JAGUAR

420

SERVICE MANUAL

NOTE: All references in this Manual to "right-hand side" and "left-hand side" are made assuming the person to be looking from the rear of the car or unit.

ISSUED BY

JAGUAR CARS LIMITED, COVENTRY, ENGLAND

Telephone	Code	Telegraphic Address
ALLESLEY 2121 (PBX)	BENTLEY'S SECOND	"JAGUAR," COVENTRY. Telex. 31622

Jaguar Cars Limited reserve the right to make changes in design, or to make additions to or improvements upon their products without incurring any obligation to install the same on vehicles previously built.

Publication No. E.143/1

INDEX TO SECTIONS

ENGINE

SECTION A

INDEX

ENGINE

Description Page

ENGINE

The Jaguar "420" has the twin overhead camshaft engine fitted with an "S" type cylinder head with straight ports and $\frac{3}{8}$" lift cams.

Compression Ratio	Engine No. Prefix
7 : 1 8 : 1 9 : 1	7F

Compression ratios of 7 : 1, 8 : 1 and 9 : 1 are specified for the 4.2 litre engine, the difference in compression ratios being obtained by varying the crown design of the piston.
The compression ratio of an engine is indicated by /7, /8 or /9 following the engine number.

DATA

Camshaft

Number of journals	Four per shaft
Journal diameter	1.00" — .0005" — .001" (2.25 mm. — .013 mm. — .025 mm.)
Thrust taken	Front end
Number of bearings	Four per shaft (eight half bearings)
Type of bearings	White metal steel backed shell
Diameter clearance	.0005" — .002" (.013 — .05 mm.)
Permissible end float	.004" — .006" (.10 — .15 mm.)
Tightening torque—Bearing cap nuts	15 lb. ft. (180 lb. in.) (2.0 kg.m.)

Connecting Rod

Length centre to centre	$7\frac{3}{4}$" (19.68 mm.)
Big end—Bearing type	Lead bronze, steel backed
Bore for big end bearing	2.288" — 2.335" (56.72 — 56.73 mm.)
Big end width	$1\frac{3}{16}$" — .006" (30.16 — .15 mm.) — .008" (— .20 mm.)
Big end—Diameter clearance	.0015" — .0033" (.037 — .083 mm.)
Big end—Side clearance	.0058" — .0087" (.15 — .22 mm.)
Bore for small end bush	1.0" — .0005" (25.5 — .013 mm.)
Small end bush — Type	Phosphor bronze—steel backed
Small end—Width	$1\frac{5}{64}$" (27.4 mm.)
Small end bush—Bore diameter	.875" + .0002" (22.22 + .005 mm.) — .0000" (— .000 mm.)
Tightening torque—connecting rod bolts	37 lb. ft. (450 lb. in.) (5.1 kg.m.)

Crankshaft

Number of main bearings	7
Main bearing type	Lead bronze—steel backed shell
Journal diameter	2.75" — 2.7505" (69.85 — 69.86 mm.)
Journal length—Front	$1\frac{9}{16}$" (39.06 mm.)
Journal length—Centre	$1\frac{3}{8}$" + .001" (34.37 + .025 mm.) — .0005" (— .0125 mm.)
Journal length—Rear	$1\frac{11}{16}$" (42.86 mm.)
Journal length—Intermediate	$1\frac{7}{32}$" ± .002" (30.96 ± .05 mm.)
Thrust taken	Centre bearing thrust washers
Thrust washer—Thickness	.092" ± .001" and .096" ± .001" (2.33 ± .025 mm. and 2.43. ± 025 mm.)
End clearance	.004" — .006" (.10 — .15 mm.)
Main bearing length	
Front } Centre } Rear }	$1\frac{1}{2}$." ± .005" (38.1 ± .13 mm.)
Intermediate	1" ± .005" (25.5 ± .13 mm.)
Diameter clearance	.0025" — .0042" (.063 — .106 mm.)

Crankshaft—continued	
Crankpin—diameter	2.086" + .0006" (52.98 + .015 mm.) — .0000" (— .000 mm.)
— length	$1\frac{3}{16}$" + .0007" (30.16 + .018 mm.) — .0002" (— .006 mm.)
Regrind undersize	.010", .020", .030", .040" (.25 .51, .76, 1.02 mm.)
Minimum diameter for regrind	—.040" (1 mm.)
Tightening torque—Main bearing bolts	83 lb. ft. (11.5 kgm.)
Cylinder Block	
Material	4 KG. dry liners
Interference fit	.001" — .005" (.125 — .127 mm.)
Overall length of liner	6.959" — 6.979" (17.39 — 17.45 cm.)
Outside diameter of lead-in	3.758" — 3.760" (93.95-94 mm.)
Size of bore honed after assembly — in cylinder block	
Nominal	3.625" (92.0750 mm.)
Main line bore for main bearings	2.9165" + .0005" (74.08 + .0125 mm.) — .0000" (— .0000 mm.)
Cylinder Head	
Type	Straight port
Material	Aluminium alloy
Valve seat angle —Inlet	45°
—Exhaust	45°
Tightening torque—Cylinder head nuts	58 lb. ft. (8.0 kgm.)
Firing order	1, 5, 3, 6, 2, 4 No. 1 cylinder at rear
Gudgeon Pin	
Type	Fully floating
Length	3.0" (76.2 mm.)
Inside diameter	$\frac{5}{8}$" (15.87 mm.)
Outside diameter	.8750" — .8752" (22.22 — 22.23 mm.)
Lubricating System	
Oil pressure—Hot	40 lb/sq. in. at 3,000 r.p.m.
Oil pump—Type	Eccentric rotor
—Clearance at end of lobes	.006" max. (.15 mm.)
—End clearance	.0025" max. (.06 mm.)
—Clearance between outer rotor and body	.010" max. (.25 mm.)
Piston and Piston Rings	
Type (8 : 1)	Solid skirt
Type (9 : 1)	Semi-split skirt
Skirt clearance	.0011" — .0017"
(measured at bottom of skirt at 90° to gudgeon pin axis)	(.028 — .043 mm.)
Compression height	
7 : 1 compression ratio	1.841" — 1.846" (46.76 — 46.89 mm.)
8 : 1 compression ratio	2.064" — 2.069" (52.42 — 52.55 mm.)
9 : 1 compression ratio	2.242" — 2.247" (56.94 — 57.07 mm.)
Piston Rings Number	
Compression	2
Oil control	1
Piston rings—Width	
Compression	.0770" — .0780" (1.97 — 2.00 mm.)
Oil control	Self-expanding
Piston rings—Thickness	
Compression	.151" — .158" (3.775 — 3.95 mm.)
Piston rings—Side clearance in groove	
Compression	.001" — .003" (.02 — .07 mm.)
Oil control	.001" — .003" (.02 — .07 mm.)
Piston rings—Gap when fitted to bore	
Compression	.015" — .020" (.38 — .51 mm.)
Oil control	.015" — .033" (.38 — .82 mm.)

Sparking Plugs

Make	Champion
Type	N.11.Y
Gap	.025" (.63 mm.)

Tappets and Tappet Guides

Tappet—Material	Cast iron (chilled)
—Outside diameter	1.3738" — 1.3742"
—Diameter clearance	.0008" — .0019" (.02 — .048 mm.)
Tappet Guide—Inside diameter (before reaming)	1.853" — 1.857" (34.37 — 34.48 mm.)
—Reaming size (when fitted)	1.375" + .0007" − .0000" (34.925 + .018 mm. − .000 mm.)
—Interference (shrink) fit in head	.003" (.07 mm.)

Timing Chains and Sprockets

Type	Duplex
Pitch	$\frac{3}{8}$" (9.5 mm.)
Number of pitches—Top chain	100
—Bottom chain	82
Crankshaft sprocket—teeth	21
Intermediate sprocket (outer)—teeth	28
Intermediate sprocket (inner)—teeth	20
Camshaft sprocket—teeth	30
Idler sprocket	21

Valve Timing

Inlet valve opens	15° B.T.D.C.
Inlet valve closes	57° A.B.D.C.
Exhaust valve opens	57° B.B.D.C.
Exhaust valve closes	15° A.T.D.C.

Valve and Valve Springs

Valves — Material — Inlet	Silicon chrome steel
— Exhaust	21 - 4 - N5
Valve head diameter — Inlet	$1\frac{3}{4}$" ± .002" (44.45 ± .05 mm.)
— Exhaust	$1\frac{5}{8}$" ± .002" (41.27 ± .05 mm.)
Valve stem diameter — Inlet and exhaust	$\frac{5}{16}$" — .0025" — .0035" (7.95 — .06 mm. — .09 mm.)
Valve lift	$\frac{3}{8}$" (9.4 mm.)
Valve clearance — Inlet	.004" (.10 mm.)
— Exhaust	.006" (.15 mm.)
Valve seat angle — Inlet	45°
— Exhaust	45°
Valve spring — Free length — Inner	$1\frac{21}{32}$" (42 mm.)
— Outer	$1\frac{15}{16}$" (49.2 mm.)
Valve spring — Fitted length — Inner	$1\frac{7}{32}$" (30.96 mm.)
— Outer	$1\frac{5}{16}$" (33.34 mm.)
Valve spring—Fitted load — Inner	30.33 lb. (13.76 kg.)
— Outer	48.375 lb. (21.95 kg.)
Valve spring—Solid length (max.) — Inner	.810" (20.57 mm.)
— Outer	.880" (22.35 mm.)
Number of free coils — Inner	6
— Outer	5
Diameter of wire — Inner	12 SWG (.104") (2.64 mm.)
— Outer	10 SWG (.128") (3.25 mm.)

Valve Guide and Valve Seat Insert

Valve guides—Material	Cast iron
Valve guide length—Inlet (without valve stem seal)	$1\frac{13}{16}$" (46.04 mm.)
—Inlet (with valve stem seal)	$1\frac{55}{64}$" (47.22 mm.)
—Exhaust	$1\frac{15}{16}$" (49.21 mm.)
Valve guide inside diameter—Inner	$\frac{5}{16}$" —.0005" (7.94 —.013 mm.) —.0015" (7.94 —.038 mm.)
—Exhaust	$\frac{5}{16}$" ± .0005" (7.94 ± .013 mm.)
Interference fit inhead	.0005" — .0022" (.013 — .055 mm.)
Valve seat inserts—Material	Cast iron (centrifugally cast)
Inside diameter—Inlet	$1\frac{1}{2}$" + .003" (38.1 + .076 mm.) — .001" (— .025 mm.)
—Exhaust	1.379"—1.383" (35.03 — 35.13 mm.)
Interference (shrink) fit in head	.003" (.076 mm.)

Fuel Requirements for 9 : 1 and 8 : 1 Compression Ratio Engines

If the engine is fitted with 9 : 1 compression ratio pistons (indicated by /9 after the engine number) use only Super grade fuel with a minimum octane rating of 98 (Research Method). If a car is fitted with 8 : 1 compression ratio pistons (indicated by /8 after the engine number) use Premium grade fuel with a minimum rating of 94 (Research Method).
If, of necessity, the car has to be operated on lower octane fuel do not use full throttle otherwise detonation may occur with resultant piston damage.
In the United Kingdom use '5 STAR' (9:1) or '4 STAR' (8:1) petrol.

ROUTINE MAINTENANCE

DAILY

Checking the Engine Oil Level

Check the engine oil level with the car standing on level ground, otherwise a false reading will be obtained. Remove the dipstick and wipe dry.

Replace and withdraw again; if the oil level is on the knurled patch, with the engine hot or cold, no additional oil is required. If the engine has been run immediately prior to making an oil level check, wait one minute after switching off before checking the oil.

Note: Almost all modern engine oils contain special additives and, whilst it is permissible to mix recommended brands, it is undesirable. If it is desired to change from one brand to another, this should be done when the sump is drained and the Oil Company's recommendation for flushing procedure carried out.

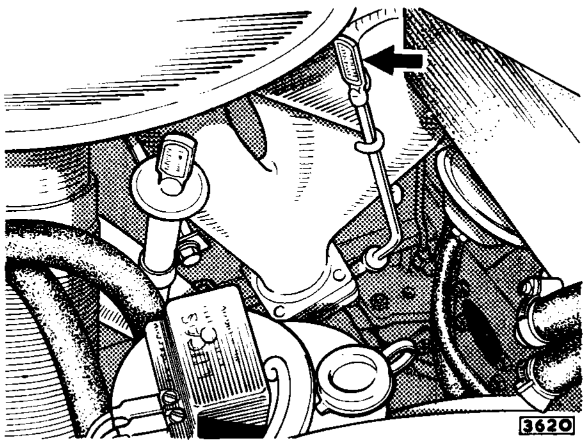


Fig. No. 1 *The engine dipstick*

EVERY 3,000 MILES (5,000 KM)

Changing the Engine Oil

Note: Under certain adverse conditions conducive to oil dilution and sludge formation, more frequent oil changing than the normal 3,000 miles (5,000 km) period is advised. Where the car is used mainly for low-speed city driving, particularly in cold weather or in dusty territory, the oil should be changed at least every 1,000 miles (1,600 km.).

The draining of the sump should be carried out at the end of a run when the oil is hot and will, therefore, flow more freely. The drain plug is situated at the right hand rear corner of the sump. When the engine oil is changed the oil filter element, which is situated on the right hand side of the engine, must also be changed. See page A.27.

Distributor—Lubrication

Lubricate the distributor, as detailed on page P.11.

Distributor Contact Breaker Gap

Check the gap between the contact points as detailed on page P.11.

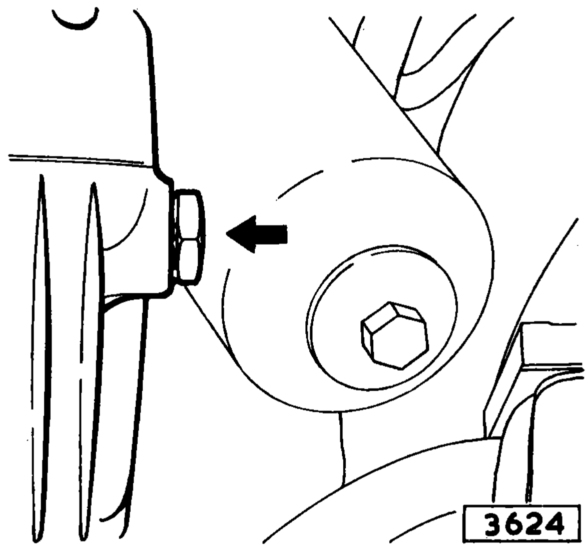


Fig. No. 2 *The engine drain plug*

Sparking Plugs

Every 3,000 miles (5,000 km.), or more often if operating conditions demand, withdraw, clean and reset the spark plugs.

The only efficient way to clean spark plugs is to have them properly serviced on machines specially designed for this purpose. These machines operate with compressed air and utilize a specially graded dry abrasive material to remove harmful deposits from the plug insulator without damaging the insulator surface. In addition, the majority of machines incorporate electrical testing apparatus enabling the plugs to be pressure tested for efficiency and gas tightness.

The points gap should be .025" (.64 mm.). When adjusting, always bend the side wire—never the centre electrode.

The Champion Spark Plug Co. supply a special combination gauge and setting tool; the use of this tool is recommended.

Every 12,000 miles (20,000 km.) a new set of plugs of the recommended type should be fitted. To save petrol and ensure easy starting, it is important to have the plugs tested regularly.

EVERY 6,000 MILES (10,000 KM)

Fan/Steering Pump Belt—Power Steering (if fitted)

Check for Wear

Every 6,000 miles (10,000 km) check the condition of the fan/steering pump belt. The belt tension is automatically adjusted by means of a spring loaded jockey pully and routine adjustment is not necessary.

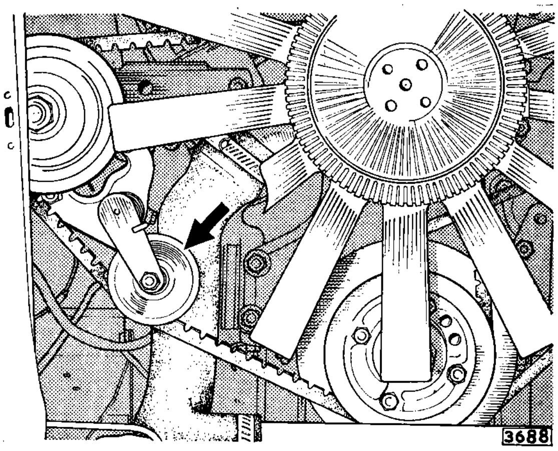


Fig. No. 3 *Fan/steering pump jockey pulley*

Fan Belt—Manual Steering (if fitted)
Check for Wear
Every 6,000 miles (10,000 km) check the fan belt for wear, and adjust as necessary.
To adjust, release the nut securing the jockey pulley pivot to the mounting bracket. Swing the pivot upwards until the correct tension is obtained and tighten the nut.

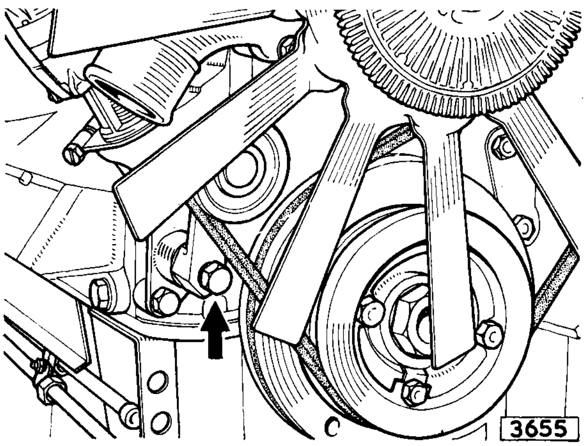


Fig. No. 4 *Fan belt tensioner (manual steering)*

Alternator Belt Tension
Every 6,000 miles (10,000 km) check the tension of the alternator belt.
To adjust, release the top mounting bolt (the nut "A" Fig. 5 is welded to the support bracket and cannot be turned). Release the bottom mounting nut "B" and swing the alternator upwards until the correct tension is obtained. Re-tighten the mounting nuts. When the belt is correctly tensioned, it should be possible to depress the belt $\frac{1}{2}$" (12.7 mm.) at a point midway between the two pulleys.

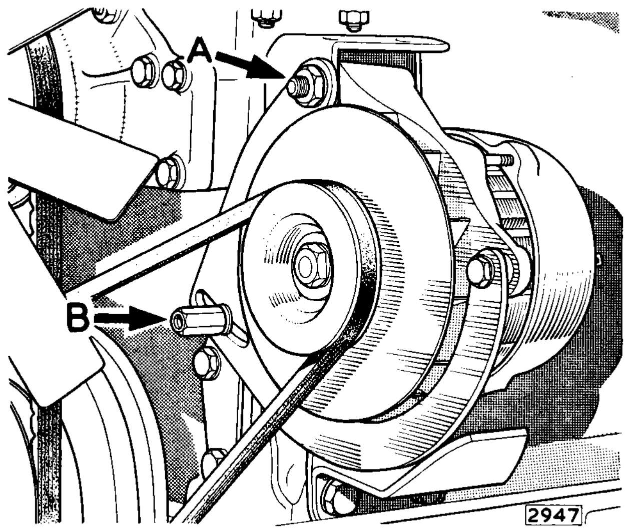


Fig. No. 5 *Alternator belt adjustment*

Air Conditioning Compressor Belt—Tension
Every 6,000 miles (10,000 km.) check the tension of the air-conditioning compressor belt (when fitted).
To tension, release the nut securing the jockey pulley pivot sufficiently to allow the pivot to be moved upward using a spanner on the pivot hexagon. Obtain the correct tension; tighten the securing nut and re-check.

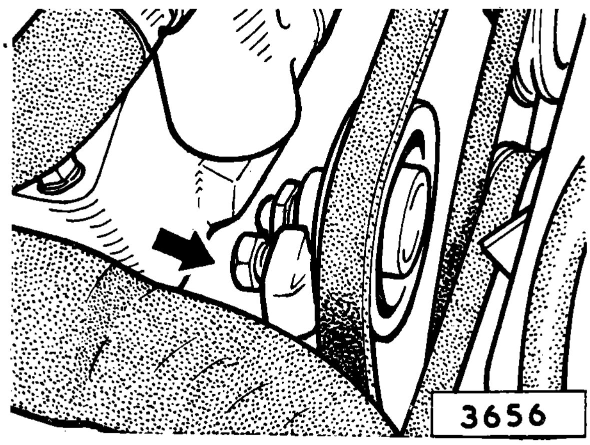


Fig. No. 6 *Compressor drive belt adjustment*

Top Timing Chain Tension
If the top timing chain is noisy, adjust the tension as detailed on page A.19.

EVERY 12,000 MILES (20,000 KM)
Air Cleaner
The air cleaner is of the paper element type and is fitted on top of the cylinder head.
No maintenance is required but the element must be renewed every 12,000 miles (20,000 km.) or more frequently in dusty territories.

To renew, roll back the sealing rubber between the carburetter elbow and the air cleaner. Slacken the two wing nuts securing the air cleaner to the bracket on the cylinder head.
Release the air cleaner by pulling it towards the left-hand wing valance. Release the two clips securing the end cover to the air cleaner; withdraw the end cover and filter element.
Remove the wing nut, washer, end cap and rubber seal securing the filter element to the end cover.
When refitting, ensure that the two rubber sealing rings are in the correct position.

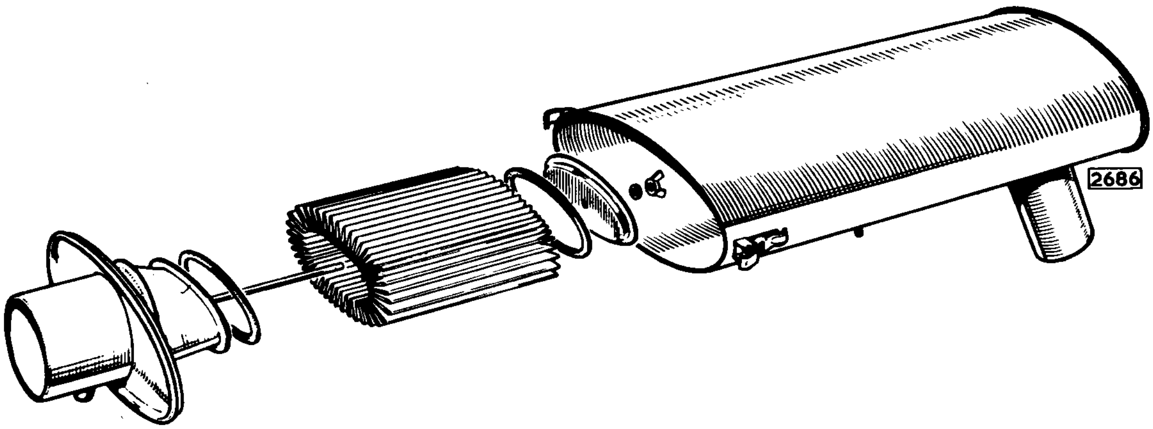


Fig. No. 7 *The air cleaner element*

RECOMMENDED LUBRICANTS

Component	Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent Caltex/Texaco
Engine	Mobil Special*	Castrol XL	Shell Super Oil	Esso Extra Motor Oil 10W/30* Esso Extra Motor Oil 20W/40*	Super Visco-Static 10W/40	Q20/50 or Q5500*	Havoline 20W/40 or 10W 30*
Upper cylinder lubrication	Mobil Upperlube	Castrollo	Shell U.C.L. or Donax	Esso U.C.L.	U.C.L.	Adcoid Liquid	Regent U.C.L.

* These oils should not be used in worn engines requiring overhaul.
If an SAE 30 or 40 oil has previously been used in the engine, a slight increase in oil consumption may be noticed but this will be compensated by the advantages gained.

CAPACITY

	IMPERIAL	U.S.	LITRES
Engine refill—including filter	12 pints	$14\frac{1}{4}$ pints	6.75

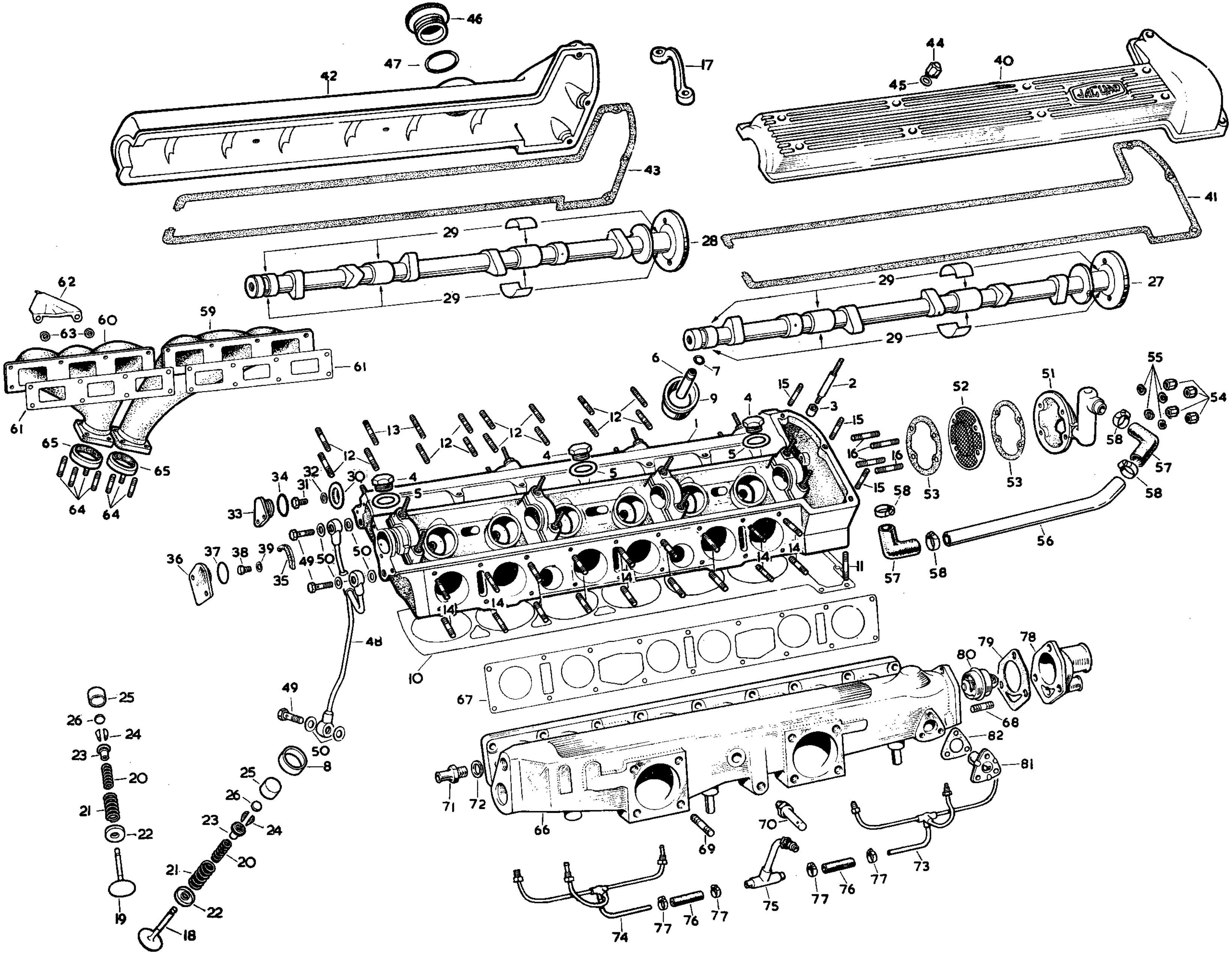


Fig. No. 8 *Exploded view of cylinder head*

JSP. 154

1 Cylinder Head
2 Stud
3 Ring Dowel
4 Core Plug
5 Copper washer
6 Guide
7 Valve guide circlip
8 Valve insert (inlet valve)
9 Tappet guide
10 Gasket
11 Stud (short)
12 Stud (exhaust manifold)
13 Stud (exhaust manifold-long)
14 Stud (Inlet manifold)
15 Stud (camshaft covers)
16 Stud (breather housing)
17 Engine lifting bracket
18 Inlet valve
19 Exhaust valve
20 Valve spring (inner)
21 Valve spring (outer)
22 Valve spring seat
23 Valve spring collar
24 Valve cotters
25 Tappet
26 Valve adjusting pad
27 Inlet camshaft
28 Exhaust camshaft
29 Bearing (camshaft)
30 Oil thrower
31 Setscrew
32 Copper washer
33 Sealing plug
34 "O" Ring
35 Seal
36 Sealing plug
37 "O" Ring
38 Setscrew
39 Copper washer
40 Inlet camshaft cover
41 Gasket
42 Exhaust camshaft cover
43 Gasket
44 Dome nuts
45 Copper washer
46 Oil filler cap
47 "O" Ring
48 Oil pipe
49 Banjo bolt
50 Copper washer
51 Front cover
52 Gauze filter
53 Gasket
54 Dome nuts
55 Spring washer
56 Breather pipe
57 Hose
58 Clip
59 Exhaust manifold-Front
60 Exhaust manifold-Rear
61 Gasket
62 Clip
63 Distance piece
64 Stud
65 Sealing ring
66 Inlet manifold assembly
67 Gasket
68 Stud
69 Stud
70 Pivot pin
71 Adaptor
72 Washer
73 R.H. Manifold starting pipe
74 L.H. Manifold starting pipe
75 Starting pipe assembly
76 Tube (Neoprene)
77 Clip
78 Pipe—water outlet
79 Gasket
80 Thermostat
81 Thermostat—automatic choke
82 Gasket

Engine Overhaul—Part 1

This section covers the overhaul of the cylinder head and other engine parts with the engine in situ.

THE CYLINDER HEAD

REMOVAL

Drain the cooling system by turning the radiator drain tap remote control and opening the cylinder block drain tap. Conserve coolant if anti-freeze is in use.

Remove the bonnet by unscrewing the four setscrews, having previously marked the position of the hinges to facilitate adjustment on re-assembly. Remove the battery and battery platform. Remove the air silencer and air intake pipe. Disconnect the accelerator linkage at the throttle spindle and at the attachment to inlet manifold. Disconnect the petrol feed pipe at float chamber unions. Disconnect leads from auxiliary starting carburetter solenoid.

Detach the overflow pipe clip from the filter head. Detach the throttle spring from the anchor bracket on the filter head. Remove the distributor vacuum advance pipe completely.

Disconnect the top water hose and by-pass hose from the front of the inlet manifold water jacket.

Remove the high tension leads from the sparking plugs and the lead carrier from the thermostat housing. Remove the sparking plugs.

Note: In the event of a stripped thread in the cylinder head sparking plug holes due to seized plugs, refer to page A.39 for instructions for fitting sparking plug inserts.

Disconnect the engine breather pipe from the front cylinder head. Disconnect the exhaust manifolds from the engine. Disconnect two camshaft oil feed pipe unions from the rear of the cylinder head.

Disconnect the heater hose from the rear of the inlet manifold water jacket. Disconnect the heater pipe clips from the inlet manifold. Disconnect the cable from the water temperature gauge bulb in the inlet manifold water jacket. Slacken the clip and disconnect the vacuum servo pipe from the connection at the front of the inlet manifold.

Remove the dome nuts from each camshaft cover and lift off the covers.

Remove four nuts securing the breather housing to the front of cylinder head and withdraw the housing, observing position of baffle plate with two holes vertical. Release tension on camshaft chain by slackening nut on eccentric idler sprocket shaft, depressing spring-loaded stop peg and rotating serrated adjuster plate clockwise. Anti-clockwise rotation of the serrated adjuster, viewed from the front of the engine, tightens the chain. Use Churchill Tool J2 (Fig. 18).

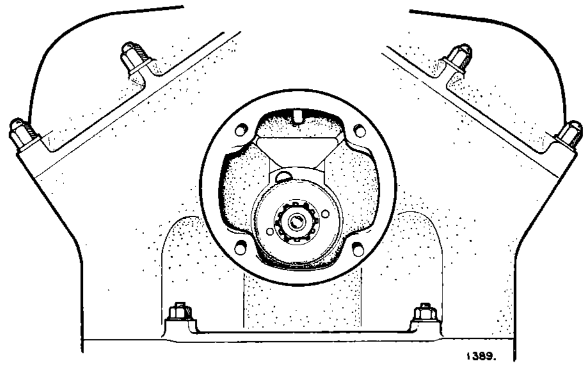


Fig. No. 9 *The serrated plate for adjustment of the top timing chain is accessible after removal of the engine breather housing*

Break the locking wire on the two setscrews securing the camshaft sprockets to respective camshaft. Remove one setscrew only from each of the camshaft sprockets; rotate the engine until the two remaining setscrews are accessible and remove these screws. Do NOT rotate the engine or the camshafts after having disconnected the sprockets. The two camshaft sprockets may now be slid up the support brackets.

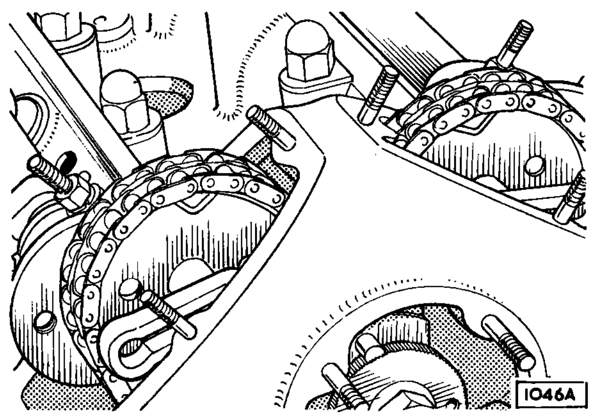


Fig. No. 10 *Showing camshaft sprockets disconnected*

Remove the fourteen cylinder head dome nuts and six nuts securing the front of the cylinder head, working diagonally out from the centre.
On cars fitted with air conditioning it will be necessary to remove the alternator and compressor to gain access to the cylinder head nuts (16 and 18, Fig. 16).
Note: On right hand drive, manual transmission cars, it will be necessary to slacken the nuts securing the clutch master cylinder and move the cylinder rearwards to enable the rear carburetter flange to pass.
Slacken the nuts, a part at a time, until they become free. Lift off the cylinder head complete with manifold and carburetters. Remove and scrap the old cylinder head gasket.
Note: As the valves in the fully open position protrude below the cylinder head joint face, the cylinder head must not be placed joint face downwards directly on a flat surface; support the cylinder head on wooden blocks, one at each end.

DISMANTLING

Remove Valves

With the cylinder head on the bench, remove the inlet manifold and carburetters.
Remove the four bearing caps from each camshaft and lift out the camshafts. Note the mating marks on each bearing cap.

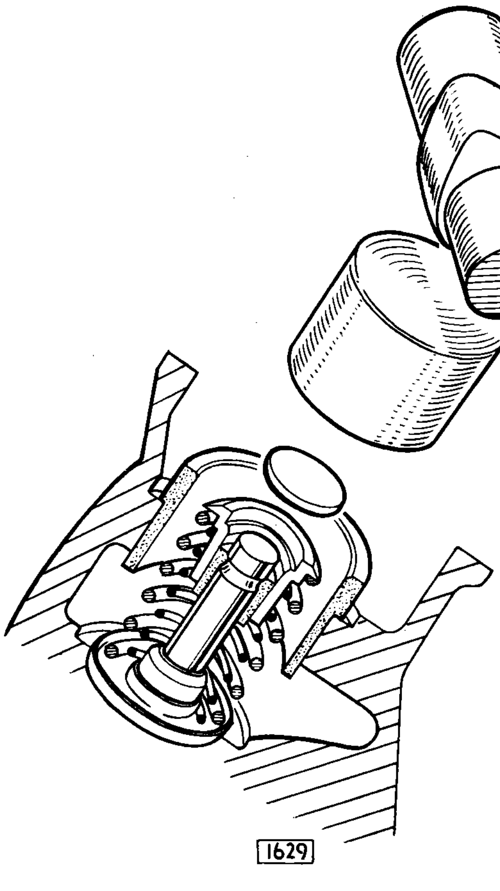


Fig. No. 11 *Tappet and adjusting pad*

Remove the twelve floating and adjusting pads situated between tappets and valve stems. Lay out the tappets and pads in order, to ensure that they can be replaced in their original guides.
Obtain a block of wood the approximate size of the combustion chambers and place this under the valve heads in No. 1 cylinder combustion chamber. Press down the valve collars and extract the split cotters. Remove collars, valve springs and spring seats. Repeat for the remaining five cylinders. Valves are numbered and must be replaced in the original locations, No. 1 cylinder being at the rear, that is, the flywheel end.
Note: Commencing at engine number 7F2478 the inlet valve guides are fitted with oil seals which should be removed before the valve spring seat.

DECARBONISE CYLINDER HEAD

Remove all traces of carbon from the combustion chambers and deposits from the induction and exhaust ports. The cylinder head is of aluminium alloy and great care should be exercised not to damage this with scrapers or sharp pointed tools. Use worn emery cloth and paraffin only. Thoroughly clean the water passages in the cylinder head. Clean the carbon deposits from the piston crowns and ensure that the top face of the cylinder block is quite clean particularly round the cylinder head studs.

CHECK VALVE GUIDES

The valve guides are of cast iron and are chamfered at the upper ends. The outside diameter of the guide is reduced at the lower end to provide a "lead-in" when fitting the guide to the cylinder head. The inlet and exhaust guides are of different lengths, the inlet being the shorter of the two.
The valve guides are fitted with circlips to ensure positive location in the head.
From engine number 7F.2478 oil seals are fitted to the inlet valve guide—a second groove being machined in the guide above the circlip groove to seat the oil seal.
Examine the guides for evidence of wear in the bore. The clearance between the valve stem and the guide when new is .001" to .004" (.025 to .10 mm.).
If it is found necessary to replace worn valve guides, they must be fitted in accordance with the following instructions and only genuine factory replacement parts used.
Heat the cylinder head by immersing in boiling water for 30 minutes. With a piloted drift, drive out the old valve guide from the combustion chamber end.
Ream the valve guide bore in the cylinder head to a diameter of 0.505" + .0005" (12.83 mm. +.012 mm.)
−.0002" (−.005 mm.)
If the bores are larger than these dimensions, they should be reamed out to the following dimensions and the respective oversize valve guides fitted.
0.510" + .0005" (12.95 mm. + .012 mm.)
−.0002" (− .005 mm.)
Coat the valve guide with graphite grease and fit the circlip.
Re-heat the cylinder head.
With a piloted drift, drive in the valve guide from the top until the circlip registers in the groove machined in

the guide bore of the cylinder head. Visually check that the circlip has seated correctly in the groove.

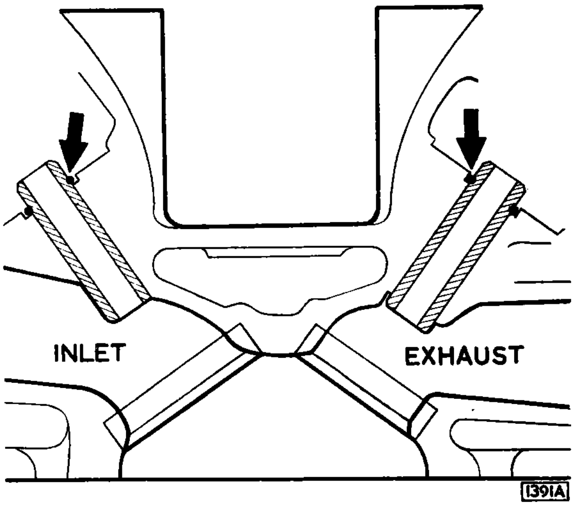


Fig. No. 12 *Showing the fitted position of the valve guides*

CHECK TAPPET GUIDES

Examine the tappets and tappet guides for signs of wear. The diametrical clearance between the tappet and tappet guide should be .0008" to .0019" (.02 to .05 mm.).
Examine the adjusting pads for signs of indentation. Renew if necessary with the appropriate size when making valve clearance adjustment on re-assembly.

Tappet Guide Replacement

Note: Before attempting to perform the operations described under the above heading and under the heading "Valve Seat Inserts", ensure that adequate machining facilities are available, and that the machine shop is equipped with an oven capable of heating the cylinder head to a temperature of 300°F (150°C).

If it is found necessary to replace the tappet guides, they must be fitted in accordance with the following instructions and only genuine factory replacement parts used.
Remove the old tappet guide by boring out until the guide collapses. Take care not to damage the bore for the guide in the cylinder head.
Carefully measure the diameter of the tappet guide bore in the cylinder head at room temperature—68°F (20°C).
Grind down the 1.643" (41.73 mm.) outside diameter of tappet guide to a diameter of .003" (.08 mm.) larger than the tappet guide bore dimension, that is to give an interference fit of .003" (.08 mm.).
Also grind off the same amount from the "lead-in" at the bottom of the tappet guide. The reduction in diameter from the adjacent diameter should be .0032" to .0057" (.08 to .14 mm.).
Heat the cylinder in an oven for half an hour from cold at a temperature of 300°F (150°C).

Fit the tappet guide, ensuring that the lip at top of guide beds evenly in the recess.
After fitting, ream tappet guide bore to a diameter of

$1\frac{3}{8}$" + .0007" (34.925 mm. + .018 mm.)
− .0000" (− .000 mm.)

Note: It is essential that, when reamed, the tappet guide bore is concentric with the bore of the valve guide.

Replacing Valve Seat Inserts

Remove the inserts by machining, leaving a thin skin of metal 0.010" (0.25 mm.) thick which can be removed easily without damaging the insert bores.
Carefully measure diameter of insert recess in cylinder head at room temperature 68°F. (20°C). Grind down outside of insert to a diameter of .003" (.08 mm.) larger than recess dimension, that is, to give an interference fit of .003" (.08 mm.).
Heat the cylinder head in an oven for one hour from cold to a temperature of 300°F. (150°C).
Fit insert, ensuring that it beds evenly in its recess.

Check Valve Springs

Test the valve springs for pressure, either by comparison with the figures given in the "Valve Spring Data" or by comparison with a new valve spring.
To test against a new valve spring, insert both valve springs end to end between the jaws of a vice or under a press with a flat metal plate interposed between the two springs. Apply a load to partly compress the springs and measure their comparative lengths.

REASSEMBLING

Regrind Valves and Seats

Examine the valves for pitting, burning or distortion, and reface or renew the valves as necessary. Also reface the valve seats in the cylinder head and grind the valves to their seats using a suction valve tool. When refacing the valves or seat inserts, do not remove more metal than is necessary to clean up the facings.
The valve seat angles :-

Inlet	Exhaust
45°	45°

Renew valves where the stem wear exceeds .003" (.08 mm.). The clearance of the valve stem in the guide when new is .001" to .004" (.025 to .10 mm.).
If any new valve seat inserts have been fitted, the following instructions should be carried out to ensure that the valve clearance can be obtained within the range of the adjusting pads, that is, .085" to .110" (2.16 to 2.79 mm.).
Assemble the camshafts to the cylinder head. Fit the appropriate valve to the insert in question and, with the valve seat faces touching, check the distance between the top of the valve stem and the back of the cam. This should be .320" (8.13 mm.) **plus** the appropriate valve clearance. (The figure of .320" (8.13 mm.) includes an allowance for an adjusting pad thickness of .095" (2.41 mm.) to .097" (2.46 mm.) which will, if necessary, permit the fitting of thicker or thinner adjusting pads when making the final valve clearance adjustment.)
If the distance is greater than the figure of .320"

(8.13 mm.), plus the appropriate valve clearance, grind the valve seat of the insert with suitable valve grinding equipment until the correct distance is obtained.

Example: Assume that the valve insert in question is an exhaust and the distance between the top of the valve stem and the back of the cam is found to be .344" (8.74 mm.).

Adding the exhaust valve clearance of .006" (.15 mm.) to .320" (8.13 mm.) equals .326" (8.28 mm.). In this case the valve seat of the insert will have to be ground down to reduce the distance between the top of valve stem and the back of the cam by .018" (.46 mm.), that is .344" minus .326" (8.74 minus 8.28 mm.).

Refit Valves and Springs

Refit valves in the order removed and place the cylinder head on the wooden blocks (Fig. 14).

Refit valve seats, (on later engines refit the inlet valve guide oil seals) springs and collars. Compress the springs, using Churchill Tool No. J6118 and insert the split cotters.

Replace the tappets and tappet adjusting pads in the order removed.

Replace the camshaft shell bearings—in their original positions if the same bearings are being refitted.

It is unlikely, except after very high mileages, to find wear in the camshafts and camshaft bearings.

The bearings are of the precision shell type and under no circumstances should these be hand scraped or the bearing caps filed. Undersize bearings are not supplied.

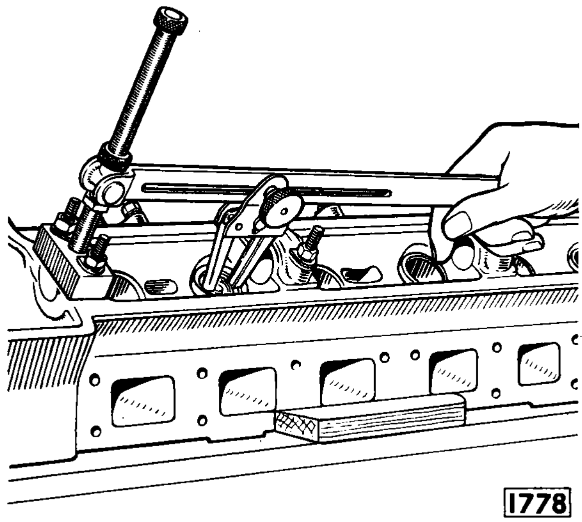


Fig. No. 13 *Fitting the valve springs utilising the valve spring compressing tool (Churchill Tool No. J6118)*

Replace each camshaft with the keyways in the front bearing flange at 90° to the adjacent cover face (using the valve timing gauge). See Fig. 21.

Refit the bearing caps to their respective positions and the 'D' washers, spring washers and nuts.

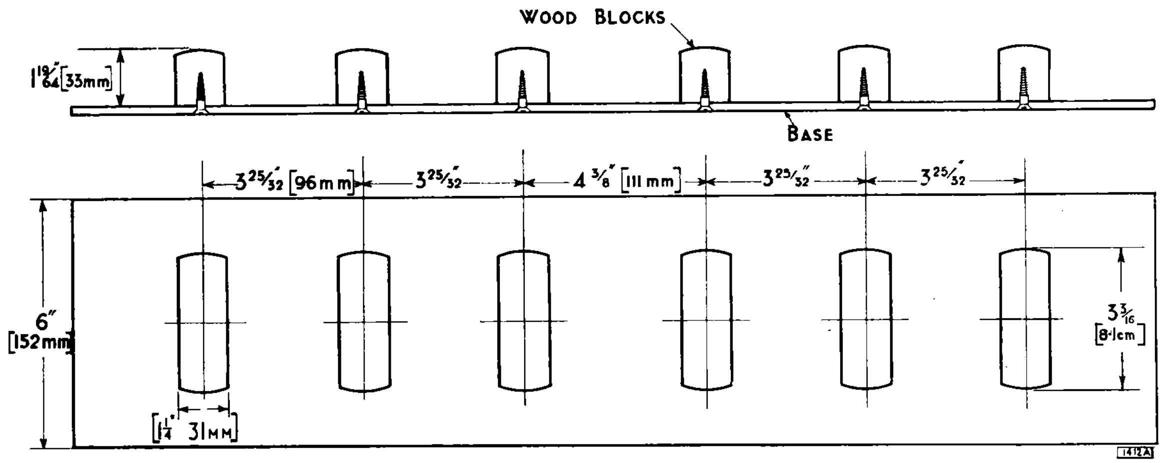


Fig. No. 14 *Combustion chamber blocks for valve removal*

Tighten down the bearing caps evenly, a turn at a time. Finally tighten the nuts to a torque of 15lb/ft. (2.0 kg/m).

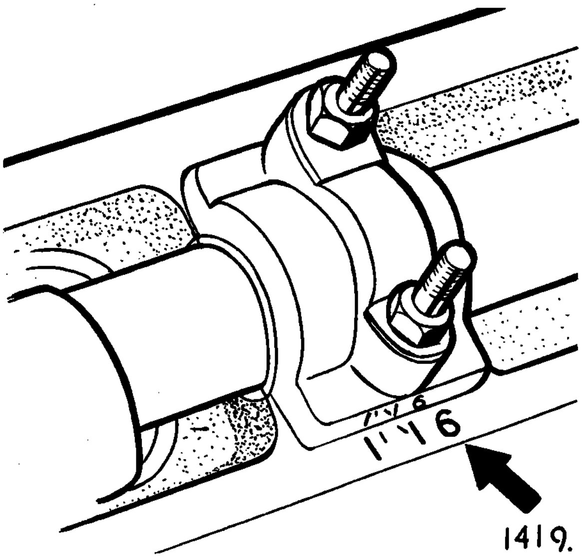


Fig. No. 15 *Showing the corresponding numbers on the bearing cap and cylinder head*

Check Valve Clearances

When checking the valve clearances, the camshafts must be fitted one at a time as, if one camshaft is rotated when the other camshaft is in position, fouling is likely to take place between the inlet and exhaust valves.
Obtain and record all valve clearances by using a feeler gauge between the back of each cam and the appropriate valve tappet.

Correct valve clearances are :-
Inlet .004" (.10 mm.)
Exhaust .006" (.15 mm.).
Adjusting pads are available rising in .001" (.03 mm.) sizes from .085" to .110" (2.16 to 2.79 mm.) and are etched on the surface with the letter 'A' to 'Z', each letter indicating an increase in size of .001" (.03 mm.).
Should any valve clearance require correction, remove the camshaft, tappet and adjusting pad. Observe the letter etched on the existing adjusting pad and should the recorded clearance for this valve have shown, say, .003" (.08 mm.) excessive clearance, select a new adjusting pad three sizes thicker than the original pad.
As an example, assume that No. 1 inlet valve clearance is tested and recorded as .007" (.18 mm.). On removal of the adjusting pad, if this is etched with the letter 'D' then substitution with a pad bearing the letter 'G' will correct the clearance for No. 1 inlet valve.
Finally, tighten the camshaft bearing nuts to a torque of 15lb./ft. (2 kg./m.).
Refit the inlet manifold with a new gasket.

Refit Cylinder Head
Turn No. 6 (front) piston to the Top Dead Centre position with the distributor rotor arm opposite No. 6 cylinder segment.
Remove all oil and grease from the mating surfaces by means of a cloth wetted with trichlorethylene, petrol or other volatile grease solvent, wiping dry with a clean cloth.
Fit the cylinder head gasket taking care that the side marked "Top" is uppermost. Fit the cylinder head, complete with inlet manifold, to the cylinder block. Note that the second cylinder head stud from the front on the left hand side is a dowel stud.
Fit the sparking plug lead carrier to the appropriate studs on the right hand side. Fit 'D' washers to the remaining studs.

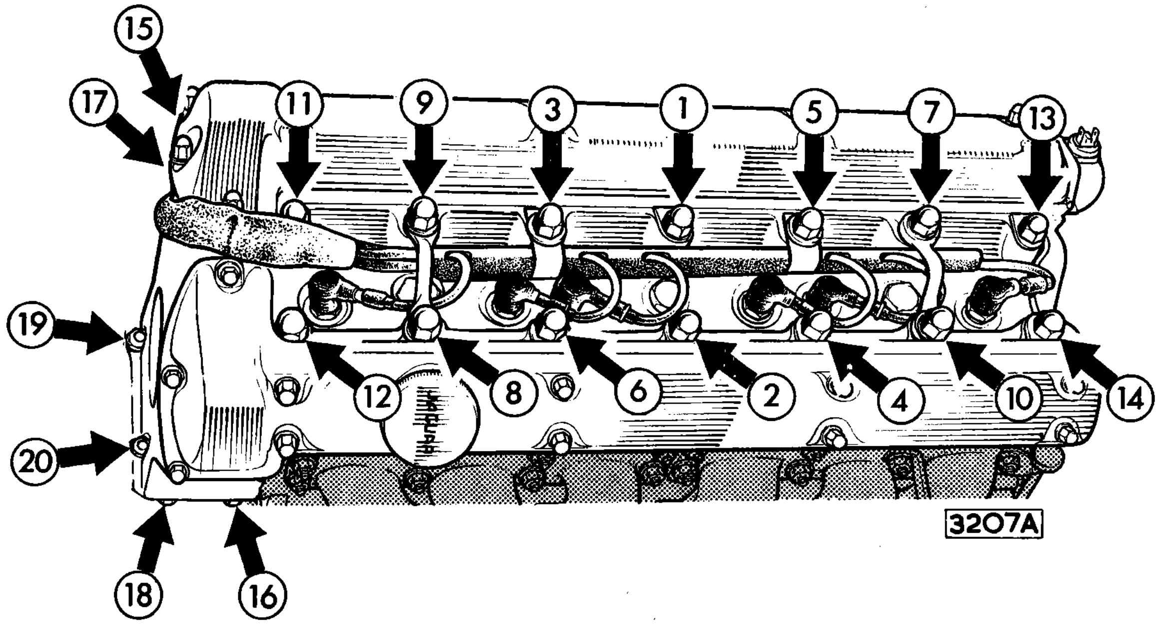


Fig. No. 16 *Cylinder head nut tightening sequence*

Tighten the fourteen large cylinder head dome nuts a part of a turn at a time to a torque of 58 lb/ft. (8.0 kg/m.) in the order shown in Fig. 16. Also tighten the six nuts securing the front end of the cylinder head.
Do NOT rotate the engine or camshafts until the camshaft sprockets have been connected to the camshafts.

Check Valve Timing
Withdraw the circlips retaining the adjusting plates to the camshaft sprockets and pull the adjusting plates forward until the serrations disengage. Replace the sprockets on to the flanges of camshafts and align the two holes in the adjuster plate with the two tapped holes in each camshaft flange. Engage the serrations of the adjuster plates with the serrations in the sprockets.

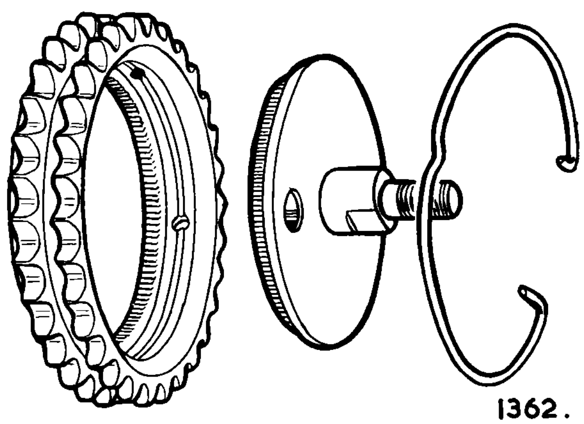


Fig. No. 17 *Exploded view of the camshaft sprocket assembly*

Note: It is most important that the holes are in exact alignment, otherwise when the setscrews are fitted the camshafts will be moved out of position. If difficulty is experienced in aligning the holes exactly, the adjuster plates should be turned through 180°, which, due to the construction of the plate, will facilitate alignment.
Fit the circlips to the sprockets and one setscrew to the accessible hole in each adjuster plate. Turn the engine until the other two holes are accessible and fit the two remaining setscrews.
Tension the timing chain by pressing the locking plunger inwards and rotating the serrated plate anti-clockwise, using Churchill Tool J2.
If required, this special tool can be made to the dimensions shown on Fig. 19.

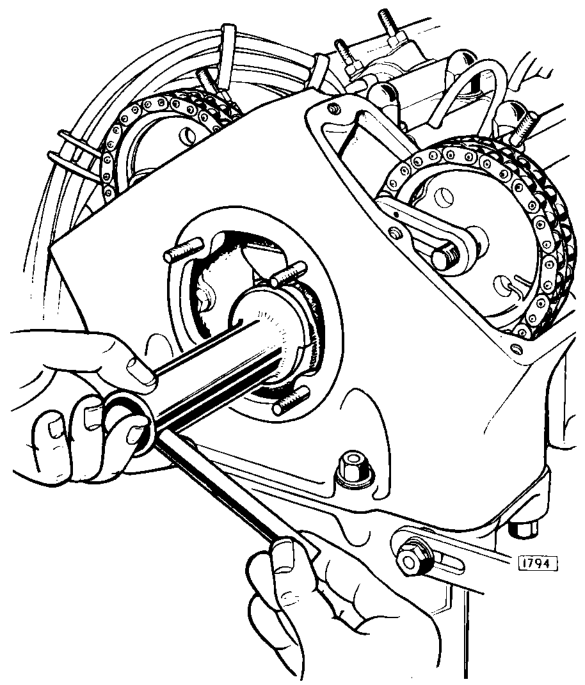


Fig. No. 18 *The top timing chain adjuster in position*

When correctly tensioned, there should be slight flexibility on both outer sides of the chain below the camshaft sprockets, that is, the chain must not be dead tight. Release the locking plunger and securely tighten the locknut.

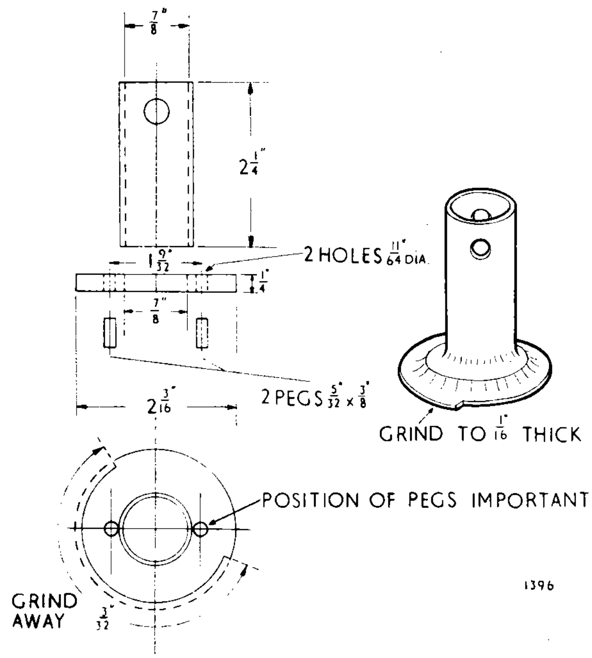


Fig. No. 19 *Dimensions for top timing chain adjuster tool*

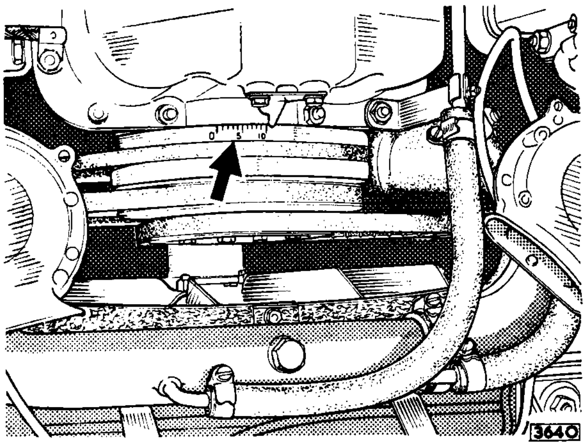


Fig. No. 20 *Location of T.D.C. marks*

Check that No. 6 piston is at Top Dead Centre; the pointer on the timing scale (Fig. 20) will then be opposite the figure "O".

Recheck the position of the camshafts with the valve timing gauge. Secure the four setscrews for the camshaft sprockets with new locking wire.

Clean the sparking plugs and set gaps; if possible, use approved plug cleaning and testing equipment. Clean and adjust distributor contact breaker points.
The remainder of the re-assembly is the reverse of the removal procedure.

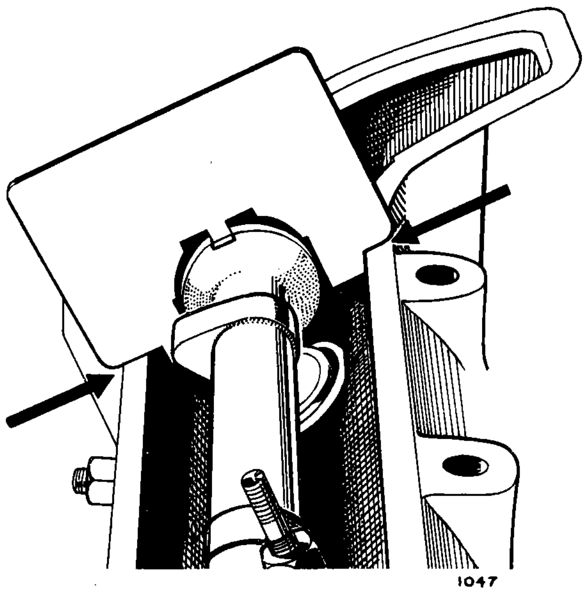


Fig. No. 21 *The valve timing gauge in position. Ensure that the gauge is seated at the points indicated by arrows*

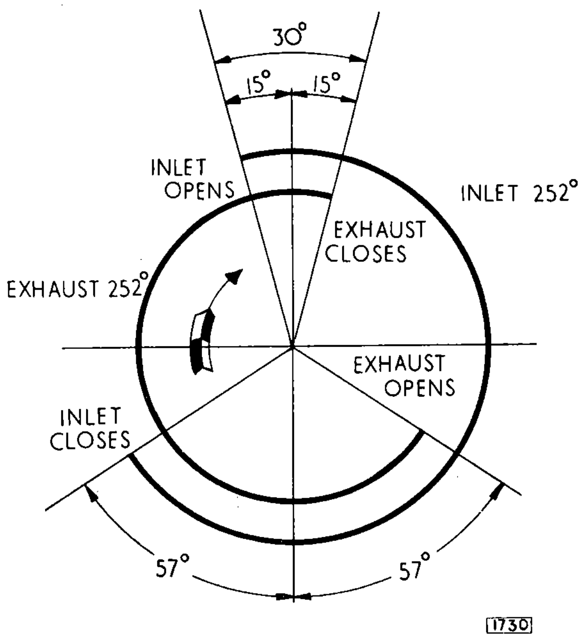


Fig. No. 22 *Valve timing diagram*

PISTONS AND GUDGEON PINS

The pistons are made from low expansion aluminium alloy.
The pistons have three rings, two compression and one oil control. The top compression ring only is chromium plated; both the top and second compression rings have tapered periphery. The fully floating gudgeon pin is retained in the piston by a circlip at each end.

REMOVAL

As the pistons will not pass the crankshaft, it will be necessary to withdraw the pistons and connecting rods from the top. The connecting rod bolts should, however, be removed to allow the big end to pass easily through the bore. Proceed as follows :-

Remove Cylinder Head
Remove cylinder head as described on page A.14.

Remove Sump
Remove the sump as described on page A.27.

Remove Piston and Connecting Rod
Remove the split pins and nuts from the connecting rod bolts. Remove the connecting rod cap, noting the

corresponding cylinder numbers on the connecting rod and cap. Remove the connecting rod bolts and withdraw the piston and connecting rod from the top cylinder block.

OVERHAUL

Pistons are supplied complete with gudgeon pins which have been selectively assembled and are, therefore, not interchangeable with one another.
The pistons fitted to an engine should not vary one with another by more than 2 drams (3.5 grammes).

Gudgeon Pin Fitting

Gudgeon pins are a double thumb push fit in the piston at normal room temperature 68 °F (20 °C).

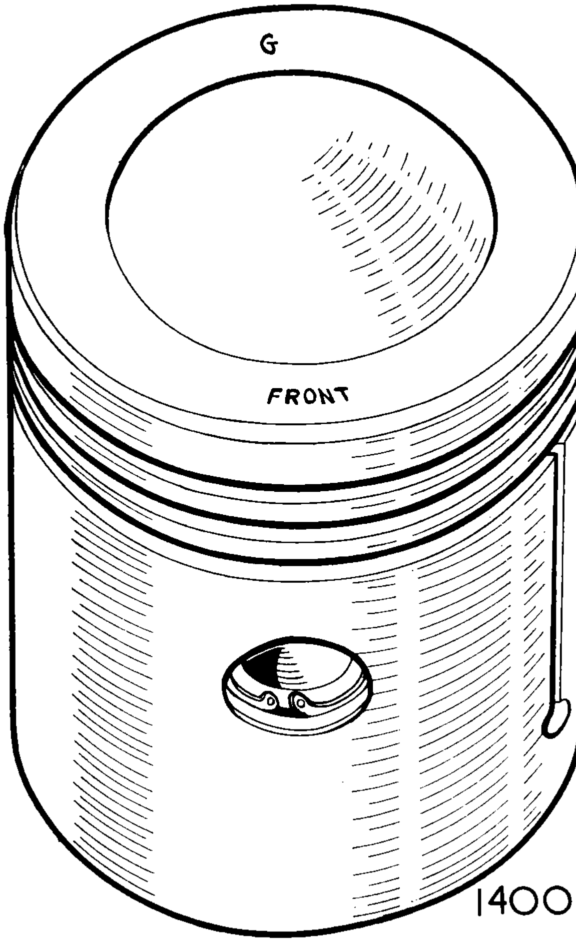


Fig. No. 23 *Showing the markings on the piston crown*

When actually removing or refitting the gudgeon pin, the operation should be effected by immersing the piston, gudgeon pin and connecting rod small end in a bath of hot oil. When the piston and the small end have reached a sufficient temperature (230 °F. 110 °C) the gudgeon pin can be moved into position. Always use new circlips on assembly.

When assembling the engine, centralise the small end of the connecting rod between the gudgeon pin bosses in the piston and ensure that the connecting rod mates up with the crankshaft journal without any pressure being exerted on the rod.

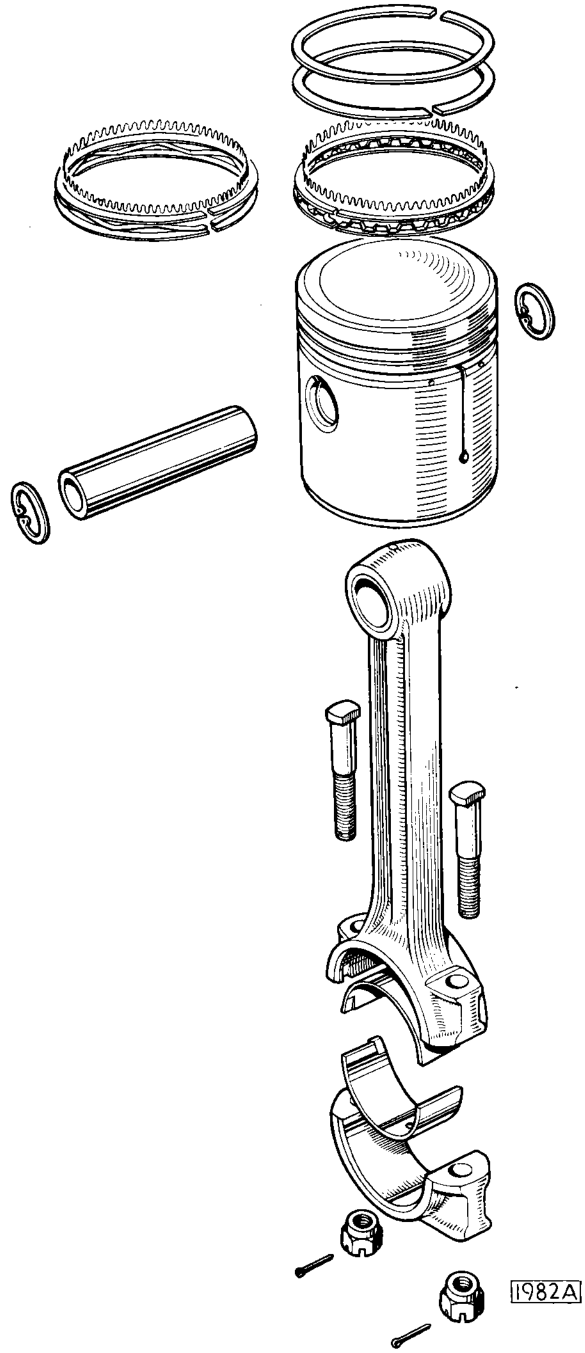


Fig. No. 24 *Exploded view of piston and connecting rod*

Piston Grades
The following selective grades are available in standard size pistons only. When ordering standard size pistons the identification letter of the selective grade should be clearly stated. Pistons are stamped on the crown with the letter identification and the cylinder block is also stamped on the top face adjacent to the bores.

Grade Identification Letter	For cylinder bore size
F	3.625 -3.6253" (92.075 -92.0826 mm.)
G	3.6254-3.6257" (92.0852-92.0928 mm.)
H	3.6258-3.6261" (92.0953-92.1029 mm.)
J	3.6262-3.6265" (92.1055-92.1131 mm.)
K	3.6266-3.6269" (92.1156-92.1233 mm.)

Oversize Pistons
Oversize pistons are available in the following sizes :- +.010" (.25 mm.) +.020" (.51 mm.) +.030" (.76mm). There are no selective grades in oversize pistons as grading is necessary purely for factory production methods.
For reboring the cylinders see the instructions given on page A.38.

Piston Rings
Check the piston ring gap with the ring as far down the cylinder bore as possible. Push the ring down the bore with a piston to ensure that it is square and measure the gap with a feeler gauge. The correct gaps are as follows :-
Compression rings .015" to .020" (.38 to .51 mm.).
Oil control rings (Maxiflex) .015" to .033" (.38 to .83 mm.)
Both the top and second compression rings have a tapered periphery and must be fitted the right way up.

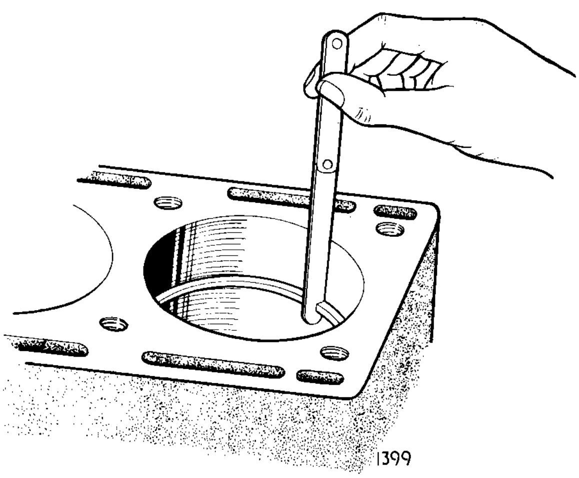


Fig. No. 25 *Checking the piston ring gap*

The narrowest part of the ring must be fitted uppermost to assist in identifying the narrowest face, a letter 'T' or 'TOP' is marked on the side of the ring to be fitted uppermost.
The oil control ring consists of two steel rails with a spacer between the two. These rails are held together as an assembly with an adhesive. The expander, which is fitted inside the oil control ring, should be assembled with the two lugs positioned in the hole directly above the gudgeon pin bore.
With the rings fitted to the piston check the side clearance in the grooves which should be .001" to .003" (.025 to .076 mm.).
One of the compression rings is hard chrome plated and the ring must be fitted to the top groove in the piston.

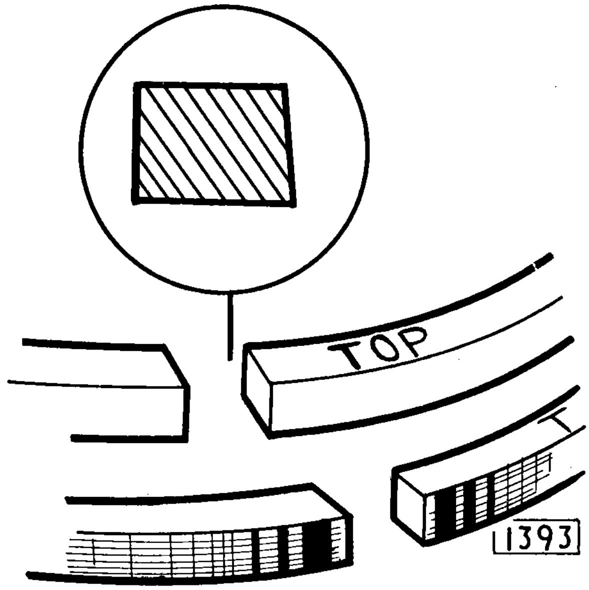


Fig. No. 26 *Showing the identification marks on tapered periphery compression rings*

Refitting
Pistons and connecting rods must be fitted to their respective cylinders (piston and connecting rods are stamped with their cylinder number, No. 1 being at the rear) and the same way round in the bore.
The pistons must be fitted with split on the left-hand or exhaust side of the engine. To facilitate correct fitting, the piston crowns are marked "Front", see Fig. 23.
Use a piston ring clamp when entering the rings into the cylinder bore.
The cap must be fitted to the connecting rod so that the cylinder numbers stamped on each part are on the same side.
Tighten the connecting rod nuts to a torque of 37lb/ft (5.1 kg.m.).
Refit sump and cylinder head.

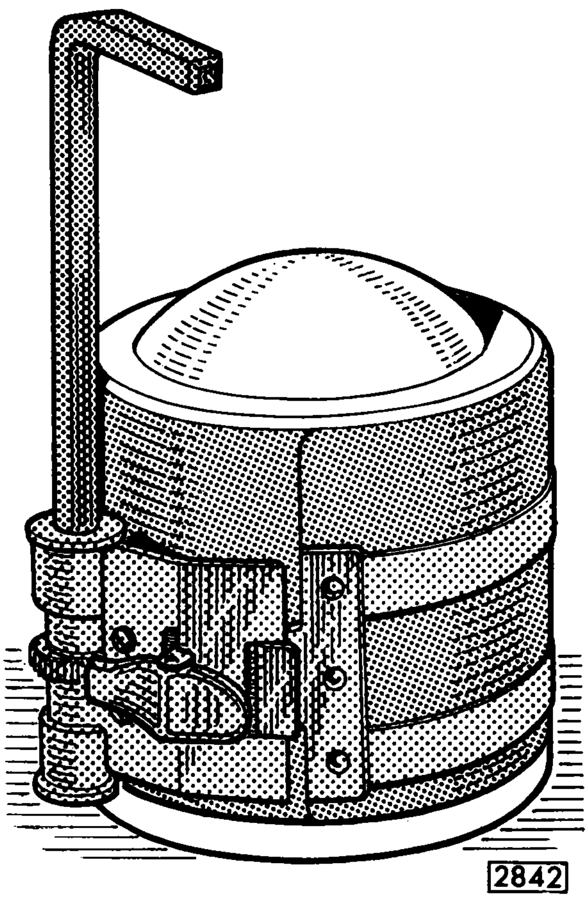


Fig. No. 27 *Using a piston ring clamp*

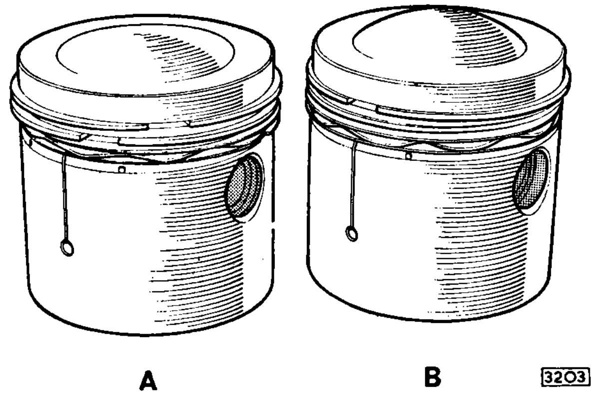


Fig. No. 28 *4.2 Litre pistons "A" 8:1 compression ratio "B" 9:1 compression ratio*

THE CONNECTING ROD AND BEARINGS

The connecting rods are steel stampings and are provided with precision shell big-end bearings and steel backed phosphor-bronze small end bushes. A longitudinal drilling through the connecting rod provides an oil feed from the big end to the small end bush.

REMOVAL

Remove piston and connecting rods as detailed on page A.20.
Remove gudgeon pin and withdraw piston as detailed on page A.21.

OVERHAUL

If connecting rods have been in use for a very high mileage, or if bearing failure has been experienced, it is desirable to renew the rod(s) owing to the possibility of fatigue.
The connecting rods fitted to an engine should not vary one with another by more than 2 drams (3.5 grammes). The alignment should be checked on an approved connecting rod alignment jig. Correct any misalignment as necessary. The big end bearings are of the precision shell type and under no circumstances should they be hand scraped or the bearings caps filed.
The small ends are fitted with steel-backed phoshor-bronze bushes which are a press fit in the connecting rod. After fitting, the bush should be reamed or honed to a diameter of .875" to .8752" (22.225 to 22.23 mm.).
Always use new connecting bolts and nuts at overhauls.
Before fitting new big end bearings, the crankpin must be examined for damage or the transfer of bearing metal.
When a new connecting rod is fitted, although the small end bush is reamed to the correct dimensions, it may be necessary to hone the bush to achieve the correct gudgeon pin fit.

REFITTING
Refit the connecting rods and pistons as detailed on page A.22.

BIG END BEARING REPLACEMENT
The big end bearings can be replaced without removing the engine from the car.
Before fitting the new bearings the crankpins must be examined for damage or for the transfer of bearing metal.
Remove the sump as detailed on page A.27.
Turn the engine until the big-end bearing is at the bottom dead centre position.
Remove the connecting rod cap, noting that the corresponding cylinder number on the connecting rod and cap are the same side.
Lift the connecting rod off the crankpin and detach the bearing shells.
If all the bearings are to be replaced they are most easily replaced in pairs, that is, in pairs of connecting rods having corresponding crankpin throws.

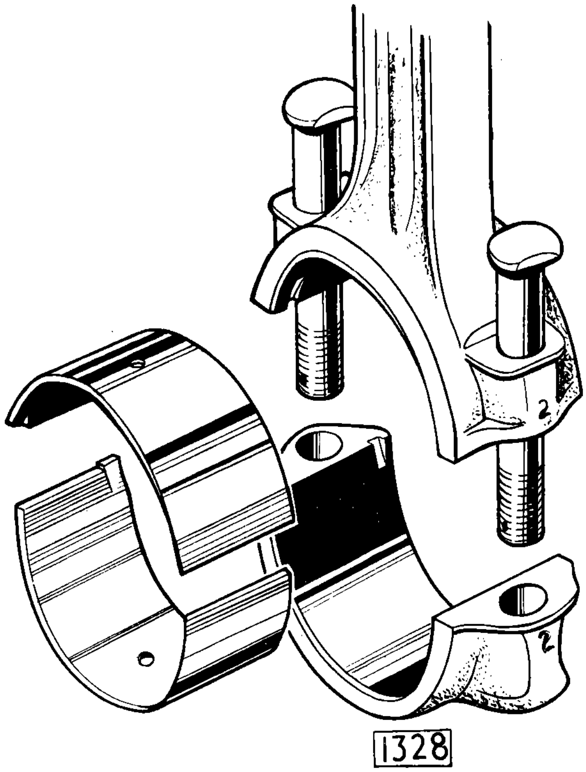


Fig. No. 29 *Corresponding cylinder number on connecting rods and caps*

THE OIL PUMP

The oil sump is of the eccentric rotor type and consists of five main parts :—the body, the driving spindle with the inner rotor pinned to it, the outer rotor and the cover, which is secured to the main body by four bolts, finally being secured to the engine with additional dowel bolts. The inner rotor has one lobe less than the number of internal segments in the outer rotor. The spindle centre is eccentric to that of the bore in which the outer rotor is located, thus the inner rotor is able to rotate within the outer, and causes the outer rotor to revolve. The inlet connection is positioned in the pump cover, and the outlet connection in the body. These are both connected to the ports in the pump.
Consider the oil flow with the lobes of the inner rotor lying along the line of eccenticity. In this position oil is free to flow from the port into the space (dotted portion) between the rotors, and on the other side of the lobe (shaded portion) the oil is free to flow into the delivery port (see Fig. 30.).
In the second position, the inner and outer rotors have rotated and caused the oil that was flowing from the inlet port into the space between them to be cut off from the port and transferred to the enclosed space between the ports. Similarly, the space which enclosed oil free to flow to the delivery port in the first position, has decreased in size in the second position, and thus caused the oil to flow into the delivery port. The action of the pump is then a repetition of the above, oil flowing into the space between the rotors from the inlet port under atmospheric pressure and being discharged into the delivery port by reason of the space in which it is contained, decreasing in size as it passes over the port.

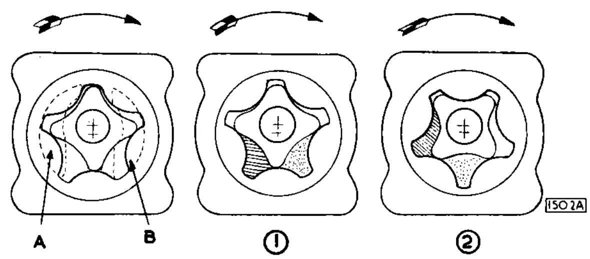


Fig. No. 30 *The operation of the rotor type oil pump. "A" indicates the outlet port. "B" indicates the inlet port. 1 First position. 2 Second position*

REMOVAL
Remove the sump as described on page A.27.
Detach the suction and delivery pipe brackets and withdraw the pipes from the oil pump.
Tap back the tab washers and remove the three bolts which secure the oil pump to the front main bearing cap. Withdraw the oil pump and collect the coupling sleeve at the top of the drive shaft.

DISMANTLING
Unscrew the four bolts and detach the bottom cover from the oil pump.
Withdraw the inner and outer rotors from the oil pump body. The inner rotor is pinned to the drive shaft and must not be dismantled.

OVERHAUL
Check the clearance between lobes of the inner and outer rotors which should be .006" (.15 mm.) maximum (see Fig. 31.).

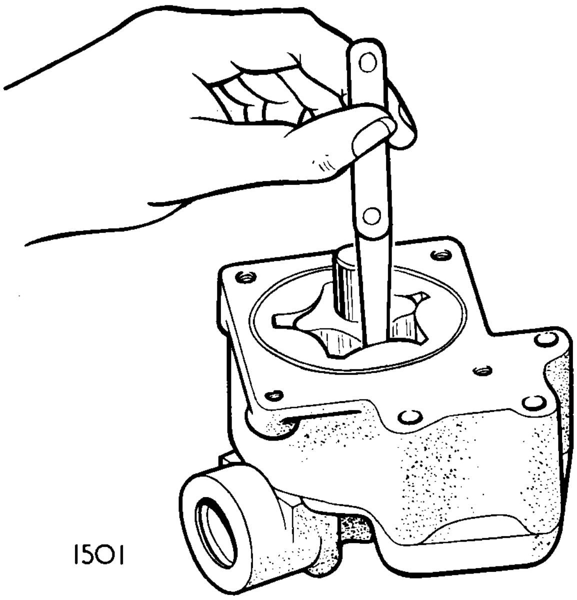


Fig. No. 31 *Measuring the clearance between the inner and outer rotors*

Check the clearance between the outer rotor and the pump body (see Fig. 32) which should not exceed .010" (.25 mm.).
Check the end-float of the rotors by placing a straight edge across the joint face of the body and measuring the clearance between the rotors and straight edge (see Fig. 33). This clearance should be .0025" (.06 mm.), and in an emergency can be restored by lapping the pump body and outer rotor on a surface plate to suit the inner rotor.

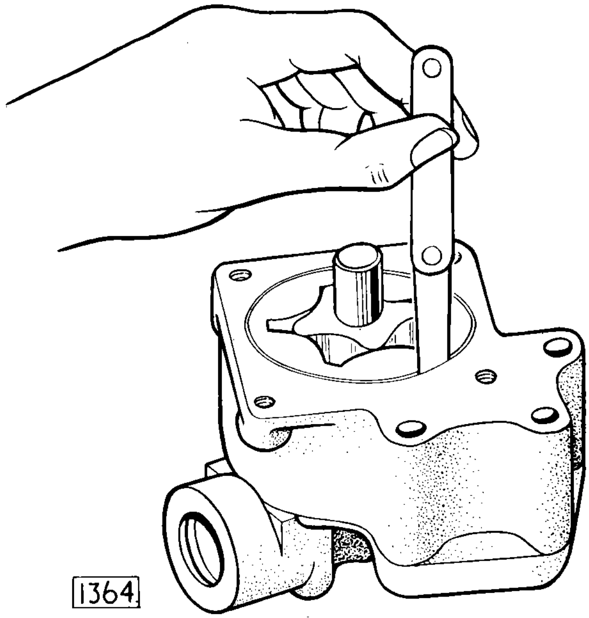


Fig. No. 32 *Measuring the clearance between the outer rotor and pump body*

Examine the pump body and bottom cover for signs of scoring and the drive shaft bores for signs of wear; fit new parts as necessary.
Place the drive shaft in a vice fitted with soft jaws and and check that the inner rotor is tight on the securing pin.
Note that the drive shaft, inner and outer rotors are supplied only as an assembly.

RE-ASSEMBLING
Re-assembly is the reverse of the dismantling procedure, but it is important when fitting the outer rotor to the pump body to insert the chamfered end of the rotor foremost.
Always fit new 'O' rings to the suction and delivery pipe hoses.

REFITTING
Refitting is the reverse of the removal procedure.
Do not omit to fit the coupling sleeve to the squared end of the drive shaft before offering up the oil pump. After fitting of the oil pump, check that there is appreciable end-float of the coupling sleeve.

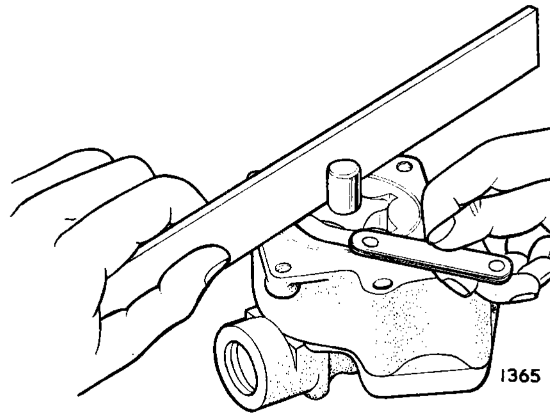


Fig. No. 33 *Measuring the end float of the rotors*

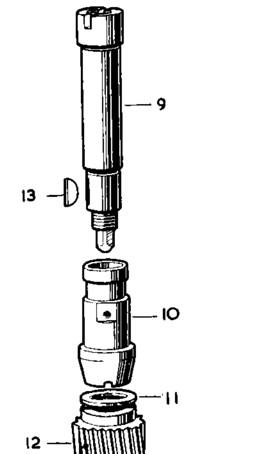
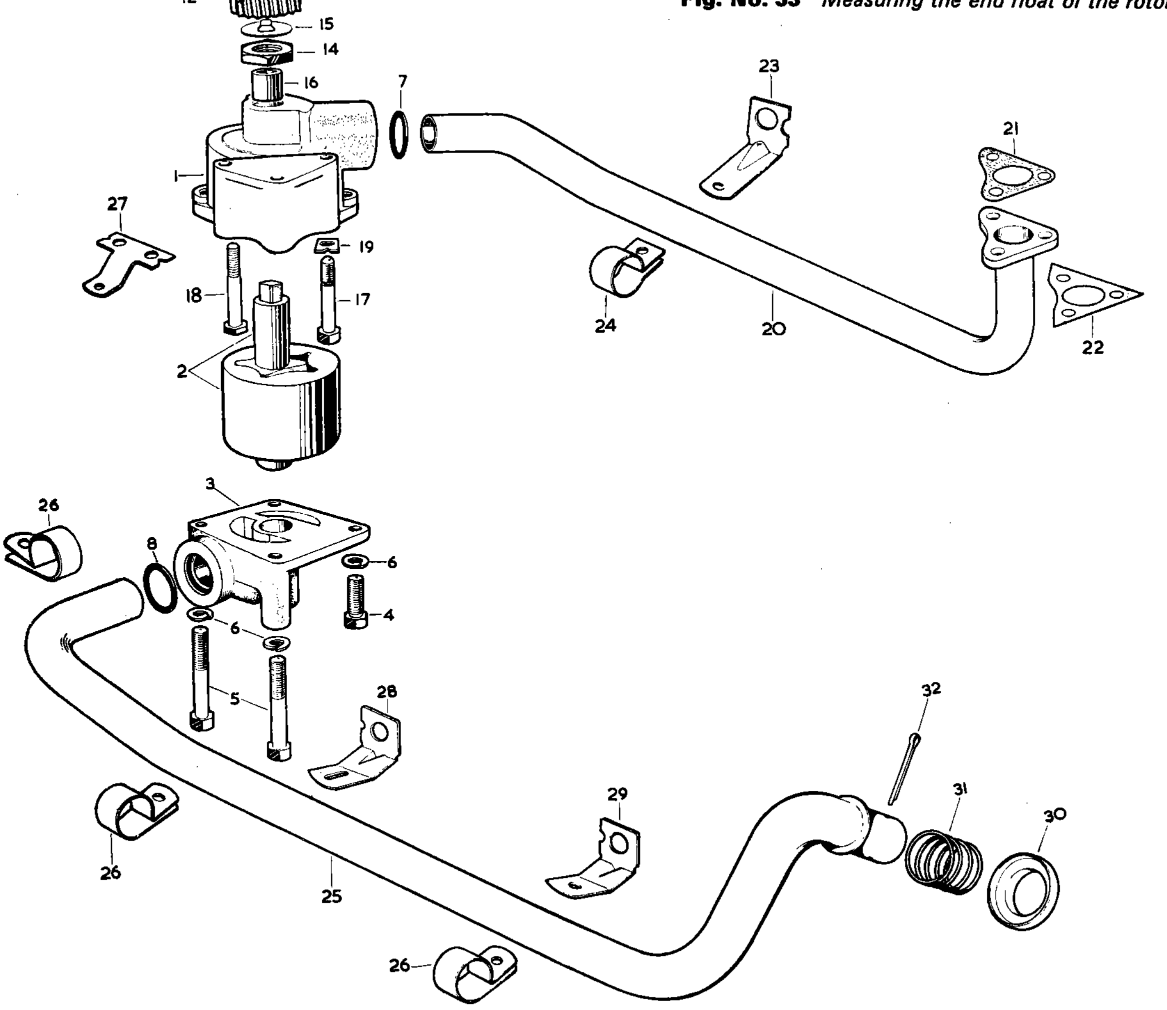



Fig. No. 34 Exploded view of the oil pump *(1) Pump body (2) Rotor assembly (3) Cover (4) Setscrew (5) Setscrew (6) Spring washer (7) "O" ring (8) "O" ring (9) Drive shaft (10) Bush (11) Washer (12) Helical gear (13) Key (14) Nut (15) Special washer (16) Coupling sleeve (17) Dowel bolt (18) Bolt (19) Tab washer (20) Oil delivery pipe (21) Gasket (22) Tab washer (23) Strut (24) Clip (25) Oil suction pipe (26) Clip (27) Strut (28) Strut (29) Strut (30) Sealing Plate (31) Spring (32) Split pin*

THE OIL FILTER

The oil filter is of the full flow type and has a renewable element. The oil from the oil pressure relief valve is returned to the sump by an external rubber hose. The oil pressure relief valve is retained by the outlet adaptor to which the hose to the sump is attached.
A balance valve fitted in the filter head opens at a pressure differential of 10-15 lb/sq. in. (0.7-1.1 kg/sq. cm.) to provide a safeguard against the possibility of the filter element becoming so choked that oil is prevented from reaching the bearings.

REMOVAL
The oil filter is located on the right hand side of the engine.
With the car on a ramp, disconnect the cable from the oil pressure transmitter unit and slacken the clip at the oil return hose. Remove the five bolts securing the filter head to the cylinder block. Remove the clip retaining the carburetter float chamber overflow pipes and the anchor bracket for the throttle spring.
Remove the oil filter assembly from beneath the car.

REFITTING
Reverse the removal procedure.
Fit a new gasket between the filter head and the cylinder block.

ELEMENT REPLACEMENT
It is most important to renew the oil filter element at every oil change.
Unscrew the central bolt and remove the canister and element from beneath the car. Thoroughly wash the canister with petrol and allow to dry before inserting a new element.
When refitting the canister, always renew the rubber sealing ring in the filter head, ensuring that it is correctly seated before tightening the centre bolt.

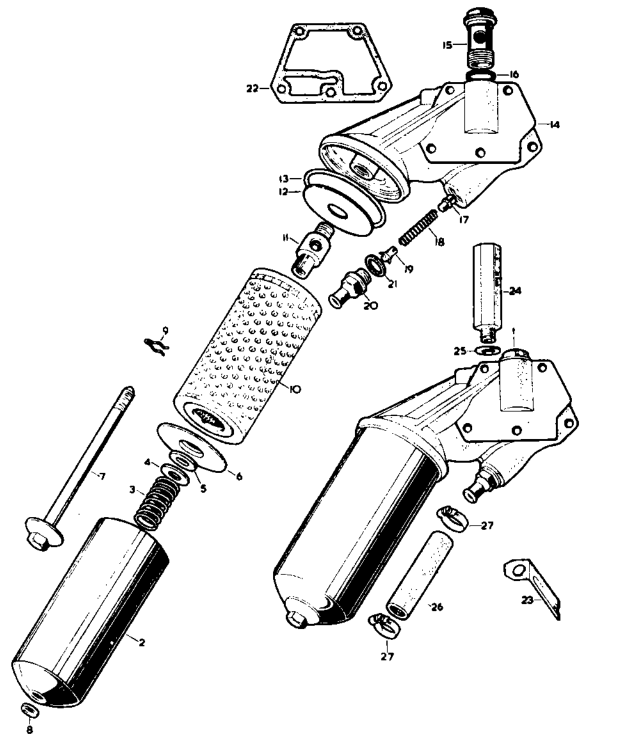


Fig. No. 35 Exploded view of oil filter *(1) Oil filter assembly (2) Canister (3) Spring (4) Plain washer (5) Felt washer (6) Pressure plate (7) Bolt (8) Rubber washer (9) Spring clip (10) Element (11) Anchor insert (12) Clamping plate (13) Sealing ring (14) Filter head (15) Balance valve (16) Washer (17) Relief valve (18) Spring (19) Spider (20) Adaptor (21) Washer (22) Gasket (23) Bracket (24) Adaptor (25) Washer (26) Hose (27) Clips*

THE OIL SUMP

REMOVAL
Drain the sump.
Remove the front suspension unit as detailed on page J.3.
Slacken the clip and disconnect the oil return hose at the oil filter head.
On cars fitted with automatic transmission, remove the two oil cooler pipes from the transmission and radiator.
Unscrew the 24 setscrews and 2 bolts and detach the sump from the cylinder block; note the short setscrew is fitted at the right-hand front corner of the sump (Fig. 36).
Remove the four nuts securing the sump baffle plate.
Withdraw the baffle plate and remove the nuts securing the filter basket. Wash the basket in petrol.
Remove the two nuts securing the oil return pipe flange to the sump; examine the 'O' ring and renew if necessary.

REFITTING
Scrape off all traces of old gaskets or sealing compound from the faces of the sump and cylinder block.
Always fit new gaskets and rear oil seal when refitting the sump. If time permits, roll the new oil seal into a coil and retain this position with string for a few hours

to assist in fitting the seal in its semi-circular housing. Fit the filter basket and baffle plate. Coat the mating surfaces of the sump and block with a good quality jointing compound; fit the new gasket and secure the sump with the setscrews and bolts.
Re-attach the oil return pipe flange and connect the oil return hose at the filter head.
Refit the transmission oil cooling pipes to the transmission and radiator.

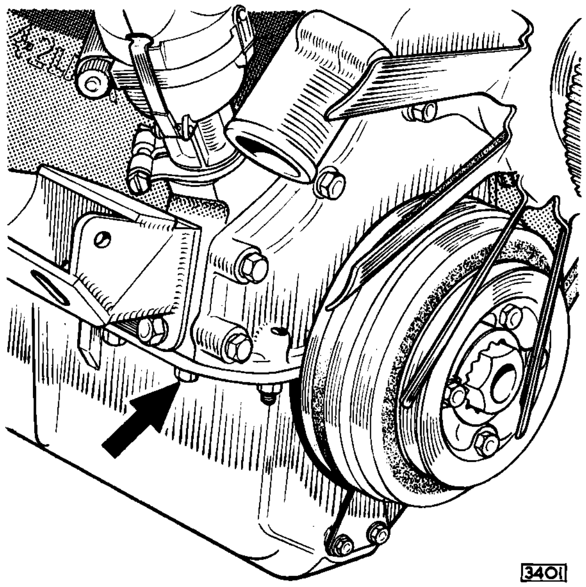


Fig. No. 36 *Location of short setscrew*

THE INLET MANIFOLD

REMOVAL
Remove the air filter, air intake and carburetters as detailed on page B.7.
Remove the distributor cap and detach the lead carrier from the thermostat housing. Tie up the distributor cap to the top of the cylinder head.
Disconnect the top water hose and by-pass hose from the front of the manifold. Disconnect the heater hose from the rear of the manifold.
Disconnect the brake vacuum hose from underneath the manifold.
Disconnect the heater vacuum hose from underneath the manifold.
Pull the cable from the "Lucar" connector to the temperature transmitter.
Withdraw the nuts securing the manifold to the cylinder head and remove the manifold.

REFITTING
Refitting is the reverse of the removal procedure.

THE CRANKSHAFT DAMPER

A torsional vibration damper is fitted at the front of the crankshaft.
The damper consists of a malleable iron ring bonded to a thick rubber disc. An inner member, also bonded to the disc, is attached to a hub which is keyed to a split cone on the front extension of the crankshaft.
The crankshaft damper and pulley are balanced as an assembly, therefore, before dismantling the assembly, mark each part so that they can be fitted in their orignal positions.

REMOVAL
Remove the fan/steering pump belt.
If the air conditioning is fitted, remove the compressor belt.
Remove the alternator belt.
Knock back the tabs and remove the washer securing the large damper bolt.
Unscrew the four setscrews securing the pulley/s to the damper and withdraw the pulley. Unscrew the large bolt and remove the flat washer. Insert two levers

behind the damper and ease it off the split cone—a sharp tap on the end of the cone will assist removal.

Overhaul
Examine the rubber portions of the damper for signs of deterioration and, if necessary, fit a new damper.

Examine the pulley/s for signs of wear. The drive should be taken on the 'V' faces of the pulley/s; renew the pulley/s if a new belt bottoms in the 'V' groove.

Refitting
Refitting is the reverse of the removal procedure.

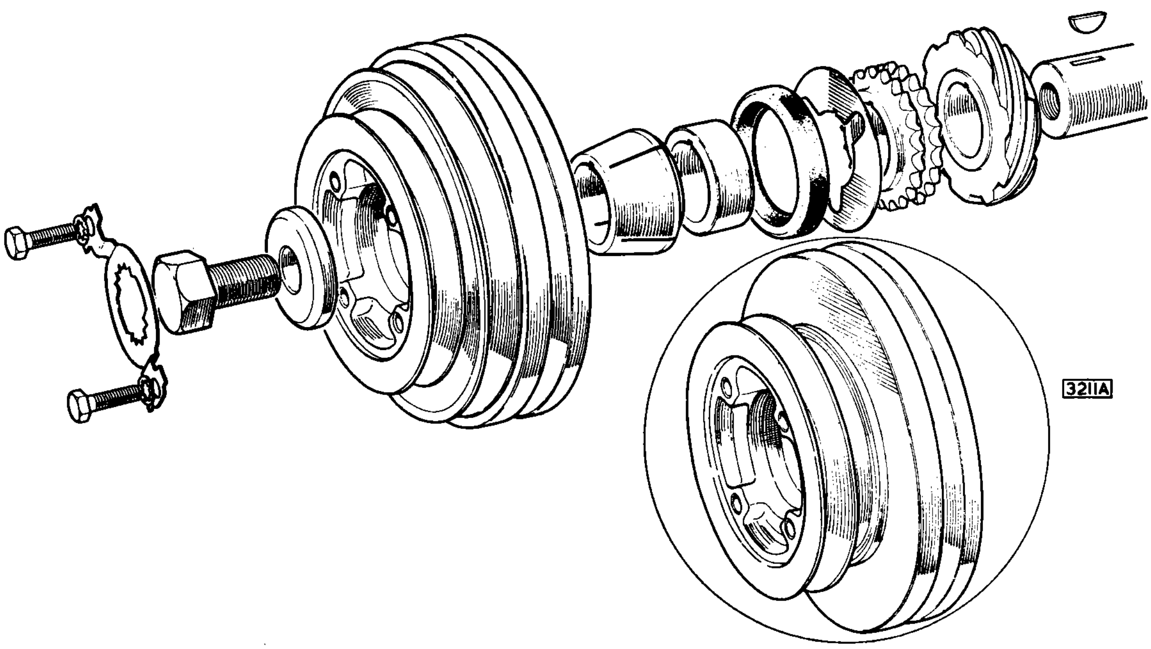


Fig. No. 37 *Exploded view of damper and pulleys*

THE TIMING GEAR

DESCRIPTION

The camshafts are driven by Duplex endless roller chains in two stages.
The first stage or bottom timing chain drives the larger wheel of a double intermediate sprocket; the second stage or top timing chain passes round the smaller wheel of the intermediate sprocket, both camshaft sprockets and is looped below an idler sprocket.
The idler sprocket has an eccentric shaft for top timing chain tension adjustment and the bottom chain is automatically tensioned by an hydraulic tensioner bolted to the cylinder block. Rubber vibration dampers are located at convenient points around the chains.

REMOVAL

Remove the cylinder head as detailed on page A.14.
Remove the sump as detailed on page A.27.
Withdraw the header tank, cowl, fan and radiator as detailed on page C.5.
Remove the water pump as detailed on page C.8.
Remove the damper assembly (see page A.28) and withdraw the split cone.
Withdraw the setscrews securing the timing cover to the block and remove the cover.
Withdraw the hexagon headed plug from the end of the bottom timing chain tensioner; insert an Allen key into the hole until it registers in the end of the restraint cylinder; turn the key clockwise until the cylinder can be felt to be fully retracted within the body. The adjuster head will then be free from the chain.
Remove the setscrews securing the tensioner body to the block and withdraw the tensioner complete with the conical gauze filter fitted in the tensioner oil feed hole in the cylinder block. Unscrew the four set screws securing the assembly to the block. Leave the setscrews in position.
Remove the two setscrews securing the intermediate damper to the block and a further two setscrews securing the bottom chain vibration damper to the block. Withdraw the timing gear assembly.

DISMANTLING

Remove the nut and serrated washer from the idler shaft and withdraw the plunger and spring.
Remove the four nuts securing the front mounting bracket to the rear bracket. Collect the upper timing chain dampers, distance pieces and top chain retainer.
Remove the bottom timing chain from the large intermediate sprocket.
Withdraw the circlip from the end of the intermediate sprocket shaft and press the shaft out of the bracket. Withdraw the two sprockets.

OVERHAUL

Examine the timing chains for signs of damage or wear. Replace as necessary.
Inspect the sprockets and replace if the teeth show signs of excessive wear.

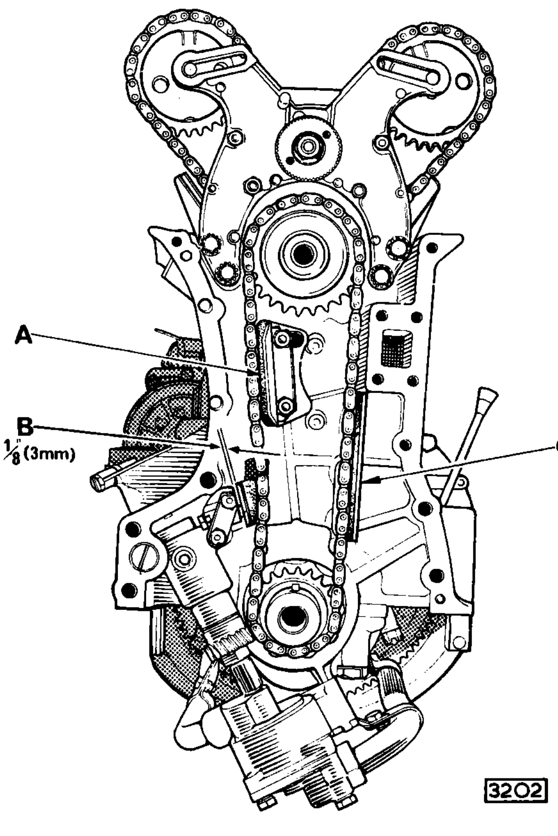


Fig. No. 38 *When fitting a new lower timing chain, set the intermediate damper (A) in light contact with the chain when there is $\frac{1}{8}$" (3mm) gap between the rubber slipper and the tensioner body. In the case of a worn chain, the gap (B) will be increased to avoid fouling between the chain and the cylinder block. Set the lower damper (C) in light contact with the chain*

Examine all vibration dampers and replace if any signs of wear are apparent.

ASSEMBLING

Fit the eccentric shaft to the hole in the front mounting bracket. Insert the spring and locking plunger for the serrated plate to the hole in the front mounting bracket. Fit the serrated plate and secure with the shakeproof washer and nut. Fit the idler sprocket (21 teeth) to the eccentric shaft.
Fit the two intermediate sprockets (20 and 28 teeth) to their shaft with the larger sprocket forward and press the shaft through the lower central hole in the rear mounting bracket locating the rollpin of the shaft in the groove machined in the rear bracket. Secure with a circlip at the rear of the bracket.
Fit the top timing chain (longer chain) to the small intermediate sprocket and the bottom timing chain (short chain) to the large intermediate sprocket.
Loop the top timing chain under the idler sprocket and assemble the front mounting bracket to the rear bracket with the two chain dampers and distance pieces interposed between.
Position the lugs of the top timing chain retainer on the front mounting bracket and pass the four securing bolts through the retainer lugs, brackets, dampers and distance pieces.
Secure the two mounting brackets together with four studs and nuts.

REFITTING

Fit the bottom timing chain over the crankshaft sprocket and attach the assembly to the block with four bolts.
Fit the top timing chain over the camshaft sprockets.
Attach the bottom chain vibration damper to the block.
Fit the conical filter to the oil feed hole in the block. Fit shims as necessary between the backing plate and the block so that the timing chain runs centrally along the adjuster slipper. Fit the tensioner to the block with two setscrews and lock the tab washers.
It is IMPORTANT that no attempt is made to release the locking mechanism until the adjuster has been finally mounted on to the engine with the timing chain in position.
Insert the Allen key, turn clockwise until the tensioner head moves forward under spring pressure against the chain. Fit the plug to the hole in the tensioner body and secure with the tab washer.
Allow the rubber slipper to project from the body by $\frac{1}{8}$" (Fig. 38) and adjust the intermediate damper on its slotted holes until this dimension is retained.
This dimension will have to be increased with a worn or stretched chain.
Complete the refitting by reversing the removal procedure.

ENGINE MOUNTINGS

The engine is supported at the front on two rubber mountings which are attached to brackets on the front sub frame. The rear is supported on a coil spring which is mounted in a channel support bolted to the body floor. An extension of the spring retainer passes through a rubber bush in the channel support.

FRONT ENGINE MOUNTINGS

Removal

Support the engine by lifting straps. Remove the large set bolt, spring washer and plain washer.
Raise the engine so that the front mounting brackets are just clear of the mounting rubbers.
Remove the two bolts securing the front engine mounting to the support bracket on the body side members. Repeat the operation for the other side.

Refitting

Reverse the removal procedure to refit.

REAR ENGINE MOUNTING

Removal

Support the rear engine mounting with a jack. Remove the four setscrews, spring washers and oval washers; lower the jack slowly to release the tension on the mounting spring. Remove the mounting and spring. Ensure that the four spacers between the mounting and the body are not mislaid.

Refitting

Reverse the removal procedure to refit.

THE ENGINE STABILISER

The engine stabiliser is situated at the rear of the engine and consists of a rubber/steel mounting attached to the body which is connected to brackets on the clutch housing via a rubber bushed link pin. The link pin is threaded at its upper end and is connected to the rubber mounting by means of flanged washers and a self-locking nut.

ADJUSTMENT

It is MOST IMPORTANT that the stabiliser is assembled in the following manner, as failure to observe this procedure may cause engine vibration and/or fouling of the gearbox in its cowl due to the engine having been pulled off its mountings.

1. Screw the lower flanged washer (D. Fig. 40) up the stabiliser pin until the flange contacts the bottom of the stabiliser rubber mounting (C). The washer is slotted on its upper face and can be screwed up the pin by engaging a thin bladed screwdriver in the slot through the centre hole of the rubber mounting.
2. Fit the upper flanged washer (B) and tighten down with the self-locking nut (A).

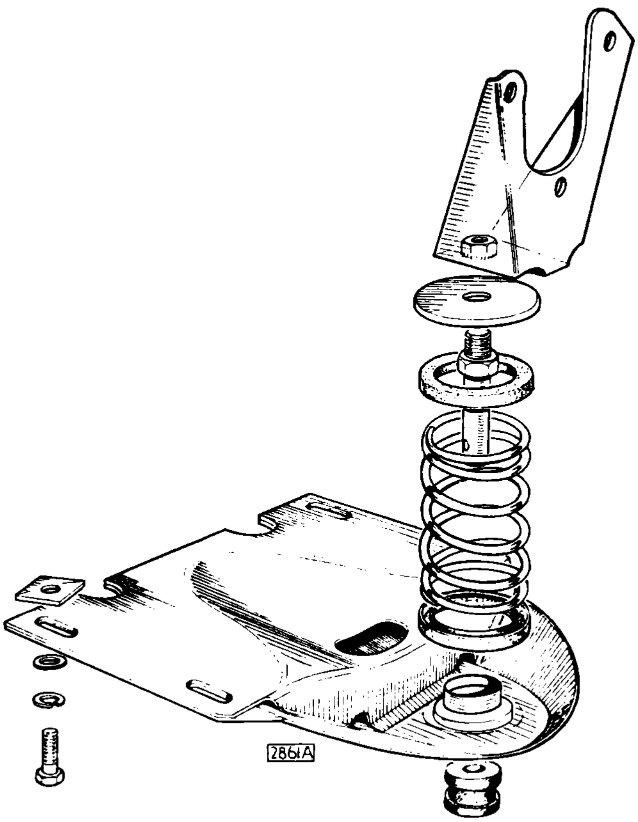


Fig. No. 39 *Rear engine mounting*

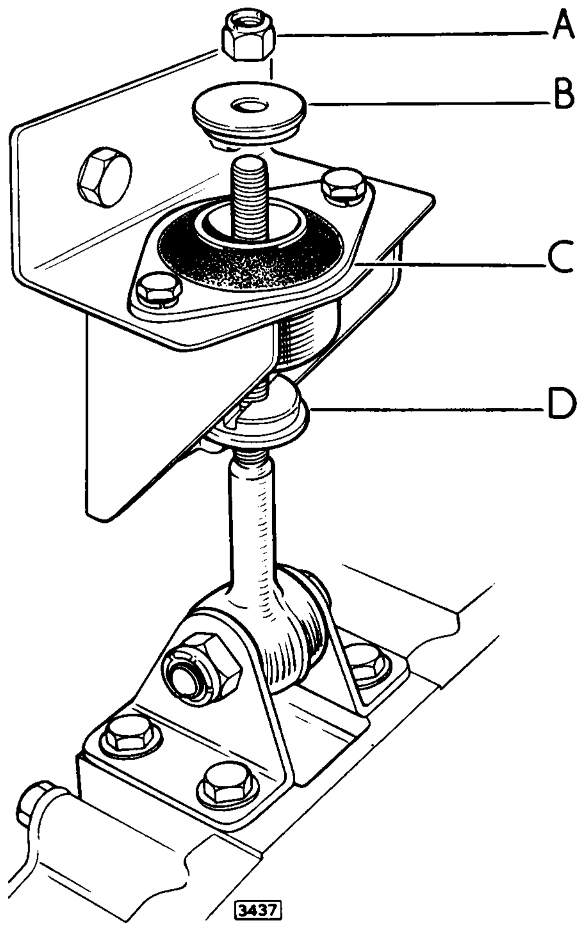


Fig. No. 40 *The engine stabiliser*

Engine Overhaul — Part 2

This section covers the removal of the engine and transmission unit from the car; dismantling the engine, and overhaul of various components which otherwise could not be serviced with the engine in situ.

ENGINE REMOVAL AND REFITTING

REMOVAL (Fig. 41)
Remove the bonnet (1)—for details see page N.6.
Remove the battery.
Drain the engine sump (2) and cooling system (3).
Remove the air cleaner (4).
Remove the automatic transmission oil cooler (5)—if fitted.
Remove the radiator (6)—for details see page C.5. If an air conditioning system is fitted, see note on page C.6 before attempting to remove the condenser.
Disconnect :-
Starter motor cables (7).
The H.T. lead from the coil (8).
The cables from the alternator (9).
The temperature transmitter cable (10).
Automatic choke cables (11).
The oil pressure transmitter cable (12).
The earth strap (13).
Remove the carburetter fuel feed pipe from the filter bowl (14).
Disconnect the carburetter linkage (15).
Disconnect the kick-down linkage (16)—automatic transmission cars.
Remove the brake vacuum pipe from the underside of the inlet manifold (17).
Remove the heater vacuum tank hose from the underside of the manifold (18).
Disconnect the heater hoses (19) from the engine.
Disconnect the power steering hoses (20) at the pump and blank off the unions. Slacken off the adjuster nuts and press the pump towards the engine to its minimum adjustment point.
If fitted, remove the air conditioning compressor unit (21) with its mounting bracket and tie securely to the wing valance. **DO NOT DISCONNECT THE HOSE CONNECTIONS FROM THE COMPRESSOR.**
Disconnect the exhaust pipes (22) at the manifold flanges and the exhaust mounting strap (23) from the bell housing.
Disconnect the speedometer cable (24).

On automatic transmission models proceed as follows :-
Remove the nut securing the selector cable to the lever on the transmission unit (25).
Remove the bolt securing the cable clamp (26) to the abutment bracket on the converter housing.

On standard transmission and overdrive models proceed as follows :-
Remove the gear control knob and the lever grommet (27).
Remove the console (28)—for details see page N.5.
Disconnect the reverse light switch (and overdrive switch if fitted) cables at the snap connectors (29).
Detach the clutch slave cylinder from the bell housing (30).

For all models continue as follows :-
Remove the rear engine mounting (31) as detailed on page A.31.
Disconnect the propeller shaft at the front flange (32).
Support the engine on lifting tackle by means of the engine lifting straps.
Remove the front engine mountings (33) and the engine stabiliser (34) as detailed on page A.31.
Lower the rear of the engine, support on the jack used for rear mounting removal, and withdraw forwards.

REFITTING
Refitting is the reverse of the removal procedure.
When fitted, adjust the rear stabiliser as detailed on page A.31.

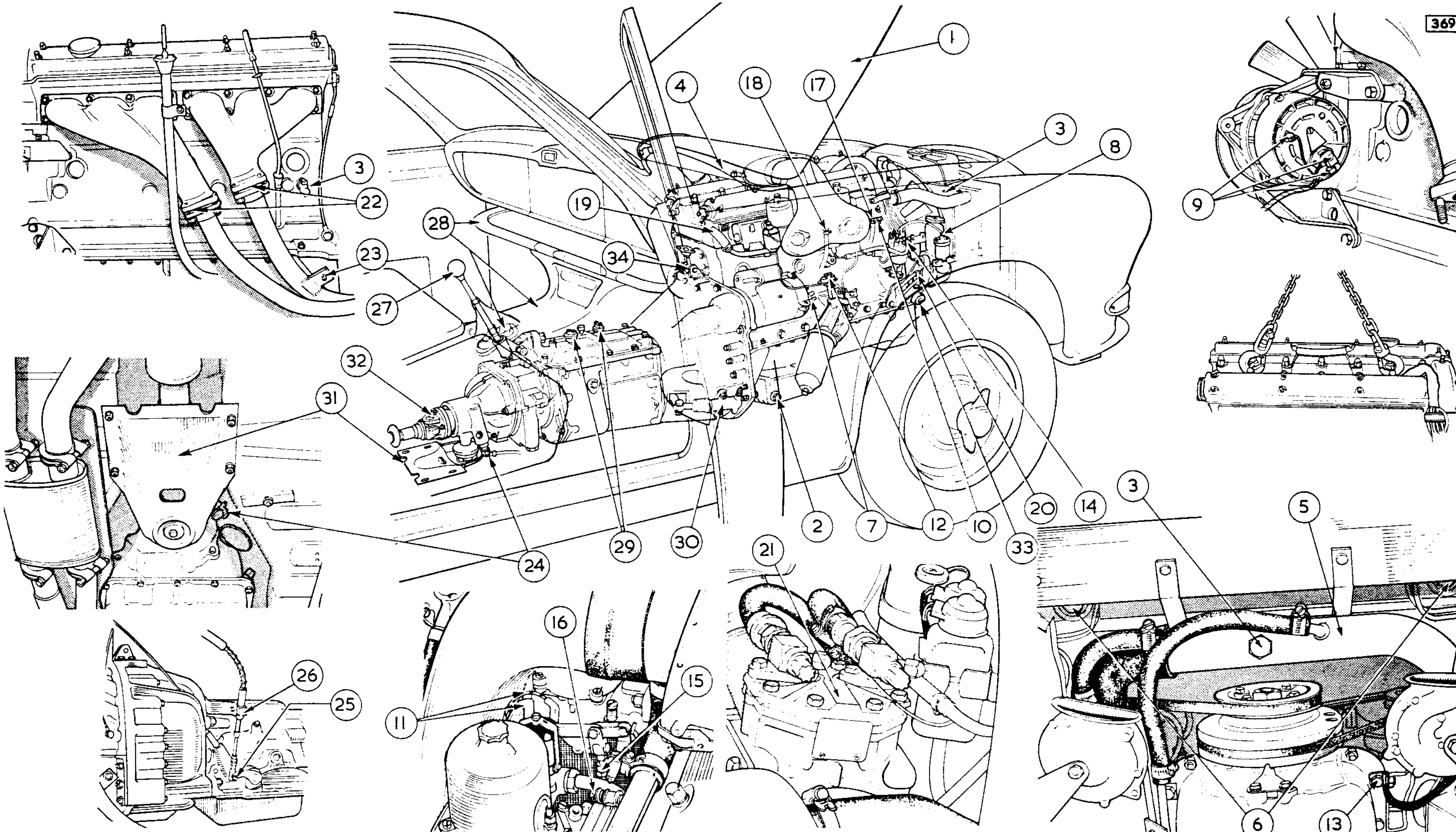


Fig. No. 41 *Engine removal*

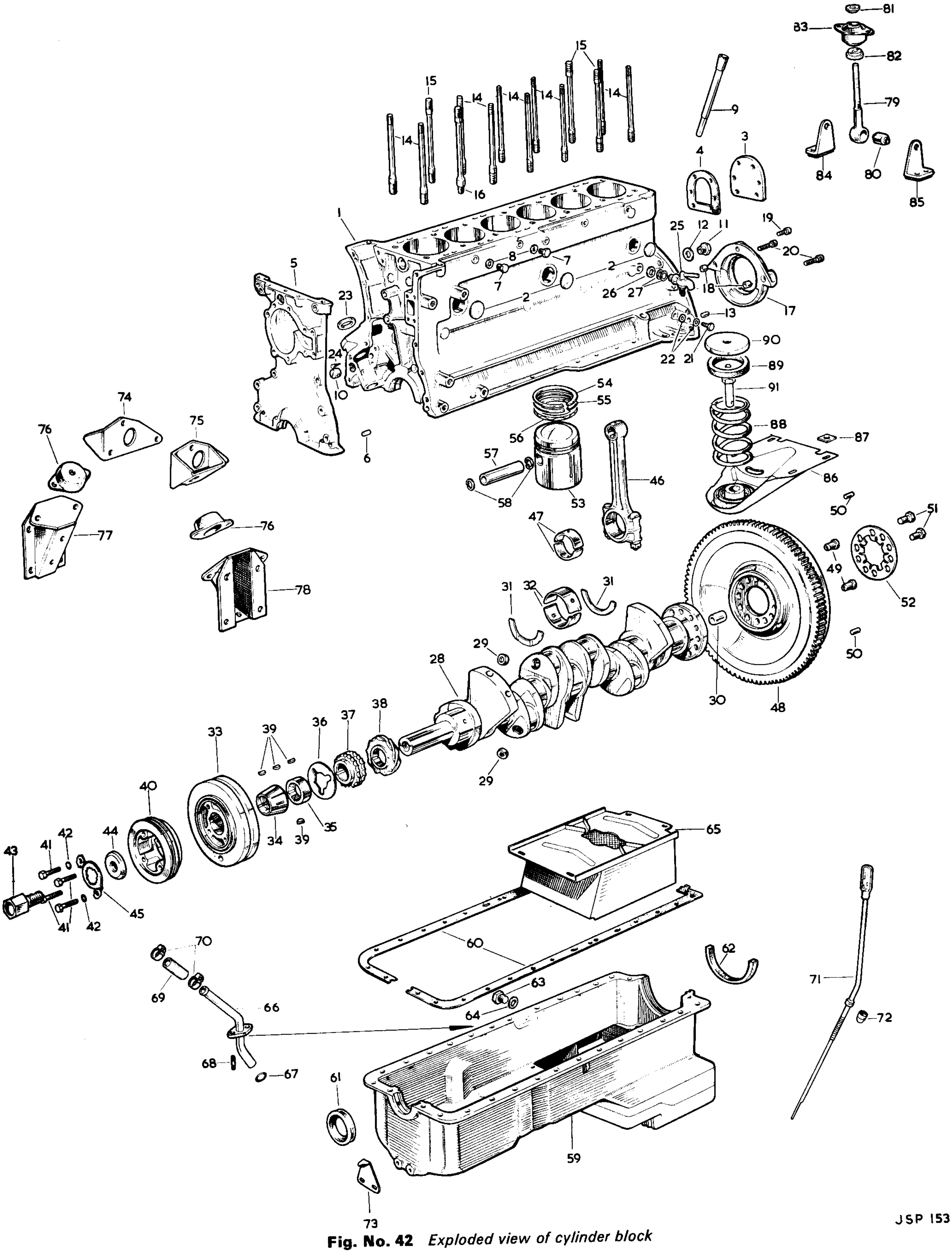


Fig. No. 42 *Exploded view of cylinder block*

1 Cylinder block assembly
2 Core plug
3 Blanking plate
4 Gasket
5 Front timing cover
6 Dowel
7 Setscrew
8 Copper washer
9 Dipstick adaptor tube
10 Plug
11 Headed plug
12 Copper washer
13 Dowel
14 Stud (plain)
15 Stud (plain)
16 Stud (dowel)
17 Cover assembly
18 Ring Dowel
19 Cap screw (centre)
20 Cap screw (outer)
21 Banjo bolt
22 Copper washer
23 Sealing ring
24 Filter gauze
25 Drain tap
26 Copper washer
27 Fibre washer
28 Crankshaft
29 Screwed plug
30 Bush
31 Thrust washer
32 Main bearings
33 Crankshaft damper
34 Cone
35 Distance piece
36 Oil thrower
37 Timing chain sprocket
38 Gear
39 Key
40 Pulley
41 Bolt
42 Lock washer
43 Bolt
44 Washer
45 Tab washer
46 Connecting rod
47 Big end bearing
48 Flywheel
49 Dowel
50 Dowel
51 Setscrew
52 Lockplate
53 Piston
54 Pressure ring (upper)
55 Pressure ring (lower)
56 Scraper ring (Maxiflex)
57 Gudgeon pin
58 Circlip
59 Oil sump
60 Gasket
61 Seal
62 Seal
63 Drain plug
64 Copper washer
65 Baffle assembly
66 Pipe assembly
67 "O" Ring
68 Stud
69 Hose
70 Hose clip
71 Dipstick assembly
72 Washer
73 Ignition timing pointer
74 Bracket assembly (R.H.)
75 Bracket assembly (L.H.)
76 Front engine mounting
77 Support bracket assembly (R.H.)
78 Support bracket assembly (L.H.)
79 Stabilising link
80 Bush
81 Stepped washer
82 Stepped bush
83 Rubber mounting
84 Bearing bracket (R.H.)
85 Bearing bracket (L.H.)
86 Bracket assembly (rear mounting)
87 Packing piece
88 Coil spring
89 Spring seat (rubber)
90 Coil spring retainer
91 Pin assembly

ENGINE—DISMANTLING

GENERAL

The following instructions apply when the engine components are removed with the engine out of the chassis.

All references made in this section to the top or bottom of the engine are with the unit in the normal upright position. References to the left or right-hand side assume the engine to be upright and viewed from the rear.

TRANSMISSION UNIT (AUTOMATIC TRANSMISSION)

Removal

Disconnect the kick-down linkage at the operating shaft.

Drain the oil from the transmission unit.

Remove the bolts securing the transmission to the converter housing and withdraw the unit.

TORQUE CONVERTER AND FLYWHEEL

Removal

Withdraw the cover from the front of the converter housing.

Remove the starter motor and withdraw the setscrews securing the converter housing to the engine.

Remove the four setscrews, accessible through the starter motor mounting aperture, securing the torque converter to the flywheel. Rotate the engine to gain access to each setscrew in turn.

Remove the ten setscrews and locking plate securing the flywheel to the crankshaft and withdraw the flywheel.

GEARBOX (STANDARD TRANSMISSION)

Removal

Remove the setscrews and nuts securing the bell housing to the engine and withdraw the gearbox unit.

The unit must be supported during this operation in order to avoid straining the clutch driven plate and constant pinion shaft.

CLUTCH AND FLYWHEEL

Removal

Unscrew the six setscrews securing the clutch cover to the flywheel and remove the clutch assembly.

Retain any balance weights which may be fitted under the setscrew heads and note the location for reference when refitting.

Knock back the tabs of the locking plate securing the ten flywheel bolts.

Unscrew the flywheel bolts and remove the locking plate, detach the flywheel from the crankshaft flange by gently tapping with a rawhide mallet.

If the starter gear ring is badly worn a new flywheel should be fitted, since the starter gear teeth are integral with the flywheel and, in this case, it will be necessary to balance the flywheel and clutch as an assembly as detailed on page D.9.

REMOVE ALTERNATOR

Release the top mounting bolt and the bottom mounting nut. Swing the alternator inwards and remove the drive belt.

Withdraw the bolt and nut and remove the alternator and mounting bracket.

REMOVE DISTRIBUTOR

Spring back the clips and remove the cover complete with high tension leads. Disconnect the low tension lead, remove the clamp plate setscrew and lock washer, and withdraw the distributor.

REMOVE CYLINDER HEAD

Remove the cylinder head as detailed on page A.14.

THE CRANKSHAFT

The counterbalanced crankshaft is of manganese molybdenum steel and is supported in seven precision shell bearings. End thrust of the crankshaft is taken on two semi-circular white metal faced steel thrust washers fitted in recesses in the centre main bearing cap. A torsional vibration damper is fitted at the front end.

Initially, the crankshaft is itself balanced both statically and dynamically and is then re-balanced as an assembly with the flywheel and clutch unit attached.

REMOVAL

Remove the crankshaft damper as detailed on page A.28. Remove the sump by unscrewing the setscrews securing the sump to the block.

Remove the pistons and connecting rods as detailed on page A.20.

Tap back the tab washer securing the distributor drive gear nut and remove the nut and washer. Tap the squared end of the distributor drive shaft through the gear noting that the gear is keyed to the shaft. Remove the gear and thrust washer and withdraw the drive shaft.

Remove the timing gear assembly as described on page A.29.

Knock back the tab washers securing the fourteen main bearing cap bolts. **Note that on later engines plain washers are substituted for tab washers.**

Unscrew the bolts and the main bearing caps, noting the corresponding numbers stamped on the caps and bottom of crankcase and also the thrust washers fitted to the recesses in the centre main bearing cap.

Detach the bottom half of the rear oil seal by unscrewing the two Allen screws.
Note that the two halves are located by hollow dowels.
The crankshaft can now be lifted out from the crankcase.
Remove the distance piece and oil thrower and withdraw the crankshaft sprocket and oil pump drive gear.
Collect the woodruff keys.

OVERHAUL

Regrinding of the crankshaft journals is generally recommended when wear or ovality in excess of .003" (.08 mm.) is found. Factory reconditioned crankshafts are available on an exchange basis, subject to the existing crankshaft being fit for satisfactory reconditioning, with undersize main and big end bearings—.010" (.25 mm.),—.020" (.51 mm.),—.030" (.76 mm), and .040" (1.02 mm.).
The identification figures for the under-size journals will be found stamped on the crankshaft webs.
The necessary bearings will not be supplied with the reground crankshaft and must be ordered separately.

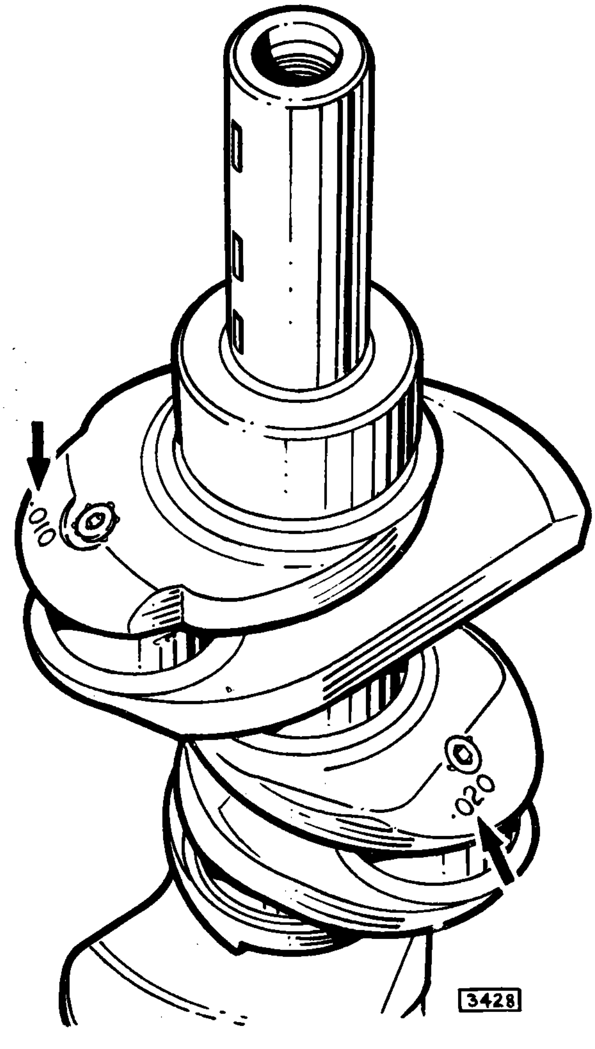


Fig. No. 43 *Identification figures for undersize main and big end bearings*

Grinding beyond the limits of .040" (1.02 mm.) is not recommended and in such circumstances a new crankshaft must be obtained.

Renewing the Rear Oil Seal
Before refitting the crankshaft, replace the rear asbestos seal and size correctly.
Remove the three Allen screws securing the top half of the oil seal noting the hollow locating dowels at the two outer holes.
Prise out the asbestos seal from the groove.

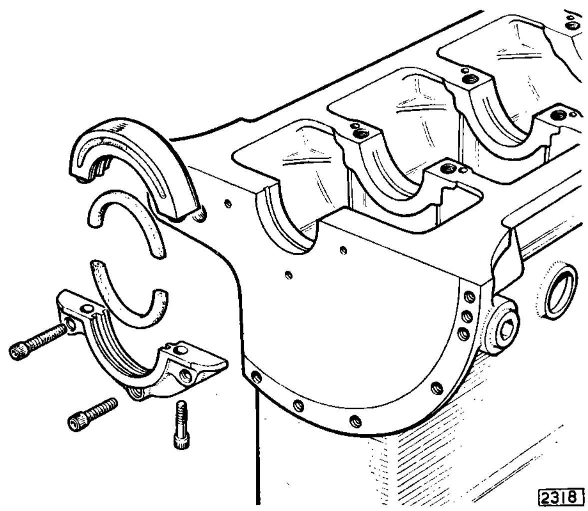


Fig. No. 44 *Exploded view of crankshaft rear oil seal*

Carefully tap the new seal on the side face to narrow the section of the seal. Fit the seals to the housing and press into the groove using a hammer handle until the seal does not protrude from the ends of the housing. DO NOT cut the ends off the seal if they protrude from the housing but continue to press the seal into the

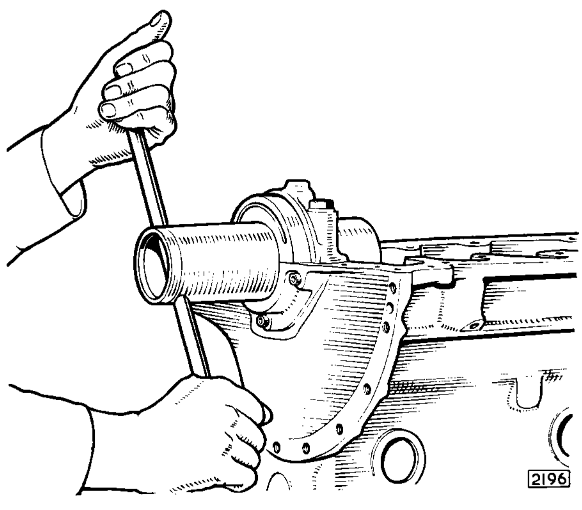


Fig. No. 45 *Sizing the rear oil seal using Churchill Tool No. J.17*

groove until both ends are flush. Using a knife or similar tool, press all loose ends of asbestos into the groove so they will not be trapped between the two halves of the housing when assembled.
Assemble the two halves of the rear seal and secure with the two Allen screws. Fit the rear main bearing cap without the bearings and tighten to a torque of 83 lb.ft. (11.5 kgm.). Fit the seal and housing to the cylinder block and secure with the three Allen screws. Smear a small quantity of colloidal graphite around the inner surface of the asbestos seal and insert the sizing bar (Churchill tool No. J.17). Ensure that the pilot end of the tool enters the bore of the rear main bearing and then press the bar inwards and rotate at the same time until the bar is fully home.
Remove the bar by pulling and twisting at the same time. Remove the three Allen screws securing the oil seal housing to the block and remove the two Allen screws securing the two halves of the seal. Separate and remove the rear main bearing.
Fit the main bearing shells to the top half of the main line bore in the cylinder block. Lay the crankshaft in the bearing shells. Fit the rear oil seal.

Refitting
New crankshaft thrust washers should be fitted, these being in two halves located in recesses in the centre main bearing cap. Fit the main bearing cap with a thrust washer, white metal side outwards, to the recess in each side of cap. Tighten down the cap and check the crankshaft end float, which should be .004" to .006" (.10 to .15 mm.). The thrust washers are supplied in two thicknesses, standard and .004" (.10 mm.) oversize and should be selected to bring the end float within the required limits. It is permissible to fit a standard size thrust washer to one side of the main bearing cap and an oversize washer to the other. Oversize thrust washers are stamped .004" on the steel face.

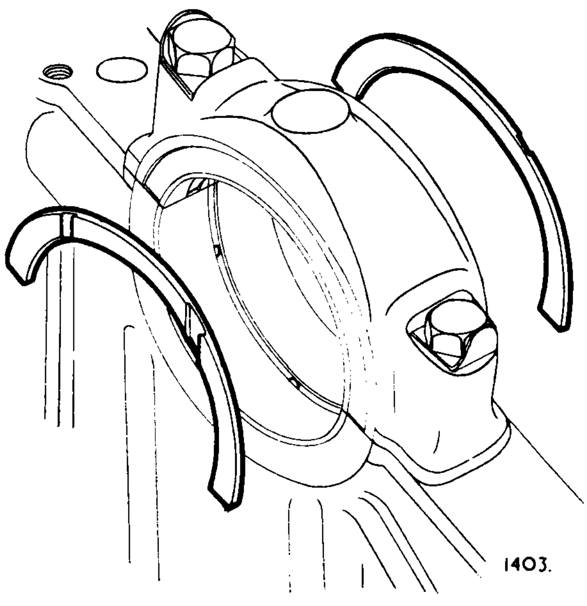


Fig. No. 46 *Crankshaft thrust washers*

Ensure that the oil passages in the crankshaft are clear and perfectly clean before re-assembling. If the original crankshaft is to be refitted remove the Allen headed plugs in the webs (which are secured by staking) and thoroughly clean out any accumulated sludge with a high pressure jet followed by blowing out with compressed air.
After refitting the plugs, secure by staking with a blunt chisel.
Fit the main bearing caps with the numbers stamped on the caps with the corresponding numbers stamped on the bottom face of the crankcase.
Fit the main bearing cap bolts and tighten to a torque of 83 lb.ft. (11.5 kgm.).
Test the crankshaft for free rotation.
The tab washers for the rear main bearing bolts are longer than the remainder and the plain ends should be tapped down around the bolt hole bosses (early engines only).
The remainder of the refitting procedure is the reverse of the removal.

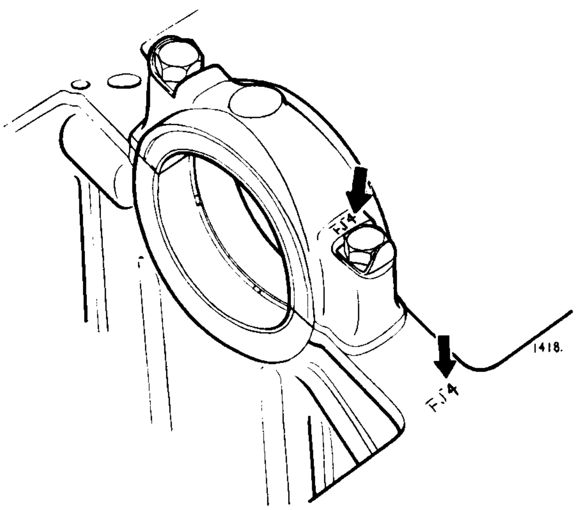


Fig. No. 47 *Showing the corresponding numbers on main bearing caps and crankcase*

Fit the Woodruff key to the inner slot and tap the oil pump drive gear into position with the widest part of the boss to the rear. Fit the Woodruff key to the outer slot and tap the crankshaft timing gear sprocket into position. Fit the oil thrower and distance piece.
Turn the engine until Nos: 1 and 6 pistons are on T.D.C. Place the distributor drive shaft into position with the offset slot in the top of the shaft as shown in Fig. 48. Withdraw the shaft slightly, maintaining the same slot position, and place the thrust washer and drive gear on the end of the shaft. Press the shaft into the drive gear ensuring that the key engages the keyway correctly.

Fit the pegged tab washer with the peg in the keyway of the drive gear.
Fully tighten the nut and secure with the tab washer. Check the end float of the shaft which should be .004"—.006" (.10—.15 mm.). If no clearance exists, fit a new oil/pump/distributor drive gear which will restore the clearance. In an emergency, the thrust washer may be reduced in thickness by rubbing down on a piece of emery cloth placed on a surface plate.

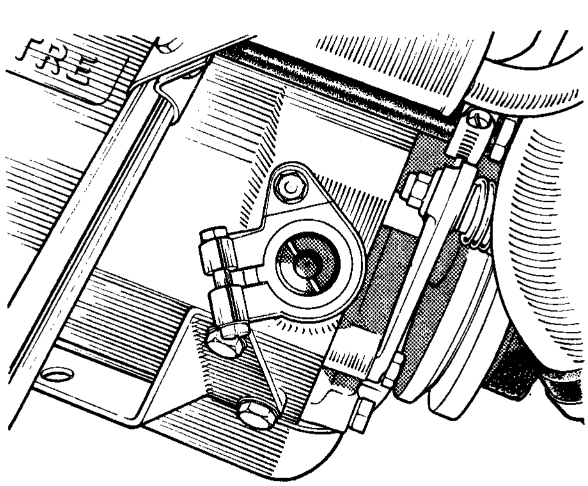


Fig. No. 48 *Showing the fitted location of distributor drive gear*

THE CYLINDER BLOCK

The cylinder block is of chromium iron and is integral with the crankcase. The main bearing housings are line bored and the caps are not interchangeable, corresponding numbers being stamped on caps and the bottom face of the crankcase for identification purposes. Pressed in dry liners are fitted.

Overhaul
Remove the cylinder head as detailed on page A.14.
Withdraw pistons and connecting rods as described on page A.20.
Remove the crankshaft as detailed on page A.35.
Check the top face of the cylinder block for truth. Check that the main bearing caps have not been filed and that the bearing bores are in alignment.
Should the caps show damage or the bearing housing misaligned, the caps must be re-machined and the bearing housings line bored.
Remove the cylinder head studs. Check area around the stud holes for flatness. Skim any raised areas flush with the joint face to ensure a perfectly flat surface.
Reboring is normally recommended when the bore wear exceeds .006" (.15 mm.). Reboring beyond the limit of .030" (.76 mm.) is not recommended. Oversize pistons are available up to this limitation—see page A.22.
If the bores will not clean out at .030" (.76 mm.), new liners and standard size pistons should be fitted.
Press out the worn liners from below, using the illustrated stepped block.
Before fitting a new liner, lightly smear the cylinder walls with jointing compound to a point halfway down the bore and also smear the top outer surface of the liner.
Press in the new liners from the top and lightly skim the tops of the liners flush with the top face of the cylinder block.
Bore out and hone the liners to suit the grade of pistons to be fitted. (See piston grades page

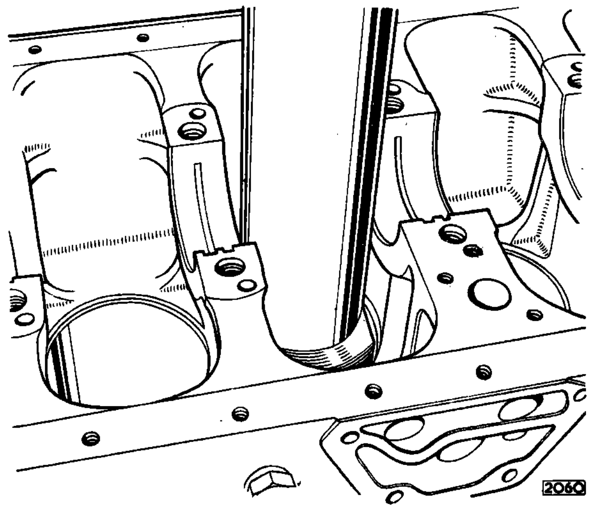


Fig. No. 49 *Pressing out a cylinder liner using a stepped block*

Following reboring, the blanking plugs in the main oil gallery should be removed and the cylinder block oilways and crankcase interior thoroughly cleaned.
When dry, coat the interior of the crankcase with an oil and heat resisting paint.
Check all welch washers fitted to the cylinder block and renew any which show signs of leaking.

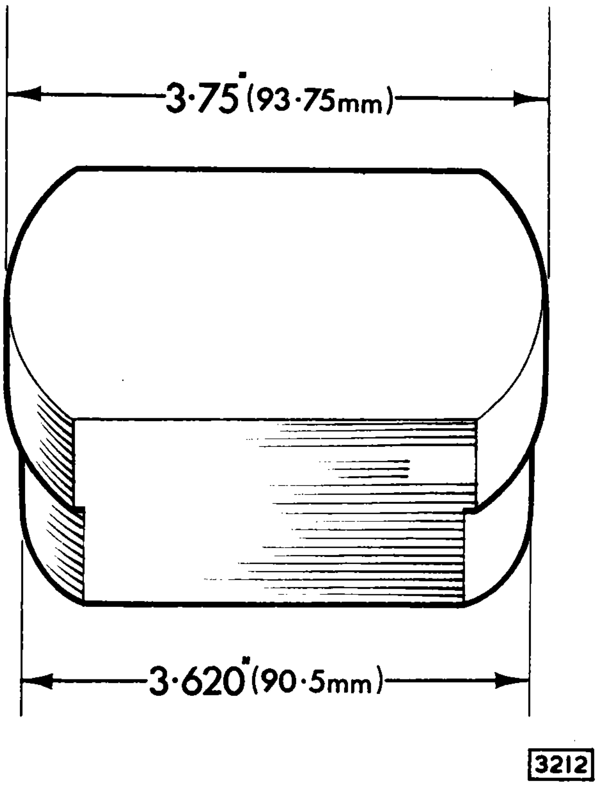


Fig. No. 50 *Dimensions for stepped block for cylinder liner removal*

Rebuilding the Engine
Refit the crankshaft as detailed on page A.37.
Replace the pistons and connecting rods as detalied on page A.22.
Refit the cylinder head as described on page A.18.

Refitting the Engine
Refit the engine by reversing the removal procedure, detailed on page A.32.

SPARKING PLUG INSERTS

If it becomes necessary to fit sparking plug inserts due to a stripped thread in the cylinder head spark plug holes, proceed as follows :-
Bore out the stripped thread to .75" (19.05 mm.) diameter and tap out to $\frac{1}{2}$" B.S.P. as shown in Fig. 51.
Make a counterbore $\frac{57}{64}$" (22.62 mm.) diameter to take the larger diameter of the insert as shown in Fig. 51.
Fit the screwed insert (C.22381) ensuring that it sits firmly in the face at the bottom of the thread.
Drill and ream a $\frac{1}{8}$" (3.17 mm.) diameter hole $\frac{3}{16}$" (4.76 mm.) deep between the side of the insert and the cylinder head as shown in Fig. 52.
Drive in the locking pin and make sure that the pin is below the surface as in Fig. 52. Secure by peening over the aluminium on the chamfered portion of the insert and also the locking pin.

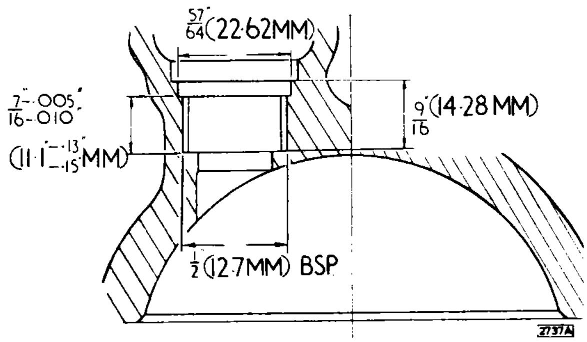


Fig. No. 51 *Boring and tapping instructions for spark plug inserts*

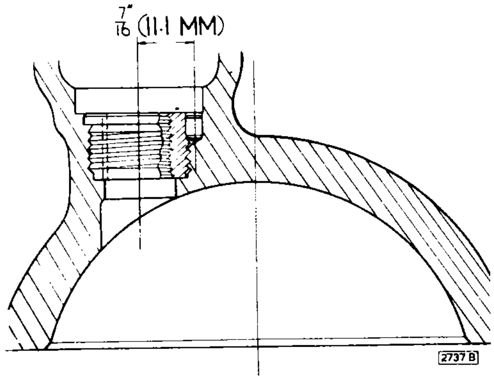


Fig. No. 52 *Fitting the screwed inserts*

CARBURETTERS AND FUEL SYSTEM

SECTION B

INDEX

CARBURETTERS

PETROL PUMP

CARBURETTERS

DESCRIPTION

The Power Unit is fitted with twin H.D.8 type carburetters. The enrichment device for starting consists of an auxiliary carburetter attached to the front carburetter.

The jet, which is fed through its lowest end, is attached to a synthetic rubber diaphragm by means of a jet cup and jet return spring cup, the centre of the diaphragm being compressed between these two parts; at its outer edge it is held between the diaphragm casing and the float chamber arm. The jet is controlled by the jet return spring and the jet actuating lever, the latter having an external adjusting screw which limits the upward travel of the jet and thus controls the mixture adjustment; screwing it in (clockwise) enriches the mixture, and unscrewing it weakens the mixture.

Idling

The carburetter idles on the main jet and the mixture is conducted along the passageway connecting the choke space to the other side of the throttle disc.

The quantity of the mixture passing through the passageway and, therefore, the engine idling speed, is controlled by the slow-run valve. It follows that, when idling, the throttle remains closed against the bore of the carburetter.

DATA

Type	S.U. H.D.8 (twin)
Size	2" (5.08 cm.)
Jet needle type . .	UM
Jet size . . .	.125" (3.17 mm.)
Auxiliary starting carburetter needle type . . .	425/8

Note: The jet needle type is stamped on the side or top face of the parallel portion of the needle. The auxiliary starting carburetter needle is stamped with the large number on the shoulder of the needle with the small number on the parallel portion of the needle.

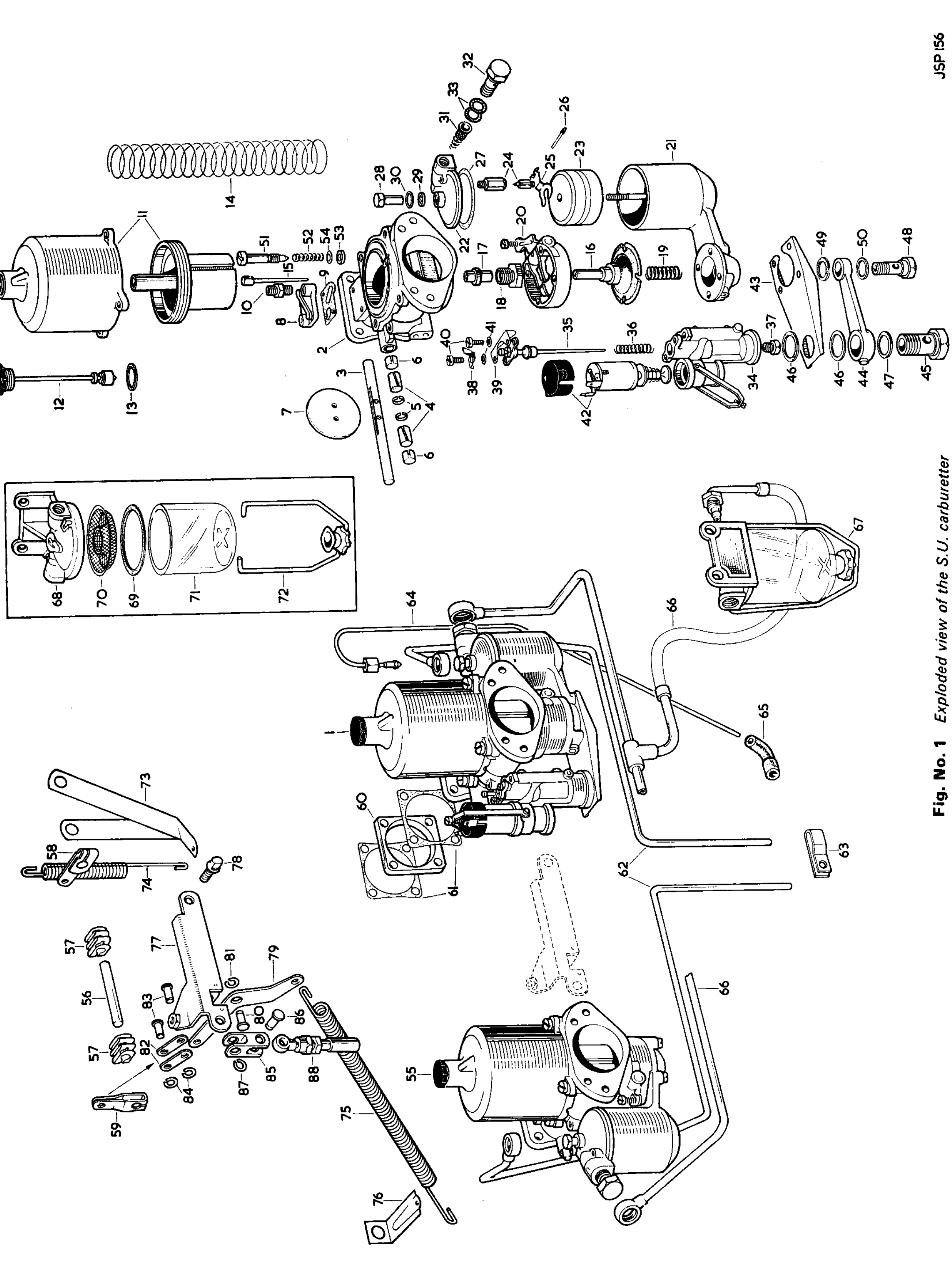


Fig. No. 1 *Exploded view of the S.U. carburetter*

1 Front carburetter assembly
2 Body
3 Throttle spindle
4 Bush
5 Retaining ring
6 Retaining ring
7 Throttle disc
8 Adaptor
9 Gasket
10 Ignition union
11 Suction chamber
12 Damper assembly
13 Washer
14 Springs
15 Jet needle
16 Jet assembly
17 Jet bearing
18 Nut
19 Spring
20 Jet housing
21 Float chamber
22 Lid
23 Float
24 Needle and seat
25 Lever
26 Knurled pin
27 Gasket
28 Cap nut
29 Serrated washer
30 Aluminium washer
31 Filter
32 Banjo bolt
33 Fibre washer
34 Thermostat washer
35 Acceleration needle assembly
36 Spring
37 Jet
38 Spring
39 Dust shield
40 Screw
41 Shakeproof washer
42 Solenoid
43 Bracket
44 Connecting arm
45 Banjo bolt
46 Washer
47 Washer
48 Banjo bolt
49 Fibre washer
50 Aluminium washer
51 Valve
52 Spring
53 Gland washer
54 Dished washer
55 Rear carburetter
56 Connecting rod
57 Coupling
58 Lever (front)
59 Lever (rear)
60 Insulator
61 Gasket
62 Overflow pipe
63 Clip
64 Suction pipe
65 Elbow (P.V.C.)
66 Petrol feed pipe
67 Petrol filter
68 Filter casting
69 Sealing washer
70 Filter gauze
71 Glass bowl
72 Retaining strap
73 Bracket assembly
74 Throttle return spring
75 Throttle return spring
76 Bracket
77 Stop bracket
78 Dowel bolts
79 Intermediate lever
80 Clevis pin
81 Circlip
82 Intermediate throttle link
83 Clevis pin
84 Circlip
85 Trunnion
86 Clevis pin
87 Circlip
88 Throttle link rod

ROUTINE MAINTENANCE

EVERY 3,000 MILES (5,000 KM.)

Lubricate Carburetter Piston Damper

Each carburetter is fitted with an hydraulic piston damper which, unless periodically replenished with oil, will cause poor acceleration and spitting back through the carburetter on rapid opening of the throttle.
To replenish with oil, unscrew the cap on top of suction chambers and lift out the damper valve which is attached to the cap. Fill the hollow piston spindle, which can be seen down inside the bore of the suction chamber, with S.A.E.20 engine oil.

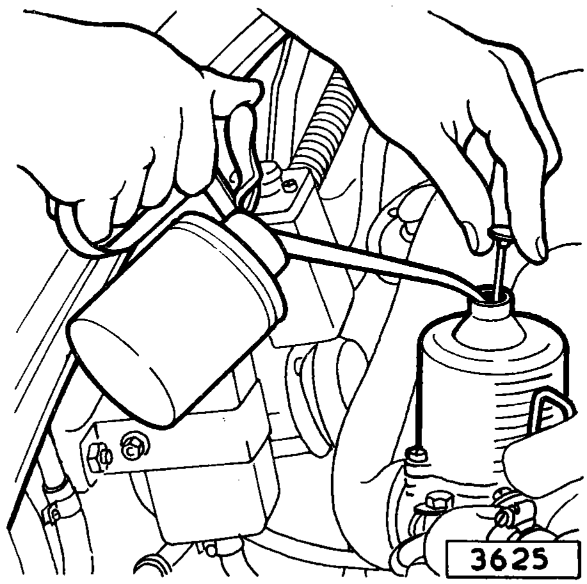


Fig. No. 2 *Topping up the hydraulic damper*

Check Carburetter Slow Running

(A) Cars fitted with synchromesh gearbox
The idling speed of the engine when fully warmed up should be set at 700 r.p.m.
If the idling speed is less than 700 r.p.m. or if the engine is not idling smoothly, chatter from the constant mesh gears may be noticeable.

(B) Cars fitted with automatic transmission
The idling speed of the engine when fully warmed up should be set at 500 r.p.m. with P. or N. selected — there will be a slight reduction of idling speed when D1 or D2 is engaged.

EVERY 6,000 MILES (10,000 KM.)

Tune Carburetters

See instructions on page B.7.

Cleaning Carburetter Filters

Removal of the bolt securing the petrol pipe banjo union to each float chamber will expose the filters. Remove the filters and clean in petrol; do not use a cloth as particles will stick to the gauze.
When refitting, insert the filter with the spring first and ensure that the fibre washers are replaced one to each side of the banjo union.

Fuel Feed Line Filter

The filter is attached to the right-hand side wing valance and is of the glass bowl type with a filter gauze.
At the recommended intervals, or more frequently if the glass bowl shows signs of becoming full of sediment, slacken the locking nut, swing the retaining clip to one side, and remove bowl, sealing washer and filter gauze.
Clean the filter gauze and bowl by washing in petrol. Examine the sealing washer and if necessary fit a new one.

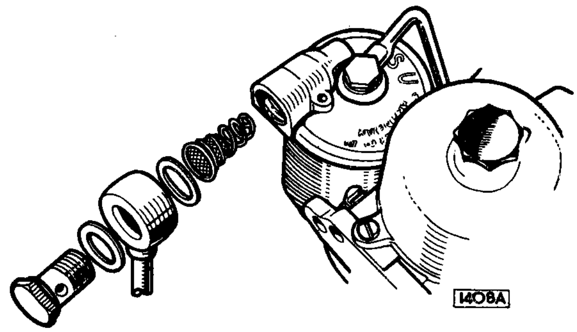


Fig. No. 3 *Carburetter filter removal*

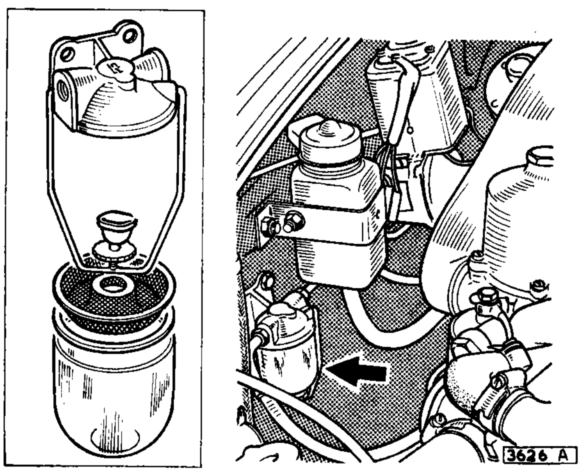


Fig. No. 4 *Fuel feed line filter*

CARBURETTERS

Removal

Remove the air intake pipe from the carburetters.
Remove the petrol feed pipes at the banjo connections of each float chamber, collecting the filters and fibre washers.
Withdraw the distributor vacuum advance pipe completely.
Disconnect the petrol feed from the auxiliary starting carburetter and the petrol overflow pipes from the clip on the oil filter head.
Disconnect the cables from the automatic choke.
Remove the circlip and withdraw the clevis pin to disconnect the throttle link rod.
On automatic transmission cars, remove the spring clip securing the kick-down link located at the rear of the rear carburetter.
Disconnect the throttle return spring from the intermediate throttle lever.
Unscrew the four nuts securing each carburetter to the inlet manifold and withdraw the carburetters.

Refitting

Refitting is the reverse of the removal procedure. Renew the carburetter/manifold gaskets. Two gaskets are fitted to each carburetter, one either side of the heat insulator pads.

CLEANING THE SUCTION CHAMBER AND PISTON

This should be done at approximate intervals of every twelve months or if the carburetter is dismantled for any reason. After detaching, clean the main inside bore of the suction chamber and the two outside diameters of the piston with a rag moistened in petrol or thinners, and then reassemble in a dry and clean condition with a few spots of thin oil on the piston rod only. Do NOT use metal polish to clean the suction chamber and piston.

CARBURETTER TUNING

It is useless to attempt carburetter tuning until the cylinder compressions, valve clearances, sparking plug gaps and contact breaker point gaps have been tested, checked and adjusted, if necessary. The distributor centrifugal advance mechanism and vacuum advance operation should be checked and ignition timing set to the correct figure. For final road test, adjustment of not more than six clicks of the micrometer adjustment at the distributor to either advance or retard is permitted. The ignition setting is important since, if retarded or advanced too far, the setting of the carburetters will be affected.
Only two adjustments are provided at the carburetters: (i) The slow running volume screw (A) (Fig. 5) governing idling speed, and (ii) the mixture adjusting screws (B) governing mixture strength. Correct setting of the mixture strength at idling speed ensures that the carburetters are correctly adjusted throughout their entire range.
Ensure that the needles are correctly located in the pistons, that is, with the shoulder of the needles flush with the base of the pistons. Check over the carburetters and ensure that pistons are free in the suction chambers, petrol filters clean, and hydraulic piston

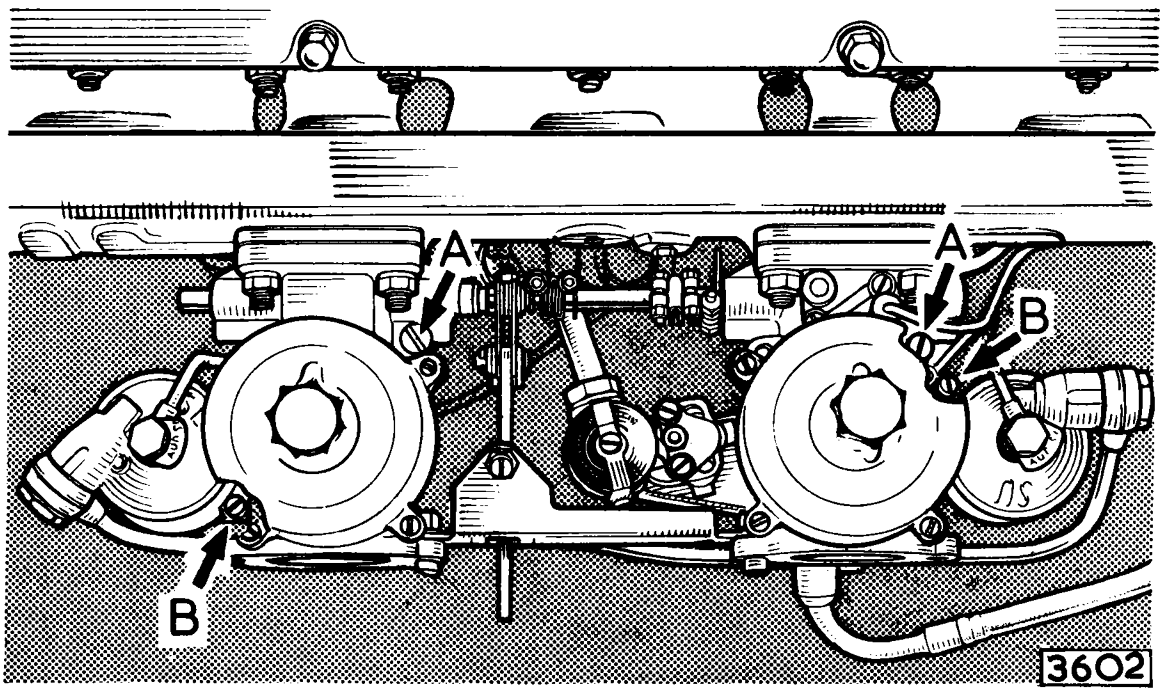


Fig. No. 5 Carburetter tuning. *"A" Slow running volume screw. "B" Mixture adjusting screw.*

dampers topped up with the recommended grade of engine oil. Lubricate the throttle controls and check for free operation and full travel.
Before carrying out the instructions which follow, it is desirable to ensure that the mixture strength of both carburetters is correct. To do this, screw out both mixture screws until the tops of the jets are flush with the jet bridge in each carburetter body; this can be observed through the piston chamber after removal of the suction chamber and piston. Screw in the mixture screws until the jets start to move and then rotate screws a further 3½ turns.
Slacken one clamp bolt on the coupling between the throttle spindles, check that both butterfly valves are fully closed by rotating both spindles clockwise when viewed from the front. Tighten the coupling clamp bolt. Screw in (rotate clockwise) the slow running volume screws until they are down fully in their seatings. Unscrew each screw 2½ turns.
Run the engine until the normal operating temperature is reached and check that both carburetters are sucking equally by placing one end of a length of rubber tube to the ear and the other end inside of each carburetter intake in turn. Rotate the slow running volume screws until the carburetters are synchronised, that is, are sucking equally and the engine is idling at approximately 500 r.p.m. on cars fitted with automatic transmission, 700 r.p.m. manual transmission cars.
Recheck that both butterfly valves are fully closed by rotating the throttle spindles (in a clockwise direction looking from the front) and noting if any change in engine speeds results; no change in engine speed or note should result if the butterfly valves are fully closed.
Recheck the mixture by screwing the mixture screws up (weaker) or down (richer) by the same amount until the fastest idling speed consistent with even running is obtained.
As the mixture is adjusted, the engine will probably run faster and it may be necessary to adjust the slow running screws to retain the correct idling speed.
Check the mixture strength by lifting the piston of the front carburetter by approximately $\frac{1}{32}$" (.08 mm.) if when:— the engine speed increases and continues to run faster, the mixture is too rich; the engine speed immediately decreases, the mixture is too weak; the engine speed momentarily increases very slightly, the mixture is correct.
Repeat the operation for the rear carburetter and, after adjustment, re-check the front carburetter as both are inter-dependent.
When the mixture is correct, the exhaust note should be regular and even. If it is irregular with a splashy type of mis-fire and colourless exhaust, the mixture is too weak. If there is a regular or rhythmical misfire in the exhaust note with a blackish exhaust, then the mixture is too rich.

Float Chamber Fuel Level

When the fuel level setting is correct a $\frac{7}{16}$" (11.1 mm.) test bar will just slide between the lid face and the inside curve of the float lever fork when the needle valve is in the "shut-off" position.

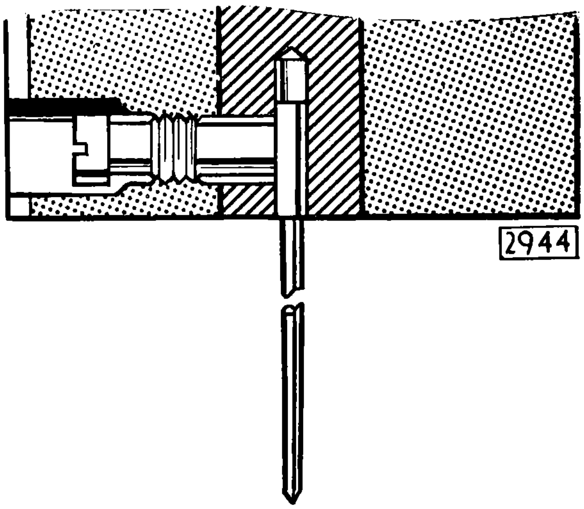


Fig. No. 6 *Positioning the jet needle*

If the float lever fails to conform with this check figure, it must be carefully bent at the start of the fork section, in the necessary direction for correction. Take care to keep both prongs of the fork level with each other and maintain the straight portion of the lever dead flat.
When setting the fuel lever, ensure that the spring loaded plunger (A) in the "Delrin" needle is not compressed.
It is not advisable to alter the fuel level unless there is trouble with flooding; although too high a level can cause slow flooding, particularly when a car is left ticking over on a steep drive. It should also be remembered that flooding can also be caused by grit in the fuel jamming open the needle valve; undue friction in the float gear; excessive engine vibration, or a porous float.

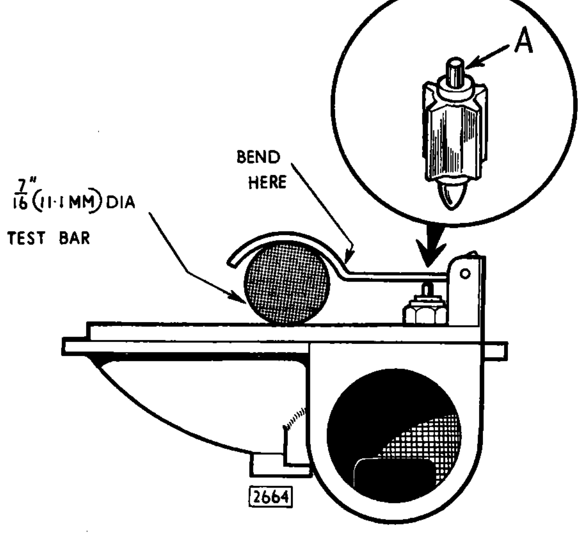


Fig. No. 7 *Checking the float lever setting*

CENTRING THE JET

Warning: Take care not to bend the carburetter needle when carrying out this operation.

Remove the carburetter from the engine as described on page B.7.

Remove the four setscrews securing the float chamber to the carburetter body. Remove the float chamber, jet housing and jet. Remove the hydraulic damper.

With a ring spanner slacken the jet locking nut approximately half a flat. Replace the jet and diaphragm assembly.

The jet is correctly centred when the piston falls freely and hits the jet "bridge" with a metallic click. To centre the jet, push the jet and diaphragm assembly as high as possible with the hand, and with a pencil or rod gently press the piston down on to the jet bridge; centralisation will be facilitated if the side of the carburetter body is tapped lightly. Tighten the jet locking nut.

The actual centring must be carried out with the setscrew holes in the jet diaphragm and carburetter in alignment. After tightening the jet locking nut the jet diaphragm must be kept in the same position relative to the carburetter body; the simplest way to do this is to mark one of the corresponding jet diaphragm and carburetter body setscrew holes with a soft pencil. Failure to do this may cause the centralisation to be upset.

Check that the centralisation is correct by noting if there is any difference in the sound of the piston hitting the jet bridge with the jet in its highest and lowest positions. If there is any difference in the sound, the procedure for centralising the jet will have to be repeated.

If difficulty in centring the jet is encountered after carrying out the above procedure, the jet needle can be lowered slightly in the piston to make the centralising effect more positive. The needle must, however, be restored to the normal position when checking the centralisation.

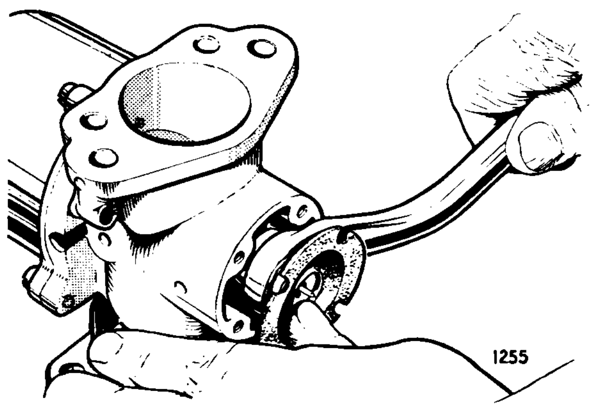


Fig. No. 8 *Centring the jet*

THE AUXILIARY STARTING CARBURETTER

Description (Fig. 9)

The enrichment apparatus for starting is, in effect, an auxiliary carburetting system. The main body casting (1) containing a solenoid-operated valve and fuel metering system is illustrated as a separate unit attached by means of a ducted mounting arm to the base of the main carburetter fuel inlet.

The auxiliary carburetter forms, therefore, a separate unit additional to the normal float chamber retained by the hollow cross-drilled bolt.

Fuel is supplied to the base of the jet (9), which is obstructed to a greater or lesser degree by the tapered slidable needle (10).

When the device is in action, air is drawn from atmosphere through the air intake (7) and thence through the passage (8), being carburetted with fuel as it passes the jet (9). The mixture is thence carried upwards past the shank of the needle (10) through the passage (14) and so past the aperture provided between the valve (3) and its seating (2). From here it passes directly to the inlet manifold through an external feed pipe.

The device is brought into action by energising the winding of the solenoid (5) from the terminals (6). The centrally located iron core (4) is thus raised magnetically, carrying with it the ball-jointed disc valve (3) against the load of the small conical spring and thus uncovering the aperture provided by the seating (2).

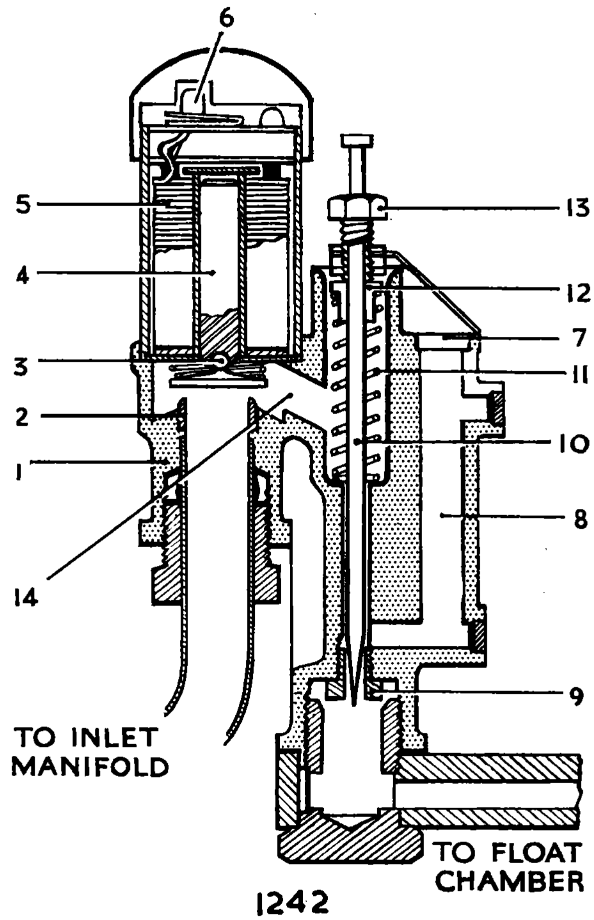


Fig. No. 9 *Sectioned view of the auxiliary starting carburetter*

Considering the function of the slidable needle (10), it will be seen that this is loaded upwards in its open position by means of the light compression spring (11) which abuts against a disc (12) attached to the shank of the needle. The needle continues upwards through the vertically adjustable stop (13) in which it is slidable mounted and it finally terminates in an enlarged head. Depression within the space surrounding the spring (11) is directly derived from that prevailing in the induction tract, and this exerts a downward force upon the disc (12), which is provided with an adequate clearance with its surrounding bore. This tends to overcome the load of the spring (11) and to move the needle downwards, thus increasing the obstruction afforded by the tapered section which enters the jet (9).
The purpose of this device is to provide two widely different degrees of enrichment, the one corresponding to idling or light cruising conditions and the other to conditions of open throttle or full-power operation. In effect, under the former conditions the high induction depression prevailing will cause the disc (12) to be drawn downwards, drawing the tapered needle into the jet (9), while under the latter, the lower depression existing in the induction tract will permit the collar to maintain its upward position with the needle withdrawn from the jet.
The tuning elements concerned in this device are the size and degree of taper of the lower end of the needle (10), the diameter of the disc (12), the load provided by the spring (11) and the degree of movement permitted to the needle assembly, as determined by the adjustment of the stop (13).
The solenoid (5) is energised by means of a thermostatically operated switch housed in the inlet manifold water jacket. This is arranged to bring the apparatus into action at temperatures below about 30-35 °C. (86-95 °F).

Adjustment
The engine must be at its normal running temperature before any attempt is made to tune the auxiliary enrichment device.
As it can generally be assumed that the tapered form of the needle (10), the strength of the spring (11), and the diameter of the disc (12) have already been appropriately chosen, tuning is generally confined to the adjustment of the stop screw (13). It will be appreciated that the main purpose of this adjustment is to limit the downward movement of the needle, the head of which abuts against the upper surface of the stop screw at the lower extremity of its travel. The final downward movement of this needle determines, as has been described, the degree of enrichment provided under idling conditions with the auxiliary carburetter in operation. An appropriate guide to its correct adjustment in this respect is provided by energising the solenoid when the engine has already attained its normal temperature. The stop screw (13) should be then so adjusted that the mixture is distinctly although not excessively rich, that is to say, until the exhaust gases are seen to be discernibly black in colour, but just short of the point where the engine commences to run with noticeable irregularity.
Anti-clockwise rotation of the stop will, of course, raise the needle under these conditions and increase the mixture strength, while rotation in the opposite direction will have the opposite effect. In order to energise the solenoid under conditions when the thermostatic switch will normally have broken the circuit, it is merely necessary to short-circuit the terminal of the thermostatic switch directly to earth with a screwdriver and flick open the throttles when the starting device will be heard to come into operation with a pronounced hissing noise.

Thermostatic Switch — Removal
The thermostatic switch which controls the operation of the auxiliary starting carburetter is situated at the front end of the inlet manifold water jacket.
Remove the electrical cable from the Lucar connection on the switch.
If the radiator filler cap is securely tightened, no appreciable amount of water will escape when the auxiliary starting carburetter switch is removed. Alternatively, a small amount of water can be drained from the radiator.
Remove the three securing setscrews and washers and withdraw the switch and the cork gasket.

Refitting
Refitting is the reverse of the removal procedure. A new cork gasket must be fitted when the switch is replaced. If any water has been drained from the radiator or has escaped during the removal of the switch, the radiator should be topped up to the correct level.

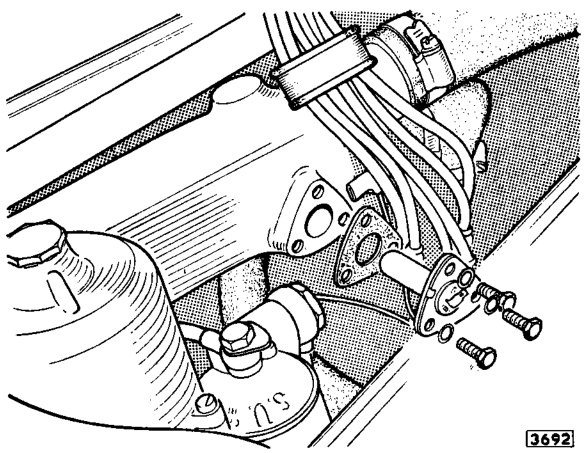


Fig. No. 10 *Removing the auxiliary starting carburetter thermostatic switch*

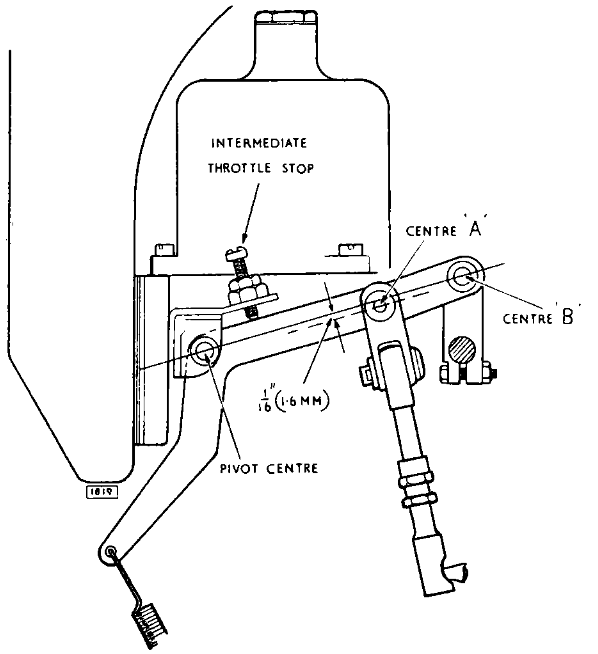


Fig. No. 11 *Throttle control linkage setting*

THROTTLE CONTROL LINKAGE SETTING

If carburetters have been removed or throttle linkages has been disturbed, particular attention must be paid to the setting adjustment of the control linkage.

To adjust, proceed as follows:—

(i) Disconnect front carburetter coupling and rear carburetter throttle lever by releasing clamp bolts.

Check that both butterflies are fully closed and that the rear carburetter coupling bolt is clearing the manifold nut. With both carburetters fully closed, retighten front coupling.

(ii) Unscrew intermediate throttle stop and push down on bell crank lever until centre "A" is $\frac{1}{16}$" (1.6 mm.) below a line from centre "B" to pivot centre (Fig. 11). When in this position screw down stop on to intermediate throttle lever and lock in position. Lock lever to carburetter spindle.

(iii) Ensure that when the throttle is closed the intermediate lever does not foul the petrol connection pipe. Open throttle fully and check that both carburetters are in the fully open position.

The Fuel System

THE PETROL PUMP

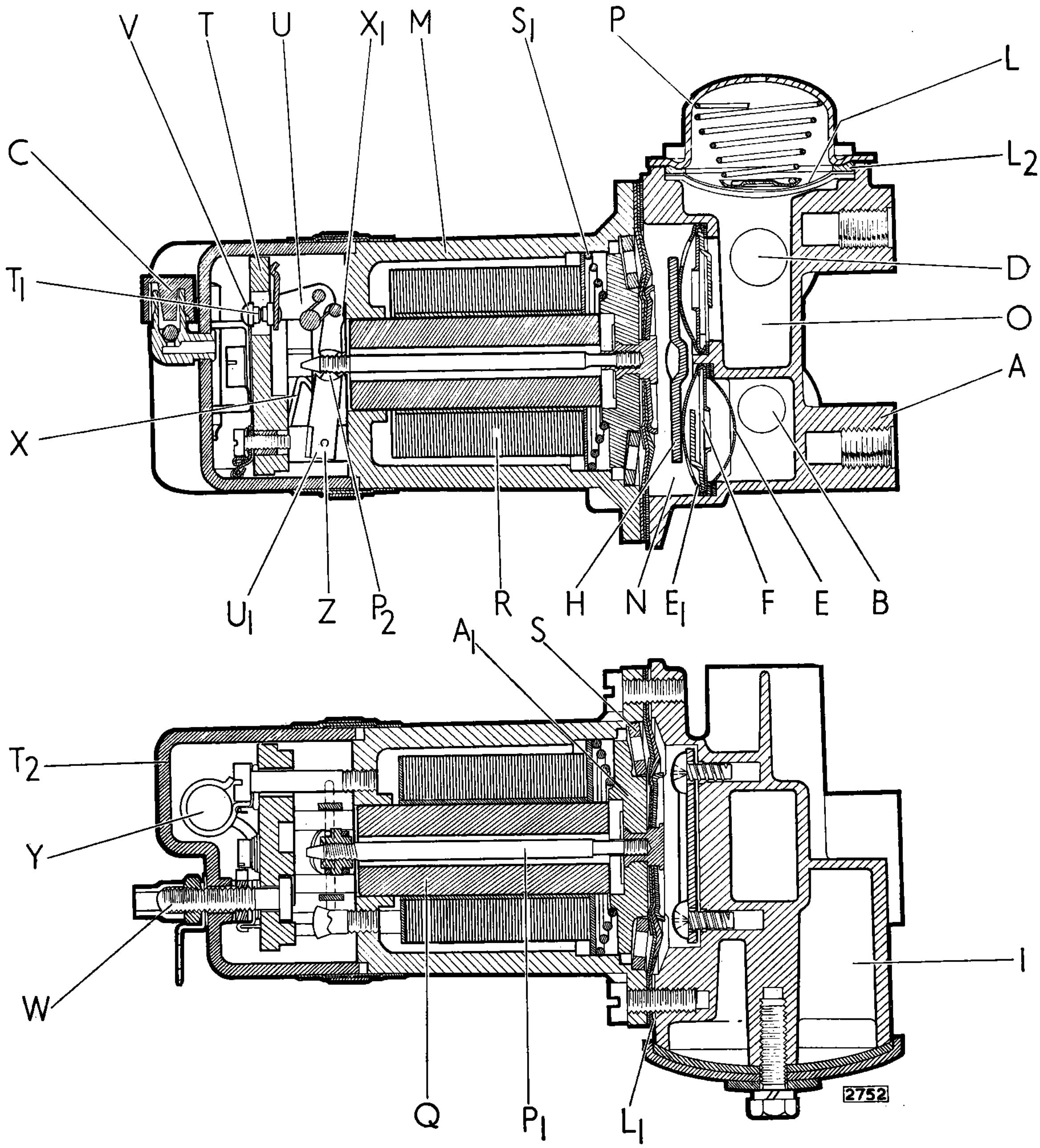


Fig. No. 12 *The petrol pump*

Warning: *If at any time, it becomes necessary to blow through the fuel feed pipes the outlet pipes must be disconnected from the pumps.*
Failure to observe this procedure will cause the Melinex valves to be displaced or damaged.

DESCRIPTION (Fig. 12)
The pump consists of three main assemblies, the main body casting (A); the diaphragm armature and magnet assembly (M) contained within the housing; and the contact breaker assembly housed within the end cap (T2). A non-return valve assembly (C) is affixed to the end cover moulding to assist the circulation of air through the contact breaker chamber.
The main fuel inlet (B) provides access to an inlet air bottle (I) while access to the main pumping chamber (N) is provided by an inlet valve assembly. This assembly consists of a Melinex valve disc (F) permanently assembled within a pressed-steel cage, held in position by a valve cover (E.1).
The outlet from the pumping chamber is provided by an identical valve assembly which operates in the reverse direction. Both inlet and outlet valve assemblies together with the filters are held in position by a clamp plate (H). The valve assemblies may be removed by detaching the clamp plate (H) after removing the self-tapping screws. A filter (E) is provided on the delivery side of the inlet valve assembly. The delivery chamber (O) is bounded by a flexible plastic spring loaded diaphragm (L) contained by a vented cover (P). Sealing of the diaphragm (L) is provided by the rubber sealing ring (L.2).

The magnetic unit consists of an iron coil housing, and iron core (Q), an iron armature (A1) provided with a central spindle (P1) which is permanently united with the diaphragm assembly (L1), a magnet coil (R) and a contact breaker assembly consisting of parts (P2), (U1), (U), (T1), (V). Between the coil housing and the armature are located 11 spherically edged rollers (S). These rollers locate the armature (A1) centrally within the coil housing and permit freedom of movement in a longitudinal direction.
The contact breaker consists of a bakelite pedestal moulding (T) carrying two rockers (U) and (U1) which are both hinged to the moulding at one end by the rocker spindle (Z). These rockers are interconnected at their top ends by means of two small springs arranged to give a throw-over action. A trunnion (P2) is carried by the inner rocker and the armature spindle (P1) is screwed into this trunnion. The outer rocker (U) is fitted with two tungsten points which contact with corresponding tungsten points which form part of the spring blade (V) connected to one end of the coil. The other end of the coil is connected to a terminal (W) while a short length of flexible wire (X) connecting the outer rocker to one of the screws holding the pedestal moulding onto the coil housing, provides an earth return to the body of the pump. It is important that the body of the pump be effectively earthed to the body of the vehicle by means of the earthing terminal provided on the flange of the coil housing.

WARNING: If at any time, it becomes necessary to blow through the fuel feed pipes, the outlet pipes must be disconnected from the pumps. Failure to observe this procedure will cause the Melinex valves to be displaced or damaged.

OPERATION
When the pump is at rest the outer rocker (U) lies in the outer position and the tungsten points are in contact. Current passes from the Lucar connector (W) through the coil and back to the blade (V), through the points and to earth, thus energising the coil and attracting the armature (A1). The armature, together with the diaphragm assembly, then retracts thereby sucking petrol through the inlet valve into the pumping chamber (N). When the armature has travelled nearly to the end of its stroke, the throw-over mechanism operates and the outer rocker moves rapidly backwards, thus separating the points and breaking the circuit.
The spring (S1) then re-asserts itself, forcing the armature and diaphragm away from the coil housing. This action forces petrol through the delivery valve at a rate determined by the requirements of the engine. As the armature nears the end of its stroke the throw-over mechanism again operates, the tungsten points remake contact and the cycle of operations is repeated. The spring blade (V) rests against the small projection moulding (T) and it should be set so that when the points are in contact, it is deflected away from the moulding. The gap at the points should be approximately 0.030" (0.75 mm.) when the rocker (U) is manually deflected until it contacts the end face of the coil housing.

REMOVAL
Disconnect the feed and earth cables from the pump. Remove two nuts and locking washers securing the pump clamp to the mounting studs.
Remove the pump and disconnect the inlet and outlet pipes by withdrawing the banjo bolts and washers.
Examine the rubber insulated mounting studs for deterioration, and replace if necessary, otherwise excessive petrol pump noise may result.

REFITTING
Refitting is the reverse of the removal procedure.

DISMANTLING (Fig. 13)
Contact Breaker
Remove the insulated sleeve (33), terminal nut (32) and connector (31), with its shakeproof washer.
Remove the tape seal (if fitted) and take off the end cover.
Unscrew the 5 B.A. screw (24) which holds the contact blade (22) to the pedestal (16) and remove the condenser (25) from its clip. This will allow the washer (23), the terminal tag (11), and the contact blade to be removed.

Coil Housing and Diaphragm
Unscrew the coil housing securing screws (7), using a thick-bladed screwdriver to avoid damaging the screw heads.
Remove the earthing screw (9).
The coil housing (6) may now be removed from the body (1). Next remove the diaphragm and spindle assembly (2) by taking hold of the diaphragm and unscrewing it anti-clockwise until the armature spring (5) pushes the diaphragm away from the coil housing.

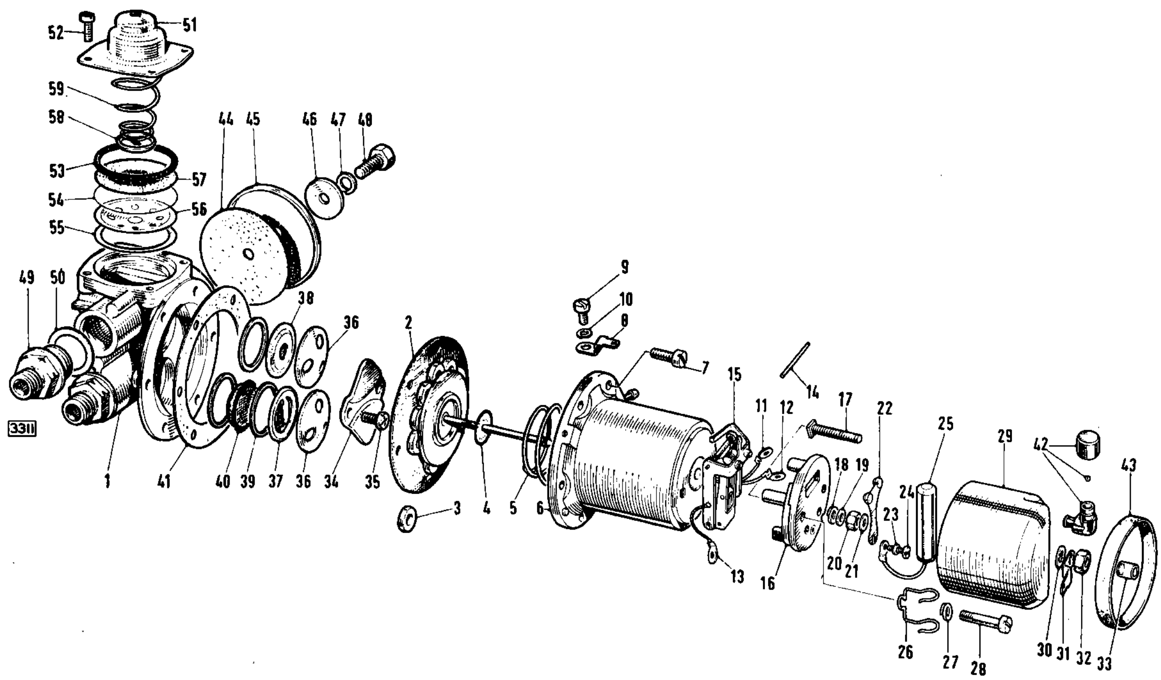


Fig. No. 13 *Exploded view of the petrol pump*

1 Pump body
2 Diaphragm and spindle assembly
3 Armature centralising roller
4 Impact washer
5 Armature spring
6 Coil housing
7 Screw
8 Earth connector
9 Screw
10 Spring washer
11 Terminal tag
12 Terminal tag
13 Earth tag
14 Rocker pivot pin
15 Rocker mechanism
16 Pedestal
17 Terminal stud
18 Spring washer
19 Lead washer
20 Terminal nut
21 Washer
22 Contact blade
23 Washer
24 Screw
25 Condenser
26 Clip
27 Spring washer
28 Screw
29 End cover
30 Shakeproof washer
31 Lucar connector
32 Nut
33 Insulating sleeve
34 Clamp plate
35 Screw
36 Valve cap
37 Inlet valve
38 Outlet valve
39 Sealing washer
40 Filter
41 Diaphragm gasket
42 Vent valve
43 Sealing band
44 Inlet air bottle cover joint
45 Inlet air bottle cover
46 Dished washer
47 Spring washer
48 Screw
49 Outlet connection
50 Fibre washer
51 Cover (delivery flow smoothing device)
52 Screw
53 "O" ring
54 Diaphragm barrier
55 Sealing washer
56 Diaphragm plate
57 Rubber diaphragm
58 Spring end cap
59 Diaphragm spring

It is advisable to hold the housing over the bench so that the 11 brass rollers (3) will not fall on the floor. The diaphragm and its spindle are serviced as a unit and should not be separated.

Pedestal and Rocker
Remove the end-cover seal washer (21), unscrew the terminal nut (20), and remove the lead washer (19). This will have flattened on the terminal tag and thread and is best cut away with cutting pliers or a knife. Unscrew the two B.A. screws (28), holding the pedestal to the coil housing, remove the earth terminal tag (13) together with the condenser clip (26). Tip the pedestal and withdraw the terminal stud (17) from the terminal tag (12). The pedestal (16) may now be removed with the rocker mechanism (15) attached.
Push out the hardened steel pin (14) which holds the rocker mechanism to the pedestal and separate the two.

Body and Valves
Unscrew the two Phillips screws (35) securing the valve clamp plate (34), remove the valve caps (36), valves (37) and (38), sealing washers and filter (40).
Note: Dismantling of the delivery flow smoothing device should only be undertaken if the operation of it is faulty, and if the necessary pressure-testing equipment after assembly is available. In this understanding proceed as follows:—
Remove the 4 B.A. screws (52) securing delivery flow-smoothing device vented cover (51), remove the cover, the diaphragm spring (59), rubber 'O' ring (53), spring cap (58), diaphragm (57), barrier (54), diaphragm plate (56) and sealing washer (55).
Remove the single 2 B.A. screw (48), securing the inlet air bottle cover (45). Remove the cover and gasket (44).
Unscrew the inlet and outlet connections.

INSPECTION
If gum formation has occurred in the fuel used in the pump, the parts in contact with the fuel will have become coated with a substance similar to varnish. This has a strong stale smell and may attack the neoprene diaphragm. Brass and steel parts so affected can be cleaned by being boiled in a 20 per cent. solution of caustic suds, dipped in a strong nitric acid solution and finally washed in boiling water. Light alloy parts must be well soaked in methylated spirits and then cleaned.
Clean the pump and inspect for cracks, damaged joint faces, and threads.
Examine the plastic valve assemblies for kinks or damage to the valve plates. They can best be checked by blowing and sucking with the mouth.
Check that the narrow tongue on the valve cage, which is bent over to retain the valve and to prevent it being forced out of position, has not been distorted but allows a valve lift of approximately $\frac{1}{16}$" (1.6 mm.).
Examine the delivery flow-smoothing device diaphragm, barrier, plate, spring, and spring cap for damage. If in doubt, renew the diaphragm.
Examine the inlet air bottle cover for damage.
Examine the valve recesses in the body for damage and corrosion; if it is impossible to remove the corrosion, or if the recess is pitted, the body must be discarded.
Clean the filter with a brush and examine for fractures, renew if necessary.
Examine the coil lead tag for security and the lead insulation for damage.
Examine the contact breaker points for signs of burning or pitting; if this is evident, the rocker assembly and spring blade must be renewed.
Examine the pedestal for cracks or other damage, in particular to the narrow ridge on the edge of the rectangular hole on which the contact blade rests.
If fitted, examine the non-return vent valve in the end-cover for damage, ensure that the small ball valve is free to move.
Examine the diaphragm for signs of deterioration.
Renew the following parts: all fibre and cork washers, gaskets, and 'O' section sealing rings, rollers showing signs of wear on periphery, damaged bolts and unions.

ASSEMBLY
Pedestal and Rocker
Note: The steel pin which secures the rocker mechanism to the pedestal is specially hardened and must not be replaced by other than a genuine S.U. part.
Invert the pedestal and fit the rocker assembly to it by pushing the steel pin (14) (Fig. 13) through the small holes in the rockers and pedestal struts. Then position the centre toggle so that, with the inner rocker spindle in tension against the rear of the contact point, the centre toggle spring is above the spindle on which the white rollers run. This positioning is important to obtain the correct "throw-over" action; it is also essential that the rockers are perfectly free to swing on the pivot pin and that the arms are not binding on the legs of the pedestal.
If necessary the rockers can be squared up with a pair of thin-nosed pliers.
Assemble the square-headed 2 B.A. terminal stud to the pedestal, the back of which is recessed to take the square head.
Assemble the 2 B.A. spring washer (1) (Fig. 14), and put the terminal stud through the 2 B.A. terminal tag (2), then fit the lead washer (3) and the coned nut with its

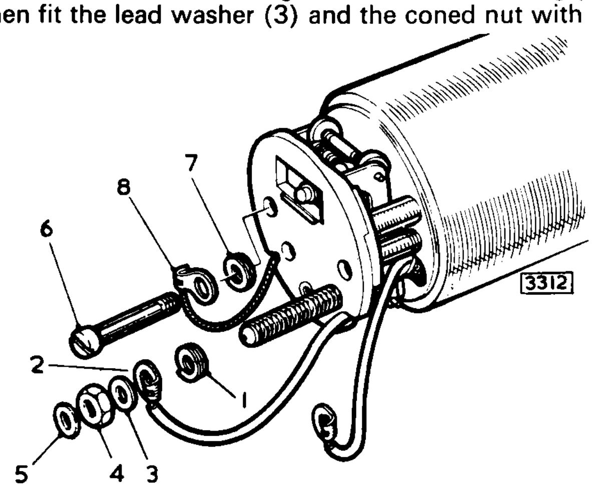


Fig. No. 14 *Attaching the pedestal to the coil housing*

coned face to the lead washer. (This makes better contact than an ordinary flat washer and nut). Tighten the 2 B.A. nut and finally add the end-cover seal washer (5).
Assemble the pedestal to the coil housing by fitting the two B.A. pedestal screws (6), ensuring that the spring washer (7) on the left-hand screw (9 o'clock position) is between the pedestal and earthing tag (8). When a condenser is fitted, its wire clip base is placed under the earthing tag and the spring washer is dispensed with. Tighten the screws, taking care to prevent the earthing tag (8) from turning, as this will strain or break the earthing flex. Do not overtighten the screws or the pedestal will crack.
Do not fit the contact blade at this stage.

Diaphragm Assembly
Place the armature spring into the coil housing with its larger diameter towards the coil (Fig. 13).
Before fitting the diaphragm make sure that the impact washer is fitted to the armature. (This is a small neoprene washer that fits in the armature recess). Do not use jointing compound or dope on the diaphragm.
Fit the diaphragm by inserting the spindle in the hole in the coil and screwing it into the threaded trunnion in the centre of the rocker assembly.
Screw in the diaphragm until the rocker will not "throw-over"; this must not be confused with jamming the armature on the coil housing internal steps.
Fit the 11 brass centralising rollers by turning back the diaphragm edge and dropping the rollers into the coil recess. The pump should be held in the left hand, rocker end downwards, to prevent rollers from falling out.
Fit the contact blade and adjust the finger setting as described under those headings, then carefully remove the contact blade.
Holding the coil housing assembly in the left hand in an approximately horizontal position (see Fig. 15), push the diaphragm spindle in with the thumb of the right hand, pushing firmly but steadily. Unscrew the diaphragm, pressing and releasing with the thumb of the right hand until the rocker just "throws over". Now turn the diaphragm back (unscrew) to the nearest hole and again 4 holes (two-thirds of a complete turn). The diaphragm is now correctly set.
Press the centre of the armature and fit the retaining fork at the back of the rocker assembly. This is done to prevent the rollers from falling out when the coil housing is placed on the bench prior to fitting the body, and it is not intended to stretch the diaphragm before tightening the body screws.

Body Components
In the AUF 301 pump the valve assemblies are retained internally in the body by a clamp plate secured with self-tapping screws. The inlet valve recess in the body is deeper than the other recess to allow for the filter and extra washer. Another feature of these pumps is the incorporation of an air bottle on the inlet and a flow-smoothing device on the delivery side.
The inlet air bottle is a chamber in the body casting blanked off by a simple cover and joint washer held by a single screw. The delivery flow-smoothing device is formed by a perforated metal plate which is in contact with a plastic barrier backed by a rubber diaphragm, all held in position by a spring and end-cap retained by a vented cover. This assembly seals the delivery chamber in the body.
Screw in the inlet and outlet connections with their sealing rings. Assemble the outlet valve components into the outlet recess in the following order, first a joint washer, then the valve, tongue side downwards, then the valve cap.
Assemble the inlet valve into the inlet recess as follows: first a joint washer, then the filter, dome side downwards, then another joint washer, followed by the valve assembly, tongue side upwards, then the valve cap.
Take care that both valve assemblies nest down in their respective recesses, place the clamp plate on top, and tighten down firmly to the body with the two screws.

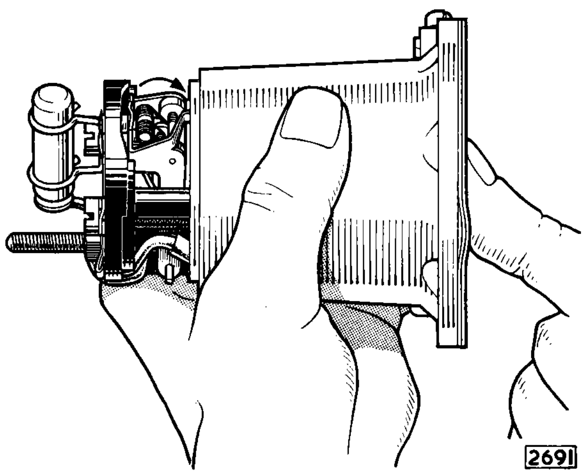


Fig. No. 15 *Checking the "throw-over" of the toggle*

Replace the inlet air bottle cover with its joint washer and tighten down the central screw.

Place the sealing washer in the bottom of the delivery flow-smoothing device recess (see Fig. 13), follow this with the perforated diaphragm plate, dome side downwards, then the plastic barrier, followed by the rubber diaphragm. Insert the 'O' section sealing ring into the recess and ensure that it seats evenly. Place the diaphragm spring, large end towards the vented cover, into the cover, place the spring end-cap on the small end of the spring, pass the assembly tool through the cover, spring, and end cap and turn it through 90° so that tension may be applied to the spring during assembly. Finally fit the spring and cap assembly onto the diaphragm, tighten the four retaining screws, and release the assembly tool. The pump should be pressure-tested after disturbance of the flow-smoothing device.

Body Attachment
Fit the joint washer to the body, aligning the screw holes.
Offer up the coil housing to the body, ensuring correct seating between them.
Line up the six securing screw holes, making sure that the cast lugs on the coil housing are at the bottom, insert the six 2 B.A. screws finger-tight. Fit the earthing screw with its Lucar connector.
Remove the roller retaining fork before tightening the body securing screws, making sure that the rollers retain their position; a displaced roller will cut the diaphragm. It is not necessary to stretch the diaphragm before tightening the securing screws.
Tighten the securing screws in sequence as they appear diametrically opposite each other.

Contact Blade (Fig. 16)
Fit the contact blade and coil lead to the pedestal with the 5 B.A. washer and screw. The condenser tag should be placed under the coil lead tag.
Adjust the contact blade so that the points are a little above the contact points on the rocker when the points are closed so that when the contact points make or break, one pair of points completely covers the other. As the contact blade is provided with a slot for the attachment screw, some degree of adjustment is possible.
Tighten the contact blade attachment screw when the correct setting is obtained.

Contact Gap Setting
Check that when the outer rocker is pressed onto the coil housing, the contact blade rests on the narrow rib or ridge which projects slightly above the main face of the pedestal. If it does not, slacken the contact blade attachment screw, swing the blade clear of the pedestal, and bend it downwards a sufficient amount so that when repositioned it rests against the rib lightly, over-tensioning of the blade will restrict the travel of the rocker mechanism. Correct positioning gives a gap of .035" ± .005" (0.9 mm. ± .13 mm.) between pedestal and tip of spring blade (Fig. 16).
Check the gap between rocker finger and coil housing with a feeler gauge, bending the stop-finger, if necessary, to obtain a gap of 0.070" ± 0.005" (1.8 mm. ± 0.13 mm.).

End-Cover
Tuck all spare cable into position so that it cannot foul the rocker mechanism. Ensure that the end-cover seal washer is in position on the terminal stud, fit the bakelite end-cover and lock washer, secure with a brass nut, fit the terminal tag or connector, and the insulated sleeve.
The pump is now ready for test.
After test replace the rubber sealing band over the end cover gap and seal with adhesive tape. This may be removed to improve ventilation when the pump is mounted internally in a moisture-free region but **must** be retained otherwise.

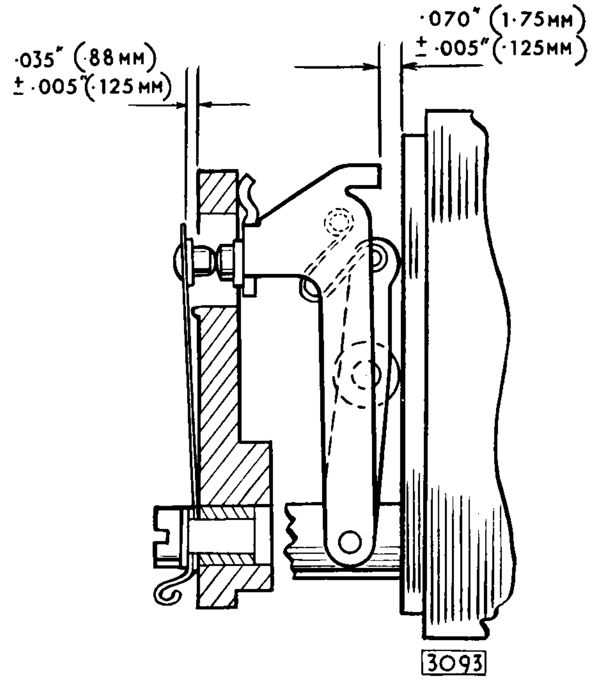


Fig. No. 16 *Rocker and contact clearances*

PETROL TANKS
Removal
It is not essential to drain the tanks as they can be lowered vertically from their mounts. The car should be raised on a hoist to allow work to be carried out from underneath.
Remove the three bolts attaching the exhaust silencers to the rubber mountings and the two bolts securing the exhaust pipes to the rear body coupling. The exhaust pipes can now be lowered.
Open the petrol filler doors and remove the filler caps. Disconnect the flexible petrol pipes from the tanks by unscrewing the unions located behind the trim panels on either side of the luggage compartment. Pull apart the snap connections to the petrol gauge units on each side.
Remove the setscrews securing the tank support cradles to the side members, unhook the cradles and remove the tanks.

Refitting
Reverse the removal procedure to refit.
Ensure that the electrical cables for the tank units are drawn up through the cover plate aperture before the tanks are attached to their mountings and that all grommets are replaced.

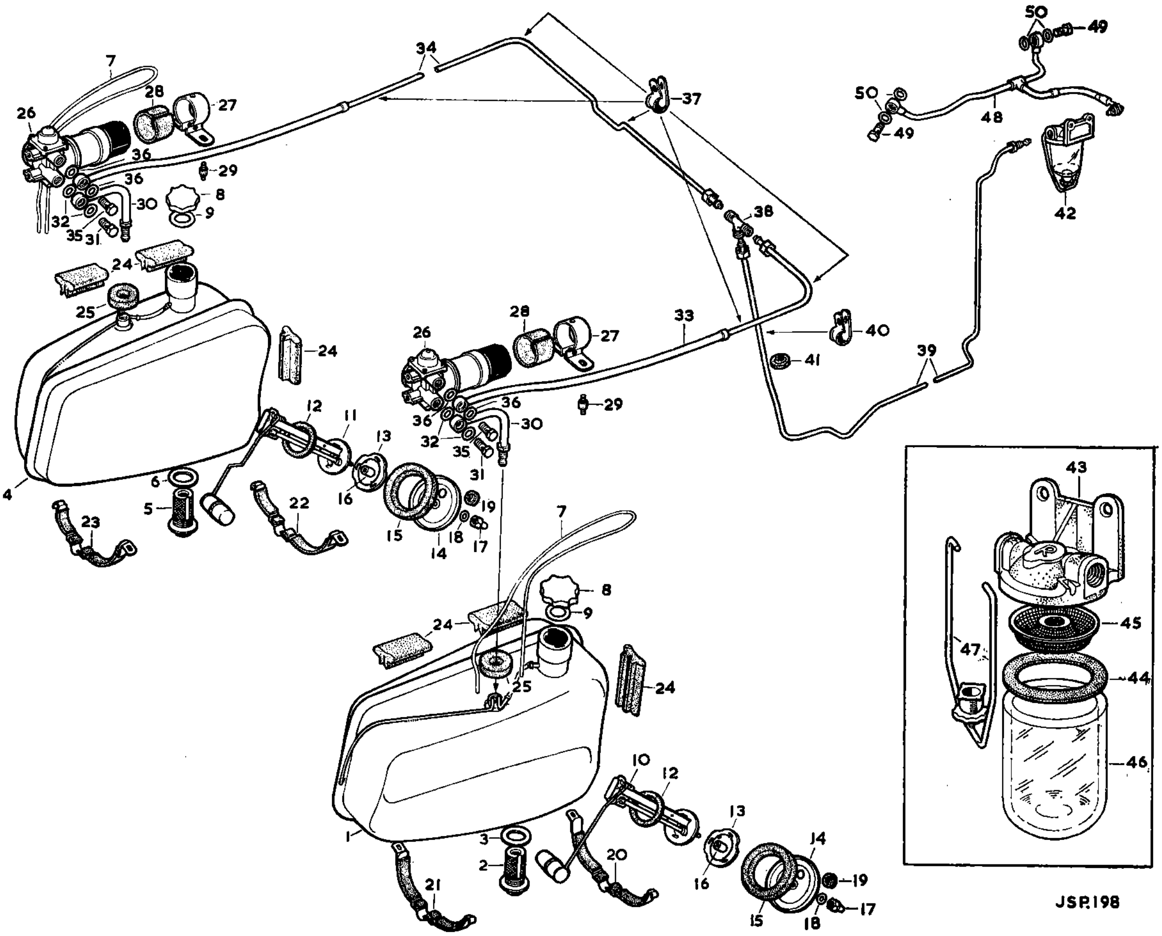


Fig. No. 17 *Exploded view of the petrol tank*

1 Petrol tank assembly R.H.
2 Petrol filter assembly
3 Washer
4 Petrol tank assembly L.H.
5 Petrol filter
6 Washer
7 Connecting tube
8 Filler cap
9 Sealing ring
10 Petrol gauge element (R.H.)
11 Petrol gauge element (L.H.)
12 Rubber seal
13 Locking ring
14 Cover ring
15 Sealing ring
16 Spacer
17 Nyloc cap nut
18 Fibre washer
19 Grommet
20 Cradle assembly
21 Cradle assembly
22 Cradle assembly
23 Cradle assembly
24 Locating pad
25 Sealing ring
26 Petrol pump assembly
27 Clip
28 Mounting rubber (Packing)
29 Mounting rubber
30 Petrol pipe assembly
31 Banjo bolt
32 Fibre washer
33 Petrol pipe assembly (R.H.)
34 Petrol pipe assembly (L.H.)
35 Banjo bolt
36 Fibre washer
37 Clip
38 T-piece
39 Petrol pipe
40 Clip
41 Grommet
42 Petrol filter assembly
43 Filter casting
44 Sealing washer
45 Filter gauze
46 Glass bowl
47 Retaining clip
48 Feed pipe
49 Banjo bolt
50 Fibre washer

COOLING SYSTEM

SECTION C

INDEX

COOLING SYSTEM

Water circulation is assisted by an impeller type pump mounted on the front cover of the engine, the system being pressurised and thermostatically controlled. Water is circulated from the right hand side of the cross-flow radiator by the water pump and flows through the cylinder block and the cylinder head water passages to the radiator header tank by way of the inlet manifold water jacket. The cooling fan is driven through a fluid coupling which slips at a predetermined speed.
When the engine is stationary, the fan is free to rotate and **it should not be assumed that the fan belt is slipping.**

DATA

Total capacity—	Imp. Pints	U.S. Pints	Litres
including heater	25½	30½	14.5
Water Pump—type			Centrifugal
—drive			Belt
Fan belt—angle of "V"			40°
Fan—number of blades			12
Fan to engine speed ratio		Fan drive through fluid coupling unit	
Cooling system control			Thermosatt
Thermostat data			See page C.8
Radiator cap			
Make and type			A.C.—relief valve

ROUTINE MAINTENANCE

DAILY

Checking Radiator Water Level

Every day, check the level of the water in the radiator header tank and, if necessary, top up to the bottom of the filler neck.

Use water that is as soft as procurable; hard water produces scale which in time will affect the cooling efficiency of the system.

PERIODICALLY

Care of the Cooling System

The entire cooling system should occasionally be flushed out to remove sediment. To do this, open the radiator block, cylinder block drain taps and automatic transmission cooling unit if fitted. Insert a water hose into the radiator filler neck. Allow the water to flow through the system with the engine running at a fast idle speed (1,000 r.p.m.) to cause circulation, until the water runs clear.

Since deposits in the water will, in time, cause fouling of the surfaces of the cooling system with consequent impaired efficiency, it is desirable to retard this tendency as much as possible by using water that is as nearly neutral (soft) as is available. One of the approved brands of water inhibitor may be used with advantage to obviate the creation of deposits in the system.

When **refilling the cooling system** open the heater control tap by depressing "Heat" button. Check the radiator water level after running the engine and top up if necessary.

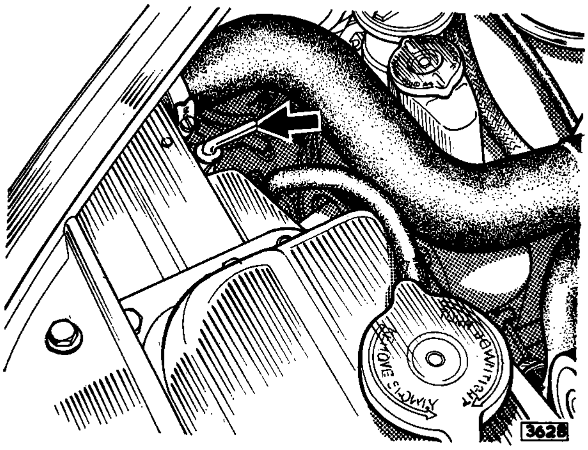


Fig. No. 1 *Radiator drain tap control*

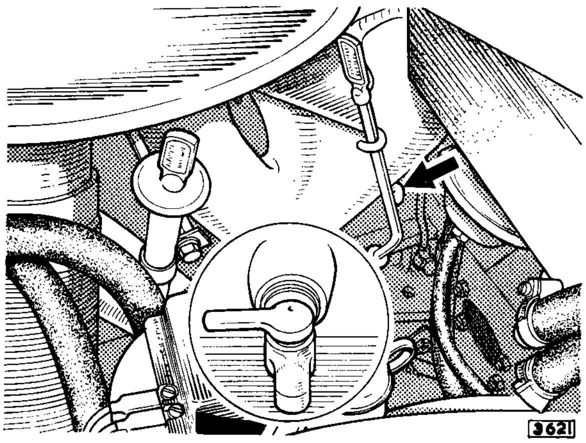


Fig. No. 2 *Cylinder block drain tap*

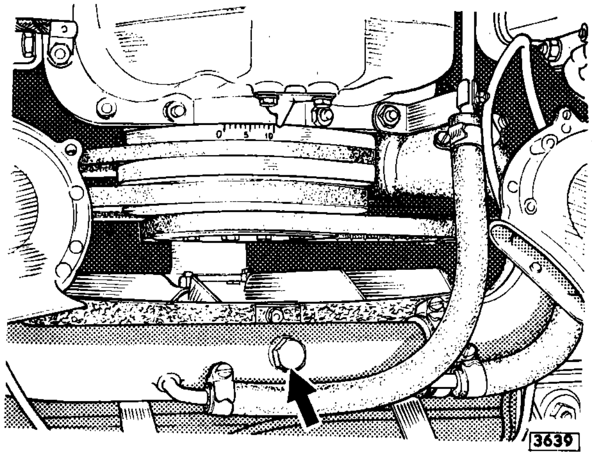


Fig. No. 3 *Drain plug for automatic transmission oil cooler*

FROST PRECAUTIONS

Anti-Freeze—Important
During the winter months it is strongly recommended that an anti-freeze compound with an inhibited Ethylene Glycol base is used in the proportions laid down by the anti-freeze manufacturers. It should be remembered that if anti-freeze is not used it is possible, owing to the action of the thermostat, for the radiator to "freeze-up" whilst the car is being driven, even though the water in the radiator was not frozen when the engine was started.
Before adding anti-freeze solution the cooling system should be cleaned by flushing.
The cylinder head gasket must be in good condition and the cylinder head nuts pulled down correctly, since if the solution leaks into the crankcase a mixture will be formed with the engine oil which is likely to cause a blockage of the oilways with consequent damage to working parts. Check the tightness of all water hose connections, water pump and manifold joints. To ensure satisfactory mixing, measure the recommended proportions of water and anti-freeze solution in a separate container and fill the system from this container, rather than add the solution direct to the cooling system.
When filling the cooling system, open the heater by depressing the "Heat" button. Check the radiator water level after running the engine and top up if necessary. If topping up is necessary during the period in which the anti-freeze solution is in use, this topping up must be carried out using anti-freeze solution or the degree of protection provided may be lost. Topping up with water will dilute the mixture possibly to an extent where damage by frost will occur.

Engine Heater
Provision is made on one side of the cylinder block for the fitment of an American standard engine heater element No. 7, manufactured by James B. Carter Ltd., Electrical Heating and Manufacturing Division, Winnipeg, Manitoba, Canada, or George Bray & Co. Ltd., Leicester Place, Blackman Lane, Leeds 2, England.

RADIATOR

The radiator is of the cross-flow type and is pressurised by the filler cap. This cap incorporates a pressure relief valve to hold pressure up to 4 lb/sq. in. above atmospheric pressure inside the system. When the pressure rises above 4 lb/sq. in., the spring loaded valve lifts off its seat and the excess pressure escapes through the overflow pipe. As the water temperature falls again, a small valve incorporated in the centre of the pressure valve unit opens and restores atmospheric pressure.
By raising the pressure inside the cooling system, the boiling point of the coolant is raised, thus reducing the risk of coolant loss.

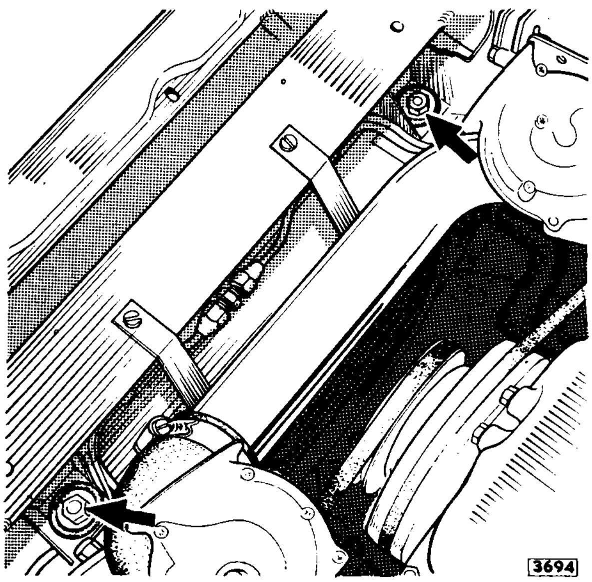


Fig. No. 4 *Radiator lower mounting points*

REMOVAL
Release the filler cap and drain the cooling system and block. Drain the lower radiator pipe if automatic transmission is fitted.
Release the hose clips and remove the header tank hose; the top radiator hose; the two hoses attached to the lower pipe.
Remove the four setscrews securing the header tank to the radiator and unscrew the two nuts securing the cowl to the tank. Withdraw the header tank.
Remove the setscrews securing the cowl to the radiator and unscrew the central bolt to the split cowl. Withdraw in two halves.
Remove the fan and Toquatrol unit as detailed on page C.7.
Withdraw the split pin and remove the remote drain control rod.
Remove the drain tap from the radiator.
Withdraw six pan-headed screws and lock washers and detach the front cross member cover plate beneath the radiator grille.
Withdraw the two lower mounting setscrews and collect the mounting rubbers. On early cars, unscrew the two nuts securing the radiator to the bracket on each wing valance. On later cars, withdraw the two bonnet stop setscrews and collect the mounting

straps. Protect the radiator matrix with suitable sheeting and withdraw from underneath the car.
Note: If an air conditioning system is fitted to the car, the condenser unit must be removed before it is possible to withdraw the radiator.
This operation requires the use of special tools and must ONLY be performed by Authorised Distributors, Dealers, or qualified Refrigeration Engineers.
IT IS DANGEROUS FOR ANY UNQUALIFIED PERSON TO ATTEMPT TO DISCONNECT OR REMOVE ANY PART OF THE AIR CONDITIONING SYSTEM.

REFITTING
Reverse the removal procedure to refit.

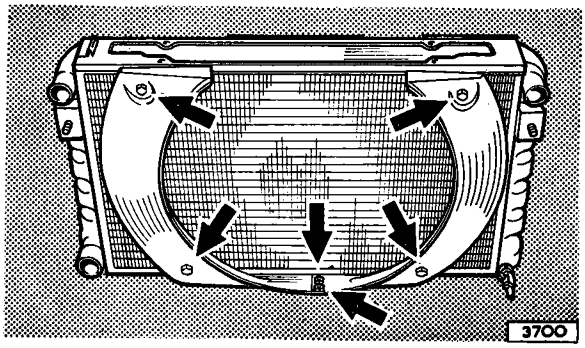
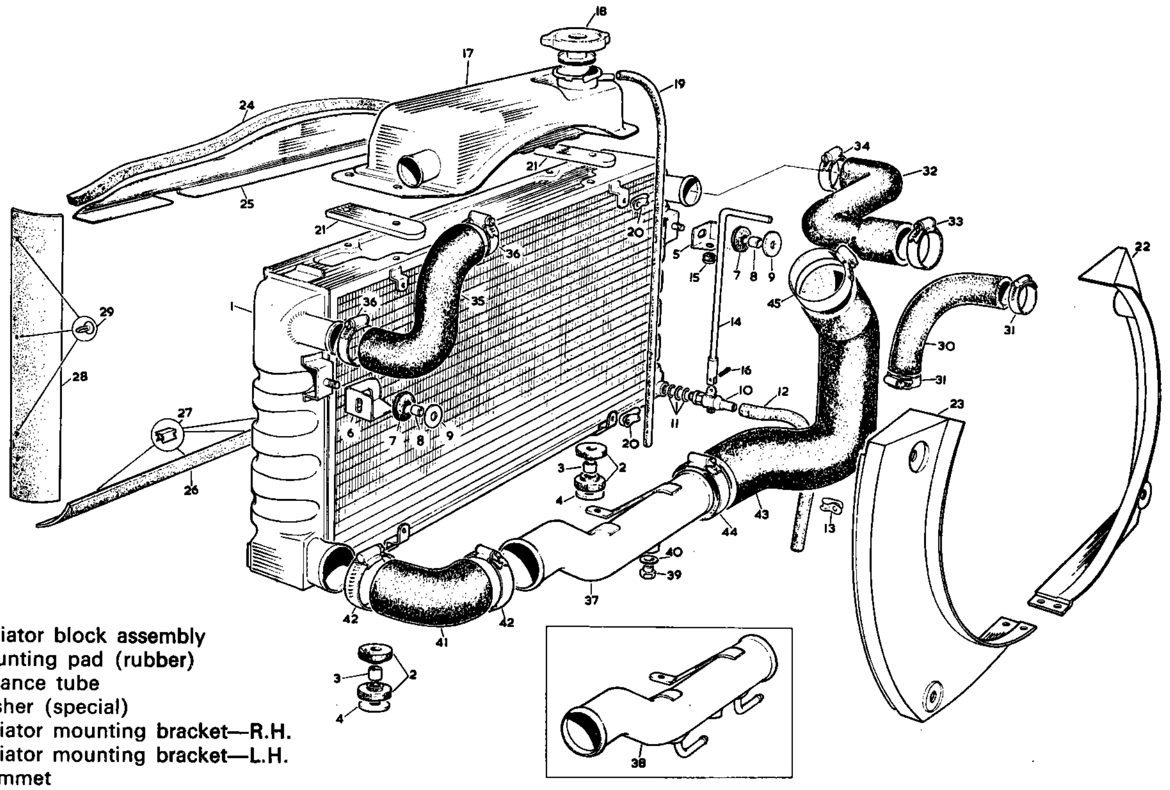


Fig. No. 5 *Radiator cowl mounting points*



1 Radiator block assembly
2 Mounting pad (rubber)
3 Distance tube
4 Washer (special)
5 Radiator mounting bracket—R.H.
6 Radiator mounting bracket—L.H.
7 Grommet
8 Distance tube
9 Washer (special)
10 Drain tap assembly
11 Fibre washer
12 Rubber tube
13 Clip
14 Control rod
15 Grommet
16 Split pin
17 Header tank
18 Filler cap
19 Overflow pipe
20 Clip
21 Packing piece
22 Fan cowl (R.H.)
23 Fan cowl (L.H.)
24 Rubber seal
25 Support strip
26 Seal
27 Clip
28 Seal
29 Stud
30 By-pass water hose
31 Clip
32 Hose
33 Clip
34 Clip
35 Header tank hose
36 Clip
37 Bottom water pipe (not automatic transmission)
38 Bottom water pipe (automatic transmission)
39 Drain plug
40 Fibre washer
41 Hose
42 Clip
43 Hose
44 Clip
45 Clip

JSR157

Fig. No. 6 *Exploded view of the radiator components*

FAN

Removal

Remove the four nuts securing the fan to the Torquatrol unit. Slide the fan up the hub of the pulley to gain access to the four nuts securing the Torquatrol unit to the pulley.
Withdraw the fan and Torquatrol unit.

Refitting

Reverse the removal procedure to refit.

FAN BELT

On cars fitted with power steering, the fan belt also drives the power steering pump. Slacken the adjustment bolt on the steering pump supporting strap and press the pump towards the engine. Press against the spring of the jockey pulley and ease the belt over the pulleys and fan blade tips. On cars fitted with manual steering, slacken the bolt securing the jockey pulley pivot to the mounting bracket; swing the pivot downwards to release the tension and remove the belt.

Refitting

Reverse the removal procedure to refit the belt. Ensure that the belt is not stretched over the pulleys by any other means than by hand. Using a tool may break the endless cords in the belt.

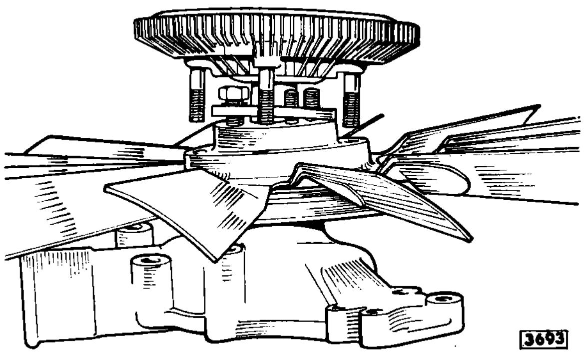


Fig. No. 7 *Fan removal*

THERMOSTAT

This is a valve incorporated in the cooling system which restricts the flow of coolant through the radiator until the engine has reached its operating temperature. When the engine temperature rises to a pre-determined figure (see "Thermostat Data") the thermostat valve commences to open and allows the water to circulate round the radiator. The flow of water increases as the temperature rises until the valve is fully open. Included in the system is a water by-pass utilizing a slot in the thermostat housing integral with the water outlet pipe. This allows the coolant to by-pass the radiator until the thermostat opening temperature is attained, thus providing a rapid warming up of the engine and in cold weather an early supply of warm air to the interior of the car via the heater.

Removal

Drain sufficient water from the system to allow the level to fall below the thermostat by operating the remote control of the drain tap situated at the top left-hand side of the radiator block. Slacken the clip and remove the top water hose on the water outlet pipe. Remove the two nuts and spring washers and the clip for the spark plug leads and withdraw the water outlet pipe. Lift out the thermostat.

Checking

Thoroughly clean the thermostat and check that the small hole in the valve is clear. Check the thermostat for correct operation by immersing in a container of cold water together with a thermometer and stirrer. Heat the water, keeping it well stirred and observe if the characteristics of the thermostat are in agreement with the data given under "Thermostat Temperatures".

Refitting

Refitting is the reverse of the removal procedure.
Always fit a new gasket between the water outlet pipe and the thermostat housing. Ensure that the recess in the thermostat housing and all machined faces are clean.

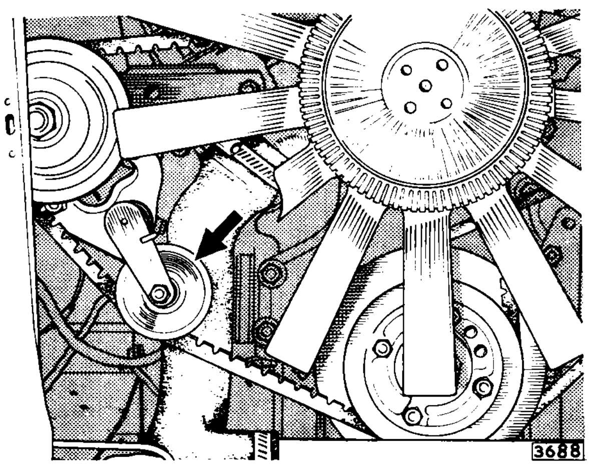


Fig. No. 8 *Fan/steering pump jockey pulley*

THERMOSTAT DATA

Start Operating Temperature	Fully Open Temperature	Remarks
159 °F. (70.5 °C.)	168 °F. (75.5 °C.)	
174 °F. (78.8 °C.)	183 °F. (83.7 °C.)	High setting for extreme winter conditions

WATER PUMP

The water pump is of the centrifugal vane impeller type, the impeller being mounted on a steel spindle which runs in a double row of ball bearings. These are sealed at their ends to exclude all dirt and to retain lubricant.

The main seal of the pump spindle is located in the pump housing by a metal cover and the carbon face maintains a constant pressure on the impeller by means of a thrust spring inside the seal.

A hole drilled in the top of the casting acts as an air vent and leads into an annular groove in the casting into which stray water is directed by a rubber thrower on the pump spindle. A drain hole at the bottom of the groove leads away any water and prevents seepage into the bearing.

REMOVAL

Drain the cooling system and cylinder block.

Remove the header tank.

Remove the fan and Torquatrol unit as detailed on page C.7.

If the car is fitted with power steering, remove the pump adjusting bolt.

If an air conditioner is fitted, remove the compressor front mounting bracket.

Disconnect all heater hoses.

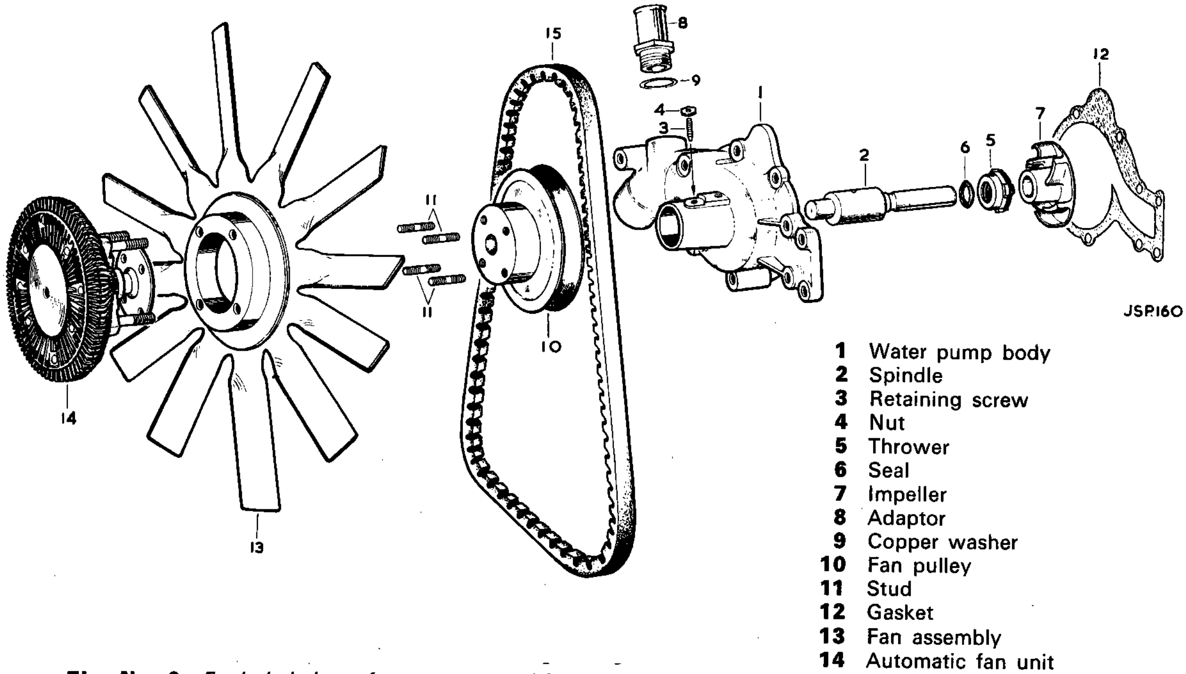
Unscrew the setscrews attaching the water pump to the cylinder block and withdraw the pump.

DISMANTLING

Remove the water pump pulley by means of a suitable extractor as shown in Fig. 10.

Slacken off the locknut (4, Fig. 9) and remove lock-screw (3, Fig. 9).

Remove the spindle and impeller assembly from the pump body. This assembly must not be pushed out by means of a shaft, or the bearing will be damaged. A tube measuring $1\frac{3}{32}$" (27.77 mm.) outside diameter and a $\frac{31}{32}$" (24.61 mm.) inside diameter must be used as shown (Fig. 12).



1 Water pump body
2 Spindle
3 Retaining screw
4 Nut
5 Thrower
6 Seal
7 Impeller
8 Adaptor
9 Copper washer
10 Fan pulley
11 Stud
12 Gasket
13 Fan assembly
14 Automatic fan unit
15 Belt

Fig. No. 9 *Exploded view of waterpump and fan*

CHECKING

Thoroughly clean all parts of the pump, except the spindle and bearing assembly, in a suitable cleaning solvent.

The bearing is a permanently sealed and lubricated assembly and therefore must not be washed in solvent. Inspect the bearing for excessive end play and remove any burrs, rust or scale from the shaft with fine emery paper. Prevent emery dust from entering the bearing by covering with a cloth.

If there are any signs of wear or corrosion in the bearing bore or on the face in front of the impeller, the housing should be renewed.

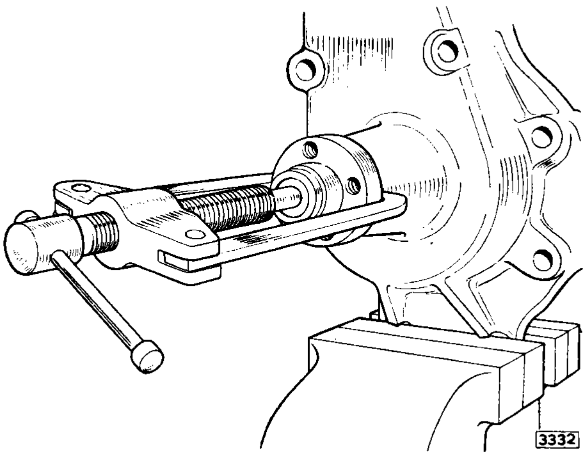


Fig. No. 10 *Withdrawing the fan hub from the spindle*

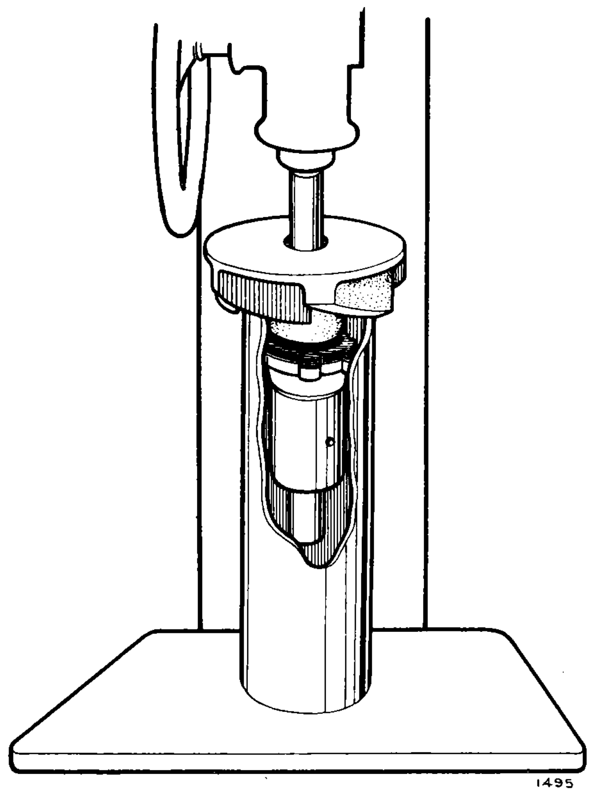


Fig. No. 11 *Removing the water pump impeller from the pump spindle*

REASSEMBLY

Install the shaft and bearing assembly into the pump body from the rear and line up the location hole in the bearing with the tapped hole in the body. Fit the locating screw and locknut. Place the rubber thrower in its groove on the spindle in front of the seal.

Coat the outside of the brass seal housing with a suitable water resistant jointing compound and fit into the recess in the pump body.

Press on the impeller as shown in Fig. 12 until the rear face of the impeller is flush with the end of the spindle. Press the water pump pulley onto the spindle until it is flush with the end of the shaft (Fig. 13).

REFITTING

Refitting is the reverse of the removal procedure, although care should be taken to renew the water pump to timing cover gasket, lightly smearing with grease before fitting. Refit the fan belt as previously described.

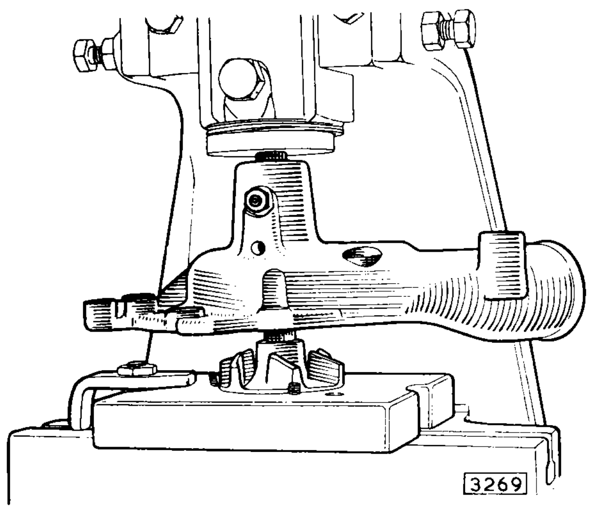


Fig. No. 12 *Fitting the impeller*

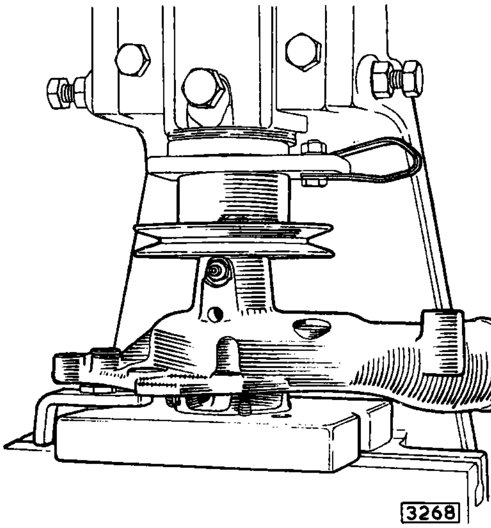


Fig. No. 13 *Pressing the water pump pulley on to the spindle*

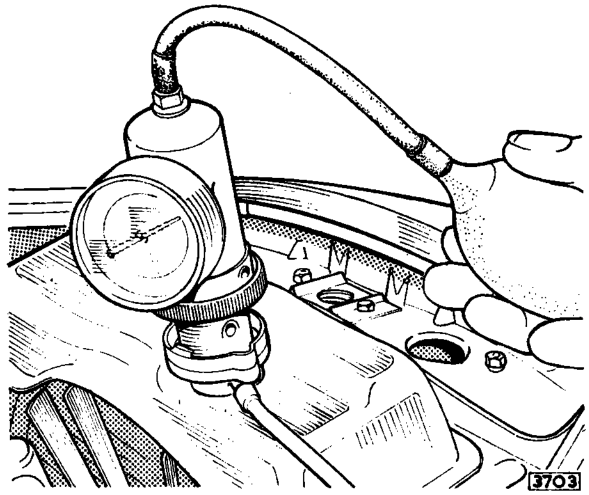


Fig. No. 14 *Pressure testing the cooling system*

WATER TEMPERATURE GAUGE

The indicator head is fitted in the instrument panel and operates on a thermal principle using a bi-metal strip surrounded by a heater winding.

The transmitter unit is mounted in the inlet manifold water jacket adjacent to the thermostat.

For a full description and a fault analysis of this instrument refer to pages P.51 and P.55.

PRESSURE TESTING RADIATOR CAP AND COOLING SYSTEM

The radiator cap and cooling system can be pressure tested and checked for leaks with the aid of the A.C. Delco Cooling Systems Tester RCT-1 (see Figs. 14, 15). This equipment is obtainable from A.C.—Delco Division of General Motors.

Fig. No. 15 *Pressure testing the radiator cap*

CLUTCH

SECTION D

INDEX

CLUTCH

DESCRIPTION

A diaphragm spring clutch is fitted to all cars equipped with standard transmission.
The diaphragm spring is riveted inside the cover pressing with two fulcrum rings interposed between the shoulders of the rivets and the cover pressing. The diaphragm spring also pivots on these two fulcrum rings. Depressing the clutch pedal actuates the release bearing causing a corresponding deflection of the diaphragm spring thus pulling the pressure plate from the driven plate and freeing the clutch.

DATA

Make	Borg and Beck
Model	BB9/412G
Clutch Release Bearing . .	Graphite
Operation	Hydraulic
Hydraulic Fluid .	Castrol/Girling Crimson Clutch/Brake Fluid

ROUTINE MAINTENANCE

EVERY 3,000 MILES (5,000 K.M.)
Check the level of the fluid in the reservoir located under the bonnet.

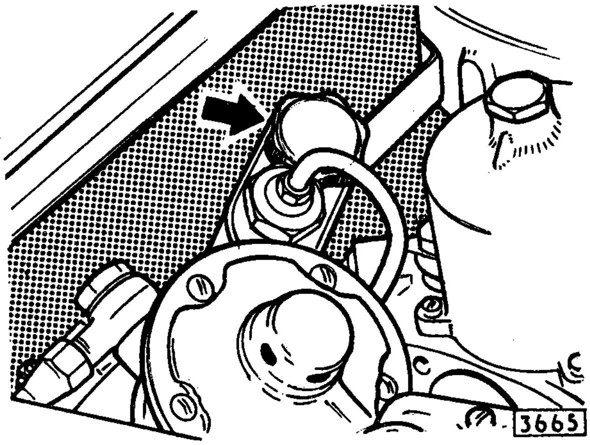


Fig. No. 1 *Location of clutch fluid reservoir (R.H.D.)*

Top up if necessary with the recommended grade of fluid to the bottom of the filler neck.

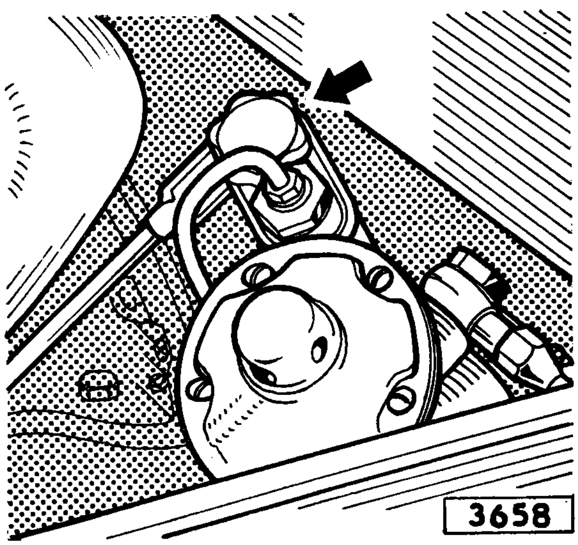


Fig. No. 2 *Location of clutch fluid reservoir (L.H.D.)*

Recommended Hydraulic Fluid
Castrol/Girling Crimson Clutch/Brake fluid is recommended. This conforms to SAE 70 R3 specifications but has a higher boiling point for additional safety.
The mixture of Castrol/Girling Crimson with a different fluid already existing in the system, is undesirable.
If Castrol/Girling Crimson is not readily available, only a fluid guaranteed to conform to SAE 70 R3 specifications may be used as an alternative.
In the event of deterioration of rubber seals and hoses due to the use of incorrect fluid, all the seals and hoses must be replaced and the system thoroughly flushed and refilled with one of the above fluids.

HYDRAULIC SYSTEM— GENERAL INSTRUCTIONS

Should it be found necessary to dismantle any part of the clutch system (that is, master cylinder or slave cylinder) the operation must be carried out under conditions of scrupulous cleanliness. Clean the mud and grease off the unit before removal from the vehicle and dismantle on a bench covered with a sheet of clean paper. Do not swill a complete unit after removal from the vehicle, in paraffin, petrol or trichlorethylene (trike) as this would ruin the rubber parts and, on dismantling, give a misleading impression of their original condition. Do not handle the internal parts, particularly rubbers, with dirty hands. Place all metal parts in a tray of clean brake fluid to soak; afterwards dry off with a clean, fluffless cloth, and lay out in order on a sheet of clean paper. Rubber parts should be carefully examined and if there is any sign of swelling or perishing, they should be renewed; in any case it is usually good policy to renew **all** rubbers. The main castings may be swilled in any of the normal cleaning fluids, but all traces of the cleaner must be dried out before assembly. In the case of the master cylinder, make sure that the by-pass port is clear by probing with a bent piece of wire not exceeding .018" (0.46 mm.) diameter.
If the by-pass port is clogged, rapid wear of the release bearing or clutch slip will result due to pressure being built up in the system.
All internal parts should be dipped in clean brake fluid and assembled wet, as the fluid acts as a lubricant. Rubber parts should be assembled by hand only.

BLEEDING THE SYSTEM

"Bleeding" the clutch hydraulic system (expelling air) is not a routine maintenance operation and should only be necessary when a portion of the hydraulic system has been disconnected or if the level of the fluid in the reservoir has been allowed to fall. The presence of air in the hydraulic system may result in difficulty in engaging gear owing to the clutch not disengaging fully.

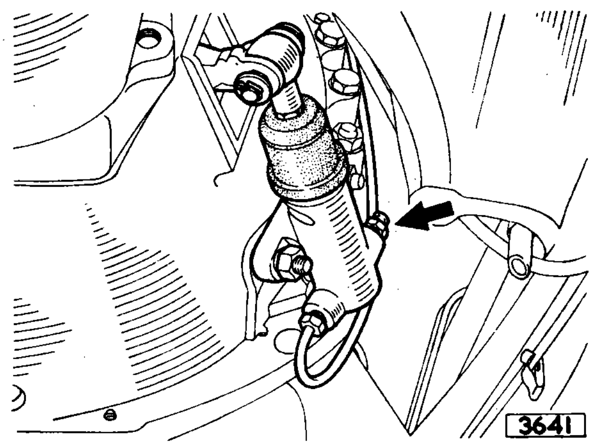


Fig. No. 3 *Location of clutch slave cylinder bleed nipple*

Fill up the master cylinder reservoir with brake fluid exercising great care to prevent the entry of dirt. Attach a rubber bleed tube to the nipple on the slave cylinder on the right-hand side of the clutch housing and allow the tube to hang in a clean glass jar partly filled with brake fluid. Unscrew the nipple one complete turn. Depress the clutch pedal slowly, **tighten the bleeder nipple before the pedal reaches the end of its travel** and allow the pedal to return unassisted.
Repeat the above procedure, closing the bleed nipple at each stroke, until the fluid issuing from the tube is entirely free from air, care being taken that the reservoir is replenished **frequently** during this operation, for should the level be allowed to drop below half-way air will enter the system.
On completion, top up the master cylinder reservoir to the bottom of the filler neck.
Do not, on any account, use the fluid which has been bled through the system to replenish the reservoir, as it will have become aerated. Always use fresh fluid straight from the tin.

FLUSHING THE SYSTEM

Should the fluid in the system become thick or "gummy" after many years in service, or after a vehicle has been laid up for some considerable time, the system should be drained, flushed and refilled. It is recommended that this should be carried out once every five years. Pump all fluid out of the hydraulic system through the bleeder screw of the clutch slave cylinder. To the bleeder screw on the slave cylinder, connect one end of a rubber tube and allow the other end to fall into a container, slacken the screw one complete turn and pump the clutch pedal by depressing it quickly and allowing it to return without assistance; repeat, with a pause between each operation, until no more fluid is expelled. Discard the fluid extracted.

Fill the supply tank with industrial methylated spirit and flush the system as described above. Keep the supply tank replenished until at least a quart of spirit has passed through the bleeder screw.

Remove the master cylinder and pour off any remaining spirit. Refit the master cylinder, refill with clean brake fluid and "bleed" the system.
Note: If the system has been contaminated by the use of mineral oil, etc., the above process will not prove effective. It is recommended that the various units, including the pipe lines, be dismantled and thoroughly cleaned and that all rubber parts, including flexible hoses, be renewed. The contaminated fluid should be destroyed immediately.

REMOVAL AND REFITTING A FLEXIBLE HOSE

In some cases, the cause of faulty clutch may be traced to a choked flexible hose. Do not attempt to clear the obstruction by any means except air pressure, otherwise the hose may be damaged. If the obstruction cannot be cleared, the hose must be replaced by a new one.

Removal

To renew a flexible hose, adopt the following procedure:—
Unscrew the tube nut from the hose union, then unscrew the locknut and withdraw the hose from the bracket. Disconnect the hose at the other end.

Refitting

When refitting a hose, first ensure that it is not twisted or "kinked" (this is MOST IMPORTANT) then pass the hose union through the bracket and, whilst holding the union with a spanner to prevent the hose from turning, fit the locknut and the shakeproof washer; connect up the pipe by screwing on the tube-nut.

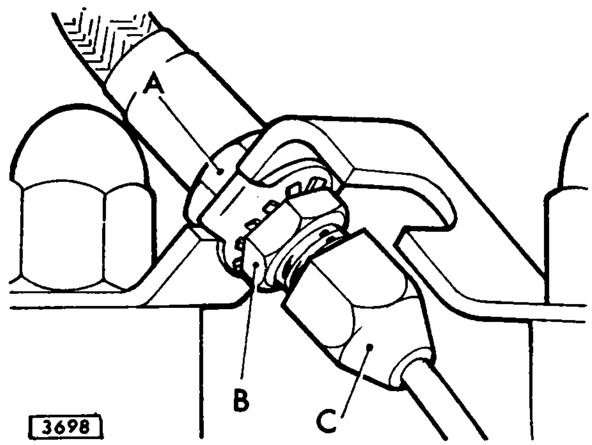


Fig. No. 4 *The flexible hose connections*

THE MASTER CYLINDER

The master cylinder consists mainly of a tank and barrel assembly (1, Fig. 5), the former surrounds the latter and is secured by soldering; at one end of the barrel a fixing flange is mounted, and this is secured in the same manner. The tank is fitted with a filler cap (2) which incorporates a baffle and screws down against a seal. A piston (7) is contained within the barrel, and has a rubber main cup (5) spring loaded against its inner end; between the cup and the piston a thin washer (6) is interposed to prevent the cup from being drawn into the small feed holes drilled around the piston head. The outer end of the piston carries a rubber secondary cup (8) and is formed with a depression to receive the spherical end of a push rod (9) which carries a piston stop and is retained by a circlip (10). A rubber boot (11), through which the push rod passes, is fitted on to the barrel to prevent the intrusion of dirt and moisture.
At the end opposite to the push rod, an end plug screws against a gasket and forms the outlet connection.

Principle of Operation

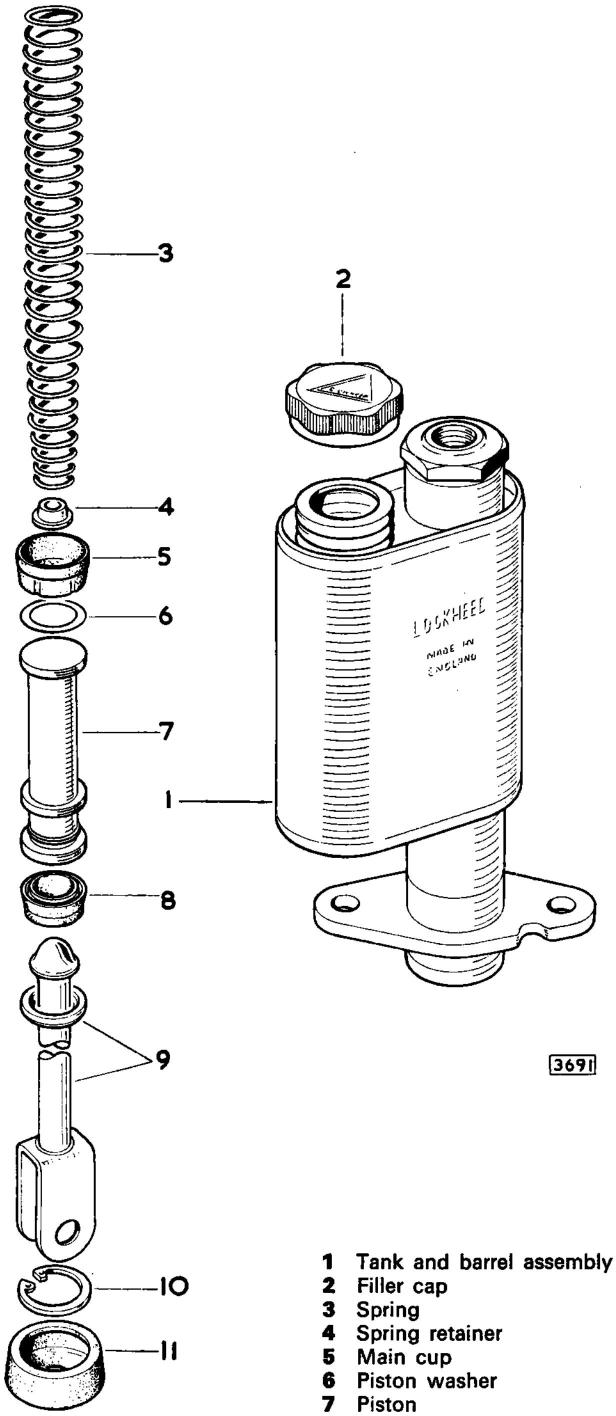
Depressing the clutch pedal causes the push rod to thrust the piston along the bore of the barrel, and the fluid thus displaced passes to the slave cylinder. Upon removal of the load from the clutch pedal, the return spring thrusts the piston back against its stop faster than fluid is able to return from the slave cylinder; this creates a depression in the master cylinder which draws the edge of the main cup away from the head of the piston and allows fluid from the tank to flow through the feed holes thus uncovered to make up the temporary deficiency. Meanwhile fluid returning from the slave cylinder, under load from the operating fork return spring, re-enters the master cylinder.
When the piston is fully back against its stop, the main cup uncovers a small by-pass port in the barrel, and this allows the release of excess fluid to the tank, thus permitting the operating fork to return to the "fully engaged" position; the by-pass port also compensates for contraction or expansion of the fluid, due to changes in temperature, allowing fluid to be drawn into or escape from the system. Should this port become blocked, the excess fluid would be unable to escape and the clutch would consequently slip.

Removal

Disconnect the outlet pipe from the end of the master cylinder; detach the push rod fork end from the clutch pedal; unscrew the fixing bolts and detach the master cylinder from the vehicle. Remove the filler cap (2) drain the fluid into a clean container, and replace the cap.

Dismantling

(1) Detach the rubber boot (11) from the end of the barrel, and move the boot along the push rod. Depress the push rod to relieve the spring load from the circlip (10), remove the circlip and with-



1 Tank and barrel assembly
2 Filler cap
3 Spring
4 Spring retainer
5 Main cup
6 Piston washer
7 Piston
8 Secondary cup
9 Push rod
10 Circlip
11 Rubber boot

Fig. No. 5 *Exploded view of the master cylinder*

draw the push rod, the piston (7), the piston washer (6), the main cup (5) and the spring (3). The end plug should not normally need to be removed from the barrel.
(2) Remove the secondary cup (8) by stretching it over the head of the piston.

Assembling
(1) If previously removed, fit the end plug and a new gasket.
(2) Fit the spring retainer (4) on to the small end of the spring; if the retainer is new the ears are to be bent over to secure it on the spring.
(3) Insert the spring, large end leading, into the barrel. Follow up with the main cup (5), lip leading, taking care not to turn back or buckle the lip.
(4) Insert the piston washer (6) so that the curved edge is towards the cup.
(5) Using the fingers only, stretch the secondary cup (8) on to the piston, with the small end towards the head, (that is, the drilled end) and with the groove engaging the ridge; gently work round the cup with the fingers to ensure correct bedding.
(6) Insert the piston in the barrel, with the head uppermost.
(7) If previously removed, stretch the rubber boot (11) on to the push rod, with the open end of the boot towards the spherical end of the push rod.
(8) Offer up the push rod to the barrel, push inwards and secure the piston stop, which is on the push rod, by fitting the circlip (10) at the end of the bore; it is MOST IMPORTANT that the circlip be correctly fitted in its groove. Stretch the large end of the boot on to the end of the barrel and into its correct position.
(9) Fill the tank with clean brake fluid to within half an inch of the filler cap orifice, and refit the filler cap (2) together with the seal; ensure that the filler cap is securely tightened, using a coin. With the master cylinder upright, filler cap at the top, test by pushing the push rod and piston further into the bore and allowing it to return unassisted; after one or two applications, fluid should flow from the outlet connection.

Refitting
Secure the master cylinder to the vehicle by fitting the fixing bolts through the flange. Connect the pipe to the outlet connection, the push rod to the pedal, refill with fluid and bleed the system. Check for leaks by depressing the clutch pedal once or twice and examining all hydraulic connections.

THE SLAVE CYLINDER
The clutch slave cylinder consists of a body (4, Fig. 6) which incorporates two threaded connections and is bored to accommodate a piston (5) against the inner face of which a rubber cup (3) is loaded by a cup filler (2) and a spring (1); the travel of the piston is limited by a circlip (6) fitted in a groove at the end of the bore. A rubber boot (7) through which a push-rod passes, is fitted on the body to prevent the intrusion of dirt or moisture.

One of the connections in the body receives a pipe from the clutch master cylinder, whilst the other is fitted with a bleeder screw; the connection for the pipe is parallel to the mounting flange on the body.

Removal
To remove from the vehicle, disconnect the pipe, detach the rubber boot from the body and remove the fixing screws; leave the push-rod attached to the vehicle. If the boot is not being renewed it may be left on the push-rod.

Dismantling
Remove the circlip (6) from the end of the bore and apply a **low** air pressure to the open connection to expel the piston (5) and other parts; remove the bleeder screw.

Assembling
Prior to assembly, smear all internal parts and the bore of the body with Rubberlube.
Fit the spring (1) in the cup filler (2) and insert these parts, spring uppermost, into the bore of the body (4). Follow up with the cup (3) lip leading, taking care not to turn back or buckle the lip; then insert the piston (5), flat face innermost, and fit the circlip (6) into the groove at the end of the bore.

Refitting
Fit the rubber boot (7) on the push-rod, if removed previously, and offer up the slave cylinder to the vehicle, with the push-rod entering the bore. Secure the cylinder with the fixing screws and stretch the large end of the boot into the groove on the body. Fit into their respective connections, the bleeder screw and the pipe from the clutch master cylinder.
When refitting the hydrostatic clutch slave cylinder it is IMPORTANT that the operating rod adjustment dimension (as shown in Fig. 7) is adhered to.
To obtain this dimension, proceed as follows:—
(1) Extract the clevis pin securing the operating rod to the clutch lever.

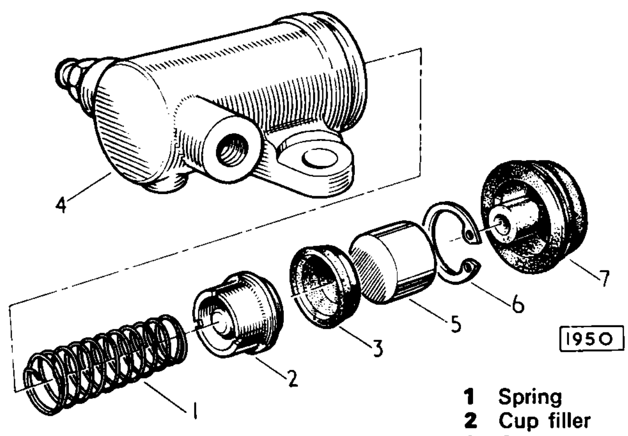


Fig. No. 6 *The hydrostatic clutch slave cylinder*

1 Spring
2 Cup filler
3 Cup
4 Body
5 Piston
6 Circlip
7 Rubber boot

(2) Release the fork end locknut.
(3) Push the clutch operating lever away from the slave cylinder until resistance is felt and retain in this position.
(4) Push the operating rod to the limit of its travel in to the slave cylinder and adjust the fork end to a dimension of .75" (19 mm.) between the centre of the fork end and the centre of the clutch operating lever. Tighten the locknut.
(5) Release the operating rod and connect the fork end to the lever. Refit the clevis pin.
(6) Bleed the clutch slave cylinder in the normal manner.

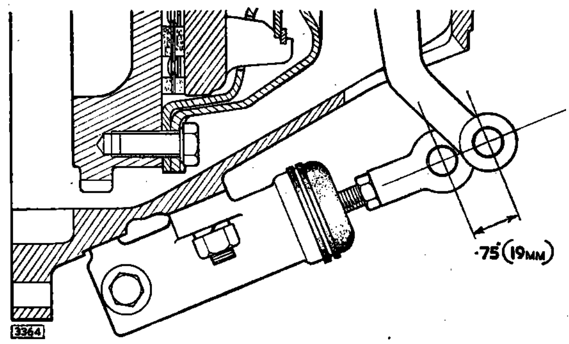
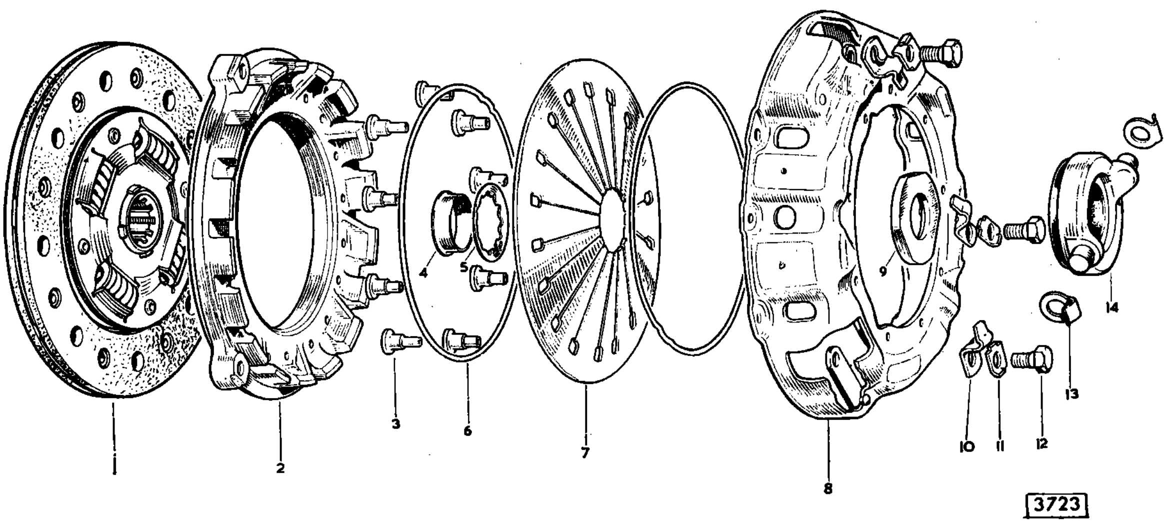


Fig. No. 7 *Setting dimension for refitting hydrostatic clutch slave cylinder*

THE CLUTCH UNIT



1	Driven plate	**6**	Fulcrum ring	**11**	Tab washer
2	Pressure plate	**7**	Diaphragm spring	**12**	Setscrew
3	Rivet	**8**	Cover pressing	**13**	Retainer
4	Centre sleeve	**9**	Release plate	**14**	Release bearing
5	Belleville washer	**10**	Retainer		

Fig. No. 8 *Exploded view of the diaphragm spring clutch*

SERVICING

The Borg and Beck diaphragm spring clutch is serviced in the U.K. ONLY by fitting an exchange unit which is available from the Works, Spares Division, Coventry. Individual parts are available from the same source for the repair of this clutch in Overseas Markets where exchange units may not be readily available. IT IS ESSENTIAL when overhauling the diaphragm spring clutch, to rigidly observe the service instructions detailed below and particular attention is drawn to the necessary special tools required.

GENERAL INSTRUCTIONS

To enable the balance of the assembly to be preserved after dismantling, there are corresponding paint marks on the cover plate and driving plate. In addition, there are corresponding reference numbers stamped in the flanges of the cover and driving plate.
When reassembling ensure that the markings coincide, and that, when refitting the clutch to the flywheel, the letter "B" stamped adjacent to one of the dowel holes coincides with the "B" stamped on the edge of the flywheel.

The clutch is balanced in conjunction with the flywheel by means of loose balance pieces which are fitted under the appropriate securing bolt. Each balance piece must be refitted in its original position, the number stamped on the balance weight corresponding to the number stamped on the cover plate. There are three balance weights stamped 1, 2 and 3, the weight stamped 3 being the heaviest.
If the graphite release bearing ring is badly worn it should be replaced by a complete bearing assembly.

CLUTCH REMOVAL

In order to remove the clutch, the engine and gearbox must first be removed (see Page A.32).
Remove gearbox and clutch housing from engine.
Remove the bolts securing the clutch to the flywheel and withdraw the clutch assembly.
Retain any balance weight fitted.

DISMANTLING

Removing Release Plate

The centrally mounted release plate is held in position by a small centre sleeve which passes through the diaphragm spring and belleville washer into the release plate.
To free the plate, collapse the centre sleeve with a hammer and chisel. To avoid any possible damage whilst carrying out this operation, support the release plate in the locating boss of the special tool which should be held firmly in a vice.

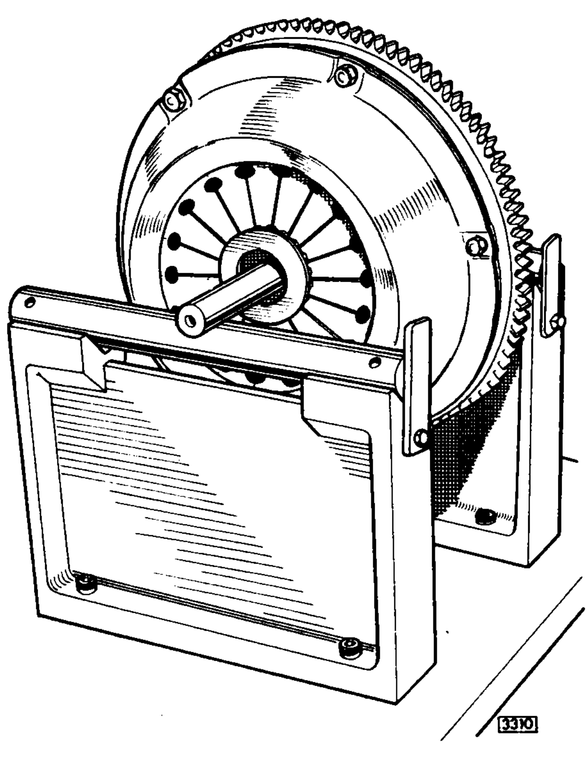


Fig. No. 9 *Clutch and flywheel balancing*

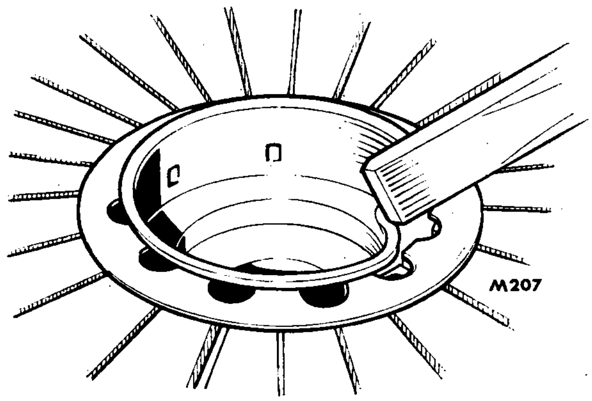


Fig. No. 10 *Collapsing the centre sleeve with a hammer and chisel*

Separating the Pressure Plate from Cover Pressing

Knock back the locking tabs and remove the three setscrews securing the pressure plate to the straps riveted to the cover pressing. These straps within the cover pressing must NOT be detached as this is an assembly reduced to its minimum as a spare part.

Dismantling the Cover Assembly

Remove the rivets securing the diaphragm spring and fulcrum rings by machining the shank of the rivets using a spot face cutter.
IT IS ESSENTIAL that the thickness of the cover is not reduced in excess of .005" (.127 mm.) at any point. The remaining portions of the rivets may be removed with a standard pin punch.

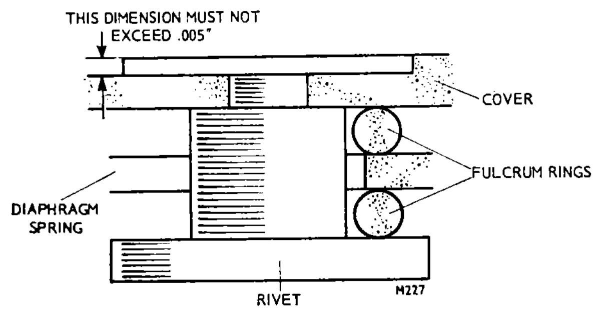


Fig. No. 11 *Do not reduce the thickness of the cover pressing in excess of .005" (.127 mm.).*

REBUILDING

The Cover Assembly

Prior to rebuilding, check the cover pressing for distortion. Bolt the cover firmly to a **flat** surface plate and check that a measurement taken at various points from the cover flange to the machined land inside the cover pressing do not vary by more than .007" (.2 mm.). If the measurement exceeds this figure the cover must be replaced.

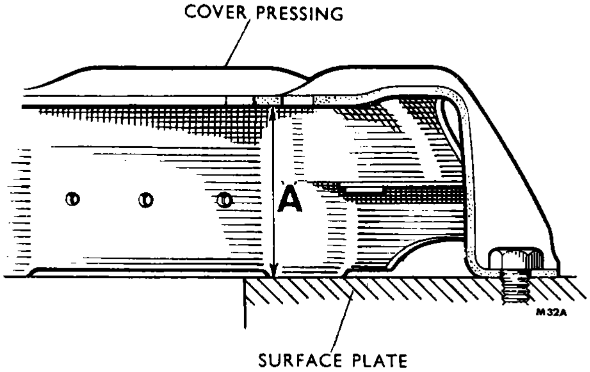
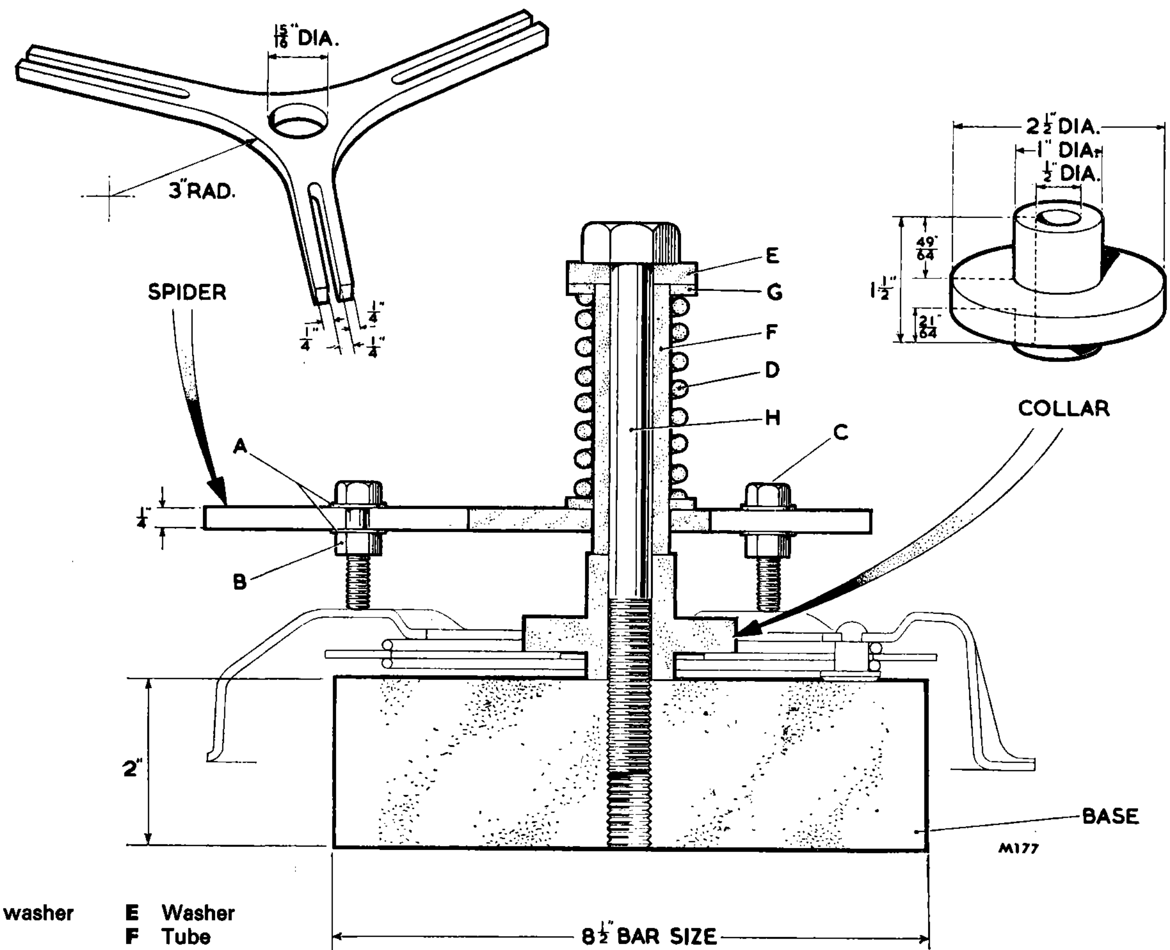


Fig. No. 12 *The measurement "A" must not vary by more than .007" (.2 mm.).*

To achieve a satisfactory result when riveting the diaphragm spring into the cover pressing, a special tool must be fabricated to the specifications given in Fig. 13.

All parts except the spring can be made from mild steel. Position the fulcrum ring inside the cover pressing so that the location notches in the fulcrum ring engage a depression between two of the larger diameter holes in the cover pressing.

Place the diaphragm spring on the fulcrum ring inside the cover and line the long slots in the spring with the small holes in the cover pressing. Locate a further fulcrum ring on the diaphragm spring so that the location notches are diametrically opposite the location notches in the first ring. Fit new shouldered rivets, ensuring that the shouldered portion of each seats on the machined land inside the cover.



A Flat washer
B Nut
C Setscrew
D Spring
E Washer
F Tube
G Washer
H Bolt

Fig. No. 13 *Dimension of special tool for compressing the diaphragm spring when rivetting the spring to cover pressing.*

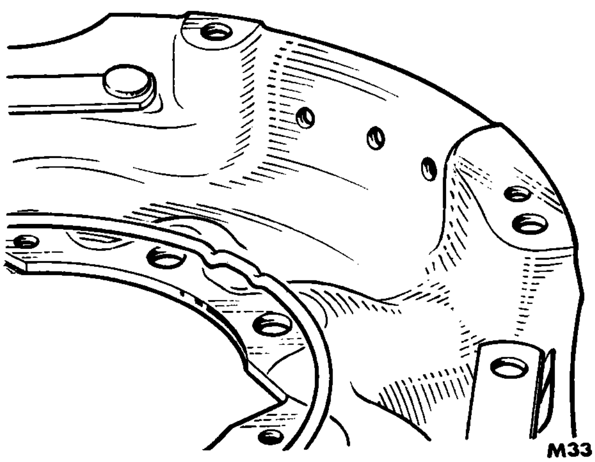


Fig. No. 14 *Assembly of cover pressing and fulcrum ring*

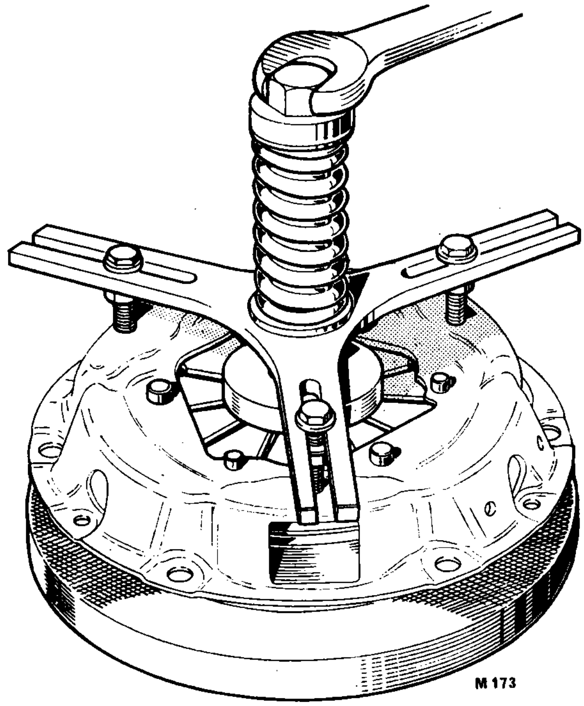


Fig. No. 16 *Tighten down the large nut so that the diaphragm spring is compressed flat*

Place the base of the special tool on to the rivet heads. Invert the clutch and base plate.
Fit the collar to the large bolt and fit the large bolt complete with spring, spider and collar into the tapped hole in the base. Position the three setscrews on the spider so that they contact the cover pressing. Tighten down the centre bolt until the diaphragm spring becomes flat and the cover pressing is held firmly by the setscrews.

Rivet securely with a hand punch.

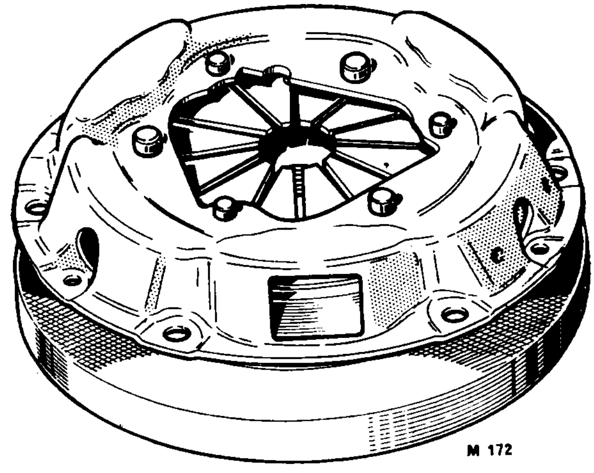


Fig. No. 15 *Clutch and base plate inverted*

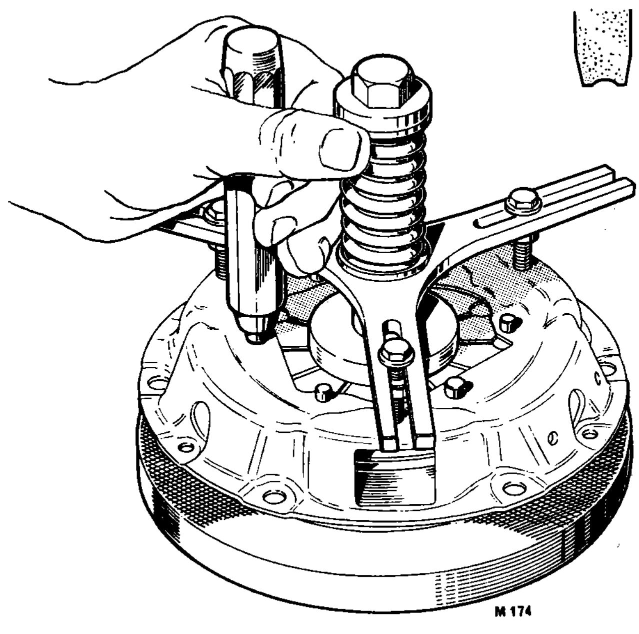
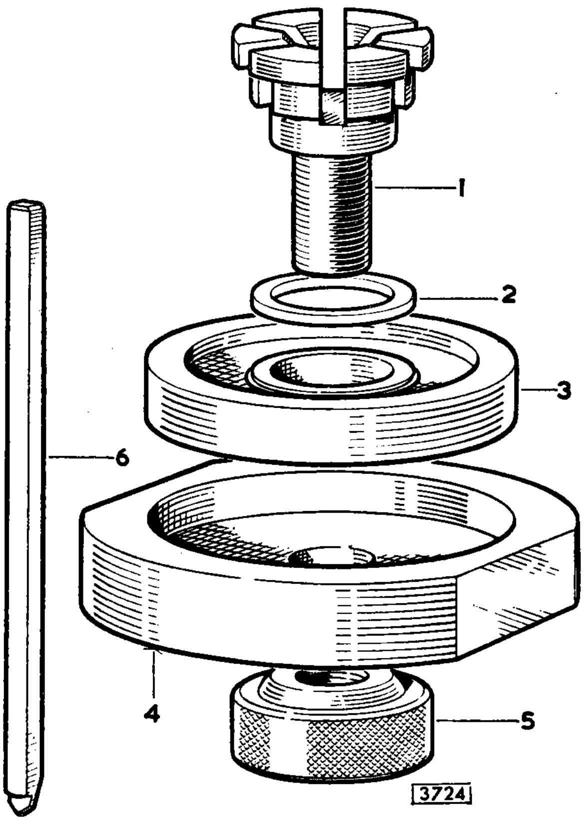


Fig. No. 17 *Rivetting with a hand punch*

Assembling the Pressure Plate to Cover Pressing
Before assembling the pressure plate to the cover pressing, examine the plate for any signs of wear. Should it have been damaged or have excessive scoring, it is strongly recommended that a new plate is fitted. If, however, renewal of the pressure plate is not possible, grinding of the original unit may be undertaken by a competent machinist, bearing in mind that incorrect grinding of the plate may seriously affect the operation of the clutch. IN NO CIRCUMSTANCES MUST THE PRESSURE PLATE BE GROUND TO A THICKNESS OF LESS THAN 1.070" (27.178 mm.).
Position the pressure plate inside the cover assembly so that the lugs on the plate engage the slots in the cover pressing. Insert the three setscrews through the straps which are rivetted to the cover pressing and lock with the tab washers.

Fitting a New Release Plate
A special tool (Part number SSC.805) is available from Automotive Products Ltd., Service and Spares Division, Banbury, England, for completion of this operation. Ensure that all parts of the clutch and special tool are clean.



1 Staking guide
2 Washer
3 Locating base
4 Base plate
5 Knurled nut
6 Punch

Fig. No. 18 *Special Tool (SSC805)*

Grip the base of the tool in a vice and place the locating boss into the counterbore of the base plate. Place the release plate, face downwards, into the counterbore of the locating boss.
Apply a little high melting point grease to the tips of the diaphragm spring fingers and position the clutch, pressure plate friction face upwards, on to the release plate.
Place the belleville washer, concave surface towards the spring, on to the centre of the diaphragm spring and then push the centre sleeve through the spring into the release plate.

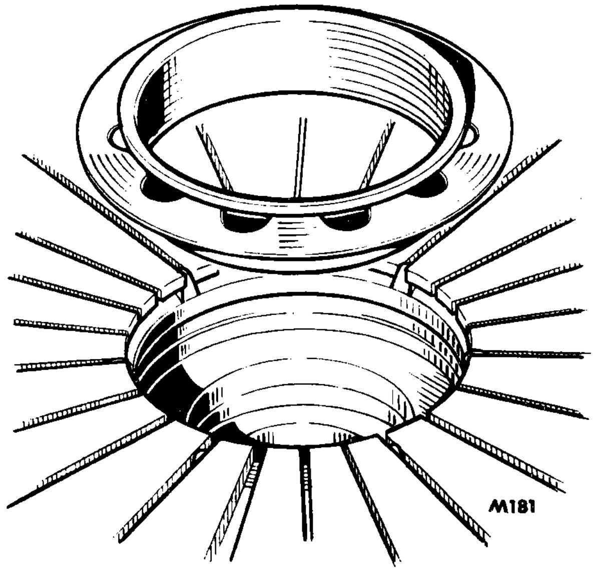


Fig. No. 19 *Fitting the sleeve and belleville washer*

Drop the special washer into the sleeve and insert the staking guide into the centre of the assembly. Fit the knurled nut to the thread on the staking guide, tighten down until the whole assembly is solid. Using the special punch, stake the centre sleeve in six places into the groove in the release plate.

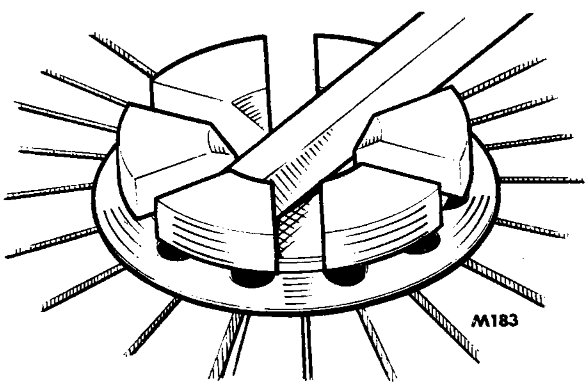


Fig. No. 20 *Staking the sleeve to the release plate*

REFITTING
Place the driven plate on the flywheel, taking care that the larger part of the splined hub faces the gearbox. Centralize the plate on the flywheel by means of the dummy shaft (a constant pinion shaft may be used for this purpose). Secure the cover assembly with the six setscrews and spring washers, tightening the screws a turn at a time by diagonal selection. Ensure that the "B" stamped adjacent to one of the dowel holes coincides with the "B" stamped on the periphery of the flywheel.

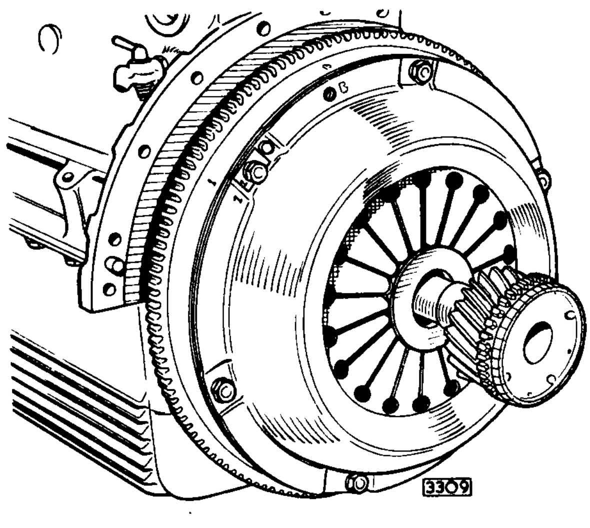


Fig. No. 21 *Centralising the driven plate on the flywheel by means of a dummy plate*

CONDITION OF CLUTCH FACINGS

The possibility of further use of the friction facings of the clutch is sometimes raised, because they have a polished appearance after considerable service. It is natural to assume that a rough surface will give higher frictional value against slipping, but this is not correct. Since the introduction of non-metallic facings of the moulded asbestos type, in service a polished surface is a common experience, but it must not be confused with a glazed surface which is sometimes encountered due to the conditions discussed below.
The ideal smooth or polished condition will provide a normal contact, but a glazed surface may be due to a film or a condition introduced, which entirely alters the frictional value of the facings. These two conditions might be simply illustrated by the comparison between a polished wood and a varnished surface. In the former the contact is still made by the original material whereas, in the latter instance, a film of dried varnish is interposed between the contact surfaces.
The following notes are issued with a view to giving useful information on this subject:—

(a) After the clutch has been in use for some little time under perfect conditions (that is, with the clutch facings working on true and polished or ground surfaces of correct material, without the presence of oil, and with only that amount of slip which the clutch provides for under normal conditions) then the surface of the facings assumes a high polish, through which the grain of the material can be clearly seen. This polished facing is of mid-brown colour and is then in a perfect condition.
(b) Should oil in small quantities gain access to the clutch in such a manner as to come into contact with the facings, it will burn off due to the heat generated by slip which occurs under normal starting conditions. The burning off of the small amount of lubricant has the effect of gradually darkening the facings, but provided the polish on the facings remains such that the grain of the material can be clearly distinguished, it has very little effect on clutch performance.
(c) Should increased quantities of oil or grease obtain access to the facing, one or two conditions, or a combination of the two, may arise, depending upon the nature of oil, etc.
   (i) The oil may burn off and leave on the surface a carbon deposit which assumes a high glaze and causes slip. This is a very definite, though very thin deposit, and in general it hides the grain of the material.
   (ii) The oil may partially burn and leave a resinous deposit on the facings, which frequently produces a fierce clutch, and may also cause a "spinning" clutch due to a tendency of the facings to adhere to the flywheel or pressure plate face.
   (iii) There may be a combination of (i) and (ii) conditions which is likely to produce a judder during clutch engagement.
(d) Still greater quantities of oil produces a black soaked appearance to the facings, and the effect may be slip, fierceness, or judder in engagement, etc., according to the conditions. If the conditions under (c) or (d) are experienced, the clutch driven plate should be replaced by one fitted with new facings, the cause of the presence of oil removed and the clutch and flywheel face thoroughly cleaned.

FAULT FINDING

SYMPTOM	CAUSE	REMEDY
Drag or Spin	(a) Oil or grease on the driven plate facings.	Fit new facings or replace plate.
	(b) Misalignment between the engine and splined clutch shaft.	Check over and correct the alignment.
	(c) Air in clutch system.	"Bleed" system. Check all unions and pipes.
	(d) Bad external leak between the clutch master cylinder and the slave cylinder.	Renew pipe and unions.
	(e) Warped or damaged pressure plate or clutch cover.	Renew defective part.
	(f) Driven plate hub binding on splined shaft.	Clean up splines and lubricate with small quantity of high melting point grease.
	(g) Distorted driven plate due to the weight of the gearbox being allowed to hang on clutch plate during assembly.	Fit new driven plate assembly using a jack to take overhanging weight of the gearbox.
	(h) Broken facings of driven plate	Fit new facings, or replace plate.
	(i) Dirt or foreign matter in the clutch.	Dismantle clutch from flywheel and clean the unit; see that all working parts are free. **Caution:** Never use petrol or paraffin for cleaning out clutch.
Fierceness or Snatch	(a) Oil or grease on driven plate facings.	Fit new facings and ensure isolation of clutch from possible ingress of oil or grease.
	(b) Misalignment.	Check over and correct alignment.
	(c) Worn out driven plate facings.	Fit new facings or replace plate.
Slip	(a) Oil or grease on driven plate facings.	Fit new facings and eliminate cause.
	(b) Seized piston in clutch slave cylinder.	Renew parts as necessary.
	(c) Master cylinder piston sticking.	Free off piston.
Judder	(a) Oil, grease or foreign matter on driven plate facings.	Fit new facings or driven plate.
	(b) Misalignment.	Check over and correct alignment.
	(c) Bent splined shaft or buckled driven plate.	Fit new shaft or driven plate assembly.
Rattle	(a) Damaged driven plate. (b) Excessive backlash in transmission. (c) Wear in transmission bearings. (d) Bent or worn splined shaft. (e) Release bearing loose on throw out fork.	Fit new parts as necessary.
Tick or Knock	Hub splines worn due to misalignment.	Check and correct alignment then fit new driven plate.
Fracture of Driven Plate	(a) Misalignment distorts the plate and causes it to break or tear round the hub or at segment necks.	Check and correct alignment and fit new driven plate.
	(b) If the gearbox during assembly be allowed to hang with the shaft in the hub, the driven plate may be distorted, leading to drag, metal fatigue and breakage.	Fit new driven plate assembly and ensure satisfactory re-assembly.
Abnormal Facing Wear	Usually produced by over-loading and by excessive clutch slip when starting.	In the hands of the operator.

GEARBOX AND OVERDRIVE

SECTION E

INDEX

Description Page

OVERDRIVE

GEARBOX

DESCRIPTION

The gearbox is of the four speed type with a baulk-ring synchromesh on all four forward gears. With the exception of the reverse, the detents for the gears are incorporated in the synchromesh assemblies, and the three synchro balls engaging with grooves in the operating sleeve.

The detent for reverse gear is a spring loaded ball which engages in a groove in the selector rod.

Two interlock balls and a pin located at the front of the selector rods prevent the engagement of two gears at the same time.

The gears are pressure fed at approximately 5lb. per sq. in. from a pump driven from the rear of the mainshaft on standard transmission cars and fed by an overdrive oil pump on overdrive transmission cars.

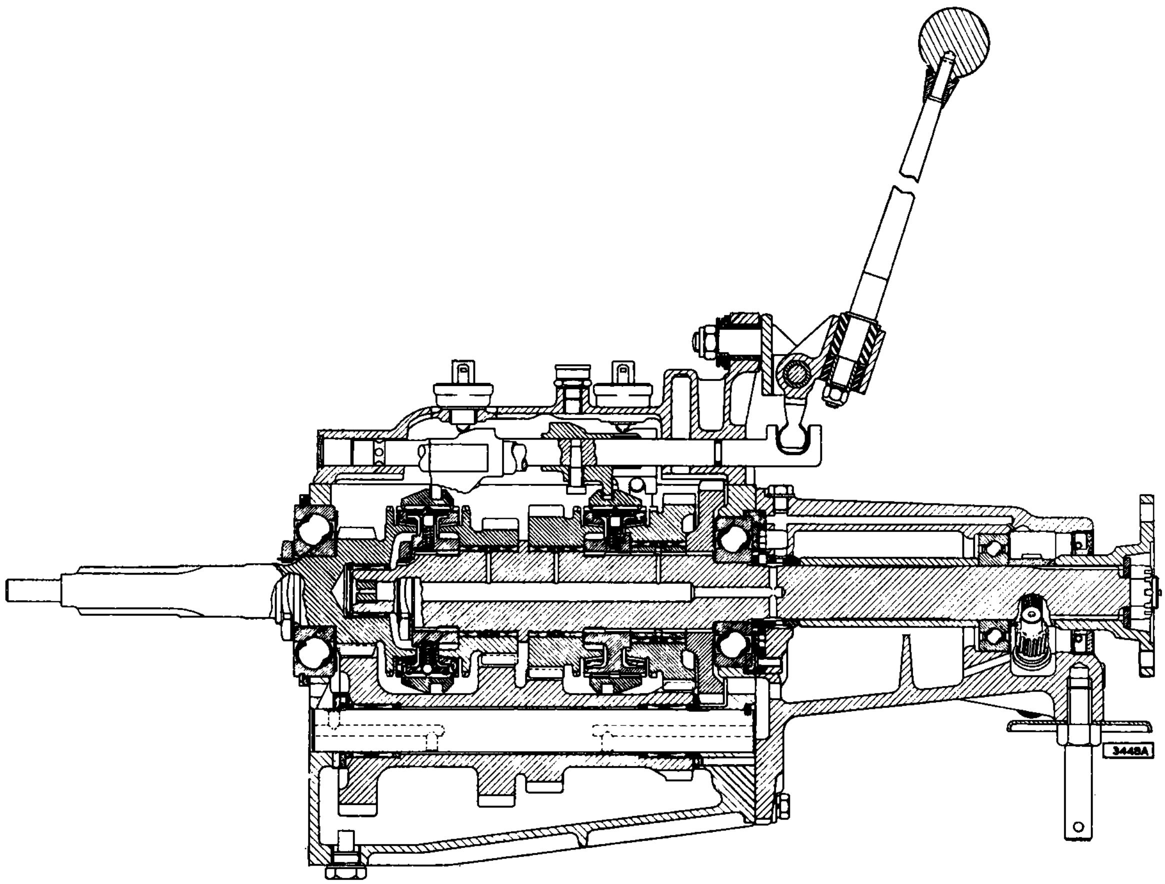


Fig. No. 1 *Longitudinal section of the gearbox*

DATA

Ratios:-

1st Gear	3.04 : 1
2nd Gear	1.973 : 1
3rd Gear	1.328 : 1
4th Gear	1.00 : 1
Reverse	3.49 : 1

1st gear-end float on mainshaft .005" to .007" (.13—.18 mm.).
2nd gear-end float on mainshaft .005" to .008" (.13—.20 mm.).
3rd gear-end float on mainshaft .005" to .008" (.13—.20 mm.).
Countershaft gear unit end float .004" to .006" (.10—.15 mm.).

ROUTINE MAINTENANCE

EVERY 3,000 MILES (5,000 KM)

Gearbox Oil Level

Check the level of the oil in the gearbox with the car standing on level ground.
A combined level and filler plug is fitted on the left hand side of the gearbox. Clean off any dirt from around the plug before removal.
The level of the oil should be to the bottom of the filler and level plug hole.

Overdrive Oil Level—Important

The oil for the lubrication and operation of the overdrive is fed from the gearbox casing and, therefore, checking the gearbox oil level will also check the level of oil in the overdrive unit, but as this unit is hydraulically controlled, extra attention should be paid to exercising absolute cleanliness when replenishing with oil. It is also important that the oil level is not allowed to fall appreciably, otherwise the operation of the overdrive will be affected.

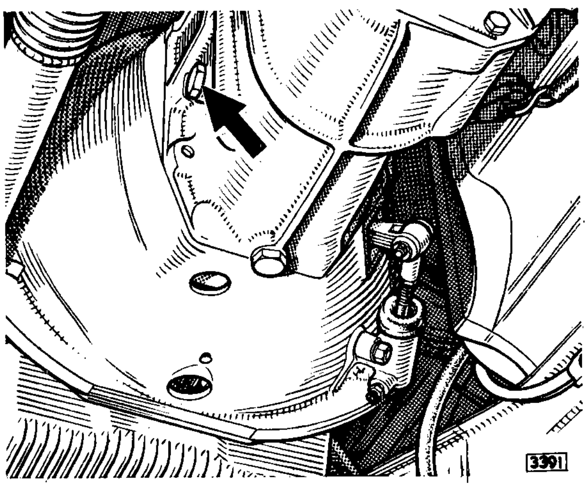


Fig. No. 2 *Gearbox oil level plug*

EVERY 12,000 MILES (20,000 KM)

Changing the Gearbox Oil

The draining of the gearbox oil should be carried out at the end of a run when the oil is hot and will therefore flow more freely.
The drain plug is situated at the front of the gearbox casing.
After all the oil has been drained, replace the drain plug and refill the gearbox with the recommended grade of oil through the combined level and filler plug hole. The level should be at the bottom of the hole.

Overdrive Oil Changing

The oil for the ovedrrive is common to that of the gearbox, but draining the oil from the gearbox will not drain the overdrive unit. When draining the gearbox, remove the filter plug (situated in the side of the overdrive unit) filter and magnetic washers. Thoroughly wash the filter and magnetic washers.
When dry, refit the filter, magnetic washers and filter plug. Fully tighten the filter plug and refill the gearbox and overdrive unit through the gearbox filler and level plug hole.
Recheck the level after the car has been run, as a certain amount of oil will remain in the hydraulic system of the overdrive.
Particular attention should be paid to maintaining absolute cleanliness when filling the gearbox and overdrive, as any foreign matter which enters may seriously affect the operation of the overdrive.

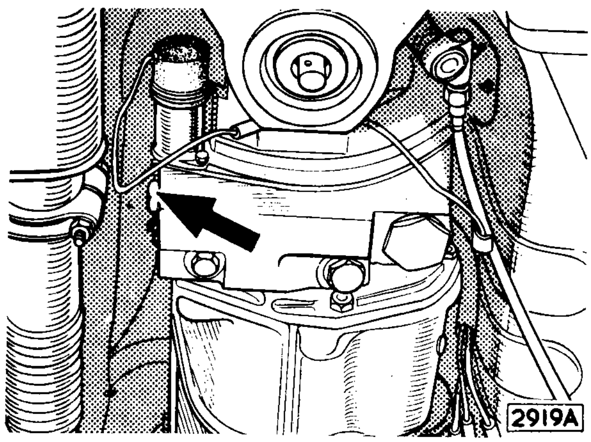


Fig. No. 3 *Overdrive filler plug*

RECOMMENDED LUBRICANTS

Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent Caltex/Texaco
Mobilube GX.90	Castrol Hypoy	Spirex E.P.90	Esso Gear Oil G.P.90/140	Gear Oil S.A.E.90 E.P.	Hypoid 90	Multigear Lubricant E.P.90

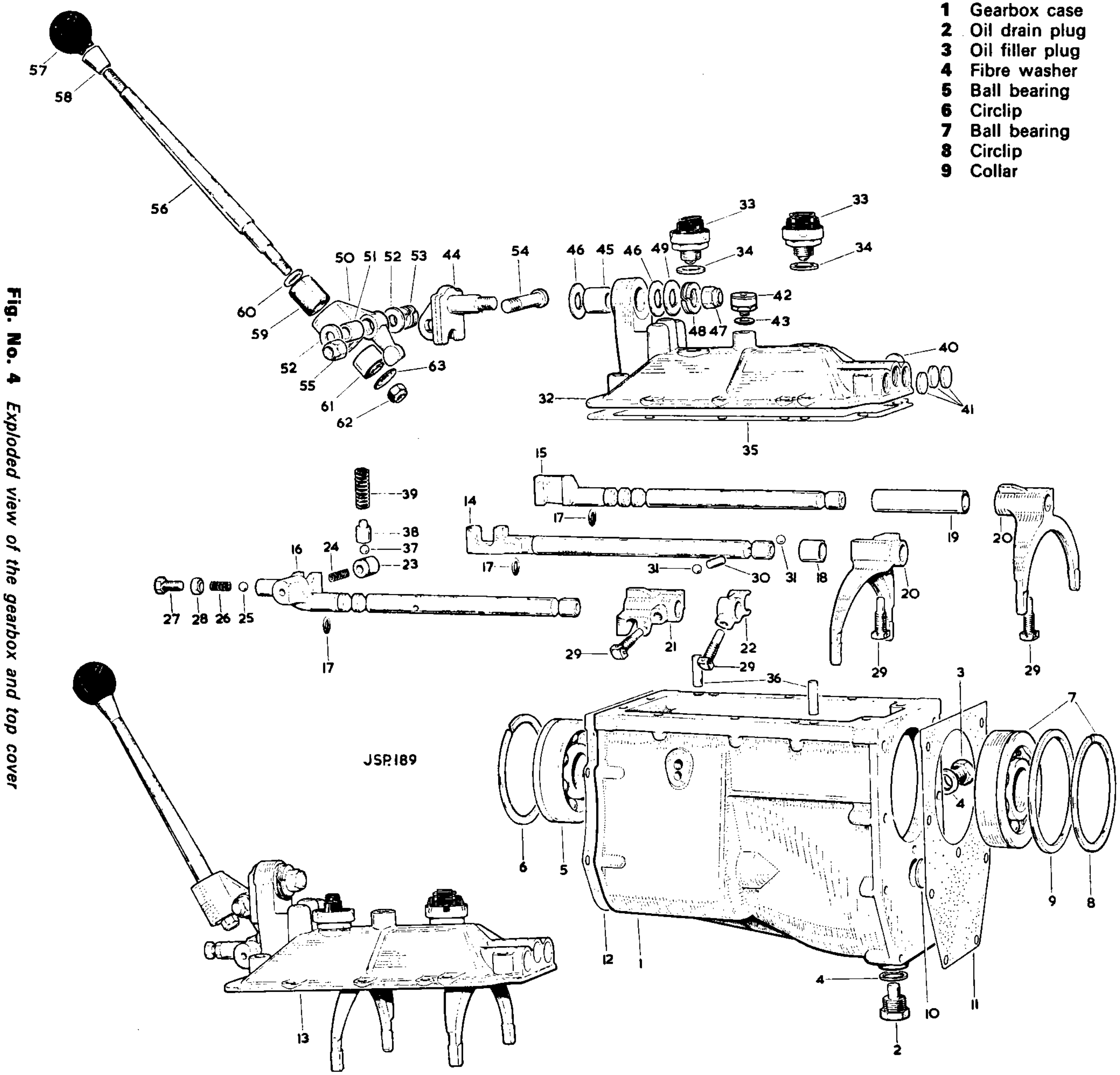
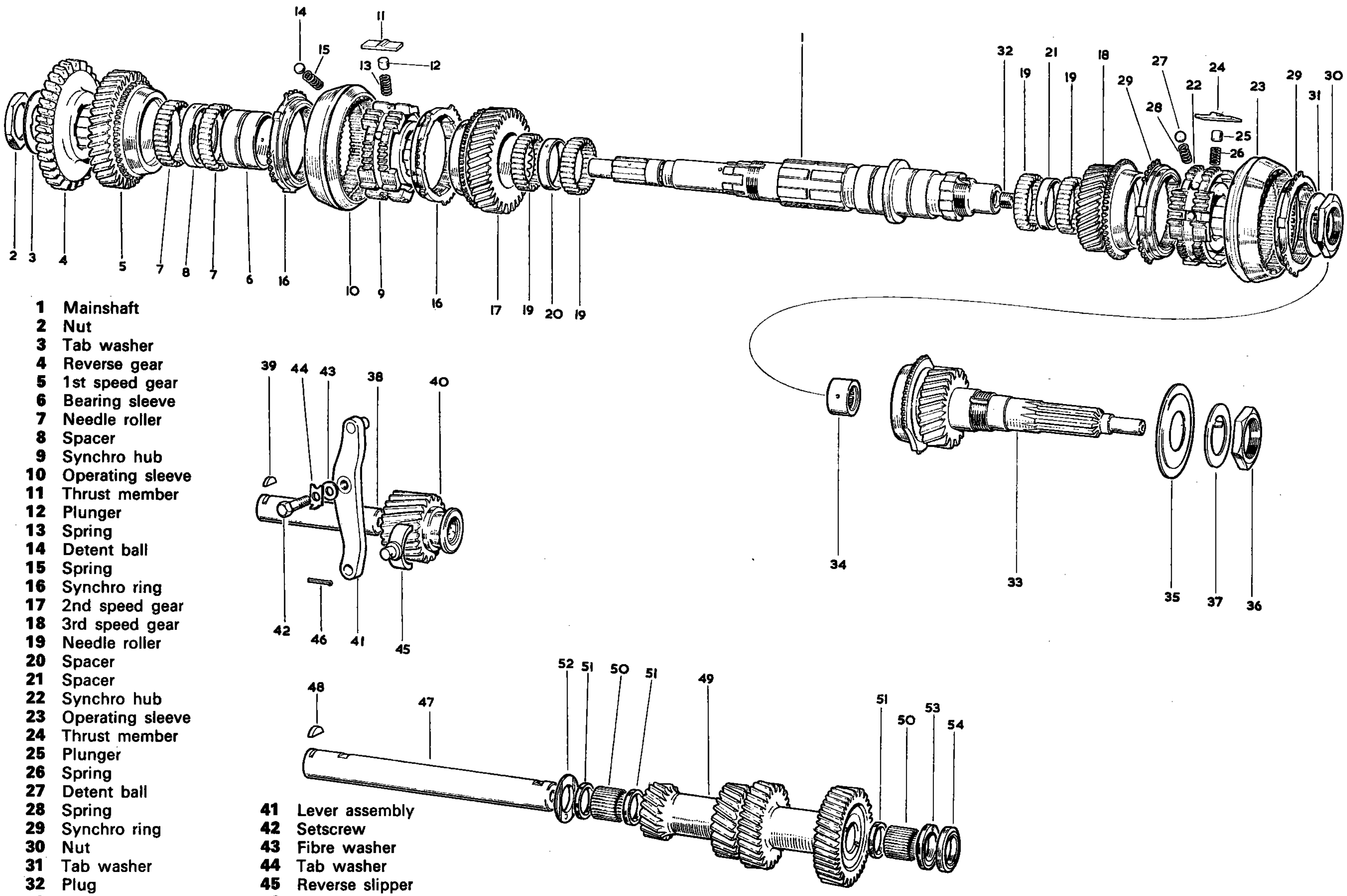


Fig. No. 4 *Exploded view of the gearbox and top cover*

1 Gearbox case
2 Oil drain plug
3 Oil filler plug
4 Fibre washer
5 Ball bearing
6 Circlip
7 Ball bearing
8 Circlip
9 Collar
10 Fibre blanking disc
11 Gasket
12 Gasket
13 Remote control assembly
14 Striking rod
15 Striking rod
16 Striking rod
17 "O" ring
18 Stop
19 Stop
20 Change speed fork
21 Change speed fork
22 Locating arm
23 Plunger
24 Spring
25 Ball
26 Spring
27 Screw
28 Nut
29 Dowel screw
30 Roller
31 Ball
32 Top Cover
33 Switch
34 Gasket
35 Gasket
36 Dowel
37 Ball
38 Plunger
39 Spring
40 Welch washer
41 Welch washer
42 Breather
43 Washer
44 Pivot jaw
45 Bush
46 Washer
47 Nut
48 Washer
49 "D" Washer
50 Selector lever
51 Bush
52 Washer
53 Washer
54 Pivot pin
55 Nut
56 Change speed lever
57 Knob
58 Locking cone
59 Upper bush
60 Washer
61 Lower bush
62 Nut
63 Washer



1 Mainshaft
2 Nut
3 Tab washer
4 Reverse gear
5 1st speed gear
6 Bearing sleeve
7 Needle roller
8 Spacer
9 Synchro hub
10 Operating sleeve
11 Thrust member
12 Plunger
13 Spring
14 Detent ball
15 Spring
16 Synchro ring
17 2nd speed gear
18 3rd speed gear
19 Needle roller
20 Spacer
21 Spacer
22 Synchro hub
23 Operating sleeve
24 Thrust member
25 Plunger
26 Spring
27 Detent ball
28 Spring
29 Synchro ring
30 Nut
31 Tab washer
32 Plug
33 Constant pinion shaft
34 Roller bearing
35 Oil thrower
36 Nut
37 Tabwasher
38 Reverse spindle
39 Key
40 Reverse idler gear
41 Lever assembly
42 Setscrew
43 Fibre washer
44 Tab washer
45 Reverse slipper
46 Split pin
47 Counter shaft
48 Key
49 Gear cluster
50 Needle roller
51 Retaining ring
52 Thrust washer
53 Thrust washer

Fig. No. 5 *Exploded view of gears*

GEARBOX—REMOVAL

In order to remove the gearbox (and overdrive if fitted) it is necessary to remove the engine and gearbox as a unit as detailed on page A.32. Separate the gearbox from the engine as described on page A.35.

GEARBOX—DISMANTLING

Remove Top Cover

Place the gear lever in neutral. Remove the eight setscrews and two nuts and lift off the top cover.

Remove Rear Extension

(Standard Transmission)
Engage first and reverse gears to lock the unit. Tap back the lockwasher and remove the flange nut. Withdraw the flange.
Withdraw the four setscrews and remove the rear cover.
Remove the speedometer pinion and bush assembly after unscrewing the retaining bolt.
Remove the six setscrews and withdraw the extension. Collect the distance piece, oil pump driving pin and oil filter.

Remove Overdrive and Rear Cover

(Overdrive Cars)
Remove the four short setscrews retaining the overdrive to the adaptor plate and the two long setscrews at the base of the unit.
Remove the seven setscrews retaining the adaptor plate and lift off the plate.
Note: No oil pump or filter is employed on cars fitted with overdrive.

Remove Oil Pump

From inside the face of the rear extension, break the staking and withdraw the three countersunk setscrews securing the oil pump gear housing. Withdraw the housing by entering two of the screws into the tapped holes in the housing; screw in the setscrews evenly until the housing is free.
Mark the gears with marking ink so that they can be replaced the same way up in the housing.

Remove Countershaft

Remove the fibre plug from in front of the countershaft
Drive out the shaft from the front of the casing.
Ensure that the rear washer (pegged to the casing) drops down in a clock-wise direction when looking from the rear, to avoid trapping the washer with reverse gear when driving the mainshaft forward. This can easily be effected by pushing down the washer with a piece of stiff wire bent at right angles.

Remove Constant Pinion Shaft

Rotate the constant pinion shaft until the cutaway portions of the driving gear are facing the top and bottom of the casing, otherwise the gear will foul the cluster gear on the countershaft.
With the aid of two levers, ease the constant pinion shaft and front bearing assembly from the casing.

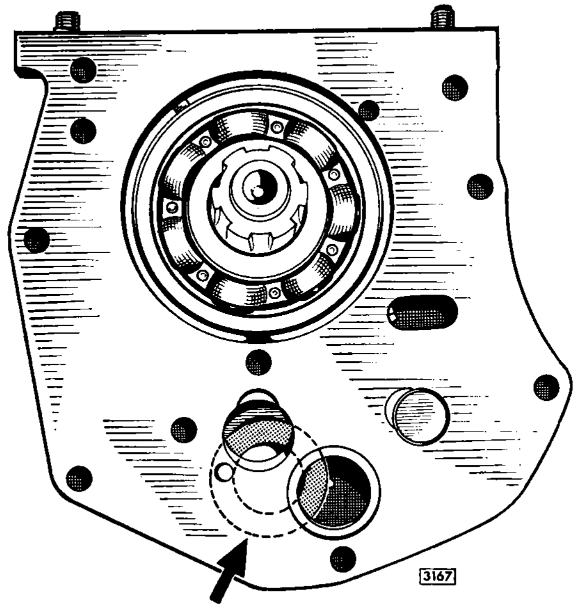


Fig. No. 6 *Ensure that the rear washer (indicated by the arrow) drops down in a clockwise direction*

Remove Mainshaft

Rotate the mainshaft until one of the cutaway portions in the 3rd/top synchro hub is in line with the countershaft, otherwise the hub will foul the constant gear of the countershaft.
Tap or press the mainshaft through the rear bearing, ensuring that the reverse gear is kept tight against the first gear.
Remove the rear bearing from the casing and fit a clamp on the mainshaft to prevent the reverse gear from sliding off the shaft.

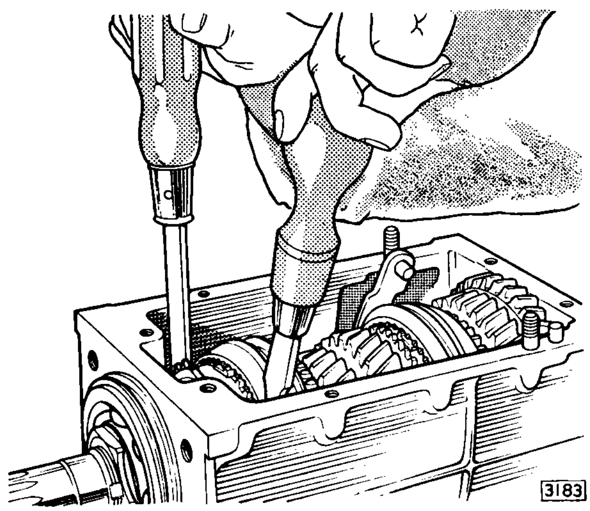


Fig. No. 7 *With the aid of two levers ease the constant pinion shaft forwards*

Slacken the reverse lever bolt to allow the lever to be moved freely back and forth. Lift out the mainshaft upwards and forward.
Lift out the cluster gear and collect the needle roller bearings and retaining rings.
Withdraw the reverse idler shaft and lift out the gear Note the locking key on the shaft.

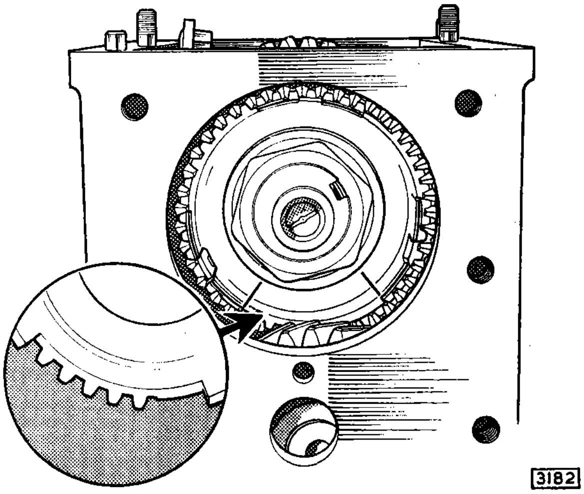


Fig. No. 8 *Rotate the mainshaft until one of the cut-away portions of the 3rd/top synchro hub is in line with the counter shaft.*

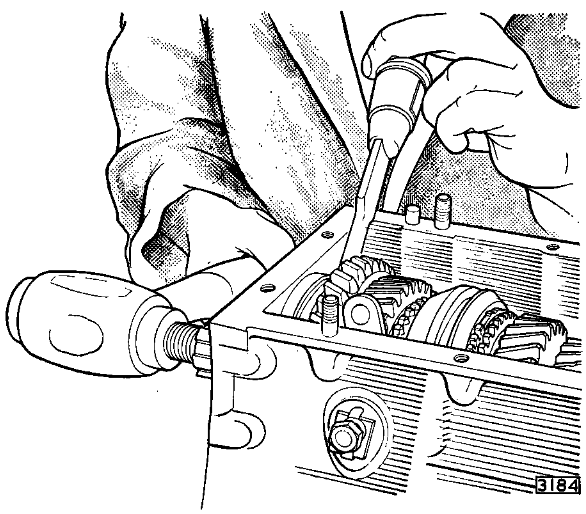


Fig. No. 9 *Tapping the mainshaft through the rear bearing*

Dismantling Constant Pinion Shaft
Remove the roller bearing from inside the constant pinion shaft.

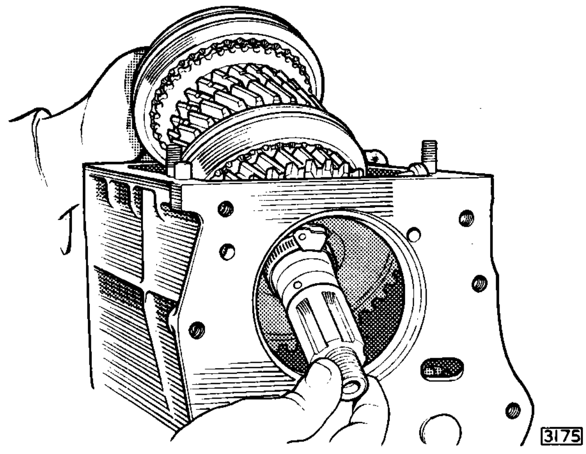


Fig. No. 10 *Removal of the mainshaft. Note the hose clamp fitted to rctain reverse gear*

Tap back the tab washer and remove the large nut, tab washer and oil thrower.
Tap the shaft sharply against a metal plate to dislodge the bearing.

Dismantling the Mainshaft
Note: The mainshaft needle roller bearings are graded in diameter and must be kept in sets for their respective positions.
Remove the hose clamp and withdraw the reverse gear.
Withdraw the 1st gear and collect the 120 needle rollers, spacers and sleeve.
Withdraw the 1st/2nd synchro assembly and collect the two loose synchro rings.
Withdraw 3rd gear and collect the 106 needle rollers.

Dismantling the Synchro Assembly
Completely surround the synchro assembly with a cloth and push out the synchro hub from the operating sleeve. Collect the synchro balls and springs, the thrust members, plungers and springs.

Dismantling the Top Cover
Unscrew the self-locking nut and remove the double coil spring, washer, flat washer, and fibre washer securing the gear lever to the top cover.
Withdraw the gear lever and collect the remaining fibre washer.
Remove the locking wire and unscrew the selector rod retaining screws.
Withdraw the 3rd/Top selector rods and collect the selector, spacing tube and interlock balls. Note the loose interlock pin at the front of the 1st/2nd selector rod.
Withdraw the reverse selector rod and collect the reverse fork, stop spring and detent plunger.
Withdraw the 1st/2nd selector rod and collect the fork and short spacer tube.

GEARBOX ASSEMBLY

Assembling the Synchros

The assembly procedure for 1st/2nd and 3rd/top synchro assemblies is the same.

Note: Although the 3rd/Top and 1st/2nd synchro hubs are similar in appearance, they are not identical and to distinguish them, a groove is machined on the edge of the 3rd/Top synchro hub (Fig. 11).

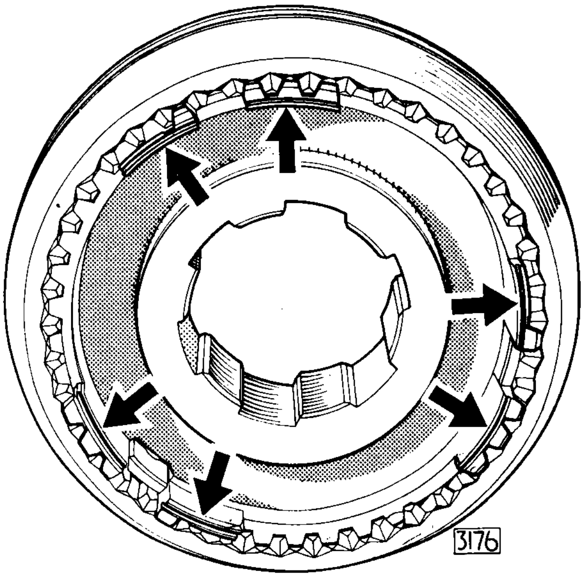


Fig. No. 11 *Identification grooves—3rd/top synchro assembly*

Assemble the synchro hub to the operating sleeve with :-

1. The wide boss of the hub on the opposite side to the wide chamfer end of the sleeve (Fig. 12).

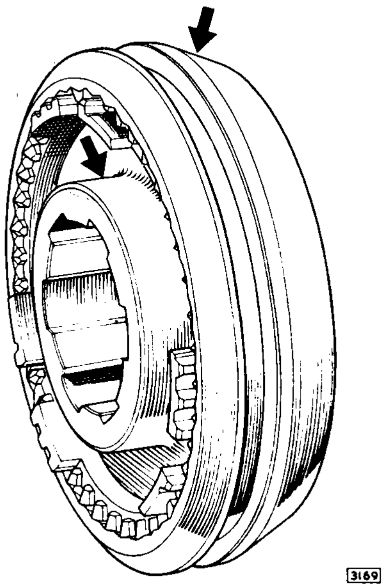


Fig. No. 12 *Assembly of synchro hub*

2. The three balls and springs in line with the teeth having three detent grooves (Fig. 13).

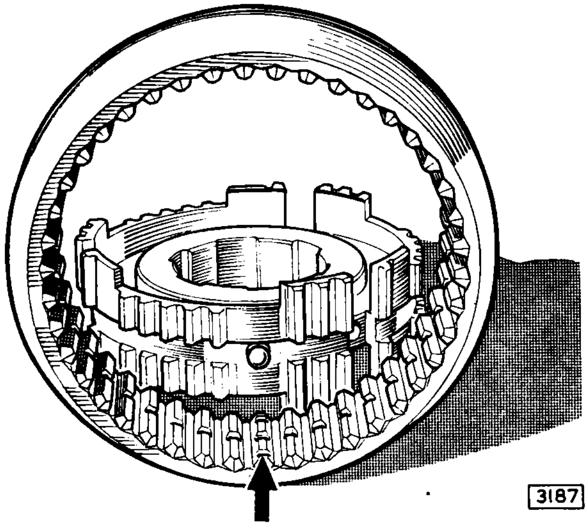


Fig. No. 13 *Fitting the synchro hub in the sleeve*

Pack the synchro hub so that the holes for the ball and springs are exactly level with the top of the operating sleeve (Fig. 14).

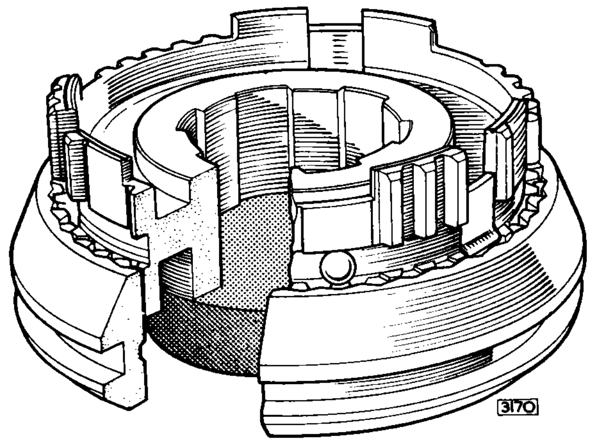


Fig. No. 14 *Fitting the springs, plungers and thrust members*

Fit the three springs, plungers and thrust members to their correct position with grease ; press down the thrust members as far as possible. Fit the three springs and balls to the remaining holes with grease.

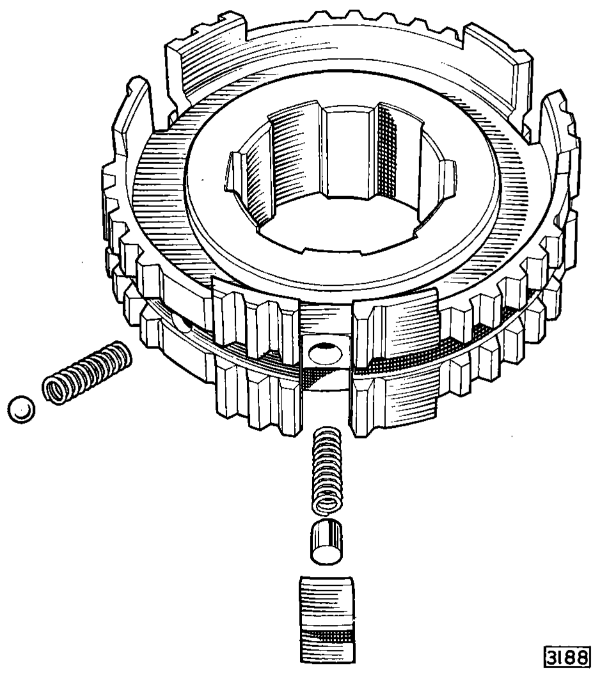


Fig. No. 15 *Showing the relative positions of the detent ball, plunger and thrust member*

Compress the springs with a large hose clip or a piston ring clamp as shown in Fig. 16, and carefully lift off the synchro assembly from the packing piece.

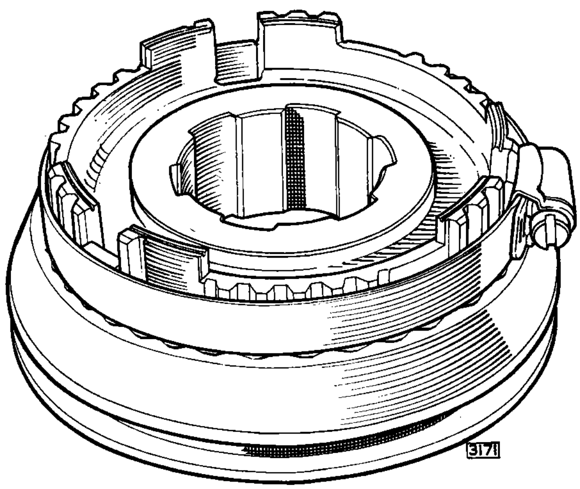


Fig. No. 16 *Compressing the spring*

Depress the hub slightly and push down the thrust members with a screwdriver until they engage the neutral groove in the operating sleeve (Fig. 17).

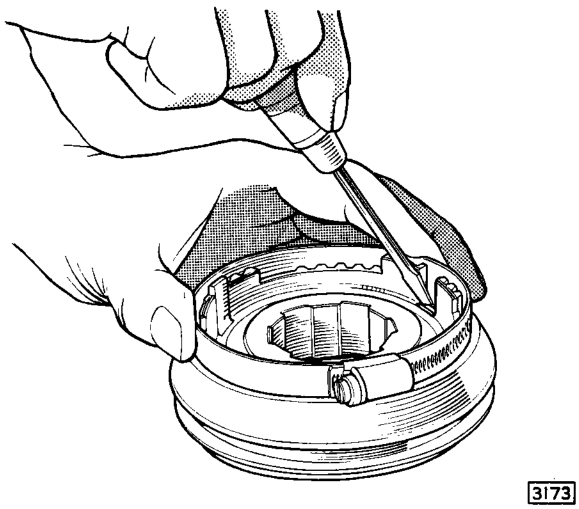


Fig. No. 17 *Pushing down the thrust members*

Finally, tap the hub down until the balls can be felt and heard to engage the neutral groove (Fig. 18).

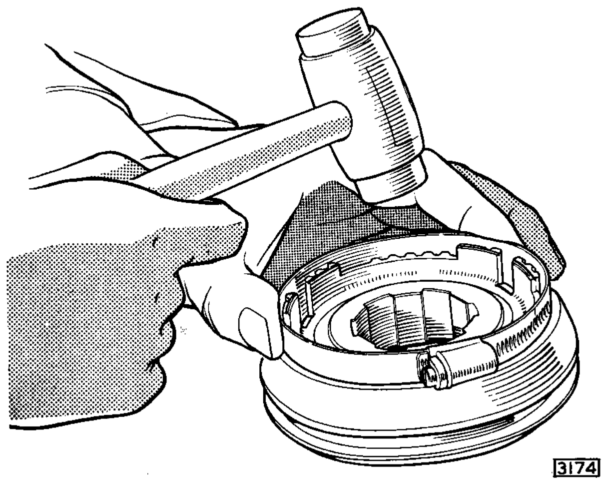


Fig. No. 18 *Tapping the hub into position*

Assembling the Cluster Gear
Fit one retaining ring in the front end of the cluster gear. Locate the 29 neddle roller bearings in position with grease and fit the inner thrust washer, ensuring that the peg on the washer locates in a groove machined on the front face of the cluster gear.
Fit a retaining ring, 29 needle roller bearings and a second retaining ring to the rear end of the cluster gear.

Checking the Cluster Gear Endfloat
Fit the reverse idler gear, lever and idler shaft.
Fit the pegged rear washer to its boss on the casing with grease.

Locate the outer thrust washer to the front of the cluster gear with grease; lower the cluster gear into position carefully. Insert a dummy shaft and check the clearance between the rear thrust washer and cluster gear. The clearance should be .004"—.006" (.10—.15 mm.) and is adjusted by means of the outer thrust washers. This is available in the following selective thicknesses:-

Part Number	**Thickness**
C.1862/3	.152" (3.86 mm.)
C.1862	.156" (3.96 mm.)
C.1862/1	.159" (4.04 mm.)
C.1862/2	.162" (4.11 mm.)
C.1862/4	.164" (4.17 mm.)

Assembling the Constant Pinion Shaft
Assembling is the reverse of the dismantling procedure but care must be taken to ensure that the bearing is seated squarely on the constant pinion shaft.

Assembling the Mainshaft
The assembling of the mainshaft is the reverse of the dismantling procedure, but the following points should be noted :-

1. The end float of the gears on the mainshaft is given in "Data" at the beginning of this section and if found to be excessive, the end float can only be restored by fitting new parts.
2. The needle rollers which support the gears on the mainshaft are graded on diameter, and rollers of one grade only must be used for an individual gear. The grades are identified by /1, /2 and /3 after the part number.
3. Fit a hose clamp to prevent reverse gear sliding off when assembling the mainshaft to the casing.

Assembling the Gears to the Casing
Withdraw the dummy shaft from the cluster gear and, at the same time, substitute a thin rod, keeping both the dummy shaft and rod in contact until the dummy shaft is clear of the casing. The thin rod allows the cluster gear to be lowered sufficiently in the casing for insertion of the mainshaft.
Fit a new paper gasket to the front face of the casing.
Enter the mainshaft through the top of the casing and pass the rear of the shaft through the rear bearing hole.
Enter the constant pinion shaft and bearing assembly through the bearing hole at the front of the casing with the cutaway portion of the driving gear at the top and bottom.
Tap the assembly into position entering the front end of the mainshaft in the spigot bearing of the constant pinion shaft.
Clamp the constant pinion shaft in position and, with a hollow drift, tap the rear bearing into position.
Withdraw the thin rod from the front bore of the cluster gear approximately half way and lever the cluster gear upwards, rotating the mainshaft and constant pinion shaft gently until the cluster gear meshes. Carefully insert the countershaft from the rear and withdraw the rod. Fit the key locating the countershaft in the casing.

Refitting the Rear Extension
Refit the gears to the oil pump the same way as removed, having previously coated the gears and the inside of the pump body with oil. Secure the pump housing with the three countersunk setscrews and retain by staking.

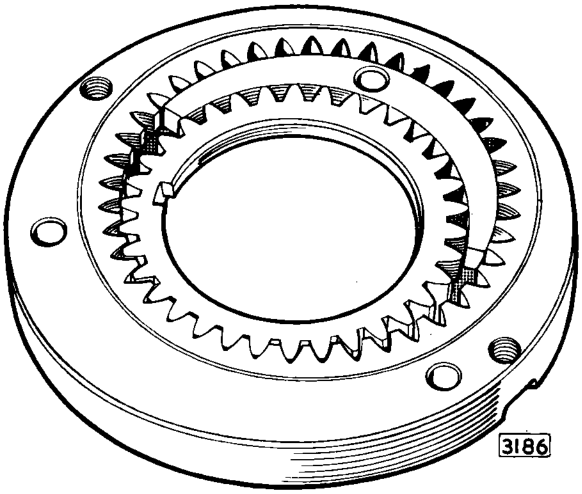


Fig. No. 19 *The oil pump*

Fit a new paper gasket to the rear of the casing.
Fit the distance piece and driving pin to the oil pump in the rear extension.
Offer up the rear extension and secure with seven screws.
Fit the speedometer driving gear to the mainshaft. Fit the speedometer driven gear and bush, with the hole in the bush in line with the hole in the casing, and secure with the retaining bolt.
Fit a new gasket to the rear cover face. Fit a new oil seal to the rear cover with the lip facing forward.
Fit the rear cover to the extension, noting that the setscrew holes are offset.
Fit the four bolts to the companion flange; slide on the flange and secure with a flat washer and split pin.

Refit Overdrive
Fit the adaptor plate to the gearbox with a new gasket and seven setscrews.
Rotate the gearbox mainshaft to position the cam with its highest point uppermost. The lower point will now coincide with the overdrive pump rollers. DO NOT TURN the mainshaft until after the overdrive has been fitted. Engage first gear.
Fit a new paper joint to the front face of the overdrive unit. Align the splines of the uni-directional clutch carrier as detailed on page E.22. Fit the overdrive to the gearbox carefully ensuring that the pump roller "rides" on the cam and that the overdrive pushes right up to the adaptor plate by hand pressure. If it will not, the splines will have become misaligned and the unit must be removed and lined up once more.
After the overdrive is fitted, tighten the four nuts on the front casing flange and also the two nuts on the long studs which go through the rear casing.

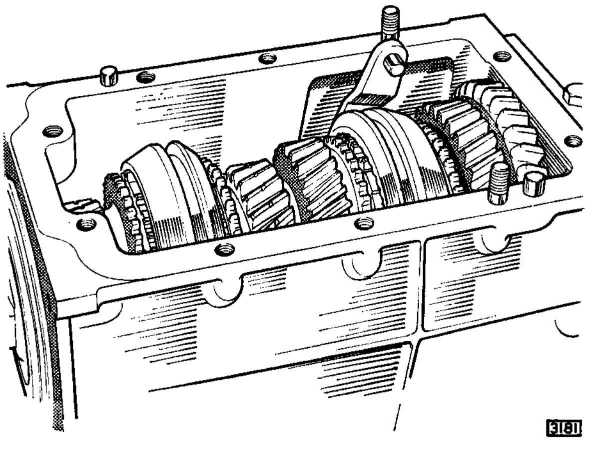


Fig. No. 20 *Re-assembled box prior to refitting the top cover*

Assembling the Top Cover
Assembling of the top cover is the reverse of the dismantling procedure, but ensure that the interlock balls and pin are fitted when assembling the selector rods. Renew the "O" rings on the selector rods.
To adjust the reverse plunger, first fit the plunger and spring. Fit the ball and spring and start the screw and locknut; press in the plunger as far as possible and tighten the screw to tighten the plunger.
Slowly slacken the screw until the plunger is released and the ball engages with the circular groove in the plunger. Hold the screw and tighten the locknut.

Fitting the Top Cover
Fit a new paper gasket. Ensure that the gearbox and top cover are in the neutral position. Ensure that the reverse idler gear is out of mesh with the reverse gear on the mainshaft by pushing the lever rearwards.
Engage the selector forks with the grooves in the synchro assemblies.
Secure the top cover with nuts and bolts noting that they are of different lengths.

Refit the Clutch Housing
Refit the clutch housing by reversing the removal procedure.
Fit a new oil seal to the housing with the lip of the seal facing the gearbox.
The oil seal has a metal flange and should be pushed in fully.
The two clutch housing securing bolts adjacent to the clutch fork trunnions are secured with locking wire; the remainder are secured with tab washers.
Note: After refitting the gearbox, run the car in top gear as soon as possible to attain the necessary mainshaft speed to prime the oil pump.

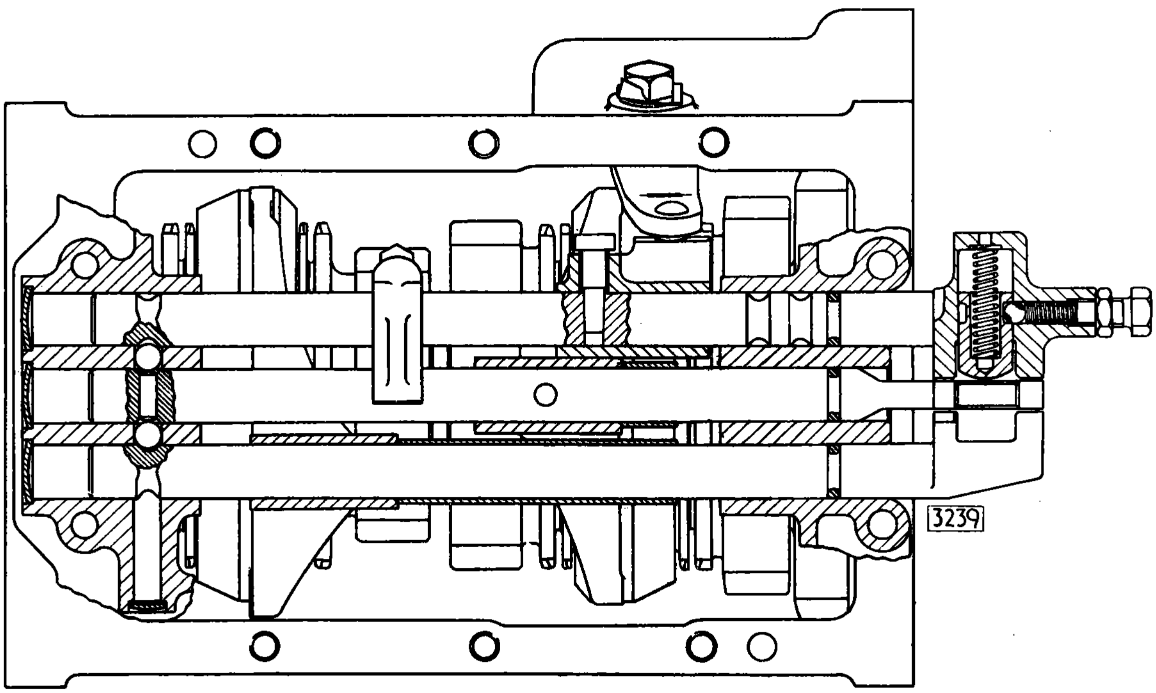


Fig. No. 21 *Plan view of gearbox showing selector arrangement*

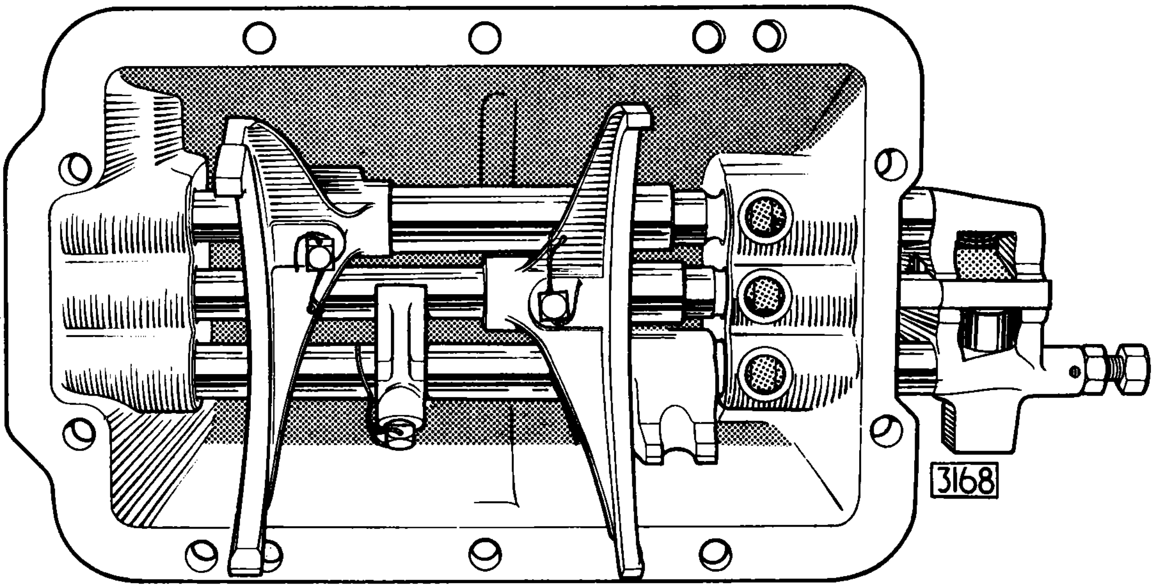


Fig. No. 22 *View of the underside of top cover*

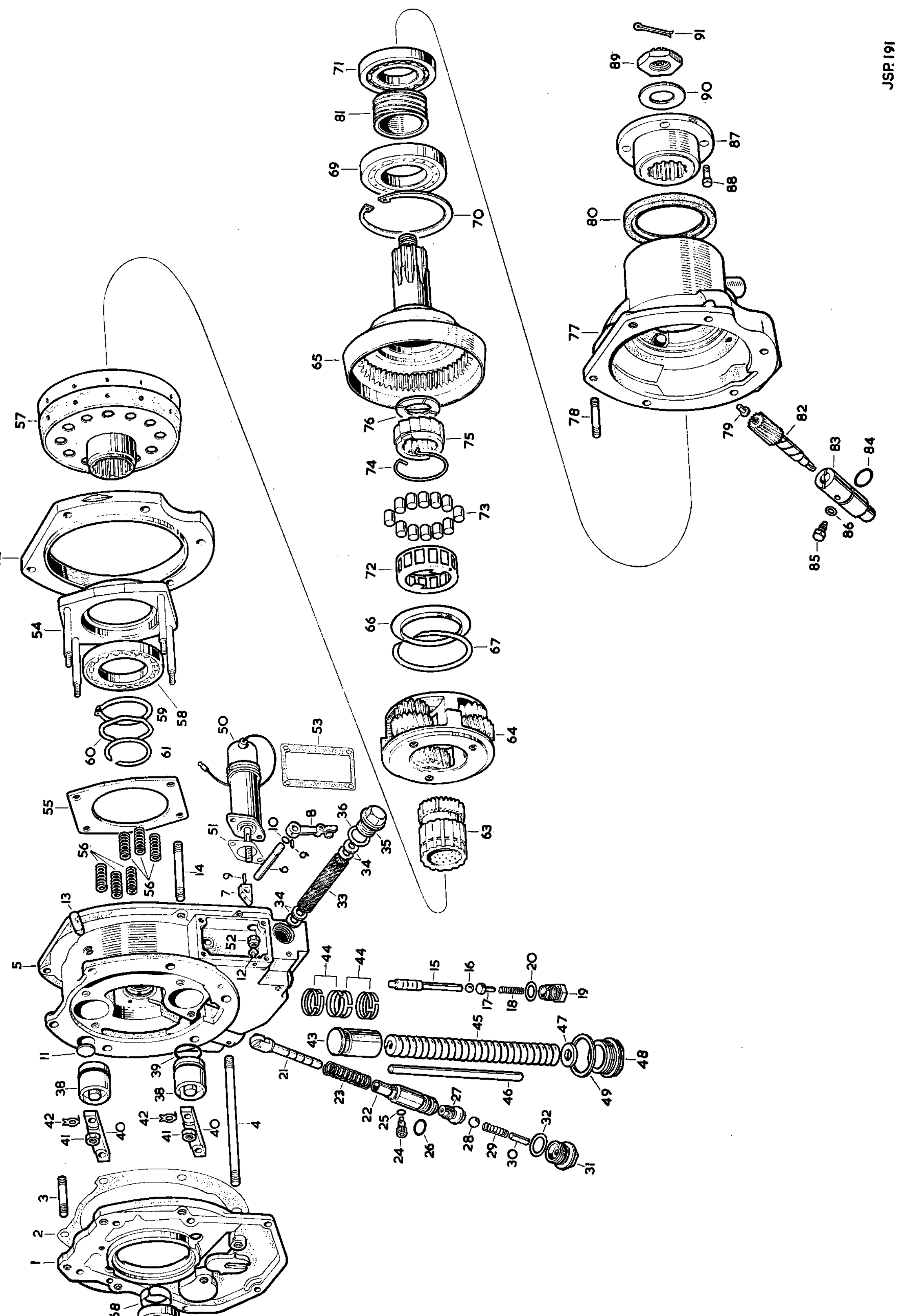


Fig. No. 23 *Exploded view of overdrive front and rear casing assemblies*

1 Adaptor plate
2 Gasket
3 Stud
4 Stud
5 Front casing
6 Shaft
7 Cam
8 Lever
9 Roll pin
10 "O" ring
11 Welch washer
12 Stop
13 Breather
14 Stud
15 Main operating valve
16 Ball
17 Plunger
18 Spring
19 Plug
20 Washer
21 Oil pump plunger assembly
22 Oil pump body
23 Spring
24 Screw
25 Fibre washer
26 "O" ring
27 Non-return valve body
28 Ball
29 Spring
30 Support rod
31 Plug
32 Copper washer
33 Oil filter
34 Magnetic ring
35 Plug
36 Washer
37 Cam
38 Operating piston
39 "O" ring
40 Bridge piece
41 Nut
42 Tab washer
43 Accumulator piston
44 Ring
45 Spring
46 Support rod
47 Packing washer
48 Plug
49 Washer
50 Solenoid
51 Gasket
52 Nut
53 Gasket
54 Thrust ring
55 Retaining plate
56 Spring
57 Clutch sliding member
58 Ball bearing
59 Circlip
60 Corrugated washer
61 Snap ring
62 Brake ring
63 Sun wheel
64 Planetary carrier assembly
65 Annulus assembly
66 Oil thrower
67 Spring ring
68 Spring ring
69 Ball bearing
70 Circlip
71 Ball bearing
72 Uni-directional clutch cage
73 Roller
74 Spring
75 Inner member for clutch
76 Thrust washer
77 Rear casing assembly
78 Stud
79 Thrust button
80 Oil seal
81 Speedometer driving gear
82 Speedometer driven gear
83 Bearing Assembly
84 "O" ring
85 Retaining screw
86 Copper washer
87 Connecting flange
88 Bolt
89 Nut
90 Washer
91 Split pin

OVERDRIVE

DESCRIPTION

The Laycock de Normanville overdrive unit consists of a hydraulically controlled epicyclic gear housed in a casing at the rear of the gearbox.
When engaged, the overdrive reduces the engine speed in relation to the road speed thus permitting high road speeds with low engine revolutions. Consequently, the use of the overdrive results in fuel economy and reduced engine wear.
The overdrive is operated by an electric solenoid controlled by a switch mounted on the steering column. Overdrive can only be engaged when the car is in top gear.

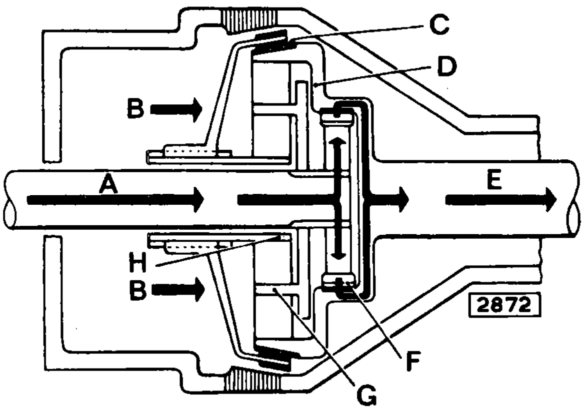


Fig. No. 24 *In direct drive*

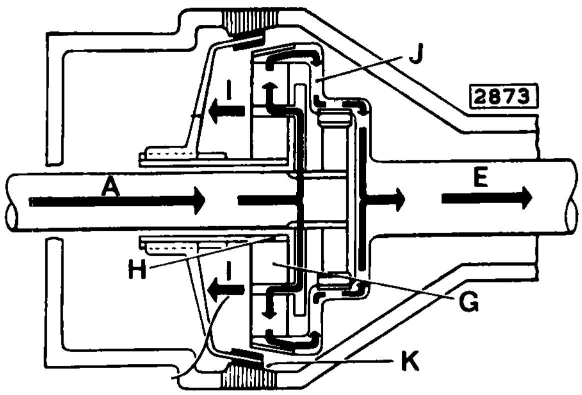


Fig. No. 25 *In overdrive*

A From gearbox
B Spring pressure
C Annulus and sunwheel locked
D Annulus
E To propeller shaft
F Uni-directional clutch
G Planet wheel and carrier
H Sunwheel
I Hydraulic pressure
J Annulus overdriven by planet wheels
K Locked cone clutch holds sunwheel

METHOD OF OPERATION (Fig. 23)

Power Input

The power input enters the overdrive unit through the extension of the gearbox driven shaft and by means of a cam (37) operates the plunger-type hydraulic pump (21). This, in turn builds up pressure against the spring loaded piston (43) in the accumulator cylinder placed across the bottom of the main casing.

The Sun-Wheel

The sun-wheel (63) is integral with an inner member (75) which is free to rotate on the input shaft. Immediately behind the sun-wheel and splined to the gearbox driven shaft is the planetary carrier (64) in which are mounted the three planet wheels.

The Uni-directional Clutch

This operates from the input shaft onto which is splined the inner member (75). The other components of this clutch are the rollers (73) and the outer member which is attached to the combined annulus and output shaft (65). The drive is transmitted from the input shaft through the clutch inner member and the rollers which are forced up the inner members' inclined faces wedging the whole clutch solid. The clutch then drives the annulus output shaft.

The Cone Clutch

The cone clutch (57) is mounted on the sliding member on which it is free to slide. The cone clutch springs (56), which hold the inner lining in contact with the corresponding cone of the annulus (65), maintain the clutch in the direct drive position. This prevents a free-wheel condition when the car tries to overun the engine. Engine braking is, therefore, always available.
Power is transmitted by way of the cone clutch, inner lining and the annulus, when the reverse gear is engaged as the uni-directional clutch is inoperative.

Hydraulic Operation

Overdrive is brought into operation by rotating the operating shaft thus lifting the operating valve. This action allows the stored hydraulic pressure in the accumulator to be applied to the two pistons (38). The pistons move the clutch (57) forward away from the annulus (65). During the forward movement of the clutch the drive from the engine to the wheels is maintained by the roller clutch.
The hydraulic operation causes the outer lining of the cone clutch to contact the brake ring (62), bringing the sun-wheel and sleeve (63) to rest.
This action is effected without shock as the clutch is oil immersed. The input drive now passes from the gearbox driven shaft to the planet carrier (64) and the rotation of the planet wheels around the stationary sun-wheel causes both the annulus and the output shaft to be driven faster than the input shaft. In this condition the outer member of the roller clutch over-runs the inner member (75).
Because the sun-wheel can move neither backwards or forwards there is always engine braking available in overdrive gear.

DATA

	Dimensions	Clearances
PUMP		
Plunger diameter	0.3742/0.3746" (9.36/9.37 mm.)	0.0002/.0.0016" (0.005/0.04 mm.)
Pump body bore	0.3748/0.3758" (9.37/9.397 mm.)	0.002/0.0016" (0.005/0.04 mm.)
PUMP ROLLER BUSH		
Outside diameter of bush	0.3736/0.3745" (9.34/9.36 mm.)	0.0005/0.0023" (0.0125/0.0575 mm.)
Inside diameter of roller	0.3750/0.3759" (9.375/9.389 mm.)	0.0005/0.0023" (0.0125/0.0575 mm.)
Inside diameter of bush	0.2510/0.2518" (6.25/6.295 mm.)	0.0007/0.0020" (0.0175/0.050 mm.)
Outside diameter of pin	0.2497/0.2502" (6.34/6.35 mm.)	0.0007/0.0020" (0.0175/0.050 mm.)
OPERATING PISTONS		
Piston diameter	1.3732/1.3741" (34.33/34.90 mm.)	0.0004/0.0023" (0.01/0.0575 mm.)
Bore diameter	1.3745/1.3755" (34.363/34.39 mm.)	0.0004/0.0023" (0.01/0.0575 mm.)
ACCUMULATOR		
Piston diameter	1.1232/1.241" (28.53/28.55 mm.)	0.0004/.0023" (0.01/0.0575 mm.)
Bore diameter	1.1245/1.1255" (28.56/28.59 mm.)	0.0004/.0023" (0.01/0.0575 mm.)
OPERATING VALVE		
Valve diameter	0.2494/0.2497" (6.235/6.243 mm.)	0.0003/0.0012" (0.0075/0.03 mm.)
Bore diameter	0.250/0.2506" (6.25/6.252 mm.)	0.0003/0.0012" (0.0075/0.03 mm.)
OVERDRIVE MAINSHAFT		
Diameter at oil transfer bush	1.1544/1.553" (28.86/28.88 mm.)	0.0029/0.0048" (0.072/0.12 mm.)
Inside diameter of bush	1.1582/1.1592" (28.96/28.98 mm.)	0.0029/0.0048" (0.072/0.12 mm.)
Diameter at sunwheel	1.1544/1.1553" (28.86/28.88 mm.)	0.0029/0.0048" (0.072/0.12 mm.)
Inside diameter of sunwheel bush	1.1582/1.1592" (28.96/29.98 mm.)	0.0029/0.0048" (0.072/0.12 mm.)
Diameter of spigot bearing	0.6235/0.6242" (15.58/15.61 mm.)	0.0008/0.0025" (0.02/0.0625 mm.)
Inside diameter of spigot bearing	0.6250/0.6260" (15.63/15.65 mm.)	0.0008/0.0025" (0.02/0.0625 mm.)
MISCELLANEOUS		
Clutch movement from direct to overdrive	0.080"/0.120" (2 — 3 mm.)	
HYDRAULIC PRESSURE	540/560 lb./sq. in. (37.966/39.372 kg./sq. cm.)	

DISMANTLING

If trouble should arise necessitating dismantling the unit, it will be necessary to remove the overdrive unit from the car. The engine, gearbox and overdrive unit are removed together as detailed on Page A.32.
Remove the gearbox and clutch housing from the engine.
Detach the clutch housing from the gearbox casing.
BEFORE COMMENCING ANY DISMANTLING OPERATIONS IT IS IMPORTANT THAT THE HYDRAULIC PRESSURE IS RELEASED FROM THE SYSTEM. DO THIS BY OPERATING THE OVERDRIVE 10-12 TIMES.

REMOVING THE OVERDRIVE FROM THE GEARBOX

The overdrive unit is separated from the gearbox at the joint between the gearbox rear extension and the overdrive front casing which are attached by seven studs.

REMOVAL

The unit is split at the rear face of the adaptor casing. There is no spring tension to release and, after removing the nuts on the securing studs, the overdrive can be withdrawn off the mainshaft, leaving the adaptor in place.

DISMANTLING

The overdrive can be divided into four main assemblies:
(a) Front casing and brake ring.
(b) Clutch sliding member.
(c) Planet carrier and gear train.
(d) Rear casing and annulus.
IMPORTANT: SCRUPULOUS CLEANLINESS MUST BE MAINTAINED THROUGHOUT ALL SERVICE OPERATIONS, EVEN MINUTE PARTICLES OF DUST, DIRT OR LINT FROM CLEANING CLOTHS MAY CAUSE DAMAGE OR, AT BEST, INTERFERE WITH CORRECT OPERATION.
Prepare a clean area in which to lay out the dismantled unit and some clean containers to receive the small parts.
Hold the overdrive with front casing uppermost in a vice fitted with suitable soft jaws.
Release the tab washers locking the four $\frac{1}{4}$" nuts retaining the operating piston bridge pieces.
Remove the nuts, tab washers and bridge pieces.
Loosen the solenoid by the two screws to allow the front casing to be removed.
Remove the four nuts which secure the front and rear casings. Separate the two casings. The brake ring is spigotted into each half and may remain attached to the front half. In order to separate the brake ring from the casing, a few taps with a mallet will suffice.
Lift out the clutch sliding member complete with thrust ring, bearing and sun-wheel.
Lift out the planet carrier and gear train.

Front Casing and Brake Ring

Remove the operating valve plug and lift out the spring, plunger and ball. Remove the operating valve as described on Page E.22.
Remove the operating pistons by gripping the centre boss with a pair of pliers and applying a rotary pull.

The Solenoid

To take off the solenoid, first remove the rectangular cover plate by removing the four screws. Remove the two screws securing the solenoid which can then be pulled off. Ease the plunger out of the yoke of the valve operating lever.

The Accumulator

Access to the accumulator is gained by removing the large plug from the bottom of the unit on the off side. The length of the thread on the plug is sufficient to allow all compression to be released from the spring before the plug is completely unscrewed. The accumulator spring, support pin and washer will come out with the plug.
The accumulator piston has a groove inside the bore and a piece of stiff wire can be hooked into this to enable the piston to be withdrawn.

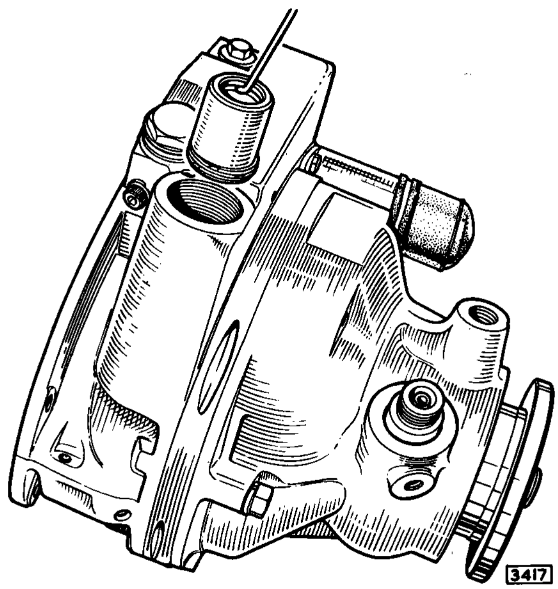


Fig. No. 26 *Removing the accumulator piston*

The Pump Non Return Valve

This valve is accessible when the centre plug in the bottom of the unit is removed. Unscrew the valve body using tool number L.213.
Remove the spring, support pin and $\frac{7}{32}$" (5.56 mm.) diameter ball.

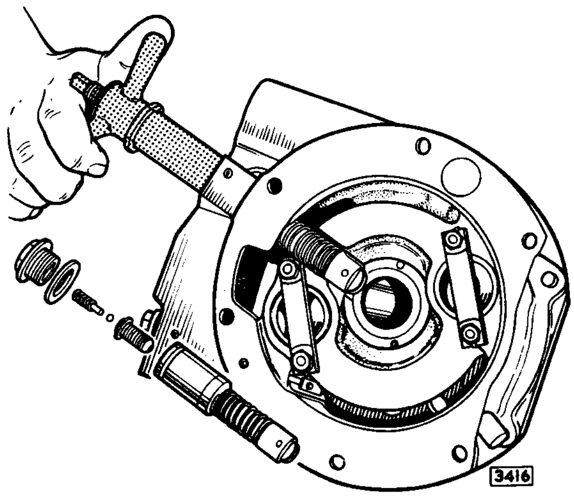


Fig. No. 27 *Removing the pump non-return valve. The valve components are shown exploded*

The Pump
Remove the locating screw (24 Fig. 23).
The pump body can now be extracted using tool number L.183A and adaptor L.183A-2. The plunger and spring will also come out when the body is withdrawn.

Oil Filter
Unscrew the plug which is situated immediately below the solenoid cover plate. The cylindrical gauze filter can then be withdrawn. Four magnetic rings are used in the filter assembly, two being located in the recess in the plug and two in the recess of the casing.

Clutch Sliding Member and Sun-wheel
Remove the circlip from the sun-wheel and slide off the corrugated washer and sliding member.

Planet Carrier Assembly
Inspect all the gear teeth for any signs of damage or chipping and assess the fit of the assembled bearings for any excessive clearance.
Planet gears are not available as separate items, therefore if damage or wear is apparent a new planet carrier assembly should be fitted.

Rear Casing and Annulus (Fig. 23)
To dismantle the assembly proceed as follows :
(a) remove spring ring (67) and oil thrower (66).
(b) remove the uni-directional clutch (72,73) by placing the special assembly ring (Tool L.178) centrally over the front face of the annulus and lifting the inner member of the uni-directional clutch up into it. This will ensure that the rollers do not fall out of the retaining cage.
(c) place the parts in a suitable container.

Alternatively, if dismantling further, remove the assembly ring and allow the rollers to come out. The hub will then come readily from the cage, exposing the spring. Remove the bronze thrust washer fitted between the hub of the uni-directional clutch and the annulus.
To remove the annulus:
(a) remove the speedometer dowel screw (85).
(b) withdraw the speedometer drive bush (83) and pinion (82).
(c) remove the coupling flange (87) and remove oil seal if necessary.
(d) press the annulus forward out of the rear casing.
The front and rear bearings will remain in the rear casing with the speedo-driving gear sandwiched between them.
(e) remove circlip (70) and then drive out the speedo driving gear and rear bearing. The front bearing can then be driven out.

IMPORTANT : EACH PART SHOULD BE THOROUGHLY CLEANED AND EXAMINED AFTER THE UNIT IS DISMANTLED.

INSPECTION
FRONT CASING AND BRAKE RING (Fig. 23)
Inspect the front casing for cracks and other damage.
Examine the bores of the operating cylinders and accumulator for scores or other wear.
Check for signs of leaks from the plugged ends of the oil passages. Ensure that the sealing disc in the front face of the casing is tight and not leaking.
Inspect the centre bush for wear or damage.
Check operating pistons (38) for signs of scores and replace sealing ring (39) if there is any sign of damage or distortion.
Check the pump roller and its bronze bush for any undue wear. The roller pin is secured by a mills pin $\frac{1}{16}$" (1.6 mm.) dia. driven vertically into the curved portion of the pump plunger fork.
This pin can be sheared by driving the roller pin through the fork.
Check pump plunger for wear and scores.
Check pump body for wear and scores. Check the valve seat and ball to ensure that they are free from nicks and scratches.
Check the pump spring (23) for distortion.
Check the accumulator piston for signs of wear or scores. Check that there are no broken piston rings.
Check the accumulator spring for distortion or collapse.
Inspect the operating valve for distortion or collapse.
See that it slides easily in the bore of the front casing.
Check that the ball seat is clean and free from scratches.
Check that the restrictor jet is clear. Check the ball and spring for distortion.
Clean the filter thoroughly in petrol. Remove all metallic particles fron the magnetic rings.
Check brake ring (62) for signs of wear, scoring or cracks.

CLUTCH SLIDING MEMBER (Fig. 23)
Inspect the clutch lining on the clutch sliding member for any signs of excessive wear or charring. If excessive wear or charring is apparent, replace the sliding member

complete. It is not possible to fit new linings only as the faces have to be fine machined to an accurate angle after rivetting.
Inspect the pins for the bridge pieces on the thrust ring (54) and check that they are tight and not distorted.
Inspect the ball race (58) and ensure that it rotates smoothly as this can otherwise be a source of noise when running in direct gear.
Inspect the clutch springs (56) for any signs of damage or collapse.

PLANET CARRIER AND GEAR TRAIN (Fig. 23)
If not previously inspected under **"DISMANTLING"** the gears and bearings should be inspected.
Inspect the teeth on the sun-wheel (63) for sign of damage or chips. If the bush is worn, a new gear complete must be fitted as the bore has to be machined concentric with gear teeth after sub-assembly.

REAR CASING AND ANNULUS (Fig. 23)
Ensure that the rollers of the uni-directional clutch (73) are not chipped and that the inner and outer members are free from damage. Check that the cage, particularly the two ears, is not distorted or broken.
Inspect the bronze washers fitted between the uni-directional clutch and the annulus.
Inspect the gear teeth of the annulus (65) for damage.
Inspect the conical surface for signs of wear. A bronze spigot bearing is fitted in the annulus under the uni-directional clutch. Inspect this for wear. This bearing has to be machined after sub-assembly and therefore cannot alone be replaced in the field. Where necessitated by bearing damage, a new annulus must therefore be used. Inspect the output shaft ball races (69) and (71). Confirm that they rotate smoothly.
Inspect the rear oil seal (80). If it is necessary to remove the seal, a new one must always be fitted.
Inspect the teeth of the speedometer pinion for wear.

RE-ASSEMBLY
FRONT CASING AND BRAKE RING
Insert the pump plunger, spring and body in the central holes in the bottom of the casing (see Fig. 27) taking care to locate the flat of the plunger against the thrust button which is situated below the centre bush. Tap the pump body home until the annular groove lines up with the locating screw hole in the casing and then insert the screw through the fibre washer and tighten ensuring that the dowel locates in the groove. Re-seat the non-return valve ball by lightly tapping it with a copper drift and then screw in the non-return valve body using Churchill Tool No. L.213. Fit the ball spring, support pin, copper washer and plug, tightening same while ensuring that the spring is located in the plug recess.

Accumulator
Carefully insert the piston in the casing, using Tool No. L.304. Insert the spring and support pin. Fit the fibre washer and plug. Ensure that the spring is located in the plug recess together with any packing washers that were originally fitted and then tighten.

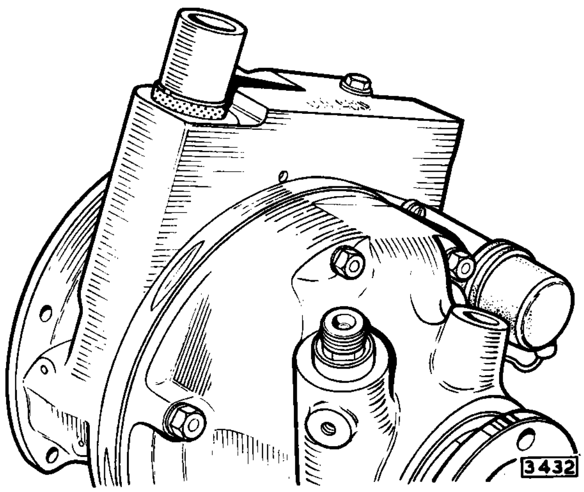


Fig. No. 28 *Refitting the accumulator piston using the special tool No. L.304*

OPERATING PISTONS
When inserting the operating pistons, carefully ease the rubber sealing rings into the cylinder bores. The centre bosses of the pistons face towards the front of the unit.

OPERATING VALVE
Insert the operating valve into the casing, ensuring that the hemispherical end engages on the flat of the small cam on the operating shaft. Drop in the $\frac{5}{16}$" dia. (7.93 mm.) ball, plunger and spring. Screw in and tighten the operating valve plug, ensuring that the copper washer is located correctly.

OIL FILTER
Fit the two magnetic rings in the recess in the casing and then insert the filter. A further two magnetic rings are fitted in the recess of the plug. Screw in the plug together with the copper washer and, ensuring that the filter is located at either end, tighten up.
The front casing, less solenoid, is now complete and ready for assembly to the rest of the unit.

REAR CASING AND ANNULUS
Press the front bearing into the rear casing using Tool No. L.303 ensuring that its outer track abuts against the shoulder of the casing and then fit the retaining circlip. Support the inner race of the bearing using Churchill Tool No. L.303 and then press in the annulus until the bearing abuts on the locating shoulder. Fit the speedometer driving gear and using Churchill Tool No L.303, press the rear bearing onto the tail shaft and into the casing simultaneously. Press in the rear oil seal using Tool No. L.305 until it is flush with the end of the rear casing. Press on the coupling flange after first fitting the bolts and then fit the washer and slotted nut. Tighten to a torque of 1200-1560 lb. in. (13.82-22.11 kg. cm.) and fit the split pin. Insert the speedometer pinion gear and bush after ensuring that the "O" ring is serviceable.

Turn the annulus to engage the gear if necessary, align the holes in the casing and bush. Fit the locating screw and copper washer.

Assembling and Fitting Uni-directional Clutch
Assemble the spring into the roller cage of the uni-directional clutch. Fit the inner member into the cage and engage it on the other end of the spring. Engage the slots of the inner member with the tongues on the roller cage and ensure that the spring rotates the cage so that, when the rollers are fitted, they will be propelled up the inclined faces of the inner member. The cage is spring loaded anti-clockwise when viewed from the front.
Place the assembly, front end downwards, into the special assembly ring, Churchill Tool No. L.178, and fit the rollers through the slots in the tool, turning the clutch clockwise until all the rollers are in place, see Fig. 29.
Replace the uni-directional clutch assembly using the special tool to enter the rollers into the outer member in the annulus. Fit the oil thrower and retaining clip.

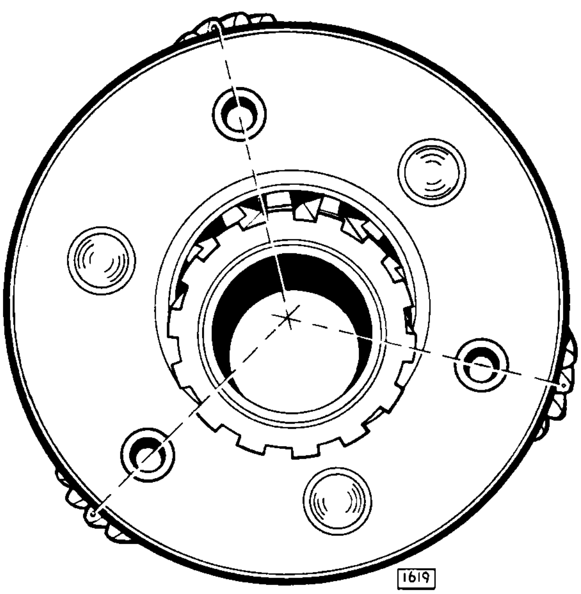


Fig. No. 30 *Assembling the planet gears—Note the positions of the marked teeth*

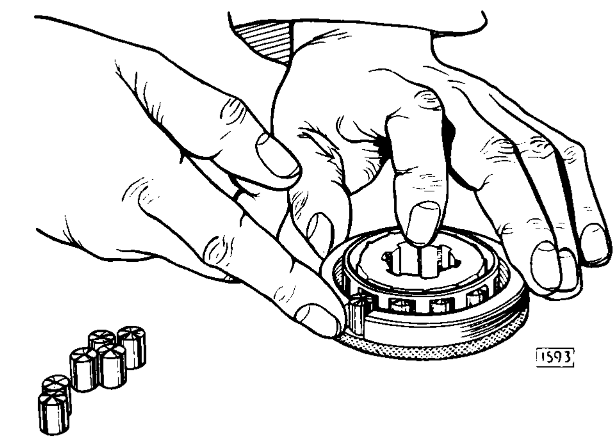


Fig. No. 29 *Assembling the uni-directional clutch using Tool No. L.178*

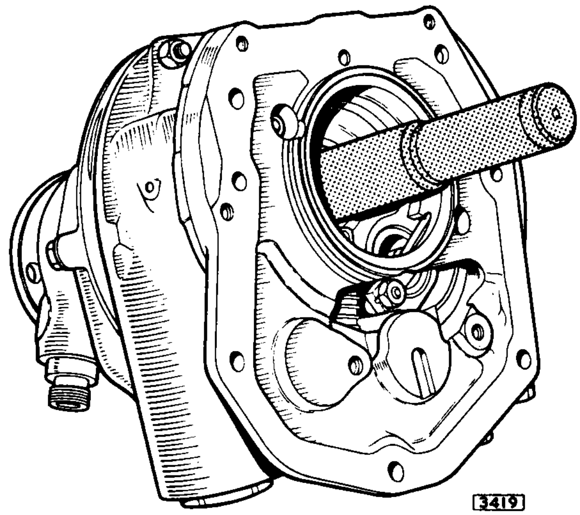


Fig. No. 31 *Using the dummy mainshaft Tool No. L.185A*

PLANET CARRIER AND GEAR TRAIN

Special care must be taken when re-assembling the planet carrier assembly to the annulus and sun-wheel. Turn each gear respectively until a dot marked on one tooth of the large gear is positioned radially outwards (see Fig. 30).
Insert the sunwheel to mesh with the planet gears, keeping the dots in the same position, and then insert this assembly to mesh with the internal gear in the annulus. Insert the dummy mainshaft Churchill Tool No. L.185A engaging in the planet carrier and uni-directional clutch splines.

CLUTCH SLIDING MEMBER

Press the thrust bearing into the thrust ring and press this assembly onto the hub of the clutch sliding member taking care not to damage the linings. Secure the assembly in position by fitting the circlip on the hub of the sliding member. Slide this assembly onto the sunwheel splines until the inner lining is in contact with the annulus and then fit the corrugated washer and circlip.

FINAL ASSEMBLY

Fit the retaining plate over the bolts of the thrust ring bearing assembly. Smear liquid jointing compound onto both faces of the brake ring flange and tap this home into the front casing. Insert the clutch return springs in the front casing. Offer up the front casing and brake ring to the rear casing, ensuring that the thrust ring bolts pass through the holes in the front casing without binding. The clutch spring pressure will be felt as the two casings go together and the four nuts should be progressively tightened until the faces meet Fit the two bridge pieces, nuts and new tab washers.

Fit the solenoid plunger in the fork of the operating lever and, after fitting a gasket to the solenoid flange, fasten the solenoid to the casing by means of the two securing screws.

Adjust the solenoid operating lever as described below. Secure solenoid gasket and cover plate with four setscrews and lockwashers.

The overdrive is now complete and ready for fitting to gearbox.

REFITTING THE OVERDRIVE TO THE GEARBOX

Place the overdrive unit upside down in a vice.
Remove the dummy mainshaft from the overdrive. The splines will now be correctly lined up and it is most important that the coupling flange is not turned until the unit has been fitted to the gearbox.
Check that the cam is not unduly worn and that the flat spring ring on the gearbox mainshaft is not distorted and does not protrude above the crown of the splines.
Rotate the shaft to position the cam with its highest point uppermost. The lowest point will now coincide with the overdrive pump roller. The mainshaft should not be turned again until the overdrive has been fitted and it is advisable to engage bottom gear.
Fit a new paper joint to the overdrive front face. Fit the gearbox carefully to the overdrive ensuring that the pump roller rides on the cam which is chamfered for this purpose, and that the overdrive pushes right up to the face of the adaptor by hand pressure only. If the overdrive will not meet the adaptor face by about $\frac{5}{8}$" (15.88 mm.) it means that the splines have become misaligned. In such a case remove the overdrive again and re-align the splines by rotating the inner member of the uni-directional clutch in an anti-clockwise direction. This can be done with a long screwdriver. Recheck by inserting the dummy mainshaft again.
When the overdrive has been fitted, tighten up the four nuts on the front casing flange and also the two nuts on the long studs which go right through the rear casing.

THE OPERATING VALVE

DESCRIPTION

The valve plug is located at the bottom of the unit on the same side as the solenoid and it is accessible from beneath the car. Unscrew the valve plug with a $\frac{5}{8}$" A/F spanner; if very tight, a sharp tap on the head will facilitate. Remove the spring, plunger and ball. The operating valve can be removed by inserting a piece of stiff wire in the central bore and drawing it down. Care must be taken to avoid damaging the seating at the bottom of the valve. Near the top of the valve will be seen a small hole breaking through the central bore (Fig. 32.) This is for the exhaust of oil from the operating cylinders. Ensure that this is not choked.

SOLENOID ADJUSTMENT

The operating valve is lifted by a cam on a transverse shaft. The solenoid operates a lever attached to this shaft. When the solenoid is operated, the valve must be fully opened.
The solenoid box is located on the left hand side of the unit and is accessible from beneath the car.
Remove the rectangular solenoid cover plate which is secured by four screws. The solenoid lever which has a $\frac{3}{16}$" dia. (4.76 mm.) hole for setting purposes is now disclosed.
Move the lever until a $\frac{3}{16}$" dia (4.76 mm.) pin pushed through the hole in the lever registers the hole in the casing.
Screw the nut on the plunger until when the plunger is pushed right home in the solenoid, the nut just contacts the fork of the lever.
Remove the $\frac{3}{16}$" (4.76 mm.) dia, pin.
Recheck by energising the solenoid and checking the alignment of the holes. When the solenoid is energised the correct consumption should be about 1 ampere. If it is 15-20 amperes it is an indication that the solenoid plunger is not moving far enough to switch from the operating to the holding coil of the solenoid and the lever must be adjusted.

THIS IS IMPORTANT AS HIGH CURRENT WILL CAUSE SOLENOID FAILURE.

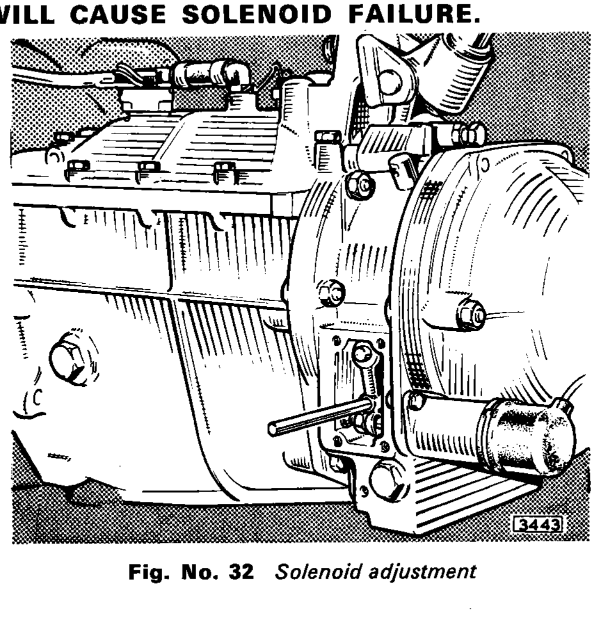


Fig. No. 32 *Solenoid adjustment*

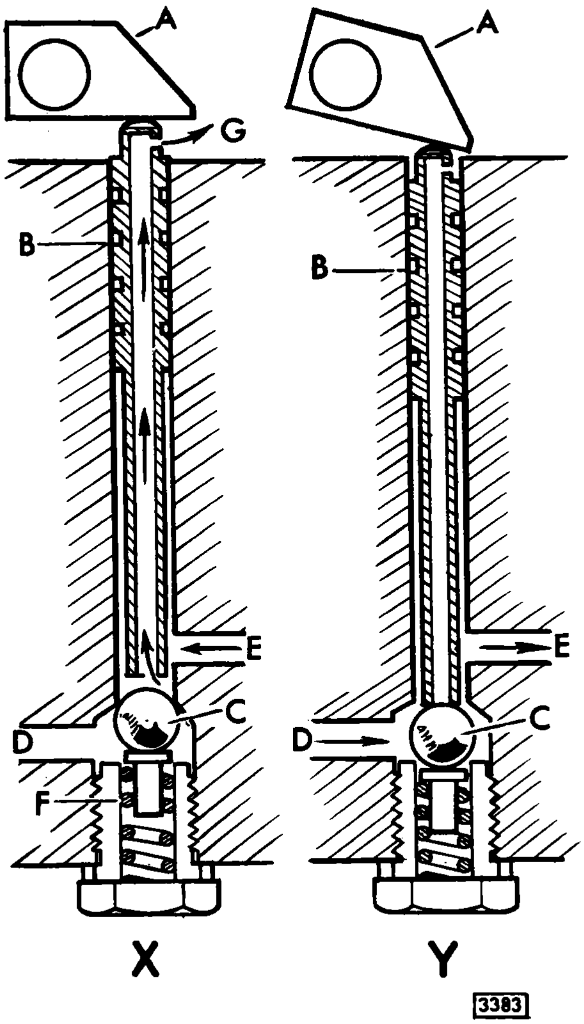


Fig. No. 33 *The operating valve*

"X" shows the position of the operating valve in direct drive. In this position the ball C is held on the seat in the casing by the valve spring F and isolates the supply D from the operating cylinders E.

"Y" shows the position of the operating valve in the overdrive position. The valve has been lifted by action of the solenoid causing the cam A to rotate, moving the ball off the seat in the casing and sealing off the top of the valve. This allows oil under pressure to transfer from port D to the operating cylinders E.

On returning to direct drive, the oil is exhausted down the hollow stem of the valve B and through the restrictor G.

STICKING CLUTCH

If an overdrive cannot be disengaged after carrying out the procedure outlined on Page E.24 this is probably due to a sticking cone clutch. This trouble can be experienced with a new unit due to insufficient "bedding-in" of the clutch, but it is unlikely to occur on a unit which has been in service for some time.
The clutch can usually be freed by giving the brake ring several sharp blows with a hide mallet. This can be done from underneath when the car is on a hoist.

THE ELECTRICAL CIRCUIT

As many operational failures are due to corroded terminals and faulty wiring, wiring and connections should be checked first.
Good earth connections are essential on all earthed components. This applies particularly to the solenoid because of the heavy current passed momentarily each time the overdrive is engaged.
Incorrect adjustment of the solenoid, resulting in the failure of the main winding contacts to open, may cause damage to the solenoid.
Check that the in-line fuse has not blown (this fuse is located behind the side facia panel). Replace with an 8 amp. fuse if necessary.
Switch on reverse light and check that main fuse, No. 8, has not blown.
If neither fuse has blown, check that current is available at the solenoid. Disconnect the cable at the solenoid junction and connect a test lamp in circuit. Switch on overdrive. If current is available as indicated by test bulb illumination, renew the solenoid unit.
If current is **NOT** available, reconnect the solenoid and short out the top gear switch terminals. Renew the switch if the solenoid now operates.
If the solenoid does not operate, replace the control switch by substitution and recheck. Renew the control switch if faulty.

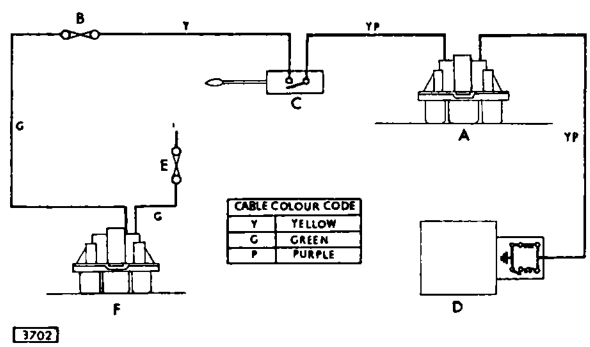


Fig. No. 34 *Overdrive circuit diagram*

TESTING OIL PRESSURE

Release the hydraulic pressure by switching on the ignition, engaging top gear and operating the overdrive switch several times. Remove the operating valve plug and replace it with the hydraulic test equipment, which has a pressure gauge reading to 800 lb./sq. in. (56.24 kg./sq. cm.).
Jack up the rear wheels of the car securely, start the engine, engage top gear and run up to about 20 m.p.h. (32 k.p.h.) on the speedometer. Hydraulic pressure should then be recorded. Check the pressure in direct and overdrive.
Failure to register pressure with overdrive selected may indicate that the pump non-return valve requires cleaning and re-seating.
Hydraulic pressure should be 540-560 lb./sq. in. (37.966/39.372 kg./sq. cm.).

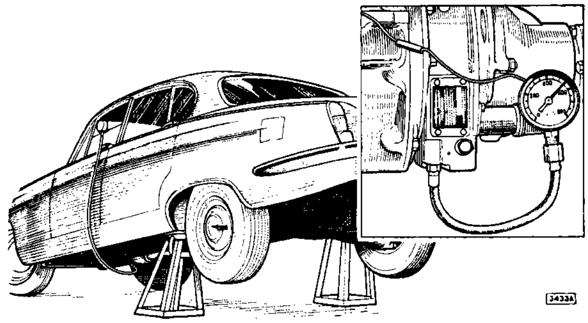


Fig. No. 35 *Testing the oil pressure*

THE PUMP VALVE

If the unit fails to operate after re-seating the operating valve, check that the pump is working. Jack up the rear wheels of the car securely, remove the operating valve plug and, using a clean receptacle, catch any oil which may spill from the valve chamber.
Start up the engine, engage top gear, and with the engine running slowly, watch for oil being pumped into the valve chamber. If none appears the pump is not functioning and its non-return valve should be cleaned.
A flow of oil does not necessarily mean that the hydraulic pressure is correct.
It is most important that any oil lost from the valve chamber is poured back into the gearbox when the operating valve plug has been replaced.
The pump valve is accessible from underneath the unit when the centre plug is removed. Unscrew the valve body, carefully clean the ball and the valve seating. Reseat the ball by tapping it sharply on to its seating.

SPECIAL TOOLS

Description
Dummy Mainshaft (L.185A)*
Pump Body Remover (Main Tool—L.183A)*
Pump Body Remover Adaptor (L.183A-2)*
Assembly Ring for Uni-directional Clutch (L.178)*
Annulus Bearing Replacer (L.303)*
Accumulator Piston Replacer (L.304)*
Rear Casing Oil Seal Replacer (L.305)*
Pump Non-Return Valve Key (L.213)*
* Churchill Tool Number.

FAULT FINDING

When an overdrive unit does not operate properly it is advisable to check the level of the oil and, if below the low level mark, top up with fresh oil and test the unit again before making any further investigations.
Faulty units should be checked for defects in the order listed below.
If the electrical control does not operate, the electrical circuit should be checked from the diagram.

OVERDRIVE DOES NOT ENGAGE

(a) Insufficient oil in the gearbox.
(b) Solenoid not operating due to fault in electric system.
(c) Solenoid operating lever out of adjustment.
(d) Insufficient hydraulic pressure due to pump non-return valve incorrectly seating (probably dirt on the seat).
(e) Insufficient hydraulic pressure due to worn accumulator.
(f) Pump not working due to choked filter.
(g) Pump not working due to damaged pump roller or cam.
(h) Leaking operating valve due to dirt on ball seat.
(i) Damaged parts within the unit requiring removal and inspection.

OVERDRIVE DOES NOT DISENGAGE

Important: If the overdrive does not release, do NOT reverse the car, otherwise extensive damage may be caused.
(a) Fault in electrical control system.
(b) Solenoid sticking.

(c) Blocked restrictor jet in operating valve.
(d) Solenoid operating lever incorrectly adjusted.
(e) Sticking clutch.
(f) Damaged gears, bearing or sliding parts within the unit.

CLUTCH SLIP IN OVERDRIVE

(a) Insufficient oil in gearbox.
(b) Solenoid lever out of adjustment.
(c) Insufficient hydraulic pressure due to pump non-return valve incorrectly seating (probably dirt on the seat).
(d) Insufficient hydraulic pressure due to worn accumulator.
(e) Operating valve incorrectly seated.
(f) Worn or glazed clutch lining.

Clutch slip in reverse or free wheel condition on overdrive

(a) Solenoid operating lever out of adjustment.
(b) Partially blocked restrictor jet in operating valve.
(c) Worn or burnt inner clutch lining.

Note: Before removing any of the valve plugs it is essential to operate the solenoid several times in order to release all hydraulic pressure from the system. To do this, engage top gear, switch on the ignition and operate the overdrive control switch several times.

AUTOMATIC TRANSMISSION

SECTION F

INDEX

GENERAL DATA

GEAR RATIOS

Maximum ratio of torque converter	2.00 : 1
1st gear reduction	2.40 : 1
2nd gear reduction	1.46 : 1
3rd gear	1.00 : 1
Reverse gear reduction	2.00 : 1

SHIFT SPEEDS

Selector Position	Throttle Position	Upshifts 1—2	2—3	Downshifts 3—2	3—1	2—1
			M.P.H.			
D1	Minimum	6.5 to 7.5	11 to 13	6.5 to 12.5	—	3.5 to 6.5
	Full	33 to 38.5	58 to 62	19.5 to 32.5	—	—
	Kickdown	45 to 49	70.5 to 77.5	63 to 71	17 to 21	17 to 21
D2	Minimum	—	11 to 13	7 to 13	—	—
	Full	—	58—62	19.5 to 32.5	—	—
	Kickdown	—	70.5 to 77.5	63 to 71	—	—
L	Zero	—	—	ANY	—	10 to 18
			K.P.H.			
D1	Minimum	10.5 to 12	18 to 21	10.5 to 12	—	6 to 10
	Full	53 to 62	.93 to 100	31 to 52	—	—
	Kickdown	72.5 to 79	113 to 125	100 to 114	27 to 34	27 to 34
D2	Minimum	—	18 to 21	11 to 21	—	—
	Full	—	93 to 100	31 to 52	—	—
	Kickdown	—	113 to 125	100 to 114	—	—
L	Zero	—	—	ANY	—	16 to 29

Note: Shift points are approximate and not absolute values. Reasonable deviations from the above values are permissible.

IMPORTANT NOTICE

ANY QUERIES ON THE USE, UPKEEP OR REPAIR OF THIS TRANSMISSION UNIT MUST BE REFERRED TO THE WORKS SERVICE DIVISION. COVENTRY, AND **IN NO CIRCUMSTANCES** TO THE MANUFACTURERS OF THE TRANSMISSION. SPARE PARTS ARE **NOT** AVAILABLE FROM THE TRANSMISSION MANUFACTURERS.

TIGHTENING TORQUE FIGURES

	lb. ft.	kgm.
Front pump to transmission case bolts	17 — 22	2.35 — 3.04
Front servo to transmission case bolts	30 — 35	4.15 — 4.70
Rear servo to transmission case bolts	40 — 45	5.53 — 6.22
Centre support to transmission case bolts	20 — 25	2.76 — 3.46
Upper valve body to lower valve body bolts	4 — 6	0.55 — 0.83
Control valve body to transmission case bolts	8 — 10	1.11 — 1.38
Pressure regulator assembly to transmission case bolts	17 — 22	2.35 — 3.04
Extension assembly to transmission case bolts	28 — 33	3.87 — 4.56
Oil pan to transmission case bolts	10 — 13	1.38 — 1.80
Case assembly-gauge hole plug	10 — 15	1.38 — 2.07
Oil pan drain plug	25 — 30	3.46 — 4.15
Rear band adjusting screw lock nut	35 — 40	4.70 — 5.53
Front band adjusting screw lock nut	20 — 25	2.76 — 3.46
Detent lever attaching nut	35 — 40	4.70 — 5.53
Companion flange nut	90 —120	12.44 —16.58
Bearing retainer to extension housing bolts	28 — 33	3.87 — 4.56

TIGHTENING TORQUE FIGURES

	lb. in.	kgm.
Front pump cover attaching screws	25 — 35	0.29 — 0.40
Rear pump cover attaching screws ¼"	50 — 60	0.60 — 0.72
Rear pump attaching screws Nos. 10 — 24	20 — 30	0.24 — 0.35
Governor inspection cover attaching screws	50 — 60	0.60 — 0.72
Governor valve body to counterweight screws	50 — 60	0.60 — 0.72
Governor valve body cover screws	20 — 30	0.24 — 0.35
Pressure regulator cover attaching screws	20 — 30	0.24 — 0.35
Control valve body screws	20 — 30	0.24 — 0.35
Control valve body plug	10 — 14	0.11 — 0.16
Control valve lower body plug	7 — 15	0.08 — 0.17

SPECIAL SERVICE TOOLS

Service tools are not available from Borg-Warner Limited. Distributors and Dealers should obtain the following tools illustrated in this manual from Messrs. V. L. Churchill & Co. Ltd., London Road, Daventry, Northants.

Description

Mainshaft end play gauge (CB.W.33)
Rear clutch spring compressor (C.B.W.37A used with W.G.37)
Hydraulic pressure test gauge equipment (C.B.W.1A used with adaptor C.B.W.1A-5A)
Spring beam torque wrench (used in conjunction with the following adaptor) (C.B.W.547A-50)
Rear band adjusting adaptor (C.B.W.547A-50-2)
Torque screwdriver (used in conjunction with the following adaptor) (C.B.W.548)
Front band adjusting adaptor (C.B.W.548-2)
Front band setting gauge (C.B.W.34)
Circlip pliers (used with "J" points) (7066)
Bench cradle (C.W.G.35)
Rear clutch piston assembly sleeve (C.W.G.41)
Front clutch piston assembly sleeve (C.W.G.42)
Rear pump discharge tube remover (C.W.G.45)

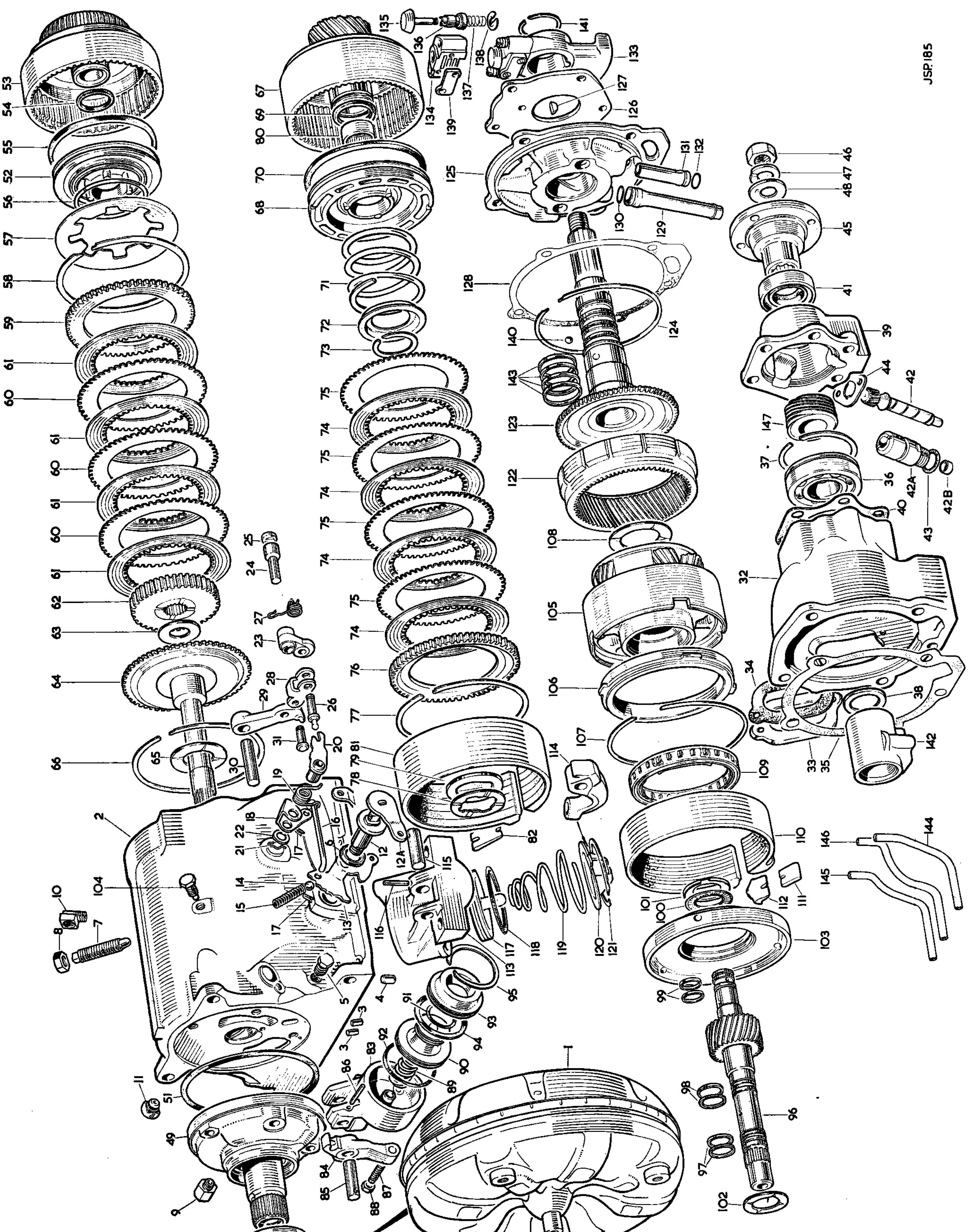


Fig. No. 118 *Exploded view of the Model 8 transmission unit*

1 Converter
2 Transmission case
3 Plug
4 Dowel
5 Plug
6 Oil seal
7 Screw
8 Nut
9 Union
10 Union
11 Breather
12 Manual control
13 Lever
14 Ball
15 Spring
16 Link
17 Clip
18 Torsion lever
19 Spring
20 Forked lever
21 Clip
22 Washer
23 Toggle lever
24 Toggle pin
25 Plug
26 Ball pin
27 Spring
28 Link
29 Pawl
30 Pivot pin
31 Pin
32 Extension case
33 Cover plate
34 Gasket
35 Gasket
36 Bearing
37 Snap ring
38 Spacing washer
39 Speedo driven gear housing
40 Gasket
41 Oil seal
42 Speedo driven gear
43 "O" ring
44 Plate
45 Flange
46 Nut
47 Lockwasher
48 Special washer
49 Front pump
50 Oil seal
51 Sealing ring
52 Piston
53 Cylinder
54 Sealing ring
55 Sealing ring
56 Split ring
57 Spring
58 Snap ring
59 pressure plate
60 Clutch plate
61 Clutch plate
62 Hub
63 Thrust washer
64 Input shaft
65 Thrust washer
66 Snap ring
67 Front drum
68 Piston
69 Sealing ring (inner)
70 Sealing ring (outer)
71 Spring
72 Spring seal
73 Snap ring
74 Clutch plate (friction)
75 Clutch plate (drive)
76 Pressure plate
77 Snap ring
78 Thrust washer
79 Thrust washer
80 Needle bearing
81 Brake band (front drum)
82 Servo strut
83 Front servo body
84 Lever
85 Pivot pin
86 Roll pin
87 Screw
88 Nut
89 Return spring
90 Piston
91 "O" ring (small)
92 "O" ring (large)
93 Piston sleeve
94 Sealing ring
95 Snap ring
96 Forward sun gear
97 Sealing ring (front)
98 Sealing ring (centre)
99 Sealing ring (rear)
100 Thrust bearing
101 Thrust bearing race
102 Thrust washer (bronze)
103 Centre support
104 Screw
105 Planetary gears and drum
106 Outer race
107 Snap ring
108 Thrust washer
109 One-way clutch
110 Brake band (rear drum)
111 Servo strut
112 Anchor strut
113 Body (rear servo)
114 Lever
115 Shaft
116 Roll pin
117 Piston
118 "O" ring
119 Return spring
120 Plate
121 Snap ring
122 Ring gear
123 Main shaft
124 Snap ring
125 Rear pump
126 Plate
127 Key
128 Gasket
129 Oil inlet tube
130 "O" ring
131 Oil outlet tube
132 "O" ring
133 Governor
134 Governor body
135 Governor weight
136 Governor valve
137 Spring
138 Retainer
139 Cover plate
140 Ball
141 Snap ring
142 Oil collector sleeve
143 Piston ring
144 Oil collector tube (front)
145 Oil collector tube (intermediate)
146 Oil collector tube (rear)
147 Speedometer drive gear

AUTOMATIC TRANSMISSION

Description
Mainshaft end play gauge (CB.W.33)
Rear clutch spring compressor (C.B.W.37A used with W.G.37)
Hydraulic pressure test gauge equipment (C.B.W.1A used with adaptor C.B.W.1A-5A)
Spring beam torque wrench (used in conjunction with the following adaptor) (C.B.W.547A-50)
Rear band adjusting adaptor (C.B.W.547A-50-2)
Torque screwdriver (used in conjunction with the following adaptor) (C.B.W.548)
Front band adjusting adaptor (C.B.W.548-2)
Front band setting gauge (C.B.W.34)
Circlip pliers (used with "J" points) (7066)
Bench cradle (C.W.G.35)
Rear clutch piston assembly sleeve (C.W.G.41)
Front clutch piston assembly sleeve (C.W.G.42)
Rear pump discharge tube remover (C.W.G.45)

DESCRIPTION AND OPERATION

The Model 8 automatic transmission incorporates a fluid torque converter in place of the usual flywheel and clutch. The converter is coupled to a hydraulically operated planetary gearbox which provides three forward ratios and reverse. All forward ratios are automatically engaged in accordance with accelerator position and car speed.
Overriding control by the driver is available upon demand for engine braking by manual selection of "L".

TORQUE CONVERTER

The feature of using a hydraulic converter in conjunction with a three-speed automatic gearbox provides a means of obtaining a smooth application of engine power to the driving wheels and additional engine torque multiplication to the 1st and 2nd gears of the gearbox.
The converter also provides extreme low-speed flexibility when the gearbox is in 3rd gear and, due to the ability of multiplying engine torque, it provides good acceleration from very low road speed without having to resort to a down-shift in the gearbox.
Torque multiplication from the converter is infinitely variable between the ratios of 2 : 1 and 1 : 1. The speed range, during which the torque multiplication can be achieved, is also variable, depending upon the accelerator position.
The hydraulic torque converter for use in conjunction with the automatic gearbox has a mean fluid circuit diameter of 11" (27.9 cm.).
It is of the single-phase, three-element type, comprising an impeller connected to the engine crankshaft, a turbine connected to the input shaft of the gearbox, and a stator mounted on a sprag-type one-way clutch supported on a fixed hub projecting from the gearbox case.

THE GEAR SET

The planetary gear set consists of two sun gears, two sets of pinions, a pinion carrier, and a ring gear. Helical, involute tooth forms are used throughout. Power enters the gear set via the sun gears. In all forward gears power enters through the forward sun gear; in reverse power enters through the reverse sun gear. Power leaves the gear set by the ring gear. The pinions are used to transmit power from the sun gears to the ring gear. In reverse a single set of pinions is used, which causes the ring gear to rotate in the opposite direction to the sun gear. In forward gears a double set of pinions is used to cause the ring gear to rotate in the same direction as the sun gear. The carrier locates the

Selector Position		Ratio	Applied	Driving		Held
L	Lock-up	1st	Front Clutch Rear Band Sprag Clutch	Forward	Sun	Planet Carrier
D1	Drive One	1st	Front Clutch Sprag Clutch	Forward	Sun	Planet Carrier
L D1 D2	Lock-up Drive One Drive Two	2nd 2nd	Front Clutch Front Band	Forward	Sun	Reverse Sun
D1 D2	Drive One Drive Two	3rd	Front Clutch Rear Clutch	Forward Secondary	Sun Sun	
R	Reverse	Reverse	Rear Clutch Rear Band	Reverse	Sun	Planet Carrier

pinions in their correct positions relative to the sun gears and the ring gear (and also forms a reaction member for certain conditions). The various mechanical ratios of the gear set are obtained by the engagement of hydraulically operated multi-disc clutches and brake bands.

CLUTCHES

Multi-disc clutches operated by hydraulic pistons connect the converter to the gear set. In all forward gears the front clutch connects the converter to the forward sun gear; for reverse the rear clutch connects the converter to the reverse sun gear.

BANDS

Brake bands, operated by hydraulic servos, hold elements of the gear set stationary to effect an output speed and a torque increase. In Lockup the rear band holds the planet carrier stationary and provides the 1st gear ratio of 2.40 : 1 and, in reverse, a ratio of 2.00 : 1. The front band holds the reverse sun gear stationary to provide the 2nd gear ratio of 1.46 : 1.

ONE-WAY CLUTCH

In D1, a one-way clutch is used in place of the rear band to prevent anti-clockwise rotation of the planet carrier, thus providing the 1st gear ratio of 2.40 : 1. This one-way clutch, allowing the gear set to freewheel in 1st gear, provides smooth ratio changes from 1st to 2nd, and vice versa.

MECHANICAL POWER FLOW

First Gear (Lockup selected)

The front clutch is applied, connecting the converter to the forward sun gear. The rear band is applied, holding the planet carrier stationary, the gear set providing the reduction of 2.40 : 1. The reverse sun gear rotates freely in the opposite direction to the forward sun gear.

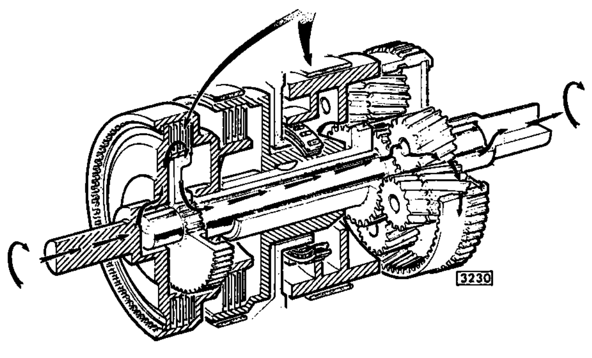


Fig. No. 1 *Mechanical power flow—First gear (Lock-up) selected*

First Gear (Drive 1 selected)

The front clutch is applied, connecting the converter to the forward sun gear. The one-way clutch is in operation, preventing the planet carrier from rotating anti-clockwise; the gear set provides the reduction of 2.40 : 1. When the vehicle is coasting the one-way clutch over-runs and the gear set freewheels.

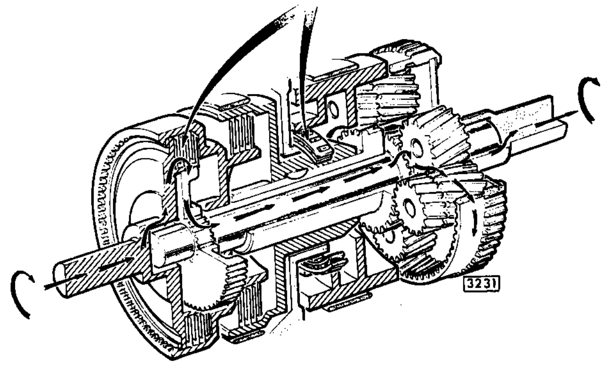


Fig. No. 2 *Mechanical power flow — First gear (Drive 1) selected*

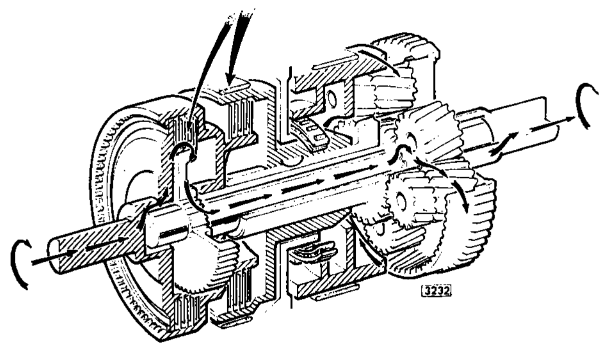


Fig. No. 3 *Mechanical power flow — Second gear (Lock-up or Drive 2) selected*

Second Gear (Lockup or Drive 2 selected)

Again the front clutch is applied, connecting the converter to the forward sun gear. The front band is applied, holding the reverse sun gear stationary; the gear set provides the reduction of 1.46 : 1.

Third Gear

Again the front clutch is applied, connecting the converter to the forward sun gear. The rear clutch is applied, connecting the converter also to the reverse sun gear; thus both sun gears are locked together and the gear set rotates as a unit, providing a ratio of 1 : 1.

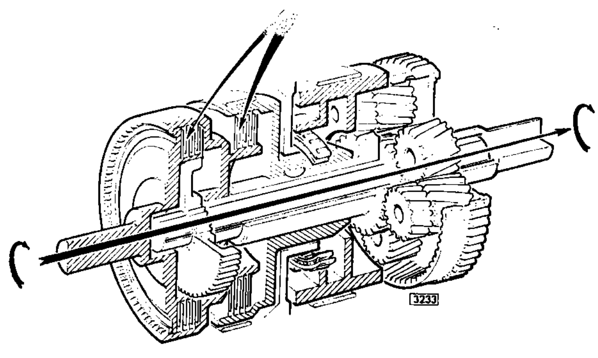


Fig. No. 4 *Mechanical power flow — Third gear (D1) selected*

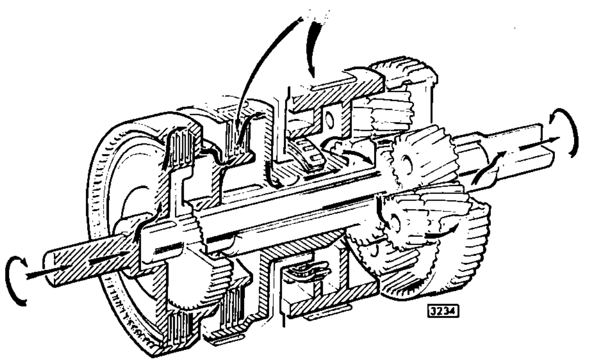


Fig. No. 5 *Mechanical power flow — Reverse gear (R) selected*

Neutral and Park

In neutral the front and rear clutches are off, and no power is transmitted from the converter to the gear set. The front and rear bands are also released. In "P" the Front Servo Apply and Release and Rear Servo circuits are pressurised while the engine is running, so that the rear band is applied.

Reverse Gear

The rear clutch is applied, connecting the converter to the reverse sun gear. The rear band is applied, holding the planet carrier stationary, the gear set providing the reduction of 2.00 : 1 in the reverse direction.

THE HYDRAULIC SYSTEM

The hydraulic system contains a front and rear pump, both of the internal/external gear pattern, picking up fluid from the oil pan through a common strainer. Shift control is provided by a centrifugally operated hydraulic governor on the transmission output shaft. This governor works in conjunction with valves in the valve body assembly located in the base of the transmission. These valves regulate fluid pressure and direct it to appropriate transmission components.

The Front Pump

The front pump, driven by the converter impeller, is in operation whenever the engine is running. This pump, through the primary and secondary regulator valves supplies the hydraulic requirements of the transmission with the engine running when the vehicle is stationary, as well as at low vehicle speeds before the rear pump becomes effective.

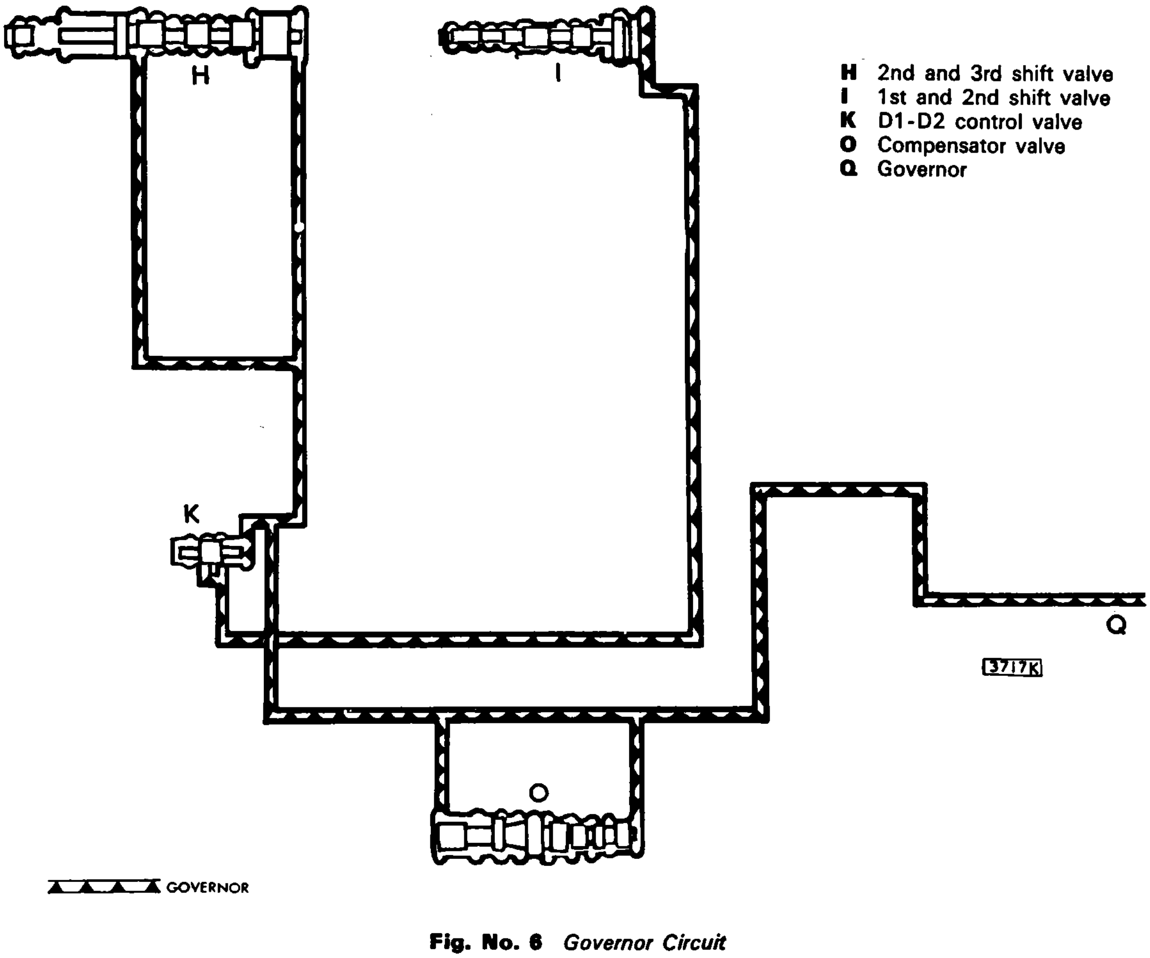


Fig. No. 6 *Governor Circuit*

The Rear Pump

The rear pump is driven by the output shaft of the transmission. It is fully effective at speeds above approximately 20 m.p.h. (32 k.p.h.) and then supplies most of the hydraulic requirements.

If, due to a dead engine, the front pump is inoperative, the rear pump, above approximately 20 m.p.h. (32 k.p.h.) can provide all hydraulic requirements, thus enabling the engine to be started through the transmission.

The Governor

The governor, revolving with the output shaft, is essentially a pressure regulating valve which reduces line pressure to a value which varies with output shaft speed. This variable pressure is utilised in the control system to effect up and down shifts through the 1-2 and 2-3 shift valves. Rotation of the governor at low speeds causes the governor weight and valve to be affected by centrifugal force. The outward force is opposed by an opposite and equal hydraulic force produced by pressure acting on the regulating area of the governor valve. The governor valve is a regulating valve and will attempt to maintain equilibrium. Governor pressure will rise in proportion to the increase in centrifugal force caused by higher output shaft speed.

As rotational speed increases the governor weight moves outward to rest on a stop in the governor body, and can move no further. When this occurs, a spring located between the counter weight and the valve becomes effective. The constant force of this spring then combines with the centrifugal force of the governor valve and the total force is opposed by governor pressure. This combination renders governor pressure less sensitive to output shaft speed variations.

It can be seen from the above, that the governor provides two distinct phases of regulation, the first of which is a fast rising pressure for accurate control of the low speed shift points.

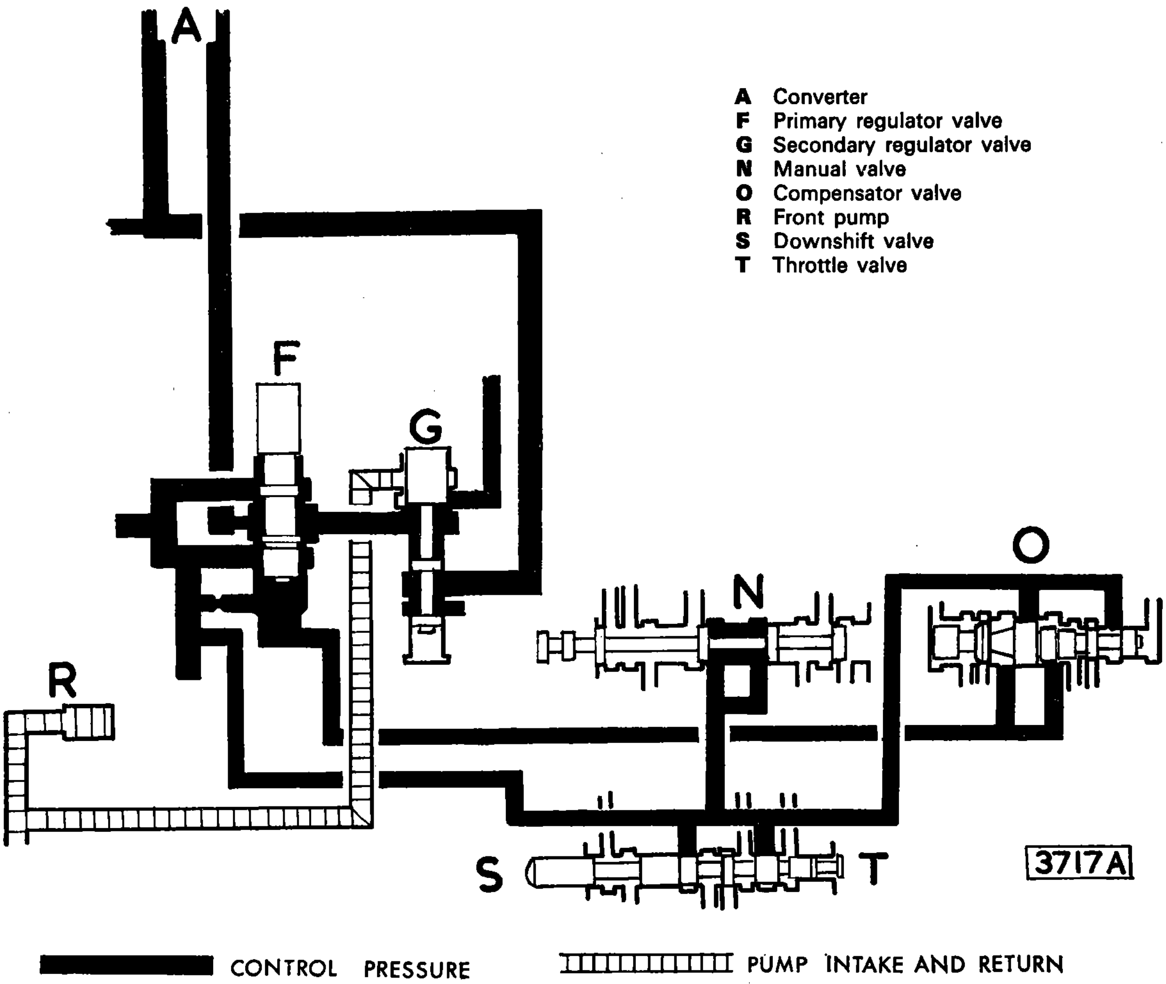


Fig. No. 7 *Hydraulic circuit — Neutral*

THE CONTROL SYSTEM

Neutral—Engine Running (See Fig. 7)
When the selector is moved to the neutral position, the manual control valve is positioned so that control pressure cannot pass through the manual valve to the clutches or servos; therefore, the clutches and servos cannot apply. There is no transmission of power through the transmission in the neutral position.
The pressure regulation system, however, is functioning. With the engine running, the front pump is driven and fluid is picked up from the pan by the front pump inlet. Fluid, circulated by the front pump, is directed to the control pressure regulator. The primary regulator valve will maintain correct control pressure by expelling the excess fluid to feed the secondary regulator valve. The secondary regulator valve maintains correct pressure for converter feed and lubrication, then forces the excess fluid back to the pump inlet.
Control pressure is directed to the manual control valve, where it is blocked by two lands on the valve. Control pressure is also directed to the throttle valve and the downshift valve and, with the valve closed (accelerator at idle position), it is blocked by lands on the valves. Control pressure to the compensator valve is regulated by that valve, and compensating pressure is directed to the primary regulator valve.

First Gear, D1 Range (See Fig. 8)
When the selector lever is placed in the D1 position, with the car standing still, and the engine running, the manual control valve is moved to admit control pressure to apply the front clutch.
Control pressure is also directed to the governor, but with the car standing still, the control pressure is blocked at the governor valve.
Control pressure from the manual valve is directed through another passage to the apply side of the front servo and the 1-2 shift valve.
From the 1-2 shift valve pressure then passes to the servo orifice control valve and the front servo release valve where it is blocked.
Control pressure is then directed from the servo orifice control valve via the 2-3 shift valve and again through the control valve to the release side of the front servo. Pressure is also present at the transition valve where it is blocked.

A Converter
B Front clutch
D Front servo
F Primary regulator valve
G Secondary regulator valve
H 2nd and 3rd shift valve
I 1st and 2nd shift valve
J Transition valve
K D1-D2 control valve
L Front servo orifice valve
M Servo orifice control valve
N Manual valve
O Compensator valve
Q Governor
R Front pump
S Downshift valve
T Throttle valve
U Throttle modulator valve

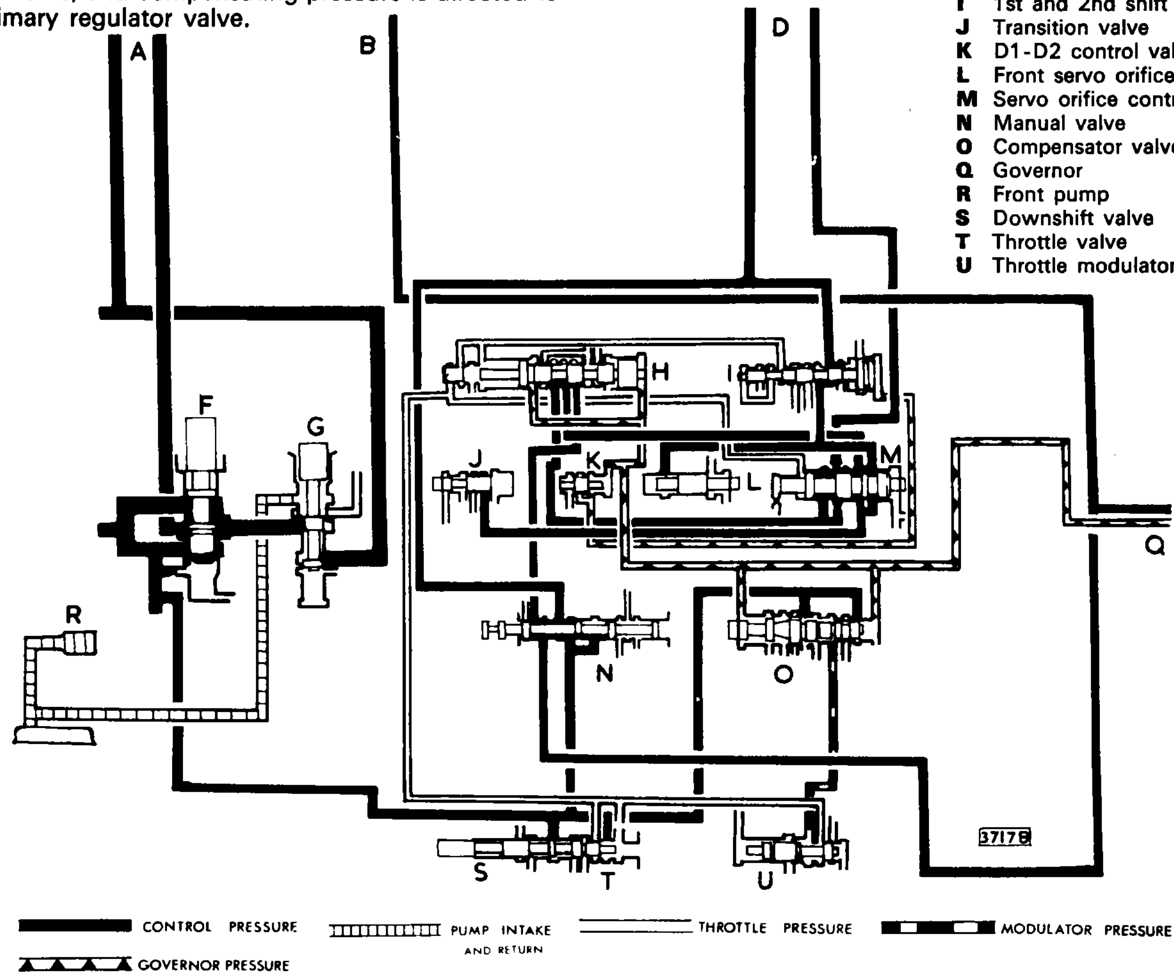


Fig. No. 8 *Hydraulic circuit — 1st gear (D1 range)*

With pressure on both sides of the front servo piston, the servo is held in a released position. The one-way clutch takes the reaction torque on the rear drum, thus eliminating need for rear servo action.

The front pump supplies the pressure to operate the transmission and this pressure is controlled as it was in the neutral position.

When the accelerator is depressed and the car starts to move, centrifugal force, acting on the governor weight and valve, moves the valve to regulate governor pressure, which is directed to the 1-2 shift valve, 2-3 shift valve, and plug, and the compensator valve. Movement of the accelerator also opens the throttle valve so that throttle pressure is directed to the modulator valve, orifice control valve, and the shift plug on the end of the 2-3 shift valve. Throttle pressure to the modulator valve is re-directed to the compensator valve to increase control pressure.

Throttle pressure to the shift plug on the 2-3 shift valve is reduced, and the reduced pressure is directed to the ends of the 1-2 shift valve and the 2-3 shift valve. This reduced pressure on the shift valves opposes governor pressure.

Second Gear, D1 Range (Fig. 9)

As the car speed increases, the governor pressure builds up until it can overcome the opposite force of the 1-2 shift valve spring and reduced throttle pressure on the end of the valve and so moves the valve.

When the 1-2 shift valve moves, control pressure as the valve is shut off and the front servo release pressure is exhausted, first slowly through a restricting orifice and then fast through the front servo release orifice valve. This leaves the front clutch and the front band applied.

A Converter
B Front clutch
D Front servo
F Primary regulator valve
G Secondary regulator valve
H 2nd and 3rd shift valve
I 1st and 2nd shift valve
K D1-D2 control valve
L Front servo orifice valve
M Servo orifice control valve
O Compensator vàlve
P Rear pump
Q Governor
R Front pump
S Downshift valve
T Throttle valve
U Throttle modulator valve

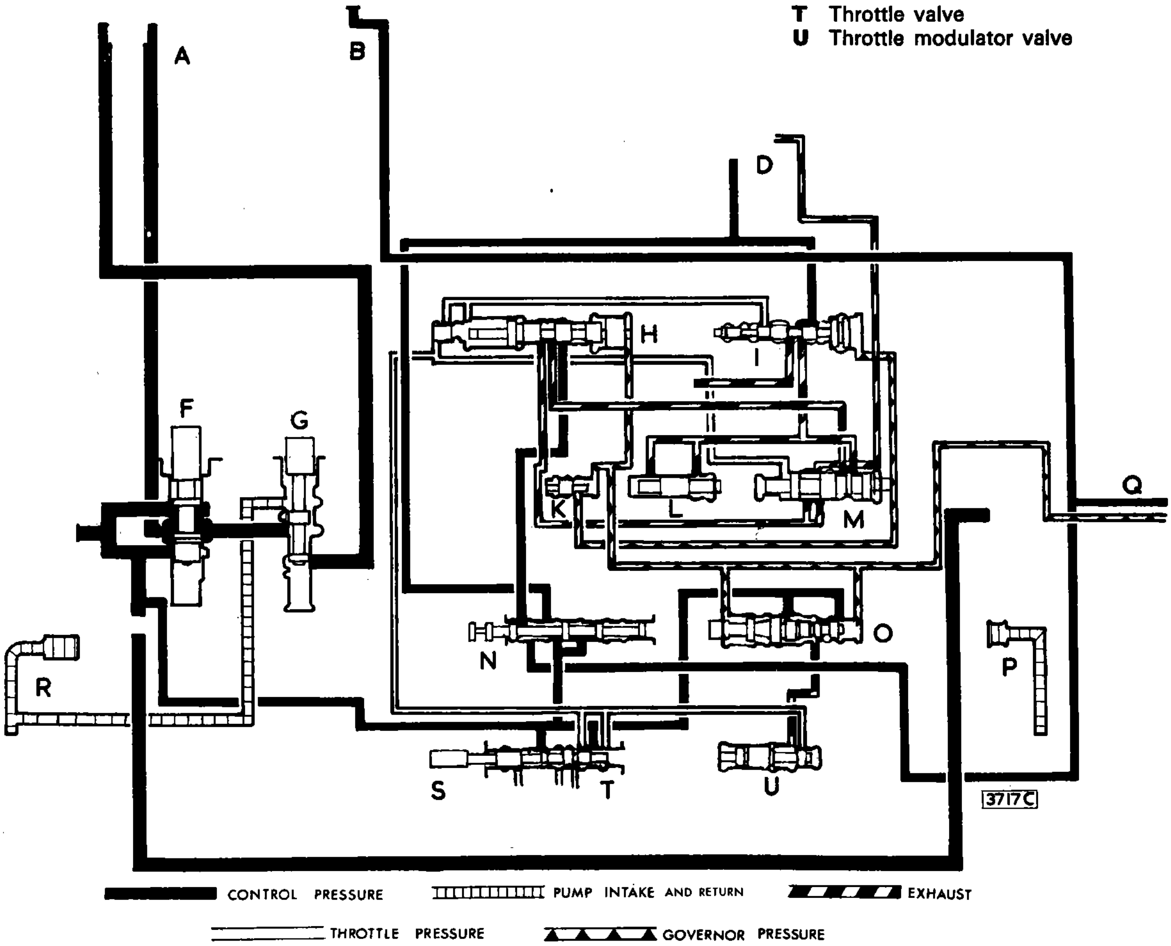


Fig. No. 9 *Hydraulic circuit — 2nd gear (D1 range)*

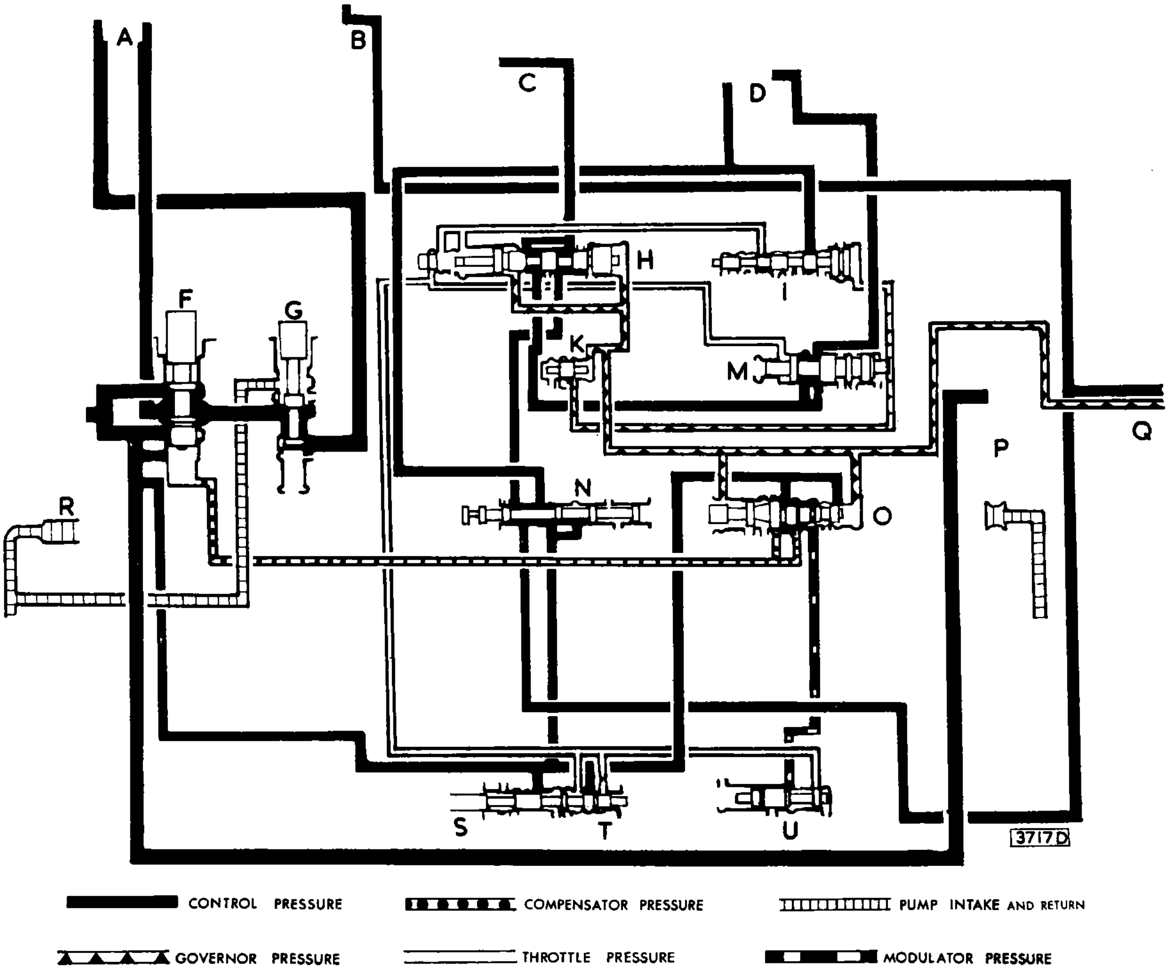


Fig. No. 10 *Hydraulic circuit — 3rd gear (D1 or D2 range)*

A Converter
B Front servo
C Rear clutch
D Front clutch
F Primary regulator valve
G Secondary regulator valve
H 2nd and 3rd shift valve
I 1st and 2nd shift valve
K D1-D2 control valve
M Servo orifice control valve
N Manual valve
O Compensator valve
P Rear pump
Q Governor
R Front pump
S Downshift valve
T Throttle valve
U Throttle modulator valve

Third Gear, D1 or D2 Range (Fig. 10)
As the car speed continues to increase, the governor pressure also increases until it overcomes the 2-3 shift valve spring and the reduced throttle pressure on the end of the 2-3 shift valve, thus causing the valve to move. When the valve moves, control pressure is admitted to the rear clutch and through the annulus of the servo orifice control valve to the release side of the front servo, thus applying the rear clutch and placing the front servo in the released position. This leaves the front clutch and the rear clutch applied.
As the governor pressure continues to increase, it acts against modulator pressure at the compensator valve to increase compensator pressure and decrease control pressure through the movement of the valve in the primary regulator.

Second Gear, D2 Range (Fig. 11)
When the selector lever is placed in the D2 (drive) position, with the car standing still and the engine running, control pressure passes through the manual valve to the D1 and D2 control valve, overcomes any governor pressure acting on this valve and passes through the valve to the governor pressure area of the 1-2 shift valve, thus positioning it in 2nd gear position. Pressure is exhausted from the release side of the front servo, which results in the front clutch and front band being applied.
All upshifts from 2nd gear ratio direct will be similar to description of 3rd gear D1 range.

2-1 Kickdown, D1 Range (Fig. 12)
As car speeds up to approximately 20 m.p.h. (32 k.p.h.) after the transmission has shifted from 1st to 2nd or 3rd gear, the transmission can be downshifted to 1st gear by depressing the accelerator pedal beyond the wide open throttle position.
Movement of the accelerator to kickdown position causes the throttle cable to move the downshift valve to allow control pressure to pass through the down-shift valve to another land on the 1-2 shift valve. The combination of control pressure and the 1-2 shift valve spring is sufficient to overcome governor pressure and return the valve to the 1st gear position. In this position, control pressure is admitted to the release side of the front servo. This places the front servo in the released position, leaving the front clutch applied and the one-way clutch holding the rear drum.

A Converter
B Front servo
D Front clutch
F Primary regulator valve
G Secondary regulator valve
H 2nd and 3rd shift valve
I 1st and 2nd shift valve
K D1-D2 control valve
L Front servo orifice valve
M Servo orifice control valve
N Manual valve
O Compensator valve
P Rear pump
Q Governor
R Front pump
S Downshift valve
T Throttle valve
U Throttle modulator valve

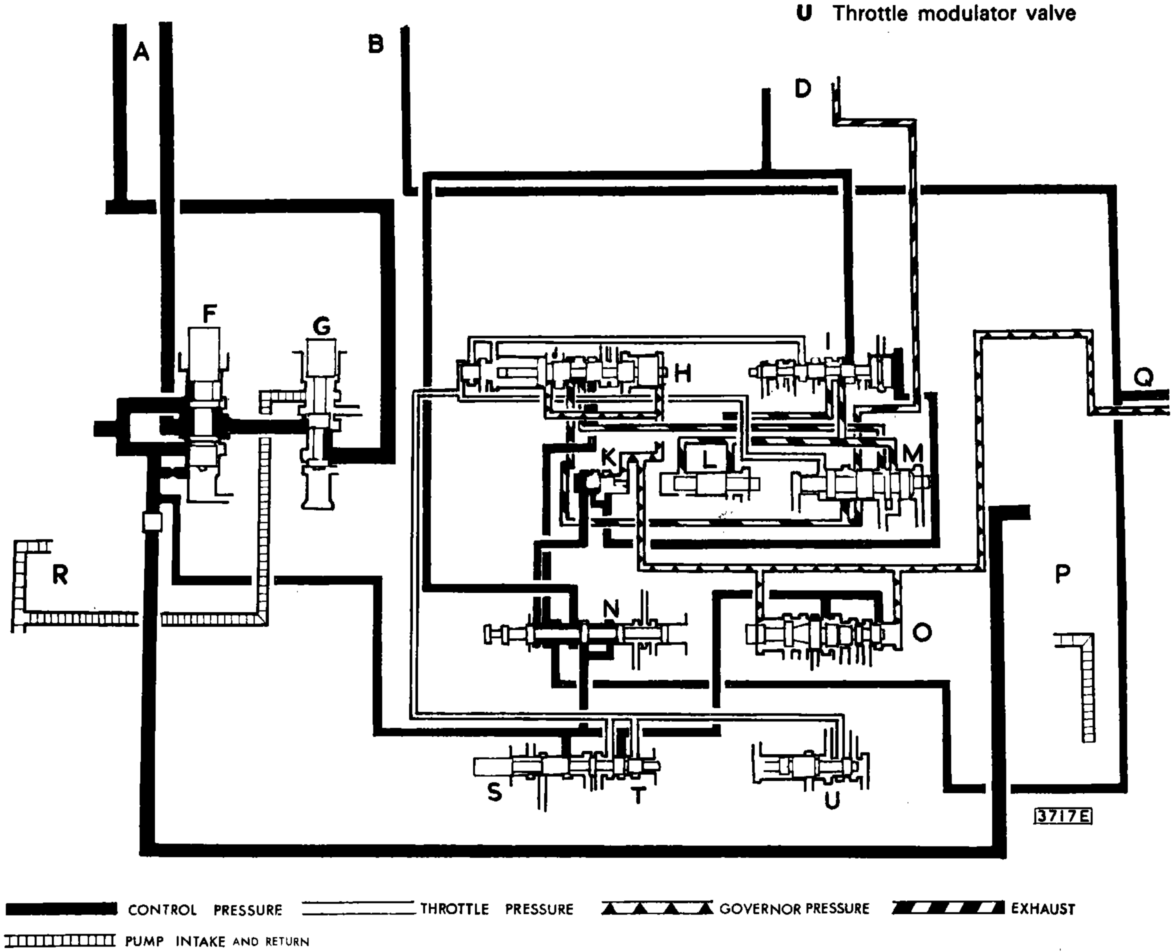


Fig. No. 11 *Hydraulic circuit — 2nd gear (D2 range)*

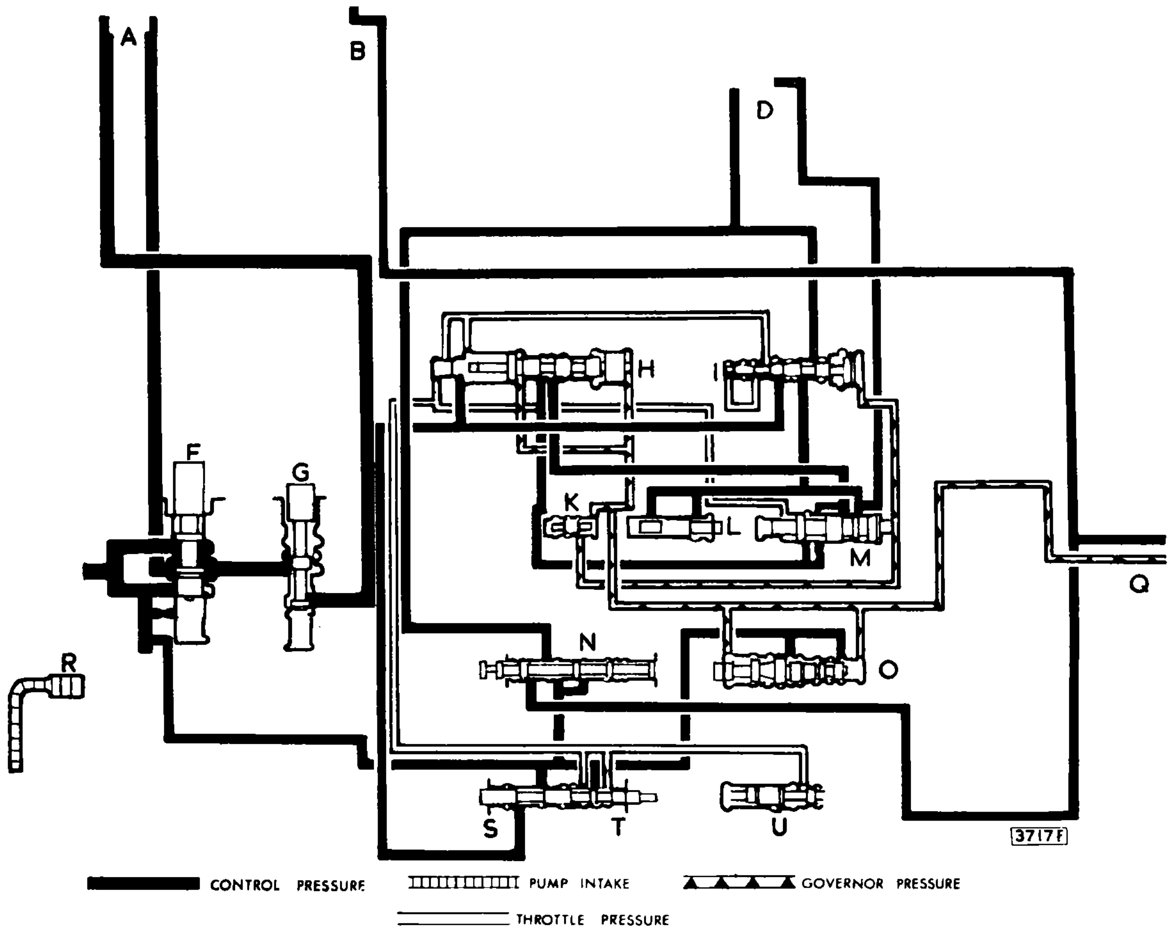


Fig. No. 12 *Hydraulic circuit — 2-1 Kick-down (D1 range)*

A Converter
B Front servo
D Front clutch
F Primary regulator valve
G Secondary regulator valve
H 2nd and 3rd shift valve
I 1st and 2nd shift valve
K D1-D2 control valve
L Front servo orifice valve
M Servo orifice control valve
N Manual valve
O Compensator valve
Q Governor
R Front pump
S Downshift valve
T Throttle valve
U Throttle modulator valve

3-2 Kickdown, D1 or D2 Range (Fig. 13)
At car speeds between approximately 22 to 66 m.p.h. (35 to 106 k.p.h.) after the transmission has shifted to 3rd gear, the transmission can be downshifted from 3rd gear to 2nd gear by depressing the accelerator pedal beyond the wide open throttle position.

Movement of the accelerator causes the throttle cable to move the downshift valve to allow control pressure to pass through the downshift valve to the spring end of the 2-3 shift valve. The combination of control pressure at the end on the 2-3 shift valve and 2-3 shift valve springs is sufficient to overcome governor pressure to move the valve. When the valve is in 2nd gear position, control pressure to the rear clutch and through the servo orifice control valve to the release side of the front servo is shut off. The rear clutch circuit exhausts through the exhaust port of the manual control valve, whereas the front servo release circuit exhausts through the 1-2 shift valve orifice and front servo release orifice valve. This leaves the front clutch and front band applied.
If the accelerator is left in the kickdown position, governor pressure will increase as the car speed increases until the governor pressure is greater than the combined pressures on the 2-3 shift valve, and the transmission will again upshift to 3rd gear.
At speeds above approximately 66 m.p.h. (106 k.p.h.) the governor pressure is so great that the combined pressures on the 2-3 shift valve cannot overcome the governor pressure; therefore, there is no kickdown.

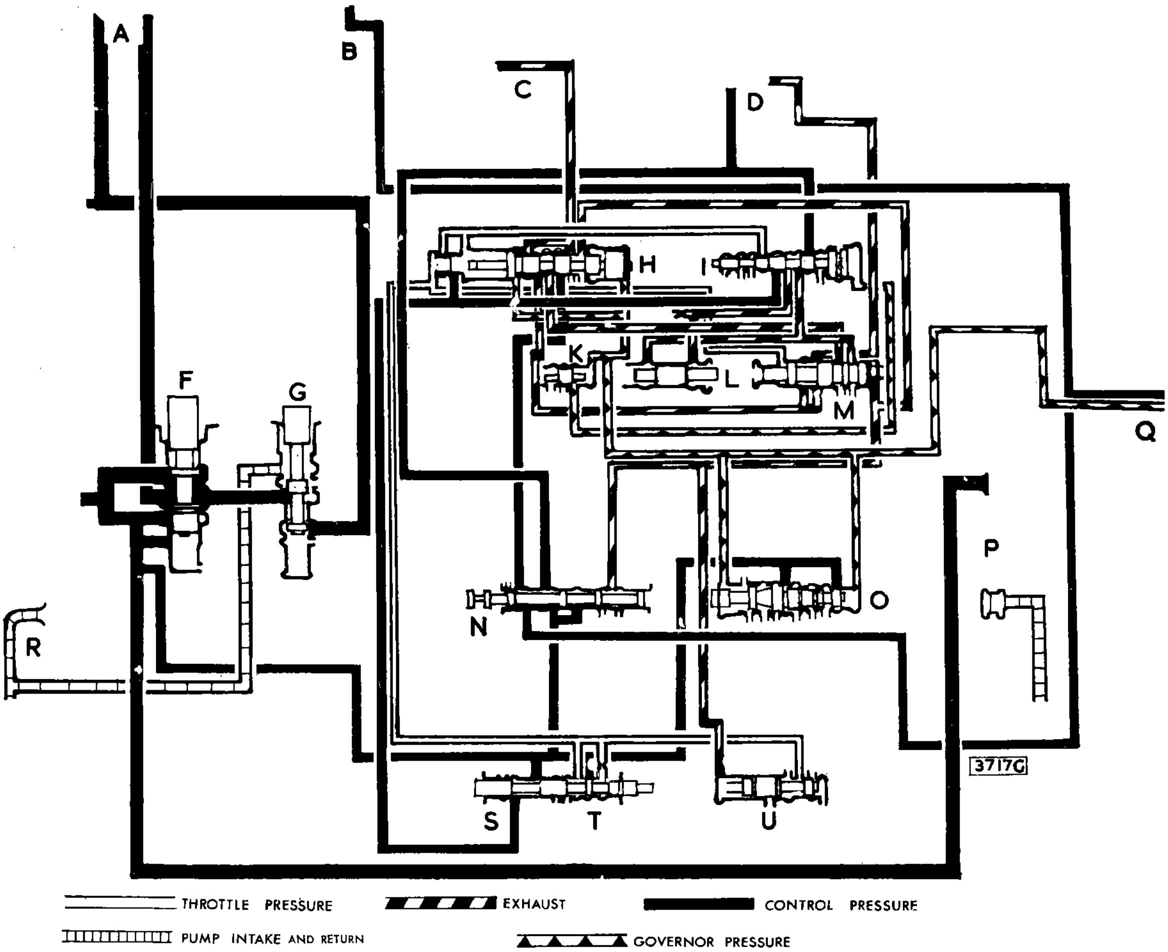


Fig. No. 13 *Hydraulic circuit — 3-2 Kick-down (D1 or D2 range)*

A Converter
B Front clutch
C Rear clutch
D Front servo
F Primary regulator valve
G Secondary regulator valve
H 2nd and 3rd shift valve
I 1st and 2nd shift valve
K D1-D2 control valve
L Front servo orifice valve
M Servo orifice control valve
N Manual valve
O Compensator valve
P Rear pump
Q Governor
R Front pump
S Downshift valve
T Throttle valve
U Throttle modulator valve

Lockup—First Gear (Fig. 14)
When the selector lever is placed in the Lockup position, the manual control valve is moved to admit through one port, control pressure to the governor feed and to apply the front clutch. Another port supplies both sides of the front servo which is held in the released position and also to the rear servo to apply the rear band through the servo orifice control and transition valves. A third port supplies pressure to move the transition valve and to an additional land on the 1-2 shift valve.
In this position, there is no automatic upshift to a higher gear ratio, since the combination of control pressure on the 1-2 shift valve and the 1-2 shift valve spring is greater than governor pressure acting against the valve, so that the valve cannot move. The combination of control pressure on the 2-3 shift valve and the 2-3 valve spring is also greater than the governor

pressure acting against the valve so that the 2-3 shift valve cannot move.

Lockup—Second Gear

In L the manual control valve opens to exhaust the rear clutch and front servo release circuit from 2-3 shift valve. This causes a downshift from 3rd gear whenever L is selected at speed. In this condition, governor pressure will have moved the 1-2 shift valve; the result is that supply to the rear servo through the servo orifice control valve and transition valve is blocked and as front servo release pressure also exhausts through the 2-3 shift valve, the front band will be applied. This band, in conjunction with the front clutch, provides 2nd gear.

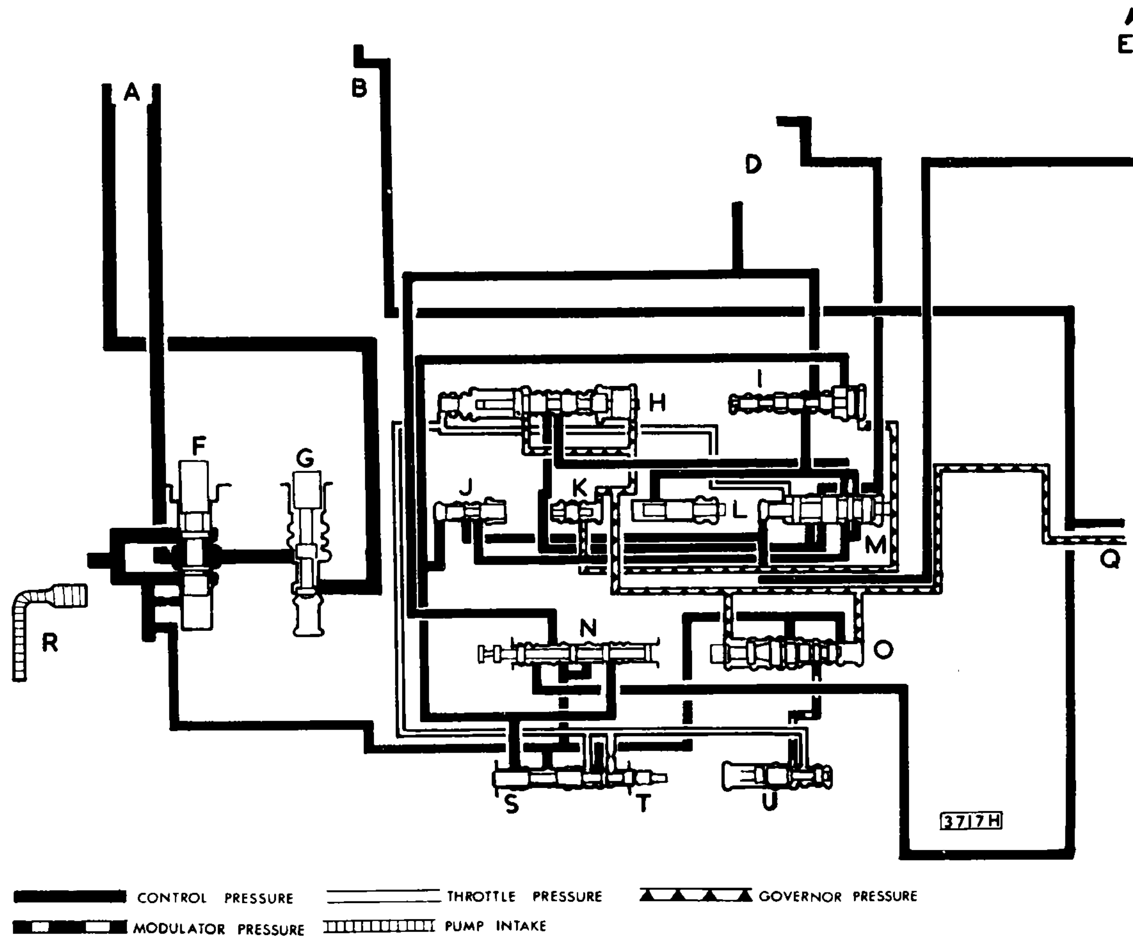


Fig. No. 14 *Hydraulic circuit — Lock-up (1st gear)*

A Converter
B Front clutch
D Front servo
E Rear servo
F Primary regulator valve
G Secondary regulator valve
H 2nd and 3rd shift valve
I 1st and 2nd shift valve
J Transition valve
K D1-D2 control valve
L Front servo orifice valve
M Servo control valve
N Manual valve
O Compensator valve
Q Governor
R Front pump
S Downshift valve
T Throttle valve
U Throttle modulator valve

Reverse (Fig. 16)
When the selector lever is placed in the reverse position, the manual control valve moves to admit control pressure to the rear clutch, both sides of the front servo and the rear servo. This applies to the rear clutch and the rear band.

Control pressure is also directed to the modulator valve to move the valve so when the throttle valve is opened by depressing the accelerator, the throttle pressure passes through the modulator valve to two lands on the compensator valve to reduce compensating pressure, thus increasing control pressure.
High control pressure is desired in reverse, since the reaction forces increase appreciably and higher pressure is required to hold the rear drum.

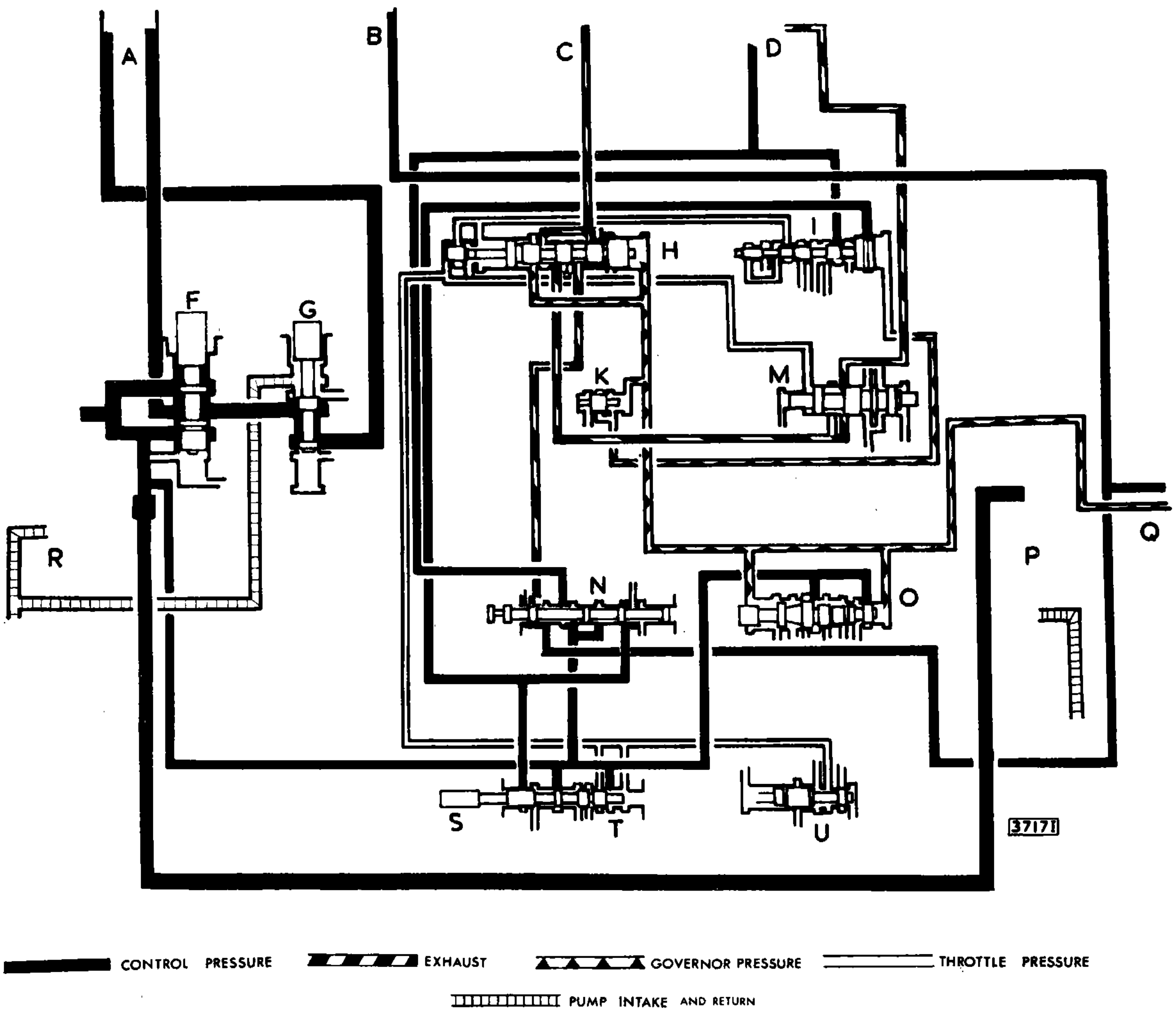


Fig. No. 15 *Hydraulic circuit—Lock-up (2nd gear)*

A Converter
B Front clutch
C Rear clutch
D Front clutch
F Primary regulator valve
G Secondary regulator valve
H 2nd and 3rd shift valve
I 1st and 2nd shift valve
K D1-D2 control valve
M Servo orifice control valve
N Manual valve
O Compensator valve
P Rear pump
Q Governor
R Front pump
S Downshift valve
T Throttle valve
U Throttle modulator valve

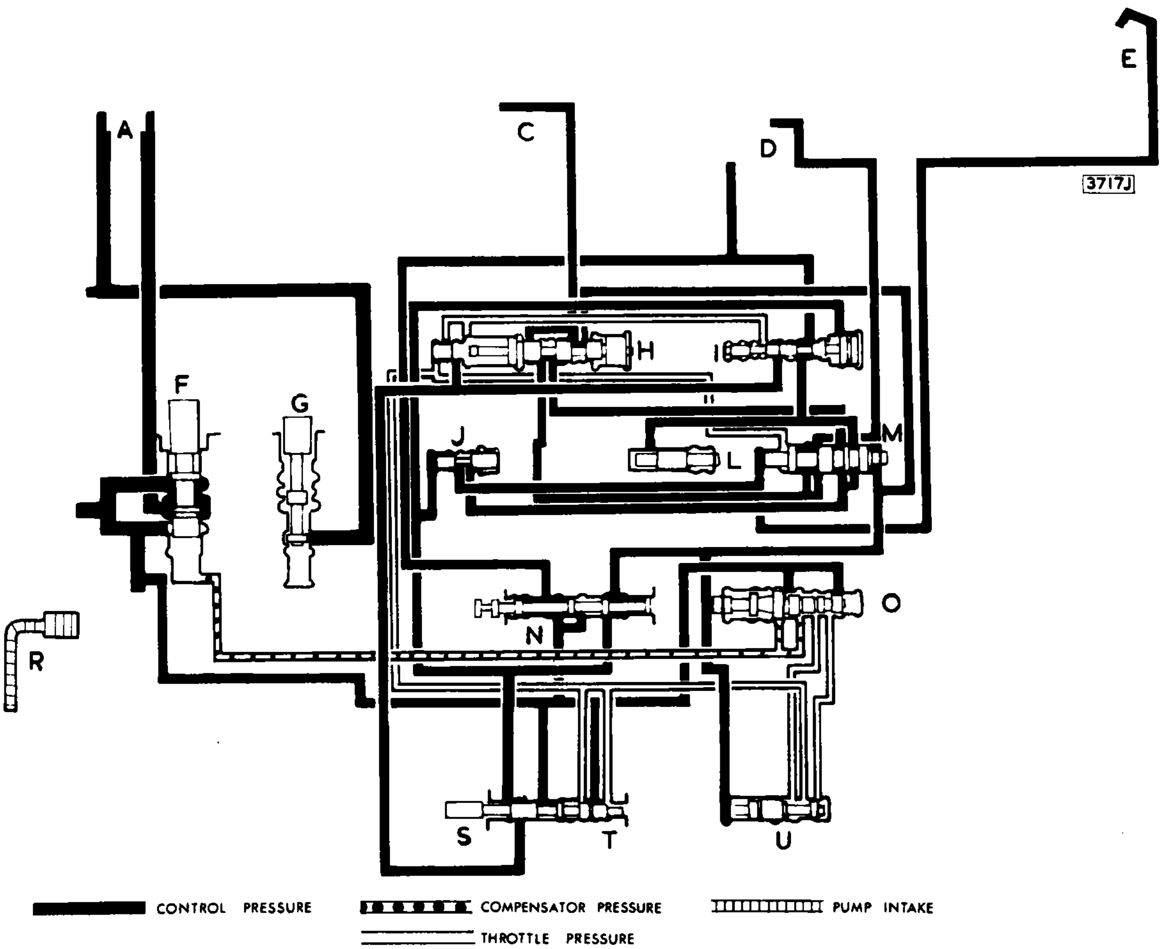


Fig. No. 16 *Hydraulic circuit — Reverse*

A	Converter	**L**	Front servo orifice valve
C	Rear clutch	**M**	Servo orifice control valve
D	Front servo	**N**	Manual valve
E	Rear servo	**O**	Compensator valve
F	Primary regulator valve	**R**	Front pump
G	Secondary regulator valve	**S**	Downshift valve
H	2nd and 3rd shift valve	**T**	Throttle valve
I	1st and 2nd shift valve	**U**	Throttle modulator valve
J	Transition valve		

MAINTENANCE

It is most IMPORTANT that the following maintenance instructions are closely followed and absolute cleanliness is maintained when topping-up or filling the transmission.
It is **vitally important** when checking the fluid level that no dirt or foreign matter enters the transmission, otherwise trouble will almost certainly arise. Before removing the transmission dipstick, the surrounding area must be cleaned off to prevent dirt from entering the dipstick aperture. When filling the transmission with fluid ensure that the fluid container and funnel are perfectly clean.
In countries where ambient temperatures are unusually high, dust and/or mud must not be allowed to decrease the effective areas of the stoneguards in the converter housing or the slots in the transmission case. Also any foreign matter on the oil pan must be removed as it would act as a temperature insulator.

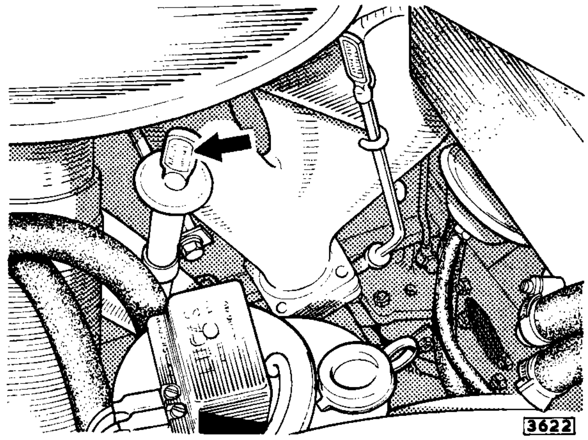


Fig. No. 17 *Automatic transmission dipstick*

EVERY 3,000 MILES (5,000 KM.)
Check Transmission Fluid Level
The transmission filler tube is located on the right-hand side of the engine under the bonnet just forward of the bulkhead. Check the fluid level every 3,000 miles (5,000 km.).
Before checking the fluid level, the car should be on level ground and the transmission should be at the normal operating temperature.
Set the handbrake firmly and select P position.
The engine should be at normal idle.
When the engine is running, remove the dipstick, wipe clean and replace in the filler tube in its correct position. Withdraw immediately and check.
If necessary, add fluid to bring the level to the FULL mark on the dipstick. The difference between FULL and LOW marks on the stick represents approximately 1½ pints (2 U.S. pints or 0.75 litres).

Be careful not to overfill.
If fluid is checked with transmission cold, a false reading will be obtained and filling to the FULL mark will cause it to be overfilled.

If it is found necessary to add fluid frequently, it will be an indication that there is a leakage in the transmission and it should be investigated immediately to prevent damage to transmission.
Total fluid capacity (including cooler) 16 Imperial pints from dry (19 U.S. pints, 9 litres).

EVERY 21,000 MILES (35,000 KM.)
Fluid Changing and Band Adjustment
Drain the oil. Remove the oil pan and wash out.
Adjust the front and rear bands as detailed on page F.24.
Refit the oil pan and refill with oil.
Recheck the oil level as detailed previously.

If these recommended lubricants are not available, only a transmission fluid conforming to the following specification should be used:—
Automatic Transmission Fluid, Type "A" or Type "A" Suffix "A" (AQ-ATF)
Fluid Capacity
Automatic transmission unit (from dry):—
16 Imperial pints, 19 U.S. pints, 9 litres.

Recommended Automatic Transmission Fluids

Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent Caltex/Texaco
Mobil-fluid 200	Castrol T.Q.	Shell Donax T.6	Esso Automatic Transmission Fluid	Automatic Transmission Fluid Type A	Nolmatic	Texamatic Fluid

ROAD TEST AND FAULT DIAGNOSIS

TESTING THE CAR

It is important to gain as much information as possible on the precise nature of any fault. In all cases the following road test procedure should be completely carried out, as there may be more than one fault.

Check that the starter will operate only with the selector in "P" and "N" and that the reverse light operates only in "R".

Apply the brakes and, with the engine at normal idling speed, select N-D, N-L, N-R. Transmission engagement should be felt in each position selected.

Check the engine stall speed (see converter diagnosis) with the transmission in "L" and "R". Check for slip or clutch break-away.

Note: Do not stall for longer than 10 seconds, or the transmission will overheat.

With the transmission at normal running temperature, select "D". Release the brakes and accelerate with minimum throttle opening. Check for 1-2 and 2-3 shifts.

Note: At minimum throttle opening the shifts may be difficult to detect. Confirmation that the transmission is in 3rd gear may be obtained by selecting "L" when a 3-2 downshift will be felt.

At just over 30 m.p.h. (48 k.p.h.), select "N", switch off the ignition and let the car coast. At 30 m.p.h. (48 k.p.h.), switch on the ignition and select "L". The engine should start through the rear wheels, indicating that the rear oil pump of the transmission is operating.

Stop and restart, using full-throttle acceleration, i.e. accelerator at the detent. Check for 1-2 and 2-3 shifts according to the shift speed chart.

At 26 m.p.h. (42 k.p.h.), in 3rd gear, depress the accelerator to full-throttle position. The car should accelerate in 3rd gear and should not down-shift to 2nd.

At 30 m.p.h. (48 k.p.h.), in 3rd gear, depress the accelerator to the kick-down position, i.e. through the detent. The transmission should down-shift to 2nd gear.

At 18 m.p.h. (29 k.p.h.) in 3rd gear, depress the accelerator to the kick-down position. The transmission should down-shift to 1st gear.

Stop and restart, using forced throttle acceleration (i.e. accelerator through the detent). Check for 1-2 and 2-3 shifts according to shift speed chart.

At 40 m.p.h. (64 k.p.h.) in 3rd gear, release the accelerator and select "L". Check for 3-2 down-shift and engine braking. Check for inhibited 2-1 down-shift and engine braking.

Stop, and with "L" still engaged, release the brakes and, using full throttle, accelerate to 20 m.p.h. (32 k.p.h.). Check for no slip or clutch break-away noise and no up-shifts.

Stop and select "R". Release the brakes and reverse, using full throttle if possible. Check for no slip or clutch break-away noise.

Stop on brakes facing downhill on gradient and select "P". Release the brakes and check that the parking pawl will hold the car. Re-apply brakes before disengaging the parking pawl. Repeat with car facing uphill.

Check that the selector is trapped by the gate in "Park" position.

At 30 m.p.h. (48 k.p.h.), in 3rd gear, D1, coast to a stop. Check roll out shifts for quality and speed in m.p.h. or k.p.h.

The front pump can be checked, with the selector in neutral, by revving the engine between idle and 2,000 r.p.m. A high pitched whine indicates a noisy front pump, a restricted front pump suction line, or a dirty oil screen.

At idle or slightly above idle speed in neutral, a gear whine indicates dragging front clutch plates. A tendency for the car to creep in neutral is a further indication of dragging front clutch plates. Check carefully, to avoid confusing this with front pump or engine noises.

PRESSURE TESTS

See "Throttle Cable Adjustment" section and ascertain correct adjustment of throttle cable and engine idle. The pressure gauge is used to check transmission pressures, which should correspond to values given below.

Note: Figures give in table are normal for transmission temperatures from 150° to 185°F. only (65.5°C. to 85°C.).

Selector Position	Control Pressure Idle r.p.m.	Control Pressure Stall r.p.m.
D2	50 — 60	150 — 185
D1	50 — 60	150 — 185
L	50 — 60	150 — 185
R	50 — 60	190 — 210
N	55 — 60	—

Recording stall speed and stall pressures at the time the converter is being checked will reduce the overall stalling time, which should be kept to a minimum.

Pressures which have been recorded should be analysed as follows: Low pressure indicates leakage in the circuit tested. Low pressure in all selector positions would indicate leakage, faulty pump or incorrect pressure regulation. High pressures, in all selector positions, indicates faulty pressure regulation, incorrect cable adjustment or stuck valves.

FAULT DIAGNOSIS

Converter

If the general vehicle performance is below standard, check the engine stall speed with the revolution indicator by applying maximum pressure on the foot brake pedal, selecting lock-up, and fully depressing the accelerator. If the engine stall speed is up to 300 r.p.m. below normal, the engine is not developing its full power.

Inability to start on steep gradients combined with poor acceleration from rest indicates that the converter stator one-way clutch is slipping. This condition permits the stator to rotate in an opposite direction to the turbine and torque multiplication cannot occur. Check the stall speed, and if it is more than 600 r.p.m. below normal the converter assembly must be renewed.
Below standard acceleration in 3rd gear above 30 m.p.h. (48 k.p.h.), combined with a substantially reduced maximum speed, indicates that the stator one-way clutch has locked in the engaged condition. The stator will not rotate with the turbine and impeller, therefore the fluid flywheel phase of the converter performance cannot occur. This condition will also be indicated by excessive overheating of the transmission, although the stall speed will remain normal. The converter assembly must be replaced.
Stall speed higher than normal indicates that the converter is not receiving its required fluid supply or that slip is occurring in the clutches of the automatic gearbox.
Note: When checking stall speeds ensure that the transmission is at normal operating temperature. Do not stall for longer than 10 seconds, or the transmission will overheat.
The torque converters are sealed by welding and serviced by replacement only.
The stoneguards in the converter housing must be unobstructed.

Stall Speed Test
This test provides a rapid check on the correct functioning of the converter as well as the gearbox. The stall speed is the maximum speed at which the engine can drive the torque impeller while the turbine is held stationary. As the stall speed is dependent both on engine and torque converter characteristics, it will vary with the condition of the engine as well as with the condition of the transmission. It will be necessary, therefore, to determine the condition of the engine in order to correctly interpret a low stall speed.
To obtain the stall speed, allow the engine and the transmission to attain normal working temperature, set the handbrake, chock the wheels and apply the footbrake. Select "L" or "R" and fully depress the accelerator. Note the reading on the revolution indicator.
NOTE: To avoid overheating, the period of stall test must not exceed 10 seconds.

R.P.M.	Condition Indicated
Under 1,000	Stator free wheel slip
1,600 - 1,700	Normal
Over 2,100	Slip in the transmission gearbox

Clutch and Band Checks
To determine if a clutch or band has failed, without removing a transmission, check as detailed below.
Refer to the chart on page F.5, showing the clutches and bands applied in each gear position.
Apply the handbrake and start the engine.
Engage each gear ratio and determine if drive is obtained through the component to be checked. If a clutch or band functions in one selector position it is reasonable to assume that the element in question is normal and that trouble lies elsewhere. If the clutch or band is tried in two positions and no drive is obtained in either position, it can be assumed that the element is faulty.

Air Pressure Checks
Air pressure may be used to test various transmission components on the bench. Care should be exercised when air pressure checks are being made to prevent oil blowing on the clothing or into the eyes.
Knowledge of various circuits should be acquired referring to Figs. 6 to 16 inclusive. It is necessary to remove the valve body to complete these checks.
Apply air to the front clutch passage and the governor should click about the same time the clutch applies with a different sounding click. Both front clutch and governor feed are on the same circuit.
Apply air to the rear clutch circuit and listen for the rear clutch to apply with a click.
Servo action may be watched as air is applied to apply circuits to each servo.
It can be assumed, that if air pressure checks indicate that clutches and servos are being applied normally with air pressure, then the trouble lies in the hydraulic system.

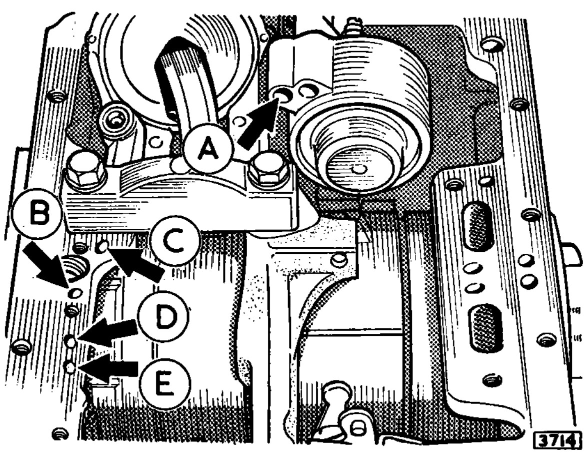


Fig. No. 18 *Showing pressure passages with valve body removed*

FAULT DIAGNOSIS

	In Car	On Bench
ENGAGEMENT		
Harsh	B, D, c, d	2, 4
Delayed	A, C, D, E, F, a, c, d	b
None	A, C, a, c, d	b, 9, 10, 11, 13
No forward	A, C, a, c, d	B, 1, 4, 7
No reverse	A, C, F, a, c, j, k, h	b, 2, 3, 6
Jumps in forward	C, D, E, F	4, 7, 8
Jumps in reverse	C, D, E	2
No neutral	C, c	2
UPSHIFTS		
No. 1-2	C, E, a, c, d, f, g, h, j,	b, 5, 17
No. 2-3	C, a, c, d, f, g, h, k, l	b, 3, 17
Shift points too high	B, C, c, d, f, g, h, j, k, l	b
Shift points too low	B, c, f, g, h, l	B
UPSHIFT QUALITY		
1-2 slips or runs up	A, B, C, E, a, c, d, f, g, k	b, 1, 5
2-3 slips or runs up	C, a, c, d, f, g, h, k, l	b, 3, 5
1-2 harsh	B, C, E, c, d, f, g, h	1, 7, 8
2-3 harsh	B, C, E, s, d, f	4
1-2 Ties up or grabs	F, c	4, 7, 8
2-3 Ties up or grabs	E, F, C	4
DOWNSHIFTS		
No. 2-1	B, C, c, h, j	7
No. 3-2	B, c, h, k	4
Shift points too high	B, C, c, f, h, j, k, l	b
Shift points too low	B, C, c, f, h, j, k, l	b
DOWNSHIFT QUALITY		
2-1 Slides		7
3-2 Slides	B, C, E, a, c, d, f, g	b, 3, 5
2-1 Harsh		b, 1, 7
3-2 Harsh	B, E, c, d, f, g, 5	3, 4, 5
REVERSE		
Slips or chatters	A, B, F, d, c, g	b, 2, 3, 6
LINE PRESSURE		
Low idle pressure	A, C, D, a, c, d	b, 11
High idle pressure	B, c, d, e, f, g	
Low stall pressure	A, B, a, c, d, f, g, h	b, 11
High stall pressure	B, c, d, f, g	
STALL SPEED		
Too low (200 r.p.m. or more)		13
Too high (200 r.p.m. or more)	A, B, C, F, a, c, d, f	b, 1, 3, 6, 7, 9, 13
OTHERS		
No push starts	A, C, E, F, c	12
Transmission overheats	E, F, e	1, 2, 3, 4, 5, 6, 13, 18
Poor acceleration		13
Noisy in neutral	m	2, 4
Noisy in park	m	14
Noisy in all gears	m	2, 4, 14, 16
Noisy during coast (30-20 m.p.h.)		16, 19
Park brake does not hold	C, 15	15

KEY TO THE FAULT DIAGNOSIS CHART

1. Preliminary Checks in Car

A. Low fluid level.
B. Throttle cable incorrectly assembled or adjusted.
C. Manual linkage incorrectly assembled or adjusted.
D. Engine idle speed.
E. Front band adjustment.
F. Rear band adjustment.

2. Hydraulic Faults

a. Oil tubes missing or broken.
b. Sealing rings missing or broken.
c. Valve body screws missing or not correctly tightened.
d. Primary valve sticking.
e. Secondary valve sticking.
f. Throttle valve sticking.
g. Compensator or modulator valve sticking.
h. Governor valve sticking, leaking or incorrectly assembled.
i. Orifice control valve sticking.
j. 1-2 shift valve sticking.
k. 2-3 shift valve sticking.
l. 2-3 shift valve plunger sticking.
m. Regulator.

3. Mechanical Faults

1. Front clutch slipping due to worn plates or faulty parts.
2. Front clutch seized or plates distorted.
3. Rear clutch slipping due to worn or faulty parts.
4. Rear clutch seized or plates distorted.
5. Front band slipping due to faulty servo, broken or worn band.
6. Rear band slipping due to faulty servo, broken or worn band.
7. One-way clutch slipping or incorrectly installed.
8. One-way clutch seized.
9. Broken input shaft.
10. Front pump drive tangs on converter hub broken.
11. Front pump worn.
12. Rear pump worn or drive key broken.
13. Converter blading and/or one-way clutch failed.
14. Front pump.
15. Parking linkage.
16. Planetary assembly.
17. Fluid distributor sleeve in output shaft.
18. Oil cooler connections.
19. Rear pump.

SERVICE ADJUSTMENTS

THROTTLE/KICKDOWN CABLE ADJUSTMENT

The importance of correct throttle cable adjustment cannot be over-emphasised. The shift quality and correct shift positions are controlled by precise movement of the cable in relation to the carburetter throttle shaft movement.

Preliminary Testing

Test the car on a flat road.
With the selector in the D1 or D2 position and at a minimum throttle opening, the 2-3 upshift should occur at 1,100 - 1,200 r.p.m.
A "run-up" of 200-400 r.p.m. at the change point indicates LOW pressure.
At full throttle opening, a jerky 2-3 upshift or a sharp 2-1 downshift (in D1 when stopping the car) indicates HIGH pressure.
Install a pressure gauge, 0-200 lb./sq. in. (0-14 kg./sq. cm.) in the line pressure point at the left hand rear face of the transmission unit. Start the engine and allow to reach normal operating temperature.
Select D1 or D2, apply the handbrake firmly and increase the idling speed to exactly 1,250 r.p.m.
The pressure gauge reading should be 72.5 $\pm$ 2.5 lb./sq. in. (5.097 $\pm$ .175 kg./cm. sq.).

Adjustment

If road and pressure tests indicate that the throttle/kickdown cable setting is incorrect, adjustment MUST be made at the fork end (see Fig. 20). Do NOT adjust the length of the connecting link between the jack shaft and the carburetter spindles to regulate the pressure.
Remove the bonnet, battery and battery tray.

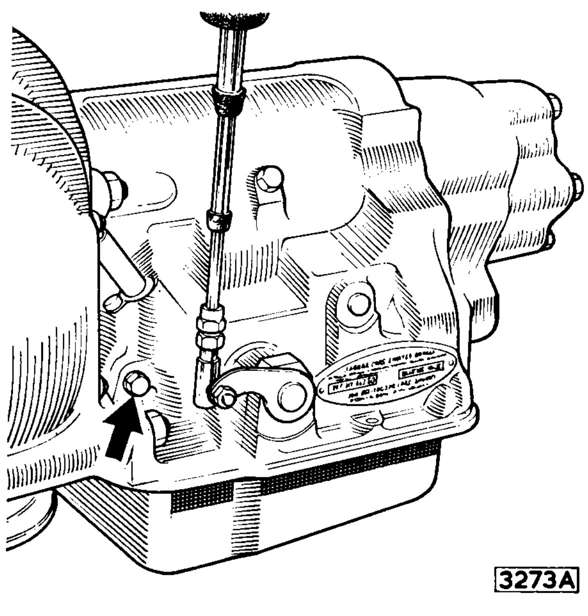


Fig. No. 19 *Transmission pressure take-off point*

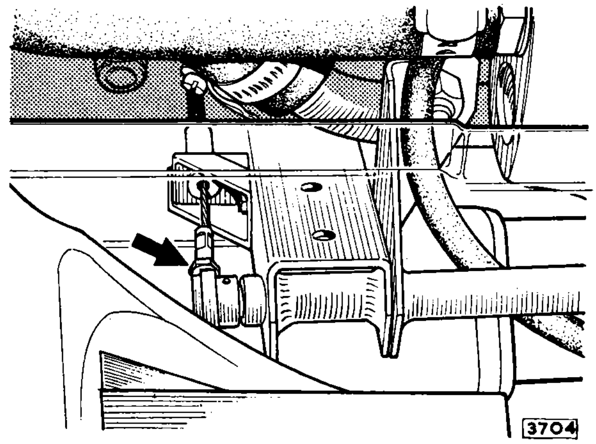


Fig. No. 20 *Kick-down cable adjustment*

Place the battery on the floor and reconnect into the circuit with a pair of leads.
Release the fork end locknut, remove the split pin and fork end clevis pin.
To LOWER the pressure, turn the fork end clockwise: to RAISE the pressure, turn anti-clockwise.
Note: One full turn will alter the setting by 9 lb./sq. in. (.63 kg./sq. cm.) approximately.
Slight adjustment only should be necessary; excessive adjustment will result in loss of "kickdown" or an increase in shift speeds.
Refit the fork end joint pin and split pin and tighten the locknut.
Restart the engine and check the pressure at 1,250 r.p.m.
Check that the carburetter butterfly valves are closed at idling speed after adjustment is completed. Adjust by means of the nut and locknut on the connecting link between the jackshaft and the carburetter spindles.
If, after repeated attempts to stabilize the change points, the pressure still fluctuates, the throttle/kickdown inner cable may be binding or kinked and the cable should be replaced.

Throttle/Kickdown Cable Renewal

Remove the jackshaft bracket from the inlet manifold studs.
Disconnect the cable at the fork end.
Remove the cable retaining clip after withdrawing the setscrew.
Lift the carpets and the underfelts from the gearbox tunnel on the left hand side below the radio speaker grille in the console.
Remove six drive screws and detach the aperture cover plate now exposed.
Remove the Allen-headed screw and washer retaining the outer cable.
Withdraw the outer cable and locate the spring clip securing the inner cable to the control rod operating the kickdown cam in the transmission unit.

Spring the clip open with a small screw driver and withdraw the inner cable.
Refitting is the reverse of the removal procedure.
Adjust the length of the operating cable to $3\frac{5}{16}$" (84.1 mm.) between the centre line of the clevis and the end of the outer cable.
Check that the carburetter butterfly valves are closed before commencing adjustments described under the previous heading.

MANUAL LINKAGE ADJUSTMENT

(See Fig. 23)
Place the selector lever in the D2 indicator position on the steering column (an assistant will be required to hold the lever in this position). Underneath the car at the gearbox selector lever, loosen the linkage cable locknut and remove the cable from the selector lever. Place the gearbox lever in the D2 detent position. This is most easily accomplished by moving the lever all the way to Lockup position and then moving back two detent positions. Adjust the cable end to fit freely onto the gearbox lever. Temporarily re-attach the cable to the lever. Next move the selector lever at the column through the various positions, checking that the indicator points to the correct selection. Check very carefully that the gating at L, R and P positions does not interfere with the gearbox lever setting at the detent positions. Always keep in mind that for correct operation, the gearbox detents must locate the gearbox lever positively. Once correct adjustment is established, be sure the linkage cable is secured to the gearbox lever and the locknut is tightened.

REMOVAL OF OIL PAN

Prior to front band adjustment or a check of internal parts, the gearbox fluid must be drained and the oil pan removed. When this is done an inspection should be made. A few wear particles in the dregs of the fluid in the pan are normal. An excess of wear particles, whether ferrous or non-ferrous metal, or pieces of band lining material, would indicate that further checking should be done. A new gasket should be used when refitting the pan and the 14 attaching screws torqued to 10-15 lb. ft. (1.382-2.073 kgm.). Always use fresh fluid when refilling.

FRONT BAND ADJUSTMENT

(See Fig. 21)
The front band should be adjusted after the first 1,000 miles (1,600 km.) of operation and at 21,000 mile (35,000 km.) intervals thereafter.
Drain the oil by removing the oil filler connection and remove the oil pan. Loosen the adjusting screw locknut on the servo, apply lever and check that the screws turn freely in the lever. Install a $\frac{1}{4}$" (6.4 mm.) thick gauge block between the servo piston pin and the servo adjusting screw, then tighten the adjusting screw with a suitable torque wrench or adjusting tool until 10 lb. ins. (0.12 kgm.) is reached. Retighten the adjusting screw locknut to 20-25 lb. ft. (2.76-3.46 kgm.) Remove the $\frac{1}{4}$" (6.4 mm.) spacer.

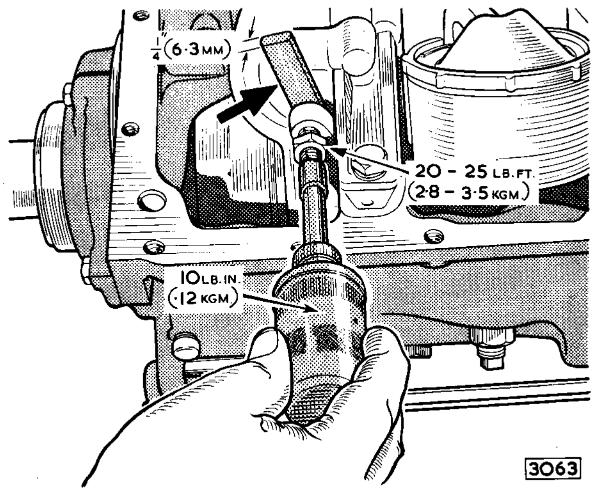


Fig. No. 21 *Front band adjustment*

REAR BAND ADJUSTMENT

The rear band adjustment at the 1,000 mile free service and at 21,000 mile (35,000 km.) intervals is made externally, thus there is no need to remove the oil pan. To make the adjustment, first loosen and back off the adjusting screw locknut three or four turns and then make sure that the adjusting screw works freely in the threads in the case. Turn the adjusting screw in with a torque wrench or special tool for this purpose to 10 lb. ft. (1.382 kgm.) torque reading. Back the adjusting screw off $1\frac{1}{2}$ turns exactly, then retighten the locknut to 35-40 lb. ft. (4.70-5.53 kgm.). The adjusting screw is on the right-hand side of the casing and an access hole is provided in the transmission cowl.

GOVERNOR

The governor can be inspected without removal of the oil pan. Remove the inspection cover and gasket. This will expose the governor, but the output shaft may have to be turned to position the governor head at the opening. First check for freedom of the valve by pushing and pulling on the governor weight. If removal of the governor body is desired, take out the two screws which retain it, being careful that they are not dropped inside the extension housing. After removal of the body, dismantle it completely and clean all parts. When re-assembling the governor, torque the governor body plate screws to 20-30 lb. in. (0.24-0.36 kgm.). When replacing the governor body on to the transmission, torque the screws which retain it to 50-60 lb. in. (0.60-0.72 kgm.). Replace the governor inspection cover, using a new gasket and torque its retaining screws to 50-60 lb. in. (0.60-0.72 kgm.).
It should be noted that if any of the four governor screws mentioned above are loose, the governor will not function correctly.

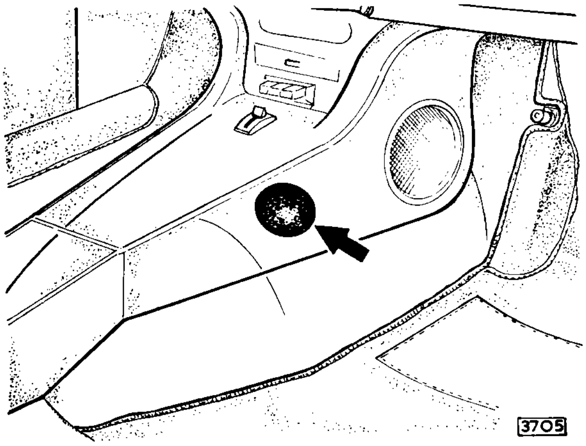


Fig. No. 22 *Rear band adjustment. Access to the adjuster is by way of the grommeted hole indicated by the arrow. It is first necessary to remove the console as detailed in Section N.*

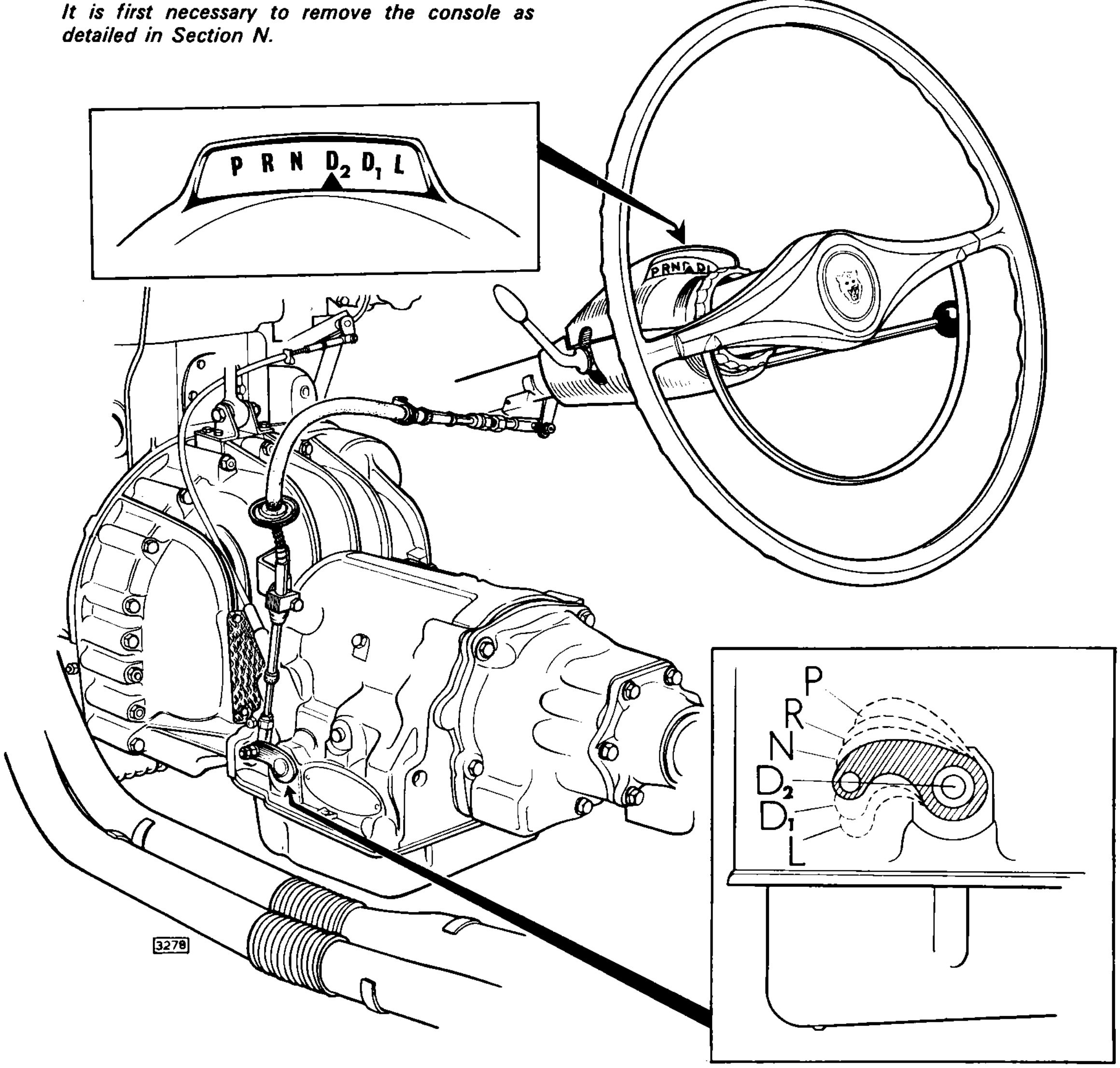


Fig. No. 23 *Manual selector linkage adjustment*

TRANSMISSION UNIT
Removal and Refitting

To remove the transmission unit the engine can either be (A) removed from the car as a unit or (B) raised from the mountings at an angle of approximately 45°. Method "A" must be used if a transmission hoist is not available.
Method "B" can be used if a transmission hoist is available.

REMOVAL
Disconnect the battery.
Remove the bonnet.
Drain the engine sump.
Release the filler cap and drain the cooling system by turning the radiator tap remote control and the cylinder block drain tap. Conserve the coolant if an anti-freeze is in use.
Remove the water drain plug from the automatic transmission oil cooler beneath the radiator.
Release the hose clips and disconnect all hoses connecting the radiator and oil cooler to the engine and header tank.
Remove the radiator as detailed on page C.5.
Disconnect all engine units, mountings and propeller shaft as detailed on pages A.31 and A.32.
Disconnect the compressor clutch unit cable and remove the compressor from the mounting bracket (if air conditioning equipment is fitted).
Tie the unit away from the engine.
Warning: Do NOT disconnect the pipe unions from the compressor. Disconnecting these unions will necessitate recharging the system. See Fig. 24.
Sling the engine from the two loops between the cylinder head studs.
Note: If a single block and tackle only is available, position the hook above the front loop.
Remove the rear mounting as detailed on page A.31.
Remove the engine front mounting bolts.
Remove the self-locking nut and stepped washer from the stabiliser between the rear of the cylinder head and the bulkhead.
Lower the rear of the engine until the stabiliser bolt can be withdrawn.
Position the transmission hoist, if available, beneath the transmission unit.
Disconnect the oil cooler pipes from the oil cooler beneath the radiator and the transmission unit.
Raise the front of the engine and lower the rear until the unit is supported on the hoist.
Remove the split pin, washers and joint pin, detach the outer cable from the support bracket and disconnect the kickdown cable from the operating shaft.
Remove the setscrews and washers and withdraw the unit from the bell housing.
Place a clean tray beneath the torque converter to catch the oil which will drain away as the unit is removed.
If the engine is to be removed as a unit, complete the removal as detailed on page A.32.

REFITTING
Refitting is the reverse of the removal procedure, as detailed on page A.32.
Check the throttle cable adjustment and the setting of the manual linkage as described on page F.24.

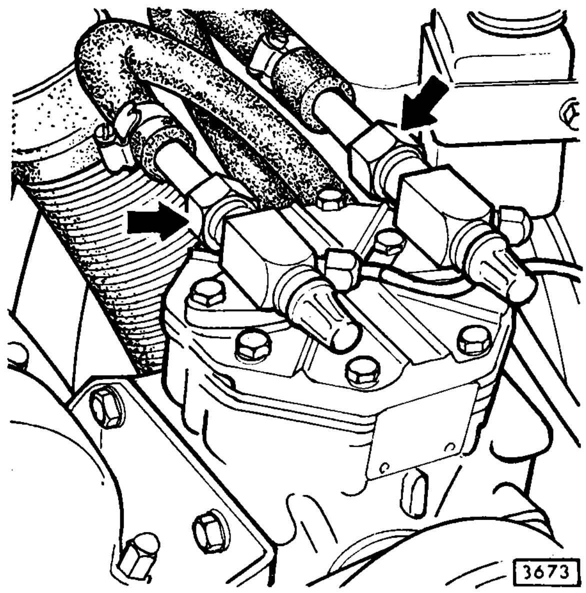


Fig. No. 24 *Showing compressor unions (air conditioning equipment)*

TRANSMISSION
Dismantling and Assembly

TRANSMISSION — DISMANTLING
Dismantling should not begin until the transmission exterior and work area have been thoroughly cleaned. Place the transmission (bottom side up) on a suitable stand or holding fixture.
Remove the oil pan bolts, oil pan and oil pan gasket. Remove the oil screen retaining clip, lift the oil screen off the regulator; then lift and remove the screen from the rear pump suction tube. (Fig. 25).

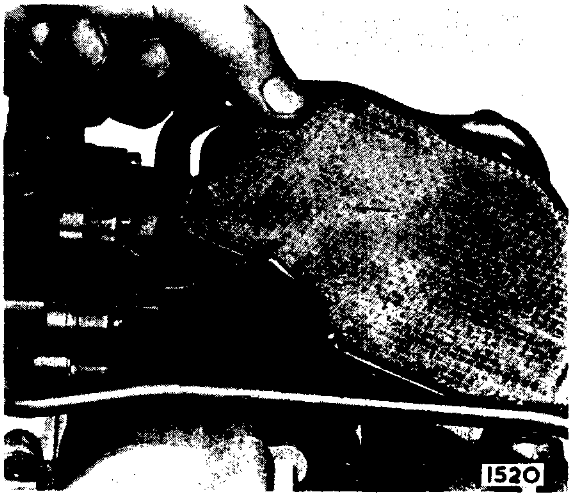


Fig. No. 25 *Removing the screen from the rear suction tube*

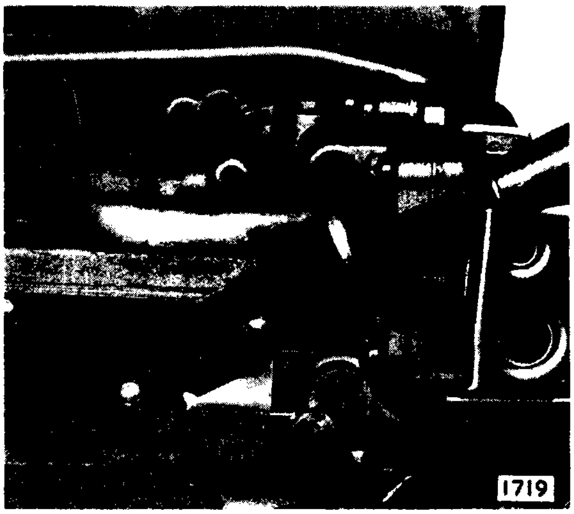


Fig. No. 26 *Removing the compensator tube*

Use a screwdriver to pry the compensator tube from the valve body and regulator assemblies (Fig. 26).
The control pressure tube should be prised from the valve body, then removed from the regulator (Fig. 27).
Remove the rear pump suction tube by pulling and twisting it at the same time.
Carefully remove the pressure regulator spring retainer. Maintain pressure on the retainer to prevent distortion of the retainer, and sudden release of the springs (Fig. 28).
Remove springs and spring pilots, but do not remove the regulator valves at this time. The valves will be protected as long as they remain in the regulator body.
Remove the two regulator attaching capscrews and lockwashers, then lift the regulator assembly from the transmission case (Fig. 29).

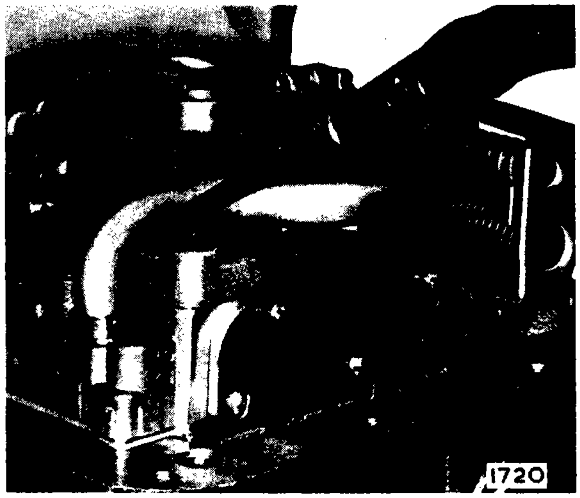


Fig. No. 27 *Removing the control line pressure tube*

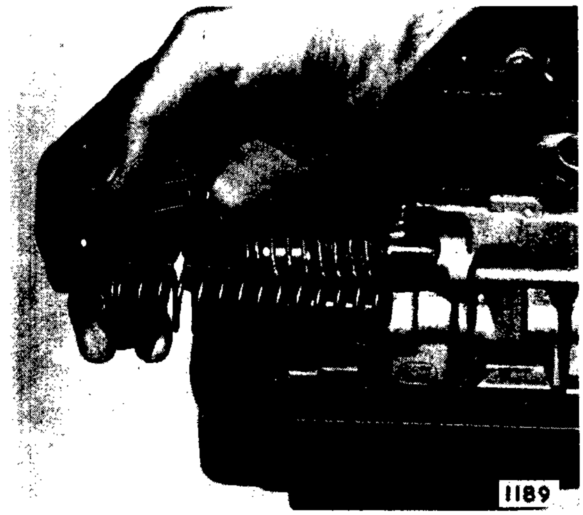


Fig. No. 28 *Removing the pressure spring retainer*

Loosen the front and rear servo adjusting screw locknuts and adjusting screws. This will aid in dismantling, and later, in assembling the transmission.
Remove the three valve body attaching capscrews and lockwashers (Fig. 30).
Loosen the front servo to case capscrew and lockwasher approximately $\frac{5}{16}$" (7.94 mm.) (Fig. 31).
Place the manual selector lever in park or reverse position. Lift the valve body until the throttle control rod will clear the manual detent lever, then remove the hook from the throttle cam using the index finger or a screwdriver.
Lift the valve body and servo until the valve body will clear the linkage and slide it off the servo apply and release tubes (Fig. 32).

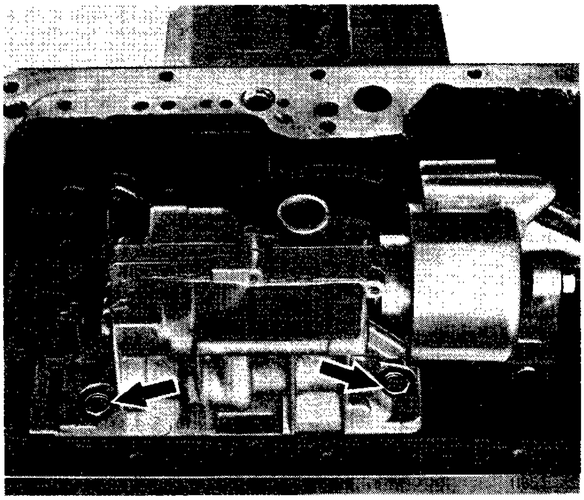


Fig. No. 29 *The regulator retaining screws*

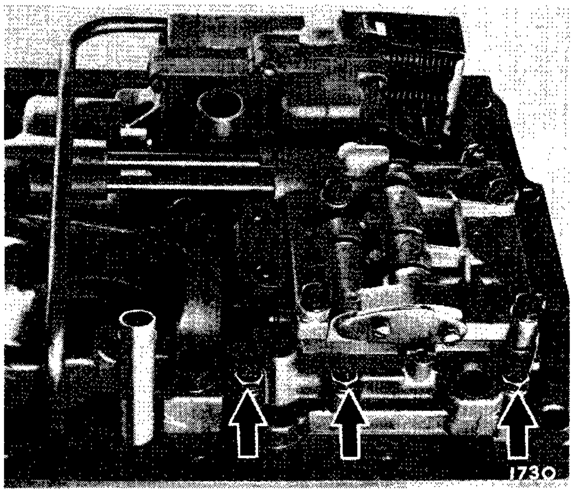


Fig. No. 30 *The valve body attaching screws*

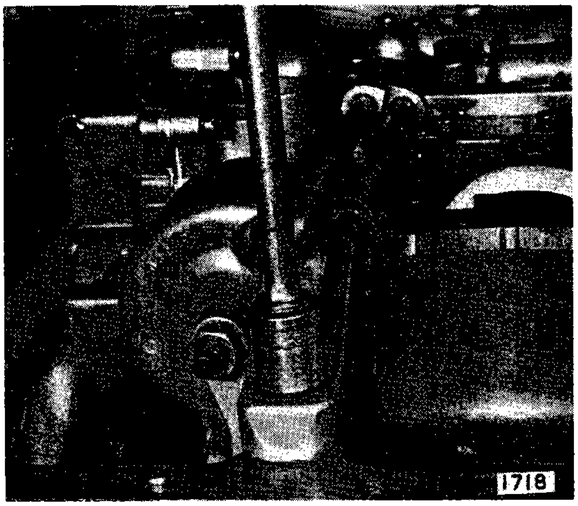


Fig. No. 31 *Slackening the front servo screw*

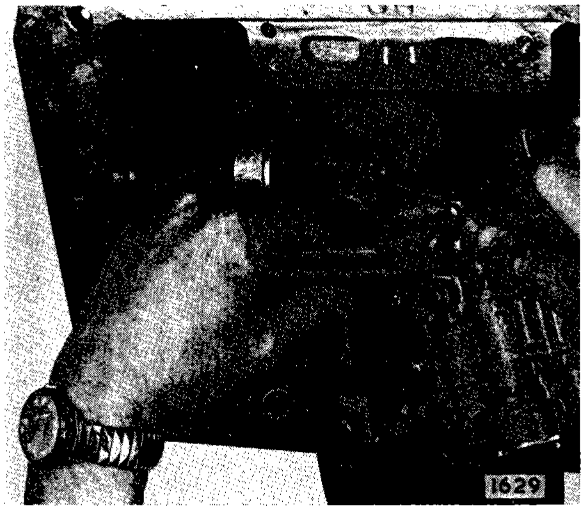


Fig. No. 32 *Lifting the valve body to clear the front servo*

Remove the front servo apply and release tubes (Fig. 33).

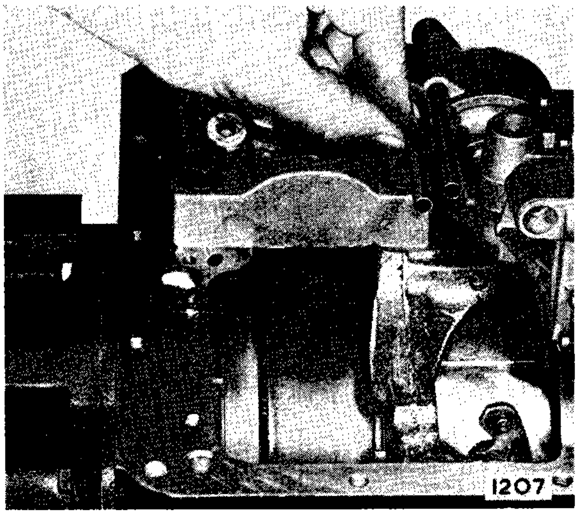


Fig. No. 33 *Withdrawing the apply and release tubes*

Remove the front servo bolt and lift the servo from the transmission, catching the servo strut with the index and middle finger of the left hand (Fig. 34).
Remove the two rear servo attaching capscrews and lockwashers, then lift the rear servo assembly from the transmission (Fig. 35).
Remove the rear band apply and anchor struts.
Remove the rear pump outlet tube, using special extractor tool Part No. CWG.45 (Fig. 36).
Check the end play at this time. Should the end play need correcting it will be done during assembly of the transmission. See Fig. 37. Place an indicator against the end of the input shaft. Pry between the front of the case and the front clutch to move clutch assemblies to their extreme rearward position.

Set the indicator to "O". Pry between the planet carrier and the internal gear with a screwdriver to move the clutches to their extreme forward position. Read the end play on the indicator. The allowable limits are 0.008"- 0.044" (0.2 - 1.1 mm.). It is preferable to have approximately 0.020" (0.5 mm.). Should correction be necessary, remove the output shaft, extension housing and companion flange as an assembly so that the selective washer can be changed.
Selective thrust washers are available in the following thicknesses:—

0.061" - 0.063" (1.53 - 1.58 mm.)	0.081" - 0.083" (2.03 - 2.08 mm.)
0.067" - 0.069" (1.68 - 1.73 mm.)	0.092" - 0.094" (2.3 - 2.35 mm.)
0.074" - 0.076" (1.85 - 1.90 mm.)	0.105" - 0.107" (2.63 - 2.68 mm.)

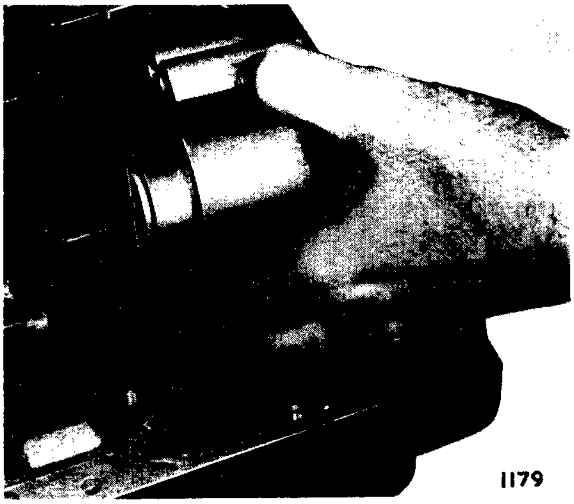


Fig. No. 34 *Removing the front servo*

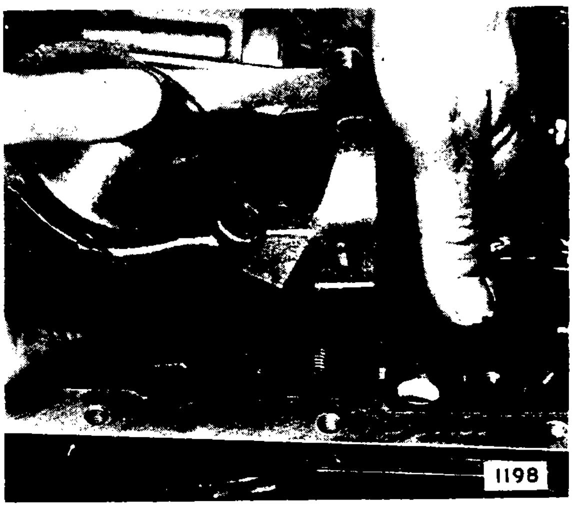


Fig. No. 35 *Removing the rear servo*

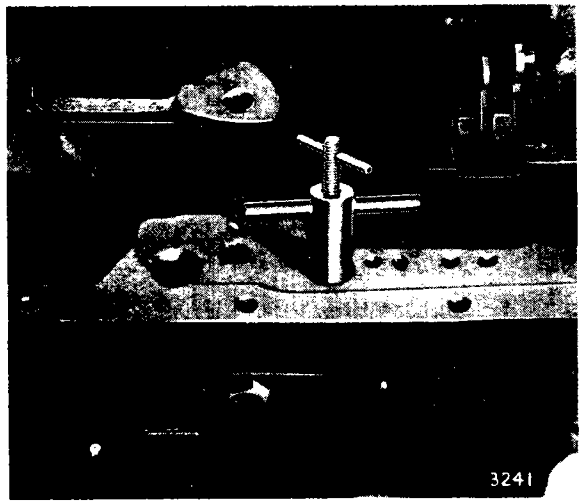


Fig. No. 36 *Removing the rear pump outlet tube (Extractor Tool Part No. CWG45)*

Place the shift selector in park position to hold the output shaft, then remove the companion flange nut, lockwasher, flat washer and flange.
Remove the bearing retainer capscrews, the bearing retainer and the bearing retainer gasket.
Slide the speedometer drive gear off the output shaft.
Remove the governor inspection cover and gasket.
Remove the five extension housing capscrews and remove the output shaft and extension housing assembly.
Remove the two hook type seal rings from the rear of the primary sun gear shaft.

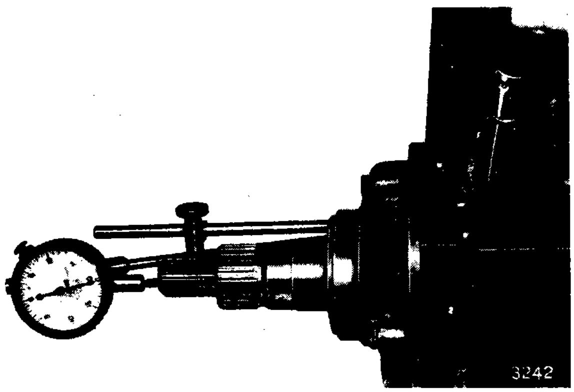


Fig. No. 37 *Checking the end play*

Remove the selective thrust washer from the rear of the planet carrier (Fig. 38).

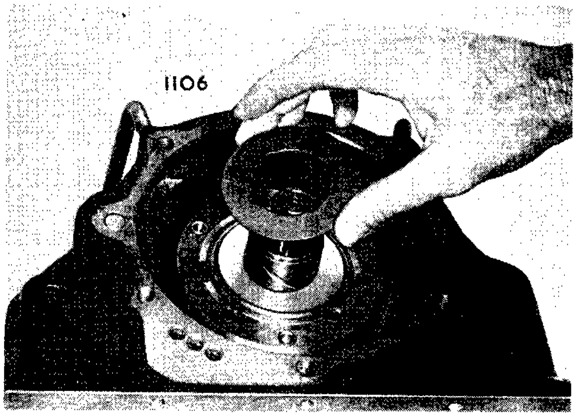


Fig. No. 38 *Removing the selective thrust washer*

Pull the planet carrier from the transmission (Fig. 39).

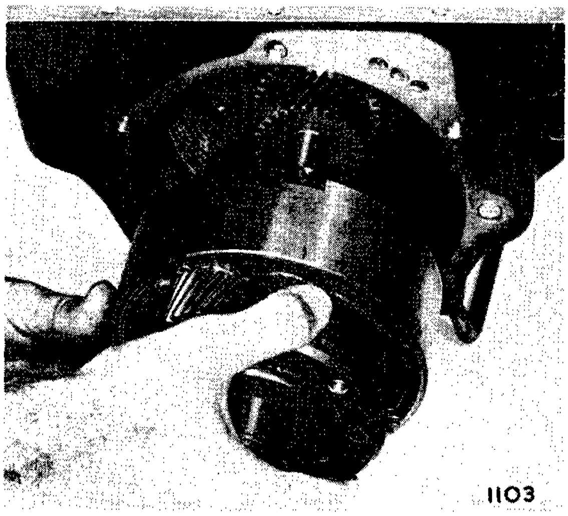


Fig. No. 39 *Removing the planet carrier*

Pull the rear band through the rear opening of the transmission. Hold the two ends of the band together with the left hand while pulling rearward through the rear of the case with the right hand (Fig. 40).

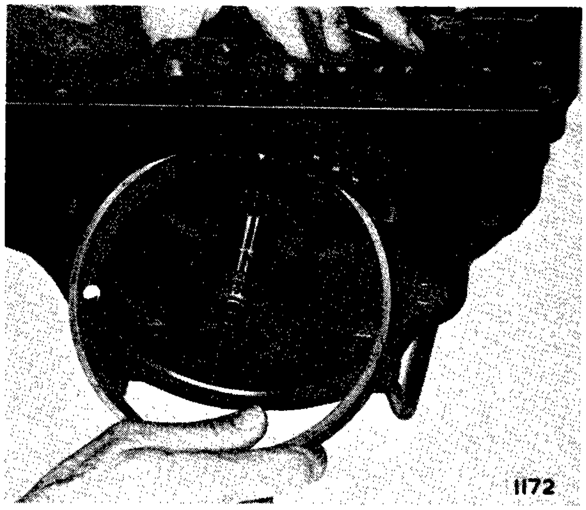


Fig. No. 40 *Removing the rear band*

Remove the two centre support bolts; one from each side of the case (Fig. 41).

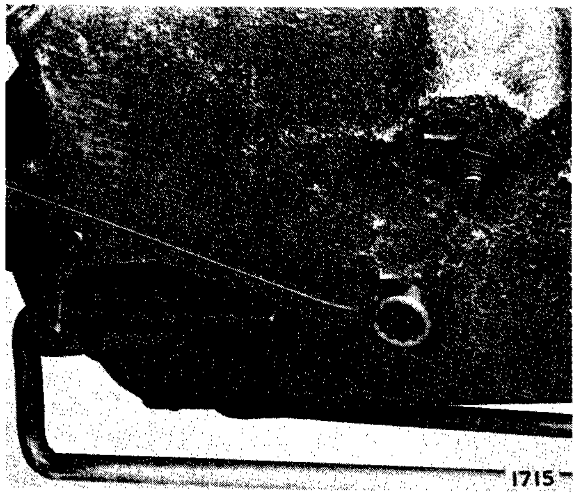
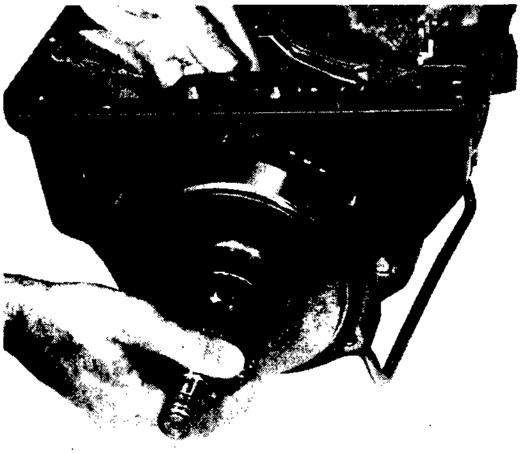


Fig. No. 41 *Removing one of the centre support bolts*

Remove the centre support, push on the end of the input shaft to start the rearward movement of the centre support.

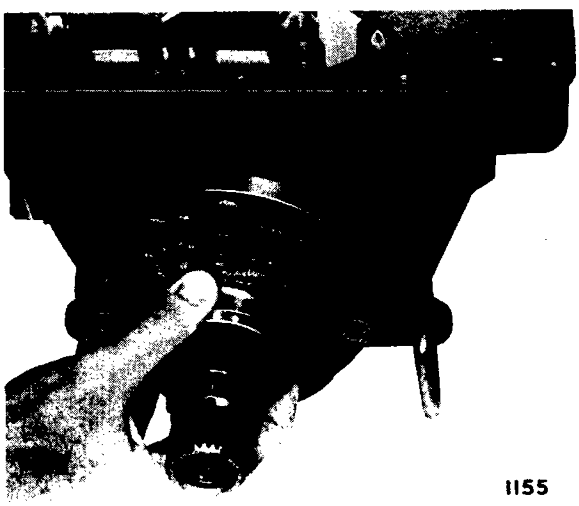
Remove the front and rear clutch assemblies, placing them in a suitable stand for dismantling, Fig. 42. (The planet carrier can be used as a stand for dismantling and assembling the clutches).



1164

Fig. No. 42 *Removing the clutch assemblies*

Remove the front band (up and out of the case).
Remove the front pump oil seal. Use a seal puller or punch.
Remove the four front pump attaching capscrews and lift off the front pump (Fig. 43).



1155

Fig. No. 43 *Removing the front pump*

Remove the front pump oil seal ring from the case.

Front Pump — Dismantling
Remove the stator support attaching screw and remove the stator support (Fig. 44). Mark the top of the internal and external gears with marking ink or a crayon. Lift the gears from the pump body.

1146

Fig. No. 44 *Removing the stator support attaching setscrew*

Inspect the pump body, the internal and external tooth gears, and stator supports for scores, scratches and excessive wear.
Minor scratches and scores can be removed with crocus cloth or jeweller's rouge. However, parts showing deep scratches, scores or excessive wear should be replaced. If excessive wear or scoring is observed, replace the complete pump assembly (since the gears and body are carefully matched when built, these parts should not be interchanged or individually replaced).

Front Pump — Assembling
Drive a new seal into the pump body until it bottoms. Lubricate all pump parts with transmission fluid before assembly. Install the internal and external gears in the pump body with marks previously made in the upward position. Insert the stator support on the pump body and install the retaining screw. Torque the screw to 25-35 lb. in. (0.29 - 0.40 kgm.). Check the gears for free movement.

Manual Linkage — Dismantling
Pull the retainer clip from the forward end of the linkage rod (Fig. 45). Disconnect the rod from the manual valve detent lever. Release the detent ball and spring by rocking the manual valve lever to the extreme of its travel. The ball will be released with considerable force, but can be caught in a shop towel or even in the hands. Remove the manual lever locknut, the manual detent lever, and then pull the manual control lever from the transmission. Prise the manual level oil seal from the transmission case with a screwdriver.

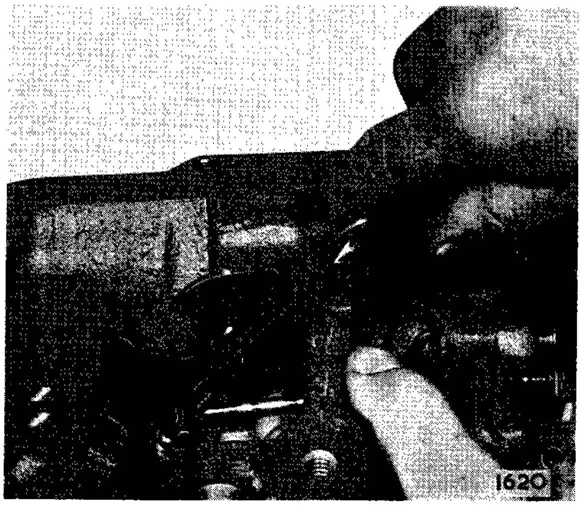


Fig. No. 45 *Removing the retaining clip from the linkage rod*

Manual Linkage — Assembling
Install a new manual lever oil seal. Assemble the manual control lever through the transmission case boss. Place the manual valve detent lever and locknut on the manual control lever shaft. Rock the manual valve lever to its extreme travel, then install the detent spring. Place the ball in position on the spring, then using the lubrication tube to depress ball and spring (Fig. 46), rock the manual valve lever back over the ball and spring. Connect the linkage rod and insert the retainer spring clip.

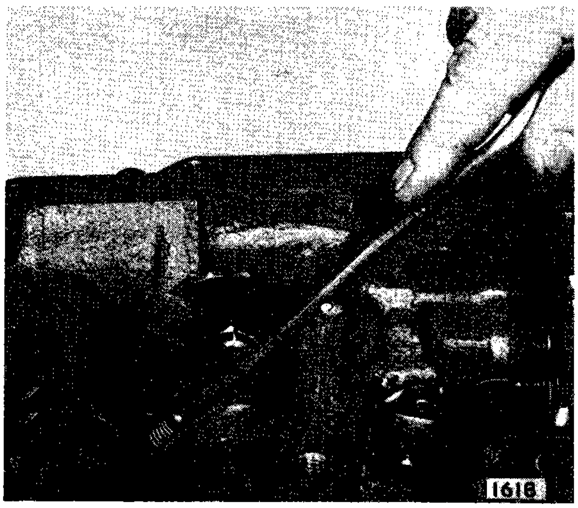


Fig. No. 46 *Releasing the detent ball*

Park Linkage — Dismantling
Pull the retainer clip from the rear of the parking brake linkage rod. Disconnect the linkage rod from the torsion lever. Remove the retainer spring from the torsion lever pin and slide the washer with the torsion lever off the pin. Tap the toggle lever rearward to loosen the pin retainer (Fig. 47), then pull the retainer using snap ring pliers (Fig. 48). The toggle lever pin and toggle lever can now be removed. A magnet may be used to pull the parking pawl anchor pin from the transmission case. The parking pawl is now free to be removed.

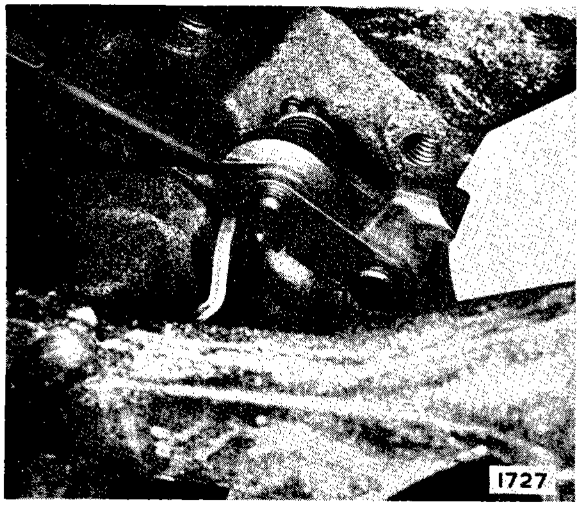


Fig. No. 47 *Tapping the toggle lever rearwards*

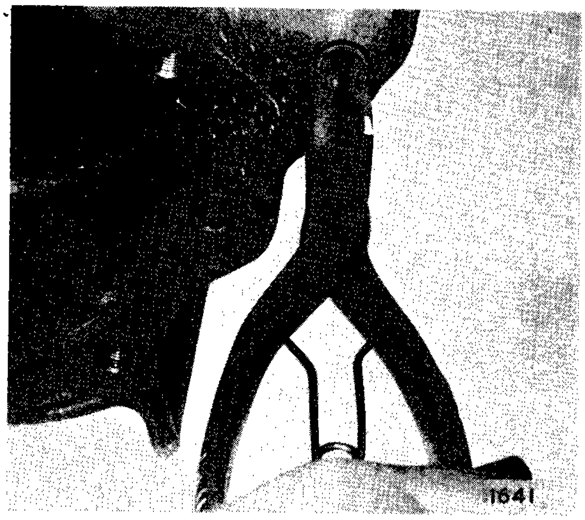


Fig. No. 48 *Removing the toggle lever pin retainer*

Parking Linkage — Assembling
Assemble the parking pawl and shaft. Use a new toggle lever retainer to assemble the toggle lever and toggle pin. Assemble the torsion lever pin, then the washer, and then place the retainer spring on the torsion lever pin. Connect the linkage rod to the torsion lever and insert the spring clip.

Clutches — Dismantling

Place the clutch pack in a suitable stand. The planet carrier will work very well for this purpose.
Lift the complete front clutch assembly from the rear clutch and forward sun gear.
Remove the snap ring and lift the input shaft from the clutch cylinder. (The clutch hub thrust washer may stick to the input shaft).
Lift the clutch hub and thrust washer from the clutch assembly.
Lift the front clutch plates and the pressure plate from the assembly.
Remove the clutch return spring snap ring and then the return spring. It is not necessary to compress the spring to remove the snap ring.
Compressed air applied to the clutch feed hole in the clutch hub will force the piston from the clutch cylinder (Fig. 49).
Remove the rubber seal rings from the clutch hub and clutch piston.

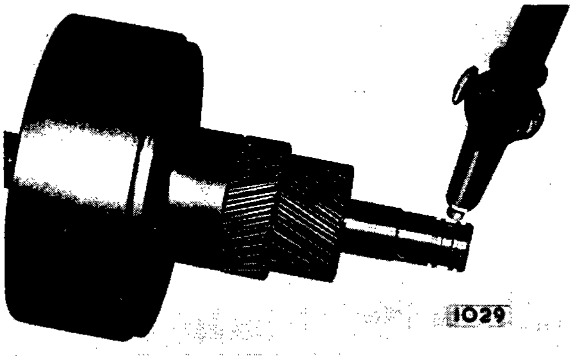


Fig. No. 49 *Applying compressed air to the clutch feed hole*

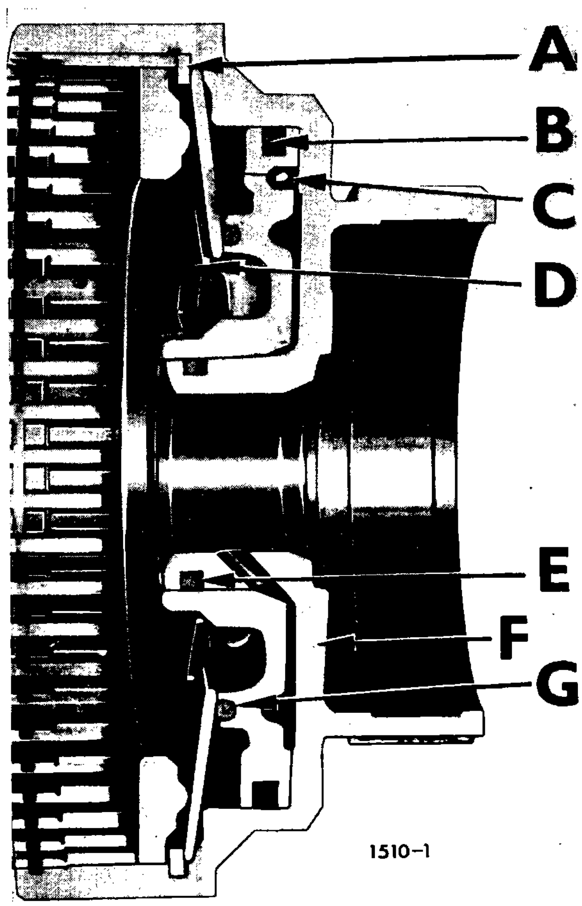


Fig. No. 50 *Sectioned view of the front clutch drum*

A Clutch spring ring
B Sealing ring
C $\frac{3}{16}$" steel ball
D Clutch spring
E Sealing ring
F Cylinder
G Piston

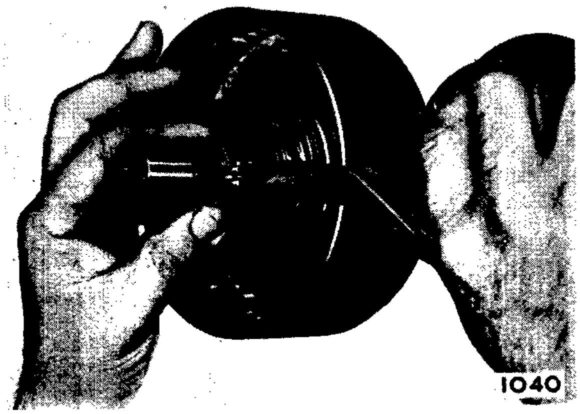


Fig. No. 51 *Removing the two front clutch sealing rings*

Remove the two front clutch sealing rings from the forward sun gear shaft (Fig. 51).
Remove the thrust washer and thrust plate from the shoulder of the rear clutch hub.
Lift the rear clutch assembly up and off the forward sun gear shaft.
Remove the rear clutch ring.
Remove the clutch pressure plate and the clutch plates.
Use the service tool, Churchill Tool No. CBW.37A), to compress the clutch return spring, then remove the spring retainer snap ring. Release the spring, but do not permit the spring retainer to catch in the snap ring groove as the spring is being released (Fig. 52).
Replace the forward sun gear shaft in the clutch hub, being careful not to break the cast iron sealing rings. The clutch piston can now be removed from the clutch cylinder by blowing compressed air through the rear clutch passage of the forward sun gear.
Remove the forward sun gear from the clutch cylinder and remove the two rear clutch sealing rings from their grooves in the shaft.
Remove the rubber seal rings from the clutch hub and the clutch piston.

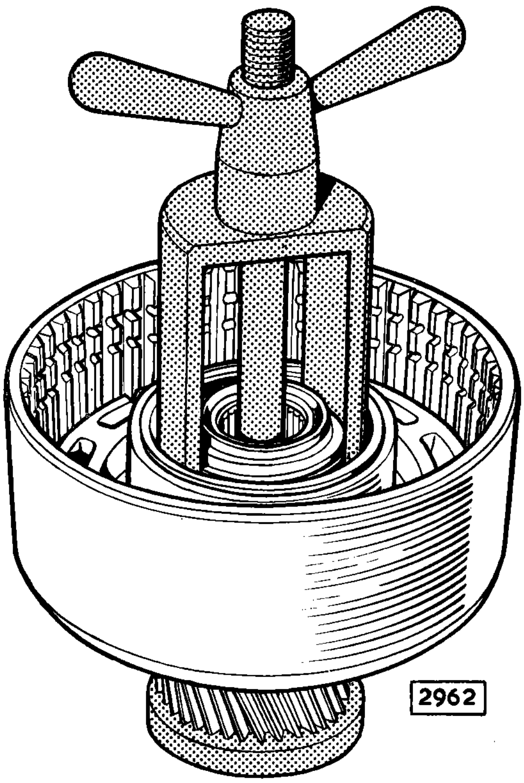


Fig. No. 52 *Dismantling the clutch using the special tool (Part No. CBW37A)*

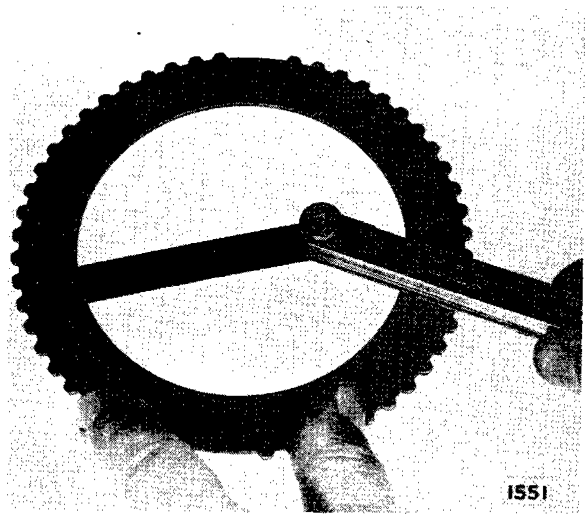


Fig. No. 53 *Checking a clutch plate*

Inspection of Clutches

Inspect all parts for burrs, scratches, cracks and wear. Check all the front clutch plates and the rear clutch friction plates for flatness. Check the rear clutch steel plates for proper cone. Lay plates on a flat surface when checking for flatness and cone. Cone should be 0.010" to 0.020" (0.25 to 0.5 mm.). Replace friction plates when wear has progressed so that the grooves are no longer visible. Replace all warped plates. Replace complete set of steel or friction plates in any clutch. Do not replace individual plates (Fig. 53).
Inspect the band surfaces of the drum for wear. If only slightly scored the drum may be refaced.
Renew if excessive.
Inspect the clutch bushing and the needle bearing for wear and brinelling and for scores. The cast iron sealing rings are normally replaced. If the transmission is being rebuilt and has had little service, the rings may be re-used if they have not worn excessively and are not scratched or distorted.
Inspect the forward sun gear for broken or worn teeth.
Inspect all journals and thrust surfaces for scores.
Inspect all fluid passages for obstruction or leakage.
Inspect the front clutch lubrication valve for freedom (Fig. 54).

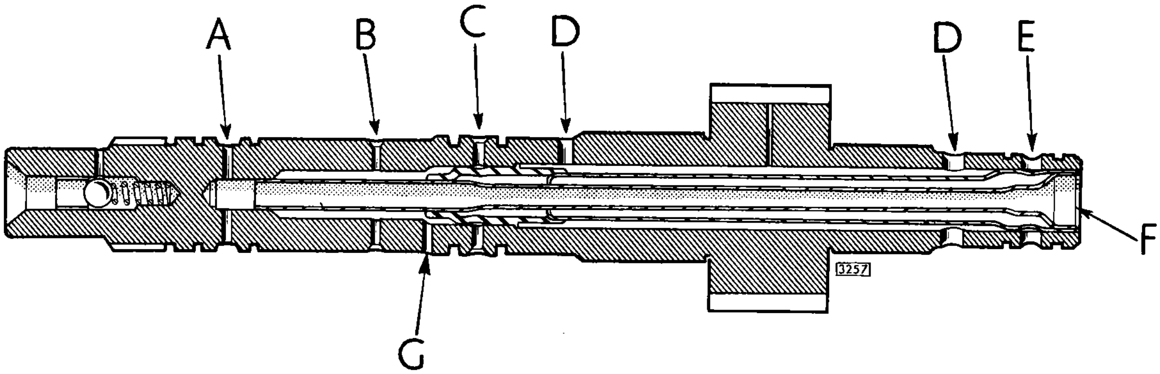
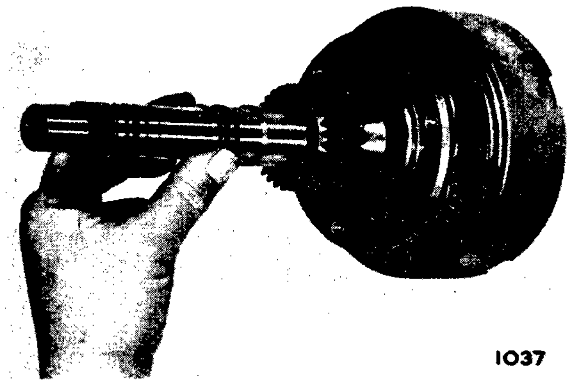


Fig. No. 54. *Longitudinal section of the forward sun gear showing oil ways*

A, F Front clutch **C, E** Rear clutch **B, D, G** Lubrication

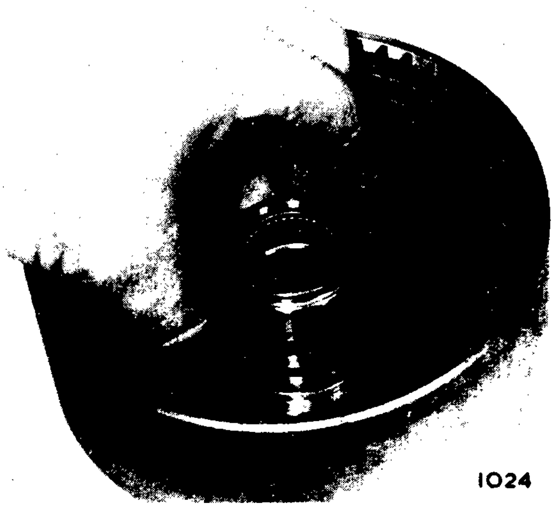
Clutches — Assembling

Place the planet carrier on the assembly bench.
Place the forward sun gear in the carrier. Be sure the thrust washer is on the shaft (Fig. 55).
Assemble the rubber "O" ring in its groove on the rear clutch hub (Fig. 56).



IO37

Fig. No. 55 *Placing the forward sun gears on the carrier*



IO24

Fig. No. 56 *Fitting the "O" ring on the rear clutch hub*

Assemble the square section rubber seal ring in its groove on the rear clutch piston (Fig. 57).

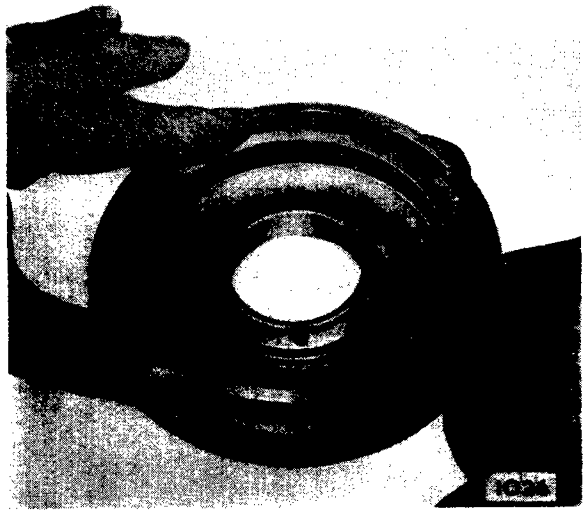
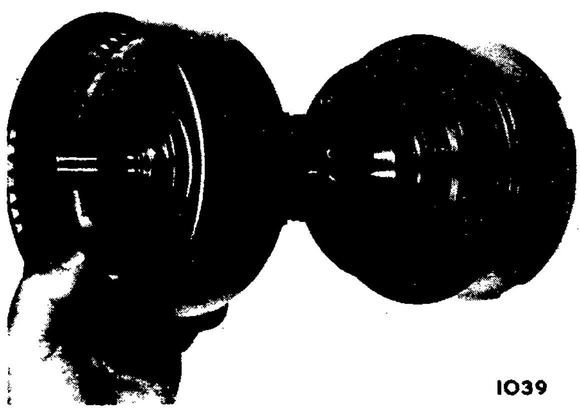


Fig. No. 57 *Fitting the rear clutch piston sealing ring*

Assemble the clutch piston in the rear clutch cylinder using Tool Part No. CWG.41 to force it into position. Be sure to lubricate the seal rings so that they will assemble easier.
Place the rear clutch return spring and spring retainer in position on the clutch piston. The rear clutch spring fixture is then used to compress the spring, then the snap ring is assembled in its groove in the clutch.
Install the rear clutch cast iron sealing rings in their grooves on the forward sun gear. Be sure that the rings are free in their grooves. Centre each ring in its groove, so that ends do not overlap edges of groove.
Place the rear clutch piston and cylinder assembly over the forward sun gear and gently slide it down over the sealing rings (Fig. 58).



IO39

Fig. No. 58 *Assembling the rear clutch over the primary sun gear ring*

Install a rear clutch steel plate with its concave face up or forward facing in the transmission. Note that these plates are identified by missing teeth on the O.D. and are not interchangeable with front clutch steel plates (Fig. 59).

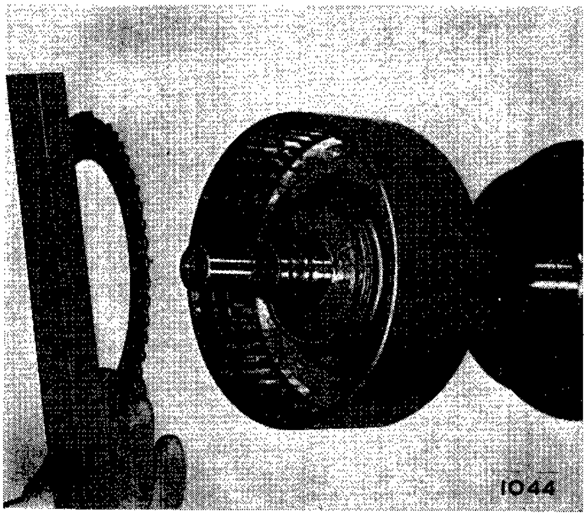


Fig. No. 59 *Fitting a rear clutch steel plate*

Install the rear clutch pressure plate.
Install the rear clutch snap ring. This ring has one tanged end (Fig. 61).

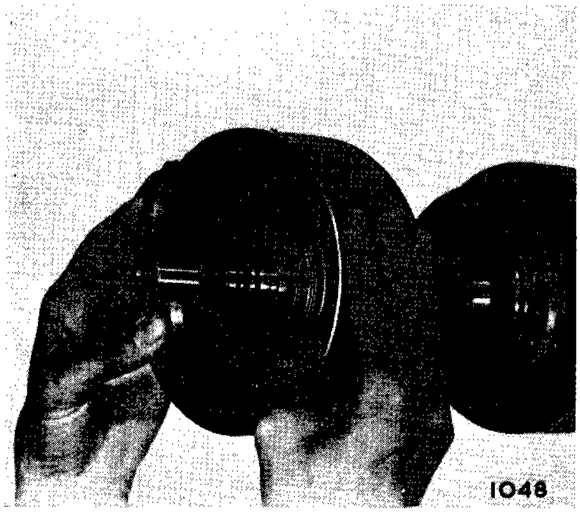


Fig. No. 61 *Fitting the rear clutch snap ring*

Install a rear clutch friction plate, then alternating with first a steel and then a friction plate, complete the clutch pack. (Fig. 60).

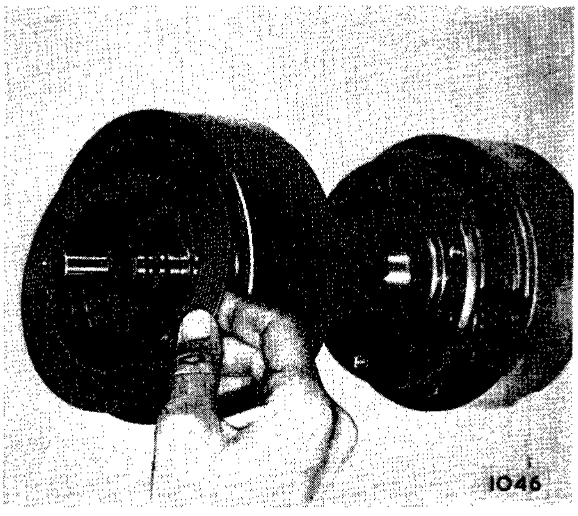


Fig. No. 60 *Fitting a rear clutch friction plate*

Install the front clutch cast iron sealing rings in their grooves on the forward sun gear. Centre each ring in its groove so that ends do not overlap edges of the groove (Fig. 62).

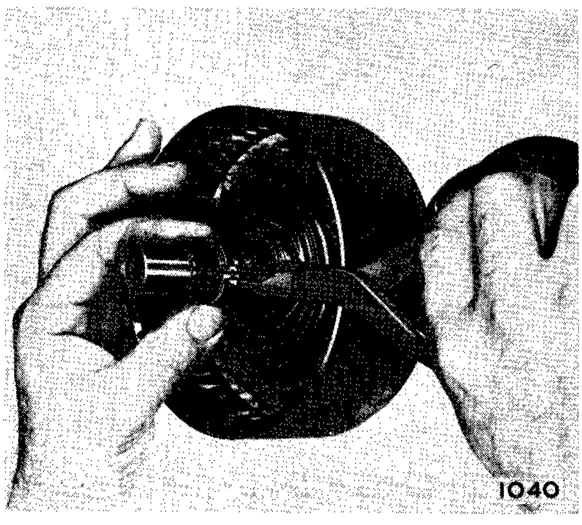
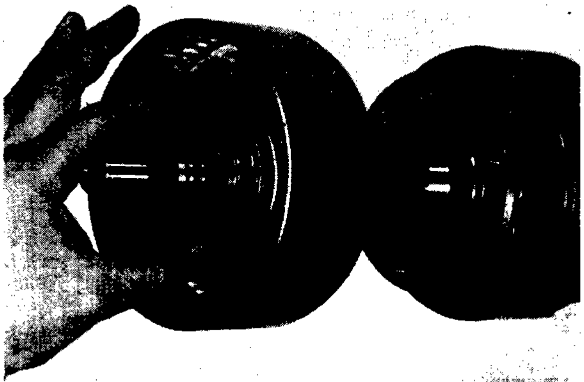


Fig. No. 62. *Fitting the sealing rings*

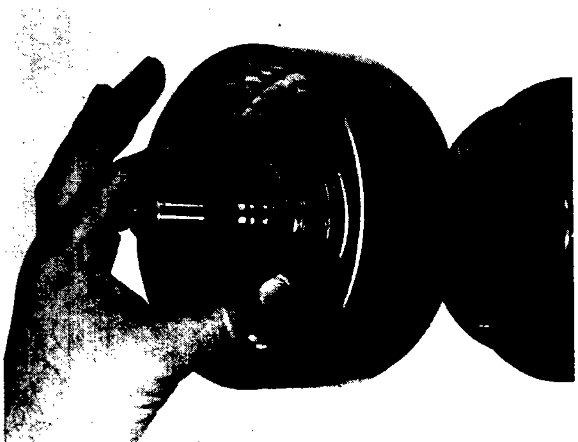
Install the front clutch cylinder thrust plate (Fig. 63). Be sure flats on the washer match flats on shaft.



1042

Fig. No. 63 *Fitting the front clutch thrust plate*

Install the front clutch cylinder thrust washer (Fig. 64).

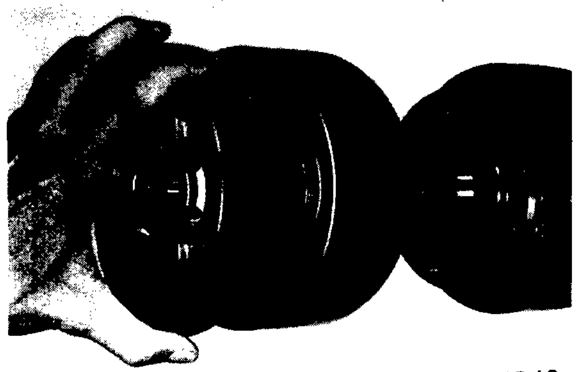


1043

Fig. No. 64 *Fitting the front clutch cylinder thrust washer*

Assemble the front clutch hub "O" ring into its groove in the clutch hub.
Assemble the front clutch piston square section rubber sealing ring in the groove of the clutch piston.

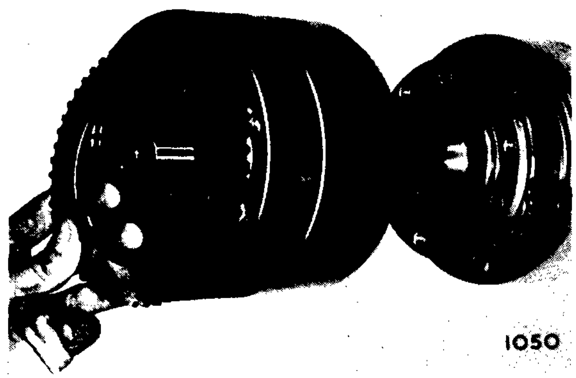
Install the clutch piston into the clutch cylinder after thoroughly lubricating the parts. Press the piston into position using Tool Part No. WG.42.
Install the front clutch belleville spring and snap ring. This snap ring is thicker than the other two clutch snap rings and has two tanged ends instead of one.
Assemble the front clutch assembly over the forward sun gear shaft and into the rear clutch, being careful not to distort or break the cast iron sealing rings. Use a short oscillating movement to engage splines of the rear clutch friction plates (Fig. 65).



1049

Fig. No. 65 *Assembling the front clutch*

Install the front clutch pressure plate (Fig. 66).



1050

Fig. No. 66 *Fitting the front pressure plate*

Install the front clutch hub, followed by front clutch hub thrust washer (Fig. 67).

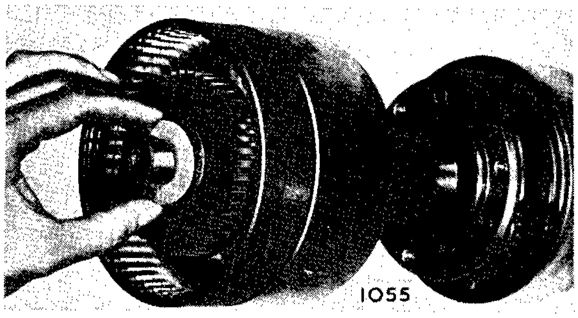


Fig. No. 67 *Fitting the front clutch hub thrust washer*

Install a front clutch friction plate over the splines of the hub (Fig. 68). Next, install a front clutch outer plate, meshing splines in the cylinder, alternating as above, complete assembly of plates (Fig. 69).

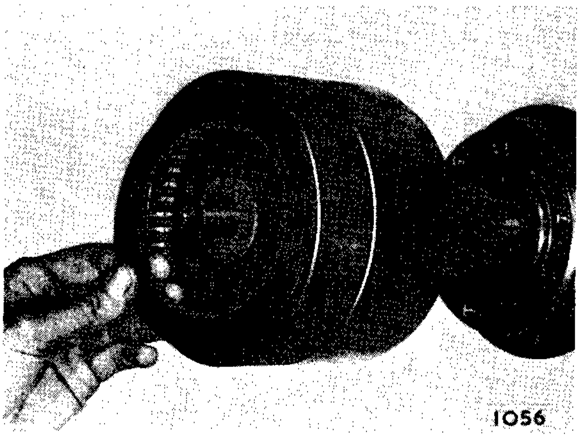


Fig. No. 68 *Fitting a front clutch friction plate*

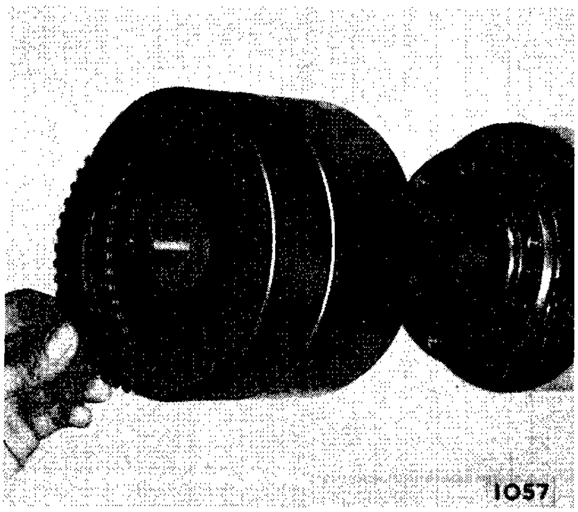


Fig. No. 69 *Fitting a front clutch outer plate*

Assemble the input shaft to the front clutch cylinder. Assemble the snap ring that holds the input shaft in place (Fig. 70).

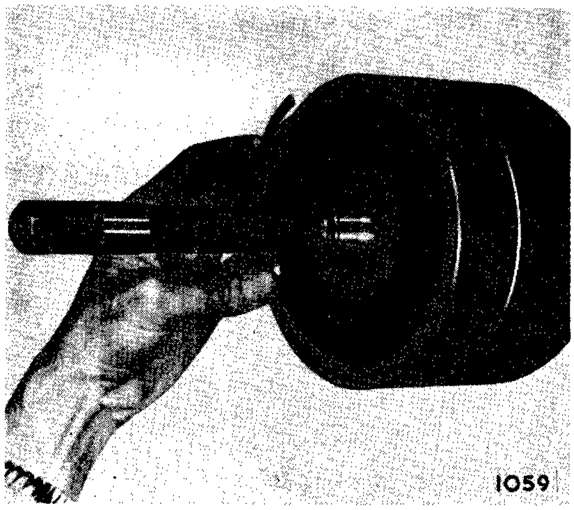


Fig. No. 70 *Fitting the input shaft snap ring*

Place the thrust washer on the input shaft and the clutch assemblies are complete (Fig. 71)

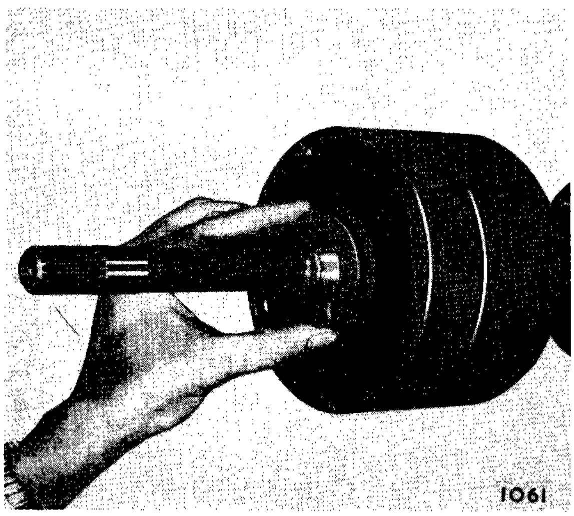


Fig. No. 71 *Placing the thrust washer in position on the input shaft*

Centre Support

The centre support is serviced as an assembly. Therefore, there is no disassembly or assembly procedure. Inspect the support for burrs or distortion, the race bearing surface for scores or scratches.

Pinion Carrier Assembly
The pinion carrier is serviced as an assembly. Therefore there is no disassembly or assembly procedure.
Inspect the band surface and the inner and outer bushing for scores. Rotate pinions on their shafts to check for freedom of movement and for worn or broken teeth. Use a feeler gauge to check pinion end play. End play should be 0.010" to 0.020" (0.25 to 0.5 mm.). Inspect pinion shafts for tightness to the planet carrier.

Sprag Clutch
A sprag-type one-way clutch assembly is incorporated in the planet carrier assembly and is held in place by a snap ring.
When installing the sprag clutch, the flange side of the sprag cage is located down into the outer race of the planet carrier assembly with the copper tension springs towards the centre support.
After the planet carrier and sprag assembly are installed in the case, the planet carrier will freewheel when turned counterclockwise and lock when turned clockwise (from the rear).

Output Shaft
Remove the extension housing and bearing from the output shaft by lifting the housing and tapping with a heavy plastic hammer.
Remove the bearing spacer washer.
Slide the oil collector and tubes from the shaft.
Remove the four sealing rings.
Remove the governor snap ring, governor and governor drive ball from the output shaft.
Lift the rear pump from the shaft and remove the rear pump drive key.
The snap ring may be removed and the output shaft removed from the ring gear; however, this is not necessary unless replacing one of these parts.
Inspect the output shaft thrust surfaces and journals for scores and the internal gear for broken teeth. Check the ring grooves, splines and gear teeth for burrs, wear or damage. The output shaft is a two-piece assembly and is serviced separately. Inspect the distributor and sleeve mating surfaces for excessive wear and for burrs, scores or leakage.

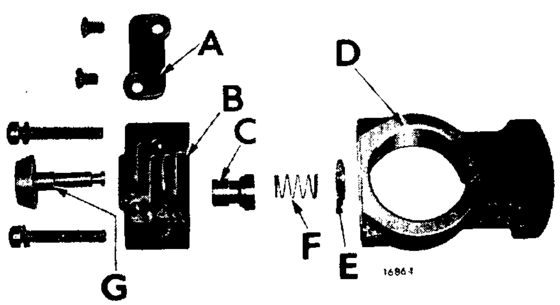


Fig. No. 72 *Exploded view of the governor*

A Governor body cover plate
B Governor body
C Valve
D Counter weight
E Spring retainer
F Spring
G Governor weight

Governor
Remove the governor body cover plate attaching screws and remove the plate (Fig. 72). Remove the governor body attaching screws, then remove the body from the counterweight. Slide the spring retainer from the stem of governor weight and remove the spring. Remove the valve and weight from the governor body. Inspect the governor weight, valve and bore for scores. Minor scores may be removed with crocus cloth. Replace the governor valve, weight or body if deeply scored. Check for free movement of the weight and valve in the bore. Inspect all fluid passages in the governor body and counterweight for obstruction. All fluid passages must be clean. Inspect the mating surfaces of the governor body and counterweight for burrs and distortion. Check governor spring retainer washer for burrs. The mating surfaces must be smooth and flat.
Re-install governor body cover plate, torqueing screws to 20-30 lb. in. (0.24 to 0.35 kgm.).
Install the governor valve in the bore of the body. Install the weight in the governor valve. Compress the spring and slide the retainer onto the stem of the weight and release the spring tension. Install the governor body on the counterweight.
Note: Make sure the fluid passages in the body and counterweight are aligned.
Torque the governor body attaching screws to 50-60 lb. in. (0.58 to 0.69 kgm.).

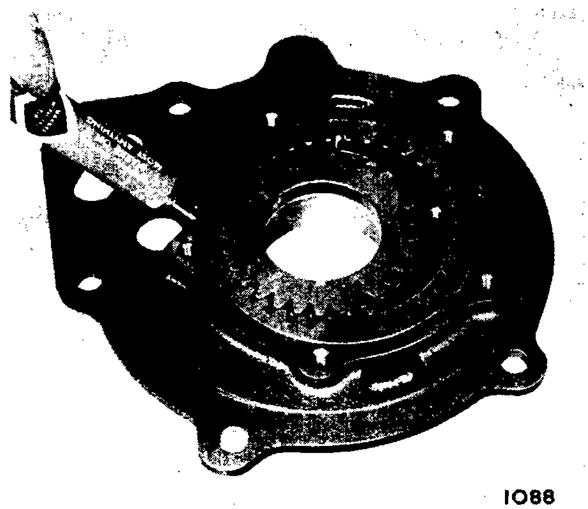


Fig. No. 73 *Marking top face of gears of rear pump*

Rear Pump
Withdraw the five $\frac{1}{4}$" screws, also the No. 10 U.N.C. screw and remove the cover. Mark the top face of the gears with marking ink or a crayon to assure correct re-installation of gears upon assembly (Fig. 73).

Remove the drive and driven gears from the pump body. Inspect the gear pockets and crescent of the pump body for scores or pitting. Inspect the bushing and drive and driven gear bearing surfaces for scores. Check all fluid passages for obstructions and clean if necessary. Inspect the mating surfaces, gear teeth, pump body and cover for burrs. If any pump parts are defective beyond minor burrs or scores, which cannot be removed with a crocus cloth, replace complete pump as a unit.
Lubricate parts with transmission fluid and replace both gears with the marks facing upward. Install the pump cover, attaching screws and lock-washers. Tighten the $\frac{1}{4}$" screws to 50-60 lb. in. (0.58 to 0.69 kgm.) torque and the number 10 screw to 20-30 lb. in. (0.24 to 0.35 kgm.) torque (Fig. 74).

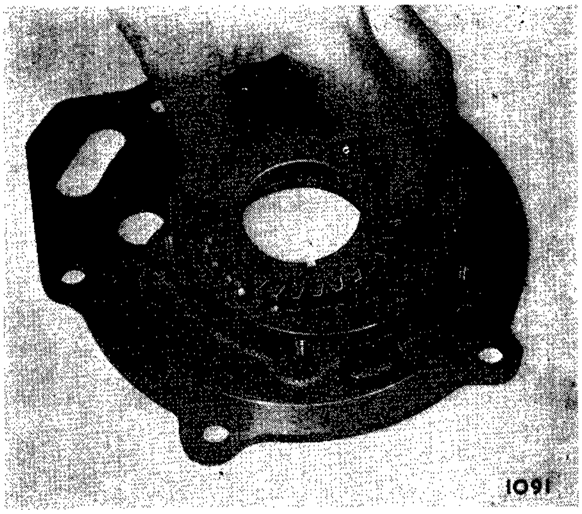


Fig. No. 74 *Replacing the gears*

Check the pump for free movement of the gears.

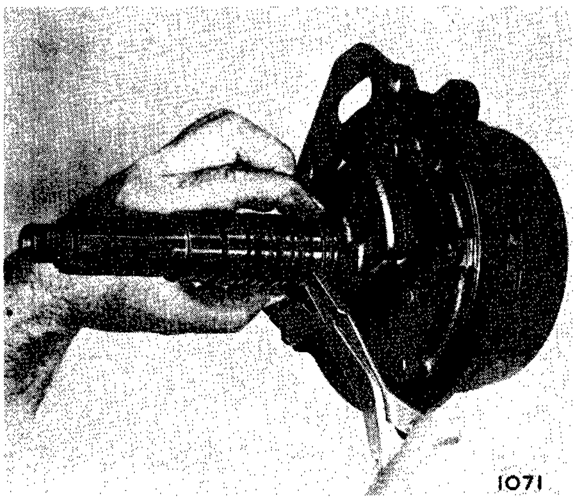


Fig. No. 75 *Fitting the snap ring*

Output Shaft and Rear Pump — Assembling
Install the rear pump drive key in the output shaft.
Install rear pump assembly over the shaft.
Install the governor drive ball into the recess in the output shaft, using a spot of petrolatum to hold in place.
Install governor assembly, with plate on the governor body down (facing pump assembly). Install snap ring to lock governor in place (Fig. 75).
Install the four output shaft sealing rings, making sure they are free in their grooves (Fig. 76).

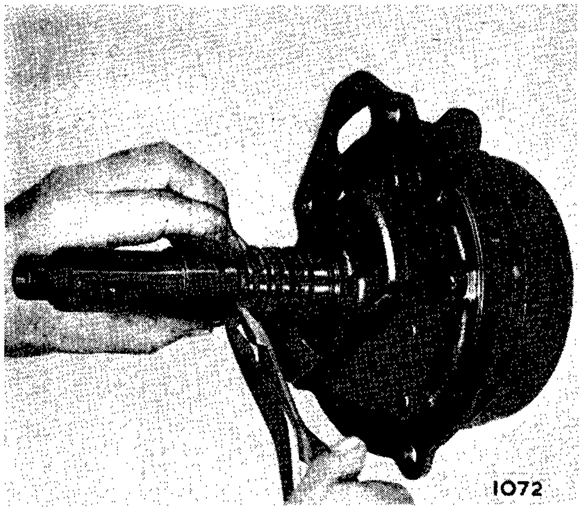


Fig. No. 76 *Fitting the output shaft sealing rings*

Install oil collector sleeve and tube assembly. Compress each ring with the fingers and carefully slide the sleeve over them (Fig. 77).

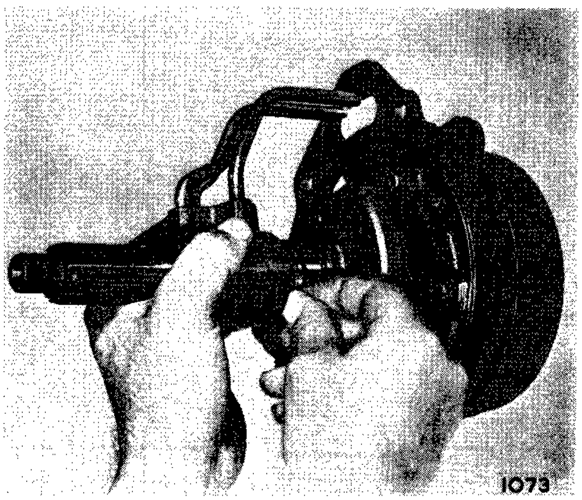


Fig. No. 77 *Installation of the oil collector sleeve and tube*

Assemble the bearing spacer washer against the shoulder on the output shaft (Fig. 78).

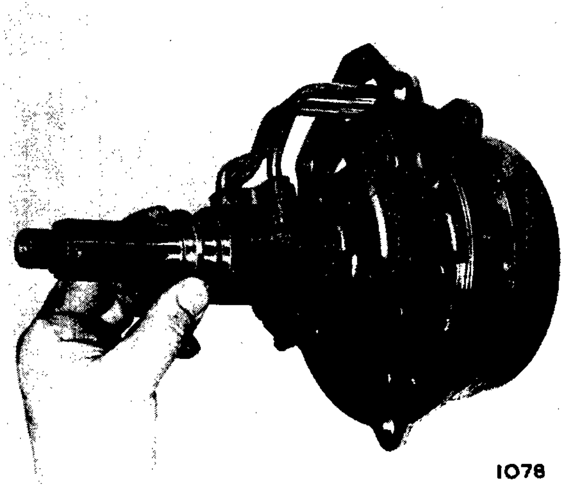


Fig. No. 78 *Fitting the bearing spacer washer*

Front Servo — Assembling
Assemble the servo lever, pivot pin and the roll pin.
Assemble the sealing rings on the sleeve and piston.
Assemble the piston to the sleeve, place the spring in the piston, and assemble the sleeve, piston and spring into the housing.
Replace the snap ring.

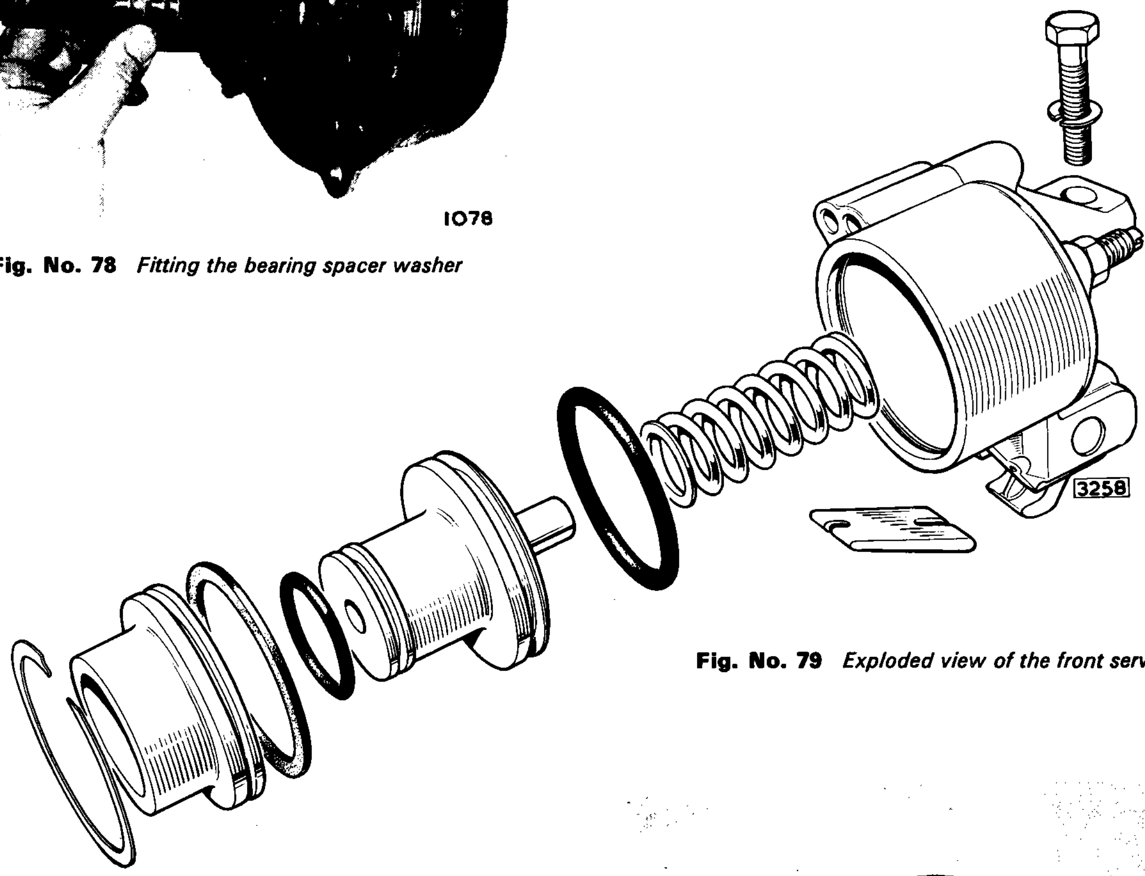


Fig. No. 79 *Exploded view of the front servo*

Front Servo — Dismantling
Use a small screwdriver to remove the snap ring. (Fig. 80).
Pull the sleeve and piston from the servo body.
Remove the piston from the servo sleeve.
Remove all sealing rings.
If the servo lever needs attention, it may be removed by first driving the roll pin from the servo and then removing the pivot pin and lever. Use a $\frac{1}{8}$" (3.1 mm.) drift punch to remove the roll pin.
Inspect the servo parts for cracks, scratches and wear.
Check the adjusting screw for freedom in the lever.
Check the lever for freedom of movement.

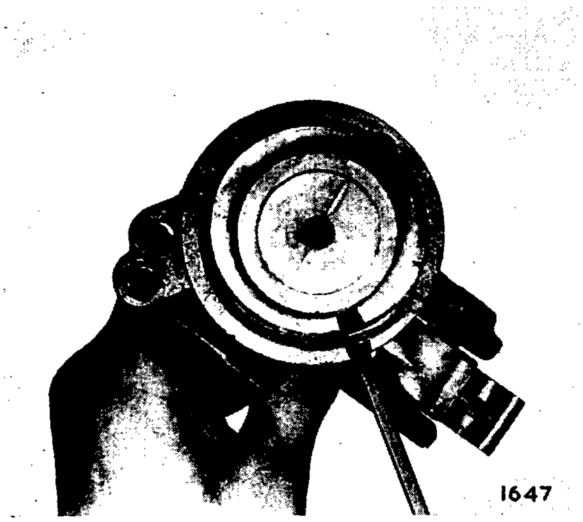


Fig. No. 80 *Removing the snap ring*

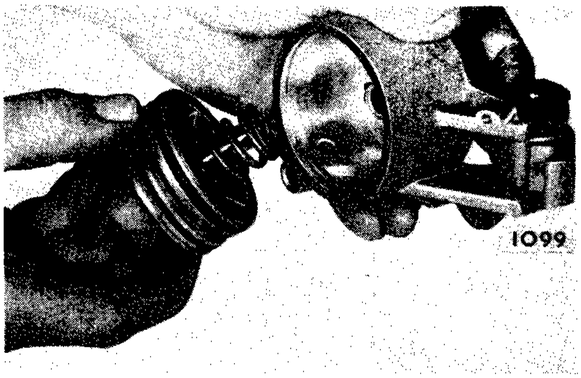


Fig. No. 81 *Assembling the front servo*

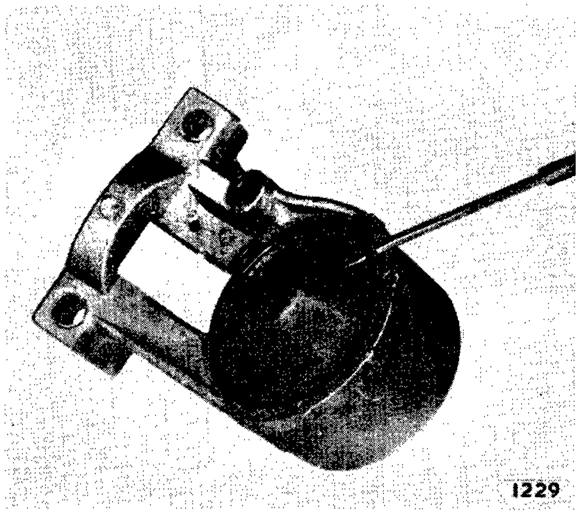


Fig. No. 83 *Removing the rear servo snap ring*

Rear Servo — Dismantling
Remove the actuating lever roll pin with a $\frac{1}{8}$" (3.1 mm.) drift punch (Fig. 82).
Remove the lever and shaft.
Depress the spring retainer while removing the snap ring (Fig. 83).
Remove the servo release spring, piston and rubber "O" ring.
Inspect the servo body for cracks, burrs and obstructed passages and the piston bore and stem for scores. Inspect the actuating lever and shaft for wear and brinnelling.

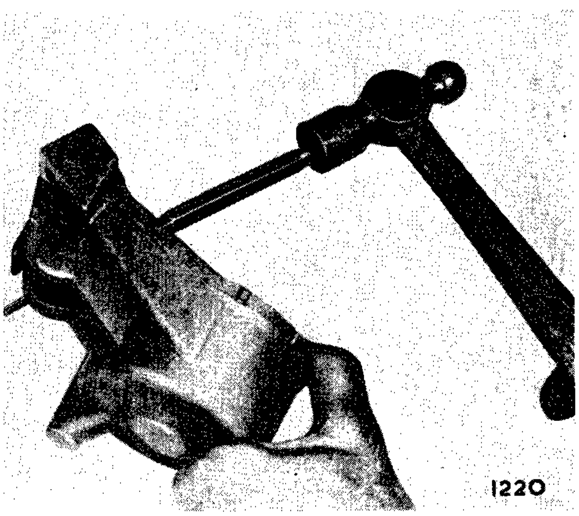


Fig. No. 82 *Removing the rear servo roll pin*

Rear Servo — Assembling
Lubricate all parts of the servo with transmission fluid before starting assembly.
Install a new "O" ring and then install piston in the servo body.
Install the release spring, retainer and snap ring.
Replace the servo lever, shaft and roll pin (Fig. 84).

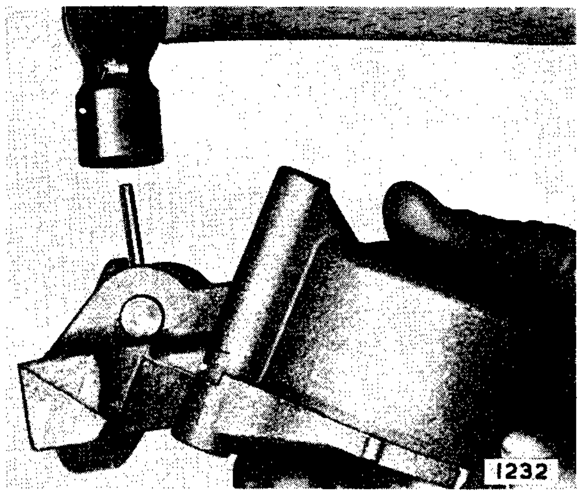


Fig. No. 84 *Replacing the roll pin*

Pressure Regulator
Remove the valves from the regulator body. Remove the regulator body cover attaching screws and remove the cover. Remove the separator plate from the regulator body.

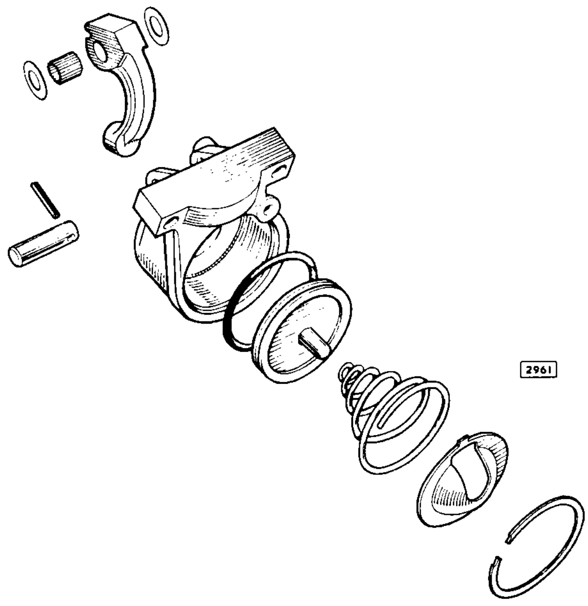


Fig. No. 85 *Exploded view of the rear servo*

Wash all parts thoroughly in cleaning solvent and dry with compressed air. Inspect the regulator body and cover mating surfaces for burrs. Check all fluid passages for obstructions. Inspect the control pressure and converter pressure valves and bores for burrs and scores. Remove all burrs carefully with crocus cloth. Check free movement of the valves in their respective bores. The valves should fall freely into the bores when both the valve and bore are dry. Inspect the valve springs for distortion.

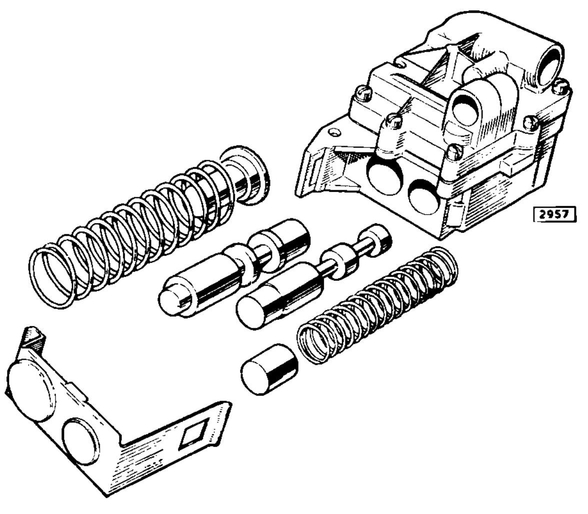


Fig. No. 86 *Regulator assembly. Valves, springs and retainer shown exploded*

When assembling, be careful to avoid damaging the parts. Replace the separator plate and then the cover on the regulator body. Install and torque the attaching screws to 20-30 lb. in. (0.24-0.35 kgm.).
Insert the valves in the pressure regulator body.

Valve Body — Dismantling

During dismantling of the control valve assembly, avoid damage to the valve parts and keep the parts clean. Place the valve parts and the assembly on a clean surface while performing the dismantling operation.
Remove the manual valve from the upper valve body.
Remove the four cap screws that retain the valve bodies.
Remove the cover and separator plates from the valve bodies. The body plate is attached to the lower valve body by a cheese head screw and to the upper valve body by a cheese head and a flat head screw. The separator plate and the lower valve body cover are held together by two cheese head screws.
Remove the front upper valve body plate retained by two screws. Remove the compensator valve plug, sleeve, springs and valve. Remove the modulator valve and spring assembly. The outer spring is retained to the modulator valve by a stamped retainer. The spring may be removed by tilting and pressing outward on the retainer.
Remove the downshift valve and spring.
Remove the rear upper valve body plate and throttle return spring retained by three screws to the body. Then remove the compensator cut back valve and the throttle valve.
Remove the four screws that retain the end body to the lower body. Remove the 2-3 shift valve inner and outer springs and the 2-3 shift valve. Remove the orifice control valve and spring and the transition valve spring and valve. Remove the orifice control valve plug and the 2-3 shift valve plug from end body. The end body plate should be removed for cleaning the end body.
Remove the four cheese head screws that retain the lower valve body side plate. Remove the 2-3 governor plug, the D1 and D2 control valve spring and valve.
The rear pump check valve, spring and sleeve generally should not be removed. The sleeve may be removed with snap ring pliers, if necessary.
Remove the end plate from the lower valve body cover. Then remove the 1-2 shift valve and spring and the front servo release orifice valve and spring.
Note: When removing all plates, be sure to hold the plates until screws are removed and release slowly as they are spring loaded.

Inspection

Clean all parts thoroughly in a cleaning solvent, then dry them with compressed air. Inspect all fluid passages for obstructions. Inspect the check valve for free movement. Inspect all mating surfaces for burrs and distortion. Inspect all plugs and valves for burrs and scores.
Note: Crocus cloth can be used to polish the valves and plugs if care is taken to avoid rounding the sharp edges.

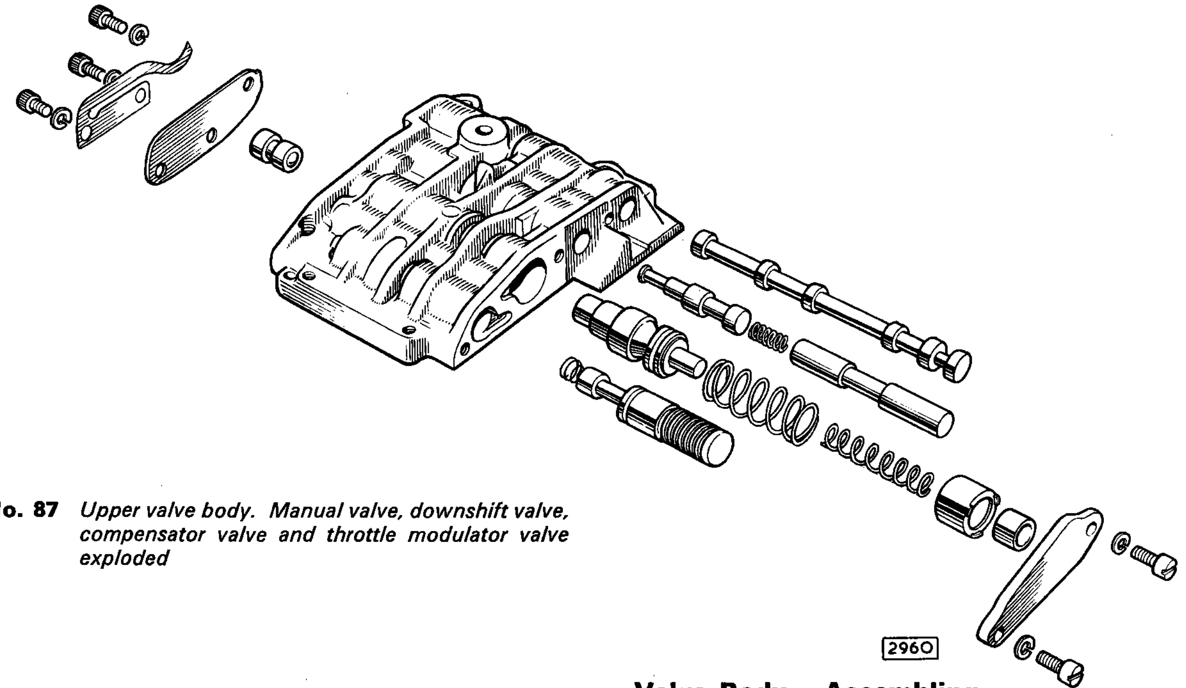


Fig. No. 87 *Upper valve body. Manual valve, downshift valve, compensator valve and throttle modulator valve exploded*

Valve Body — Assembling

When assembling the control valve bodies, always use the following procedure:

Install the valve body plate on the upper valve body (retained by one cheese head and one flat head screw). Do not tighten the screws. If the rear pump check valve sleeve, valve and spring were removed from the lower valve body, install them, carefully staking the sleeve in the bore with the smooth end against the valve.

Place the upper body on the lower body and install the cheese head screw, but do not tighten the screw.

Place the lower valve body separator plate and cover on the lower valve body and install the two cheese head screws, leaving them loose.

Install the four cap screws and lockwashers; torque the four screws to 72 lb. in. (.84 kgm.), then tighten the cheese head screws and flat head screw to 20-30 lb. in. (0.23-0.35 kgm.).

Try all valves dry in their respective bores, rotating them to make sure that they are free before final assembly in the valve body. If any sticking or binding occurs, the valve bodies will have to be separated and each surface lapped on crocus cloth, using a surface plate or a glass

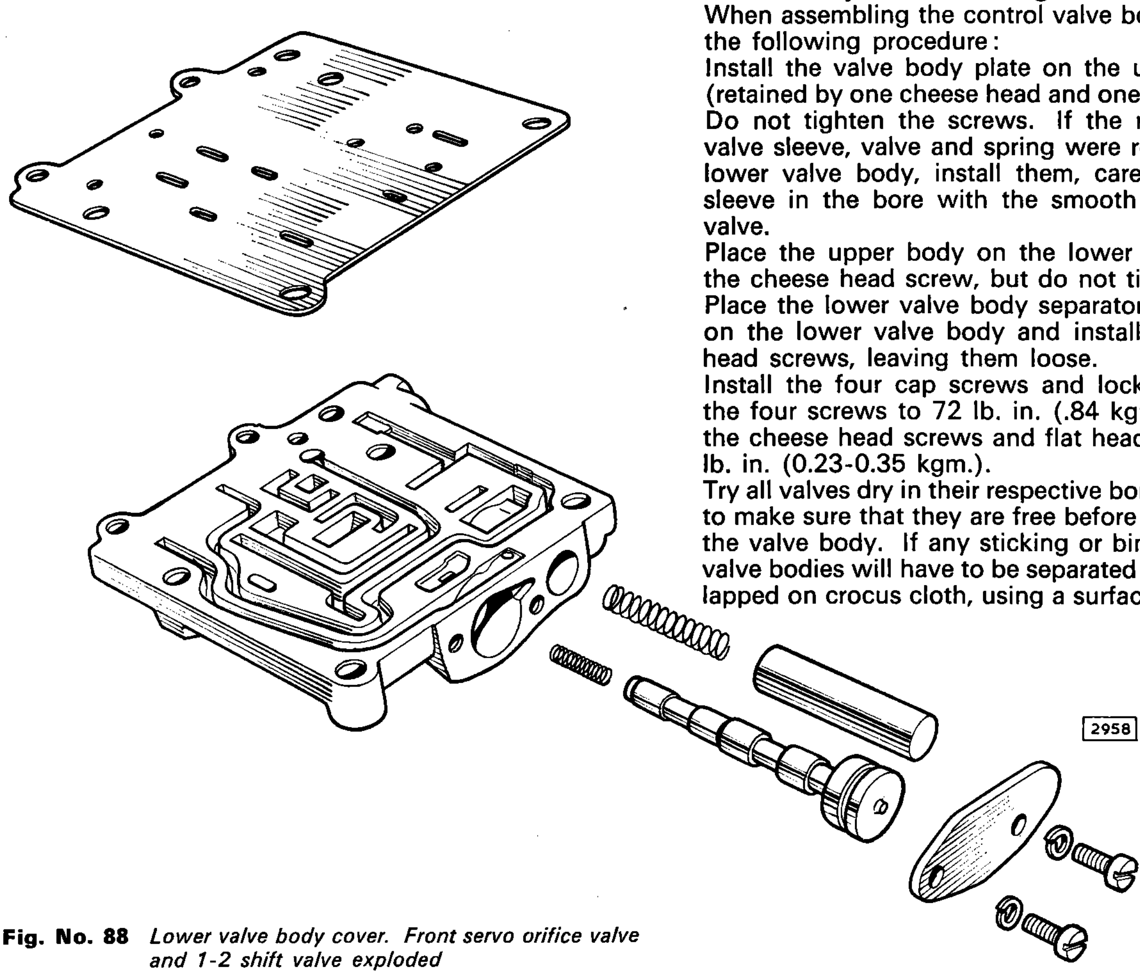


Fig. No. 88 *Lower valve body cover. Front servo orifice valve and 1-2 shift valve exploded*

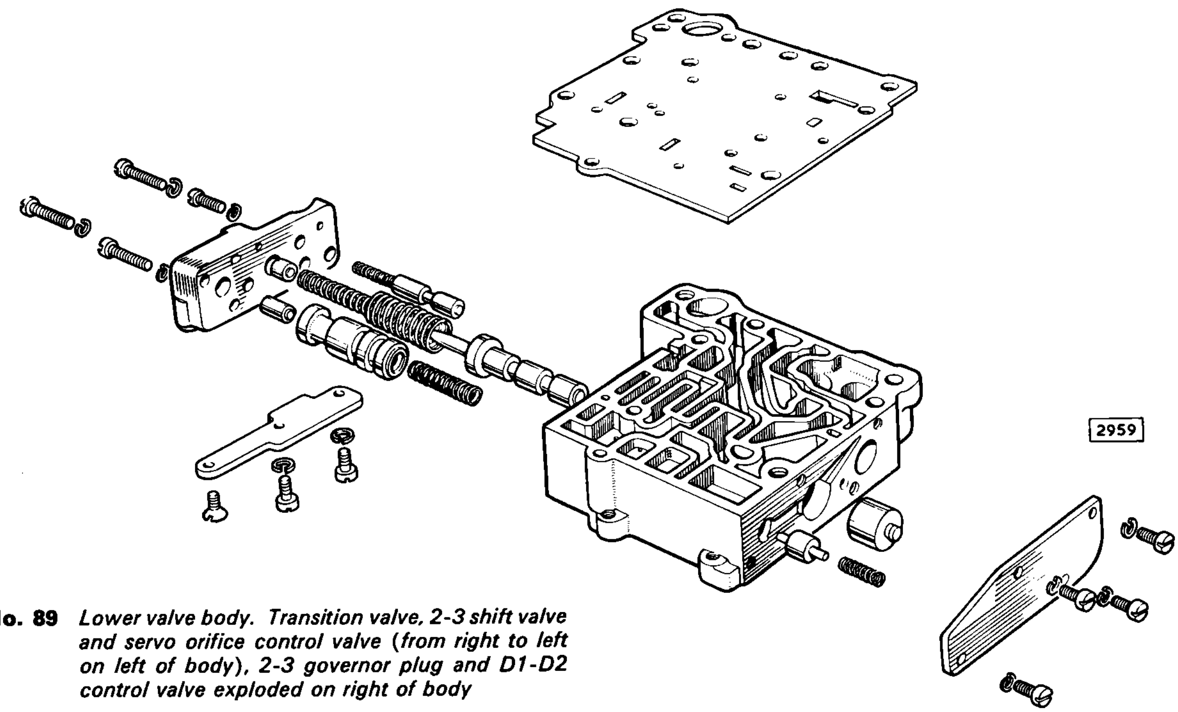


Fig. No. 89 *Lower valve body. Transition valve, 2-3 shift valve and servo orifice control valve (from right to left on left of body), 2-3 governor plug and D1-D2 control valve exploded on right of body*

plate, to ensure against low or high spots or a warped condition.

Note: Lubricate all valves and plugs with automatic transmission fluid before final assembly in their respective bores.
Install the 1-2 shift valve spring and valve in the lower valve body cover. Install the front servo release orifice valve spring and valve and the cover end plate with two cheese head screws.
Install the range control valve and spring, the governor plug, and then install the side plate with four cheese head screws.

Install the orifice control valve spring and valve, the 2-3 shift valve, the 2-3 shift valve inner and outer springs, the transmission valve, and spring in the lower valve body.
Replace the end body plate using one flat head and two cheese head screws and torque to 20-30 lb. in. (0.23-0.35 kgm.). Install the orifice control valve plug and the 2-3 shift valve plug in the lower valve body. Install the end body to the lower valve body, guiding the 2-3 shift valve inner spring into the 2-3 shift valve plug. Three long and one short special cheese head screws are used to retain the end body.

Note: Make sure the inner spring is piloted on the 2-3 shift valve plug.
Install the modulator valve and spring assembly. Install the compensator valve, compensator inner and outer springs, compensator plug and sleeve (be sure end of sleeve with the three protrusions is towards the plate and the smooth end to the spring in the upper valve body). Assemble the plate which is retained by two cheese headed screws.
Install the compensator cut-back valve in the rear end of the upper body. Install the rear plate so that the edge of the plate fits into the band of the throttle valve and install one screw to hold the rear plate in place. Install the throttle return spring and install the two remaining cheese headed screws.
Install the manual valve. Torque on all cheese headed screws should be 20-30 lb. in. (0.23 to 0.35 kgm.).

Fig. No. 90 *Fitting a front pump gasket*

TRANSMISSION ASSEMBLING

Lubricate all parts as they are assembled, with the same fluid used for filling the transmission. Petrolatum can be used sparingly to hold gaskets or thrust washers in position during assembly.

Wash the transmission case and dry with compressed air.

Install a new front pump to case gasket, then install the front pump. Torque the four attaching cap screws to 17-22 lb. ft. (2.35 to 3.04 kgm.).

Install the front band through the bottom of the case, positioning the band so that the anchor end is aligned with the anchor in the case.

Install the front clutch, rear clutch and forward sun gear assembly in the case. Handle the clutch assemblies in a manner that will prevent the clutches being pulled apart.

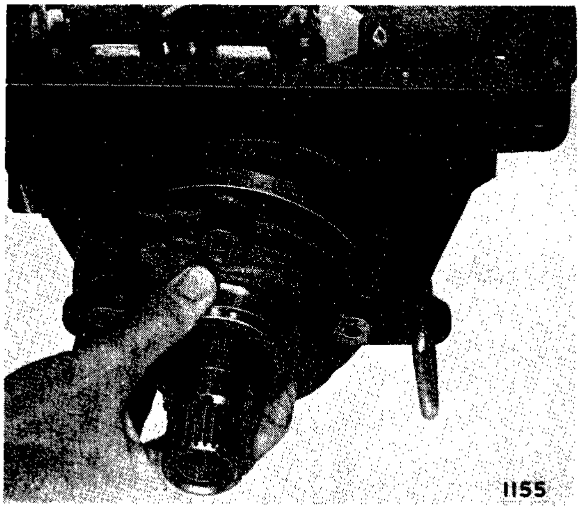


Fig. No. 91 *Installing the front pump*

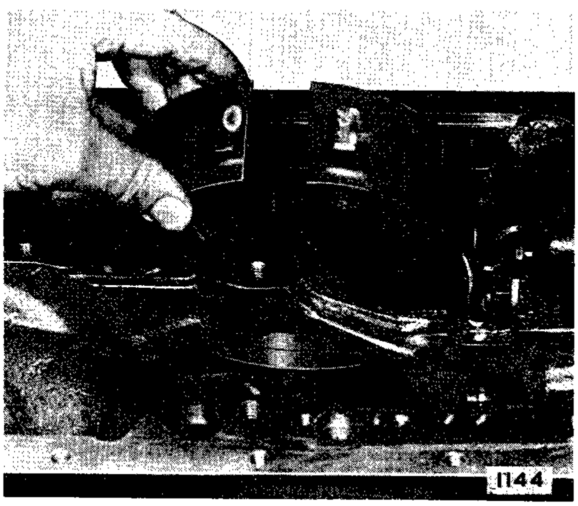


Fig. No. 92 *Installing the front band*

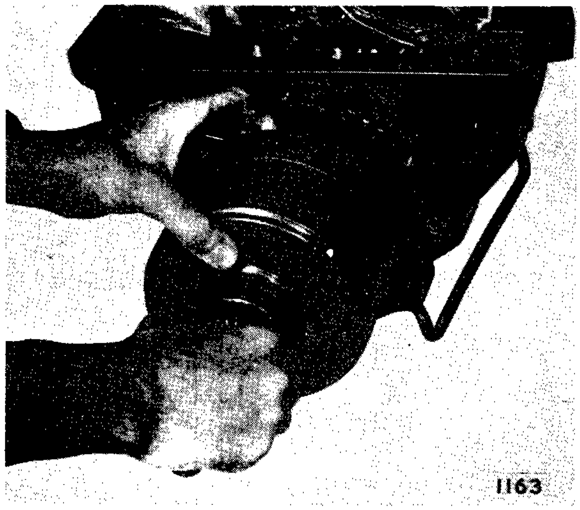


Fig. No. 93 *Installing the front clutch, rear clutch and forward sun gear*

Install the centre support in the transmission case with the three positioning holes aligned with the holes in the case.

Install the centre support cap screws with the rolled edge of each lockwasher towards the case. Torque to 20-25 lb. ft. (2.76 to 3.46 kgm.).

Install the rear band through the rear of the case. Be sure that the end with the depression or dimple is placed toward the adjusting screw.

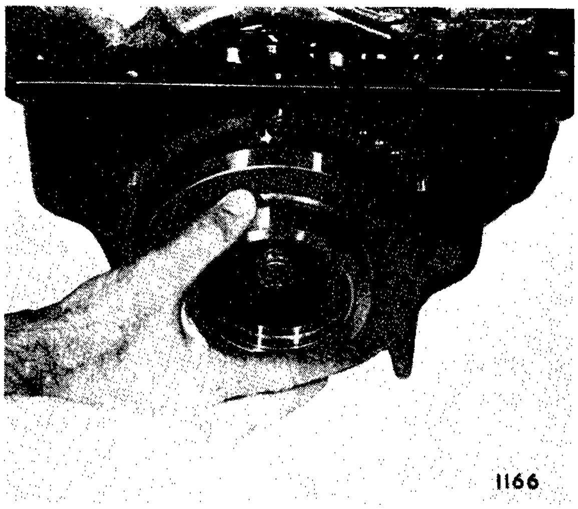


Fig. No. 94 *Installing the centre support*

Use petrolatum sparingly to hold the forward sun gear thrust plate and needle bearing in the planet carrier, while the carrier is assembled over the sun gear.

Install the hook type seal rings on the rear of the forward sun gear. Check the rings for free movement in their grooves.

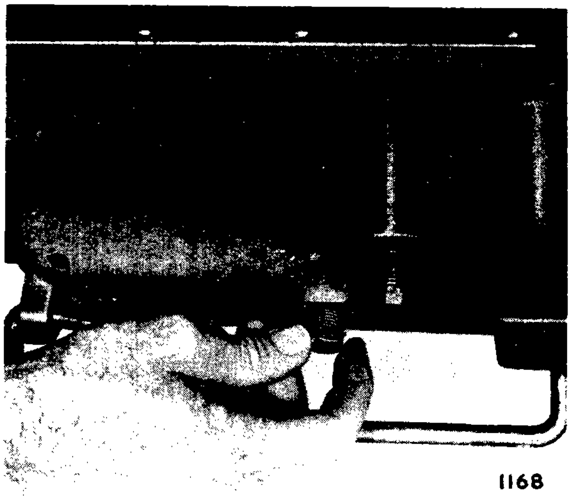


Fig. No. 95 *Fitting the centre support cap screws*

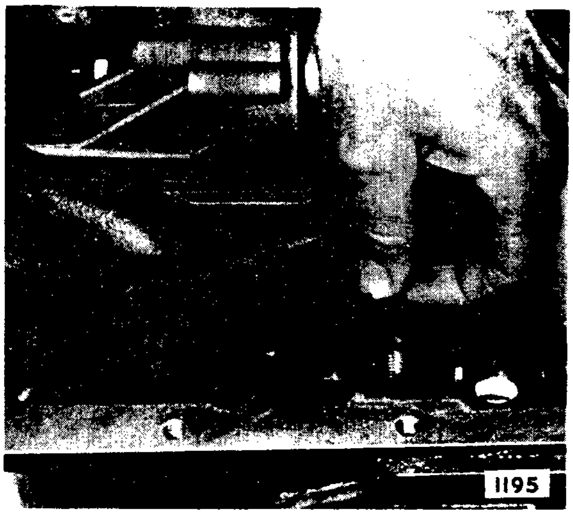


Fig. No. 96 *Fitting the rear band*

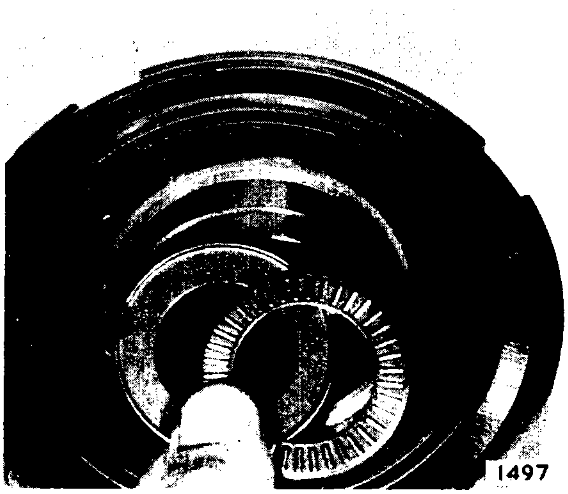


Fig. No. 97 *Fitting the thrust plate and needle bearing*

Choose a selective washer to give the correct end play (end play determined during dismantling is used to determine the need for a different thrust washer). Install washer on the rear of the planet carrier.

Use petrolatum to hold the rear pump to case gasket to rear of the case.

Install the ring gear and output shaft assembly. Align the three oil tubes as the assembly is fitted and tap them in position.

Place the rear pump to extension housing gasket in position, then assemble the extension housing. Torque the five extension housing cap screws to 28-33 lb ft. (3.87 to 4.56 kgm.).

Install the bearing snap ring, and then tap the ball bearing into position in the extension housing and on the output shaft (be sure spacer washer is on shaft ahead of bearing).

Slide the speedometer drive gear on the output shaft. Install rear seal in bearing retainer. Assemble the bearing retainer in its gasket.

Install the companion flange, flat washer, lockwasher and nut. Torque the nut to 90-120 lb. ft. (12.44-16.58 kgm.).

Fig. No. 98 *Assembling the carrier over the sun gear*

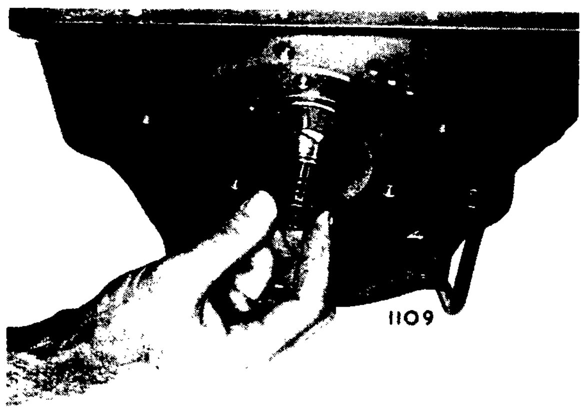


Fig. No. 99 *Fitting the sealing rings*

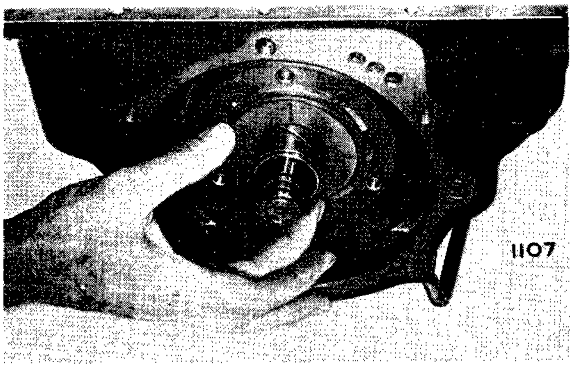


Fig. No. 100 *Fitting washer on rear of planet carrier*

Front Servo Installation

Rotate the front band into position so that the anchor end is positioned over the anchor pin in the case.
Position the servo strut with the slotted end aligned with the servo actuating lever, and hold it in position with the middle and index fingers of the left hand.
Engage the end of the band with the small end of the strut then position the servo over the dowel pin.
Install the attaching cap screw but do not screw it in more than two or three threads at this time.

Rear Servo Installation

Position the servo anchor strut over the adjusting screw, then rotate the rear band to engage this strut.
Place the servo actuating lever strut with the notched end to the band and lift the other end with index finger or screwdriver, while locking the servo lever over the strut.
Install the long pointed bolt in the forward servo hole so that it will engage the centre support.
The other shorter bolt is used in the rear position.
Torque the bolts to 40-50 lb. ft. (5.53-6.91 kgm.).

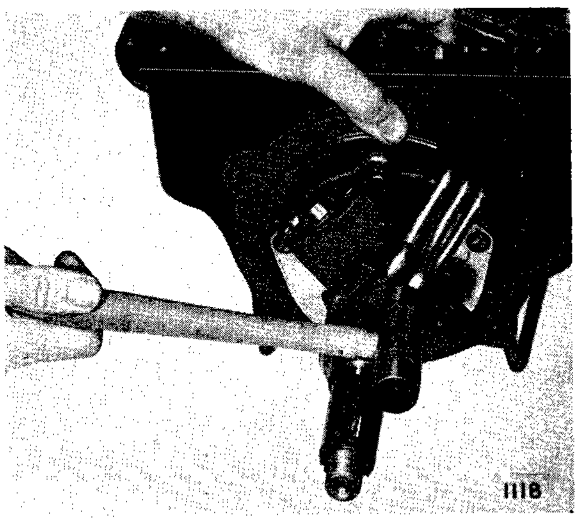


Fig. No. 101 *Tapping the output shaft assembly into position*

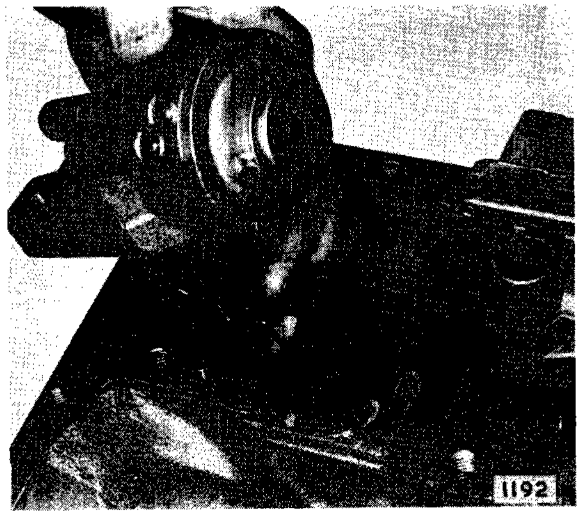


Fig. No. 102 *Installing the front servo*

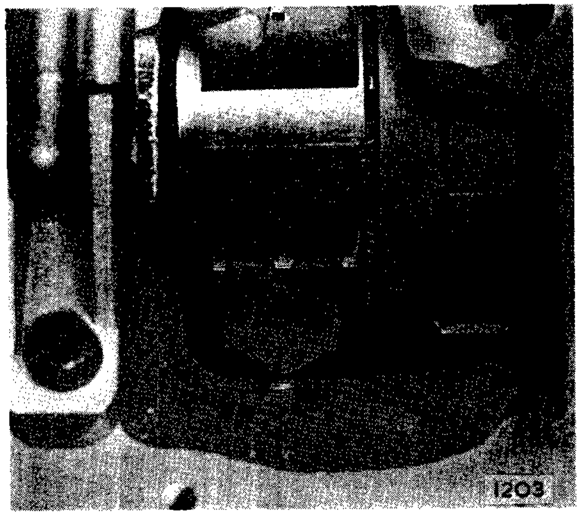


Fig. No. 103 *Engaging the servo anchor strut*

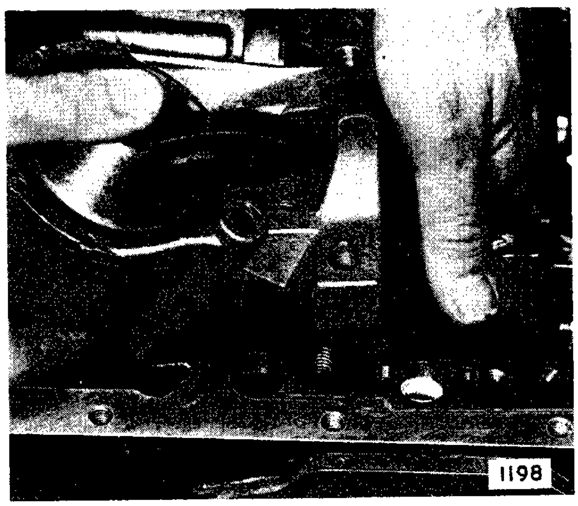


Fig. No. 104 *Fitting the rear servo*

Valve Body Installation
Place the manual selector in park or reverse position. Carefully align the valve body with the servo tubes and gently slide the valve body further onto the tubes.
The front servo must be pulled up off the dowel to allow easy assembly. Be careful at this point — the servo apply strut may become disengaged from the servo. Before seating the valve body on the case, install the nipple end of the throttle cable into the throttle cam.
Next, align the manual valve with the inside lever pin and the valve body will then drop into position. Torque the three valve body attaching cap screws to 8-10 lb. in. (0.09-0.12 kgm.).

Torque the front servo attaching cap screw to 30-35 lb. ft. (4.15-4.84 kgm.) and adjust the front servo.
Replace the control pressure tube, by first assembling the long straight end into the regulator, then rocking the tube downward into the control valve body. If too much resistance is encountered, it will help to loosen the control body attaching cap screws until the tube can be assembled.

Pressure Regulator Installation
Assemble the regulator, with the valves in position in their bores, to the case with the attaching cap screws. Torque cap screws to 17-22 lb. ft. (2.35-3.04 kgm.).

Fig. No. 105 *Fitting the servo tubes*

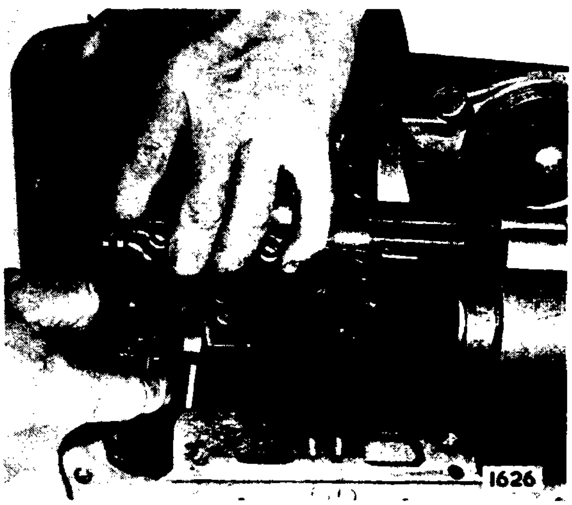


Fig. No. 106 *Positioning the valve body*

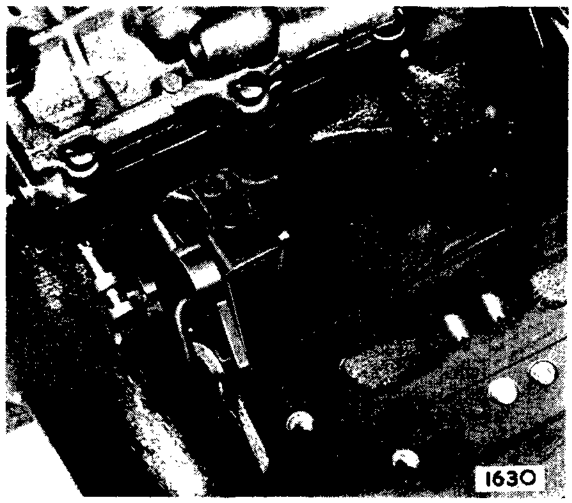


Fig. No. 107 *The valve body in position*

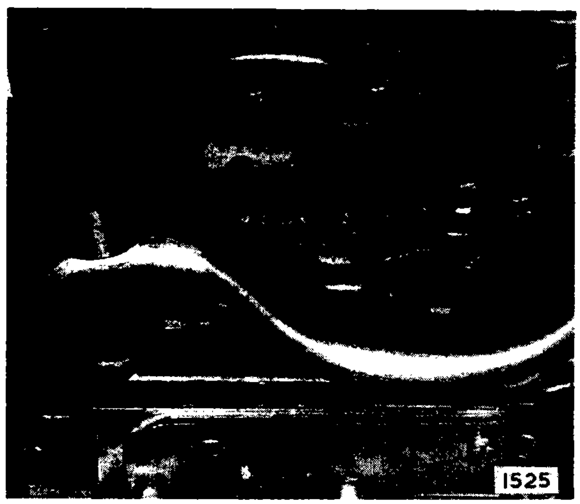


Fig. No. 108 *Replacing the control pressure tube*

Install both springs and guides, then install the spring retainer.
Install the front servo apply and release tubes in the servo.

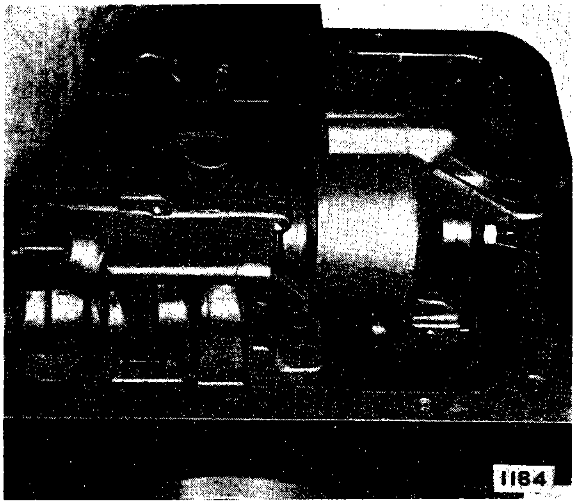


Fig. No. 109 *The pressure regulator installed*

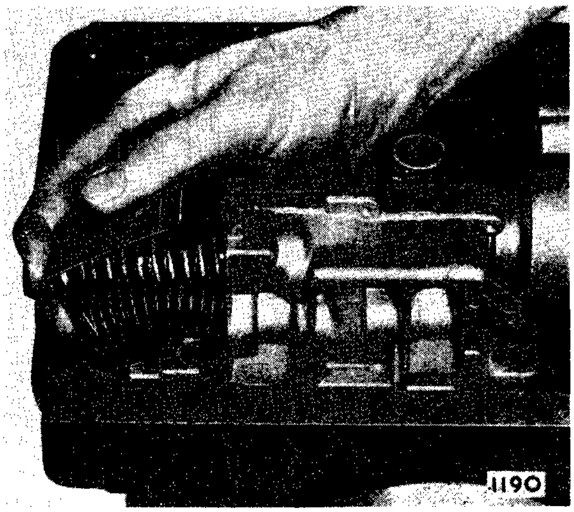


Fig. No. 110 *Fitting the pressure regulator springs*

Install the rear pump inlet and outlet tubes, using new "O" rings.
Replace the compensator tube by aligning one end with the pressure regulator and the other end with the control valve body and then tap it into position.
Assemble the long end of the lubrication tube into the rear pump, then rock the other end into position and tap it into the pressure regulator assembly.

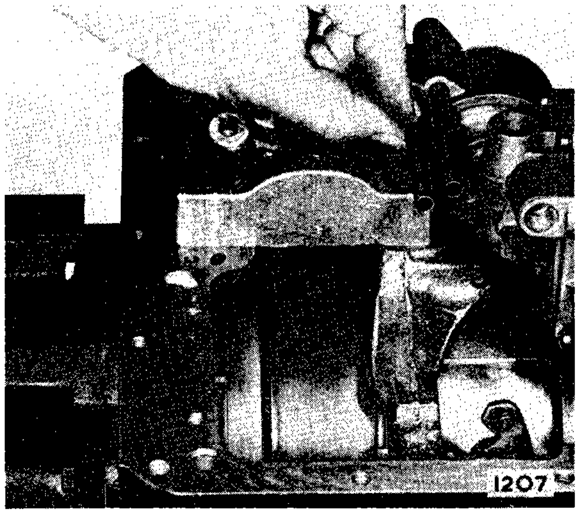


Fig. No. 111 *Fitting apply and release tubes*

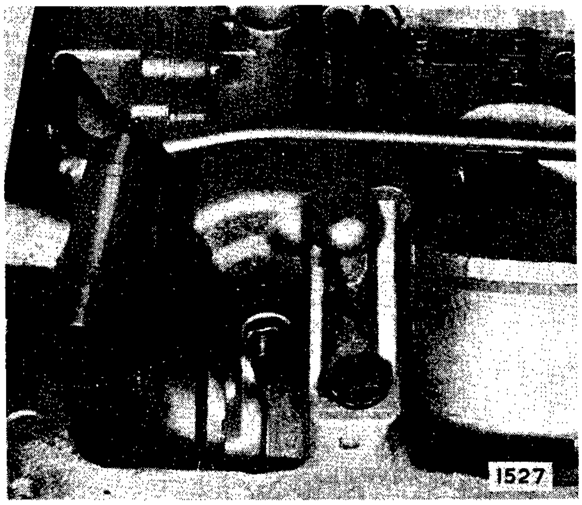


Fig. No. 112 *Fitting the lubrication tube*

Replace the front band lubrication tube. Be sure the tube is aligned so that the open end will direct oil onto the front drum surface at the front band gap. Tube should point at approximately the centre of the gap.
Assemble the oil screen assembly onto the rear pump inlet tube and then rock into position over the front pump inlet on the pressure regulator assembly. Hook the screen retainer under the lubrication tube, lay across screen, and snap onto compensator tube.
Install the oil pan gasket, the oil pan and torque, the 14 cap screws to 10-20 lb. ft. (1.38-2.76 kgm.).
Adjust the rear band.

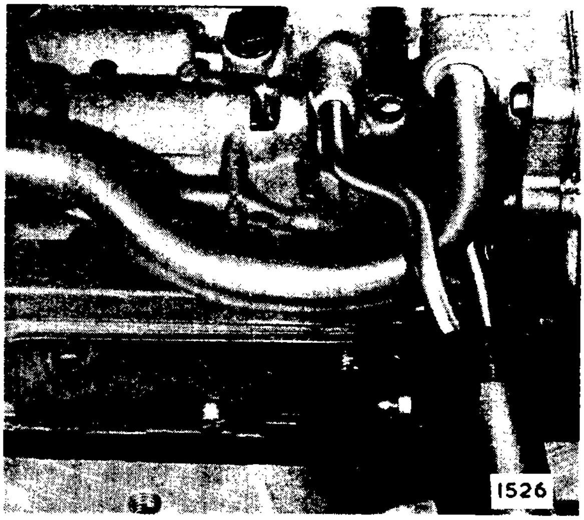


Fig. No. 113 *Fitting the compensator tube*

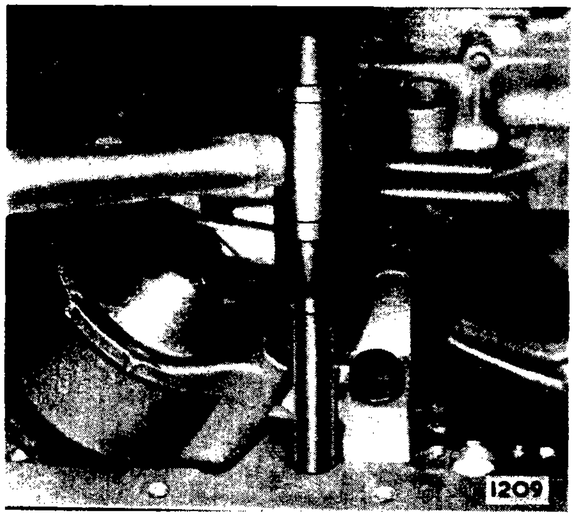


Fig. No. 114 *Fitting the rear pump inlet tube*

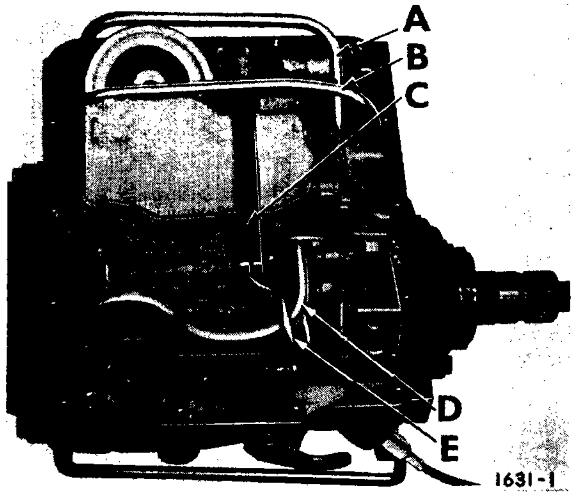


Fig. No. 115 *View of the Model 8 Transmission unit inverted with the oil pan removed showing tube location*

A Front brake band oil tube
B Rear pump to regulator oil tube
C Retaining clip
D Control pressure oil tube
E Compensator oil tube

CONVERTER AND CONVERTER HOUSING

When installing the converter housing, the maximum allowable runout should not exceed 0.010" (0.25 mm.) for bore or face indicator readings relative to crankshaft centre line; however, it is preferable to have less than 0.006" (0.015 mm.) reading for both.

When installing the transmission to the converter housing and converter assembly, be certain that the converter lugs are properly aligned with the front pump drive gear, so that the parts will not be damaged by forcing impeller hub drive tangs against the pump drive gear lugs.

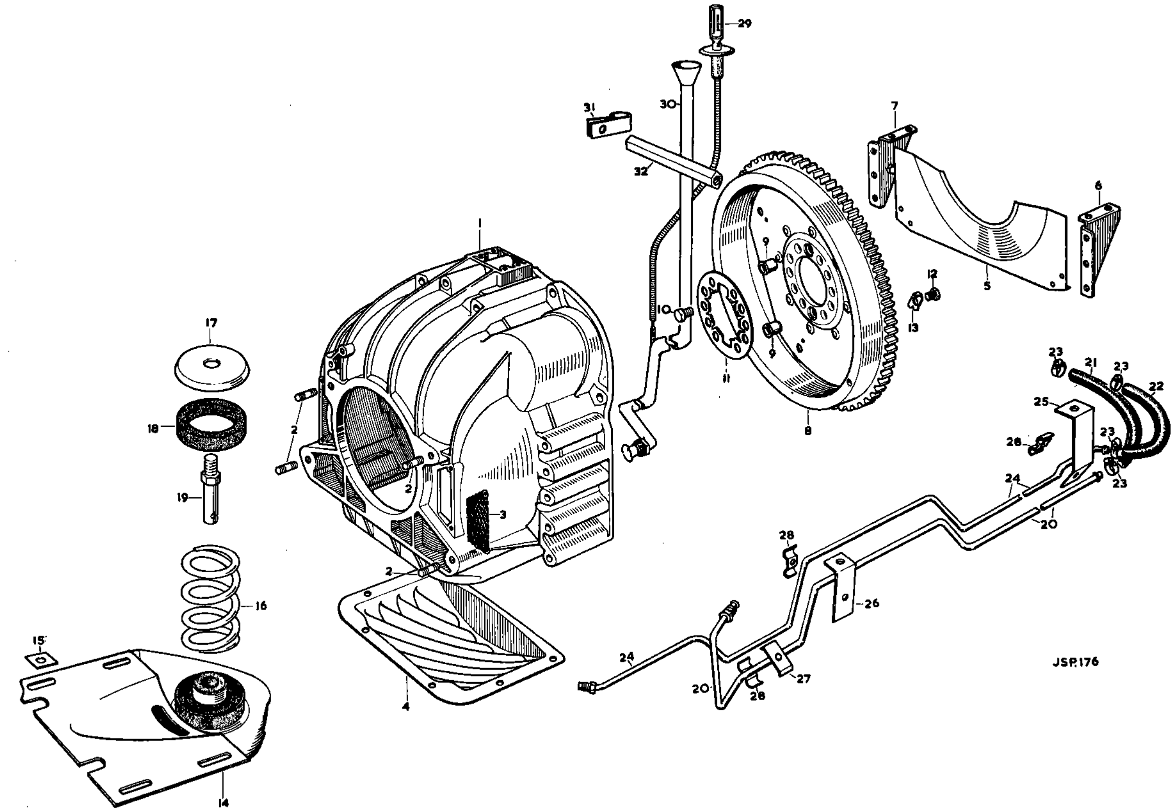


Fig. No. 116 *Exploded view of the converter housing and transmission mounting*

1	Converter housing	**17**	Retainer
2	Stud	**18**	Spring seat
3	Stoneguard	**19**	Pin
4	Bottom cover	**20**	Cooler pipe (outlet)
5	Front cover	**21**	Flexible hose
6	Support bracket, R.H.	**22**	Flexible hose
7	Support bracket, L.H.	**23**	Hose clip
8	Drive plate	**24**	Oil return pipe
9	Dowel	**25**	Bracket
10	Setscrew	**26**	Bracket
11	Locking plate	**27**	Clamp
12	Screw	**28**	Clip
13	Tab washer	**29**	Dipstick
14	Mounting bracket	**30**	Dipstick tube
15	Spacer	**31**	Clip
16	Coil spring	**32**	Support bar

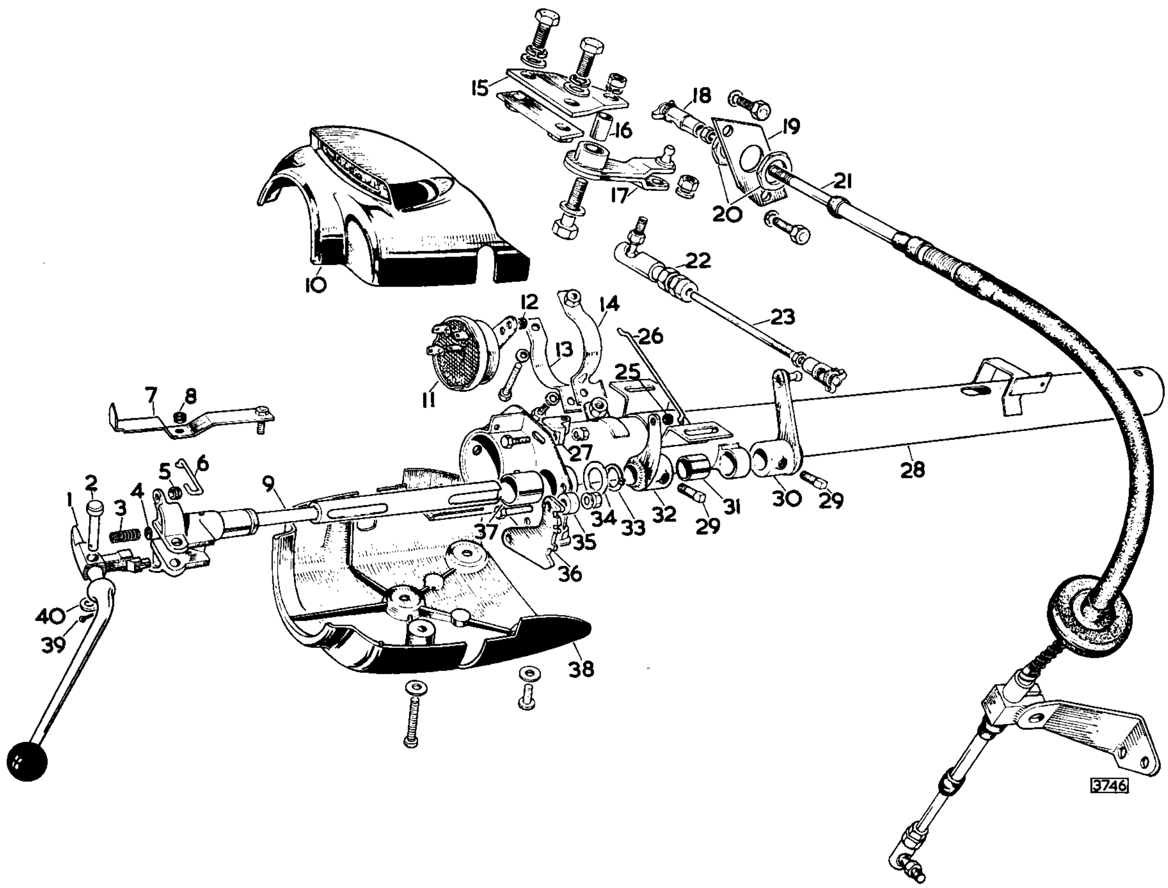


Fig. No. 117 *The automatic transmission controls*

1	Selector lever	**21**	Control cable
2	Pin	**22**	End fitting
3	Spring	**23**	Link
4	Shim	**25**	Grommet
5	Grommet	**26**	Link
6	Link	**27**	Bracket
7	Indicator arm	**28**	Column outer tube
8	Grommet	**29**	Lock screw
9	Housing and shaft assembly	**30**	Lever
10	Upper switch cover	**31**	Bush
11	Inhibitor switch	**32**	Switch operating lever
12	Grommet	**33**	Circlip
13	Lower half clip	**34**	Washer
14	Upper half clip	**35**	Spacer
15	Mounting bracket	**36**	Gate
16	Distance piece	**37**	Bush
17	Transfer lever	**38**	Lower switch cover
18	Ball joint	**39**	Split pin
19	Abutment plate	**40**	Washer
20	Nut		

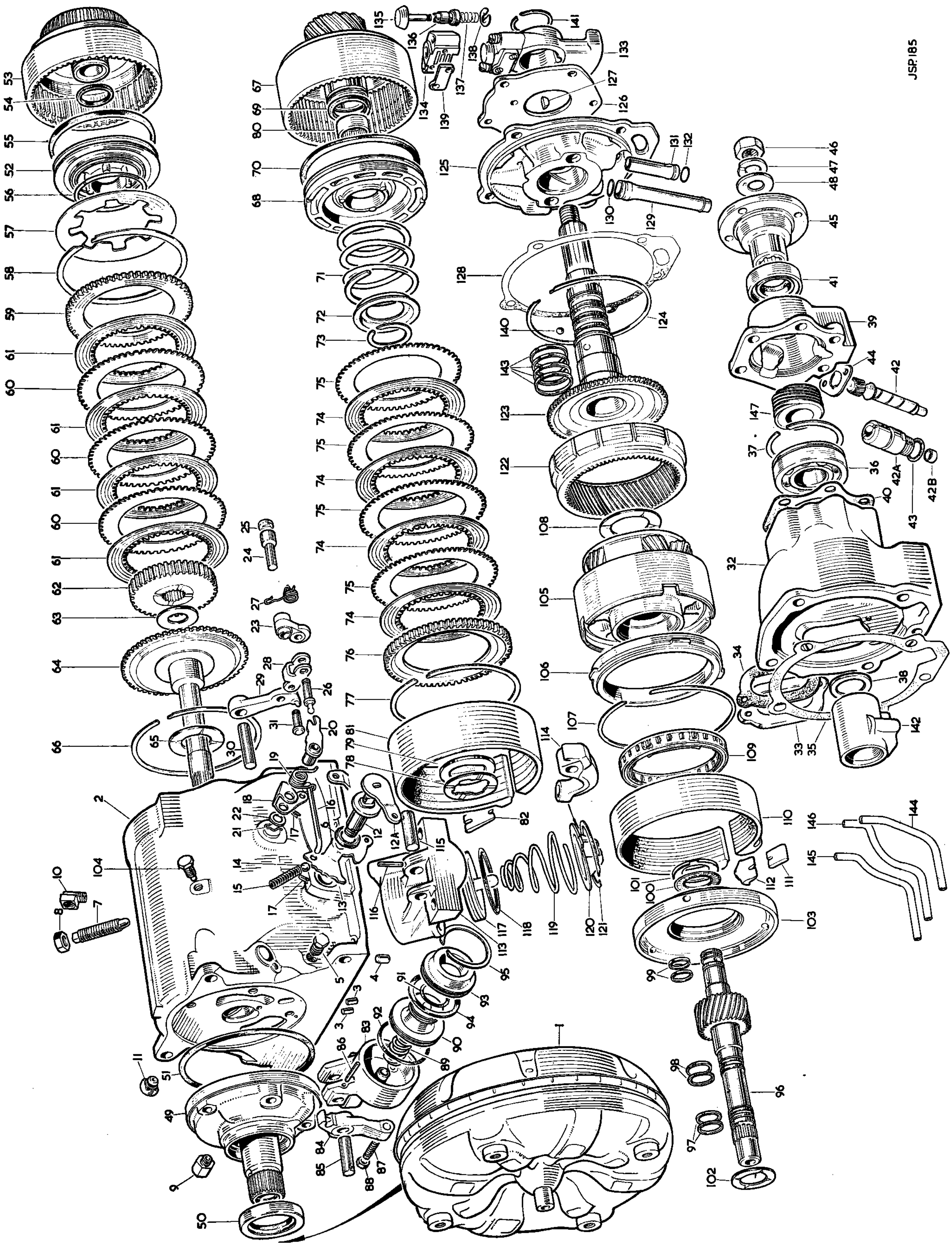


Fig. No. 118 *Exploded view of the Model 8 transmission unit*

1 Converter
2 Transmission case
3 Plug
4 Dowel
5 Plug
6 Oil seal
7 Screw
8 Nut
9 Union
10 Union
11 Breather
12 Manual control
13 Lever
14 Ball
15 Spring
16 Link
17 Clip
18 Torsion lever
19 Spring
20 Forked lever
21 Clip
22 Washer
23 Toggle lever
24 Toggle pin
25 Plug
26 Ball pin
27 Spring
28 Link
29 Pawl
30 Pivot pin
31 Pin
32 Extension case
33 Cover plate
34 Gasket
35 Gasket
36 Bearing
37 Snap ring
38 Spacing washer
39 Speedo driven gear housing
40 Gasket
41 Oil seal
42 Speedo driven gear
43 "O" ring
44 Plate
45 Flange
46 Nut
47 Lockwasher
48 Special washer
49 Front pump
50 Oil seal
51 Sealing ring
52 Piston
53 Cylinder
54 Sealing ring
55 Sealing ring
56 Split ring
57 Spring
58 Snap ring
59 pressure plate
60 Clutch plate
61 Clutch plate
62 Hub
63 Thrust washer
64 Input shaft
65 Thrust washer
66 Snap ring
67 Front drum
68 Piston
69 Sealing ring (inner)
70 Sealing ring (outer)
71 Spring
72 Spring seal
73 Snap ring
74 Clutch plate (friction)
75 Clutch plate (drive)
76 Pressure plate
77 Snap ring
78 Thrust washer
79 Thrust washer
80 Needle bearing
81 Brake band (front drum)
82 Servo strut
83 Front servo body
84 Lever
85 Pivot pin
86 Roll pin
87 Screw
88 Nut
89 Return spring
90 Piston
91 "O" ring (small)
92 "O" ring (large)
93 Piston sleeve
94 Sealing ring
95 Snap ring
96 Forward sun gear
97 Sealing ring (front)
98 Sealing ring (centre)
99 Sealing ring (rear)
100 Thrust bearing
101 Thrust bearing race
102 Thrust washer (bronze)
103 Centre support
104 Screw
105 Planetary gears and drum
106 Outer race
107 Snap ring
108 Thrust washer
109 One-way clutch
110 Brake band (rear drum)
111 Servo strut
112 Anchor strut
113 Body (rear servo)
114 Lever
115 Shaft
116 Roll pin
117 Piston
118 "O" ring
119 Return spring
120 Plate
121 Snap ring
122 Ring gear
123 Main shaft
124 Snap ring
125 Rear pump
126 Plate
127 Key
128 Gasket
129 Oil inlet tube
130 "O" ring
131 Oil outlet tube
132 "O" ring
133 Governor
134 Governor body
135 Governor weight
136 Governor valve
137 Spring
138 Retainer
139 Cover plate
140 Ball
141 Snap ring
142 Oil collector sleeve
143 Piston ring
144 Oil collector tube (front)
145 Oil collector tube (intermediate)
146 Oil collector tube (rear)
147 Speedometer drive gear

PROPELLER SHAFT

SECTION G

INDEX

PROPELLER SHAFT

DESCRIPTION
All models are fitted with a fixed length propeller shaft with a universal joint at each end and a sliding spline, encased in a rubber gaiter, at the front end.

ROUTINE MAINTENANCE
The propeller shaft universal joints and sliding spline are of the "sealed for life" type which do not require periodic maintenance.

In the rare event of wear in the cross holes of either the yokes or flange yokes, the units must be replaced. In the case of wear in the cross holes of the fixed yoke (which is part of the shaft) the shaft must be replaced. Check for excessive movement of the splined shaft in the splined sleeve yoke. If circumferential movement, measured on the outside diameter of the spline exceeds .004" (.1 mm.), replace the complete propeller shaft.

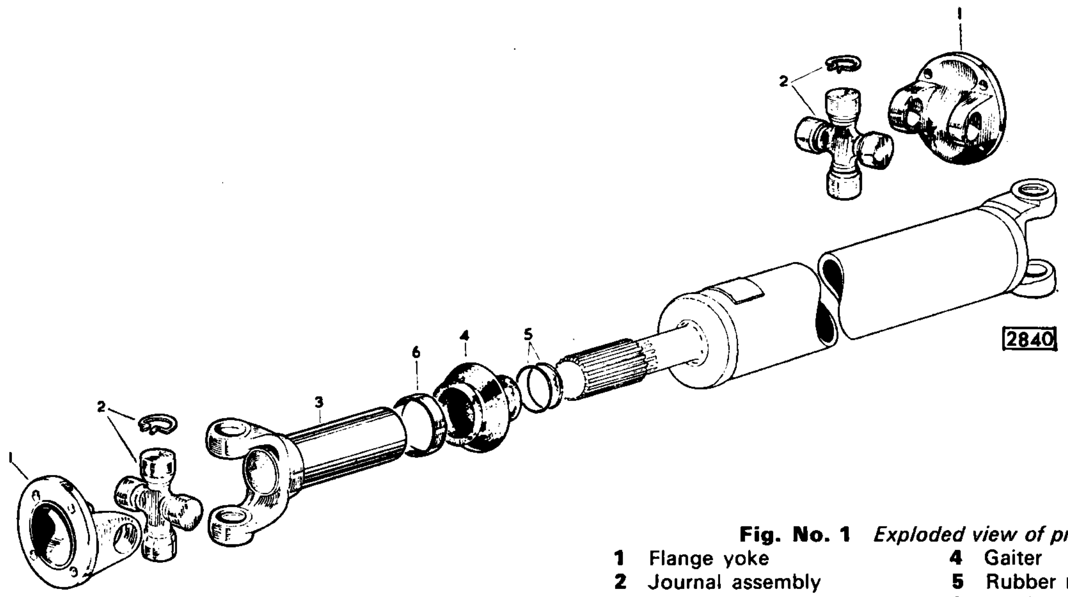


Fig. No. 1 *Exploded view of propeller shaft*

1 Flange yoke
2 Journal assembly
3 Sleeve yoke assembly
4 Gaiter
5 Rubber ring
6 Steel ring

Removal
Remove the rear engine mounting as described on page A.31.
Separate the propeller shaft from the gearbox and the rear axle by removing the four bolts at each attachment flange.
Compress the shaft at the sliding spline and withdraw.

Refitting
Reverse the removal procedure to refit.

UNIVERSAL JOINTS
Check for Wear
The parts most likely to show signs of wear after long usage are the bearings and the journals. Should looseness, load markings or distortion be observed, renew the complete journal assembly.

Dismantling
Release the rubber gaiter retaining ring and remove the sliding joint from the splined shaft. Clean thoroughly.
Remove the snap rings from their grooves in the yokes. If a ring does not snap out of its groove readily, tap the bearing to relieve the pressure against the ring.
Tap the yoke lug as shown in Fig. 2 with a soft nosed hammer and the top bearing will gradually emerge. It can be finally removed by hand.
If great difficulty is encountered in tapping out the bearing, it may be driven out from inside using a small diameter drift. See Fig. 3.
Repeat the operation for the opposite bearing and withdraw the yoke. Rest the two exposed trunnions on a block of wood and tap the yoke with a soft nosed hammer to remove the two remaining bearings.
Wash all parts thoroughly in petrol.

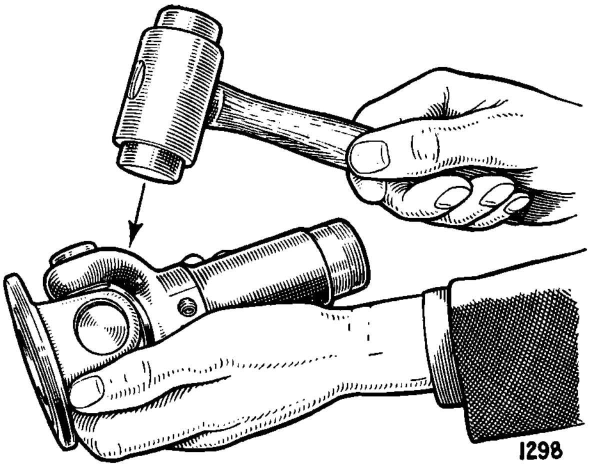


Fig. No. 2 *Tapping the yoke to remove the bearing*

Assembling

Prior to assembling, fill each journal trunnion reservoir with the recommended grease and half fill each bearing with similar lubricant.
Fit the rubber seals to the inner end of each bearing.
Insert the journal into the flange yoke. Fit one of the bearings in the bore of the yoke and, using a drift approximately $\frac{1}{32}$" (.08 mm.) smaller than the bearing diameter, tap the bearing into position. Locate the retaining circlip securely in its groove. Repeat this operation for the remaining three bearings and wipe off any superfluous grease.
Finally recheck that all circlips are seated correctly and that the journals are free in movement.

IMPORTANT

When replacing the sliding joint, it must be refitted with its yoke in line with the fixed yoke at the other end of the shaft. Arrows are stamped on the two parts to facilitate alignment.

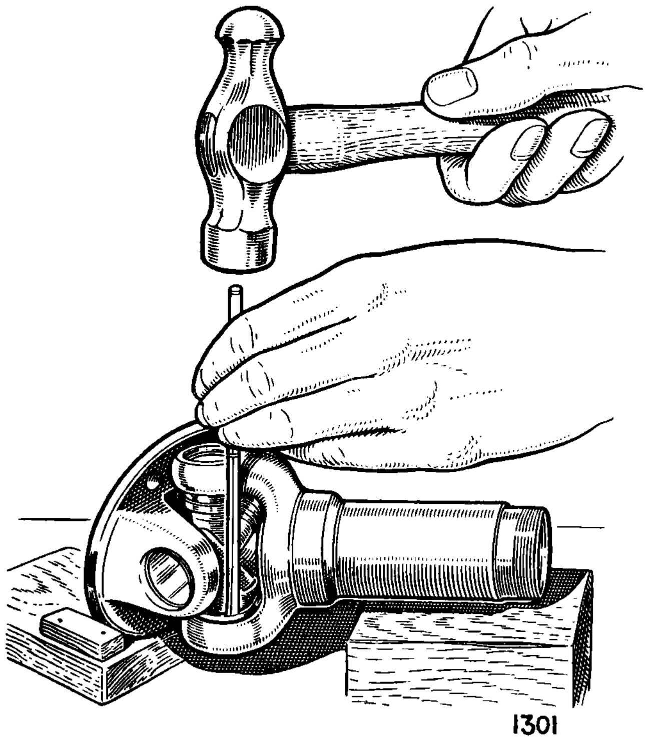


Fig. No. 3 *Tapping out a bearing with a small diameter rod*

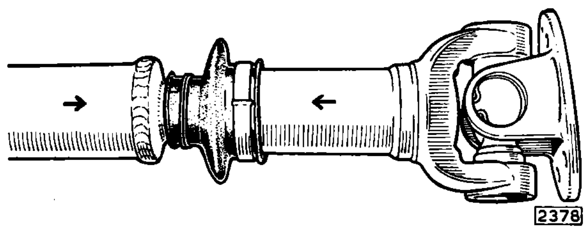


Fig. No. 4 *Showing the arrows on the sliding joint*

FINAL DRIVE UNIT

SECTION H

INDEX

FINAL DRIVE UNIT

DESCRIPTION

The final drive unit is the Salisbury 4.HU. Mounted independently from the hubs, it is fitted with a Thornton "Powr-Lok" differential unit. Short drive shafts with universal joints at each end are coupled to the final drive output shafts. These output shafts also provide mounting points for the discs of the inboard rear brakes. The final drive gear ratio is stamped on a tag attached to the assembly by one of the rear cover screws. The final drive serial number is stamped on the underside of the gear carrier housing.

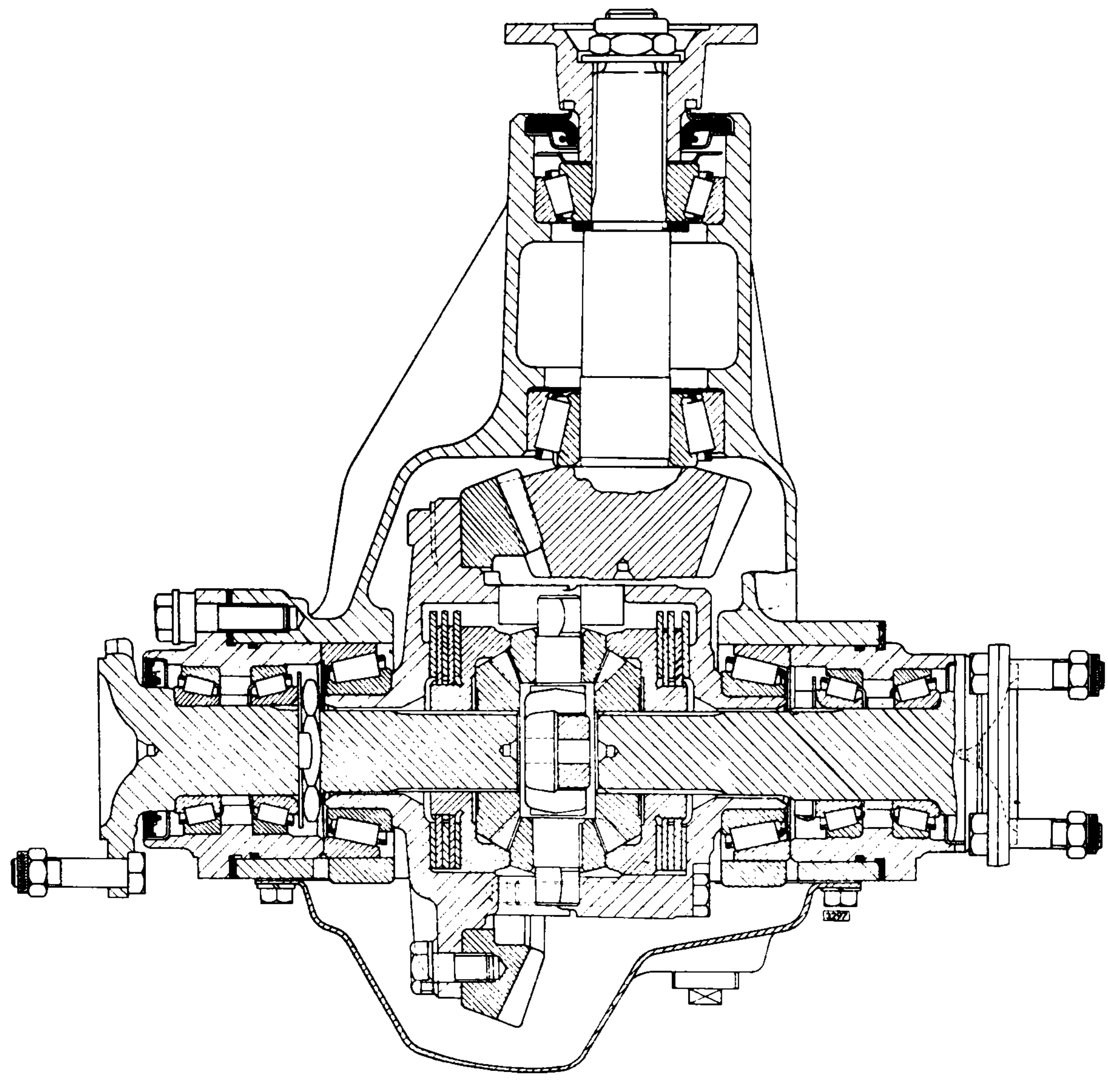


Fig. No. 1 *Sectioned view of the final drive unit*

THE THORNTON "POWR-LOK" DIFFERENTIAL

DESCRIPTION

A conventional differential will always drive the wheel which is easier to turn as the torque is divided equally between both driving wheels. A limited slip differential directs greater driving force to the wheel with better traction thus eliminating the major disadvantage of a conventional differential.

The limited slip differential has two pinion shafts with two bevel pinion mate gears to each shaft.

When the driving force is applied to the differential case, the pinion shaft, pinion mates and differential side gears splined to the driving shafts, rotate as a unit.

The pinion shafts are mounted at right angles to each other but do not make contact at their intersection. Double ramps with flat surfaces at each end of the pinion shafts mate with similar shafts in the differential case. Clearance in the differential case permits slight peripheral movement at the ends of the pinion shafts. The driving forces move the cross pins "B", Fig. 2, up the ramp of the cam surfaces, "C", applying load to the clutch rings, "D", and restricting turning of the differential through the friction clutches, "E". This provides a torque ratio between the axle shafts which is based on the amount of friction in the differential and the amount of load that is being applied to the differential.

When turning a corner, this process is, in effect, reversed. The differential gears become a planetary set with the gear on the inside of the curve becoming the fixed gear of the planetary.

The outer gear of the planetary over-runs as the outside wheel on the curve has a greater distance to travel. With the outer gear over-running and the inner gear fixed, the pinion mates "A", Fig. 3, are caused to rotate but, inasmuch as they are restricted by the fixed gear, they must first move the pinion mate shafts "B" back down the cam surfaces "C" relieving the thrust loads on the clutch plates "E". Thus when turning a corner, for all practical purposes, the limited slip differential is similar to the conventional type, and the wheels are free to rotate at different speeds.

On straight ahead driving, the clutches are engaged and thus prevent momentary spinning when poor traction is encountered. In corners, the load is relieved from the clutch plates so that wear is reduced to a minimum.

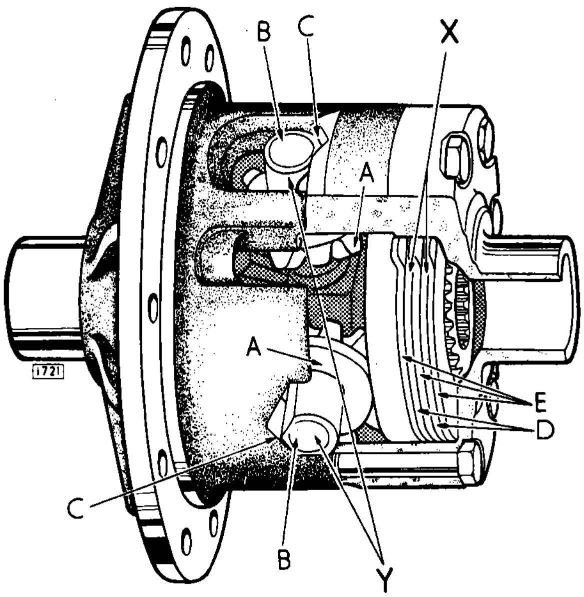


Fig. No. 2 *The operation of the limited slip differential (straight ahead driving)*

A Pinion mates
B Cross pins
C Cam surfaces
D Clutch rings
E Friction clutches
X Clutch rings engaged (both sides)
Y Pins move up ramps under load

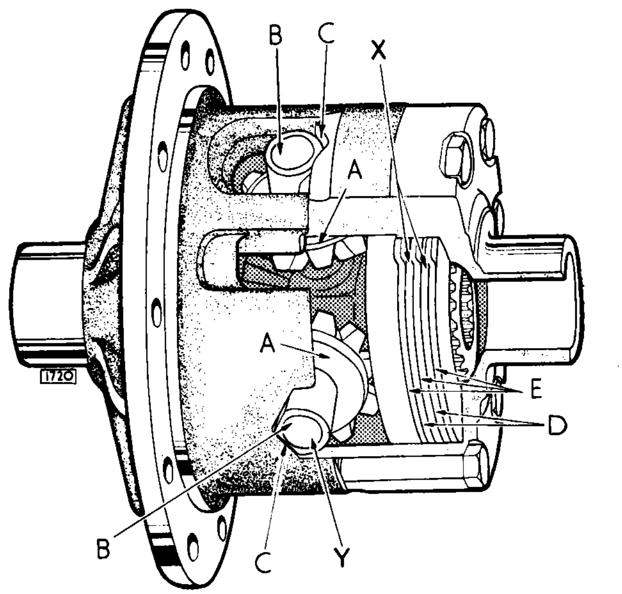


Fig. No. 3 *The operation of the limited slip differential (cornering) X—Engaging force released*

POWER FLOW IN FORWARD DRIVING

Under normal starting and operating conditions the torque or power flow in both the limited slip and conventional type differential is transmitted equally to each axle shaft and wheel. However, when sudden patches of ice, loose gravel or oil are encountered, the limited slip differential will not permit the wheel with the lesser traction to spin, gain momentum and swerve the car when a dry surface is regained.

POWER FLOW IN TURNS

In turning, the limited slip differential gives normal differential action and permits the outer wheel to turn faster than the inner wheel. At the same time the differential applies the major driving force to the inside rear wheel, improving stability and cornering.

ACTION ON ROUGH ROADS

Bumps do not adversely affect wheel action when wheels are controlled by the limited slip differential. The free wheel does not spin and gain momentum. There is no sudden wheel stoppage to cause car swerve or tyre scuffing, and wheel hop is reduced.

DATA

Output shaft end float	0.001"—0.003" (0.02—0.07 mm.)
Differential bearing preload	0.006"—0.010" (0.15—0.25 mm.) total shim allowance
Pinion bearing preload	8—12 lb. in. (0.09—0.14 kgm.)
Backlash	As etched on drive gear 0.004" (0.10 mm.) minimum
Tightening torque	
—Drive gear bolts	70—80 lb. ft. (9.7—11.1 kgm.)
—Differential bearing cap bolts	60—65 lb. ft. (8.3—9.0 kgm.)
—Pinion nut	120—130 lb. ft. (16.6—18.0 kgm.)
Thornton "Powr-Lok" bolts	40—45 lb. ft. (5.5—6.2 kgm.)

FINAL DRIVE RATIOS

Standard model	3.31 : 1
Overdrive model	3.77 : 1
Automatic transmission model	3.31 : 1

Reconditioning Scheme (Great Britain only)

Although full servicing instructions for the final drive unit are given in the following pages, it is recommended that, wherever possible, advantage is taken of the factory reconditioning scheme, particularly in view of the intricate adjustments and the number of special tools required.

Reconditioned final drive units are supplied on an exchange basis. They comprise a final drive unit less half shafts, hubs and brake details: final drive units for exchange should, therefore, be returned in this condition.

New final drive units, or, units which have been stripped down for overhaul should be filled initially with special oil Part No. 9991.

This oil is obtainable from the Works Spares Division in 1 quart tins (1.14 litres).
The oil change period remains as stated under "Routine Maintenance".

In those countries to which it is not practicable to send quantities of this oil, Distributors and Dealers should use a reputable limited slip differential oil.

RECOMMENDED LUBRICANTS

Component	Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent Caltex/Texaco
Final Drive Unit	Mobilube GX 90	Castrol Hypoy	Spirax 90 EP	Esso Gear Oil GP90/140	Gear Oil SAE 90EP	Hypoid 90	Multigear Lubricant EP 90

Capacities

Imperial	U.S.	Litres
$2\frac{3}{4}$ pints	$3\frac{1}{4}$ pints	1.5

SPECIAL SERVICE TOOLS

Multi-purpose hand press (SL.14*).
Pinion bearing inner race remover (SL.14-1*).
Differential side bearing cone remover (SL.14-3*).
Rear hub outer bearing inner race remover (J.16B*).
Hub remover (JD.IC*).
Multi-purpose handle (550*).
Differential side bearing cone replacer (SL.550-1*).
Pinion outer bearing cup replacer (SL.550-4*).
Pinion inner bearing cup replacer (SL.550-5*).
Pinion cone setting gauge (SL.3*).
Pinion oil seal replacing collar (SL.4*).
* Churchill Tool Number.

ROUTINE MAINTENANCE

EVERY 3,000 MILES (5.000 KM.)

Checking Final Drive Oil Level

Check the level of the oil in the final drive unit with the car standing on level ground.

A combined filler and level plug is fitted in the rear of the casing and is accessible from underneath the car. Clean off any dirt from around the plug before removing. The oil level should be to the bottom of the filler and level plug hole. USE ONLY HYPOID OIL OF THE CORRECT GRADE.

Since different brands of oil do not mix satisfactorily, draining and refilling is preferable to replenishing when the brand of oil in the final drive unit is unknown.

EVERY 12,000 MILES (20,000 KM.)

Changing the Final Drive Oil

Draining of the final drive unit should be carried out at the end of a run when the oil is hot and will, therefore, flow more freely. The drain plug is situated in the base of the differential casing.

Refill with the correct grade of oil.

FINAL DRIVE UNIT OIL CHANGING

Do NOT drain and refill the final drive unit at the first 1,000 miles (1,600 km.) free service. Change the oil after the car has completed 6,000 miles (10,000 km.) and thereafter at the recommended intervals.

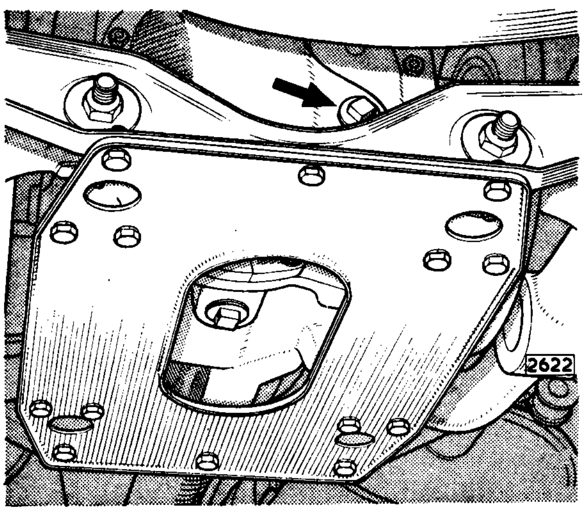


Fig. No. 4 *Final drive unit level and filler plug*

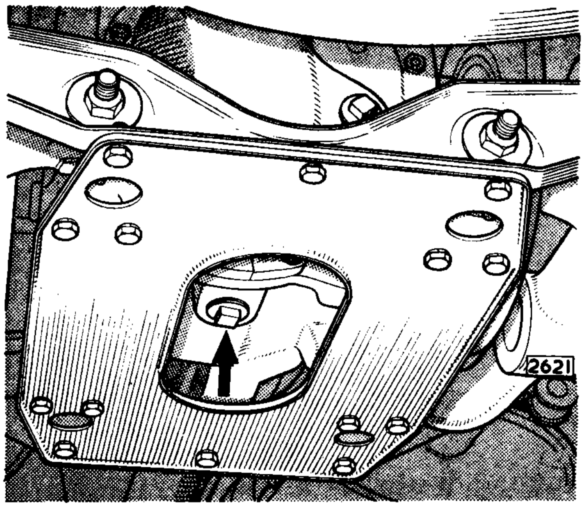


Fig. No. 5 *Final drive unit drain plug*

REMOVAL

Note: The following removal and refitting instructions are detailed assuming that the rear suspension has been removed from the car as described on page K.4.

Invert the suspension assembly on the bench and remove the 14 bolts securing the tie plate. Disconnect the four hydraulic dampers and road springs. Remove the four self-locking nuts securing the half-shaft inner universal joint to the brake disc and final drive output flange. Withdraw the half-shaft from the bolts noting the number of camber shims.

Remove one self-locking nut from the inner wishbone fulcrum shaft and drift out the shaft. Withdraw the hub, half-shaft, wishbone and radius arm assembly. Repeat the operation for the opposite side.

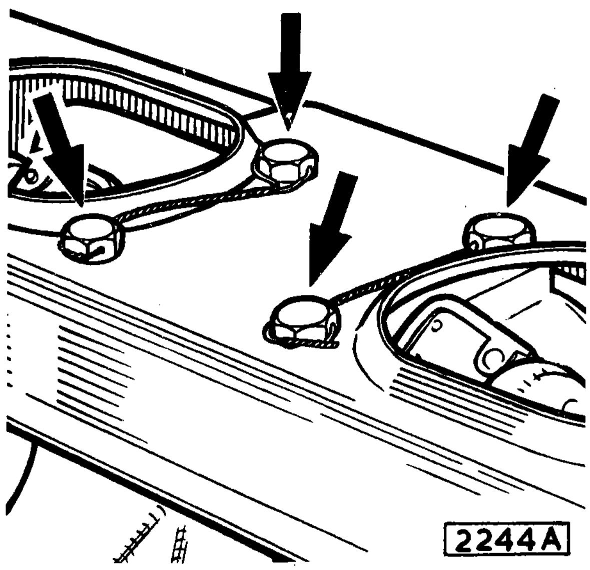


Fig. No. 6 *Showing final drive unit top mounting bolts*

Disconnect the hydraulic feed pipes at the brake calipers.
Turn the assembly over and remove the locking wire from the four differential carrier bolts. Unscrew the bolts and remove the cross beam from the carrier by tilting forward over the nose of the pinion.

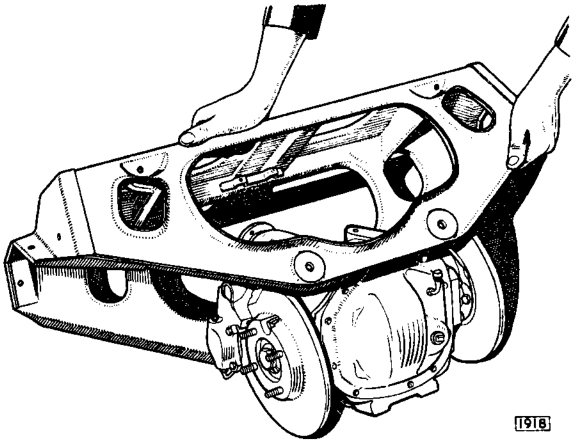


Fig. No. 7 *Removing the cross beam from the final drive unit*

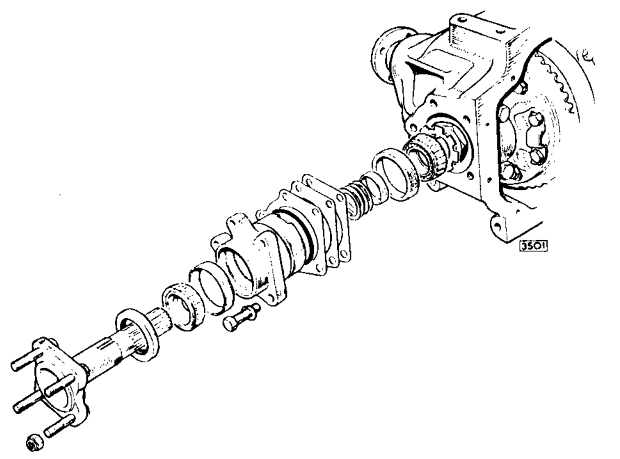


Fig. No. 8 *The drive shaft components*

REFITTING

Refitting is the reverse of the removal procedure. The inner wishbone fulcrum shaft self-locking nut must be tightened to a torque of 55 lb. ft. (7.6 kgm.). Tighten the four differential carrier mounting bolts to a torque of 75 lb. ft. (10.4 kgm.).
Owing to heat dissipation of the rear brakes IT IS MOST IMPORTANT that the locknuts fitted to the output shaft flange studs are of metal and not the nylon self-locking type.

DISMANTLING

The Drive Shafts

Remove the brake calipers and brake discs as detailed on pages L.13 and L.15.
Unscrew the five bolts securing each drive shaft bearing housing, remove the brake caliper adaptor plates, and withdraw the drive shaft assemblies.
Note the number of shims fitted between the flange of the bearing housing and differential case.
Knock back the tab washer and remove the nut from the drive shaft. Press the drive shaft through the bearing housing. Collect the inner bearing inner race, spacing collar, and bearing shims. The outer bearing inner race and oil seal will remain on the drive shaft. If the outer bearing is to be replaced, the oil seal must also be renewed, as withdrawing the bearing from the shaft will damage the seal.
The bearing outer races may be driven from the housing.

The Differential Unit

Drain the lubricant from the gear carrier and remove the rear cover.

Withdraw the four bolts securing the two differential bearing caps and remove the caps.

Fit the stretching fixture (Churchill Tool No. SL 1). The fixture should be adjusted by means of the turn-buckle until it is hand tight; then spread the case by using a spanner. DO NOT OVER-SPREAD OR THE CASING WILL BE DAMAGED BEYOND REPAIR. The correct spread does not exceed half a turn on the turn-buckle and this figure should not be exceeded even if the differential is still difficult to remove.

Prise out the differential assembly with two levers, one on each side of the differential case opening. Use suitable packing between the levers and the gear carrier.

If no stretching fixture is available, the differential unit may be removed with two levers as described above, but care must be exercised not to tilt the assembly which may only result in it becoming wedged in the case.

Using Churchill Tool No. SL 14 with adaptor, Tool No. SL 14-3, withdraw the differential bearings from each half of the differential case.

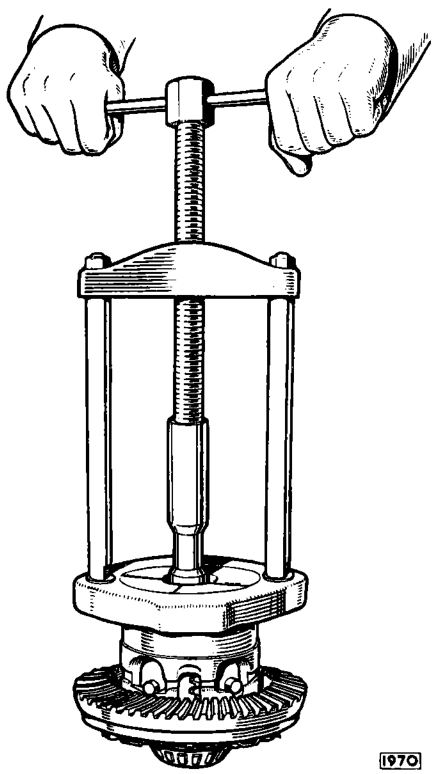
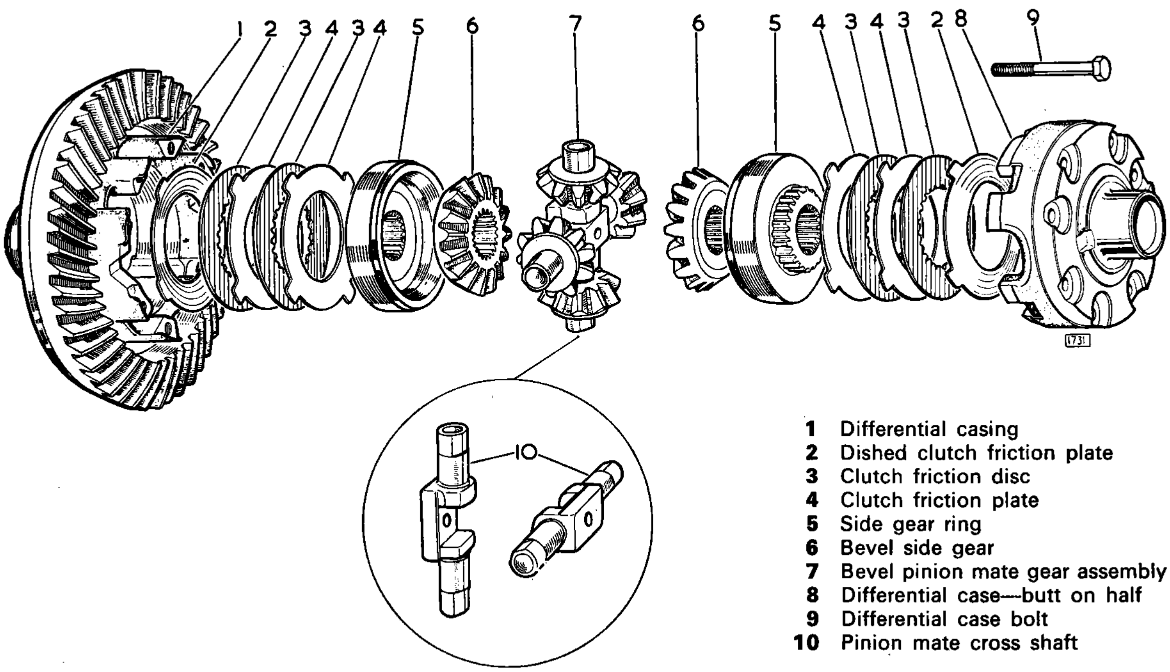


Fig. No. 9 *Withdrawing a differential bearing using Churchill Tool No. SL 14 with adaptor No. SL 14-3*

Knock back the locking tabs from the crown wheel securing setscrews. Remove the setscrews and tap the crown wheel from the differential case with a rawhide mallet.
In the absence of any mating or aligning marks, scribe a line across the two half casings to facilitate assembly.
Remove the eight bolts (9, Fig. 10) securing the two halves of the differential casing.
Split the casing and remove the clutch discs (3) and plates (2 and 4) from one side.
Remove the differential side gear ring (5).
Remove the pinion side gear (6) and the pinion mate cross shafts complete with the pinion mate gears (7).
Separate the cross shafts (10).
Remove the remaining side gear and the side gear ring.
Extract the remaining clutch disc and plates.

The Pinion

Remove the pinion nut and washer. Withdraw the universal joint companion flange with a suitable puller. PRESS the pinion out of the outer bearing. It is important that the pinion should be pressed out, not driven out, to prevent damage to the outer bearing. The pinion having been pressed from its outer bearing may now be removed from the differential casing.
Note: Keep all shims intact.



1 Differential casing
2 Dished clutch friction plate
3 Clutch friction disc
4 Clutch friction plate
5 Side gear ring
6 Bevel side gear
7 Bevel pinion mate gear assembly
8 Differential case—butt on half
9 Differential case bolt
10 Pinion mate cross shaft

Fig. No. 10 *Exploded view of the "Powr-Lok" differential*

Remove the pinion oil seal together with the oil slinger and outer bearing race. Examine the outer bearing for wear and if replacement is required, extract the bearing outer race. If the correct tool is not available and the bearing cup is to be scrapped it is possible to drive out the cup, the shoulder locating the bearing being recessed to facilitate this operation. Remove the pinion inner bearing outer race if the bearing requires replacement or adjustment of the pinion setting is to be undertaken. Take care of the shims fitted between the bearing cup and the housing abutment face. If the inner bearing is to be replaced it may be driven out but the correct service tool should be used when the bearing is removed in order to carry out pinion setting adjustment.

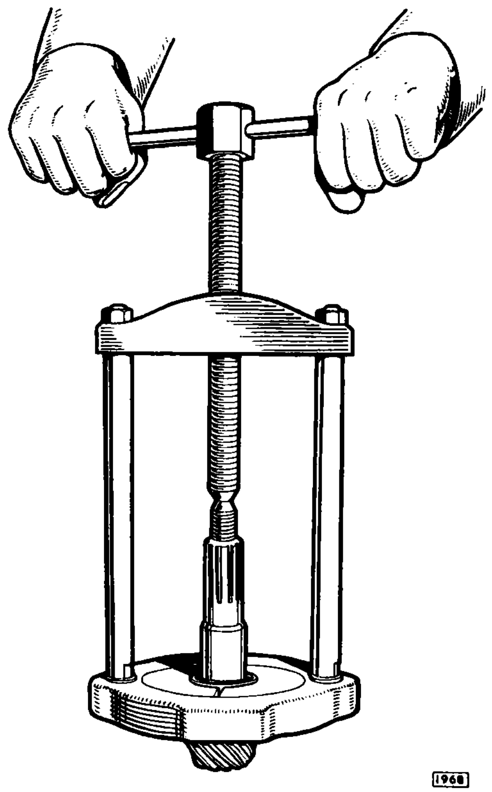


Fig. No. 11 *Withdrawing the pinion inner bearing using Churchill Tool No SL 14 with adaptor No. SL 14-3*

ASSEMBLING

The Pinion

Refit the pinion outer bearing outer race using Tool 550 with the adaptor, SL 550-4 as shown in Fig. 12. Refit the pinion inner bearing outer race with the original shims in position between the outer race and its abutment shoulder.

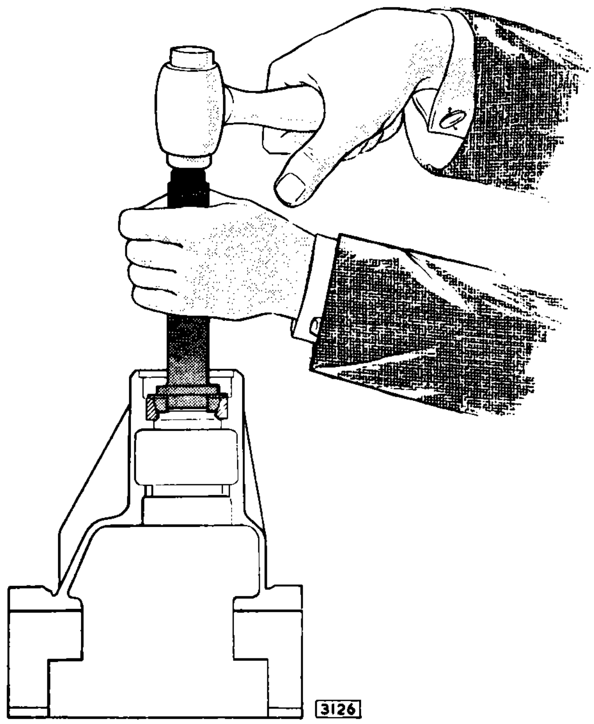


Fig. No. 12 *Replacing a pinion outer bearing outer race using Churchill Tool No. 550 with adaptor No. SL 550-4*

Press the inner bearing inner race onto the pinion using a hand press and a length of tube. Ensure that the tube contacts only the inner portion of the race and not the roller retainer. Place the pinion in position, turn the gear carrier over and support the pinion with a suitable block of wood. Fit the original outer bearing shims to the pinion shank so that they seat on the shoulder of the shank.

Fit the outer bearing inner race, companion flange, washer and nut only, omitting the oil slinger and oil seal assembly and tighten the nut.

It will now be necessary to check the pinion cone setting as follows:—

Pinion Cone Setting

The correct pinion cone setting is marked on the ground end of the pinion as shown on the inset in Fig. 13. The serial number of the matched crown wheel and pinion assembly is marked above the cone setting, it is most important that similarly marked crown wheels and pinions are kept in their matched sets as each pair is lapped together at the factory. The letters on the left and right of the pinion should be disregarded.

Hold the gear carrier so that the ground end of the pinion is uppermost. Take the pinion cone setting gauge (Tool No. SL 3) and remove the magnetic keeper from the gauge post. Using the setting block on a surface plate as shown in Fig. 13 set the dial test gauge to zero on the 4 HA setting.

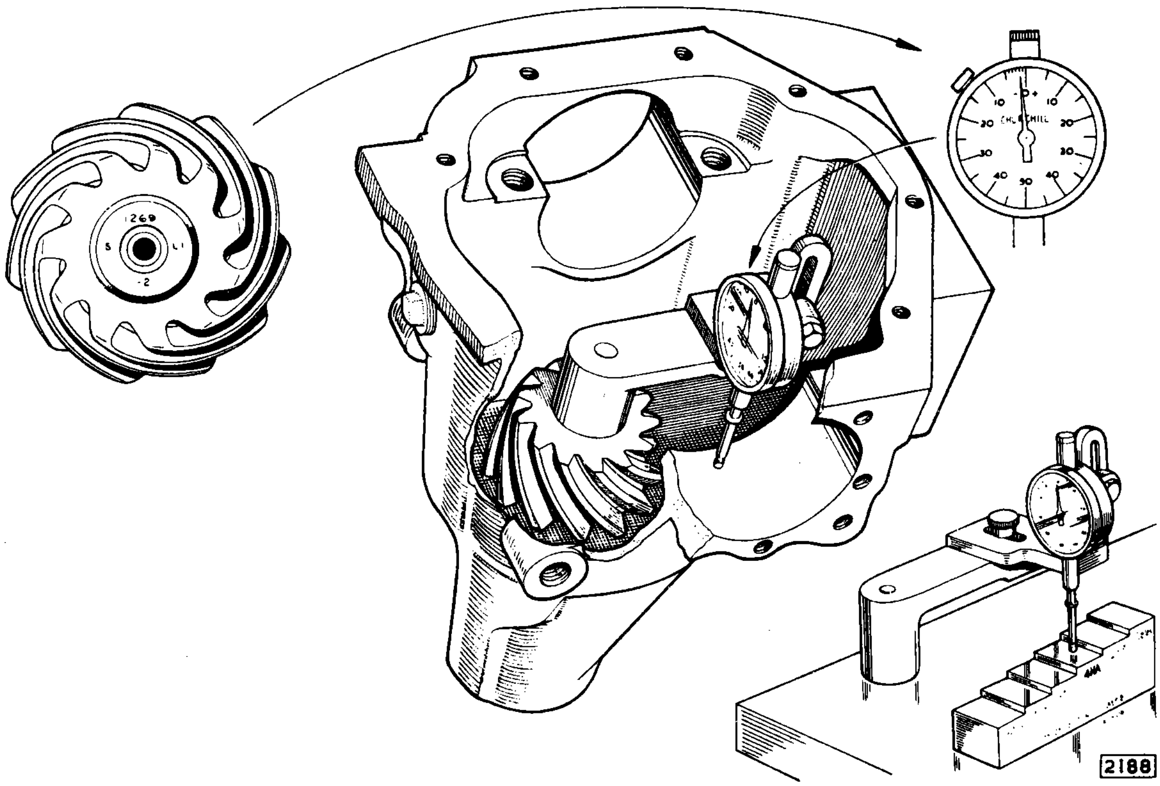


Fig. No. 13 *Checking the pinion cone setting using Churchill Tool No. SL 3. Note the pinion setting marks located on the end of the pinion.*

Place the dial gauge post on the end of the pinion so that the plunger of the dial gauge registers in the differential bearing bore. Check the pinion cone setting by moving the gauge plunger in the differential bore; the actual reading being the minimum obtained. If the cone setting is correct, the reading on the dial gauge will be the same as the figure marked on the pinion end. For example, if the setting marked on the pinion is —2 then the reading on the dial gauge must also be —2.
If the pinion setting is incorrect, it will be necessary to remove the pinion assembly and remove the pinion inner bearing outer race. Withdraw the shim pack and add or remove shims as necessary. Adding shims to the pack will decrease the gauge reading, that is, increase the number on the gauge of negative (—) and decrease the number if positive (+); removing shims will increase the reading; shims are available in 0.003", 0.005" and 0.010" (0.076, 0.127 and 0.254 mm.) thicknesses.
Example, assume the required pinion cone setting distance (marked on the pinion end) to be —2, if on checking with the dial gauge, the reading is —7 it will be necessary to remove a 0.005" (0.127 mm.) thick shim in order to reduce the gauge reading to —2.
Replace the inner bearing outer race, fit the pinion and re-check the cone setting.
When the correct pinion setting has been obtained, check the pinion bearing preload. There should be no end play in the pinion and a slight resistance to turning should be felt. The correct pinion bearing preload is given as a torque figure under "Data" on page H.5.
Inadequate preload will result in pinion deflection under load whilst excessive preload will lead to pitting and failure of the bearings.
To adjust the preload, add or remove shims at the shim

pack between the outer bearing inner race and the shoulder on the pinion shank. Removing shims will increase the preload and adding shims will decrease the preload; shims are available in thicknesses of 0.003", 0.005", 0.010" and 0.030" (0.76, 0.127, 0.254 and 0.762 mm.). It is most important that the shims behind the inner bearing outer race which control the pinion cone setting are not disturbed when setting the preload.

The Differential Unit

Fit one Belleville clutch plate (i.e. dished plate) so that the convex side is against the differential casing (flange half).

Refit the clutch plates and discs alternately into the flange of the casing (see Fig. 10).

Fit the side gear ring so that the gear teeth mesh with the serrations in the two clutch discs.

Place one of the bevel side gears into the recess of the side gear ring so the splines in both align.

Refit the pinion mate cross shafts complete with pinion mate gears, ensuring that the ramps on the shafts coincide with the mating ramps in the differential case.

Assemble the remaining bevel side gear and side gear ring so the splines in both align.

Refit the remaining clutch plates and discs.

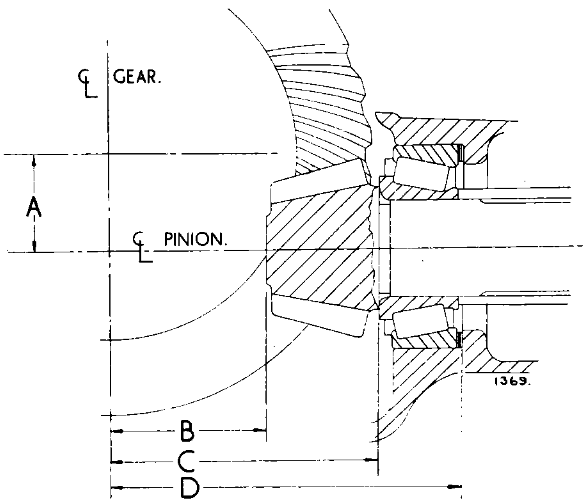


Fig. No. 14 *Pinion setting distances*

A Pinion drop 1.5" (38.1 mm.)
B Zero cone setting 2.625" (66.67 mm.)
C Mounting distance 4.312" (108.52mm.)
D Centre line to bearing house 5.495" (139.57 mm.) to 5.505" (139.83 mm.)

Offer up the butt-on half of the differential case to the flange half in accordance with the identification marks and position of the tongues of the clutch friction plates so they align with the grooves in the differential case. Assemble the butt-on half to the flange half of the differential case with eight bolts but do not tighten at this juncture.

Check the alignment of the splines in the side gear rings and side gears by inserting two drive shafts, then tighten the eight bolts to a torque of 40-45 lb. ft. (5.5 to 6.2 kgm.) while the drive shafts are in position. Failure to observe this instruction will render it difficult or impossible to enter the drive shafts after the eight bolts have been tightened.

Refit the crown wheel to the differential case, having first ensured that the locating faces are not damaged, by aligning the bolt holes on the crown wheel and case and tapping the crown wheel into position with a rawhide mallet. Fit the securing setscrews using NEW locking straps and tighten to a torque of 70 to 80 lb. ft. (9.7 to 11.1 kgm.). Knock up the tabs around the heads of the setscrews.

Using Churchill Tool No. 550 with adaptor, Tool No. SL 550-1, press on the differential bearings to each half of the differential case.

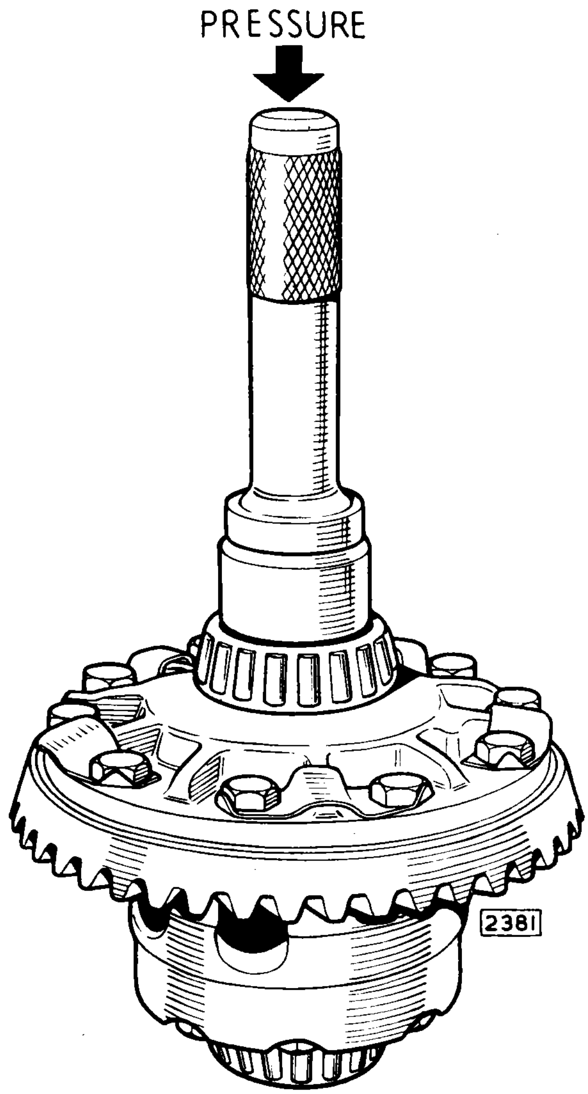


Fig. No. 15 *Replacing the differential bearing using Churchill Tool No. 550 with adaptor No. SL 550-1.*

With the pinion (less the oil seal and oil thrower) installed in the differential carrier, fit the differential assembly. Fit the differential bearing caps noting that the numerals marked on the bearings caps and the end cover face correspond as shown in Fig. 16. Fit the cap bolts and tighten to a torque of 60 to 65 lb. ft. (8.3 to 9.0 kgm.).

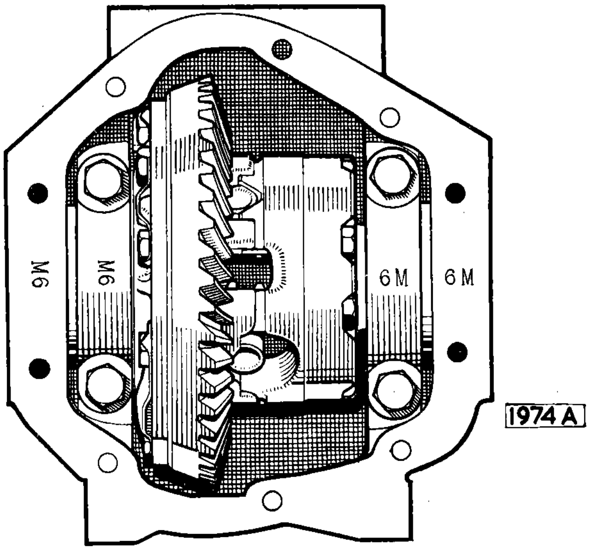


Fig. No. 16 *Differential bearing cap markings*

Mount a dial indicator on the gear carrier with the plunger of the gauge against the back face of the drive gear as shown in Fig. 17. Turn the crownwheel by hand and check the run-out on the back face which should not exceed 0.005" (0.13 mm.). If the run-out exceeds this figure, the differential assembly should be removed, the crown wheel withdrawn from the assembly and the locating surfaces on the crown wheel and differential casing cleaned and the burrs removed.

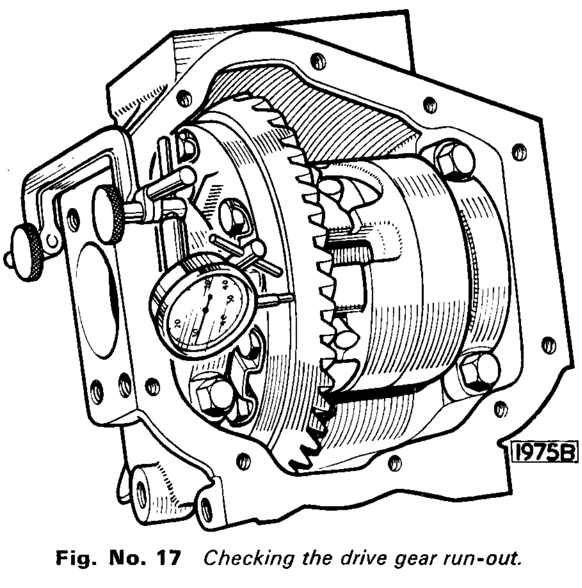


Fig. No. 17 *Checking the drive gear run-out.*

The Drive Shafts

Press the bearing outer races into the housing ensuring that they are fully home in their recesses. The races must be fitted so that the bearings are opposed.
Fit the inner races in the housing with shims and the spacing collar interposed between them. Fit the drive shaft, tab washer and nut. Tighten the nut securely. Check the end-float with a dial gauge. This should be .001"—.003" (.025—.076 mm.) and is adjusted by adding shims to increase or removing shims to reduce end-float. When correct end-float has been obtained, remove the nut and tab washer; withdraw the drive shaft ensuring that the correct number of shims is retained. Withdraw the outer bearing inner race from the drive shaft and place in position in the housing. Press a new oil seal into the housing; insert the drive shaft. Fit the shims, spacing collar, inner bearing inner race, tab washer and nut. Lock the nut with the tab washer ensuring that the tabs lie as flat as possible against the nut.
Renew the "O" ring on the bearing housing. Install the drive shafts without any shims between the shaft bearing housing and the differential carrier.

DRIVE GEAR MESH ADJUSTMENT AND DIFFERENTIAL BEARING PRELOAD

Fit three bolts evenly spaced around each bearing housing. Set up a dial indicator on the differential carrier with the plunger of the gauge against one of the crown wheel teeth as nearly in line with the direction of tooth travel as possible (as shown in Fig. 18). Move the crown wheel by hand to check the backlash; the correct backlash will be etched on the sloping face of the crown wheel. If the backlash reading is incorrect, move the crown wheel towards or away from the pinion as necessary until the correct backlash reading is obtained. To move the crown wheel in the required direction, it will be necessary to tighten the bolts in the drive shaft housing on one side of the differential carrier and slacken the bolts on the other side.

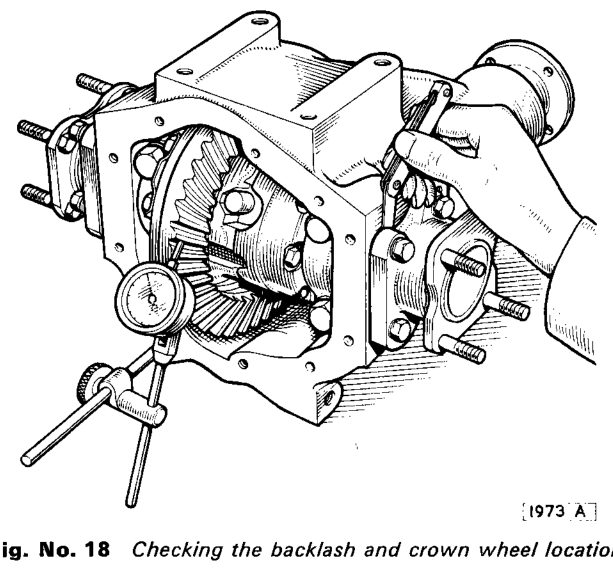


Fig. No. 18 *Checking the backlash and crown wheel location*

When the correct backlash has been obtained, measure the gap between the drive shaft bearing housing and the differential carrier on each side using a set of feeler gauges. Note the gap having first checked around the circumference of the housing to ensure that the gap is even, make up a shim pack to fill the gap on each side but subtract 0.003" (0.076 mm.) from the pack to give the correct preload on the differential bearings. The shims are available in thicknesses of 0.003", 0.005", 0.010" and 0.030" (0.076, 0.127, 0.254 and 0.762 mm.).
For example: Assume that the backlash etched on the crown wheel is 0.007" (0.178 mm.) when this figure has been obtained as described previously, the gap on one side is 0.054" (1.37 mm.) and 0.046" (1.17 mm.) on the other, then the amount of shims to be fitted will be 0.054" — 0.003", that is 0.051" (1.30 mm.) and .046" — 0.003", that is, 0.043" (1.09 mm.) to the other side.
Finally, fit the drive shafts with the shims in position to the differential carrier, fit the five bolts to each housing and tighten up.

Checking Tooth Contact
Paint eight or ten teeth of the crown wheel sparingly with engineers blue or marking raddle. Move the pinion to mesh with the painted teeth until a good impression of tooth contact is obtained.
Fig. 19 shows the ideal tooth bearing impression on the drive and coast sides of the gear teeth. The area of contact is evenly distributed over the working depth of the tooth profile and is located nearer to the toe (small end) than the heel (large end). This type of contact permits the tooth bearing to spread towards the heel under operating conditions when allowance must be made for deflection.

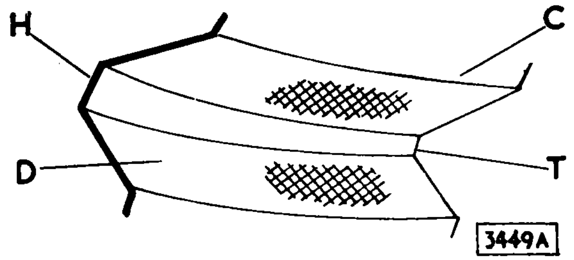


Fig. No. 19 *Ideal contact*

In Fig. 20 it will be observed that the tooth contact is heavy on the crown wheel face or addendum, that is, high tooth contact. To rectify this condition, move the pinion deeper into mesh, that is, reduce the pinion inner race setting distance, by adding shims between the pinion inner bearing outer race and the housing and adding the same thickness of preload shims between the pinion bearing spacer, or the shoulder of the pinion shank and outer bearing inner race. This correction has a tendency to move the tooth bearing towards the toe on drive and heel on coast, and it may therefore be necessary after making this change to adjust the crown wheel as described in the paragraphs on Toe Contact and Heel Contact.

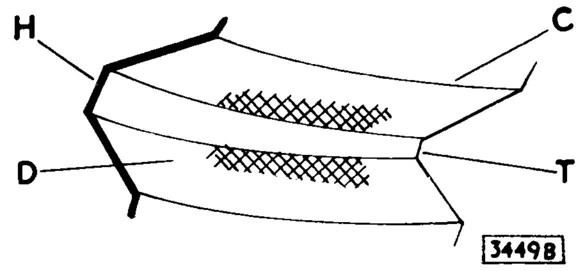


Fig. No. 20 *High tooth contact*

In Fig. 21 it will be observed that the tooth contact is heavy on the crown wheel flank or dedendum, that is, low tooth contact. To correct, move the pinion out of mesh, that is increase the pinion inner race setting distance by removing shims from between the pinion inner bearing outer race and housing, and removing the same thickness of preload shims from between the pinion bearing spacer or the shoulder on the pinion shank and the outer bearing inner race. The correction has a tendency to move the tooth bearing towards the heel on drive and toe on coast, and it may therefore be necessary after making this change to adjust the crown wheel.

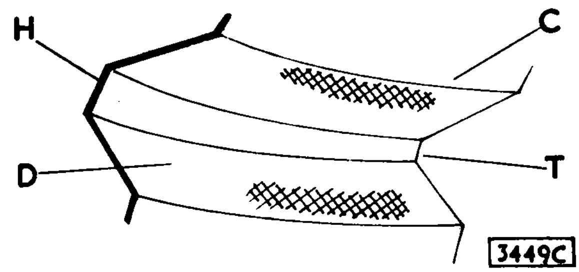


Fig. No. 21 *Low tooth contact*

Fig. 22 shows an example of toe contact which occurs when the bearing is concentrated at the small end of the tooth. To rectify this condition, move the crown wheel out of mesh, that is, increase backlash, by transferring shims to the drive gear side of the differential from the opposite end.

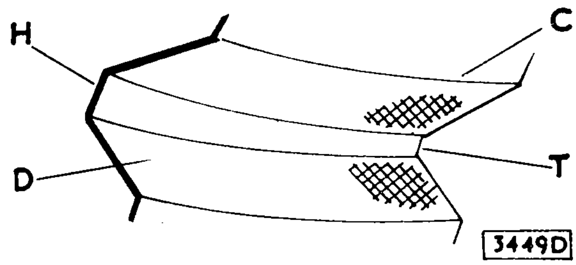


Fig. No. 22 *Toe contact*

Fig. 23 shows an example of heel contact which is indicated by the concentration of the bearing at the large end of the tooth. To rectify this condition, move the crown wheel closer into mesh, to reduce backlash, by removing shims from the drive gear side of the differential and adding an equal thickness of shims to the opposite side.

Note: Sufficient backlash for satisfactory operation must be maintained. If there is insufficient backlash the gears will at least be noisy and have a greatly reduced life, whilst scoring of the tooth profile and breakage may result. Therefore, always maintain a minimum backlash requirement of 0.004" (0.10 mm.).

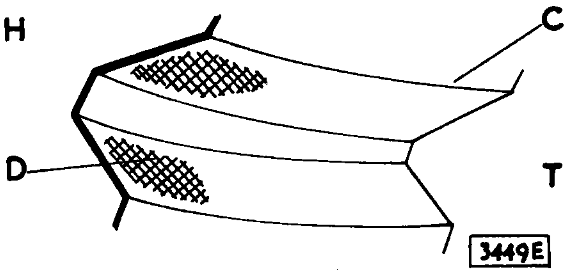


Fig. No. 23 *Heel contact*

H Heel (outer end)
D Drive
C Coast
T Toe (inner end)

FINAL ASSEMBLY

Remove the pinion flange nut, washer and the companion flange, and fit the oil thrower. Place the oil seal gasket into position in the oil seal recess, then fit the oil seal so that the lip of the seal faces inwards and the dust excluder flange is uppermost. Fit the installation collar Tool No. SL.4 and tighten down the pinion nut and washer to drive the assembly home as shown in Fig. 24. Remove the installation collar, fit the companion flange, washer and pinion nut and tighten to a torqeu of 120 to 130 lb. ft. (16.6 to 18.0 kgm.).
Fit the differential carrier rear cover gasket, renewing if necessary, fit the rear cover and secure with setscrews and spring washers. Do not omit to refit the "Powr-Lok" (P.L.) and axle ratio tags which are also secured by the cover setscrews for identification purposes. Check that the drain plug is tightened and fill the axle with one of the recommended lubricants specified on page H.5. Replace the filler plug, check the tightness of the cover setscrews and check the complete unit for oil leaks.
Refit the brake discs and calipers, centralising the calipers by means of the adjusting shims (as described on page L.13. Fit new tab washers to the mounting bolts, tighten the bolts to a torque of 55 lb. ft. (7.6 kgm.) and secure the bolt heads with the tab washers.

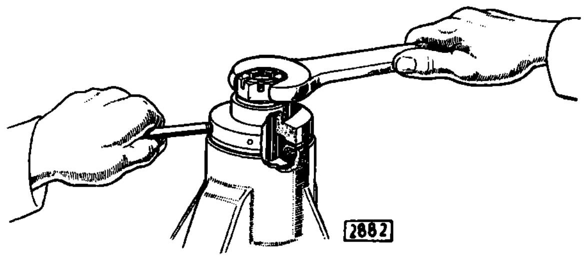
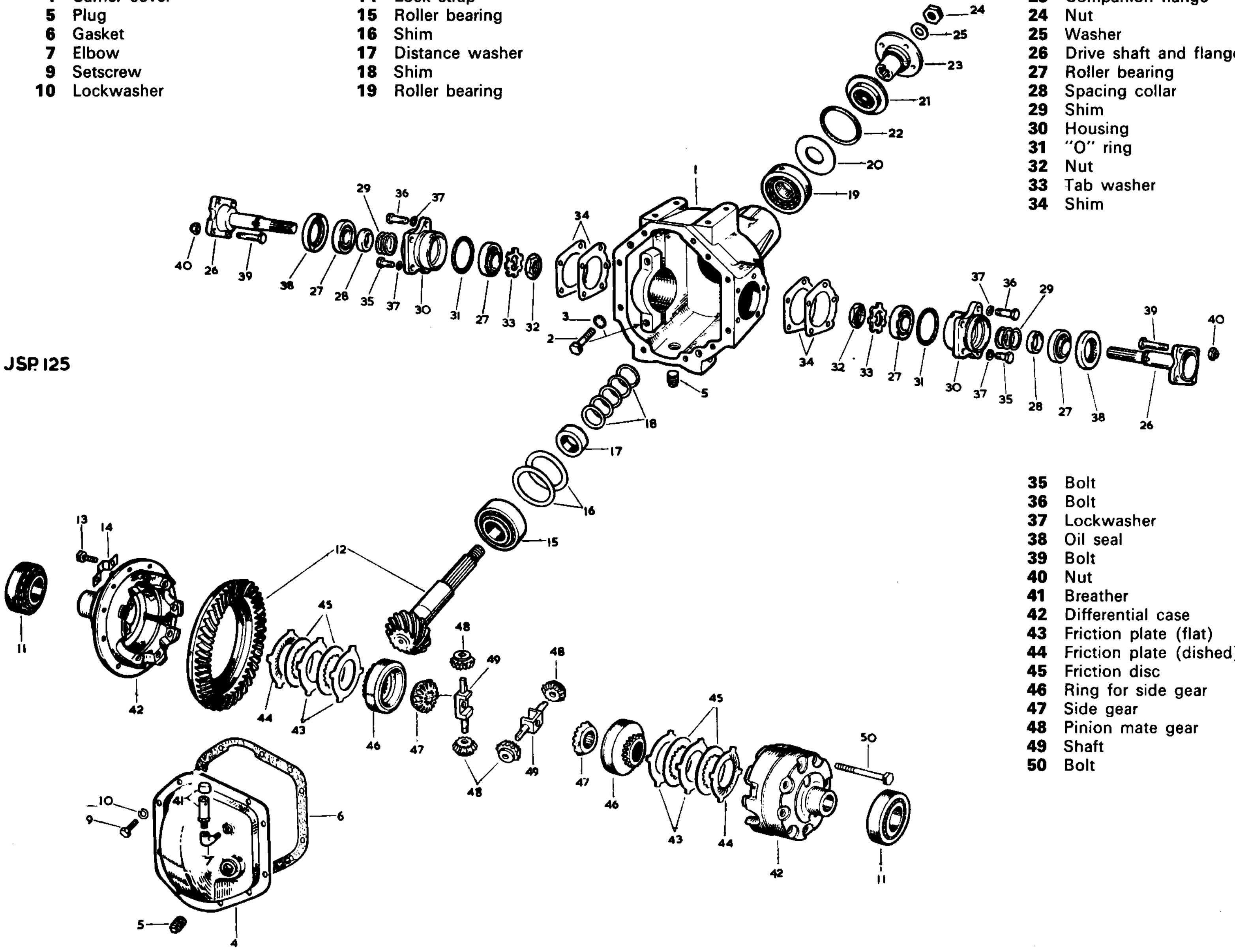


Fig. No. 24 *Fitting the pinion seal using Churchill Tool No. SL 4*

1 Gear carrier
2 Screw
3 Lockwasher
4 Carrier cover
5 Plug
6 Gasket
7 Elbow
9 Setscrew
10 Lockwasher
11 Roller bearing
12 Crown wheel and pinion
13 Setscrew
14 Lock strap
15 Roller bearing
16 Shim
17 Distance washer
18 Shim
19 Roller bearing
20 Oil slinger
21 Oil seal
22 Gasket
23 Companion flange
24 Nut
25 Washer
26 Drive shaft and flange
27 Roller bearing
28 Spacing collar
29 Shim
30 Housing
31 "O" ring
32 Nut
33 Tab washer
34 Shim



35 Bolt
36 Bolt
37 Lockwasher
38 Oil seal
39 Bolt
40 Nut
41 Breather
42 Differential case
43 Friction plate (flat)
44 Friction plate (dished)
45 Friction disc
46 Ring for side gear
47 Side gear
48 Pinion mate gear
49 Shaft
50 Bolt

Fig. No. 25 *Exploded view of the final drive unit*

STEERING

SECTION I

INDEX

STEERING

A Burman F.3 steering unit is fitted as standard equipment. Adwest power-assisted steering is specified as an optional extra and is dealt with in Section II.

STANDARD STEERING

DESCRIPTION

The Burman F.3 steering unit is of the high efficiency recirculating ball type in which motion is transmitted from the inner column worm to the rocker shaft by means of a nut on a continuous train of steel balls.
The worm is supported at each end by a loose ball race. Adjustment of the ball races is by means of shims under the end plates at the top and bottom of the steering box.
The rocker shaft is supported in a single bush pressed into the steering box. End float of the rocker shaft is controlled by an adjusting screw and locknut fitted to the top cover plate.
The one piece drop arm is taper splined to the rocker shaft and secured by a spring washer and nut.
The drop arm and idler lever are connected by an adjustable track rod with rubber/steel end assemblies. Extensions of the track rod ends are attached to the inner ball joints of steering tie rods. The outer ball joints of the tie-rods are connected to steering arms which are bolted to the stub axle carriers.

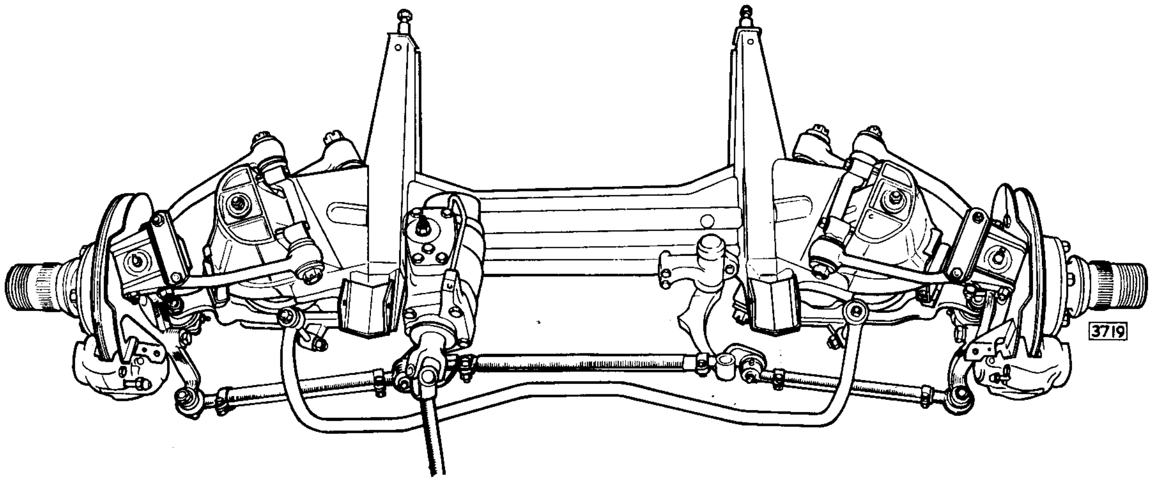


Fig. No. 1 *Steering layout (Power steering illustrated)*

DATA

Type	Recirculating ball
Steering Gear Ratio (Standard)	20.3 : 1
(Special Order)	17.6 : 1
Number of Turns—Lock to Lock	$4\frac{1}{4}$
Turning Circle	33′ 6″ (10.21 m.)
Diameter of Steering Wheel	17″ (43 cm.)
Front Wheel Alignment	Parallel to $\frac{1}{8}$″ (3.2 mm.) toe in

ROUTINE MAINTENANCE
EVERY 6,000 MILES (10,000 KM.)
Steering Box

The steering box is attached to the front suspension cross member; the filler plug is situated in the top cover and is accessible from the engine compartment on the driver's side of the car. The filler plug has a plain head and should not be confused with the rocker shaft adjustment screw which is threaded externally. Top up the steering box with recommended grade of lubricant until no more oil will enter.

Steering Idler Lever Housing

The idler housing is pre-packed with grease which only requires replenishing if the idler assembly is dismantled for overhaul.

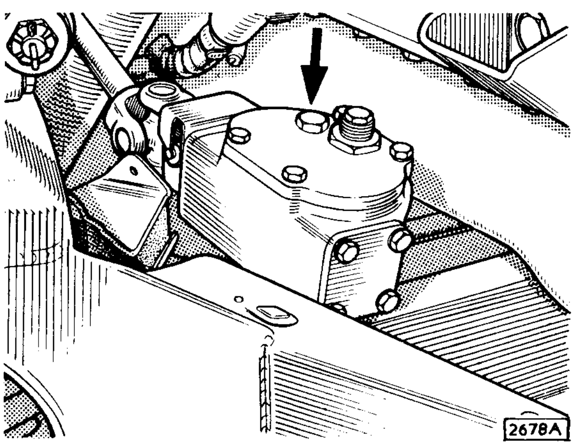


Fig. No. 2 *Steering Box Filler Plug (R.H.D.)*

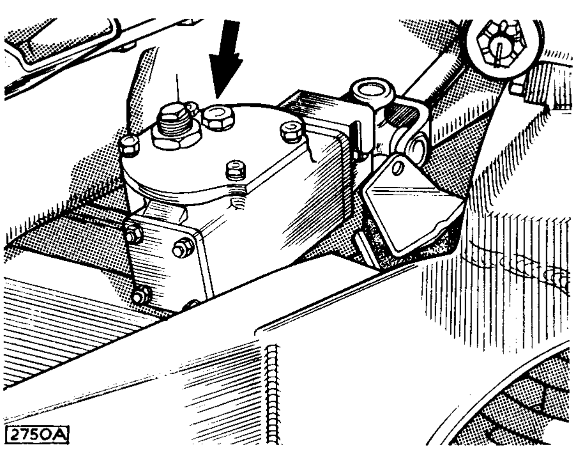


Fig. No. 3 *Steering box Filler Plug (L.H.D.)*

Steering Tie-Rods

Lubricate the ball joints at the ends of the two steering tie-rods with the recommended lubricant. The tie-rods are situated at the rear of the front suspension cross-member. When carrying out this operation, examine

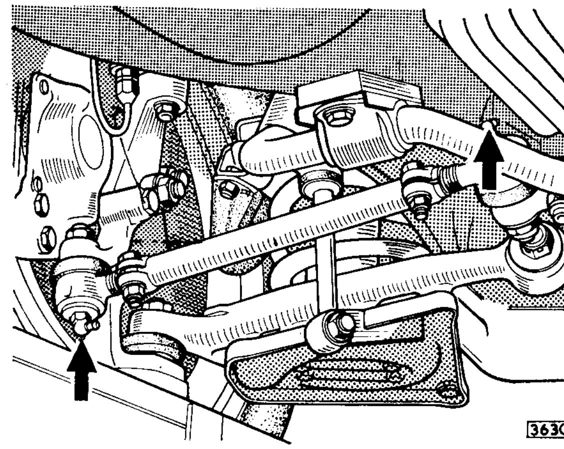


Fig. No. 4 *Steering Tie rod grease nipples*

the rubber seals at the ends of the ball housings to se if they have become displaced or split. In this ever they should be replaced or repositioned as any dirt c water that enters the ball joints will cause prematur wear.

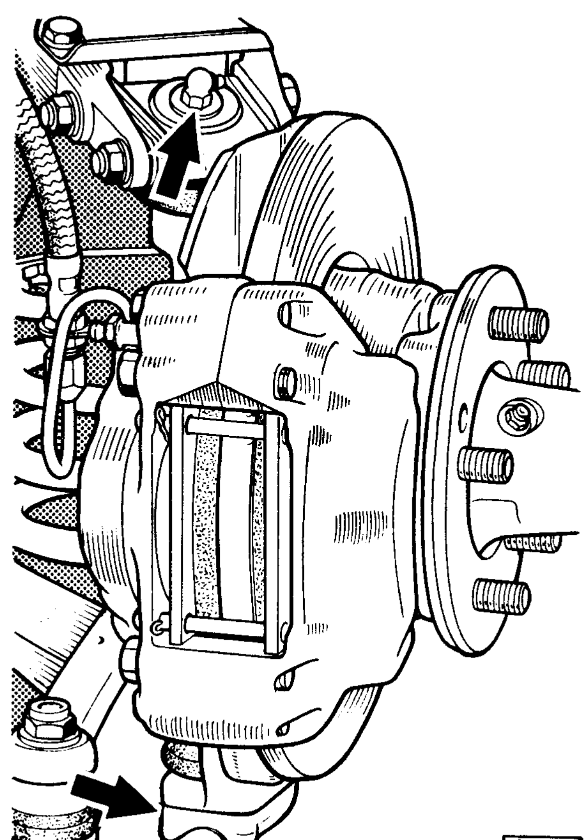


Fig. No. 5 *Wheel swivel grease nipples*

A bleed hole, covered by a circular nylon washer which lifts under pressure, indicates when sufficient lubricant has been applied.
This prevents grease from escaping past the seals when too much pressure is applied.

Wheel Swivels
Lubricate the nipples (four per car) fitted to the top and bottom wheel swivels.
The nipples are accessible from underneath the front of the car.

Front Wheel Alignment
Check the front wheel alignment as detailed on page I.11.

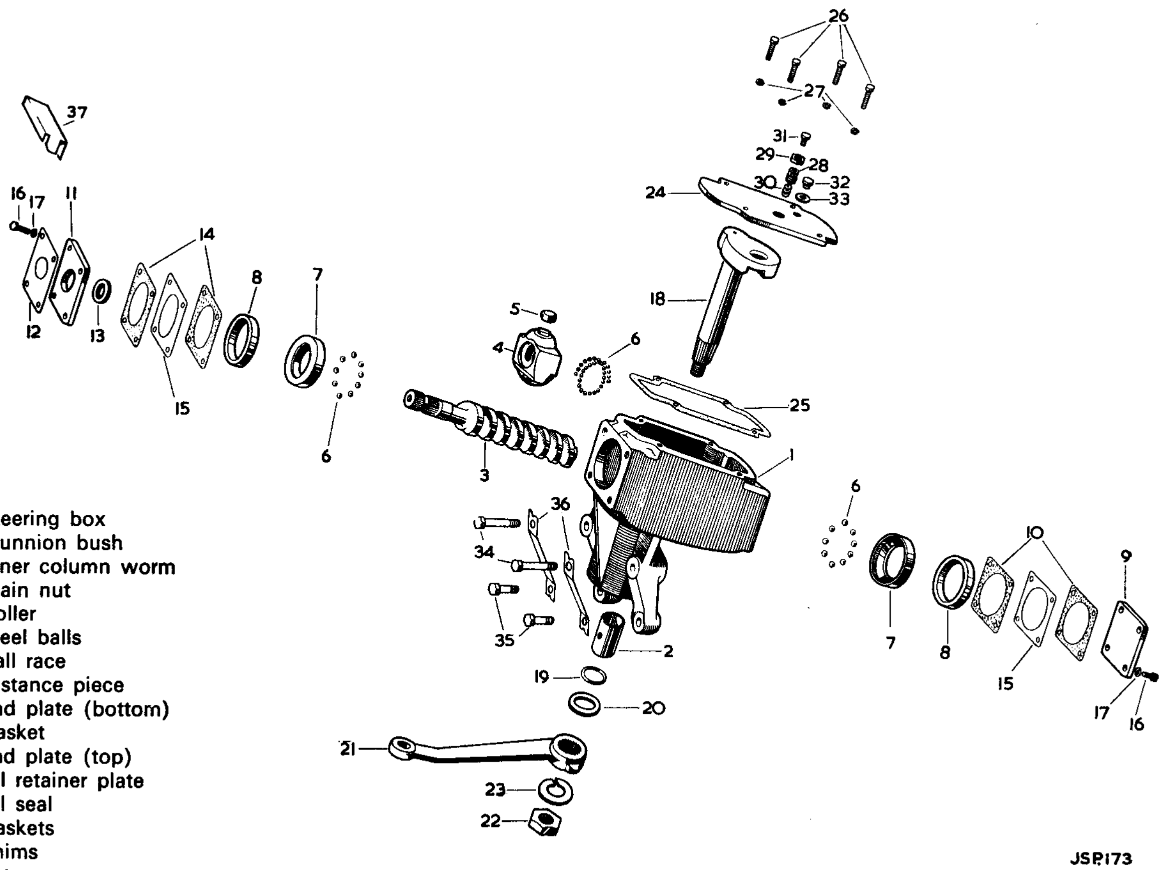
EVERY 12,000 MILES (20,000 KM.)
Check the condition of the rubber coupling between the upper and lower steering columns. Renew if worn or contaminated with petrol, oil or brake fluid.

RECOMMENDED LUBRICANTS

	Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent Caltex/Texaco
Steering Box	Mobilube C140	Castrol D	Shell 140 EP	Esso Gear Oil GP 90/140	Gear Oil SAE 140 EP	Nol EP 140	Multigear Lubricant 140
Steering idler housing Steering tie rods	Mobilgrease MP	Castrolease LM	Retinax A	Esso Multi-purpose Grease H	Energrease L.2	LB.10	Marfak All-Purpose

STEERING UNIT
Removal
Remove the pinch bolt securing the steering column upper universal joint to the inner column.
Pull the steering wheel and inner column upwards to clear the splines from the universal joint socket.
Using a suitable extractor, disconnect the tie-rod end assembly from the drop arm.
Knock back the tab washers; remove the two long and two short bolts securing the steering unit to the front suspension cross member.
Withdraw the steering unit complete with the lower column and drop arm from underneath the car.

Dismantling (Fig. 6)
Withdraw the pinch bolt and remove the lower steering column.
Remove the nut (22) securing the drop arm (21) to the rocker shaft (18).
Observe the line scribed on the drop arm and rocker shaft to ensure correct assembly. Using a suitable extractor, draw the drop arm off the spline on the rocker shaft. (Under no circumstances must the drop arm be hammered off otherwise indentation will be caused to the ball tracks).
Remove the four setscrews and spring washers securing the rocker shaft cover plate (24) to the steering box. Remove the cover plate and gasket, taking care not to dislodge the spring (30) from the rocker shaft adjustment screw (28). Drain the oil into a suitable receptacle. Remove the roller (5) from the top of the main nut (4).
Withdraw the rocker shaft. Remove the 'O' ring (19) from the bottom of the box.
Remove the four setscrews and spring washers securing the upper end plate and stone guard to the steering box.
Remove the retainer plate (12), oil seal (13), end plate (11), gaskets (14), shims (15) and the distance piece (8).
Push the worm shaft upwards and withdraw the outer race of the upper bearing. Collect the ten balls. Unscrew the worm through the worm nut and withdraw from the box.
Remove the four setscrews and washers attaching the end plate to the bottom of the steering box. Remove the gaskets, shims and distance piece. Withdraw the outer race of the lower bearing and collect the ten balls.
Remove the two setscrews and tab washers retaining the transfer tube to the main nut and remove the clip, tube and thirty-one balls (20 balls, high ratio box).



1 Steering box
2 Trunnion bush
3 Inner column worm
4 Main nut
5 Roller
6 Steel balls
7 Ball race
8 Distance piece
9 End plate (bottom)
10 Gasket
11 End plate (top)
12 Oil retainer plate
13 Oil seal
14 Gaskets
15 Shims
16 Setscrew
17 Spring washer
18 Rocker shaft
19 'O' ring
20 Washer
21 Drop arm
22 Nut
23 Spring washer
24 Cover plate
25 Gasket
26 Setscrews
27 Spring washer
28 Rocker shaft adjustment screw
29 Locking nut
30 Spring
31 Spring tension bolt
32 Oil filler plug
33 Washer
34 Bolt (long)
35 Bolt (short)
36 Tab washer
37 Stoneguard

Fig. No. 6 *Exploded view of steering unit*

Assembling

Note: When assembling the steering unit carry out adjustment of the worm shaft and rocker shaft end float as described in this section.
Fit the transfer tube and clip to the worm nut and secure with two setscrews.

Fit the circulating balls into the unit; use grease to retain the balls in position. Fit the ten ball bearings to the bottom race with grease and assemble to the bottom of the steering box together with the distance piece. Fit the gaskets, shims, distance piece and end plate to the bottom of the steering box and secure with four setscrews. Screw the worm shaft into the worm nut until the nut is halfway along the worm. Feed the worm shaft carefully into the steering box through the top cover aperture, making sure that the balls in the bottom ball race are all securely in position when the wormshaft makes contact with them.
Fit the ten balls to the top race with grease and assemble to the top of the steering box together with the distance piece.
Fit the shims with a gasket at each side to the top of the steering box. Cover the splines at the top of the worm shaft with adhesive tape to protect the oil seal when fitting the end plate.
Assemble the end plate, oil seal and oil seal retainer plate and carefully slide over the wormshaft. Remove all traces of adhesive tape from the splines. Refit the stone guard and secure the end plate with four setscrews.

Adjust wormshaft end float as follows:—
The wormshaft bearings should be adjusted to a pre-load of .002" to .003" (.05 to .08 mm.) by means of the shims and gaskets at each end of the steering box. The shims are .005" (.13 mm.) thick; the gaskets are .003" (.08 mm.) thick.
Eliminate or reduce to a minimum the end float of the worm shaft by removing shims as necessary. Check that the worm shaft turns freely.
Remove a shim and/or gasket to obtain the required pre-load. Always maintain a minimum of two gaskets at each end of the steering box, one at each side of the shim pack.
Enter the rocker shaft into its bore in the steering box and engage the slotted extension with the top portion of the main nut. Fit the roller to the top of the main nut. Fit the gasket and secure the cover plate with the four set screws.
Adjust rocker shaft end float as follows:—
When adjusting the end float, the rocker shaft must be at the centre of its travel.
Unscrew the bolt (31) (Fig. 6) and extract the spring (30). Slacken the locknut (29) securing the adjuster screw (28) in the cover plate. Screw down the adjuster screw by hand until it contacts the rocker shaft. so that all end float is eliminated.
Hold the adjuster screw firmly and tighten the locknut.
Test the freedom of the movement of the wormshaft throughout its travel; if tightness exists in the centre, it will be necessary to re-adjust the end float.
Refit the spring and retaining bolt.
This operation may also be carried out with the unit on the car and the front wheels in the straight ahead position.
Fit the drop arm to the rocker shaft, ensuring that the scribed line on the rocker shaft matches the appropriate line on the drop arm, according to whether the steering unit is for right-hand or left-hand drive (Fig. 7).
Refit the lower steering column to the steering box.

Refitting
Check that the road wheels are in the straight ahead position.
Refit the steering unit to the front cross member.
Attach the track rod to the drop arm.
Refit the lower universal joint to the steering unit and secure with the pinch bolt.
Set the steering wheel so that the spokes are horizontal and the motif is upright.
Push the inner column down and connect to the universal joint socket on the lower column.
Remove the two retaining screws and detach the switch upper cover.
Pull the inner column upwards until the lower edge of the indicator switch striker is level with the bottom of the slot in the nylon trip ring.
Refit the pinch bolt and self-locking nut.

STEERING WHEEL

Removal
Withdraw the four cheese-headed screws from the underside of the steering wheel centre and detach the horn switch cover.

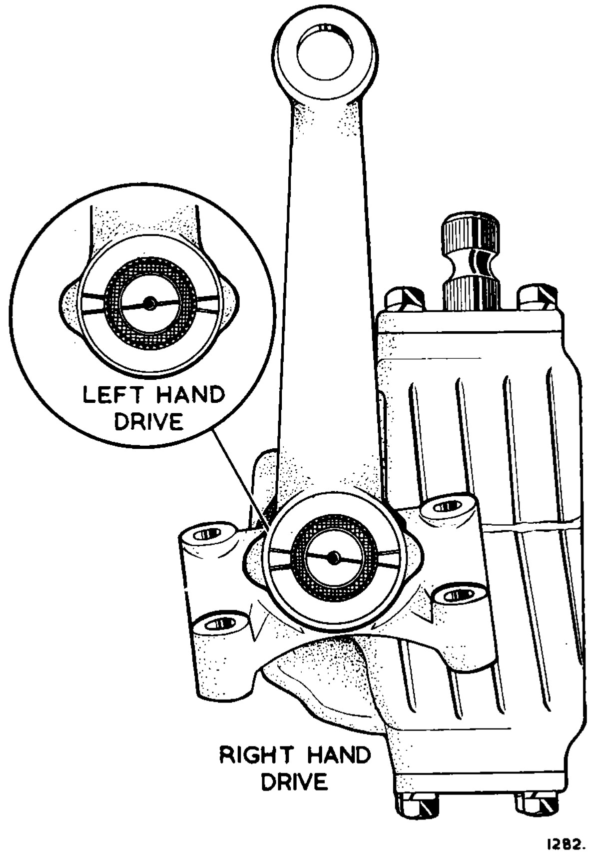


Fig. No. 7 *Showing the alignment of the drop arm/rocker shaft marks, both right-hand and left-hand steering*

Unscrew the locknut and the nut securing the steering wheel to the inner column.
Withdraw the steering wheel and collect the two halves of the split cone.

Refitting
Secure the split cone in position in the inner column shaft grooves, ensuring that the narrowest portion of the cone is towards the top of the column.
Slide the steering wheel onto the column shaft splines so that the two spokes are horizontal when the road wheels are pointing straight ahead.
Push the steering wheel fully home onto the split cone.
Fit the plain washer, securing nut and locknut. Refit the horn ring and cover.

STEERING COLUMN (UPPER)

Removal (Fig. 14)
Disconnect the battery.
Turn the road wheels to the straight ahead position. If retained in this position, this will facilitate the re-fitting procedure.
Disconnect the cables from the flashing indicator/headlamp flasher switch at the snap connectors.
If overdrive is fitted, disconnect the cables from the overdrive switch at the snap connectors.

Remove the two screws and washers securing the switch upper cover to the lower cover below the steering wheel.
Lift off the upper cover and remove the three bulb holders from the back. Note the location of the bulbs for reference when refitting.
Disconnect the four cables from the inhibitor switch located on a bracket attached to the steering column. Note the location of the cables for reference when refitting (Automatic Transmission cars only).
Disconnect the gear selector control cable ball joint from the selector lever on the steering column. (Automatic transmission cars only).
Disconnect the four cables from the steering column lock (if fitted) and ensure that the key is in the "Garage" (normal stop) position.
Note the location of the cables for reference when refitting.
Note: The switch unit cannot be removed from the outer column.
Remove the four cap nuts and detach the trim panels covering the column above the parcel tray.
Release the clip securing the bottom of the outer tube to the mounting bracket on the bulkhead.
Remove the horn switch cable from the contact at the bottom of the steering column.
Remove the pinch bolt securing the inner column to the top universal joint of the lower column. Mark the location of the inner column splines in relation to the joint for reference when refitting.
Remove two bolts, nuts and washers securing the steering column to the upper mounting bracket. Collect the shim plates which may be located between the column and body brackets.

Dismantling
Remove the steering wheel as detailed previously.
Withdraw the inner column.
Unscrew the steering wheel locking nut and withdraw the nut from the splined inner shaft.
Remove the two setscrews, serrated and plain washers securing the flashing indicator switch striking ring.
Remove the stop button and withdraw the inner shaft.
Slide off the horn pick-up ring and remove the bottom half of the rotor assembly. Remove the circlip from the end of the horn contact nipple and remove the spring and plastic sleeve.
Withdraw the horn wire and top half of the rubber rotor.
Remove the flashing indicator switch as follows:—
Release the locknut from the lower clamp screw, detach the clamp and switch. Note the distance piece fitted to the top screw.
If the car is fitted with automatic transmission proceed as follows:—
Remove the screws securing the inhibitor switch carrier bracket to the mounting bracket and outer column and detach the link.
Release the square headed screw securing the operating lever to the operating shaft.
Remove the circlip and washer from the underside of the shaft bearing. Remove the setscrew securing the gear indicator arm bearing to the bracket on the outer column.
Withdraw the shaft and bearing as an assembly.
To remove the gear selector lever from the pivot bracket, extract the split pin and washer and withdraw the clevis pin.
Detach the lever and collect the return spring and shims (if fitted).
Remove the two setscrews and lockwashers and remove the selector quadrant and spacers.
Remove the nuts and bolts securing the two rubber contact holders, fibre insulating strip, slip ring contact blade and earth contact.
Depress the retaining lugs and withdraw the bearing bushes from the top and bottom of the outer tube.
If the car is fitted with overdrive transmission, remove the overdrive switch after withdrawing two setscrews, nuts and lockwashers.

Re-assembly
Replace the two bearing bushes ensuring that the lugs register in the holes in the outer column.
If the car is fitted with automatic transmission, refit the selector control as follows:—
Refit the selector quadrant and spacers. If removed during the dismantling procedure, insert the shims and return spring in the pivot bracket, refit the gear selector lever and secure with the clevis pin, plain washer and split pin. Lightly grease the lever spring before fitting the lever.
Pass the operating shaft through the top bearing. Slide the plain washer and circlip over the shaft, fit the operating lever to the shaft and feed the shaft through the bottom bearing.
Secure in position with the circlip and plain washer.
Secure the operating lever to the operating shaft with the square headed locking screw, ensuring that the screw registers with the flat on the shaft.
Refit the gear indicator arm bearing to the bracket on the outer column.

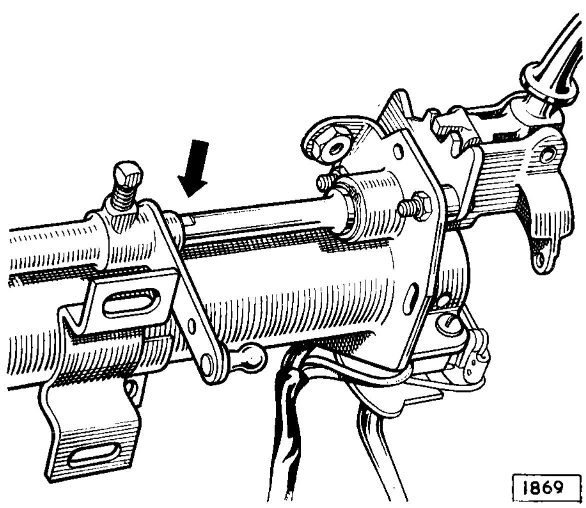


Fig. No. 8 *Align the flat on the end of the upper control shaft with the securing screw on the control lever.*

Reconnect the inhibitor switch to the operating link and secure to the mounting bracket. Do not tighten the screws at this juncture.
Refit the flashing indicator switch.
Pass the two fixing screws through the switch clamp; attach the spring washer and locknut to the lower screw and the distance piece and washer to the top screw.
Feed the screws through the column bracket and secure to the indicator switch.
Tighten the top screw fully.
If the car is fitted with overdrive transmission, refit the overdrive switch to the outer tube.
Thread the horn wire through the inner column and fit the top half of the rubber rotor. Fit the bottom half of the rotor and slide the horn slip ring over both halves with the serrations in the ring towards the bottom of the column.
Gently knock the serrations of the ring into the groove of the rubber rotors until secure.
Refit the two rubber contact holders, fibre insulating strip, slip ring contact blade and earth contact to the outer tube.
Slide the inner shaft over the horn wire into the inner column so that the slot in the shaft serrations aligns with the stop button hole in the inner column. Screw in the stop button fully until the inner shaft binds on the button. Slacken the stop button off until the inner shaft can move freely.
Fit the striker plate with the peg towards the bottom of the column and on the opposite side to the stop button.
Turn the inner column until the striker retainer bolts are in the vertical position and set the striker peg so that it is just below the horizontal position.

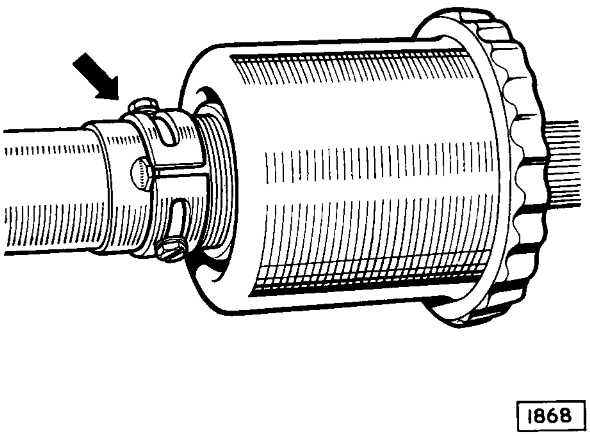


Fig. No. 9 *Centralising the flashing (turn) indicator switch striker peg*

If the car is fitted with automatic transmission set the inhibitor switch (see Fig. 10) as follows:—
Select neutral (N) on the gear selector quadrant and hold this position.
Rotate the switch in the clamp ring (C) and move the bracket in the elongated holes until the small hole in the lever (B) registers with the indent in the back of the switch (A).
Tighten the clamp ring and bracket screws.

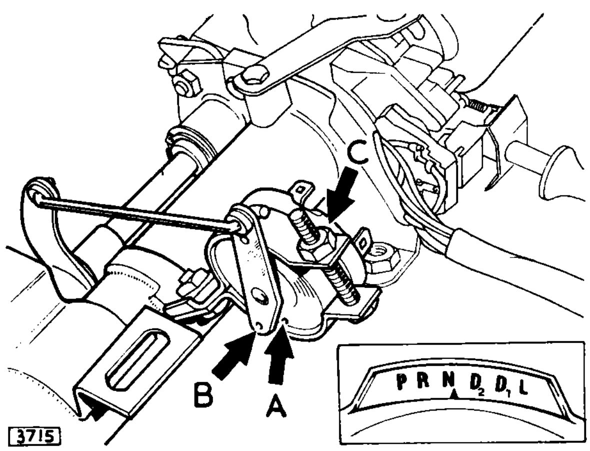


Fig. No. 10 *Setting the starter/reverse inhibitor switch. (Automatic transmission models).*

Slide the inner column into the outer tube ensuring that the earth contact is not damaged and that the horn contact does not foul on the slip ring of the inner column. The contact may be lifted slightly whilst the column is placed in position.
Attach a spring balance to the steering wheel (Fig. 11). Tighten the bottom screw until the steering wheel will just turn with a pull of 5 ozs. (141.7 grammes) registered on the balance.
Turn the locknut towards the switch carrier bracket and lock the screw. Two thicknesses of distance piece are available to compensate for variation in the bore of the outer tube.

Grade "A" 0.188" (4.7 mm.).
Grade "B" 0.166" (4.2 mm.).

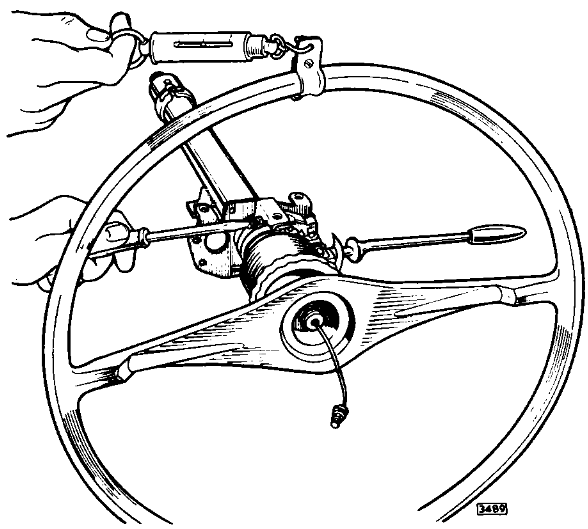


Fig. No. 11 *Upper steering column bearing adjustment points*

Refitting

Ensure that the front road wheels are in the straight ahead position.
Feed the outer tube through the bottom mounting bracket and secure to the top mounting bracket with two bolts, nuts and washers.
Tighten the clip securing the outer tube to the bottom mounting bracket.
Turn the inner column and centralise the flashing indicator striker between the two arms of the indicator switch.
Engage the splines of the inner column with the socket of the upper universal joint of the lower steering column.
Pull the inner column upwards until the lower edge of the indicator switch striker is level with the bottom of the slot in the nylon trip ring.
Reconnect the flashing indicator switch cables in their correct colour sequence.
If the car is fitted with overdrive transmission, reconnect the cables to the overdrive switch.
If fitted with automatic transmission, reconnect the four cables to the inhibitor switch in the correct sequence.
Reconnect the cables to the steering column lock (if fitted).
Attach the gear selector control cable ball joint.
Refit the plastic sleeve and spring to the horn wire and secure with the circlip.
Re-insert the bulb holders into the upper switch cover in the correct sequence.
Refit the steering wheel locking nut to the inner shaft.
Refit the covers (top and bottom), steering wheel and trim panels by reversing the removal procedures.

STEERING COLUMN (LOWER)

Removal

Turn the road wheels until the pinch bolt of the lower column is accessible.
Remove the pinch bolt.
Re-set the road wheels in the straight ahead position.
Disconnect the upper column as detailed on page I.7.
Withdraw the lower column and detach the rubber coupling.

Detaching the Rubber Coupling

Remove the four locknuts (47, Fig. 14).
Remove the plain washers and unscrew the four Allen headed screws (49) attaching the upper column joint and the lower column to the rubber coupling.
Remove the lower steady bush from the upper universal joint if worn or damaged.
Check the condition of the rubber coupling and renew if worn or contaminated with oil or petrol.

Refitting

Check that the road wheels are in the straight ahead position.
Refit the lower column joint to the steering box shaft and tighten the pinch bolt.
Refit the rubber coupling and upper column joint by reversing the removal procedure.
Refit the upper column as detailed on page I.10.

Note:

(1) Early cars will have a lower column fitted with the rubber coupling flange phased at 45° with the lower universal joint pinch bolt.
(2) Intermediate cars will have the flange and pinch bolt phased at 90°.
(3) Later cars will also have the flange and pinch bolt phased at 90° but will have bolts replacing the Allen-headed screws securing the rubber coupling.

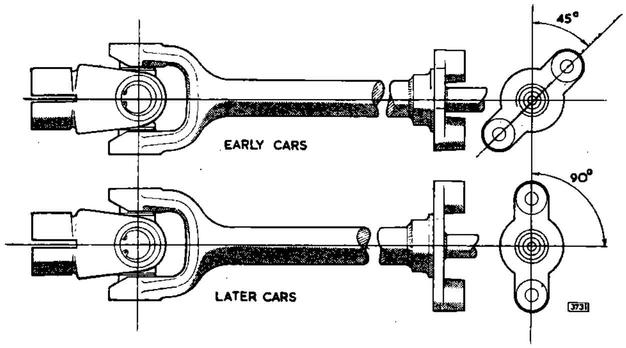


Fig. No. 12 *Showing the 45° and 90° phased lower steering columns*

Important

If the lower steering columns phased at 90° are fitted to cars which have previously had the 45° phased column fitted, it will be necessary to re-position the steering wheel on the splined shaft and also to reset the turn indicator switch striker on the inner column in order to restore the correct cancellation in the straight ahead position.

STEERING IDLER ASSEMBLY

Removal

Remove the self-locking nut securing the track rod end to the idler lever.
Extract the track rod end which is a tapered fit.
Remove the two setscrews and one long bolt attaching the steering idler bracket to the front suspension cross member and detach the assembly.
Note the location of any packing washers which may be between the idler bracket and the front cross member.

Dismantling

Prise out the dust cap from the top of the idler assembly.
Tap back the tab washer and unscrew the nut from the idler spindle.
Remove the tab washer and the "D" washer.
The spindle, arm abutment ring and felt seal can now be withdrawn.
If the bearings are to be renewed, tap out the outer races using a small drift.

Assembling

Clean the bearings and the idler housing thoroughly before re-assembling.
Repack the housing and bearings with the recommended grade of lubricant.

Fit the abutment washer, seal retainer, felt seal, abutment ring and bearing to the idler spindle and pass the spindle upwards into the housing.

1 End cap
2 Nut
3 Tab washer
4 "D" washer
5 Idler spindle
6 Bearing
7 Mounting bracket
8 Abutment washer
9 Bearing
10 Idler lever
11 Abutment ring
12 Washer
13 Nut
14 Seal retainer
15 Felt seal

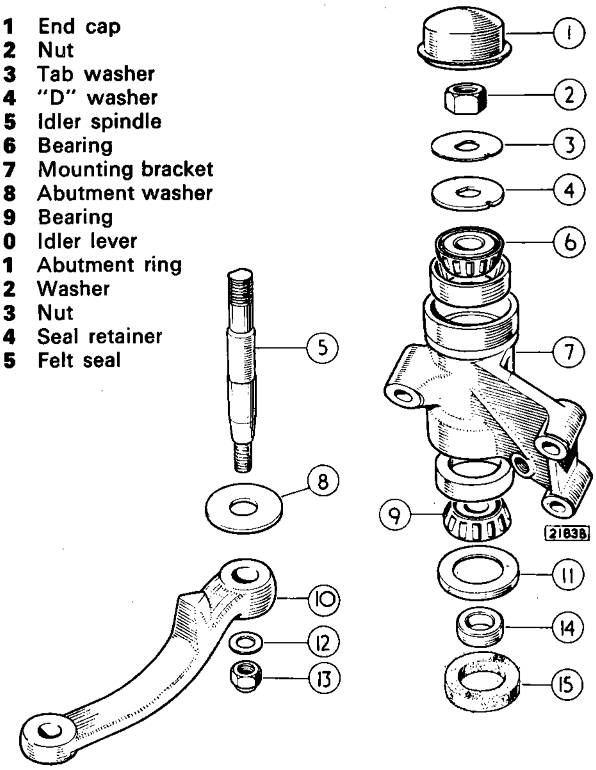


Fig. No. 13 *The steering idler components*

Fit the upper bearing, "D" washer, tab washer and nut. Tighten the nut to a torque of 5 lb. ft. (0.7 kg.m.).
If a torque wrench is not available, tighten the nut until rotation of the idler spindle by the idler arm feels "sticky" and back off the nut one flat: lock the nut with the tab washer and fit the dust cap.

Refitting
Reverse the removal procedure to refit. Ensure that the idler lever is in the straight ahead position before attaching the track rod ends.
Refit the packing washers between the idler lever bracket and the front cross member as noted on removal.
Check the height of the under-face of the idler lever from the ground against the steering drop arm measurement.
Adjust to within $\pm\frac{1}{16}$" (1.6 mm.) differential if necessary by adding or subtracting washers between the idler bracket and the front cross member at the top or bottom mounting bolts.

CENTRE TRACK ROD
The track rod ends incorporate rubber/steel bonded bushes. If the bushes show signs of deterioration they should be replaced.

Remove the self-locking nuts and washers from the inner ball joint of each tie rod. Withdraw the ball pin using Churchill Tool J.D.24.
Remove the self-locking nuts and washers securing the track rod ends to the drop arm and idler lever.
Withdraw the track rod ends from the drop arm and idler lever using Churchill Tool No. J.D.24.

Dismantling
To remove the track rod ends, slacken the clamp at each end of the centre tube; unscrew each end from the tube noting that one end has a left-hand thread and the other a right-hand thread.

Assembling
When refitting the track rod ends to the centre tube, screw in each end **an equal number of turns.** The final setting of the track rod length must be carried out after the track rod has been refitted under the heading "Front Wheel Alignment".

Refitting
Refitting is the reverse of the removal procedure.
When refitting the ball pins to the idler lever and the steering drop arm ensure that the pins are fully home in their respective tapers by means of a suitable lever applied to the top of the pins before fitting and tightening the nuts.
Failure to ensure this may introduce a bias on the rubber bushes which will affect the steering geometry.
It is essential that the steering drop arm and the idler lever are both turned to the straight ahead position before fitting the centre track rod.

OUTER TIE RODS
The tie rod ball joints cannot be dismantled and if worn, a complete tie rod assembly must be fitted.

Removal
Remove the self-locking nuts and plain washers securing the tie rod to the steering arm and track rod end.
Withdraw the tie rod ball pins out of the steering arm and track rod end using Churchill Tool No. J.D.24.

Refitting
Refitting is the reverse of the removal procedure.

FRONT WHEEL ALIGNMENT
Ensure that the tyre pressures are correct and that the car is standing on a level surface.
With the wheels in the straight ahead position, check the alignment of the front wheels with an approved track setting gauge.
The front wheel alignment should be 0 — $\frac{1}{8}$" (3.2 mm.) total "toe-in" measured at the wheel rims.
Re-check the alignment after pushing the car forward until the wheels have turned half a revolution (180°).
If adjustment is required, slacken the clamp bolt at each end of the central track rod and rotate the rod in the required direction until the alignment of the front wheels is correct. Tighten the clamp bolts and re-check the alignment.

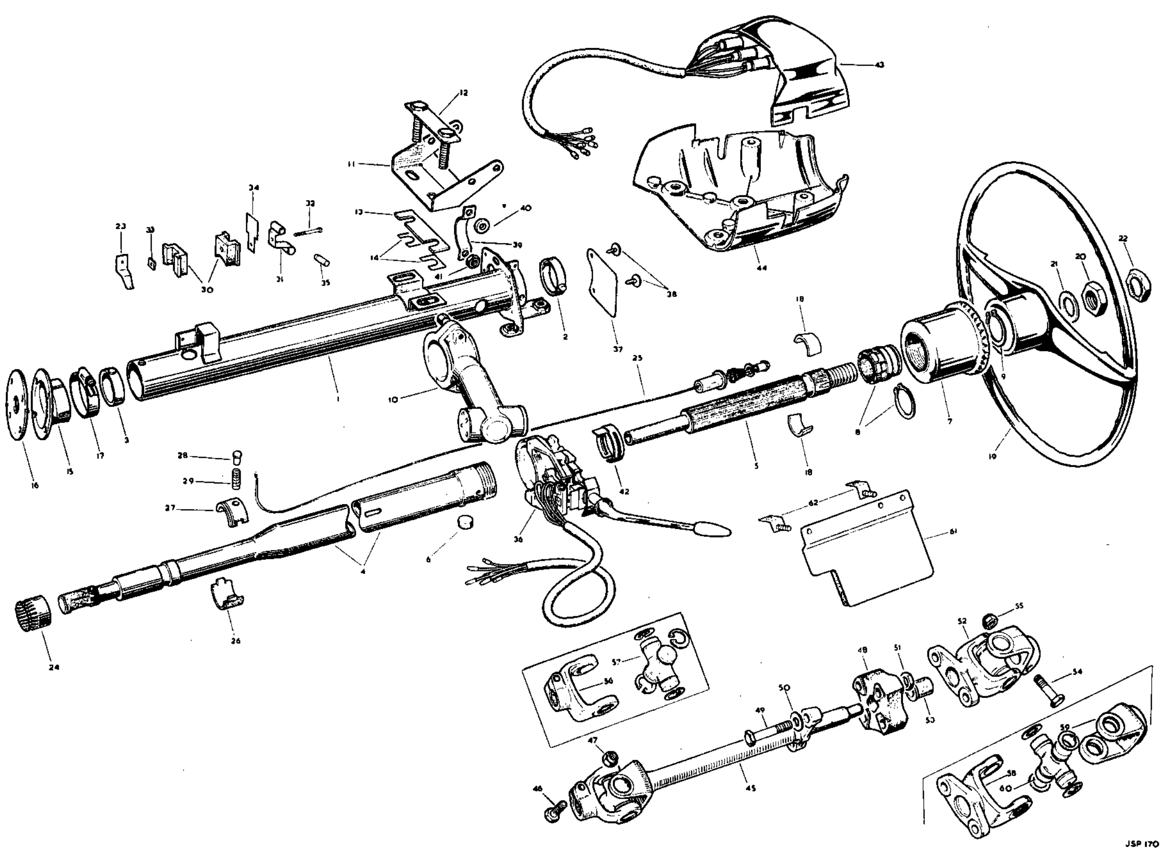


Fig. No. 14 *Exploded view of the steering column*

1 Outer assembly
2 Top bearing
3 Bottom bearing
4 Inner column
5 Inner column shaft
6 Stop button
7 Locknut
8 Split collet and circlip assembly
9 Circlip only
10 Steering column lock (when fitted)
11 Upper mounting bracket
12 Screw plate assembly
13 Spacer
14 Shims
15 Lower mounting bracket
16 Gasket
17 Clip
18 Split cone
19 Steering wheel
20 Steering wheel nut
21 Washer
22 Locknut
23 Earth contact
24 Slip ring
25 Horn switch cable
26 Rotor—bottom half
27 Rotor—top half
28 Cable contact
29 Contact spring
30 Contact holder
31 Contact
32 Contact securing bolt
33 Nut
34 Insulating strip
35 Dowel
36 Direction indicator switch
37 Insulating strip
38 Studs for insulating strip
39 Direction indication switch clamp
40 Spacer
41 Locking nut
42 Striker ring
43 Switch cover—upper
44 Switch cover—lower
45 Lower column
46 Bolt
47 Locknut
48 Rubber coupling
49 Bolt
50 Plain washer
51 Locknut
52 Upper universal joint
53 Rubber steady bush
54 Bolt
55 Locknut
56 End yoke, lower universal joint
57 Journal assembly
58 Flange yoke—upper universal joint
59 End yoke—upper universal joint
60 Journal assembly
61 Shield assembly
62 Shield bracket

LOCK STOP ADJUSTMENT

The lock stop bolts are screwed into the idler bracket and are retained in position by locknuts.

The stops are set at the factory to allow equal travel of the drop arm and idler lever each side of the central (straight ahead) position.

Normally, the lock stop bolts should not require adjustment, but if attention is found to be necessary the adjustment should be carried out in the following manner.

Slacken the locknuts and screw in the lock stop bolts as far as possible. Turn the steering until the steering unit is at the end of its travel on that lock. Screw out the lock stop bolt until the head contacts the abutment on the idler lever. Screw out the stop bolt a further two turns and tighten the locknut. Repeat for the other lock.

STEERING ARM

Removal

Raise the car by placing a jack under the front suspension cross member and remove the road wheel. Remove the self-locking nut and plain washer securing the tie rod to the steering arm. Withdraw the tie rod ball pin using Churchill Tool No. J.D.24.
Unscrew the centre self-locking nut securing the stub axle shafts and steering arm to the carrier and remove the wired bolt attaching the steering arm to the carrier. Note the shims fitted between the steering arm and the brake caliper lower mounting point. The steering arm can now be removed.

Refitting

Refitting is the reverse of the removal procedure. Use new locking wire to secure the steering arm attachment bolt.

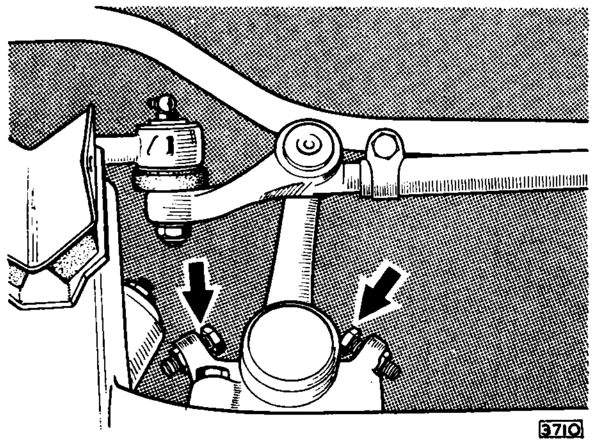


Fig. No. 15 *The steering lock stop bolts*

ACCIDENTAL DAMAGE

The following dimensional drawings are provided to assist in assessing accidental damage.
A component suspected of being damaged should be removed from the car, cleaned off and the dimensions checked and compared with those given in the appropriate illustration.

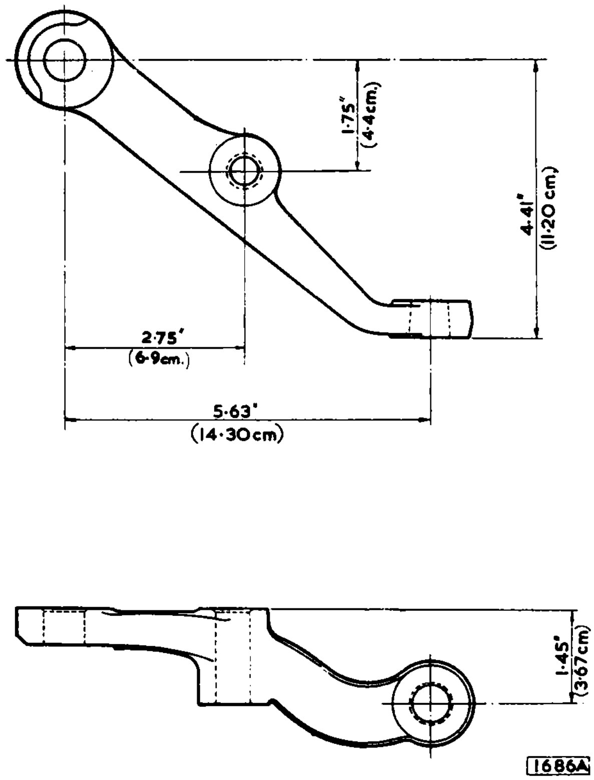


Fig. No. 16 *The steering arm*

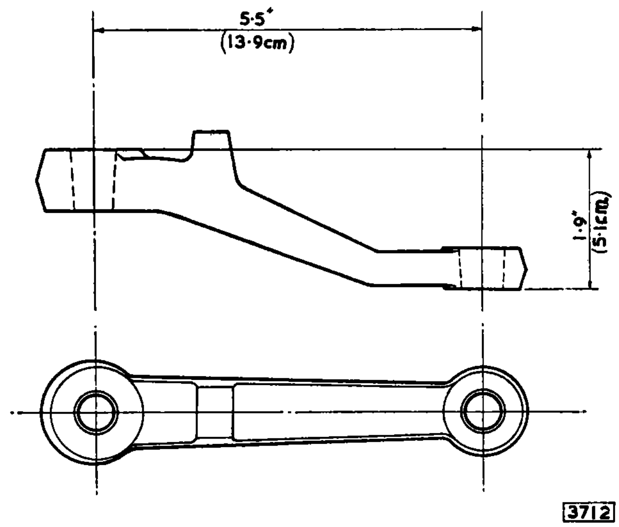


Fig. No. 17 *The steering idler lever*

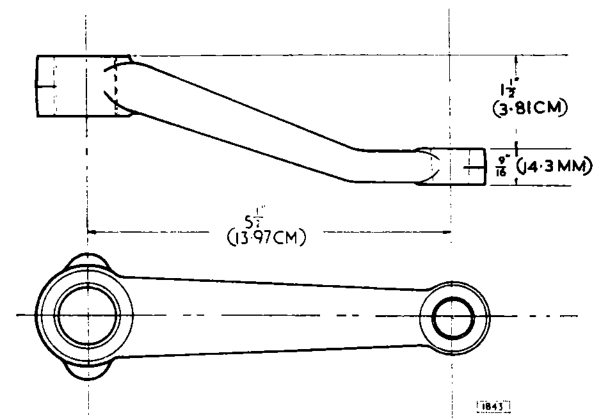


Fig. No. 18 *The steering drop arm*

STEERING
(POWER ASSISTED)

SECTION II

INDEX

STEERING (POWER ASSISTED)

STEERING (POWER ASSISTED)

DESCRIPTION

The power-assisted steering system consists of two separate components; the steering box and pump. The two are connected together by flexible hoses. The pump is contained in its own reservoir.
Oil flows from the output side of the pump to the steering box (pressure hose) and from the steering box to the pump (return hose). The feed from the reservoir to the pump occurs within the unit.
The pump is situated on the right hand side of the engine and is belt driven, tension being regulated by a spring loaded jockey pulley.
A continuous flow of oil is pumped through the system whilst the engine is running, but pressure builds up only when the steering wheel is turned.

DATA

Steering Gear

Make . . .	Adwest Engineering Co. Ltd.
Type	Marles Varamatic—Hour glass and roller with hydraulic servo cylinder.
Steering gear ratio on centre	21.6:1
Steering gear ratio on lock	13:1
Number of turns—lock to lock	$2\frac{7}{8}$
Turning circle . .	33 ft. 6 ins.

Oil Pump

Make . . .	Saginaw
Location . . .	Right—front of engine.
Operating pressure .	1110-1250 lb./sq. in. (77.7—87.5 kg/cm^2.).

RECOMMENDED LUBRICANTS

Unit	Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent/ Caltex/Texaco
Power steering reservoir	Mobil Fluid 200	Castrol T.Q.	Shell Donax T6	Esso Automatic Transmission Fluid	Automatic Trans. Fluid Type "A"	Nolmatic	Texamatic Fluid

OPERATION

STEERING GEAR

The steering gear operates on an "hour glass" cam and roller principle, with a hydraulic control valve embodied in the input shaft of the cam. The hydraulic assistance is supplied by a servo piston operating in a cylinder which is integral with the steering box casting. A rack projects from this piston and the rack teeth mesh with a sector of a spur gear which is machined on a projection from the sector shaft.
The "hour glass" cam is a hardened steel component and its track (or thread) is machined with a varying helix angle, so that the pitch is non-constant. A roller carried in the sector shaft meshes with this track and the assembly is responsible for providing the variable ratio. The ratio curve is highest (that is, lowest geared) "on centre". At this point the ratio is 21.6 : 1 and it reduces rapidly towards either lock where its value becomes 13 : 1. This drop in ratio occurs almost entirely within a half turn from the straight ahead position with the same sensitivity for all speeds.

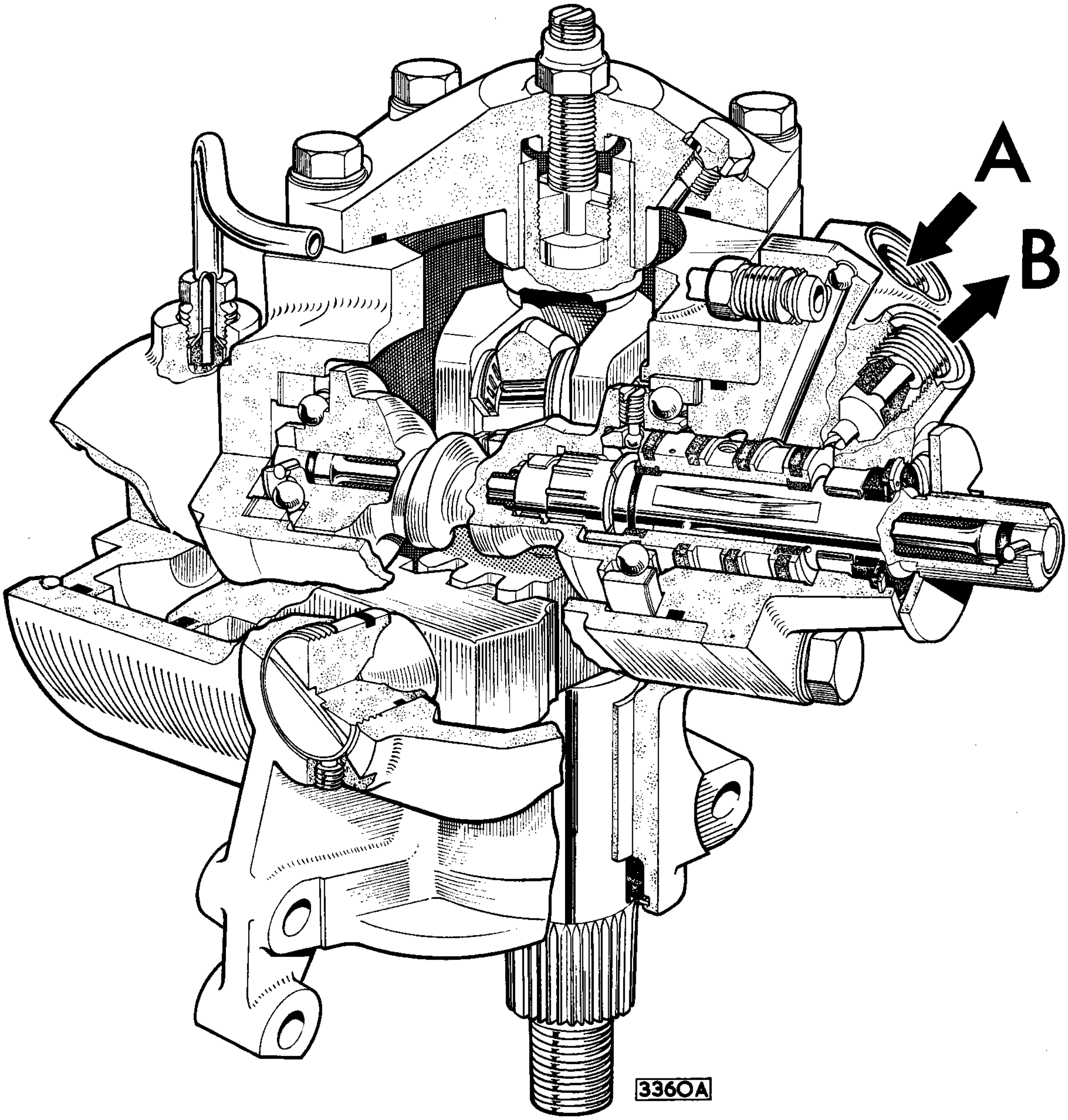


Fig. No. 1 *Cut-away section of the steering box*

A High pressure connection
B Low pressure connection

THE VALVE

This is a rotary type control valve and it is made up of two parts. The valve rotor, which is also the input shaft to the steering gear, has six grooves machined in it. These grooves lie between six grooves in the valve sleeve when no load is applied to the steering wheel, the rotor being centred in the sleeve by a torsion bar. When steering effort is applied at the wheel this is transmitted to the rotor which, in turn, transmits the effort to the hour glass cam by means of a torsion bar. The torsion bar is, however, slender and the manual effort causes it to twist, thus allowing the rotor to rotate within the sleeve. The relative movement of the grooves in the rotor to the grooves in the sleeve causes a hydraulic pressure build up on one or the other side of the servo piston and this assists in turning the steering

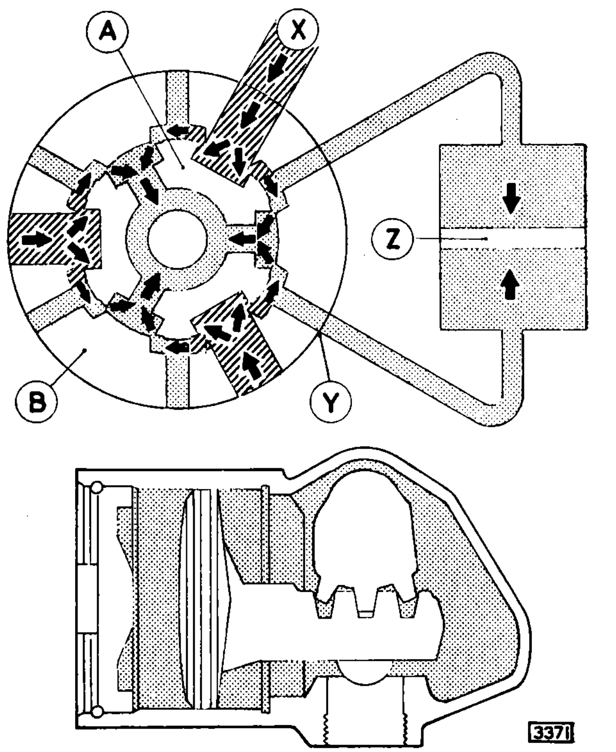


Fig. No. 2 *Operating diagram of the rotor valve (straight ahead)*

A Rotor
B Sleeve
X Pump pressure
Y Reservoir pressure
Z Equilibrium

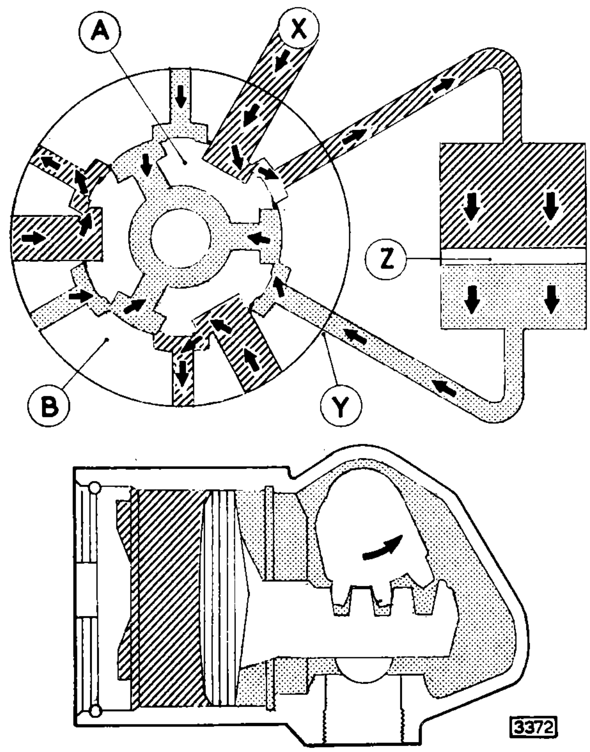


Fig. No. 3 *Operating diagram of the rotor valve (steering turned)*

A Rotor
B Sleeve
X Pump pressure
Y Reservoir pressure
Z Pressure displacement

THE PRESSURE PUMP

The pressure pump, which provides the hydraulic pressure in the system is of the vane type and incorporates a combined flow and relief valve.
The pump, which is contained within its own reservoir, is mounted on the right-hand side of the engine and is belt driven from the crankshaft pulley, the belt tension being automatically regulated by a spring loaded jockey pulley.

ROUTINE MAINTENANCE

EVERY 3,000 MILES (5,000 KM.)

Checking the Reservoir Oil Level

The only regular maintenance required for the power steering system is that of checking the oil level every 3,000 miles (5,000 km.)
The oil reservoir is mounted on the right-hand side of the engine. It is important that absolute cleanliness is observed when replenishing with oil, as any foreign matter that enters may effect the hydraulic system.
Clean the area around the filler cap and then remove the cap by turning anti-clockwise.
Check the level of oil and top up, if necessary, with the recommended grade. The level of oil must be up to the "Full" mark when the oil is warm.

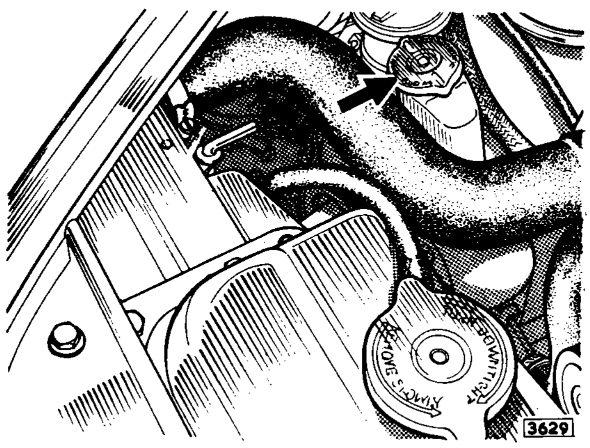


Fig. No. 4 *Power steering oil reservoir*

EVERY 6,000 MILES (10,000 KM.)

Steering Tie Rods

Lubricate the ball joints at the ends of the two steering tie-rods with the recommended lubricant.
The tie-rods are situated at the rear of the front suspension cross member.
When carrying out this operation examine the rubber seals at the ends of the ball housings to see if they have become displaced or split.
In this event, they should be repositioned or replaced, as any water or dirt that enters will cause premature wear.
A bleed hole covered by a circular nylon washer which lifts under pressure, indicates when sufficient lubricant has been applied.
This prevents grease from escaping past the seal when too much pressure is applied.

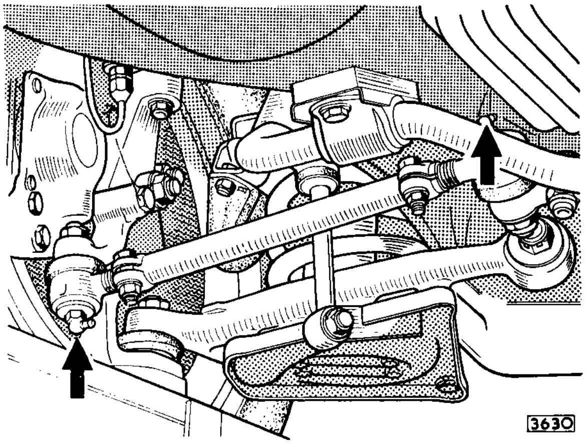


Fig. No. 5 *Steering tie rod grease nipples*

Wheel Swivels

Lubricate the nipples (four per car) fitted to the top and bottom of the wheel swivels.
The nipples are accessible from underneath the front of the car.

Front Wheel Alignment

Check the front wheel alignment as detailed on Page II.23.

EVERY 12,000 MILES (20,000 KM.)

Check the condition of the rubber coupling between the upper and lower steering columns. Renew if worn or contaminated with petrol, oil or brake fluid.

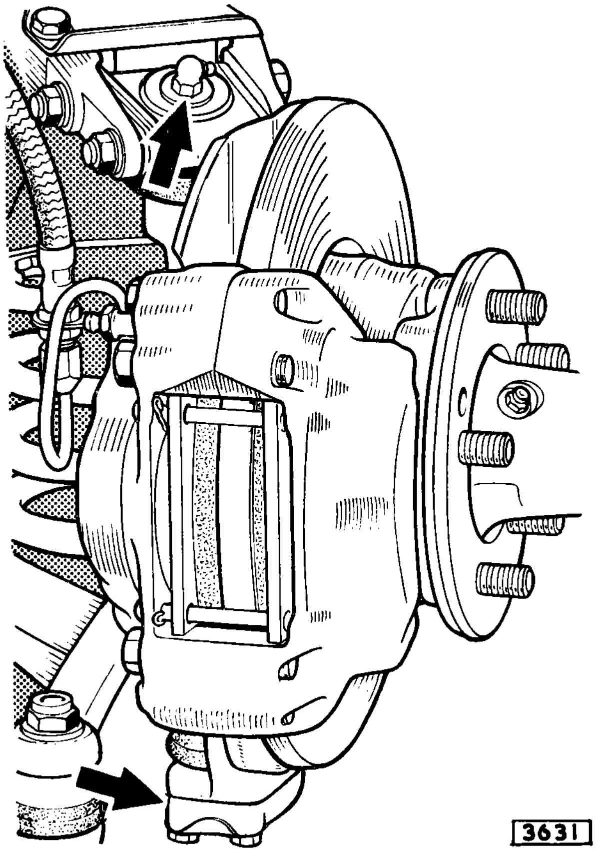


Fig. No. 6 *Wheel swivel grease nipples*

ADJUSTMENTS IN CAR

CENTRALISATION

This adjustment is carried out only when setting the front wheel alignment.
Because of the varying ratio curve, **it is most important** that the steering gear is centralised whilst the toe-in is being adjusted. Adjust the position of the steering wheel until the hole in the centralising plate on the input shaft aligns with the hole in the steering box.
Set the steering to the straight ahead position.
Check by inserting a $\frac{1}{4}''$ (6.4 mm.) rod, suitably bent. (Fig. 7).

SECTOR SHAFT ADJUSTMENT

If lost motion is present in the steering box, it is probably due to wear between the hour glass cam and roller. It is unlikely that this wear will occur except after very high mileage has been covered.
To check, centralise the steering as detailed under the previous heading; disconnect the centre tie-rod from the drop arm. Rock the drop arm by hand to both sides of the centre line to feel for excessive backlash. If necessary, release the locknut at the top of the steering box; screw in the adjuster screw until only slight backlash can be felt.

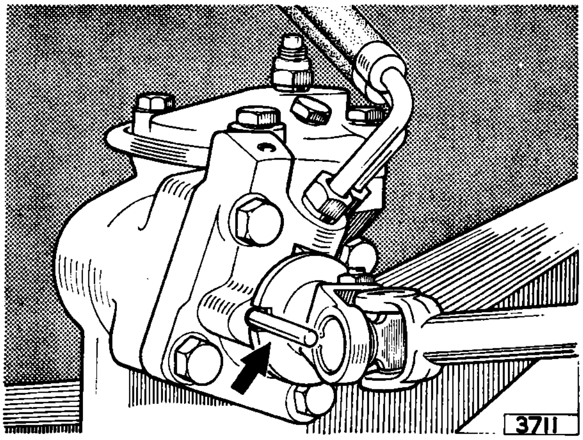


Fig. No. 7 *Centralising the steering*

Secure the locknut; refit the centre tie-rod (see note Page II.23) and road test the car.
Note: It is **IMPORTANT** that the steering gear is centralised when checking sector shaft backlash.
If this adjustment fails to remove the lost motion from the steering gear then the remedy will have to be effected with the gear removed from the car. However, before removal, it is possible to ascertain the cause of the trouble by carrying out the following test:-
With the engine switched off, oscillate the steering wheel and feel the gear input shaft for end-float, that is, it should not move in and out of the housing.
Note: If input shaft end-float exists, the steering will not only exhibit lost motion but will also rattle over rough roads.

If the steering suffers from pulling to the right or left, carry out the following preliminary tests before proceeding further:-
Check tyre pressures and change the front tyres from one side to the other.
If the pull changes direction then the trouble lies with one or both of the front tyres.
If the pull remains unchanged by the above operation, proceed as follows:-
Check the steering linkage for wear and carry out front wheel alignment procedure as detailed on page II.23.
If no improvement is apparent the fault must lie in the trimming of the valve in the steering unit.
To check, install a 2,000lb/sq.in. pressure gauge into the pressure line.
Set the steering in the straight ahead position, start the engine and allow to idle.
Turn the steering first to the left and then to the right, the pressure gauge should be watched during this operation to check that the pressures recorded are equal.
If the pressure rise is not balanced, the steering unit must be removed from the car and the worm and valve assembly renewed.

RACK ADJUSTMENT

In order to rectify certain knocking noises etc., (see Fault Finding Chart) it may be found necessary to remove any clearance between the teeth on the piston rack and the teeth on the sector shaft. New gears are built with the rack teeth pre-loaded into the sector shaft teeth and it is unlikely that its adjustment will be necessary until after considerable mileage. However, if the symptoms indicated in the Fault Finding Chart are present, then the rack can only be adjusted when the steering unit is removed from the car as detailed on Page II.8.

CHECKING THE HYDRAULIC SYSTEM

A number of faults in the steering system can be caused by inefficiencies in the hydraulic circuit, see Page II.25 for "Fault Finding" chart. The following checks can be carried out without removing any components from the car. Before starting any of this work the fluid should be checked for correct level and for lack of froth.

PUMP BLOW OFF PRESSURE

Fit pressure gauge into pressure line, start engine, run at idling speed, turn steering to full lock and continue to increase steering wheel effort until the pressure ceases to increase. The peak pressure should lie between 1,100 and 1,250 lb/sq. in. (77-87.5 kg/cm^2) and it should not increase with increased engine R.P.M. If, however, the pressure is below 1,100 lb/sq. in. at tickover but rises to the correct figure with increased engine speed then the trouble is caused either by a faulty control valve in the pump or by excessive internal leaking in the steering gear.
Fit a pressure gauge into the pressure line system with an "ON-OFF" tap in series between the gauge and the steering unit.
Start the engine; open the tap and turn the steering to full lock. Check the pressure reading on the gauge. This should read 1,200 lb/sq. in. (84 kg/cm^2).
If the pressure does not rise to this figure, **close the tap for a maximum of 5 seconds** and note the gauge reading. This should be 1.200 lb/sq. in. (84 kg/cm^2)—pump blow-off pressure.
If this reading is obtained, the leaks are confined to the steering unit which should be removed and overhauled.

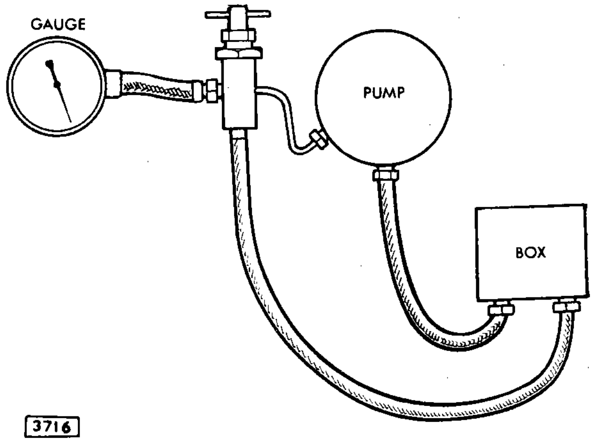


Fig. No. 8 *Checking the hydraulic system*

THE STEERING BOX

REMOVAL

The steering box can only be removed from beneath the chassis with the car on a ramp or over a pit.
Disconnect the high and low pressure pipe unions from the steering box unit and catch the oil, which will drain away, in a container.
Blank off the pipe and box unions to prevent the ingress of dirt.
Remove the nut and washer and disconnect the steering tie-rod ball joint from the drop arm using a suitable extractor.
Remove the upper steering column as detailed on Page II.18.
Withdraw three bolts and two nuts securing the steering unit to the cross member. Remove the unit complete with lower column and drop arm from beneath the car.

DISMANTLING (Fig. 9)

Withdraw the pinch bolt and remove the lower steering column.
Remove the nut (34) securing the drop arm (33) to the sector shaft (24).
Mark the location of the drop arm to the shaft to ensure correct assembly.
Using a suitable extractor, withdraw the drop arm from the spline of the shaft.
Invert the unit and drain the oil through the inlet orifice.
Remove feed pipe.
Set input shaft to straight ahead.
Slacken screw (22) and remove rack adjusting screw complete with thrust pad (23).
Undo four bolts (28) retaining top cover (25) and remove sector shaft and top cover from unit housing.

Annotations for Fig. 9 (opposite)

1	Steering box	**13**	Feed pipe assembly	**25**	Top cover
2	Screw	**14**	Piston and rack	**26**	Bleed screw
3	Valve and worm	**15**	Teflon sealing ring	**27**	Washer
4	Ball bearing	**16**	Teflon sealing ring	**28**	Screw and lockwasher
5	Ball bearing	**17**	Cylinder cover	**29**	Seal
6	Shims	**18**	Seal	**30**	Washer
7	Valve housing	**19**	Clip	**31**	Seal
8	Bolt	**20**	Plug	**32**	Circlip
9	Bolt	**21**	Seal	**33**	Drop arm
10	Spring washer	**22**	Screw	**34**	Nut
11	Centralising washer	**23**	Thrust pad	**35**	Tab washer
12	Shims	**24**	Sector shaft and worm follower		

JSP 168

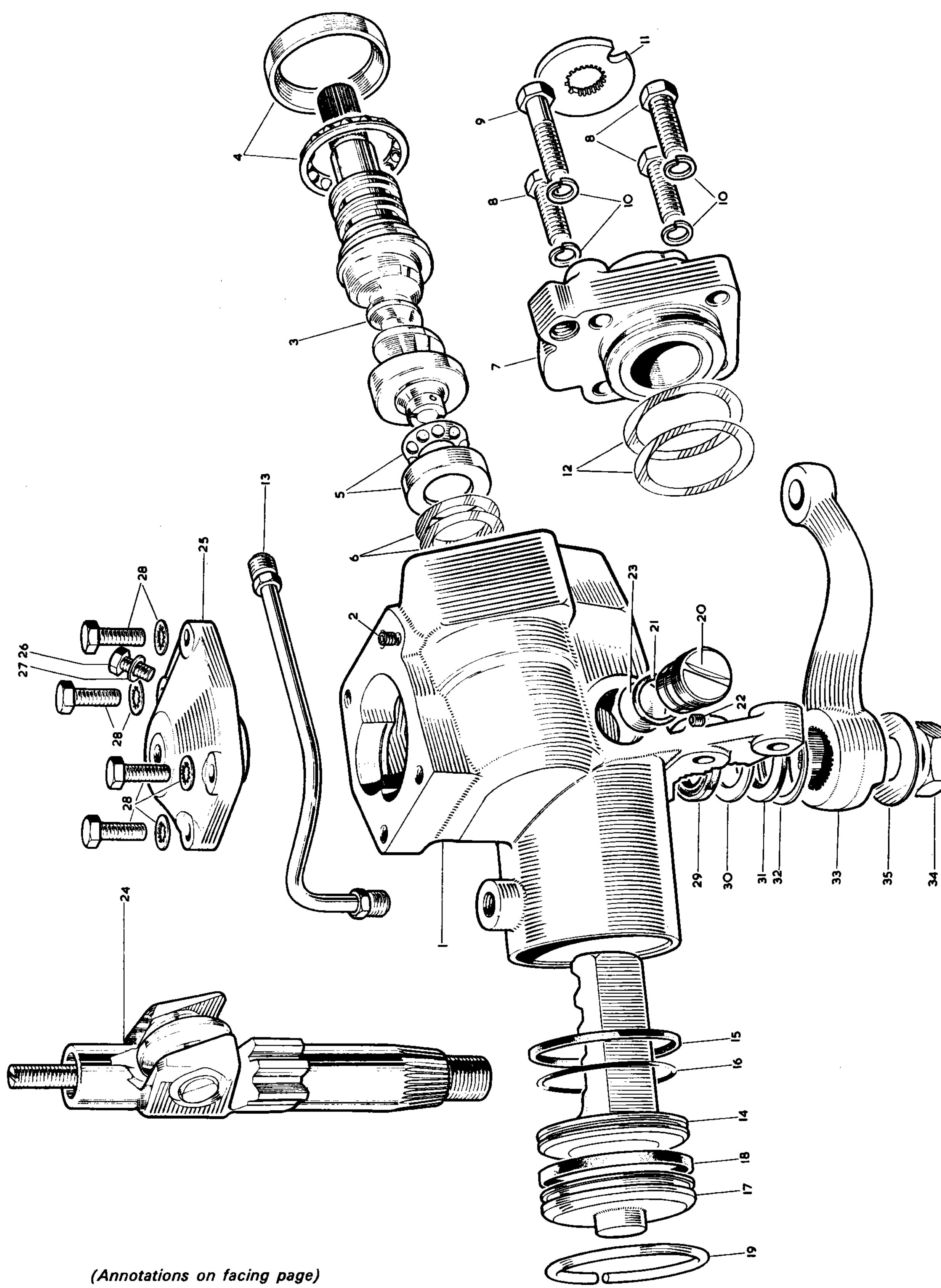


Fig. No. 9 *The steering box components*

(Annotations on facing page)

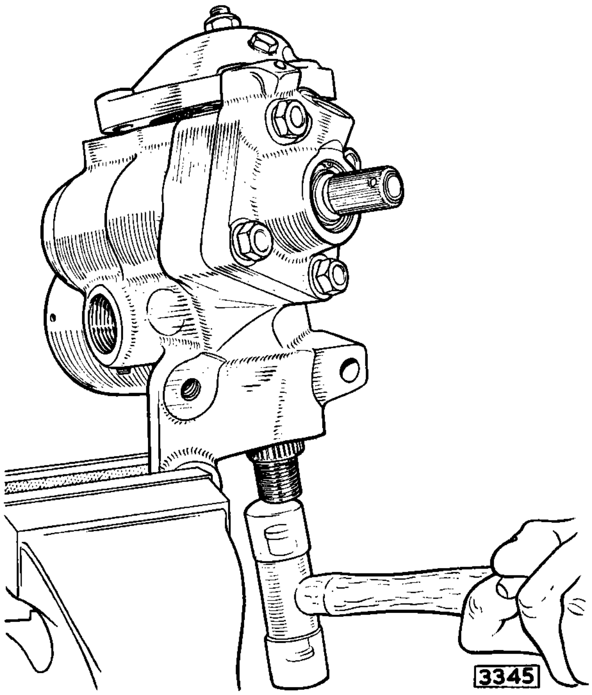


Fig. No. 10 *Removing the sector shaft and top cover*

Separate top cover from sector shaft assembly (24) by removing the self-locking locknut and screwing cover off adjusting bolt.
Withdraw the centralising washer from the input shaft.
Undo four bolts (8 and 9) and tap the valve housing (7) with a mallet.
Collect the shims (12) between the housing and the bearing outer races.
Remove the valve and worm assembly (3) complete with bearing (4).
Collect the inner race of bearing (4). If the bearing is to be replaced, withdraw the outer race with an extractor. It is important that none of the shims behind the outer race is mislaid. DO NOT remove the trim screw shown in Fig. 12.

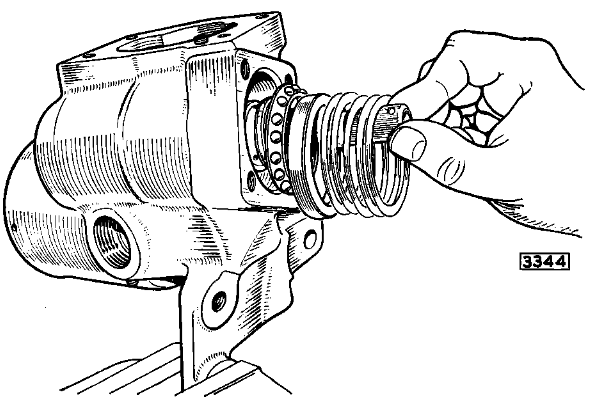


Fig. No. 11 *Removing the valve and worm assembly*

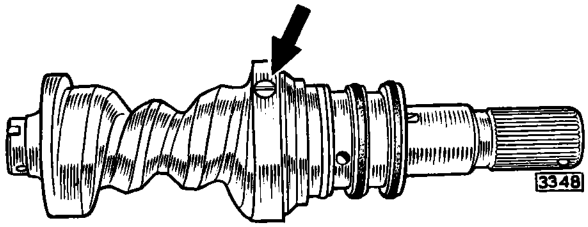


Fig. No. 12 *Location of trim screw*

Remove the cylinder cover retainer clip (19) by forcing it out of its groove with a short $\frac{3}{16}$" (4.5 mm.) steel punch. Once out of the groove a screwdriver will ease it completely clear.

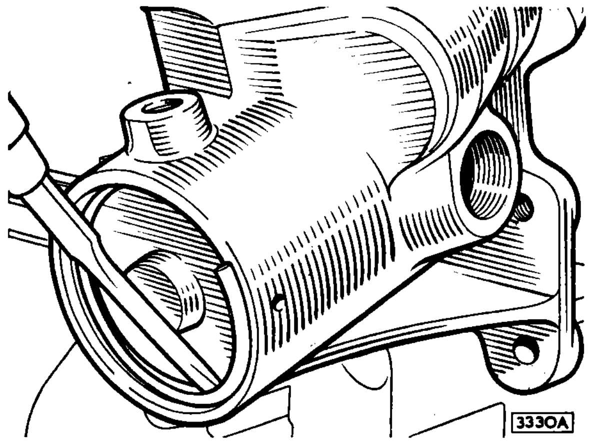


Fig. No. 13 *Removing the cylinder cover retainer clip*

Remove cylinder cover (17) complete with its seal, by pulling on the boss in the centre of the cover with grips or pliers.

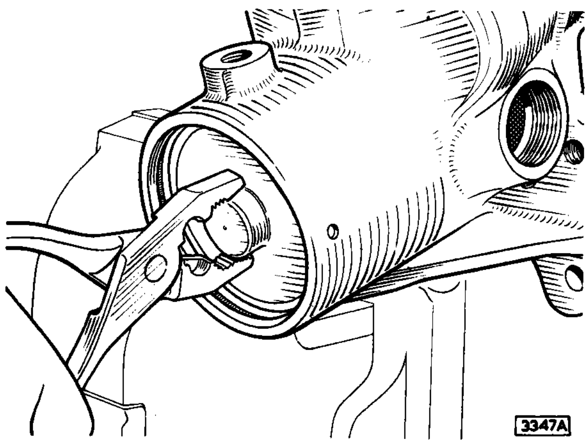


Fig. No. 14 *Removing the cylinder cover*

Screw a long $\frac{1}{2}$" UNC bolt or extractor into the tapped hole in centre of piston and rack (14) and withdraw assembly through open cylinder end.

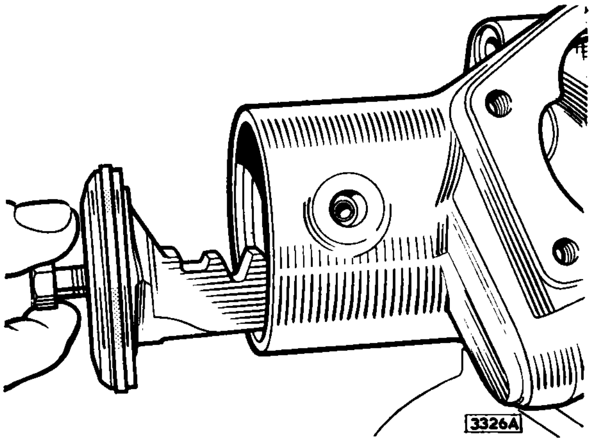


Fig. No. 15 *Withdrawing the piston and rack assembly*

The gear is now stripped down into its basic components as supplied for spares.

EXAMINATION OF COMPONENTS

Sector Shaft Assembly

If any wear or damage is found during the inspection points detailed below, the sector shaft must be replaced as an assembly.
Check roller for preload on thrust bearings, it should be free to rotate, but slightly stiff, with no side play.
Examine the three sector teeth for signs of excessive wear.
Examine bearing areas on top and bottom of sector shaft for excessive wear.
Examine seal area at bottom of sector shaft for wear, damage or grooving etc.

Cover Assembly

Examine sector shaft bush for wear. If excessive, the cover must be replaced.
Renew cover sealing ring.

Housing Assembly

Examine sector shaft bush for wear.
Examine hydraulic cylinder bore for damage, wear or scoring.
If unserviceable, the housing must be replaced.
Renew sector shaft seal.
Check the condition of the high and low pressure pipe seats in the housing and cover assemblies.
If worn, cracked or damaged, these can be renewed by tapping a suitable thread in the internal bore of the seat and inserting a setscrew with an attached nut and plain washer.
Tighten the nut down against the housing case and withdraw the seat.
Fit the new seat by inserting in the housing and tapping home square with a soft drift.

Valve and Worm Assembly

Examine the three teflon rings on the valve sleeve for damage. The rings should be a loose fit in their grooves and their outer diameter should be free from cuts, scratches and similar blemishes.
Replace any damaged rings.
Carry out the following examinations:- If, during any of these checks the condition of the valve and worm assembly proves unsatisfactory, the assembly must be replaced as a unit.
Examine valve and worm ball bearing tracks for wear or damage.
Ensure that there is no relative movement at the trim pin between valve sleeve and worm.
Check that there is no wear in the torsion bar assembly pins by ensuring that there is no free movement between the input shaft and the worm.
Examine the needle bearing area towards the outer end of the shaft for damage and wear, similarly examine the seal area.

Piston and Rack

(a) Examine teflon ring for damage, etc.
(b) Examine rack teeth for signs of undue wear.
(c) Examine back face of rack, that is, behind the teeth for signs of wear caused by the rack adjuster pad.

Valve Housing

Examine bore for signs of wear or damage, particularly on rubbing surfaces of teflon rings.
Examine the needle roller bearing for damage and replace if necessary. Renew the seal.

ASSEMBLING

Valve and Worm Assembly

It is important that the worm be centered in the gear housing to ensure the correct relationship between the ratio curve, the preload peak and the central position of the steering gear. During manufacture the critical dimension of both the worm and housing is measured in special fixtures, this dimension is effectively the distance from the small ball race to the centre of the worm. The checking fixture shows the amount in thousands of an inch that the box is deep also the amount that the worm is short. This error is etched on the worm and stamped on the box, hence, a worm which is 0.006" (0.15 mm.) short and a box which is 0.004" (0.10 mm.) deep will need a total of 0.010" (0.25 mm.) shims to bring the datum into the correct position, that is, simply add the two datum errors together to give the correct thickness of shims in "thous" (0.001's). Having determined and selected the correct number of shims, these should be placed in the bottom of the recess in the race housing.
Press the outer race of the small bearing into the recess on top of the shims.

Place the inner race of the bearing in position and lower the valve and worm assembly into place.

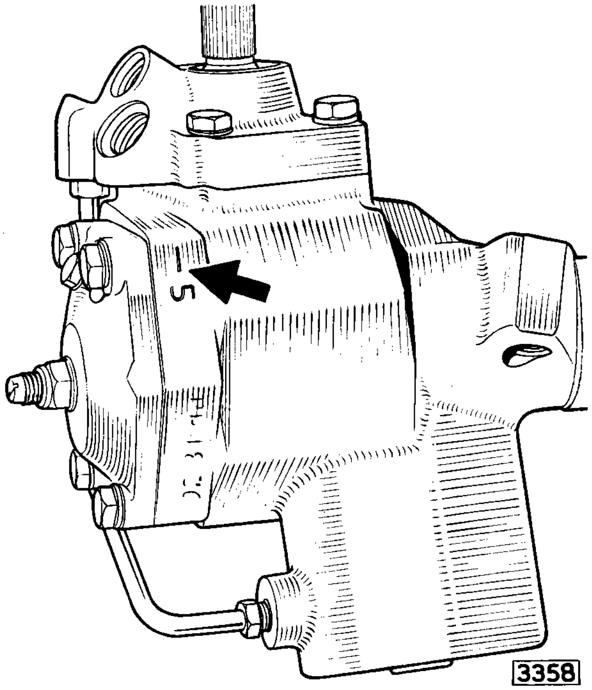


Fig. No. 16 *Location of the depth reading to facilitate the fitting of the valve shaft shims*

Fit the ball bearing assembly and cage (large) over top of worm.
Take valve housing assembly and remove large square sectioned "O" ring from the spigot.
Fit the valve housing over valve rotor, protecting rotor seal from rotor splines with seal saver and check input shaft for end-float. Remove valve housing and add shims in sufficient quantities to provide a 0.0015" (0.04 mm.) gap between the valve housing and the gear housing (see Fig. 17). This gap should be measured whilst reasonable hand pressure is applied to the valve housing. Remove the valve housing and tighten down the four bolts. The tightening down operation should increase the torque on the input shaft by 2 lb. in. (0.02 kg.m.). If this torque increase is not achieved then the shim pack should be altered accordingly.

Rack and Pinion Assembly
Always fit a new teflon piston ring with rubber "O" ring underneath it in the groove.
Screw a long $\frac{1}{2}$" UNC bolt into the tapped hole in the centre of the piston face.
Press the piston into its cylinder bore with its teeth facing the sector shaft bore so that the tips of the teeth are parallel to the sector shaft centre line. Push the piston into the bore until the piston top is 1.675" (42.5 mm.) from the mouth of the cylinder. In order to obtain this dimension it is necessary to remove the end plate.

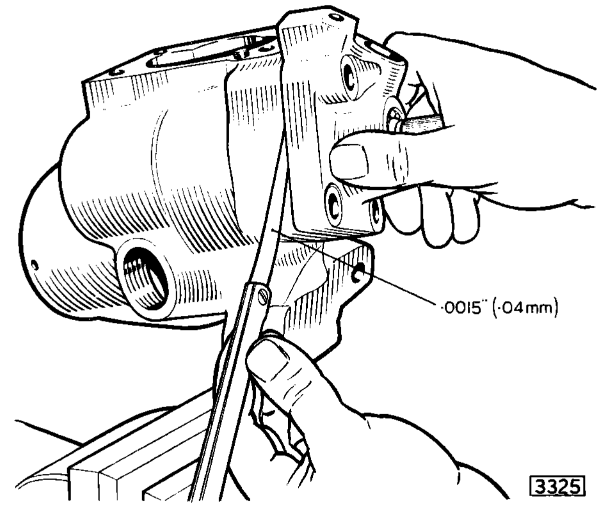


Fig. No. 17 *Checking the gap between the valve and gear housings*

Mis-align the piston in bore so that the back face of the rack is hard up against the gear casing adjacent to the rack adjuster screw bore.

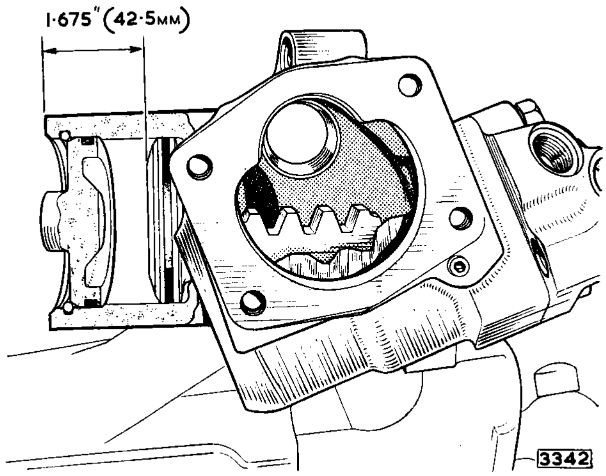


Fig. No. 18 *Rack and pinion assembly*

Sector Shaft Assembly
Remove the self-locking nut from top of adjuster screw, screw cover assembly onto adjuster screw as far as it will go.
Fit seal saver onto splined end of sector shaft and insert sector shaft into gear housing with the roller positioned towards the middle of the worm.
Manoeuvre the sector shaft to engage the rack teeth and move input shaft to and fro to engage the worm. Push sector shaft fully home.
Note: Ensure that the square sectioned 'O' ring seal is fully home in its recess before the top cover is bolted down.

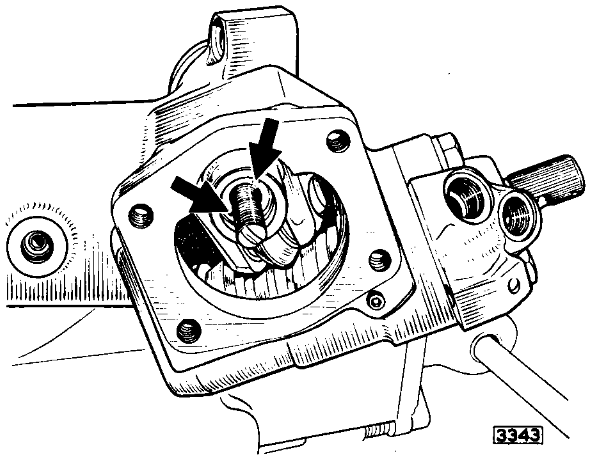


Fig. No. 19 *Positioning the roller towards the middle of the cam. The arrows indicate the adjustment slots in the top of the sector shaft.*

Fit the four screws with spring washers and tighten, at the same time ensuring that the spigot of the top cover is hard up against its recess in the casing aperture. This is done by forcing the cover away from the worm bore, possibly tapping it with a hide mallet.
Remove the long bolt from the piston face.

Rack Adjuster Screw
Position pad in its seating in rack adjusting screw. Fit a new seal into its recess and offer assembly up into screwed bore in gear housing ensuring that the pad remains in position. The gear should be laid on its side and the assembly screwed up vertically. Fit rack screw loosely and fit locking screw into its tapped hole.

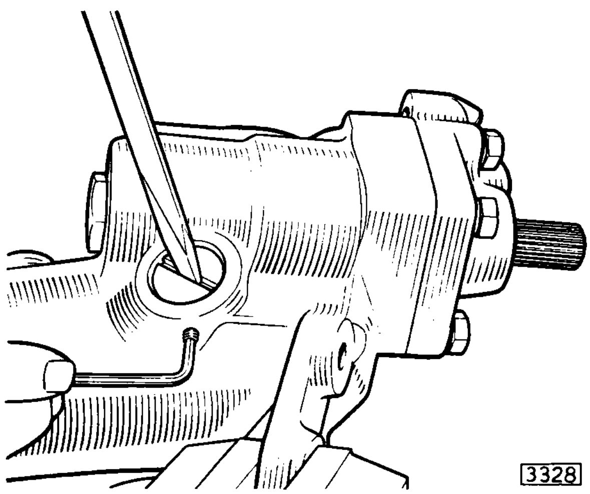


Fig. No. 20 *Tightening the rack pad locking screw*

Cylinder Cover
Fit new seal to cylinder cover and press into cylinder bore.
Fit cylinder cover retainer clip.

ADJUSTMENT OF REBUILT GEAR

Sector Shaft Adjustment
Using a torque wrench or just by "feel", turn the input shaft from lock to lock, noting the position at which the wrench arm passes through centre. Note the torque felt one full turn from centre in either position.
Using a screwdriver, turn the adjusting bolt in a clockwise direction a little at a time, turning the input shaft through the centre position until an increase of 4 lb. in. over the torque previously noted is achieved at the centre position. Hold the bolt stationary and lock in position with the nyloc nut.
Recheck the adjustment by turning from lock to lock If adjustment is correct, there will be an increase of 4lb. in. torque at centre over that of a turn from centre in either direction. N.B. The rack adjusting screw should be slackened off during this operation or false readings will result.
Excessive preloading of the sector shaft assembly into the hour glass worm will result in possible poor return efficiency in the car and should, therefore, be avoided.

Rack Adjustment
Again, with the use of a torque wrench, note the torque reading over centre of the gear (the position being found as under Sector Shaft Adjustment).
With the gear in this central position, screw in the rack adjustment screw firmly to ensure proper seating and then slacken off by about one quarter turn.
Screw in a little at a time, turning the input shaft through centre until an increase of 4 lb. in. over the previous centre torque is achieved at the centre position.
Rotate the input shaft from lock to lock and check this adjustment has not produced an increase of torque at any other point in excess of 4 lb.in. If it has, the centre torque should be reduced until this maximum is achieved.
Lock the rack adjusting screw by means of the small socket screw.
Finally, check the total torque reading for the whole assembly—this should not be more than 16 lb. in. at or near the centre position.

Remaining Parts
Fit the feed pipe assembly.
Fit the drop arm to the steering unit, noting the location marks as scribed on removal. Fit the tab washer and nut, tightening the nut to a torque of 130 lb. ft.

REFITTING

Refitting is the reverse of the removal procedure.
Reconnect the high and low pressure hoses, care being taken to ensure that the connections are perfectly clean.
Refit the upper steering column as detailed on page II.21.

Refill the reservoir to the full mark on the dipstick with the recommended grade of Automatic Transmission Fluid and bleed the system as follows:-

(a) Release the hexagon plug in the steering unit top cover and start the engine. Close the plug when the air has been expelled.

(b) With the engine running, turn the steering from lock to lock a few times to check for lumpiness.

(c) Check the fluid level in the reservoir; the correct level is to the full mark on the dipstick with the oil hot. Top up, if necessary, with the recommended grade of fluid.

REPLACEMENT OF EXTERNAL SEALS

Sector Shaft Seal

This seal can be replaced with the sector shaft in position but great care must be exercised to protect the splines of the shaft to prevent damage to the new seals.

Input Shaft Seal

This seal cannot be replaced with the steering unit in position on the car.
Remove the steering unit, as detailed on Page II.8.
Remove the valve housing, taking care not to misplace any of the large shims between the valve housing and the bearing. Withdraw the circlip and remove the seal.

REPLACEMENT OF INTERNAL SEALS

Dismantle the steering unit as described on Page II.8.
To replace worn or damaged Teflon rings on the valve and worm proceed as follows:-
Cut the old ring through with a sharp knife and remove from the groove.
Teflon rings have poor elastic qualities. They can, however, be stretched and compressed if handled with care. To fit a ring into a particular groove, slide the ring onto the Valve Seal Expander (Tool No. J.32) and work it up to the large end. Slide the expander over the sleeve positioning the end cover over the groove. Push ring over the end of the expander into the groove.
Note: The expander will not fit over the sleeve when the rings are fitted in their grooves, so that it may be necessary to remove good rings in order to replace faulty ones.
Now, having expanded the ring it is necessary to compress it into its groove. This is achieved by gently working the sleeve assembly into the valve seal compressor (Tool number J.33) starting with the end having the shallow taper and finishing with the other end which has the steep taper.

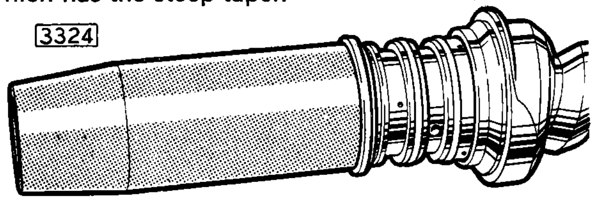


Fig. No. 21 *Fitting a Teflon ring using the valve seal expander (Tool No. J.32)*

When the compressor is withdrawn, the rings should be fitting snugly in their grooves. They should be free to rotate, free from cuts and blemishes and have slight interference with the bore of the valve housing into which they fit when the steering unit is assembled.

Replacement of Piston Rings

If the teflon piston ring is found to be damaged or worn, replace it with a new one. Cut the ring and remove from groove and remove rubber "O" ring which will be found underneath it. Expand a new rubber "O" ring and position it in the bottom of the groove. Then take a new ring and fit it into one side of the groove, working round the groove in both directions in much the same way as a tyre is fitted to a wheel rim. Care should be taken to avoid stretching the ring excessively.

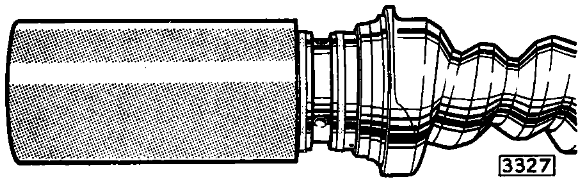


Fig. No. 22 *The valve and compressor (Tool J.33 in position)*

THE PRESSURE PUMP

REMOVAL

Release the nut securing the pump mounting bracket bottom bolt and remove the setscrew and washer securing the adjusting link to the water pump.
Swing the pressure pump inboard, lift the jockey pulley against the spring pressure and remove the drive belt from the pump pulley.
Release the hose clip and disconnect the low pressure hose from the pump. Blank off the union to prevent the ingress of dirt and catch any escaping oil in a clean container.
Disconnect the high pressure hose from the pump connection and blank off the union.
Remove the two nuts and lockwashers from the pump mounting studs and withdraw the unit from the bracket. Note the location and number of the spacing washers between the pump and the mounting bracket for reference when refitting.

DISMANTLING

Drain the oil out of the pump and thoroughly clean the exterior.
Tap back the tab washer, remove the nut and withdraw the pulley.
Clamp the pump into a vice, taking care not to exert undue pressure on the front hub as this may distort the shaft bushing.
Remove the outlet union (4 Fig. 33) noting the "O" ring (5) in the recess. Remove the two mounting studs (3 Fig. 33).
Detach the reservoir from the pump body.
Collect the three "O" rings (6 and 7 Fig. 33) from the recesses in the pump body.
Remove the end plate retaining ring by pushing a pin through the hole in the pump body and levering out with a screwdriver.

Remove the end plate and spring (20 and 19 Fig. 33). If the end plate sticks in the pump body a light tap will free it.

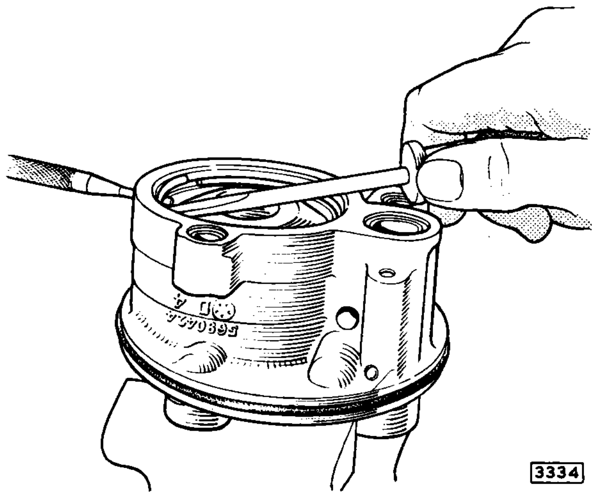


Fig. No. 23 *Removing the end plate retaining ring*

Remove the end plate "O" ring (22 Fig. 33) from the recess in the pump body.
Remove the flow control valve and spring (23 and 24 Fig. 33).
Remove the key (11 Fig. 33) from the shaft and gently tap the end until the pressure plate, pump ring, rotor and thrust plate can be removed as an assembly.

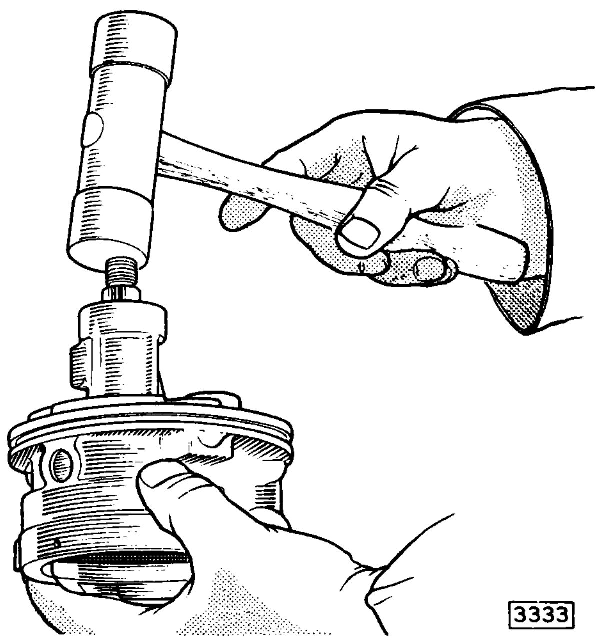


Fig. No. 24 *Removing the pressure plate assembly*

Remove the pressure plate "O" ring (22) from the pump body.
Separate the components taking care not to damage the pump rotor vanes.
Remove the clip (14 Fig. 33) and withdraw the rotor (13) and thrust plate (12).
Remove the shaft oil seal (25 Fig. 33).

INSPECTION

Carefully clean all parts except the "O" rings and shaft seal which should be replaced. Do not immerse any of the new seals in the cleaning solvent otherwise they may be damaged.
Check the pressure plate, thrust plate and rotor for scoring. A high polish is always present on the faces as a result of normal wear—do not confuse this with scoring. Light scoring can be rectified by lapping.
Examine the contour surface of the pump ring for extreme wear. There may be some scuff marks and uniform wear, but this is not detrimental. However, if chatter marks or grooves are present which can be felt with the finger, both the ring and the vanes should be replaced.
Inspect the pump shaft and bushing; the bush is not supplied as a separate part.
The flow control valve must slide freely in the bore and if the valve tends to stick, check for burrs or foreign matter.
Renew the valve if faulty.

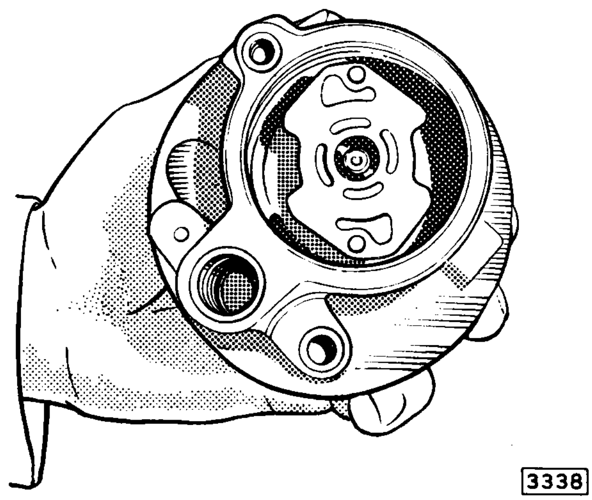


Fig. No. 25 *Fitting the thrust plate*

ASSEMBLING

Lubricate a new shaft seal with petroleum jelly and fit the seal to the pump body using a tube of suitable diameter. Insert the pump shaft, splined end first, from the hub end of the body.
Insert the dowel pins into the holes in the pump body.
Fit the thrust plate over the dowel pins with the ported face uppermost (Fig. 25).

Fit the rotor to the splined shaft with the countersunk side downwards, that is, towards the thrust plate. The rotor must be free on the splines.

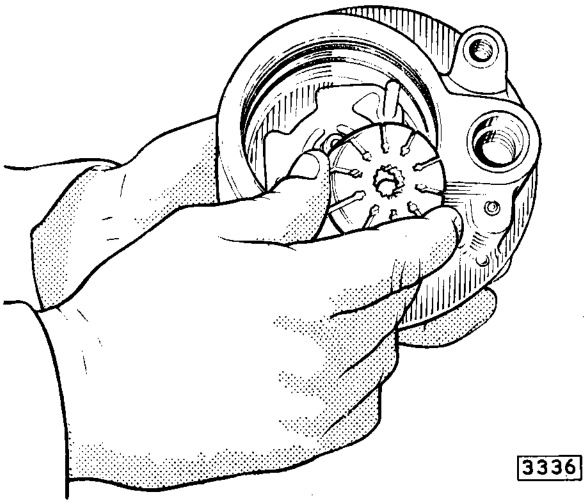


Fig. No. 26 *Fitting the rotor*

Fit the retaining clip to the groove in the end of the shaft. Fit the pump to the dowel pins with the rotation arrow uppermost.

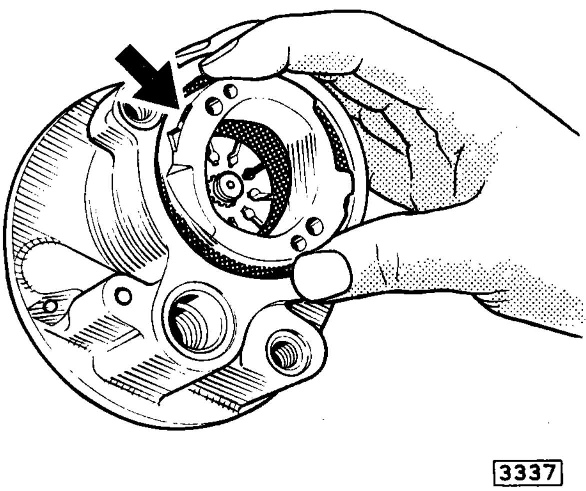


Fig. No. 27 *Fitting the pump ring*

Place the vanes in the rotor slots ensuring that the radiused edge of each vane faces towards the outside. Smear the pressure plate "O" ring with petroleum jelly and install into lowest groove in the pump body.
Lubricate periphery of pressure plate with petroleum jelly and fit to the dowel pins with the circular recess for the spring uppermost. Push the plate down by means of a piece of tube applied at the outer edge. Do NOT press or tap the plate into position.

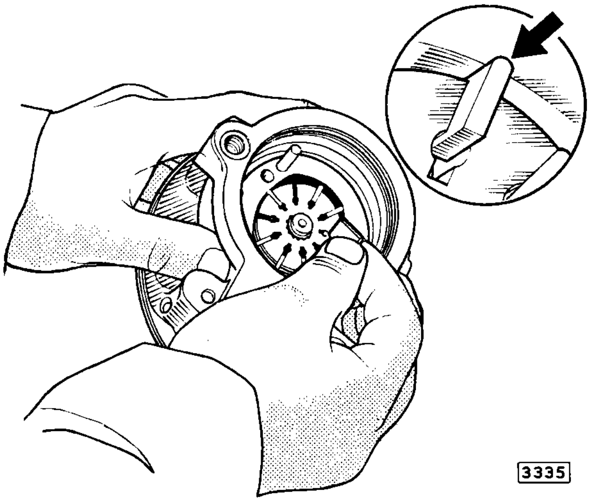


Fig. No. 28 *Placing the vanes in the rotor slots*

Smear the end plate "O" ring with petroleum jelly and install into its groove in the pump body.

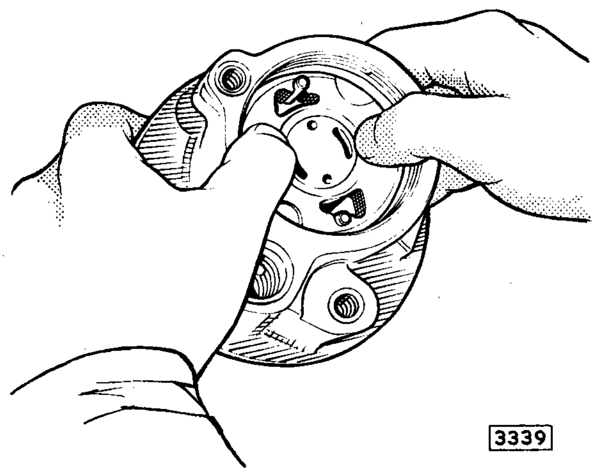


Fig. No. 29 *Placing the pressure plate in position*

Fit the spring (19 Fig. 33) into the circular groove in the pressure plate.
Lubricate the periphery of the end plate with petroleum jelly to avoid damaging the "O" ring.
Place the end plate in position with the retaining ring on top. Ensure that the gap in the clip is not opposite the hole used for removal.
Place the assembly under a press and apply pressure until the retaining clip can be sprung into the groove in the body.

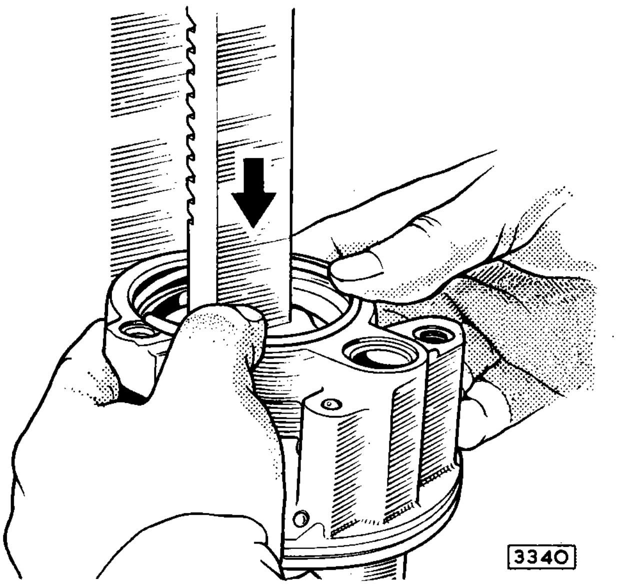


Fig. No. 30 *Compressing the spring prior to final assembly*

Ensure that the spring is fully wound onto the flow control valve and insert the valve, spring foremost, into the bore in the pump.
Place new "O" rings for the reservoir retaining bolts and outlet union in position.

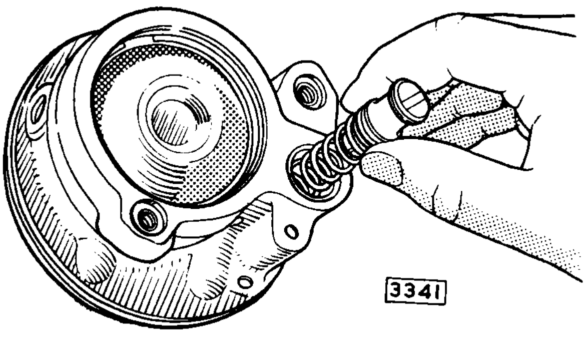


Fig. No. 31 *Inserting the flow control valve*

Smear the large reservoir "O" ring (9, Fig. 33) with petroleum jelly and fit to the groove in the pump body. Fit the reservoir to the pump body taking care not to displace the "O" rings.
Fit the reservoir retaining studs (3 Fig. 33) outlet union (4) with "O" ring (5) located in the groove in the union.
Refit the pulley key and pulley and secure with the tab washer and nut.

REFITTING

Refitting is the reverse of the removal procedure.
Reconnect the high and low pressures hoses, care being taken to ensure that the connections are perfectly clean.

Fill the reservoir to the full mark on the dipstick with the recommended grade of Automatic Transmission Fluid and bleed by turning the pulley anti-clockwise a few times to dispel any air in the pump.

Lift the jockey pulley against the spring pressure and feed the drive belt over the jockey pulley. Move the pump outboard to the full extent of the elongated hole in the adjuster link and lock the securing screw.
Release the jockey pulley.
Bleed the complete system as follows:-

(a) Release the hexagon plug in the steering unit top cover.
(b) Start the engine and while running, turn the steering from lock to lock a few times.
(c) Retighten the hexagon plug and check the fluid level in the reservoir. The correct level is to the full mark on the dipstick with the oil hot. Top up, if necessary, with the recommended grade of Automatic Transmission Fluid.

1 Driving shaft
2 Pump vane
3 Pump ring
4 Pump body
5 Filler cap
6 Reservoir
7 Oil seal
8 End plate
9 Spring
10 Pressure plate
11 Flow control valve
12 Spring
13 Thrust plate
14 Rotor

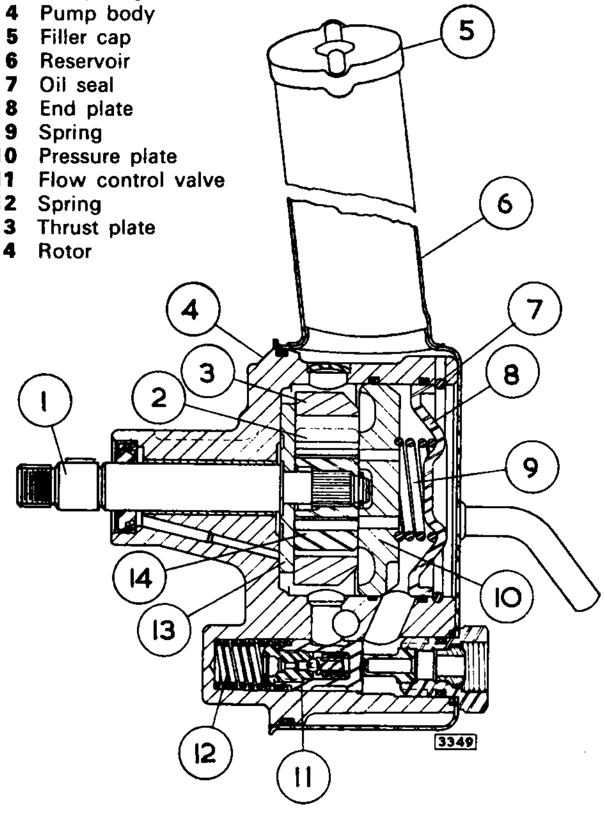


Fig. No. 32 *Section of steering pump*

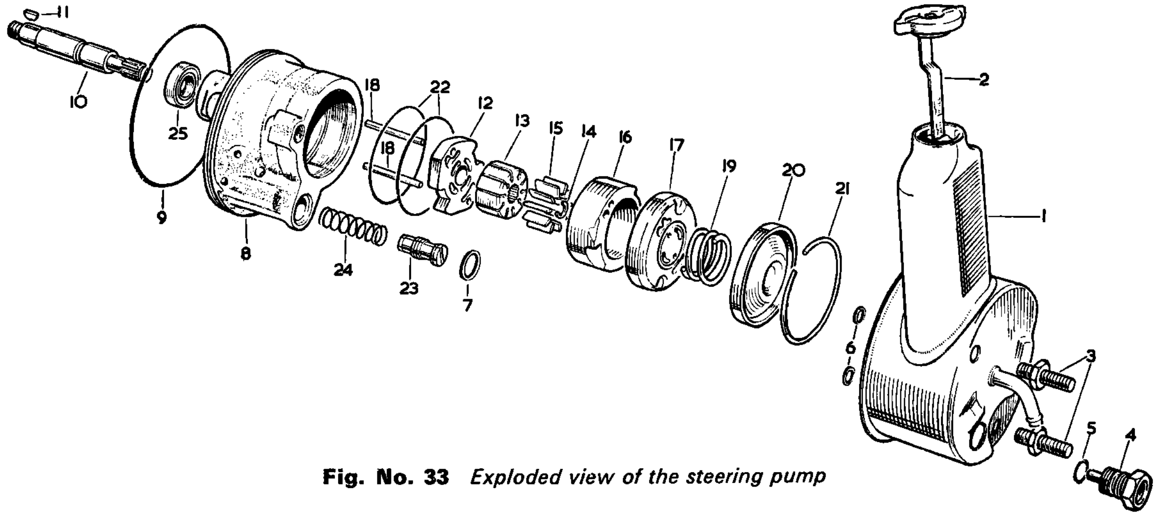


Fig. No. 33 *Exploded view of the steering pump*

1	Reservoir assembly	**10**	Shaft	**19**	Spring
2	Filler cap assembly	**11**	Key	**20**	End plate
3	Stud	**12**	Thrust plate	**21**	Clip
4	Outlet union	**13**	Rotor	**22**	"O" ring
5	"O" ring	**14**	Clip	**23**	Flow control
6	Seal (small)	**15**	Pump vane	**24**	Spring
7	Seal (large)	**16**	Pump ring	**25**	Oil seal
8	Pump body assembly	**17**	Pressure plate		
9	"O" ring	**18**	Pin		

STEERING WHEEL

Removal (Fig. 34)

Withdraw four cheese-headed screws from the underside of the steering wheel centre and detach the horn switch cover.
Remove three setscrews and washers securing the horn ring to the steering wheel and detach the ring.
Unscrew the locknut (22) and the nut (20) securing the steering wheel to the inner column.
Withdraw the steering wheel and collect the two halves of split cone (18).

Refitting

Secure the split cone (18) in position in the inner column shaft grooves, ensuring that the narrowest portion of the cone is towards the top of the column.
Slide the steering wheel onto the column shaft splines so that the two spokes are horizontal when the road wheels are pointing straight ahead.
Push the steering wheel fully home onto the split cone
Fit the plain washer, the securing nut and the locknut.
Refit the horn ring and cover.

STEERING COLUMN (UPPER)

Removal (Fig. 34)

Disconnect the battery.
Turn the road wheels to the straight ahead position. If retained in this position, this will facilitate the refitting procedure.
Disconnect the cables from the flashing indicator/headlamp flasher switch at the snap connectors.
If overdrive is fitted, disconnect the cables from the overdrive switch at the snap connectors.
Remove the two screws and washers securing the switch upper cover to the lower cover below the steering wheel.
Lift off the upper cover and remove the three bulb holders from the back. Note the location of the bulbs for reference when refitting.
Disconnect the four cables from the inhibitor switch located on a bracket attached to the steering column Note the location of the cables for reference when refitting. (Automatic Transmission cars only).
Disconnect the gear selector control cable ball joint from the selector lever on the steering column. (Automatic Transmission cars only).
Disconnect the four cables from the steering column lock (if fitted) and ensure that the key is in the "Garage" (normal stop) position. Note the location of cables for reference when refitting.
Note: The switch unit cannot be removed from the outer column.
Remove the four cap nuts and detach the trim panels covering the column above the parcel tray.
Release the clip securing the bottom of the outer tube to the mounting bracket on the bulkhead.
Remove the horn switch cable from the contact at the bottom of the steering column.
Remove the pinch bolt securing the inner column at the top universal joint of the lower column. Mark the location of the inner column splines in relation to the joint for reference when refitting.
Remove two bolts, nuts and washers securing the steering column to the upper mounting bracket. Collect any shim plates located between the column and body brackets.

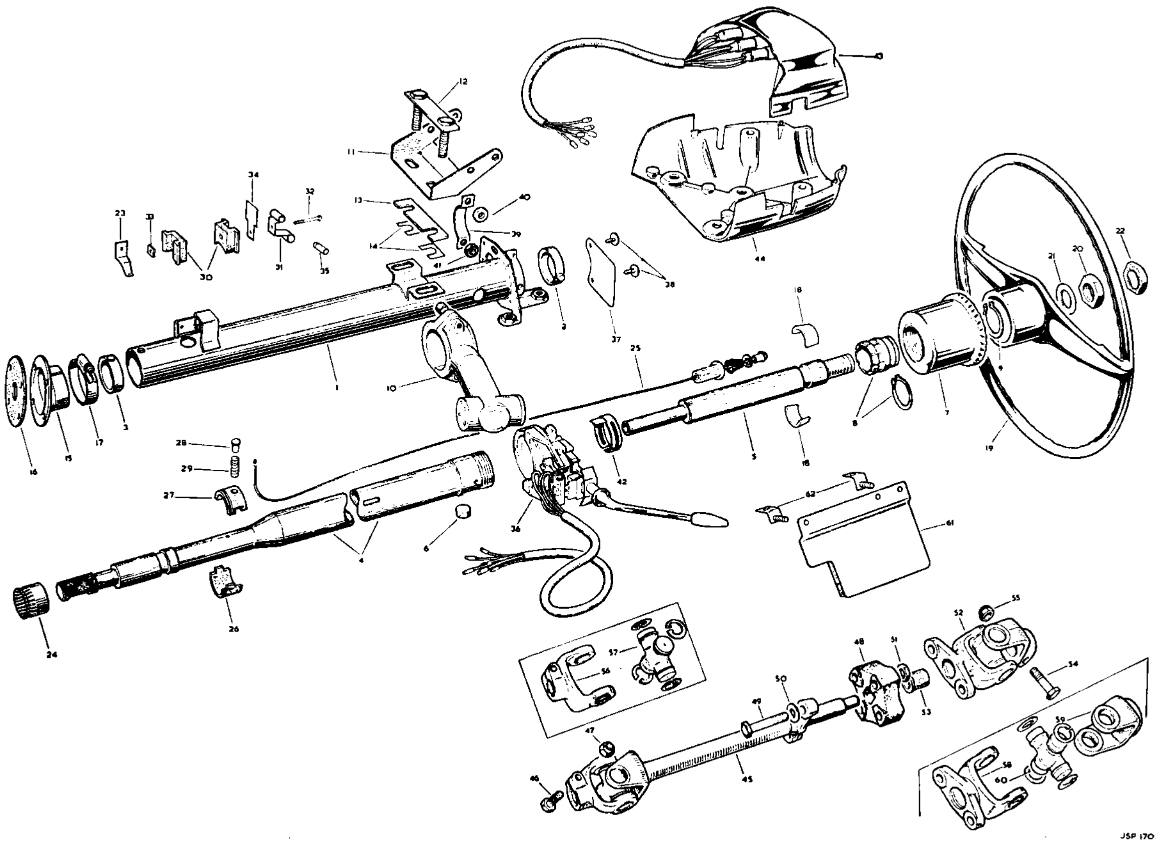


Fig. No. 34 *Exploded view of the steering column*

Dismantling

Remove the steering wheel as described previously.
Withdraw the inner column.
Unscrew the steering wheel locking nut and withdraw the nut from the splined inner shaft.
Remove the two setscrews, serrated and square washers securing the flashing indicator switch striking ring.
Remove the stop button and withdraw the inner shaft.
Slide off the horn pick-up ring and remove the bottom half of the rotor assembly. Remove the circlip from the end of the horn contact nipple and remove the spring and plastic sleeve.
Withdraw the horn wire and top half of the rubber rotor.
Remove the flashing indicator switch as follows:-
Release the locknut from the lower clamp screw.
Detach the clamp and switch. Note the distance piece fitted to the top of the screw.
If the car is fitted with automatic transmission, proceed as follows:-
Remove the screws securing the inhibitor switch carrier to the mounting bracket and outer column and detach the link.
Release the square headed screw securing the operating lever to the operating shaft.
Remove the circlip and washer from the underside of the shaft upper bearing. Remove the setscrew, nut and washer securing the gear indicator arm bearing to the bracket on the outer column.

1	Outer tube assembly	**32**	Bolt
2	Top bearing	**33**	Nut
3	Bottom bearing	**34**	Insulating strip
4	Inner column	**35**	Eyelet dowler
5	Shaft	**36**	Direction indicator switch
6	Stop button	**37**	Insulating strip
7	Locknut	**38**	Stud
8	Split collet	**39**	Clamp
9	Circlip	**40**	Spacer
10	Steering column lock	**41**	Nut
11	Upper bracket	**42**	Drive clip
12	Screw plate assembly	**43**	Upper switch cover
13	Spacer	**44**	Lower switch cover
14	Shim	**45**	Lower column assembly
15	Bracket assembly	**46**	Bolt
16	Gasket	**47**	Nut
17	Clip	**48**	Coupling
18	Split cone	**49**	Bolt
19	Steering wheel	**50**	Washer
20	Steering wheel nut	**51**	Locknut
21	Washer (special)	**52**	Universal joint
22	Locknut	**53**	Steady bush
23	Earth contact	**54**	Bolt
24	Slip ring	**55**	Nut
25	Contact cable	**56**	End yoke
26	Rotor (bottom half)	**57**	Journal assembly
27	Rotor (top half)	**58**	Flange yoke assembly
28	Contact	**59**	End yoke
29	Spring	**60**	Journal assembly
30	Contact holder	**61**	Shield assembly
31	Contact	**62**	Bracket assembly

Withdraw the shaft and lever as an assembly.
To remove the gear selector lever from the pivot bracket, extract the split pin and washer and withdraw the clevis pin. Detach the lever and collect the return spring and shims (if fitted).
Remove two setscrews and lock washers and remove the selector quadrant and spacers.
Remove the nuts and bolts securing the two rubber contact holders, fibre insulating strip, slip ring contact blade and earth contact.
Depress the retaining lugs and withdraw the bearing bushes from the top and bottom of the outer tube.
If the car is fitted with overdrive transmission, remove the overdrive switch after withdrawing two setscrews, nuts and lockwashers.

REASSEMBLY

Replace the two bearing bushes ensuring that the lugs register in the holes of the outer column.
If the car is fitted with automatic transmission, refit the selector control as follows:-
Refit the selector quadrant and spacers.
If removed during the dismantling procedure, insert the shims and return spring in the pivot bracket, refit the gear selector lever and secure with the clevis pin, washer and split pin. Lightly grease the spring before fitting the lever.
Pass the operating shaft through the top bearing. Slide the plain washer and circlip over the shaft. Fit the operating lever to the shaft and feed the shaft through the bottom bearing. Secure in position with the plain washer and circlip.
Secure the operating lever to the operating shaft by tightening the square headed locking screw, ensuring that the screw registers with the flat on the shaft.

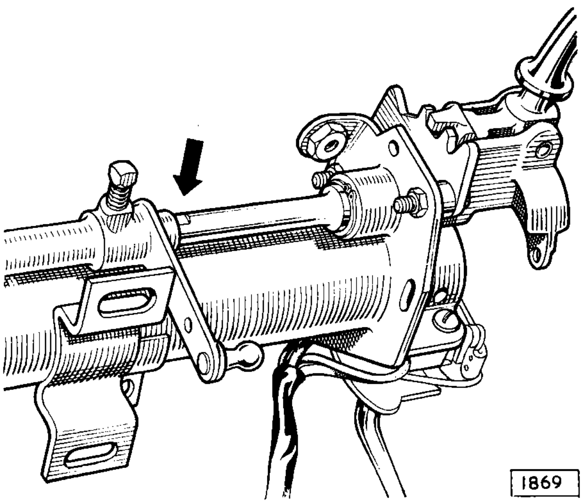


Fig. No. 35 *Align the flat on the end of the upper control shaft with the securing screw on the control lever.*

Refit the gear indicator arm bearing to the bracket on the outer column.
Reconnect the inhibitor switch to the operating link and secure to the mounting bracket. Do not tighten the screws at this juncture.

Refit the flashing indicator switch. Pass the two fixing screws through the switch clamp; attach the spring washer and locknut to the lower screw and the distance piece and washer to the top screw. Feed the screws through the column bracket and secure to the indicator switch. Tighten the top screw fully.
If the car is fitted with overdrive transmission, refit the overdrive switch to the outer tube.
Thread the horn wire through the inner column and fit the top half of the rubber rotor. Fit the bottom half of the rotor and slide the horn slip ring over both halves with the serrations in the ring towards the bottom of the column. Gently knock the serrations of the ring in the groove of the rubber rotors until secure.
Refit the two rubber contact holders, fibre insulating strip, slip ring contact blade and earth contact to outer tube.
Slide the inner shaft over the horn wire into the inner column so that the slot in the shaft serrations aligns with the stop button hole in the inner column. Screw the stop button fully into position until the inner shaft binds on the button. Slacken the stop button until the inner shaft can move freely.
Fit the striker plate with the striker peg towards the bottom of the column and on the opposite side to the stop button.
Turn the inner column until the striker retaining bolts are in the vertical position and set the striker peg so that it is just below the horizontal axis position.

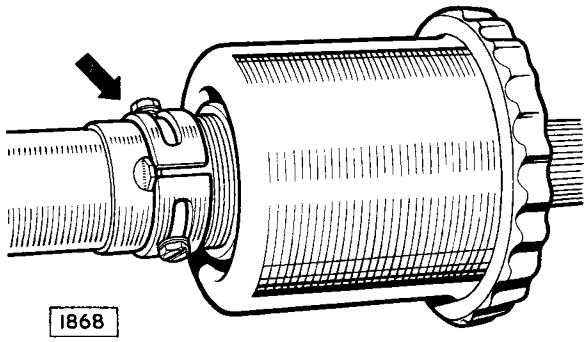


Fig. No. 36 *Centralising the flashing (turn) indicator switch striker peg*

If the car is fitted with automatic transmission set the inhibitor switch as follows:-
Select neutral (N) on the gear selector quadrant and hold in this position.
Rotate the switch in the clamp ring (C) and move the bracket in the elongated holes until the small hole in the lever (B) registers with the indent in the back of the switch (A).
Tighten the clamp ring and bracket screws.
Slide the inner column into the outer tube ensuring that the earth contact is not damaged and that the horn contact does not foul on the slip ring of the inner column. The contact may be lifted slightly with a screwdriver whilst the column is placed in position.

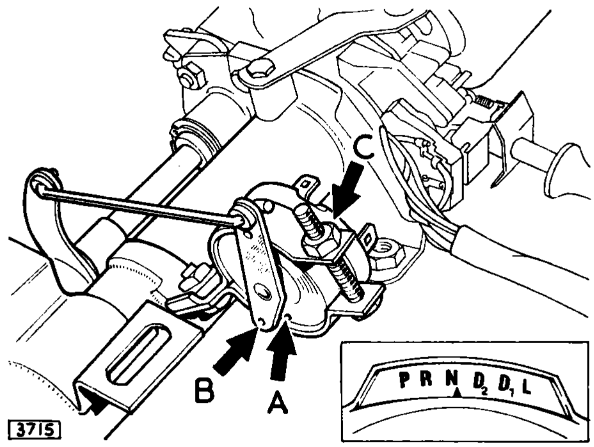


Fig. No. 37 *Setting the starter/reverse inhibitor switch striker peg*

Attach a spring balance to the steering wheel (Fig. 38) Tighten the bottom screw until the steering wheel will just turn with a pull of 5 ozs. (141.7 grammes) registered on the balance. Turn the locknut towards the switch carrier bracket and lock the screw. Two thicknesses of distance piece are available to compensate for any variation in the bore of the outer tube.

Grade "A" 0.188" (4.7 mm.).
Grade "B" 0.166" (4.2 mm.).

REFITTING

Ensure that the front roadwheels are in the straight ahead position.
Feed the outer tube through the bottom mounting bracket. Fit shim plates and secure to the top mounting bracket with two bolts, nuts and washers.

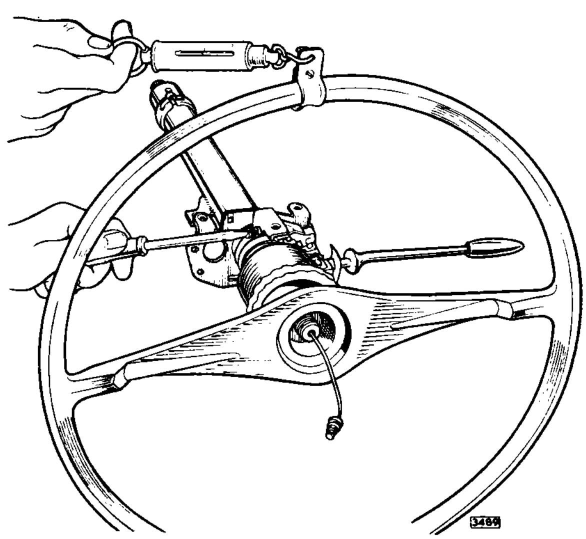


Fig. No. 38 *Upper steering column bearing adjustment points*

Tighten the jubilee clip securing the outer tube to the bottom mounting bracket.
Turn the inner column and centralise the flashing indicator striker between the two arms of the indicator switch.
Engage the splines of the inner column with the socket of the upper universal joint of the lower steering column.
Pull the inner column upwards until the lower edge of the indicator switch striker is level with the bottom of the slot in the nylon trip ring.
Reconnect the flashing indicator switch cables in their correct colour sequence.
If the car is fitted with overdrive, reconnect the cables to the overdrive switch.
If fitted with automatic transmission, reconnect the four cables to the inhibitor switch in the correct sequence.
Reconnect the cables to the steering column lock (if fitted).
Attach the gear selector control cable ball joint.
Refit the plastic sleeve and spring to the horn wire and secure with a circlip.
Re-insert the bulb holders into the upper switch cover in the correct sequence.
Refit the steering wheel locking nut to the inner shaft.
Refit the covers (top and bottom), steering wheel and trim panels by reversing the removal procedure.

STEERING COLUMN (LOWER)

Removal

Turn the road wheels until the pinch bolt of the lower column is accessible.
Remove the pinch bolt.
Re-set the road wheels in the straight ahead position.
Disconnect the upper column as detailed on Page II.18.
Withdraw the lower column and detach the rubber coupling.

Detaching the Rubber Coupling

Remove the four locknuts (51 Fig. 34).
Withdraw the plain washers and unscrew the four Allen headed screws (49) attaching the upper column universal joint and the lower column (45) to the rubber coupling.
Remove the lower steady bush from the upper universal joint if worn or damaged.
Check the condition of the rubber coupling and renew if worn or contaminated with oil or petrol.

Refitting

Check that the road wheels are in the straight ahead position and centralise the steering unit.
Refit the lower column joint to the steering unit shaft and tighten the pinch bolt.
Refit the rubber coupling and upper column joint by reversing the removal procedure.
Refit the upper column as detailed on Page II.21.

Note:- (1) Early cars will have a lower column fitted with the rubber coupling flange phased at 45° with the lower universal joint pinch bolt.

(2) Intermediate cars will have the flange and pinch bolt phased at 90°.

(3) Later cars will also be phased at 90° but will have bolts replacing the Allen-headed screws securing the rubber coupling.

Important

If lower steering columns phased at 90° are fitted to cars which have previously had the 45° phased column fitted it will be necessary to reposition the steering wheel on the splined shaft and also to reset the turn indicator switch striker on the inner column in order to restore the correct cancellation in the straight ahead position.

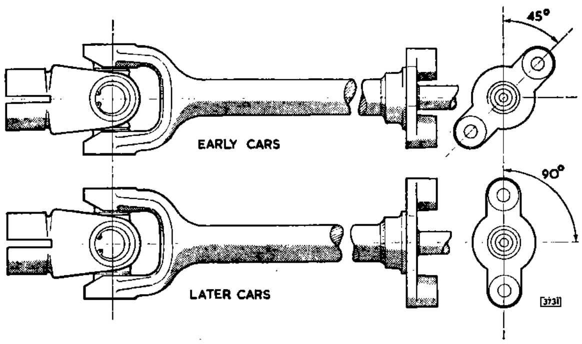


Fig. No. 39 *Showing the 45° and 90° phased lower steering columns*

1 End cap
2 Nut
3 Tab washer
4 "D" washer
5 Idler spindle
6 Bearing
7 Mounting bracket
8 Abutment washer
9 Bearing
10 Idler lever
11 Abutment ring
12 Washer
13 Nut
14 Seal retainer
15 Felt seal

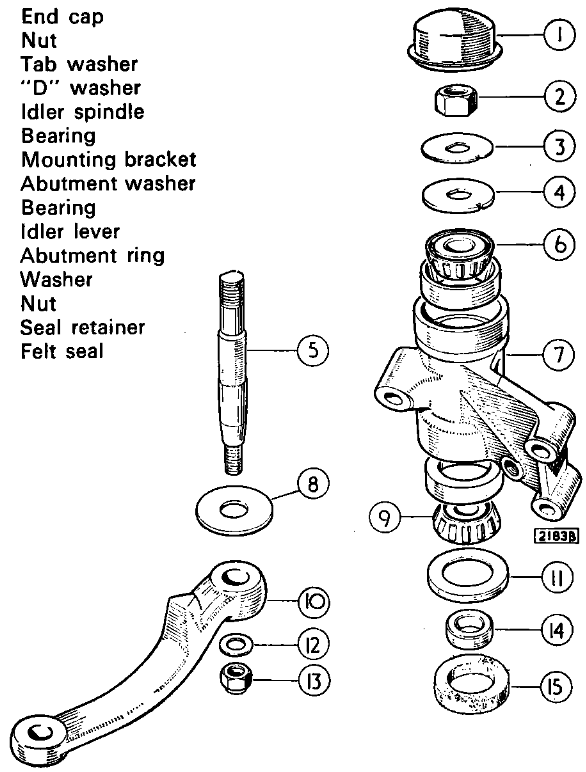


Fig. No. 40 *The steering idler components*

STEERING IDLER ASSEMBLY

Removal

Remove the self-locking nut securing the track rod end to the idler lever. Extract the track rod end which is a tapered fit.

Remove the two setscrews and one long bolt attaching the steering idler bracket to the front suspension cross member and detach the assembly.

Note the location of any packing washers which may be between the idler bracket and the front cross member.

Dismantling

Prise out the dust cap from the top of the idler assembly.

Tap back the tab washer and unscrew the nut from the idler spindle.

Remove the tab washer and the "D" washer.

The spindle, arm, abutment ring and felt seal now can be withdrawn.

If the bearings are to be renewed tap out the outer races using a small drift.

Assembling

Clean the bearings and the idler housing thoroughly before re-assembling.

Repack the housing and bearings with the recommended grade of lubricant.

Fit the abutment washer, seal retainer, felt seal, abutment ring, and bearing to the idler spindle and pass the spindle upwards into the housing.

Fit the upper bearing, "D" washer, tab washer and nut. Tighten the nut to a torque of 5 lb. ft. (0.7 kgm). If a torque wrench is not available, tighten the nut until rotation of the idler spindle by the idler arm feels "sticky" and back off the nut one flat: lock the nut with the tab washer and fit the dust cap.

Refitting

Reverse the removal procedure to refit. Ensure that the idler lever is in the straight ahead position before attaching the track rod end.

Refit the packing washers between the idler bracket and the front cross-member as noted on removal.

Check the height of the underface of the idler lever from the ground against the steering drop arm measurement. Adjust to within $\pm\frac{1}{16}$" (1.6 mm.) differential if necessary by adding or subtracting washers between the idler bracket and the front cross member at the top or bottom mounting bolts.

CENTRE TRACK ROD

Removal

The centre track rod ends incorporate rubber/steel bonded bushes. If the bushes show signs of deterioration they should be replaced.

Remove the self-locking nuts and washers from the inner ball joint of each tie-rod.

Withdraw the ball pins using Churchill Tool No. J.D 24.

Remove the self-locking nuts and washers securing the track rod ends to the drop arm and the idler lever.

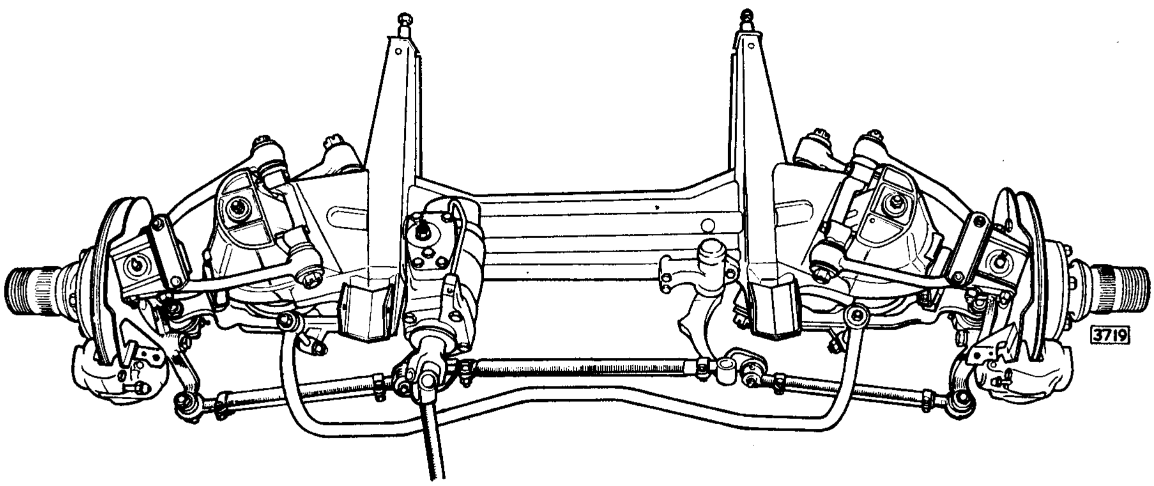


Fig. No. 41 *The steering layout*

Withdraw the track rod ends from the drop arm and idler lever using Churchill Tool No. J.D 24.

Dismantling

To remove the track rod ends, slacken the clamp at each end of the centre tube; unscrew each end from the tube noting that one end has a left hand thread and the other a right hand thread.

Assembling

When refitting the ends to the track rod, screw in each end **an equal amount** and adjust to a final length of $16\frac{7}{16}$" (41.7 mm).
Important: The centre track rod assembly must NOT be used for setting the toe-in.

Refitting

Refitting is the reverse of the removal procedure.
When refitting the ball pins to the idler lever and the steering drop arm, ensure that the pins are fully home in their respective tapers by means of a suitable lever applied to the top of the pins before fitting and tightening the nuts. Failure to follow this instruction may introduce a bias on the rubber bushes which will affect the steering geometry.

STEERING LOCK STOPS

No external lock stops are provided as stops are incorporated in the steering unit.
It is, therefore, ESSENTIAL if the steering unit has been dismantled that the centralising procedure, as detailed on page II.6 is carried out when refitting.

FRONT WHEEL ALIGNMENT

It is ESSENTIAL that the following instructions are observed when checking the front wheel alignment, otherwise steering irregularities may result.

Important

The centre tie-rod is set to a fixed length of $16\frac{7}{16}$" (41.7 mm.) and must NOT be used for setting the toe-in.
Inflate all tyres to the recommended pressures.
Each wheel must be individually adjusted by the outer tie-rod to give half the total toe-in of 0—$\frac{1}{8}$" (0—3.2 mm)

Procedure

Set the front wheels in the straight ahead position.
Centralise the steering unit as detailed on page II.6.
Preferred method:- Use light beam equipment.
Alternative method:-
Place a straight edge between the front and rear wheels on one side of the car. The straight edge should be positioned as high as possible on the wheels. Owing to the car having a wider track at the front, the straight edge will not contact the rear wheel. Adjust the track of the front wheel so that the gap between the straight edge and the front and rear wall of the rear tyre is equal. The front wheel will now be parallel to the rear wheel. Repeat the operation for the opposite side.
Re-check the alignment after pushing the car forwards until the wheels have turned half a revolution.

ACCIDENTAL DAMAGE

The following dimensional drawings are provided to assist in assessing accidental damage. A component suspected of being damaged should be removed from the car, cleaned off and the dimensions checked with those given in the appropriate illustration.

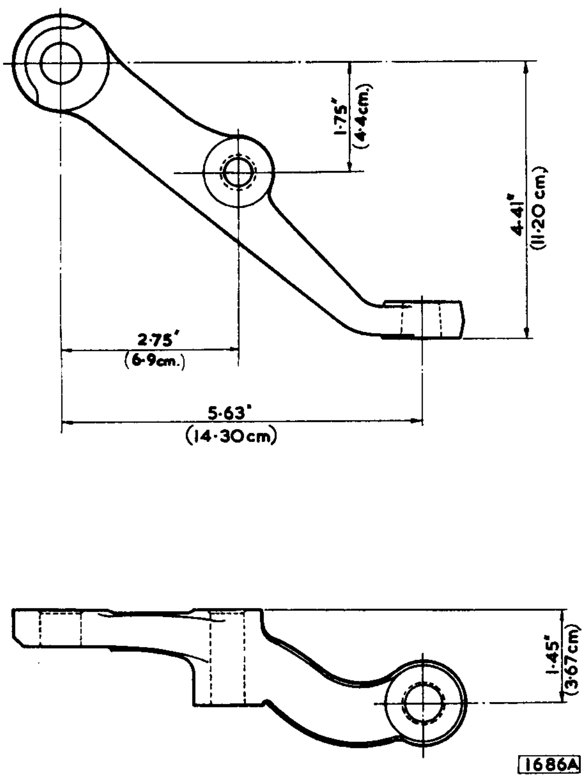


Fig. No. 42 *The steering arm*

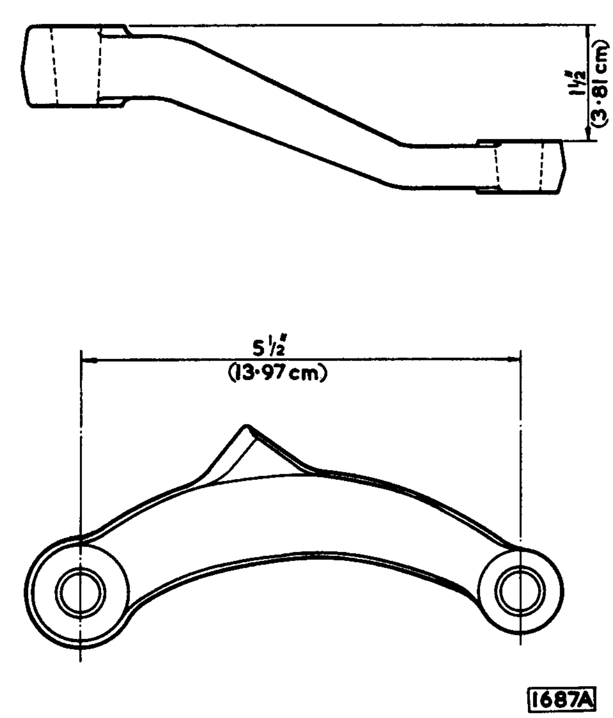


Fig. No. 43 *The idler lever*

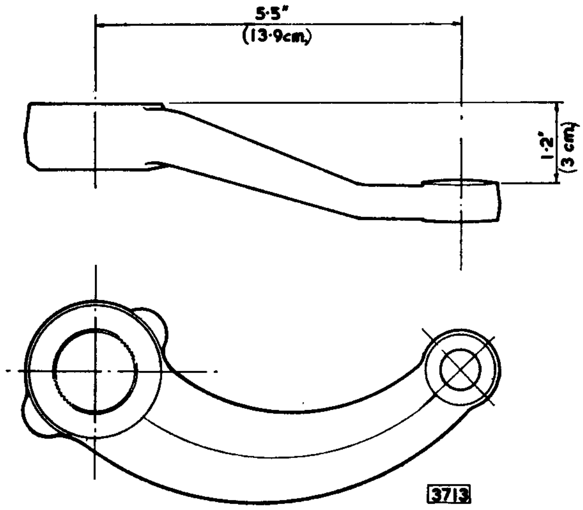


Fig. No. 44 *The steering drop arm*

FAULT FINDING CHART

Most Important: Always check that the Pump Fluid Reservoir is filled to the correct level before investigating any steering fault.

FAULT	POSSIBLE CAUSE	REMEDY
External oil leaks from steering box.	Damage or wear to seals or incorrect tightening of unions and bolts.	It is most important that the source of leak be traced before any attempt is made to rectify. Once the leak is located tighten the units or bolts or replace seals as necessary.
External oil leaks from pump.		Check that the reservoir is not over-filled.
Leak at Reservoir.	"O" Ring damaged or "O" ring improperly installed.	Replace "O" ring.
Oil leak at pressure fitting or filler cap.	Not tightened sufficiently or damaged seals or hose seats.	Tighten hoses or replace seats as necessary.
Oil leak at pump shaft.	Worn or damaged seals or damaged shaft.	Replace components as necessary.
Steering pulling to one side or the other.	Unbalanced front tyre pressures.	Adjust pressures.
	Faulty tyres. Steering gear out of trim.	See paragraph "Trimming" in service notes. **Note:** If these remedies fail to cure the pull then check steering and suspension geometry.
Steering feels different to left and right but it does not actually pull.	Incorrectly centred worm and valve means that the worm and valve assembly will be on the wrong part of the ratio curve when driving straight ahead.	Centralise as detailed on page II.8. It may be necessary to re-align the steering wheel after carrying out this operation.
Heavy Steering		
(A) Heavy steering when driving.	1. Low tyre pressure.	Inflate.
	2. Tightness or stiffness in the steering column and/or steering joints and suspension joints.	Grease or replace.
	3. Steering gear adjusted too tight.	Re-adjust steering box as necessary, see Service Notes.
(B) Heavy steering when parking.	1. Loose pump belt (nearly always accompanied by a squealing noise).	Check pump driving belt and replace if necessary.
	2. Insufficient pressure from pump due to restricted hoses or defective pump valve.	Remove restriction or check pump output pressure as described on Page II.7 Service Instructions. Check the flow control valve is not stuck open and that valve is free to move.
	3. Insufficient pressure due to high leaks in steering gear.	Confirm high internal leaks by carrying out leak tests as described on page II.7. If proven, remove gear from car and replace seals.

STEERING (POWER ASSISTED)

FAULT	POSSIBLE CAUSE	REMEDY
Steering effort too light.	Worn torsion bar dowel pins or torsion bar broken.	Remove steering box from car, remove worm and valve assembly from box and check that the valve rotor has no free play relative to the valve sleeve. Replace worm and valve assembly as necessary.
Unbalance of steering effort varying irregularly.	1. Worn or loose trim pin.	Remove steering box and replace worm and valve assembly.
	2. Rotor sticking in valve sleeve.	Remove steering box from car and take worm and valve assembly out. Hold worm in hand and rotate rotor to and fro feeling for stickness, Replace worm and valve assembly if necessary.
Poor straight running.	1. Incorrect tyre pressure.	Inflate.
	2. Incorrect toe-in.	Check and reset if necessary.
	3. Steering gear requires adjustment.	
	(a) If there is lost motion in the steering box.	Adjust steering box as described on Page II.13.
	(b) If the steering box is too stiff due to over-adjustment.	Adjust box correctly as above.
Noise Pump.	1. Belt loose indicated by squealing during parking manoeuvres.	Check driving belt and replace if necessary.
	2. Other pump noises are due to wear or damaged parts.	Replace the pump.
	Note: The pump pressure release valve is invariably noisy and it will be heard when the steering is turned hard on the lock stops.	There is no remedy to this noise.
Noise Steering Gear.	There are hissing noises present in most power steering systems, one of the most common is a sizzling sound which is most evident when parking. This noise does not effect the performance of the steering gear in any way.	
	If the steering gear grunts when the steering wheel is being moved this could be caused by a faulty damping ring in the valve assembly.	Remove steering box from car and replace worm and valve assembly.

FAULT	POSSIBLE CAUSE	REMEDY
Rattles 1. General.	1. Steering column joints.	These should be checked first before investigating steering box.
2. A sharp light rattle when running straight ahead over anything but the smoothest roads, particularly noticeable at low speed. Can be heard and felt at steering wheel.	2. Input Shaft End Float. It should be possible to feel this end float on the worm whilst steering wheel is oscillated gently.	Remove box from car and add shims between valve housing and the bearing outer race as described on Page II.12 Assembling.
3. As 2 but slightly muffled and caused by slightly rougher roads.	3. Sector Shaft End Float. This is due to clearance between the head of the adjuster screw and the sector shaft. End float can be felt between the sector shaft and the gear housing whilst the steering wheel is oscillated gently. Also a pointer to this fault is the fact that the rattle will be more prevalent during left hand corners with a R.H.D. car and vice versa.	Remove steering box from car and replace sector shaft assembly.
4. A heavy muffled flutter which appears particularly when running straight ahead over bumps in the road, best detected at 20 m.p.h. (32 k.m.) Also, steering will probably thump and pulse when the direction of movement of the steering wheel is changed rapidly.	Clearance between the piston rack teeth and the sector shaft teeth.	Tighten as per Service Instructions Page II.13.

SPECIAL SERVICE TOOLS

Description
Valve seal expander (J.32)*
Valve seal compressor (J.33)*
Spline seal protector (J.34)*
Ball joint-separator (J.D 24)*
* Churchill Tool Number.

FRONT SUSPENSION

SECTION J

INDEX

FRONT SUSPENSION

FRONT SUSPENSION

DESCRIPTION

The assembly comprises a fabricated pressed steel cross member with two "turrets" welded at either end. The steering unit, idler assembly, track rod and tie-rods are also attached to the cross member. The coil springs are housed in the "turrets" and are retained at the lower end by seat pans bolted to the lower wishbone. Each coil spring is controlled by a direct acting hydraulic damper mounted in the centre of the spring. The top end of the damper is attached to the turret and the lower end is bolted to a mounting bracket which is, in turn, bolted to the coil spring seat pan.

The upper wishbone levers are steel forged ano are mounted at the fulcrum shaft end on rubber/steel bonded bushes. The outer ends of the wishbone levers are bolted to the upper wishbone ball joint which is attached to the stub axle carrier.

The lower wishbone is a one-piece forging attached at the inner ends to rubber/steel bonded bushes and at the outer ends to the lower ball joint which is also attached to the stub axle carrier.

The wheel hub is supported on two tapered roller bearings, the inner races of which fit on a shaft located in a tapered hole bored in the axle stub axle carrier.

An anti-roll bar, fitted between the two lower wishbones, is attached to the chassis side members by rubber insulated brackets.

The front suspension assembly is attached to the body underframe at four points. The two longitudinal members are attached to brackets at the front end of the chassis side members with rubber/steel bonded mountings. The transverse member is attached to the chassis side members with two "V" shaped rubber/steel bonded mountings.

DATA

Type	Independent—Coil Spring
Dampers	Telescopic hydraulic
Castor angle	$0 \pm \frac{1}{2}°$
Camber angle	$\frac{1}{2}° \pm \frac{1}{2}°$ positive
Swivel inclination	$3\frac{1}{2}°$

ROUTINE MAINTENANCE

Front Suspension

The front suspension wishbone levers and anti-roll bar are supported in rubber bushes which do not require any periodic attention.

Front Hydraulic Dampers

The front hydraulic dampers are sealed units and no provision is made for adjustment or replenishing fluid.

EVERY 6,000 MILES (10,000 KM.)

Wheel Swivels

Lubricate the nipples (four per car) fitted to the top and bottom wheel swivels.

A bleed hole is incorporated in each ball joint. This hole is covered by a circular nylon washer which lifts under pressure, allowing grease to escape and indicating when sufficient lubricant has been applied.

Front Wheel Alignment

Check and adjust if necessary, the front wheel alignment as detailed on pages I.11 (Standard Steering) and page II.23 (Power Assisted Steering).

EVERY 12,000 MILES (20,000 KM)

Front Wheel Bearings

Remove the front wheel nave plate to expose a grease nipple in the wheel bearing hubs. Lubricate sparingly with the recommended grade of lubricant.

Wheel Bearing Adjustment

Check the front wheel bearings for correct end float and adjust if necessary, as detailed on page J.6.

FRONT SUSPENSION ASSEMBLY

Removal

Jack up the car under the front suspension cross member until the road wheels are clear of the ground. Remove the wheels.

Support the weight of the car under the front jacking sockets by means of blocks not less than 16" (40 cm.) in height. Leave the jack in position.

Remove the four self-locking nuts securing the front suspension rear mountings to the chassis side members. Remove the four bolts, washers and nuts securing the front mountings to the brackets at the front ends of the chassis side members.

ROUTINE MAINTENANCE

ROUTINE MAINTENANCE
Every 6,000 Miles (10,000 km.)
Outer Pivot Bearings
A grease nipple is located in the centre of the rear wishbone outer pivot. Lubricate sparingly with the recommended grade of lubricant. A bleed hole is provided, opposite the grease nipple, to indicate when an excess of lubricant has been applied. Always ascertain that the bleed hole is clear before carrying out this operation.

Inner Pivot Bearing
Two grease nipples are provided, one at each end of the wishbone fork. Lubricate sparingly with the recommended grade of lubricant.

EVERY 12,000 MILES (20,000 KM.)
Check rear wheel bearings for correct end float and adjust as necessary. See instructions given on page K.7.

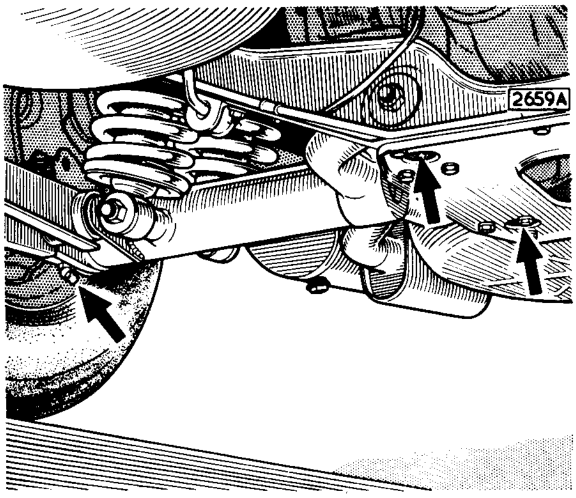


Fig. No. 2 *Inner and outer pivot bearing grease nipples*

RECOMMENDED LUBRICANTS

	Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent Caltex/Texaco
Wishbone Pivots	Mobilgrease MP	Castrolease LM	Retinax A	Esso Multi-purpose Grease H	Energrease L2	LB10	Marfak All-purpose

REAR SUSPENSION ASSEMBLY
Removal
Slacken the two clamp bolts which secure the muffler boxes to the rear silencers.
Remove the four nuts and washers retaining the muffler mounting rubbers to the underside of the car.
Withdraw the mufflers.
Remove the locking wire from the radius arm safety strap and securing bolt.
Unscrew the two bolts securing the safety strap to the body floor.
Remove the radius arm securing bolt and spring washer and remove the safety strap.
Withdraw the radius arm from the mounting post on the body.
Place a stout piece of wood approximately 9" × 9" × 1" (22.8 cm. × 22.8 cm. × 25.4 mm.) between the rear suspension tie plate and the jack.
Jack up the rear of the car and place two chassis stands of equal height under the body forward of the radius arm mounting posts. Place blocks of wood between the chassis stands and the body to avoid damage.
Remove the rear road wheels.
Disconnect the flexible brake pipe at the connection on the body.
Remove the split pin, washer and clevis pin securing the handbrake cable to the handbrake caliper actuating levers mounted on the suspension cross beam.
Slacken the locknut and screw the outer handbrake cable screw out of the adjuster block.
Remove the four bolts and self-locking nuts securing the mounting rubbers at the front of the cross beam to the body frame. Remove the six self-locking nuts and four bolts securing the rear mounting rubbers to the cross beam.
Remove the four self-locking nuts and bolts securing the propeller shaft to the differential pinion flange.

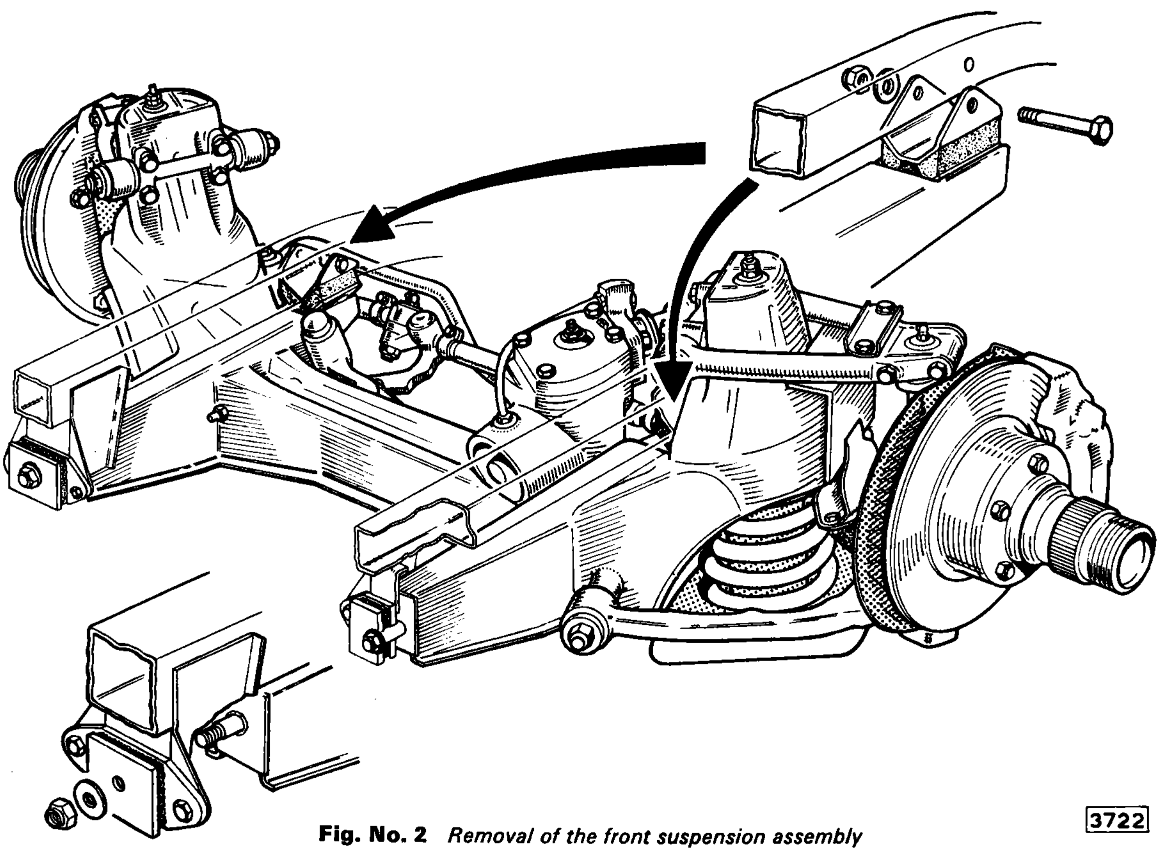


Fig. No. 2 *Removal of the front suspension assembly*

Coil Springs
The coil springs are marked with coloured paint (which may be covered by tape) to denote springs of the same static load. It is, therefore, important that the two front springs fitted to the car are of the same colour code.

Removal
Remove the hydraulic damper as detailed previously. Insert a coil spring compressor (Churchill Tool No. JD.16) through the centre of the spring from underneath and compress the spring sufficiently to relieve the load on the spring seat pan screws.
Withdraw the nut and bolt and detach the anti-roll bar link arm from the bracket welded to the rear edge of the spring seat pan.
Remove the six setscrews and spring washers securing the seat pan to the lower wishbone.
Release the spring compressor until the load is completely relieved from the spring. Unscrew the compressor and withdraw the spring and seat pan.
Note any packing pieces which may be fitted on top of the spring. See under heading "Coil Spring Packing Pieces", page J.6.

Refitting
Align the seat pan holes with the tapped holes in the lower wishbone by using 8" (20 cm.) pilot studs as shown in Fig. 3.
Reverse the removal procedure to refit.

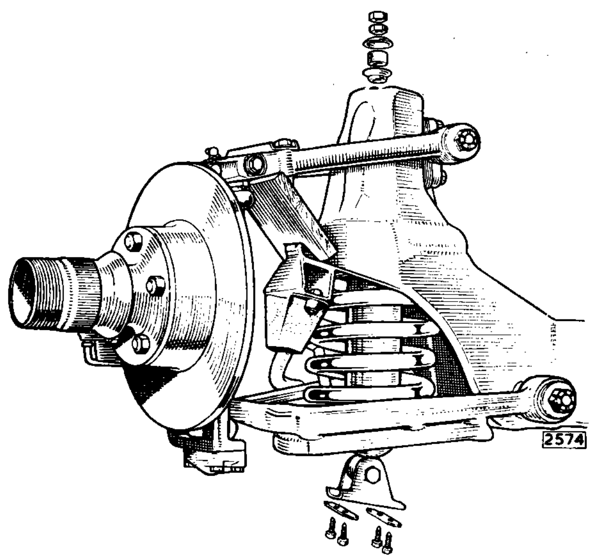


Fig. No. 3 *Removal of the front shock absorber*

Coil Spring Packing Pieces
Packing pieces may be fitted above the coil springs of some cars to accommodate manufacturing variations in the springs which are graded into three groups and

identified by a colour patch in the middle of the coil. On Right Hand Drive cars ONLY, the right hand spring has $\frac{1}{8}$" (3.2 mm.) more packing than the left hand spring to equalise the standing height of the car.

Colour Code	**Packing required L.H. Drive**
Red	$\frac{1}{4}$" (6.4 mm.)
Yellow	$\frac{1}{8}$" (3.2 mm.)
Purple	None

Colour Code	**Packing required R.H. Drive**	
	L.H. Spring	**R.H. Spring**
Red	$\frac{1}{4}$" (6.4 mm.)	$\frac{3}{8}$" (9.5 mm.)
Yellow	$\frac{1}{8}$" (3.2 mm.)	$\frac{1}{4}$" (6.4 mm.)
Purple	None	$\frac{1}{8}$" (3.2 mm.)

On cars fitted with air conditioning **only springs with purple colour coding may be used.** The correct packing pieces employed are given below.

Packing required L.H. Drive

L.H. Spring	**R.H. Spring**
$\frac{1}{4}$" (6.4 mm.)	$\frac{1}{4}$" (6.4 mm.)

Packing required R.H. Drive

L.H. Spring	**R.H. Spring**
$\frac{1}{4}$" (6.4 mm.)	$\frac{3}{8}$" (9.5 mm.)

WHEEL HUBS

Removal

Firmly apply the handbrake. Jack up the front of the car and remove the road wheel.

Remove the caliper from the front stub axle.

Prise off the end cap and remove the split pin retaining the hub nut.

On cars fitted with wire wheels, holes are provided in the hub through which the split pin can be withdrawn.

Remove the slotted nut and washer from the stub axle shaft and withdraw the hub by hand.

Dismantling

Extract the grease seal. Withdraw the inner races of the taper roller bearings. If new bearings are to be fitted, the outer races may be drifted out, grooves being provided in the abutment shoulders of the hub for this purpose.

Refitting

Lubricate the bearings as detailed in "Routine Maintenance". Reverse the removal procedure to refit the hub.

Adjust the bearing end-float as described in the next paragraph.

Ensure that the brake caliper is centralised and bleed the brake system.

Bearing End-Float Adjustment

The correct end-float of the wheel bearing is .003—.005" (.08—.13 mm.).

This end-float may be measured with a dial indicator gauge mounted with the plunger against the end of the hub.

If a gauge is not available, tighten the hub nut until there is no end-float, that is, when the rotation of the hub is slightly restricted.

Slacken back the hub between one and two flats dependent upon the position of the split pin hole relative to the slots in the nut.

Temporarily attach the road wheel and check that the wheel spins freely.

If satisfactory, fit a new split pin and turn over the ends.

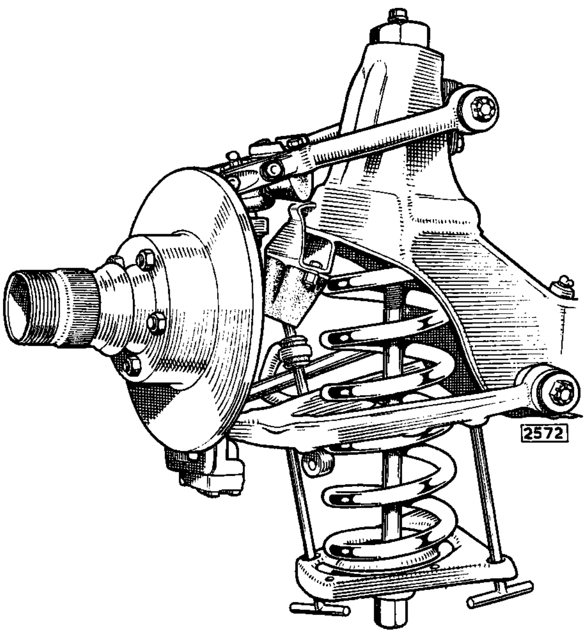


Fig. No. 4 *Refitting the coil spring*

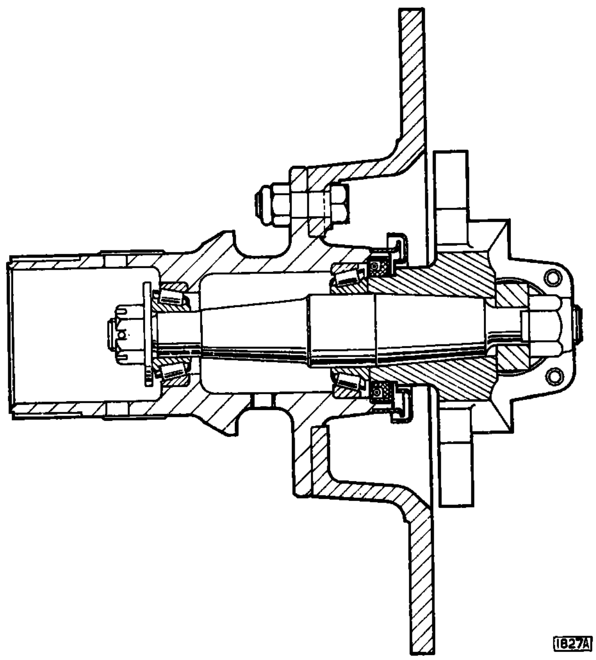


Fig. No. 5 *Sectional view of the disc brake arrangement*

STUB AXLE CARRIERS

Removal

Jack up under the lower wishbone lever and remove the road wheel.
Remove the caliper from the stub axle carrier and remove the front wheel hub complete with disc brake as described on page J.6.
Remove the self-locking nut and plain washer securing the upper ball joint to the stub axle carrier; remove the split pin, nut and plain washer securing the lower ball joint to the lower wishbone. Remove the ball joint using the extractor (Churchill Tool No. JD. 24) and remove the stub axle carrier.

Refitting

Refitting is the reverse of the removal procedure.

LOWER WISHBONE

Removal

Remove the coil spring as described on page J.5.
Remove the stub axle carrier as described above.
Withdraw the split pin, slotted nut and washer from one end of the lower wishbone fulcrum shaft. The shaft can now be drifted out.

Fitting the Rubber/Steel Bushes

Drift out or press out the bush from the wishbone eye. Press the new bush into the eye, ensuring that the bush projects from each side by an equal amount. Fitting of the bush will be facilitated if a lubricant, made up of twelve parts of water to one part of liquid soap, is used.

Refitting

Refitting is the reverse of the removal procedure. When refitting the fulcrum shaft the car should be in normal riding position before the nuts at each end of the shaft are fully tightened. Omitting to carry out this procedure will result in undue torsional loading of the rubber bushes with possible premature failure.

LOWER WISHBONE BALL JOINT

Removal

Remove the stub axle carrier complete with the lower wishbone ball joint as described on this page.

Dismantling

Remove the retaining ring and withdraw the rubber gaiter. Withdraw the retainer from the top of the ball pin.
Tap back the tab washers and unscrew the four setscrews securing the ball pin cap to the stub axle carrier.
Remove the cap, shims, ball pin socket, spigot and ball pin.

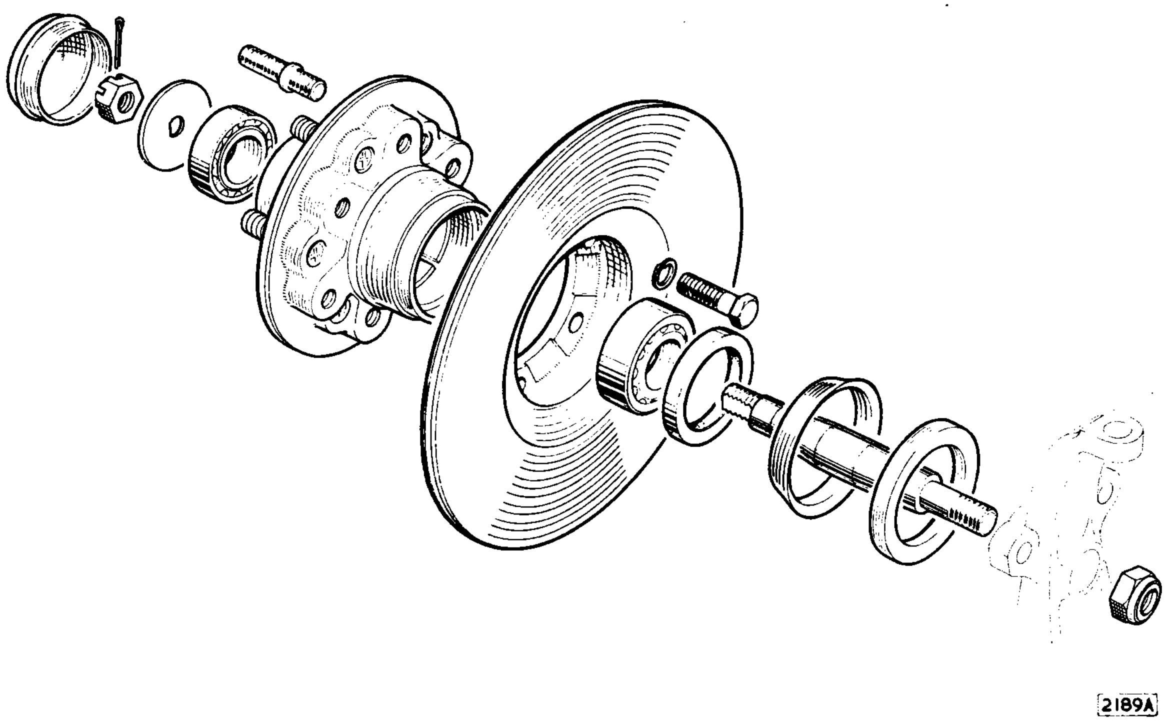


Fig. No. 6 *Exploded view of the wheel hub*

Reassembling

Reassembling is the reverse of the dismantling procedure but, if necessary, re-shim the ball joint to obtain the correct clearance of .004"—006" (.10 mm.—.15 mm.).

Note: Shims should not be removed to take up **excessive** wear in the ball pin and socket; if these parts are badly worn, replacements should be fitted.

Adjustment of the Ball Joint

The correct clearance of the ball pin in its socket is .004"—.006" (.10 mm.—.15 mm.). Shims for adjustment of the ball joint are available in .002" (.05 mm.) and .004" (.10 mm.) thicknesses.

To adjust the ball pin clearance to the correct figure, remove shims one by one until, with the ball cap fully tightened, the ball is tight in its socket. Fit shims to the value of .004"—.006" (.10 mm.—.15 mm.) which should enable the shank of the ball pin to be moved by hand.

Refitting

Refit the stub axle carrier complete with the lower wishbone ball joint as described on page J.7.

UPPER WISHBONE

Removal

Jack up under the lower wishbone and remove the road wheel.

Remove the two bolts, nuts and plain washers securing the ball joint to the upper wishbone levers. Note the relative positions of the packing piece and shims as these control the castor angle. Alternatively, remove the self-locking nut and remove the ball joint using an extractor (Churchill Tool No. JD. 24) from the sub axle carrier. Tie-up the stub axle carrier to the suspension cross member so that the flexible brake hose does not become extended.

Remove the four set bolts which secure the upper wishbone fulcrum shaft to the suspension cross-member turret. Note the relative positions of the shims as these control the camber angle.

The upper wishbone assembly can now be removed.

Dismantling

Remove the nuts, bolts and distance pieces securing the rebound stop bracket to the upper wishbone levers. Extract the split pin and remove the slotted nuts and plain washers which secure the wishbone levers to the fulcrum shaft. The wishbone levers can now be removed from the fulcrum shaft.

Fitting the Rubber/Steel Bushes

Drift out or press out the bush from the wishbone eye. Press the new bush into the eye, ensuring that the bush projects from each side by an equal amount. Fitting of the bush will be facilitated if a lubricant, twelve parts of water to one part of liquid soap, is used.

Reassembling

The reassembly of the upper wishbone assembly is the reverse of the dismantling procedure but the slotted nuts securing the wishbone levers to the fulcrum shaft

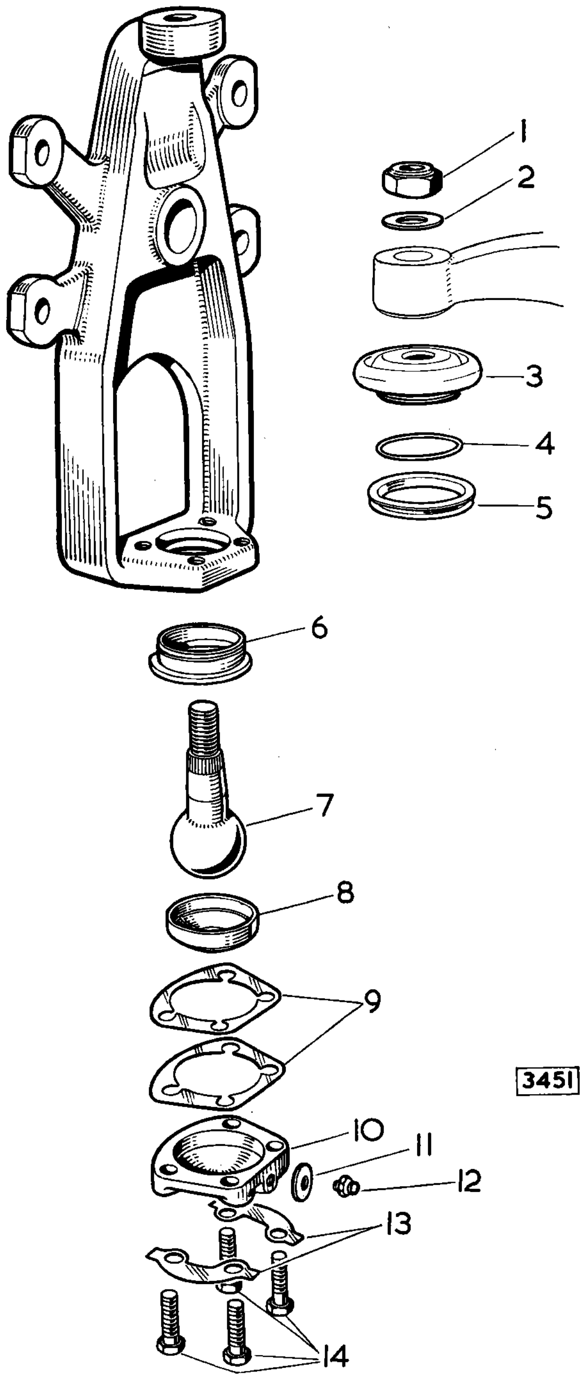


Fig. No. 7 *Exploded view of the lower wishbone ball joint*

1	Nut	**8**	Socket
2	Washer	**9**	Shim
3	Rubber gaiter	**10**	Cap
4	Ring	**11**	Washer
5	Plastic insert	**12**	Grease nipple
6	Spigot	**13**	Tab washer
7	Ball pin	**14**	Bolts

must not be tightened until the upper wishbone assembly has been refitted and the full weight of the car is on the suspension. Omitting to carry out the procedure will result in undue torsional loading of the rubber bushes with possible premature failure.

Refitting
Refitting is the reverse of the removal procedure.

UPPER WISHBONE BALL JOINT

The upper wishbone ball joint cannot be dismantled and, if worn, the complete assembly must be replaced.

Removal
Jack up the car under the lower wishbone and remove the road wheel.
Remove the two bolts, nuts and plain washer securing the ball joint to the upper wishbone levers. Note the relative positions of the packing piece and shims as these control the castor angle.
Remove the self-locking nut and plain washers which secure the ball joint to the stub axle carrier.
The ball joint can now be removed from the stub axle carrier in which it is a taper fit by using an extractor (Churchill Tool No. JD. 24).
Note: When carring out the above operation do not allow the flexible brake hose to become extended; tie up the stub axle carrier to the cross member turret.

Refitting
Refitting is the reverse of the removal procedure. Ensure that the packing piece and shims are refitted in their original positions otherwise the castor angle will be upset.

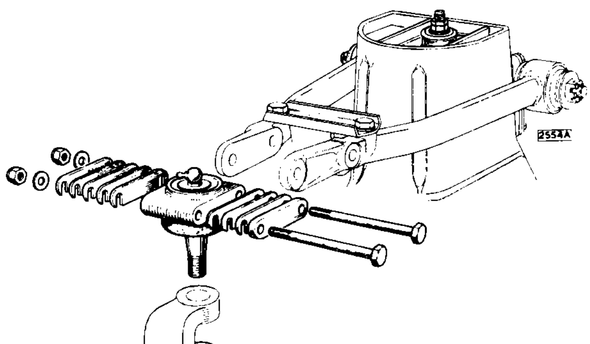


Fig. No. 8 *Removal of the upper wishbone ball joint*

CASTOR ANGLE ADJUSTMENT

Before checking the castor angle, examine all rubber/steel bushes for deterioration or distortion. Check the upper and lower wishbone ball joints for excessive play; check the shock absorbers and mountings. Ensure that the standing height of the car is satifactory.

Make up two setting blocks to the dimensions given in Fig. 9 in order to lock the front suspension in the mid-laden position. Compress the front suspension and place the setting blocks under the upper wishbone adjacent to the bump stop rebound rubber and over the bracket welded to the bottom of the "turret". See Fig. 10.
Using the special links, set the rear suspension in the mid-laden position as described on page K.15.
Ensure that all tyre pressures are correct and that the car is standing on a perfectly level surface.

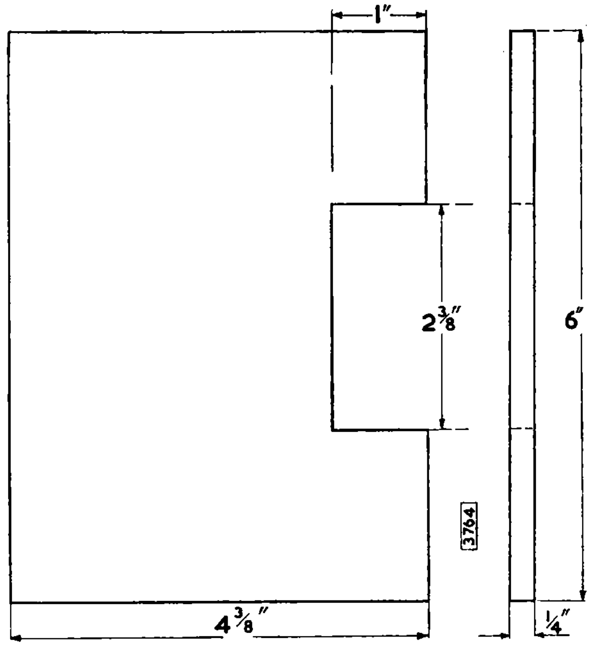


Fig. No. 9 *Dimensions for the setting block*

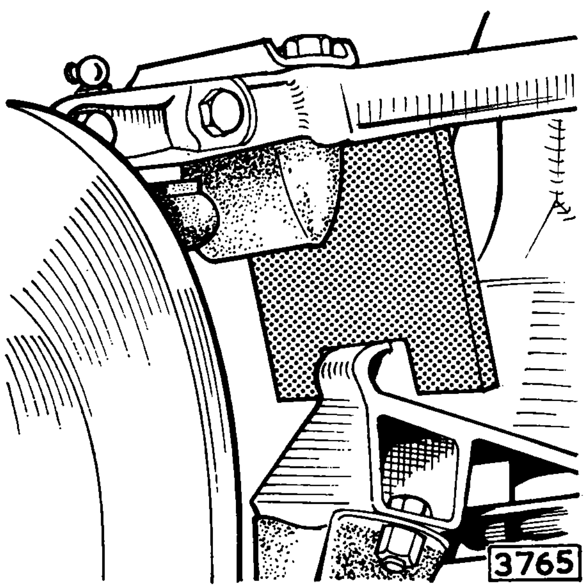


Fig. No. 10 *The setting block in position*

Using an approved gauge, check the castor angle.
Castor angle: $0° \pm \frac{1}{2}°$.
Note: The two front wheels must be within $\frac{1}{2}°$ of each other.
Adjustment is effected by either transposing the shims from the rear of the upper wishbone ball joint to the front, or transposing the packing piece and shim(s). To decrease negative castor or increase positive castor, transpose shims from the rear to the front; the holes in the shims are slotted and therefore it will only be necessary to slacken the two bolts securing the upper wishbone members to enable the shims to be removed. To increase negative castor or decrease positive castor, transpose the packing piece and shims as necessary. As the holes in the packing piece are not slotted it will be necessary to remove the two bolts after first having placed a support under the brake disc or lower wishbone.
The shims are $\frac{1}{16}$" (1.6 mm.) thick and it should be noted that $\frac{1}{16}$" (1.6 mm.) of shimming will alter the castor angle by approximately $\frac{1}{4}°$.

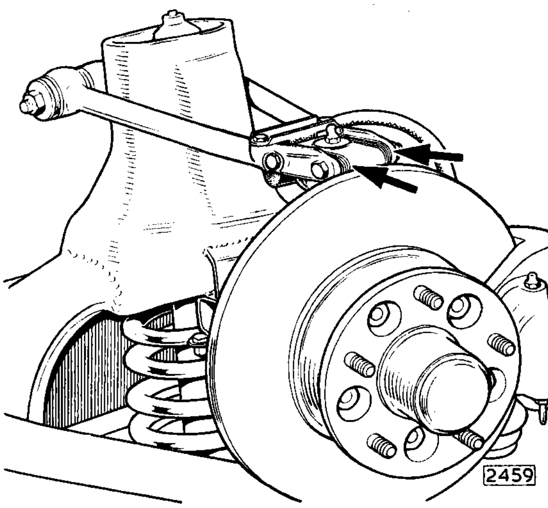


Fig. No. 11 *The castor angle is adjusted by means of shims and packing pieces indicated by the arrows*

The front of the car should be jacked up when turning the wheels from lock to lock during checking.
If any adjustment is made to the castor angle, the front wheel alignment should be checked and if, necessary, re-set.
Note: A packing piece and 8 shims must always be fitted between the wishbone levers and the upper ball joint; their relative positions may, of course, not always be the same.

CAMBER ANGLE ADJUSTMENT

Before checking the camber angle, examine all rubber/steel bushes for deterioration or distortion. Check the upper and lower wishbone ball joints for excessive play; check the shock absorbers and mountings. Ensure that the standing height of the car is satisfactory. Lock the front and rear suspensions in the mid-laden position as detailed under the heading "Castor Angle Adjustment".

Ensure that the tyre pressures are correct and that the car is standing on a level surface.
Line up the front wheel being checked parallel to the centre line of the car. Using an approved gauge, check the camber angle. Rotate the wheel being checked through 180° and re-check.
Camber angle : $\frac{1}{2}° \pm \frac{1}{2}°$ positive.
Note: The two front wheels must be within $\frac{1}{2}°$ of each other.
Adjustment is effected by removing or adding shims at the front suspension top wishbone bracket; the holes in the shims are slotted and it is therefore only necessary to slacken the set screws securing the bracket to enable the shims to be removed. Inserting shims decreases the positive camber; removing shims decreases negative camber or increases positive camber. Remove or add an equal thickness of shims from each position, otherwise the castor angle will be affected. Shims for the adjustment of camber are available in $\frac{1}{32}$" (.8 mm.) $\frac{3}{64}$" (1.2 mm.) and $\frac{1}{16}$" (1.6 mm.) thicknesses and it should be noted that $\frac{1}{16}$" (1.6 mm.) of shimming will alter the camber angle by approximately $\frac{1}{4}°$.
Check the other front wheel in a similar manner. If any adjustment is made to the camber angle, the front wheel alignment should be checked and, if necessary, reset.

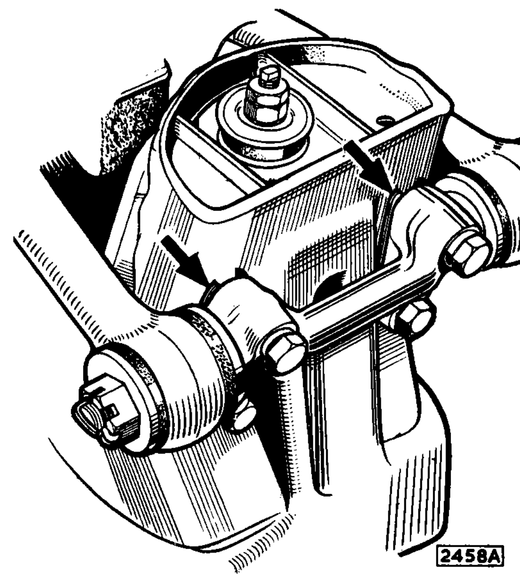


Fig. No. 12 *The front wheel camber is adjusted by means of the shims indicated by the arrows. Remove or add an equal thickness of shims from each position.*

ANTI-ROLL BAR

Removal

Raise the car on a lift to enable work to be carried out underneath. Remove the four bolts from the anti-roll bar support brackets on the chassis side members.
Remove the self-locking nut and remove the bolt attaching the link arm to the coil spring seat. Repeat for the other side.

To seperate the anti-roll bar from the link arms remove the self-locking nuts, upper cup washers and rubbers. Care should be taken to replace the distance tube when refitting.
The anti-roll bracket rubbers are split to enable them to be removed.

Fitting the Link Arm Bush
Drift out or press out the bush from the link arm eye. Press the new bush into the eye, ensuring that the bush projects from each side by an equal amount. Fitting of the bush will be facilitated if a lubricant, twelve parts of water to one part of liquid soap, is used.

Refitting
Refitting is the reverse of the removal procedure. It is important when attaching the support brackets to the chassis side members, to have the full weight of the car on the road wheels.

ACCIDENTAL DAMAGE

The dimensioned drawings are provided to assist in assessing accidental damage. A component suspected of being damaged should be removed from the car, cleaned off and the dimensions checked and compared with those given in the appropriate illustration.

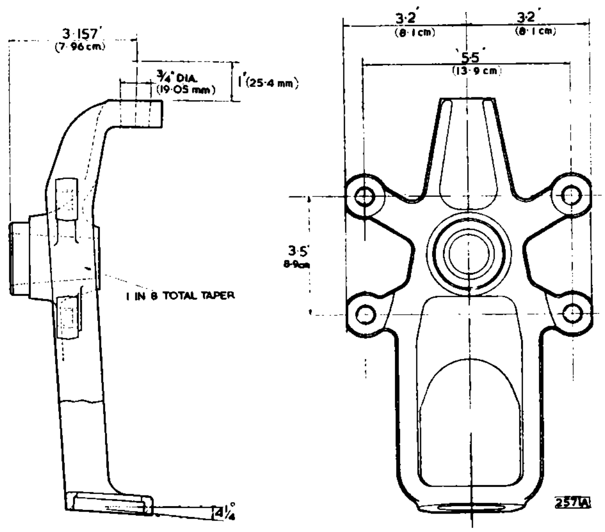


Fig. No. 13 *Stub axle carrier*

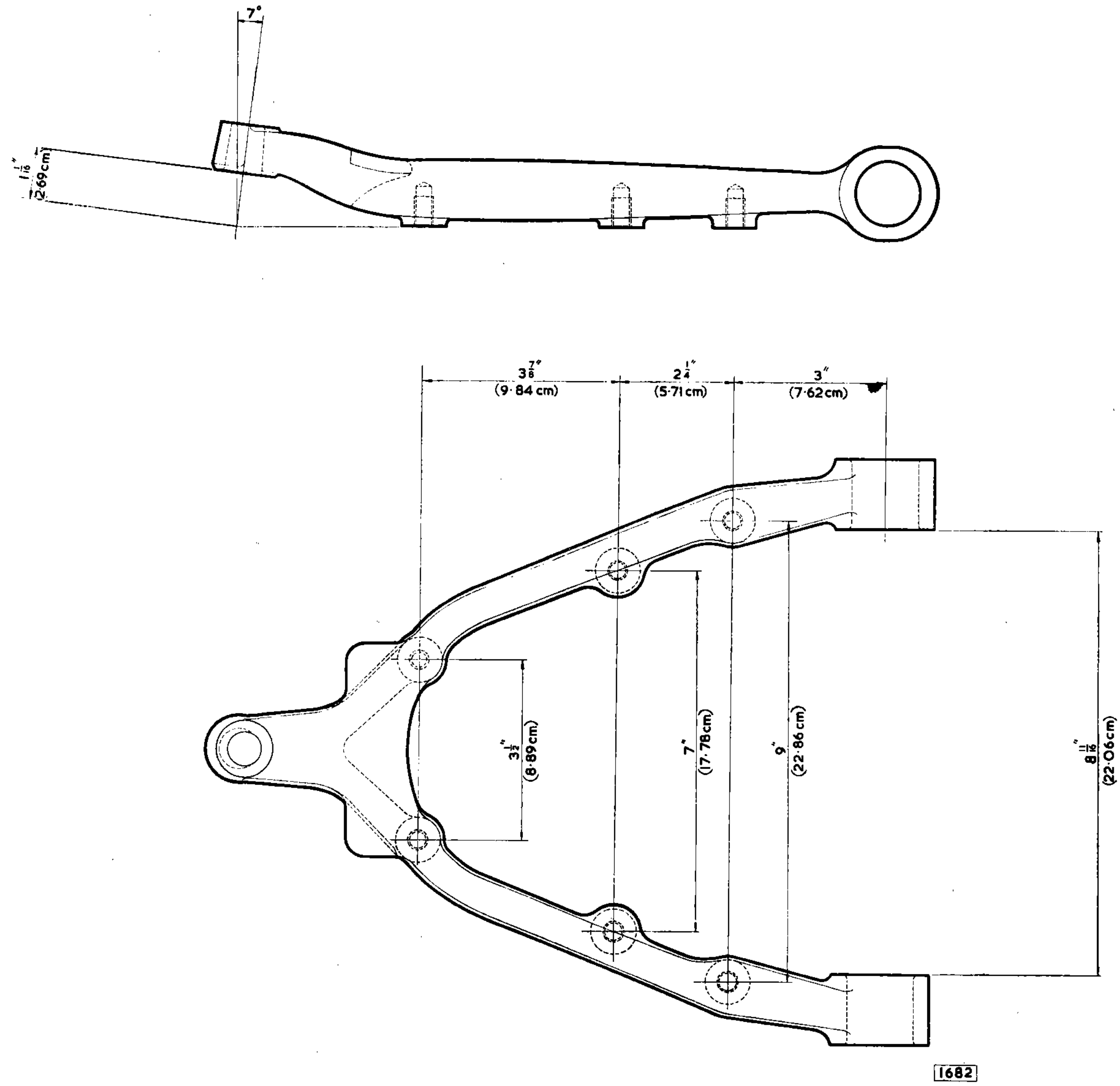


Fig. No. 14 *Lower wishbone*

REAR SUSPENSION

SECTION K

INDEX

REAR SUSPENSION

REAR SUSPENSION

DESCRIPTION

The rear wheels are located in a transverse plane by two links of which the top link is the half shaft universally jointed at each end. The lower link is pivoted at the wheel carrier and at the crossbeam adjacent to the differential casing. To provide maximum rigidity in a longitudinal plane the pivot bearings at both ends of the lower link are widely spaced. The suspension medium is provided by four coil springs enclosing telescopic hydraulic dampers, two being mounted on either side of the differential casing. The complete assembly is carried in a fabricated steel crossbeam. The crossbeam is attached to the body by four "Vee" rubber blocks and is located by radius arms. The radius arm pivots are rubber bushes mounted on each side of the car between the lower link and a mounting point on the body structure.

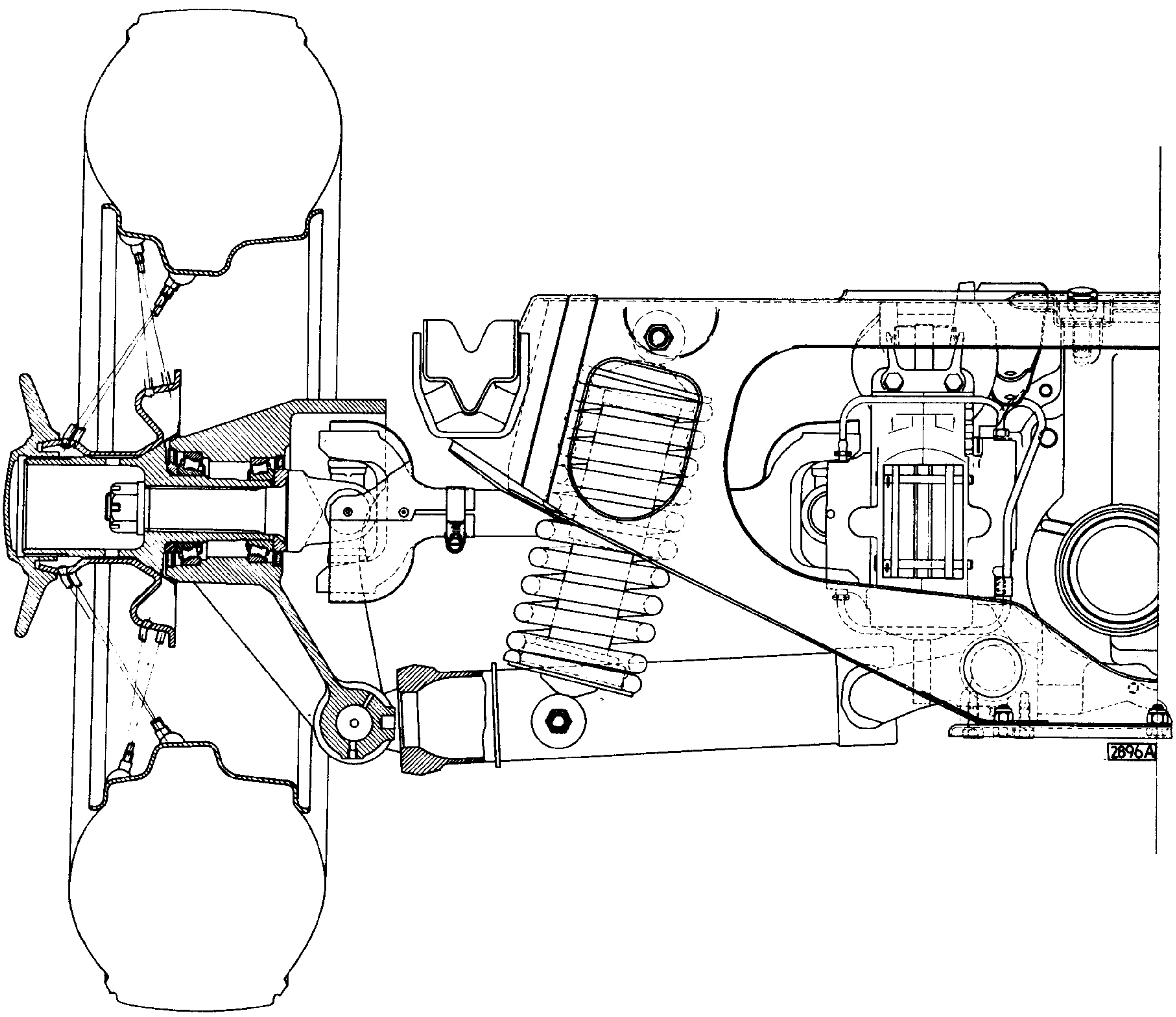


Fig. No. 1 *Sectioned view of rear suspension*

DATA

Rear Road Spring:	
Free length .	11.295" (28.9 cm.)
Identification colour .	Red/Yellow
Wire diameter . .	.475" (12.06mm.)
Dampers	Telescopic

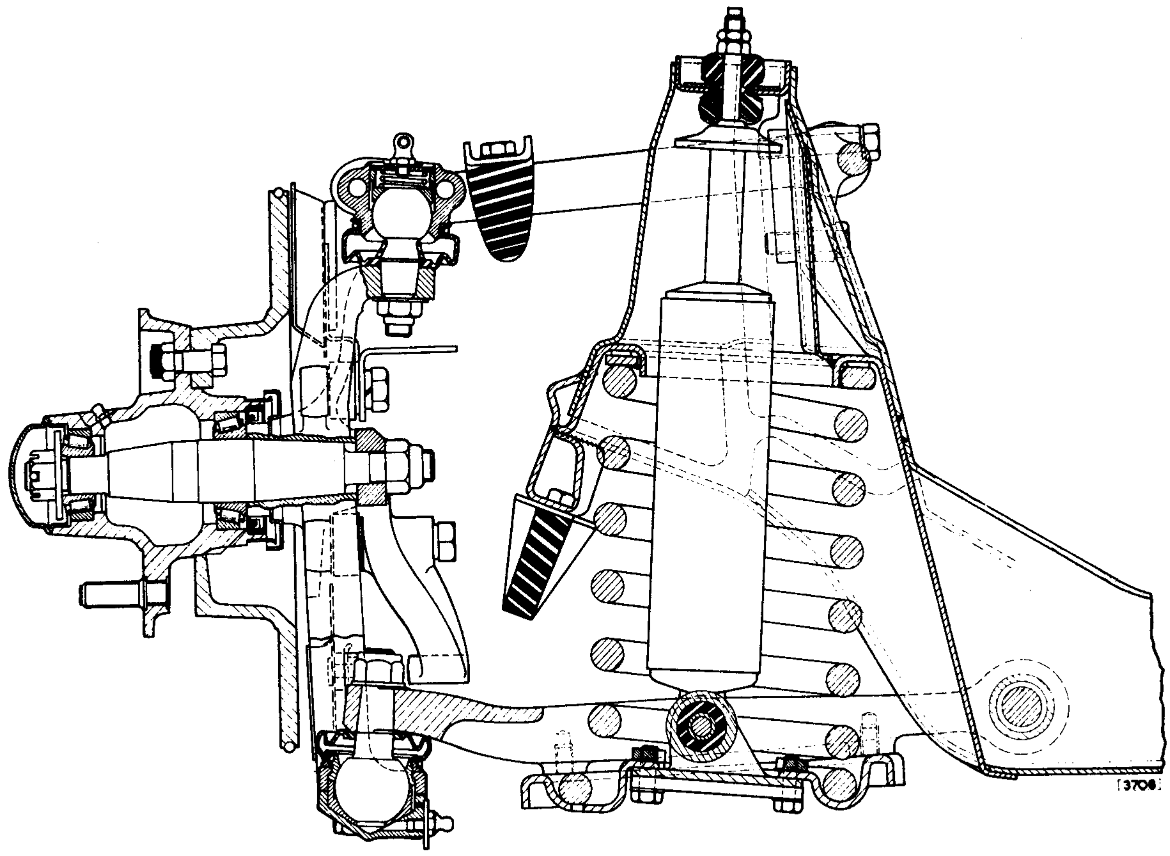


Fig. No. 1 *Sectional view of the front suspension unit*

Disconnect the two anti-roll bar mountings from the chassis underframe members.
Disconnect the flexible brake hoses at the body brackets. Seal all open hoses and connections.
Remove the two hoses from the power assisted steering unit (if fitted) and drain the fluid into a clean container Seal off the open ends of the hoses and ports.
Remove the clamping bolt securing the lower steering column universal joint to the steering unit input shaft.
Lower the front suspension assembly on the jack until it can be withdrawn forwards from the car.

Refitting
Reverse the removal procedure to refit the front suspension assembly. Ensure that the brake discs are in the straight ahead position and that the steering wheel is centralised.
Bleed the braking system as detailed on page L.6.
Bleed the steering unit as detailed on page II.14. (Power steering), if fitted.

Hydraulic Dampers
The telescopic hydraulic dampers are sealed with no provision for adjustment or replenishment with fluid. Therefore, in the event of a damper being unserviceable, a replacement unit must be fitted.

Removal
Jack up the car under the front suspension until the road wheels are clear of the ground. Remove the road wheel.
To facilitate removal, either place a packing piece between the upper wishbone and the cross member turret or place a support under the lower wishbone and lower the jack to compress the spring.
Remove the locknut and nut from the top damper mounting and withdraw the outer washer, rubber buffer and inner washer.
Knock back the tabs of the lock washer on the four serscrews securing the lower mounting bracket to the coil spring seat.
Remove the setscrews and withdraw the damper.

Refitting
Before fitting new dampers, it is advisable to "bleed" any air which may have accumulated in the pressure chamber due to the damper having been stored in the horizontal position.
Hold the damper vertically and make several strokes (not extending more than halfway) until there is no lost motion. Then extend the damper to its full length once or twice. Keep the damper upright until refitted.
Reverse the removal procedure to refit the damper unit.

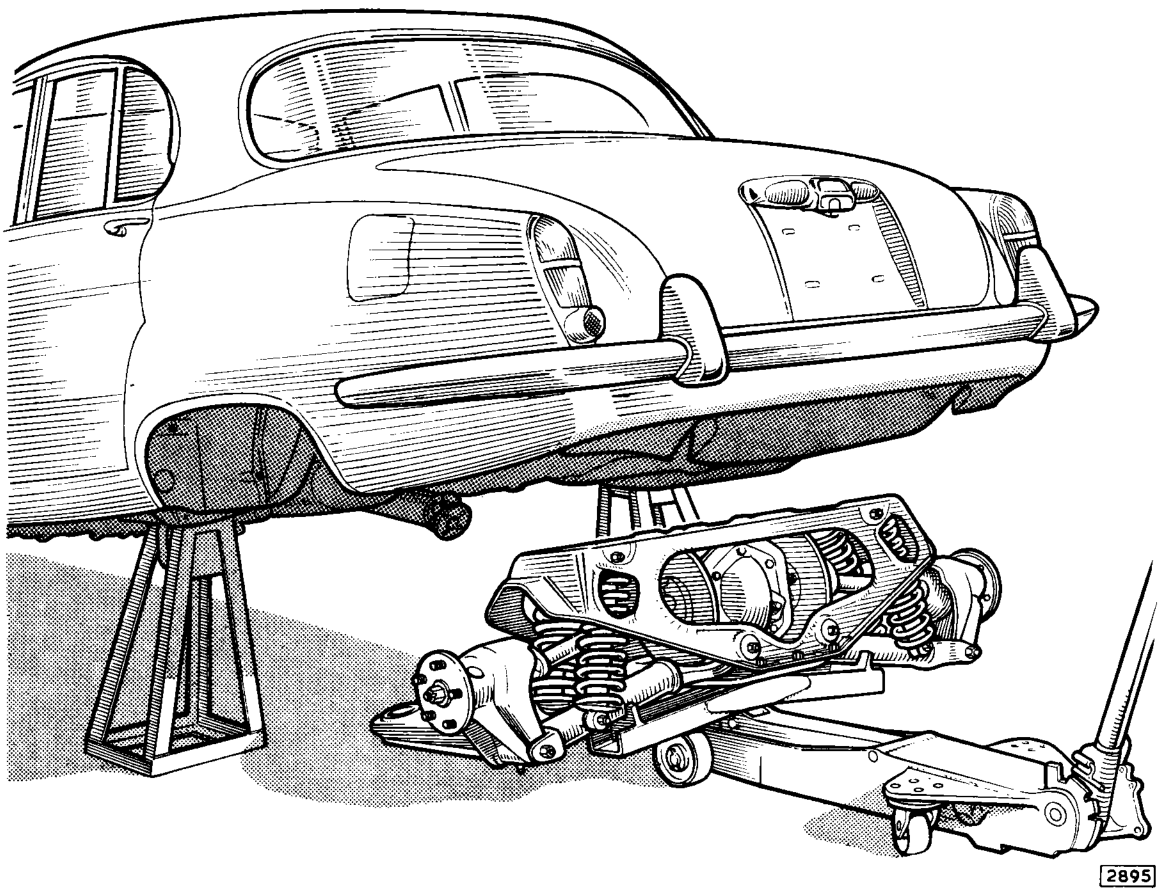


Fig. No. 3 *Removal of the rear suspension assembly from the car*

Lower the rear suspension unit on the jack and withdraw the unit from under the car as shown in Fig. 3.

Refitting
Refitting is the reverse of the removal procedure.
Check all mounting rubbers for deterioration.
Bleed the braking system as described on page L.6.
If the radius arms have been removed the rear suspension should be at the normal riding height before tightening the radius arm securing nuts on the rear suspension wishbone. Refit the radius arms as described on page K.10.

IMPORTANT
The following removal and refitting operations are described assuming the rear suspension is removed from the car. If it is possible for the operations to be carried out with the rear suspension in position on the car the fact will be noted in the text.

ROAD SPRING AND HYDRAULIC DAMPER ASSEMBLY
Removal
The road spring and hydraulic damper assembly may be removed from the car with the rear suspension assembly in position.

Remove the two self-locking nuts and washers securing the two hydraulic dampers to the wishbone.
Support the appropriate wishbone and drift out the hydraulic damper mounting pin, Fig. 5.
Remove the self-locking nut and bolt securing each hydraulic damper to the cross beam.
Withdraw the hydraulic damper and road spring assembly.

Refitting
Refitting is the reverse of the removal procedure.

THE REAR HUBS
Removal
It is not necessary to remove the rear suspension unit from the car to carry out this operation.
Jack up and support the rear end of the car and remove the appropriate road wheel. Withdraw the split pin and remove the castellated nut and washer from the half shaft. Using the extractor, Special Tool No. JD 1C as shown in Fig. 6, withdraw the hub and hub carrier assembly from the splined end of the half shaft retaining the inner oil seal track and end float spacer. Remove the lower wishbone outer fulcrum shaft (as described on page K.11) and remove the hub and hub carrier assembly.

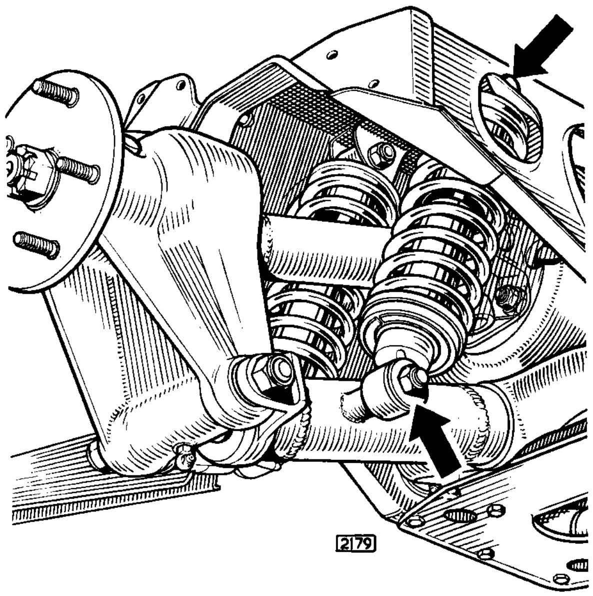


Fig. No. 4 *Hydraulic damper mounting points*

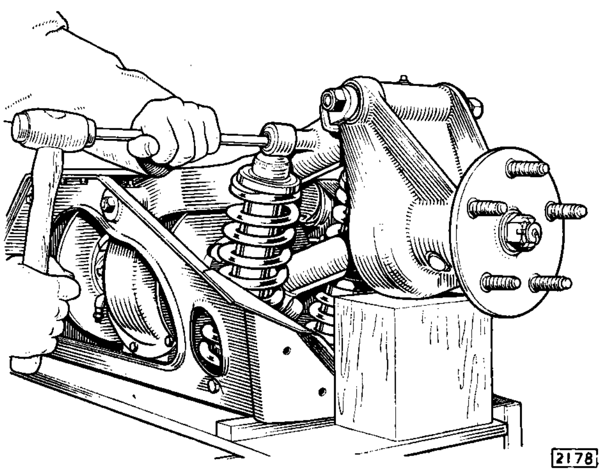


Fig. No. 5 *Drifting out the hydraulic damper mounting pin*

Note: Since it is necessary to press the hub assembly onto the half shaft before refitting the rear suspension assembly, remove the half shaft as follows:—
Remove the front hydraulic damper and spring unit (as described on page K.5. Remove the four steel type self-locking nuts securing the half shaft inner universal joint to the axle shaft output flange and brake disc. Withdraw the half shaft from the bolts noting the number of camber shims fitted.

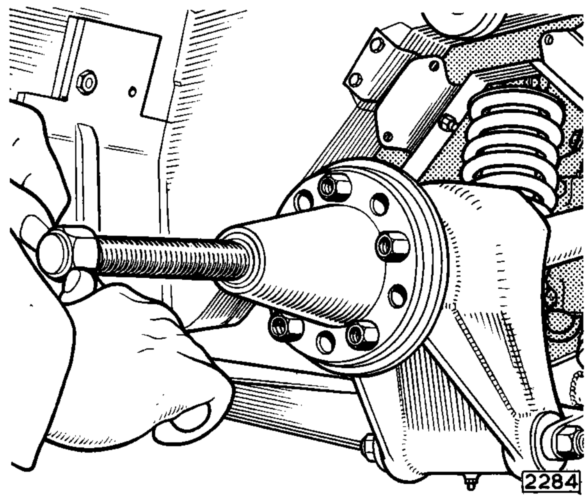


Fig. No. 6 *Removing the rear hub with the extractor (Churchill Tool No. JD. 1 C)*

Dismantling
Invert the hub carrier so that the inner hub bearing is at the top and press out the hub (Fig. 7) with the outer bearing inner race and the outer oil seal track in place, discarding the outer oil seal. Remove the three set-screws and withdraw the water deflector. Prise out the inner oil seal and remove the inner bearing inner

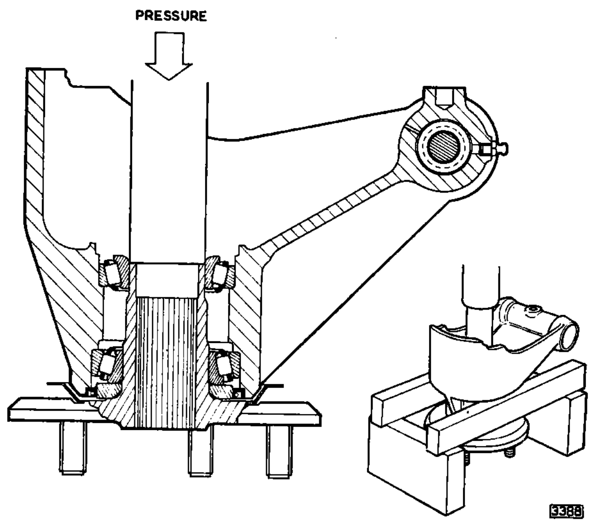


Fig. No. 7 *Pressing the hub from the hub carrier*

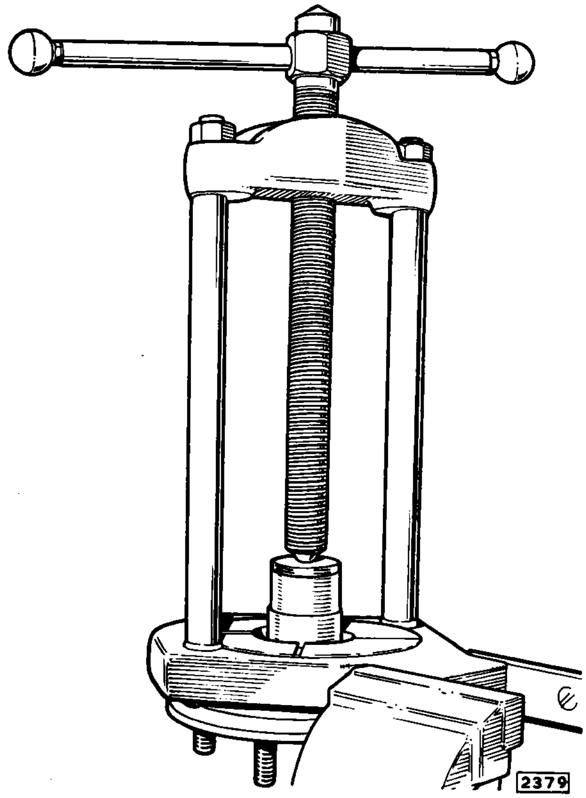


Fig. No. 8 *Removing the inner race from the hub using Churchill Tool No. J.16 B with multi-purpose hand-press, Tool No. SL.14*

race (Fig. 8). Drift out the outer races of the inner and outer bearings if necessary. Withdraw the outer bearing inner race with a suitable extractor.

Assembling

If new bearings are to be fitted, press new inner and outer bearing outer races into the hub carrier ensuring that they seat correctly in their recesses.
With the hub carrier held so that the outer bearing will be at the top, place the outer bearing inner race in position and press the outer oil seal into its recess (Fig. 9). Fit the water deflector and press the hub with the outer oil seal track In position into the outer bearing inner race until the hub is fully home.

Hub Bearing End Float

Hold the hub and hub carrier vertically in a hand press with the inner end of the hub uppermost. Place the inner bearing inner race on the hub, fit the master spacer (Special Tool No. J.15) into the race and press the race onto the hub (Fig. 10) until the master spacer contacts the hub. This will ensure a certain amount of end float. Remove the hub and hub carrier from the hand press and secure in a vice in order to measure the end float. With the inner end of the hub uppermost, and the master spacer in position as before, fit a dial gauge (Special Tool No. J.13) to the hub as shown in Fig. 11. Tap the hub carrier downwards, zero the dial gauge and using two screwdrivers or similar levers between the hub and hub carrier, move the hub carrier upwards to its fullest extent. Note the reading on the dial gauge.

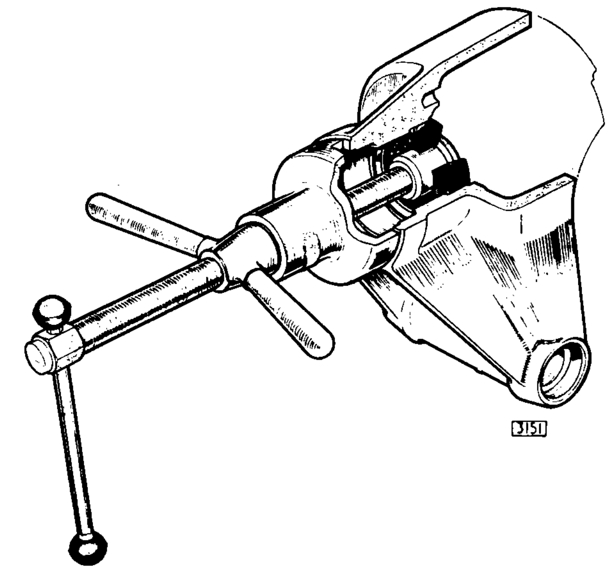


Fig. No. 9 *Replacing the hub bearing outer races using Churchill Tool No. J.20A with adaptor No. J.20A-1*

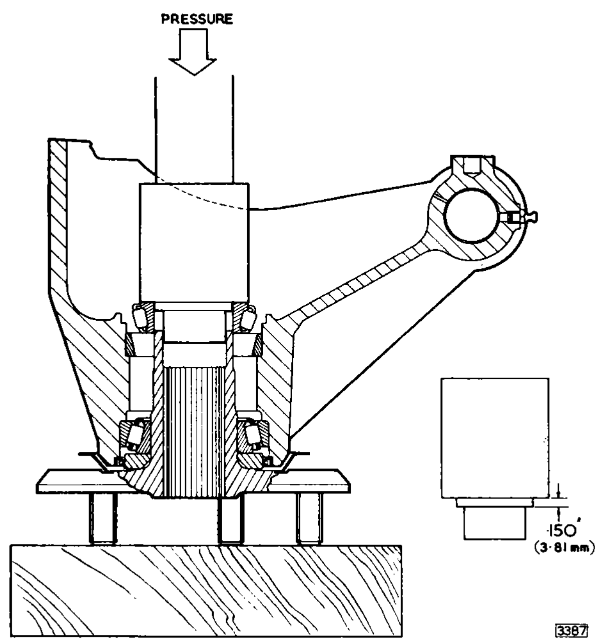


Fig. No. 10 *Pressing in the hub inner bearing inner race using Master spacer, (Churchill Tool No. J.15)*

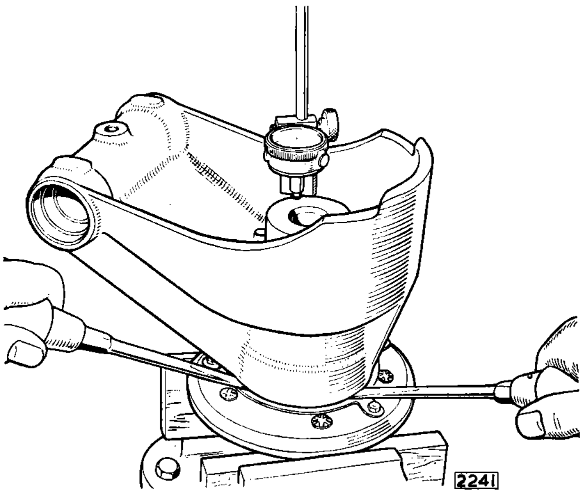


Fig. No. 11 *Checking the hub bearing end-float with a dial test indicator (Churchill Tool No. J.13)*

Having determined the measured end float, a spacer must be fitted in place of the special collar to give an end float of 0.002" - 0.006" (0.051 - 0.152 mm.). Spacers are supplied in thicknesses of 0.109" - 0.151" (2.77 - 2.87 mm.) in steps of 0.003" (0.076 mm.) as shown in the following table:—

Spacer Letter	Thickness inches	mm.
A	0.109	2.77
B	0.112	2.85
C	0.115	2.92
D	0.118	3.00
E	0.121	3.07
F	0.124	3.15
G	0.127	3.23
H	0.130	3.30
J	0.133	3.38
K	0.136	3.45
L	0.139	3.53
M	0.142	3.61
P	0.145	3.68
Q	0.148	3.75
R	0.151	3.87

For example, assume the end float measured to be 0.025" (0.64 mm.). Subtract the nominal end float of 0.004" (0.10 mm.) from the measured end float giving 0.021" (0.53 mm.). Since the Master Spacer is 0.150" (3.81 mm.) thick, the thickness of the spacer to be fitted will be 0.150" - 0.021" i.e. 0.129" (3.28 mm.). The nearest spacer is 0.130" (3.30 mm.) so a letter H spacer should be fitted.
When the hub assembly and half shaft have been refitted to the rear suspension the end float should be checked using the dial indicator as shown in Fig. 13.

Fitting the Hub Assembly to the Half Shaft
To fit the hub assembly to the half shaft it will be necessary to use a hand press (see Fig. 12). Ensure that both splines of the half shaft and the hub are free of grease by using a suitable solvent. Place the inner oil seal track and end float spacer on the half shaft. Apply a drop or two of "Loctite" (available in 10 c.c. bottles, Part No. 9035) to the half shaft splines for about an inch from the threaded end using a small paint brush to ensure even spreading. Only use "Loctite" sparingly as no additional benefit will be achieved by using large amounts. Introduce the half shaft into the hub and engage the splines. Place the assembly on the hand-press and press the hub onto the half shaft. Fit the washer and castellated nut, tighten to 140 lb. ft. (19.3 kgm.) torque and fit the split pin.
Note: To obtain the best results from the "Loctite" sealant, the joint should be allowed to set for 4 to 12 hours, that is, this period should be allowed to elapse before the car is run.

Refitting
The hub assembly and half shaft are refitted to the rear suspension as described under "Half Shaft Refitting".

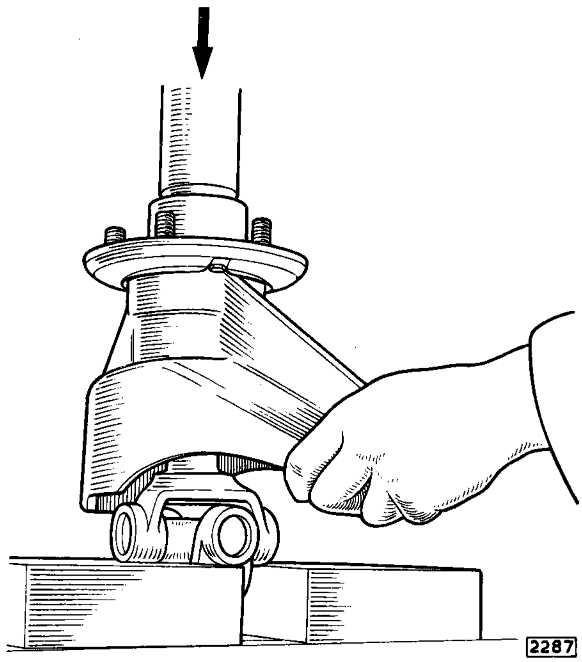


Fig. No. 12 *Fitting the hub to the half shaft using a press*

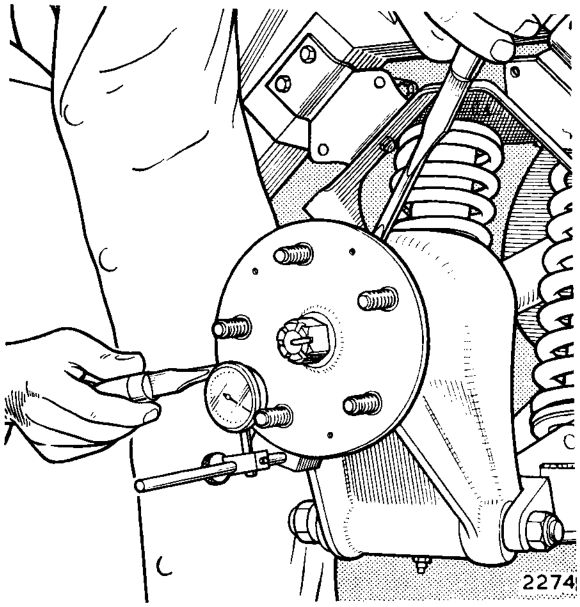


Fig. No. 13 *Checking the hub bearing end-float when in position (Churchill Tool No. J.13)*

THE HALFSHAFTS

Removal
Proceed as described under Rear Hub Removal until the hub assembly can be withdrawn. Remove the front hydraulic damper and spring unit (as described on page K.5). Remove the four steel type self-locking nuts securing the half shaft inner universal joint to the axle output shaft flange and brake disc. Withdraw the half shaft from the bolts noting the number of the camber shims fitted.

Refitting
Refit the hub assembly to the half shaft as described in the Rear Hub section and proceed as follows:—
Replace the camber shims and place the half shaft and hub into position with the half shaft inner universal joint over the four bolts. Fit the four steel-type self-locking nuts and tighten up. Refit the front hydraulic damper and spring unit (as described on page K.5). Refit the lower wishbone as described on page K.11. If the half-shaft has been renewed it will be necessary to check the rear wheel camber as described on page K.15.

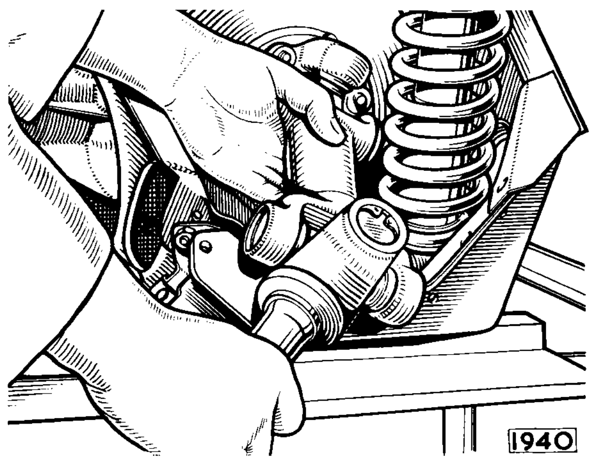


Fig. No. 14 *Withdrawing the half shaft*

THE UNIVERSAL JOINTS

Examine and Check for Wear
The parts most likely to show wear after long usage are the bearing races and spider journals. Should looseness in the fit of these parts, load markings or distortion be observed, they should be renewed as a unit, as worn needle bearings used with a new spider journal or new needle bearings with a worn spider journal will wear more rapidly, making another replacement necessary in a short time.

Dismantling and Assembling
Dismantling and assembling of the half-shaft universal joints should be carried out in accordance with the instructions given on pages G.3 and G.4.

RADIUS ARM

Removal
Remove the locking wire from the radius arm safety strap and securing bolt.
Unscrew the two bolts securing the safety strap to the body floor.
Remove the radius arm securing bolt and spring washer and remove the safety strap.
Withdraw the radius arm from the mounting post on the body.
Remove one of the self-locking nuts securing the hub bearing assembly fulcrum shaft to the wishbone.
Drift out the fulcrum shaft from the wishbone and hub assembly as described on page K.11.
Remove the self-locking nut and bolt securing the radius arm to the wishbone and remove the radius arm.
Examine the radius arm mounting rubbers for deterioration.
If the rubber bushes need replacing they can be removed and refitted by means of Churchill Tool Number J.21.
When replacing the large rubber bush the two holes should be in the longitudinal position in the radius arm.
When fitting the smaller bush ensure that an equal amount of the steel centre sleeve protrudes from each side of the radius arm.

Refitting
Refitting is the reverse of the removal procedure.
When refitting the hub bearing assembly shaft, refer to page K.8.
Refit the safety strap into position, refit the spring washer and radius arm securing bolt.
Refit the two bolts and nuts securing the safety strap to the body.
Tighten the radius arm securing bolt to 46 lb. ft. (6.36 kgm.) and pass the locking wire through the hole in the head of the bolt and secure round the safety strap.

HYDRAULIC DAMPERS

The telescopic hydraulic dampers are of the sealed type with no provision for adjustment or "topping-up" with fluid. Therefore, in the event of a damper becoming unserviceable a replacement must be fitted.

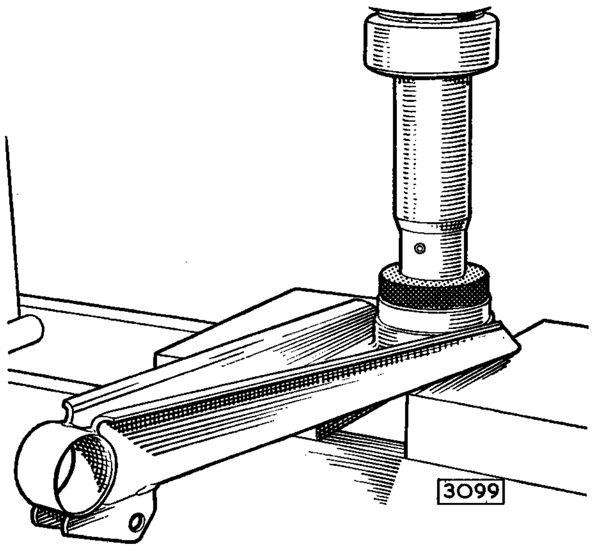


Fig. No. 15 *Showing removal of radius arm bushes (Churchill Tool No. J.21)*

Removal
Remove the road spring and hydraulic damper as described on page K.5.
Utilizing Churchill Tool No. J.11A and SL.14, Fig. 16, compress the road spring until the split collet can be removed from under the road spring retainer.
Carefully release the pressure on the road spring and withdraw the hydraulic damper.

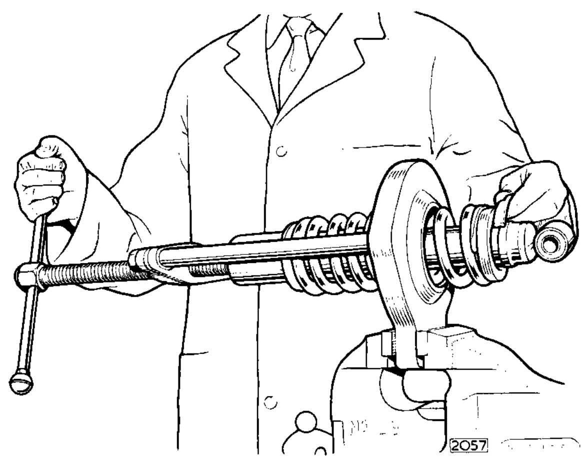


Fig. No. 16 *Removing the rear road spring from the hydraulic damper with Churchill Tool No. J.11 A in conjunction with SL.14*

Refitting
Compress the road spring, utilizing Churchill Tool No. J.11A and SL.14, sufficiently to allow the hydraulic damper to be passed through the road spring. Fit the packing ring, spring and split collet. Ensure that the split collet and spring are seating correctly. Release the pressure on the road spring.

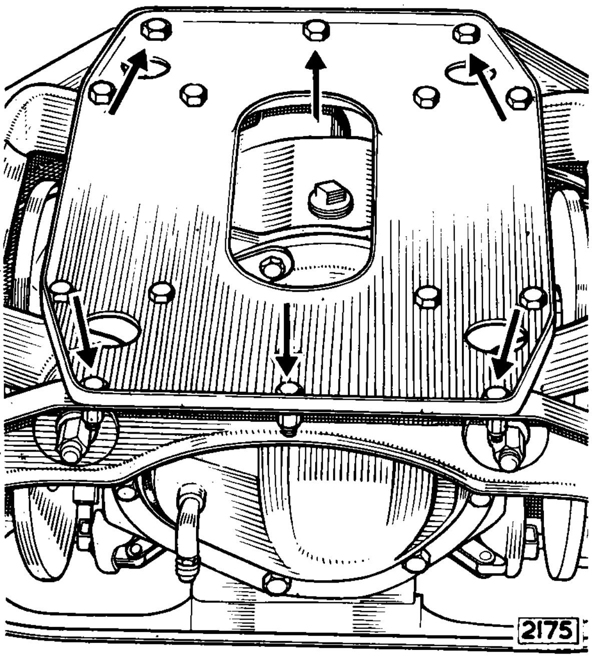


Fig. No. 17 *Showing the six bolts which secure the tie plate to the crossbeam*

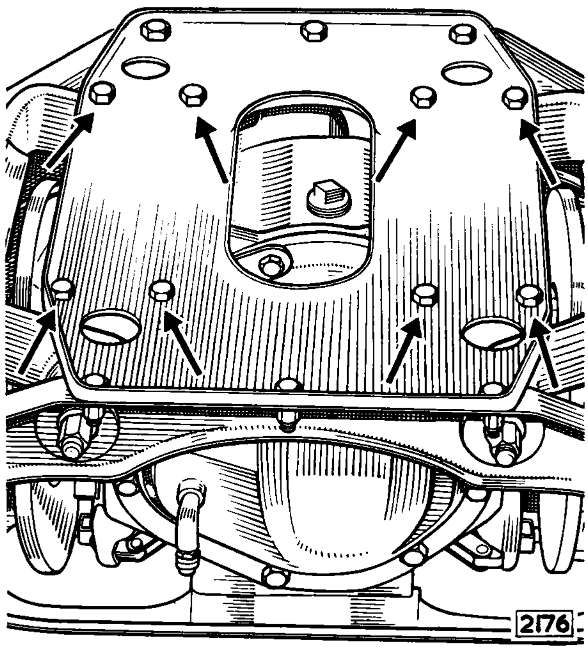


Fig. No. 18 *Showing the eight bolts which secure the tie plate to the inner fulcrum mounting bracket*

Refit the road spring and hydraulic damper assembly as described on page K.5.

WISHBONE
Removal
Remove the hydraulic dampers as described in previous paragraph.
Remove the six self-locking nuts and bolts securing the tie plate to the cross beam.
Remove the eight self-locking nuts and bolts securing the tie plate to the inner fulcrum wishbone mounting brackets and remove the tie plate, see Fig. 18.

Remove one of the self-locking nuts securing the hub bearing assembly fulcrum shaft to the wishbone and drift out the fulcrum shaft, see Fig. 19.
Separate the hub carrier from the wishbone. If any shims are fitted between the wishbone and hub assembly note the amount and position of the shims as it is essential to replace the exact amount in the correct position. To facilitate refitting, slide a dummy fulcrum shaft, Churchill Tool No. J.14 through the hub carrier.
Place a piece of sticky tape over each of the hub carrier assembly oil seal tracks to prevent them becoming displaced.
Remove the self-locking nut securing the radius arm to the wishbone. Withdraw the special thin headed bolt and remove the radius arm from the wishbone.
Remove the self-locking nut securing the wishbone fulcrum shaft to the cross beam.
Drift the inner fulcrum shaft out of the wishbone and inner fulcrum mounting bracket.
Withdraw the wishbone assembly and collect the four outer thrust washers, inner thrust washers, oil seals and retainers.
Examine the oil seals for deterioration.
Remove the two bearing tubes.
There is no need to remove the spacer fitted between the inner fulcrum mounting bracket unless the mounting bracket is to be replaced. To remove the spacer, tap out of position. To remove the needle rollers gently tap the needle cages out of the wishbone using a suitable drift. Remove the needle roller spacer.

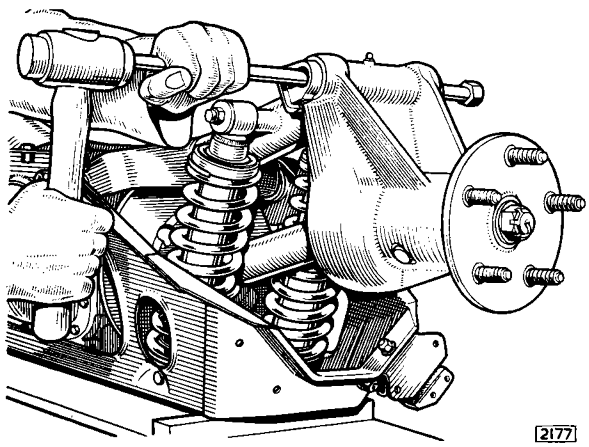


Fig. No. 19 *Drifting out the wishbone outer fulcrum shaft*

Refitting

If the needle rollers have been removed from the larger fork of the wishbone lever press one roller cage into position, with the engraving on the roller cage facing outwards.

Insert the roller spacing tube and press in the other roller cage.

Repeat for the other side.

Insert the bearing tubes. Smear the four outer thrust washers, inner thrust washers, oil seals and oil seal retainers with grease and place into position on the wishbone.

Offer up the wishbone to the inner fulcrum mounting bracket with the radius arm mounting bracket towards the front of the car. Align the holes and spacers. Press a dummy shaft Churchill Tool No. J.14 through each side of the cross beam and wishbone.

The dummy shafts locate the wishbone, thrust washers, cross beam and inner fulcrum mounting bracket and facilitate refitting of the fulcrum shaft.

Smear the fulcrum shaft with grease and gently tap the shaft through the crossbeam, wishbone and inner fulcrum mounting bracket. As the fulcrum is tapped into position, the short dummy shafts will be displaced from the opposite end. It will be found advantageous to keep a slight amount of pressure exerted on the dummy shafts as they emerge from the cross beam. This will reduce the tendency for the dummy shafts to be knocked out of position and allow a spacer or thrust washer to be displaced. If a washer or spacer becomes displaced it will be necessary to remove the fulcrum shaft, dummy shafts and wishbone and then repeat the operation.

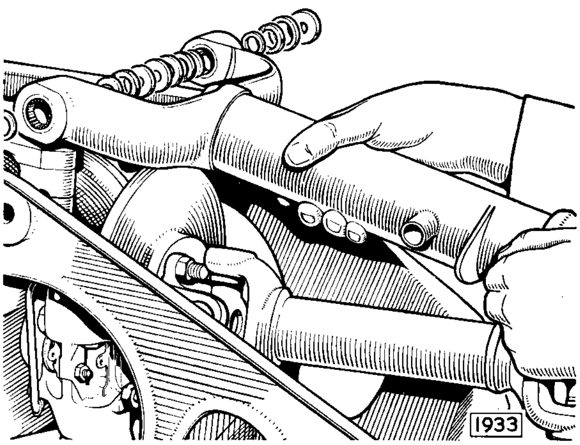


Fig. No. 20 *Showing the wishbone inner fork components*

When the fulcrum shaft is in position, tighten the two self-locking nuts to .55 lb. ft. (7.60 kgm.) with a torque wrench.

Refit the eight bolts and self-locking nuts securing tie plate to the inner fulcrum wishbone mounting bracket, see Fig. 18.

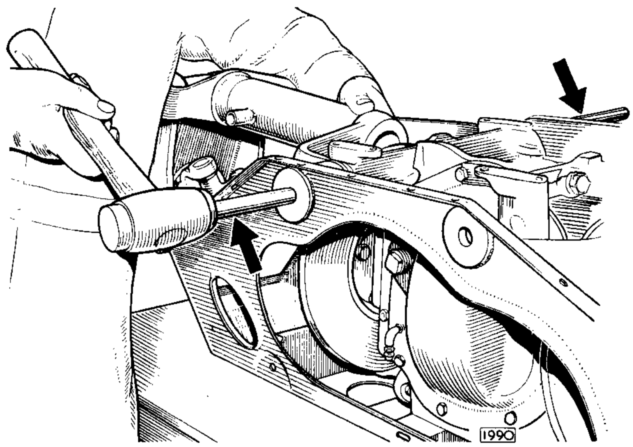


Fig. No. 21 *Tapping the dummy shafts into position at the wishbone inner fulcrum*

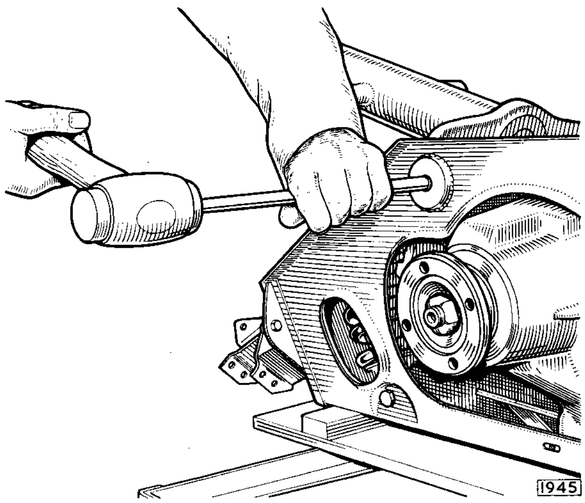


Fig. No. 22 *Drifting the inner fulcrum shaft into position and displacing the dummy shaft*

Refit the six bolts and self-locking nuts securing the tie plate to the crossbeam, see Fig. 17.

Refit the radius arm to the wishbone as described on page K.10.

Remove the two pieces of sticky tape holding the oil seal tracks in position.

Offer up the wishbone to the hub assembly.

Using a dummy shaft, Churchill Tool No. J.14, line up the wishbone hub assembly oil tracks and spacers. Smear the fulcrum shaft with grease and gently tap the fulcrum shaft into position and displace the dummy shaft.

It will be found advantageous to apply a small amount of pressure on the dummy bar against the fulcrum shaft to prevent the bar being knocked out of position and allowing a spacer to be displaced. If a spacer is displaced it may be necessary to repeat the operation. Slide the fulcrum shaft through the wishbone and hub carrier. Using feeler gauges, check the amount of clearance between the hub carrier and the wishbone lever, see Fig. 25. If necessary, fit sufficient shims between the hub carrier and the wishbone to centralize the hub carrier. Tighten the nuts on the fulcrum shaft to 55 lb. ft. (7.60 kgm.).
Check the rear suspension camber angle as described on page K.15.
Refit the hydraulic dampers as described on page K.11.
Refit the rear suspension as described on page K.5.
Re-lubricate the wishbone fulcrum shafts as described in "Routine Maintenance" at the beginning of this section.

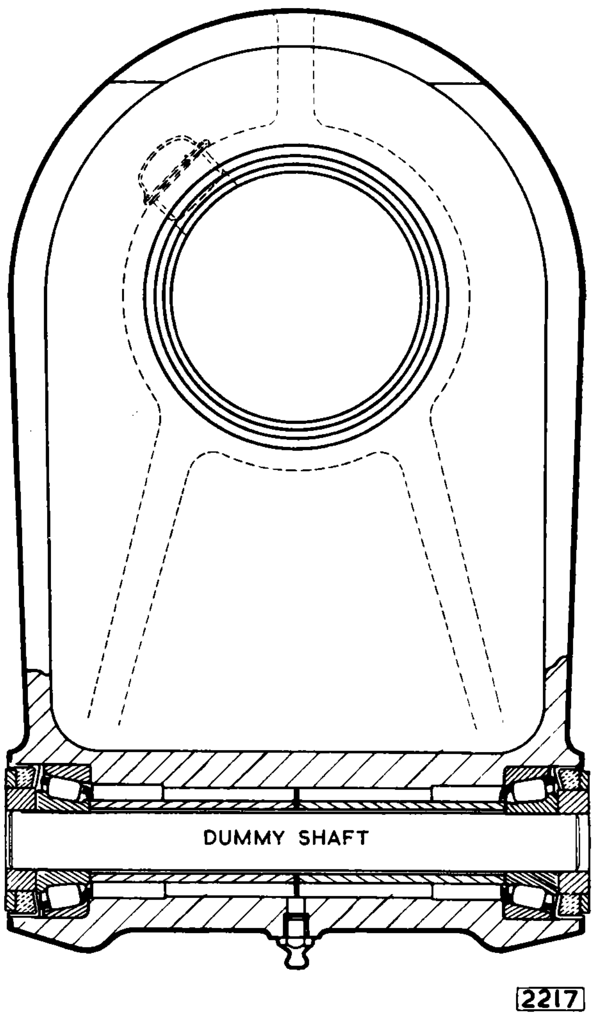


Fig. No. 23 *Showing the dummy shaft in position in the hub carrier*

WISHBONE OUTER PIVOT

Removal

Support the hub carrier and wishbone.
Remove one of the self-locking nuts securing the outer fulcrum shaft.
Drift out the fulcrum shaft, and collect the shims, if any, between the hub carrier and the wishbone.
Separate the hub carrier and wishbone.

Dismantling

Remove the oil seal track and prise out the oil seals.
Remove the inner races of the tapered roller bearings by tapping out with the aid of a drift in the grooves provided.
Remove the spacers and shims.

Reassembly

Refit the inner races for the tapered roller bearings.
Fit the spacers and a known quantity of shims, this is necessary to obtain the correct bearing adjustment as described in the following paragraphs.
Fit the tapered roller bearings and oil seal tracks.

Bearing Adjustment

If it is necessary to adjust the tapered roller bearings it will be necessary to extract the hub from the rear axle half shaft as described on page K.5.
Bearing adjustment is effected by shims fitted between the two fulcrum shaft spacer tubes. The correct bearing adjustment is .000" - .002" (.00 mm. - .05 mm.) pre-load.
Shims are available in sizes of .004" (.101 mm.) and .007" (.17 mm.) thick and 1⅛" (28.67 mm.) diameter.
A simple jig should be made consisting of a piece of plate steel approximately 7" × 4" × ⅜" (17.7 cm. × 10.1 cm. × 9.5 mm.). Drill and tap a hole suitable to receive the outer fulcrum shaft. Place the steel plate in a vice and screw the fulcrum shaft into the plate and slide an oil seal track onto the shaft. Place the assembly into position on the fulcrum shaft minus the oil seals and with an excess of shims between the spacers. Place an inner wishbone fork outer thrust washer onto the fulcrum shaft so that it abuts the oil seal track. Fill the remaining space in the shaft with washers and secure with a nut. Tighten the nut to 55 lb. ft. (7.60 kgm.).
Press the hub carrier assembly towards the steel plate using a slight twisting motion to settle the rollers onto the bearing surface. Maintain a steady pressure against the hub carrier and using a feeler gauge measure the amount of clearance between the large diameter washer and the machined face of the hub carrier.
Subtract the one measurement from the other which gives the amount of end float present in the bearings. Remove sufficient shims to obtain a reading of .000" .002" (.00 mm. - .05 mm.) preload.
Example:—
Correct preload .000" - .002" (.00 mm. - .05 mm.).
Mean .001" (.02 mm.).
Assume the bearing end-float to be .010" (.35 mm.).
Therefore .010" + .001" = .011" (.25 mm. + .02 mm. = .27 mm.) to be removed to give the correct preload.

Refit the hub carrier to the half shaft as described in Section H "Rear Axle".
Fit the new oil seals with the lips inwards and place the fulcrum shaft into position in the hub carrier.
Offer up the hub carrier to the wishbone. Ease the dummy shaft through the wishbone with the fulcrum shaft.
Using feeler gauges measure the gap between the oil seal track and the wishbone. Shims of .004" (.101 mm.) thickness by $1\frac{1}{8}$" (22.2 mm.) diameter should be used. Repeat for the other end and shim as necessary to centralize the hub carrier in the wishbone fork. The above procedure is to prevent the wishbone fork ends from closing inwards. Tighten the nuts on the fulcrum shaft to 55 lb. ft. (7.60 kg.m.).

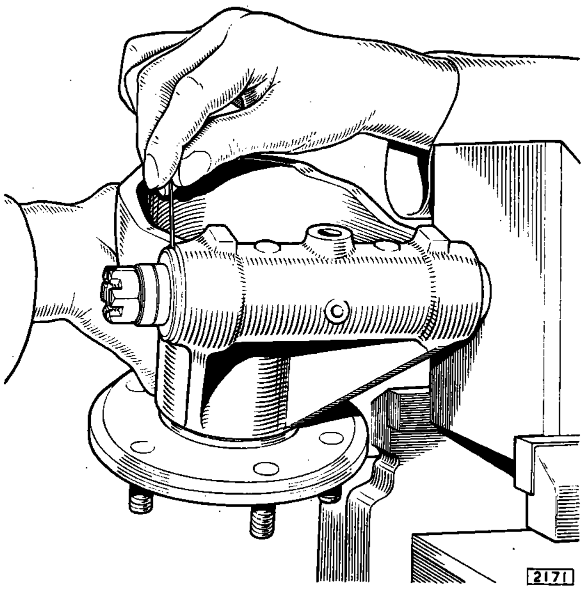


Fig. No. 24 *Measuring the amount of clearance between the hub carrier and large washer to determine the end-float of the bearings*

Refitting
To facilitate refitting, slide a dummy shaft Churchill Tool No. J.14 through the hub carrier before offering up the wishbone to the hub carrier.
Refitting is the reverse of the removal procedure.
Re-lubricate the bearings as described in "Routine Maintenance" at the beginning of the section.

INNER FULCRUM WISHBONE MOUNTING BRACKET
Removal
Remove the eight bolts and self-locking nuts securing the tie plate to the inner fulcrum wishbone mounting bracket.
Remove the six bolts and self-locking nuts securing the tie plate to the cross beam.
Remove one self-locking nut and drift out the inner fulcrum shaft.

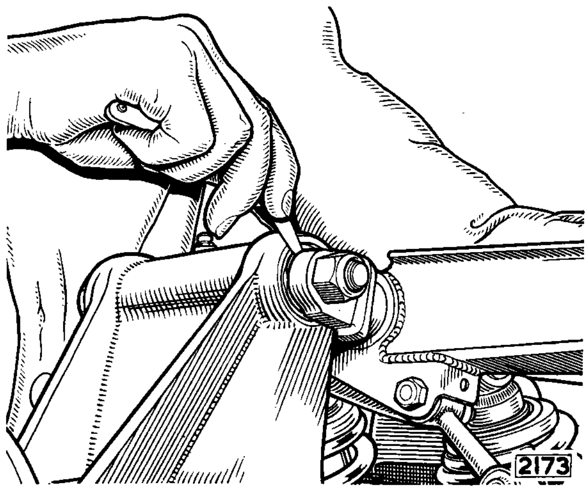


Fig. No. 25 *Using feeler gauges to measure the clearance between the hub carrier oil seal tracks and wishbone forks*

Withdraw the forks of the wishbone from between the cross beam and inner fulcrum wishbone mounting bracket.
Collect the oil seal retainers, oil seals, inner and outer thrust washers and bearing tubes.
Remove the lock wire from the two setscrews which secure the inner fulcrum wishbone mounting bracket to the differential unit.
Remove the spacer between the inner fulcrum mounting bracket.
Remove the two setscrews and note the amount of shims between the bracket and the differential.
Remove the inner fulcrum wishbone mounting bracket.

Refitting
When refitting the inner fulcrum wishbone mounting bracket, replace the same amount of shims between the differential casing and the bracket.
Shims are available in sizes of .005" (.13 mm.) and .007" (.18 mm.) thickness.
Hold the inner fulcrum wishbone mounting bracket in position between the crossbeam.
Insert the fulcrum shaft through the crossbeam and bracket. Screw the inner fulcrum bracket securing setscrews in two or three threads, enough to locate the bracket.
Insert the required amount of shims and tighten the two setscrews securing the inner fulcrum wishbone mounting bracket to the differential casing. Secure the two setscrews with locking wire.
Tap the spacer fitted between the inner fulcrum mounting bracket lugs, into position.
Withdraw the inner fulcrum shaft from the crossbeam and fulcrum bracket.
Offer up the wishbone to the inner fulcrum mounting bracket complete with bearing tubes, needle roller bearing and spacers, inner and outer thrust washers, oil seals and oil seal retainers. Ensure that the radius

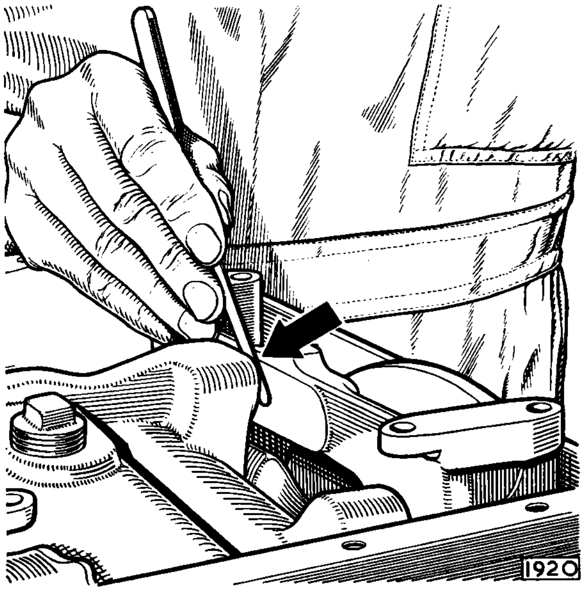
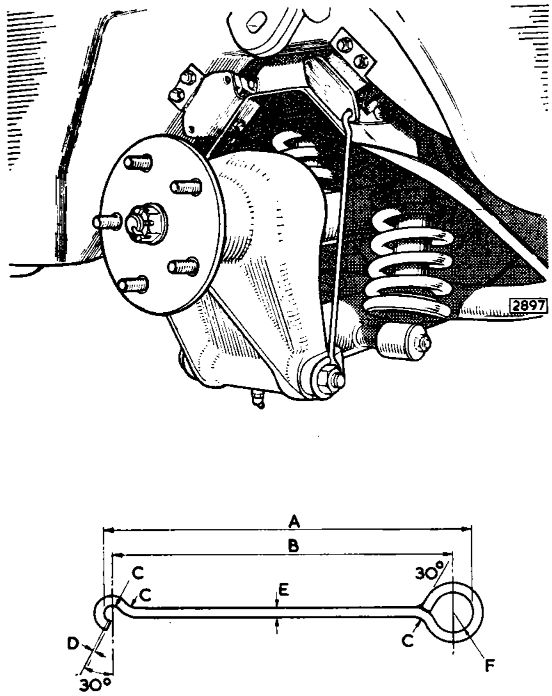


Fig. No. 26 *Measuring the clearance between the inner fulcrum mounting bracket and the differential casing*

arm mounting bracket is towards the front of the car. Align the holes and spacers. Press a dummy shaft through each side of the cross beam and wishbone.
The dummy shafts locate the wishbone, spacers, cross-beam and inner fulcrum mounting bracket and facilitate refitting of the fulcrum shaft.
Smear the fulcrum shaft with grease and gently tap the shaft through the crossbeam, wishbone and inner fulcrum mounting bracket. As the fulcrum is tapped into position the short dummy shafts will be displaced from the opposite side. It will be found advantageous to keep a slight amount of pressure exerted on the dummy shafts as they emerge from the crossbeam. This will reduce the tendency for the dummy shafts to be knocked out of position and allow a spacer or thrust washer to be displaced. If a washer or spacer becomes displaced it will be necessary to remove the fulcrum shaft, dummy shafts and wishbone and then repeat the operation.
When the fulcrum shaft is in position, tighten the two self locking nuts to 55 lb. ft. (7.60 kg.m.) with a torque wrench.
Refit the eight bolts and self-locking nuts securing the tie plate to the inner fulcrum wishbone mounting bracket.
Refit the six bolts and self-locking nuts securing the tie plate to the crossbeam.
Refit the rear suspension unit as described on page K.5.

REAR WHEEL CAMBER ANGLE — ADJUSTMENT

To check the camber of the rear wheels the car must be standing on a level surface with the tyre pressures set correctly. Owing to the variations in the camber angle with different suspension heights, it is necessary to lock the front and rear suspension in the mid-laden position: on the rear, by means of two setting links (Churchill Tool No. J.25) as shown in Fig. 27. To fit the setting links hook one end in the lower hole of the rear mounting and depress the body until the other end can be slid over the hub carrier fulcrum nut. Repeat for the other side.
Lock the front suspension in the mid-laden position as detailed on page J.9.



	INCHES	METRIC
A	9 1/32"	22·9 cm
B	8 3/16"	20·79 cm
C	1/4" RAD	6·3 mm
D	1/16"	1·5 mm
E	9/32"	7·1 mm
F	19/32" RAD	15·0 mm

Fig. No. 27 *When checking the rear camber angle, the rear suspension must be retained in the mid-laden position by means of the setting links (Churchill Tool No. J.25)*

With the car in this condition the camber angle should be $\frac{3}{4}$° negative $\pm \frac{1}{4}$°.
Note: The two rear wheels must be within a $\frac{1}{4}$° of each other.

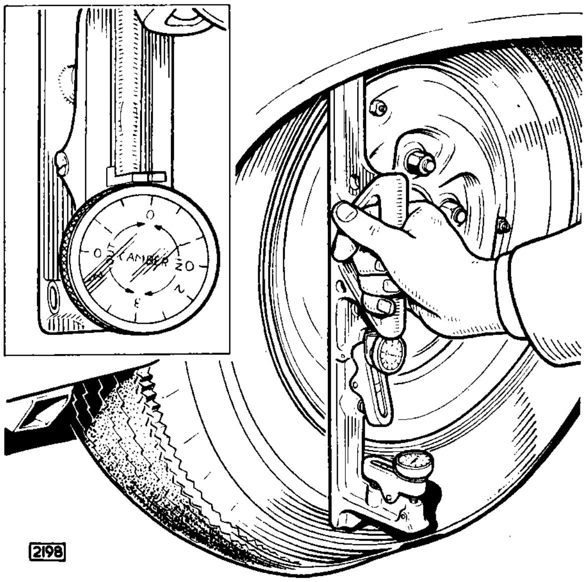


Fig. No. 28 *Checking the rear wheel camber angle*

If the reading is incorrect it will be necessary to add or subtract shims between the half-shaft and the brake disc. One shim .020" (.05 mm.) will alter the rear camber angle by approximately $\frac{1}{4}°$.
Jack up the car on the appropriate side and remove the rear road wheel.
Unscrew the four self-locking nuts securing the half shaft and the camber shims to the brake disc. Pull the hub and half shaft away from the shims sufficiently to clear the disc mounting studs. Remove or add shims as necessary.

Offer up the half shaft to the four disc mounting studs and secure with four self-locking nuts. Offer up the forward road spring and hydraulic damper assembly to the crossbeam and secure with a bolt and self-locking nut.
Align the hydraulic damper and road spring assembly bottom mounting with the mounting pin in the wishbone and drift the pin through the assembly. Replace the plain washer and secure with a self-locking nut.
Replace the road wheels and recheck the camber angle.
Warning: After completing the adjustment do not omit to remove the setting links from the suspension.

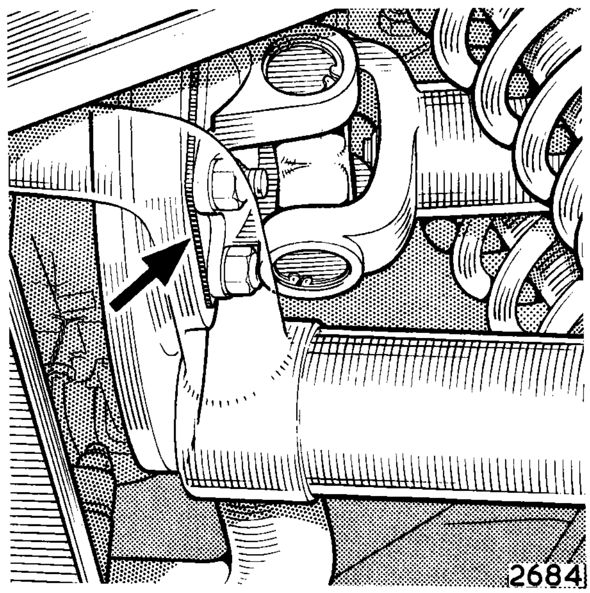


Fig. No. 29 *The rear wheel camber angle is adjusted by means of shims indicated by arrows*

SPECIAL TOOLS

Description	**Tool No.**
Shock Absorber/Spring Unit Dismantling Tool . .	J.11 A (Use with S.L.14)
Rear Wishbone Pivot Dummy Shaft	J.14 (2 off per set)
Radius Arm Bush Remover/ Replacer . . .	J.21
Rear Suspension Setting Link (for camber checking) .	J.25 (2 off per set)

BRAKES

SECTION L

INDEX

Description Page

THE BRAKING SYSTEM

DESCRIPTION

The braking system consists of four wheel disc brakes hydraulically operated by a dual-line servo unit.
The dual-line servo has an integral vacuum booster with tandem slave cylinder, a master cylinder combined with a booster reaction valve and two fluid reservoirs.
The master cylinder is of conventional design having a single cast iron cylinder, housing a steel, black oxided piston sealed by a single hydraulic cup. Mounted on the end of the master cylinder is a reaction valve which consists of a pair of flow control valves controlling the flow of air to the booster.
The tandem slave cylinder, mounted on the forward face of the boost tank, consists of a single cast iron cylinder housing two pistons in tandem, each piston having its own inlet and outlet port. Either piston will, in the event of failure, operate independently.
The front wheel brake units consist of hub-mounted disc rotating with the wheels. Each disc is straddled by a caliper rigidly attached to the stub axle carrier.

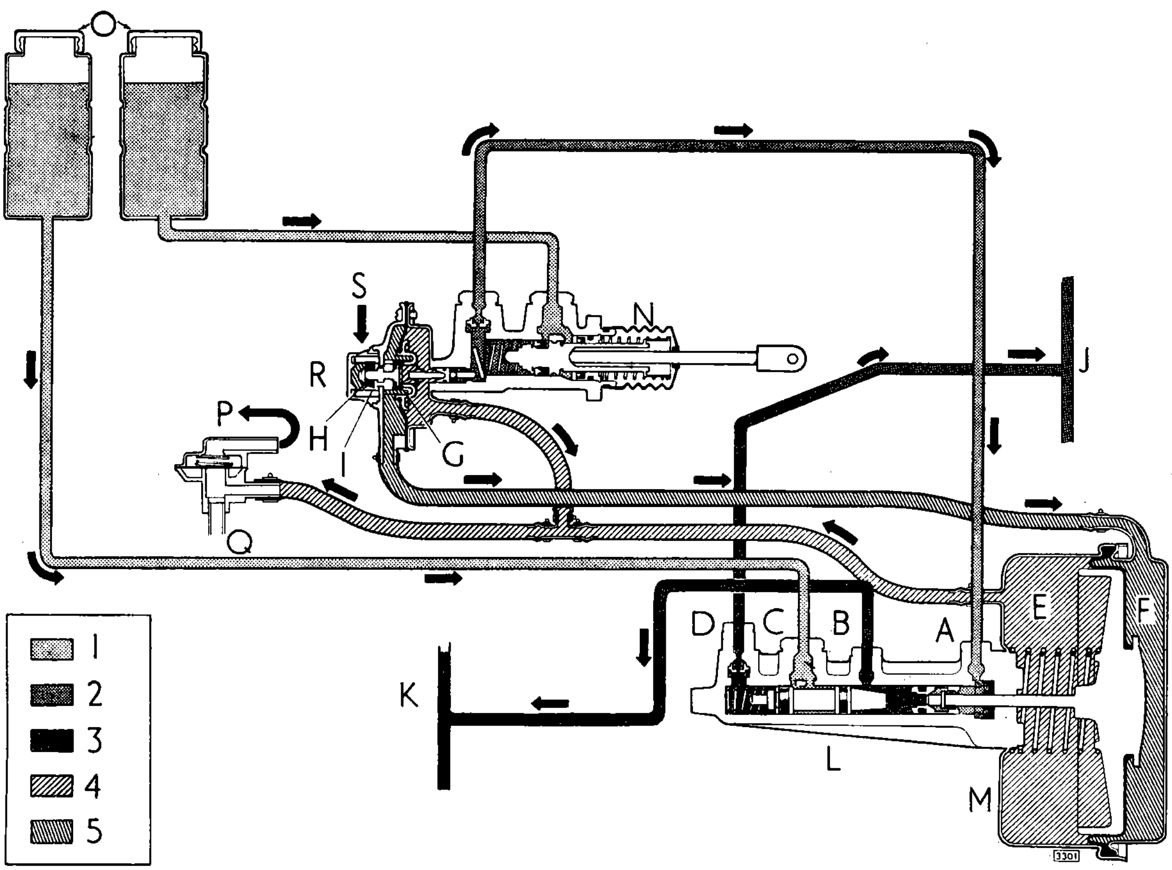


Fig. No. 1 *Dual-line servo system*

1	Fluid at feed pressure	**G**	Diaphragm
2	Fluid at master cylinder delivery pressure	**H**	Filter
3	Fluid at system delivery pressure	**I**	Air control
4	Vacuum	**J**	To rear brakes
5	Air at atmospheric pressure	**K**	To front brakes
A	Primary chamber-slave cylinder	**L**	Tandem slave cylinder
B	Outlet port-front brakes	**M**	Vacuum cylinder
C	Inlet port-Secondary piston	**N**	Master cylinder
D	Outlet port-rear brakes	**O**	Fluid reservoir
E	Vacuum	**P**	To manifold
F	Air pressure	**Q**	To reserve
		R	Reaction valve

The rear wheel brakes are mounted inboard on the differential output flanges with the calipers attached to the differential housing.
Each caliper assembly is made in two paired halves bolted together by **four bolts which must not be disturbed.**
The front calipers contain two cylinders and pistons in the outer half and a single large piston and cylinder in the inner half.
In the cylinders are square sectioned sealing rings located in a groove in the cylinder bore. The pistons are protected by rubber dust covers which have one lip located in a groove in the piston and the other lip fitted in a groove in the cylinder.
The inner half of each front caliper incorporates the port for the hydraulic fluid and a bleed valve. A drilling from the inner half of the caliper to the outer half forms a passage for fluid to the outer caliper pistons and is sealed at the junction of the two halves by a rubber "O" ring.
The rear calipers have a single large cylinder and piston on each side; the two halves being interconnected by a bridge pipe.
The friction pads are located by two retaining pins which pass through the caliper body and through holes drilled in the friction pad backing plates. The pads are fully floating on the pins to allow for brake application and automatic adjustment.
Handbrakes, attached to the rear calipers, are self-adjusting to compensate for friction pad wear and automatically provide the necessary clearance between the pads and the discs.

DATA

Caliper type . .	Girling bridge type with quick changing pads
Brake disc diameter — Front	11.1875" (28.4 cm.)
— Rear	10.395" (26.3 cm.)
Brake disc thickness— Front .	½" (12.7 mm.)
— Rear .	½" (12.7 mm.)
Master cylinder bore diameter .	⅞" (22.23 mm.)
Master cylinder stroke . .	1.30" (3.3 cm.)
Servo unit type . .	Lockheed Type 8 Dual Line
Brake fluid . .	Castrol/Girling Crimson Clutch/brake fluid
Main brake friction pad material .	Mintex M33
Handbrake friction pad material . .	Mintex M34

ROUTINE MAINTENANCE

EVERY 3,000 MILES (5,000 KM.)
On the right hand drive cars the brake fluid reservoirs are attached to the right and left wing valances; on left hand drive cars both are attached to the left hand wing valance.
The reservoir for the master cylinder feeds the front brakes and the reservoir to the servo feeds the rear brakes.
At the recommended intervals, check the level of the fluid in the reservoirs and top up, if necessary, to the level mark which is above the fixing strap and marked "Fluid Level". **Do not overfill.**
The level can be seen through the plastic reservoir container.
Note: The fluid level will fall during service as pad wear takes place and the pistons move out correspondingly, thus enlarging the cylinder volume.
After topping up the reservoir(s), re-insert the combined filler cap and float slowly into the reservoir to allow for displacement of fluid. Wipe off any fluid from the top of the cap and re-connect the electric cables to either of the two terminals. Refit the plastic covers.
Note: A further indication that the level is getting low is provided by an indicator pin situated between the two terminals. First press in the pin and allow to return to its normal position. If the pin can then be lifted with the thumb and forefinger, the reservoir must be topped up immediately.

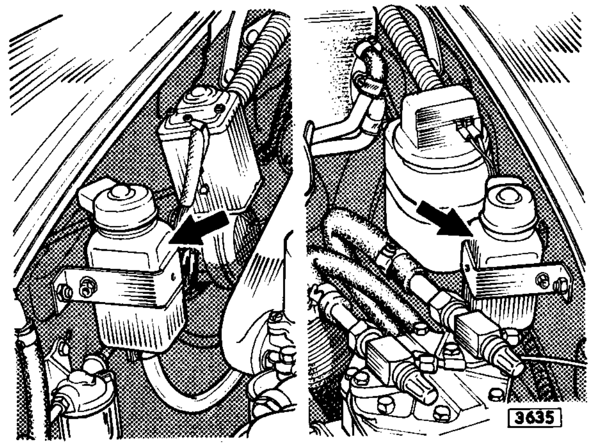


Fig. No. 2 *Brake fluid reservoirs—right hand drive*

Brake Fluid Level and Handbrake Warning Light
A warning light (marked "Brake Fluid — Handbrake") situated on the facia behind the steering wheel, serves to indicate if the level in either of the two brake fluid reservoirs has become low, provided the ignition is on. As the warning light is also illuminated when the handbrake is applied, the handbrake must be fully released before it is assumed that the fluid level is low. If with the ignition "on" and the handbrake fully released, the warning light is illuminated, the brake fluid must be "topped up" and the reason for the loss investigated and corrected immediately. IT IS ESSENTIAL that the correct specification of brake fluid be used when topping up.

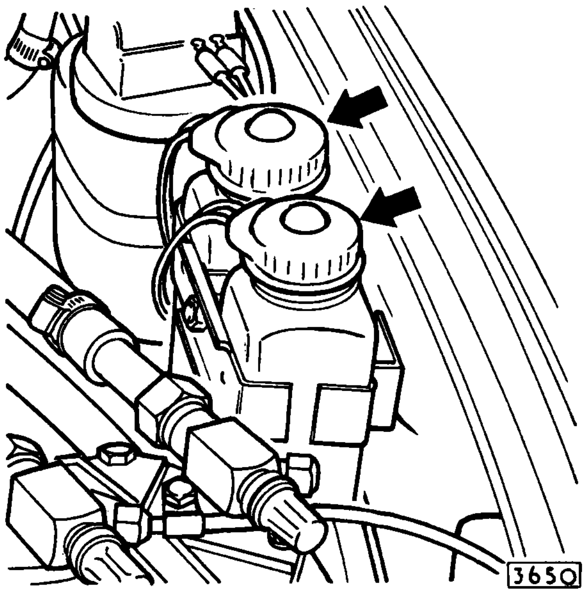


Fig. No. 3 *Brake fluid reservoirs—left hand drive*

As the warning light is illuminated when the handbrake is applied and the ignition is "on", a twofold purpose is served. Firstly, to avoid the possibility of driving away with the handbrake applied. Secondly, as a check that the warning light bulb has not "blown"; if, on first starting up the car with the handbrake fully applied, the warning light does not become illuminated, the bulb should be changed immediately.

Friction Pads — Examination for Wear
At the recommended intervals, or if a loss of braking efficiency is noticed, the brake friction pads (2 per brake) should be examined for wear: the ends of the pads can be easily observed through the apertures in the brake calipers. When the friction pads have worn down to a thickness of approximately $\frac{1}{8}$" (3.2 mm.) they need renewing.

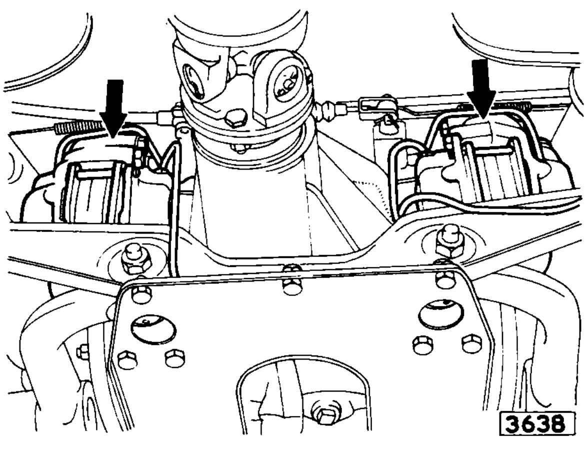


Fig. No. 4 *Location of the rear calipers*

Handbrake Cable Adjustment
The handbrake cable adjustment linkage is situated on the underside of the floor panel below the handbrake lever.
To adjust, fully release the handbrake control in the car and slacken the lock-nut at the rear of the adjustment trunnion.
Ensure that the levers at the calipers are in the "fully off" position by pressing towards the caliper and adjust the length of the cable to a point just short of where the caliper levers start to move: no attempt should be made to place the cable under tension, otherwise the handbrakes may bind.
Note: Both front and rear footbrakes and the handbrakes are so designed that no manual adjustment to compensate for friction pad wear is necessary.

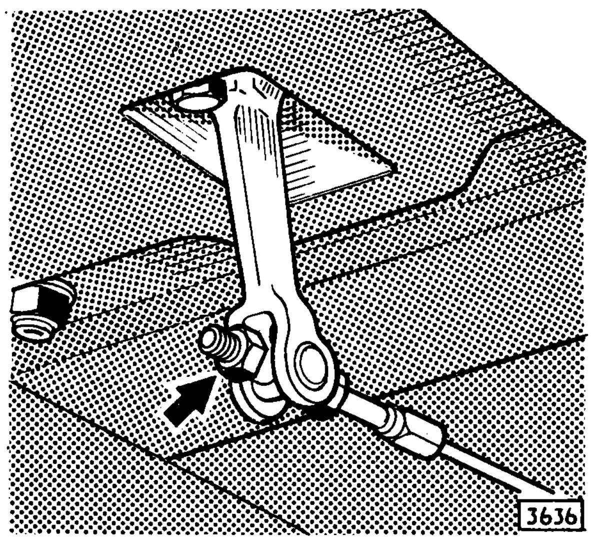


Fig. No. 5 *The handbrake adjustment*

EVERY 12,000 MILES (20,000 KM.)
Clean the air filter element attached to the reaction valve.
Remove the cover from the reaction valve on the master cylinder by inserting a thin bladed tool under the tip of the cover and prising off. Care must be taken to control the run of the valve spring.
Withdraw the filter element, wash in clean, denatured alcohol, dry in clean air and refit. DO NOT lubricate the element with oil or Brake Fluid.

FRICTION PADS
Renewal
Withdraw the hairpin clips and extract the pad retaining pins. Withdraw the pads from the calipers.
To enable the new friction pads to be inserted, it will be necessary to force the pistons back down the cylinder bores by using a lever. It is advisable to half empty the brake reservoirs, otherwise forcing the pistons back will eject fluid from the reservoirs with possible damage to the paintwork.

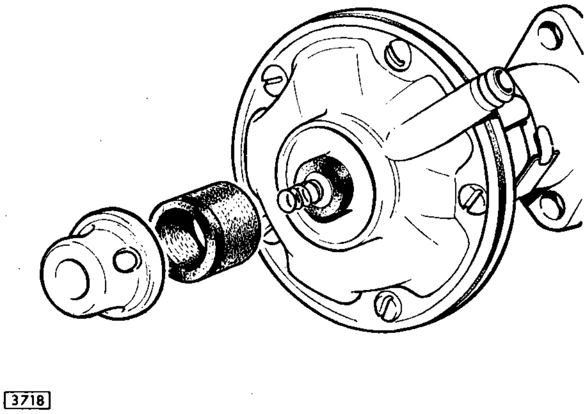


Fig. No. 6 *The reaction valve filter components*

Insert new pads. Line up the holes in the backing plates and caliper body. Fit the retaining pins and secure with the hairpin clips. The retaining pins must NOT be forced into their locating holes. Ensure that the pads are free to move slightly to allow for brake application and automatic adjustment.
Top up the reservoirs to the correct level and apply the brakes several times until the pedal feels "solid".

CALIPER OVERHAUL

In order to replace the pistons, rubber sealing rings or rubber dust covers, it will first be necessary to remove. the caliper from the car as detailed on page L.13.

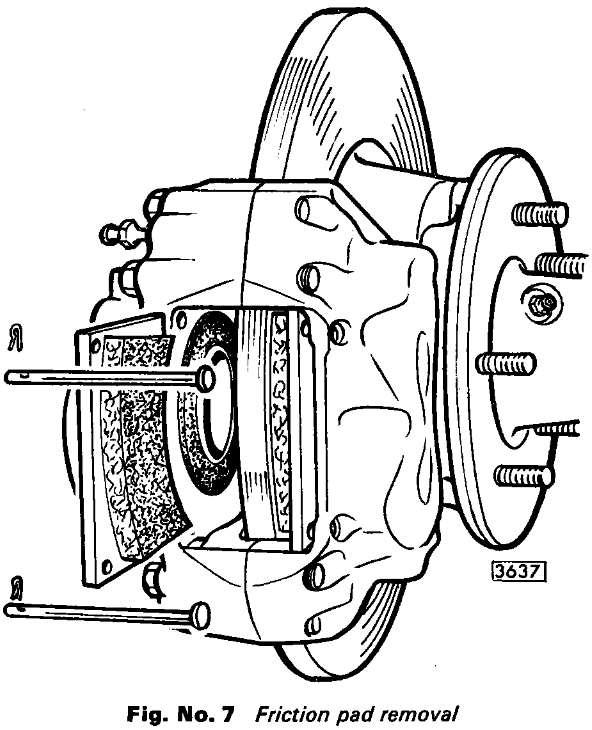


Fig. No. 7 *Friction pad removal*

Release the rubber dust cover lip from its groove in the cylinder bore.
Pack a rag between the pistons and apply air pressure through the inlet port to "blow" the pistons from the cylinder bores. Extract the cylinder sealing ring from the bore.
Examine the cylinder bore for any sign of abrasion, "scuffing" or corrosion. The bore may be cleaned up with fine steel wool but be sure to remove all traces or particles before proceeding.
It is important that, in cleaning the components, no petrol, paraffin, or any mineral fluid of any kind should be used. Use ONLY Girling Cleaning Fluid.
Lubricate the working surfaces of the bores and pistons with clean Castrol/Girling Crimson Clutch/ Brake Fluid.
Fit new rubber sealing rings into the grooves of the cylinder bores. Locate the outer lip of the rubber dust cover into its groove in the cylinder bore.
Smear the piston with Girling Red Rubber Grease and insert the piston through the dust cover, closed end first, and engage the other lip of the cover in the groove in the piston. Apply even pressure to the piston and force it down the cylinder bore.
Refit the caliper to the car as detailed on page L.13.

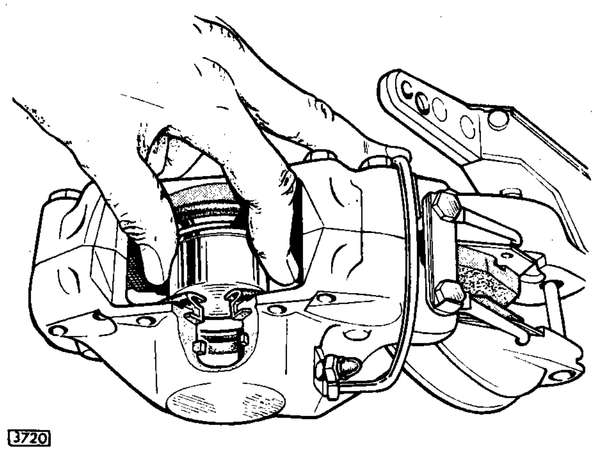


Fig. No. 8 *Fitting a caliper piston*

BLEEDING THE BRAKE SYSTEM

Bleeding the brake hydraulic system (expelling the air) is not a routine maintenance operation and should only be necessary when a portion of the hydraulic system has been disconnected, or if the fluid level has been allowed to fall. The presence of air in the system will cause the brake pedal to feel "spongy" when applied.
During the bleeding operation, **it is important** that the level in the appropriate reservoir is kept topped-up to avoid drawing more air into the system.
Check that all connections are tight and all bleed screws closed.
Fill the appropriate reservoir with the recommended brand of brake fluid.

Attach the bleeder tube to the bleed screw on the left hand rear brake and immerse the open end of the tube in a small quantity of brake fluid contained in a clean glass jar. Slacken the bleed screw and, with the assistance of another, operate the brake pedal slowly through its full stroke until the fluid pumped into the jar is reasonably free from air bubbles.
Keep the pedal depressed and close the bleed screw. Release the pedal.
Repeat the operation for the right hand rear brake and the two front brakes.
Repeat the complete bleeding sequence until the brake fluid pumped into the jar is completely free from air bubbles.
Lock all bleed screws and finally regulate the fluid level in the reservoirs.
Apply a working load to the brake pedal and examine the entire system for any sign of leakage.
Warning: Do NOT use fluid which has been bled through the system to replenish the reservoirs. It will have become aerated. Always use fresh fluid straight from the tin.

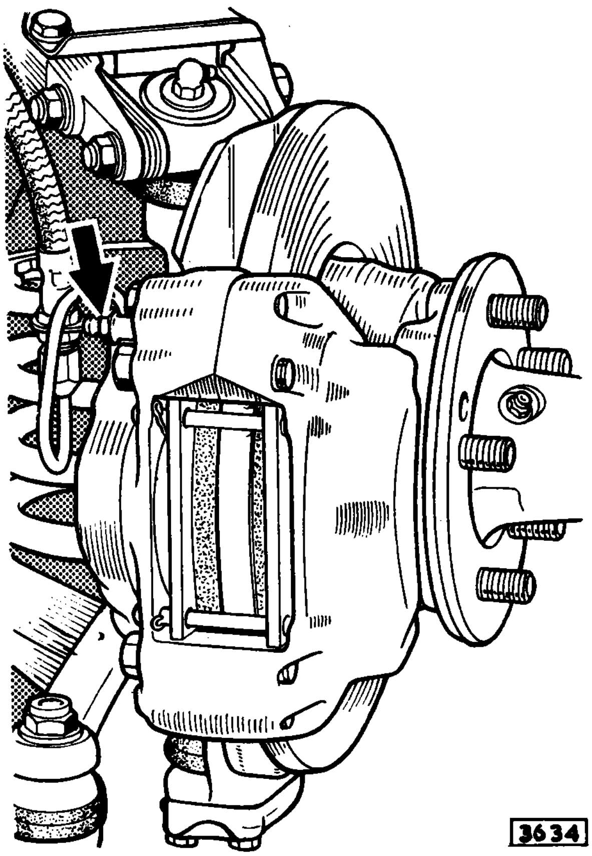


Fig. No. 9 *The brake bleed nipple*

BRAKE OVERHAUL — PRECAUTIONS

The complete brake system is designed to require the minimum of attention, provided the fluid level in the reservoirs is not allowed to fall below the correct level. A drop in fluid level will be noticed during service due to pad wear with the pistons moving outwards correspondingly, thus increasing the cylinder volume. Always top up the reservoir(s) with the recommended fluid.
If air is detected in the hydraulic system due to induction at a loose hose connection, or at a reservoir in which the fluid level has been allowed to fall, correct these defects immediately and bleed the system as detailed in the previous paragraph.
The following instructions detail the procedure for renewal of component parts and for the complete overhaul of the disc brakes, handbrakes, master cylinder and servo unit. These units should be thoroughly cleaned externally before dismantling. Girling Cleaning Fluid ONLY should be used for cleaning purposes.
Throughout every operation it is essential that the workbench is maintained in a clean condition and that the components are not handled with dirty hands.
Precision parts should be handled with extreme care and placed away from tools or other equipment likely to cause damage.
After cleaning, all components should be dried with a lint-free cloth.
When it is not the intention to renew rubber components, they must be carefully examined for serviceability. There must be no evidence of perishing, excessive swelling, cutting or twisting and, where doubt exists, comparison with new parts may be of assistance in making an accurate assessment of their condition.
Flexible pipes must not show signs of deterioration or damage and their bores should ONLY be cleaned out with compressed air. No attempt must be made to clear blockage by probing as this may damage the lining and cause serious restriction of the fluid flow.

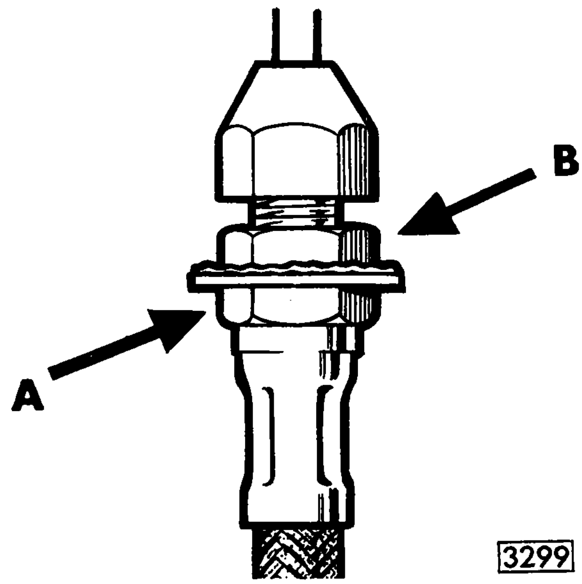


Fig. No. 10 *Flexible hose connection. Hold hexagon "A" with a spanner when removing or refitting locknut "B"*

Partially or totally blocked pipes should always be renewed.
When removing or refitting a flexible pipe, the end sleeve hexagon, "A", Fig. 10, should be held with a spanner to prevent the pipe from twisting.

FLUSHING THE SYSTEM

If the fluid in the system becomes thick or "gummy" after long service or because the vehicle has been laid up for some time, the system should be drained off, flushed and refilled. This should be carried out at least every eighteen months. The system should also be flushed if it has become contaminated by the use of unsuitable fluid.
Start the engine and permit to idle.
Pump all fluid out of the system through the bleeder screw on each of the disc brake calipers in turn, as follows:—
Connect one end of a rubber tube to the bleeder screw, insert the other end into a container; slacken the bleeder screw one complete turn and pump the brake pedal by depressing it quickly and permitting it to return without assistance. Repeat, with a pause between each operation, until no more fluid can be expelled. Discard all fluid extracted from the system.
Fill the master cylinder fluid supply tanks with industrial methylated spirits and flush the system. Continue flushing with methylated spirit until at least one quart has been passed through each disc brake caliper.
Before filling the system with the recommended brake fluid, ensure that all methylated spirit has been bled off.
Note: If the system has become contaminated by the use of mineral oil, the above process may not prove effective. In such cases it is recommended that the various hydraulic units, including the pipe line be dismantled and thoroughly cleaned. All rubber parts, including flexible hoses, should be renewed and the contaminated fluid destroyed immediately.

MASTER CYLINDER AND REACTION VALVE

Removal

Drain the brake fluid from the reservoir feeding the master cylinder.
Disconnect the two vacuum hoses from the reaction valve and the two hydraulic pipes from the master cylinder. Remove the split pin and withdraw the clevis pin securing the brake pedal to the master cylinder push rod accessible from inside the car.
Remove two nuts and washers and detach the master cylinder from the pedal housing.

Refitting

Refitting is the reverse of the removal procedure. Renew banjo union sealing washers.
Refill the reservoir and bleed the brake system as detailed on page L.6.

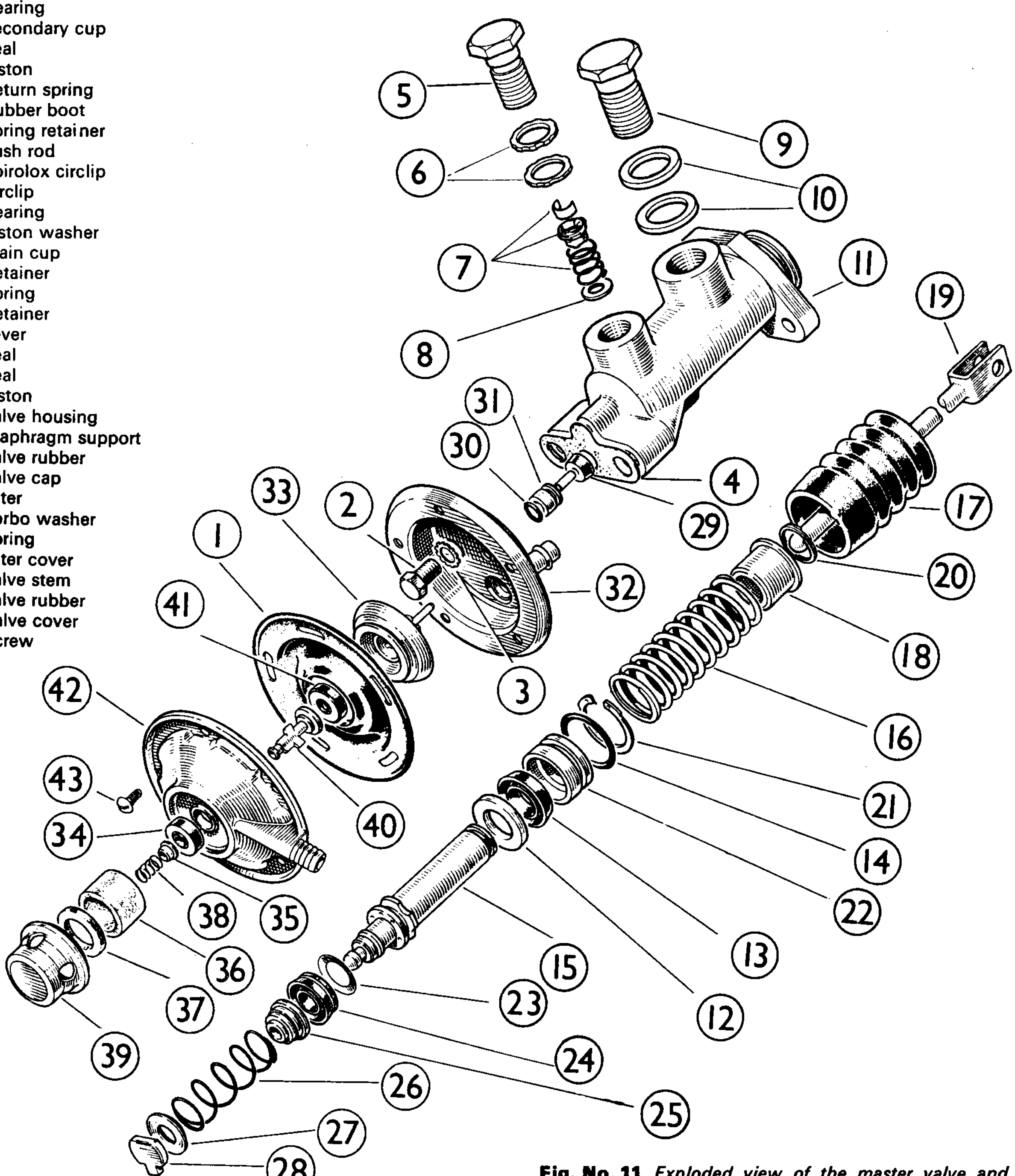
Dismantling

Before dismantling, it is advisable to obtain the master cylinder and reaction valve repair kits available from a Distributor or Dealer, or from the Works' Spares Division, Coventry.

Extract the valve assembly (7) from the outlet port.
Remove the rubber boot (17) from the mouth of the cylinder bore, compress the piston return spring (16) and unwind the spirolox circlip (20) from the heel of the piston. The spring retainer (18) and piston return spring (16) can at this stage be removed.
Press the piston (15) down the bore and, with the aid of special circlip pliers (Churchill Tool number 7066), extract the circlip (21) from the mouth of the cylinder bore. Care should be taken during this operation not to damage the finely machined cylinder piston.
The piston assembly, complete with nylon bearings and rubber seals, can be withdrawn from the cylinder bore.
Remove the plastic bearing (22), complete with "O" ring (14), secondary cup (13) and rectangular section plastic bearing (12) from the piston by sliding the assembly along the finely machined portion.
Due to the plastic spring retainer (25) being an interference fit onto the piston head extension, this part is likely to become damaged during dismantling. In view of this, a new spring retainer is contained in the appropriate repair kit. To remove the spring container, hold the piston on a bench, piston head downwards, applying a downwards force to the back face of the spring retainer with a slim open-ended spanner. The piston return spring (26) pressed steel retainer (27) and lever (28) may, at this stage, be withdrawn from the cylinder bore.
Remove the filter cover (39) and collect the filter (36) sorbo washer (37), and spring (38).
Unscrew and remove the five screws securing the valve cover (42), remove the valve cover assembly from the valve housing (32) which can be dismantled further by prising off the snap-on clip securing the valve rubber (34).
The valve stem (40) complete with other valve rubber (41) can now be withdrawn from the valve housing and the valve rubber removed from the valve stem flange. The reaction valve diaphragm (1) can now be separated from the diaphragm support (33) and, by unscrewing the two hexagon-headed screws (2), the valve housing can be separated from the master cylinder body.
Removal of the valve piston assembly (31) can be effected by inserting a small blunt instrument into the master cylinder fluid outlet port and easing the valve piston assembly along its bore until it can be removed by hand.

Important: No attempt should be made to withdraw the valve piston assembly along its bore by using pliers.
When either of the units have been dismantled the component parts should be washed in denatured alcohol (industrial methylated spirits). Parts that have been washed should be thoroughly dried using a clean lint-free cloth or pressure line and then laid out on clean paper to prevent dirt being assembled into the servo or master cylinder and reaction valve assembly.
Examine all metal parts for damage.
If any of the vacuum hose connections have become loose in service these must be rectified prior to re-assembly.

1 Diaphragm
2 Screw
3 Shakeproof washer
4 Gasket
5 Banjo bolt
6 Washers
7 Trap valve body
8 Washer
9 Banjo bolt
10 Copper gasket
11 Body
12 Bearing
13 Secondary cup
14 Seal
15 Piston
16 Return spring
17 Rubber boot
18 Spring retainer
19 Push rod
20 Spirolox circlip
21 Circlip
22 Bearing
23 Piston washer
24 Main cup
25 Retainer
26 Spring
27 Retainer
28 Lever
29 Seal
30 Seal
31 Piston
32 Valve housing
33 Diaphragm support
34 Valve rubber
35 Valve cap
36 Filter
37 Sorbo washer
38 Spring
39 Filter cover
40 Valve stem
41 Valve rubber
42 Valve cover
43 Screw



3225A

Fig. No. 11 *Exploded view of the master valve and reaction valve*

Assembling
Prior to assembly, liberally coat all rubber seals and plastic bearings, with the exception of the two valve rubbers, with Girling disc brake lubricant.
Holding the master cylinder body at an angle of approximately 25° to the horizontal, insert the lever (28), tab foremost, into the cylinder bore, ensuring that when it reaches the bottom of the bore, the tab on the lever drops into the recessed portion provided.
Place the piston washer (23) on the piston head, convex face towards the piston flange, together with a new main cup (24) and press the plastic spring retainer (25) onto the piston head extension.
Drop the pressed steel spring retainer (27) into the bottom of the bore following up with the piston return spring (26). When these two parts have been assembled it is advisable to recheck the position of the lever.
Press the piston assembly into the cylinder bore and locate the rectangular section plastic bearing (12), secondary cup (13) and bearing (22) together with seal (14) onto the mouth of the cylinder bore.
Press the assembly down the bore to its fullest extent and, with the aid of the special circlip pliers (Churchill Tool number 7066) (with "K" points), fit the circlip to retain the internal parts.
Locate the other piston return spring (16) over the heel of the piston together with the pressed steel spring retainer (18), slide the spring retainer down the finely machined portion of the piston against the load of the spring and fit the spirolox circlip (20) into the groove ground around the heel of the piston.
Using the fingers only, stretch a new valve seal (29) and "O" ring into position on the valve piston and insert the assembly into the valve box.
Secure the valve housing to the master cylinder body by fitting the two hexagon headed screws (2) complete with spring washers and tighten each screw to a torque of 160/180 lb./ins. (1.8-2 kgm.). A new gasket should be fitted between the valve housing and the master cylinder body.
Stretch the reaction valve diaphragm onto the diaphragm support through the hole in the valve housing so that it engages the depression in the valve piston.
Using the fingers only, stretch the valve rubber, which is formed with the groove around its inside diameter, onto the valve stem flange, insert the valve stem through the hole in the valve cover and secure it by placing the other valve rubber over the valve stem and fitting the snap-on clip.
The valve cover assembly can now be placed into position on the valve housing ensuring that all the holes line up and that the hose connections are in line with each other at the bottom of the unit. Secure the valve cover assembly by fitting the five self-tapping screws.
Hold the master cylinder in an upright position (valve uppermost) and place the air filter together with the rubber washer in position upon the valve cover with the small spring on the snap-on valve stem clip.
Carefully locate the air filter cover over the air filter and press it firmly home.
If the trap valve assembly has been dismantled, insert the small clip into the trap valve body ensuring that it does not become distorted and locate the spring on the reduced diameter of the trap valve body.
Assemble the trap valve complete (spring innermost) into the master cylinder fluid outlet port.
Refit the master cylinder push rod and convoluted rubber boot.

DUAL-LINE SERVO

OPERATION (Fig. 1)
When the system is at rest, both sides of the boost system are continuously exhausted by the engine manifold depression.
As the brake pedal is depressed, the master cylinder piston moves along the cylinder, building up pressure and forcing fluid out to the primary chamber of the slave cylinder (A). Simultaneously, the intermediate piston, in the end of the master cylinder, closes the diaphragm valve (G) in the reaction valve and, in so doing, isolates the vacuum (E) from the air pressure side (F) of the boost system.
Further progress of the intermediate piston along its bore will crack open the air control spool (I) in the reaction valve, thus admitting air at atmospheric pressure to the rear of the boost cylinder piston. The air enters the system through a small cylindrical filter (H) on the reaction valve.
The pressure imbalance, created by the admission of air to the pressure side of the boost system, will push the boost piston down the cylinder transmitting a linear force, through the push rod, to the primary piston of the slave cylinder.
Forward motion of the primary piston, supplemented by the output of the master cylinder, transmits hydraulic pressure to the secondary piston (C) and fluid under pressure flows simultaneously from the two output ports (B and D) to the rear and front brakes.

SAFETY FACTORS
In the event of fluid line failure in the pipe linking the master cylinder to the slave cylinder, or the pipe linking the master cylinder to the fluid supply tanks, the reaction valve will be actuated mechanically by the master cylinder piston providing the booster pressure to the front and rear brakes.
A failure in the fluid line coupling the slave cylinder to the front brakes will result in the slave cylinder secondary piston travelling to its fullest extent down the bore. This has the effect of isolating the front brake line from the rest of the system and permitting normal fluid pressure to build up in the rear brake line.
If a fault exists in the rear brake line, the slave cylinder piston will travel along the bore until it contacts the other piston and the two pistons will then travel along the bore together to apply the front brakes.

In the case of leaks in either the air or vacuum pipes, both front and rear brakes may still be applied by the displacement of fluid at master cylinder pressure.

SERVO UNIT AND SLAVE CYLINDER

Removal

Drain the fluid from the reservoir feeding the slave cylinder.
Jack up the front of the car and remove the left-hand roadwheel.
Remove the two nuts and two setscrews securing the fibreglass cover to the servo unit and mounting bracket respectively and withdraw the cover.
Disconnect the three flexible hoses and three pipe unions from their connections on the servo unit and slave cylinder. Seal all open ends of the hoses and pipes to prevent the ingress of dirt.
Remove the four setscrews securing the servo unit mounting bracket to the inner wing valance and withdraw the unit and bracket as an assembly.
Separate the servo unit from the mounting bracket by unscrewing four nuts from the retaining studs on the servo unit.

Refitting

Reverse the removal procedure to refit the servo unit and slave cylinder.
Refill the reservoir and bleed the system as detailed on page L.6.

Dismantling

Support the servo slave cylinder in the jaws of a vice, shell uppermost, with specially formed wooden blocks placed either side of the cylinder and against the jaws of the vice.
Fit the cover removal tool (Churchill Tool No. J.31) to the end cover and secure it by fitting the three nuts.
Turn the end cover in an anti-clockwise direction until the indents in the servo shell line-up with the small radii around the periphery of the end cover. At this stage the end cover may be removed from the servo.
Remove the diaphragm (11) from its groove in the diaphragm support (10) and, with the servo removed

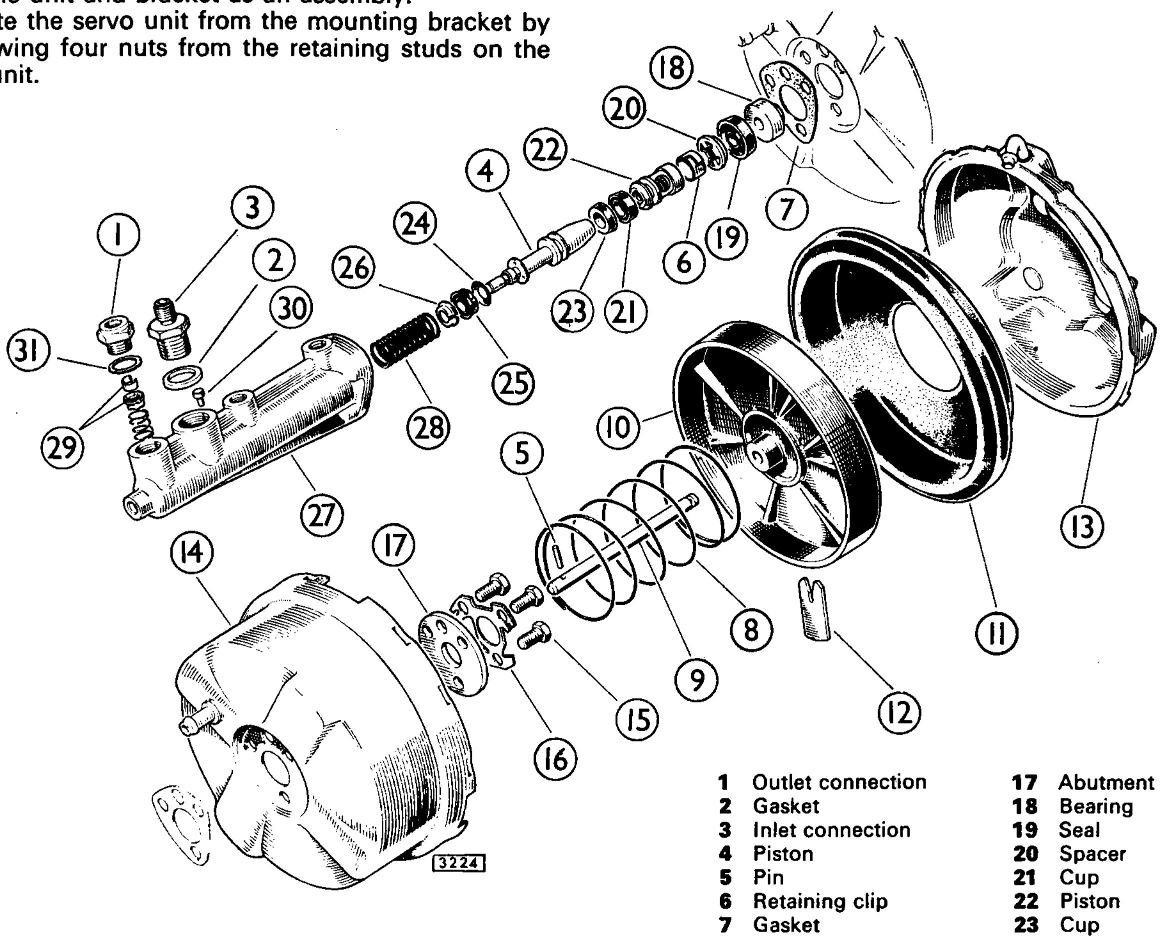


Fig. No. 12 *Exploded view of the remote servo*

1 Outlet connection
2 Gasket
3 Inlet connection
4 Piston
5 Pin
6 Retaining clip
7 Gasket
8 Spring
9 Push rod
10 Diaphragm support
11 Diaphragm
12 Key
13 Cover
14 Vacuum cylinder shell
15 Screw
16 Locking plate
17 Abutment plate
18 Bearing
19 Seal
20 Spacer
21 Cup
22 Piston
23 Cup
24 Piston washer
25 Seal
26 Retainer
27 Slave cylinder body
28 Spring
29 Trap wire
30 Stop pin
31 Gasket

from the jaws of the vice, apply a gentle pressure to the diaphragm support and shake out the key (12).
The diaphragm support (10) and diaphragm support return spring (8) can then be removed.
Bend down the tabs on the locking plate (16) and remove the locking plate, abutment plate (17) and the servo shell (14) from the slave cylinder by unscrewing and removing three screws (15).
Extract the seal (19) and bearing (18) from the mouth of the slave cylinder bore which will permit the removal of the push rod (9) together with the slave cylinder piston assembly.
The push rod may be separated from the piston by sliding back the spring steel clip (6) around the piston and removing the pin (5). It is not necessary to remove the cup (21) from the piston as a new piston together with a cup are contained in the new repair kit.
Unscrew and remove the fluid inlet connection (3) and extract the piston stop pin (30) from the base of the inlet fluid port. To facilitate this operation, apply gentle pressure to the secondary piston (4).
Tap the open end of the slave cylinder body with a hide or rubber hammer to remove the secondary piston together with the piston return spring (28) from the bore.
The rubber seal (25) located in the groove adjacent to the heel of the piston may be removed, but it is advisable to first remove the spring retainer (26) from the piston head extension before attempting to remove the seal (25) and piston washer (24). Removal of the plastic spring retainer (26) is sometimes difficult, but as a new one is provided in the repair kit, this part can be replaced if damaged.
To remove the trap valve assembly, unscrew and remove the adaptor (1) from the fluid outlet port. If it is necessary to remove the shim-like clip from the body of the trap valve (29) ensure that this part is not distorted in any way.

Assembling

Assemble the trap valve (29) complete with spring and clip into the outer port and secure it by fitting the fluid outlet adaptor (1) together with the copper gasket (31).
Prior to further assembly, lightly coat the four rubber seals to be replaced in the slave cylinder bore with Girling Disc Brake Lubricant.
Locate the piston washer (24) over the piston head extension, convex face towards the piston flange and, using the fingers only, assemble the two rubber seals (23 and 25) onto the piston so that their concave faces oppose each other.
Press the spring retainer (26) onto the piston head extension with both seals in position.
Fit the piston return spring (28) to the secondary piston complete and assemble into the slave cylinder bore, spring leading.
Press the piston assembly down the cylinder bore, using a short length of brass bar, until the drilled piston flange passes the piston stop pin hole.
Insert the piston stop pin (30) into the fluid inlet port and secure it by fitting the inlet adaptor (3) complete with the copper gasket (2). Place the push rod (9) in the primary piston and, with the aid of a small screwdriver, compress the small spring within the piston to enable the pin (5) to be inserted. Prior to fitting the pin retainer (6), it is important to establish that a small coil spring is loaded between the heel of the piston and the pin. Ensure that the pin does not pass through the coils of the spring.
Fit the spring retainer by sliding it into position along the piston ensuring that no corners are left standing proud after assembly.
Using fingers only, fit a new cup (21) into the groove on the piston so that its lip (concave face) faces towards the piston head and assemble the piston into the slave cylinder bore.
Insert the spacer (20), gland seal (19) and plastic bearing (18) into the slave cylinder counterbore leaving the bearing projecting slightly from the mouth of the bore.
Place the gasket (7) in position on the end face of the slave cylinder, using the plastic bearing as a location spigot and fit the vacuum shell (14), abutment plate (17) and locking plate (16).
Insert the three securing screws (15) and tighten down to a torque of 150/170 lb./ins. (1.7-1.9 kgm.).
Bend the tabs on the locking plate against the flats on the three screws.
Locate the diaphragm support return spring (8) centrally inside the vacuum shell, fit the diaphragm support (10) to the push rod and secure it by dropping the key (12) into the slot provided in the diaphragm support.
Stretch the rubber diaphragm (11) into position on the diaphragm support ensuring that the bead around its inside diameter fits snugly into the groove in the diaphragm support.
If the surface of the rubber diaphragm appears wavy or crinkled this indicates it is not correctly seated. To ease assembly, smear the outside edges of the diaphragm liberally with Girling disc brake lubricant.
Fit the end cover using Tool No. J.31.

Note: As it is possible to fit the end cover in three different positions, ensure that the end cover hose connections line up with the slave cylinder inlet and outlet ports when assembly is complete.

THE VACUUM RESERVOIR AND CHECK VALVE

DESCRIPTION
The vacuum reservoir is incorporated in the vacuum line between the inlet manifold and the servo unit.
It is located, together with a stone guard, in the front section of the right hand front wing.
Its purpose is to provide a reserve of vacuum in the event of braking being required after the engine has stalled.
The vacuum check valve, located on the inner wing valance is in line communication with the inlet manifold, vacuum servo unit and the vacuum reservoir.
Included in the inlet port of the check valve is a flat rubber spring-loaded valve and when there is a depression in the inlet manifold the valve is drawn away from its seat against its spring loading, thus the interior of the reservoir becomes exhausted. When the depression in the reservoir becomes equal to that of the inlet manifold, the valve spring will return the valve to its seat, thus maintaining the highest possible degree of vacuum in the reservoir.

Removal
Vacuum Reservoir
Apply the handbrake and jack up the front of the car. Remove the right hand roadwheel. Detach the vacuum reservoir and stone guard by withdrawing three nuts and bolts. Disconnect the vacuum pipe from the check valve.
Remove the stone guard from the reservoir by withdrawing the four nuts and bolts.

Check Valve
Disconnect the two pipes from inside the engine compartment and the remaining pipe from the underside of the wing valance.
Withdraw the check valve through the grommet.

Refitting
Refitting is the reverse of the removal procedure.
Note: The check valve and vacuum reservoir are sealed units and must be replaced if faulty.

FRONT CALIPERS
Removal
In order to remove the front calipers, jack up the car and remove the road wheel. Disconnect the fluid feed pipe and plug the hole in the caliper. Discard the locking wire from the mounting bolts. Remove the caliper.

Refitting
Locate the caliper body in position and secure with two bolts. Lockwire the mounting bolts.
Connect the supply pipe to the caliper body. Bleed the brakes as detailed on page L.6.
Note: No centralisation shims are fitted at the front caliper mounting points.

REAR CALIPERS
Removal
The rear suspension unit must be removed in order to withdraw the rear caliper. Proceed as described on page K.4 and support the suspension unit under its centre.
Disconnect the handbrake compensator linkage from the handbrake operating levers. Discard the split pins and withdraw the clevis pins.
Lift the locking tabs and remove the pivot bolts together with the retraction plate.
Remove the handbrake friction pad carriers from the caliper bridges by moving them rearwards round the discs and withdrawing from the rear of the rear suspension assembly.
Remove the hydraulic feed pipe at the caliper and plug the hole to prevent the entry of dirt.
Remove the friction pads from the caliper as described on page L.5.
Remove the front hydraulic damper and road spring unit (detailed on page K.5) and remove the four self-locking nuts from the half shaft inner universal joint.
Withdraw the joint from the bolts and allow the hub carrier to move outwards—support the carrier in this position.
Note the number of small circular shims fitted to the caliper mounting bolts between the caliper and the adaptor plate.
The caliper can now be removed from the aperture at the front of the cross member.

Refitting
Refit the caliper to the adaptor plate with the original shims fitted between the caliper mounting bolts and the adaptor plate.
Refit the handbrake pivot bolts but do not fit the handbrake calipers at this juncture.

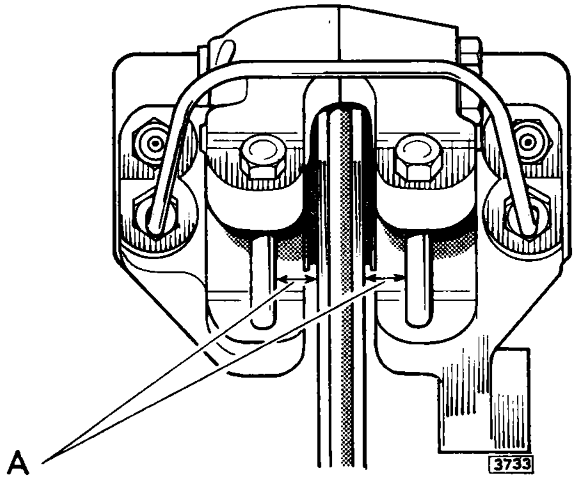
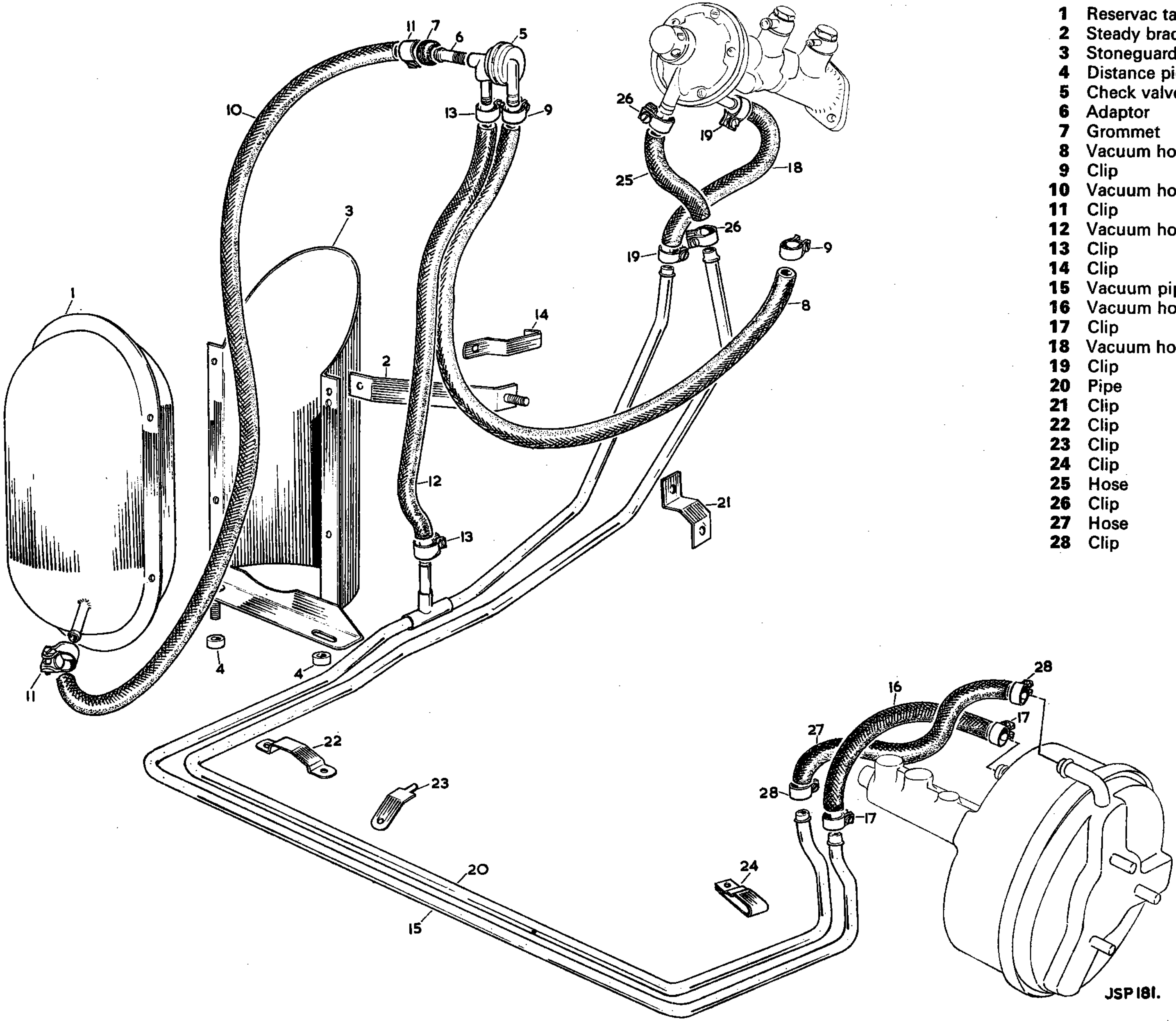


Fig. No. 13 *Checking the handbrake caliper centralisation*



1 Reservac tank assembly
2 Steady bracket
3 Stoneguard
4 Distance piece
5 Check valve
6 Adaptor
7 Grommet
8 Vacuum hose
9 Clip
10 Vacuum hose
11 Clip
12 Vacuum hose
13 Clip
14 Clip
15 Vacuum pipe
16 Vacuum hose
17 Clip
18 Vacuum hose
19 Clip
20 Pipe
21 Clip
22 Clip
23 Clip
24 Clip
25 Hose
26 Clip
27 Hose
28 Clip

Fig. No. 14 *Exploded view of the vacuum reservoir and check valve*

Check that the measurements taken from the shank of each pivot bolt to the brake disc are equal. If not, add or remove shims at the caliper mountings accordingly. This ensures correct centralisation of the handbrake calipers.
Reverse the removal procedure to complete the refitting. Ensure that the correct number of camber shims are refitted.
Bleed the braking system as detailed on page L.6.

THE FRONT BRAKE DISCS

Removal

Jack up the car and remove the road wheel. Disconnect the flexible hydraulic pipe from the frame connection and plug the connector to prevent ingress of dirt and loss of fluid.
Discard the locking wire and remove the two caliper mounting bolts. Remove the caliper.
Remove the hub (as described on page J.6).

THE REAR BRAKE DISCS

Removal

Remove the rear suspension unit (as described on page K.4).
Invert the suspension and remove the two hydraulic damper and road spring units (as described on page K.5).
Remove the four steel type self-locking nuts securing the halfshaft inner universal joint and brake disc to the axle output shaft flange.
Withdraw the halfshaft from the bolts, noting the number of camber shims between the universal joint and the brake disc.

1 Rear caliper assembly (R.H.)
2 Piston
3 Seal
4 Dust Seal
5 Friction pad
6 Pin
7 Clip
8 Bridge pipe
9 Bleed screw
10 Dust cap
11 Distance piece
12 Shim
13 Adaptor plate
14 Handbrake mechanism assembly
15 Pad carrier assembly (R.H. outer)
16 Pad carrier assembly (R.H. inner)
17 Anchor plate
18 Operating lever
19 Return spring
20 Pawl assembly
21 Tension spring
22 Anchor pin
23 Adjusting nut
24 Friction Spring
25 Hinge pin
26 Split pin
27 Protection cover
28 Protection cover
29 Bolt
30 Washer
31 Bolt
32 Split pin
33 Bolt
34 Retraction plate
35 Tabwasher
36 Disc assembly

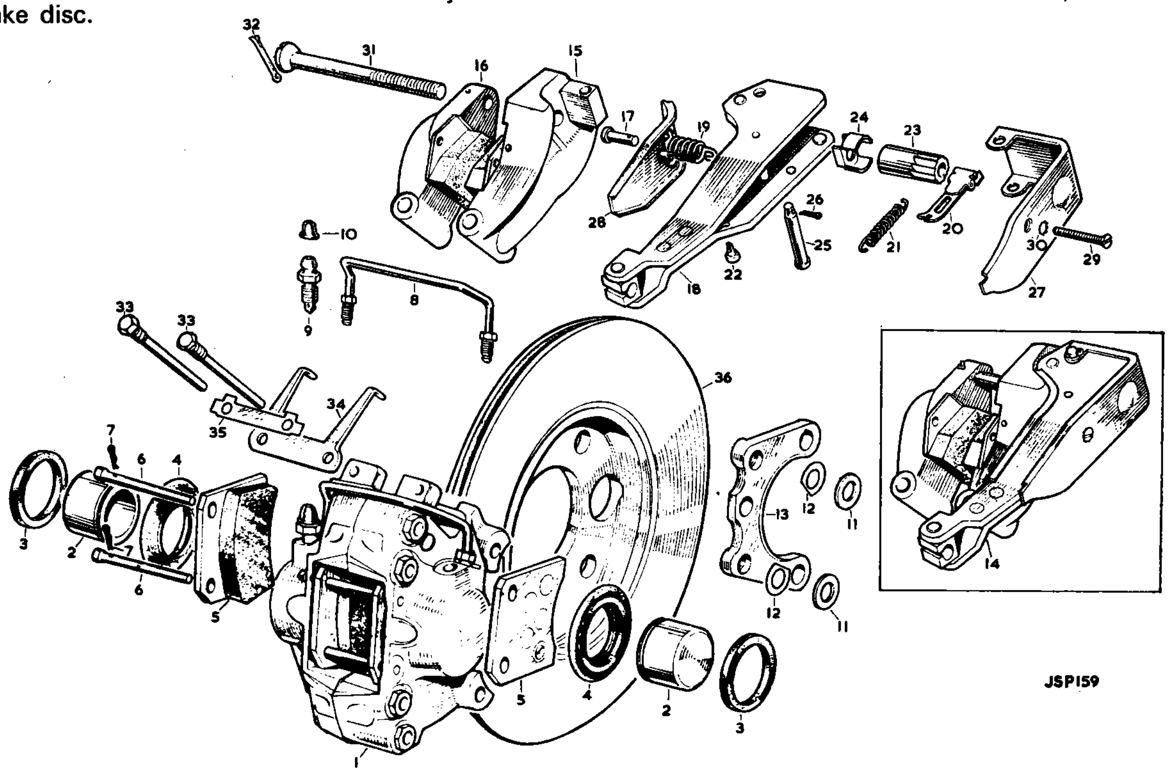


Fig. No. 15 *Exploded view of the rear brake caliper*

Knock back the tabs and unscrew the two pivot bolts securing the hand brake pad carriers to the caliper. Remove the pivot bolts and the retraction plate (Fig. 15).
Withdraw the handbrake pad carriers from the aperture at the rear of the cross members.
Break the locking wire on the caliper mounting bolts.
Remove the hairpin clips and retaining pins and withdraw the friction pads.
Disconnect the brake fluid feed pipe at the caliper.
Unscrew the mounting bolts through the access holes in the brake disc.
Withdraw the bolts, noting the number and position of the round caliper centralising shims.
Withdraw the caliper through the aperture at the front of the cross member.
Tap the halfshaft universal joint and brake disc securing bolts back as far as possible.
Lift the lower wishbone, hub carrier and half shaft assembly upwards until the brake disc can be withdrawn from the mounting bolts.

1 Front caliper assembly (R.H.)
2 Outer piston
3 Inner piston
4 Seal
5 Dust seal (outer piston)
6 Seal
7 Dust seal (inner piston)
8 Friction pad kit
9 Pin
10 Clip
11 Bleed screw
12 Dust cap
13 Shim
14 Disc assembly
15 Shield assembly (Upper)
16 Shield assembly (Lower R.H.)
17 Shield assembly (Lower L.H.)

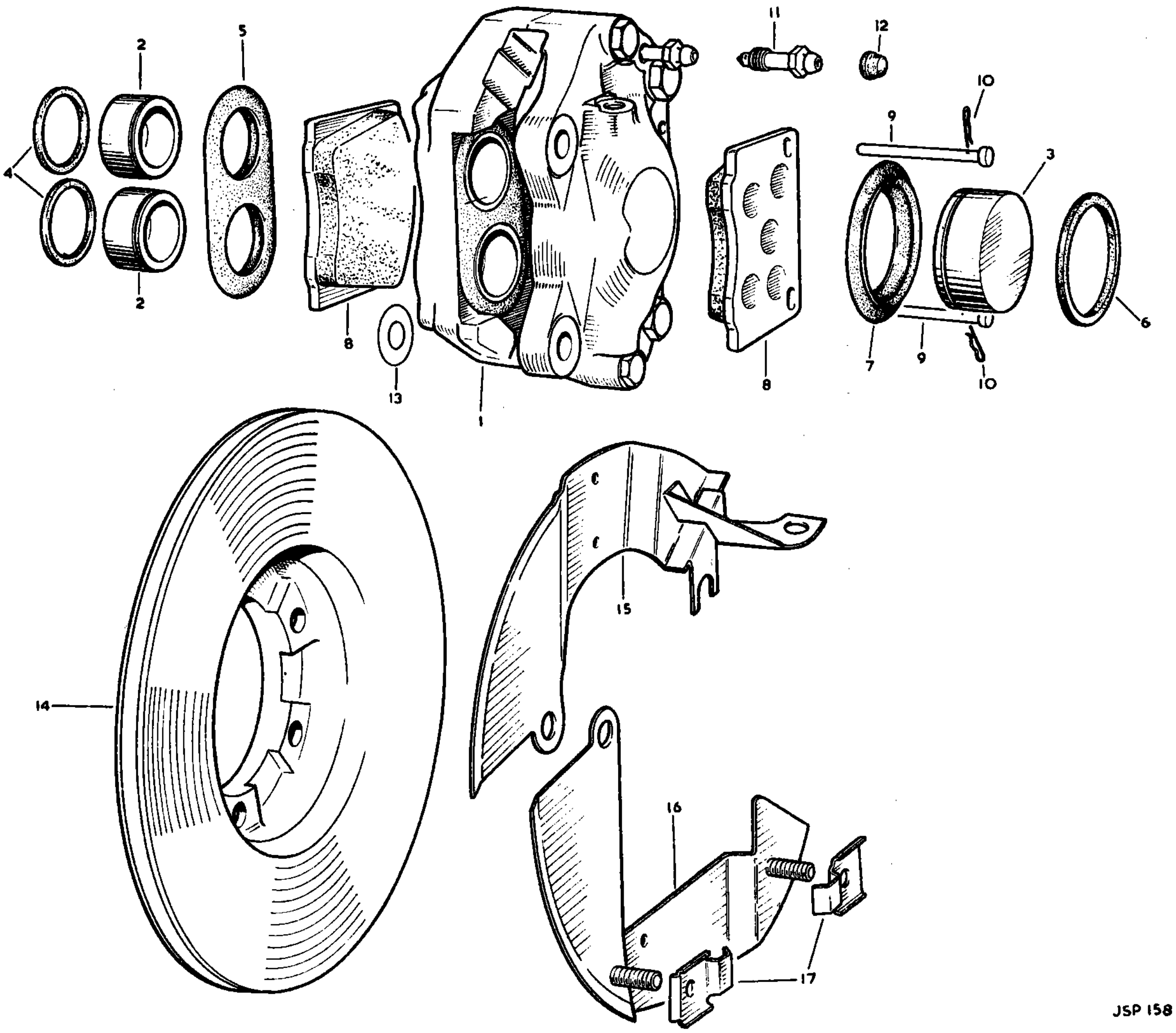


Fig. No. 16 *Exploded view of the front brake caliper*

Refitting
Refitting the brake discs is the reverse of the removal procedure. The securing bolts must be knocked back against the drive shaft flange when the new disc has been fitted.
Care must be taken to refit the caliper centralising shims in the same position. The centralisation of the caliper should be checked (as described in "Refitting the Calipers") when the half shaft has been refitted.
Refit the rear suspension (as described on page K.5.
Bleed the brakes as described on page L.6.

BRAKE DISC "RUN-OUT"
Check the brake discs for "run-out" by clamping a dial test indicator to the stub axle carrier for the front discs and the cross member for the rear discs. Clamp the indicator so that the button bears on the face of the disc. "Run-out" should not exceed .006" (.15 mm.) gauge reading. Manufacturing tolerances on the disc should maintain this truth and in the event of "run-out" exceeding this value, the components should be examined for damage.
Note: It is most important that the endfloat of the front hubs and the rear axle output shafts is within the stated limits, otherwise the brakes may not function correctly. The front hub endfloat adjustment is described on page J.6. The endfloat adjustment of the rear axle output shafts is described on page H.12.

THE HANDBRAKE

DESCRIPTION
The self-adjusting handbrakes are attached to the rear brake caliper bodies and consists of independent mechanically actuated systems complete with friction pads. Each handbrake is self-adjusting to compensate for friction pad wear to provide the necessary clearance between the brake discs and the friction pads.

OPERATION (Fig. 17)
On applying the handbrake, the operating lever is moved away from the friction pad carrier and draws the friction pads together.
Under normal conditions, when the lever is released, the pawl, in the adjusting mechanism, returns to its original position. In this manner the correct running clearance between the brake disc and the friction pad is maintained.
As the friction pad wears, the pawl will turn the ratchet nut on the bolt thread drawing the adjuster bolt inwards and bringing the friction pads closer to the brake disc until the normal running clearance is restored.

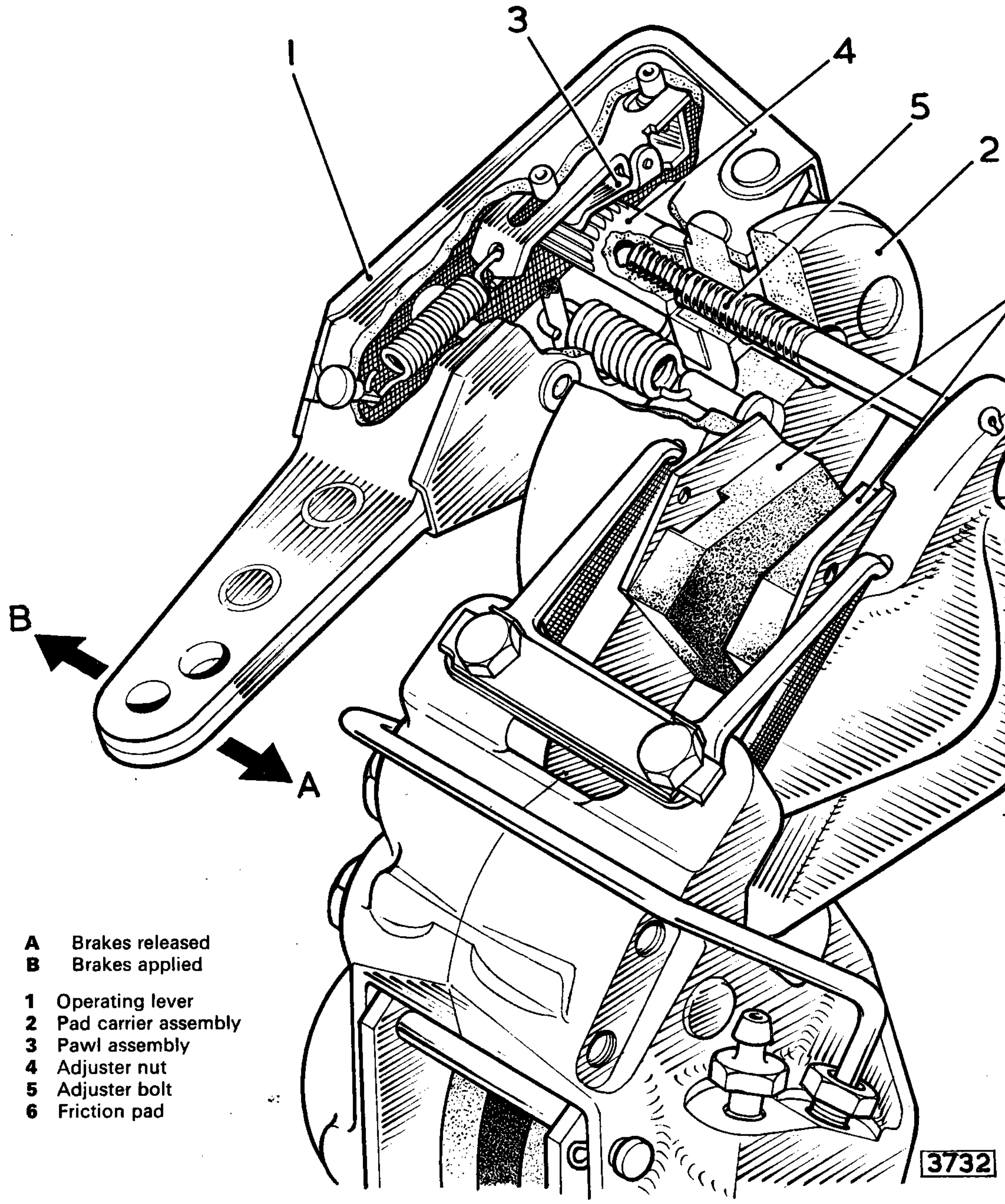
FRICTION PAD CARRIERS
Removal
With the car on a ramp, disconnect the handbrake cable from the operating levers on the handbrake mechanism as follows:
Remove the split pin, withdraw the clevis pin and disconnect the fork end on one lever and withdraw the outer cable from the trunnion on the other lever. Lift the locking tabs and remove the pivot bolts and retraction plate. Remove the friction pad carriers by moving them rearwards around the disc and withdrawing from the rear of the rear suspension assembly. Repeat for the second handbrake.

Dismantling
Remove the cover securing bolt, discard the split pin and withdraw the pivot clevis pin. Remove the dust cover and remove the split pin from the screwdriver slot in the adjusting bolt. Unscrew the adjusting bolt from the ratchet nut and withdraw the nut and bolt. Detach the pawl return spring and withdraw the pawl over the locating dowel. Detach the operating lever return spring and remove the operating lever and lower cover plate.

Assembling
Assembly is the reverse of the dismantling procedure.

Refitting
Refitting is the reverse of the removal procedure, but the handbrake should be set as follows:—
Ensure that the handbrake pivot bolts are slack.
Remove the split pin from the head of the adjuster bolt and slacken the bolt until there is approximately $\frac{1}{4}$" (6.35 mm.) free movement between the head and the outer pad carrier.
Pull the inner and outer pad carriers away from the disc, bending the brass retraction fingers until there is $\frac{1}{16}$" (1.6 mm.) clearance between each pad and the disc.
Take up the free movement of the adjuster bolt, tightening until the bolthead is in light contact with the outer pad carrier seating.
Fit a new split pin to lock the adjuster bolt.
Pull and release the handbrake lever repeatedly until the ratchet ceases to operate, which will indicate that the correct adjustment has been obtained.
With the handbrake applied reasonably hard, tighten the pivot bolts and secure with the tab washer.
Note: It is ESSENTIAL that the brass retraction fingers are in good condition, i.e. not badly distorted. The ends which fit into the pad carriers must be inserted fully into the holes to avoid the possibility of twisting the fingers.
Reconnect the handbrake compensator linkage to the operating levers and check the cable adjustment as detailed on page L.5.

HANDBRAKE FRICTION PADS—RENEWING
With the friction pad carriers removed, withdraw the old pads by slackening the nuts in the outer face of each carrier and utilizing a hooked tool in the hole of



A Brakes released
B Brakes applied

1 Operating lever
2 Pad carrier assembly
3 Pawl assembly
4 Adjuster nut
5 Adjuster bolt
6 Friction pad

Fig. No. 17 *Sectioned view of the handbrake mechanism*

each pad securing plate. Fit new pads, short face upwards, ensuring that each pad locates the head of the retaining bolt. Fit new retraction fingers and assemble the carrier to the main calipers, leaving the pivot bolts slack.
Pull and release the handbrake lever repeatedly until the ratchet ceases to operate, which will indicate that the correct adjustment has been obtained.

With the handbrake applied reasonably hard, tighten the pivot bolts and secure the tab washer.

Note: It is recommended that new retraction fingers are fitted when replacing the handbrake pads.
Reconnect the handbrake compensator linkage to the operating levers and check the handbrake cable adjustment.

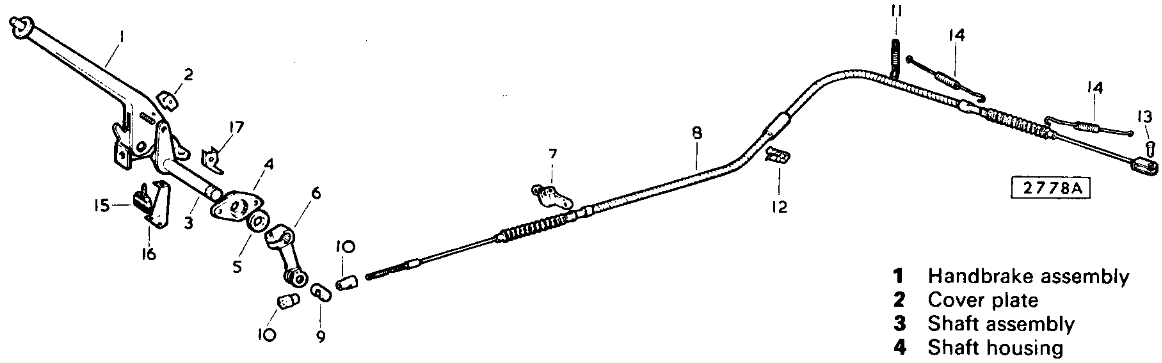


Fig. No. 18 *Handbrake components*

1 Handbrake assembly
2 Cover plate
3 Shaft assembly
4 Shaft housing
5 Rubber seal
6 Lever
7 Cable abutment bracket
8 Cable
9 Trunnion
10 Adjusting nut
11 Spring
12 Clip
13 Clevis pin
14 Return spring
15 Handbrake warning light switch
16 Bracket
17 Bracket

HAND BRAKE CABLE

Removal

Place the car over a ramp or pit.
Remove the split pin, withdraw the clevis pin and detach the fork end from the operating lever. Withdraw the outer cable from the trunnion on the other lever.
Unhook the cable from the support spring and release the cable from the spring anchor clip located forward of the rear radius arm.
Remove the two setscrews securing the intermediate cable abutment bracket to the underside of the body, withdraw the pinch bolt and detach the bracket from the cable.
Remove the brass adjuster nut and withdraw the cable from the handbrake lever trunnion.
Withdraw the cable from the rear of the car.

Refitting

Refitting is the reverse of the removal procedure. Adjust the cable as detailed in "Routine Maintenance" on page L.5.

HANDBRAKE LEVER ASSEMBLY

Removal

From beneath the car, remove the brass adjusting nut and withdraw the cable from the lever trunnion.
Mark the location of the lever in relation to the operating shaft splines; remove the pinch bolt and withdraw the lever.
Remove the front seat on the driver's side of the car. Lift the carpet locally around the lever.
Withdraw the two setscrews securing the warning light switch carrier bracket to the floor.
Remove the two setscrews securing the operating shaft bearing to the body and the two setscrews from the lever mounting bracket.
Slide the bearing along the shaft and withdraw the lever assembly.

Refitting

Refitting is the reverse of the removal procedure.
Adjust the handbrake cable as detailed in "Routine Maintenance" on page L.5.
Adjust the position of the brake warning light switch in the mounting bracket by means of the two nuts on the threaded shank until the warning light goes out with the handbrake released.

HANDBRAKE WARNING LIGHT SWITCH—ADJUSTMENT

Should the warning light fail to extinguish when the handbrake is "off", ensure that the handbrake is moving the full length of its travel and that the switch bracket has not inadvertently become off set. Examine the electrical leads for short-circuiting.
Apply the handbrake and switch on the ignition. Depress the plunger in the centre of the interrupter switch and observe the warning light: should the light continue to glow, check the brake fluid levels in the reservoirs which may be low. Top up to the correct level.
Reposition the switch, if necessary, as detailed under "Handbrake Lever Assembly".

WHEELS AND TYRES

SECTION M

INDEX

WHEELS AND TYRES

DESCRIPTION

Pressed steel disc wheels are fitted as standard equipment; wire spoke wheels are specified as an optional extra.
Dunlop SP41 tyres (with tubes) are fitted to both types of wheels.

DATA

Roadwheel:

Type—standard equipment	Pressed steel disc
—optional equipment	Wire spoke (72 spoke)
Fixing—pressed steel disc	Five studs and nuts
—wire spoke	Centre lock, knock on hub cap
Rim section —disc	5J
—wire spoke	5K
Rim diameter —all types	15″ (381 mm.)

Tyres:

Make	Dunlop
Type	SP.41
Size	185 x 15 (185 x 380)

IMPORTANT

It is particularly important that tyres of different makes, types, or those having different tread patterns should not be mixed on individual cars as this may adversely affect the handling and steering characteristics.
A car should not, of course, be driven on bald tyres or on tyres which have only part of the tread left showing. Driving with badly worn tyres on wet roads also greatly increases the risk of "aquaplaning" with consequent loss of steering and braking.
The importance of having tyres that are in good condition and of the correct type cannot be overstressed. The Dunlop SP.41 tyres fitted as original equipment are specially produced to suit the performance of the model concerned and a change of make or type of tyre should not be made unless an assurance is given by the tyre manufacturer concerned that the alternative type is suitable for the particular car under maximum performance conditions.

INFLATION PRESSURES

PRESSURES SHOULD BE CHECKED WHEN TYRES ARE COLD, SUCH AS STANDING OVERNIGHT, AND NOT WHEN THEY HAVE ATTAINED THEIR NORMAL RUNNING TEMPERATURES.

DUNLOP SP.41
(185 x 15)

Pressures:	**Front**	**Rear**
For conditions where maximum performance with sustained speed is being used, or for touring conditions where the car is fully laden.	36lb./sq.in. (2.5 kg/sq.cm)	36lb./sq.in. (2.5 kg/sq.cm)
For normal motoring with maximum speed up to 100 m.p.h. (160 k.p.h.) For two up normal motoring to give maximum comfort it is permissable, and may be found desirable, to reduce the rear tyre pressures by 3lb/sq.in (0.2 kg/sq.cm.)	30lb./sq.in. (2.1 kg/sq.cm)	30lb./sq.in. (2.1 kg/sq.cm)

TYRES—GENERAL INFORMATION

The Dunlop tyres specified have been specially designed for the high speeds possible of this car.
When replacing worn or damaged tyres and tubes it is essential that tyres with exactly the same characteristics are fitted.
Due to the high speed performance capabilities of the car it is important that repair of damaged or punctured tyres should only be undertaken by a tyre specialist. All tyres which are suspect in any way should be submitted to the tyre manufacturers for their examination and report. The importance of maintaining all tyres in perfect condition cannot be too highly stressed.

CONSTRUCTION OF THE TYRE

One of the principal functions of the tyres fitted to a car is to eliminate high frequency vibrations. They do this by virtue of the fact that the unsprung mass of each tyre—the part of the tyre in contact with the ground—is very small.
Tyres must be flexible and responsive. They must also be strong and tough to contain the air pressure, resist damage, give long mileage, transmit driving and braking forces, and at the same time provide road grip, stability and good steering properties.
Strength and resistance to wear are achieved by building the casing from several plies of cord fabric, secured at the rim position by wire bead cores, and adding a tough rubber tread.
Part of the work done in deflecting the tyres on a

car is converted into heat within the tyres. Rubber and fabric are poor conductors and internal heat is not easily dissipated. Excessive temperatures weaken the tyre structures and reduce the resistance of the tread to abrasion by the road surface.
Heat generation, comfort, stability, power consumption, rate of tread wear, steering properties and other factors affecting the performance of the tyres and car are associated with the degree of tyre deflection. All tyres are designed to run at pre-determined deflections, depending upon their size and purpose.
Load and Pressure Schedules are published by all tyre makers and are based on the correct relationship between tyre deflection, tyre size, load carried and inflation pressure. By following the recommendations the owner will obtain the best results both from the tyres and the car.

Inflating

When inflating the tyre, after re-fitting to wheel, be sure that the valve core is in the valve and DO NOT EXCEED 40 POUNDS AIR PRESSURE as there is a risk of breaking the bead wires.
If it is found that the bead will not seat properly, deflate lubricate and centralise tyre before re-inflating. When the tyre bead does not inflate properly at the second attempt, the wheel rim circumference is suspect and should be checked with a rim gauge, if available, or replaced with a new wheel.
After the beads have seated properly, reduce pressure to the recommended operating pressure.
Note: Lock the wheel down when using the mounting machine and do not stand over the tyre when inflating it. Check the tyre pressure frequently to be absolutely sure that the pressure never exceeds 40 lb. sq. in. It is advisable to use an extension pressure gauge with a clip-on chuck and stand well back for maximum safety.

Inflation Pressures

It is important to maintain the tyre pressures at the correct figures, incorrect pressures will affect the steering, riding comfort, and tyre wear.

Effect of Temperature

Air expands with heating and, therefore, tyre pressures increase as the tyres warm up. Pressure increases more in the hot weather than in the cold weather and as a result of high speed. These factors are taken into account when designing the tyre and when determining recommended inflation pressures.
Pressures in warm tyres should not be reduced to standard pressures for cold tyres. "Bleeding" the tyres increases their deflections and causes temperatures to climb still higher. The tyres will be under inflated when they have cooled.
Always ensure that the valve caps are fitted as they prevent the ingress of dirt and form a secondary seal to the valve core.

Tyre Examination

Examine tyres periodically for flints, nails, etc., which may have become embedded in the tread. These should be removed with a blunt screwdriver or a similar instrument.

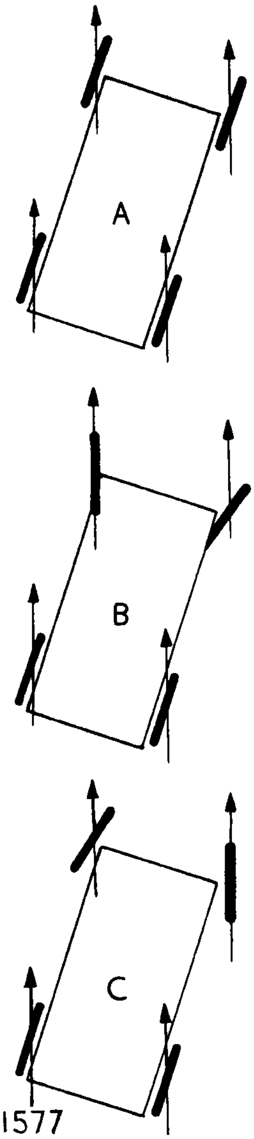


Fig. No. 1 *Exaggerated diagram of the way in which road camber affects a car's progress*

"A" Wheels parallel in motion; tyre wear equal
"B" Wheels toed-out in motion; right front tyre wears faster
"C" Wheels toed-in in motion; Left front tyre wears faster

WHEEL ALIGNMENT AND ITS ASSOCIATION WITH ROAD CAMBER

It is very important that correct wheel alignment should be maintained. Misalignment causes a tyre tread to be scrubbed off laterally because the natural direction of the wheel differs from that of the car.
An upstanding sharp "fin" on the edge of each pattern rib is a sure sign of misalignment and it is possible to determine from the position of the "fins" whether the wheels are toeing in or toeing out.
"Fins" on the inside edges of the pattern ribs—nearest the car—and particularly on the near side tyre indicate

toe in. "Fins" on the outside edges, particularly on the offside tyre, indicate toe out.

With minor misalignment, the evidence is less noticeable and sharp pattern edges may be caused by road camber even when wheel alignment is correct. In such cases it is better to make sure by checking with an alignment gauge.

Road camber affects the direction of the car by imposing a side thrust and if left to follow its natural course, the car will drift towards its near side. This is instinctively corrected by steering towards the road centre.

As a result, the car runs crabwise, diagrammatically illustrated in an exaggerated form in Fig. 1. The diagram shows why nearside tyres are very sensitive to too much toe in and offside tyres to toe out. It also shows why sharp "fins" appear on one tyre but not on the other, and why the direction of misalignment can be determined by noting the position of the "fins". Severe misalignment produces clear evidence on both tyres.

The front wheels on a moving car should be parallel. Tyre wear can be affected noticeably by quite small variations from this condition. It will be noted from the diagram that even with parallel wheels the car is still out of line with its direction of movement, but there is less tendency for the wear to be concentrated on any one tyre.

The near front tyre sometimes persists in wearing faster and more unevenly than the other tyres even when the mechanical condition of the car and tyre maintenance are satisfactory. The more severe the average road camber the more marked will this tendency be.

Precautions when Measuring Wheel Alignment

1. The car should have come to rest from a forward movement. This ensures as far as possible that the wheels are in the neutral running positions.
2. It is preferable for alignment to be checked with the car laden.
3. With conventional base-bar tyre alignment gauge measurements in front of and behind the wheel centres should be taken at the same points on the tyres or rim flanges. This is acheived by marking the tyres where the first reading is taken and moving the car forwards approximately half a road wheel revolution before taking the second reading at the same points. With the Dunlop Optical Gauge two or three readings should be taken with the car moved forwards to different positions—180° road wheel turn for two readings and 120° for three readings. An average figure should then be calculated.

Wheels and tyres vary laterally within their manufacturing tolerances or as the result of service, and alignment figures obtained without moving the car are unreliable.

TYRE AND WHEEL BALANCE

Static Balance

In the interests of smooth riding, precise steering and the avoidance of high speed "tramp" or "wheel hop" all Dunlop tyres are balance checked to predetermined limits.

To ensure the best degree of tyre balance the covers are marked with white spots on one bead and these indicate the lightest part of the cover. Tubes are marked on the base with black spots at the heaviest point. By fitting the tyre so that the marks on the cover bead exactly coincide with the marks on the tube, a high degree of tyre balance is achieved (Fig. 2). When using tubes which do not have the coloured spots it is usually advantageous to fit the covers so that the white spots are at the valve position.

Some tyres are slightly outside standard balance limits and are corrected before issue by attaching special patches to the inside of the covers at the crown. These patches contain no fabric, they do not affect the local stiffness of the tyre and should not be mistaken for repair patches. They are embossed "Balance Adjustment Rubber".

The original degree of balance is not necessarily maintained and it may be affected by uneven tread wear, by cover and tube repair, by tyre removal and refitting or by wheel damage and eccentricity. The car may also become more sensitive to unbalance due to normal wear of moving parts.

If roughness or high speed steering troubles develop and mechanical investigation fails to disclose a possible cause, wheel and tyre balance should be suspected.

A Tyre Balancing Machine is marketed by the Dunlop Company to enable Service Stations to deal with such cases.

Warning: If balancing equipment is used which dynamically balances the road wheels on the car, the following precaution should be observed.

In the case of the rear wheel always jack **both** wheels off the ground otherwise damage may be caused to the differential.

This is doubly important in the case of cars fitted with a Thornton "Powr-Lok" differential as in addition to possible damage to the differential, the car may drive itself off the jack or stand.

2256

Fig. No. 2 *Correct position of the inner tube to outer cover to facilitate wheel balance*

Dynamic Balance

Static unbalance can be measured when the tyre and wheel assembly is stationary. There is another form known as dynamic unbalance which can be detected only when the assembly is revolving.

There may be no heavy spot, that is, there may be no natural tendency for the assembly to rotate about its centre due to gravity, but the weight may be unevenly distributed each side of the tyre centre line. Laterally eccentric wheels give the same effect. During rotation the off set weight distribution sets up a rotating couple which tends to steer the wheel to right and left alternatively.

Dynamic unbalance of tyre and wheel assemblies can be measured on the Dunlop Tyre Balancing Machine and suitable corrections made when cars show sensitivity to this form of unbalance. Where it is clear that a damaged wheel is the primary cause of severe unbalance it is advisable for the wheel to be replaced.

TYRE REPLACEMENT AND WHEEL INTERCHANGING

When replacement of the rear tyres becomes necessary, fit new tyres to the existing rear wheels and, after balancing, fit these wheels to the front wheel positions on the car, fitting the existing front wheel and tyre assemblies (which should have useful tread life left) to the rear wheel positions on the car.

If at any time this operation is carried out and the tyre of the spare wheel is in new condition, it can be fitted to one of the front wheel positions in preference to replacing one of the original rear tyres, which wheel and tyre can then become the spare.

Note: Due to the change in the steering characteristics which can be introduced by fitting to the front wheel positions, wheels and tyres which have been used on the rear wheel positions, interchanging of part worn tyres from rear to front wheel positions is not recommended.

WIRE SPOKE WHEELS

DESCRIPTION

Dunlop cross-spoked wire wheels are fitted as optional equipment and the following instructions are issued to assist in the repair and adjustment of the road wheels in the event of damage due to accident or from any other cause.

Cross-spoking refers to the spoke pattern, where the spokes radiate from the well of the wheel rim to the nose or outer edge of the hub shell, and from the tyre seat of the rim to the flanged or inner end of the shell (Fig. 3).

REMOVAL AND DISMANTLING

Detach wheel from car and remove tyre complete from wheel rim.

Remove spoke nipples and detach spokes from rim and centre.

Check wheel rims and centre; renew if damaged beyond normal repair.

Examine spokes and renew as necessary.

REBUILDING

Place the wheel centre and the rim on a flat surface with the valve hole upwards in the 6-o'clock position.

Note: All spoking operations commence in this position, and the valve hole is always the starting point for all rebuilding operations.

With the valve hole in the 6-o'clock position, fit one A,B,C. and D spoke to produce the pattern as shown in Fig. 3.

Having established the correct pattern remove the A and B spokes and proceed as follows:-

1. Attach the D spoke to the rim and screw up the nipple finger tight; leave the C spoke loosely fitted without a nipple attached.
2. Attach all D spokes with the nipples finger tight.
3. Insert all the C spokes through the hub shell without nipples.
4. Attach all the B spokes as paragraph 2 above.
5. Attach all the A spokes as paragraph 2 above.
6. Attach the nipples and finger tighten all C spokes.
7. Tighten the two C spokes and the two D spokes on each side of the valve hole until the end of the spokes are just below the slot in the nipple heads.
8. Tighten the four C and D spokes diametrically opposed to the valve hole (12 o'clock position).
9. Mark around the wheel until all the C and D spokes are similarly tightened.
10. Follow with all A and B spokes as in paragraphs 7, 8 and 9 above.
11. Work around the wheel with a spoke spanner and tighten all nipples until some resistance is felt. Diametrically opposed spokes should be tightened in sequence.

 The wheel is now ready for trueing and adjustment.

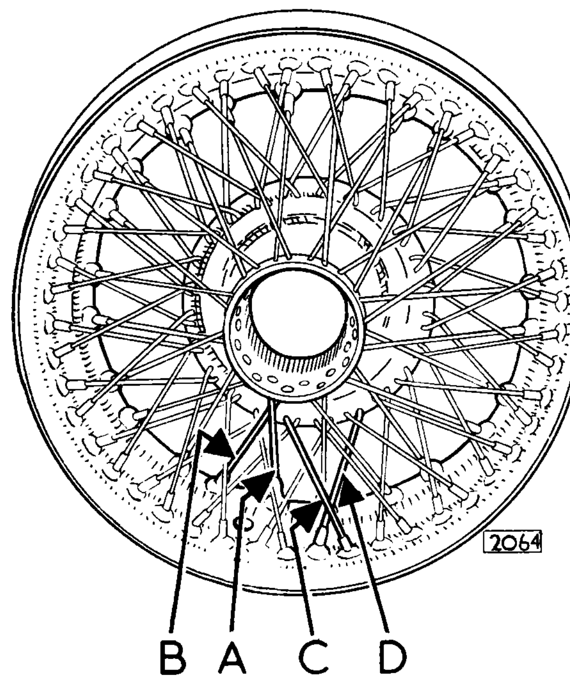


Fig. No. 3 *Showing the spoke arrangement*

TRUEING

Wheels can be out of true in a lateral or radial direction, or in a combination of both.

As a general rule, lateral out of true should be corrected first.

The wheel to be trued must be mounted on a free-running trueing stand before any adjustment can be carried out.

Lateral Correction

Mount the wheel on a trueing stand. Spin the wheel and, holding a piece of chalk near the wall of the rim flange, mark any high spots. Tighten the A and B spokes in the region of the chalk marks and slacken the C and D spokes in the area.

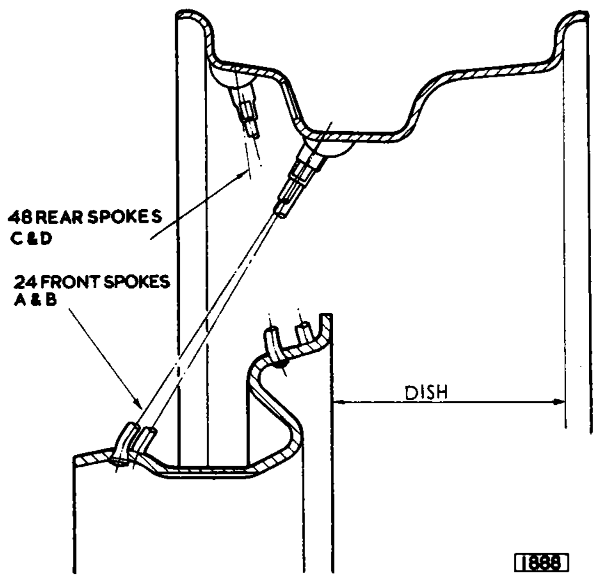


Fig. No. 4 *Location for measuring the dish and the "A" "B", "C" and "D" spokes*

Note: Throughout the trueing operations no spoke should be tightened to such an extent that it is impossible to tighten it further without risk of damage. If any spoke is as tight as it will go, all the other spokes must be slackened.

Radial Correction

When lateral out of truth has been corrected, spin the wheel on the trueing stand and, with the chalk, mark the high spots on the horizontal tyre seat. Tighten **all** spokes in the region of the chalk marks or, if the spokes are on the limit of tightness, slacken the remaining spokes.

CHECKING FOR DISH

The term "dish" defines the lateral dimension from the inner face of the flanges of the wheel centre to the inner edge of the wheel rim. To check "dish" place straight edge across the inner edge of the wheel rim and measure the distance to the inner face of the wheel centre flange (Fig. 4.). This dimension should be $3\frac{7}{16}$" $\pm$ $\frac{1}{16}$" (87.3 mm. $\pm$ 1.58 mm.)

Adjustment for "Dish"

If the "dish" is in excess of the correct dimension $3\frac{7}{16}$" $\pm$ $\frac{1}{16}$" (87.3 mm. $\pm$ 1.58 mm.) tighten all A and B spokes and slacken all C and D spokes by a similar amount.

When the "dish" dimension is less than the given tolerance slacken all A and B spokes and tighten all C and D spokes by a similar amount.

It will be necessary, after completing the "dish" adjustments, to repeat the lateral and radial trueing procedure until the wheel is not more than .060" (1.5 mm.) out of true in either direction.

It is important that after the wheel trueing operation is completed that all spokes should be tensioned uniformly and to a reasonably high degree.

Correct tension can be closely estimated from the high pitched note emitted when the spokes are lightly tapped with a small hammer.

If a spoke nipple spanner of the torque recording type is used, a normal torque figure should be in the order of 60 lb. ins. (0.7 kg/m.).

BODY AND EXHAUST SYSTEM

SECTION N

INDEX

BODY AND EXHAUST SYSTEM

BODY

THE INSTRUMENT PANEL

Opening

Disconnect the battery.
Remove the ignition key and cigar lighter for safe keeping. Hinge the centre instrument panel downwards on its bottom edge, after withdrawing the thumb screws situated in each top corner.

Removal

The instrument panel can be removed completely by detaching the earth lead from the battery, identifying and removing the leads from the instruments, cigar lighter and switches, removing the electrical harness together with the clips from the instrument panel and withdrawing two bolts from the extended portion of each hinge, accessible through the newspaper tray beneath.

Refitting

Refitting is the reverse of the removal procedure. Check that the leads are reconnected in accordance with their colour coding.

Closing

Closing is the reverse of the opening procedure. Care must be taken to ensure that the clips securing the main harness to the instrument panel will in no way foul any of the switch or instrument terminals, otherwise a direct short may occur when the battery is re-connected.
Note: If air conditioning equipment is fitted it will be necessary to remove the sub-panel with the controls from the stud mounting before the instrument panel can be lowered.

CONSOLE AND PARCEL TRAY ASSEMBLY

Removal

Disconnect the battery.
Remove the console and parcel tray as an assembly as follows:—
Withdraw the drive screws and detach the right hand and left hand side kick panels.
Remove the air conditioning sub-panel (if fitted) from the stud mountings.
Remove the heater control perforated guard cover from the parcel tray after withdrawing four nylon retaining pins.
Disconnect the operating cable from the heater control lever and release the clip securing the outer cable.
Disconnect the control cables from the right and left hand front air outlet ducts, located under the parcel tray, by releasing the locking screw securing the inner cable to the air duct operating spindles.
Remove the locknuts securing the outer cables to the air duct brackets. Disconnect the cables and collect the loose adaptors.
Remove the heater control button escutcheon, retained by two pegs to the control panel and unscrew the two round-headed screws now exposed.
Lift the parcel tray trimming above the control panel and withdraw the two round-headed thumb screws located in recesses in the tray.
Withdraw the control panel facia and disconnect the three rubber pipes connected to the control button unit. Note the location of the individual pipes for reference when refitting.
Disconnect the feed and aerial cables from the radio control unit (if fitted).
Disconnect the rear heater duct pipe from the front junction. Access is gained through the control panel aperture.
Remove the two drive screws on each side securing the parcel tray support bracket to the base of the screen pillar.
Remove the two drive screws securing the parcel tray back-panel to the bulkhead.
Remove the two hexagon headed drive screws securing the rear end of the console to the gearbox tunnel.
Unscrew the gear control knob and tapered nut (not applicable to automatic transmission).
Slide the assembly rearwards to clear the console front clip fixings and lift over the gear control lever to remove.
If the crash rail is to be detached from the parcel tray, remove ten dome nuts and two hexagon nuts.

Refitting

Refitting is the reverse of the removal procedure.

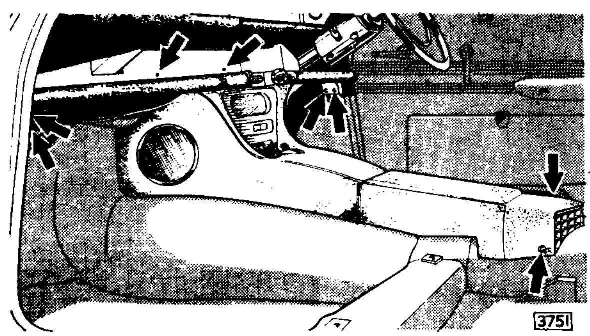


Fig. No. 1 *Showing the attachment points for the console*

THE FACIA PANEL

Removal

The two side facia panels and the screen rail are removed as a complete unit as follows:—

Remove the console and parcel tray assembly as detailed under the previous heading.

Hinge down the instrument panel as detailed on page N.5.

Disconnect the flashing indicator warning light harness at the snap connectors above the steering column and withdraw the harness through the loop bracket attached to the facia panel.

Remove the two nuts securing the steering column assembly to the mounting bracket on the body and lower the column.

Collect any packing washers which may be interposed between the steering column and body mounting brackets.

Disconnect the speedometer drive cable from the back of the instrument.

Remove the two setscrews securing the facia panel to the body below the screen pillars.

Remove four setscrews securing the facia panel to the brackets located in the instrument panel aperture.

Remove four nuts, two adjacent to each end and two central, attaching the screen rail to brackets below the windscreen. The nut situated above the glove-box is accessible through a hole in the glove-box top cover; the centre nuts are exposed with the instrument panel lowered; the fourth nut is accessible from underneath the panel.

Disconnect the earth lead from the clock fixing strap and the illumination feed from the snap connector.

Pull the panel assembly forward and disconnect the remaining cables from the map light, glove-box light, switches and warning lights. Detach the cable socket from the revolution counter. Note the cable colours and location for reference when refitting.

Withdraw the panel assembly.

If necessary, the side facia panel or glove-box can be removed after withdrawing seven screws.

BONNET

Removal

To open the bonnet pull the control knob situated under the facia panel on the right-hand side. This will release the bonnet which will still be retained by the safety catch.

Insert the fingers under the nose of the bonnet and lift the safety catch upwards when the bonnet may be raised.

The bonnet is automatically retained in the fully open position by the action of the hinge springs.

Mark the positions of the hinge brackets on the bonnet to facilitate refitting.

Remove the four setscrews and washers securing the bonnet to each hinge and lift off the bonnet.

Refitting

Position hinges on marks made before removal. Refitting is the reverse of the removal procedure.

BONNET LOCK

Removal

To remove the bonnet catch, slacken the locknut at the top of the peg. Insert a screwdriver into the slot in the peg and unscrew the peg complete with locknut, two washers and spring.

Remove the radiator grille as detailed on page N.7.

Slacken the nut securing the bonnet release cable and withdraw the cable from the release lever.

Remove the two setscrews securing the striker, plate, catch plate and base plate to the body.

Remove the striker, catch and base plates, spacers and spring.

Withdraw the release cable from the outer casing if it is to be replaced.

Adjustment of Bonnet Lock (Fig. 4)

Slacken the locknut on the striker peg and rotate the peg with a screwdriver, until there is approximately $\frac{1}{16}$" (1.5 mm.) movement between the catch plate and the peg. This is to ensure that the catch plate will fully engage with the peg.

Tighten the locknut on the striker peg.

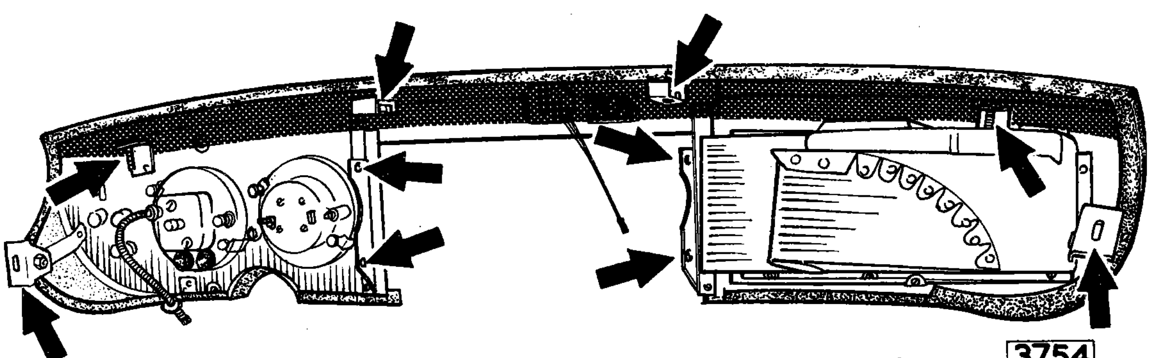


Fig. No. 2 *Showing the attachment points for the facia panel*

Refitting
Refitting is the reverse of the removal procedure.

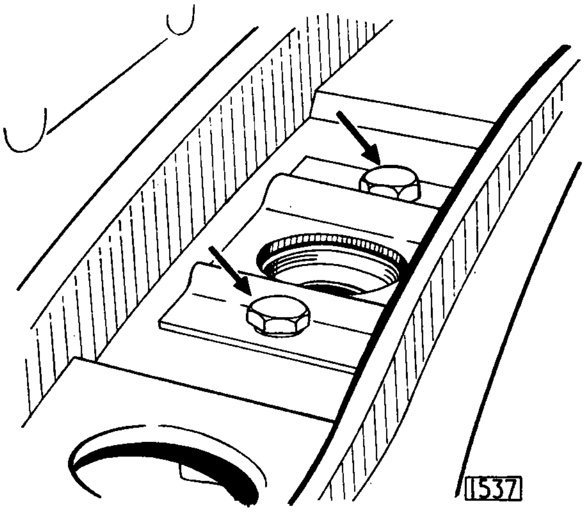


Fig. No. 3 *Showing the two setscrews which secure the bonnet catch striker plate.*

CHROME STRIP ON BONNET

Removal
Remove the nuts, plain and lock washers securing the strip to the bonnet. Detach the strip with the fixing screws.

Refitting
Refitting is the reverse of the removal procedure.

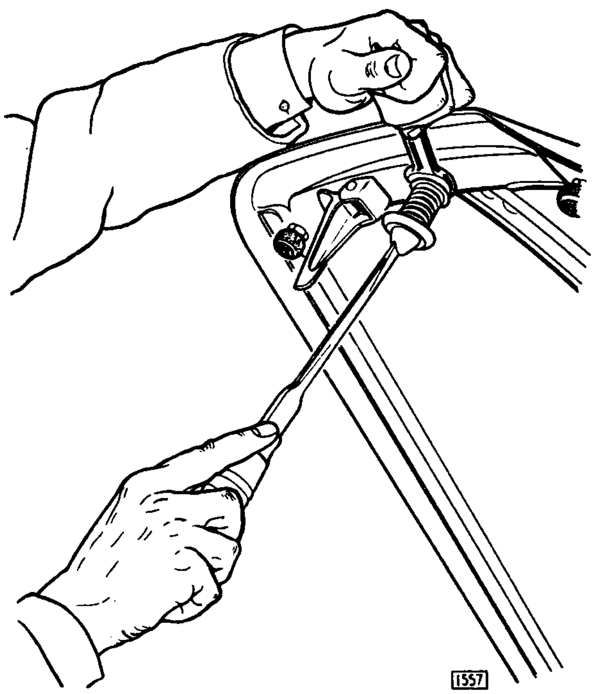


Fig. No. 4 *Adjusting the bonnet lock peg*

RADIATOR GRILLE

Removal (Early cars) (Fig. 5)
Remove five setscrews, lockwashers and plain washers from points A and C, and two nuts, plain washers and lockwashers from point B as shown in Fig. 5 and withdraw the grille.
The attachment points are accessible from beneath the car. The badge is detachable after removing two "Speed" nuts.

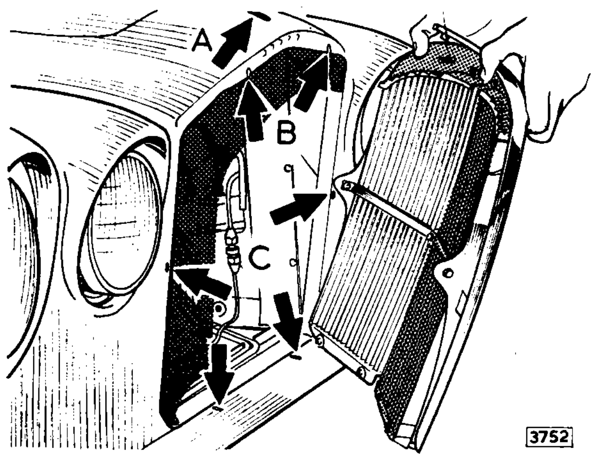


Fig. No. 5 *Showing the mounting points for the radiator grille (Early cars)*

Removal (Later cars) (Fig. 6)
Insert a thin bladed tool between the radiator badge and the grille and prise the badge upwards away from the nylon bush mountings.
The badge has two integral pegs which register in the bushes.
Withdraw the grille top securing screw from points 1 and four setscrews from points 2 and 3.
Attachment points 2 and 3 are accessible from beneath the car.
Note: Care must be taken when removing the badge that the plating on the grille is not scratched or damaged.

Refitting
Refitting is the reverse of the removal procedure.
Check that the grille lines up correctly with the aperture before finally tightening the screws.

Dismantling
Remove the two bolts, nuts, plain and lock washers from the centre retaining strap.
Remove the retainer strap and collect the rubber strips.
Remove four drive screws, plain and lock washers from the bottom of the grille and three setscrews, plain and lock washers from the top.
Withdraw the vane assembly.

Reassembling
Reassembling is the reverse of the dismantling procedure.

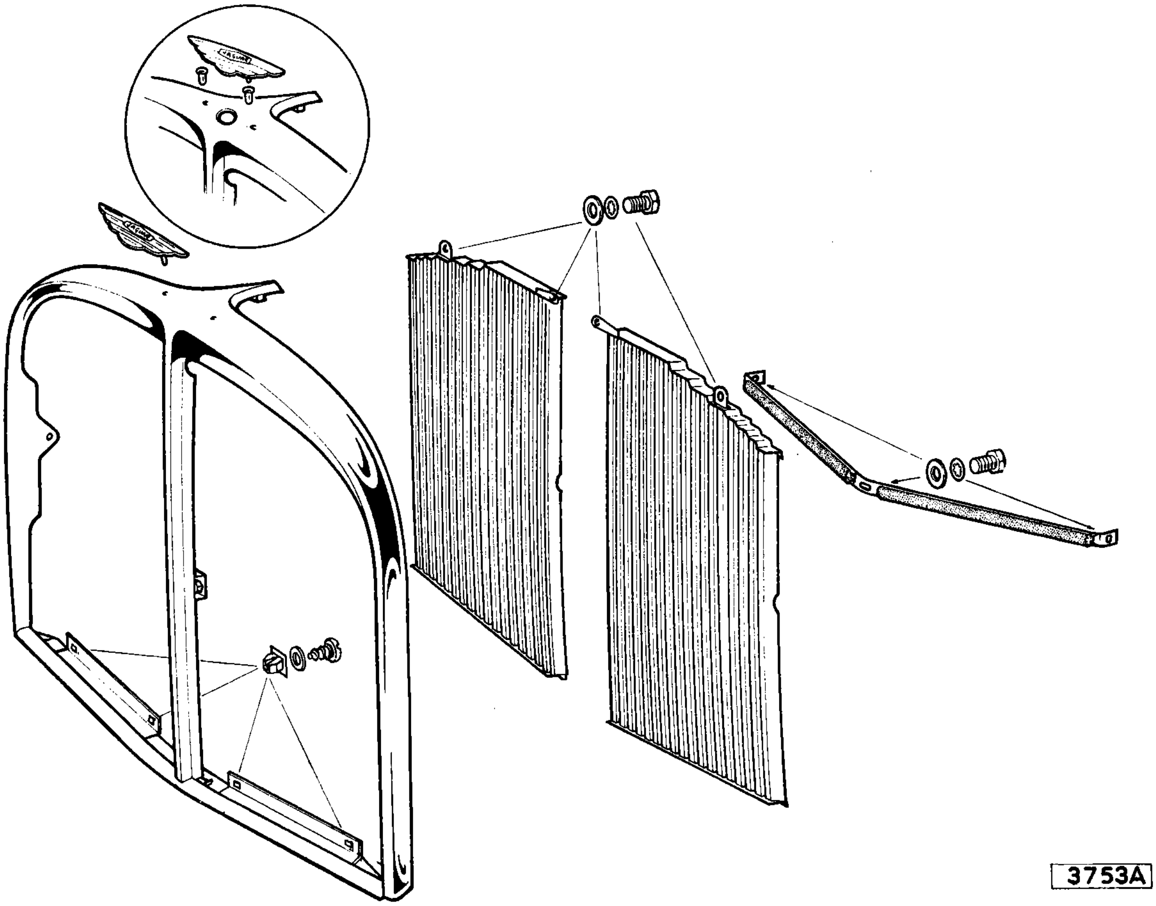


Fig. No. 6 *The radiator grille dismantled. Inset shows the top fixing on later cars.*

MASCOT

Removal

Remove the radiator grille as detailed on page N.7. Remove the two nuts, plain and cup washers securing the mascot to the body.

Refitting

Refitting is the reverse of the removal procedure. Adjust the mascot to line up with the radiator grille and the bonnet chrome strip before finally tightening the nuts.

LUGGAGE COMPARTMENT LID AND HINGES

Removal

Open the luggage compartment and disconnect the electrical connections in the reverse lamp.
Remove the setscrew securing the earth wire to the luggage compartment lid.
Withdraw the harness from the luggage compartment lid. Remove the two metal straps securing the reverse lamp cable to the left hand hinge. Mark the position of the hinges on the luggage compartment lid.
Remove the eight setscrews, plain and serrated washers and remove the luggage compartment lid.

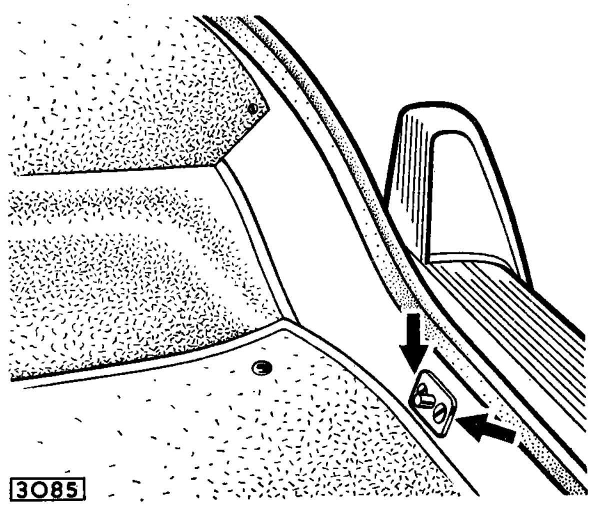


Fig. No. 7 *Showing the screws for adjustment of the luggage compartment lid strikers*

Mark the positions of the hinges on the body and remove the eight setscrews, plain and serrated washers securing the hinges to the body.
Remove the luggage compartment lid hinges.

Refitting
Refitting is the reverse of the removal procedure.

Boot Lock Adjustment
Slacken the four setscrews securing the two lock strikers. Move the striker in the elongated holes until the lock operates correctly and does not rattle. Tighten the retaining setscrews.

PETROL FILLER LIDS
Removal
Unscrew the three setscrews and washers securing the hinge to the petrol filler compartment and detach the assembly from the body.
Remove the two setscrews and washers securing the lid to the hinge.

Refitting
Refitting is the reverse of the removal procedure. When refitting the lid retain it by screwing the setscrews finger tight in the elongated holes, then align the lid to fit into the recess of the body panel. Tighten the setscrews securely.

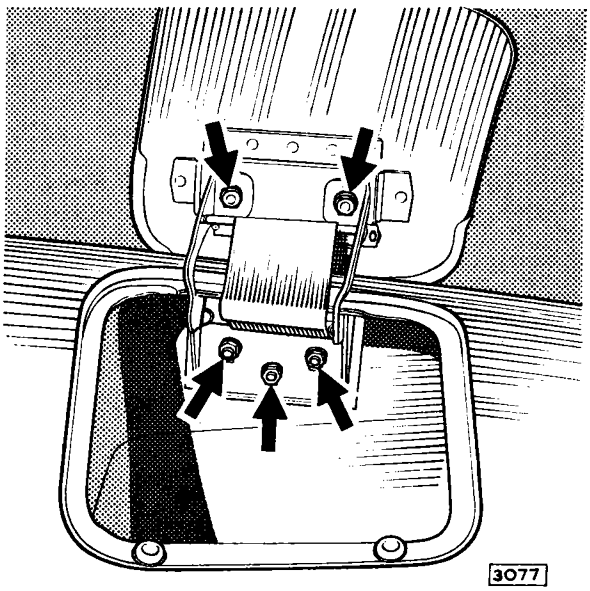


Fig. No. 8 *Removal of the fuel filler lid (R.H.)*

FRONT BUMPER
Removal
Remove two bolts, nuts and washers from the outer mountings and two setscrews and washers from the inner mountings and detach the bumper from the support brackets.

Refitting
Refitting is the reverse of the removal procedure. Adjust the position of the bumper to the body by utilising the slotted holes in the support brackets before finally tightening the bolts.

FRONT BUMPER OVER-RIDERS
Removal
Remove the two nuts, plain and serrated washers securing the over-riders to the front bumper.
Remove the over-riders and beading.

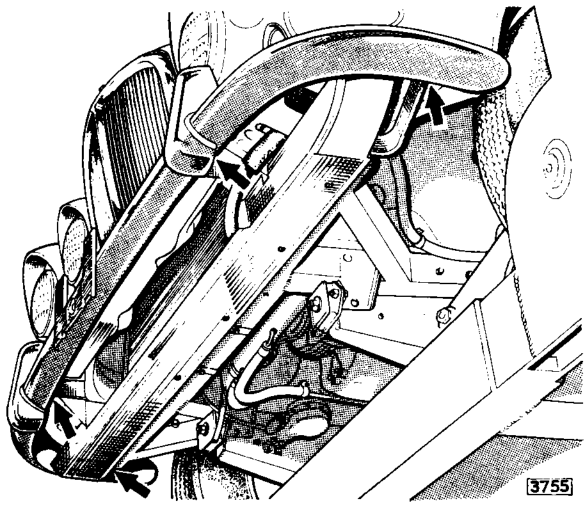


Fig. No. 9 *Showing the mounting points for the front bumper*

Refitting
When refitting the over-riders replace the beading between the over-riders and the bumper.
Refitting is the reverse of the removal procedure.

REAR BUMPER
Removal
Remove the eight setscrews, plain and serrated washers from the outer and inner mountings and detach the bumper.
Remove the nuts and washers securing the bumper mounting rubbers to the wings and reinforcement panels.

Refitting
Refitting is the reverse of the removal procedure.

REAR BUMPER OVER-RIDERS
Removal
Remove the two nuts, plain and serrated washers securing the over-riders to the rear bumper.
Remove the over-riders and beading.

Refitting
When refitting the over-riders replace the beading between the over-riders and the bumper.
Refitting is the reverse of the removal procedure.

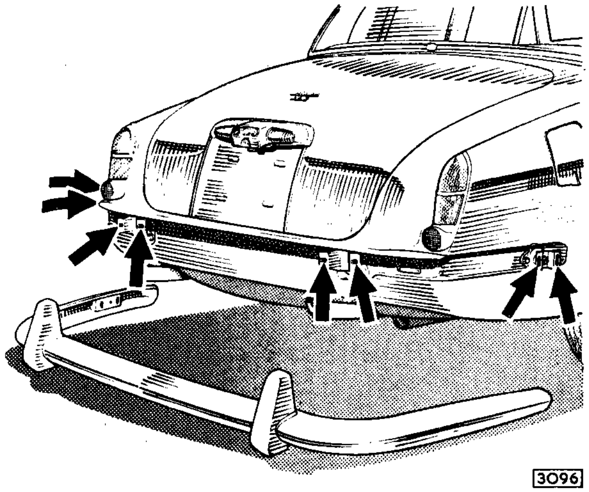


Fig. No. 10 *Showing the mounting points for the rear bumper*

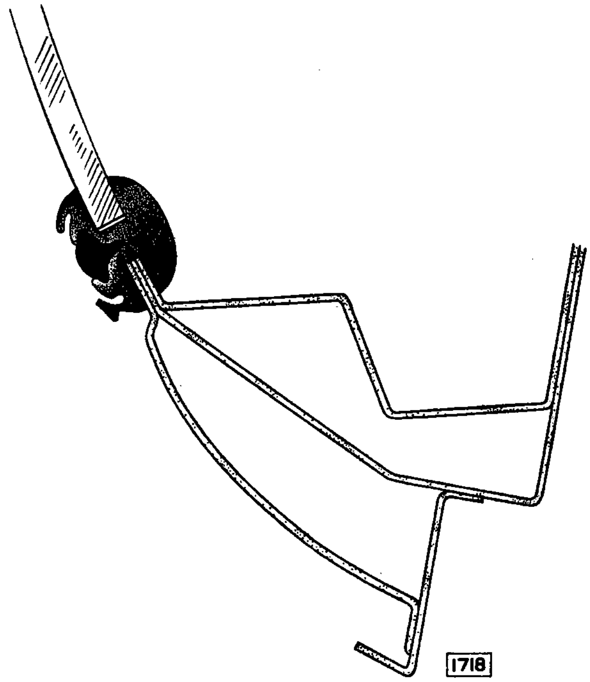


Fig. No. 12 *Section through the windscreen glass and sealing rubber*

WINDSCREEN

Removal

Prise off the two chrome finisher pieces securing the ends of the chrome finisher which encircles the windscreen.
Prise off the chrome finisher from the windscreen rubber. Extract one end of the rubber insert and withdraw completely.
Run a suitable thin bladed tool around the windscreen to break the seal between the rubber and the windscreen aperture flange.
Strike the glass with the flat of the hand from inside the car, starting in one corner and working towards the bottom.
Repeat this process around the complete windscreen. Withdraw the windscreen.

Refitting

Remove the old sealer from the windscreen flange. Examine the windscreen rubber for cuts. If the windscreen was of toughened glass type it is recommended that the windscreen rubber should be replaced. This is because small particles may have been impregnated in the rubber and could break the screen again. If, however, the windscreen was not broken by a projectile the windscreen aperture flange should be examined for a bump in the metal. If this is found, the bump should be filed away otherwise the glass may break again.
The rubber should be attached to the windscreen aperture with the flat side of the rubber towards the rear and the joint in the rubber preferably at the bottom.
Using the special tool (A, Fig. 16) insert the screen into the rubber along the bottom edge first (Fig. 13). It is important that the glass should be fitted equally. DO NOT fit one end and then try to fit the other. Using a special tool (B, Fig. 16) insert the rubber sealing strip with the rounded wide edge to the outside.

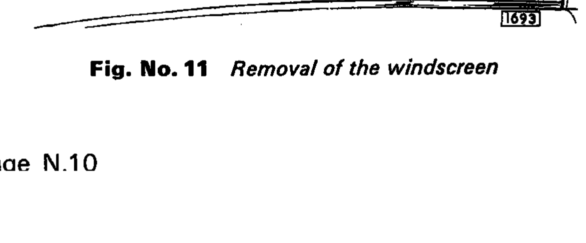


Fig. No. 11 *Removal of the windscreen*

Using a pressure gun filled with a sealing compound and fitted with a copper nozzle (so that the glass will not be scratched) apply the nozzle of the gun between the metal body flange and the rubber and fill with sealing compound. Repeat the operation between the glass and the rubber. Remove excess sealing compound with a rag soaked in white spirit. DO NOT USE THINNERS as this will damage the paintwork.

Fit the chrome strip on top of the windscreen rubber and bend to suit contour if necessary. Coat the inside of the chrome strip with a layer of Bostik 1251 and allow to become tacky. Place the chrome strip on the rubber over the rubber sealing strip and with a hook (A, Fig. 16) lip the rubber of the chrome finisher. Fit the two centre chrome clips and lip the rubber over the edges of the clips.

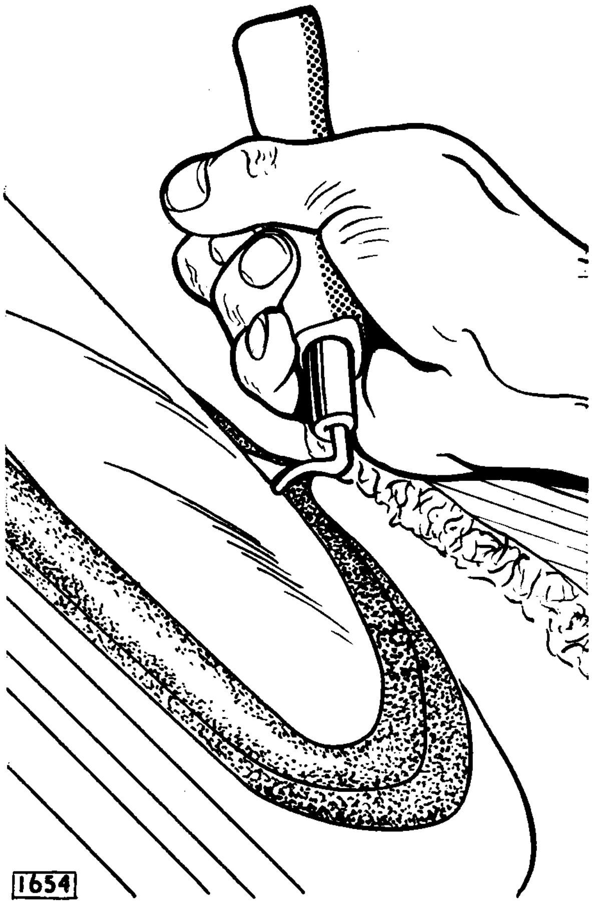


Fig. No. 13 *Using the special tool ("A" Fig. 16) for lifting the rubber over the glass*

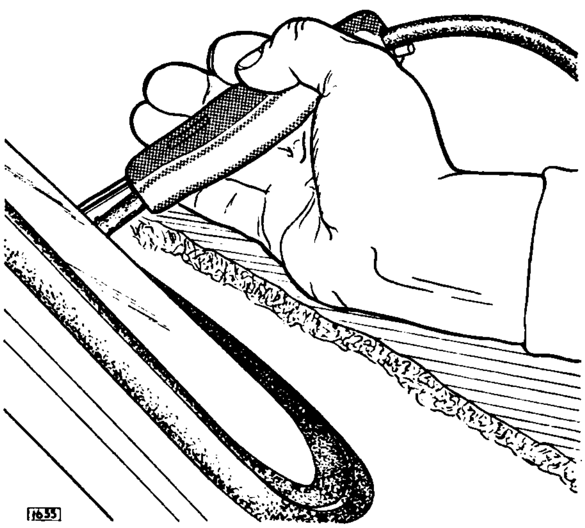


Fig. No. 14 *Using the special tool ("B" Fig. 16) for inserting the rubber sealing strip in the windscreen sealing rubber*

REAR GLASS

Removal

Prise off the two chrome finisher pieces securing the ends of the chrome finisher which encircles the backlight.
Prise off the chrome finisher from the backlight rubber.
Extract one end of the rubber insert and withdraw completely.
Run a suitable thin bladed tool around the backlight to break the seal between the rubber and the backlight aperture flange.
Strike the glass with the flat of the hand from inside the car, starting in one corner and working towards the bottom.
Repeat this process around the complete rear light glass.
If the car is fitted with a heated backlight it is necessary to disconnect the two electrical connections in the boot (page P.63 Figs. 75 and 76) and care should be taken when removing the backlight not to break the two wires which pass through the holes in the sealing rubber.

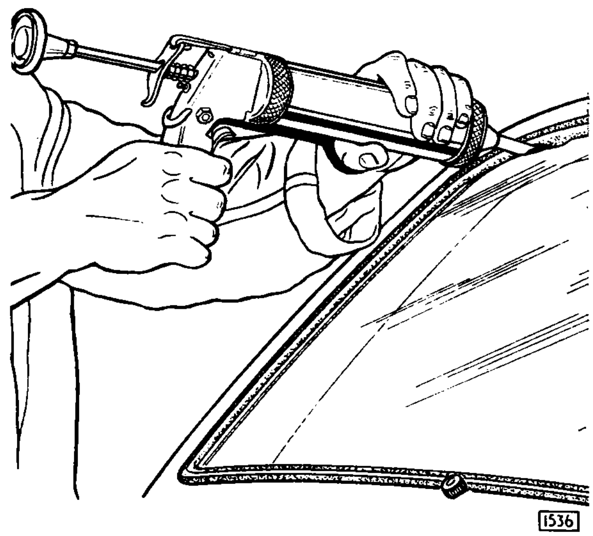


Fig. No. 15 *Using a gun to inject sealing compound between the surround rubber and the glass*

Refitting

Remove the old sealer from the backlight flange. Examine the sealing rubber for cuts. If the backlight is of the toughened glass type (i.e. all cars except those fitted with heated backlights) it is recommended that the backlight rubber should be replaced.

This is because small particles of glass may have been impregnated into the rubber and it could break the glass again. If, however, the backlight was not broken by a projectile the backlight aperture flange should be examined for a bump in the metal. If this is found the bump should be filed away, otherwise the glass may break again.

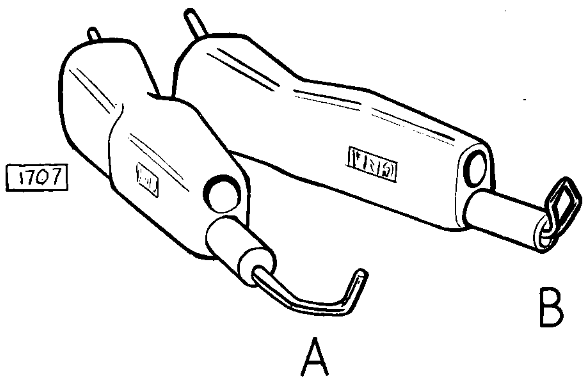


Fig. No. 16 *The two special tools (Churchill Tool No. JD 23) used when refitting a windscreen*

The rubber should be attached to the backlight aperture with the flat side of the rubber facing the inside of the car.
If the car is fitted with a heated backlight, pierce the sealing rubber in the two appropriate positions, Fig. 18, to take the wires which lead to the element.

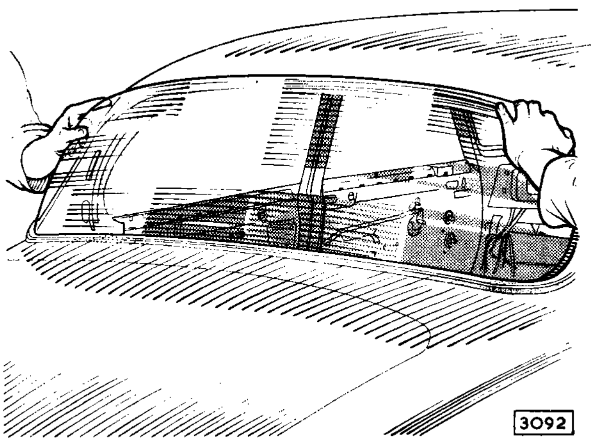


Fig. No. 17 *Removal of the rear glass*

Using the special tool (A, Fig. 16), insert the backlight into the rubber along the bottom edge first. On cars fitted with heated backlight, feed electrical wires through holes in sealing rubber first (Fig. 18). It is important that the glass is fitted equally. DO NOT fit one end and then try to fit the other. Using the special tool (B, Fig. 16), insert the rubber sealing strip with the rounded wide edge to the outside.
Using a pressure gun filled with a sealing compound and fitted with a copper nozzle (so that it will not scratch the glass) apply the nozzle of the gun between the metal body flange and the rubber and fill with sealing compound (Fig. 19). Also apply sealing compound between the rubber and the glass (Fig. 15).

Remove excess sealing compound with a rag soaked in white spirit, DO NOT USE THINNERS as this will damage the paintwork.

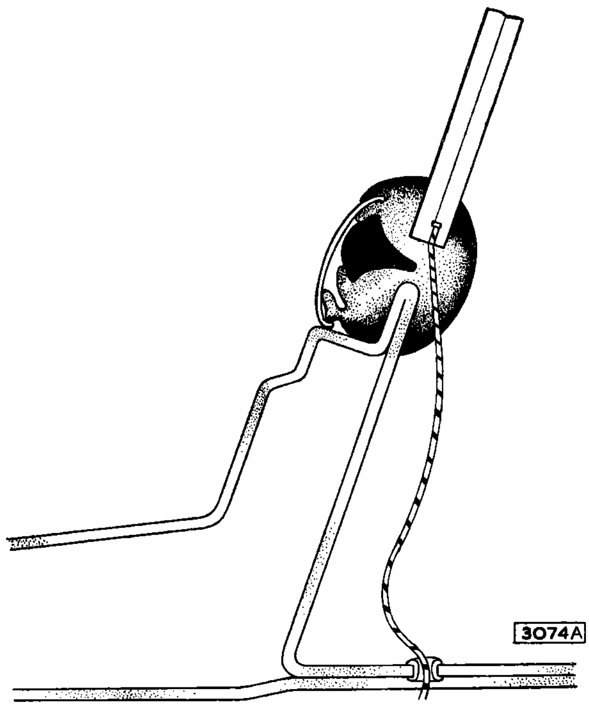


Fig. No. 18 *Section through the rear light glass and sealing rubber*

Check that there is a small gap between the sealing rubber edge and the depression for the rear glass aperture. This is necessary to allow the chrome finishing strip to seat on the sealing rubber. If the rubber bends hard onto the depression at certain points insert a small length of stiff piping cord $\frac{1}{8}$" (3.1 mm.) diameter at the required positions, this will facilitate the fitting of the chrome strip. Fit the chrome on top

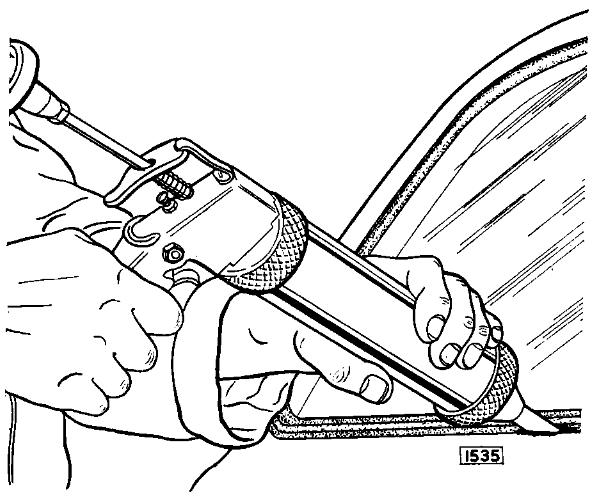


Fig. No. 19 *Using a gun to inject compound between the rubber and the rear glass aperture*

of sealing rubber and bend to suit contour if necessary. Coat the inside of the chrome strip with a layer of Bostik adhesive and allow to become tacky. Place the chrome strip onto the sealing rubber and with a hook (A, Fig. 16) lift the lip of the rubber over the chrome finisher. Fit the two centre chrome clips and lip the rubber over the edges of the clips.
Reconnect the heated backlight cables (if fitted).

FRONT DOORS AND HINGES

Removal

Remove the split pin and clevis pin on the door check strap bracket situated on the door hinge pillar.
Mark the position of the hinges on the door.
Remove the six bolts securing the hinges to the door side and remove the door.
Remove the scuttle side casing by unscrewing the three drive screws. Remove the two screws securing the aperture cover plate. Unscrew the door courtesy light switch from the bottom hinge recess. Pull out the electrical connection at the rear of the switch.
To remove the hinges unscrew the four cross headed screws and two bolts inside the hinge recess.

Refitting

Refitting is the reverse of the removal procedure.

REAR DOORS AND HINGES

Removal

Remove the split pin and clevis pin on the door check strap bracket on the door hinge pillar. Remove the door trim casing.
Mark the positions of the hinges on the door.
Remove the three bolts securing the bottom hinge to the rear door and remove the four cross headed screws securing the top hinge to the door.

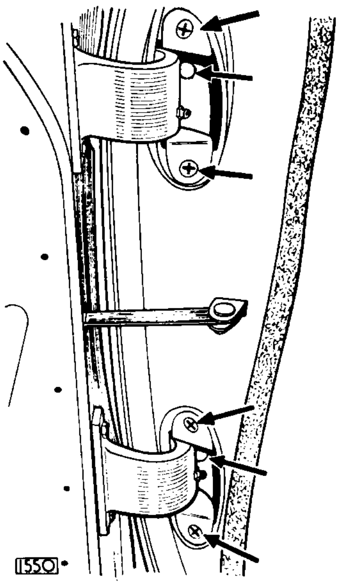


Fig. No. 20 *Showing the screws which secure the front door hinge*

Remove the rear door.
Remove the four cross headed screws securing the hinges to the rear door side of the centre pillar.
Remove the two cross headed screws from the front door side of the centre pillar.
Withdraw the hinges.

Refitting

Refitting is the reverse of the removal procedure.

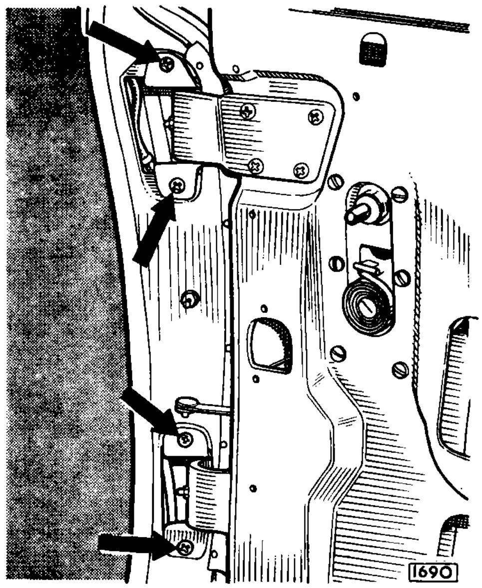


Fig. No. 21 *Showing the screws which secure the rear door hinges*

FRONT AND REAR DOOR TRIM CASINGS

Removal

Remove the four chrome screws and washers securing the wood capping to the waist rail.

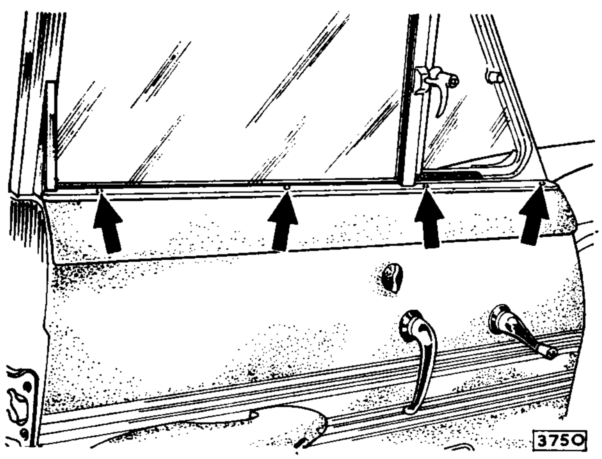


Fig. No. 22 *Showing the four screws which secure the wood capping to the waist rail*

Remove the three woodscrews now exposed and detach the padded waist rail.
Withdraw four drive screws and remove the two wooden fillets from the top of the door panel.

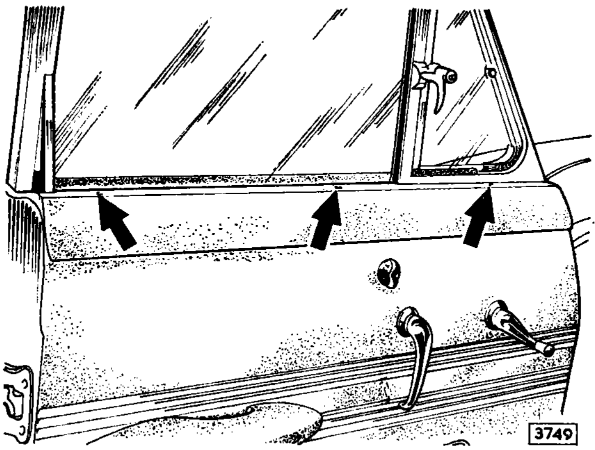


Fig. No. 23 *Showing the three screws which secure the padded waist rail to the door frame*

Ensure that the winding window is completely closed. Insert a screwdriver between the handle and the spring cap and press the cap inwards, into the escutcheon. This will expose the retaining pin which can then be pushed out. Remove the handle, spring cap and escutcheon.
Repeat operation to remove the door handle.
Remove the central retaining screw and detach the locking turn button.
Remove two screws and washers and detach the arm rest (front doors only).
Carefully remove the door casing fabric, where secured by adhesive solution to the door inner panel at the bottom of the window aperture.

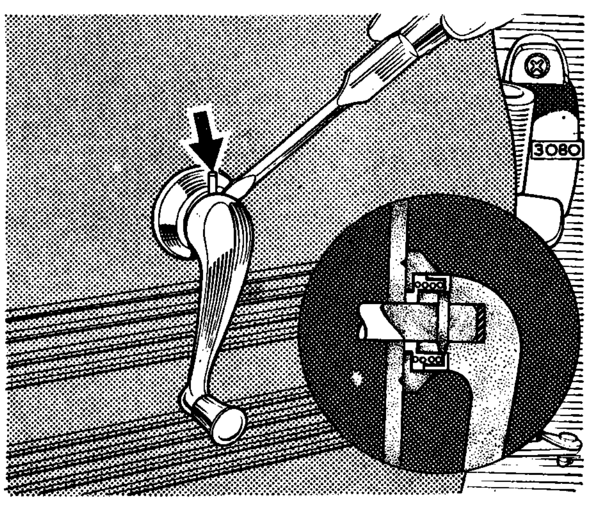


Fig. No. 24 *Showing the location of the interior door lock handle retaining pin*

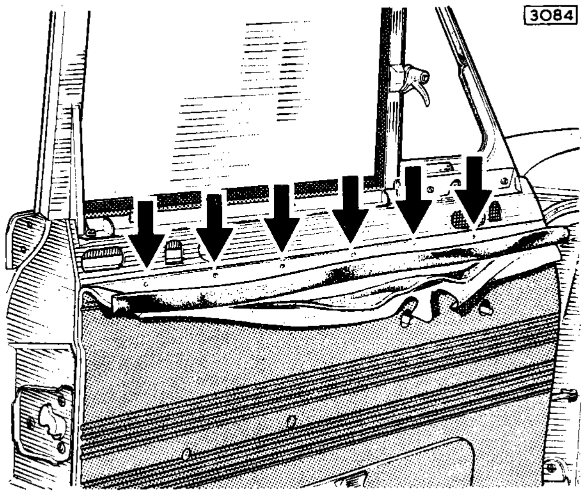


Fig. No. 25 *Showing the screws which secure the top of the door trim casing*

Remove the drive screws, five on the rear doors and six on the front doors, securing the top of the casing to the door panel.
Insert a thin bladed screwdriver between the door casing and the door panel. Prise off the casing which is secured by spring clips to the door.
On the front doors it will be necessary to unhook the two tensioning devices, which retain the map pocket in the closed position, from the inner panel before the casing can be completely detached.

Refitting
Refitting is the reverse of the removal procedure.

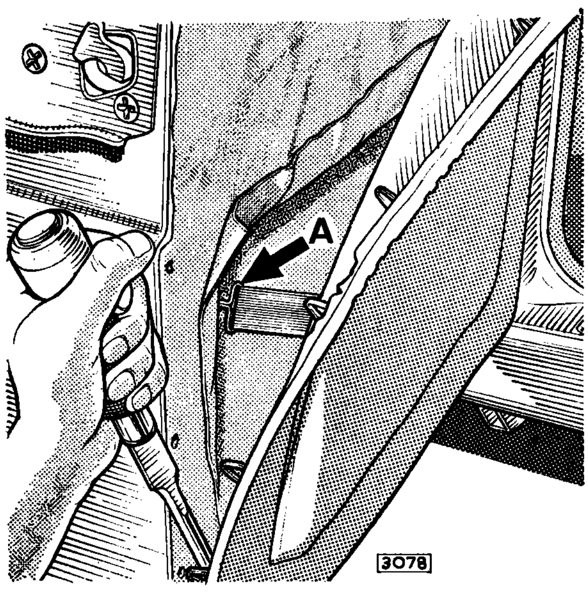


Fig. No. 26 *Removal of the door trim casing. Arrow "A" shows the location of the map pocket tensioner anchorage*

FRONT AND REAR DOOR WINDOW FRAMES AND GLASS

Removal

Remove the door trim casing as described previously. Pull off the clear plastic sheet which is stuck to the door frame with upholstery solution.
Remove the four round headed screws, serrated and plain washers securing the window frame to the top of the door panel.

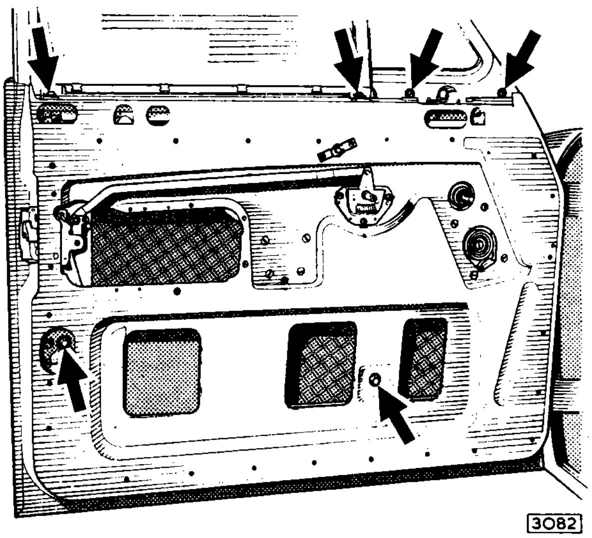


Fig. No. 27 *The location of the window frame securing screws*

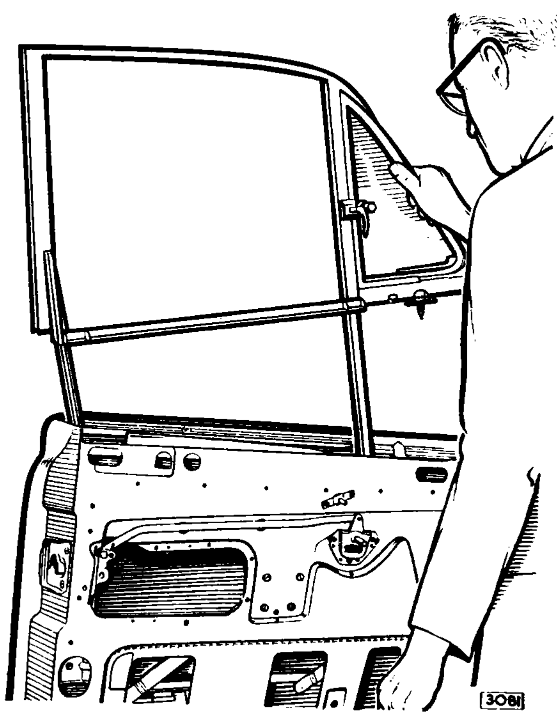


Fig. No. 28 *Removal of the front window frame*

Collect all the packing pieces.
Care should be taken to replace the same number of packing pieces under their respective screws.
Remove the two bolts, serrated and plain washers securing the two legs of the window frame to the door.
Collect the packing pieces.
Unclip the weather strip from the door frame, this is secured by four clips. Withdraw the window frame from the door frame and collect the rubber packing piece between the light frame and the door frame above the door lock.
Slide the glass out of the retaining channel.

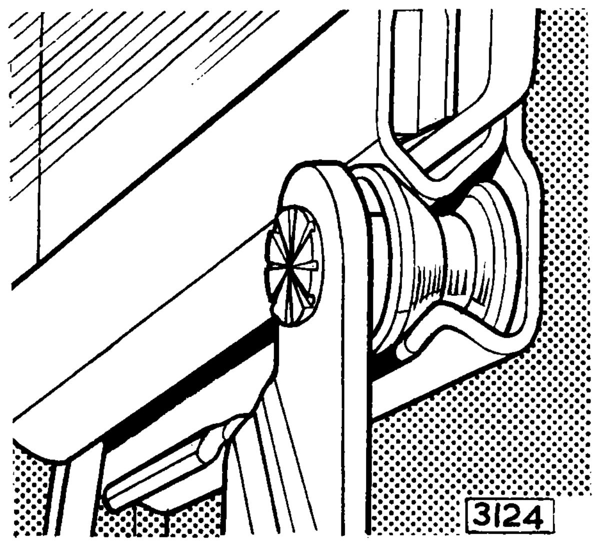


Fig. No. 29 *Showing the window regulator arm and channel*

Refitting

Refit the four clips securing the weather strip to the outer inside edge of the door frame.
Clip the weather strip in position.
Place a layer of sealing compound on the section of the door frame on to which the no draught ventilator window in the window frame seats.
Place the door glass into position on the window winding mechanism slide channel and slide the glass into position between the door frame.
Insert the window frame into the door frame. On the rear door it is necessary to wind up the window glass approximately one third of its maximum height before inserting the window frame. Insert the rubber packing piece. Refit all screws and bolts finger tight.
Insert the four round headed screws, serrated and plain washers which secure the window frame to the door. Replace the various packing pieces under the round headed screws.
Refit the bolt, serrated and plain washers securing the window frame bracket furthest away from the door hinge and replace the fibre packing pieces.
Refit the bolt, serrated and plain washer securing the window frame bracket nearest the door hinge and replace any packing pieces.

Adjust the window frame to give an equal clearance with the door pillars with the door closed.
The front window should clear the screen pillar by $\frac{1}{16}$" (1.5 mm.).
When the correct clearance has been achieved, tighten the four round headed screws and two bolts securing the window frame to the door.
Remove any excess sealing compound from the bottom of the no draught ventilator.
Refit the door trim casings, door lock and window winder handles and capping by reversing the removal procedure.

FRONT NO DRAUGHT VENTILATOR

Removal

Remove the trim casing from the front door as described on page N.13.
The no draught ventilator adjustment and securing mechanism is visible through a small aperture in the door frame.

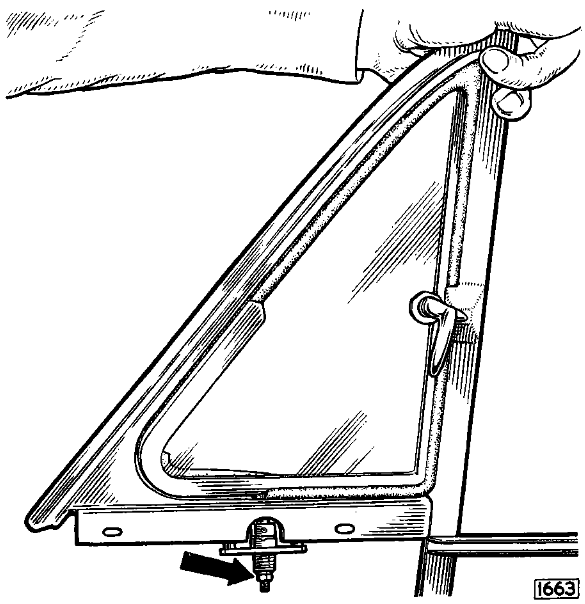


Fig. No. 30 *Showing the front N.D.V. light adjustment nut*

Remove the locknut, nut and washer securing the spring against the quadrant on the N.D.V. post.
Remove the pin and segment on the N.D.V. post.
Remove the two screws securing the front N.D.V. hinge to the window frame.
Turn the N.D.V. catch to allow it to open.
Withdraw the N.D.V. from the window frame.

Refitting

Care should be taken not to leave any parts between the inner and outer door frames.
Refitting is the reverse of the removal procedure.

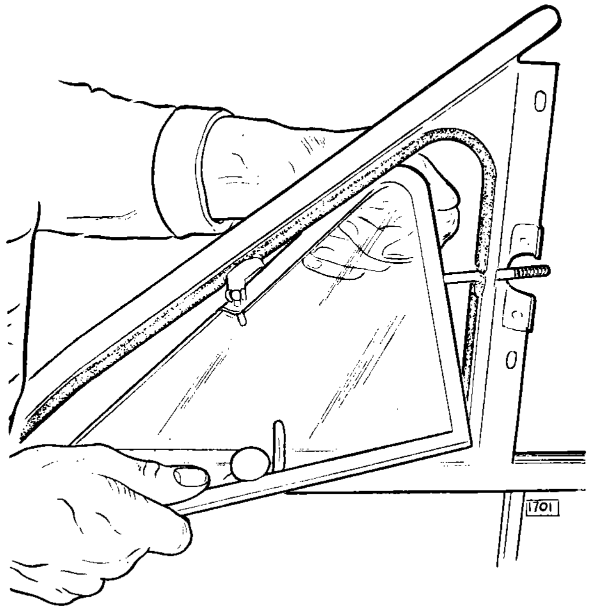


Fig. No. 31 *Removal of the front N.D.V. glass from the frame*

REAR NO DRAUGHT VENTILATOR

Removal

Remove the nut, screw and fibre washer securing the rear N.D.V. bracket to the catch arm which operates the N.D.V.
Open the N.D.V.
Remove the five screws securing the rear N.D.V. light hinge to the window frame.

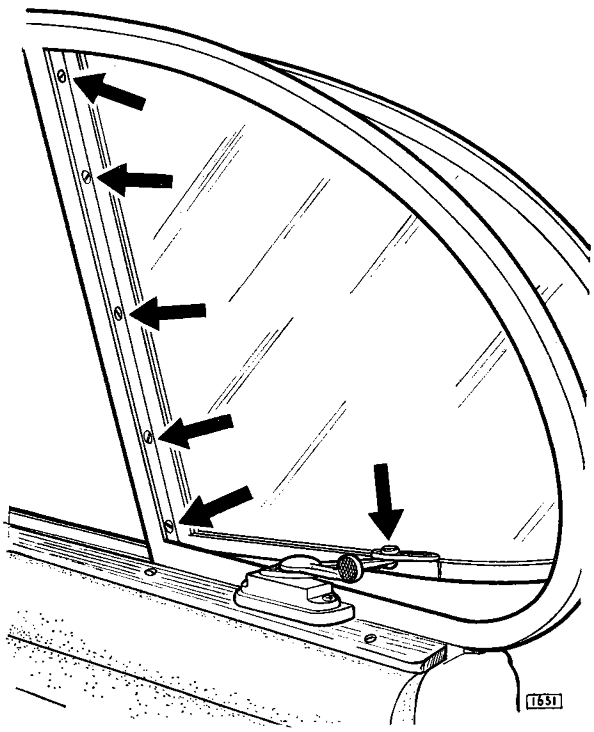


Fig. No. 32 *Removal of the rear N.D.V. glass*

Refitting
Refitting is the reverse of the removal procedure.
Coat the thread of the pivot screw with "Locktite" before fitting the nut.

FRONT WINDOW REGULATOR

Removal
Remove the door casing and window glass as described on pages N.13 and N.15.
Remove the felt placed over the window regulator spindle.

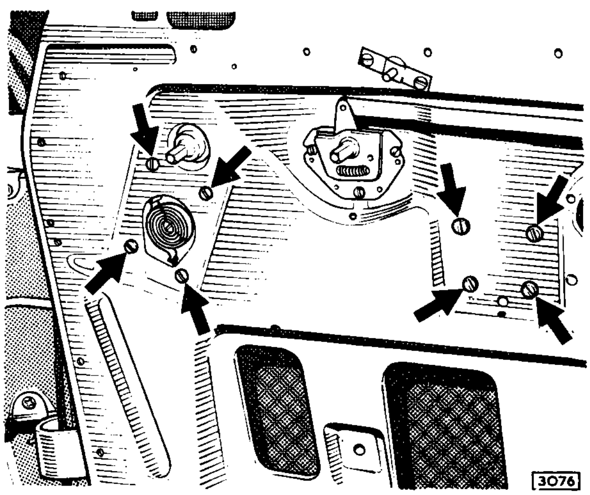


Fig. No. 33 *Showing the screws securing the window winding mechanism to the door frame*

Remove the four screws and serrated washers securing the window regulator to the door frame.
Remove the four screws and serrated washers securing the window regulator spring to the door frame.
Withdraw the window regulator mechanism from the door frame.

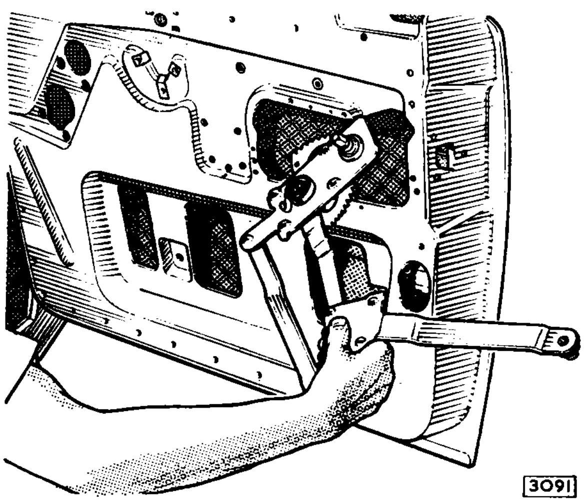


Fig. No. 34 *Removal of the window winding mechanism*

Refitting
Refitting is the reverse of the removal procedure.

REAR WINDOW REGULATOR

Removal
Remove the door casing and window as described on pages N.13 and N.15.
Remove the piece of felt placed over the window regulator spindle.
Remove the four screws and serrated washers securing the window regulator mechanism to the door frame.
Withdraw the window regulator mechanism from the door frame.

Refitting
Refitting is the reverse of the removal procedure.

FRONT SEAT AND SEAT RUNNERS

Removal
Remove the cushion from the front seat.
Slide the seat fully rearwards.
Remove the two bolts and plain washers securing the front of the seat runners to the body floor.
Remove the two bolts and washers securing the seat front support plate to the body floor; remove the seat.

Refitting
Refitting is the reverse of the removal procedure.

REAR SEAT AND SQUAB

Removal
Lift the rear seat cushion upward, off the two locating pins on the rear seat and remove the rear seat.
Remove the two round headed screws, serrated and plain washers securing the bottom of the rear seat squab to the back of the seat pan.
Lift the rear squab to disengage the three retaining hooks and withdraw the squab.

Refitting
Refitting is the reverse of the removal procedure.

POLISHED WOOD CAPPINGS

Removal of Upper and Lower Capping on the Door Pillar
Insert a thin bladed screwdriver between the trim casing and the centre door pillar. Prise off the trim casing and pull downwards to release the tongue on the casing from behind the upper capping.
Knock the wooden capping downward with the hand and remove. The wooden capping is secured by two clips.
Note: If seat belts are fitted it will be necessary to detach the anchorage plate by withdrawing the fixing bolt before removing the capping.

Removal of Screen Pillar Capping
Withdraw the rubber wedge piece located between the facia panel and the base of the capping.
Lift the sealing rubber locally down the door aperture.
Remove the two screws now exposed securing the capping to the screen pillar and withdraw the capping.

Removal of Rear Quarter and Cant Rail Capping
Lift the door aperture sealing rubber, withdraw the screws now exposed and detach the cant rail and rear quarter cappings.
It will be necessary to remove the rear quarter capping before the cant rail can be detached in order to clear the overlap joint.

Refitting
Refitting is the reverse of the removal procedure.

COURTESY LIGHT AND CAPPING

Removal
Pull off the courtesy light glass from the two plastic prongs securing it to the lamp body.
Remove the two screws securing the wooden base to the body of the car.
Disconnect the positive battery lead.
Disconnect the electrical connections at the rear of the courtesy light.

Refitting
Refitting is the reverse of the removal procedure.

REMOVAL OF LOCK MECHANISM

Front Doors (Fig. 36)
Release the spring clip holding the top of the spring loaded handle/lock connecting link (A) to the dowel on the plunger operating lever (B). This is accessible through an aperture in the inner door panel.

Rear Doors
Remove the starlock washer holding the bottom handle/lock connecting link (C) to the cross-shaft (D), together with the plain washer behind the link.

Removing Remote Opening Control
Remove the wire clip, plain washer and the wavy washer fitted between the connecting link and the latch operating lever (E). Detach the connecting link. Remove the three screws (F) securing the remote control to the inner door panel.

Removing Turn-Button Locking Control
Detach the control wire by removing the large spring clip which secures it to the locking lever (G).
To facilitate removal, place control in the locked position.
Remove the two screws (H) together with the shakeproof washers to release the turn-button control.

Removing Lock Unit
Remove the three countersunk screws (I) which pass through the dovetail plate (J) and the door into the lock.
On the front doors it is advisable to remove the lower glass run channel bolt with its plain washers, shakeproof washers and packing pieces in order to press the lock inwards so that the projecting latch passes inside the shut face.
Remove the lock through the large aperture in the inner door panel.

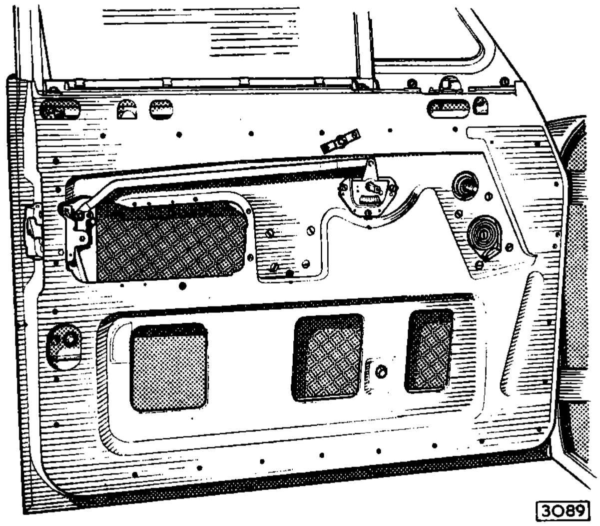


Fig. No. 35 *Showing the door lock in position*

Removing Outside Handle Base-Plate
Remove the two bolts (K) together with the shakeproof washers from the inside of the door.

Removing Striker Unit
Do not disturb the three fixing screws (L) unless making an adjustment or fitting a new striker unit.

Removing Outside Handle
When fitting a replacement, remove nut (M) together with two washers and remove the handle.
Fit the replacement handle, noting that a packing washer (N) is fitted to the front fixing stud.
On the rear doors it is desirable that the lower screw, in the shut face of the door, be removed to facilitate the removal of nut (O) together with the shakeproof and plain washers.
In the case of front doors, it is preferable to remove the window frame complete with glass to facilitate the removal of nut (O) which is in the extreme inside top rear corner of the door, unless a suitable spanner is available.
To remove the window frame, lower the glass and release the bolts, thus freeing the bottoms of the front and rear glass channels.
Remove the four screws from the window sill and lift the window frame out of the top of the door.
Raise the glass; slide it towards the lock face to release from the window regulator lifting arms and remove the glass.
Important: All window frame mounting points have spring washers, plain washers and packing pieces. Ensure that all these components are replaced in the reverse order.

Refitting
If the outside handle has been removed this should be refitted before installing the lock mechanism. It is, however, advisable to fit the window frame and glass later.

When the outside handle has not been removed, ensure that the winding window is raised to its fullest extent.
On front doors attach the bottom of the spring-loaded handle/lock connecting link (A) to the dowel on the cross-shaft (D). The link is fitted with a plain washer and it is retained with a new starlock washer.
Insert the lock through the upper aperture in the inner door panel so that the latch projects through the aperture in the shut face of the door.
On front doors it is advisable to remove the lower glass run channel bolt together with the plain washers, shakeproof washers and packing pieces in order to facilitate this operation.
The dovetail plate (J) should then be placed in position over the latch bezel and secured by means of the three countersunk screws (I) which pass through the shut face into the lock.
The base plate assemblies are stamped L.H. (Left hand) and R.H. (Right hand).
On rear doors the top of the handle/lock connecting link (C) should be located on the lug on the plunger operating lever (B).
Then the washer (P) should be fitted and retained by the plunger-bolt (Q) and the locknut (R).
Each base-plate assembly should be held in position inside the door in order that the clearance between the end of push button plunger bolt (Q) and the lock contactor (S) mav be checked through the aperture in the inner door panel.

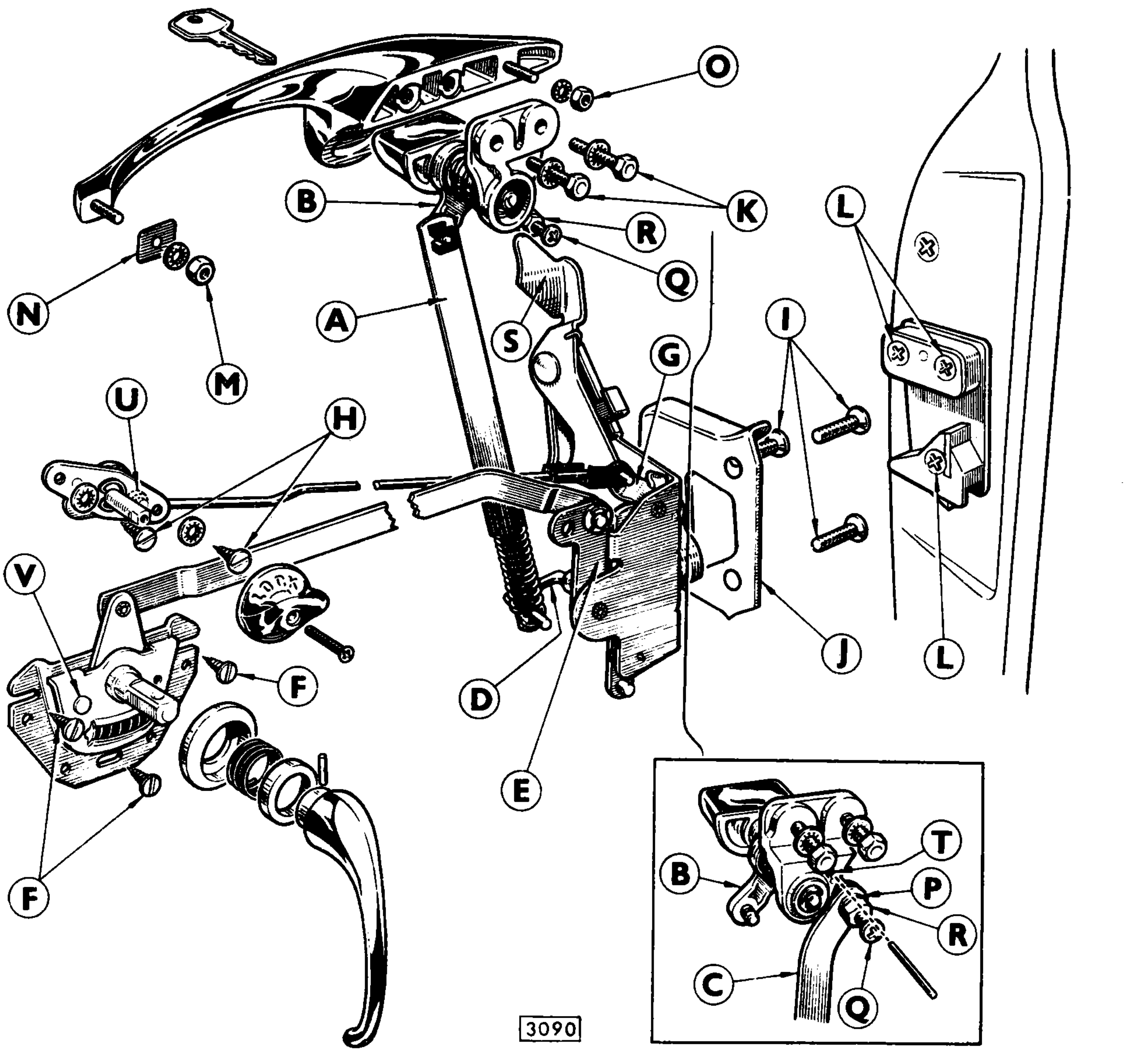


Fig. No. 36 *The door lock mechanism*

This clearance should be $\frac{1}{32}$" (.79 mm.).
To adjust, release the locknut (R), screw the plunger bolt (Q) in or out as required and retighten the locknut.
The base-plate assemblies are secured from the inside of the doors by means of two bolts (K), with shakeproof washers, which pass into the back of the inside handle.
When connecting the push-button mechanism to the lock unit, ensure that the cross shaft (D) is moved **downwards** into the locked position.
Important: On the rear doors provision is made for the plunger operating lever (B) to be pegged in the locked position prior to connecting the handle/lock link (C). This is done by inserting a short length of $\frac{1}{8}$" dia. (3.18 mm.) rod through the **rectangular** hole (T) in the base-plate assembly.
To compensate for variations in fitting, the links (A and C) are provided with three holes which are at the top end on the front links and at the bottom end on the rear links.
It will be observed that one of these holes, usually the centre one, can be used to give the correct setting.
The rear link is fitted with a plain washer underneath and it is retained by a starlock washer.
The front link is finally secured by a spring clip.
To check the locking action, remove the rod from the rectangular hole in the rear base-plate assembly, depress the push-button and check that the plunger bolt (Q) clears the lock contactor (S).
Alternatively, raise the cross-shaft (D) into the unlocked position and check that the plunger passes squarely behind the lock contactor to come in contact with it when the push button is operated.
When refitting the turn button locking control it is important to ensure that each turn button is in the unlocked position when inclined vertically and in the locked position when rotated into the horizontal plane.
In the locked position the control wire is moved **away** from the lock passing over the top of the control.

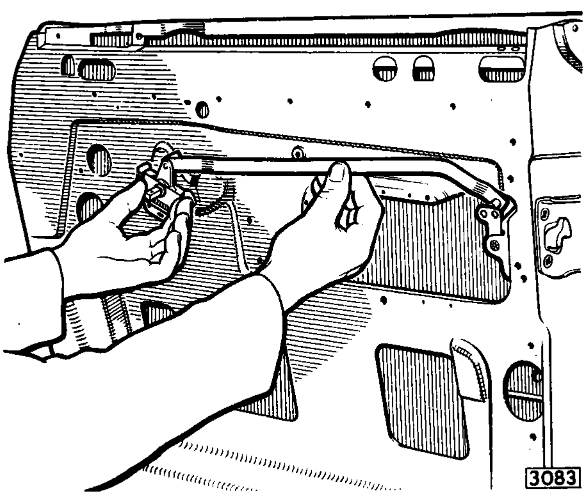


Fig. No. 37 *Showing the door lock in position*

Note: The front controls may be identified by a larger front stop (U).
To refit, the control wire is threaded through the aperture provided for the control in the inner door panel and it is connected to the locking lever (G) with the large spring clip provided.
The control is retained by two screws (H) together with shakeproof washers, which should be adjusted to provide a uniform turn button position before tightening.
When refitting the remote opening controls it must be noted that these controls are handed and a rivetted stop (V) ensures that the control can only be operated in one direction, that is, away from the lock face.
Each control should be loosely fitted to the inner door panel with its three screws (F). The dowel on the connecting link is then attached via the hole in the latch operating lever (E) nearest the lock with a wavy washer interposed. The assembly is retained by one or two plain washers and a wire clip.
The remote control is aligned by sliding it through its slots towards the lock unit until the latch operating lever (E) is in contact with the stop in the lock case and then secured by tightening the three screws (F).
To fit and adjust the striker unit, attach the striker loosely by means of the three screws (L) which pass through the door pillar into an adjustable tapping plate. Positioning is carried out by a process of trial and error until the door can be closed easily without rattling or movement up or down.
Important: The striker must be retained in the horizontal plane relative to the door axis.

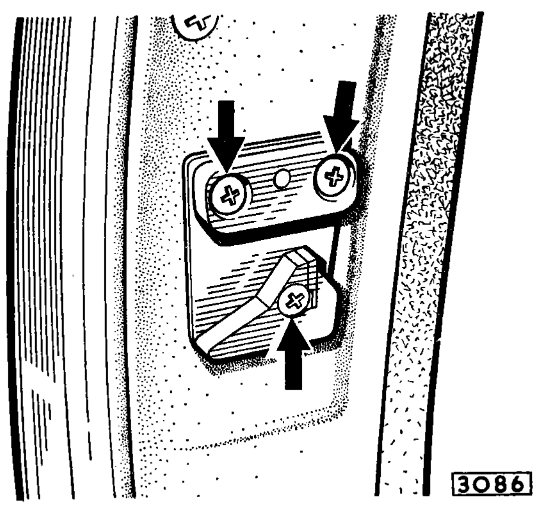


Fig. No. 38 *Location of the door striker plate securing screws*

MASTER CHECK FOR CORRECT ALIGNMENT
Front Doors
Fit an inside handle **vertically downwards** on the remote control spindle. Turn the handle rearward to open the door. Fit the appropriate locking turn-button vertically and rotate anti-clockwise on the right side door or clockwise on the left hand door into the horizontally locked position. Close the door while holding the push-button in the fully depressed position.

The door will remain locked although the push button may be freely depressed.
Insert the key in the push-button slot and turn in the appropriate direction. Push-button control will then be restored and the door can be opened.
After turning, the key will automatically return to the horizontal position when it can be removed.
Important: The key must be removed from the locking device before closing a door in the locked position.

Rear Doors
Fit the inside handle vertically upwards on the remote control spindle. Turn the handle forward to open the door. Fit the appropriate locking turn-button vertically and rotate anti-clockwise on the right side door, clockwise on the left hand side door into the horizontally locked position.
Close the door. It will then be locked although the push-button may be freely depressed.
To unlock, the turn-button is rotated to its original position when push-button control is restored.

Lubrication
Before fitting the door casing ensure that any moving parts are adequately greased.
After assembly introduce a few drops of thin machine oil into the private lock key slots. These must be lubricated once a month.
The private lock cylinders must not, under any circumstances, be lubricated with grease.

Features of Lock Operation
When the doors are locked the push-buttons may be freely depressed. No amount of wilful pressure on the outside button will force or damage the lock.
Either front door can be locked from inside or outside irrespective of which door was last used as an exit.
This feature is invaluable in cases of traffic congestion and parking.
If either front door is closed after accidentally setting the turn-button in the locked position, locking is automatically cancelled. This action obviates the risk of locking oneself out of the car.
Front doors, however, can be locked from the outside without using the key, a great advantage in inclement weather or under heavy traffic conditions where instant locking is desirable. This is achieved by setting the turn-button in the locked position and, while closing the door, deliberately holding the push-button in the fully depressed position. The key will then be used for unlocking either front door in the usual way.

ACCIDENTAL DAMAGE

The repair of integral construction bodies varies in some degree, dependent upon the extent of the damage, to that of separate body and chassis construction.
Superficial damage can be rectified in a similar manner to that employed on "all steel" bodies which is familiar to all body repairers.
Repairs to rectify extensive damage affecting the main members of the underframe must be carried out so that when the repair is completed the main mounting points for the engine, front and rear suspensions, etc., are in correct relation to each other.
When checking for or rectifying distortion in the main underframe members, reference should be made to the diagrams in the section headed "Checking Body Underframe Alignment" which gives the important dimensions to be observed.

Replacement Body Panels
Where the existing panels or members are badly damaged and it is not possible to effect a satisfactory repair in position, the affected panels will have to be cut out and replacement panels welded in their place.
It will frequently be found advantageous to use only part of a given panel so that the welded joint can be made in a more accessible position. Great care must, of course, be taken when cutting the mating portions of the panel to ensure that perfect matching is obtained.
For example, if damage to a front wing is confined to the forward end a simpler and quicker repair can be effected by cutting the front wing off between the wheel aperture and the wing valance. If the replacement front wing is then cut to match, a simple butt weld can be made and after cleaning down with a sanding disc and filling with plumber's lead the joint should be invisible.
Any unused portions of replacement panels should be retained as it will often be found that they can be used for some future repair job.
Where a replacement panel to be fitted forms part of an aperture such as for a door or the luggage boot lid, an undamaged door or lid should be temporarily hinged into position and used as a template to assist location while the replacement panel is clamped and welded in position.
Similarly, an undamaged radiator grille can be used as a template to accurately form the aperture when fitting a replacement front wing or wings.
Before any dismantling takes place after accidental damage, a check of the underframe alignment should be carried out.

CHECKING BODY UNDERFRAME ALIGNMENT

Checking for Distortion in the Horizontal Plane
The plan view of the body on page N.24 provides the important dimensions for checking for distortion in the underframe. These dimensions can be measured actually on the underside of the body or by dropping perpendiculars from the points indicated by means of a plumb-bob on to a clean and level floor. If the latter method is adopted, the area directly below each point should be chalked over and the position at which the plumb-bob touches the floor marked with a pencilled cross.

Checking for Distortion in the Vertical Plane

For checking the underframe for distortion in the vertical plane the side elevation gives the details of the important dimensions from a datum line.

If the relative distance between two points **above** the datum line is required, one dimension should be subtracted from the other.

If the relative distance between a point above the datum line and the straight section of the chassis side member is required, assess the dimension "T" — $3\frac{13}{16}$" (9.7 cm.) — to the dimension above the datum line.

If it is required to check the dimensions from ground level, raise up the car at the front and rear and insert four blocks or stands of exactly equal height between the ground and the straight section of the chassis side members.

Do not allow the weight of the car to rest on the blocks, use them only as test pieces.

The distance from the ground to any given check point will be: height of blocks + "T" ($3\frac{13}{16}$" — 9.7 cm.) + distance from datum line to check point.

Body Alignment Jig

The use of the Churchill "700" body alignment jig is recommended. This jig with the special additional adaptors supplied also covers many other Jaguar models.

Full details of this equipment can be obtained from the manufacturers:—

Messrs. V. L. Churchill & Co. Ltd.,
London Road,
Daventry, Northants,
England,

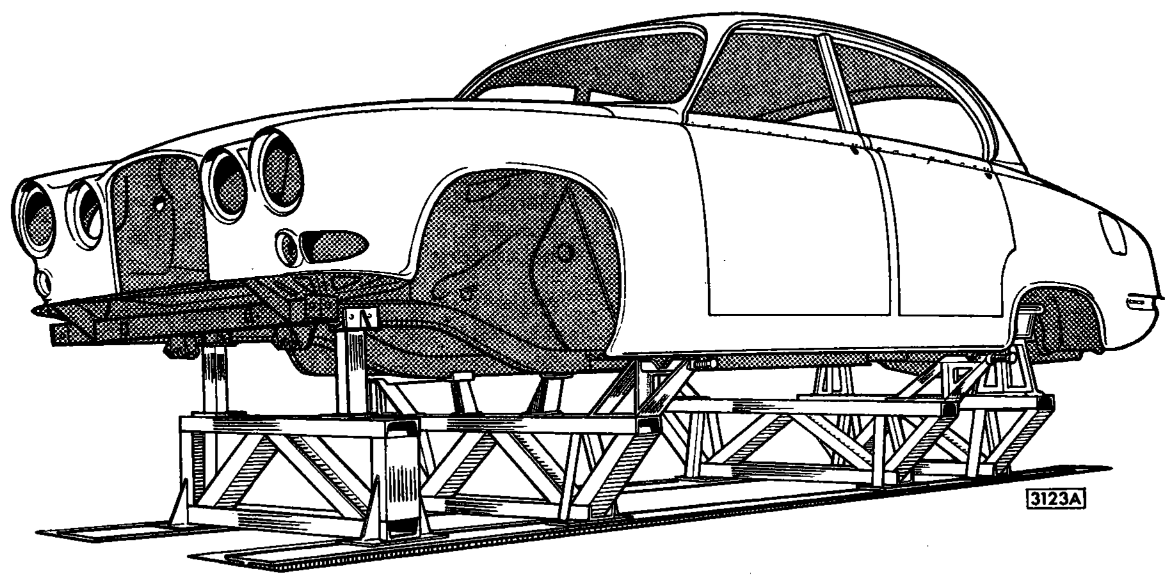
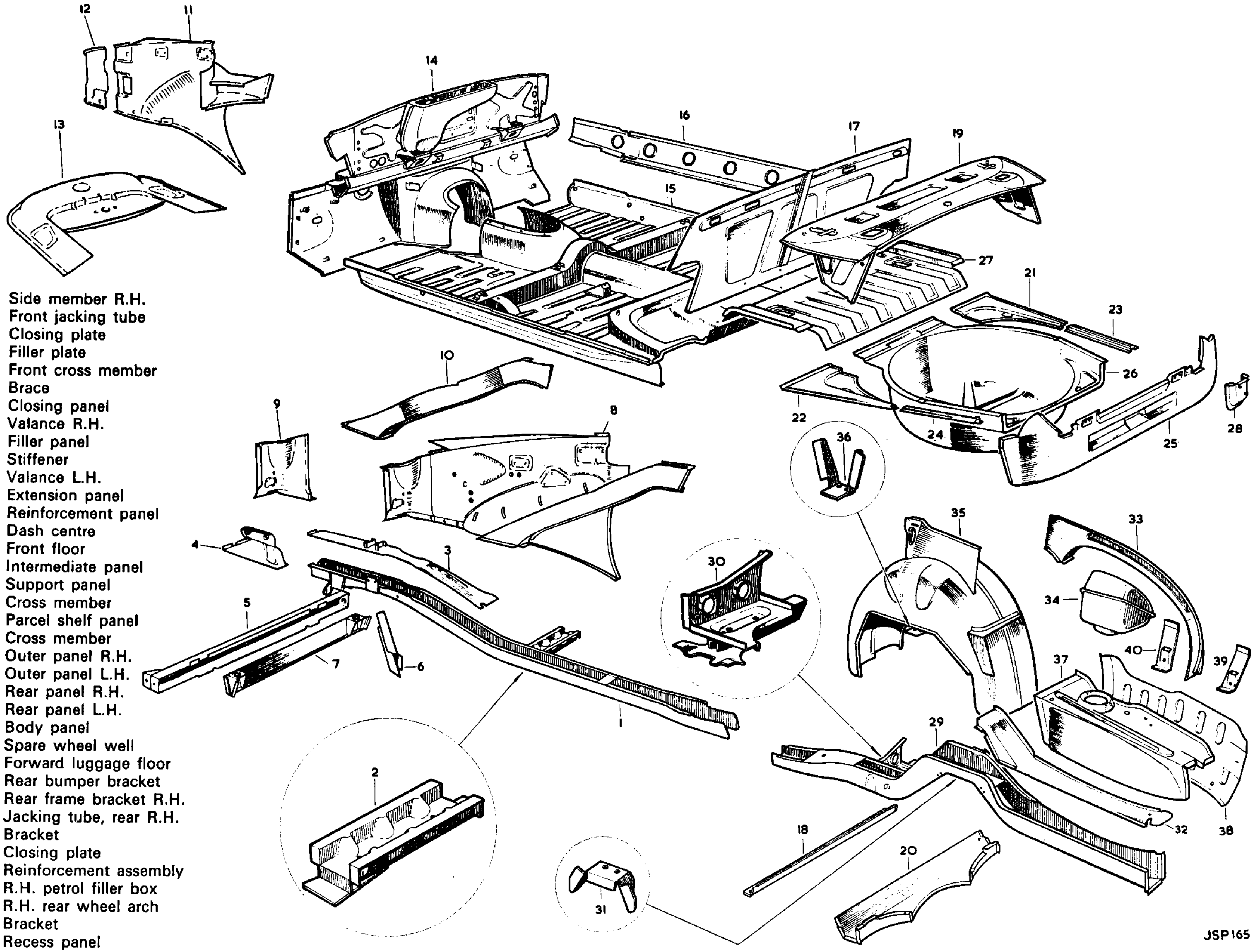


Fig. No. 39 *The Churchill "700" body alignment jig*



1 Side member R.H.
2 Front jacking tube
3 Closing plate
4 Filler plate
5 Front cross member
6 Brace
7 Closing panel
8 Valance R.H.
9 Filler panel
10 Stiffener
11 Valance L.H.
12 Extension panel
13 Reinforcement panel
14 Dash centre
15 Front floor
16 Intermediate panel
17 Support panel
18 Cross member
19 Parcel shelf panel
20 Cross member
21 Outer panel R.H.
22 Outer panel L.H.
23 Rear panel R.H.
24 Rear panel L.H.
25 Body panel
26 Spare wheel well
27 Forward luggage floor
28 Rear bumper bracket
29 Rear frame bracket R.H.
30 Jacking tube, rear R.H.
31 Bracket
32 Closing plate
33 Reinforcement assembly
34 R.H. petrol filler box
35 R.H. rear wheel arch
36 Bracket
37 Recess panel
38 Side panel
39 Bracket—petrol tank, R.H. rear
40 Bracket—petrol tank, R.H. front

Fig. No. 40 *Body under-frame components*

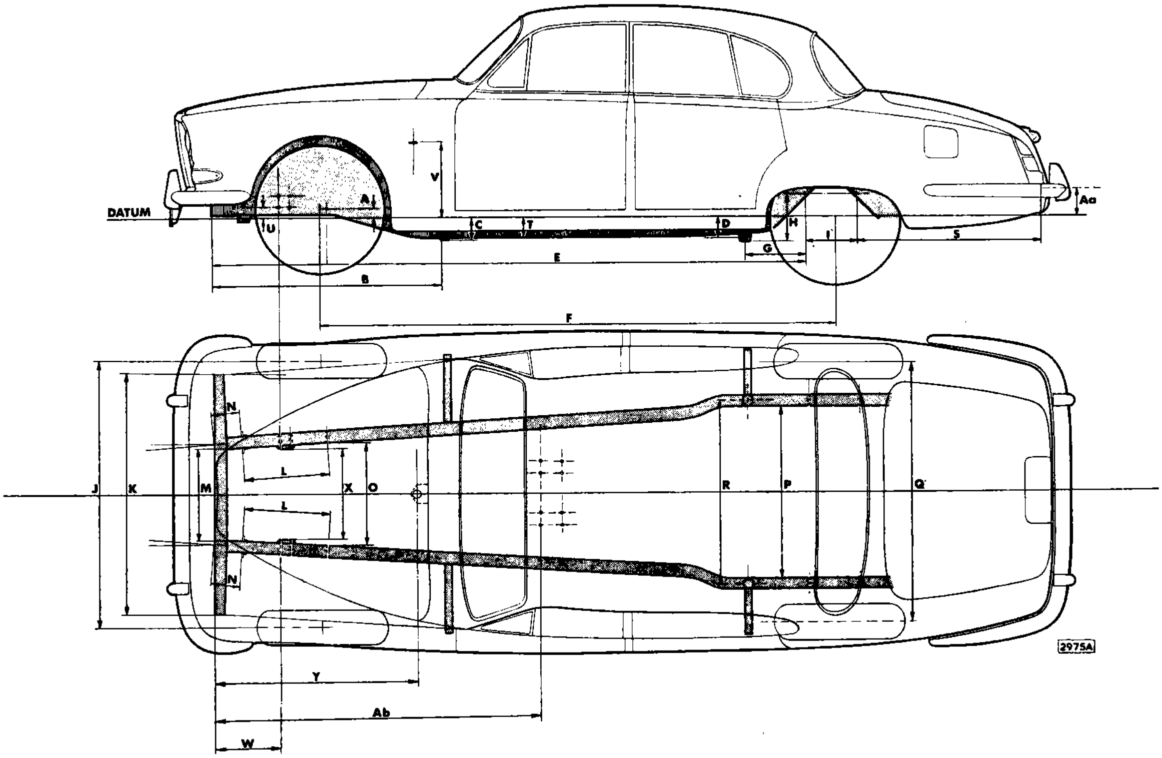


Fig. No. 41 *The under frame alignment diagram*

Symbol	Measurements taken from	Dimension
A	Datum line to centre of tube in chassis side member for front suspension cross-member mounting	$2\frac{1}{16}$" (52.4 mm.)
B	Front of jacking tube to front face of sub-frame cross-member	$47\frac{29}{32}$" (121.7 cm.)
C	Datum line to bottom face front jacking tube	$4\frac{7}{32}$" (107.16 mm.)
D	Datum line to bottom face rear jacking tube	$4\frac{9}{64}$" (105.17 mm.)
E	Forward face of front cross-member to C/L lower tube of rear suspension frame mounting	$123\frac{35}{64}$" (3.14 m.)
F	Centre of front wheel to centre of rear wheel (wheelbase)	$107\frac{3}{8}$" (2.72 m.)
G	C/L radius arm body mounting bracket to C/L lower front tube of rear suspension frame mounting	$12\frac{35}{64}$" (31.87 cm.)
H	C/L bottom of radius arm body mounting bracket to C/L lower front tube of rear suspension frame mounting	$9\frac{23}{32}$" (24.69 cm.)
I	C/L of lower front tube to C/L of lower rear tube rear suspension frame mounting	$10\frac{21}{32}$" (27.07 cm.)
J	Front track	$55\frac{1}{4}$" (1.403 m.)
K	Outer ends of front cross-member	50" (1.27 m.)
L	Forward face of front suspension mounting bracket to C/L tube in chassis side for front suspension cross-member mounting	$17\frac{27}{32}$" (45.32 cm.)
M	Inner faces of chassis side members at joints with front suspension cross-member mounting brackets	$18\frac{23}{32}$" (47.55 cm.)
N	Forward face of front cross-member to forward face of front suspension cross-member mounting bracket (measured along C/L chassis side member)	$5\frac{25}{32}$" (14.68 cm.)
O	Inner faces of chassis side members at C/L front suspension cross-member mounting tubes	$21\frac{1}{16}$" (53.49 cm.)
P	Inner faces of rear chassis side member	$35\frac{5}{8}$" (90.49 cm.)
Q	Rear track	54.2" (1.38 m.)
R	Centre of radius arm body mounting	38" (96.52 cm.)
S	C/L lower rear tube of rear suspension frame mounting to rear bumper mounting face	$38\frac{25}{64}$" (97.5 cm.)
T	Datum line to underside straight section of chassis side member	$3\frac{13}{16}$" (9.7 cm.)
U	Lower forward hole forward engine mounting above datum	$2\frac{19}{64}$" (5.83 cm.)
V	Datum line to top face engine mounting bracket (dash)	$15\frac{27}{32}$" (40.24 cm.)
W	Forward face of front cross-member to C/L lower front tube forward engine mounting	$13\frac{25}{32}$" (35 cm.)
X	Inner faces of support plates engine mounting at C/L forward lower tube	$18\frac{29}{64}$" (46.87 cm.)
Y	Forward face of front cross-member to C/L of dash centre engine mounting bracket	$42\frac{3}{16}$" (1.07 m.)
Z	Forward face of front cross-member to 'O' datum	$5\frac{5}{8}$" (14.29 cm.)
Aa	Datum line to C/L upper bumper mounting bolt hole	$5\frac{5}{8}$" (14.29 cm.)
Ab	Forward face of front cross-member to C/L of forward holes to the rear engine mounting support channel	$67\frac{31}{32}$" (1.726 m.)

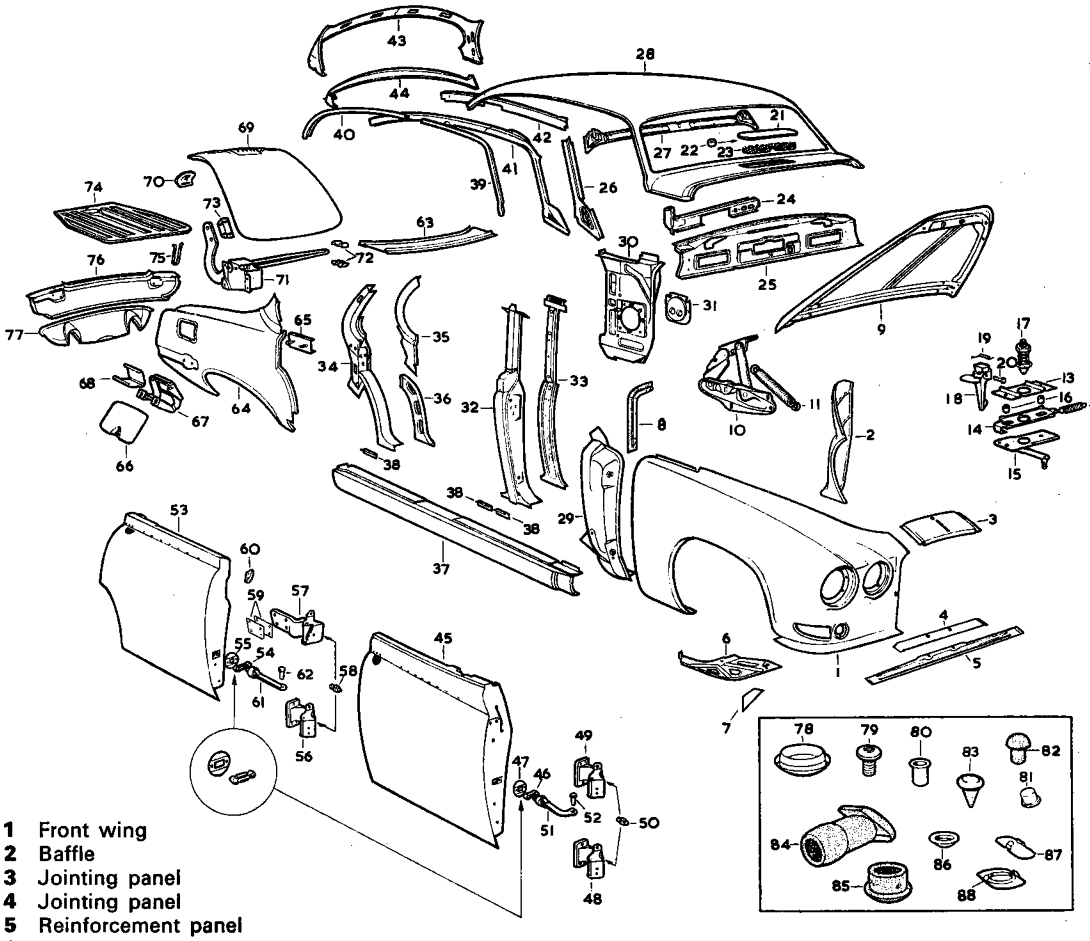


Fig. No. 42 *Exploded view of the body panels*

1 Front wing
2 Baffle
3 Jointing panel
4 Jointing panel
5 Reinforcement panel
6 Stay bracket
7 Gusset
8 Seal assembly
9 Bonnet
10 Bonnet hinge
11 Hinge spring
12 Return spring
13 Striker plate
14 Catch plate
15 Base plate
16 Spacing bush
17 Peg
18 Safety hook
19 Spring
20 Pin
21 Scuttle ventilator lid
22 Distance piece
23 Gauze
24 Windscreen rail
25 Reinforcement assembly
26 Closing panel
27 Windscreen header panel
28 Roof panel
29 'A' post panel
30 Dash side panel
31 Cover plate
32 B/C post panel
33 Spacer
34 'D' post panel
35 Reinforcement
36 Spacer
37 Door sill panel R.H.
38 Retainer
39 Drip moulding R.H. front
40 Drip moulding R.H. rear
41 Cantrail panel R.H.
42 Reinforcement
43 Reinforcement
44 Reinforcement
45 Door shell R.H. front
46 Felt
47 Reinforcement bracket
48 Lower hinge
49 Upper hinge
50 Grease nipple
51 Check arm
52 Pin
53 Door shell R.H. rear
54 Guide spring
55 Reinforcement bracket
56 Lower hinge
57 Upper hinge
58 Grease nipple
59 Shim
60 Filler piece
61 Check arm
62 Pin
63 Tonneau panel
64 Rear wing
65 Bracket
66 Petrol filler door R.H.
67 Hinge bracket
68 Spring
69 Boot lid
70 Cover plate
71 Hinge assembly L.H.
72 Clamp
73 Attachment bracket
74 Spare wheel cover
75 Prop
76 Body panel
77 Tail panel
78 Plastic plug
79 Plastic plug
80 Plastic plug
81 Plastic plug
82 Rubber plug
83 Rubber plug
84 Rubber plug
85 Rubber plug
86 Steel plug
87 Steel plug
88 Steel plug

WELDING METHODS

The following are the principle methods of welding used in the assembly of the body and underframe panels. The instructions given below for breaking the different types of welds should be adhered to when removing a damaged panel as this will facilitate the assembly of the new panel.

Spot Welding

This type of welding is used for the jointing of two or more overlapping panels and consists of passing electric current of high amperage through the panels by means of two copper electrodes.
This results in complete fusion of the metal between the electrodes forming a "spot" weld which is frequently repeated along the length of the panels to be joined. Spot welds can easily be recognised by slight indentation of the metal.
Lap joints on the outer body panels which are spot welded together are usually lead filled and in this case it will be necessary to direct the flame of an oxy-acetylene torch on the lead so that the filling can be melted and wiped off by means of a piece of cloth.

Breaking Spot Welds

Spot welds cannot be broken satisfactorily other than by drilling; any attempt to separate the panels by using a chisel will result in the tearing of the metal in the vicinity of the spot welds.
Use a $\frac{3}{16}$" (4.7 mm.) diameter drill and carefully drill out each weld. There is no necessity to drill completely through both panels; if the "spot" is drilled out of one of the panels the weld can be completely broken by inserting a thin sharp chisel between the two panels and tapping lightly with a hammer.
Where possible, drill the spot welds completely out of the panel that is to be left in position on the body. This will allow the new panel to be joined to the mating panel on the body by gas welding through the holes in the overlapping flange. (This does not apply if spot welding equipment is available).
If this is not possible, and the holes have to be drilled out in the damaged panel, new holes can be drilled in the replacement panel and the same type of weld effected.

Gas Welding

This type of welding is carried out by means of oxy-acetylene equipment and is used for the jointing of overlapping panels or the butt-welding of the edges of two panels.

Breaking Gas Welds

Gas welds may be broken either by means of a sharp chisel or by cutting through with a hacksaw; welding can be removed by grinding with a pointed emery wheel.

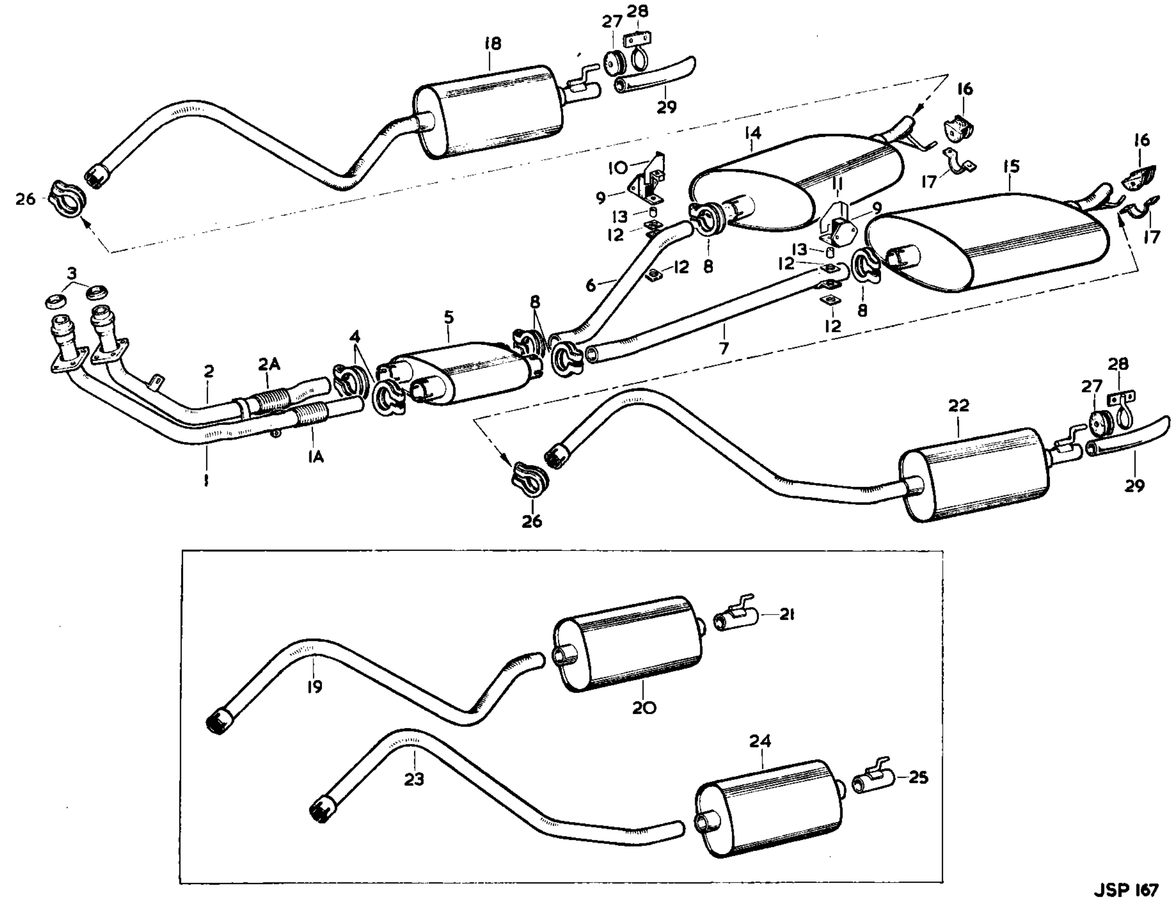
EXHAUST SYSTEM

Removal

Remove the two setscrews, together with the spring washers, securing each of the ring brackets (28) to the body.
Slacken the two clips (26) and remove the tail pipe and rear silencer assemblies (18) and (22).
Remove the four setscrews, together with nuts and shakeproof washers, securing the rubber mounting brackets (16 and 17) for the main silencers.
Slacken the two clips (8) and remove the main silencers (14 and 15).
Remove the intermediate exhaust pipes (6 and 7) by slackening clips (8) at the front silencer and removing the securing bolts in the rubber mounting bracket (9).
Slacken the two clips (4) and remove the front silencer (5).
Remove the four nuts, together with the washers, securing each downpipe to the exhaust manifold on the engine and remove the downpipes (1 and 2) having first separated the downpipes at the clamping strap adjacent to the flexible pipes (1A and 2A) and having removed the bolt securing the downpipe (2) to the clutch housing.
Collect the sealing rings (3) between the exhaust manifold and the downpipes.
On left hand drive cars it will be necessary to remove the steering column joint heat shield after withdrawing two setscrews, nuts and lockwashers to gain access to the downpipe flange nuts.

Refitting

Refitting is the reverse of the removal procedure.
Renew the sealing rings (3).
Check the pipe connections after running the engine for a short period and retighten as necessary.



JSP 167

Fig. No. 43 *Exploded view of the exhaust system*

1 Front down pipe
1A Flexible pipe
2 Rear down pipe
2A Flexible pipe
3 Sealing ring
4 Clip
5 Front silencer
6 Intermediate pipe R.H.
7 Intermediate pipe L.H.
'8 Clip
9 Rubber mounting
10 Heat shield
11 Heat shield
12 Washer (insulating)
13 Distance collar (insulating)
14 Main silencer R.H.
15 Main silencer L.H.
16 Rubber mounting
17 Bracket
18 Tail pipe/rear silencer R.H.
19 Rear intermediate pipe R.H.
20 Rear silencer
21 Tail pipe
22 Tail pipe and rear silencer L.H.
23 Rear intermediate pipe L.H.
24 Rear silencer
25 Tail pipe
26 Clip
27 Rubber mounting
28 Ring bracket
29 Tail pipe extension

HEATING AND WINDSCREEN WASHING EQUIPMENT

SECTION O

INDEX

CAR HEATING AND VENTILATING SYSTEM

CAR HEATING AND WINDSCREEN WASHING EQUIPMENT

WINDSCREEN WASHING EQUIPMENT

HEATING AND WINDSCREEN WASHING EQUIPMENT

CAR HEATING AND VENTILATION SYSTEM

DESCRIPTION

The car heating and ventilation system consists of a combined heating element and a two-speed electrically driven fan assembly.
Air from the heating and ventilation system is directed :-

(a) To the front of the car through outlets (one on the driver's side and one on the passenger's side) below the parcel shelf.
(b) To the rear of the car through an outlet situated on the propeller shaft tunnel cover between the two front seats.
(c) To vents at the base of the windscreen to provide demisting and defrosting.

Fresh air is introduced into the car by pressing the Air button and switching on the fan if required (see also Air Distribution).

HEATER CONTROLS

The heater control buttons marked "AIR", "HEAT", "OFF", are situated centrally below the parcel tray (Fig. 1).
These controls operate the air intake vent on the scuttle and the water valve. Operating the "OFF" button automatically cancels the "HEAT" and "AIR" buttons. The "HEAT" button also cancels the "AIR" button. If it is desired to have the "HEAT" and "AIR" buttons in operation at the same time the "HEAT" button must be pressed first.
The heater control quadrant marked "HOT-COLD" and situated centrally in the edge of the parcel shelf, regulates the temperature of the air delivered.

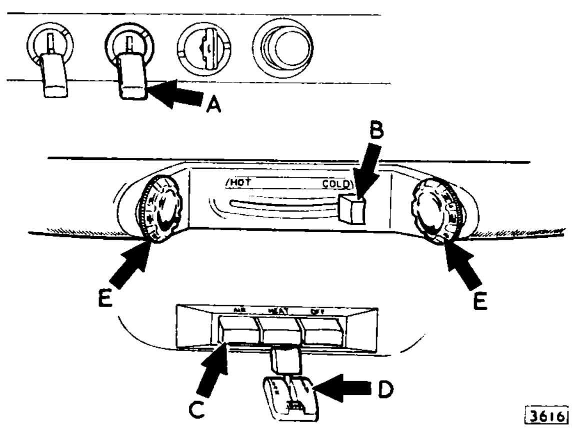


Fig. No. 1 *Heating and Ventilating Controls*

A Fan switch
B Temperature control
C Heater control switches
D Rear outlet control
E Control for front outlet

Off
When the "OFF" button is pressed the system is inoperative.

Heat
To obtain hot or warm air in the car, press the "HEAT" button which will open the water valve to supply hot water to the heater element. Before operating the "AIR" button, it is advisable to allow the engine to reach normal operating temperature, particularly in cold weather, to enable hot water to circulate through the heater unit prior to admitting cold air through the scuttle vent.
Adjust the heater control quadrant to give the required temperature.

Air
If cold fresh air is required, press the "AIR" button which will open the scuttle vent and direct the air to the outlets in the car, by-passing the heating element. The fan can be switched on if it is desired to increase the circulation. The heater control quadrant should be set at cold.

THE FAN SWITCH

The fan for the heating and ventilating system increases the flow of air through the system and is controlled by a three-position switch (marked "FAN" on the indicator strip), on the instrument panel (Fig. 1).
Lift the switch to the second position for slow speed and to the third position for fast speed, whichever is required.
Operation of the fan is required mainly when the car is stationary or running at a slow speed. At higher speeds it will be found possible to dispense with the fan due to the speed of the car forcing air through the scuttle vent.

AIR DISTRIBUTION

The demisting outlets operate whenever the system is working. To obtain the maximum amount of air at the windscreen, both the front and rear outlets should be closed.
The two front outlets are fitted with thumb operated directional controls, one each side of the heater control quadrant. Fully rotating the right hand knob clock-wise and the left knob anti-clockwise will cut off the supply of air completely. Reverse rotation of the knobs will progressively re-direct the air flow from the feet to the body.

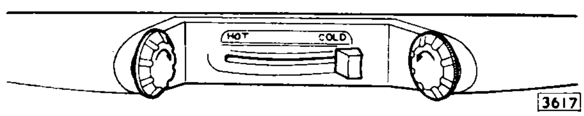


Fig. No. 2 *Rotation of the knobs in the direction of the arrows will progressively direct the flow of air out of the front outlets from the feet to the body*

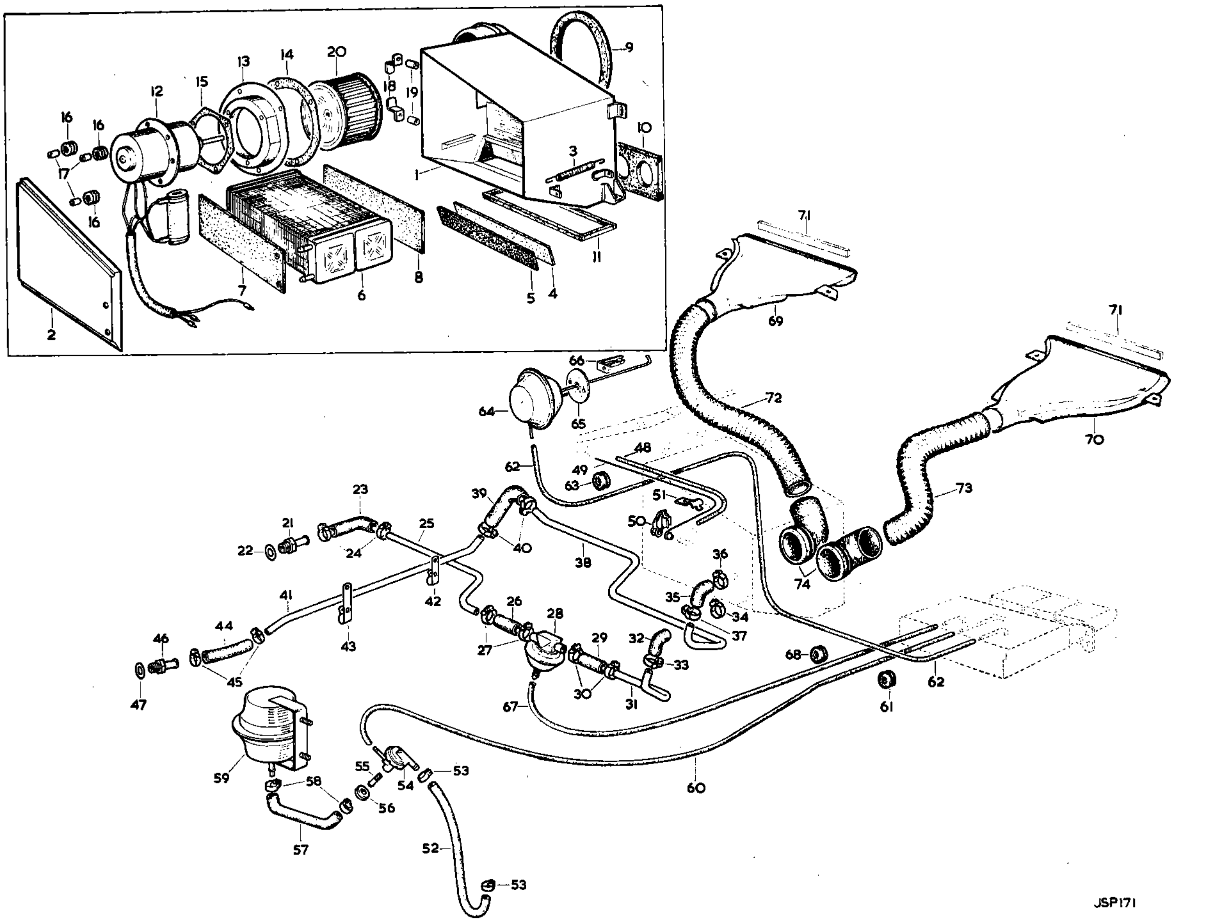


Fig. No. 3 *Exploded view of the heating equipment components*

1 Heater case
2 Lid
3 Spring
4 Seal (Polyurethane)
5 Seal (Polyurethane)
6 Radiator
7 Seal (Polyurethane)
8 Seal (Polyurethane)
9 Seal (Polyurethane)
10 Seal (Polyurethane)
11 Seal (Rubber)
12 Heater motor
13 Heater motor housing assembly
14 Seal (Polyurethane)
15 Seal (Polyurethane)
16 Grommet
17 Distance tube
18 Resistance mounting bracket
19 Distance tube
20 Heater motor fan
21 Adaptor
22 Copper washer
23 Hose (adaptor to feed pipe)
24 Clip
25 Feed pipe
26 Hose (Feed pipe to vacuum valve)
27 Clip
28 Valve
29 Hose (Vacuum valve to feed pipe)
30 Clip
31 Feed pipe
32 Hose (feed pipe to radiator)
33 Clip
34 Clip
35 Hose (radiator to rear return pipe)
36 Clip
37 Clip
38 Rear return pipe
39 Hose (Rear return pipe to front return pipe)
40 Clip
41 Front return pipe
42 Bracket
43 Bracket
44 Hose (Front return pipe to water pump)
45 Clip
46 Adaptor
47 Copper washer
48 Heater control outer cable
49 Heater cable (inner)
50 Clip
51 Clamp
52 Vacuum hose
53 Clip
54 Check valve
55 Adaptor
56 Grommet
57 Vacuum hose
58 Clip
59 Reservac tank
60 Vacuum hose
61 Grommet
62 Vacuum hose
63 Grommet
64 Vacuum diaphragm assembly
65 Packing
66 Clip
67 Vacuum hose
68 Grommet
69 R.H. Demister nozzle
70 L.H. Demister nozzle
71 Light seal
72 Hose
73 Hose
74 Rubber elbow

Operating the lever for the rear outlet (Fig.1) turns the air supply "ON" or "OFF".

COLD WEATHER

To obtain heating, demisting and defrosting

(a) Depress the button marked "HEAT" and allow a short period to elapse to permit the heater to warm up.
(b) Depress the "AIR" button.
(c) Switch the fan on at the desired speed.
(d) Open the front and rear outlets as desired.
(e) Adjust the heater control quadrant to give the required temperature.

To obtain rapid demisting and defrosting

(a) Depress the button marked "HEAT" and allow a short period to elapse to permit the heater to warm up.
(b) Depress the "AIR" button.
(c) Switch the fan on at the desired speed.
(d) Close the front and rear outlets.
(e) Move the heater control quadrant to "HOT".

HOT WEATHER

To obtain ventilation and demisting:

(a) Depress the button marked "AIR".
(b) Switch the fan ON at the desired speed.
(c) Open the front and rear outlets as desired.
(d) Move the heater control quadrant to "COLD".

To obtain rapid demisting:

(a) Depress the button marked "AIR".
(b) Switch the fan ON at the "FAST" position.
(c) Close the front and rear outlets.
(d) Move the heater control quadrant to "COLD".

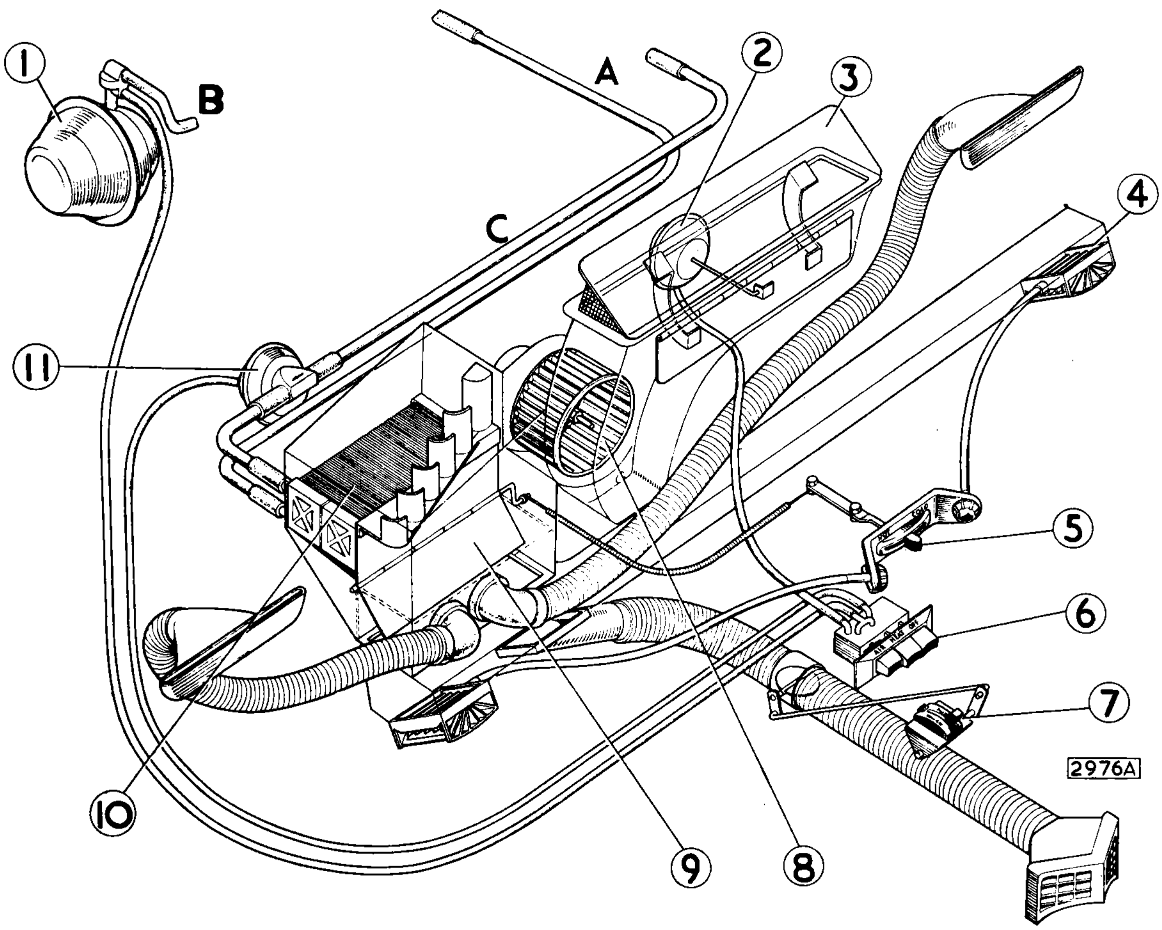


Fig. No. 4 *The Vacuum Servo System*

1 Reservac tank
2 Vacuum actuator
3 Scuttle vent
4 Air direction box
5 Heater flap control
6 Three button control
7 Rear air supply control
8 Fan
9 Flap
10 Heater box
11 Vacuum actuator

A Heater box to pump
B To induction manifold
C Water manifold to heater box

VACUUM SERVO SYSTEM

Description (Fig. 4)

The vacuum servo system controlled by the heater buttons (6) includes a vacuum supply tank (1) situated under the right hand front wing, with an attached non-return valve located in the engine compartment. Two servo units are included in the system, one serving as a heater water tap control (11) and one controlling the opening and closing of the scuttle (fresh air) vent (2).

The vacuum supply tank will provide approximately six complete operations after the ignition is switched off.

Note: In frosty weather it is advisable to close the scuttle vent by pressing the OFF button to obviate the possibility of the controls freezing.

The vacuum tank is connected via the non-return valve to the inlet manifold.

A small diameter rubber tube from the non-return valve leads directly to the air temperature control panel situated on the console.

Rubber tubing connects the "AIR" control button to the scuttle vent vacuum servo and the "HEAT" control button to the heater water tap vacuum servo.

The servo units are sealed during manufacture and must be replaced if faulty.

SCUTTLE VENTILATOR SERVO UNIT

Removal

Start the engine and depress the "AIR" button to open the scuttle vent. Switch off the ignition.

If the servo unit has failed, it will not be possible to raise the scuttle vent by this method.

Insert two thin levers under the front edge of the vent and carefully lever the vent open.

Care must be taken that the paintwork is not damaged.

Withdraw the three retaining screws and remove the scuttle ventilator gauze.

Remove the two self-locking nuts and plain washers and lift off the ventilator lid. Retain the two distance pieces attached to the fixing studs.

Remove the rubber seal, secured to the ventilator aperture with an adhesive and release the three countersunk-headed screws now exposed.

Withdraw the shroud panel from the air vent box.

Note: It is not necessary to remove the three countersunk screws completely to enable the shroud to be removed.

Release the spring clip anchoring the operating rod to the inner flap.

Remove the two nuts and washers securing the vacuum unit to the bulkhead and detach the rubber tube.

Withdraw the unit noting the sealing washer located between the unit and the bulkhead.

Refitting

Refit the unit to the bulkhead and attach the operating rod to the inner flap with the spring clip. Secure the unit with the two self-locking nuts and washers. Ensure that the sealing washer is located correctly when refitting.

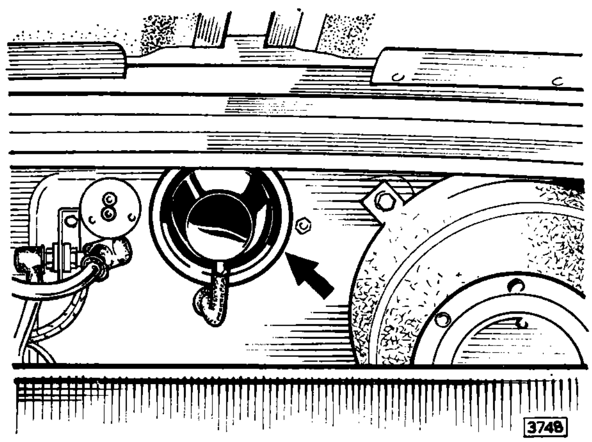


Fig. No. 5 *Showing location of scuttle vent servo retaining nuts*

Locate the shroud panel on the countersunk screws. Seal the top edge of the panel with Bostik 692 sealing compound.

Refit the rubber seal and secure with a good quality adhesive. Renew seal if worn or damaged.

Reconnect the rubber tubing to the vacuum unit, switch on the ignition, start the engine, depress the "AIR" button and raise the vent lid brackets.

Switch the engine OFF.

Refit the vent lid and secure with the two self-locking nuts and washers. Ensure that the two distance pieces are fitted before attaching the lid.

Do not fully tighten the nuts when fitting.

Lower the vent by depressing the "OFF" button and position the vent lid correctly in the aperture.

Raise the vent and fully tighten the nuts.

Refit the ventilator gauze.

HEATER TAP SERVO UNIT

Removal

Drain the coolant from the cooling system by opening the radiator tap.

Conserve the coolant if an anti-freeze is in use.

Release the hose clips and withdraw the rubber hoses from the unit. Remove the small rubber tube from the connecting nipple.

Release the nut securing the servo unit to the mounting bracket and withdraw the unit.

Note: The mounting bracket is slotted, it is therefore unnecessary to remove the nut completely unless the unit is to be replaced.

Refitting

Refitting is the reverse of the removal procedure.

Ensure when fitting that the arrow indicating the direction of the water flow points to the outside of the car.

VACUUM SUPPLY TANK

Removal

Clean off all dirt from the supply tank located under the right hand front wing at the rear.

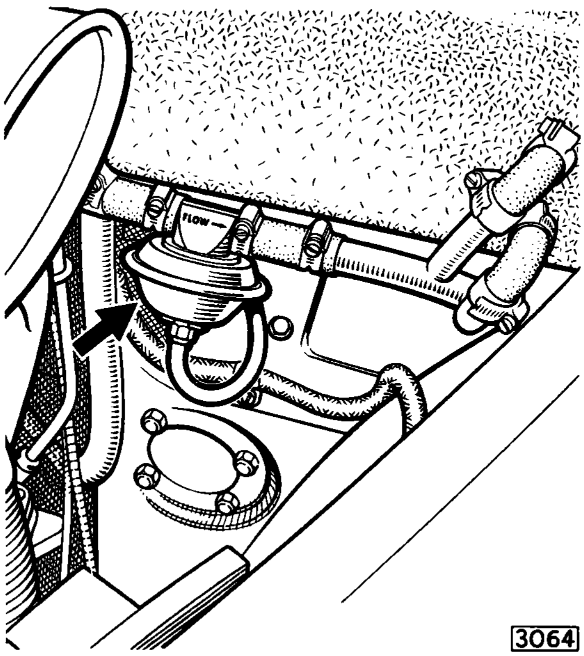


Fig. No. 6 *Showing location of tap servo unit*

Release the clip and detach the hose from the union. Remove two nuts and washers and withdraw the tank from the mounting bracket.
To remove the non-return valve, disconnect the large hose from the valve union under the wing and the small rubber pipe from inside the engine compartment. Withdraw the valve through the grommet in the wing. The supply tank and the valve are sealed units and must be replaced if faulty.

Refitting
Refitting is the reverse of the removal procedure.
Check that all unions are clean before reconnecting.

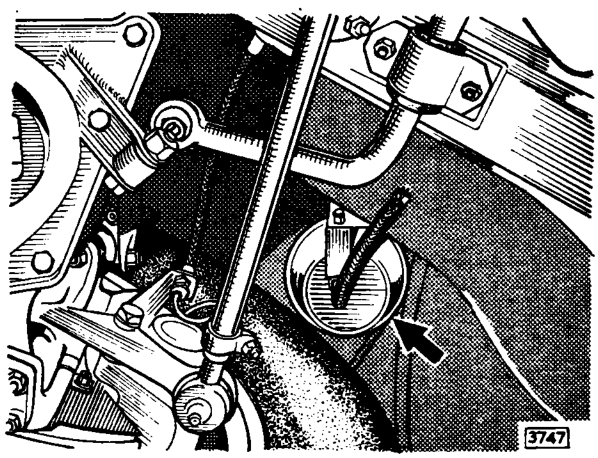


Fig. No. 7 *Showing location of vacuum supply tank*

HEATER UNIT

Removal
Drain the radiator and cylinder block. Conserve the coolant if an anti-freeze is in use.
Disconnect the battery.
Remove the bonnet as detailed in Section N.
Roll back the sealing rubbers between the carburetter elbow, air inlet pipe and the air cleaner.
Slacken the two wing nuts securing the cleaner to the brackets on the cylinder head. Remove the cleaner by pulling it towards the left-hand wing valance.
Slacken off the clips and detach the heater water pipe hoses from the heater unit. Remove the top water pipe from the support clips attached to the heater box.
Remove the electrical cables from the clip on the bulkhead and disconnect at the snap connectors. Disconnect the earth cable by removing the drive screw.
Remove the water valve vacuum unit as detailed previously.
Remove the spring clip securing the control cable to the hot/cold flap control lever and withdraw the cable.
Release the bolt and nut securing the outer casing clip.
Remove the five setscrews and washers securing the heater unit to the bulkhead and lift the unit away.

Refitting
Refitting is the reverse of the removal procedure.
Renew the sealing rings if worn or damaged.
Adjust the flap control cable to maintain full movement of the control lever.

HEATER MATRIX

Removal
Drain the radiator and cylinder block. Conserve the coolant if an anti-freeze is in use.
Slacken off the clips and detach the heater water pipe from the heater unit. Remove the top water pipe from the support bracket attached to the heater box.
Remove the two nuts and washers and withdraw the 2-speed resistance unit from the mounting studs.
Carefully prise away the plastic covered felt covering the front of the unit.
Remove the three hexagon-headed drive screws from the top edge of the front cover and three screws from the bottom edge.
Remove the cover and withdraw the matrix.

Refitting
Refitting is the reverse of the removal procedure.
When refitting the material over the cover plate use a rubber solution.

FAN MOTOR

Removal
Disconnect the battery earth terminal.
Disconnect the wires from the fan motor at the snap connectors and detach the earth wire from the bulkhead. Remove the resistance unit from the mounting studs.
Carefully prise away the plastic-covered felt on the front of the unit.

Remove the four hexagon-headed setscrews and lock-washers securing the motor mounting bracket to the water heater unit.
Withdraw the motor complete with fan, note the plastic foam joint between the mounting bracket and the heater unit.
Remove the fan after slackening off the nut on the spindle.
Note: In order to preserve the balance of the fan assembly care must be taken that the balance pieces are not displaced nor the assembly damaged on removal.
Remove the three Phillips-headed drive screws and detach the mounting bracket from the motor unit. Note the plastic foam joint between the mounting bracket and the motor.

Refitting
Refitting is the reverse of the removal procedure.
When reassembling the fan to the motor spindle check that there is at least $\frac{1}{8}$" (3.2 mm.) clearance between the fan and motor mounting bracket and that the fan is running true on the spindle.

FAN SWITCH

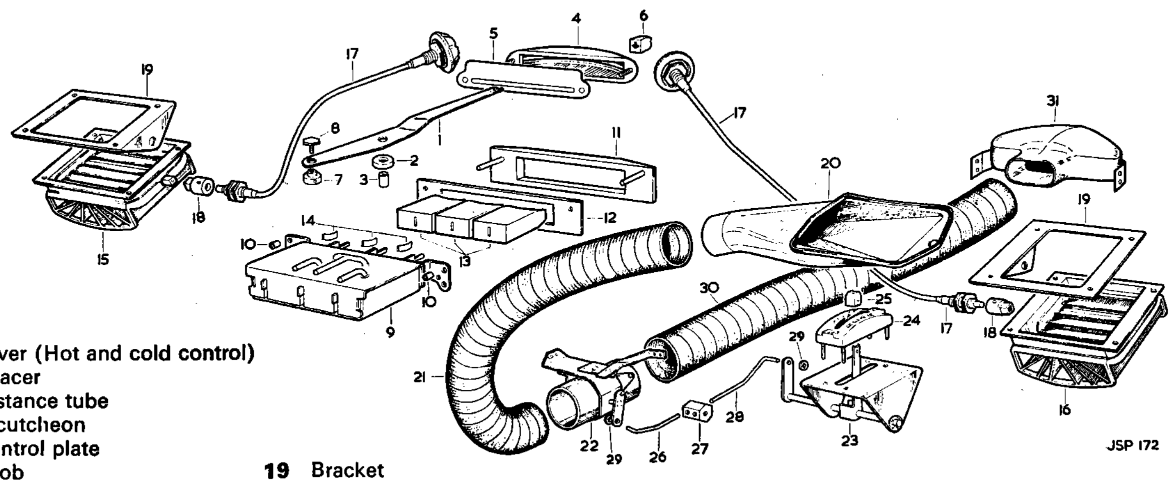
Removal
Disconnect the battery.
Remove the two thumb-screws securing the instrument panel to the facia.
Remove the three "Lucar" connectors from the fan switch.
Unscrew the chrome bezel securing the switch to the instrument panel and withdraw the switch. Note the location of the wires on the switch before removing.

Refitting
Refitting is the reverse to the removal procedure.
Connect the switch cables to the correct terminals as noted on removal.

AIR TEMPERATURE CONTROL PANEL

Removal
Disconnect the battery.
Withdraw the control button escutcheon retained by two pegs to the control panel and unscrew the two round-headed screws now exposed.
Remove the heater control perforated guard cover from the parcel tray after withdrawing the four nylon retaining pins.
Lift the parcel tray trimming above the control panel and unscrew the two rounded-headed thumb screws located in recesses in the tray.
Withdraw the control panel facia and disconnect the three rubber pipes connected to the control button unit. Note the location of the individual pipes for reference when refitting.
Note: If a radio is fitted to the car it will be necessary to disconnect the supply feed cable from the fuse holder and the aerial and loud-speaker leads from the control unit before completing the removal of the control panel.
Remove the two wood screws from the back of the panel and withdraw the control button unit.

Refitting
Refitting is the reverse of the removal procedure.
Ensure that the rubber tubes are connected to the correct junctions as noted on removal.



1 Lever (Hot and cold control)
2 Spacer
3 Distance tube
4 Escutcheon
5 Control plate
6 Knob
7 Inner cable end fitting
8 Screw
9 Vacuum control box
10 Friction bush
11 Escutcheon
12 Backing plate
13 Knob
14 Clip
15 Air director box R.H.
16 Air director box L.H.
17 Remote control assembly
18 Adaptor
19 Bracket
20 Collector
21 Hose
22 Butterfly control assembly
23 Lever assembly
24 Escutcheon
25 Knob
26 Front control
27 Adjustment slide
28 Rear control rod
29 Retaining washer
30 Hose
31 Air distributor box

Fig. No. 8 *Exploded view of heater controls*

HEATER CONTROL LEVER

Removal

Remove the heater control perforated guard cover from the parcel tray after withdrawing four nylon retaining pins.

Pull off the heater control lever knob.

Disconnect the control lever at the forward end, unscrew the lever pivot pin, note the washer fitted between the lever and the bracket.

Withdraw the lever through the escutcheon plate.

Refitting

Refitting is the reverse of the removal procedure.

Ensure that the full movement of the lever on the heater unit is maintained when connecting the control cable.

FRONT AIR DIRECTION VENTS

Removal

Remove the four drive-screws securing the vents to the air duct.

Lower the vent and withdraw from the control cable junction.

Note on removal that the assemblies are handed.

Refitting

Refitting is the reverse of the removal procedure.

DIRECTION VENT CONTROL CABLES

Removal

Release the locknuts securing the outer cables to the vent bracket.

Disconnect the cables and collect the loose adapter.

Unscrew the cable from the centre finisher and withdraw the assemblies.

Note: A thin spanner will be required to remove the outer casing from the finisher.

Refitting

Refitting is the reverse of the removal procedure.

WINDSCREEN WASHER

Description

The Lucas 5SJ Screen Jet is an electrically operated unit comprising a small permanent magnet motor driving a centrifugal pump through a 3-piece Oldham coupling and a high density polythene water container mounted in the engine compartment. The container is connected to two water jets at the base of the windscreen.

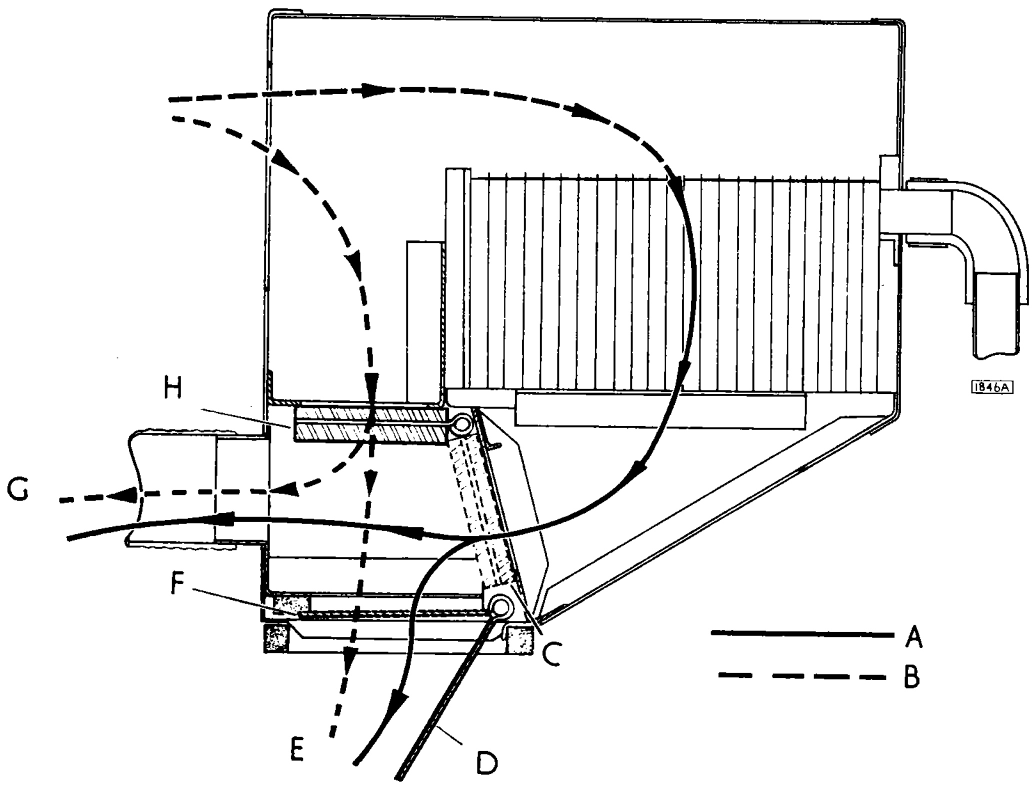


Fig. No. 9 *Cross section of the heater unit showing path of hot and cold air*

Operation
The windscreen washer should be used in conjunction with the windscreen wipers to remove any foreign matter that settles on the windscreen.
Lift the switch lever (marked "Washer" on the indicator strip) when the washer should operate at once and continue to function until the switch is released.

Warning: If the washer does not function immediately check that there is water in the container. The motor will be damaged if the switch is held pressed for more than one or two seconds if the water in the container is frozen. The washer should not be used under freezing conditions as the fine jets of water spread over the windscreen by the blades will tend to freeze up.

DATA

Nominal Voltage of Unit	12
Maximum Current Consumption	2.0 amp
Resistance between Commutator Segments	2.8-3.1 Ohm.
Minimum Water Delivery Pressure	4.5 lb/sq.in. (0.32 kg/cm.^{2})
Minimum Water Delivery per sec.	3.5 cc.
Container Capacity	$2\frac{1}{4}$ pints (1.1 litres)
Usable Quantity of Water	2 pints (1 litre)
Diameter of Nozzle Orifice	0.25"–0.28" (6.3-7 mm.)

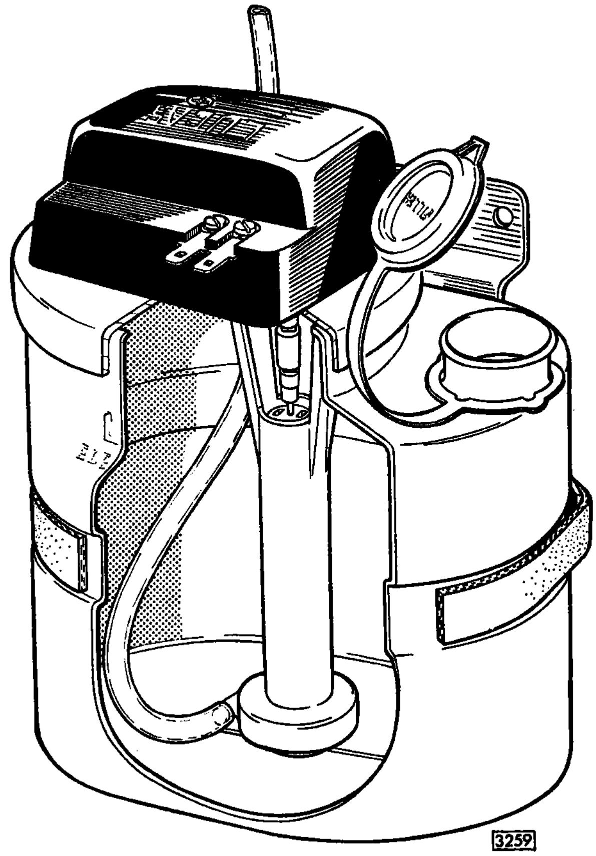


Fig. No. 10 *Windscreen washer water container*

Filling Up
The correct water level is up to the bottom of the container neck. Do not overfill or unnecessary splashing may result. Always replace the filler cover correctly after filling up.
It is not possible to empty the container with the pump. Refilling is necessary when the water level has fallen below the level of the pump.
Keep the pump filler clean and the container free from sediment.

Cold Weather
The water container can be given a safe degree of protection down to —28°F (—33°C) by the use of proprietary anti-freeze solvents as marketed by Trico or Holts. Instructions regarding the use of the solvent will be found on the container.
Denatured alcohol (Methylated Spirits) must NOT be used. The use of this chemical will discolour the paintwork.

Servicing—Testing in Position

(a) Testing with a voltmeter:-
Connect a suitable direct current voltmeter to the motor terminals, observing the polarity as indicated on the moulding housing. Operate the switch. If a low or zero voltage is indicated the A4 fuse, switch and external connections should be checked and corrected as necessary.
If the voltmeter gives a reverse reading, the connections to the motor must be transposed.
If supply voltage is registered at the motor terminals but the unit fails to function, an open-circuit winding or faulty brush gear can be suspected. Dismantle the motor as described under the heading "Dismantling".

(b) Checking the external nozzles and tubes:-
If the motor operates but little or no water is delivered to the screen, the external tubes and nozzles may be blocked.
Remove the external plastic tube from the short connector on the container and, after checking that the connector tube is clear, operate the washer switch.
If a jet of water is ejected, check the external tubes and nozzles for damage or blockage.
If no water is ejected, proceed as detailed under the heading "Dismantling".

(c) Testing with an ammeter:-
Connect a suitable direct current ammeter in series with the motor and operate the switch. If the motor does not operate but the current reading exceeds that given in "DATA", remove the motor and check that the pump impeller shaft rotates freely.
If the shaft is difficult to turn, the water pump unit must be replaced.

If the shaft turns freely, the fault lies in the motor which must be dismantled and its component parts inspected.

Dismantling

(a) Disconnect the external tube and the electrical connections and remove the cover from the container.

(b) Remove the self-tapping screw which secures the motor to the cover and pull away the motor unit.
Take care not to lose the loose intermediate coupling which connects the armature coupling to the pump spindle coupling.

(c) Remove the armature coupling from the armature shaft as follows:-
Hold the armature shaft firmly with a pair of snipe-nosed pliers and, using a second pair of pliers, draw off the armature coupling.

(d) Remove the two self-tapping screws from the bearing plate. The bearing plate and rubber gasket can now be removed.

(e) Remove the two terminal screws. The terminal nuts and brushes can be removed and the armature withdrawn.
Take care not to lose the bearing washer which fits loosely on the armature shaft.

(f) The pole assembly should not normally be disturbed. If, however, its removal is necessary, make careful note of its position relative to the motor housing. The narrower pole piece is adjacent to the terminal locations.
Also the position of the pole clamping member should be observed. When fitted correctly, it locates on both pole pieces but, if fitted incorrectly, pressure is applied to one pole piece only.

Bench-Testing

If the motor has been over-heated, or if any part of the motor housing is damaged, a replacement motor unit must be fitted.

(a) Armature:-
If the armature is damaged, or if the winding is loose or badly discoloured, a replacement armature must be fitted.
The commutator must be cleaned with a fluffless, petrol-moistened cloth or, if necessary, by polishing with a strip of very fine glass paper.
The resistance of the armature winding should be checked with an ohm meter. This resistance should be in accordance with that given in "DATA".

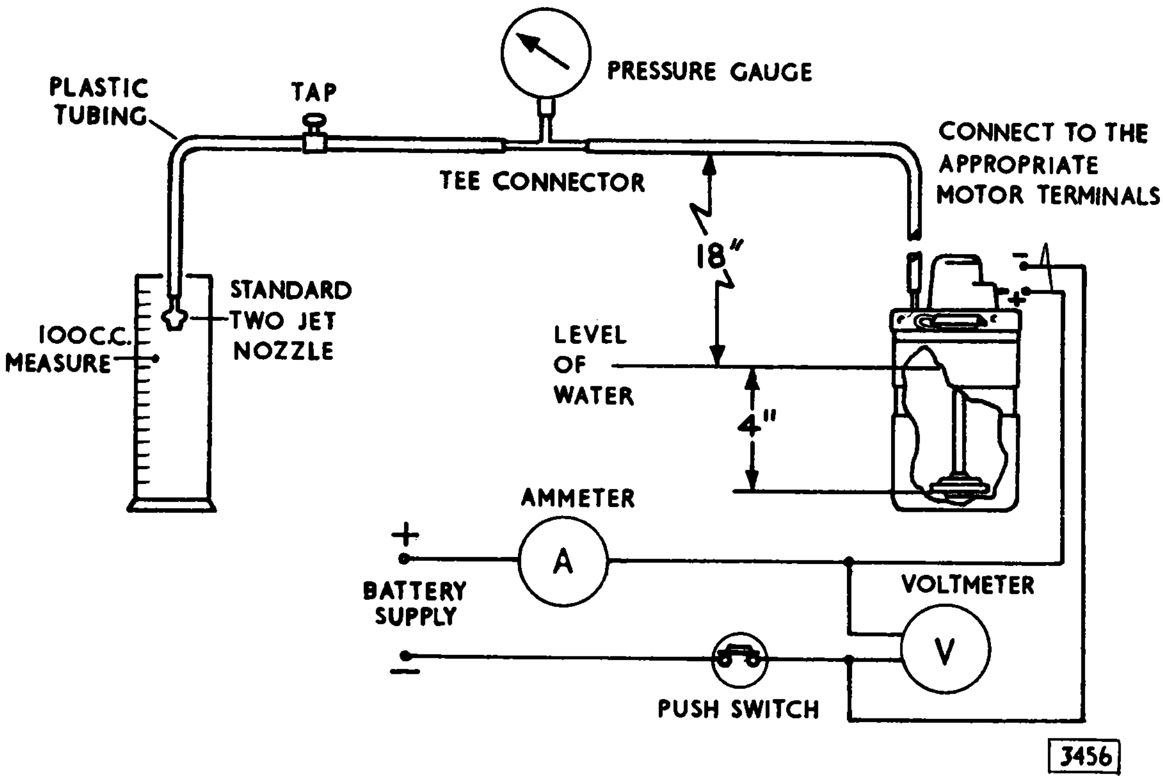


Fig. No. 11 *Performance testing equipment*

(b) Brushes:-
If the carbon is less than $\frac{1}{16}$" (1.59 mm.) long a new brush must be fitted.
Check that the brushes bear firmly against the commutator.

Re-assembling
Re-assembling of the unit is the reverse of the dismantling procedure. The following points should be observed:-
(a) Make sure the bearing recess in the motor is filled with Rocol Molypad molybdenised grease. Remove the excessive grease from the face of the bearing boss.
(b) Check that the pole piece assembly does not rock and that the pole pieces are firmly located on the circular spigot. Ensure that the pole piece assembly and the clamping member are the right way round.
(c) Before replacing the motor unit on the cover, ensure that the armature coupling is pushed fully home and that the intermediate coupling is in place.

Performance Testing
Equipment required:-
D.C. supply of appropriate voltage.
D.C. voltmeter, first grade, moving coil.
0-3 amp D.C. ammeter.
0-15 lb/in.^{2} (0-1 kg/cm.^{2}) pressure gauge.
Pushbutton with normally open contacts
Two-jet nozzle
On-off tap.
100 c.c. capacity measure.
4' 6" (1.37 m.) length of plastic tubing.
(a) Connect up the equipment as shown in Fig. 11. The water level in the container must be 4" (101.6 mm.) above the base of the pump assembly. The pressure gauge and nozzle must be 18" (457.2 mm.) above the water level.
(b) Open the tap.
(c) Depress the push button for approximately 5 seconds and check the voltmeter reading which should be the same as the supply voltage. On releasing the switch, close the tap to ensure that the plastic tubing remains charged with water.
(d) Empty the measuring cylinder.
(e) Open the tap and operate the push switch for precisely 10 seconds, after which period release the switch and close the tap.
During the 10 second test the current and pressure values should be in accordance with those given in "DATA" at least 35 c.c. of water should have been delivered.

ELECTRICAL AND INSTRUMENTS

SECTION P

INDEX

BATTERY

DISTRIBUTOR

ALTERNATOR

ALTERNATOR CONTROL UNIT

WARNING LIGHT CONTROL UNIT

THE STARTER MOTOR

Description

LAMPS

FLASHER UNIT

FUSE UNITS

TRAFFIC HAZARD WARNING

HORNS

WINDSCREEN WIPER

WIRING HARNESS REPLACEMENT

THE INSTRUMENTS

OPTIONAL EXTRAS

ELECTRICAL AND INSTRUMENTS

BATTERY

The Lucas S11/9/8 battery is of the "cleantop" pattern, the cell filler holes being covered by a manifold vent cover.
Small sealed holes are provided over each inter-cell connector to enable the prongs of a heavy discharge tester to be inserted for testing purposes.

DATA

Battery type	S11/9/8
Voltage	12
Number of plates per cell	11
Capacity at 10-hour rate	60 ampere hours
Capacity at 20-hour rate	67 ampere hours

ROUTINE MAINTENANCE

Wipe away any foreign matter or moisture from the top of the battery and ensure that the connections and the fixings are clean and tight.
About once a month, or more frequently in hot weather, examine the level of the electrolyte in the cells. If necessary add distilled water to bring the electrolyte just level with the separator guards which can be seen when the vent cover is removed.
The use of a Lucas battery filler will be found helpful in this topping-up process, as it ensures that the correct electrolyte level is obtained automatically and also prevents distilled water from being spilled over the battery top.
Distilled water should always be used for topping-up. In an emergency, however, clean soft rain water collected in an earthenware container may be used.
Note: Never use a naked light when examining a battery, as the mixture of oxygen and hydrogen given off by the battery when on charge and to a lesser extent when standing idle, can be dangerously explosive.

REMOVAL

Unscrew the two wing nuts retaining the battery strap; remove the fixing rods and strap. Disconnect terminals and lift out the battery from the tray.

REFITTING

Refitting is the reverse of the removal procedure. Before refitting the cable connectors, clean the terminals and coat with petroleum jelly.

PERSISTENT LOW STATE OF CHARGE

First consider the conditions under which the battery is used. If the battery is subjected to long periods of discharge without suitable opportunities for recharging, a low state of charge can be expected. A fault in the generator or regulator, or neglect of the battery during a period of low or zero mileage may also be responsible for the trouble.

Manifold Vent Cover

See that the ventilating holes in the cover are clear.

Level of Electrolyte

The surface of the electrolyte should be just level with the tops of the separator guards. If necessary top up with distilled water. Any loss of acid from spilling or spraying (as opposed to the normal loss of **water** by evaporation) should be made good by dilute acid of the same specific gravity as that already in the cell.

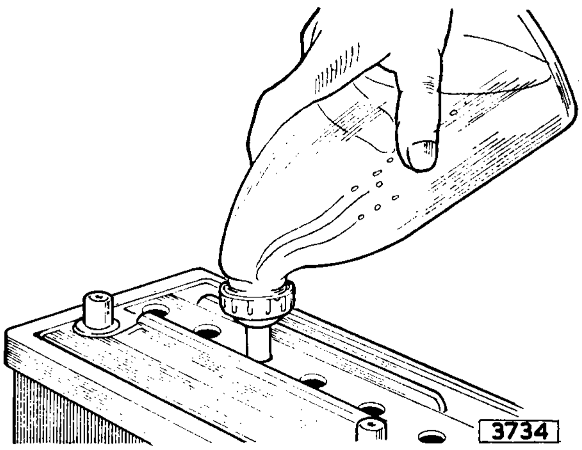


Fig. No. 1 *Using the Lucas battery filler*

Cleanliness

See that the top of the battery is free from dirt or moisture which might provide a discharge path. Ensure that the battery connections are clean and tight.

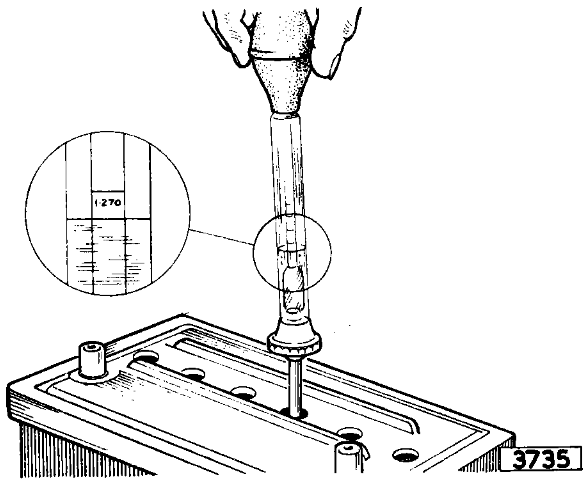


Fig. No. 2 *Testing with a hydrometer*

Hydrometer Tests

Measure the specific gravity of the acid in each cell in turn with an hydrometer. To avoid misleading readings, do not take hydrometer readings immediately after topping-up.

The readings given by each cell should be approximately the same.

If one cell differs appreciably from the others, an internal fault in the cell is indicated.

The appearance of the electrolyte drawn into the hydrometer when taking a reading gives useful indication of the state of the plates. If the electrolyte is very dirty, or contains small particles in suspension, it is possible that the plates are in a bad condition.

The specific gravity of the electrolyte varies with the temperature, therefore, for convenience in comparing specific gravities, this is always corrected to 60°F. (16°C.) which is adopted as a reference temperature. The method of correction is as follows:—

For every 5°F. (2.8° C.) below 60°F. (16°C.) deduct 0.002 from the observed reading to obtain the true specific gravity at 60°F.

For every 5°F. (2.8° C.) above 60°F. (16°C.) add 0.002 to the observed reading to obtain the true specific gravity at 60°F. (16°C.).

The temperature must be that indicated by a thermometer actually immersed in the electrolyte and not the air temperature.

Compare the specific gravity of the electrolyte with the values given in the table and so ascertain the state of charge of the battery.

If the battery is in a discharged state, it should be recharged, either on the vehicle by a period of daytime running or on the bench from an external supply, as described under "Recharging from an External Supply".

Discharge Test

A heavy discharge tester consists of a voltmeter, 2 or 3 volts full scale, across which is connected a shunt resistance capable of carrying a current of 150-160 amperes. It is important to use only a suitably rated instrument. Pointed prongs are provided for making contact with the inner-cell connectors.

Press the contact prongs against the exposed positive and negative terminal of each cell. A good cell will maintain a reading of 1.2 - 1.5 volts, depending on the state of charge, for 10 seconds.

If, however, the reading rapidly falls off, the cell is probably faulty and a new plate assembly may have to be fitted.

RECHARGING FROM AN EXTERNAL SUPPLY

If the battery tests indicate that the battery is merely discharged and is otherwise in a good condition, it should be re-charged either on the car by a period of day-time running or from an external supply.

Note correct battery polarity (NEGATIVE EARTH) and remove the battery leads when connecting the charging unit cables if charging from an external supply. If the latter, the battery should be charged at 6 amperes until the specific gravity and voltage show no increase over three successive hourly readings.

During the charge the electrolyte must be kept level with the tops of the separator guards by the addition of distilled water.

A battery that shows a general falling-off in efficiency common to all cells will often respond to the process known as "cycling". This process consists of fully charging the battery as described above and then discharging it by connecting to a lamp board or other load, taking a current of 5 amperes. The battery should be capable of providing this current for at least 7 hours before it is fully discharged, as indicated by the voltage of each cell falling to 1.8. If the battery discharges in a shorter time, repeat the "cycle" of charge and discharge.

When using a fast charger to boost the battery it is ESSENTIAL to check that the ignition switch is in the "OFF" position.

Failure to ensure this will result in damage to the 4TR control unit.

If using the fast charger to start the engine it is **essential** to see that the 4TR control is disconnected.

On cars fitted with a steering column lock, disconnect the 6RA relay at terminal W2.

On cars not equipped with a steering lock, disconnect the cables from the control unit.

Care must be taken when reconnecting; **any wrong connections will cause irreparable damage.**

The cables must not be connected to the control unit until the charger has been disconnected and the speed reduced to tick-over.

PREPARING NEW UNFILLED, UNCHARGED BATTERIES FOR SERVICE

Preparation of Electrolyte

Batteries should not be filled with acid until required for initial charging.

Electrolyte of the specific gravity required is prepared by mixing distilled water and concentrated sulphuric acid usually of 1.835 specific gravity. The mixing must be carried out either in a lead-lined tank or in a suitable

glass or earthenware vessel. Slowly add the acid to the water, stirring with a glass rod. **Never add the water to the acid** as the resulting chemical reaction causes violent and dangerous spurting of the concentrated acid. The correct specific gravity for the filling acid and approximate proportions of acid and water are indicated in the following table:
Heat is produced by the mixture of acid and water, and the electrolyte should be allowed to cool before taking hydrometer readings — unless a thermometer is used to measure the actual temperature, and a correction applied to the reading before pouring the electrolyte into the battery.

Filling the Battery
The temperature of the acid, battery and filling-in room must not be below 32°F. (0°C.).
Carefully break the seals in the filling holes and fill each cell to the level of the separator guard with electrolyte of the approximate specific gravity. Allow the battery to stand for 12 hours in order to dissipate the heat generated by the chemical action of the acid on the plates and separators. Restore levels by adding more acid of the same specific gravity and then proceed with the initial charge.

Initial Charge Rate
Charge at the rate of 4 amps until the voltage and specific gravity readings show no increase over five successive hourly readings. This may take up to 80 hours, depending on the length of time the battery has been stored before charging.

Keep the current constant by varying the series resistance of the circuit or the generator output.

This charge should not be broken by long rest periods. If, however, the temperature of any cell rises above the permissable maximum (that is, 100°F. (38°C.) for batteries filled with 1.270 S.G. acids, 120°F. (49°C.) for those with 1.210 S.G. acid), the charge must be interrupted until the temperature has fallen at least 10°F. (—10°C.) below that figure. Throughout the charge, the electrolyte must be kept level with the top of the separator guards by the addition of acid solution of the same specific gravity as the original filling-in acid, until the specific gravity and voltage readings have remained constant for five successive hourly readings. If the charge is continued beyond that point, top up with distilled water.

State	Home and climates with shade temperature ordinarily below 80°F. (26.6°C). Specific gravity of electrolyte (corrected to 60°F.) (16°C.).	Climates with shade temperature frequently over 80°F. (26.6°C). Specific gravity of electrolyte (corrected to 60°F. (16°C.).
Fully charged About half discharged	1.270 — 1.290 1.190 — 1.210	1.210 — 1.230 1.130 — 1.150
Completely discharged	1.110 — 1.130	1.050 — 1.070

Specific Gravity of Filling Acid (corrected to 60°F.)

Home and climates with shade temperature ordinarily below 80°F. (26.6°C.).	Climates with shade temperature frequently above 80°F. (26.6°C.).
1.260 Add 1 part by volume of acid ((1.840 S.G.) to 3.2 parts of distilled water to mix this electrolyte	1.210 Add 1 part by volume of acid (1.835 S.G.) to 4 parts of distilled water to mix this electrolyte)
Quantity of electrolyte required per cell 1¼ pints approximately (720 c.c.).	

At each end of the charge carefully check the specific gravity in each cell to ensure that when corrected to 60°F. (16°C.), it lies within the specified full-charged limits.

If any cell requires adjustment, some of the electrolyte must be siphoned off and replaced by distilled water or by acid of the strength originally used for filling-in, depending on whether the specific gravity is too high or too low. Continue the charge for an hour or so to ensure adequate mixing of the electrolyte and again check the specific gravity readings. If necessary, repeat the adjustment process until the desired reading is obtained in each cell. Finally, allow the battery to cool and siphon off any electrolyte above the tops of the separator guards.

PREPARING NEW "DRY-CHARGED" BATTERIES FOR SERVICE

Filling the Cells

Carefully break the seals in the filling holes and fill each cell with correct specific gravity acid as shown in the table on page P.9 to the top of the separator guards in one operation. The temperatures of the filling room, battery and acid should be maintained at between 60 °F. (16 °C.) and 100 °F. (38 °C.). If the battery has been stored in a cool place, it should be allowed to warm up to room temperature before filling.

Freshening Charge

Batteries filled in this way are up to 90% charged and capable of giving a starting discharge one hour after filling. When time permits, however, a short freshening charge will ensure that the battery is fully charged. Such a freshening charge should be 5 amperes for not more than 4 hours.

During the charge the electrolyte must be kept level with the top of the separators by the addition of distilled water. Check the specific gravity of the electrolyte at the end of the charge; if 1.270 acid was used to fill the battery, the specific gravity should now be between 1.270 and 1.290; if 1.210 acid, between 1.210 and 1.230.

Maintenance in Service

After filling, a dry-charged battery needs only the attention normally given to all lead-acid type batteries.

DISTRIBUTOR

DESCRIPTION

The Lucas 22D6 distributor is fitted to all engines.

All models fitted with automatic transmission have a speed limiter incorporated in the rotor. The distributor DATA remains the same irrespective of the type of transmission installed.

This device operates as a spring controlled governor plate attached to the rotor and lifts at a pre-determined maximum engine speed to earth out the H.T. circuit.

The speed limiter is necessary due to the safe maximum speed limitations of the Borg-Warner transmission unit, therefore no attempt must be made to fit the standard rotor arm which will not have the governor plate fitted, as a replacement.

A waterproof cover is incorporated in the distributor assembly and is located between the distributor cap and the body.

The cover is detachable after removing the distributor cap and disconnecting the cable from the contact breaker spring post. The distributor DATA remains the same as that stated on page P.12.

REMOVAL

Spring back the clips and remove the distributor cap.

Disconnect the low tension wire from the distributor.

Disconnect the vacuum pipe by withdrawing the elbow sleeve junction.

Remove distributor clamping plate retaining setscrew and withdraw distributor.

REFITTING

If the distributor clamping plate pinch bolt has not been slackened during removal of distributor, refitting will be the reverse of the removal procedure. Enter the distributor into the cylinder block with the vacuum advance unit connection facing the cylinder block.

Rotate the rotor arm until the driving dog engages with the distributor drive shaft.

If the distributor clamping plate pinch bolt has been slackened during removal of distributor it will be necessary to reset the ignition timing as follows:—

Ignition Timing

Set the micrometer adjustment in the centre of the scale.

Connect the low tension wire to the terminal on the distributor body.

Enter the distributor into the cylinder block with the vacuum advance unit connection facing the cylinder block.

Rotate the rotor arm until the driving dog engages with the distributor drive shaft.

Rotate the engine until the rotor arm approaches the No. 6 (front) cylinder segment in the distributor cap.

Slowly rotate the engine until the ignition timing scale on the crankshaft damper is the appropriate number of degrees before the pointer on the sump. (See Data).

Connect a 12 volt test lamp with one lead to the distributor terminal (or the CB terminal of the ignition coil) and the other to a good earth.

Slowly rotate the distributor body until the points are just breaking, that is, when the lamp lights up.

Tighten the distributor plate pinch bolt.

A maximum of six clicks on the vernier adjustment from this setting, to either advance or retard, is allowed.

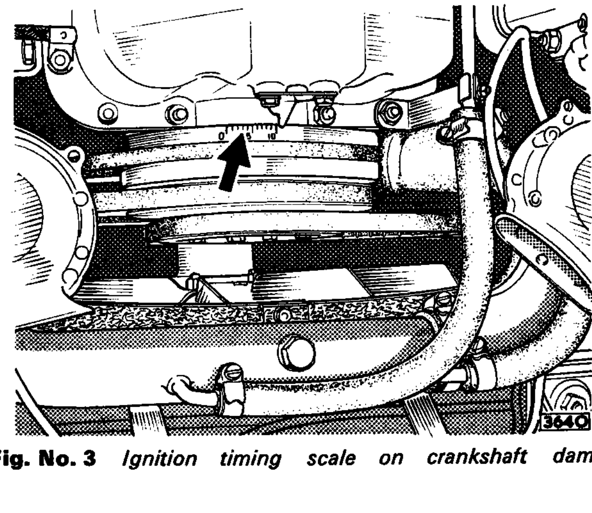


Fig. No. 3 *Ignition timing scale on crankshaft damper*

ROUTINE MAINTENANCE

Every 3,000 Miles (5,000 km.)

Distributor Contact Breaker Points

Every 3,000 miles (5,000 km.) (first 500 miles (800 km.) with new contact set), check the gap between the contact points with feeler gauges when the points are fully opened by one of the cams on the distributor shaft. A combined screwdriver and feeler gauge is provided in the tool kit.

The correct gap is 0.014 - 0.016" (0.36 - 0.41 mm.). If the gap is incorrect, slacken (very slightly) the contact plate securing screw and adjust the gap by turning a screwdriver in the nick in the contact plate and the slot in the base plate, clockwise to decrease the gap and anti-clockwise to increase the gap. Tighten the securing screw and recheck the gap (Fig. 4).

Examine the contact breaker points. If pitted, clean with a fine carborundum stone or very fine emery cloth. Afterwards wipe away any trace of grease or metal dust with petrol moistened cloth.

Contact cleaning is facilitated by removing the lever to which the moving contact is attached. To do this, remove the nut, insulating piece and electrical connections from the post to which the contact breaker spring is anchored. The contact breaker lever can then be lifted off the pivot post and the spring from the anchor post.

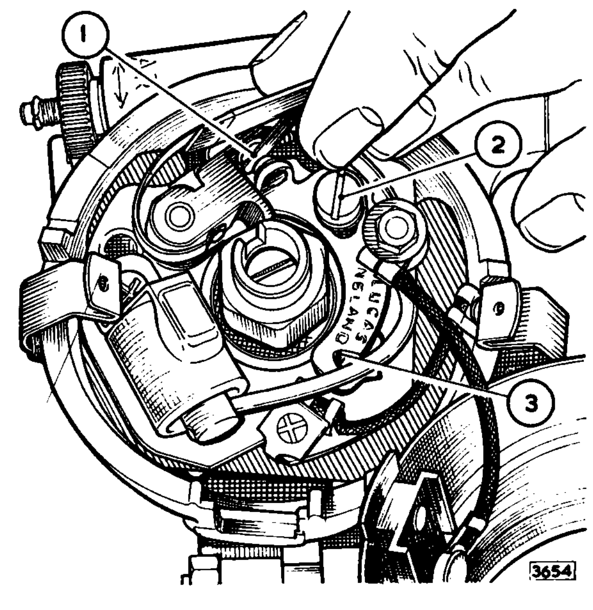


Fig. No. 4 *Checking the contact breaker gap*

After cleaning and trimming the contacts, smear the pivot post (Fig. 5) with Ragosine Molybdenised Non-creep Oil or with Mobilgrease No. 2. Reassemble the contact breaker and check the setting.

Refit the rotor arm, carefully locating its moulded projection in the spindle keyway and pushing it on as far as it will go.

Clean the moulded cover inside and outside with a soft dry cloth. Pay particular attention to spaces between the terminals. Check that the small carbon brush inside the moulding can move freely in its holder. Refit the cover and spring the two side clips into position.

Lubrication

Remove the moulded cover and withdraw the rotor arm. A tight rotor arm can be withdrawn by using a suitable pair of levers carefully applied at opposite points below the rotor moulding — never against the metal electrode.

Important: Do not allow oil or grease on or near the contacts when carrying out the following lubrication.

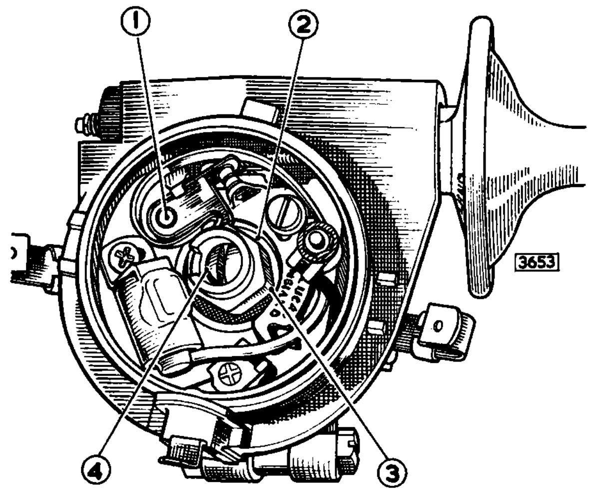


Fig. No. 5 *Distributor lubrication points*

Cam Bearing

To lubricate the cam bearing, inject a few drops of thin machine oil into the rotor arm spindle (Fig. 5). Do not remove or slacken the screw located inside the spindle — a space is provided beneath the screwhead to allow the lubricant to reach the cam bearing.

Pivot Post

Place a drop of clean engine oil on the tip of the pivot post (Fig. 5).

Cam

Lightly smear the faces of the cam (Fig. 5) with Mobilgrease No. 2 or with clean engine oil.

Centrifugal Timing Control

Inject a few drops of thin machine oil through a convenient aperture in the contact breaker base plate (Fig. 5).

SERVICING

Dismantling

When dismantling, note carefully the position in which the various components are fitted in order to simplify their re-assembly.

Bearing Replacement
The ball bearing at the upper end of the shank can be removed with a shouldered mandrel locating on the inner journal of the bearing.
When fitting a new ball bearing, the shouldered mandrel must locate on both inner and outer journals of the bearing.
The bearing bush at the lower end of the shank can be driven out with a suitable punch.
A bearing bush may be prepared for fitting by allowing it to stand completely immersed in medium viscosity (S.A.E. 30-40) engine oil for at least 24 hours. In cases of extreme urgency, this period of soaking may be shortened by heating the oil to 100°C. for 2 hours and then allowing to cool before removing the bush.
The bush is pressed into the shank with a shouldered mandrel. The mandrel should be hardened and polished and approximately 0.0005" greater in diameter than the distributor shaft. To prevent subsequent withdrawal of the bush with the mandrel, a stripping washer should be fitted between the shoulder of the mandrel and the bush.
Under no circumstances should the bush be overbored by reaming or by any other means, since this will impair the porosity and therefore the lubricating quality of the bush.

Re-assembly
When re-assembling, Ragosine molybdenised non-creep oil or (failing this) clean engine oil, should be smeared on the shaft and, more lightly, on the contact breaker bearing plate.

DISTRIBUTOR DATA

Compression Ratio	8 : 1 - 9 : 1
Lucas Ignition Distributor Type	22 D.6
Model No.	
Lucas Service	41060A
Cam dwell angle	34° ± 3°
Contact breaker gap	0.014 - 0.016" (0.36 - 0.41 mm.)
Contact breaker spring tension measured at free contact	18 - 24 ozs. (512 - 682 gms.)

IGNITION TIMING

8 : 1 Compression Ratio	8° BTDC
9 : 1 Compression Ratio	8° BTDC

IGNITION DISTRIBUTOR TEST DATA

			VACUUM TIMING ADVANCE TESTS The distributor must be run immediately below the speed at which the centrifugal advance begins to function to obviate the possibility of an incorrect reading being registered				CENTRIFUGAL TIMING ADVANCE TESTS Mount distributor in centrifugal advance test rig and set to spark at zero degrees at 100 r.p.m.				
Distributor Type	Lucas Service Number	Lucas Vacuum Unit Number	Vacuum in inches of mercury and advance in degrees Inches	Degrees	No advance timing below-ins. of mercury	Lucas Advance Springs Number	Accelerate to-RPM and note advance in degrees RPM	Degrees	Decelerate to-RPM and note advance in degrees RPM	Degrees	No advance in timing below-RPM
22D6	41060A (standard) (auto. trans.)	54415894	20 13 9 7½ 6	7—9 6—8½ 2½—5½ 0—3 0—½	4½	55415562	2,300	8½—10½	1,800 1,250 800 650 525	82—10½ 6½—8½ 5—7 2—4 0—1½	300

Auto advance weights Lucas number 54413073. One inch of mercury = 0.0345 kg/cm2.

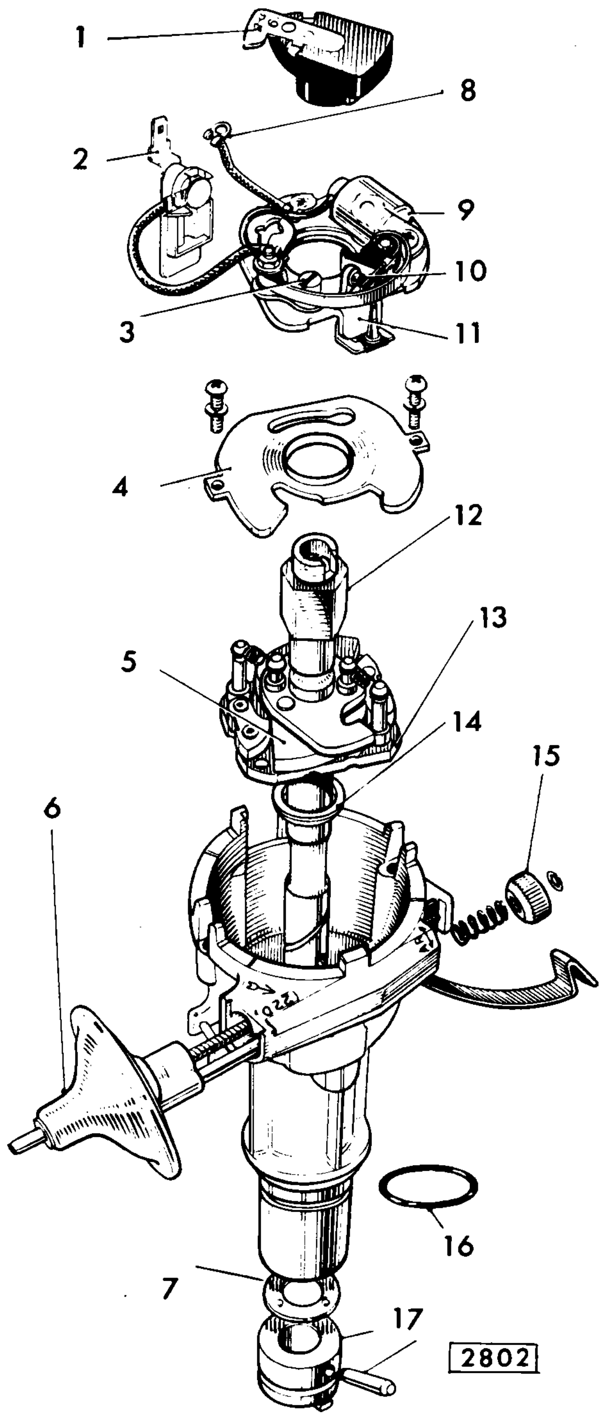


Fig. No. 6 *The distributor components*

1 Rotor arm
2 L.T. terminal
3 Fixed contact plate securing screw
4 Contact breaker base plate
5 Centrifugal timing control weights
6 Vacuum timing control unit
7 Thrust washer
8 C.B. earth connector
9 Capacitor
10 Contacts
11 Contact breaker moving plate
12 Cam
13 Action plate
14 Distance collar
15 Micrometer adjustment nut
16 Oil seal washer
17 Dog and pin

ALTERNATOR

GENERAL DESCRIPTION

The Lucas 11 A.C. alternator is a lightweight machine designed to give increased output at all engine speeds. Basically, the unit consists of a stationary output winding with built-in rectification and a rotating field winding energised from the battery through a pair of slip-rings.

The stator consists of a 24 slot, 3 phase star connected winding on a ring shaped lamination pack, housed between the slip-ring end cover and the drive end bracket.

The rotor is of 8 pole construction and carries a field winding connected to two face type slip-rings. It is supported by a ball bearing in the drive end bracket and a needle roller bearing in the slip-ring end cover. See Fig. 7.

The brushgear for the field system is mounted on the slip-ring end cover. Two carbon brushes, one positive and the other negative, bear against a pair of concentric brass slip-rings carried on a moulded disc attached to the end of the rotor.

The positive brush is always associated with the inner slip-ring.

The slip-ring end cover also carries six silcon diodes connected in a 3 phase bridge circuit to provide rectification of the generated alternating current output. See Fig. 8. The diodes are cooled by air flow through the alternator induced by a 6" (152.4 mm.) ventilating fan at the drive end.

The alternator is matched to an output control unit, Model 4 TR, see page P.19 for full details of the unit. This unit controls the alternator field current and hence the alternator terminal voltage.

A cut-out is not included in the control unit as the diodes in the alternator prevent reverse currents from flowing through the stator when the machine is stationary or is generating less than the battery voltage.

No separate current-limiting devise is incorporated; the inherent self-regulating properties of the alternator effectively limit the output current to a safe value.

A Lucas 3AW warning light control unit is incorporated in the circuit.

The output control unit and the alternator field windings are isolated from the battery when the engine is stationary by a separate pair of contacts in the ignition switch.

On cars fitted with a steering column lock the field windings are isolated by means of a relay replacing the ignition switch control.

PERFORMANCE DATA

Cutting-in speed	500 engine r.p.m. at 13.0 alternator volts
Maximum D.C. output	45 amp. at 3,000 engine r.p.m. (6,000 alternator r.p.m.) 13.5 volts
Stator phases Phase connection Resistance/phase at 68 °F. (20 °C.) ± 5%	3 Star 0.107 ohms
Resistance of field coil at 68 °F. (20 °C.) ± 5%	3.770 ohms

ROUTINE MAINTENANCE

No routine maintenance is necessary with the alternator and warning light unit.

Occasionally wipe away any dirt or oil which may collect around the slip-ring end cover.

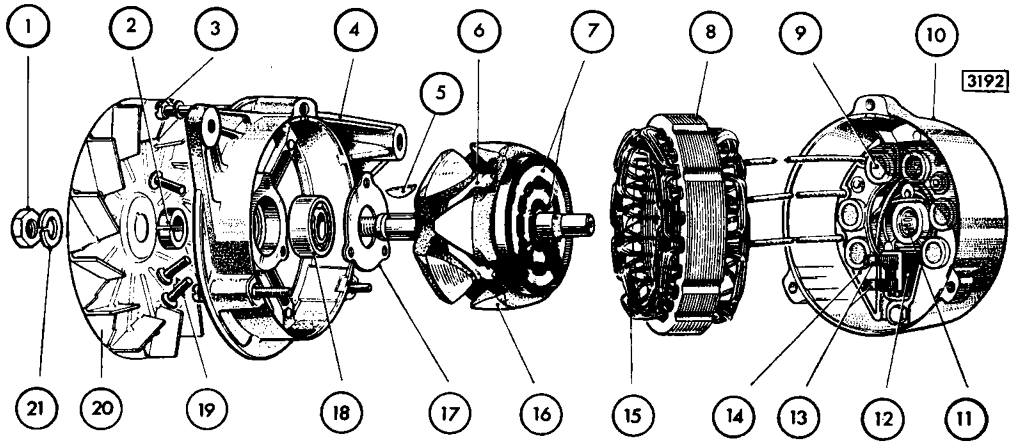


Fig. No. 7 *Exploded view of the Lucas 11AC alternator*

1	Shaft nut	**12**	Brush box moulding
2	Bearing collar	**13**	Brushes
3	Through fixing bolts (3)	**14**	Diode heat sink
4	Drive end bracket	**15**	Stator windings
5	Key	**16**	Rotor
6	Rotor (field) winding	**17**	Bearing retaining plate
7	Slip rings	**18**	Ball bearing
8	Stator laminations	**19**	Bearing retaining plate
9	Silicon diodes (6)	**20**	Fan
10	Slip ring end bracket	**21**	Spring washer
11	Needle roller bearing		

REMOVAL

Disconnect the cables from the terminals on the slip ring end cover. Note the colour and location of the cables with "Lucar" termination for reference when refitting.

Remove the bolts securing the alternator to the mounting bracket and adjuster link, lift the belt over the pulley and withdraw the alternator.

Note: If air-conditioning equipment is fitted it will be necessary to remove the compressor unit and the mounting bracket as detailed on page A.32 to gain access to the alternator. **DO NOT** release or disconnect the compressor hose unions. Support the compressor in the engine compartment after removing.

REFITTING

Refitting is the reverse of the removal procedure. Replace the drive belt and adjust to the correct tension by swinging the alternator outwards away from the engine. Tighten the securing bolts.

When correctly adjusted the belt deflection should be ½" (12.7 mm.) with pressure applied between the two pulleys.

Important: To avoid bearing damage when adjusting the belt tension, apply leverage ONLY to the drive end bracket and **not** to any other part of the alternator.

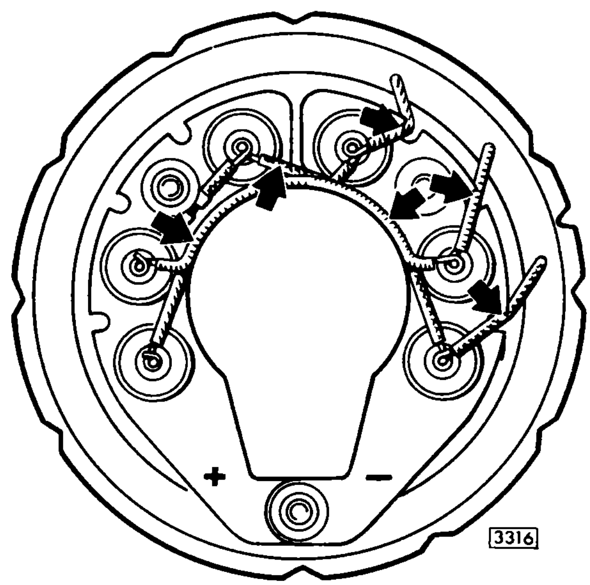


Fig. No. 8 *Showing the silicon diodes and connections in the slip ring end cover*

SERVICE PRECAUTIONS

Important: The units incorporate transistors in the control box and diode rectifiers in the alternator. The car electrical system must NOT be checked with the ohmmeter incorporating a hand driven generator until these components have been isolated.

REVERSED battery connections will damage the diode rectifiers.

Battery polarity must be checked before connections are made to ensure that the connections to the car battery are NEGATIVE earth. This is most important when using a slave battery to start the engine.

NEVER earth the brown/green cable if it is disconnected at the alternator. If this cable is earthed, with the ignition switched ON, the control unit and wiring may be damaged.

NEVER earth the alternator main output cable or terminal. Earthing at this point will damage the alternator or circuit.

NEVER run the alternator on open circuit with the field windings energised, that is with the main lead disconnected, or the diodes are likely to be damaged due to peak-inverse voltages.

SERVICING

Testing the Alternator in position

In the event of a fault developing in the charging circuit, check by the following procedure to locate the cause of the trouble.

(a) Disconnect the battery earth cable.

(b) Lower the instrument panel and disconnect the brown/white cables from the ammeter. Connect the two cables to a good quality moving-coil ammeter registering at least 75 amperes.

(c) Detach the terminal connector block from the base of the control unit and connect the black and brown/green cables together by means of a short length of cable with two "Lucar" terminals attached. This operation connects the alternator field winding across the battery terminals and by-passes the output control unit (Fig. 9).

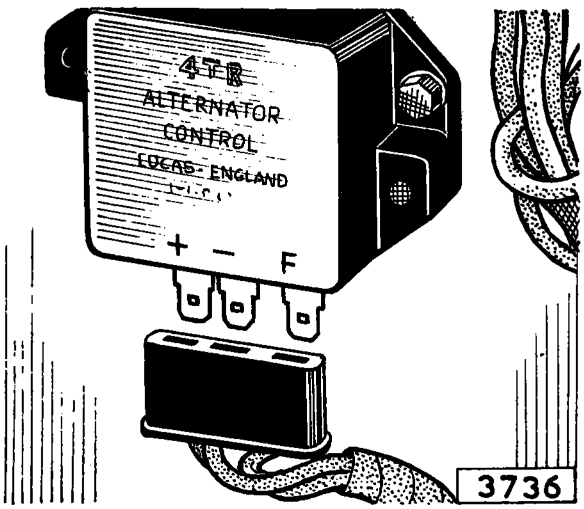


Fig. No. 9 *Showing the cable terminals disconnected from the base of the control unit*

(d) Reconnect the battery earth lead. Switch on the ignition and start the engine. Slowly increase the engine speed until the alternator is running at approximately4,000R.P.M.(2,000 engineR.P.M.). Check the reading on the ammeter which should be approximately 40 amperes with the machine at ambient temperature.
A low current reading will indicate either a faulty alternator or poor circuit wiring connections.
If, after checking the latter (especially the earth connections), a low reading persists on repeating the test, proceed to paragraph (e).
If, however, a zero reading results, switch on the ignition and check that the battery voltage is being applied to the rotor windings by connecting a voltmeter between the two cable ends normally attached to the alternator field in the field isolating contacts in the ignition switch or the wiring associated with this circuit.
Check each item in turn and rectify as necessary.

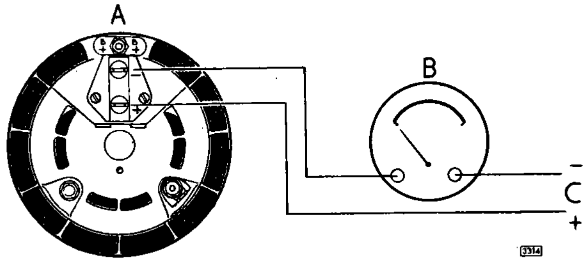


Fig. No. 10 *Testing the alternator with an ammeter*

(e) If a low output has resulted from the test described in paragraph (d) and the circuit wiring is in order, measure the resistance of the rotor coil (field) by means of an ohmmeter connected between the field terminal blades with the external wiring disconnected. The resistance must approximate to 3.77 ohms.
If an ohmmeter is not available, connect a 12 volt D.C. supply between the field terminals with an ammeter in series. The ammeter reading should be approximately 3.2 amperes. (Fig. 10).
A zero reading on the ammeter, or an "Infinity" reading on the ohmmeter indicates an open circuit in the field system, that is, brushgear, slip-rings, or windings. Conversely, if the current reading is much above or the ohmmeter is much below the values given above, it is an indication of a short circuit in the rotor-winding, in which case the rotor/slip-ring assembly must be changed.

DISMANTLING

Disconnect the battery and remove the alternator as detailed on page P.15

Remove the shaft nut and spring washer and withdraw the pulley and fan.

Unscrew the nuts and remove the three through bolts.

Note: The nuts are staked to the through bolts and the staking must be removed before the nuts are unscrewed. If the threads of the nuts or bolts are damaged new bolts must be fitted when re-assembling.

Mark the drive end bracket, lamination pack and slip ring end cover so that they may be re-assembled in correct angular relation to each other. Care must be taken not to damage the lamination pack when marking. Withdraw the end drive bracket and rotor from the stator. The drive end bracket and rotor need not be separated unless the bearing requires examination or the rotor is to be replaced, in which case the rotor should be removed from the drive end bracket by means of a hand press, having first removed the shaft key and bearing collar.
Remove the terminal nuts, washers, insulating pieces, brush box screws and the 2 BA hexagon headed set-screws and withdraw the stator and heat sink assemblies from the slip ring end cover.
Close up the retaining tongue at the root of each field terminal blade and withdraw the brush spring and terminal assemblies from the moulded brushbox.

REASSEMBLY

Reassembly of the alternator is the reverse of the dismantling procedure. Care must be taken to align the drive end bracket, lamination pack and slip ring end bracket correctly.
Tighten the three "through" bolts evenly to a maximum torque of 45-50 lb. ins. (0.518-0.576 kgm.). Restake the nuts after tightening.
Tighten the brush box fixing screws to a maximum torque of 10 lb. ins. (0.115 kg/m.).

IMPORTANT

It is important to ensure that a .045" (1.28 mm.) gap exists between the non-pivotal ends of the heat sinks (see Fig. 8) when reassembling the alternator.
Check by inserting a feeler gauge through the slip ring end cover aperture.
FAILURE TO ENSURE THIS CLEARANCE WILL RESULT IN A SHORT IN THE AMMETER CIRCUIT BEHIND THE INSTRUMENT PANEL.

INSPECTION OF BRUSH GEAR

Measure brush length. A new brush is $\frac{5}{8}$" (15.88 mm.) long; a fully worn brush is $\frac{5}{32}$" (3.97 mm.) long and must be replaced at, or approaching, this length. The new brush is supplied complete with brush spring and "Lucar" terminal blade and has merely to be pushed in until the tongue registers.
To ensure that the terminal is properly retained, carefully lever up the retaining tongue with a fine screwdriver blade so that the tongue makes an angle of about 30° with the terminal blade.
The normal brush spring pressures are 4-5 oz. (113-142 gms.) with the spring compressed to $\frac{25}{32}$" (19.84 mm.) in length and $7\frac{1}{2}$ - $8\frac{1}{2}$ oz. (212 - 242 gms.) with the spring compressed to $\frac{13}{32}$" (10.31 mm.) in length. These pressures should be measured if the necessary equipment is available.

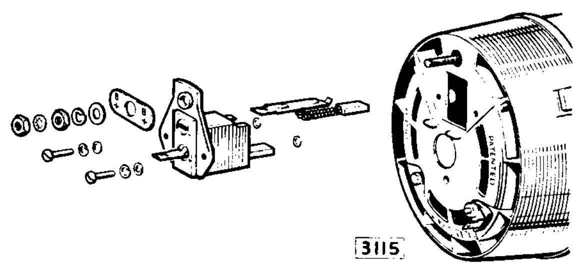


Fig. No. 11 *Showing the bush removal*

Check that the brushes move freely in their holders. If at all sluggish, clean the brush sides with a petrol moistened cloth, or if this fails to effect a cure, lightly polish the brush sides on a smooth file. Remove all traces of brush dust before re-housing the brushes in their holders.

INSPECTION OF SLIP-RINGS

The surfaces of the slip-rings should be smooth and uncontaminated by oil or other foreign matter. Clean the surfaces using a petrol moistened cloth, or if there is any evidence of burning, very fine glasspaper. On no account must emery cloth or similar abrasives be used. No attempt should be made to machine the slip-rings, as any eccentricity in the machining may adversely affect the high-speed performance of the alternator. The small current carried by the rotor winding and the unbroken surface of the slip-rings means that the likelihood of scored or pitted slip-rings is almost negligible.

ROTOR

Test the rotor winding by connecting an ammeter or 12-volt D.C. supply between the slip-rings (as described on page P.16 where this test was made with the brushgear in circuit). The readings of resistance or current should be as given in para. (e)., page P.16).
Test for defective insulation between each of the slip-rings and one of the rotor poles using a mains low-wattage test lamp for the purpose. If the lamp lights, the coil is earthing and a replacement rotor/slip-ring assembly must be fitted.
No attempt should be made to machine the rotor poles or to true a distorted shaft.

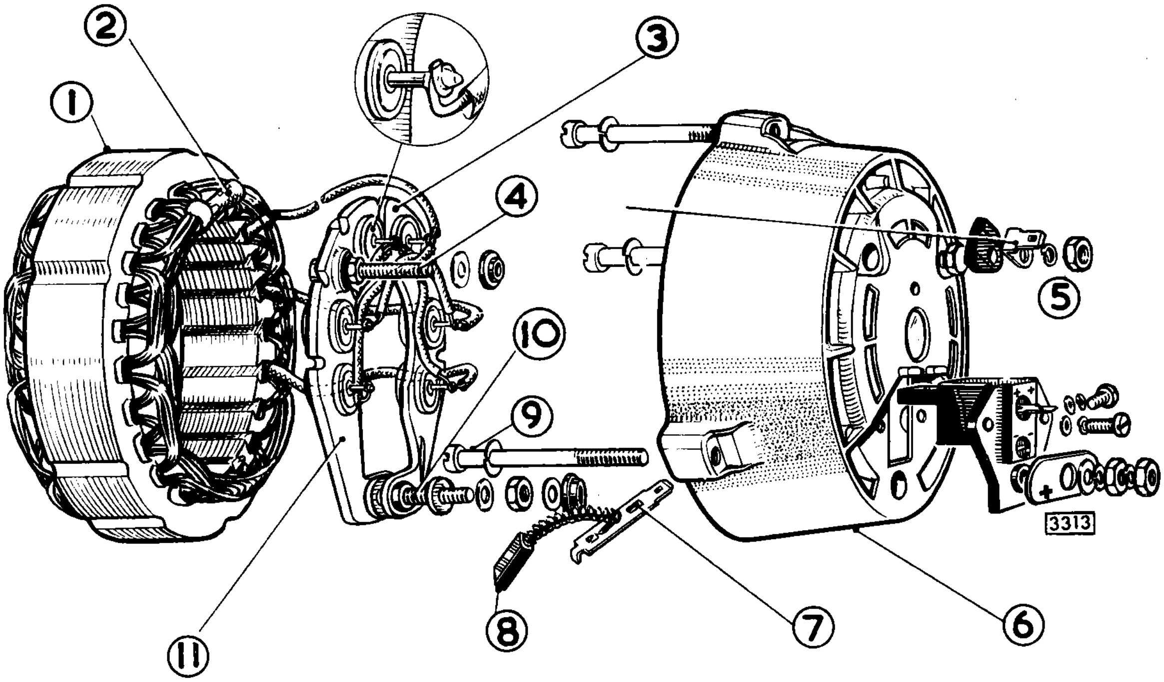


Fig. No. 12 *Exploded view of the slip ring end cover*

1 Stator
2 Star point
3 Negative heat sink and anode base diodes (black)
4 Warning light terminal "AL"
5 Field terminal
6 Slip ring end cover
7 Terminal blade retaining tongue
8 Rotor slip ring brush
9 "Through" bolts
10 Output terminals
11 Positive heat sink and cathode base diodes (red)

STATOR

Unsolder the three stator cables from the heat sink assembly taking care not to overheat the diodes. By lettering these cables A, B and C, three pairs of cables — AB, BC and AC — are available for testing the stator windings. Measure the volt drop across each of these "pairs" in turn while passing 20 amp between the cable ends. The volt drop should be approximately 4-3 volts in each of the three measurements. If any, or all, of the readings are other than these, a replacement stator must be fitted.

Test for defective insulation between stator coils and lamination pack with a mains test lamp. Connect the test probes between any one of the three cable ends and the lamination pack. If the lamp lights, the stator coils are earthing and a replacement stator must be fitted.

Before re-soldering the stator cable ends to the diode pins carry out the following test.

DIODES

Each diode can be checked by connecting it in series with a 1.5 watt test bulb (Lucas No. 280) across a 12 volt D.C. supply and then reversing the connections. Current should flow and the bulb light in one direction only. Should the bulb light up in both tests or not light up in either, the diode is defective and the appropriate heat sink assembly must be replaced.
The above procedure is adequate for service purposes. Any accurate measurement of diode resistance requires factory equipment.
Since the forward resistance of a diode varies with the voltage applied, no realistic readings can be obtained with battery-powered ohmmeters. However, should a battery-ohmmeter be used, a good diode will yield "Infinity" in one direction, and some indefinite but much lower reading in the other.
Warning: OHMMETERS OF THE TYPE INCORPORATING A HAND-DRIVEN GENERATOR MUST NEVER BE USED FOR CHECKING DIODES.

ALTERNATOR DIODE HEAT SINK REPLACEMENT

The alternator heat sink assembly comprises two mutually-insulated portions, one of positive polarity and the other negative. The diodes are not individually replaceable but, for service purposes, are supplied already pressed into the appropriate heat sink portion. The positive portion carries three cathode base diodes marked red, and the negative portion three anode base diodes marked black.

When soldering the interconnections, "M" grade 45-55 tin-lead solder should be used.

Great care must be taken to avoid overheating the diodes or bending the diode pins. The diode pins should be lightly gripped with a pair of suitable long-nosed pliers (which act as a thermal shunt) and the operation of soldering carried out as quickly as possible. After soldering, the connections must be neatly arranged around the heat sinks to ensure adequate clearance of the rotor and be tacked down with "MM" EC1022 adhesive where indicated in Fig. 8. The stator connections must pass through the appropriate notches at the edge of the heat sink.

When reassembling the alternator care **MUST** be taken to ensure that the clearance is maintained between the positive and negative heat sinks as detailed on page P.17.

BEARINGS

Bearings which are worn to the extent that they allow excessive side movement of the rotor shaft must be renewed.

The needle-roller bearing in the slip-ring end cover is supplied complete with the end cover.

To renew the drive end ball-bearing (following withdrawal of the rotor shaft from the drive-end bracket) proceed as follows:—

File away the roll-over on each of the three bearing retaining plate rivets and punch out the rivets.

Press the bearing out of the bracket.

Before fitting the replacement bearing see that it is clean and, if necessary, pack it with high-melting point grease such as Shell Alvania No. 3 or an equivalent lubricant.

Locate the bearing in the housing and press it home.

Refit the bearing retaining plate using new rivets.

ALTERNATOR OUTPUT CONTROL UNIT
Model 4TR

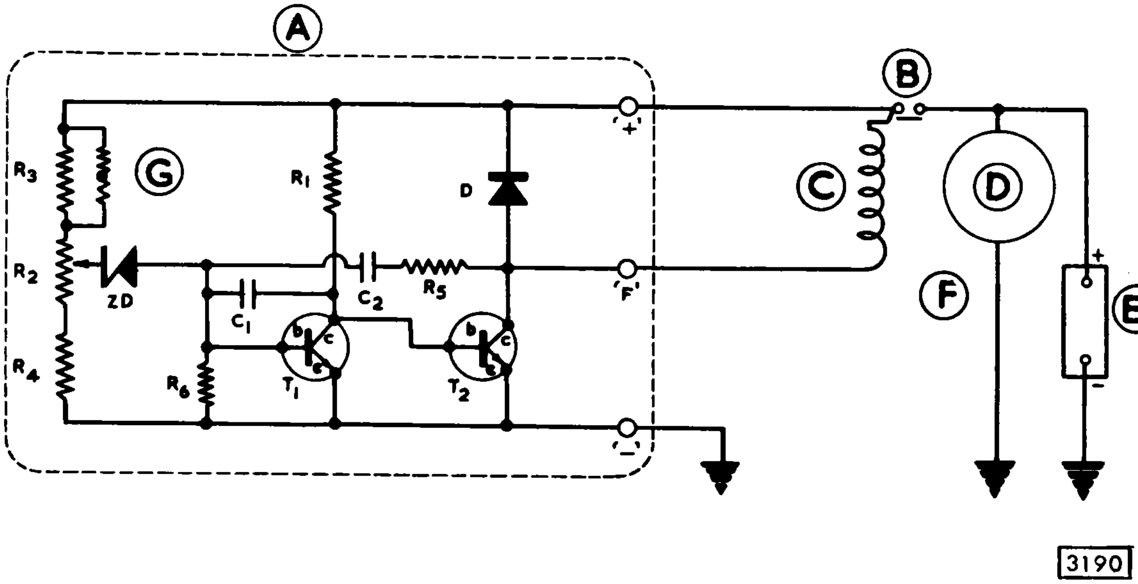


Fig. No. 13 *Alternator output control unit circuit diagram*

A	Control unit	**E**	12 volt battery
B	Field isolating device	**F**	Stator winding (rectified) output
C	Rotor field winding	**G**	Thermistor
D	Alternator		

DESCRIPTION

Model 4TR is an electronic control unit. In effect its action is similar to that of the vibrating contact type of voltage control unit, but switching is achieved by transistors instead of vibrating contacts, while a Zener diode provides the voltage reference in place of the voltage coil and tension spring system. No cut-out is required since the diodes incorporated in the alternator prevent reverse currents flowing. No current regulator is required as the inherent self-regulating properties of the alternator effectively limit the output current to a safe value.

The control unit and the alternator field windings are isolated from the battery when the engine is stationary by a special double-pole ignition switch. On cars fitted with a steering column lock the field windings are isolated by means of a relay replacing the ignition switch control.

Care must be taken at all times to ensure that the battery, alternator and control unit are correctly connected. Reversed connections will damage the semi-conductor devices employed in the alternator and control unit.

OPERATION

When the ignition is switched on, the control unit is connected to the battery through the field isolating switch or relay. By virtue of the connection through R1 (see Fig. 13) the base circuit of the power transistor T2 is conducting so that, by normal transistor action, current also flows in the collector-emitter portion of T2 which thus acts as a closed switch to complete the field circuit and battery voltage is applied to the field winding.

As the alternator rotor speed increases, the rising voltage generated across the stator winding is applied to the potential divider consisting of R3, R2 and R4. According to the position of the tapping point on R2, a proportion of this potential is applied to the Zener diode (ZD). This latter is a device which opposes the passage of current through itself until a certain voltage is reached, above which it conducts comparatively freely. The Zener diode can thus be considered as a voltage-conscious switch which closes when the voltage across it reaches "breakdown" voltage (about 10 volts) and, since this is a known proportion of the alternator output voltage as determined by the position of the tapping point of R2, the breakdown point therefore reflects the value of the output voltage. Thus at "breakdown" voltage the Zener diode conducts and current flows in the base-emitter circuit of the driver transistor T.1. Again, by transistor action, current will now flow in the collector-emitter portion of T1 so that some of the current which previously passed through R1 and the base circuit of T2 is diverted through T1. Thus the base current of T2 is reduced and, as a result, so also is the alternator field excitation. Consequently, the alternator output voltage will tend to fall — and this in turn will tend to reduce the base current in T1, allowing increased field current to flow in T2. By this means, the field current is continuously varied to keep the output voltage substantially constant at the value determined by the setting of R2.

To prevent overheating of T2 (due to power dissipation) this transistor is operated only either in the fully-on or fully-off condition. This is achieved by the incorporation of the positive feed-back circuit comprising R5 and C2. As the field current in transistor T2 starts to fall, the voltage at "F" rises and current flows through resistor R5 and capacitor C2 thus adding to the Zener diode current in the base circuit of transistor T1. This has the effect of increasing the current through T1 and decreasing still further through T2 so that the circuit quickly reaches the condition where T1 is fully-on and T2 fully-off. As C2 charges, the feed-back current falls to a degree at which the combination of Zener diode current and feed-back current in the base circuit of T1 is no longer sufficient to keep T1 fully-on. Current then begins to flow again in the base circuit of T2. The voltage at "F" now commences to fall, reducing the feed-back current eventually to zero. As T2 becomes yet more conductive and the voltage at "F" falls further, current in the feed-back circuit reverses in direction, in effect reducing still further the base current in T1. This effect also is cumulative and the circuit reverts to the condition where T1 is fully-off and T2 fully-on.

This condition is only momentary since C2 quickly charges to the opposite polarity, when feed-back current is reduced and current again flows in the base circuit of T1. The circuit thus oscillates, switching the voltage across the alternator field winding rapidly on and off.

Transistor T2 is protected from the high induced voltage surge which results from the collapse of the field current, by the surge quench diode D connect across the field windings. This diode also provides a measure of field current smoothing since current continues to flow in the diode after the excitation voltage is removed from the field. The elimination of radio interference is achieved by connecting condenser C1 between the base and collector terminals of T1 to provide negative feed-back. At high temperatures, a small leakage current may flow through the Zener diode even though the latter is in the nominally nonconductive state. Resistor R6 provides a path for this leakage current which otherwise would flow through T1 base circuit and adversely affect the regulator action.

A thermistor is connected in parallel with resistor R3. The thermistor is a device whose resistance increases as the temperature falls and vice versa. Any alteration in its ohmic value will modify the voltage distribution across the potential divider and thus affect the voltage value at which the Zener diode begins to conduct, so matching the changes which take place in battery terminal voltage as the temperature rises.

CHECKING AND ADJUSTING THE CONTROL UNITS

Important: The following voltage checking and setting procedure must be carried out only:—

(a) providing the alternator and associated wiring circuits have first been tested and found satisfactory, and

(b) in conjunction with a well-charged battery, i.e. with the charging current not exceeding 10 amperes.
(c) Run the alternator at charging speed for eight minutes. This operation applies when bench testing or testing on the car.

VOLTAGE CHECKING
Leave the existing connections to the alternator and control unit undisturbed. Connect a high-quality voltmeter between control unit terminals " + " and " — ". If available, use a voltmeter of the suppressed-zero type, reading 12-15 volts. Switch on an electrical load of approximately 2 amperes, e.g. side and tail lighting. Start the engine and run the alternator at 3,000 r.p.m. until conditions (b) and (c) above are obtained.
The voltmeter should now show a reading of 13.9 - 14.3 volts at 68-78 °F. (20-26 °C.) ambient temperature volts. If not, but providing the reading obtained has risen to some degree above battery terminal voltage before finally reaching a steady value; the unit can be adjusted to control at the correct voltage (see "ADJUSTING").
If, however, the voltmeter reading remains unchanged (at battery terminal voltage) or, conversely, increases in an uncontrolled manner, then the control unit is faulty and as its component parts are not serviced individually, a replacement unit must be fitted.

ADJUSTING
Stop the engine and withdraw the control unit mounting screws. Invert the unit and chip away the sealing compound which conceals the potentiometer adjuster (see Fig. 14). Check that the voltmeter is still firmly connected between terminals " + " and " — ". Start the engine and, while running the alternator at 3,000 r.p.m. turn the potentiometer adjuster slot — clockwise to increase the setting or anti-clockwise to decrease it — until the required setting is obtained. Use care in making this adjustment — a small amount of adjuster movement causes an appreciable difference in the voltage reading. Re-check the setting by first stopping the engine then again running the alternator at 3,000 r.p.m.
If the control unit regulates satisfactorily after the adjustment has been made, refit the unit.
No attempt should be made to reseal the potentiometer. Any undue heat applied at this point may damage the unit.

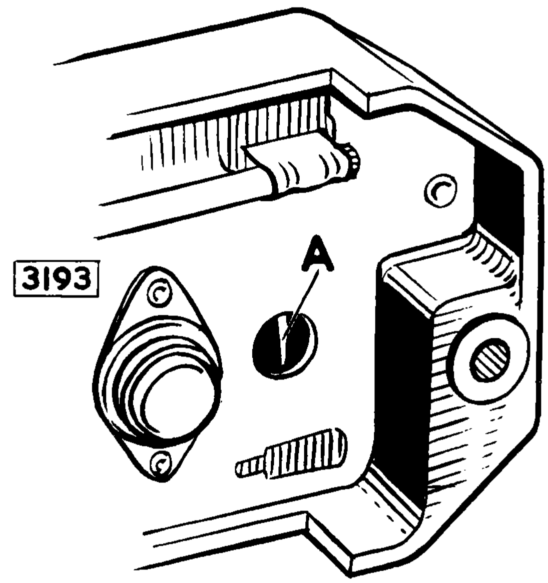


Fig. No. 14 *4TR control unit "A" indicates the poteniometer*

WARNING LIGHT CONTROL UNIT (Model 3AW)

DESCRIPTION
The Model 3AW warning light unit is a device connected to the centre point of one of the pairs of diodes in the alternator and operates in conjunction with the ignition warning light to give indication that the alternator is charging.
The unit is mounted on the wing valance adjacent to the control box and is similar in appearance to the flasher unit, but has different internal components consisting of an electrolytic (polarised) capacitor, a resistor, and a silicon diode mounted on an insulated base with three "Lucar" terminals.
The unit is sealed, therefore servicing and adjustment is not possible.
Faulty units must be replaced.
Note: Due to the external similarity of the 3AW warning light unit to the flasher unit, a distinctive green label is attached to the aluminium case of the 3AW unit.

Checking
Check by substitution after ensuring that the remainder of the charging circuit (including the drive belt) is functioning satisfactorily.
Warning: A faulty diode in the alternator or an intermittent or open circuit in the alternator-to-battery circuit can cause excessive voltages to be applied to the warning light unit. Therefore, to prevent possible damage to a replacement unit, it is important to first check the voltage between the alternator "AL" terminal and earth. Run the engine at 1,500 r.p.m. when the voltage should be 7 - 7.5 volts, measured on a good quality moving coil voltmeter. If a higher voltage is registered, check that all charging circuit connections are clean and tight, then, if necessary, check the alternator rectifier diodes before fitting a replacement 3AW unit.

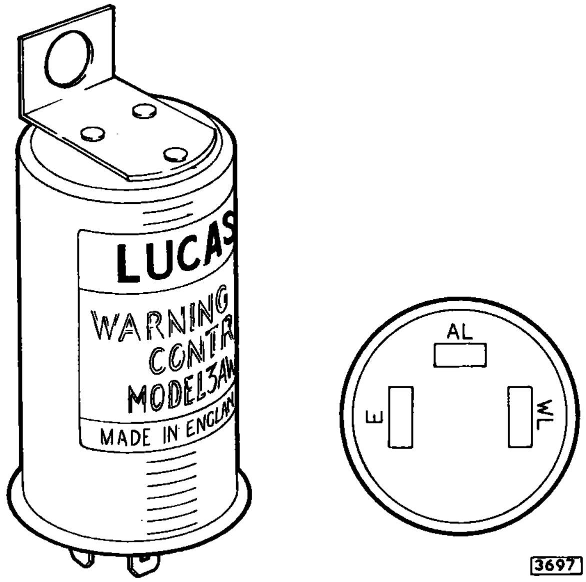


Fig. No. 15 *The 3AW warning light control unit*

THE STARTER MOTOR

DESCRIPTION

The purpose of the pre-engaged (or "positive engagement") starter motor is to prevent premature pinion ejection.
Except on occasions of tooth-to-tooth abutment, for which special provision is made, the starter motor is connected to the battery only after the pinion has been meshed with the flywheel ring gear, through the medium of an electro-magnetically operated linkage mechanism. After the engine has started, the current is automatically switched off before the pinion is retracted. On reaching the out-of-mesh position, the spinning armature is brought rapidly to rest by a braking device. This device takes the form of a pair of moulded shoes driven by a cross peg in the armature shaft and spring loaded (and centrifuged) against a steel ring insert in the commutator end bracket. Thus, with the supply switched off and the armature subjected to a braking force, the possibility is minimised of damaged teeth resulting from attempts being made to re-engage a rotating pinion.
A bridge-shaped bracket is secured to the front end of the machine by the through bolts. This bracket carries the main battery input and solenoid winding terminals, short extension cables being connected between these and the corresponding solenoid terminals.

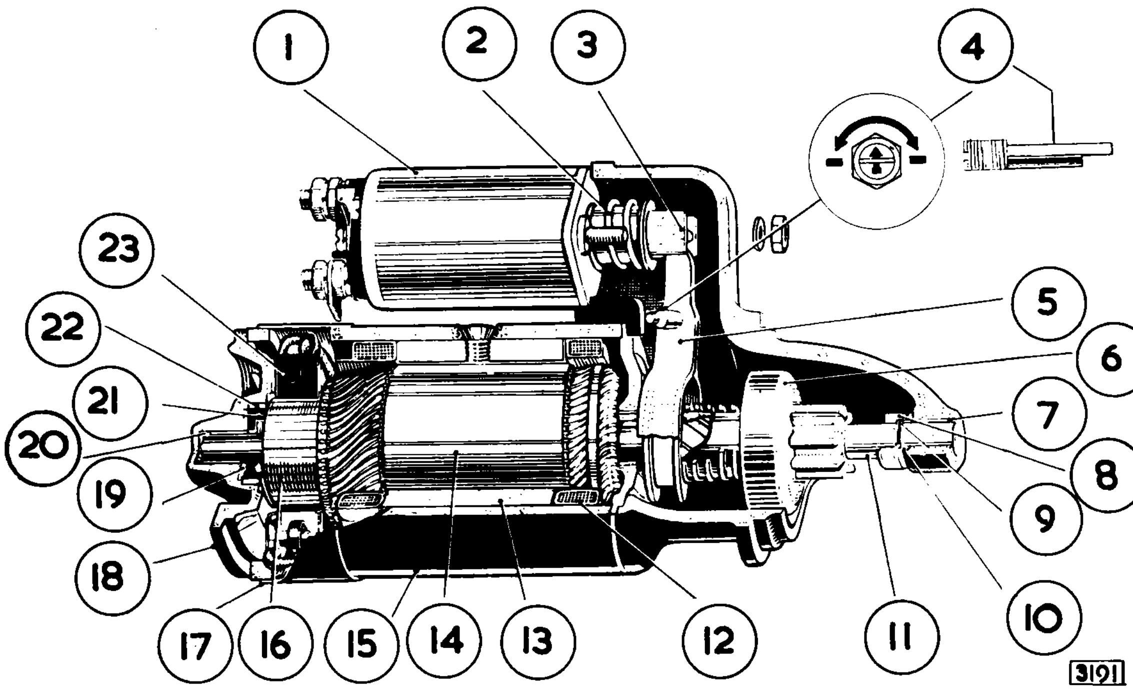


Fig. No. 16 *The Pre-engaged starter motor. Model M45G*

1	Actuating solenoid	**13**	Pole shoes
2	Return spring	**14**	Armature
3	Clevis pin	**15**	Yoke
4	Eccentric pivot pin	**16**	Commutator
5	Engaging lever	**17**	Band cover
6	Roller clutch	**18**	C.E. bracket
7	Porous bronze bush	**19**	Thrust washer
8	Thrust collar	**20**	Porous bronze bush
9	Jump ring	**21**	Brake shoes and cross peg
10	Thrust ring	**22**	Brake ring
11	Armature shaft extension	**23**	Brushes
12	Field ring		

TOOTH-TO-TOOTH ABUTMENT

The electro-magnetically actuated linkage mechanism consists essentially of a pivoted engaging lever having two hardened steel pegs (or trunnion blocks) which locate with and control the drive through the medium of a groove in an operating bush. This bush is carried, together with the clutch and pinion assembly, on an internally splined out-board driving sleeve — the whole mechanism being housed in a cut-away flange mounting snout-shaped end bracket. This operating bush is spring loaded against a jump ring in the driving sleeve by an engagement spring located between the bush and the clutch outer cover. The system return or drive de-meshing spring is located round the solenoid plunger.

On occasions of tooth-to-tooth abutment (between the ends of the starter pinion teeth and those of the flywheel ring gear), the pegs or trunnion blocks at the "lower" end of the engaging lever can move forward by causing the operating bush to compress the engagement spring, thus allowing the "upper" end of the lever to move sufficiently rearwards to close the starter switch contacts. The armature then rotates and the pinion slips into mesh with the flywheel ring gear under pressure of the compressed engagement spring.

THE "LOST MOTION" (SWITCH-OFF) DEVICE

As it is desirable that the starter switch contacts shall not close until the pinion has meshed with the flywheel ring gear, so it is important that these same contacts should always re-open before the pinion has been retracted — or can be opened in the event of a starter pinion remaining for some reason enmeshed with the flywheel ring gear. To ensure this, a measure of "lost motion" is designed into some part of the engagement mechanism, its effect being to allow the starter switch or solenoid contacts (which are always spring-loaded to the open position) to open before pinion retraction begins.

Several methods of obtaining "lost motion" have been adopted, but each depends upon the yielding of a weaker spring to the stronger system return (drive de-meshing or disengagement) spring of the solenoid plunger.
This initial yielding results in the switch contacts being fully-opened within the first $\frac{1}{8}$" (3.18 mm.) of plunger return travel — this action being followed by normal drive retraction.
Solenoid model 10S has a weaker ("lost motion") spring located inside the solenoid plunger. Here, enclosed at the outer end by a retaining cup, it forms a plunger-within-a-plunger and is spring-loaded against the tip of the engaging lever inside the plunger clevis link.

THE ROLLER CLUTCH

Torque developed by the starting motor armature must be transmitted to the pinion and flywheel through an over-running or free-wheeling device which will prevent the armature from being rotated at an excessively high speed in the event of the engaged position being held after the engine has been started. The roller clutch performs this function.
The operating principle of the roller clutch is the wedging of several plain cylindrical rollers between converging surfaces. The convergent form is obtained by matching cam tracks to a perfectly circular bore. The rollers, of which there are three, are spring-loaded and, according to the direction of drive, are either free or wedgelocked between the driving and driven members. The clutches are sealed in a rolled over steel outer cover and cannot be dismantled for subsequent re-assembly.

THE STARTER SOLENOID

The starter solenoid is an electro-magnetic actuator mounted pick-a-back fashion on the yoke of the pre-engaged motor. It contains a soft iron plunger (linked to the engaging lever), the starter switch contacts and a coil consisting of two windings, i.e., a heavy-gauge pull-in or series winding and a lighter-gauge hold-on or shunt winding.
Initially, both windings are energised in parallel when the starter device is operated, but the pull-in winding is shorted out by the starter switch contacts at the instant of closure — its duty having been effected.
Magnetically, the windings are mutually assisting.
Like the roller clutch assembly, the starter solenoid is sealed in a rolled-over steel outer case or body and cannot be dismantled for subsequent re-assembly.

STARTER MOTOR

PERFORMANCE DATA

Model	M 45 G Pre-engaged
Lock Torque	22.6 lb. ft. (3.13 kgm.) with 465 amperes at 7.6 terminal volts
Torque at 1000 r.p.m.	9.6 lb. ft. (1.33 kgm.) with 240 amperes at 9.7 terminal volts
Light running current	70 amperes at 5,800 — 6,500 r.p.m.

SOLENOID SWITCH

Model	
Closing coil resistance (measured between terminal "STA", copper link removed and "Lucar" terminal)	0.36 — 0.42 ohms
Hold on coil resistance (Measured between "Lucar" terminal and solenoid outer case)	1.49 — 1.71 ohms

ROUTINE MAINTENANCE

EVERY 24,000 MILES (38,400 KM.)

Checking the Brushgear and Commutator

Remove the starter motor (see below) from the engine. Release the screw and remove the metal band cover and check that the brushes move freely in the brush boxes by holding back the spring and pulling gently on the flexible connection. If a brush is inclined to stick, remove it from its holder and clean its sides with a petrol moistened cloth. Replace the brushes in their original positions in order to retain "bedding". Brushes which will not bed properly or have worn to $\frac{5}{16}$" (7.94 mm.) in length must be renewed. See page P.27 for method of procedure.
Check the tension of the brush springs with a spring balance. The correct tension should be 52 ozs. (1.47 kg.) on a new brush.
Replace each existing brush in turn with a new brush to enable the tension of the brush spring to be tested accurately.
Check that the commutator is clean and free from oil or dirt. If necessary, clean with a petrol moistened cloth. If this is ineffective, rotate the armature and polish the commutator with a fine glass paper. DO NOT use emery cloth. Blow out all abrasive dust with a dry air blast.
A badly worn commutator can be re-skimmed by first rough turning, followed by diamond finishing. DO NOT undercut the insulators.
Armatures must NOT be skimmed below a minimum diameter of 1.531" (38.90 mm.).
Replace the armature if below this limit.

REMOVAL

Withdraw four setscrews and lockwashers and remove the bonnet. Mark the position of the hinges to the bonnet before removing the setscrews for reference when refitting.
Remove the battery.
Remove the oil filter unit from the engine, catch any escaping oil in a container.
Disconnect the battery cable and solenoid switch cable from the starter motor.
Remove the two setscrews and lockwashers securing the motor to the housing, gently bend away the carburetter drain pipes and remove the starter motor through the chassis frame.
The bottom setscrew is accessible from beneath the car. The best method of removing the setscrew is to use a socket spanner with extensions of approximately 30" (76 cms.) in length and enter the spanner from behind the transmission unit. A second operator will be needed to guide the socket spanner on to the setscrews from inside the engine compartment.

REFITTING

Refitting is the reverse of the removal procedure.
Care must be taken when refitting the two setscrews, which have a fine thread, that they are not cross-threaded.
Renew the oil filter joint when refitting the unit.

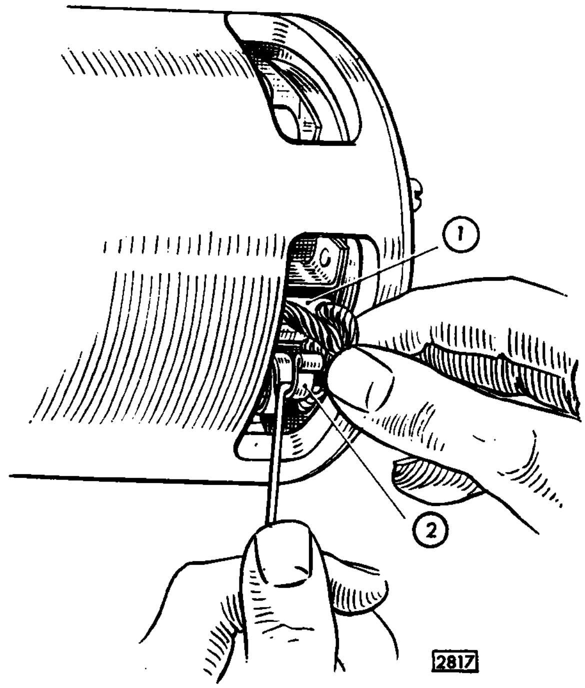


Fig. No. 17 *Checking the brush gear*

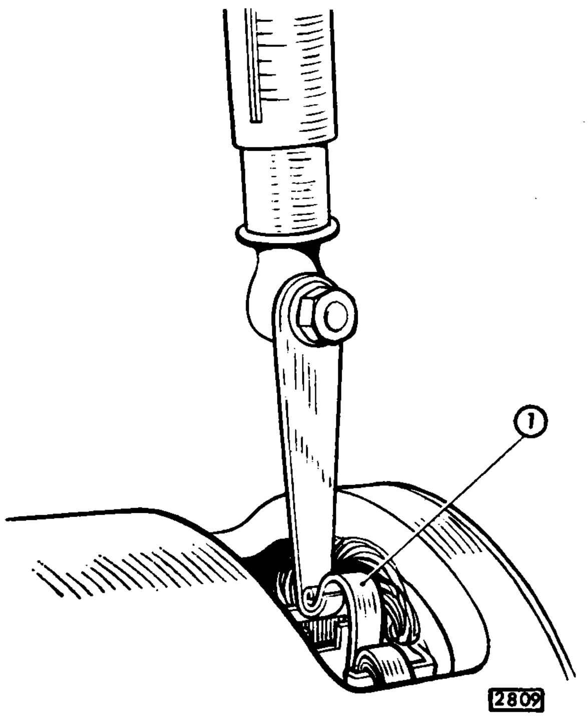


Fig. No. 18 *Testing the brush spring tension. Brush spring indicated.*

SERVICING

Testing in Position

Check that the battery is fully charged and the terminals are clean and tight. Recharge if necessary. Switch on the lamps and ignition and operate the starter control. If the lights go dim but the starter does not crank the engine, an indication is given that the current is flowing through the starter motor winding, but the armature is not rotating for some reason.
The fault is possibly due to high resistance in brush gear or open circuit in armature or field coils.
Remove the starter motor for examination.
If the lights retain their full brilliance when the starter control is operated check:
(a) the starter motor circuit for continuity.
(b) the solenoid unit for continuity.
If the supply voltage is found to be applied to the starter motor when the control is operated, the unit must be removed from the engine and checked for an internal fault.
Sluggish or slow action of the starter motor is usually due to a loose connection causing a high resistance in the motor circuit. Check as described above.
If the motor is heard to operate but does not crank the engine, indication is given of damage to the drive.

BENCH TESTING

Removing the Starter Motor from the Engine

Disconnect the battery. Disconnect and remove the starter motor from the engine. See page P.25 for removal procedure.

MEASURING THE LIGHT RUNNING CURRENT

With the starter motor securely clamped in a vice and using a 12-volt battery, check the light running current and compare with the value given on page P.24.
If there appears to be excessive sparking at the commutator, check that the brushes are clean and free to move in their boxes and the spring pressure is correct. See symptoms 7 and 8, page P.26.

MEASURING LOCK TORQUE AND LOCK CURRENT

Carry out a torque test and compare with the values given on page P.24.
If a constant voltage supply is used, it is important to adjust this to be 7.6 volts at the starter terminal when testing.

FAULT DIAGNOSIS

An indication of the nature of the fault or faults may be deduced from the results of the no-load and lock torque tests.

	Symptom	Probable Fault
1.	Speed, torque and current consumption correct	Assume motor to be in normal operating condition.
2.	Speed, torque and current consumption low	High resistance in brush gear e.g. faulty connections, dirty or burned commutator causing poor brush contact
3.	Speed and torque low, current consumption high	Tight or worn bearings, bent shaft, insufficient end play, armature fouling a pole shoe, or a cracked spigot on drive end bracket. Short circuited armature earthed armature or field coils
4.	Speed and current consumption high, torque low	Short-circuited windings in field coils
5.	Armature does not rotate, high current consumption	Open-circuited armature, field coils, or solenoid unit. If the commutator is badly burned, there may be poor contact between brushes and commutator
6.	Armature does not rotate, high current consumption	Earthed field winding or short-circuited solenoid unit. Armature physically prevented from rotating
7.	Excessive brush movement causing arcing at commutator	Low brush spring tension, worn or out-of-round commutator. "Thrown" or high segment on commutator
8.	Excessive arcing at the commutator	Defective armature windings, sticking brushes or dirty commutator

DISMANTLING

Disconnect the copper link between the lower solenoid terminal and the starter motor yoke.
Remove the two solenoid unit securing nuts. Detach the extension cable and withdraw the solenoid from the drive end bracket casting, carefully disengaging the solenoid plunger from the starter drive engagement lever.
Remove the cover band and lift the brushes from their holders.
Unscrew and withdraw the two through bolts from the commutator end bracket. The commutator end bracket and yoke can now be removed from the intermediate and drive end brackets.
Extract the rubber seal from the drive end bracket.
Slacken the nut securing the eccentric pin on which the starter drive engagement lever pivots and unscrew and withdraw the pin.
Separate the drive end bracket from the armature and intermediate bracket assembly.
Remove the thrust washer from the end of the armature shaft extension using a mild steel tube of suitable bore.
Prise the jump ring from its groove and slide the drive assembly and intermediate bracket from the shaft.
To dismantle the drive further, prise off the jump ring retaining the operating bush and engagement spring.

BENCH INSPECTION

After dismantling the motor, examine individual items.

Replacement of Brushes

The flexible connectors are soldered to terminal tags; two are connected to brush boxes and two are connected to free ends of the field coils. Unsolder these flexible connectors and solder the connectors of the new brush set in their place.
The brushes are pre-formed so that "bedding" to the commutator is unnecessary. Check that the new brushes can move freely in their boxes.

Commutator

A commutator in good condition will be burnished and free from pits or burned spots. Clean the commutator with a petrol moistened cloth. Should this be ineffective, spin the armature and polish the commutator with fine glass paper; remove all abrasive dust with a dry air blast. If the commutator is badly worn, mount the armature between centres in a lathe, rotate at high speed and take a light cut with a very sharp tool. Do not remove more metal than is necessary. Finally polish with very fine glass paper. The INSULATORS between the commutator segments **MUST NOT BE UNDERCUT.**
Armatures must NOT be skimmed below a minimum diameter of 1.531" (38.90 mm.). Replace the armature if below this limit.

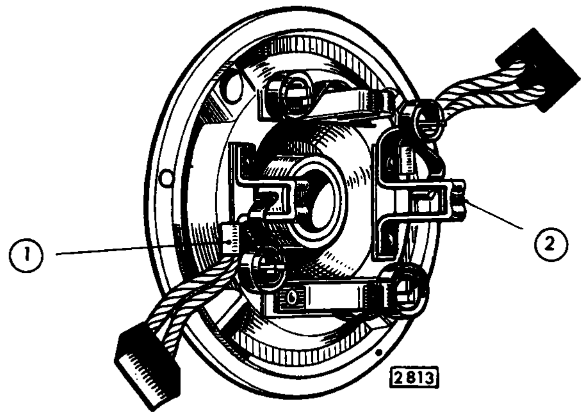


Fig. No. 19 *Comutator end bracket brush connections*

Armature

Lifted conductors

If the armature conductors are found to be lifted from the commutator risers, overspeeding is indicated. In this event, check that the clutch assembly is operating correctly.

Fouling of Armature Core against the Pole Faces

This indicates worn bearings or a distorted shaft. A damaged armature must, in all cases, be replaced and no attempt should be made to machine the armature core or to true a distorted armature shaft.

Insulation Test

To check armature insulation, use a 110-volt A.C. test lamp.
The test lamp must not light when connected between any commutator segment and the armature shaft.
If a short circuit is suspected, check the armature on a "growler". Overheating can cause blobs of solder to short circuit the commutator segments.
If the cause of an armature fault cannot be located or remedied, fit a replacement armature.

Field Coils

Continuity Test

Connect a 12-volt test lamp and battery between the terminal on the yoke and each individual brush (with the armature removed from the yoke). Ensure that both brushes and their flexible connectors are clear of the yoke. If the lamp does not light, an open circuit in the field coils is indicated.
Replace the defective coils.

Insulation Test

Connect a 110-volt A.C. test lamp between the terminal post and a clean part of the yoke. The test lamp lighting indicates that the field coils are earthed to the yoke and must be replaced.
When carrying out this test, check also the insulated pair of brush boxes on the commutator end bracket. Clean off all traces of brush deposit before testing.

Connect the 110-volt test lamp between each insulated brush box and the bracket.
If the lamp lights, this indicates faulty insulation and the end bracket must be replaced.

Replacing the Field Coils
Unscrew the four-pole-shoe retaining screws, using a wheel-operated screwdriver. Remove the insulation piece which is fitted to prevent the inter-coil connectors from contacting with the yoke.
Draw the pole shoes and coils out of the yoke and lift off the coils. Fit the new field coils over the pole shoes and place them in position inside the yoke. Ensure that the taping of the field coils is not trapped between the mating surfaces of the pole shoes and the yoke.
Locate the pole shoes and field coils by lightly tightening the retaining screws.
Replace the insulation piece between the field coil connections and the yoke.
Finally, tighten the screws by means of the wheel-operated screwdriver while the pole pieces are held in position by a pole shoe expander or a mandrel of suitable size.

Bearings and Bearing Replacement
The commutator and drive end brackets are each fitted with a porous bronze bush and the intermediate bracket is fitted with an indented bronze bearing.
Replace bearings which are worn to such an extent that they will allow excessive side play of the armature shaft.
The bushes in the intermediate and drive end brackets can be pressed out, whilst that in the commutator end bracket is best removed by inserting a $\frac{9}{16}$" tap squarely into the bearing and withdrawing the bush with the tap.
Before fitting a new porous bronze bearing bush, immerse it for 24 hours in clean engine oil (SAE.30-40).
In cases of extreme urgency, this period may be shortened by heating the oil to 100°C., for two hours and then **allowing the oil to cool before removing the bush.** Fit new brushes by using a shouldered, highly polished mandrel approximately 0.0005" greater in diameter than the shaft which is to fit in the bearing.
Porous bronze bushes must not be reamed out after fitting, as the porosity of the bush will be impaired.
After fitting a new intermediate bearing bush, lubricate the bearing surface with Rocol "Molypad" molybdenised non-creep, or similar oil.

CHECKING THE ROLLER CLUTCH DRIVE

A roller clutch drive assembly in good condition will:
Provide instantaneous take-up of the drive in the one direction.
Rotate easily and smoothly in the other.
Be free to move round or along the shaft splines without roughness or tendency to bind.
Similarly, the operating bush must be free to slide smoothly along the driving sleeve when the engagement spring is compressed.
Trunnion blocks must pivot freely on the pegs of the engaging lever.
All moving parts should be smeared liberally with Shell Retinax "A" grease, or an equivalent alternative.

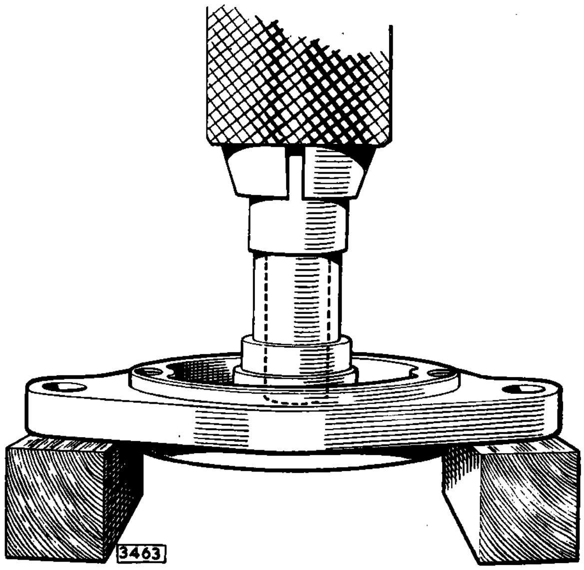


Fig. No. 20 *Method of fitting the porous bronze bush*

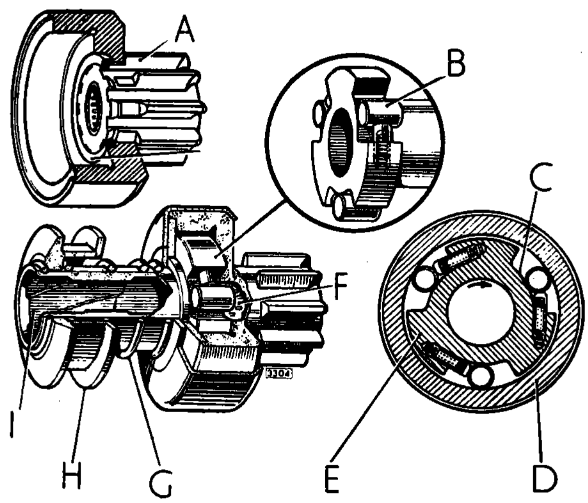


Fig. No. 21 *The roller clutch components*

A Alternative construction (pinion pressed and clear-ringed into the drive member)
B Spring loaded rollers
C Cam tracks
D Driven member (with pinion)
E Driving member
F Bush
G Engagement spring
H Operating bush
I Driving sleeve

RE-ASSEMBLY

After cleaning all parts, re-assembly of the starter motor is a reversal of the dismantling procedure given in paragraph 4(c), but the following special points should be noted.

The following parts should be tightened to the maximum torques indicated:

Nuts on solenoid copper terminals:	20 lb. in. (0.23 kg.m.)
Solenoid fixing bolts:	4.5 lb. ft. (0.62 kg.m.)
Starter motor through bolts:	8.0 lb. ft. (0.83 kg.m.)

When refitting the C.E. bracket, see that the moulded bracket shoes seat squarely and then turn them so that the ends of the cross peg in the armature shaft engage correctly with the slots in the shoes.

SETTING PINION MOVEMENT

After complete assembly of the starter motor, connect the "Lucar" solenoid terminal by way of a switch to a 6-volt supply.

Connect the other side of the supply to the starter motor yoke.

Close the switch (this throws the drive assembly forward into the engage position) and measure the distance between the pinion and the thrust washer on the armature shaft extension. Make this measurement with the **pinion pressed lightly towards the armature** to take up any slack in the engagement linkage. For correct setting, this distance should be 0.005" - 0.015" (0.127 - 3.81 mm.). To adjust the setting, slacken the eccentric pivot pin securing nut and turn the pin until the correct setting is obtained. Note that the arc of the adjustment is 180° and the head of the arrow marked on the pivot pin should be set only between the arrows on the arc described on the drive end bracket casting.

After setting, tighten the securing nut to retain the pin position.

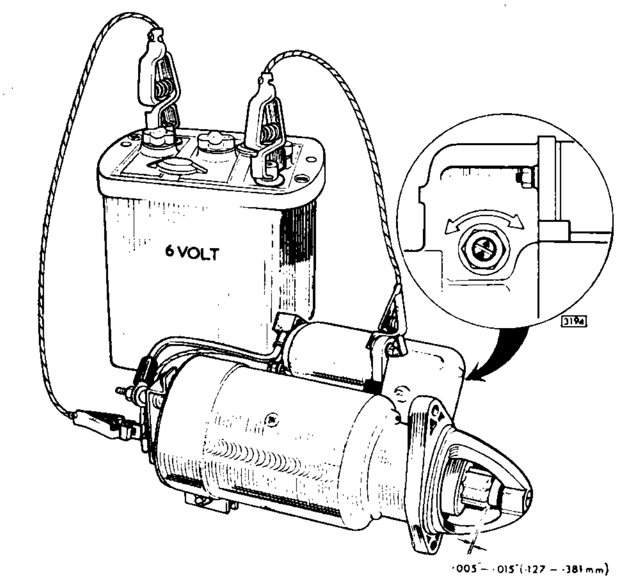


Fig. No. 22 *Setting pinion movement*

CHECKING OPENING AND CLOSING OF STARTER SWITCH CONTACTS

The following checks assume that pinion travel has been correctly set. Remove the copper link connecting solenoid terminal "STA" with the starter motor terminal.

Connect, through a switch, a supply of 10-volts D.C., to the series winding, i.e., connecting between the solenoid "Lucar" terminal and large terminal "STA". DO NOT CLOSE THE SWITCH AT THIS STAGE.

Connect a separately energised test lamp circuit across the solenoid main terminals.

Insert a stop in the drive end bracket to restrict the pinion travel to that of out-of-mesh clearance — normally, a nominal $\frac{1}{8}$" (3.17 mm.). An open-ended spanner of appropriate size and thickness can often be utilised for this purpose — its jaws embracing the armature shaft extension.

Energise the shunt winding with a 10-volt D.C. supply and then close the switch in the series winding circuit. The solenoid contacts should close fully and remain closed, as indicated by the test lamp being switched on and emitting a steady light.

Switch off and remove the stop.

Switch on again and hold the pinion assembly in the fully engaged position.

Switch off and observe the test lamp.

The solenoid contacts should open, as indicated by the test lamp being switched off.

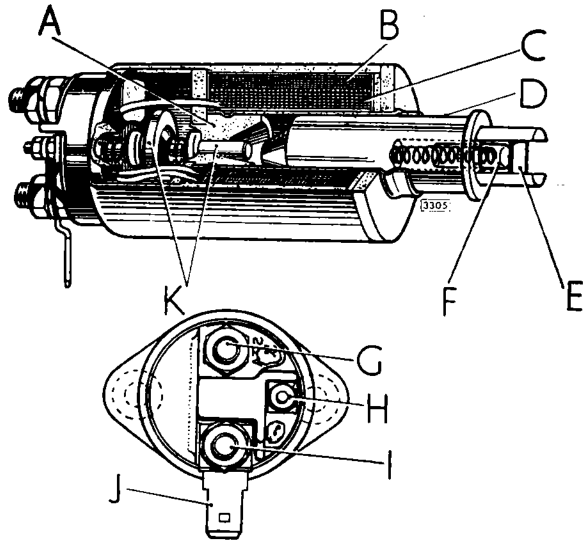


Fig. No. 23 *Checking the opening and closing of the starter switch contacts*

- **A** Core
- **B** Shunt winding
- **C** Series winding
- **D** Plunger
- **E** Clevis pin
- **F** "lost motion" Device
- **G** Starter terminal
- **H** Solenoid terminal
- **I** Battery terminal
- **J** Accessories terminal
- **K** Spindle and moving contact terminal

LAMPS
Light Bulbs

LIGHT	LUCAS BULB No.	VOLTS	WATTS	APPLICATION
Outer Headlight (Main and dip beams)	Sealed Beam Unit 410	12	60/45	Home and R.H.D. Export
		12	50/40	S. America & M. East
		12	37.5/50	U.S.A.
		12	45/40	Belgium, Holland, Sweden, Austria, Italy & Germany
	411	12	45/40 (Yellow)	France
Inner Headlight (Main beam only)	Sealed Beam Unit 410	12	50	Home
		12	37.5	R.H.D. Export
		12	37.5	Austria, U.S.A., Germany
		12	37.5 (Yellow)	France
		12	45	Italy
Side light	989	12	6	
Front and rear flashing indicators	382	12	21	
Rear brake	380	12	6/21	
Number plate	989	12	6	
Reversing lights	382	12	21	
Interior lights—pillar/rear	254	12	6	
Glovebox illumination	254	12	6	
Map light	989	12	6	
Luggage compartment illumination	989	12	6	
Heated rear window warning Instrument illumination, headlight warning, Ignition warning, handbrake/fluid warning Sidelamp warning light Traffic hazard warning	987	12	2.2	Optional extra Italy only U.S.A. only
Switch indicator strip, flasher warning Overdrive indicator Automatic transmission indicator	281	12	2	
Heater control panel	286	24	3	
Fog lamp	Phillips 683	12	48	Optional extra

HEADLIGHTS

DESCRIPTION

The 420 Model is fitted with the four headlight system, the standard light units fitted are of the sealed beam type having aiming pads mounted into the lenses. These pads are of use with an approved mechanical aimer (such as the Lucas Lev-L-Lite).

To obtain the best possible results from the headlights, it is essential that they are correctly adjusted. The alignment of the headlight beam is set correctly before the car leaves the factory but, if for any reason adjustment becomes necessary and an approved beam setter is not available, the following procedure should be carried out.

ROUTINE MAINTENANCE

Every 12,000 Miles (20,000 km.)

Check the headlight alignment and adjust as necessary.

HEADLAMP BEAM SETTING

Place the car on a level surface in front of a wall or board. Mark out the vertical and horizontal centre lines of both inner and outer headlight units on the wall or board and position the car 25 feet (7.6 m.) away from, and square to, the surface.

Inner Headlamp Beam Setting (All Cars)

Switch off the headlights in the full beam position and blank off the outer headlights. Set the inner headlights to the position shown in Fig. 24.

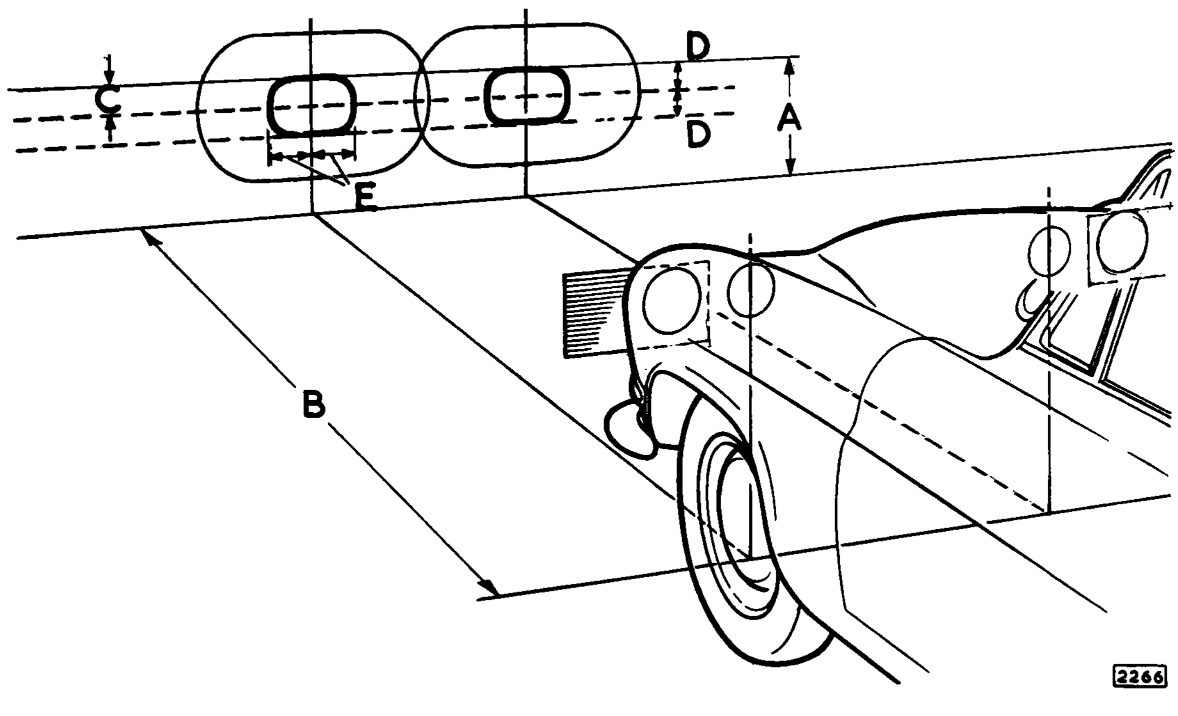
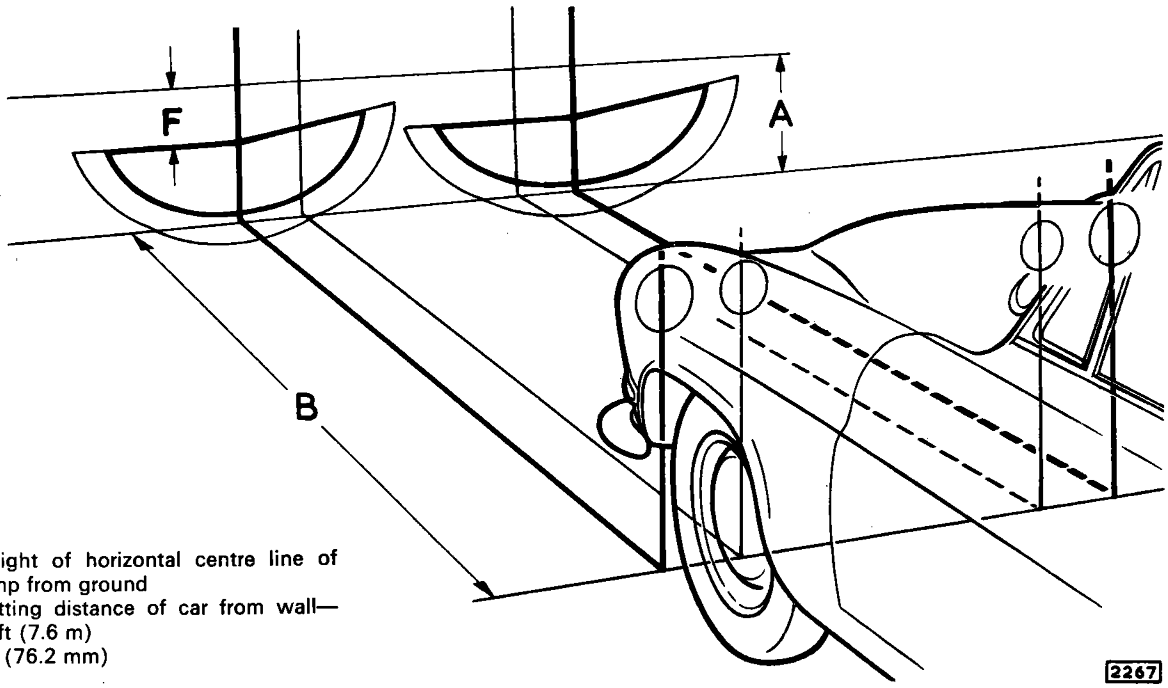


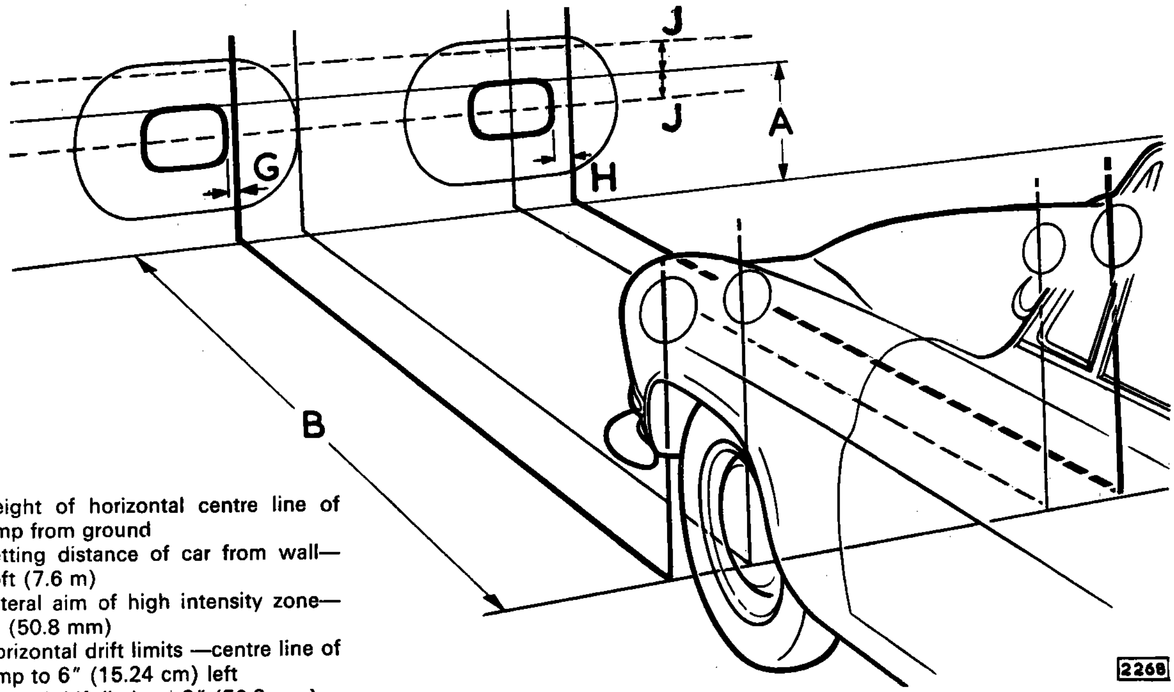
Fig. No. 24 *Inner headlight beam setting*

- **A** Height of horizontal centre line of lamp from ground
- **B** Setting distance of car from wall—25ft. (7.6 m)
- **C** Centre of "Hot Spot" below horizontal centre line 2" (50.8 mm).
- **D** Vertical drift limits ±2" (50.8 mm)
- **E** Horizontal drift limits ±6" (15.24cm)



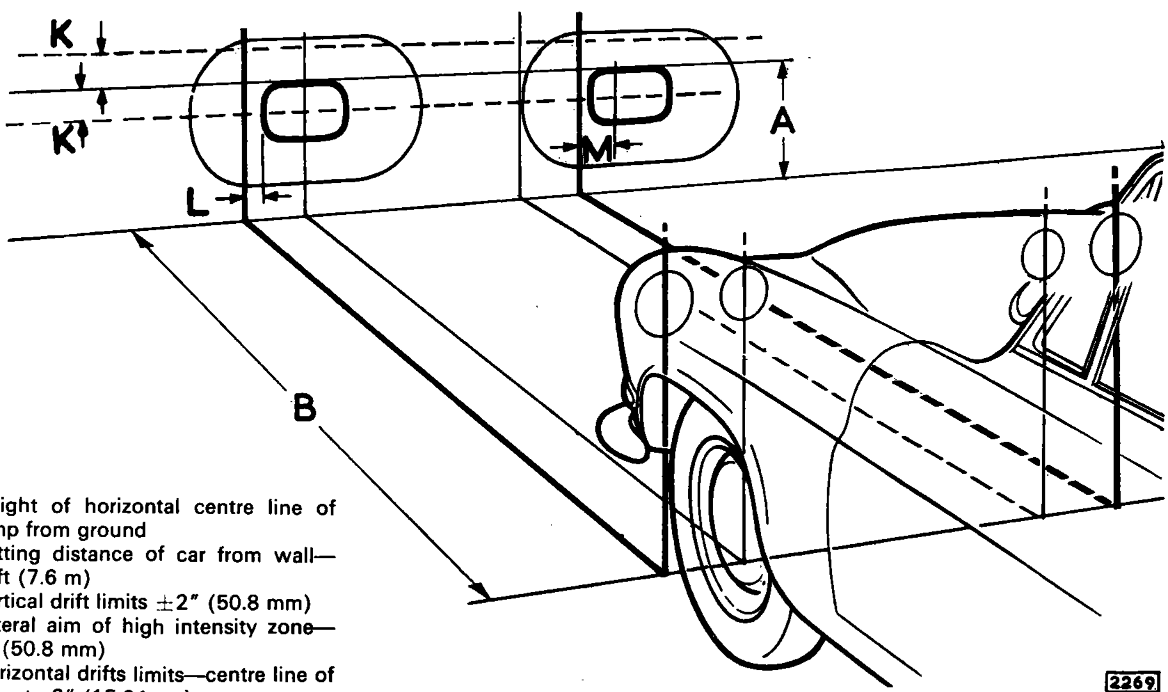
A Height of horizontal centre line of lamp from ground
B Setting distance of car from wall—25ft (7.6 m)
F 3″ (76.2 mm)

Fig. No. 25 *Outer headlight beam setting—vertical dip*



A Height of horizontal centre line of lamp from ground
B Setting distance of car from wall—25ft (7.6 m)
G Lateral aim of high intensity zone—2″ (50.8 mm)
H Horizontal drift limits —centre line of lamp to 6″ (15.24 cm) left
J-J Vertical drift limits $\pm 2''$ (50.8 mm)

Fig. No. 26 *Outer headlight beam setting (right-hand drive cars)*



A Height of horizontal centre line of lamp from ground
B Setting distance of car from wall—25ft (7.6 m)
K-K Vertical drift limits $\pm 2''$ (50.8 mm)
L Lateral aim of high intensity zone—2″ (50.8 mm)
M Horizontal drifts limits—centre line of lamp to 6″ (15.24 cm)

Fig. No. 27 *Outer headlight beam setting (left-hand drive cars)*

Outer Headlight Beam Setting (Vertical Dip Units)

With the headlights switched on in the dip position, set the outer headlight beams to the position shown in Fig. 25.

Outer Headlight Beam Setting (Right-hand Drive Cars excluding Vertical Dip Units)

With the headlights switched on in the dip position, set the outer headlight beams to the position shown in Fig. 26.

Adjusting the Headlight Beam

Remove the headlight surround by unscrewing the retaining screw and springing the surround away from the bottom clip fixings.

The setting of the outer beams is adjusted by two screws, one being located at the top centre and the other at the centre left-hand side. The top screw is for vertical adjustment, that is, to raise or lower the beam; turn the screw anti-clockwise to lower the beam and clockwise to raise the beam. The side screw is for lateral adjustment, that is, to turn the beam to left or right. To move the beam to the right, turn the screw clockwise and to move the beam to the left, turn the screw anti-clockwise.

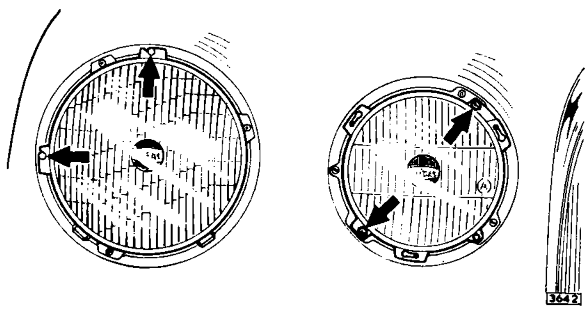


Fig. No. 28 *The inner and outer headlight beam setting screws*

The setting of the two inner beams is adjusted by two screws diagonally opposite each other. The upper screw is for vertical adjustment, turn the screw clockwise to move the beam to the right and anti-clockwise to move the beam to the left.

Note: Cars for some countries are fitted with similar light units in the inner and outer positions. The adjustment of the beam on these outer lights is the same as that described above for the inner headlights.

LIGHT BULB REPLACEMENT

OUTER HEADLAMP REPLACEMENT

Remove the top retainer screw and withdraw the headlamp embellisher noting the two retaining lugs at the lower edge. Remove the three cross headed screws and the headlight retaining rim. Withdraw the headlight unit and detach the socket from the rear of the unit. The headlight may now be replaced with a unit of the correct type.

On cars fitted with non-sealed beam headlights proceed as described above until the headlight unit is withdrawn, release the bulb retaining spring clips and withdraw the bulb. Replace with a bulb of the correct type (see page P.30). When reassembling, note that a groove in the bulb plate must register with a raised portion of the bulb retainer.

Note: Do not turn the two slotted screws or the setting of the headlights will be upset.

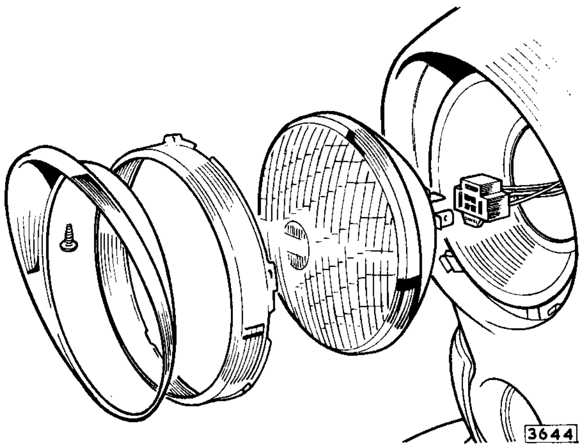


Fig. No. 29 *The outer headlight unit removal*

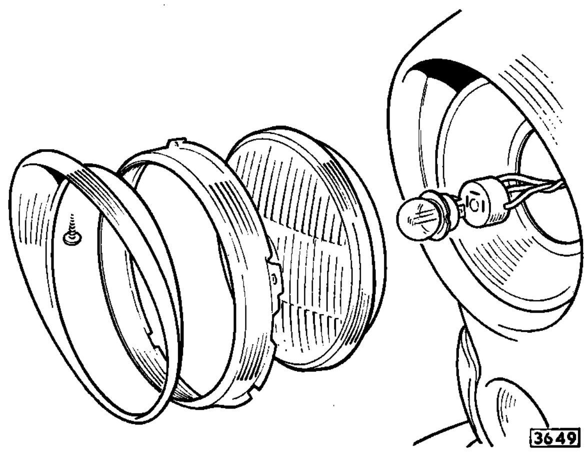


Fig. No. 30 *The outer headlight unit removal (non-sealed beam unit)*

INNER HEADLIGHT — REPLACEMENT

The procedure for replacing the inner headlight unit or bulb is the same as that described in "Outer Headlight — Replacement". However, when removing the headlight unit retaining rim, it is not necessary to remove the three cross headed screws, these should be slackened and the rim turned anti-clockwise until it can be withdrawn.

Note: Do not turn the two slotted screws or the setting of the headlight will be upset.

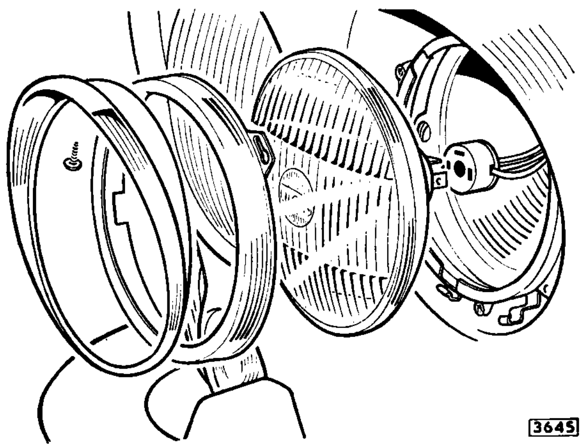


Fig. No. 31 *The inner headlight unit removal*

SIDELIGHT BULB — REPLACEMENT

Remove two screws, withdraw the embellisher and light unit.

Detach the bulb holder and remove the bulb.

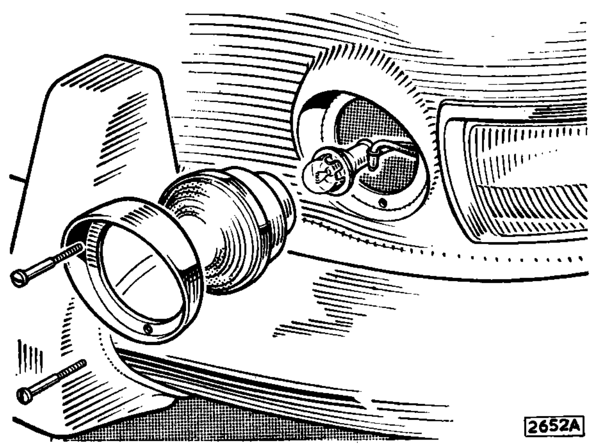


Fig. No. 32 *Side light bulb removal*

FRONT FLASHER BULB — REPLACEMENT

Remove the screw retaining the glass. Detach the glass at the three tags under the chrome surround and remove the bulb.

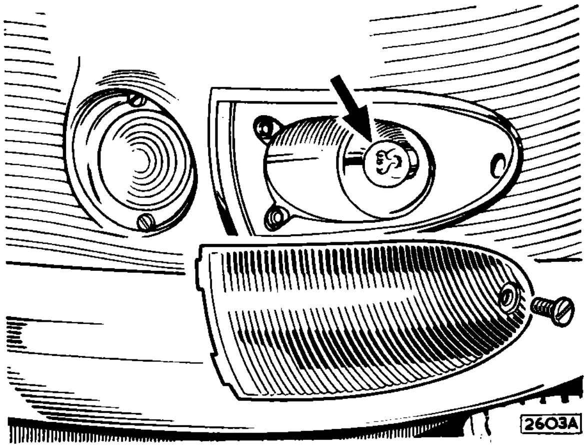


Fig. No. 33 *Front flasher bulb removal*

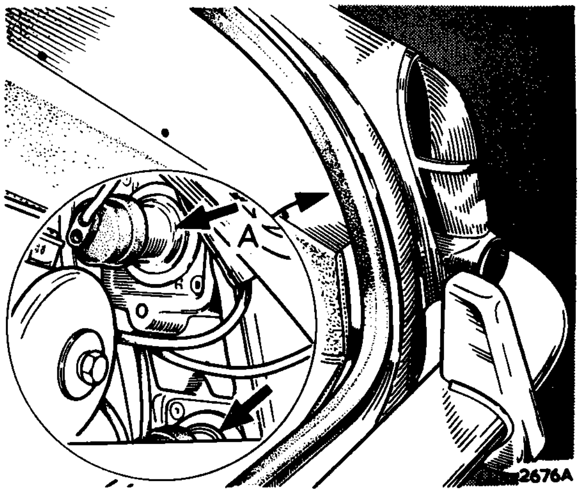


Fig. No. 34 *Rear flasher/rear light/brake light bulb removal*

REAR FLASHER BULB — REPLACEMENT

Remove the screws securing the appropriate luggage compartment casing. Withdraw the upper bulb holder from the rear of the light assembly and remove the bulb.

REAR/BRAKE LIGHT BULB — REPLACEMENT

Proceed as for Rear Flasher Bulb, but withdraw the lower bulb holder. When fitting a replacement bulb note that the pins are offset.

LUGGAGE COMPARTMENT LIGHT BULB — REPLACEMENT

The bulb is accessible through an aperture in the luggage compartment lid casing. Remove the bulb by pressing in and turning anti-clockwise.

INTERIOR LIGHT BULBS — REPLACEMENT

Using care to avoid breakages, prise the cover from the appropriate interior light noting the stud fixings. Remove the bulb by pressing in and turning through 90°. Replace the bulb with one of the correct value by pressing the bulb into the holder and turning until the notches inside the holder are located. Replace the cover by pressing onto the securing studs.

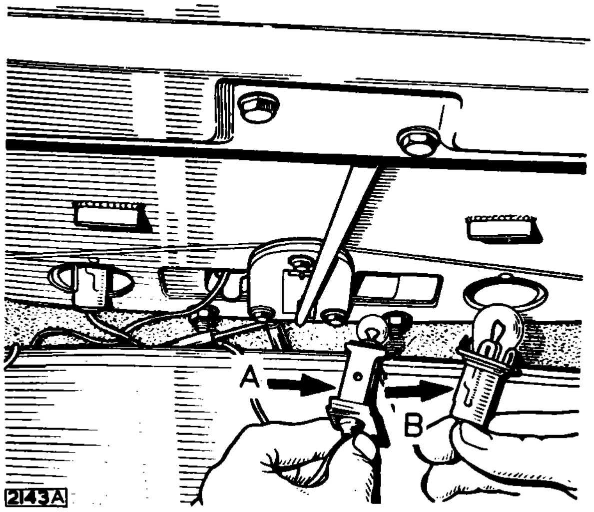


Fig. No. 35 *Number plate and reverse light bulb removal*

NUMBER PLATE LIGHT BULB — REPLACEMENT

Remove sufficient screws securing the luggage compartment lid casing to allow access to the bulb holders. The number plate bulb holders are the two in the centre of the group. Press the tag in, lift and withdraw the holder. Remove bulb.

REVERSING LIGHT BULB — REPLACEMENT

Proceed as for the number plate light bulb. The reversing light bulb holders are those on the outside of the group.

GLOVEBOX LIGHT BULB — REPLACEMENT

Open the glove box lid and remove the mauve glass from its holder. Care should be taken when removing this glass to avoid breakages. Remove the bulb from between the two contacts and replace with a bulb of the correct value. Replace the glass.

SIDELAMP WARNING LIGHT BULB — REPLACEMENT (ITALIAN MARKET ONLY)

Withdraw the bulb carrier unit only from the holder (accessible from the rear face of the side facia panel). Unscrew the bulb and replace with one of the correct value, that is, 12-volt 2.2 watts screw cap.

BRAKE FLUID AND HANDBRAKE WARNING LIGHT BULB — REPLACEMENT

Unscrew the bezel of the lamp, exercising care to control the run of the spring loaded bulb beneath. Feed the bulb into the spring-loaded bulb holder, ensure that the red transparent window is retained in the bezel by a small circlip, position the designation plate on the bulb holder and screw on the bezel.

FLASHING INDICATOR BULB — REPLACEMENT

Disconnect the earth lead at the battery.
Detach the switch cover from above the steering column by withdrawing the two most sunken screws from below. Withdraw one or both flasher indicator warning light bulb holders from the outer sockets of the upper switch cover. Remove the bulb from the holder by applying inward pressure and rotating through 90° in either direction.
The bulb is replaced by inserting into the bulb holder and rotating through 90° until the notches inside the bulb holder are located. Replacing the bulb holder and upper switch cover is the reverse of the removal procedure.

AUTOMATIC SELECTOR BULB — REPLACEMENT

Disconnect the earth cable at the battery. Detach the upper switch cover from the steering column by removing the two most sunken screws from below. Remove the bulb holder from the centre socket in the switch cover. Remove the bulb from the holder by pressing in and turning through 90° in either direction. The bulb is replaced by inserting into the bulb holder and turning until the notches inside the bulb holder are located. Replacing the bulb holder and upper switch cover is the reverse of the removal procedure.

MAP LIGHT BULB — REPLACEMENT

Remove the bulb which is situated under the centre of the screen rail in front of the instrument panel. Removal is effected by pressing the bulb inwards, rotating slightly and withdrawing outwards.
Replace the bulb by a reversal of the above procedure.

INDICATOR STRIP BULBS — REPLACEMENT

Three bulbs are provided along the bottom rear edge of the instrument panel. Withdraw the bulbs by pulling out from the sockets provided in the panel.
Replace the appropriate bulb with one of the correct value.

HEATED BACKLIGHT INDICATOR BULB (WHEN FITTED) — REPLACEMENT

Remove the chrome bezel and unscrew the bulb from the bulbholder.

FLASHER UNIT

The flasher unit is housed in a small cylindrical container behind the screen rail and is accessible after lowering the instrument panel.
The automatic operation of the flasher lamps is controlled by means of a switch, contained in the flasher unit, being operated automatically by the alternative heating and cooling of an actuating wire; also incorporated is a small relay to flash the indicator warning lights when the system is functioning correctly. Failure of either of these lights to flash will indicate a fault.
In the event of trouble occurring, the following procedure should be followed:

(a) Check bulbs for broken filaments.

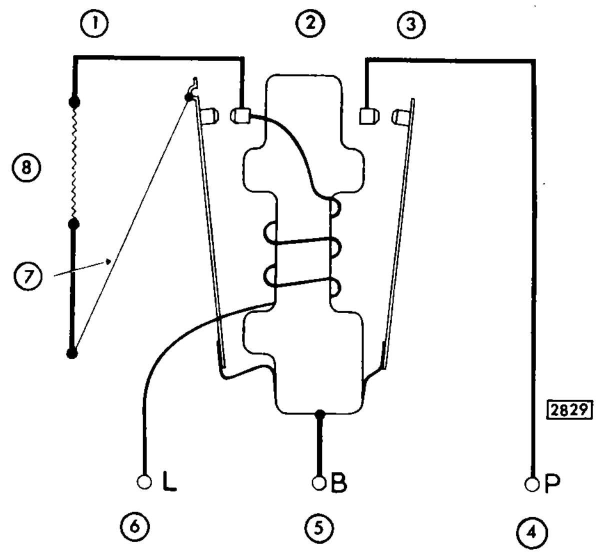


Fig. No. 36 *Flasher unit circuit diagram*

1 Main armature/contact
2 Steel core and coil
3 Secondary armature and pilot contacts
4 To pilot lamp(s)
5 From battery
6 To lamp via switch
7 Actuating wire
8 Ballast resistor

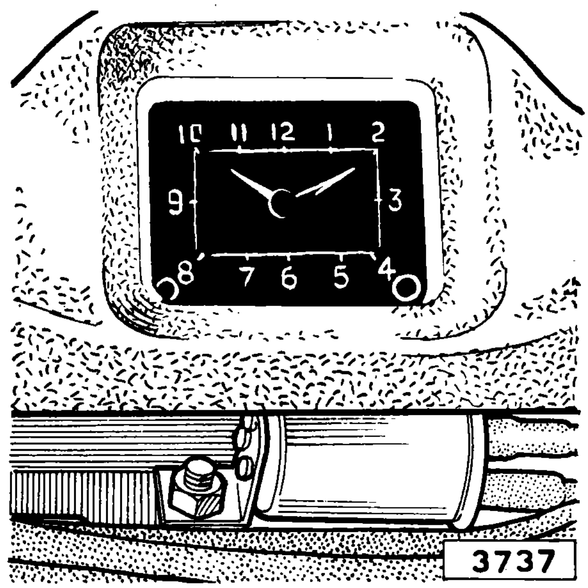


Fig. No. 37 *Location of the flasher unit behind the instrument panel*

(b) Refer to the wiring diagram and check all flasher circuit connections.

(c) Switch on the ignition and check with a voltmeter that flasher unit terminal "B" is at 12 volts, with respect to earth.

(d) Connect together flasher unit terminals "B" and "L" and operate the direction indicator switch. If the flasher lamps now light, the flasher unit is defective and must be replaced.

(e) If, after the above check, the bulb still does not light, a fault is indicated in the manual flasher switch on the steering column which is best checked by substitution.

Note: It is important that only bulbs of the correct wattage rating (that is, 21 watts) are used in the flasher lamps.

FUSE UNIT

Four Lucas Model 4 FJ fuse units each carrying two live glass cartridge type fuses and two spares are incorporated in the electrical system and are located behind the instrument panel.
Access to the fuses is obtained by removing the two instrument panel retaining screws (top left-hand and top right-hand corners). The instrument panel will then hinge downwards exposing the fuses and the fuse indicator panel. The circuits controlled by individual fuses are shown on the indicator panel and it is

essential that the blown fuse is replaced by one of the correct value.
Only one of the spare fuses is visible and they are retained in position by a small spring clip. Always replace the spare fuse as soon as possible.

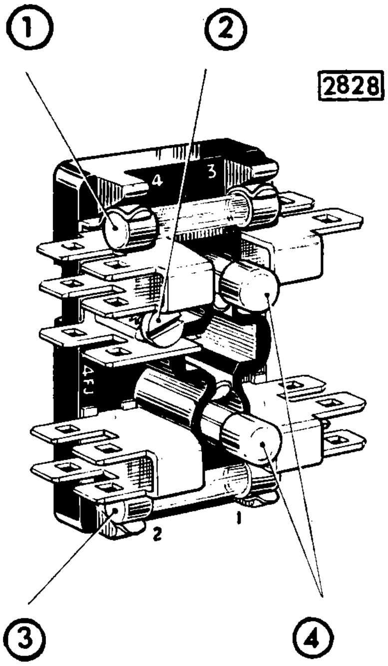


Fig. No. 38 *The 4J fuse unit*

On cars exported to Germany the tail lamps and number plate lamps are not fused.
The fuses for the heated back light and the air-conditioning equipment, both available as optional extras, are located in plastic fuse holders behind the instrument panel.

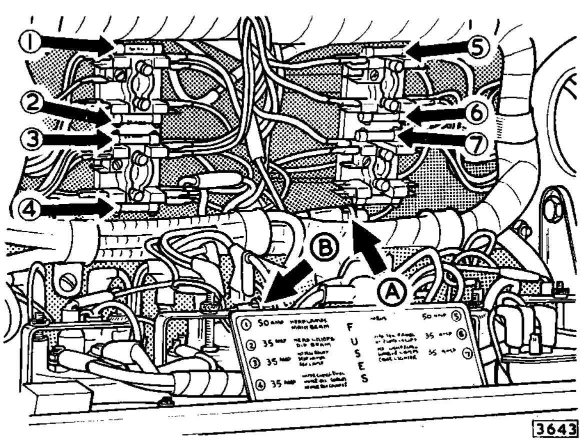


Fig. No. 39 *Location of fuses*

CIRCUITS

Fuse No.		Amps.
1	Headlamp (main beam)	35
2	Headlamp (dip beam)	35
3	Horn relay, screen washer, stop lamps, flashers, reverse lamps, overdrive solenoid	35
4	Windscreen wipers, auxiliary starting carburetter, fuel, oil and water gauges, heater motor	35
5	Horns	50
6	Side, tail, panel and number plate lamps	35
7	Headlamp flashers, interior lamps, cigar lighter	35
8	Spare	35
A	Heated backlight (optional extra)	15
	Overdrive solenoid (when fitted)	8
	Radio line fuse (when fitted)	5
	Traffic hazard warning (U.S.A. only)	35
B	Air-conditioning equipment (optional extra)	30

TRAFFIC HAZARD WARNING DEVICE U.S.A. MARKET ONLY

Description

In order to comply with the traffic regulations for the State of New York, U.S.A., all cars exported to the U.S.A., and cars sold for subsequent shipment to the U.S.A., after September 1st, 1965, will have a traffic hazard warning device fitted as standard equipment.
The system operates in conjunction with the four flashing (turn) indicator lamps fitted to the car.
The operation of a toggle switch will cause the four turn indicator lamps to flash simultaneously.
A red warning lamp is incorporated in the circuit to indicate that the hazard warning system is in operation.
A 35 amp. in-line fuse (20 amp. U.S.A. rating) is incorporated in the sub-panel circuit.
The flasher unit is located behind the sub-panel and is similar in appearance to the one used for the flashing (turn) indicators but has a different internal circuit.
A correct replacement unit must be fitted in the event of failure.
The pilot lamp bulb is accessible after removing the bulb-holder from the rear of the panel.
Failure of one or more of the bulbs due to accident or other causes will not prevent the system from operating on the other lamps.

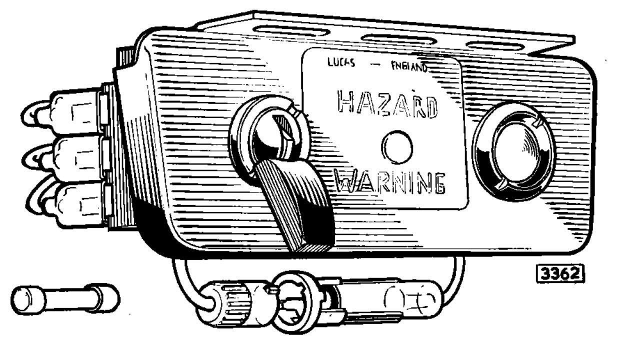
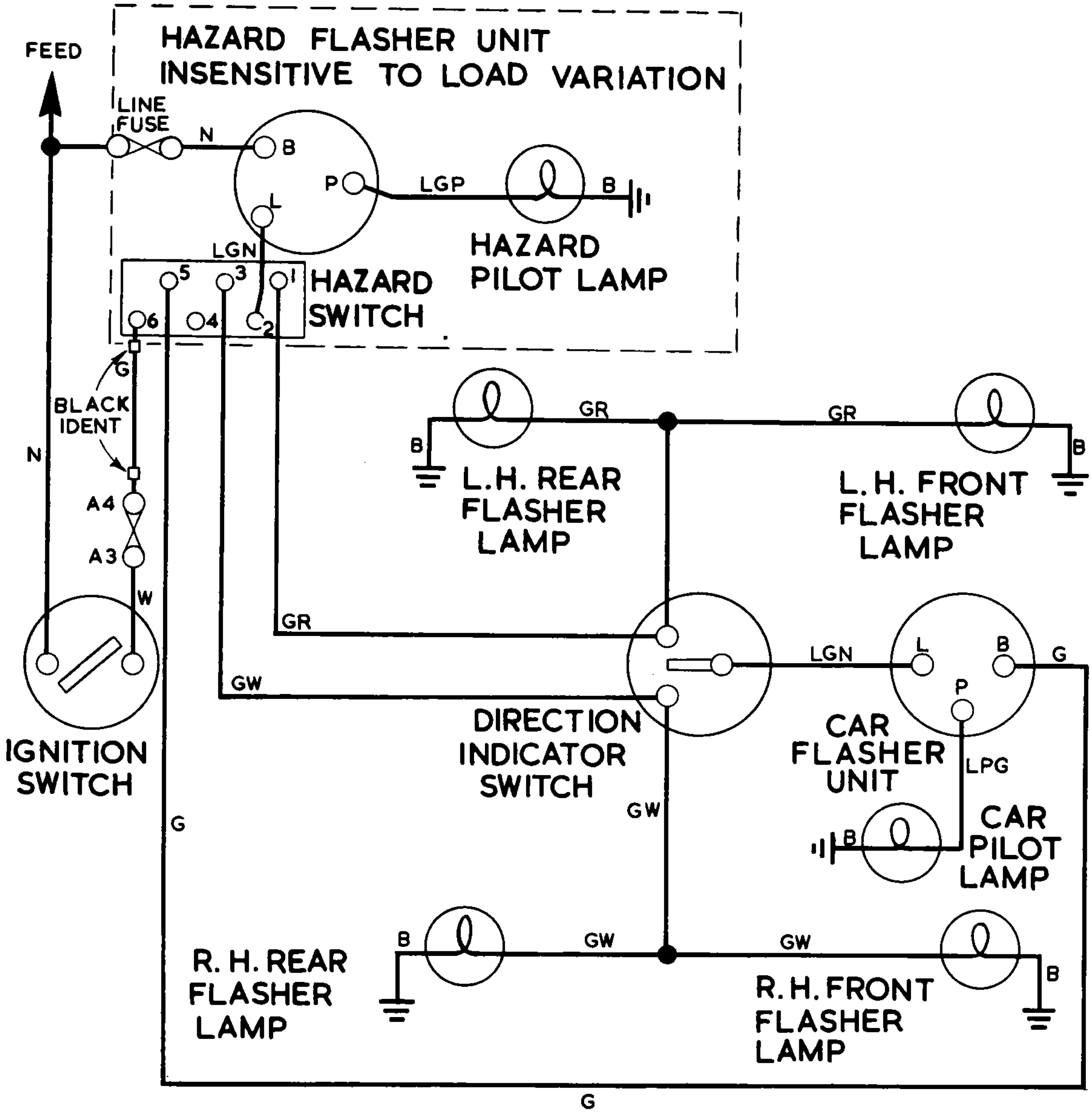


Fig. No. 40 *The haxard warning panel showing in-line fuse*



B	BLACK	LGN	LIGHT GREEN\BROWN
G	GREEN	LGP	LIGHT GREEN\PURPLE
GR	GREEN\RED	N	BROWN
GW	GREEN\WHITE	W	WHITE

Fig. No. 41 *Hazard warning device wiring diagram*

HORNS — Model 9H

DESCRIPTION

The Lucas 9H horns are mounted at the front end on either side of the engine compartment immediately below the radiator. The horn circuit operates through a Lucas 6 RA relay, the contacts C1 and C2 closing when the relay coil is energised by depressing the semi-circular ring attached to the steering wheel or by pressing the centre button.

Maintenance

In the event of the horn(s) failing to sound or performance becoming uncertain, check that the fault is not due to external causes before any adjustments are made.
Check as follows and rectify as necessary:

(i) Battery condition.
(ii) Loose or broken connections in the horn circuit. Test with voltmeter at cable terminals.
(iii) Loose fixing bolts. It is important to keep the horn mountings tight and to maintain rigid the mountings of any unit fitted near the horns.
(iv) Faulty relay. Check by substitution after verifying that current is available at terminal C2 (cable colour — brown and blue) and terminal W1 (green).
(v) Check that fuse 3 (35 amperes) and fuse 5 (50 amperes) have not blown.

Note: Horns will not operate until the ignition is switched on.

Adjustment

The horns cannot be conveniently adjusted in position. Remove and securely mount on the test fixture.
A small serrated adjusting screw is provided to take up wear of moving parts only in the horn and it is located adjacent to the horn terminals. Turning this screw does not alter the pitch of the note.
Connect an 0-25 moving coil ammeter in series with the horn supply feed. The ammeter should be protected from overload by connecting an ON-OFF switch in parallel with its terminals.
Keep this switch ON except while taking the readings, that is, when the horn is sounding.
Turn the adjustment screw anti-clockwise until the horn just fails to sound.
Turn the screw clockwise until the horn operates within the specified current limits of 6.5 - 7.0 amperes.

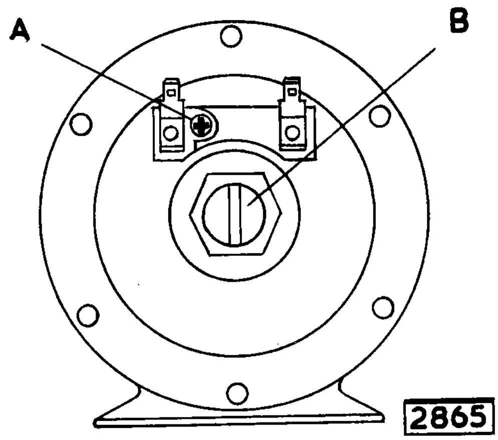


Fig. No. 42 *The Lucas 9H horn*

A Contact breaker adjustment screw
B Slotted centre core (Do not disturb)

Service Replacements

When fitting replacement horns it is essential that the following procedure be carried out.

(i) Refit the lockwashers in their correct positions, one on each side of the mounting bracket centre fixing.
(ii) Ensure, after positioning the horn, that the $\frac{5}{16}$" centre fixing bolt is secure but not overtightened. Over-tightening of this bolt will damage the horn.
(iii) Ensure that, when a centre fixing bolt or washers other than the originals are used, the bolt is not screwed into the horn to a depth greater than $\frac{11}{16}$" (17.5 mm.).

Muted Horns (Holland only)

Special horns are fitted to cars exported to Holland. These horns are muted to comply with the Traffic Regulations of that country and incorporate a rubber plug inserted in the trumpet.

Horn Relay — Checking

If the horn relay is suspected, check for the fault by substitution or by the following method:

(i) Check that fuses No. 3 and No. 5 have not blown. Replace if necessary.

(ii) Check with a test lamp that current is present at relay terminals W1 (green) and C2 (brown and purple). Switch on ignition before checking terminal W1.

(iii) Remove cable from terminal W2 (purple and black) and earth the terminal to a clean part of the frame. Relay coils should now operate and close contacts. Reconnect cable.

(iv) Remove cables from terminal C2 (brown and purple). Check for continuity by means of an earthed test lamp, the horn button or ring is depressed with the ignition ON. Replace relay if faulty.

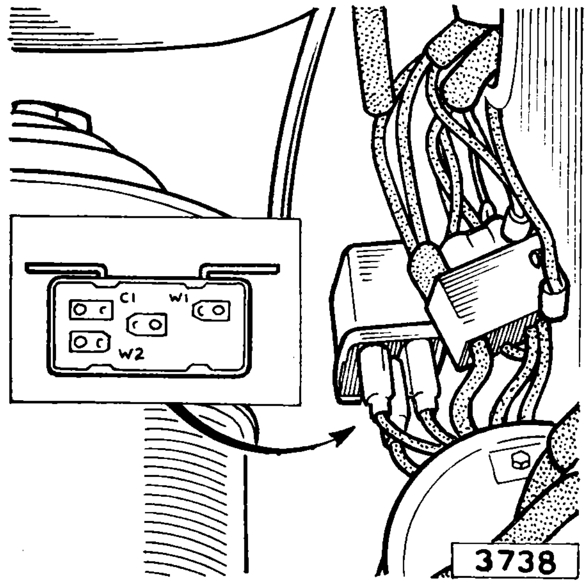


Fig. No. 43 *The 6RA relay connections*

WINDSCREEN WIPER

DATA

Wiping Speed	
Normal	45-50 cycles per minute
High	60-70 cycles per minute
Light Running	
Normal Speed	2.7 - 3.4 amperes
High Speed	2.6 (or less) amperes
Stall Current	10-11 amperes (DR3)
Control Switch	79.SA.
Pressure of Blades against Windscreen	11-13 ounces (312-369 gms.)
Maximum permissable force to move cable rack in protective tubing with motor, arms and blades disconnected	6.0 lb. (2.72 kilograms)

DESCRIPTION

The windscreen wiper assembly consists of a two speed, thermostatically protected motor coupled by a cable rack drive to two scuttle mounted wheel boxes.

The cable rack consists of a flexible inner core of steel wire wound with a wire helix. A reciprocating motion is imparted to the rack by a connecting rod in the motor gearbox and transmitted to the wiper arm spindles by the engagement of the rack with a gear in each wheelbox.

The wipers are self parking and are controlled by a switch on the instrument panel, giving Park, Slow, and Fast operation. The fast speed is intended for use when driving fast through heavy rain or light snow. It should **not** be used with heavy snow or a drying windscreen.

If overloaded, the motor windings will overheat and cause the thermostat to trip and isolate the motor from the supply. Possible causes include: packed snow or ice on the screen, over-frictional or oil contaminated blades, damaged drive mechanism or spindle units. Provided the obstruction or other cause of excessive heating is removed, normal working resumes automatically when the temperature falls to a safe level.

MAINTENANCE

Efficient wiping is dependent upon having a clean windscreen and wiper blades in good condition.
Use methylated spirits (denatured alcohol) to remove oil, tar spots and other stains from the windscreen. Silicone and wax polishes should not be used for this purpose.
Note: The wiper blades are manufactured with special anti-smear properties. Renew only with genuine Jaguar replacement parts.
Worn or perished wiper blades are readily removed for replacement.

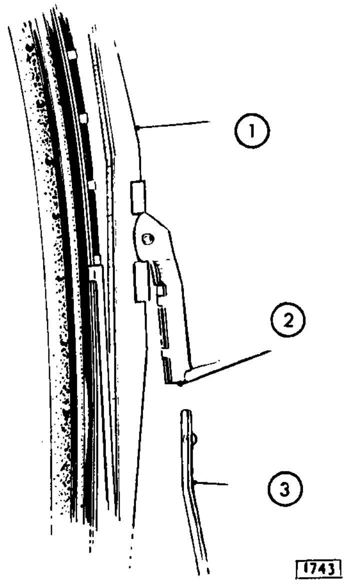


Fig. No. 44 *Wiper blade to arm attachment*

1 Blade
2 Entry slot
3 Arm

When necessary, adjustment to the self-parking mechanism can be made by turning the knurled nut located near the cable rack outlet on the wiper motor. Turn the nut only one or two serrations at a time, and test the effect on each setting before proceeding.

REMOVAL OF WIPER MOTOR AND CABLE

Withdraw the wiper arms from the spindles. Unscrew the large nut connecting cable guide to the wiper motor.

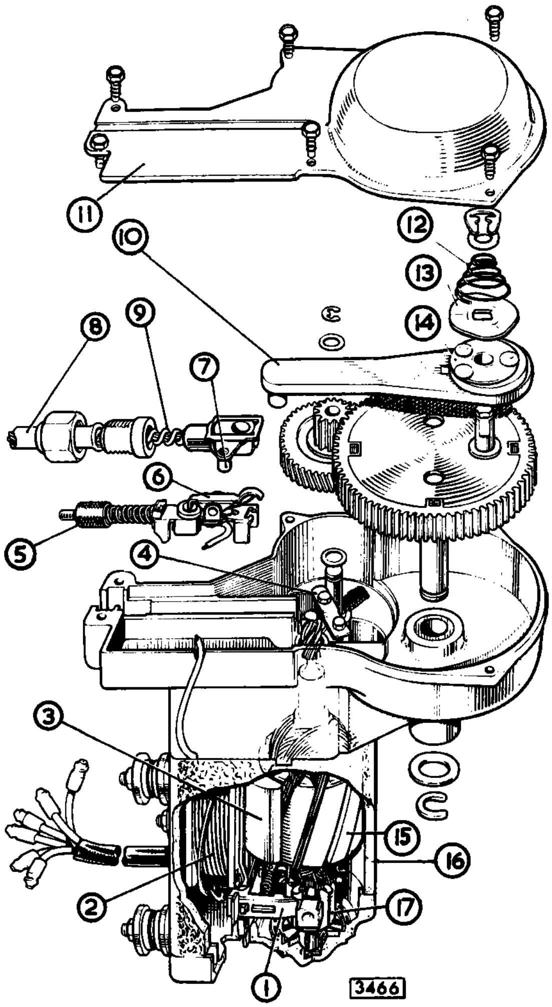


Fig. No. 45 *The DR3 wiper motor components*

1 Brush gear
2 Field coil
3 Pole piece
4 Armature end play stop plate
5 Parking adjuster
6 Crosshead-actuated limit switch
7 Switch striker pin
8 Protective tubing
9 Cable rack
10 Connecting rod
11 Gearbox cover
12 Conical spring
13 Friction plate
14 Pivoted coupling (eccentric)
15 Armature
16 Yoke
17 Commutator

Remove the setscrew securing the earth wire to the motor.
Disconnect the cable harness attached to the motor at the snap connectors noting the cable colours.
From underneath the right hand front wing, remove the three nuts securing the wiper motor to the wing valance.
The wiper motor and cable can now be removed as an assembly by drawing the cable through the guide tube.

Disconnecting the Cable
Remove the six small set bolts from the wiper motor gearbox cover.
Lift off the cover, remove the circlip from the post in the gearwheel.
Remove the washer, conical spring, friction plate and connecting rod from the crosshead.
Lift out the cable ferrule from the gear casing.

REFITTING
Refitting is the reverse of the removal procedure.
Renew grommets in the wing valance if worn or damaged.
Refit the wiper arms and blades as follows:
(a) Switch on the ignition.
(b) Switch on the windscreen wipers to slow speed and note the arc of rotation of the wheelbox spindles.
(c) Switch off the ignition when the spindles reach the left hand limit of travel.
(d) Fit the wiper arms to the spindles in the approximate left-hand position and switch on the ignition. Adjust the position of the arms to give equal movement either side of the arc central line. Lift the spindle locking catch before withdrawing the arms from the spindles.
(e) Switch off the wiper switch.
(f) Adjust the parking position of the arms by turning the knurled adjuster nut anti-clockwise to lower the arms (Right-hand drive cars) and clockwise to lower the arm (Left-hand drive cars).

WHEELBOXES
Removal
Disconnect the battery.
Disconnect the speedometer drive cable and withdraw the facia panel from the four mounting points as detailed on page N.6.

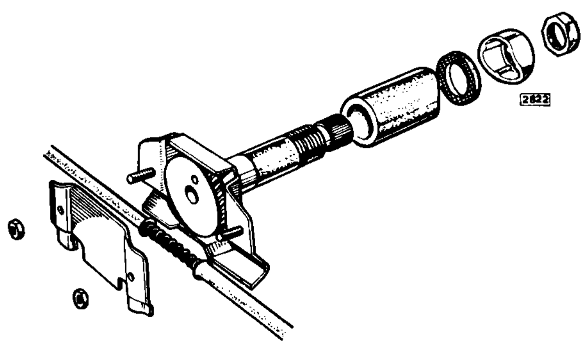


Fig. No. 46 *Exploded view of wheel boxes*

Note: It will not be necessary to disconnect the electrical cables from the panel components, but care must be taken to ensure that the panel covering is not damaged. Support the panel in a convenient position when removing the wheelboxes.

Withdraw the wiper blades and arms.
Remove the wiper motor and withdraw the drive cable from the wheelboxes.
Remove the two securing nuts and detach the back plates from the wheelboxes and withdraw the conduit tubing.
Unscrew the nuts securing the wheelboxes to the scuttle and remove the chrome distance pieces and rubber seals.
Withdraw the wheelboxes.

REFITTING
Refitting is the reverse of the removal procedure. When refitting ensure that the flared ends of tubes register with the narrow slots in the cover plate.

FAULT DIAGNOSIS
Poor performance can be electrical or mechanical in origin and not necessarily due to a faulty motor, for example:
Low voltage at the motor due to poor connections or to a discharged battery.
Cable rack binding in protective tubing;
Excessive loading on the wiper blades;
Wheelboxes loose, out of alignment or spindles binding in the bearing housing.

TESTING
Unless the origin of the fault is apparent, proceed as follows to determine the cause of the failure.

Measuring Supply Voltage
Using a first grade moving coil voltmeter, measure the voltage between the motor supply terminal (to which the green cable is connected) and a good earthing point. This should be 11.5 volts with wiper working normally. If the reading is low, check the battery, switch (by substitution) cabling and connections.

To Check the "Fast" Speed Current
Using a fully charged 12-volt battery and two test leads, connect the "GREEN" cable on the wiper motor to the "Negative" battery terminal. Join the "YELLOW" and "RED" cables together and connect to the "Positive" battery terminal. Connect the "BLUE" and "WHITE" cables together. Check the cycles per minute of the wiper spindle.

To Check the "Slow" Speed Current
Connect the "GREEN" cable to the "Negative" battery terminal. Join the "BROWN" and "RED" cables together and connect to the "Positive" battery terminal. Connect the "BLUE" and "WHITE" cables together. Check the cycles per minute of the wiper spindle.

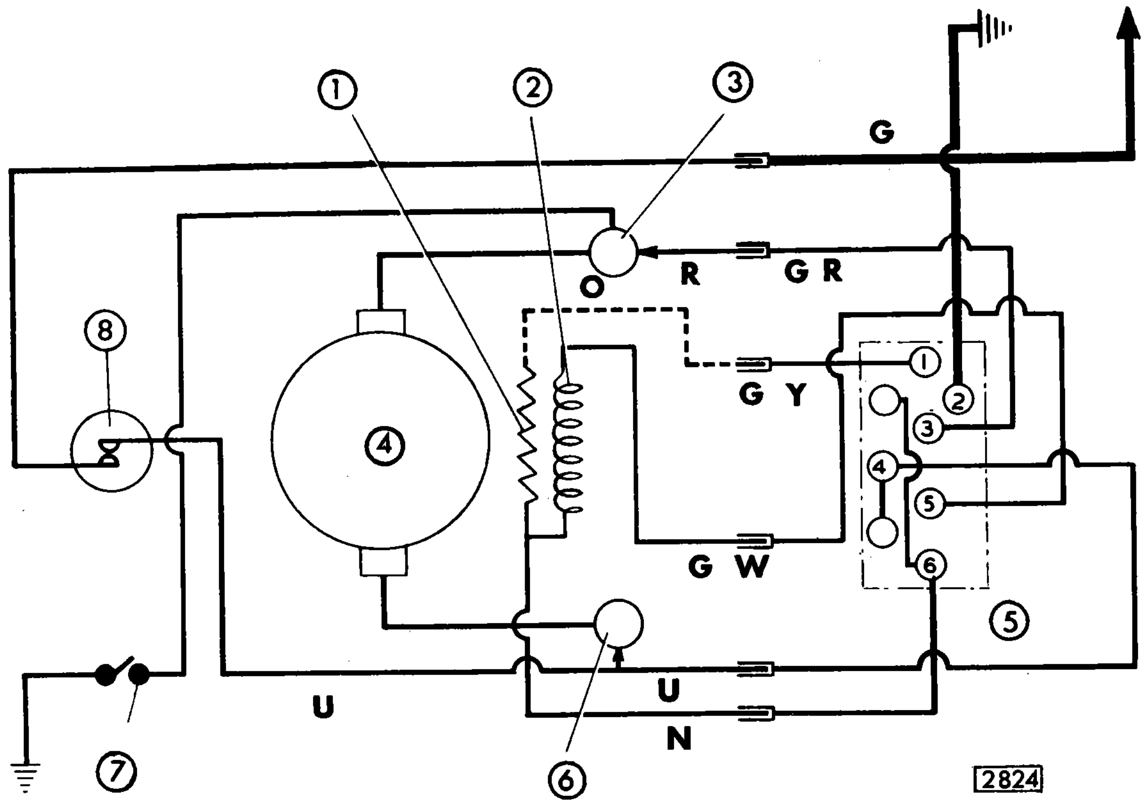


Fig. No. 47 *Wiring connections—switch to wiper*

1	Resistor	**G**	Green
2	Field coil	**GR**	Green with red
3	R.H. terminal	**GY**	Green with yellow
4	Armature	**GW**	Green with white
5	79 SA switch	**M**	Brown
6	L.H. terminal	**O**	Orange
7	Parking switch	**R**	Red
8	Thermostatic circuit breaker	**U**	Blue

Measuring the Light Running Current

The light running current must not exceed 3.4 amperes at normal speed of 45-50 r.p.m./or t.p.m. of the output motor shaft; also 2.6 amperes at fast speed 60-70 c.p.m./or r.p.m. of output motor shaft.
If the current is in excess of these figures, change the wiper motor. See DATA chart for other information.

Checking Cable Rack and Tubing

The maximum permissable force to move the cable rack in its protective tubing is 6 pounds with the wiper arms, blades and motor disconnected. The measurement can be made by hooking a spring balance in the hole in the cross-head (into which a pin on the connecting rod is normally located) and withdrawing the rack with the balance.
Before checking, disconnect the cable rack from the motor, remove the motor, wiper arms and blades.
When refitting the tubing check that they do not foul the body at any point. Failure to ensure this may result in the transmission of cable rack noise.
Binding of the rack can be due to kinked or flattened tubing or to a faulty installation.
Minor faults can be cleared with a suitable testing mandrel sold specifically for checking wiper installations. Badly kinked or flattened tubing must be renewed. Any bends of less than 9" radius must be reformed.
It is ESSENTIAL that all the flared ends of the tubing are registered in the slots provided in the wheelbox plates before tightening the wheel box cover plate securing nuts.
The cable rack should be well lubricated with Duckham's HBB grease.

Checking Wheelboxes
Check the wheelboxes for misalignment or looseness and rectify as required.
Renew seized wheelboxes.

Checking the Brush Gear
Withdraw the two through bolts and detach the end cover.
Expand the retaining spring and lift off the two brush carriers as an assembly.

Note: The two brushes are loose in the carriers and care must be taken that they are not misplaced when removed.

Refitting
Refitting is the reverse of the removal procedure. Ensure that the brushes are replaced in the same way as originally fitted.

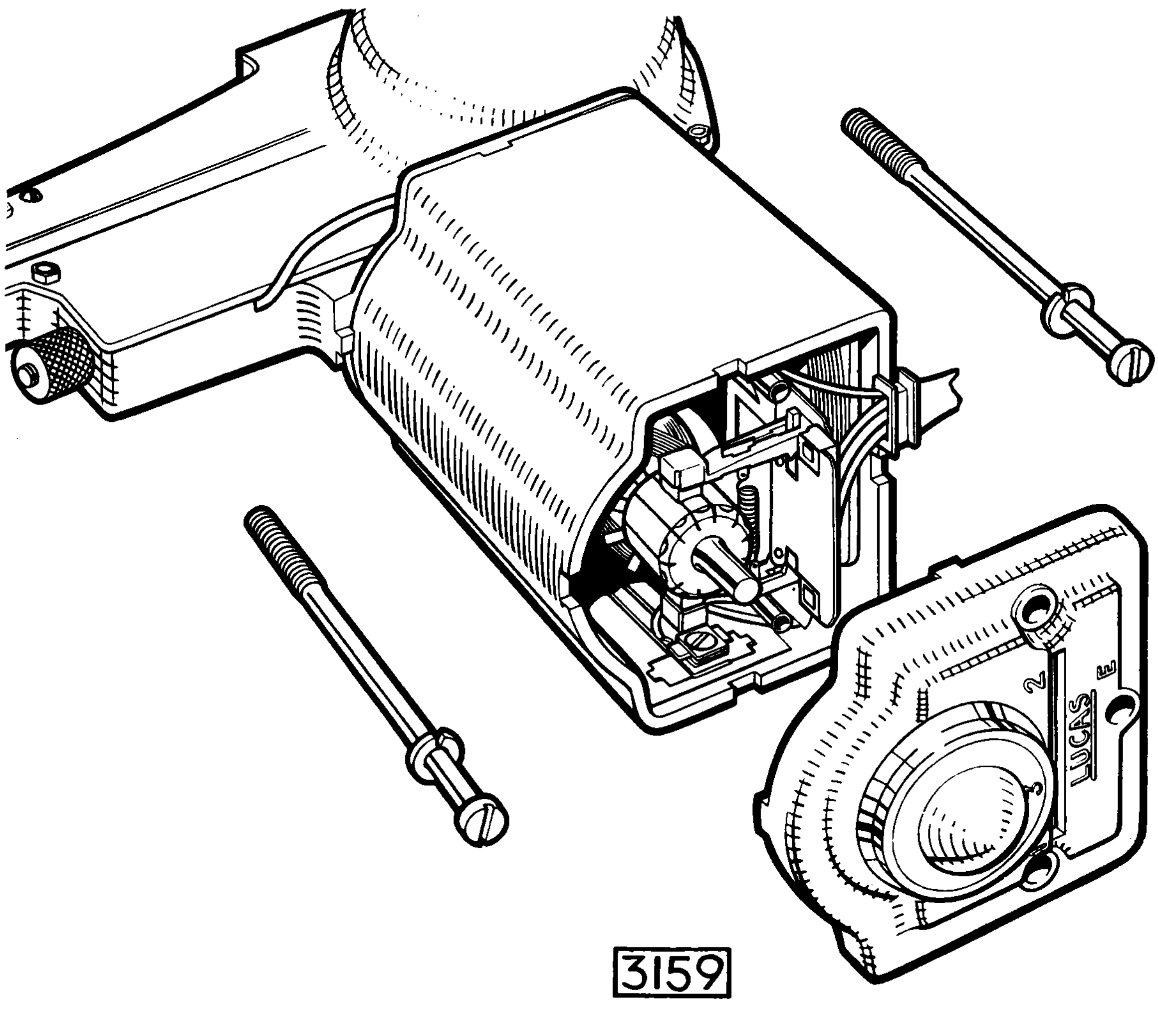


Fig. No. 48 *Showing access to bush gear*

WIRING HARNESS REPLACEMENT

GENERAL

The wiring harness consists of four main items, namely, the forward, the panel and right and left-hand body harness.
The junctions between the forward and body harnesses are behind the side facia panel and the glove box adjacent to the screen pillars.

When replacing harness, all items must be secured in the clips provided and all grommets must be renewed if worn or damaged.
The body harnesses are routed over the door sills.
Refer to the wiring diagram when making any connections (see page P.65).

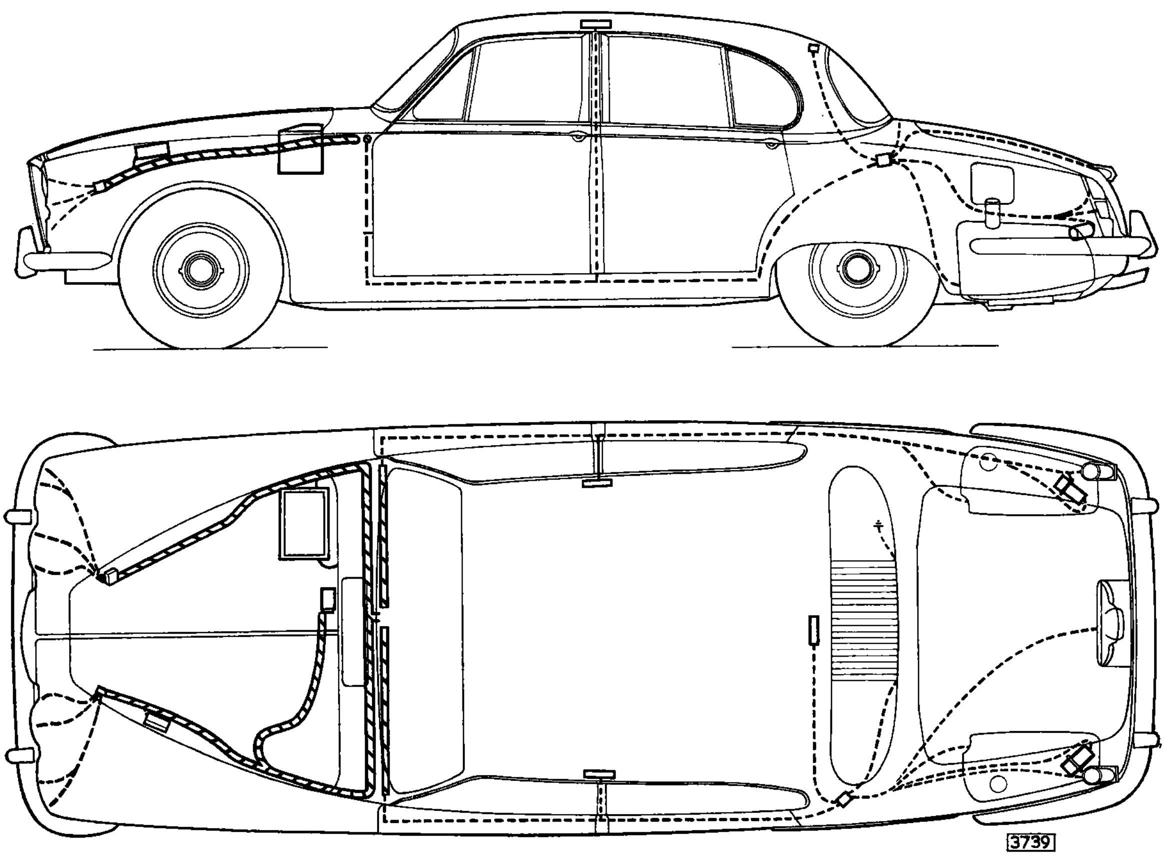


Fig. No. 49 *Layout of wiring harness*

THE INSTRUMENTS

THE INSTRUMENT PANEL

Opening

Disconnect the battery.
Remove the ignition key and cigar lighter for safe keeping.
Hinge the centre instrument panel downwards on its bottom edge, after withdrawing the thumb screws situated in each top corner.

Note: If air-conditioning equipment is fitted, it will be necessary to slide the sub-panel with the controls forward towards the bulkhead before the instrument panel can be lowered. Slacken the two knurled nuts to release the sub-panel.

Removal
The instrument panel can be removed completely by detaching the earth lead from the battery, identifying and removing the leads from the instruments, cigar lighter and switches, removing the electrical harness and clips from the instrument panel and withdrawing the two hinge pivot bolts from the instrument panel support brackets.

Refitting
Refitting is the reverse of the removal procedure.
Re-connect the leads in accordance with their colour coding, utilizing the wiring diagram as a reference.

Closing
Closing is the reverse of the opening procedure. Check that the clips securing the main harness to the instrument panel will in no way foul any of the switch or instrument terminals, otherwise a direct short will occur when the battery is connected.

THE ELECTRIC CLOCK
The electric clock fitted in the centre of the screen rail is a fully transistorised instrument powered by a mercury cell housed in a plastic holder, located at the back of the clock.
Frontal adjustment is provided by means of a small knurled knob for setting the hands and a slotted screw for time-keeping regulation.
To reset the hands, pull the knurled knob out, rotate and release.
Push in to restart the clock.
To regulate the time-keeping, turn the slotted screw with a small screwdriver towards the positive (+) sign if gaining, and towards the minus (—) sign if losing.

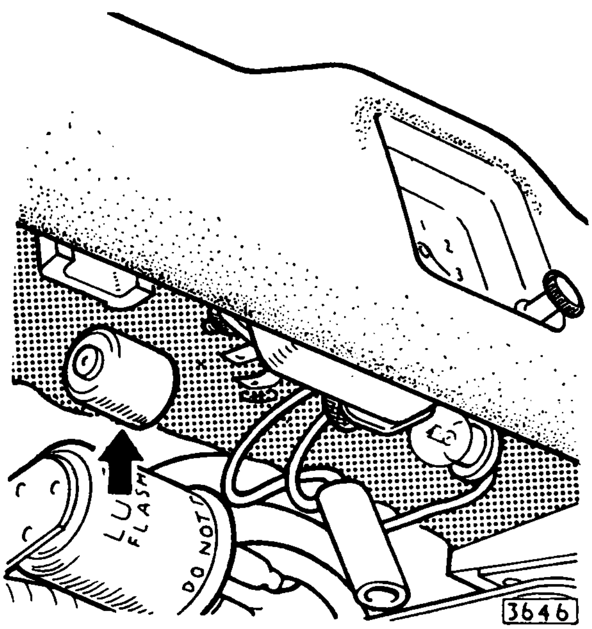


Fig. No. 50 *The electric clock battery removal*

Moving the indicator through one division will alter the time-keeping by approximately four minutes a week.
The window of the electric clock is a plastic moulding. It should only be cleaned with a cloth or chamois leather slightly dampened with water. Oil, petrol and other fluids generally associated with cleaning, are harmful and must not be used.

MAINTENANCE
The mercury cell life is in the region of 18 months throughout which it ensures a steady and continuous voltage to the clock.
Renew the cell at this period to maintain perfect time-keeping.

Battery Replacement
Remove the instrument panel retaining screws and hinge panel downwards.
Lever the battery out of the holder and discard.
Press the new battery into the holder.
Refit the panel.

Clock — Removal
Hinge the instrument panel downwards.
Remove the two nuts and the clamp strap from the back of the clock.
Withdraw the battery from the holder and remove the two cables with attached terminals.
Remove the clock and cables from the screen-rail.

Refitting
Refitting is the reverse of the removal procedure.

SPEEDOMETER
Removal
Detach the earth lead from the battery and raise the steering wheel to the highest position.
Detach the speedometer from the facia board by removing the two knurled nuts, earth lead and two retaining pieces.
Unscrew the knurled nut from the centre of the instrument and withdraw the flexible drive.
Remove the speedometer from the facia board, indentifying and removing the two warning lights and the two illumination lights from the instrument.
Unscrew the knurled nut and withdraw the odometer setting control.

Refitting
Refitting is the reverse of the removal procedure.
Replace the headlamp warning light in the right-hand aperture at the back of the instrument.
Replace the ignition warning light in the left-hand aperture.

THE SPEEDOMETER DRIVE CABLE
Removal
Disconnect the drive cable from the speedometer by unscrewing the knurled nut. Detach the opposite end of the cable from the gearbox and release from the retaining clips.

Refitting
Refitting is the reverse of the removal procedure.
Sharp bends must be avoided when installing the cable, and securing clips must retain the cable without crushing.
The original run of the cable must be maintained and the clips should **not** be repositioned

SPEEDOMETER CABLE — GENERAL INSTRUCTIONS
Flexible cable condition to a great extent affects the performance of speedometers. Poor installation or damage to the flexible drive will show up as apparent faults. It is most important that the flexible drive should be correctly fitted and maintained as illustrated in the following diagrams.

Connection
Ensure tightness of outer flex connections. They should be finger tight only. It may be necessary to clean thoroughly the point of drive before the connection can be screwed completely home.

Lubrication
Withdraw inner flexible drive (see below).
Place a blob of grease on end of outer cable and insert flex through it, carrying grease inside. Use Esso T.S.D. 119 or equivalent. Do NOT use oil. Avoid excessive lubrication. If oil appears in flexible drive, suspect faulty oil-seal at point of drive.

Connection of Inner Flexible Shaft to Gearbox
Where possible, slightly withdraw inner flex and connect outer first. Then slide inner into engagement.

Removal of Inner Shaft
Inner flexes can be removed by disconnecting the instrument end and pulling out flex. Broken inner flex will have to be withdrawn from both ends.

Examination of Inner Flexible Shaft
Check for kinked inner flexible shaft by rolling on clean flat surface. Kinks will be seen and felt.

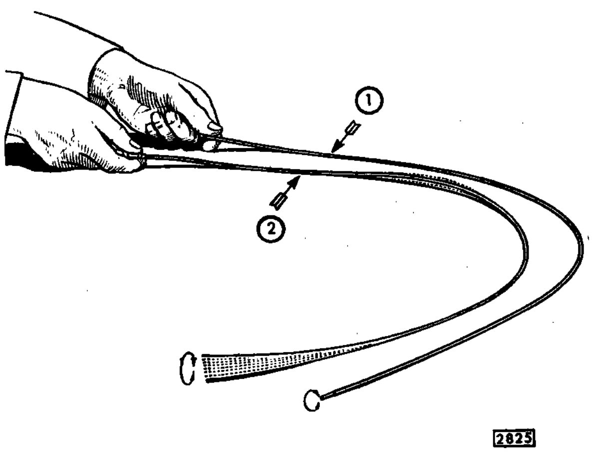


Fig No. 51 *Checking the inner flex for kinks*

Inner Shaft Projection
Check $\frac{3}{8}$" projection of inner flex beyond outer casing at instrument end. This ensures correct engagement in instrument and point of drive.

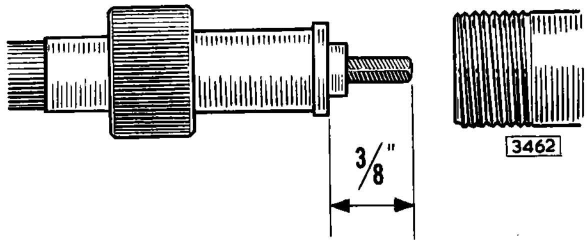


Fig. No. 52 *Showing the amount the inner flex must protrude from the outer cable*

Concentric Rotation
Check that the inner flex rotates in centre of outer cable.

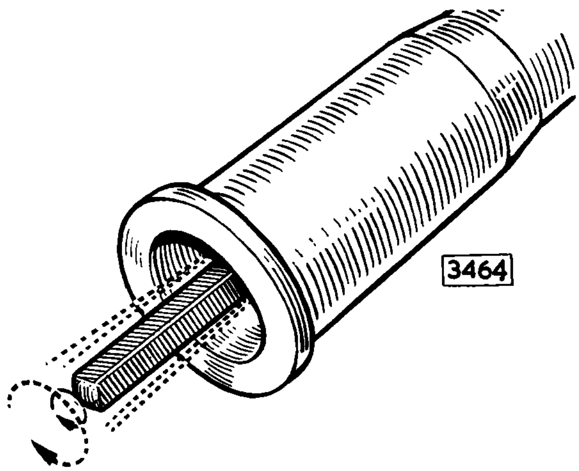


Fig. No. 53 *Checking the inner flex "run-out"*

Damaged Inner Shaft
Examine inner flex ends for wear or other damage. Before fitting new flex ensure instrument main spindle is free.

SPEEDOMETERS — GENERAL INSTRUCTIONS
Speedometer performance is dependent on the flexible drive, and apparent faults in the instrument may be due to some failure of the drive. Before returning a speedometer for service, the flexible drive should be checked, as described in the previous paragraphs. The following paragraphs show you how to check the instrument performance.

Instrument Operating
(1) Flexible cable broken/damaged — renew.
(2) Defective instrument — return for service.

Speedometer Inaccurate
Check tyre pressures. Inaccuracy can be caused by badly worn tyres. If non-standard tyres are fitted, apply to Smiths for specially calibrated instrument.
Check that the code number on the face of the instrument (Fig. 54) is correct for the final drive unit ratio as stated in the Spare Parts Catalogue.

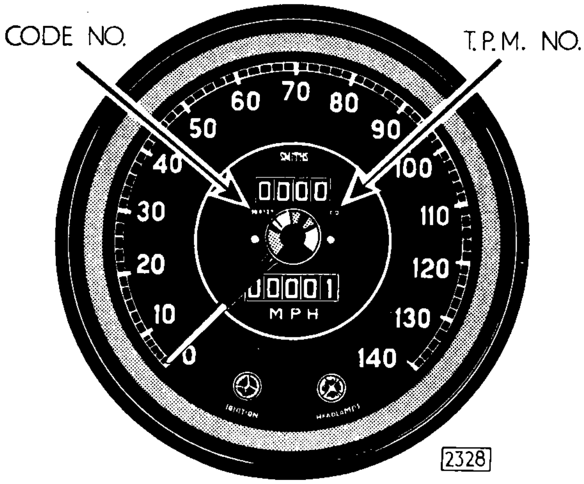


Fig. No. 54 *Showing the code numbers on the face of the instrument*

Pointer Waver
Pointer waver may be due to one or more of the following causes:
1. Oiled up instrument. Replace the oil seal if necessary; clean the flexible drive and re-lubricate.
2. Inner shaft not engaging fully. Check the inner shaft projection.
3. Kinked or crushed flexible drive. Remove and examine inner cable.
4. Instrument defective. Return for replacement.

Noisy Installation
1. Inner flex damaged. Remove and check, replace if necessary. Check for lack of lubrication.
2. General high noise level. Withdraw the inner flex and reconnect the outer flex. If the noise continues at a lower level then the source of the noise is at the point of drive.
3. Regular ticking in time with speedometer distance counter. Return the instrument for replacement.
4. Loud screeching, more prevalent in cold weather. Return the instrument for replacement.

THE REVOLUTION COUNTER (TACHOMETER) DESCRIPTION
The revolution counter is an impulse tachometer instrument with transistors and a printed circuit, the pulse lead (coloured white) being wired in circuit with the S/W terminal on the ignition coil and the ignition switch.
Mechanical drive cables or an engine driven generator are not required with this type of instrument.
The performance of the instrument is not affected by distributor contacts setting, by corrosion of the sparking plug points or by differences in the gap setting.
Connections to the back of the tachometer is by means of a locked plug and socket, the contacts being offset to prevent incorrect coupling.

Removal
Disconnect the battery.
Remove the two knurled nuts, earth lead and instrument retaining pieces.
Withdraw the instrument from the facia panel and remove the illumination bulb holders.
Disconnect the plug and socket as follows:
Pinch together the prongs of the plastic retainer clip and withdraw from the plug and socket assembly (Fig. 55).
Detach the plug from the socket and complete the removal of the tachometer.
Note: On right-hand drive cars, remove the steering column switch lower cover to gain access to the two knurled nuts.

IMPORTANT
Do not detach the green and white cables connected to the plug from the instrument.

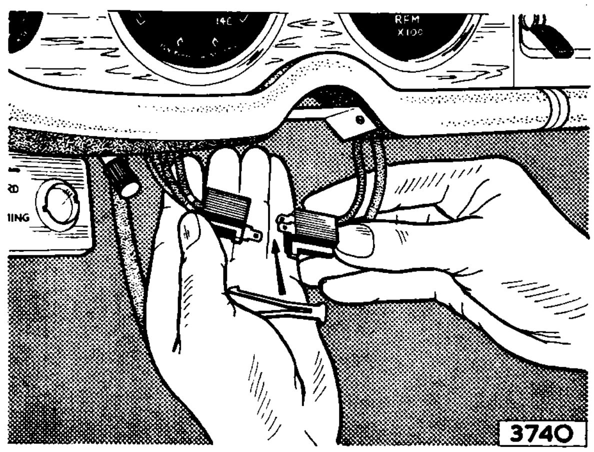


Fig. No. 55 *The tachometer plug and socket assembly*

Refitting
Refitting is the reverse of the removal procedure. Reconnect the plug and socket assembly and lock with the retaining clip.

FLASHING INDICATOR CONTROL

Removal

Disconnect the battery. Detach the upper and lower switch covers from around the column by removing the five screws from below. Disconnect the seven-cable harness at the snap connectors at the left-hand side of the column.
The indicator control mounting is utilised as a means of adjusting the steering column top bush bearing.
To remove, release the locknut from the bottom clamp screw, withdraw the two fixing screws, collect the distance pieces from the top screw and detach the switch.

Refitting

Refitting is the reverse of the removal procedure.
Reconnect the cables so that similar coloured cables are opposite each other.
Re-adjust the steering column upper bearing as detailed in Section I — Steering — Page I.9.

OVERDRIVE SWITCH

Removal

Disconnect the battery. Detach the upper switch cover from the steering column by removing the two sunken screws from below. Disconnect the two cables at the snap connectors, release the nut securing the switch to the mounting bracket and withdraw the switch.

Refitting

Refitting is the reverse of the removal procedure but ensure that the switch lever is horizontal in the "out" position when tightening the securing nut.

INHIBITOR SWITCH AND RELAY (AUTOMATIC TRANSMISSION ONLY)

On cars equipped with automatic transmission an inhibitor switch, mounted on the steering column and connected to the gear selector lever by a link, is provided to prevent the starter motor solenoid operation unless the gear lever is in the "N" or "P" positions.
A relay is incorporated in the inhibitor switch/starter solenoid circuit to obviate over-loading the inhibitor switch contacts when the starter motor is engaged.
In operation the closing of the inhibitor switch contacts by movement of the gear selector lever to the "N" or "P" positions energises the relay coil windings when the starter button is depressed with the ignition "ON". Current is then supplied to the starter solenoid through the relay main contacts (C1 and C2).
The inhibitor switch also incorporates the reverse lamp switch.

THE INHIBITOR SWITCH

Removal

Remove the steering column switch lower cover to gain access to the inhibitor switch.
Disconnect the cables from the switch, note the location of the cables for reference when refitting.
Detach the control link from the switch by withdrawing from the rubber bush, release the clamp ring setscrew and remove the switch.

Refitting

Insert the switch in the clamp ring, but do not tighten the setscrew. Reconnect the control link.
Select neutral ("N") on the gear selector quadrant and hold in this position.
Rotate the switch in the clamp ring until the small hole in the lever registers with the indent in the back of the switch.
A small mirror held at the back of the switch will enable the indent to be located correctly.
Tighten the clamp ring setscrew.
Reconnect the cables to the switch in the order noted on removal.
Refit the steering column switch lower cover.

THE INHIBITOR SWITCH RELAY

Removal

The relay is mounted behind the right-hand side facia panel and is attached to the dash structure by two drive screws.
To remove, detach the facia panel as detailed in page N.6.
Withdraw the two securing screws, disconnect the cables and remove the relay. Note the location of the cables for reference when refitting.

Refitting

Refitting is the reverse of the removal procedure.

THE INSTRUMENT PANEL COMPONENTS

REMOVAL

Disconnect the battery.
Remove the ignition key and cigar lighter for safe keeping.
Hinge the centre instrument panel downward after withdrawing the thumb screws situated in each top corner.
If air-conditioning equipment is fitted, it will be necessary to slide the sub-panel forward before the instrument panel can be lowered.
Slacken the two knurled nuts to release the sub-panel.

IGNITION SWITCH

Identify and remove the ignition switch cables. Withdraw the ignition switch from the rear of the instrument panel by removing the chrome ring and fibre washer.
Note the locating washer fitted to the threaded portion of the switch.
The lock barrel can be withdrawn by inserting a thin rod through a hole in the body of the switch and depressing the plunger in the lock. Insert the key and turn to the "ON" position to gain access to the plunger.
Refitting is the reverse of the removal procedure. When

refitting a new lock barrel, check that the number of the key is the same as that stamped on the lock barrel. Insert the key in the lock and turn the switch to the "ON" position before inserting the lock barrel. Refit the locating washer over the threaded portion of the switch before inserting in the panel and locate the tag with the cut-out portion in the panel hole.
Note: On cars not fitted with a steering column lock, the ignition switch also functions as an alternator field isolation switch. Care must be taken when reconnecting the switch that the cables are connected as shown in the wiring diagram. Use the diagram as a reference.

Cigar Lighter Element
Withdraw the cigar lighter and ensure that it is cold. Place the unit in the palm of the hand, knob first, and hold the sleeve downwards against the pressure of the spring. Unscrew the lighter element and fit a replacement. It is important **not** to omit the spring as it ejects the lighter unit when it attains the correct temperature.

Cigar Lighter Unit
Disconnect the battery. Withdraw the cigar lighter. Identify and remove the cables from the cigar lighting housing. Unscrew the outer casing at the rear of the panel and withdraw the inner section of the cigar lighter unit.
Refitting is the reverse of the removal procedure.

Starter Push Button
Remove the cables from the push button. Withdraw the push button through the face of the instrument panel by removing the nut, washer and spring washer at the rear of the instrument panel.
Refitting is the reverse of the removal procedure.

Head and Side Light Switch
Disconnect the battery.
Remove the light switch control lever from the face of the instrument panel by depressing the plunger in the right-hand side.
Identify and remove the leads from the light switch.
Remove the three nuts, shakeproof washers, washers and blade terminal from the switch mounting posts. Withdraw the light switch. The designation plate can be removed from the instrument panel by detaching the nut on the rear of the panel.
Refitting is the reverse of the removal procedure. Reposition the designation plate on the instrument panel by allowing a flat on the threaded barrel to locate a flat in the panel.
The light switch control lever is pressed onto the light switch so that the plunger locates with a drilling in the hub of the control lever.

Tumbler Switches
Disconnect the battery.
Identify and remove the leads from the Lucar tags on the switch body. Withdraw the tumbler switch from the rear of the instrument panel by holding the switch lever in a horizontal position and removing the screwed chromium ring from the face of the instrument panel. Refitting is the reverse of the removal procedure. The flat face of the switch lever should be facing downwards.

Ammeter and Oil Pressure Gauges
Disconnect the battery.
Withdraw the illumination bulb holder from the rear of the gauge. Remove the cables from the terminal posts. Remove the two knurled nuts and "U" clamp. Withdraw the gauge through the front face of the instrument panel.
When refitting the gauges, check that the "U" clamp does not foul any terminals or the bulb holder.

Fuel and Water Temperature Gauges
Removal and refitting of these gauges is similar to the ammeter and oil pressure gauges. But in this case, the "U" clamp is retained by one knurled nut.
The removal and replacement of the fuel gauge tank unit and water temperature transmitter unit are detailed in the "Fuel System" and "Cooling System" respectively.

Voltage Regulator (Fuel and Water Temperature Gauges)
Remove the cables (noting their respective positions) from the voltage regulator situated in the left-hand corner of the instrument panel. Withdraw the voltage regulator by removing one nut, shakeproof washer and blade terminal.
When refitting the voltage regulator, ensure that a good earth is made between the regulator and panel.

Switch Indicator Strip
Remove the indicator strip, chrome finisher and light filter from the bottom edge of the instrument panel by withdrawing four screws.
Refitting is the reverse of the removal procedure.

THE BI-METAL RESISTANCE INSTRUMENTATION

Engine Temperature, Fuel Tank and Oil Pressure Gauge

DESCRIPTION

The Bi-metal Resistance Instrumentation for engine temperature, petrol tank contents and engine oil pressure consists of a gauge unit fitted in the instrument panel, a transmitter unit fitted in the engine unit or petrol tanks and connected together to the battery, the oil pressure gauge being an exception, through a common voltage regulator.
The purpose of the latter is to ensure a constant supply of predetermined voltage, thus avoiding errors due to

a low battery voltage. In the instance of the oil pressure gauge this is not quite so critical to supply voltage. In all systems the gauge unit operates on the thermal principle utilizing a heater winding wound on a bi-metal strip, while the transmitter units of the engine temperature and petrol tank contents gauge are of the resistance type, but in both instances the system is voltage sensitive. The transmitter unit of the oil pressure gauge is of the thermal pressure principle utilizing a heater winding wound on a bi-metal strip, having contact at one end with the second contact mounted on a diaphragm which is sensitive to engine oil pressure.

OPERATION OF THE ENGINE TEMPERATURE GAUGE

The transmitter unit of the engine temperature gauge is fitted in the water outlet pipe of the engine unit and is a variable resistance and consists of a temperature sensitive resistance element contained in a brass bulb. The resistance element is a semi-conductor which has a high negative temperature co-efficient of resistance and its electrical resistance decreases rapidly with an increase in its temperature. As the temperature of the engine unit rises the resistance of the semi-conductor decreases and increases the flow of current through the transmitter, similarly a decrease in engine temperature reduces the flow of current.

The gauge unit fitted in the instrument panel consists of a heater winding, connected at one end to the transmitter unit and at the second end to the "I" terminal of the voltage regulator, wound on a bi-metal strip which is linked to the indicator needle. The heater winding and bi-metal strip assembly is sensitive to the changes in voltage received from the transmitter unit causing the heater winding to heat or cool the bi-metal strip, resulting in the deflection of the indicator needle over the scale provided. The calibration of the scale is such that the movement of the indicator needle over it is relative to the temperature of the transmitter unit bulb and therefore the temperature of the engine unit.

OPERATION OF THE FUEL TANK GAUGE

The transmitter units of the petrol gauge are fitted in the petrol tanks and each is a variable resistance actuated by a float, the arm of which carries a contact travelling across a resistance housed in the transmitter body. The float arm takes up a position relative to the level of petrol in the tank being used and thus varies the amount of current passing through the indicator unit.

The gauge unit in the instrument panel consists of a heater winding, connected at one end to the transmitter units and at the other to the "I" terminal of the voltage regulator, wound on a bi-metal strip which is linked to the indicator needle. The heater winding and bi-metal strip assembly is sensitive to the changes in voltage received from the position of the transmitter float, causing the heater winding to heat or cool the bi-metal strip, resulting in the deflection of the indicator needle over the scale provided. The calibration of the scale is such that the movement of the indicator needle over it is relative to the position of the transmitter float actuated by the level of the contents in the petrol tank.

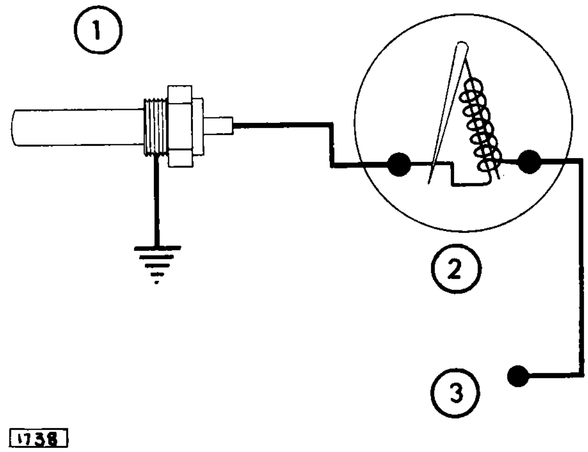


Fig. No. 56 *The engine temperature gauge circuit*

1 Temperature transmitter
2 Rear of indicator
3 Voltage regulator terminal "I"

Exaggerated indicator needle movement due to petrol swirl in either tank is considerably reduced as there is a delay before current changes from the transmitter can heat or cool the bi-metal and heater winding assembly in the indicator unit, which causes the deflection of the needle.

Similarly the indicator needle will take a few moments to register the contents of the petrol tank being used when the ignition is switched on.

OPERATION OF THE OIL PRESSURE GAUGE

The transmitter unit of the oil pressure gauge, fitted in the head of the engine oil filter, is a voltage compensated pressure unit and consists of a diaphragm, a bi-metal strip with a heater winding wound thereon, a resistance and a pair of contacts. One contact is attached to the diaphragm, while the second is mounted on one end of the bi-metal strip, the second end of which is connected through the resistance and the gauge unit to the battery supply; the heater winding is also connected to the battery supply but not through the resistance. Engine oil pressure will close the contacts causing current to flow through the gauge unit, bi-metal strip and contacts to earth resulting in the heating of the heater winding which will, after a time, open the contacts.

The gauge unit fitted in the instrument panel consists of a winding, connected at one end to the battery supply and at the second to the transmitter unit wound on to a bi-metal strip which is linked to an indicating needle. The heater winding and bi-metal strip assembly is sensitive to the continuity changes received from the thermal pressure unit, fitted in the oil filter, causing the heater winding to heat or cool the bi-metal strip, resulting in the deflection of the indicating needle over the scale provided.

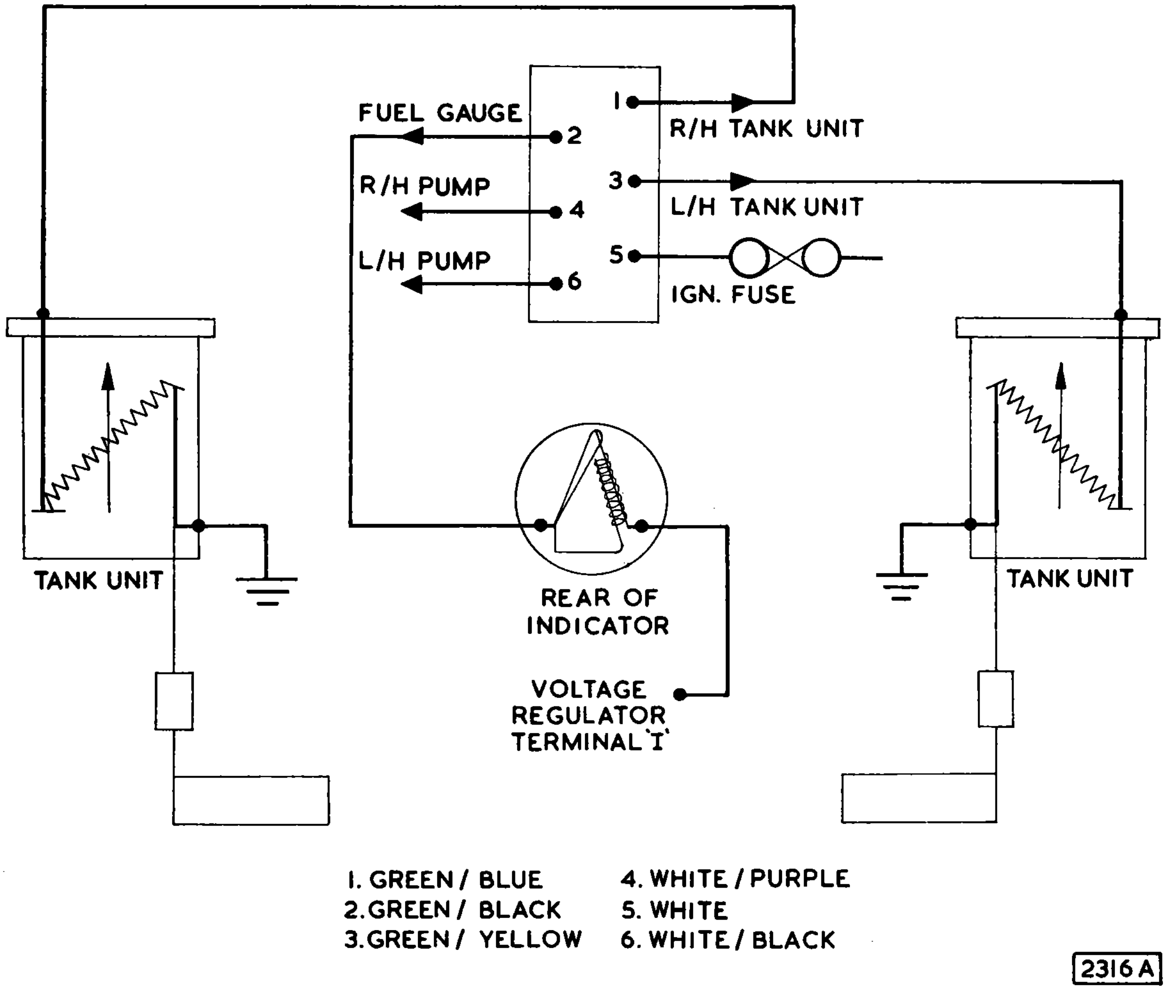


Fig. No. 57 *The fuel tank contents gauge circuit*

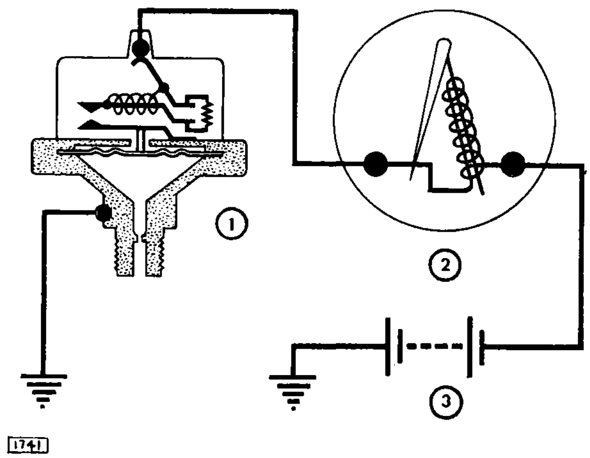


Fig. No. 58 *The engine oil pressure gauge circuit*

1 Transmitter unit
2 Gauge
3 Battery

The changes in continuity of current from the transmitter unit will vary according to the amount of oil pressure, for as the latter rises the outward moving diaphragm contact limits the return travel of the bimetal strip contact, thus allowing a longer continuity period.
This results in a greater heating of the heater winding in the gauge unit and increased deflection of the indicating needle over the scale showing a greater oil pressure.
The opening and closing of the transmitter unit contacts is continuous, thus the temperature of the heater winding in the gauge unit is kept within close limits and the calibration of the scale is such that the movement of the indicating needle over it is relative to the opening of the transmitter unit contacts and therefore the oil pressure of the engine is recorded.

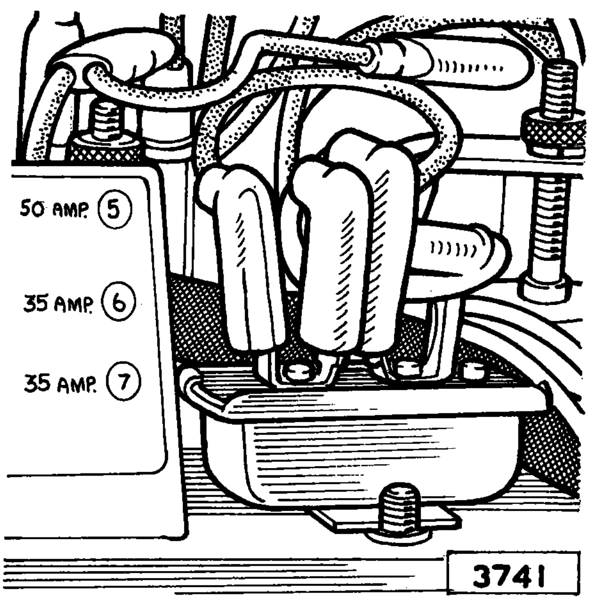


Fig. No. 59 *The location of the voltage regulator*

ANALYSIS OF THE ENGINE TEMPERATURE AND PETROL TANK GAUGE FAULTS

NOTE: THE INSTRUMENT PANEL GAUGES MUST NEVER BE CHECKED BY SHORT-CIRCUITING THE TRANSMITTER UNITS TO EARTH.

SYMPTOM	UNIT POSSIBLY AT FAULT	ACTION
Instrument panel gauge showing a "zero" reading	Voltage regulator	Check that output voltage at terminal "I" is 10 volts
	Instrument panel gauge	Check for continuity between the gauge terminals with the leads disconnected.
	Transmitter unit in petrol tank or engine unit	Check for continuity between the terminal and the case with lead disconnected.
	Wiring	Check for continuity between the gauge, the transmitter and the voltage regulator, also that the transmitter is earthed.
Instrument panel gauge showing a high/low reading when ignition switched on	Voltage regulator	Check output voltage at terminal "I" is 10 volts.
	Instrument panel gauge	Check by substituting another instrument panel gauge.
	Transmitter unit in petrol tank or engine	Check by substituting another transmitter unit in petrol tank or engine unit.
	Wiring	Check for leak to earth.
Instrument panel gauge showing a high reading and overheating	Voltage regulator	Check output voltage at terminal "I" is 10 volts.
	Wiring	Check for short circuit on wiring to each transmitter unit.
Instrument panel gauge showing an intermittent reading	Voltage regulator	Check by substituting another voltage regulator.
	Instrument panel gauge	Check by substituting another instrument panel gauge.
	Transmitter unit in petrol tank or engine unit	Check by substituting another transmitter unit in petrol tank or engine unit.
	Wiring	Check terminals for security, earthing and wiring continuity.

ANALYSIS OF THE OIL PRESSURE GAUGE FAULTS

SYMPTOM	UNIT POSSIBLY AT FAULT	ACTION
Instrument panel gauge showing a "zero" reading	Wiring	Check for continuity between the gauge and the transmitter unit and that the latter is earthed.
	Instrument panel gauge	Check for continuity between the gauge terminals with leads disconnected. If satisfactory replace the transmitter unit.
Instrument panel gauge showing a reading with ignition switched on but engine not running	Transmitter unit on oil filter head	Check by substituting another transmitter unit.
Instrument panel gauge showing a high reading and overheating	Transmitter unit on oil filter head	Check by substituting another transmitter unit
Instrument panel gauge showing a below "zero" reading with ignition switched off	Instrument panel gauge	Check by substituting another instrument panel gauge.

OPTIONAL EXTRAS

This section covers the installation of the equipment available as optional extras.

THE STEERING COLUMN LOCK

DESCRIPTION

A "WASO-WERKEN" combined ignition switch/steering column lock is available as an optional extra, and replaces the normal ignition switch in the instrument panel.

The switch/lock unit is mounted on an extension arm attached to the steering column, below the steering wheel and has three operative positions — Drive, Garage and Stop as listed below; the fourth position "Start" not being used.

The normal ignition, which becomes inoperative, is retained in the instrument panel.

OPERATION OF SWITCH

(1) Drive

This is the normal driving position.. The key cannot be withdrawn in this position and the ignition is "ON".

(2) Garage

This is the normal stop position. The key can be withdrawn leaving the car capable of being steered with the ignition "OFF".

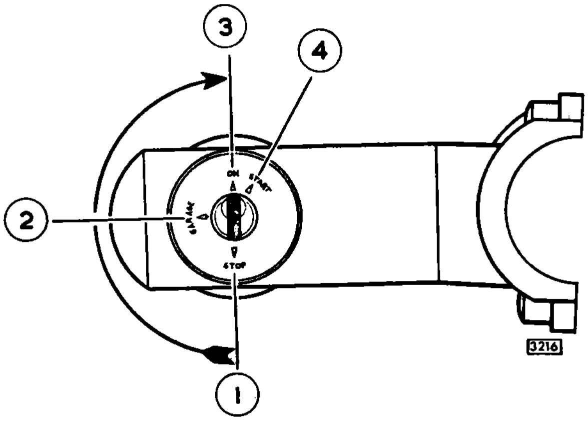


Fig. No. 60 *The switch positions (steering column lock)*

1 Stop
2 Garage
3 On
4 Start

(3) Stop

This is the locked stop position. They key can be removed leaving the steering locked and the ignition "OFF".

To unlock the steering, insert the key in the lock and turn to Garage or Drive position.

FITTING THE STEERING COLUMN LOCK

The normal ignition switch, which becomes inoperative also functions as a field isolation switch. Modifications are therefore necessary to the wiring system to the alternator and the 4TR control unit and includes the fitting of a Lucas 6RA relay.

Disconnect the battery.

Withdraw the five securing screws and remove the steering column upper and lower switch covers. Withdraw the warning light bulb holders from the upper cover.

Position the lock on the column covering the oval register hole and secure with the clamp and clamp bolts, but do not tighten the bolts. Note the location of the terminals on the lock before fitting, for reference when connecting the cables.

Note: On cars equipped with Automatic Transmission it will be necessary to withdraw the selector control shaft as detailed on page II.19, before the clamp can be fitted.

Refit the steering column switch lower cover.

Check that the switch/lock assembly is correctly aligned in the lower cover cut-out. Insert the key and turn to the Stop position. Remove the key and check that the lock bolt is entering the register holes in the outer and inner columns and the steering is locked.

Tighten the clamp bolts evenly until the heads shear off.

Important: IT IS IMPORTANT THAT THE CORRECT OPERATION OF THE LOCK IS ENSURED BEFORE THE CLAMP BOLTS ARE FULLY TIGHTENED. AFTER THE HEADS OF THE BOLTS HAVE BEEN SHEARED OFF THE LOCK CANNOT BE REMOVED.

Modify the Wiring as follows:

Lower the instrument panel to gain access to the fuses and panel switches. Disconnect the brown/purple, brown/white and brown cables from the ignition switch and tape into harness.

Disconnect the brown and brown/white cables, feeding the ignition switch, from the ammeter and tape into the harness.

Disconnect the brown/purple cable from the alternator and tape into the harness.

Detach the plug socket from the 4TR control unit and withdraw the brown and purple cable in the harness.

Tape the steering lock connector harness (C.27187) into the panel harness. Connect the single white cable to the A3 (white) side of the ignition controlled fuse (No. 3).

Connect the single brown/white cable to the ammeter.
Connect the white and brown/white cables at the junction to the steering column lock switch.
Connect the white cable to terminal No. 15 and the brown/white cable to terminal No. 30.

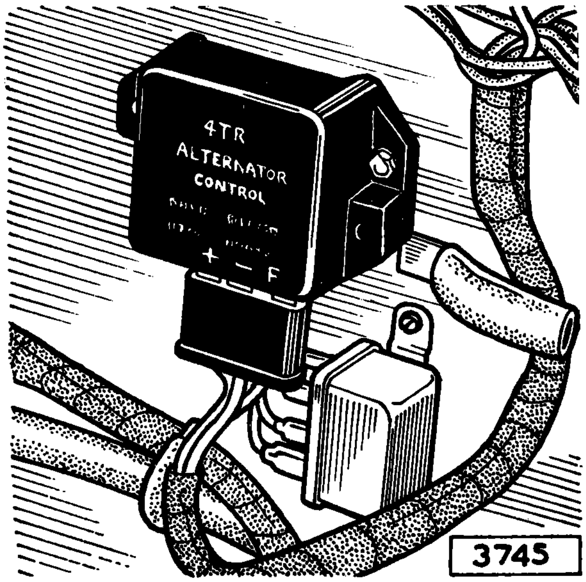
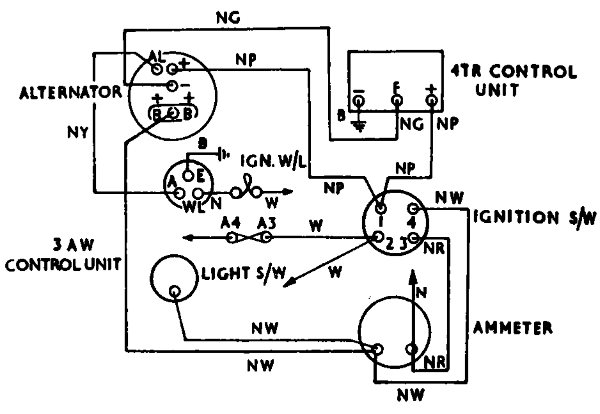


Fig. No. 61 *Location of the steering lock relay*

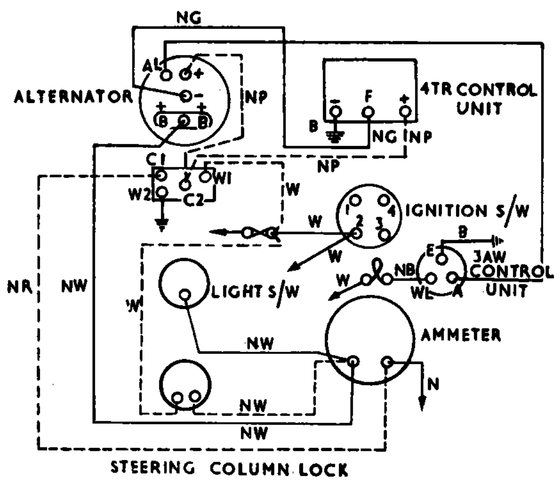
Place the relay on the left-hand wing valance adjacent to the rear of the control box.
Mark the position of the holes in the fixing bracket on the valance.
Drill two $\frac{7}{32}$" (5.5 mm.) holes in the valance and mount the relay with the terminals at the bottom.
Tape the relay harness (C.27188) into the forward harness over the left-hand wing valance.
Feed the white and brown/red harness junction through the main harness grommet and connect the white cable to the ignition controlled fuse (3).
Connect the brown/red cable with the eyelet to the ammeter in conjunction with the brown cable.
Connect the long brown/purple cable to the vacant terminal marked (+) on the alternator.
Insert the short brown/purple cable into the control unit plug socket, replacing the cable previously removed and reconnect the socket.
Connect the cables to the relay as follows:—

Brown/red to terminal	C.1
Brown/purple to terminal	C.2
White to terminal	W.1
Black to terminal	W.2
Black with eyelet to earth	

Refit instrument panel, reconnect battery and test through.



ALTERNATOR CIRCUIT DIAGRAM WITHOUT STEERING COLUMN LOCK SWITCH



ALTERNATOR CIRCUIT DIAGRAM WITH STEERING COLUMN LOCK SWITCH THE CONNECTIONS SHOWN DOTTED ARE INCLUDED IN HARNESS C27187 AND C27188

CABLE COLOUR CHART	
N	BROWN
R	RED
G	GREEN
W	WHITE
P	PURPLE
B	BLACK

3221A

Fig. No. 62 *Circuit diagram for steering column lock*

RADIO

GENERAL

SMITHS "Radiomobile" radio sets are available in the following models to suit the broadcasting requirements of different countries. Rear extension speakers are also available if required.

980T — Long and medium wave band.
982T — Medium wave band.
530T — Medium and Short wave band.

This instruction covers both left-hand and right-hand drive cars.

Warning: Before connection to battery supply is made, it is essential to ensure that the receiver is connected for NEGATIVE GROUND. DAMAGE TO TRANSISTORS IS INEVITABLE IF POLARITY IS INCORRECT.

The radio and front loudspeaker are fitted in the console situated centrally below the parcel tray.

The aerial is fitted on the **drive side** front wing.

AERIAL MOUNTING

Warning: When removing trim secured by adhesive, extreme care must be taken.

Disconnect battery.

Remove the drive side trimmed scuttle casing.

Remove the cover plate secured by four screws.

Drill $\frac{7}{8}$" dia. hole in drive side front wing, as shown in Fig. 63.

From inside the car, pass aerial mast assembly up through the hole in the wing and secure base of aerial to the bracket provided in car. See Fig. 64.

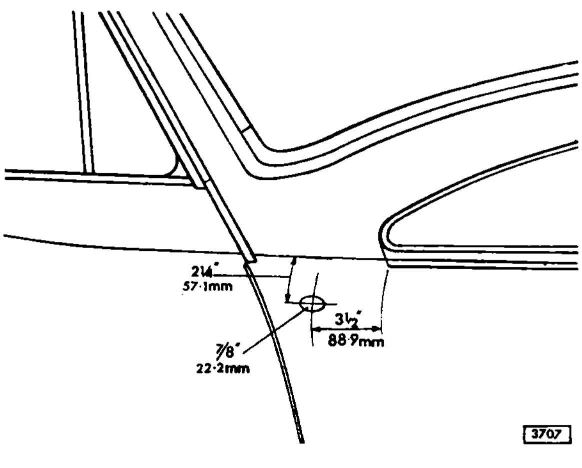


Fig. No. 63 *Location of hole for aerial mounting*

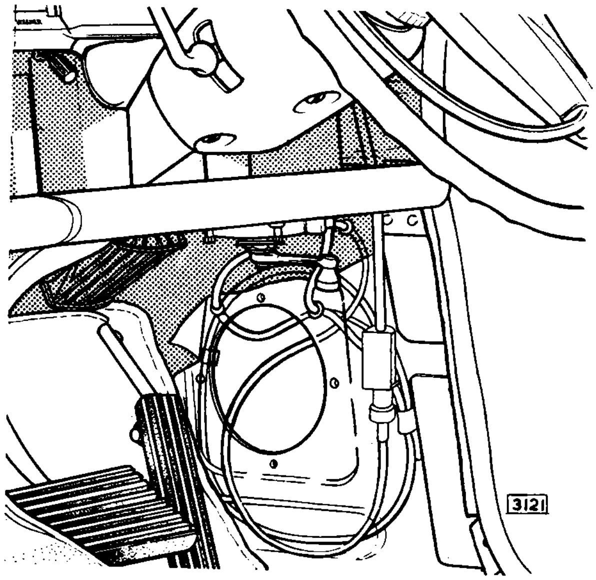


Fig. No. 64 *Aerial base mounting and run of operating cable*

Fit aerial grommet to wing.

Wind up aerial mast to maximum height and remove the drive cable from the winder mechanism, as shown in Fig. 65.

Route the drive cable via hole inside scuttle, as shown in Fig. 64. Fit the grommet provided and refit cable to winder box.

Secure the winder box to underside of parcel tray, as shown in Fig. 64.

Note: On right-hand drive cars, the three fixing holes are provided as shown. On left-hand drive cars, two fixing studs and one hole are provided.

Fit grommets provided for aerial lead and reservoir cable.

Route aerial lead and drive cables as shown in Fig. 64. Drive cable should be routed to maximum radius. Clip and tape up cables as shown.

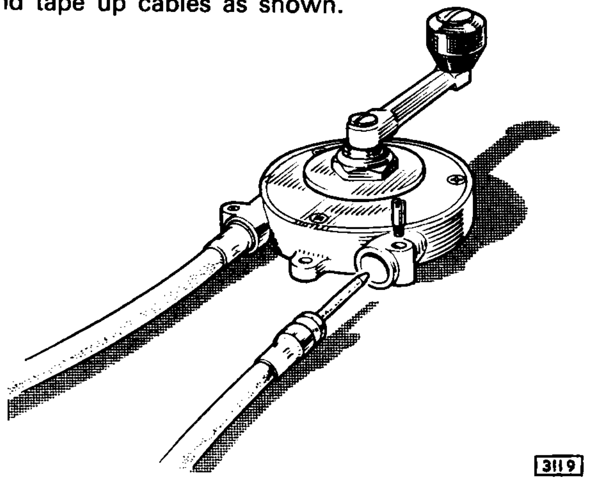


Fig. No. 65 *The aerial winder*

RADIO UNIT AND FRONT LOUDSPEAKER MOUNTING (FIG. 66)

Carefully pull out escutcheon surrounding heater push button controls.
Remove two screws which are covered by escutcheon.
Remove the perforated cover plate in centre tray. This plate is secured to tray with nylon studs and should be eased off.
Carefully pull back parcel tray trim to expose two fixing screws.
Remove fixing screws and pull out veneered wooden radio panel.
Remove the escutcheon secured by wood screws from behind radio aperture in panel. Discard the grille and remove excess material covering scale aperture and holes in escutcheon.
Note: Model 530T: An escutcheon with piercing to suit is supplied in the kit for this model.
Assemble radio unit to panel as shown.
Connect fuse lead to feed side (brown-lead) of fuse panel, No. 7, located on bulkhead behind the centre instrument panel. Connect other end to battery fly lead from radio unit.

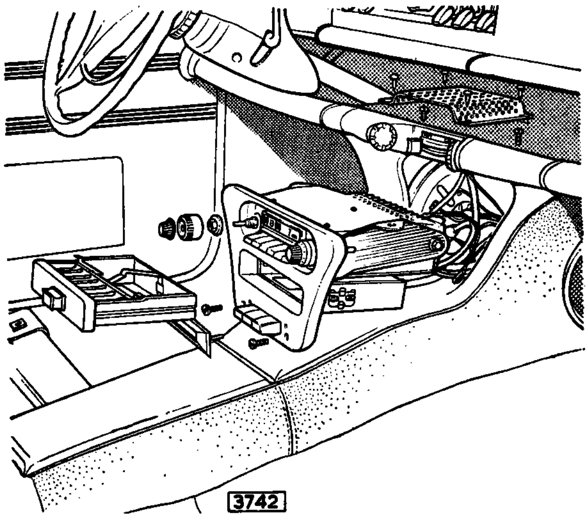


Fig. No. 66 *Fitting the receiver to the console*

Attach the loud speaker lead to loudspeaker.
Secure the loudspeaker to the fixing studs provided inside the console as shown in Fig. 67. The excess studding securing the loudspeaker bezel and grille must be cut flush with the securing nuts.
Note: If the car is equipped with Automatic Transmission, check that the gear control outer casing is not in contact with the loudspeaker case or speaker leads.

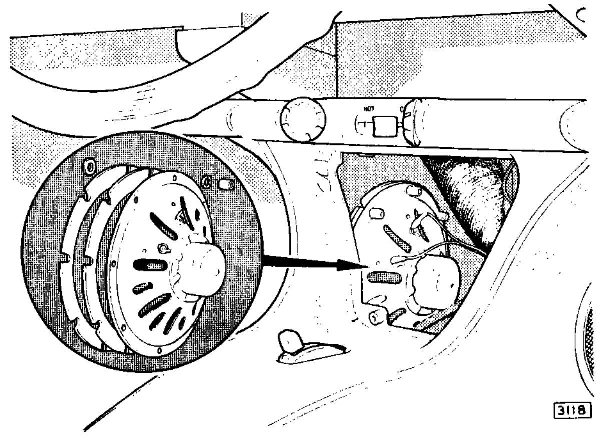


Fig. No. 67 *Fitting the front speaker*

Connect loudspeaker to radio unit.
Connect the aerial lead to radio unit.
Re-connect battery.
Switch on the radio and tune to a weak signal on 1200 kc/s (approx. 250 metres) and adjust aerial trimmer for maximum volume.
Replace wooden radio panel assembly.
Note: It is important that the area underneath and behind the heat sink is well ventilated. Felt should be removed from this area if necessary.

Suppression

It is important to scrape bare metal all points at which an earth connection is made.
Fit 1 mfd. capacitor to dynamo output terminal. Earth to dynamo fixing bolt.
Fit 1 mfd. capacitor to (SW) terminal on coil. Earth under coil fixing screw.
Fit 1 mfd. capacitor to each petrol pump feed. Earth under pump fixing bolt.
Fit .15 mfd. capacitor to oil pressure indicator transmitter. Earth under suitable filter fixing bolt ensuring that bolt is re-tightened securely.
Fit the bonding straps supplied in the kit of parts between (1) the power-assisted steering pump and the coil bracket and (2) the steering box and the engine mounting.

REAR SPEAKER FITTING

1. Disconnect battery.
2. Remove rear seat.
3. Remove two $\frac{1}{4}''$ U.N.F. screws retaining the attached brackets at the bottom of the rear squab to body of car.
4. Remove rear squab in an upward and forward direction disengaging from the retaining clips attached to the front edge of the metal parcel shelf.
5. Break adhesive bond of parcel tray trim to body of car and locate and remove two PK screws retaining trimmed parcel tray to metal parcel shelf.

6. Disengage retaining clips on underside of the combined trimmed parcel tray and lower rear light finisher from metal parcel tray. Remove trimmed parcel tray.
7. Remove the felt packing on top of metal parcel shelf.
8. Cut away painted "DEDSHETE" in area of left-hand depression in metal parcel shelf to expose metal cover plate. See Fig. 68.

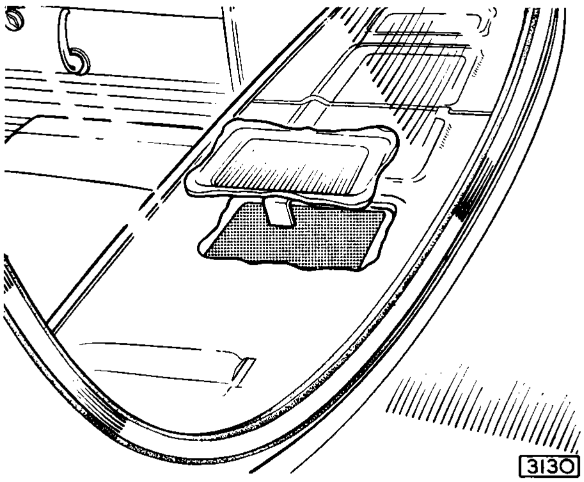


Fig. No. 68 *Cut away "Dedshete" to expose depression in parcel tray*

9. From inside boot, remove sufficient felt on underside of metal parcel shelf in the area of metal cover plate to expose welded retaining tabs.
10. Remove and discard metal cover plate.

On cars not equipped with air-conditioning equipment proceed as follows:—

11. Secure loudspeaker mounting board, and loudspeaker to metal parcel shelf using fixings provided.
12. Locate in top left-hand corner of boot, twin plastic loudspeaker lead in wiring harness.
13. Bare the ends of the loudspeaker lead in wiring harness and connect to the two way terminal block provided. Connect bare ends of the short loudspeaker lead provided to the two way terminal block. Connect loudspeaker lead to loudspeaker.
14. Locate the square pre-pierced cut-out portion on the left-hand underside of the trimmed parcel tray. Carefully remove this portion with a sharp knife, cut the trimming and secure to the underside of the tray with a good quality adhesive.
15. Assemble bezel and masking cloth to the parcel tray using fixings provided.
16. Replace felt packing and trimmed parcel tray assembly. Secure trim of parcel tray to the body of car with a suitable adhesive.
17. Replace rear squab and rear seat.
18. From inside the boot, on the underside of metal parcel shelf and using suitable adhesive, replace felt, trimming around outline of loudspeaker mounting board as required.
19. From behind centre instrument panel, locate twin plastic loudspeaker lead in weaved cotton covering, routed with main wiring harness above fuses.
20. In vertical rear face of front parcel tray, on drive side of steering column, drill a $\frac{3}{8}$" diameter (9.5 mm.) hole to dimensions as shown in Fig. 69 for balance control.
21. Remove the radio from console unit.
22. Remove existing lead from receiver to front loudspeaker. Replace with long loudspeaker lead terminated at one end with small "Lucar" type connectors and bare ends at the other.

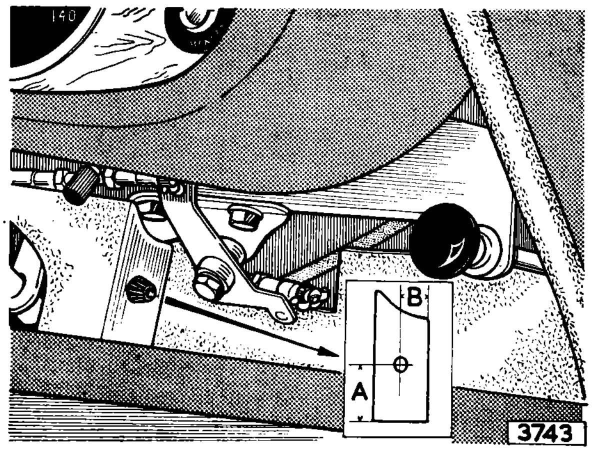


Fig. No. 69 *Drilling the front parcel tray for balance control mounting*

23. Connect new loudspeaker lead terminated with two pin plug to appropriate socket in receiver.
24. Connect the twin plastic lead from rear loudspeaker to two-way terminal block provided. Bare the ends of unterminated lead provided and connect to two-way terminal block.

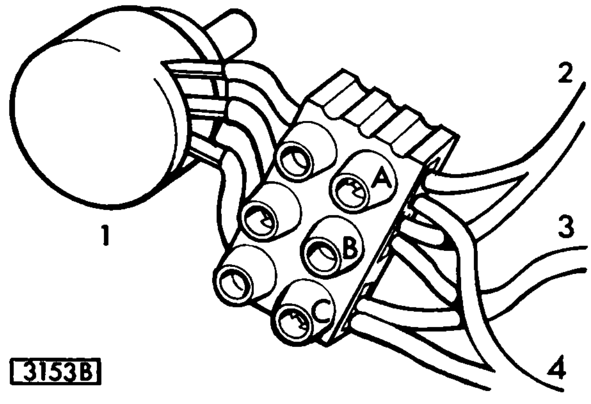


Fig. No. 70 *Showing connections to balance control*

1 Balance control
2 To front speaker
3 To rear speaker
4 Radio output

25. Bare other ends of unterminated lead and connect to points "B" and "C" on terminal block of the balance control assembly — see Fig. 71.
26. Connect the loudspeaker lead from front loudspeaker to points "A" and "B" on the terminal block of balance control assembly — see Fig. 71.
27. Connect loudspeaker lead from receiver to points "A" and "C" on terminal block of balance control assembly — see Fig. 71.
28. Affix the balance control assembly to vertical rear face of front parcel tray.
29. Replace receiver into console unit.
30. Re-connect battery.

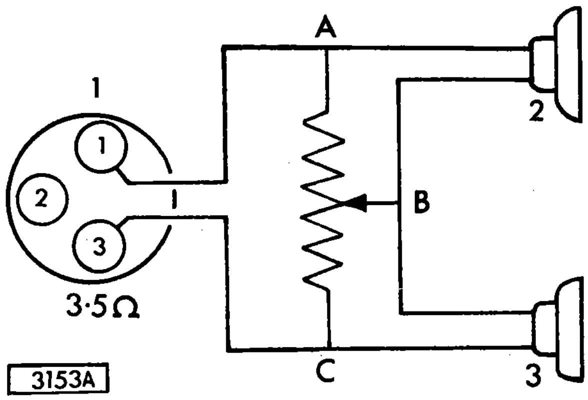


Fig. No. 71 *Rear loudspeaker circuit diagram*

On Cars fitted with Air-Conditioning Equipment proceed as follows:

Twin rear loudspeakers are fitted when air-conditioning equipment is installed, replacing the normal single rear speaker installation.

The speakers are mounted in the right and left hand corners of the parcel tray, the necessary holes being exposed on removal of the "DEDSHETE" insulation.

The parcel tray trim board has two pre-pierced portions. Installation instructions remain basically the same as that stated for the single rear speaker.

The twin rear speakers are wired in series and it is essential that they are phased when connecting the leads (see Fig. 72).

Note: Early models may not have the metal parcel tray pierced. These cars should have the necessary portions removed as illustrated in Fig. 73.

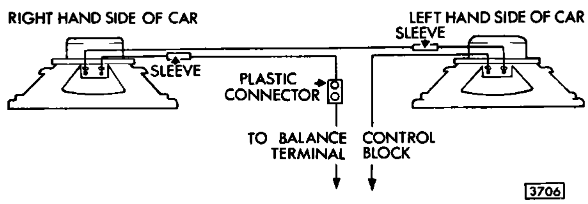


Fig. No. 72 *Twin rear speaker circuit diagram*

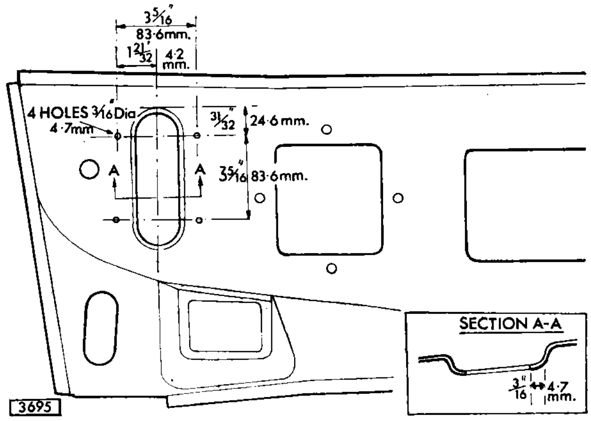


Fig. No. 73 *Twin rear speaker installation*

ELECTRICALLY-HEATED BACKLIGHT

Description

An electrically heated backlight to provide demisting and defrosting of the rear window is available as an optional extra.

Operation

The heating element consisting of a fine wire mesh between laminations of the glass is connected to the main wiring harness.

The element will come into operation only when the ignition and the rear window switches are in the "ON" position.
An amber warning light, situated in the facia panel, lights up when the backlight heater is switched on.
A resistance in the circuit through the side lamp switch automatically dims the warning light for night driving.
The current consumption is approximately 5 amperes.
A 15 amp fuse contained in a plastic holder, located in a clip behind the instrument panel, is provided in the circuit as a safety precaution.

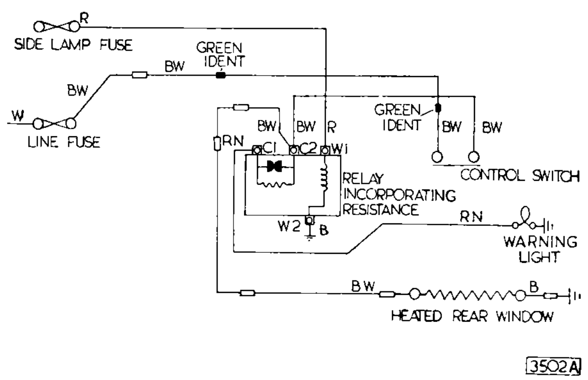


Fig. No. 74 *The heated back light switch and warning light circuit*

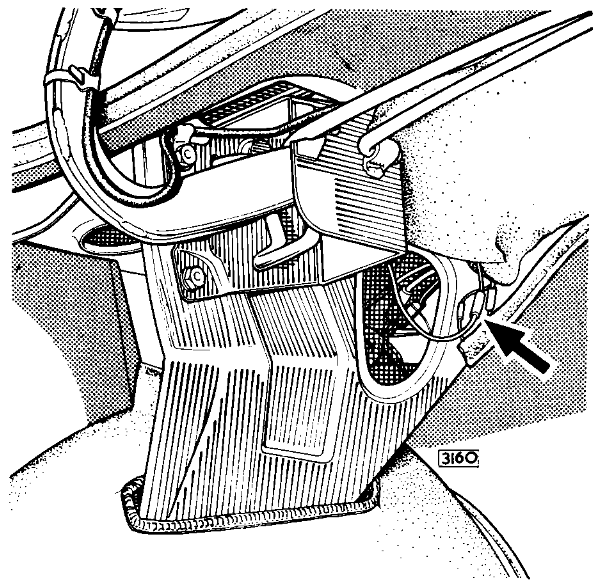


Fig. No. 75 *Location of black/white cable in the boot*

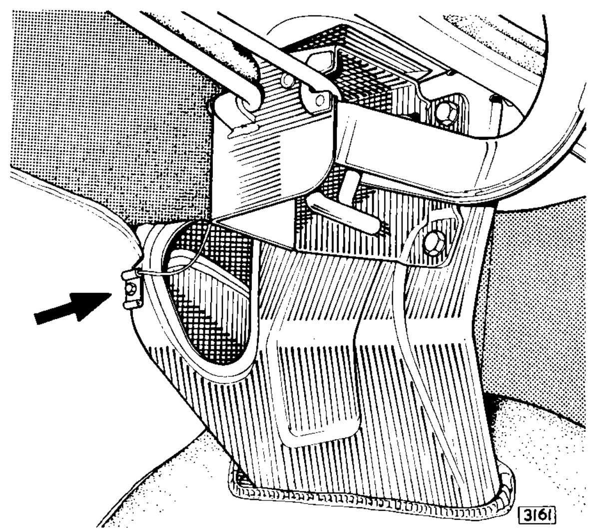


Fig. No. 76 *Location of earth tab in boot*

Fitting Instructions
Remove the backlight as detailed on Page N.11.
Remove the rear seat cushion and squab as detailed on page N.17.
Lift the rear parcel tray trimming where stuck to the rear squab panel and remove the two drive screws, now exposed, securing the parcel tray trim board. Pull the board away from the rear edge.
Drill two $\frac{1}{4}$" (6.4 mm.) holes in the parcel tray 17" (43.2 cm.) from either side of the centre line of the backlight and 6" (15.2 cm.) from the front edge. Fit the two small grommets in the holes.
Fit the backlight as detailed on Page N.11.
Feed the two cables attached to the backlight through the grommets.
Connect the left-hand cable to the black and white cable located in the luggage compartment behind the left-hand hinge bracket.
Attach the earth contact to the right-hand hinge bracket and connect the black cable.
Refit the parcel tray trim board.
Refit the squab and seat cushion.
Disconnect the battery.
Lower the centre instrument panel.

Drill a $\frac{7}{64}$" (2.78 mm.) hole in the top left-hand corner of the metal back plate of the instrument panel.
Important: EXTREME CARE must be taken to ensure that the drill does not penetrate the wooden facia panel. Fit a stop or sleeve over the drill shank to allow the drill to pierce the back plate only.
Attach the spring clip with the small drive screw to the panel and clip in the fuse holder.
Connect the white cable to the vacant A3 terminal on the fuse block along with the existing white cables.
Remove the side facia panel as detailed on Page N.6.
Note: If care is taken to ensure that the polished woodwork and the facia covering cannot be damaged, it will not be necessary to disconnect the switches and remove the panel completely from the car.

Locate the two semi-drilled holes in the back face of the side facia panel above the handbrake warning light. Complete the drilling of these holes through the panel, taking care that the polished face of the panel is not damaged.
Fit the switch warning light bulb holder and escutcheon.
Fit the relay to the scuttle reinforcement panel with the two drive screws as shown in Fig. 77.

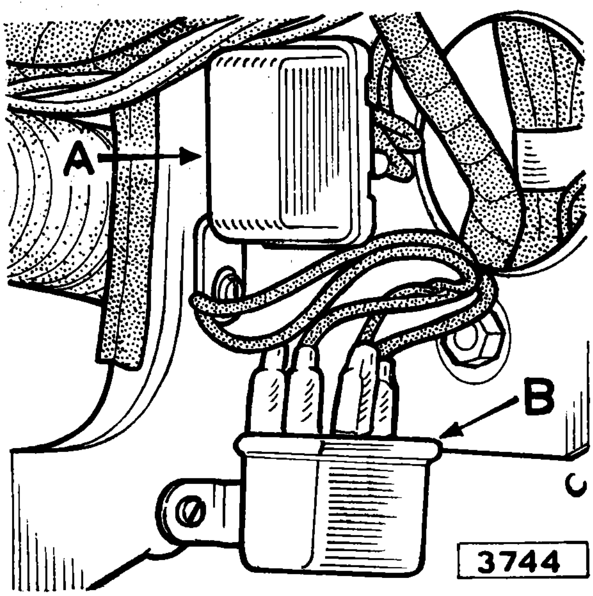


Fig. No. 77 *Location of the relay for the heated backlight*

Route the switch connector harness (C.26472) behind the facia panel with the panel harness.
Connect the connector harness as follows:—

1. Connect the left-hand side of the harness to the relay as shown in the wiring diagram on page P.65.
2. Connect the two black/white cables on the right-hand side of the harness to the operating switch and insert the warning light adaptor into the holder.

Refit the facia panel.
Complete the wiring details by connecting the black/white cable in the centre of the connector harness to the corresponding cable in the main panel harness, the black/white cable with the green indent to the corresponding cable in the fuse connector and the red cable to the side lamp fuse.
Connect the black/white cable in the main panel harness on the left-hand side to the corresponding cable at the base of the screen pillar.
Refit the instrument panel.
Reconnect the battery and test through.

Fault Diagnosis
Check that the fuse has not blown. Replace if necessary by one of the correct value.
Check the rear light element by disconnecting the cable connectors in the luggage compartment and reconnecting the backlight cables to a 12-volt battery with a 0-20 moving coil ammeter in series.
If no reading is apparent on the meter replace the backlight glass.
If a reading is shown on the meter, check the feed cables connection in the luggage compartment for continuity with a volt meter. Insert fuse and switch on ignition before checking.
The relay, which incorporates a resistance only controls the warning light circuit. It should, therefore, not be necessary to change the relay unless the warning light is suspect.

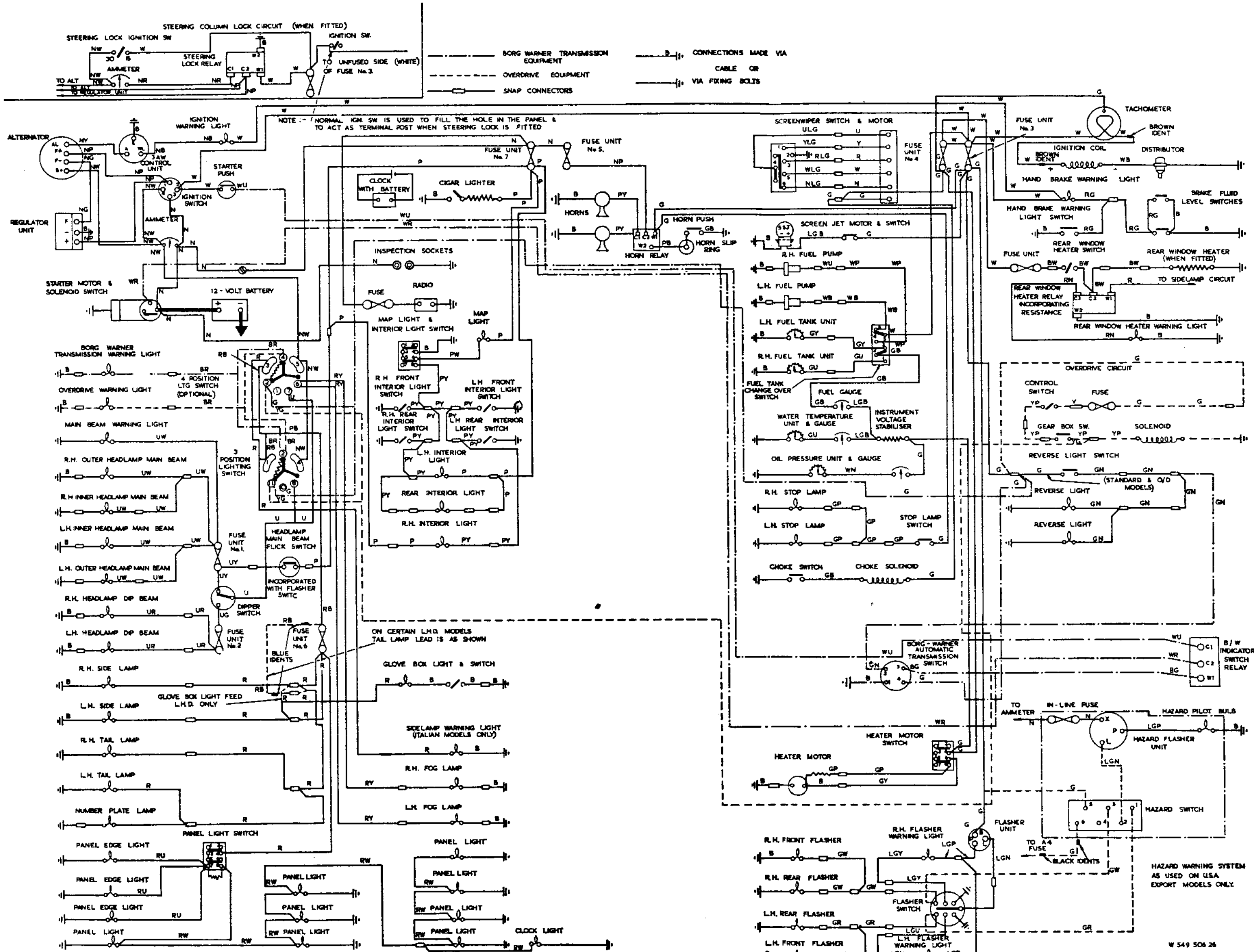


Fig. No. 78 *Wiring diagram*

CABLE COLOUR CODE

B	BLACK
U	BLUE
N	BROWN
G	GREEN
K	PINK
P	PURPLE
R	RED
S	SLATE
W	WHITE
Y	YELLOW
D	DARK
L	LIGHT
M	MEDIUM