7:7. Try fitting the inner member to the outer member of the first/second synchronizer aligning the detent spring bores and ball retaining grooves. Remove the inner and try again after rotating it first 120 deg. and then 240 deg. from the first position. Note which position gives the best sliding fit. Fit the block, springs and balls to the inner member and slide into the outer member while retaining the parts by hand. Refit the front synchronizing cone, the synchronizer unit, the rear synchronizing cone, the gear bush and thrust washer to the rear of the mainshaft. Check that there is .002 to .007 inch (.05 to .18 mm) clearance between the thrust washer and bush. Remove the thrust-washer, fit the first gear and replace the thrust washer with its stepped face outwards. Press the shaft through the rear bearing.
- 11 Reassemble the series II and IIA layshaft as follows.

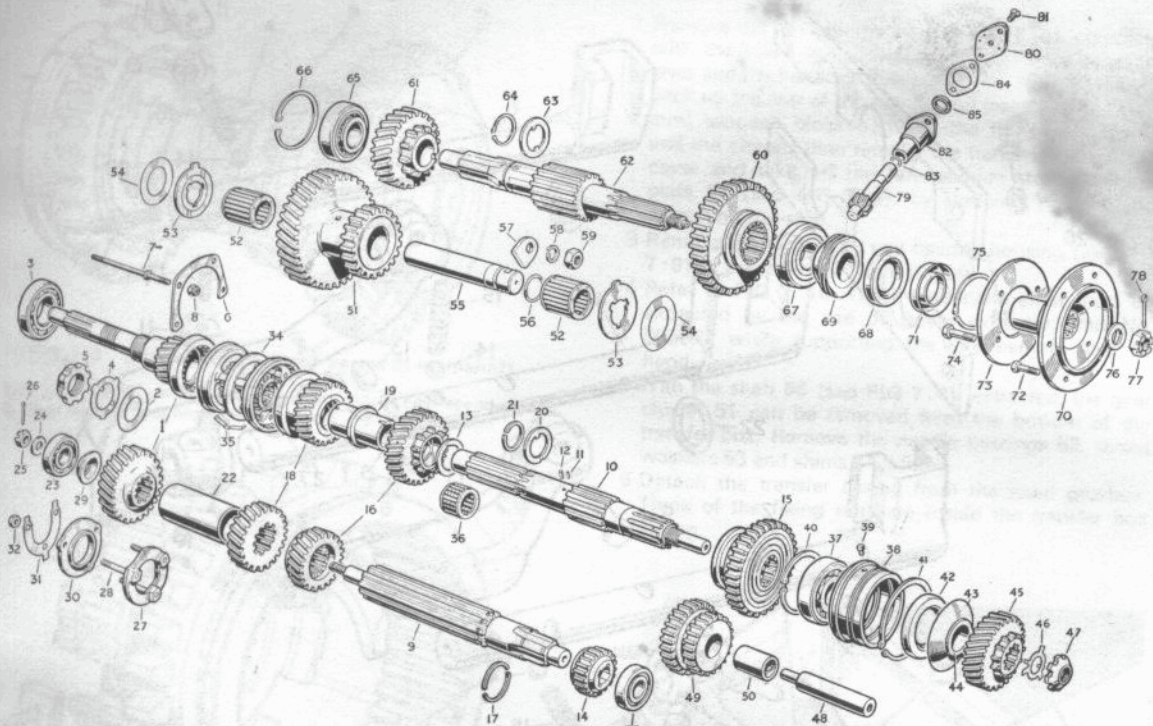


FIG 7:4 Gears and shafts

- Key to Fig 7:4** 1 Primary pinion and constant gear 2 Shield for primary pinion 3 Ballbearing for primary pinion 4-5 Fixings for bearing 6-8 Fixings for bearing 9 Layshaft 10 Mainshaft 11 Peg for 2nd gear thrust washer 12 Peg for mainshaft distance sleeve 13 Thrust washer for 2nd speed gear 14 1st speed layshaft gear 15 1st speed mainshaft gear 16 2nd speed layshaft and mainshaft gear 17 Splitring for 2nd speed layshaft gear (early gearboxes) 18 3rd speed layshaft and mainshaft gear 19 Distance sleeve for mainshaft 20 Thrust washer for 3rd speed mainshaft gear 21 Spring ring fixing 2nd and 3rd gear 22 Sleeve for layshaft 23 Bearing for layshaft, front 24-26 Fixings for bearing to layshaft 27 Bearing plate assembly for layshaft 28 Stud for bearing cap 29 Distance piece for layshaft 30 Retaining plate for layshaft front bearing 31-32 Fixings for cap and bearing 33 Bearing for layshaft, rear 34 Synchronizing clutch 35 Detent spring for clutch 36 Roller bearing for mainshaft 37 Ballbearing for mainshaft 38 Housing for mainshaft bearing, rear 39 Peg, housing to casing 40 Circlip, bearing to housing 41 Circlip, housing to casing 42 Oil seal for rear of mainshaft 43 Oil thrower for mainshaft 44 Distance piece, rear of mainshaft 45 Mainshaft gear for transfer box 46-47 Fixings for gear 48 Shaft for reverse gear 49 Reverse wheel assembly 50 Bush for reverse wheel 51 Gear, intermediate 52 Roller bearing for intermediate gear 53 Thrust washer for intermediate gear 54 Shim for intermediate gear 55 Shaft for intermediate gear 56 Sealing ring for shaft, rear drive 57 Retaining plate for shaft 58-59 Fixings for plate 60 Low gearwheel 61 High gearwheel 62 Output shaft, rear drive 63 Thrust washer for high gearwheel 64 Circlip fixing washer to shaft 65 Bearing for output shaft, front complete 66 Circlip fixing bearing to case 67 Bearing for output shaft, rear 68 Oil seal for output shaft 69 Speedometer worm flange for brake drum bolts 70 Flange for output shaft, rear drive 71 Mudshield for flange 72 Fitting bolt for brake drum 73 Retaining plate for pinion 74 Fitting bolt for propeller shaft 75 Circlip retaining bolts and flange 76-78 Fixings for flange for sleeve 79 Speedometer pinion 80 Retaining plate for pinion 81 Screw fixing plate to housing 82 Sleeve for pinion 83 Sealing ring for sleeve 84 Joint washer for sleeve 85 Oil seal for pinion

Slide the layshaft first speed gear 14 onto the rear of the layshaft 9 with the chamfered end of the teeth to the front. Fit the split ring 17 and slide gear 16, flange forwards, over the ring. Ensure that the ring is properly seated in the shaft 9. Slide gear 18 onto the layshaft with its flange forwards, followed by sleeve 22, constant gear and distance piece 29. Press bearing 23 onto the shaft and lock by means of nut 25 and washer 24.

12 Should the gears have any end float, fit a different thickness of distance piece 29. These are made in three thicknesses, .312 inch (7.9 mm) .332 inch (8.4 mm) and .352 inch (8.91 mm). When the end float is removed take off the nut and washer, distance piece and constant gear from the shaft.

13 Fit the rest of the assembly in the casing, engaging the constant mesh gears.

14 Now assemble the primary pinion shaft 1 by pressing bearing 3 on until it abuts the shoulder. On series II and IIA models secure by fitting washer 2 and 4 the lock-up nut 5. Bend up the tab of washer 4. On series III models fit the distance washer and old circlip and check the end float. Fit a new distance washer of suitable thickness if end float is not minimal and secure it with a new circlip.

15 Press the primary shaft and bearing assembly into the previously warmed bellhousing and secure with retaining plate 6.

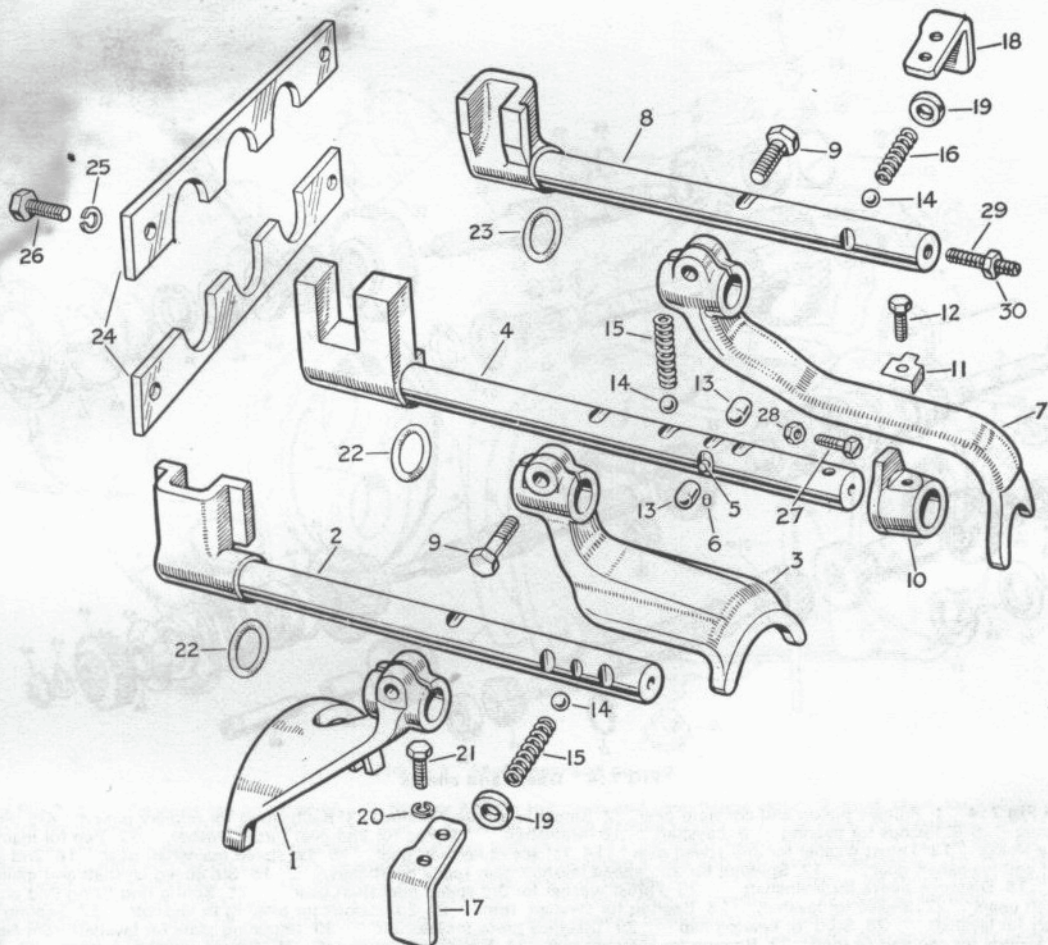


FIG 7:5 Main gearbox selectors

Key to Fig 7:5 1 Selector fork, 3rd and 4th speed 2 Shaft for fork, 3rd and 4th speed 3 Selector fork, 1st and 2nd speed 4 Shaft assembly for fork, 1st and 2nd speed 5 Interlocking pin 6 Peg fixing interlocking pin 7 Selector fork, reverse 8 Shaft for fork, reverse 9 Setbolt fixing forks to shafts 10 Stop for 2nd speed 11-12 Fixings for stop 13 Interlocking plunger 14 Steel ball for selectors 15 Selector spring, forward 16 Selector spring, reverse 17 Retaining plate lefthand (For selector springs, side) 18 Retaining plate righthand (For selector springs, side) 19 Rubber grommet (For selector springs, side) 20-21 Fixings for retaining plates 22 Seal for selector shafts 23 Seal for reverse shaft 24 Retaining plate for sealing ring 25-26 Fixings for retaining plate 27 Setbolt (In cover for 2nd gear stop) 28 Locknut (In cover for 2nd gear stop) 29 Adjustable stop for reverse selector shaft 30 Locknut for stop

16 Press the layshaft front bearing 23 into the bellhousing simultaneously with operation 15. Fit retaining plate parts 27, 28, 30, 31 and 32.

17 Check the synchronizing unit spring 35 and renew if necessary. The springs should be replaced if a force less than 15 to 20 lb (6.5 to 9 kg) is sufficient to operate the synchronizer unit.

18 Fit the synchronizing clutch assembly 34 to the main shaft with its recessed portion towards gear 18.

19 Place the needle roller bearing 36 on the main shaft then place the gear 1 and distance piece 29 on the layshaft 9. Offer the bellhousing to the gearbox casing meshing the constant gears 1. Use a new joint washer between the bellhousing and the gearbox then bolt them together.

20 Select top and second speeds together to lock the gears. Fit the nut 25 and washer 24 to the layshaft and tighten. Fit a new splitpin 26.

21 Fit the oil thrower 43, distance piece 44 and gear 45, splined flange rearwards, to the rear of the main shaft and lock with washer 46 and nut 47.

22 The selector mechanism can now be replaced. Refer to FIG 7:5 unless otherwise stated. Fit new rubber sealing rings 22 to shafts 2 and 4. Fit the selectors 1 and 3 to their shafts 2 and 4. Fit the stop 10 to shaft 4. The stop 10 is not fitted to series III models. Fit the cork seal 23 and selector 7 to the shaft 8.

23 Reverse the dismantling procedure to refit the selectors and locking plungers 13.

24 Fit the top cover.

25 Replace the reverse and third/fourth balls 14, and springs 15. The reverse spring is the stronger of the two. Fit the rubber grommets 19 and plates 17 and 18. Replace the first/second ball and spring then retain with the screwed plug 14 (see FIG 7:3).

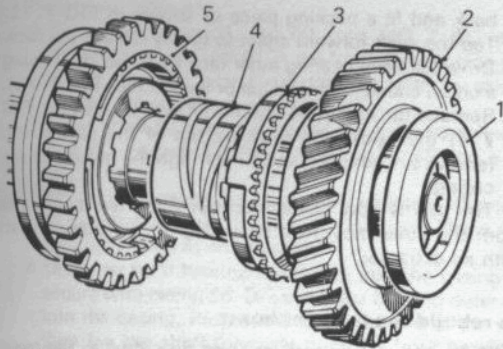


FIG 7:6 Rear components of Series III mainshaft

Key to Fig 7:6 1 Thrust washer 2 First speed gear
3 Rear cone of synchronizer 4 Bush 5 Synchronizer

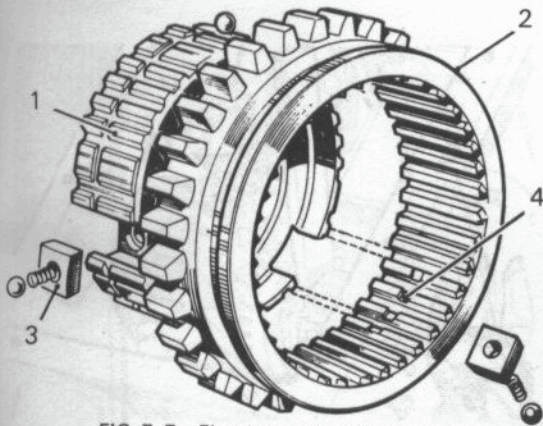


FIG 7:7 First/second synchronizer

Key to Fig 7:7 1 Inner member 2 Outer member
3 Block with spring and ball 4 Ball retaining groove

- 26 Refer to FIG 7:8 and adjust the stop bolt so that there is .002 inch (.05 mm) clearance between the bolt head and the stop on the shaft when second speed is selected. The reverse stop bolt cannot be adjusted until the transfer box has been fitted.
- 27 Replace the clutch withdrawal mechanism in the bell-housing, refit the transfer box and front output housing complete, refit the gearchange mechanism.
- 28 Refill with the correct oil when the box is fitted to the vehicle.
- 29 With reverse gear selected check that a clearance of .002 inch (.05 mm) exists between the end of the reverse selector shaft and the stop bolt. Slacken the locknut and adjust the stop bolt if required.

7:4 The transfer box

In this section refer to FIG 7:4.

The transfer box can be removed without removing the main gearbox. To do this, carry out the preliminary operations of obtaining access as described in Section 7:2.

From here the operations are the same whether the gearbox is in the vehicle or out on the bench.

- 1 Remove the drive flange 70 (see FIG 7:4), complete with the brake drum. Disconnect the transfer gear-lever and the handbrake lever.
- 2 Jack up the rear of the engine and insert a 1 inch (25 mm) wooden block between the flywheel housing and the chassis then remove the transfer box bottom cover and take off the intermediate shaft retaining plate 57 (see FIG 7:4), by undoing the nut and extracting the stud.
- 3 Remove the main shaft rear bearing housing (see FIG 7:9) or power takeoff unit if fitted.
- 4 Refer to FIG 7:10. The intermediate shaft must be extracted by the use of Rover extractor, Part No. 605862 while supporting the intermediate gear by hand.
- 5 With the shaft 55 (see FIG 7:4), extracted, the gear cluster 51 can be removed from the bottom of the transfer box. Remove the needle bearings 52, thrust washers 53 and shims 54 if fitted.
- 6 Detach the transfer casing from the main gearbox. Three of the fixing nuts are inside the transfer box casing.

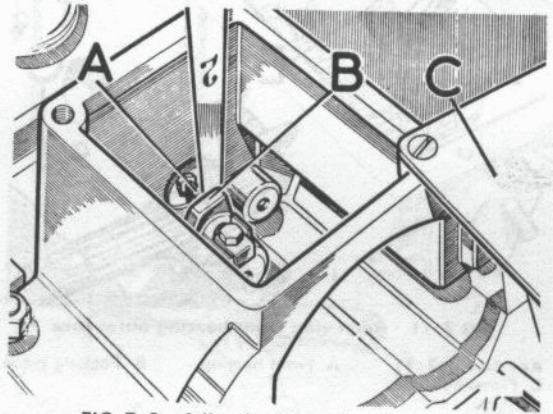


FIG 7:8 Adjusting second speed stop

Key to Fig 7:8 A Bolt B Stop C Cover

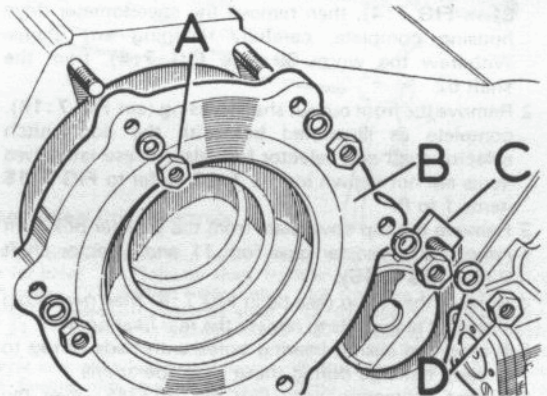


FIG 7:9 Mainshaft rear bearing housing

Key to Fig 7:9 A Fixing nuts B Housing C Retainer
D Retainer fixings

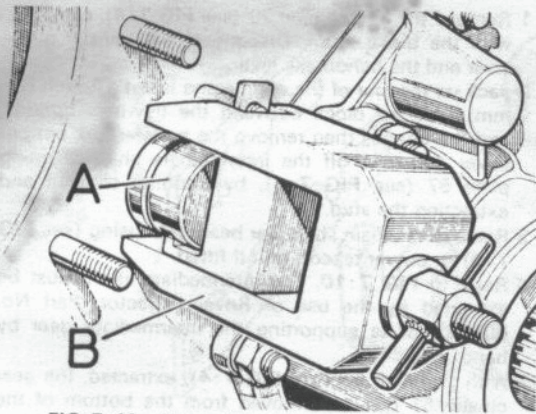


FIG 7:10 Removing intermediate gearshaft

Key to Fig 7:10

A Shaft

B Special tool

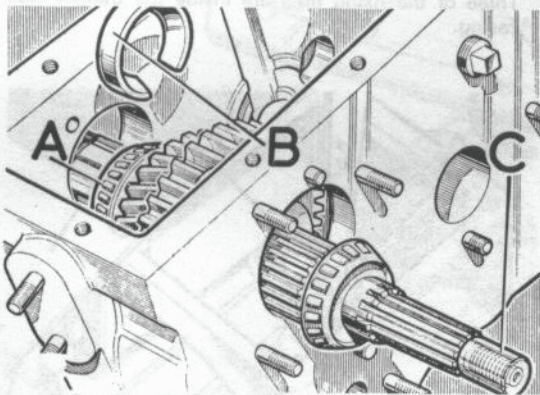


FIG 7:11 Removing front bearing outer race

Key to Fig 7:11

A Front bearing

B Packing piece

C Protection cap

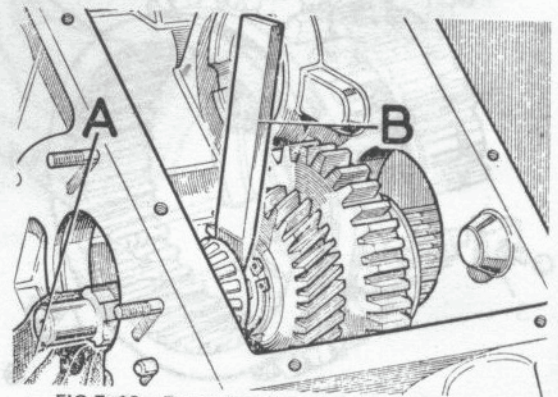


FIG 7:12 Removing front bearing inner race

Key to Fig 7:12
chisel edged drift

A Rag to protect casing

B Mild steel

To dismantle the transfer box:

- 1 Remove the speedometer drive pinion unit (see 79 to 81 in FIG 7:4), then remove the speedometer drive housing complete, carefully retaining any shims. Withdraw the worm 69 (see FIG 7:4), from the shaft 62.
- 2 Remove the front output shaft housing (see FIG 7:16), complete as illustrated but with the dog clutch selector shaft and selector fork also. These latter two items are not shown in FIG 7:16. Refer to FIG 7:15 items 1 to 8.
- 3 Remove the top coverplate from the transfer box then remove the transfer gear fork 11 and selector shaft 9 (see FIG 7:15).
- 4 Release the circlip (see 66 in FIG 7:4) then gently tap the shaft rearwards to release the rear bearing 67.
- 5 Protect the casing bearing bores with pads of rag to prevent damage during these next operations.
- 6 Fit the protection cap (Part No. 243241) over the threaded portion of shaft 62 (see FIG 7:4) and tap the shaft forwards as far as possible to start the front bearing outer race out of the casing. Slide the shaft

- back and fit a packing piece as shown in FIG 7:11. Tap the shaft forward again to finally release the race.
- 7 Drive the front bearing inner race from the shaft using a chisel ended mild steel bar or wedge (see FIG 7:12).
- 8 Remove the circlip 64 and thrust washer 63 (see FIG 7:4) then push the shaft 62 out of the casing and remove the gears 60 and 61 through the bottom of the casing.

The box is now dismantled but if the rear bearing is worn the inner race must be pulled off the output shaft with an extractor.

To rebuild the transfer box:

Clean and examine all parts as described in the main gearbox section. Renew where necessary but always use new locking washers, splitpins and joint washers.

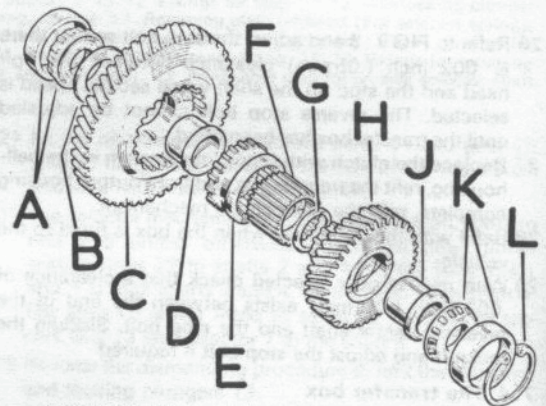


FIG 7:13 High and low speed gear assembly

Key to Fig 7:13

A Bearing for output shaft, rear

B Thrust washer for low gearwheel

C Low gearwheel

D Bush for low gearwheel

E Outer member for transfer change speed

F Inner member for transfer change speed

G Thrust washer for high gearwheel

H High gearwheel

J Bush for high gearwheel

K Bearing for output shaft, front

L Circlip fixing bearing

Proceed as follows:

- 1 Place the gears 61 and 60 (see FIG 7:4), in the transfer casing. Gear 61 at the front with its face teeth to the rear and gear 60 at the rear with its selector groove facing rearwards.
- 2 Insert shaft 62 from the rear and engage its splines in gear 60. Fit gear 61 then thrust washer 63 and a new circlip 64.
- 3 Fit the inner members of the two bearings 65 and 67 to the shaft; smaller bearing to the front. These must be a light press fit on the shaft.
- 4 Drive the front bearing outer race into the casing and secure with circlip 66. Drive the rear bearing outer race into the casing. Protect the threaded end of the shaft then tap the shaft forwards until the front bearing is hard against the circlip. Lightly tap the outer race of the rear bearing until the shaft has no end float.

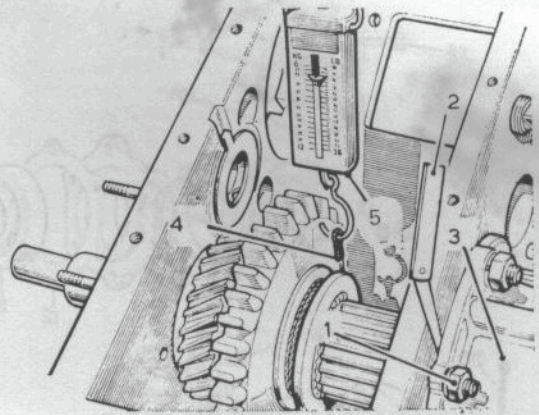


FIG 7:14 Setting the output shaft bearing pre-load

Key to Fig 7:14 1 Speedometer housing nuts 2 Feeler gauge
3 Speedometer housing 4 Nylon chord
5 Spring balance

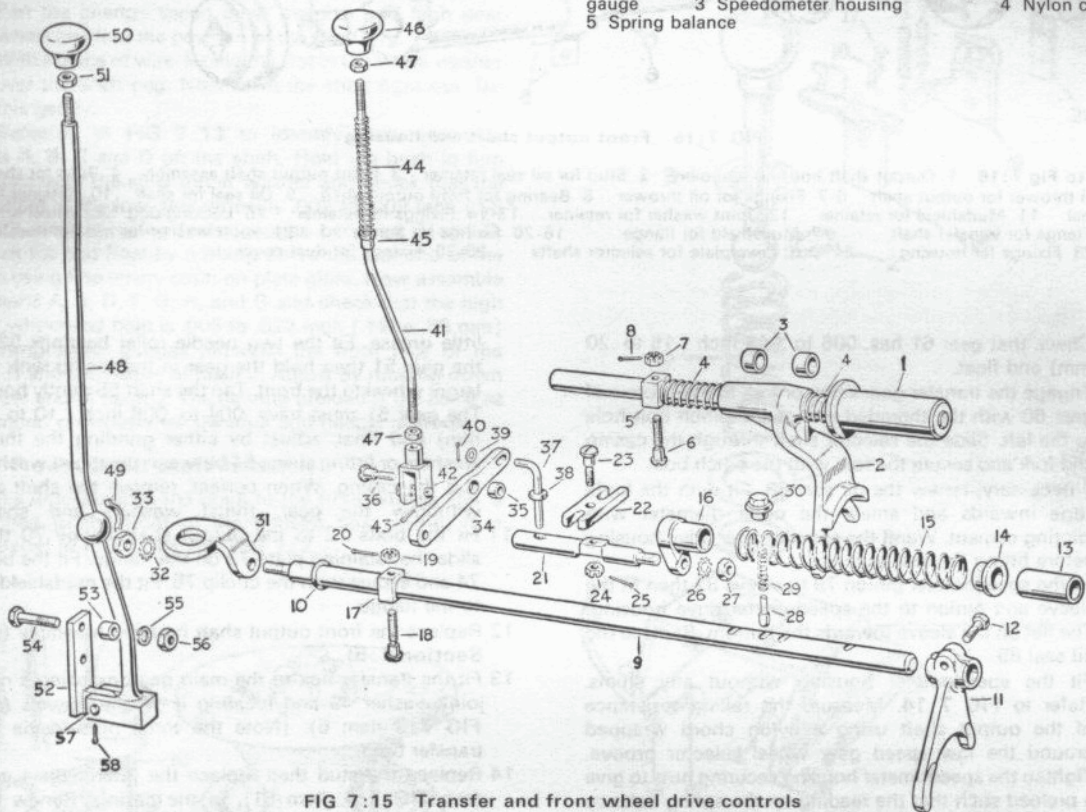


FIG 7:15 Transfer and front wheel drive controls

Key to Fig 7:15 1 Selector shaft, four wheel drive 2 Selector fork complete, four wheel drive 3 Bush for selector fork
4 Spring for selector fork 5 Block for selector shaft 6-8 Fixings for block 9 Selector shaft, transfer gearchange 10 Sealing ring for transfer gearchange shaft 11 Selector fork, transfer gearchange 12 Setbolt fixing fork 13 Distance tube for transfer selector shaft 14 Locating bush for selector shaft spring 15 Spring for gearchange selector shaft 16 Connector, gearchange to pivot shaft 17 Block for selector shaft 18-20 Fixings for block 21 Pivot shaft for selector shafts 22 Coupling, selector shafts to pivot 23-25 Fixings for coupling 26-27 Fixings for pivot shaft 28 Plunger for transfer selector shaft 29 Spring for plunger 30 Plug 31 Link for selector shaft 32-33 Fixings for link 34 Lever assembly, four wheel drive 35 Bush for lever 36 Special bolt, lever to housing 37 Locking pin, four wheel drive lever 38 Sealing ring, four wheel drive locking pin 39-40 Fixings for locking pin 41 Selector rod, four wheel drive 42 Clevis complete for rod 43 Splitpin for clevis 44 Spring for selector rod 45 Special bush for spring 46 Control knob for rod 47 Locknut for knob and clevis 48 Transfer gearchange lever complete 49 Spring for transfer gearchange lever 50 Knob for gearchange lever 51 Locknut for knob 52 Bracket for gearchange lever 53 Distance piece for bracket 54-56 Fixings for bracket 57-58 Fixings for gearlever

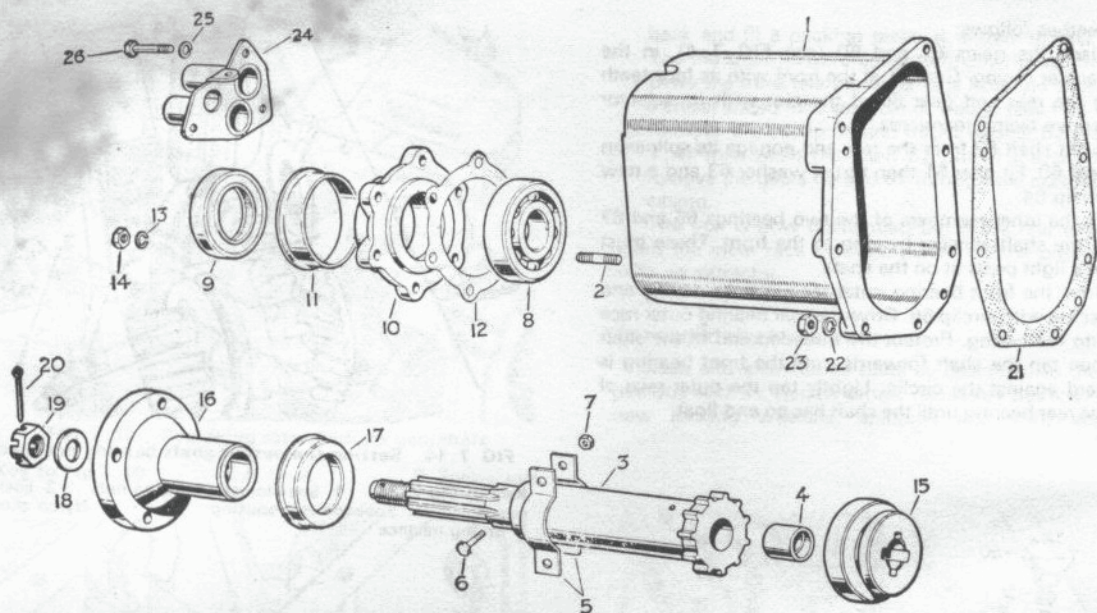


FIG 7:16 Front output shaft and housing

Key to Fig 7:16 1 Output shaft housing assembly 2 Stud for oil seal retainer 3 Front output shaft assembly 4 Bush for shaft
 5 Oil thrower for output shaft 6-7 Fixings for oil thrower 8 Bearing for front output shaft 9 Oil seal for shaft 10 Retainer for oil seal 11 Mudshield for retainer 12 Joint washer for retainer 13-14 Fixings for retainer 15 Locking dog, four wheel drive
 16 Flange for transfer shaft 17 Mudshield for flange 18-20 Fixings for flange 21 Joint washer for transfer housing
 22-23 Fixings for housing 24 Dust coverplate for selector shafts 25-26 Fixings for dust cover

- 5 Check that gear 61 has .006 to .008 inch (.15 to .20 mm) end float.
- 6 Engage the transfer gear selector fork in the groove of gear 60 with the threaded end of the pinch bolt hole to the left. Slide the selector shaft through the casing and fork and secure the fork with the pinch bolt.
- 7 If necessary, renew the oil seal 68. Fit with the knife edge inwards and smear the outer diameter with jointing cement. Warm the speedometer drive housing before fitting the seal to it.
- 8 Fit the speedometer pinion 79 to sleeve 82 then fit the sleeve and pinion to the speedometer drive housing. The flat on the sleeve towards the bottom. Replace the oil seal 85.
- 9 Fit the speedometer housing without any shims. Refer to FIG 7:14. Measure the rolling resistance of the output shaft using a nylon chord wrapped around the low speed gear wheel selector groove. Tighten the speedometer housing securing nuts to give a preload such that the reading on the spring balance is 2 to 4 lbs with the shaft rotating. Measure the gap between the speedometer and transfer gear housings and fit shims of this thickness between the two housings.
 Slide the worm 69 over the shaft 62 with its conical end inwards then fit the speedometer housing to the transfer box casing fitting the correct shims.
- 10 The intermediate gear end float must now be checked. Position the two thrust washers 53 in the transfer casing, bronze face inwards. Hold them in place with a

little grease. Fit the two needle roller bearings 52 in the gear 51 then hold the gear in the casing with the larger wheel to the front. Tap the shaft 55 gently home. The gear 51 must have .004 to .008 inch (.10 to .20 mm) end float; adjust by either grinding the thrust washers or fitting shims 54 between the thrust washers and the casing. When correct, remove the shaft and withdraw the gear, thrust washers and shims.

- 11 Fit the bolts 72 to the output shaft flange 70 then slide the retaining plate 73 on the flange. Fit the bolts 74 and secure with the circlip 75. Fit the mudshield 71 to the flange.
- 12 Replace the front output shaft housing assembly (see Section 7:5).
- 13 Fit the transfer box to the main gearbox using a new joint washer 49 and locating it on the dowels (see FIG 7:3 item 6). (Note the three nuts inside the transfer box).
- 14 Replace the stud then replace the intermediate gear (see FIG 7:4, item 51), in the casing. Renew the O-ring 56 and fit the shaft with plate 57 in the deepest slot. Replace the nut holding the retaining plate on stud 2.
- 15 Replace the mainshaft rear bearing housing.
- 16 Replace the bottom cover complete with a new joint washer. See that the drain plug is tight. Remove the wooden support block.
- 17 Fit the transmission brake assembly and shield to the speedometer housing with the expander rod on the righthand side.

- 18 Fit the front output shaft drive flange.
- 19 Fit the rear drive flange (see FIG 7:4, item 70) and lock with the nut and washer. Fit the transmission brake drum and the propeller shafts.
- 20 Refill the box with oil.

All helical box:

Certain transfer boxes are of all helical gear construction and the only visible indication is a selector shaft adjuster fitted to the front output shaft housing on this box only. The general overhaul instructions are as given earlier in this Section with the following exceptions.

To remove the output shaft proceed as follows:

- 1 Remove the front output shaft housing, speedometer housing and the front bearing retaining circlip.
- 2 Put two $\frac{3}{8}$ inch (16 mm) distance pieces between the rear face of the low gearwheel and the casting.
- 3 Drive the shaft back until the wheel just touches the distance pieces.
- 4 Prise the front bearing forwards $\frac{1}{4}$ inch (6 mm).
- 5 Part the change speed inner member and high gear wheel and find the position of the shaft peg.
- 6 With a piece of wire, locate the slot in the thrust washer over the shaft peg. Now drive the shaft right out. Do this gently.

Referring to FIG 7:13 to identify parts assemble parts A, B, C and D on the shaft. Hold the bush in firm contact with the steel thrust washer and check that the end float of the low gear wheel is .002 to .009 inch (.05 to .22 mm) by using feeler gauges between B and C. Adjust the end float by rubbing down the rear end of the bush using fine emery cloth on plate glass. Now assemble the parts A, B, D, F, G, H, and G and check that the high gear wheel end float is .005 to .022 inch (.12 to .55 mm) by using feeler gauges between the front face of the gear H and the flange of bush J. Adjust by rubbing down the rear end of bush J. The bearing preload is the same as described previously for the spur and helical gearbox.

7:5 Front output shaft assembly

This unit provides the drive to the front wheels and is attached to the front of the transfer box casing: It is illustrated in FIG 7:16 and FIG 7:2.

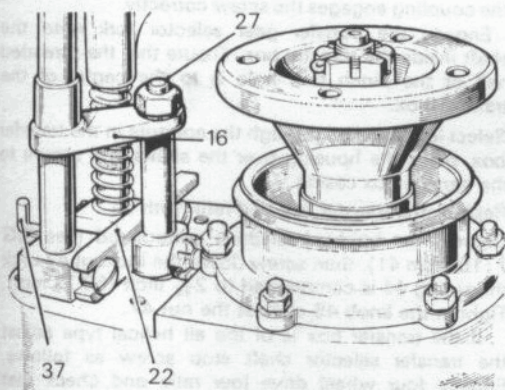


FIG 7:17 Aligning the pivot shaft. For key refer to Fig 7:15

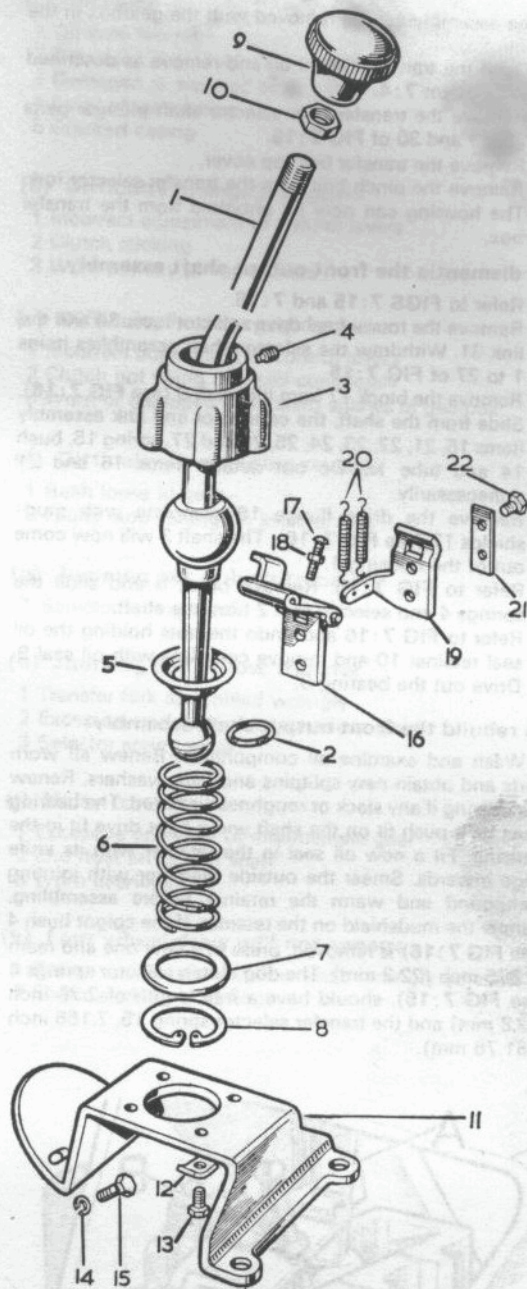


FIG 7:18 Main gearchange lever

Key to Fig 7:18 1 Gearchange lever 2 O-ring for lever
 3 Housing for lever 4 Locating pin for lever 5 Spherical seat for gearlever 6 Retaining pin for lever ball 7 Retaining plate for spring 8 Circlip fixing retaining plate 9 Knob for lever 10 Locknut for knob 11 Mounting plate for gearchange 12-13 Fixings for housing 14-15 Fixings for mounting plate 16 Reverse stop hinge complete 17 Adjusting screw (for hinge) 18 Locknut (for hinge) 19 Bracket for reverse stop spring 20 Spring for reverse stop 21-22 Fixings for hinge and bracket

The assembly can be removed with the gearbox in the vehicle.

- 1 Drain the transfer box of oil and remove as described in **Section 7:4**.
- 2 Remove the transfer gear selector shaft plunger parts 28, 29 and 30 of **FIG 7:15**.
- 3 Remove the transfer box top cover.
- 4 Remove the pinch bolt from the transfer selector fork.
- 5 The housing can now be unbolted from the transfer box.

To dismantle the front output shaft assembly:

Refer to **FIGS 7:15** and **7:16**.

- 1 Remove the four wheel drive selector lever 34 and the link 31. Withdraw the selector shaft assemblies items 1 to 27 of **FIG 7:15**.
- 2 Remove the block 17 from the shaft 9 (see **FIG 7:16**). Slide from the shaft, the connector and link assembly items 16, 21, 22, 23, 24, 25, 26 and 27, spring 15, bush 14 and tube 13. Do not detach items 16 and 21 unnecessarily.
- 3 Remove the drive flange 16 complete with mudshields 17 (see **FIG 7:16**). The shaft 3 will now come out of the housing 1.
- 4 Refer to **FIG 7:15**. Remove block 5 and slide the springs 4 and selector fork 2 from the shaft.
- 5 Refer to **FIG 7:16** and undo the nuts holding the oil seal retainer 10 and remove complete with oil seal 9. Drive out the bearing 8.

To rebuild the front output shaft assembly:

Wash and examine all components. Renew all worn parts and obtain new splitpins and joint washers. Renew the bearing if any slack or roughness is noted. The bearing must be a push fit on the shaft and a light drive fit in the housing. Fit a new oil seal in the retainer with its knife edge inwards. Smear the outside diameter with jointing compound and warm the retainer before assembling. Renew the mudshield on the retainer. If the spigot bush 4 (see **FIG 7:16**) is removed, press in a new one and ream to .875 inch (22.2 mm). The dog clutch selector springs 4 (see **FIG 7:15**), should have a free length of 2.75 inch (69.8 mm) and the transfer selector spring 15, 7.156 inch (181.76 mm).

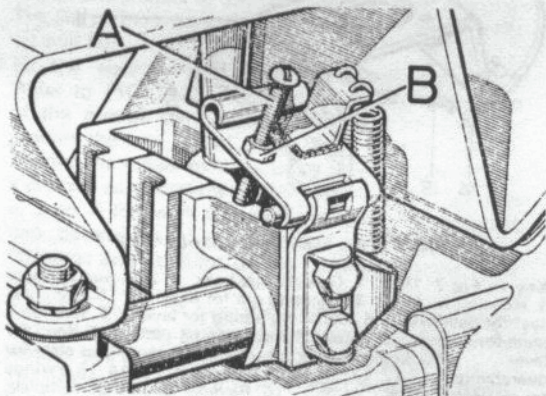


FIG 7:19 Adjusting reverse selector stop

Key to Fig 7:19 A Adjusting screw B Locknut

To assemble the unit proceed as follows:

- 1 Replace the oil seal retainer on the front of the housing.
- 2 Fit the two springs 4 (see **FIG 7:15**), and the selector fork 2 to the shaft 1. Replace block 5.
- 3 If items 16 and 21 have been separated, replace them with the hole for the locking peg vertical and the cut-away underneath item 21. Secure lightly with the nut and washer.
- 4 Secure item 22 to 21 with the screwed pin 23 and nut 24. Fit a new splitpin 25. The shorter end of the coupling 22 must be towards the transfer selector.
- 5 Fit the output shaft 3 in the housing 1 (see **FIG 7:16**) and secure with the flange 16 and nut, washer and splitpin 18, 19 and 20. Tighten the nut to 85 lb ft (11.75 kgm).
- 6 Fit the block 17 to the shaft 9 securing it with the screwed pin 18 and nut 19. Fit a new splitpin. Ensure that the nut and splitpin are on the same side of the shaft as the plunger grooves.
- 7 Fit the connector 16 of the pivot shaft over the transfer selector shaft. To ensure that the connector 16 is fitted at the correct angle to the pivot shaft 21 remove the dust cover (24 in **FIG 7:16**) and proceed as follows:
Engage the transfer selector shaft, pivot shaft and dog clutch selector shaft into the front face of the housing ensuring that the coupling 22 engages the screwed pins of the transfer and dog clutch shafts as shown in **FIG 7:17**. Locate the pivot shaft in the housing and insert the locking pin 37. Tighten the nut 27 securing the connector 16 to the pivot shaft.
- 8 Remove the locking pin. Withdraw the selector shafts and keeping them together engage them in their correct location in the output shaft housing. Fit the spring 15, bush 14 and distance tube 13 to the transfer gear selector shaft.
- 9 Fit the output shaft housing.
Fit a new joint washer 21 then engage the dog clutch selector fork in the groove of the locking dog 15. Engage the selector shaft in the bush in the transfer box at the same time sliding the locking dog over the splines of the transfer box output shaft ensuring that the coupling engages the screw correctly.
Engage the transfer gear selector fork onto the shaft inside the transfer box. Ensure that the threaded half of the pinch bolt hole is to the centre of the transfer box.
- 10 Select low transfer, through the aperture in the transfer box, place the housing over the shafts and secure to the transfer box casing.
- 11 Replace the transfer box and refill with oil.
- 12 Depress the front wheel drive control rod (see **FIG 7:15**, item 41), then screw down the locknut 47 until the spring 44 is compressed to $2\frac{5}{16}$ inch (58.73 mm). Tighten the knob 46 against the nut 47.
If the transfer box is of the all helical type adjust the transfer selector shaft stop screw as follows. Engage four wheel drive low ratio and check that locking pin 37 is an easy slide fit. Adjust the stop bolt if necessary.

7:6 The main gearchange lever

To overhaul this unit refer to **FIG 7:18** and proceed as follows:

- 1 Remove the front floor complete then undo the two bolts and two nuts. Lift the lever out complete.
 - 2 Remove the circlip 8 and draw the gearlever out of the housing.
 - 3 Renew any worn components.
- Rebuilding the unit is a reversal of the dismantling process.

To adjust the reverse stop (see **FIG 7:19**):

- 1 The screw and locknut on the reverse stop hinge should be adjusted so that:
 - (a) The hinge rides easily up the gearlever when reverse gear is selected, and
 - (b) Appreciable resistance is felt on moving the gearlever to the reverse gear position.
 - (c) When selecting first gear reverse gear is not simultaneously engaged.
- 2 This adjustment should be carried out on any gearbox removed for attention, before the gearbox cover is fitted.
- 3 It can also be carried out at any time after:
 - (a) Detaching the inspection cover from the righthand side of the gearbox cover on vehicles so fitted, or
 - (b) Selecting reverse gear and sliding the inspection cover up the front wheel drive control rod.

7:7 Fault diagnosis

(a) Gearbox noisy in neutral

- 1 Primary pinion bearing worn
- 2 Constant mesh gears worn
- 3 Layshaft bearing worn
- 4 Insufficient oil

(b) Gearbox noisy in gear

- 1 Worn speedometer gears
- 2 Noise in 1st, 2nd and 3rd; see 2 and 3 at (a)
- 3 Noise in either 1st, 2nd or 3rd only, renew the pair of gears in question
- 4 Noise in all gears, worn bearings

(c) Oil leaks

- 1 Oil level too high
- 2 Damaged joint washers
- 3 Damaged or worn oil seals
- 4 Level plugs missing
- 5 Cracked casing

(d) Difficulty in engaging gears

- 1 Incorrect adjustment of control levers
- 2 Clutch sticking
- 3 Worn primary pinion splines

(e) Difficulty in disengaging gears

- 1 Incorrect adjustment of control levers
- 2 Clutch not being released completely
- 3 Worn or damaged main shaft splines in gearbox

(f) Difficulty in engaging reverse

- 1 Bush loose in gear
- 2 Faulty stop setting on selector fork

(g) Jumping out of high transfer

- 1 Selector spring weak

(h) Jumping out of low transfer

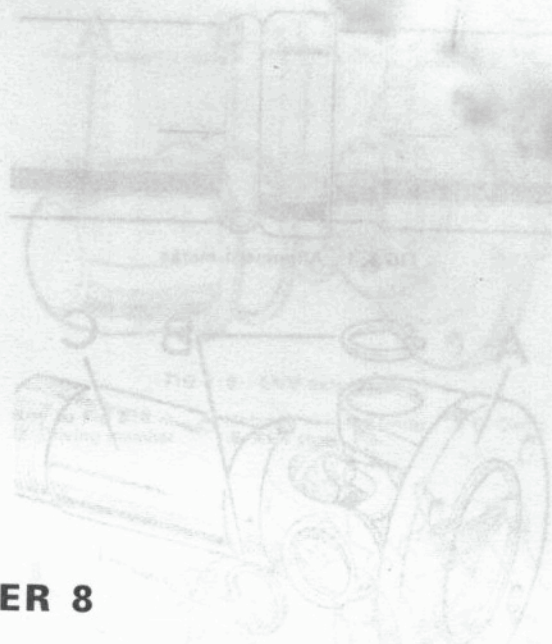
- 1 Transfer fork assembled wrongly
- 2 Excessive end float of intermediate gear
- 3 Selector spring weak

(j) Noisy transfer box

- 1 Excessive end float of intermediate gear
- 2 End float on output shaft
- 3 Worn bearings

(k) Four wheel drive will not engage

- 1 Return spring below yellow knob wrongly adjusted
- 2 Shafts sticking in casing



CHAPTER 8

PROPELLER SHAFT, REAR AXLE, REAR SUSPENSION

- 8:1 Description
- 8:2 Servicing the universal joints
- 8:3 The rear axle
- 8:4 Servicing axle shafts
- 8:5 The rear hubs

- 8:6 The differential units
- 8:7 To remove the rear axle
- 8:8 The rear springs
- 8:9 The hydraulic dampers
- 8:10 Fault diagnosis

8:1 Description

The Land Rover is a four wheel drive vehicle, therefore the drive must be transmitted to two axles. The two propeller shafts are basically similar so that overhaul instructions are given which apply to both. The universal joints are identical. Suspension is by leaf spring, damped by hydraulic dampers mounted between the axle and the chassis frame. Differential units are usually of Rover manufacture and are fitted to both front and rear axles.

(Note that some vehicles built to special order may have the ENV differential).

8:2 Servicing the universal joints

The propeller shafts can be removed by simply undoing the four nuts and bolts at each end flange and withdrawing the shaft from the transfer box and differentials.

If a rear power takeoff drive is fitted, to 107 and 109 models, the shaft to this must be disconnected at the centre bearing assembly first. Then proceed as for the road wheel transmission shafts and disconnect at the rear power takeoff unit or remove the unit first then disconnect the shaft, depending on the accessibility of the particular vehicle.

To renew universal joints:

Refer to FIG 8:1. Check that the arrows on the halves of the sliding joint are marked then unscrew the dust cap and withdraw the shaft from the sleeve. The dust cap is covered by a rubber bellows held at each end by large hose clips to retain the lubricant. Undo the hose clips and slide the bellows up the shaft before undoing the cap.

Proceed to dismantle each joint as follows:

- 1 Remove the circlips B (see FIG 8:2).
 - 2 Hold the joint in the lefthand with one of the yoke lugs uppermost and tap the radius of the yoke lightly with a soft-faced mallet. The top bearing should then emerge from the yoke (see FIG 8:3).
 - 3 Turn the joint over and remove the bearing downwards so as not to drop the needle rollers (see FIG 8:4).
 - 4 Repeat for the opposite side bearing. Remove the shaft as shown in FIG 8:5.
 - 5 Rest the yoke on a short piece of tubing and, with the aid of a brass drift, drive out the remaining two bearings as shown in FIG 8:6.
- Wash all the parts and inspect for wear. The most likely location will be the spider journals and the bearing races. An overhaul kit which consists of a new spider, four races and cork seals will cure this type of wear. If,

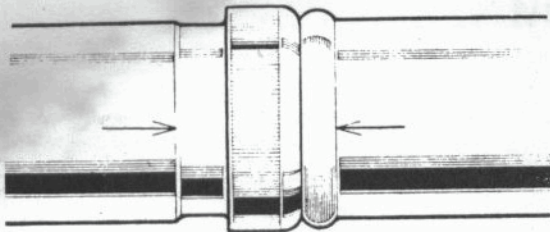


FIG 8:1 Alignment marks

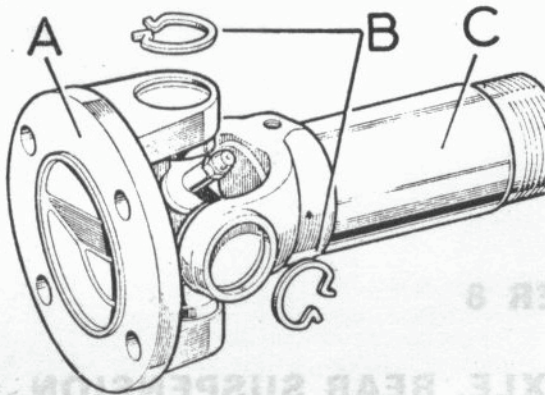


FIG 8:2 Universal joint

Key to FIG 8:2 A Flange yoke B Circlips C Shaft yoke

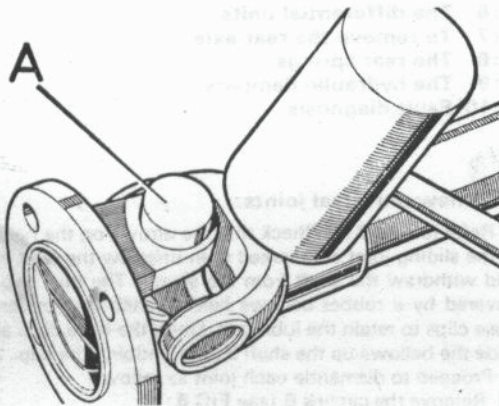


FIG 8:3 Removing a yoke bearing, Stage 1

Key to FIG 8:3 A Bearing emerging

2 Assemble the new spider in the flange yoke with its journals in the yoke holes. Gently tap the first bearing upwards from the lower hole into position. Do not forget to assemble the cork oil seal on the journal. Repeat for the other bearing. Fit the shaft over the spider and fit the two bearings in the shaft yoke by the same method.

3 Use a brass drift to tap the bearings home, then fit the circlips making sure they seat properly in their grooves.

4 Tap the yokes a few times with the soft-faced mallet to ensure that the bearings seat back against the circlips.

The shaft sliding portion must now have the splines liberally smeared with grease and must then be assembled to the sleeve making sure that the arrows are in alignment (see FIG 8:1). Tighten the dust cap by hand only, slide the rubber bellows back over the shaft and sleeve and tighten the hose clips. (Fit the clips so that their fixings are at 180 deg. so as to maintain shaft balance).

Replace the shaft by reversing the dismantling procedure but make sure that the mating faces of the flanges on the shaft, the differential and the transfer box are clean. Ensure that the register engages and the joint faces of the flanges have bedded down all round.

When the shaft flange is bolted to the differential, see that the bolts face the differential, i.e. the nuts are nearest to the differential, behind the differential flange. On Series III models the bolt heads are on the differential side of the flange.

8:3 The rear axle

Three types of differential have been fitted; most vehicles have the Rover unit but some built to special order and also the One Ton Van have the ENV unit while some series III models have the Salisbury unit. Where the heavier duty ENV and Salisbury units are fitted this is generally only to the rear axle. Instructions

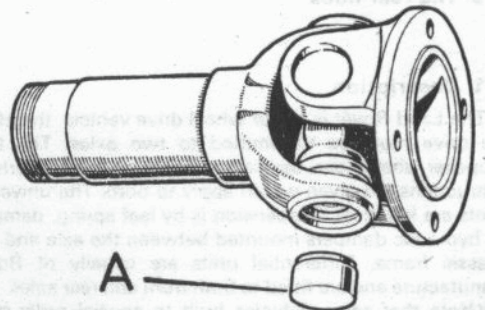


FIG 8:4 Removing a yoke bearing, Stage 2

Key to FIG 8:4 A Bearing withdrawn

however, the shaft has been allowed to so deteriorate that the races have hammered the yoke bores oval, then the complete shaft must be renewed. At this stage, when all is clean, check the sliding joint for movement. If more than .004 inch (.1 mm) of circumferential movement is found, then again, the whole shaft must be renewed.

Assuming that the wear can be eliminated by fitting an overhaul kit, proceed now as follows:

- 1 Assemble the needle rollers in the bearing races, if necessary using a smear of petroleum jelly to hold them in. About half fill the races with a recommended grease.

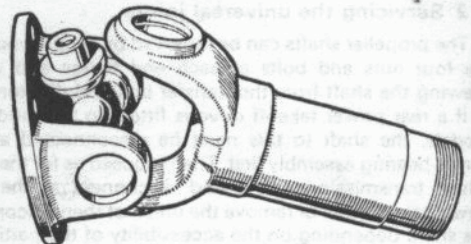


FIG 8:5 Removing the shaft

are given in this Chapter to cover the removal of the differential from the axle but overhaul of any unit is best left to a Rover Service Station as it demands special equipment and knowledge. FIGS 8:11 and 8:12 show the Rover and ENV units respectively.

8:4 Servicing axle shafts

On the Rover type axle, the axle shafts (half shafts) can be removed without removing the road wheel.

Rover differential:

Refer to FIG 8:7.

Remove the bolts A and withdraw the shaft.

To replace a shaft, first fit a new joint washer C, smearing both sides with grease. If the hub is grease lubricated ensure that the space in the end of the hub and driving member B is packed with grease. Fit the shaft carefully engaging the splines in the differential then tighten bolts A to 28 lb ft (3.9 mkg). If the hub is oil lubricated top up with $\frac{1}{2}$ pint (.190 litre) of recommended final drive oil. Check and if necessary top up the differential with oil.

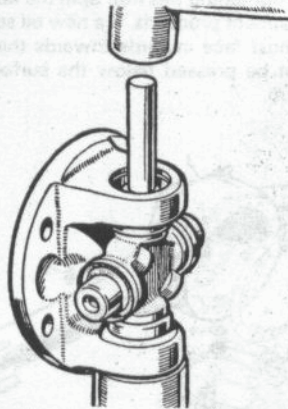


FIG 8:6 Removing the flange yoke

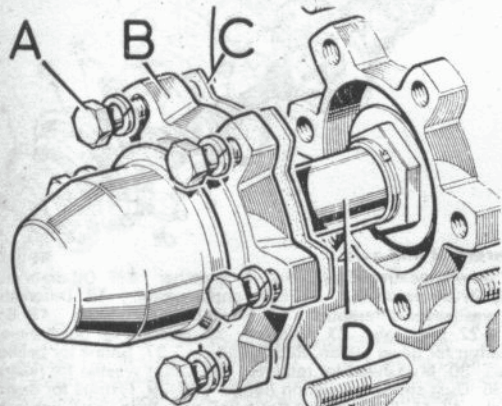


FIG 8:7 Rover axle shaft

Key to Fig 8:7 A Bolts B Driving member C Joint washer D Axle shaft

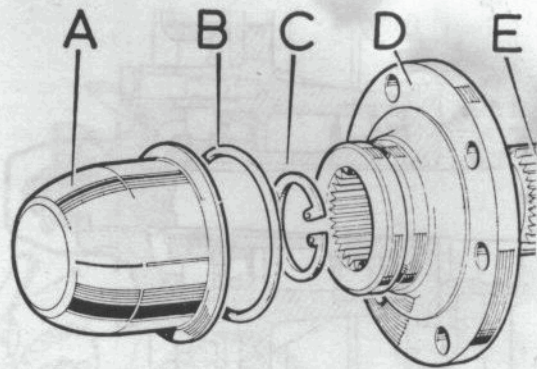


FIG 8:8 ENV axle shaft

Key to Fig 8:8 A Hub cap B O-ring C Circlip D Driving member E Axle shaft

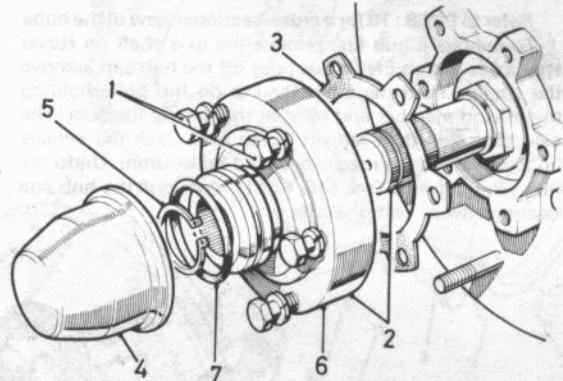


FIG 8:9 Salisbury axle shaft

Key to Fig 8:9 1 Driving bolts 2 Axle shaft 3 Joint washer 4 Hub cap 5 Circlip 6 Driving member 7 O-ring seal

ENV differential:

Refer to FIG 8:8.

To remove the axle shafts the vehicle must be jacked up and the road wheel taken off.

Remove the brake drum, disconnect the hydraulic pipe and then detach the brake backplate as detailed in Chapter 11.

The hub and axle shaft can now be pulled away from the axle. Undo the axle shaft driving member bolts, prise off the hub cap and remove the circlips. The axle shaft will now be free of the hub.

Replacement is a reversal of the removal procedure but do not forget to bleed the brakes.

Salisbury differential:

Refer to FIG 8:9.

Remove the bolts 1 and withdraw the shaft. To free the axle from the driving member, prise off the hub cap and remove the circlip. Renew the O-ring seal 7 if necessary.

To replace a shaft, first fit a new joint washer 3 smearing both sides with grease. Ensure that the space in the end of the hub and driving member 6 is packed with grease. Fit the shaft carefully engaging the splines in the differential then tighten the bolts 1 to a torque of 28 lb ft (3.9 mkg).

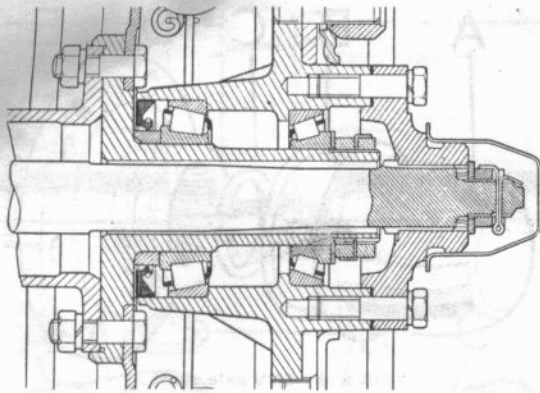


FIG 8:10 The rear hub

8:5 The rear hubs

Refer to FIG 8:10 for a cross-sectional view of the hubs.

To remove a hub first remove the axle shaft on Rover type axles but on ENV axles prise off the hub cap, remove the circlips from the shaft then undo the bolts holding the driving member and remove the driving member. The axle shaft can then remain in the axle. Jack the vehicle up and remove the road wheel and brake drum. Undo the hub securing nuts (see FIG 8:11), then pull the hub and bearings away from the axle.

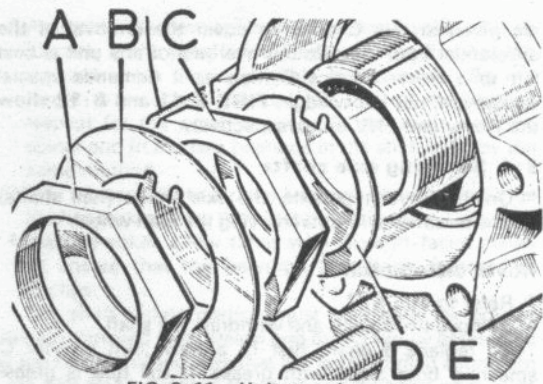


FIG 8:11 Hub securing nuts
Key to Fig 8:11 A Locknut B Lockwasher
C Adjuster nut D Key washer E Hub

Examine and renew the bearings if wear is evident. Replace the hub by reversing the dismantling process. Adjust the bearings to .004 to .006 inch (.10 to .15 mm) end float then tighten locknut A (see FIG 8:11). Always recheck after tightening this nut. Spin the hub to settle the races as adjustment proceeds. If a new oil seal is fitted the lipped side must face inwards towards the hub and the seal must not be pressed below the surface of the rear face of the hub.

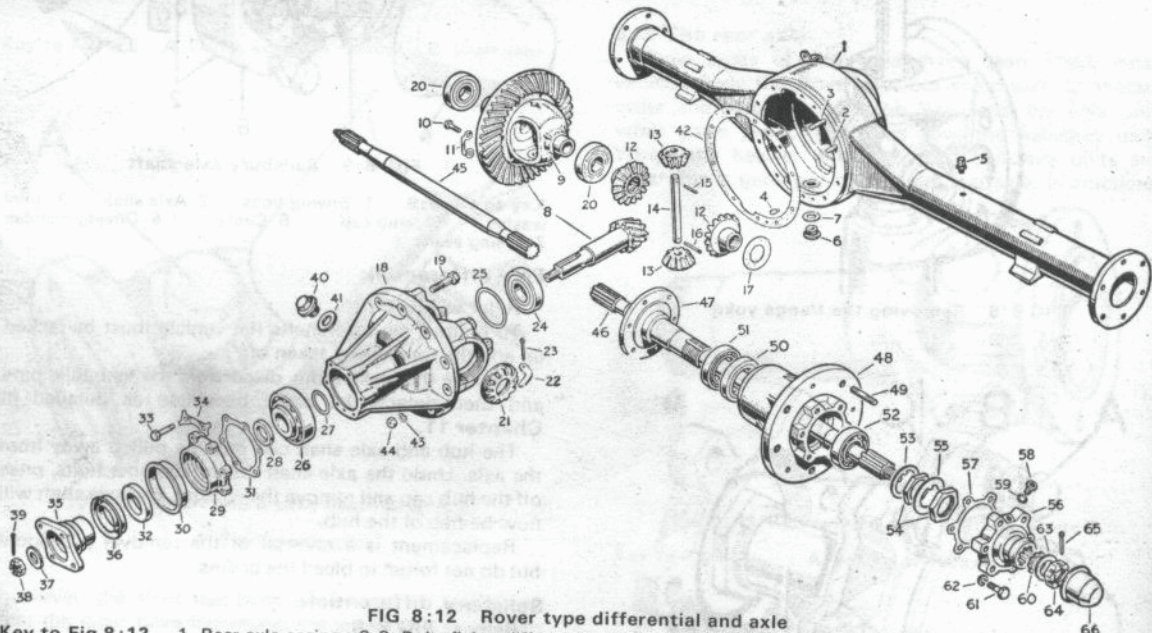


FIG 8:12 Rover type differential and axle

Key to Fig 8:12 1 Rear axle casing 2-3 Bolts fixing differential 4 Dowel locating differential 5 Breather 6-7 Oil drain plug 8 Crownwheel and bevel pinion 9 Differential casing 10-11 Fixings for crownwheel 12 Differential wheel 13 Differential pinion 14 Spindle for pinions 15-16 Fixings for spindle 17 Thrust washer for differential 18 Bevel pinion housing 19 Bolt fixing bearing cap 20 Roller bearings for differential 21 Serrated nut 22 Lock tab 23 Splitpin 24 Bearing for bevel pinion, pinion end 25 Shims for bearing adjustment, pinion end 26 Bearing for bevel pinion, flange end 27 Shims for bearing adjustment, flange end 28 Washer for bearing 29 Retainer for oil seal 30 Mudshield for retainer 31 Joint washer for retainer 32 Oil seal for pinion 33-34 Fixings for retainer 35 Driving flange 36 Dust shield for driving flange 37-39 Fixings for driving flange 40-41 Oil filler plug and washer 42 Joint washer for differential 43-44 Fixings for differential 45 Axle shaft, righthand 46 Axle shaft, lefthand 47 Rear hub bearing sleeve 48 Rear hub assembly 49 Stud for road wheel 50 Hub bearing, inner 51 Oil seal for inner bearing 52 Hub bearing, outer 53-55 Fixings—for hub bearing 56 Driving member for rear hub 57 Joint washer for driving member 58 Filler plug for hub driving member 59 Joint washer for filler plug 60 Oil seal for rear axle shaft 61-62 Fixings—driving member to rear hub 63-65 Fixings—axle shaft to driving member 66 Hub cap, rear

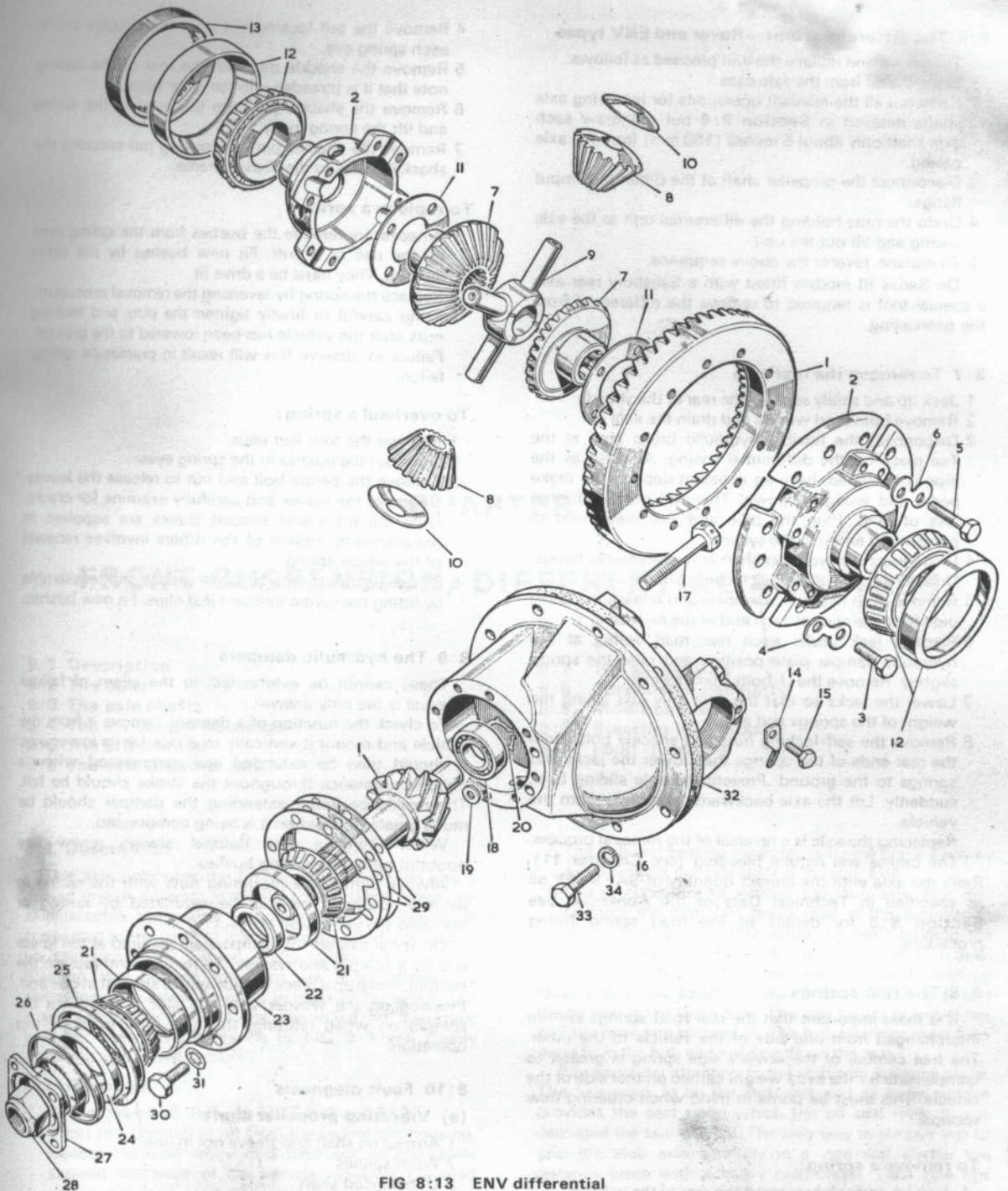


FIG 8:13 ENV differential

Key to Fig 8:13 1 Crownwheel and bevel pinion 2 Differential casing 3 Setbolt ($\frac{7}{16}$ in UNF x 1 in long) 4 Locking plate
 5 Setbolt ($\frac{1}{16}$ in UNF x $1\frac{1}{2}$ in long) 6 Locking plate 7 Differential wheel 8 Differential pinion 9 Spindle for pinions
 10 Spherical washer, differential pinion 11 Washer, differential wheel 12 Taper roller bearing for differential 13 Adjuster,
 differential bearings 14 Locking plate 15 Setbolt 16 Nose piece complete with bearing caps 17 Special bolt fixing bearing
 cap 18 Bearing for bevel pinion, nose end 19 Retaining washer 20 Circlip 21 Bearing for bevel pinion 22 Spacer for
 bearing adjustment 23 Bevel pinion housing 24 Oil seal for pinion 25 Mudshield for bevel pinion housing 26 Mudshield for
 driving flange 27 Driving flange for bevel pinion 28 Special nut fixing driving flange 29 Shim, bevel pinion to crownwheel
 engagement 30 Setbolt 31 Shakeproof washer 32 Joint washer, differential to axle casing 33 Setbolt 34 Spring washer

8:6 The differential unit—Rover and ENV types

To remove and replace the unit proceed as follows:

- 1 Drain the oil from the axle case.
- 2 Carry out all the relevant operations for removing axle shafts detailed in **Section 8:4** but withdraw each axle shaft only about 6 inches (150 mm) from the axle casing.
- 3 Disconnect the propeller shaft at the differential input flange.
- 4 Undo the nuts holding the differential unit to the axle casing and lift out the unit.
- 5 To replace, reverse the above sequence.

On Series III models fitted with a Salisbury rear axle a special tool is required to remove the differential from the gearcasing.

8:7 To remove the rear axle

- 1 Jack up and safely support the rear of the vehicle.
- 2 Remove both road wheels and drain the axle oil.
- 3 Disconnect the flexible hydraulic brake pipe at the Tee piece on the differential casing. As soon as the pipe is loosened, have an assistant depress the brake pedal and wedge it down. This will prevent further loss of fluid. Plug the pipe and Tee piece port to prevent dirt entering the system.
- 4 Disconnect the propeller shaft at the differential flange. Disconnect one end of each check strap.
- 5 Remove both hydraulic dampers and release the brake pipe from the clips at each end of the axle case.
- 6 Place a jack under each rear road spring at the hydraulic damper plate position and raise the spring slightly. Remove the U-bolts from the axle.
- 7 Lower the jacks so that they are only just taking the weight of the springs and axle.
- 8 Remove the self-locking nuts and shackle bolts from the rear ends of the springs then lower the jacks and springs to the ground. Prevent the axle sliding back suddenly. Lift the axle backwards and away from the vehicle.

Replacing the axle is a reversal of the removal process.

The brakes will require bleeding (see **Chapter 11**). Refill the axle with the correct quantity of SAE.90.EP oil as specified in Technical Data of the Appendix. See **Section 8:8** for details of the road spring fitting procedure.

8:8 The rear springs

It is most important that the rear road springs are not interchanged from one side of the vehicle to the other. The free camber of the driver's side spring is greater to compensate for the extra weight carried on that side of the vehicle. This must be borne in mind when ordering new springs.

To remove a spring:

- 1 Jack up and safely support the rear of the vehicle.
- 2 Remove the road wheels.
- 3 Jack up the spring under the damper plate and remove the damper at the lower fixing and remove the U-bolt nuts. Lower the damper plate and remove the jack so that the axle is supported by the check strap and the spring is relaxed.

- 4 Remove the self-locking nut from the shackle pin in each spring eye.
- 5 Remove the shackle pin from the rear of the spring; note that it is threaded into the inner plate.
- 6 Remove the shackle pin from the front of the spring and lift the spring away.
- 7 Remove the shackle pin self-locking nut securing the shackle plates to the chassis frame.

To replace a spring:

- 1 If necessary remove the bushes from the spring eyes by the use of a drift. Fit new bushes by the same method. They must be a drive fit.
- 2 Replace the spring by reversing the removal procedure, being careful to finally tighten the pins and locking nuts after the vehicle has been lowered to the ground. Failure to observe this will result in premature spring failure.

To overhaul a spring:

- 1 Remove the four leaf clips.
- 2 Drive out the bushes in the spring eyes.
- 3 Remove the centre bolt and nut to release the leaves.
- 4 Degrease the leaves and carefully examine for cracks. Only the main and second leaves are supplied as replacements. Failure of the others involves renewal of the whole spring.
- 5 Grease each leaf with graphite grease and reassemble by fitting the centre bolt and leaf clips. Fit new bushes.

8:9 The hydraulic dampers

These cannot be overhauled; in the event of failure renewal is the only answer.

To check the function of a damper, remove it from the vehicle and mount it vertically in a vice by its lower eye. It should then be extended and compressed when a uniform resistance throughout the stroke should be felt. The resistance when extending the damper should be much greater than when it is being compressed.

When fitting a new damper always renew any doubtful rubber mounting bushes.

Always tighten the mounting nuts with the spring in its mid-position. This can be estimated by raising or lowering the vehicle on the jack.

On some models the dampers are secured at the lower end by a splitpin and washer. To remove and replace the splitpin, make up a piece of tube with a slot cut at one end. Pressing on the washer with the slot in line with the splitpin or, when refitting, the hole, will facilitate this operation.

8:10 Fault diagnosis

(a) Vibrating propeller shaft

- 1 Arrows on shaft and sleeve not in line
- 2 Worn splines
- 3 Unbalanced shaft
- 4 Loose flange bolts

(b) Universal joints noisy

- 1 Lack of lubrication
- 2 Loose flange bolts
- 3 Worn bearings or splines

CHAPTER 9

FRONT SUSPENSION, DIFFERENTIAL AND HUBS

- 9:1 Description
- 9:2 The hubs
- 9:3 The axle shafts
- 9:4 The swivel pin housings
- 9:5 The differential
- 9:6 The axle breather unit

- 9:7 The suspension
- 9:8 Suspension geometry
- 9:9 Modifications
- 9:10 Steering lock stops
- 9:11 Fault diagnosis

9:1 Description

This axle combines the functions of a steering and a driving unit. A differential, similar to that fitted to the rear axle, accepts the power input from the propeller shaft connected to the front of the transfer box and transmits it via two universally jointed shafts to the front wheels. Steering and braking functions are accomplished by swivelling stub axles mounted in massive housings. The suspension is by leaf springs controlled by telescopic hydraulic dampers. Reference to **FIG 9:1** will clearly show the axle construction.

9:2 The hubs

- To remove a hub. Refer to **FIGS 9:1** and **9:2**.
- 1 Drain the lubricating oil from the swivel pin housing, slacken the road wheel nuts then jack up and safely support the front of the vehicle. Remove the road wheel.
 - 2 Slacken the brake adjusters and remove the drum.
 - 3 Prise off the hub cap then undo the axle shaft nut. Remove the driving member from the shaft and hub.
 - 4 Undo the hub locking nut and remove it with its tab washer. Unscrew the inner adjusting nut and remove this and the inner tabwasher.

5 The hub and bearing assembly will now come away as a unit leaving the axle shaft in the stub axle.

6 If it is necessary to remove the stub axle; first disconnect the hydraulic brake pipe at the connection to the flexible pipe then undo the bolts holding the brake backplate, remove the backplate and stub axle.

With the hub away from the axle examine the bearing races and renew where required. It is advisable to renew the oil seal at the same time. This can be easily prised out and the new one pressed in. The hub bearings must be a press fit in the hub and a sliding fit on the axle.

Pay particular attention to the stub axle distance piece. This is a press fit on the stub axle and its outer surface provides the seat upon which the oil seal runs. If it is damaged the seal will fail. The only way to remove it is to grip the stub axle carefully in a vice and shatter the distance piece with a heavy cold chisel. Take care not to damage the stub axle. The new distance piece is pressed on.

Note that early stub axles are fitted with a bush at the inner end which must be reamed after fitting to 1.250 inch + .004 inch (31.75 + .10 mm). Later axles are of strengthened design and do not need this bush. Both types are interchangeable.

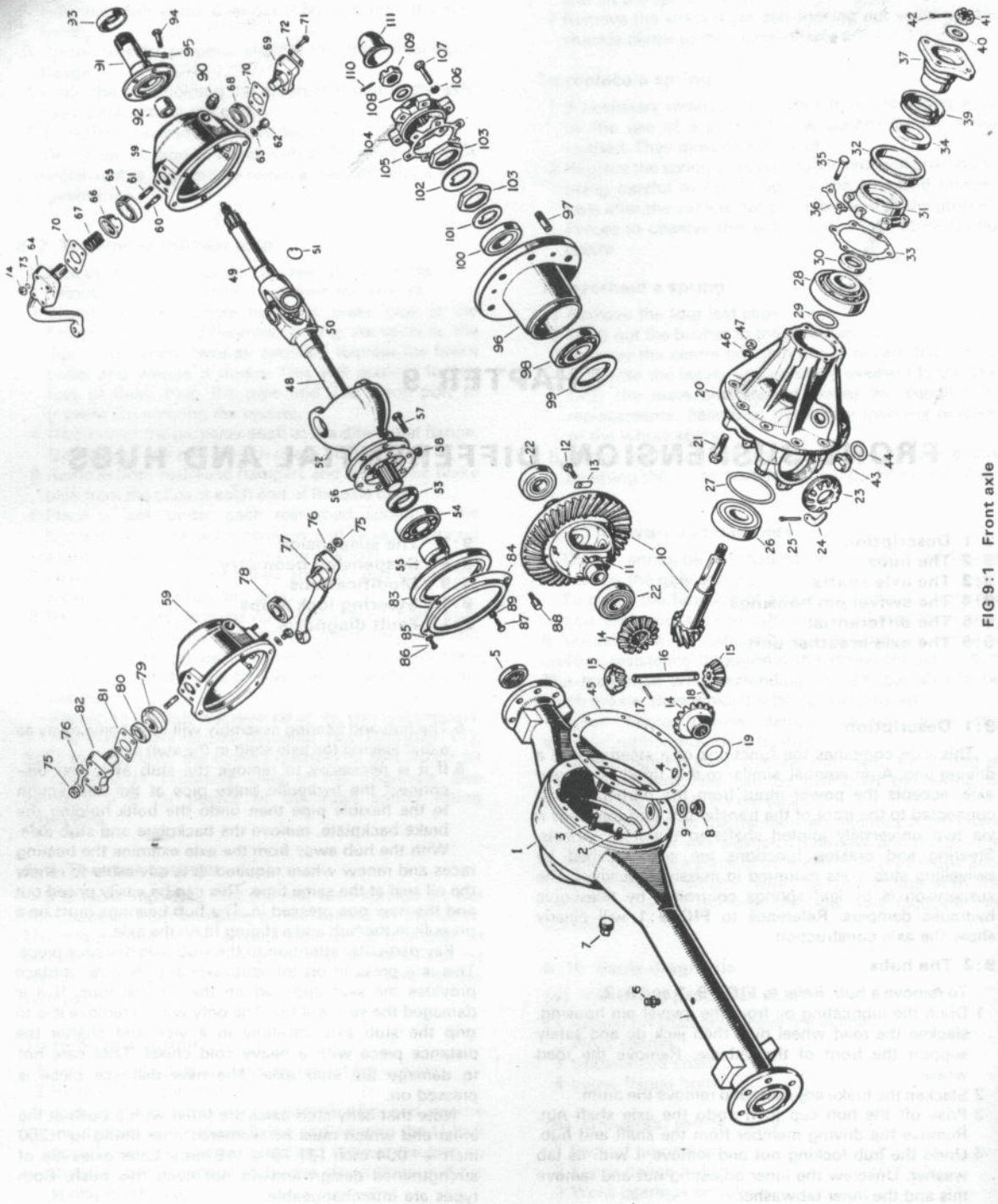


FIG 9:1 Front axle

Key to Fig 9:1

1 Axle casing complete
 2-3 Fixings, bevel pinion housing to axle casing
 4 Dowel, locating housing
 5 Oil seal, in casing
 6 Breather
 7 Oil filler plug
 8-9 Drain plug and joint washer
 10 Crownwheel and bevel pinion
 11 Differential casing
 12 Setbolt
 13 Locker (double type)
 14 Differential wheel
 15 Differential pinion
 16 Spindle for pinion
 17 Plain pin
 18 Splitpin
 19 Thrust washer
 20 Bevel pinion housing
 21 Special bolt, fixing bearing cap
 22 Taper roller bearing for differential
 23-24 Bearing adjustment
 25 Splitpin, fixing lock tab
 26 Bearing for bevel pinion, pinion end
 27 Shim, bearing adjustment, pinion end
 28 Bearing for bevel pinion, flange end
 29 Shim, bearing adjustment, flange end
 30 Washer for pinion bearing
 31 Retainer for oil seal
 32 Mudshield for oil seal
 33 Joint washer for oil seal, retainer
 34 Oil seal for pinion
 35-36 Fixings oil seal retainer
 37 Driving flange
 39 Mudshield for driving flange
 40-42 Fixings for retainer flange
 43-44 Oil filler plug and joint washer
 45 Joint washer, differential to axle casing
 46-47 Fixings, differential to axle casing
 48 Halfshaft
 49 Stub shaft
 50 Journal assembly
 51 Circlip for journal
 52 Housing for swivel pin bearing
 53 Distance piece for bearing
 54 Bearing for halfshaft
 55 Retaining collar for bearing
 56 Joint washer for housing
 57-58 Fixings, housing to front axle casing
 59 Housing assembly for swivel pin
 60 Special stud for steering lever and bracket
 61 Stud for steering lever
 62-63 Drain plug and joint washer
 64 Swivel pin and steering lever
 65 Cone seat for swivel pin, top
 66 Cone bearing for swivel pin, top
 67 Spring for cone bearing
 68 Bearing for swivel pin, bottom
 69 Swivel pin and bracket
 70 Shim, for swivel pin bearing
 71-74 Fixings, swivel pin to swivel pin housings
 75-76 Fixings, swivel pins to swivel pin housings
 77 Swivel pin and steering lever
 78 Bearing for bottom swivel pin
 79 Bush for top swivel pin
 80 Thrust washer for bush
 81 Shim for top swivel pin
 82 Swivel pin and bracket
 83 Oil seal for swivel pin bearing housing
 84 Retainer for oil seal
 85-89 Fixings, retainer and lock stop plate to swivel pin housing
 90 Oil filler plug for swivel pin housing
 91 Stub axle assembly
 92 Bush for driving shaft, early models only
 93 Distance piece for inner bearing
 94-95 Fixings, stub axle to swivel pin housing
 96 Front hub assembly
 97 Stud for road wheel
 98 Bearing for front hub, inner
 99 Oil seal for inner bearing
 100 Bearing for front hub
 101 Keywasher
 102 Locker
 103 Special nut
 104 Driving member for front hub
 105 Joint washer for driving member
 106-107 Fixings, driving member to front hub
 108 Plain washer
 109 Slotted nut
 110 Splitpin
 111 Hub cap, front

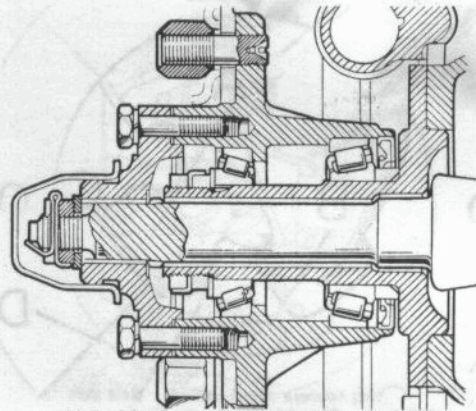


FIG 9:2 Cross-section of front hub

To replace a hub:

- 1 Smear a new joint washer with grease and place it on the rear face of the stub axle.
- 2 Fit the stub axle, keyway uppermost, then the brake backplate to the swivel pin housing.
- 3 Fit new lockplates to the bolts and tighten the bolts. Connect the brake hydraulic pipe.
- 4 Grease the inner roller bearings but do not pack the hub centre with grease.
- 5 Slide the hub onto the stub axle and fit the inner tab-washer and the adjusting nut. Adjust the hub end float to between .004 to .006 inch (.10 to .15 mm). Fit the outer tabwasher and locknut. Check the float after tightening the locknut. The end float on Series III models should be .002 to .004 inch (.05 to .10 mm).
- 6 Using a new joint washer and felt oil seal fit the driving member ensuring that the oil seal is fitted with the **rubber side facing outwards**. Tighten the driving member bolts to 28 lb ft (3.9 mkg) and the axle shaft nut to 10 to 15 lb ft (1.4 to 2.0 mkg). Fit a new splitpin.
- 7 Bleed and adjust the brakes, then refill the hub with oil.
- 8 Refit the road wheel then lower the vehicle to the ground. Check the tightness of the road wheel securing nuts.

9:3 The axle shafts

Removing an axle shaft:

- 1 Drain the oil from the axle and swivel pin housing, jack up and safely support the front of the vehicle then remove the road wheel.
- 2 Remove the front hub (see **Section 9:2**), brake anchor plate and stub axle.
- 3 Gently pull the axle shaft out of the axle case.

Servicing the axle shaft:

The universal joints are identical to those used on the propeller shafts. Full details of the overhaul of these are given in **Chapter 8**.

Replacing an axle shaft:

- 1 Be careful not to damage the oil seal in the axle case when inserting the axle shaft.
- 2 Rotate the axle shaft and check that there is a minimum clearance of .050 inch (1.2 mm) between the

**Latest type

*Early type

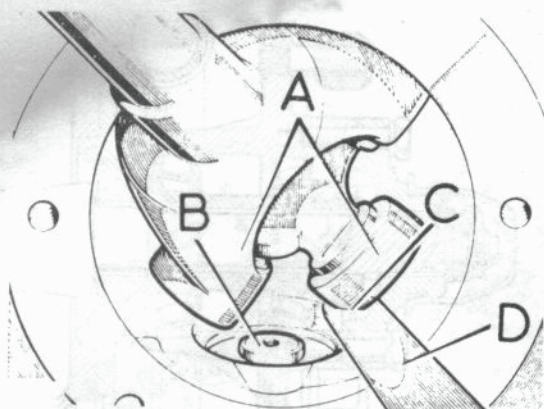


FIG 9:3 Checking axle shaft clearance

Key to Fig 9:3 A Yokes B Swivel pin C Yoke radius D Feeler gauge .050 inch (1.2 mm) minimum

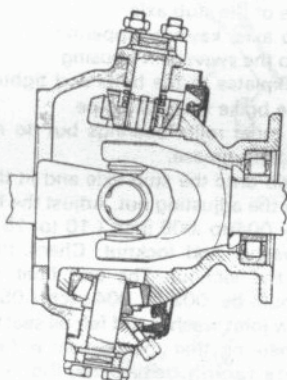


FIG 9:4 Spring-loaded swivel pin

universal joint yoke ears and the swivel pin end faces (see FIG 9:3). If the clearance is insufficient, grind the chamfer on the yoke ears.

- 3 Complete the reassembly by reversing the dismantling process.

9:4 The swivel pin housings

Design modifications over the years have resulted in two main variations of swivel pin assemblies. The earlier type has a coil spring damper and the latest type a 'Railko' bush. Both are shown in FIG 9:1. Cross-sections of both are also shown in FIGS 9:4 and 9:5. In this Section servicing instructions are given for both types.

Removing the housing, both types:

To remove a swivel pin housing, first remove the hub and stub axle as described in Section 9:2, but in addition drain the oil from the axle case. It is sometimes possible to release the brake backplate without disconnecting the hydraulic pipe, thereby avoiding having to bleed the brakes. If so, suspend the backplate without straining the flexible pipe.

Now proceed as follows:

- 1 Very carefully pull the axle shaft out of the casing to avoid damaging the oil seal.
- 2 Disconnect the steering ball joints using the special extractor, Rover Part No. 600590.
- 3 Undo the bolts between the housing and the axle case and withdraw the housing complete.

Replacing the housing, both types:

- 1 Examine and if necessary renew the oil seal in the end of the axle case.
- 2 Smear a new joint washer with grease and fit to the axle case.
- 3 Fit the swivel pin housing to the axle case and tighten the bolts.
- 4 Connect the steering ball joints, tightening the nuts to 30 lb ft (4.0 mkg).
- 5 Continue reassembly by reversing the dismantling procedure. Refill the axle and hub with oil.
- 6 Check the setting of the lock stops.

Servicing the housing; spring-loaded type:

Refer to FIG 9:1

- 1 Remove the oil seal retainer 84 and prise the oil seal 83 from the housing 59.
- 2 Undo the nuts 74 and remove the swivel pin and steering lever 64. Keep the shims 70, together. Remove the cone bearing 66 and spring 67.
- 3 Now remove the bottom swivel pin bracket 69, again keeping the shims 70 together. The swivel pin bearing housing 52 will now come away from the housing 59.
- 4 Examine the bearings carefully. Replace either if wear is evinced by roughness or flaking tracks. The roller bearing must be a light press fit in the housing and a light push fit on the pin. The cone seat of the upper bearing must be a light press fit in the housing.
- 5 If the swivel pins themselves are worn, drill out the grooved pin by means of an $\frac{1}{8}$ inch (3.17 mm) drill, then drive the swivel pin out of its bracket. Support the bracket on a solid object and use a brass drift for this operation.
- 6 A new swivel pin can be pressed into the bottom bracket in any relative position and a new grooved pin pressed in to retain it. Drill the hole for the grooved pin $\frac{5}{32}$ inch (4 mm) and fit a $\frac{5}{32}$ inch pin in place of the $\frac{1}{8}$ inch pin removed when dismantling.
- 7 The new swivel pin for the top steering lever assembly must be positioned as shown in FIG 9:6 to ensure that the cone is seated correctly.
- 8 To reassemble the unit, press any new race outer members into their seatings and the bottom swivel pin race inner member onto the swivel pin.
- 9 Smear the cone bearing with oil and locate it in its outer member, being careful to position the vertical oil hole towards the rear of the vehicle (see FIG 9:7).
- 10 Hold the bottom roller cage in its outer race and then put the swivel pin bearing housing inside the swivel pin housing. Smear the faces of the bottom swivel pin bracket and the swivel pin housing with sealing compound. Now fit the bracket using .040 inch (1.0 mm) thickness of shims removed when dismantling. Push the bracket upwards so that the pin enters the bottom roller race cage. Tighten the bracket nuts securely.
- 11 Insert the cone spring in the top bearing then fit the swivel pin and steering bracket. Use sealing compound

and shims to the thickness of .040 inch (1.0 mm) exactly as described for the bottom bearings. Tighten the nuts.

- 12 Grip the swivel pin bearing housing in a vice fitted with soft jaws or temporarily mount it on the axle. Attach a spring balance to the track rod eye of the steering lever and check the resistance to turning of the swivel pin housing. This must lie between 14 to 16 lb (6.3 to 7.3 kg) after overcoming the inertia. Add or subtract shims at the top bearing only until the correct resistance figure is obtained. Check on the tightness of all nuts then lock them with the lock-plates.
- 13 Pack the housing oil seal with heavy grease and fit the seal and its retainer to the housing making sure that it wipes the whole surface of the bearing housing. Slacken the retainer and reposition the seal if necessary. Note that the steering lockstop adjustment bolt goes in the forwardmost hole. The unit can now be replaced on the vehicle.

Servicing the housing, Railko bush type:

Refer to FIG 9:1.

- 1 Separate the inner and outer members of the housing in a manner similar to that used for the spring-loaded type of housing, i.e. remove the oil seal and the swivel pin brackets then pull the housings apart.
- 2 Clean and examine all the components replacing any worn or damaged items. Note that the Railko bush and thrust washer, if fitted, must not be cleaned in any type of cleaning fluid as this can spoil their damping characteristics. The bush must be a light push fit on the swivel pin, if not, renew the worn component. Only the early models have a thrust washer.
- 3 To assemble the unit first press into the housing any new races. Lubricate the inner diameter of the Railko bush with the grade of oil recommended for the swivel pin housing and press it into its seating. If an early type, place the thrust washer in the bush.
- 4 Assemble the housing as described for the spring-loaded type but in addition, fit a new O-ring to the bottom swivel pin as shown in FIG 9:8.
- 5 Connect the spring balance to the track rod eye and adjust the resistance to movement to 12 to 14 lb (5.4 to 6.3 kg) by adding or removing shims from the top swivel pin bracket.
- 6 Check all the nuts for tightness then lock with the lock-plates.
- 7 Refit the oil seal and retainer as described for the spring-loaded swivel pin housing. The unit is ready for replacing on the vehicle.

9:5 The differential

It is not an economic proposition for the private owner to attempt to dismantle and re-build this unit due to the special equipment and knowledge needed to make a satisfactory job of it. Instructions are given for removing and replacing the differential so that it may be taken to a Rover Service Station and an exchange unit obtained.

To remove the differential:

- 1 Drain the oil from the axle, loosen the road wheel nuts then jack up and safely support the front of the vehicle. Remove the road wheels.

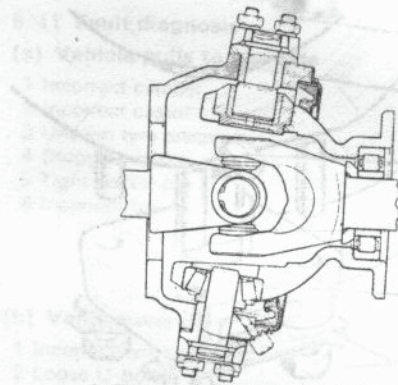


FIG 9:5 Railko bush swivel pin

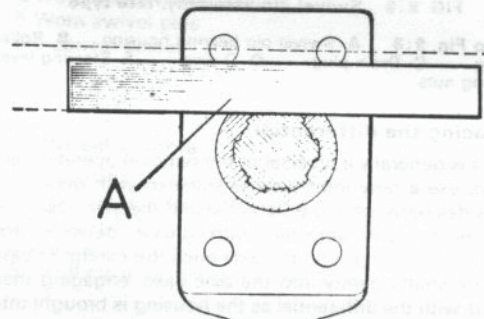


FIG 9:6 Setting the top swivel pin

Key to Fig 9:6

A Straightedge

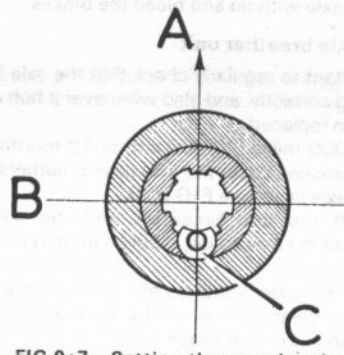


FIG 9:7 Setting the cone bearing

Key to Fig 9:7 A Front of vehicle B Centre line of axle C Vertical oil hole

- 2 Disconnect the flexible hydraulic brake pipes at each side of the vehicle. It is wise to wedge the brake pedal down to prevent fluid loss while these pipes are disconnected.
- 3 Disconnect the track rod and drag link by using the special ball joint extractor, Rover Part No. 600590.
- 4 Undo the bolts holding each swivel pin housing to the axle case then remove each housing complete with brake drum, hub and axle shaft.
- 5 Disconnect the propeller shaft, undo the nuts round the differential housing and lift it away from the axle case.

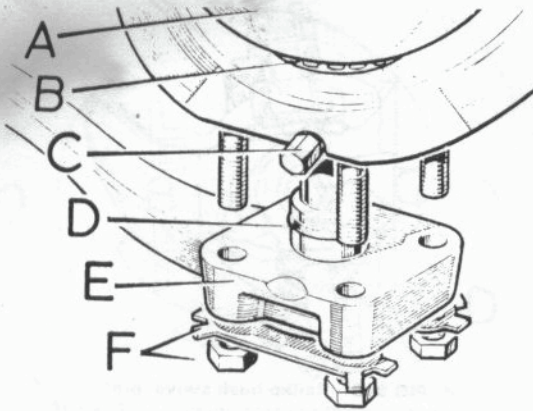


FIG 9:8 Swivel pin assembly, late type

Key to Fig 9:8 A Swivel pin bearing housing B Roller bearing C Drain plug D O-ring E Steering lever F Fixing nuts

Replacing the differential:

This is generally a reversal of the removal operation but always use a new joint washer smeared with grease on both sides between the differential and the axle. Use new washers similarly smeared with grease between the swivel pin housings and the axle ends. Be careful to ease the axle shafts gently into the axle case, engaging their splines with the differential as the housing is brought into position.

The steering ball joints are tightened to a torque of 30 lb ft (4.0 mkg).

Refill the axle with oil and bleed the brakes.

9:6 The axle breather unit

It is important to regularly check that the axle breathers are operating correctly, and also whenever a hub or axle oil seal has been replaced.

Every 12,000 miles (20,000 km) or 12 months, whichever comes sooner, clean the axle case breathers. There is one in each axle case (see FIG 9:9):

- 1 Clean off the axle breathers and the surrounding surfaces of the axle cases, taking care to remove all dirt and grit.
- 2 Unscrew the axle breathers and soak them in petrol or a suitable cleaning solvent for several minutes, and then clean with a soft brush.
- 3 Shake each breather to ensure the ball valve is free. If it sticks the breather valve must be renewed.
- 4 Lubricate the balls lightly with engine oil before replacing the breathers.

9:7 The suspension

The front suspension is identical with the rear suspension and the instructions regarding the springs and hydraulic dampers given in **Chapter 8** apply here.

Note that if new or reconditioned springs are fitted, the shackle bolts must not be finally tightened until the vehicle is standing on its own wheels.

9:8 Suspension geometry

No adjustment is provided for castor, camber or swivel pin inclination. If the angles are different from

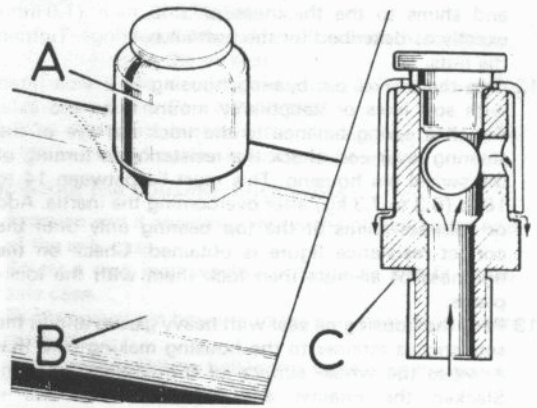


FIG 9:9 Axle breather unit

Key to Fig 9:9 A Breather B Axle C Air-flow path

those given here, damage has been sustained and immediate steps must be taken to correct the faults.

Castor	3 deg.
Camber	1½ deg.
Swivel pin inclination	7 deg.

The toe-in should lie between $\frac{3}{64}$ to $\frac{3}{32}$ inch (1.2 to 2.4 mm). Adjust this by loosening the track rod clamps and turning the track rod. It must be emphasized that this operation is best left to a Rover Service Station equipped with the proper optical gauges as an incorrect setting can dangerously affect the handling of the vehicle as well as causing rapid front tyre wear.

9:9 Modifications

It is possible to fit the latest Railko bush type bearing to swivel pin housings having the earlier spring-loaded type. A conversion kit, Rover Part No. 532268, complete with full fitting instructions is available.

The parts supplied can be easily fitted to any Land Rover from 1954 onwards by removing the existing swivel pin, coil spring, cone and cone seat and fitting in their place the new swivel pin and swivel pin bearing housing and bush.

From axles numbered:

141107339	88 righthand drive
144104520	88 lefthand drive
151108875	109 righthand drive
154103275	109 lefthand drive onwards

the steering levers are fitted to the bottom of the swivel housings with the ball joints above the levers.

Swivel pin and steering levers are not interchangeable as individual items; they can, however, be fitted in pairs provided either the swivel pin housing complete is changed for the latest type, or studs are fitted in the bottom position of the existing swivel pin housing. Studs required are six off 508152, two off 508153. **It is most important that the latest type steering levers are not fitted to an early type housing in the lower position with the existing bolts;** the studs detailed above including the special fitting studs 508153 must be fitted. This prevents any tendency for movement between lever and housing which could give rise to premature

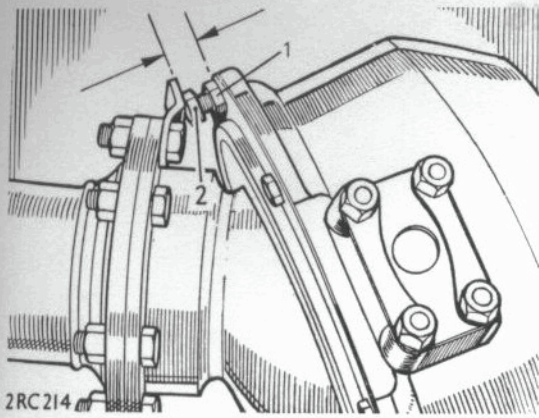


FIG 9:10 Adjusting the lock stops

Key to Fig 9:10 1 Locknut 2 Bolt

breakage of the bolts with the possibility of serious damage.

9:10 Steering lock stops

Check the setting of the lock stops and adjust if necessary to give .5 inch (12.5 mm) between the bolt head top face and the oil seal retainer face as shown in FIG 9:10.

9:11 Fault diagnosis

(a) Vehicle pulls to one side

- 1 Incorrect camber
- 2 Incorrect castor
- 3 Uneven tyre pressures
- 4 Dragging brake
- 5 Tight swivel pin
- 6 Incorrect toe-in

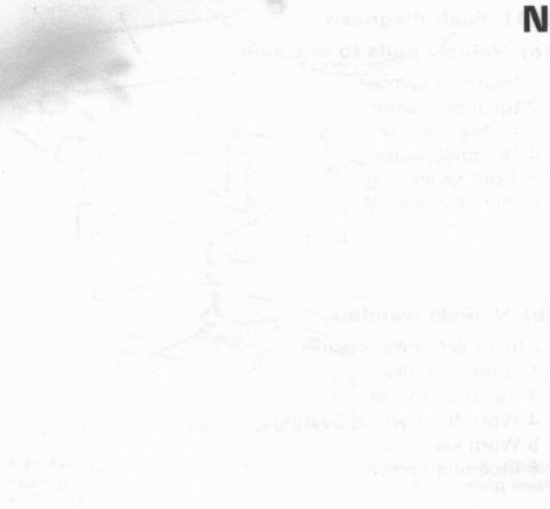
(b) Vehicle wanders

- 1 Incorrect tyre pressures
- 2 Loose U-bolts
- 3 Incorrect toe-in
- 4 Worn front wheel bearings
- 5 Worn swivel pins
- 6 Incorrect castor

(c) Wheel wobble

- 1 Incorrect tyre pressures
- 2 Eccentric wheels or tyres
- 3 Loose hub bearings
- 4 Worn swivel pins
- 5 Insufficient damping at swivel pins

NOTES



(c) Wheel wobble
 - When the wheel wobbles, it causes the vehicle to shimmy and lose control. This is often caused by loose wheel bearings or a bent axle. The driver should stop the vehicle and check the wheel bearings for play. If the bearings are loose, they should be replaced. If the axle is bent, it should be replaced.

3.2 The suspension
 - The suspension system is responsible for supporting the weight of the vehicle and providing a smooth ride. It consists of various components including springs, dampers, and control arms. Regular maintenance is essential to ensure proper suspension function.

3.3 The steering
 - The steering system allows the driver to control the direction of the vehicle. It includes the steering wheel, steering column, and steering knuckles. A power steering system may also be present. Proper alignment and tire condition are crucial for safe steering.

3.4 The brakes
 - The braking system is used to slow down or stop the vehicle. It typically consists of front disc brakes and rear drum brakes. Regular inspection and adjustment are necessary to maintain effective braking performance.

3.5 Suspension geometry
 - Suspension geometry refers to the angles and positions of the suspension components. Key parameters include camber, toe, and caster. Incorrect geometry can lead to uneven tire wear and poor handling.

- The adjustment of the suspension geometry is a critical task. It should be performed using a suspension alignment rack to ensure precise measurements.

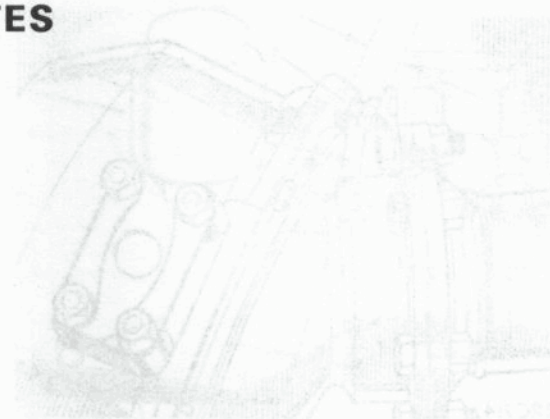


FIG. 2. Adjusting the lock stop

FIG. 2. Adjusting the lock stop
 - This diagram illustrates the process of adjusting the lock stop on a steering knuckle. The lock stop is a component that prevents the steering knuckle from turning too far in one direction. To adjust it, the lock stop nut should be loosened and the lock stop moved to the desired position. The nut should then be tightened to secure the adjustment.

FIG. 3. Adjusting the lock stop
 - This diagram shows another view of the lock stop adjustment process. It highlights the relationship between the lock stop, the steering knuckle, and the suspension components. Proper adjustment is essential for correct steering geometry.

The lock stop is a critical component of the steering system. It ensures that the steering knuckle remains in a safe position during a turn. If the lock stop is not properly adjusted, it can lead to excessive steering effort and potential loss of control.

When adjusting the lock stop, it is important to follow the manufacturer's specifications. This typically involves setting the lock stop to a specific angle or position. A suspension alignment rack can be used to verify the correct adjustment.

After adjusting the lock stop, it is recommended to perform a road test to ensure that the steering is smooth and responsive. The vehicle should be driven at low speeds in a safe area to check for any unusual steering behavior.

Regular maintenance of the steering system is essential for safe driving. This includes checking the lock stop, steering knuckles, and other components for wear and tear.

CHAPTER 10

THE STEERING GEAR

- 10:1 Description
- 10:2 Removing the steering column
- 10:3 Overhauling the steering gearbox
- 10:4 Replacing the steering column
- 10:5 The relay unit and damper

- 10:6 The ball joints
- 10:7 Wheel alignment
- 10:8 Steering lock stops
- 10:9 Steering column lock
- 10:10 Fault diagnosis

10:1 Description

The steering gear fitted to Mk 2, 2A and 3 Land Rovers is of the recirculating ball type. From the steering gearbox a longitudinal rod carries the movement from the drop arm to a steering relay mounted on the front of the chassis. This relay has two spring-loaded tapered tufnol bushes which damp out road shocks. From the relay a drag link carries the steering effort to either one or the other swivel housings depending on whether the vehicle is right or lefthand drive. Some models additionally have a telescopic damper mounted between a chassis bracket and the drag link. A track rod, adjustable for length, connects the two swivel housings. FIGS 10:1 and 10:2 show the layout of these components in detail. Apart from maintaining the oil level in the steering gearbox no other maintenance is needed. The ball joints are fitted with rubber 'boots' which retain the lubricant for the life of the vehicle.

10:2 Removing the steering column

Refer to Fig 10:1:

- 1 Unscrew the clamp bolt 44 or nut 48 after removing the centre cover 49 or 57 and remove the steering wheel.
- 2 Unscrew bolt 52 and release the horn push button or flasher switch bracket from the steering column (early

models only). Remove the column support clamp and the steering column switch assembly from the steering column.

- 3 Remove the engine air cleaner (righthand drive models only).
- 4 Remove the name plate and withdraw the radiator grille.
- 5 Refer to FIG 10:2. Loosen the bolt 16 and prise the upper relay lever 15 clear of the relay.
- 6 Turn the steering shaft to bring the longitudinal rod 54 as far forward as possible. Undo clamp 64 and unscrew the longitudinal rod.
- 7 Remove the bolts holding the steering box to the support bracket and the steering column to the dash. Jack up and safely support the front of the vehicle then remove the road wheel.
- 8 The steering cover box can now be removed from under the front wing followed by the steering column itself.
- 9 At this stage, the nut 32 (see FIG 10:1) and washer 33 can be removed and the drop arm 34, pulled from the shaft 17 by the use of a heavy extractor tool. Mark the shaft and drop arm so that they can be replaced in the same relative position if necessary.
- 10 Remove the ball joint 55 (see FIG 10:2) from the drop arm 34 (see FIG 10:1), again using an extractor or tapping the side of the drop arm adjacent to the ball joint.

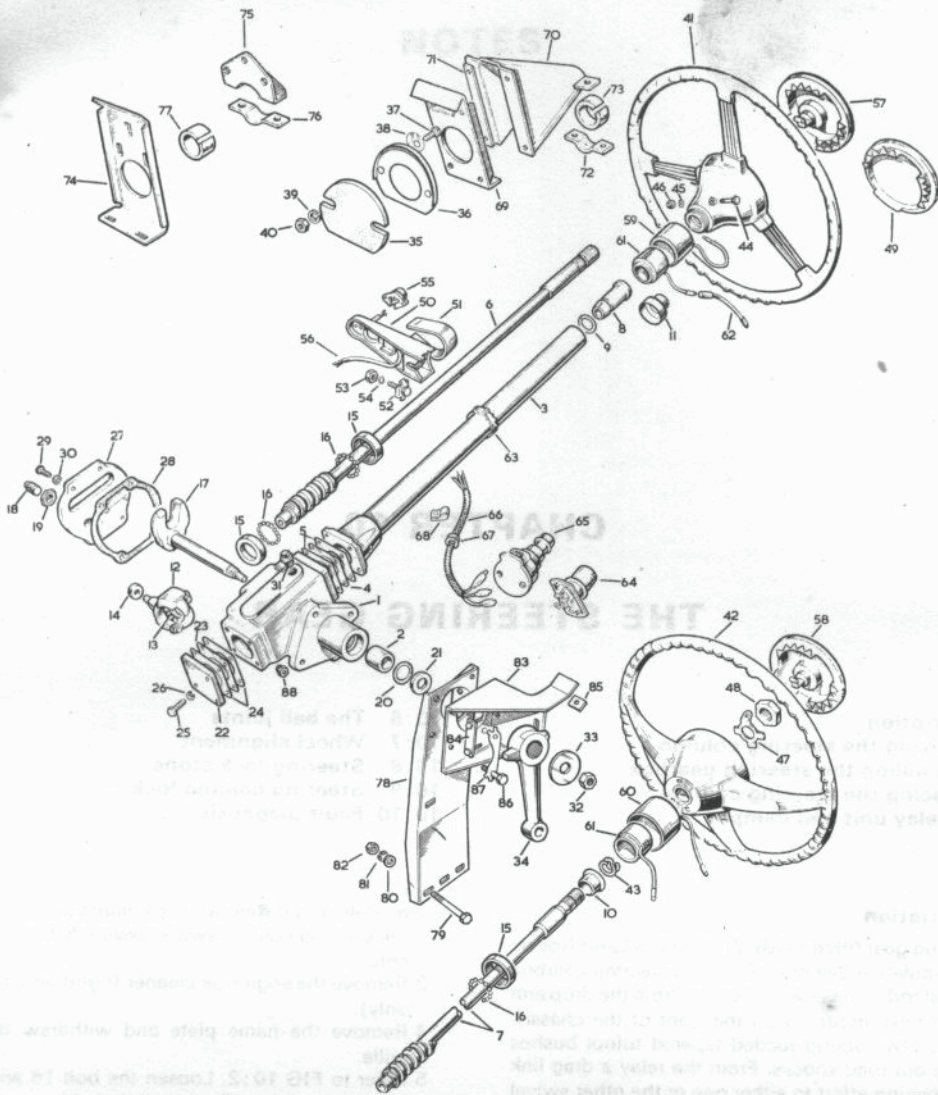


FIG 10:1 Layout of steering column

- Key to Fig 10:1**
- | | | | | |
|---|---|--|--|--|
| 1 Steering box assembly | 2 Bush for rocker shaft | 3 Outer column | 4 Joint washer, steel | 5 Joint washer, paper |
| 6 Inner column, early type | 7 Inner column, latest type | 8 Bush for inner column | 9 Spring ring for inner column bush | 10 Ballbearing for inner column ($\frac{3}{8}$ inch) for main nut |
| 11 Dust shield for inner column | 12 Main nut assembly | 13 Steel ball ($\frac{3}{8}$ inch) | 14 Roller for main nut | 15 Adjustable ballrace |
| 16 Steel balls (.280 inch) for adjustable race | 17 Rocker shaft | 18 Adjuster screw for rocker shaft | 19 Locknut for adjuster screw | 20 Oil seal for rocker shaft ($\frac{3}{8}$ inch long) |
| 21 Washer for rocker shaft oil seal | 22 End plate | 23 Joint washer, steel | 24 Joint washer, paper | 25 Bolt ($\frac{1}{8}$ inch UNC x $1\frac{1}{8}$ inch long) |
| 26 Spring washer | 27 Side coverplate | 28 Joint washer for side coverplate | 29 Bolt ($\frac{1}{8}$ inch UNC x $1\frac{1}{8}$ inch long) | 30 Spring washer |
| 31 Oil filler plug | 32 Special nut | 33 Lockwasher | 34 Steering drop arm | 35 Rubber seal for steering column |
| 36 Cover for steering column seal washer | 40 Nut (2 BA) | 41 Steering wheel, early type column for wheel | 44 Bolt ($\frac{1}{8}$ inch UNF x 2 inch long) | 45 Plain washer |
| 42 Steering wheel, latest type | 43 Special spring washer on inner column | 46 Nut ($\frac{1}{8}$ inch UNF) | 47 Tag washer | 48 Special nut |
| 49 Steering wheel centre cover, early type assembly for horn push bracket | 53 Nut ($\frac{1}{2}$ inch BSF) junction box | 54 Shakeproof washer | 55 Horn push | 56 Lead, horn push to horn contact |
| 57 Horn push and centre cover for steering wheel, early type | 58 Horn push and centre cover for steering wheel, latest type | 59 Dust cover and horn contact, early type for horn contact | 60 Dust cover and horn contact, latest type | 61 Slip ring complete |
| 62 Lead, slip ring to junction box | 63 Cable cleat on steering column | 64 Dipswitch, early type | 65 Dipswitch, latest type | 66 Lead, dipswitch to junction box |
| 67 Grommet for lead in toe box floor | 68 Clip fixing dipswitch lead to floor | 69 Support bracket on dash for steering column support bracket | 70 Support bracket for steering column | 71 Packing piece for steering column support bracket |
| 72 Clip for steering column | 73 Rubber strip for clip | 74 Support bracket on dash for steering column | 75 Clamp, upper, for steering column steering box to chassis | 76 Clamp, lower, for steering column |
| 77 Rubber strip for clamp | 78 Support bracket stiffener bracket for steering box | 79 Bolt ($\frac{1}{2}$ inch UNF x $3\frac{1}{2}$ inch long) | 80 Plain washer, thin | 81 Spring washer |
| 82 Nut ($\frac{1}{8}$ inch UNF) | 83 Stiffener bracket for steering box | 84 Bolt plate | 85 Shim washer | 86 Setbolt ($\frac{3}{8}$ inch UNC x $\frac{7}{8}$ inch long) |
| 87 Locking plate | 88 Self-locking nut ($\frac{1}{8}$ inch UNF) | | | |

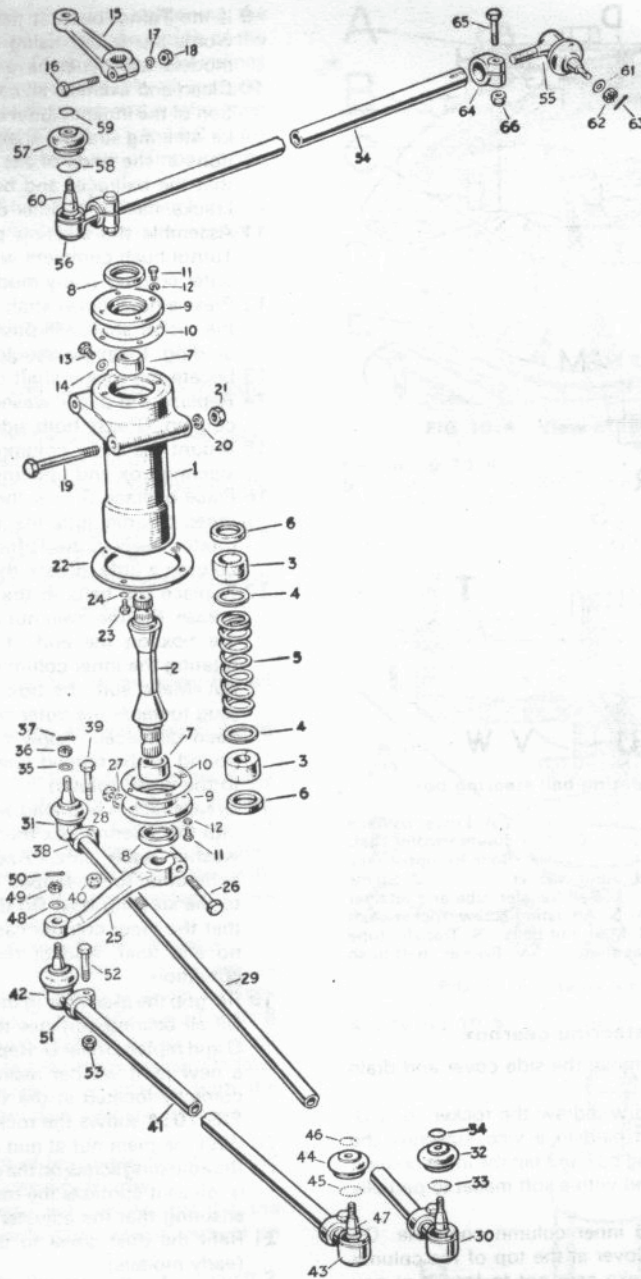


FIG 10:2 Layout of relay unit

- Key to Fig 10:2**
- | | | | |
|---|--|---|--|
| 1 Housing for relay shaft | 2 Shaft for steering relay levers | 3 Split bush for housing | 4 Washer for spring |
| 5 Spring for bushes | 6 Thrust washer for shaft | 7 Distance piece for shaft | 8 Oil seal for shaft |
| 9 Retainer for oil seal | 10 Joint washer for retainer | 11/12 Fixings for retainer | 13 Plug for oil hole |
| 14 Joint washer for plug | 15 Relay lever, upper | 16/18 Fixings for lever | 19/21 Fixings for housing |
| 22 Flange plate for relay mounting | 23/24 Fixings for flange plate | 25 Relay lever, lower | 26/28 Fixings for lever |
| 29 Steering track rod assembly | 30 Ball joint assembly righthand thread | 31 Ball joint assembly lefthand thread | 32 Rubber cover for ball joint |
| 33 Spring ring, cover to body | 34 Spring ring and retainer, cover to ball | 35/37 Fixings for ball joints | 38 Clip for ball joint |
| 39/40 Fixings for ball joint clips | 41 Steering drag link assembly | 42 Ball joint assembly righthand thread | 43 Ball joint assembly lefthand thread |
| 44 Rubber cover for ball joint | 45 Spring ring, cover to body | 46 Spring ring | 47 Retainer |
| 48/50 Fixings for ball joints | 51 Clip for ball joint | 52/53 Fixings for ball joint clips | 54 Longitudinal steering tube assembly |
| 55 Ball joint assembly righthand thread | 56 Ball joint assembly lefthand thread | 57 Rubber cover for ball joint | 58 Spring ring, cover to body |
| 59 Spring ring | 60 Retainer | 61/63 Fixings for ball joints to levers | 64 Clip for ball joint |
| 65/66 Fixings for ball joint clips | | | |

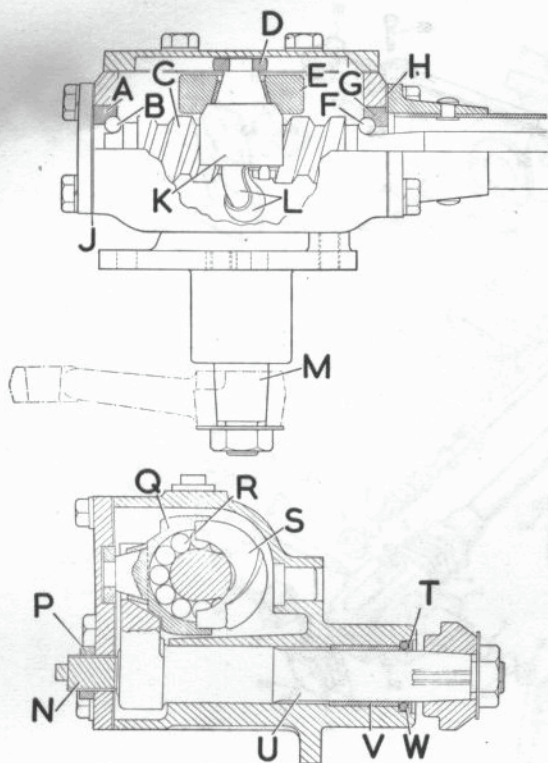


FIG 10:3 Recirculating ball steering box

Key to Fig 10:3

- | | | | | | |
|---------------------------------|---------------------|---------------------|------------------------|-----------------------------------|-----------------------------|
| B Balls for lower race | D Roller | E Rocker | F Balls for upper race | A Lower ballrace | C Inner column worm shaft |
| G Upper ballrace | H Joint washer | J Shims | K Main nut | L Ball transfer tube and retainer | M Rocker shaft and drop arm |
| N Adjusting screw, rocker shaft | P Locknut | Q Main nut | R Main nut balls | S Transfer tube | T Seal retainer |
| U Rocker shaft | V Rocker shaft bush | W Rocker shaft seal | | | |

10:3 Overhauling the steering gearbox

- 1 Refer to FIG 10:3. Remove the side cover and drain off the oil.
- 2 Lift off the roller D and withdraw the rocker shaft U.
- 3 With the outer column held in a vice, unscrew the bolts holding the steering box and tap the inner column at the steering wheel end with a soft mallet to partially remove the box.
- 4 Withdraw the box and inner column complete. On early models the dust cover at the top of the column will be freed by this. Take care not to lose it or any balls from the steering box.
- 5 Position the main nut K midway on the cam C and tap the box away from the inner column sufficiently to release the ballrace G.
- 6 Turn the inner column to release the main nut then remove the inner column and main nut from the box.
- 7 Remove the end cover with shims J and ballrace A. The ball transfer tube L can be removed from the main nut.
- 8 If worn, remove the retaining washer T and oil seal W then press the rocker shaft bush V out of the box.

- 9 If the Tufnol bush at the top of the outer column is worn, tap it out using a long wooden rod. (Early models; later types have a ballrace.)
- 10 Clean and examine all components for wear. Indentation of the inner column cam at the centre of its length, i.e. steering straight-ahead, involves renewal. Indentations at the ends of the cam can be ignored. Check that the ballraces and balls are free from any pitting, cracks, flaking or other damage. Renew as necessary.
- 11 Assemble the steering gear by first pressing a new Tufnol bush complete with oil seal into the top of the outer column (early models).
- 12 Press a new rocker shaft bush into the box; check that the rocker shaft will push through and rotate without binding. Reaming should not be required.
- 13 Locate the rocker shaft oil seal and retaining washer.
- 14 Replace the paper washer H on the end of the outer column. Grease both sides of the paper washer.
- 15 Mount the outer column vertically in a vice with the steering box end uppermost.
- 16 Place ballrace G over the inner column then slide the inner column into the outer column. Make sure it rotates freely in the Tufnol bush, if fitted. Lift the inner column a little, grease the race G and fit ten balls F.
- 17 Replace the balls in the main nut K and retain with grease. Put the main nut in the steering box then place the box on the end of the inner column, carefully rotating the inner column to screw the cam C into the nut. Make sure the box is the right way round, filler plug towards the outer column and that no balls have been displaced. Apply non-hardening jointing compound to the tapped holes then bolt the steering box to the outer column.
- 18 Grease race A and load with ten balls B. Push the race into the steering box then fit the shims J with a paper washer each side. Apply non-hardening jointing compound to the tapped holes then bolt the end cover to the steering box. Do this carefully, checking to see that the inner column can be turned by hand but has no end float. Add or remove shims to achieve this condition.
- 19 Re-grip the assembly in the vice in a horizontal position. Oil all bearing surfaces then slide in the rocker shaft U and replace roller D. Replace the cover complete with a new joint washer making sure that the roller D is correctly located in the slot. Tighten the cover bolts. FIG 10:4 shows the rocker shaft fitted.
- 20 With the main nut at mid position on the cam, tighten the adjusting screw on the cover by hand until resistance is felt as it contacts the rocker shaft. Lock the locknut, ensuring that the adjuster does not move.
- 21 Refit the dust cover to the top of the inner column (early models).

10:4 Replacing the steering column

Reverse the dismantling operations but do not fit the drop arm until the column is securely bolted to the vehicle. Turn the inner column lock to lock and find the exact intermediate position. Refit the steering wheel, tightening the centre nut on later models to 40 lb ft (5.4 kg m). Connect the ball joints of the longitudinal side rod to the drop arm and relay lever tightening the nuts to 30 lb ft (4.0 kg m). Slide the rod along the side of the vehicle and

connect the relay lever to the relay unit, tightening the pinch bolt to 55 lb ft (7.6 kg m). Adjust the length of the side rod until the drop arm will fit on the tapered splines of the rocker shaft exactly. (Have the road wheels straight-ahead while doing this.) Fit the drop arm and washer then the nut. Tighten the nut to 60 to 80 lb ft (8.5 to 11.0 kg m) and engage the lockwasher. Tighten the clamps on the side rod.

Check that the steering will turn freely from lock to lock then refill the steering box with oil and securely replace the filler plug.

10:5 The relay unit and damper

To remove the unit (refer to FIG 10:2):

- 1 Remove the name plate and withdraw the radiator grille.
- 2 Remove the pinch bolts from the upper and lower relay levers then prise the levers clear of the unit.
- 3 Remove the fixings between the relay housing and the chassis top face.
- 4 Remove the relay mounting flange plate from the underside of the chassis (see FIG 10:5).
- 5 Undo the bolts and remove the unit upwards, tapping gently with a soft mallet if necessary.

To service the unit:

- 1 Drain off as much oil as possible by removing the oil filler and bleed plugs.
- 2 Undo bolts 11 and remove the oil seal retainer 9 and oil seal 8.
- 3 Secure a strong sack over the bottom half of the relay and then mount the unit in the vice with the bottom pointing downwards into the sack. Carefully tap out shaft 2 complete with spring 5, rings 4 and Tufnol bushes 3 into the sack. The spring will be released with great force into the sack since it is compressed to over 100 lbs (45 kgs) when in position.
- 4 Remove the top oil seal retainer 9 and oil seal 8.
- 5 Examine all components for wear and renew as necessary. Pay particular attention to the outer surfaces of the two distance pieces 7 on which the oil seals 8 seat. Any roughness must involve renewal. The oil seals should be renewed as a matter of course. On later models the distance pieces 7 are integral with the shaft, therefore if these are damaged the whole shaft must be renewed.
- 6 Check that the free length of the spring 5 is $7\frac{1}{4}$ inches (184 mm). Renew if appreciably shorter.
- 7 Fit the oil seals to their retainers making sure that the lipped side is facing inwards. Use jointing cement on the outside diameter.
- 8 Locate the split bush 3 on the top cone of the shaft 2. Insert into the housing from the bottom then grip in a vice as shown in FIG 10:6.
- 9 Insert the washer 4 then fit two oil seal retaining bolts 11 diametrically opposite each other. Insert the spring followed by the other washer 4.
- 10 Refer to FIG 10:7 and by the use of special tool, Rover Part No. 600536, compress the spring and lock the tool under the bolt heads 11 (see FIG 10:2).
- 11 Locate the other split bush 3 on the exposed cone of the shaft and secure with a 2 inch (50 mm) hose clip (see FIG 10:8).

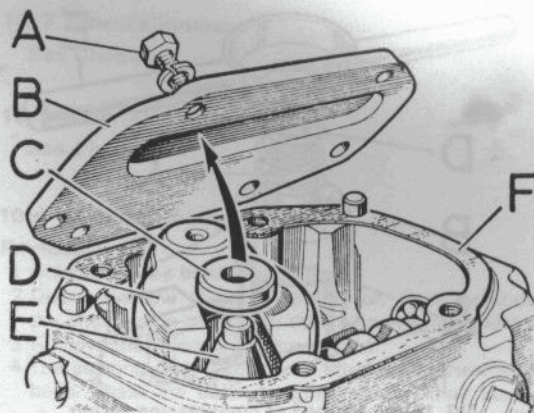


FIG 10:4 View of rocker shaft fitted

Key to Fig 10:4
 A Fixings for side cover
 B Side cover
 C Roller for main nut
 D Rocker shaft
 E Main nut
 F Joint washer

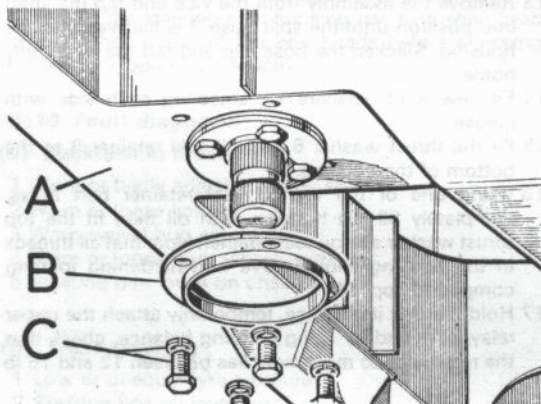


FIG 10:5 Relay mounting flange plate

Key to Fig 10:5 A Chassis B Flange plate C Bolts

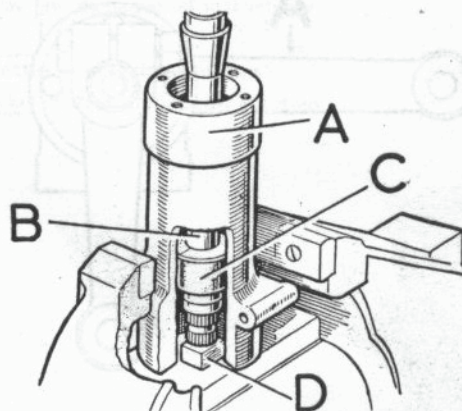


FIG 10:6 Relay shaft assembled

Key to Fig 10:6
 A Housing
 B Shaft
 C Split bush halves
 D $\frac{3}{4}$ inch (19 mm) block

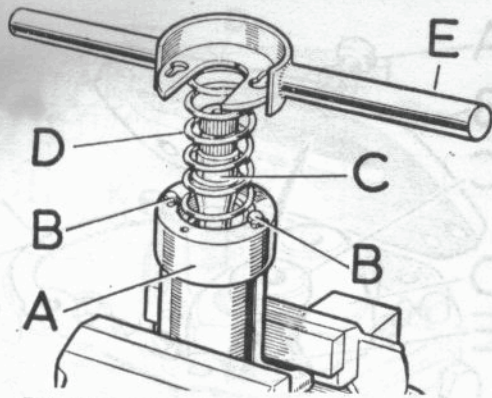


FIG 10:7 Method of compressing spring

Key to Fig 10:7
 B Bolts for oil seal retainer
 E Special tool
 C Shaft
 A Housing
 D Spring

- 12 Carefully remove the special tool and the two bolts 11 (see FIG 10:2).
- 13 Remove the assembly from the vice and tap the shaft into position until the split bush 3 is halfway into the housing. Slacken the hose clip and tap the shaft fully home.
- 14 Fit new joint washers 10, smearing each side with grease.
- 15 Fit the thrust washer 6 and oil seal retainer 9 to the bottom of the housing.
- 16 Using one of the top oil seal retainer bolt holes, completely fill the housing with oil then fit the top thrust washer and oil seal retainer. Note that all threads in the housing should have non-hardening jointing compound applied.
- 17 Hold the unit in the vice, temporarily attach the upper relay lever and by using a spring balance, check that the resistance to movement lies between 12 and 16 lb

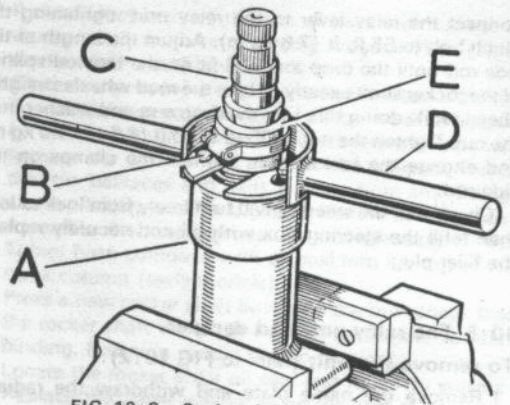


FIG 10:8 Spring fully compressed

Key to Fig 10:8
 B Bolts for oil seal retainer
 E Split bush secured with hose clip
 C Shaft
 A Housing
 D Special tool

(5.4 and 7.3 kg). If the resistance is less than 12 lb (5.4 kg) fit a new spring. If the resistance is greater than 16 lb (7.3 kg) remove the oil seal retainers and thrust washers then using a suitable piece of tubing push each split bush in turn until it is clear of its cone and inject some oil. Reassemble and recheck.

To refit the unit:

Reverse the removal procedure but ensure that the filler plug boss faces the driver's side of the vehicle. Refer to FIG 10:9. The lower relay lever must be fitted at either A or B positions depending on whether the vehicle is righthand or lefthand drive.

Telescopic damper:

The telescopic steering damper fitted to some models is illustrated in FIG 10:10. To remove the damper, release the locknut and nut from the chassis bracket.

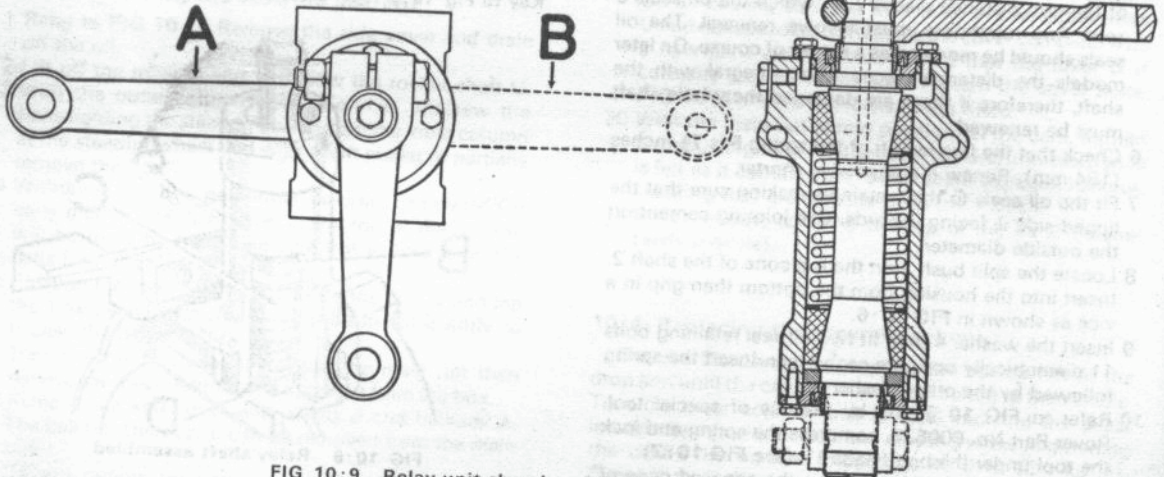


FIG 10:9 Relay unit showing righthand or lefthand drive

Key to Fig 10:9
 A Lower relay lever lefthand steering
 B Lower relay lever righthand steering

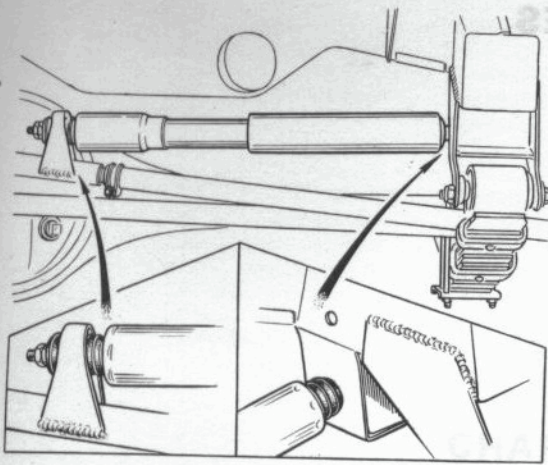


FIG 10:10 Telescopic steering damper installation

Remove the outer rubber mounting complete with inner and outer seating washers. Repeat this operation at the drag link end. Withdraw the damper and the inner rubber mountings. To refit, reverse the procedure, ensuring that the outer sleeve end of the damper is nearest the chassis bracket.

10:6 The ball joints

These should be examined periodically to see that the rubber covers are undamaged. The ball joints themselves are not adjustable and wear must involve renewal. The rubber covers and their spring rings are separately obtainable and can be fitted once the ball joints are removed from the vehicle. To remove a ball joint, pull out the splitpin and undo the nut. Either use a proper extractor or else release the tapers by holding a heavy hammer against one side of the lever and tapping the other side sharply with a light hammer. Release the tube clamp and unscrew the ball joint from the tube. Screw the nut on to the first few threads of the taper pin then compress the ball joint in a vice by gripping it between the nut and the bottom of the joint. Clean round the inside of the joint as much as possible and squirt heavy oil or thin grease into it. Release the vice. Pack a new rubber cover with grease and fit to the joint with new spring rings. Wipe the taper clean and dry before fitting to the vehicle. Refit by reversing the dismantling procedure.

10:7 Wheel alignment

See Chapter 9.

10:8 Steering lock stops

See Chapter 9.

10:9 Steering column lock

Removal:

- 1 Disconnect the battery earth lead.
- 2 Disconnect the choke control or on diesel engines the engine stop control, in the engine compartment.
- 3 Remove the steering column shroud.
- 4 The steering lock assembly is fitted using shearhead bolts. These are bolts designed so that their heads shear off when tightened to a specific torque. To remove these bolts centrepunch and drill centrally into the bolts and use an Easy-out extractor.
- 5 Withdraw the steering lock assembly.
- 6 The ignition switch can be removed from the rear of the steering lock housing after removing the fixing screws which go through the housing.
To refit the steering lock housing use new shearhead bolts. Do not shear off the bolt heads before checking that the lock operates correctly.

10:10 Fault diagnosis

(a) Backlash in steering

- 1 Worn or badly adjusted rocker shaft
- 2 Worn or loose linkage
- 3 Worn swivel hub assembly
- 4 Worn or loose front wheel bearings
- 5 Steering box loose on chassis

(b) Tight steering

- 1 Low or unequal tyre pressures
- 2 Steering box oil level low
- 3 Rocker shaft adjusted too lightly
- 4 Inner column binding
- 5 Seized ball joint
- 6 Relay unit damaged or oil level low

(c) Rattle in steering column

- 1 Rocker shaft worn or badly adjusted

NOTES



FIG. 10-10. Vehicle steering system installation.

Remove the front wheel bearing, disc brake rotor and hub assembly, lower ball joint and tie rod end, and the lower control arm and steering knuckle assembly. To install the steering knuckle, insert the lower ball joint into the steering knuckle and the lower control arm and tie rod end. Tighten the nut and washer to the specified torque. Install the lower control arm and tie rod end. Tighten the nut and washer to the specified torque. Install the front wheel bearing, disc brake rotor and hub assembly. Tighten the nut and washer to the specified torque.

10-9. The ball joint

Inspect the ball joint for wear. If the ball joint is worn, it should be replaced. To inspect the ball joint, remove the front wheel bearing, disc brake rotor and hub assembly, lower ball joint and tie rod end, and the lower control arm and steering knuckle assembly. To inspect the ball joint, insert the lower ball joint into the steering knuckle and the lower control arm and tie rod end. Tighten the nut and washer to the specified torque. Inspect the ball joint for wear. If the ball joint is worn, it should be replaced. To inspect the ball joint, remove the front wheel bearing, disc brake rotor and hub assembly, lower ball joint and tie rod end, and the lower control arm and steering knuckle assembly. To inspect the ball joint, insert the lower ball joint into the steering knuckle and the lower control arm and tie rod end. Tighten the nut and washer to the specified torque. Inspect the ball joint for wear. If the ball joint is worn, it should be replaced. To inspect the ball joint, remove the front wheel bearing, disc brake rotor and hub assembly, lower ball joint and tie rod end, and the lower control arm and steering knuckle assembly. To inspect the ball joint, insert the lower ball joint into the steering knuckle and the lower control arm and tie rod end. Tighten the nut and washer to the specified torque.



FIG. 10-11. Vehicle steering system installation.

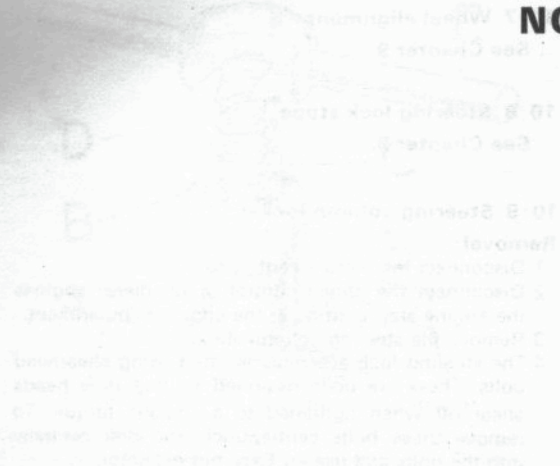


FIG. 10-12. Vehicle steering system installation.

Remove the front wheel bearing, disc brake rotor and hub assembly, lower ball joint and tie rod end, and the lower control arm and steering knuckle assembly. To install the steering knuckle, insert the lower ball joint into the steering knuckle and the lower control arm and tie rod end. Tighten the nut and washer to the specified torque. Install the lower control arm and tie rod end. Tighten the nut and washer to the specified torque. Install the front wheel bearing, disc brake rotor and hub assembly. Tighten the nut and washer to the specified torque.

10-10. Four disc brake

Inspect the front disc brake for wear. If the front disc brake is worn, it should be replaced. To inspect the front disc brake, remove the front wheel bearing, disc brake rotor and hub assembly, lower ball joint and tie rod end, and the lower control arm and steering knuckle assembly. To inspect the front disc brake, insert the lower ball joint into the steering knuckle and the lower control arm and tie rod end. Tighten the nut and washer to the specified torque. Inspect the front disc brake for wear. If the front disc brake is worn, it should be replaced. To inspect the front disc brake, remove the front wheel bearing, disc brake rotor and hub assembly, lower ball joint and tie rod end, and the lower control arm and steering knuckle assembly. To inspect the front disc brake, insert the lower ball joint into the steering knuckle and the lower control arm and tie rod end. Tighten the nut and washer to the specified torque.



FIG. 10-13. Vehicle steering system installation.

CHAPTER 11

THE BRAKING SYSTEM

- 11:1 Description
- 11:2 Routine maintenance and adjustments
- 11:3 The master cylinder
- 11:4 Servicing the road wheel brakes
- 11:5 Removing a brake flexible hose
- 11:6 Bleeding the brakes

- 11:7 The handbrake (transmission brake)
- 11:8 Servo units
- 11:9 The exhauster
- 11:10 Dual braking system
- 11:11 Fault diagnosis

11:1 Description

The Land Rover braking system is unusual in that although the foot pedal operates the road wheel brakes, the hand lever operates a transmission brake. Two types of master cylinder have been fitted, the C.V. (centre valve) and C.B. (compression barrel). **FIG 11:1** shows how to identify either one. In addition, some vehicles are fitted with servo assistance and again, two types exist. One type operates directly on the master cylinder and the other is installed remotely from the master cylinder and generates pressure in the hydraulic line. On diesel engine vehicles an exhauster pump is fitted to produce the vacuum, and on Series 3 vehicles a vacuum reservoir tank is fitted under the lefthand seat, access to which is gained by removing the seat cushion and the cover panel. This reservoir is kept at low pressure for servo operation by means of the butterfly valve and one way valve arrangement described in **Section 3B:9** so that an exhauster pump is not required.

A dual braking system is employed on later cars so that adequate braking is still available even after a complete failure in the hydraulic circuit to either the front or the rear wheel units.

11:2 Routine maintenance and adjustment

Occasionally apply a little heavy oil to all the wearing parts of the handbrake linkage, clevis pins, bearing bushes etc., being careful to keep oil away from the brake itself.

Regularly inspect the level of fluid in the hydraulic system supply tank and top up with Castrol Girling

Crimson Brake Fluid (all models) if necessary. This should be an infrequent requirement; if the level drops at short intervals, immediately inspect all the fluid lines, wheel cylinders and master cylinder until the leak is found then rectify at once.

To adjust the brake shoes, jack up the vehicle and safely support on substantial packing so that the road wheel is clear of the ground. At the rear of the brake back-plate will be seen one hexagonal adjuster on 10 inch front and rear brakes, two hexagonal adjusters on the front wheels of 11 inch brakes and one square-ended adjuster at the rear brakes. Spin the wheel and turn each adjuster until the shoes just contact the drum then slacken back one notch in the case of all front wheel brakes and two 'clicks' in the case of all rear wheel brakes. The adjuster at the rear may not give a definite 'click' but differences in effort needed to turn the adjuster will be noticeable. Lower the wheel to the ground and repeat for the other three wheels. The transmission brake (hand-brake) is of similar construction to the 11 inch rear wheel brakes and is adjusted by the same method.

11:3 The master cylinder

To remove, type C.B. (compression barrel):

- 1 Remove the fluid reservoir then disconnect the pipes from the master cylinder.
- 2 Disconnect the pedal return spring then undo the bolts holding the pedal bracket to the bulkhead.

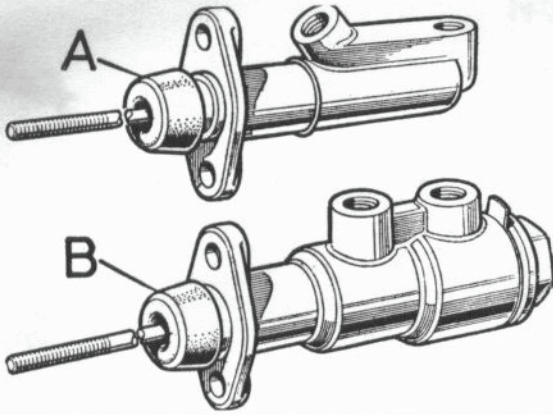


FIG 11:1 Identification of master cylinders

Key to Fig 11:1 A C.V. type B C.B. type

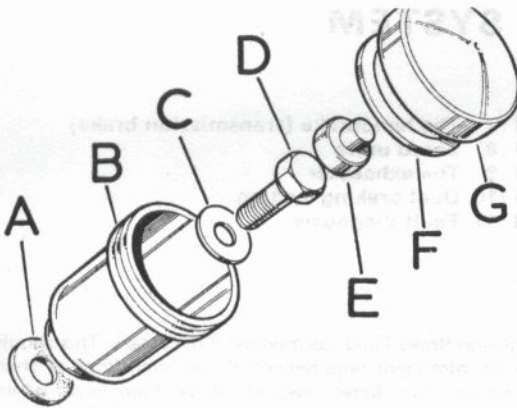


FIG 11:2 Fluid reservoir, C.V. cylinder

Key to Fig 11:2 A Seal B Body C Washer D Bolt
E Plastic cover F Gasket G Cap

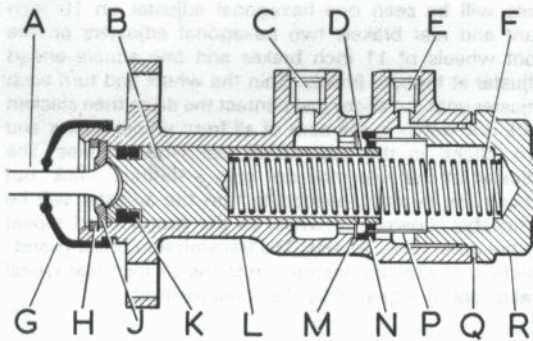


FIG 11:3 Master cylinder, type C.B.

Key to Fig 11:3 A Pushrod B Piston
C Inlet from reservoir D Inlet ports
E Outlet to wheel cylinders F Piston spring
G Dust cover H Circlip J Retaining washer
K End seal L Cylinder M Shim
N Recuperating seal P Seal support Q Gasket
R End cap

Manoeuvre the pedal through the bulkhead and withdraw the complete assembly from the engine compartment.

- 3 Remove the cover from the pedal bracket, release the pushrod then undo the bolts holding the master cylinder to the bracket.

To remove, type C.V. (centre valve):

- 1 Proceed as for the C.B. type but do not remove the pedal bracket. The coverplate can be taken away with the bracket still bolted to the bulkhead thus exposing the pushrod nuts and the bolts holding the master cylinder. Undo these and the unit can be lifted away.
- 2 This type of master cylinder is the one to which the mechanical servo unit is usually fitted. To remove the master cylinder simply remove the pipes then unbolt the master cylinder from the face of the servo unit.
- 3 If this master cylinder is fitted to a servo unit it will have the fluid reservoir attached to the inlet port. To remove the reservoir, drain off the fluid, withdraw the plastic cover at the bottom of the reservoir E (see FIG 11:2), then undo the bolt thus exposed. When the reservoir is parted from the master cylinder do not attempt to remove the distance piece from the base of the reservoir.

To service the master cylinder:

Type C.B. refer to Fig 11:3:

- 1 Wipe the outside of the unit as clean as possible using a rag soaked in methylated spirit. Do not let petrol or paraffin come near it at any stage of the operation. Exercise extreme measures to ensure cleanliness; use clean newspaper on the work bench and clean, lint free rag.
- 2 Grip the unit carefully in a vice and remove end cover R and copper washer Q.
- 3 Withdraw spring F.
- 4 If the pushrod A has the locking nut or trunnion nut still attached, remove it.
- 5 Remove the pushrod rubber boot G, the circlip H and pull the pushrod A and retaining washer J away.
- 6 Push out the piston B, seal K and seal support P.
- 7 Remove the recuperating seal N and shim M.
- 8 Carefully wash the body in Girling cleaning fluid, Girling Crison brake fluid, or, in emergency, methylated spirit. Examine the bore carefully; any scores, discoloration or damage involves renewal of the whole unit.
- 9 Obtain an overhaul kit. This will contain all new rubber components, a piston and a new copper washer.
- 10 Lubricate the bore freely with Girling Crimson Brake Fluid. Dip the piston seal K in fluid and assemble to the piston B. The large diameter of the seal K must face forwards away from the pushrod, A. Gently insert the piston and piston seal into the body making sure both are well wetted with brake fluid.
- 11 Insert the pushrod A and retaining washer J then fit a new circlip H.
- 12 Smear the inside of the new rubber boot G with Girling rubber grease and assemble to the body.
- 13 Insert the shim M into the body followed by the recuperating seal N. This seal also has the recess facing forwards (see FIG 11:4). (Latest type cylinders have a plastic washer in place of the shim.)

14 Put the seal support P in position. If it is plastic locate it in the seal, if metal, locate it in the end cap R.

15 Fit spring F then replace and securely tighten the end cover R on a new copper washer Q.

Type C.V., refer to Chapter 6:

The procedure detailed in **Chapter 6** for the clutch master cylinder applies to this brake cylinder since they are identical. Reference to **FIGS 6:7** and **6:10** will clearly show the method of assembly. Be careful to fit the seals as shown and lubricate the rubber boot with rubber grease.

To replace the master cylinder:

Type C.B.:

- 1 Reverse the removal procedure.
- 2 Refill the supply tank (reservoir) with Girling Crimson Brake Fluid and bleed the brakes (see **Section 11:6**).
- 3 Check for leaks.
- 4 Ensure the pushrod has $\frac{1}{16}$ inch (1.6 mm) free play.

Type C.V.:

- 1 Reverse the removal procedure.
- 2 Refill the reservoir and bleed the brakes (see **Section 11:6**).
- 3 Check for leaks.
- 4 Adjust the pushrod to give $\frac{1}{16}$ inch (1.6 mm) free play by slackening the nuts and moving the rod in the trunion. Tighten the nuts.

11:4 Servicing the brakes

10 inch brakes, 86 and 88 models:

These models use the same single leading shoe assembly both front and rear. Refer to **FIG 11:5** for an exploded view and **FIG 11:6** for an assembled view.

To remove the brake assembly:

- 1 Loosen the road wheel nuts then jack up and safely support the vehicle. Remove the road wheel, undo the setscrew retaining the brake drum and pull the drum off the wheel studs.
- 2 Turn back the adjuster to release the tension of the leading shoe pull-off spring 13 (see **FIG 11:5**), then remove the spring.

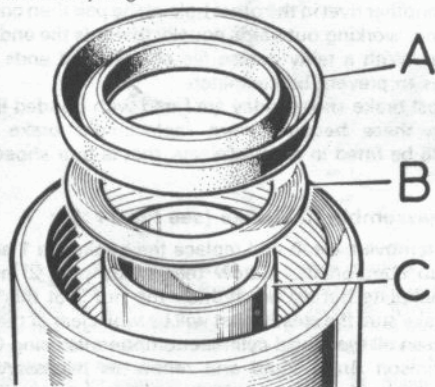


FIG 11:4 Fitting recuperating seal and shim

Key to **FIG 11:4** A Seal B Shim C Piston

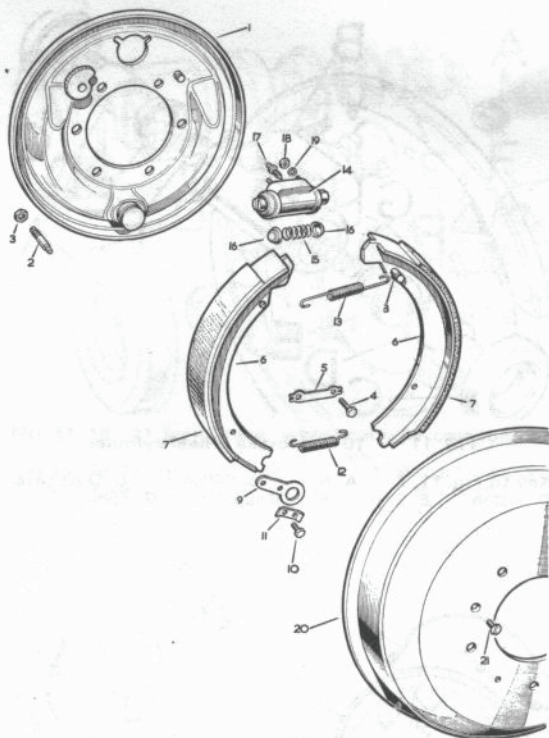


FIG 11:5 10 inch brake

Key to Fig 11:5

- | | |
|--|--|
| 1 Brake anchor plate assembly | 5 Locker |
| 2 Shoe, steady post | 7 Linings complete with rivets, for brake shoe |
| 3 Locknut for steady post | 8 Spring post for brake shoe |
| 4 Setbolt ($\frac{1}{2}$ inch x 1 inch long) | 9 Anchor for brake shoe |
| 6 Brake shoe assembly, front and rear | 10 Special setscrew, fixing anchor |
| 7 Linings complete with rivets, for brake shoe | 11 Locking plate for bolt |
| 8 Spring post for brake shoe | 12 Pull-off spring for brake shoe |
| 9 Anchor for brake shoe | 13 Pull-off spring for leading shoe |
| 10 Special setscrew, fixing anchor | 14 Wheel cylinder assembly |
| 11 Locking plate for bolt | 15 Spring for piston, front |
| 12 Pull-off spring for brake shoe | 16 Washer for spring, front |
| 13 Pull-off spring for leading shoe | 17 Bleed screw |
| 14 Wheel cylinder assembly | 18 Special nut |
| 15 Spring for piston, front | 19 Spring washer |
| 16 Washer for spring, front | 20 Brake drum |
| 17 Bleed screw | 21 Setscrew, fixing brake drum |

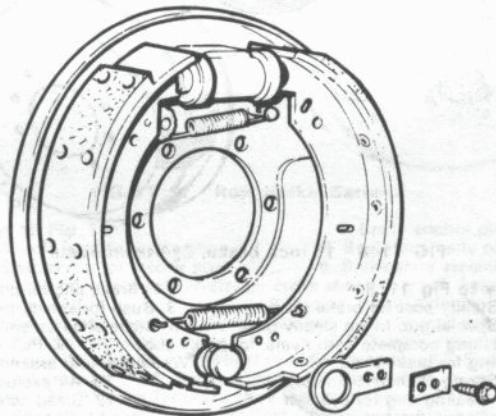


FIG 11:6 10 inch brake assembly

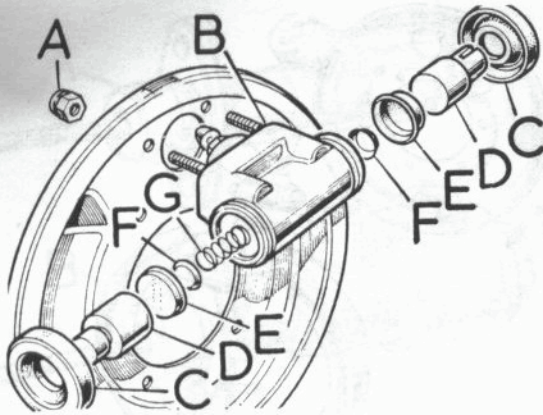


FIG 11:7 10 inch brake wheel cylinder

Key to Fig 11:7 A Nut B Cylinder C Dust cover
D Piston E Seal F Seal support G Spring

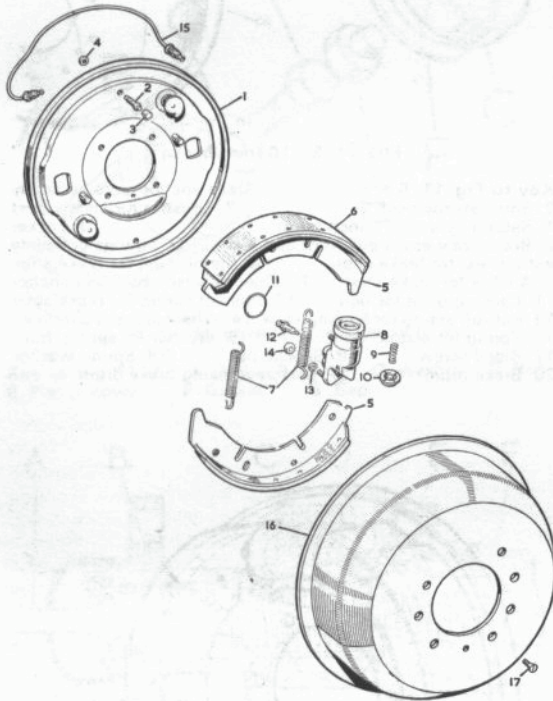


FIG 11:8 11 inch brake, 2½ litre models

Key to Fig 11:8
1 Brake anchor plate
2 Steady post for brake shoe
3 Bush for steady post
4 Special nut, fixing steady post
5 Brake shoe assembly
6 Lining complete with rivets, for brake shoe
7 Pull-off spring for brake shoe
8 Wheel cylinder assembly
9 Spring (3/8 inch diameter)
10 Air excluder
11 Sealing ring for cylinder
12 Bleed screw
13 Spring washer
14 Special nut
15 Connecting pipe for wheel cylinder
16 Brake drum
17 Setscrew, fixing brake drum

- 3 Remove the two setbolts 10, locking plate 11 and trailing shoe anchor plate 9. Take a careful note of the positions of the return springs. There are several alternative arrangements on different models and incorrect refitting can seriously affect braking.
- 4 Take off the brake shoes by pulling them apart at the pivot pin then part them by removing spring 12. If the wheel cylinder is not being removed wind a piece of soft wire or put a heavy rubber band over the two pistons to prevent them coming out of the cylinder. If the brake shoes are not being relined be very careful not to touch the friction surface with oily or greasy hands. This applies of course to relined or new shoes also. Never allow oil, grease, paint or any foreign matter to come into contact with the friction material.
- 5 If the hydraulic cylinder is to be dismantled the front brakes must be disconnected from the flexible hose by the method described in **Section 11:5**. This is important to avoid twisting and thereby damaging the hose. The rear brake cylinder can be removed by simply undoing the union nut on the hydraulic pipe. At this stage depress the footbrake pedal to its fullest extent and wedge it down. This will prevent undue loss of fluid. Support the front wheel brakes flexible hoses as high as possible, this will also help to minimize fluid loss from the pipelines.
- 6 Remove the wheel cylinder by undoing the nuts 18 (see **FIG 11:5**). Detach the rubber dust covers C (see **FIG 11:7**), pistons D, piston seals E, and the piston spring G with its supports F. Take off the bleed nipple cap then unscrew the bleed nipple and remove the steel ball.

To reline the brake shoes:

If it is necessary to reline the shoes make sure that the correct linings are obtained and always reline both shoes on each wheel of the axle being dealt with. Never mix makes and grades of lining. Cut off the old rivets with the shoes gripped in a vice then punch out the rivet shanks and strip off the old lining. Clean the shoes and run a file lightly over the seating face to remove any burrs. With clean hands, position a new lining on the shoe, insert a rivet in one of the centre pairs of holes and, holding the shoe, lining and rivet against a steel dolly rod gripped in the vice, securely clinch the end of the rivet over in the shoe by using a centre punch in the hollow shank. Repeat with another rivet in the other hole of the pair then continue riveting, working outwards equally towards the end of the linings. With a fairly coarse file chamfer the ends of the linings to prevent brake snatch.

Most brake shoes today are fitted with bonded linings. When these become worn replacement brake shoes should be fitted in complete sets, that is four shoes to an axle.

To reassemble the brake (see Fig 11:5):

- 1 If removed, clean and replace the backplate 1 and the hub components. Screw the steady post 2 into the backplate but do not tighten the nut 3 at this stage. Make sure the steady post will be well clear of the shoe.
- 2 Clean all the wheel cylinder components using Girling Crimson Brake Fluid and renew as necessary. Any scores on the pistons or in the cylinder bore must mean renewal. Renew all the rubber components from the makers overhaul kit supplied for this purpose.

- 3 Reassemble the wheel cylinder components ensuring that the cylinder bore, pistons and piston seals are copiously smeared with brake fluid. Refit the dust covers, bleed nipple ball, nipple and cover. Retain the pistons by the method described earlier. Attach the cylinder to the backplate.
- 4 Connect the spring 12 to the shoes then apply them to the brake by first positioning them against the hydraulic pistons. Pull the other ends apart and fit to the pivot (anchor) pin.
- 5 Reconnect the pull-off spring 13.
- 6 Replace the anchor plate 9, renew the locking plate 11 and fit the setbolts 10. Tighten up and then bend up the ends of the locking plate 11 (see FIG 11:6).
- 7 Reconnect the hydraulic pipe and release the foot-brake pedal.
- 8 Examine the brake drum for scoring or ovality. If necessary the drum can be skimmed oversize by not more than .03 inch (.75 mm). Replace the brake drum and fit the retaining screw.
- 9 Set the leading shoe adjuster so that the shoe just contacts the drum.
- 10 If necessary, bleed the brakes as described in Section 11:6.
- 11 To set the steady post, apply the brakes lightly and turn the drum by hand to centralize the shoes. Apply the brakes hard then screw the steady post in until it just contacts the shoe web then tighten the locknut.

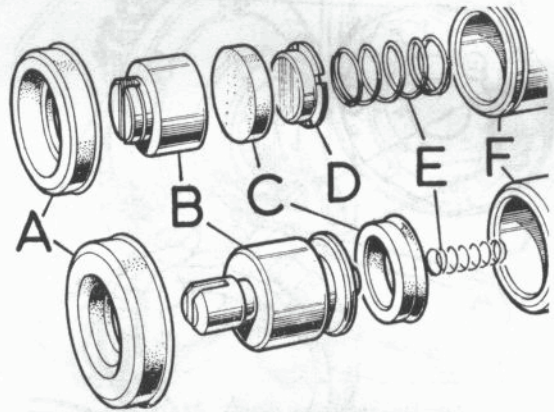


FIG 11:10 11 inch brake, wheel cylinder components

Key to Fig 11:10
 A Dust cover B Piston C Seal
 D Seal support E Spring F Cylinder

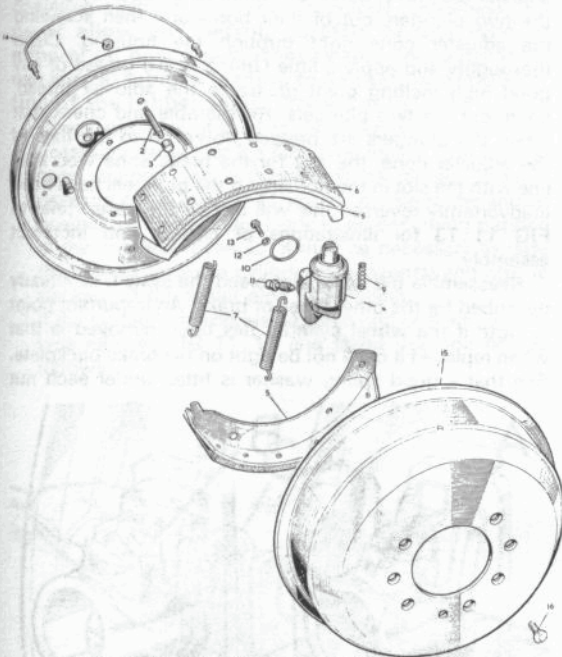


FIG 11:9 11 inch brake, 2.6 litre models

Key to Fig 11:9
 1 Brake anchor plate, lefthand front
 2 Steady post for brake shoe 3 Bush for steady post
 4 Special nut, fixing steady post 5 Brake shoe assembly
 6 Lining complete with rivets, for brake shoe 7 Spring, adjuster end
 8 Wheel cylinder assembly 9 Spring, wheel cylinder end
 10 Sealing ring for cylinder 11 Bleed screw
 12 Spring washer 13 Special setbolt
 14 Connecting pipe for wheel cylinder 15 Brake drum
 16 Setscrew, fixing brake drum

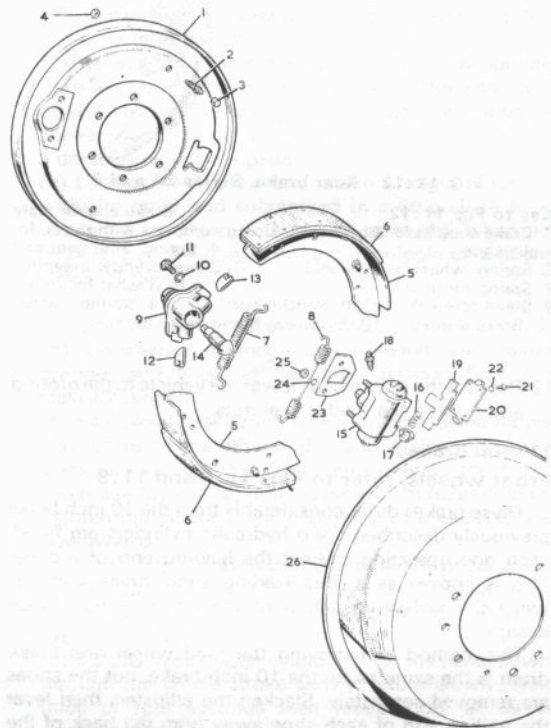


FIG 11:11 Rear brake, Series 2

Key to Fig 11:11
 1 Brake anchor plate
 2 Steady post for brake shoe 3 Bush for steady post
 4 Special nut for steady post 5 Brake shoe assembly
 6 Lining complete with rivets, for brake shoe 7 Spring, adjuster end
 8 Spring, wheel cylinder end
 9 Adjuster housing 10 Spring washer 11 Special setbolt
 12 Plunger, lefthand 13 Plunger, righthand
 14 Cone for adjuster 15 Wheel cylinder assembly 16 Spring
 17 Air excluder 18 Bleed screw 19 Brake shoe abutment plate
 20 Retainer for brake shoe abutment plate 21 Screw
 22 Shakeproof washer 23 Dust coverplate for brake wheel cylinder
 24 Spring washer 25 Self-locking nut
 26 Brake drum 27 Setscrew, fixing brake drum

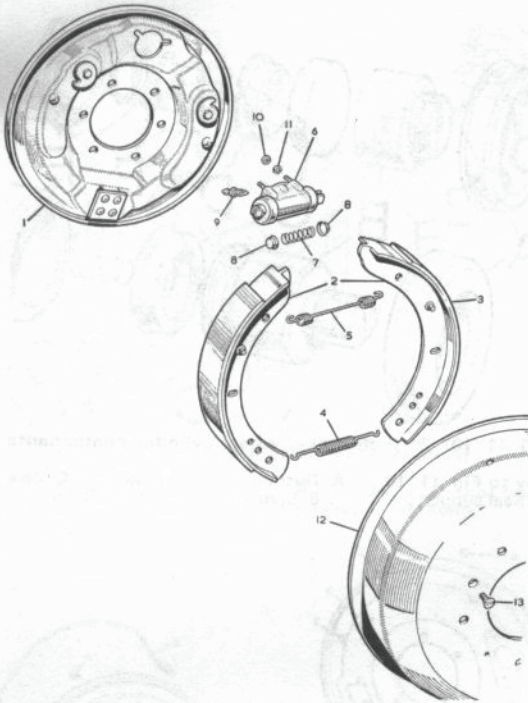


FIG 11:12 Rear brake, Series 2A and 3

Key to Fig 11:12

- | | | |
|--------------------------------------|---|---------------------------|
| 2 Brake shoe assembly for brake shoe | 3 Lining complete with rivets, for brake shoe | 1 Brake anchor plate |
| 5 Spring, wheel cylinder end | 4 Spring, abutment end | 6 Wheel cylinder assembly |
| 7 Spring for piston | 8 Washer for spring | |
| 9 Bleed screw | 10 Special nut | 11 Spring washer |
| 12 Brake drum | 13 Setscrew, fixing brake drum | |

12 Replace the road wheel, lower the vehicle to the ground and tighten the road wheel nuts.

11 inch brakes:

Front wheels, refer to Figs 11:8 and 11:9:

These brakes differ considerably from the 10 inch brake previously described. Two hydraulic cylinders are fitted, each one operating against the leading end of a shoe. This is known as a 'two leading shoe' brake and has twice the self-servo action of the single leading shoe design.

The method of removing the road wheel and brake drum is the same as for the 10 inch brake, but the shoes are removed separately. Slacken the adjusters then lever the trailing end of each shoe away from the back of the hydraulic cylinder and disconnect the spring. Reline the shoes as described earlier.

If the wheel cylinders are not being removed, retain the pistons by winding soft wire round, or by attaching a strong rubber band to the cylinder unit.

If it is intended to remove the cylinders, release the bleed nipple, depress the footbrake pedal and wedge it down to prevent undue fluid loss. Disconnect the pipe connecting the two cylinders and then the flexible hose (see Section 11:5). (This should be done before the shoes are removed so that the pistons do not come away inadvertently.)

Remove the cylinders by undoing the retaining bolts and service them exactly as described for the 10 inch brake cylinder observing the most scrupulous cleanliness throughout the operation. Refer to FIG 11:10 for details of the two types of cylinder components which may be encountered.

Rebuild the brake by reversing the dismantling operation. The steady posts are adjusted by the same method as described for the 10 inch brake. If the wheel cylinders have been disturbed, bleed the hydraulic system as described in Section 11:6. Adjust each shoe by rotating the drum by hand and turning the adjuster until the shoe just contacts the drum then slacken back two serrations. The drum can be skimmed .03 inch (.75 mm) oversize if scored or distorted.

11 inch brakes:

Rear wheels, refer to Figs 11:11 and 11:12:

These brakes are of single leading shoe design and are similar in principle. Only the adjuster mechanism varies. The Series 2 has the cone type adjuster whereas the Series 2A and 3 a pair of snail cams. The latter construction is self-explanatory but the cone type is described in more detail.

Dismantle the brake assembly generally as described for the 10 inch brake but before removing the drum, slacken the adjusters right off. Reline the shoes and service the cylinder as already described. The cone adjuster assembly, Series 2, should be stripped by pulling the two plungers out of their bores and then screwing the adjuster cone right through the housing. Clean thoroughly and apply a little Girling Brake grease or any good high melting point grease to the adjuster thread, cone and the two plungers. Reassemble and check that when the plungers are pressed down on to the flats of the adjuster cone, the slot for the brake shoe web is in line with the slot in the housing. If the plungers have been inadvertently reversed this will not be the case. Refer to FIG 11:13 for illustrations of correct and incorrect assembly.

Reassemble the brake and bleed the system as already described for the other types of brake. An important point to note if the wheel cylinder has been removed is that when replaced it must not be tight on the brake backplate. See that a good spring washer is fitted under each nut

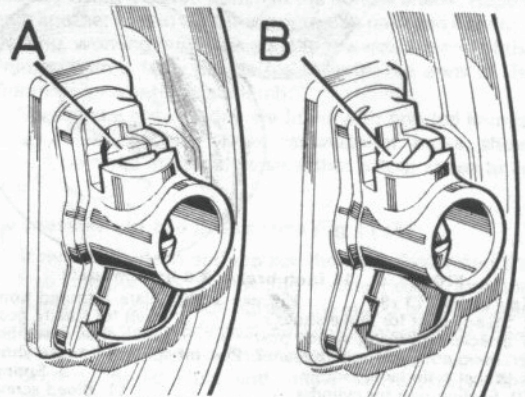


FIG 11:13 Plunger locations

Key to Fig 11:13

A Correct

B Incorrect

and then tighten the nut moderately hard. Slacken back one turn and check that the cylinder is just free to float on the backplate. If this is not done the shoes may not centralize properly. The brake drum can be skimmed .03 inch (.75 mm) oversize if scored or distorted.

11:5 Removing the brake flexible hose

Refer to Fig 11:14:

It is essential that the following procedure is adopted whenever a flexible hose is removed or replaced. Otherwise the hose can be twisted and ruined.

- 1 Unscrew the metal pipe union nut 'A'.
- 2 Hold the nut 'D' with a spanner and remove nut 'B' and shakeproof washer 'C'.
- 3 Withdraw the hose from the bracket then disconnect at the wheel cylinder end.
- 4 Replace by reversing this procedure, always making sure that dirt does not become trapped in the system or between the mating faces of the hose, wheel cylinder or metal pipe.

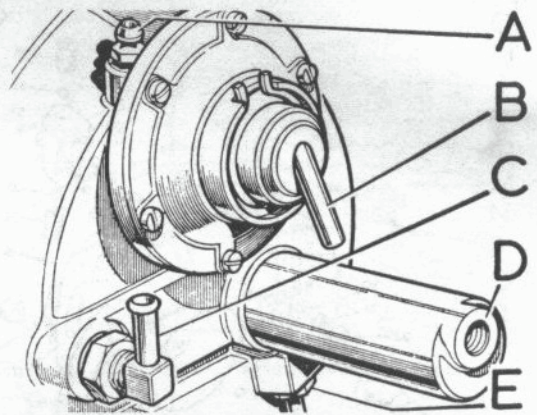


FIG 11:15 Servo unit connections

Key to Fig 11:15
 B Atmospheric inlet C Vacuum connection D Fluid outlet
 E Fluid inlet from master cylinder A Bleed nipple

11:6 Bleeding the brakes

If the level of the fluid in the supply tank has been allowed to fall too low or if any section of the system has been disconnected, the pedal will feel 'spongy' due to the presence of air trapped in the pipes or cylinders. This air must be removed by the process of bleeding. During this operation exercise the most scrupulous cleanliness and never allow any petrol, paraffin or any type of mineral oil near the system as this contamination can spread rapidly, leading to dangerous deterioration of the rubber seals. Proceed as follows:

- 1 Check the level of fluid in the reservoir and top up if necessary. Note that if a C.B. type master cylinder has been drained, the system must be refilled under a pressure of 14 lb/sq in (1 kg/sq cm) since the angled position of the cylinder leads to air becoming trapped at the cap end. Even so, it may be necessary to raise the vehicle until the cylinder is horizontal and also to slacken off the outlet pipe while filling.
- 2 If the system incorporates a servo unit of the hydraulic type refer to FIG 11:15 and bleed this unit first as follows:

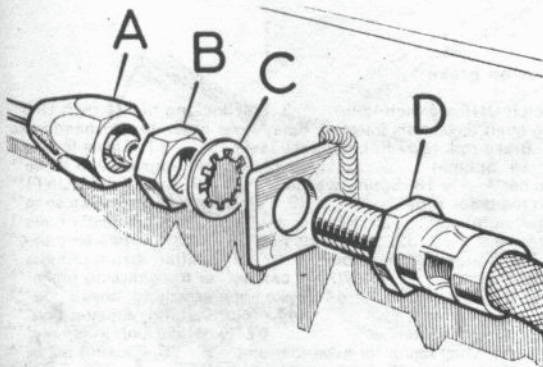


FIG 11:14 Flexible hose connections

Key to Fig 11:14
 A Metal pipe B Locknut
 C Shakeproof washer D Flexible pipe

- (a) Make sure no vacuum exists by applying the brakes at least six times.

- (b) Release the pipe nut at D one turn. Now operate the brake pedal slowly using only half to three quarters of the stroke. Continue until no more air bubbles appear round the nut and then tighten the nut during a down stroke of the pedal.

- (c) Loosen the nipple A and attach a length of tubing with the other end submerged in a little clean fluid in a glass jar. Operate the pedal as at (b), when no more air bubbles appear tighten the nipple on a down stroke of the pedal.

- 3 For all brake systems continue as follows:

- (a) Slacken all brake shoe adjusters right off.
- (b) Commence at the wheel nearest the master cylinder and finish at the one furthest from the master cylinder.

- (c) Fit a bleed tube to the wheel cylinder bleed nipple and submerge the other end in a little clean fluid in a glass jar. Slacken the nipple and operate the brake pedal, see (d) and (e) until no more air bubbles appear. Tighten the nipple at the beginning of a pedal stroke downwards.

- (d) If a C.V. type master cylinder, push the pedal down through the full stroke, give three short strokes then let the pedal fly back quickly. Repeat until all air is expelled. Refer to (c).

- (e) If a C.B. type master cylinder, push the pedal down through the whole stroke slowly, return slowly, wait three or four seconds then repeat until all air is expelled. Refer to (c).

- (f) Rebleed the servo unit as at 2(c) when all wheel cylinders have been bled.

- 4 During all these operations keep the fluid level up in the supply tank so that air cannot enter and cause the whole process to be repeated. Never top up the supply tank with fluid just bled from the system since air may be held in suspension.

11:7 The handbrake (transmission brake)

Refer to FIG 11:16 for details of this brake layout.



FIG 11:16 Transmission brake

- Key to Fig 11:16**
- | | | |
|---|--|--|
| 1 Shaft for handbrake relay lever* | 2 Bolt ($\frac{3}{8}$ inch UNF x 4 inch long)* | 3 Self-locking nut ($\frac{3}{8}$ inch UNF) |
| 4 Shaft for handbrake relay lever | 5 Self-locking nut ($\frac{3}{8}$ inch UNF) fixing shaft to chassis frame | 6 Relay lever assembly for handbrake |
| 7 Bush for relay lever | 8 Plain washer | 9 Circlip |
| 10 Brake rod, relay to handbrake lever | 11 Clevis fork end | 12 Clevis pin complete |
| 13 Locknut ($\frac{5}{16}$ inch UNF) | 14 Splitpin | 15 Anchor plate, transmission brake** |
| 16 Oil catcher for transmission brake** | 17 Joint washer for oil catcher** | 18 Spring washer** |
| 19 Nut ($\frac{3}{8}$ inch UNF)** | 20 Brake shoe assembly, boxed pair** | 21 Lining complete with rivets for shoe** |
| 22 Pull-off spring for brake shoe** | 23 Adjuster housing** | 24 Spring washer** |
| 25 Setbolt** | 26 Plunger, righthand** | 27 Plunger, lefthand** |
| 28 Adjuster cone** | 29 Expander housing** | 30 Special washer** |
| 31 Spring washer** | 32 Simmonds nut** | 33 Expander cone** |
| 34 Pin, fixing cone to brake rod** | 35 Roller for expander** | 36 Plunger for expander** |
| 37 Splitpin, fixing plunger** | 38 Brake rod, expander to relay lever** | 39 Anchor plate, transmission brake** |
| 40 Oil catcher for transmission brake** | 41 Joint washer for oil catcher** | 42 Spring washer** |
| 43 Nut ($\frac{3}{8}$ inch BSF)** | 44 Brake shoe assembly, boxed pair** | 45 Lining complete for shoe, boxed pair** |
| 46 Pull-off spring, expander end** | 47 Return spring, adjuster end** | 48 Adjuster unit assembly** |
| 49 Nut ($\frac{1}{2}$ inch UNF)** | 50 Tabwasher** | 51 Expander unit assembly** |
| 52 Clip retaining tappets** | 53 Brake rod, expander to relay lever** | 54 Dust cover for expander unit** |
| 55 Packing plate** | 56 Locking plate** | 57 Retaining spring** |
| 58 Clevis complete | 59 Locknut ($\frac{7}{16}$ inch BSF) | 60 Splitpin |
| 61 Dust cover for brake rod | 62 Return spring for brake rod | 63 Anchor for spring |
| 64 Anchor for spring, on transfer box | 65 Brake drum | 66 Self-locking nut ($\frac{1}{2}$ inch BSF) fixing brake drum and damper |
| 67 Transmission damper at rear end of gearbox | | |
- *Up to vehicle suffix 'C' inclusive
 **Up to gearboxes numbered: 146000565 156000430 151005187
 ***From gearboxes numbered: 146000566 156000431 151005188 onwards

To service the transmission brake unit:

If access is only required to the brake shoes, e.g. for relining, the propeller shaft may be left in position. It is only necessary to detach the brake drum and push it back over the shaft.

- 1 Remove the brake shoes complete with springs by levering them apart and pulling off the expander plungers and adjuster plungers. Remove the springs and separate the shoes.
- 2 Release the rod 38 or 53 if the expander is to be removed, then release the nuts (early type) or clips (later type) and the expander will come away. Remove the adjuster housing by releasing the bolts or nuts.
- 3 Remove the two splitpins 37 or clip 52 and lift out the plungers being careful not to lose the rollers.
- 4 Push out pin 34 and separate rod 38 and expander cone 33.
- 5 Clean all the parts and examine for wear or damage. Reline the shoes as described in **Section 11:4** if necessary.
- 6 Reassembly is a reversal of the dismantling procedure but on early type brakes make sure that the adjuster plungers are replaced in the correct bores. These plungers are handed, righthand and lefthand, therefore assemble the adjuster housing to the anchor plate but leave the bolts finger tight. Screw the adjuster cone right home then try the plungers in their bores. When pushed hard down against the flats of the adjuster cone, the slots in their outer ends must be in line with the plane of the brake shoe webs. Smear a little high

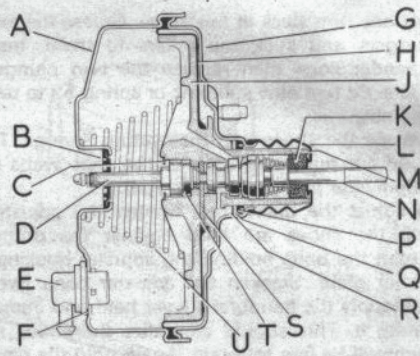


FIG 11:17 Girling mechanical servo

Key to Fig 11:17

- | | |
|--------------------------------|--------------------------------|
| A Front shell | G Rear shell |
| B Seal and plate assembly | H Diaphragm |
| C Retainer sprag washer | I Non-return valve |
| D Hydraulic pushrod | J Diaphragm plate |
| E Non-return valve | K Filter |
| F O-ring | L Dust cover |
| G Rear shell | M End cap |
| H Diaphragm | N Valve operating rod assembly |
| I Non-return valve | O Seal |
| J Diaphragm plate | P Seal |
| K Filter | Q Bearing |
| L Dust cover | R Retainer |
| M End cap | S Valve retaining plate |
| N Valve operating rod assembly | T Reaction disc |
| O Seal | U Diaphragm return spring |

- melting point grease on all the bearing surfaces and finally assemble the plungers with the adjuster cone right back as far as it will go. Later type plungers are not handed and can be fitted either side.
- 7 Refit the expander cone to the brake rod and dust cover, lightly grease the expander cone. Refit the housing to the anchor plate but leave the retaining

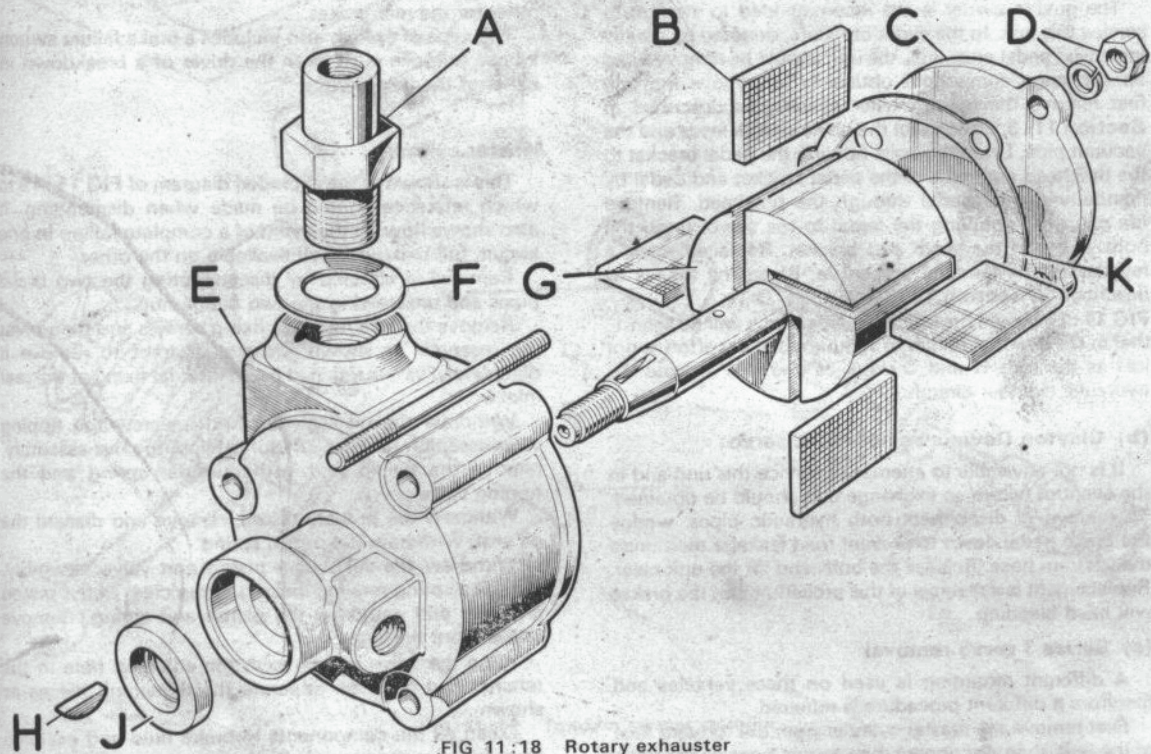


FIG 11:18 Rotary exhauster

Key to Fig 11:18

- | | | | | |
|--------------------|------------------|---------------------|---------------------|--------------------------|
| A Inlet union | B Vane for rotor | C Cover for housing | D Fixings for cover | E Rotor housing |
| F Washer for union | G Rotor | H Woodruff key | J Oil seal | K Joint washer for cover |

nuts one turn slack at this stage. Grease the expander plungers and stick the rollers to them. Insert the expander cone then replace the two plungers and rollers. Fit two new splitpins or spring 52 to retain the assembly.

- 8 Replace the shoes and their return springs. The half round cut-out in the ends of the shoe webs goes to the adjuster plungers (early type).
- 9 To adjust the brake, first tighten the adjuster cone until the shoes are hard against the drum. Now tighten the bolts holding the adjuster housing to the anchor plate. Slacken the adjuster cone two clicks then apply the handbrake lever hard and immediately release it. This should centralize the shoes and the drum will be free to rotate. Again hold the handbrake on and just nip up the nuts holding the expander housing (early type only). Release them slightly and then release the handbrake. This will ensure that the expander housing is free to float on the anchor plate. Adjust the handbrake linkage at the vertical rod 10 so that the brake comes on after moving the hand lever one or two clicks.
- 10 It is unlikely that this brake drum will be scored but in the event that it is damaged, it can be skimmed over-size by .03 inch (.75 mm) in the same way as the road wheel brake drums.

11:8 Servo units

(a) Girling mechanical servo:

The private owner is not recommended to attempt to service this unit. In the event of failure, denoted by greatly increased pedal pressures, the unit should be removed and an exchange component obtained. To remove the unit first remove the brake master cylinder as described in **Section 11:3**, disconnect the brake switch leads and the vacuum pipe. Undo the bolts holding the pedal bracket to the bulkhead and remove the pedal bracket and pedal by manoeuvring the pedal through the bulkhead. Remove the pivot pin coupling the pedal to the servo, undo the bolts and part the servo and bracket. Replacement is a reversal of the removal procedure. Bleed the brakes as described in **Section 11:6**.

FIG 11:17 shows the unit in section and it will be seen that in the event of failure of vacuum, braking effort is not lost as the rods N and D work as one and operate the hydraulic cylinder directly.

(b) Clayton Dewandre hydraulic servo:

It is not advisable to attempt to service this unit and in the event of failure an exchange unit should be obtained. To remove it, disconnect both hydraulic pipes, wedge the brake pedal down to prevent fluid leakage then undo the vacuum hose. Release the bolts and lift the unit clear. Replacement is a reversal of this procedure but the brakes will need bleeding.

(c) Series 3 servo removal:

A different mounting is used on these vehicles and therefore a different procedure is required.

First remove the master cylinder from the forward face of the unit, then disconnect the vacuum hose and remove the switch plate from the top of the pedal mounting bracket.

Remove the rubber plugs at each side of the pedal box and pull out the splitpin to free the clevis pin securing the servo rod to the brake pedal.

Remove the four securing nuts and lift away the servo unit.

Refitting is the reverse of the above procedure.

For diesel engined models refer also to **Section 3B:9**, 'Setting the throttle controls'.

11:9 The exhauster

Refer to **FIG 11:18**. This unit is fitted to diesel engined vehicles to provide the vacuum for the servo. The illustration makes clear the method of dismantling and reassembly. When the exhauster is serviced always replace the rotor vanes, oil seal and the joint washers. These are all included in the overhaul kit. Adjust the rotor end float by means of different thicknesses of joint washer K. The rotor must turn freely without excessive end float. Note that the radiused edges of the vanes are fitted pointing outwards.

11:10 Dual braking system

On certain later cars a dual braking system is available in which a tandem master cylinder is used having two individual piston/cylinder assemblies in order to serve two separate braking circuits, one for the front and the other for the rear brakes.

This type of system also includes a brake failure switch whose purpose is to warn the driver of a breakdown in either of the two circuits.

Master cylinder:

This is shown in the exploded diagram of **FIG 11:19** to which reference should be made when dismantling. It also shows how, in the event of a complete failure in one circuit, full braking is still available on the other.

Removal is effected by disconnecting the two brake pipes and unscrewing the two flange nuts.

Remove the two reservoir fixing screws and then pivot the reservoir as shown. Do not attempt to remove it completely, as it is retained by an internal fixing at the rear inlet bore.

Withdraw the oil seal ring and unscrew the tipping valve assembly retainer. Lift out the tipping valve assembly, remove the circlip and withdraw the spring and the tipping valve.

Withdraw the primary piston, remove and discard the oil seal. Withdraw the piston spring.

Withdraw the secondary piston and valve assembly. Prise the spring retainer locking prong clear of the piston shoulder and withdraw the piston and spring. Remove and discard the seal.

Align the valve system with the enlarged hole in the retainer and pull out. Separate the remaining pieces as shown.

Clean all the components in brake fluid and examine them for wear or corrosion. Replace as necessary including all seals. These will be included in the master cylinder overhaul kit.

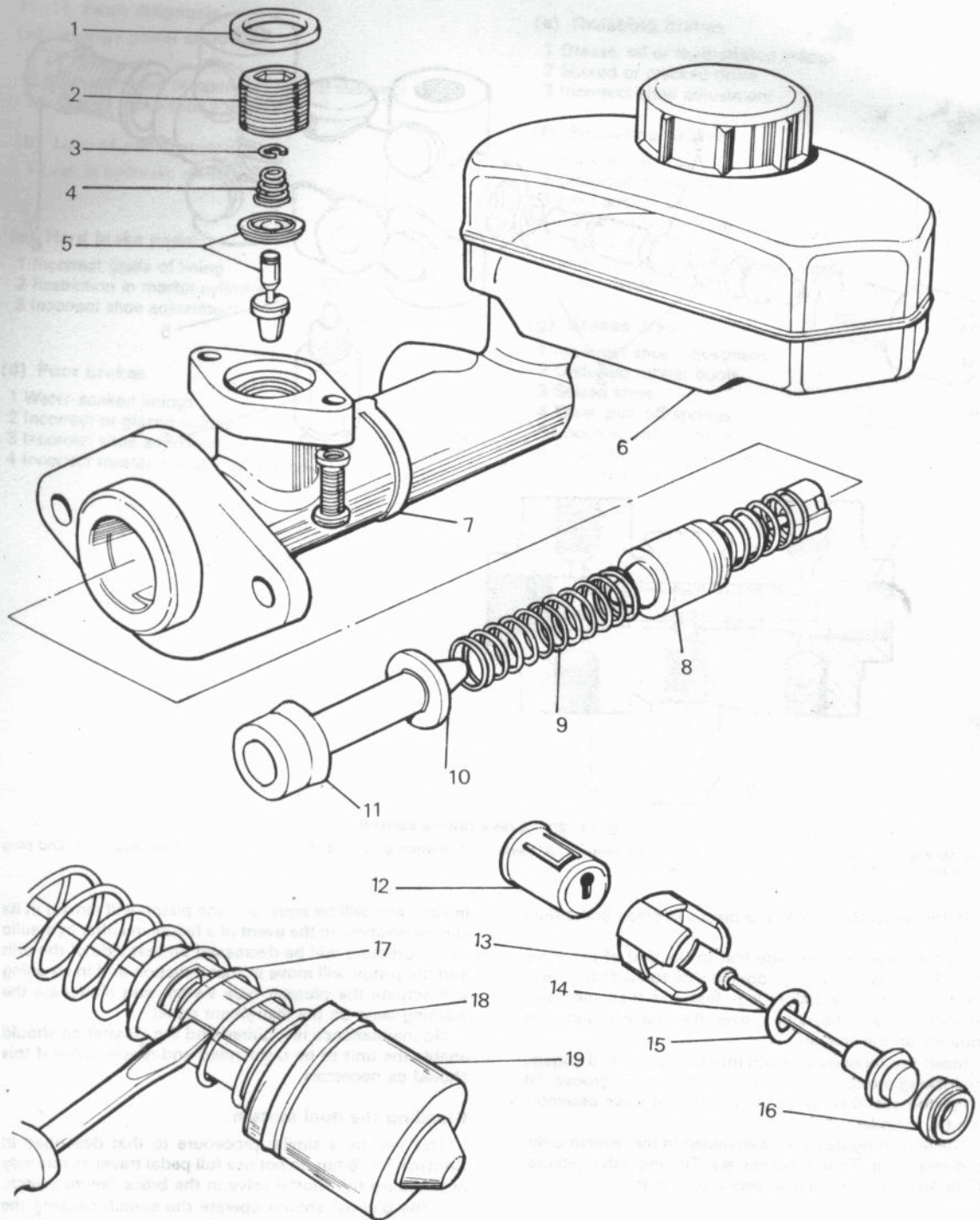


FIG 11:19 Tandem master cylinder

Key to Fig 11:19 1 Seal ring 2 Tipping valve assembly retainer 3 Circlip 4 Spring 5 Tipping valve and plate
 6 Reservoir 7 Screw 8 Secondary piston 9 Piston spring 10 Primary piston 11 Seal 12 Valve retainer 13 Valve
 spacer 14 Valve stem 15 Wave washer 16 Seal 17 Locking prong 18 Seal 19 Secondary piston and valve assembly

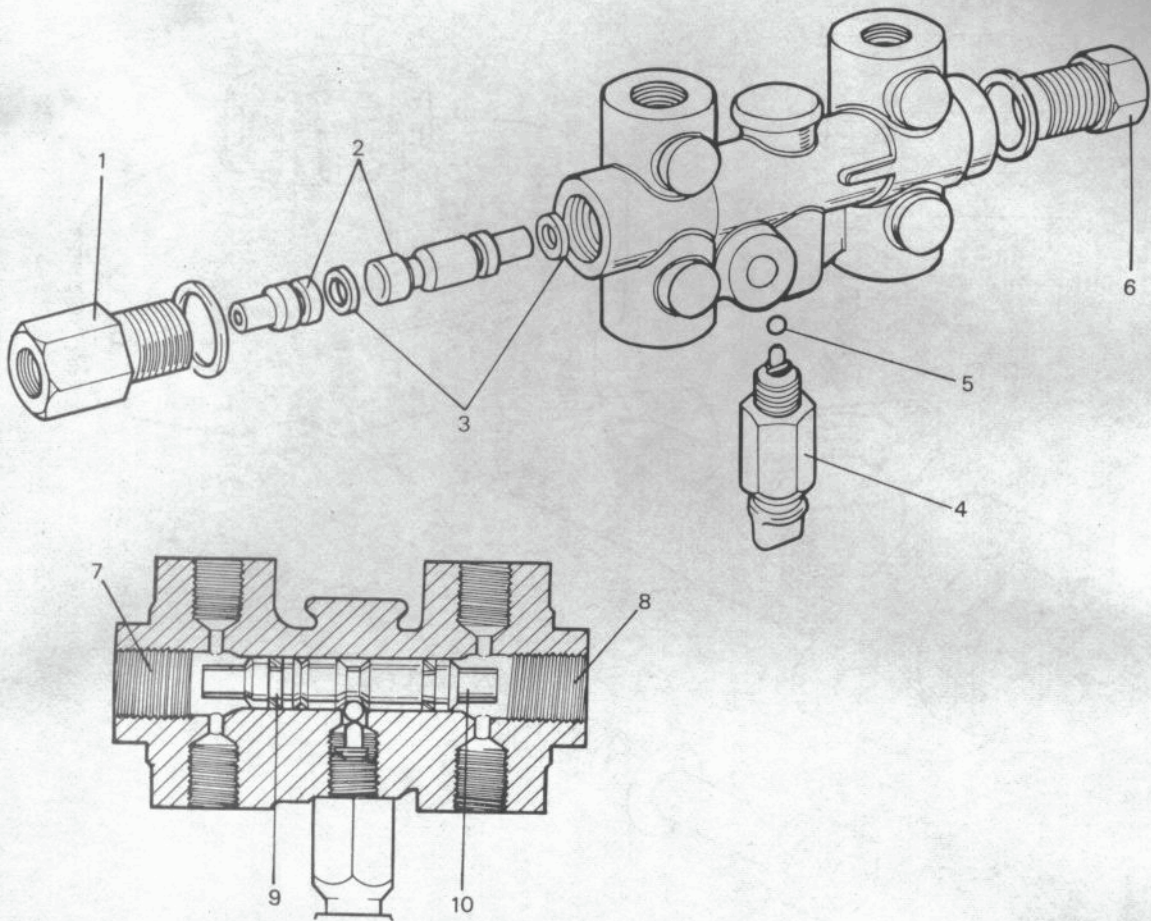


FIG 11:20 Brake failure switch

Key to Fig 11:20 1 Union nut 2 Shuttle valve 3 Seals 4 Switch unit 5 Plunger ball 6 End plug 7 End plug
8 Union 9 Short section 10 Long section

Before assembly dip all the pieces in clean brake fluid then:

Fit the valve seal flat side first to the end of the valve stem. Fit the wave washer, domed side towards the valve head. Fit the valve spacer legs first and then the valve retainer. Locate the spring over the retainer and seat squarely on the spacer.

Insert the secondary piston into the spring and engage the locking prong on the retainer in the piston groove. Fit the piston seal then insert the piston and valve assembly into the cylinder.

The remaining items are assembled in the reverse order to dismantling. Torque figures are: Tipping valve retainer 35 to 45 lb ft. Reservoir screws 2 to 3 lb ft.

Brake failure switch:

This, as will be seen from the section view in FIG 11:20, is in the form of an H in which the two arms are inserted in the two braking circuits and the cross bar carries a shuttle type piston. Under normal conditions the pressure

in each arm will be equal and the piston will remain in its central position. In the event of a failure in either hydraulic circuit pressure will be decreased on that side of the unit and the piston will move in that direction and in so doing will actuate the plunger type switch and illuminate the warning lamp on the instrument panel.

No maintenance is required and the illustration should enable the unit to be dismantled and reassembled if this should be necessary.

Bleeding the dual system:

This will be a similar procedure to that described in Section 11:6 but do not use full pedal travel as this may decentralise the shuttle valve in the brake failure switch.

If the plunger should operate the switch causing the warning light to come on, the bleed screw must be closed and a bleed screw at the other end of the car opened.

Apply a steady pressure to the pedal until the light goes out, then release the pedal immediately and close the bleed screw, otherwise the piston will move too far in the opposite direction and require resetting again.

11:11 Fault diagnosis

(a) Spongy pedal action

- 1 Air in system
- 2 Swollen rubber components (use of incorrect fluid)
- 3 Incorrect brake shoe adjustment

(b) Loss of pedal pressure

- 1 Leak in hydraulic system

(c) Hard brake pedal

- 1 Incorrect grade of lining
- 2 Restriction in master cylinder
- 3 Incorrect shoe adjustment

(d) Poor brakes

- 1 Water-soaked linings
- 2 Incorrect or glazed linings
- 3 Incorrect shoe adjustment
- 4 Incorrect master cylinder adjustment

(e) Grabbing brakes

- 1 Grease, oil or fluid-soaked linings
- 2 Scored or cracked drum
- 3 Incorrect shoe adjustment

(f) Squealing brakes

- 1 Incorrect linings
- 2 Distorted brake drum
- 3 Bent anchor plate
- 4 Damaged brake shoe
- 5 Dust in drums
- 6 Shoes binding on the steady posts
- 7 Loose wheel cylinder

(g) Brakes drag

- 1 Incorrect shoe adjustment
- 2 Distorted rubber boots
- 3 Seized shoe
- 4 Weak pull-off springs
- 5 Loose wheel bearings
- 6 Restriction in brake pipe
- 7 Distorted drum

CHAPTER 12

THE ELECTRICAL EQUIPMENT

- 12:1 Description
- 12:2 Batteries
- 12:3 The generator
- 12:4 The 11 ACR alternator
- 12:5 The 16 ACR alternator
- 12:6 The starter motors
- 12:7 The control boxes

- 12:8 Headlamp beam setting
- 12:9 The heater plugs, diesel models
- 12:10 The heater
- 12:11 The instrument panel, Series 3
- 12:12 Ignition starter switch
- 12:13 Combined flasher, headlights, horn switch
- 12:14 Fault diagnosis

12:1 Description of system

Over the years, important changes have been made to the system, particularly the charging circuits and generators. The polarity has been changed from positive earth to negative earth; therefore make very sure which system is used when carrying out any work on the electrical components. Transistorized equipment will be ruined if connected wrongly. All $2\frac{1}{2}$ litre Petrol and Diesel vehicles up to suffix chassis C, inclusive, are **positive earth**. $2\frac{1}{4}$ litre Petrol and Diesel vehicles from suffix chassis D, and all 2.6 litre Petrol models are equipped with **negative earth systems**.

Three dynamo types have been fitted, each with its own particular control box. It is important to check that the correct dynamo and control box are mated. Incorrect control box types will burn out the dynamo. Only one dynamo type is illustrated and described as all are basically similar. Some vehicles are fitted with an alternator and as this needs a different technique for servicing, full details of its construction and testing are given.

12:2 The batteries

Keep the top of the battery and surrounding parts dry and clean. Clean off any corrosion from the metal parts of the battery mounting with diluted ammonia and paint

with anti-sulphuric paint. If the terminal posts are corroded remove the cables and clean with diluted ammonia. Before refitting the cables smear the terminal posts with petroleum jelly.

If the electrolyte level of the cells is below the plate separators, top up with distilled water; never add neat acid. If it is ever necessary to make up new electrolyte due to loss by spillage add the sulphuric acid to the distilled water. **It is highly dangerous to add water to acid.**

The hydrometer readings of a battery in good condition should be as follows:

For climates below 80°F (26.5°C)

Cell fully charged	1.270 to 1.290
Cell three-quarters charged	1.230 to 1.250
Cell half-charged	1.190 to 1.210

For climates above 80°F (26.5°C)

Cell fully charged	1.210 to 1.230
Cell three-quarters charged	1.170 to 1.190
Cell half-charged	1.130 to 1.150

When bench charging a battery, take out the vent plugs and charge at 4 amps until it gases freely. Never put a naked light near the vents when the battery is gassing as an explosion is possible.

The drive screws securing the battery leads are made from a special non-corrosive metal and must never be replaced with ordinary drive screws.

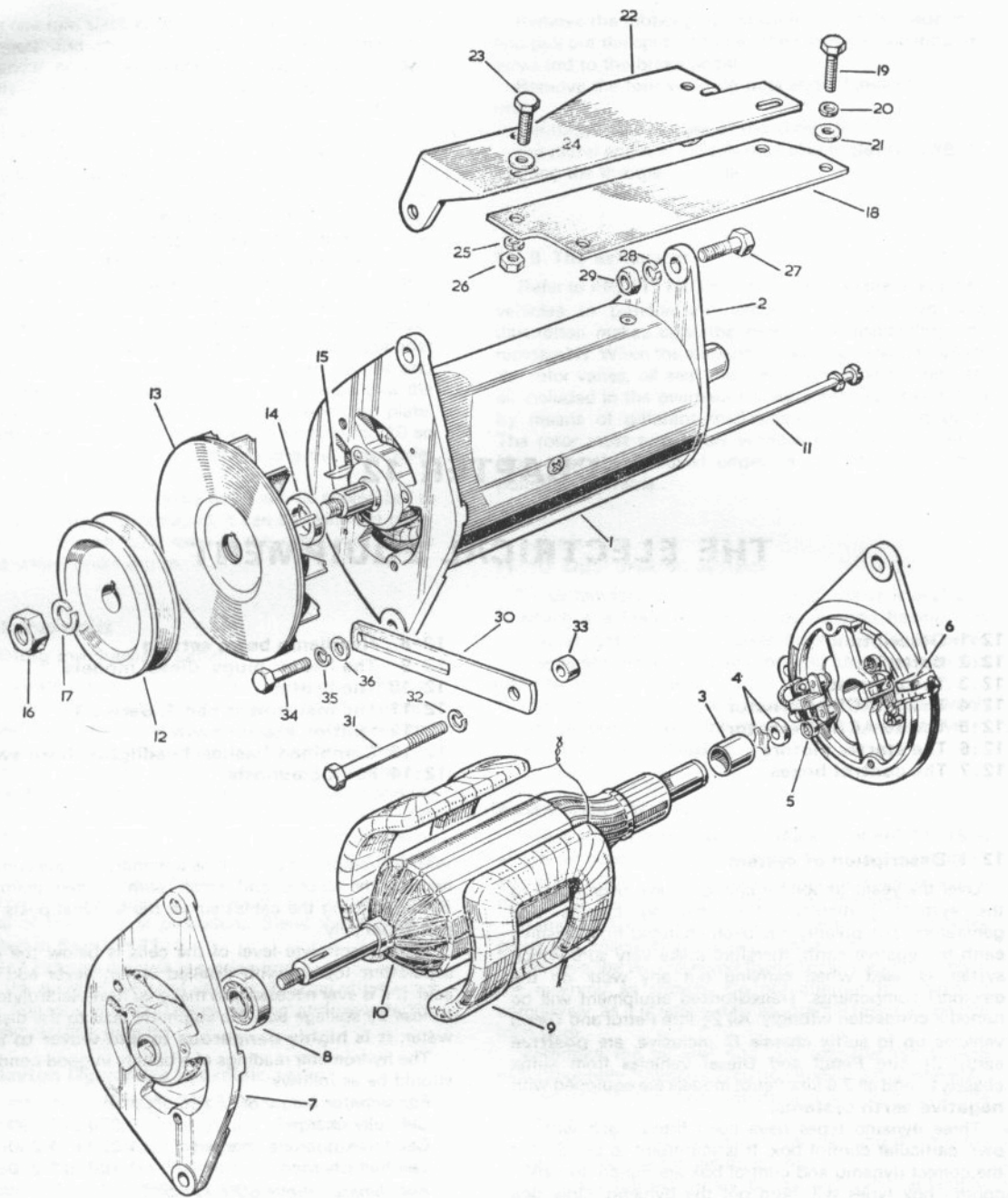


FIG 12:1 Generator, type C42

- | | | | | |
|-----------------------------------|---|---|---|--|
| Key to Fig 12:1 | 1 Yoke | 2 Bracket, commutator end | 3 Brush for armature, commutator end | 4 Oiler for dynamo |
| 5 Springs, set, for brush tension | 6 Brushes, set, for dynamo | 7 Bracket, drive end | 8 Ballbearing, drive end | 9 Field coil for dynamo |
| 10 Armature for dynamo | 11 Bolt for bracket | 12 Pulley for dynamo | 13 Fan for dynamo | 14 Distance washer for fan |
| 15 Woodruff key | 16 Special nut | 17 Spring washer | 18 Mounting plate for dynamo | 19 Setbolt ($\frac{1}{8}$ inch UNF x $\frac{3}{4}$ inch long) |
| 20 Spring washer | 21 Plain washer | 22 Anchor bracket for dynamo | 23 Bolt ($\frac{1}{8}$ inch UNF x 1 inch long) | 24 Plain washer |
| 25 Spring washer | 26 Nut ($\frac{5}{16}$ inch UNF) | 27 Bolt ($\frac{1}{8}$ inch UNF x 1 inch long) | 28 Spring washer | 29 Nut ($\frac{3}{8}$ inch UNF) |
| 30 Adjusting link for dynamo | 31 Setbolt ($\frac{3}{8}$ inch UNF x $2\frac{1}{2}$ inch long) | 32 Spring washer | 33 Distance piece | 34 Setbolt ($\frac{1}{8}$ inch UNC x $\frac{1}{2}$ inch long) |
| 35 Spring washer | 36 Plain washer | | | |

When removing one battery from a diesel vehicle always remove the connecting battery lead from both batteries.

12:3 The generator (dynamo)

Although detail differences exist between the three types, all the generators conform to the general configuration of FIG 12:1.

To test the generator in situ:

If the generator fails to charge, first check, and if necessary, adjust the driving belt tension. Petrol models should have $\frac{1}{2}$ to $\frac{3}{4}$ inch (12 to 19 mm) and diesel models $\frac{1}{16}$ to $\frac{1}{4}$ inch (4 to 6 mm) deflection of the belt at the mid point between the crankshaft and generator pulleys. Should this fail to correct the trouble proceed as follows:

- 1 Disconnect the two cables from the generator then link the terminals together with a short lead.
- 2 Start the engine and allow to run at idling speed. Clip one lead of a good quality moving coil voltmeter, calibrated 0 to 20 volts to the linked terminals of the generator. Clip the other lead from the voltmeter to a good earthing point on the body (yoke) of the generator.
- 3 Gradually increase the engine speed; the voltmeter reading should rise rapidly without fluctuations. Do not allow the voltmeter reading to reach 20 volts and do not race the engine in an attempt to obtain a reading. An engine speed of 1000 rev/min should not be exceeded.
- 4 No reading points to brush gear failure, a reading of $\frac{1}{2}$ to 1 volt is a possible fault in the field winding and 4 to 5 volts, a faulty armature.
- 5 If the generator is found to be serviceable, remove the link connecting the terminals and reconnect the cables to the control box.

To service the generator:

If the armature or field coil is faulty, the wisest plan is to exchange the whole generator for a factory rebuilt unit. However, it may be that attention to the brush gear and commutator will effect a cure.

Refer to FIG 12:1.

- 1 Unscrew the two through-bolts 11 and withdraw them.
- 2 Pull off the commutator end bracket, 2, complete with the brush gear attached.
- 3 Pull off the drive end bracket 7, complete with the armature. A thin steel or fibre thrust washer may be fitted to the spindle at the commutator end; do not lose this.
- 4 If the ball race 8, is slack or roughness can be felt when the bracket is rotated, the race can be renewed (refer to FIGS 12:3 and 12:4).
- 5 With the armature free of its bearings, examine the commutator. Early types are fabricated, later ones are moulded. If it is only discoloured it can be cleaned up by rotating the armature in a lathe and holding a piece of glasspaper to the surface. If it is pitted or burnt, mount the armature in the lathe between centres and using a sharp tool, fine feed and medium speed, remove the minimum amount of metal to just clean up the surface. A moulded commutator must not be reduced beyond 1.450 inch (36.83 mm) diameter,

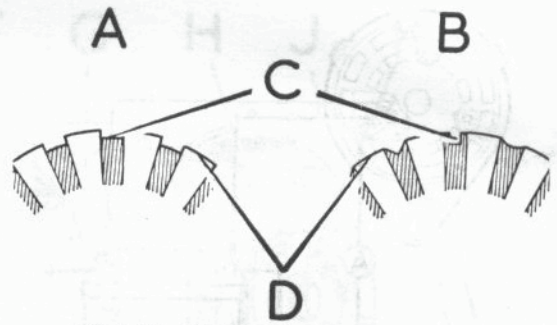


FIG 12:2 Undercutting the commutator

Key to Fig 12:2 A Correct B Incorrect
C Insulators D Segments

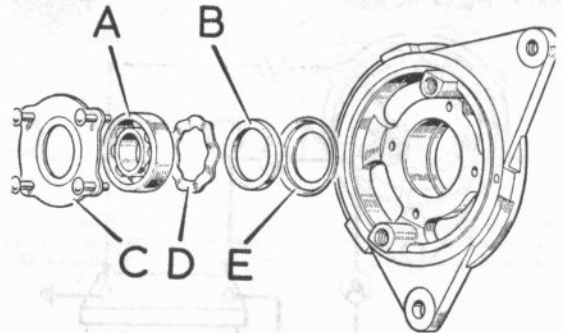


FIG 12:3 Bearing location, early type

Key to Fig 12:3 A Bearing B Felt washer
C Retaining plate D Corrugated washer
E Retaining washer

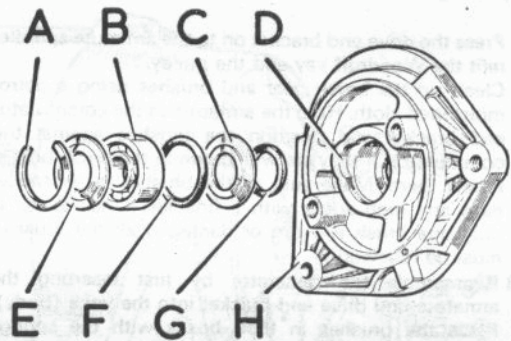


FIG 12:4 Bearing location, latest type

Key to Fig 12:4 A Circlip B Bearing
C Felt ring retaining plate D Circlip extractor notch
E Bearing retaining plate F Pressure ring G Felt ring
H End plate

After this, the insulation between the copper segments of the early type fabricated commutator must be undercut as shown in FIG 12:2 to a depth of $\frac{1}{2}$ inch (.7 mm). A hacksaw blade ground to the width of the insulation is the best tool for this operation. A moulded commutator cannot be undercut.

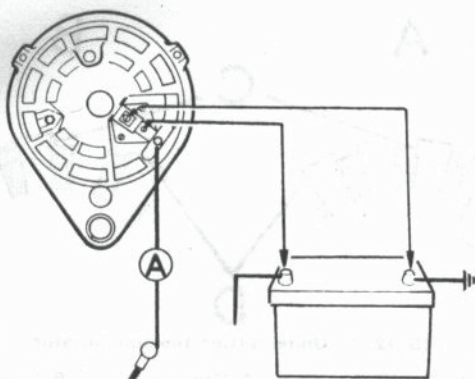


FIG 12:5 Alternator output test

Key to FIG 12:5

A Ammeter

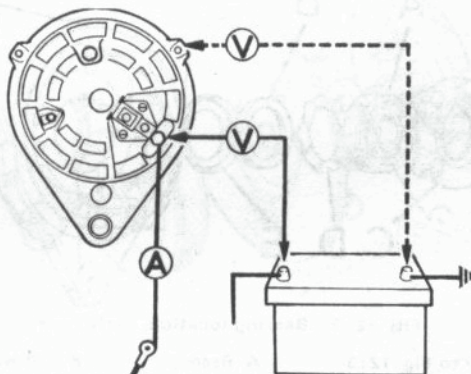


FIG 12:6 Charging circuit, voltage drop test

Key to FIG 12:6

A Ammeter

V Voltmeter

- 6 Press the drive end bracket on to the armature spindle, refit the Woodruff key and the pulley.
- 7 Clean up the brush gear and brushes using a petrol moistened cloth. Hold the armature in the commutator end bracket and position the brushes against the commutator. If they are well down in the brush boxes, renew them. Make sure all the brushes move freely; ease any high spots with a fine file if necessary. If only one brush is worn or damaged all the brushes must be renewed.
- 8 Reassemble the generator by first inserting the armature and drive end bracket into the yoke (body). Place the brushes in their boxes with the springs against the side of each brush. Replace the commutator end bracket until the brushes are just over the commutator, then with a thin screwdriver press the brushes down and position the brush springs behind the brushes. Complete the insertion of the armature.
- 9 Replace and tighten the through-bolts.
- 10 Inject a few drops of SAE.30 oil into the oil hole at the end of the commutator bearing housing.

12:4 The 11 ACR alternator

Warning: If a fast charger is used to boost the battery or start the engine, withdraw the three-way connector from the 4TR control box. Do not reconnect until the

charger is withdrawn and the engine speed is reduced to idling. Disconnect the battery completely when any work is being done on the alternator or its control gear.

Testing the system:

- 1 Check the alternator driving belt for correct tension.
- 2 Disconnect the battery negative terminal and the 35 amp alternator output lead. Connect a good quality moving coil ammeter between the output terminal and the alternator output lead.
- 3 Disconnect the leads from the alternator field terminals and connect them to the battery terminals with extension leads. Polarity is not important (see FIG 12:5).
- 4 Reconnect the battery negative terminal. Start the engine and speed up until the alternator is running at about 4000 rev/min. The ammeter should read 40 amps if the alternator and output cable are in order.
- 5 If a zero or low reading is obtained, check the output circuit and wiring by connecting a voltmeter between the alternator output terminal and the battery positive terminal and noting the reading (see FIG 12:6), then transfer the voltmeter to the alternator frame and the battery negative terminal noting the reading. If either reading exceeds .5-volt there is high resistance in the circuit that must be corrected.
- 6 If the test at paragraph 5 does not reveal high resistance and the alternator output is low, examine the brush gear. If no fault can be found here the alternator must either be overhauled or renewed.
- 7 If the alternator output is in order, disconnect the battery negative terminal, remove the ammeter and connect the alternator output cable to its terminal. Remove the extension leads from the alternator field cables.
- 8 Connect the battery negative terminal. Switch on the ignition and check that battery voltage is applied to the cable normally attached to the alternator field terminals by connecting a voltmeter across them. A reading of battery voltage proves that the field isolating relay circuit and wiring is in order. Conversely a low or zero reading indicates a fault in the field isolating relay or the isolating contacts in the ignition switch (as applicable) associated wiring or the alternator control unit. To test the field isolating relay refer to FIG 12:7 and connect terminals C1 and C2 in series with a 1.5 watt bulb and a 12-volt battery. Connect terminals W1 and W2 to the battery terminals. The bulb should light when the relay winding between W1

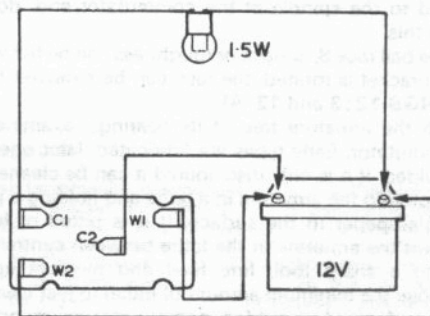


FIG 12:7 Testing the field isolating relay

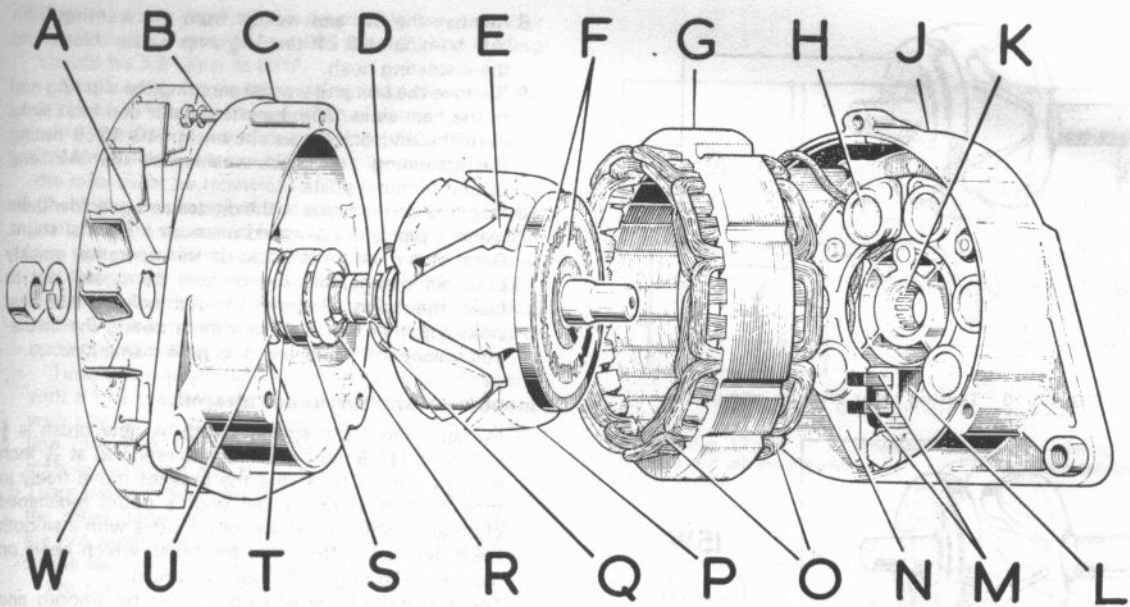


FIG 12:8 Exploded view of alternator

Key to Fig 12:8 A Woodruff key B Through-bolt (3) C Drive end bracket D Jump ring shroud E Rotor (field) winding
 F Slip rings G Stator laminations H Silicon diodes (6) J Slip ring end bracket K Needle roller bearing L Brush box
 M Brushes (2) N Diode heat sink (2) O Stator winding P Rotor Q Circlip R Bearing retainer plate S Ballbearing, drive end
 T O-ring U O-ring retaining washer W Fan

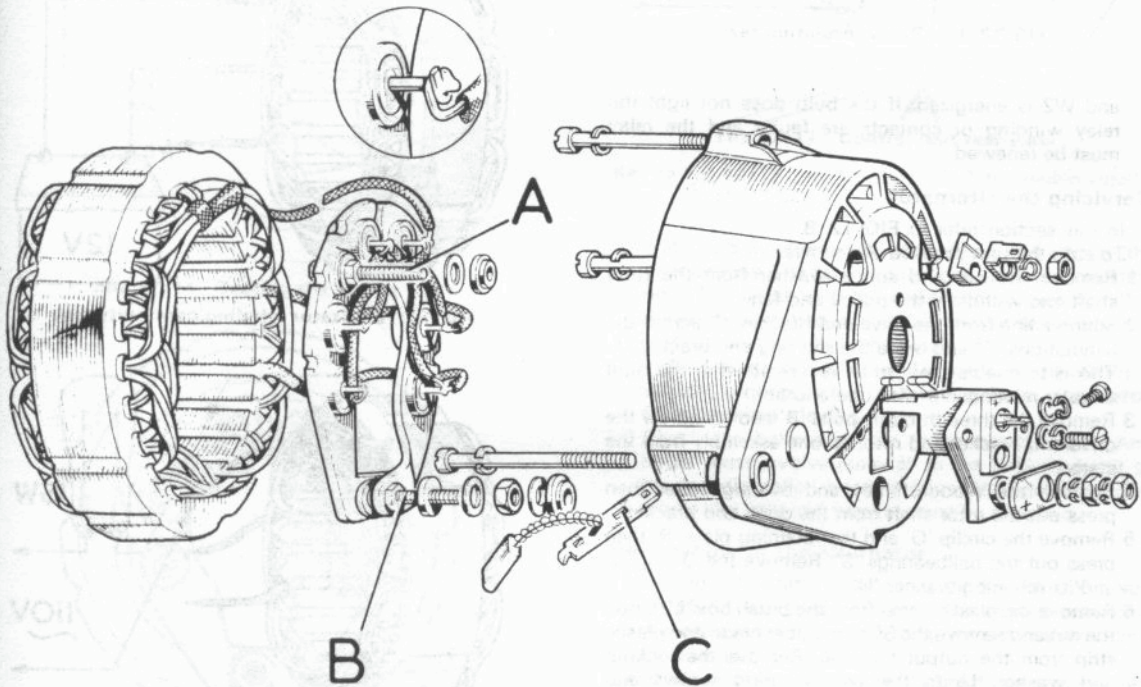


FIG 12:9 Slip ring end showing heat sinks

Key to Fig 12:9 A Warning light terminal 'AL' B Output terminal C Terminal block retaining tongue

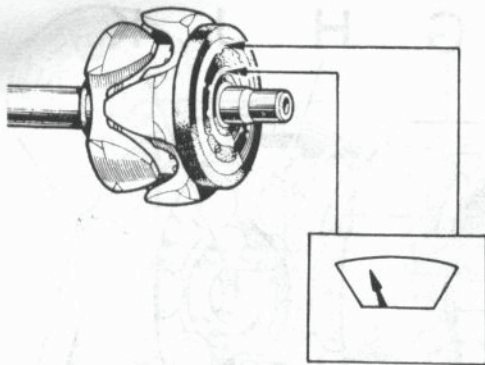


FIG 12:10 Testing rotor with an ohmmeter

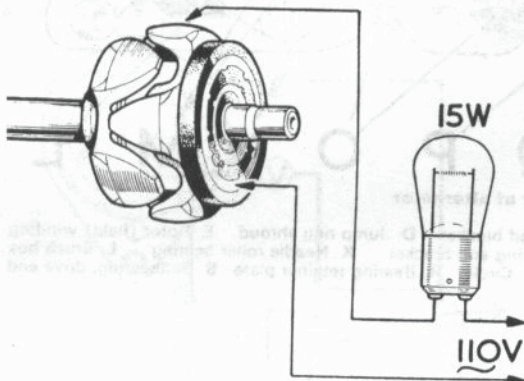


FIG 12:11 Rotor insulation test

and W2 is energized. If the bulb does not light the relay winding or contacts are faulty and the relay must be renewed.

Servicing the alternator

In this section refer to FIG 12:8.

To strip the unit proceed as follows:

- 1 Remove the nut and spring washer from the rotor shaft and withdraw the pulley and fan.
- 2 Scribe a line from the drive end bracket 'C' across the laminations 'G' and on to the slip ring end bracket 'J'. This is to enable them to be reassembled in the right angular relationship with one another.
- 3 Remove the three through-bolts 'B' and withdraw the drive end bracket and rotor as one assembly from the stator.
- 4 Remove the Woodruff key and bearing collar then press out the rotor shaft from the drive end bracket.
- 5 Remove the circlip 'O' and the retaining plate 'R' then press out the ballbearings 'S'. Remove the O-ring 'T' and its retaining washer 'U'.
- 6 Remove the plastic cover from the brush box 'L'. Undo the nut and remove the 35 amp Lucar blade and plastic strip from the output terminal. Remove the locknut and washer. Undo the two securing screws and washers and withdraw the brush box 'L'.
- 7 Withdraw the brush-spring-terminal assemblies 'M' from the brush box 'L'.

- 8 Remove the nut and washer from the warning light 'AL' terminal. Lift off the 17½ amp 'Lucar' blade and the insulating bush.
- 9 Remove the bolt and washer securing the slip ring end to the heat sinks. Withdraw the stator end heat sinks from the end bracket as shown in FIG 12:9 noting the insulating and plain washers at the 'AL' and output terminal posts.
- 10 Note the connections to the diodes and unsolder them using a pair of long-nosed pliers as a thermal shunt. Great care must be taken to do this operation quickly to avoid overheating the diodes. Be careful not to bend their pins. Remove the nut holding the heat sinks together then separate them noting the insulation washers. The alternator is now dismantled.

Inspection and testing of alternator:

- 1 Measure the brush spring length. A new brush is $\frac{5}{8}$ inch long (15.9 mm) and must be replaced at $\frac{5}{32}$ inch long (4 mm). Check that the brushes move freely in their holders. If not, clean with a petrol moistened cloth and lightly polish the brush sides with a smooth file if necessary. Note that the brush which bears on the inner slip ring is the positive brush.
- 2 The surfaces of the slip rings must be smooth and clean. Wipe the surfaces with a petrol moistened cloth, or, if there are signs of burning, with smooth glass-paper. No attempt should be made to machine the rings.

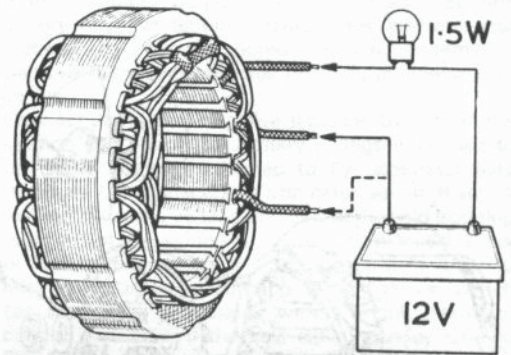


FIG 12:12 Stator winding continuity test

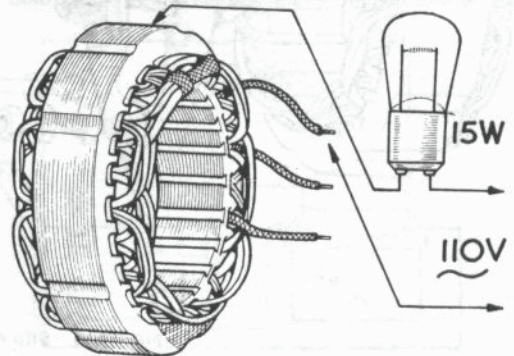


FIG 12:13 Stator winding insulation test

3 Test the rotor windings by connecting an ohmmeter between the slip rings (see FIG 12:10). The reading should be 3.8 ohms at 68°F.

Test the slip ring/rotor winding insulation by using a 110-volt AC mains supply with a test lamp in series with a slip ring and rotor pole (see FIG 12:11). If the lamp lights the insulation has broken down and the rotor must be renewed.

4 Check the continuity of the stator windings with the stator cables separated from the heat sinks. Connect any two of the three cables in series with a 1.5 watt test lamp and a 12-volt battery (see FIG 12:12). Repeat, replacing one of the two cables with the third cable. If the lamp fails to light, part of the winding is open circuit and the stator must be renewed.

Test the insulation between the coils and laminations with a 110-volt AC supply and 15 watt bulb in series with any one of the three cable ends and the lamination (see FIG 12:13). If the bulb lights the stator coils are earthing and the stator must be renewed.

5 There are two heat sink assemblies, one positive and the other negative. Each carries three diodes which are not separately replaceable. If one is defective the whole heat sink must be replaced.

For service purposes the diodes can be tested as shown in FIG 12:14. Disconnect the stator leads from the diodes as described earlier if this has not already been done. Connect a 12-volt battery and 1.5

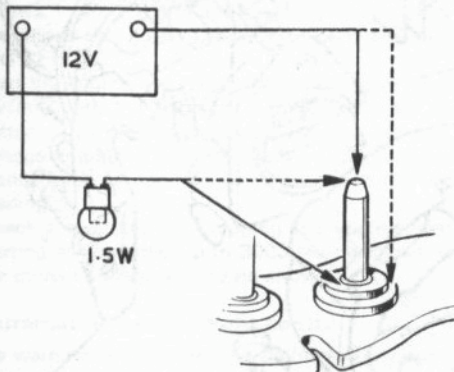


FIG 12:14 Testing the diodes

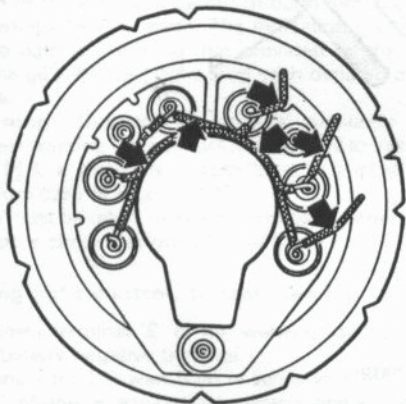


FIG 12:15 Layout of heat sink cables

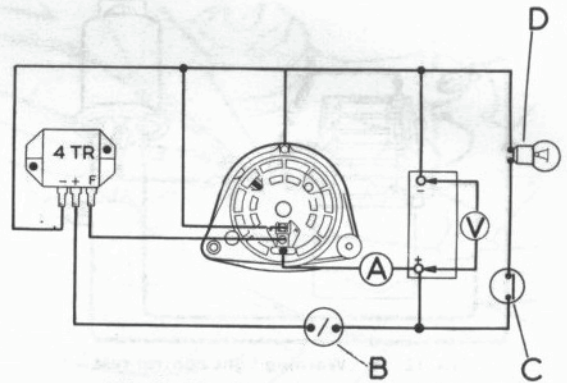


FIG 12:16 Control unit test circuit

Key to Fig 12:16 A Ammeter B Field isolating relay
C Side and tail lamp switch D Side and tail lamps
V Voltmeter

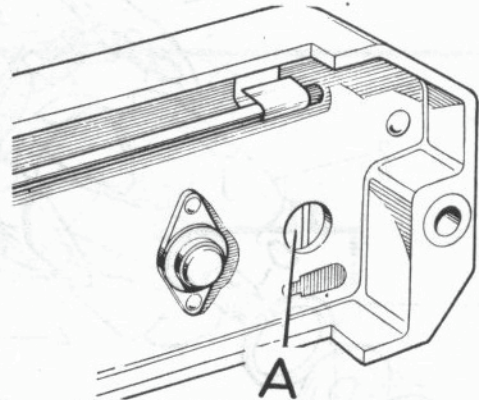


FIG 12:17 Control unit rear view

Key to Fig 12:17 A Potentiometer adjuster

watt bulb in series with each diode and reverse the connections. The bulb should light up in one direction only. If it lights with the connections made in either direction or fails to light at all, the diode is defective and the heat sink must be renewed.

Warning: Never use the type of ohmmeter which incorporates a hand driven generator for checking diodes.

6 Check the ballbearing for roughness or slack. Any doubt must involve renewal. In the unlikely event of the needle roller bearing becoming defective the whole slip ring end bracket must be renewed.

Reassembly of the alternator:

- 1 Resolder the stator wires to the diodes using M grade 45/55 tin/lead solder. Observe the same precautions against overheating or bending the pins as described for dismantling.
- 2 After soldering, tack the connections down with 3M.EC.1022 adhesive so that the layout appears as shown in FIG 12:15 and gives adequate clearance for the rotor.

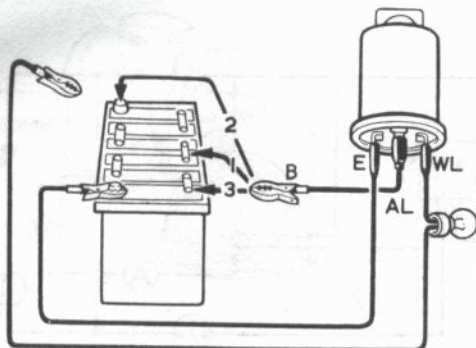


FIG 12:18 Warning light control test

Key to Fig 12:18 Connect battery clip 'B' in sequence 1, 2 and 3

3 The rest of the assembly procedure is the reverse of dismantling but particularly note these points:

- (a) The insulation washers between the heat sinks are in the order of: thick plain washer, thin plain washer, then small plain washer.
- (b) Refit the plain and insulating washers to the 'AL' and output terminal posts before fitting the stator to the slip ring end bracket.
- (c) Fit the two small insulating washers under the brush box.
- (d) To ensure the Lucar terminals of the brushes are properly retained, the tongue should be levered up to make an angle of 30 deg. with the terminal blade.
- (e) Support the inner journal of the drive end bearing when pressing in the rotor shaft. Do not use the bracket as a support for the bearing while fitting the rotor shaft.

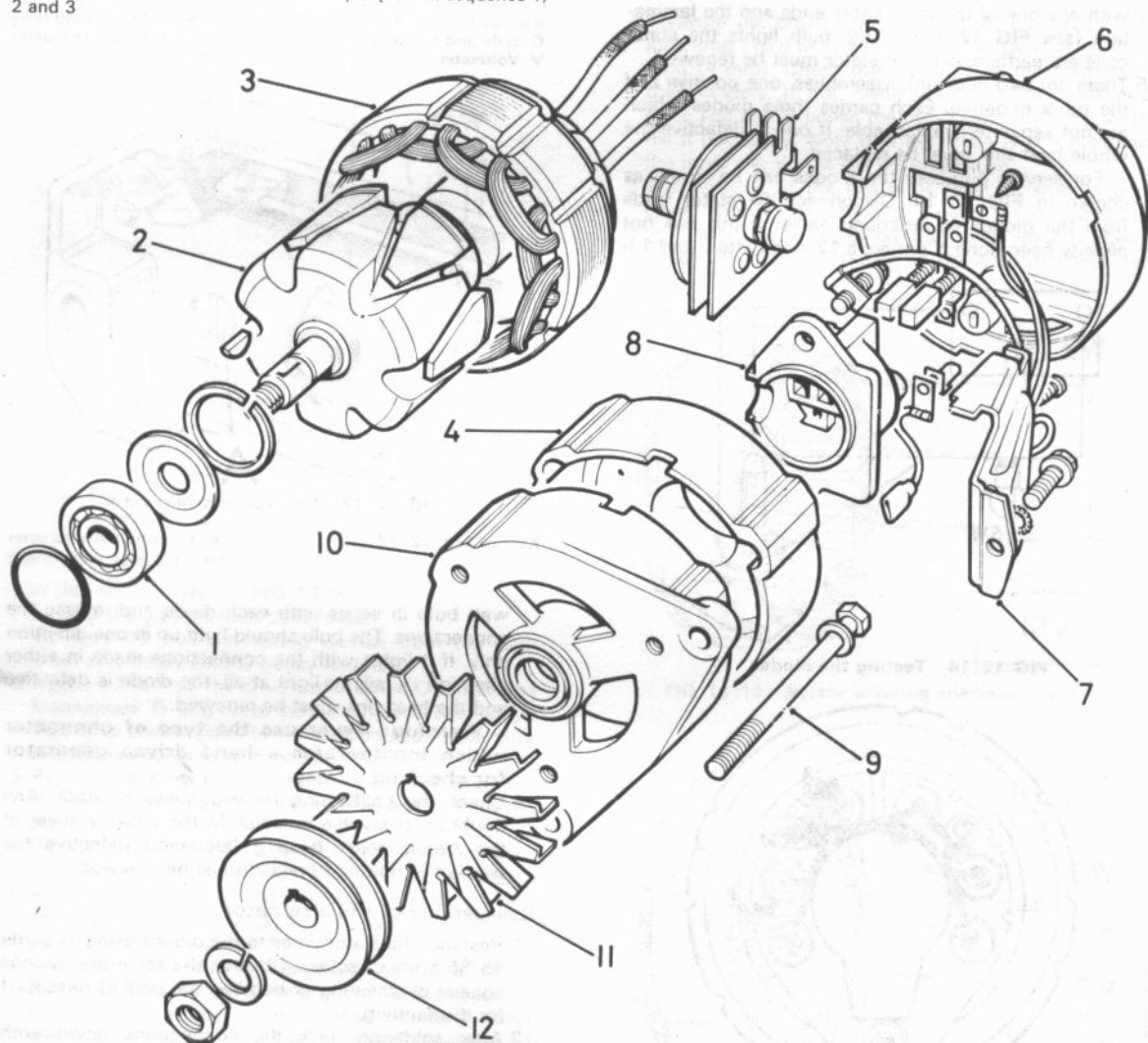


FIG 12:19 The 16 ACR alternator

Key to Fig 12:19 1 Drive end bearing 2 Rotor and slip ring 3 Stator 4 Slip ring end bracket 5 Rectifier 6 End cover 7 Regulator 8 Brush box 9 Throughbolt 10 Drive end bracket 11 Fan 12 Pulley

(f) Align the drive end bracket, laminations and slip rings bracket with the line previously scribed along these three components and tighten the three bolts evenly. Check that the rotor spins freely.

The control unit, test and adjust:

Testing the unit:

- 1 Refer to FIG 12:16. Disconnect the alternator main output lead and connect a 50 amp range ammeter in series with the lead and the alternator. Connect a voltmeter of at least 1 per cent accuracy between the battery terminals and note the reading with all the electrical equipment switched off.
- 2 Switch on the side and tail lamps to give a load of approximately 2 amps.
- 3 Start the engine and run the alternator at 3000 rev/min for at least 8 minutes to stabilize the system. If the charging current is then still above 10 amps continue to run until this figure is reached. The voltmeter should then read 13.9 to 14.3 volts.
- 4 If the reading on the voltmeter is stable but outside these limits, adjustment is possible. If the reading remains unchanged at open circuit battery voltage or increases in an uncontrollable manner, the control unit must be renewed.

Adjusting the unit:

- 1 Stop the engine and remove the control unit securing screws, invert the unit and carefully scrape away the compound that covers the potentiometer adjuster (see FIG 12:17).
- 2 Start the engine and run the alternator at about 3000 rev/min with the voltmeter firmly connected to the battery. Turn the adjuster clockwise to increase the voltage or anticlockwise to decrease it. A small movement makes an appreciable difference to the voltage reading.
- 3 Check the setting by stopping the engine then re-starting and running up to 3000 rev/min again when the correct voltage should be shown.

The alternator warning light control:

The warning light control is a thermally operated relay for controlling the switching on and off of an instrument panel warning light. It is connected to the centre point of one pair of the alternator diodes through terminal 'AL' on the alternator, and to earth. The indication given by the warning light is similar to that provided by the ignition ('No charge') warning light used with dynamo charging systems.

Warning: Due to the external similarity of the alternator warning light control model 3AW to flasher unit model FL5, a distinctive green label is applied to the aluminium case of model 3AW.

Care must be taken to avoid connecting either of these units into a circuit designed for the other.

Warning light control, to test (see Fig 12:18):

- 1 Connect terminal 'E' of the warning light control to the battery negative terminal.
- 2 Connect the 2.2 watt bulb in series with the terminal 'WL' of the warning light control and the positive battery terminal. The bulb should light up immediately.

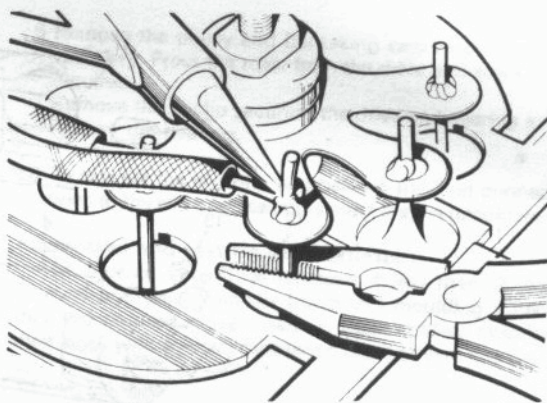


FIG 12:20 Unsoldering the stator connections

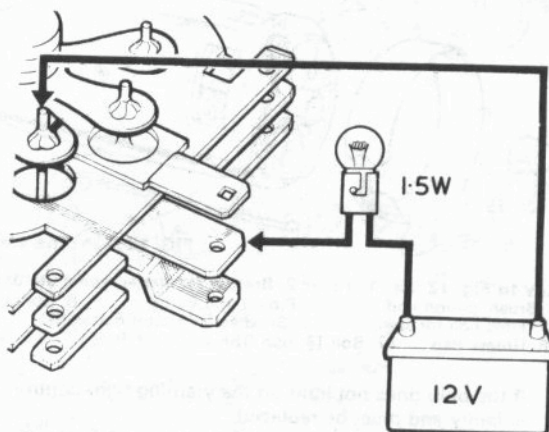


FIG 12:21 Testing the diodes

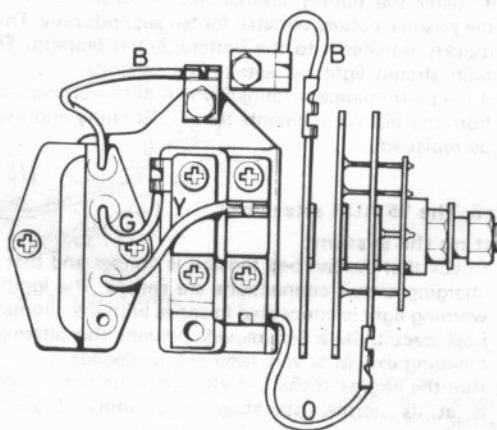


FIG 12:22 Regulator, brush box and rectifier leads

Key to Fig 12:22 B Black G Green O Orange Y Yellow

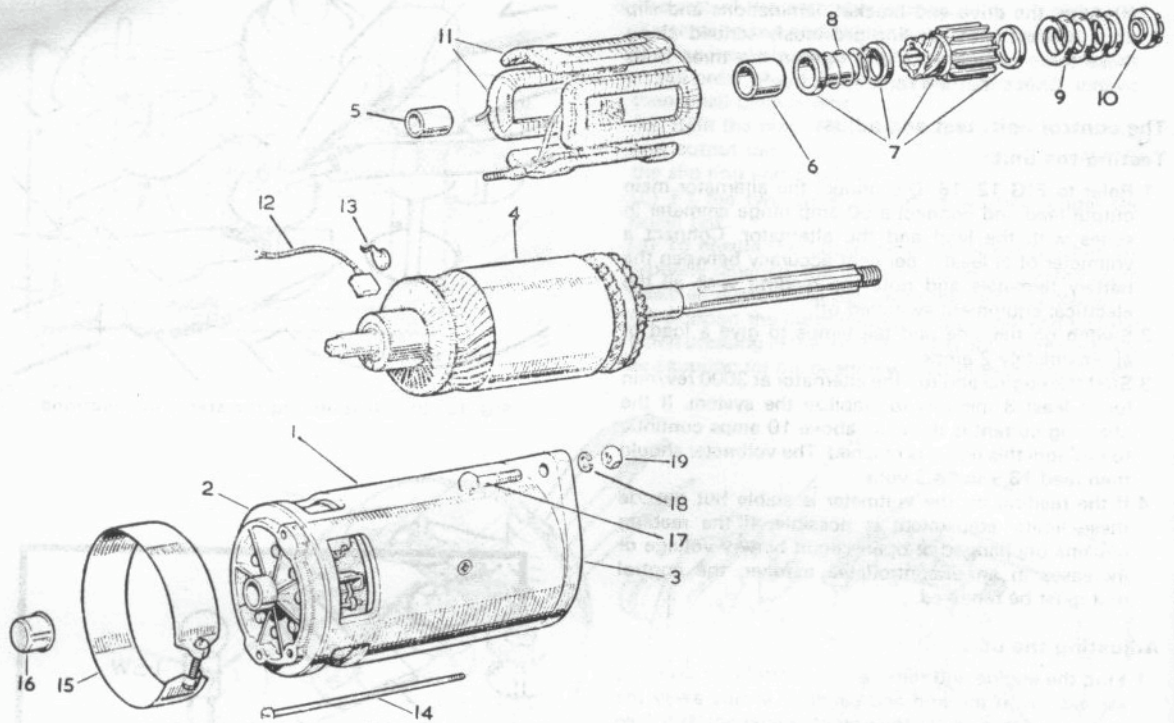


FIG 12:23 The starter motor inertia type

Key to Fig 12:23 1 Yoke 2 Bracket for starter, commutator end 3 Bracket, drive end 4 Armature 5 Brush, commutator end
 6 Brush, pinion end 7 Pinion and sleeve 8 Spring for pinion 9 Main spring for pinion 10 Nut for pinion
 11 Field coil for starter 12 Brushes for starter motor, set 13 Spring set for brushes 14 Bolt for bracket 15 Coverband
 16 Grease cap 17 Bolt ($\frac{3}{8}$ inch BSF x $1\frac{1}{2}$ inch long) 18 Spring washer 19 Nut ($\frac{3}{8}$ inch BSF)

If the bulb does not light up the warning light control is faulty and must be replaced.

- 3 With the terminals connected as in 1 and 2 above, connect terminal 'AL' of the warning light control to the 6-volt tapping of the battery. The bulb should go out within five seconds.
- 4 Transfer the battery connection of terminal 'AL' to the positive battery terminal for ten seconds only. Then quickly transfer it to the battery 2-volt tapping. The bulb should light up within five seconds.
- 5 If the performance in items 3 and 4 differs appreciably from the test requirements the unit is faulty and must be replaced.

- 4 Connect a 0-40 ammeter between the alternator and the battery. Connect a 0-20 voltmeter across the battery terminals. Connect a 15 ohm 35 amp variable resistor across the battery terminals. Do not connect for longer than is necessary to conduct the tests as it will become hot.
- 5 Start the engine and run it at 750 rev/min. The warning light should go out. Increase the engine speed to 3000 rev/min and adjust the variable resistance until the voltmeter reads 14 volts. The ammeter should then read 34 amps. If appreciable deviation is found dismantle and service the alternator. If the test is satisfactory proceed with the regulator test.

12:5 The 16 ACR alternator

Testing the system:

- 1 Check that the fan belt tension is correct and that all charging circuit connections are secure. The ignition warning light is connected in series with the alternator field circuit. Bulb failure will prevent the alternator charging except at very high engine speeds.
- 2 Run the engine at the fast idle speed until the engine is at its normal operating temperature. Stop the engine.
- 3 Withdraw the connector from the alternator and remove the end cover. Link the terminals marked 'F' and '—'.

Regulator test:

- 6 Disconnect the variable resistor and remove the link joining the terminals marked 'F' and '—'.
- 7 With the remainder of the circuit unaltered run the engine at 3000 rev/min until the ammeter shows an output current of less than 10 amps.
- 8 The voltmeter reading should then be between 14.0 and 14.4 volts. Any appreciable deviation from the test figures stated indicates that a new regulator is required.

Dismantling the alternator:

- 1 Refer to the exploded diagram of the components in FIG 12:19. Remove the rear cover.

- 2 Unsolder the stator connections from the rectifier pack noting the position of the connections. The diodes will be damaged unless pliers are used as a heat sink as shown in FIG 12:20.
- 3 Unscrew the brush moulding securing screws and if necessary the lower regulator pack securing screw. Slacken the rectifier pack retaining nuts and withdraw both brush moulding with or without regulator pack and rectifier pack.
- 4 Remove the three through bolts.
- 5 Fit a tube over the slip ring moulding so that it registers against the outer track of the slip ring end bearing and carefully drive the bearing from its housing.

- 6 Remove the pulley and fan taking care to collect the shaft key. Press the rotor from the drive end bracket if required.
- 7 Remove the circlip securing the drive end bearing and remove the bearing.
- 8 To remove the slip ring end bearing the field connections to the slip ring assembly must first be unsoldered.

Inspection and testing of alternator:

The brushes should be replaced if less than .2 inch (5 mm) protrudes from the brush box moulding. Check that the brushes move freely in their holders cleaning their sides with a petrol moistened cloth or very fine file if

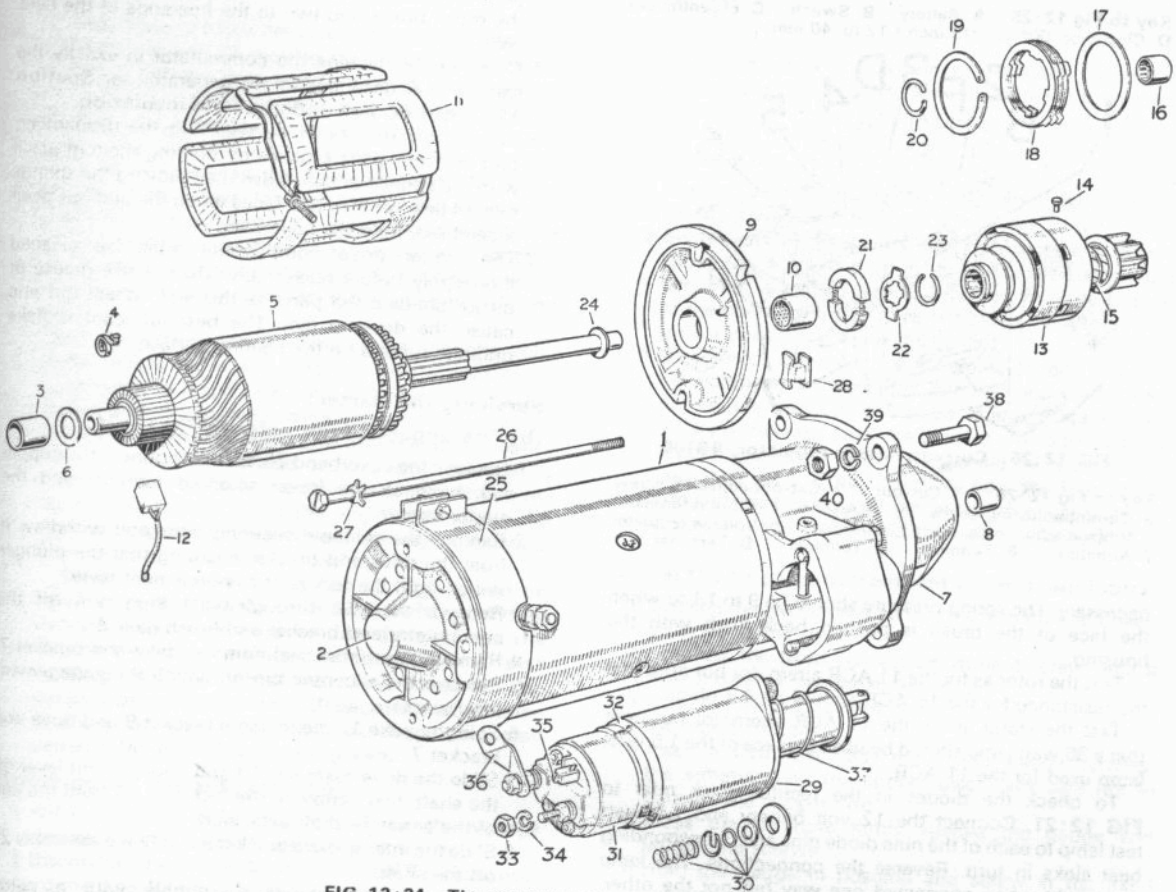


FIG 12:24 The starter motor, pre-engaged type

- Key to Fig 12:24
- | | | | | |
|---|--|---|---|------------|
| 1 Yoke | 2 Bracket, commutator end | 3 Bush, commutator end | 4 Spring set for brushes | 5 Armature |
| 6 Thrust washer, commutator end | 7 Bracket for starter, drive end | 8 Bush for bracket | 9 Bracket for brake | |
| 10 Bush for brake bracket | 11 Field coil for starter | 12 Brushes for starter pinion | 13 Drive assembly for starter motor | |
| 14 Rivet for pinion retaining ring | 15 Return spring for starter pinion | 16 Bush, pinion end | 17 Clutch adjusting shim | |
| 18 Clutch plates | 19 Circlip retaining clutch assembly | 20 Lock ring retaining clutch plates | 21 Brake shoe complete with springs | |
| 22 Driving washer for brake shoe | 23 Lock ring retaining brake | 24 Coverband for starter | 25 Bolt for starter motor | |
| 27 Lockwasher for bolt | 28 Rubber grommet in drive end bracket | 29 Solenoid for starter motor | 30 Contact plate for solenoid | |
| 31 Base for solenoid | 32 Gasket for starter solenoid base | 33 Terminal nut for starter solenoid | 34 Terminal washer for starter solenoid | |
| 34 Terminal washer for starter solenoid | 35 Terminal screw for solenoid | 36 Terminal connector for starter motor | 37 Plunger spring for solenoid | |
| 40 Nut ($\frac{1}{8}$ inch UNF) | 38 Bolt ($\frac{7}{8}$ inch UNC x $1\frac{1}{2}$ inch long) | 39 Spring washer | | |

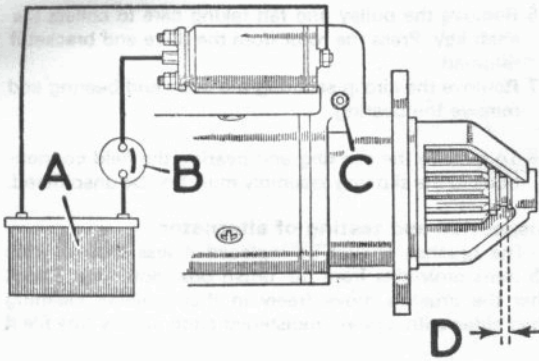


FIG 12:25 Adjusting pinion clearance

Key to Fig 12:25 A Battery B Switch C Eccentric pin
D Clearance .005 to .015 inch (.12 to .40 mm)

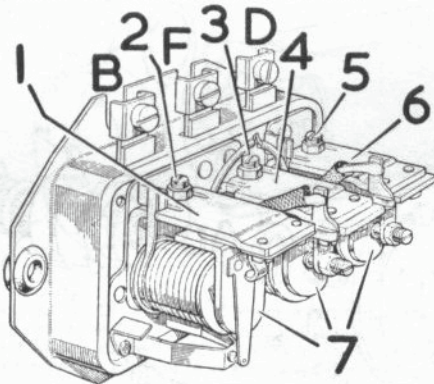


FIG 12:26 Current voltage regulator, RB106

Key to Fig 12:26 1 Cut-out 2 Cut-out adjusting screw
3 Current adjusting screw 4 Current regulator
5 Voltage adjusting screw 6 Voltage regulator
7 Armature B Terminal F Terminal D Terminal

necessary. The spring pressure should be 9 to 13 oz when the face of the brush is pushed back flush with the housing.

Test the rotor as for the 11 ACR alternator but note that the resistance for the 16 ACR should be 4.3 ohms.

Test the stator as for the 11 ACR alternator but note that a 36 watt lamp should be used in place of the 1.5 watt lamp used for the 11 ACR.

To check the diodes in the rectifier pack refer to FIG 12:21. Connect the 12 volt battery and 1.5 watt test lamp to each of the nine diode pins and corresponding heat sinks in turn. Reverse the connections. The lamp must light when connected one way but not the other. If this is not so renew the rectifier pack.

Reassembly:

Reverse the dismantling procedure. Lubricate the bearings with Shell Alvania 'RA'. Use Fry's H.T.3 solder on the slip ring field connections.

When refitting the rotor to the drive end bracket ensure that the inner track of the bearing is supported.

Reconnect the leads between the regulator, brush box and rectifier as shown in FIG 12:22.

12:6 The starter motors

(a) Inertia type:

Servicing the starter, refer to Fig 12:23:

- 1 Remove the coverband, 15, hold back the brush springs and release the brushes 12.
- 2 Pull out the splitpin and unscrew the nut holding the starter drive pinion, early models; on later models, compress the spring and remove the circlip. Remove the drive pinion assembly.
- 3 Unscrew the two long through-bolts 14, then pull off the brackets from each end of the yoke. Remove the armature.
- 4 Clean all the components with a petrol moistened cloth then service the brushes and brush gear as described in Section 12:3 for the generator. If new brushes are to be fitted, the flexible connectors must be soldered to the terminal tags. Two are connected to the brush boxes and two to the free ends of the field coil.
- 5 Clean up or machine the commutator in exactly the same way as described for the generator, see Section 12:3, but do not undercut the insulation.
- 6 Reassemble the starter by reversing the dismantling process, fitting the brushes by holding them in place with the springs at their sides then moving the springs over to bear on their rear faces when the unit has been assembled. Refit the coverband.
- 7 The starter drive components must be cleaned thoroughly before reassembly. Do not use grease or oil to lubricate the parts as this will collect dirt and cause the drive to jam. The best lubricant is flake graphite rubbed on the bearing surfaces.

Servicing the starter:

(b) Pre-engaged type, refer to Fig 12:24:

- 1 Remove the coverband 25, then disconnect the copper link between the lower solenoid terminal and the starter casing.
- 2 Remove the solenoid securing bolts and withdraw it from the drive end bracket ensuring that the plunger is free from the fork in the engagement lever.
- 3 Remove the two through-bolts then pull off the commutator end bracket and brush gear 2.
- 4 Remove the rubber seal from the drive end bracket 7.
- 5 Remove the eccentric pin on which the engagement lever pivots.
- 6 Split the yoke 1, intermediate bracket 9 and drive end bracket 7.
- 7 Slide the drive assembly 13 and engagement lever off the shaft, first removing the lock ring 24 from the end of the armature shaft extension.
- 8 Slide the intermediate bracket 9 and brake assembly 21 off the shaft.
- 9 Clean all components thoroughly with a petrol moistened cloth.
- 10 Service the brushes and commutator exactly as described for the petrol engine starter.

To rebuild the starter reverse the dismantling process. When fitting the starter drive clutch unit, make sure it moves freely on the armature shaft then smear the shaft with a general purpose grease.

The engagement of the pinion movement must now be set. Proceed as follows, referring to FIG 12:25 for clarity.

- 1 Connect a twelve volt supply to the small centre terminal and a solenoid fixing stud as shown.
- 2 Close the switch B, thus throwing the drive into engagement.
- 3 Keep light pressure against the pinion to take up any slack, then turn the eccentric pivot pin C, until the dimension 'D' is .005 to .015 inch (.12 to .40 mm). After setting, lock the nut.

12:7 The control box, DC generator (dynamo)

When cleaning current or voltage regulator contacts use a fine carborundum stone or silicone carbide paper followed by washing with methylated spirit. When cleaning the cut-out contacts use fine glasspaper; never carborundum stone or emerycloth.

Checking the voltage regulator, type RB106 (see FIG 12:26):

Place a piece of paper between the cut-out contacts 1, and connect a 0 to 20 moving coil voltmeter to the 'D' terminal on the regulator and to a good earth (not the one on the box). Start the engine and increase rev/min until the voltage remains constant. This should occur between 15.8 and 16.4 volts. If it does, transfer the earth lead of the voltmeter to the 'E' terminal on the box. If the reading is now lower the fault lies in a bad connection between the box and earth. If the reading was incorrect in the first instance reset the voltage regulator as follows:

- 1 Disconnect control box terminal B. Connect a good moving coil 0 to 20 voltmeter between terminal D and earth.
- 2 Start the engine and increase speed until the voltmeter needle flicks and steadies. This should occur at between 14.2 and 14.8 volts. If it does not, stop the engine and remove the control box cover. Slacken the adjusting screw locknut 5 and turn the screw clockwise to raise the voltage setting, anticlockwise to lower it. Turn the screw a fraction at a time and re-tighten the locknut. Start the engine and check the reading. Repeat until the correct reading is obtained. Reconnect terminal B to its cable.

When the generator is run at high speed on open circuit it builds up a high voltage. When carrying out this adjustment do not run the engine up to more than half throttle or a false reading will be obtained. Try to keep the periods of running below 30 seconds, otherwise heating of the regulator winding can also cause a false reading to be given.

Checking the current regulator:

- 1 Refer to FIG 12:27 and shortcircuit the voltage regulator with a large crocodile clip as shown.
- 2 Disconnect the two cables from terminal B and connect a good 0 to 40 amp ammeter between the cables and the terminal. Do not leave any cables attached to terminal B except the ammeter cable.
- 3 Switch on all lamps and accessories to load the circuit. Check that the ammeter is correctly wired to show a discharge.
- 4 Start the engine and speed up until the generator is running at approximately 3000 rev/min. The ammeter should be steady and show a current of 19 amps (C39 dynamo). If not, slacken the locknut on the

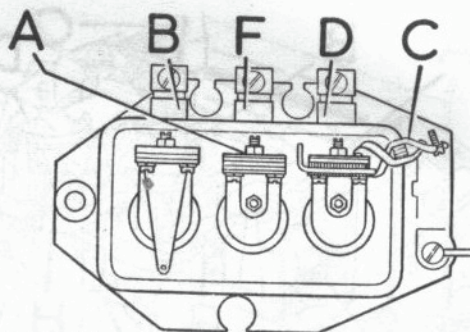


FIG 12:27 Shortcircuiting the voltage regulator

Key to Fig 12:27
 A Current regulator adjusting screw
 B Terminal
 F Terminal
 C Clip, shortcircuiting
 D Terminal

adjusting screw 3, and turn as described for setting the voltage regulator. Remake the terminal B connection.

To set the cut-out:

- 1 Connect a good moving coil 0 to 20 voltmeter between terminal D and earth.
- 2 Switch on the headlamps, start the engine and slowly speed up. A slight drop in the meter reading should occur between 12.7 and 13.3 volts to indicate closure of the contacts. If this does not occur adjust screw 2, until it does. Stop the engine.
- 3 Disconnect the cable from terminal B and connect the voltmeter between the terminal and earth. Start the engine, run up to a good charging speed then slowly decelerate. Note the point at which the reading suddenly drops to zero. This should be between 9.5 and 10.5 volts. If not, carefully bow the legs of the fixed contact post until the armature releases at the proper voltage. Reconnect the cable to terminal B.

To set the air gaps, current and voltage regulators:

- 1 Slacken the two screws so that the armature is loosely attached to the frame.
- 2 Unscrew the fixed contact adjustment screw until it is well clear of the armature contact.
- 3 Unscrew the adjustment screw, 3 or 5, well clear of the tension spring.
- 4 Insert a .015 inch (.381 mm) feeler gauge between the armature and the copper disc. Take care not to damage the copper disc.
- 5 Press the armature firmly against the gauge and tighten the screws.
- 6 Hold the gauge in position and screw in the fixed contact adjustment screw until it just touches the armature then tighten the locknut.
- 7 Carry out the electrical settings as previously described.

To set the air gap (cut-out relay):

- 1 Slacken the two screws so that the armature is loosely attached to the frame.
- 2 Unscrew adjustment screw 2 well clear of the spring.
- 3 Press the armature down squarely on to the core face and tighten the two screws.

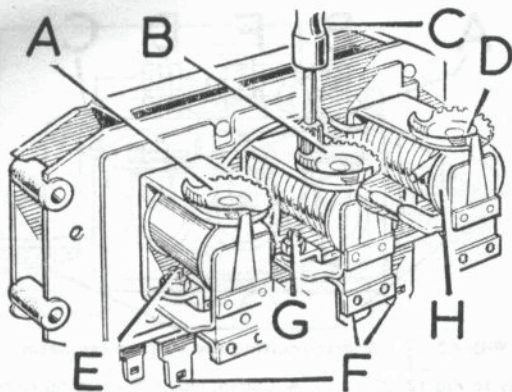


FIG 12:28 Current voltage regulator RB340

Key to Fig 12:28
A Adjustment cam of voltage regulator
B Adjustment cam of current regulator
C Special setting tool
D Adjustment cam of cut-out relay
E Adjustable contact of voltage regulator
F 'Lucar' connection terminals
G Adjustable contact of current regulator
H Core face of cut-out relay

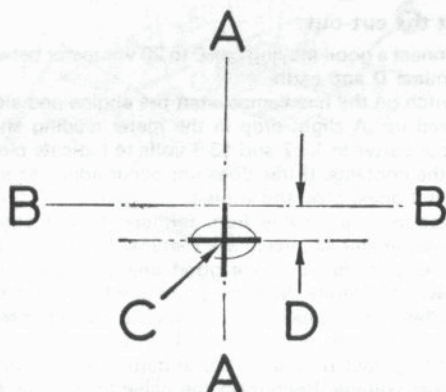


FIG 12:29 Beam setting marks

Key to Fig 12:29
AA Vertical centre line of headlamp
BB Horizontal centre line of headlamp measured from level floor
C Centre of concentrated area of light
D 2 inch \pm 1 inch (50 mm \pm 25 mm)

- 4 Hold the armature down and adjust the backstop so that there is a gap of .018 inch (.45 mm) between it and the armature moving contact blade.
- 5 Insert a .01 (.25 mm) feeler gauge between the armature and core. The gauge should be inserted from the side of the core nearest to the fixed contact post. The leading edge of the gauge should not be inserted beyond the centre line of the core face. Press the armature down and, if necessary, bow the fixed contact post legs until the contacts are just touching.
- 6 Carry out the electrical setting as described previously.

Current voltage regulators, type RB.310 and RB.340 (see FIG 12:28):

Setting of these control boxes is carried out in a similar manner to the RB.106 except that a special tool is needed to set the geared cams on the RB.340. This is Lucas Part No. 54381742.

Checking the voltage regulator:

- 1 Disconnect all cables from terminal B and then connect them together without touching any part of the vehicle.
- 2 Connect the 0 to 20 voltmeter between terminal D and earth.
- 3 Speed the generator up to 300 rev/min. The reading should rise to a maximum value, then flick back and remain steady. This steady reading should lie within the following limits.

Ambient temperature	Voltage setting	
	RB.310	RB.340
10°C (50°F)	15.1 to 15.7	14.9 to 15.5
20°C (68°F)	14.9 to 15.5	14.7 to 15.3
30°C (86°F)	14.7 to 15.3	14.5 to 15.1
40°C (104°F)	14.5 to 15.1	14.3 to 14.9

- 4 If the reading lies outside these limits adjust the voltage regulator by turning the adjusting screw or cam exactly as described for the RB.106.

Checking the current regulator:

Proceed as for the type RB.106 but run the generator at 4500 rev/min. Adjust the current screw or cam until the meter reads 22 amps for a type C40 generator or 30 amps for a type C42.

To set the cut-out:

Proceed as for the RB.106. The drop in the meter reading should occur at the same value (12.7 to 13.3 volts). If not, adjust the cut-out with the engine idling and speed up to recheck. Repeat as necessary.

The drop off voltage (when the meter reading suddenly drops to zero) should occur between 9.5 and 11 volts.

To set the air gaps, current and voltage regulators:

RB.310 Set as for the RB.106.

RB.340 Proceed as follows:

- 1 Disconnect the battery then turn the adjustment cam fully anticlockwise.
- 2 Screw the adjustable contact right back.
- 3 Insert a .045 (1.00 mm) gauge between the armature and the core, pushing it back as far as the two rivet heads on the underside of the armature, (on the latest units, use a .052 (1.30 mm) gauge.)
- 4 Screw in the contact until the gauge is just trapped. Tighten the locknut.
- 5 Check that the narrowest gap between the armature back face and the frame on both sides of the armature is between .030 to .040 inch (.76 to 1.00 mm) with a maximum of .010 inch (.25 mm) taper for current regulators.
- 6 Carry out the electrical setting of the voltage regulator leaving the current regulator until the cut-out has been set mechanically and electrically.

To set the air gap, cut-out relay:

RB.310 Set as for the RB.106.

RB.340 Proceed as follows:

- 1 Turn the cam fully clockwise.
- 2 Press the armature down against the copper on the core face. Check that the narrowest part of the back gap, between the armature back face and the frame is between .030 and .040 inch (.76 and 1.00 mm).
- 3 Insert a .015 gauge between the head of the core and the armature. Press the armature down and bend the fixed contact bracket until the contacts just touch.

Now adjust the armature backstop until it just touches the armature.

4 Check that the top gap, controlled by the backstop and using the nearest rivet as a datum is from .035 to .045 inch (.8 to 1.0 mm).

5 Set the cut-out electrically as previously described.

12:8 Headlamp beam setting

Refer to Fig 12:29:

Draw the mark C on a vertical surface in two places the centre distance of the headlamps apart. Position the vehicle, unladen, 25 feet (7.6 metres) away on a level floor. Adjust the headlamps so that on main beam the concentrated area of light corresponds with mark C.

12:9 The heater plugs, diesel models

The heater plugs require no maintenance but if when they are in use the warning lamp glows brightly a short-circuit is indicated. No light shows an open circuit.

If either of these conditions obtain, first examine the fuse in the fuse box and replace if blown. Check the warning light bulb and replace if necessary, although failure here will not affect the heater circuit.

For further tests, proceed as follows:

Connect one lead of a 12 volt test lamp to the earth lead terminal on No. 1 heater plug and the other lead to the battery positive terminal on negative earth vehicles or vice versa, whereon the bulb should light. If the bulb remains unlit, a faulty earth lead is indicated.

Move the test lamp lead from the earth terminal on No. 1 heater plug, to the terminal, also on No. 1 plug, to which the interconnecting lead is attached. If the plug is

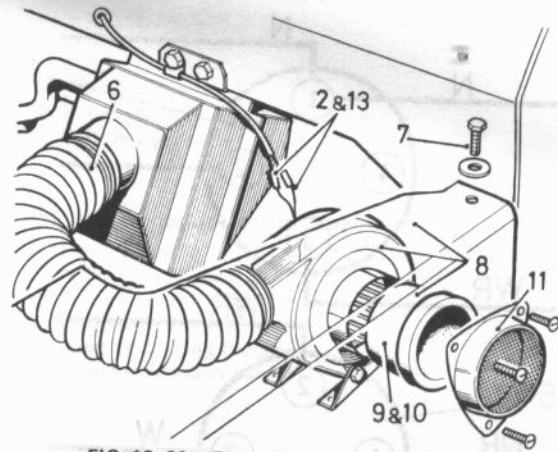


FIG 12:30 Removing the heater motor

Key to Fig 12:30
 2 Electrical connection
 6 Air hose
 7 Wing panel bolt
 8 Air inlet and seal
 9 and 10 Air intake grille
 11 Air grille
 13 Electrical connection

serviceable the bulb will light but a broken heater plug filament will be indicated by the lamp remaining unlit.

Check the remaining plugs in the same manner until the fault is located.

If the heater plugs are found serviceable check each terminal of the resistance unit in the same way.

If the heater plugs are to be removed, proceed as follows, taking the greatest care not to distort or damage the element.

1 Disconnect the leads from the plugs, using two

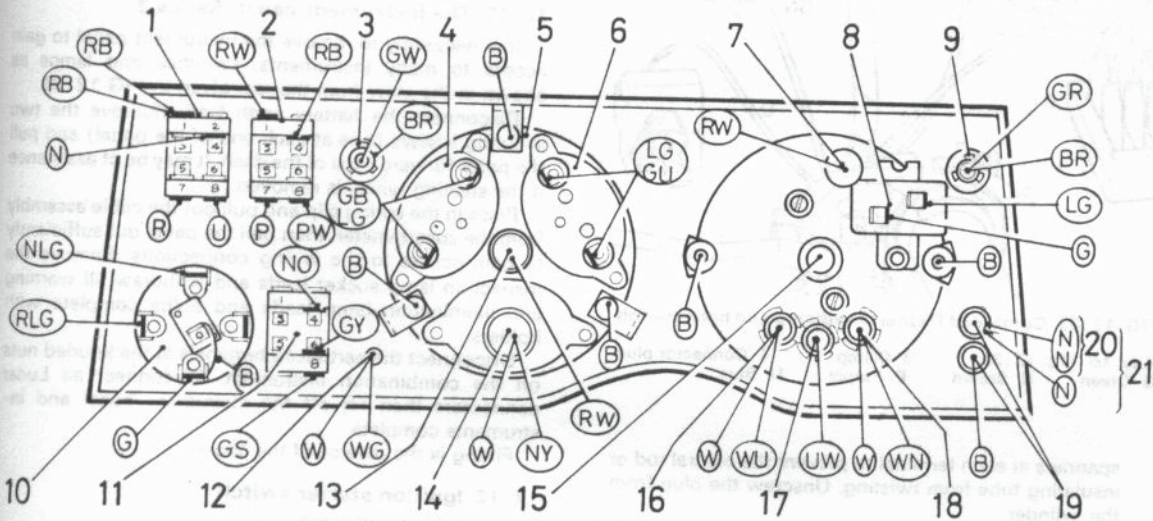


FIG 12:31 Instrument panel (Series 3) from the rear

Key to Fig 12:31
 1 Lighting switch
 2 Panel light switch, also interior light switch on Station Wagon models
 3 RH turn indicator warning light
 4 Fuel contents gauge
 5 Grouped instruments
 6 Coolant temperature gauge
 7 Panel illumination light
 8 Instruments voltage stabilizer
 9 LH turn indicator warning light
 10 Wiper/wash switch
 11 Heater switch (where fitted)
 12 Fuel level warning light (Diesel models)
 13 Panel illumination light
 14 Battery charge warning light
 15 Speedometer drive head
 16 Cold start warning light
 17 Headlamp main beam warning light
 18 Oil pressure warning light
 19 Inspection lamp sockets
 20 Leads for Petrol models
 21 Leads for Diesel models

Key to electrical cable colours: Where cables have two colour code letters, the first denotes the main colour and the latter denotes the tracer colour.

B Black G Green R Red U Blue O Orange S Slate N Brown P Purple W White Y Yellow D Dark L Light

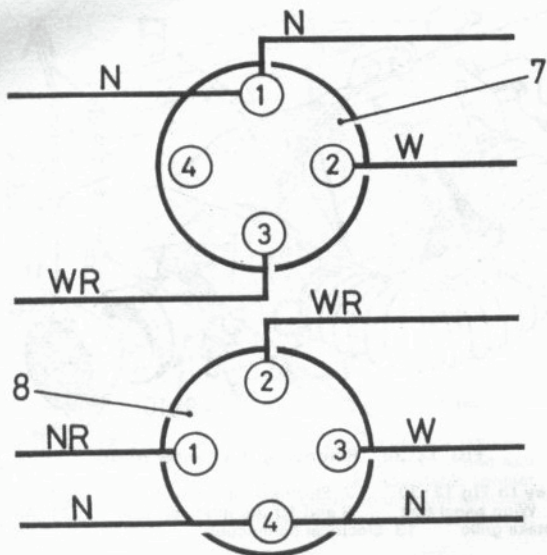


FIG 12:32 Ignition starter switch connection

Key to Fig 12:32 7 Petrol engines 8 Diesel engines
N Brown W White R Red

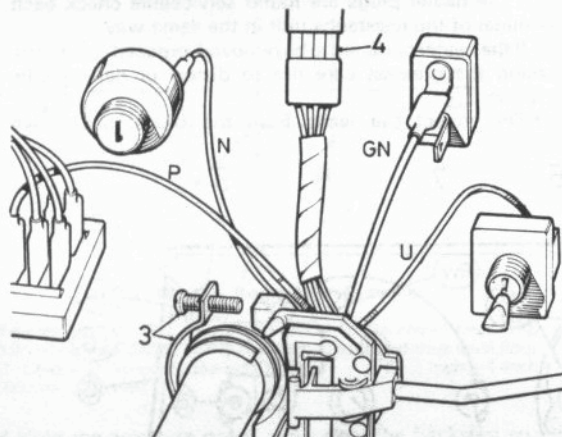


FIG 12:33 Combined flasher, headlamp and horn switch

Key to Fig 12:33 3 Clamp 4 Connector plug
G Green N Brown P Purple U Blue

spanners at each terminal to prevent the central rod or insulating tube from twisting. Unscrew the plug from the cylinder.

- 2 Remove carbon from base of heater plug to avoid possible shortcircuiting of the element. Do not sand-blast.
- 3 Examine the element for signs of fracture or severe heat attack and the seating for scores. Plugs with fractured elements must be replaced. Where scoring of the seating is sufficient to allow gas leakage or erosion of the element such that a fracture is likely to occur, then a replacement plug must be fitted.

4 Test the plug internal circuit for continuity, by connecting it and a 12 volt side-lamp bulb in circuit, to a 12 volt battery. **The inclusion of a bulb in circuit is essential.**

5 Ensure that the terminal nuts and threads are clean and that the thread at the base of the plug is free of carbon, then refit the plugs and tighten to 25 lb ft (3.4 kg m).

Note: Make sure the shakeproof washers are fitted under the terminals in order to maintain good electrical contact.

Replace the leads in accordance with the wiring diagram and tighten the terminals, using two spanners to each terminal.

12:10 The heater

The procedure for removing the blower motor is as follows:

See FIG 12:30. Disconnect the battery earth lead and the two leads to the blower, noting the colour connections.

From inside the cab remove the trim board rail and withdraw the trim board from the clip. Remove the five screws securing the blower motor.

Disconnect the air hose at the inlet to the matrix.

Remove the wing panel rear top fixing bolt and manoeuvre the motor assembly clear, lifting the wing panel sufficiently to allow passage. Withdraw the air inlet seal.

Refitting:

Fit the blower motor but omit the air inlet seal at this stage. Remove the air intake grille then fit the air inlet seal and replace the grille.

Reverse the removal procedure for the rest of the operation.

12:11 The instrument panel, Series 3

It is necessary to remove the instrument panel to gain access to many instruments, switches and lamps as shown in the view from the rear given in FIG 12:31.

Disconnect the battery earth lead. Remove the two securing screws (one at each end of the panel) and pull the panel forward clear of the dash. It may be of assistance if the steering wheel is removed.

Press in the spring clip and pull out the cable assembly from the speedometer, then pull the panel out sufficiently to gain access to the wiring connections. Remove the inspection lamp socket leads and withdraw all warning and illumination lamp leads and bulbs complete with holders.

Disconnect the earth lead terminals at the knurled nuts on the combination instrument. Disconnect all Lucar connectors then lift off the instrument panel and instruments complete.

Fitting is the reverse of the above.

12:12 Ignition starter switch

This is removed as follows:

Disconnect the battery earth lead, then remove the upper half of the switch shroud from the steering column.

Disconnect the electrical leads from the switch.

On cars with a steering column lock there are two small screws locating the switch in the housing which must be removed to free the switch.

On cars without a steering column lock there is a locking ring which must be unscrewed.

Refitting is the reverse of the above, but refer to FIG 12:32 for the correct wiring connections.

12:13 Combined flasher, headlight and horn switch

This is removed as follows: Disconnect the battery earth lead, then remove the upper half of the switch shroud from the steering column.

Unscrew the securing screw in the clamp to free the switch then pull it out sufficiently to disconnect the main harness at the plug connector.

Withdraw the instrument panel clear of the dash as detailed in Section 12:11 and disconnect the switch leads from the flasher unit, lighting switch, fuse box and ignition switch. Withdraw the combined switch.

Reverse the above procedure to refit. See FIG 12:33 for details of the wiring and connections.

12:14 Fault diagnosis

(a) Battery discharged

- 1 Battery unserviceable
- 2 Corroded battery terminals
- 3 Control box faulty
- 4 Generator faulty
- 5 Break in charging circuit

(b) Generator not charging

- 1 Slack driving belt
- 2 Generator loose
- 3 Break in circuit
- 4 Worn brushes
- 5 Commutator burnt (dynamo only)
- 6 Control box faulty

(c) Starter failure, petrol engine

- 1 Tight engine
- 2 Battery discharged
- 3 Break in starter circuit
- 4 Commutator burnt
- 5 Worn or sticking brushes
- 6 Pinion jammed in mesh

(d) Starter failure, diesel engine

- 1 Check 1 to 5 in (c)
- 2 Starter/heater switch unserviceable
- 3 Solenoid circuit broken
- 4 Solenoid defective

CHAPTER 13

THE BODYWORK

- 13:1 Description
- 13:2 Panel beating 'Birmabright' alloy
- 13:3 Gas welding 'Birmabright'
- 13:4 Riveting 'Birmabright'
- 13:5 Painting 'Birmabright'
- 13:6 General construction
- 13:7 Fitting seat belts
- 13:8 Removing the radiator grille panel
- 13:9 The heater water valve

13:1 Description

The Land Rover bodywork is practical and rugged as befits the type of vehicle and the many duties it can undertake. With the exception of the steel radiator grille, dash panel, door and tailboard frames all the rest of the body is made from 'Birmabright' alloy. This is a magnesium-aluminium alloy which will not rust or corrode under any normal circumstances. It is work hardening and so becomes brittle when hammered but is easily annealed. It has the property of forming a hard oxide skin when exposed to the air and so care and special preparation are necessary when painting is undertaken. Some hints on the working of this alloy are given in the following sections.

13:2 Panel beating 'Birmabright' alloy

This alloy can be beaten out after accidental damage in the same way as sheet steel but protracted hammering will harden the material and cracking is likely. The affected area must be annealed by the application of heat, but as the melting point of the alloy is low this must be applied carefully. Check the temperature by applying oil or a smear of soap to the cleaned surface to be annealed

then play the flame of a welding torch over the opposite side of the panel. Hold the torch well away from the surface and keep it moving steadily over the whole area. When the oil or soap clears and leaves the panel bright and clean, remove the heat and allow the panel to cool slowly in air. The clearing of the oil or soap takes place quite quickly. Do not quench the panel in oil or water. Repeat the operation as soon as the panel shows signs of re-hardening under the panel beating hammer or dolly.

13:3 Gas welding 'Birmabright'

Use a jet one or two sizes less than would be used for a comparable thickness of steel sheet. For instance, use a No. 2 nozzle for welding 18 S.W.G. (.048 inch) and a No. 3 for 16 S.W.G. (.064 inch) sheet. The flame should be neutral or slightly reducing (see FIG 13:1). Use only 5 per cent magnesium-aluminium welding rod such as 'Sifalumin' No. 27 (MG5 alloy) or a strip of metal cut from a scrap 'Birmabright' panel. 'Sifbronze' Special flux must be used with the 'Sifalumin' rod.

Clean off all grease and paint, dry thoroughly then clean the edges and half an inch each side with a stiff wire brush or wire wool. Clean the rod or filler strip with

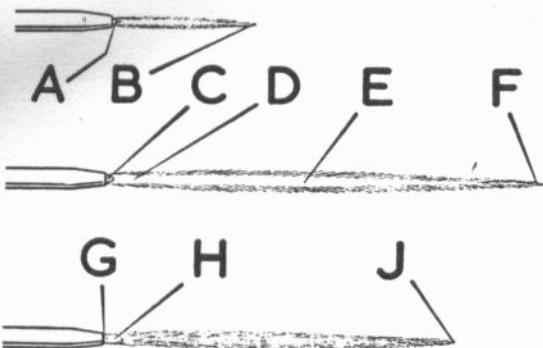


FIG 13:1 Welding jet, Oxidizing, Neutral and Reducing

the wire wool. Cleanliness is absolutely essential for successful welding.

Use special acid flux, either 'Hari-Kari' from the Midland Welding Supply Co. Ltd., 105 Lakey Lane, Birmingham 28, England, or Sifbronze Special Flux, from the Suffolk Iron Foundry (1920) Ltd., Sifbronze Works, Stowmarket, England. The 'Hari-Kari' flux is made into a paste with water and the paste applied to both surfaces to be welded and also to the rod. Use the Sifbronze flux in a powder as directed on the tin.

Key to Fig 13:1

A	Short pointed inner cone bluish white	C	Brilliant inner cone well defined
B	Bluish envelope	D	Hottest point of flame
E	Blue to orange envelope	F	Nearly colourless
G	Brilliant inner cone	H	Feathery white plume
J	Blue to orange envelope		

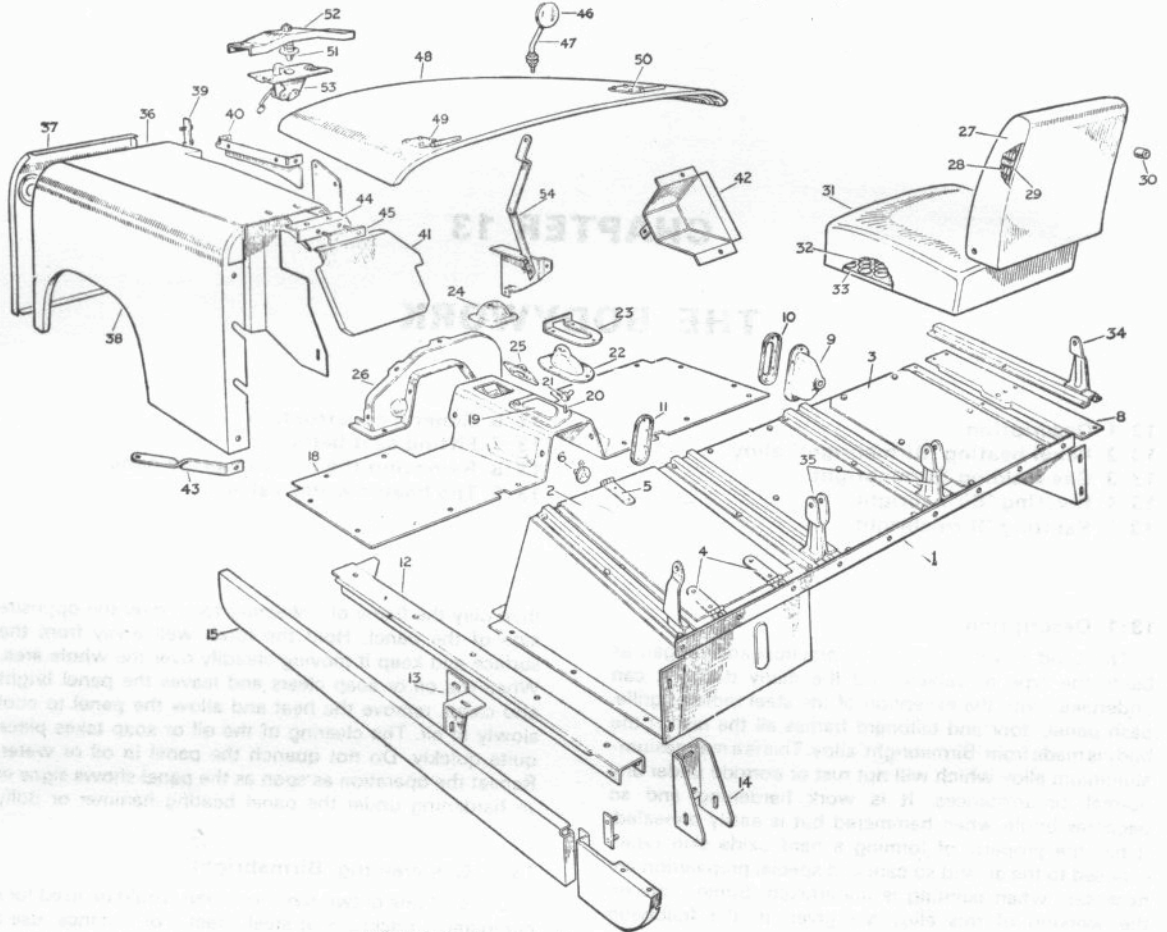


FIG 13:2 Layout of seats, floor and bonnet

Key to Fig 13:2

1	Seat base and floor assembly	2	Tool locker lid	3	Fuel tank cover panel	4	Lid hinge
5	Locker lid hasp	6	Locker lid turnbuckle	7	Centre cover panel	8	Extension panel, at seat base ends
9	Handbrake rubber cover	10	Retainer for rubber cover	11	Handbrake slot coverplate	12	Sill channel lefthand front
13	Sill channel mounting bracket, to rear body	14	Sill channel mounting bracket, to front body	15	Front sill panel	16	Rear sill panel
17	Fixing plate for sill panels	18	Front floor complete	19	Inspection cover, for front floor	20	Stud plate for inspection cover wingnut
21	Wingnut, fixing inspection cover	22	Transfer gearlever seal	23	Transfer lever seal retainer	24	Gearlever rubber seal
25	Operating rod coverplate	26	Gearbox cover complete	27	Seat squab	28	Squab spring case
29	Squab frame	30	Buffer, for seat backrest on bracket	31	Seat cushion	32	Cushion spring case
33	Cushion frame	34	Cushion support, outer	35	Seat support, centre	36	Front wing
37	Front panel and registration plate	38	Front wing outer panel	39	Fixing plate, wings to grille panel	40	Wing valance bottom panel
41	Mudshield, front wing	42	Steering unit cover box	43	Front wing stay	44	Bracket, for rear of wing
45	Fixing plate, brackets to dash	46	Mirror	47	Arm for mirror	48	Bonnet top panel
49/50	Bonnet hinges	51	Bonnet catch striker pin	52	Bonnet striker bracket	53	Bonnet control

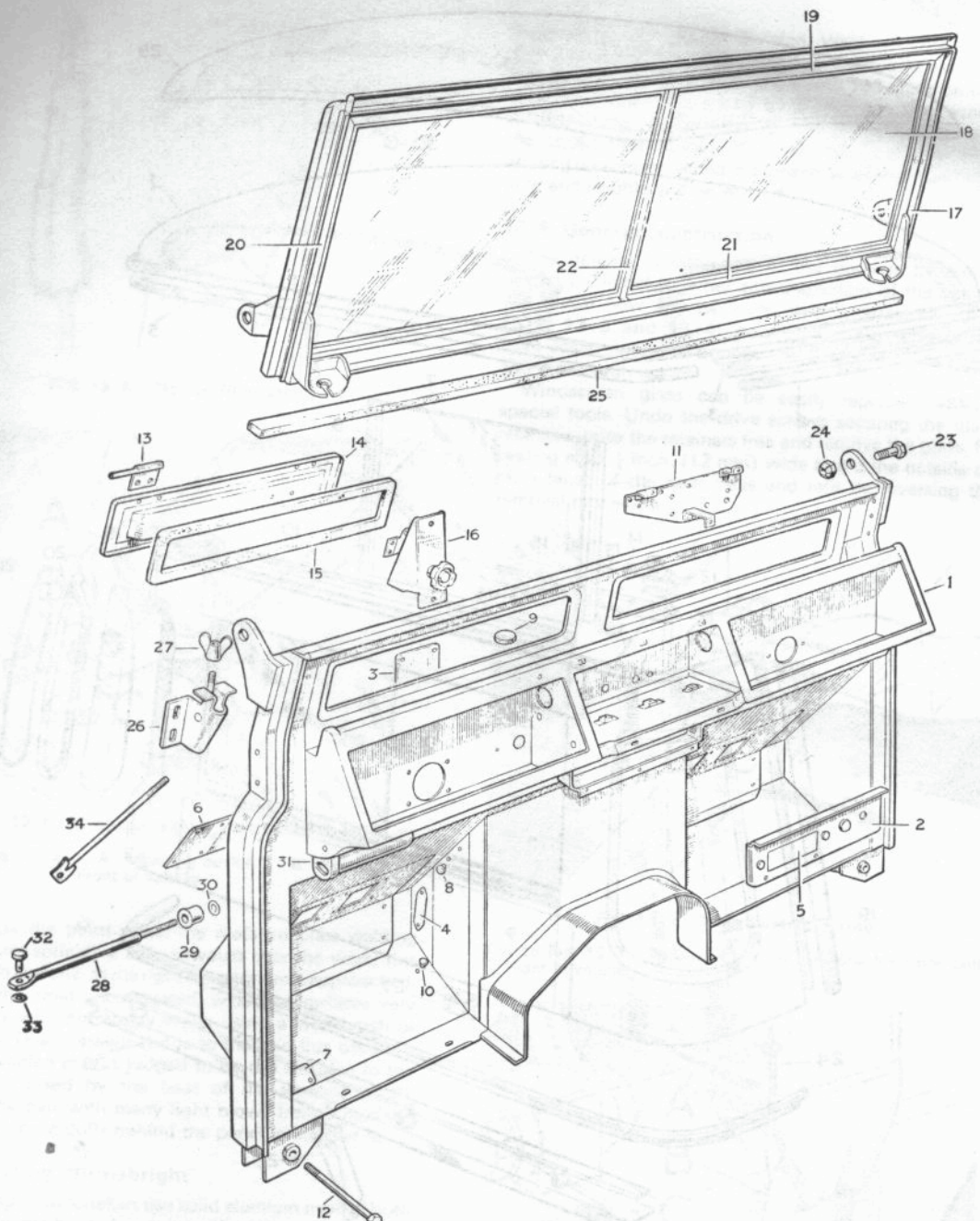


FIG 13:3 Layout of dash and windscreen, Series 2 and 2A

Key to Fig 13:3

- | | | |
|--|--|--|
| 1 Dash complete | 2 Panel for controls | 3 Cover panel for steering cut-out |
| 4 Coverplate for accelerator pedal hole | 5 Cover panel for governor cut-out in dash (petrol models) | 6 Coverplate for pedal holes |
| 7 Coverplate for dipswitch hole | 8 Rubber plug, redundant accelerator holes | 9 Rubber grommet for demister hose |
| 10 Rubber plug, redundant accelerator stop holes | 11 Mounting plate for pump | 12 Tie bolt |
| 14 Ventilator lid for dash | 15 Sealing rubber for ventilator lids | 13 Ventilator hinge |
| 17 Windscreen complete assembly | 16 Ventilator control mechanism complete | 14 Ventilator hinge |
| 20 Retainer for windscreen glass, side | 18 Glass for windscreen | 15 Sealing rubber for ventilator lids |
| 23/24 Fixings for windscreen to dash | 21 Retainer for windscreen glass, bottom | 16 Ventilator control mechanism complete |
| 27 Wingnut for fastener | 19 Retainer for windscreen glass, top | 17 Windscreen complete assembly |
| 28 Check strap rod | 22 Cover for centre strip | 18 Glass for windscreen |
| 29 Check strap buffer | 25 Rubber sealing strip for windscreen | 19 Retainer for windscreen glass, top |
| 30 Fixings, buffer to rod | 26 Fastener for windscreen, righthand | 20 Retainer for windscreen glass, side |
| 32/33 Fixings, check strap rod to front door | 31 Check strap mounting bracket | 21 Retainer for windscreen glass, bottom |
| | | 22 Cover for centre strip |
| | | 23/24 Fixings for windscreen to dash |
| | | 25 Rubber sealing strip for windscreen |
| | | 26 Fastener for windscreen, righthand |
| | | 27 Wingnut for fastener |
| | | 28 Check strap rod |
| | | 29 Check strap buffer |
| | | 30 Fixings, buffer to rod |
| | | 31 Check strap mounting bracket |
| | | 32/33 Fixings, check strap rod to front door |

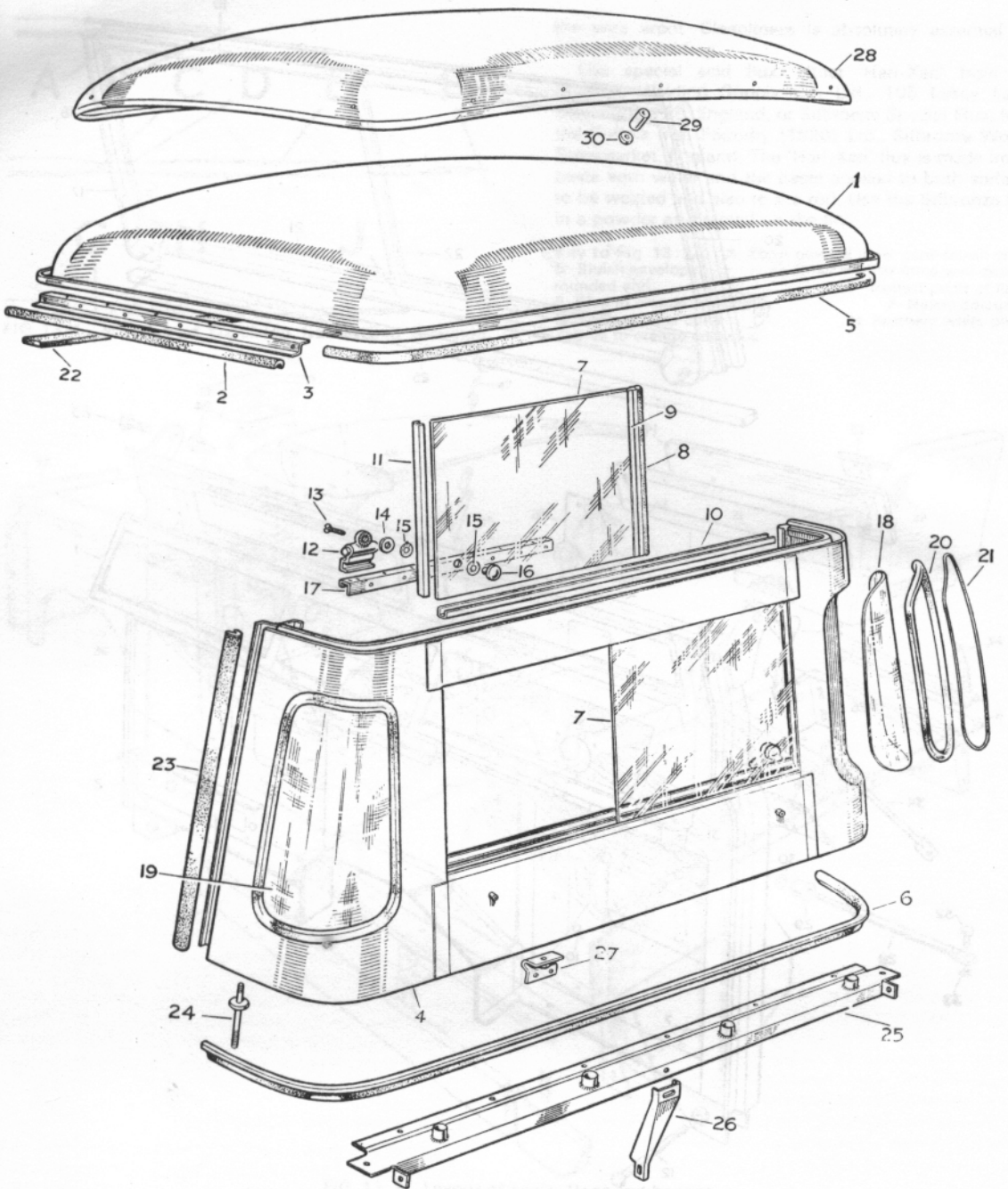


FIG 13:4 Cab unit

- | | | | |
|--|---------------------------------------|---------------------------------------|--------------------------------|
| 1 Cab roof | 2 Sealing rubber, door top | 3 Retainer for seal | 4 Cab rear panel assembly |
| 5 Rubber seal, roof to back panel, top | 6 Rubber seal back panel to rear body | 7 Sliding backlight | 8 Sealing rubber for catches |
| 9 Channel for rubber | 10 Channel, top and bottom | 11 Channel, sides | 12 Backlight catch |
| 13/16 Fixings for backlight | 17 Runner for sliding backlight catch | 18 Cab quarterlight, righthand | 19 Cab quarterlight, lefthand |
| 20 Weatherstrip | 21 Sealing strip | 22 Sealing rubber, windscreen to roof | 23 Sealing rubber, door side |
| 24 Mounting stud | 25 Mounting rail for cab | 26 Mounting rail support bracket | 27 Cab mounting distance piece |
| 28 Cab tropical roof panel | 29 Distance piece | 30 Rubber | |

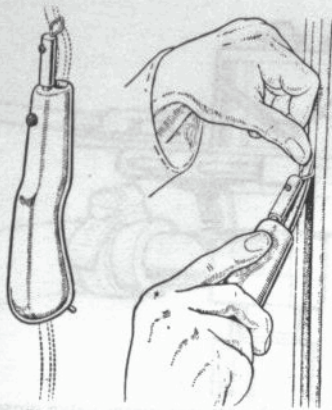


FIG 13:5 Fitting filler strip

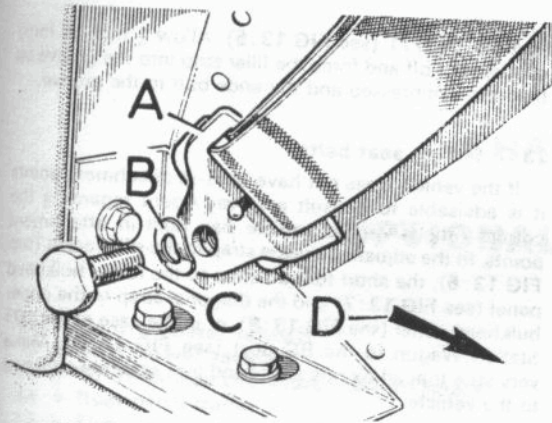


FIG 13:6 Diagonal safety belt fitted to sill

Key to Fig 13:6
 A Adjusting buckle
 B Wave washer
 C Screw
 D Front of vehicle

To judge the point when the metal reaches welding temperature, sprinkle a little sawdust over the work; this will sparkle and char as the right temperature is approached.

When the weld is completed, wash the surfaces very thoroughly with hot soapy water using a wire brush or wire wool. This is essential due to the acid flux used.

If the welded area is judged to be too soft due to the annealing caused by the heat of the welding torch, hammer the part with many light blows from a medium hammer, using a dolly behind the panel to support it.

13:4 Riveting 'Birmabright'

If riveting is undertaken use solid aluminium rivets if both sides are accessible or 'pop' rivets if only one side can be worked on. These latter rivets are inserted and closed by special pliers.

13:5 Painting 'Birmabright'

Owing to the hard oxide skin which forms on the surface when exposed to air, it is necessary to etch a repaired panel before painting to make sure that the paint will adhere properly. Wipe the area with thinners, dry thoroughly, then apply 'Deoxidine 125' acid etch

supplied by I.C.I. Paints Division. Wash off thoroughly with hot water then dry absolutely clean and moisture free. Slightly roughen the surface with 100 grade emery-paper and apply a thin coat of 'Glasso' primer or similar suitable primer. Apply three coats of filler and finish with the appropriate colour. It is essential that the initial etching is properly carried out otherwise all the subsequent time and trouble will be wasted.

13:6 General construction

The general construction of the body is by panels riveted or bolted together and inspection of the vehicle will reveal how any particular item is attached. FIGS 13:2, 13:3 and 13:4 show typical examples of the front seats, floor and bonnet, the dash and windscreen and a cab unit.

Windscreen glass can be easily replaced without special tools. Undo the drive screws securing the glass retainers, prise the retainers free and remove the glass. Fit sealing strip, 1/2 inch, (12 mm) wide round the outside on both faces of the new glass and refit by reversing the removal procedure.

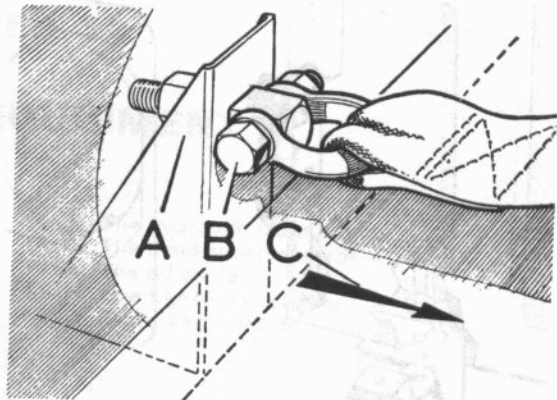


FIG 13:7 Tongue strap fixing

Key to Fig 13:7
 A Gusset bracket
 B Shackle fixing bolt
 C Front of vehicle

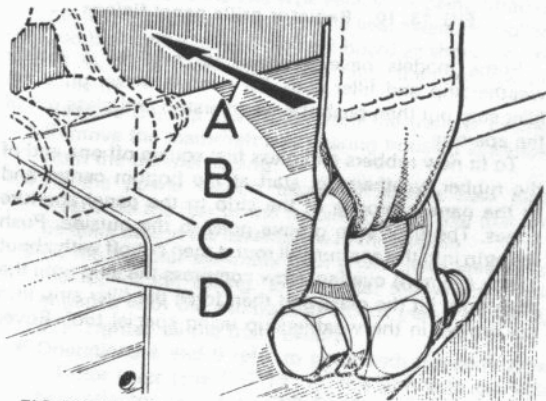


FIG 13:8 Diagonal strap fitted to bulkhead panel

Key to Fig 13:8
 B Shackle position (early models)
 C Shackle position (late models, in dotted line)
 A Front of vehicle
 D Seat panel capping

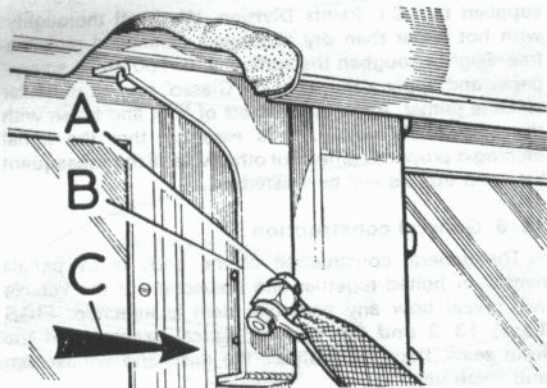


FIG 13:9 Diagonal strap fitted to BC post

Key to Fig 13:9
B Mounting bracket

A Shackle fixing bolt
C Front of vehicle

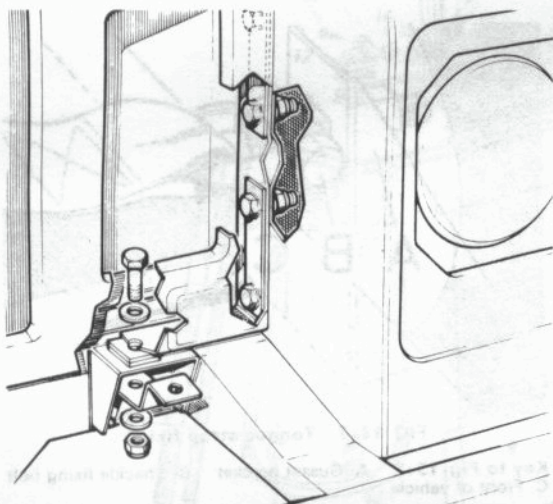


FIG 13:10 Radiator grille panel fixings

Some models have quarterlights held by a rubber weatherstrip and filler strip. To remove these, prise the filler strip out then push the weatherstrip and glass out of the aperture.

To fit new rubbers and glass first square off one end of the rubber weatherstrip, start at the bottom centre and fit the narrow groove of the strip to the panel aperture edges. The filler strip groove goes to the outside. Push the strip into the aperture all round then cut off with about 1 inch (25 mm) overlap. Now compress the strip until the ends butt. Fit the glass and then force the filler strip into the groove in the weatherstrip using special tool, Rover

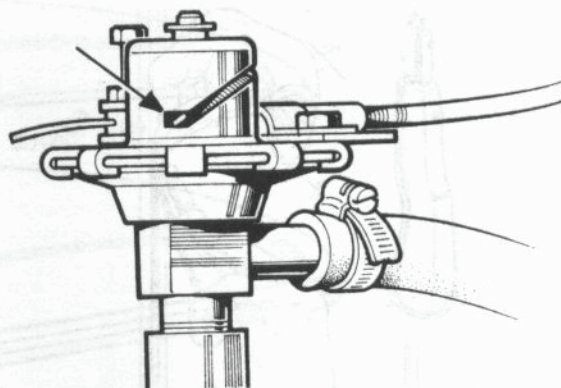


FIG 13:11 Heater water valve closed

Part No. 262771 (see FIG 13:5). Allow $\frac{1}{4}$ inch (6 mm) overlap, cut off and force the filler strip into the groove so that it is compressed and the ends butt in the groove.

13:7 Fitting seat belts

If the vehicle does not have built-in attachment points it is advisable to consult a Rover Agent regarding the correct fittings. If the vehicle has built-in attachment points, fit the adjusting buckle strap to the sill bracket (see FIG 13:6), the short tongue strap to the lower bulkhead panel (see FIG 13:7) and the diagonal strap to the upper bulkhead panel (see FIG 13:8), or in the case of the 109 Station Wagon to the BC post (see FIG 13:9). Make very sure that all fixings are sound and securely attached to the vehicle.

13:8 Removind the radiator grille panel

- 1 Remove the bonnet. Disconnect the battery and on 2.6 litre models remove the air cleaner.
- 2 Remove the front apron panel secured by four screws. Remove the nameplate and radiator grille.
- 3 Drain the coolant. Remove the shroud from the radiator fan cowl. Remove the coolant hoses. Detach the fan and rest it on the lower part of the fan cowl.
- 4 Disconnect the leads to the front lamps.
- 5 Remove the grille panel fixings in the wheelarches and on the chassis crossmember (see FIG 13:10).

13:9 The heater water valve

Before removing the valve partially drain the coolant. After removing the control cable the water valve can be unscrewed.

When refitting the water valve set the cable as follows. Refer to FIG 13:11 and set the water valve in the closed position as shown. With the heater control on the dash fully in the cold position take up the slack in the inner cable and tighten the cable fixings at the water valve.

CHAPTER 14

OPTIONAL EQUIPMENT

- 14:1 Centre power takeoff
- 14:2 Rear power takeoff
- 14:3 To transpose the power takeoff gears
- 14:4 Rear drive pulley
- 14:5 The engine governor. Petrol models
- 14:6 The front capstan winch, mechanical

- 14:7 The hydraulic front winch
- 14:8 The hand speed control
- 14:9 The oil cooler
- 14:10 Fire fighting equipment
- 14:11 Fault diagnosis (Fire pump)

14:1 Centre power takeoff

The same unit is applicable to all models but the latest types have a modified selector lever. This is shown in **FIG 14:4** and involves a different cutting pattern for access to the control knob through the seat panels. Both patterns with all dimensions necessary are shown in this Section.

It is essential that the centre power takeoff is only used in conjunction with an engine speed governor. See **Section 14:5** for instructions for fitting and servicing the governor.

Reference to **FIG 14:2** will show that two types of housing, 1 and 2 and drive shaft, 4 and 5 are illustrated. Two bearings 11 and 12 and two flanges 19 and 20 are also included. The upper assembly in **FIG 14:2** is used to drive the welding generator, compressor, etc; where it is an advantage to reverse the pulley to bring it over the housing thus putting the load from the Vee-belts directly over the heavier bearing 12.

To fit the centre power takeoff:

- 1 Remove the centre inspection panel from the seat box and mark out and cut the holes as shown in **FIG 14:5** (early type selector). Rivet the cover retaining

clip to the panel, placing the plain washer between the clip and the panel. Engage the tongues of the cover in the slots C. If the late type selector is being fitted do not cut this panel. Remove the seat retaining bollard and then drill a hole in the heel board as shown in **FIG 14:6**. Fit a grommet to the hole, then replace the bollard.

- 2 Remove the top coverplate from the transfer casing.
- 3 Remove the mainshaft rear bearing housing assembly from the transfer casing.
- 4 Fit the power takeoff assembly with a new joint washer to the rear of the transfer casing. See that the oil drain hole in the assembly is to the bottom.
- 5 Fit the selector assembly with a new joint washer to the top of the casing. Ensure that the selector fork engages with the sliding dog clutch (see **FIG 14:2, 27**). Tighten all the bolts evenly.
- 6 Operations 4 and 5 refer to units with the early type selector lever (see **FIG 14:1**). If a unit with the late type selector lever (see **FIG 14:4**), is being installed the following additional operations are necessary.
 - (a) Remove the bearing housing fixing stud from the lefthand top corner on the transfer casing and replace it with the new stud supplied with the unit.

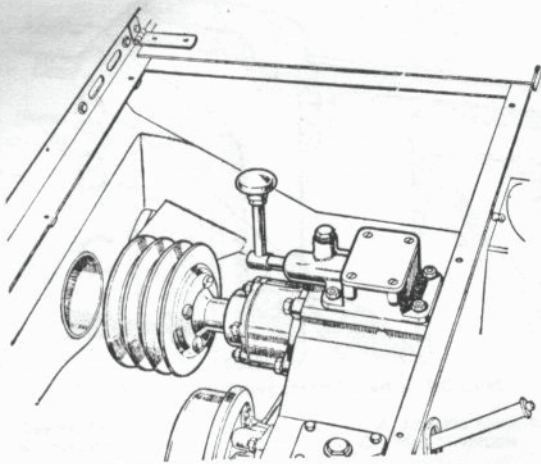


FIG 14:1 Installation of centre power takeoff

(b) Fit the selector rod to the lever using a clevis pin, spring and splitpin. Pass the rod through the hole previously cut in the heel board, screw the knob on and secure with a locknut. Attach the lever to the selector shaft and to the new stud on the transfer casing. Use a locknut on the stud and check that the link moves freely without excessive slack.

7 Replace the centre inspection panel after fitting the pulley or, if a rear power takeoff is to be added, the drive shaft.

Servicing the centre power takeoff:

Refer to FIGS 14:2 and 14:3.

Remove the selector assembly and power take off unit by reversing the preceding fitting instructions.

The selector assembly is easily dismantled by removing the brass plug, releasing the detent spring and ball then undoing the bolts holding the coverplate and loosening the selector fork clamp bolt. The shaft and fork will now

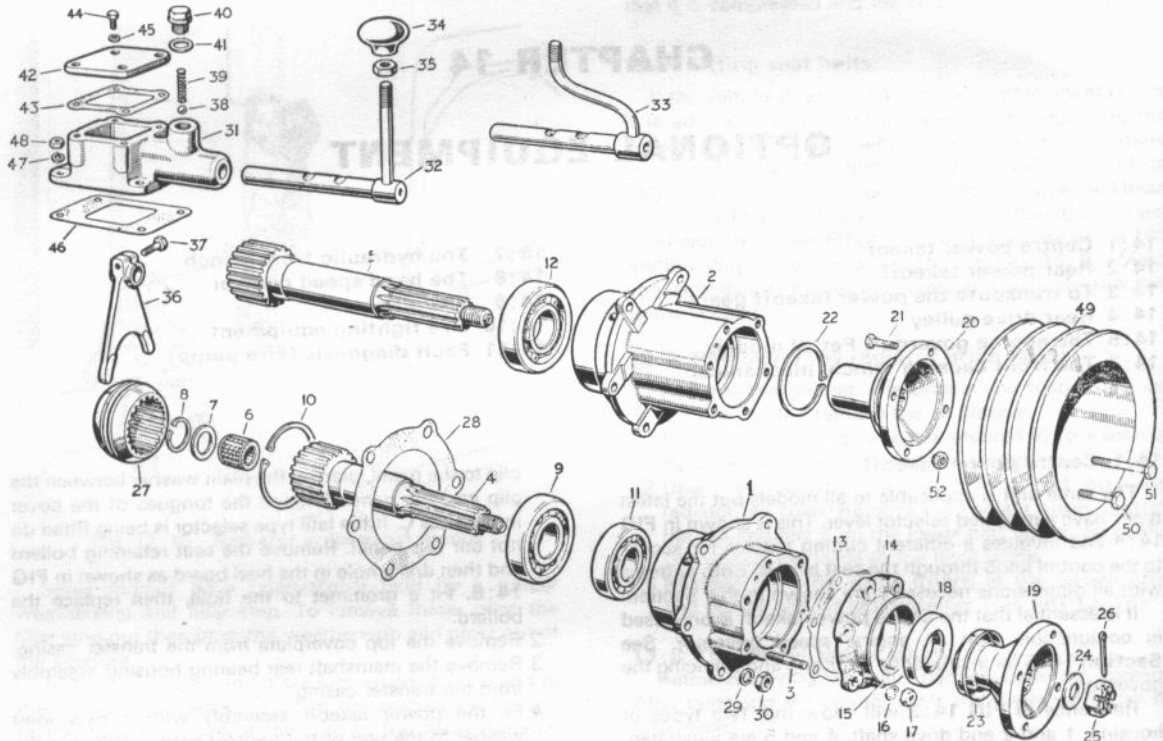


FIG 14:2 Layout of drive unit

- Key to Fig 14:2**
- | | |
|--|---|
| 1 Housing assembly for drive bearing | 2 Housing assembly for drive bearing (with welder, compressor, etc.) |
| 3 Stud for oil seal housing | 4 Shaft for power takeoff drive |
| 6 Bearing for gearbox mainshaft | 7 Retaining plate for bearing |
| 8 Circlip fixing retaining plate | 9 Bearing for drive shaft, front |
| 10 Circlip, bearing to housing | 11 Bearing for drive shaft, rear |
| 12 Bearing for drive shaft, rear (with welder, compressor, etc.) | 13 Shim for bearing |
| 14 Housing for oil seal | 15 Mudshield for housing |
| 16/17 Fixings for oil seal housing | 18 Oil seal for drive shaft |
| 19 Flange for power takeoff drive shaft | 20 Flange for power takeoff drive shaft (with welder, compressor, etc.) |
| 21 Bolt for flange (with welder, compressor, etc.) | 22 Circlip retaining bolts (with welder, compressor, etc.) |
| 23 Mudshield for flange | 24/26 Fixings for flange |
| 27 Dog clutch for power takeoff shaft | 28 Joint washer for housing |
| 29/30 Fixings for housing | 31 Housing for power takeoff selector (with welder, compressor, etc.) |
| 32 Selector shaft and rod for power takeoff | 33 Selector shaft for rod and power takeoff |
| 34 Knob for rod | 35 Locknut for knob |
| 36 Fork for selector shaft | 37 Setbolt fixing fork to shaft |
| 38 Steel ball (for selector shaft) | 39 Spring (for selector shaft) |
| 40 Plug for spring | 41 Joint washer for plug |
| 42 Coverplate for housing | 43 Joint washer for plate |
| 44/45 Fixings for plate | 46 Joint washer for housing |
| 47/48 Fixings for housing | 49 Pulley for centre power takeoff |
| 50/52 Fixings for pulley | |

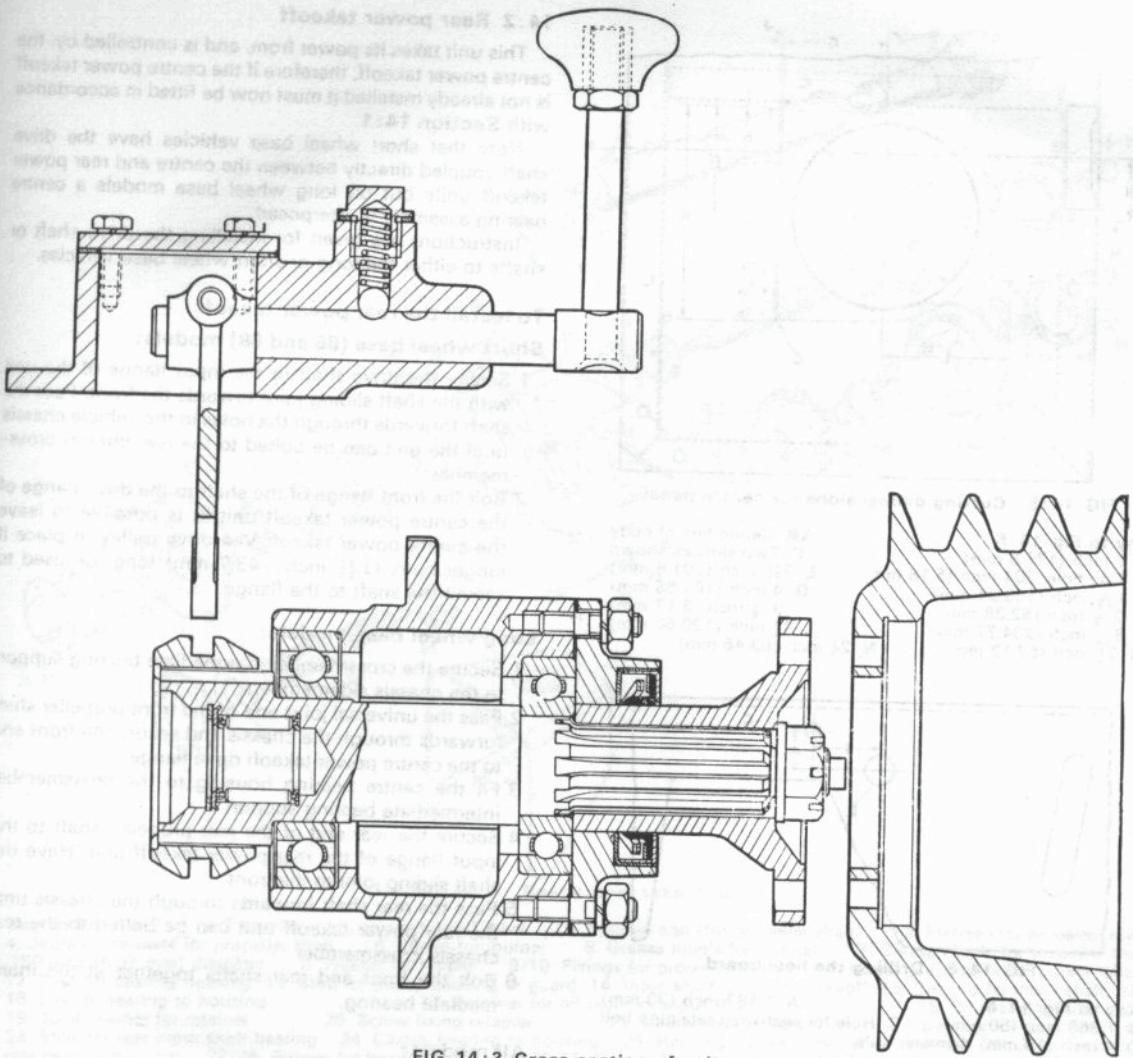


FIG 14:3 Cross-section of unit

come out of the housing. Replace any worn parts and reassemble by reversing the dismantling procedure.

The drive unit is dismantled as follows:

- 1 Remove the pulley, if fitted.
- 2 Slide the dog clutch off and grip the shaft in a vice with soft jaws. Undo the flange retaining nut and pull the flange from the shaft.
- 3 Remove the oil seal housing 14 (see FIG 14:2), and drift out the oil seal 18. If any shims 13 are fitted, preserve them for reassembly.
- 4 Remove the front bearing retaining circlip 10, then protect the threaded end of the shaft and drive the shaft and front bearing out of the housing.
- 5 Remove the circlip 8 and washer 7 then release the needle roller bearing 6 from the bore of the shaft.
- 6 Drift the rear bearing 11 out of the housing and extract the front bearing from the shaft.
- 7 Wash all parts in paraffin and dry thoroughly. Spin the bearings and take note of any slack or roughness

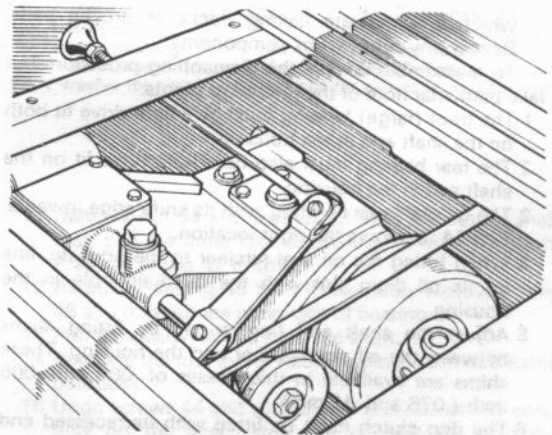


FIG 14:4 Late type selector

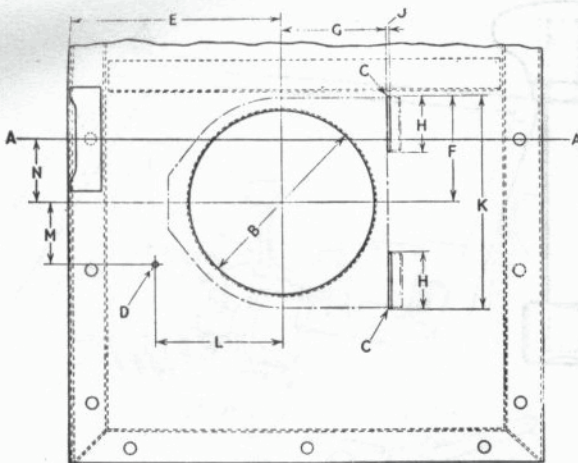


FIG 14:5 Cutting dimensions for centre panel

Key to Fig 14:5

- B 7 inch (177.8 mm)
- D One hole .204 inch (5.18 mm)
- F $4\frac{3}{8}$ inch (103.94 mm)
- H $2\frac{1}{8}$ inch (52.38 mm)
- K $8\frac{1}{16}$ inch (204.77 mm)
- M $2\frac{1}{2}$ inch (57.12 mm)

- AA Centre line of body
- C Two slots as shown
- E $7\frac{1}{2}$ inch (201.6 mm)
- G 4 inch (101.56 mm)
- J $\frac{1}{2}$ inch (3.17 mm)
- L $4\frac{1}{2}$ inch (120.60 mm)
- N $2\frac{1}{2}$ inch (63.46 mm)

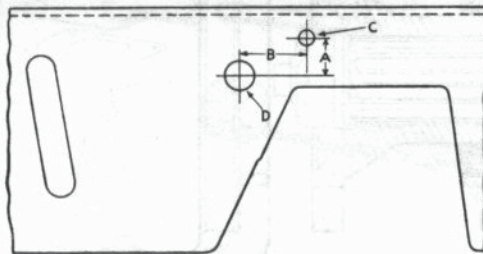


FIG 14:6 Drilling the heel board

Key to Fig 14:6

- B 1.968 inch (50 mm)
- D $\frac{3}{4}$ inch (19 mm) diameter hole
- A 1.187 inch (30 mm)
- C Hole for seat strap retaining bolt

which will indicate flaking tracks or broken balls. Renew any other worn components.

To reassemble reverse the dismantling procedure but take particular note of the following points:

- 1 The front (large) bearing must be a light drive fit both on the shaft and in the housing.
- 2 The rear bearing must also be a light drive fit on the shaft and in the housing.
- 3 The oil seal must be fitted with its knife edge inwards.

FIG 14:3 shows the right location.

- 4 When fitting the oil seal retainer to the housing, line up its oil drain slot with the oil drain hole in the housing.
- 5 Adjust the shaft end float to nil by fitting shims between the oil seal retainer and the housing. These shims are available in thicknesses of .003 and .005 inch (.076 and .12 mm).
- 6 The dog clutch must be fitted with its recessed end towards the gearbox.

14:2 Rear power takeoff

This unit takes its power from, and is controlled by, the centre power takeoff, therefore if the centre power takeoff is not already installed it must now be fitted in accordance with Section 14:1.

Note that short wheel base vehicles have the drive shaft coupled directly between the centre and rear power takeoff units but on long wheel base models a centre bearing assembly is interposed.

Instructions are given for installing the drive shaft or shafts to either the long or short wheel base vehicles.

To install the rear power takeoff:

Short wheel base (86 and 88) models:

- 1 Secure the drive shaft to the input flange of the unit with the shaft sliding joint towards the front. Pass the shaft forwards through the holes in the vehicle chassis until the unit can be bolted to the rear chassis cross-member.
- 2 Bolt the front flange of the shaft to the drive flange of the centre power takeoff unit. It is possible to leave the centre power takeoff Vee drive pulley in place if longer bolts ($1\frac{3}{8}$ inch—43.7 mm) long are used to secure the shaft to the flange.

Long wheel base models:

- 1 Secure the crossmember intermediate bearing support to the chassis sidemembers.
- 2 Pass the universal joint end of the front propeller shaft forwards through the chassis and secure the front end to the centre power takeoff drive flange.
- 3 Fit the centre bearing housing to the crossmember intermediate bearing support.
- 4 Secure the rear end of the rear propeller shaft to the input flange of the rear power takeoff unit. Have the shaft sliding joint to the front.
- 5 Pass the rear shaft forwards through the chassis until the rear power takeoff unit can be bolted to the rear chassis crossmember.
- 6 Bolt the front and rear shafts together at the intermediate bearing.

All models:

Fill the unit with 1 pint (.5 litre) of oil.

To service the rear power takeoff unit:

Refer to FIGS 14:7 and 14:8.

Remove the unit by reversing the installation procedure.

- 1 Remove plug 62 and drain off the oil then grip the unit in the vice by the input flange. Remove guard 68.
- 2 Remove coverplate 56 and washer 57. Remove the breather 60.
- 3 Undo nut 30 and pull the inner bearing race 22 out of the housing 25. Preserve any shims, 23.
- 4 Undo the nuts 28 and pull the housing 25 from the main housing 11. If necessary remove circlip 24 and drift the outer race of the bearing 22 from the housing.
- 5 Pull gearwheel 21 from the input shaft 14.
- 6 Remove circlip 34 then detach the input flange bolts 33.
- 7 Undo the nut 36 and pull flange 32 from the shaft 14. The unit must be relocated in the vice for this.

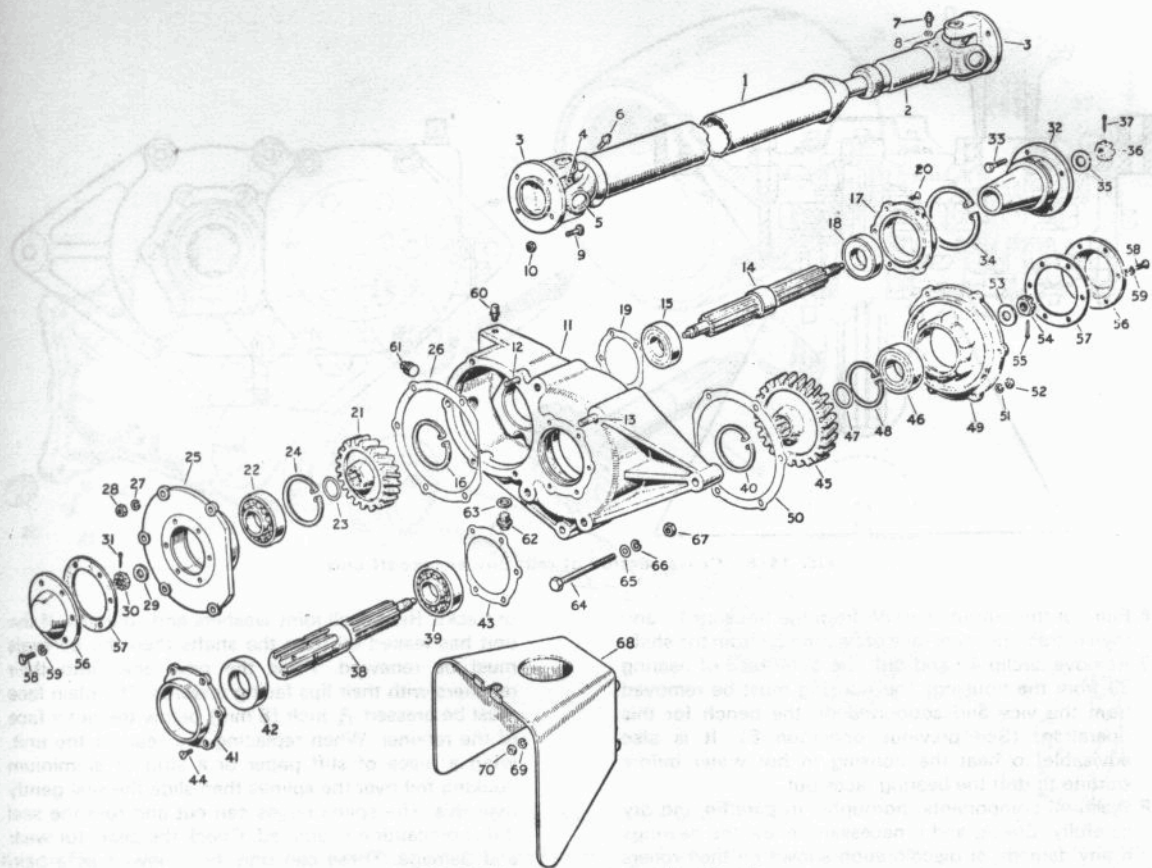


FIG 14:7 Rear power takeoff unit

- Key to Fig 14:7**
- | | | |
|--|---|--|
| 1 Propeller shaft, power takeoff drive | 2 Splined end (for propeller shaft) | 3 Flange (for propeller shaft) |
| 4 Journal complete for propeller shaft | 5 Circlip for journal | 6 Grease nipple for journal |
| 7 Grease nipple for propeller shaft, 250 inch (6.35 mm) diameter | 8 Washer for nipple | 9/10 Fixings for propeller shaft |
| 11 Housing assembly for power takeoff | 12 Stud for bearing housing or guard | 13 Stud for pulley housing or guard |
| 14 Input shaft for power takeoff | 15 Bearing for input shaft, front | 16 Circlip, bearing to housing |
| 17 Retainer for oil seal (for input shaft) | 18 Oil seal (for input shaft) | 19 Joint washer for retainer |
| 20 Screw fixing retainer | 21 Gearwheel, 20 teeth | 22 Bearing for input shaft, rear |
| 23 Shim for rear input shaft bearing | 24 Circlip, bearing to housing | 25 Housing for rear input shaft bearing |
| 26 Joint washer for rear bearing housing | 27/28 Fixings for bearing housing | 29/31 Fixings for rear bearing |
| 32 Flange for power takeoff input shaft | 33 Special bolts for propeller shaft | 34 Circlip retaining bolts to flange |
| 35/37 Fixings for flange | 38 Output shaft for power takeoff 6-spline | 39 Bearing for output shaft, rear |
| 40 Circlip for bearing | 41 Retainer for oil seal (for output shaft) | 42 Oil seal (four output shaft) |
| 43 Joint washer for retainer | 44 Screw fixing retainer | 45 Gearwheel, 24 teeth |
| 46 Bearing for output shaft, front | 47 Shim, for front output shaft bearing | 48 Circlip, bearing to housing |
| 49 Housing for output shaft front bearing | 50 Joint washer for bearing housing | 51/52 Fixings for bearing housing |
| 53/55 Fixings for front bearing | 56 Coverplate for bearings | 57 Joint washer for coverplate |
| 58/59 Fixings for cover | 60 Breather for casing | 61 Filler plug |
| 62 Drain plug for casing | 63 Fibre washer for plug | 64/67 Fixings for power takeoff assembly |
| 68 Guard for power takeoff spline | 69/70 Fixings for guard | |

- 8 Unscrew the screws holding the oil seal retainer 17 and slide the retainer and seal carefully off the shaft. The shaft 14 complete with the inner race of bearing 15 will now slide out of the unit. If necessary remove circlip 16 and drift out the outer race of bearing 15 from the unit. (See later operation 17; it may be possible to combine these).
- 9 Drift the oil seal 18 from the retainer 17 if necessary.
- 10 Remove the cover 56 and washer 57 from the front of the output shaft. Grip the unit in a soft jawed vice by the splined end of the output shaft.

- 11 Remove nut 54 and washer 53 from the output shaft then pull the inner race of bearing 46 from the shaft. Preserve shims 47 if fitted.
- 12 Remove housing 49 then if necessary remove circlip 48 and drift out the outer race of bearing 46.
- 13 Pull the gearwheel 45 from the shaft.
- 14 Relocate the unit in the vice, gripping it across a fixing bolt boss.
- 15 Undo screws 44 and slide the oil seal retainer 41 carefully off the shaft. Drift the oil seal 42 from the retainer if necessary.

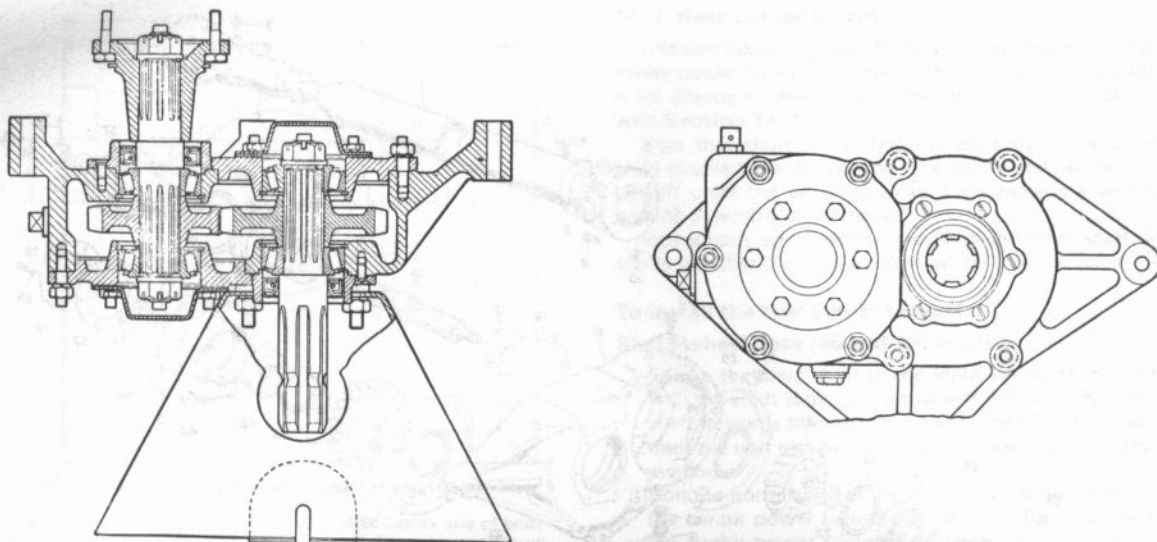


FIG 14:8 Cross-section of rear power takeoff unit

- 16 Pull out the output shaft 38 from the housing 11 and then extract the inner race of bearing 39 from the shaft.
- 17 Remove circlip 40 and drift the outer race of bearing 39 from the housing. The housing must be removed from the vice and supported on the bench for this operation. (See previous operation 8). It is also advisable to heat the housing in hot water before starting to drift the bearing races out.
- 18 Wash all components thoroughly in paraffin and dry carefully. Check, and if necessary renew the bearings if any damage or discoloration shows on their rollers

or tracks. Renew all joint washers and splitpins. If the unit has leaked oil from the shafts then the oil seals must be renewed. Press the new ones into their retainers with their lips facing inwards. The plain face must be pressed $\frac{5}{16}$ inch (8 mm) below the outer face of the retainer. When replacing the seals in the unit, wrap a piece of stiff paper or a strip of aluminium cooking foil over the splines then slide the seal gently over this. The spline edges can cut and ruin the seal if this precaution is omitted. Check the gears for wear and damage. These can only be renewed as a pair.

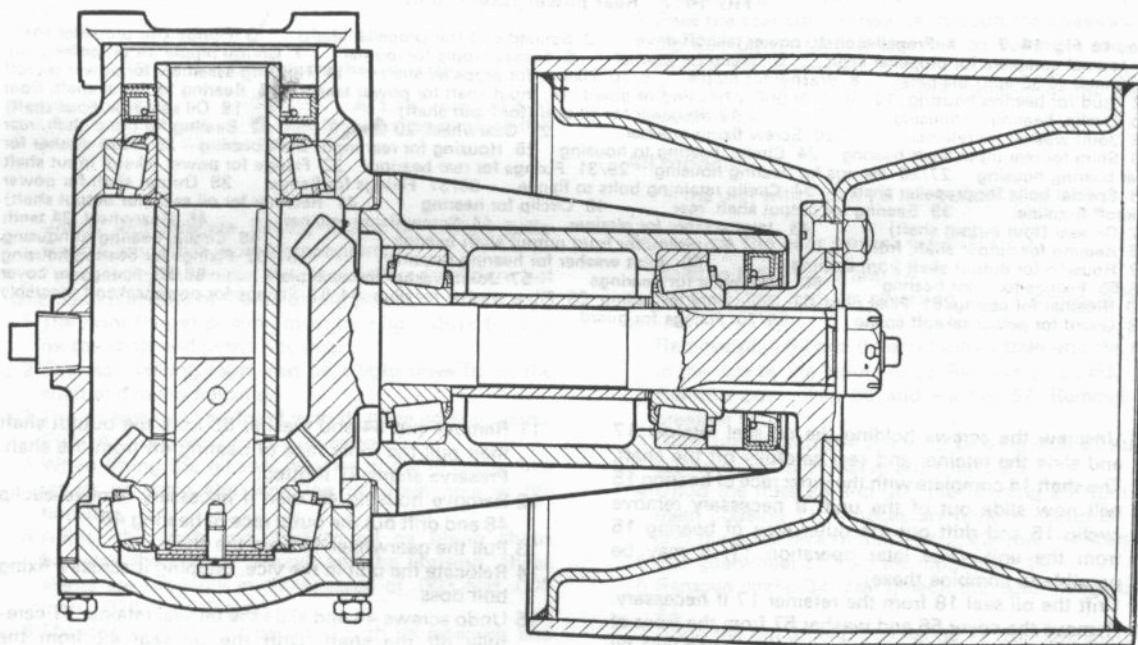


FIG 14:9 Cross-section of rear drive pulley

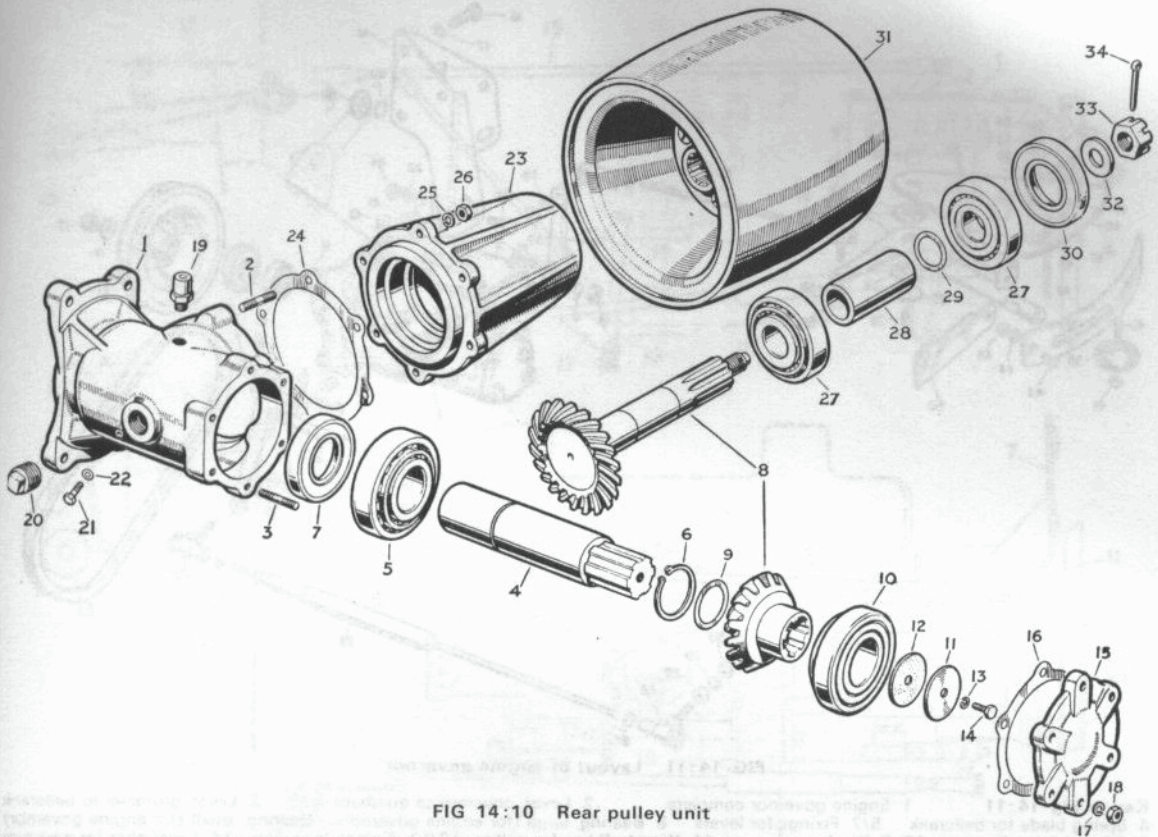


FIG 14:10 Rear pulley unit

- Key to Fig 14:10**
- | | | |
|---|---|---------------------------------------|
| 1 Housing assembly for power takeoff pinion | 2 Stud for pulley drive housing | 3 Stud for end plate |
| 4 Pinion driving sleeve, 6-spline | 5 Bearing for sleeve | 6 Circlip, bearing to sleeve |
| 8 Spiral bevel wheel and pinion | 9 Shim | 10 Bearing for bevel wheel |
| 12 Cork washer for retaining plate | 13/14 Fixings for plate | 15 End plate for bevel wheel bearing |
| 17/18 Fixings for bearing end plate | 19 Breather for housing | 20 Filler plug for housing |
| 23 Housing for pulley drive pinion | 24 Shim for pulley drive pinion housing | 25/26 Fixings for pulley drive |
| 27 Bearings for pinion | 28 Distance tube for bearings | 29 Shim for bevel pinion bearings |
| 31 Pulley | 32/34 Fixings for pulley | 30 Oil seal for bevel pinion bearings |

Examine the housings for cracks or excessive wear in any bearing bore and if these are present, scrap the housing.

- 19 Reassemble the unit by reversing the dismantling process but note the following points:
 - (a) Warm the main housing before fitting the two outer bearing races. These must only be a tap fit.
 - (b) The other two outer bearing races in housings 25 and 49 must be a light drive fit, cold.
 - (c) The bearing inner races must be a light tap fit on the shafts.
 - (d) The backlash between the gears must lie between .008 and .012 inch (.2 to .3 mm).
 - (e) The recess in the splined bore in each gear must be fitted adjacent to the centre flange on each shaft. The input shaft gear 21 must be fitted on the longer end of the shaft 14.
- 20 Adjust the bearings by tightening the nuts on the ends of the shafts then tapping both ends of each shaft to settle the bearings. Each shaft must turn freely with no end float. Add or take away shims 47 and 23 until

this condition is achieved. These shims are available in thicknesses of .005, .01 and .02 inch (.12, .25 and .5 mm).

- 21 Replace the spline guard and refit the unit to the vehicle. Refill with oil.

14:3 To transpose the power takeoff gears

If it is desired to alter the speed of the power output shaft at the rear power takeoff in relation to the engine or vehicle speed, the gears in the rear unit may be transposed.

To carry out this operation proceed as follows:

- 1 Remove the rear drive pulley if fitted, then drain the oil from the power takeoff unit.
- 2 Remove the unit from the chassis frame (see **Section 14:2**).
- 3 Remove the input shaft coverplate; take out the split-pin and unscrew the castle nut from the shaft.
- 4 Remove the input shaft bearing housing and bearing.
- 5 Remove the 20 tooth gear, carefully preserving any shims fitted to the shaft.

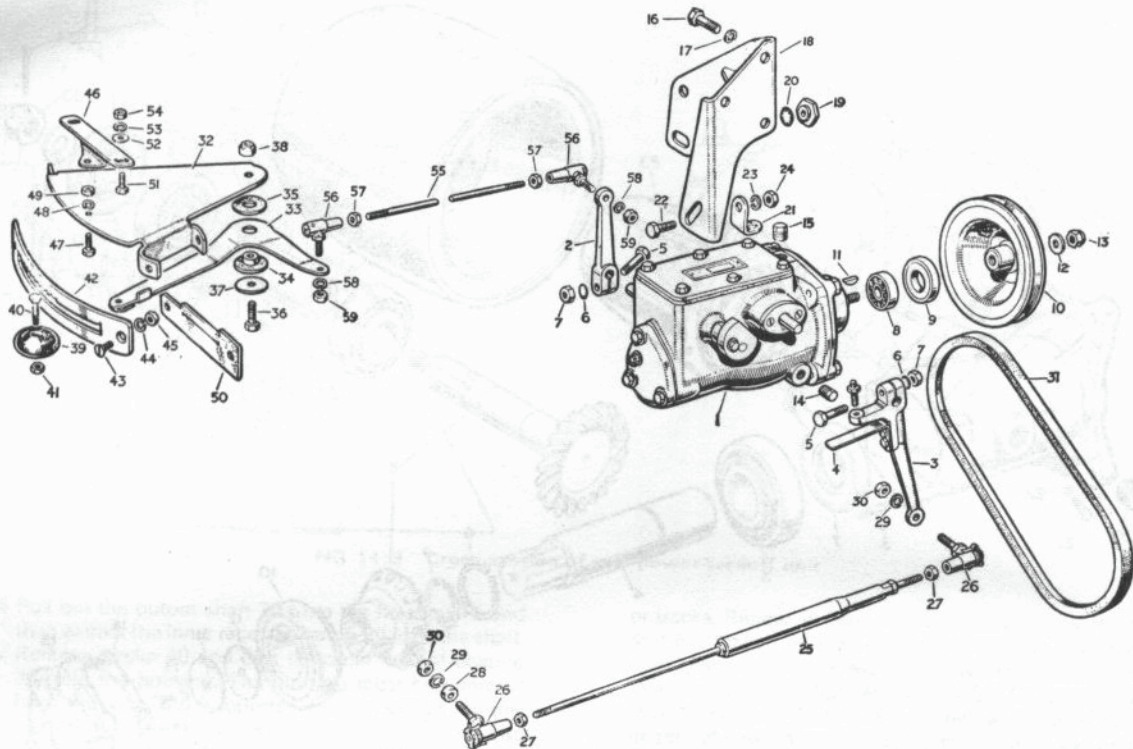


FIG 14:11 Layout of engine governor

- Key to Fig 14:11**
- | | | |
|--|----------------------------------|---|
| 1 Engine governor complete | 2 Lever, governor to quadrant | 3 Lever, grommet to bellcrank |
| 4 Spring blade for bellcrank | 5/7 Fixings for levers | 8 Bearing, large (for engine governors—Bearing, small (for engine governor) |
| 9 Oil seal for pulley end | 10 Pulley for governor | 11 Woodruff key for pulley |
| 12/13 Fixings for pulley | 14 Level plug for governor | 15 Filler plug for governor |
| 16/17 Fixings for governor | 18 Bracket for governor | 19/20 Fixings for bracket |
| 21 Support for bracket | 22/24 Fixings for support | 25 Control rod, governor to bellcrank |
| 26 Ball joint complete for rod | 27 Locknut for ball joint | 28 Distance piece, bellcrank lever end |
| 29/30 Fixings for rod | 31 Belt for governor drive | 32 Housing for governor control quadrant |
| 33 Lever for control | 34 Bush for lever | 35 Washer for lever |
| 36/38 Fixings for control lever to housing | 39 Knob for lever | 40/41 Fixings for knob |
| 42 Quadrant plate | 43/45 Fixings for quadrant plate | 46 Support for governor control |
| 47/49 Fixings for support | 50 Rubber draught excluder | 51/54 Fixings for control |
| 52 Operating rod, quadrant to governor | 53 Locknut for ball joint on rod | 54/55 Fixings for operating rod |
| 56 Ball joint for rod | 57 Locknut for ball joint on rod | |

- 6 Repeat the process for the output shaft and withdraw the 24 tooth gear.
- 7 Transpose the gears, replacing any shims on the shaft from which they were removed. **This is important.**
- 8 Reassemble the unit using new splitpins to lock the castle nuts.
- 9 Replace it on the vehicle and refill with 1 pint (.5 litre) of oil.

14:4 Rear drive pulley

In this Section refer to FIGS 14:9 and 14:10.

To fit the rear drive pulley:

- 1 Remove the output shaft guard from the rear power takeoff.
- 2 Slide the pulley unit over the output shaft and secure it to the rear power takeoff casing in place of the output shaft guard.
- 3 Fill the unit with oil, $\frac{3}{4}$ pint (.4 litre).
- 4 When the belt is connected to the driven machine, the tension is correct if the handbrake will hold the

vehicle and the two sides of the belt cannot be made to touch when compressed by hand midway between the vehicle and the driven machine.

To service the pulley unit:

- 1 Remove the pulley from the shaft then remove the whole unit from the vehicle by reversing the installation procedure. Drain off the oil.
- 2 Refer to FIG 14:10 and undo the six nuts 26 and pull the pinion housing 23 from the housing 1. Retain any shims 24.
- 3 Tap out the pinion shaft 8, inner element of race 27, tube 28 and shims 29 out of the pinion housing.
- 4 Warm the pinion housing, drift out the oil seal 30, remove the inner element of race 27 then drift out both of the race outer elements.
- 5 Remove end plate 15 and shims 16. The race 10 will come away with the end plate and can be released if the plate is heated.
- 6 Pull shaft 4 complete with the bevel wheel 8 from the housing then remove the setbolt 14. Dismantle the

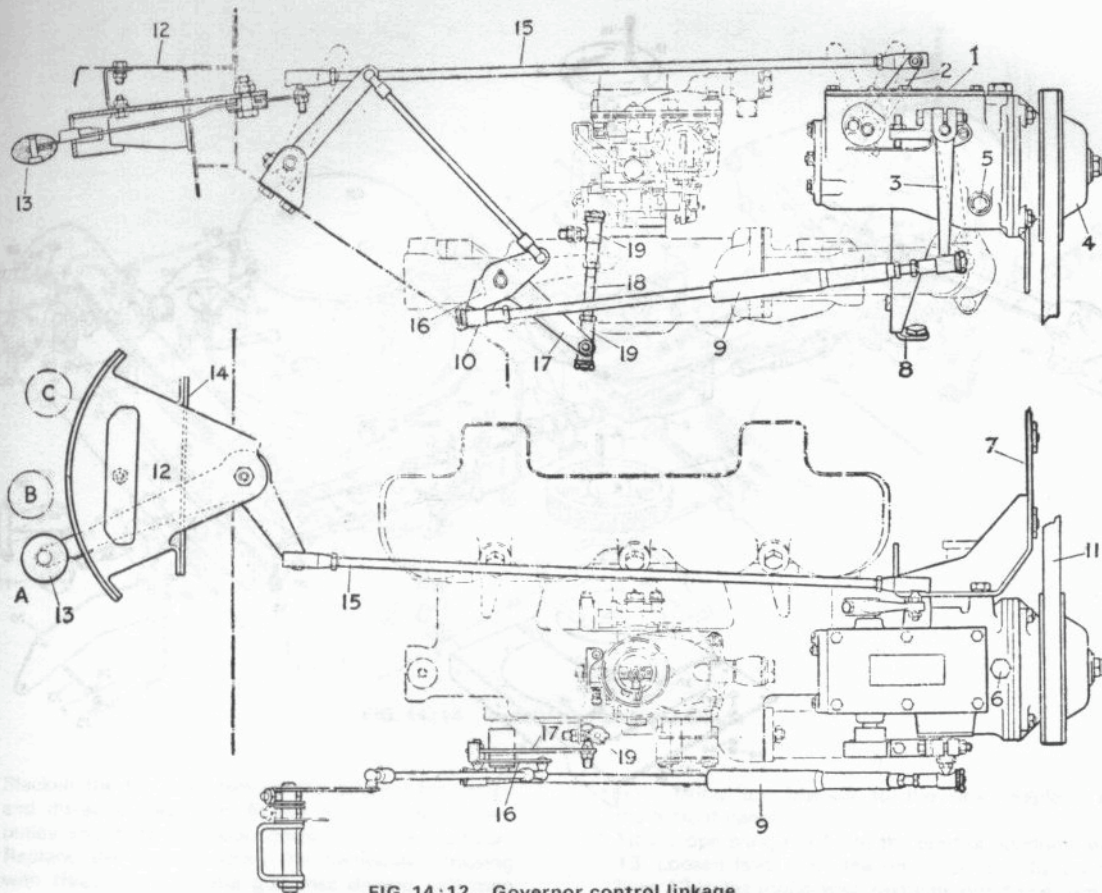


FIG 14:12 Governor control linkage

Key to Fig 14:12 A Inoperative position B 1500 rev/min C 3000 rev/min 1 Engine governor 2 Loading lever
 3 Throttle control lever 4 Governor pulley 5 Oil level plug 6 Oil filler plug 7 Bracket for governor 8 Support for bracket
 9 Collapsible control rod 10 Adjustable ball joint for rod 11 Drive belt 12 Control quadrant 13 Operating lever
 14 Draught excluder 15 Governor operating rod 16 Relay lever 17 Carburettor bellcrank 18 Rod, bellcrank to carburetter
 19 Adjustable ball joint for rod

bevel wheel and races from the shaft. Preserve any shims 9.

- 7 Heat the housing and drive the outer element of race 5 from the bore with the oil seal 7.
- 8 Wash all the components carefully in paraffin and dry thoroughly. Inspect the races, shafts and gears for damage and renew as required. The gears must be renewed as a pair. New oil seals must be fitted.
- 9 Assemble the unit by reversing the dismantling process noting that the outer elements of the races must be a tap fit in warm housings, the inner elements of the drive shaft races must be a light drive fit and those on the pinion shaft an easy tap fit.
- 10 The shims 9 provide adjustment for the bevel wheel and are available in .005, .01 and .02 inch (.12, .25 and .5 mm) thickness. The bevel wheel must align with the pinion face as shown in FIG 14:9.
- 11 The drive shaft and pinion shaft oil seals must be fitted with their lips inwards.
- 12 Adjust the drive shaft to a condition of free movement without end float by means of shims 16. These are

also available in the same range of sizes as those for the bevel wheel.

- 13 The pinion shaft 8 is adjusted to the same condition as the drive shaft by means of shims 29. These are also available in the same three thickness as shims 9 and 16.
- 14 Add or remove shims 24 until there is definite backlash between the bevel wheel and pinion throughout a complete revolution. This backlash must not exceed .004 inch (.1 mm) at any point.

14:5 The engine governor. Petrol models

In this Section refer to FIGS 14:11 and 14:12.

To install the governor:

- 1 Remove the bonnet for easy access to the engine.
- 2 Refer to FIG 14:11. Fit bracket 21 on top of the existing generator support bracket, turn it to the rear leaving the bolt slack. Fit the governor to bracket 18.

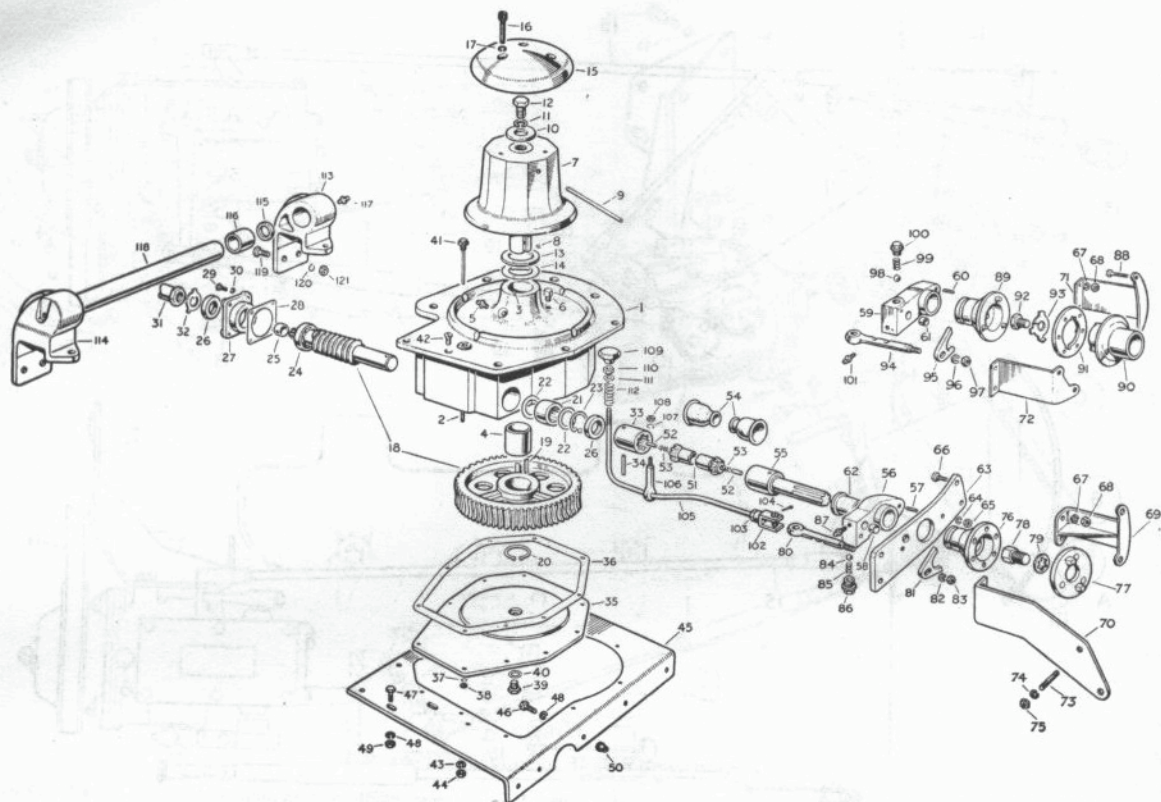


FIG 14:13 Layout of front winch

- Key to Fig 14:13**
- | | | | |
|--|--|--|--|
| 1 Casing assembly for front winch | 2 Stud for bottom cover | 3 Dowel for thrust washer | 4 Bush for bollard shaft |
| 5 Grease point for shaft | 6 Breather cup for housing | 7 Bollard and shaft assembly | 8 Dowel for shaft |
| 9 Pin for bollard | 10/12 Fixings for bollard | 13 Thrust washer (for bollard) | 14 Shim (for bollard) |
| 15 Cap for bollard | 16/17 Fixings for cap | 18 Worn wheel and worm complete | 19 Special key to worm wheel |
| 20 Circlip fixing worm wheel | 21 Roller bearing for worm | 22 Washer for bearing | 23 Circlip fixing bearing to casing |
| 24 Ballbearing for worm shaft | 25 Distance piece for worm shaft | 26 Oil seal for worm shaft | 27 Retainer for oil seal |
| 28 Joint washer for oil seal retainer | 29/30 Fixings for oil seal retainer | 31 Starting dog | 32 Lockwasher for starting dog |
| 33 Universal joint sleeve | 34 Special pin fixing sleeve to worm | 35 Bottom cover for winch casing | 36 Joint washer for bottom cover |
| 37/38 Fixings for bottom cover | 39 Drain plug for front winch | 40 Joint washer for drain plug | 41 Filler plug and dipstick |
| 42/44 Fixings for front winch | 43 Support plate for front winch | 44/49 Fixings for support plate | 50 Rivnut |
| 51 Propeller shaft for front winch | 45 Support plate for front winch | 52 Plunger spring (for propeller shaft) | 53 Plunger (for propeller shaft) |
| 54 Dust cover (for propeller shaft) | 55 Driving shaft for front winch | 56 Winch shaft housing assembly (2½ litre Petrol/Diesel models) | 57 Stud for support plate (2½ litre Petrol/Diesel models) |
| 58 Bush for control shaft (2½ litre Petrol/Diesel models) | 59 Winch shaft housing assembly (2 litre Petrol models) | 60 Stud for support plate (2 litre Petrol models) | 61 Bush for control shaft (2 litre Petrol models) |
| 62 Bush for winch driving shaft | 63 Support plate for winch shaft | 64/65 Fixings for housing | 66/68 Fixings for support |
| 69 Bracket for winch shaft support plate righthand (2½ litre Petrol/Diesel models) | 70 Bracket for winch shaft support plate righthand (2 litre Petrol models) | 71 Bracket for winch shaft support plate righthand (2 litre Petrol models) | 72 Bracket for winch shaft support plate lefthand (2½ litre Petrol models) |
| 73/75 Fixings (bracket to front cover) | 74 | 75 | 76 Driving flange for front winch |
| 77 Winch driving plate | 78/79 Fixings for driving plate | 80 Control shaft for driving flange | 81 Selector fork for control shaft |
| 82/83 Fixings for fork | 84 Steel ball (for control shaft) | 85 Spring (for control shaft) | 86 Plug for spring (for control shaft) |
| 87 Grease point for control shaft | 88 Setbolt fixing bracket to front cover | 89 Driving flange for front winch | 90 Driving flange for fan pulley |
| 91 Winch driving plate | 92/93 Fixings for driving flange and plate | 94 Control shaft for driving flange | 95 Selector fork for control shaft |
| 96/97 Fixings for fork | 98 Steel ball (for control shaft) | 99 Spring (for control shaft) | 100 Plug for spring (for control shaft) |
| 101 Grease point for control shaft | 102/104 Clevis, locknut and splitpin | 103 Control rod for winch | 104 Locknut for knob |
| 105 Control rod for winch | 106 Eye bolt for winch control rod | 107/108 Fixings for eye bolt | 109 Knob for control rod |
| 110 Locknut for knob | 111 Plain washer for spring | 112 Spring for control rod | 113 Rope guide bracket assembly righthand |
| 114 Rope guide bracket assembly lefthand | 115 Thrust washer | 116 Bush for guide bar | 117 Grease point for bush |
| 118 Guide bar for winch rope | 119/121 Fixings for rope guide | | |

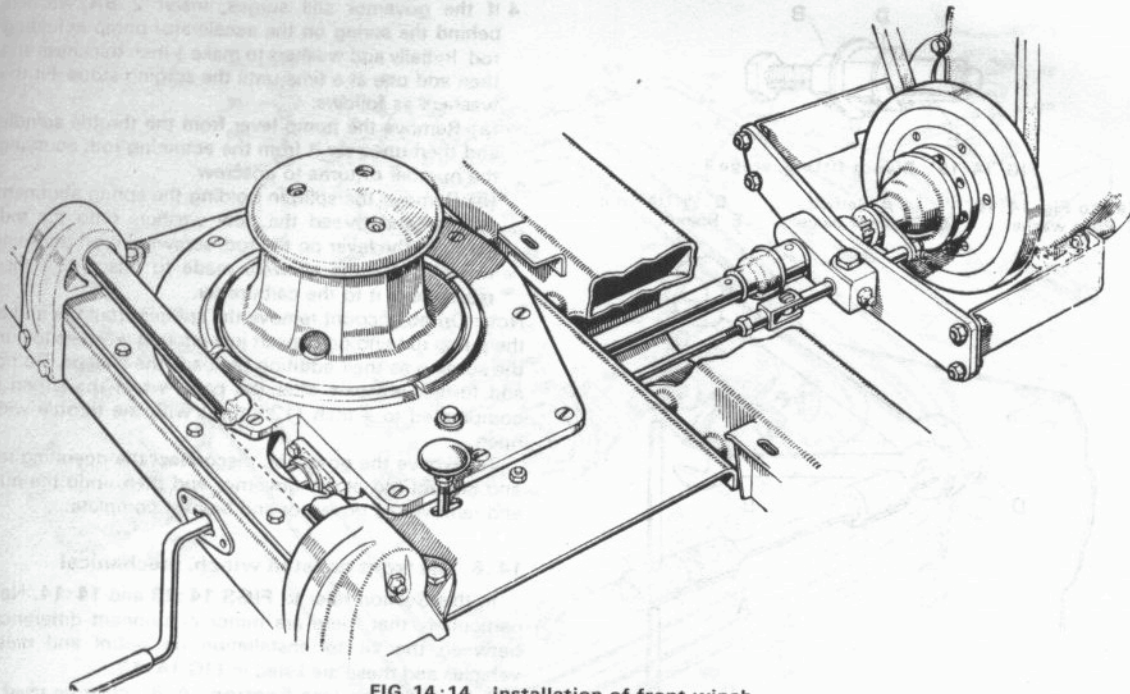


FIG 14:14 Installation of front winch

- 3 Slacken the fan belt, remove the original fan pulley and distance piece and fit the new double groove pulley and distance piece. Readjust the belt tension.
- 4 Replace the bolts holding the thermostat housing with three studs, fit the governor driving belt then attach the governor bracket to the thermostat housing but leave the nuts on the studs slack. Connect bracket 21 to bracket 18 but leave the nut and bolt slack. See that the distributor vacuum pipe clears the bracket.
- 5 Hold the governor out to tension the belt so that it can be depressed $\frac{1}{2}$ inch (12.5 mm) midway between the pulleys by thumb pressure. Tighten all the supporting bracket nuts and bolts.
- 6 Check the oil level in the governor and replenish as necessary until the level reaches the bottom of the level plug hole.

Refer to FIG 14:12 and install the linkage as follows:

- 7 Discard the throttle spring between the bellcrank lever and the petrol filter bracket.
- 8 Remove the coverplate on the dash below the instrument panel.
- 9 Insert the control quadrant in the hole thus uncovered in the dash using the fixings originally holding the coverplate. Fit the rubber draught excluder between the quadrant housing and the dash. Leave all the fixings slack at this stage.
- 10 Remove the instrument panel complete without disconnecting the instruments then secure the quadrant bracket to the bottom of the instrument box. Tighten the nuts securing the quadrant to the dash and then the

nuts fixing the bracket to the box. Replace the instrument panel.

- 11 Fit the operating rod 15 to the control quadrant lever 13. Loosen lever 3 on the governor, put the control lever 13 in the inoperative (extreme righthand) notch, then push lever 2 forward until a marked resistance is felt. Hold in this position and adjust the length of rod 15 until it can be fitted to lever 2. Tighten the ball joint locknuts.
- 12 Fit rod 9 between the relay lever 16 and the governor lever 3. A distance piece must be fitted between the ball joint 10 and the relay lever 16 to allow the rod to clear the end of the shaft.
- 13 Adjust the throttle linkage to ensure that the carburetter butterfly is fully open when the accelerator is fully depressed.

Set the control linkage as follows:

- 1 Place the quadrant lever in the extreme lefthand notch.
- 2 Hold the throttle wide open and tighten lever 3 on its shaft. Return the quadrant lever to the righthand notch.
- 3 Start the engine and warm up. Move the control lever to the first operating notch (1500 rev/min) and check the anti-surge stop clearance. This should be .02 to .025 inch (.5 to .65 mm) measured between the spring leaf attached to lever 3 and the cam on the shaft which carries lever 2. Adjust by the screw in the bracket attached to lever 3.
- 4 Return the quadrant lever to the extreme righthand position. The linkage is now correctly set to control the engine speed between 1500 and 3000 rev/min.
- 5 The engine speed can be checked with a revolution

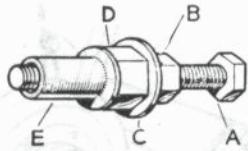


FIG 14:15 Rivnut fitting, stage 1

Key to Fig 14:15
 C Plain washer A Setbolt B $\frac{5}{16}$ UNF nut
 D Distance piece E Rivnut

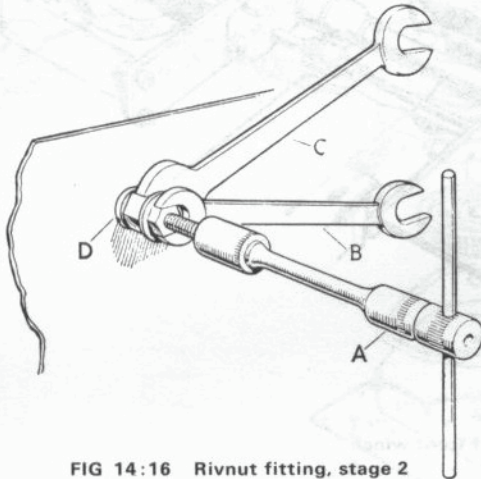


FIG 14:16 Rivnut fitting, stage 2

Key to Fig 14:16
 B $\frac{5}{16}$ UNF spanner A $\frac{5}{16}$ UNF spanner
 C $\frac{3}{8}$ UNF spanner D Rivnut

counter applied to the rear power takeoff. The relationship between the power takeoff and engine speeds is given in the following tables:

(a) Rear power takeoff pulley:

Governor position	Engine speed	Pulley speed	
		5:6 Power takeoff ratio	6:5 Power takeoff ratio
1	1500	1070	1540
4	1950	1390	2000
8	2550	1820	2630
11	3000	2145	3100

(b) Rear power takeoff drive shaft:

Governor position	Engine speed	Drive shaft speed	
		5:6 Power takeoff ratio	6:5 Power takeoff ratio
1	1500	1250	1800
4	1950	1625	2350
8	2550	2125	3050
11	3000	2500	3600

Rectifying governor surging:

- 1 Ensure that backlash in the linkage does not exceed .01 inch (.25 mm) and that there are no tight spots in the linkage operation.
- 2 See that the carburetter jets are clean and that the governor and fan belts are correctly tensioned.
- 3 Fit a new spring to the accelerator pump rod.

4 If the governor still surges, insert 2 BA washers behind the spring on the accelerator pump actuating rod. Initially add washers to make $\frac{1}{8}$ inch thickness and then add one at a time until the surging stops. Fit the washers as follows:

(a) Remove the pump lever from the throttle spindle and then unscrew it from the actuating rod, counting the number of turns to unscrew.

(b) Remove the splitpin holding the spring abutment washer and thread the new washers onto the rod. Replace the lever on the rod, screwing it on the same number of turns as were made to unscrew it then reassemble it to the carburetter.

Note: On no account remove the splitpin from the end of the pump rod and only insert just enough washers to cure the surging as their addition preloads the linkage. Do not add further washers after the point when the spring is compressed to $\frac{1}{2}$ inch (12.5 mm) with the throttle wide open.

To remove the governor, disconnect the operating rod and control rod at the governor end then undo the nuts and remove the governor and bracket complete.

14:6 The front capstan winch, mechanical

In this Section refer to FIGS 14:13 and 14:14. Note particularly that there are minor component differences between the kit for installation on petrol and diesel vehicles and these are listed in FIG 14:13.

A hand throttle (see Section 14:8), must be used in conjunction with the winch on petrol engined vehicles. New heavy duty front springs should also be fitted to these vehicles.

To fit the winch:

- 1 Remove the grille and radiator then slacken the belt and withdraw the fan.
- 2 Drill a $\frac{23}{64}$ inch (10.318 mm) hole in the front face of the second chassis crossmember (the bumper is the first), midway between the sidemembers and $3\frac{3}{8}$ inch (83.3 mm) from the top face.
- 3 Fit a nut and plain washer to a $\frac{5}{16}$ UNF bolt screwed $1\frac{1}{2}$ inches long. Drill the thread out of a $\frac{3}{8}$ inch UNF nut, slide it on the bolt then screw on a Rivnut. Have $\frac{1}{8}$ inch (3.2 mm) of the bolt protruding then lock the $\frac{5}{16}$ nut onto the distance piece ($\frac{3}{8}$ inch nut) and Rivnut (see FIG 14:15). Insert the assembly into the drilled hole, then keeping the bolt and $\frac{3}{8}$ inch nut stationary, turn the $\frac{5}{16}$ inch nut clockwise $2\frac{1}{2}$ turns. Remove bolt, nut, plain washer and distance piece. FIG 14:16 shows the method of inserting and locking the Rivnut in the chassis.
- 4 Assemble the winch support plate (see FIG 14:13), item 45, to the chassis crossmember securing it with a bolt in the Rivnut. Using the support plate as a template mark off the other four holes for Rivnuts in the second chassis crossmember and the five $\frac{5}{16}$ inch (8 mm) clearance holes in the front bumper. Remove the support plate and bumper; drill all the holes and fit the four Rivnuts.
- 5 Remove the starting dog.
- 6 Remove the crankshaft pulley, strip it and fit the new driving plate making sure the correct one for the engine, either petrol or diesel, is fitted.

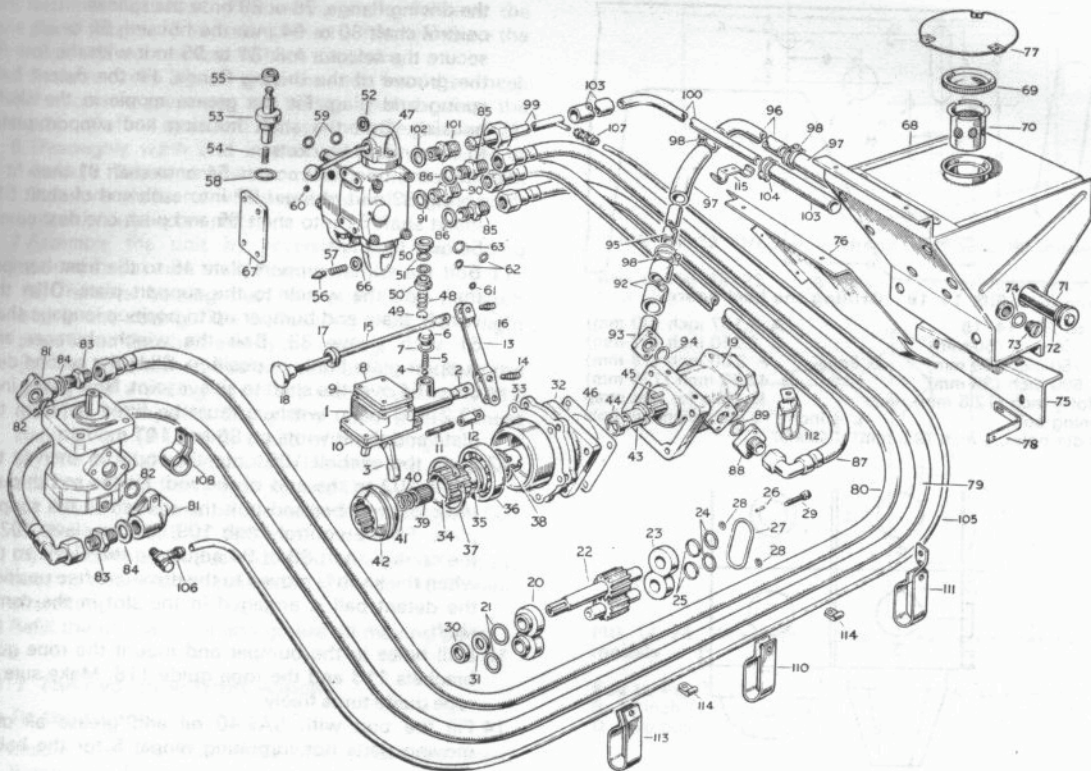


FIG 14:17 Hydraulic system layout

- Key to Fig 14:17**
- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 1 Selector housing | 2 Selector shaft | 3 Selector fork | 4 Ball (for selector control mechanism) | 5 Spring (for selector control mechanism) | 6 Plug for spring (for selector control mechanism) | 7 Joint washer (for selector control mechanism) | 8 Coverplate for selector housing | 9 Joint washer, top coverplate | 10 Joint washer | 11 Stud for selector pivot | 12 Pivot for selector lever | 13 Operating lever for shaft | 14 Clevis complete (fixing lever and pivot to selector shaft) | 15 Rod for operating lever | 16 Clevis complete (fixing rod to operating lever) | 17 Grommet for rod | 18 Knob | 19 Hydraulic pump for power takeoff unit | 20 Bush 'A' for gearshafts | 21 O-ring for 'A' bushes | 22 Gears and shafts | 23 Bush 'C' for gearshafts | 24 Sealing ring for 'C' bushes | 25 Support ring for 'C' bushes | 26 Special dowel for body and bush | 27 O-ring for housing | 28 O-ring, body ports | 29 Special screw fixing body cover body | 30 Oil seal for shaft | 31 Baffle for oil seal | 32 Adaptor for hydraulic pump | 33 Joint washer (for power takeoff unit) | 34 Drive shaft (for power takeoff unit) | 35 Distance piece (for power takeoff unit) | 36 Ballbearing (for power takeoff unit) | 37 Circlip (for power takeoff unit) | 38 Circlip (for power takeoff unit) | 39 Roller bearing (for power takeoff unit) | 40 Retaining ring (fixing roller bearing to shaft) | 41 Circlip (fixing roller bearing to shaft) | 42 Dog clutch | 43 Coupling sleeve (connecting hydraulic pump to drive shaft) | 44 Coupling dog (connecting hydraulic pump to drive shaft) | 45 Key (connecting hydraulic pump to drive shaft) | 46 Joint washer, hydraulic motor | 47 Control valve assembly | 48 Piston return spring | 49 Retaining ring for piston | 50 Gland washer for piston | 51 O-ring for piston | 52 Washer for selector lever | 53 Unloader piston | 54 Spring for unloader piston | 55 Valve seat for unloader piston | 56 Relief valve | 57 Spring, relief valve | 58 O-ring, relief valve housing to unloader housing | 59 O-ring body face | 60 O-ring body face | 61 O-ring body face | 62 O-ring lefthand coverplate | 63 O-ring lefthand coverplate | 64 O-ring lefthand unloader | 65 O-ring lefthand unloader | 66 Special seal | 67 Mounting plate (fixing control valve to heel board) | 68 Oil tank | 69 Filler cap | 70 Filter gauze | 71 Oil filter | 72 Joint washer, oil filter | 73 Drain plug | 74 Joint washer, drain plug | 75 Brackets for oil tank | 76 Protection panel | 77 Coverplate | 78 Rear wing stay | 79 Flexible pipe, control valve to motor, 113 inch long | 80 Flexible pipe, control valve to motor, 101½ inch long | 81 Elbow for flexible pipe | 82 O-ring | 83 Adaptor | 84 Special seal | 85 Adaptor (fixing flexible pipe to control valve) | 86 Special seal (fixing flexible pipe to control valve) | 87 Flexible pipe, pump to control valve, 26 inch long | 88 Connection for pipe, pump to control valve | 89 O-ring (connection to pump) | 90 Adaptor (for pipe, pump to control valve, on control valve) | 91 Special seal (for pipe, pump to control valve, on control valve) | 92 Adaptor (for pipe, pump to control valve, on control valve) | 93 Elbow on pump for flexible pipe | 94 O-ring (fixing elbow to pump) | 95 Pipe, steel, front (pump to tank) | 96 Pipe, steel, rear (pump to tank) | 97 Rubber connection, front to rear pipe and rear pipe to tank | 98 Hose clip | 99 Pipe, steel, front (control valve to tank) | 100 Pipe, steel, rear (control valve to tank) | 101 Adaptor on control valve for tank pipe | 102 Joint washer for adaptor | 103 Rubber connection, front to rear pipe and rear pipe to tank | 104 Hose clip | 105 Oil exhaust pipe for motor | 106 Banjo complete | 107 Union for exhaust pipe at rear | 108 Clip (fixing oil pipes) | 109 Clip (fixing oil pipes) | 110 Clip (fixing oil pipes) | 111 Clip (fixing oil pipes) | 112 Clip (fixing oil pipes) | 113 Clip (fixing oil pipes) | 114 Clip (fixing oil pipes) | 115 Clip (fixing oil pipes) |
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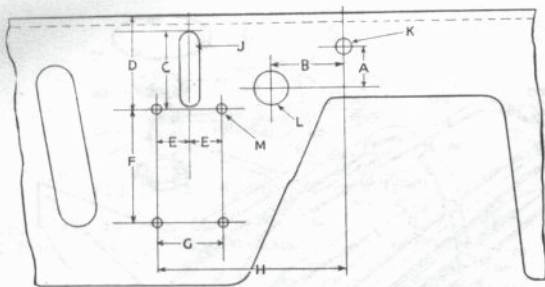


FIG 14:18 Drilling the heel board

Key to Fig 14:18
 A 1.187 inch (30 mm)
 B 1.968 inch (50 mm)
 C 2.250 inch (57 mm)
 D 2.750 inch (69 mm)
 E Equal
 F 3.00 inch (76 mm)
 G 1.500 inch (38 mm)
 H 4.968 inch (126 mm)
 J Slot $\frac{1}{2}$ inch (12.5 mm) wide
 K Hole for seat strap retaining bolt
 L $\frac{3}{4}$ inch (19 mm) diameter hole
 M Four holes, $\frac{3}{8}$ inch (9.5 mm) diameter

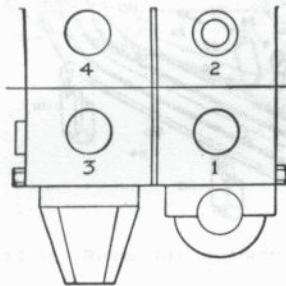


FIG 14:19 Position of control box connections

Key to Fig 14:19
 A Steel adaptor and seal
 B Brass union and washer
 C Steel adaptor and seal
 D Steel adaptor and seal

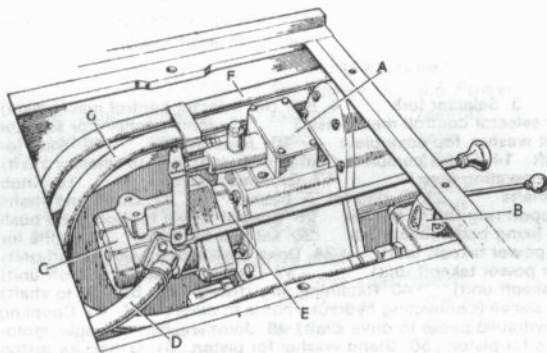


FIG 14:20 Hydraulic pump mounted in position

Key to Fig 14:20
 A Power takeoff
 B Control valve
 C Pump
 D Suction pipe to tank
 E Pump adaptor
 F Hose, winch motor to control valve, lefthand side
 G Hose, winch motor to control valve, righthand side

- Secure the shaft support brackets to the engine front cover using the longer bolts or studs supplied. These brackets are items 69 and 70 or 71 and 72 (see FIG 14:13).
- Replace the crankshaft pulley and the fan belt.
- Secure the shaft housing 56 or 59 to plate 63, grease the shaft 55 and insert in the housing 56 or 59 sliding

the driving flange, 76 or 89 onto the splines. Insert the control shaft 80 or 94 into the housing 56 or 59 and secure the selector fork 81 or 95 to it with the fork in the groove of the driving flange. Fit the detent ball spring and plug. Fit the grease nipple in the shaft housing. Bolt the shaft housing and support plate to the engine brackets.

- Slide the two dust covers 54 onto shaft 51 then fit a spring 53 and plunger 52 into each end of shaft 51. Insert shaft 51 into shaft 55 and push one dust cover 54 over the joint.
- Bolt the winch support plate 45 to the front bumper then bolt the winch to the support plate. Offer the winch, plate and bumper up to position, engage shaft 51 with sleeve 33. Bolt the winch, bumper and support plate firmly in position. Slide the second dust cover 54 over the shaft to sleeve joint. Note that $\frac{1}{8}$ inch (3.2 mm) plain washers must be fitted between the plate and the Rivnuts on 86 and 107 models.
- Slide the eyebolt 106 onto the rod 105 then fit the clevis 102 to the end of the rod. Fit the rod through the crossmember and bolt the eyebolt to the support plate. Fit the control knob 109. Fit the clevis 102 to the control shaft 80 or 94 adjusting the clevis so that when the knob is moved to the drive and free positions the detent ball is engaged in the slot in the control shaft.
- Drill holes in the bumper and mount the rope guide brackets 113 and the rope guide 118. Make sure the rope guide turns freely.
- Fill the unit with SAE 40 oil and grease all other moving parts not forgetting nipple 5 for the bollard shaft.
- Replace the fan blade, grille panel and radiator.

To service the unit:

Remove the winch from the vehicle by reversing the fitting procedure then proceed as follows:

- Drain off the oil.
- Drive out pin 34 and remove sleeve 33 then unscrew dog 31. Remove the oil seal retainer 27 then turn the worm shaft 18 while tapping it forwards out of the casing. Pull the ballbearing 24 from the shaft.
- Remove cover 35, turn the unit over and remove screws 16 and cap 15. Undo bolt 12, drift out pin 9

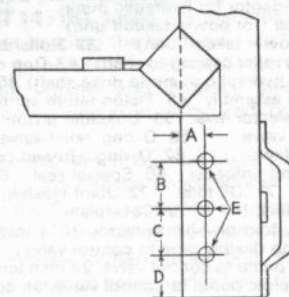


FIG 14:21 Mounting holes in rear crossmember, 88 models

Key to Fig 14:21
 A $1\frac{1}{2}$ inch (32.0 mm)
 B $2\frac{3}{8}$ inch (67.0 mm)
 C $2\frac{3}{8}$ inch (67.0 mm)
 D $2\frac{1}{2}$ inch (63.5 mm)
 E Three holes $\frac{1}{2}$ inch (9.0 mm) dia.

and lift the bollard 7 from the shaft. Preserve the thrust washer 13 and any shims 14 then withdraw the shaft and worm wheel 18 from the casing.

4 Remove circlip 20 and press the shaft from the wheel.

5 If necessary press out the bollard shaft bushes, the worm shaft oil seals and remove the roller bearing 21.

6 Thoroughly wash and inspect all parts for wear or damage. Renew any worn components noting that the worm shaft and wheel and the bollard and shaft are only supplied as pairs.

7 Assemble the unit by reversing the dismantling procedure but note the following points:

(a) The roller bearing must be a push fit on the shaft and in the casing. The ballbearing must be a light press fit on the shaft and in the casing.

(b) The bollard shaft bushes must be a press fit in the casing and a sliding fit on the shaft. Ream to 1.312 inch (33.4 mm) after fitting. The upper bearing must stand $\frac{1}{8}$ inch (3.17 mm) proud of the casing.

(c) The oil seal lips must face inwards and the worm shaft must turn freely with no end float.

(d) Adjust the shims on the bollard shaft to give .003 to .005 inch (.075 to .125 mm) end float.

(e) The drive shaft bush 62 must be a press fit in the housing and must be reamed to .75 inch (19.05 mm) after fitting.

8 Refill the unit with oil and grease all moving parts.

14:7 The hydraulic front winch

To fit the winch:

1 Ensure that the bumper is level and undamaged. Remove and discard the front valance. Remove the radiator grille.

2 Fit the hydraulic pipe elbows to the motor as shown in FIG 14:17.

3 Install the winch between the front bumper and the chassis crossmember using the winch mounting bracket holes as drilling templates. For fitting the necessary Rivnuts, refer to Section 14:6. It will be necessary to remove and replace the front bumper during this operation. Replace the radiator grille.

4 Drill the heel board as shown in FIG 14:18 then fit the hydraulic control valve to it. Before fitting the control valve install the adaptors and brass union in the positions shown at FIG 14:19.

5 Fit the power takeoff unit with the hydraulic pump and selector to the transfer casing in a similar manner to that adopted for the centre power takeoff described in Section 14:1. Pass the selector control rod through the hole in the heel board. FIG 14:20 shows

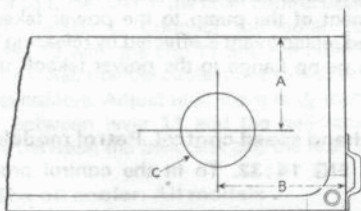


FIG 14:22 Hole in rear wheel arch, 88 model

Key to Fig 14:22 A 7 inch (178 mm)
B 9 inch (229 mm) C 6 inch (152 mm) dia.

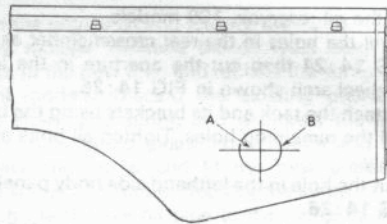


FIG 14:23 Hole in lefthand body side, 88 models

Key to Fig 14:23 A 4 inch (102 mm) hole central to oil filter plug
B Rubber grommet

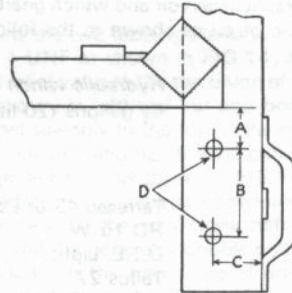


FIG 14:24 Mounting holes in rear crossmember, 109 models

Key to Fig 14:24 A $4\frac{1}{2}$ inch (121 mm)
B $7\frac{1}{2}$ inch (191 mm)
D Two holes $\frac{1}{2}$ inch (7.0 mm) dia.

C $2\frac{1}{2}$ inch (64 mm)

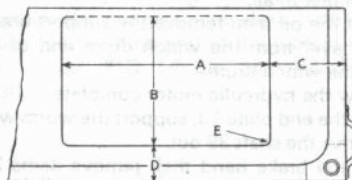


FIG 14:25 Aperture in lefthand side wheel arch, 109 models

Key to Fig 14:25 A 15 inch (381 mm)
B 12 inch (304 mm)
D $1\frac{1}{2}$ inch (38 mm)
E $\frac{1}{4}$ inch (6.0 mm) radius

C $3\frac{1}{2}$ inch (89 mm)

the layout. The port marked inlet must be to the right-hand side.

6 The oil reservoir must now be installed. Slightly different fittings are needed for the 88 and 109 models therefore the 88 will be described first.

(a) Drill three holes in the underside of the rear crossmember as shown in FIG 14:21.

(b) Cut the hole in the lefthand wheel arch box to the dimensions given in FIG 14:22.

(c) Using the coverplate as a template drill the wheel arch box and fit the three spire nuts.

(d) Jack up the vehicle and remove the lefthand road wheel and wing stay.

(e) Bolt the tank mounting bracket to the chassis then mount the tank. Drill all other holes for fixing bolts, fit the bolts and tighten all nuts.

(f) Cut a 3 inch hole in the lefthand side rear wing as shown in FIG 14:23.

7 To fit the oil reservoir, 109 models.

(a) Drill the holes in the rear crossmember as shown in FIG 14:24 then cut the aperture in the lefthand side wheel arch shown in FIG 14:25.

(b) Attach the tank and its brackets using the brackets. To drill the remaining holes. Tighten all bolts and nuts securely.

(c) Cut the hole in the lefthand side body panel shown in FIG 14:26.

8 Connect the hydraulic pipes as shown in FIG 14:27. This shows the 109 model layout but the 88 model is generally similar. Fit the pipes to the control valve as shown in FIG 14:28.

9 Fill the hydraulic reservoir and winch gearbox with the correct grade of oil as shown in the following table.

	Hydraulic winch supply tank
Capacities	4½ gallons (20 litres)
SAE	—
BP	—
Duckhams	—
Esso	Terresso 43 or Essolube HD 10/W
Mobil	D.T.E. Light
Shell	Tellus 27
Wakefield	Hyspin 70 or Castrolite

To service the winch:

Refer to FIG 14:29. Dismantling is straightforward provided the following points are noted.

- 1 Remove the screw plugs 50 and withdraw the springs and pads first of all.
- 2 Drain off the oil then remove the support bracket and selector lever from the winch drum end of the unit. Pull off the winch drum.
- 3 Withdraw the hydraulic motor complete.
- 4 Remove the end plate 13, support the worm wheel and gently drive the shaft 39 out.
- 5 Slacken the brake band then remove items 20 to 30 and drive out the worm shaft 19. Note which way round the distance piece 24 is fitted.
- 6 Clean all the components and renew where needed. The worm shaft and wheel must be renewed as a pair if damaged.
- 7 First fit the worm shaft and its bearings. Make sure the bearings are fitted the correct way round as they are thrust bearings. Adjust the end float to .002 inch (.05 mm) by shims 21. Fit the brake components.
- 8 Fit the oil seal 44 and bearing 41 to the casing.
- 9 Check that shaft 39, key 40 and wheel 19 can be assembled to a smooth sliding fit. Place the wheel in the casing in mesh with the worm shaft. Fit shaft 39 without the key, 40. Fit the distance ring 43 and then measure with feeler gauges the gap between this ring and the wheel. Remove the shaft and wheel and place shims 42 to this value between the wheel and bearing 41. Reassemble the shaft wheel and key.
- 10 Complete the assembly by reversing the dismantling procedure.

The hydraulic motor:

Refer to FIG 14:30. This unit should not be dismantled unless conditions of absolute cleanliness can be provided. If this is possible, proceed as follows:

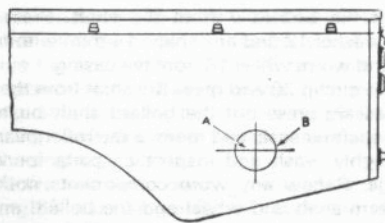


FIG 14:26 Hole in lefthand side panel, 109 models
Key to Fig 14:26 A 4 inch (102 mm) hole central to oil filter plug B Grommet

Components

Hydraulic winch gearbox	Lubrication nipples
2 pints (1 litre)	—
90 EP	—
Energol EP SAE.90	Energrease L.2
Duckhams Hypoid 90	Duckhams L.B.10 Grease
Esso Gear Oil G.P.90	Esso Multi-purpose Grease H
Mobilube G.X.90	Mobilgrease M.P.
Spirax 90 EP	Retinax A
Castrol Hypoy	Castrolase L.M.

- 1 Remove all dirt from the exterior then withdraw the end cover screws and the end cover. Lift out the seals H, J, K and G.
- 2 Slide out the shafts D and E and then jar out the seals F, L and M.
- 3 Renew the shaft seal N if necessary.
- 4 Renew any damaged components or worn seals.
- 5 Reassemble by reversing the dismantling operation but when fitting the drive shaft put a thimble with a tapered nose over the key way end so that the shaft seal is not cut by forcing over the larger diameter. A smear of Silicone MS.4 grease will hold the seals J, K, L, M in position while fitting.
- 6 When the motor is completely assembled, pour a small quantity of hydraulic oil in the ports and see that the shaft rotates easily by hand. If new seals have been fitted the motor must be carefully run in for at least thirty minutes.
- 7 Refit to the winch using a new joint washer.

The hydraulic pump:

Refer to FIG 14:31. This unit is almost identical to the hydraulic motor and similar procedures are necessary to strip and recondition it. The necessity for running in also applies if new seals have been fitted. FIG 14:17 shows the attachment of the pump to the power takeoff unit. Removal and replacement is effected by releasing the nuts holding the pump flange to the power takeoff unit.

14:8 The hand speed control. Petrol models

Refer to FIG 14:32. To fit the control proceed as follows:

- 1 Disconnect the throttle linkage then remove the existing spindle, bellcrank and relay levers and replace them with the new spindle 5, hand control lever 11, bellcrank 8 and relay lever 9. Reconnect the linkage.

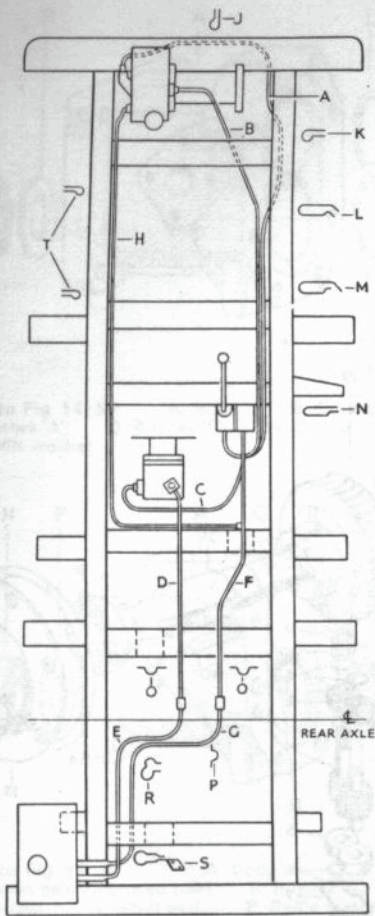


FIG 14:27 Layout of pipes and clips, 109 models

Key to Fig 14:27

A Pipe, upper on control valve	C Pipe, lower, on control valve
B Pipe, lower, on control valve	D Pipe, suction
E Pipe, suction	F Pipe, upper, on control valve
H Pipe, exhaust	G Pipe, return reservoir
J Clip, front bumper (single)	K Clip, righthand chassis sidemember (single)
L Clip, righthand chassis sidemember (double)	M Clip, righthand chassis sidemember (double)
N Clip, righthand, rear engine mounting (double)	O Clip, chassis crossmember
P Clip, return pipe to body	R Clip, suction and return pipes together
S Clip, suction return pipe to rear crossmember	T Clip, motor exhaust pipe to chassis frame

- Secure bracket 13 to the tapped hole in the top rear face of the inlet manifold.
- Drill a suitable hole in the dash control panel and fit the hand control 1. Connect the outer cable to the bracket 13 with the clip 17 and the inner cable to the lever 11. See that the cable is not kinked or taken round sharp corners. Adjust until there is $\frac{1}{8}$ inch (1.58 mm) play between lever 11 and the bellcrank 8 and the same between the bellcrank and the relay lever 9.

14:9 The oil cooler. All models

This is essential equipment whenever the vehicle is used as a stationary power unit or operates in high ambient temperatures for any appreciable time.

To fit the oil cooler:

- Drain the engine oil and remove the sump.
- Diesel models: Remove the oil relief plug from the pump, fit the new plug and replace the sump.
Petrol models: Discard the existing pressure relief valve screw and spring and withdraw the oil pump. Fit the new pump gears, cover, bolts and splitpins. Replace the pump and fit the new pressure relief valve screw and spring. Replace the sump.
- Attach the flexible oil pipe to the sump by the banjo and two joint washers.
- Remove the air cleaner, the battery (or batteries), drain and remove the radiator and grille panel.
- Discard the fan and on petrol models, the distance piece.
- Drive screw the two tapping plates to the chassis then tap them $\frac{1}{4}$ UNF as shown in FIG 14:33.
- Fit the oil relief valve to the top union of the cooler.
- Discard the inner lefthand nut and bolt securing the grille panel assembly to the top of the radiator, detach the earth clip and retighten the top panel bolt.
- Drill the grille panels as shown in FIG 14:34.
- Petrol models: Fit the new fan cowl and radiator cap.
- Diesel models: Fit the new crankshaft double pulley assembly and the generator double pulley.
- Both models. Fit the new fan and driving belts and replace the radiator and grille panel assembly.
- Fit the oil cooler and connect the pipes as shown in FIGS 14:35 or 14:36.
- Cut a 1 inch (25.4 mm) hole in the lefthand glove box, 3 inches (75 mm) from the base and 2 inches (50.8 mm) from the righthand side.
- Pass the oil temperature gauge capillary tube through and attach the gauge to the dash with the bracket supplied. Fit the bulb end of the tube in the thermometer pocket. FIG 14:35, item 42, FIG 14:36, item 36.

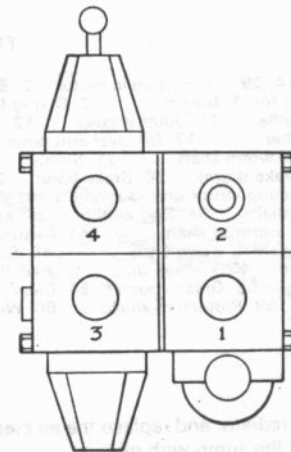


FIG 14:28 Pipe fitting sequence, control valve

Key to Fig 14:28

- Flexible pipe from pump, to be fitted first
- Return pipe to tank, to be fitted second
- Flexible pipe from front winch, righthand side connection, fitted third
- Flexible pipe from front winch, lefthand side connection, fitted last

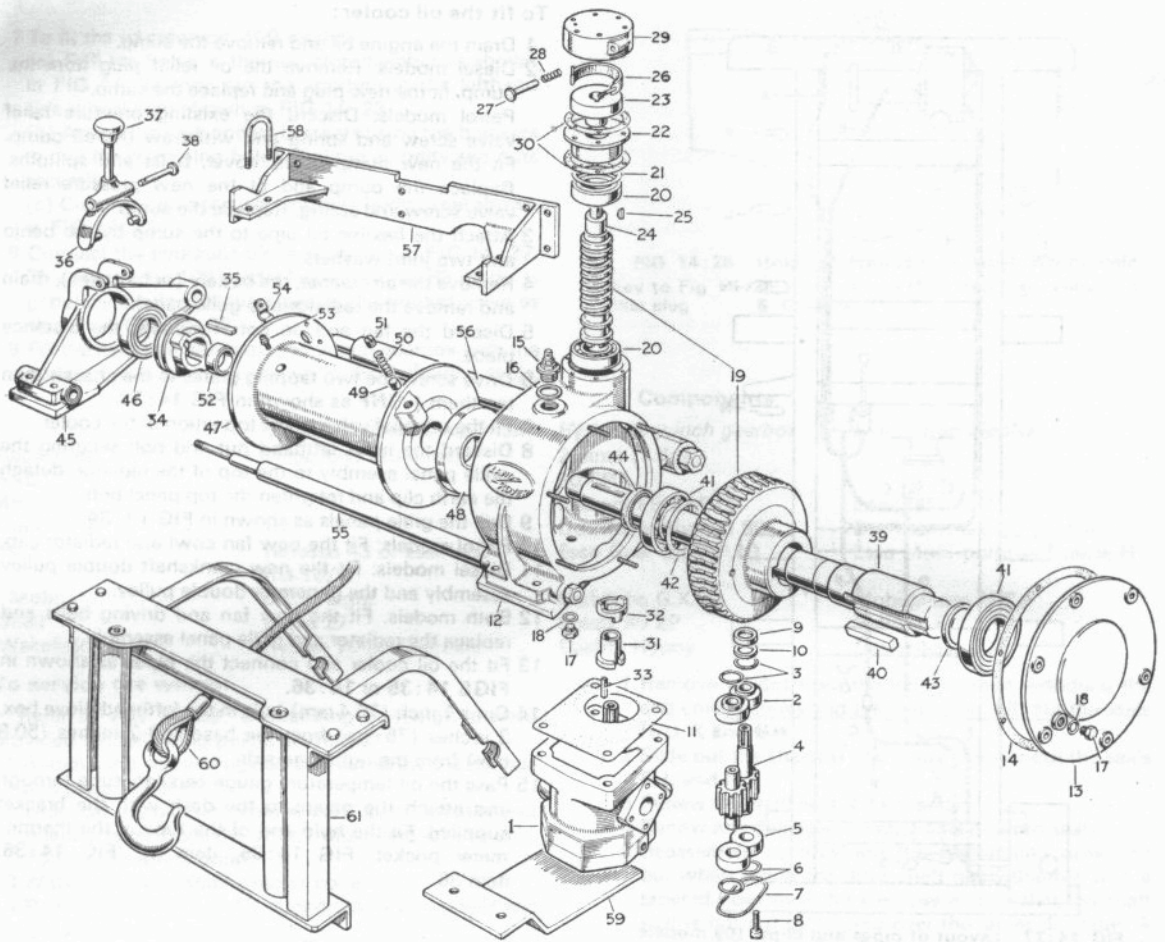


FIG 14:29 Layout of hydraulic winch

- Key to Fig 14:29**
- | | | | | |
|--|---|--|---|--|
| 1 Hydraulic motor | 2 Bushes, 'B' for gearshaft | 3 O-rings | 4 Gears and shafts | 5 Bush 'A' for gearshafts |
| 6 Sealing ring for 'A' bushes | 7 O-ring for housing | 8 Special screw fixing body cover and body | 9 Shaft oil seal | 10 Oil seal baffle |
| 11 Joint washer | 12 Gearbox casing | 13 End plate for casing | 14 Joint washer | 15 Oil filler plug |
| 16 Joint washer | 17 Oil level and drain plug | 18 Joint washer | 19 Worm wheel, worm shaft and distance pieces | 20 Bearing for worm shaft |
| 21 Shims | 22 Retaining cap | 23 Brake drum | 24 Distance piece (for brake drum) | 25 Key (for brake drum) |
| 26 Brake band | 27 Plunger | 28 Spring | 29 Brake drum cover | 30 Joint washer |
| 31 Coupling sleeve (connecting motor unit to worm shaft) | 32 Coupling dog (connecting motor unit to worm shaft) | 33 Key (connecting motor unit to worm shaft) | 34 Dog clutch | 35 Key |
| 36 Selector lever | 37 Knob | 38 Retaining pin | 39 Worm and drum shaft | 40 Key fixing worm to shaft |
| 41 Bearing for shaft, worm end | 42 Shims | 43 Distance ring for shaft, worm end | 44 Oil seal for shaft, worm end | 45 Support bracket for worm and drum shaft |
| 46 Bearing for worm and drum shaft | 47 Cable drum | 48 Friction disc | 49 Pad (for friction disc) | 50 Spring (for friction disc) |
| 51 Retaining plug (for friction disc) | 52 Thrust ring | 53 Grease point | 54 Cleat | 55 Connecting tube, front |
| 56 Connecting tube, rear | 57 Rear mounting bracket | 58 U-bolt | 59 Protection shield | 60 Winch cable |
| 61 Guide frame for cable | | | | |

16 Refill the radiator and replace the air cleaner, batteries, etc. Refill the sump with oil.

17 Petrol models: Fit a slave oil pressure gauge to the warning light tapping and adjust the oil pressure relief valve to give 75/80 lb/sq inch (5.3 to 5.6 kg/sq cm) at 2500 rev/min at normal temperature. Stop the engine, remove the gauge and reconnect the warning light switch.

14:10 Fire fighting equipment

Land Rover Fire Tenders are basically the same as standard models and maintenance procedure, generally, is unchanged.

The pump, mounted at the rear of the vehicle, is a two-stage, self-priming, high-pressure impeller type. A single shaft, supported on a plain bearing at the rearmost end and a ballbearing at the driving end, carries three

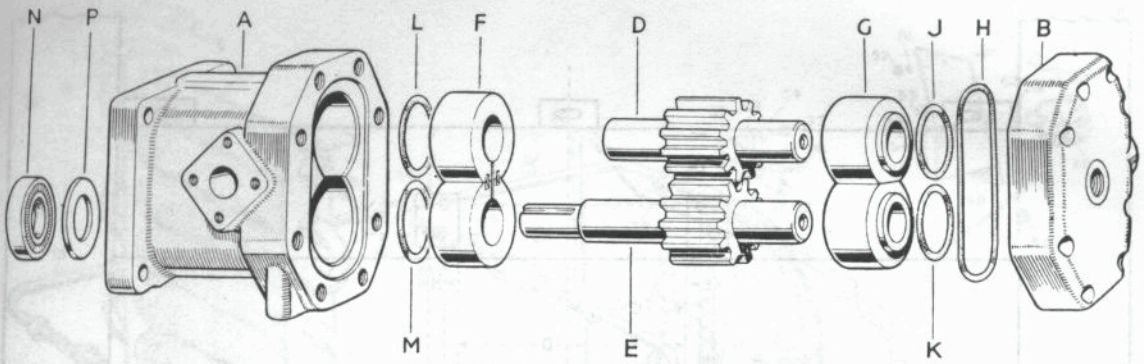


FIG 14:30 The hydraulic motor

Key to Fig 14:30 A Body B Coverplate D Drive shaft and gear (matched pair) E Driven gear (matched pair)
 F Bushes 'A' G Bushes 'C' H O-ring J Support ring K Support ring L O-ring M O-ring N Shaft seal
 P Baffle washer

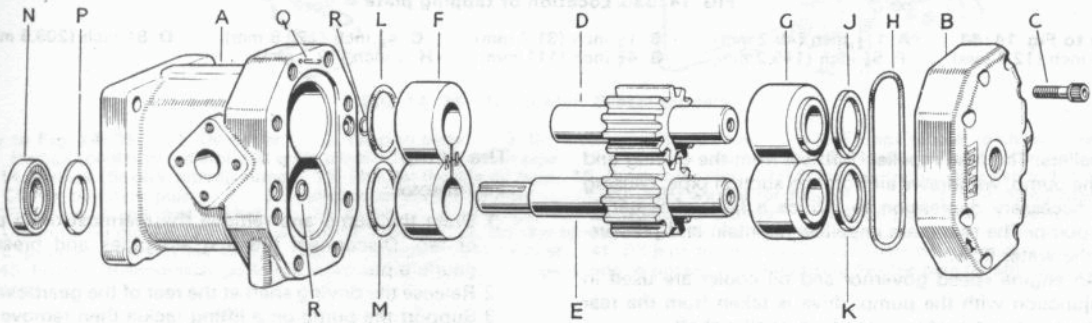


FIG 14:31 The hydraulic pump

Key to Fig 14:31 A Body B Coverplate C Special bolts D Drive shaft and gear (matched pair)
 E Driven gear (matched pair) F Bushes 'A' G Bushes 'C' H O-ring J Support ring K Support ring L O-ring
 M O-ring N Shaft seal P Baffle washer Q Dowel R O-ring

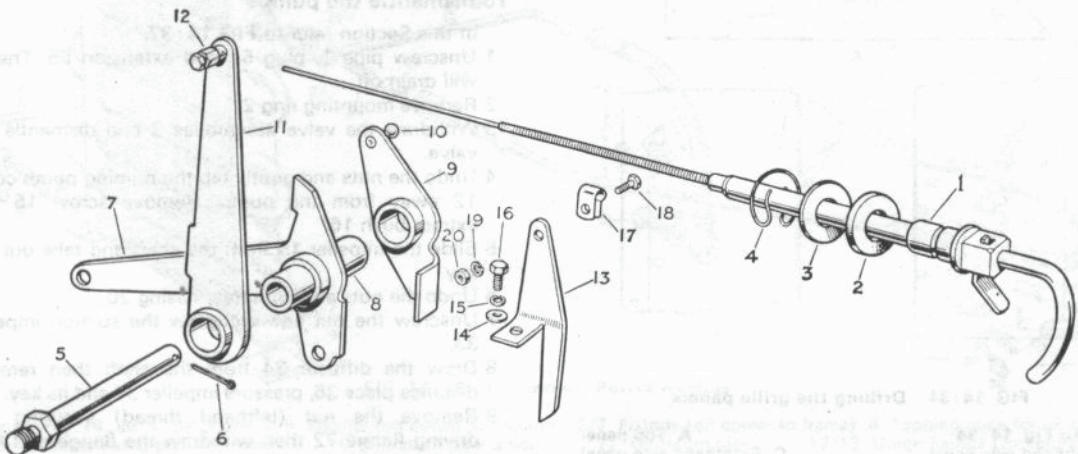


FIG 14:32 Hand speed control

Key to Fig 14:32 1/4 Hand throttle control 5/6 Spindle for bellcrank 7/8 Bellcrank lever 9/10 Relay lever
 11/12 Hand throttle lever 13 Abutment bracket for hand throttle 14 Plain washer (fixing abutment bracket)
 15 Spring washer (fixing abutment bracket) 16 Setbolt (fixing abutment bracket) 17 Cable clip (fixing hand throttle cable to
 abutment bracket) 18 Screw (fixing hand throttle cable to abutment bracket) 19 Spring washer (fixing hand throttle cable
 to abutment bracket) 20 Nut (fixing hand throttle cable to abutment bracket)

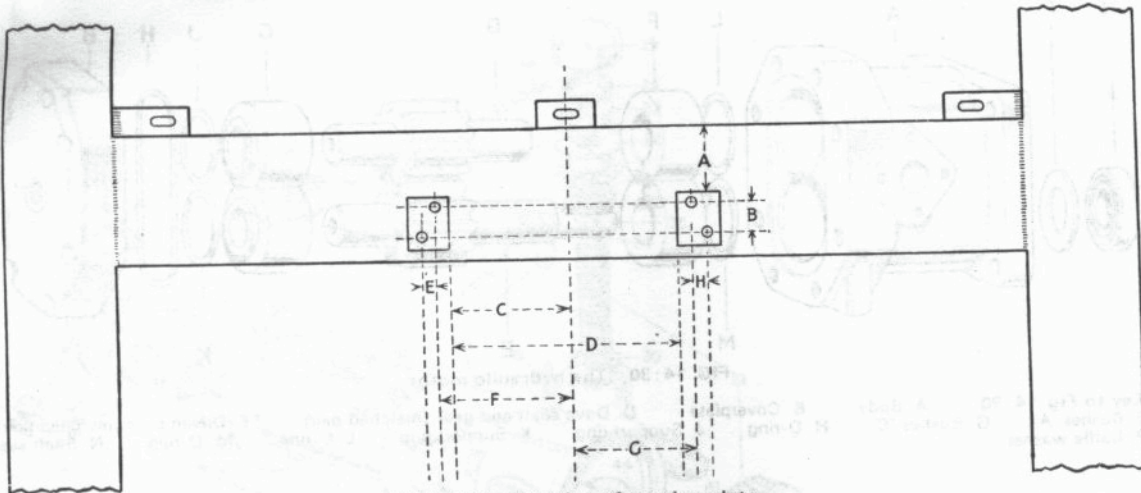


FIG 14:33 Location of tapping plate

Key to Fig 14:33	A $1\frac{1}{8}$ inch (49.2 mm)	B $1\frac{1}{2}$ inch (31.7 mm)	C $4\frac{7}{8}$ inch (123.8 mm)	D $8\frac{1}{2}$ inch (209.5 mm)
	E $\frac{1}{2}$ inch (12.7 mm)	F $5\frac{7}{8}$ inch (149.2 mm)	G $4\frac{3}{8}$ inch (111 mm)	H $\frac{1}{2}$ inch (12.7 mm)

impellers. The first impeller, furthest from the driving end of the pump, withdraws air from the suction pipe, causing the necessary depression to induce a flow of water to the pump. The two main impellers maintain and pressurize the water flow.

An engine speed governor and oil cooler are used in conjunction with the pump; drive is taken from the rear of the gearbox transfer casing by propeller shaft.

The pump:

To remove:

- 1 Drain the pump and remove the rearmost drain plug or tap. Disconnect the first aid pipes and pressure gauge pipe.
- 2 Release the driving shaft at the rear of the gearbox.
- 3 Support the pump on a lifting tackle then remove the mounting bolts. Either draw the pump and shaft backwards or move the vehicle forwards.
- 4 Lower the unit to the ground, remove the foremost drain tap and disconnect the propeller shaft.

To dismantle the pump:

In this Section refer to FIG 14:37.

- 1 Unscrew pipe 1, plug 53 and extension 55. The oil will drain off.
- 2 Remove mounting ring 2.
- 3 Withdraw the valve assemblies 3 and dismantle the valve.
- 4 Undo the nuts and gently tap the priming pump cover 12 away from the pump. Remove screw 15 and extract bush 16.
- 5 Slide the impeller 19 from the shaft and take out the key.
- 6 Undo the nuts and withdraw casing 20.
- 7 Unscrew the nut and withdraw the suction impeller 33.
- 8 Draw the diffuser 34 from the shaft then remove distance piece 36, pressure impeller 37 and its key.
- 9 Remove the nut (lefthand thread) securing the driving flange 72 then withdraw the flange and key. Hold the shaft in soft jaws in a vertical position while doing this otherwise it can easily be bent.
- 10 Unscrew the 'Allen' bolts 71 then tap the shaft on the impeller side of the main casing to remove the shaft, bearing 65 and cover 69. All the seals may now be removed from the bearing cover and main casing.

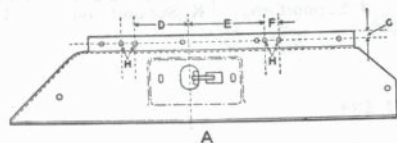


FIG 14:34 Drilling the grille panels

Key to Fig 14:34	A Top panel
B Lefthand side panel	C Righthand side panel
D $3\frac{1}{8}$ inch (100 mm)	E $5\frac{7}{8}$ inch (138 mm)
F $\frac{1}{2}$ inch (23.8 mm)	G $\frac{3}{4}$ inch (14.3 mm)
H Four new holes $\frac{7}{32}$ inch (7.1 mm) dia.	J $3\frac{1}{4}$ inch (82.5 mm)
K One new hole $1\frac{1}{4}$ inch (28.6 mm) dia.	L $\frac{1}{8}$ inch (3.2 mm)
M Shaded area represents section to be cut away	N $1\frac{1}{2}$ inch (44.4 mm)
P $\frac{5}{8}$ inch (15.8 mm)	Q $\frac{1}{2}$ inch (12.7 mm)
R One new hole $\frac{7}{32}$ inch (7.1 mm) dia.	

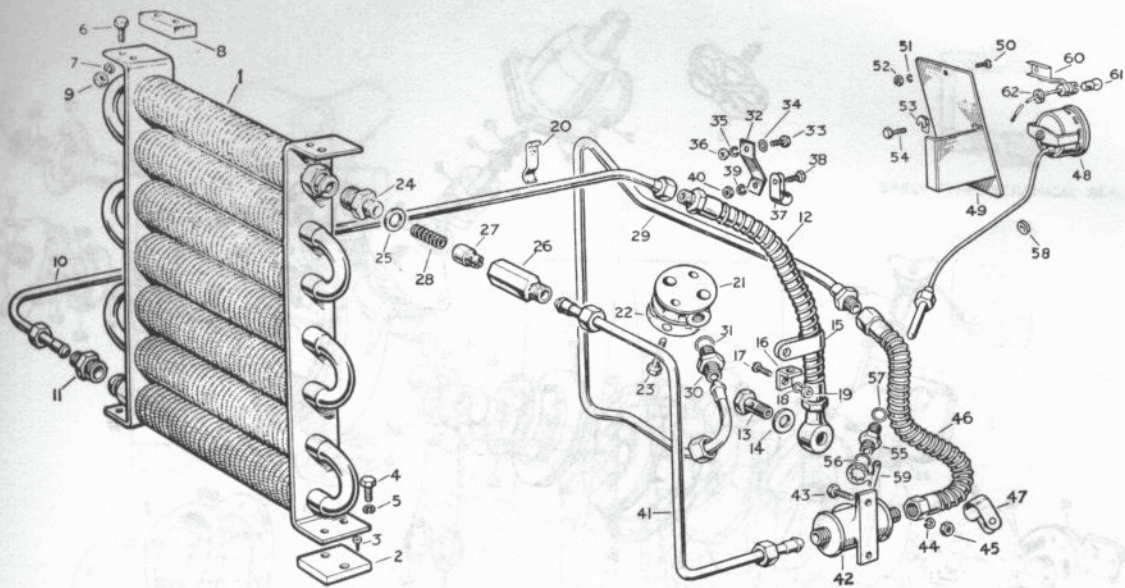


FIG 14:35 Oil cooler, Diesel models

Key to Fig 14:35 1 Oil cooler 2 Tapping plate 3 Drive screw, plate to frame 4/5 Fixings (cooler to chassis frame) 6/9 Fixings (cooler to radiator and grille panel) 10 Oil return pipe 11 Union for return pipe 12 Flexible oil pipe, return to sump 13/14 Fixings (flexible pipe to sump) 15 Clip, for flexible oil pipe 16 Bracket for clip 17/19 Fixings (return pipe clip to bracket) 20 Clip for oil return pipe 21 Adaptor for engine oil filter 22 Joint washer for adaptor 23 Bolt, fixing adaptor 24/25 Oil union and joint washer 26 Body 27 Plunger 28 Spring for plunger 29 Oil pipe, union to flexible pipe 30 Union for oil pipe 31 Joint washer for union 32 Bracket for clip 33/36 Fixings (bracket to front engine lifting bracket) 37 Clip for union to flexible oil pipe 38/40 Fixings (clip to bracket) 41 Oil pipe to relief valve 42 Thermometer pocket complete 43/45 Fixings (thermometer pocket to valance 46 Flexible oil pipe, pump to pocket 47 Clip fixing flexible pipe to left-hand battery support

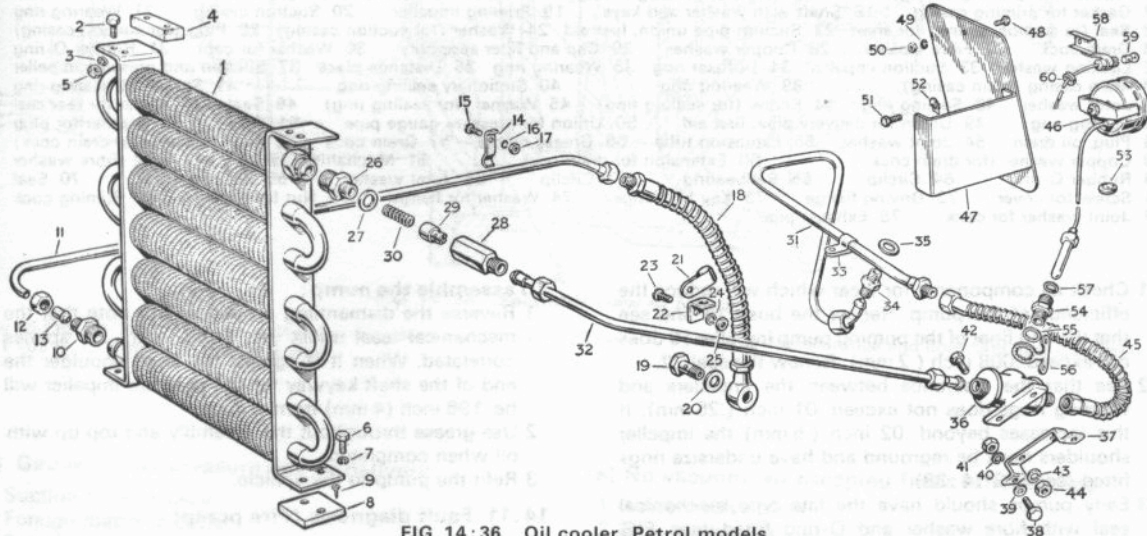


FIG 14:36 Oil cooler, Petrol models

Key to Fig 14:36 1 Oil cooler 2/5 Fixings (oil cooler to radiator) 6/7 Fixings (oil cooler to frame) 8 Tapping plate for oil cooler 9 Drive screw fixing plate to frame 10 Oil return pipe union 11 Oil return pipe 12/13 Union fixings (for return pipe) 14 Oil return pipe clip 15/17 Fixings (for clip) 18 Flexible oil pipe, return to sump 19/20 Fixings (flexible pipe to sump) 21 Flexible pipe clip 22 Clip bracket 23/25 Fixings (for clip) 26 Oil union (oil release valve) 27 Joint washer for union (oil release valve) 28 Body (oil release valve) 29 Plunger (oil release valve) 30 Spring for plunger (oil release valve) 31 Oil pipe, union to flexible pipe 32 Oil pipe to relief valve 33 Clip for pipe (union to flexible pipe) 34 Union for oil pipe (on oil filter adaptor) 35 Joint washer for union (on oil filter adaptor) 36 Thermometer pocket complete 37/41 Not required 42/44 Fixings (pocket to wing valance) 45 Flexible pipe (pump to pocket) 46 Oil temperature gauge 47 Mounting bracket for gauge 48/52 Fixings (mounting bracket to dash) 53 Grommet for pipe in dash

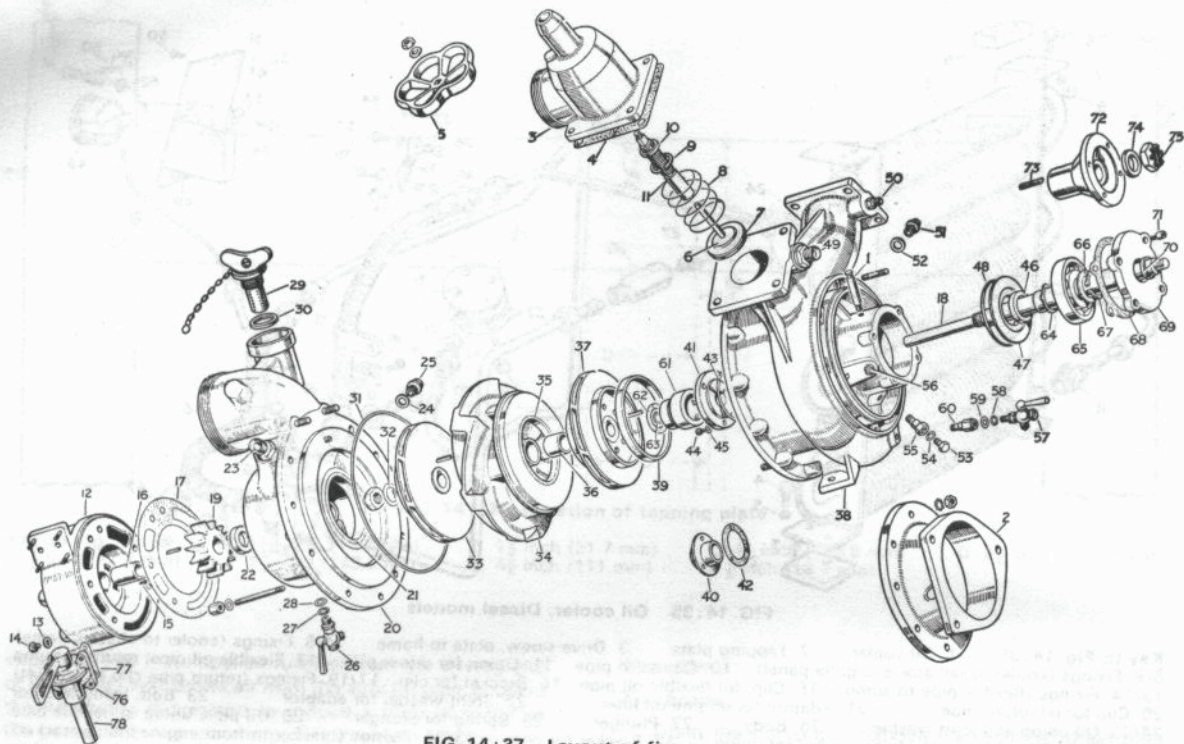


FIG 14:37 Layout of fire pump

- Key to Fig 14:37**
- | | | | | |
|-----------------------------|---------------------------------------|----------------------------------|---------------------------------------|----------------------------------|
| 1 Oil filler tube | 2 Mounting ring | 3 Delivery valve | 4 Joint washer for valve | 5 Control wheel |
| 6 Spindle and seal assembly | 7 Rubber seal | 8 Spring | 9 Circlip | 10 Seal |
| 11 Spindle body | 12 Priming casing | 13 Washer (for priming casing) | 14 Plug (for priming casing) | 15 Grubscrew, securing bush |
| 16 Bush for shaft | 17 Gasket for priming casing | 18 Shaft with washer and keys | 19 Priming impeller | 20 Suction casing |
| 21 Wearing ring | 22 Seal (in suction casing) for shaft | 23 Suction pipe union, first aid | 24 Washer (for suction casing) | 25 Plug (for suction casing) |
| 26 Drain cock | 27 Fibre washer | 28 Copper washer | 29 Cap and filter assembly | 30 Washer for cap |
| 31 Rubber O-ring | 32 Locking washer | 33 Suction impeller | 34 Diffuser ring | 35 Wearing ring |
| 36 Distance piece | 37 Suction and pressure impeller | 38 Main casing (main casing) | 39 Wearing ring | 40 Stationary sealing ring |
| 41 Stationary sealing ring | 42 Joint washer | 43 Sealing ring | 44 Screw (for sealing ring) | 45 Washer (for sealing ring) |
| 46 Seal | 47 Cover for rear seal | 48 Sealing ring | 49 Union for delivery pipe, first aid | 50 Union for pressure gauge pipe |
| 51 Plug | 52 Washer for plug | 53 Plug, oil drain | 54 Joint washer | 55 Extension tube |
| 56 Grease nipple | 57 Drain cock | 58 Fibre washer (for drain cock) | 59 Copper washer (for drain cock) | 60 Extension for drain cock |
| 61 Mechanical seal | 62 Fibre washer | 63 Rubber O-ring | 64 Circlip | 65 Ballbearing |
| 66 Fibre washer | 67 Seal | 68 Joint washer | 69 Bearing cover | 70 Seal |
| 71 Screw for cover | 72 Driving flange | 73 Key for flange | 74 Washer for flange | 75 Nut for flange |
| 76 Priming cock | 77 Joint washer for cock | 78 Exhaust pipe | | |

- 11 Check all components for wear which will reduce the efficiency of the pump. Renew the bush 16 and see that the end float of the priming pump impeller 19 does not exceed .008 inch (.2 mm). Renew the seal 22.
- 12 See that the clearance between the impellers and wearing rings does not exceed .01 inch (.25 mm). If this increases beyond .02 inch (.5 mm) the impeller shoulders must be reground and have undersize rings fitted (see FIG 14:38).
- 13 Early pumps should have the late type mechanical seal with fibre washer and O-ring fitted (see FIG 14:38). Ensure that the dimension from the friction face of the stationary seal and the shaft shoulder is 1.102 inch \pm .012 inch (28 \pm .3 mm) (see FIG 14:38, item C).
- 14 If a new stationary seal (see FIG 14:37, item 41), is fitted it must be accurately turned and lapped in position.
- 15 Renew the ballbearing if at all doubtful.

To assemble the pump:

- 1 Reverse the dismantling procedure but note that the mechanical seal must be fitted with its splines correlated. When it is against the shaft shoulder the end of the shaft keyway for the pressure impeller will be .196 inch (4 mm) from its face.
- 2 Use grease throughout the assembly and top up with oil when completed.
- 3 Refit the pump to the vehicle.

14:11 Fault diagnosis (Fire pump)

- (a) **No delivery. High vacuum, valves closed but no pressure build up**
- 1 Suction pipe blocked
- (b) **No delivery. Low vacuum and air escaping from exhaust pipe**
- 1 Leaking hose
 - 2 Leaking delivery valve
 - 3 Leaking mechanical seal

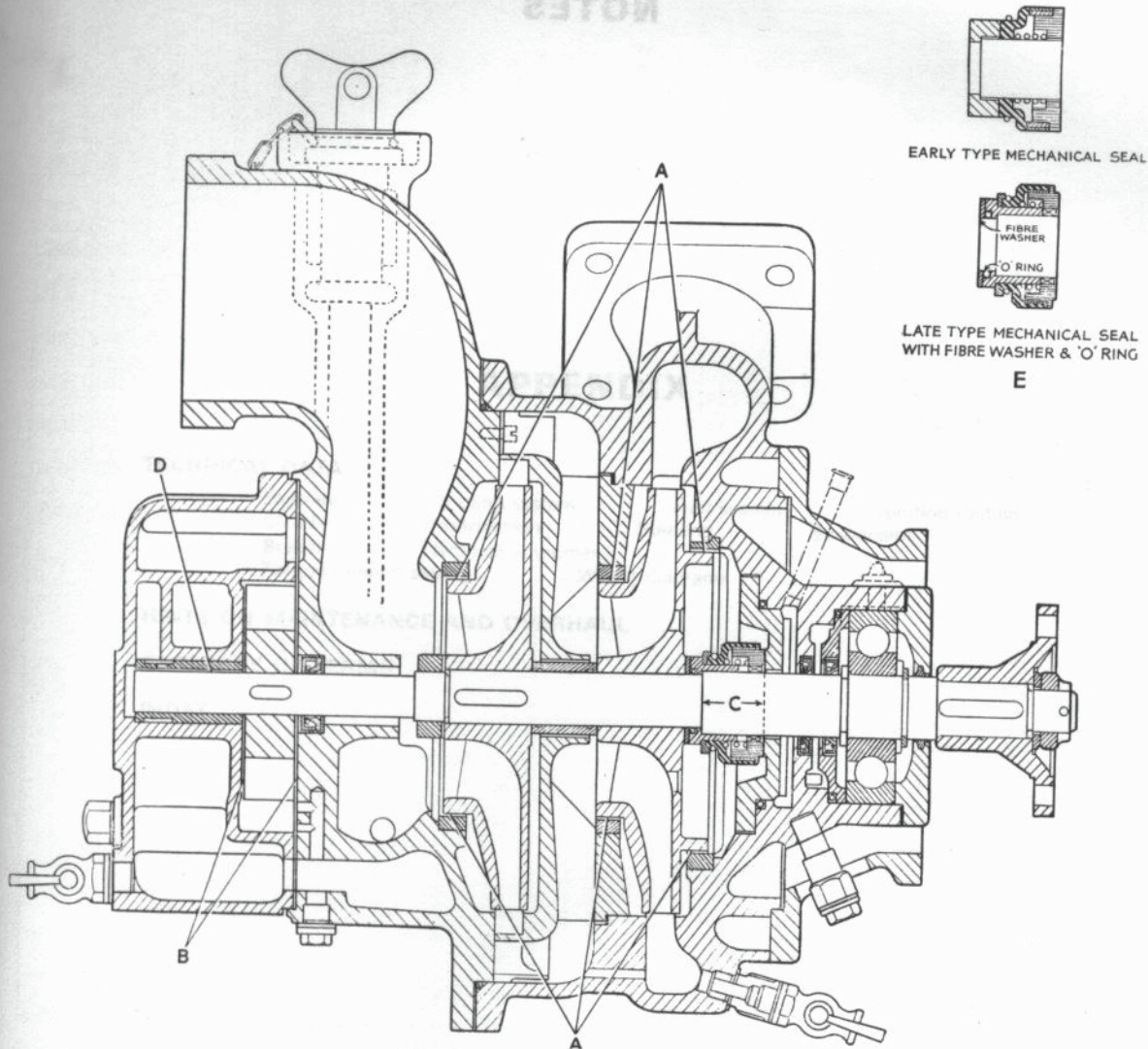


FIG 14:38 Sectional view of pump

Key to Fig 14:38

A Wearing ring clearance .01 inch (.25 mm)

B Impeller total end float .008 inch (.2 mm)

C $1.102 \pm .012$ inch (28 mm $\pm .3$ mm)

(c) Gauge shows pressure but no delivery

- 1 Suction hose blocked
- 2 Foreign matter in pump
- 3 Pressure gauge failed
- 4 Water level at supply failing

(e) No vacuum, air escaping from exhaust pipe

- 1 Delivery valve open
- 2 Drain cock open

(d) Vacuum falls after prolonged running with closed valve

- 1 Water in priming pump overheated

(f) No vacuum, no air escaping from exhaust pipe

- 1 No water in priming pump
- 2 Filler strainer choked
- 3 Priming lever in 'Working' position

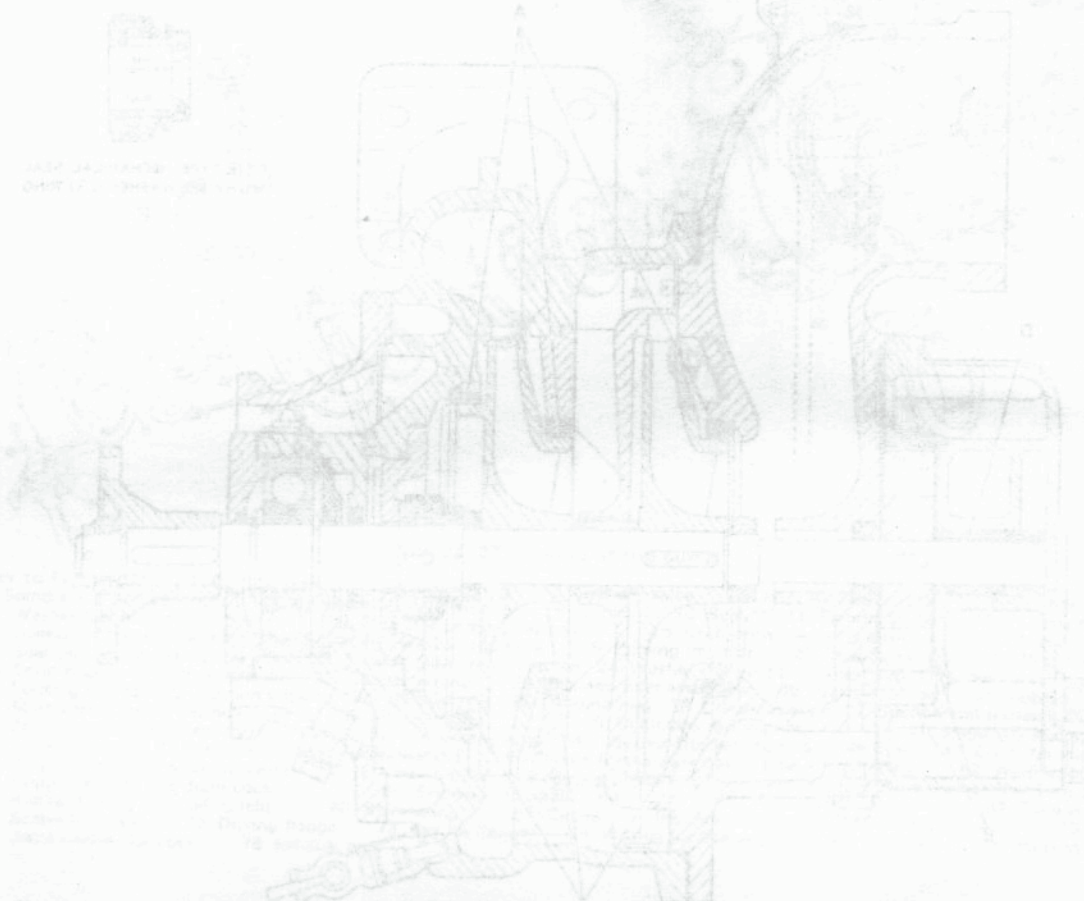
(g) Water leak from oil filler

- 1 Worn mechanical seal or scored stationary seal

NOTES



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(a) Gauge shows pressure but no delivery
 1. Suction hose blocked
 2. Suction water in jacket and/or in valves on 14
 3. Impeller/gearwheel removed with excessive oil
 4. Water level in supply falling
 5. Oil level too low

(b) Vacuum falls after prolonged running
 1. Impeller/gearwheel removed with excessive oil
 2. Suction hose blocked
 3. Water in pump group overfilled

(c) Water leak from jacket
 1. Water in pump group overfilled

(d) Water leak from jacket
 1. Water in pump group overfilled

(e) No vacuum or air escaping from exhaust pipe
 1. Impeller/gearwheel removed with excessive oil
 2. Suction hose blocked

(f) No vacuum or air escaping from exhaust pipe
 1. Impeller/gearwheel removed with excessive oil
 2. Suction hose blocked

(g) Water leak from jacket
 1. Water in pump group overfilled

TECHNICAL DATA

Model	Year	Engine	Cooling system	Fuel system	Ignition system
1970	1971	1972	1973	1974	1975
1976	1977	1978	1979	1980	1981
1982	1983	1984	1985	1986	1987
1988	1989	1990	1991	1992	1993
1994	1995	1996	1997	1998	1999
2000	2001	2002	2003	2004	2005
2006	2007	2008	2009	2010	2011
2012	2013	2014	2015	2016	2017
2018	2019	2020	2021	2022	2023

Model	Year	Engine	Cooling system	Fuel system	Ignition system
1970	1971	1972	1973	1974	1975
1976	1977	1978	1979	1980	1981
1982	1983	1984	1985	1986	1987
1988	1989	1990	1991	1992	1993
1994	1995	1996	1997	1998	1999
2000	2001	2002	2003	2004	2005
2006	2007	2008	2009	2010	2011
2012	2013	2014	2015	2016	2017
2018	2019	2020	2021	2022	2023

APPENDIX

TECHNICAL DATA

- Engines
- Cooling system
- Fuel system
- Ignition system
- Clutch
- Transmission
- Steering
- Suspension
- Brakes
- Electrical equipment
- Wiring diagrams
- Torque wrench settings

HINTS ON MAINTENANCE AND OVERHAUL

GLOSSARY OF TERMS

INDEX

Model	Year	Engine	Cooling system	Fuel system	Ignition system
1970	1971	1972	1973	1974	1975
1976	1977	1978	1979	1980	1981
1982	1983	1984	1985	1986	1987
1988	1989	1990	1991	1992	1993
1994	1995	1996	1997	1998	1999
2000	2001	2002	2003	2004	2005
2006	2007	2008	2009	2010	2011
2012	2013	2014	2015	2016	2017
2018	2019	2020	2021	2022	2023

Inches	Decimals	Milli- metres	Inches to Millimetres		Millimetres to Inches		
			Inches	mm	mm	Inches	
	$\frac{1}{64}$	.015625	.3969	.001	.0254	.01	.00039
	$\frac{1}{32}$	.03125	.7937	.002	.0508	.02	.00079
	$\frac{3}{64}$	.046875	1.1906	.003	.0762	.03	.00118
$\frac{1}{16}$	$\frac{1}{8}$	.0625	1.5875	.004	.1016	.04	.00157
	$\frac{5}{64}$	.078125	1.9844	.005	.1270	.05	.00197
$\frac{3}{32}$	$\frac{1}{4}$	.09375	2.3812	.006	.1524	.06	.00236
	$\frac{3}{16}$	.109375	2.7781	.007	.1778	.07	.00276
$\frac{1}{8}$	$\frac{1}{2}$	.125	3.1750	.008	.2032	.08	.00315
	$\frac{5}{32}$	.140625	3.5719	.009	.2286	.09	.00354
$\frac{3}{16}$	$\frac{3}{8}$	.15625	3.9687	.01	.254	.1	.00394
	$\frac{7}{32}$	.171875	4.3656	.02	.508	.2	.00787
$\frac{1}{4}$	$\frac{1}{2}$	.1875	4.7625	.03	.762	.3	.01181
	$\frac{5}{8}$	.203125	5.1594	.04	1.016	.4	.01575
$\frac{5}{16}$	$\frac{3}{4}$	.21875	5.5562	.05	1.270	.5	.01969
	$\frac{7}{8}$	.234375	5.9531	.06	1.524	.6	.02362
$\frac{3}{8}$	$\frac{1}{2}$	.25	6.3500	.07	1.778	.7	.02756
	$\frac{5}{4}$	.265625	6.7469	.08	2.032	.8	.03150
$\frac{7}{16}$	$\frac{3}{2}$	.28125	7.1437	.09	2.286	.9	.03543
	$\frac{7}{4}$	.296875	7.5406	.1	2.54	1	.03937
$\frac{2}{8}$	$\frac{3}{2}$	.3125	7.9375	.2	5.08	2	.07874
	$\frac{7}{8}$	.328125	8.3344	.3	7.62	3	.11811
$\frac{1}{2}$	$\frac{3}{2}$	.34375	8.7312	.4	10.16	4	.15748
	$\frac{7}{4}$	.359375	9.1281	.5	12.70	5	.19685
$\frac{3}{4}$	$\frac{3}{2}$	.375	9.5250	.6	15.24	6	.23622
	$\frac{7}{4}$	.390625	9.9219	.7	17.78	7	.27559
$\frac{5}{8}$	$\frac{3}{2}$	.40625	10.3187	.8	20.32	8	.31496
	$\frac{7}{4}$	.421875	10.7156	.9	22.86	9	.35433
$\frac{3}{4}$	$\frac{3}{2}$	.4375	11.1125	1	25.4	10	.39370
	$\frac{7}{4}$	.453125	11.5094	2	50.8	11	.43307
$\frac{5}{8}$	$\frac{3}{2}$	.46875	11.9062	3	76.2	12	.47244
	$\frac{7}{4}$	.484375	12.3031	4	101.6	13	.51181
$\frac{3}{4}$	$\frac{3}{2}$	.5	12.7000	5	127.0	14	.55118
	$\frac{7}{4}$	.515625	13.0969	6	152.4	15	.59055
$\frac{5}{8}$	$\frac{3}{2}$	.53125	13.4937	7	177.8	16	.62992
	$\frac{7}{4}$	.546875	13.8906	8	203.2	17	.66929
$\frac{3}{4}$	$\frac{3}{2}$	.5625	14.2875	9	228.6	18	.70866
	$\frac{7}{4}$	.578125	14.6844	10	254.0	19	.74803
$\frac{5}{8}$	$\frac{3}{2}$	.59375	15.0812	11	279.4	20	.78740
	$\frac{7}{4}$	.609375	15.4781	12	304.8	21	.82677
$\frac{3}{4}$	$\frac{3}{2}$	.625	15.8750	13	330.2	22	.86614
	$\frac{7}{4}$	.640625	16.2719	14	355.6	23	.90551
$\frac{5}{8}$	$\frac{3}{2}$	.65625	16.6687	15	381.0	24	.94488
	$\frac{7}{4}$	.671875	17.0656	16	406.4	25	.98425
$\frac{3}{4}$	$\frac{3}{2}$	.6875	17.4625	17	431.8	26	1.02362
	$\frac{7}{4}$	.703125	17.8594	18	457.2	27	1.06299
$\frac{5}{8}$	$\frac{3}{2}$	.71875	18.2562	19	482.6	28	1.10236
	$\frac{7}{4}$	.734375	18.6531	20	508.0	29	1.14173
$\frac{3}{4}$	$\frac{3}{2}$	.75	19.0500	21	533.4	30	1.18110
	$\frac{7}{4}$	.765625	19.4469	22	558.8	31	1.22047
$\frac{5}{8}$	$\frac{3}{2}$	.78125	19.8437	23	584.2	32	1.25984
	$\frac{7}{4}$	.796875	20.2406	24	609.6	33	1.29921
$\frac{3}{4}$	$\frac{3}{2}$	.8125	20.6375	25	635.0	34	1.33858
	$\frac{7}{4}$	.828125	21.0344	26	660.4	35	1.37795
$\frac{5}{8}$	$\frac{3}{2}$	.84375	21.4312	27	685.8	36	1.41732
	$\frac{7}{4}$	.859375	21.8281	28	711.2	37	1.45669
$\frac{3}{4}$	$\frac{3}{2}$	.875	22.2250	29	736.6	38	1.49606
	$\frac{7}{4}$	.890625	22.6219	30	762.0	39	1.53543
$\frac{5}{8}$	$\frac{3}{2}$	.90625	23.0187	31	787.4	40	1.57480
	$\frac{7}{4}$	.921875	23.4156	32	812.8	41	1.61417
$\frac{3}{4}$	$\frac{3}{2}$	.9375	23.8125	33	838.2	42	1.65354
	$\frac{7}{4}$	.953125	24.2094	34	863.6	43	1.69291
$\frac{5}{8}$	$\frac{3}{2}$	.96875	24.6062	35	889.0	44	1.73228
	$\frac{7}{4}$	.984375	25.0031	36	914.4	45	1.77165

UNITS	Pints to Litres	Gallons to Litres	Litres to Pints	Litres to Gallons	Miles to Kilometres	Kilometres to Miles	Lbs. per sq. In. to Kg. per sq. Cm.	Kg. per sq. Cm. to Lbs. per sq. In.
2	1.14	9.09	3.52	.44	3.22	1.24	.14	28.50
3	1.70	13.64	5.28	.66	4.83	1.86	.21	42.67
4	2.27	18.18	7.04	.88	6.44	2.49	.28	56.89
5	2.84	22.73	8.80	1.10	8.05	3.11	.35	71.12
6	3.41	27.28	10.56	1.32	9.66	3.73	.42	85.34
7	3.98	31.82	12.32	1.54	11.27	4.35	.49	99.56
8	4.55	36.37	14.08	1.76	12.88	4.97	.56	113.79
9		40.91	15.84	1.98	14.48	5.59	.63	128.00
10		45.46	17.60	2.20	16.09	6.21	.70	142.23
20				4.40	32.19	12.43	1.41	284.47
30				6.60	48.28	18.64	2.11	426.70
40				8.80	64.37	24.85		
50					80.47	31.07		
60					96.56	37.28		
70					112.65	43.50		
80					128.75	49.71		
90					144.84	55.92		
100					160.93	62.14		

UNITS	Lb ft to kgm	Kgm to lb ft	UNITS	Lb ft to kgm	Kgm to lb ft
2	.276	14.466	8	1.106	57.864
3	.414	21.699	9	1.244	65.097
4	.553	28.932	10	1.382	72.330
5	.691	36.165	20	2.765	144.660
6	.829	43.398	30	4.147	216.990

TECHNICAL DATA

Dimensions are in inches unless otherwise stated

PETROL ENGINES

	2½ litre	2.6 litre
Bore and stroke	90.47 × 88.9 mm	77.8 × 92.075 mm
Capacity	2286 cc	2625 cc
Compression ratio	7:1 or 8:1	7:1 or 7.8:1
Crankshaft:		
Main journal diameter	2.4995 to 2.50	2.6240 to 2.6245
Main bearing clearance	.001 to .0025	.0006 to .002
Main journal minimum regrind diameter	2.460	2.584
End float	.002 to .006	.002 to .006
Crankpin diameter	Early models 2.126 Late models 2.312	All models 1.875
Crankpin minimum regrind diameter	2.272	1.835
<i>(Early models may not be ground)</i>		
Connecting rods:		
Bearing fit on crankpin	.001 to .0025	.001 to .002
End float at big-end	.007 to .012	.006 to .015
Gudgeon pin bush, fit in rod, interference	.001 to .003	.001 to .003
Gudgeon pin bush internal diameter	1.000 + .0003	.8755— .0005
Gudgeon pin fit in bush, clearance	.0003 to .0005	.0002 to .0006
Pistons:		
Clearance top of skirt	.003 to .004	.003 to .0035
Clearance bottom of skirt:	Series II and IIA Series III	.002 to .0025 .0019 to .0023 .0023 to .0027
Compression rings:		
Type	Taper periphery, both engines	
Gap	.015 to .020 both engines	
Clearance in groove	.0018 to .0038 both engines	
Oil control ring:		
Type	Slotted, square edge Duaflex 61	
Gap	.015 to .020	.015 to .033
Clearance in groove	.0015 to .0035	.002 to .004
Fit of gudgeon pin in piston, interference	0 to .0002	Push fit at 60°F
Camshaft:		
Journal diameter	1.842-.001	.999
End float	.0025 to .0055	.0045 to .0065
Clearance in bearings	.001 to .002	.001 to .0025
Cam lift, inlet	.257	.374
Cam lift, exhaust	.257	.403
Tappet clearance:		
Inlet	.010 hot or cold	.006 hot
Exhaust	.010 hot or cold	.010 hot or cold
Valves:		
Seat angle inlet	30 deg.	30 deg.
Seat angle exhaust	45 deg.	45 deg.
Stem diameter inlet	.3107 to .3112	.3420 to .3425
Stem diameter exhaust	.3410 to .3415	.3410 to .3415
Valve springs:		
Inner inlet:		
Free length	1.68	1.703
Length under 17.7 lb load	1.462	
Length under 21.5 lb load		1.437

Outer inlet:			
Free length	.. .. .	1.822	1.960
Length under 46 lb load	.. .. .	1.587	
Length under 69.5 lb load	.. .. .		1.625
<i>Exhaust valve springs on 2 1/4 litre models are the same as the inlet</i>			
Inner exhaust:			
Free length	.. .. .		1.703
Length under 16.4 lb load	.. .. .		1.500
Outer exhaust:			
Free length	.. .. .		1.861
Length under 41.8 lb load	.. .. .		1.625
Valve timing:			
Inlet opens	.. .. .	6 deg. BTDC	12 deg. BTDC
Inlet closes	.. .. .	52 deg. ABDC	46 deg. ABDC
Exhaust opens	.. .. .	34 deg. BBDC	47 deg. BBDC
Exhaust closes	.. .. .	24 deg. ATDC	17 deg. ATDC
Oil pump:			
Type	.. .. .	Skew gear	Spur gear
Gear end float:			
Steel gear	.. .. .	.002 to .005	.002 to .005
Aluminium gear	.. .. .	.003 to .006	.003 to .006
Radial clearance of gears	.. .. .	.001 to .004	.001 to .004
Backlash	.. .. .	.006 to .012	.006 to .012
Oil pressure, engine warm, 2000 rev/min	.. .. .	35 to 65 lb/sq in	40 to 50 lb/sq in

DIESEL ENGINE

Bore and stroke	.. .. .	90.47 × 88.9 mm
Capacity	.. .. .	2286 cc
Compression ratio	.. .. .	23:1
Crankshaft:		
Main journal diameter	.. .. .	2.499 to 2.50
Main bearing clearance	.. .. .	.001 to .002
Regrinding not permitted		
End float	.. .. .	.002 to .006
Crankpin diameter	.. .. .	2.312 to 2.313
Regrinding not permitted		
Connecting rods:		
Bearing fit on crankpin	.. .. .	.001 to .0025
End float at big-end	.. .. .	.007 to .012
Gudgeon pin bush fit in rod	.. .. .	.002 to .004 interference
Gudgeon pin bush internal diameter	.. .. .	1.1875 + .0005
Gudgeon pin fit in bush, clearance:	Series II and IIA	.0002 to .0008
	Series III	.0003 to .0006
Gudgeon pin fit in piston	.. .. .	Push fit by hand
Pistons:		
Type	.. .. .	Light alloy
Clearance, bottom of skirt	.. .. .	.0044 to .0053
Rings:		
Compression No. 1:	Type	Square, friction edge, chromium-plated
	Gap	.014 to .019
	Clearance in groove	.0025 to .0045
Compression Nos. 2 and 3:	Type	Bevelled, friction edge
		Marked 'T' on upper side
	Gap	.010 to .015
	Clearance in groove	.0025 to .0045

Scrapper No. 4:	Early type	Slotted, square edge
	Gap . . . . .	.010 to .015
Scrapper No. 4:	Clearance in groove . . . . .	.0025 to .0045
	Later type	Expander and rails
	Gap . . . . .	.015 to .045
	Clearance in groove . . . . .	.0015 to .0025
Camshaft:		
Journal diameter		1.841 to 1.842
End float . . . . .		.0025 to .0055
Clearance in bearings . . . . .		.001 to .002
Cam lift, inlet . . . . .		.262
Cam lift, exhaust . . . . .		.279
Tappet clearance, all		
Valves:		
Face angle, both		45 deg.
Inlet valve stem diameter . . . . .		.3107 to .3112
Exhaust valve stem diameter . . . . .		.3410 to .3415
Valve springs		Details as 2½ petrol engine
Valve guides:		
Inlet stem fit in guide, clearance . . . . .		.0013 to .0019
Exhaust stem fit in guide, clearance . . . . .		.0023 to .0029
Valve timing:		
Inlet opens		16 deg. BTDC
Inlet closes		42 deg. ABDC
Exhaust opens		51 deg. BBDC
Exhaust closes		13 deg. ATDC
Oil pump		
Oil pressure, engine warm, 2000 rev/min		Details as 2½ litre petrol engine 35 to 65 lb/sq in

COOLING SYSTEM

Thermostat:	
Bellows type	Opens at 161°F to 168°F Fully open 185°F
Wax filled type:	
2.6 litre engines	Opens at 161°F to 170°F
2.6 litre Series III engines	Opens at 167°F to 176°F
2½ litre engines	Opens at 159°F to 167°F
2.6 litre engines	Fully open at 190°F
2½ litre engines	Fully open at 185°F

FUEL SYSTEM PETROL ENGINES

Carburettor type, Series 2 and 2A	2½ litre	2.6 litre
	<i>Solex</i>	<i>Stromberg</i>
	PA.10-5 and 6	175.CD.2S
	<i>Zenith</i>	SU
	36.IV	HD.6
	<i>Solex</i>	<i>Zenith</i>
Choke size	28 mm	27 mm
Main jet	125	125
Correction jet	185	—
Enrichment jet	—	150
Pilot jet	50	—
Slow-running jet	—	60

Needle	Stromberg	SU
Air valve return spring	B18362.Z/41	SS
Jet	B18277.Z	—
Needle valve	—	.100
Piston spring	B18353	—
Carburettor type, Series 3	—	Yellow (8 oz)
	<i>Zenith 36.IV</i>	<i>Stromberg</i>
		<i>175CD.SE</i>
Choke	27 mm	1.625
Main jet	125	—
Compensating jet	150	—
Pump jet	65	—
Needle	—	B18362.Z/4J
Float height	—	.629 to .669
Fast-idle setting	—	1.1 mm at edge of throttle
Fuel pump	AC mechanical	SU electric

FUEL SYSTEM DIESEL ENGINE

Injection pump	CAV
Injection nozzle	CAV Pintaux
Nozzle size	BDNO/SPC6209
Opening pressure of nozzle valve	135 atm
Fuel lift pump	AC mechanical

IGNITION SYSTEM

Ignition timing:	Fuel octane rating	Timing point
2¼ litre engines	74 to 76	TDC
	80 to 85	3°BTDC
	90 to 96	6°BTDC
2.6 litre engines (7:1 CR)	78	2°ATDC
	80	TDC
	83	2°BTDC
(7.8:1 CR)	90	2°ATDC
	95	6°BTDC
2¼ litre Series 3 (7:1 CR)	75 to 82	TDC
	83 to 89	3°BTDC
	90	6°BTDC
(8:1 CR)	90	TDC
2.6 litre Series 3 (7:1 CR)	78	2°ATDC
	80 to 85	2°BTDC
(7.8:1 CR)	80 to 85	6°ATDC
	90	2°ATDC
Sparking plug:	Compression ratio	Champion
Series III	8.0:1	UN 12Y
Series III	7.0:1	N 8
Series III, 2.6 litre	7.8:1 and 7.0:1	N 5
Sparking plug gap .. .. .	.029 to .032	

CLUTCH

Coil spring type	Borg and Beck A6
Springs	9
Free length, petrol	2.680
Free length, diesel	2.688
Colour identification	Early 2¼ litre petrol, yellow and light green

Pressure plate regrind limit	..	..	Early 2 $\frac{1}{2}$ litre diesel, yellow and dark green
Operating levers	..	..	All late models, black
			.010 undersize
			Set at 1.655 from flywheel face using $\frac{3}{8}$ distance piece in place of driven plate
Driven plate:			
Thickness, new	..	..	.330
Maximum permissible wear	..	..	.120
Diaphragm spring type clutch	..	..	Borg and Beck DS (Other data as coil spring type)
Hydraulic master cylinder	..	..	Girling CV
Hydraulic slave cylinder	..	..	Girling $\frac{7}{8}$ bore

TRANSMISSION

Gearbox:

Ratios, series 2, 2A:

			<i>Up to gearbox B</i>	<i>Gearbox C on</i>
Top	..	..	1:1	1:1
Third	..	..	1.377:1	1.50:1
Second	..	..	2.043:1	2.22:1
First	..	..	2.996:1	2.60:1
Reverse	..	..	2.547:1	3.02:1

Ratios, series 3:

Top	..	..	1:1
Third	..	..	1.50:1
Second	..	..	2.22:1
First	..	..	3.68:1
Reverse	..	..	3.88:1 or 4.02:1

Transfer box, helical and spur gear type:

Overall ratios, series 2, 2A:

			<i>High ratio</i>	<i>Low ratio</i>
Top	..	..	5.396:1	13.578:1
Third	..	..	7.435:1	18.707:1
Second	..	..	11.026:1	27.742:1
First	..	..	16.171:1	40.688:1
Reverse	..	..	13.745:1	34.585:1

Overall ratios, series 3:

Top	..	..	5.40:1	11.10:1
Third	..	..	8.05:1	16.50:1
Second	..	..	12.00:1	24.60:1
First	..	..	19.88:1	40.70:1
Reverse	..	..	20.47:1 or 21.66:1	42.87:1 or 44.30:1

Transfer box, all helical gear type:

Overall ratios, series 2, 2A:

			<i>High ratio</i>	<i>Low ratio</i>
Top	..	..	7.19:1	15.40:1
Third	..	..	10.80:1	23.10:1
Second	..	..	15.96:1	34.10:1
First	..	..	25.90:1	55.30:1
Reverse	..	..	21.70:1	46.40:1

Overall ratios, series 3:

Top	..	..	7.19:1	15.40:1
Third	..	..	10.81:1	23.10:1
Second	..	..	15.96:1	34.10:1
First	..	..	26.46:1	56.56:1
Reverse	..	..	27.87:1 or 28.91:1	56.76:1 or 61.78:1

Transmission brake, lining, all models:

Length	8 ⁵ / ₁₆
Width	1 ³ / ₄
Thickness	³ / ₁₆
Master cylinder—88 models	Type Girling CV
Master cylinder—109 models	Type Girling CB
Servo unit, hydraulic	Clayton Dewandre
Servo unit, mechanical	Girling Supervac type 38

ELECTRICAL EQUIPMENT

Battery, petrol models	Single 12-volt 58 or 60 AH
Battery, diesel models	Two 6-volt, in series, 120 AH
Battery, Series III diesel models	Single 12-volt, 95 AH

Polarity

2¹/₄ litre Petrol and Diesel models up to vehicle suffix 'C' inclusive
 As above from suffix 'D' onwards and all 2.6 litre models.

Positive earth

Negative earth

Generators and control boxes:

	Generator	Control box
Series II 2 ¹ / ₄ litre petrol	C39	RB106/37182
Series IIA 2 ¹ / ₄ litre petrol	C40	RB106/37290
Series IIA 2.6 litre petrol	C42	RB340/37517
Series II and IIA 2 ¹ / ₄ litre diesel up to vehicle suffix 'C' inclusive	C40	RB310/37472
As above from vehicle suffix 'D' onwards	C40	RB340/37387

Alternator:

Type	Lucas 11 AC
Output	43 amps
Field coil resistance at 68°F	3.8 ohms
Maximum speed	12,500 rev/min
Stator phases	3
Stator connections	Star
Slip ring brushes: Length new	⁵ / ₈
Replace at	⁵ / ₃₂
Field isolating relay cut-in voltage	6.0 to 7.5
Drop off voltage	4.0
Type (Series 3)	Lucas 16 ACR
Output	35 amps
Type (Series 3)	Lucas 18 ACR
Output	45 amps

Four, on steering column shroud

CAPACITIES

Engine sump 2 ¹ / ₄ litre	11 pints+1 ¹ / ₂ pints for filter
Engine sump 2.6 litre	12 pints+1 pint for filter
Air cleaner oil 2 ¹ / ₄ litre	1 ¹ / ₂ pints
Air cleaner oil 2.6 litre	1 pint
Main gearbox oil	2 ¹ / ₂ pints
Transfer box oil	4 ¹ / ₂ pints
Rear differential, Rover	3 pints
Rear differential, ENV	2 ⁵ / ₈ pints
Rear differential, Salisbury	4 ¹ / ₂ pints
Front differential, Rover	3 pints
Front differential, ENV	2 ¹ / ₈ pints
Swivel pin housing oil	1 pint each
Cooling system 2 ¹ / ₄ litre, petrol	18 pints
Cooling system 2 ¹ / ₄ litre, diesel	17 ¹ / ₂ pints

Cooling system Series III, 2 $\frac{1}{4}$ litre petrol	14 $\frac{1}{4}$ pints
Cooling system Series III, 2 $\frac{1}{4}$ litre diesel	13 $\frac{3}{4}$ pints
Cooling system 2.6 litre, long model	20 pints

LUBRICANTS

SAE 20W	Engine, air cleaner, governor (petrol engine)
SAE 90EP	Gearbox, transfer box, differential, swivel housings, steering box, steering relay, rear power take-off, pulley unit
BP Energrease L2, Castrol LM grease, Duckhams LB10 grease, Esso multipurpose grease H	Ball joints, wheel hubs, propeller shafts

TORQUE WRENCH SETTINGS

2 $\frac{1}{4}$ litre petrol engine:

Inlet to exhaust manifold	17 lb ft
Rocker shaft $\frac{1}{2}$ inch bolts	65 lb ft
Rocker shaft $\frac{5}{16}$ inch bolts	18 lb ft
Cylinder head $\frac{1}{2}$ inch bolts	65 lb ft
Cylinder head $\frac{5}{16}$ inch bolts	18 lb ft
Starter dog	150 lb ft
Flywheel to crankshaft bolts	65 lb ft
Main bearing bolts	85 lb ft
Big-end bolts, machined threads	35 lb ft
Big-end bolts, rolled threads	25 lb ft

2 $\frac{1}{4}$ litre diesel engine:

Injector clamps	8 lb ft
Rocker shaft and cylinder head $\frac{1}{2}$ inch bolts	90 lb ft
Rocker shaft and cylinder head $\frac{5}{16}$ inch bolts	18 lb ft
Starter dog	200 lb ft
Flywheel to crankshaft bolts	65 lb ft
Clutch to flywheel bolts	25 lb ft
Main bearing bolts	100 lb ft
Big-end bolts	25 lb ft

2.6 litre petrol engine:

Cylinder head bolts 'A'	50 lb ft
Cylinder head bolts 'B'	30 lb ft
Starter dog	200 lb ft
Flywheel to crankshaft bolts	65 lb ft
Clutch to flywheel bolts	25 lb ft
Main bearing bolts	75 lb ft
Big-end bolts	20 lb ft

Gearbox:

Output flange nut	85 lb ft
Layshaft nut	75 lb ft
Layshaft bolt (Series III)	60 lb ft

Rear axle:

Halfshaft bolts	28 lb ft
Halfshaft nut	15 lb ft
Differential drive flange nut, Rover	85 lb ft
Differential drive flange nut, ENV	120 lb ft

Front axle:

Halfshaft bolts	28 lb ft
Halfshaft nuts	15 lb ft

Steering:

Ball joint nuts	30 lb ft
Drop arm nut	80 lb ft
Relay lever pinch bolt	55 lb ft
Steering wheel nut	40 lb ft

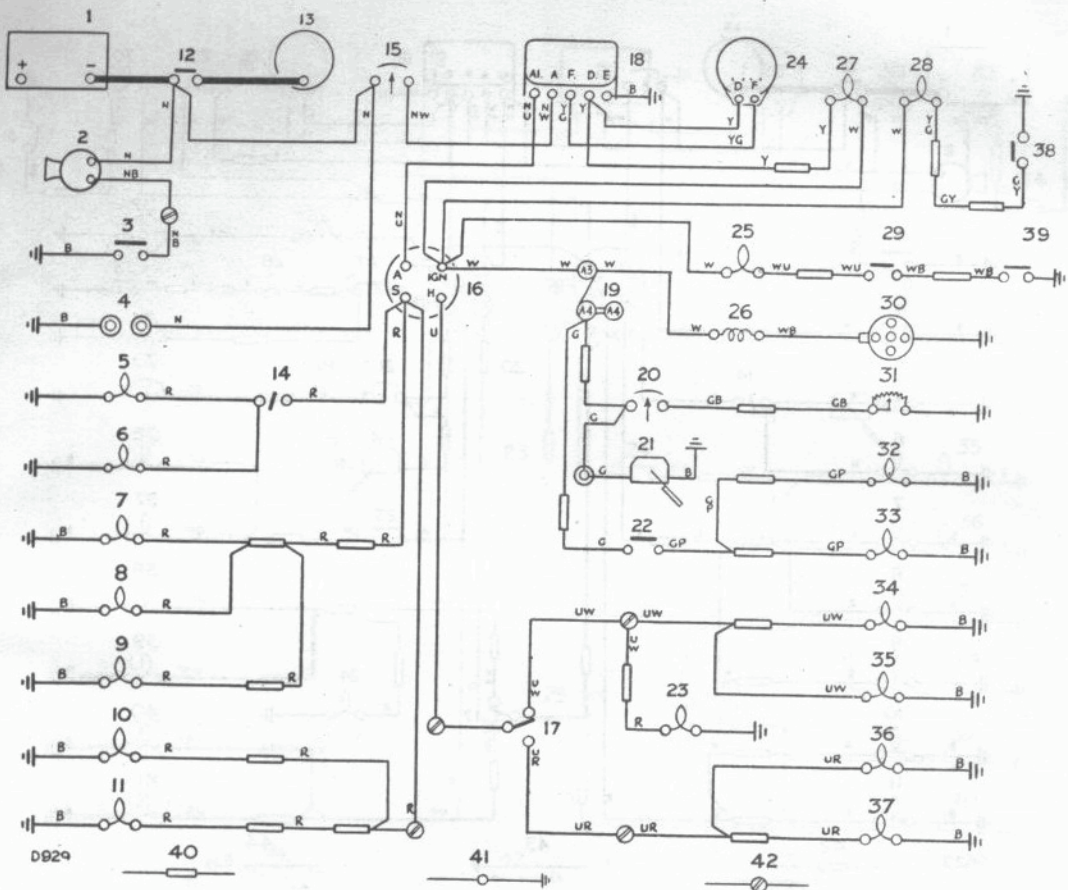


FIG 15:1 2 1/2 litre petrol models, Series 2, positive earth

- Key to Fig 15:1**
- | | |
|---|---------------------------------|
| 1 12-volt battery | 2 Horn |
| 3 Horn push button | 4 Inspection light sockets |
| 5 Panel illumination | 6 Panel illumination |
| 7 Tail light | 8 Number plate illumination |
| 9 Tail light | 10 Sidelight |
| 11 Sidelight | 12 Starter switch |
| 13 Starter | 14 Panel light switch |
| 15 Ammeter | 16 Ignition and lighting switch |
| 17 Headlight dipswitch | 18 Voltage control box |
| 19 Fuse box | 20 Fuel gauge |
| 21 Screen wiper, plug and socket | 22 Stoplight switch |
| 23 Main beam warning light | 24 Dynamo |
| 25 Mixture warning light | 26 Ignition coil |
| 27 Charging warning light | 28 Oil pressure warning light |
| 29 Mixture switch | 30 Distributor |
| 31 Fuel gauge, petrol tank | 32 Stoplight |
| 33 Stoplight | 34 Headlight, main |
| 35 Headlight, main | 36 Headlight, dip |
| 37 Headlight, dip | 38 Oil pressure switch |
| 39 Thermostat | 40 Snap connectors |
| 41 Earth connections via terminals and fixing bolts | 42 Junction box terminals |

Key to cable colour code

B Black	G Green
N Brown	P Purple
R Red	U Blue
Y Yellow	W White
RN Red with Brown, and so on	

When cables have two colour code letters, the first denotes the main and the latter the tracer.

On vehicles to the North American specification, the connections at the lighting switch are such that the sidelamps are extinguished when the headlamps are in use

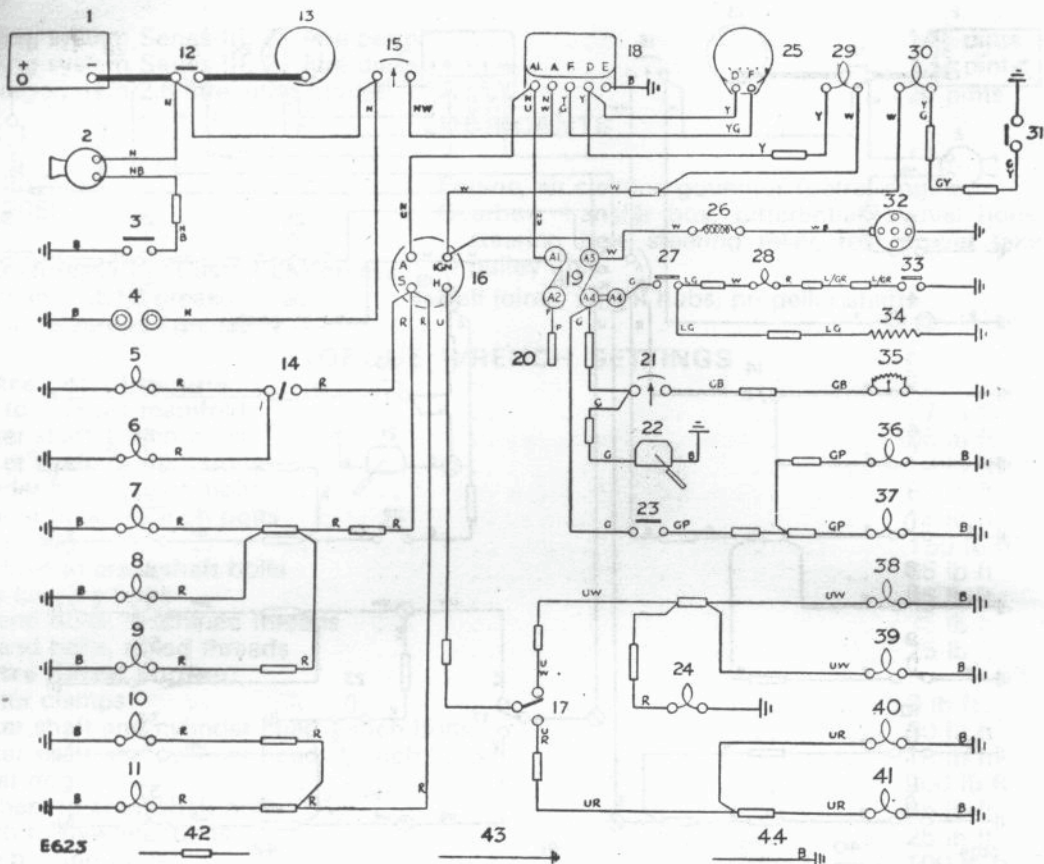


FIG 15:2 2½ litre petrol models, Series 2A, positive earth

- Key to Fig 15:2**
- | | | | |
|----|--|----|--|
| 1 | 12-volt battery | 2 | Horn |
| 3 | Horn push button | 4 | Inspection light sockets |
| 5 | Panel illumination | 6 | Panel illumination |
| 7 | Tail light | 8 | Number plate illumination |
| 9 | Tail light | 10 | Sidelight |
| 11 | Sidelight | 12 | Starter switch |
| 13 | Starter | 14 | Panel light switch |
| 15 | Ammeter | 16 | Ignition and lighting switch |
| 17 | Headlight dipswitch | 18 | Voltage control box |
| 19 | Fuse box | 20 | To interior lights |
| 21 | Fuel gauge | 22 | Screen wiper, plug and socket |
| 23 | Stoplight switch | 24 | Main beam warning light |
| 25 | Dynamo | 26 | Ignition coil |
| 27 | Mixture switch | 28 | Mixture warning light |
| 29 | Charging warning light | 30 | Oil pressure warning light |
| 31 | Oil pressure switch | 32 | Distributor |
| 33 | Mixture thermostat switch | 34 | Carburettor heater element, optional equipment |
| 35 | Gauge, fuel tank | 36 | Stoplight |
| 37 | Stoplight | 38 | Headlight, main |
| 39 | Headlight, main | 40 | Headlight, dip |
| 41 | Headlight, dip | 42 | Snap connectors |
| 43 | Earth connections via terminals and fixing bolts | 44 | Earth connections via cables |

- Key to cable colour code**
- | | | | |
|----|---------------------------|---|--------|
| B | Black | G | Green |
| N | Brown | P | Purple |
| R | Red | U | Blue |
| Y | Yellow | W | White |
| RN | Red with Brown, and so on | | |

When cables have two colour code letters, the first denotes the main and the latter the tracer.

On vehicles to the North American specification, the connections at the lighting switch are such that the sidelights are extinguished when the headlamps are in use.

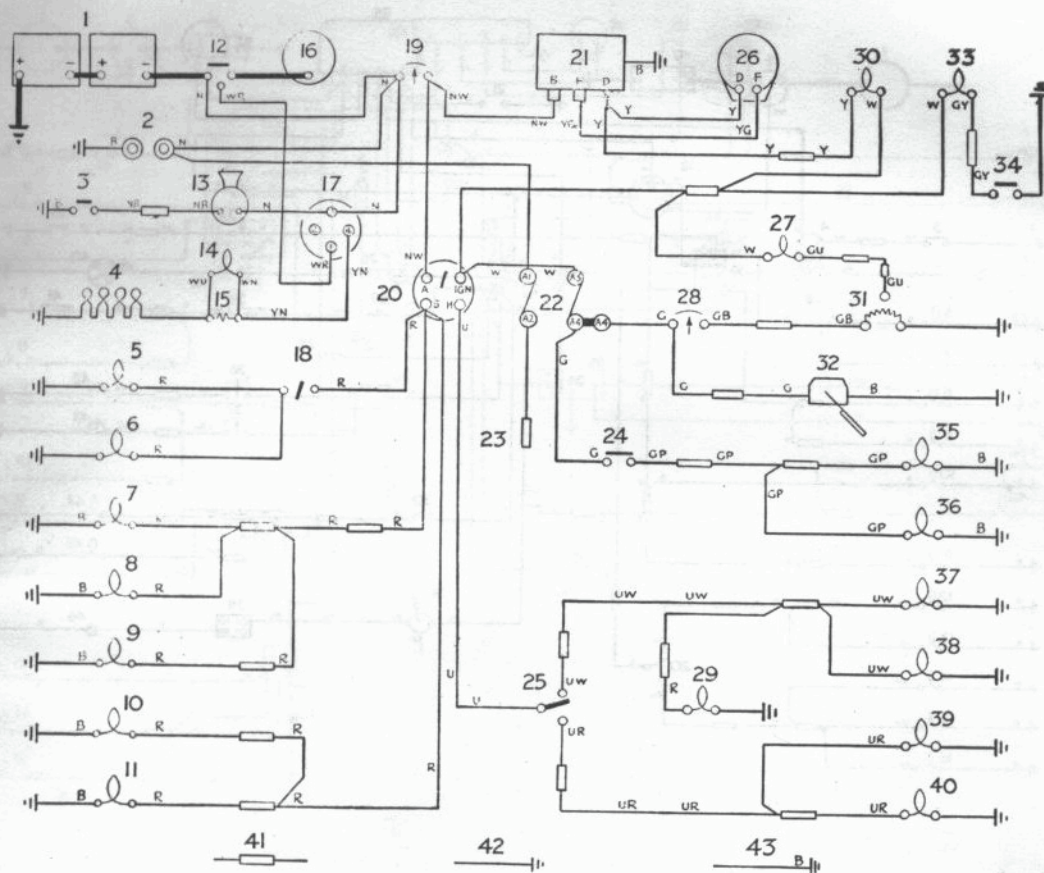


FIG 15:3 2½ litre diesel models, Series 2A, positive earth

- Key to Fig 15:3**
- | | | |
|---|---|---|
| 1 Two 6-volt positive earth batteries | 12 Starter switch | 13 Horn |
| 2 Inspection socket | 13 Horn | 14 Heater plug warning light |
| 3 Horn push button | 14 Heater plug warning light | 15 Resistor for heater plug |
| 4 Heater plugs | 15 Resistor for heater plug | 16 Starter motor |
| 5 Panel illumination | 16 Starter motor | 17 Heater plug switch |
| 6 Panel illumination | 17 Heater plug switch | 18 Panel light switch |
| 7 Tail lamp | 18 Panel light switch | 19 Ammeter |
| 8 Number plate illumination | 19 Ammeter | 20 Switch, electrical services and lighting |
| 9 Tail lamp | 20 Switch, electrical services and lighting | 21 Current/voltage regulator |
| 10 Sidelamp | 21 Current/voltage regulator | 22 Fuse box |
| 11 Sidelamp | 22 Fuse box | 23 To interior lights |
| 12 Starter switch | 23 To interior lights | 24 Stoplight switch |
| 13 Horn | 24 Stoplight switch | 25 Headlamp dipswitch |
| 14 Heater plug warning light | 25 Headlamp dipswitch | 26 Dynamo |
| 15 Resistor for heater plug | 26 Dynamo | 27 Fuel level warning light |
| 16 Starter motor | 27 Fuel level warning light | 28 Fuel gauge |
| 17 Heater plug switch | 28 Fuel gauge | 29 Headlamp main beam warning light |
| 18 Panel light switch | 29 Headlamp main beam warning light | 30 Charging warning light |
| 19 Ammeter | 30 Charging warning light | 31 Fuel tank gauge unit |
| 20 Switch, electrical services and lighting | 31 Fuel tank gauge unit | 32 Wiper motor |
| 21 Current/voltage regulator | 32 Wiper motor | 33 Oil pressure warning light |
| 22 Fuse box | 33 Oil pressure warning light | 34 Oil pressure warning light switch |
| 23 To interior lights | 34 Oil pressure warning light switch | 35 Stop lamp |
| 24 Stoplight switch | 35 Stop lamp | 36 Stop lamp |
| 25 Headlamp dipswitch | 36 Stop lamp | 37 Main beam headlamp |
| 26 Dynamo | 37 Main beam headlamp | 38 Main beam headlamp |
| 27 Fuel level warning light | 38 Main beam headlamp | 39 Dip beam headlamp |
| 28 Fuel gauge | 39 Dip beam headlamp | 40 Dip beam headlamp |
| 29 Headlamp main beam warning light | 40 Dip beam headlamp | |
| 30 Charging warning light | | |
| 31 Fuel tank gauge unit | | |
| 32 Wiper motor | | |
| 33 Oil pressure warning light | | |
| 34 Oil pressure warning light switch | | |
| 35 Stop lamp | | |
| 36 Stop lamp | | |
| 37 Main beam headlamp | | |
| 38 Main beam headlamp | | |
| 39 Dip beam headlamp | | |
| 40 Dip beam headlamp | | |
- 41 Snap connectors 42 Earth connections via terminals or fixing bolts
43 Earth connections via cables

Key to cable colour code

B Black	G Green
L Light	N Brown
O Orange	P Purple
R Red	S Slate
U Blue	W White
Y Yellow	

RN Red with Brown, and so on

When cables have two colour code letters, the first denotes the main and the latter the tracer.
On vehicles to the North American specification, the connections at the lighting switch are such that the sidelamps are extinguished when the headlamps are in use.

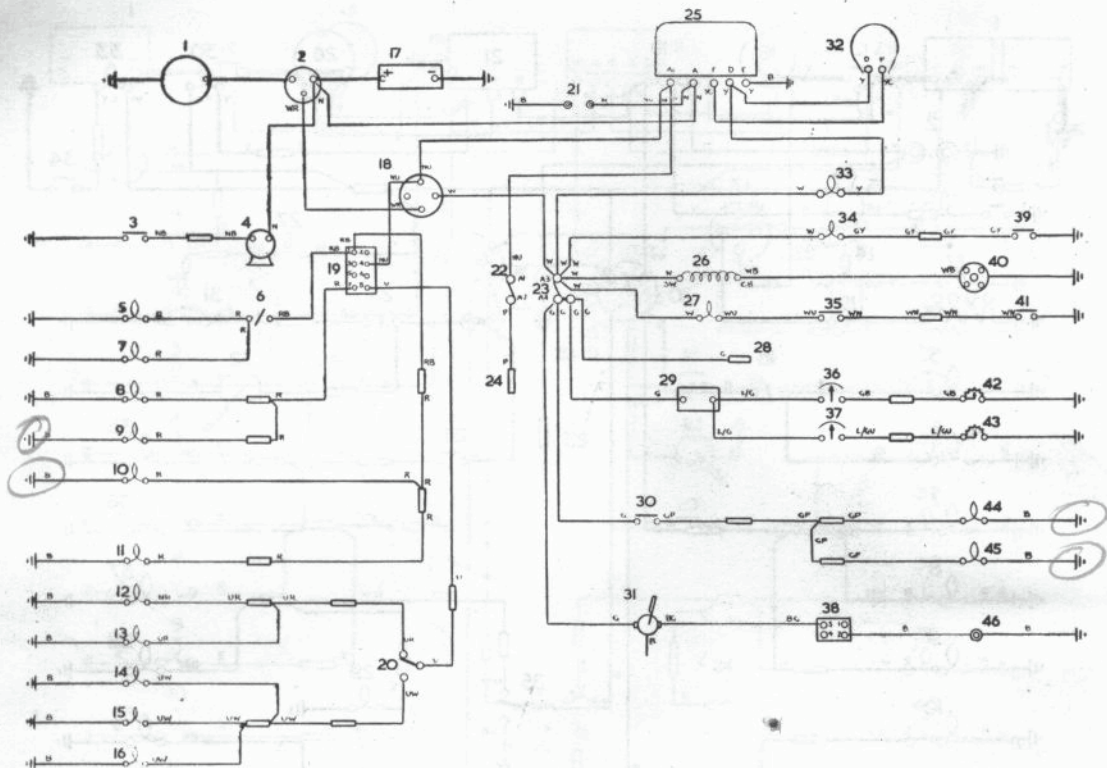


FIG 15:4 2½ litre petrol models, negative earth

- | | |
|-------------------------------------|--|
| Key to Fig 15:4 | 1 Starter motor |
| 2 Starter motor solenoid | 3 Horn push button |
| 4 Horn | 6 Panel light switch |
| 5 Speedometer panel light | 8 Righthand side lamp |
| 7 Instrument panel lights | 10 Righthand tail lamp |
| 9 Lefthand side lamp | 12 Righthand dipped beam headlamp |
| 11 Lefthand tail lamp | 14 Lefthand main beam headlamp |
| 13 Lefthand dipped beam headlamp | 15 Righthand main beam headlamp |
| 16 Headlamp main beam warning light | 17 12-volt battery |
| 18 Ignition and starter switch | 19 Lights switch |
| 20 Headlamp dipswitch | 21 Inspection sockets |
| 22 A1-A2 (35-amp) fuse | 23 A3-A4 (35-amp) fuse |
| 24 Interior light feed | 25 Regulator box |
| 26 Ignition coil | 27 Choke warning light |
| 28 Flasher lights feed | 29 Fuel and temperature gauge voltage stabilizer |
| 30 Stop-lamp switch | 31 Wiper motor |
| 32 Dynamo | 33 Ignition warning light |
| 34 Oil pressure warning light | 35 Cold start on control switch |
| 36 Fuel gauge | 37 Temperature gauge |
| 38 Wiper switch | 39 Oil pressure switch |
| 40 Distributor | 41 Cold start in cylinder head switch |
| 42 Fuel tank unit | 43 Temperature transmitter unit |
| 44 Righthand stoplamp | 45 Lefthand stoplamp |
| 46 Wiper lead | |

Snap and Lucar connections—| |—
 Earth connections—|||

Key to cable colour code	B Black	P Purple
W White	R Red	N Brown
G Green	L Light	Y Yellow
		U Blue

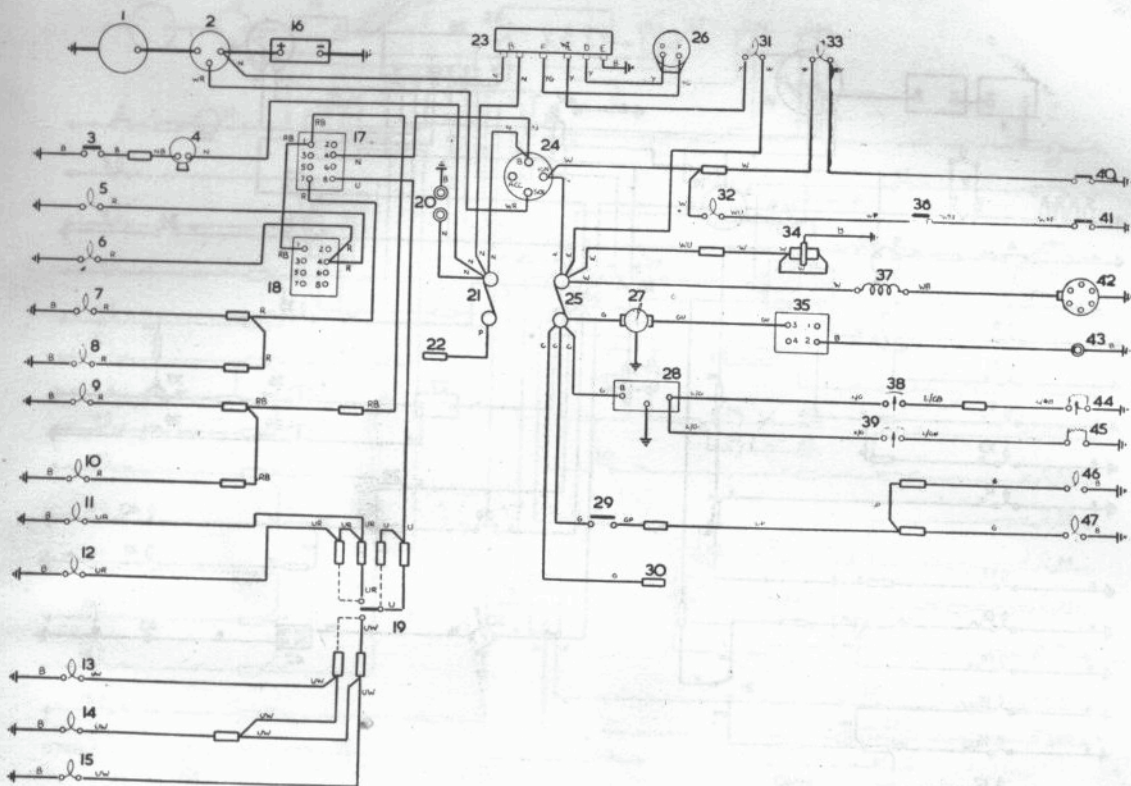


FIG 15:5 2.6 litre petrol models, negative earth

- Key to Fig 15:5**
- | | |
|--|--|
| 1 Starter motor | 16 Battery |
| 2 Starter motor solenoid | 17 Lights switch |
| 3 Horn push button | 18 Panel lights switch |
| 4 Horn | 19 Headlamp dipswitch |
| 5 Panel illumination | 20 Inspection lamp sockets |
| 6 Panel illumination | 21 A1-A2 fuse |
| 7 Righthand sidelamp | 22 Interior light feed, where fitted |
| 8 Lefthand sidelamp | 23 Regulator box |
| 9 Righthand tail-lamp | 24 Ignition and starter switch |
| 10 Lefthand tail lamp | 25 A3-A4 fuse |
| 11 Righthand dipped beam headlamp | 26 Dynamo |
| 12 Lefthand dipped beam headlamp | 27 Wiper motor |
| 13 Lefthand main beam warning | 28 Fuel and temperature gauge voltage stabilizer |
| 15 Righthand main beam headlamp | 29 Stop-lamp switch |
| 16 Battery | 30 Flasher lights feed, where fitted |
| 17 Lights switch | 31 Ignition warning light |
| 18 Panel lights switch | 32 Cold start warning light |
| 19 Headlamp dipswitch | 33 Oil pressure warning light |
| 20 Inspection lamp sockets | 34 Dual fuel pump |
| 21 A1-A2 fuse | 35 Wiper switch |
| 22 Interior light feed, where fitted | 36 Cold start switch, on control |
| 23 Regulator box | 37 Ignition coil |
| 24 Ignition and starter switch | 38 Fuel gauge |
| 25 A3-A4 fuse | 39 Water temperature indicator |
| 26 Dynamo | 40 Oil pressure switch |
| 27 Wiper motor | 41 Cold start switch, in cylinder head |
| 28 Fuel and temperature gauge voltage stabilizer | 42 Distributor |
| 29 Stop-lamp switch | 43 Wiper lead socket |
| 30 Flasher lights feed, where fitted | 44 Fuel tank unit |
| 31 Ignition warning light | 45 Water temperature transmitter |
| 32 Cold start warning light | 46 Lefthand stop lamp |
| 33 Oil pressure warning light | 47 Righthand stop lamp |
- Snap and Lucar connections— —
 Earth connections via terminals or fixing bolts—|||
 Earth connections via cables B|||

- Key to Cable colour code**
- | | | | | |
|---------|----------|---------|----------|----------|
| W White | R Red | N Brown | B Black | P Purple |
| G Green | O Orange | S Slate | Y Yellow | U Blue |
| | | | L Light | |

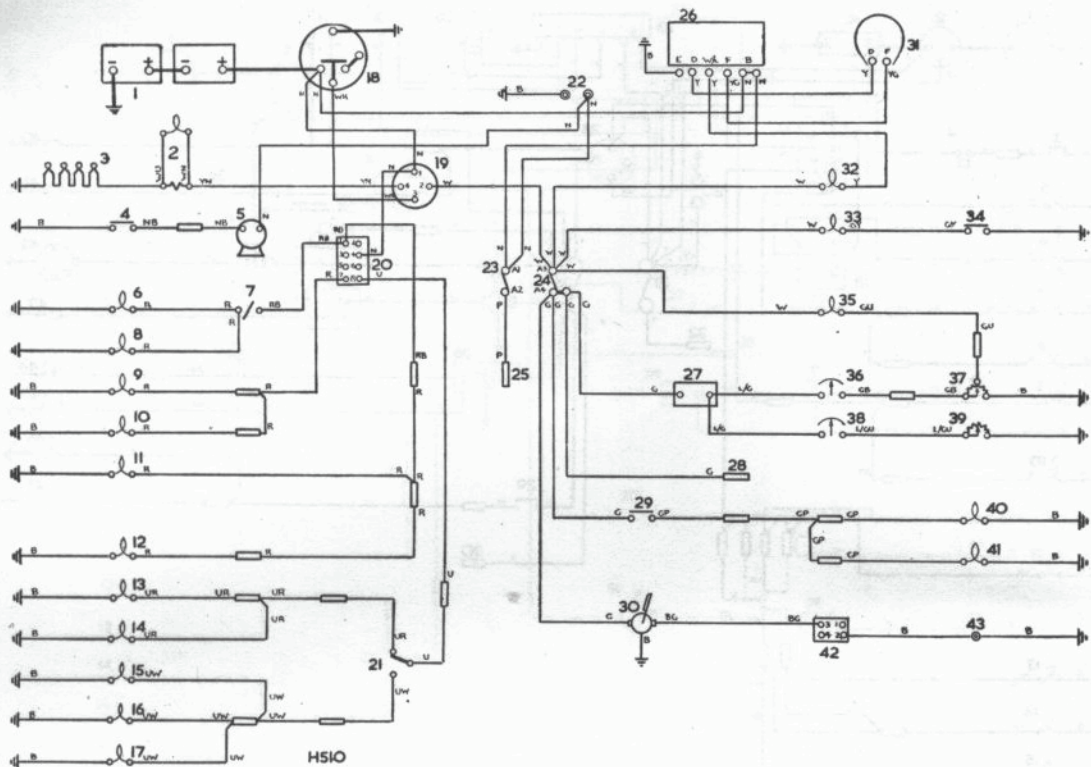


FIG 15:6 2½ litre diesel models, Series 2A, negative earth

- Key to Fig 15:6**
- | | |
|---|--|
| 1 Two 6-volt batteries | 18 Starter motor |
| 2 Heater plugs warning light and resistor | 19 Starter/heater plugs switch |
| 3 Heater plugs | 20 Lights switch |
| 4 Horn push button | 21 Headlamp dipswitch |
| 5 Horn | 22 Inspection sockets |
| 6 Speedometer panel light | 23 A1-A2 (35-amp) fuse |
| 7 Panel light switch | 24 A3-A4 (35-amp) fuse |
| 8 Instrument panel light | 25 Interior light feed |
| 9 Righthand side lamp | 26 Regulator box |
| 10 Lefthand side lamp | 27 Fuel gauge and water temperature gauge voltage stabilizer |
| 11 Righthand tail lamp | 28 Flasher lights feed |
| 12 Lefthand tail lamp | 29 Stop lamp switch |
| 13 Righthand dipped beam headlamp | 30 Wiper motor |
| 14 Lefthand dipped beam headlamp | 31 Dynamo |
| 15 Lefthand main beam headlamp | 32 Dynamo warning light |
| 16 Righthand main beam headlamp | 33 Oil pressure warning light |
| 17 Headlamp main beam warning light | 34 Oil pressure switch |
| | 35 Fuel level warning light |
| | 36 Fuel gauge |
| | 37 Fuel tank unit |
| | 38 Temperature gauge |
| | 39 Temperature transmitter unit |
| | 40 Righthand stop lamp |
| | 41 Lefthand stop lamp |
| | 42 Wiper motor switch |
| | 43 Wiper lead socket |

- Key to cable colour code**
- | | |
|---------|----------|
| B Black | P Purple |
| W White | R Red |
| N Brown | Y Yellow |
| G Green | L Light |
| U Blue | |

Snap and Lucar connections— —
 Earth connection—||—

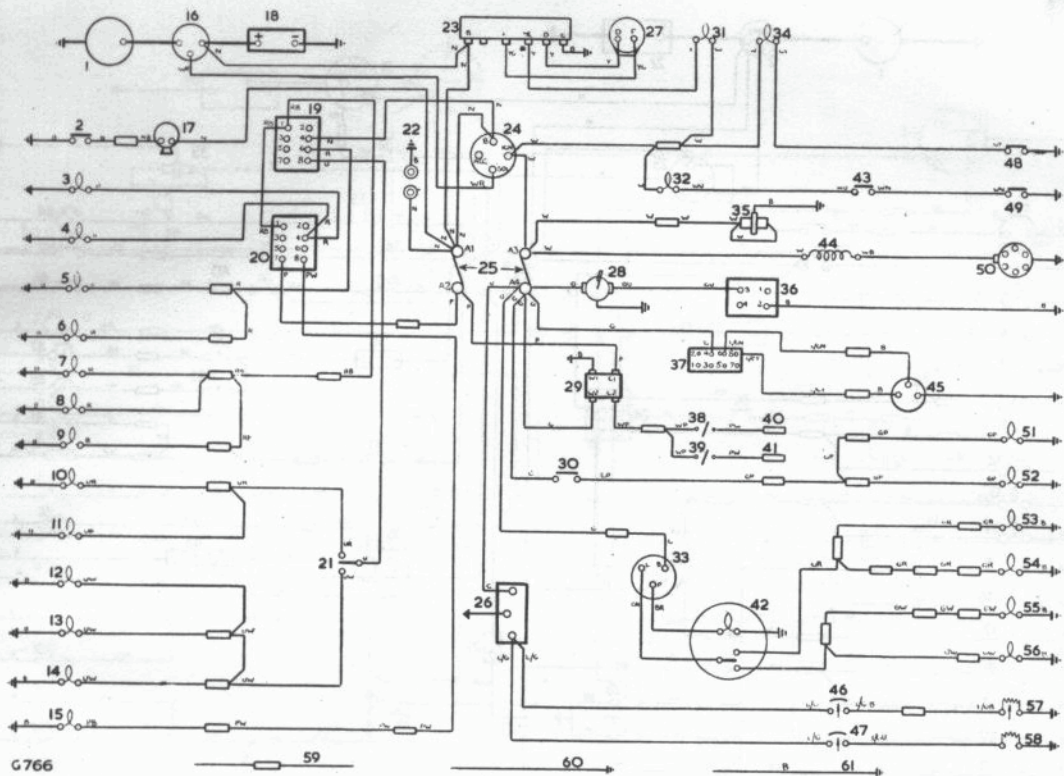


FIG 15:7 2.6 litre, 109 Station wagon, negative earth

Key to Fig 15:7

- | | |
|---|--|
| 1 Starter motor | 19 Lighting switch |
| 2 Horn push | 20 Panel and interior light switch |
| 3 Panel illumination | 21 Foot dipper switch |
| 6 Lefthand side lamp | 22 Inspection lamp socket |
| 8 Number plate illumination | 23 Voltage regulator |
| 10 Righthand dip headlamp | 24 Ignition/starter switch |
| 12 Righthand headlamp main beam | 25 Fuses |
| 14 Headlamp main beam warning light | 26 10-volt stabilizer |
| 15 Interior light | 27 Dynamo |
| 16 Starter solenoid | 28 Windscreen wiper motor |
| 17 Horn | 29 Relay for heated windscreen |
| 18 Battery | 30 Stoplight switch |
| 20 Panel and interior light switch | 31 Ignition warning light |
| 21 Foot dipper switch | 32 Choke warning light |
| 22 Inspection lamp socket | 33 Direction indicator unit |
| 23 Voltage regulator | 34 Oil pressure warning light |
| 24 Ignition/starter switch | 35 Dual petrol pump |
| 25 Fuses | 36 Windscreen wiper switch |
| 26 10-volt stabilizer | 37 Heater switch |
| 27 Dynamo | 38 Switch for heated windscreen, screen No. 1 |
| 28 Windscreen wiper motor | 39 Switch for heated windscreen, screen No. 2 |
| 29 Relay for heated windscreen | 40 Heated windscreen, screen No. 1 |
| 30 Stoplight switch | 41 Heated windscreen, screen No. 2 |
| 31 Ignition warning light | 42 Direction indicator switch |
| 32 Choke warning light | 43 Choke switch |
| 33 Direction indicator unit | 44 Coil |
| 34 Oil pressure warning light | 45 Two-speed heater unit |
| 35 Dual petrol pump | 46 Fuel gauge |
| 36 Windscreen wiper switch | 47 Water temperature gauge |
| 37 Heater switch | 48 Oil pressure switch |
| 38 Switch for heated windscreen, screen No. 1 | 49 Choke thermostat |
| 39 Switch for heated windscreen, screen No. 2 | 50 Distributor |
| 40 Heated windscreen, screen No. 1 | 51 Lefthand stop lamp |
| 41 Heated windscreen, screen No. 2 | 52 Righthand stop lamp |
| 42 Direction indicator switch | 53 Lefthand front indicator lamp |
| 43 Choke switch | 54 Lefthand rear indicator lamp |
| 44 Coil | 55 Righthand rear indicator lamp |
| 45 Two-speed heater unit | 56 Righthand front indicator lamp |
| 46 Fuel gauge | 57 Fuel tank unit |
| 47 Water temperature gauge | 58 Water temperature transmitter |
| 48 Oil pressure switch | 59 Snap connector |
| 49 Choke thermostat | 60 Earth connections via terminals or fixing bolts |
| 50 Distributor | 61 Earth connections made via cables |

Key to Cable colour code

- | | | | | |
|---------|---------|---------|----------|----------|
| W White | R Red | N Brown | Y Yellow | P Purple |
| G Green | L Light | | | U Blue |

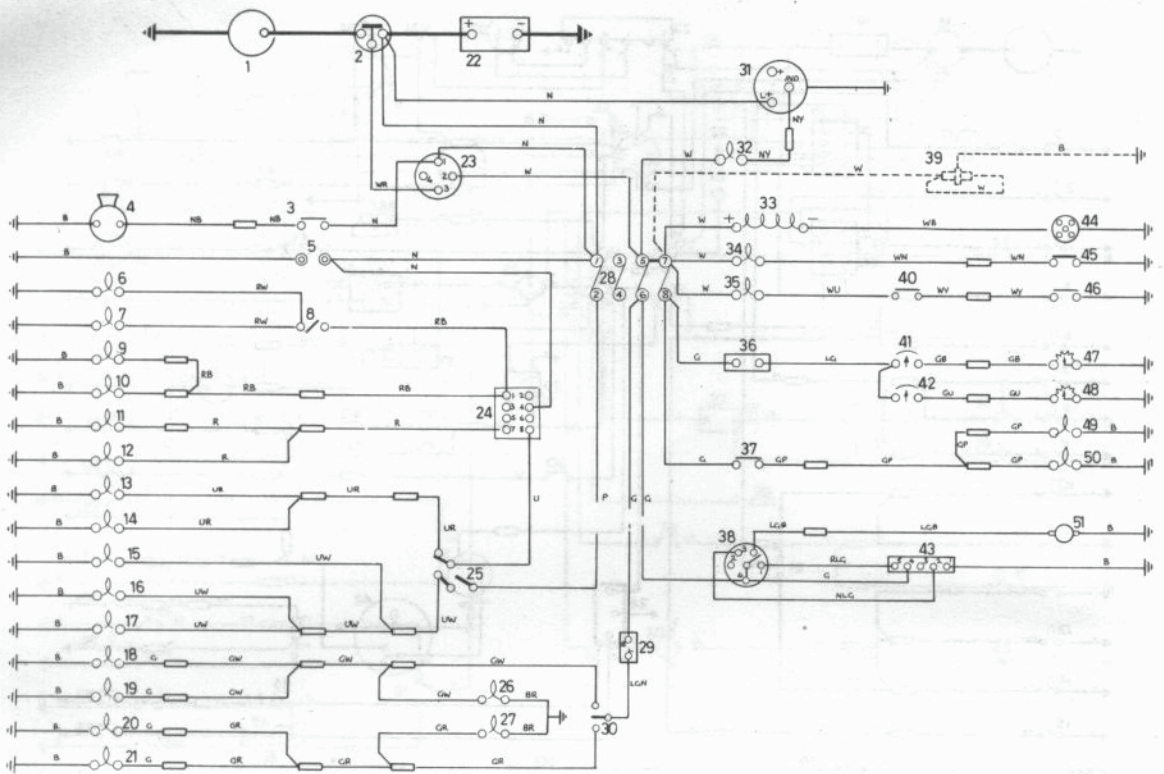
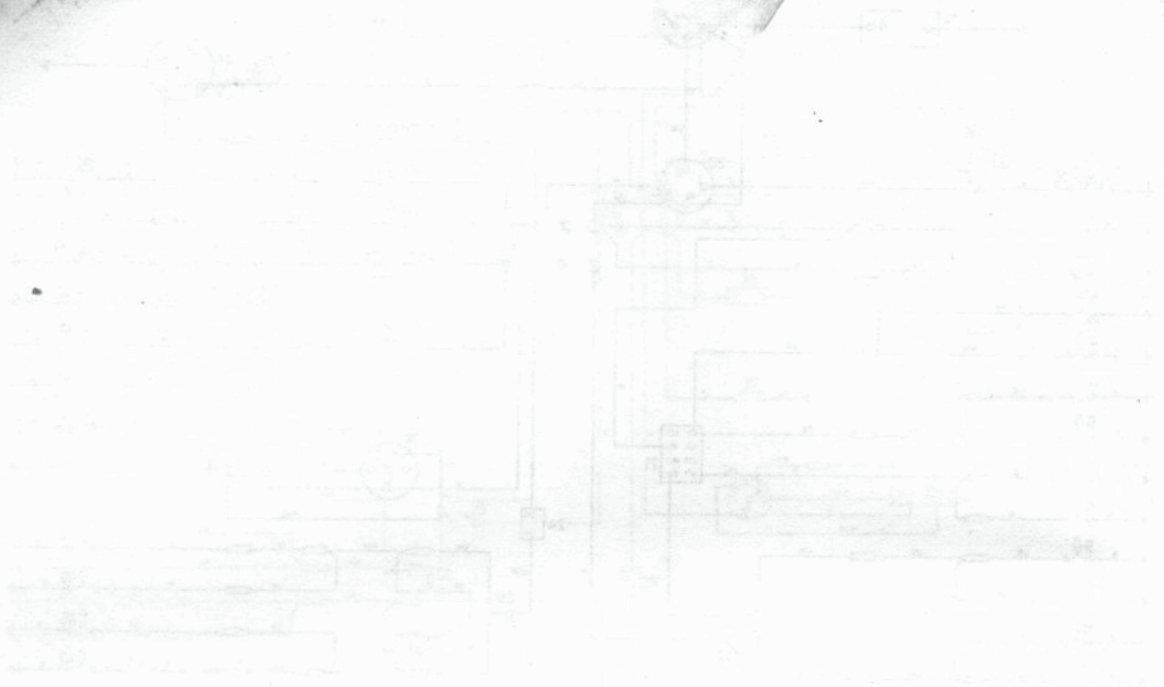


FIG 15:8 2½ litre and 2.6 litre Petrol models, Series 3

- Key to Fig 15:8**
- | | | | | |
|---|---------------------------------|---------------------------------------|---|--------------------------------------|
| 1 Starter motor | 2 Solenoid, starter motor | 3 Switch for horns | 4 Horn | 5 Inspection sockets |
| 6 Instrument panel illumination | 7 Instrument panel illumination | 8 Switch, panel lights | 9 Tail lamp, LH | 10 Tail lamp, RH |
| 11 Side lamp, LH | 12 Side lamp, RH | 13 Headlamp, LH dipped beam | 14 Headlamp, RH dipped beam | 15 Warning light, headlamp main beam |
| 16 Headlamp, LH main beam | 17 Headlamp, RH main beam | 18 Direction indicator lamp, front LH | 19 Direction indicator lamp, front RH | 20 Direction indicator lamp, rear LH |
| 21 Direction indicator lamp, rear RH | 22 Battery | 23 Switch, ignition and starter | 24 Switch, lights | 25 Switch, headlamp flash and dip |
| 26 Warning light, indicator LH | 27 Warning light, indicator RH | 28 Fuses, 1 to 8, 35-amp | 29 Indicator unit, flasher | 30 Switch, direction indicators |
| 31 Alternator, Lucas 16 ACR | 32 Warning light, ignition | 33 Ignition coil | 34 Warning light, oil pressure | 35 Warning light, choke |
| 36 Voltage stabilizer, fuel gauge and water temperature gauge | 37 Switch, stop lamp | 38 Switch, windscreen wiper | 39 Dual fuel pump, 6-cylinder models only | 40 Switch cold start warning light |
| 41 Fuel gauge | 42 Water temperature gauge | 43 Screenwiper motor | 44 Distributor | 45 Switch, oil pressure |
| 46 Switch, cold start thermostat | 47 Fuel tank unit | 48 Water temperature transmitter unit | 49 Stop lamp, LH | 50 Stop lamp, RH |
| 51 Screenwasher motor (when fitted) | | | | |

NOTES



198

HINTS ON MAINTENANCE AND OVERHAUL

There are few things more rewarding than the restoration of a vehicle's original peak of efficiency and smooth performance.

The following notes are intended to help the owner to reach that state of perfection. Providing that he possesses the basic manual skills he should have no difficulty in performing most of the operations detailed in this manual. It must be stressed, however, that where recommended in the manual, highly-skilled operations ought to be entrusted to experts, who have the necessary equipment, to carry out the work satisfactorily.

Quality of workmanship:

The hazardous driving conditions on the roads to-day demand that vehicles should be as nearly perfect, mechanically, as possible. It is therefore most important that amateur work be carried out with care, bearing in mind the often inadequate working conditions, and also the inferior tools which may have to be used. It is easy to counsel perfection in all things, and we recognise that it may be setting an impossibly high standard. We do, however, suggest that every care should be taken to ensure that a vehicle is as safe to take on the road as it is humanly possible to make it.

Safe working conditions:

Even though a vehicle may be stationary, it is still potentially dangerous if certain sensible precautions are not taken when working on it while it is supported on jacks or blocks. It is indeed preferable not to use jacks alone, but to supplement them with carefully placed blocks, so that there will be plenty of support if the car rolls off the jacks during a strenuous manoeuvre. Axle stands are an excellent way of providing a rigid base which is not readily disturbed. Piles of bricks are a dangerous substitute. Be careful not to get under heavy loads on lifting tackle, the load could fall. It is preferable not to work alone when lifting an engine, or when working underneath a vehicle which is supported well off the ground. To be trapped, particularly under the vehicle, may have unpleasant results if help is not quickly forthcoming. Make some provision, however humble, to deal with fires. Always disconnect a battery if there is a likelihood of electrical shorts. These may start a fire if there is leaking fuel about. This applies particularly to leads which can carry a heavy current, like those in the starter circuit. While on the subject of electricity, we must also stress the danger of using equipment which is run off the mains and which has no earth or has faulty wiring or connections. So many workshops have damp floors, and electrical shocks are of such a nature that it is sometimes impossible to let go of a live lead or piece of equipment due to the muscular spasms which take place.

Work demanding special care:

This involves the servicing of braking, steering and suspension systems. On the road, failure of the braking system may be disastrous. Make quite sure that there can be no possibility of failure through the bursting of rusty brake pipes or rotten hoses, nor to a sudden loss of pressure due to defective seals or valves.

Problems:

The chief problems which may face an operator are:

- 1 External dirt.
- 2 Difficulty in undoing tight fixings.
- 3 Dismantling unfamiliar mechanisms.
- 4 Deciding in what respect parts are defective.
- 5 Confusion about the correct order for reassembly.
- 6 Adjusting running clearance.
- 7 Road testing.
- 8 Final tuning.

Practical suggestions to solve the problems:

- 1 Preliminary cleaning of large parts—engines, transmissions, steering, suspensions, etc.—should be carried out before removal from the car. Where road dirt and mud alone are present, wash clean with a high-pressure water jet, brushing to remove stubborn adhesions, and allow to drain and dry. Where oil or grease is also present, wash down with a proprietary compound (Gunk, Teepol etc.) applying with a stiff brush—an old paint brush is suitable—into all crevices. Cover the distributor and ignition coils with a polythene bag and then apply a strong water jet to clear the loosened deposits. Allow to drain and dry. The assemblies will then be sufficiently clean to remove and transfer to the bench for the next stage.

On the bench, further cleaning can be carried out, first wiping the parts as free as possible from grease with old newspaper. Avoid using rag or cotton waste which can leave clogging fibres behind. Any remaining grease can be removed with a brush dipped in paraffin. If necessary, traces of paraffin can be removed by carbon tetrachloride. Avoid using paraffin or petrol in large quantities for cleaning in enclosed areas, such as garages, on account of the high fire risk.

When all exteriors have been cleaned, and not before, dismantling can be commenced. This ensures that dirt will not enter into interiors and orifices revealed by dismantling. In the next phases, where components have to be cleaned, use carbon tetrachloride in preference to petrol and keep the containers covered except when in use. After the components have been cleaned, plug small holes with tapered hard wood plugs cut to size and blank off larger orifices with grease-proof paper and masking tape. Do not use soft wood plugs or matchsticks as they may break.

- 2 It is not advisable to hammer on the end of a screw thread, but if it must be done, first screw on a nut to protect the thread, and use a lead hammer. This applies particularly to the removal of tapered cotters. Nuts and bolts seem to 'grow' together, especially in exhaust systems. If penetrating oil does not work, try the judicious application of heat, but be careful of starting a fire. Asbestos sheet or cloth is useful to isolate heat.

Tight bushes or pieces of tail-pipe rusted into a silencer can be removed by splitting them with an open-ended hacksaw. Tight screws can sometimes be started by a tap from a hammer on the end of a suitable screwdriver. Many tight fittings will yield to the judicious use of a hammer, but it must be a soft-faced hammer if damage is to be avoided, use a heavy block on the opposite side to absorb shock. Any parts of the

steering system which have been damaged should be renewed, as attempts to repair them may lead to cracking and subsequent failure, and steering ball joints should be disconnected using a recommended tool to prevent damage.

- 3 If often happens that an owner is baffled when trying to dismantle an unfamiliar piece of equipment. So many modern devices are pressed together or assembled by spinning-over flanges, that they must be sawn apart. The intention is that the whole assembly must be renewed. However, parts which appear to be in one piece to the naked eye, may reveal close-fitting joint lines when inspected with a magnifying glass, and, this may provide the necessary clue to dismantling. Left-handed screw threads are used where rotational forces would tend to unscrew a right-handed screw thread.

Be very careful when dismantling mechanisms which may come apart suddenly. Work in an enclosed space where the parts will be contained, and drape a piece of cloth over the device if springs are likely to fly in all directions. Mark everything which might be reassembled in the wrong position, scratched symbols may be used on unstressed parts, or a sequence of tiny dots from a centre punch can be useful. Stressed parts should never be scratched or centre-popped as this may lead to cracking under working conditions. Store parts which look alike in the correct order for reassembly. Never rely upon memory to assist in the assembly of complicated mechanisms, especially when they will be dismantled for a long time, but make notes, and drawings, to supplement the diagrams in the manual, and put labels on detached wires. Rust stains may indicate unlubricated wear. This can sometimes be seen round the outside edge of a bearing cup in a universal joint. Look for bright rubbing marks on parts which normally should not make heavy contact. These might prove that something is bent or running out of truth. For example, there might be bright marks on one side of a piston, at the top near the ring grooves, and others at the bottom of the skirt on the other side. This could well be the clue to a bent connecting rod. Suspected cracks can be proved by heating the component in a light oil to approximately 100°C, removing, drying off, and dusting with french chalk, if a crack is present the oil retained in the crack will stain the french chalk.

- 4 In determining wear, and the degree, against the permissible limits set in the manual, accurate measurement can only be achieved by the use of a micrometer. In many cases, the wear is given to the fourth place of decimals; that is in ten-thousandths of an inch. This can be read by the vernier scale on the barrel of a good micrometer. Bore diameters are more difficult to determine. If, however, the matching shaft is accurately measured, the degree of play in the bore can be felt as a guide to its suitability. In other cases, the shank of a twist drill of known diameter is a handy check.

Many methods have been devised for determining the clearance between bearing surfaces. To-day the best and simplest is by the use of Plastigage, obtainable from most garages. A thin plastic thread is laid between the two surfaces and the bearing is tightened, flattening the thread. On removal, the width of the thread is

compared with a scale supplied with the thread and the clearance is read off directly. Sometimes joint faces leak persistently, even after gasket renewal. The fault will then be traceable to distortion, dirt or burrs. Studs which are screwed into soft metal frequently raise burrs at the point of entry. A quick cure for this is to chamfer the edge of the hole in the part which fits over the stud.

- 5 **Always check a replacement part with the original one before it is fitted.**

If parts are not marked, and the order for reassembly is not known, a little detective work will help. Look for marks which are due to wear to see if they can be mated. Joint faces may not be identical due to manufacturing errors, and parts which overlap may be stained, giving a clue to the correct position. Most fixings leave identifying marks especially if they were painted over on assembly. It is then easier to decide whether a nut, for instance, has a plain, a spring, or a shakeproof washer under it. All running surfaces become 'bedded' together after long spells of work and tiny imperfections on one part will be found to have left corresponding marks on the other. This is particularly true of shafts and bearings and even a score on a cylinder wall will show on the piston.

- 6 Checking end float or rocker clearances by feeler gauge may not always give accurate results because of wear. For instance, the rocker tip which bears on a valve stem may be deeply pitted, in which case the feeler will simply be bridging a depression. Thrust washers may also wear depressions in opposing faces to make accurate measurement difficult. End float is then easier to check by using a dial gauge. It is common practice to adjust end play in bearing assemblies, like front hubs with taper rollers, by doing up the axle nut until the hub becomes stiff to turn and then backing it off a little. Do not use this method with ballbearing hubs as the assembly is often preloaded by tightening the axle nut to its fullest extent. If the splitpin hole will not line up, file the base of the nut a little.

Steering assemblies often wear in the straight-ahead position. If any part is adjusted, make sure that it remains free when moved from lock to lock. Do not be surprised if an assembly like a steering gearbox, which is known to be carefully adjusted outside the car, becomes stiff when it is bolted in place. This will be due to distortion of the case by the pull of the mounting bolts, particularly if the mounting points are not all touching together. This problem may be met in other equipment and is cured by careful attention to the alignment of mounting points.

When a spanner is stamped with a size and A/F it means that the dimension is the width between the jaws and has no connection with ANF, which is the designation for the American National Fine thread. Coarse threads like Whitworth are rarely used on cars to-day except for studs which screw into soft aluminium or cast iron. For this reason it might be found that the top end of a cylinder head stud has a fine thread and the lower end a coarse thread to screw into the cylinder block. If the car has mainly UNF threads then it is likely that any coarse threads will be UNC, which are not the same as Whitworth. Small sizes have the same number of threads in Whitworth and UNC, but in the $\frac{1}{2}$ inch size for example, there are twelve threads to the inch in the former and thirteen in the latter.

7 After a major overhaul, particularly if a great deal of work has been done on the braking, steering and suspension systems, it is advisable to approach the problem of testing with care. If the braking system has been overhauled, apply heavy pressure to the brake pedal and get a second operator to check every possible source of leakage. The brakes may work extremely well, but a leak could cause complete failure after a few miles.

Do not fit the hub caps until every wheel nut has been checked for tightness, and make sure the tyre pressures are correct. Check the levels of coolant, lubricants and hydraulic fluids. Being satisfied that all is well, take the car on the road and test the brakes at once. Check the steering and the action of the handbrake. Do all this at moderate speeds on quiet roads, and make sure there is no other vehicle behind you when you try a rapid stop.

Finally, remember that many parts settle down after a time, so check for tightness of all fixings after the car has been on the road for a hundred miles or so.

8 It is useless to tune an engine which has not reached its normal running temperature. In the same way, the tune of an engine which is stiff after a rebore will be different when the engine is again running free. Remember too, that rocker clearances on pushrod operated valve gear will change when the cylinder head nuts are tightened after an initial period of running with a new head gasket.

Trouble may not always be due to what seems the obvious cause. Ignition, carburation and mechanical condition are interdependent and spitting back through the carburetter, which might be attributed to a weak mixture, can be caused by a sticking inlet valve.

For one final hint on tuning, never adjust more than one thing at a time or it will be impossible to tell which adjustment produced the desired result.

WARNING

If, during any overhaul or service, it is necessary to extract any roll pins and/or circlips they **MUST** be discarded.

New pins and/or circlips **MUST** be fitted on reassembly. The refitting of used roll pins and/or circlips could result in failure of a component and possibly create a safety hazard.

NOTES

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WARNING

If wearing this headset or headset, it is necessary to extract your ear and/or hearing aid MUST be removed.

The headset and/or hearing aid MUST be removed immediately. The headset and/or hearing aid MUST be removed immediately. The headset and/or hearing aid MUST be removed immediately.

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GLOSSARY OF TERMS

- Allen key** Cranked wrench of hexagonal section for use with socket head screws.
- Alternator** Electrical generator producing alternating current. Rectified to direct current for battery charging.
- Ambient temperature** Surrounding atmospheric temperature.
- Annulus** Used in engineering to indicate the outer ring gear of an epicyclic gear train.
- Armature** The shaft carrying the windings, which rotates in the magnetic field of a generator or starter motor. That part of a solenoid or relay which is activated by the magnetic field.
- Axial** In line with, or pertaining to, an axis.
- Backlash** Play in meshing gears.
- Balance lever** A bar where force applied at the centre is equally divided between connections at the ends.
- Banjo axle** Axle casing with large diameter housing for the crownwheel and differential.
- Bendix pinion** A self-engaging and self-disengaging drive on a starter motor shaft.
- Bevel pinion** A conical shaped gearwheel, designed to mesh with a similar gear with an axis usually at 90 deg. to its own.
- bhp** Brake horse power, measured on a dynamometer.
- bmp** Brake mean effective pressure. Average pressure on a piston during the working stroke.
- Brake cylinder** Cylinder with hydraulically operated piston(s) acting on brake shoes or pad(s).
- Brake regulator** Control valve fitted in hydraulic braking system which limits brake pressure to rear brakes during heavy braking to prevent rear wheel locking.
- Camber** Angle at which a wheel is tilted from the vertical.
- Capacitor** Modern term for an electrical condenser. Part of distributor assembly, connected across contact breaker points, acts as an interference suppressor.
- Castellated** Top face of a nut, slotted across the flats, to take a locking splitpin.
- Castor** Angle at which the kingpin or swivel pin is tilted when viewed from the side.
- cc** Cubic centimetres. Engine capacity is arrived at by multiplying the area of the bore in sq cm by the stroke in cm by the number of cylinders.
- Clevis** U-shaped forked connector used with a clevis pin, usually at handbrake connections.
- Collet** A type of collar, usually split and located in a groove in a shaft, and held in place by a retainer. The arrangement used to retain the spring(s) on a valve stem in most cases.
- Commutator** Rotating segmented current distributor between armature windings and brushes in generator or motor.
- Compression ratio** The ratio, or quantitative relation, of the total volume (piston at bottom of stroke) to the unswept volume (piston at top of stroke) in an engine cylinder.
- Condenser** See capacitor.
- Core plug** Plug for blanking off a manufacturing hole in a casting.
- Crownwheel** Large bevel gear in rear axle, driven by a bevel pinion attached to the propeller shaft. Sometimes called a 'ring gear'.
- 'C'-spanner** Like a 'C' with a handle. For use on screwed collars without flats, but with slots or holes.
- Damper** Modern term for shock-absorber, used in vehicle suspension systems to damp out spring oscillations.
- Depression** The lowering of atmospheric pressure as in the inlet manifold and carburetter.
- Dowel** Close tolerance pin, peg, tube, or bolt, which accurately locates mating parts.
- Drag link** Rod connecting steering box drop arm (pitman arm) to nearest front wheel steering arm in certain types of steering systems.
- Dry liner** Thinwall tube pressed into cylinder bore.
- Dry sump** Lubrication system where all oil is scavenged from the sump, and returned to a separate tank.
- Dynamo** See Generator.
- Electrode** Terminal, part of an electrical component, such as the points or 'Electrodes' of a sparking plug.
- Electrolyte** In lead-acid car batteries a solution of sulphuric acid and distilled water.
- End float** The axial movement between associated parts, end play.
- EP** Extreme pressure. In lubricants, special grades for heavily loaded bearing surfaces, such as gear teeth in a gearbox, or crownwheel and pinion in a rear axle.

Fade	Of brakes. Reduced efficiency due to overheating.	Journals	Those parts of a shaft that are in contact with the bearings.
Field coils	Windings on the polepieces of motors and generators.	Kingpin	The main vertical pin which carries the front wheel spindle, and permits steering movement. May be called 'steering pin' or 'swivel pin'.
Fillets	Narrow finishing strips usually applied to interior bodywork.	Layshaft	The shaft which carries the laygear in the gearbox. The laygear is driven by the first motion shaft and drives the third motion shaft according to the gear selected. Sometimes called the 'countershaft' or 'second motion shaft.'
First motion shaft	Input shaft from clutch to gearbox.	lb ft	A measure of twist or torque. A pull of 10 lb at a radius of 1 ft is a torque of 10 lb ft.
Fullflow filter	Filters in which all the oil is pumped to the engine. If the element becomes clogged, a bypass valve operates to pass unfiltered oil to the engine.	lb/sq in	Pounds per square inch.
FWD	Front wheel drive.	Little-end	The small, or piston end of a connecting rod. Sometimes called the 'small-end'.
Gear pump	Two meshing gears in a close fitting casing. Oil is carried from the inlet round the outside of both gears in the spaces between the gear teeth and casing to the outlet, the meshing gear teeth prevent oil passing back to the inlet, and the oil is forced through the outlet port.	LT	Low Tension. The current output from the battery.
Generator	Modern term for 'Dynamo'. When rotated produces electrical current.	Mandrel	Accurately manufactured bar or rod used for test or centring purposes.
Grommet	A ring of protective or sealing material. Can be used to protect pipes or leads passing through bulkheads.	Manifold	A pipe, duct, or chamber, with several branches.
Grubscrew	Fully threaded headless screw with screwdriver slot. Used for locking, or alignment purposes.	Needle rollers	Bearing rollers with a length many times their diameter.
Gudgeon pin	Shaft which connects a piston to its connecting rod. Sometimes called 'wrist pin', or 'piston pin'.	Oil bath	Reservoir which lubricates parts by immersion. In air filters, a separate oil supply for wetting a wire mesh element to hold the dust.
Halfshaft	One of a pair transmitting drive from the differential.	Oil wetted	In air filters, a wire mesh element lightly oiled to trap and hold airborne dust.
Helical	In spiral form. The teeth of helical gears are cut at a spiral angle to the side faces of the gearwheel.	Overlap	Period during which inlet and exhaust valves are open together.
Hot spot	Hot area that assists vapourisation of fuel on its way to cylinders. Often provided by close contact between inlet and exhaust manifolds.	Panhard rod	Bar connected between fixed point on chassis and another on axle to control sideways movement.
HT	High Tension. Applied to electrical current produced by the ignition coil for the sparking plugs.	Pawl	Pivoted catch which engages in the teeth of a ratchet to permit movement in one direction only.
Hydrometer	A device for checking specific gravity of liquids. Used to check specific gravity of electrolyte.	Peg spanner	Tool with pegs, or pins, to engage in holes or slots in the part to be turned.
Hypoid bevel gears	A form of bevel gear used in the rear axle drive gears. The bevel pinion meshes below the centre line of the crownwheel, giving a lower propeller shaft line.	Pendant pedals	Pedals with levers that are pivoted at the top end.
Idler	A device for passing on movement. A free running gear between driving and driven gears. A lever transmitting track rod movement to a side rod in steering gear.	Phillips screwdriver	A cross-point screwdriver for use with the cross-slotted heads of Phillips screws.
Impeller	A centrifugal pumping element. Used in water pumps to stimulate flow.	Pinion	A small gear, usually in relation to another gear.
		Piston-type damper	Shock absorber in which damping is controlled by a piston working in a closed oil-filled cylinder.
		Preloading	Preset static pressure on ball or roller bearings not due to working loads.
		Radial	Radiating from a centre, like the spokes of a wheel.

Radius rod	Pivoted arm confining movement of a part to an arc of fixed radius.	TDC	Top Dead Centre. The highest point reached by a piston in a cylinder, with the crank and connecting rod in line.
Ratchet	Toothed wheel or rack which can move in one direction only, movement in the other being prevented by a pawl.	Thermostat	Automatic device for regulating temperature. Used in vehicle coolant systems to open a valve which restricts circulation at low temperature.
Ring gear	A gear tooth ring attached to outer periphery of flywheel. Starter pinion engages with it during starting.	Third motion shaft	Output shaft of gearbox.
Runout	Amount by which rotating part is out of true.	Threequarter floating axle	Outer end of rear axle halfshaft flanged and bolted to wheel hub, which runs on bearing mounted on outside of axle casing. Vehicle weight is not carried by the axle shaft.
Semi-floating axle	Outer end of rear axle halfshaft is carried on bearing inside axle casing. Wheel hub is secured to end of shaft.	Thrust bearing or washer	Used to reduce friction in rotating parts subject to axial loads.
Servo	A hydraulic or pneumatic system for assisting, or, augmenting a physical effort. See 'Vacuum Servo'.	Torque	Turning or twisting effort. See 'lb ft'.
Setscrew	One which is threaded for the full length of the shank.	Track rod	The bar(s) across the vehicle which connect the steering arms and maintain the front wheels in their correct alignment.
Shackle	A coupling link, used in the form of two parallel pins connected by side plates to secure the end of the master suspension spring and absorb the effects of deflection.	UJ	Universal joint. A coupling between shafts which permits angular movement.
Shell bearing	Thinwalled steel shell lined with anti-friction metal. Usually semi-circular and used in pairs for main and big-end bearings.	UNF	Unified National Fine screw thread.
Shock absorber	See 'Damper'.	Vacuum servo	Device used in brake system, using difference between atmospheric pressure and inlet manifold depression to operate a piston which acts to augment brake pressure as required. See 'Servo'.
Silentbloc	Rubber bush bonded to inner and outer metal sleeves.	Venturi	A restriction or 'choke' in a tube, as in a carburetter, used to increase velocity to obtain a reduction in pressure.
Socket-head screw	Screw with hexagonal socket for an Allen key.	Vernier	A sliding scale for obtaining fractional readings of the graduations of an adjacent scale.
Solenoid	A coil of wire creating a magnetic field when electric current passes through it. Used with a soft iron core to operate contacts or a mechanical device.	Welch plug	A domed thin metal disc which is partially flattened to lock in a recess. Used to plug core holes in castings.
Spur gear	A gear with teeth cut axially across the periphery.	Wet liner	Removable cylinder barrel, sealed against coolant leakage, where the coolant is in direct contact with the outer surface.
Stub axle	Short axle fixed at one end only.	Wet sump	A reservoir attached to the crankcase to hold the lubricating oil.
Tachometer	An instrument for accurate measurement of rotating speed. Usually indicates in revolutions per minute.		

INDEX

A	
Air filter	52
Alternator	134, 140
Antifreeze	71
Armature, generator	133
Armature, starter	142
Axle shafts, front	103
Axle shafts, rear	97
B	
Ball joints	104
Battery	131
Big-ends	23, 38
Bleeding, brakes	123, 128
Bleeding, clutch	76
Bodywork	149
Brake failure switch	128
Brakes, road wheels	119
Brake, transmission	125
Brushes	134-136
C	
Camshaft, diesel	32
Camshaft, petrol	17
Capacitor	65
Capstan, winch	166
Carburettors	41
Centre power take-off	155
Choke	46
Clutch	75
Clutch withdrawal mechanism	80
Commutator	133
Connecting rods, diesel	38
Connecting rods, petrol	23
Contact breaker	65
Controls, throttle	62
Cooling system	69
Crankcase emission control	25
Crankshaft, diesel	39
Crankshaft, petrol	24
Cut-out	143
Cylinder head, diesel	29
Cylinder head, petrol	12
D	
Dampers	100
Decarbonizing, diesel	31
Decarbonizing, petrol	14
Differentials	100
Distributor	64
Dual braking system	126
E	
Electrical equipment	131
Electrolyte	131
Emission control, distributor	66
Engine governor	163
Evaporative loss control	53
Exhaust emission control	53
F	
Fan	67
Final drive	100
G	
Gearbox	81
Generator	133
Glossary of terms	203
H	
Handbrake	125
Hand speed control	170
Headlamp beam setting	145
Heater	146
Heater plugs, diesel	145
Hints on maintenance and overhaul	199
Hot spot	14
Hydraulic system, brakes	123
Hydraulic system, clutch	76
Hydraulic winch	169
I	
Idling adjustment	46
Ignition	63
Injection pump	60
Injectors	61
J	
Jet positioning, Stromberg	48
Jet positioning, SU	52
M	
Main bearings, diesel	39
Main bearings, petrol	24
Manifolds	14
Master cylinder, brakes	117
Master cylinder, clutch	77
Metric conversion table	198
O	
Oil cooler	171
Oil filter, diesel	37
Oil filter, petrol	22
Oil pump, diesel	37
Oil pump, petrol	22
Optional equipment	155
P	
Pedal clearance	76
Pistons, diesel	38
Pistons, petrol	23
Propeller shafts	95
R	
Radiator	71
Rear axle	97
Rear hub	98
Rear power take-off	158
Rear suspension	100

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