SINGER

Gazelle

SERIES: I-II-IIA-III-IIIA

Workshop Manual

SINGER GAZELLE

Workshop Manual

FOR

SINGER GAZELLE

1957-1961

INCORPORATING AUTOMATIC TRANSMISSION

Models

SERIES I SERIES II SERIES IIA SERIES III SERIES IIIA

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SINGER GAZELLE

SERIES I - II - IIA - III - IIIA — 1957 - 1961

SECTION A

GENERAL DATA, DIMENSIONS AND SPECIFICATIONS

Note.—All dimensions are in inches unless otherwise specified.

Models	Series I to IIIA.
Year of manufacture	Series I-II — 1957-1958. Series IIA, III, IIIA — 1959-61.
Track:	
Front	4′ 1″.
Rear	4′ 0½″.
Wheelbase	8′ 0″.
Turning circle	34′ 3″ Series I and early Series II. 36′ later Series.
Ground clearance	7″ (Coupe 5½″).
Height, unladen	4′ 11½″ (Coupe 4′ 10″. Estate Car 5′ 0″).
Width	5′ 1″.
Length	13′ 7½″.
Weight (unladen) (Saloon)	2,250 lbs. approx.
Location of serial number, all Models	On plate on engine side of scuttle.
Location of engine number:	
Series I-II	Off-side of flywheel housing near dipstick.
Series IIA-III-IIIA	On R.H. side of cylinder block.
Chassis type, all Models	Unitary construction.

Torque Figures (In Lbs. Ft.)

	O.H.V. Engine:	O.H.C. Engine:
Cylinder head	41 to 43	58 to 66
Main bearings	50 to 60	58 to 66
Big end bearings	17	33 to 42
Rear spring U bolts	10½ to 12½.	
Front wheel bearings	15 to 20 (then back off nuts 1 to 1½ flats).	
Rear axle shaft nuts	180 to 200.	
Lower inner fulcrum pin bolts	26 to 28.	
Lower suspension eyebolt castellated nut	30.	

Capacities

Engine (with filter)	8 pints.
Engine only	7 pints.
Gearbox or automatic transmission	2¾ pints.
Gearbox and overdrive	4 pints.
Rear axle	1¾ pints.
Cooling system	12¼ pints.
Fuel tank—Series I	7 gallons.
Series II-IIA-III-IIIA	10 gallons.

Recommended Lubricants

Engine:	
Winter	S.A.E. 20.
Summer	S.A.E. 30.
Air cleaner	Engine oil.
Gearbox	S.A.E. 30.
Automatic transmission	S.A.E. 30.
Rear axle	S.A.E. 140 EP.
Steering gear	S.A.E. 140 E.P.
Universal joints	S.A.E. 140 EP or General Purpose Grease.
Brake and clutch master cylinders	Lockheed S.A.E. Spec. 70R.2.
Handbrake cable	S.A.E. 140 or General Purpose Grease.
Wheel bearings (front)	Wheel bearing grease.
Front suspension and steering linkage	S.A.E. 140 EP or General Purpose Grease.

Wheels and Tyres

Wheel:	
Type	Pressed steel disc.
Size	4J x 15.
Maximum permissible run-out	.010.
Maximum permissible eccentricity	.010.
Tyre type	4-ply tubeless.
Tyre size:	
Saloon, Coupe and Convertible	5.25/5.50/5.60 x 15.
Estate Car	5.50/5.90 x 15.
Tyre pressures:	
Normal:	
Front and rear (all models)	24 p.s.i.
Rear fully laden (cars only)	26 p.s.i.
Rear fully laden (Estate cars)	28 p.s.i.

SECTION B

ENGINE

Data and Specifications

	Series I-II:	Series IIA-III-IIIA:
Type	4-cylinder, in-line, O.H.C.	4-cylinder, in-line, O.H.V.
Bore	2.873	3.110
Stroke	3.520	3.00
Firing order	1-3-4-2	1-3-4-2
Normal H.P. (R.A.C.)	13.2	15.4
Capacity	91.3 cu. ins. (1496 c.c.)	91.16 cu. in. (1494 c.c.)
Compression ratio	7.5 to 1	8.5 to 1
Maximum B.H.P. at R.P.M.	52.5 at 4,500	60.2 at 4,500
Maximum torque (lbs. ft. at R.P.M.)	77 at 2,000	82.8 at 2,300
Maximum B.M.E.P. in P.S.I.	127 at 2,000	137 at 2300
Compression pressure at cranking speed	140 to 150 P.S.I.	175 to 185 p.s.i.
Initial timing:		
Series I-II	4° to 5° B.T.D.C.	
Series IIA-III	9° to 11° B.T.D.C.	
Series IIIA	6° to 8° B.T.D.C.	

Cylinder Block

Material	Cast iron.
Standard bore	"A" grade is standard, but subject to grading as indicated below. Individual bores in any production engine may conform to any of these grades (i.e., bores in any one cylinder block may not conform to one grade).

	Series I-II:	Series III-IIIA:
A	2.8727 to 2.8731	3.1102 to 3.1106
B	2.8731 to 2.8735	3.1106 to 3.1110
C	2.8735 to 2.8739	3.1110 to 3.1114
D	2.8739 to 2.8743	3.1114 to 3.1118

Bore for oversizes:	
Maximum with liners	.040.
Maximum without liners	.040.
Number of main bearings	3.
Cylinders:	
Location of No. 1	Front.

Cylinder Head

Material	Cast iron.
Interference fit of valve guides	.0008 to .002 Series I-II. .0003 to .0015. Series IIA-III-IIIA.
Valve seat angle	45°.
Gasket type	Copper and asbestos. Series I-II Varnished steel pressing. Series IIA-III-IIIA.
Gasket thickness	.031 (fitted). Series I-II. .022 (fitted). Series IIA-III-IIIA.

Crankshaft

	Series I-II:	Series IIA-III-IIIA:
Type	Integral counter-weights.	Balanced (counter-weights integral).
Thrust taken at	Rear main bearing.	Centre bearing (thrust washers).
Number of journals	3.	3.
End float	.001 to .008.	.002 to .004.
Main bearing journal diameter	1.9995 to 2.00.	2.2490 to 2.2495.
Minimum regrind diameter	1.9985.	2.189.
Crankpin bearing journals:		
Diameter	1.7495 to 1.750.	1.8755 to 1.876
Undersizes for regrind	—.010.	—.020, —.040, —.060.
Minimum regrind diameter	1.7395	1.8155.
Method of sealing oil:		
Front end of shaft	Seal.	Seal and slinger.
Rear end of shaft	Slinger and scroll.	Slinger and return thread.

Main Bearings

Type	Steel-backed, white metal.	Steel-backed white metal.
Number of main bearings	3.	3.
Clearance on crankshaft (diameter)	.001 to .0025.	.0007 to .0025.
Undersizes	—.010.	—.020, —.040, —.060.

Connecting Rods

Type	"H" section.	"H" section.
Material	Steel forging.	Steel forging.
Length, centre to centre	6.250.	5.749 to 5.751.
Small end lubrication	Splash.	Splash.
Small end bearings:		
Type	Bronze bush.	Bronze bush.
Bore of bush fitted—graded:		
High grade	White, .6252 to .6251.	White, .8752 to .8753.
Medium grade	Green, .6251 to .6250.	Green, .8751 to .8752.
Low grade	Yellow, .6250 to .6249.	Yellow, .8750 to .8751.
Big end bearings:		
Type	Steel shells, white metal lined.	Steel shell, lead indium lined.
Diameter (outer)	1.8555 to 1.8566.	2.021 to 2.0215.
Diammetrical clearance	.001 to .002.	.0015 to .002.
End float on crankpin	.006 to .008.	.0012 to .0075.

Gudgeon Pins

	Series I-II:	Series IIA-III-IIIA:
Type	Tubular—fully floating.	Tubular—fully floating.
Method of securing	Circlips in piston.	Circlips in piston.
Diameter — graded:		
High grade		.8751 to .8752 (painted white).
Medium grade		.8750 to .8751 (painted green).
Low grade		.8749 to .8750 (painted yellow).
Oversize available +.003	.6248 to .6250.	.8780 to .8782.
Fit in connecting rod } Fit in piston }		Hand push fit at 65°F.

Pistons

Type — Series I-II	Split skirt.
Series IIA-III-IIIA	"T" slot.
Note.—Low compression engines have hollow crown pistons.	
Material — Series I-II	"Heplex" alloy, tin plated.
Series IIA-III-IIIA	"LO-EX" alloy, tin plated.
Removal	From above block.

Grade sizes:	Series I-II:	Series IIA-III-IIIA:
Grade A	2.8713 to 2.8709	3.1088 to 3.1084
Grade B	2.8717 to 2.8713	3.1092 to 3.1088
Grade C	2.8721 to 2.8717	3.1096 to 3.1092
Grade D	2.8725 to 2.8721	3.1100 to 3.1096
Grade E (for service use)	2.8725 to 2.8729	3.1104 to 3.1100
Grade F (for service use)	2.8729 to 2.8733	3.1108 to 3.1104

	Series I-II:	Series IIA-III-IIIA:
Maximum oversize for rebore	.030.	.040.
Compression height	1.7205 to 1.7275.	1.845 to 1.850.
Piston length	3.140.	3.25.
Maximum weight variation between pistons	3.55 grams.	3.55 grams.
Ring to groove clearance	.0015 to .0035.	.0015 to .0035.
Number of compression rings	2.	2.
Number of oil control rings	1.	2.
Ring gap (fitted)	.008 to .013.	.009 to .014 (checked in "A" grade bore).

Valves

Type	Poppet.
Position	In cylinder head.
Operation—Series I-II	Camshaft and rocker.
Series IIA-III-IIIA	Pushrod and rocker.

Timing:	Series I-II:	Series IIA-III-IIIA:
Inlet opens	14° B.T.D.C.	10° B.T.D.C.
Inlet closes	50° A.B.D.C.	45° A.B.D.C.
Exhaust opens	50° B.B.D.C.	46° B.B.D.C.
Exhaust closes	10° A.T.D.C.	9° A.T.D.C.

Dimensions:	Inlet	Exhaust	Inlet	Exhaust
Overall length	4.310	4.310	4.66	4.66
Head diameter	1.375	1.250	1.432-1.436	1.172-1.176
Stem diameter	.310-.311	.310-.311	.3105-.3110	.3095-.310
Stem clearance in guide	.0002-.0017	.0002-.0017	.0015-.003	.0025-.004
Clearance at rocker arms (hot)	.018	.020	.012	.014

Valve Guides

	Series I-II:		Series IIA-III-IIIA:	
Dimensions:	**Inlet**	**Exhaust**	**Inlet**	**Exhaust**
Length	2.75	2.75	2.15	2.42
Outside diameter	.6263-.6268	.6263-.6268	.5635-.5640	.5635-.5640
Inside diameter	.3112-.3117	.3123-.3128	.312-.314	.312-.314
Interference fit in head	.0008-.002	.0008-.002	.0003-.0015	.0003-.0015
Fitted height above head	Located by shoulder (on guide).		.58 above spring pocket (both guides).	

Valve Springs

Type	Dual.		Dual.	
	Inner	**Outer**	**Inner**	**Outer**
Free length	1.828	2.109		
Fitted load	25 lbs.	55 lbs.	26.6 lbs.	53.7 lbs.
Spring retention	Cup and split collet.		Cup and split collet.	
Fitted length	$1\frac{1}{16}$	$1\frac{9}{64}$	1.46	1.58

Camshaft

Method of taking thrust	Centre bearing.	Front locating plate.
End float	.0015 to .005.	.002 to .003.
Bearing journals diameter	.9352 to .9357.	1.7470 to 1.7477.

Camshaft Bearings

Type	Cast iron.	Steel-backed, white metal lined.
Bearing inside diameter	.9372 to .938.	1.749 to 1.750.
Diametrical clearance	.0015 to .0028.	.002 to .0023.

Camshaft Drive

Type	Duplex chain.	Duplex chain.
Type of chain tensioner	Spring loaded sprocket.	Spring blade.
Chain lubrication	Drillings in lower drive sprocket.	Oil jet.

Lubrication System

Type	Pressure.	Pressure.
Type of pump	Submerged gear.	Eccentric lobe.
Type of pump drive	Skew gear on intermediate shaft.	Skew gear from camshaft.
Normal pressure (hot)	30 p.s.i. at 30 m.p.h.	30 to 50 p.s.i. at 50 m.p.h.
Filter:		
Type	By-pass.	Full flow.
Make	A.C.	Tecalemit or Fram.
Element number		Tecalemit FP3305/101. Fram FC41721.
Capacity	$\frac{1}{2}$ pint.	1 pint.

ENGINE

O.H.C. ENGINE: SERIES I-II

To Remove and Replace the Engine Sump and Filter.

Completely drain the oil from the sump and take out the dipstick.

Remove the three bolts securing the forward cover for the lower half of the flywheel housing and detach the cover.

Remove the 15 setbolts and 6 nuts securing the sump to the crankcase and withdraw the sump .

Remove the oil pump filter basket by bending back the tabs securing the basket to the cover-plate.

Remove the four nuts securing the sump baffle plates to the crankcase — two to each plate — and withdraw.

Swill out the sump with kerosene and clean the filter basket in petrol with a stiff brush. Inspect the joint seal and if damaged fit a new one. Sealing compound is not necessary when making the joint.

Refit the baffle plates, filter basket and sump, tightening the securing bolts evenly. Clean and replace the drain plug and dipstick before refilling the sump with 7½ pints of the recommended oil.

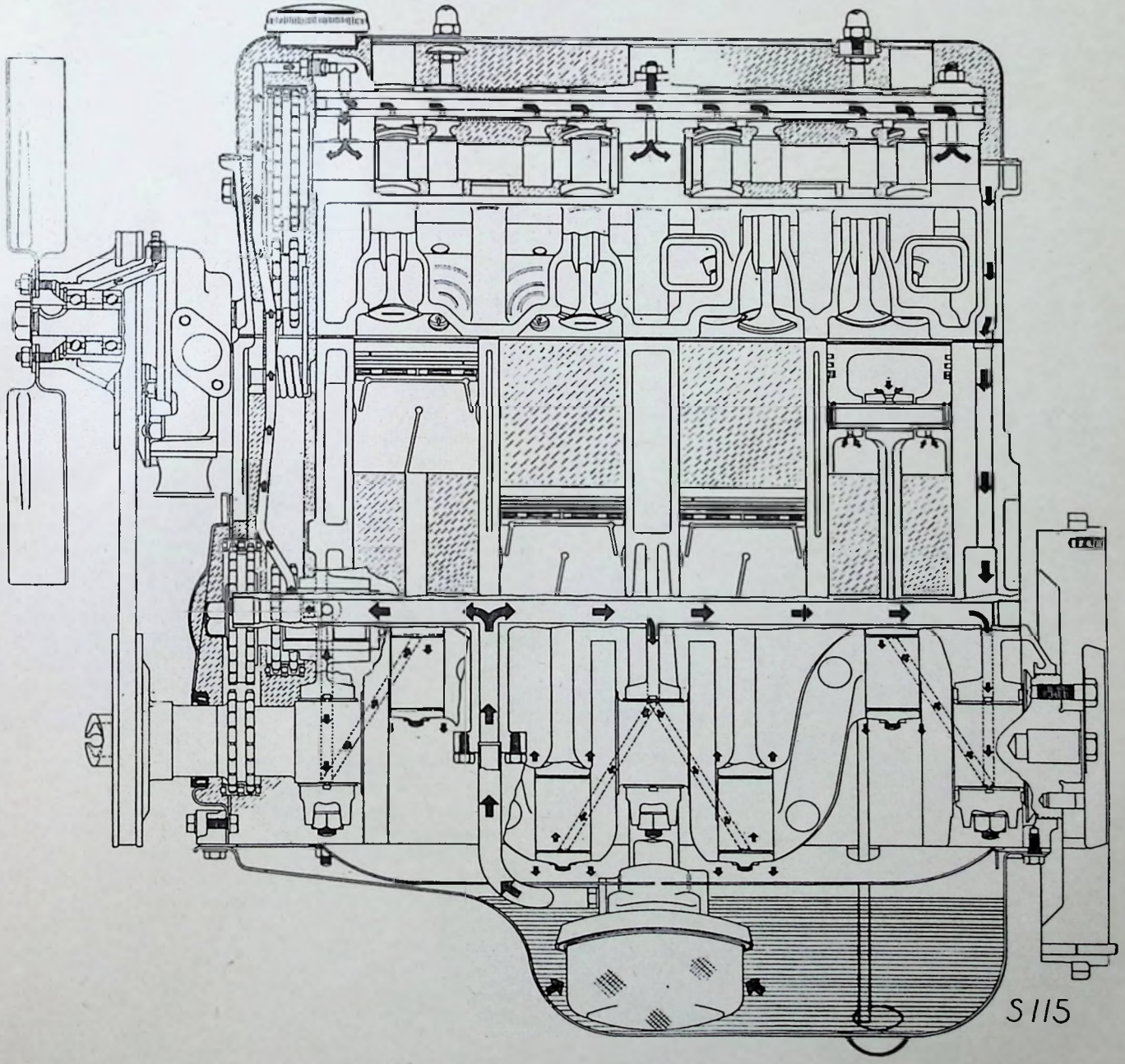


FIG. 1.—Engine lubrication, longitudinal section, Series I-II.

To Remove and Replace the Oil Pump.

Drain and remove the engine sump .

Detach the oil delivery pipe from the pump. Note the gaskets between the flanges.

Undo the nuts securing the oil pump to the crankcase and withdraw the pump, complete with its drive shaft and gear.

Replacement of the oil pump is a reversal of the method given for its removal, but a point to be noted is that the slotted end of the drive shaft which engages with the distributor spindle must be located correctly.

The offset slot should be parallel to the centre line of the engine, with the narrow segment nearest to the cylinder block when No. 1 cylinder inlet valve is just opening and No. 4 piston is at T.D.C. on its firing stroke. The distributor must be removed to ensure that this position is obtained.

As the pump is pushed into its housing and the drive shaft gear engages that on the intermediate shaft, the pump driving shaft will rotate in a clockwise direction when seen from above, and if the slot is set to point approximately towards No. 1 sparking plug before the pump is inserted into its housing, it should be in the correct position when the pump is fully home.

Check and if necessary reset the ignition timing before assembling the engine sump.

To Dismantle and Re-assemble the Oil Pump.

The efficiency of the pump depends on two main facts, the extent of the clearances between the end

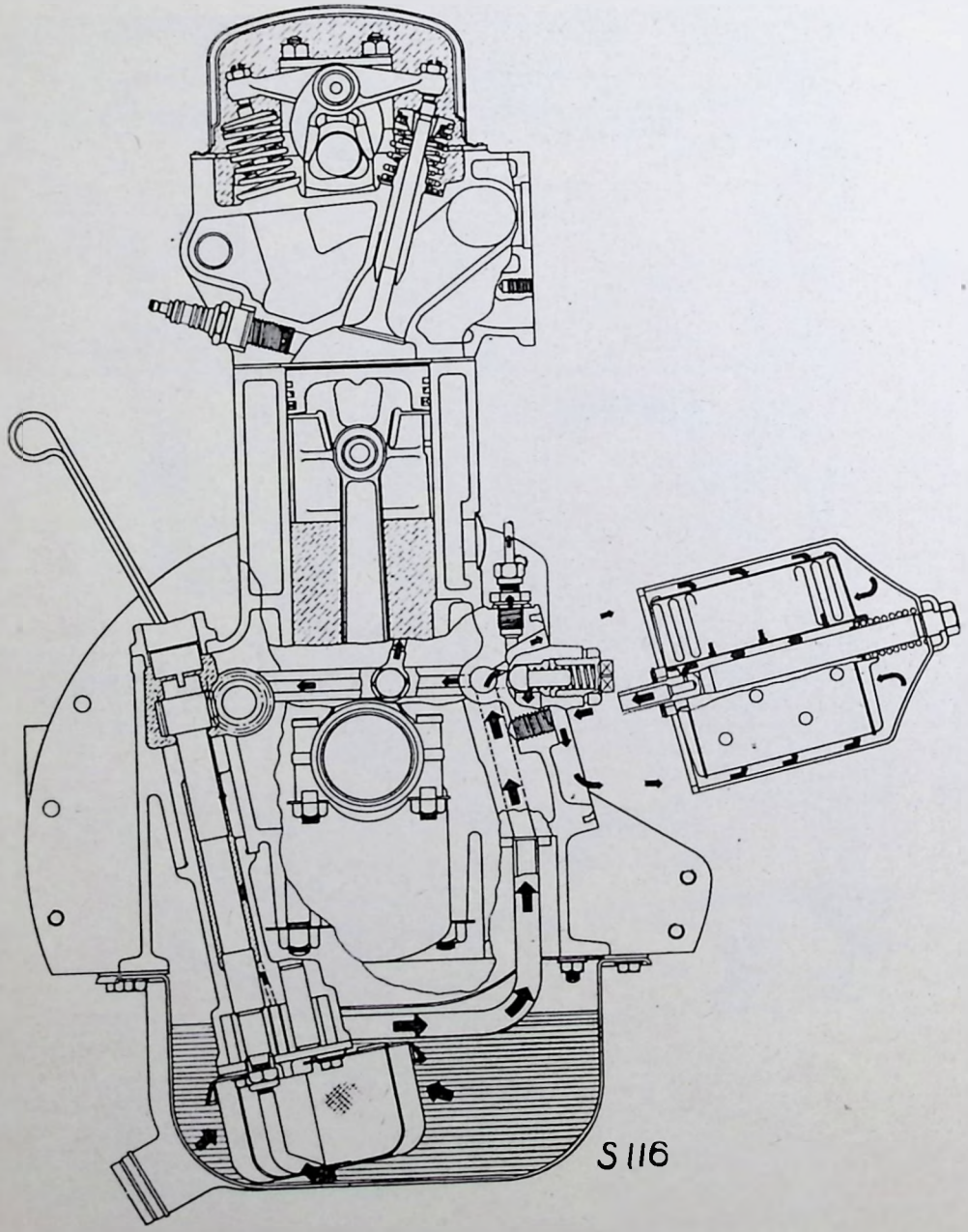


FIG. 2.—Engine lubrication, cross-section (Series I-II).

faces of the gear, and the cover; and between the periphery of the gears and the surfaces of the bores in which they revolve. The extent of the clearance for the former varies from .0028 to .048 and for the latter from .0012 to .0037.

Excessively worn and/or deeply marked gear tooth faces will also affect the efficiency. Gears showing these conditions should be replaced.

To check the clearances the pump must be stripped as follows:—

First remove the filter by bending back the tabs securing it to the cover-plate. Remove the large self-locking nut in the centre of the pump cover, and the four setpins and plain washers securing the cover to the body. Note the distance piece under the large nut and the method of wiring the four cover setpins.

The cover can now be removed.

Drive out the main spindle from its gear, taking care not to damage the thread on the end. Note when doing so, the driving key on the spindle. Remove the gears from the pump body.

Clean all the parts carefully, particularly the joint faces of the body and cover. Insert the spindle and check the clearance between it and the bore in which it revolves. If the clearance is excessive and there are signs on the spindle of wear, replace the spindle. Should excessive wear still be evident, replace the body.

Assemble the spindle and gears to the body and check the clearances between the periphery of the gears and their bores. If the body is new and the clearance is greater than .0037, replace the gears, but if the body is the original, follow the same procedure as previously suggested for the body and spindle.

When assured that the foregoing conditions are correct, place a straight-edge across the face of the gears and the body. The machined face of the body should stand proud of the face of the gears to an extent where, with a standard gasket and the cover bolted securely to the body, there is a clearance of .0028 to .0048 between the gear faces and cover.

Any excess clearance may be reduced by machining the face of the body the required amount.

The machining operation must be carried out carefully and accurately, for the efficiency of the pump depends on the condition of the joint.

The pump can now be re-assembled in the reverse order to dismantling.

To Remove and Replace the Cylinder Head.

Disconnect the positive lead from the battery terminal. Drain the cooling system by means of the tap at the bottom left-hand side of the radiator and the tap on the right-hand side of the cylinder block. If the cooling system contains any anti-freeze solution, drain the mixture into a suitable container.

Unscrew the temperature gauge thermobulb, complete with its adapter, from the water outlet pipe.

Remove the oil bath air cleaner and carburetter.

Slacken the clips on the top water hose connection between the cylinder head outlet pipe and the radiator and remove the hose.

Disconnect the inner and outer throttle control cables.

Disconnect the exhaust pipe from the manifold flange.

Disconnect the high and low tension leads to the coil and remove the coil.

Remove the valve rocker cover, complete with gasket.

Disconnect the oil feed to the front rocker shaft bearing and when doing so disturb the pipe as little as possible, to help maintain the necessary clearance between the pipe and the timing chains.

Remove the four bolts and shakeproof washers securing the cylinder head front cover.

Revolve the engine by means of the starting handle and set the flywheel with the mark $\frac{1}{4}$ on top centre with No. 1 cylinder inlet valve open. No. 4 cylinder sparking plug is now about to fire.

Screw the chain tensioner out as far as possible.

Place sufficient clean rag beneath the chainwheel and around the chain, to prevent anything dropping down the chain case. Bend back the lock tab of the bolt securing the chainwheel to the camshaft and remove the bolt with the plain and tab-washers. Now prise the chainwheel, complete with chain, off the camshaft and support it by lashing the wheel, with the chain in position, to the radiator cap with a piece of suitable wire.

From this point onwards do not revolve the crankshaft, since to do so will upset the valve and ignition timing.

Should it be necessary to revolve the crankshaft for any purpose, re-time the valve and ignition timing as described on page 9.

Remove the sparking plugs.

Remove the ten cylinder head holding-down nuts and plain washers; take care not to drop any down the front or rear apertures.

Release the head from the cylinder block and lift it off by a direct pull.

Replacement is by reversing the foregoing.

Do not forget to re-adjust the chain tensioner.

If the head has been dismantled, then proceed as follows:—

Check that the flywheel is set with the mark $\frac{1}{4}$ on top centre and that the electrode of the rotor in the distributor is pointing to the segment in the cap connected to No. 4 sparking plug.

Place the head in position on the cylinder block, taking care to see that their joint faces and those of the gasket are clean; set the camshaft so that the mark on the rim of its driving flange is in line with the machined face of the pad at the butt face

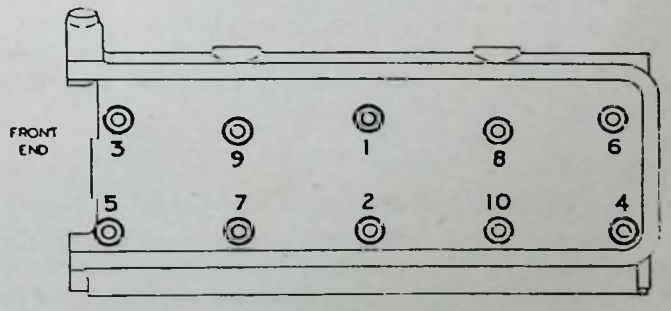


FIG. 3.—Order of tightening cylinder nuts. (Series I-II.)

of No. 1 bearing cap of the camshaft. Offer the chainwheel assembly to the camshaft and if the holes in the wheel will not register with the studs on the driving flange, lower the chainwheel sufficiently to work the chain over the wheel a tooth at a time until engagement is effected without altering the positions of the camshaft or crankshaft, and with the right-hand length of the chain in tension and the chain tensioner also in engagement.

Check the valve and ignition timings as described on page 9 before proceeding any further with the assembly, which from here is the reverse order to dismantling.

When re-assembling, it is important that the ten cylinder nuts are tightened in the order shown in Fig. 3.

To Adjust the Camshaft Chain Tensioner.

Slacken off the locknut on the adjuster bolt and remove all the existing adjustment by screwing the adjuster outwards. Using the fingers only, screw the adjuster inwards until tension can be felt. Then, screw the adjuster back half a turn and re-tighten the locknut.

Care must be taken not to over-tighten the tensioner, otherwise the normal load on the camshaft will be increased and excessive wear introduced.

To Adjust the Valve Rockers.

Remove the rocker cover.

Turn the engine slowly until No. 8 valve, exhaust valve, No. 4 cylinder, is fully lifted from its seat.

In this position No. 1 valve, exhaust valve, No. 3 cylinder, is fully closed, with the pad of the rocker resting on the centre of the back of the cam. Check the clearance between the valve stem of No. 1 valve and the rocker adjusting screw, with the appropriate feeler gauge. The gauge should be a sliding fit.

To adjust the clearance, release the locknut on the valve end of the rocker and, with a screwdriver, screw 'in' or 'out' the adjusting screw until the required clearance is obtained. Tighten the locknut, avoiding undue force, and re-check the clearance.

If the adjustment of the remaining valves is repeated in the following sequence, only the minimum amount of engine turning will be required.

With No. 8 valve fully open, adjust No. 1 rocker.
With No. 6 valve fully open, adjust No. 3 rocker.
With No. 4 valve fully open, adjust No. 5 rocker.
With No. 7 valve fully open, adjust No. 2 rocker.
With No. 1 valve fully open, adjust No. 8 rocker.
With No. 3 valve fully open, adjust No. 6 rocker.
With No. 5 valve fully open, adjust No. 4 rocker.
With No. 2 valve fully open, adjust No. 7 rocker.

The clearance between the end of the valve stems and the rocker adjusting screws, when the engine is warm, should be as follows:—

Inlet valves	.018
Exhaust valves	.020

To Dismantle and Re-assemble the Cylinder Head.

Remove the six nuts and washers securing the upper halves of the camshaft bearings, and lift off the halves, complete with valve rockers and shaft. The camshaft can now be lifted out.

Remove the lockplate and setpin which secures the rocker shaft to the top half of the camshaft intermediate bearing, and slide the various components off the rocker shaft towards the rear. Note the order and mark the rockers so that they can be re-assembled in their original positions.

Notice the order in which the inlet valve and exhaust valves are removed. It is important that the valves are returned in this order to ensure correct re-assembly.

With the valve cup and spring depressed, the retaining collars can be removed readily.

The valve can then be withdrawn from its guide, through the combustion chamber.

Re-assembly is in the reverse order to the foregoing.

When fitting the retaining collars to the valves, make sure that they are properly located in their spring cups and in the annular grooves machined in the valve stems. It is advisable to tap them lightly into position with the aid of a tube and hammer. The bore of the tube should be such that it will just pass over the valve stems.

The rocker bushes and the camshaft bearings receive their supply of oil through the hollow rocker shaft and oilways drilled radially in the shaft and vertically downwards in the bearing caps.

Before assembling these parts make sure that the bore of the shaft, the oil ways in it and in the bearing caps are clean; also, that when inserting the shaft the end with two oil holes diametrically opposite each other fits into No. 1 bearing cap and that the holes register with the oilways in the cap. To ensure correct assembly the rear end of the shaft is grooved for identification. These precautions are necessary to ensure a supply of oil to the bearings and rockers.

To Renew the Valve Guides.

It is seldom necessary to renew valve guides except after long service, but it may be necessary, for the purpose of recutting valve seatings where great accuracy is essential, to ensure concentricity of work performed by cutters, which are used with their pilots inserted in the valve guides.

Remove the cylinder head.

Remove the rocker gear and valves.

The valve guides are a press fit in the cylinder head.

In fitting the valve guides it is important that they are the prescribed interference fit in the cylinder head, which is .0008 to .002.

The valve guides should be drawn into position from top to bottom until the shoulder on the guide is seated firmly on the top face of the head.

When fitted the valve guides must be to the correct internal dimensions which are:—

Inlet	.3112 to .3117
Exhaust	.3123 to .3128

Finally check the fit of the valves in the new guides. They should be a free sliding fit without excessive clearance.

The Valve Timing.

The overhead camshaft receives its drive from the crankshaft by means of two endless duplex roller chains. The primary chain drives the intermediate shaft and the secondary the camshaft via the intermediate shaft. The intermediate shaft also drives, through a set of helical gears, the oil pump and distributor, also an eccentric on this shaft actuates the mechanical fuel pump.

The secondary chain is provided with a spring loaded adjustable jockey sprocket for tensioning.

The crankshaft chainwheel is keyed to the crankshaft and so also is the driving chainwheel of the intermediate shaft. The flange of the intermediate shaft driving chainwheel is fitted with three pegs which engage with holes drilled, and equally spaced, in the flange of the intermediate driver chainwheel. Both wheels are held to the shaft by a nut and lockplate.

The camshaft chainwheel is attached to the camshaft flange in a similar way, except that the six holes in the flange of the wheel are not equally spaced but offset in a manner which permits the wheel being engaged with the camshaft flange in six different positions, thereby providing an accurate method of adjusting the valve timing.

Timing Marks.

Top Dead Centre Location.

The top dead centre marks $\frac{1}{4}$ stamped on the rim of the flywheel can be seen through an aperture cut in the clutch housing and vertically above the centre of the flywheel.

To obtain top centre for Nos. 1 and 4 pistons, place the stroke in line with the mark engraved on the clutch housing.

Valve Timing Mark.

A timing mark is scribed across the edge of the large driving flange of the camshaft. This mark, when in line with the machined face on No. 1 camshaft bearing, indicates that No. 1 cylinder inlet valve has opened 14° before top dead centre, and that the valve timing is correct if Nos. 1 and 4 are at top centre.

To Check the Valve Timing.

Check that the clearance between the valve rockers and the valve stems is .020 for the exhaust valves and .018 for the inlet valves. If necessary, reset the rocker adjusting screws to obtain correct clearance. Rotate the engine slowly until the mark $\frac{1}{4}$ stamped on the rim of the flywheel appears exactly in the centre of the aperture on the top of the clutch housing; remove the distributor cap and check that the rotor is pointing towards the electrode in the cap connected to No. 4 sparking plug.

If, at this point, the mark scribed across the edge of the large driving flange of the camshaft is exactly in line with the machined face on the forward camshaft bearing, the valve timing is correct.

If, however, the mark on the camshaft driving flange is not exactly in line with the machined face on the camshaft bearing, adjustment is necessary and should be carried out in the following manner:—

Release the locknut on the chain tensioner adjusting bolt, remove the tensioner bolt and prise the tensioner sprocket away from the chain.

Bend back the lock tab of the bolt securing the chainwheel to the camshaft and remove the bolt with the plain and tab-washers. Prise the chainwheel, complete with chain, off the camshaft. **Do not allow the assembly to drop as this will disengage the chain from the intermediate chainwheel.**

Turn the camshaft until the timing mark scribed across the edge of the large driving flange is in line with the machined face on No. 1 camshaft bearing.

Lower the chain and wheel sufficiently to permit the chain being worked over the wheel a tooth at a time until, with the right-hand length of chain in tension, it is possible to engage the holes in the wheel with the pegs on the camshaft driving flange without altering the positions of the crank or camshafts.

The direction in which the chain must be worked over the chainwheel will depend on the position of the camshaft timing mark before the camshaft was re-positioned; if the mark was above the machined face on the camshaft bearing then the chain must be worked in an anti-clockwise direction, and if below in a clockwise direction.

When satisfied that the position of the camshaft timing mark is correct, secure the wheel temporarily to the camshaft, re-engage the chain tensioner with a slightly abnormal tension setting and re-check that the positions of the two timing marks are correct.

If correct, re-assemble in the reverse order to dismantling and do not forget to set the tension of the chain tensioner correctly.

To Check and Adjust the Ignition Timing.

Remove the distributor cap and check that the gap between the distributor points is .014″ to .016″ (.356 mm. to .406 mm.) when in their maximum open position. Turn the engine slowly with the starting handle until No. 1 cylinder inlet valve commences to open. Now watch the distributor points and cease turning the engine when they just part. If the ignition timing is correct the mark 1/4 on the flywheel will be 10° before top dead centre or $\frac{15}{16}$″ before the centre line of the engine, measured in an arc on the flywheel rim. This distance can be measured approximately by counting off three teeth on the starter ring gear, through the aperture in the clutch housing. Should any correction prove necessary, release the nuts securing the distributor clamp or index plate to the adaptor, set the pointer to zero and tighten the nuts. Set the flywheel so that the mark 1/4 on the rim of the flywheel is 10° B.T.D.C. or $\frac{15}{16}$″ before the centre line of the engine. Then release the pinch bolt of the distributor clamp or index plate, rotate the body in a clockwise direction until the points are closed, then in an anti-clockwise direction until the point just part; tighten the clamp pinch bolt and recheck the opening position of the points.

Any slight alteration to the setting to suit running conditions should be made by releasing the nuts securing the clamp or index plate and moving the distributor as required, within the movement of the slotted holes in the plate. Do not omit to tighten all nuts released.

Important: Later models are fitted with an improved Distributor, Type No. D2A4, and on cars so equipped the correct ignition timing is 5° B.T.D.C. or $\frac{15}{32}$" measured on the rim of the flywheel. The two distributors are readily distinguishable by the ignition suppressor which is integral with the cap on the D2A4 Distributor, and of the screw-in-type on the earlier model.

To Remove and Replace the Distributor.

Turn the engine with the starting handle until the inlet valve of No. 1 cylinder is just opening. No. 4 cylinder is now on firing stroke. Continue to turn the engine very gently until the mark 1/4 on the rim of the flywheel is 10° before top dead centre or $\frac{15}{16}$" before the centre line of the engine, measured in an arc on the flywheel rim. This distance can be measured approximately by counting off three teeth on the starter ring gear, through the aperture in the clutch housing.

Disconnect the distributor high tension leads from the sparking plugs and the spark coil, also the low tension lead from the body of the distributor.

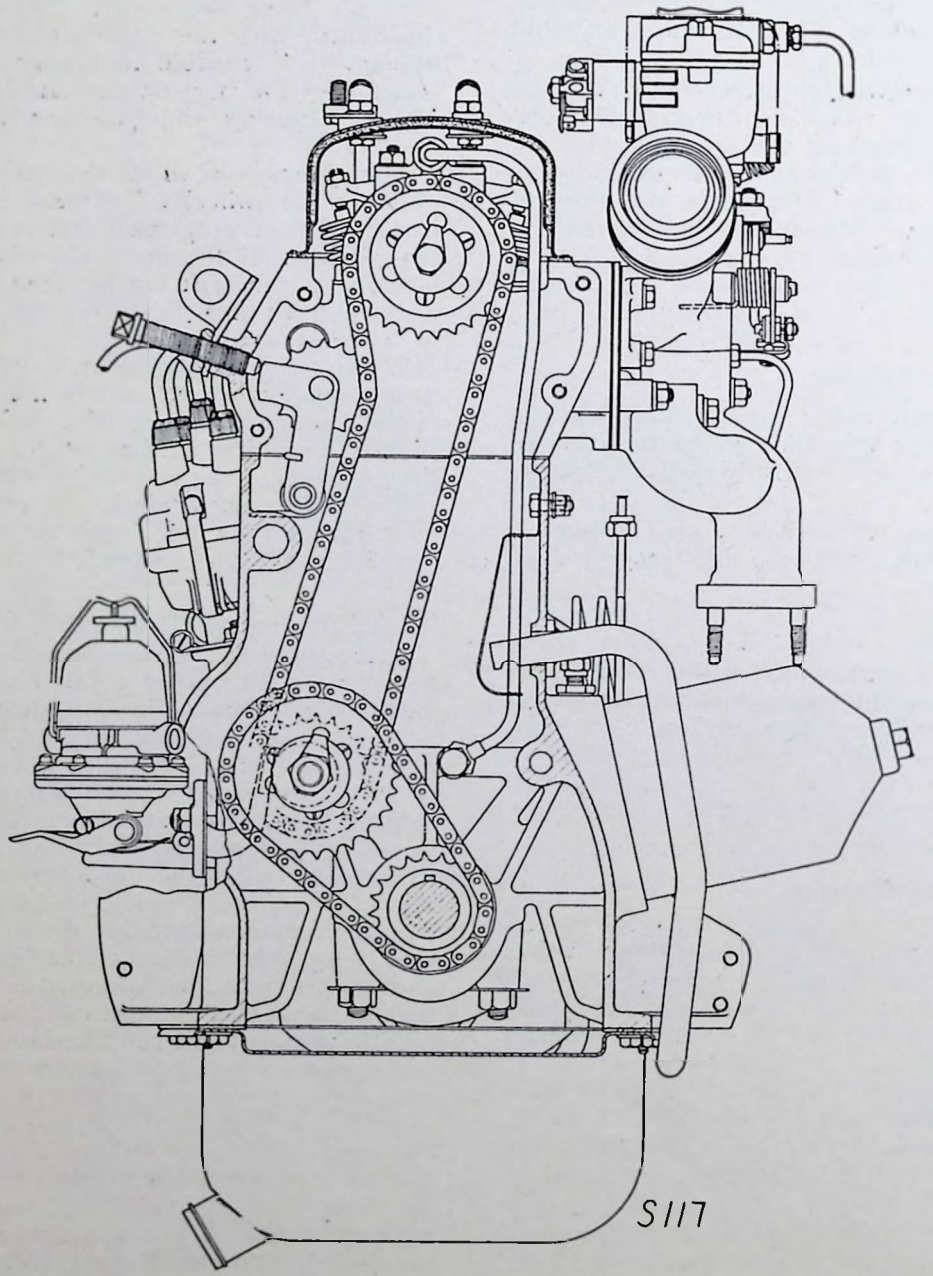


FIG. 4.—Layout of camshaft drive. (Series I-II.)

Remove the two nuts securing the adaptor of the distributor to the cylinder block, and withdraw the distributor complete with adaptor. If possible avoid turning the engine until the distributor is replaced, but as the spade drive is offset no difficulty should be experienced when replacing the distributor, always providing the oil pump and/or camshaft and the chain have not been removed from the engine.

To Replace the Distributor.

Fit the assembly in the engine, rotate the spindle until the drive engages, and bolt the flange of the adaptor to the cylinder block.

Release the pinch bolt of the distributor clamp and rotate the body in a clockwise direction until the points are closed and the electrode of the rotor is approaching the segment in the cap connected to No. 4 sparking plug. Now rotate the body of the distributor in an anti-clockwise direction until the points are just parting and tighten the clamp pinch bolt securely. To check, rotate the engine backwards for a quarter of a revolution, then forwards gently until the joints just part. For the timing to be correct the marks 1/4 on the flywheel should be 10° B.T.D.C. The distributor revolves in an anti-clockwise direction when viewed from the rotor end, or clockwise when viewed from the drive end, check that the leads are attached to the cap and connected to sparking plugs in their correct sequence, i.e., 1, 3, 4, 2. counting in the direction in which the rotor revolves. From this point replacement is the reversal of dismantling.

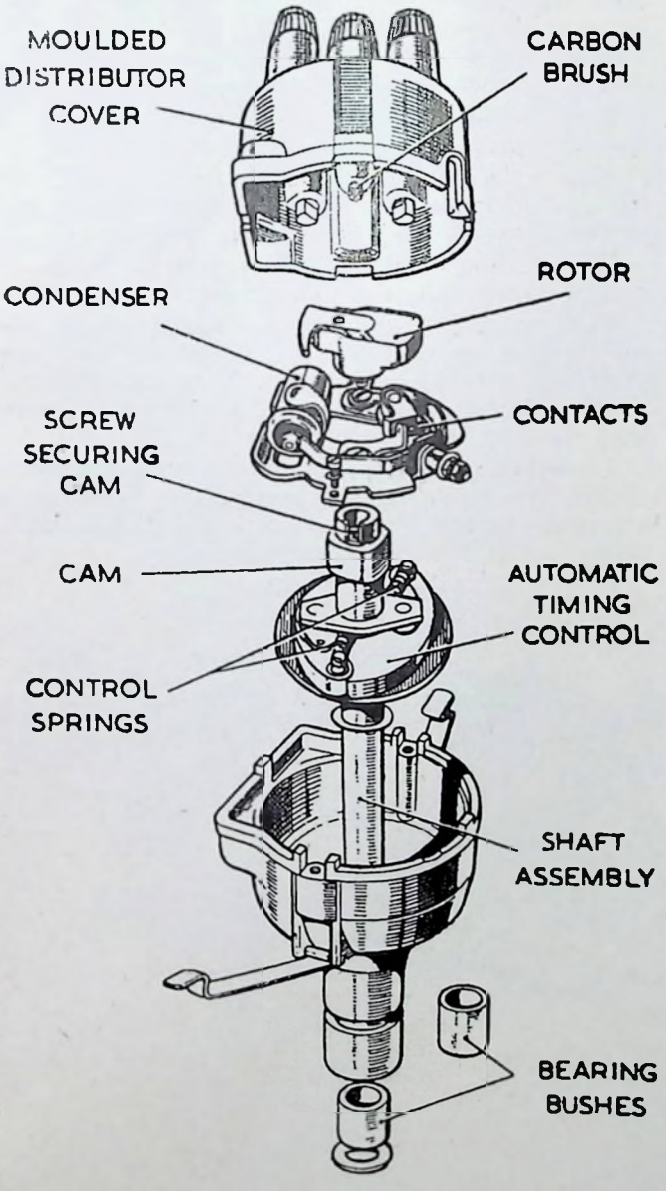


FIG. 5.—Exploded view of the DKY 4A distributor.

To Remove and Replace a Piston and Connecting Rod Assembly.

Remove the cylinder head.

Drain and remove the engine sump.

Remove the oil suction pipe. Note the gaskets.

Turn the engine until the connecting rod assembly to be treated has its big end in the lowest position.

Remove the nuts and tab-washers from the big end bearing bolts and remove the cap, complete with the bearing shells. Push the connecting rod and piston assembly up the bore until the gudgeon pin is exposed to view above the top face of the block.

Turn the assembly through an angle of 90°, extract one of the circlips locating the gudgeon pin in the piston and with a helper supporting the connecting rod, drive out the gudgeon pin.

Remove the piston upwards and the rod downwards out of the bore. Replace the gudgeon pin into the piston and mark the piston with the number of the bore from which it was removed, naming the bore nearest the radiator as No. 1. The caps and rods are numbered 1, 2, 3, 4, and must be replaced as removed and in their respective bores, but the positions of the halves of each bearing relative to the cap and rod are not marked and should, on dismantling, be marked suitably. These precautions are necessary to assist correct re-assembly.

Replacement is the reverse of the above but observe the following:—

For the connecting rods to be assembled correctly in the bore the figures 1, 2, 3 or 4 stamped on each rod and cap must face towards the exhaust manifold side of the engine. On final assembly use new locking washers on the connecting rod bolts.

The small end bearings are fixed bronze bushes pressed into position and broached to give a gudgeon pin tolerance fit of .00022.

When pressing in the bush, make sure that the oil hole in it and the one in the rod register.

The gudgeon pins are ground for correct assembly to the small ends but it may, on occasions, be necessary to adopt selective assembly to give a condition where it is just possible, by holding the big end in the palm of the hand, to oscillate the rod on the pin.

The gudgeon pin is a shrink fit in the piston which should be fitted to the rod so that when in the bore the word "FRONT" is towards the radiator and the figures 1, 2, 3 or 4, stamped on the big end of the connecting rod towards the exhaust manifold side of the engine. The gudgeon pin is held in the piston by two circlips. To fit a gudgeon pin to a piston, immerse the piston for a few minutes in very hot water.

The Pistons.

Each piston is fitted with two compression rings and one oil control or upper scraper ring. The skirt is split circumferentially on the thrust and non-thrust sides. There is also an axial groove extending from the open end, part-way up the non-thrust side of the skirt.

Before inserting a piston and rod assembly in its bore, check that the circlips locating the gudgeon in the piston are correctly positioned in the grooves machined for them, that the gaps of the piston rings are equally spaced, and that the word 'FRONT' stamped on the crown is towards the front of the car when the piston is fitted in its bore. Do not disturb the compression rings unnecessarily. If one has to be removed, insert a thin piece of steel approximately .020 thick and $\frac{3}{8}$ inch wide between the ring and the piston at a point near the gap. Then work the steel round the piston, moving the ring out of the groove and at the same time forcing it upwards over the crown. If a new ring is fitted to an original piston, check that the gap is .008 to .013 and that the piston groove is clear of all carbon.

To check the gap, support a piston about an inch or so down the bore, then insert the ring so that it lies flat on the crown of the piston. The dimension of the gap can now be readily checked and if an alteration is to be made, use a smooth file, maintaining the original angle, keep the surface flat and confine the filing to one butt face only.

Pay particular attention to see that all parts are clean and liberally coated with clean oil before assembly to ensure lubrication when the engine is started up. Replace all the locking washers on the big end bolts.

To Remove the Primary Chain and Timing Wheels.

Lift the bonnet.

Drain the cooling system.

Remove the radiator.

Detach the fan blades.

Remove the fan belt.

Remove the cylinder head top cover.

Remove the cylinder head front cover.

Turn the engine until the mark engraved on the rim of the camshaft driving flange is level or in line with the machined pad at the butt face of No. 1 camshaft bearing cap. Note, or mark on the clutch housing, the relative positions of the mark $\frac{1}{4}$ of the rim of the flywheel and the centre line of the engine.

Disconnect the engine tie-bar from the front suspension crossmember.

Place a jack under the engine sump and, to distribute the load, position a block of wood suitably shaped between the jack pad and the sump.

Remove the engine front support bracket and the two nuts securing the gearbox rear mounting.

Raise the front of the engine sufficiently to allow the starting dog nut to be removed and the crankshaft pulley to be withdrawn. Note the shims positioning the starting dog nut at 60° after vertical with the flywheel at top centre $\frac{1}{4}$.

Remove the engine front cover with the bottom clamp, first removing the two setbolts which secure the sump to the bottom clamp, also the gasket between it and the cylinder block.

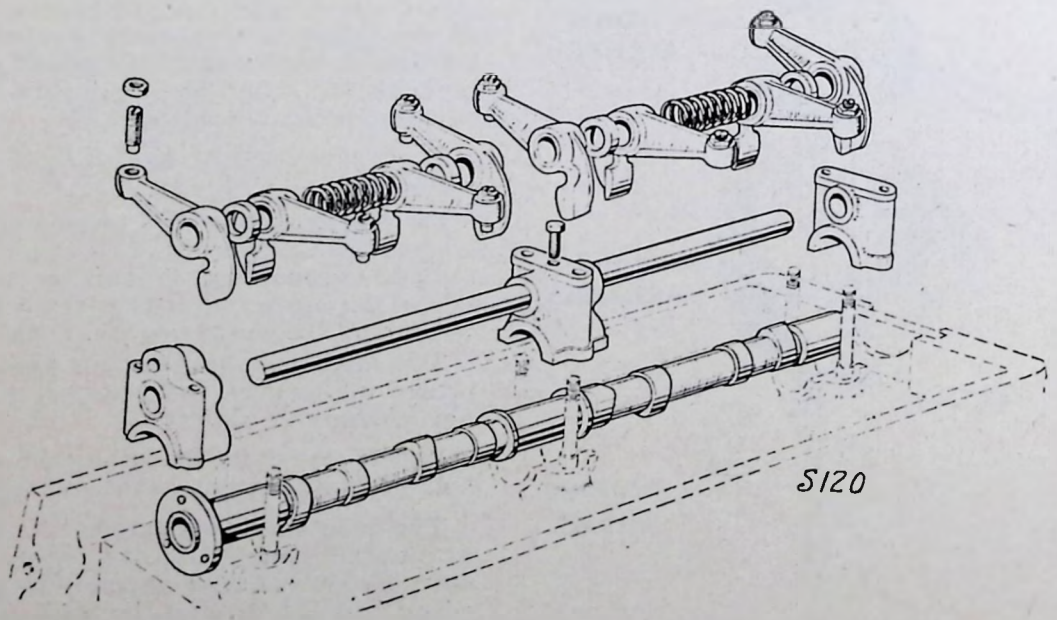


FIG. 6.—Rocker and camshaft components. (Series I-II.)

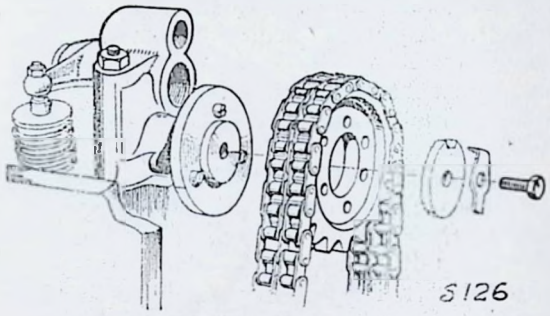
When removing the bottom clamp and front cover, great care must be taken not to damage the sump gasket, otherwise the sump will have to be removed to enable a replacement gasket to be fitted.

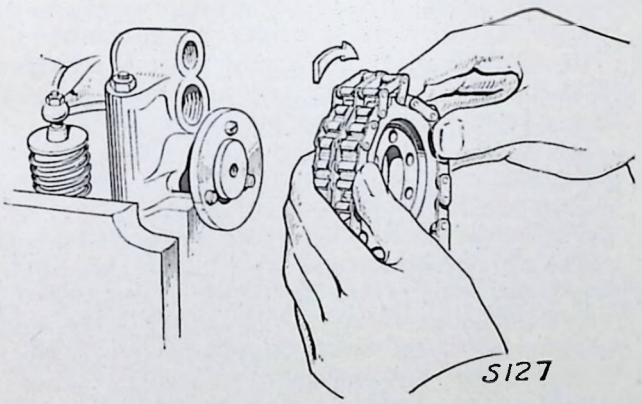
Care must be exercised when removing and replacing the front cover to ensure that the oil seal is not damaged.

Bend back the tab locking the nut securing the driven chainwheel to the intermediate shaft and remove the nut, the tab and plain washers.

Notice that the lug of the tab-washer is located in one of the holes in the chainwheel.

Prise the driven chainwheel from off its locating studs on the intermediate shaft driver chainwheel and partially withdraw the crankshaft chainwheel to assist the foregoing. The primary drain and intermediate driven wheel can now be removed.





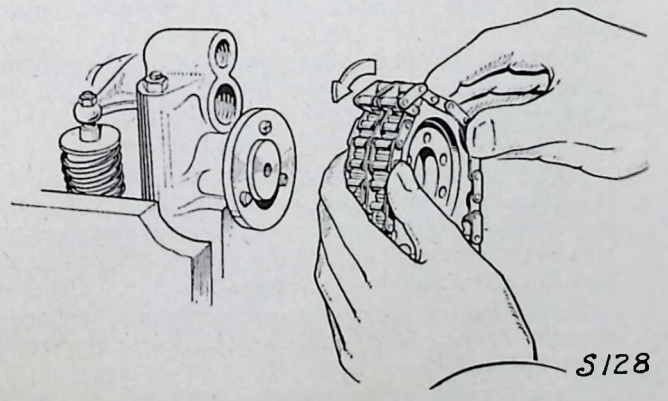


FIG. 7.—Valve timing adjustment. (Series I-II.)
Top: Valve timing correct.
Centre: Valve timing advanced.
Bottom: Valve timing retarded.

If the crankshaft chainwheel is to be replaced, draw it from off the shaft completely. **Be careful not to rotate the crankshaft, and observe the same precaution with the camshaft.**

To Remove the Camshaft Chain and Timing Wheels.

Remove the primary chain and its timing wheels.

Remove the camshaft chain tensioner by slackening off the locknut and unscrewing the tensioner.

Disconnect the union of the oil feed pipe to the valve mechanism from the camshaft front bearing cap and when doing so avoid moving it away from its original setting as little as possible. This precaution helps to maintain the necessary clearance between the pipe and the timing chains and must be observed during the period the pipe is disconnected, also when being reconnected.

Bend back the tab locking the bolt securing the camshaft chainwheel and remove the bolt the tab and plain washers. As a precaution against any part being detached, falling down the chain case, stuff or pack the opening with clean non-fluffy rag.

Prise off the chainwheel from the camshaft when the chain can be disengaged from its wheels and drawn out of position upwards.

Draw off the intermediate driver chainwheel from its shaft.

To Re-assemble the Timing Chains and Wheels.

Push the crankshaft timing chainwheel, with the keyway in engagement with the key, on the crankshaft to a little over half the normal distance.

Turn the camshaft until the mark on the driving flange is in line with the machined surface of the pad at the butt joint of the camshaft front bearing cap.

If the distributor is in position on the engine, turn the intermediate shaft until the electrode of the rotor is pointing to the segment in the cap, connected to No. 4 sparking plug. If the distributor is not in position on the engine, set the oil pump spindle so that the driving slot for the distributor is parallel to the centre line of the engine and with the narrower segment adjacent to the cylinder block.

Engage the secondary chain with the intermediate shaft driven chainwheel and select a tooth engagement between the chain and the camshaft timing wheel, which will allow the holes in the wheel to register with the pegs on the camshaft driving flange without altering the position of the camshaft and intermediate shaft. **When this operation is being carried out, keep the length of chain on the right in tension, and when complete engage the chain tensioner.**

Fit the plain and tab-washer to the camshaft and secure with the setbolt; do not, at this point, bend over the locking tab.

Adjust the chain tensioner.

Position the flywheel—and incidentally the crankshaft—with the mark $\frac{1}{4}$ at top centre.

Engage the primary chain with the crankshaft chainwheel and, as before, select a tooth engagement between the chain and intermediate driven chainwheel which will permit the holes in the wheel to register with the pegs on the intermediate driver wheel and without altering the position of the intermediate shaft and crankshaft.

Drive home the crankshaft wheel with the chain and intermediate wheel as an assembly.

Place in position the plain washer, with the machined relief towards the wheels, the tab-washer with the lug engaging a hole in the wheel, insert the securing bolt, tighten up and lock with the tab of the washer.

Place in position the oil flinger with its concave surface facing towards the front, and replace the front cover, using a new gasket.

Push on the crankshaft pulley and with the shims fitted between the pulley face and the starting dog nut, position the nut so that when it is securely tightened the dogs are approximately 60° after the vertical, with the flywheel set at top centre. From now on proceed in the reverse order of dismantling.

To Remove and Replace the Intermediate Shaft.

Remove the primary chain.

Remove the camshaft chain.

Release the locknut on the bearing locating pin situated immediately beneath the dynamo. Remove the pin. The shaft can now be withdrawn complete with bearing bush.

Press off the chainwheel and remove the bearing. There is no detachable bearing for the rear end of the shaft. The rear journal runs in a bore machined in the cylinder block.

Replacement is the reverse of the foregoing, but bear in mind if the oil pump is in position, to select a gear meshing which will permit the slot in the pump spindle to be parallel to the centre line of the engine and with the smaller segment near to the cylinder block. If the distributor is in position then the electrode of the rotor must be opposite the segment in the cap attached to No. 4 sparking plug.

When replacing the bush and chainwheel, make sure that the hole in the bush for the locating pin is towards the rear, and the boss of the wheel towards the front of the car.

When inserting the locating pin, do not tighten it excessively as this will distort the bush, but make sure that the tapered end is in firm contact with the bush before tightening the locknut securely.

Before assembling the chainwheel, clean the annular and radial grooves in the face of the boss of the wheel, the oilways drilled through the boss, and those drilled radially between the two rows of teeth.

The last mentioned instruction refers equally as well to the driven chainwheel. Note, oil to the chain is fed via these oilways.

To Remove the Engine and Gearbox Complete.

Remove the bonnet.

Disconnect the negative lead from the battery terminal and its fixing on the water pump body.

Drain the radiator, keeping anti-freeze mixture if this has been used.

Disconnect the top and bottom water hoses and heater hoses if fitted.

Remove the radiator.

Remove the air cleaner or silencer.

Disconnect the electrical leads to the coil and dynamo.

Disconnect the petrol pipe feeding the fuel pump.

Disconnect the electrical lead to the water temperature gauge at the water outlet pipe.

Disconnect the choke control wire at the carburetter.

Disconnect the accelerator connections at the carburetter.

Disconnect the oil gauge pipe.

Disconnect the electrical lead to the starter motor.

Disconnect the exhaust pipe at the exhaust manifold flange.

Disconnect the speedometer cable.

Remove the propeller shaft guard strips at the rear of the gearbox.

Disconnect the gear selector cable. This is reached through the removable floor cover.

Disconnect the rod from the external change speed lever on the relay lever assembly.

Remove the clutch hydraulic operating cylinder.

Disconnect the propeller shaft flange coupling bolts at the rear axle pinion flange.

Withdraw the propeller shaft and wrap its internal splined end in clean paper to prevent entry of dirt.

Raise the front of the car by placing a jack with a block of wood or other suitable packing under the front crossmember.

Disconnect the main hydraulic fluid pipe at the right-hand side front connector.

Remove the front road wheels.

Disconnect the track rods from the steering arms.

Remove the four nuts (two either side) attaching the frame bracket to the fulcrum pin bracket. It is not necessary to disconnect the upper links.

Note the slotted distance pieces.

Replace the road wheels.

Position a suitable skid or bogey underneath the gearbox and remove the rear engine mounting bracket.

Remove the remaining four bolts and washers (two either side) securing the front crossmember to the underframe; these bolts are reached through the holes in the underside of the crossmember.

Lower the car to the ground and remove the jack.

Insert suitably shaped bars into the jacking slots in the underframe, place chocks behind the rear wheels and with a crane sling the front of the car from the bars inserted in the jacking slots.

Raise the car until the underframe is clear of the engine, then wheel the power unit forward, away from the car.

Replacement is the reverse order of dismantling.

Care should be taken to ensure that the brakes are bled and that the gearshift mechanism is correctly adjusted.

To Remove and Replace the Crankshaft Assembly.

Remove the power unit.
Detach the self-starter.
Detach the gearbox from the engine.
Remove the clutch assembly.
Remove the flywheel and the engine rear cover, secured by six bolts to the cylinder block.

Pay particular attention not to damage the bore of this cover or the oil return thread on the crankshaft, for the retention of oil at this point depends on the condition of the bore, and the oil return threads.

Before re-assembling, check that the bore is true, the threads undamaged, and that with the cover in position there is approximately .002 to .004 at all points between the bore and the periphery of the threads.

Note the gasket between the joint faces of the cover and block.
Detach the dynamo and bracket.
Remove the distributor.
Remove the primary chain. When removing the front cover care must be taken not to damage the oil seal pressed into the cover.
Remove the sump.
Remove the oil pump.

Remove the locking nuts and washers securing the main bearing caps and before detaching the caps mark them suitably to assist correct re-assembly.

If the main bearing shells are not to be renewed treat them similarly. Note the two pairs of thrust washers which are fitted one on each side of the rear main bearing. They control the end float of the crankshaft. The correct dimension for this float is .002 to .004.

Lift off the caps and remove the crankshaft. The main bearings are renewable self-aligning steel shells, white metal lined. They are of the full butted type and under no circumstances must their butt faces or those of their caps be filed to reduce excessive diametrical clearance between the bearings and the crankshaft journals. The correct diametrical clearance between these parts is .001 to .0025. Should clearance in excess of this be present, the bearing must be replaced, but if the excess is still present the journals should be reground and bearings to suit fitted.

Re-assembly is in the reverse order to dismantling, but remember that all parts must be perfectly clean and liberally coated with clean oil before assembly.

Pay particular attention to see that the lugs of the crankshaft thrust washers engage with the slots machined for them in the rear main bearing cap.

SERIES IIA-III-IIIA
O.H.V. ENGINE

Compression Ratios.

Distributors having different advance characteristics are used on the high and low compression engines, and it is most important that the correct distributor is used when a replacement unit is fitted. The possibility of a wrong unit having been previously fitted during servicing must not be overlooked.

Engines having high compression ratio may be externally recognised by the letter "H" after the engine number.

Engines having medium or low compression ratios may be externally recognised by the letter "M" or "L" after the engine number.

To Remove the Engine.

The engine and gearbox may be lifted out as a complete unit, and the following detailed procedure should be followed. Work underneath the car is best done in a pit or with the car on a lift.

The body section covering the gearbox is not detachable. Small removable cover plates are provided to give access to the gearbox oil level dipstick, the gearbox gearshift lever and gear selector lever.

The lifting gear should be adjusted so that the engine and gearbox can hang at about 20° from the vertical during removal.

Working under the bonnet:

Remove the bonnet.
Remove the battery and battery cradle.

Drain the radiator, keeping anti-freeze mixture if this has been used.
Disconnect the top and bottom water hoses and heater hoses, if fitted.
Remove the radiator.
Disconnect the oil pressure switch wire.
Remove the engine tie-bar (if fitted).
Disconnect the accelerator connections at the carburetter.
Remove the air silencer or cleaner.
Disconnect the choke control wire. Remove the carburetter and blank off the carburetter flange hole in the inlet manifold.
Remove the rocker cover.
Disconnect the petrol pipe feeding the fuel pump, and remove the fuel pump.
Loosen off the nuts on the front engine mounting rubbers.
Provide means of taking the engine weight at the rear end of the engine.

Working under the car:

The car should be over a pit, or raised on a lift.
Remove the propeller shaft guard strips at the rear of the gearbox.
Disconnect the propeller shaft flange coupling bolts at the rear axle pinion flange.
Withdraw the propeller shaft and wrap its internal splined end in clean paper to prevent entry of dirt.
On left-hand drive cars remove the change speed cross-shaft.

On right-hand drive cars remove the change speed shaft.

Disconnect the gear selector cable. This is reached through the removable floor cover.

Disconnect the speedometer cable.

Remove the clutch hydraulic operating cylinder.

Disconnect the exhaust pipe at the exhaust manifold flange.

Inspect the engine to ensure that all wires feeding accessories, etc., have been removed.

Support the engine weight by means of slinging eyes at the rear end of the engine.

Do not place a jack under the sump.

Unbolt the crossmember and rubber mountings at the rear end of the gearbox and take the gearbox weight by means of a jack or blocks while the lifting gear is re-adjusted.

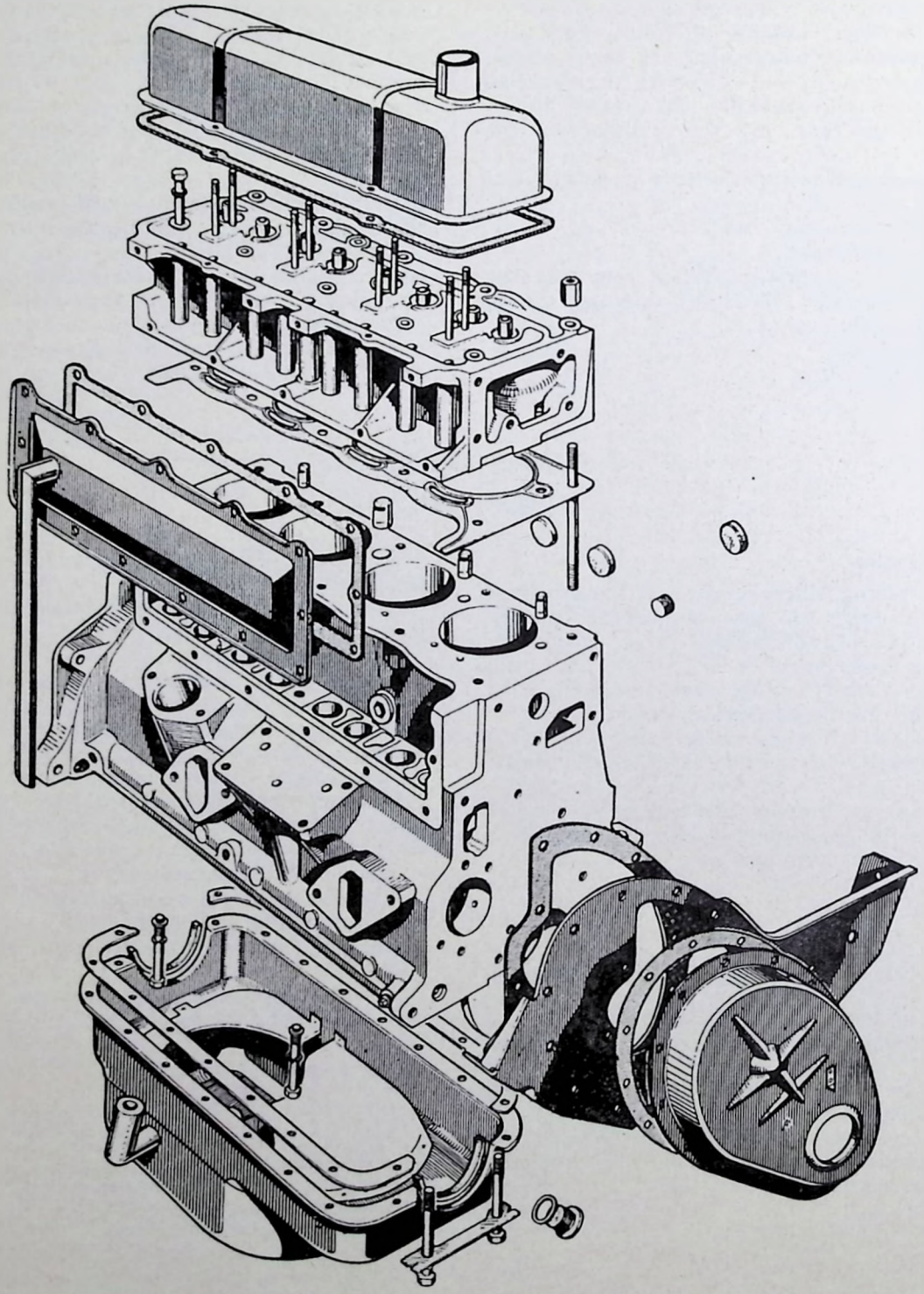


FIG. 8.—Cylinder block and associated parts (O.H.V. engine).

Working under the bonnet:

Arrange the lifting gear so that the gearbox weight raises the front of the engine as the unit has to be lifted out at about 20° from the vertical.

Lift the engine enough to allow removal of the front mounting rubbers and remove the jack or blocks used to support the gearbox weight.

Draw the engine as far forward as possible and lift out, raising the front of the engine and lowering the gearbox end.

To Refit the Engine.

Refitting is a reversal of the above procedure.

Care should be taken to ensure that adjustments to the clutch pedal, gearshift mechanism and engine tie-rod are carried out correctly before starting the engine. **Note:** Series III and IIIA cars have no tie-rod.

Check the gearbox oil level and refill the engine sump.

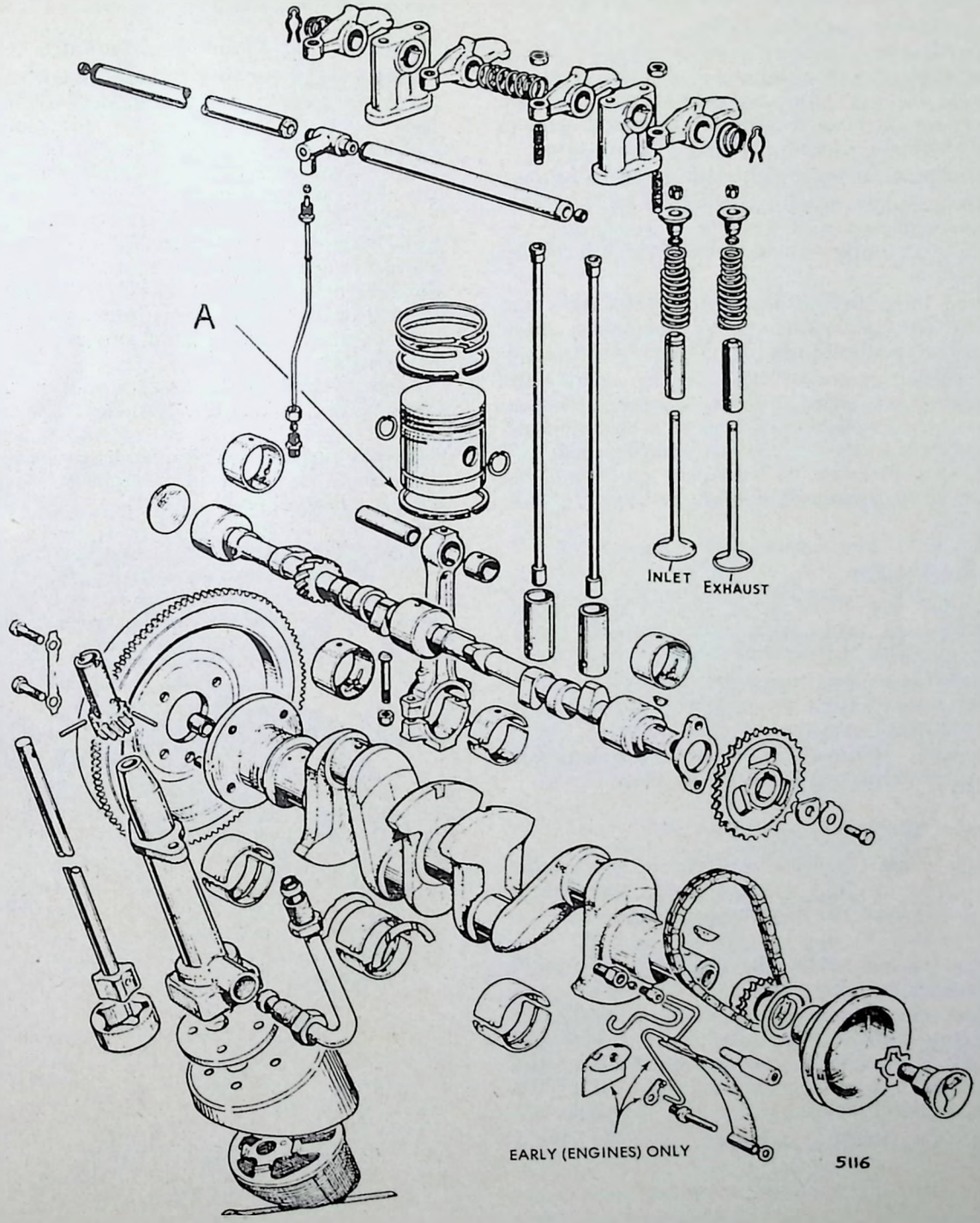


FIG. 9.—Exploded view of the O.H.V. engine working parts. A—Bottom ring fitted as standard.

Ignition Timing and Distributor.

Distributors having different advance characteristics are used on the high and low compression engines, and it is most important that the correct distributor is used when a replacement unit is fitted. The possibility of a wrong unit having been previously fitted in service must not be overlooked.

Distributors may be identified by the despatch number on the plate fitted on the side of the distributor. Correct despatch numbers are:—

High compression engines, 40530.

Low compression engines, 40492.

The distributor is mounted on a bracket on the right-hand side of the engine and is driven by an extension of the oil pump spindle, the connection being made by an offset coupling. The rotor revolves in an anti-clockwise direction, viewed from above.

Three means of adjusting the timing are provided:

(a) A clamp screw mounted horizontally. This is the main adjustment, and when it is slackened, the body of the distributor can be turned relative to the mounting plate.

(b) Slotted holes in the mounting plate allow the complete distributor to be turned through a small angle when the two holding nuts have been slackened.

(c) The vernier control. This allows a small variation to cater for fuels of differing octane ratings or to eliminate pinking when excessive carbon deposits have formed in the engine. The knurled knob should be turned anti-clockwise to advance, one complete turn of the knob being equivalent to three crankshaft degrees.

To Time the Ignition.

Most engines are fitted with pistons giving the higher compression ratios which requires the use of premium grade (higher octane) fuels.

Cars exported to territories where only regular grade (lower octane) fuels are available have pistons giving 7:1 compression ratio.

Static ignition settings for these conditions are given on pages 1 and 2 "Electrical" Section.

To Check the Timing — Method 1.

Engage the starting handle and rotate the engine until the pointer in the rear face of the crankshaft pulley is the required distance before the pointer on the timing cover.

Set the vernier control to the midway position (2 divisions showing on the scale).

Remove the distributor cap and connect a 12-volt bulb between the LT terminal of the distributor and a good earth. With the battery connected and the ignition switched on, this bulb will light when the contact breaker points open.

Disconnect the vacuum advance pipe to avoid straining it.

Slacken the distributor clamp screw and rotate the body of the distributor anti-clockwise as far as possible.

Switch on the ignition and, applying light finger pressure to the rotor in a clockwise direction, return the distributor body clockwise until the bulb just lights.

Tighten the distributor clamp screw.

Check the setting by turning the crankshaft two revolutions clockwise until the bulb again lights, observing the relative positions of the pointers. The crankshaft pulley pointer must be the required distance before the pointer on the timing case.

Switch off the ignition, remove the bulb, and refit all parts.

To Check the Timing — Method 2.

Engage the starting handle and rotate the engine until the pointer on the crankshaft pulley exactly lines up with the pointer on the timing cover.

This gives T.D.C. No. 1 and 4 cylinders.

Set the vernier control so that only one division is showing on the scale.

Remove the distributor cap and connect a 12-volt bulb between the LT terminal of the distributor and a good earth. With the battery connected and the ignition switched on, this bulb will light immediately the contact breaker points open.

Disconnect the vacuum advance pipe to avoid straining it.

Slacken the distributor clamp screw and rotate the body of the distributor anti-clockwise as far as possible.

Switch on the ignition and, applying light finger pressure to the rotor in a clockwise direction, return the distributor body clockwise until the bulb just lights.

Tighten the distributor clamp screw.

Check the setting by turning the crankshaft two revolutions clockwise to see if the bulb lights immediately the pointer on the crankshaft pulley lines up to the pointer on the timing case.

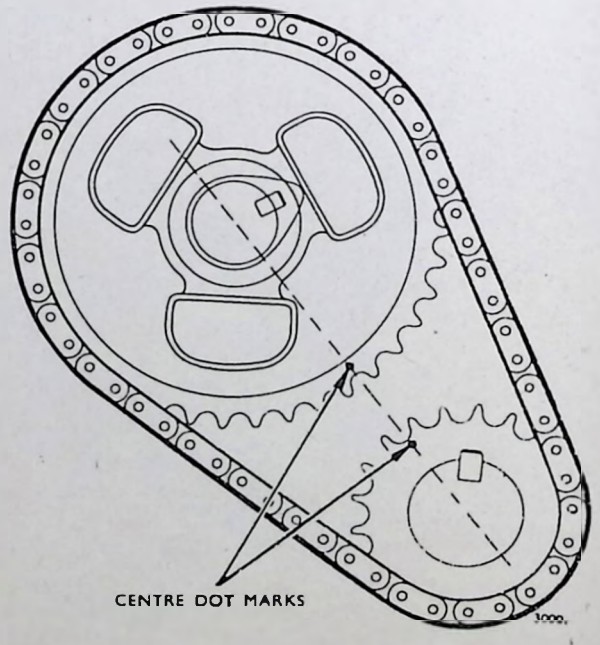


FIG. 10.—Timing wheel alignment (O.H.V. engine).

Switch off the ignition, remove the bulb and refit all parts.

The engine is now timed to fire at T.D.C., and should be advanced the required number of degrees by means of the vernier adjustment to give the correct static timing.

One division in the vernier scale corresponds to four crankshaft degrees, and one turn of the knurled knob corresponds to three crankshaft degrees.

Therefore, if 8° B.T.D.C. is the setting needed, the distributor will have to be advanced by two divisions on the vernier scale.

To Check the Timing, Using a Stroboscopic Timing Light — Method 3.

The pointers on the crankshaft pulley and timing case should be clean and are easier to see if marked with white chalk.

Connect the leads from the timing lamp according to the maker's instructions and run the engine at an idling speed of 400 to 500 r.p.m. (This is below the speed at which the centrifugal advance action begins.)

Correctly connected, and with the engine running, the timing light gives a high intensity flash every time the contact breaker points open. When this light is directed on to the crankshaft pulley, the pulley will appear to be stationary. The apparent distance between the pointer on the pulley and the pointer on the timing case indicates the amount of ignition advance.

The engine should idle at 400 to 500 r.p.m. and the relative positions of the crank pulley pointer and timing case pointer observed in the light given by the timing lamp.

If the ignition setting requires 11 mm. between the pointers B.T.D.C. the pointers must appear this distance apart in an anti-clockwise direction, viewed from the front of the radiator.

If necessary, the distributor can be adjusted to obtain this, or any other required timing condition, while the engine is still idling.

Still observing the "stationary" pointer of the crank pulley, gradually increase the engine speed. The distance between the pointers will increase, showing that the centrifugal advance mechanism has begun to operate over its speed range. Jerky movement of the pulley timing marks whilst accelerating or decelerating indicates sticky centrifugal advance mechanism. (To check the centrifugal advance only, the vacuum pipe connection to the diaphragm unit should be disconnected).

The throttle should be opened to give an engine speed of 1,200 to 1,500 r.p.m. or until the vacuum connection drilling in the carburetter has been uncovered by the butterfly valve. With the engine running under these conditions, the vacuum connection on the distributor diaphragm should be alternately disconnected and reconnected whilst observing the mark on the crank pulley. This mark should retard and advance as the end of the vacuum pipe is removed and refitted.

To Remove and Refit the Distributor.

Remove the high tension leads from the plug terminals, noting their positions. Disconnect the high tension lead at the coil. Disconnect the low tension lead at the distributor body. Disconnect the vacuum pipe. Remove the two setbolts securing the aluminium distributor housing to the crankcase and withdraw the distributor and housing together.

Refitting is a reversal of the above.

To Remove and Refit the Rocker Cover.

Slacken the clip securing the air cleaner rubber hose to the carburetter. Remove the two bolts securing the air cleaner bracket to the right side of the cylinder head, disconnect the ignition coil and lift off the air cleaner and bracket complete.

Remove the four screws securing the rocker cover to the cylinder head and lift off the cover, taking care not to damage the joint.

Refitting is a reversal of the above. The joint should be replaced if damaged.

To Adjust the Valve Rockers.

Turn the engine until the exhaust valve of No. 4 cylinder is fully open and, starting at this point, adjust the valves in the following order, turning the engine progressively through two revolutions to complete the cycle of adjustment:—

No. 1 exhaust is adjusted when No. 4 exhaust is fully open.

No. 2 inlet is adjusted when No. 3 inlet is fully open.

No. 3 exhaust is adjusted when No. 2 exhaust is fully open.

No. 1 inlet is adjusted when No. 4 inlet is fully open.

No. 4 exhaust is adjusted when No. 1 exhaust is fully open.

No. 3 inlet is adjusted when No. 2 inlet is fully open.

No. 2 exhaust is adjusted when No. 3 exhaust is fully open.

No. 4 inlet is adjusted when No. 1 inlet is fully open.

To check the clearance, insert a feeler gauge of the correct thickness between the valve stem and the rocker foot.

Correct clearances (engine hot or cold) are:—

Inlet valve: .012.

Exhaust valve: .014.

To adjust the clearance, slacken the locknut and turn the screw with a screwdriver until the correct clearance is obtained. Tighten the locknut and recheck the clearance. Check all valves in this manner, then refit the rocker cover.

To Remove the Rocker Shaft Assemblies.

Remove the air cleaner and rocker cover. Undo the union nut and disconnect the oil pipe to rocker shaft. The oil feed pipe is flanged below the nut, to prevent the latter dropping down into the tappet chamber.

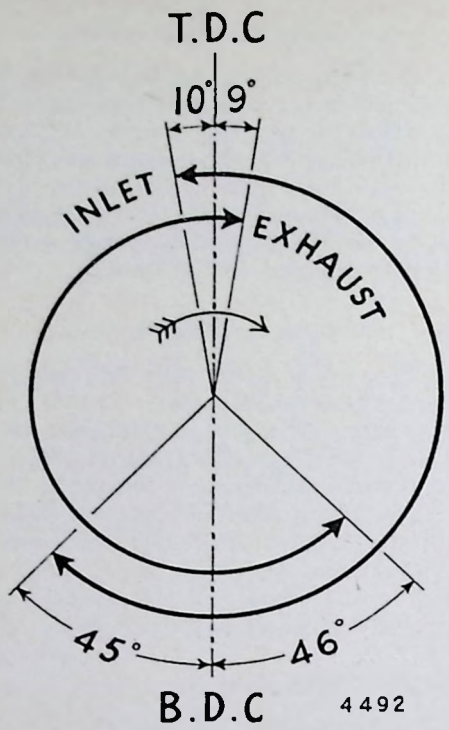


FIG. 11.—Valve timing diagram (Series IIA-III-IIIA).

Remove the eight nuts securing the rocker standards to the cylinder head.

Lift out the rocker shafts and upper oil feed complete.

To Dismantle the Rocker Shaft Assemblies.

Remove the spring clip from one end of each assembly and take off the rockers, standards and springs, noting their correct order for re-assembly.

Inspect the rockers and shaft and replace if worn or scored.

To Re-assemble the Rocker Shaft Assemblies.

Assemble the components on the rocker shaft in the order shown in Fig. 12, locating the standards on each shaft to allow the oil feed holes to face downwards. Note that the rockers are offset.

To Refit the Rocker Shaft Assemblies.

Make sure that each rocker shaft assembly is fitted with its open end towards the oil feed "T" piece, which is then inserted between the two shafts with its elbow facing the pushrods.

The other ends of the shafts are plugged.

The rocker shafts are grooved and located by the rocker standard studs nearest to the valves. Upon re-assembly the grooves should be located on the side nearest the valves.

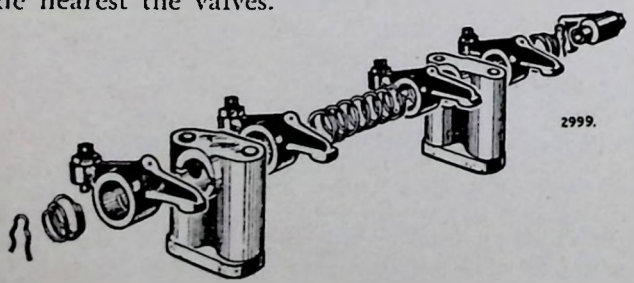


FIG. 12.—Rocker components (O.H.V. engine).

To Remove and Refit the Pushrods.

The correct pushrods for this engine are tubular type.

When removing pushrods make sure that the tappets are not pulled out of their bores. A sharp tap on the side of the pushrod will normally break the oil film on the ball end.

Normal removal of the pushrods necessitates removal of the rocker shafts and standards. If, however, it is desired to remove only one or two pushrods the following procedure may be adopted:—

Having removed the rocker cover and air cleaner, turn the crankshaft by means of the starting handle until the pushrod which is to be removed can be turned by hand, i.e., until that valve is fully closed.

Slacken the locknut and remove the adjusting screw.

Push the rocker to one side against the pressure of the rocker shaft spring, and withdraw the pushrod.

In the case of Nos. 1 and 8 pushrods, it will be found necessary to remove the retaining ring (which is held by a circlip) from the appropriate end of the rocker shaft.

When the pushrods have been replaced, reset the valve clearances.

To Remove the Tappets.

Remove the rocker cover, rocker shaft assemblies, and the pushrods.

Remove the engine side cover, as follows:—

Drain the oil filter (one small hexagon headed plug adjacent to the two large plugs in the body). Remove the container and element. Remove the distributor. Remove the ignition coil. Take out the screws securing the side cover and remove the cover.

Lift out the tappets. The tappets should be numbered in pencil on removal so that they can be replaced in their original positions.

Refitting is a straightforward reversal of the above procedure. Note that the tappets should be replaced in the bores from which they were removed.

To Remove the Timing Cover.

Drain and remove the radiator.

Slacken the generator mounting screws and remove the fan belt.

Unscrew the crankshaft jaw nut and pull off the crankshaft pulley (two tapped holes provided).

Remove all screws and nuts holding the cover in position, and withdraw the cover.

To Refit the Timing Cover.

Reverse the above operations, taking great care to centralise the cover around the crankshaft pulley, before fully tightening the bolts.

To Remove the Timing Wheels and Chain.

Remove the timing cover.

Remove the split pin and plain washer from the tensioner pivot pin and lift off the tensioner blade.

Remove the setscrew, tab washer and plain washer from the front end of the camshaft.

Remove the oil thrower in front of the crankshaft sprocket.

Pull or lever off both the camshaft and crankshaft wheels simultaneously.

To Refit the Timing Wheels and Chain.

When refitting, set Nos. 1 and 4 pistons to T.D.C. so that the key is to the top of the crankshaft.

Push the crankshaft wheel on to the crankshaft until it is approximately 1.5 from the shaft shoulder.

To obtain the correct valve timing, fit the chain to the crankshaft wheel and camshaft wheel so that the dots on the camshaft and crankshaft wheels are in line (see Fig. 10).

Turn the camshaft until the key lines up with the keyway in the camshaft wheel.

Pull the camshaft wheel onto the camshaft using a washer and bolt screwed into the end of the camshaft at the same time tapping the crankshaft wheel onto the crankshaft.

Refit the chain tensioner and timing cover, making sure that the tensioner blade is correctly fitted.

Replace the crankshaft oil thrower.

The front face of the timing case is bolted to a pedestal bolt, and the free end of the tensioner blade rests on the inside of the timing case.

Camshaft and Sprockets.

Important: Camshaft sprockets used on these engines are identified by a groove machined on the rear face of the sprocket, just below the bottom of the sprocket teeth.

The camshaft used may be identified by the .080" wide groove cut around the camshaft rear journal.

To Remove and Refit the Camshaft.

Disconnect the electrical leads, remove the distributor, bracket and distributor driving shaft.

Drain and remove the sump.

Remove the oil pump.

Remove the tappets.

Remove the radiator.

Remove the fuel pump.

Remove the timing cover, crankshaft oil thrower, and wheels and chain.

Remove the two setscrews and take off the camshaft thrust plate, and withdraw the camshaft gently to avoid damage to the bearings.

Refitting is a reversal of this procedure, correctly timing the camshaft, and replacing the oil pump as explained on page 26.

After replacing the timing wheels, the camshaft end float should be checked with a clock gauge. The end float must not exceed .002 to .003. Oversize thrust plates are available for fitting, if required.

To Remove the Camshaft Bearings.

Using special tool (V 7.. Churchill RG 32), the forward and centre bearings can be withdrawn forwards. The gearbox, clutch and flywheel, together with the rear sealing disc, will have to be removed to enable the rear bearing to be withdrawn rearwards.

This operation will, in all probability, be carried out on most occasions when an engine is overhauled, and will be facilitated with the cylinder block in a stripped condition.

Replacement bearing shells require no machining.

To Refit the Camshaft Bearings.

Using tool RG 32, draw in the bushes. Ensure that the oil feed holes are correctly aligned, and that the camshaft sealing disc is made oil tight.

Inlet and Exhaust Manifold.

To Remove.

Remove air cleaner.

Disconnect petrol pipe at carburetters.

Disconnect inner choke control cable from its lever on carburetter, and disconnect outer cable from abutment bracket.

Disconnect throttle and vacuum advance pipe.

Remove two nuts securing front exhaust pipe flange to exhaust manifold.

Remove six nuts securing manifold to cylinder head. Remove manifold.

To Dismantle and Re-assemble.

Undo four nuts securing inlet and exhaust branches and separate.

Examine the metal joint and discard if damaged or burnt.

To re-assemble, reverse the above procedure. Refit exhaust branch, but do not fully tighten the four nuts.

To Refit.

The assembly should be refitted with new joints and tightened to the cylinder head before finally tightening the nuts securing inlet and exhaust branches together. This will ensure correct alignment of the manifold face.

To Remove (Series IIIA Twin Carburetters).

Remove air cleaner and air box above carburetters. Disconnect both fuel pipe connections, choke control cable, throttle connecting link to front carburetter, and vacuum advance pipe.

Unbolt throttle operating shaft bracket from the front inlet manifold and remove throttle operating shaft after disconnecting its operating link at the rear end.

Remove the two nuts securing exhaust pipe flange to exhaust manifold.

Remove manifold fixing nuts and clamps, and lift off manifolds and carburetters as a complete assembly to avoid disturbing carburetter throttle synchronisation.

To Refit.

This is a reversal of the removal procedure. New joints should be fitted. If the carburetters have been removed from the inlet manifolds their throttles should be synchronised as described in Section D under "Synchronisation of throttles and slow running adjustment".

The Cylinder Head.

The cylinder head is of conventional design, although it should be noted that four inserted brass water ducts are incorporated in the water passages, adjacent to the valve seats.

A steel cylinder head gasket is used.

To Remove the Cylinder Head.

Remove the air cleaner and engine stabiliser bolt from the right side of the cylinder head. Remove the rocker cover.

Disconnect the thermometer lead at the bulb by gripping the rubber sleeve at the end of the lead and pulling out the snap connector from the bulb.

Disconnect the oil feed to rocker shafts.

Disconnect the heater pipe (if fitted).

Remove the screws securing the tappet side cover to the cylinder head.

(If the joint is damaged, remove the side cover complete, as previously described.)

Disconnect the petrol pipe and carburetter controls.

Remove the two nuts at the exhaust flange joint.

Remove the rocker gear and pushrods, taking care not to lift out the tappets when the pushrods are lifted out.

Remove the eight bolts, two nuts and washers securing the cylinder head.

Lift off the head complete with the manifold and carburetter.

To Refit the Cylinder Head.

Reverse the above procedure, ensuring that all the joint faces are clean. Always use a new gasket. Jointing compound should not be used.

Do not displace the tappet cover gasket when lowering the head. The cylinder head bolts should be tightened to a torque figure of 41 to 43 lbs. ft. in the order shown in Fig. 13, before tightening the tappet side cover screws. Adjust the valve clearances.

It is not necessary to re-tighten the head after the engine is warm, as is common practice.

It is essential to adhere strictly to the torque wrench figures quoted.

It is most important that the cylinder head is aligned so as to correctly position the machined location for the tappet cover in relation to the corresponding machined face on the cylinder block, before tightening the cylinder head bolts.

Compression Pressures.

An engine in good condition should give similar compression pressures at starter cranking speed, all spark plugs removed, throttle fully open and engine hot:—

If readings are obtained substantially below those quoted on page 1 of this section, the engine concerned is in need of attention to the valves or piston rings, or possibly a rebore.

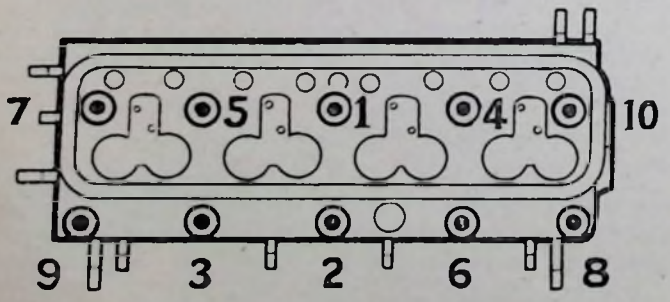


FIG. 13.—Cylinder head nut tightening diagram (O.H.V. engine).

To Decarbonise.

When the cylinder head has been removed for decarbonising the complete set of valves should be removed for cleaning, inspection and refacing (detailed instructions for these operations are given elsewhere in this section). The valve guides should also be checked for wear on their internal diameters and in this respect reference should be made to "To Renew the Valve Guides".

When removing the carbon from each piston crown it is always advisable to leave a ring of carbon adjacent to the cylinder bore as this helps to preserve a good seal and to conserve oil. A convenient method of doing this is to turn the engine until the piston is slightly below the top dead centre position, and insert an old piston ring of correct size in the bore, and press it down on to the piston. In this way all the carbon within the old piston ring may be removed, leaving a ring of carbon around the edge.

Remove the carbon from the tops of the pistons, the combustion chambers in the cylinder head and also from the valve ports. With a suitable scraper clean out the inside of the exhaust manifold.

Place a clean rag in the exposed area of the tappet chamber, as no carbon should be allowed to enter.

Remove all loosened carbon, preferably by use of a compressed air line.

Care must be taken when decarbonising the tops of the pistons, these being of aluminium alloy. No pointed instruments or emery cloth may be used. Do not on any account use abrasives for removing carbon, or damage will result.

Having attended to the preceding operations and given the valves and seatings any attention that may be required, the engine may be re-assembled.

To Remove and Refit the Valves.

Remove the cylinder head.

Using the valve spring compressor, remove the split coned cotters. When carrying out this operation care should be taken to ensure that no damage is caused to the valve stem by the hardened steel cotters and spring cups.

Release the valve spring compressor and lift off the cups and dual valve springs.

Remove the valves.

Before refitting the valve springs reference should be made to "Examination of the Valves, Springs and Guides, Etc.".

Give the valve stems a thin coating of oil, then replacing each valve separately, proceed as follows:—

Fit the dual springs and spring cups.

The valve spring cups have a sealing ring in the lower end. When fitting care should be taken to avoid damage to the sealing ring, or the seal will not be effective and oiling of the plugs may result. The sealing rings should be renewed if faulty.

Compress the spring and fit the cotters around the groove in the valve stems.

Release the spring compressor, when the spring cup will grip the two halves of the cotters.

Refit the cylinder head in accordance with the instructions given above.

Examination of the Valves, Springs and Guides, Etc.

The Valves:

Examine for pits on the face, burning and distortion or cracks in the heads. Burnt or cracked valves must always be scrapped. See also "To Reface the Valves".

Examine the seatings in the cylinder head, and if defective they should be treated as subsequently described. If the valve stems are bent or appreciably worn the valves must be scrapped.

Wear of the valve stems may be checked by means of a micrometer, and the stem should be checked from various angles and positions, as the stems of the valves do not wear evenly. The stem diameter of new valves is:—

Inlet	.3105 to .3110
Exhaust	.3095 to .3100

The Guides:

These may be checked for wear by using a new valve as a gauge. The valve stem should be a free sliding fit in the guide without excessive side play.

In making the foregoing tests both valve stem and valve guide must be free from carbon or burrs and free from oil.

The Springs:

If possible the loaded height of the springs should be checked. These dimensions should be as follows:—

Inner	26.6 lbs. at 1.46 ins.
Outer	53.7 lbs. at 1.58 ins.

A maximum loss of 10 per cent. on used springs is permissible.

A convenient alternative method of checking used valve springs is by comparing them with new springs. Place them end to end on a long bolt and compress them in a press. Any loss will then be apparent as the weaker spring will close up first. If either spring of a pair is weak, both inner and outer should be replaced as a pair, even though the other spring in the original pair may appear to be good when compared with a new spring as described. Inner and outer valve springs are supplied in new pairs only, and should not be interchanged.

Cotters and spring cups are best compared with new parts visually, and replaced as necessary.

To Grind in the Valves.

This operation will be satisfactory only if the valves and seatings are found to be in good condition after dismantling and examination, and there is no evidence of distortion or burning of the faces and heads of the valves: It is also necessary after new valves have been fitted or seatings recut. The valve stems must be straight and their guides must be in good condition.

Place a small amount of valve grinding paste (fine) evenly around the face of the valve to be ground, not allowing it to get on the stem or other parts.

Place the valve on its seating and by means of a suction grinding tool rotate the valve from side to side through a few degrees only, using a light pressure. Frequently raise the valve and move round to a new position on its seating and continue grinding. (On no account should the valve be revolved through complete revolutions when grinding, or rings will be formed on the faces with detrimental effects).

The grinding should be continued in this manner until a continuous but narrow seating has been obtained both on the valve and the seating. The seatings should not be more than .070 in width.

After thoroughly cleaning off all traces of grinding paste from the valve and seating with a dry cloth, test by placing a small amount of engineers' marking on the seating and revolving the valve in place not more than about $\frac{1}{8}$ inch in each direction. A complete circle of marking should appear on both valve face and seating, indicating a good seal.

To Renew the Valve Guides.

It is seldom necessary to renew the valve guides except after long service, but it may be necessary for the purpose of recutting valve seatings, where great accuracy is essential to ensure concentricity of work performed by cutters, which are used with their pilots inserted in the valve guides.

Remove the cylinder head.

Remove the rocker gear and valves.

The valve guides are a press fit in the cylinder head and may be removed by drawing through the combustion chamber.

In fitting the new guides it is important that they are the prescribed interference fit in the cylinder head, i.e., .0002 to .0017.

Oversize valve guides are available in .001 and .003.

The valve guides should be drawn into position from top to bottom. When fitted, the guides must project above the bottom of the spring pockets by .58. This dimension must not be exceeded, as insufficient clearance for the valve spring cup, with the valve fully open, will result.

It is essential that the guides are fitted to the correct ports. The exhaust guides are chamfered at each end and the inlets at the upper end only. Care must be taken to ensure that the inlet guides are assembled the correct way up.

Finally check the fit of the valves in the new guides. They should be a free sliding fit without excessive clearance.

To Reface the Valves.

If, on examination of the valves, it appears unlikely that they would clean up satisfactorily with ordinary grinding in, they must be refaced. If the seatings are also in bad condition they must be recut, but generally it will be found that these are better than the valves as regards condition unless the engine has been a very long time in service. It is quite practicable to reface the valves and grind them in on the seatings if the latter are in good order.

It is always better to replace a badly burnt or pitted valve as extended refacing will bring it very low on its seating by reason of the consequent reduction in the effective diameter of the valve face, and "pocketing" will result. This condition is detrimental

to the running of the engine and will cause overheating and loss of power.

Refacing of the valves is best performed by a valve refacing machine, but otherwise can be done in an ordinary lathe.

The valve face should be machined only until it is just true and clear of marks, to the standard angle of 45° for inlet and exhaust. These angles are reckoned from the top face of the valve head. Standard dimensions of valves are given in "Data and Specifications" at the beginning of this section. It should be noted that the inlet and exhaust valves are of different size.

A valve which has been refaced as described must also be finally ground in on its seating (see "To grind in the Valves"). The seating must be in good condition and the face not more than .070 in width.

To Re-Cut the Valve Seatings.

A damaged or burnt seating may be corrected by means of a cutter tool of 45° angle (inclusive angle 90°).

It is most important that the pilot of the valve cutting tool should be a close fit in the valve guide, and this will be ensured if the guide is renewed (see "To Renew the Valve Guides").

It is important that the highest possible degree of concentricity should exist between the valve seatings and the valve guide bores.

Having fitted a new valve guide, place the cutter tool in position in the new valve guide and proceed to cut the face of the seating, revolving the cutter smoothly in a clockwise direction. No lubricant is required. Continue cutting until all marks have disappeared and a new face appears and the seating conforms to the dimensions indicated in Fig. 14.

When the new face has been cut check that the valve, which may now be inserted for trial, is not brought too low on its seating, as a result of its being faced. This may also occur due to recutting of the seating, causing pocketing. This condition may be rectified by means of the 15° angle cutter tool.

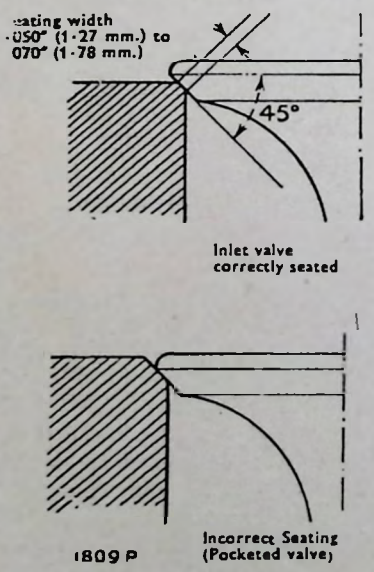


FIG. 14.—Valve seating angle and width. (O.H.V. engine).

Finally examine the face of the newly cut seating for width, which must not exceed .070. If found to be above this figure the 15° cutter may be used to correct it. Occasionally it may be necessary to reduce the width of a seating face from the bottom edge, in which case the 75° angle cutter may be used. Either or both of the above should be used, with a view to obtaining a marking, on the seat of the valve itself, as shown in Fig. 14.

When the work of recutting the seating has been completed as described, the valve must be ground in, as described under "To Grind in the Valves".

Very little attention in this way will be required, but it must not be omitted.

All cuttings must be carefully removed before reassembling the engine.

The Exhaust Valve Seat Inserts.

The exhaust valve seat inserts are not normally fitted to new engines, but inserts are available for service use in four sizes, standard, +.002, +.005 and +.010.

When inserts have to be used new valve guides should be fitted and the cylinder head recessed to the dimensions given in Fig. 15. These give an interference fit of .0025 to .0045. The insert must be pressed in perfectly square until it seats on the entire bottom face of the recess.

The valve seat, on the newly fitted insert, should be cut at an angle of 45° to a width of .05 to .06, and must be concentric to within .001 of the valve guide bore.

The Lubrication System.

Lubrication of all working parts of the engine is effected by the forced feed system, pressure being generated by a vane type pump, mounted in the right-hand side of the crankcase and driven, in tandem with the distributor, through skew gears from the camshaft.

Oil is drawn through a submerged gauze filter and rises through the inlet tube and oil pump to an internal delivery pipe, whence it is fed to the full flow filter, before passing to the main oil gallery, situated along the right-hand side of the crankcase.

From there the oil is distributed into the oilways, drilled in the main bearing support webs of the cylinder block, whence the oil is carried to all main and camshaft bearings. Drilled passages in the crankshaft allow oil to flow from the main bearings to the crankpins, where it lubricates the connecting rod big end bearings.

Oil squirt holes drilled through the big end bearings and connecting rod webs project oil on to the cylinder walls at each revolution of the crankshaft, thus ensuring adequate lubrication of the bores.

The timing gears are lubricated by a metered jet of oil from a hole drilled in the side wall of a small diameter pipe which is fitted to the front end at the main oil gallery by means of an adapter. This oil pipe fits into one of the main drain holes in the front bearing cap, and oil supplied in excess of the chain's requirements is returned direct to the sump.

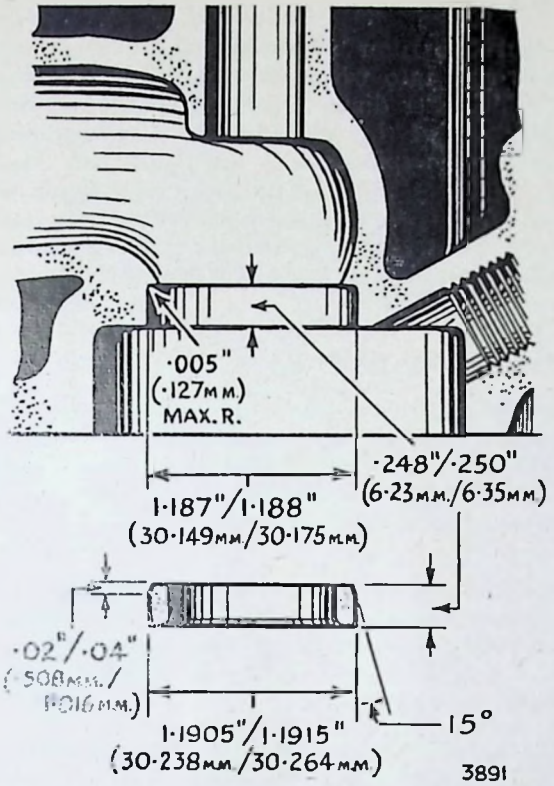


FIG. 15.—Details of the exhaust seat inserts. (O.H.V. engine).

The reason for this design is that the diameter of the oil pipe is thus larger than would be possible if it were designed to supply just sufficient oil for the chain's requirements. The advantage of this larger pipe is that blockage is less likely to occur should the oil become contaminated.

The tappets are lubricated by oil draining back from the valve operating mechanism.

A pressure relief valve of the ball and spring type is situated in the forward end of the oil filter body casting. This valve allows a proportion of the circulated oil to return direct to the sump when the pump pressure exceeds approximately 50 p.s.i. Fitted into the rear end of the oil filter body is a by-pass valve, which opens in the event of the oil filter element becoming choked, thus ensuring a supply of oil to vital parts in such circumstances.

An internal pipe from the centre camshaft bearing supplies oil to the hollow rocker shafts. Holes in the underside of the rocker shaft feed each rocker bearing. Grooves in the bearing pass the oil to drillings through the rockers, which connect with drillings through the adjusting screws, allowing oil to feed to the pushrod cup ends and drain on to the tappets.

To Remove the Oil Sump.

Drain the oil from the sump by removing the drain plug at the left side.

Undo the eighteen bolts securing the sump to the lower face of the crankcase. It is advisable to leave one centre bolt on each side in place until the weight of the sump can be taken by hand, to avoid distortion of the joint faces.

To Refit the Oil Sump.

As the sump face is in line with the horizontal axis of the crankshaft main bearings, it follows that the main bearing caps lie below this face.

The front and rear main bearing caps must form oil tight joints with their respective locations at the front and rear of the sump, in addition to the normal face joints at each side.

To accomplish this, a curved cork strip is fitted between each main bearing cap and its sump location, whilst normal composition face joints are fitted at each side.

The sealing of each of these joints is most critical, especially where the main bearing caps join the side faces of the sump location, and great care must be taken in the assembly of the sump to the engine.

The cork joints on the main bearing caps should be fitted after the side joints are in place.

Sump corks should be fitted dry, and the centre sump bolts must be fitted first. All bolts should then be progressively tightened.

The Full Flow Oil Filter.

The full flow oil filter body is bolted to a flange on the right-hand side of the crankcase, and is divided internally to form three separate compartments (see Figs. 16 and 17).

Oil from the pump flows through a drilling in the crankcase to compartment "A", into which is screwed the hollow bolt retaining the element casing to the filter body, this bolt passing the oil, via a drilling just below the head, into the filter casing.

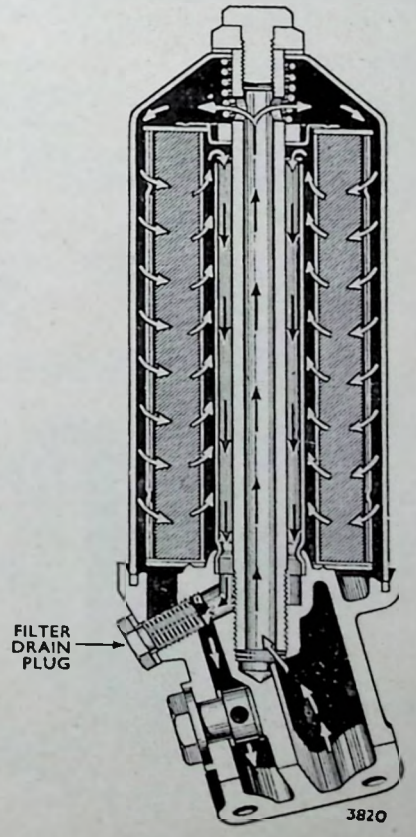


FIG. 16.—Section through the oil filter (O.H.V. engine).

The filter element bore is sealed at its ends by two Neoprene rings, the upper ring being fitted into a sleeve passing over the hollow bolt, and spring-loaded away from the top of the element casing. The lower ring is fitted into a groove formed in the top of the filter body.

It follows, therefore, that oil passing into the element casing must flow through the sides of the element, which are drilled for this purpose. Filtered oil then passes into the clearance formed between the bore of the element and a hollow tube fixed to the filter body, and directly connected to gallery compartment "B", whence it flows to the main oil gallery.

A pressure relief valve is situated in compartment "C" and opens if the oil pressure exceeds approximately 50 p.s.i., allowing a proportion of oil to flow back to the sump.

A by-pass valve normally closes a port connecting compartments "A" and "B" if the filter element is not restricted, as, in this case, pressure in these compartments will be equal.

If, however, the element becomes choked, pressure will be appreciably reduced in compartment "B" due to starvation, and this will allow the by-pass valve to open, in turn ensuring a feed to the oil gallery in such conditions.

To Renew the Filter Element.

Drain the filter by removing the small hexagon-headed plug shown in Fig. 16.

Remove the centre bolt.

Take out the element and renew.

Run the engine and carefully check for oil leaks.

Examine the sump level after running the engine and allow one pint filter capacity.

The Oil Filter Valves.

The oil pressure relief valve has a hexagonal head and is screwed into the front of the filter body casting.

The filter by-pass valve is similar and is screwed into the rear of the filter body casting.

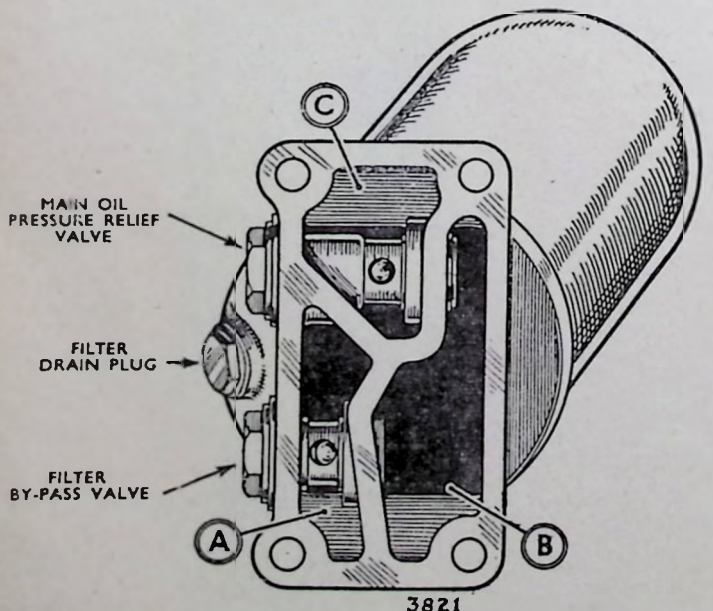


FIG. 17.—Oil filter details.

The Oil Pump.

A four-lobe rotor mounted on the main spindle drives a ring into which are machined five internal lobes. The outer diameter of the ring rotates in the circular bore of the oil pump body, which is offset from the main spindle.

The action of the four-lobe cam on the five-lobe ring creates a strong pumping force by progressively increasing and reducing the clearance between each set of lobes. The pump itself is driven by skew gears from the camshaft.

To Remove the Oil Pump.

Remove the distributor cap and turn the engine until the distributor rotor is pointing to No. 1 firing position, and the crankshaft pulley pointer lines up with the timing cover pointer at T.D.C.

Remove the distributor.

Remove the sump.

Disconnect the oil delivery pipe from the pump and from inside the crankcase. Undo the two setscrews at the oil pump locating flange and remove the pump.

To Refit the Oil Pump.

The ignition distributor takes its drive from the helical gear on the oil pump shaft axially, through an offset tongue and slot type coupling which can only be coupled one way. It is essential that the oil pump helical gear is meshed to the corresponding gear on the camshaft so that the driving slot in the end of the gear is timed in correct relation to the camshaft.

In view of this, the pump must be refitted as described below.

Ensure that the engine is at T.D.C. (top dead centre) with the piston of No. 1 cylinder in firing position.

Replace the oil pump so that the distributor driving slot in the oil pump gear takes up the position shown in Fig. 18.

No jointing of any kind is required between the pump face and cylinder casting.

Refit the sump.

Refill with engine oil of the specified grade to the correct level.

Refit the distributor and check the ignition timing.

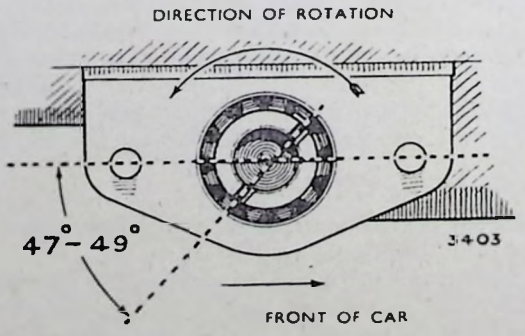


FIG. 18.—Oil pump correct assembly — No. 1 cylinder T.D.C. firing. (O.H.V. engine).

To Dismantle the Oil Pump.

Hold the oil pump with the base facing upwards. Remove the filter gauze. Remove the four setscrews securing the shroud and base plate to the pump body. Remove the base plate and outer driven ring. **It is essential that this ring is not dropped, as if this should happen it will crack.**

If the oil pump base plate is removed with the pump in position, care should be taken to remove the ring by hand before it is able to drop out of the oil pump body.

Drive out the two pins securing the bronze driving gear to the spindle, pull off the gear and withdraw the spindle from the pump body.

It is most unlikely that this pump will require any major attention, but in the event of the rotary parts being worn, they should be replaced as a complete set.

Re-assembly is a reversal of the above instructions.

Oil Pressure.

Oil pressure may vary considerably according to engine temperature, grade of lubricant, and condition of engine and oil pump. Normally, the pressure should be between 30 and 50 p.s.i. at 50 m.p.h. minimum.

Tick-over pressure is not critical and the condition of the engine should be judged by its normal running pressure.

The Piston and Connecting Rod Assemblies.

Unless the crankshaft has been removed the pistons and connecting rods can only be withdrawn from the top of the engine.

The Pistons.

Engines with 8 : 1 and 8.5 : 1 compression ratios have flat top pistons and those with 7 : 1 and 7.8 : 1 compression ratios have pistons with a hollow crown. Fitting clearances and grading dimensions are the same for both pistons.

To Remove the Pistons.

Remove the sump.

Remove the cylinder head.

Remove the self-locking nuts securing the big end bearing caps.

Remove the connecting rod caps with the bottom half big end bearings. No identifying numbers are stamped on either the connecting rod or connecting rod cap.

Push the pistons up the cylinder bores and withdraw the assemblies from above.

If the original parts are to be used again it is essential that the big end caps are re-assembled to the same rods from which they were removed. To show correct assembly, a forging flash is left on the oil squirt hole side of the connecting rod. This flash lines up with a similar flash on the connecting rod cap. Each complete connecting rod should be refitted to the same piston and cylinder bore from which it was removed.

To Refit the Pistons.

When the rods are fitted, the oil squirt holes, drilled through the small projections immediately above the big ends, must face towards the right-hand (thrust) side of the cylinder walls, with the engine viewed from the rear.

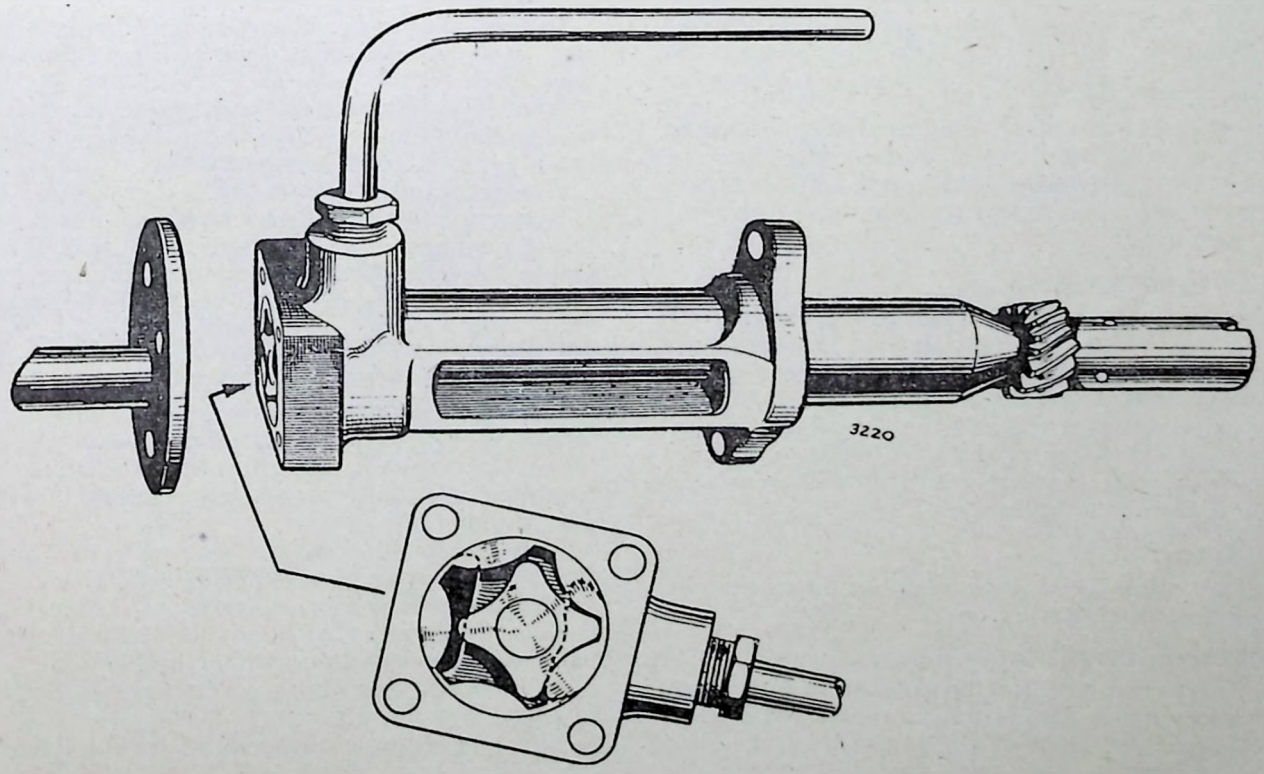


FIG. 19.—Oil pump details (O.H.V. engine).

The pistons must be fitted to the appropriate connecting rods so that the split sides of the piston skirts are all to the left-hand side of the engine as viewed from the rear.

Check that the pistons and connecting rods are correctly assembled, then insert the connecting rods and pistons into the cylinder bores from above in the opposite manner to that detailed for removal.

To facilitate insertion of the pistons in the cylinders, and to minimise risk of ring breakage, a piston ring compressor should be used.

Tighten the nuts to the correct torque of 17 lbs. ft.

The self-locking nuts must not be used again if they can be screwed on with the fingers.

To Dismantle the Pistons.

Remove the circlips retaining the gudgeon pin in the piston with circlip pliers. Scrape away any carbon which may have accumulated in the outer ends of the piston bosses to facilitate removal of the gudgeon pin.

Warm the assemblies, preferably in oil, and push out the gudgeon pins.

To Assemble the Pistons.

The fit of the gudgeon pin in the piston bosses and small end bush is critical.

The original piston, gudgeon pin and small end bush may be used again, in this respect, only if the gudgeon pin is without shake, both in the piston bosses and in the small end bush.

When new parts are fitted the small end bush in the connecting rod should be honed, after pressing in, so that the new gudgeon pin can be inserted by firm hand pressure at room temperature of 65°F. The gudgeon pin fit in the piston bosses should be a firm push fit at 65°F.

Piston Rings.

Top Compression Ring.

Series IIA, III and IIIA engines have chromium plated top compression rings. These rings may be recognised by their bright finish, and like the plain ring they replace, are untapered and have the same fitting clearances.

Second Compression Ring.

To provide more rapid running in, a tapered compression ring is fitted in the second groove from the top of both standard and oversize pistons. It is most important that this piston ring is correctly fitted with its narrowest face towards the top of the piston. This face of the ring marked "TOP" to indicate the narrower edge. Incorrect fitting will result in higher initial oil consumption.

Scraper Rings.

These are the slotted type and are fitted in the third and fourth (lower) grooves.

Top Chromium Plated Piston Rings.

These rings require a greater mileage to bed down and if for any reason the pistons are removed a careful note should be taken of the position of the ring gap as the piston is lifted out. This will enable the rings to be replaced in exactly the same position, assuming they are in good condition, and ensure that they will again operate in the position into which they were bedded in.

Where the need arises to fit new chromium rings to polished (part worn) bores, it will be necessary first to remove the glaze from the bores as otherwise these rings would never bed down properly.

To Fit the Piston Rings.

In order to ensure that the ring gap, when the piston is fitted to the cylinder bore, will be within the limits .009 to .014 (these apply to all rings), fit the rings first to the cylinder bore and check the ring gap with a feeler gauge.

Fit the rings to the pistons, making sure that the rings checked at No. 1 cylinder are fitted to No. 1 piston, and so on. A tapered compression ring is fitted into the second groove from the top on each piston. These rings are stamped **"Top"** on their upper faces, and should be fitted this way up. With a feeler gauge, check for correct vertical clearance of the rings in the grooves, which should be .0015 to .0035 for both compression and scraper rings. Fit the rings to the pistons in such a way that the ring gaps are equally spaced out round the piston, and not in line with one another.

Matching the Pistons to the Cylinders.

Every effort is made in the course of manufacture to ensure that the pistons and cylinders conform to their correct dimensions in machining. Normal production methods, however, allow for a minute variation in machined sizes, and for this purpose the pistons and cylinders are classified in four different grades.

In this manner the ideal clearance between the pistons and cylinder bores can be maintained on all engines.

The variation between each grade letter is .0004, the total difference between the highest and lowest cylinder bore limits being .0016.

Grades E and F pistons are for service use only.

Reference to the cylinder bore and piston grading tables on pages 1 and 3 respectively, will show at a glance the appropriate grade letter for any given bore measurement, together with the piston diameter.

To Assemble New Pistons to New Cylinder Blocks, as Supplied as Service Replacements.

It is normal practice to supply cylinder blocks separately, but a set of suitably graded pistons can be supplied to suit any given block. Cylinder blocks complete with pistons are not serviced under one part number.

It is essential to ensure that each new piston is fitted into a bore of appropriate grade.

The cylinder grade indication is stamped on two machined bosses at each end of the cylinder block below the level of the cylinder head on the exhaust manifold side, and visible when the cylinder head is in place.

The piston grade and weight are stamped on the top face of each piston.

Application of Piston and Cylinder Grading in Service.

Oversize pistons are supplied for rebored cylinders, and conform to grade B plus the requisite oversize.

When reboring cylinders to suit oversize pistons it is imperative that each bore is machined to the actual diameter of the piston to be fitted, plus the specified clearance in the bore.

For Service use with rebored cylinders, oversize pistons will not be supplied to any specific grade, since grading is incidental to manufacture.

In exceptional circumstances, however, graded oversize pistons can be supplied to meet special requirements.

Measurement of the Pistons:

T-Slot Type:

Pistons are machined oval in plan view, and tapered in side view. The largest dimension, which is the one to be measured, is taken across the bottom of the skirt, at right angles to the gudgeon pin.

Measurements should be taken with a micrometer equipped with a vernier scale.

After reboring, each piston should be checked in its bore for clearance, using a feeler strip $\frac{1}{2}$ inch wide by .0015 in conjunction with a spring balance.

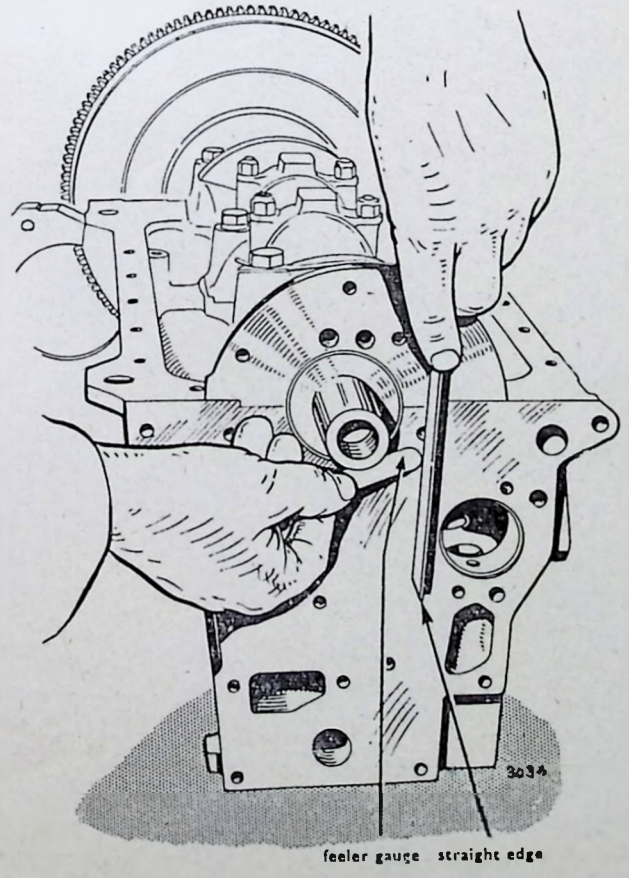


FIG. 20.—Checking the front main bearing cap alignment with a straight-edge and .0015 feeler. (O.H.V. engine).

Invert the piston and insert in the bore with the feeler strip in line with the thrust face of the piston skirt. A pull of $1\frac{1}{2}$ to 3 lbs., should then be required to withdraw the feeler strip, with the piston and cylinder wall wiped dry.

The Cylinder Liners.

Some engines are fitted with liners during production and these should be dealt with as follows:—

To Renew the Cylinder Liners.

The method used to remove liners will depend to a great extent on the facilities available. Liners may be drawn or pressed out from either the top or the bottom.

Check the cylinder for concentricity and correct size for the full length.

The cylinders should then be bored to provide the correct interference fit.

Provided the conditions set out above are fulfilled, press in the new liners. Finally, bore and hone the liners to suit the standard pistons.

To Remove the Crankshaft.

Remove the engine from the chassis.

Remove the cylinder head, pushrods and tappets.

Remove the timing wheels and chain.

Remove the engine front plate and sump.

Remove the connecting rods and pistons.

Remove the clutch and flywheel.

Remove the main bearing capbolts, and caps.

Lift out the crankshaft.

Crankshafts having oval or scored journals should be replaced by factory reground units. These are available in .020, .040 and .060. Similar dimensioned oversize main and big end bearings can also be obtained.

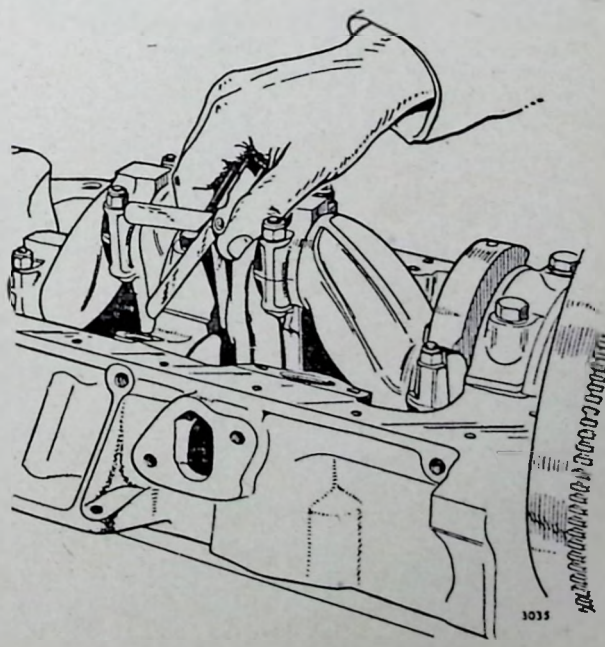


FIG. 21.—Checking the crankshaft end float (O.H.V. engine).

To Refit the Crankshaft.

Check that the oilways are clear.

Place the crankshaft in position checking that the top halves of the main bearings and thrust washers (centre) are correctly fitted into the crankcase. Thrust is taken by two half washers fitted to the side faces of the centre main bearing in the cylinder block.

Fit the lower halves of the bearings, together with the main bearing caps.

Replace the main bearing capbolts. Check that the machined front face of the front main bearing cap is in alignment with the machined front surface of the cylinder block. (See Fig. 20).

Tighten the bolts to the correct torque of 50 to 60 lbs. ft.

Check the end float of the crankshaft (.002 to .004) (Fig. 21). .005 thrust washers are available if needed.

Re-assemble the engine to the instructions given in the foregoing section, and refill the sump with fresh engine oil.

To Remove and Refit the Flywheel.

Remove the gearbox and bellhousing.
Remove the clutch.
Knock the flywheel tabwashers clear of the setbolts.
Remove the setbolts.

Remove the flywheel from the crankshaft flange. It will be found expedient to screw a stud of suitable size into the top setbolt hole before levering off the flywheel, to prevent the flywheel from falling accidentally with possible damage to the starter ring.

To replace, reverse the above order of operations, observing the following notes:—

It is important that the flywheel fits squarely on the crankshaft. Should the dowel have come away with the flywheel when it was removed, tap it out of the flywheel and refit in the crankshaft.

Make sure that the surface of the crankshaft flange and the register in the flywheel are perfectly clean and free from burrs, as otherwise the flywheel may not seat properly on the crankshaft.

Tighten the setbolts and check for run-out at the outer edge of the flywheel clutch facing. A total clock gauge reading of .003 must not be exceeded.

Lock the setbolts with new lockwashers.

SECTION C

COOLING SYSTEM

To Clean the Cooling System.

Periodically, the entire cooling system should be cleaned, particularly in districts where, contrary to instructions, water having a high content of lime has been used for replenishing the radiator.

Remove the radiator filler cap.

Open the drain tap in the bottom tank of the radiator (or preferably remove the tap complete) when the engine is still hot; also open or remove the tap from the left-hand side of the cylinder block.

Allow time for the engine to cool after all water has drained off. When cold, flush the radiator through to remove all loose sediment by means of a hose inserted in the filler neck.

Allow to drain and then close the drain taps or refit if removed.

Fill the system to normal level with a solution of cleansing compound and run the engine as directed by the makers of the compound.

It is important to drain off the cleansing compound directly it has been used for its recommended period.

Finally flush the system thoroughly with running water by means of a hose, turn off the drain taps and fill the system to normal level with soft water or anti-freeze mixture as required.

A furred radiator which is removed from a vehicle during overhaul should not be allowed to dry out as when this occurs the deposit inside will set hard and will not soften when the radiator is refilled and used again. Always cleanse the radiator immediately and whilst still wet inside, or seal up the apertures and fill with water pending treatment. Alternatively, the radiator can be left immersed in a suitable tank of water.

Do not invert the radiator or lay it flat as this allows any sediment which has accumulated in the bottom tank to pass into the cooling ducts. Always store the radiator in its normal upright position.

When using flushing compounds it is important to avoid splashing the paintwork of the car as they can have an injurious effect.

In very dusty conditions, and where insects are numerous, the radiator tube system should be kept clean by blowing through with compressed air from the engine side.

To Remove and Refit the Radiator.

Drain the cooling system.

Disconnect the top and bottom water hoses.

Remove the six fixing bolts that secure the radiator to the baffle plates. There are three bolts each side.

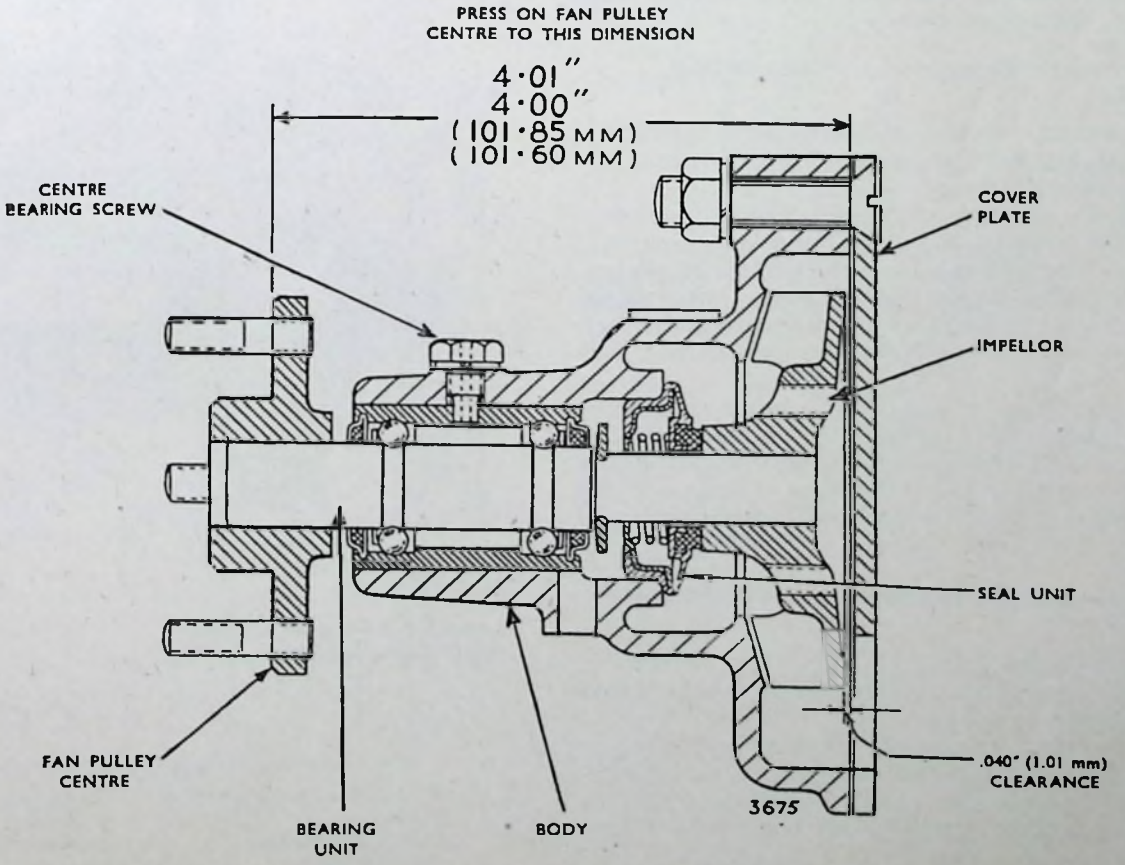


FIG. 1.—The water pump assembly. (Series IIA-III-IIIA.)

Replacement is made in the reverse order. The fixing bolts and their cage nuts should be lubricated with thick oil to prevent rusting of the bolt threads.

The Radiator Relief Valve.

Incorporated in the filler cap is a valve which prevents the water from escaping through the overflow when at normal level. This can occur through the agitation of the water in circulating.

When water is heated and expansion takes place the internal pressure lifts the spring-loaded valve off its seating in order to relieve excessive pressure through the overflow pipe.

In addition, this valve allows a small pressure build-up within the radiator. This raises the boiling point of the water a few degrees, which is an advantage in high altitudes, tropical conditions and hard driving.

To Test the Thermostat.

Suspend the unit in a vessel of water with a reliable thermometer.

Heat the water slowly, noting the thermometer reading and stirring the water continually.

The thermostat valve should commence to open at 170°F. and be fully open at 185°F.

If the thermostat valve is found open on removal from the engine, it may be assumed that it is defective and a new unit should be fitted.

Thermostats are sealed and their setting and manufacture is specialised work. Always renew if doubt exists. If a replacement is not immediately available, it should be left out temporarily, as a faulty unit could cause serious overheating.

To Remove and Replace the Water Pump. (Series I-II.)

Lift the bonnet and drain the cooling system.
Disconnect the top and bottom water hoses.
Remove the radiator.
Slack off the dynamo pivot and adjusting nuts.
Depress the dynamo body and remove driving belt.

Bend back the lock tab from the central nut securing the fan pulley to the pump spindle and remove the nut. Detach the fan blades by removing the four nuts and spring washers. Note the control nut lock plate.

Drive, with the aid of a lead or wooden mallet, the fan pulley sufficiently forward to obtain access to the six nuts and shakeproof washers securing the pump assembly to the pump housing. The pump can now be detached from its housing when these nuts and washers have been removed.

To Dismantle and Re-assemble the Water Pump. (Series I-II.)

Remove the unit from the engine.

Secure the boss of the fan pulley in a vice fitted with lead clamps to its jaws.

Remove the nut securing the impeller and screw it off the spindle in an anti-clockwise direction. Be careful not to damage the gland assembly which is situated in a register machined in the forward face of the vane.

The gland assembly is a push fit in its register and should not be disturbed unnecessarily. If a replacement is necessary, pay particular care not to damage the assembly as it is being inserted. The new gland must be a push fit and the carbon face must run dead true. Before replacing the impeller, clean the sealing face on pump body and lap it with grinding paste, if the surface is not smooth .

Secure the vane end of the spindle in the vice fitted with lead clamps and draw off the fan pulley. The tab of the locking washer should already have been bent back and the nut removed when the unit was detached from the engine. Remove woodruff key.

Remove the circlip retaining the outer bearing in position and with a lead or wooden mallet drive out the spindle complete with inner and outer bearings and distance piece.

Press off the bearings and distance piece from the spindle. Be careful not to damage the oil thrower and return thread machined on the spindle.

Assembly is the reversal of the foregoing.

To Remove and Refit the Water Pump. (Series IIA-III-IIIA.)

Remove the radiator.
Slacken the by-pass hose.
Remove the thermostat housing.
Slacken the dynamo mounting bolts.
Remove the driving belt and fan blades.
Disconnect the heater hose (if fitted).
Remove the four bolts and withdraw the pump.

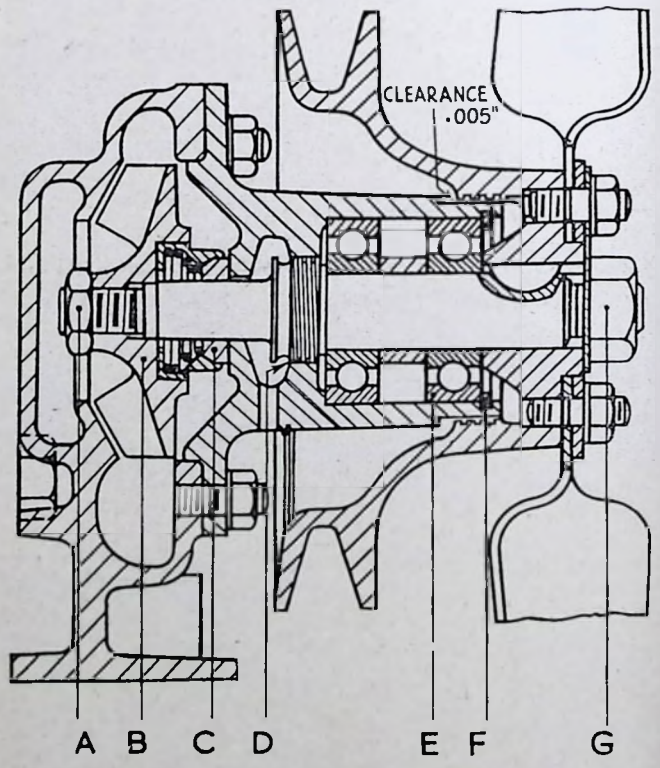


FIG. 2.—Section through water pump. (Series I-II.)

A—Impeller retaining nut.
B—Impeller.
C—Gland assembly.
D—Oil retainer.
E—Bearing.
F—Bearing retainer.
G—Fan retaining nut.

Replace in the reverse order, renewing any faulty joints or water hoses. When replacing the fan belt adjust so that there is $\frac{5}{8}$ inch belt slackness in the centre of the longest run of the belt.

To Dismantle the Water Pump.
(Series IIA-III-IIIA.)

The construction of the pump is shown in sectional drawing Fig. 2. It should be noted that both the impeller and the fan pulley centre are secured to the pump spindle by interference fits, i.e., they are pressed on.

The pump spindle forms part of a specially constructed shaft and bearing unit. It cannot be removed without first extracting the impeller and removing the bearing locating screw.

The only special tool required in the following operations is a draw type puller for removing the fan pulley centre and the impeller from the pump spindle.

Fan pulley centres must not be driven on to the pump spindle without supporting the rear end of the spindle. Hammering on a pulley centre will damage the ball race tracks.

To overhaul the pump, proceed as follows:—

Do not wash the pump complete, or its bearing unit, in petrol, kerosene, or any other form of cleansing fluid, because the pump bearing assembly is of a special construction and is lubricated in manufacture only. There is no provision for renewal of the lubricant in service.

Remove the nut and countersunk bolt securing the cover-plate to the pump body.

Remove the cover plate, taking care of the joint washer.

Remove the impeller by means of a suitable puller.

Two $\frac{1}{4}$ inch UNF tapped holes of 1.4 inch centres are provided in the impeller for the attachment of the puller, and these should be cleaned with a $\frac{1}{4}$ inch UNF tap before attaching the body of the puller by means of its draw bolts.

Remove the centre bearing screw from the top of the pump body and from the impeller end push out the spindle complete with the fan pulley centre.

If the spindle and bearing assembly cannot be removed by hand pressure, it can be freed quite easily by applying light pressure on the impeller end of the spindle.

The fan pulley centre is removed from the bearing unit spindle with a suitable puller.

Push out the rubber seal rearwards from the housing.

Inspect the housing and clean out all deposits.

Carefully examine the spindle and bearing unit.

If the bearing is showing signs of wear or roughness, the bearing unit should be replaced.

To Re-assemble the Water Pump.
(Series IIA-III-IIIA.)

Place the bearing unit in the pump body (large diameter of the spindle to the front of the housing), lining up the hole in the bearing with the threaded hole in the pump body.

Replace the centre bearing screw in the top of the pump body.

Place the fan pulley centre on a suitable block, under a press.

Press the larger diameter of the spindle into the pulley centre from the rear, until the front face of the fan pulley centre is positioned as shown by the dimensions in Fig. 2. This ensures the correct alignment of the pump pulley to the crankshaft pulley.

Place the special rubber seal on the smaller diameter of the spindle with the metal support of the seal facing towards the pulley end of the pump, and push firmly into the housing.

The special rubber seal has a carbon face, which is held by a spring in the rubber seal against the rear machined face of the impeller. If either of these parts are worn or if the pump is leaking at this point these parts should be renewed. It is most important to have a smooth flat face on the part of the impeller in contact with the carbon face of the seal.

Support the pump spindle end inside the fan pulley centre, and press on the impeller with its blades facing inwards. The rear face of the impeller must be .040 below the level of the machined rear face of the pump body. This can be measured by means of a feeler gauge and straight-edge placed across the machined face of the pump housing.

Fit the cover plate, using a new joint if required and secure with the countersunk bolt and nut, in the uppermost hole.

The Water Temperature Gauge.

This instrument is electrically operated and consists of two units, the temperature element (transmitter) in the thermostat housing, and the temperature gauge in the instrument panel. These units are connected by a single insulated wire in the wiring harness, and temperature is only recorded when the ignition is switched on.

To Remove the Element.

The radiator should be drained enough to allow removal of the element without the loss of water or anti-freeze.

A snap electrical connection is used and the wire may be pulled off.

To Remove the Temperature Gauge.

Two electrical leads have to be disconnected and the fixing screws removed to allow removal of the gauge from the instrument panel.

SECTION D

FUEL SYSTEM

Specifications

Fuel Pump

Make	A.C. No. E.7950327 (Series I-II). A.C. No. E/EP.1880.B. (Series IIA-III-IIIA).
Type	Mechanical.
Location	Right-hand side.
Operation	Lever by eccentric on camshaft.
Pressure	1½ to 2½ p.s.i.

Carburetters

	Series I-II:	Series IIA-III:	Series IIIA:
Make	Solex	Solex	Solex
Type	30 F.A. 10-2	32 PB104	32 PB1S (twin).
Settings:			
Venturi	24 mm.	24 mm.	24 mm.
Main jet	120	115	97.5
Air correction jet	200	150	250
Pilot jet	45	50	50
Pilot air bleed	80	120	120
Pump jet	——	——	40
Air cleaner type	A.C. oil bath.	Combined silencer and cleaner. A.C. No. E/AC.6535D or oil wetted air silencer A.C. No. 7223477.	A.C. oil bath No. 7223628

CARBURETTERS. SERIES I-II.

Description of the Carburetter.

The Solex FAIO-2 carburetter is a downdraught model without an accelerator pump, having a throttle bore size of 30 mm.

The names of the various parts, jet positions and internal passage ways are shown in Fig. 1.

(t) Is the main jet holder, screwed in the rear of which is the main jet itself (G). This meters petrol from the float chamber into the horizontally disposed channel leading from the jet to the well (A) of the Spraying assembly.

Down the middle of this well is the emulsion tube (et) which is located on a conical seating and held by the air correction jet (a) which surmounts the whole and locks the emulsion tube immovably.

Main Jet Operation.

The metered petrol from the main jet (G) passes into the well (A) where it meets air drawn downwards via the calibrated air correction jet (a). This air passes out through the small holes (ch) into the annulus, where an emulsion is formed with the petrol, and the resulting mixture rises to the four large spraying orifices of which two are shown (oo) in the waist of the choke tube. Here the emulsion is caught up in the main air current and passes down to the manifold via the throttle (V).

Pilot Jet Operation.

Idling is effected by petrol drawn from the main jet well via a small channel which will be seen emerging immediately above the larger horizontal lead from the main jet. This, it will be noted, turns upwards and eventually passes through the pilot

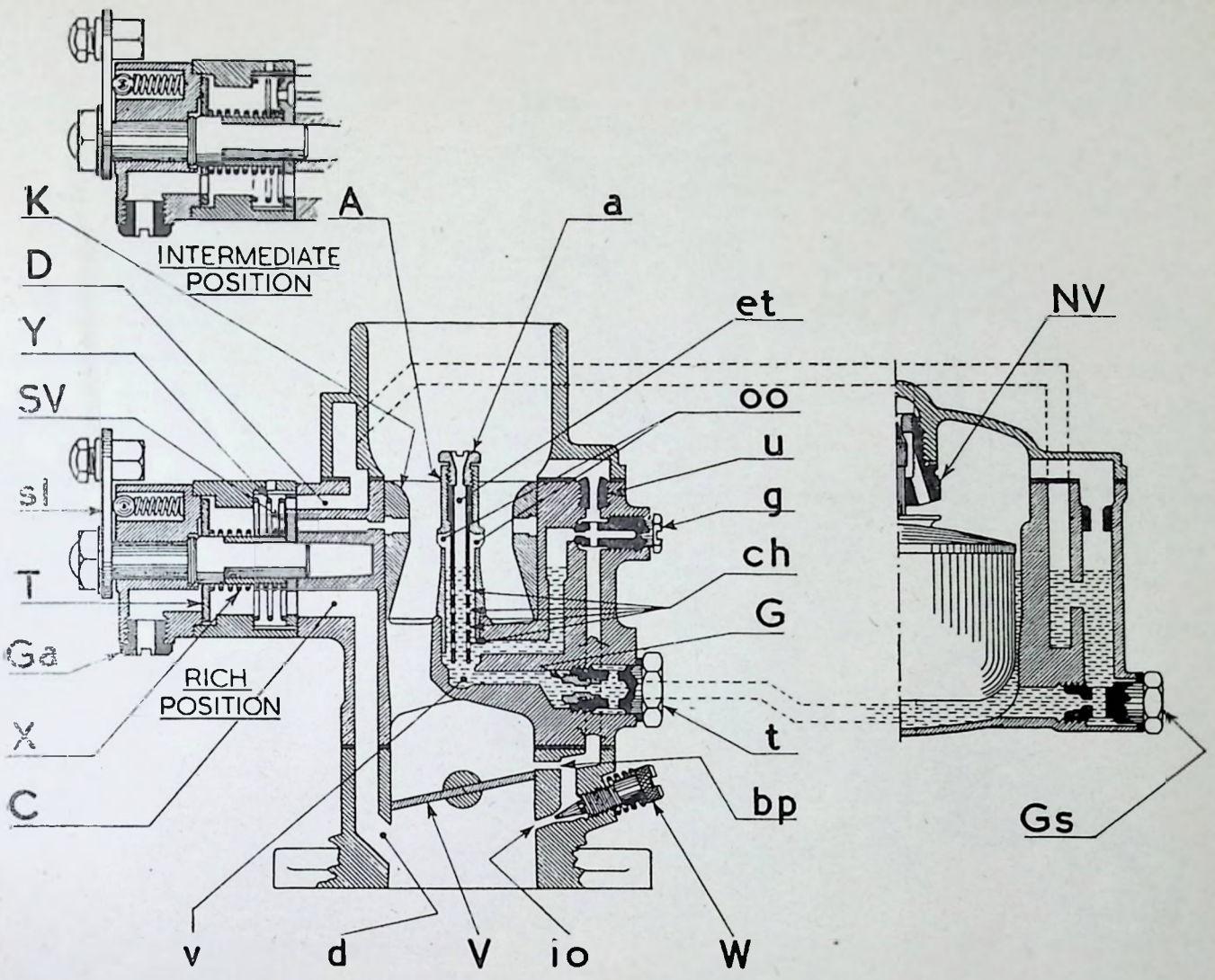


FIG. 1.—Sectional view of the Solex FA10-2 model carburetter.

PROGRESSIVE STARTER:

Ga—Starter air jet.
D—Inlet duct.
C-d—Mixture exit duct.
SV—Starter valve.
T—Air inlet disc.
Y—Valve spring.
X—Disc spring.
Gs—Starter petrol jet.
sl—Starter lever.

MAIN CARBURETTER:

K—Choke tube.
A—Spraying well.
a—Air correction jet.
et—Emulsion tube.
so—Spraying orifice.
u—Pilot jet air bleed.
g—Pilot jet.
ch—Emulsion holes.
t—Main jet holder.
bp—By-pass.
W—Volume control screw.
io—Idling mixture orifice.
V—Butterfly.
v—Reserve well.
NV—Needle valve.
G—Main jet.

jet (g) into the downwardly-disposed channel where an emulsion is formed with air from the pilot jet air bleed (u). This channel communicates with the mixture orifice (io) controlled by the spring-loaded and knurled taper screw (W).

The orifice (io) is on the engine and therefore on the suction side of the throttle. A branch lead communicates with another orifice (bp) which enters the airway slightly on the atmospheric side of the almost closed throttle.

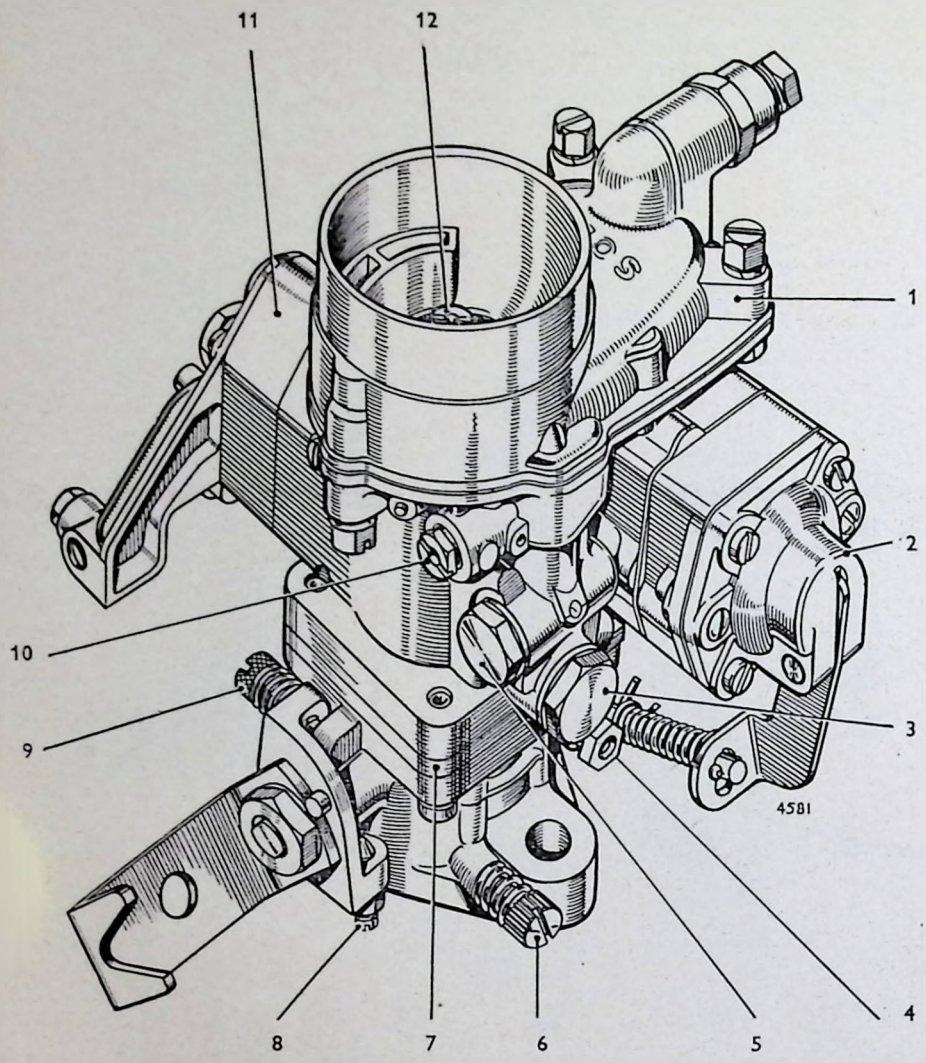
When the throttle is in the idling position, this branch lead which is termed the by-pass, acts as an air bleed upon the idling petrol supply and prevents over-richness when idling. Directly the throttle opens, however, the van passes to the atmospheric side of the orifice, so that both (bp) and (io) function as delivery orifices, thereby proportionately enriching the output at the transfer position between the pilot and main supplies preventing a lean flat spot which might otherwise take place.

Adjustment.

The adjustment of the carburetter consists in the selection of a choke tube (k) of suitable diameter; a main jet (G) and air correction jet (a) of suitable sizes to correspond with the choke characteristics, and a pilot jet (g) to handle the idling end of the mixture curve which is in turn assisted in effecting a perfect transfer by the air bleed (u), and eventually by the volume screw (W) which determines the final strength of the idling mixture.

The Progressive Starter.

With the dashboard control pulled out to its full extent the discs (T) and (SV) are rotated to the rich



1—Float chamber cover.
2—Accelerator pump.
3—Main jet holder.
4—Vacuum connection (distributor).
5—Accelerator pump jet.
6—Slow running volume control screw.
7—Heat resisting joint (carburetter to throttle body).
8—Full throttle adjustable stop.
9—Slow running adjustment screw.
10—Slow running jet.
11—Starter unit.
12—Air correction jet.

FIG. 2.—External view of the Solex B32. PB10-4 model carburetter.

position as shown, and with the engine running petrol drawn from the calibrated jet (GS) (in the base of the float chamber) is mixed with a small amount of air in the wells above (GS) and then passes through the channels to duct (D) and through a drilling in (SV), into the mixing chamber of the starter carburetter. Further small amounts of air are now admitted via the small bleed hole at the top of the chamber, and round the edges and through the drillings of the spring-loaded disc (T) which is drawn off its seating and pulled to the right by engine suction once the engine has fired. Prior to this the suction created by the cranked engine does not normally lift the spring-loaded disc (T), so that the initial mixture is very rich, only mixing with air from the bleed hole in the starter box. The emulsion passes out of the mixing chamber to the engine via a drilling at the bottom of (SV) and the ducting (C-d) on the engine side of the throttle (V). This arrangement provides a very rich but well disintegrated mixture which will permit the engine to fire and then continue to run at temperatures well below freezing point.

After the engine has run for a few seconds the dashboard control should be pushed to the "intermediate" position. This is reached when a marked resistance to movement is felt, caused by the engagement of a spring-loaded ball with a depression in lever (SL).

With the starter carburetter in the intermediate position, the discs have been rotated so that now a smaller dished hole at the top of disc (SV) whilst admitting the rich emulsion from the starter wells also puts the mixing chamber in communication with the waist of the choke tube (K) via a drilling through the carburetter body and the choke tube itself. When the throttle is closed, air is drawn through this drilling, by depression acting on (C-d), which mixes with petrol from (D) before passing through the dished hole into the starter mixing chamber.

Also a drilling at the bottom of disc (T) allows unrestricted air to the capacity of jet (GA) into the mixing chamber. (The starter air jet (GA) in this case is cast integrally with the cover and is, therefore, non-detachable nor adjustable).

The car can now be driven away at this setting and the dashboard control pushed gradually home as the engine warms up with the following sequence of events:—

When driving away engine suction at point (d) is relieved progressively as the throttle opens, but for the same reason air passing down the choke tube (K) creates suction on the choke tube drilling which communicates with the starter mixing chamber.

The act of pushing in the dashboard control **gradually** allows suction at the above point to become effective, so that the mixture from the starter unit drawn through the hole in the choke tube supplements the supply being discharged from (C-d) to ensure clean acceleration, and elimination of unpleasant "flat spots" without "popping-back" and stalling. At the same time the mixture discharge drilling, in the bottom of the valve (SV), is slowly reduced, progressively blanking-off channel (C-d), and reducing the volume of starter mixture being discharged until it is finally closed, when the engine is warm enough to run on the main spraying assembly.

Notes on Starting.

During cold weather, when the engine has remained at rest for a long period, it is advisable, before switching on the ignition and pulling out the dashboard mixture control of the starter carburetter to give the engine a few turns by hand to break the normal inertia of the oil.

If the car has been standing for some time the petrol in the float chamber may be stale and difficult starting may be experienced during cold weather. It is therefore advisable to pump into the float chamber a fresh supply of petrol before attempting to start the engine.

The progressive starter carburetter as explained can be selected to give:—

(a) A very rich mixture for very cold weather (fully out), or a less rich mixture for temperatures above freezing point (midway position) and so ensures instantaneous starting from cold.

(2) A means of weakening the mixture rapidly by pushing in the dashboard control half-way as soon as the engine will "take it", thus avoiding the possibility of "piling up' as 'the engine temperature rises.

(3) A means of gradually reducing the volume of mixture by pushing dashboard control gradually from the half-way to "out of action" positions.

To start the engine switch the ignition "ON", pull out the dashboard control to the full extent, when temperatures are freezing or below, and operate the starter switch. Immediately the engine fires, release the starter switch and push the dashboard control to the half-way position after a few seconds running. The car can now be driven away and the mixture control gradually pushed right home as the engine warms up. The starter carburetter can usually be dispensed with after running a mile or so, depending on type of driving, and ambient temperature etc.

Summarising, use of dashboard control is as follows:—

(1) Dashboard mixture control pulled fully out to start in very cold weather, or to the midway position in temperatures above freezing. Engine allowed to run for a few seconds.

(2) Dashboard mixture control pushed half-way as soon as possible. This stage is for driving away, or when starting from the midway position. It will be possible to push the control in a little way to a position which gives a fast smooth tick-over a few seconds after starting.

(3) Dashboard mixture control pushed fully "home" gradually from intermediate position as engine warms up.

Under no circumstances should the dashboard mixture control be used for starting the engine when hot.

Careful attention to these details will ensure permanent satisfaction at minimum cost of petrol and engine wear and tear.

To Service the Carburetter.

The pilot jet (g), the main jet (G) and the starter petrol jet (Gs) are all accessible from the exterior without dismantling the carburetter, after removing air cleaner.

Access to the Interior.

Two slotted square headed bolts secure the top casting to the body of the carburetter, and the removal of these allow the top to be detached from the main body of the carburetter, thus exposing the float chamber, air correction jet (a) and the pilot jet air bleed (u). These two jets can now be removed with a small screwdriver.

Adjustment of the Carburetter.

The sizes of the choke tube, those of the various jets for the progressive starter device, idling and general running have been chosen by careful experiment and there should be no reason to replace them with others of different dimensions. If the results being obtained are not satisfactory, the sizes stamped on the choke tube and various jets should be checked against the table given below, and replacements fitted as necessary:—

Choke tube	24 mm.
Main jet	120 mm.
Air correction jet	200 mm.
Emulsion tube	L4
Pilot jet	45 mm.
Pilot jet air bleed	80 mm.
Starter petrol jet	100 mm.
Float	26 gms.
Needle valve	1.5 mm.

The only adjustment which may at times be needed is that for slow running and is as follows:—

Slow Running Adjustment.

The idling or pilot jet (g) provides the necessary output for idling. The slow running screw mounted on the abutment plate of the throttle lever, limits the closing of the throttle and fixes the idling speed of the engine. By screwing in this screw the engine idling speed will be increased and vice versa.

The mixture adjustment screw (W) permits the richness of the idling mixture to be varied. By turning it in an anti-clockwise direction (out) enrichment takes place up to the limit of the pilot jet output; conversely by clockwise rotation (in) the mixture is weakened.

Poverty of mixture is recognised by the irregular behaviour of the engine and the tendency to stall. Over-richness will cause the engine to "hunt" and tend to stall when the "hunt" becomes excessive. Normal adjustment is carried out as follows:—

(1) Wait until the engine is hot.

(2) Set the slow running screw until the idling is on the high side.

(3) Slacken the volume screw (W) until the engine begins to "hunt".

(4) Screw it in very gradually until the "hunting" just disappears.

(5) If the engine speed is too high reset the slow running screw to slow it down to idling speed of about 600/700 r.p.m.

(6) This may cause a resumption of slight "hunting". If so, turn the volume control screw gently in a clockwise direction until the idling is perfect.

For "Diagnosis of Faults", see B.32 PB10-4 model carburetter, page 7.

SERIES IIA-III.

General Description.

The B.32.PB10-4 Solex Carburetter is a down-draught model in which is incorporated a fully progressive cold starting device and a mechanically operated diaphragm type of accelerator pump.

32 denotes the throttle bore size in millimetres and not the venturi or choke tube size. The symbols PB10-4 are the code reference of the model. An external view of the carburetter showing the positions of the various jets is given in Fig. 2.

Carburetter Operation.

Starting from Cold. (See Fig. 3.)

Cold starting conditions require a very rich fuel/air mixture and a progressively weaker mixture until the engine is warm enough to run on the normal settings of the main carburetter.

These requirements are met by the manually operated cold starting device which is a small auxiliary carburetter fed from the float chamber and mounted on the side of the main carburetter. The choke control operates this device and the richest mixture is given when the choke control is pulled fully out. In this position satisfactory starting is obtained under conditions of extreme cold but when starting in moderately cold temperatures, the choke control need only be pulled about two thirds of the

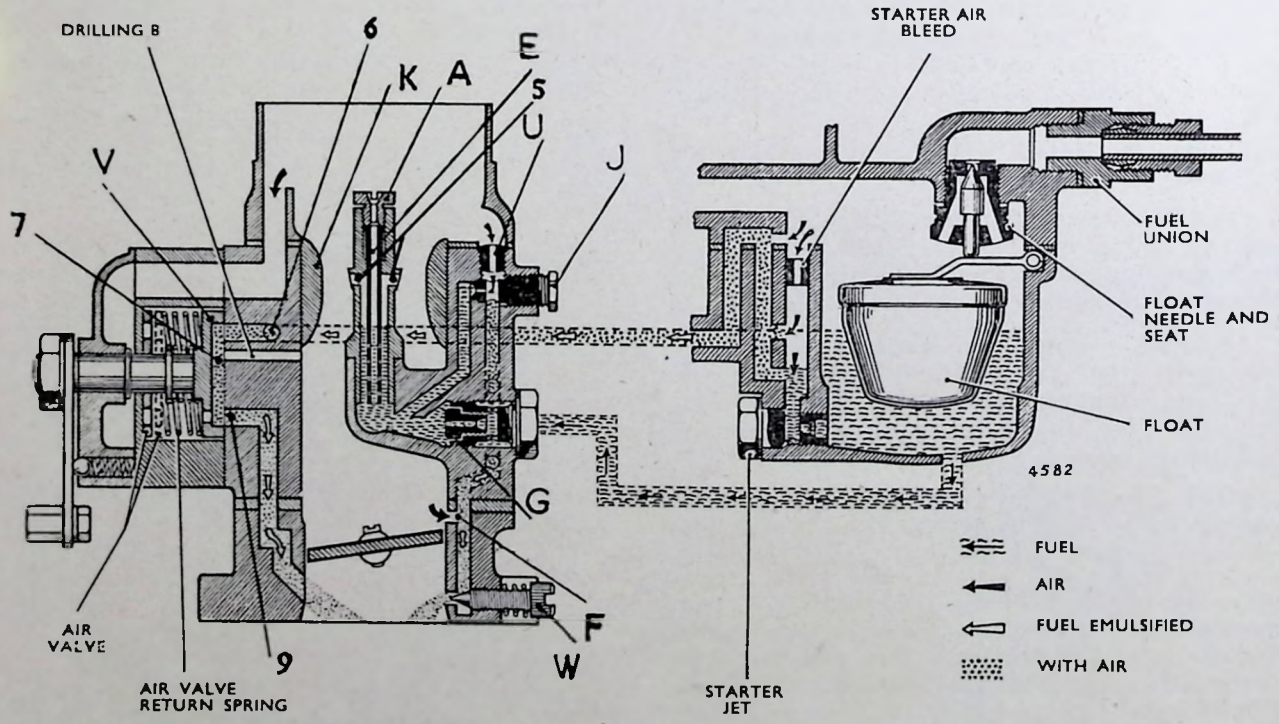


FIG. 3.—Sectional view showing the B32 PB10-4 carburetter operation under starting conditions.

A—Air correction jet.
E—Emulsion tube.
F—By-pass.
G—Main jet.
J—Pilot jet.
K—Choke tube (venturi).
U—Pilot jet air bleed.
V—Starter valve.
W—Volume control screw.
5—Spraying orifices.
6—Fuel passage.
7—Starter valve passage.
8—Drilling passage (body).
9—Passage to mixture exit duct.

way out to a position when the action of a spring-loaded ball can be felt. This puts the starting device fuel and air passage ways into a suitable position to provide a rich enough mixture for this starting condition.

Starting Procedure.

Under conditions of extreme cold (below 32°F. —0°C.). Pull out choke control fully, switch on ignition, and operate starter control. Do not depress the accelerator. When the engine has started and is showing signs of uneven running due to richness, push in choke to half-way position and push in progressively as the engine warms up.

Under normal cold conditions (Summer and mild Winter). Pull out choke to half-way position only, switch on ignition and operate starter. Do not depress the accelerator and gradually push in the choke as the engine warms up.

It is important to note that as the choke control is progressively pushed in from this midway position, the mixture will be progressively reduced in strength, and the idling speed of the engine will be progressively reduced.

This is very important as it is now possible to allow the engine to warm up with the vehicle stationary should it be so desired without the mixture becoming too rich.

It is also possible to increase the idling speed of the engine at halts in traffic before the engine reaches its normal working temperature. This will prevent stalling.

In short, after the engine has been started and the control knob is being pushed inwards, the control can virtually be considered to operate in a similar way to a hand throttle.

With the Engine Warm. If the engine is warm and the choke is pulled out fully, there is a possibility that the engine will not start, due to over-richness. Should this occur, push in choke, fully depress accelerator pedal and release accelerator pedal as the engine fires.

If the engine will not start without the choke, pull out to half-way position. (See important note above with regard to over-choking.)

Zero Progressive Starter Operation. (See Fig. 3.)

When starting under very cold conditions the choke control knob is pulled out which moves the lever against its rear stop. This lever turns the shaft which moves the starter disc valve and its transverse channel into position so that suction created by cranking the engine draws fuel from the starter jet shown in Fig. 3. This fuel is emulsified by air drawn through the starter air bleed also shown in Fig. 3, and travels along the channel (6), across the channel in the disc valve (V) and then into the induction manifold.

As soon as the engine fires, the inlet manifold suction increases and lifts the air valve from its seating against its light return spring as shown in Fig. 3.

When the engine has run a few seconds the dashboard control is pushed in about $\frac{1}{8}$ of its travel, which is to when the indent ball moves into the hole in the lever arm. This movement rotates the disc valve (V) to a position where the emulsified fuel supply from the passage (7) is now controlled by the sizes of the two fuel feed holes which are parallel. The volume of mixture drawn from the passage (6) is, therefore, considerably reduced, and is weakened by air admitted to the capacity that the two elongated holes in the air valve have uncovered two holes in the starter unit body.

The car may now be driven away without difficulty, although the engine is still cold. When the throttle is opened depression acting on the drilling (8) (Fig. 3) draws an additional supply of fuel from the channel in the disc valve (V) to meet engine requirements. At the same time depression acting on the hole (9) continues to draw fuel from the channel in the disc valve.

As the engine warms up the choke control is moved progressively towards the off position bringing the disc valve to the position where the two fuel feed holes are then in "series" and the air holes fully uncovered by the elongated holes in the air valve which further reduces the mixture quantity and strength.

Finally, the position is reached when the engine becomes warm enough for the choke control to be pushed fully in bringing the lever against the front stop. The disc valve (V) then blanks off the feed channel and the channel in the disc valve is connected to atmosphere.

Slow Running. (See Fig. 3.)

When the throttle is in the idling position fuel is metered by the slow running jet which is fed from the float chamber through the main jet. Air to emulsify the fuel metered by the slow running jet is drawn through the calibrated air bleed. Air is also drawn through the nearly closed throttle and by adjusting the slow running volume control screw, the amount of emulsion drawn from the slow runnning jet and air bleed can be adjusted so that, with the air passing the throttle, a suitable slow running mixture passes into the engine.

Further opening of the throttle allows more air to be drawn past the throttle and also uncovers the by-pass orifices (progression holes) from which additional emulsified fuel is drawn. This maintains the correct mixture strength and freedom from "Flat-spot" as the engine speed is increased from slow running.

Normal Acceleration to Cruising Speed. (See Fig. 3.)

As the throttle is progressively opened past the by-pass orifices the air velocity through the venturi generally called the choke tube, begins to increase. This causes a suction to be exerted on the spraying orifices drawing fuel from the well below and around the emulsion tube. This fuel is emulsified by air entering the emulsion tube in increasing quantities as the engine speed rises. The amount of fuel drawn from the passages between the main jet and the emulsion tube before metering through the main jet, provides the slight temporary enrichment of mixture which prevents a flatspot on increase of engine speed from fast idling.

Cruising or Part Throttle Operation.

(See Fig. 3.)

With a steady throttle opening, fuel is drawn from spraying orifices by the depression in the venturi after being emulsified by air through the air correction jet and the small holes in the emulsion tube. At a lower cruising speed the depression in the venturi (choke) is comparatively slight and the flow of fuel through the main jet is controlled by the size of this jet and the difference of fuel level in the float chamber and fuel level in the main well.

At higher cruising speeds the flow through the main jet becomes affected more by the higher depression in the venturi than by the difference in fuel level previously referred to, and the increasing air supply from the air correction jet ensures that an economical mixture is provided under cruising conditions.

Rapid or Snap Acceleration. (See Fig. 4.)

The sudden opening of the throttle to obtain rapid acceleration allows a greatly increased quantity of air to pass through the venturi and the main spraying well is then unable to provide the fuel needed to maintain a correct mixture strength. A temporary supply of extra fuel is needed to ensure a good response from the engine. This fuel is provided by the action of the accelerator pump.

The pump consists of a membrane, a return spring, a non-return ball valve, a pump jet and the operating linkage coupled to the throttle spindle.

On the return stroke of the pump, which occurs whenever the accelerator pedal is released, the accelerator pump draws fuel from the float chamber through the non-return ball valve. A small gauze filter is fitted on the outside of this valve. When the accelerator is rapidly depressed the pump operating lever compresses the pump membrane against its return spring, this forces the non-return ball on to its seat and petrol is discharged from the injector tube into the air stream passing through the venturi. The rate of pump discharge is governed by the size of the pump jet and the quantity by the length of the pump stroke.

Full Throttle Running.

More fuel is required for this condition to augment the main jet supply which has been calibrated to give maximum economy for cruising speeds. The extra fuel needed is drawn from the injector tube and metered by the pump jet, under the influence of high depression in the venturi or choke tube and will continue until the throttle is returned to the part open cruising position.

Diagnosis of Faults.

See instructions given for 32 PBIS model carburetter, page 10.

Adjustments.

The only adjustments that may need attention are:
(a) Slow running.
(b) Choke control cable after removal and replacement of the carburetter.
(c) Accelerator pump stroke.

Slow Running. (See Fig. 3.)

The mixture strength at idling speeds can be varied within the limits imposed by the slow running jet and its air supply jet by regulation of the volume control screw in the throttle barrel.

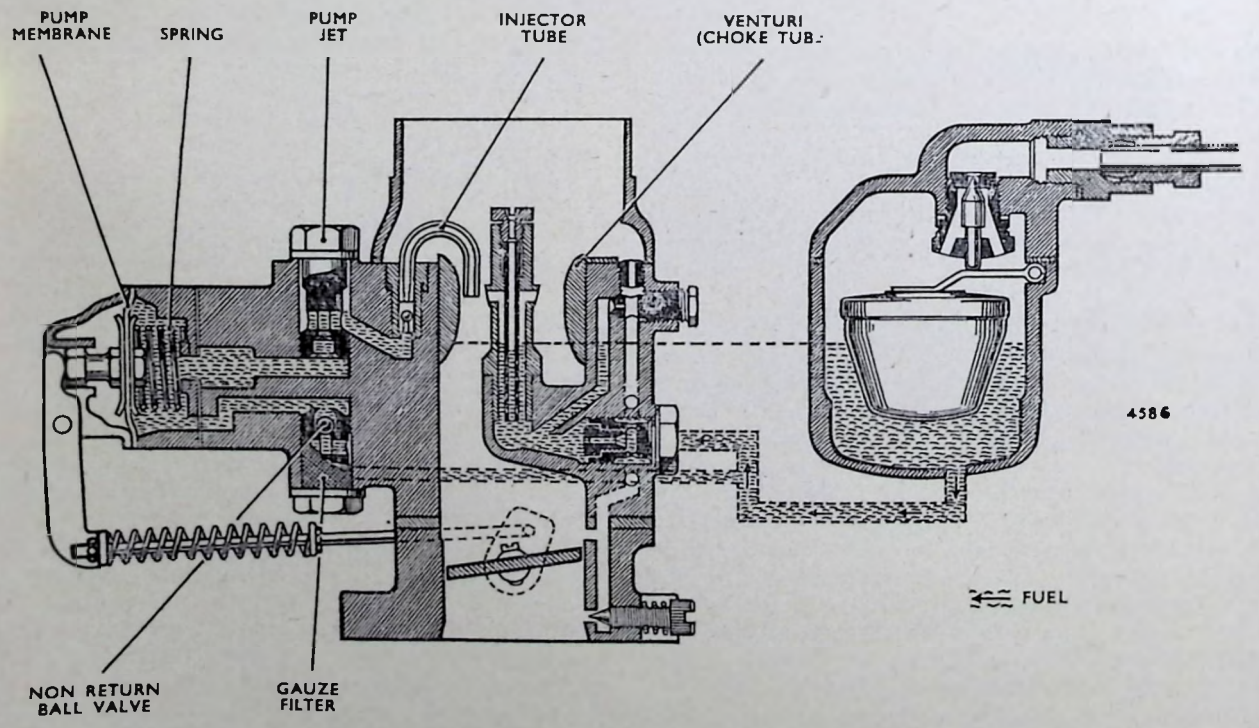


FIG. 4.—Sectional view of the B32 PB10-4 carburetter showing details of the accelerator pump. (Typical also of the 32 PBIS carburetter accelerator pump.

Turning this screw clockwise reduces the annulus between the conical end of the screw and the hole in the barrel from which the idle mixture is discharged. This will weaken the slow running mixture. Unscrewing the volume control screw will enrich the mixture by increasing the annulus which causes a greater depression on the slow running jet. The slow running speed is adjusted by rotating the screw clockwise to increase the speed, and anti-clockwise to reduce the speed.

When making this adjustment the speed should always be adjusted by the screw. Should the speed be too slow and the mixture correct, increasing the speed with the screw will slightly open the butterfly. This will allow more air to pass into the induction manifold, and the slow running volume control screw will have to be rotated a small amount anti-clockwise to slightly enrich the slow running mixture. The opposite may apply if the slow running speed is reduced; it is generally necessary to use both adjustments when setting the idling speed.

After setting the slow running a check should be made to ensure that the engine does not stall when the clutch is fully depressed.

Starter Control Cable.

The control cable should be fitted so that the choke control knob is about $\frac{1}{8}$" clear of the facia board when the control is in its normal position. This will ensure that the starter unit operating lever is pushed back against its stop when the starter unit is not in use.

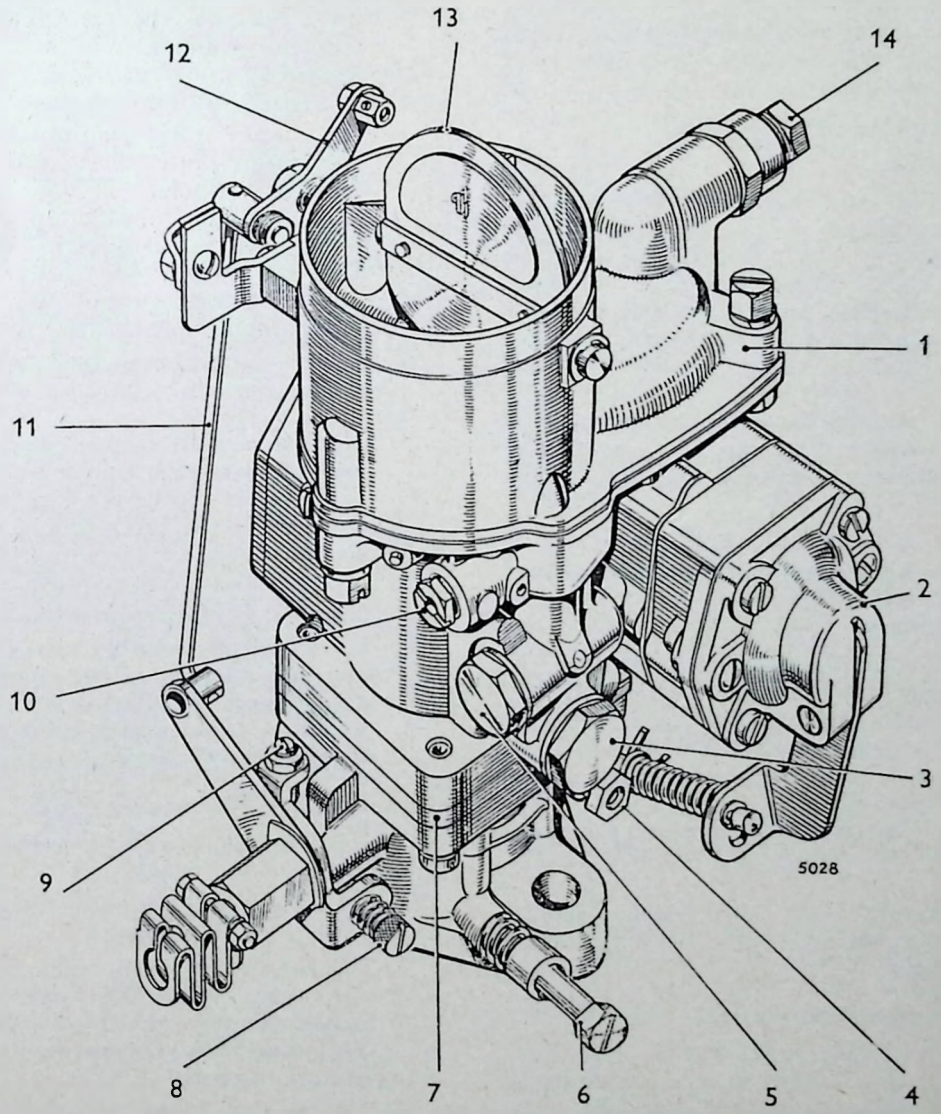


FIG. 5.—External view of the Solex 32 PBIS model carburetter.

1—Float chamber cover.
2—Accelerator pump.
3—Main jet holder.
4—Vacuum connection (distributor).
5—Accelerator pump jet.
6—Slow running volume control screw.
7—Heat resisting joint.
8—Slow running adjustment screw.
9—Full throttle adjustable stop. screws (front carb. only).
10—Slow running jet.
11—Strangler to throttle fast idle connection.
12—Strangler lever.
13—Strangler valve.
14—Fuel pipe union.

Accelerator Pump Adjustment. (See Fig. 4.)

The travel of the accelerator pump lever, and hence the volume of fuel that the pump injects, can be altered by changing the split pin position in the link rod that couples the accelerator pump lever to the throttle shaft lever.

Three holes are provided for the split pin which is normally fitted to the outer hole which gives a short pump stroke.

The longest pump stroke is obtained by fitting the split pin in the hole nearest to the throttle spindle. The ideal adjustment is the smallest stroke that will give proper acceleration.

Fuel Level.

The design of the float mechanism ensures complete stability of the predetermined petrol lever, thus eliminating all need for routine checking. However, in the event of damage occurring to the float arm or float, this would of course seriously affect fuel level and calls for replacement action.

Dismantling, Cleaning and Overhauling.

To Service in Position.

This carburetter can be dismantled with ordinary spanners and a screwdriver.

Jets and orifices must be cleaned by blowing hrough with CLEAN compressed air. FLOAT MUST BE REMOVED FIRST. Wire or other similar hard material must not be used as the slightest alteration to a jet size will increase the amount of fuel that it meters.

Normal cleaning of the float chamber, jets if blocked, and most passage ways can be done in the following manner without removing the carburetter from the engine:—

1. Disconnect air cleaner and fuel pipe.
2. Remove three securing screws and remove float chamber cover.
3. Lift out float and its pivot.
4. Remove main jet holder, accelerator pump jet and slow running jet (pilot jet). See Fig. 2.
   Also remove slow running jet (pilot jet) air bleed, injector tube assembly, air correction jet, the emulsion tube and the non-return valve with its cylindrical gauze filter.
5. Blow out the carburetter float chamber, the passage ways and the various jets with CLEAN compressed air.
6. Replace the jets and their fibre washers where fitted and the non-return valve with its cylindrical gauze filter.

To Completely Dismantle Carburetter.

When it becomes necessary to dismantle and overhaul the carburetter due to wear of the throttle spindle it is usually cheaper to fit a reconditioned carburetter.

To completely dismantle the carburetter the following procedure should be followed:—

1. Disconnect air cleaner, fuel pipe, throttle control, choke control cable, and distributor vacuum pipe union.
   Remove the two flange fixing nuts and lift off carburetter.
   Place a cardboard blanking flange over the inlet manifold flange to prevent anything falling into the inlet manifold.
   Clean carburetter exterior with petrol (gasolene).
2. Remove three securing screws and remove float chamber cover.
3. Lift out float and its pivot.
4. Remove main jet holder, accelerator pump jet and slow running jet (pilot jet). See Fig. 2. Also remove slow running jet (pilot jet) air bleed, injector tube assembly, air correction jet, the emulsion tube, and the non-return valve with its cylindrical gauze filter.
5. Scribe a line across the flanges and insulating joint between the carburetter main body and throttle chamber.
   Remove four screws securing throttle chamber to main body and separate these items.
6. Note split pin position in rod coupled to accelerator pump lever and remove, also spring and flat washers.
   Remove four brass flat headed screws securing pump unit to carburetter body.
   Remove two raised headed screws securing pump cover to pump body and remove cover, pump membrane and its return spring.
7. Remove four brass flat headed screws securing starter unit to carburetter body and remove this unit.
   Note how starter unit operating lever is fitted and remove lever by undoing its fixing nut. As the lever is withdrawn care is needed to prevent the loss of the lever indent ball and spring.
   Remove wire circlip around starter unit spindle and withdraw starter valve assembly.
8. Remove float needle valve seat.
9. Clean all parts with petrol (gasolene) and blow through all jets and passage ways with CLEAN compressed air. Particular attention should be given to the transfer holes (progression holes) in the throttle body.

Inspection of Carburetter Parts.

1. All jet sizes should be compared to those given on page 1.
2. Check pump membrane for sign of porosity and replace if necessary.
3. Check face of carburetter body against which the starter valve face operates for scores. Also check the face of the starter valve. If necessary these faces may be rubbed down if scores are not too deep.
4. Check the flange on the lower face of the throttle chamber for distortion. It should be finished flat if necessary.
5. Check slow running mixture volume control screw taper end. If bruised it must be renewed.
6. Check that the full throttle position stop screw is set to give full throttle.

Re-assembly.

This is a reverse of the dismantling procedure. The joint between the float chamber cover and main body should be renewed together with any damaged or faulty fibre washers.

The cylindrical gauze filter used on the accelerator pump non-return valve should also be renewed if it is any way faulty.

SERIES IIIA.

General Description.

The Solex 32PBIS carburetter is a downdraught model in which is incorporated a mechanically operated diaphragm type of accelerator pump and a hand operated strangler valve. 32 denotes the throttle bore size in millimetres. The symbols PBIS are the maker's code reference of this model. An external view of the carburetter showing the position of the various jets, etc., is given in Fig. 8.

The float chamber is air vented externally through the carburetter top body and internally into the air intake.

The accelerator pump stroke is not adjustable and the stroke occurs during the early part of the throttle opening period.

Jet and all other sizes required are given on page 1.

A lever type float made of a fuel-resisting plastic material is employed.

The main body is insulated by a thick heat-resisting joint from the throttle chamber to reduce conduction of heat from the manifold to the actual carburetter body.

Carburetter Operation.

Starting from Cold.

Cold starting conditions require a very rich mixture for a few seconds and a weaker but not normal mixture until the induction manifold begins to warm up. Correct throttle opening is also needed.

These requirements are met by the strangler butterfly valve closing off the air supply, and the strangler valve operating mechanism opening the throttle to the correct starting position when the choke control is pulled out to start the engine.

When the engine starts with the strangler valve closed, air pressure operating on the upper side of the strangler valve, opens the light spring-loaded plate valve. This allows entry of sufficient air to prevent over-choking of the engine immediately the engine starts when the choke is pulled out.

Starting Procedure.

Starting Engine When Cold.

Pull out the choke control. Operate the starter. The engine should start immediately and continue to run at fast idling speed. If the engine fails to start, do not operate the starter again until both engine and starter have come to rest. A pause of one or two seconds will be sufficient and will obviate risk of damage to starter mechanism.

When the engine begins to run erratically (or "hunt"), the choke control should be pushed in far enough to make it run smoothly again. The choke control should be pushed in fully as soon as is possible without causing the engine to misfire or stop, but it should be noted that when the choke control is pushed to within about half an inch of the instrument panel, the mixture is reduced to normal strength. This is a very important point, as it means that for its last half inch of travel the choke control may be used to increase the idling speed of the engine before it reaches its normal working temperature, which will prevent stalling.

Starting Engine When Hot.

Switch on ignition and operate the starter. Depress accelerator pedal slightly and remove the foot as soon as the engine starts.

Starting in Very Hot Weather.

If difficulty is experienced in starting a "hot" engine in very warm weather, do not agitate the accelerator but press down fully and hold with foot, then operate starter, when the engine will start easily. The foot must then be removed from the accelerator at once to prevent racing.

Slow Running.

See B.32 PBIO-4 model carburetter, page 6.

Normal Acceleration to Cruising Speed.

See B.32 PBIO-4 model carburetter, page 6.

Cruising or Part Throttle Operation.

See B.32 PBIO-4 model carburetter, page 7.

Rapid or Snap Acceleration.

See B.32 PBIO-4 model carburetter, page 7.

Full Throttle Running.

See B.32 PBIO-4 model carburetter, page 7.

Diagnosis of Faults.

Since the function of the carburetter is closely connected with other items of engine operation, troubles are sometimes difficult to trace and the carburetter is often blamed when it is not at fault.

Unless known to be in perfect condition, the following items should be checked before making carburetter adjustments.

Ignition System.

1. Check spark plug condition. Clean and set gaps.
2. Check condition and tightness of H.T. and L.T. leads.
3. Check condition and setting of contact breaker points and contact moving point spring tension.
4. Ensure that the centrifugal and vacuum advance mechanism is working correctly.
5. Check ignition timing. Only small variations from the correct static timing are permissible.

Fuel System.

1. Ensure that an adequate supply of fuel is being delivered to the float chamber.
2. Check that fuel pump output pressure is correct to the figures given on page 1.
3. Examine induction manifold and carburetter flange for air leaks.

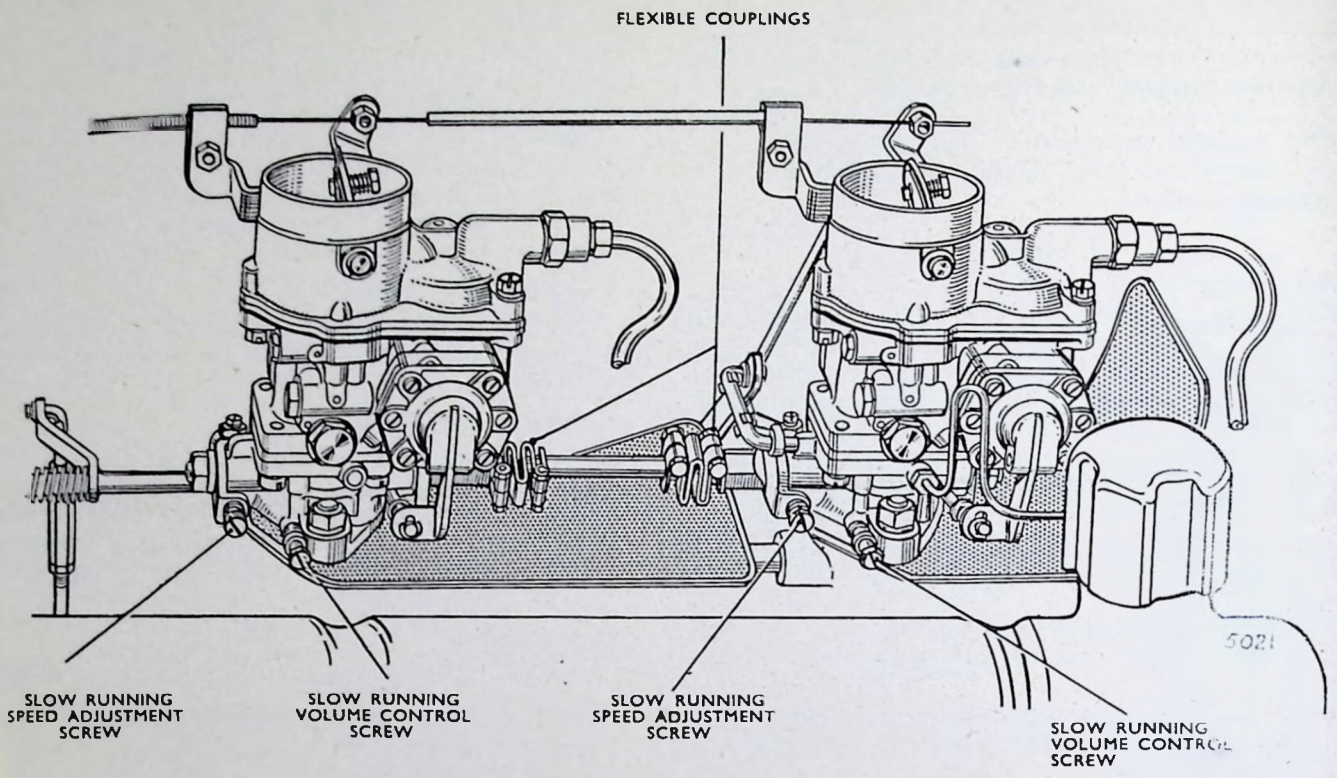


FIG. 6.—Adjustments for synchronising the throttles and adjusting slow running (twin carburetters).

4. Ensure that air cleaner (or silencer) is fitted correctly and not restricting air supply to carburetter.

Compression.

1. Check valve clearances and compressions.
2. Make sure valves are not sticking.

Exhaust system.

1. Check that exhaust pipe has not become damaged or blocked.

If the carburetter has been proved faulty a systematic check should be carried out in order to locate the exact source of the trouble. Random adjustment on the carburetter is useless and harmful and must never be attempted.

Excessive Fuel Consumption.

(a) Check that the main jet is to the specified size and tight in its housing.
(b) Check that the accelerator pump jet is correct to the specified size.
(c) Ensure that partial flooding of the carburetter is not occurring due to a defective needle valve. a damaged float or needle valve washer, or needle valve insufficiently tightened in float chamber cover.
(d) Ensure that the choke operating cable is correctly adjusted and returning the stranglers to their normal running positions.

Insufficient Top Speed.

(a) See that the throttles are opening fully and that the full throttle stop screw is correctly adjusted on the front carburetter.
(b) Check for fuel obstruction in the main and accelerator pump jets and passage ways.
(c) Check fuel supply to the float chamber and fuel pump output pressure. A condition can arise when due to worn fuel pump linkage or improperly fitted pump, the pump output is too low under full throttle condition.

Faulty Slow Running.

(a) With twin carburetters, check synchronisation of throttles and slow running. See under "Adjustments".
(b) Check that the slow running jet is clear.
(c) Blow through the slow running system passage way in the carburetter body with clean compressed air: WITH FLOAT REMOVED.
(d) Make sure that no air leaks exist at the carburetter mounting flange and joints between the carburetter bodies.
(e) Check that the mixture control taper screw and seating is not damaged.

Flat Spot at Small Throttle Opening.

(a) Adjust the idle speed to give smooth running just off the rich or "Hunting" condition.
(b) If the flat spot is then still evident, check that the transfer (progression) holes are clear.
(c) Check synchronisation of throttles and slow running.

Poor Acceleration.

(a) Check small cylindrical gauze filter fitted around the non-return valve body. If this is restricting fuel, the accelerator pump output will be lessened.

(b) Check that non-return valve is seating. Dirt under this valve will cause the pump to return fuel to the float chamber.

(c) Check action of the atmospheric non-return ball situated in the injector nozzle. This can be done by removing the injector nozzle and blowing into the nozzle from the outlet end. If the valve is not seating the pump capacity will be reduced and hence the amount of fuel it can discharge will also be reduced.

Difficult Starting from Cold.

This is very rarely a carburetter fault.... If the vehicle has not been used for several days the carburetter should be primed by operating the fuel pump hand lever several times.

(a) Check that choke control cable is operating both strangler valves correctly.

(b) Check fuel delivery to the float chamber.

Adjustments.

The only adjustments that may need attention are:

(a) Synchronisation of throttles and slow running adjustment.

(b) Choke control cable.

(c) Accelerator pedal adjustment.

(d) Fast idle throttle position for cold starting.

Synchronisation of Throttles and Slow Running Adjustment. (See Fig. 6.)

(Including Cars Fitted with Easidrive".)

This adjustment can only be made when the engine is at its normal running temperature. The correct procedure to follow is:—

1. Slacken the rear clamping bolt on the rear flexible coupling so that the front carburetter throttle and rear flexible coupling can move independently of the rear throttle.
2. Slacken back each slow running speed adjustment screw clear of each carburetter body abutment boss.
3. Holding the front throttle closed, rotate the front slow running speed adjustment screw clockwise until it just makes contact with the abutment on the carburetter body. The throttle can be held closed by applying finger pressure to the end of the rod protruding through the accelerator pump operating lever. This adjustment must be very carefully made and can be difficult because it is not easy to see when the throttle adjustment screw touches its abutment on the carburetter body. To overcome this a 10" length cardboard pointer can be fitted between the centre "U" of the rear coupling. This temporary pointer magnifies throttle spindle movement and makes it easy to see when the slow running speed adjustment screws contact their abutments.
4. Tighten the rear clamping bolt on the rear flexible coupling and loosen off its front clamping bolt. This will allow the rear throttle and the rear flexible coupling to move independently of the front throttle. Repeat the operation described in previous paragraphs.
5. Screw in each slow running speed adjustment screw three-quarters of a turn clockwise.
6. Tighten the rear flexible coupling front clamping bolt and ensure that both throttle stop screws still come against the carburetter body abutments when the throttles are in the closed position.
7. Gently screw in the volume control screws clockwise until light contact is made with their seatings. Then unscrew each screw one complete turn.
8. Start the engine and adjust each slow running speed adjustment screw equal amounts until the engine is running at approximately 600 r.p.m.
9. Carefully adjust each volume control screw clockwise or anti-clockwise until it gives the highest engine speed. Clockwise rotation weakens, and anti-clockwise rotation richens the slow running mixture.
10. Adjust the engine speed to approximately 600 r.p.m. by altering the slow running adjustment screws by equal amounts and if necessary make further small adjustments to the volume control screws to give even idling. Final adjustments should be made with the carburetters coupled to the air cleaner.
11. If after making these adjustments the slow running is erratic, or a "Flat Spot" is evident the following method can be used to determine which carburetter is at fault.
    With the connecting air box removed, a suitable length of cardboard tube is used to listen to each carburetter suction noise as the engine

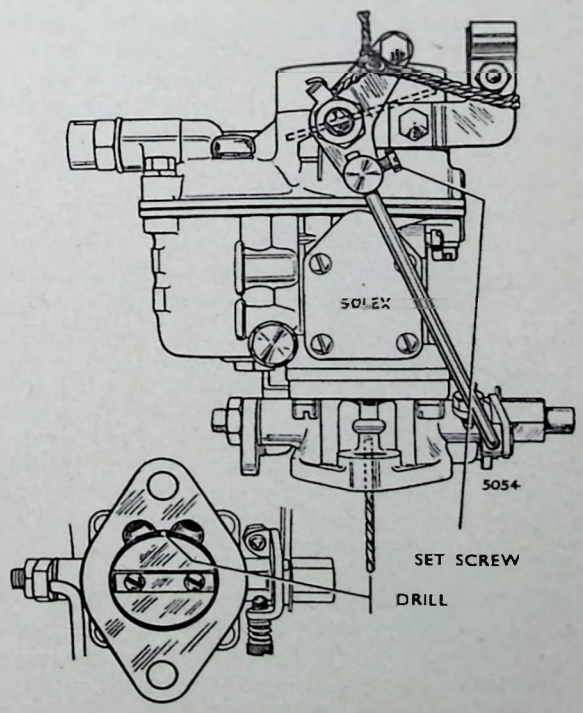


FIG. 7.—Method of making fast idle starting setting.

speed is increased to about 1,000 r.p.m. This corresponds to a very fast idling speed and brings in the usual "Progression hiss" noise. Each carburetter should give a similar sound. If they do not the rear flexible coupling rear bolt should be slackened off, and the more silent carburetter throttle opened up a little by screwing in its throttle stop screw. The rear coupling bolt is then re-tightened and another check made by listening to each carburetter suction noise.

Accelerator Pump.

The accelerator pump stroke is not adjustable on this carburetter.

Choke Control.

To Adjust.

1. Remove the air cleaner top body and the air box forming the common air feed to the two carburetters by undoing the clips and wing nut holding these parts.
2. Slacken off the two hexagon headed set screws that secure the choke operating wire to the pivots in the strangler spindle levers.
3. Pull out the choke control knob about $\frac{1}{2}$" and push it back to within $\frac{1}{8}$" of the dashboard.
4. Tighten the strangler operating wire securing screws on both strangler spindle levers, making sure that both levers are against their stops.
5. Pull the choke control fully out and check that BOTH strangler valves are fully closed. If one of the strangler valves is not properly closed, further adjustment should be made at its operating lever set screw and it is most important that both strangler valves close together.
6. The strangler valves should remain closed when the choke control is pulled out. If there is not sufficient stiffness in the operating cable to do this the inner wire should be removed and bent so as to give the required stiffness.

Accelerator Pedal Adjustment.

An adjustable rod is fitted between the accelerator shaft and the lever on the rear end of the throttle shaft. This rod should be adjusted so that full throttle opening is obtained when the accelerator pedal pad end is 1" from the floor.

Fuel Level.

The design of the float mechanism ensures complete stability of the predetermined petrol level, thus eliminating all need for routine checking. However, in the event of damage occurring to the float arm or float, this would of course seriously affect fuel level and calls for replacement action.

Fast Idle — Throttle Cold Starting Setting.

This adjustment should be made if difficult cold starting is experienced. When correct it ensures that a fast idling speed is obtained when the choke control is pulled out about $\frac{1}{2}$".

1. Remove both carburetters.
2. Tie the strangler levers in their full over position, as shown in Fig. 7 and slacken off the strangler lever connecting rod set screws.
3. Insert a drill shank of the diameter given on page 1 between the throttle edge and throttle bore, as shown in Fig. 7 and while holding the throttle in this position tighten the connecting rod set screw. This must be done on BOTH carburetters.
4. Release the strangler levers and recheck that when the strangler levers are pulled fully over the throttles are open to the positions in which the drill shank will just enter.
5. Replace carburetters and synchronise throttles as previously described.

Dismantling, Cleaning and Overhauling.

To Service in Position.

This carburetter can be dismantled with ordinary spanners and a screwdriver.

Jets and orifices must be cleaned by blowing through with CLEAN compresed air. FLOAT MUST BE REMOVED FIRST. Wire or other similar hard material must not be used as the slightest alteration to a jet size will increase the amount of fuel that it meters.

Normal cleaning of the float chamber, jets if blocked, and most passage ways can be done in the following manner without removing the carburetter from the engine:—

1. Disconnect air cleaner and fuel pipe.
2. Remove three securing screws and remove float chamber cover.
3. Lift out float and its pivot.
4. Remove main jet holder, accelerator pump jet and slow running jet (pilot jet), see Fig. 5. Also remove slow running jet (pilot jet), air bleed, injector tube assembly, air correction jet, the emulsion tube and the non-return valve with its cylindrical gauze filter.
5. Blow out the carburetter float chamber, the passage ways and the various jets with CLEAN compressed air.
6. Replace the jets and their fibre washers where fitted and the non-return valve with its cylindrical gauze filter.

To Completely Dismantle Carburetters.

When it becomes necessary to dismantle and overhaul the carburetter due to wear of the throttle spindle it is usually cheaper to fit a reconditioned carburetter.

To completely dismantle the carbuertter, the following procedure should be followed:—

1. Disconnect air cleaner, fuel pipe, throttle control, choke control cable, and distributor vacuum pipe union.
   Remove the four flange fixing nuts and lift off carburetters.
   Place a cardboard blanking flange over the inlet manifold flanges to prevent anything falling into the inlet manifold.
   Clean carburetter exterior with petrol (gasolene).

2. Remove three securing screws and remove float chamber cover.
3. Lift out float and its pivot.
4. Remove main jet holder, accelerator pump jet and slow running jet (pilot jet). See Fig. 5. Also remove slow running jet (pilot jet) air bleed, injector tube assembly, air correction jet, the emulsion tube, and the non-return valve with its cylindrical gauze filter.
5. Scribe a line across the flanges and insulating joint between the carburetter main body and throttle chamber.
   Remove four screws securing throttle chamber to main body and separate these items.
6. Remove four brass flat headed screws securing pump unit to carburetter body.
   Remove two raised headed screws securing pump cover to pump body and remove cover, pump membrane and its return spring.
7. The accelerator pump cover and arm can be left hanging on its push rod that couples it to the throttle shaft lever.
8. Remove float needle valve seat.
9. Clean all parts with petrol (gasolene) and blow through all jets and passage ways with CLEAN compressed air. Particular attention should be given to the transfer holes (progression holes) in the throttle body.

Inspection of Carburetter Parts.

1. All jet sizes should be compared to those given on page 1.
2. Check pump membrane for sign of porosity and replace if necessary.
3. Check the flange on the lower face of the throttle chamber for distortion. It should be finish flat if necessary.
4. Check slow running mixture volume control screw taper end. If bruised it must be renewed.
5. Check that the full throttle position stop screw is set to give full throttle on the front carburetter.
   There is no full throttle stop screw on the rear carburetter.

Re-assembly.

This is a reverse of the dismantling procedure. The joint between the float chamber cover and main body should be renewed together with any damaged or faulty fibre washers.

The cylindrical gauze filter used on the accelerator pump non-return valve should also be renewed if it is in any way faulty.

THE FUEL PUMP.

An A.C. mechanically operated pump is mounted on the right side of the engine near the front, and operated by an eccentric on the camshaft.

Details of Operation of the Fuel Pump. (See Fig. 8.)

As the engine camshaft revolves, an eccentric actuates the fuel pump rocker arm (A), pivoted at (B) which moves the pullrod (C), together with the diaphragm (D), downwards against spring pressure (E), thus creating a depression in the pump chamber (F). Fuel is drawn from the tank and enters at (G), passing through the filter gauze (H) and the inlet valve (J) into the pump chamber (F).

On the return stroke, pressure of the spring (E) pushes the diaphragm (D) upwards, forcing fuel from the chamber (F) through the outlet valve (K) to the outlet (L) and thence to the carburetter. When the carburetter bowl is full the float will shut the needle valve, thus preventing any flow of petrol from the pump chamber (F). This will force the diaphragm (D) downward against the spring pressure (E) and it will remain in this position until the carburetter requires further petrol and the needle valve opens. The rocker arm (A) operates the connecting link (M) by making contact at (Q) and this construction allows idling movement of the rocker arm when there is no movement of the fuel pump diaphragm.

The spring (O) keeps the rocker arm (A) in constant contact with the eccentric to eliminate noise.

A spring steel strip riveted on to the connecting link prevents the diaphragm pull rod from rattling in its socket.

The hand priming lever (N) operates a cam which bears on top of the connecting link. Lifting the priming lever will force the connecting link downwards, which in turn actuates the diaphragm pull rod.

The Filter.

The cleaning of the fuel pump gauze filter, exposed when the glass filter cover is removed, is the only item of maintenance required on the fuel pump. The filter cover is removed simply by unscrewing the retainer clip hand screw on the top of the cover and pulling aside the clip, when the cover can be lifted off. The filter gauze can now be lifted upwards from the neck of the pump, and should be washed in clean

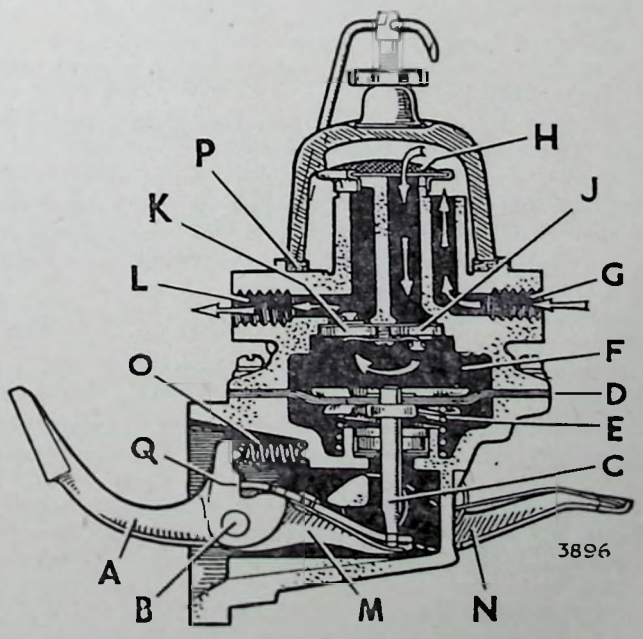


FIG. 8.—Sectional view of the fuel pump.

fuel. Refit carefully and ensure the filter is pushed fully home downwards.

When refitting the filter cover, care must be taken to see that the cork gasket around the body of the pump is intact and that it lies squarely on its seating. Whilst naturally the filter cover retaining screw must be refitted tightly to ensure an air tight joint, excessive pressure must not be applied, as this will cause rapid deterioration of the cork gasket.

Fuel Shortage at the Carburetter.

If the pump should fail to deliver fuel to the carburetter, the following points should be checked:—

That the fuel is available in the tank and that the unions in the pipe connecting the tank to the pump are tight.

That the pump filter is clean and that the cork washer below the filter cover is in good condition.

The action of the pump, proved by revolving the engine with the starter with the delivery pipe (pump to carburetter) disconnected.

Testing While on the Engine.

With the engine stopped and switched off, the pipe to the carburetter should be disconnected at the carburetter end, leaving a free outlet from the pump. The engine can then be turned over by hand when there should be a well-defined spurt of fuel at every working stroke of the pump, namely once every two revolutions of the engine.

To Remove the Fuel Pump from the Engine.

Firstly, the pipe unions should be disconnected, the two setscrews fixing the fuel pump at the engine crankcase should then be unscrewed, after which the fuel pump will come away readily, together with the packing and flange joints.

To Dismantle the Fuel Pump .

Before commencing to dismantle the pump, thoroughly clean the exterior and make a mark across the two flanges of the pump housing, as a guide when re-assembling.

Remove the six securing setscrews and separate the two halves of the main casting.

Turn the diaphragm, and pull-rod assembly through an angle of 90°, when it may be disconnected from its securing slot in the connecting link and withdrawn. Remove the diaphragm spring, oil seal spring, and oil seal washer.

Note.—Do not attempt to separate the four diaphragm layers.

Remove the rocker arm pin circlips and withdraw the pin.

The rocker arm spring, pin washers, together with the rocker arm and connecting link, may now be removed.

Withdraw the valve retainer screws from inside the upper casting and remove the retainer plate, valve assemblies, and valve retainer gasket.

To Inspect the Parts.

Thoroughly clean all parts in kerosene; those parts that comprise the valve assemblies and retainers should be washed separately from the other dirtier components.

The diaphragm assembly should be renewed if there is any sign of hardening or cracking.

Note.—If a leakage of fuel is observed from the drain hole in the base of the petrol pump body it may be assumed that the diaphragm is unserviceable.

All badly worn parts must be renewed and very little wear may be tolerated on the rocker arm pin, holes and engagement slot in the link, holes in the rocker arm, contact face of the rocker arm.

The valve assemblies cannot be dismantled but should be tested for air-tight seatings by suction and renewed where necessary.

Check the valve retaining joint very carefully for damage or distortion; it is advisable to renew this gasket after dismantling as any fault preventing correct seating of the valve assembly will greatly decrease the efficiency of the pump.

Test the diaphragm spring, although these seldom require replacement. Where necessary ensure that the replacement spring has the same identification colour and consequently the same strength as the original.

All gaskets and joints should be renewed as a matter of routine, including the oil seal round the diaphragm pull rod.

To Re-assemble the Fuel Pump.

Replace the valve retainer gasket, valves, valve retainer, and secure in position with two retaining screws.

Replace the filter gauze and cork seating gasket in position. Fit the filter cover and secure by tightening the nut on the retainer.

Assemble the link, placing washers, rocker arm and rocker arm spring in the body.

Insert the rocker arm pin through the hole in the body, at the same time engaging the packing washers, link, and the rocker arm, then spring the retaining clips into the grooves on each end of the pin.

The rocker arm pin should be a tap fit in the body, and if due to wear it has more play than this, the ends of the holes in the body may be burred over slightly.

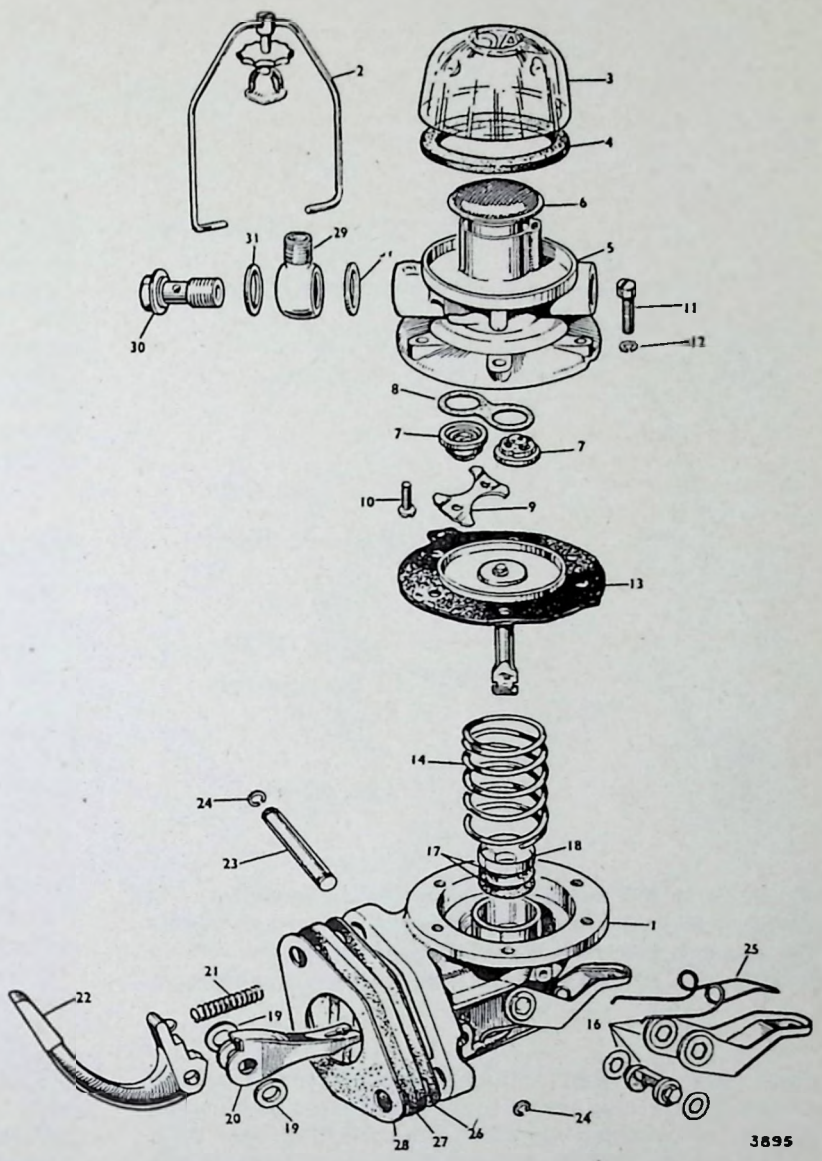
Note.—The fitting of the rocker arm pin can be simplified by first inserting a piece of .240 diameter rod through the pin hole in one side of the body far enough to engage the rocker arm washers and link, and then pushing the rocker arm pin in from the opposite side, removing the temporary rod as the pin takes up its proper position.

Place the diaphragm spring in position in the pump body. Place the diaphragm assembly over the spring (the pump rod being downwards) and centre the upper end of the spring in the lower protector washer.

Press downwards on the diaphragm, at the same time turning the assembly to the left in such a manner that the slots on the pull rod will engage the fork in the link, ultimately turning the assembly a complete quarter turn to the left, which will place the pull rod in the proper working position in the link, and at the same time permit the alignment of the holes in the diaphragm with those in the pump

FIG. 9.—Exploded view of the fuel pump.

1—Body.
2—Retainer—glass cover.
3—Glass bowl.
4—Gasket—bowl.
5—Cover.
6—Filter gauze.
7—Valve.
8—Gasket—valve.
9—Retaining plate—valve.
10—Screw—valve retainer.
11—Screw No. 10 UNF.
12—Washer, 3/16 spring.
13—Pull rod and diaphragm.
14—Spring—diaphragm.
16—Priming lever.
17—Washer—oil seal.
18—Retainer—oil seal.
19—Washer—rocker pin.
20—Link.
21—Return spring—rocker arm.
22—Rocker arm.
23—Pin—rocker arm.
24—Circlip—rocker arm pin.
25—Primer spring.
26—Joint—pump to insulator.
27—Heat insulator.
28—Joint—insulator to cylinder block.
29—Outlet union.
30—Banjo bolt.
31—Fibre washer.



body flanges. When first inserting the diaphragm assembly into the pump body, the locating "tab" on the outside of the diaphragm should be at position "A" (shown in Fig. 10). After turning the diaphragm assembly a quarter turn to the left the "tab" should be in position "B" (Fig. 10).

The sub-assemblies of the pump are now ready for fitting together, and this is carried out as follows:—

Push the rocker arm towards the pump until the diaphragm is level with the body flanges. Place the upper half of the pump into the proper position, as shown by the mark made on the flanges before dismantling.

Install the cover screws and spring washers and tighten until the heads of the screws just engage the washers.

Important.—Before finally tightening the screws, push the rocker arm towards the pump, using about a 4 inch length of tube slipped over the end of the rocker arm so as to hold the diaphragm at the bottom of its stroke. Hold in this position and tighten the screws alternately. After assembly the edges of the diaphragm should be about flush with the two clamping flanges.

Any appreciable protrusion of the diaphragm indicates incorrect fitting, in which case special care should be paid to maintaining downward pressure on the rocker arm while the diaphragm screws are finally tightened alternately and securely.

To Refit the Fuel Pump to the Engine.

Reverse the procedure outlined for removal from the engine. Ensure that the rocker arm is correctly positioned. After refitting to the engine, the pump should be run for a short time and the pipe unions and pump examined for the possibility of fuel leakage.

From the foregoing description of the operation of the pump it will be appreciated that the pressure of fuel at the carburetter is determined by the spring (E, Fig. 8), and the further this spring is compressed the greater will be the pressure. All parts of the pump and the cylinder block are machined to definite limits. It will, however, be appreciated that circumstances

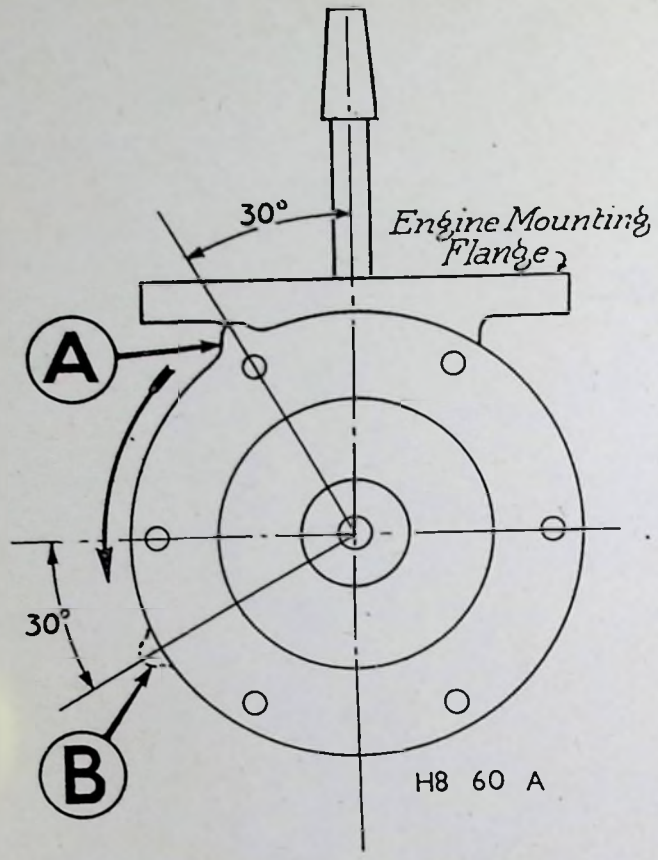


FIG. 10.—When first fitting the diaphragm to the pump body, the locating tab (A) on the diaphragm must first be in the position shown. After engaging the notches in the bottom of the pull rod, with the slot in the link, turn the diaphragm until the tab is at position (B).

might arise in which all the lower limits exist on one particular engine, with the result that the spring will be compressed on the downward stroke to a greater extent than is normal, resulting in an excess pressure at the carburetter.

Excessive Fuel Pump Pressure can be the cause of poor fuel consumption. This can be checked and, if necessary, rectified as follows:—

Disconnect the pipe to the carburetter at the pump.

A suitable pressure gauge, calibrated up to 6 p.s.i. should then be fastened to and, as near as possible, on the same level with the outlet on the pump.

Rotate the engine on the starter, and a reading of 1½ to 2½ p.s.i. should be recorded on the gauge.

To remedy excessive pressure, additional packings should be fitted between the pump and the cylinder block. As a general guide, it may be stated that each additional packing reduces the pressure by ½ p.s.i.

Important Note.—It must be clearly understood that the actual mounting on the engine affects the output pressure of the pump and thus these tests cannot be carried out unless the pump is mounted in its normal position. The use of jigs or other fixtures for testing A.C. pumps will not necessarily give the same results.

AIR CLEANER AND SILENCER.

Oil Bath Air Cleaner.

The intervals at which the A.C. oil bath air cleaner needs to be serviced will vary according to the conditions under which the car is operating.

For town work or areas where there are good roads, every 3,000 miles can be taken as a guide, although in territories where the roads are bad and dust prevalent, servicing should be carried out more frequently.

Procedure is as follows:—

To Clean and Re-Oil Cleaner.

Undo the top clip to release flexible hose connecting the air cleaner top to the carburetter.

Undo the wing nut in centre of air cleaner and dismantle.

Wash the element in clean paraffin (kerosene) and blow dry with airline or allow to drain thoroughly. It is not necessary to re-oil as this is done automatically by the passage of air when the engine is running.

Clean out the oil bath and refill with clean engine oil to the level mark. DO NOT OVERFILL.

Re-assemble filter element, refit air cleaner to engine and tighten up flexible hose clip at carburetter connection.

SECTION E

CLUTCH

Specifications

Make	Borg and Beck.
Type	Single dry plate.
Model	8 inch.
Driven plate:	
Type	Flexible hub.
Diameter	8 inches.
Operation	Hydraulic.
Thrust bearing	MY3D carbon ring.
Free movement of pedal	$\frac{7}{8}$ equivalent to $\frac{3}{32}$ at withdrawal lever outer end.
Pressure springs:	
Number	6.
Colour	Cream.
Driven plate thickness	.285.
Release lever height	1.815.
Master cylinder bore	$\frac{3}{4}$ inch.
Slave cylinder bore	1.00.

A single dry plate type clutch is fitted incorporating a copper impregnated graphite (MY3D) release bearing which is self-lubricating. No attention in the way of lubrication to the release bearing is necessary.

Every 2,000 miles the clutch pedal free movement should be checked and the pivot points of the withdrawal linkage oiled.

To Remove and Refit the Release Bearing.

Disconnect the pipe to the clutch operating cylinder.

Remove the gearbox, complete with the bell-housing.

Remove the spring clips securing the release bearing to the withdrawal lever and withdraw the release bearing.

When re-assembling always renew the spring clips.

Re-assembly is a direct reversal of the above operations.

Bleed the system after refitting the pipe.

To Remove and Refit the Clutch Driven Plate.

Disconnect the pipe to the operating cylinder.

Remove the gearbox, complete with the bell-housing.

Remove the setscrews securing the clutch cover to the flywheel. It is important that these should be slackened off evenly in order to prevent undue strain being applied to the cover at any one point.

Remove the clutch assembly, together with the driven plate.

If a new driven plate is to be fitted, this should first be set up on an ordinary mandrel of suitable size to locate in the hub of the plate and the whole should be run between centres on a lathe to check for true running as indicated by a clock gauge. The run-out should not exceed .010. Correction can be made by careful setting of the clutch plate until the run-out has been eliminated.

It is important to note that the forked tool for setting the driven plate must be 1 inch in width, and it must be placed centrally over the rivet nearest to the part of the driven plate requiring setting, otherwise damage to the segments of the plate may result. Suitable dimensions for making up this tool are given in Fig. 2.

Note.—It is essential that the driven plate hub internal splines should not be assembled dry. For this

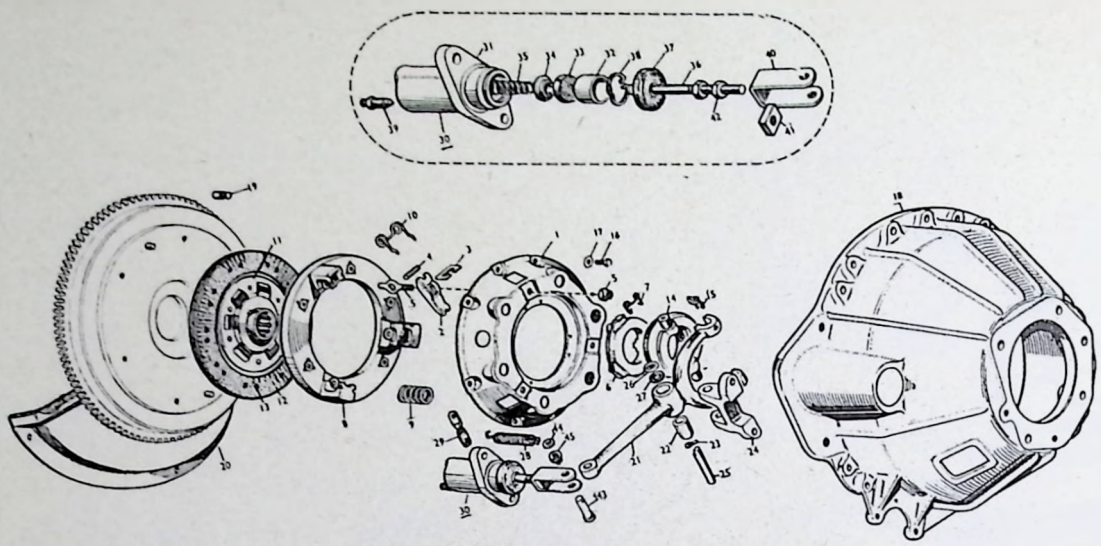


FIG. 1.—Exploded view of the clutch and slave cylinder.

1—Pressure plate cover.
2—Release lever.
3—Release lever wedge.
4—Release lever pivot pin.
5—Eyebolt and nut.
6—Thrust plate (release bearing).
7—Thrust plate spring clips.
8—Pressure plate.
9—Pressure plate springs.
10—Release lever spring (anti-rattle).
11—Driven plate assembly.
12—Driven plate facing.
13—Facing rivets.
14—Release bearing.
15—Retainer (release bearing).
16—Setscrews.
17—Spring washer.
18—Bell housing.
19—Dowel.
20—Cover plate.
21—Withdrawal lever.
22—Bushing.
23—Waved washer.
24—Pivot bracket.
25—Pivot pin.
26—Spacer.
27—Seal.
28—Return spring.
29—Bracket.
30—Slave cylinder assembly.
31—Slave cylinder.
32—Piston.
33—Cup.
34—Cup filler.
35—Return spring.
36—Pushrod.
37—Rubber boot.
38—Circlip.
39—Bleeder.
40—Clevis.
41—Clevis nut.
42—Locknut.
43—Clevis pin.
44—Washer.
45—Spring washer.

reason a small amount of waterproof grease should be applied. This waterproof grease is white.

Place the driven plate in position with a suitable mandrel fitted through the hub of the plate, so that it may be located correctly when the clutch cover is fitted. **The smaller boss of the driven plate hub faces towards the flywheel.**

This procedure is most important, otherwise it will be impossible to enter the gearbox primary shaft through the clutch plate into the spigot bearing. A gearbox stemwheel forms an ideal mandrel for this purpose.

Enter the clutch cover on the dowels.

Tighten the six securing setscrews evenly.

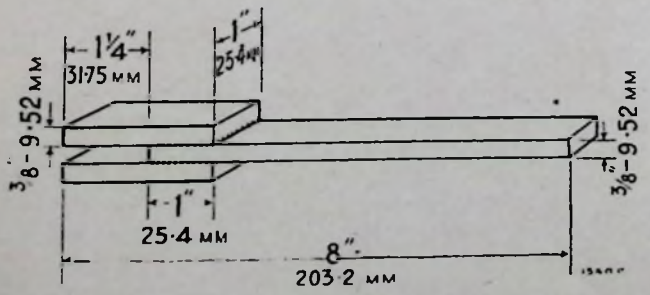


FIG. 2.—Suggested tool for setting the driven plate.

Refit the gearbox, complete with the bellhousing.

Note.—On a new replacement clutch assembly it will be found that there are three small L-shaped "keepers" between the release levers and the clutch cover. These are painted red and are fitted to enable a clutch unit to be fitted to a flywheel without the necessity of compressing the springs in the cover into position by means of the fixing bolts. The L-shaped pieces should be removed and discarded as the fixing bolts are finally tightened, when it will be found that the L-pieces are freed. Do not allow them to fall into the clutch cover.

Hydraulic Operation of the Withdrawal Mechanism. Adjustment.

The only external adjustment is to the operating piston rod attached to the clutch withdrawal lever. Adjustment between the pedal and master cylinder is pre-set and is not provided for in service.

Adjustment, when necessary, should be effected by slackening the locknut at the back of the fork on the withdrawal lever outer end, and turning the piston rod (Fig 3). Free movement at the outer end of the withdrawal lever should be about $\frac{3}{32}$ inch.

The Master Cylinder.

Note.—A groove is formed round the edge of the master cylinder outlet plug (see item 4 in Fig. 4). This identifies it from the brake master cylinder, which has no groove. Clutch and brake master cylinders are not interchangeable, owing to the fact that the clutch master cylinder has no valve.

Description.

This unit incorporates a fluid reservoir and a master cylinder. Directly in front of the main rubber cup, when the system is at rest, is a by-pass port which ensures that the system is maintained full of fluid at all times, and allows full compensation for expansion or contraction of the fluid due to changes of temperature. It also serves to release additional fluid drawn into the cylinder from the annular space formed by the reduced skirt of the piston, through the small holes in the piston, after each application. If this additional fluid is not released to the reservoir through the by-pass port, due either to the hole being covered by the main cup as a result of incorrect pedal adjustment, or to the holes being choked by foreign matter, pressure will build up in the system. In order that the rubber cup shall not tend to be drawn into the holes in the piston head, a piston washer is interposed between the two parts; it is important that this washer be assembled as shown in figure 4 (inset).

To Remove the Master Cylinder.

Disconnect the pressure pipe from the cylinder barrel, and the clevis pin from the clutch pedal. Remove the fixing bolts and detach the cylinder and pushrod. Unscrew the filler cap and drain the fluid into a clean container.

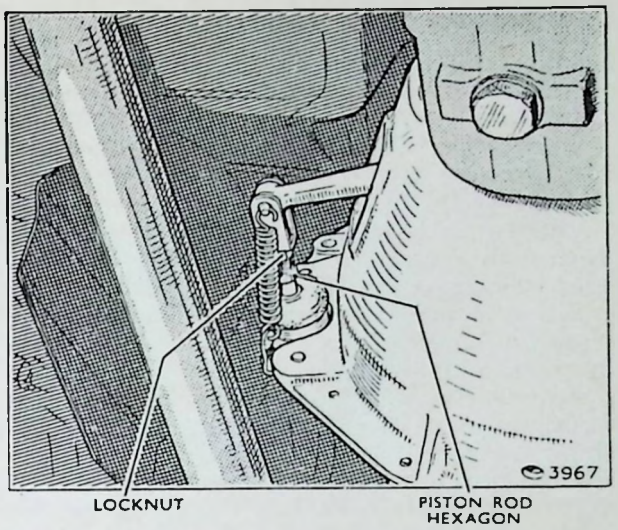
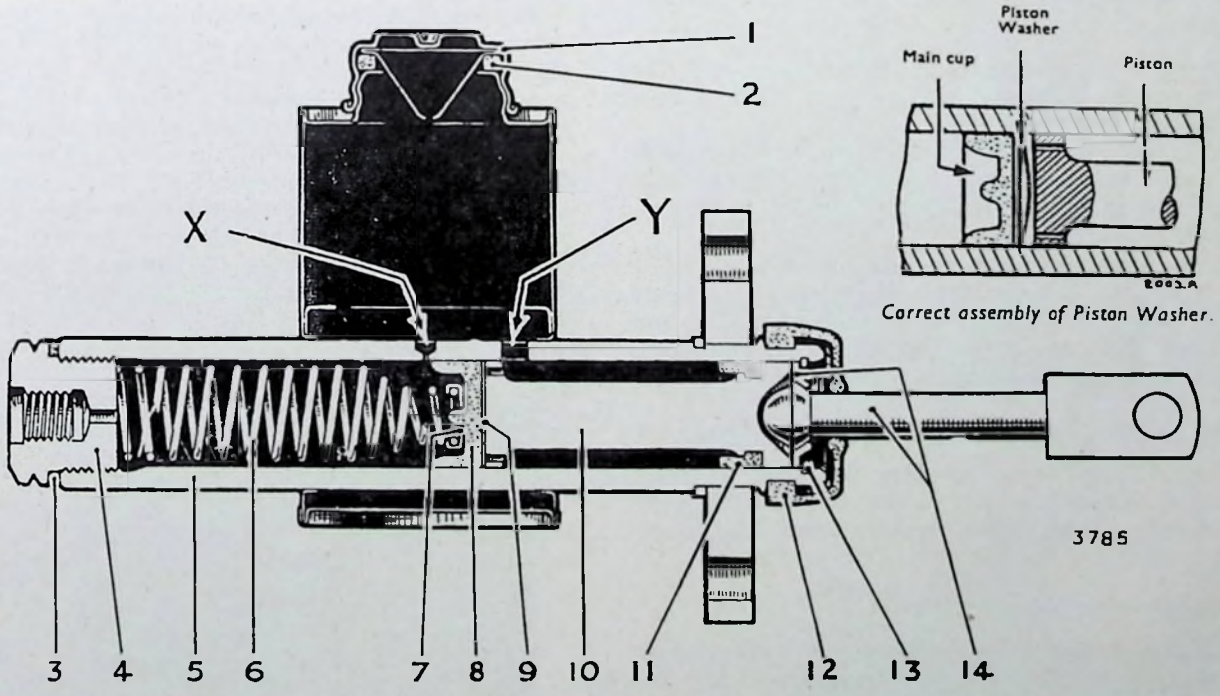


FIG. 3.—Pedal adjustment.

To Dismantle the Master Cylinder.

Push the piston down the bore of the cylinder and remove the circlip. Withdraw the piston, piston washer, rubber cup, retainer and return spring. Using only the fingers to prevent damage, remove the secondary cup by stretching it over the end flange of the piston.



Correct assembly of Piston Washer.

FIG. 4.—Master cylinder, sectional view.

1—Filler cup.
2—Washer.
3—Outlet plug washer.
4—End plug.
5—Cylinder.
6—Return spring.
7—Spring retainer.
8—Main cup.
9—Piston washer.
10—Piston.
11—Secondary cup.
12—Rubber boot.
13—Stop circlip.
14—Pushrod.
X—By-pass port.
Y—Main port.

To Assemble the Master Cylinder.

Fit the secondary cup on the piston so that the lip of the cup faces the piston head and gently work the cup round the groove with the fingers to ensure that it is properly seated. Assemble the retainer on the smaller end of the return spring and insert the assembly into the cylinder. Insert the main cup into the cylinder, lip foremost, taking care not to damage or turn back the lip of the cup; follow up with the piston washer, paying particular attention to the illustration showing the method of assembly. Insert the pushrod and press the piston into the cylinder, taking care not to damage or turn back the lip of the secondary cup. Fit the circlip ensuring that it beds evenly in its groove and that the collar in the pushrod is retained by the circlip.

Fill the reservoir with clean Lockheed brake fluid and test the master cylinder by pushing the piston inwards and allowing it to return unassisted; after a few applications, fluid should flow from the outlet connection in the cylinder head.

To Refit the Master Cylinder.

Fit the boot on the cylinder so that the vent hole in the boot will be at the bottom when the cylinder is mounted on the vehicle. If the boot is damaged or perished, a new boot should be fitted. Attach the master cylinder to the mounting bracket. Check the pedal adjustment, fill with fluid, bleed the system and check for leakage by applying a firm pressure to the pedal and inspecting the "line" and connections.

The Slave Cylinder.
Description.

The slave or operating cylinder works on similar principles to the hydraulic brake wheel cylinder and consists of the following parts:—

A main body or cylinder assembly inside which operate a piston, rubber cup, cup filler, return spring, operating rod to withdrawal lever, rubber boot and piston-retaining circlip.

A bleeder screw provides the only means of bleeding the hydraulic system. The operating rod affords the clutch pedal adjustment by screwing it in or out of the rectangular nut which is housed in the withdrawal lever jaw. This linkage is locked by the nut.

To Remove the Slave Cylinder from the Car.

Disconnect the pipe at the slave cylinder. Unhook the return spring at the end of the withdrawal lever and remove the slave cylinder fixing screws. The pushrod and boot may be left attached to the car.

To Dismantle the Slave Cylinder.

Remove the circlip from the bore and apply a low air pressure to the fluid connection to expel the internal parts.

To Assemble the Slave Cylinder.

Fit the spring in the cup filler and insert these parts, spring innermost, into the bore of the body. Follow up with the cup lip leading, ensuring that the lip is not turned back or buckled, then insert the piston, flat face innermost, and fit the circlip.

To Refit the Slave Cylinder.

Offer up the slave cylinder to its mounting, with the pushrod entering the bore and fit the fixing screws. Stretch the large end of the boot on to the body.

Bleed the system.

To Bleed the System.

As there is no check valve fitted in the clutch master cylinder, the normal bleeding procedure is not applicable; the following is the recommended method:—

Fill the supply tank with brake fluid and keep it at least a quarter full throughout the operation. If this is not done, air will be drawn in, necessitating a fresh start.

Attach a rubber tube to the bleeder screw on the slave cylinder, allowing the free end to be submerged in a little brake fluid in a clean glass jar.

Slacken the bleeder screw and depress the clutch pedal slowly; tighten the screw before the pedal reaches the end of its stroke and allow the pedal to return unassisted.

Repeat the operation until air bubbles cease to appear from the end of the tube in the jar.

Pressure Plate Assembly.

Further dismantling operations involve dismantling of the internal mechanism of the clutch, but before doing so, it is important that proper equipment is available, and that the operators are conversant with the correct method of final adjustment on re-assembly.

For such work the Churchill Clutch Assembly Fixture No. 99 is recommended; it is simple and speedy to operate whilst at the same time it ensures maximum accuracy. The adaptors together with the appropriate code card (use numbers 2 and 5), the gauge finger, the pillar and the actuator are shown in Fig. 5.

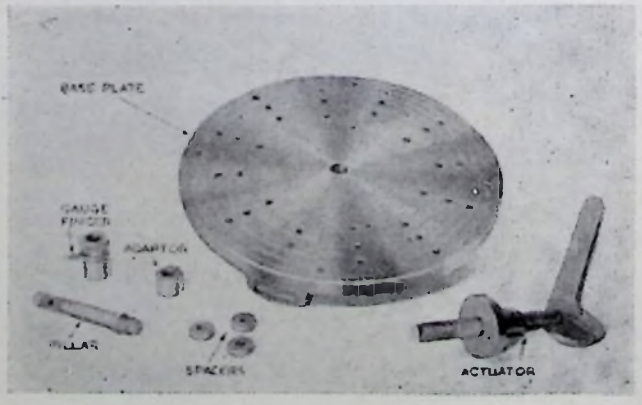


FIG. 5.—Churchill finger adjustment fixture.

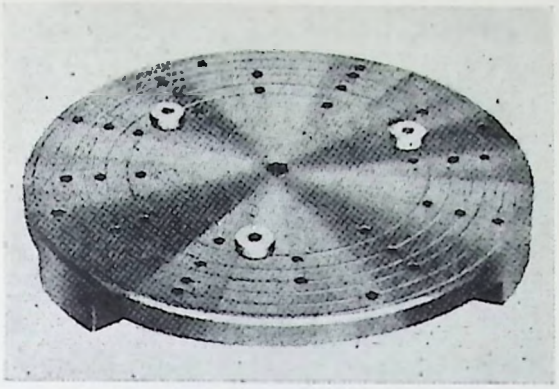


FIG. 6.

To Dismantle.

Remove the gearbox complete with bell housing. Remove clutch assembly from flywheel.

Note.—Before proceeding further, it is advisable to mark the end of eyebolt, adjusting nuts, cover and lugs of the pressure plate, so that they may be re-assembled in the same relative positions should new parts be unnecessary.

Rest the base plate on a flat surface, wipe it clean and place the spacers upon it in the positions quoted on the code cards (Fig. 6).

Place the clutch on the spacers, aligning it with the appropriate tapped holes in the base, arranging it so that the release levers are as near to the spacers as possible.

Screw the actuator into the centre hole in the base plate and press the handle down to clamp the clutch. Then screw the set bolts provided firmly into the tapped holes in the base plate using the speed brace; remove the actuator (Fig. 7).

Remove the adjusting nuts and gradually unscrew the setbolts to relieve the load of the thrust springs. Lift the cover off the clutch and carry out whatever additional dismantling may be desired.

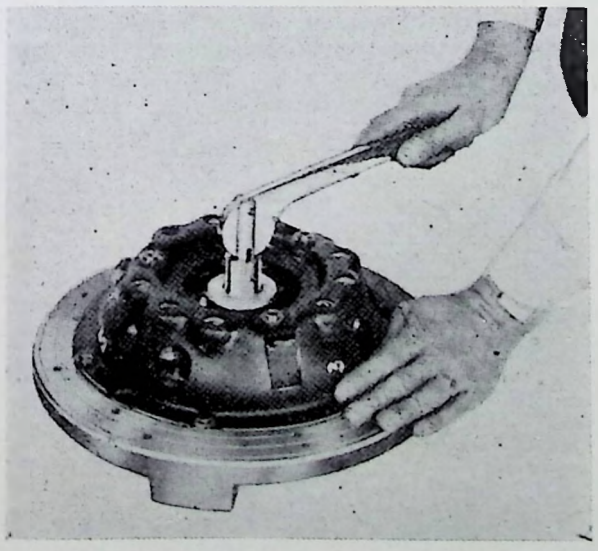


FIG. 7.

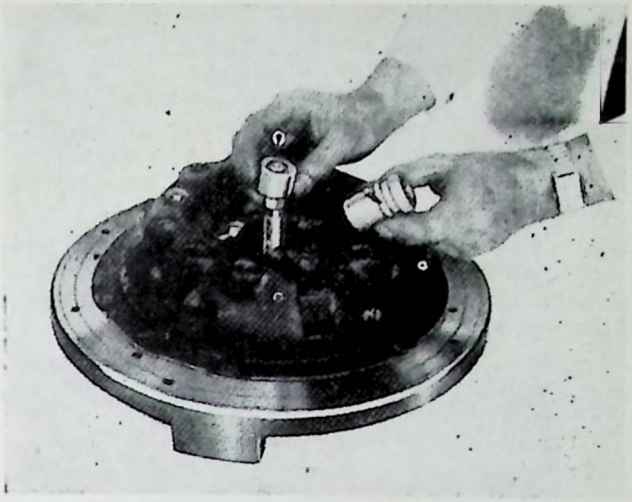


FIG. 8.

To Re-assemble and Adjust.

After carrying out the necessary servicing of the clutch components, care must be taken to ensure that the anti-rattle springs are in place between the levers and the cover. Also that the adjusting nuts, eyebolts, pressure plate lugs and cover are all assembled in accordance with the identification marks made on them prior to dismantling. This is to ensure correct adjustment and balance if none of the parts have had to be renewed. Then re-assemble the parts on the clutch pressure plate, place the cover upon it and transfer the assembly to the base plate resting on the spacers and aligned correctly.

Carefully bolt the cover to the base plate and screw the adjusting nuts on to the eyebolts until flush with the top of the latter.

Screw the actuator into the base plate (Fig. 7) and pump the handle a dozen times to settle the clutch mechanism. Remove the actuator.

Screw the pillar firmly into the base and place upon it the appropriate adaptor, recessed face downwards, and the gauge finger (Fig. 8:).

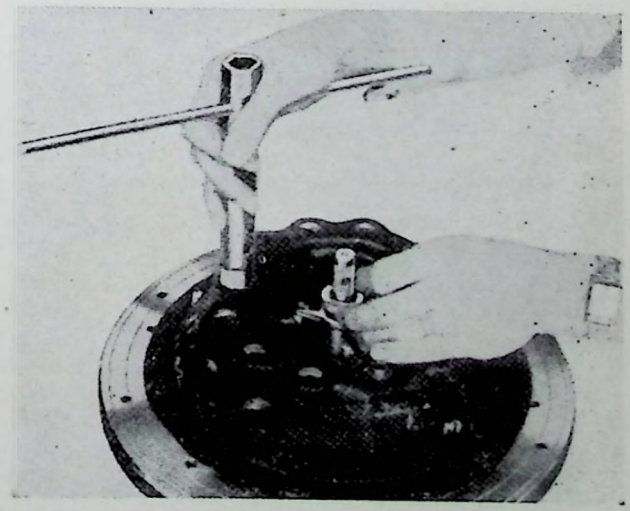


FIG. 9.

Turn the adjusting nuts until the finger just touches the release levers, pressing downwards on the finger assembly to ensure that it is bearing squarely on the adaptor (Fig. 9). Remove the finger, adaptor and pillar, replace the actuator and operate the clutch a further dozen times. Replace the pillar and check the lever setting, making any final correction.

Finally, lock the adjusting nuts. The cylindrical portion of the nut must be peened into the slot in the eyebolt, using a blunt chisel and hammer as described in detail below.

The lever tip height is 1.815" (46.1 mm.) with a .285" (7.24 mm.) gauge plate. VLC Code Numbers 2 and 6.

Staking Locknuts.

To provide for variation in manufacture an individual adjustment is provided for locating each release lever, but the adjusting nut is positively locked by staking, and should never be disturbed unless the clutch is dismantled for replacement of parts.

The adjusting nuts are locked by staking the top of each nut into the slot provided in the eyebolt. Use a blunt cross-cut chisel and give a light angular blow just sufficient to ensure that metal is peened into the slot, preventing the nut from turning. Restaking used nuts may not give a satisfactory lock, for this reason it is advisable to use new nuts and eyebolts.

Clutch Helper Device. (See Fig. 10.)

On Series IIIA cars a clutch helper device is fitted. This consists of an over-centre spring mounted between the pedal and the pedal stanchion. On the pedal it is mounted at a point below the pedal fulcrum. On the pedal stanchion it is attached to a small bracket which is adjustable for position.

This bracket must always be positioned so that the axis of the spring passes .2" to .25" behind the pedal fulcrum ,when the pedal is released and rests against a $\frac{3}{8}$" diameter pin inserted in the hole (D) in the pedal stanchion.

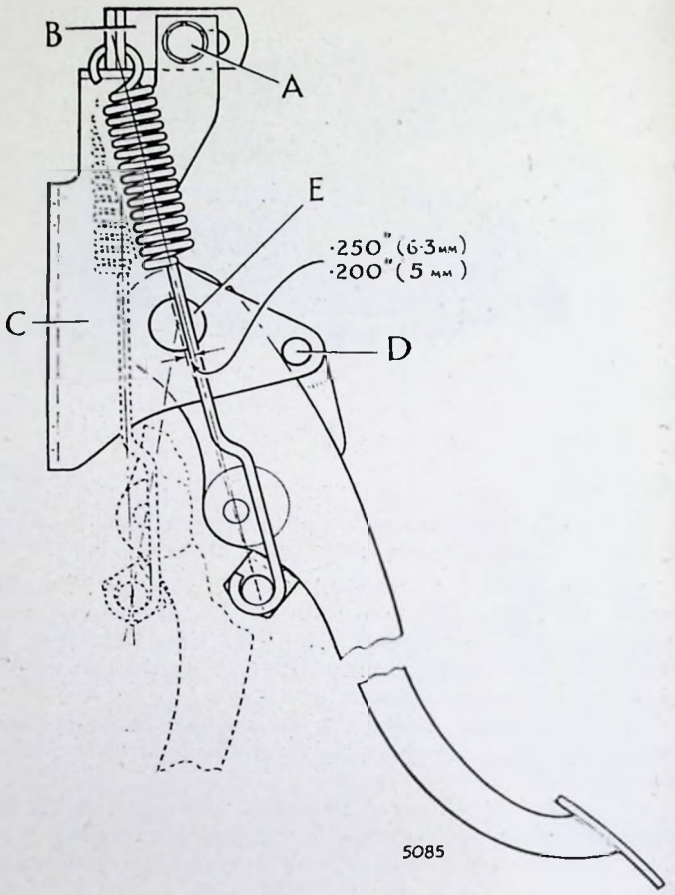


FIG. 10.—Clutch helper assembly, showing required adjustment. (Series IIIA.)

To Adjust Clutch Helper Device.

Slacken off the bolt (A) securing the upper spring mounting bracket (B) to the pedal stanchion (C). Insert a $\frac{3}{8}$" (9.5 mm.) diameter pin in the hole D in the pedal stanchion.

Slide the bracket backwards or forwards as appropriate in order to achieve .2" to .25" offset of the spring axis to the rear of the pedal fulcrum (E) with the pedal butting the $\frac{3}{8}$" diameter pin.

SECTION F

GEARBOX AND OVERDRIVE

Specifications

Type			4-speed and reverse — with baulking ring synchromesh.
Number of forward speeds			4.
Synchromesh			Top, 3rd and 2nd.
Stemwheel bearing			Ball bearing.
Mainshaft bearings			Front spigot—needle roller. Rear—ball bearing.
Layshaft bearings			Needle roller.
Reverse gear bearings			Phosphor bronze bush.
Stemwheel spigot bearing type			Oilite bush.
Gearbox mounting			In unit with engine.
Combined dipstick and filler			Accessible through floor.
Oil capacity			$2\frac{3}{4}$ pints.

Gearbox ratios:	Series I-II	Series IIA-III	Series IIIA
Top	1.00 : 1	1.00 : 1	1.00 : 1
Third	1.491 : 1	1.491 : 1	1.392 : 1
Second	2.471 : 1	2.471 : 1	2.141 : 1
First	3.567 : 1	3.187 : 1	3.346 : 1
Reverse	4.757 : 1	4.037 : 1	4.239 : 1

Layshaft end float		.006 to .008.
Adjustment of layshaft		Selective assembly to tolerance — .006 to .008.

To Remove and Refit the Gearbox.

To remove the gearbox, the rear end of the engine must be lowered. To do this proceed as follows:—

Place the car on a lift or over a pit.

Drain the radiator.

Undo the clip securing the radiator top hose and disconnect the hose.

Disconnect the negative lead from the battery.

Remove the rocker cover. (It may be necessary to remove the rocker shaft complete if a heater is fitted.)

Disconnect the accelerator control linkage.

Remove both the rear lifting brackets.

Disconnect the exhaust flange from the manifold.

Disconnect the exhaust hanger bracket at the propeller shaft safety strap and remove the strap.

Remove the propeller shaft rear coupling bolts, disconnect the coupling and remove the shaft rearwards off the reverse spline.

Jack up the engine at the rear.

Remove the bolts securing the engine rear mounting bracket to the frame.

Disconnect the speedometer cable.

Disconnect the rod from the external change speed lever on the countershaft below the steering column.

Remove the centre floor cover-plate and disconnect the selector cable trunnion through the floor.

Remove the selector cable complete, to avoid kinking.

Remove the bolt and nut securing the engine tie-bar at the bellhousing.

Remove the nuts and washers securing the tie-bar front fixing and remove the tie-bar.

Disconnect the hydraulic clutch pipe.

Disconnect the starter cable and remove the starter motor.

Lower the rear of the engine.

Remove the nuts and bolts securing the bellhousing.

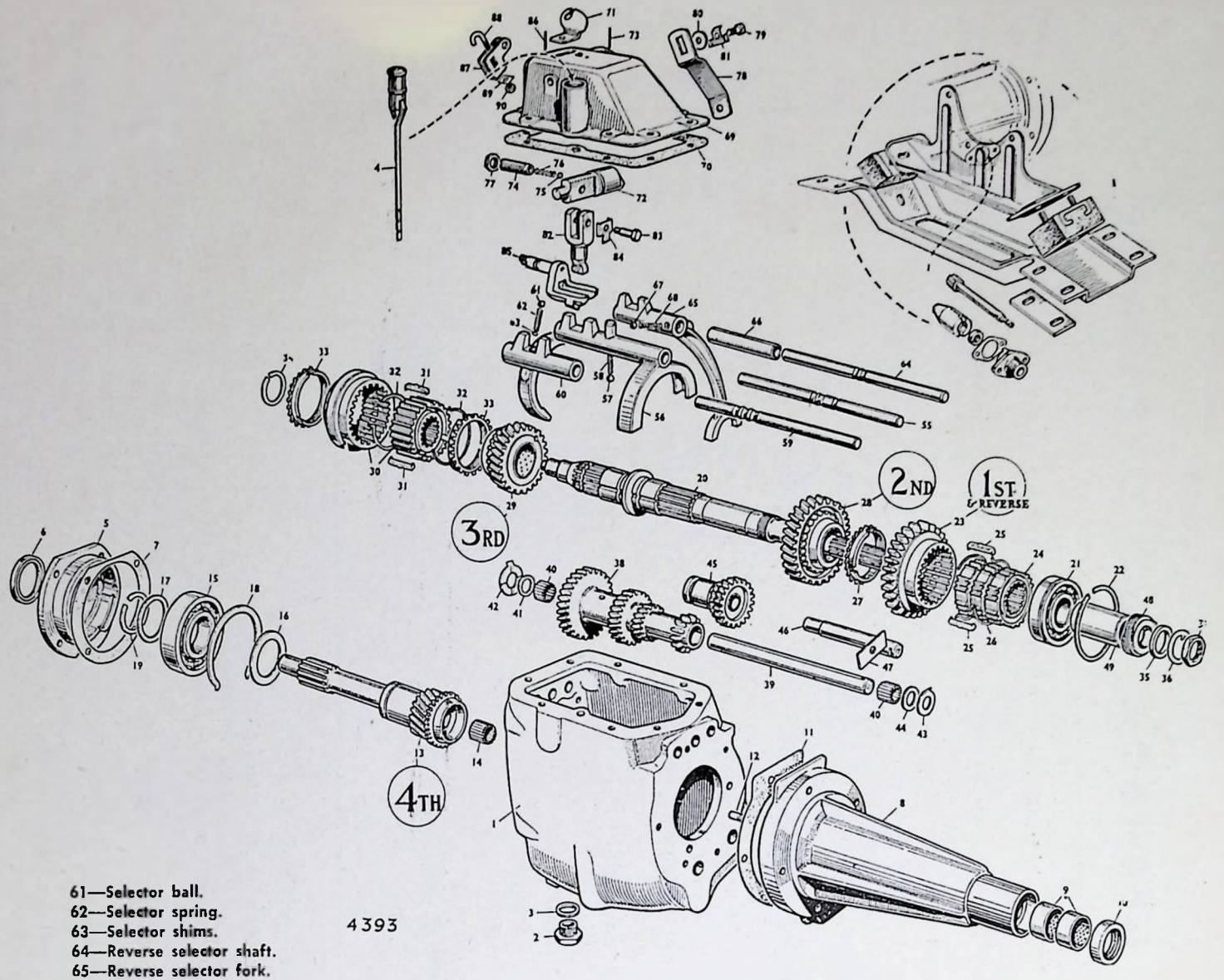
Remove the gearbox and bellhousing unit rearwards and downwards.

Reverse this procedure for refitting.

Check the oil level and linkage adjustment.

Note.—Do not tilt the gearbox when removing or refitting, as a great strain is thus imposed on the clutch driven plate.

1—Gearbox case.
2—Drain plug.
3—Drain plug seal.
4—Dipstick.
5—Front cover.
6—Front cover oil seal.
7—Front cover gasket.
8—Rear cover.
9—Rear cover bushing.
10—Rear cover oil seal.
11—Rear cover paper joint.
12—Rear cover stud.
13—Stemwheel.
14—Needle bearing.
15—Stemwheel bearing.
16—Bearing shield.
17—Abutment washer.
18—Bearing circlip.
19—Stemwheel circlip.
20—Mainshaft.
21—Mainshaft bearing.
22—Bearing circlip.
23—First speed wheel.
24—First speed hub.
25—Second speed shift plate.
26—Synchro circlip.
27—Second speed baulk ring.
28—Second speed wheel.
29—Third speed wheel.
30—Third and fourth speed hub and sleeve.
31—Third and fourth speed shift plate.
32—Synchro circlip.
33—Third and fourth speed baulk ring.
34—Mainshaft circlip.
35—Abutment washer.
36—Lockplate.
37—Nut.
38—Laygear cluster.
39—Laygear spindle.
40—Needle bearing.
41—Spacer.
42—Thrust washer.
43—Thrust washer.
44—Spacer.
45—Reverse wheel.
46—Reverse wheel spindle.
47—Locating plate.
48—Speedo drive worm.
49—Distance piece.
50—Speedo driven gear.
55—First and second selector shaft.
56—First and second selector fork.
57—Selector ball.
58—Selector spring.
59—Third and fourth selector shaft.
60—Third and fourth selector fork.



61—Selector ball.
62—Selector spring.
63—Selector shims.
64—Reverse selector shaft.
65—Reverse selector fork.
66—Distance piece.
67—Selector ball.
68—Selector spring.
69—Main cover.
70—Main cover paper joint.
71—Bracket.
72—Change speed lever shaft.
73—Locating pin.
74—Screwed thimble.
75—Detent ball.
76—Thimble spring.
77—Thimble locknut.
78—Gearshift lever (external).
79—Gearshift lever bolt.
80—Gearshift lever washer.
81—Gearshift lever lockwasher
82—Gearchange lever (internal).
83—Setscrew.
84—Lockwasher.
85—Selector safety latch.
86—Locating pin.
87—Selector lever (external).
88—Lockbolt.
89—Lockwasher.
90—Nut.

FIG. 1.—Exploded view of the gearbox.

Inset: Crossmember and rear mountings assembly and speedometer drive assembly.

To Remove and Refit the Main Cover.

Remove the oil level dipstick.

Remove the gearbox cover bolts and lift off the main cover without damaging the paper joint.

Refitting is a reversal of the above, taking care to ensure that the internal change speed lever and its selector safety latch engage in the selector fork gaps.

Before finally tightening the cover securing bolts, position the main cover by tapping its edges with a mallet, in order to obtain unrestricted "swing" of the selector safety latch across the selector fork gaps.

To Dismantle and Re-assemble the Main Cover (See Fig. 1.)

(Do not dismantle unless known to be faulty in operation.)

Undo the lockwasher and remove the bolt and washer securing the external gearshift lever (78). Undo the lockwasher and slacken the nut, releasing the external selector lever (87).

Undo the lockwasher on the internal gearchange lever (82); remove the setscrew, releasing the lever.

At this stage special attention should be paid to the detent mechanism comprising items 74 to 77, which has two functions: first to provide a detent to locate "neutral" position of the shaft (72), and secondly, by virtue of the fact that the screwed thimble (74) is bored eccentrically where it contains the spring controlling the detent ball. The operating position of the shaft (72) can be adjusted axially to a limited degree by turning the thimble by means of its slotted head. This axial adjustment is provided so that initial adjustments can be made in manufacture only. **Neither of these adjustments should be disturbed in service operations.**

Remove the locating pin (73) by means of a punch and push out the change speed lever shaft from inside. It will be obvious that the ball and spring will then be released into the bore in the cover. **Take care that these items are not lost.**

Drive out the pin (86) and push the selector shaft and lever into the cover.

Refitting is a reversal of the above, but care must be taken when tightening the bolt (83) securing the change speed lever (internal) (82) to ensure that the bolt is not over-tightened, and that the change speed lever is free to "swing" on its shaft. The lockwasher must be securely fixed around the flats of the bolt head. Also, the re-assembly of items 75 and 76 must be by inserting through the bore in the cover for the shaft (72). **Do not dismantle items 74 and 77.**

After replacing the locating pins peen over both ends of the holes, using a suitable punch.

To Remove the Clutch Bellhousing from the Gearbox.

Extract the springs securing the clutch release bearing.

Remove the release bearing assembly.

Remove the bolts and washers securing the withdrawal lever bracket to the bellhousing and extract the withdrawal lever.

Remove the bolts and washers securing the bellhousing to the gearbox.

Remove the bellhousing from the gearbox spigot.

Tools for Dismantling and Re-assembling the Gearbox (Less the Cover Assembly).

The dismantling and re-assembling of the gearbox will be simplified by the use of the following tools, their uses being fully described in the ensuing instructions.

The first two tools can be made up to the dimensions given.

1. Dummy layshaft spindle $\frac{3}{4}$ inch diameter x $6\frac{1}{2}$ inches long — made up.
2. Dummy selector shaft $\frac{7}{16}$ inch diameter x 2 inches.
3. Selector shaft loading tester clamp. (Churchill No. R.G.62 or any suitable clamp to attach to the end of the selector shaft).

To Remove the Rear Cover Assembly.

Remove the speedometer pinion and bush.

Remove the five bolts and washers (three short and two long) securing the rear cover to the casing and remove the cover.

Remove the paper joint.

To Remove and Refit the Selector Shafts and Forks.

It is imperative that these are removed rearwards only.

Carefully push out the reverse selector shaft. Note the distance piece at the rear of the selector fork.

Carefully push out the first and second speed selector shaft, at the same time entering a short dummy shaft, to be made up from $\frac{7}{16}$ inch mild steel bar 2 inches long, in order to secure the ball and spring against dropping into the casing.

Remove the first and second selector shaft.

The distance from the neutral groove to the first speed groove is much greater than that from neutral to the second speed groove.

Remove the third and fourth selector shaft.

Remove the reverse selector fork.

Remove the first and second selector fork.

Remove third and fourth selector fork, taking care of the ball, spring and shims, if the latter are fitted.

Note.

On Series IIIA cars the above procedure is changed in that the 3rd and 4th speed selector must be removed before the 1st and 2nd speed selector can be removed.

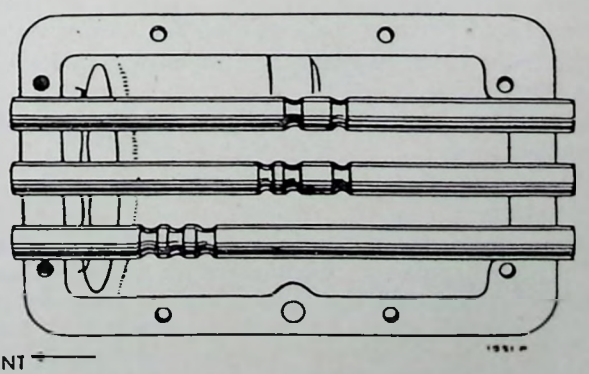


FIG. 2.—Arrangement of the selector shafts.

When refitting the 3rd and 4th speed selector shaft, care should be taken that it is installed with the detent grooves offset towards the rear of the gearbox.

The amount of offset is only .084" and, therefore, particular attention is necessary.

Later models have the rear plain portion of the shaft marked with a groove.

With the above exception, refitting the selector shafts and forks is a reversal of the removal procedure.

Adjustment of the Axial Load Between 3rd and 4th Selector Shaft and Fork:

This operation should be carried out before assembling the 3rd and 4th speed selector shaft and fork into the gearbox: proceed as follows:—

Grip the 3rd and 4th speed selector fork in a vice; insert shim/s, spring and ball, then the selector shaft, depressing the ball by inserting a punch. **The axial load necessary to move the selector shaft groove across the ball in the fork should be 25 to 30 lbs.** This may be tested by means of a suitable spring balance, attached to the end of the selector shaft by a hand vice or the Churchill selector shaft loading tester V.L.C. No. R.G.62. Adjust the axial load to the above figure by addition or removal of shims. As it will be necessary to detach the selector shaft from the fork in order to assemble to the gearbox it will be necessary to retain the adjusted ball and spring in the fork by means of a dummy selector shaft, as previously described.

To Remove the Front Cover Assembly.

The front cover assembly can only be withdrawn after the layshaft cluster has been lowered into the bottom of the gearbox casing.

Remove the rear cover as previously described.

Remove the four securing setscrews from the front cover.

Remove the setscrew and washer securing the lockplate.

Remove the lockplate by sliding it downwards.

Displace the layshaft by entering a dummy layshaft from the front, pushing it rearwards until clear of the fixed thrust washer so lowering the layshaft cluster assembly to the bottom of the casing.

Note.—It is essential that the layshaft be removed and replaced through the rear of the casing only.

The front cover assembly should now be withdrawn from the casing.

Do not lose the needle rollers from the mainshaft spigot bearing.

Remove the fourth speed baulking ring from the synchro-hub.

Note.—In order to maintain efficient functioning of the synchronising mechanism it is advisable to correlate each baulk ring to its mating cone by some form of identification, e.g., using a sharp instrument, scribe in a prominent position the numbers 2, 3 and 4, indicating second, third and fourth speeds.

To Dismantle and Re-assemble the Front Cover and Stemwheel.

Remove the circlip securing the bearing in the front cover.

Press the stemwheel assembly, complete with bearing, out of the front cover.

Remove the circlip securing the bearing and abutment washer to the stemwheel.

Press the bearing off the stemwheel.

Remove the bearing shield. (Do not omit this on re-assembly).

Remove the oil seal. (This is a press fit in the cover).

Re-assembly of the front cover assembly is a reversal of the preceding instructions, with particular attention to the following points:—

The circlip securing the bearing to the stemwheel must always be renewed.

In this assembly a predetermined amount of float is provided for and is controlled by the class of fit of the members of the ball bearing (usually three spot, denoted by three faint rings on the face of the bearing outer member).

To Remove the Mainshaft Assembly from the Casing.

Remove the front, rear and main covers.

Release the lockwashers and undo the nut securing the bearing to the shaft.

Support the mainshaft assembly at its forward end and, with the aid of a mallet, drive the mainshaft assembly forward until it is free of the rear bearing. Hold the second speed synchrohub assembly by hand and withdraw the mainshaft assembly through the aperture in the front of the casing. Lift out the second speed synchromesh assembly and wheel through the aperture in the top of the casing.

To Refit the Mainshaft Assembly to the Casing.

Refitting of the mainshaft assembly is a reversal of the preceding instructions, with particular attention to the following:—

Oil the inner surface of the second speed baulking ring and secure it to its mating cone by light hand pressure in order to safeguard against the baulking ring floating and becoming trapped during the driving rearward of the mainshaft into the bearing.

During the driving in of the mainshaft to the rear bearing care must be taken to align the second speed shifting plates with the slots in the second baulking ring; also the first speed wheel and the 3rd and 4th speed sliding sleeve should be retained in position on their respective hubs by hand.

On Series IIIA cars having the recessed second speed hub, it is essential that the rear main bearing is positioned so that it is held firmly against the second speed hub distance piece.

To ensure this condition, place the gearbox on a press so that the bearing inner track rests on the base plate and the main shaft passes through the V blocks. Place the protector sleeve R.G. 188/2 over the stemwheel spigot and press the shaft through the bearing until the hub distance piece is securely held between the bearing and the second speed hub.

To Dismantle and Re-assemble the Mainshaft Assembly.

Remove the second speed wheel.

Secure the mainshaft in a vice, using soft metal jaws.

Using circlip pliers, remove the front mainshaft circlip.

Remove the sliding sleeve from the third and fourth synchrohub.

Remove the three shifting plates (short).

Remove the synchrohub from the mainshaft.

Remove the two synchro circlips from the synchrohub.

Remove the third speed wheel.

Remove the baulking ring from the third speed wheel cone.

Re-assembly of the mainshaft is a reversal of the preceding instructions, with particular attention to the following:—

Always use a new circlip (34, Fig. 1).

Ensure that the synchro circlip tags remain in their respective locating holes in the hub, especially after driving the mainshaft into the rear bearing.

The end float of the second speed wheel is predetermined in manufacture, therefore no adjustment is necessary.

End float of the 3rd speed wheel:

The circlip (34, Fig. 1) is made in selective thicknesses, as follows:—

1202371	.116 to .115
1202370	.118 to .117
P109410	.120 to .119
P109411	.122 to .121
P109412	.124 to .123

To determine the correct circlip to ensure correct end float of .004 to .006:—

Place the mainshaft (spigot end upwards) in a vice. Slide on the third speed wheel and hub.

Break a piece off the old circlip, less than half the circumference, and insert it in the mainshaft groove.

Using feelers, check the end float which still exists.

If this is more than .006, measure the trial circlip thickness and select a new circlip of the correct thickness to provide end float of .004 to .006.

To Dismantle and Re-assemble the Second Speed Synchro Assembly.

Remove the first speed wheel from the hub.

Remove the synchro circlips from the hub.

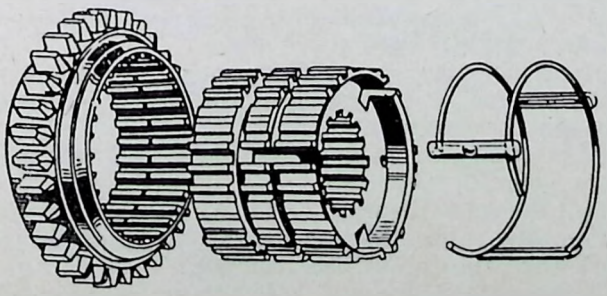


FIG. 3.—Arrangement of the 2nd speed synchrohub circlips. (All cars up to Series III.)

If necessary, remove the rear synchro circlip from the groove by pulling it upwards, i.e., by pulling the gap of the circlip over the hub groove diameter.

It will be noted that the second speed synchro hub is tin-plated for ease of movement.

Re-assembly of the second speed synchro hub is a reversal of the preceding operation.

It is most important that the first speed wheel should be a good sliding fit on the six pads around the periphery of the hub.

Wear of these parts necessitates replacement of the hub and casing by stoning of the corners of the first speed splines if burrs are present.

Ensure correct location of the synchro circlips in the underside of the shifting plates. (See Fig. 3.)

In the second speed synchro hub arrange the circlips so that their locating hooks do not locate in the same shifting plate, and so that at least one circlip passes across the underside of each shifting plate.

The free ends of the circlips must follow opposite directions from one another in relation to their respective locating hooks.

The third and top speed hub circlips must be assembled in exactly the same way as for the second speed hub, except that they both fit inside the hub instead of one in the groove around its circumference.

Note that the three short shifting plates are used with the third and top speed hub, and the three long shifting plates with the second speed hub.

When the first speed wheel is in the first speed position on its hub an appreciable amount of backlash will be evident, since the splines on the hub in the first speed area are of reduced width. This is a correct and normal condition.

To Remove the Layshaft Assembly from the Casing and Refit (Mainshaft Removed).

Extract the layshaft assembly, complete with rollers, abutment ring, and floating steel thrust washer, through the aperture in the front of the casing.

Remove the two bronze thrust washers.

Replacement is a reversal of the preceding operation, with particular attention to the following:—

End float of the layshaft cluster between the thrust washers should be .006 to .008. This clearance should be checked with the assembly in a dry condition and adjusted by selective assembly of the floating thrust washer.

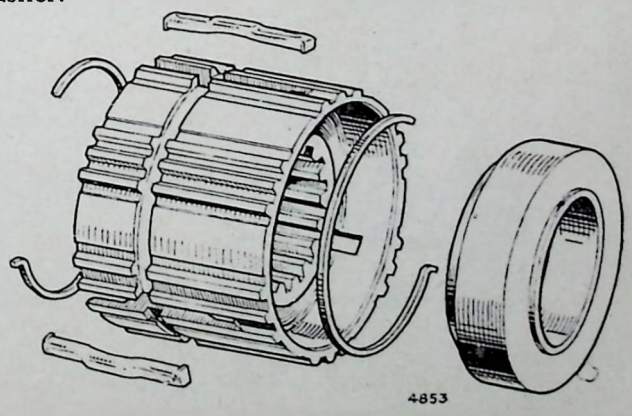


FIG. 4.—Arrangement of the 2nd speed synchromesh circlips (Series IIIA).

After the insertion of the needle rollers, place the abutment ring in the recess at the front of the cluster.

To Remove the Reverse Wheel from the Casing and Refit (Mainshaft and Layshaft Removed).

Withdraw rearwards, the reverse wheel spindle from the casing.

Remove the reverse wheel.

Replacement is a reversal of the preceding instructions.

To Remove the Rear Bearing from the Casing.

Support the gearbox on its face and press out the bearing. Should the bearing circlip be removed from the bearing a new circlip must be fitted.

To Re-assemble the Gearbox.

Important.—It is strongly recommended that on vehicles not already so equipped, a paper joint, Part No. P.88568, should be fitted between the gearbox casing and the front cover. This will prevent the occurrence of oil leaks. Additionally, all external set-screws must be dipped in jointing compound immediately before assembling.

Fit the reverse wheel and shaft into the casing (gears to the rear).

With the aid of thick grease, position the bronze layshaft thrust washers (large one to the front) in the casing.

See that there are twenty-seven needle rollers at each end of the layshaft cluster. Locate them with thick grease.

Fit the abutment ring or spacer into the front of the cluster and lower the cluster, complete with dummy shaft, into the casing, and then fit the rear floating steel thrust washer.

Pass the first and second synchrohub and second speed wheel assembly through the top of the casing, with the bevelled first speed teeth to the rear, and enter the mainshaft through the first and second synchro assembly, and the bearing aperture in the casing.

Fit the rear bearing and tap it right home. Then fit the speedometer gear, spacer, lockwasher and nut.

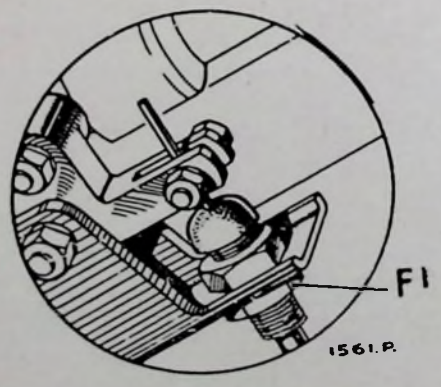


FIG. 5.—Steering column end of conduit.

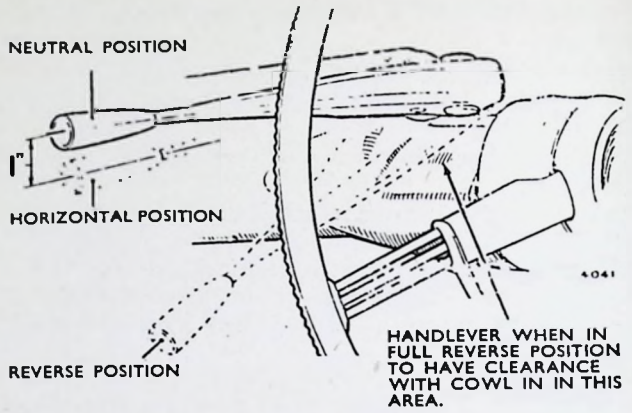


FIG. 6.—Adjustment of the gearshift lever.

Ensure that the twenty-seven needle rollers are in position in the stemwheel and then fit the front cover and stemwheel assembly.

Invert the gearbox and insert the layshaft spindle, ensuring that the thrust washers at each end are correctly positioned.

Fit the layshaft and reverse spindle lockplate.

Place the gearbox upright and fit the third and top, first and second and reverse forks in this order. Fit the reverse distance piece and shaft, with the long end of the shaft to the front. Fit the first and second and third and top shafts.

Refit the rear cover and check that the shafts are free and that all the gears can be selected.

Fit the main cover, taking care to position it so that the internal selector lever moves freely across the slots in the forks.

During the assembly the following points must be borne in mind:—

Absolute cleanliness is essential.

Use a liberal supply of clean oil when assembling movable parts finally.

Check movable parts for freedom of movement. Always fit new paper joints.

Seal the gearbox casing at the front end of the layshaft spindle with a good brand of sealing compound.

To Adjust the Selector Control Cable.

Open the bonnet and slacken the cable pinch nut, using two spanners. (See Fig. 5.)

Engage first gear and wedge the lever in this position.

Grip the inner cable with pliers and pull it upwards as far as it will go.

Mark the cable with chalk and make a pencil mark on the cable at the exact spot where it protrudes through the trunnion.

Push the inner cable right down and mark the cable again.

Pull the cable up again and mark the mid position.

Push the cable down to line up the mid position mark with the top of the trunnion.

Tighten the pinch nut, holding the trunnion with another spanner, to avoid kinking the cable.

Adjustment of the Gearshift Lever.

It is important to note that if the gearshift lever is incorrectly set, it may be brought into contact with the steering column cowl when the reverse gear is engaged, causing the cowl to crack.

Adjustment is effected by placing the gearshift lever in the neutral position, and disconnecting the ball joint from the end of the gearchange actuating lever at the bottom of the control shaft. The ball joint should then be rotated to lengthen the control rod until, when it is reconnected, the end of the gearshift lever assumes a position one inch above the horizontal, as shown in Fig. 6. After adjustment, check that clearance exists between the steering column cowl and gearshift lever when the latter is in the reverse position.

OVERDRIVE

The Laycock-de Normanville Overdrive unit as fitted to the Singer Gazelle gives an increase in propeller shaft speed of 32.2%, that is, it has a ratio of 0.756 : 1.

Working Principles.

At the top of Fig. 7, the unit is shown diagrammatically in direct drive. The cone clutch, which is fixed to an extension of the sunwheel, is held to the rear by spring pressure so that the inner friction band contacts the outside of the annulus. This locks the gear train, and the drive is transmitted directly through the uni-directional clutch. Any over-run or reverse torque is taken by the cone clutch.

The lower illustration in Fig. 7 shows the unit in overdrive. The cone clutch is held forward by hydraulic pressure so that the outer friction band of the clutch is locked to the stationary brake ring. As the cone clutch is splined to the sunwheel, the sunwheel is also held stationary. The planet carrier is splined to the input shaft, and is driven by it. The planet wheels are thus driven round the stationary sunwheel, and in so doing rotate the annulus and tail shaft at a speed greater than that of the input shaft.

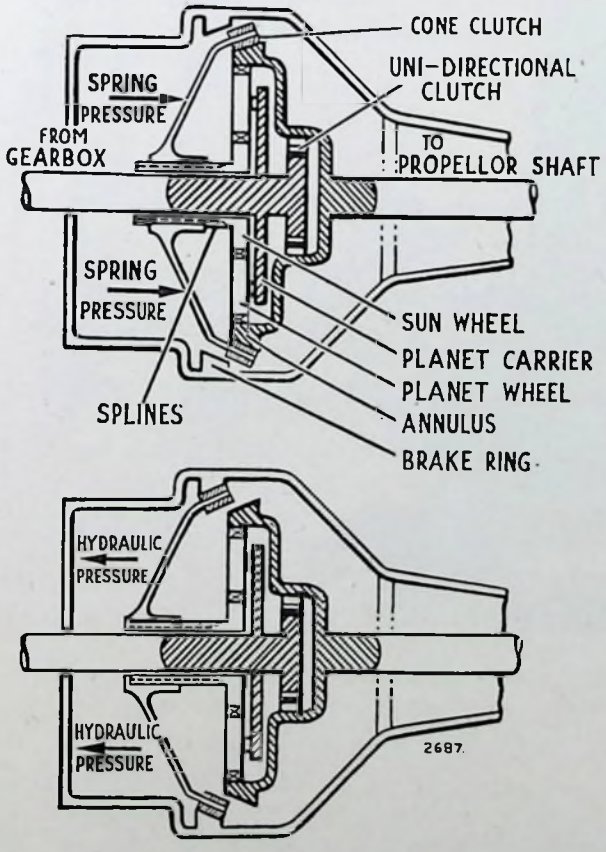


FIG. 7.—Diagrammatic sections.

The Hydraulic System. (See Fig. 7.)

A cam, keyed to the gearbox mainshaft, operates the plunger of a pump, which forces oil via its discharge valve, into the relief valve. The line pressure is kept constant by introducing a relief valve into the system.

From the pump, oil under pressure is passed to the operating cylinders via the operating valve shown diagrammatically in Fig. 7. When the overdrive control is operated the valve is lifted, thus holding the ball off its seat against the pressure of the plunger spring. Oil then passes to the operating cylinders forcing the pistons forward. When the overdrive control is moved to the disengaged position, the spring plunger pushes the ball on to its seat, and the valve falls away from the ball. Oil from the cylinders then returns through the centre of the valve to the sump. Near the bottom of the valve is a small jet which slows down the emptying of the cylinders, to provide smooth re-engagement of direct drive.

CONTROL OF OVERDRIVE.

The overdrive is actuated by a solenoid, controlled by a switch on the steering column. A switch mounted in the gearchange linkage ensures that overdrive can be obtained only in third or top gear. Both these switches are connected in series with the operating coil of a relay, and the solenoid is energised through the relay contacts.

LUBRICATION AND MAINTENANCE.

The oil in the overdrive unit is common with that in the gearbox and the level should be checked at the gearbox. To drain the gearbox and overdrive units, two drain plugs must be removed.

Note: The overdrive drain plug is the one nearest the left side of the unit. The pump valve plug in the centre, and the relief valve plug on the right are wired together, and are not removed unless attention to valves is required.

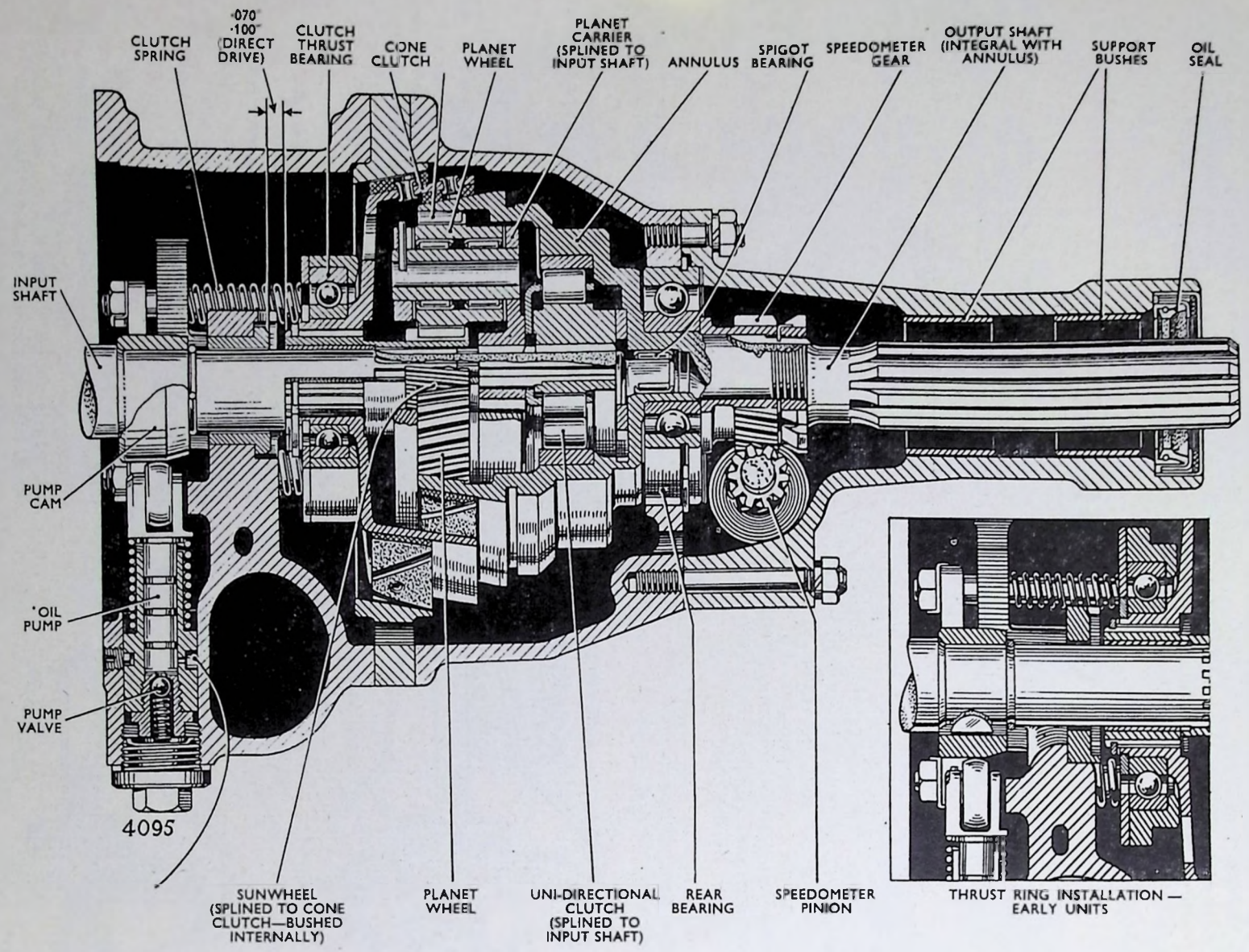


FIG. 8.—Section through the overdrive unit.

NOTE: The thrust ring and sunwheel front face are in contact only in overdrive when the sunwheel is held stationary.

It is essential that the approved lubricant is used when refilling. Trouble may be experienced if some types of extreme pressure lubricants are used because the planets act as a centrifuge to separate the additives from the oil.

If the gearbox and overdrive units have been drained and refilled the oil level should be re-checked after the car has been run, since a certain amount of oil will be retained in the hydraulic system.

It must be emphasised that any hydraulically controlled transmission must have clean oil at all times, and great care must be taken to avoid the entry of dirt whenever any part of the case is opened. This applies to adding oil to the transmission and to servicing the unit. Any dirt or even lint from the wiping cloth that finds its way into a valve may cause serious difficulty. When the unit is dismantled for any service work the parts must be thoroughly cleaned and kept covered with an oily lintless cloth until reassembled.

Similar care should be taken when handling the hydraulic valves, etc., since scratches or nicks might cause leakage on reassembly.

DIAGNOSIS OF FAULTS.

If the overdrive unit does not operate properly, it is advisable first to check the level of oil and, if below the low level mark, to top up with fresh oil and test the unit again before making any further investigations.

Before commencing any dismantling operations, it is imperative that the overdrive is operated ten to twelve times in order to release any hydraulic pressure from the system.

Faulty units should be checked for defects in the order listed below:—

Overdrive Does Not Engage:

1. Insufficient oil in the gearbox.
2. Control mechanism out of adjustment.
3. Leaking pump non-return valve due to foreign matter on ball seat or broken valve spring.
4. Leaking operating valve due to foreign matter on ball seat or broken valve spring.
5. Insufficient hydraulic pressure due to leaks or faulty relief valve — test pressure.
6. Pump not working due to choked filter.
7. Pump not working due to broken pump spring.
8. Damaged gears, bearings or shifting parts within the unit requiring removal and inspection of the assembly.

Overdrive Does Not Release:

Important: This calls for immediate attention. Do not reverse the car, as selection of reverse in overdrive can cause extensive damage.

1. Control mechanism out of adjustment.
2. Blocked restrictor jet in valve.
3. Sticking clutch.
4. Damaged parts within the unit necessitating removal and inspection of the assembly.

Clutch Slip in Overdrive:

1. Insufficient oil in gearbox.
2. Worn or carbonised clutch lining.
3. Insufficient pressure due to leaks, or foreign matter in valves.

Clutch Slip in Reverse or Free-wheel Condition on Overrun:

1. Worn or carbonised clutch linings.
2. Blocked restrictor jet in valve.
3. Insufficient pressure on clutch due to broken clutch springs.

ADJUSTMENTS.

Controls:

The operation of the controls can be checked by means of the hole in the solenoid lever on the right-hand side of the unit, accessible from under the car after removal of the cover-plate. The controls are operating correctly when a $\frac{3}{16}$ inch diameter rod can be passed through the hole in the solenoid lever into the hole in the overdrive casing. (see Fig. 8) with the ignition switched on, top gear engaged and the facia panel switch in the overdrive position.

If the solenoid operates, but does not move the setting lever far enough to allow the rod to be inserted, the solenoid plunger must be adjusted. Adjustment is effected by screwing the self-locking nut on the plunger in or out, with the plunger pushed into the solenoid as far as it will go. The solenoid spindle must be held against rotation by using a suitable spanner. All units have two milled flats on the spindle for spanner access. The fork on the solenoid lever should just contact the nut with the $\frac{3}{16}$ inch rod in position.

Ensure that with the control in the overdrive position the setting rod can be inserted, and that the solenoid current does not exceed 2 amperes. If the

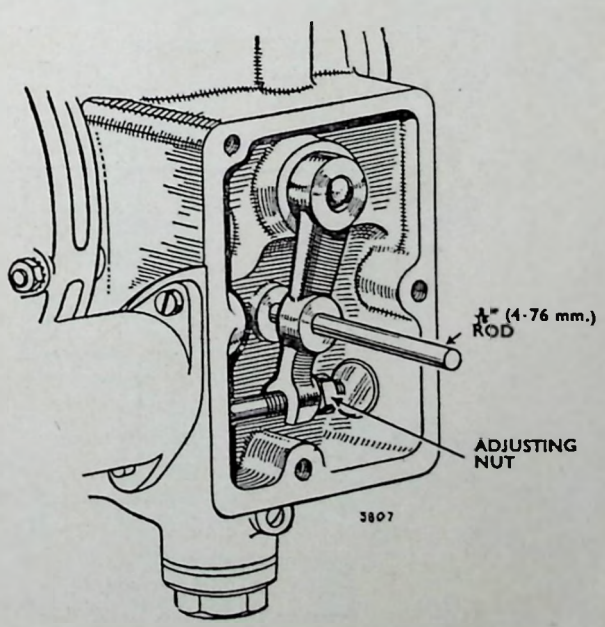


FIG. 9.—Checking the setting lever position.

current is maintained in the order of 15 to 17 amperes, it is an indication that the solenoid plunger is not moving far enough to switch from the operating to the holding coil, and the plunger must be re-adjusted. This is important, as high amperage will cause solenoid failure.

If the solenoid does not operate, the electrical circuits should be checked. A circuit diagram is shown in Fig. 10.

Overdrive Isolator Switch:

Correct adjustment of the isolator switch, operated by the gearshift selector lever, is most important because:—

1. The switch must ensure engagement of overdrive when this is selected in 3rd and top gears and must maintain the electrical circuit to keep overdrive "in".
2. The switch must ensure that overdrive does **NOT** engage in first, 2nd or reverse gears.

To Check Adjustments:

1. Switch on the ignition but do not start the engine.
2. Move the overdrive switch to OVERDRIVE.
3. Engage 3rd or top gear; the selector lever will now be at its highest position in relation to the switch plunger, and must lift the plunger TO CLOSE the switch.
4. As the switch CLOSES a distinct "click" from the overdrive relay will be heard.
5. Move the gear lever back into NEUTRAL and downwards (through the neutral "gate") towards first and second.
6. The isolator switch should **OPEN** as the lever is moved downwards (through the NEUTRAL "gate") denoted by a further audible "click" from the relay.
7. The isolator switch MUST be fully OPEN in the first and 2nd speed range and will automatically be OPEN in the reverse range.
8. Engage first or 2nd gear, operate the Overdrive switch and ensure that the overdrive relay and solenoid do not operate: denoting isolation of overdrive in first and 2nd gears.
9. Road test to confirm correct adjustment—overdrive will engage and remain engaged in third and top with the manual switch at overdrive, and WILL NOT engage in first and 2nd.

To Adjust:

1. Remove the rubber cover from the switch and disconnect the leads.
2. Slacken the locking nut on the shank of the switch.
3. Screw the switch up or down to obtain the setting previously described.
4. Tighten the locknut and check the setting as described under "Isolator Switch—To Check Adjustments".

TESTING OIL PRESSURE.

Release the hydraulic pressure by operating the overdrive control ten or twelve times.

Remove the operating valve plug and fit in its place the special adapter. Use an oil pressure gauge reading to 800 p.s.i., using a pipe union to fit the $\frac{1}{8}$ inch B.S.P. internal thread in the adapter.

Jack up the rear wheels of the car, start the engine and engage top gear with the engine ticking over slowly.

A pressure of 440 to 480 p.s.i. (approx.) should be recorded.

THE OPERATING VALVE. (See Fig. 11.)

To gain access to the operating valve, remove the cover-plate from the floor centre, on the driver's side. With the ignition on and the engine stopped, move the overdrive switch into and out of the overdrive position ten or twelve times to release the hydraulic pressure.

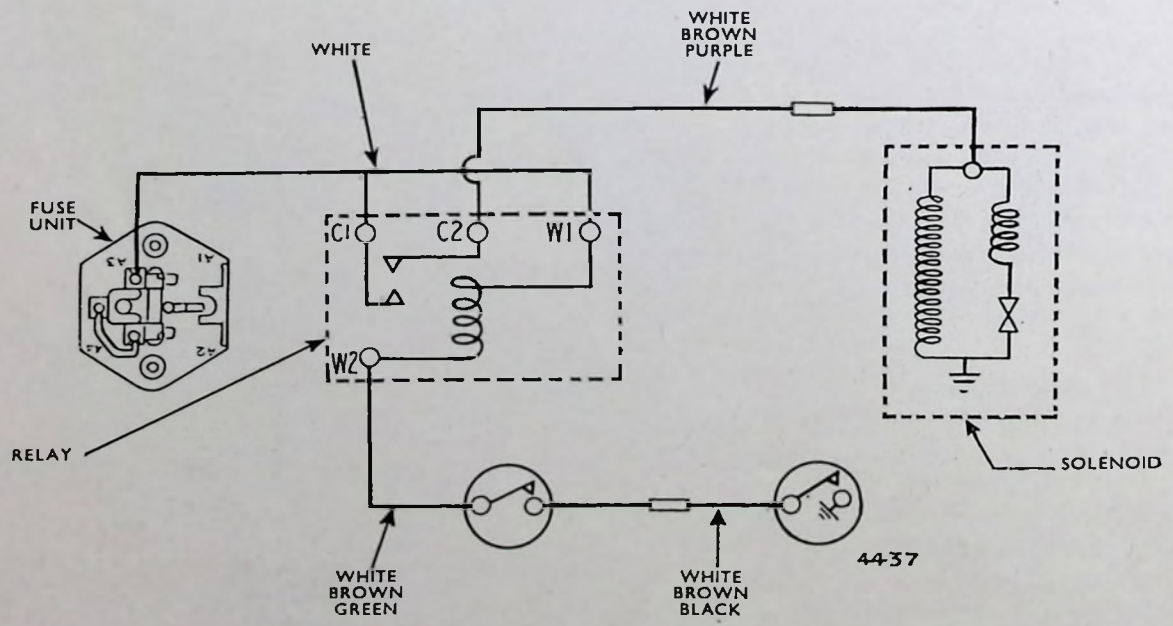


FIG. 10.—Circuit diagram.

The valve can be removed with a tapered piece of wood, but care must be exercised to avoid damage to the seating at the top of the valve.

Remove the valve plug, take out the plunger and spring and remove the ball with a magnet.

Near the bottom of the valve will be seen a small hole breaking through to the centre drilling. This is the jet for restricting the exhaust of oil from the operating cylinders. Ensure that this jet is not choked.

If the ball valve is not seating correctly the ball should be tapped sharply on to its seat in the casing, using a copper drift.

Care must be taken not to hit the ball too hard on to the valve seat or the latter will be closed up so that the valve cannot be assembled.

If the unit fails to operate and the ball valve is found to be seating and lifting correctly, check that the pump is functioning.

Jack up the rear wheels of the car, then with the engine ticking over and the valve plug removed, engage top gear. Watch for oil being pumped into the valve chamber. If none appears then the pump is not functioning.

THE OIL PUMP.

The pump is of the plunger type and delivers oil via a non-return valve to the pistons. Possible sources of trouble are failure of the non-return valve due to foreign matter on the seat or to a broken valve spring and breakage of the spring holding the pump plunger in contact with the cam.

THE PUMP VALVE.

Access to the pump valve is gained through the centre plug in the bottom of the main casing.

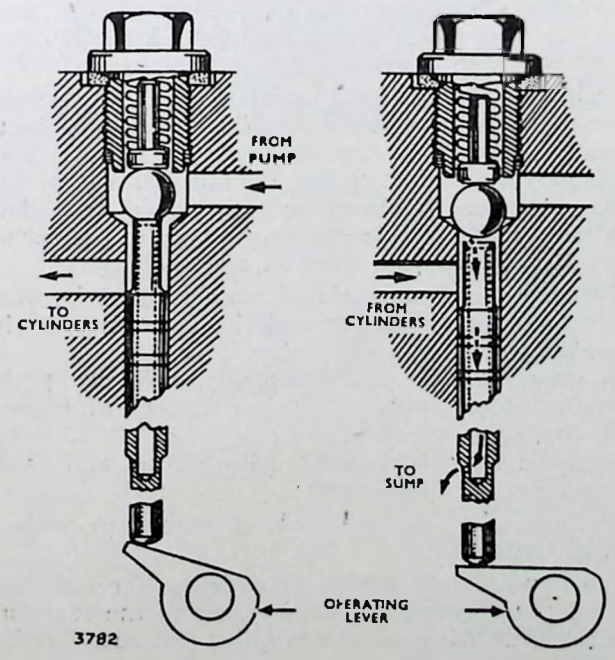


FIG. 11.—The operating valve.

To Dismantle:

Proceed as follows:

Operate the overdrive switch (ignition on) ten or twelve times to empty the system. Remove the drain plug and drain off the oil.

Unscrew the valve cap and take out the spring, plunger and ball.

Reassembly is the reverse of the above operations. Ensure that the soft copper washer between the valve cap and pump housing is nipped up tightly to prevent oil leakage.

Gearbox and Overdrive Units.

To Remove.

If it is necessary to remove the gearbox from the car for any reason, the gearbox and overdrive must be taken out as one assembly and subsequently separated. Before refitting to the car, the gearbox and overdrive units must be re-assembled.

To remove gearbox and overdrive units, the rear end of the engine must be lowered. To do this proceed as follows:—

Place the car on a lift or over a pit.

Drain radiator.

Undo clip securing radiator top hose and disconnect hose.

Disconnect negative lead from battery.

Disconnect oil gauge pipe from engine.

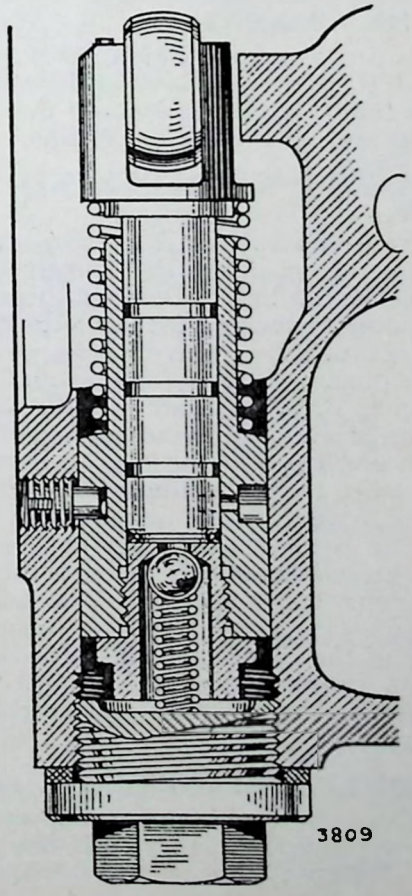


FIG. 12.—The oil pump.

Remove rocker cover. (It may be necessary to remove the rocker shaft complete if a heater is fitted).

Disconnect accelerator control linkage.

Disconnect exhaust flange from manifold.

Disconnect exhaust hanger bracket at prop-shaft safety strap and remove strap.

Remove propeller shaft rear coupling bolts, disconnect coupling and remove shaft rearwards off reverse spline.

Jack up engine at rear.

Remove bolts securing engine rear mounting bracket to frame.

Disconnect speedometer cable from overdrive unit.

Disconnect rod from external change speed lever on countershaft below steering column.

Remove centre floor cover plate and disconnect selector cable trunnion through floor.

Remove selector cable complete to avoid kinking.

Remove bolt and nut securing engine tie-bar at bellhousing.

Remove nuts and washers securing tie-bar front fixing and remove tie-bar.

Disconnect hydraulic clutch flexible pipe.

Disconnect starter cable and remove starter motor.

Disconnect wires from solenoid and from gearbox switch.

Remove nuts and bolts securing bellhousing.

Remove gearbox, bellhousing and overdrive unit lownwards and rearwards.

TO REMOVE THE OVERDRIVE UNIT FROM THE GEARBOX.

The unit is split at the front cover-plate (adapter plate) which is attached to the front housing by eight studs. The unit can be drawn off the mainshaft, leaving the front cover-plate in position.

TO REFIT THE OVERDRIVE UNIT TO THE GEARBOX.

Before the overdrive unit is fitted to the gearbox the splines of the planet carrier and uni-directional clutch must be in line. To align them, insert a dummy mainshaft and engage it first with the internal splines of the planet carrier.

Turn the dummy shaft and planet carrier and, at the same time, press the shaft inwards until it engages the roller clutch internal splines.

The splines will now be lined up correctly, and it is most important that neither the gearbox mainshaft nor the overdrive coupling driver is turned until the unit is fitted to the gearbox.

Turn the gearbox mainshaft to locate the cam with its highest point facing upwards. The lowest point will then coincide with the overdrive pump plunger.

The edge of the cam facing the overdrive unit is chamfered to enable the pump plunger to "ride" on to the cam as the overdrive and gearbox flanges come together.

TO DISMANTLE THE OVERDRIVE UNIT.

Assuming that the overdrive front cover has been retained on the gearbox as previously described, dismantle the overdrive unit in the following order, with the front end uppermost:

Remove the operating valve, as previously described. This will allow air to enter the cylinders of the operating pistons and will thus facilitate removal of these pistons.

Remove the 3 setscrews securing the operating lever cover assembly to the offside of the unit (adjacent to the solenoid). Remove the cover.

Remove the 2 screws securing the solenoid to the casing. Ease the plunger out of the operating lever yoke and remove the solenoid.

Release the lockwashers securing the four $\frac{1}{4}$ inch nuts retaining the operating piston bridge pieces. Remove the nuts, lockwashers and bridge pieces and withdraw the operating pistons by gripping their spigots with pliers.

Loosen and progressively remove the eight $\frac{1}{4}$ inch nuts around the centre flange of the casing. This will gradually release the four clutch springs. Remove the front half of the casing, complete with the brake ring. Take the four clutch springs off their pegs on the thrust plate.

The brake ring is spigoted into each half and will normally come away with the front half of the casing. A few light taps with a mallet around its flange will remove the ring from the rear casing.

Lift out the clutch sliding member, complete with the thrust bearing and sunwheel. If the cone clutch sticks in the brake ring, a light tap with a mallet on the rear end of the casing will free it.

Remove the sunwheel from the sliding cone clutch member by withdrawing the sunwheel circlip from its groove in the forward end of the sunwheel hub.

Remove the thrust bearing and the thrust plate by removing the large circlip and pressing out the cone clutch hub from the thrust plate and bearing. Remove the bearing from the thrust plate assembly, using a special tool.

Remove the planet carrier assembly. If necessary to remove the roller clutch, first remove the brass locating ring, which is pressed into an annular recess in front of the clutch.

Place the fitting ring (special tool L.178) centrally over the front face of the annulus and lift the inner member of the uni-directional clutch into it. This will ensure that the rollers do not fall out of the inner member. Remove the fitting ring and place the parts in a suitable container. Remove the spring ring, located between the hub and the cage.

Remove the bronze thrust washer fitted between the clutch inner member and the front face of the annulus.

A caged needle roller bearing is fitted in the annulus centre spigot. If it is necessary to remove this, use a special tool.

Remove the speedometer drive pinion and bush, located by one dowel screw.

Remove the rear oil seal (if necessary) with a special extractor.

To remove the annulus, first remove the tail shaft casing, then remove the circlip around the rear ball bearing and drive out the annulus and rear bearing forwards.

To remove the rear bearing, disengage the lockwasher and remove the ring nut securing the speedometer driving gear and rear bearing. Remove the gear and draw off the ball bearing.

TO INSPECT THE OVERDRIVE UNIT.

When the unit has been dismantled, each part should be thoroughly cleaned and inspected to determine whether any parts should be replaced. Inspect the front casing for cracks, damage, etc. Examine the bores of the operating cylinders for scores and wear. Check for leaks from the plugged ends of the oil passages.

Examine the clutch sliding member assembly. Ensure that the clutch linings are not burned or worn. Inspect the bolts locating the clutch springs and bridge pieces and see that they are not distorted. Ensure that the ball bearing is in good condition and rotates freely.

Inspect the clutch springs for distortion or collapse.

Inspect the teeth of the gear train for damage. If the sunwheel bush is worn, the gear will have to be replaced, since it is not possible to fit a new bush in service, because it has to be bored to the pitch line of the teeth.

Inspect the face of the sunwheel front thrust ring in the front casing. This should be renewed only if deeply scored, and it is only subjected to sunwheel rotation whilst the overdrive is in course of selection.

Inspect the uni-directional clutch. See that the rollers are not chipped and that the inner and outer members of the clutch are free from damage. Make sure that the outer member is tight in the annulus. Ensure that the spring is free from distortion.

Inspect the ball race on the output shaft and see that there is no roughness when it is rotated slowly.

Examine the tailshaft sleeve (reverse spline) bushes.

Inspect the mainshaft splines for nicks and burrs. See that the oil holes are open and clean.

Inspect the oil pump for wear on the pump plunger and roller pin. Ensure that the plunger spring is not distorted. Inspect the valve seat and ball and make sure that they are free from nicks and scratches.

Inspect the operating valve for distortion and damage and see that it slides easily in its bore in the front casing.

Inspect the relief valve body, "O" ring and ball, etc.

Inspect the planet carrier and gears for tooth and bearing wear.

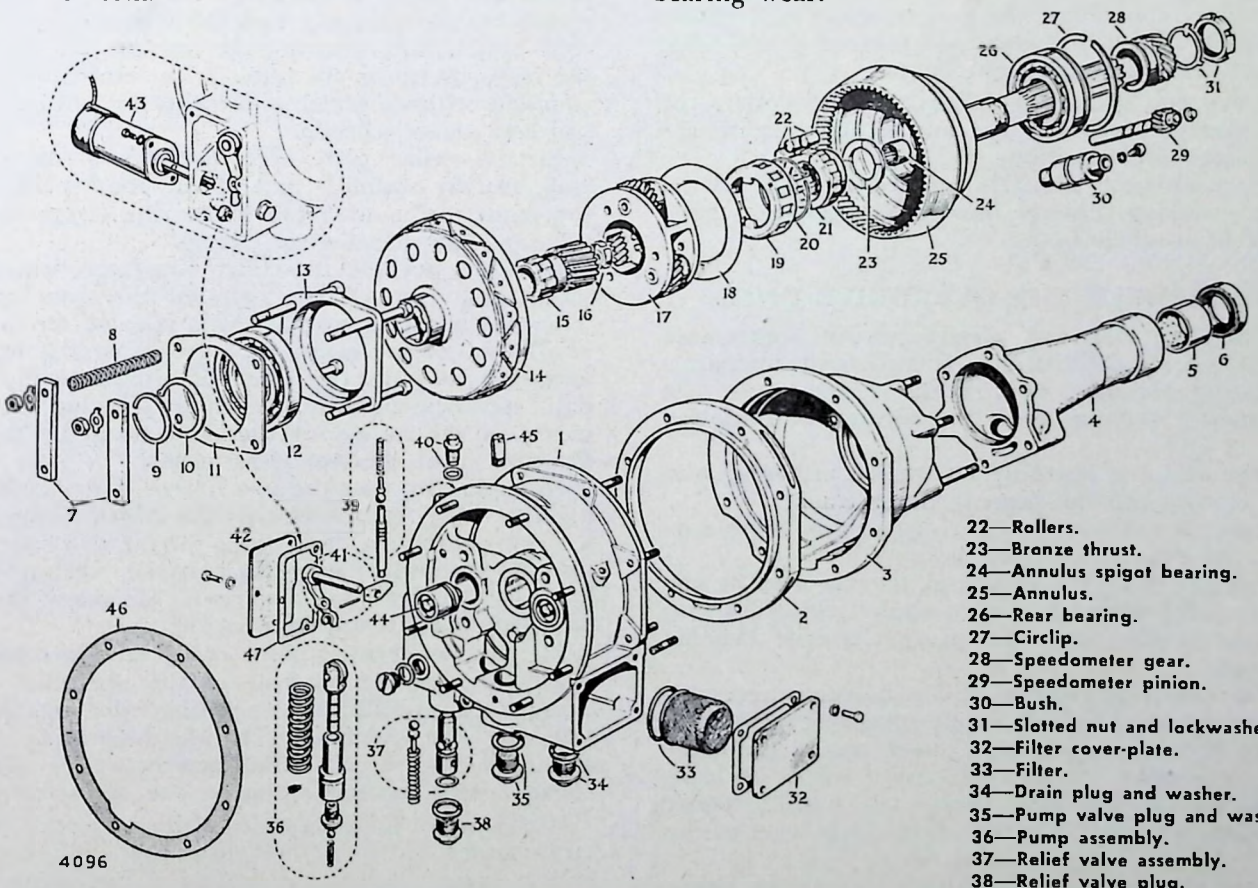


FIG. 13.—Exploded view of the overdrive unit.

1—Front casing.
2—Brake ring.
3—Rear casing.
4—Rear cover.
5—Bush.
6—Oil seal.
7—Bridge pieces (to operating pistons).
8—Clutch spring (4 off).
9—Sunwheel circlip.
10—Clutch hub circlip.
11—Spacer plate.
12—Thrust bearing.
13—Clutch thrust ring.
14—Cone clutch.
15—Sunwheel.
16—Planet carrier locating clip.
17—Planet carrier.
18—Roller clutch protector ring.
19—Roller cage.
20—Spring.
21—Inner member.
22—Rollers.
23—Bronze thrust.
24—Annulus spigot bearing.
25—Annulus.
26—Rear bearing.
27—Circlip.
28—Speedometer gear.
29—Speedometer pinion.
30—Bush.
31—Slotted nut and lockwasher.
32—Filter cover-plate.
33—Filter.
34—Drain plug and washer.
35—Pump valve plug and washer.
36—Pump assembly.
37—Relief valve assembly.
38—Relief valve plug.
39—Operating valve assembly.
40—Operating valve plug and washer.
41—Operating lever assembly.
42—Cover-plate.
43—Solenoid.
44—Operating piston.
45—Breather.
46—Joint to gearbox adapter.

THE PLANET CARRIER ASSEMBLY.

To Remove the Planet Wheel Pins:

This operation is not normally necessary, but should a pivot pin or planet wheel roller cage require renewing, adopt the following procedure:

Support the carrier on a suitable hollow abutment through which the pin will pass.

Using a suitable drift, drive the pin out, shearing the small Mills pin.

Temporarily replace the planet wheel pin and, using its small hole as a guide, drill out the broken end of the Mills pin in the carrier.

Note: The drill size must be smaller than the new Mills pin to be fitted.

To Extract the Needle Roller Cages (Using a Special Tool).

Secure the square ended shank of the tool in the vice and remove the wing nut and all collars.

Slide the gear over the spindle and allow the roller cage to abut against the spindle shoulder.

Fit the main body and wing nut and press the gear off the roller cages.

To Replace the Roller Cages:

Fit the guide bush, flange downwards, over the shank of the tool. Place the gear over the guide bush, followed by one roller cage, spacing collar and wing nut and press the cage right home.

Remove the gear and collars, fit one collar, the gear inverted, second cage and collar. Screw the second cage into position.

Treat each gear similarly and refit to the planet carrier, ensuring that the new Mills pins are a good driving fit in their holes.

TO REASSEMBLE THE OVERDRIVE UNIT.

Fit the rear bearing, circlip groove uppermost, over the output shaft, driving it into position against its locating shoulder behind the annulus. Fit the speedometer driving gear, lockwasher and slotted nut.

Fit the annulus assembly into the rear casing and fit the circlip into the bearing outer track.

Ensure that the rear bearing circlip is located against the rear face of the casing.

The rear bearing is located at its rear end by the tailshaft cover assembly, and a shim is inserted into the recess of the cover to ensure that the bearing is trapped.

If a new bearing is fitted and it becomes necessary to assess the thickness of shims required, place two or more shims into the rear cover recess and offer up the rear cover to the rear casing with the bearing and circlip installed, measuring with a feeler the amount by which the rear cover fails to meet the casing.

Remove the rear cover again, measuring the thickness of shims previously inserted, and subtract the gap already checked by a feeler gauge from the thickness of the shims. This will assess the actual shimming required.

The rear cover can then be fitted and then the speedometer drive bush and pinion.

If the spigot roller bearing in the centre of the annulus is to be replaced, use a special tool to insert the bearing.

Assemble the spring into the roller cage of the uni-directional cluch. Fit the centre member into the cage and engage it on the other end of the spring. Engage the slots in the inner member with the tongues on the roller cage and see that the spring rotates the cage to urge the rollers up the ramps of the inner member. The cage is spring-loaded anti-clockwise when viewed from the front.

Place this assembly, front end downwards, into the fitting ring (VLC.L.178) and fit the rollers through the slots in the tool, turning the clutch clockwise.

Replace the thrust washers and uni-directional clutch inner member with its rollers, cage and spring, using tool VLC.178 to enter the rollers into the outer member.

Fit the brass protector ring into its groove in front of the roller clutch assembly, peening over the edges of the recess to secure the ring.

Fit the planet carrier, pass the sunwheel splines into the open ends of the cone clutch member and fit the small circlip at the forward end of the sunwheel. Press the clutch bearing into the thrust plate, fit the four bolts of the thrust ring and then fit the clutch bearing assembly into the forward end of the cone clutch hub, securing the assembly in place by the large circlip on the hub. Fit the clutch assembly, complete with sunwheel, into the casing, engaging the sun and planet wheels.

Fit the spacer plate over the bolts of the thrust ring bearing assembly and fit the four springs. Fit the front casing with the brake ring (large end of the taper towards the rear casing).

Carefully position the clutch ring bolts, which are shouldered, through the holes in the front casing. The clutch spring pressure will now be felt as the two halves of the casing go together, and it will be necessary to push the front half towards the rear half, start the nuts on the studs, securing the two halves of the casing together and gradually tighten the nuts until the two faces meet.

Note: Ensure that the two halves of the casing go together easily and check that the clutch spring bolts are not binding in their holes. Fit the two operating pistons, carefully easing their rubber sealing rings into the cylinder bore. The centre spigots of the pistons face towards the front of the unit.

Fit the two bridge pieces, nuts and lockwashers.

Fit the solenoid plunger to the operating lever arm before installing the operating valve and spring, then fit the solenoid. Fit the operating valve assembly, ensuring that the lower operating plunger engages with the small cam on the operating shaft.

If the pump body has been removed (rarely necessary), insert its small end into the casing in the middle plug orifice at the bottom of the casing, with the oil inlet port in the annular groove of the body facing towards its similar port in the main casing. Gently tap the body into position until the groove lines up with the grub screw hole at the bottom of the casing front face. Fit the grub screw and tighten.

Fit the pump valve, cap and washer.

Fit the relief valve assembly and plug in the right-hand bottom position of the casing and the drain plug in the left-hand bottom position. Fit and secure the filter side cover-plate. Insert the pump plunger and spring from above.

Do not yet fit the operating lever cover-plate as it will be necessary to adjust the setting lever after finally fitting the unit to the car.

The assembly is now ready for fitting to the gear-box unit.

OVERDRIVE UNIT — DIMENSIONS AND TOLERANCES.

Parts and Description:	Dimensions New:	Clearance New:
Pump:		
Plunger diameter	$\frac{3}{8}$″ —.004″ —.0008″	+.0016″, +.0002″
Bore for plunger in pump body	$\frac{3}{8}$″ +.0008″ —.0002″	
Plunger spring fitted load at top of stroke	9 lbs. 12$\frac{3}{4}$ ozs.	
Valve spring load	5 lbs. at $\frac{9}{16}$″ long	
Pin for roller	$\frac{1}{4}$″ ±.00025″	
Bore for pin in roller	$\frac{1}{4}$″ +.002″ +.001	+.00225″ +.00075″
Gearbox Mainshaft:		
Shaft diameter at sunwheel bush	$\frac{7}{8}$″ —.001″ —.002″	
Sunwheel bush internal	.877″-.878″	+.005″ +.003″
Shaft diameter at rear steady	$\frac{9}{16}$″ +.0000″ —.0005″	
Torrington bearing	B.97	
Piston Bores:		
Operating piston bore	$\frac{7}{8}$″ +.0005″ dia.	
Miscellaneous:		
Clutch movement, $\frac{1}{16}$″ nominal (1.6 mm.) from direct to overdrive		
Clutch spring free length	1.667″	
Pump plunger spring free length	2″	

SECTION G

PROPELLER SHAFT

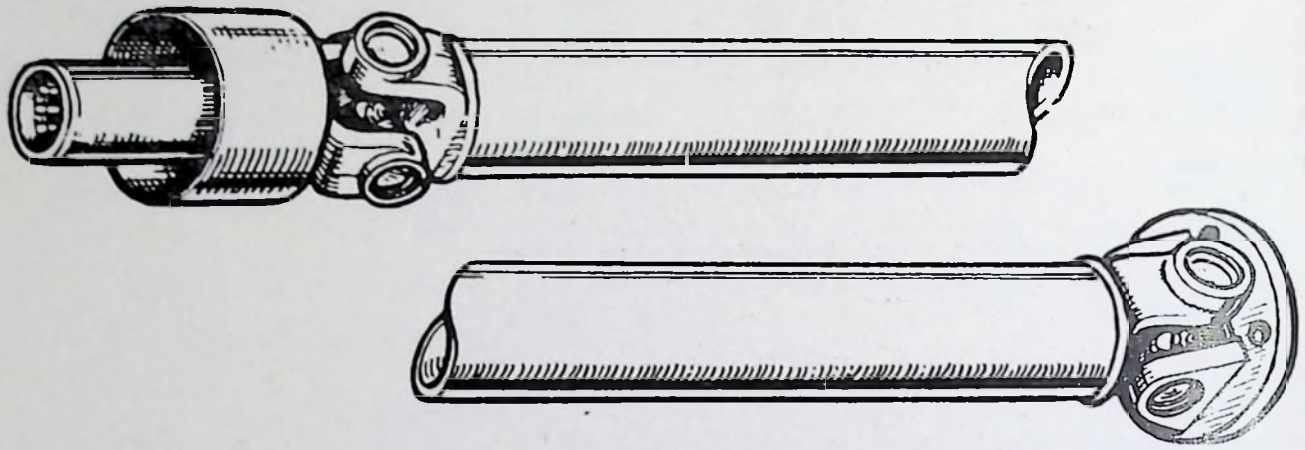


FIG. 1.—The propeller shaft.

General.

A Hardy Spicer needle roller bearing propeller shaft, which is so designed that assembly is very simple, is fitted to the car. The sliding spline portion of the propeller shaft is enclosed within the rear end of the gearbox. Sliding parts are thus lubricated by the gearbox system and freedom of movement is assured.

To Remove and Refit the Propeller Shaft. (See Fig. 1.)

Remove the bolts and nuts from the rear coupling. Note the position of the shakeproof washers; these are fitted under the nuts and should be renewed on refitting.

Lower and withdraw the shaft in a rearwards direction.

Refitting is a reversal of these instructions.

Care must be taken to ensure that the internal splines at the front end of the propeller shaft assembly are kept free from dirt.

When fitted, it is imperative that the heads of the bolts should face the differential unit.

The Universal Joints.

The needle bearing type universal joints are so designed that correct assembly is a very simple matter, no hand fitting or special tools being required.

Individual parts of the needle roller bearing assemblies should not be renewed singly. If replacements are found to be necessary, the complete set of bearing parts comprising journal, complete with gaskets and retainers, needle bearing assemblies and snap rings should be fitted.

The journal and needle bearing assemblies are the only parts subject to wear after prolonged service, and when it becomes necessary to replace these for any reason the work should be carried out as follows:—

To Dismantle.

Remove the snap rings by pinching the ends together with a pair of pliers. If a ring does not readily snap out of the groove, remove the enamel from the yoke holes and tap the end of the bearing lightly, which will relieve pressure against the ring.

Holding the joint in one hand, tap gently with a piece of copper or copper hammer on the radius of the ear of the yoke, as shown in Fig. 2.

The needle bearing will gradually emerge and can finally be removed with the fingers. Be sure to hold the bearing in a vertical position and when free re-

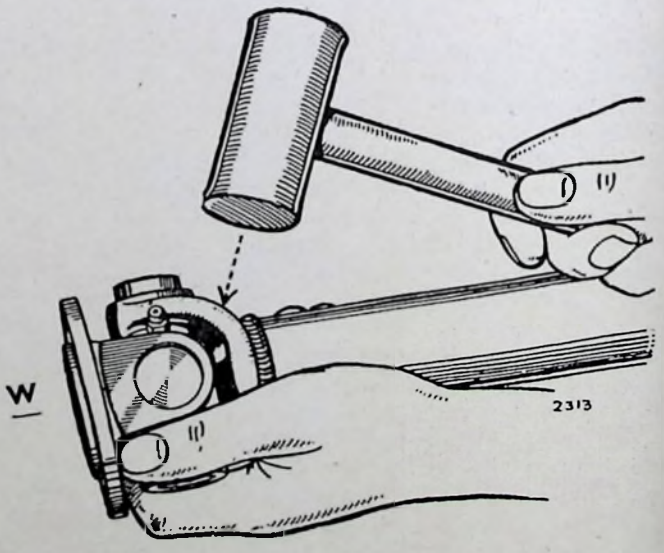


FIG. 2.—To extract the bearing after removal of the snap ring, tap on the ears of the yoke with a copper hammer.

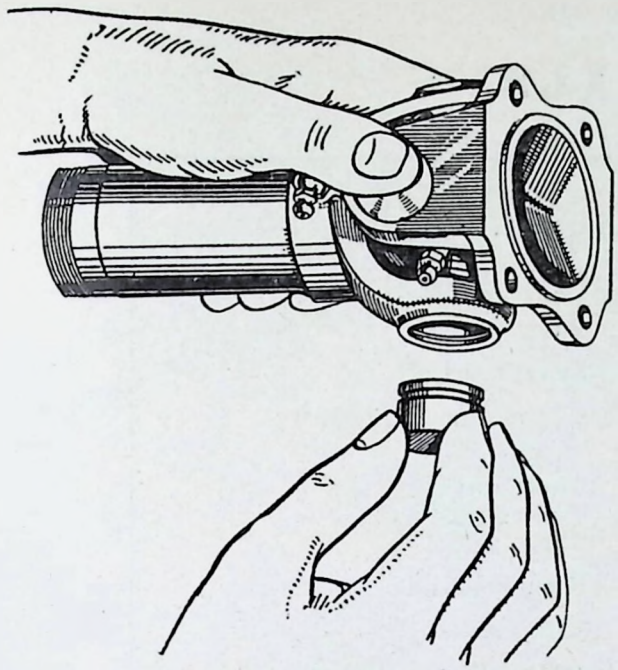


FIG. 3.—Hold the bearing in a vertical position when removing and replacing so that the needle bearings are not displaced.

move the race from the bottom side so as to avoid dropping the needle rollers.

Repeat this operation for the opposite bearing.

Support the two exposed journal pegs on lead blocks (to protect the ground surface) and tap the ears of the flange yoke to remove the race.

Reverse the assembly and repeat the operation.

Wash all parts in petrol or kerosene.

If the parts are not worn, repack with 140 E.P. oil. Make sure that the journal oil channels are filled with lubricant. With the rollers in position, fill the face about one-third full. Should any difficulty be encountered when assembling the rollers in the housing, smear the wall of the race with vaseline. Install the new gaskets and gasket retainers on the journal assembly. The journal shoulders should be coated with shellac or other suitable jointing prior to fitting the retainers so as to ensure a good oil seal. It is also useful to have spare snap rings available as replacements in the event of damaging a ring in assembling the joint.

To Re-assemble.

Insert the journal in the flange yoke holes.

Using a soft, round drift with a flat face, about $\frac{1}{32}$ inch smaller in diameter than the hole in the yoke, tap the bearing into position.

Repeat this operation for the other three bearings.

Fit new snap rings and be sure that these are firmly located in the grooves.

When assembled, if the joint appears to bind, tap the lugs lightly with a wooden mallet, which will relieve pressure of the bearing on the end of the journal.

It is essential that no play exists between the roller races and the bores of the yokes. If the yoke cross-holes have worn oval, the yokes must be replaced.

In the case of the inner yokes, renewal can only be effected by fitting a new propeller shaft, since this yoke is welded to, and balanced with, the tubular shaft.

SECTION H

REAR AXLE

Specifications

Type	Semi-floating.
Casing	Banjo.
Final drive	Spiral bevel.
Final drive ratio	4.78 to 1 or 4.55 to 1.
Bearings:	
Bevel pinion	Taper roller.
Differential and crownwheel assembly	Taper roller.
Hub	Ball.
Filler and oil level plug	Right-hand side.
Oil capacity	1.75 pints.
Differential side bearing pre-load	.002 pinch on each bearing.
Backlash, crownwheel to pinion	.005 to .009.
Pinion bearing pre-load	5 to 9 lbs. in. (new bearings).
Number of teeth:	
Crownwheel	43 (4.78 ratio), 41 (4.55 ratio).
Bevel pinion	9.
Adjustment:	
Bevel pinion	Shims.
Differential assembly	Shims.
Axle shaft nut torque loading	180 to 200 lbs. ft.

General Description.

The rear axle is of the semi-floating type, incorporating a spiral bevel gear. In design it is essentially straightforward, but as the position of the crownwheel relative to the pinion requires accurate adjustment, the original setting should remain untouched as far as possible.

Provision is made for the adjustment of all roller bearings in the differential and bevel pinion assembly. The complete differential unit with crownwheel and bevel pinion is detachable as a unit from the axle assembly. This should be done when it is necessary to carry out any work on the differential unit.

The Bevel Pinion Housing Oil Seal.

In the bevel pinion housing an oil seal is fitted just to the rear of the propeller shaft drive coupling. Whenever a replacement oil seal is fitted, the outside of the cage should be coated with a liquid jointing compound before the seal is pressed into position. These seals operate most effectively in one direction, and thus they should be fitted with the lip and spring facing the rear axle. They are easily removed and replacements can be pressed into position.

The Hub Oil Retainers.

An oil splash guard which consists of an outer ring sandwiched between the rear hub bearing outer track and its abutment in the axle casing, overlapping an inner ring retained between the bearing inner track and its abutment on the axle shaft, is supplemented by an oil seal located in a housing adjacent to the inside face of the brake backing plate, the lip of this seal operating on the machined outer diameter of the rear hub. An effective oil sealing arrangement is thus obtained.

The oil seal is replaceable after removal of the rear hub (described in a later paragraph), and the five nuts and bolts passing through the dust shield, seal housing, brake backing plate and axle casing flange.

To Remove the Axle Shaft.

It is most important that those responsible for the repair of this rear axle should know that the design

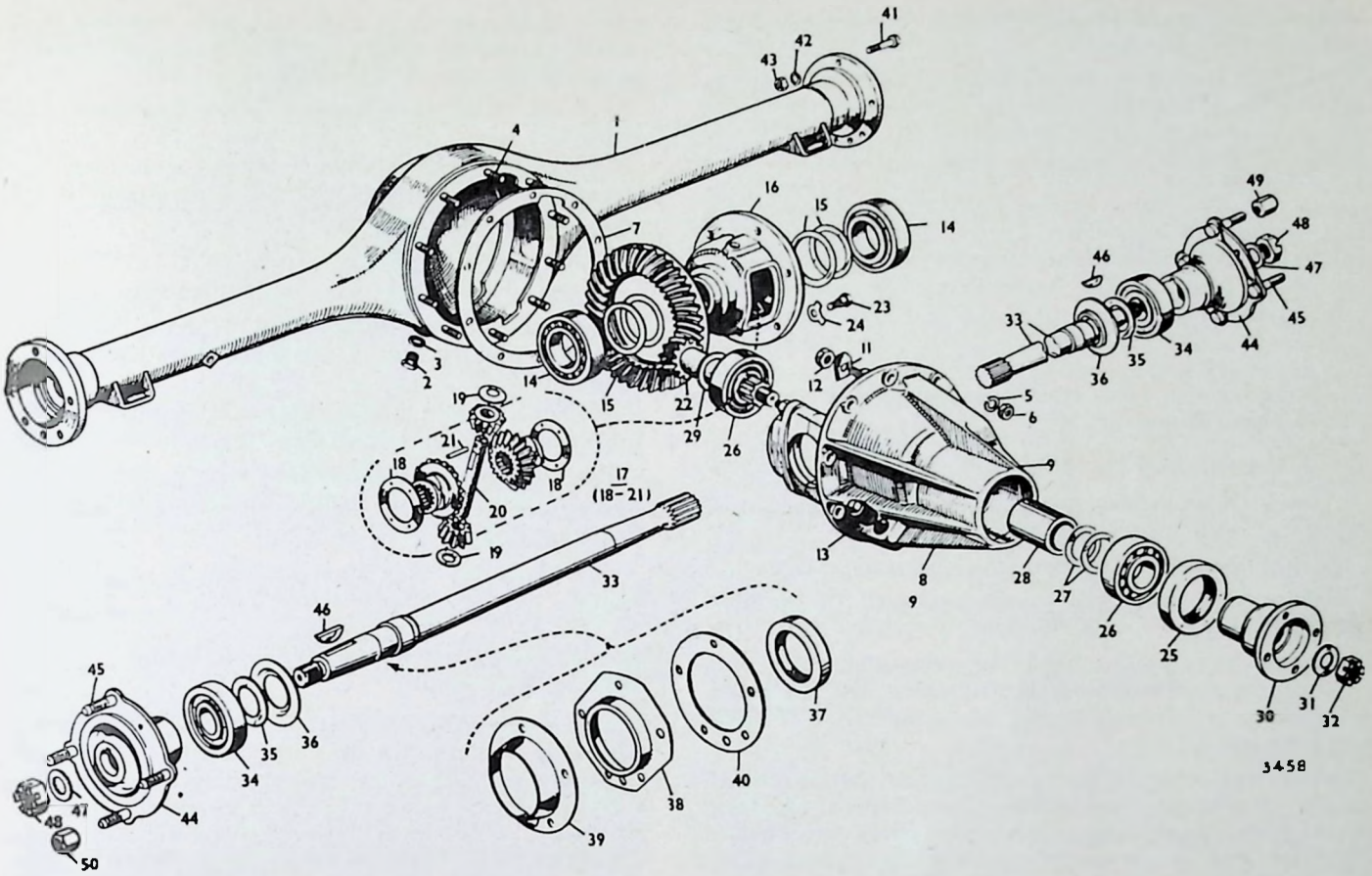


FIG. 1.—Exploded view of the rear axle.

1—Axle casing.
2—Drain plug.
3—Drain plug washer.
4—Stud.
5—Spring washer.
6—Nut.
7—Joint gasket.
8—Differential housing.
9—Differential assembly.
10—Side bearing cap stud.
11—Lockwasher.
12—Nut.
13—Filler plug.
14—Side bearing.
15—Crownwheel.
16—Differential box.
17—Differential box gears (18 to 21).
18—Thrust washers.
19—Thrust washers.
20—Cross-pin.
21—Tapered pin.
22—Pinion.
23—Setscrews.
24—Lockwashers.
25—Oil seal.
26—Pinion bearings.
27—Shims.
28—Distance piece.
29—Pinion spacer.
30—Drive coupling.
31—Abutment washer.
32—Coupling nut.
33—Axle shaft.
34—Axle shaft bearing.
35—Oil guard inner ring.
36—Oil guard outer ring.
37—Oil seal.
38—Seal housing.
39—Dust shield.
40—Joint gasket.
41—Bolt.
42—Spring washer.
43—Nut.
44—Hub.
45—Hub stud.
46—Key.
47—Flat washer.
48—Axle nut.
49—Wheel nut.
50—Wheel nut.

of the rear hub bearing assembly is such that serious damage will result from any attempt to remove an axle driving shaft by any method other than the following:—

Remove the road wheel.

Remove all road dirt from the brake backing plate around its fixing to the axle tube flange.

Remove the setscrews securing the brake drum.

Remove the brake drum.

Release the brake connections from the rear of the backing plate.

Protect the brake connections against the ingress of foreign matter.

Remove the nuts and bolts securing the brake backing plate to the flange on the axle casing.

Fit the axle shaft removing tool over the four wheel studs and secure it by the nuts.

Move the sliding weight sharply along the shaft of the tool against its outer abutment in order to draw the shaft out of the axle casing.

Remove the shaft complete with brake backplate, oil seal, dust excluder and hub.

Remove the outer ring of the splash guard from the bearing recess.

To Refit the Axle Shaft.

Ensure that the brake backplate and axle casing flange around the bearing recess are free from road dirt. It is essential that the bearing remains clean during assembly.

Fit the outer member of the splash guard into the bearing recess with the recessed centre inwards. A little grease smeared around the housing will help

to keep the guard in place whilst entering the shaft and bearing.

Pass the shaft into the casing and enter the splines into those of the axle shaft end wheels.

Carefully drive the shaft assembly inwards until the bearing is fully home in its recess.

Fit the five bolts through the dust excluder, oil seal casing and backplate. Turn the hub to centralise the oil seal before tightening the nuts. Reconnect the brake hoses, fit the brake drum and road wheel.

Bleed the brakes.

To Remove the Hub from the Axle Shaft (After Shaft Removal).

Use special tool RG.188A-1.

Attach the retaining plate to the four wheel studs, using the existing wheel nuts.

Clamp the plate securing the shaft in a vice.

Remove the split pin, loosen and remove the hub retaining nut.

Release the vice, remove the retaining plate and fit the extractor tool over the wheel studs, placing a protector over the shaft thread, and secure it with the four wheel nuts.

Secure the assembly in a vice by the flats provided on the extractor, screw in the centre bolt of the tool to take the load, and smartly tap the end of the extractor bolt — remove the hub and extractor. The dust shield, oil seal, carrier and backplate can now be removed. Remove the key from the tapered end of the shaft.

To Remove the Rear Hub Bearing from the Axle Shaft.

Remove hub, brake gear, etc., as previously described.

Slide the solid ring (part of VLC kit No. RG.188A-1) over the splined end of the axle shaft until the ring impinges on the inner race of the hub bearing.

Screw in the four extension legs and fit the extractor and short protector. Rotation of the centre bolt of the extractor will pull the hub bearing off the axle shaft.

To Refit to Axle Shaft.

It is essential that the hub bearing is always tightly compressed between the sleeve and the hub.

Therefore, when fitting a new hub bearing, the following procedure should be adopted:—

Fit the split bush (part of VLC kit RG.188A-1) to the solid ring. **Note:** It is not necessary to dismantle the tool to fit the split bush. The bearing may be left resting on the tapered portion of the axle shaft and the split bush inserted in the solid ring with the extractor in the fully released position. Alternatively, before fitting the split bush, and after screwing back the extractor centre bolt, the bearing may be removed between the legs of the extractor.

Fit the four extension legs, short protector, and extractor.

Rotate the centre bolt of the extractor until the sleeve has been pulled $\frac{1}{32}''$ in the direction of the outer end of the axle shaft.

Remove split bush.

Remove axle shaft from tool assembly.

Pass the inner splash guard (35) (Fig. 1) and bearing (34), over the end of the shaft. Press the bearing onto the shaft.

Fit key and hub and fit the retaining plate (V.L.C. tool) over the wheel studs, securing it by the nuts.

Place the whole assembly in a vice, fit the nut and tighten with a torque spanner to 180/200 lbs. ft.

Fit split pin.

The assembly may now be refitted to the axle casing. (See "To Refit — Axle Shaft".)

Special Points to Observe When Refitting Hub to Axle Shaft.

The lateral location of the hub bearing is controlled by a sleeve on the inner side of the bearing against which the latter is located by the hub when fully positioned on its taper. It is essential, therefore, that when a new bearing is fitted to the axle shaft, the inner race should be subject to a degree of compression between the sleeve and the hub.

The method of obtaining this compression is described under the heading "To Refit the Rear Hub Bearings".

It can be checked that this compression has been obtained by attempting to rotate the inner splash guard which is interposed between the ring and the bearing inner race.

As the inner track of the hub bearing is an interference fit on the axle shaft it is essential that bearings of the correct type are used.

Note: Bearing sleeves are not supplied separately.

To Remove and Refit the Differential Unit.

Drain the oil from the axle case.

Remove both axle driving shafts as previously described.

Disconnect the propeller shaft from the rear axle driver coupling.

Remove the nuts securing the differential housing to the axle case.

Lift out the assembly.

When replacing the assembly the operations are a reversal of the above.

The joint faces must be clean and free from burrs. Use a new joint and coat both faces with a jointing compound.

Important.—Bleed the brakes on completing re assembly of the rear axle unit.

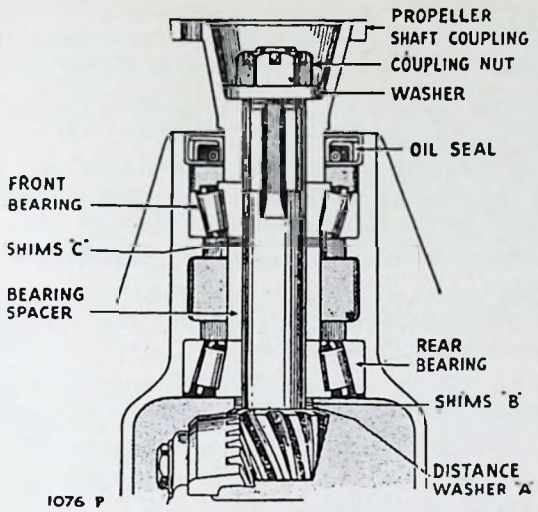


FIG. 2.—View of the bevel pinion assembly.

The Rear Axle Breather.

The breather hole is $\frac{3}{32}$ inch in diameter and is drilled directly on top of the right-hand side of the sleeve of the axle casing 14.2 inches from the centre of the banjo casing.

The breather hole should be kept clear at all times.

To Dismantle and Re-assemble the Differential Unit.

Remove the assembly from the axle.

Remove the caps over the bearings supporting the differential assembly.

Lift off the differential assembly complete with crownwheel and bearings, taking care that the outer races of the bearings are not interchanged, one side with the other.

Knock out the taper pin securing the cross-pin in the differential box.

Push out the cross-pin; the differential pinions complete with the thrust washers can then be carried round and brought out through the wide openings in the differential box.

The differential wheels and thrust washers can now be taken out of the differential box through the same openings. The crownwheel is secured to the differential box by six setscrews, which are locked in position by tabwashers. If it is necessary to remove this for any purpose, two important points should be carefully observed during re-assembly.

1. The faces of both crownwheel and differential box should be thoroughly clean, otherwise there is every possibility of misalignment after re-assembly.

2. The tabwashers for the six setscrews should be renewed.

Reverse the above procedure for re-assembly of the differential gears. If the bearings or crownwheel and pinion are renewed, refer to the instructions laid out in the following paragraphs.

Note.—Should it be found necessary to renew the bearings which carry the differential assembly, the old inner races may be withdrawn by means of a claw type bearing puller. The inner and outer portions of these bearings must be renewed as a pair, as is the case with all bearings of this type. It is not permissible to renew either inner or outer portion separately in any circumstances.

To Dismantle, Adjust and Re-assemble the Bevel Pinion.

Suitable jigs as illustrated are available from Messrs. V. L. Churchill & Co. Ltd., Tool No. RG 328 (H.329C). When adjustment is necessary it can be carried out by the use of these jigs, which are shown in operation in Fig. 3.

Remove the split pin, nut and washer and withdraw the propeller shaft driver coupling. Tap out the bevel pinion, using a soft metal drift to avoid damaging the threads. The inner race of the rear bearing, distance washer A, shims B and C and bearing spacer, which have become detached with the pinion shaft, should be removed. (See Fig. 2.)

The inner race of the bevel pinion rear bearing should be removed from the pinion by means of an arbor press, using a suitably shaped drift block to support the inner race while pressure is applied to the threaded end of the pinion shaft.

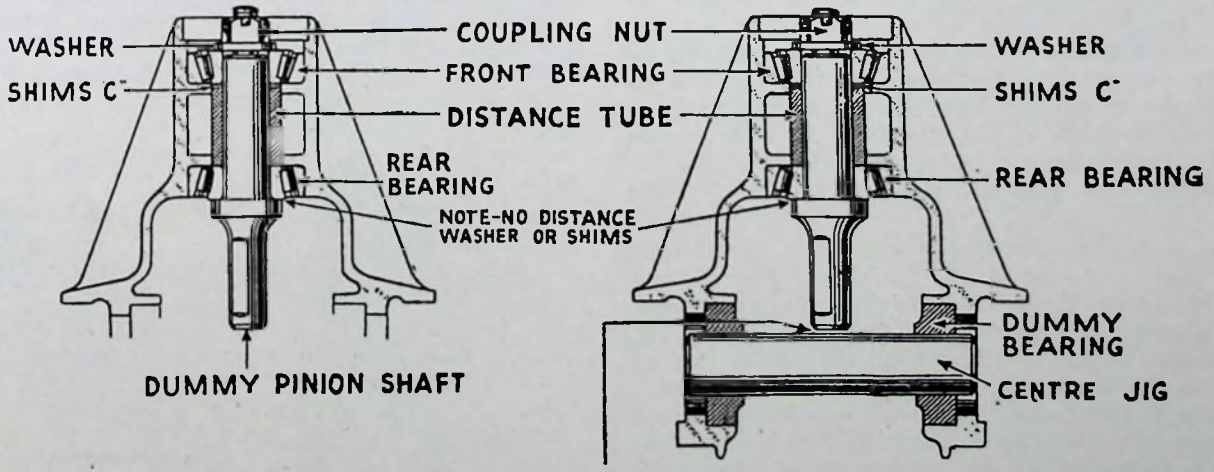


FIG. 3.—Jigs used in adjusting the bevel pinion bearing pre-load and bevel pinion in relation to the axis of the crownwheel

The inner and outer races of the bevel pinion bearings must not be renewed separately as these are mated in manufacture. Failure of a bearing necessitates renewal of the complete bearing assembly, comprising the inner race, rollers and cage and outer race. Remove the oil seal from the nose of the housing as pre-load is checked without the seal.

Now take the dummy pinion shaft and place on it the inner half of the rear bearing, the bearing spacer and any shims which were originally fitted between this and the bearings.

Do not yet fit the shims or washer between the inner bearing and pinion head.

Make sure that the bearing inner race is fully "home" and that no foreign matter is present between the bearing, bearing spacer and shims.

Fit the dummy pinion shaft, complete with both bearings, spacer tube and the original shims; fit the coupling nut and washer and tighten fully. If the shimming adjustment is correct the bearings should be pre-loaded, i.e., tightened beyond the normal position for free movement.

The extent of the pre-load is measured by testing the torque required to turn the shaft; this should be 5 to 9 lbs. in. for new bearings.

When re-assembling the bevel pinion with the original bearings, the pre-load is slightly less; the torque required to turn the shaft in this instance is 3 to 7 lbs. in.

The torque loading can be checked conveniently by means of an ordinary tension type spring balance of suitable calibration. This should be attached to a ring spanner, fitted to the dummy pinion nut, as a lever. This lever should be so arranged that the point of attachment of the gauge shall be 4 inches from the centre of the pinion shaft.

When making the check, the lever should be arranged to point downwards, and the gauge operated at right angles to it. The reading shown on the scale should be $1\frac{1}{4}$ to $2\frac{1}{4}$ lbs., at the 4 inch radius of the lever for new bearings.

After re-assembling with the original bearings the reading shown on the scale should be $\frac{3}{4}$ to $1\frac{3}{4}$ lbs. at the 4 inch radius of the lever.

To obtain the correct pre-load, shims should be added to, or removed from, the location between the bearing spacer and the front bearing. Having established this pre-load, fit the centre jig into the casing, using the two dummy bearings and replacing the two bearing caps with the securing nuts fully tightened.

A gap will exist between the end of the dummy pinion shaft and the centre jig. Place the distance washer shown at "A" in Fig. 2 in this gap and measure the remaining clearance with feeler gauges. This measurement is the thickness of the shims (B), required to be built on to the pinion shaft when re-assembled. In practice, however, it is found that, as the bearing is pressed on to the pinion shaft, the bearing alters in length to the extent of approximately .002. This dimension (.002) should therefore be subtracted from the thickness of shims which would be required to fill the gap and added to the shims (C) at the end of the distance piece between the bearings.

Remove the centre jig and dummy bearings and dismantle the dummy pinion shaft and assembly.

Now take the actual bevel pinion shaft and place on it the distance washer (chamfer towards the gear), followed by the correct thickness of shims (B).

Press on the inner race of the rear bearing.

Place the bearing spacer and then the shims (C), with .002 shim added, on the shank and rebuild the whole into the housing.

When refitting the oil seal, the outer cage should be coated with quick drying jointing compound.

It is essential that of the three apertures in the rear face of the oil seal, one should be at the top or "12 o'clock" position.

This completes the assembly and adjustment of the pinion.

To Adjust and Refit the Crown Wheel and Differential Unit.

Having carried out the preceding operations, remove the differential box bearings (as previously described) and shims. In their place fit the dummy bearings without shims, their inner faces abutting the differential box. Place the differential box assembly (complete with the dummy bearings) in position in the housing, replace the bearing caps and lightly tighten the securing nuts. Paint the teeth of the crownwheel thinly with a light paste made of dry red lead and engine oil and rotate the wheel to obtain an impression of the pinion tooth bearing. When correctly meshed the area of contact of the teeth of the crownwheel is between the crown and the base of the tooth but is considerably nearer the toe (inner end) than the heel (outer end) of the tooth. Adjustment is effected by using a suitable length of tubing to drive the appropriate dummy bearing inwards. Having obtained the correct adjustment, measure the gaps between the outer faces of the dummy bearings and the casing, points A, Fig. 4.

By adding .8125 (the thickness of the dummy bearings) to each measurement at point A, the dimensions C and D are obtained. Now measure the thickness of the actual bearings to be used and subtract these from dimensions C and D. The result gives the thickness of

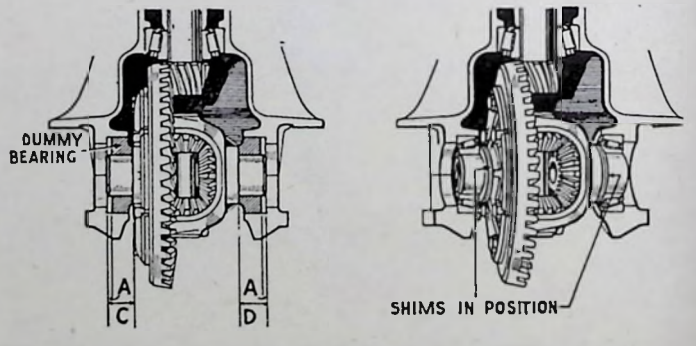


FIG. 4.—Adjustment of the crownwheel and differential box bearings.

the shims required for each side, but .002 must be added to each side to provide the required pre-load for the bearings. Make a careful note of the measurements. Remove the differential box from the casing and dismantle the dummy bearings. Place the shims in position and press on the bearings. Replace the differential box in the housing and refit the caps. The bearing recesses are machined to such limits that the outer member of the bearings will be gripped securely when the bearing cap nuts are tightened.

Measurement of the Bearings of the Differential Unit.

This requires great accuracy and may present a little difficulty. Two methods may be used.

1. A clock gauge is suitably mounted on a surface plate and set to zero on the dummy bearing. The reading then taken on the actual bearing to be used gives the difference.

2. In the absence of a clock gauge the difference between the dummy and the actual bearing can be ascertained by the use of feeler gauges and a straight edge if both are placed on a surface plate.

Adjustment of the Bearings of the Differential Unit.

The foregoing instructions may appear somewhat complicated, but no difficulty should be experienced if the measurements are set out in the manner indicated, it being essential, of course, to deal with each side separately, e.g., side "C":—

Dummy bearing	.8125
Gap "A" (say)	.012
When dimension "C"	.8245
Actual bearing (say)	.8130
Difference	.0115
Pre-load	.002
Total shimming required	.0135

To Check the Adjustments.

If it is considered desirable to check the adjustments effected by use of jigs, this may be done after the assembly of the differential unit by lightly coating the teeth of the crownwheel with a light paste of red lead and engine oil. The crownwheel should then be revolved in both directions, when the marking should be observed and corrected if necessary.

Backlash must be measured at three positions of the crownwheel and must be .005 to .009.

To Remove and Refit the Rear Axle.

As described in the foregoing operations, in the majority of cases it is quite unnecessary to remove the rear axle from the underframe, but in the event of this being necessary for any purpose the following procedure should be adopted.

Remove the rebound straps.

Jack up the rear of the car so that the road wheels are clear of the ground and support the underframe on stands.

Remove the road wheels.

Disconnect the propeller shaft at the rear driver coupling.

Remove the rear shock absorbers.

Disconnect the handbrake cable from the linkage.

Disconnect the rear brake hose at the 3-way union on the axle casing.

Protect the brake hose from the ingress of foreign matter, lift the hose upwards and tie to prevent loss of fluid.

Remove all spring U-bolts.

Withdraw the axle from between the springs.

Re-assembly is a reversal of the above operations.

Bleed the brakes.

Note.—The rear road springs are rubber mounted, the rubber being interposed between the axle casing brackets and the road springs.

When refitting the axle to the road springs, the U-bolts must not be over-tightened as this will destroy the insulation effect of the rubber.

To obtain the correct tightness of the nuts, the use of a torque wrench is strongly recommended.

The correct torque loading for the main U-bolt nuts is 10 to 12 lbs. ft. with the road spring flat, i.e., no camber.

If no torsion wrench is available use an ordinary 6-inch spanner and tighten the nuts until the rubber is compressed just showing signs of being "squeezed out" from the axle bracket and road spring; the pressure required is light; using the wrist only is sufficient.

When fitting the locknuts, use two spanners to prevent the main nuts from turning. For either of the above methods the threads of the U-bolts must be clean and the nuts reasonably free on the thread.

SECTION J

STEERING

Specifications

	Series I and Early Series II.	Later Series II-IIA-III-IIIA.
Make	Burman "P".	Burman "F".
Type	Worm and nut.	Recirculating Ball.
Steering wheel:		
Type	2 spoke.	2 spoke.
Diameter	16½ inches.	16½ inches.
Turns, lock to lock	2.5.	3.15.
Turning circle	34 ft. 3 inches.	36 ft.
Wheel toe-in	$\frac{3}{16}$ inch. (As taken from the wall or periphery of the tyre with the car fully laden.)	
Steering box ratio (straight-ahead)	15.7 : 1.	14.5 : 1.
Total angular movement of drop-arm	75° nominal.	74°.
Rocker arm end float adjustment	Adjusting screw.	Shims.

NOTE.—For steering angles see "Front Suspension" section "K".

Burman "P" Type.

Description.

The steering unit operates on the worm and nut principle, the nut being integral with a long tubular member having a socket assembly built into the lower end, and a brass bush and seal at the upper end, encircling the inner column (Fig. 1).

The ball pin of the socket assembly is tapered and fixed in the rocker arm by a nut secured by a split pin. Axial movement of the tubular member is, therefore, converted to rotary movement at the rocker shaft, at the lower end of which the swing lever is secured by tapered serrations, a nut and lockwasher.

To provide for axial movement of the nut and radial movement of the rocker arm, the inner column tilts in the outer column to a small extent. The upper column bearing is self-aligning for this purpose.

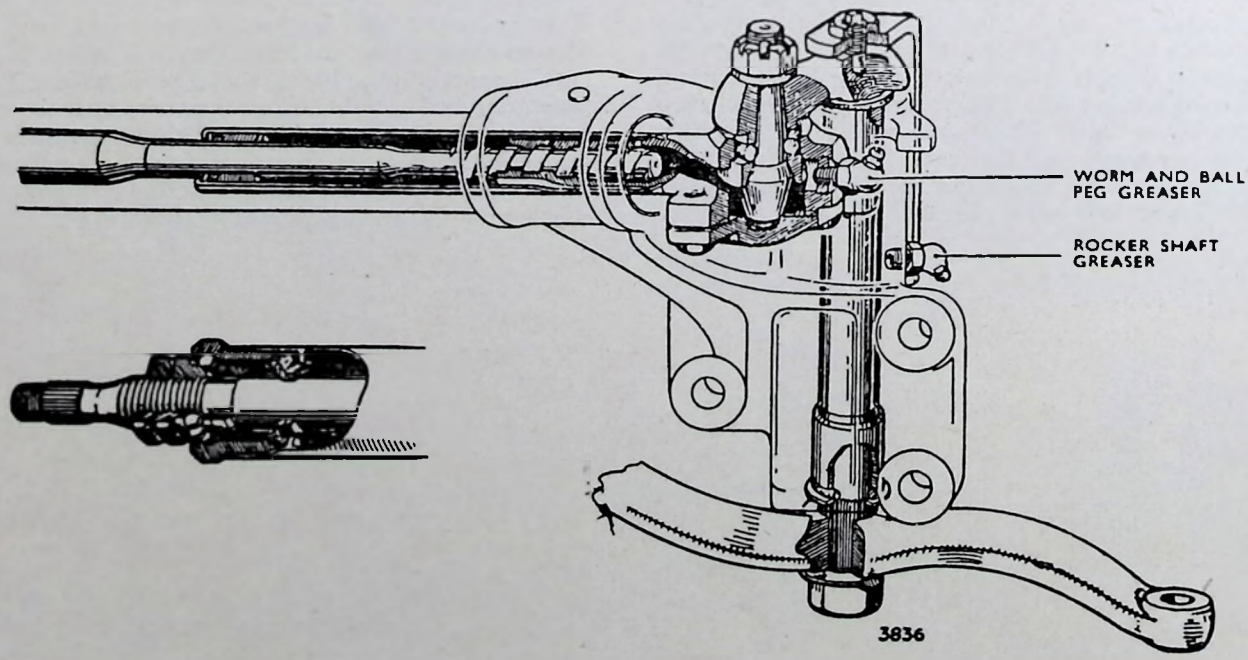


FIG. 1.—Section through the unit, Burman "P" type.

To Remove the Steering Unit from the Car.

Jack up the car and remove the front wheel on the steering box side.

Disconnect the track rod from the drop arm.

Disconnect the battery.

Slacken the three screws around the steering wheel hub and withdraw the horn push or horn ring.

Remove the steering wheel.

Remove one self tapping screw on the right-hand side of the steering column cowl, securing the warning light panel to the cowl and ease the panel carefully off its key location in the cowl, pulling the panel towards you.

Disconnect the wires at the connectors now exposed behind the warning light panel.

Remove the two screws on the left-hand side of the column cowl. Remove the left-hand section of the cowl and ease the right-hand section off the trafficator switch.

Disconnect and remove the trafficator switch.

Disconnect the parcel tray, where required, adjacent to the column hanger clip.

Disconnect the gearchange linkage at the lower end of the column. Move the lever and shaft up into the car.

Disconnect the steering column hanger clip from its hanger on the dash panel, leaving the hanger in position. Remove the clip from the column.

Remove the bolts securing the steering column to the underframe sidemember.

Pull the unit forward to expose the centre track-rod ball joint and extract the joint.

Remove the front seat to enable the upper end of the column to be laid on the car floor.

Raise the lower end of the column and ease the column forward out of the scuttle aperture, removing it from above the front wing.

To Refit the Steering Unit to the Car.

Reverse the above procedure, noting particularly the followings points:—

Always tighten the steering box to the underframe fittings first. This will allow the facia bracket bolts to assume their correct locations in the elongated holes provided. The upper bracket must not be secured until it is known that no strain exists between the column and the facia. It may be necessary to shim between the steering box and the frame to obtain this condition.

As the column cowl is of plastic material, great care must be taken when refitting it and when tightening

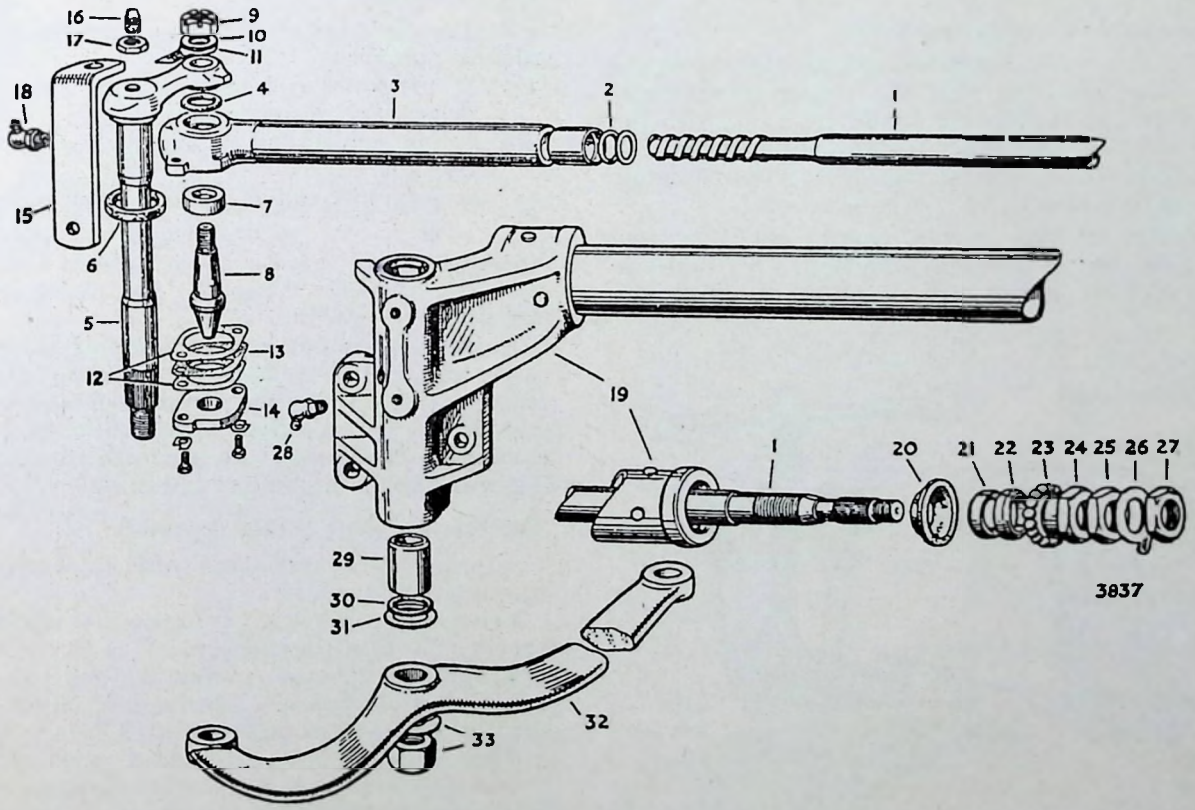


FIG. 2.—Exploded view of the Burman "P" type steering gear.

1—Inner column.
2—Seal.
3—Sleeve assembly.
4—Seal.
5—Rocker shaft.
6—Seal.
7—Bush—ball peg.
8—Ball peg.
9—Nut.
10—Washer.
11—"Oil only" tab.
12—Joint.
13—Shim.
14—Base plate.
15—Adjustment bracket.
16—Adjusting screw.
17—Locknut.
18—Greaser.
19—Main casing.
20—Seal.
21—Collar.
22—Lower track.
23—Balls.
24—Adjusting nut.
25—Locknut.
26—Trafficator cancelling ring.
27—Locknut.
28—Greaser.
29—Bush.
30—Seal.
31—Backing washer.
32—Swing lever.
33—Nut and washer.

the retaining screws. Care must also be taken when fixing the warning light panel.

Ensure that the drop arm is refitted on its correct splines. The rocker shaft and arm are marked.

To Dismantle the Steering Unit.

Release the lockwasher and undo the nut securing the drop arm to the rocker shaft. Draw off the drop-arm from the taper splines, using a suitable puller.

Remove the rocker shaft adjustment bracket from the steering box.

Remove the split pin and nut from the rocker shaft socket assembly.

Remove the base plate, shims, plain washer and paper washers from the base of the socket assembly, noting the number of shims.

Press out the taper peg from the rocker shaft arm, using a universal puller as shown in Fig. 3.

Withdraw the rocker shaft.

Screw the lower sleeve out of the inner column.

Remove the locknut and adjusting nut from the top of the inner column.

Take out the 16 balls.

Withdraw the inner column through the top of the outer casing.

To Re-assemble the Steering Unit.

Insert the inner column through the top end of the outer casing, ensuring that the upper bearing distance collar and inner cone are in position, with the steeper side of the inner cone facing down the column. The cone bearing face is at approximately 45° to the column axis.

Insert the 16 balls evenly around the cone and screw in the adjusting nut by hand until the balls are located. A little grease will assist in retaining the balls.

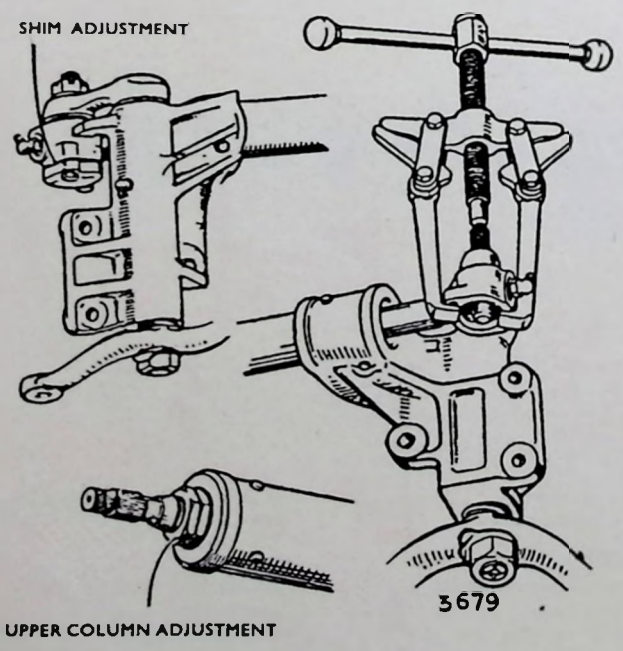


FIG. 3.—Rocker shaft ball peg removal.

Insert the lower sleeve over the inner column worm and turn the inner column until the threads are engaged.

Assemble the rocker shaft peg into the socket assembly. Fit the base plate, shims and washers. Add or subtract shims as required (see "Adjustment"—"Rocker Shaft Socket Assembly").

Fit a new felt washer (6, Fig. 2), insert the rocker shaft and engage the peg in the tapered hole on the rocker shaft arm. Fit the plain washer, nut and split pin.

Adjust the cone bearing at the upper end of the column to allow no end float and free rotation. Tighten the locknut.

Fit the swing lever, together with nut and lockwasher.

Lubrication of the Steering Unit.

Two nipples are provided, as follows:—

1. One feeds the rocker shaft bearings.
2. One in the rocker shaft socket assembly, to feed this joint and the main worm and nut. Gear oil EP 140 should be used.

Note.—Lubricate the worm on the left lock for R.H.D. cars, and the right lock for L.H.D. cars.

The Oil Seals.

Replaceable rubber "O" rings are fitted at the following points:—

(a) At the lower end of the rocker shaft housing (felt washer at upper end).
(b) At the upper end of the rocker shaft socket assembly.
(c) At the upper end of the screwed sleeve assembly.

Adjustments.

The Inner Column:

A cup and double cone bearing is fitted at the upper end and is adjusted by slackening the upper locknut and turning the lower cone nut until no end float exists together with ability to turn the column by hand with the steering wheel removed. Tighten the locknut after adjusting.

The Rocker Shaft Socket Assembly:

Adjustment is carried out with the steering unit removed from the car.

Remove the drop-arm (swing lever) and press the ball peg out of the rocker arm.

Remove the base plate from the ball peg housing and by the addition or subtraction of shims pre-load the peg to give a torque figure of 10 lbs. in. ±2lbs. in.

This figure should be observed when assembling a unit with new parts, but if the old parts are being used again pre-load the peg to give a torque of 5 lbs. in. ±2 lbs. in.

This is the torque figure to turn the ball peg itself. To achieve this loading a suitable double-ended ring spanner can be used. Put one end of the ring spanner on the nut of the peg and the spring balance on the other end. It will be necessary to adjust the spring balance reading to suit the length of the spanner. This can be done by dividing the torque figure re-

quired by the length between the spanner centres. The result will give the amount of poundage that should appear on the spring balance, giving the correct torque figure which should just turn the peg, for example: To obtain a torque of 10 lbs. in., with a 6 in. spanner, divide 10 by 6, which gives 1.7 lbs. required. The peg is turned by pulling the spanner with the spring balance attached.

Finally, a check for side play in the rocker shaft bush in the steering box can be made. This should not exceed .0025.

Rocker Shaft End Float:

The rocker shaft end float is adjusted by a screw and locknut housed in a bracket adjacent to the upper end of the rocker shaft.

Slacken the locknut and turn the adjusting screw clockwise to give very slight pre-load, then re-tighten the locknut. This will ensure that the felt seal is fully compressed.

Having completed the adjustments described above, connect a spring balance to the end of the drop-arm (swing lever).

A pull of approximately 20 lbs. should be required to start the unit moving from rest.

Important:

It should be noted that any tendency for the steering unit to rattle or knock may usually be attributed to:—

Lack of lubrication.

Rocker shaft end float.

Incorrect top column bearing adjustment.

In order to avoid the possibility of unnecessarily removing the steering unit from the car, these points should be checked before attempting to adjust the rocker shaft ball peg assembly. If the latter item is adjusted to eliminate knock, the opportunity should be taken to check the end float of the screwed assembly on the inner column.

This should not exceed .0025. If excessive end float is present an improvement may sometimes be obtained by unscrewing the sleeve from the inner column, which has a two start thread, and replacing it on the opposite starts.

Burman "F" Type.

Description.

The unit which is known as the recirculating ball type, operates in such a way that movements of the inner column and worm are transferred to the nut through the medium of recirculating balls housed within the nut. This provides light and positive steering.

Movement of the nut is transferred to the rocker arm, which causes the rocker shaft to rotate and turn the drop arm (swing lever) which is secured to the shaft by tapered serrations, a nut and lockwasher. A plain Tufnol bearing is fitted at the upper end of the steering column, and ball bearings at each end of the worm support the inner column inside the steering box, these bearings being adjustable and governing the column end location. The rocker shaft is located by the cover plate, end float being controlled by shims. A double coil spring and plunger serve to damp the rocker shaft against road reaction.

To Remove from Car.

Jack up the car and remove the front wheel on the steering unit side.

Disconnect the outer track rod from the drop arm.

Disconnect the battery.

Slacken the three screws around the steering wheel hub and withdraw the horn push or horn ring. Note the snap connector inside the steering wheel boss.

Remove the self-tapping screw on the side of the steering column cowl, securing the warning light panel to the cowl and ease the panel carefully off its key location in the cowl, pulling the panel towards you.

Disconnect the wires at the connectors now exposed behind the warning light panel.

Remove the two screws on the side of the column cowl. Remove one side of the cowl and ease the other side off the trafficator switch.

Disconnect and remove the trafficator switch.

Remove the steering hand wheel.

Disconnect the parcel tray at its inner corner, dropping it clear of the column to give access to the rubber grommet around the column.

Disconnect the gearchange linkage at the lower end of the column by removing the square-headed bolt in the lower lever and driving out the pin from the operating boss for the cable linkage; move the lever and shaft up into the car. Remove two bolts securing the lower support bracket to the steering box and ease the bracket slightly towards the engine to clear the steering column.

Disconnect the steering column hanger clip from its hanger on the dash panel, leaving the hanger in position. Remove the clip from the column.

Move back the front seat as far as it will go.

Remove the bolts securing the steering column to the underframe side member.

Pull the unit forward to expose the centre track rod ball joint and extract the joint.

Raise the lower end of the column and ease it forward out of the scuttle aperture, removing it from above the front wing.

To Refit.

Reverse the above procedure, noting particularly the following points:—

Before inserting the fixing bolts, assemble the column grommet in place around the scuttle.

Offer up the unit to the frame and check the position of the upper column bracket. If this has to be strained into place, shims will have to be made to locate the unit to the frame. It may also be necessary to file the upper bracket to ensure that it fits without strain. It is most important that there should be no tension at the top bracket.

As the column cowl is of plastic material, great care must be taken when refitting it and when tightening the retaining screws. Care must also be taken when fixing the warning light panel.

Ensure that the drop arm is refitted on its correct splines.

The track rods are fitted with rubber bushes rendering lubrication of these parts unnecessary.

When refitting the centre track rod, or when reconnecting either end, it is essential that the steering is in the straight ahead position.

To Dismantle.

Remove the drop arm.

Remove the cover plate, shims and guide roller. Note the damper springs and cup which locate on the rocker shaft.

Remove the three bolts securing the outer column to the steering box and withdraw the outer column, noting the number of shims and paper joints fitted.

At this stage the loose balls in the upper and lower worm bearings will become displaced. There are twelve balls in each bearing and thirteen balls in the nut itself.

To Re-assemble.

Assemble together the nut and tube assembly and pack with grease.

Insert thirteen balls into the nut and tube.

Fit the lower bearing outer track into the recess at the base of the steering box complete with twelve balls packed with grease, to retain the balls during assembly.

Pass the outer track of the upper bearing and the spacing collar over the inner column, pack the outer track with grease, assemble the twelve balls into the upper bearing and hold the outer track in working position.

Pass the worm into the steering box and rotate it to engage the balls of the nut, then lower worm on to bottom bearing, at the same time guiding outer track of upper bearing into box bore. Press firmly into place.

See that the upper bearing is correctly positioned and the spacing collar is fitted. Inspect to ensure that twelve balls are in position in each bearing.

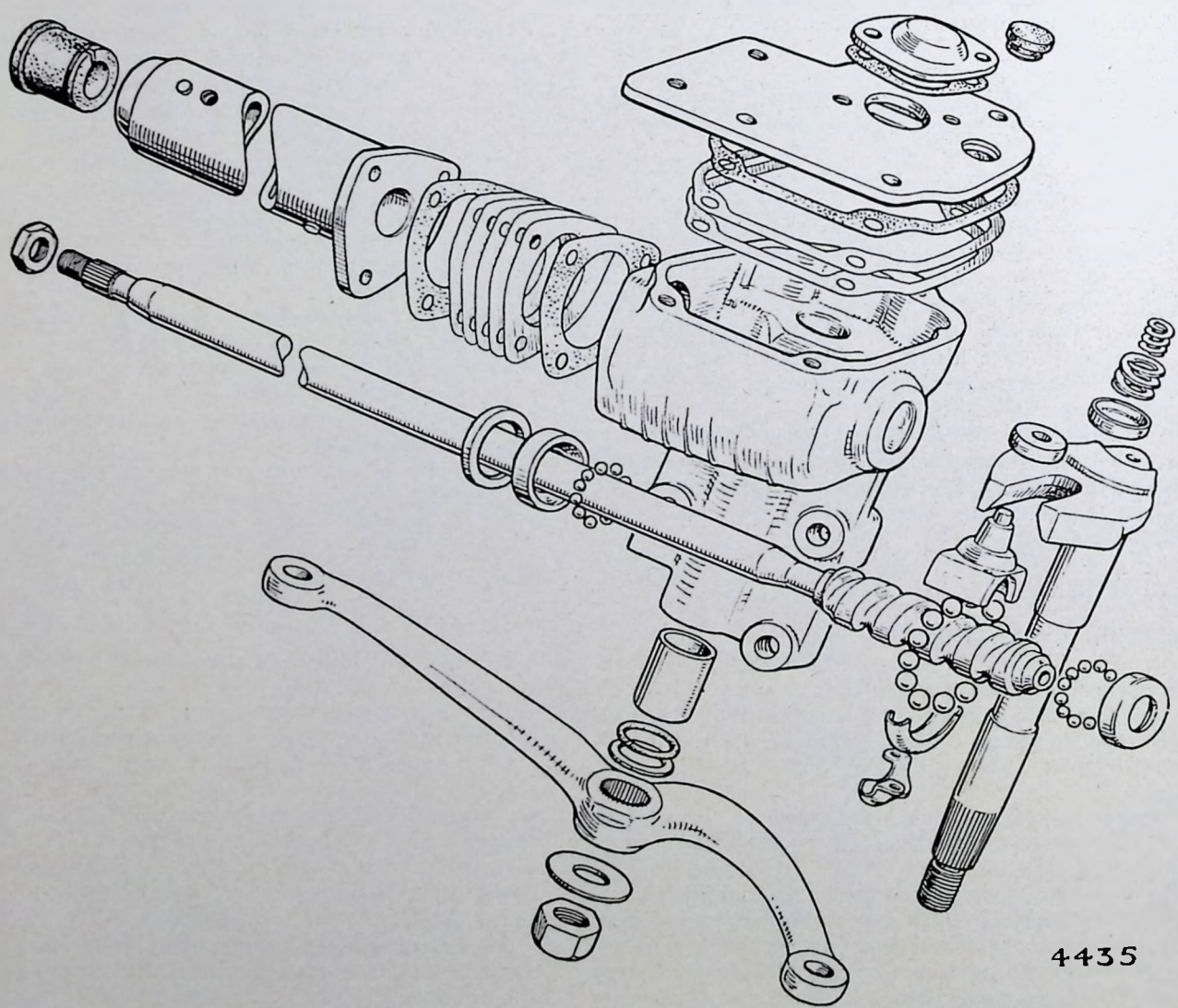


FIG. 4.—Exploded view of the steering gear components, Burman "F" type.

Adjustment.

Inner Column.

Offer up the outer column of the steering box without shims and, using feelers, assess the thickness of shims required to fill the gap. Take out one .0055" steel shim and insert two .002" paper shims.

This gives .0015" preload.

Fit the requisite number of shims with a paper joint on each side and locate them on the steering box flange before fitting the outer column over the inner column.

Bolt up the outer column. The two tapped holes at the top of the outer column face upwards.

Rocker Shaft.

Fit the rocker shaft. Fit the guide roller over the spigot of the nut. Fit the shims, gasket and cover plate.

The cover plate should never be fitted with the thrust cup, springs and flange plate in position. This operation should always be carried out after the cover plate has been properly fitted to the steering box.

Check that in the straight ahead position there is .004"/.008" rocker shaft end float. Adjust with shims.

Fit the thrust cup, springs and flange plate to control the rocker shaft damping.

Fit the drop arm, securing it with its nut and lockwasher.

Fill the unit with oil.

Direction Indicator Switch.

To Remove Switch.

Disconnect the battery.

Remove the column cowl.

Remove the clamping screws securing the switch to the steering column.

Disconnect the wiring at six snap connectors under the facia panel near the steering column to release the switch.

To Refit Switch.

Locate the switch on the column keyway, set it axially so that the striker ring fully engages the switch strikers, but does not foul the switch casing, and secure it with the clamping screws. This ensures that the switch is correctly positioned.

Reconnect the wiring at the six snap connectors.

Refit the column cowl.

Reconnect the battery.

Horn Ring, Cover and Motif Assembly.

Description.

The horn ring consists of a circular central plate with two spokes, to which the outer ring is secured.

This assembly is in turn secured, with the upper and lower horn contact plates, to the underside of the centre cover by three screws. The upper and lower horn contact plates are held apart by three light springs, the upper (moving) plate being insulated and the lower (fixed) plate being earthed.

The whole unit is retained in the hollow centre of the steering wheel boss by three pointed grub-screws clamping on to the horn switch lower contact plate. An external wire running by the steering column, inside the cowling, is attached to an insulated terminal on the flashing direction indicator switch body, feeding a spring loaded plunger which is in contact with a slip ring recessed into the lower face of the steering wheel centre boss. From this slip ring a wire with a snap connector feeds the upper contact of the horn switch, the lower side being earthed through the horn switch lower contact plate and three grubscrews to the steering column, via the splined centre of the steering wheel boss.

Horn Ring Assembly

To Remove and Refit.

Slacken the three grubscrews recessed into, and equally spaced around the steering wheel boss.

Lift up the horn ring or button assembly, withdraw the snap connector from its socket inside the steering wheel boss and then remove the assembly.

Reverse this procedure for refitting, ensuring that the base plate of the horn ring or button assembly is correctly and securely located over the key inside the wheel boss.

Steering Column Cowl.

To Remove and Refit.

Remove one clamping screw at the lower fixing.

Remove one screw at the upper fixing.

Part the assembly, easing one side over the flasher switch.

When refitting, take great care to ensure that both halves fit correctly together before tightening the screws, and that the flasher switch aperture clears the switch lever. Check this with the switch side of the cowl fitted, and the other side removed, to give access for switch adjustment.

Steering Wheel.

To Remove.

Remove the horn ring assembly as previously described.

Undo the centre securing nut.

Mark the position of the steering wheel boss on the splines, if the existing wheel is to be fitted.

Draw off the wheel.

If the flasher cancelling ring, which is clamped around the lower part of the steering wheel boss, has to be removed, mark and note its position first in relation to the steering wheel spokes.

To Refit.

If a new wheel has to be fitted, ensure that the lug on the indicator cancelling ring is correctly positioned as follows:—

With the front wheels in the straight ahead position and the steering wheel located to fit on the correct spline (wheel spokes at 3 o'clock and 9 o'clock), the striking lug on the cancelling ring should be in line with the axis of the flasher switch. If the original parts are refitted and marked as previously described, refitting is straightforward.

Place the wheel over the column splines in the correct position.

Refit and tighten the nut.

See that the striker ring engages the flasher switch.

Refit the horn ring assembly.

SECTION K

FRONT SUSPENSION

Specifications

Type	Independent coil spring and swinging link.	
Spring:		
Outer diameter	4.46.	
Static laden length	7.75 + 010.	
Static load	1,150 lbs.	
Free length	11.52.	
Castor Angle:		
Series I and early Series II	3° 33′ ± ½°.	With car Fully laden.
Later Series II and Series III	1° 45′ ± ½°.	
Estate car	2° 58′ ± ½°.	
Camber angle	0° 45′ ± ¼°.	
King pin inclination	5° 15′ ± ¼°.	
Toe-out on turns	Inner wheel 22½°. Outer wheel 20°.	

Note.—For correct method of checking with gap gauges see text.

Toe-in	$\frac{3}{16}$″ (taken at tyre side wall with car laden).
Wheel lock angle	25° on each outer lock.
Length of top link	7.625.
Length of bottom link	12.85.

General Description.

The front suspension is of the coil spring and unequal length wishbone type, employing long inner fulcrum pins threaded at each end to carry the bushes of the upper and lower links. Provision for camber adjustment is made by the insertion of shims between the upper fulcrum pin and its bracket location on the crossmember (Fig. 5 and Fig. 6).

The stub axle is located, by means of a ball socket assembly, directly into the outer end of the upper link and by means of a short swivel pin into the trunnion. A short threaded outer fulcrum pin completes the connection between trunnion and lower link. Thrust is taken via a nut and thrust washer to the lower face of the stub axle swivel. This design obviates the necessity for a separate stub axle carrier, thus affording a saving in unsprung weight. A sectional view of the near side of the front suspension is shown in Fig. 6.

On certain Series II cars the castor angle has been reduced, and attention is drawn to the information given on page 5.

Front Suspension and Alignment Check.
Preparation of Vehicle.

When carrying out checks on the front suspension and steering dimensions, the following requirements must be met.

1. The car must be placed on a perfectly level floor or level ramp.
2. Tyres must be inflated to their correct pressures.
3. For checking the front wheel track the car should be in a laden condition.
4. For a complete geometry check the suspension system must be loaded down on to four gap gauges by placing enough weight in the front compartment of the car to grip the gap gauges. This brings the car to a condition in which the camber and castor angles are checked. At the front, steel gap gauges are used between the lower link and underside of the crossmember each side as illustrated in Fig. 2. At the rear, hardwood gap gauges are placed between the top of the axle casing and chassis frame, the blocks being shaped to clear the bump rubbers and to fit on the axle casing each side as illustrated in Fig. 9. Usually the car has to be slightly lifted by hand on the rear bumper to enable the rear wood gap gauge to be placed in position. Should this not be so and the gap gauge is not properly gripped, a small amount of weight should be placed in the back of the vehicle to bring it down on to the gap gauge. The approximate weight required is 350 lb. evenly spaced in the front. Excessive loading should, of course, be avoided.

Dimensional details of front and rear gap gauges are given in Figs. 8 and 9.

To Adjust Toe-in.

Slacken the locknuts on the outer track rod ball joints.

Using a suitable toe-in gauge check the alignment of the wheels.

Note the difference between this reading and the recommended setting.

Adjust the alignment by rotating each outer track rod equally until the recommended setting has been attained.

Re-tighten the ball joint locknuts, at the same time making sure that the balljoint sockets at each end of the track rods are centrally disposed with their ball pins so that the track rods are free to turn slightly.

Setting up Outer Track Rods.

If new track rods are being fitted after accident damage, or if excessive tyre wear is present, the following procedure should be observed to ensure correct toe-out on turns when the wheel track is correct.

1. Disconnect each outer track rod inner ball joint from the drop arm and idler lever.
2. Count the number of steering wheel turns from lock to lock (in the steering unit).
3. Obtain the mid-position of the steering unit by turning the wheel back half this amount from full lock, and KEEP IT IN THIS POSITION.

   N.B.—It is most important that great accuracy is observed when carrying out item 2 and 3, and it is recommended that the steering unit is marked appropriately and a datum line or pointer is used to achieve this.
4. If necessary, reposition the steering wheel on its splines so that the spokes are straight across.
5. Reconnect track rods to drop arm and idler lever.
6. Prepare the car for a steering geometry check as described earlier.
7. Check the measurement at the front of the car between the centre of each tyre tread and the greaser on the lower link inner fulcrum pin.

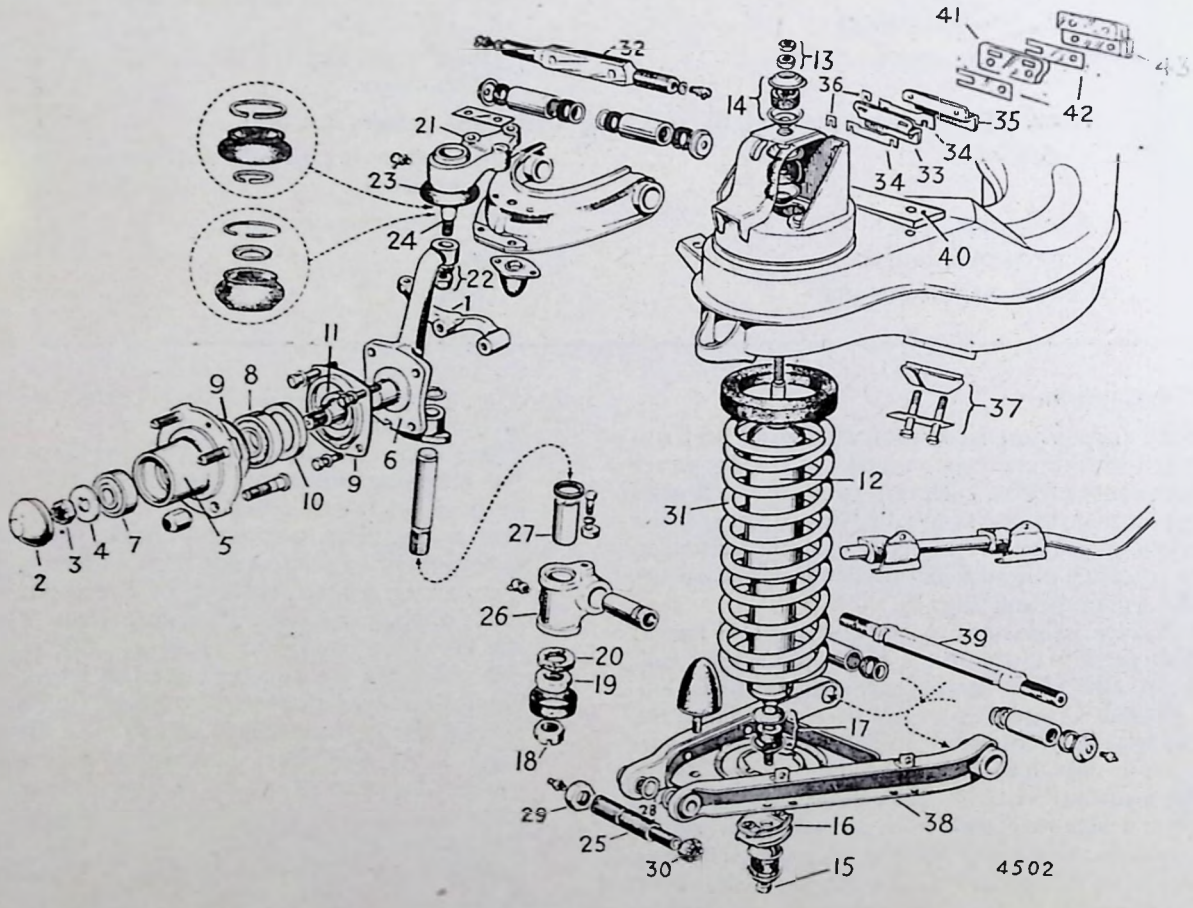


FIG. 1.—Exploded view of the front suspension components.

1—Steering arm.
2—Cap.
3—Axle nut.
4—Axle washer.
5—Hub.
6—Stub axle.
7—Outer bearing.
8—Inner bearing.
9—Oil catcher.
10—Grease seal.
11—Distance piece.
12—Shock absorber.
13—Nut and locknut.
14—Upper shock absorber rubbers and washers.
15—Lower nut.
16—Lower plate.
17—Rubber and cup washers.
18—Locknut.
19—Adjusting nut.
20—Thrust washer.
21—Upper swivel assembly.
22—Nut and washer.
23—Dust seal.
24—Ball joint.
25—Lower link eyebolt.
26—Trunnion.
27—Trunnion bush.
28—Seal rings.
29—Locknut.
30—Castellated nut.
31—Coil spring.
32—Fulcrum pin (upper).
33—Upper bracket.
34—Shims.
35—Frame bracket.
36—Small shims.
37—Fixing bolts.
38—Bottom link.
39—Inner lower fulcrum pin.
40—Mounting wedge.
41—Bracket.
42—Shim.
43—Bracket.

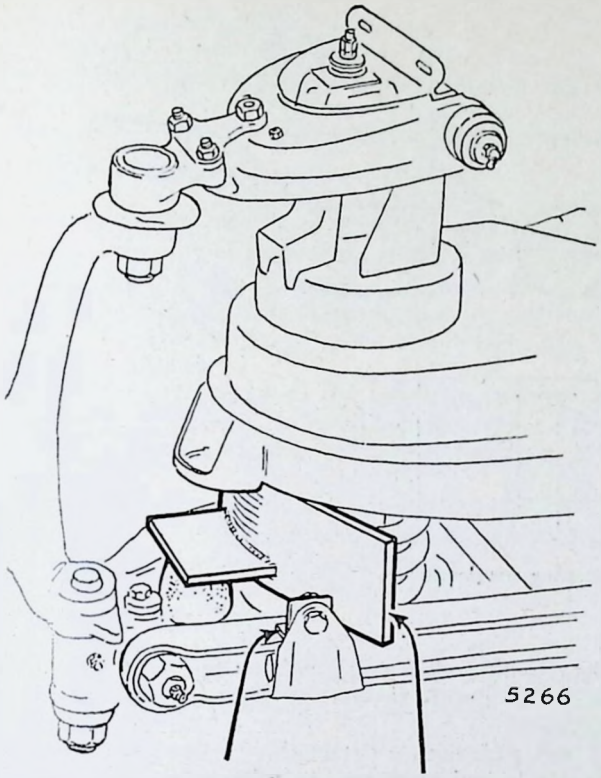


FIG. 2.—Front suspension loaded down on to the steel gap gauge.

8. These measurements should be equal on each side with the steering unit and idler lever in the straight ahead position.

9. Adjust each outer track rod until these measurements are equal. THE TRACK RODS MAY NOT NECESSARILY BE OF EQUAL LENGTH WHEN THIS HAS BEEN DONE.

10. Check the front wheel toe-in before tightening the track rod lock nuts and adjust both outer track rods EQUALLY to obtain the correct toe-in.

Important.

Attention is drawn to the vital importance of maintaining correct alignment of steering ball joints.

If any misalignment exists, angular deflection of the pins under conditions of bump and rebound may cause the sides of the pins to contact the necks of the ball joint housings. This condition is liable to promote a high rate of wear resulting in early failure.

Therefore the importance of checking this point, after track rod adjustment, cannot be over-emphasised.

When track has been adjusted or the ball joint lock nuts slackened for any purpose, it is essential to make sure that the pins are CENTRAL IN THEIR HOUSINGS when the vehicle is in the static laden condition.

It is recommended that the ball joint alignment is checked as a routine measure during the 12,000 miles (19,200 km.) service.

Toe-Out on Turns.

When the front wheels are turned from the straight ahead position to negotiate a left or right-hand bend the arc described by the front wheel nearest the inside of the bend is of smaller radius than the arc described by the outside wheel.

In order that each front wheel shall follow its respective arc, the inside wheel, or the wheel nearest the centre of turn, requires more "lock", i.e., it must be turned through a greater angle, than the outside wheel.

To achieve this, the steering arm attached to each stub axle is set inwards when viewed from above, and the steering drop arm and idler lever must be disposed correctly to their respective steering arms. This is ensured by correct outer track rod adjustment.

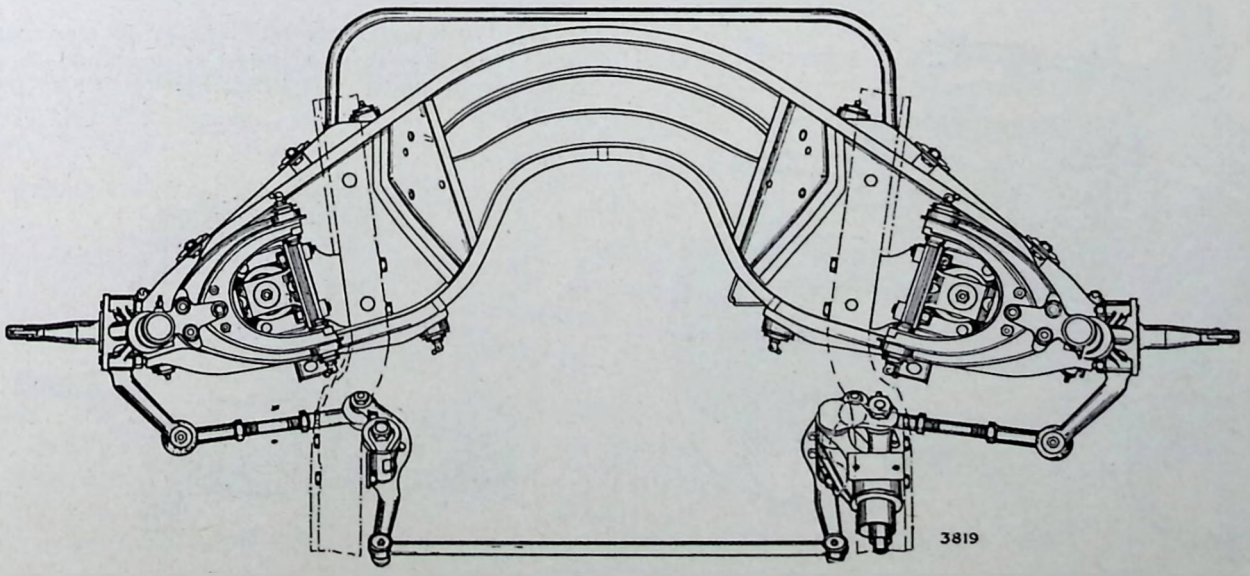


FIG. 3.—Plan view of the steering linkage.

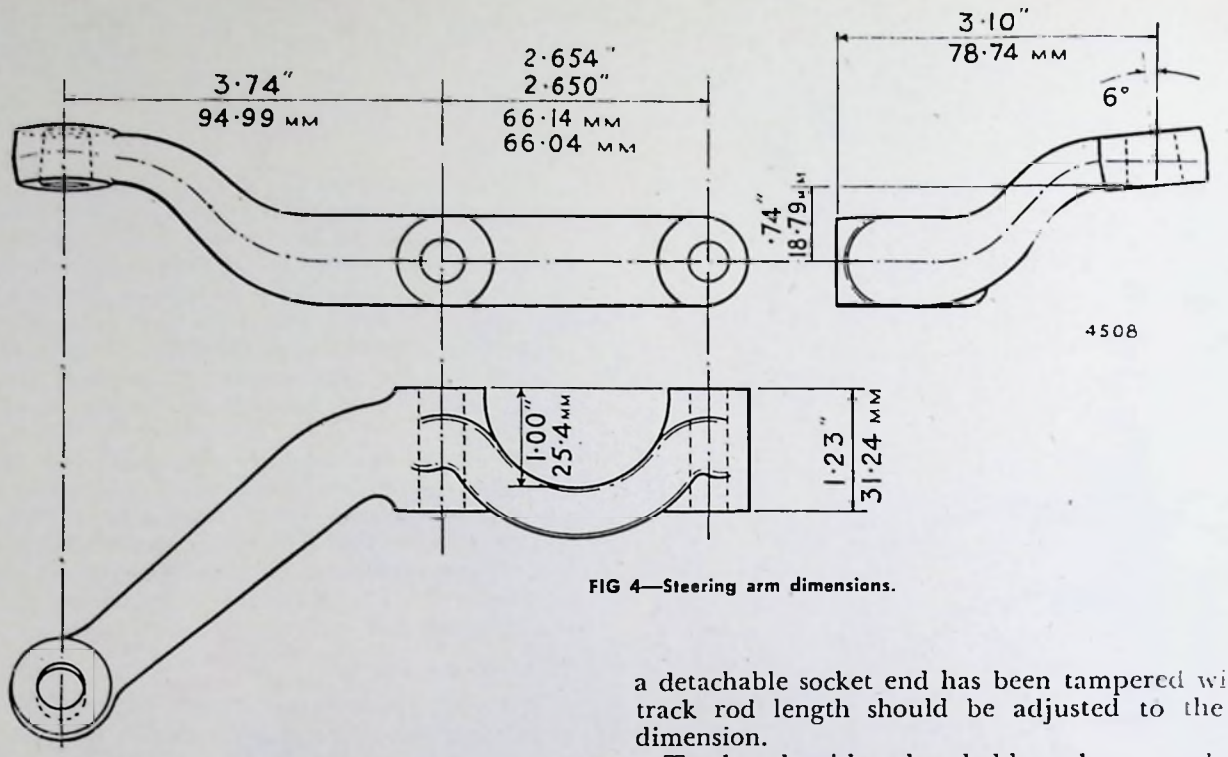


FIG 4—Steering arm dimensions.

The centre track rod is not adjustable and therefore the drop arm and idler lever will remain in correct relationship unless this rod is bent. A limited number of track rods have one detachable socket end. The length between centres of ball pegs on both types of rod must be 21 inches. If it is suspected that a detachable socket end has been tampered with, the track rod length should be adjusted to the above dimension.

Track rods with a detachable socket must have the detachable end fitted on the idler lever side.

To Check the Angles.

With the front wheels resting in turntables, move the offside front wheel through a 20° forward turn (to the left).

The turntable scale under the near side front wheel should then read 22° 45′ ($\pm \frac{1}{4}°$).

Now move the nearside front wheel through a 20° forward turn (to the right).

The turntable scale under the offside front wheel should read 22° 45′ ($\pm \frac{1}{4}°$).

If either of the above readings is outside of the specified limits, with the front wheels having correct toe-in:

(a) The outer track rod lengths are not correctly set. They should be adjusted as described in earlier paragraphs under SETTING UP OUTER TRACK RODS.

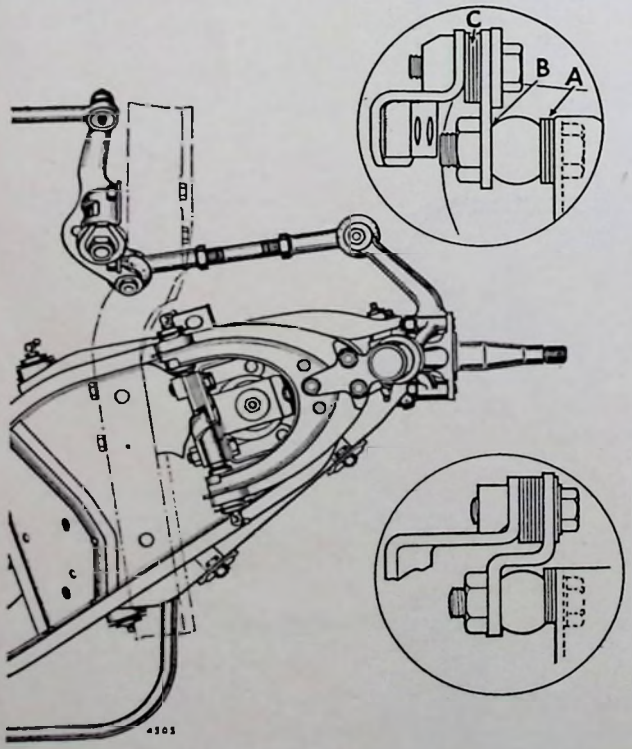


FIG. 5.—Plan view of the front suspension showing camber shim positions.

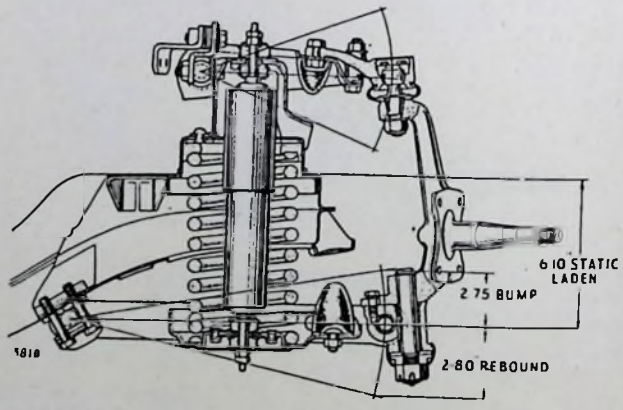


FIG. 6.—Sectional view of suspension unit showing static laden position.

(b) A track rod is bent.
(c) A steering arm or arms are bent.
Fig. 4 gives the correct dimensions of the steering arm.
Bent parts should be renewed as it is not advisable to straighten them.

Wheel Lock Angles—To Adjust.

The maximum wheel lock angle gives a wheel angle of 25° on the outer wheel. Turntables should be placed under each front wheel and the adjustable stops on the trunnions set on the outer wheels in the following manner.
Turn the steering on to the left-hand lock and set stop on the right-hand (offside) wheel to 25° because on this lock the outer wheel is on the right-hand side (offside).
Turn the steering on to the right-hand lock and set the stop on the left-hand (nearside) wheel to 25° as this wheel is now on the outer lock.

Castor Angle Readings
(Vehicle Loaded on to Gap Gauges).

The designed castor angle can only be obtained when the vehicle is loaded down to the static laden condition front and rear.
The gap gauges used for service checking of front suspension angles have been purposely made to require the smallest amount of weight for loading the vehicle on to the gauges, and with the front and rear gap gauges in position, the correct castor angles are those given on this page.
On Series II Saloons after the chassis numbers given below the castor angle has been reduced.
The reduced castor on Saloon models is achieved by the introduction of wedges (tapered packing pieces) between the front crossmember and frame.

Castor Angle
(with Vehicle Loaded on to Gap Gauges).

Series I	+2° 13′ (approx. $2\frac{1}{4}$°)
Series I (with wedges)	+0° 25′ approx. $\frac{1}{2}$°)
Series II and III without wedges)	+2° 13′ (aprox. $2\frac{1}{4}$°)
Series II (with wedges)	+2° 13′ (approx. $2\frac{1}{4}$°)
Estate Car (Series II and III (wedges not fitted) ...	+1° 38′ (approx. $1\frac{3}{5}$°)

The chassis number introduction points for the castor angle reduction on Series II models are:—

Series II Saloon and Coupe	From A.7800576 less 79 and 82
Series II C.K.D.	From introduction

Camber Angle—To Adjust (See Fig. 1).

If, on checking, it is found necessary to effect an adjustment to the wheel camber, proceed as follows:—

1. **On Series I and early Series II cars having cranked top bracket as shown in Fig. 5 bottom inset.**

Remove road wheel.
The upper link inner attachments can now be seen.
SLACKEN the nuts retaining the upper fulcrum pin (32) to the crossmember.
SLACKEN the bolts between brackets (33 and 35) to permit selection of shims. To increase the wheel camber angle remove shims (which are slotted for convenient removal or refitting) from the road wheel side of the upper fulcrum pin (32). To decrease the wheel camber angle add shims to the road wheel side of the upper fulcrum pin.
If shims are removed from between the upper fulcrum pin (32) and crossmember, these shims should be fitted between the frame bracket (35) and the frame. (See Fig. 5 inset.)
If extra shims are fitted between the upper fulcrum pin and crossmember, the same thickness of shims should be removed from between the frame bracket and frame.
Shims for these two locations are interchangeable and are the twin slotted type. On early cars a single slotted "button stick" type of shim was used at the frame bracket.

2. **On Series II and any Series I and II later cars having flat top bracket as shown in Fig. 5 top inset.**

To increase the camber angle move the required number of shims from position (A) to position (B). (See Fig. 5 top inset.)
To decrease the camber angle remove the required number of shims from position (C) and add a similar thickness of shims to position (A)—OR if shims are found in position (B) remove from this position and insert in position (A).

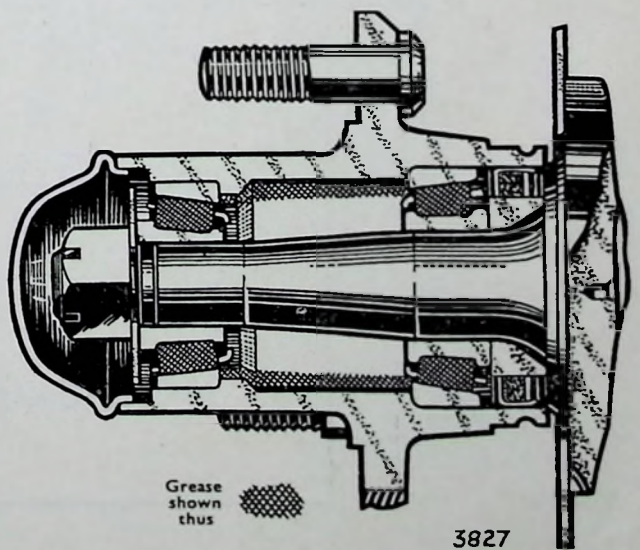


FIG. 7.—Correctly packed hub.

Note.

Small shims are sometimes found at either end of these shim locations, and should be replaced in their previous positions.

The purpose of these shims is to ensure correct alignment of the upper and lower link, which is necessary to give free movement of the axle carrier, or to deal with any lack of parallelism between the frame bracket and frame.

It is important to ensure that all shim fixing bolts are properly tightened and not in any way thread bound and giving a false impression of tightness.

This especially applies to the two bolts that screw into the frame bracket, Item 35 or 43, Fig. 1. The ends of these bolts must have full thread engagement in the threads of the frame bracket.

The relationship of the wheel camber angle to track or "toe-in" is such that the track setting must always be checked following a wheel camber reset.

Checking Steering Ball Pin Heights.

After accident damage, or in a case of excessive tyre wear, these dimensions should be checked. If they are outside the limits shown in Fig. 11 the wheels will not remain in track as the suspension system reacts to rough road surfaces.

The dimensions are taken between the following points after removing both outer track rods.

(a) The lower link outer fulcrum pin centre and the underside centre of the taper hole in the end of the steering arm.

(b) The lower link inner fulcrum pin centre and the centre of the taper hole in the Swing and Idler Levers on their underside face.

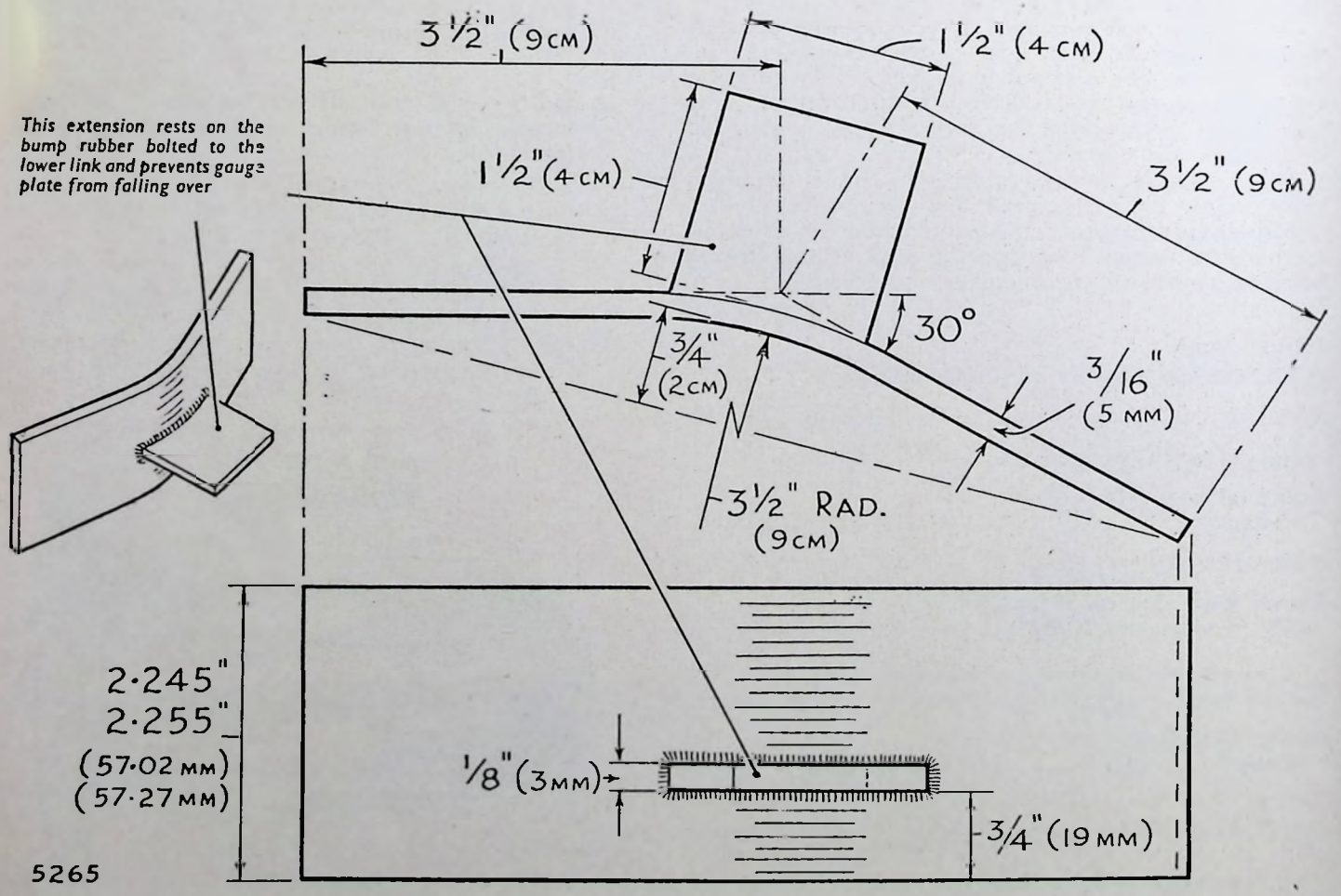
Steering ball pin heights are checked by means of a scribing block used on the simple tool illustrated in Figs 10 and 11. This tool is necessary as it enables measurements to be taken from the lower link fulcrum pin centres which are the correct datum points.

The tool can be cheaply and easily made from angle iron and bright strip steel. Its details are shown in Fig. 12 with convenient alternative metric dimensions.

Note.

It is impossible to check ball pin height dimensions from a level surface plate because the fulcrum pins lie at the castor angle and not in a horizontal plane.

The following procedure should be followed when making these checks:—



MATERIAL $\frac{3}{16}$" (5 mm.) MILD STEEL

FIG. 8.—Details of the steel gap gauge.

Ensure that the wheels are in a straight ahead position noting steering wheel position. Remove both outer track rods and check that front wheels and steering wheel positions remain unaltered.

Remove greasers from both ends of each lower link inner fulcrum pin.

Fit up tool as illustrated in Fig. 10, making sure that no slackness exists between centres and greaser holes.

The centres of the large end of the taper holes are found as follows:—

The taper part of a discarded ball socket can be put into the taper hole and cut off and filed flush at the largest end of the taper hole. It is then a simple matter to mark the centre of the now flush fitting taper shaft.

Using scribing block, measure the height of the scribed lines immediately behind the centres on

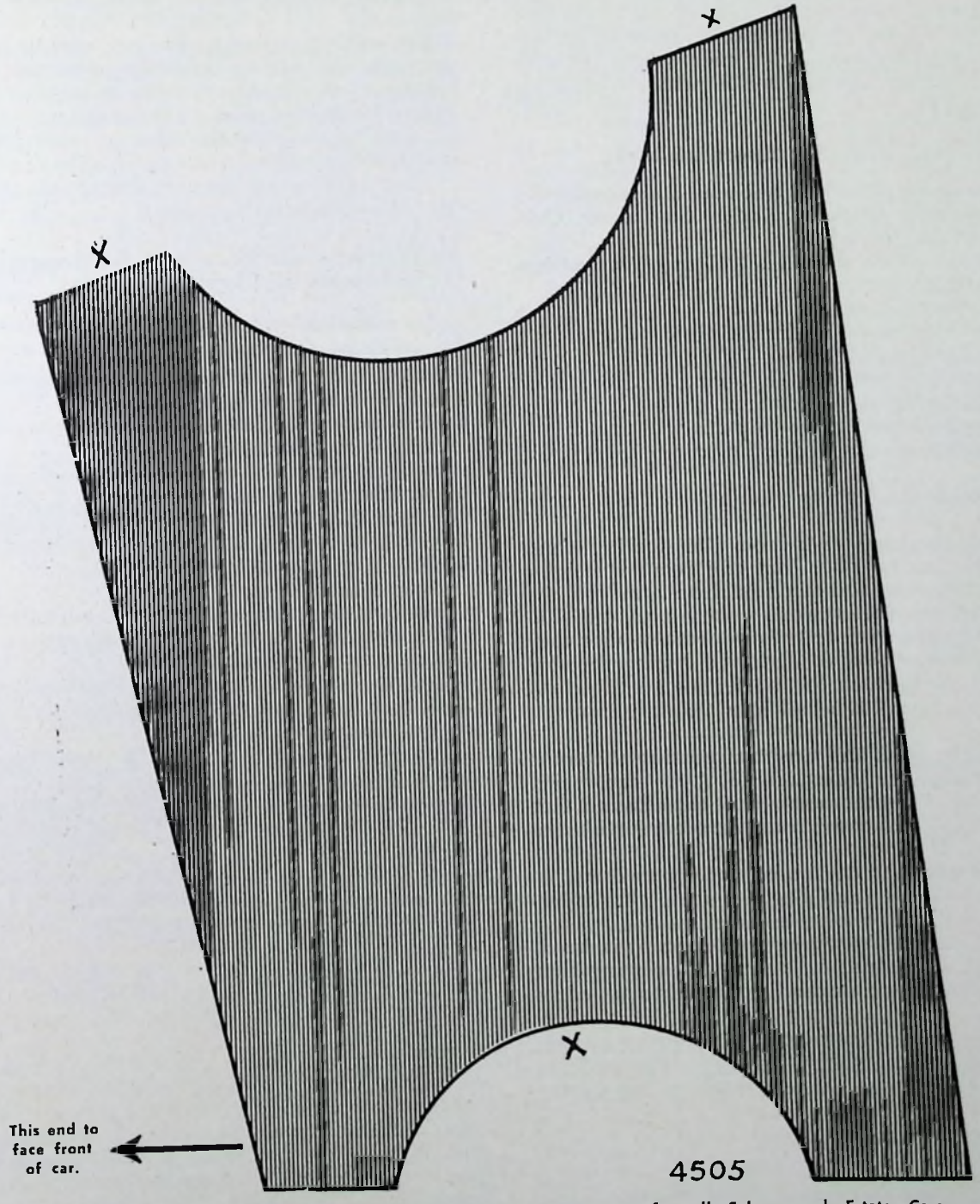


FIG. 9.—Details of the rear suspension wooden gap gauges for all Saloon and Estate Cars. This item should be made from 1 inch thickness hardwood by glueing a carefully made tracing of this illustration to the wood.

It can then be cut to shape on a bandsaw. The important faces are marked with an X.

brackets item 3, from the measuring surface item 4, see Fig. 10. These heights should be equal.

Measure the height of the centre made on the drop arm and idler lever. (See Fig. 11.)

From these dimensions subtract those taken of the respective centre heights. If the ball pin heights are correct the results should be the dimensions shown in Fig. 11.

The steering arm ball pin heights are checked in a similar manner except that the centre height is taken from the greaser centre at the rear of the lower link fulcrum pin. Owing to the nearly level underside face of the steering arm outer end, it is possible to check the steering arm dimension without plugging its taper hole.

To Remove and Refit the Suspension Unit.

Raise the car by placing a jack with a block of wood or other suitable packing under the front crossmember.

Place stands under the sidemembers of the underframe.

Remove the road wheels.

Disconnect the main hydraulic fluid pipe at the right-hand side front connector. Wherever it is necessary to disconnect the brake hoses, do not allow hydraulic brake fluid to come in contact with the bodywork, otherwise damage to paint will result.

Place wooden blocks under the sump to support the engine.

Disconnect front engine mountings from crossmember.

Disconnect the track rods from the steering arms.

It is important to note that the relative heights of the steering arms and steering drop arm and the angles of the steering arms in relation to the stub axles are critical; therefore it is imperative that they should not become bent or distorted during removal of the ball pins to which the track rods are attached.

Remove split pins from ball joint retaining nuts.

Remove nuts.

Remove eight bolts and washers securing the front crossmember to the underframe (two each side through the holes in the underside of the crossmember and two each side attaching frame bracket to fulcrum pin bracket).

It is not necessary to disconnect the upper links.

Steady the assembly and lower it from the underframe.

Note the slotted distance pieces (36, Fig. 1) if fitted.

Reverse this procedure for refitting, ensuring that all location points are clean and free from rough edges and burrs.

AFTER RECONNECTING THE HYDRAULIC BRAKE HOSES IT IS ESSENTIAL TO BLEED THE BRAKE SYSTEM IN ORDER TO REMOVE AIR.

Crossmember Details.

Later Series II cars having the reduced castor angle (see page 5) have two taper wedges riveted to the top of the crossmember on new production. (See Fig. 1, Item 40.) Two packing pieces are spot welded to the inside of the crossmember. These packings are used to obtain a proper face for the crossmember fixing bolt head faces to bed on.

A few vehicles were assembled with loose wedges between the front crossmember and the frame members and loose packing strips under the crossmember fixing bolts. When replacing crossmembers on these cars, the thick end of the wedges must face the front of the car and thin ends of the packers used under the bolt heads must also face the front of the car.

Replacement crossmembers are supplied without the wedges riveted on the crossmember and it is important to see that the correct crossmember is fitted. Where wedges are used, a crossmember having internal packing pieces spot welded on to the top inside face of the crossmember must be fitted.

These packings can be seen through the crossmember underside fixing bolt holes.

To Dismantle and Re-assemble the Suspension Unit (Unit Attached to Chassis.)

To dismantle and re-assemble the front hubs.

Slacken the road wheel nuts.

Jack up the front end of the car (using a block of wood under the front crossmember).

Remove the road wheel.

Remove the brake drum.

In cases where it is not necessary to dismantle the brake shoe and backing plate assembly CARE MUST BE TAKEN TO PREVENT ANY GREASE COMING INTO CONTACT WITH THE BRAKE LININGS whilst dismantling the front hub.

Remove the hub cap.

Remove the split pin from the castellated nut.

Remove the castellated hub-retaining nut.

Remove the large plain washer.

Pull the hub off the stub axle, at the same time holding a hand under the hub to catch the bearing cage of the outer taper bearing.

Remove the bearing cage of the inner taper bearing, seal and the distance piece.

The outer shells for each of the hub bearings can now be removed from the hub by tapping them out with a suitable drift.

To re-assemble the front hub and to refit to the stub axle, particular attention must be given to points such as greasing and adjustment, and the following procedure should be adopted.

Press into the hub the outer shells of each of the two taper bearings. (In each case, the larger internal diameter must be outwards from the respective ends of the hub.)

The rollers and inner races of both bearings should be packed with grease and the inner bearing roller race put in position in the hub together with distance piece and seal. Grease should then be packed into the hub between the two bearings, until level with the inside diameter of both bearing outer tracks. This condition can be obtained by packing with grease, then scooping out any surplus with a straight edged piece of wood or metal in contact with both outer tracks.

The hub should then be fitted to the stub axle, the hub outer bearing roller race, washer and nut fitted, and the bearings adjusted.

Note that no further grease should be added to the hub cap.

To Adjust the Front Hub.

It is important that the following procedure be used. Tighten the hub nut using a torque spanner to obtain a reading of 15-20 lbs. ft.

Release the nut 1 to 1½ flats in order to provide end float, and to line up one of the two split pin holes in the stub axle with the slots in the nut. Using a dial gauge, check that the hub end float is between .005"—.009". If the end float is not within these figures the nut must be further adjusted, and the end float again checked with a dial gauge.

When the correct adjustment has been obtained, lock the nut with a NEW SPLIT PIN OF CORRECT DIAMETER.

Fit hub cap, tapping firmly into position with a hammer.

Refit the brake drum.

Refit the road wheel.

To Remove Stub Axle.

Remove the front shock absorber as follows:—

Load the vehicle to a laden condition. This is important to avoid straining the shock absorber and its mountings.

Undo the two nuts at the upper spindle fixing and remove upper rubber and cup washers. Slacken the two nuts at the lower spindle fixing (but do not remove).

Remove the nuts around the shock absorber lower plate, lift the lower plate to clear the studs and revolve it through 90° when, due to its shape, it will pass downwards, complete with shock absorber and its remaining upper rubber and cup washers, through the lower link spring pan.

Remove the road wheel.

Remove the brake drum.

Disconnect the hydraulic brake hose from the chassis bracket.

The end of the hose should be covered with a piece of clean rag to prevent the ingress of dirt and to prevent undue loss of fluid.

Remove the front hub assembly from the axle.

Remove the four nuts and bolts securing the oil catcher, brake back plate and steering arm to the stub axle flange.

Remove the oil catcher and brake back plate. Using spring compressor, passed up through the coil spring in place of the shock absorber, take the "load" of the spring to enable the stub axle assembly to be released from the upper and lower links.

Remove the split pin, locknut, adjusting nut and thrust washer from base of lower swivel pin.

Remove the upper swivel assembly from the stub axle.

Lift out the stub axle with pin from its bushing in the lower link, leaving the upper swivel on the link.

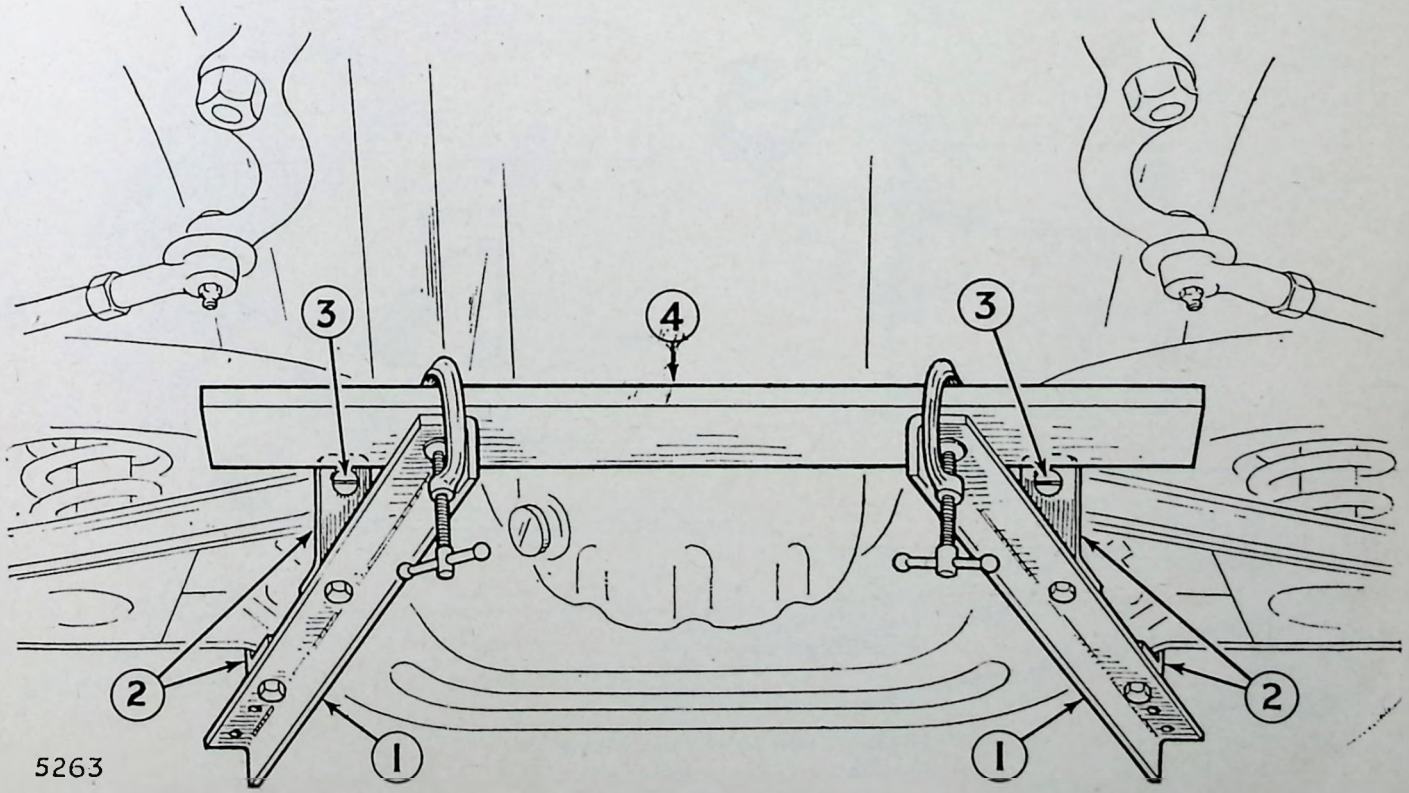


FIG 10—Ball pin height checking fixtures in position. Details of items 1 to 4 are given in figure 12.

To Refit the Stub Axle.

Insert the swivel pin into its bushing in the lower link trunnion, ensuring that the sealing rubber is not damaged.

Refit the upper swivel assembly.

Fit thrust washer, and screw on the adjusting nut to give an end float of .015"/.018". Fit slotted locknut and screw it on by hand until it is in contact with the adjusting nut lower face. Turn locknut until split pin hole is exposed. Fit split pin and, using two spanners, hold the locknut whilst slackening back the adjusting nut until the two nuts are locked together.

By this means the required end float of the stub axle assembly is obtained.

Remove the spring compressor but do not yet fit the shock absorber, as its upper and lower mountings must be parallel before fitting.

Refit steering arm.

Refit brake back plate and oil catcher.

Refit front hub (see previous instructions) and brake drum. Reconnect brake hose and bleed the brakes.

Fit road wheel and release stands and jack.

The shock absorber may now be refitted in reverse order of dismantling, with the front suspension located as previously described.

Stub Axle Upper Swivel Assembly.

To Remove from Upper Link.

Remove rebound rubber to give access to the head of the inner securing bolt.

Remove the three nuts and bolts securing the upper swivel assembly to the upper link.

If this operation is carried out on the vehicle, the shock absorber must be removed and the spring compressor used, as already described.

Trunnion (Fig. 1, No. 26).

To Renew Swivel Pin Bush.

This involves removal of the lower link outer eyebolt and the thrust nuts at the base of the swivel pin.

Remove trunnion from stub axle.

Press out bush from lower trunnion and press in new bush.

Broach the bush and re-assemble all parts.

To Renew Threaded Eyebolt Bush (Fig. 1).

The threaded bush is externally knurled at one end, and pressed in with the knurling to the front on new cars. It follows that the bush must be pressed out towards the front of the trunnion assembly, i.e., the reverse way to which it went in, as otherwise the knurling will damage the parent bore of the trunnion.

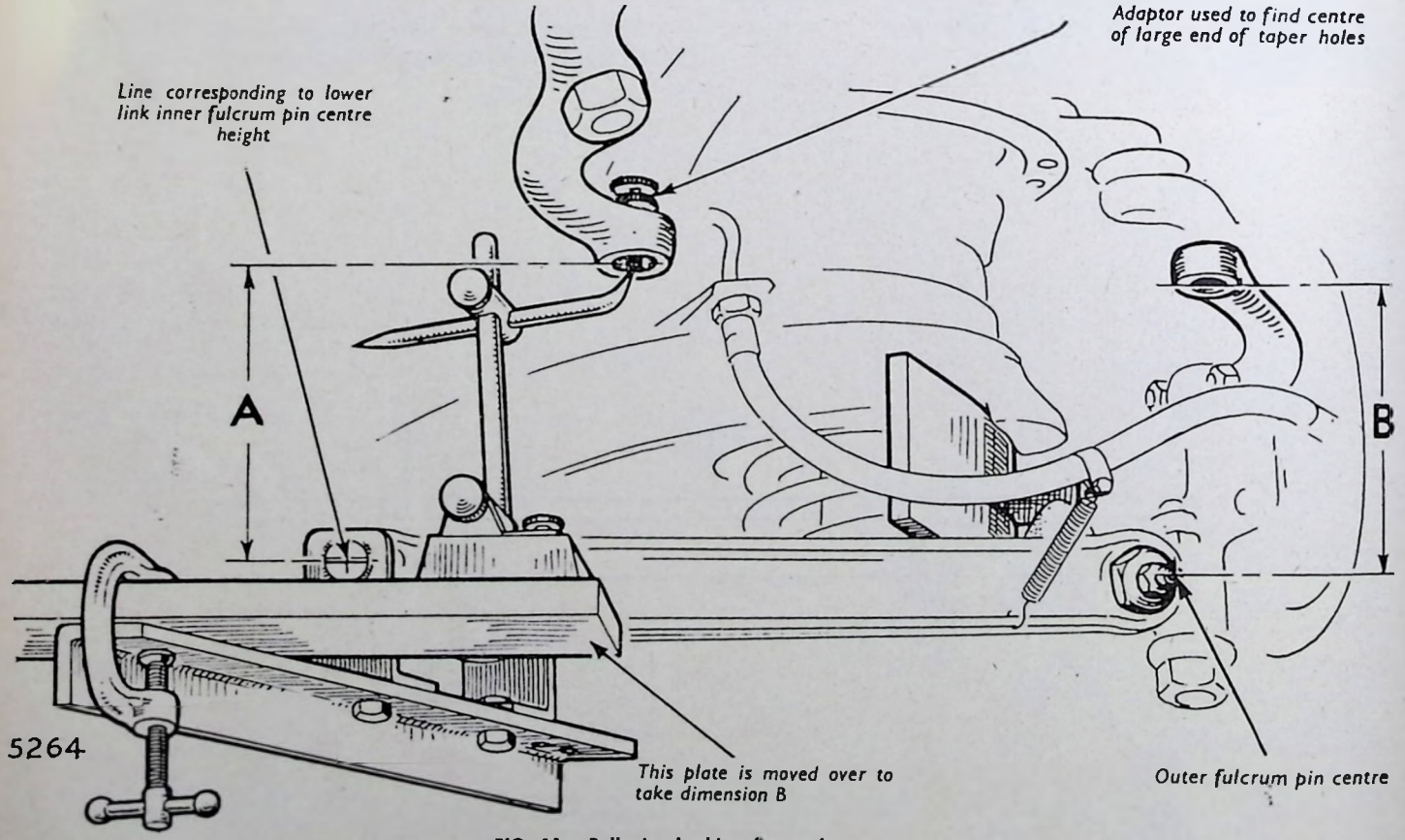


FIG. 11.—Ball pin checking fixture in use.

A = Idler lever, 5.83 to 6.01.
A = Swing lever, 5.86 to 6.00.
B = 5.78 to 5.94.

When a new bush is fitted in service, it must be pressed in from the rear end of the trunnion, with the knurling to the rear, so that the knurling engages a plain portion of the parent bore.

Re-assemble stub axle to upper and lower links as previously described, using new thrust and sealing washers.

Before fitting the lower eye bolt, place the sealing rings on the boss of the trunnion, one each side; when the eye bolt is properly located, the rings can be slid outwards along the bosses into position. If these sealing rings show any signs of deterioration, they should be renewed.

The eye bolt must be screwed in from the rear until the shoulder of the bolt butts firmly against the front inner face of its link, but care must be taken to ensure that the arms of the link are not stressed by "spreading".

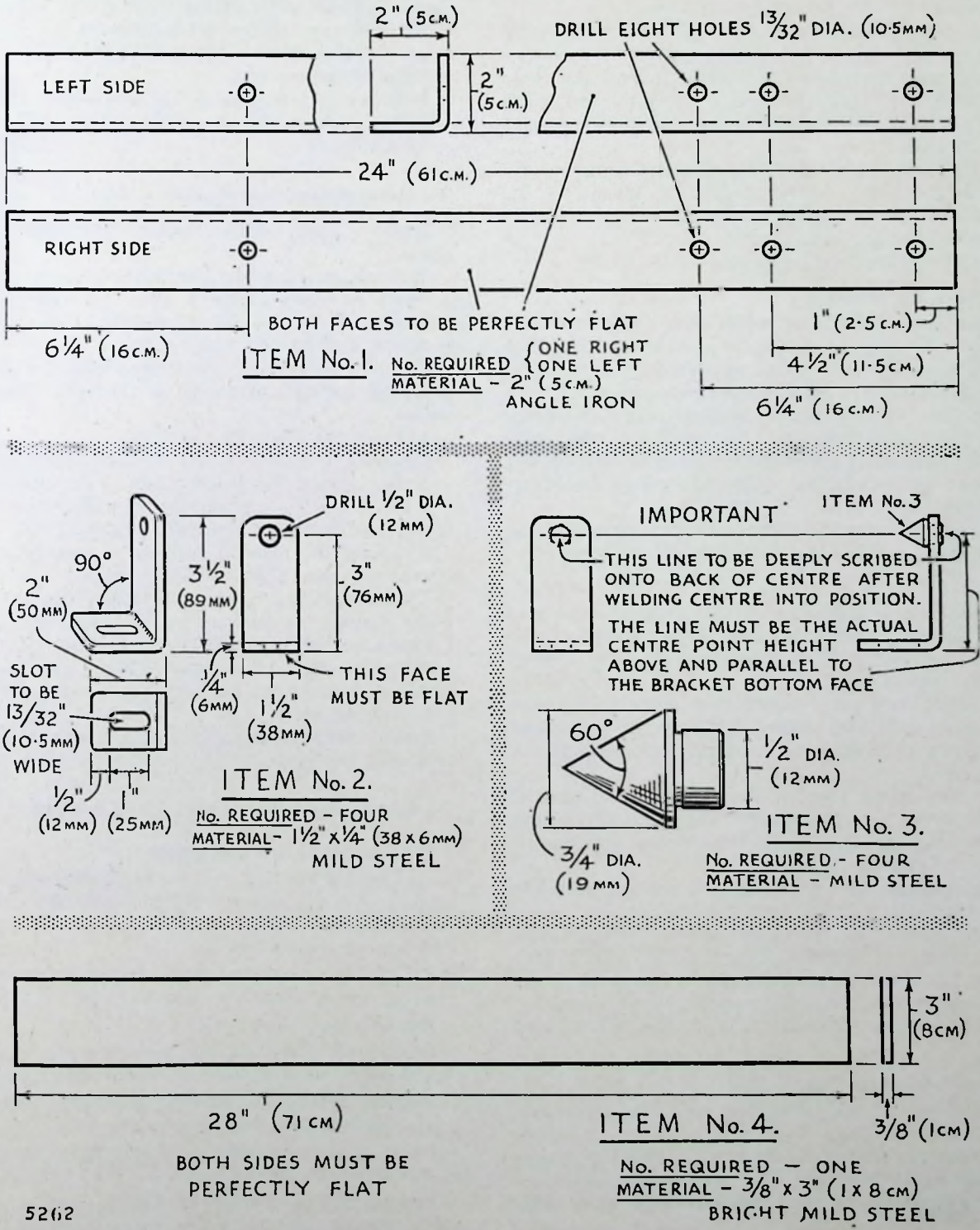


FIG. 12.—Details of ball pin checking fixture parts.

The locknut (29) must be fitted BEFORE the castellated nut, and tightened very securely, at the same time holding the eye bolt from turning.

The castellated nut (30) should be tightened to 50 lbs. ft. and if the split pin hole is not in line for fitting the split pin, TIGHTEN the nut to the next slot.

Service Replacement Swivel Pins.

Stub Axle, to Renew Lower Swivel Pin.

As the design of the stub axle and swivel pin calls for a very high degree of interference fit, it is essential that a press, having a capacity of at least ten tons, is available. A special service swivel pin pack (P.48766) is supplied, in which the circlip is replaced by two locknuts.

Swivel pin removal and replacement tools, to be used with the press, are provided by Messrs. V. L. Churchill to the following numbers:—

R.G. 193—Swivel pin remover.

R.G. 192—Swivel pin replacer.

Swivel Pin—To Remove.

Pass the large abutment collar over the swivel pin and place the stub axle assembly on the bed plate of the press, with the stub axle supported by the collar.

Remove the circlip from the upper end of the pin and place the short drift, with deep recess upwards, over the pin end (from which the circlip is removed).

Pass the long drift through the tapered hole in the upper yoke and insert its spigoted end in the deep recess of the short drift.

Carefully press out the swivel pin, ensuring that the assembly does not become tilted while pressing.

To Refit.

Assemble the two halves of the jacking tool and insert it between the upper and lower yokes of the stub axle, locating the spigoted end in the tapered hole of the upper yoke.

Ensure that the counterbored end of the jack sleeve is concentric with the swivel pin hole in the lower yoke. Tighten the jack with a tommy bar to hold the assembly rigid.

Locate the upper face of the upper yoke on the bed of the press, pass the smaller threaded end of the swivel pin through the lower yoke (now uppermost) and start the pin in its hole.

Pass the hollow drift over the pin and press in the pin until the hollow drift abuts the lower yoke.

This will press the pin the correct distance into the yoke. The pin should project 3.27″/3.26″. This dimension is important and should be checked.

Remove assembly from press and remove jack.

Fit and tighten one locknut. Fit second locknut and tighten.

To Remove and Refit Top Link.

Remove front shock absorber (see stub axle removal).

Jack up the car under the front crossmember (using a block of wood between the jack and the crossmember). Place the car on stands below each sidemember.

Remove the road wheel.

Fit the road spring compressor tool and compress the road spring sufficiently to take the load of the spring.

Remove upper swivel from axle carrier.

Undo nuts and bolts securing upper link inner fulcrum pin to the upper bracket.

Before disconnecting the upper link inner attachments, precautions should be taken to secure the shims in position by wiring them to the fulcrum pin.

Remove two bolts securing fulcrum pin bracket to frame bracket. Note number of shims.

Remove the top link.

Refitting is a reversal of the above procedure.

Check camber, castor and King Pin Inclination.

Check toe-in.

To Remove and Refit Bottom Link.

Remove front shock absorber (see stub axle removal).

Jack up the car under the front crossmember (using a block of wood between the jack and the crossmember). Place the car on stands below each sidemember, and remove road wheel.

Fit the road spring compressor tool and compress the road spring sufficiently to take the load of the spring.

Remove the lower link eyebolt.

Disconnect stabilizer bar and remove four bolts securing bottom link fulcrum pin to the crossmember.

Release spring compressor gradually until road spring and bottom link can be removed.

Refitting the bottom link is a reversal of these operations except for the following:—

Ensure that the rubber insulating ring is in place when placing the road spring in position.

Compress the spring until the fulcrum pin can be rebolted to the crossmember. The bolts should be tightened to a torque of 26-28 lbs. ft. and secured with new lock washers.

Ensure that sealing rings are correctly fitted when replacing the eyebolt.

To Remove and Refit Front Road Spring.

Remove front shock absorber.

Jack up the car under the front crossmember (using a block of wood between the jack and the crossmembers). Place the car on stands below the sidemember, and remove road wheel.

Fit the spring compressor tool and compress the road spring sufficiently to take the load of the spring.

Remove lower link eyebolt.

Disconnect stabilizer bar and remove four bolts securing bottom link fulcrum pin to the crossmember.

Release spring compressor gradually until road spring and bottom link can be removed.

Refitting the road spring is a reversal of these operations except for the following:—

Ensure that the rubber insulating ring is in place when placing the road spring in position.

Compress the spring until the fulcrum pin can be rebolted to the crossmember. The bolts should be tighten to a torque of 26-28 lbs. ft. and secured with new lock washers.

Ensure that sealing rings are correctly fitted when replacing the eyebolt.

To Check Front Springs.

If required the front springs can be roughly checked in position by the following method:—

Place a load of 300 lbs. evenly across the front compartment of the car.

Each spring is now checked by measuring the height between the crossmember top fixing face and the centre of the greaser at the forward outer end of the lower link eye bolt. This distance should be 6.10" ± .125".

Full details of the loadings and lengths for checking these springs on a spring testing rig, are given on Page 1.

SECTION L

SHOCK ABSORBERS AND REAR SUSPENSION

Specifications

The Shock Absorbers

Make:	Girling, or Woodhead Munroe.
Type	Telescopic direct acting.
Linkage	Rubber bushed.
Sway eliminator type	Torsion bar between lower links of front suspension.

The Rear Springs

Type	Semi-elliptic.
Length between centres	46.89 to 47.01.
Width	1.5.
Bushes	Steel and rubber insert type.
Number of leaves:	
Saloon	6 at $\frac{15}{64}$ and 1 at $\frac{5}{16}$.
Estate car	7 at $\frac{1}{4}$" and 2 at $\frac{11}{32}$".
Laden camber:	
Saloon	1 inch reverse at load of 494 lbs. placed 33 inches forward of rear wheel centres.
Estate car	Zero, with 800 lbs. over rear axle centre.
Free camber:	
Saloon	4.26.
Estate car	4.3.

Description.

Girling direct-acting telescopic dampers are fitted.

The body of the shock absorber is telescopic and is mounted more or less vertically through the coil spring between the suspension cradle and wishbone spring pan on the front, and the spring pad brackets and body on the rear. It is, therefore, direct-acting, no links or levers being required.

To Service the Shock Absorbers.

Unless proper facilities are available, including a shock absorber testing machine, it is almost invariably found that to attempt repairs to the modern telescopic shock absorbers is neither practical or economical.

These units are completely sealed, no topping up, adjustment, or other service is required apart from periodical checks of mountings and rubber bushes, which can be carried out without the aid of special tools.

In the event of any shock absorbers requiring attention, it is strongly recommended that the faulty unit should be removed and a replacement shock absorber fitted.

Removal and refitting instructions for front shock absorbers are contained in "Front Suspension" Section K of this manual; instructions for removing and refitting of the rear shock absorbers will be found on page 3 of this section.

Construction of the Shock Absorber.

The assembly can be divided into two main moving parts, the upper one consisting of the piston rod with the piston attached to its lower end and the outer tubular shroud attached at the top just below the stem. The lower part consists of a cylinder and an outer reservoir tube which terminates in a base cup and is welded to the stem, and at its upper end is a welded cap. This cap forms part of an assembly which houses the seal on the piston rod, compresses

the static seal rubber, and locates the piston rod bearing—usually referred to as the piston rod guide. The piston rod seal is of synthetic rubber and has multi-wiping lips and all, except one, face inwards. The outer lip acts to exclude dirt, etc., and faces outwards.

Any fluid which exudes past the guide bearing is prevented from escaping further by the seal and a port below the seal allows fluid to return into the reservoir tube via a closed circuit drain tube fitted to prevent frothing and aeration.

The operating cylinder is normally completely full of fluid, and the reservoir tube is about half full when the piston rod is extended.

A baffle, in the form of a pressed steel collar anchored to the drain tube, is fitted between the outside of the operating cylinder and the inside of the reserve tube just above the level of the fluid, to prevent the fluid in the reserve tube being shaken about by movement of the suspension.

Operation of the Shock Absorbers. (Fig. 1.)

Assume that the damper is in the midway position and that the car passes over a bump in the road. The road springs flex and the damper is compressed and shortened. The piston in effect moves downwards in the cylinder applying pressure to the fluid beneath it.

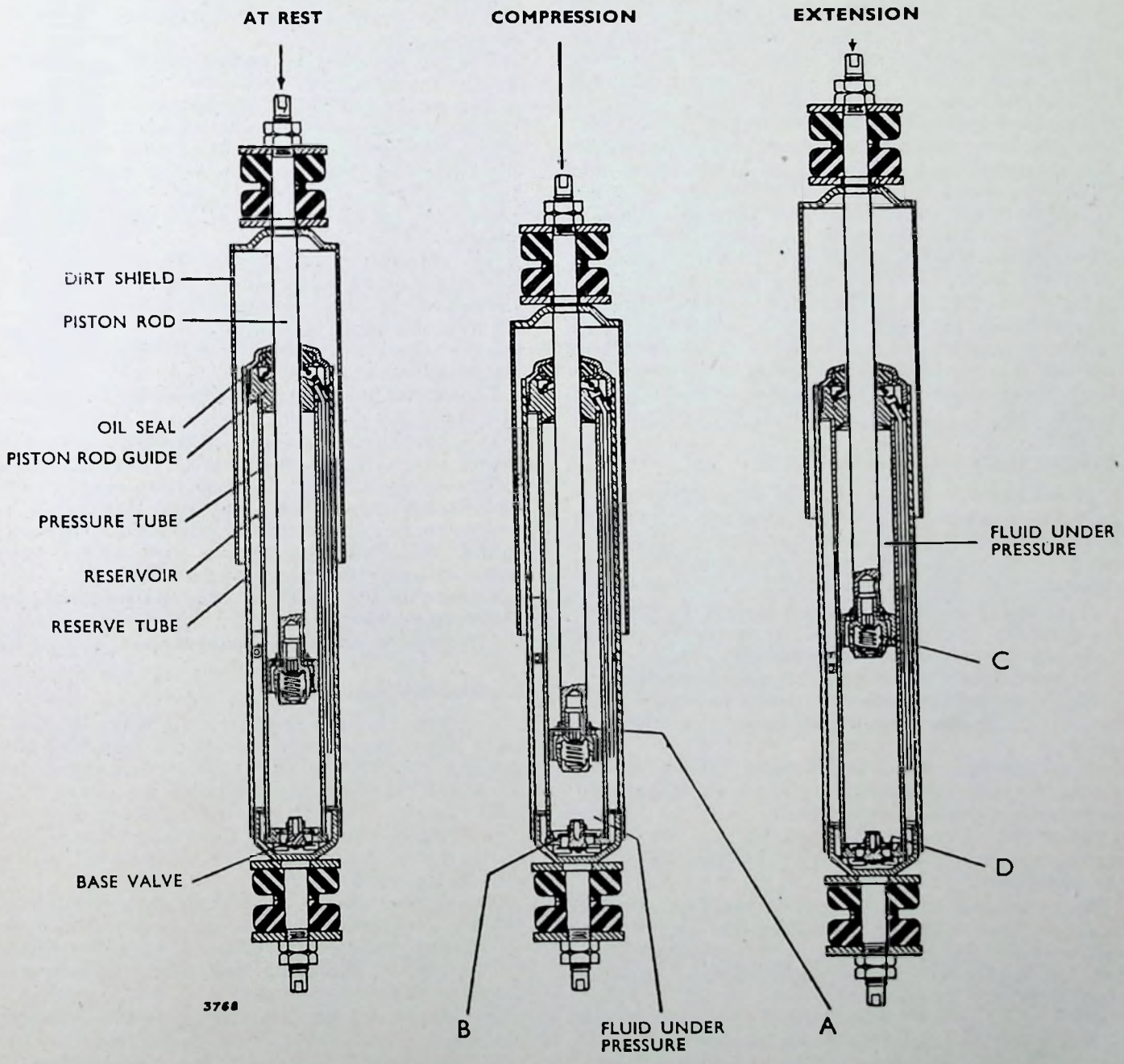


FIG. 1.—Diagrammatic sections of the telescopic shock absorbers.

If the movement is slow the fluid passes through the metering restriction in the valve discs (A) and enters the upper part of the cylinder.

If the movement is fast the fluid passes through the spring controlled compression valve also at (A) which is quite lightly loaded. The ported sleeve in the piston remains closed.

Downward movement of the piston displaces a greater volume of fluid than the lesser volume above the piston. Hence during a slow movement the excess can find a restricted way out to the reservoir via a groove machined in the valve disc of the compression valve assembly (B) in the base of the cylinder. If, however, a downward movement of the piston is a fast one the slotted sleeve valve also at (B), controlled by the strong laminated spring washer, will be opened. When the car wheel is over the bump the road spring commences to return to zero position. The damper then is in the state where the piston is moving away from the bottom of the cylinder, instead of towards it. The fluid above the piston is thus put into compression. It can pass through the restriction provided by a calibrated slot in the bleed shim if the movement is slow, but if the movement is fast it will open the spring-controlled valve (C) and flow through that way. While this is happening the fluid in the cylinder below the piston will not be sufficient to fill the space. In this event the large diameter disc valve (D) in the case of the cylinder opens against its comparatively light spring and allows fluid to return from the reservoir tube and fill the space. It will be realised that the cylinder above and below the piston is always maintained full of fluid provided from the reserve tube.

To Test the Shock Absorbers.

When there is any question of the suspension not being adequately damped, the condition of the following should be considered; the road springs, tyre pressures, bump rubbers and bump rubber seats, as these carry the full bump load of the suspension.

If a shock absorber does not appear to function satisfactorily an indication of its resistance can be obtained by carrying out the following check:—

Remove the shock absorber from its mounting.

Place the shock absorber vertically in a vice, holding it by the lower spindle between two pieces of wood.

Grip the dirt shield firmly with the hands and prime the shock absorber by working it up and down several times to expel the air.

Move the piston (free top half) up and down through one complete cycle to check the nature of the movement.

Moderate and even resistance throughout the outward and inward stroke should be felt. If, however, the resistance is slight, erratic, or free movement cannot be eliminated by priming, then the shock absorber should be changed.

As only the "bleed" incorporated in the valves can be felt when operating the shock absorber manually even when new, no amount of hand testing will provide a true indication of the resistance of the shock absorbers at speeds obtained on bumpy roads. It will, therefore, be appreciated that a new shock absorber may appear to be weak when operated by hand, but this should not be taken as evidence of a fault. Air will bleed into the working parts of a shock absorber when not in use, particularly if it is stored in any position other than vertical, and this air must be expelled before the shock absorber is tested.

THE REAR SPRINGS.

To Remove the Rear Spring.

Jack up the car and support it by means of chassis stands or suitable blocks of wood placed under the chassis frame just forward of the front eyes of the springs.

Remove the road wheel on that side of the car from which the spring is to be removed.

Remove the locknut and securing nut, with the retaining washers and bush, from the lower end of the shock absorber. Repeat at the upper end of the shock absorber (which is accessible from inside the luggage locker) and take out the shock absorber, noting the relative positions of the bush retaining washers.

The cupped retaining washers are placed at each side of the spring clamp plate at the lower end, and the floor of the luggage locker at the upper end.

Clean the projecting threads of the "U" bolts using a wire brush, and oil with kerosene or penetrating oil.

Remove the securing nuts, with washers, from the "U" bolts.

Jack up the rear axle until it is parted from the spring and support it with suitable blocks of wood.

Remove the "U" bolts with the clamp plate, clamp plate bushes, and the clamp plate bush retainer.

Tap out the lower shackle pin with shakeproof washer, after removing the nut with washer, and lower the rear end of the spring to the floor.

Remove the front pivot pin in a similar manner to the lower shackle pin.

The spring is now free to be taken away.

To Refit the Rear Spring.

Refitting is a direct reversal of the removal operations, but it is extremely important to assemble the spring so that the two spring clips are forward of the dowel bolt. When finally tightening the spring "U" bolts, shackle pins, and pivot pin, the car must be raised until the underside of the chassis immediately to the rear of the bump rubber is $10\frac{1}{4}$ inches above the top leaf of the spring.

The simplest way to achieve this is to obtain two suitable blocks of wood $10\frac{1}{4}$ inches long and to raise the chassis until these pieces of wood can be placed on the tops of the springs and then to lower the chassis until the wood is nipped.

One end of each block should be suitably rounded to conform to the contour of the chassis frame.

Tighten the "U" bolt nuts to a torque loading of 10 to 12 lbs. ft. only.

To Dismantle the Rear Spring.

Remove the spring (see preceding operation).

Before dismantling, mark one end of each leaf with a centre punch. This ensures that the leaves are replaced in the position they occupied prior to dismantling.

Remove the spring clip bolts.

Grip the spring securely in a vice, holding it securely by the top and bottom leaves.

Unscrew the dowel bolt nut.

Knock out the dowel bolt.

Unscrew the vice and the leaves will fall apart.

Remove the polythene thrust buttons.

To Examine the Rear Spring.

Clean off the spring, using kerosene.

Check the thrust buttons for any excessive wear and replace with new, if necessary, before re-assembling with spring.

In the event of the fracture of a spring leaf, the other leaves—particularly the ones above and below the broken leaf—should be examined for cracks.

These will often show up on the dirty surface by the exudation of kerosene along the line of the crack. Any faulty leaves should be replaced.

The "setting up" of the spring leaves is not recommended and in the case of a weak spring a new or factory reconditioned assembly should be fitted.

To Rebuild the Rear Spring.

Before rebuilding the spring the leaves should be thinly smeared with graphite grease.

Rebuilding is a reversal of the dismantling instructions, but alignment of the leaves will be greatly facilitated if a suitable length of steel rod is inserted through the dowel bolt hole, otherwise damage to the threads of the dowel bolt may occur. When the leaves have been fully pressed home the rod should be removed and replaced by the dowel bolt.

Refit the clip bolts.

Before fitting the spring to the chassis, check that the leaves are lying flush on each other.

Bushes may be pressed out of the frame or spring for renewal purposes.

The use of a suitable withdrawal tool is recommended.

To Check the Rear Spring Camber.

Spring camber is the difference in height between the top of the main leaf and a line drawn through the centre of the spring eyes.

As will be appreciated, this varies according to the weight carried in the vehicle.

Load the vehicle by placing weights to the value of 494 lbs. across the rear floor, 33 inches in front of the rear wheel centres.

Stretch a length of thread between the spring eye centres and measure the distance between the top of the main leaf and the thread.

Positive camber means that the line of the thread will be **above** the main leaf in the spring. Reverse or negative camber means that the line of the thread will be **below** the main leaf.

For correct spring camber, refer to the specifications at the beginning of this section.

SECTION M

BRAKES

Specifications

Make	Lockheed.
Type of system	Hydraulic.
Means of operation:	
Foot	Hydraulic.
Hand	Mechanical.
Footbrake operates on	All four wheels.
Handbrake operates on	Rear wheels only.
Front brakes	Two leading shoe.
Rear brakes	Leading and trailing shoe.
Linings:	
Front and Rear	Ferodo D.M.53A or Mintex M11.
Handbrake:	
Type	Ratchet and pawl.
Location	On floor on driver's side.
Brake drums:	
Material	Cast iron.
Diameter	9 inches.
Total brake lining area	121 sq. inches.
Brake lining width	1.75.
Brake adjustment location	Hole in wheel and brake drum.
Master cylinder bore	.75.
Wheel cylinder bore:	
Front and rear	.88.

Fluid Level.

The Lockheed brake fluid is contained in a supply tank which is integral with the master cylinder.

Replenish, if necessary, to keep the level half an inch below the filler cap. Do not fill completely. The addition of fluid should only be necessary at extremely long intervals, and a considerable fall in fluid level would indicate a leak at some point in the system which should be traced and rectified.

Ensure that the air vent in the filler cap of the master cylinder is not choked; blockage at this point would cause the brakes to drag.

To Adjust the Brakes.

When properly adjusted there should be $\frac{1}{4}$ inch free movement of the brake pedal pad before the piston in the master cylinder begins to move. When checking this setting take care that the floorboards or mats are not fouling the pedal.

As the linings wear, pedal travel will increase. When a point is reached when the pedal is $1\frac{1}{2}$ inches off the floorboards before solid resistance is obtained, the brake shoes must be adjusted.

If it is desired, adjustment may be carried out before the brake linings have worn to this extent.

The actual method of adjustment is as follows:—

The Front Brakes:

Remove the nave plate from the road wheel and jack up one front wheel until it is free to rotate.

Turn the wheel so the the hole in the road wheel and brake drum is opposite the slotted head of one of the "micram" adjusters.

Using a screwdriver, turn the adjuster in a clockwise direction until the brake shoe is in contact with the brake drum, then turn the adjuster anti-clockwise one notch; this should provide the clearance between the shoe and the drum. If closer adjustment is re-

quired, spin the wheel and drum and apply the brake hard; this will correctly position the shoe, after which a further adjustment check should be carried out.

Turn the road wheel through 180° and repeat the above adjustment on the second "micram" adjuster.

There are two "micram" adjusters in each front brake, one for each shoe, and each must be adjusted separately in accordance with the above instructions.

The Rear Brakes:

Place chocks in front of and behind one of the front wheels to prevent the car rolling, and release the handbrake.

Remove the nave plate and jack up one rear wheel until it is free to rotate.

Turn the wheel so that the hole in the wheel and brake drum is opposite the slotted head of the "micram" adjuster.

Using a screwdriver, turn the adjuster in a clockwise direction until the brake shoes are in contact with the brake drum.

Apply the footbrake hard, to ensure that the wheel cylinder is centralised, and release the brakes. If after doing this the wheel is still locked, turn back the adjuster one notch, or if necessary two notches, to provide the correct clearance between the shoes and the drum; if, however, the wheel is free to rotate after centralising, turn the adjuster until the shoes are in contact with the drum and then turn the adjuster anti-clockwise one notch.

Repeat the above paragraph on the opposite rear wheel.

Note.—There is only one "micram" adjuster to each rear brake.

The Handbrake:

Normally the handbrake is adjusted automatically when the footbrake is adjusted.

In the event of excessive handbrake travel still being present after the footbrake has been adjusted in accordance with the preceding instructions, proceed as follows:—

Turn each rear brake "micram" adjuster clockwise as far as it will go, so that the rear brake is locked on hard. With these adjusters still in position and the handbrake off, adjust the cable length so that the slack is taken out of the linkage; finally release each rear brake "micram" adjuster one notch or until the brakes are free.

Bleeding the Hydraulic System.

Bleeding the system, to expel all air, is not a routine maintenance operation and should only be necessary when some portion of the equipment has been disconnected or fluid drained off, thereby allowing air to enter.

Fill the fluid reservoir with Lockheed brake fluid and keep quarter full throughout the whole of the bleeding operation, otherwise air will be drawn into the system, defeating the object of the operation.

Attach a rubber tube to the bleeder screw on one wheel cylinder and allow the free end of the tube to be submerged in a little fluid in a clean glass jar.

Unscrew the bleeder screw one complete turn, not more.

Depress the brake pedal slowly and allow it to return without assistance; repeat this pumping operation with a slight pause between each depression of the pedal. Observe the flow of fluid being discharged into the glass jar, when all air bubbles cease to appear, hold the pedal firmly down and securely tighten the bleeder screw. When bleeding the front brakes, give two additional strokes to the footbrake pedal, after all bubbles have ceased to flow, to ensure that no air is trapped in the top cylinder.

Repeat on each wheel, one bleeder screw to each wheel.

Note.—Clean fluid discharged from the system should be allowed to stand, protected from dust, for several hours until it is quite clear of air bubbles, before being used again. Dirty fluid should be discarded.

The Hydraulic Pipe Connections.

It is of vital importance that there are no leaks at any of the hydraulic brake pipe lines, unions, flexible hoses, etc., therefore it is essential that these should be checked periodically, when the brakes are receiving normal maintenance inspection or adjustment and also at 1,000 mile intervals.

If tightening the unions should be necessary, it is important to use spanners of short length, say 4 to 5 inches only, so as to eliminate risk of damage to face joints of unions, etc., which might result from over-tightening.

The Brake Shoes.

The brake shoes carry linings of special construction, which are formed to the exact shape of the shoe in order to obtain a perfect and effective contact on the brake drum. Whenever possible it is highly advisable that relining of the brakes should be effected by the use of factory relined shoe assemblies.

Cleaning the Internal Parts.

Never clean the internal parts of the system with petrol or kerosene, or lubricate with oil or grease. Use "Genuine Lockheed Fluid" for both purposes.

To Remove and Refit the Brake Shoes.

Jack up the vehicle. Remove the nave plates and road wheels.

Release the handbrake.

Back off all available brake adjustment by turning the "micram" adjusters anti-clockwise to the fullest extent.

Remove the countersunk setscrews securing the brake drums to the axle flanges.

Remove the brake drums. A sharp blow on the side of each drum with a copper-headed hammer will loosen the drum and facilitate removal.

To remove the brake shoes, dislodge the ends of the pull-off springs where they protrude through the brake shoe webs, with the blade of a screwdriver. When the springs have been disconnected from one shoe, both shoes may be removed. Take care not to damage the "micram" adjusters and masks.

To refit the brake shoes, engage the ends of the pull-off springs in one shoe, place the shoe in position (less the "micram" adjusters), attach the free ends of the springs to the other shoe, and pull against the tension of the pull-off springs until the second shoe can be positioned correctly.

Note that the pull-off springs must be assembled so that they run underneath the brake shoe webs.

Pull against the tension of the pull-off springs and insert the "micram" adjusters and masks in the small "S" slots in the tips of the shoes.

When the brakes require relining it is most strongly recommended that advantage be taken of the factory reconditioned service units scheme whereby replacement brake shoe and lining assemblies can be obtained in exchange for old.

To Reline the Brakes.

Mark the position of the old lining across each end of the brake shoe, using a scriber. This will ensure that, when fitted, the new lining will be in the correct position.

Grip the shoe lightly in a vice. Care must be taken to ensure that there is no distortion of the shoe.

Cut away the portion of each rivet which protrudes through the underside of the brake shoe platform, using a sharp chisel, alternatively a rose bit, or large diameter drill may be used, but do not allow the drill to damage the brake shoe platform or enlarge the holes. The shoe should be positioned in the vice so that it is held as near as possible to the rivet being removed.

Degrease the shoes. The use of a trichlorethylene bath is recommended.

Thoroughly inspect the shoe for damage or cracks.

Apply marking to the brake shoe platform, and roll it against a flat surface. Note the high spots, and remove with a smooth file.

Mount the rivet dolly in a vice (.3 dia. anvil).

Place the lining in the correct position on the shoe, so that the ends correspond with the marks previously made and the rivet holes coincide.

Place the rivet in position so that the hollow end protrudes through the underside of the brake shoe platform. Hold the brake shoe and lining so that the head of the rivet bears firmly against the anvil of the dolly, and secure the rivet shanks by means of a suitable punch.

Start at the centre of the shoe and work outwards towards the ends, fitting the rivets in pairs. Each shoe requires 10 rivets. It should be noted that any foreign matter sticking to the underside of the lining may cause a high spot on the surface of the lining, and this point should be checked before assembly. Make sure that no gap exists between the lining and the platform of the brake shoe.

It is not necessary to impart any chamfer to the heel and toe of the lining after fitting.

In certain instances difficulty may be experienced in fitting the brake drums after the brake shoes have been assembled to the backing plates.

This condition is due to the fact that an extra .010 to .015 is allowed on each lining for grinding down, so that where grinding facilities are available the brakes may be rendered efficient immediately after assembly without the usual period required for bedding down.

If grinding equipment is not to hand, and it proves impossible to fit the brake drum, the linings must be rubbed down with glass paper as required. In such cases chalk should be applied to the linings after re-assembly of the shoes to the backing plate. Fit the brake drums, and apply the brakes hard. Remove the drums, examine the linings and rectify the high spots with glass paper.

The utmost care should be taken to ensure that all abrasive particles from the glass paper are removed from the brakes before the drums are finally fitted. The use of an air jet is recommended.

In territories where ready drilled linings of the correct type are not available, linings must conform to the following dimensions: Thickness .193 to .203. Width 1.69 to 1.75, length 8.5".

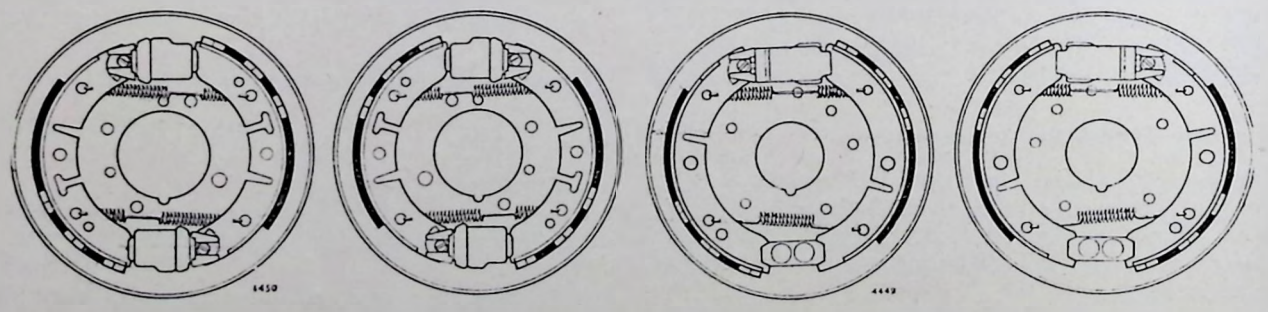


FIG. 1.—View of brakes with the drums removed, showing correct location of pull off springs.

After cutting to the correct length, the lining should be held to the shoe for drilling by means of a clamp.

The correct drill size is .166 (No. 19).

The counterbore size is .31 and should not exceed a depth of .143.

When lining "off the roll" is used, a slight chamfer should be imparted to the heel and toe of each lining after assembly to the brake shoe.

The Hydraulic System.

When dismantling the master cylinder or wheel cylinders, the operation must be carried out under conditions of scrupulous cleanliness.

All external dirt should be cleaned off before removing the unit.

After removing the unit from the vehicle, do **not** swill in kerosene, petrol or trichlorethylene, as this will damage the rubber parts, and render the brakes dangerous.

Dismantle the unit on a sheet of clean paper.

Do not handle the interior parts, particularly the rubbers, with dirty hands.

Place all internal metal parts in a tray of clean brake fluid to soak; dry off with a clean fluffless cloth.

Examine all the rubber parts for signs of swelling, distortion, perishing or damage, and renew all faulty parts immediately.

In the case of the master cylinder, check that the by-pass port is clear by applying air pressure. The by-pass port is the smaller of the two holes that can be seen through the filler plug hole, and is deliberately drilled first with a small drill half-way and then with a very fine drill which just breaks through into the bore. The port is then peened to ensure a smooth finish.

All internal parts should be dipped in clean Lockheed brake fluid, and assembled wet.

When any part of the hydraulic system has been disconnected, it is necessary, after re-assembling, to expel all the air which will have been admitted into the system. This operation is fully described in "Bleeding the Hydraulic System".

The Master Cylinder.

Note.—A groove is formed round the edge of the clutch master cylinder outlet plug (see item 44 in Fig. 2.) This identifies it from the brake master cylinder which has no groove. The master cylinders are not interchangeable owing to the fact that no valve is fitted to the clutch master cylinder.

To Remove and Refit the Master Cylinder.

Disconnect the metal fluid pipe from its connection at the front of the cylinder, by unscrewing the union nut.

Remove the clevis pin from the pedal, at the push-rod location.

Remove the two bolts passing through the master cylinder.

The master cylinder can now be removed by easing it forward away from the bulkhead.

Refitting is a reversal of the above instructions.

To Dismantle the Master Cylinder.

Push the piston down the bore of the cylinder and remove the circlip. Withdraw the piston, piston washer, rubber cup, retainer, return spring and valve. Using only the fingers to prevent damage, remove the secondary cup by stretching it over the end flange of the piston.

To Re-assemble the Master Cylinder.

Fit the secondary cup on the piston so that the lip of the cup faces the piston head, and gently work the cup round the groove with the fingers to ensure that it is properly seated. Assemble the retainer on the smaller end of the return spring and the valve on the larger end and insert the assembly into the cylinder. Insert the main cup into the cylinder, lip foremost, taking care not to damage or turn back the lip of the cup; follow up with the piston washer, concave face of the washer towards the cup.

Insert the pushrod in the piston and press the piston into the cylinder, taking care not to damage or turn back the lip of the secondary cup. Fit the circlip, ensuring that it beds evenly in its groove and that the collar in the pushrod is retained by the circlip.

Fill the reservoir with clean Lockheed brake fluid and test the master cylinder by pushing the piston inwards and allowing it to return unassisted; after a few applications, fluid should flow from the outlet connection in the cylinder head.

To Remove the Front Wheel Cylinders.

Remove the brake shoes, as detailed in "To Remove and Refit the Brake Shoes".

Disconnect the flexible pipe from the frame bracket.

Unscrew the two nuts securing the bridge pipe to the wheel cylinders, and remove the bridge pipe. Remove the two nuts and spring washers securing each wheel cylinder to the backplate and withdraw the cylinder.

To Refit the Front Wheel Cylinders.

Refitting is a reversal of the above instructions.

To Dismantle the Front Wheel Cylinder.

Withdraw the piston and cover assembly from the cylinder. Remove the rubber cup and cup filler by applying gentle air pressure to the fluid pipe connections.

To Re-assemble the Front Wheel Cylinder.

Re-assembly is a reversal of the above instructions. Take care when inserting the rubber cup not to damage or turn back the lip.

To Remove the Rear Wheel Cylinders.

Remove the brake shoes as detailed in "To Remove and Refit the Brake Shoes".

Unscrew the hollow bolt securing the pipe connection to the wheel cylinder.

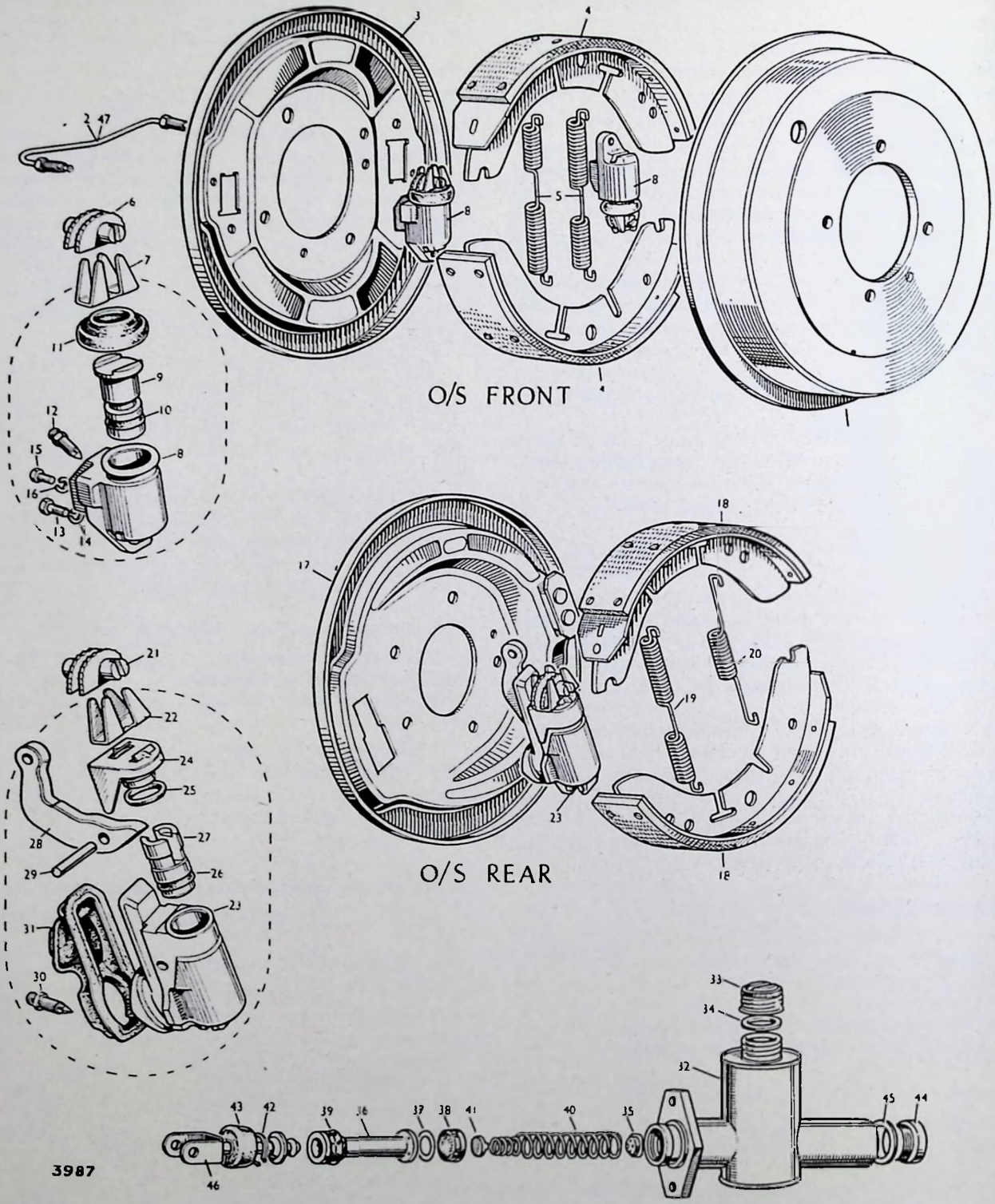


FIG. 2.—Exploded view of the brake components.

NOTE.—Early type brake drum shown.

KEY TO FIGURE 2:

1—Brake drum.
2—Bridge pipe.
3—Backplate (front).
4—Shoe and lining assembly (front).
5—Return springs.
6—"Micram" adjuster cam.
7—"Micram" adjuster plate.
8—Wheel cylinder (front).
9—Piston.
10—Cup.
11—Dust shield.
12—Bleeder screw.
13—Attaching screw.
14—Attaching screw washer.
15—Attaching screw.
16—Attaching screw washer.
17—Backplate (rear).
18—Shoe and lining assembly (rear).
19—Return spring.
20—Return spring.
21—"Micram" adjuster cam.
22—"Micram" adjuster plate.
23—Wheel cylinder (rear).
24—Cylinder metal dust cover.
25—Cylinder metal dust seal.
26—Cup.
27—Piston.
28—Handbrake lever.
29—Fulcrum pin.
30—Bleeder valve.
31—Rubber dust shield.
32—Master cylinder body and reservoir.
33—Master cylinder filler cap.
34—Master cylinder filler cap seal.
35—Valve.
36—Piston.
37—Piston washer.
38—Primary cup.
39—Secondary cup.
40—Return spring.
41—Return spring cap.
42—Circlip.
43—Rubber dust shield.
44—Cylinder outlet plug.
45—Cylinder outlet plug gasket.
46—Connecting rod.

Disconnect the handbrake operating rod from the handbrake lever protruding through the backplate, by removing the clevis pin. Remove the rubber boot.

Remove the piston cover assembly.

The wheel cylinder can now be manoeuvred from the brake drum side of the backplate.

To Refit the Rear Wheel Cylinders.

Refitting is a reversal of the above instructions, but it is important to ensure that the rubber boot is correctly located in the groove along the wheel cylinder and in the annular groove around the union boss; also that the outer lip of the boot is inwards of the rib on the handbrake lever. Care should be taken not to trap the boot between the wheel cylinder and the backplate.

To Dismantle the Rear Wheel Cylinder.

Push out the handbrake pivot pin and remove the lever. Remove the piston, cup and expander by applying gentle air pressure to the fluid pipe connection.

To Re-assemble the Rear Wheel Cylinder.

Re-assembly is a reversal of the above instructions, Take care when inserting the rubber cup not to damage or turn back the lip.

To Remove the Flexible Brake Hoses.

Do not attempt to release a flexible hose by turning either end with a spanner. Remove the hoses as follows:—

Front:

Disconnect the metal fluid pipe by unscrewing the pipe union nut from the hose union. Remove the locknut and shakeproof washer securing the flexible hose to the bracket and release the hose. Unscrew the hose from the connection on the brake backplate.

Rear:

Disconnect the metal fluid pipe by unscrewing the pipe union nut from the hose union.

Remove the locknut and shakeproof washer securing the flexible hose to the bracket and release the hose.

Unscrew the hose from the three-way connector attached to the rear axle case.

To Refit the Flexible Brake Hoses.

Refitting is a reversal of the above instructions, but it is important to tighten up the hose at the connection to the backplate before attaching the hose to its bracket.

When tightening the flexible hose locknut to the bracket, the hexagon on the end sleeve of the hose must be held with a spanner, to avoid twisting the hose.

Check that no chafing can occur under conditions of bump and rebound by bouncing the car up and down.

This check should be carried out with the wheels in the straight-ahead position, and also on right and left-hand full lock.

SECTION N

ELECTRICAL

Specifications

Battery

Make	Lucas.
Type	GTW.7A.
Location	On left-hand wing valance.
Capacity	38 amp./hr.
Voltage	12.
System	Positive earth.

Coil

Make	Lucas.
Type	L.A. (Desp. No. 45053 E).
Location	Right-hand side.

Distributor

Type of system	Coil and distributor.
Firing order	1, 3, 4, 2.
Ignition control:	
Series I-II	Automatic centrifugal.
Series IIA-III-IIIA	Fully automatic—vacuum and centrifugal.
Ignition timing (nominal):	
Series I-II	4° to 5° B.T.D.C.
Series IIA-III	9° to 11° B.T.D.C.
Series IIIA	6° to 8° B.T.D.C.

Ignition centrifugal advance (with distributor decelerating on test rig)

Series I-II		Series IIA-III-IIIA	
Distributor r.p.m.	Distributor Degrees	Distributor r.p.m.	Distributor Degrees
400	2½° to 5½°	450	2½° to 5½°
700	8° to 10°	650	5° to 7°
1000	10½° to 12°	1800	12° to 14°
1300	13½° to 15°	2100	14° to 16°
1600	16° to 18°	2500	15° to 17°
1900	19° to 21°	3000	16° to 18°

Ignition vacuum advance

6″ Hg.	0° to 2°
10″ Hg.	4½° to 6½°
14″ Hg.	5½° to 7½°

Spark plugs	Champion—N5—14 mm.
Gaps	.025.
Contact breaker gap	.015.
Distributor:	
Makers No. — Series I-II	DKY4A* or D2A4.
IIA-III-IIIA	DM2/P4 S94.
Despatch No. — Series IIA-III-IIIA	40530.
Series I-II	40167H* or 40564.
Drive — Series IIA-III-IIIA	Skew gear on camshaft.
Series I-II	Skew gear on intermediate shaft.
Direction of rotation	Anti-clockwise viewed from above.

* Early Series I only.

Generator

Make	Lucas.
Type	C39PV-2 (Desp. No. 22258A). Series I-II-III. C40-1 (Desp. No. 22700). Series IIIA. C45PV-6 "Easidrive" models.
Location	Left-hand side.
Mounting	Adjustable.
Drive	"V" belt from crankshaft.
Control of output	C.V.C.
Brush spring tension	22 to 25 ozs.

Control Box

Model	RB106/2 (RB310 for C45PV-6 generator).
Setting data	See page 7.

Starter

Make	Lucas.
Type	M35G (Desp. No. 25022F).
Control type	Solenoid.
Drive type	Lucas "SB".
Lock torque	9.3 lbs. ft., 370 to 390 amps. at 7.7 to 7.3 volts.
Brush spring tension	15 to 25 ozs.

Lighting

System	Earth return.
Headlamp type	P 700.
Sidelamp type	Model 1539.

Lamp Bulbs

Make	Lucas.	
	Series I-II-IIA	**Series III-IIIA**
R.H.D. Head	No. 354 12V., 42/36W.	No. 414 12V. 50/40W.
L.H.D. Head	No. 360 (Duplo) 12V. 45/35W.	No. 410 12V. 45/40W.
Side and flasher	No. 380 12V. 6/21W. all models	
Beam indicator	No. 987 12V. 2.2W.	No. 281 12V. 2W.
Ignition warning light	No. 987 12V. 2.2W.	No. 281 12V. 2W.
Panel illumination light	No. 987 12V. 2.2 W., all models	
Stop and tail	No. 380 12V. 21/6W., all models	
Rear number plate	No. 222 12V. 4W., all models	
Interior:		
Series I to III	No. 222 12V. 4W., all models	
Series IIIA	No. 254, 12V. 6W.	
Flasher warning lamps	No. 987 12V. 2.2W. all models.	
Rear flasher	No. 382 12V. 21W., all models	

Windscreen Wiper

Make	Lucas DR.2.
Type	Dual arm.
Blades	Steel back rainbow.

Horns

Make	Lucas.
Type	WT618 Windtone.

Fuses

Rating — Series I-IIIA	35 Amp. (2).
All other Series	35 Amp. (1).

Battery.

Maintenance.

Keep the battery and its surroundings clean and dry. Give particular attention to the top of the battery to prevent electrical leakage between the cell terminals.

Remove the vent plugs. Inspect the rubber anti-leak washers and see that the vent holes are clear.

Check the electrolyte level and top up, when necessary. The correct level is just to the tops of the separators. Do not over-fill or acid will escape through the vent hole, with detrimental effect to the connections and adjacent parts of the car.

Distilled water should always be used for topping-up. In an emergency, however, drinking water, clean rainwater or melted snow may be used. The following waters must not be used: salt water, chlorinated water, chemically softened water or stagnant water.

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.

If a battery is found to need an excessive amount of topping-up, the cause should be sought. If an excessive charge is suspected, check the regulator setting. If one cell in particular is at fault, examine the container for cracks.

Note.—Never transfer electrolyte from one cell to another.

With the diecast type of connector, no corrosion difficulties arise. When fitting the connectors to the battery, first smear the inside of the tapered hole of the connector with petroleum jelly and push on the connector by hand.

Insert the self-tapping screw and tighten with medium pressure only; fill in the recess around the screw head with more petroleum jelly. If the connectors are fitted dry, and driven home with too much force, they may be difficult to remove at a later date.

Examine the earth connection to ensure that it is clean and free from rust or corrosion.

Measure the specific gravity of the acid, in each cell in turn, with a hydrometer. The reading 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 a useful indication of the state of the plates; if it is very dirty, or contains small particles in suspension, it is possible that the plates are in a bad condition.

Check the specific gravity of the electrolyte as an indication of the state of charge of the battery, using a hydrometer. Table "A" shows what the specific gravity of the electrolyte should be at various temperatures, when the battery is fully charged. If the gravity is below the figures shown for the appropriate temperatures in table "B", the battery should be charged as soon as possible by the normal running of the vehicle. If this cannot be arranged, the battery should be charged from an external source.

If the level of the electrolyte is so low that a hydrometer reading cannot be taken, no attempt should be made to take a reading after adding distilled water until the battery has been on charge for at least thirty minutes. Never transfer the electrolyte from one cell to another.

Table "A":	Table "B":
1.270 at 120°F.	1.220 at 120°F.
1.280 at 100°F.	1.230 at 100°F.
1.285 at 80°F.	1.235 at 80°F.
1.295 at 60°F.	1.245 at 60°F.
1.305 at 40°F.	1.255 at 40°F.
1.310 at 20°F.	1.260 at 20°F.
1.320 at 0°F.	1.270 at 0°F.
1.325 at —21°F.	1.275 at —21°F.

Note.—If the car is out of use for any length of time the battery should not be allowed to run down or to remain in a discharged condition. It should be recharged about every fortnight from an independent electric supply.

The Generator.

Lubrication.

Every 6,000 miles. Lubrication is by means of a hole in the end of the bracket through which engine oil is injected. The oil is then absorbed by a felt washer which acts as a reservoir. An aluminium washer is located immediately inside the oiling hole and prevents the ingress of dirt.

Inspection of the Commutator and Brushgear.

Every 12,000 miles remove the generator from the engine. Inspect the commutator through the ventilator, which is the larger of the two apertures in the end bracket.

The commutator should be clean, free from oil and dirt and have a polished appearance. If it is dirty it should be cleaned through the smaller aperture in the end cover, using a soft cloth. This operation will be facilitated if the cloth is wrapped round a piece of hard wood and pressed on the commutator while the armature is revolved by hand. In the event of the commutator being very dirty, the cloth should be moistened with petrol.

Examination of the brushgear is carried out by removing the two through bolts, commutator end bracket and the yoke.

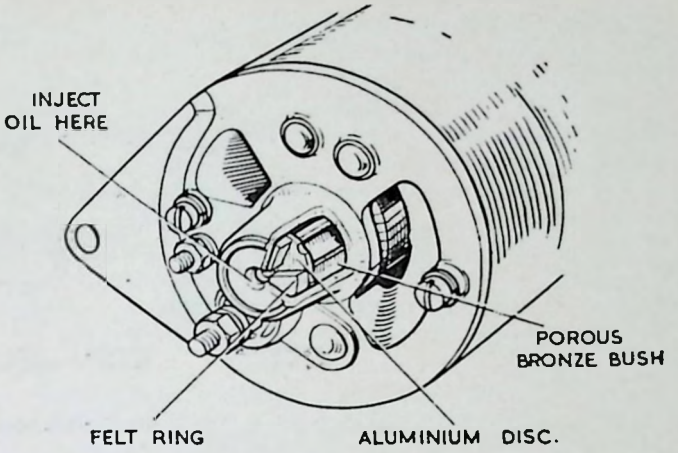


FIG. 1.—Commutator end bearing cut away to show details of the lubricator.

Partly lift both brushes and trap them in this raised position with the tension springs.

Loosely assemble the end cover to the armature and release the brushes so that they resume their correct position on the commutator.

Check that the brushes move freely in the holders, by holding back the tension springs and pulling gently on the flexible connectors. If a brush is inclined to stick, remove it from its holder and clean its sides with a petrol moistened cloth.

In order to retain the "bedding", brushes must always be replaced in their original position.

Brushes which have worn so that they will not "bed" properly on the commutator, or have worn to $\frac{11}{32}$ inch, must be renewed.

Testing in Position.

In the event of a fault in the charging circuit, adopt the following procedure to locate the cause of trouble:—

Check that the driving belt is not slipping, and adjust if necessary.

Check that the generator and control box are connected correctly. The larger generator terminal "D" must be connected to the control box terminal "D" and the smaller generator terminal "F" to control box terminal "F". Check the control box earth lead from the "E" terminal to the scuttle.

Switch off all lights and accessories, disconnect the cables from the terminals of the generator and connect the two terminals with a short length of wire.

Start the engine and set to run at normal idling speed.

Clip the negative lead of a moving coil type voltmeter, calibrated 0-20 volts, to one generator terminal and the other lead to a good earthing point on the yoke.

Gradually increase the engine speed, when the voltmeter reading should rise rapidly and without fluctuation. Do not allow the voltmeter reading to reach 20 volts and do not race the engine in an attempt to increase the voltage. It is sufficient to run the generator up to about 1,000 r p.m. If there is no reading, check the brush gear as described below.

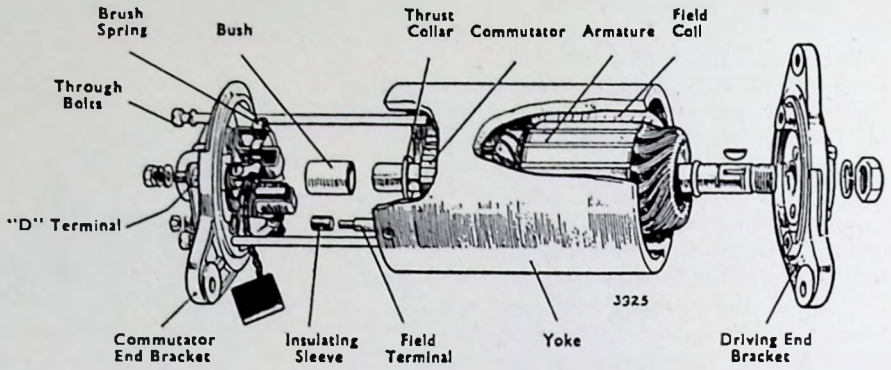


FIG. 2.—Exploded view of the generator.

If there is a low reading of approximately $\frac{1}{2}$ to 1 volt, the field winding may be at fault. If there is a reading of 4 to 5 volts, the armature may be at fault.

Examine the commutator and brushes. Hold back each of the brush springs and move the brush by pulling gently on its flexible connector. If the movement is sluggish, remove the brush from its holder and ease the sides by gently polishing on a smooth file. Always replace brushes in their original positions. If the brushes are worn so that they do not bear on the commutator, new brushes must be fitted and bedded to the commutator.

Test the brush spring tension with a spring scale.

The tension of the springs when new is 22 to 25 ozs. In service, it is permissible for this value to fall to 15 ozs. before performance is affected. Fit new springs if the tension is below this figure.

If the commutator is blackened or dirty, clean it by holding a petrol moistened cloth against it while the engine is slowly turned by hand cranking. Re-test the generator; if there is still no reading on the voltmeter, there is an internal fault, and the complete unit, if a spare is available, should be replaced. Otherwise the unit must be dismantled (see below) for internal examination.

If the generator is in good order, remove the link from between the terminals and restore the original connections, taking care to connect generator terminal "D" to the control box terminal "D", and the generator terminal "F" to the control box terminal "F". Proceed to test the regulator unit as described under "Control Box".

To Dismantle the Generator.

Unscrew and withdraw the two through bolts.

The commutator end bracket can now be withdrawn from the generator yoke.

The driving end bracket, together with the armature, can now be lifted out of the yoke.

The armature and armature shaft ball bearing need not be separated unless the bearing is suspected and requires examination, or the armature is to be replaced; in this event the ball race should be removed from the armature shaft by means of a claw extractor.

The Commutator.

A commutator in good condition will be smooth and free from pits or burned spots. Clean the commutator with a petrol-moistened cloth. If this is ineffective, carefully polish with a strip of fine glass paper while rotating the armature. To remedy a badly worn commutator, mount the armature, with or without the drive end bracket, 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. Polish the commutator with very fine glass paper. Undercut the insulators between the segments to a depth of $\frac{1}{32}$ inch with a hacksaw blade ground down to the thickness of the insulator.

The Armature.

The testing of the armature winding requires the use of a volt drop test and growler. If these are not available the armature should be checked by substitution. No attempt should be made to machine the armature core or to true a distorted armature shaft.

The Field Coils.

Measure the resistance of the field coils, without removing them from the generator yoke, by means of an ohmmeter connected between the field terminal and the yoke. The correct resistance is 6.2 ohms. A very high reading indicates a faulty connection or an open circuit in the field circuit, whilst a reduced reading indicates an earthed field coil. If an ohm meter is not available, connect a 12 volt D.C.

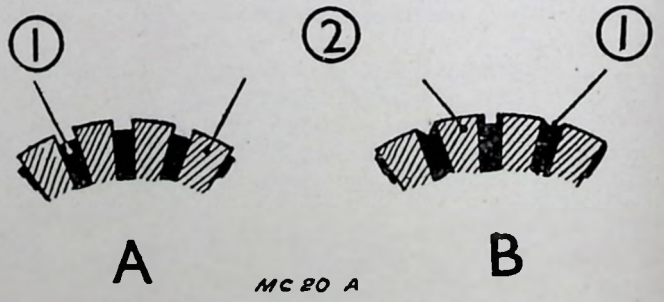


FIG. 3.—Undercutting the dynamo commutator. A is the correct and B the wrong method.
1—Insulation. 2—Segments.

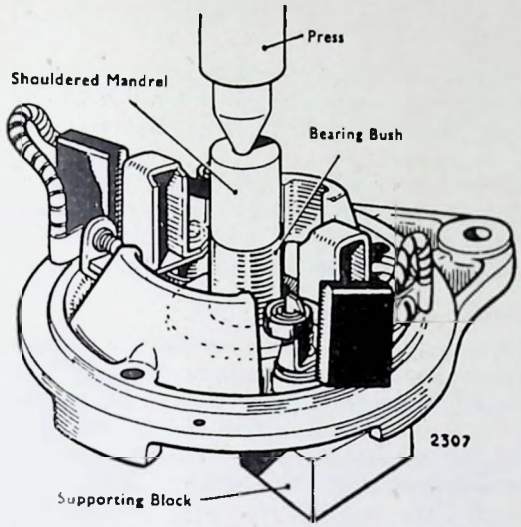


FIG. 4.—Fitting the commutator end bush.

supply with an ammeter in series between the field terminal and generator yoke. The ammeter reading should be approximately 2 amperes. No reading on the ammeter indicates an open circuit in the field winding, and a higher reading indicates an earthed field coil.

In either case, unless a replacement generator is available, the field coils must be replaced. To do this carry out the procedure outlined below, using a pole shoe expander and a wheel-operated screwdriver.

Remove the insulation piece which is provided to prevent the junction of the field coils from contact with the yoke.

Mark the yoke and pole shoes in order that they can be fitted in their original positions.

Unscrew the two pole shoe retaining screws by means of a wheel-operated screwdriver.

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. Take care to ensure that the taping of the field coils is not trapped between the pole shoes and the yoke.

Locate the pole shoes and field coils by lightly tightening the fixing screw.

Insert the pole shoe expander, open it to the fullest extent and tighten the screws.

Finally tighten the screws by means of the wheel-operated screwdriver and lock them by caulking.

Replace the insulation piece between the field coil connections and the yoke.

Re-solder the field coil connections to the field coil terminal tags and re-rivet the assembly to the yoke.

The Bearings.

The generator is fitted with a ball bearing at the driving end and a porous bronze bush at the commutator end.

Bearings which are worn to such an extent that they will allow side movement of the armature shaft, must be replaced.

To replace the bearing bush at the commutator end, proceed as follows:—

The correct method of removing the bush in these cases is to use a lipped expanding type extractor. Where such a tool is not immediately available the bush can be removed by screwing in a $\frac{5}{8}$ inch tap for a few turns and withdrawing the bush and tap complete. Care should be taken to screw the tap squarely into the bush to avoid damage to the bracket.

Press the new bearing bush into the end bracket using a shouldered, highly polished mandrel of the same diameter as the shaft which is to fit in the bearing. **Porous bronze bushes must not be opened out after fitting, or the porosity of the bush may be impaired.**

Note.—Before fitting the new bearing bush it should be allowed to stand for 24 hours completely immersed in thin engine oil; this will allow the pores of the bush to be filled with lubricant. In cases of extreme urgency, this period may be shortened by heating the oil to 100°C. when the time of immersion may be reduced to 2 hours.

The ball bearing, which is a push fit in the driving end bracket, is replaced as follows:—

Drill out the rivets securing bearing retaining plate to the end bracket.

Push the bearing out of the end bracket and remove the corrugated washer, felt washer and oil retaining washer.

Before fitting the replacement bearing see that it is clean and pack it with high melting point grease.

Place the oil retaining washer, felt washer and corrugated washer in the bearing housing in the end bracket.

Locate the bearing in the housing and push it home (hand pressure only is needed).

Fit the bearing retaining plate. Insert the new rivets from the inside of the end bracket and open the rivets by means of a punch to secure the plate rigidly in position.

It is recommended that a piece of mild steel tubing 4 inches long, with an internal diameter of $\frac{5}{8}$ inch, is used to support the inner race of the bearing when fitting the drive end bracket to the armature shaft.

Under no circumstances is it permissible to use the drive end bracket as a support. This would cause damage to the corrugated washer, and as a result the armature would not maintain its correct position and the brushes may overhang the edge of the commutator.

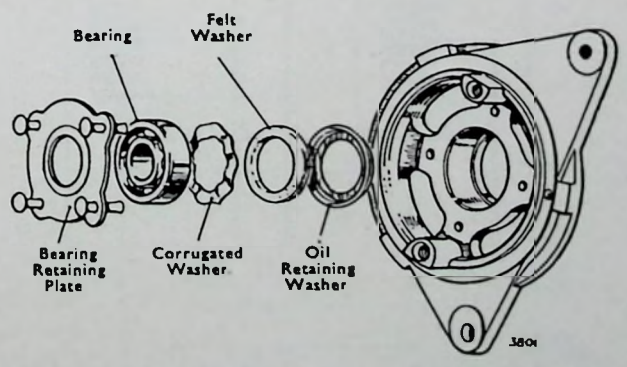


FIG. 5.—Exploded view of the driving end bracket.

The bearing and end bracket should be thoroughly cleaned and repacked with high melting point grease immediately prior to re-assembly.

To Re-assemble the Generator.

In the main, the re-assembly of the generator is a reversal of the dismantling operations. Before refitting the generator to the vehicle, refill the oil hole in the commutator end bracket with engine oil.

The Control Box (RB106/2).

Setting Data.

Regulator:

Open circuit setting at 20°C. (68°F.) at 1,500 dynamo r.p.m. is 15.6 to 16.2 volts (C39PV-2), 16 to 16.6 volts (C40-1).

Note.—For ambient temperatures other than 20°C., 68°F., the following corrections should be made:—

For every 10°C. (18°F.) increase of temperature, decrease the figure quoted above by 0.3 volt. At lower temperatures, corresponding additions should be made to the figure quoted.

Cut-out:

Cut-in voltage	12.7 to 13.3
Drop-off voltage	8.5 to 11.0.
Reverse current	3.8 to 5.0 amps.

Note.—See Section Q, Page 49, for control box type RB310 seting data.

Testing in Position to Locate Fault in the Charging Circuit.

If the generator and battery are in order, check as follows:—

Ensure that the wiring between the battery and regulator is in order. To do this, disconnect the wire from control box terminal "A" and connect the end of the wire removed to the negative terminal of a voltmeter.

Connect the positive voltmeter terminal to an earthing point on the chassis. If a voltmeter reading is given, the wiring is in order and the regulator must be examined.

If there is no reading, examine the wiring between the battery and control box for defective cables or loose connections.

Re-connect the wire to terminal "A".

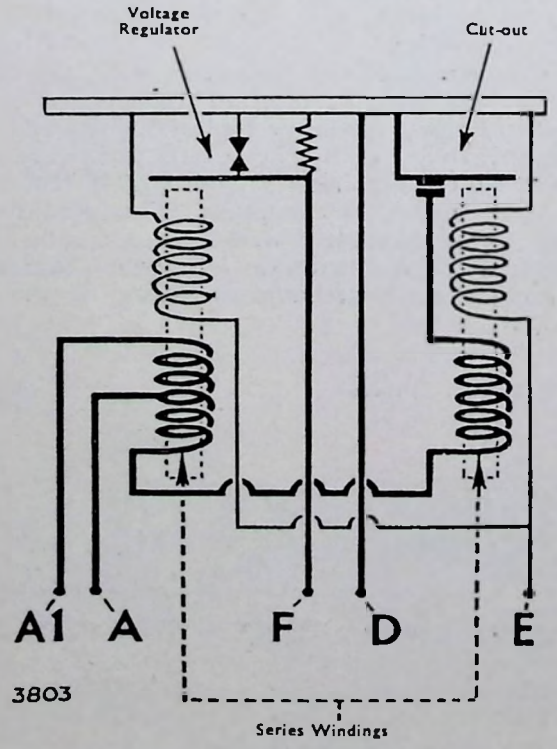


FIG. 6.—Control box internal connections.

Regulator Adjustment.

The regulator is carefully set during manufacture and, in general, it should not be necessary to make further adjustments. If, however, the battery does not keep in a charged condition, or if the generator output does not fall when the battery is fully charged, the setting should be checked and, if necessary, corrected.

It is important before altering the regulator setting to check that the low state of charge of the battery is not due to a battery defect or to slipping of the generator belt.

Electrical Setting:

It is important that only a good quality moving coil voltmeter (0-20 volts) is used when checking the regulator. The electrical setting can be checked without removing the cover from the control box.

Withdraw the cables from the control box terminals "A" and "A1" and connect these cables together. Connect the negative lead of the voltmeter to the control box terminal "D" and connect the other lead to terminal "E".

Slowly increase the speed of the engine until the voltmeter needle 'flicks" and then steadies. This should occur at a voltmeter reading between the appropriate limits given, according to the ambient temperature.

If the voltage at which the reading becomes steady occurs outside these limits, the regulator must be adjusted.

Stop the engine and remove the control box cover. Slacken the locknut of the regulator adjusting screw and turn the screw in a clockwise direction to raise the setting or an anti-clockwise direction to lower the setting. Turn the screw only a fraction of a

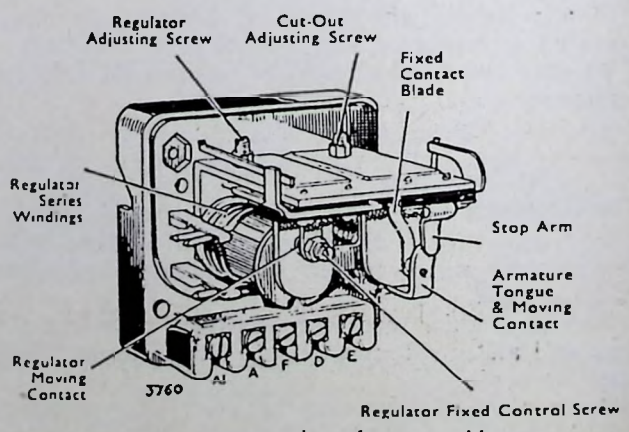


FIG. 7.—Cut-out and regulator assembly.

turn at a time and then tighten the locknut. Repeat as above until the correct setting is obtained.

Adjustment of regulator open circuit voltage should be completed within 30 seconds, otherwise heating of the shunt winding will cause false settings to be made.

Remake the original connections.

A generator run at high speed on open circuit will build up a high voltage. Therefore, when adjusting the regulator do not run the engine up to more than half throttle or a false setting will be made.

Mechanical Settings:

The mechanical or air-gap settings of the regulator, shown in Fig. 8 are accurately adjusted before leaving the works and, provided that the armature carrying the moving contact is not removed, these settings should not be tampered with. If, however, the armature has been removed, the regulator will have to be reset. To do this proceed as follows:—

Slacken the fixed contact locking nut and unscrew the contact screw until it is well clear of the armature moving contact.

Slacken the voltage adjusting screw locking nut and unscrew the adjuster until it is well clear of the armature tension spring.

Slacken the two armature assembly securing screws.

Using a .015 thick feeler gauge, wide enough to cover completely the core face, insert the gauge between the armature and core shim, taking care not to turn up or damage the edge of the shim.

Press the armature squarely down against the gauge and re-tighten the two armature assembly securing screws.

With the gauge still in position, screw the adjustable contact down until it just touches the armature contact. Re-tighten the locking nut.

Re-set the voltage adjusting screw as described under "Electrical Setting" above.

Cleaning the Contacts:

After long periods of service it may be found necessary to clean the regulator contacts. Clean the contacts by means of fine carborundum stone or fine emery cloth.

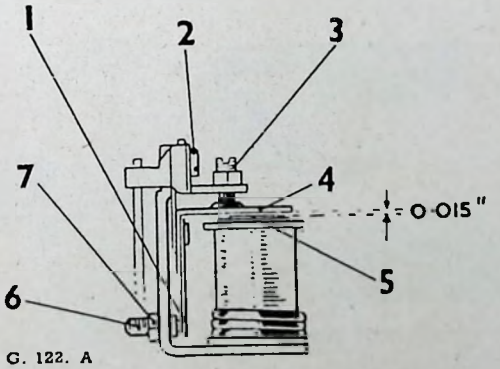


FIG. 8.—Regulator mechanical setting.

1—Armature tension spring.
2—Armature securing screws.
3—Fixed contact adjustment screw.
4—Armature.
5—Core face and shim.
6—Voltage adjusting screw.
7—Locknut.

Carefully wipe away all traces of dust or other foreign matter with methylated spirits (de-natured alcohol).

Cut-out Adjustment (Fig. 9).

Electrical Setting:

If the regulator is correctly set but the battery is still not being charged, the cut-out may be out of adjustment. To check the voltage at which the cut-out operates, remove the control box cover and connect the voltmeter between terminals "D" and "E". Start the engine and slowly increase its speed until the cut-out contacts are seen to close, noting the voltage at which this occurs. This should be 12.7 to 13.3 volts.

If operation of the cut-out takes place outside these limits, it requires adjusting. To do this, slacken the locknut securing the cut-out adjusting screw and turn the adjusting screw in a clockwise direction to raise the voltage setting or in an anti-clockwise direction to reduce the setting.

Turn the screw only a fraction of a turn at a time and then tighten the locknut. Test after each adjustment by increasing the engine speed and noting the voltmeter readings at the instant of contact closure. Electrical settings of the cut-out, like the regulator, must be made as quickly as possible because of temperature rise effects. Tighten the locknut after making the adjustment.

If the cut-out does not operate, there may be an open circuit in the wiring of the cut-out and regulator unit, in which case the unit should be removed for examination or replacement.

Mechanical Setting:

If for any reason the cut-out armature has to be removed from the frame, care must be taken to obtain the correct air gap settings on re-assembly. These can be obtained as follows:—

Slacken the adjusting screw locking nut and unscrew the cut-out adjusting screw until it is well clear of the armature tension spring.

Slacken the two armature securing screws.

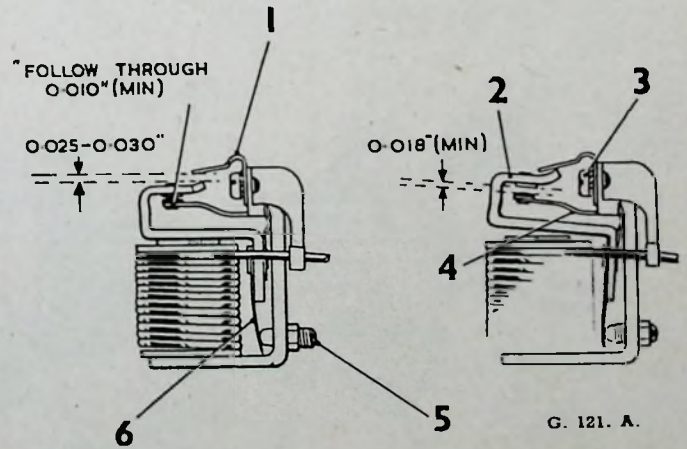


FIG. 9.—Cut-out mechanical setting.

1—Stop arm.
2—Armature tongue and moving contact.
3—Armature securing screw.
4—Fixed contact blade.
5—Cut-out adjusting screw.
6—Armature tension spring.

Press the armature squarely down against the copper-sprayed core face and re-tighten the armature securing screws.

Using a pair of suitable pliers, adjust the gap between the armature stop-arm and the armature tongue by bending the stop-arm. The gap must be .025 to .030 when the armature is pressed squarely down against the core face.

Similarly, the fixed contact blade must be bent so that when the armature is pressed squarely down against the core face there is a **minimum** "follow-through", or blade deflection, of .010.

The contact gap, when the armature is in the free position, must be .018 minimum.

Re-set the cut-out adjusting screw as described above.

Cleaning the Contacts:

If the cut-out contacts appear rough or burnt, place a strip of fine glass paper between the contacts—then, with the contacts closed by hand, draw the paper through. This should be done two or three times with the rough side towards each contact. Wipe away all dust or other foreign matter, using a clean fluffless cloth moistened with methylated spirits (denatured alcohol).

Do not use emery cloth or a carborundum stone for cleaning cut-out contacts.

The Fuses—Series I and IIIA.

Two 35 amp. fuses with spares are carried by a separate fuse unit. The fuse which bridges terminal A1—A2 is to protect auxiliary circuits independent of the ignition switch. The fuse bridging terminals A3—A4 protects those circuits by way of the ignition switch, such as the reverse and stop lights, direction signals, instruments, horns, etc.

All Other Series.

The single fuse mounted adjacent to the control box protects accessories on the auxiliary circuit controlled by the ignition switch.

The Starter Motor.

Routine Maintenance.

The only maintenance normally required is the occasional checking of the brushgear and commutator. About every 12,000 miles remove the metal band cover. Check that the brushes move freely in their holders by holding back the brush springs and pulling gently on the flexible connectors. If a brush is inclined to stick, remove it from its holder and clean its sides with a petrol-moistened cloth. Be careful to replace the brushes in their original position in order to retain the "bedding". Brushes which have worn so that they will not "bed" properly on the commutator must be renewed.

The commutator should be clean, free from oil or dirt and should have a polished appearance. If it is dirty, clean it by pressing a fine dry cloth against it while the starter is turned by hand by means of a spanner applied to the squared extension of the shaft. Access to the squared shaft is gained by removing the thimble-shaped metal cover. If the commutator is very dirty, moisten the cloth with petrol.

To Test the Starter Motor in Position.

Switch on the lamps and operate the starter control. If the lights go dim, but the starter motor is not heard to operate, and indication is given that current is flowing through the starting motor windings, but that the armature is not rotating for some reason; possibly the pinion is meshed permanently with the geared ring on the flywheel. In this case the motor must be removed from the engine for examination.

Should the lamps retain their full brilliance when the starter switch is operated, check the circuit for continuity from battery to starting motor via the starter switch, and examine the connections at these units. If the switch is found to be faulty, a new switch must be fitted. If the supply voltage is found to be applied to the motor when the switch is operated, an internal fault in the motor is indicated,

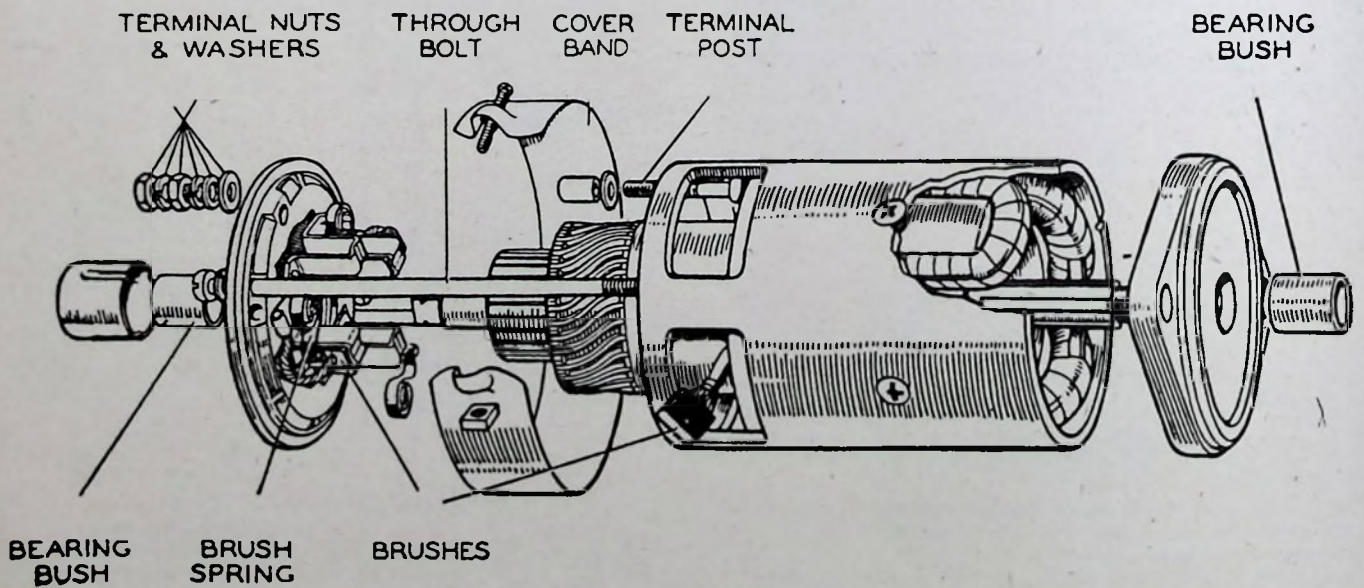


FIG. 10.—A dismantled view of the starting motor.

and the unit must be removed from the engine for examination.

Sluggish or slow action of the starting motor is usually caused by a poor connection in the wiring, giving rise to 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 and Examination of the Brushgear and Commutator.

If it is necessary to remove the motor from the engine, first proceed as follows:—

Disconnect the cable from the positive battery terminal to avoid any danger of causing short circuits.

Disconnect the heavy cable from the starting motor.

After removing the starter motor from the engine, secure the body in a vice and test by connecting it with heavy gauge cables to a 12 volt battery. One cable must be connected to the starter terminal and the other held against the body or end bracket. Under these light load conditions, the starter should run at a very high speed.

If the operation of the motor is unsatisfactory, remove the cover band and examine the brushes and commutator. Hold back each of the brush springs and move the brush by pulling gently on its flexible connector. If the movement is sluggish, remove the brush from its holder and ease the sides by lightly polishing on a smooth file. Always replace the brushes in their original position. If the brushes are worn so that they will not bear on the commutator, or if the brush flexible connector is exposed on the running face, they must be replaced.

Check the tension of the brush springs with a spring scale. The correct tension is 32 to 40 ozs. A new spring should be fitted if the tension is low.

If the commutator is blackened or dirty, clean it by holding a petrol-moistened cloth against it while the armature is rotated.

Re-test the starter as described above. If the operation is still unsatisfactory, the unit must be dismantled for detailed inspection and testing.

To Dismantle the Starter Motor.

Remove the cover band, hold back the brush springs and lift the brushes from their holders.

Remove the terminal nuts from the terminal post.

Remove the two through bolts from the commutator end bracket, and take off the commutator end bracket from the yoke.

Remove the driving end bracket, complete with armature and drive, from the starting motor yoke. If it is necessary to remove the armature from the driving end bracket it can be done by means of a hand press after the drive has been dismantled.

To Replace the Brushes.

If the brushes are worn so that they do not bear on the commutator, or if the flexible connectors are exposed on the running face, they must be replaced.

Two of the brushes are connected to terminal eyelets attached to the brush boxes on the commutator end bracket and two are connected to tappings on the field coils.

The flexible connectors must be removed by unsoldering and the connectors of the new brushes secured in their place by soldering. The brushes are pre-formed so that bedding to the commutator is unnecessary.

The Commutator.

A commutator in good condition will be smooth and free from pits and burned spots. Clean the commutator with a petrol-moistened cloth. If this is ineffective, carefully polish with a strip of fine glass paper while rotating the armature. To remedy a badly worn commutator, dismantle the starter drive (as described under "Starter Drive") and remove the armature from the end bracket. Now mount the armature in a lathe, rotate at a high speed and take a light cut with a very sharp tool. Do not remove any more metal than is necessary. Finally polish with a very fine glass paper. The insulators between the commutator segments **must not be undercut.**

The Armature.

Examination of the armature may reveal the cause of failure, e.g., conductors lifted from the commutator due to the starter drive being engaged while the engine is running and causing the armature to be rotated at an excessive speed. A damaged armature must in all cases be replaced — no attempt should be made to machine the armature core or to true a distorted armature shaft.

The Field Coils.

Test the field coils for continuity by connecting a 12 volt battery with a 12 volt bulb in series between the tapping points of the field coils at which the brushes are connected. Failure of the lamp to light indicates an open circuit in the wiring of the field coils.

Lighting of the lamp does not necessarily mean that the field coils are in order, as it is possible that one of them may be earthed to a pole shoe or to the yoke. This may be checked with a 110 volt test lamp, the test leads being connected to one of the field coil tapping points and to a clean part of the yoke. Should the lamp light it indicates that the field coils are earthed to the yoke.

In either case, unless a replacement starting motor is available, the field coils must be replaced. To do this, carry out the procedure outlined below, using a pole shoe expander and a wheel-operated screwdriver.

Remove the insulation piece which is provided to prevent the inter-coil connectors from contact with the yoke.

Mark the yoke and pole shoes in order that they can be fitted in their original positions.

Unscrew the four pole shoe retaining screws by means of the wheel-operated screwdriver.

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. Take care to ensure that the taping of the field coils is not trapped between the pole shoes and the yoke.

Locate the pole shoes and field coils by lightly tightening the fixing screws.

Insert the pole shoe expander, open it to the fullest extent and tighten the screws.

Finally tighten the screws by means of the wheel-operated screwdriver.

Replace the insulation piece between the field connections and the yoke.

The Bearings.

Bearings which are worn to such an extent that they will allow excessive side play of the armature shaft must be replaced. To replace the bearing bushes proceed as follows:—

Press the bearing bush out of the end bracket.

Press the new bearing bush into the end bracket, using a shouldered, highly polished mandrel of the same diameter as the shaft which is to fit in the bearing. Porous bronze bushes must not be opened out after fitting, or the porosity of the bush may be impaired.

Note.—Before fitting a new porous bronze bearing bush it should be completely immersed for 24 hours in clean thin engine oil. In cases of extreme urgency this period may be shortened by heating the oil to 100°C., when the time of immersion may be reduced to 2 hours.

To Re-assemble the Starter Motor.

The re-assembly of the starting motor is a reversal of the dismantling procedure.

The Starter Drive.

The pinion is mounted on a screwed sleeve, which is carried on splines on the armature shaft. The sleeve is so arranged that it can move along the shaft against a compression spring to reduce the shock loading at the moment engagement takes place.

When the starter switch is operated the armature shaft and screwed sleeve rotate. Owing to the inertia of the pinion, the latter is caused to move along the sleeve until the pinion comes into engagement with the flywheel ring. The starter will then turn the engine.

As soon as the engine fires and commences to run under its own power the flywheel will be driven faster by the engine than the starter. This will cause the pinion to be screwed back along the sleeve, so drawing the pinion out of mesh with the flywheel teeth. In this manner the drive safeguards the starter against damage due to being driven at high speeds.

A pinion restraining spring is incorporated in the drive. This spring prevents the pinion vibrating into mesh when the engine is running.

Routine Maintenance.

If any difficulty is experienced with the starting motor not meshing correctly with the flywheel, it may be that the drive requires cleaning. The pinion should move freely on the screwed sleeve; if there is any dirt or other foreign matter on the sleeve it must be washed off with kerosene.

In the event of the pinion becoming jammed in mesh with the flywheel, it can usually be freed by turning the starter motor armature by means of a spanner applied to the shaft extension at the commutator end. This is accessible by removing the cap, which is a push fit.

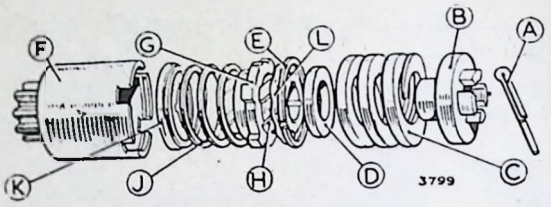


FIG. 11.—Exploded view of the starter drive.

To Dismantle and Re-assemble the Starter Drive.

Having removed the armature as described in the section dealing with starting motors, the drive can be dismantled as follows (see Fig. 11):—

Remove the split pin from the shaft nut at the end of the starter drive. Hold the squared starter shaft extension at the communtator end by means of a spanner and unscrew the shaft nut (B). Lift off the main spring (C) and buffer washer (D) and remove the retaining ring from inside the end of the pinion and barrel assembly (F). The corrugated washer, control nut (G), sleeve (H) and restraining spring will now slide off. Withdraw the splined washer from the armature shaft and remove the pinion and barrel.

The re-assembly of the drive is a reversal of the dismantling procedure.

Note.—Should either the control nut or screwed sleeve be damaged, then a replacement assembly of screwed sleeve and control nut must be fitted. These components must not be renewed individually.

The Distributor.

Routine Maintenance.

In general, lubrication and cleaning constitute normal maintenance procedure.

Lubrication.

Take great care to prevent oil or grease from getting on or near the contacts.

Lightly smear the cam and the pivot on which the contact breaker works with lubricant as specified.

Lift off the rotor arm by pulling vertically and apply to the spindle a few drops of engine oil to lubricate the cam bearing. It is not necessary to remove the exposed screw, since it affords a clearance to permit passage of oil.

Replace the rotor arm carefully, locating its moulded projection in the keyway in the spindle and pushing it on as far as it will go, in order to avoid the risk of the moulded cap being burned or tracked.

Carefully add a few drops of engine oil through the aperture at the edge of the contact breaker plate to lubricate the automatic timing control.

To Dismantle (DKY4A).

Spring back the securing clips and remove the moulded cap.

Lift the rotor arm off the top of the spindle if tight, carefully lever off with a screwdriver.

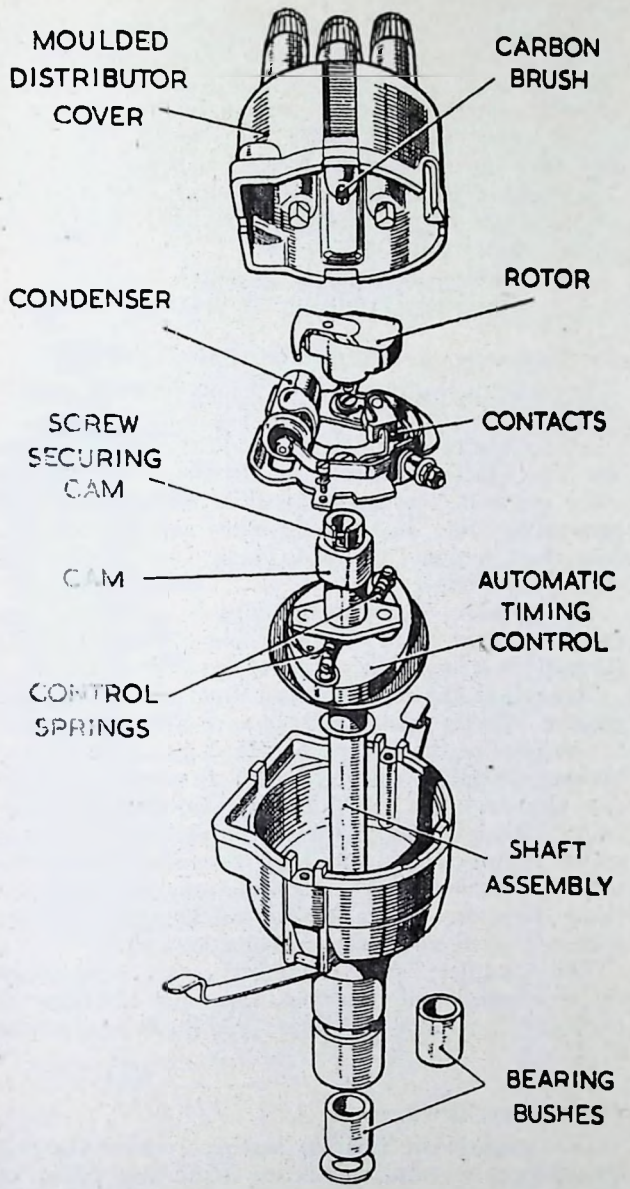


FIG. 12.—DKY4A distributor dismantled.

Slacken the nut on the terminal post and lift off the contact breaker spring. The contact breaker lever can now be lifted from its pivot. Lift the fibre washer from the pivot. Remove the two screws, together with the spring and plain steel washers, securing the fixed contact plate, and remove the plate.

Undo the two screws with spring washers from the edge of the contact breaker base, which can now be removed from the distributor body.

Remove the dog from the shaft.

Remove the cam, centrifugal timing control and shaft assembly from the distributor. Take out the screw from inside the top of the cam spindle. Lift off the cam and cam-foot.

Capacitor (Condenser) — Replacement. (Types DKY4A and D2A4.)

Should the capacitor have been found to be faulty when testing, it is advisable to fit a complete new capacitor and contact breaker base.

Bearing Bushes — Replacement. (DKY4A.)

Bushes are removed and fitted using a vertical drilling machine or hand press in which is fitted a highly polished mandrel of the same size as the distributor shaft.

To remove the bushes, locate the distributor body (inverted) beneath the press. A sleeve must be fitted over the mandrel to enlarge it to the size of the bushes. Apply a steady pressure to force the bushes from their seats. Remove the sleeve.

New bushes must be completely immersed in thin engine oil for 24 hours before fitting. In cases of emergency, this process may be shortened by heating the oil to 100°C., for 2 hours, **then allowing the oil to cool before removing the bush.**

Place a long bush on the mandrel, then the distributor body (inverted) and finally one of the smaller bushes. Locate the lower end of the mandrel in a suitable packing block and apply a steady downward pressure. Ensure that both bushes enter the distributor squarely. When they have been fully inserted, carefully withdraw the mandrel.

Under no circumstances should the bushes be overbored by reamering or any other means, since this will impair the porosity and thereby the effective lubricating quality of the bushes.

Re-assembling (DKY4A).

Before assembly, the centrifugal advance mechanism, distributor shaft and the portion of the shaft on which the cam fits, must be lubricated with thin engine oil.

Assemble the centrifugal timing control, taking care that the parts are fitted in their original positions and the control springs not stretched. Two holes are provided in each toggle for the control springs, which must in each case be fitted to the inner hole. Place the cam on the spindle and secure with the locking screw.

Fit the shaft in its bearings and replace the driving member.

Place the contact-breaker base in position on the distributor body, securing by replacing the two side screws. Spring washers must be fitted under each screw head and the screws firmly tightened.

Place the end of the connector strip over the condenser terminal post, refit the spring washer and secure by tightening the terminal nut.

Replace the fixed contact plate on the contact breaker base, fit the two screws, together with their plain and spring washers, and lightly tighten. Place the insulating washer over the contact breaker pivot pin and fit the contact breaker lever on the pin. Locate the slotted end of the contact breaker spring under the head of the terminal screw and tighten the nut to lock the spring in position. Adjust the contact breaker setting to give a gap of 0.014"-0.016" when the contacts are fully opened.

Note.—If it is necessary to renew the contacts, a replacement set comprising fixed and moving contacts must be fitted.

Place the rotor on the spindle, locating the register correctly and pushing the rotor fully home.

Fit the distributor cover moulding and secure by means of the spring clips.

Replacement Contacts.

If the contacts are so badly worn that replacement is necessary, they must be renewed as a pair and not individually. The contact gap must be set to 0.014" to 0.016". After the first 500 miles running with new contacts fitted, the setting should be checked and the gap reset to 0.014" to 0.016". This procedure allows for the initial "bedding-in" of the heel.

To Dismantle (D2A4).

When dismantling, note carefully the positions in which the components are fitted in order to ensure their correct re-assembly.

Remove the moulded cover and withdraw the rotor arm.

Remove the contact breaker base plate, complete with contacts, capacitor and terminal assembly. The plate is secured by two screws to the distributor body.

Withdraw the screw from inside the cam spindle and lift out the cam, toggles, springs and weights.

Knock out the driving dog securing pin and, when fitted, the collar securing pin and withdraw the dog and collar from the lower end of the shaft. The shaft and action plate can now be withdrawn from the body.

The single long porous bronze bearing bush can be pressed out of the shank with a shouldered mandrel. If a bush is removed, a new bush must be fitted on re-assembly.

Re-assembly (D2A4).

In general, re-assembly is the reversal of dismantling. The following details, however, should be noted.

Bearing Replacement.

A replacement bush must be allowed to soak for at least 24 hours, completely immersed in medium viscosity (S.A.E. 30-40) engine oil. On occasions of urgency, this period can be shortened by heating the oil to 100°C. for 2 hours and then allowing the oil to cool before removing the bush.

Using a shouldered mandrel, press the new bearing into the shank. 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.

Important.

A bush must never be over-bored by reamering or by any other process, since this will impair the porosity and, therefore, the effective lubricating quality of the bush.

Drilling a New Shaft.

A shaft and action plate must be free to rotate without excessive end-play. To obviate binding on the one hand and excessive end-play on the other, a 0.002" gauge should be inserted before drilling as a temporary spacer between the dog or collar and the fibre thrust washer. Whilst drilling, the shaft and action plate must be pushed down from the cam end and the dog or collar to be hard against the thrust washer and 0.002" spacer.

After drilling, remove the spacer.

The maximum permissible end-play is 0.006".

To Dismantle the Distributor (DM2/P4-S94).

In order to ensure that the various components are refitted correctly, a careful note should be made of the positions of the items as they are removed. Note the relationship between the driving dog and the rotor electrode and maintain this relation when re-assembling the distributor. The amount of dismantling necessary will obviously depend on the repair required.

Spring back the securing clips and remove the moulded cover. Lift the rotor arm off the spindle, carefully levering with a screwdriver if it is tight.

Disconnect the vacuum unit link to the moving contact breaker plate, and remove the two screws at the edge of the contact breaker base. The contact breaker assembly, complete with external terminal, can now be lifted off (see "The Contact Breaker" below). Remove the circlip on the end of the micrometer timing screw, and turn the micrometer nut until the screw and the vacuum unit assembly are freed. Take care not to lose the ratchet and coil type springs located under the micrometer nut.

The complete shaft assembly, with centrifugal timing control and cam foot, can now be removed from the distributor body (see "The Shaft and Action plate").

The Contact Breaker:

To dismantle the assembly further, remove the nut, insulating piece and connection from the pillar on which the contact breaker spring is anchored. Slide out the terminal moulding. Lift off the contact breaker lever and the insulating washers beneath it. Remove the screw securing the fixed contact plate, together with the spring and plain steel washers, and take off the plate. Withdraw the single screw securing the capacitor and contact breaker earthing lead. Dismantle the contact breaker base assembly by turning the base plate clockwise and pulling to release it from the moving contact breaker plate.

The Shaft and Action Plate:

To dismantle the assembly further, take out the screw inside the cam and remove the cam and cam foot. The weight springs (2) of the centrifugal timing control can now be lifted off the action plate.

To Replace the Bearing.

The single long bearing bush used in this distributor can be pressed out of the shank by means of a shouldered mandrel. If the bearing has been re-

moved the distributor must be assembled with a new bush fitted. The bush should be prepared for fitting by allowing it to stand completely immersed in engine oil for at least 24 hours. Press the bearing into the shank, using a shouldered polished mandrel of the same diameter as the shaft. Under no circumstances should the bush be overbored by reaming or any other means, since this will impair the porosity and thereby the effective lubricating quality of the bush.

To Re-assemble the Distributor (DM2/P4-S94).

The following instructions assume that complete dismantling has been undertaken.

Place the distance collar over the shaft, smear the shaft with clean engine oil, and fit it into its bearing.

Refit the vacuum unit into its housing and replace

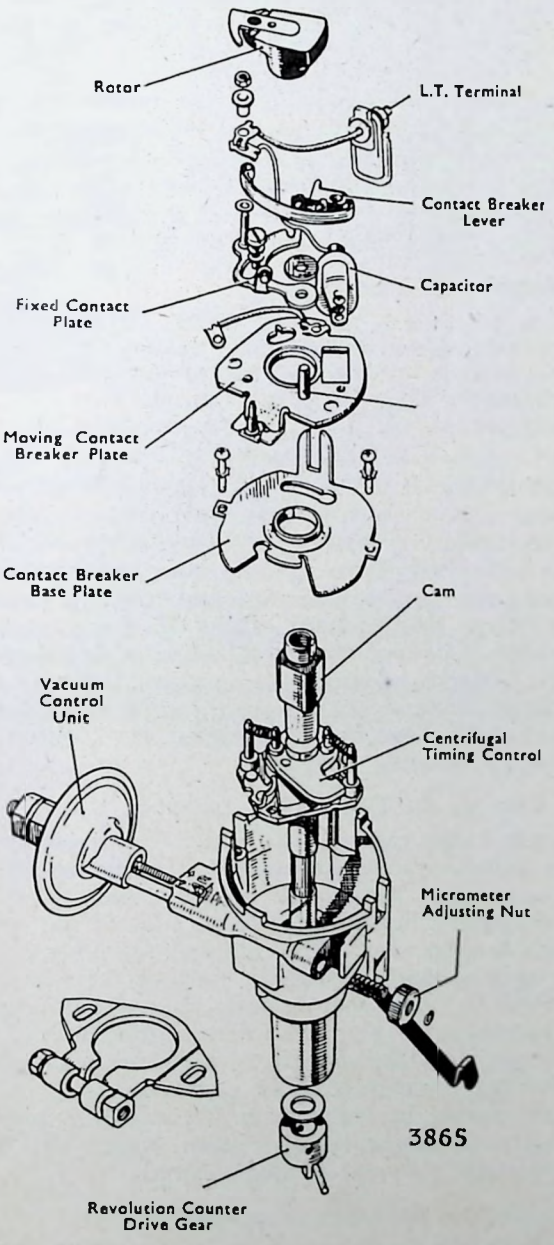


FIG. 13.—Exploded view of the distributor (DM2/P4S94).

the springs, milled adjusting nut and securing circlip.

Re-assemble the centrifugal timing control. See that the springs are not stretched or damaged. Place the cam and cam foot assembly over the shaft, engaging the projections on the cam foot with the weights or, on earlier models, the toggles, and fit the securing screw.

Before re-assembling the contact breaker base assembly, lightly smear the base plate with clean engine oil.

Fit the moving contact breaker plate to the contact breaker base plate and secure, using a reversal of the dismantling procedure. Refit the contact breaker base into the distributor body. Engage the link from the vacuum unit. Insert the two base plate securing screws, one of which also secures one end of the contact breaker earthing cable.

Fit the capacitor into position. Place the fixed contact plate in position and secure lightly. One plain and one spring washer must be fitted under the securing screw.

Place the insulating washers, etc., on the contact breaker pivot post and on the pillar on which the end of the contact breaker spring locates. Refit the contact breaker lever and spring.

Slide the terminal block into its slot.

Thread the low tension connector and capacitor eyelets on to the insulating piece, and place these on to the pillar which secures the end of the contact breaker spring. Refit the washer and securing nut.

Set the contact gap to .016 and tighten the fixed contact securing screw.

Refit the rotor arm, locating the moulded projection in the rotor arm with the keyway in the shaft. and pushing fully home. Refit the moulded cover.

Replacement Contacts.

If the contacts are so badly worn that replacement is necessary, they must be renewed as a pair and not individually. The contact gap must be set to .016; after the first 500 miles running with new contacts fitted, the setting should be checked and if required the gap should be reset to .016. This procedure allows for the initial "bedding-" in of the heel.

The Flashing Direction Signals.

The correct operation of direction signals requires that the bright filament in the parking and tail lamp bulbs (depending on the position of the switch) flash intermittently whether or not the headlamps, parking lamps, tail lamps or stop lamps are "on".

A correctly operating direction signal will be indicated by a regular intermittent flashing of the green pilot lamp located on the facia panel in front of the driver. If, when the direction indicator is switched on, the warning (or pilot) lamp does not flash in the usual manner but remains unlit, first check that this is not due to filament failure in either the front or rear lamp on that side. This can be checked by turning the switch to the opposite side — if the pilot lamp now flashes, the circuit is in order and bulb replacement is indicated. On the other hand,

if the pilot lamp still does not flash, inspect the indicator lamps. If these are working normally, failure of the pilot lamp bulb is indicated. If, however, the indicator lamps are not functioning it will be necessary to proceed to check the wiring and flasher unit.

The efficiency of the flasher unit may be readily checked by plugging in a known substitute.

The inoperative parking or stop/tail lamp bulbs should be checked for a burned out bright filament. Where it is found that neither lamp has a burned out filament the wiring between the defective lamp and indicator switch must be checked.

If the direction signal is entirely inoperative, check the fuse (A.4 on the fuse box), flasher unit and circuit from the fuse box up through the steering column switch in the order named.

The flasher unit is located inside the car and is plugged into a socket on the underside of the facia. No servicing of the flasher is required, and where this unit breaks down in service it should be replaced.

It is important to note that the twin filament bulbs used in the side and tail lamps (Lucas 380 12V. 21/6W. are the same type. These bulbs have offset pins and cannot be fitted incorrectly.

Operation of the Flasher Unit. (See Fig. 14.)

This unit depends for its operation on an electro-magnet in conjunction with the linear expansion of a piece of wire which becomes heated as current flows through it.

The expanding and contracting of the wire controls the speed at which the armature carrying the moving contact will move, as a result of the pull exerted by the electro-magnet and the sequence of operations is as follows:—

As current flows from terminal "X" to terminal "L" and the lamps via the resistance wire and electro-magnet, the wire heats up and expands.

This allows the armature carrying one of the contacts to be attracted to the pole piece of the electro-magnet closing contacts (A) and full voltage is then applied to the lamps via the windings of the electro-magnet. Contacts (B) are also closed, completing the pilot lamp circuit.

While contacts (A) are closed the resistance wire is short circuited and cools off. The taut section of the resistance wire contracts and pulls back the armature to open contacts (A).

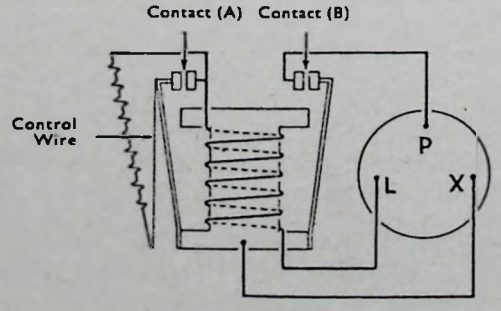


FIG. 14.—Showing the internal connections of the flasher unit.

The pilot lamp on the facia panel will not flash unless sufficient current to light the bright filaments in the side (parking) lamp and the stop/tail or rear flasher lamp is passing through the windings of the electro-magnet to close the contacts (B). The flashing pilot lamp, therefore, gives the driver a clean indication that the direction signals are working correctly.

It will be noted that in order to maintain the desired rate of flashing (60 to 120 per minute) the filaments of the front and rear lamps are "pre-heated" via the resistance wire during the "out" period of the flash.

Operation of the Direction Indicator Switch.

When the direction indicator switch is moved to give left or right turn signal it connects the tail lamp on that side of the car to termial "L" on the flasher unit. At the same time it connects the bright filament in the side (parking lamp) also to flasher unit terminal (L).

The Horn.

The windtone horn requires no attention in service. If a horn fails, or becomes uncertain in its action, it does not follow that it has broken down, as the fault may be caused by a discharged battery or a wiring fault in the horn circuit.

Adjustment of the Horn.

The adjustment provided on the horn does not alter its note, but merely takes up any wear of the moving parts. Adjustment should not be necessary until after a long period of service.

Remove the cover of the horn and detach the cover securing bracket. Slacken the locknut on the fixed contact of the horn, and rotate the adjusting nut until the contacts are just separated, as indicated by the failure of the horn to sound when the horn push is pressed. Turn the adjusting nut for half a turn in the opposite direction, and measure the current taken by the horn when the horn push is operated. This should be 6 to 7 amperes. If this value is not obtained, continue to re-adjust the nut in a clockwise direction to decrease the current and in an anti-clockwise direction to increase it. Tighten the nut when correctly adjusted.

To Remove the Horn Ring Assembly.

Remove the three screws which secure the horn ring assembly in the hub of the steering wheel.

These screws are equally spaced around the hub and located in line with the lower edge of the spokes of the steering wheel. The complete assembly is now free to be withdrawn from the hub of the wheel.

It will be noted that a short cable which supplies the current to the ring has a snap connector end, and is plugged into the connector on the steering wheel.

To refit, reverse the above instructions.

Care should be taken to ensure that the plug of the snap connector is fully home before the horn ring assembly is replaced and secured.

To Dismantle the Horn Ring Assembly.

Remove the horn ring assembly from the steering column (see above).

Turn the assembly over and remove the three 4 B.A. self-locking nuts with washers securing the lower horn contact plate and springs.

Take off the contact plate and springs.

Remove the three screws securing the hub mouldings to the horn rings.

To re-assemble, reverse the above instructions. It is important, however, to ensure that the air gap between the contacts is maintained at .020.

Adjustment of the gap is effected by means of the three 4 B.A. self-locking nuts.

The Windscreen Wiper.

The dual arms of the windscreen wiper are driven by a cable rack from a separately mounted motor. The rotary motion of the motor armature is converted to the reciprocating motion of the cable rack by means of a single stage reduction gear, connecting rod and crosshead in the gearbox.

The cable rack comprises an inner steel core carrying a wire helix, the whole being run within rigid connecting tubes between the motor and wheelboxes. At the wheelboxes the rack engages with toothed wheels on the wiper arm spindles. The method of arm-to-spindle fixing consists of an internally splined headpiece and a retaining clip mating with a splined driving drum.

To Replace the Wiper Rubber.

New elements should be handled with care. It is particularly important to keep the rubber clean and free from oil and petrol and to avoid distortion of the metal "backbone". Fig. 15 (A) shows an assembled Lucas "Rainbow" windscreen wiper blade. To replace a defective element, proceed as described below:

Press down the locking pin and slide the element in the direction shown in Fig. 15 (B) to free it from the supporting yokes.

There are four pairs of locating projections along the "backbone" of the new wiping element, as shown in Fig. 15 (C).

When fitting, first locate the element projections "A" and "C", afterwards guiding projections "B" and "D" into position and sliding the element to the left as shown in Fig. 15 (D) until the locking pin is heard to snap into position.

To Replace a Wiper Blade.

Pull the wiper arm away from the windscreen and insert the curved "wrists" of the arm into the slotted spring fastening of the blade. Swivel the two components into engagement.

To Replace or Adjust the Wiper Arm.

Lift the spring retaining clip on the wiper arm and slide the arm from the spindle. The spindle is splined giving adjustment steps of 5° for the arm. Fit the new arm on the spindle and check the sweep when the wiper is operated. To adjust the sweep the clutch must be removed from the spindle and replaced on the appropriate spline.

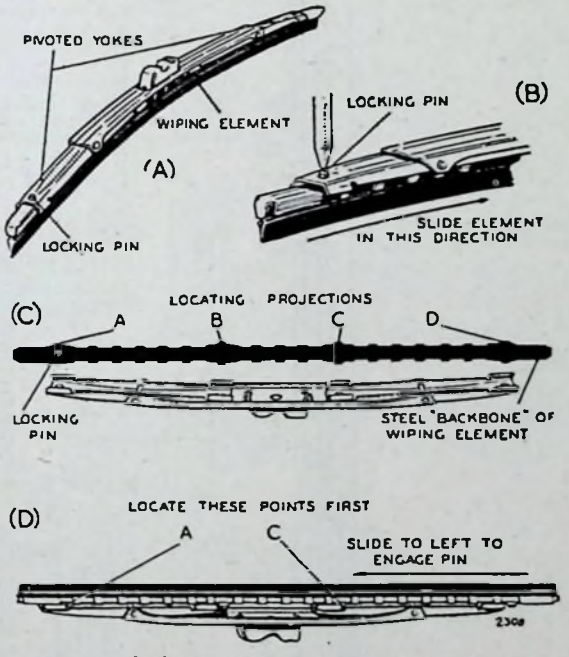
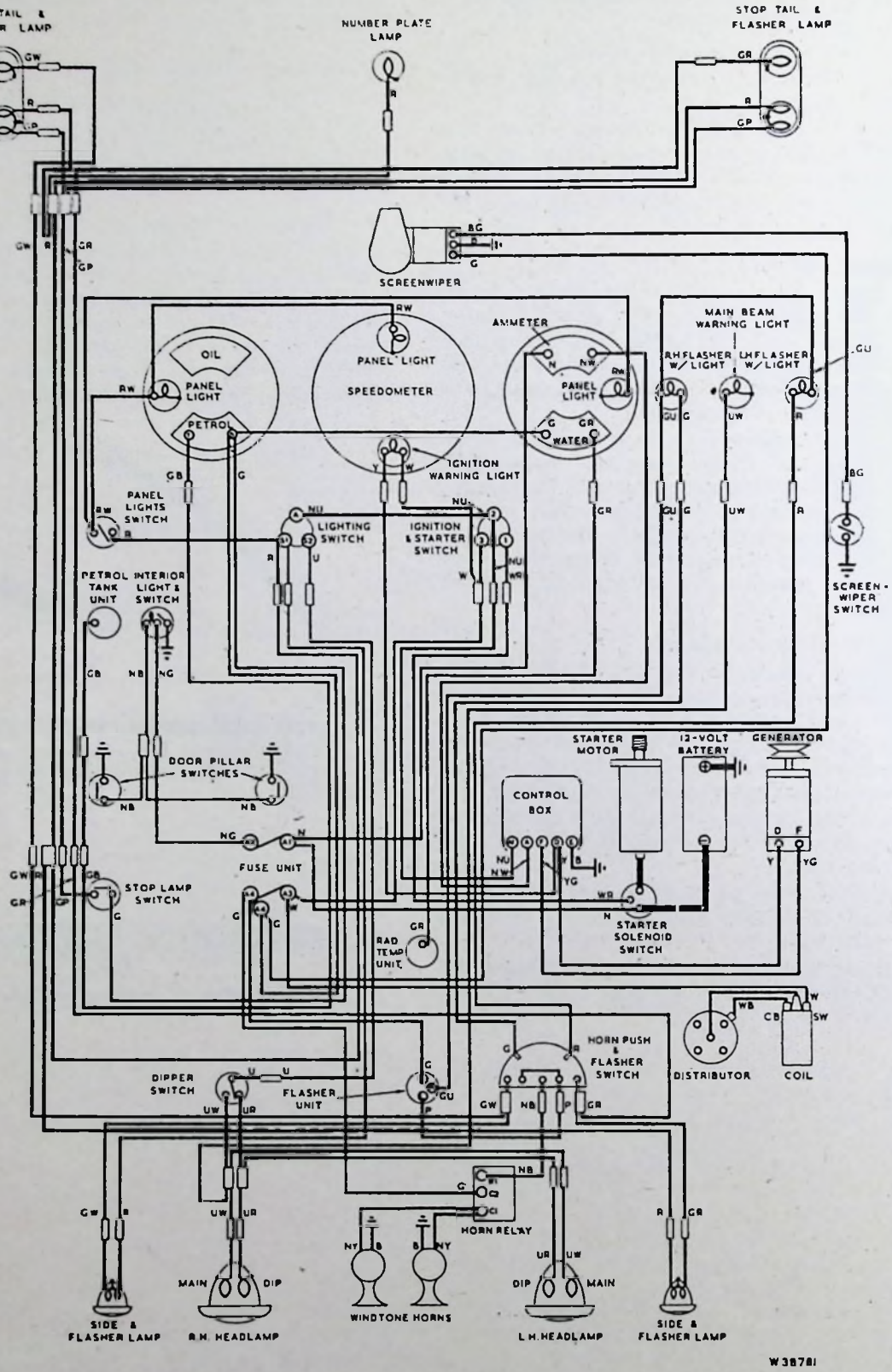


FIG. 15.—Method of renewing the rubber wiper elements.



Cable colour code:

B—Black.
U—Blue.
N—Brown.
G—Green.
P—Purple.
R—Red.
S—Slate.
W—White.
D—Dark.
Y—Yellow.
L—Light.
M—Medium.

FIG. 16.—Wiring diagram, Series I.

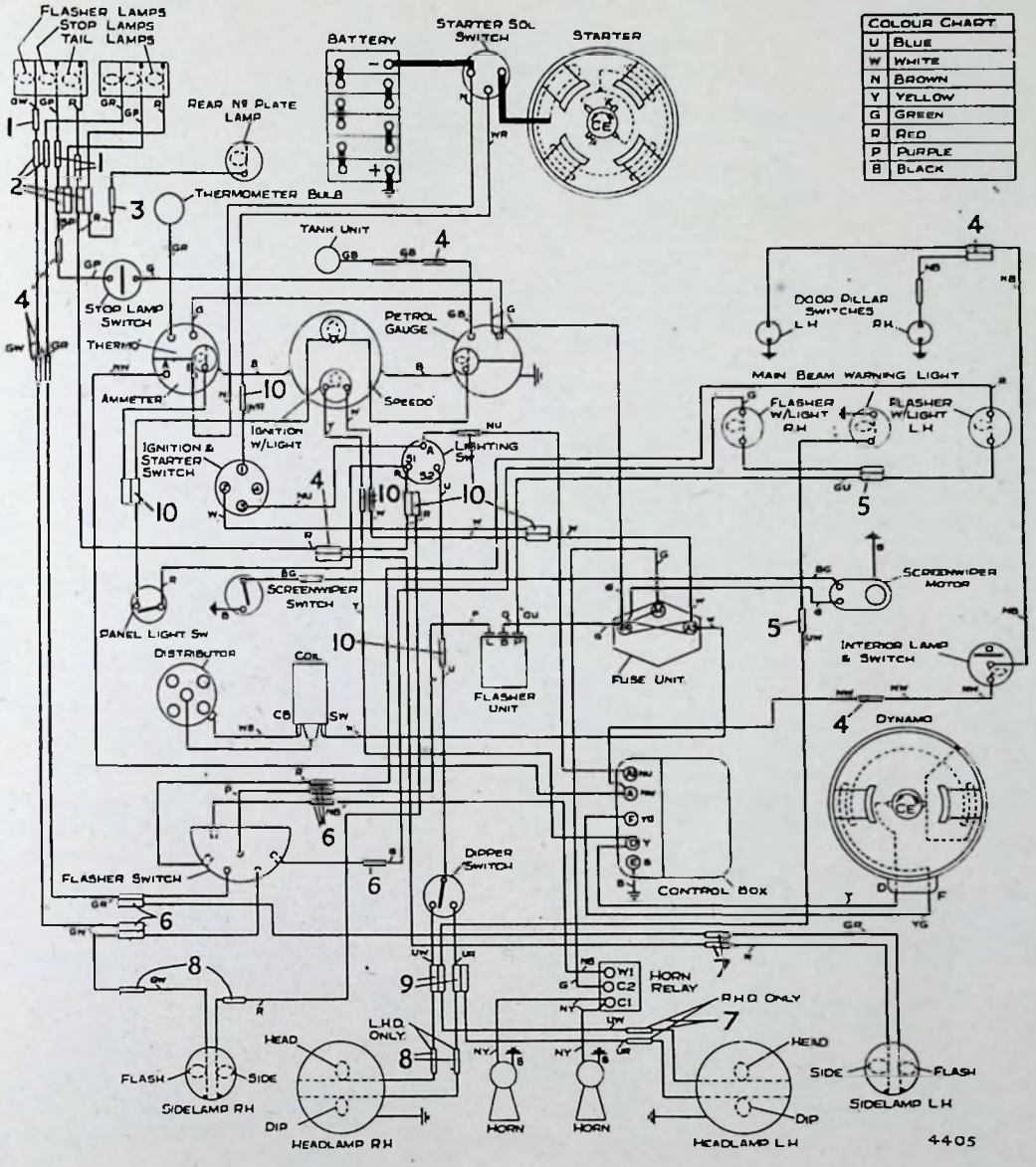


FIG. 17.—Series II-IIA-III wiring diagram and location of snap connectors.

1—Top right-hand corner of luggage locker.

2—Top left-hand corner of luggage locker.

3—In luggage locker under parcel tray.

4—Under facia on left-hand side of car.

5—Under facia behind warning lights.

6—Behind facia in line with steering column.

7—Left-hand front wing valance.

8—Right-hand front wing valance.

9—At left-hand wing valance. L.H.D.

—At Right-hand wing valance. R.H.D.

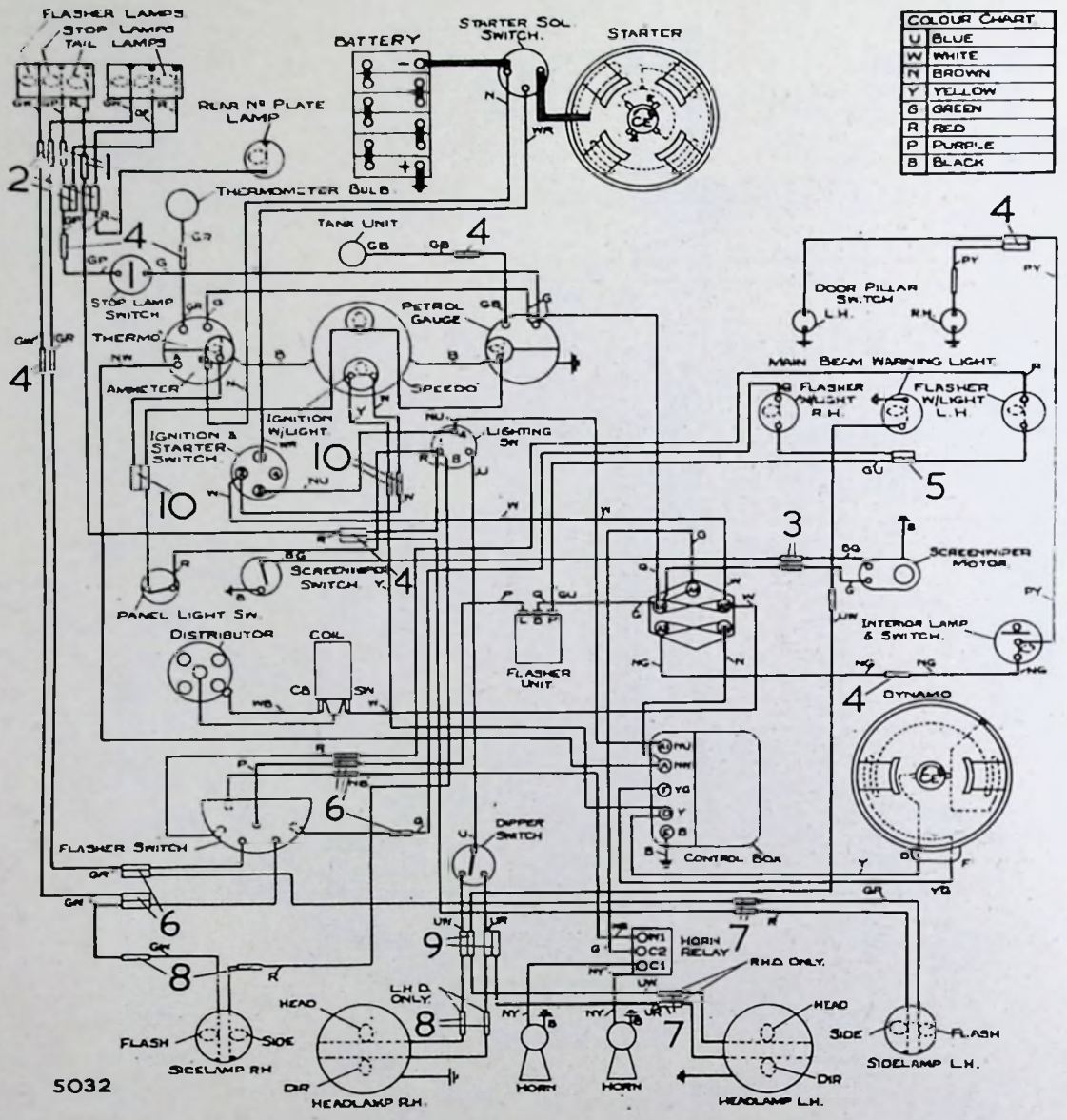


FIG. 18.—Wiring diagram, Series IIIA.

Location of snap connectors:

1—Top right-hand corner of luggage boot.

2—Top left-hand corner of luggage boot.

3—Adjacent to wiper motor.

4—Under facia on left-hand side of car.

5—Under facia behind warning light panel.

6—Behind facia in line with steering column.

7—Left-hand side wing valance (front).

8—Right-hand side wing valance (front).

9—At right-hand wing valance, R.H.D. or left-hand wing valance L.H.D.

10—Behind facia adjacent to instrument.

SECTION O

BODY

WINDSCREEN (All Models).

The services of two operators are necessary to carry out the removal and refitting operations, one working from inside the car and one from the outside. The windscreen is located and retained in position by means of the rubber weatherstrip around its periphery. No other form of fixing is used, but the contacting surfaces are treated with "Seelastik" sealing compound during assembly.

To Remove.

Remove the wiper arms.

Remove the interior rear view driving mirror and sun visors where fitted.

Remove the chromium-plated beading (if fitted). The beading is retained in position by lips formed in the rubber.

To release the weatherstrip from the inner and outer contacting surfaces of the body, the "Seelastik" seal formed during the original assembly must be broken. The use of a small screwdriver from which all the sharp edges have been removed is recommended. Care should be taken when drawing this tool around and under the weatherstrip to keep the tip firmly under the lip, otherwise damage to paintwork may result.

Apply hand pressure to one of the lower corners and force the windscreen outwards. The second operator (outside the car) can then support the glass as it is released.

Remove the weatherstrip from the glass.

To Refit.

Remove all traces of old sealing compound from the glass and weatherstrip.

Fit the weatherstrip to the glass (item B, Fig. 1).

Apply a coating of "Seelastik" to the face of the weatherstrip which is in contact with the outside face of the glass.

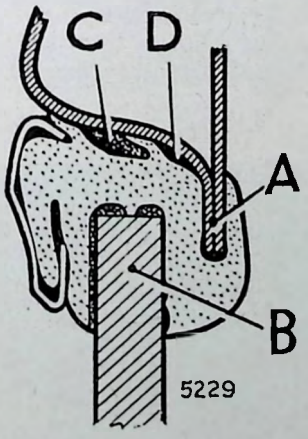


FIG. 1.—Cross-section of the windscreen and backlight weatherstrip.

For this operation a special gun is recommended. In the absence of such a gun it is suggested that an adaptor in the form of a piece of piping with flattened end could be fitted to a lubrication gun which has a screwtype plunger.

Cut a piece of strong cord of a length considerably greater than the periphery of the glass. The use of thin string should be avoided as this will cut the rubber.

Insert the cord into the inner channel of the rubber (Fig. 1) with the aid of a piece of small diameter pipe through which the cord passes, so that loose ends are near to the centre of the upper edge. On Estate cars it will be found more convenient if the loose ends of the cord are at the lower edge.

Ensure that the flange of the aperture in the body is clean and free from grease.

Apply a coating of "Seelastik" to the outer channel of the rubber weatherstrip which is to be in contact with the flange of the aperture in the body.

Press the windscreen assembly into the aperture from the outside of the car after passing the ends of the cord from the inner channel into the inside of the car. Work the lip of the rubber over the flange by pulling the ends of the cord. Pull out this cord completely.

If the outer lip of the weatherstrip becomes folded under itself, work it free with a small screwdriver.

Fit the chromium-plated beading (if fitted).

On Series IIIA vehicles it will be found easier to fit the beading to the weatherstrip by making up a special tool as illustrated in Fig. 3 before fitting the windscreen assembly. Smear the weatherstrip with a soap solution, fit the lower surround, starting at the centre and working outwards.

Fit the lower corner pieces, finally fitting the two upper surrounds and the cover plate.

Carefully remove any surplus sealing compound with a rag slightly dampened with petrol or white spirit.

Backlight (Saloon).

The services of two operators are needed to carry out the removal and refitting operations, one working on the inside and one on the outside of the car. The glass is located by means of the rubber weatherstrip around its periphery only. No other form of fixing is used but the contacting surfaces are treated with "Seelastik" sealing compound during assembly. The backlight is removed by pressing it outwards from the interior of the car. In order to do this it will be necessary to break the seal of the "Seelastik" compound between the rubber weatherstrip and the backlight aperture.

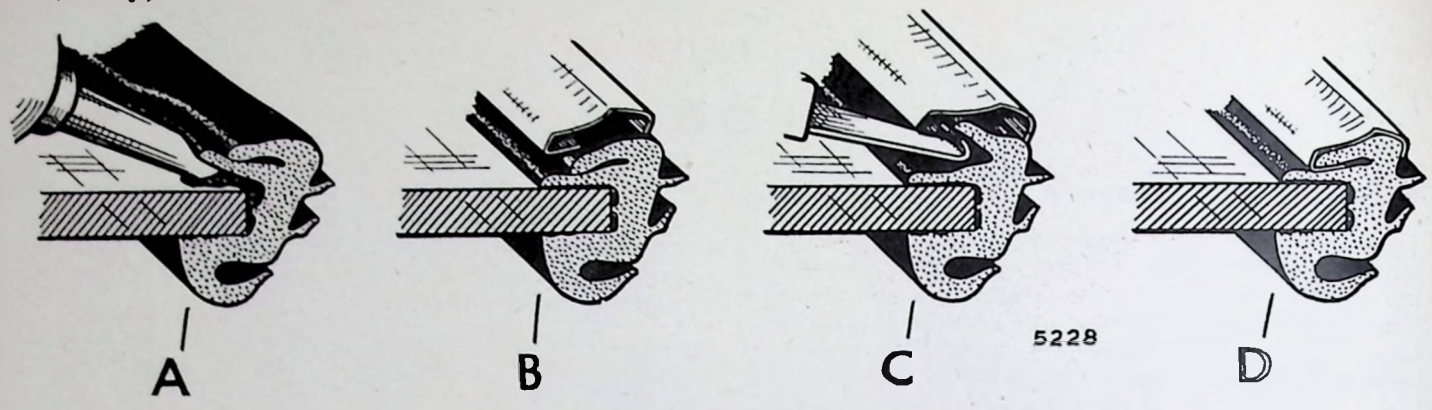


FIG. 2.—Method of fitting the chrome beading to the weatherstrip.

To Remove.

Remove the chromium beading (if fitted) from the weatherstrip by releasing the cover plates located at the upper and lower centres of the beading. The cover plates and beading are retained in position by lips formed in the rubber.

To release the lip of the weatherstrip from the surface of the rear panel, the "Seelastik" seal formed during the original assembly must be broken. This is done by inserting the point of a wedge, and drawing it all round the outer edge of the backlight.

Apply hand pressure to the glass from inside the car, and force the glass complete with weatherstrip outwards. The second operator (outside the car) can then support the glass as it is released.

Remove the weatherstrip from the glass.

To Refit.

Remove all traces of old sealing compound from the glass and weatherstrip. Fit the weatherstrip to the glass.

Apply a coating of "Seelastik" to the face of the weatherstrip which is in contact with the outside face of the glass.

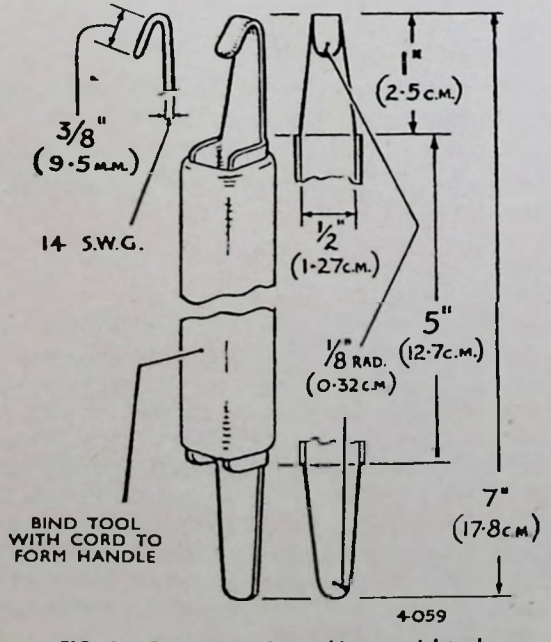


FIG. 3.—Dimensions for making special tool.

Cut a piece of strong cord of length considerably greater than the periphery of the glass. The use of thin string should be avoided as this will cut the rubber.

Insert the cord into the inner channel of the sealing rubber (Fig. 4) so that the loose ends are near to the middle of the upper edge.

Ensure that the aperture in the body is clean and free from grease.

Apply a coating of "Seelastik" to the outer channel of the rubber weatherstrip which is to be in contact with the flange of the aperture in the body.

Allow the two ends of the cord to hang on the inner side of the glass.

Press the assembly into the aperture from outside the car, after first making sure that the two retaining clips are in position at the upper edge of the aperture. Work the inner lip of the weatherstrip over the flange of the aperture by pulling the ends of the cord.

Pull out the cord completely.

If the outer lip of the weatherstrip becomes folded under itself, work it free with a small screwdriver.

Tail-Gate Window (Estate Car).

To Remove and Refit.

Commencing at the top of the glass and working from the inside, lever the lip of the weatherstrip over the flange of the door, at the same time applying hand pressure to the glass.

Instructions for refitting are the same as those given under "Fixed Side Windows (Estate Car) To Refit".

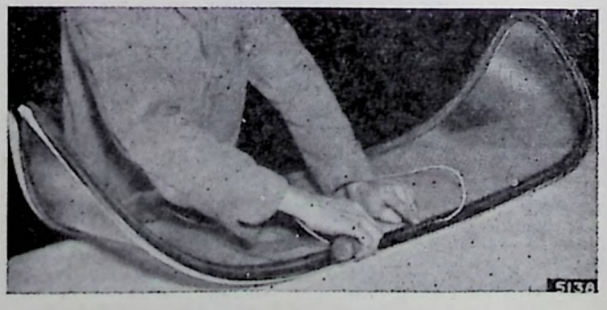


FIG. 4.—Inserting the cord in the weatherstrip.

Fixed Side Windows (Estate Car).

To Remove.

The instructions for the removal and refitting of side windows are basically similar to those given for the removal of the windscreen.

In each case it will be necessary to break the "Seelastik" seal formed during original assembly.

Commencing at the top edge of the glass and working from the inside, lever the lip of the weatherstrip over the flange of the aperture in the body, at the same time hand pressure must be applied to the glass.

A piece of wedge-shaped wood, or a screwdriver from which all sharp edges have been removed may be used as a lever.

To Refit.

Apply a coating of "Seelastik" to the channel in the body aperture.

Fit the weatherstrip to the glass.

Cut a piece of strong cord of length considerably longer than the periphery of the glass. The use of thin string should be avoided as this will cut the rubber.

Insert the cord into the inner channel of the sealing rubber (in a similar manner to Fig. 4) so that the loose ends are near to the middle of the upper edge.

Ensure that the aperture in the body is clean and free from grease.

Apply a coating of "Seelastik" to the outer channel of the rubber weatherstrip which is to be in contact with the flange of the aperture in the body. Allow the two ends of the cord to hang on the inner side of the glass.

Press the assembly into the aperture from outside the car. Work the inner lip of the weatherstrip over the flange of the aperture by pulling the ends of the cord.

Pull out cord completely.

If the outer lip of the weatherstrip becomes folded under itself, work it free with a small screwdriver.

Interior Door Handles (All Models).

To Remove.

Turn the escutcheon so that the radial groove in its face is parallel with the dowel hole in the handle.

This will expose the retaining pin.

With an awl, tap out the pin securing the handle to its spindle. Remove the handle and its escutcheon from the spindle.

Repeat this procedure with the other handle.

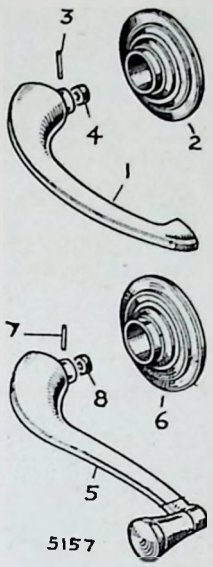
To Refit (Fig. 5).

Slide the escutcheon on to its spindle.

Slip the handle on to its spindle, matching its position with the handle on the opposite door.

Insert the pin into the hole in the handle shank.

When the pin locates with the hole in the spindle, force it home, and allow the escutcheon to return over the handle shank.



1—Door lock handle.
2—Escutcheon.
3—Pin.
4—Rubber pad.
5—Window regulator handle.
6—Escutcheon.
7—Pin.
8—Rubber pad.

FIG. 5.—The interior door handles.

Repeat the procedure with the other handle, ensuring that both are in the same positions as the opposite door.

Trim Pad (All Models).

To Remove.

Remove the interior door handles.

The trim pads are attached to the door panel by spring-in clips which are concealed.

Insert a broad bladed knife or screwdriver under the edges of the trim pad at any convenient point around its edges. Ease the trim pad away from the door panel, working progressively around the edges, and keeping the tool close to each clip as it is prised out.

Pull the trim pad downwards until the upper edge is clear of the retaining flange on the door at its upper edge.

The pad is now free.

To Refit (All Models).

Enter the upper edge of the trim pad into the retaining flange and fit the spring clips on the trim pad into the holes around the door panel. Press the trim pad firmly home and refit interior handles.

Winding Window, Front Door (Saloon, Estate Car).

To Remove (See Fig. 6).

Remove the interior handles and trim pad. This will reveal a cloth or paper covering on the inside door panel. Carefully peel this covering away.

Take out one screw and remove the bottom stop bracket. (On earlier cars, this bracket is retained by four screws.)

Remove two screws (3 and 4) securing the lower ends of glass run channels.

Lower the glass to the full extent of its travel and disengage it from the operating arm.

Lightly spring the lower ends of the glass run channels outwards and remove the glass from the channels and out of the lower aperture in the door panel.

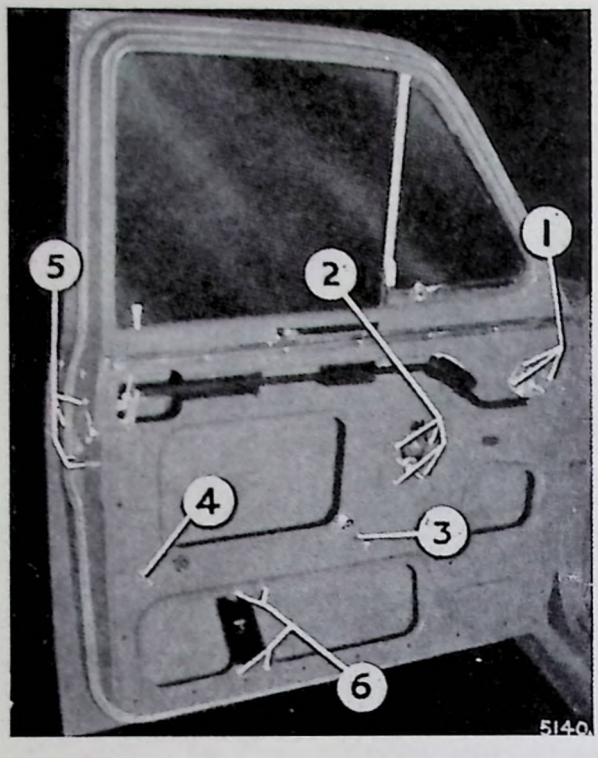


FIG. 6.—General view of the front door with trim pad removed. (Saloon and Estate car.)

WINDING WINDOW, FRONT DOOR

To Refit.

(Saloon, Estate Car.)

Enter the glass through the lower aperture in the door panel and slide it into the glass run channels. Engage the channel on the bottom of the glass into the operating arm.

Secure the lower ends of the glass run channels with their retaining screws.

Fit the bottom stop bracket and secure with its screw(s).

Replace trim pad and interior handles.

Winding Window, Door (Coupe).

To Remove and Refit.

Remove the interior handles and trim pad.

Remove the bottom stop.

Replace the window winding handle temporarily and lower the window to the bottom of the door and clear of its operating arms.

Remove the screw, nut and washer from the rear end of the channel in which the arms operate.

Remove the top stop.

Lift the glass up the channel in which it normally operates, and out of the top of the door.

Replacement is a reversal of the above procedure.

Winding Window, Rear Doors (Saloon).

To Remove and Refit.

Remove the interior door handles and trim pad. This will reveal a piece of rexine cloth covering the inside door panel. Carefully remove this cloth.

Withdraw screw and remove bottom stop bracket. (On earlier cars this bracket is retained by four screws).

Remove the felt anti-rattle strips by easing them down with a screwdriver.

Remove the front and rear glass run channels retained by three screws.

Wind the window to its lowest position and release it from its operating arm.

Turn the glass through 90° inside the door so that its upper edge becomes the forward edge.

Lift the glass up and out through the window aperture.

Re-assembly is a reversal of this procedure.

Rear Passenger Door Window (Estate Car).

To Remove and Refit.

Remove the interior door handles and trim pad.

This will reveal a piece of rexine cloth covering the inner door panel. Carefully remove this cloth.

Withdraw screw and remove bottom stop bracket.

Remove the felt anti-rattle strips by easing them down with a screwdriver.

Remove the front and rear glass run channels, taking care not to kink the channelling.

Temporarily refit the window winding handle and wind down window to its fullest extent. Release the window from its operating arm.

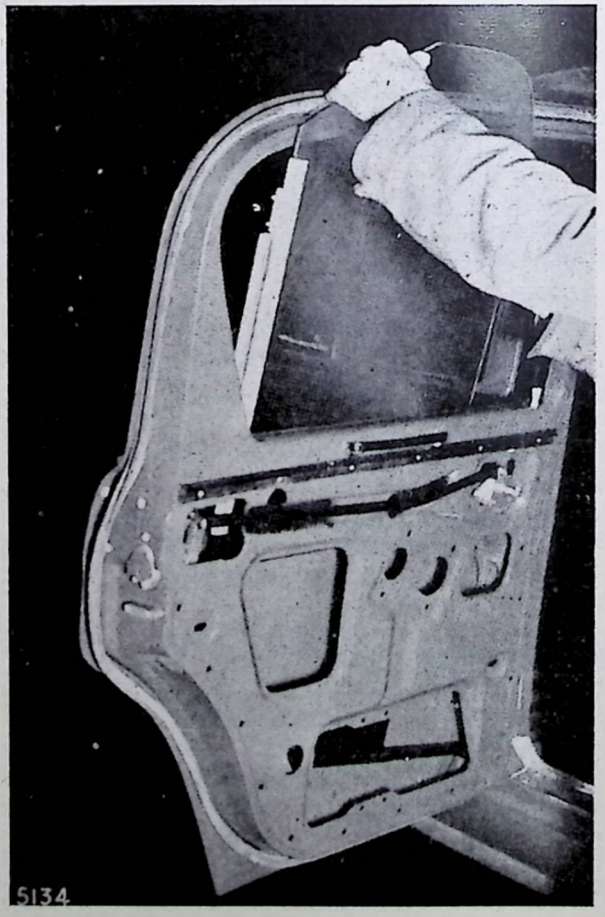


FIG. 7.—Removing the rear door winding glass. (Saloon.)

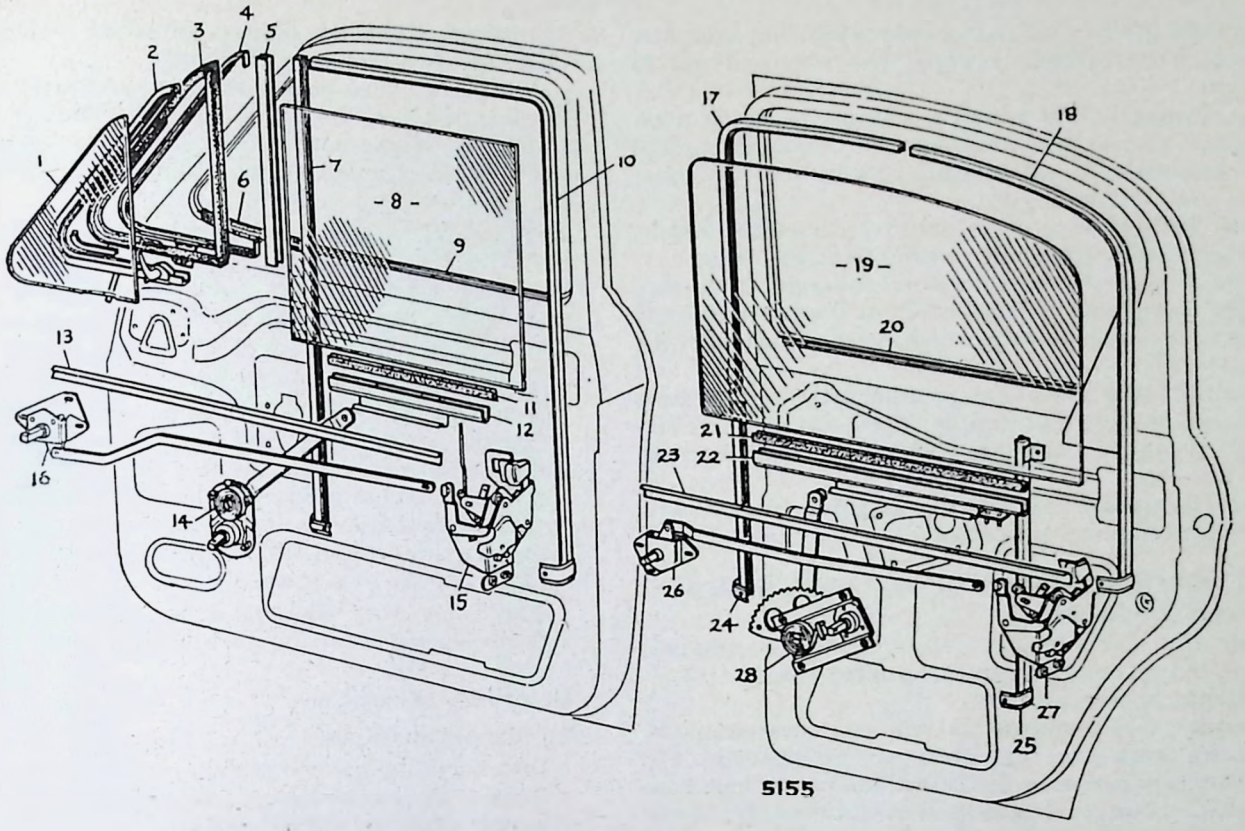


FIG. 8.—Door glasses and mechanism (Saloon).

1—Glass.
2—Inner frame.
3—Weatherstrip.
4—Outer frame.
5—Centre channel.
6—Weatherstrip.
7—Glass run channel.
8—Winding window.
9—Seal.
10—Glass run channel.
11—Glazing rubber.
12—Glass channel and cam plate.
13—Retainer (trim pad).
14—Window regulator.
15—Door lock.
16—Remote control.
17—Glass run channel.
18—Glass run channel.
19—Winding window.
20—Seal.
21—Glazing rubber.
22—Glass channel and cam plate.
23—Retainer (trim pad).
24—Glass run channel.
25—Glass run slide channel.
26—Remote control.
27—Door lock.
28—Window regulator.

With the window in this position, turn it through 90° so that its upper edge now becomes the forward edge.

Lift the glass up and out through the window aperture.

To remove the fixed glass, grasp it firmly at the rear top edge and pull towards the winding window opening. (Note: This glass is retained in position by the glass run channels of the winding window.) When refitting, reverse the above procedure, not forgetting to apply a coating of "Seelastik" to the inner channel of the weatherstrip before fitting to the fixed glass.

Quarter-Light Glass (Coupe).

To Remove and Refit.

Remove the window winding handle.

Remove the rear seat cushion and squab. The retaining screws for the squab are accessible from inside the boot.

Remove the trim panel from below the window aperture.

Remove the cotter pin and large nut from the quarter-light pivot.

Temporarily replace the window winding handle and lower the window to approximately the halfway position.

Release the operating arm from its guide channel. Pull the glass assembly by grasping the upper forward edge, clear of its pivot, and up and out of the body side.

No-Draught Ventilator (All Models Except Coupe).

To Remove and Refit.

Remove the winding window.

Remove the felt anti-rattle strips by easing their clips downwards with a screwdriver. Withdraw the retaining screws on the glass run channel. Remove both glass run channels, taking care not to kink the channelling.

The no-draught ventilator is held by one screw at its upper hinge. With the removal of this screw the ventilator may be withdrawn by easing out the lower swivel bracket from its location in the door. Refit in reverse order.

No-Draught Ventilator (Coupe).

To Remove and Refit.

Remove the winding window.

Remove the four screws securing the ventilator and frame to the door, located as follows:—

Two at the upper and forward edge of the door.

One immediately above the winding window regulator, and one above the bottom stop.

Slightly lift the ventilator and withdraw, complete with its outer frame, towards the rear and out of the door.

To dismantle the ventilator from its frame, carefully ease the weatherstrip from the outer frame and with a steady hand pressure, push out the inner frame complete with glass.

After easing the weather strip from the inner frame, the glass may be freed by pulling straight out.

To assemble the ventilator to its frame, commence by applying a coat of "Seelastik" to the inner channel of the inner weatherstrip which is in contact with the glass.

Assemble the glass and weatherstrip to the inner frame not forgetting to apply "Seelastik" to the channel of the inner frame into which the glass weatherstrip fits.

For the remainder of the refitting instructions, reverse the removal procedure.

Front Seat (Bench Type) (Saloon, Coupe, Estate Car).

To Remove and Refit.

Slide the seat rearwards and remove the two seat runner fixing bolts securing runners to floor.

Note the spring washers.

Slide the seat forwards and remove two corresponding bolts from the rear ends of the runners. The seat assembly can then be lifted out of the car, complete with runners. Refitting is reversal of the above, but care should be taken to see that the spring washers are fitted to the runner securing bolts.

Headlining (Saloon).

To Remove.

Disconnect the battery at the positive terminal.

Remove the sun visors and rear view mirror.

Remove the roof lamp assembly.

Remove the front seat.

Remove the rear seat cushion and squab.

Release the draught welt from above all four doors, and down as far as the striker on the rear doors.

Remove the rear quarter trim panels and the upper half of the "B" and "C" post trim panel.

Release the forward edge of the rear parcel tray and lift out the tray.

Remove the backlight glass.

Remove the clips securing the edges of the roof lining to the flanges of the door and backlight, and release the roof lining. All edges are secured to the flanges in production with adhesive solution.

The lining is now supported by the listing rails and the header pad only. Remove the rearmost listing rail from the retaining clips located above the backlight glass.

Continue to release the remaining rails in turn by springing the lower edges inwards to release from the locating holes in the cantrails.

Finally remove the header pad.

To Refit.

The services of two people are required to refit the lining. In order that the lining will conform to the shape of the inside of the roof, listing rails of different contours are used, the ends of which are coloured to aid identification, the position of which MUST be observed when removing the lining.

It will be noted that there are three alternative locating holes in the cantrail for the ends of each listing rail. These holes accommodate any variations which may occur during the original making up of the lining.

Clean off all traces of old adhesive from the flanges of the doors and backlight aperture. Before fitting the new headlining, apply a suitable adhesive to the door flanges and backlight aperture and allow it to become nearly dry.

To refit the lining, reverse the removal procedure.

Note: After fitting the header pad, and BEFORE fitting the remainder of the lining, secure the header pad by temporarily replacing the sun visor and rear view mirror retaining screws, otherwise when pulling on the lining to remove the creases which occur while fitting, the header pad will be pulled out of position necessitating starting again.

The lining when fitted must be free from creases with no sagging occurring anywhere.

Headlining (Estate Car).

To Remove and Refit.

Disconnect the battery at the positive terminal.

Remove the sun visors and rear view mirror.

Remove the roof lamp assembly.

Remove the front seat, and fold down the rear seat and squab.

Pull off the coloured draught welt from around the door and along the interior of the car. The welt is retained in position by clips which must be eased off the flanges otherwise damage may result when removing the welt.

Remove the upper half of the "B" and "C" post trim panel.

Remove the clips securing the lining to the cantrail.

Remove the rearmost listing rail and, working forward, remove the remainder of the listing rails, noting the colours on their ends. Remove the screws securing the header pad and remove pad. To refit, reverse the above instructions.

Doors (All Models).

Lubrication.

It is essential that the hinge pins and door locks are lubricated at regular intervals.

From the commencement of Series IIIA vehicles an oil hole is provided in the shut face of the door approximately on a line with the operating push-button of the exterior handle (Fig. 9). When not in use, the oil hole is sealed by a polythene grommet. (Part No. P.49120).

For vehicles which do not have an oil hole provided reference should be made to Fig. 10 if an oil hole is desired. The front door only is illustrated, but the measurements are exactly the same for the rear doors

When oiling the door locking mechanism the windows should be fully wound up, and after oiling, the doors should be left open for as long as possible, otherwise, since some oil is bound to be wasted, it

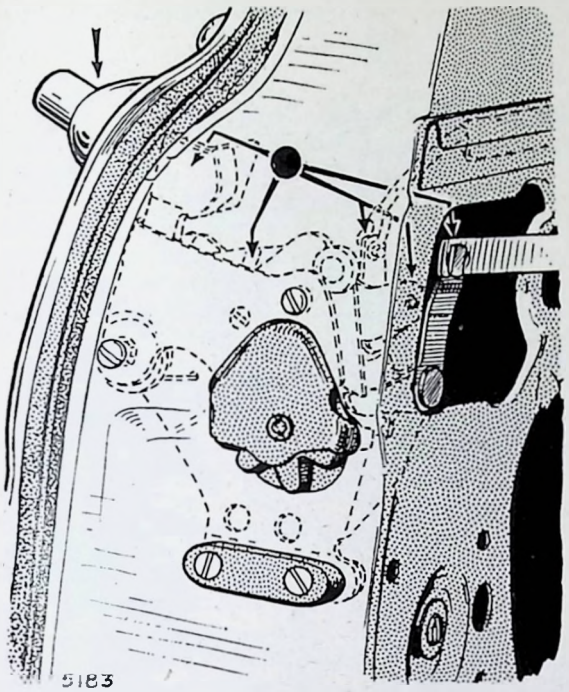


FIG. 9.—Door mechanism lubrication points (Saloon and Estate Car).

may flow out of the drain holes and possibly into the interior of the car.

The wards of the lock should be lubricated by applying oil to the key which is then inserted into the lock in the normal manner.

The push-button of the exterior handle is lubricated from the outside.

To Adjust Hang of Doors.

Remove the hinge cover plates. Free the door weatherstrip around the vicinity of the door hinges.

Note: If hinges are adjusted, then the door lock striker plates must also be adjusted.

Adjustment of the doors is carried out by loosening off the bolts securing the hinges to the body, and moving the doors in the required direction, after which, the securing bolts must be re-tightened.

In order to raise or lower the door diagonally, packing pieces of the required thickness may be fitted between the hinges and their respective attachment points.

Refit the weatherstrip and hinge cover plates.

If damage to the locks, the door components, and trim is to be added, the following dismantling instructions should be adhered to.

Door Locks (All Models).

To Remove (Fig. 11).

Remove the interior trim.

Remove the three securing screws which hold the remote control to the door and swing the unit and connecting link vertically downwards. In this position the unit can be detached from its dowel on the operating lever.

Remove the securing screws in the shut face of the door (on Saloon and Estate Car, two of these screws also retain the dovetail).

On front doors, press the safety catch knob downwards into the locked position.

Unscrew the knob and swing the control wire down against the lock.

The lock unit is now free to be removed. If it is necessary to remove the rear safety catch assembly (Fig. 12), press the knob downwards into the locked position so that the clip (G) which holds the control wire to the actuating lever (H) can be detached.

The assembly can now be withdrawn through the lock aperture in the shut face of the door.

Reference can be made to Figs. 11 and 12 for the location of the above components.

To Refit.

Reverse the above instructions, except that when the remote control unit is fitted, slide the unit away from the lock until approximately $\frac{1}{32}$" free movement is obtained. A small working clearance is essential for the correct functioning of the lock mechanism.

After successfully refitting the door locks and remote control, the safety catch controls should also be adjusted, the procedure of which is as follows:—

Check that the catch wires do not foul their respective apertures, bending them if necessary. Press the control knob downwards into the locked position, screw the knob home leaving a small clearance between the knob head and the door sill to ensure that the full travel of the control is not restricted.

On rear doors, reconnect the catch control wire fitting the spring clip (G) to the lock actuating lever (H).

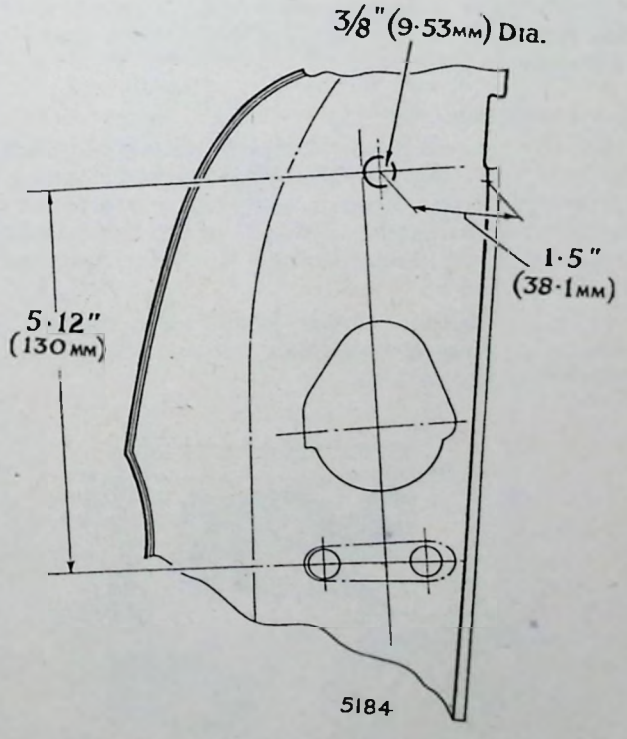


FIG. 10.—Drilling dimensions for earlier series Saloon and Estate car.

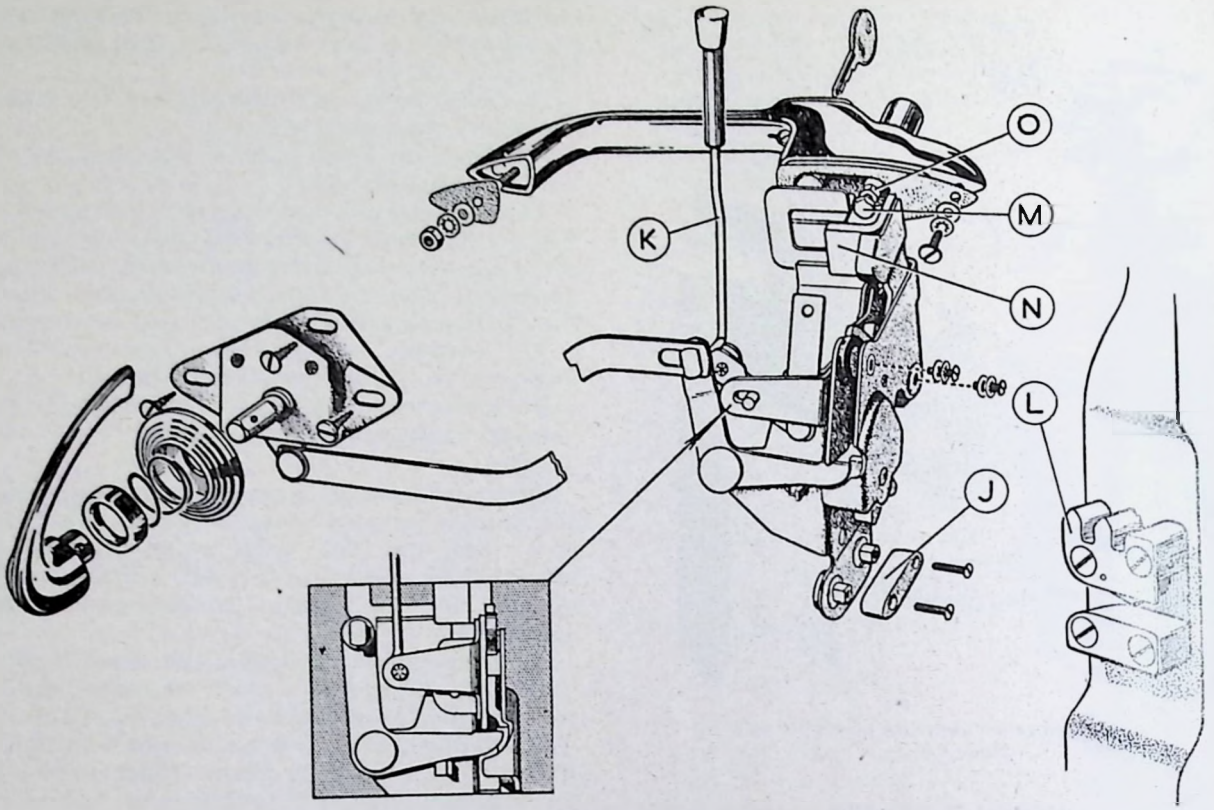


FIG. 11.—Components of the door lock mechanism. (Inset shows later type safety catch.)

Push Button Handle (Saloon, Estate Car and Coupe).

To Remove (Fig. 13).

Remove the door trim.

From inside the door casing remove the nut at front and screw at rear. Both are fitted with plain and shakeproof washers.

To Adjust (Fig. 13).

On the reverse side of the push button is a plunger (2) held by a locknut (1). The correct clearance between the plunger head and the lock contactor should be $\frac{1}{32}$" and must be checked when the handle is attached to the door, through the large aperture in the inner door.

When adjusting, simply release the locknut and rotate the plunger bolt in or out as required, finally tightening the locknut.

To Refit.

Reverse the removal instructions, not forgetting the two seating washers between the handle and the door panel.

Striker Unit (All Models).

To Remove (Fig. 14).

It is not necessary to disturb this component other than to fit a replacement or to make adjustments. In this case, remove the securing screws (B) (4 on Saloon, Estate Car; 2 on Coupe). Screws (A) retain the lock in the shut face of the door.

To Refit.

Attach the striker unit loosely to the door pillar, moving to the desired position before finally tightening the securing screws.

When fitted the unit should be at right angles to the door hinges.

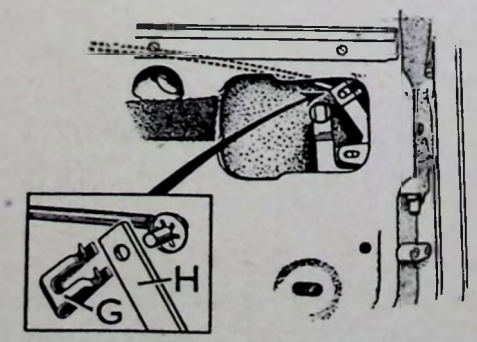


FIG. 12.—Rear door safety catch.

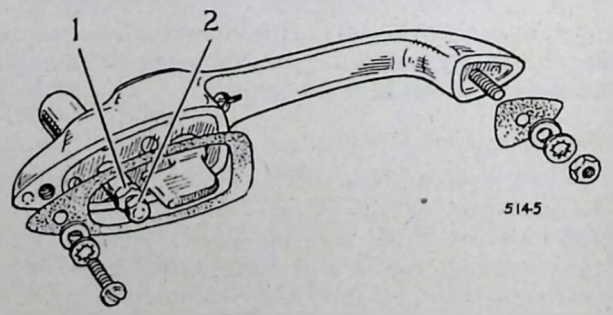


FIG. 13.—Push button door handle showing: (1) Adjusting screw locknut and (2) Adjusting screw.

Window Regulator (All Models).

To Remove.

Remove interior trim.

Temporarily replace window winding handle and lower window to approximately halfway down and support the glass.

Remove the screws holding the lower ends of the glass run channels.

Remove the screws securing the regulator to the inner door panel. Spring the operating arm from its location in the bottom channel of the glass and remove regulator from the door.

To Refit.

Reverse the above procedure.

Reference can be made to Figs. 6 for guidance as to the location of the components.

Quarter-Light Glass Regulator (Coupe).

To Remove.

Remove interior trim.

Temporarily replace window winding handle and lower window to approximately halfway.

Remove the cotter pin and large nut from the window pivot.

Release the operating arm from its location and the screws securing the regulator to the inner body panel.

To refit, reverse the above instructions.

Bonnet Lock (All Models).

To Remove.

Take out the two bolts with their spring and flat washers.

Gently ease the lock out of its aperture and release the operating cable (where fitted).

With the cable released, turn the lock unit while removing so that the lock safety arm (which protrudes through the upper part of the grille) is not damaged on removal.

To remove striker, undo the locknut from above the baffle into which the unit fits, and turn in an anti-clockwise direction by the screwdriver slot provided.

Replace both striker unit and lock by reversing the above procedure.

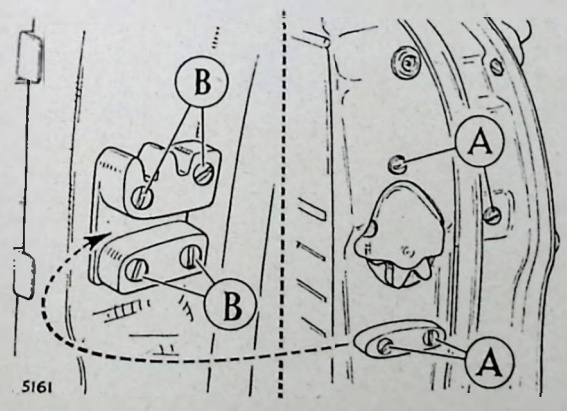


FIG. 14.—The lock striker and dovetail.

Adjustment of the striker is carried out by screwing in or out of the striker pin, finally locking up with the locknut.

When correctly adjusted, a slight movement is perceptible in the bonnet top when it is in the closed position.

Bonnet (All Models).

To Remove.

Support the bonnet lid with a suitable sling in the open position.

Remove the two setscrews with their respective washers from each bonnet hinge, whereupon the bonnet is free to be removed.

Replacement is a reversal of the above instructions.

Boot Lid Lock (Saloon, Coupe).

To Remove.

Remove the two screws with their washers.

The lock can now be removed by pulling out from inside the boot.

The striker plate is removed by taking out the four securing screws with their washers. The mounting holes in the plate are elongated to provide a means of adjustment.

To Refit.

Reverse the above procedure.

Boot Lid (Saloon and Coupe).

To Remove.

Disconnect the battery at the positive terminal. Open the boot lid, and from the underside, pull out the number plate lamp wire from its snap connector.

Support the lid with a suitable sling and remove the retaining bolts from the prop at each side.

Finally, remove the two nuts and washers from each hinge and take off the boot lid.

Reverse these instructions when refitting.

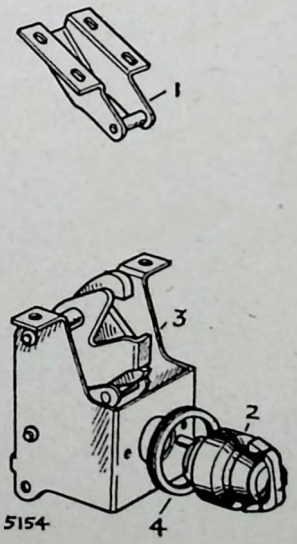


FIG 15.—Components of the boot lid lock.

1—Striker plate.

2—Operating knob.

3—Lock.

4—Seal.

Tail Gate Lock (Estate Car).

To Remove.

From the rear of the door remove the four securing screws with their washers and take off the lock.

To remove the outside handle, take off the two nuts and washers from the rear of the door which are exposed after removal of the lock.

To remove the striker plate take out the two securing screws with their spring washers.

To Refit.

Reverse the above procedure, noting that the striker plate has elongated holes to provide a means of adjustment before final tightening of the securing screws.

Front and Rear Bumpers (All Models).

To Remove.

The bumpers can either be removed complete with their mounting brackets, or without.

In the first case, remove two (one each side) large bolts with their respective washers.

If overriders are fitted, they are retained by nuts and washers screwed onto a bolt in the overrider itself.

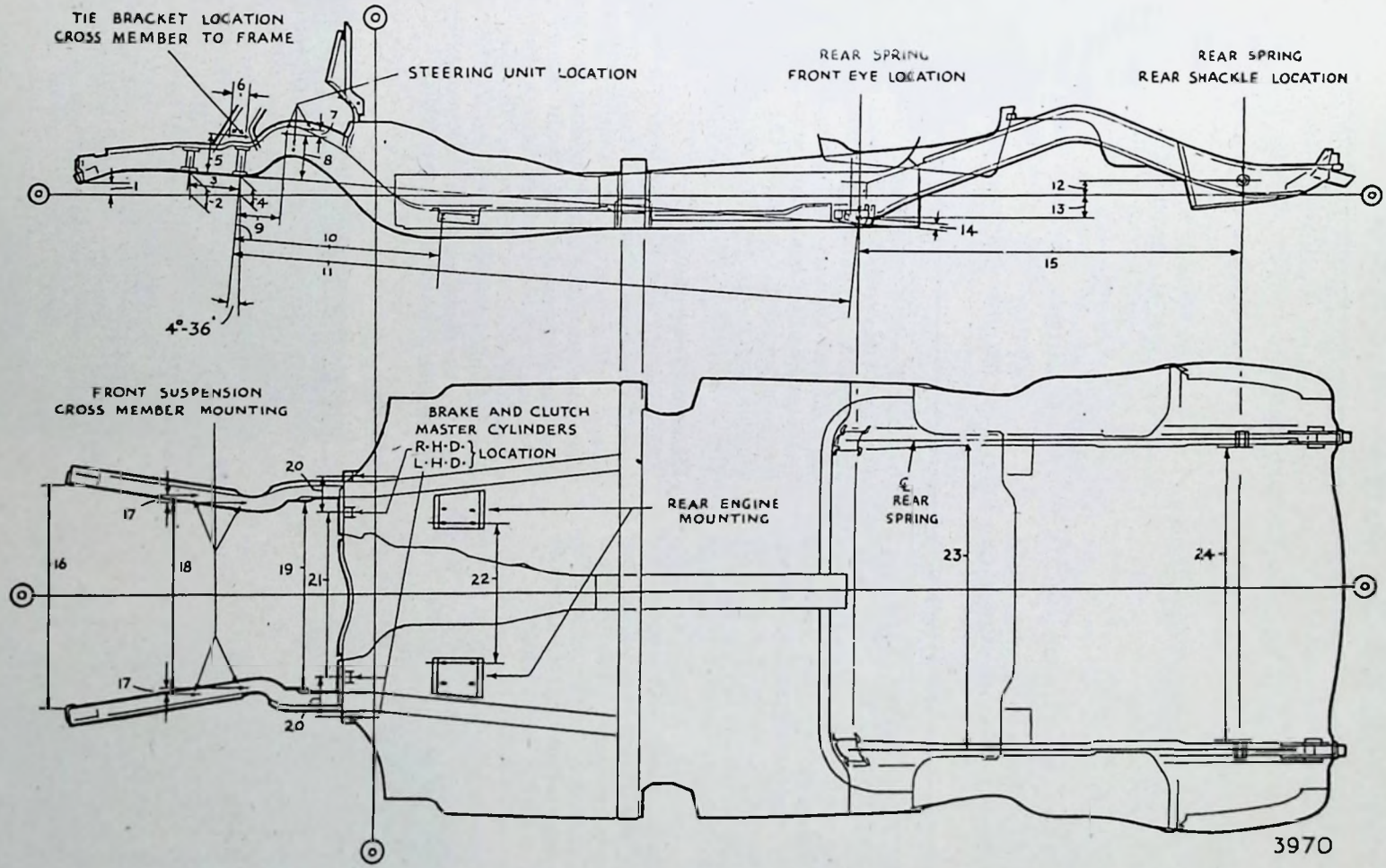


FIG. 16.—Principal underframe dimensions.

1—1.66″	5—4.50″	9—5.56″	13—2.96″	17—.88″	21—19.64″
2—3.12″	6—2.18″	10—24.36″	14—.34″	18—22.56″	22—16.50″
3—6.00″	7—.53″	11—74.16″	15—46.44″	19—22.34″	23—37.50″
4—2.64″	8—5.15″	12—1.38″	16—27.12″	20—5.00″	24—35.84″

SECTION P

WHEELS AND TYRES

Specifications

Tyre type	4-ply tubeless.
Tyre size:	
Saloon, Convertible and Coupe	5.25/5.50/5.60 x 15.
Estate Car	5.50/5.90 x 15.
Tyres pressures:	
Normal:	
Front and rear (Saloon)	24 p.s.i.
Rear fully laden (cars only)	26 p.s.i.
Rear fully laden (Estate Car)	28 p.s.i.

FACTORS AFFECTING TYRE LIFE AND PERFORMANCE.

Under normal conditions, there is an average loss of 13% tread mileage for every 10% reduction in inflation pressure below the recommended figure.

The tyre is designed so that there is minimum pattern shuffle on the road surface and a suitable distribution of load over the tyre's contact area when inflation is correct.

Moderate under-inflation causes an increased rate of tread wear although the tyre's appearance may remain normal. Severe and persistent under-inflation produces unmistakable evidence on the tread (Fig. 1). It also causes structural failure due to excessive friction and temperature within the casing.

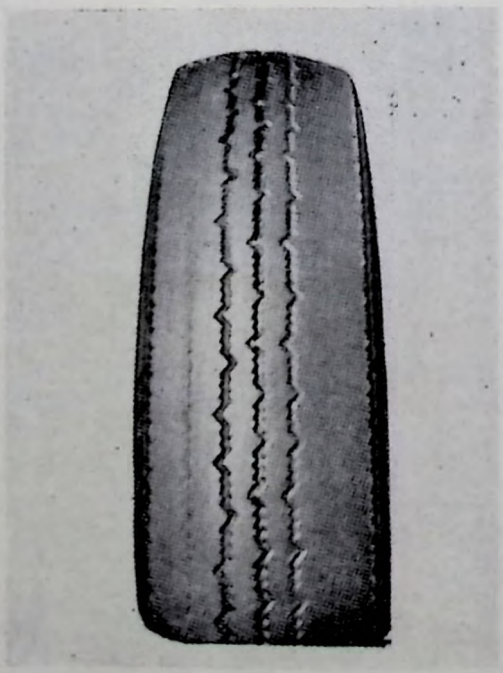


FIG. 1.—Wear due to under inflation.

Pressures which are higher than those recommended for the vehicle reduce comfort. They may also reduce tread life due to a concentration of the load and wear on a smaller area of tread, aggravated by increased wheel bounce on uneven road surfaces. Excessive pressures over-strain the casing cords, in addition to causing rapid wear, and the tyres are more susceptible to impact fractures and cuts.

Effects of Temperature:

Air expands with heating and tyre pressures increase as the tyres warm up. Pressures increase more in hot weather than in cold weather. This factor is taken into account when designing the tyre and in preparing load and pressure schedules.

Pressure in warm tyres should not be reduced to standard pressures for cold tyres. "Bleeding" the tyres increases their deflections and causes their temperatures to climb still higher. The tyres will also be under-inflated when they have cooled.

Braking:

"Driving on the brakes" increases rate of tyre wear, apart from being generally undesirable. It is not necessary for wheels to be locked for an abnormal amount of tread rubber to be worn away.

Other braking factors not directly connected with the method of driving can affect tyre wear. Correct balance and lining clearances and freedom from binding are very important; braking may vary between one wheel position and another, due to oil or foreign matter on the shoes even when the brake mechanism is free and correctly balanced.

Brakes should be relined and drums reconditioned in complete sets. Tyre wear may be affected if the shoes are relined with non-standard material having unsuitable characteristics or dimensions, especially if the linings differ between one wheel position and another in such a way as to upset the brake balance. Front tyres, and particularly near side front tyres, are very sensitive to any condition which adds to the severity of front braking in relation to the rear.

"Picking up" of shoe lining leading edges can cause grab and reduce tyre life. Local "pulling up" or flats on the tread pattern can often be traced to brake eccentricity (Fig. 2). The braking varies during each wheel revolution as to the minor and major axes of the eccentric drum pass alternately over the shoes. Drums should be free from excessive scoring and be true when mounted on their hubs with the road wheels attached.

Road Surfaces:

The extent to which road surfaces affect tyre mileage is not always realized. Present day roads generally have better non-skid surfaces than formerly. This factor has tended to cause faster tyre wear, although developments in tread compounds and patterns have done much to offset the full effects.

Road surfaces vary widely between one part of the country and another, often due to surfacing with local material. In some areas the surface dressing is coarser or of larger "mesh" than in others. The material may be comparatively harmless rounded gravel or more abrasive crushed granite or knife-edged flint. Examples of surfaces producing very slow tyre wear are smooth stone setts and wood blocks but their non-skid properties are poor.

Bends and corners are severe on tyres because a vehicle can be steered only by misaligning its wheels relative to the direction of the vehicle. This condition applies to the rear tyres as well as to the front tyres. The resulting tyre slip and distortion increase the rate of wear according to speed, load, road camber and other factors.

The effect of hills, causing increased driving and braking torques with which the tyres must cope, needs no elaboration.

Road camber is a serious factor in tyre wear.

An analysis of tyre performance must include road conditions.

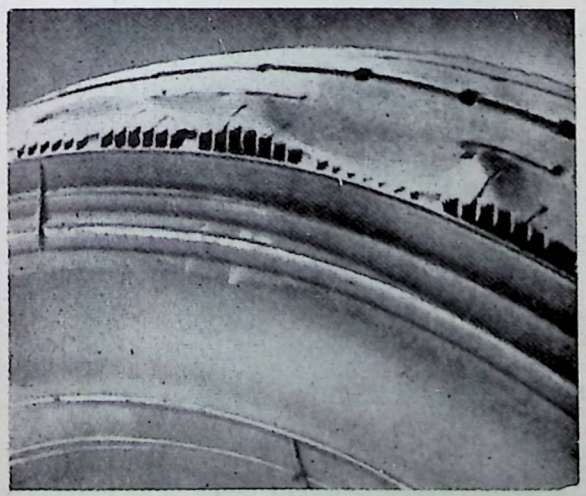


FIG. 2.—Local excessive wear due to brake drum eccentricity.

Impact Fractures:

In order to provide adequate strength, resistance to wear, stability, road grip and other necessary qualities, a tyre has a certain thickness and stiffness. Excessive and sudden local distortion such as might result from striking a kerb, a large stone or brick, an upstanding manhole cover, or a deep pothole may fracture the casing cords.

Impact fractures often puzzle the vehicle operator because the tyre and road spring may have absorbed the impact without his being aware of anything unusual; only one or two casing cords may be fractured by the blow and the weakened tyre fails some time later; there is usually no clear evidence on the outside of the tyre unless the object has been sufficiently sharp to cut it.

This damage is not associated solely with speed and care should be exercised at all times, particularly when drawing up to a kerb or parking against one.

"Spotty" Wear:

Fig. 4 shows a type of irregular wear which sometimes develops on front tyres and particularly on near side front tyres. The causes are difficult to diagnose although evidence of camber wear, misalignment, under-inflation, balance or braking troubles may be present.

Front tyres are at a disadvantage due to their slip and distortion being in one direction. These are connected to the vehicle through swivelling stub axles and jointed steering linkage and they are subjected to complicated movements resulting from steering, spring deflection, braking and camber. Load transference during braking causes increased loading and pattern displacement on front tyres, and adds to the severity of front tyre operation. Unbalance of the rotating assembly may also contribute to a special form of irregular wear with one half of the tyre's circumference more worn than the other. Unbalance alone does not cause the type of "spotty" wear illustrated, but the unbalance usually becomes progressively worse as the irregular or unequal wear develops. The nature of "spotty" wear—the pattern being much worn and little worn at irregular spacings round the circumference — indicates an alter-

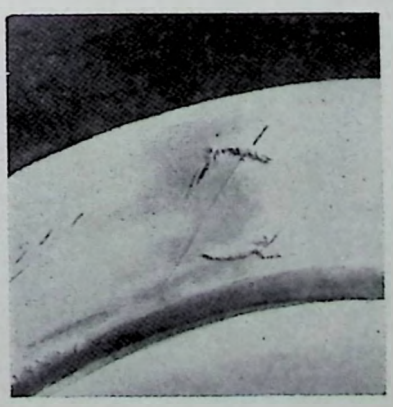


FIG. 3.—A typical double fracture.

nating "slip-grip" phenomenon but it is seldom possible to associate its origin and development with any single cause.

It is preferable to check all points which may be contributory factors. The front and rear wheel assemblies may then be interchanged, which will also reverse their direction of rotation, or better still, the front tyres may be interchanged with the rear tyres.

Points for checking are:—

1. Inflation pressures and the consistency with which the pressures are maintained.

2. Brake freedom and balance, shoe settings, lining condition, drum condition and concentricity.

3. Wheel alignment.

4. Camber and similarity of camber of the front wheels.

5. Play in hub bearings, steering swivels, suspension bearings and steering joints.

6. Wheel eccentricity at the tyre bead seats. S.M.M. & T. tolerances provide for a radical throw not exceeding $\frac{3}{32}$", but this may be affected by impact or other damage.

7. Balance of the wheel and tyre assemblies.

8. Condition of road springs and dampers.

Corrections which may follow a check of these points will not always effect a complete cure and it may be necessary to continue to interchange wheel positions and reverse directions of rotation at suitable intervals. Irregular wear may be inherent in the local road conditions such as from a combination of steep camber, abrasive surfaces, and frequent hills and bends. Driving methods may also be involved. Irregular wear is likely to be more prevalent in summer than in winter, particularly on new or little worn tyres.

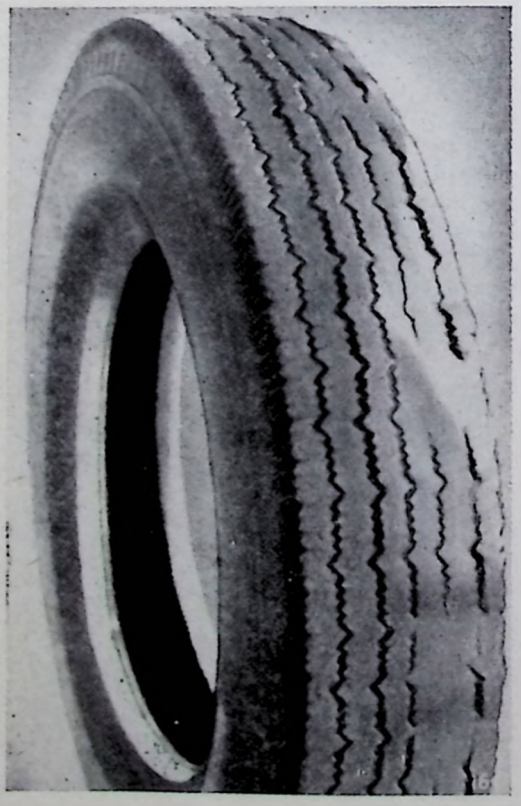


FIG. 4.—Irregular spotty wear due to a variety of causes.

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 vehicle.

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 toed in or toed out.

"Fins" on the inside edges of the pattern ribs—nearest to the vehicle—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.

Camber, Castor and Steering Axis Inclination.

These angles normally require no attention unless they have been disturbed by a severe impact or abnormal wear of front end bearings. It is always advisable to check them if steering irregularities develop. Wheel camber, usually combined with road camber, causes a wheel to try to turn in the direction of lean, due to one side of the tread attempting to make more revolutions per mile than the other side. The resulting increased tread shuffle on the road and

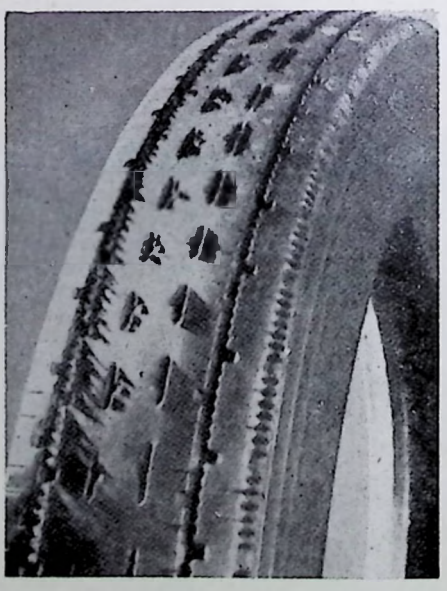


FIG. 5.—Fin or feathers caused by severe misalignment. This condition is usually associated with "heel and toe" wear across the tread pattern.

the off centre tyre loading tend to cause rapid and one sided wear. If wheel camber is excessive for any reason, the rapid and one-sided tyre wear will be correspondingly greater. Unequal cambers introduce unbalanced forces which try to steer the vehicle one way or the other. This must be countered by steering in the opposite direction, which results in still faster tread wear.

When tyre wear associated with camber results from road conditions and not from vehicle condition little can be done except to interchange or reverse the tyres. This will prevent one-sided, irregular and fast wear from developing to a maximum degree on any one tyre, usually the near side front tyre.

Castor and steering axis inclinations by themselves have no direct bearing on tyre wear but their measurement is often useful for providing a general indication of the condition of the front end geometry and suspension.

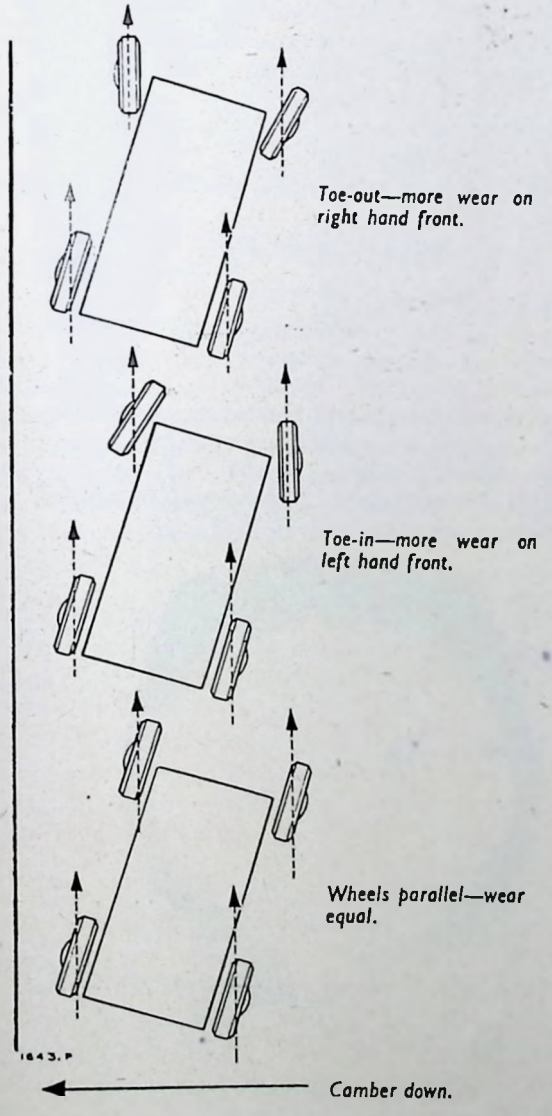


Fig. 6.—Exaggerated diagram showing effect of road camber on a car's progress.

Tyre and Wheel Balance.

All tyres are balance checked to predetermined limits.

Some tyres are slightly outside standard balance limits and are corrected before issue by attaching special loaded 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 Adjusting Rubber".

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 (Fig. 7). Laterally eccentric wheels give the same effect. During rotation the offset weight distribution sets up a rotating couple which tends to steer the wheel to right and left alternately. Dynamic unbalance of tyre and wheel assemblies can be measured on a tyre balancing machine and suitable corrections made when vehicles 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.

Changing Position of Tyres:

There have been references to irregular tread wear which is confined almost entirely to front tyres and there may be different rates of wear between one tyre and another.

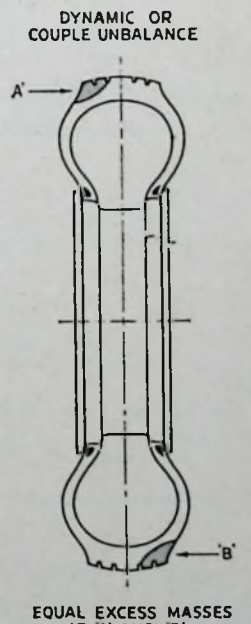


Fig. 7.—Dynamic or couple unbalance.

The causes may lie in road conditions, traffic conditions, driving methods and certain features of design which are essential to the control, steering and driving of a vehicle. Close attention to inflation pressures and the mechanical condition of the vehicle will not always prevent irregular wear.

It is therefore recommended that the front tyres be interchanged with the rear tyres at least every 2,000 miles. Diagonal interchanging between the near front and off rear and between the off front and near rear provides the most satisfactory first change because it reverses the directions of rotation.

Subsequent interchanging of the front and rear tyres should be as indicated by the appearance of the tyres with the object of keeping the wear of all tyres even and uniform.

WHEELS.

Tolerances:

(a) Wobble: The lateral variation measured on the vertical inside face of the flange shall not exceed $\frac{3}{32}$".

(b) Concentricity: On a revolving wheel the differences between the high and low points, measured at any location on either type bead seat, shall not exceed $\frac{3}{32}$".

Radial and lateral eccentricity outside these limits contribute to static and dynamic unbalance respectively. Severe radial eccentricity also imposes intermittent loading on the tyre. Static balancing does not correct this condition which can be an aggravating factor in the development of irregular wear.

A wheel which is eccentric laterally will cause the tyre to "snake" on the road but this in itself has no effect on the rate of tread wear.

At the same time undue lateral eccentricity is undesirable and it affects dynamic balance.

There is no effective method of truing eccentric pressed steel wheels economically and they should be replaced.

Wheel nuts should be free on their studs.

A small quantity of grease applied to each stud thread is beneficial.

When fitting a wheel all the nuts should be screwed up very lightly, making sure that their seatings register with the seatings in the wheel.

Final tightening should be done progressively and alternately by short turns of opposite nuts to ensure correct seating and to avoid distortion.

The correct wheel nut tightening torque is 38 to 42 lbs. ft.

Wheels with damaged or elongated stud holes, resulting from slack nuts, should be replaced.

Rim seatings and flanges in contact with the tyre beads should be free from rust and dirt.

TYRE REMOVAL, REFITTING AND INFLATION.

Removal:

Tubeless tyres are removed from their rims in exactly the same way as covers for use with tubes.

It is, however, more than ever necessary to avoid damage to the bead surfaces when breaking the adhesion between beads and rim and when lifting the beads over the rim flanges. Damaged beads will cause air leaks and may also cause premature tyre failures.

Tyre levers and bead breaking tools must be of suitable type, have smooth contact faces in good condition and be used correctly.

Levers should be kept moistened with water during use.

(a) Rim Preparation:

1. Remove loose or excessive mud from the wheel, taking care not to damage the paint.
2. Hammer out any dents in the rim flanges.
3. Clean the rim bead seats and flanges thoroughly. Use emery cloth, steel wool, a wire brush or a file, depending on the amount of dirt, rust, rubber and surface irregularities to be removed. Smooth paint need not be removed.
4. File or buff away any high spots at the welded joint.
5. Wipe clean with moist rag.

(b) Valve Fitting:

Assemble the valve through the valve hole. All vehicles are initially supplied with snap-in rubber valves and where this type of valve is used, **it should never be refitted once it has been removed from the rim.** It should be renewed every time a new tyre is fitted. The old valve can be cut out or pulled through the valve hole. A new snap-in rubber valve

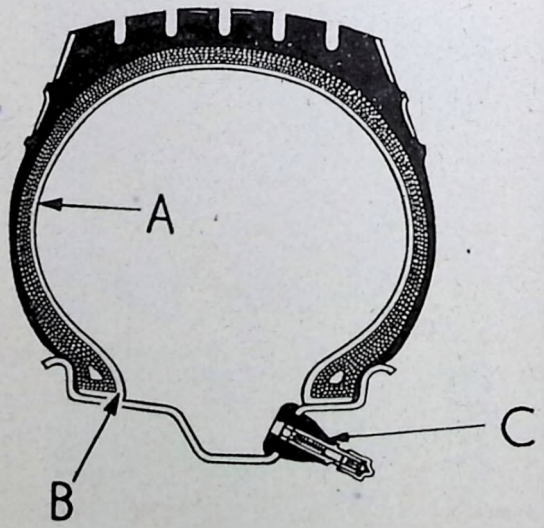


Fig. 8.—A section through a tubeless tyre.

A—Air-retaining liner.
B—Rubber air seal.
C—Rubber-sealed valve.

of the same type can be fitted by lubricating it with soap solution and pulling the valve through the rim hole from the inside to the outside.

The valve should be pulled until the flange on the rubber base of the valve is in full contact with the inner rim surface. For fitting snap-in valves, the Schrader No. 553 mounting tool is recommended. This consists of a handle which screws direct on to the valve threads.

If an attempt is made to pull the valve through the rim hole by means of pliers or some other unsuitable tool, the valve threads or valve cap will probably be damaged.

(c) Tyre Fitting:

The tyre beads and their rubber surfaces must not be damaged during fitting. **Do not use a hammer or mallet.**

1. Wipe beads with a damp cloth.

2. Moisten tyre beads, rim surfaces and fitting levers with clean water.

3. Fit the tyre in a normal way, using narrow levers which are in good condition and free from sharp edges. Take small bites so as not to strain or damage the beads. Take particular care not to tear the rubber bead toes when they are lifted over the rim finger.

Fit the second bead so that the part of the bead nearest the valve goes over the rim flange last.

Note: The white balance spots near the tyre bead should be at the valve position.

(d) Inflation:

Remove the inner core from the valve:

1. Holding the tyre and wheel upright, bounce the tread of the tyre on the ground at several points around its circumference. This will help to snap the beads on to the tapered rim seats and provide a partial seal.

2. Connect the air line and with the valve core still removed, inflate with the wheel and tyre upright. If the first rush of air does not seal the beads, continue to bounce the tyre with the air line attached.

3. Continue to inflate until both beads are fully home against the rim flanges.

4. Remove the air line and fit the valve core. Then inflate to 40 p.s.i.

Note: If air continues to escape under the beads after bouncing and the tyre cannot be inflated, use one of the supplementary methods described later.

(e) Testing for Leaks:

A few minutes after inflation, immerse the tyre and wheel in a water tank and check for leaks.

If a water tank without submerging tool is being used, proceed as follows:—

1. Place the assembly in a tank with the valve uppermost. Submerge the valve and check.

2. Release and allow the assembly to float, with the channel between the rim flange and the tyre filled with water. Check carefully for air bubbles above the rim flange.

3. Turn the wheel assembly over and submerge the wheel rivets if they are not already under water. Check for leaks at the rivets.

4. Submerge the assembly to fill the channel between the flange and tyre and then allow to float. Repeat as at 2.

Check for leaks at the valve, rivets, and each flange in turn.

(f) To Seal Leaks:

1. Leak at top of rim flange:

Mark on the tyre and rim the position of the leak and deflate the tyre. The leak may be caused by dirt, rust, a high weld or chipped paint.

By holding the bead away from the rim seat, the cause of the leak can often be detected and removed without removal of the tyre.

Make sure that the rim is clean after treatment.

2. Leak at the Wheel Rivet:

Mark the position of the leak on the rim. Deflate and remove the tyre. The leak should be sealed by peening over the rivet head with a ball pein hammer, backed up by another hammer or a solid resistance such as an anvil.

3. Leak at the Valve Base:

In the case of a metal clamp-in valve, if the valve has been fitted correctly and the valve hole is in good condition, the leak can be stopped by tightening the nut.

(g) Final Inflation Pressure:

After testing at 40 p.s.i., make sure that the inflation pressure is adjusted to the correct running figure.

REPAIR OF SMALL PENETRATIONS.

Dunlop "Reddiplug" Method.

Normally, a tubeless tyre will not leak when penetrated by a nail or other normal puncturing object, provided that it is left in the tyre.

These objects should be withdrawn every 2,000 to 3,000 miles, or at a time when loss of air will cause least inconvenience. If they are left in the tyre indefinitely, the original injuries may extend and cause a road delay, and possibly, more serious damage.

For the repair of punctures, the Dunlop "Reddiplug" method is recommended. It does not require the tyre to be removed from the rim nor to be completely deflated.

The following instructions are included with each outfit:

1. Mark the spot and extract the puncturing object, taking note of the direction of penetration. If the tyre is leaking and the puncturing object cannot be located by sight, it is necessary to immerse the inflated tyre in water.

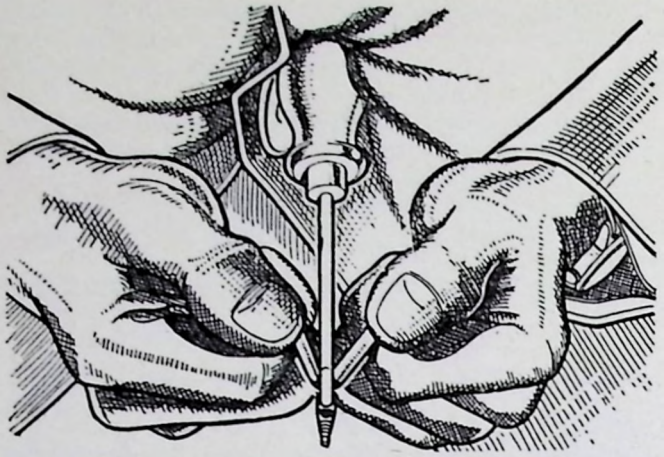


Fig. 9.—Rolling the plug into the needle eye.

2. Dip the needle into the flask of solution and insert through the hole. When the needle eye is through the hole, work it up and down several times and then pull out. Again dip the needle into the solution and repeat the process until the hole is well lubricated.

3. Select a suitable plug according to the size of the puncturing object and stretch and roll into the eye of the needle about $\frac{1}{4}$" from the end.

4. After dipping the plug into the solution, insert the point of the needle into the hole and push the plug through the tyre until a sudden release in pressure is felt indicating the double piece of cord is completely through the hole.

5. Withdraw the needle and cut off the surplus plug about $\frac{1}{8}$" from the surface of the tread. The tyre can be inflated and used immediately.

INFLATION AFTER FITTING.

Supplementary Methods for Dealing with Difficult Cases or for More General Use:

Method 1: Employing a Tourniquet:

The Dunlop Tubeless Tyre Tourniquet, Part No. TT/1, is very suitable for assisting the inflation of tubeless tyres. Its purpose is to contract the centre of the tread so that the beads are forced outwards against the rim seats and so provide a partial seal for inflation.

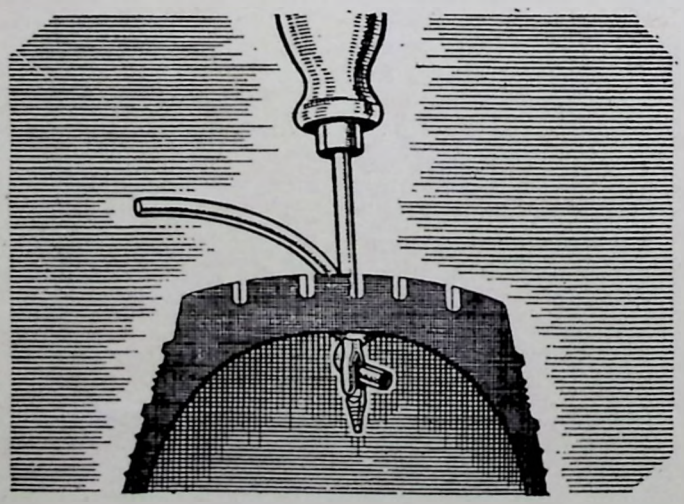


Fig. 10.—The inserted plug prior to withdrawing the needle.

1. With the tool in the open position, buckle the strap centrally around the tread of the deflated tyre and wheel assembly. Pull the strap through the buckle as tightly as possible. The strap must be threaded between the buckle bar and teeth on the clip and not between the clip and the end of the buckle.

2. Thread the loose end of the strap through the gap between the rivet and roller on the link mechanism and compress the tread by pulling the handle through 180°.

3. With the valve insert removed, attach the air line and inflate until the beads are sealed against the flanges. If they fail to seal at the first attempt, move the handle back and re-tighten the strap.

When the beads are home, disconnect the air supply and fit the valve core. Then remove the tourniquet before final inflation.

4. To remove the tourniquet, move the handle back and press the thumb on the end of the buckle — pushing the slider bar on the buckle inwards and upwards.

5. Inflate to 40 p.s.i. and test.

Note: When an air line is not available, the tourniquet enables tubeless tyres to be inflated with an efficient foot or hand pump.

In necessary cases, a tourniquet may be improvised from a piece of rope and a twisting bar.

Method 2: Without a Tourniquet.

This method is usually effective if bouncing fails and a tourniquet is not available.

1. With the tyre on the rim, wipe the beads and rim seats dry.

2. Lean the tyre and wheel against a wall at an angle greater than 45°.

3. Press the wheel centre so that the nearest bead obtains a hold on the rim seat.

4. Reverse the assembly, taking care not to dislodge the first bead, and lean at a greater angle.

5. With the valve core removed, attach the air line.

Whilst inflating, press gently against the wheel centre to seal the second bead. Alternating hand pressure rather than continuous pressure may be found helpful. Continue to inflate until the beads are home against the flanges.

6. Remove the air line and fit the valve core. Inflate the tyre to 40 p.s.i. and test it in water.

Adjust the tyre pressures to those recommended on page 1.

Note: Some rims have a wider seat on one side than the other. When fitting to a rim with equal seats, the first part of the operation should be carried out with the valve at the front. On the other rims, the first operation should be carried out with the valve towards the wall and the wider rim seat to the front.

SECTION Q

AUTOMATIC TRANSMISSION

IMPORTANT NOTES.

CLEANLINESS.

The normal high standards of cleanliness found in workshops are not sufficient. Exceptional cleanliness is essential to secure satisfactory performance. Contamination by any trace of grease, lubricating oil, paraffin, dust or dirt of any description must be avoided. Clean hands and a clean, dry work bench are absolute essentials.

Units must never be unpacked from their cartons until they are actually required.

The Automatic Transmission provides the driver with fully automatic control over gearshift operations.

One unique feature of this Automatic Transmission is the ease with which service can be carried out. This is because the complete system is made up of several units which are linked electrically but which can be serviced individually.

SERVICING TECHNIQUE.

Maintenance and repair of the Automatic Transmission differs from the orthodox transmission and diagnosis of faults must be carried out strictly in the order described in this manual.

Random adjustments, or any attempts to diagnose faults by methods other than those recommended, will result in unnecessary waste of time and probably fail to indicate the correct means of ratification.

TOOLS.

The Test Set and other special tools which facilitate service work are listed at the end of this section. They are obtainable from V. L. Churchill & Co. Ltd., Great South West Road, Bedfont, Feltham, Middlesex.

DRIVING INSTRUCTIONS.

THE SELECTOR LEVER.

Situated to the left of the steering column (right-hand drive models), or the right of the steering column (left-hand drive models), the position of the lever is indicated by the quadrant which bridges the steering column, being clearly visible through the steering wheel.

There are four positions, namely **D**—Drive; **2**—Intermediate; **N**—Neutral and **R**—Reverse.

The selector lever may be moved freely between **D**, **2**, and **N** with the car stationary or in motion, but to prevent accidental engagement of Reverse gear, the lever must be lifted towards the steering wheel before **R** can be engaged.

N — NEUTRAL.

Engage **N** at all times when the car is parked or when starting the engine.

To Start Engine—Engage **N** and start the engine in the normal way.

Notes: 1. As a safety precaution the starter will not operate with the selector lever in any position but neutral.

2. Although **N** may be selected at any speed, the car will run in Intermediate until the speed drops below 10 m.p.h. approximately.

D — DRIVE.

Normal Driving. With the engine idling and the foot off the accelerator pedal, select **D**. On depressing the accelerator pedal the car will move off changing up and down completely automatically as requirements demand. For instance when hill climbing the gears change as the load increases without any action by the driver.

When the car is new, changes into Intermediate may be accompanied by a "click"; this is not detrimental to the normal operation of the transmission and will diminish during the "running-in" period.

When starting from cold the choke may be used quite normally, as despite the increased engine idling speed there is no tendency for creep to occur before the accelerator pedal is depressed.

"Plus" Acceleration (Kick-down). At speeds below 40 m.p.h. when additional acceleration is required for passing other vehicles or to climb gradients and the lever is in **D** position, depress the accelerator pedal down to the full throttle position.

The transmission will then shift automatically into Intermediate to provide more rapid acceleration. The transmission will automatically revert to Direct Drive as the car speed increases, or if the accelerator pedal is released.

Similarly, at speeds below 18 m.p.h. the kick-down may be used to obtain an immediate shift from Intermediate to Low to provide extra pulling power on steep gradients or when moving in dense traffic.

2 — INTERMEDIATE.

By moving the selector lever to **2** the automatic devices are over-ridden, and Intermediate is held regardless of road speed or throttle opening, thus allowing the full engine braking when descending steep gradients.

Intermediate selection also permits the experienced driver to over-ride the automatic controls and slip in and out of this gear with complete smoothness. Thus, under conditions of town traffic or winding roads when an automatic shift into Direct Drive may be inappropriate, he is able to hold Intermediate to advantage, moving into **D** at will when circumstances are favourable.

Notes: Since it is impossible to obtain low gear with **2** selected, this position should **not** be used for starting from rest or for manoeuvring in confined spaces.

To avoid over-stressing the engine or the transmission it is not advisable to select or retain 2 above 55 m.p.h. In addition, should the car be brought to rest on an up-gradient in 2, a restart must be made in **D** even if it is desired to reverse immediately afterwards.

R — REVERSE.

The car must be brought to rest and the foot removed from the accelerator pedal before the selector lever is moved into or away from the **R** position. Failure to observe these functions may cause gear clashing.

To engage Reverse, lift the selector lever towards the steering wheel before sliding it into **R**.

MANOEUVRING AND TAKE-OFF ON GRADIENTS.

Provision of a wide brake pedal enables the footbrake to be applied by either foot; and for manoeuvring the car in confined spaces, or when driving away from rest on a gradient, it will be found most convenient to control the car by using the left foot on the brake pedal and right foot on the accelerator. Until the owner is fully conversant with this transmission it is not recommended that the left foot brake technique be used on the open road.

TAKE-OFF WITH ABNORMAL LOADS, OR ON VERY STEEP GRADIENTS.

"Easidrive" is able to withstand a high amount of operational abuse and will normally provide a far more satisfactory take-off with the car excessively loaded, or on very steep gradients, than a manually operated transmission. If, however, very abnormal conditions of load and gradient are encountered, particularly if the terrain is heavily rutted, under no circumstances should the attempt to drive away be prolonged if the car does not move immediately, as excessive slipping of the transmission is likely to cause it to overheat and be damaged.

EMERGENCY CONDITIONS.

Push Starting.

On the rare occasion when for one reason or another (i.e., near-flat battery) it is desired to start the car by pushing or rolling downhill, the engine can be started by switching on the ignition, setting the choke (if necessary) and selecting **D**.

When the vehicle reaches 10 m.p.h. approximately, the transmission will automatically commence to drive the engine provided the accelerator pedal is depressed to about one-third of its available travel.

Handle Starting.

Do not attempt to crank the engine with the starting handle unless the selector lever is in the neutral position, otherwise the car may start and move off of its own accord.

As a further precaution, the handbrake should always be applied.

Towing.

The vehicle may be towed only when the ignition is switched off.

EMERGENCY DRIVE SYSTEM.

"Easidrive" has received the most thorough testing over many hundred thousands of miles, and in all climatic conditions before being offered to the public. It has proved completely reliable and the possibility of failure is remote. However, if the unlikely occurs, and for any reason the transmission fails to function, the following procedure should be carried out as a means of getting home:—

With the ignition switched off, remove the retaining screw (1) and red cover (2) from the front plug (3) on the selector switch at the foot of the steering column, withdraw the plug, reverse it and re-insert it with the red face downwards. (See Fig. 1.)

Replace cover. (**CAUTION.** Tighten retaining screw (1) finger tight only.) The control unit, governor, gearshift solenoid, and dynamo are now cut out and the "Easidrive" Transmission is now working on current SUPPLIED FROM THE BATTERY ONLY.

Position 2 of the selector lever now engages low gear. Position **D** engages direct drive. Intermediate gear is not obtained.

To move away from rest, accelerate the engine and select 2 on the selector lever. The take-up of drive will be abrupt, and it may be necessary to move the selector between 2 and **N** once or twice until the engine will accept the load.

After accelerating to approximately 20 m.p.h. lift the foot slightly off the accelerator pedal, select **D** and direct drive will be engaged.

Low gear may be re-engaged whilst the car is in motion.

Select **N** before coming to rest, otherwise the engine will be stalled as the car is stopped.

Note: It is emphasised that this system is intended as a temporary expedient and the car should be referred to a Rootes dealer as soon as possible for rectification.

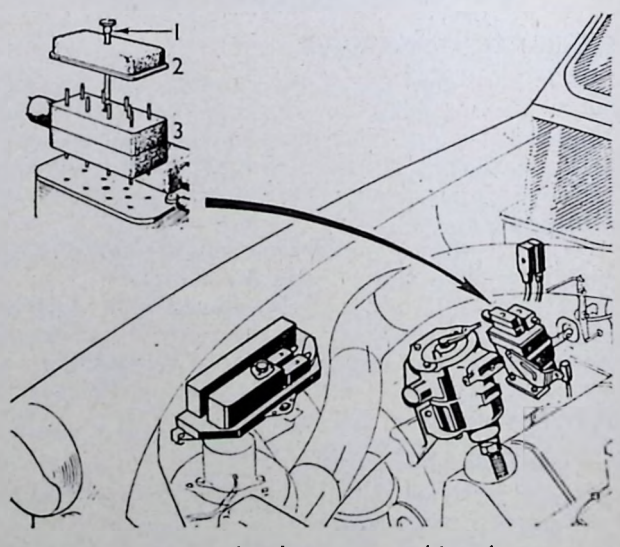


FIG. 1.—Reversing the emergency drive plug.
1—Retaining screw. 2—Plug cover. 3—Emergency drive plug.

CAUTION.

To immobilse the car for engine compartment service the selector lever must always be placed in N and the handbrake engaged to avoid the car inadvertently moving off if the engine is accelerated.

DESCRIPTION.

COUPLING.

The coupling unit (Fig. 2) comprises four main sub-assemblies:—

(a) A stator (1) containing the excitation coils, fitted in the coupling housing:—

(b) A rotating driving member (6) attached to the engine crankshaft, this member being subdivided into two compartments respectively housing items (c) and (d) undernoted.

(c) A "direct" driven member (7), co-axial with the driving member and splined to the gearbox mainshaft (3).

(d) An "indirect" driven member (2), also co-axial with the driving member, and mounted on an outer concentric shaft (4), drives the gearbox countershaft.

A quantity of metallic powder is placed in each of the annular gaps between the driving and driven members.

GEARBOX.

The gearbox is of the countershaft type employing two co-axial input shafts, the innermost being the mainshaft (providing Direct Drive) and the outermost driving the countershaft gear (providing Low, Intermediate and Reverse gears). Three forward gear ratios and reverse are thus provided, a freewheel being employed to permit Intermediate gear to operate by overrunning low gear without disengaging the latter. (See page 5.)

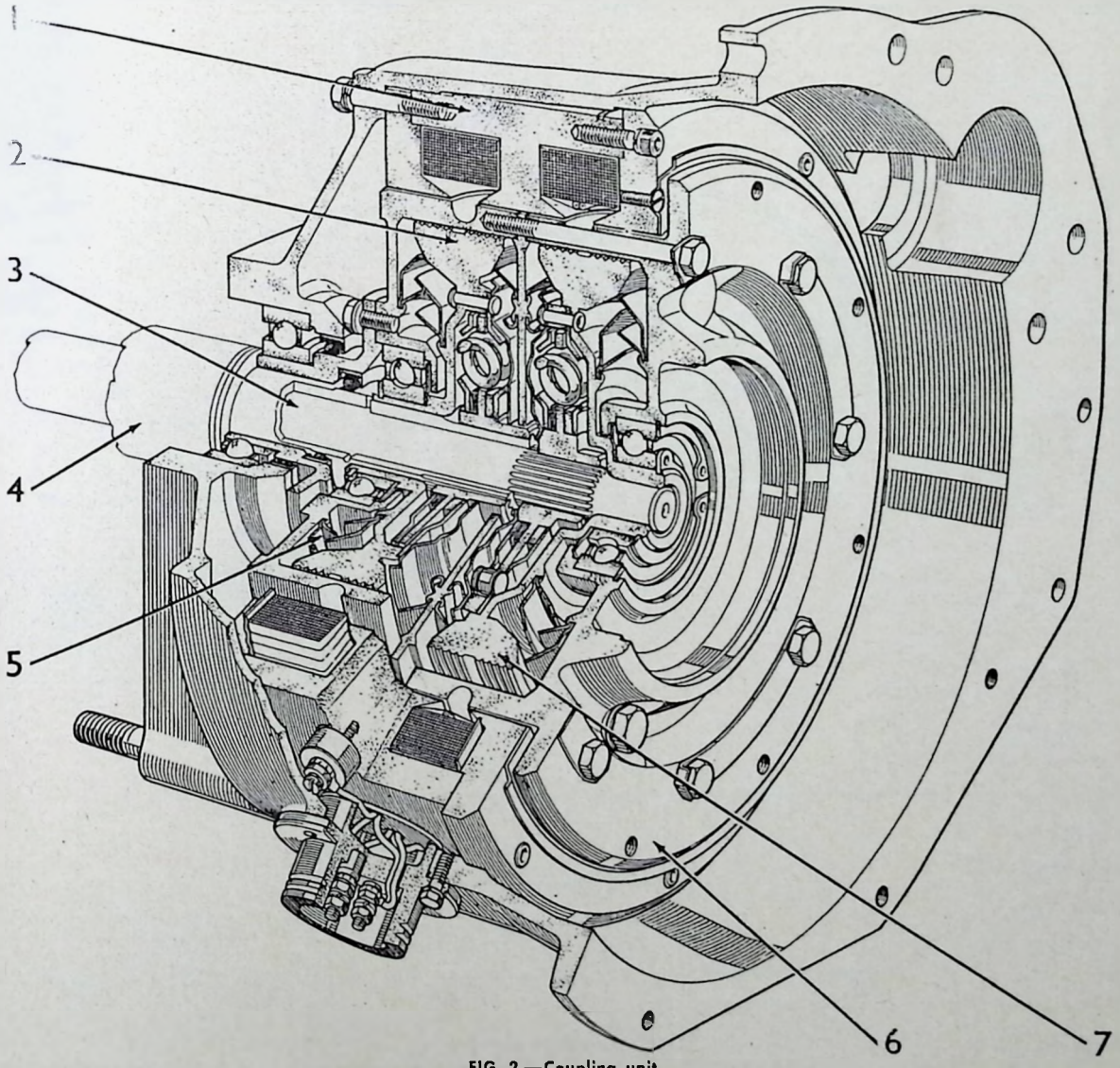


FIG. 2.—Coupling unit.

1—Stator. 2—Driven member (Indirect). 3—Gearbox main shaft. 4—Gearbox outer shaft. 5—Labyrinth 6—Driving member 7—Driven member (Direct).

GEARSHIFT SOLENOID.

The gearshift solenoid (8, Fig. 3) which operates the intermediate gear dog clutch incorporates two switches which are sensitive to the position of the dog-clutch.

GOVERNOR.

The governor (2) determines when the engagement of each of the three forward gear ratios is to be effected and is basically a three-position switch which is controlled by road-speed and is biased by accelerator pedal position. It is driven by a flexible drive from the gearbox mainshaft and is connected by a mechanical linkage to the accelerator pedal.

The governor casing is also used to house four switches sensitive to accelerator pedal position.

THROTTLE SOLENOID.

The plunger of this solenoid (5) is connected to the carburettor butterfly by a mechanical linkage and is used to open the throttle electrically to ensure immediate engagement when selecting Intermediate.

SELECTOR SWITCH.

The selector switch (3) is operated by a shaft from the selector lever on the steering column. In addition to operating various contacts, the switch is mechanically linked with the gearbox to engage reverse gear.

CONTROL UNIT.

The control unit (1) contains the eight relays, thermal switch, rectifier and resistances used in the control circuit.

WIRING HARNESS.

The units of the automatic system are interconnected electrically by the wiring harness shown in Fig. 3.

PRINCIPLES OF OPERATION.

NOTE.

The magnetic powder coupling should not be confused with a magnetically operated friction clutch as it is completely free from the many disadvantages inherent in any type of friction drive.

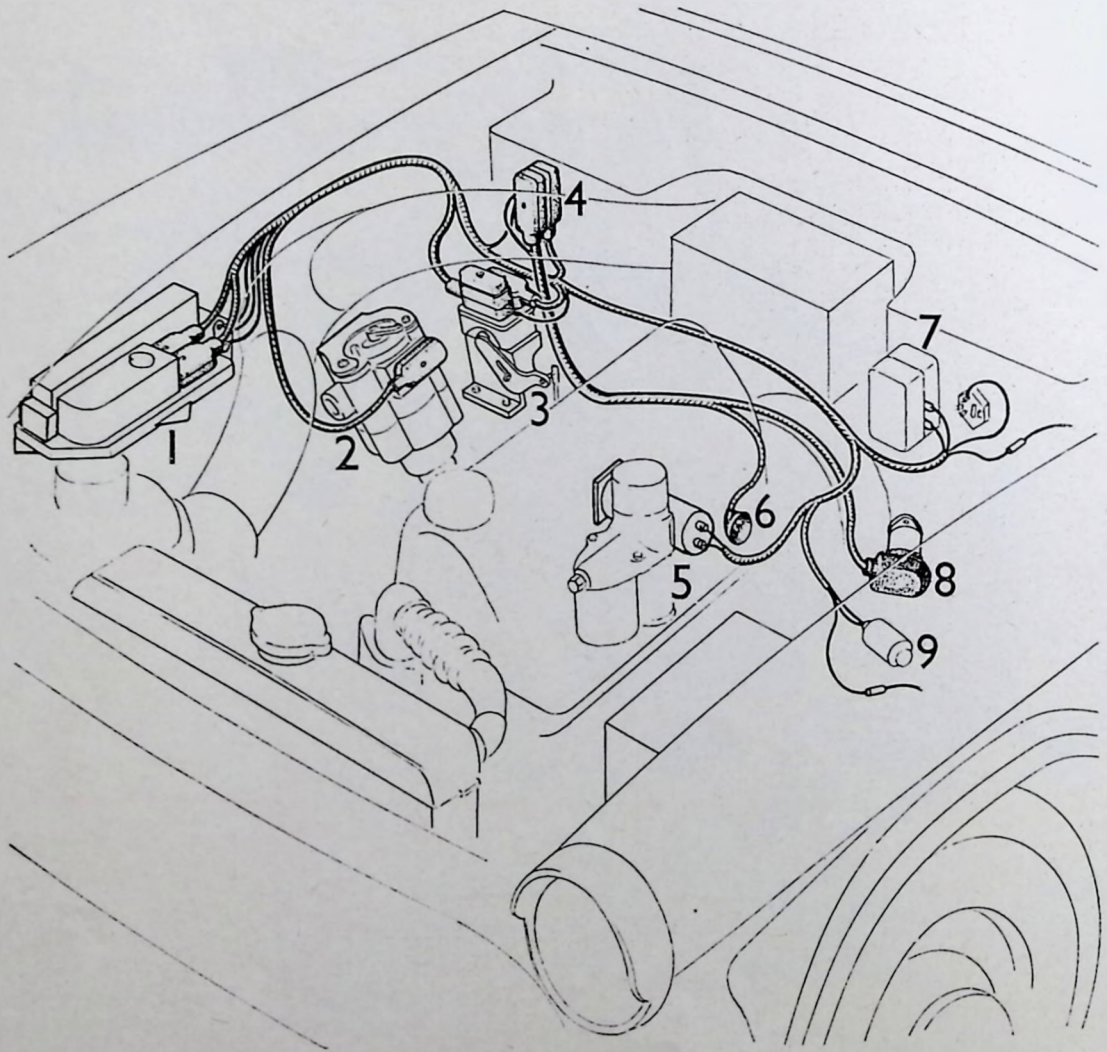


FIG. 3.—Wiring harness.

1—Control unit.
2—Governor.
3—Selector switch.
4—Top and bottom harness connection.
5—Throttle solenoid.
6—Coupling connection.
7—Voltage regulator.
8—Gearshift solenoid.
9—Starter solenoid.

Noteworthy amongst the magnetic powder coupling features is complete freedom from dry friction "stick-slip" characteristic which tends to promote the judder to which all friction clutches are liable. "Stick-slip" in friction clutches results from intermittent change in the co-efficient of friction as slip occurs. With the magnetic coupling, however, the torque transmitted is independent of the slip speed, and of the temperature of the slipping surfaces.

THE MAGNETIC POWDER COUPLING.

Essentially, the magnetic powder coupling consists of three iron members and a copper coil. The coil is housed in a stationary member (stator) which is secured through a housing to the engine crankcase with its bore concentric with the crankshaft. A driving member attached to the crankshaft, rotates within the stator, the two members being separated by a small air gap. A driven member rotates co-axially within the driving member and is splined to the gearbox input shaft.

A measured quantity of a fine metallic powder is placed in the small annular clearance between the driving and driven members; the quantity is such that, when the driving member is rotating and no current is flowing in the coil, centrifugal force disperses the powder evenly around the bore of the driving member but clear of the driven member.

When, however, current flows in the coil magnetic lines of force are created in a plane at right angles to the direction of the current and a magnetic flux flows round the stator. The flux crosses the air gap between the stator and driving member and passes through the powder in the gap between the driving and driven members. Under the influence of the magnetic flux, the powder particles arrange themselves into columns along the magnetic lines of force between the poles formed by the driving and driven members and pack themselves into these columns in such a way as to provide the best possible path for the magnetic flux through the particles.

Since the particles are irregular in shape, and in fact potentially wedged shaped, this produces a secondary effect whereby the powder columns exert a force on the magnetic poles parallel to the lines of force, and therefore normal to the pole faces—in other words, the columns tend to become longer.

Since the force of friction applies between the ends of the powder columns and the pole pieces, any attempt to move either pole relative to the other at right angles to the lines of force produces a resisting force tangential to the pole face, equal to the product of the force exerted by the column of powder against the pole face and the coefficient of friction between the powder and the pole face.

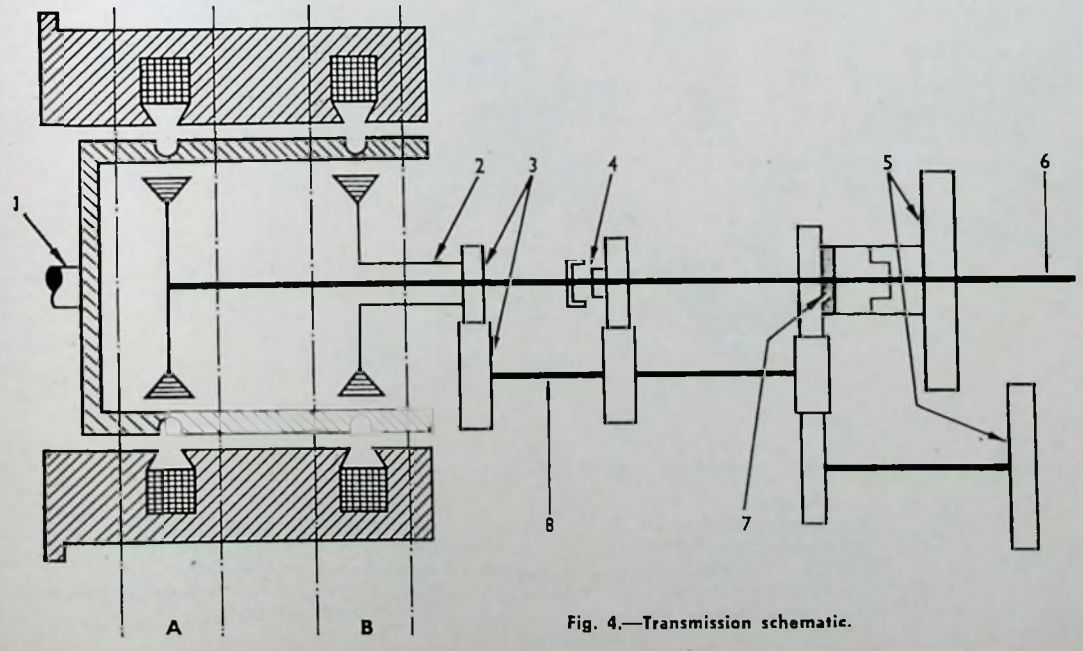
The torque transmitted is almost directly proportional to the current in the coil.

The stator does not exert drag on the driving member. Although high magnetic forces exist across the air gap, these are disposed equally around the air gap and cancel one another out.

THE AUTOMATIC TRANSMISSION SYSTEM.

The automatic transmission comprises two magnetic powder couplings driving a gearbox by means of co-axial shafts. A cut-away view of the arrangement is provided in Fig. 5 and its operation is shown in schematic form in Fig. 4.

The front magnetic coupling (A, Fig. 4) drives the gearbox mainshaft (6) and gives Direct drive. The rear magnetic coupling (B) drives the countershaft (8), through a hollow stemwheel (2) mounted co-axially with the mainshaft, via constant-mesh gears (3). The countershaft drives the mainshaft either through a pair of constant-mesh gears and a freewheel (7) giving Low gear, or through a further constant-mesh gear train and a solenoid-operated dog-clutch (4) giving Intermediate gear. Reverse is obtained by a sliding gear (5), splined to the mainshaft, which is manually engaged with the reverse gear train; moving this gear also disengages the freewheel.



1—Engine crankshaft.
2—Hollow stemwheel.
3—Constant-mesh gears.
4—Dog-clutch.
5—Reverse gears.
6—Main shaft.
7—Freewheel.
8—Countershaft.
A—Direct coupling.
B—Indirect coupling.

Fig. 4.—Transmission schematic.

The following is a description of the routing of the drive through the transmission after the above gear conditions have been engaged. (Refer to Fig. 4.)

Low Gear.

The indirect (i.e., the rear) coupling is energised, turning the countershaft which drives the mainshaft via the low-gear train and the freewheel (the solenoid-operated dog-clutch not being engaged in this condition).

Intermediate Gear.

The gearshift solenoid is energised and operates the dog-clutch, returning the drive from the indirect coupling to the mainshaft via the countershaft and intermediate train. A freewheel allows the low-gear train to be over-run since, in Intermediate, the mainshaft turns at a higher speed than the low gear.

Direct Drive (High Gear).

The direct (i.e., front) coupling is energised, driving the mainshaft directly.

Reverse Gear.

Reverse drive is selected manually, moving the sliding gear into engagement with the reverse train. The indirect coupling is energised driving the mainshaft via the countershaft.

Gear Changing.

Undernoted are particulars of the mechanical processes by which gear changing is effected. **(The operation of the electrical control of these mechanical functions is described under "Switch and Component Functions", page 11.)** All changes into Intermediate involve operation of a dog-clutch and therefore synchronisation must be provided. To prevent engagement until synchronisation has been achieved, the dog-clutch is fitted with a baulk ring (Fig. 6).

Up Changes.

In the course of acceleration, a change from Low to Intermediate is necessary. The engine speed in Low, of course, is considerably higher than that required for Intermediate. Therefore, engine speed

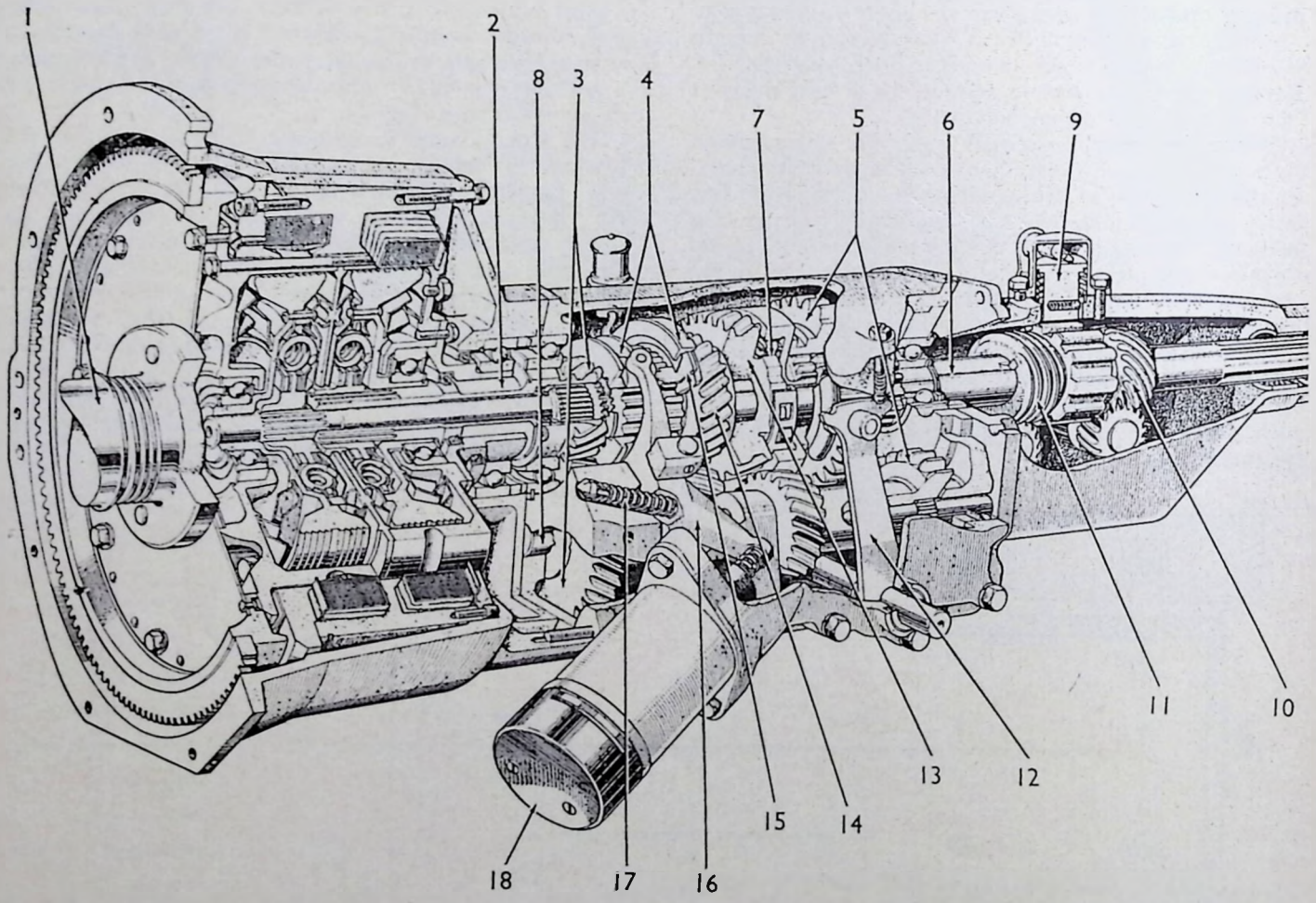


FIG. 5.—Sectioned transmission.

1—Crankshaft.
2—Stemwheel.
3—Countershaft gears.
4—Dog clutch.
5—Reverse gears.
6—Mainshaft.
7—Freewheel.
8—Countershaft.
9—Parking lock (if fitted).
10—Governor drive.
11—Speedometer drive.
12—Forward/reverse shift lever.
13—Low gear.
14—Intermediate gear.
15—Intermediate gear baulk ring.
16—Intermediate shift fork.
17—Intermediate shift fork withdrawal spring.
18—Gearshift solenoid.

must be reduced momentarily. This is achieved by the engagement of the direct coupling, which will slow down the engine to the required speed. At the moment of synchronisation the baulk ring will assume a position permitting the dog-clutch to engage. As the dog-clutch engages, the direct coupling is released.

To complete the course of acceleration, a change from Intermediate to Direct drive is made, the dog-clutch disengaging on release of torque of the indirect coupling.

Down Changes.

To achieve synchronisation for dog engagement from Direct to Intermediate gear, an increase in engine speed is required. Assuming the throttle is open, the engine speed will rise automatically when the direct coupling is released, thus ensuring synchronisation. In practice, the coupling is only partially released, thus restraining the rate of increase in engine speed.

When the change from Direct to Intermediate is called for with a closed throttle (i.e., when the car is being brought to rest) synchronisation by engine speed acceleration is not achieved. As soon as the throttle is opened, however, Intermediate or Low gear is engaged in the normal way.

When Intermediate is selected by the driver with the throttle closed, the above condition is taken care of by the throttle solenoid which momentarily opens the throttle until synchronisation is achieved.

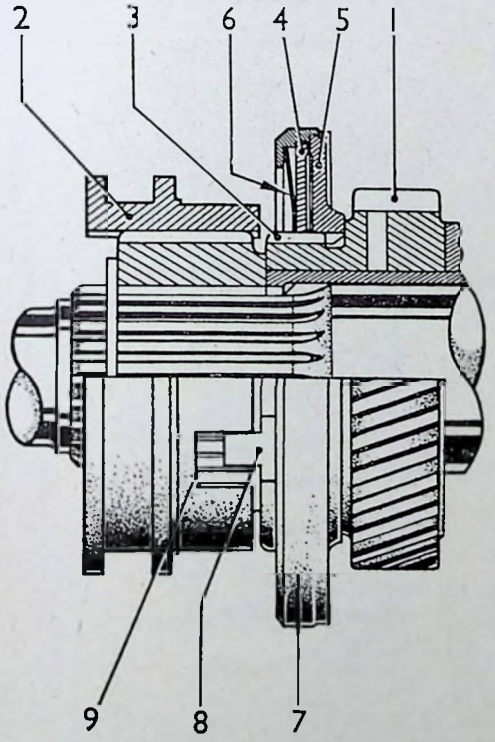


FIG. 6.—Dog-clutch.

1—Intermediate gear.
2—Sliding member.
3—Splines.
4—Baulk ring.
5—Carrier plate.
6—Friction spring.
7—Cover.
8—Baulk ring tongue.
9—Slot.

The down change from Intermediate to Low gear necessitates disengagement of the dog-clutch. As disengagement is effected by the influence of a return spring which cannot take effect until the release of torque frees the dog-teeth, the electrical control momentarily de-energises the indirect coupling, thus releasing the torque.

Baulk Ring (Fig. 6).

The intermediate gear (1) is free to rotate on the mainshaft, but may be locked in position by the sliding member (2) which mates with splines (3) on the intermediate gear. The baulk ring (4) is held against a carrier plate (5) by a friction spring (6) so that it will tend to turn with the intermediate gear. The assembly is held together by a cover (7). The shouldered tongues on the baulk ring engage with the slots in the sliding member in such a manner that this member can only move into the engaged position if the shoulders of the tongues (8) are in line with the slots (9).

Summary of Gear Change Conditions.

Gear	Direct Coupling	Indirect Coupling	Dog Clutch	Forward Reverse Sliding Gear
Low		Energised		Forward
Low-Int.	Energised	Partly energised	Solenoid energised but dog clutch not engaged	Forward
Int.		Energised	Dog clutch engaged	Forward
Direct	Energised			Forward
Direct-Int.	Partly energised	Partly energised	Solenoid energised but dog clutch not engaged	Forward
Int.		Energised	Dog clutch engaged	Forward
Low		Energised		Forward
Reverse		Energised		Reverse

GOVERNOR.

The duty of the governor is to determine the point at which each gear change is to be effected. To illustrate its operation, it is helpful to consider changing gear with a manually-operated gearbox. A change may take place at high or low road speed. When obtaining maximum acceleration, the car reaches a much higher road speed in Low gear than if driven gently; in the former, the accelerator pedal is depressed further. It follows, therefore, that the governor must be sensitive to throttle opening as well as to road speed.

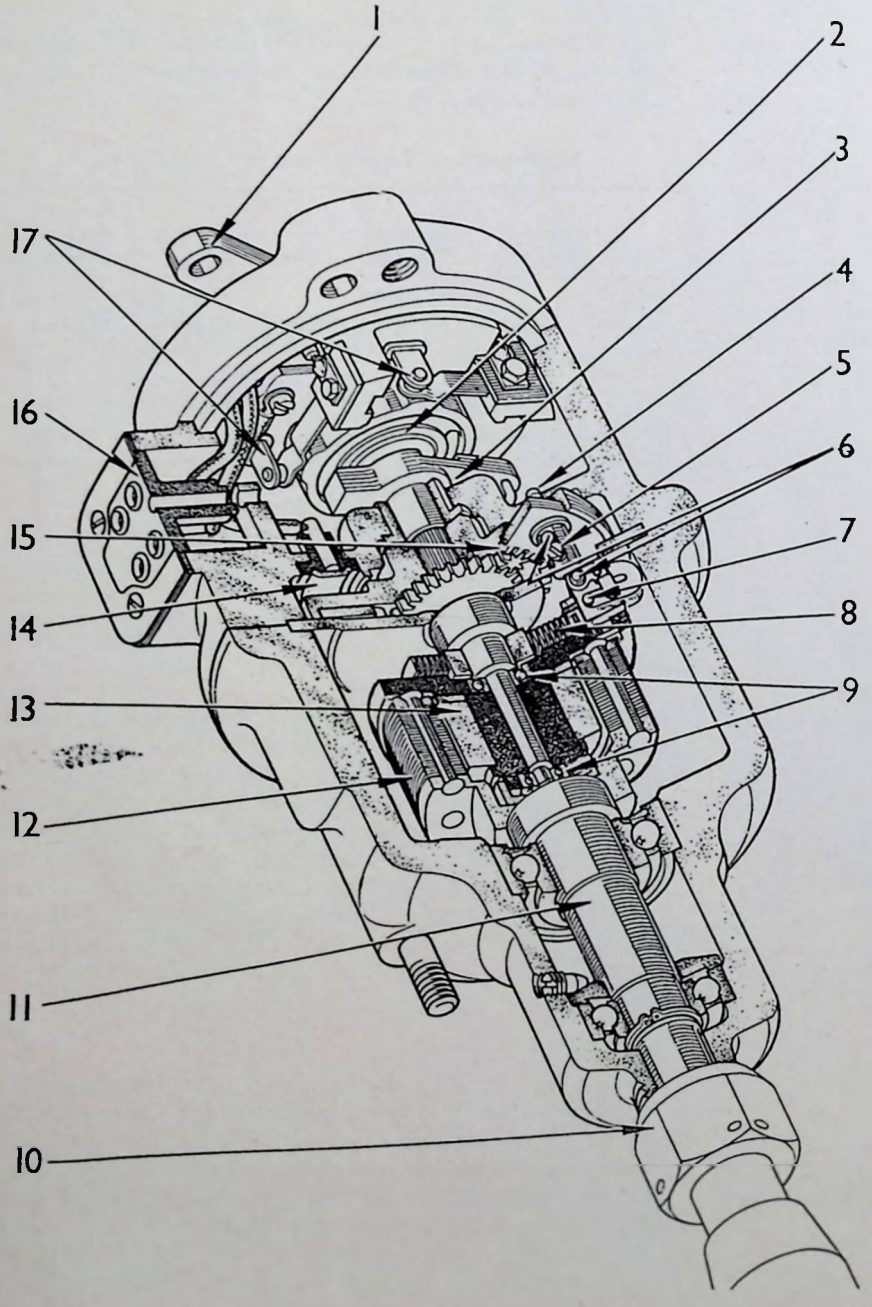
Road Speed.

The part of the governor which is sensitive to road speed embodies the same principles as the magetic type of speedometer. The principles of the modern speedometer is briefly as follows. A cup-shaped member (the drag-cup), made from a good electrical conductor, is rotated at a speed proportional to road speed. A permanent magnet is pivoted within the drag-cup and held towards a stop by a hairspring.

The drag-cup is thus cut by lines of magnetic force and, when it is rotating, currents are induced in the drag-cup thus creating a tendency for the magnet to follow in the direction of rotation of the drag-cup, the amount of deflection being determined by the speed of the drag-cup and the restraining influence of the hairspring. A pointer fixed to the magnet indicates road speed. The pointer could serve to indicate the road speed electrically. If, for example, the pointer were arranged to travel between two stops, one at a position corresponding to, say, 11 m.p.h. and the other to 22½ m.p.h., provided the stops were fitted with electrical contacts, the pointer would then be able to indicate three ranges of road speeds; that is to say, one contact would be closed between zero and 11 m.p.h., both would be open between 11 and 22½ m.p.h. and the second would close above 22½ m.p.h. This principle would provide road speed signals in a manner required for the transmission system, i.e., to initiate gear changes Low to Intermediate at 11 m.p.h. and Intermediate to Direct drive at 22½ m.p.h.

Throttle Opening.

So far, the device does not cater for the second condition, i.e., throttle opening. This, however, can be incorporated by causing the positions of the stops to alter as the throttle position changes. The respective change points are not affected by the first 30% of throttle opening and, beyond that point, movement of the Intermediate/Direct contact must be greater than the Low/Intermediate contact in relation to throttle opening. This differential movement is arranged by a gear train (15, Fig. 7).



1—Lever for throttle linkage.

2—Cam (operates throttle position switches).

3—Lost motion coupling to throttle linkage.

4—Silver brush (High speed contact).

5—High speed contact.

6—Hysteresis (delay) magnets.

7—Moving contact.

8—Hairspring.

9—Magnet bearing.

10—Flexible drive.

11—Driving shaft.

12—Drag cup.

13—Magnet.

14—Slip ring.

15—Epicyclic gear train.

16—Socket.

17—Throttle position switches.

FIG. 7.—Sectioned governor.

With the system as above, the up changes would occur at the same speeds as the down changes, resulting in up and down shifts at the slightest change of speed or throttle position. But it is desirable for down changes to occur at a lower speed than up changes. This is achieved by fixing small hysteresis (delay) magnets to the moving contact (i.e., the "pointer") and to the "stops"; the magnets give a small "hold on" effect so that, as the road speed increases, the Low/Intermediate contact does not open until a speed is reached higher than that at which it would close. A further increase in speed causes the Intermediate/Direct contact to "make". When the speed decreases the Intermediate/Direct contact opens at a speed lower than that at which it closed. (Similarly, with a further decrease in speed, the Low/Intermediate contact "makes" at a speed lower than its "break" speed.)

The governor also houses four throttle switches (17) (i.e., switches which open or close at various position of the throttle pedal).

GEARSHIFT SOLENOID.

The gearshift solenoid (Fig. 8) is used to engage the dog-clutch to obtain Intermediate gear. It uses the well-known solenoid principle, but in order to provide a larger pull at the beginning of its travel it contains two coils (6) (a main coil and a "hold" coil). At the commencement of its travel both these coils are used, but having reached full engagement the main coil is switched out by the solenoid switch (1) which is operated by the solenoid armature via a small plunger (5).

In addition, the solenoid carries a further switch (dog switch) (3) which indicates to the control circuit the moment the baulk ring has been passed when the dog clutch is going into engagement.

THROTTLE SOLENOID.

This is a solenoid which is used to raise engine speed when Intermediate (2) is selected from "D" with a closed throttle. As its operation is intermittent it has only a single coil.

SELECTOR SWITCH.

This unit (Fig. 9) has four switch positions: Drive ("D"), Intermediate ("2"), Neutral ("N") and Reverse ("R"). When the switch moves from Neutral to Reverse it also manually engages a gear in the gearbox via a linkage. The switches operated in each position are identified in the circuit diagrams by the letters "D", "I", "N" and "R" respectively; e.g., the switches operated at "N" are called N1 and N2.

CONTROL UNIT.

This unit (Fig. 10) contains the relays, resistances and rectifier used in the electrical control system. Connections are made via two 9-pole sockets for light currents and via two terminals for heavy currents.

RELAYS (Fig. 11).

There are eight of the type shown in Fig. 11 used in the control system.

These relays are electromagnetically operated switches, each having two change-over contacts. The operation is as follows:—

When a current is passed through the coil (1), the electromagnet core attracts the armature (2) thus moving the change-over contacts (3) from one position to the other.

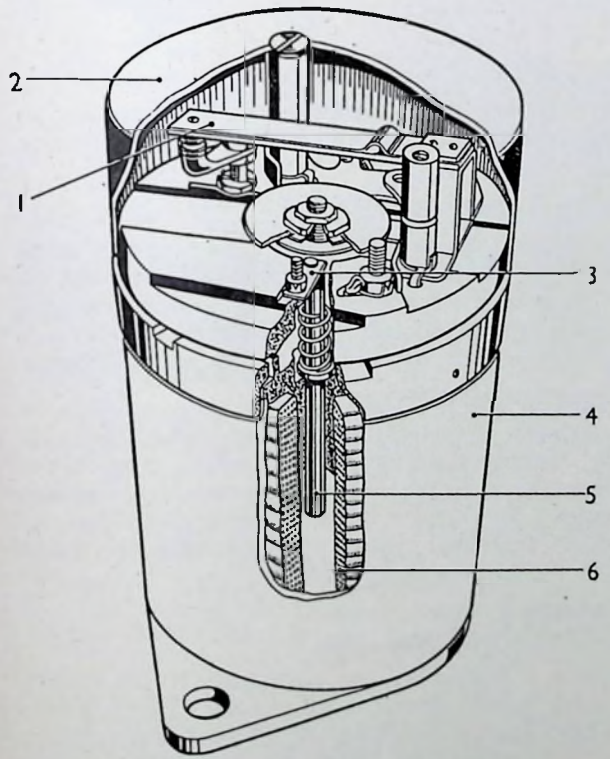


FIG. 8.—Sectioned gearshift solenoid.

1—Solenoid switch (SS).
2—Cover.
3—Dog switch (DS).
4—Can assembly.
5—Plunger.
6—Coils.

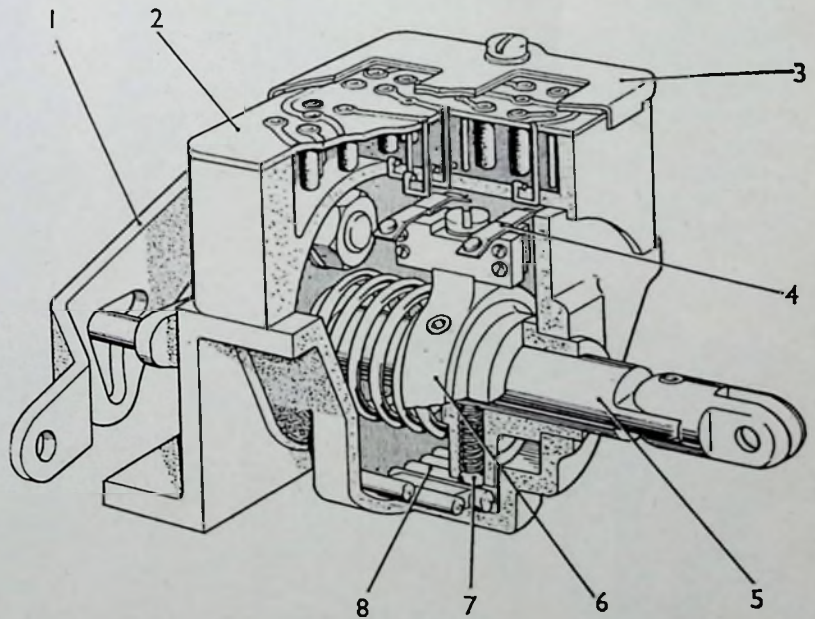


FIG. 9.—Sectioned selector switch

1—Reverse arm.
2—Socket moulding.
3—Cover.
4—Contacts.
5—Spindle.
6—Contact block.
7—Spring-loaded ball.
8—Indent bars.

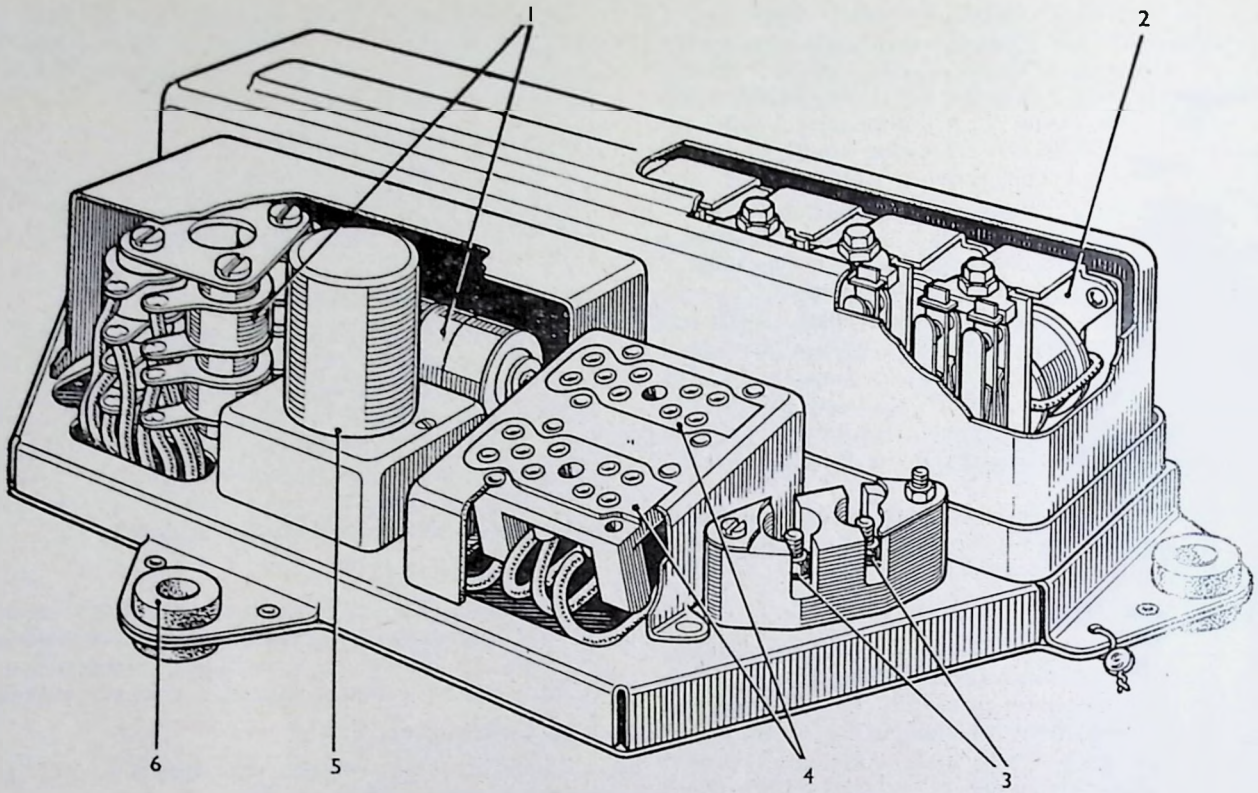


FIG. 10.—Sectioned control unit.

1—Resistances.
2—Relay.
3—Heavy current connections.
4—Light current connections.
5—Thermal switch.
6—Resilient mounting.

When relays are shown in the circuit diagrams it is convenient to show the sets of contacts detached from the operating coil of the relay, the coil being identified by a letter, and the number of contacts associated with the coil are indicated by a numeral printed underneath the letter. The contacts themselves are identified by the same letter followed by a numeral. For example, the W relay coil is shown as W/2 and the contacts associated with it will be shown as W1 and W2.

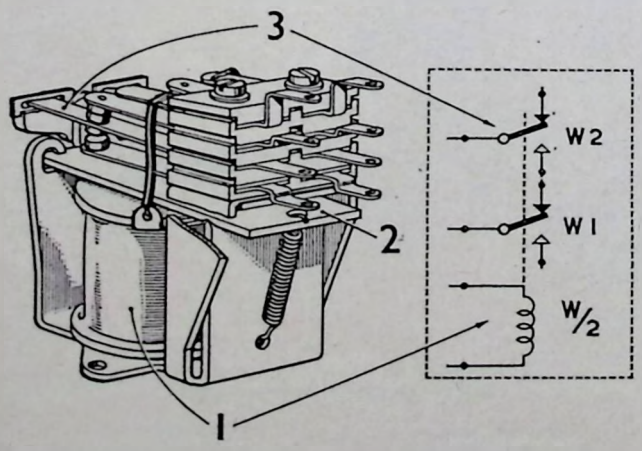


FIG. 11.—Relay and circuit conventions

1—Coil. 2—Armature. 3—Changeover contact set.

RECTIFIER.

There is one silicon rectifier used in the circuit: its function is to permit flow of current in one direction only.

THERMAL SWITCH.

The thermal switch is used as a delay device, using a heater coil which, when energised will cause the bi-metal strip to distort, breaking the switch contacts. The time taken to break these contacts can be controlled by a series resistance in the heater coil circuit.

TRIMMING RESISTORS.

Refinement of operation of the transmission is largely dependent upon the torque capacity of the couplings being to the specified figure; after testing, adjustment is effected (where necessary) by the insertion of trimming resistors in series with the stator coils. (See Fig. 27 and Fig. 30.)

RESISTORS R15, R16 AND THROTTLE SWITCH TS4.

Resistors R15 and R16 are mounted on the control unit under a small cover which is secured by a single nut. These resistances form part of the throttle switch TS4 circuit to the direct coupling and their purpose is to assist in bringing about a smooth Low/Intermediate gear change under light throttle conditions. (See Coupling Torque Test, page 25.)

Summary of Switch and Component Functions.

Component	Circuit Reference	Notes
Governor Switch	GOV	Change-over switch with three positions indicating road speed/throttle setting.
Throttle Switch	TS1	Opens when throttle pedal is moved.
Throttle Switch	TS2	Opens at about 1/12 throttle.
Throttle Switch	TS3	Opens at about 1/7 throttle.
Throttle Switch	TS4	Closes at about 1/6 throttle.
Dog Switch	DS	Opens when intermediate dog clutch has passed through baulk.
Solenoid Switch	SS	Opens when gearshift solenoid has operated, i.e., when Intermediate is engaged.
Selector Switch Contacts	D	Closed when DRIVE IS selected.
Selector Switch Contacts	11, 12	Closed when INTERMEDIATE is selected.
Selector Switch Contacts	N1, N2	Closed when NEUTRAL is selected.
Selector Switch Contacts	R1	Closed when REVERSE is selected (also reverse train engaged mechanically).
Throttle Solenoid	—	Partially opens throttle (used only when "2" is selected from "D").
Gearshift Solenoid	—	Engages Intermediate gear.
Thermal Switch	T/1	Consists of heater (T/1) and one pair of normally closed contacts (T1).
6-volt Relays	E/2, H/2	These have 6-volt coils (fed through resistances) to allow the relay coils to be de-energised by short-circuiting without short-circuiting the supply.
12-volt Relays	B/2, C/2, Z/2, G/2, X/4	X/4 consists of two relays, with the coils strapped in parallel; this is to obtain two additional contact sets using standard relays.

CIRCUIT DESCRIPTION.

The illustrations appended to the text in this section depict a condition with ignition switched off, parking lock off, selector switch at Neutral and governor closed on Low contact (i.e., vehicle stationary) and are a series of stage by stage diagrams of one complete circuit. As the section proceeds the diagrams are progressively extended. All relay contacts are shown in the normally closed (de-energised position. (See inset on Fig. 27.)

Starting Interlock Circuit.

This circuit (Fig. 12) prevents the car engine starter from being used unless the selector switch is at "N" and the parking lock (if fitted) is released: the line from the starter switch to the starter solenoid is completed via selector switch N2 and the parking lock switch.

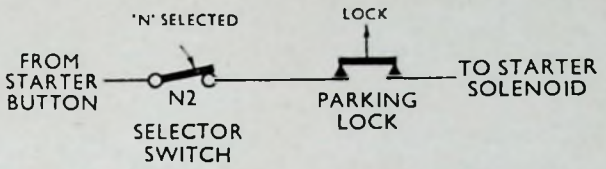


FIG. 12.—Starting interlock system.

Coupling Coils Supply Circuit.

Current to the coupling coils is supplied from either the dynamo or the battery as determined by the position of relay contact X1 (Fig. 13). Relay X/4 is controlled by the low-speed contacts of the governor; when the car first moves, relay X/4 is energised and contact X1 selects the dynamo supply; as the road speed rises, the governor low-speed contacts open, relay X/4 is de-energised, and contact X1 changes over and selects the battery supply.

To ensure a smooth take-up of the drive, the dynamo field circuit is modified by the action of contact X4, which removes a short-circuit from resistance R1 and connects a battery supply to the field winding via resistance R2. This produces the dynamo output shown by the full line in Fig. 14, providing a steady rise in the coupling current, and hence a progressive increase in the transmission of torque to the road wheels. (The chain line in Fig. 14 illustrates the output of an unmodified dynamo, and the dotted line the effect produced by resistance R1 only.)

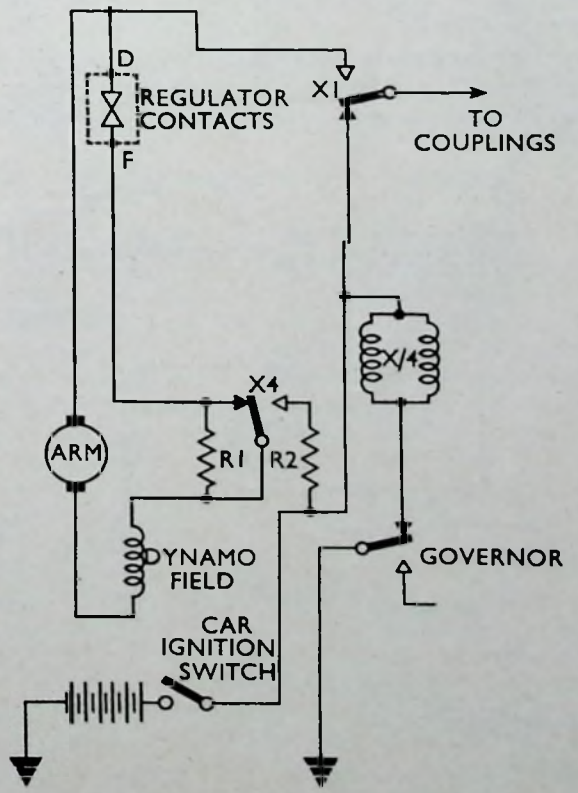


FIG. 13.—Coupling coils supply circuit.

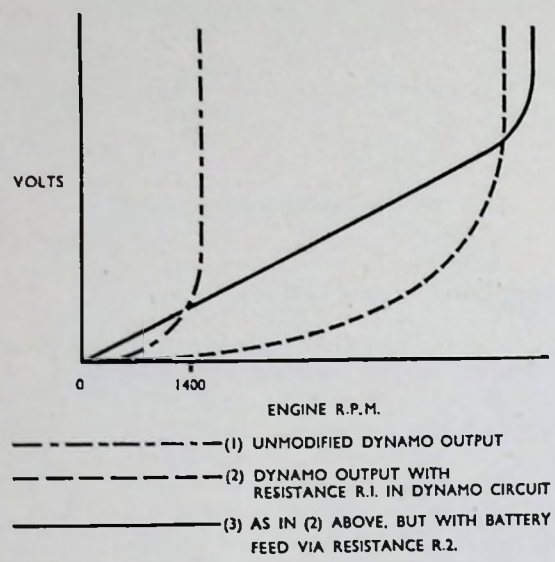


FIG. 14.—Effect of dynamo field modification.

Light Throttle Circuit.

The above system is unsuitable for a light throttle start since the modified dynamo output provides insufficient battery charging. To maintain the charging rate during the time taken for a light throttle start, the dynamo circuit modifications (Fig. 15) are short-circuited by relay contact G2, and, to smooth the take-off, relay contact G1 opens and brings resistances R6 and R7 into the coupling circuit. Relay G/2 is energised via throttle switch TS3 when the throttle is almost closed (viz., as for a light throttle start).

Economy Circuit.

For Intermediate gear and Direct driving, relay X/4 (Fig. 16) is de-energised, since the governor low-speed contact is open, and contact X1 connects the coupling coils circuit to the battery supply while contact X2 short-circuits resistance R6. At above 1/7th throttle opening, R7 is short-circuited by G1 to feed full current to the coupling coils. At below 1/7th throttle opening, solid drive can be obtained with a reduced current. At light throttle, relay G/2 is energised by throttle switch TS3, opening G1 to economise battery current by introducing R7 into the coupling circuit.

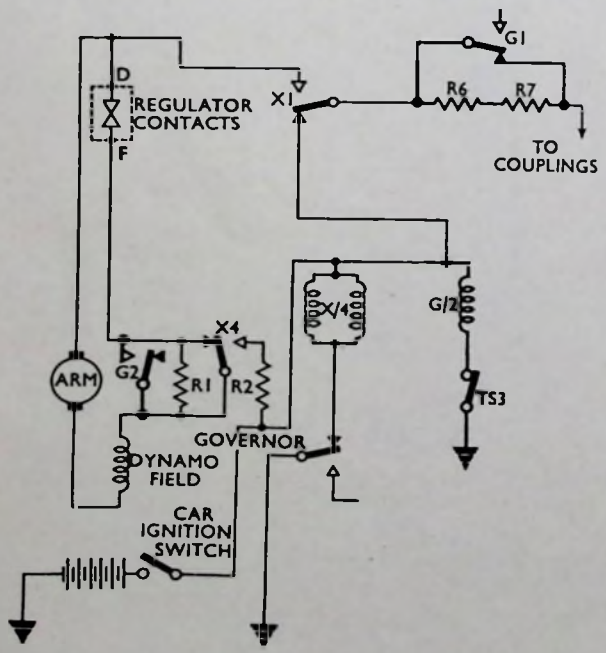


FIG. 15.—Light throttle circuit.

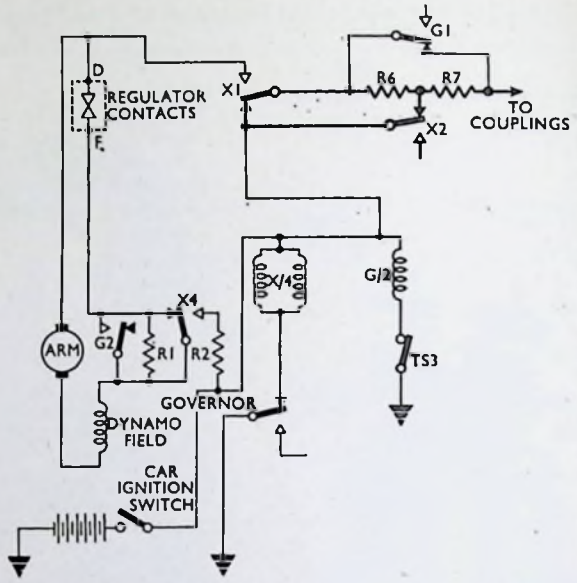


FIG. 16.—Economy circuit.

Coupling Selection Circuit.

Selection of the required coupling coil is made by contact B1 (Fig. 17). The indirect coupling coil is energised for Low and Intermediate gears, whilst the direct coil is energised for Direct drive. When the high-speed contact of the governor closes and energises relay B/2, contact B1 selects the direct coupling coil.

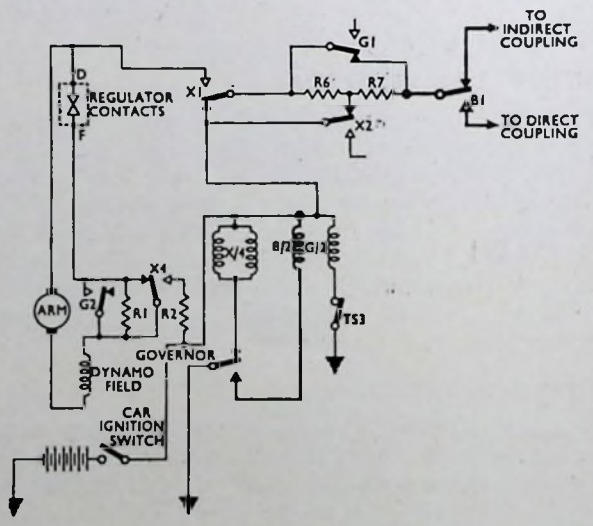


FIG. 17.—Coupling selection circuit.

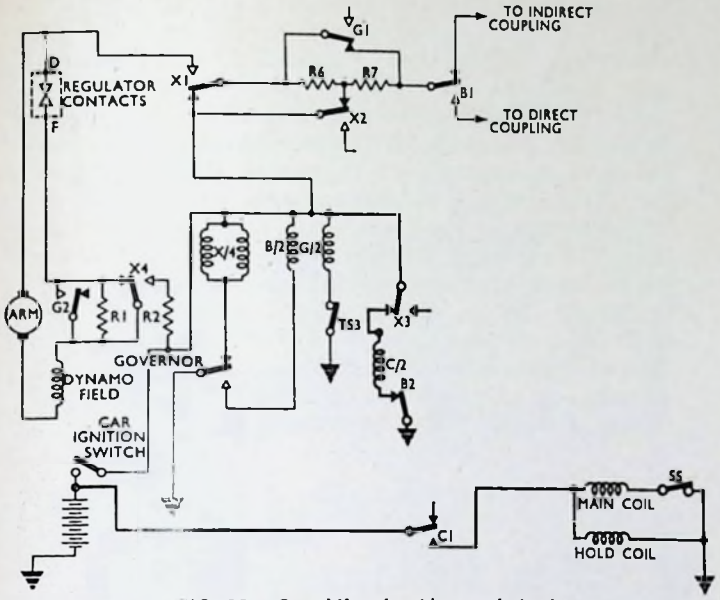


FIG. 18.—Gearshift solenoid control circuit.

Gearshift Solenoid Control Circuit.

Intermediate gear is engaged by energising the gearshift solenoid (Fig. 18) which engages a dog-clutch in the gearbox. The Intermediate drive range is determined by the governor, and occurs between the opening of the low-speed contact and the closing of the high-speed contact. During this period, relays X/4 and B/2 are de-energised and relay C/2 is energised, via contacts X3 and B2: contact C1 connects the solenoid coils to the battery. As the dog-clutch engages, solenoid switch SS opens and disconnects the heavy-current "main" coil the solenoid being maintained in operation by the light-current "hold" coil.

Synchronising Circuit (Low to Intermediate).

The dog-clutch in the gearbox is fitted with a baulk ring which prevents the engagement of Intermediate gear until the shaft speeds are synchronised. When the engine speed is too high, synchronisation is achieved by energising the direct coupling, thus loading the engine and reducing its speed. This is effected by relay E/2 (Fig. 19) (which is energised via contacts C2, resistor R13 and the dog switch).

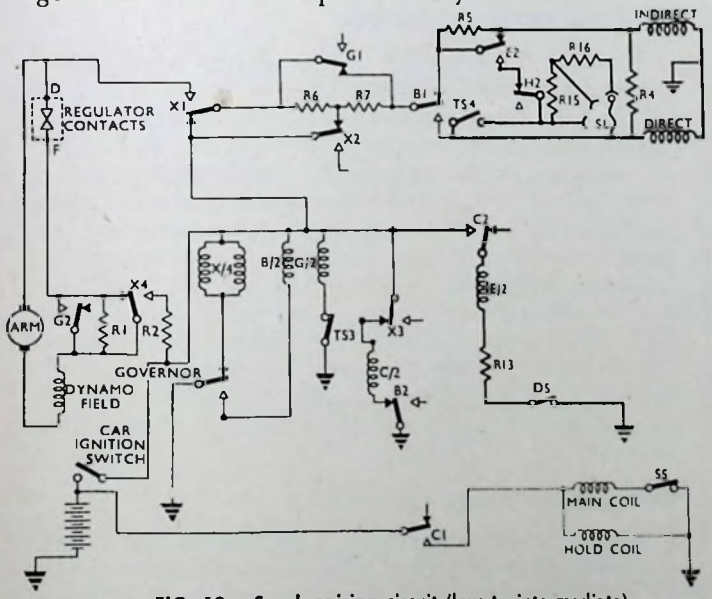


FIG. 19.—Synchronising circuit (low to intermediate).

At throttle openings below approximately 1/6th contacts E2 and H2 supply current, modified by R15 and R16, to the direct coupling coil (shorting lead SL may be connected so that only R15, or no resistance, is in circuit, if the direct coupling torque does not necessitate the use of both resistances). At approximately 1/6 throttle opening, throttle switch TS4 closes and full current is applied to the direct coupling coil.

A reduced current is maintained in the indirect coupling coil (via resistance R5) to smooth the take-up when the drive reverts from the direct to the indirect coupling. Relay E/2 is de-energised when the dog switch opens.

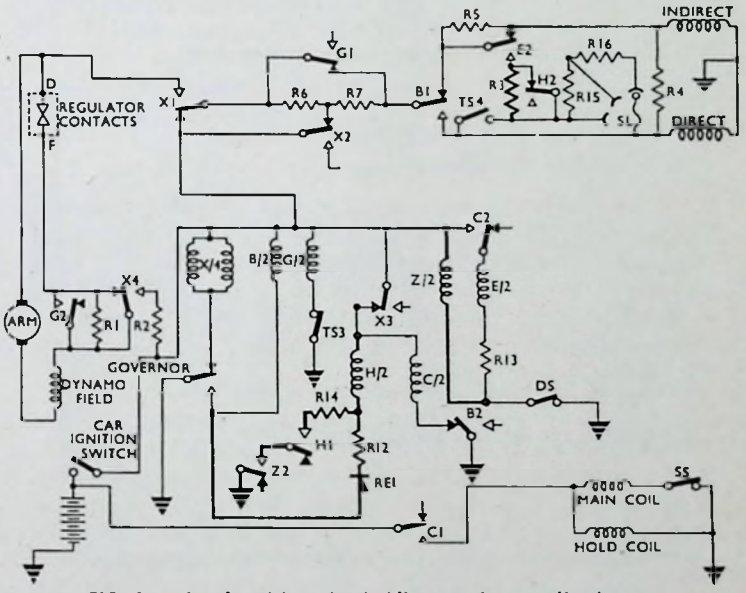


FIG. 20.—Synchronising circuit (direct to intermediate).

Synchronising Circuit (Direct to Intermediate).

In Direct drive (Fig. 20), relay H/2 is energised via contacts X3, resistance R12, rectifier RE1 and the governor high-speed contacts; relay Z/2 is also energised, via the dog switch. When the governor signals for a change to Intermediate by de-energising relay B/2 (the circuit via resistances R12 and R14 and relay contacts H1 and Z2 being broken by rectifier RE1 in this direction) and thus energising rely C/2 via contacts B2 and X3 (relay H/2 remaining energised via its own contact H1 and contact Z2), then relay E/2 is energised via contact C2, and a reduced current is passed to the direct coupling coil via contact E2 and resistance R3. At throttle openings below approximately 1/6th, the current is further reduced by R15 and R16 when these resistances are in circuit. Thus engine speed is increased to enable synchronisation to take place, whereupon relays E/2 and Z/2 are de-energised by the opening of the dog switch. Contact Z2 de-energises relay H/2 and the circuit returns to the normal Intermediate condition.

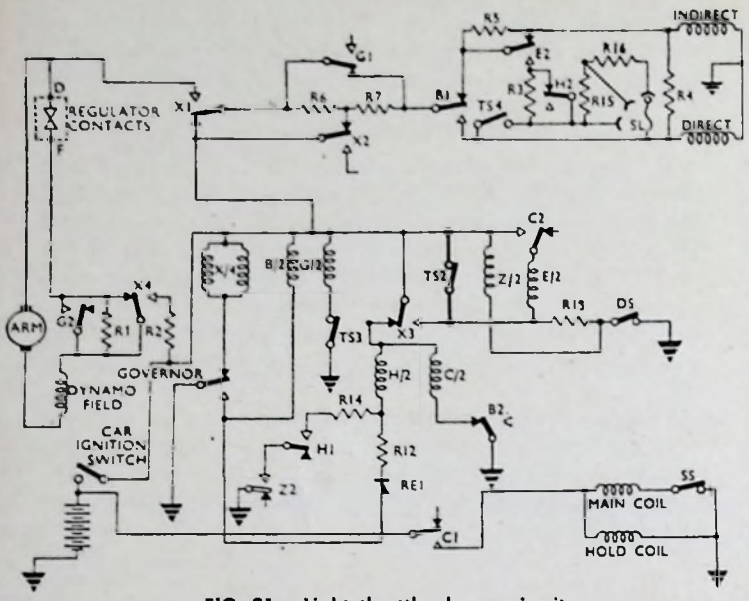


FIG. 21.—Light throttle change circuit.

Light Throttle Change Circuit (Low to Intermediate).

For a light throttle gear change, the drag effect of the direct coupling is not necessary since the engine speed is already reduced. Therefore, relay E/2 (Fig. 21) is short-circuited by throttle switch TS2, which is closed at very low throttle. **Note:** In this condition there is no short circuit of the supply, since resistance R13 remains in circuit.

Intermediate to Direct Circuit.

In Intermediate, the dog switch is open and relays Z/2 and E/2 are de-energised. When the governor signals a change from Intermediate to Direct (Fig. 22), the high-speed contact energises relays B/2 and H/2 (via resistance R12 and rectifier RE1). B1 contacts select the direct coupling coil and contact B2 de-energises relay C/2 allowing the dog-clutch to disengage. Until the dog switch energises relay Z/2, the indirect coupling coil is short circuited via contacts Z1 and B2. The changeover of the B2 contact puts the indirect coupling coil in a closed circuit. The inductance of the coupling induces a current in its coil which holds the torque for a momentary period and thus delays the release of the Intermediate dog clutch. This has the effect of minimising the time lag between the loss of the torque of the indirect coupling and the build-up of the torque in the direct coupling. When the dog-clutch is disengaged, relay Z/2 is energised opening contact Z1 and closing contact Z2: the circuit returns to the normal Direct condition.

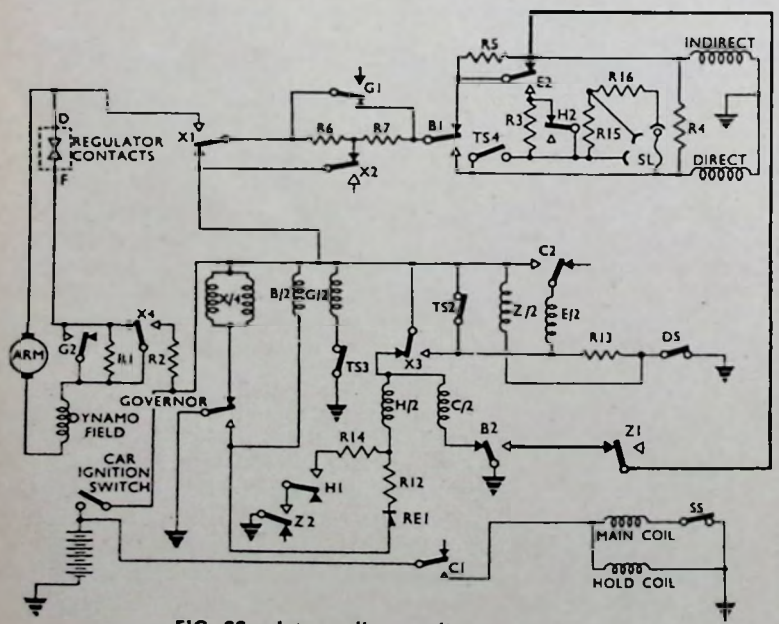


FIG. 22.—Intermediate to direct circuit.

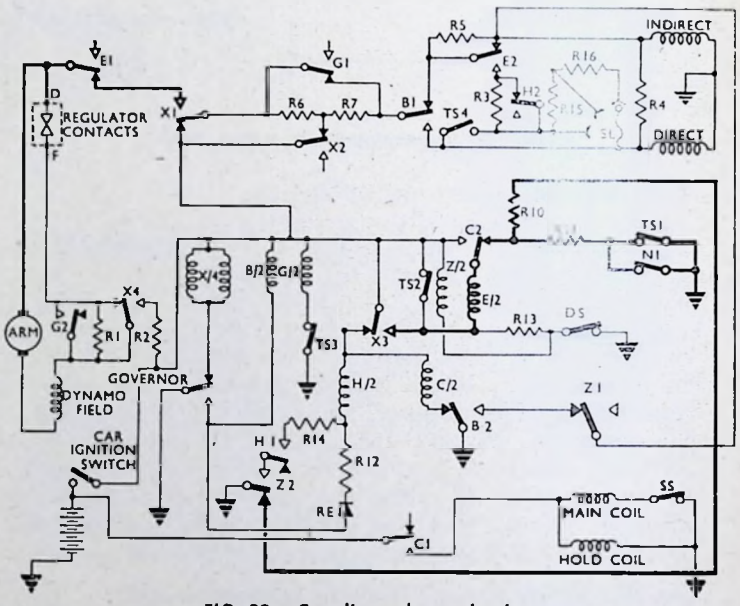


FIG. 23.—Coupling release circuit.

Coupling Release Circuit (In Low Gear Speed Range).

Positive disconnection of the drive, when either Neutral is selected or the throttle is closed, is effected by the opening of contact E1 (Fig. 23) in the dynamo supply line to the coupling coils circuit. Relay E/2 is energised via contact X3 when relay X/4 is energised by the governor low-speed contacts. When the throttle is closed, relay E/2 is energised via throttle switch TS1, and when Neutral is selected, a circuit is completed via selector switch N1. Resistance R11 is connected in series as the relay has a 6-volt coil. The circuit also serves to release the torque on the dog-clutch when a change is made from Intermediate to Low. This is effected by contacts Z2, via resistance R10, which operate relay E/2 in a similar manner.

Intermediate Range Circuit.

When the selector switch is moved to "2" (Intermediate), relay C/2 (Fig. 24) is energised via switch I1 and relay contacts B2. Because contacts D are open

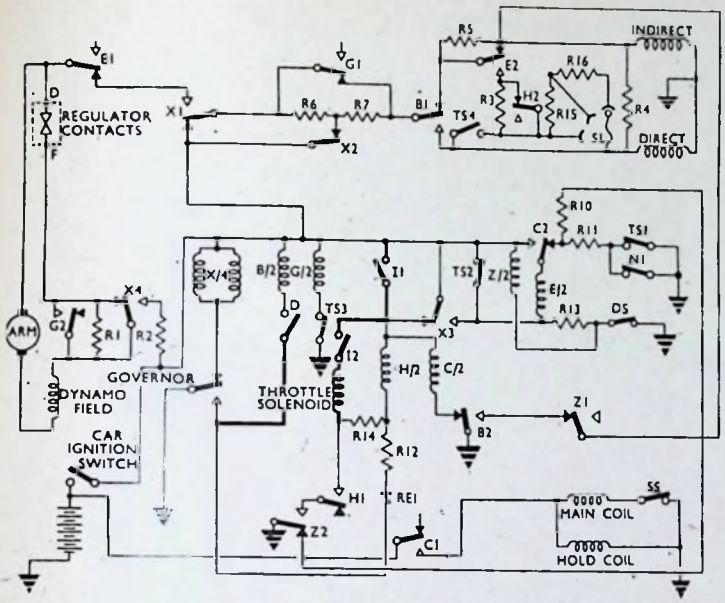


FIG. 24.—Intermediate range circuit.

in this condition of the selector switch, relay B/2 cannot be operated.

Synchronisation is effected as already described, but to cater for closed throttle conditions, the throttle solenoid is introduced by I2, H1 and Z2 contacts. When synchronisation is achieved the dog switch opens, which by de-energising relay Z/2, changes over contacts Z2 thus de-energising the throttle solenoid. Resistances R12 and R14 prevent the supply being short circuited to earth via the governor high-speed contact when contact I2 is closed (relay H/2 has a 6-volt coil).

Thermal Switch Circuit.

If after Intermediate has been selected the car is brought to rest on an up gradient, the following condition arises. Since Low gear is engaged continuously during the periods of Intermediate gear engagement, there are in actual fact two gears engaged at once. This is of no consequence for forward motion of the vehicle since Low gear drives through a freewheel. When the car is brought to rest on an up gradient, however, it will not roll backwards because in the reverse direction the two gears are both in engagement.

This hill-held condition results in the weight of the vehicle being supported by means of torque applied to the over-run side of the intermediate gear clutch dogs, which cannot then become disengaged under the influence of the return spring. If the steering column selector is moved into DRIVE position, the control circuit will now ask for Low gear (i.e., a change from Intermediate to Low). It will be remembered that, when under normal conditions the transmission changes from Intermediate to Low, the engine torque is released by de-energising the indirect coupling to allow the dog-clutch to disengage; but under the conditions considered above, it is not engine torque but torque from the road wheels that is preventing the clutch dogs from disengaging.

When the intermediate gear dogs are engaged the E/2 relay remains energised and there is no current supply through contact E1 from the dynamo to the indirect coupling.

A thermal switch is provided in the circuit to overcome this difficulty. The heating of the thermal switch causes T1 contact to open and thus de-energises the E/2 relay. E1 contact closes and current is supplied by the dynamo to the indirect coupling. (See Fig. 25.)

The drive is taken up in low gear and as soon as the intermediate gear dogs are relieved of the weight of the car, the dogs are disengaged by the action of the return spring.

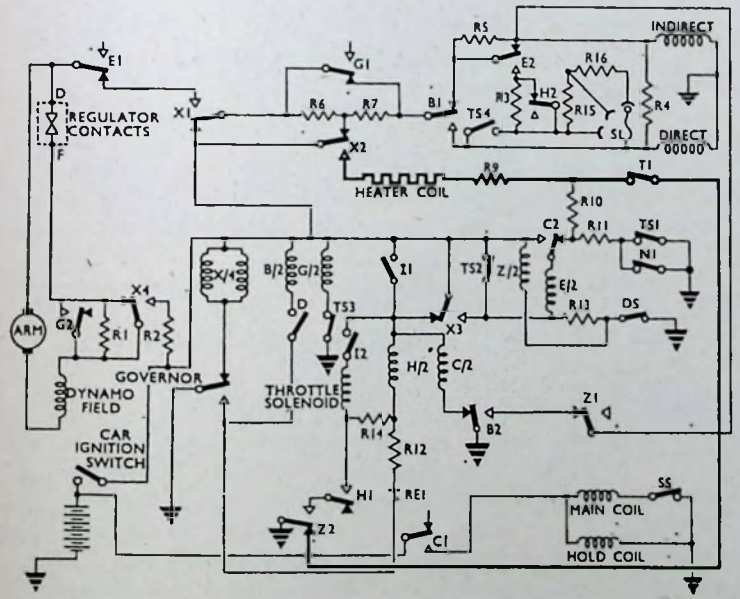


FIG. 25.—Thermal switch circuit.

Emergency Drive Circuit.

In the event of a failure in the control circuit, the couplings can be operated directly from the battery by the selector switch. The necessary reconnections (Fig. 26) are made by reversing a plug on the selector switch. Positions "2" and "R" energise the indirect coupling (giving Low and Reverse gears respectively) and position "D" energises the direct coupling, giving Direct drive.

Complete Circuit (Neutral Selected Condition).

A complete diagram of the circuit with Neutral selected, ignition switch off, and parking lock off, is given in Fig. 27.

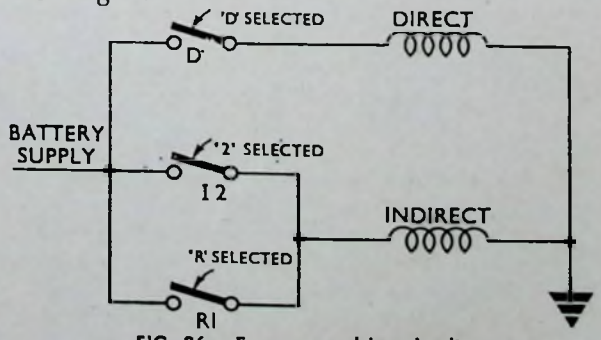
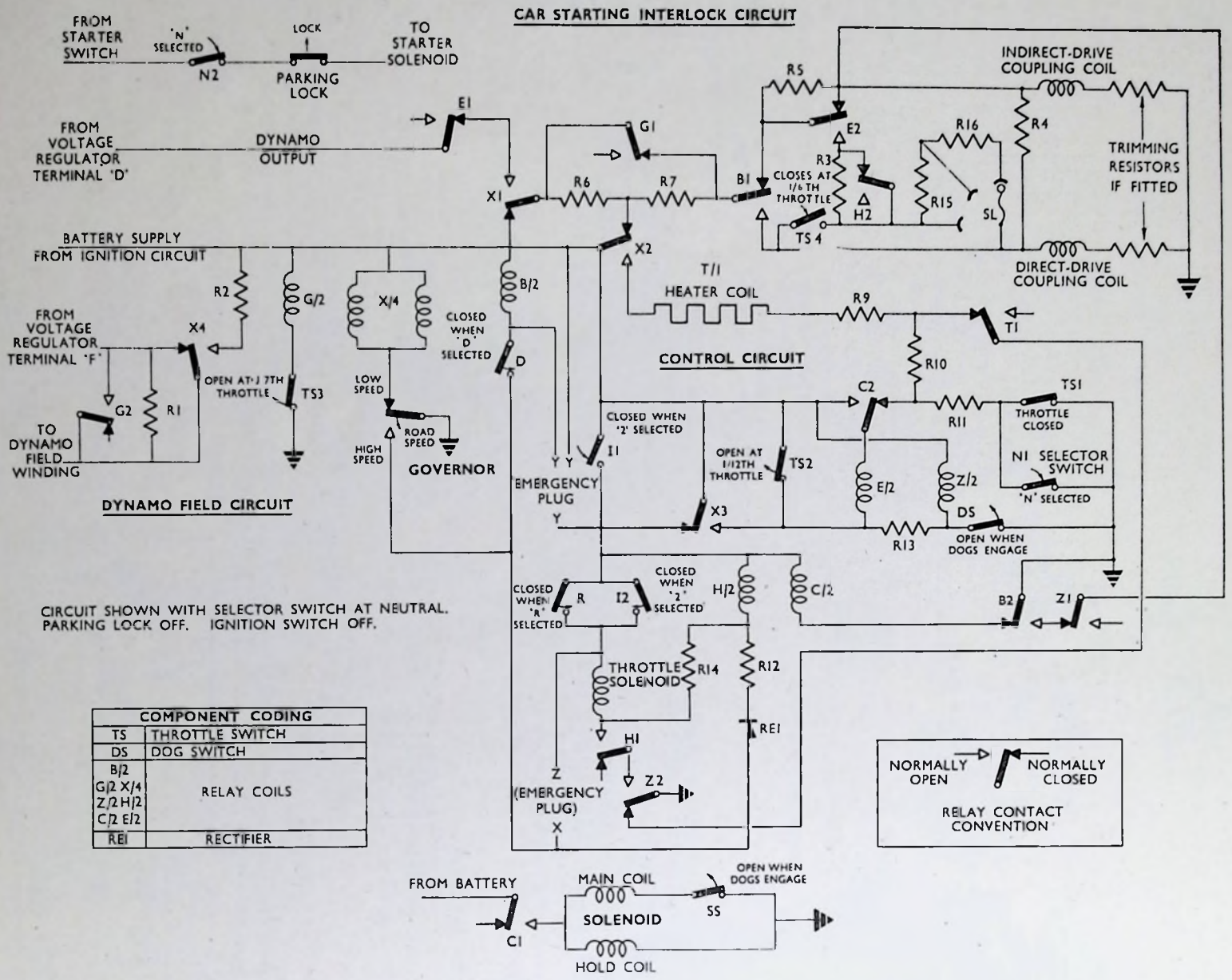


FIG. 26.—Emergency drive circuit.



COMPONENT CODING	
TS	THROTTLE SWITCH
DS	DOG SWITCH
B/2 G/2 X/4 Z/2 H/2 C/2 E/2	RELAY COILS
RE1	RECTIFIER

FIG. 27.—Complete circuit (neutral selected).

NOTE:—With emergency plug in operation, points y, y, y are connected together and point x to x and z to z.

TESTING AND FAULT DIAGNOSIS.

NOTE.

This section is divided into three parts.

Part A comprises a Fault Finding Chart, listing symptoms, methods of testing and action required to clear faults. To carry out some of the tests specified, it is necessary to use a Test Set Part No. A.200839 (Churchill Tool No. RG 268).

Symptoms appearing the Fault Finding Chart are arranged progressively in the sequence of starting the vehicle, moving from rest, up and down changes and miscellaneous possible faults which occur when driving under "Emergency Drive" conditions.

Part B describes the use of the Test Set, including fitting instructions and a sequence of testing. The Test Set provides a means of checking systematically the whole of the transmission circuitry, with the exception of certain harness connections. These connects are detailed appropriately in the Fault Finding Chart,, so that they may be checked separately.

Where the Fault Finding Chart specifies the use of Test Set against any one symptom, it is essential that **the whole of the test set procedure and its testing sequence is completed,** so that a comprehensive picture of the serviceability of the components is obtained with only one disturbance of the harness plugs.

Harness Faults can be located by testing lead continuity at the points specified by means of a test buzzer and battery or ohmmeter. (See page 34.)

Part C describes the method of stall speed testing the transmission and timing the Low to Intermediate gear change. These tests should be carried out after the renewal of any component liable to affect the torque transmission of the coupling. (See page 25.) Fitting trimming resistors, if necessary to bring the stall speed or gear change timing within the specified limits, is also described in detail.

CAUTION.

Mains testing equipment must not be used.

KEY TO ABBREVIATIONS IN TEXT.

Plug pin: Plug pins denoted by "P" thus:—
Numbering: P6/1 = No. 6 Plug, No. 1 Pin.

Socket Outlet: Socket outlets denoted by "S" thus:—
Numbering: S6/1 = No. 6 Socket, No. 1 Outlet.

THE AUTOMATIC TRANSMISSION TEST SET

The Test Set is an electrical instrument designed for the purpose of testing the electrical circuits of the Automatic Transmission. It consists of a metal box which contains the follows components:

(1) A meter, the face of which is divided in coloured sectors.
(2) A rotary switch by which the set can be connected to any of the 22 circuits referred to in this section.
(3) Four lamps, three of which are wired in circuit with Nos. 1, 2 and 3 throttle switches of the Governor and one in circuit with the Selector Switch. The bulbs used are 12 volt 2.2 watt single contact, M.E.S.

The leads from the internal circuits of the Test Set are gathered into a harness which has three nine-pin plugs, one seven-pin plug and two single leads. To ensure correct assembly, the four plugs are numbered and the black single lead is fitted with a 2 B A bolt and nut with a rubber sleeve. The red single lead is fitted with an open 2 B A eyelet.

Resistances of various values are used in the internal circuits of the Test Set to ensure that, when the conditions are normal, the correct amount of current passes through the meter to swing the pointer into the coloured sector which indicates that the cirsuit being tested is correct.

To test the bulbs of the Test Set, connect the battery across:—

P5/4—S2/4; tests T.S.1 bulb.
S2/5—S5/8; tests T.S.2 bulb.
S2/7—P5/4; tests T.S.3 bulb.
P5/8—S5/8; tests selector switch bulb.

PART A.

FAULT FINDING CHART.

All the tests and recommended action for a particular symptom must be carried out in the sequence given.

The limits specified against symptoms marked * refer to factory testing with special precision instruments. Test readings made in the field may therefore vary slightly.

The r.p.m. figures quoted may be checked using a speedometer and the conversion table on page 51, but a more accurate method is to use an electric tachometer.

When a test calls for use of a "test ammeter", connect a 0-30 amp. instrument in series with the main feed to the gearshift solenoid, as follows:—

(1) Disconnect the battery positive lead.
(2) From the terminal situated beside socket No. 6 on the bulkhead (see Fig. 3 and Fig. 37), disconnect the black/purple lead coming from the control unit; leave the second black/purple lead, from the gearshift solenoid, connected.
(3) Join the lead disconnected in (2) to the negative terminal of the ammeter by means of an extension capable of carrying 30 amp. and long enough to enable the meter to be placed near the driver's position where it can be read by an observer whilst road testing. Insulate the temporary connection.
(4) Connect the ammeter positive terminal by a similar extension lead to the terminal referred to in (2).
(5) Reconnect the battery lead.

No.	SYMPTOM	TEST	UNIT SUSPECT	ACTION
1.	Starter Motor fails to operate	With Selector Lever at "N" check continuity between S5/5 and S5/9	Selector Switch	If open circuit change Selector Switch.
			or	
		If Selector Switch is satisfactory check Harness connections:— Ignition Switch—P5/5 : P5/9— Starter Solenoid (via Park Lock if fitted)	Harness	Change Top Harness if faulty.
			or	
			Starter Solenoid	
			or	
		Check in accordance with manufacturer's information.	Starter Motor	
2.	Car moves forward when engine is running, "N" selected and throttle depressed.	With lever at "N" check continuity between S5/4 — S5/8	Selector Switch	If open circuit change Selector Switch.
			or	
		Check continuity between P5/4 — P2/4; P5/8 and earth.	Harness	Change Top Harness if open circuit.
			or	
		Refer to Test Set Procedure	Control Unit	Change Control Unit if faulty.
3.	Car creeps forward when engine running, "D" selected and choke pulled out		Throttle linkage	Adjust in accordance with instructions on Page 29.
			or	
		Check Harness connections P2/4—P3/1	Harness	If open circuit change Top Harness.
			or	
		Check Throttle Switch No. 1 by means of Test Set	Governor	If faulty change Governor.
			or	
		Refer to Test Set Procedure	Control Unit	Change Control Unit if faulty.
4.	Car fails to move from rest	With "N" selected increase engine speed and check that charging is indicated by car ammeter Note: Engine speed should be increased by movement of throttle at carburetter and not at accelerator pedal	Dynamo	If no charge is indicated, check Dynamo and its connections. If charge is indicated:— check Harness connections P1/4—Regulator (D) and Ignition Switch—P5/3; P4/8—P1/6. Check S5/3—S4/8.
			or	
		Refer to Test Set Procedure	Control Unit or Selector Switch or Harness	Use Test Set to check Control Unit, Selector Switch, Harness connections to Indirect Coupling, and Indirect Coupling.
5.	Car attempts to move from rest in Intermediate with Selector Lever at "D"	Check Harness connections P2/1—P3/9	Harness	Change Top Harness if faulty.
			or	
		Check continuity from S3/9 to earth	Governor	If open circuit change Governor.
			or	
		Refer to Test Set Procedure	Control Unit	Change Control Unit if faulty.
6.	Car attempts to move from rest in Direct	Check that Harness connections P3/7, P4/1, P4/4 and P2/3 are not earthed	Harness	Correct or change Top Harness.
			or	
		Refer to Test Set Procedure	Control Unit	Change Control Unit if faulty.
			or	
			Selector Switch	Change Selector Switch if faulty.
7.	Car moves from rest with fierceness.		Throttle Linkage	Check Throttle Linkage adjustment (see Page 29).
			or	
		Refer to Test Set Procedure	Control Unit	Change Control Unit if faulty.
			or	
		Carry out Coupling Torque Test Procedure (See Part C on Page 25)	Indirect Coupling	Add trimming resistor if necessary.
8.	After having moved from rest car suddenly jerks forward, whilst still in low gear		Throttle Linkage	Check Throttle Linkage adjustment for correct lost motion (see Page 31).
			or	
		Refer to Test Set Procedure	Control Unit	Change Control Unit if faulty.

No.	SYMPTOM	TEST	UNIT SUSPECT	ACTION
9.	Fails to change from Low to Intermediate	Observe whether transmission makes any attempt to change gear (An attempt by the solenoid to effect a change will be accompanied by a heavy discharge indication on the test ammeter)	Governor Flexible Drive	If no attempt is made, check Flexible Drive for damage and correct engagement. Change if necessary. Check also governor drive pinions in gearbox.
		Refer to Test Set Procedure	or Governor or Control Unit or Harness or Gearshift Solenoid or Direct Coupling Gearshift Solenoid and/or Gearbox	If no attempt is made and flexible drive is in order, change Governor if Test Set Procedure passes Control Unit, Harness, Selector Switch, Gearshift Solenoid and Direct Coupling. If an attempt is made but Intermediate is not achieved and the Test Set Procedure has passed Control Unit and Gearshift Solenoid continuity, check adjustment of Dog Switch in accordance with instructions on Page 42, and freedom of travel of Solenoid Plunger with particular reference to:— (a) Operation of the Dog Clutch. (b) Solenoid linkage (see Page 39).
10.*	Low/intermediate change occurs early or late	Drive the car on a level road, from rest, with the lightest throttle opening which will cause the engine speed to pass through the range 2040 to 2500 r.p.m.	Governor	If Intermediate is achieved outside specified speed range, change Governor.
		Drive the car as above but at full throttle until the engine speed passes through the range 3600 to 4350 r.p.m.	Throttle Linkage or Governor	If Intermediate is achieved outside specified speed range, check Throttle Linkage adjustment (Page 29); if correct, change Governor.
11.	Throughout the Intermediate range, transmission jumps out of and into Intermediate	With the car in motion, move the Selector Lever to "2" and accelerate and decelerate at speeds not exceeding 40 m.p.h.	Gearshift solenoid.	If Intermediate is not held, change Gearshift Solenoid.
12.	Fails to change from Intermediate to Direct	Check Harness connections P3/7—P4/1 and P4/4—P2/3	Harness or Governor or Control Unit or Harness or Selector Switch or Direct Coupling	Change Top Harness if open circuit. Change Governor if Test Set Procedure passes Control Unit, Harness, Selector Switch and Direct Coupling.
13. *	Intermediate/Direct change occurs early or late	With Selector Lever at "D", drive the car on a level road in Intermediate at the lightest throttle opening at which the engine speed will pass through the range 2230 to 2520 r.p.m.	Governor	If Direct is achieved outside specified speed range, change Governor.
		Drive the car as above but at full throttle until the engine speed passes through the range 4450 to 4850 r.p.m.	Throttle Linkage or Governor	If Direct is achieved outside specified speed range, check Throttle Linkage adjustment Page 29). If correct change Governor.
14.	Fails to change from Direct to Intermediate.		Control Unit	Apply Test Set Procedure. Change Control Unit if faulty.

No.	SYMPTOM	TEST	UNIT SUSPECT	ACTION
15.*	Direct/Intermediate change occurs early or late	Drive the car at approximately 27 m.p.h. with the lightest possible throttle opening. Maintaining throttle position, reduce road speed by gently applying brakes until engine speed passes through the range 1340 to 1150 r.p.m.	Governor	If Intermediate is achieved outside specified speed range, change Governor.
		Drive the car at approximately 45 m.p.h; gently open throttle to the full position. Maintaining throttle position, reduce road speed by applying brakes (a gradient may also be used) until engine speed passes through the range 2550 to 2360 r.p.m.	Governor	If Intermediate is achieved outside specified speed range, change Governor.
16.	Fails to change from Intermediate to Low		Thermal Switch or Control Unit	Apply Test Set Procedure. If Test Set passes Thermal Switch and Control Unit, check freedom of travel of Solenoid Plunger and Linkage.
17.*	Intermediate/Low change occurs early or late	With the Selector Lever at "D" drive the car in Intermediate, at approximately 15 m.p.h. with the lightest possible throttle opening. Maintaining the throttle position reduce the road speed by gently applying the brakes until the engine speed passes through the range 990 to 740 r.p.m. (Note: The moment of disengagement of Intermediate is indicated by a definite "click" from the solenoid)	Governor	If Low is achieved outside the specified range, change Governor.
		With the Selector Lever at "D" drive the car in Intermediate at approximately 20 m.p.h. Progressively apply brakes, whilst gently opening throttle fully, such that the car remains in Intermediate. Maintaining this throttle position, further reduce road speed by applying brakes until engine speed passes through the range 1930 to 1630 r.p.m.	Governor	If Low is achieved outside the specified speed range, change Governor.
18.	Transmission "hunts" between Low and Intermediate or Intermediate and Direct		Governor Flexible Drive or Governor	Check Flexible Drive for damage and correct engagement. If Flexible Drive is in order change Governor.
19(a)	Full throttle Low/Intermediate change occurs with sudden jerk	Refer to Test Set Procedure	Governor or	Change Governor if faulty.
		Carry out Coupling Torque Test Procedure (see Part C on Page 25)	Direct Coupling	Add trimming resistor if necessary.
19(b)	Light throttle Low/Intermediate change occurs with a sudden jerk	Refer to Test Set Procedure	Governor	Change Governor if faulty.
		Carry out Light Throttle Gear Change Timing Test (see Part C on Page 25)	Direct Coupling	After checking 19 (a) adjust R15 and R16 as necessary.
20(a)	Duration of Low/Intermediate change excessive at light throttle (for change times see Page 51)	Carry out Light Throttle Gear Change Timing Test (see Part C Page 25)	Control Unit supplementary resistors R15 and R16	Adjust R15 and R16 as required.
20(b)	Duration of Low/Intermediate change excessive at full throttle (for change times see Page 51)	Refer to Test Set Procedure	Control Unit or Governor or Direct Coupling	Change rotor assembly subject to Test Set Procedure passing Throttle Switches 3 and 4. Control Unit.

NOTE: It is important to assess this symptom only after the engine, and more important the Automatic Transmission, have thoroughly warmed up, say after 1 hour running.

No.	SYMPTOM	TEST	UNIT SUSPECT	ACTION
21.	When Selector Lever is moved to "2" whilst car is in motion below 50 m.p.m. Intermediate is not obtained	Check Harness connections P1/9—P4/2 and if correct use Test Set to check Selector Switch, Throttle Solenoid, its harness connections and the Control Unit	Top Harness or Throttle Solenoid or Control Unit or Selector Switch or Throttle Solenoid Linkage	Change Top Harness if faulty. Change unit if shown to be faulty by Test Set Procedure. Check Throttle Solenoid Linkage in accordance with instructions on Page 31.
22.	Coupling "slips" during hard acceleration in Low and/or Intermediate	Refer to Test Set Procedure Carry out Coupling Torque Test Procedure (see Part C on Page 25)	Control Unit or Governor or Indirect Coupling	If engine stabilises at a speed above 2150 r.p.m., change rotor assembly subject to Test Set Procedure passing Throttle Switch 3 and Control Unit.
23	After coming to rest on a hill with Selector Lever at "2" and when attempting to move off again with the Selector Lever at "D" car fails to move off.	Drive the car in Direct with the Selector Lever at "D" whilst ascending a steep incline, move the Selector Lever to "2" and bring the car to rest. Release the brakes and make sure that the car is "Hill Held". If not repeat the procedure until this condition is imposed. Move the Selector Lever to "D" and after about 1 second open the throttle	Thermal Switch	If car fails to move off change the Thermal Switch. Note: If this symptom is allied to symptom No. 16, Test Set Procedure should be applied to check Control Unit and continuity of Thermal Switch.
24.	When car is at rest, gears grate if Selector Lever is moved between "N" and "R".		Throttle Linkage or Governor	Check adjustment in accordance with instructions on Page 29. Use Test Set to confirm that Throttle Switch 1 is functioning correctly. If faulty, change Governor.
25.	Fails to move in Reverse when Selector Lever is at "R" but moves forward when Selector Lever is at "D".		Gearbox Selector Linkage	Adjust linkage in accordance with instructions on Page 32.
26.	Under "emergency drive" conditions, car fails to move irrespective of Selector Lever positions.	Check "emergency drive plug" connections P4/8—P4/6 and P4/4 (Red side of plug)	Harness	Change Top Harness if open circuit.
27.	Under "emergency drive" conditions car fails to move when Selector Lever is at "2".	Check "emergency drive plug" connections P4/3—P4/9 (Red side of plug) With Selector Lever at "2" check continuity between:— S4/3 and S4/6, S4/9 and S5/1	Harness or Selector Switch	Change Top Harness if open circuit. Change Selector Switch if open circuit.
28.	Under "emergency drive" conditions, car fails to change from Low to Direct when Selector Lever is moved from "2" to "D".	Check "emergency drive plug" connections P4/1—P4/7 (Red side of plug) With Selector Lever at "D" check continuity between:— S4/1 and S4/4, S4/7 and S5/2	Harness or Selector Switch	Change Top Harness if open circuit. Change Selector Switch if open circuit.
29.	Under "emergency drive" conditions car fails to reverse when Selector Lever is at "R".	With Selector Lever at "R" check continuity between S4/3 and S4/6	Selector Switch	Change Selector Switch if open circuit.

PART B.

TEST SET PROCEDURE.

Warning: This procedure must be carried out with the car stationary, engine stopped and battery fully charged. Before the car is restarted after test, the Test Set must be completely disconnected and the car harness reconnected.

Important: It is essential that vehicle plugs and Test Set plugs are pushed firmly into their respective sockets.

NOTES.

(1) Plug identity numbers are shown on harness marker sleeves adjacent to each plug. These numbers also identify the socket to which a numbered plug is fitted, e.g., plug No. 2 fits into socket No. 2, viz., sockets are numbered in accordance with plugs.

(2) Insertion or removal of plugs must be kept to a minimum to preserve contact pin life. As it may be necessary to carry out replacement ser-

vice indicated during testing, hence subsequent retesting with the Test Set, the vehicle plugs must not be restored into the units until after the required service and retesting is completed. Whilst vehicle plugs remain disconnected, battery must be disconnected.

(3) The Test Set only partially tests throttle switch TS4 circuitry; to complete the test a lamp and battery is required as follows:—

(a) With a lamp and battery connected across S1/7 - S2/8 the bulb lit will indicate that the control unit is serviceable.

(b) With a lamp and battery connected across P1/7 - P2/8, bulb should be unlit.

(c) With a lamp and battery still connected across P1/7 - P2/8 depress accelerator pedal, bulb should light up; if it does not, check across:—
(i) S3/2 - S3/8 with throttle depressed. (if unlit change governor). If illuminated check across.
(ii) P1/7 - P3/2 and P2/8 - P3/8. If lamp is not lit in both cases change top harness.

FITTING TEST SET.

Install Set in following sequence only:—

1. Disconnect battery positive lead. Remove heater trunking—from branch pipe to heater (if fitted).

(2) Unscrew retaining screws from plugs Nos. 1 and 2 (Fig. 3) on control unit and plugs Nos. 4 and 5 on the selector switch (plug No. 4 being double-sided). Withdraw vehicle plugs Nos. 1 and 2 from the control unit.

(3) Unscrew nut and bolt retaining control unit under front wing, pull unit from spring clips towards engine and pivot out forward end.

(4) Slacken screw on terminal block cover on control unit, slacken 4 BA nut on cover and swing cover aside to expose 2 BA and 4 BA terminals. Retighten 4 BA nut holding cover to provide a good earth connection. Remove lead from 2 BA terminal and fit Test Set lead having an open 2 BA eyelet. Connect removed vehicle harness lead to Test Set single lead fitted with 2 BA bolt and nut for this purpose and pull rubber sleeve over joint.

(5) Insert Test Set plugs 1 and 2 into vehicle sockets 1 and 2. Insert vehicle plugs 1 and 2 into tops of respective Test Set plugs and press home.

(6) From the selection switch situated at the foot of the steering column, withdraw the red topped plug 4 and plug 5 and insert, in place of plug 5 Test Set plug 5, and in place of the red plug 4 Test Set plug 4. Re-insert into the tops of the respective Test Set plugs, vehicle plug 5 and also the red topped plug 4, red face to top, and press home.

7. Reconnect battery **ONLY** for duration of testing and, with Test Set switch at **OFF** check that battery voltage is between 11.5 and 12.5 volts.

SEQUENCE OF TESTING.

Use the following sequence only:—

When the Test Set is connected as described:—

(1) Steady light should appear in Governor Throttle Switch lamps "1", "2" and "3". (The Selector Switch light should also be lit see para. 2).) No. 1 lamp out indicates a fault in either the Governor Throttle Switch or the Throttle Linkage Adjustment.

Check Throttle Linkage Adjustment and if satisfactory, change Governor Unit.

Either No. 2 or No. 3 lamp out or any single lamp flickering, faults the Governor Throttle Switches.

Change Governor Unit.

Depress accelerator pedal slowly. The steady light in lamps "1", "2" and "3" must go out in sequence. If faulty, change Governor Unit.

Release accelerator pedal slowly, the lamps must light up in the reverse sequence. If No. 1 fails to light when foot is removed from accelerator, check Throttle Linkage for free operation.

(2) Move Gear Selector Lever into "N", "2" and "D". Light to remain steady in Selector Switch lamp, except during change-over. Lamp out or flickering light when Selector Lever lightly shaken in each gear position faults Selector Switch.

(3) Note respective meter readings when multi-position switch is rotated in sequence to each of the 22 positions. All switch positions **MUST** be checked.

(4) Pass appropriate units when meter reading is in green sector only at switch positions 13 ,17, 19 and 21; fail when in blue or red sectors. Pass units at all other switch positions when in green or blue sectors. Where readings are in "fail" sectors A or B (red or blue) renew unit traced by reference to Test Set Testing Chart.

(5) "Fail" indications at the majority or all of the following switch positions, 2, 3, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21 and 22, indicate that the Gearshift Solenoid Dog Switch is not closing or that the Harness connections P2/2—4 BA terminal on Gearshift Solenoid is not continuous.

Check Dog Switch in accordance with instructions commencing page 42.

Check continuity of Harness connection P2/2 —4 BA terminal on Gearshift Solenoid. If open circuit check:—

(a) P2/2—S6/4. If open circuit change Top Harness.

(b) P6/4—4 BA terminal on Gearshift Solenoid. If open circuit change Bottom Harness.

TEST SET TESTING CHART.

Switch Position Nos.	Test Set		Unit Affected	Action
	Pass Indication	Fail Indication		
1	Green or Blue	Red A	Thermal Switch	Remove Thermal Switch and check continuity between diametrically opposite pairs of terminals: change if faulty.
			or	
			Control Unit	If Thermal Switch is satisfactory change Control Unit.
		Red B	Control Unit	Change Control Unit.
2	Green or Blue	Red A	Control Unit	Change Control Unit.
		Red B	Control Unit	Change Control Unit.
3	Green or Blue	Red A	Indirect Coupling	Ensuring that P2 is removed, measure resistance between P5/1 and earth. If short circuit (circuit resistance should measure approximately 1.35 ohms) change Stator.
			or	
			Control Unit	If test on Indirect Coupling satisfactory change Control Unit.
		Red B	Control Unit	See indication obtained at switch position 11. If green or blue, change Control Unit.
		See "Sequence of testing" paga. 5.	or	
			Harness	Check continuity of Harness connections:— (a) P2/9—P4/9. If open circuit change top harness. (b) P5/1—Indirect Coupling (small terminal). If open circuit check: (1) P5/1—S6/2: If open circuit change Top Harness. (2) P6/2—Indirect Coupling (small terminal): If open circuit change Bottom Harness.
			or	
			Selector Switch	Check continuity between S4/9 and S5/1. If open circuit change Selector Switch.
			or	
			Indirect Coupling	See Indication obtained at switch position 11. If Red "B" change Stator.
4	Green or Blue	Red B	Harness	Check continuity of Harness connections:— (a) 4 BA Terminal on Control Unit—Terminal Block on S6. If open circuit change Top Harness. (b) Terminal Block on S6—2 BA terminal on Gearshift Solenoid. If open circuit change Bottom Harness.
			or	
			Gearshift Solenoid	Check continuity from 2 BA terminal on Gearshift Solenoid to earth (approx. 0.4 ohms). If open circuit change Gearshift Solenoid.
			or	
			Control Unit	If harness connections and Gearshift Solenoid are satisfactory change Control Unit.
5	Green or Blue	Red A	Harness	Check continuity of harness connections:— (a) P1/5—Throttle Solenoid. If open circuit change Top Harness. (b) P4/3—Throttle Solenoid. If open circuit change Top Harness.
			or	
			Throttle Solenoid	Check continuity of Throttle Solenoid (resistance approx. 2 ohms). If open circuit change Throttle Solenoid.
		Red B	Control Unit	Change Control Unit.
6	Green or Blue	Red A	Control Unit	Change Control Unit.
		Red B	Control Unit	Change Control Unit.
7	Green or Blue	Red A	Direct Coupling	Ensuring that P2 is removed, measure resistance between P5/2 and earth. If short circuit (circuit resistance should measure approximately 1.35 ohms) change Stator.
			or	
			Control Unit	If test on Direct Coupling is satisfactory, change Control Unit.
		Red B	Harness	Check continuity from:— (a) P2/8—P4/7. If open circuit change Top Harness. (b) P5/2—Direct Coupling (large terminal). If open circuit check:— (1) P5/2—S6/1. If open circuit change Top Harness. (2) P6/1—Direct Coupling (large terminal). If open circuit change Bottom Harness.
			or	
			Selector Switch	Check continuity between S4/7 and S5/2. If open circuit change Selector Switch.
			or	
			Direct Coupling	Ensuring that P2 is removed, measure resistance between Direct Coupling (large terminal) and earth. If greater than 2 ohms change Stator.
			or	
			Control Unit	See indication obtained at switch position 8. If green or blue change Control Unit, provided that there are no faults in Harness, Selector Switch or Direct Coupling.

Switch Position Nos.	Test Set		Unit Affected	Action
	Pass Indication	Fail Indication		
8	Green or Blue	Red A	Control Unit	Change Control Unit if a blue or green indication was obtained at switch position 7 and Direct Coupling is not short circuited.
		Red B		This indication can only be obtained if a "Red B" indication was obtained at switch position 7.
9	Green or Blue	Red A	Control Unit	Change Control Unit if blue or green indication was obtained at switch position 3 and Indirect Coupling is not short circuited.
		Red B		This indication can only be obtained if a "Red B" indication was obtained at switch position 3.
10	Green or Blue	Red A	Control Unit	Change Control Unit if a blue or green indication was obtained at switch position 7.
		Red B		This indication can only be obtained if a "Red B" indication was obtained at switch position 7.
11	Green or Blue	Red A	Harness	If the Indirect Coupling harness connections are open circuit a "Red B" indication will have been given at switch position 3. If the Direct Coupling harness connections are open circuit a "Red B" indication will have been given at switch position 7.
			or	
			Direct Coupling	If green or blue indications were obtained at switch position 3, 7, 8, 9 and 10, change Stator.
			or	
			Control Unit	If the harness connections are satisfactory and the Direct Coupling coil was found to be not short circuited at position 7, change Control Unit.
		Red B	Indirect Coupling	Change Stator only if "Red B" is also obtained at switch position 3. (A slight encroachment into the "Red B" sector may be caused by resistance tolerance and is acceptable).
12	Green or Blue	Red A	Control Unit	Change Control Unit.
		Red B	Control Unit	Change Control Unit.
13	Green	Blue A or Red A	Control Unit	Change Control Unit.
14	Green or Blue	Red A	Control Unit	Change Control Unit, if a green or blue indication was obtained at switch position 3.
		Red B	Harness	If the Direct Coupling connections are open circuit a "Red B" indication will have been obtained at switch position 3.
			or	
			Selector Switch	If the Selector Switch is defective a "Red B" indication will have been obtained at switch position 3.
			or	
			Indirect Coupling	If the Indirect Coupling is open circuit a "Red B" indication will have been obtained at switch position 3.
15	Green or Blue	Red A	Control Unit	Change Control Unit if a green or blue indication was obtained at switch position 3.
		Red B	Harness	If the Indirect Coupling harness connections are open circuit a "Red B" indication will have been obtained at switch position 3.
			or	
			Selector Switch	If Selector Switch is defective a "Red B" indication will have been obtained at switch position 3.
			or	
			Control Unit	If green or blue indications were obtained at switch position 3 change Control Unit.
16	Green or Blue	Red A	Control Unit	Change Control Unit.
17	Green	Blue A or Red A	Control Unit	Change Control Unit.
18	Green or Blue	Red A	Control Unit	Change Control Unit.
		Red B	Control Unit	Change Control Unit.
19	Green	Blue A or Red A	Control Unit	Change Control Unit.
20	Green or Blue	Red A	Control Unit	Change Control Unit.
21	Green	Blue A or Red A	Control Unit	Change Control Unit.
22	Green or Blue	Red A	Thermal Switch	Remove Thermal Switch and check continuity between diametrically opposite pairs of terminals; change if faulty. **Note:** The thermal switch used in this circuit gives a pulsed reading on the meter, the first pulse being delayed for up to 10 secs. and thereafter the delay time between pulses decreases.
			or	
			Control Unit	If Thermal Switch is satisfactory, change Control Unit.
		Red B	Control Unit	Change Control Unit.

PART C.

COUPLING TORQUE TEST PROCEDURE.

STALL SPEED TEST.

Warning: The stall speed test causes heating of the coupling unit; the duration of the full throttle opening must not exceed 5 seconds, and a half hour interval must be allowed between successive checks.

NOTE.

The stall speed figures stated are those obtained with an engine in good condition. Allowances must be made for an engine developing less than rated power due to wear or operating at altitude, comparing the results obtained with those taken under similar conditions with a car known to give satisfactory performance.

To carry out a stall speed test proceed as follows:—

(1) Fit a tachometer to the engine.
(2) Start the engine and allow it to reach its normal working temperature.
(3) With both the hand and foot brakes firmly applied, select "D" and fully depress the accelerator pedal.
(4) Note the tachometer reading after allowing the needle to stabilise. See warning above.
(5) Release the accelerator pedal and select "N".

If the tachometer reading is below 1600* r.p.m. a trimming resistor should be fitted in the lower position shown in Fig. 30. Remove the screws securing the earth leads. Connect the lead fitted with a red sleeve to the higher connection using the original screw. Connect the lead, fitted with a black sleeve, and a trimming resistor to the lower connection as shown using a longer screw provided with the resistor.

Untrimmed stall speeds lower than 1450 r.p.m. indicate poor engine performance which should be remedied before trimming couplings.

Untrimmed stall speeds above 2150* r.p.m. indicate coupling inefficiency.

GEAR CHANGE TIMING TEST (FULL THROTTLE).

To carry out a gear change timing test proceed as follows:—

(1) Connect an ammeter in the gearshift solenoid circuit as in Part A, on page 17.
(2) Start the engine and allow it to reach its normal working temperature.
(3) Select "D" and move off normally; fully depress the accelerator pedal to make a full throttle gear change from Low to Intermediate.
(4) Time the duration of the ammeter heavy discharge indication as the transmission changes from Low to Intermediate.
(5) Bring the car to rest in the normal manner.

If the duration of the heavy discharge is less than 1.4 seconds a trimming resistor should be fitted in the upper position shown in Fig. 30. The earth lead fitted with a red sleeve and the trimming resistor should be fitted as shown, using the longer screw provided with the resistor.

Untrimmed change times exceeding 2.0 seconds indicate coupling inefficiency for a new or reconditioned coupling.

LIGHT THROTTLE GEAR CHANGE TIMING TEST (R15 : R16).

When throttle switch TS4 is open (i.e., at less than 1/6 throttle opening), resistances R15 and R16 are included in the Low-to-Intermediate synchronising circuit. They have the effect of reducing the torque capacity of the direct coupling while it is used to reduce engine speed. By this means synchronisation at light throttle is achieved gradually in order to obtain a smooth take-up of drive. At throttle openings greater than 1/6, TS4 closes and short circuits R15 and R16, the full torque capacity of the direct coupling is available to reduce engine speed and synchronisation is achieved more rapidly.

Gear change times are specified on page 52, General Data, for the two throttle conditions.

In service, change in the torque characteristics of the direct coupling, due to either normal wear and tear or replacements of components, may produce an excessive time lag or a "jerk" during take-up of drive following a light throttle Low/Intermediate gear change. This may be corrected by adjusting R15 and R16 as follows:—

(1) Connect an ammeter in gearshift solenoid circuit as in "Testing and Fault Diagnosis", Part A, Page 17.
(2) With the engine and Automatic Transmission at normal working temperature, drive the car on a level road so as to make a light throttle Low/Intermediate gear change at 12-15 m.p.h.
(3) Time the period of the gear change. If this is less than 1.75 secs. move snap connector at R15 and R16 to a higher position. If time is more than 2.0 secs. move connector to a lower position.
(4) The circuit connection is by a snap connector which may be attached to one of three positions.
    (a) Bottom position—no resistance in circuit.
    (b) Centre position—R15 in circuit.
    (c) Top position—R15 and R16 in circuit.

REMOVAL AND REPLACEMENT OF UNITS.

Notes: The gearbox must NOT be placed end upwards on the coupling housing when these units are removed from the car. Oil from the gearbox may leak into the coupling housing and cause serious damage.

It is essential that the positions of plain, spring, or tab washers, or locking wire be noted and care exercised to ensure that these items are correctly refitted during re-installation.

GEARBOX.

Removal.

Position car on a lift, or over a pit.
Disconnect battery positive lead.
Drain oil from the gearbox.

* These figures apply to Control Unit Serial No. A009399 and below. From A009400 onwards the figures should read 1750 r.p.m. and 2250 r.p.m. respectively.

Remove throttle linkage bracket from bulkhead or alternatively uncouple linkage from carburetter.

Coupe models require the gearbox to be lowered further to clear the underframe cruciform member, and the following additional operations are necessary:

Partially drain radiator and release one end of top water hose. Release wiring harness from clips on bulkhead below heater platform, and raise to avoid being trapped. If a heater is fitted, remove rocker cover.

Disconnect exhaust pipe from manifold.

Disconnect exhaust hanger bracket at propeller shaft safety strap.

Remove propeller shaft rear coupling bolts, disconnect coupling and remove shaft rearwards.

Support engine with block of wood and jack at rear of sump.

Remove the bolts securing the engine rear mounting bracket to the frame.

Disconnect the governor and speedometer flexible drives.

Disconnect the linkage from Forward/Reverse lever.

Disconnect the parking lock cable from the gearbox **(if fitted).**

Remove the solenoid protection plate from the bracket.

Disconnect the gearshift solenoid wiring (first five notes under "Removal", page 28).

Note: In some earlier models the tags may be supported in a block.

Lower the rear of the engine just sufficiently to enable the gearbox to be removed.

Remove the two nuts and two bolts securing the gearbox to the coupling housing, using special spanner RG264 as necessary.

To assist in keeping gearbox shafts central to the oil seal in the coupling housing during removal, insert two guide studs in place of the bolts removed. These may be made from $\frac{7}{16}$" (11 mm.) diameter steel rod, 6" (150 mm.) long, with 1" (25 mm.), of thread, $\frac{7}{16}$" UNF.

Withdraw the gearbox squarely.

Take care that the solenoid return spring plug (and shims if fitted) are not lost, as these may fall out of position when gearbox is removed.

For location of plug and shims. See Fig. 52, page 41.

Reinstallation.

To reinstall gearbox, reverse above procedure, paying particular attention to the following:—

If the coupling housing, gearbox casing, rear rotor bearing or stemwheel bearing has been changed, it is necessary to check the clearance between these two bearings as follows (Fig. 28):—

With spacer in position and paper joint temporarily removed, measure the depth from the rear face of the coupling housing to the outer face of the spacer ("A"); and the height of the stemwheel outer race from the front of the gearbox casing ("B"). The latter dimension must exceed the former by .006"/.009". Provided that the correct paper joint is used, which is 008" thick when compressed, this gives .002" clearance to .001" nip between the bearings.

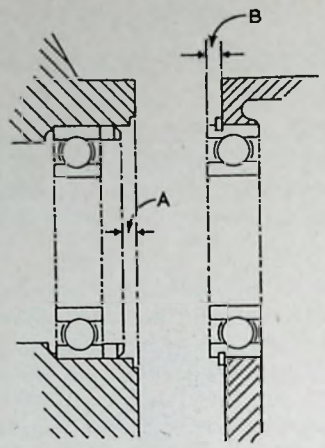


FIG. 28.—Selecting gearbox spacer.

Adjust if necessary by selection of a spacer of suitable thickness. If above parts have not been changed, replace original spacer.

Extreme care should be taken when replacing gearbox in position not to damage the oil seal in the coupling; the shafts should be centralised while entering the coupling housing, using guide studs described above.

Do not allow the weight of the gearbox to be taken on the shafts at any stage during their entry.

Make sure that solenoid return spring, plug, and shims (if fitted) are in position by applying a little grease to the plug.

In some earlier models additional terminals may be fitted. These are not used and care must be taken to avoid making connections to these terminals on re-assembly.

Solenoid contact adjustments may be necessary; refer to "Servicing the Gearshift Solenoid" on page 41.

After reinstallation, fill the gearbox with the correct grade and quantity of oil. (See page 52.)

COUPLING.

Removal of Stator and Coupling Housing:—

Remove the gearbox (as above).

Remove the starter motor.

Disconnect the coupling wiring.

Remove the cover plate at bottom of coupling housing.

Remove the coupling housing. (Fig. 29.)

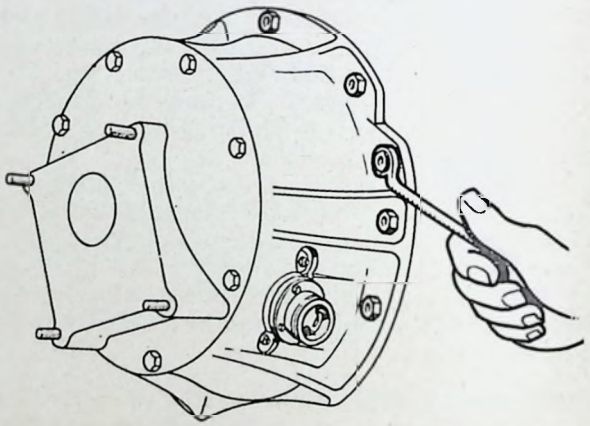


FIG. 29.—Removing coupling housing.

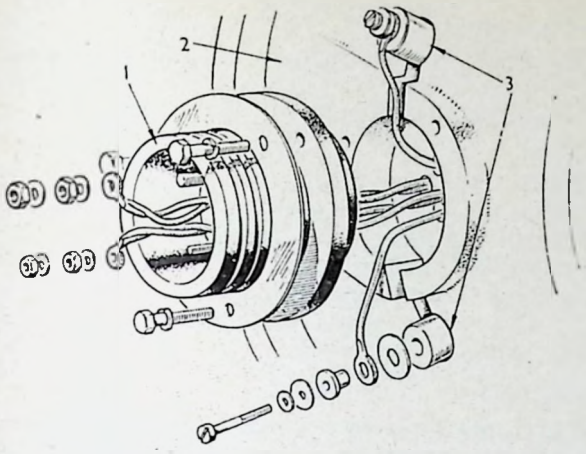


FIG. 30.—Removing stator connections.

Identification of wires.

Red Sleeve:	Direct Coupling. Higher Connection.
Black Sleeve:	Indirect Coupling. Lower Connection.

Reinstallation.

To install the stator and coupling housing, reverse procedure specified for removal. If the coupling housing or stator is to be changed or if any of the components of the stator require replacement, the bore of the assembled stator must be checked for concentricity (refer to Page 49).

Removal of Stator from Coupling Housing.

Disconnect the stator leads (Fig. 30) from terminal block (1) and stator body (2) (or resistors (3) if fitted).
Remove the terminal block.
Remove the chip shield from front of stator.
Support the stator on wooden blocks.
Remove the stator bolts.
Remove the stator (Fig. 31).

Reinstallation.

Reverse above procedure. Carefully feed the stator leads into the terminal block aperture via the depression in the coupling housing. Reconnect stator

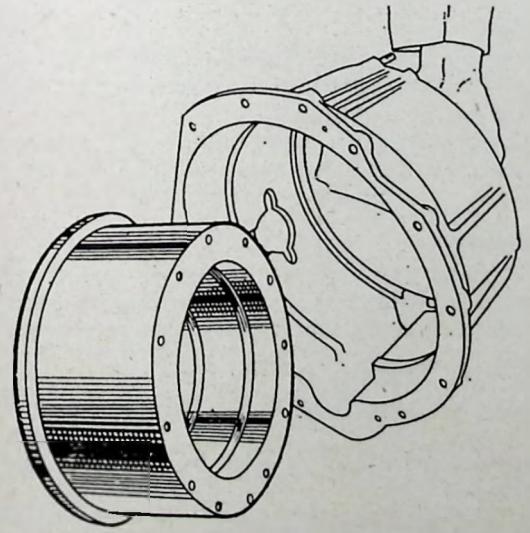


FIG. 31.—Removing stator.

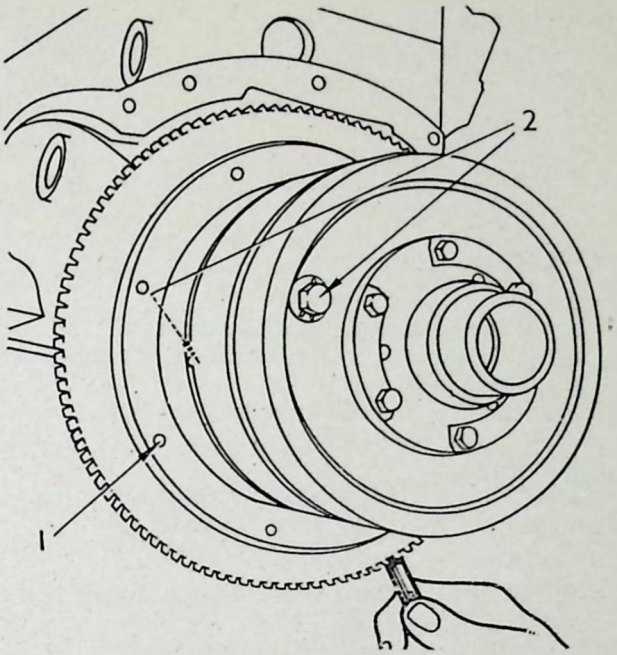


FIG. 32.—Removing rotor.

leads as shown in Fig. 30 (i.e., thick WHITE lead and one thin white lead to larger terminal (DIRECT coupling); YELLOW lead and a thin white lead to smaller terminal (INDIRECT coupling); either earth lead RED or BLACK to each earth point on stator body).

If resistors (3) were fitted before servicing, these must be replaced in their original positions when reconnecting the earth leads, but when either stator or rotor, or both these units, have been renewed, no resistors should be fitted during re-assembly, care being taken to connect the earth leads by shorter screws provided if resistors are omitted. A coupling torque test (refer to Part C, page 25) will be carried out and resistors fitted if necessary during testing of the vehicle after servicing. Tighten stator bolts with a torque wrench set to 8 lb./ft. It stator has been dismantled or renewed, check concentricity as indicated on page 49).

N.B.—Replacement rotor assemblies are supplied empty and will require filling. Correct powder charges are supplied in separate containers. Ensure that each half of coupling is charged through its respective filler hole (2, Fig. 32). For filling instructions see "Servicing the Coupling", page 46.

Removal of Rotor.

Remove the gearbox and coupling housing.
Remove the rotor nuts (1, Fig. 32).

Reinstallation.

Refit in the reverse order to above, locking all tabs after tightening nuts.

Removal of Flywheel.

Remove the gearbox, stator and rotor.
Remove the support plate from the crankshaft.
Withdraw the flywheel from spigot on crankshaft.

Re-installation.

Reverse above procedure ensuring that the chamfered edge of the support plate is fitted next to the flywheel.

Starter Ring Gear.

Removal and refitting of the starter ring gear is as for cars with synchromesh gearbox.

GOVERNOR.

Removal.

Disconnect the battery positive lead.
Remove the heater trunk (if fitted) between heater unit and branch pipe.
Disconnect the throttle linkage (1, Fig. 33).
Carefully remove 9-pin plug (2); withdraw squarely.
Remove spring (3).
Cut the locking wire and disconnect flexible drive (4).
Remove the governor from bracket (5).

Re-installation.

Fit the flexible drive (ensure that it is not bent to radius of less than 9 in.).
Replace the governor on the bracket.
Connect the throttle linkage.
Replace the spring.
Tighten the flexible drive union nut and lock with wire.
Insert the 9-pin plug squarely. Tighten screw.
Replace the heater trunk ensuring that it is clear of governor control rod.
Check throttle linkage adjustment. (See page 29.)

GOVERNOR DRIVE.

Removal.

Release the three clips on underside of car. Cut the locking wire and release union nuts at governor and gearbox.

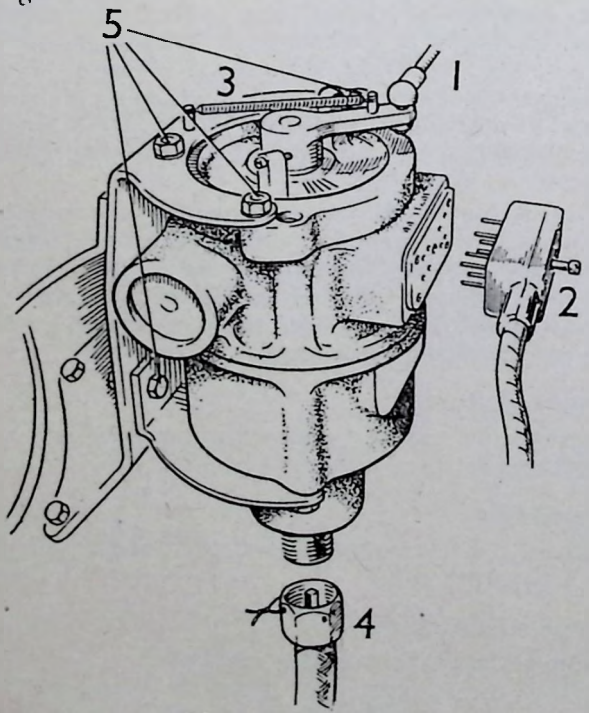


FIG 33.—Removing governor.

Re-installation.

Reverse above procedure. Wire lock union nuts.

GEARSHIFT SOLENOID.

Removal.

Remove the solenoid protection plate.
Release the clips on rubber cap.
Slide the cap along the harness.
Remove the solenoid cover.
Disconnect the solenoid wiring.
Cut the locking wire and remove the solenoid fixing bolts.

Re-installation.

Reverse above procedure; ensure that solenoid fixing bolts are secured by spring washers and locking wire.

Adjustment.

Refer to "Servicing the Gearshift Solenoid", page 41.

SELECTOR SWITCH.

Removal.

Disconnect the battery positive lead.
Remove the heater trunk (if fitted).
Carefully remove the 9-pin and 7-pin plugs (withdraw squarely) and earth leads.
Select Reverse (R.H.D. cars), or "D" (L.H.D. cars).
Support the lever so that quadrant pointer is not damaged when control rod is disconnected (for example, with a piece of string from the lever to the rear view mirror support).
Disconnect the control rod by the removing bolt.
Disconnect the gearbox linkage.
Remove the distributor cap to give spanner clearance.
Remove the two mounting bolts.

Re-installation.

Reverse above procedure. Do not forget to connect the earth lead.

CONTROL UNIT.

Removal.

Disconnect the battery positive lead.
Carefully remove the 9-pin plugs on the control unit and withdraw squarely.
Remove the heavy current and earth connections.
Remove one bolt and nut and pull out control unit.

Re-installation.

Reverse above procedure; do not reconnect the battery until control unit connections are complete. Insert plugs carefully and tighten centre screws.

Renewal of Thermal Switch.

Remove the three screws and the thermal switch cover.
Remove the thermal switch by turning counterclockwise.
Insert replacement (turn clockwise).
Replace the cover.

THROTTLE SOLENOID.

Removal.

Disconnect the wiring.

Remove the four bolts and nuts securing the unit and withdraw the solenoid body, supporting the plunger.

Disconnect the plunger from the linkage.

Re-installation.

Reverse the above procedure.

Great care must be taken not to overtighten the terminal nuts when reconnecting the wiring, as rotation of the terminal may cause damage to the solenoid wiring and so render the unit unserviceable. A defective throttle solenoid unit must be changed.

Adjustment.

Refer to "Servicing the Throttle and Selector Linkage", page 31.

SERVICING THE THROTTLE AND SELECTOR LINKAGE.

THROTTLE AND GOVERNOR LINKAGE.

THE WHOLE PERFORMANCE OF THE CAR CAN BE UPSET BY INCORRECT ADJUSTMENT OF THIS LINKAGE.

It is essential to understand how incorrect linkage adjustment can bring about various faults, so that the appropriate re-adjustment can be made to correct any given complaint.

The function of the switches and contacts in the governor are explained on pages 7 to 9. Correct phasing of these switches relative to the carburretor throttle is most important and mal-adjustment gives the faults described later in this section.

When fitting or replacing a heater unit, every care should be taken to ensure that the throttle linkage rear support bracket is not distorted and is replaced as near to the original position as possible. It is important to check the throttle linkage for correct adjustment following completion of this installation.

THROTTLE AND GOVERNOR LINKAGE ADJUSTMENT PROCEDURE.

The linkage (Figs. 34 and 34A) should be lubricated with engine oil every 3,000 miles (5,000 kilometers).

However, if the adjustment has been disturbed, or if certain symptoms show the linkage to be faulty (see "Fault Diagnosis", Part A, Page 17) adjust the throttle and governor linkage settings in the sequence given in the following instructions. If the adjustments have not been disturbed, it is advisable to carry out a road test to ensure that adjustment is necessary. (See page 31.)

Checking Procedure.

(a) Push choke (strangler) control fully home.
(b) Disconnect rod (1) from lever arm (6).
(c) Check setting of throttle solenoid plunger travel by taking dimensions from the plunger end, with the plunger in its normal out position, and pushed fully in. The difference between these two measurements should be 0.3″ (7.6 mm.).

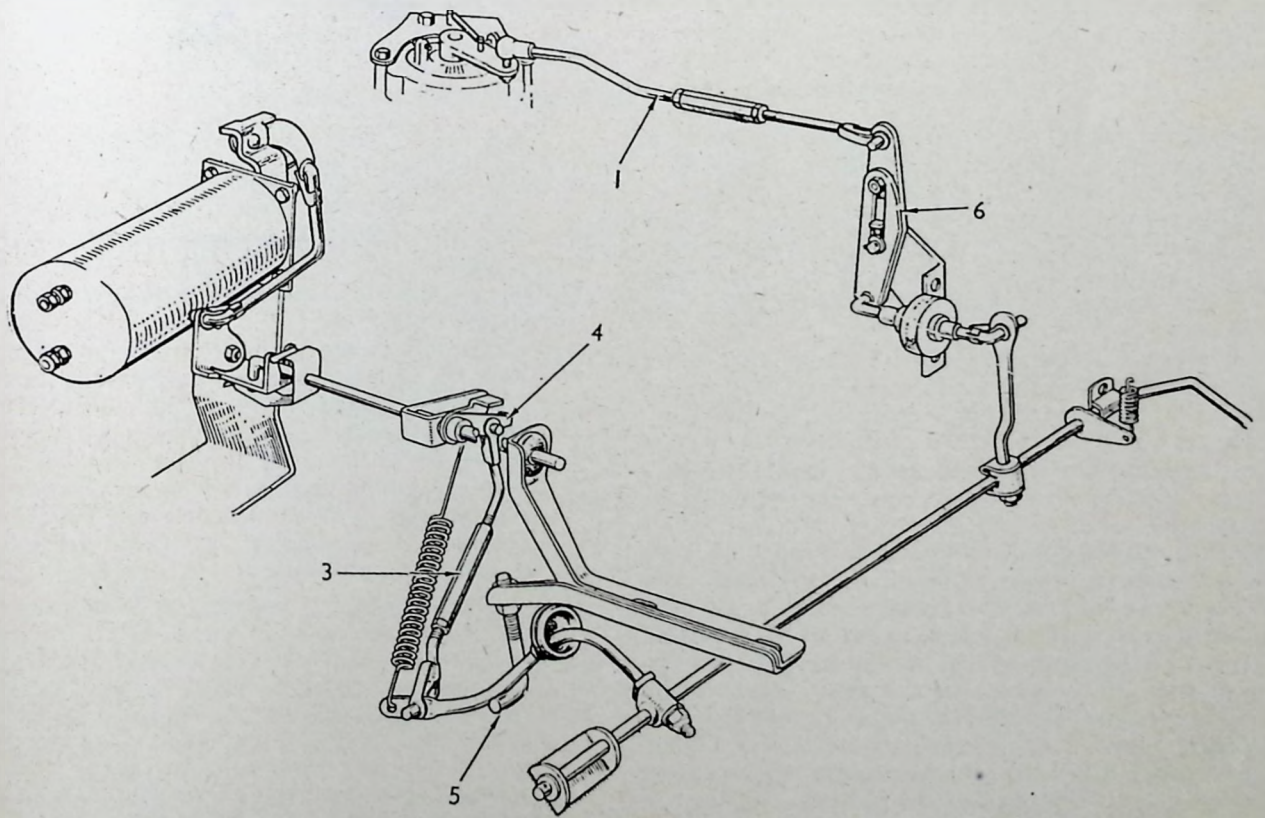


FIG. 34.—Throttle and Governor Linkage. (Hillman Minx illustrated—See also Fig. 34A).

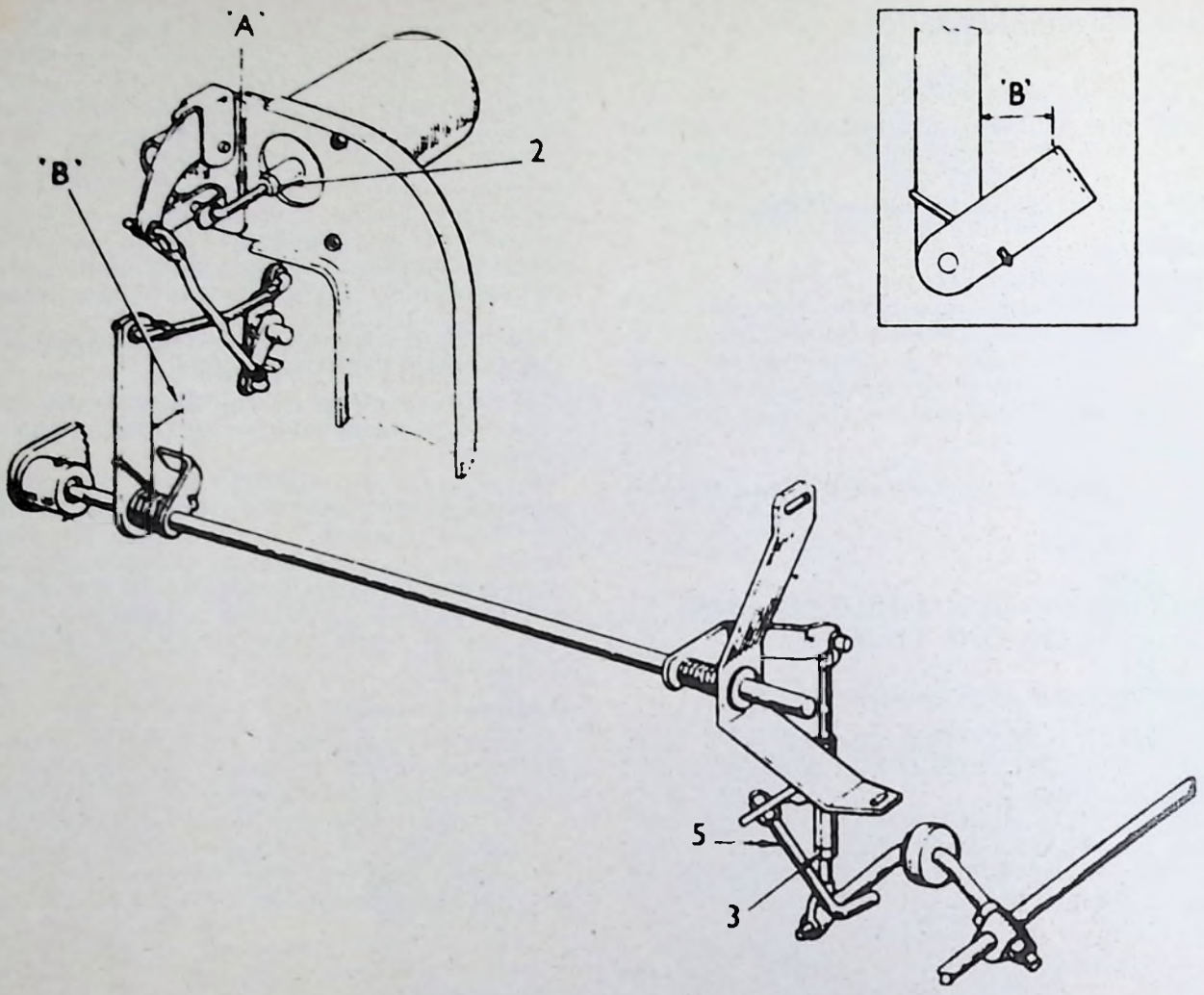


FIG. 34A.—Gazelle Throttle Linkage (for governor linkage see Fig. 34).

(d) Carefully check the entire linkage for freedom of operation. Depress accelerator pedal fully and check that full throttle is given at carburettor at the same time as the pedal touches the floor coverings. It is essential to ensure that full throttle is achieved without any over-strain on the linkage. Lengthen or shorten rod (3) as necessary to achieve this.

(e) Release accelerator pedal and check that, after carburettor throttle has closed, rod (3) moves down approximately a further $\frac{3}{8}$". Adjust stop bracket (5) if necessary to give this approximate lost motion. On twin carburetter model this produces a clearance of $\frac{3}{16}$" at point "B", Figure 34A.

(f) With accelerator pedal fully released and governor arm set to "closed" on governor stop, adjust length of rod (1) until it is $\frac{3}{32}$" [2.3 mm. (half a hole)] short of location in relay lever, when the locknut has been tightened. This ensures that the governor arm is pulled back on its stop when the accelerator pedal is released.

(g) Depress accelerator pedal slowly to floor covering and ensure that full throttle and full governor lever travel is obtained without deflecting governor on bracket or straining the throttle linkage. If necessary adjust length of lever (6) to give this result.

Check that the "closed" governor position is still maintained; if necessary, re-adjust rod (1) and re-check.

(h) Attach suitable pointer to the governor arm as shown in Fig. 35.

Set the pointer to the first line of the degree scale on governor top cover. Slowly depress the accelerator pedal and check that, when the throttle butterfly just begins to move, the pointer has moved through an angle of 11 degrees (note that the graduations are 5 degrees apart). The commencement of the throttle movement can be felt by placing a finger on the throttle spindle lever on the carburettor.

(i) Check that throttle switch No. 1 is closed when the accelerator pedal is released. To do this, run the engine with the choke in the fast idle position, and **D** selected. The car should not creep forward. Finally, to ensure that throttle switch No. 1 closes each time accelerator pedal is fully released, stop bracket (5) is lowered to give an extra $\frac{3}{32}$" clearance between it and the lever passing through the bulkhead grommet.

FAULTS CAUSED BY INCORRECT THROTTLE LINKAGE ADJUSTMENT.

It is necessary for the linkage to be adjusted so that the initial movement on the accelerator pedal produces movement of the governor lever without corresponding movement of the carburettor throttle butterfly.

In relation to the carburettor throttle the first movement of the accelerator pedal is therefore "lost motion".

(1) **The absence of, or insufficient battery charge in the low speed range in low gear.**

This can arise if, as a result of too much "lost motion" the movement of the governor arm opens TS3 too early, thus modifying the dynamo output.

At low engine speeds this reduces the dynamo output below the necessary level. Correct "lost motion" adjustment ensures that battery charging is maintained when crawling in low gear, as in dense fog.

(2) **Light throttle gear change speeds too high.**

This can be brought about by too much lost motion causing the throttle linkage to operate the governor too early which means a higher road speed is required to signal for Intermediate and Direct.

An excessive "willingness' to change down is also noticed, resulting in too many gearshifts during traffic driving.

(3) **When moving from rest at a light throttle opening a pronounced snatch occurs after moving away but before the Low to Intermediate change point.**

This is a result of insufficient "lost motion". The generator output is modified at the incorrect road speed so that the coupling receives a sudden surge of current which produces the jerk.

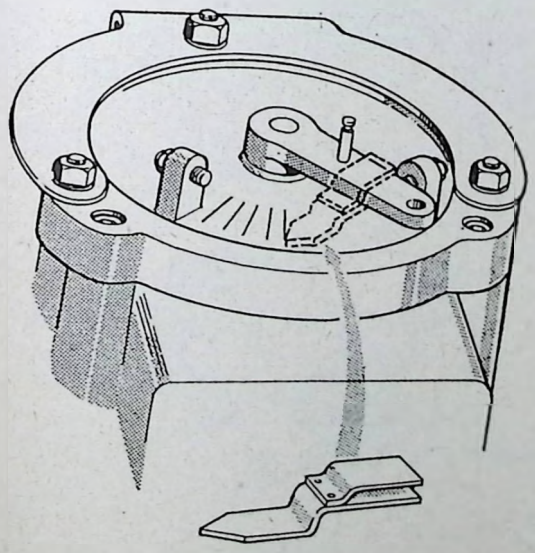


FIG. 35.—Checking free movement of Governor lever.
Note.—On early models the degree scale will be found on the rim of the cover.

(4) **Car moves off when D is selected and with choke pulled out.**

This is caused by TS1 (anti-creep switch) still being open when the accelerator pedal is released. For safety reasons when TS1 is closed, current to the coupling is cut off until the accelerator pedal is depressed.

(5) **Difficulty in engaging or disengaging reverse.**

If TS1 (anti-creep switch) is not closed, the coupling will be energised as soon as the selector lever is moved away from the **N** position. This means that grating of gears will occur as the lever is moved towards **R**. It will also cause difficulty in disengaging **R** owing to the drag imposed by the energised coupling.

NOTE: This can be an intermittent fault depending on how the throttle is closed. Linkage friction may cause the fault to appear when the accelerator is released very slowly, whereas it would not be present after a quick release of the pedal.

ROAD TEST.

(1) **Checking throttle switch No. 1.**

With **D** selected, handbrake off and choke pulled out until charging is indicated on the ammeter, the car should not move off.

2. **Checking linkage for correct lost motion.**

This test should be carried out on level ground with the engine at normal running temperature making sure that the choke is pushed fully home.

Drive the car with the lightest possible throttle opening which will enable it to accelerate gently to the Low to Intermediate gear change point, which should be 11 to 13½ m.p.h.

If the lost motion adjustment is correct, it will be noted that charging as indicated on the ammeter will continue up to about 9 m.p.h. and then cease as throttle switch No. 3 opens to modify the generator output. A charge will again be indicated as Intermediate gear is engaged.

If no charge is indicated or the charging ceases before 9 to 10 m.p.h. is reached this is an indication of excessive lost motion. If charging does not cease before the Low to Intermediate gear change is achieved, this is an indication of insufficient lost motion.

(3) **Checking full throttle adjustment (engine stopped).**

Depress the accelerator pedal slowly to the floor covering and check that the throttle butterfly reaches the fully open position at the same time as the governor lever reaches its maximum stop without deflecting the governor in its bracket or straining the linkage.

(4) **Checking throttle solenoid linkage.**

Drive the car in top gear at 55 m.p.h. Release the accelerator pedal, select Hold 2nd which will operate the throttle solenoid and automatically increase the engine speed. Slowly reduce the road

speed by applying the brakes and note the speed at which Intermediate gear is actually engaged. If this speed is in excess of 50 m.p.h., reduce solenoid plunger travel. If it is less than 47 m.p.h. increase plunger travel.

FORWARD AND REVERSE SELECTOR LINKAGE.

The selector linkage (Fig. 36) requires no periodic servicing apart from lubrication with engine oil every 3,000 miles. If the gearbox or selector switch has been removed, it is necessary to re-adjust the linkage as follows:—

(a) Place the vehicle on a hoist.

(b) Disconnect the vertical rod (2) at the ball joint adjacent to the selector switch lever (1).

(c) Set the driver's handlever to reverse ("R") **ensure it is retained in this position throughout the** adjustment.

(d) Remove the horizontal rod (4) at its forward end and set the external gearbox lever into the reverse detent, **ensure that it remains in this position whilst adjustments are made.**

(e) **Right-hand drive vehicles.**

Set the relay lever (6) so that its vertical lever is as near to parallel to the gearbox lever (3) as possible. Connect up by adjusting the horizontal rod **without disturbing the position of the levers.**

Left-hand drive vehicles.

Set the relay lever (6) so that it points downwards approximately 1" rearwards of its vertical position (Fig. 36). Connect up by adjusting the horizontal rod **without disturbing the position of the levers.**

Nominal dimensions of horizontal rod (4) are: R.H.D. vehicles 10.8". L.H.D. vehicles 10.4".

(f) Connect up the vertical rod (2) to selector switch lever (1). Any adjustments necessary may be made at the ball joint end. Ensure that the ball joint lock nut and securing nut are properly tightened.

(g) Check the setting by removing the clevis pin from the bottom of the vertical rod (2). If the pin will not re-enter the relay lever (6) re-adjust from ball joint end of the vertical rod (2) to give this condition.

SELECTOR LEVER, QUADRANT, ETC.

Dismantling of these parts will seldom be called for except in such cases as accidental damage.

When refitting the plastic steering column cowls, it is important that they are correctly aligned before the fixing screws are tightened, to avoid straining the plastic. **Do not use force.**

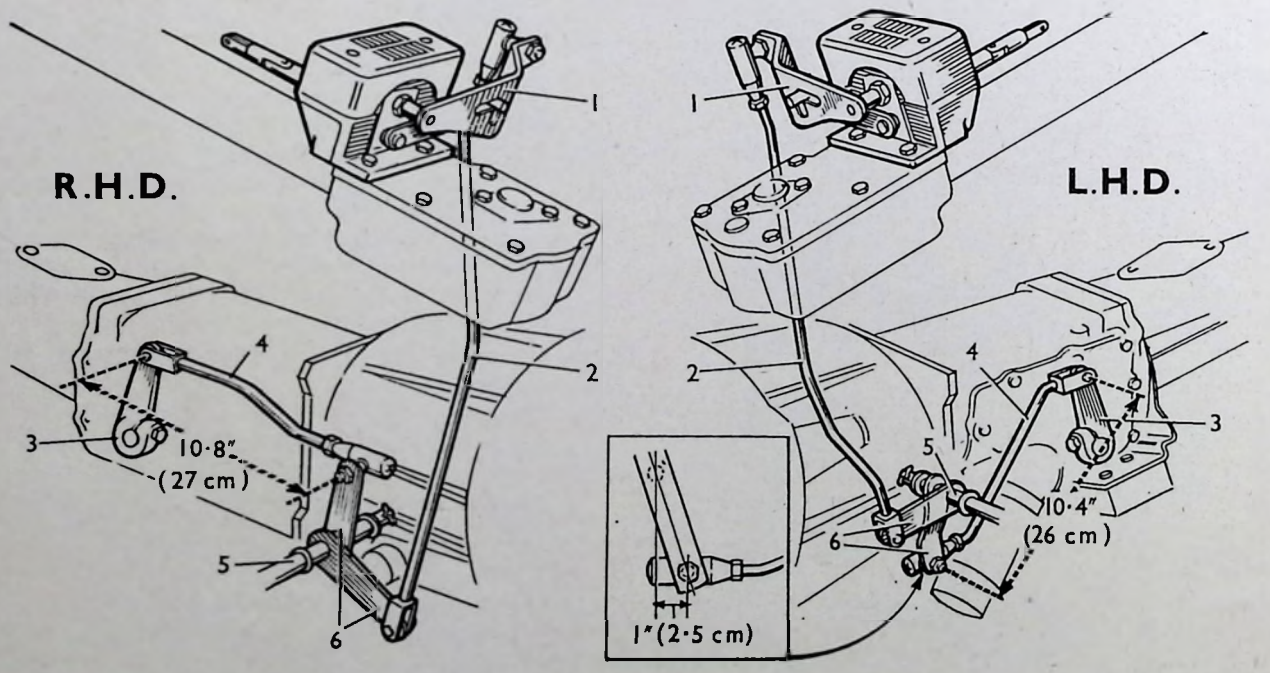
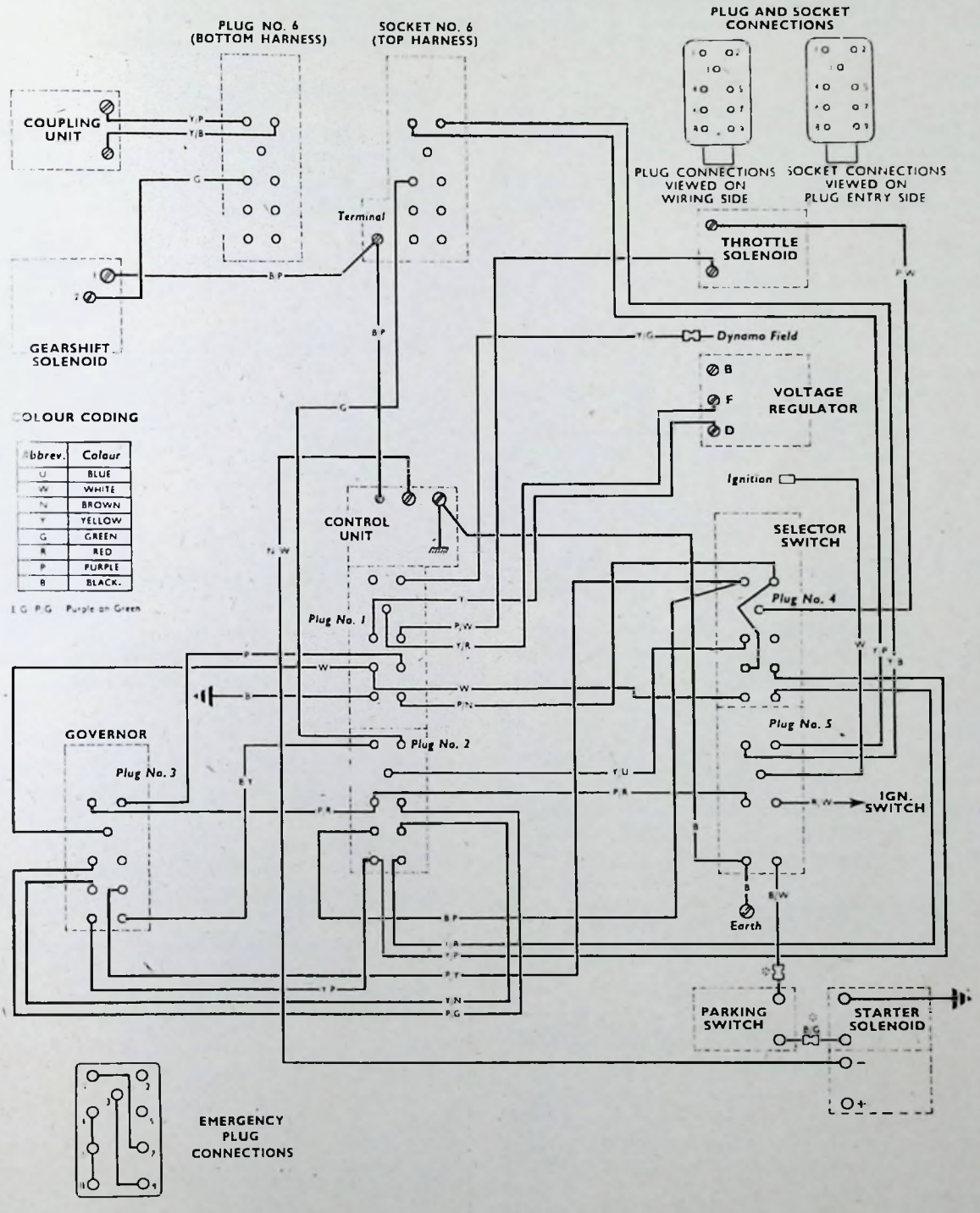


FIG. 36.—Selector linkage.



* Connect together when no parking switch is fitted.

FIG. 37.—Wiring diagram.

SERVICING THE WIRING HARNESS.

N.B.: The withdrawal and insertion of plugs must be kept to a minimum. When removal or insertion is necessary this should be done carefully and squarely to avoid damage and possible voltage drop. The centre fixing screw must always be tightened securely.

SERVICING.

The wiring is contained in two harnesses interconnected by a plug (bottom harness) and a socket (top harness). (See Fig. 37.)

Slight damage to the outer covering of a harness may be repaired with adhesive tape or other suitable plastic covering, provided the damage does not extend to the conductors.

Before reconnecting, after replacing or testing a unit, closely examine plug pins or tags for signs of damage or corrosion. Do not attempt to salvage damaged contacts. These can only be serviced by fitting a complete replacement moulding.

CONTINUITY CHECKS.

Fig. 37 provides all information necessary for checking continuity, viz., the colour coding of conductors and the location of all plugs, plug pins, terminals, etc.

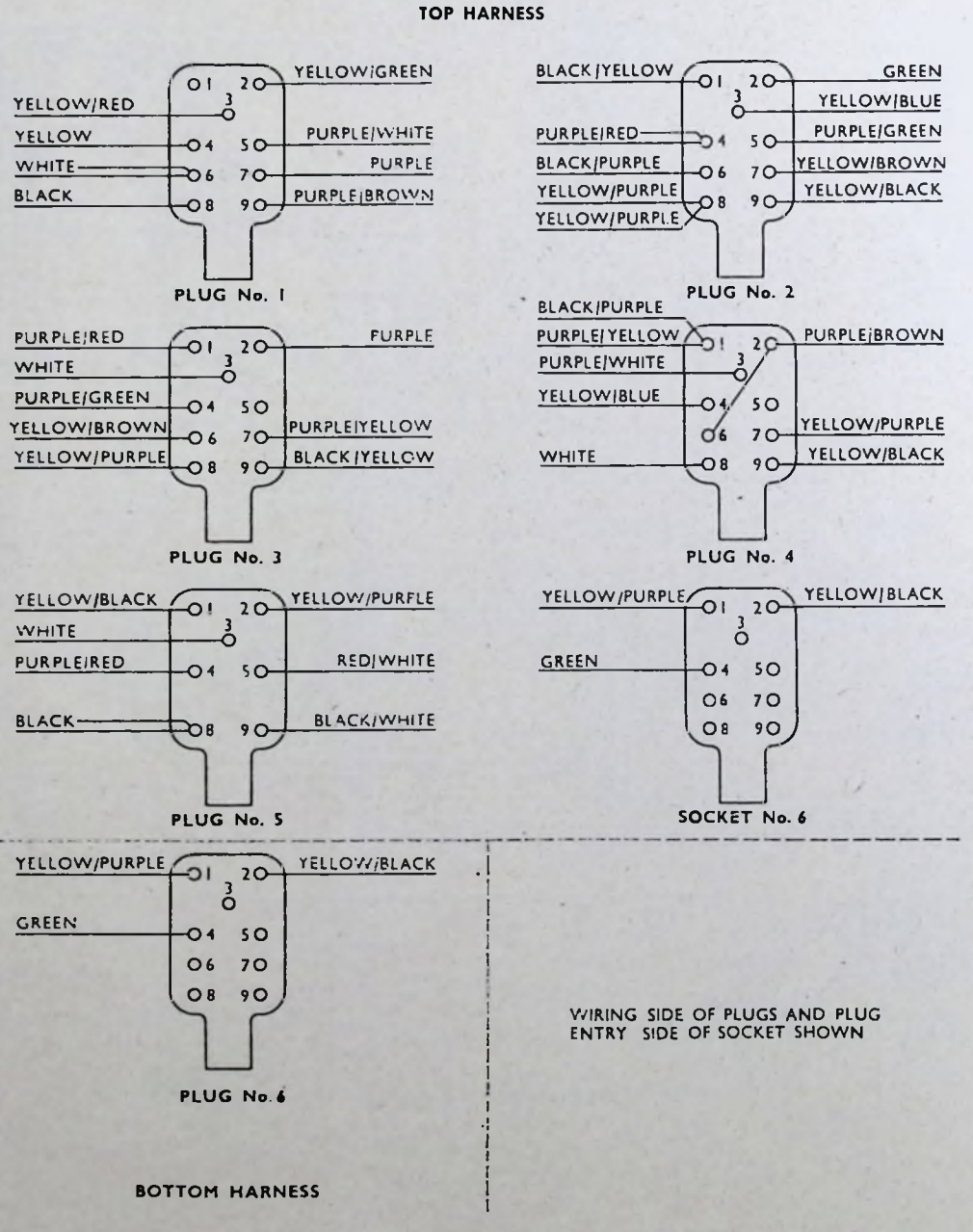


FIG. 38.—Plug and socket wiring.

PLUGS AND SOCKETS.

A plug or socket need not be replaced completely if the moulding only is damaged; renew the moulding as follows:—

Disconnect plug or socket by releasing central screw.

Remove the four cover screws.

Remove cover and body.

Unsolder conductors from pins.

Solder conductors to new moulding (from the wire entry side).

N.B.: Do not solder plug pins at tip of pin as this will damage the plating. Use only resin-cored solder or a resin flux.

Re-assemble the plug or socket.

SERVICING THE GEARBOX.

Refer to exploded drawings Figs. 39 and 40 throughout.

DISMANTLING.

Remove dipstick (2).

Remove speedometer and governor pinions and housings (59-73).

Remove rear mounting bracket (13), rear cover (5) and paper joint (10).

Slacken external forward/reverse lever pinch bolt (108) and remove lever (106).

Remove Woodruff key (107) from forward/reverse cross-shaft.

Remove gearshift solenoid.

Remove inspection plug (16) from side cover and uncouple linkage (95-105) from shift fork.

Remove linkage.

Remove side cover (14) and paper joint, using special tool RG 248 to protect oil seal.

Remove stemwheel bearing retaining tab washer and nut.

Remove intermediate-gear plug (92), shims (91), if fitted, and return spring (90).

Remove forward/reverse detent screw (85), locknut (86), spring (84) and ball (83).

Remove forward/reverse shift lever (81) and fork (87) using special tool RG 248 to protect oil seal.

Remove reverse idler spindle grub screw (57) and push out spindle with dummy spindle* from front to rear.

Remove reverse idler gear (51), with dummy spindle, rollers (53) and thrust washers (54-56).

Remove stemwheel (21) and bearing (22).

Remove circlip (40) from front of mainshaft assembly.

Tap mainshaft (27) rearwards, and remove assembly through rear of gearbox; the intermediate gear (37) sliding dog (38) and hub (39) will remain in gearbox and may now be removed separately.

Remove intermediate-gear shift fork grub screw (93), pivot pin (89), shift fork (82) and its two shoes (88) and collar (94) between fork and lower supporting lug.

Remove countershaft spindle lock screw (49) and tab washer (50) and push out spindle from front to rear with dummy spindle.*

Lift out countershaft gear (43) with rollers (45) and thrust washers (46-48).

Remove rollers (24), abutment ring (25) (using tool 7600/6 with main tool 7600) and oil seal (26) from stemwheel.

Remove oil seals (15) from gearbox casing and side cover.

*** Dummy spindles may be manufactured locally from steel tube to the following dimensions:—**

$\frac{47}{64}$" o/d × $3\frac{13}{16}$" long (18.5 × 97 mm.)
$\frac{3}{4}$" o/d × $4\frac{3}{8}$" long (19 × 111 mm.)

INSPECTION.

Examine all parts for undue wear and renew as necessary.

Correct end-floats, etc., are quoted in assembly paragraphs later in this section.

INTERMEDIATE GEAR AND BAULK RING ASSEMBLY (37, Fig. 40).

Check the torque required to rotate the baulk ring relative to the gear in the following manner:—

With the assembly in position on the mainshaft (27), which should be held in a vice with soft jaws, wind a length of thin cord around the periphery of the gear teeth (one end may be tried to a peg inserted in one of the oil holes).

Attach the free end to a light spring balance. Fit the sliding dog (38) and hub (39) and position so as to prevent the baulk ring from rotating, and rotate the gear by pulling squarely and steadily on the spring balance; with components lightly oiled, the reading should be 4-8 lbs. A figure outside these limits may give incorrect baulking action. (See page 7.)

ASSEMBLY OF LOW GEAR AND FREEWHEEL.

Two pairs of radially-drilled holes are provided in the combined low gear and freewheel hub (32, Fig. 41) and in the roller cage (35) to locate the two springs (36); these holes are drilled at different levels in each compartment and will be referred to as "A" and "B", "A" being the pair of holes nearer the front of the gearbox when assembled. Thus the springs lie side by side when in position. Insert the Z-shaped ends of the springs (36, Fig. 42) into the holes in the cage (35) and lay the springs so as to run clockwise from these ends. Holding the cage and springs between finger and thumb with the thumb over hole "A" and the springs held clear of each other with spring "A" upwards, turn the cage over and enter the

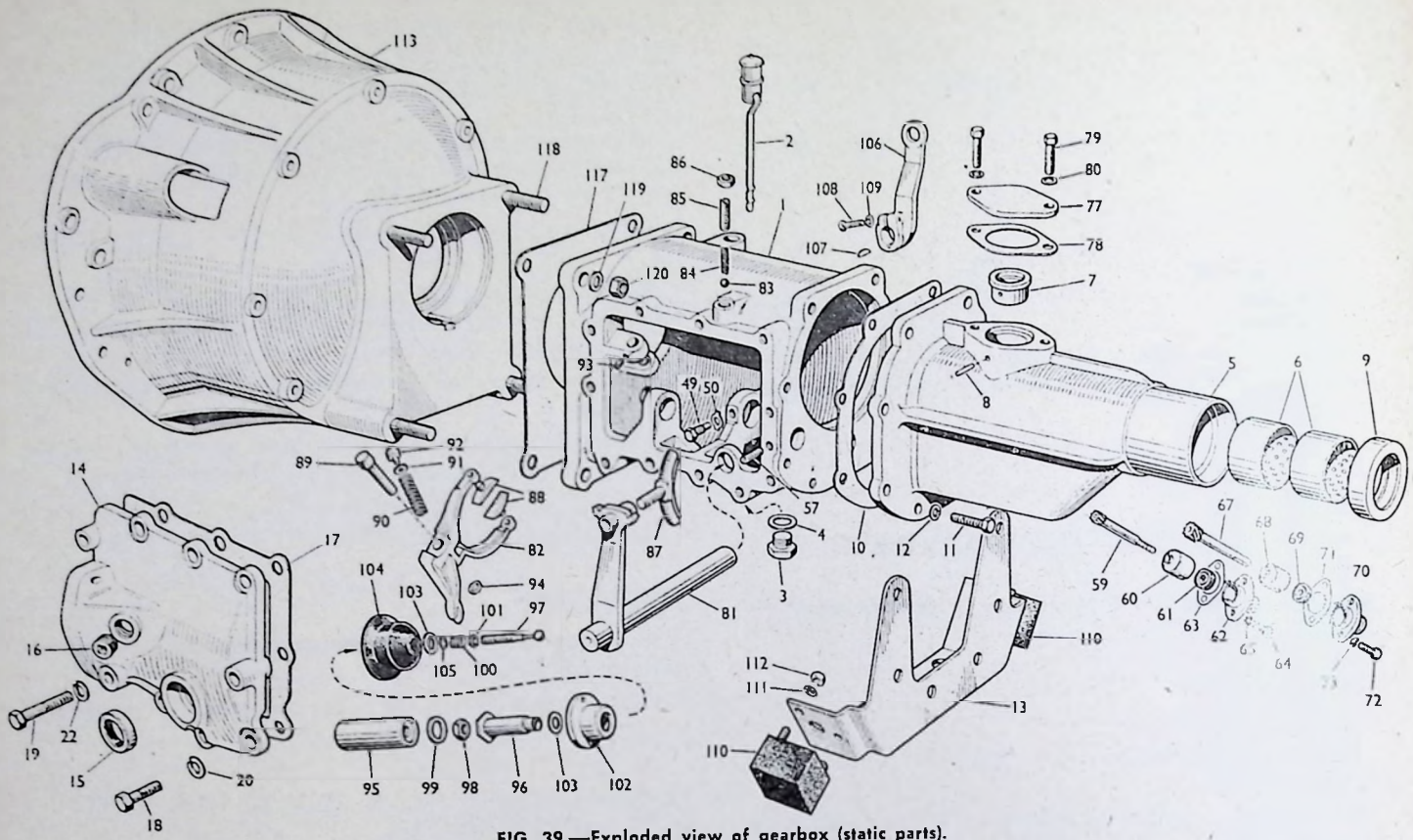


FIG. 39.—Exploded view of gearbox (static parts).

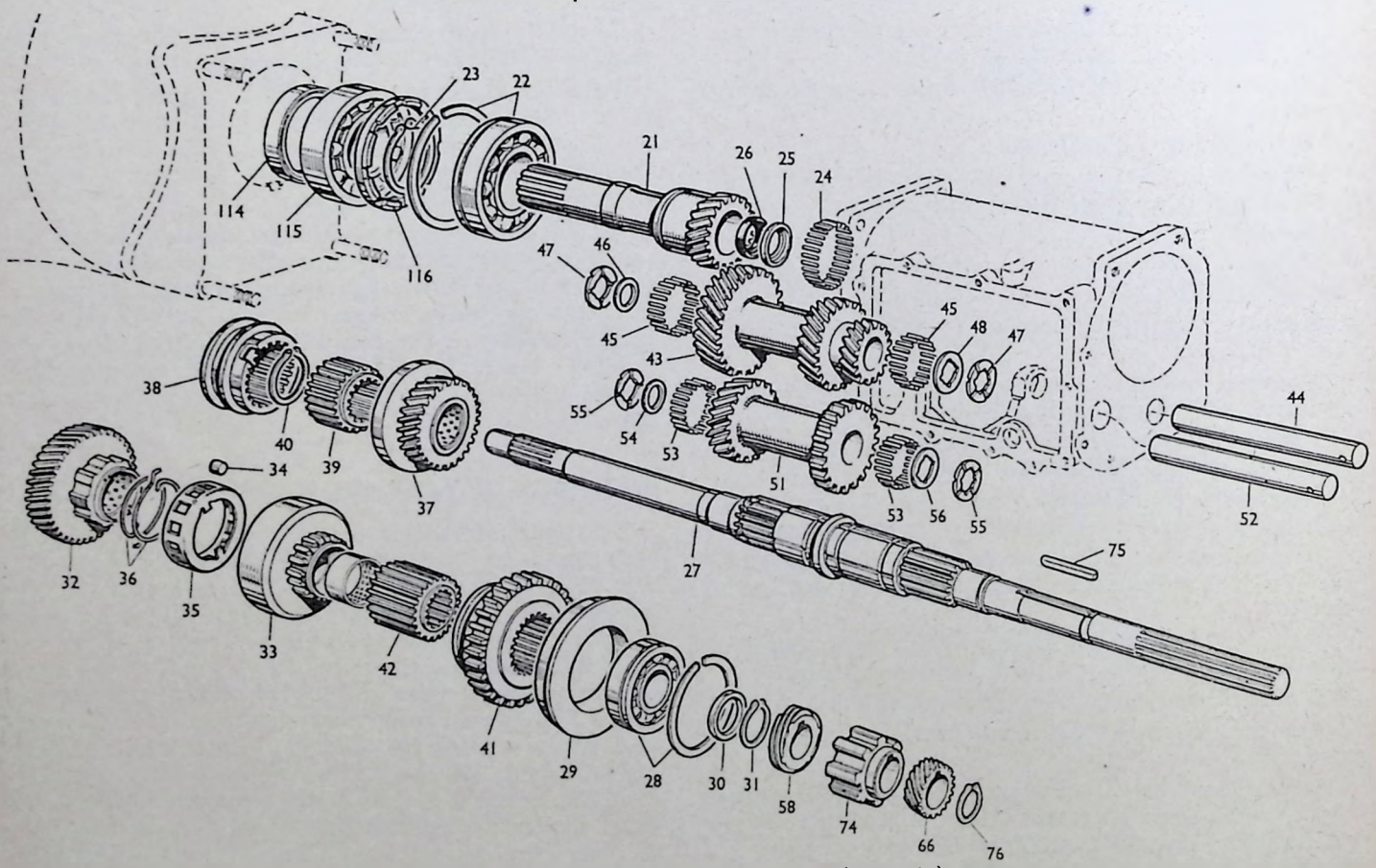


FIG. 40.—Exploded view of gearbox (gears, etc.).

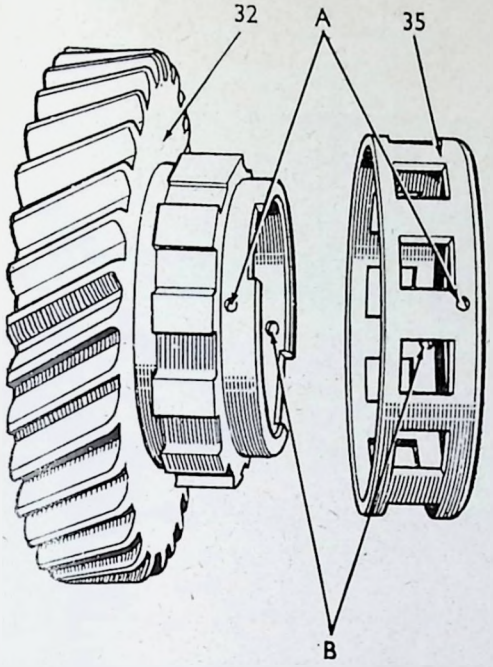


FIG. 41.—Freewheel spring holes.

free end of spring "A" into hole "A" in the gear hub (32). Moving the cage slightly over the hub towards hole "B" (Fig. 43), enter the free end of spring "B" into hole "B" with a small screwdriver, ensuring that spring "A" is still underneath. Rotate the cage a few degrees anti-clockwise so that its tongues lie in the slots in the hub.

Check that the assembly functions freely, with the full movement of the cage across the slots, and the springs tending to rotate the cage clockwise. Wedge the cage anti-clockwise against spring pressure; a tab of the countershaft spindle lock washer may be found suitable.

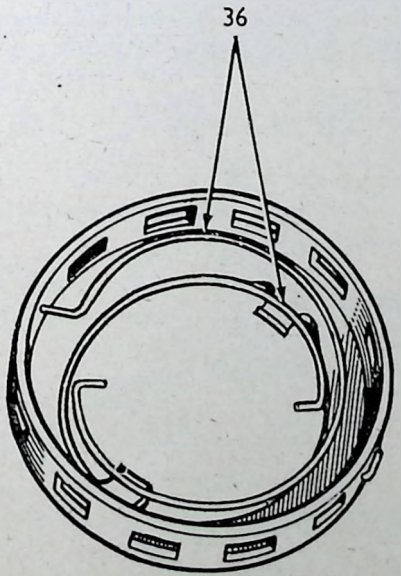


FIG. 42.—Freewheel roller cage and springs.

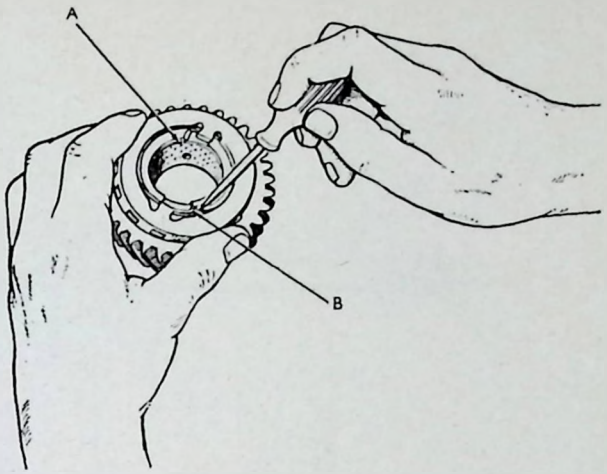


FIG. 43.—Entry of spring "B" into freewheel hub.

With the gear flat on bench, insert 12 rollers (34) into the apertures in the cage where they will balance. Fit the outer race (33, Fig. 44) over the rollers, and remove wedge. Check the assembly for correct operation.

ASSEMBLY OF MAINSHAFT.

Hold mainshaft (27, Fig. 45) upright in a vice with soft jaws, with the rear end upwards.

Slide on the low gear and freewheel assembly (32-36) and the gear itself (32) next to the shoulder on the mainshaft.

Fit forward/reverse sliding gear (41) and hub (42), with the shouldered end of the hub upwards, and the gear itself upwards.

With the hub pressed right home, check end float of low gear and freewheel; this should be .004-.006".

Press on the rear ball bearing (28), complete with housing (29) and circlip (Fig. 40).

Select a spacer (30) to give less than .002" clearance between bearing (28) and spacer (30) when circlip (31) is fitted; fit spacer (30) and circlip (31, Fig. 40).

Fit key (75) in keyway being careful to support mainshaft directly opposite keyway to avoid distortion of shaft (Fig. 40).

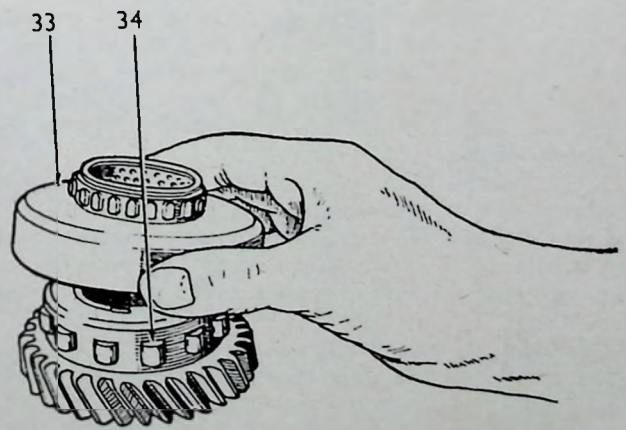


FIG. 44.—Fitting freewheel outer race with rollers in position.

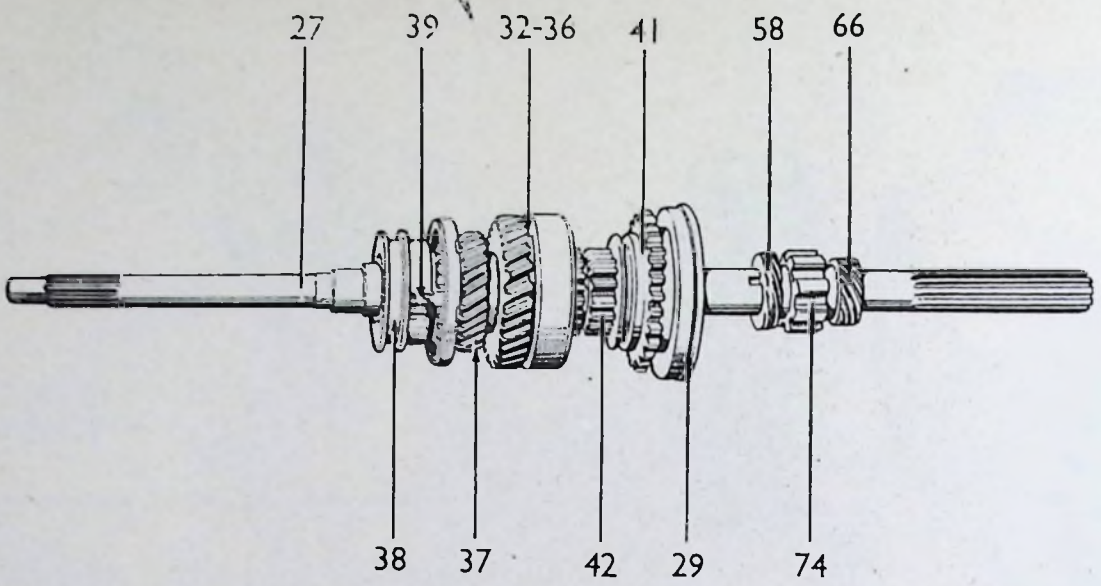


FIG. 45.—Mainshaft assembly.

Fit bronze speedometer gear (58) (this has a larger outer diameter than the governor gear), park lock wheel (74) and bronze governor gear (66) on to key on shaft.

Fit wavy circlip (76, Fig. 40).

Invert mainshaft and hold in vice.

Temporarily fit intermedite gear and baulk ring assembly (37) with bauk ring tongues upwards.

Fit intermediate sliding dog hub (39) with shouldered end downwards.

Fit circlip (40) and check that intermediate gear (37) is quite free to rotate (Fig. 40) and that its end float is .004-.006".

Fit intermediate gear sliding dog (38) with slots down ensuring that it is a free sliding fit on the hub (39) over its full travel.

Remove circlip (40), sliding dog (38), hub (39) and intermediate gear (37) to facilitate fitting the mainshaft into the gearbox (Fig. 40).

ASSEMBLY OF GEARBOX COMPLETE.

NOTE: Needle rollers are not interchangeable with those fitted to manually-operated gearboxes.

NOTE: Oil Seals. Although it is possible to protect the oil seals in the side cover and gearbox casing, by use of the special tools during disassembly, it is always advisable to replace these two seals and the stem wheel seal as a precautionary measure after the unit has been dismantled.

Check the endfloat of the countershaft gear in the gearbox, which should be .006"/.008, with bronze thrust washers (47) and floating steel thrust washer (48) in place; all parts should be dry. Adjust by selection of steel thrust washer (48) of appropriate thickness.

Assemble countershaft gear (43) with 23 needle rollers (45) at each end and abutment ring (46) at front end on a dummy spindle using a little thick grease. Position two bronze (47) and one steel thrust washer (48) in the casing with grease, entering countershaft spindle (44) from rear just far enough to locate one bronze washer and the steel washer. Place countershaft gear (43) in position and fit spindle (44) from the rear, aligning its drilling with the tapped hole in the casing.

Lock the spindle with set screw (49) and tab washer (50) (Fig. 46).

Fit intermediate shift fork collar (94), then fork (82) with shoes (88) held in position with a little grease.

Fit pivot pin (89) (Fig. 46) (noting that the cross-drilling is tapped to receive the grub screw at one end only) and lock with grub screw (93).

Position intermediate sliding dog (38), hub (39) and intermediate gear (37) in gearbox, ensuring that the shift fork shoes (88) engage in the groove in the sliding dog (38, Figs. 39 and 40).

Insert mainshaft assembly through rear of casing, entering it through the intermediate gear and hub (Fig. 47). When fully home, fit circlip (40).

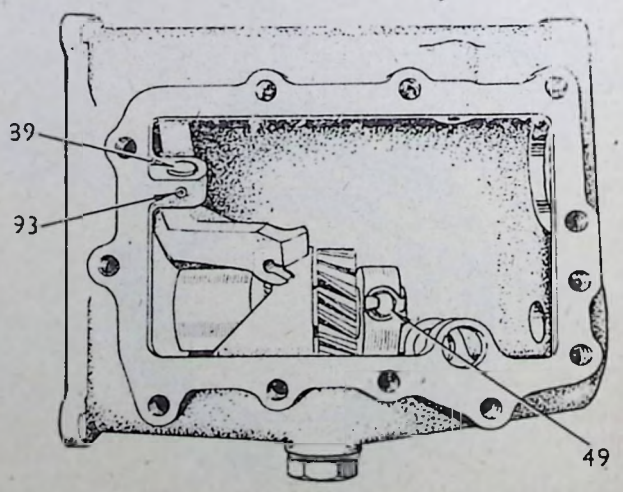


FIG. 46.—Gearbox internal locking arrangements.

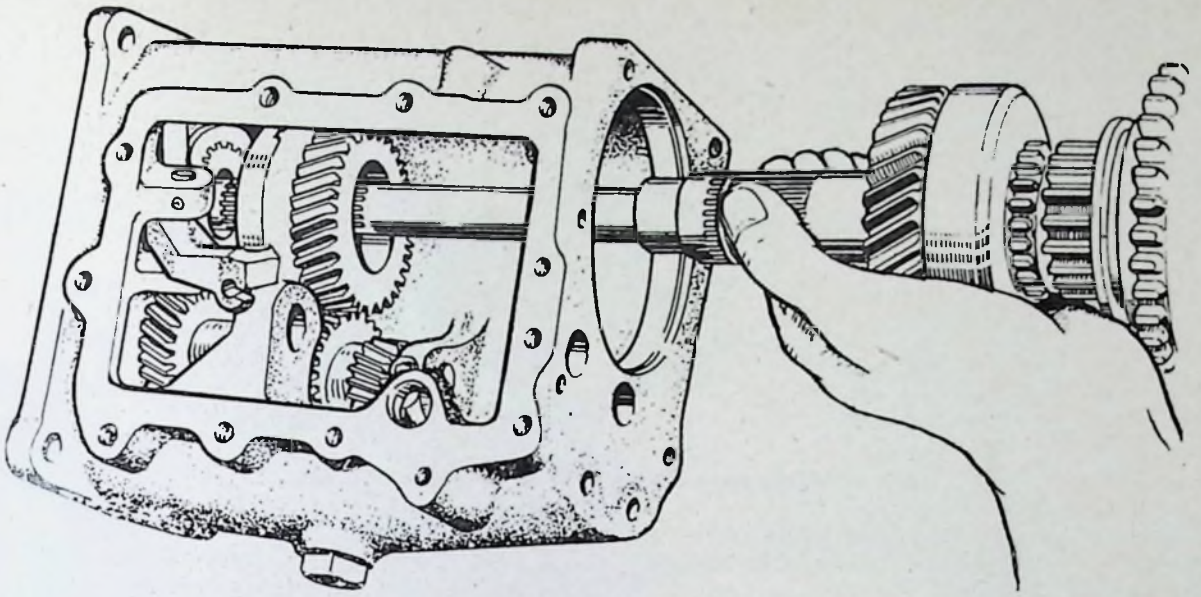


FIG. 47.—Entering mainshaft into intermediate gear and sliding dog hub.

Press bearing (22) on to stemwheel (21) and fit circlip (23, Fig. 40).

Fit a new oil seal and abutment ring to the stemwheel, using special tools RG 243 and RG 245.

Fit the 32 needle rollers with grease.

With oil seal protector (RG 242) on front of mainshaft (Fig. 48), fit stemwheel assembly to casing from front, tapping bearing fully home and aligning gap of circlip with intermediate fork return spring hole.

Remove oil seal protector.

Assemble the reverse idler gear, after checking end float (.006″-.008″) in similar manner to the countershaft gear.

Fit the spindle from rear, lock with grub screw.

Fit forward/reverse lever (81, Fig. 49) and fork (87), detent ball (83), spring (84), screw (85) and locknut (86). Lock up with nut flush with top of screw).

Fit the side cover (14) with paper washer (17). (Fig. 39).

Fit oil seals (15) to side cover and right-hand side of gearbox casing (special tool RG 248).

Fit Woodruff key (107) to cross-shaft (81) and fit external lever (106). (N.B.: On right-hand side of unit for right-hand drive cars, and left-hand side for left-hand drive.) Tighten pinch bolt (108).

Fit rear cover (5) with paper joint (10); hold cover in position with top two screws.

Fit rear support bracket (13).

Fit the speedometer and governor drive pinions and housings with new oil seals if required. (N.B.: Speedometer to front.)

ASSEMBLY AND ADUSTMENT OF SOLENOID LINKAGE (Fig. 50).

The following operations refer to servicing the gearbox when removed from the vehicle, but adjustment of the solenoid cable may be performed, if required, with the gearbox in position.

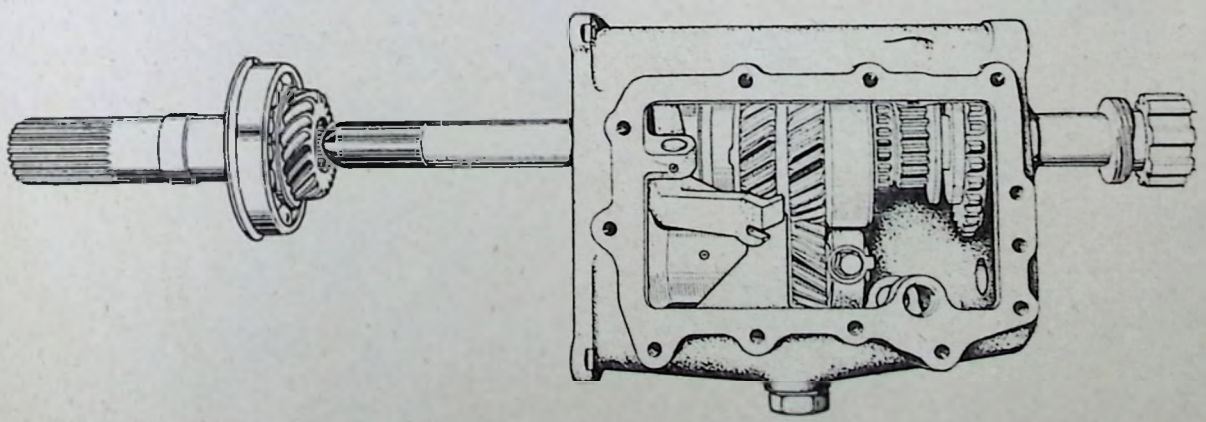


FIG. 48.—Fitting of stemwheel with oil seal protector on mainshaft.

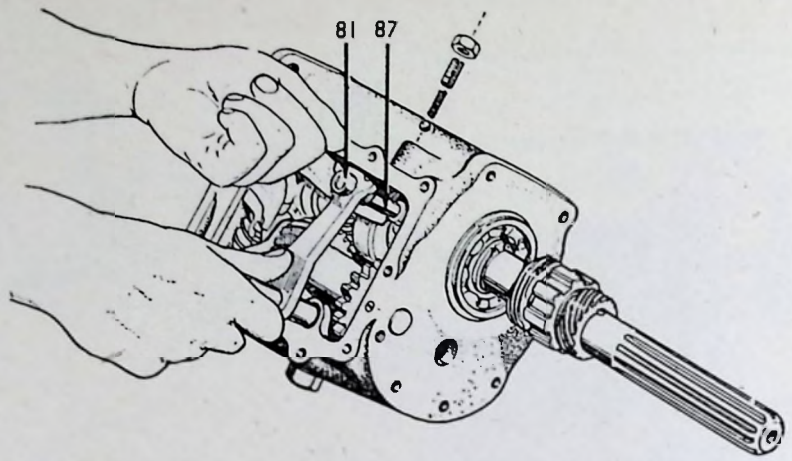


FIG. 49.—Fitting forward/reverse lever and fork with detent parts.

Should it be necessary to adjust pressure of the shift fork return spring, the gearbox must be removed from the coupling housing.

Fit seal insert (102) to armature stem (96).

Assemble seal (104) to stem with 2 washers (103) and circlip (105).

Screw operating cable (97) complete with spring (100) and collar (101) 2-3 turns into stem.

Offer up linkage through aperture in side cover (14), and hook cable onto shift fork (82) with spring (100) and collar (101) positioned as shown. Access is obtained through inspection hole. Ensure that the ball at end of the cable is correctly seated in the socket of the shift fork and that it rotates freely.

Screw cable further outwards through stem, and fit lock nut (98) loosely.

Fit clamp plate (Tool RG 260) and tighten flush with side cover.

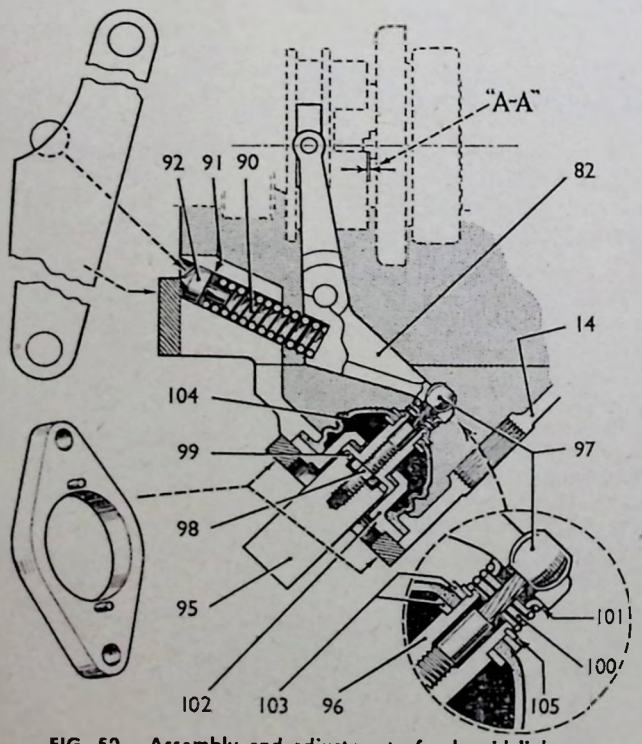


FIG. 50.—Assembly and adjustment of solenoid linkage.

Continue screwing cable outwards until baulk faces "A-A" of sliding dog and baulk ring meet. This may be observed through dipstick hole with pencil torch, or a miniature bulb and holder (as used in the gear indicator quadrant) which may be passed through the dipstick hole. Screw cable inwards one turn to provide .035" clearance between baulk faces "A-A".

Tighten lock nut, while preventing cable slot from turning with screwdriver.

Fit return spring (90), 3-4 shims (91) and plug (92); clamp flush with suitable plate (see Fig. 51). Apply tension to cable with spring balance and suitable adaptor threaded $\frac{1}{4}$" U.N.F. to screw on to cable. When baulk faces "A-A" meet, the spring balance should read 18-22 lb. Add or subtract shims to correct as required (one 005" shim varies tension by approximately 1 lb. Re-check tension.

Remove spring balance.

Fit sealing washer (99) and armature (95) using close-fitting $\frac{3}{4}$" A/F spanner to prevent burring; do not over-tighten.

Remove clamp plates.

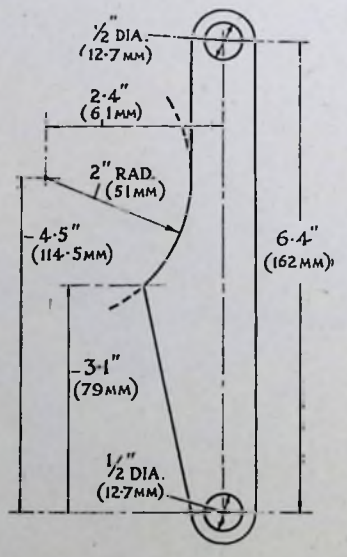


FIG. 51.—Dimensions of clamp plate for solenoid spring. (Make from steel plate at least $\frac{3}{8}$" (9.5 mm.) thick.)

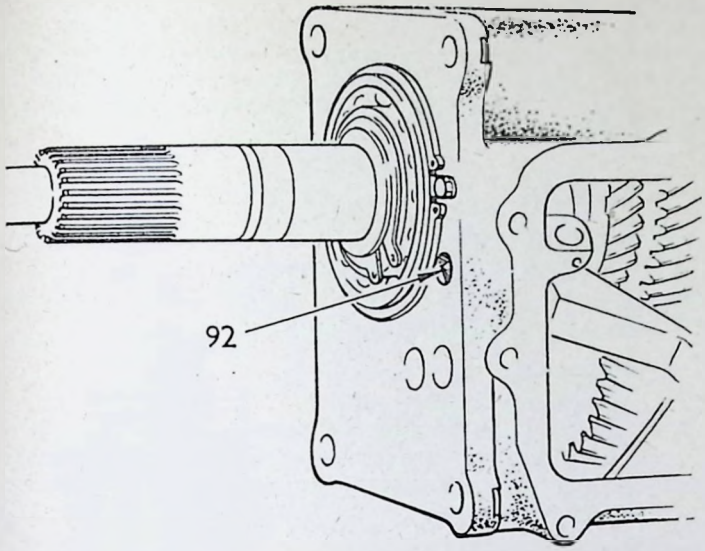


FIG. 52.—Location of gearshift spring, shims and plug.

Turn stemwheel bearing circlip and fit stemwheel retaining screw and special washer (Fig. 52).

Fit inspection plug (16).

NOTE: When re-installing the gearbox, ensure that plug (92, Fig. 52) and spacer (116, Fig. 40) are still in position.

After overhaul of the gearbox and adjustment of the internal linkage, it will be necessary to adjust the gearshift solenoid dog switch as described on page 42.

SERVICING THE GEARSHIFT SOLENOID

DISMANTLING.

Remove the two countersunk screws and lift off solenoid cover. Straighten lock washers and remove hexagon pillars (1, Fig. 53). Remove solenoid switch moving contact (9, Fig. 55), and 2 BA nut from No. 1 terminal. Unsolder the four lead ends (5), straighten leads and lift off insulated switch assembly (2) vertically, together with plunger (3). To dismantle plunger, unscrew locknut (8, Fig. 56) and contact disc (7) using special ring spanners (RG 262).

To remove solenoid coil (Fig. 54): Using a pin punch small enough in diameter to clear the hole for the Mills pin, and with special care to avoid damaging the hole, punch in Mills pin until it bottoms in hole in body. (This hole is deep enough to receive pin.) Unscrew clamping ring using special spanner (RG 263).

RE-ASSEMBLY.

NOTE: Before pinning clamping ring or re-soldering connectors, measure the insulation resistance between each lead and the body with a 250 volt Megger. The minimum reading should be 3 megohms.

To secure clamping ring: Tighten with special spanner, carefully drill through one of the existing holes in the ring, taking care not to damage or enlarge the hole, and lock with a new Mills pin. **Note that the position selected for drilling must be clear of the leads and the top cover mounting studs.** Use a No. 42 Morse drill; penetrate squarely to a depth of .625″/.635″ deep. This depth is important, being sufficient to allow the pin again to be punched in for subsequent servicing. Drive in Mills pin of correct length .312″ until flush with edge of ring.

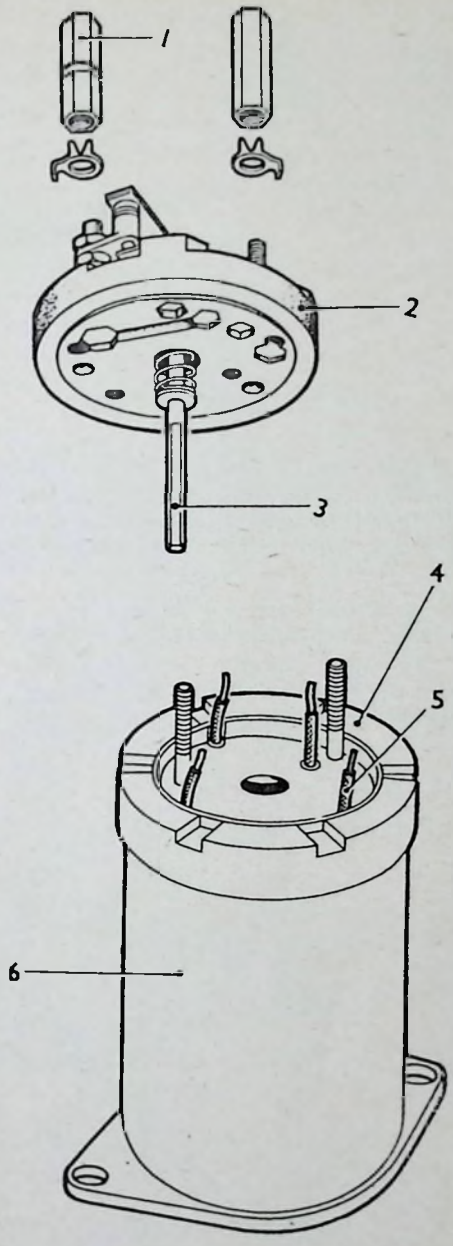


FIG. 53.—Removing contact moulding.

Before re-assembling plunger, remove and clean silver contacts with suitable solvent (such as methylated spirit). Examine contact surfaces; if they are deeply pitted, then renew them. Shallow pitting can be removed by a very fine abrasive paper and the contacts finally polished, but the contour present on one of each pair of contacts must be maintained. Re-clean with solvent to remove abrasive. Re-assemble with silver side of contact plate (7) downwards.

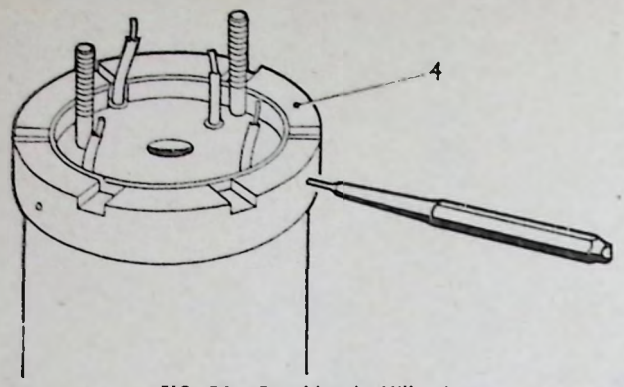


FIG. 54.—Punching in Mills pin.

When fitting contact base (2), pass the four leads through their respective holes, fit mounting pillars over new lock washers, resolder the leads to their respective tags, and recheck insulation resistance as above.

To set solenoid switch contact gap (9 and 10, Fig. 55): Use a suitable mandrel $\frac{3}{4}$" max. dia. (19 mm.) × 3" min. length (76 mm.) with one end square to axis and flat) to raise plunger (3) to full extent (with flat end of mandrel), and adjust contact gap to .015"/.020".

In preparation for final adjustment of the dog switch contacts when solenoid is assembled to gearbox, the nut for adjusting DS contacts (7, Fig. 56) should be screwed to an approximately central position.

TESTING.

Electrical.

Connect a 12-volt supply with an ammeter in series to + and — terminals (Fig. 57). Consumption should not exceed 26-30 amps.

Mechanical.

Disconnect voltage supply.

Test tension of solenoid switch contact spring (9, Fig. 55) with a spring balance. The force necessary to open the contacts, measured at the extremity, should be between 2.5 and 4.5 lb.

DOG SWITCH ADJUSTMENT.

NOTE: Final adjustment of the dog switch DS must be made after solenoid is re-installed on gearbox. A 12-volt supply is required; leads and switch to carry in excess of 26 amps. During this adjustment, the solenoid should not be energised continuously for periods exceeding 5 minutes.

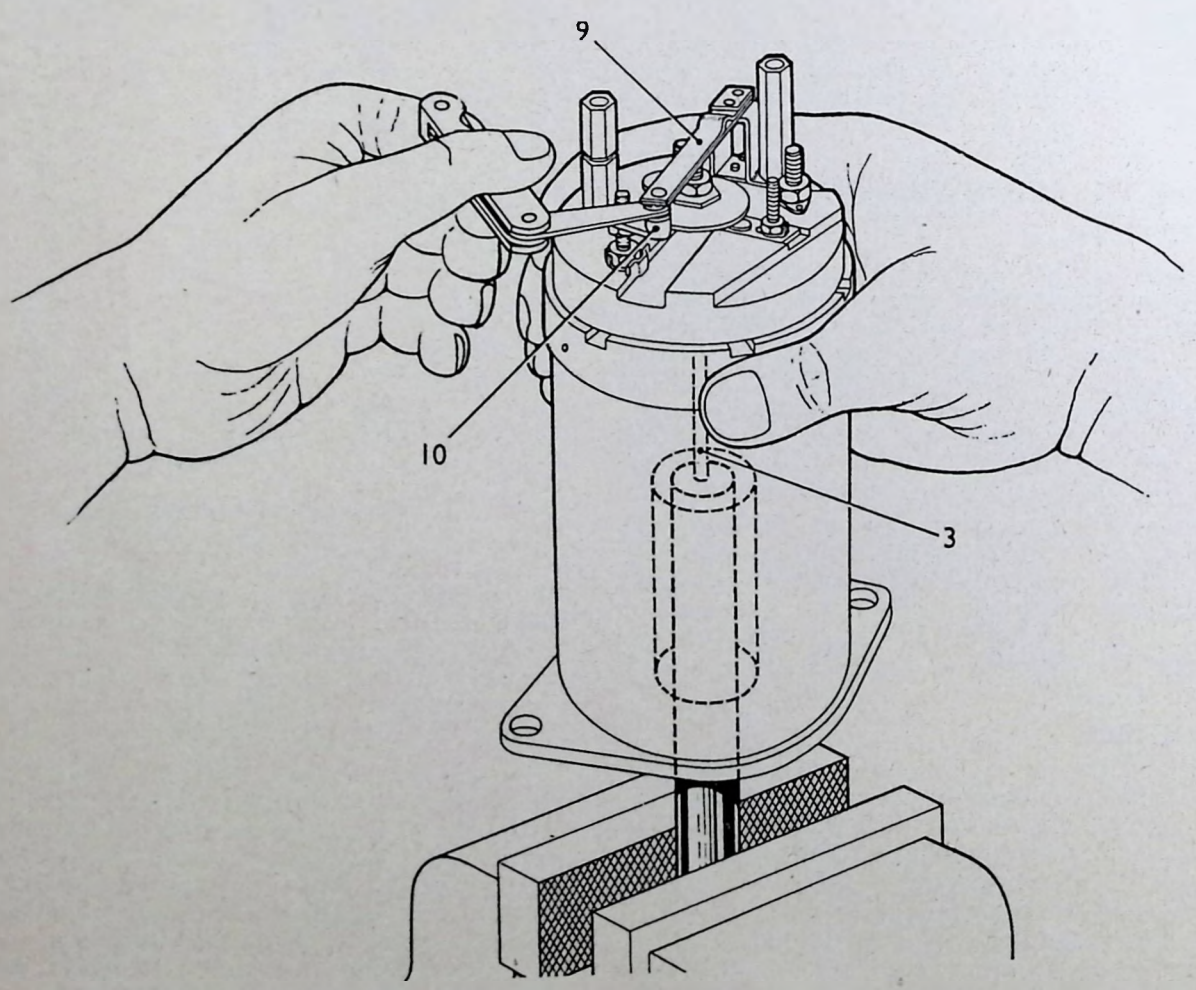


FIG. 55 — Main contact gap.

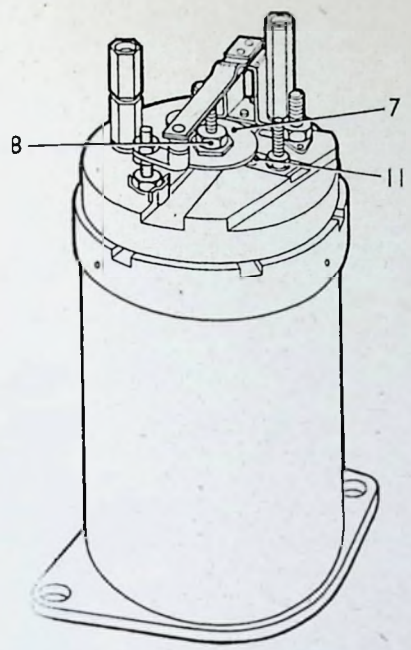


FIG. 56.—Dog switch details.

IMPORTANT: To adjust the dog switch correctly, it is necessary first to place the intermediate gear dogs in the true baulked condition, and not to confuse the true baulked condition with other possible positions of the sliding dog. Therefore, before making the adjustment, obtain the four possible conditions of the dogs as described below, so that the true baulked position is recognised:—

(1) When solenoid is not energised, the dogs are in the free position as shown in Fig. 58. Note that the gearbox linkage has already been adjusted to give a clearance ("a") of .035".

(2) Obtain the baulked condition (Fig. 59) as follows: Move the forward/reverse lever on the gearbox towards the rear of the car. Energise the solenoid with the 12-volt supply as shown in Fig. 57. In most instances, the dogs will be baulked, as showned in Fig. 59, but it may happen that the dogs are synchronised in which case the dog clutch will engage fully as in Fig. 61. If this happens, de-energise the solenoid, rotate the output shaft slightly to upset synchronisation, and energise the solenoid again.

(3) It is also possible that the spurious condition shown in Fig. 60 may be obtained: viz., the sliding dog has passed through the baulk but the ends of the dog teeth happen to be in line and butting together ("**dogs on**" condition). Do not confuse this with the true baulked condition.

(4) Finally, note the **fully-engaged condition** (Fig. 61). Obtain this by intermittently energising the solenoid whilst rotating the output shaft to and fro, until the dog clutch is fully home. In this condition, the solenoid plunger is at the end of its travel and has opened the large solenoid switch (SS).

When the true baulked condition is clearly recognised, adjust the dog switch as follows:—

(1) Energise the solenoid.

(2) Check that true baulked condition has been obtained.

(3) Slacken the locknut (8, Fig. 57) (use the special spanners RG 262).

(4) Adjust the height of contact disc (7) until it just touches fixed contacts (11). During this operation a pressure should be applied to the end of the switch disc plunger (3) with an insulated rod, to ensure that the plunger maintains contact with the armature.

(5) De-energise solenoid.

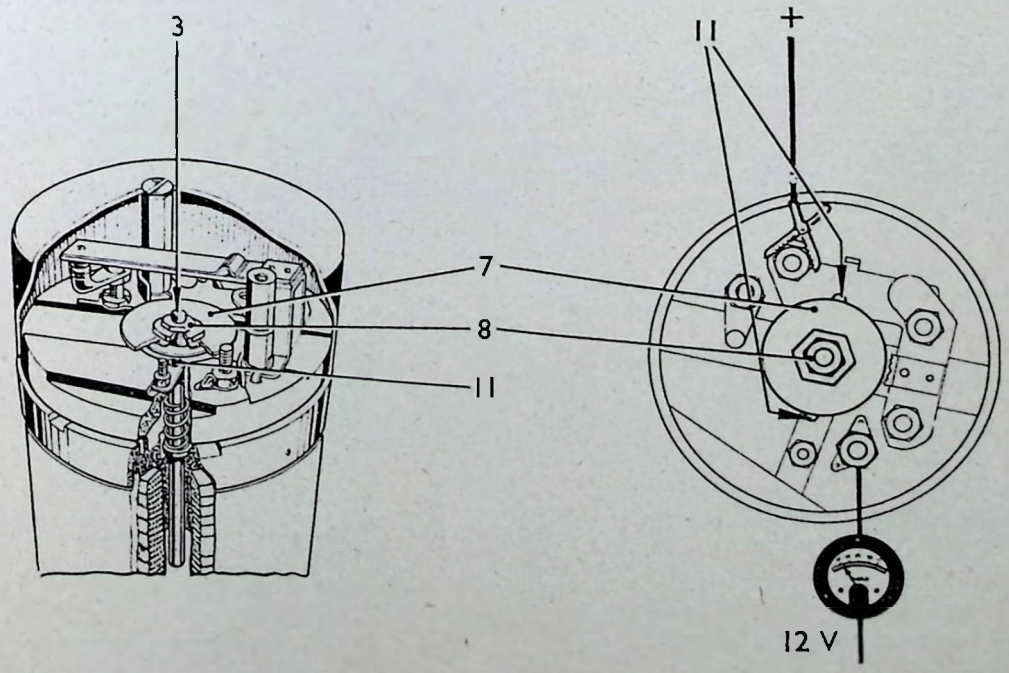


FIG. 57 — Dog switch adjustment.

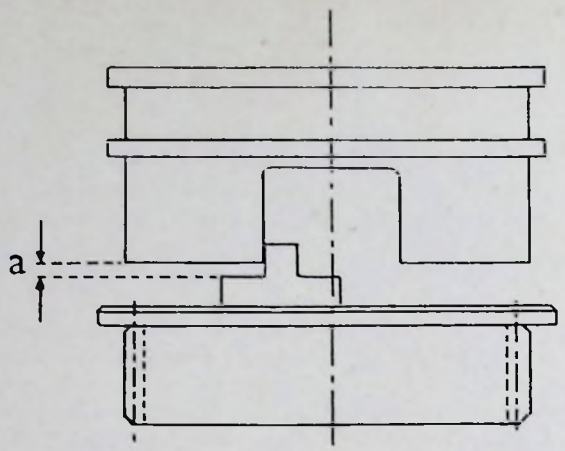


FIG. 58.—"Dogs free".

(6) Turn contact disc nut two full turns clockwise and lock with locknut. (Torque spanner setting 22 lbs. inch/1.83 lbs. ft.)

Disconnect test wiring, seal cover in position, and refit harness and rubber cover.

SERVICING THE SELECTOR SWITCH

DISMANTLING.

Remove the two screws and lift off the cover, insulating strip and socket moulding.

Remove the screw and withdraw the contact assembly.

Remove the circlip, washer and reverse arm.

Remove the rubber plug (Fig. 62).

Rotate the switch spindle until the ball is not engaged by the two pins exposed through the hole and drift out pins with a $\frac{3}{32}$" pin punch (Fig. 63).

Placing cloth over hole, remove ball and spring by rotating switch to eject them (Fig. 64).

Remove the two socket-head grub screws (socket key $\frac{1}{8}$" across flats) from contact block.

Extract spindle (Fig. 65), contact block and spring (Fig. 66).

Using special mandrel (Tool RG 265-1/1), press out the upper bearing (Fig. 67). Pass mandrel through upper bearing bore to press out lower bearing.

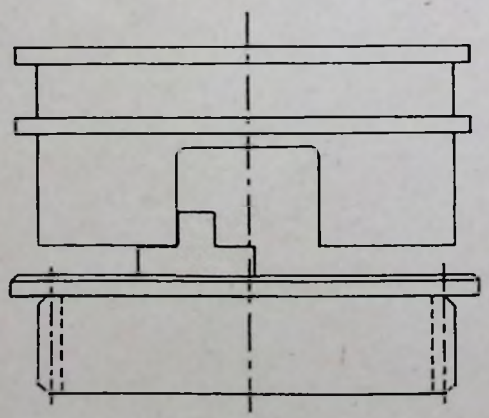


FIG. 59.—True baulked condition.

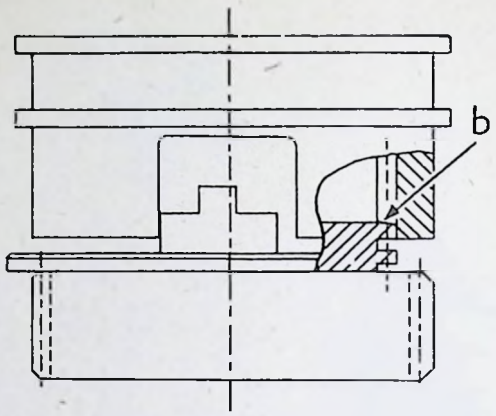


FIG. 60.—"Dogs on".

Press out reverse arm bearing using special mandrel (tool RG 265-2/1) and support (RG 265/2).

SERVICING.

Examine bearing bushes and spindle for undue wear, scoring, etc., and renew as necessary.

If contacts are pitted or burnt, renew them. Otherwise, clean with a fine abrasive paper and finally polish. Check condition of socket inserts and printed circuits and that the contact bars are not worn, damaged or insecure. If sockets or printed circuit are damaged, renew. If contact bars are damaged or irretrievably pitted, the socket moulding must be renewed. The cam path should be kept lightly oiled.

RE-ASSEMBLING.

Reverse the dismantling procedure, noting the following instructions. If bearings are renewed, use special sizing mandrels (RG 265-1/2, RG 265-2/2) as follows. Press bush on mandrel; press bush into casting or reverse arm; leave mandrel in bush to cool off in atmosphere for about five minutes before removing mandrel. Grease indent bars very lightly, ensuring that grease cannot reach the contacts. When inserting ball and spring, turn spindle to retain ball while assembling indent bars.

Degrease control arm grub screws and apply Loctite Sealing Compound to the threads before assembling.

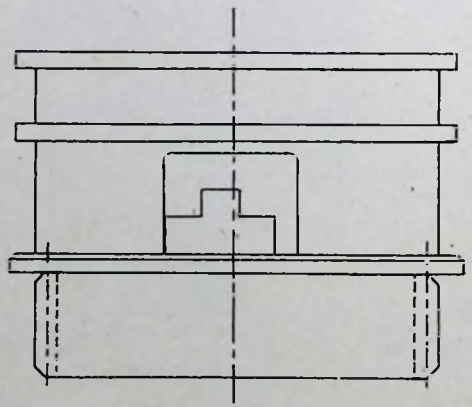


FIG. 61.—Fully-engaged condition.

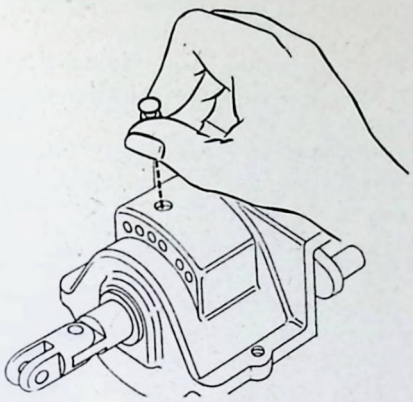


FIG. 62.—Removing rubber plug.

Peen casing over indent bars at drive end of switch.

Check height and if necessary adjust contacts as follows, using "go" and "no go" gauge illustrated in Fig. 69.

(1) Position "no go" side of gauge on casting. (See Fig. 68). During this operation ensure that the gauge is not tilted but kept vertical to the axis of the spindle. Slide gauge across contact faces and check that all four just touch.

(2) Use opposite ("go") side of gauge and repeat check. Contact faces must not touch gauge.

(3) Loosen screws which clamp contacts to moulding and raise or lower contacts until condition is met.

NOTE: Contacts must not be bent to satisfy this test. If they are distorted renew them.

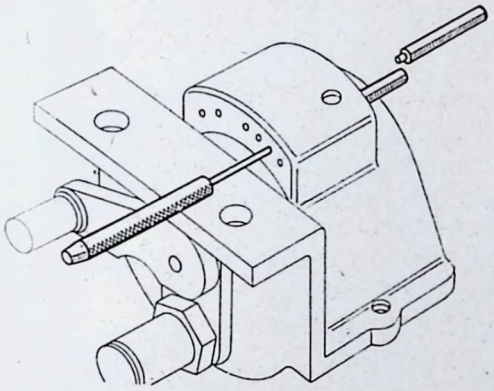


FIG. 63.—Removing indent bars.

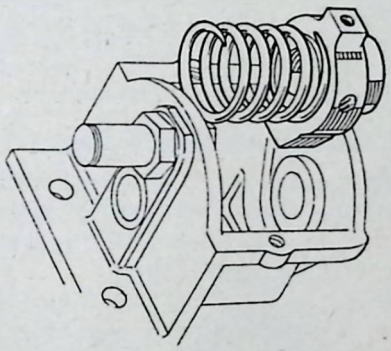


FIG 66.—Removing contact block.

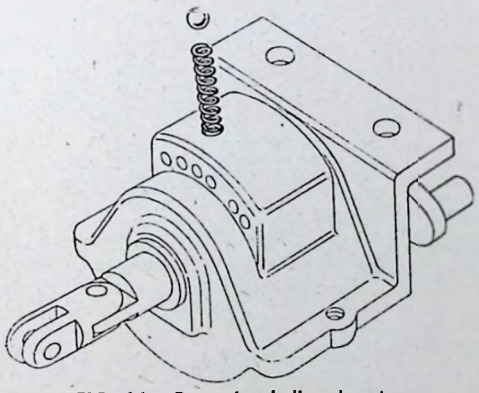


FIG. 64.—Removing ball and spring.

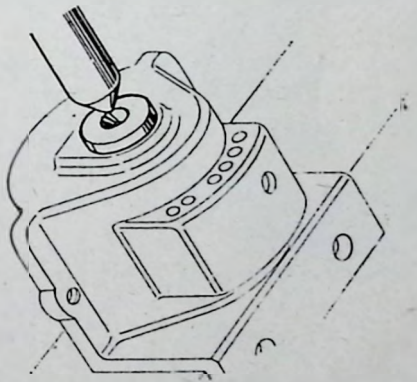


FIG. 67.—Removing flanged bearing

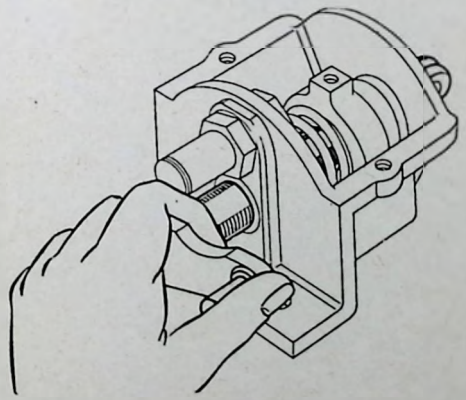


FIG. 65.—Removing spi[illegible]

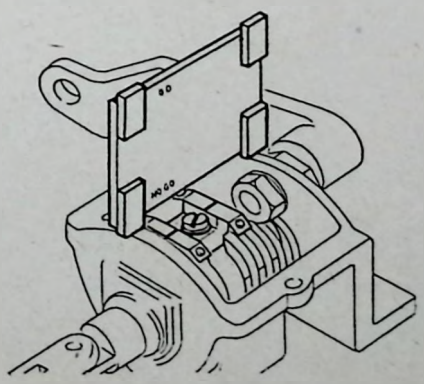


FIG. 68.—Checking contact height.

TESTING.

Fit a dummy lever and test circuit continuity in all positions using a 12-volt supply and lamp. (See table.)

Continuity must exist at respective indent positions and persist in the full lever positions, i.e., Drive, Neutral and Reverse. Also, continuity must exist for at least 2 degrees angular movement on each side of relevant indent position. The insulation resistance from all sockets to the switch body, using a 250-volt megger, must not be less than 3 megohms.

Position	Test for Continuity Between
DRIVE (D)	Socket 4, pin 1 and Socket 4, pin 4
INTERMEDIATE (2)	Socket 4, pin 2 and Socket 4, pin 8
	Socket 4, pin 3 and Socket 4, pin 6
NEUTRAL (N)	Socket 5, pin 8 and Socket 5, pin 4
	Socket 5, pin 5 and Socket 5, pin 9
REVERSE (R)	Socket 4, pin 3 and Socket 4, pin 6
(Printed Circuit)	Socket 5, pin 2 and Socket 4, pin 7
	Socket 5, pin 1 and Socket 4, pin 9
	Socket 5, pin 3 and Socket 4, pin 8

Manufacture of Contact Height Gauge (Fig. 69).

Cut a rectangular piece "A" of $\frac{1}{16}$" mild steel, $2\frac{1}{2}$" long, and of any convenient width, say $1\frac{1}{2}$".

Cut four rectangular pieces "B" and "C" of $\frac{1}{4}$" × $\frac{1}{16}$" strip steel and about $\frac{5}{8}$" long.

Clip parts "B" to plate "A" in approximately correct position. Lower assembly vertically on surface plate with feeler gauges .017" thick under plate "A" to give correct dimension. Securely solder parts "B" to plate "A" keeping corners square, and recheck .017" dimension at each end.

Repeat with .008" feeler gauges for parts "C" at opposite edge of plate "A".

SERVICING THE COUPLING

NOTE: Instructions on removing the rotor assembly and the stator assembly are provided on Pages 26 and 27.

IMPORTANT: It is essential that, on assembly, the coupling components are completely free from oil, grease and dirt.

Labyrinths are comparatively fragile and should be handled carefully.

Never re-use metallic powder. Always recharge the coupling with the correct amounts from new containers.

DISMANTLING ROTOR.

Scribe a line to indicate the relative positions of the driving and centre members.

Straighten the locking strips and remove the bearing hub screws.

Remove the bearing hub.

Invert the assembly, straighten locking strips (4, Fig. 70) and remove rotor assembly bolts (5).

Part the assembly by tapping round flange with soft-faced hammer.

Take out the centre plate (6, Fig. 71).

Remove the front rotor circlip (7, Fig. 72).

Support the driving member with suitable packings and separate by pressing in a fly press or tapping on spigot. Insert some soft material underneath to avoid damage when the unit separates (Fig. 73).

Remove the front bearing circlip and front bearing.

Separate the indirect driven member similarly by removing the circlip and pressing or tapping the driven member through the rear bearing.

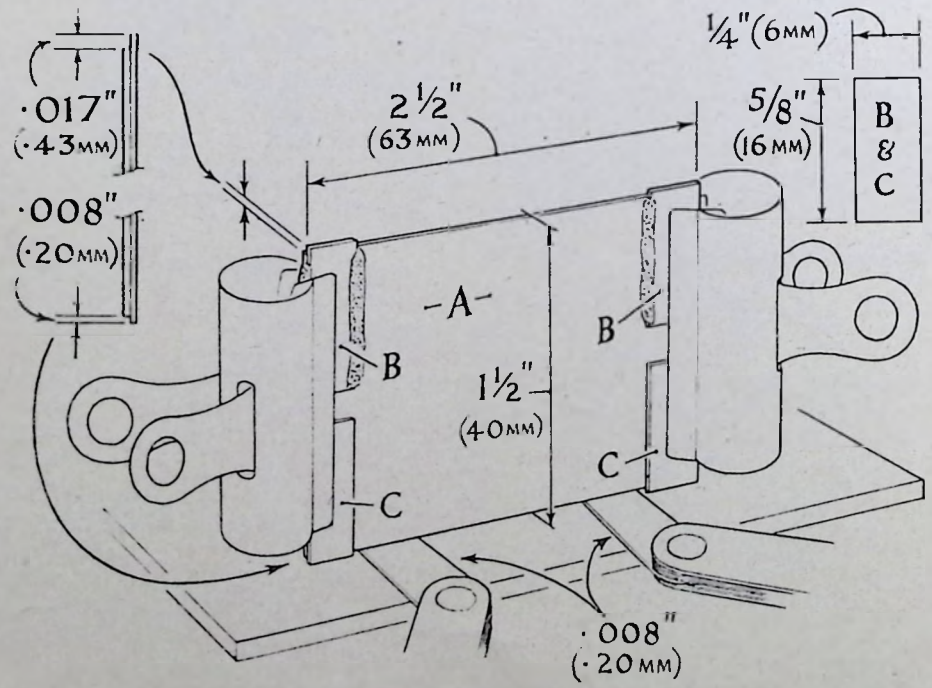


FIG. 69.—"Go" and "no go" gauge.

RE-ASSEMBLING ROTOR.

Re-assemble in reverse order of dismantling, noting the following:—

All components removed, except ball bearings, must be degreased before re-assembly. After a considerable mileage, scale (consisting of compacted powder) may form on the periphery of the driven member and the inner surface of the driving member. All traces of scale must be scraped or wire-brushed off the polished surfaces and grooves without damaging their finish. Ball bearings are prepacked and sealed and no attempt may be made to clean and regrease.

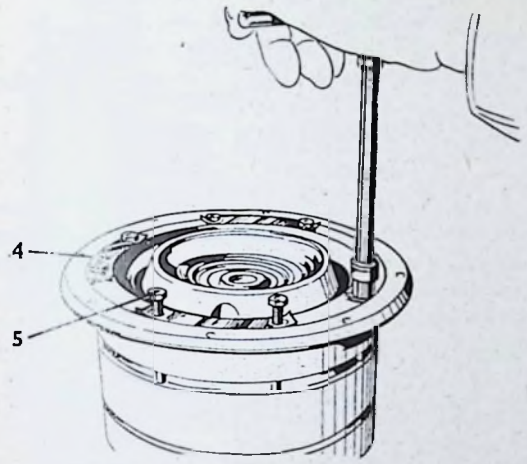


FIG. 70.—Removing Rotor Assembly Bolts.

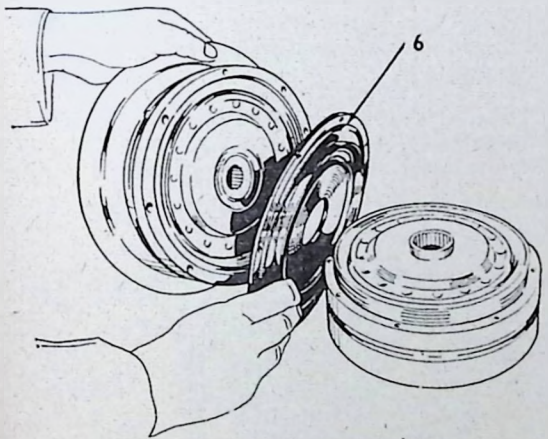


FIG. 71.—Removing centre plate.

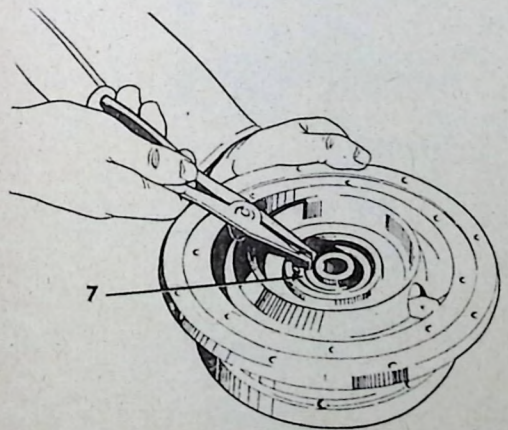


FIG. 72.—Removing direct driven member circlip.

The oil seal must be changed, using the special tool RG 246A (multi-purpose handle 550 is being used as a driver).

The rotor must be re-assembled so that the original assembly marks are in line. The assembly must then be tested for concentricity (see "Re-assembling Coupling", page 47). Tighten the main assembly bolts (5) to 7½-8½ lbs. ft. torque wrench setting.

FILLING THE ROTOR.

1. The rotor has two filling holes. (See Fig. 32.)
2. Each capsule contains a carefully measured quantity of powder which is sufficient for one driving member.
3. It is essential that each driving member is filled with all the powder contained in one capsule.
4. The metallic powder must not be contaminated by oil, grease, dust or any foreign matter.
5. **Never** open a capsule until the powder is required for use.
6. If any powder is spilled when filling a rotor it must **NOT** be swept up and used in the rotor. The rotor must be stripped, cleaned, re-assembled and refilled with a new capsule of powder.
7. Never top up the rotor with powder. (See 3, above.)

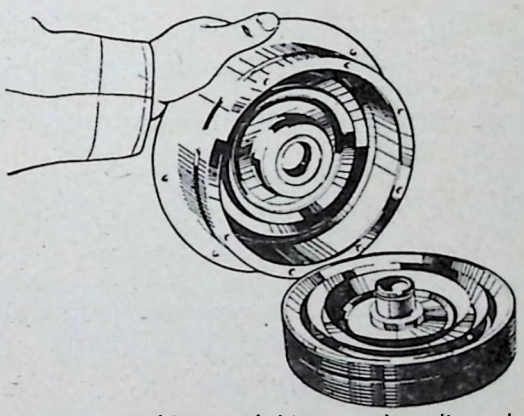


FIG. 73.—Direct driving and driven members dismantled.

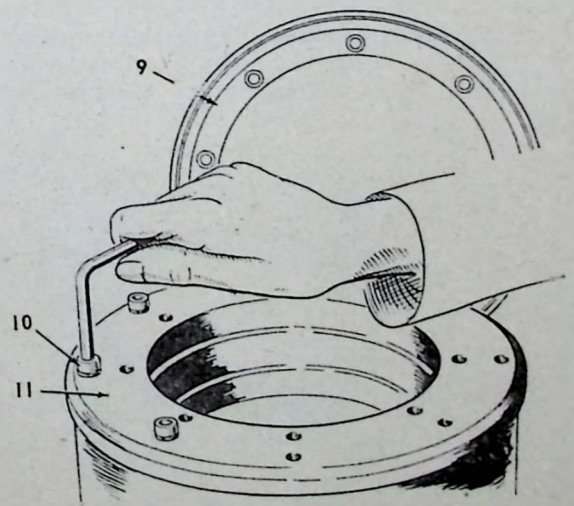


FIG. 74.—Removing front field piece bolts.

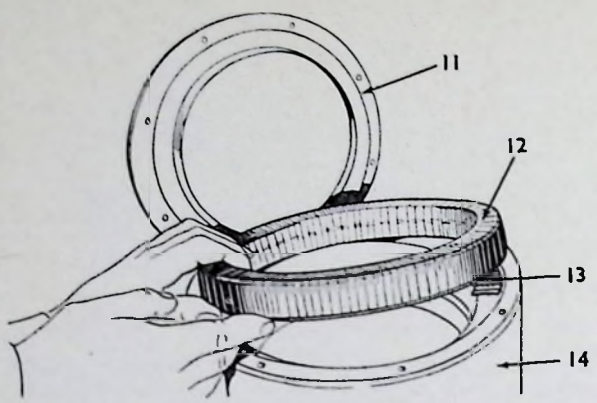


FIG. 75.—Removing coil.

DISMANTLING STATOR.

With chip shield (9, Fig. 74) removed, remove socket head screws $\frac{3}{16}$" A/F (10) spring washers and front outer field piece (11).

Remove rubber grommet, separate leads from 4BA eyelet and lift out coil (12, Fig. 75) feeding leads inwards through hole in field piece (14).

Remove springs (13, Fig. 76).

Remove rear field piece (secured by four socket-head screws—$\frac{3}{16}$" A/F), rear field coil and springs similarly.

RE-ASSEMBLING STATOR.

Re-assembly is the reverse of dismantling; note the following instructions:—

All parts removed, except coils, must be degreased before re-assembly.

Insert coil with four leads into front end of stator.

Assemble three springs between each coil and centre field piece (14), equally spaced, sharp ends away from coil.

When assembling front outer field piece (11) note that the cut-out (A, Fig. 77) must be positioned with respect to the wire grommet (B) as shown.

RE-ASSEMBLING COUPLING.

If either rotor or stator has been dismantled, it is necessary to check the concentricity with an indicator gauge before re-assembling the coupling.

Check the concentricity of the rotor assembly. Use mandrel (RG 269) to mount rotor assembly on vee-blocks. With a dial indicator test at the points on the periphery of the front and rear driving members. If the run-out on any component exceeds .003" total indicator reading, loosen the main assembly bolts slightly (or the bearing hub bolts) and tap the eccentric component with a soft hammer to centralise. Tighten bolts to the correct torque (see "Re-assembly of Rotor") and again test the rotor assembly for concentricity.

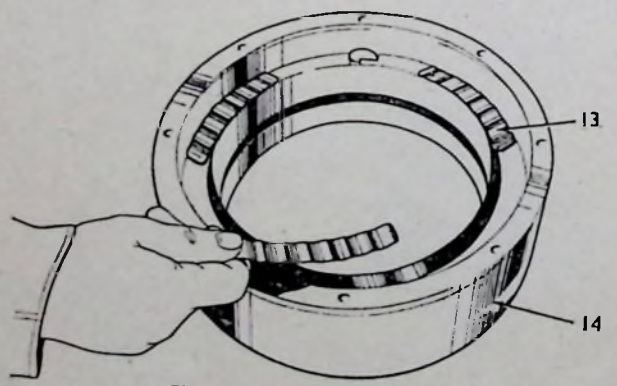


FIG. 76.—Removing springs.

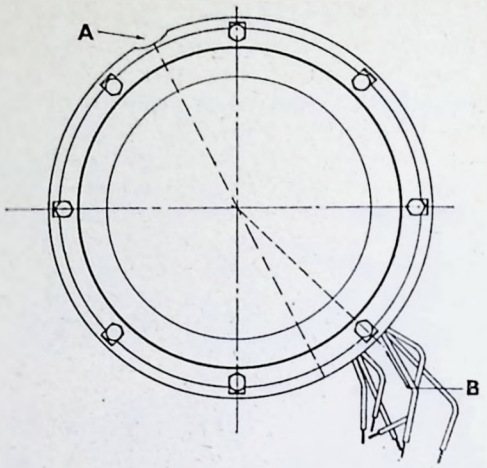


FIG. 77.—Positioning front field piece.

Replacement rotor assemblies are supplied empty and will require filling. Correct powder charges are supplied in separate containers. Ensure that each half of coupling is charged through its respective filler hole (2, Fig. 32.).

When a coupling is dismantled it is essential to use new powder charges to ensure that the couplings contain the correct amounts of powder.

Note: See instructions for filling on page 47.

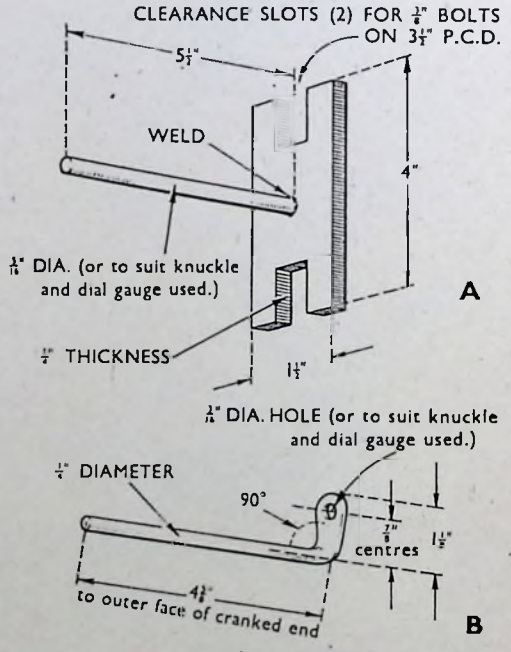


FIG. 78.—Dial gauge fittings.

Assembling the Stator into the Housing.

When carrying out this operation great care must be taken to avoid damage to the insulation of the leads. The leads should be laid in the direction of the housing, not sharply bent, and kept in the groove formed to facilitate the entry of the leads into the aperture of the housing.

RE-INSTALLATION OF STATOR AND COUPLING HOUSING.

To re-install the stator and coupling housing reverse procedure on page 26. If coupling housing, stator or any of its components have been changed, the bore of the assembled stator and the bearing bore in the rear of the coupling housing must be checked for concentricity when assembled to the engine.

The concentricity of the stator is checked as follows:—

Remove the spark plugs.

Remove the coupling housing and stator assembly.

Remove the rotor assembly.

Detach the support plate, flywheel and starter ring from the crankshaft.

Mount on the crankshaft flange a dial gauge stand of the type depicted at "A" in Fig. 78.

Mount the assembled stator and coupling housing into position on the engine crankcase, securing all the coupling housing bolts.

Using a dial gauge equipped with a stylus extension (illustrated at "C" in Fig. 79), adjust the position of the dial gauge to give light contact between the stylus and the top of the bore of the rearmost component of the stator ("c"), and arrange for the dial gauge to face rearwards to be visible through the rear bearing hole in the coupling housing.

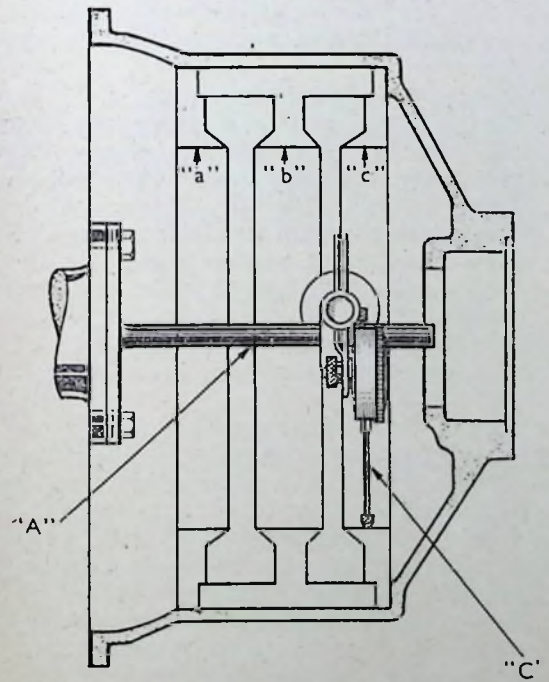


FIG. 79.—Checking concentricity of stator bores.

Rotate the crankshaft by means of the starting handle and, with the handle released, record the measurement on the dial gauge taken at 8 points equally spaced round the stator bore.

Reposition the dial gauge to bring the stylus into contact with the centre component ("b") of the stator and repeat the 8-point check, at the same angular positions.

Repeat this check on front stator member ("a").

Slight eccentricity of any component can be corrected by slackening the assembly bolts and tapping gently to displace the misaligned component in the necessary direction.

Repeat this check on coupling housing rear bearing bore with dial gauge arranged on fitting "B" as in Fig. 80.

The tolerance for eccentricity allowable for each of the stator components and for the rear bearing bore is shown below and, provided that the concentricities of the assembled unit fall within these limits and that the stator is not subsequently detached from the coupling housing, the assembly is satisfactory. If the eccentricity exceeds the limits shown below the following action may result in an improvement.

Withdraw the stator from the coupling housing (as described under "Removal of Stator", page 27), and rotate the rear component only relative to the other two, within the coupling housing registers, until, on final checking, the required degree of concentricity is obtained at each component.

The maximum run-out must not exceed the following limits:—

	Total Indicator Reading
Stator front part ("a", Fig. 79)	.005"
Stator centre part ("b", Fig. 79)	.005"
Stator rear part ("c", Fig. 79)	.006"
Rear bearing housing ("d", Fig. 80)	.003"

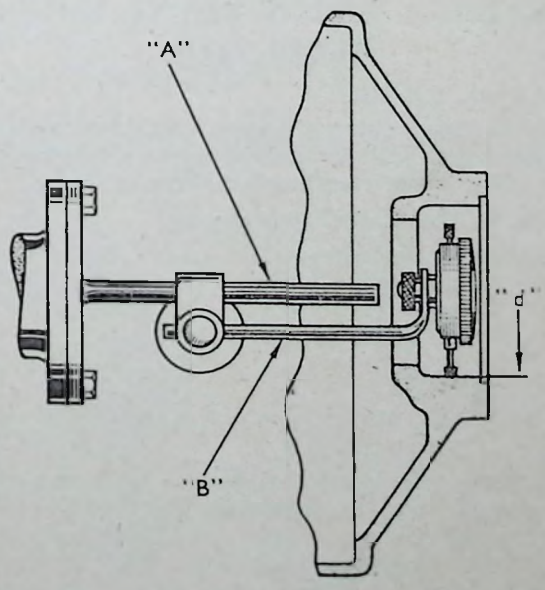


FIG. 80.—Checking concentricity of rear bearing housing.

COUPLING TORQUE TESTS.

After an overhaul of the coupling which has involved replacement of any of the major components, the following tests should be carried out. The indirect coupling is checked by a stall speed test, the direct coupling by timing the gear change from Low to Intermediate. (See part C, page 25.)

SERVICING THE GENERATOR

Lucas Type C45PV6.

GENERAL.

The generator is a shunt wound two-pole two-brush machine, arranged to work in conjunction with a current/voltage control regulator unit. A fan, integral with the driving pulley, draws cooling air through the generator, inlet and outlet holes being provided in the end brackets of the unit.

The output of the generator is controlled by the regulator and is dependent on the state of charge of the battery and the loading of the electrical equipment in use. When the battery is in a low state of charge, the generator gives a high output, whereas if the battery is fully charged, the generator gives only sufficient output to keep the battery in good condition without any possibility of over-charging. An increase in output is given to balance the current taken by lamps and other accessories when in use.

PERFORMANCE DATA.

Cutting in speed: 1,450 r.p.m. at 13 generator volts.

Maximum output: 30 amps at 2,200 r.p.m. at 13.5 generator volts (on resistance load of .45 ohms).

Field resistance: 6.0 ohms.

Brush spring tension: 33 ozs. (new), 15 ozs. (minimum worn).

For maintenance and servicing the generator refer to Electrical Section N.

SERVICING THE CURRENT/VOLTAGE REGULATOR

Lucas Type RB.310.

NOTE: Before altering any control box settings, it is important to check that the battery, generator and all charging circuit connections are in order.

(a) Voltage Regulator Adjustment.

Open Circuit Settings.

Ambient Temperature	Voltage Setting
10°C. (50°F.)	14.4 — 15.0
20°C. (68°F.)	14.2 — 14.8
30°C. (86°F.)	14.0 — 14.6
40°C. (104°F.)	13.8 — 14.4

Method of Adjustment.

Checking and adjusting should be completed as rapidly as possible to avoid heating errors.

(i) Disconnect white lead in "Easidrive" harness from terminal A3 on fuse unit. Remove the heavy battery lead from control box terminal "B".

(ii) Connect a first-grade 0—20 moving coil voltmeter between control box terminal "D" and a good earthing point.

(iii) Start the engine and run the generator at 3,000 r.p.m.

(iv) Observe the voltmeter pointer.

The voltmeter reading should be steady and lie between the appropriate limits given above according to the temperature. An unsteady reading may be due to dirty contacts. If the reading occurs outside the appropriate limits, an adjustment must be made. In this event, continue as follows:—

(v) Stop the engine and remove the control box cover.

(vi) Restart the engine and run the generator at 3,000 r.p.m.

(vii) Slacken the locknut of the voltage adjustment screw and turn the screw (clockwise to raise the setting or anti-clockwise to lower it) until the correct setting is obtained. (See Fig. 82.)

(viii) Retighten the locknut.

(ix) Check the setting by stopping the engine and again raising the generator speed to 3,000 r.p.m.

(x) Restore the original connection and refit the cover.

(b) Current Regulator Adjustment.

On-Load Setting.

The current regulator on-load setting is equal to the maximum rated output of the generator.

Method of Adjustment.

The generator must be made to develop its maximum rated output, whatever the state of charge of the battery might be at the time of setting. The voltage regulator must therefore be rendered inoperative and the function of the crocodile clip used in paragraph (ii) is to short out the voltage regulator contacts.

(i) Remove the control box cover.

(ii) Place a crocodile clip between the insulated fixed contact bracket of the voltage regulator and voltage regulator frame. (See Fig. 82.)

(iii) Disconnect white lead in "Easidrive" harness from terminal A3 on fuse unit; disconnect the cable from control box terminal "B" and connect a first-grade 0-40 moving coil ammeter between this cable and terminal "B".

(iv) Switch on all lamps and accessories.

(v) Start the engine and run the generator at 4,000 r.p.m.

(vi) Observe the ammeter pointer.

The ammeter pointer should be steady and indicate a current equal to the maximum rated output of the generator, i.e., 30 amperes. An unsteady reading may be due to dirty contacts. If the reading is too high or too low, an adjustment must be made.

In this event, continue as follows:—

(vii) Slacken the locknut of the current adjustment screw and turn the screw (clockwise to raise the setting or anti-clockwise to lower it) until the correct setting is obtained.

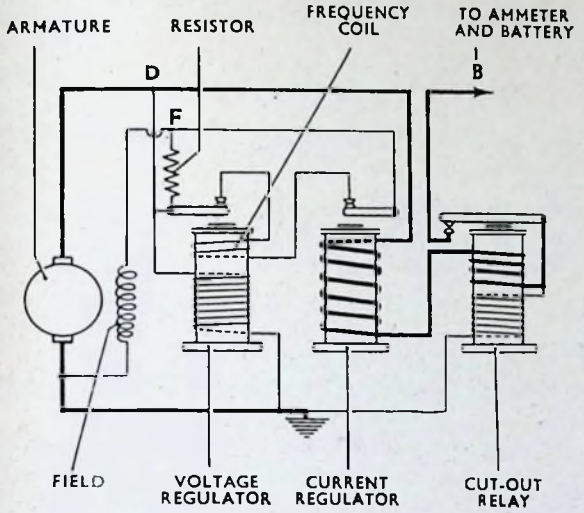


FIG. 81.—Circuit diagram of current/voltage control system.

(viii) Retighten the locknut.
(ix) Switch off and restore the original connections.
(x) Refit the cover.

(c) Cut-out Relay Adjustment.

Electrical Settings.

Cut-in voltage	12.7—13.3
Drop-off voltage	9.5—11.0

Method of Cut-in Adjustment.

Checking and adjusting should be completed as rapidly as possible to avoid heating errors.

(i) Connect a first-grade 0—20 moving coil voltmeter between control box terminal "D" and a good earthing point.
(ii) Switch on an electrical load, such as the headlamps.
(iii) Start engine and slowly increase the engine speed.
(iv) Observe the voltmeter pointer.

Closure of the contacts, indicated by a slight drop in the voltmeter reading, should occur between the limits given above. If the cut-in occurs outside these limits, an adjustment must be made. In this event, continue as follows:—

(v) Remove the control box cover.
(vi) Slacken the locknut of the cut-out relay adjustment screw and turn the screw (clockwise to raise the setting or anti-clockwise to lower it), until the correct setting is obtained. (See Fig. 82.)
(vii) Retighten the locknut.
(viii) Restore the original connection and refit the cover.

Method of Drop-off Adjustment.

(i) Disconnect the cable from control box terminal "B" and connect a first-grade 0—20 moving coil voltmeter between this terminal and earth.
(ii) Start the engine and run up to speed.
(iii) Slowly decelerate and observe the voltmeter pointer.

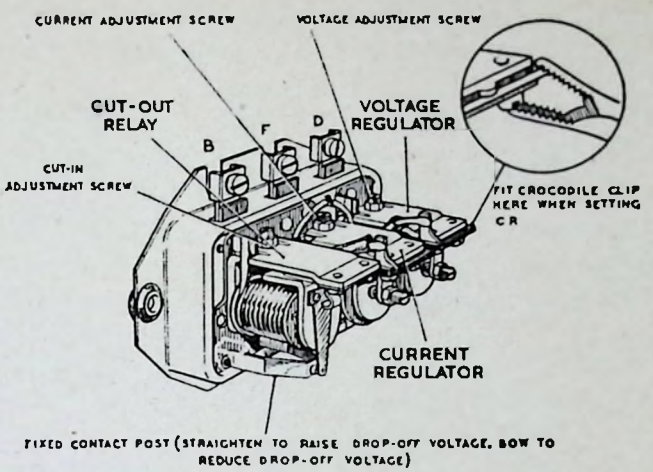


FIG. 82.—Control box with cover removed.

Opening of the contacts, indicated by the voltmeter pointer dropping to zero, should occur between the limits given above. If the drop-off occurs outside these limits, an adjustment must be made. In this event, continue as follows:—

(iv) Stop the engine and remove control box cover.
(v) Adjust the height of the fixed contact post by carefully bowing or straightening the legs of the post to reduce or to raise the drop-off voltage, respectively.
(vi) Repeat (ii) and (iii) and, if necessary, readjust until the correct drop-off setting is obtained.
(vii) Restore the original connections and refit cover.

(d) Cleaning Contacts.

Regulator Contacts.

To clean the voltage or current regulator contacts, use fine carborundum stone or silicone carbide paper followed by methylated spirits (denatured alcohol).

Cut-out Relay Contacts.

To clean the cut-out relay contacts, use a strip of fine glasspaper—never carborundum stone or emery cloth.

GENERAL DATA.

ROAD SPEED (IN M.P.H.) AND EQUIVALENT ENGINE SPEED (R.P.M.).

NOTE: These figures are based on a tyre rolling radius of 12.3" (5.60 × 15 tyres), and do not take account of slip and other variable factors.

M.P.H.	Direct	Intermediate	Low	Reverse
5	311	494	922	964
10	622	988	1842	1926
15	932	1482	2762	2891
20	1243	1976	3688	3852
25	1554	2470	4660	4830
30	1865	2965	5530	5780
35	2176	3460	—	—
40	2487	3952	—	—
45	2798	4448	—	—
50	3108	4940	—	—
55	3419	5440	—	—
60	3730	—	—	—
65	4041	—	—	—
70	4352	—	—	—
75	4663	—	—	—

DATA VARIATIONS FOR CARS WITH AUTOMATIC TRANSMISSIONS.

Transmission Ratios.	Gearbox Internal	Overall
Direct	1 : 1	4.55 : 1
Intermediate	1.59 : 1	7.23 : 1
Low	2.96 : 1	13.49 : 1
Reverse	3.08 : 1	14.01 : 1

Lubrication.

Gearbox oil capacity	2.75 pints (1:5 litres. 3:3 American pints).
Grade	Above 0°F. (—18°C.): S.A.E. multigrade 10W/30. Below 0°F. (—18°C.): S.A.E. multigrade 5W/20.

Electrical Equipment.

Battery	Lucas GTW9A, 51 amp./hr. (at 10 hr. rating).
Generator	Lucas C45PV6 (max. rated output 30 amp.).
Control Box	Lucas RB.310.
Bulbs	One fitted to gear indicator quadrant. Lucas 280, 0.75W.

Weight.

Weight of standard car increased by 112 lb. (51 Kg.).

ENGINE STALL SPEED TEST.

(See pages 10 and 25.)

Add Trimming Resistors to indirect coupling when stall speed is 1,600* r.p.m. or less.

Note 1: Untrimmed stall speeds lower than 1,450 r.p.m. indicate poor engine performance which should be remedied before trimming couplings.

2: Untrimmed stall speeds above 2,150* r.p.m. indicate coupling inefficiency.

*These figures apply to Control Unit Series no A009399 and below. From A009400 onwards the figures should read 1,750 r.p.m. and 2,250 r.p.m respectively.

LOW/INTERMEDIATE FULL THROTTLE GEAR CHANGE TIME TEST.

(See pages 10 and 25.)

Add Trimming Resistors to direct coupling when change time is less than 1.4 seconds.

Note 1: Untrimmed change times exceeding 2.0 seconds indicate coupling inefficiency for new or reconditioned couplings.

2: Untrimmed change times less than 1.2 seconds indicate poor engine performance which should be remedied before trimming coupling.

LOW/INTERMEDIATE LIGHT THROTTLE GEAR CHANGE TIME TEST.

(See pages 10 and 25.)

On a level road at 12-15 m.p.h. not more than 2.0 seconds.

GEARSHIFT CHANGE SPEEDS.

Throttle Position	Gear Change	MP.H.
Light	Low to Intermediate	11 to 13½
Light	Intermediate to Direct	22½ to 25½
Light	Direct to Intermediate	18½ to 21½
Light	Intermediate to Low	7½ to 10
Full	Low to Intermediate	19½ to 23½
Full	Intermediate to Direct	45 to 49
Full	Direct to Intermediate	38 to 41
Full	Intermediate to Low	16½ to 19½

SPECIAL TOOLS AND EQUIPMENT

The following general hand tools are required when carrying out work on the automatic transmission.

Additional equipment and special tools necessary for each functional test, repair or adjustment procedures are listed under appropriate headings below.

HAND TOOLS.

Screwdrivers. 6″ and 12″.
Box spanners, 2BA and 4BA.
Open-ended spanner, $\frac{3}{8}$″ x $\frac{7}{16}$″ UNF.
Open-ended spanner, $\frac{1}{2}$″ x $\frac{9}{16}$″ UNF.
Open-ended spanner, $\frac{11}{16}$″ UNF.
Open-ended spanner, $\frac{7}{16}$″ x $\frac{1}{2}$″ UNF.
Open-ended spanner, $\frac{3}{4}$″ x $\frac{1}{8}$″ UNF.
Open-ended spanner, $\frac{3}{8}$″ x $\frac{5}{16}$″ UNF.
Spanner, $\frac{1}{4}$″ BSF.
Spanner, $\frac{1}{2}$″ AF.
Spanner, $\frac{1}{2}$″ Whitworth or $\frac{9}{16}$″ BSF.
Spanner, $\frac{9}{16}$″ AF.
Ring spanner, $\frac{1}{2}$″ x $\frac{9}{16}$″ UNF.
Set of socket spanners with ratchet and extension handles.
Torque spanner (adjustment in excess of $7\frac{1}{2}$ to $8\frac{1}{2}$ lbs. ft.).
Allen Key, $\frac{1}{8}$″ across flats.
Allen Key, $\frac{3}{16}$″ across flats.
Pliers, long-nose.
Pliers, flat-nose side cutting.
Pliers, circlip—medium.
Pliers, circlip—large straight.
Pin punch, 42 Morse—clearance $\frac{1}{16}$″.
Pin punch, $\frac{3}{32}$″.
Punch and chisel set.
Centre punch.
Feeler gauge set.
Light hammer.
Mallet, copper or hide-faced.

SPECIAL TOOLS AND GENERAL EQUIPMENT.

TESTING AND FAULT DIAGNOSIS.

Garage Equipment.

Wing protection covers.
Electric tachometer.
Ammeter, 0 - 30 amps.

Special Tools.

Test set (Code No. A.200839 (EG 268).
Stop watch.

REMOVAL AND REPLACEMENT OF UNITS.

Garage Equipment.

Wing protection covers.
Pit or ramp.
Hydraulic jack (small bottle type).
Wooden blocks (between jack and sump or coupling housing).
Facilities for draining gearbox before removal.
Depth gauge.
Inspection lamp.

Special Tools.

Spanner RG 264 (removal of gearbox fixing nuts).
Guide studs (local manufacture). (See page 26.)

SERVICING THE THROTTLE AND SELECTOR LINKAGE.

Garage Equipment.

Inspection lamp.
Wing protection covers.

Special Tools.

Small plate guage. (For dimension indicated in paragraph (c), page 29.)
Pointer (local manufacture). (See Fig. 35.)

SERVICING THE WIRING HARNESS.

Garage Equipment.

Avometer (or similar test set) or lamp and battery.

General Tools.

Soldering iron (5 oz.), or light radio type.
Non-corrosive flux.
Soft solder.

SERVICING THE GEARBOX.

Garage Equipment.

Bench or tripod (for supporting gearbox).
Spring tension balance, 0 - 25 lb. reading (with adaptor threaded $\frac{1}{4}$" UNF).
Miniature lamp, battery and leads.

Special Tools.

7600 main tool (for use with 7600/6).
L 212 rear cover oil seal replacer.
RG 260 clamp plate (for solenoid linkage adjustment).
RG 243 stemwheel oil seal replacer.
7600/6 abutment ring remover adaptor.
RG 245 abutment ring replacer.
550 main tool (for RG 245).
Clamp plate (local manufacture). (See fig. 51.)
RG 248 gearbox side cover oil seal replacer and protector.
RG 262 dog switch spanner (for solenoid) (2 per set).
RG 242 oil seal protector for mainshaft.
L 204 rear cover oil seal remover/adaptor.
7657 main tool (for L 204).
Dummy layshaft. (See page 35.)
Dummy reverse idler shaft. (See page 35.)

SERVICING GEARSHIFT SOLENOID.

Garage Equipment.

Ammeter.
Megger.
12-volt supply.
Switch and lead (to carry in excess of 26 amps.).
Spring balance (reading at least 0 - 5 lb.).
Feeler gauges.

Special Tools.

RG 261 slotted nut wrench.
RG 262 solenoid dog switch spanners.
RG 263 solenoid ring wrench.

General Tools.

Pin punch, 42 Morse clearance $\frac{1}{16}$".
Mandrel $\frac{3}{4}$" max. diameter x 3" minimum length.
Soldering iron (5 ozs., or light radio type).
Non-corrosive flux.
Soft solder.

SERVICING THE SELECTOR SWITCH.

Garage Equipment.

12-volt supply.
Lamp and flex.
Megger, 250-volt.

Special Tools.

RG 265 selector switch bush remover and replacer.
RG 265-1 adaptor for RG 265.
RG 265-2 adaptor for RG 265.
Contact height gauge (local manufacture. See page 46).

SERVICING THE COUPLING.

Garage Equipment.

Vee blocks and surface plate.
Bench, clear of all grease and oils and away from all workshop swarf and metal particles.
Dial test indicator.

Special Tools.

RG 246A oil sealer replacer (rear hub bearing).
550 handle for RG 246A.
RG 269 mandrel (for rotor assembly check).

SERVICING THE GENERATOR.

Garage Equipment.

Wing protection covers.
Electric tachometer.
12-volt supply.
Ohm meter. } or 1 moving
Voltmeter (moving coil type, calibrated to read 20 volts). } coil multi-scale meter
Spring gauge (to read at least 50 oz.).

Special Tools.

Brush spring lifter.
Extractor for removing pulley and armature.
Shoulder mandrel for refitting bush:
(diameter of fitting pin 0.6263");
(diameter of shoulder $\frac{3}{4}$").

SERVICING THE CURRENT/VOLTAGE REGULATOR.

Wing protection covers.
Electric tachometer.
Ammeter.
Voltmeter.
Feeler gauges (range 0.0015" to 0.015").

SECTION R

LUBRICATION

RECOMMENDED LUBRICANTS.

ENGINE: Where prevailing climatic temperature is:—

SUMP (OIL PAN)	Above 90°F. (32°C.)	S.A.E. 30 or MULTIGRADE 20W/40
	90F°. to 10F°. (32C°. to minus 12C°.)	S.A.E. 20W/20 or MULTIGRADE 10W/30
	10F°. to minus 10F°. (minus 12C.° to minus 23°C.)	S.A.E. 10W or MULTIGRADE 10W/30
	Below minus 10F°. (minus 23°C.)	MULTIGRADE 5W/20

AIR CLEANER	ENGINE OIL
DISTRIBUTOR:	
SHAFT AND CAM BEARING	ENGINE OIL
CONTACT BREAKER PIVOT	ENGINE OIL
CAM PROFILE	SMEAR OF LIGHT GREASE
AUTOMATIC TIMING (SPARK) CONTROL	ENGINE OIL
GENERATOR	ENGINE OIL
BATTERY TERMINALS	PETROLEUM JELLY
STEERING UNIT	S.A.E. 90 E.P.
FRONT SUSPENSION AND STEERING LINKAGE:	
LINKS, STEERING LINKAGE, IDLER PIVOT AND KING PINS	S.A.E. 140 E.P. or GENERAL PURPOSE GREASE
GEAR SHIFT LINKAGE AND CABLE (Column change)	ENGINE OIL
ACCELERATOR LINKAGE	ENGINE OIL
GEARBOX (TRANSMISSION):	
Above minus 10°F. (minus 23°C.)	MOTOR OIL S.A.E. 30
Below minus 10°F. (minus 23°C.)	MOTOR OIL S.A.E. 20/20W
PROPELLER SHAFT:	
NEEDLE ROLLER BEARINGS	S.A.E. 140 E.P.
REAR AXLE:	
Above minus 32°F. (0°C.)	S.A.E. 140 E.P.
to minus 10°F. (minus 23°C.)	S.A.E. 90 E.P.
Below minus 10°F. (minus 23°C.)	S.A.E. 80 E.P.
WHEEL HUB BEARINGS	WHEEL BEARING GREASE
HANDBRAKE:	
CABLE	S.A.E. 140 E.P. or G.P. GREASE
LINKAGE	ENGINE OIL
BRAKE AND CLUTCH PEDAL PIVOTS	ENGINE OIL
CLUTCH LINKAGE	ENGINE OIL
BRAKE AND CLUTCH MASTER CYLINDER	LOCKHEED BRAKE FLUID S.A.E. Spec. 70 R.1
SHOCK ABSORBERS	NO ATTENTION
BODY HINGES, LOCKS, CATCHES	ENGINE OIL

NOTES.

When a hand gun is employed S.A.E. 140 E.P. is recommended for all chassis points.

Any addition to the above lubricants which may alter their characteristics sufficiently to affect mechanical efficiency should not be used

ENGINE OIL DRAIN PERIOD.

The frequency of the drain period should be related to the driving conditions to which the car is subjected.

The periods shown represent the maximum interval for average driving conditions. It should be reduced for unfavourable conditions and may be extended for definitely favourable conditions.

Favourable.

Essentially long distance journeys, with little or no engine idling, on well surfaced roads reasonably free from dust.

Average.

Predominantly medium length journeys on well surfaced roads with a small proportion of stop/start operation.

Unfavourable.

Any of the following:—

(a) Habitual stop/start driving.

(b) Operation during cold weather especially when appreciable engine idling is involved.

(c) When much driving is done under dusty conditions.

KEY TO LUBRICATION CHART.

PERIODICAL ATTENTION.

DAILY.

29 **Radiator**—Check water level (use soft or rain water).

WEEKLY.

31 **Battery**—Check electrolyte level (to top of separators only)

34, 43 **Tyres**—Check pressures (including spare).

EVERY 250 MILES.

14 **Engine**—Check oil level in sump.

EVERY 1,000 MILES.

29 **Radiator**—Check water level (use soft or rain water).

31 **Battery**—Check electrolyte level.

34, 43 **Tyres**—Check pressure (including spare wheel).

14 **Engine sump**—Check oil level.

10, 11 **Brakes and Clutch**—Check master cylinder fluid level and top up if necessary.

Steering linkage and front suspension:—

18, 23 Lubricate stub axle ball joint and swivel pin.

24, 27 Lubricate track rod joints.

19, 21 Lubricate suspension link bushes.

26 Lubricate idler lever bushes.

2, 41 **Propeller shaft**—Lubricate universal joints.

EVERY 2,000 MILES.

29 **Radiator**—Check water level (use soft or rain water).

31 **Battery**—Check electrolyte level.

34, 43 **Tyres**—Check pressure (including spare wheel).

32, 37 **Engine sump and oil filter**—Drain when hot. Refill with new oil of recommended grade.

10, 11 **Brakes and Clutch**—Check master cylinder fluid level and top up if necessary.

Steering linkage and front suspension:—

18, 23 Lubricate stub axle ball joint and swivel pin.

24, 27 Lubricate track rod joints.

19, 21 Lubricate suspension link bushes.

26 Lubricate idler lever bushes.

2, 41 **Propeller shaft**—Lubricate universal joints.

EVERY 3,000 MILES.

29 **Radiator**—Check water level (use soft or rain water).

31 **Battery**—Check electrolyte level. Clean terminals and smear with petroleum jelly.

34, 43 **Wheels**—Change all wheels diagonally.

34, 43 **Tyres**—Check pressures (including spare wheel).

14 **Engine sump**—Check oil level.

33 **Oil bath air cleaner**—Clean and refill with fresh oil.

Sparking plugs—Clean and check gaps.

Distributor:—

13 Oil automatic timing mechanism.

13 Grease cam profile.

13 Oil contact breaker moving contact pivot.

13 Oil shaft and cam bearing.

13 Check contact breaker gap, clean and adjust if necessary and reset ignition timing.

Accelerator—Oil cable control linkage and pedal fulcrum.

36 **Gearbox**—Check oil level.

12, 38 **Gearshift mechanism**—Lubricate. **Column change only.**

11, 40 **Clutch**—Check master cylinder fluid level and top up if necessary. Oil withdrawal lever jaw pin (slave cylinder to withdrawal lever). Check free movement at end of withdrawal lever and adjust if necessary. Inspect hydraulic pipe connections for leaks.

Brake and clutch pedals—Oil pivot bushes and linkage joints.

10 **Brakes**—Check master cylinder fluid level and top up if necessary. Inspect hydraulic pipe connections, pipe lines and unions for leaks. Test and adjust if necessary.

1, 6, 9 Lubricate handbrake cable and linkage.

16 **Steering unit**—Top up.

Steering linkage and front suspension:—

18, 23 Lubricate stub axle ball joint and swivel pin.

24, 27 Lubricate track rod joints.

19, 21 Lubricate suspension link bushes.

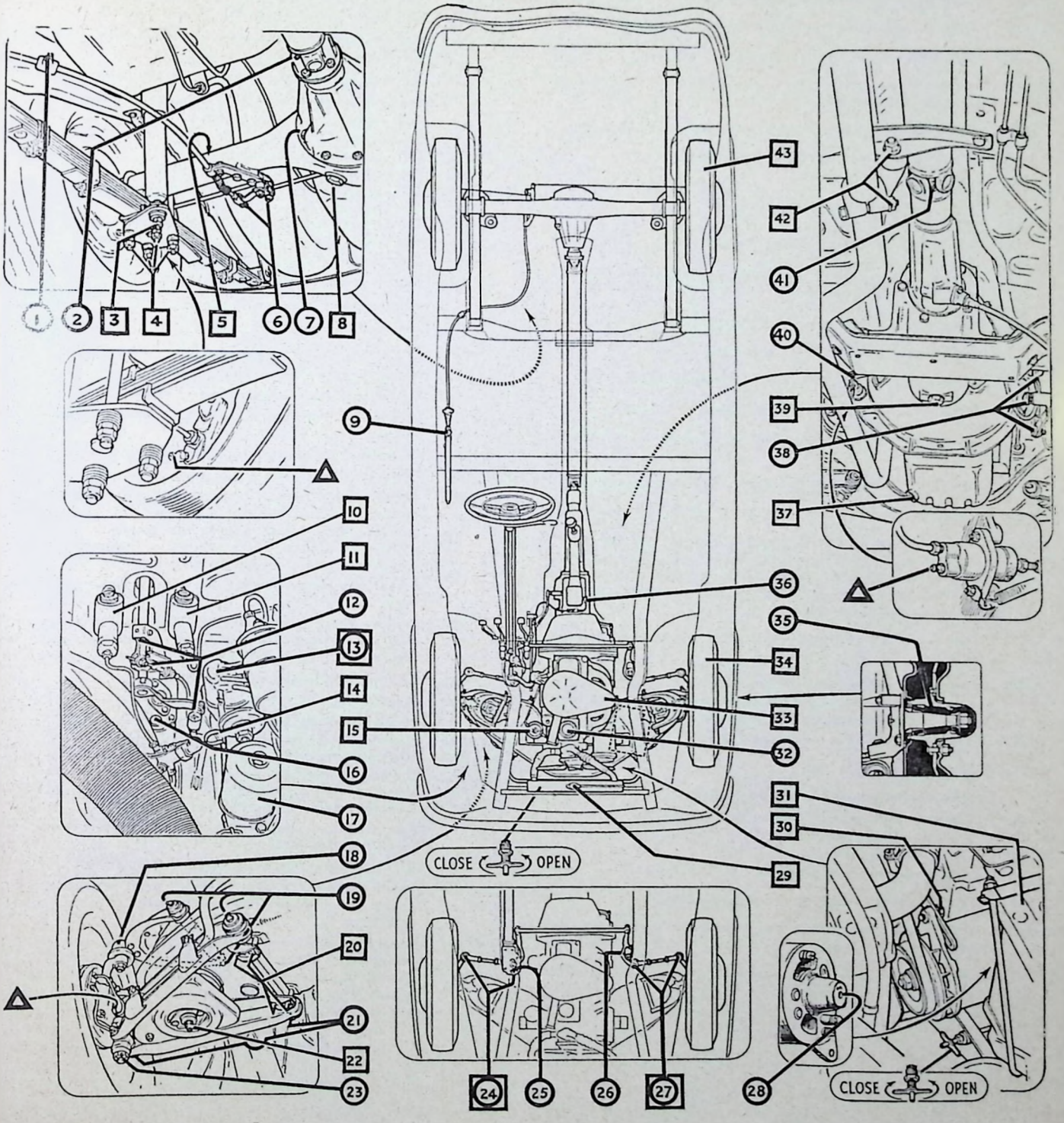
26 Lubricate idler lever bushes.

2, 41 **Propeller shaft**—Lubricate universal joints.

7 **Rear axle**—Check level and top up.

Body—Oil door strikers, catches, hinges, bonnet and boot hinges and catches. Check drain holes in lower edge of each door.

LUBRICATION CHART



3—(*Lubrication*)

EVERY 6,000 MILES.

29 **Radiator**—Check water level (use soft or rain water).

31 **Battery**—Check electrolyte level. Clean terminals and smear with petroleum jelly.

34, 43 **Wheels**—Change all wheels diagonally.

34, 43 **Tyres**—Check pressures (including spare wheel).

17 **Oil Filter**—Drain when hot. Renew element.

32, 37 **Engine sump**—Drain when hot. Refill with new oil of recommended grade.

33 **Oil bath air cleaner**—Clean and refill with fresh oil.

Sparking plugs—Clean and check gaps.

Distributor:—

13 Oil automatic timing mechanism.
13 Grease cam profile.
13 Oil contact breaker moving contact pivot.
13 Oil shaft and cam bearing.
13 Check contact breaker gap, clean and adjust if necessary, and reset ignition timing.

28 **Generator**—Lubricate rear bearing.

Carburetter—Clean float chamber.

15 **Fuel pump**—Clean filter and sediment chamber.

30 **Fan belt**—Check tension and adjust if necessary.

Accelerator—Oil cable, control linkage and pedal fulcrum.

12, 38 **Gearshift mechanism**—Lubricate. **Column change only.**

36, 39 **Gearbox**—Drain (when hot) and refill with fresh oil.

11, 40 **Clutch**—Check master cylinder fluid level and top up if necessary. Oil withdrawal lever jaw pin (slave cylinder to withdrawal lever). Check free movement at end of withdrawal lever and adjust if necessary. Inspect hydraulic pipe connections for leaks.

Brake and clutch pedals—Oil pivot bushes and linkage joints.

10 **Brakes**—Check master cylinder fluid level and top up if necessary, Inspect hydraulic pipe connections, pipe lines and unions for leaks. Test and adjust if necessary.

1, 6, 9 Lubricate handbrake cable and linkage.

15 **Steering unit**—Top up.

Steering linkage and front suspension:—

18. 23 Lubricate stub axle ball joints and swivel pin.
24. 27 Lubricate track rod joints.
19. 21 Lubricate suspension link bushes.
26 Lubricate idler lever bushes.

2. 41 **Propeller shaft**—Lubricate universal joints.

5, 7, 8 **Rear axle**—Drain (when hot) and refill with fresh oil. Clean breather hole.

Body—Oil door strikers, catches, hinges, bonnet and boot hinges and catches. Check drain holes in lower edge of each door.

EVERY 12,000 MILES.

29 **Radiator**—Check water level (use soft or rain water).

31 **Battery**—Check electrolyte level. Clean terminals and smear with petroleum jelly.

34, 43 **Wheels**—Change all wheels diagonally.

34, 43 **Tyres**—Check pressures (including spare wheel).

17 **Oil filter**—Drain when hot. Renew element.

32, 37 **Engine sump**—Drain when hot. Refill with new oil of recommended grade.

33 **Oil bath air cleaner**—Clean and refill with fresh oil.

Sparking plugs—Clean and check gaps. Test and renew if necessary.

Distributor:—

13 Oil automatic timing mechanism.
13 Grease cam profile.
13 Oil contact breaker moving contact pivot.
13 Oil shaft and cam bearing.
13 Check contact breaker gap, clean and adjust if necessary, and reset ignition timing.

28 Generator—Lubricate rear bearing and clean commutator.

Starter motor—Clean commutator.

Carburettor—Clean float chamber.

15 **Fuel pump**—Clean filter and sediment chamber.

30 **Fan belt**—Check tension and adjust if necessary.

Valve rockers—Check and adjust clearances.

Cylinders—Check compression pressures.

Accelerator—Oil cable, control linkage and pedal fulcrum.

12, 38 **Gearshift mechanism**—Lubricate. **Column change only.**

36, 39 **Gearbox**—Drain (when hot) and refill with fresh oil.

11, 40 **Clutch**—Check master cylinder fluid level and top up if necessary. Oil withdrawal lever jaw pin (slave cylinder to withdrawal lever). Check free movement at end of withdrawal lever and adjust if necessary. Inspect hydraulic pipe connections for leaks.

Brake and clutch pedals—Oil pivot bushes and linkage joints.

10 **Brakes**—Check master cylinder fluid level and top up if necessary. Inspect hydraulic pipe connections, pipe lines and unions for leaks. Test and adjust if necessary.

1, 6, 9 Lubricate handbrake cable and linkage.

16 **Steering unit**—Top up.

Steering linkage and front suspension:—

18, 23 Lubricate stub axle ball joint and swivel pin.
24, 27 Lubricate track rod joints.
19, 21 Lubricate suspension link bushes.
26 Lubricate idler lever bushes.
2, 41 Propeller shaft—Lubricate universal joints.
5, 7, 8 **Rear axle**—Drain (when hot) and refill with fresh oil. Clean breather hole.

35 **Hub bearings**—Check lubrication and end float.

Body—Oil door strikers, catches, hinges, bonnet and boot hinges and catches. Check drain holes in lower edge of each door.

3, 4, 20 **General**—Check mounting bolts for tightness (engine,
22, 24 transmission, propeller shaft, exhaust system, shock
27, 42 absorbers, rear spring "U" bolts and front suspension bottom link fulcrum pin securing bolts). Check steering ball joints for correct alignment.