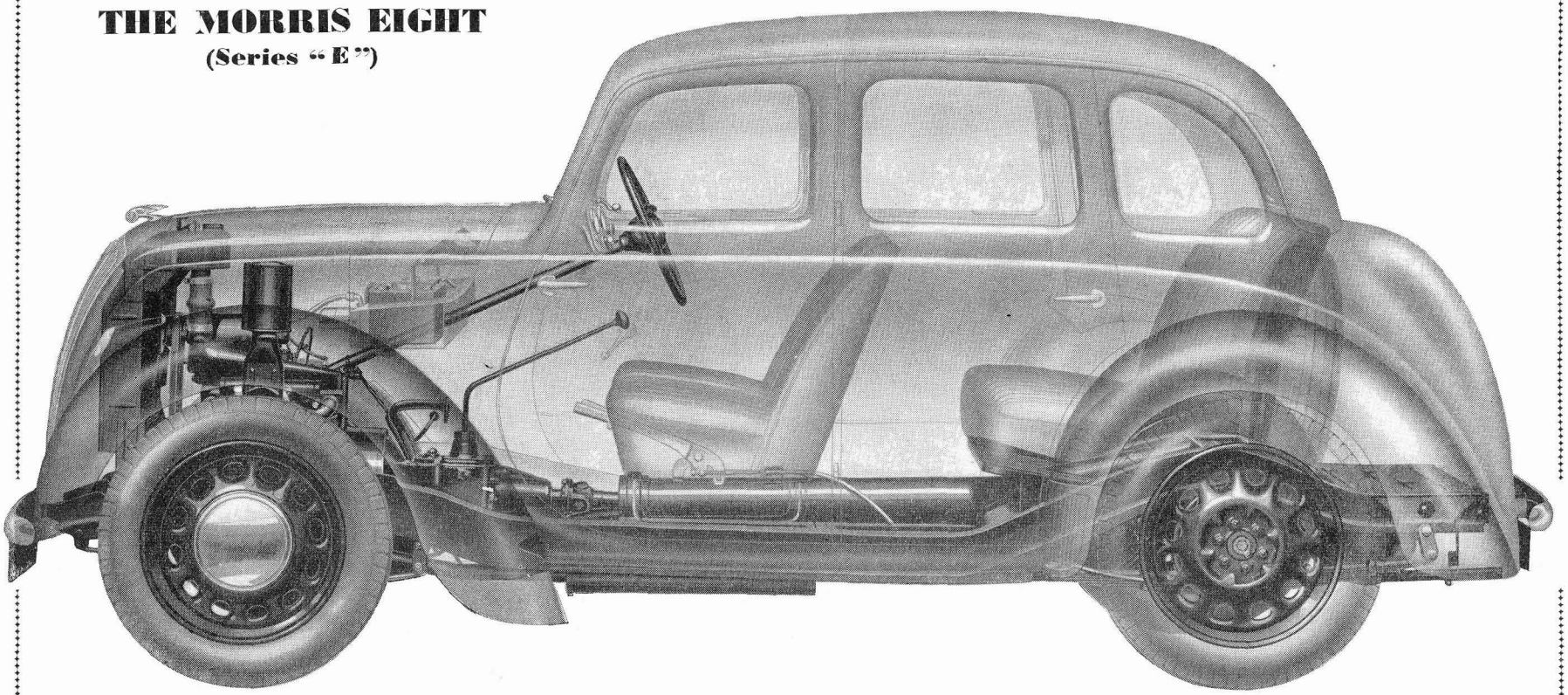
The MORRIS EIGHT
(Series "E")
WORKSHOP MANUAL

Issued by
MORRIS MOTORS LIMITED
COWLEY - OXFORD - ENGLAND

THE MORRIS EIGHT
(Series "E")



CONTENTS

GENERAL DATA

ENGINE U.S.H.M. 1

Number of cylinders	Four.
Treasury rating	8.057 h.p.
C.C.	918.636
B.H.P.	29.6 at 4,400 r.p.m.
Bore	57 mm. (2.244 in.).
Stroke	90 mm. (3.543 in.).
Compression ratio	6.5/6.7–1.
System of cooling	Thermo syphon and fan.
Radiator hose top	5 in. × $1\frac{3}{4}$ in. (127 mm. × 44.45 mm.).
Radiator hose bottom	$8\frac{1}{4}$ in. × $1\frac{5}{8}$ in. (21 cm. × 4.1 cm.).
First oversize bore	+.010 in. (.25 mm.).
Maximum oversize for boring	+.060 in. (1.5 mm.).
Firing order	1–3–4–2.
Piston clearance (top)	.40 mm. (.016 in.) top land ; .30 mm. (.012 in.) bottom land.
Piston clearance (bottom)	Slotted .06 mm. (.0024 in.).
Ring gap	.0025—.0065 in. (.06 mm.—.16 mm.).
Number of compression rings	Two
Width of compression rings	2.5 mm. (.100 in.).
Number of oil rings	One.
Width of oil rings	3 mm. (.118 in.).
Oil pressure, lb. sq. in.	30 to 60 at 30 m.p.h. (2.1—4.2 kg./cm.^{2} at 48 km.p.h.)
Gudgeon pin type	Semi-floating.
Gudgeon pin diameter	15 mm. (.591 in.).
Fit in piston	Floating.
Fit in connecting rod	Clamped.
Crankpin diameter (standard)	40 mm. (1.575 in.).
Crankpin minimum diameter for regrind	38.75 mm. (1.526 in.).
Connecting rod—length between centres	165 mm. (6.496 in.).
Connecting rod—type of bearing	Shimless, steel backed, white metal lined.
Connecting rod—side clearance	.100 mm.—.150 mm. (.004 in.—.006 in.).
Connecting rod—diametrical clearance	.03 mm. (.001 in.—.002 in.).
Number of crankshaft bearings	Three.
Type of main bearings	Shimless, steel backed, white metal lined.
Standard main journal diameter	42 mm. (1.654 in.).
Main journals minimum diameter for regrind	40.75 mm. (1.604 in.).
Main Bearings—length	Front 34 mm. (1.338 in.). Centre 35 mm. (1.378 in.). Rear 36.5 mm. (1.437 in.).
Main bearing—end clearance	.035 mm.—.095 mm. (.0015 in.—.0038 in.).
Main bearing—diametrical clearance	.03 mm. (.001 in. to .0015 in.).
End thrust taken on—crankshaft	Centre main bearing.
Number of camshaft bearings	Three.
Type of camshaft bearing	Plain (running in block).
Camshaft—bearing clearance	.06 mm. (.0024 in.).
Camshaft—end thrust taken on	Single blade thrust spring.
Camshaft drive (type)	Chain (duplex roller)
Valve timing markings	" T " mark on teeth and bright links on chain.
Exhaust valve diameter	Head 28 mm. (1.102 in.) and stem 7 mm. (.276 in.).
Inlet valve diameter	Head 28 mm. (1.102 in.) and stem 7 mm. (.276 in.).
Valve seat angle	45°.

GENERAL DATA—*continued*

Tappet type	Hollow chill cast.
Inlet valve clearance for timing	.018 in. (.46 mm.).
Inlet valve opens	8° early.
Inlet valve closes	52° late.
Exhaust valve opens	52° early.
Exhaust valve closes	20° late.
Inlet valve opens—piston traverse	.557 mm. B.T.D.C. (.022 in.).
Inlet valve working clearance	.017 in. hot. (.43 mm.)
Exhaust valve working clearance	.017 in. hot (.43 mm.).
Valve guides	Removable.

FUEL SYSTEM

Petrol tank level	Recorded by electric gauge on instrument panel.
Fuel delivery	S.U. electric pump, Type "L," 6-volt.
Carburetter	S.U. horizontal type.
Carburetter needles	Rich—M.9 ; Standard—E.K. ; Weak—M.O.W.

CLUTCH

Type	Borg & Beck 6¼ in. (158.7 mm.) dry plate A-G.
Facing	Borg & Beck composite.

GEARBOX

Synchromesh	Second, Third, Top.
Ratio	Reverse and First 3.95–1. Second 2.3–1. Third 1.54–1. Top 1–1.

FRONT AXLE AND STEERING, ETC.

Camber	2½°.
Caster angle	2½°.
Toe-in	⅛ in. (3.175 mm.).
King pin inclination	6½°.
Track	46¼ in. (1.175 m.) rear, 44⅝ in. (1.133 m.) front.
Turning circle	R.H. 35 ft. 11 in. (10.95 m.) ; L.H. 32 ft. 7 in. (9.931 m.).
Wheelbase	7 ft. 5 in. (2.261 m.).
Tyre size and pressure	4.50–17. Normal pressures : Front : 24 lb. (1.7 kg./cm.²). Rear : 27 lb. (1.9 kg. cm.²). Fully loaded : Front : 26 lb.(1.83 kg./cm.²). Rear : 29 lb. (2.04 kg./cm.²).

REAR AXLE

Type of axle	Three-quarter floating.
Type of drive	Spiral bevel.
Ratio or number of teeth	7×37 ; 5.286 to 1.
Adjustment	Pinion—shims, crown wheel—adjusting nuts.
End play—inches	Nil.
Backlash—inches	.008 in. (.20 mm.)—.010 in. (.25 mm.).

GENERAL DATA—*continued*

BRAKES

Type	Lockheed hydraulic.
Type of linings	Ferodo.
Lining size—front	7½ in. × 1⅛ in. × 3/16 in. (19.05 cm. × 2.86 cm. × 4.8 mm.).
Lining size—rear	7½ in. × 1⅛ in. × 3/16 in. (19.05 cm. × 2.86 cm. × 4.8 mm.).

SPRINGS

Type	Semi-elliptic.
Length—front	32 in. (81.3 cm.).
Width—front	1½ in. (38.1 mm.).
Number of leaves—front	Five.
Thickness of leaves—front	Four leaves 3/16 in. (4.76 mm.) and one leaf 5/32 in. (3.97 mm.).
Camber—front	4.13 in. free (104.9 mm.).
Working load—front	450 lb. (204 kg.).
Length—rear	40 in. (101.6 cm.).
Width—rear	1½ in. (38.1 mm.).
Number of leaves—rear	Five leaves 15/64 in. (5.95 mm.) and two leaves 13/64 in. (5.16 mm.).
Camber—rear	2.3 in. free (58.4 mm.).
Working load—rear	560 lb. (254 kg.).

HYDRAULIC DAMPERS

Type	Armstrong vertical piston double acting (front and rear).

ELECTRICAL

Distributor rotation	Anti-clock.
Manual advance	No.
Automatic advance	Yes.
Breaker gap	.010 in.—.012 in. (.25 mm.—.30 mm.).
Plug make and type	Champion L.10 14 mm. ½ in. reach.
Plug gap	.018 in.—.022 in. (.46 mm.—.56 mm.).
Firing order	1–3–4–2.
Ignition timing—degrees	T.D.C. (fully retarded), final setting by road trial.
Charging system	Compensated voltage control.
Battery—capacity and make, type	51 AA Lucas STXW9E 6-volt.
Battery earth	Positive.

CAPACITIES

Sump	6 pints (3.4 litres).
Gearbox	1½ pints (.85 litres).
Rear axle	1 pint (.6 litres).
Cooling system	15 pints (8.5 litres).
Petrol	5½ gallons (25 litres).

GENERAL DIMENSIONS

Overall length	12 ft. 0 in. (3.658 m.).
Overall height	5 ft. 2 in. (1.575 m.).
Overall width	4 ft. 8 in. (1.423 m.).
Ground clearance	6⅜ in. (162 mm.).
Total weight	15¼ cwt. (775 kg.).

MAINTENANCE ATTENTION

FIRST 500 MILES (800 KM.) FREE SERVICE ATTENTION

(*a*) Drain sump, gearbox and back axle, and refill with appropriate N.O.L. lubricant.

(*b*) Oil and grease vehicle throughout with appropriate N.O.L. lubricant.

Note.—New lubricants chargeable to customers.

(*c*) Check, and if necessary, adjust :—

(1) Ignition timing.

(2) Tappet clearances.

(3) Carburetter control gear, mixture setting and slow running.

(4) Dynamo drive belt.

(5) Correct clearance for clutch pedal.

(6) Alignment of front wheels.

(7) All steering controls.

(8) Tyre pressures.

(*d*) Adjust brakes and check level of Lockheed fluid in supply tank.

(*e*) Look over and tighten all nuts, particularly cylinder head, wheels, spring clips and body bolts.

(*f*) Top-up battery and check working of all electrical equipment.

All this first service is free, only material used being charged for.

PERIODICAL

Every 250 miles (400 km.) : Inspect oil level in engine. Refill if necessary.

Every 500 miles (800 km.) : See that wheel nuts are tight. Oil up the steering gear.

Attach oilgun to Enots fittings, and give pump three or four strokes.

These Enots are situated as under :—

2 on front spring front anchorage pins,	1 on brake pedal,
4 on front axle knuckles,	1 on clutch pedal,
2 on steering track rod,	1 on propeller shaft sliding joint,
2 on steering draglink,	2 on propeller shaft universal joint spiders,

making 15 in all.

See that radiator is full of water. The water level should never be allowed to sink so low that the opening for the cylinder outlet-pipe is not fully covered.

Test tyre pressures. (See Section O.1).

Every 1,000 miles (1,600 km.) : Inspect oil level in gearbox and rear axle. Refill if necessary.

Examine level in Lockheed brake supply tank and replenish with Lockheed Orange fluid if necessary.

Add two drops of thin oil to distributor oiler.

Top-up battery.

Add N.O.L. "Twenty" oil to carburetter piston dashpot.

Every 3,000 miles (5,000 km.) : Drain engine and refill with fresh oil. (Page 13.)

Withdraw rotating arm from distributor and add two drops of thin machine oil in the aperture.

Remove also contact breaker platform and lubricate the automatic advance mechanism with engine oil.

Every 6,000 miles (10,000 km.) : Remove filters from carburetter and petrol pump, clean and replace. (See Section B.)

Drain gearbox and rear axle. Refill with fresh oil.

Remove wheel covers and give one stroke of oilgun to nipple.

Examine the gaps of the sparking plug points and make sure that they are not too wide ; they should be .018 in. to .022 in. (.5 mm. to .6 mm.).

Add a smear of Duckham's " Laminoid " grease to the distributor cam contact breaker pivot.

Every 12,000 miles (20,000 km.) : Remove sump and oil pump, clean and refill with fresh oil. Examine fluid level in shock absorbers and replenish with Armstrong fluid if necessary.

Remove dynamo lubricator cap and refill with Duckham's " Laminoid " grease.

Replace sparking plugs with new ones.

Adjust clutch pedal clearance. (See Section E.1.)

FROST PRECAUTIONS

If the car is not stored in a warmed building, steps must be taken to prevent the cooling water from freezing during frosty weather. Water upon freezing expands, with the result that there is a very considerable risk of bursting either the radiator or the cylinder block by the pressure generated. As a precautionary measure when frost is anticipated, the water should be drawn from the radiator before the car is stored for the night, or, better still, an anti-freezing solution may be used in the radiator.

We recommend the use of Smith's " Bluecol " non-corrosive anti-freeze in order to protect the cooling system during frosty weather and reduce corrosion to a minimum.

The recommended quantities of " Bluecol " for different degrees of frost resistance are :—

15° of frost (--8° C.)	25° of frost (--14° C.)	35° of frost (-19° C.)
size 1	sizes 0 and 01	size 2

First decide what degree of frost protection is required before adding the anti-freeze to the radiator.

Make sure that the cooling system is watertight and examine all joints, replacing any defective rubber hose with new.

Before introducing anti-freeze mixture to the radiator it is advisable to clean out the cooling system thoroughly by draining out the water and swilling out the water passages with a hose inserted in the water filler cap opening, keeping the drain tap open.

Avoid excessive topping-up, otherwise there is the risk of losing valuable anti-freeze due to the expansion of the solution. Only top-up when the cooling system is at its normal running temperature.

Generally speaking, anti-freeze is not injurious to cellulose paint, provided it is wiped off in reasonable time. It must not, however, be allowed to remain on the paintwork.

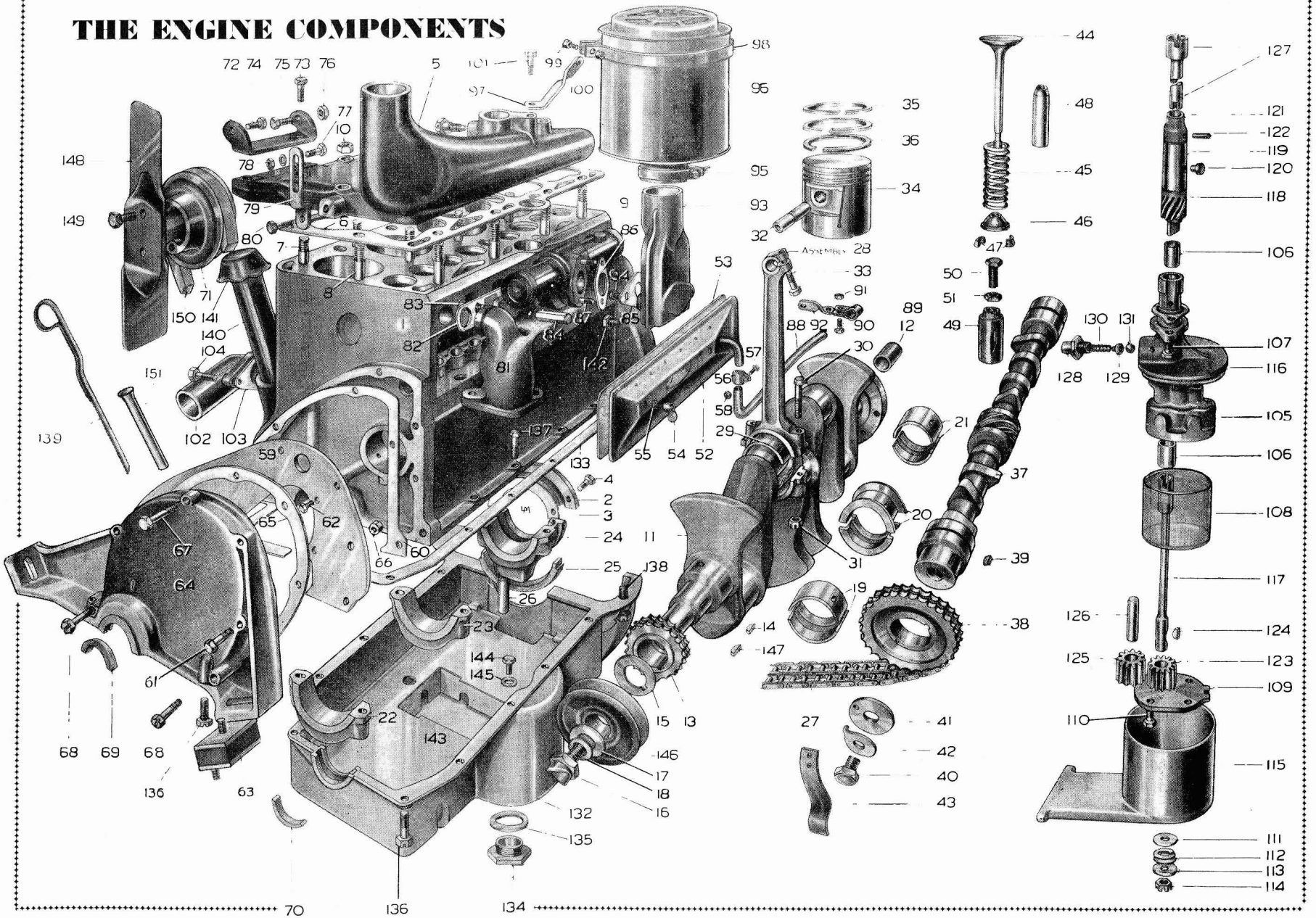
SECTION A

ENGINE U.S.H.M. 1

General Description.

Lubrication System.

THE ENGINE COMPONENTS



KEY TO ENGINE COMPONENTS

No.	Description
1.	Cylinder block assembly.
2.	Oil seal cover.
3.	Joint for oil seal cover.
4.	Bolt for oil seal cover.
5.	Cylinder head.
6.	Gasket.
7.	Stud for cylinder head (short).
8.	Stud for cylinder head (medium).
9.	Stud for cylinder head (long).
10.	Nut for head.
11.	Crankshaft.
12.	Bush for drive gear (in crankshaft).
13.	Gear.
14.	Key for gear.
15.	Oil thrower.
16.	Nut (special) (starter handle dog).
17.	Washer for pulley.
18.	Shim for nut.
19.	Main bearing (front).
20.	Main bearing (centre).
21.	Main bearing (rear).
22.	Cap for main bearing (front).
23.	Cap for main bearing (centre).
24.	Cap for main bearing (rear).
25.	Seal for bearing cap (rear).
26.	Oil drain pipe (rear).
27.	Chain (timing).
28.	Connecting rod and cap.
29.	Bearing (halves).
30.	Bolt for cap.
31.	Nut for cap bolt.
32.	Gudgeon pin.
33.	Clamp screw for gudgeon pin.
34.	Piston assembly.
35.	Piston ring (top).
36.	Piston ring (bottom).
37.	Camshaft.
38.	Gear.
39.	Key for gear.
40.	Thrust screw.
41.	Washer for thrust screw.
42.	Lock washer for thrust screw.
43.	Thrust spring.
44.	Valve.
45.	Spring for valve.
46.	Spring cap.
47.	Retainer for spring cap.
48.	Valve guide.
49.	Tappet.
50.	Adjusting screw for tappet.
51.	Locknut for adjusting screw.
52.	Tappet cover.
53.	Joint for tappet cover.
54.	Wing nut for cover stud.
55.	Washer for cover stud.
56.	Clip for breather elbow.
57.	Bolt for breather elbow clip.
58.	Nut for clip bolt.
59.	Front packing plate.
60.	Joint (to block).
61.	Bolt (chain case to packing plate).
62.	Bolt (small head) (packing plate to block).
63.	Front support block.
64.	Timing case.
65.	Joint (to timing chain case).
66.	Nut for bolt.
67.	Bolt (timing chain case to block).
68.	Bolt (slotted) (timing chain case to block).
69.	Packing (in timing case) (top).
70.	Packing (in sump) (bottom).
71.	Pulley for dynamo.
72.	Bracket for dynamo.
73.	Bolt for dynamo bracket.
74.	Swivel bolt (front).
75.	Swivel bolt (rear).
76.	Nut for swivel bolt.
77.	Bolt (adjusting).
78.	Nut.
79.	Dynamo link.
80.	Bolt for dynamo link.
81.	Exhaust manifold.
82.	Gasket for manifold.
83.	Stud for exhaust manifold.
84.	Nut for stud in cylinder block (barrel type).
85.	Gasket (carburetter).
86.	Gasket for carburetter (Hallite).
87.	Stud (carburetter).
88.	Fume vent pipe.
89.	Clip.
90.	Bolt for clip.
91.	Nut for clip bolt.
92.	Support.
93.	Pipe (carburetter to air silencer).
94.	Bolt (carburetter to pipe).
95.	Clip (air silencer to pipe).
96.	Air silencer.
97.	Support (to cylinder head).
98.	Clip (air silencer to support).
99.	Bolt (clip to support).
100.	Nut for clip bolt.
101.	Bolt (support to cylinder head).
102.	Water inlet pipe.
103.	Joint for inlet pipe.
104.	Bolt (to block).
105.	Oil pump body assembly (with bushes).
106.	Bush.
107.	Bolt (body to block).
108.	Gauze.
109.	Cover for body.
110.	Bolt (cover to body).
111.	Fibre washer for stud.
112.	Spring washer (special).
113.	Plain washer.
114.	Nut.
115.	Body hood.
116.	Joint (hood to body).
117.	Shaft.
118.	Gear for oil pump shaft.
119.	Bush for oil pump shaft (in block).
120.	Dowel for shaft bush.
121.	Shaft connection.
122.	Pin for shaft connection.
123.	Gear (driver).
124.	Key (gear).
125.	Gear (driven).
126.	Pin for driven gear.
127.	Distributor shaft assembly.
128.	Release plug.
129.	Release pad.
130.	Release spring.
131.	Release ball.
132.	Sump.
133.	Joint (sump to block).
134.	Drain plug.
135.	Washer for drain plug.
136.	Bolt (to block) (short).
137.	Bolt (to block) (medium).
138.	Bolt (to block) (long).
139.	Oil level indicator.
140.	Oil filler (with baffle assembly).
141.	Cap for oil filler.
142.	Oil test union.
143.	Tray.
144.	Bolt (tray to sump).
145.	Washer (tray to sump).
146.	Pulley (crankshaft).
147.	Key for pulley.
148.	Blade.
149.	Bolt (blade to pulley).
150.	Belt.
151.	Guide for level indicator.

GENERAL DESCRIPTION

The four-cylinder, side-valve engine is built in unit construction with a single plate dry clutch and four-speed gearbox.

It has a robust four-throw crankshaft, carried in three renewable white metal steel-backed bearings fitted without shims.

The thrust is taken by the centre bearing, which is flanged for this purpose.

The connecting rod big-end bearings are also renewable white metal lined steel-backed bearings fitted without shims. The little-end, embracing the gudgeon pin, is slotted and fitted with a clamp screw and spring washer, which serve to lock it solidly to the gudgeon pin.

The pistons are of tin-coated aluminium alloy, and are fitted with two compression rings and one oil control ring.

The camshaft is supported in three bearings in the cylinder block casting and is driven from the crankshaft by a Duplex roller chain. The camshaft bearings are pressure fed with oil from the main oil gallery.

The camshaft operates the valves through the medium of chill cast tappets, located in guides cast integrally with the block. Provision for adjustment of the tappets is made by the orthodox tappet head screw and locknut.

Cooling is by thermo-syphon action assisted by a fan secured to the dynamo pulley.

THE LUBRICATION SYSTEM

The oil supply is carried in the sump below the cylinder block. An oil filler and an oil indicator rod are fitted on the off-side of the engine. The oil level indicator rod has two marks on its lower extremity, indicating the maximum and minimum levels.

The gear type oil pump is carried in the sump of the engine, and is driven from a helical gear on the camshaft. It draws the oil from the sump through a large filter and thus delivers clean oil to the pumpshaft tunnel.

At its upper end, the pumpshaft tunnel connects with a horizontal oil gallery running from front to rear of the engine, from which the oil is fed to the camshaft bearings and crankshaft main bearings through drilled passages.

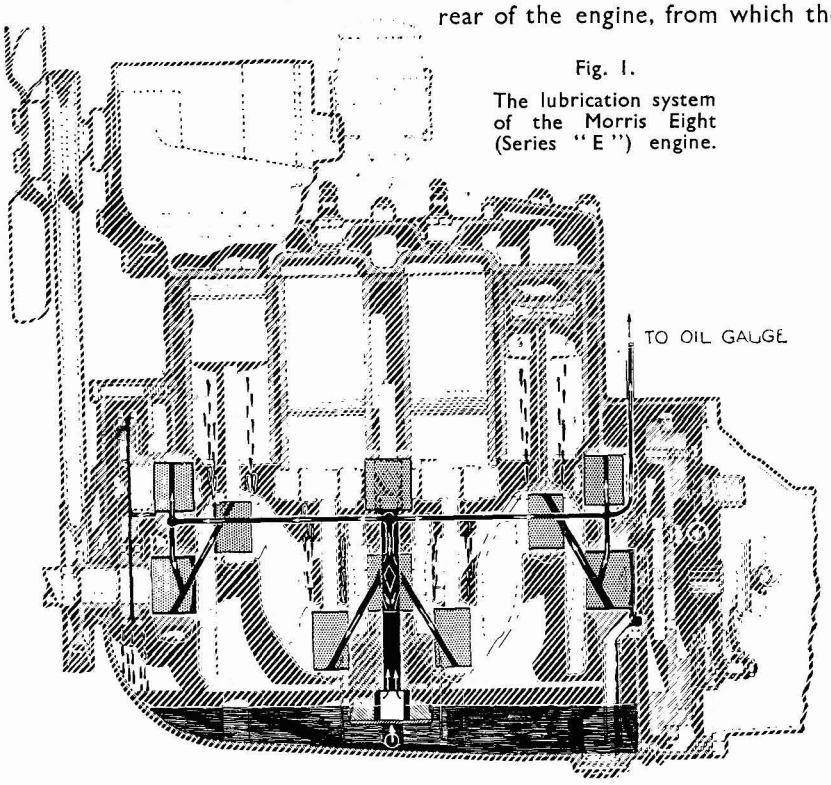


Fig. 1.
The lubrication system of the Morris Eight (Series "E") engine.

Drilled passages in the crankshaft provide lubrication for the big-end bearings, the surplus oil from which splashes on to the camshaft, tappet gear, and cylinder walls.

An oil pipe connects the rear end of the main oil gallery with the oil gauge on the instrument panel. A release valve of the non-adjustable ball type is fitted on the delivery side of the pump to deal with cases of excessive pressure.

The timing chain is well lubricated by surplus oil from the front camshaft bearing, through passages which transfer it into the concave rim of the chain wheel by centrifugal action and then through radial feed holes on to the chain itself.

Section A.1

DRAINING THE ENGINE SUMP

The sump on new and reconditioned engines must be drained and filled with new oil after the first 500 miles (800 km.) and then at intervals of every 3,000 miles (5,000 km.). The large hexagon-headed drain plug is centrally situated at the rear end of the sump. The oil should preferably be drained when the engine is hot, in which condition it will flow more readily.

Unless the sump is to be removed and cleaned, it should be allowed to drain for at least ten minutes before the drain plug is replaced. When the sump has been drained, approximately 6 pints (3.4 litres) of oil are required to fill it.

Section A.2

REMOVAL AND REPLACEMENT OF SUMP

The sump is located by ten $\frac{3}{16}$ in. hexagon-headed bolts and spring washers inserted from the underside of the sump flange and two screwed in from the top at either side of the oil pump housing.

Important.—Avoid displacing the hood of the oil pump when removing and replacing the sump, as any such displacement may distort or break the gasket between the hood and the pump body, and so cause an air leak on the suction side, resulting in a loss of oil pressure. Should there be any doubt about the condition of the gaskets, fit new ones.

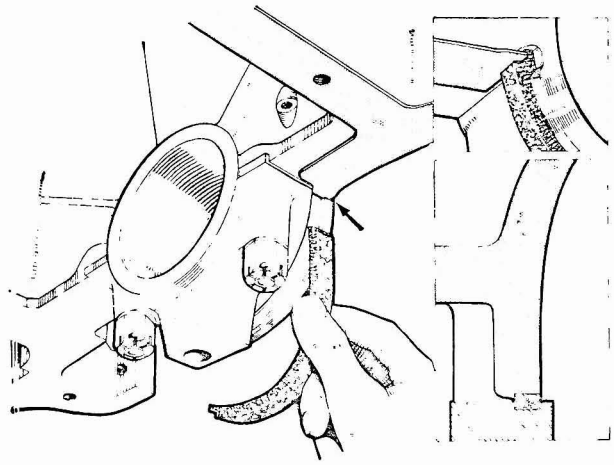


Fig. 2.

The fitting of the cork sealing strip at the rear bearing is most important to prevent oil leakage. Here is shown the correct method.

To remove the sump, raise the front of the car, so that the full weight of the front axle is suspended on the front springs. This will provide sufficient clearance between the axle beam and the engine base for the sump to be withdrawn after the sump bolts have been removed. With the engine in position, it is also essential to disconnect the exhaust pipe flange, and position the exhaust pipe to give clearance for the sump upon removal. Remove the three $\frac{1}{4}$ in. hexagon-headed bolts inserted through the clutch housing into the sump and the twelve bolts mentioned above. The sump can then be withdrawn downwards, if moved sufficiently to the near-side to clear the oil pump.

To clean the sump remove the three sump tray securing bolts, the sump tray and drain plug. Wash out all oil from the sump with paraffin and clean all deposit from the drain plug. Thoroughly dry the sump and refit the tray and drain plug.

When refitting the sump to the engine particular attention should be given to the three sealing gaskets. They are :—

1. The gasket on the crankcase face.
2. The cork strip fitted into the recess in the rear main bearing cap.
3. The packing fitted into the recess in the front of the engine sump.

If the gaskets are in good condition and have not been damaged during the removal of the sump they may be used again, but damage generally takes place and it is therefore advisable to fit new ones.

Before fitting new gaskets, remove all traces of the old ones from the crankcase face, the sump face and the recess in the rear main bearing cap. Smear the faces of the crankcase joint with a light coating of grease. Next fit the two halves of the large gasket to the crankcase face, so that the holes in the gasket and crankcase register, and the ends of the gasket (see arrow, Fig. 2) fit against the side of the rear main bearing cap.

The cork strip should then be fitted tightly into the recess of the main bearing cap, taking care that the stepped ends fit the small recess (shown black in the sketch) at each end of the bearing without damaging the cork.

When correctly fitted, the step of the cork strip will overlap and seal the ends of the sump gaskets (see Fig. 2). Check that all holes register correctly.

Fit the packing seal into the recess at the front end of the sump, and lift the sump into position on the crankcase, taking care not to displace the cork strip while doing this.

First tighten evenly the ten screws into the crankcase flange, and the two inserted from the top into the sump flange. Then insert and tighten the three bolts that pass through the flywheel housing.

Section A.3

REMOVAL OF OIL PUMP

Drain and remove engine sump as in Sections A.1 and A.2.

The oil pump assembly is extracted by removing the two $\frac{3}{16}$ in. hexagon-headed bolts and spring washers, locating the pump to the crankcase, and easing the pump downwards. This is accomplished without interfering with the ignition timing.

Section A.4

DISMANTLING, REASSEMBLING, AND REPLACING OIL PUMP

The pump hood is detached by extracting the cotter pin from the fixing stud at the bottom of the pump assembly, and removing the $\frac{3}{16}$ in. nut, plain steel washer, double coil spring washer, and fibre washer. This may distort or break the gasket between the hood and the pump body, and so cause an air leak on the suction side and loss of oil pressure on reassembly. Should there be any doubt about the condition of the gasket, fit a new one.

To gain access to the pump gears, undo the four $\frac{3}{16}$ in. bolts with spring washers, and remove the pump cover and filter gauze. The gears may now be extracted.

The oil feed from the pump is taken via the pump drive shaft into the pump body, on which is mounted the oil pressure release valve assembly. This assembly is held in position by the release plug (see Fig. 3), and should be examined to ensure that the release ball is perfectly round and that it is seating properly. Check if the release spring has lost its tension. This can be done by measuring the length of the spring, which should not be less than 1 in. (25.4 mm.). Fit a new ball and spring if necessary.

The body gauze oil filter which is incorporated in the oil pump should be cleaned thoroughly in petrol with a stiff brush. If damaged in any way, a new gauze should be fitted. *Never use rag to clean it.*

To check the gear clearances, the pump body, gears and shaft should be cleaned carefully and reassembled before carrying out the following procedure :—

1. Measure the radial clearance between the teeth of the gears and the pump body (see Fig. 4). This should not be more than .006 in. (.15 mm.).
2. Check the end float on the gears, placing a straight-edge across the face of the pump body, and measuring the clearances with feelers, as shown in the illustration (Fig. 5). This should not be more than .003 in. (.08 mm.).

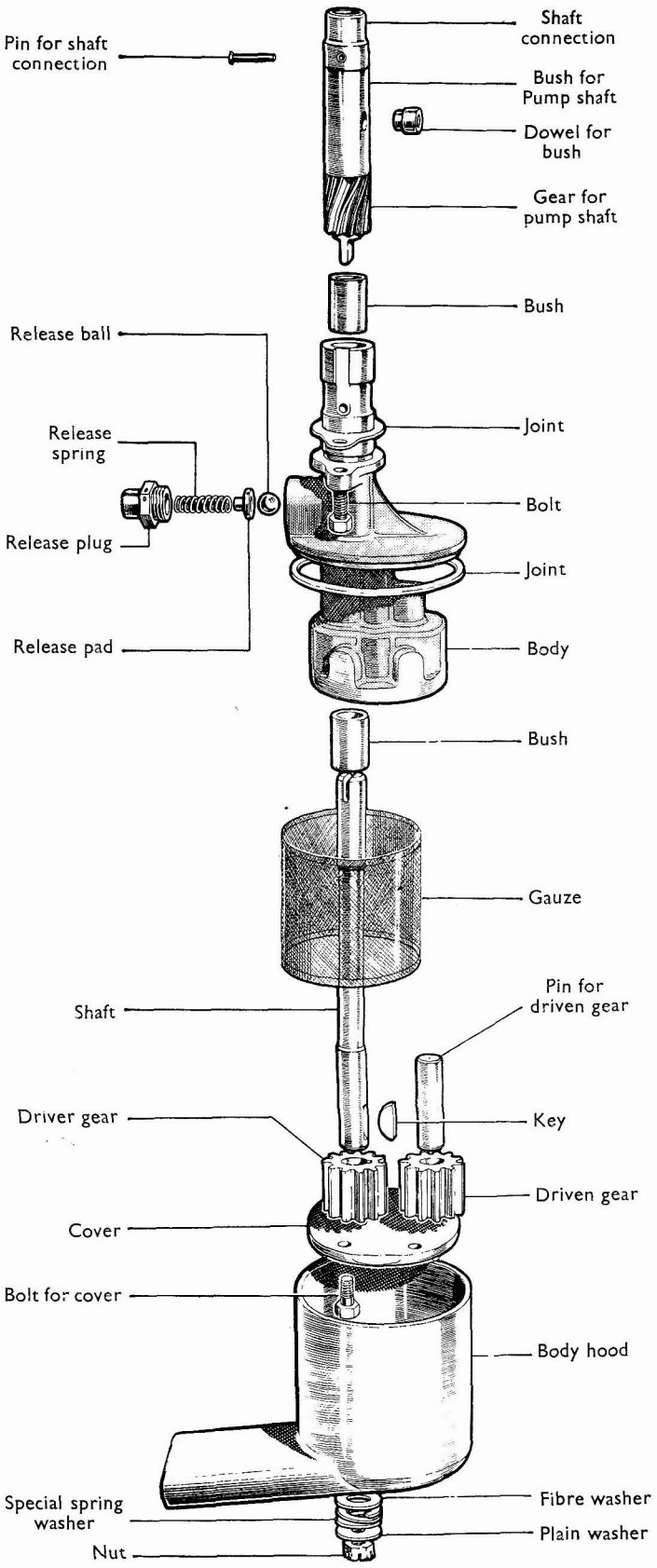


Fig. 3.
The component parts of the oil pump.

The pump is reassembled in the reverse order to dismantling. It should be observed, however, that the pump body cover is fitted with the hood locating slot facing to the near-side of the engine. The hood gasket should be placed carefully in its recess on the body flange, and the hood assembled so that its intake faces the off-side of the engine (i.e. at right angles to the crankshaft) when the assembly is refitted to the engine.

When replacing the pump assembly in the engine, care must be exercised to see that the slot in the pump drive shaft is set so as to engage with the tongue on the distributor drive gear.

It is essential that the connecting rod and piston assemblies should be replaced in their own bore and fitted the same way round, i.e. with the gudgeon pin clamp screw on the opposite side to the camshaft.

(**Note :**—The illustration on page 10 is intended for parts identification only.)

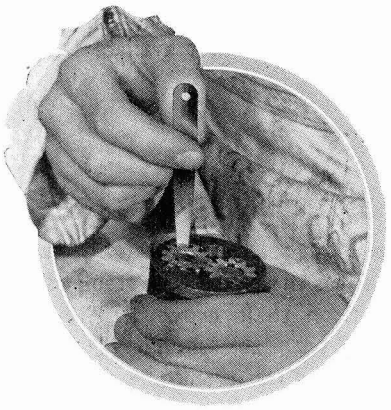


Fig. 4.

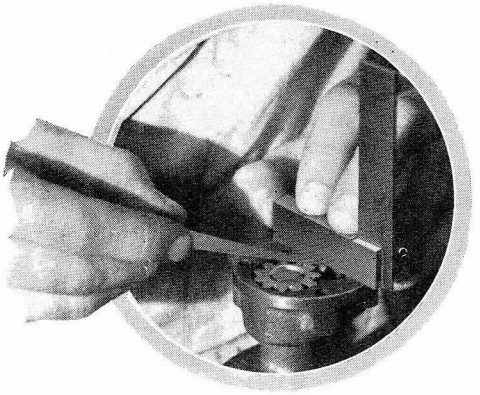


Fig. 5.

The method of checking the clearance between the pump gear teeth and the pump body is clearly shown in these illustrations.

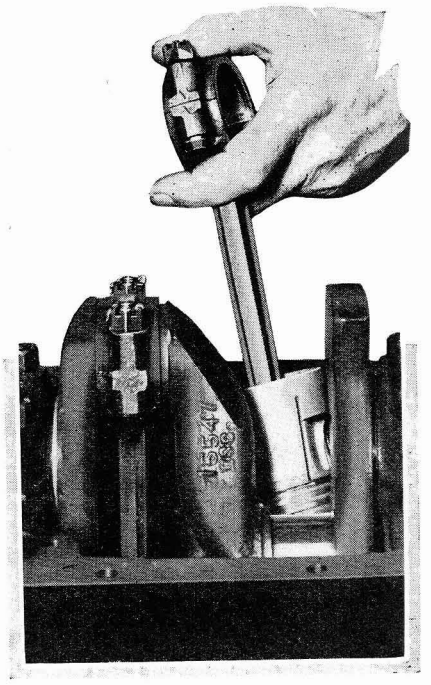


Fig. 6.

Showing the position of the crank web to enable the piston to be withdrawn.

Section A.5

REMOVAL AND REPLACEMENT OF PISTON AND CONNECTING ROD

Drain engine oil and remove sump as in Sections A.1 and A.2.

Remove oil pump as in Section A.3.

Remove cotter pins and $\frac{1}{4}$ in. nuts from big-end bolts.

Withdraw big-end bolts and bearing caps.

Remove connecting rod from crankshaft.

Refit bearing cap with the numbered side registering with the corresponding number on the connecting rod.

Rotate the crankshaft slowly, and draw out the piston and connecting rod assembly down the off-side of the engine.

Replacement of the pistons and connecting rods is a direct reversal of the above, but the piston ring gaps should be set at 120° to each other.

An ample chamfer is given to the base of each cylinder bore to facilitate the refitting of the pistons and rings, and no difficulty should be experienced in replacement.

Section A.6

DISMANTLING AND REASSEMBLING PISTON AND CONNECTING ROD

Before the piston and gudgeon pin can be dismantled from the connecting rod, it is necessary to remove the clamp screw. To enable the assembly to be held in a vice for this operation, special holding plugs should be inserted in each end of the gudgeon pin (see Fig. 7).

Unscrew the gudgeon pin clamp screw (Special Tool, Part No. 66243) and remove it completely.

Push out the gudgeon pin.

Reassembly is a reversal of the above.

Important.—Attention must be given to the following points when assembling the piston to the connecting rod.

1. That the piston is fitted the same way round on the connecting rod.
2. That the gudgeon pin is positioned in the connecting rod so that its groove is in line with the clamp screw hole.

3. That the clamp screw spring washer has sufficient tension.
4. That the clamp screw will pass readily into its hole, and screw freely into the threaded portion of the little-end, also that it is firmly tightened down on the spring washer.

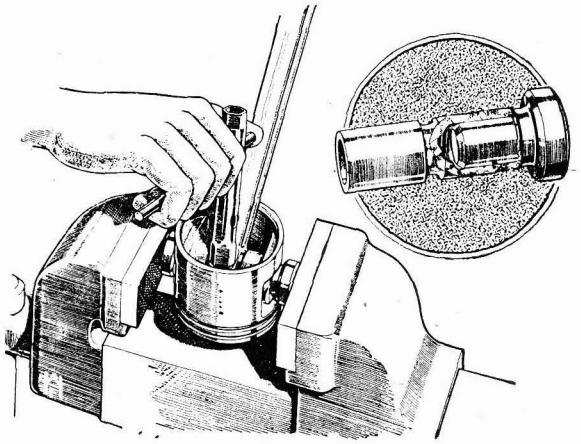


Fig. 7.
When releasing or tightening the little-end bolt the gudgeon pin should be held by the special plugs.

Section A.7

REMOVAL AND REPLACEMENT OF PISTON RINGS

If no special piston ring expander is available, use a piece of thin steel such as a suitably ground hacksaw blade, or disused .020 in. (.50 mm.) feeler gauge.

Raise one end of the ring, and insert the steel strip between the ring and the piston. Rotate the strip round the piston, applying slight upward pressure to the raised portion of the ring, until it rests on the land above the ring groove. It can then be eased off the piston.

Do not remove the piston rings downwards over the skirt of the piston.

Before fitting new piston rings, the grooves in the piston must be scraped clean from any carbon deposit, taking care not to remove any metal, since play between the ring and the groove reduces gas tightness and produces a pumping action leading to excessive oil consumption.

Important.—New rings should be tested in the cylinder bore to ensure that the ends do not butt together.

To do this effectively the piston should be inserted approximately 1 in. down the cylinder bore and each ring then pushed down onto the top of the piston and held there in order to keep the ring square with the bore. The correct ring gap is from .0025 in. to .0065 in. (.06 mm. to .17 mm.).

When in position in the piston groove, the ring must move round quite freely, but there must be no movement in a vertical direction.

Section A.8

FITTING GUDGEON PINS

When gudgeon pins are fitted to pistons, a certain amount of selective assembly may be necessary, and the following points should be observed :—

With the standard aluminium alloy pistons, the gudgeon pins must be a thumb-push fit for three-quarters of their travel, being finished by lightly tapping with a raw hide mallet. This with the piston cold. Never attempt to ream out a gudgeon pin bore, as oversize gudgeon pins are not available or permissible.

Section A.9

PISTON SIZES AND CYLINDER BORES

When fitting new pistons selective assembly is necessary, and to facilitate this the pistons are stamped with identification figures on their crowns. These figures should correspond with the similar figures stamped on the bottom face of the crankcase on the oil pump side to indicate each cylinder bore size. The pistons are also graded for weight and are stamped accordingly on their crowns. It is advisable to fit pistons of the same weight grading to an engine to ensure the correct balance.

Symbols are used to indicate the actual measurements, the bores being marked :—

" A " OK, indicating a standard size diameter possessing the actual nominal measurement of 57 mm. (2.244 in.).

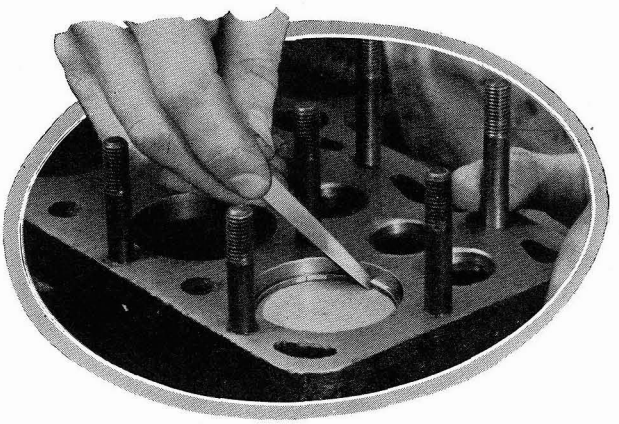


Fig. 8.
Piston ring gaps should always be measured while the ring is firmly held on top of a piston inserted in the cylinder bore.

A+2, indicating an oversize of .02 mm. on the standard size and thus having an actual measurement of 57.02 mm. and so on through the range of sizes permitted.

The pistons are marked with the actual cylinder bore size, the requisite running clearance being allowed for in the machining.

While the cylinder head and the pistons are withdrawn, the cylinder bores should be measured for wear.

Indication that a rebore of the cylinders is necessary is given by general loss of performance, oiling up and poor compression. The pistons are supplied graded in the same way as the cylinder bores, and those marked " A " OK should be fitted to bores marked " A " OK and so on throughout the range.

Oversize pistons are supplied in the following sizes :—

A+1	=	.01 mm.	oversize from	standard,	or	57.01 mm. dia.
A+2	=	.02 mm.	,,	,,	,,	,, 57.02 mm. ,,
A+3	=	.03 mm.	,,	,,	,,	,, 57.03 mm. ,,
A+4	=	.04 mm.	,,	,,	,,	,, 57.04 mm. ,,
A+5	=	.05 mm.	,,	,,	,,	,, 57.05 mm. ,,
B OK	=	.25 mm.	,,	,,	,,	,, 57.25 mm. ,,
C OK	=	.50 mm.	,,	,,	,,	,, 57.50 mm. ,,
D OK	=	.75 mm.	,,	,,	,,	,, 57.75 mm. ,,
E OK	=	1.00 mm.	,,	,,	,,	,, 58.00 mm. ,,
F OK	=	1.25 mm.	,,	,,	,,	,, 58.25 mm. ,,
G OK	=	1.50 mm.	,,	,,	,,	,, 58.50 mm. ,,

Section A.10

REMOVAL AND REPLACEMENT OF MAIN AND BIG-END BEARINGS

The replacement of both main and big-end bearings can be carried out without withdrawing the engine from the frame. Detachable bearing caps and steel-backed liners are used both for the main and the big-end bearings which are of the shimless type and therefore non-adjustable.

Dismantling procedure

Drain the engine oil and remove the sump as in Sections A.1 and A.2.

Remove the oil pump as in Section A.3.

As the bearings are of the shimless type it is essential that no attempt should be made to adjust worn bearings. They should be replaced with new parts. Similarly, if the crankshaft journals are found to be in worn condition, it is advisable to fit a service reground crankshaft, complete with main and big-end bearings, as supplied by the Works. (See Section A.25.)

Both the main and big-end bearing liners are located in position in the bearing housings by a small tag on one side of each half liner, and it should be noted that the bearings are fitted so that the tags come on the same joint edge of the bearing housing as shown in Fig. 9, although on opposite corners.

To detach the big-end bearings, extract the split pins from the big-end bolts, and undo the $\frac{1}{4}$ in. castellated nuts. Remove the connecting rod caps and extract the bearings. Care should be exercised to

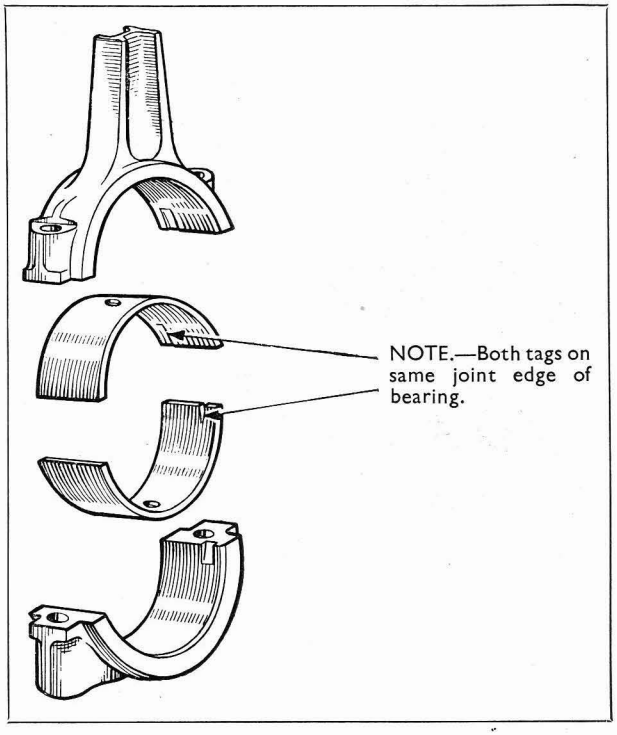


Fig. 9.
Shows the location of the tags on the joint edge of the bearing.

see that the bearing journals, etc., are thoroughly cleaned before installing new bearings. No scraping is required as the bearings are machined to give the correct diametrical clearance of .03 mm. (.001 in. to .0015 in.).

The main bearings should be dealt with one at a time. Detach the main bearing caps, together with the bottom half bearing liner. The top halves of the bearing liners are extracted by rotating them round the crankshaft in the direction of their locating tags, using a small grub screw inserted in their crankshaft oil-feed holes to facilitate this if necessary. The replacements are fitted in a similar manner, by first inserting the plain side of each bearing liner into its housing. Here again, no scraping is required as the bearings are machined to give the correct diametrical clearance of .03 mm. (.001 in. to .0015 in.).

In the case of a " run " bearing, it is always advisable thoroughly to clean out all the oilways in the crankshaft and block ; wash out the engine base with

paraffin ; and remove the pump cover, to ensure that no particles of white metal are left anywhere in the lubricating system.

Section A.11

REMOVAL AND REPLACEMENT OF ENGINE

There is no difficulty in removing the engine, leaving the gearbox in the frame, if the work is carried out in accordance with the following sequence. It is not necessary to remove the bonnet, but as a safety measure it should be secured carefully in the open position.

Drain the water from the radiator by means of the drain tap located in the near-side of the radiator bottom tank. If " Bluecol " or other anti-freeze mixture is used, it should be drained into a suitable clean container and carefully preserved for future use.

Disconnect the battery connection by slackening the $\frac{1}{4}$ in. bolt and removing the positive cable lug from the battery terminal post.

Detach the radiator mask by removing the two countersunk-headed metal-threaded screws and nuts and spring washers locating the radiator core to the mask. Undo the ten $\frac{3}{16}$ in. set screws, with spring washers and plain steel washers, locating the radiator mask to the front wing valances.

Release the clips on the top and bottom water hoses and separate the hoses from their connections.

Undo the $\frac{5}{16}$ in. locknut and retaining nut, with plain steel washers, from the two radiator foundation studs which pass through the front chassis cross-member, and remove the radiator.

Release the throttle return spring from the air intake pipe. Detach the air silencer complete with the air intake pipe by removing the $\frac{3}{16}$ in. bolt, and spring washer, attaching the air cleaner support bracket to the air cleaner, and the two $\frac{1}{4}$ in. bolts, with spring washers, locating the air intake pipe to the carburetter flange.

Disconnect the throttle and mixture controls from the carburetter, and release the Bowden throttle control steady bracket from its attachment on the cylinder head by removing the fixing bolt.

Release the flexible pipe from the pump and detach the carburetter from the manifold.

Disconnect the high-tension cable from the coil, and the low-tension cable from the distributor. Remove the two leads from the dynamo, noting that the yellow wire goes to the terminal nearest the off-side. Detach the starter cable from the switch on the scuttle dash by undoing the $\frac{5}{16}$ in. terminal bolt with spring washer. Disconnect the earth cable from the cylinder head.

Disconnect the oil gauge pipe from its connection on the cylinder block and release it from the clip on the tappet cover. Remove the two $\frac{5}{16}$ in. nuts, bolts, and spring washers from the exhaust manifold flange, and remove the flange gasket.

Remove the three $\frac{1}{4}$ in. and $\frac{5}{16}$ in. nuts and washers from each of the front engine mountings.

Support the engine with suitable lifting tackle. If a lifting ring is employed, it should form part of a plate which can be fitted under two of the stud nuts. Raise the front end of the engine with the lifting tackle, and remove the front engine mounting rubbers.

Lower the engine down until the bearer brackets on the timing cover rest on the chassis frame bearer brackets.

It is now possible to slacken and remove the four short $\frac{1}{4}$ in. hexagon-headed bolts, locating the clutch housing to the cylinder block, and the three longer $\frac{1}{4}$ in. hexagon-headed bolts, locating the clutch housing to the sump housing.

To prevent the gearbox from dropping when it is released from the engine, place a suitable support beneath the gearbox housing.

The engine may then be raised and carefully manoeuvred forward clear of the car.

When replacing the engine in the frame, it will be found helpful if a second operator raises the front end of the gearbox by exerting downward pressure on the gear lever, while in gear. If the car is then moved forward steadily, this will assist in aligning the gearbox drive shaft with the clutch and flywheel.

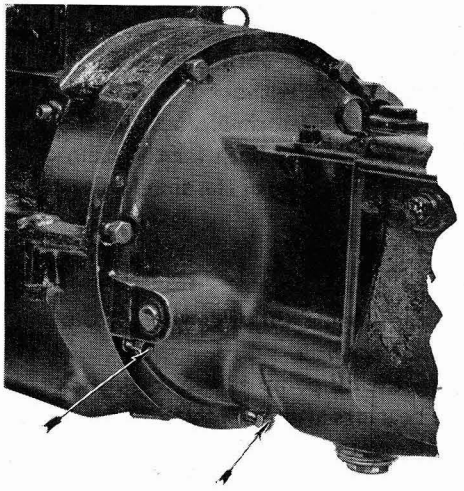


Fig. 10.
The location of the clutch casing retaining bolts of different lengths are indicated by the arrows on this illustration. The corresponding one on the other side is, of course, hidden.

Ensure that the clutch casing is located on the two dowel pins in the flywheel housing, and then lower the power unit until the front engine bearer brackets rest on the chassis frame brackets.

Replace the seven bolts locating the clutch casing to the flywheel housing, making sure the correct length of bolt is used in each case.

Raise the engine and insert the front engine mounting rubbers.

Lower the engine onto the rubbers.

The replacement operation now continues in the reverse manner to the sequence of removal.

Section A.12

REMOVAL AND REPLACEMENT OF POWER UNIT

The removal of the power unit does not present any serious difficulty if the operations are carried out in the following sequence. It is not necessary to remove the bonnet, but as a precautionary measure it should be secured safely in the open position.

Drain the water from the radiator by means of the drain tap located in the near-side of the radiator bottom tank. If " Bluecol " or other anti-freeze mixture is used, it should be drained into a suitable clean container and carefully preserved for future use.

Disconnect the battery connection by slackening the $\frac{1}{4}$ in. pinch bolt and removing the positive cable lug from the battery terminal post.

Detach the radiator mask by removing the two countersunk-headed screws with nuts and spring washers, locating the radiator core to the mask. Undo the ten $\frac{3}{16}$ in. set screws, equipped with spring washers and plain steel washers, locating the radiator mask to the front wing valances. Release the clips on the top and bottom water hoses, and separate the hoses from their connections.

Undo the $\frac{5}{16}$ in. lock and brass nuts, with plain steel washers, from the two radiator foundation studs which pass through the front chassis cross-member. Remove the radiator.

Detach the throttle return spring from the air intake pipe.

Detach the air silencer complete with the air intake pipe, by undoing the $\frac{3}{16}$ in. bolt, nut, and spring washer from the air cleaner support bracket, and the two $\frac{1}{4}$ in. bolts with spring washers, locating the air intake pipe to the carburetter flange.

Disconnect the throttle and mixture control from the carburetter, and release the throttle control steady bracket from its attachment on the cylinder head by undoing the $\frac{3}{16}$ in. fixing bolt.

Release the flexible petrol pipe from the pump, and detach the carburetter from the manifold.

Disconnect the high-tension cable from the coil, and the low-tension cable from the distributor. Remove the two leads from the dynamo, noting that the yellow wire goes to the terminal nearest the off-side. Detach the starter cable from the switch on the scuttle dash by undoing the $\frac{5}{16}$ in. terminal bolt with spring washer. Detach the earth cable from the cylinder head.

Disconnect the oil gauge pipe from its connection on the cylinder block and release it from the clip on the tappet cover. Remove the two $\frac{5}{16}$ in. nuts, bolts, and spring washers from the exhaust manifold flange, and remove the flange gasket.

Remove the front floor mat by extracting the press pins, and remove the near-side front seat by undoing

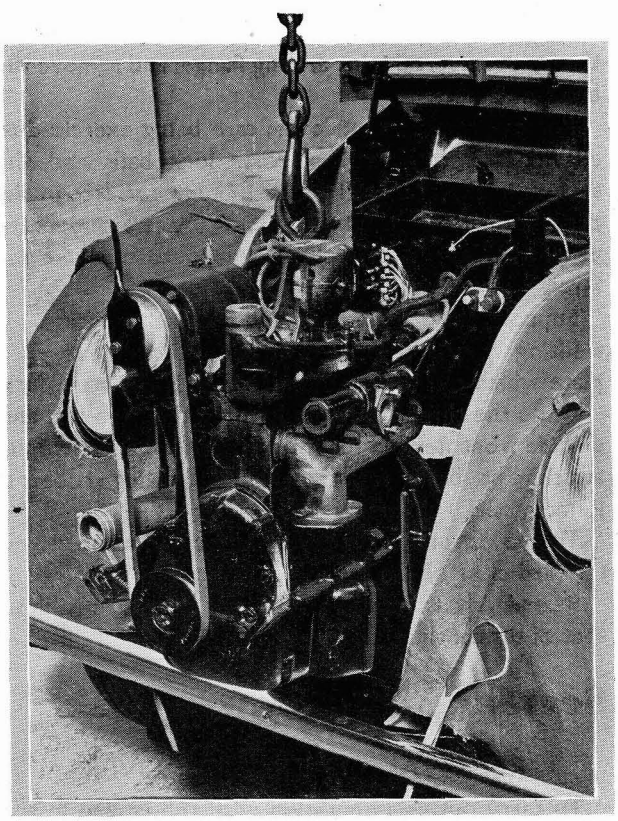


Fig. 11.
Showing the power unit in the process of being withdrawn from the car.

the four $\frac{3}{16}$ in. bolts and clips locating the seat to the floor of the car. The off-side seat is removed by releasing the four $\frac{3}{16}$ in. nuts locating this seat to its runners, and lifting the seat clear.

Unscrew the gear lever knob from the gear lever after slackening the locknut, and remove the gearbox rubber cowl.

Remove the off-side and near-side floorboards by undoing the eight countersunk-headed fixing screws with washers.

Release the off-side toeboard by undoing the six countersunk-headed metal-threaded fixing screws and washers, and detach the headlamp dipswitch from the board by undoing the two round-headed screws.

Remove the near-side toeboard and gearbox shield assembly by undoing the eight countersunk-headed screws equipped with dished washers and one round-headed fixing screw.

Disconnect the speedometer cable from its drive at the rear of the gearbox ; also the earth wire by undoing the $\frac{1}{4}$ in. stud nut at the rear of the gearbox, replacing the nut to avoid its possible loss.

Extract the split pin from the clevis pin locating the clutch operating chain to the clutch operating lever, and withdraw the clevis pin.

Extract the split pins from the four $\frac{1}{4}$ in. bolts on the front universal joint driving flange, and remove the bolts and nuts.

Remove the gearbox cover, care being exercised to ensure that the three selector lock balls and the springs in the rear wall of the box are not lost in the process or dropped into the box. Place a temporary protecting cover over the gearbox, to exclude any foreign matter.

Support the engine with suitable lifting tackle. If a lifting ring is employed, it should form part of a plate which can be fitted under two of the stud nuts.

Undo the three stud nuts locating the near-side and off-side front flexible mounting brackets, and the four attachment bolts for the rear mounting rubbers. Remove the rubbers.

The power unit may now be raised and manoeuvred forward clear of the car.

Reassembly is carried out in the reverse order to that of dismantling.

Section A.13

REMOVAL OF TIMING COVER

To carry out this operation with the engine in the frame, it is necessary to remove the radiator mask, the radiator core, as in Section A.11, and the fan belt.

Release the engine from its forward mounting rubbers by removing the two $\frac{5}{16}$ in. nuts and washers.

Raise the front of the engine with suitable lifting tackle, until the fan pulley can be extracted without fouling the front chassis cross-member.

Removing the timing cover

Remove starting handle dog nut, washer and shim, taking care not to lose the shim.

Remove crankshaft fan pulley with suitable extractor.

Remove the six $\frac{1}{4}$ in. bolts securing the timing cover to the cylinder casting, observing that the two near-side bolts do not actually screw into the casting, but are provided with $\frac{1}{4}$ in. nuts.

Remove the two $\frac{3}{16}$ in. bolts locating the timing cover to the sump.

Remove the timing cover.

Important.—Care should be exercised to ensure that the sump gasket is not damaged during removal of the timing cover. If, however, it is damaged, the sump must be removed and the gasket replaced by a new one.

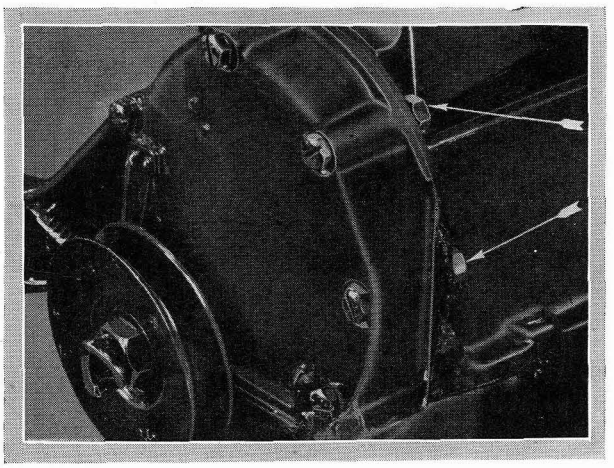


Fig. 12.
The location of the two $\frac{1}{4}$ in. bolts with retaining nuts at the back of the engine bearer is here shown.

Section A.14

REPLACEMENT OF TIMING COVER

To ensure oil-tight joints, it is essential :—

1. That a new gasket is fitted between the cleaned faces of the timing cover and the engine.
2. That a new timing case top packing is fitted.
3. That the sump gasket is not damaged and is smeared with grease.
4. That the oil thrower is in position on the crankshaft, with its concave side forward.
5. That the fan driving pulley key is in position.

Place the timing cover in position, first locating all the securing bolts and nuts loosely and then tightening them up.

Examine the new timing case top packing and fan driving pulley key, to ensure that they are fitted correctly. Slide the fan driving pulley home on the shaft.

Replace the starting handle dog nut shims, washer and finally the dog nut.

Section A.15

REMOVAL AND REPLACEMENT OF TIMING CHAIN

To carry out this schedule with the engine in the frame, it is necessary to remove the radiator mask and drain and remove the radiator, as detailed in Section A.12 ; to remove the timing cover, as detailed in Section A.13, and to support the engine after the timing cover has been removed.

Drain and remove sump as detailed in Sections A.1 and A.2.

Remove the dished oil thrower washer from the front of the crankshaft, having noted that it is fitted with its concave side forward.

Tap back the lock washer from the $\frac{3}{8}$ in. set screw locating the camshaft sprocket and remove the screw,

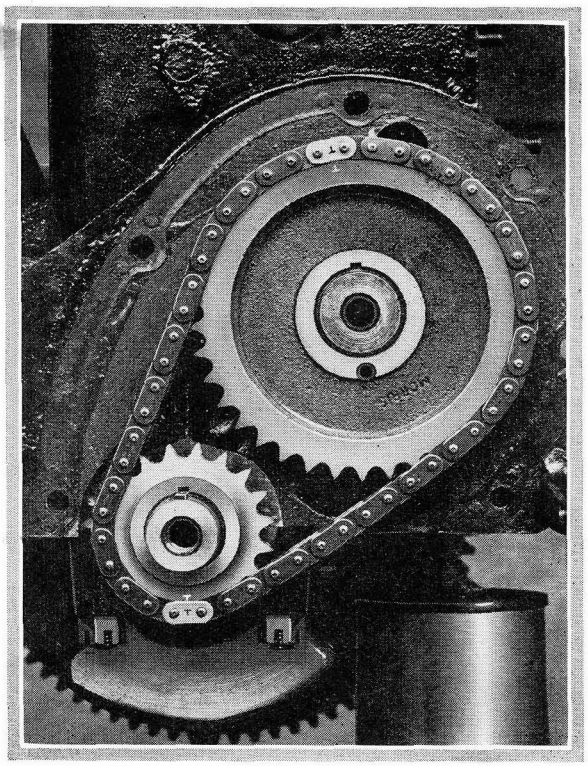


Fig. 13.
This clearly shows the position of the marked teeth on the sprockets and bright links on the timing chain when set correctly for the replacement of the timing chain.

together with the lock washer and plain steel washer.

The timing chain and sprockets are now extracted by easing each chain wheel forward a fraction at a time with suitable small levers.

Replacement

When replacing the timing chain, set the camshaft with its keyway approximately 7° before T.D.C. and the crankshaft with its keyway at T.D.C.

Double the timing chain, bringing both bright links together. This gives a long and short portion of the chain on either side of the bright links.

With the shorter part of the chain on the left (the bright links facing the operator) and the longer on the right, engage the camshaft sprocket tooth, marked "T," with the top bright link, and the crankshaft sprocket with the tooth marked "T" coinciding with the other bright link.

Place the sprockets in their respective positions on the camshaft and crankshaft complete with the chain and push the assembly home. Carefully keep the sprockets in line with each other all the time to avoid straining the chain.

When replaced in the engine, the bright links and the marked teeth should take up the position shown in Fig. 13.

The engine valve timing is such that with the engine cold and the valve clearance set at .018 in. (.46 mm.) the inlet valves open 8° before T.D.C. and close 52° after B.D.C. The exhaust valves open 52° before B.D.C. and close 20° after T.D.C.

Reassembly of the remaining parts is carried out in the reverse order to that of dismantling.

Section A.16

REMOVAL AND REPLACEMENT OF THE CARBURETTER

Detach the throttle control return spring from the air intake.

Detach the air intake silencer bracket from the cylinder head by unscrewing the $\frac{3}{16}$ in. bolt equipped with a spring washer, and unscrew the two $\frac{1}{4}$ in. fixing bolts and spring washers attaching the intake pipe to the carburetter flange. The air intake silencer and intake pipe may now be removed.

Disconnect the mixture control from the carburetter by removing the $\frac{3}{32}$ in. split pin and flat washer from the clevis pin on the inner cable and slackening the clip on the outer cable.

Disconnect the throttle control from the carburetter by removing the $\frac{3}{32}$ in. split pin and flat washer from the clevis pin locating it to the throttle spindle.

Release the flexible petrol pipe at the $\frac{5}{16}$ in. union nut on the petrol pump.

Remove the two $\frac{3}{16}$ in. nuts and spring washers holding the carburetter to the inlet manifold, and remove the carburetter.

Refitting of the carburetter is a reversal of the above procedure, but if the carburetter flange gasket is damaged, the respective faces should be cleaned, levelled, and a new gasket fitted.

Section A.17

REMOVAL AND REPLACEMENT OF INLET AND EXHAUST MANIFOLD

Remove the air silencer and carburetter, as detailed in Section A.16.

Release the exhaust pipe from the manifold by removing the two $\frac{5}{16}$ in. bolts, spring washers, and brass nuts, observing that a copper-asbestos gasket is fitted between the two flanges. Remove the manifold by unscrewing the four $\frac{1}{4}$ in. elongated stud nuts.

Refitting the manifold is a reversal of the above procedure, but before doing so, any excessive carbon should be cleaned from the faces, and a new gasket fitted with the perforated metal strip away from the cylinder block.

Disconnect the positive cable from the battery by slackening the $\frac{1}{4}$ in. pinch bolt, and remove the cable lug from the battery terminal.

Release the clips from the top water hose, and separate the hose from its connections.

Disconnect the low-tension wire from its terminal on the side of the distributor. Remove the $\frac{1}{4}$ in. dynamo attachment bolt providing belt tension adjustment, together with its plain steel washer, and release the belt from the fan pulley. Remove the two $\frac{1}{4}$ in. bolts, nuts, and spring washers locating the dynamo to its cradle, after which the dynamo with its wires attached may be withdrawn and laid in the tool tray.

Disconnect the high-tension wires from the sparking plugs and coil ; extract the lock wire from the dowel bolt locating the distributor clamp plate assembly to the cylinder head and remove the bolt. If the pinch bolt on the clamp plate assembly is not disturbed, the ignition setting will not be altered. The distributor assembly may now be withdrawn from the cylinder head.

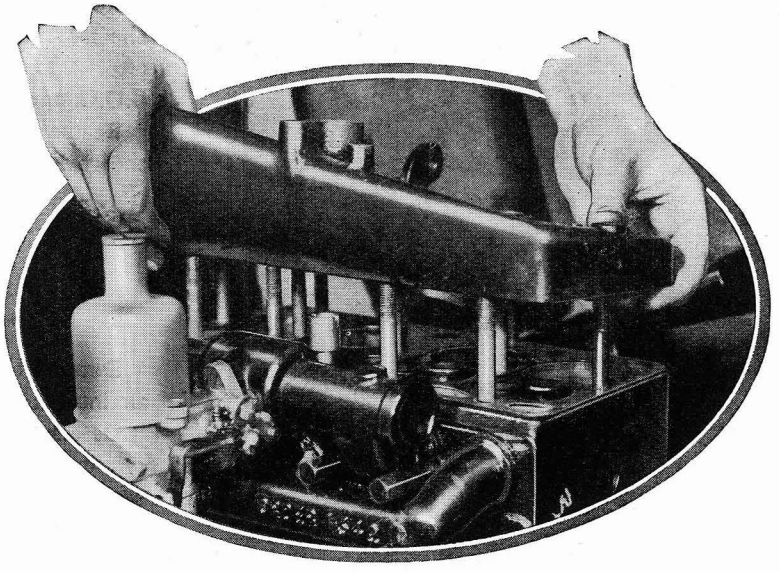


Fig. 14.
The cylinder head can be lifted from the studs in the manner indicated.

Section A.18

REMOVAL AND REPLACEMENT OF CYLINDER HEAD

Raise the bonnet of the car, and as a safety measure secure it in the open position, using a suitable piece of cord attached to some convenient point.

Drain the water from the cooling system by means of the drain tap located on the near-side of the radiator bottom tank. If " Bluecol " or other anti-freeze mixture is used, it should be drained into a suitable clean container and carefully preserved for future use.

Remove the throttle control bracket from the cylinder head by undoing the $\frac{3}{16}$ in. set screw with shakeproof washer, and release the controls from the carburetter throttle lever by removing the $\frac{3}{32}$ in. cotter pin and flat washer from the clevis pin.

Detach the air intake silencer bracket from the cylinder head by unscrewing the $\frac{3}{16}$ in. attachment bolt, and remove the air silencer by slackening the screw in the clip retaining it to the air intake pipe.

Undo the thirteen $\frac{5}{16}$ in. cylinder head stud nuts, slackening each half a turn at a time, until they are all quite free. This will avoid any tendency for the head to be distorted. Observe that the engine earthing

cable is located under the rearmost nut. The cylinder head may now be lifted clear of the studs, and placed aside for cleaning.

Extract the distributor drive shaft from its housing. Its drive tongue is off-set to ensure that it is replaced correctly without disturbing the timing.

Reassembly of the remaining parts takes place in exactly the reverse order to that of dismantling.

Run the engine until it is properly warmed up, then tighten the cylinder head nuts again in the proper sequence.

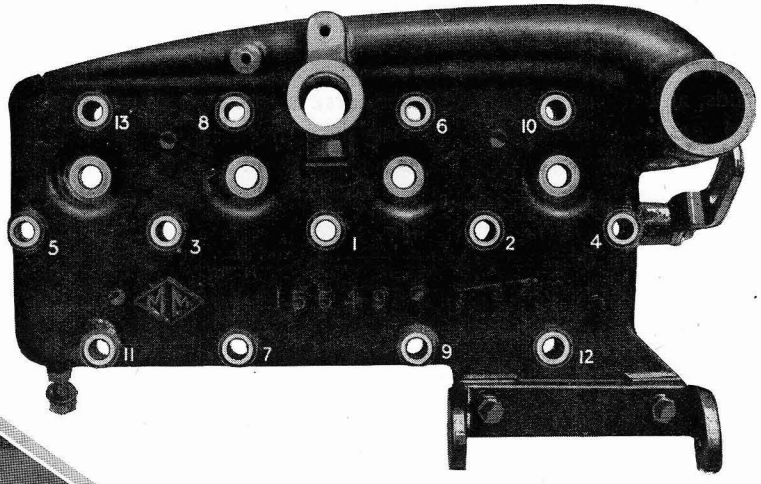


Fig. 15.
(*Right*). Indicating the sequence in which the cylinder head stud nuts should gradually be slackened or tightened.

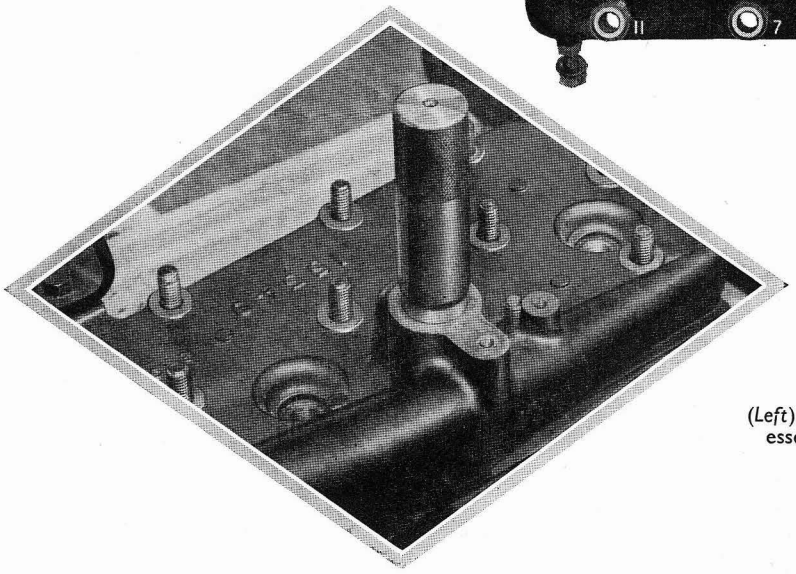


Fig. 16.
(*Left*). An alignment gauge, Part No. 39387, is essential when replacing the cylinder head.

The cylinder head gasket should be examined carefully and, if damaged in any way, should be replaced by a new one. No jointing is required with a new gasket.

The gasket should be guided over the cylinder head studs evenly with a length of tube to avoid damage.

To ensure the correct alignment of the distributor shaft tunnel in the head and in the cylinder block, when refitting the cylinder head a special cylinder head distributor shaft alignment gauge, Part No. 39387, must be used.

The tool must be inserted in the distributor shaft housing in the cylinder head, and in the cylinder block before the head is tightened down. The cylinder head stud nuts may then be tightened, half a turn at a time, in the sequence shown in the illustration, Fig. 15, until they are all quite tight. The tool should then be extracted, and the distributor drive shaft placed in position.

Section A.19

REMOVAL AND REPLACEMENT OF CAMSHAFT

Note.—With the engine in the frame, it is necessary to remove the radiator mask.

Drain and remove the radiator as detailed in Section A.12.

Undo the two $\frac{5}{16}$ in. engine mounting nuts, and raise the engine so that the crankshaft pulley will clear the chassis frame cross-member.

Slacken the $\frac{3}{16}$ in. pinch bolt locating the fume pipe to the tappet cover, and remove the $\frac{3}{16}$ in. bolt, nut and spring washer from the pipe bracket on the clutch housing, and detach the pipe before removing the tappet cover.

Drain and remove the sump as detailed in Sections A.1 and A.2.

Remove the cylinder head as detailed in Section A.18.

Remove timing cover as detailed in Section A.13.

Remove timing chain as detailed in Section A.15.

Remove inlet and exhaust manifold as detailed in Section A.17.

Remove the wing valance inspection cover as detailed in Section A.26.

Undo the two wing nuts on the tappet cover fixing studs, and withdraw the fibre washers, tappet cover, and gasket. Raise the engine valves from their seatings as far as possible, and secure them in the open position with suitable wooden wedges, as illustrated in Fig. 17.

Extract the distributor drive gear dowel. This is equipped with a 5 mm. tapped hole, into which a 5 mm. screw may be entered to enable the dowel to be withdrawn. Alternatively a small extractor can be made, as illustrated in Fig. 18.

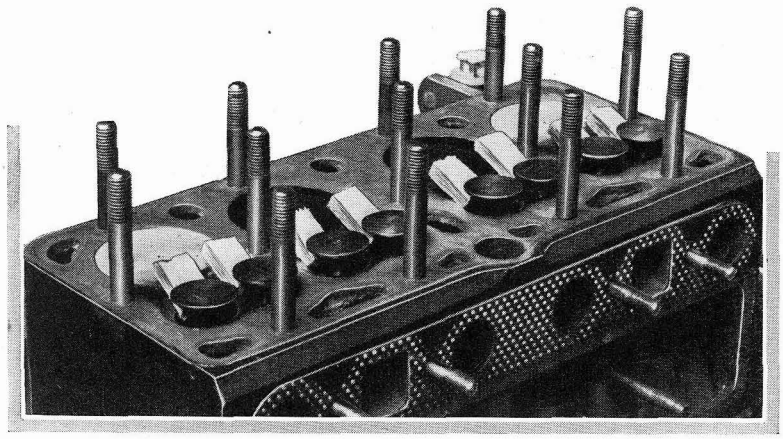


Fig. 17.
The valves are held in the open position by inserting blocks of wood under the heads.

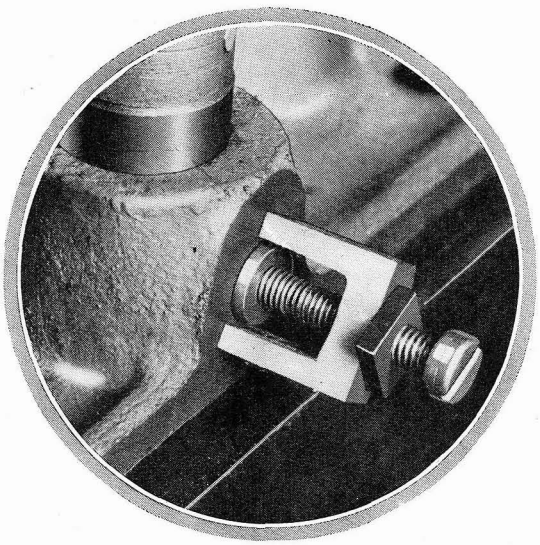


Fig. 18.
A simple extractor can be made to withdraw the distributor drive spindle dowel.

The distributor drive gear is now eased upward and extracted from the top of the cylinder block.

The tappets may now be raised to their fullest extent, and the camshaft withdrawn from the front of the engine, taking care not to chip the edges of the cams or tappets through contact between them.

Replacement is in the main a reversal of the foregoing instructions, though reference should be made to the appropriate sections when reassembling.

To refit the distributor drive gear

Turn the engine until No. 1 piston is at T.D.C. on its compression stroke. This can best be effected by turning the engine and observing the valves. When the valves are "rocking" (i.e. exhaust just closing and inlet just opening) on No. 4 cylinder, No. 1 piston is at the top of its compression stroke. If the engine is set so that the groove in the crankshaft pulley is in line with the pointer on the timing cover, the piston is exactly at T.D.C.

Set the oil pump shaft so that the slot points to the twelve o'clock position, i.e. at right angles to the camshaft, insert the gear with the tongue at the tip pointing at eleven o'clock, observing that the tongue is off-set and the widest portion is directed to the rear of the engine. Care must be exercised to see that the dowel hole in the distributor drive gear bush is lined up to correspond with the hole in the cylinder block.

The gear is then pushed home, when the tongue at the top will take up a position at one o'clock. If the distributor drive shaft and the distributor are then offered up, it will be found that the rotor points between the seven and eight o'clock positions and the engine is set for firing on No. 1 cylinder.

The distributor is set with its points just opening at T.D.C. as a preliminary setting, but final adjustment should be made on a road trial, when an appreciable advance from this setting will usually be found to give the best results.

Section A.20

REMOVAL AND REPLACEMENT OF TAPPETS

Remove the cylinder head as in Section A.18.

Remove the carburetter as in Section A.16.

Remove the exhaust manifold as in Section A.17.

Remove the appropriate valve as in Section A.26.

Remove the valve guide as in Section A.29.

The tappet can now be lifted out of its housing.

New tappets should be fitted by selective assembly, so that they just fall through their guides under their own weight when lubricated with engine oil.

Assembly is the reverse of the above operation, but care should be taken to replace the valve guide exactly in accordance with Section A.29.

In the unlikely event of it being necessary to replace all the tappets, it is advisable to remove the camshaft as in Section A.19, and to remove the tappets from the bottom of their guides in order to leave the valve guides undisturbed and reduce the amount of work involved.

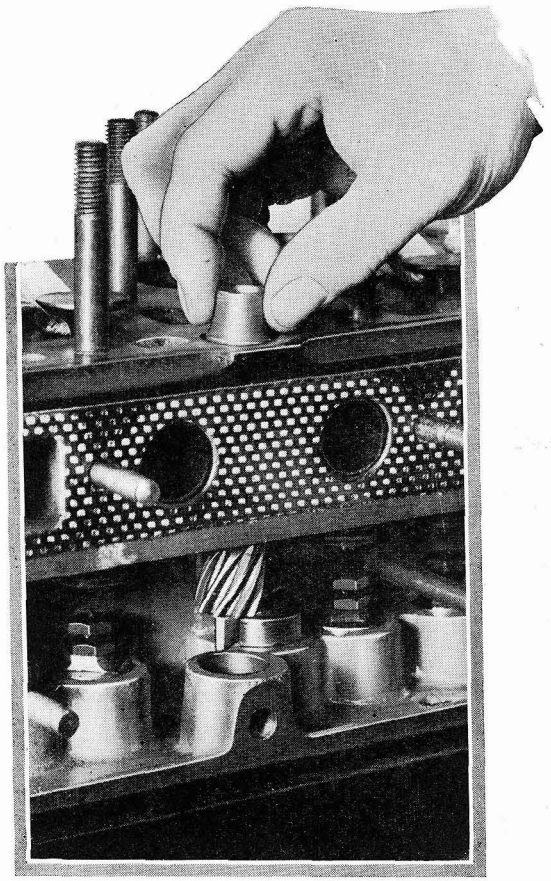


Fig. 19.
The distributor drive gear is withdrawn upwards through the cylinder block.

Section A.21

TAPPET ADJUSTMENT

If the engine is to give its best performance and the valves are to attain their maximum useful life, it is essential to maintain the correct tappet clearance. The clearance for both inlet and exhaust valves is .017 in. (.43 mm.) when hot, or .018 in. (.46 mm.) when cold.

To give access to the tappets it is necessary to remove the detachable observation panel in the wing valance, as in Section A.26.

Important.—When the clearance is being set, it is essential that the tappet should then be on the back of its cam, i.e. exactly opposite the peak.

As this cannot be observed easily, the adjustment is best carried out in the following order, which also avoids turning the engine more than is necessary.

Adjust No. 1 tappet with No. 8 valve fully open.

,,	,,	3	,,	,,	,,	6	,,	,,	,,
,,	,,	5	,,	,,	,,	4	,,	,,	,,
,,	,,	2	,,	,,	,,	7	,,	,,	,,
,,	,,	8	,,	,,	,,	1	,,	,,	,,
,,	,,	6	,,	,,	,,	3	,,	,,	,,
,,	,,	4	,,	,,	,,	5	,,	,,	,,
,,	,,	7	,,	,,	,,	2	,,	,,	,,

From this table it will be realised that one can ascertain that a valve is at the back of its cam by observing that the corresponding valve paired with it is in the " fully open " position.

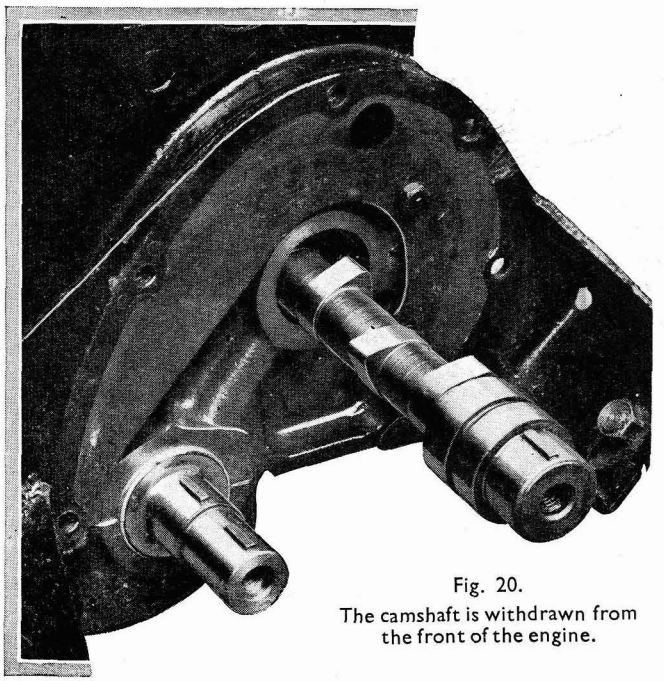


Fig. 20.
The camshaft is withdrawn from the front of the engine.

Section A.22

CHECKING VALVE TIMING

Set No. 1 cylinder inlet valve to .023 in. (.58 mm.) clearance when cold, and then turn the engine until the valve is about to open.

The indicating groove in the rear flange of the crankshaft pulley should then be opposite the pointer on

the timing cover, i.e. the valve should be about to open at T.D.C.

Note.—Do not omit to reset the tappet to the correct running clearance of .018 in. (.46 mm.) (cold) when the timing check has been completed. The clearance of .023 in. is necessary to bring the opening position of the valve to T.D.C. as the normal valve opening is 8° before T.D.C.

Section A.23

REMOVAL AND REPLACEMENT OF FLYWHEEL

(Engine out of Chassis)

Drain and remove sump as in Sections A.1 and A.2.

Remove clutch assembly as in Section E.2.

Remove the rear main bearing cap and bottom half bearing.

Using a suitable pin punch, drive out the two flywheel locating dowels towards the rear of the engine, care being exercised not to damage the oil return thread and thrower on the crankshaft.

Extract the locking wire, and remove the four $\frac{5}{16}$ in. flywheel attachment bolts.

Detach the flywheel from the crankshaft flange with a suitable extractor or by tapping it with a copper hammer towards the rear of the engine, slowly rotating the crankshaft so that the flywheel is driven off evenly.

Reassembling is carried out in the reverse order to the above.

Section A.24

REMOVAL AND REPLACEMENT OF CRANKSHAFT

(Engine out of Chassis)

Drain and remove the sump as detailed in Sections A.1 and A.2.

Remove the oil pump as detailed in Section A.3.

Remove the timing cover as detailed in Section A.13.

Remove the timing chain as detailed in Section A.15.

Remove the flywheel as detailed in Section A.23.

Remove the pistons and connecting rods as detailed in Section A.5.

Unscrew the two securing nuts from each main bearing, and remove the caps.

Note.—Mark each bearing cap and bearing to ensure that they are reassembled to the correct journal.

Lift the crankshaft out of the bearings.

Replacement of the crankshaft is the reversal of the above operations.

Important.—Before replacement of the crankshaft, thoroughly clean out all the oilways. The clearance between the oil return thread on the crankshaft and the oil thrower cover should be .004 in. (.10 mm.). Clearances in excess of this may lead to oil leaks from the crankcase.

Section A.25

REGRINDING OF CRANKSHAFT

If on examination the crankshaft is found to be worn, scored or oval, it must be reground to one of the following undersizes.

Reground sizes

R1	—0.30 mm.	(—.012 in.).
R2	—0.50 mm.	(—.020 in.).
R3A	—0.75 mm.	(—.030 in.).
R4	—1.00 mm.	(—.040 in.).
R4A	—1.25 mm.	(—.050 in.).

Standard sizes

The standard main journal diameter is 42 mm. (1.654 in.).

The standard big-end journal diameter is 40 mm. (1.575 in.).

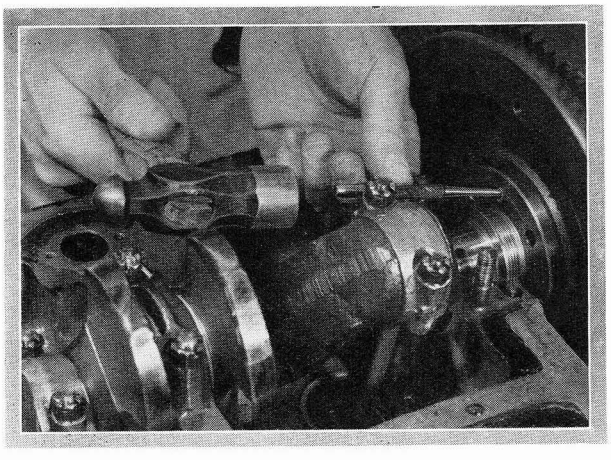


Fig. 21.
Driving out the flywheel locating dowels.

The reground size is clearly stamped on all reground crankshafts between No. 3 and No. 4 big-end journals.

Undersize bearings are supplied to definite dimensions, with the requisite clearance of .03 mm. (.001 in. to .0015 in.), and do not require any adjustment by scraping or fitting of the caps before assembly into the engine.

Section A.26

REMOVAL AND REPLACEMENT OF VALVES

Remove the cylinder head as detailed in Section A.18.

Raise the near-side front wheel clear of the ground and remove the wheel. Place a suitable stand under the front axle. Remove the wing valance inspection cover by undoing the three $\frac{3}{16}$ in. fixing bolts, equipped with spring washers.

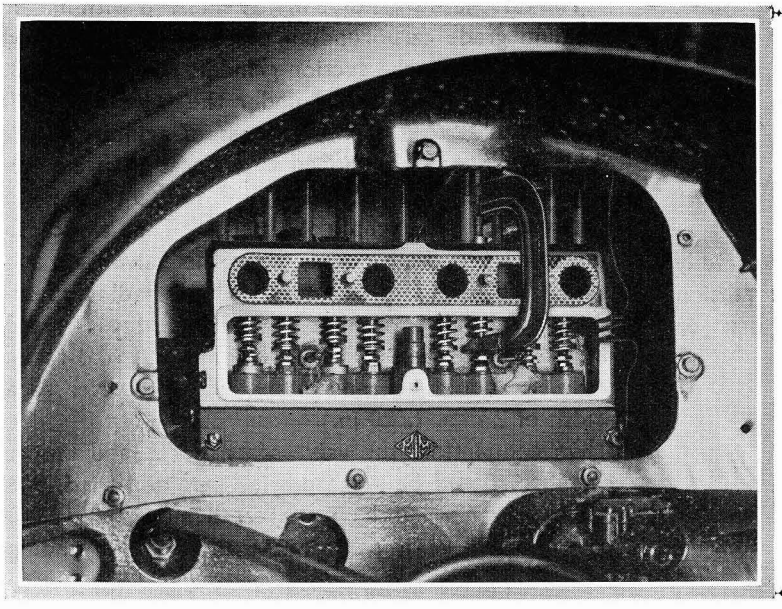


Fig. 22.
This illustrates the method of extracting the valve spring cotters by the use of the special extractor, Part No. 38378, through the opening in the wing valance.

Remove the carburetter as detailed in Section A.16.

Remove the inlet and exhaust manifold as detailed in Section A.17.

Slacken the $\frac{3}{16}$ in. pinch bolt on the clip locating the fume pipe to the tappet cover, and remove the $\frac{3}{16}$ in. bolt, nut and spring washer from the pipe bracket on the clutch housing and detach the pipe. Undo the two wing nuts on the tappet cover fixing studs, and remove the fibre washers, cover and gasket.

Before extracting the valves, it is advisable to plug the two holes in the floor of the tappet chamber with clean rag to prevent the possibility of the cotters dropping into the engine base.

The valve cotters may now be extracted by compressing the valve spring with compressor Part No. 38378. (See Fig. 22.)

Remove the valves, ease out the valve springs and caps.

Replacement is the reversal of the above operations.

Note.—Oil the valve stems and the guides before refitting them. Replace valves in their original positions. They will be found to be numbered on their heads, No. 1 being at the front of the engine. Number any new valves on their heads when new ones are necessary.

The valve springs are of the progressive pitch type and should be refitted with the close coils at the top.

Make sure that the top end of the valve spring is seating properly in its recess.

The tappet cover gasket is fitted with the two small holes at the bottom to allow trapped oil to drain back into the crankcase.

Section A.27

DECARBONISING

Remove the cylinder head as detailed in Section A.18 and extract the distributor drive shaft.

Remove the carburetter as detailed in Section A.16.

Remove the inlet and exhaust manifold as detailed in Section A.17.

It is recommended that as much of the carbon deposit as possible is cleaned off the piston crown, top of the cylinder block and exhaust ports before detaching the tappet cover and extracting the valves. This reduces the risk of foreign matter finding its way into the tappet chamber and then into the engine base. A ring of carbon should be left round the periphery of the piston crown, and the rim of carbon round the top of the cylinder bore should not be touched. To facilitate this, an old piston ring can be sprung into the bore so that it rests on top of the piston.

Where special equipment is not available for the purpose of decarbonising it will be necessary to scrape the carbon deposit from the piston crowns, cylinder

block and cylinder head, using a blunt scraper. Before commencing this operation, the waterways and distributor drive housing should be plugged with clean rag.

Remove the valves as detailed in Section A.26.

When the valves and the springs are withdrawn, the carbon deposit should be cleaned from the valve ports, and all traces of carbon removed by compressed air or by the vigorous use of a pair of household bellows.

The cylinder head is next given attention. The sparking plugs must be removed, cleaned and adjusted. The carbon deposit is scraped from the combustion spaces and the head thoroughly cleaned in paraffin, and when dry, again cleaned with compressed air.

Section A.28

GRINDING AND TESTING VALVES AND SEATINGS

Each valve must be cleaned thoroughly and carefully examined for pitting. Valves in a pitted condition should be refaced with a suitable grinder or alternatively replaced with new valves.

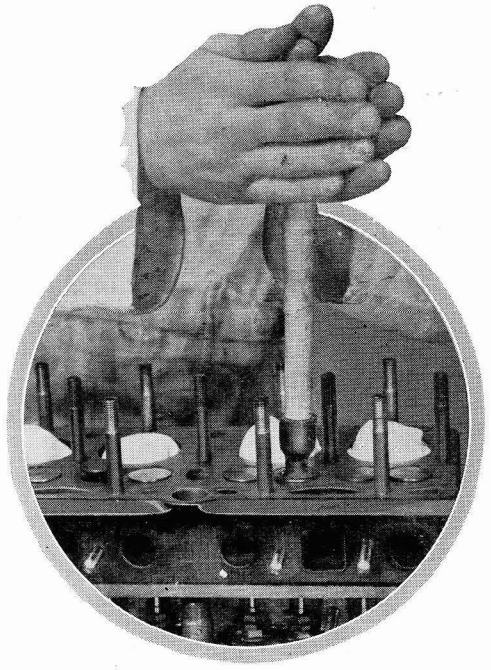


Fig. 23.
The special suction type valve-grinding tool in use. The use of a light spring under the valve head greatly facilitates the grinding-in process.

If valve seats show signs of pitting or unevenness, they should be trued by the use of a suitable grinder or a special cutter, Part No. 65925. When using this tool, care should be exercised to remove only as little metal as is necessary to ensure a true surface.

All valves when fitted at the factory are numbered on their heads from 1 to 8, and should be replaced in the corresponding valve ports, No. 1 valve being fitted to the port nearest the front of the engine. When replacement valves are fitted, they should be numbered to identify the port to which they belong. The tappet head must be slackened back three or four turns before commencing to grind the valves, and care must be taken to see that the tappet for the valve being ground is on the back of its cam. (See Section A.21.)

The valve face should be lightly smeared with fine or medium grade carborundum paste, and then ground to its seat, using the suction grinder, Part No. 66893. A light coil spring placed under the valve head will assist considerably in the process of grinding. The valve face should be lapped to its seat with a semi-rotary motion and occasionally allowed to rise by the pressure of the light coil spring. This assists in spreading the paste evenly over the valve face and seat. It is necessary to carry out the grinding operation until a dull, even matt surface is produced on the valve seat and face. If the valve seat is found to be wide, it should be reduced with a 30° cutter to a width of 2 mm. (.080 in.).

On completion, the valve seats, ports, and tappet chamber should be washed with paraffin, dried, and thoroughly cleaned by compressed air. The valves should be washed in paraffin, and all traces of grinding paste removed.

Section A.29

REMOVAL AND REPLACEMENT OF VALVE GUIDES

Remove the cylinder head as in Section A.18.

Remove the carburetter as in Section A.16.

Remove the exhaust manifold as in Section A.17.

Remove the appropriate valve and spring as in Section A.26.

Release the $\frac{1}{4}$ in. tappet adjustment locknut and remove the tappet screw from the tappet. (Special tool, Part No. 38932.)

Rotate the engine until the tappet is resting on the back of the cam, i.e. at its lowest position. (See Section A.21.)

Using a suitable drift, the valve guide may now be removed by driving it downwards until it is clear of the block. It can then be withdrawn over the tappet.

When refitting a valve guide, care must be exercised to ensure that it is inserted into the top of its housing with the bevelled end downwards. The guide is then

driven into position with a suitable drift, taking care to see that it is driven in to the correct distance.

The distance from the top face of the block to the valve guide should be :—

Inlet 20 mm. Exhaust 25.5 mm.

Section A.30

OIL PRESSURE

Under normal running conditions the oil should not drop below 40 lb. (2.8 kg./cm.^{2}) on the gauge at normal road speeds, whilst approximately 20 lb. (1.4 kg./cm.^{2}) should be shown when the engine is ticking over.

Should there be a noticeable drop in pressure, the following points should be checked over :—

1. That there is a good supply of the correct grade of oil in the engine sump.
2. That there is a complete absence of air leakage on the suction side of the pump and that the gears are in order with the correct gear clearances. (See Section A.4.)
3. That the gauze oil pump filter is clean and not choked with sludge.
4. That the bearings on the delivery side to which oil is fed under pressure have the correct working clearance. Should the bearings be worn and the clearances excessive, the oil will escape more readily from the sides of the bearings, particularly when the oil warms up and becomes more fluid. This will cause a drop in pressure on the gauge, as compared with that shown when the bearings are in good order.

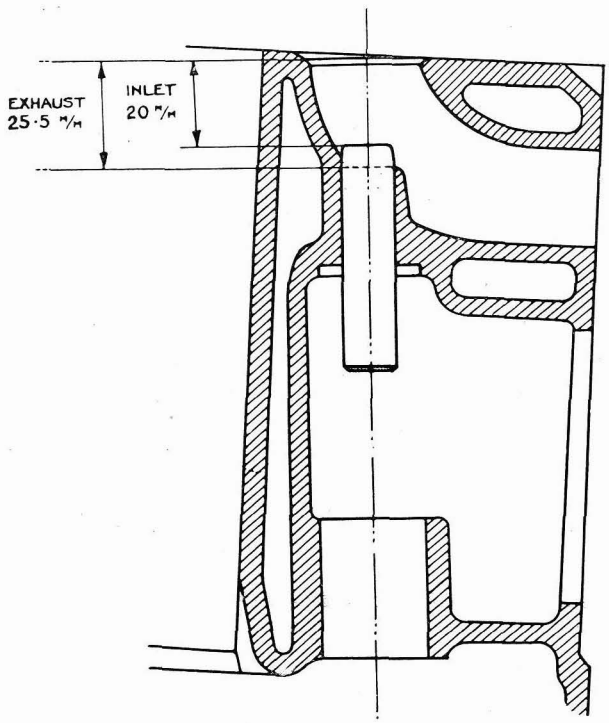


Fig. 24.
When replacing valve guides make sure that they are correctly located as shown.

Note.—The automatic release valve in the pump deals with any excessive oil pressure when starting from cold. When hot the pressure drops as the oil becomes more fluid.

Cold running and the unnecessary use of the mixture control is often the cause of serious oil dilution by petrol, and a consequent drop in pressure.

New engines with new oil will give considerably higher pressure readings than those given in the first paragraph.

Particular attention is called to the recommended change of oil every 3,000 miles (5,000 km.).

Section A.31

LOCATING TROUBLES

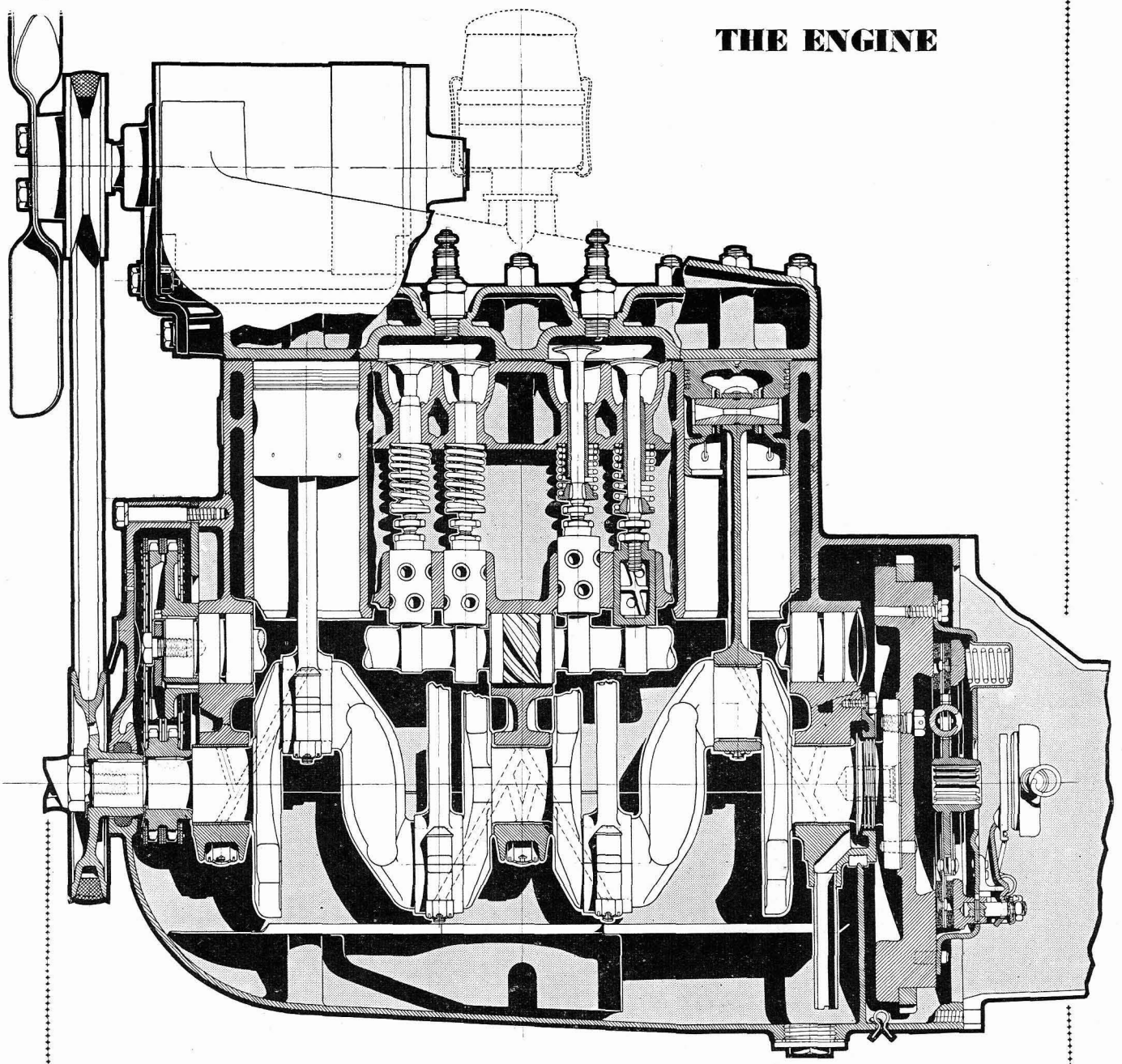
Engine will not start

A. If the starter will not turn the engine, check the following :—
   1. Battery discharged, and/or defective.
   2. Disconnected or broken leads.
   3. Faulty starter switch.
   4. Faulty starter motor.
   5. Starter cables shorting to earth.
   6. Battery terminals badly corroded or battery leads loose.

B. If starter turns engine very slowly, check :—
   1. Partly discharged battery.
   2. Loose terminals or connections.
   3. Dirty or corroded connections.
   4. Faulty insulation on starter cables.
   5. Tightness in engine.

C. If starter turns engine smartly, but it will not fire, check :—
   1. Plugs not sparking.
   2. Spark at the coil. If the coil gives good spark, check :—
      (*a*) Gaps in plugs too wide or too close.
      (*b*) Plugs oiled up.
      (*c*) Plug insulators damaged, or excessively dirty.
   3. If poor spark at coil, check :—
      (*a*) Low-tension or high-tension leads from coil to distributor loose or corroded.
      (*b*) Distributor points dirty, worn or out of adjustment.
      (*c*) Carbon brush not making contact.
      (*d*) Rotor cracked.

THE ENGINE



(e) Faulty condenser (substitute a condenser known to be in order).
(f) Faulty coil (substitute a coil known to be in order).

4. Check carburetter for petrol supply. If no petrol in float-chamber, check :—
   (a) Functioning of the petrol pump.
   (b) Air leak in pipe line, indicated by rapid action of the pump.
   (c) Float-chamber needle sticking.
5. If petrol is reaching float-chamber, check :—
   (a) For choked jet.
   (b) Water in the petrol.
   (c) Dirt in carburetter.
   (d) Air leak in induction system.
   (e) Check adjustment of carburetter control.

If engine starts, but runs erratically

A. Check the following ignition points.
   1. Loose high-tension leads to sparking plugs or corroded connection.
   2. Incorrect setting of plug points.
   3. Damaged plug or moisture on plugs.
   4. Loose connection on battery or in ignition circuit.
   5. Faulty high-tension leads.
   6. Battery charge low.
   7. Battery connections faulty.
   8. Defective contact breaker.
   9. Defective distributor.
   10. Faulty condenser.

B. Check the following carburetter points :—
   1. Water in float-chamber.
   2. Choked filters in carburetter or petrol pump, indicated by slow pumping of petrol pump.
   3. Action of petrol pump. Suspect if sluggish.
   4. Jet partially choked.
   5. Carburetter set too rich, indicated by sooty exhaust.
   6. Petrol tank filler-cap vent choked.
   7. Obstruction in fuel feed pipe lines.
   8. Air leak into induction system.

C. Check the following mechanical points :—
   1. Sticking valves.
   2. Incorrect valve clearance.
   3. Burnt or broken valves.
   4. Incorrect valve timing.
   5. Incorrect ignition timing.
   6. Broken or weak valve spring.
   7. Valve guides worn, causing air leaks.
   8. Faulty cylinder head gasket.
   9. Back pressure due to damaged exhaust system.

If engine starts and stops

A. Check the following ignition points :—
   1. Loose low-tension leads.
   2. Loose distributor clamp screw.
   3. Faulty ignition switch contact.

B. Check the following carburetter points :—
   1. Incorrect setting of carburetter controls.
   2. Blocked petrol pipe.
   3. Water in float-chamber.
   4. Sticking needle valve.
   5. Petrol pump failing to function regularly.
   6. Air leak into petrol line.
   7. Fuel level low in tank.

If engine will not idle or run slowly

A. Check the following carburetter points :—
   1. Throttle stop screw incorrectly set.
   2. Throttle controls incorrectly set.
   3. Weak mixture or over-rich mixture.
   4. Faulty functioning of petrol pump.

B. Check the following mechanical points :—
   1. Sticking valves.
   2. Incorrect valve tappet clearance.
   3. Air leak in induction system.
   4. Burnt or broken valves, indicated by loss of compression.
   5. Broken valve spring.
   6. Damaged cylinder head or gasket.

C. Check the following ignition points :—
   1. Loose high-tension leads.
   2. Incorrect setting of plug points.
   3. Damaged plugs or moisture on plugs.
   4. Loose connections on battery or in ignition circuit.
   5. Faulty high-tension leads.
   6. Battery charge low.
   7. Battery connections faulty.
   8. Defective contact breaker, or burnt points.
   9. Defective distributor.
   10. Defective condenser.

Engine fails to give full power

A. Check the following carburetter points :—
   1. Faulty or insufficient petrol supply.
   2. Air leaks in induction pipe, or petrol pipe.
   3. Partly choked jet.

B. Check the following mechanical points :—
   1. Incorrect valve tappet clearance.
   2. Burnt valve or badly seating valve.
   3. Cylinder head stud nuts not tight.
   4. Damaged cylinder head gasket.

5. Valve timing incorrect.
6. Broken or weak valve spring.
7. Excessive carbon deposit.
8. Excessively worn pistons and cylinders.

C. Check the following ignition points :—
1. Ignition retarded too far.
2. High-tension leads shorting, or loose.
3. Dirty sparking plugs.
4. Sparking plug points incorrectly set.
5. Contact breaker points incorrectly set.
6. Contact breaker points pitted.
7. Faulty coil.
8. Faulty condenser.
9. Low-tension connection or leads faulty.
10. Battery run down or faulty.

Engine knocks

A. Check the following :—
1. Ignition timing too far advanced.
2. Excessive carbon deposit.
3. Fuel unsuitable or weak mixture.
4. Loose or worn bearings or pistons.
5. Defective or unsuitable plugs.
6. Valve timing incorrect or tappet clearance incorrect.

Engine backfires

A. Check the following ignition points :—
1. High-tension cables defective or connections loose.
2. High-tension leads incorrectly fitted.
3. Low-tension wiring defective or connections loose.
4. Switch contact faulty.
5. Distributor gap incorrect or points pitted or dirty.
6. Contact breaker arm sticking or defective.
7. Distributor cover cracked or loose.
8. Distributor not correctly timed.
9. Rotor carbon brush pick-up defective or worn.
10. Clearance between rotor arm and distributor studs excessive.
11. Coil defective or wet.
12. Defective condenser.
13. Plugs overheated, unsuitable, or points incorrectly set.

B. Check the following carburation points :—
1. Jet choked or restricted.
2. Jet incorrectly set causing weak mixture.
3. Water in petrol.
4. Choked petrol filters.
5. Inlet manifold joint leaking, or manifold cracked.
6. Air cleaner passages blocked.
7. Engine running temperature too cold.
8. Throttle not closing completely (indicated by engine backfiring when proceeding downhill with throttle shut).

C. Check the following mechanical points :—
1. Valve timing incorrect.
2. Valve tappet clearance incorrectly set.
3. Valve sticking.
4. Valve seats pitted or faulty.
5. Valve spring weak or broken.
6. Valve guides excessively worn causing air leaks.
7. Timing chain excessively loose.
8. Excessive carbon deposit.

SECTION B

THE FUEL SYSTEM

Section B.1

REMOVAL AND REPLACEMENT OF THE PETROL TANK

Raise the rear of the car.

Drain all petrol from the tank by removing the $\frac{3}{8}$ in. hexagon-headed drain plug. Replace the plug when the tank is empty.

Disconnect the petrol gauge wire from its attachment to the tank unit.

Open the luggage boot lid and remove the spare wheel from its tray. Tip the tray to the rear of the car.

Disconnect the petrol pipe from the tank by undoing the $\frac{5}{16}$ in. union nut, which is now easily accessible through the floor of the luggage boot.

Slacken off both clips on the hose joining the petrol tank to the filler neck.

Remove the rubber grommet from the tank filler neck, and extract the neck and rubber hose joint.

Slacken the two $\frac{1}{4}$ in. locknuts and nuts securing the petrol tank straps in the floor of the luggage boot.

Support the petrol tank and remove the two pins securing the front end of the tank straps to the inside of the boot floor.

The tank may now be lowered from the car.

The tank is replaced by reversing the above procedure, noting that the floor grommet and the four felt pads are properly in position and that the drain plug and its washer are fully tightened.

Section B.2

CONSTRUCTION OF THE PETROL PUMP

The petrol pump is an S.U. Type L, 6-volt electric pump.

The pump consists of three main assemblies, the body, the magnet assembly and the contact breaker.

The body is composed of a hollow stamping or casting (8), into the bottom of which the filter (12) is screwed. The pump inlet union (29) is screwed in at an angle on one side. The outlet union (1) is screwed into the top and tightens down on the delivery valve cage (5) which is clamped between the two fibre washers (2) and (6). In the top of the delivery cage is the delivery valve, a thin brass disc (4) held in position by a spring clip (3). Inserted in the bottom of the cage is the suction valve (7), being a similar disc to (4) and resting on a seating machined in the body. Holes connect the space between the valves to the pumping chamber, which is a shallow depression on the forward face of the body. This space is closed by a diaphragm assembly (9) which is clamped at its outside edge between the magnet housing (27) and body (8) and at its centre between the retaining plate and the steel armature (15). A bronze rod (16) is screwed through the centre of the armature, to which the diaphragm is attached, and it passes through the magnet core to the contact breaker, which is located at the other end. A volute spring (28) is interposed between the armature and the end plate of the coil to return the armature and diaphragm.

The magnet consists of a cast-iron pot having an iron core (17), on which is wound a coil of copper wire which energises the magnet. Between the magnet housing and the armature are fitted eleven spherical-edged brass rollers (10). These locate the armature centrally within the magnet at all times, and allow absolute freedom of movement in a longitudinal direction. The contact breaker consists of a small bakelite moulding carrying two rockers, (25) and (26), which are both hinged to the moulding at one end and are connected together at the top end by two small springs, arranged to give a " throw over " action. A trunnion is fitted into the centre of the inner rocker, and the bronze push-rod (16) connected to the armature is screwed into this. The outer rocker (26) is fitted with a tungsten point, which makes contact with a further tungsten point on a spring blade (24). This spring blade is connected to one end of the coil, and the other end of the coil is connected to the terminal (20).

A short length of flexible wire is connected to the outer rocker and to the other terminal (23) which also serves to hold the bakelite moulding onto the magnet housing.

The rocker mechanism is insulated by fibre bushes. Two fibre bushes are fitted to one of the spindles of the " throw over " mechanism in order to silence the operation of the contact breaker.

Later pumps have an alloy body, die-cast in two pieces, the joint between them being sealed by a gasket.

Section B.3

ACTION OF THE PETROL PUMP

The action of the pump is as follows :—

When the pump is at rest, the outer rocker lies in the outer position and the tungsten points are in contact. The current passes from the terminal through the coil back to the blade, through the points and to the earth return, thus energising the magnet and attracting the armature. This comes forward, bringing the diaphragm with it and sucking petrol through the suction valve into the pumping chamber. When the armature has advanced nearly to the end

of its stroke the " throw over " mechanism operates, and the outer rocker flies back, separating the points and breaking the circuit. The spring (28) then pushes the armature and diaphragm back, forcing petrol through the delivery valve at a rate determined by the requirements of the engine. As soon as the armature gets near the end of this stroke the " throw over " mechanism again operates, the points again make contact, and the cycle of operations is repeated.

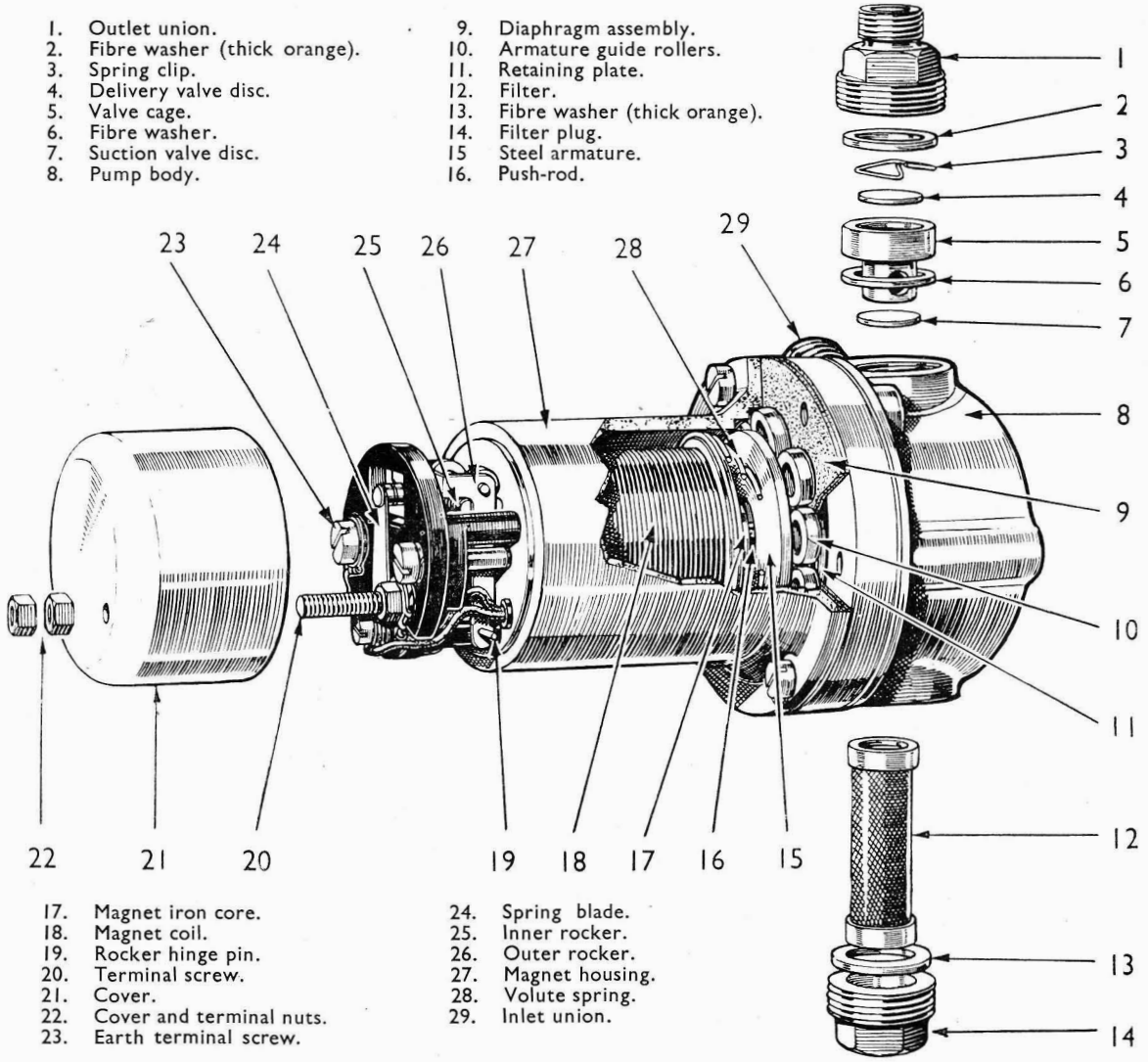


Fig. 25.
The S.U. petrol pump.

Section B.4

TO DISMANTLE AND REASSEMBLE THE PETROL PUMP

When a pump comes in for reconditioning the first thing to do is to determine whether it has been in contact with gum formation in the fuel, resulting in the parts in contact with the fuel becoming coated with a substance similar to varnish. These deposits also cause the eventual destruction of the neoprene diaphragm. The easiest way to identify this deposit is by the sense of smell. Place the outlet union of the pump close to one nostril, put a finger over the other nostril and breathe. If an unpleasant, stale smell is noticed it will indicate that there is some gum present in the pump. The ordinary sharp acrid smell of petrol denotes that no gum is present.

Assuming that trouble with gum formation is indicated, the whole of the parts coming into contact with petrol will have to be dismantled, boiled in 20 per cent. caustic soda solution, given a dip in strong nitric acid and then washed in boiling water.

To dismantle the pump

First undo the filter plug, remove the filter plug washer and the filter. The latter may be found to be clogged completely with gum. Next the inlet union and its washer should be removed, followed by the outlet union, outlet union washer, valve cage, valve cage washer and suction valve. The valve cage should then be dismantled by removing the circlip retaining the delivery valve in place, and the valve itself can then be withdrawn.

Next undo the six screws holding the two main components of the pump together. All the components of the pump body—with the exception of the washer, but including the pump body itself—should now be given the caustic soda and nitric acid treatment. New fibre washers should be used on replacement.

If there is no evidence of gum formation, proceed as follows :—First undo the six screws holding the two parts of the pump together. The action of the valves can then be checked by blowing and sucking in the inlet union, which will check the suction valve ; carrying out the same procedure with the outlet union will check the delivery valve. In the case of the former you should be able to blow freely but not be able to suck air back, and with the latter you should be able to suck freely and not blow air back. If these are in order it is best to leave the valves alone.

Clean the filter in petrol with a brush and swill out the body of the pump.

Next unscrew the diaphragm assembly from its trunnion in the contact breaker. This is done by rotating the whole assembly in an anti-clockwise direction. While doing this, care should be taken not to lose the brass rollers fitted behind the diaphragm. The easiest method is to hold the body in the left hand and to rotate the diaphragm.

Now remove the contact breaker cover by taking off the nut which holds it in place on the terminal, and then undo the further nut on the terminal, which acts as a seating for the cover. Beneath this will be found a lead washer which is squeezed into the thread on the terminal. This should be cut away with a pocket knife, allowing the terminal to be pushed down a short way so that the tag on the coil end is free on the terminal.

The 5 B.A. screw holding the contact blade in position should now be removed, together with its spring washer and the contact blade.

The two long 2 B.A. screws holding the bakelite pedestal in place should now be removed, together with their spring washers. This will enable the contact breaker assembly to be taken off, using great care to get the coil end tag over the terminal without damaging the coil end.

The hinge pin on which the rockers pivot can now be pushed out sideways and the pump is completely dismantled, since the rocker mechanism is not supplied in broken-down sections but only as a complete assembly.

Under no circumstances should any attempt be made to disturb the core of the magnet. The core can only be located in position correctly with special press tools, and in any case should not need to be interfered with.

To reassemble the pump

When reassembling, see that all parts are clean. The valves (4 and 7) should be fitted with the smooth side downwards. Care should be taken that the valve retaining clip (3) in the delivery valve cage (5) is correctly located in its groove. The thin hard red fibre washer (6) should be fitted under the valve cage and a thick orange-coloured one (2) above the valve cage and also above the filter plug. The washer on the inlet union (29) is a thick red fibre one.

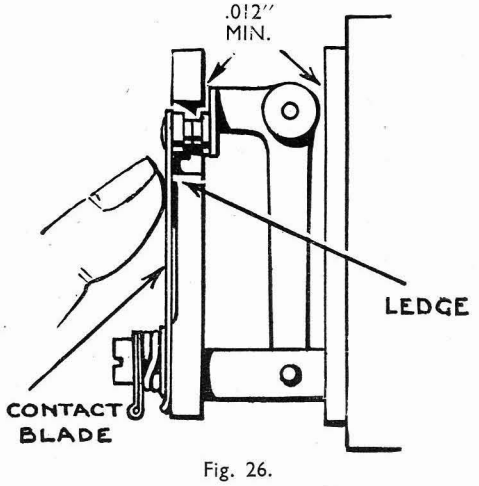


Fig. 26.
The correct setting for the contact breaker points is clearly indicated in this illustration.

The contact breaker should be assembled on its pedestal in such a manner that the rockers are free in their mountings, without appreciable side play. Any excessive side play on the outer rocker will allow the points to get out of line, while excessive tightness will make the action of the contact breaker sluggish and interfere with its action. To obtain the required freedom in cases of tightness, it may be necessary to square the outer rocker up with a pair of thin-nosed pliers. The hinge pin is case-hardened and on no account should ordinary wire be used as a replacement. Always use the correct hardened pin.

Should the spring contact-breaker blade be removed, it should always be replaced bearing directly against the bakelite pedestal, i.e. underneath the tag.

When properly fitted the blade should rest against the ledge formed below the opening in the pedestal for the contact points when the points are separated, and it should not be sufficiently stiff to prevent the outer rocker from coming right forward when the points are in contact. The points should make contact when the rocker is in its midway position. The most simple way to check this is to hold the blade in contact with the pedestal, taking care not to press on the overhanging portion, and see that you can get a .012 in. (.30 mm.) feeler between the white rollers and the cast iron body of the pump (see Fig. 26). If necessary the tip of the blade may be set to give the correct clearance.

Note.—The spring washer on the B.A. screw, to which the earth connection is made, should be fitted between the tag and the pedestal. The reason for this is that the spring washer is not a reliable conductor, and the brass tag must therefore bear directly against the head of the screw.

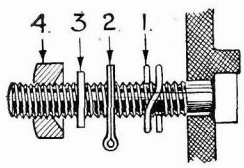


Fig. 27.
(*Above*). The correct sequence of assembly of the connecting components on the terminal screw.

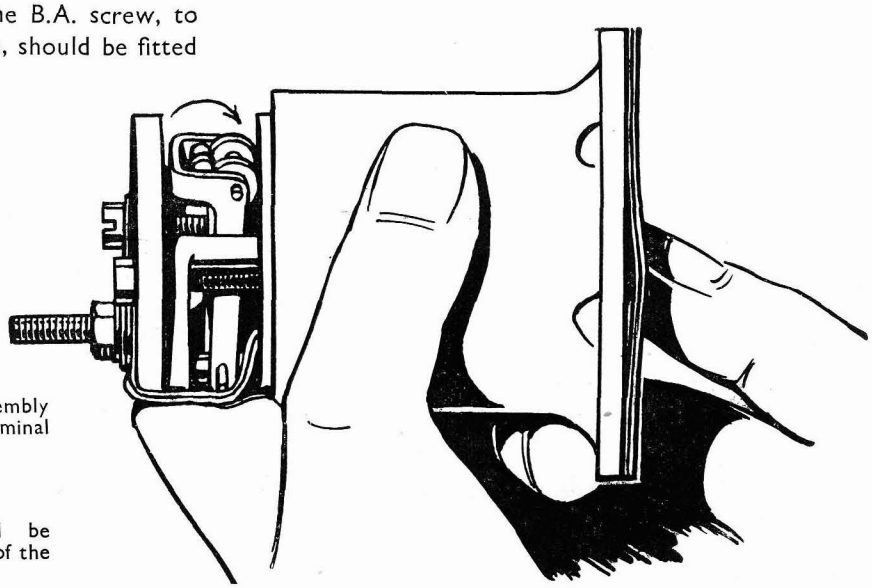


Fig. 28.
(*Right*). The method which should be employed to check the correct setting of the armature.

All four connections, namely the two ends of the earthing tag and the two ends of the coil, should be soldered. The coil end leading to the terminal should be soldered to its tag and not to the retaining nut. In the case of the terminal screw which holds the bakelite cover in position, similar considerations apply, the assembly being :—Spring washer (1), wiring tag (2), lead washer (3), and recessed nut (4), see Fig. 27. A lead washer has been found necessary at this point as some few cases of bad connection have been found. Under no circumstances must the spring washer be omitted, or the assembly shortened in any way. Any attempt to do so is likely to lead to breakage of the pedestal when the nut retaining the cover in position is tightened up.

The armature return spring should be fitted with its larger diameter towards the coil and its smaller diameter resting against the armature. This spring must not be stretched or otherwise interfered with, or the action of the pump will be affected.

Section B.5

PETROL PUMP ADJUSTMENT

The correct adjustment for the armature, if it has been removed, is carried out as follows :—

1. Swing the contact blade on the pedestal to one side while the adjustment is being made.
2. Fit the impact washer (10) in recess of armature.
3. Screw the armature in position.
4. Place the eleven guide rollers in position around the armature. **No jointing compound may be used on the diaphragm.**
5. Hold the magnet assembly in the left hand, in an approximately horizontal position.
6. Push armature in with the thumb of the right hand, pushing firmly but steadily. If the contact breaker throws over, the armature should be screwed in further until it ceases to do so, it should then be unscrewed one-sixth of a turn at a time, until a position is found where the contact breaker rocker just throws over, care being taken to avoid jerking the armature. It should be pressed in steadily (see Fig. 28). The armature should then be unscrewed a further two-thirds of a turn when the setting is correct. **Do not forget that this setting must be carried out.**

When a new diaphragm is fitted, it is probable that considerable pressure will be required to push the armature right home. If there is any

doubt concerning the point at which the contact breaker throws over, come back one-sixth of a turn.

7. Place the cast iron body in position on the main body, taking care to see that the drain hole in the cast iron body is at the bottom in line with the filter plug of the main body, and that all the rollers are still in their correct positions.

   If a roller drops out of position it will get trapped between the two ports, and this will cut a hole in the diaphragm.

   Make sure that the cast iron body is seating properly on the main body, and insert the five coupling screws and the earth terminal screw. These screws should not be screwed up tightly in the first instance as it is absolutely necessary at this stage to stretch the diaphragm to its outermost position. This is best effected by using a special forked wedge to keep the armature in its extreme position (Fig. 29). The wedge is inserted between the white rollers of the outer rocker and pressed under the tips of the inner rocker until it lifts the trunnion in the centre of the inner rocker as far as it will go. If this wedge is not available the diaphragm may be stretched by holding the points in contact by inserting a matchstick under one of the white fibre rollers and passing the current through the pump. This will excite the magnet, actuate the armature, stretching the diaphragm, and the screws may then be tightened down fully while the diaphragm is held in this position.

   The spring blade rests against a small projection on the bakelite moulding, and it should be so set that when the points are in contact it is deflected back from the moulding. The width of the gap at the points is approximately .030 in. (.76 mm.).

8. The pump should now be placed on test, using a cut-away cover to enable the contact breaker action to be observed, and at the same time prevent the rocker hinge pin from falling out.

A test rig of the type illustrated in Fig. 30 is advised, either petrol or paraffin may be used for testing purposes, and the pump should be mounted approximately 3 ft. (91 cm.) above the test tank. The use of a glass tube and rubber connections between the pump and the test tank is advised. When the pump is switched on it should prime itself promptly, and the paraffin, which is normally used for testing, should rise in the glass container until it flows over the top of the pipe having the $\frac{5}{32}$ in. (4 mm.) hole drilled in it 2 in. (5 cm.) below the top of the pipe. If the output of the pump is not up to normal, the $\frac{5}{32}$ in. (4 mm.) diameter hole will be able to deal with all the paraffin pumped and the liquid will not flow over the top of the pipe. If a time test is used, one pint (.57 litres) of fuel per minute should be pumped.

This, therefore, constitutes a simple form of flow-meter which establishes in a simple manner whether

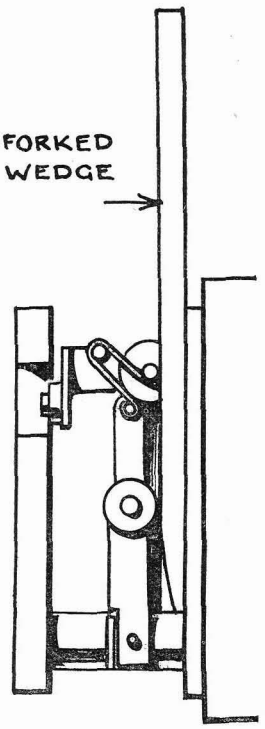


Fig. 29.
The use of a forked wedge to keep the armature in the correct position for fitting the diaphragm.

the pump is giving a sufficient output or not. If there is any air leak in the pump or in its connections, bubbles will be seen coming out of the pipe projecting downwards into the flow-meter. Bubbles will certainly come through here for a short while after starting up, but they should cease after the pump has been running for a minute or so. The tap should then be turned right off and the pump should stand without repeating its action for at least fifteen seconds. If it repeats within this time, the suction valve is not seating correctly.

The tap should then be turned off slowly to see if the pump idles satisfactorily, and that the outer rocker comes forward till it makes contact with the pedestal, and while it is in this position the tip of the blade should be pressed inwards to reduce the stroke of the pump gradually. However much this stroke is reduced the pump should go on pumping normally until it fails altogether owing to there being no gap left. If instead of pumping it buzzes, it usually indicates excessive flexibility in the diaphragm. This,

of course, is not likely to be experienced with a new diaphragm. The tap should then be turned on again and the pump tested on 9 volts (or on $4\frac{1}{2}$ volts if it is a 6-volt pump) and it should work satisfactorily under these conditions, although probably with a reduced output.

It is as well to let the pump run for ten minutes or so before carrying out these various tests. The cover, which is black for 12-volt and brown for 6-volt, should then be fitted and held in place with an ordinary

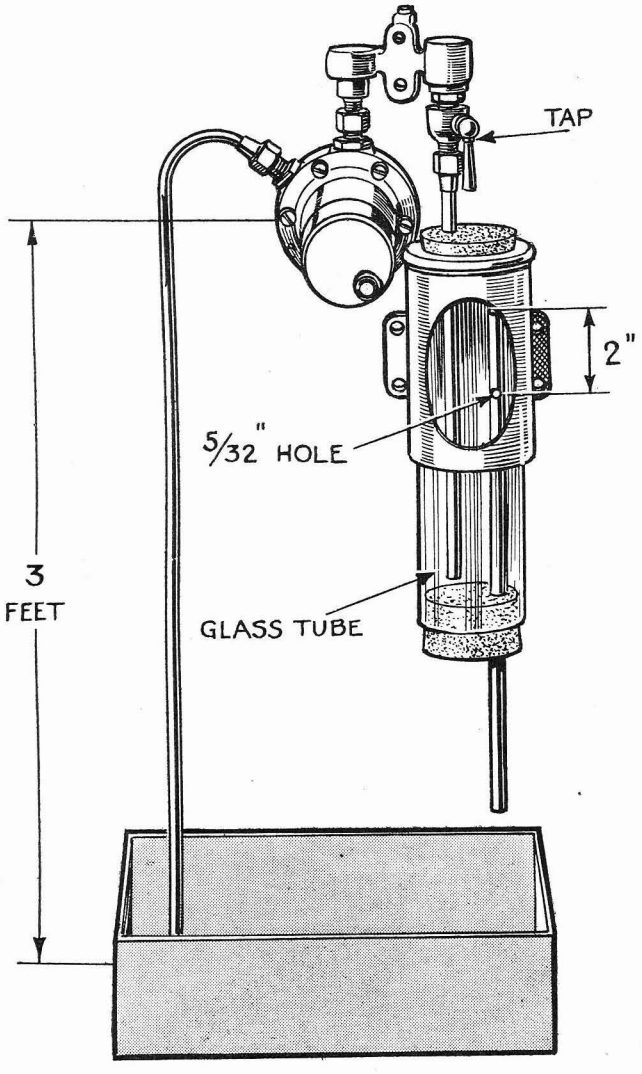


Fig. 30.
Checking rig.

brass nut and an insulated dome nut fitted on the end of the terminal. The voltage of the pump can always be identified by the colour of the sleeving on the coil ends, this being red for 12-volt and green for 6-volt.

Note.—There are three important points which are repeatedly overlooked by operators. These seriously affect the functioning of the pump ; they are :—

1. To keep the contact breaker blade out of contact while obtaining the correct diaphragm setting.
2. To press firmly and steadily on the armature, instead of jerking it while obtaining the setting.
3. Omission to stretch the diaphragm to the limit of its stroke while tightening up the body screws.

Section B.6

TRACING PETROL PUMP TROUBLES

Should the pump cease to function, first disconnect the petrol delivery pipe from the pump. If the pump then works the most likely cause of the trouble is a sticking needle in the float-chamber of the carburetter. Should the pump not work, disconnect the lead from the terminal and strike it against the body of the pump after switching on the ignition. If a spark occurs it indicates that the necessary current is available at the terminals, and that the trouble arises with the pump mechanism. If no spark can be detected, then it is an indication that the current supply has failed and that attention should be given to the wiring and battery. If current is present, further investigation should be carried out by removing the bakelite cover which is retained by the terminal nut. Touch the terminal with the lead. If the pump does not operate and the contact points are in contact yet no spark can be struck off the terminal, it is very probable that the contact points are dirty and require cleaning. These may be cleaned by inserting a piece of card between them, pinching them together and sliding the card backwards and forwards.

If, when the wire is connected to the terminal, and the tickler of the carburetter is depressed, the points fail to break, it is possible that there is either an obstruction in the suction pipe, which should be cleared by blowing it through with air, or some irregularity in the pump itself is preventing the correct movement. This may be due either to the diaphragm having stiffened, or to foreign matter in the roller assembly which supports the diaphragm, in which case the diaphragm should be removed and the whole assembly cleaned and reassembled in accordance with the instructions on page 35.

On the other hand, if the points are not making contact, see that the tips of the inner rocker (25) are in contact with the magnet housing. If they are not it is an indication that the armature has failed to return to the end of its normal travel.

To cure this, loosen the six screws which attach the magnet housing to the pump body, and make sure that the diaphragm is not sticking to the face of the magnet housing by carefully passing a penknife between the two. The hinge pin (19) should then be removed and the six retaining screws tightened up again. The tips of the inner rockers will probably now be found to be making contact with the face of the magnet housing, but if they are not, it will be necessary to remove and dismantle the whole magnet assembly in order to ascertain if an accumulation of foreign matter has caused a jam. Remember that whenever the magnet housing is removed, care should be taken to see that the guide rollers (10) do not drop out.

Pump noisy

If the pump becomes noisy and works rapidly, it is usually an indication that there is an air leak on the suction side of the pump. Check the level of the petrol in the tank and see that it is not too low.

The simplest way to test for air leakage is to disconnect the petrol pipe from the carburetter and place its end in a glass jar (approximately 1 pint or half a litre) and allow the pump to deliver petrol into it. If air bubbles appear when the end of the pipe has become submerged in the petrol it is a clear indication of an air leak on the suction side of the pump in the petrol feed pipe between the tank and the pump, which should be found and cured. Check all the unions and joints, making sure that the filter union and inlet unions are all quite airtight.

Failure to deliver petrol

Should the pump continue beating without delivering petrol, it is probable that some dirt has become lodged under one of the valves, in which case they should be dismantled by unscrewing the top or delivery union and lifting out the valve cage, when they can be cleaned and reassembled. When replacing it see that the thin hard red fibre washer is *below* the valve cage and the thick orange one above.

If the pump struggles to pump and becomes very hot, it is probable that the filter has become clogged or there is an obstruction on the suction side. The filter is readily removed for cleaning by unscrewing its retaining plug at the bottom of the pump.

Section B.7

PETROL PUMP MAINTENANCE

Apart from keeping the contacts clean and removing the filter at regular intervals for cleaning, there is no maintenance required on the petrol pump.

The filter can be removed by unscrewing the hexagon plug at the bottom of the pump, when it can be cleaned in petrol with a stiff brush. Never use rag to clean a filter.

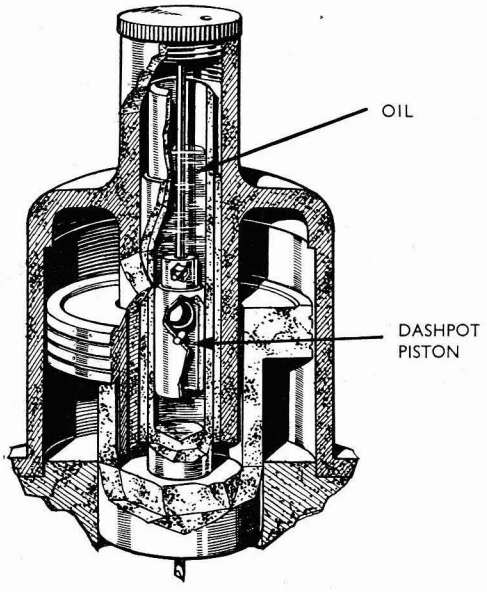


Fig. 31.
The carburetter suction chamber, suction disc, piston and piston rod, partly sectioned to show the details of the oil dashpot.

Section B.8

THE CARBURETTER

The carburetter is an S.U. of the controllable jet type, fitted with an air silencer.

A damper is provided consisting of a plunger and non-return ball valve attached to the oil cap nut, which operates in the hollow piston rod which is partly filled with oil. Its function is to give a slightly enriched mixture on acceleration by controlling the rise of the piston and prevent piston flutter.

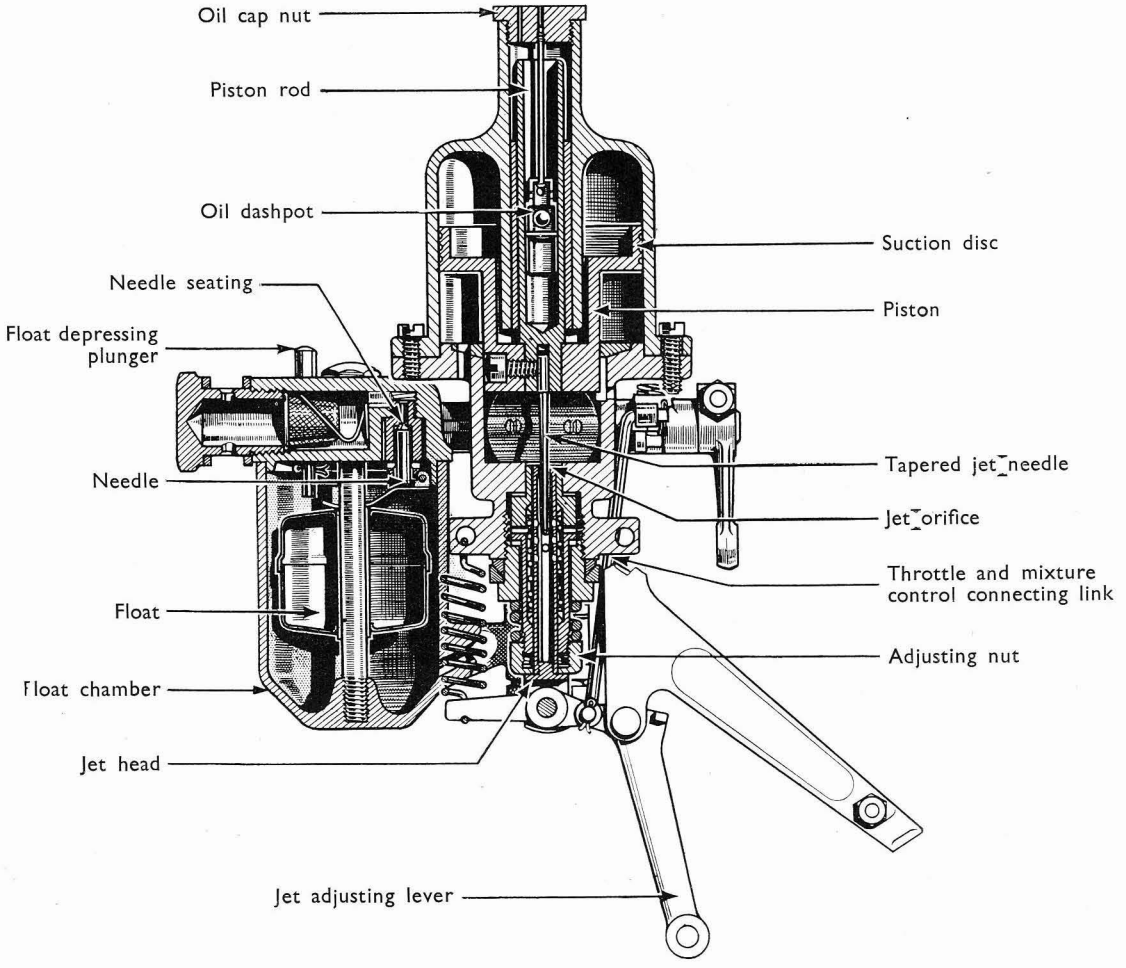


Fig. 32.
The S.U. carburetter.

Section B.9

CARBURETTER ADJUSTMENTS

The mixture

Run the engine until it attains its normal running temperature.

Adjust the throttle abutment screw to such a position that the engine idles at a moderate speed. Adjust the jet to give a richer mixture by screwing the jet adjusting nut downwards, keeping the jet head in contact with it, until the mixture is obviously too rich as indicated by " hunting " and a sooty exhaust. Now screw the jet adjusting nut upwards, still keeping the jet head in contact with it, until it brings the jet to the position where the engine idles with an even exhaust and runs at the best possible speed for this throttle opening.

A simple way to test for correct mixture at this stage is to lift the piston up slightly with a pencil or similar object to a height of approximately $\frac{1}{32}$ in. (.8 mm.). When this is done the engine should run slightly faster. If it runs appreciably faster and continues to do so when the piston is still further lifted, the mixture is too rich.

If the engine stops when the piston is raised $\frac{1}{32}$ in. (.8 mm.) the mixture is too weak. Final slow-running adjustment is carried out by resetting the throttle.

If, after this adjustment has been made, the road performance is not satisfactory, a larger or smaller

needle may be necessary. If the car pulls better with the manual control pulled out, a richer needle is indicated, and the reverse if the running becomes worse.

Should it be necessary to change the needle, this can be done by removing the two screws holding the suction chamber in position, and lifting off the suction chamber after marking its position to ensure that it is refitted in its original position. The piston can now be removed. At the side of the piston will be found a set screw. When this is slackened off the needle can be withdrawn and the new needle fitted. **The correct position of the needle is with its shoulder flush with the face of the piston.** When replacing, care should be taken that the keyway at the side of the piston registers with the key in the body. Great care should also be taken to see that all machined faces and parts are kept scrupulously clean.

The float-chamber

The position of the forked lever in the float-chamber must be such that the level of the float (and therefore the height of the fuel at the jet) is correct.

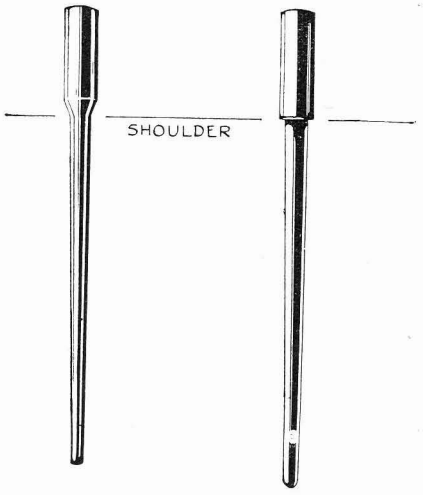


Fig. 33.
The shoulder of the needle should be flush with the under face of the piston.

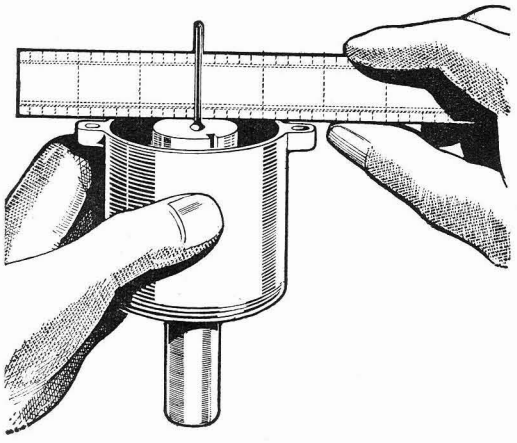
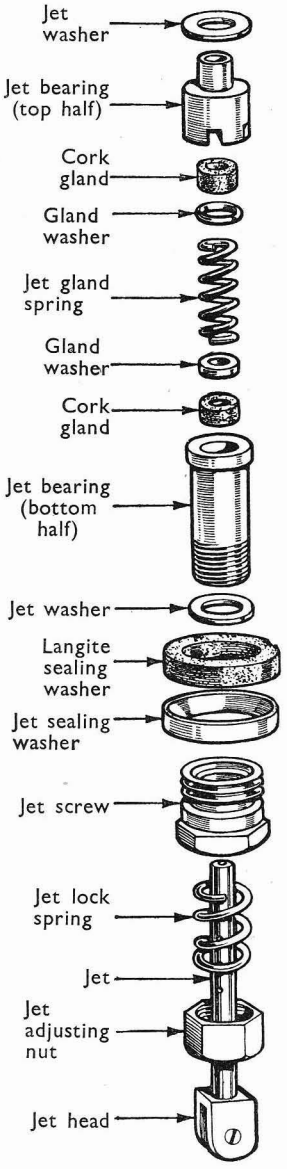


Fig. 34.
Checking the correct location of the needle shoulder.



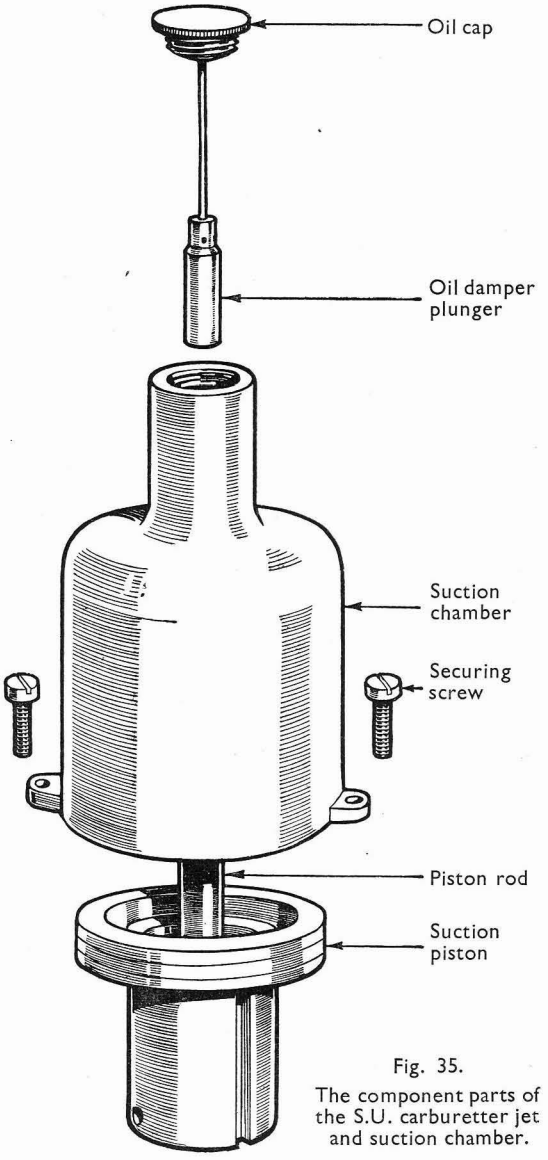


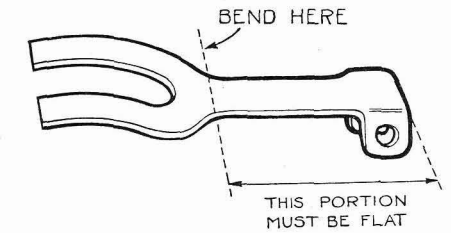
Fig. 35.
The component parts of the S.U. carburetter jet and suction chamber.

This is checked by inserting a $\frac{3}{8}$ in. (9.5 mm.) round bar between the forked lever and the machined lip of the float-chamber lid. The prongs of the lever should just rest on the bar (see Fig. 36) when the needle is on its seating. If this is not so, the lever should be reset at the point where the prongs meet the shank. Care must be taken not to bend the shank, which must be perfectly flat and at right angles to the needle when it is on its seating.

Section B.10

CENTRING THE JET

First remove the clevis pin at base of the jet, which attaches the jet head to the jet operating lever ; withdraw the jet completely, and remove the adjusting nut and the adjusting nut spring. Replace the adjusting nut without its spring and screw it up to the highest position. Slide the jet into position until the jet head



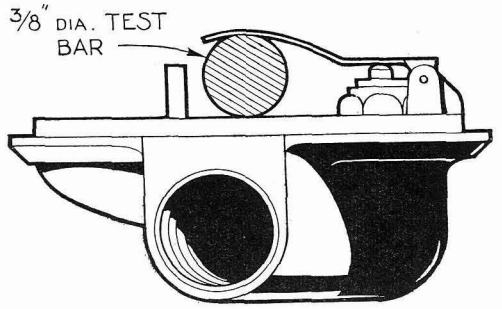


Fig. 36.
Showing the place where the float lever should be set and, below, the method of checking the correct adjustment of the lever.

is against the base of the adjusting nut. When this has been done, feel if the piston is perfectly free by lifting it up with the finger with the dashpot piston removed. If it is not, slacken the jet holding screw and manipulate the lower part of the assembly, including the projecting part of the bottom half jet bearing, adjusting nut and jet head. Make sure that this assembly is now slightly loose. The piston should then rise and fall quite freely as the needle is now able to move the jet into the required central position. The jet holding screw should now be tightened and a check made to determine that the piston is still quite free. If it is not found to be so, the jet holding screw should be slackened again and the operation repeated. When complete freedom of the piston is achieved the jet adjusting nut should be removed, together with the jet, and the spring replaced. The adjusting nut should now be screwed back to its original position.

Experience shows that a large percentage of carburetters returned for correction have had jets removed and not correctly centred on replacement.

Section B.11

SOURCES OF CARBURETTER TROUBLE

Piston sticking

The piston assembly comprises the suction disc and the piston forming the choke, into which is inserted the hardened and ground piston rod which engages in a bearing in the centre of the suction chamber and in which is, in turn, inserted the jet needle. The piston rod running in the bearing is the only part which is in actual contact with any other part, the suction disc, piston, and needle all having suitable clearances to prevent sticking. If sticking does occur the whole assembly should be cleaned carefully and the piston rod lubricated with a spot of thin oil. No oil must be applied to any other part except the piston rod. A sticking piston can be ascertained by removing the

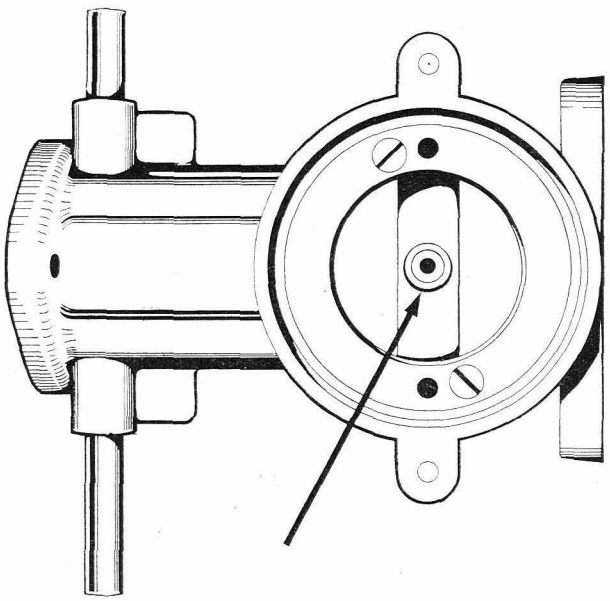


Fig. 37.
Indicates an incorrectly centred jet which is eccentric to the jet aperture in the carburetter body.

dashpot piston damper, inserting a finger in the air intake and lifting the piston, which should come up quite freely and fall back smartly onto its seating when released.

Water or dirt in the carburetter

When this is suspected, lift the piston with a pencil. The jet can then be seen. Flood the carburetter by depressing the float depressing plunger and watch the jet ; if the petrol does not flow through freely there is a blockage. To remedy this, start the engine, open the throttle, and block up the air inlet momentarily without shutting the throttle, keeping the throttle

open until the engine starts to race. This trouble seldom arises with the S.U. carburetter owing to the size of the jet and petrol ways. When it does happen the above method will nearly always clear it. Should it not do so, the only alternative is to remove the jet. This, however, should on no account be done unless it is absolutely necessary, as it has to be carefully centred when refitting and it is practically impossible to assemble this part correctly unless it is first thoroughly understood how to carry this out.

Float-chamber flooding

This can be seen by the petrol flowing over the float-chamber and dripping from the air inlet, and is generally caused by grit between the float-chamber needle and its guide. This can usually be cured by depressing the float depressing plunger to allow the incoming flow of petrol to wash the grit through the guide and into the float-chamber.

Float needle sticking

If the engine stops, apparently through lack of fuel, when there is plenty in the tank and the pump is working properly, the probable cause is a sticking float needle. An easy test for this is to disconnect the pipe from the electric pump to the carburetter, switch on the ignition to check if fuel is delivered ; if it is, starvation has almost certainly been caused by the float needle sticking to its seating, and the float-chamber lid should therefore be removed, the needle and seating cleaned, and refitted. At the same time it will be advisable to clean out the entire fuel feed system, as this trouble is caused by foreign matter in the petrol, and unless this is removed it is likely to recur. It is of no use whatever replacing any of the component parts of the carburetter, and the only cure is to make sure that the petrol tank and pipe lines are entirely free from any kind of foreign matter or sticky substance capable of causing this trouble.

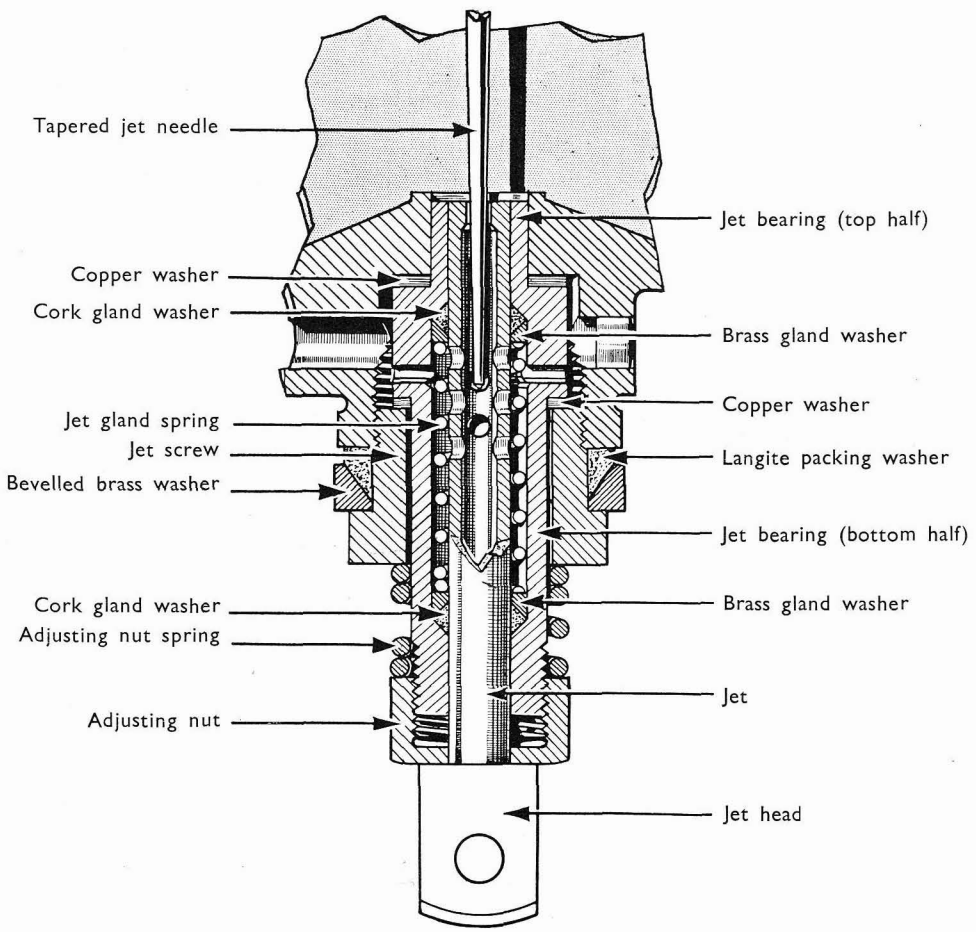


Fig. 38.
An enlarged view of the jet assembly, showing its component parts.

SECTION C

THE IGNITION EQUIPMENT

Description and specification of equipment.

GENERAL DESCRIPTION

The ignition equipment is of the coil type and is provided with automatic advance mechanism which relieves the driver of the necessity of adjusting the timing. Its advantages are particularly evident when accelerating and during hill climbing, since the danger of knocking or pinking through excessive advance is very much reduced.

The automatic advance device is housed in the distributor unit, and it consists of a centrifugally operated mechanism by means of which the ignition is advanced in proportion to the engine speed.

1. *Distributor type*

The distributor is a Lucas Model DKYH4A, Service No. 40056B. These identification marks are stamped on the side of the distributor. When ordering replacements, always quote these numbers.

2. *Ignition coil type*

The coil is a Lucas Model 6Q6, Service No. 45020A. These identification marks are stamped on the base of the ignition coil. When ordering, always quote these numbers.

Section C.1

TESTING WITH SPARKING PLUGS IN POSITION TO LOCATE CAUSE OF UNEVEN FIRING

(*a*) Start the engine and set it to run at a fairly fast idling speed.

(*b*) Short-circuit each plug in turn by placing a hammer-head or the blade of a wooden-handled screwdriver between the terminal and the cylinder head. No difference in the engine performance will be noted when short-circuiting the plug in the defective cylinder. Shorting the other plugs will make the uneven running more pronounced.

(c) Having located the cylinder which is at fault, stop the engine and remove the cable from the terminal of the sparking plug. Re-start the engine and, holding the rubber, keep the end of the cable about $\frac{3}{16}$ in. (5 mm.) from the cylinder head.

(*d*) If a strong and regular spark occurs the fault probably lies in the sparking plug. Remove

the plug, clean it, and adjust its gap to the correct setting or alternatively fit a replacement plug.

(e) If there is no spark, or if it is weak and irregular, examine the cable from the sparking plug to the distributor. After a long period of service the rubber insulation may be cracked or perished, in which case the cable should be replaced. Finally, examine the moulded distributor cap, wipe the inside and outside with a clean dry cloth, see that the carbon brush moves freely in its holder and examine the moulding closely for signs of breakdown of the insulation, usually indicated by spark tracks, that is, a conducting path may have formed between two or more of the electrodes or between one of the electrodes and some part of the distributor in contact with the cap. Evidence of a tracked cap is shown by the presence of a thin black line indicating the path of the leaking current. A replacement distributor cap must be fitted in place of the one that has failed.

Section C.2

TESTING LOW-TENSION CIRCUIT

1. (*a*) Spring back the securing clips on the distributor and remove the moulded cap and rotor. If the rotor is a tight fit, it can be levered off carefully with a screwdriver.

(*b*) Check that the contacts are clean and free from pitting, burning, oil or grease. Turn the engine and check that the contacts are opening and closing correctly and that the clearance, when the contacts are fully opened, is .010 in. —.012 in. (.25 mm.—.30 mm.). Correct this if necessary.

(*c*) Disconnect the cable at the "CB" terminal of the coil and at the low-tension terminal of the distributor, and connect a test lamp between these terminals. If the lamp lights when the contacts close and goes out when the contacts open, the low-tension circuit is in order. If not, proceed to locate the fault in the low-tension circuit.

2. *Low-tension circuit. To locate fault*

Having determined, by testing as described in paragraph 1, that the fault lies in the low-tension circuit, switch on the ignition and turn the engine until the contact breaker points are fully opened.

Refer to the wiring diagram (see pages 110 and 111) and check the circuit with a voltmeter (0—20 volts) as follows :—

Note.—If the circuit is in order the reading on the voltmeter will be approximately 6.

(*a*) *Battery to control box.* Connect the voltmeter between the terminal "A" on the control box and a good earthing point. No reading indicates a damaged cable or loose connections.

(*b*) *Control box to lighting and ignition switch.* Connect the voltmeter to the switch terminal "A" and earth. No reading indicates a damaged cable or loose connections.

(*c*) *Ignition switch.* Connect the voltmeter to the ignition switch terminal "IG" and earth. No reading indicates a fault in the ignition switch.

(*d*) *Switch box terminal to ignition coil terminal "SW."* Connect the voltmeter to the ignition coil terminal "SW" and earth. No reading indicates a damaged cable or loose connections.

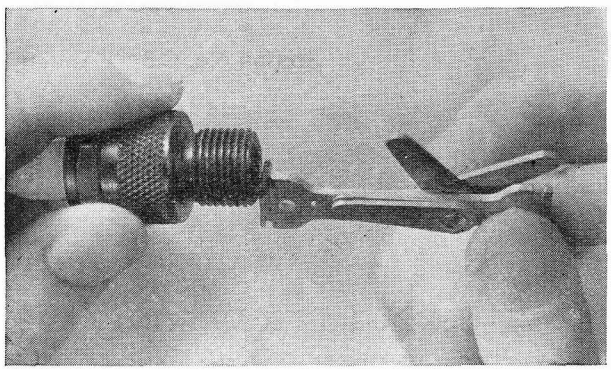


Fig. 39.
Adjustments to the spark cap should be made only by bending the side wire, preferably by using a proper setting tool such as the "Champion" setting tool here illustrated.

(*e*) *Ignition coil.* Disconnect the cable from the ignition coil terminal "CB" and connect the voltmeter to this terminal and to earth. No reading indicates a fault in the primary winding of the coil. If the correct reading is given, replace the original connection to the "CB" terminal.

(*f*) *Ignition coil to distributor.* Disconnect the cable from the low-tension terminal on the distributor and connect the voltmeter to the end of this cable and to earth. No reading indicates a damaged cable or loose connection. If the correct reading is given replace the connection to the distributor low-tension terminal.

(g) *Contact breaker and condenser.* Connect the voltmeter across the contact breaker points. No reading indicates a fault in the condenser.

Section C.3

HIGH-TENSION CABLES

(a) The high-tension cables must be examined carefully and any which have the insulation cracked, perished or damaged in any way, must be replaced.

(b) To fit the cable to the ignition coil, thread the knurled moulded terminal nut over the lead, bare the end of the cable for about $\frac{1}{4}$ in (6 mm.), thread the wire through the brass washer

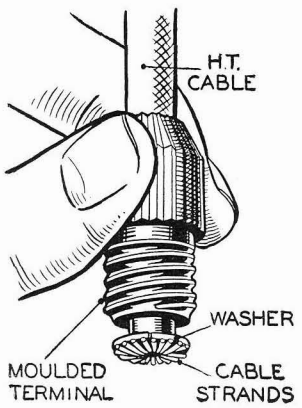


Fig. 40.
Demonstrates the correct method of fitting the high-tension cable to the moulded terminal nut of the ignition coil.

removed from the original cable and bend back the strands radially against the face of the washer. Finally screw the nut into its terminal.

(c) The cables are secured in the distributor moulding by means of pointed fixing screws. To fit new cables, unscrew the pointed fixing screws on the inside of the moulding and push the cables (which should not be bared but cut off flush to the required length) well home into their respective terminals. The screw securing the centre cable is accessible when the carbon brush is removed. Now tighten up the screws, which will pierce the insulation and make contact with the cable core.

Section C.4

ATTENTION TO SPARKING PLUGS

Cleaning

Sparking plugs should, whenever possible, be cleaned in a special plug cleaner. If one is not available, a wire brush dipped in petrol is the best substitute.

Adjusting the gap

The electrode gap should be set between .018 in. and .022 in. (.46 mm. and .56 mm.) by adjusting the side electrode. **Never bend the central electrode.**

Note.—After the first 250 miles (400 km.) of operation it will be necessary to clean the sparking plugs for the reason that, during the running-in

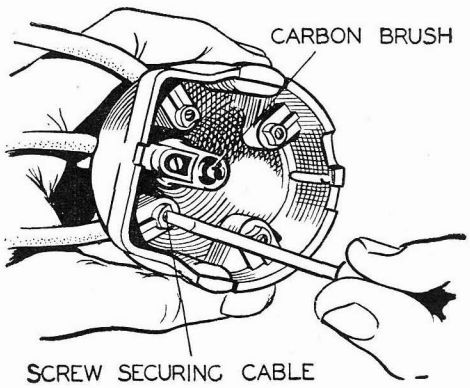


Fig. 41.
Shows how the high-tension cables are secured to the distributor pick-up segments by means of pointed fixing screws.

process, an excess amount of oil is generally used, and the carburetter adjustment is usually a little on the rich side, which produces a tendency for carbon to deposit on the sparking plug insulator, causing fouling. This soon disappears, however, when the motor has been well run in and fresh oil has been introduced.

Section C.5

CONTACT BREAKER MECHANISM

After the first 500 miles (800 km.) and subsequently every 3,000 miles (5,000 km.) check the contact breaker as follows :—

(a) Turn the engine until the contact breaker points are fully opened, and check the gap with a gauge having a thickness of .010 in.—.012 in. (.25 mm.—.30 mm.). If the gap is correct the gauge should be a sliding fit. Do not alter the setting unless the gap varies considerably from the gauge. To adjust the setting, keep the engine in the position to give maximum opening of the contacts and then slacken the two screws securing the fixed contact plate. Adjust the position of the plate until the gap is set to the thickness of the gauge and then tighten the two locking screws.

(b) If the contacts are dirty or pitted, clean them with a fine carborundum stone or with very

fine emery cloth. Afterwards wipe away any trace of dirt or metal dust with a petrol-moistened cloth. Cleaning of the contacts is made easier if the contact breaker lever carrying the moving contact is removed. To do this, slacken the nut on the terminal post and lift off the spring, which is slotted to facilitate removal. The lever can then be

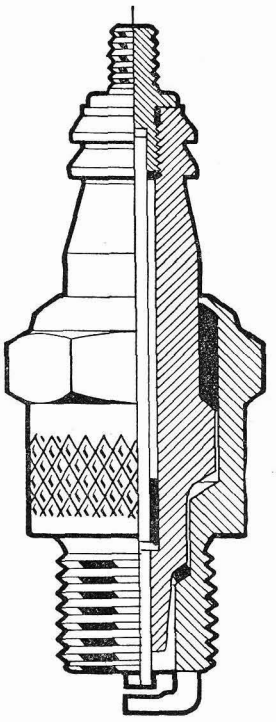


Fig. 42.
A sectional drawing of the Champion L.10 sparking plug fitted as standard to Morris Eight (Series "E") cars.

lifted off its pivot pin. After cleaning, check the contact breaker setting.

(*c*) If the contacts are badly burned they should be replaced. Replacement contacts can only be fitted in pairs. To remove the moving contact, follow the procedure in paragraph (*b*). To remove the plate carrying the fixed contact, take out the two screws, complete with spring washers and flat steel washers. The replacement set of contacts can now be refitted by a reversal of the above procedure.

Section C.6

DISTRIBUTOR LUBRICATION

To be carried out after servicing the distributor and at intervals of about 3,000 miles (5,000 km.).

(*a*) Give the cam a light smear of Duckham's "Laminoid" or, if not available, clean engine oil, and apply a slight trace of this grease to the top of the pivot pin on which the contact breaker lever works.

(*b*) Lift the rotor arm off the top of the spindle and add a few drops of thin machine oil to

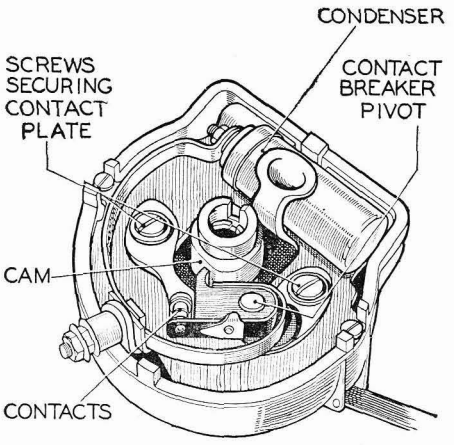


Fig. 43.
The contact breaker with its cover removed to show its primary components.

lubricate the cam bearing and distributor shaft. Refit the rotor correctly in engagement with its driving slot and push it on to the shaft as far as it will go.

(*c*) Add a few drops of thin machine oil through the hole in the contact breaker base through which the cam passes, in order to lubricate the automatic timing control.

Section C.7

REMOVAL AND REPLACEMENT OF DISTRIBUTOR

The distributor can be removed and replaced without interfering with the ignition timing, provided the clamp plate pinch bolt is not disturbed.

To facilitate the replacement of the high-tension leads, turn the engine over until the rotor arm is pointing to the segment in the cover for No. 1 cylinder plug lead.

Disconnect the high-tension leads from the sparking plugs and coil, and the low-tension lead from the 2 BA terminal on the distributor.

Extract the lock wire from the dowel bolt locating the distributor clamp plate to the cylinder head, and remove the bolt. The distributor can now be withdrawn from the cylinder head.

To replace the distributor, insert it into the cylinder head until the driving dog rests on the distributor drive shaft. The rotor arm should then be rotated slowly until the driving dog lugs engage with the drive shaft slots, both of which are offset to ensure correct replacement. The remainder of the assembly is now in the reverse order to that of removal.

Note.—Provided that the engine has not been turned the rotor arm will be opposite the segment for No. 1 plug lead. The high-tension leads can then be replaced on their respective plug terminals in the order of firing, i.e. 1, 3, 4, 2, remembering that the distributor rotation is anti-clockwise.

Section C.8

IGNITION TIMING

It will be necessary to reset the ignition timing if the distributor clamp plate bolt has been slackened, otherwise the distributor can be removed and replaced without interfering with the ignition timing as detailed in Section C.2.

To set the distributor in the correct position for firing if the timing has been lost, the following procedure should be followed :—

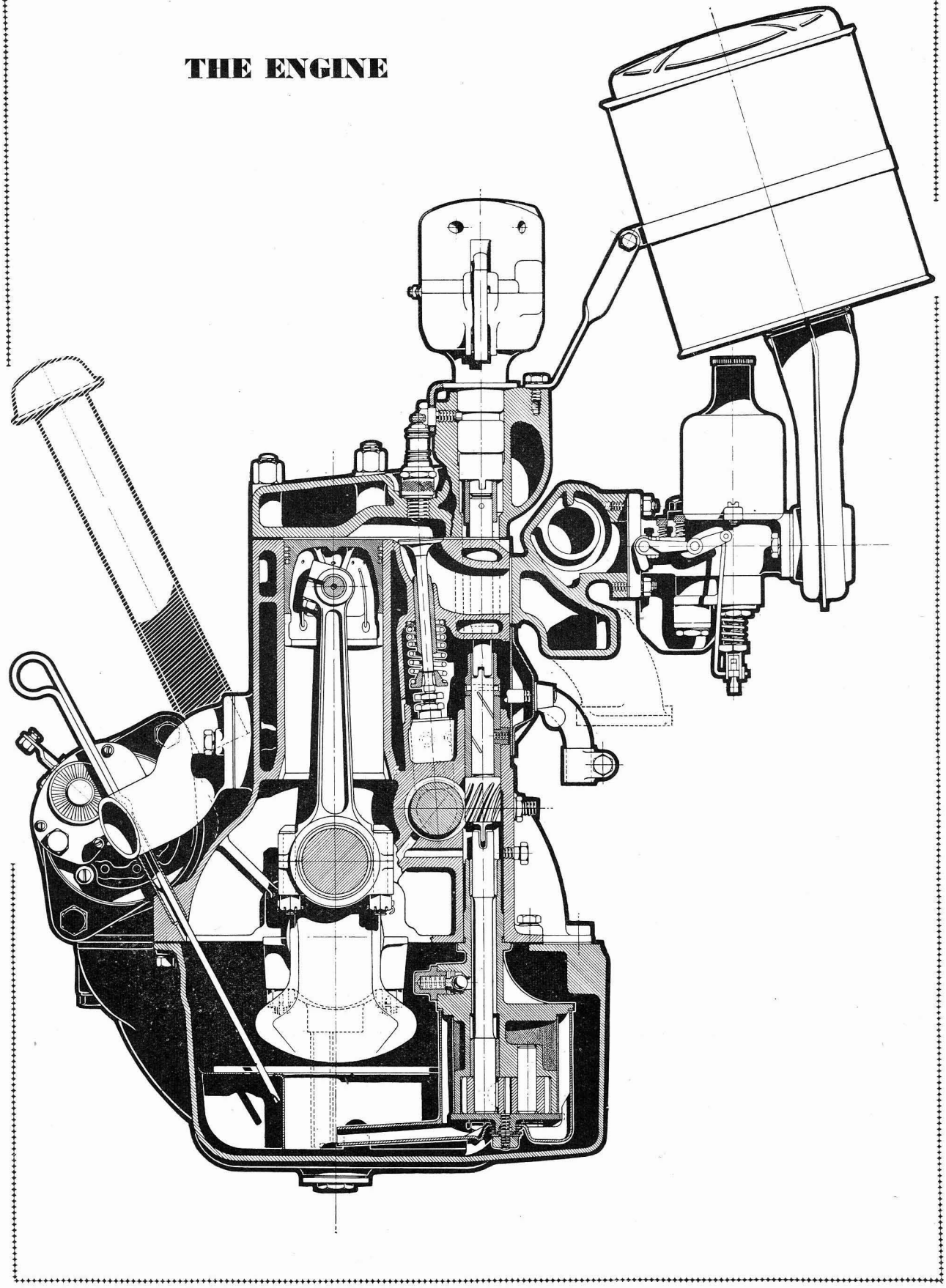
1. Turn the engine until No. 1 piston is at T.D.C. on its compression stroke. This can best be effected by turning the engine and observing the valves. When the valves are " rocking " (i.e. exhaust just closing and inlet just opening) on No. 4 cylinder, No. 1 piston is approximately at T.D.C. on its compression stroke. If the engine is now rotated until the groove in the crankshaft pulley is in line with the pointer on the timing cover, the piston is exactly at T.D.C.
2. Set the contact breaker points to .010 in.—.012 in. (.25 mm.—.30 mm.) when in their maximum open position.
3. Insert the distributor into its housing, and engage the drive dog lugs with the drive shaft slots (both of which are offset) by slowly rotating the rotor arm.
4. Screw in the dowel bolt locating the distributor clamp plate to the cylinder head, and secure the bolt with locking wire.
5. Position the distributor so that the flat side of the body is facing, and parallel to, the sparking plugs.
6. Rotate the distributor body anti-clockwise until the points are fully closed. Then slowly rotate it in a clockwise direction until the points just commence to open. Secure the distributor body in this position by tightening up the clamp plate bolt and nut. Finally, check that the rotor arm is opposite the correct segment for the cylinder which is at the top of its compression stroke.

Important.—To obtain an accurate setting, an electrical method should be used to determine the actual position at which the points break, and the following method can be used.

With the low-tension lead connected to the distributor, turn on the ignition switch and connect a 6-volt lamp in parallel with the contact breaker point (i.e. one lead from the distributor low-tension terminal, and the other to earth) and turn the distributor as detailed in paragraph 6 until the lamp lights, which indicates that the points have just opened.

Note.—If the distributor drive gear assembly has been removed from the engine, it should be refitted in accordance with the instructions given in the last paragraph of Section A.19, and the above operation should then be carried out.

THE ENGINE



SECTION D

THE COOLING SYSTEM

Description of Circulating System.

Section No. D.1 Draining the cooling system.

Section No. D.2 Filling the cooling system.

Section No. D.3 Removal and replacement of radiator.

Section No. D.4 Fan belt adjustment.

GENERAL DESCRIPTION

The cooling system is of the thermo-syphon type. The water circulates from the base of the radiator and passes around the cylinders and cylinder head, reaching the header tank of the radiator core via the top water hose. From the header tank it passes down the radiator core to the base tank of the radiator. Air is drawn through the radiator by a fan attached to the dynamo pulley, which is driven by a belt from the crankshaft.

Section D.1

DRAINING THE COOLING SYSTEM

Remove the radiator header tank filler cap.

Open the drain tap on the near-side of the base of the radiator.

Note.—If "Bluecol" or other anti-freeze mixture is being used, it should be drained into a suitable container and carefully preserved for replacement.

Section D.2

FILLING THE COOLING SYSTEM

Close the radiator drain tap.

Ensure that the water hose clips are tightened.

Fill up the system through the filler in the radiator header tank until the water is just below the top of the filler orifice.

When possible rain-water should be used for filling the system.

Avoid overfilling when anti-freeze is in use to avoid unnecessary loss on expansion.

Screw the filler cap firmly into position.

Section D.3

REMOVAL AND REPLACEMENT OF RADIATOR

It is unnecessary to detach the radiator mask to remove the radiator core.

Drain the water from the radiator as in Section D.1.

Release the clips on the top and bottom water hoses, and detach the hoses from their connections.

Disconnect the low-tension cable from the distributor.

Detach the dynamo and fan assembly from its bracket by removing the $\frac{1}{4}$ in. dynamo belt tension adjusting nut, bolt, and spring washer ; and the two $\frac{1}{4}$ in. dynamo fixing bolts, nuts, and spring washers. The dynamo may now be placed in the tool tray, leaving its wires attached.

Undo the $\frac{5}{16}$ in. locknuts and brass nuts with plain steel washers from the two radiator foundation studs which pass through the front chassis cross-member.

Remove the two countersunk-headed screws and $\frac{3}{16}$ in. nuts and spring washers locating the radiator core to the mask.

The radiator core may now be extracted by easing the top towards the rear of the car and lifting it upwards, taking care that the fins of the radiator core clear the engine.

The radiator core may now be replaced by a reversal of the above procedure, and the fan belt adjusted as in Section D.4.

Section D.4

DYNAMO BELT ADJUSTMENT

The adjustment of the dynamo belt tension is effected by slackening off slightly the two bolts on which the dynamo pivots, releasing the set screw securing it to the slotted link, and raising the dynamo bodily until the belt tension is correct. Tighten up the three bolts with the dynamo in this position.

Note.—A gentle hand pull only must be exerted on the dynamo, or the belt tension will be excessive and undue strain thrown on the dynamo bearings.

To check the tension for correctness rotate the fan blades. If the dynamo pulley slips inside the fan belt, the tension is insufficient. When the tension is correct, it should be possible to move the belt from side to side to the extent of 1 in. (2.5 cm.) at the centre of the belt run.

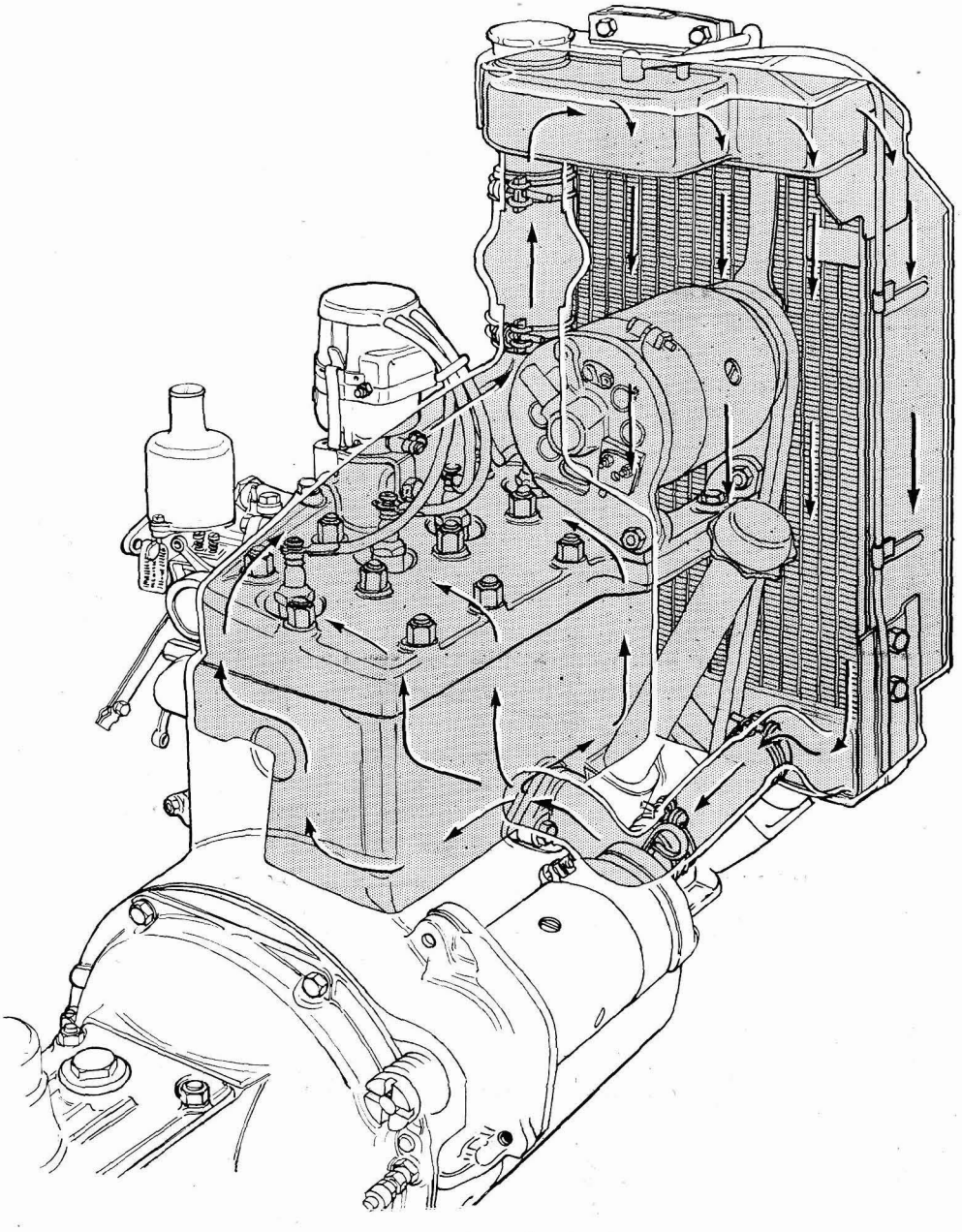


Fig. 44.
The engine cooling system.

SECTION E

THE CLUTCH

Description and Functioning.

GENERAL DESCRIPTION

The clutch is of the single plate dry disc type, no adjustment for wear being provided in the clutch itself. Individual adjustment is provided for locating each lever during manufacture. The adjusting nut is locked in place by means of a special tag lock washer, and should not be disturbed unless the clutch is dismantled for the replacement of parts.

The general construction may be followed by reference to Fig. 45, and the following description :—

The driven plate assembly

This consists of a splined hub and flexible steel driven plate to the outer diameter of which are fixed the annular friction facings " C." The disc is attached to the splined hub by a spring coupling, which acts as a torsional cushion.

Withdrawal bearing assembly

This comprises the graphite release bearing " G " which is mounted in a cup " H " attached to the throw-out fork, and a release plate " K " attached to the inner ends of the release levers " N." Release is accomplished by moving the release bearing forward into contact with the release plate and applying pressure to the inner ends of the levers.

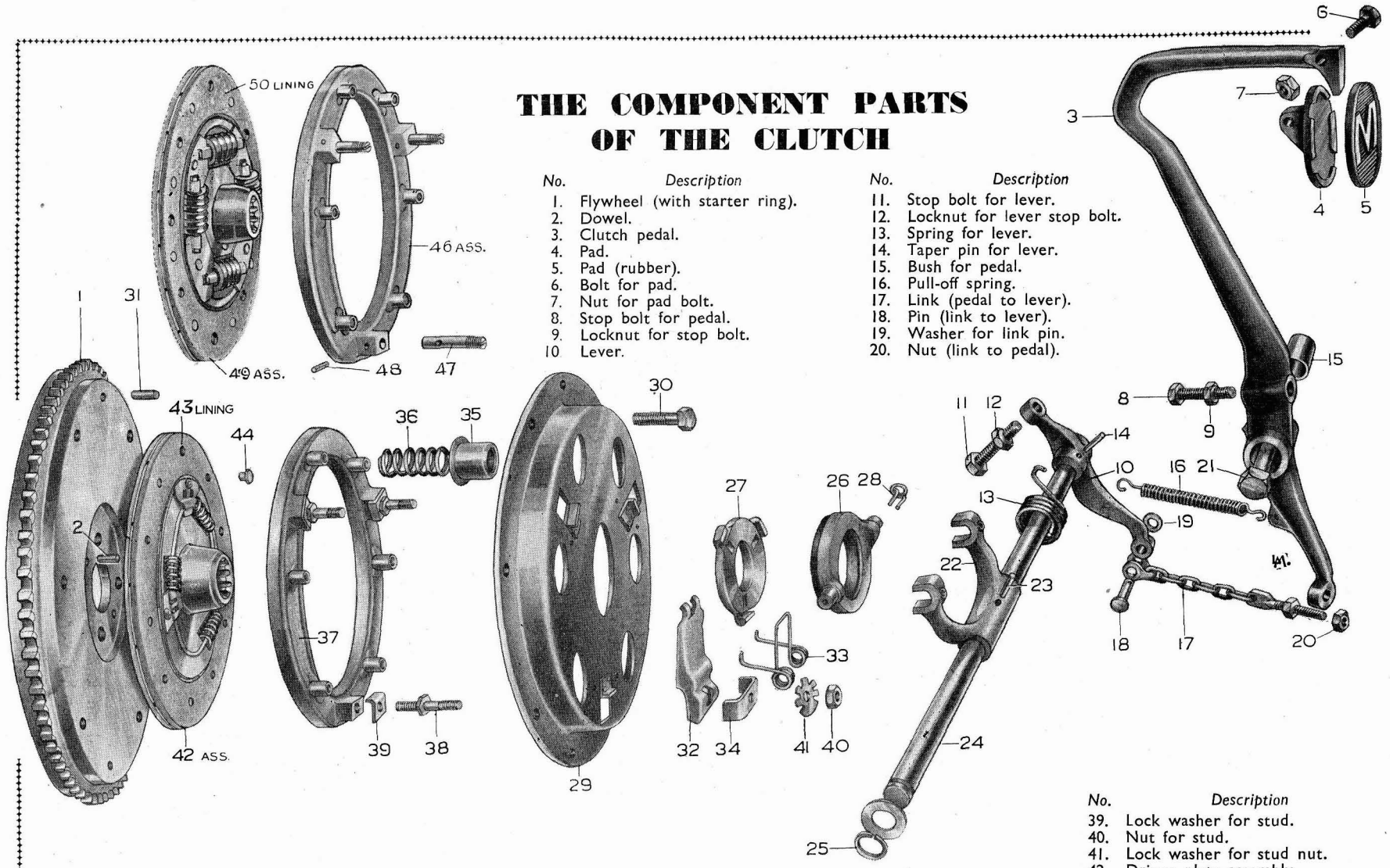
The cover assembly

The release levers are pivoted on knife-edge fulcrums " O " mounted upon the clutch cover " D " and shoulder studs " Q " extend through holes at their outer ends. The studs are fitted with adjusting nuts " R " which locate each lever in its correct position. The outer or shorter ends of the release levers engage the bearing plate " S " carried upon the shoulder studs attached to pressure plate lugs, and thus the pressure plate " T " is pulled away from the driven plate " C," compressing the six thrust springs " E " which are assembled between the pressure plate and the clutch cover.

When the foot pressure is removed from the clutch pedal, the thrust springs force the pressure plate forward against the driven plate, gradually and smoothly applying the power of the engine to the rear wheels.

As the clutch facings on the driven plate " C " wear, the pressure plate " T " moves closer to the flywheel face " A," and the outer or shorter ends of the release levers follow. This causes the inner or longer ends of the levers to travel farther towards the gearbox, and decreases the clearance between the release lever plate " K " and the release bearing " G." The effect on the clutch pedal is to decrease the clearance or free travel ; in other words it reduces the distance the clutch pedal moves forward away from the back stop before the release bearing comes in contact with the release lever plate. Some free movement must always be maintained here to prevent the clutch pedal riding against the underside of the toeboard and applying pressure on the release bearing, thus causing the clutch to slip. This essential free movement is restored by adjusting the position of the clutch pedal by the adjusting screw at its lower end.

THE COMPONENT PARTS OF THE CLUTCH



No.	Description
1.	Flywheel (with starter ring).
2.	Dowel.
3.	Clutch pedal.
4.	Pad.
5.	Pad (rubber).
6.	Bolt for pad.
7.	Nut for pad bolt.
8.	Stop bolt for pedal.
9.	Locknut for stop bolt.
10	Lever.

No.	Description
11.	Stop bolt for lever.
12.	Locknut for lever stop bolt.
13.	Spring for lever.
14.	Taper pin for lever.
15.	Bush for pedal.
16.	Pull-off spring.
17.	Link (pedal to lever).
18.	Pin (link to lever).
19.	Washer for link pin.
20.	Nut (link to pedal).

No.	Description
21.	Bolt (to frame brace).
22.	Fork.
23.	Taper pin for fork.
24.	Shaft.
25.	Circlip for shaft.
26.	Thrust ring assembly.

No.	Description
27.	Thrust plate.
28.	Retaining wire for thrust ring.
29.	Cover-plate.
30.	Bolt (to flywheel).
31.	Dowel.
32.	Release lever.

No.	Description
33.	Retaining spring for release lever.
34.	Anchor plate for release lever.
35.	Thimble.
36.	Thrust spring.
37.	Pressure plate.
38.	Stud.

No.	Description
39.	Lock washer for stud.
40.	Nut for stud.
41.	Lock washer for stud nut.
42.	Driven plate assembly.
43.	Lining.
44.	Rivet for lining.
46.	Pressure plate assembly.
47.	Stud for levers.
48.	Pin for stud.
49.	Driven plate assembly.
50.	Lining.

Section E.1

RUNNING ADJUSTMENTS

Insufficient pedal backlash or free movement will cause clutch slip. Excessive pedal movement causes the clutch springs to become compressed solid or "coil bound," which imposes an undue load on the release bearing, causing excessive wear.

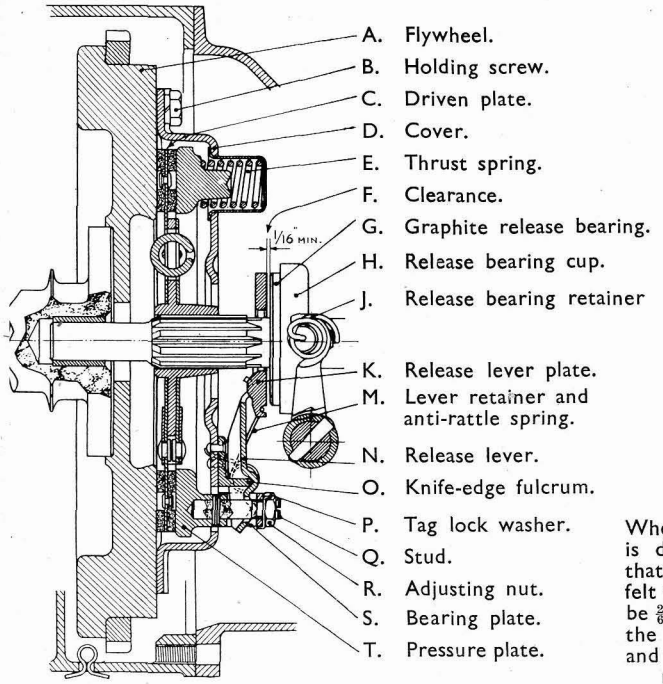


Fig. 45.
The clutch unit in section.

The required pedal travel is the sum of :—

(*a*) *The free movement* or travel produced by the clearance between the release bearing and the release lever plate, necessary to ensure that the clutch is fully engaged when the foot is removed from the pedal.

(*b*) *The effective movement* or travel necessary to release the clutch, i.e. the amount of effective pedal movement necessary to move the release lever plate the distance required to free the clutch completely.

The pedal travel should be limited by the front and back stops to the correct amount indicated below. It is essential that these clearances be adhered to, in order to allow the clutch to be completely released and at the same time prevent the possibility of damage to the clutch release bearing, due to over-travel.

If any difficulty is experienced in freeing the clutch when the correct release movement is provided, on no account should efforts be made to improve matters by attempting to increase the effective pedal travel. The actual cause must be ascertained and rectified.

The free pedal movement, measured at the pedal pad, should preferably be $\frac{3}{4}$ in. (19 mm.), and the clearance between the stop on the clutch withdrawal lever and that on the clutch housing should not be more than $\frac{21}{64}$ in. (8.3 mm.) when the pedal is held forward lightly so that the carbon release bearing is just in contact with the release lever plate. (Fig. 45.)

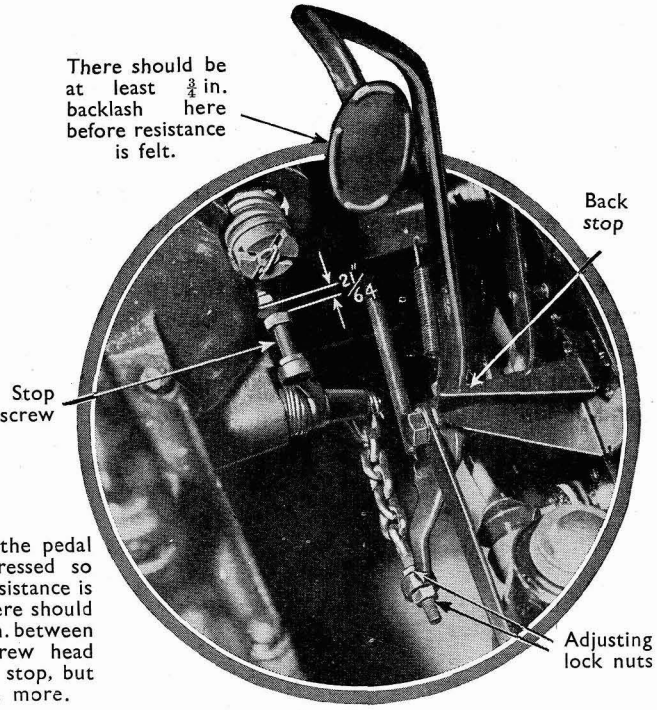


Fig. 46.
The correct setting for the clutch pedal.

Section E.2

REMOVAL OF CLUTCH

Remove the gearbox as in Section F.1.

The clutch cover-plate assembly is removed by extracting the six $\frac{1}{4}$ in. bolts locating it to the flywheel. These should be slackened part of a turn at a time, to prevent distortion of the flanged edge of the cover by the pressure of the thrust springs, until the spring pressure is completely released.

The complete clutch may now be lifted off the two dowel pins, all components except the driven plate remaining assembled to the cover.

Section E.3

DISMANTLING OF CLUTCH

After removal from the engine, and before stripping down, mark the parts in such a manner that they can be reassembled in the same relative position to each

other, to ensure that correct balance is maintained; this applies particularly to the cover, pressure plate and release levers. Failure to follow these instructions may result in excessive vibration at high revolutions. When a new pressure plate is fitted it is essential that the complete cover and pressure plate assembly be accurately balanced, for which reason it is not a practical proposition to fit new pressure plates unless balancing facilities are available.

If it is found necessary to replace any of the components of the cover assembly, this unit can be dismantled, reassembled and adjusted with the aid of an Arbor press or drill press in the following manner :—

First straighten the bent up lobes of the tag lock washers " P " (Fig. 45), then place the cover on the bed of the press with the pressure plate resting on wood blocks so arranged that the cover is left free to move down. Place three blocks of wood to form a bridge, the legs of which should rest on the outer rim of the clutch cover as shown in Fig. 47.

Compress the cover with the spindle of the press, and, holding it under compression, remove the adjusting nuts " R " (Fig. 45) and then slowly release the pressure to prevent the thrust springs from flying out.

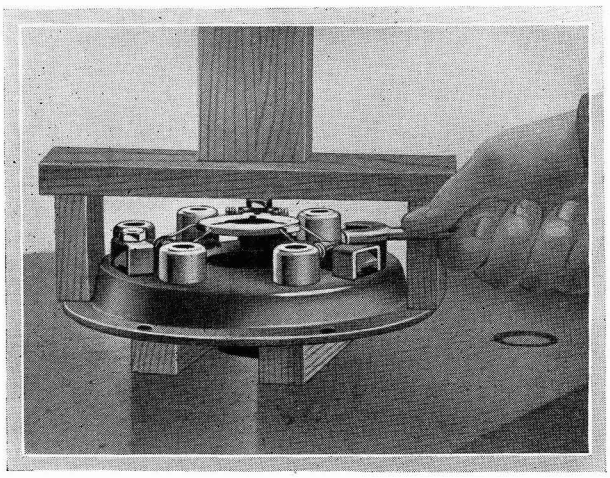


Fig. 47.

Showing how the clutch assembly should be supported on wood blocks and the pressure of the press applied through a bridge of wood blocks to compress the springs for dismantling.

The cover can then be lifted off and all parts will be accessible for inspection. It is advisable to replace any parts which show signs of wear.

Section E.4

ASSEMBLING OF CLUTCH

When reassembling the clutch it is essential that the components should be replaced in exactly the same position as they were before removal to ensure that the clutch assembly remains in balance. This is most important and the parts should have been marked before dismantling so that their correct position can be identified, as indicated in Section E.3.

When new components are fitted it is essential that the complete cover and pressure plate assembly be accurately balanced. It is, therefore, inadvisable to fit new components unless adequate balancing facilities are available.

1. Lay the pressure plate " T " on the wood block in the press, and place the springs on it in a vertical position, seating them on the small locating bosses on the pressure plate. Now place the spring cups over their outer ends, as shown in Fig. 48.

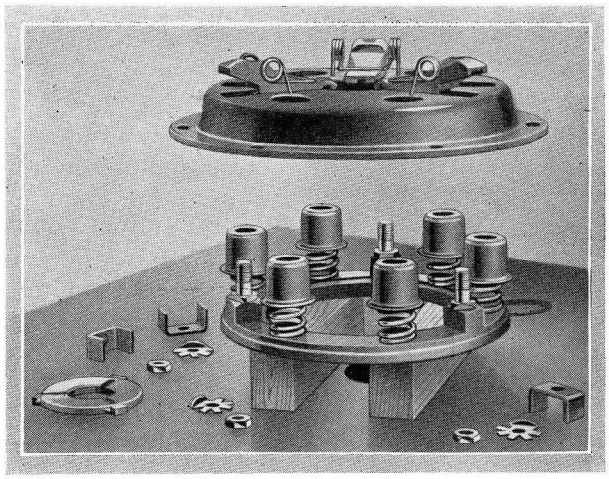


Fig. 48.

The components of the clutch ready for assembly. Note that the pressure plate is again supported on wood blocks and that the springs and their cups have to be correctly located, as shown, before the cover-plate is placed in position.

2. The levers " N " can then be mounted on the knife-edge fulcrums " O " by slipping the inner ends of the release levers under the retainer spring " M," taking care that the release levers are properly seated. It is advisable to wipe the short ends of the levers and the knife-edge fulcrums with a little graphite moistened with oil, as this will help to eliminate friction at this point.
3. The cover can now be laid on top of the assembled parts, as shown in Fig. 48, taking care that the machined portions of the pressure plate lugs are directly underneath the slots formed in the clutch cover.
4. Place three blocks of wood to form a bridge, the legs of which should rest on the outer rim of the clutch cover (as used in the dismantling operation). The assembly is then slowly

compressed, the pressure plate lugs being guided through the slots formed in the clutch cover. Care must be taken that the thrust springs remain correctly on their seats on the pressure plate.

5. Holding the clutch under compression, the bearing plate " S " and tag lock washers " P " are then placed in position on the shoulder studs " Q." . The adjusting nut " R " can then be screwed down on the shoulder stud until the nut is flush with the top of the stud.
6. The clutch unit may now be removed from the Arbor or drill press, and the final setting of the release levers carried out by use of the special service tool, Part No. 38446, as detailed in Section E.5.

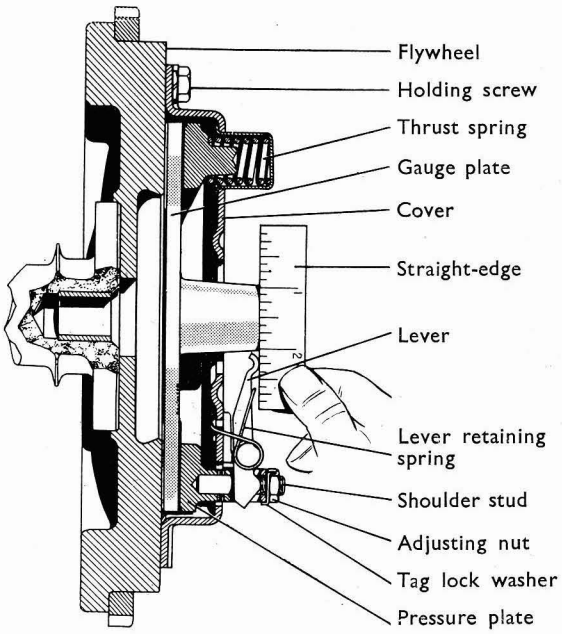


Fig. 49.
Shows how the release levers are set by means of a short straight-edge or rule placed across the boss of the special Borg & Beck gauge plate.

7. The release lever plate " K " should then be assembled to the release levers, taking care that the projecting portions engage properly in the slots formed in the release lever ends. Finally the retaining springs " M " should be fitted into the grooves formed in the release lever plate, as indicated in Fig. 45.

Section E.5

ADJUSTING THE RELEASE LEVERS

Satisfactory operation of the clutch is absolutely dependent on accurate adjustment of the release levers, so that the pressure plate face is perfectly parallel to the flywheel face. This cannot be accomplished satisfactorily by setting the ends of the release levers parallel to the face of the release bearing after the clutch has been assembled to the flywheel, because of likely variation in the thickness of the driven plate.

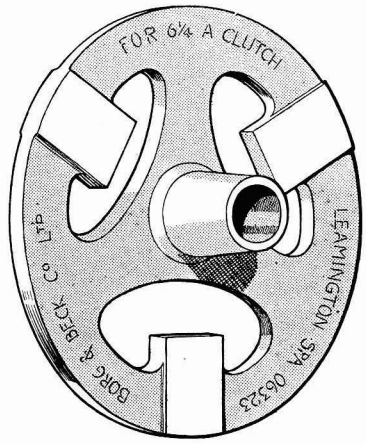


Fig. 50.
The special gauge plate necessary for setting the release levers correctly.

The only accurate method is to adjust the release levers while the pressure plate is held parallel to the flywheel, by means of the Borg & Beck lever adjustment gauge. This special tool (Part No. 38446) is shown in Fig. 50.

Place this gauge on the flywheel in the position normally occupied by the driven plate, and mount the cover assembly on the flywheel in the same position as before dismantling. Tighten the holding screws a turn or two at a time when taking up the spring pressure, otherwise the cover will be distorted. Before the cover is tightened down be sure that the gauge is correctly centred. The clutch release lever plate is attached to the release levers by the anti-rattle springs and it must be taken off to set the levers.

After the cover assembly has been mounted in position, a short straight-edge can then be laid across the centre boss and the bearing surface of one lever, and the nut adjusted until they are the same height. The other levers can then be set in turn by the same method. If carefully done, this setting will be within .005 in. (.13 mm.) which is the permissible tolerance. After this adjustment is completed, loosen the clutch cover holding screws a turn at a time until the spring pressure is released, which will allow the clutch assembly and the gauge plate to be removed.

Two or more lobes of the tag lock washers should then be bent flat against the adjacent side of the adjusting nut, thereby definitely locking it in position. When carrying out this operation, take care not to upset the adjustments previously made.

On some clutches a different type of stud is

employed, having no shoulder. It is held in position in the pressure plate by a pin passing through it and through the boss on the pressure plate. The outer end of the stud is screwed and slotted for the adjusting nut and locking split pin. If adjustment has taken place it will be necessary to re-drill the nut for the split pin so that it registers with the slot in the stud.

Section E.6

REPLACEMENT OF THE CLUTCH

Adjust the release levers as in Section E.5.

Refit the release lever plate as in paragraph 7, Section E.4.

Assemble the driven plate and clutch assembly loosely to the flywheel with the chamfered end of the driven plate hub facing the gearbox, i.e. the rear of the car.

Line up the driven plate and pilot bearings with a dummy shaft (special tool, Part No. 39371).

Tighten the clutch cover holding screws in sequence, a turn at a time, to take up the clutch spring tension evenly and avoid distortion. When all the screws are quite tight withdraw the dummy shaft.

Caution.—Do not under any circumstances let the gearbox hang in the clutch assembly during the removing or refitting of the gearbox to the engine. On no account allow oil, grease or paraffin to get on the clutch surfaces. Keep the faces dry and absolutely free from all oil.

Section E.7

SERVICING THE CLUTCH

After removal from the engine, and before stripping down, mark the parts in such a manner that they can be reassembled in the same relative position to each other to ensure that correct balance is maintained ; this applies particularly to the cover, pressure plate, and release levers. Failure to follow these instructions may result in excessive vibration at high revolutions. When a new pressure plate is fitted it is essential that the complete cover and pressure plate assembly be balanced accurately, for which reason it is not a practical proposition to fit new pressure plates unless balancing facilities are available.

Spring pressure

A tolerance of from 10 to 15 lb. (4.5 kg. to 6.8 kg.) pressure is allowable on the compression load of the operating springs when at their assembled height ; all clutch springs are tested for this before assembly.

Lubrication of the splines of the driven plate is provided at assembly only. CS.881 graphite grease or Duckham's " Kenol " must be used.

The clutch operation springs are not normally submitted to high temperatures, as the pressure plate absorbs heat rapidly and the springs make only line contact with it. In addition a draught is continuously passing them when the engine is running.

Tolerances

Wear on the working faces of the driven plate is approximately .001 in. per thousand miles (.015 mm. per 1,000 km.) under normal running conditions. The alignment of the face of the driven plate must be within .015 in. (.38 mm.) for satisfactory results.

Driven plates

It is most important that the clutch facings are not touched with greasy hands, or any oil or grease allowed to come into contact with them.

It is essential to install a complete driven plate assembly when renewal of the friction plate is required. Obviously, if the facings have worn to such an extent as to warrant replacement, then slight wear will have

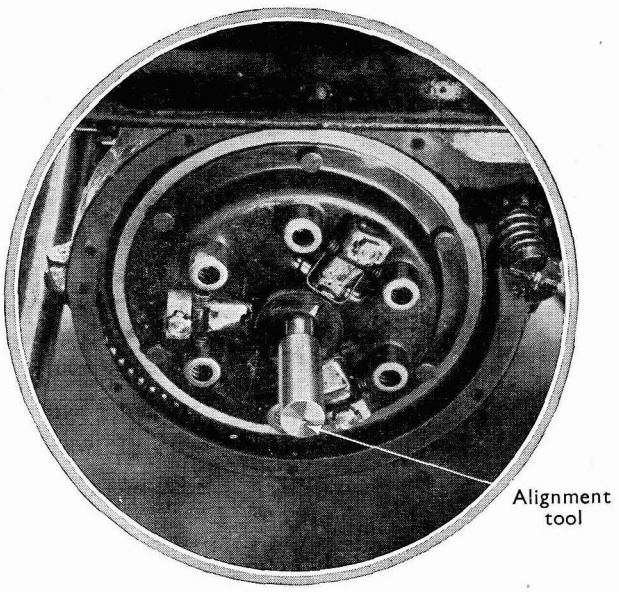


Fig. 51.
When reassembling the clutch the use of a special alignment tool is necessary.

taken place in the splines, and also on the torque reaction springs and their seatings. The question of balance and concentricity is also involved. Under no circumstances is it satisfactory to repair or rectify faults in clutch driven plate centres, and we do not countenance this as manufacturers.

Condition of clutch facings in service

It is natural to assume that a rough surface will give a higher frictional value against slipping than a polished one, but this is not necessarily correct. A roughened surface consists of small hills and dales, only the

" high spots " making contact. As the amount of friction available for the purpose of taking up the drive is dependent upon the actual surface area in contact, it is obvious that a perfectly smooth face is required to transmit the maximum amount of power for a given surface area.

Since non-metallic facings of the moulded asbestos type have been introduced in service, a polished surface is common, but it must not be confused with a glazed surface, which is sometimes encountered due to conditions which will be discussed subsequently.

The ideally smooth or polished condition, therefore, provides proper surface contact, but a glazed surface does not, as it entirely alters the frictional value of the surface, which will result in excessive clutch slip. These two conditions might be simply illustrated by the comparison between a piece of smoothly finished wood and one with a varnished surface. In the former the contact is made directly by the original material, whereas in the latter instance a film of dried varnish is interposed between the contact surfaces, and actual contact is made by the varnish.

Thus the conditions encountered are :—

(*a*) After the clutch has been in use for some little time, under satisfactory conditions, the surface of the facings assumes a high polish, through which the grain of the material can be seen clearly. This polished facing is of light colour when in perfect condition.

(*b*) Should oil in small quantities gain access to the clutch and find its way on to the facings, it will be burnt off as a result of the heat generated by the slipping occurring under normal starting conditions. The burning of this small quantity of lubricant has the effect of gradually darkening the faces, but provided the polish of the facing remains such that the grain of the material can be distinguished clearly it has little effect on clutch performance.

(*c*) Should increased quantities of oil obtain access to the facing, then one of two conditions, or a combination of them, may arise, depending upon the nature of the oil.

1. The oil may burn off and leave a carbon deposit on the surface of the facings, which assume a high glaze and cause further slip. This is a very definite, though very thin, deposit, and in general it hides the grain of the material.
2. The oil may partially burn and leave a resinous deposit on the facings. This has a tendency to produce a fierce clutch, and may also cause excessive " spinning " on clutch release, due to the tendency of the face linings to adhere to the surface of the flywheel or pressure plate.
3. There may be a combination of conditions (1) and (2) which produces a tendency to " judder " on clutch engagement.

(*d*) Still greater quantities of oil produce a dark and soaked appearance of the facings, and the result will be still further slip, accompanied by fierceness or " juddering " on engagement, according to the severity of the condition.

If the conditions under (*c*) or (*d*) are experienced, the clutch driven plate should be replaced by a new one. **The cause of the presence of the oil must be traced and removed.** It is, of course, necessary for the clutch and flywheel to be thoroughly cleaned out before reassembly.

Release bearing

Where the graphite release bearing ring is badly worn in service, a complete replacement assembly should be fitted, returning the old assembly for salvage of the metal cup. These graphite rings are shrunk into their metal cups by heating the metal cup to a cherry red before forcing the graphite ring into position. This is a specialised job, but can be carried out provided care is exercised. Immediately the ring is forced into position, the whole should be quenched in oil. Alignment of the thrust pad in relation to its face, and the trunnions, should be within .005 in. (.13 mm.).

In almost every case of rapid wear on the splines of the clutch driven plates, misalignment is responsible.

Looseness of the driven plate on the splined shaft results in noticeable backlash in the clutch. Misalignment also puts undue stress on the driven member, and may result in the hub breaking loose from the plate, with consequent total failure of the clutch. It may also be responsible for a fierce chattering or dragging of the clutch.

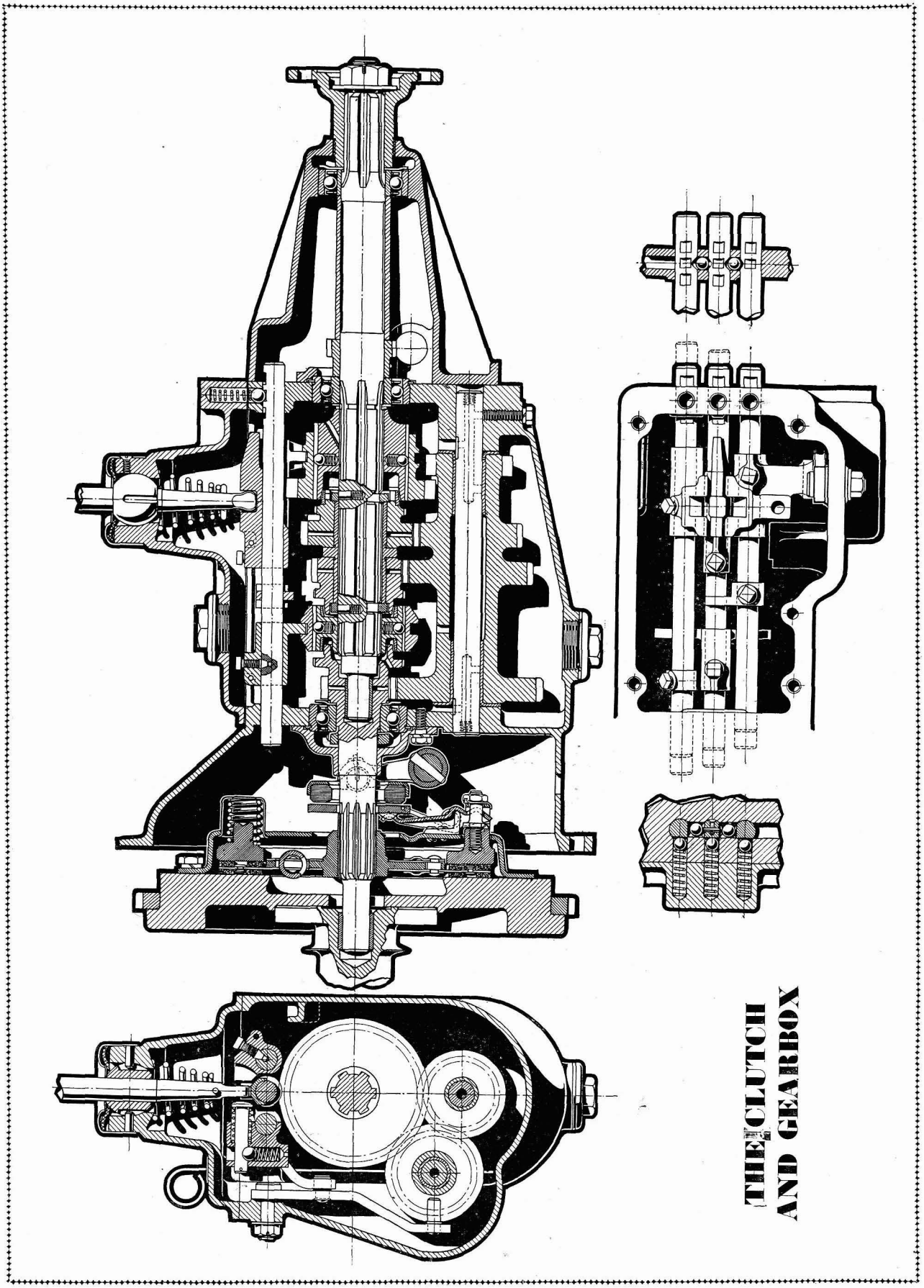
In cases of persistent difficulty it is advisable to check the flywheel for truth, with a dial indicator, to determine any possible misalignment. The dial reading should not vary more than .003 in. (.08 mm.) anywhere on the flywheel face.

The clutch shaft return spring

Should it be necessary to replace a weak or broken clutch lever return spring, this may be accomplished without removal of the clutch shaft or the operating lever.

Unhook the spring end from the lever and lift the locating spigot on the inner end of the spring from its seat in the clutch housing.

The spring may now be unscrewed from the shaft over the operating lever, if rotated clockwise.



THE CLUTCH AND GEARBOX

SECTION F

THE GEARBOX

GENERAL DESCRIPTION

The gearbox has four forward gears and one reverse gear.

Synchromesh is incorporated on second, third and fourth gears.

Top gear is obtained by direct drive, third and second through gears in constant mesh, and first and reverse by sliding spur gears.

Section F.1

REMOVAL AND REPLACEMENT OF GEARBOX

Remove the front floor mat by extracting the press pins, and remove the near-side front seat by undoing the four $\frac{3}{16}$ in. bolts and clips locating the seat to the floor of the car. The off-side seat is removed by releasing the four $\frac{3}{16}$ in. nuts locating the seat to its runners and lifting the seat clear.

Detach the gear lever knob, and remove the gear box rubber cowl.

Remove the off-side and near-side floorboards by undoing the eight countersunk-headed fixing screws and washers, and detach the headlamp dipswitch from the board by undoing the two round-headed metal-threaded screws.

The near-side toe-board and gearbox shield assembly is removed by undoing the eight countersunk-headed screws equipped with dished washers and the one round-headed metal-threaded fixing screw.

Disconnect the speedometer cable from its drive at the rear of the gearbox, and the earth wire by undoing the $\frac{1}{4}$ in. stud nut at the rear of the gearbox, replacing the nut to avoid its possible loss.

Extract the split pin from the clevis pin locating the clutch operating chain to the clutch operating lever and withdraw the clevis pin.

Extract the split pins from the four $\frac{1}{4}$ in. bolts on the front universal joint driving flange and remove the bolts and nuts.

Support the engine with suitable lifting tackle. If a lifting ring is employed, it should form part of a plate which can be fitted under two of the stud nuts. Remove the seven $\frac{1}{4}$ in. bolts locating the clutch housing to the engine.

Undo the stud nuts and bolts locating the near-side and off-side flexible mounting brackets and remove the brackets.

With the engine supported, the gearbox may now be withdrawn from the two dowel pins locating it to the flywheel housing and lifted clear of the car.

The gearbox may be replaced by reversing the above procedure, if attention is given to the following points :—

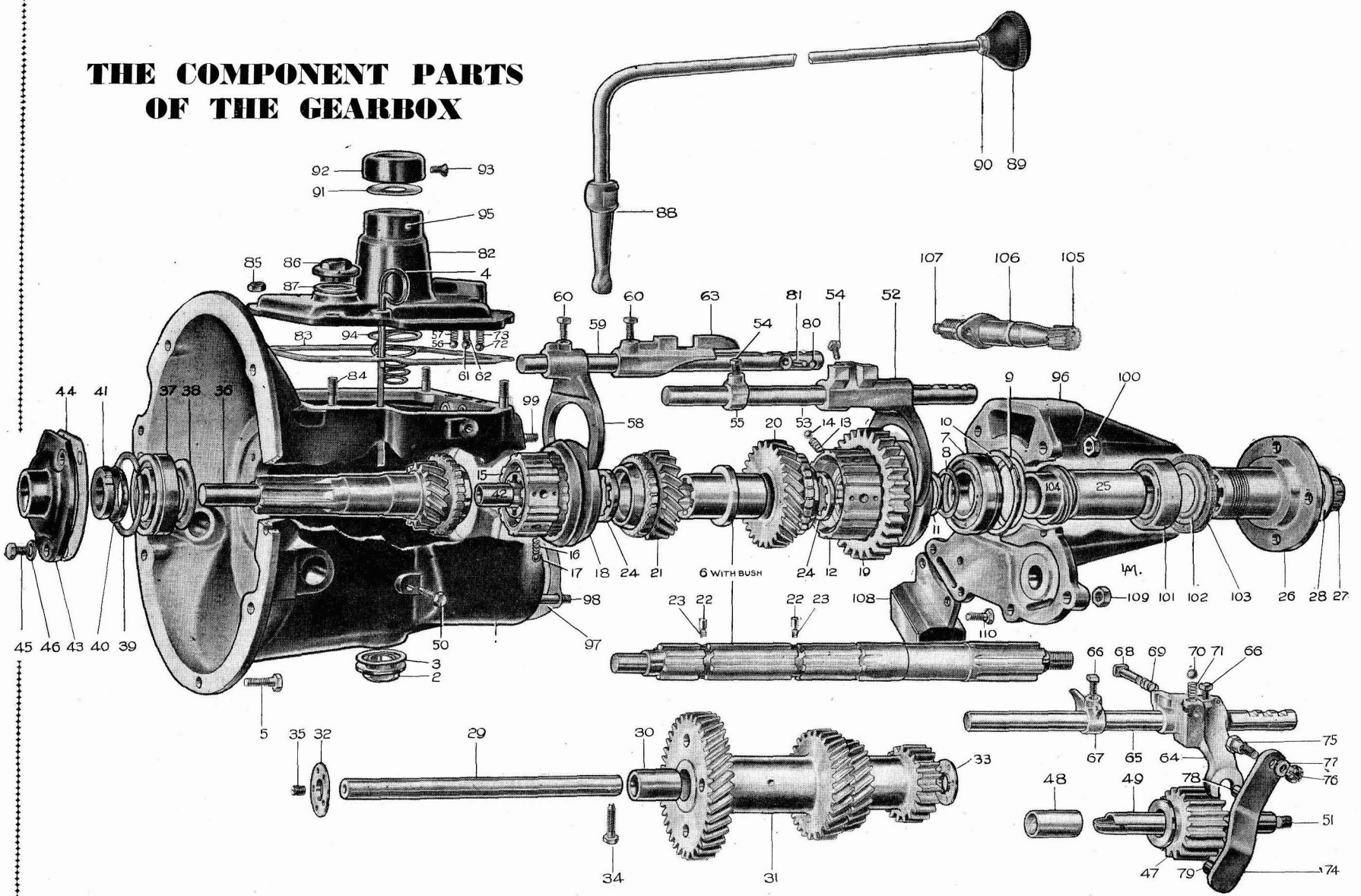
When aligning the gearbox drive shaft with the clutch and flywheel, care should be exercised to ensure that the weight of the gearbox is not allowed to hang on the hub of the driven plate and that it is not displaced.

Engage a gear, and rotate the propeller shaft flange in order to engage the gearbox drive shaft with the splines in the clutch driven plate.

When the gearbox drive shaft has been aligned with the clutch and flywheel, the gearbox assembly should be rotated to align the dowel pins in the flywheel housing with the dowel holes of the clutch housing, and the gearbox assembly moved forward into position.

When replacing the clutch housing locating bolts, care should be exercised in fitting the respective sizes in their correct positions. The four short bolts locate the clutch housing to the cylinder block, and the three long bolts locate the clutch housing to the sump. The near-side bolt in the sump housing also secures the tappet cover breather pipe clip.

THE COMPONENT PARTS OF THE GEARBOX



KEY TO THE COMPONENT PARTS OF THE GEARBOX

No.	Description
1.	Gearbox casing.
2.	Drain plug.
3.	Washer for drain plug.
4.	Oil level indicator.
5.	Bolt (casing to sump).
6.	Mainshaft (with bush).
7.	Bearing for mainshaft (front).
8.	Plate for bearing.
9.	Guard for bearing.
10.	Circlip for bearing.
11.	Circlip for mainshaft.
12.	Sliding hub (first and second).
13.	Spring for sliding hub.
14.	Ball for sliding hub.
15.	Sliding hub and cone assembly (top and third).
16.	Spring for sliding hub.
17.	Ball for sliding hub.
18.	Striking dog.
19.	First speed gear.
20.	Second speed gear with cone.
21.	Third speed gear.
22.	Plunger.
23.	Spring for plunger.
24.	Thrust washer.
25.	Distance piece.
26.	Universal joint flange.
27.	Nut for universal joint flange.
28.	Washer for universal joint flange.
29.	Layshaft.
30.	Bush.
31.	Gear unit with bushes.
32.	Thrust washer (front).
33.	Thrust washer (rear).
34.	Screw for layshaft.
35.	Plug.
36.	Drive gear (with bush).
37.	Bearing for drive gear.
38.	Guard for bearing.
39.	Circlip for bearing.
40.	Tab washer for bearing.
41.	Nut for bearing.
42.	Spigot bearing.
43.	Oil seal cover.
44.	Joint for oil seal cover.
45.	Bolt for oil seal cover.
46.	Washer for oil seal cover.
47.	Reverse gear (with bush).
48.	Bush.
49.	Shaft for reverse gear.
50.	Screw for shaft.
51.	Plug for shaft.
52.	First and second gear shifter.
53.	Shaft.
54.	Screw for shaft.
55.	Stop for second speed gear.
56.	Ball.
57.	Spring for ball.
58.	Third and fourth gear shifter.
59.	Shaft.
60.	Screw for shaft.
61.	Ball.
62.	Spring for ball.
63.	Selector (top and third).
64.	Selector (reverse gear).
65.	Shaft.
66.	Screw for shaft.
67.	Steady for shaft.
68.	Plunger.
69.	Spring for plunger.
70.	Ball for plunger.
71.	Spring for plunger ball.
72.	Ball for shaft.
73.	Spring for ball.
74.	Shifter lever for reverse gear.
75.	Pin.
76.	Nut for pin.
77.	Washer for pin.
78.	Pin (centre).
79.	Pin (bottom).
80.	Interlock ball for third and fourth shaft.
81.	Pin.
82.	Top cover.
83.	Joint (top cover).
84.	Stud for top cover.
85.	Nut for stud.
86.	Filler plug.
87.	Washer for filler plug.
88.	Change speed lever.
89.	Knob for lever.
90.	Locknut for knob.
91.	Felt washer.
92.	Retainer for felt washer.
93.	Screw for felt washer retainer.
94.	Supporting spring.
95.	Snug.
96.	Speedometer gear casing.
97.	Joint.
98.	Stud (long) (speedometer gear casing).
99.	Stud (short) (speedometer gear casing).
100.	Nut for stud.
101.	Bearing for mainshaft (rear).
102.	Guard for bearing.
103.	Felt washer.
104.	Gear (speedometer drive).
105.	Pinion (speedometer drive).
106.	Bearing for pinion.
107.	Screw for bearing.
108.	Mounting rubber.
109.	Nut (mounting rubber to engine).
110.	Bolt (to speedometer casing).

Section F.2

DISMANTLING AND REASSEMBLING THE GEARBOX

When dismantling the gearbox, it will be found advantageous to support it in a vice by means of a piece of steel bar, approximately 1½ in. (40 mm.) square by 5 in. (120 mm.) long, this being turned down and threaded at one end (30 mm. × 2 mm. pitch thread) to enable it to be screwed into the gearbox drain plug hole. (See Fig. 52.)

Remove the circlip at the near-side of the clutch operating fork shaft, and the ¼ in. adjusting screw and locknut from the clutch operating lever.

Release the clutch operating lever return spring (Section E.7) and remove the clutch thrust pad by extracting the two retaining springs.

Extract the clutch fork locating taper pin, driving this upward by inserting a suitable pin punch through

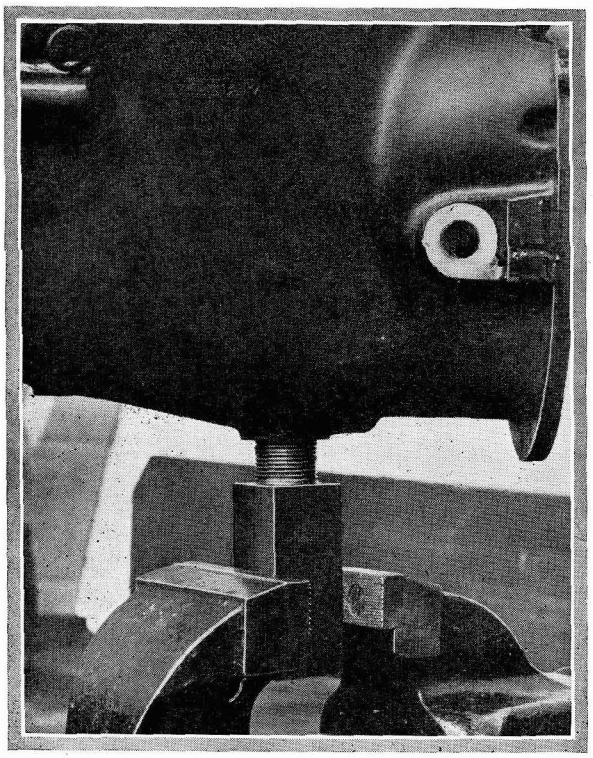


Fig. 52.
A plug threaded into the drain plug hole is used to locate the gearbox in the vice.

the clutch housing drain hole. The clutch operating shaft may then be tapped out with the aid of a suitable drift towards the off-side.

Detach the gearbox drive shaft bearing oil seal cover from the front of the gearbox by removing the three ⅜ in. fixing bolts, observing that the two top bolts are equipped with spring washers and the bottom bolt with a plain copper washer.

Extract the split pin from the ½ in. nut retaining the driving flange at the rear of the gearbox mainshaft, and remove the nut and the plain steel washer. Using a suitable extractor withdraw the driving flange.

Remove the speedometer pinion assembly by undoing the locking wire and unscrewing the two cheese-headed screws, enabling the assembly to be withdrawn from the housing.

Release the speedometer drive housing from the rear of the gearbox by removing the four ¼ in. nuts

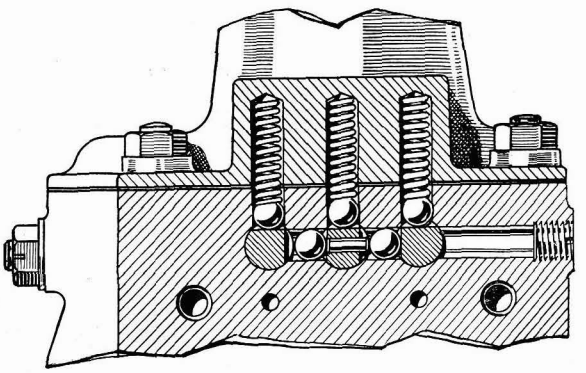


Fig. 53.
This illustrates clearly the position of the selector lock balls and springs.

and spring washers from their locating studs. Note that a paper gasket is fitted between the joint faces.

The felt oil-retaining washer is fitted behind the mainshaft rear bearing at the rear of the speedometer drive housing. If a replacement is being fitted, it is essential to see that the outer edge of the washer is right home in the recess provided.

Note that a plain steel washer is fitted in the register for the gearbox mainshaft bearing, at the forward end of the speedometer drive housing. Remove the bearing guard, noting that the dished portion goes towards the bearing. Using a suitable extractor, withdraw the bearing from the rear end of the mainshaft, and remove the distance piece and speedometer drive gear.

With the change-speed lever in the neutral position, undo the four ¼ in. nuts evenly until they can be removed. Lift off the gearbox cover, taking care to hold the selector springs so that they do not fall into the gearbox.

Extract the lock wire from the six square-headed screws locating the gear shifters, etc., to the selector shafts, and remove the screws.

Withdraw the selector shafts one at a time, exercising care not to lose the lock balls in the process. Reference to Fig. 53 will show the position of the various lock balls and springs. The selector forks may now be extracted. Particular note should be made of the correct location of the various selector forks on the selector shafts. (See Fig. 54.)

Remove the $\frac{3}{16}$ in. layshaft spindle dowel bolt, located in the base of the gearbox casing at the rear.

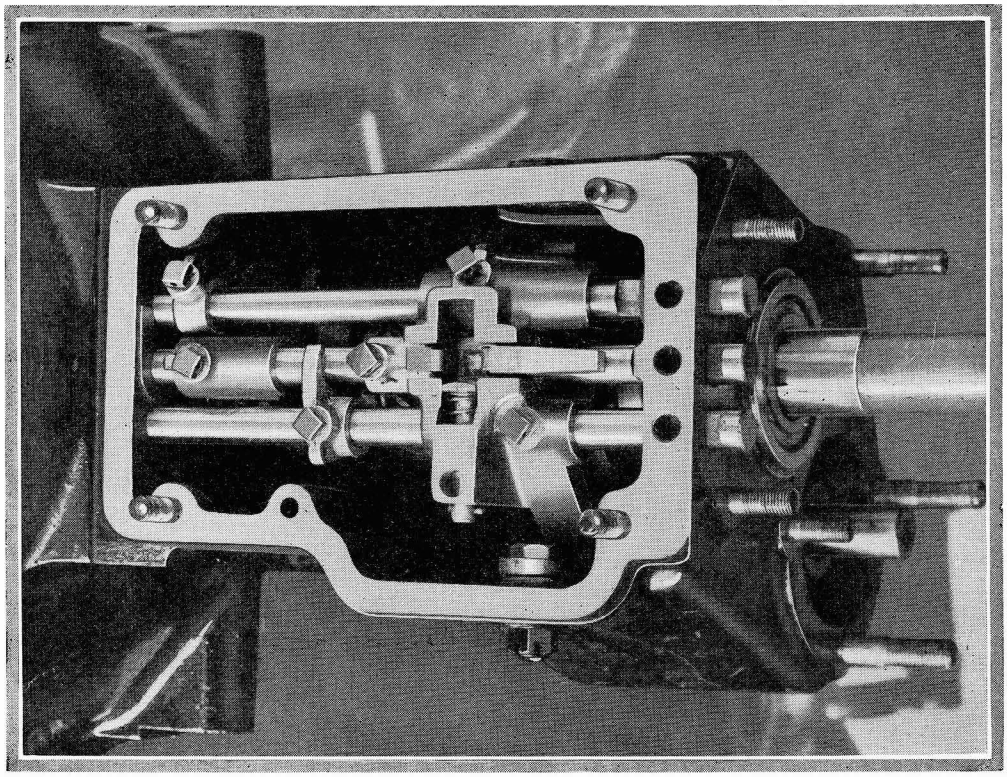


Fig. 54.
The positions of the selectors and stops are here clearly shown.

Using a suitable copper or brass drift, extract the spindle, tapping it from the forward end, thus allowing the layshaft gear unit to drop to the bottom of the gearbox.

With a copper or brass drift, gently tap the rear end of the gearbox mainshaft forward, which will, in turn, drive the gearbox drive gear assembly from its housing.

The gearbox mainshaft and ball bearing is now tapped gently from its housing towards the rear of the gearbox, using a suitable copper or brass drift, and the bearing withdrawn from the shaft, together with the bearing plate fitted inside the gearbox against the circlip. The mainshaft complete with gears is now extracted from the inside of the gearbox. (See Fig. 55.) The layshaft gear unit, which has a thrust washer fitted at either end, may now be removed.

Extract the split pin from the $\frac{1}{4}$ in. bolt and undo the bolt and nut locating the reverse gear shifter to the side of the gearbox. The reverse gear can then be removed from its spindle. The spindle is extracted by removing the $\frac{3}{16}$ in. dowel bolt from the near-side of the gearbox, and gently tapping the spindle from the forward end, using a suitable copper drift for the purpose.

Reassembly

With the various sub-assemblies built up in accordance with the instructions given in their appropriate sections, reassemble the gearbox in the following manner :—

1. Refit the reverse gear and selector fork.
2. The layshaft gear unit, together with the correct sized thrust washer at either end, is next placed in position on the bottom of the gearbox. The layshaft spindle is not inserted until the mainshaft assembly and drive gear have been installed.
3. The mainshaft is entered into the gearbox casing, the drive gear assembly fitted in position, and the bearing front cover replaced. The mainshaft bearing is now located in its housing, at the rear of the gearbox.
4. When fitting the layshaft spindle, raise the layshaft gear unit with a suitable tapered mandrel, and insert the spindle from the rear of the gearbox. Care must be taken to see that the dowel bolt hole in the spindle is lined up to

correspond with the bolt hole in the gearbox casing.

5. When reassembling the selector mechanism it should be refitted in the following order :—

   Replace the first and second, and third and top gear selector forks. Insert the selector shafts with the interlocking ball between them and replace the selectors and stops.

   Replace the selector shaft interlocking ball and push the reverse gear selector shaft through its selector and stop, taking care that the selector fork engages the pin on the reverse gear shifter lever.

The remainder of the reassembly is carried out in the reverse order to that of dismantling.

Section F.3

DISMANTLING AND REASSEMBLING THE MAINSHAFT ASSEMBLY

To dismantle the gearbox mainshaft assembly, withdraw the top and third gear synchromesh hub from the forward end of the shaft, observing that the plain side of the hub faces to the rear of the gearbox.

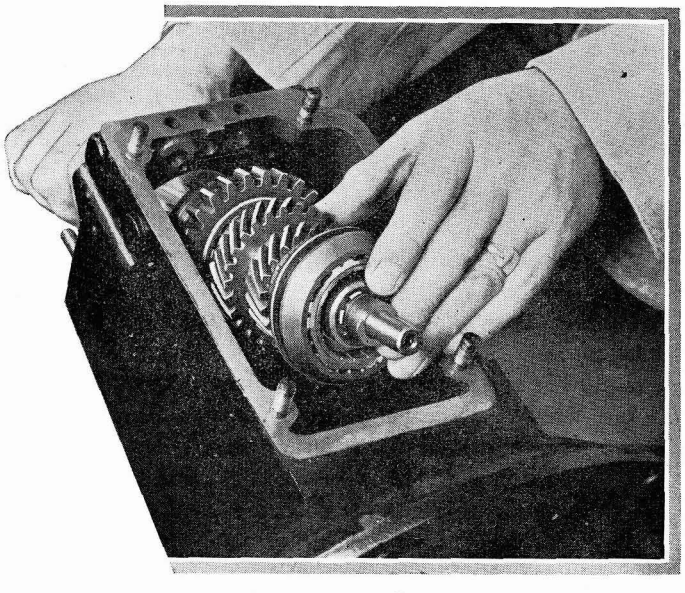


Fig. 55.
Showing the method whereby the mainshaft assembly is removed.

Remove the third speed gear collar by pressing down the spring-loaded locating plunger, and rotate the collar until the splines register with those on the shaft. The third gear may now be withdrawn from its bush. Care must be exercised not to lose the plunger or the spring.

In order to remove the second gear synchromesh hub unit, it is necessary to extract the third and second gear bush from the shaft.

The mainshaft is then placed in a press with the second speed gear supported by suitable steel packings, and the shaft pressed downwards, in order to extract the bush together with the gear from the forward end of the shaft. Reference to Fig. 56 will demonstrate how this operation is carried out.

To remove the second gear synchromesh hub unit, extract the second speed gear collar by pressing down the spring-loaded locating plunger, and rotate the

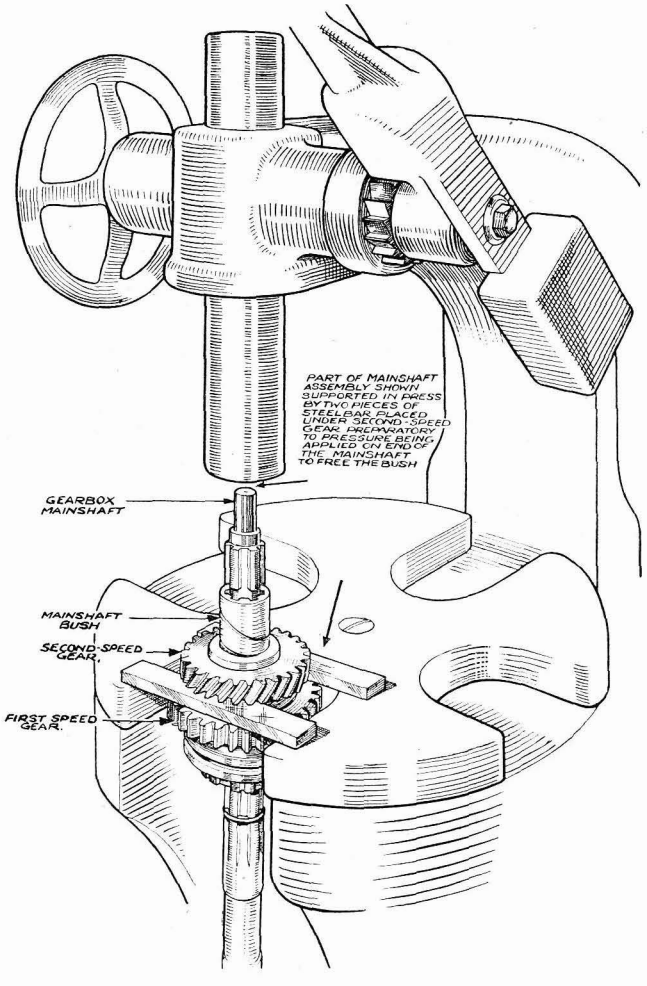


Fig. 56.
The mainshaft is withdrawn from the second gear bush in the manner here illustrated.

collar until the splines register with those on the shaft. The synchromesh hub may then be withdrawn from the shaft.

If it is necessary to separate the striking dog from either of the synchromesh hub and cone assemblies, the assembly should be wrapped with a suitable piece

of cloth in order to retain the six balls and springs which are located in each hub.

The hub is then pushed through the striking dog.

When reassembling the synchromesh hub, the use of broken hacksaw blades with a $\frac{3}{16}$ in. (4.8 mm.) wide slot cut to a depth of $\frac{3}{8}$ in. (9.5 mm.) at one end will facilitate the replacement of the balls and springs. The slotted end can be fitted in between the grooves of the striking dog and the ball compressed against its spring (see Fig. 57). When the six balls and springs have been replaced in their housings the hub can be pressed into the striking dog.

Reassembly of the mainshaft is a reversal of the dismantling procedure, but care should be taken to ensure that the synchromesh hubs slide freely on the mainshaft splines, and that the second and third speed gears are free on their bush.

Section F.4

DISMANTLING AND REASSEMBLING THE DRIVE GEAR ASSEMBLY

Tap back the lock washer and remove the securing nut and lock washer.

Note.—The securing nut has a left-hand thread.

Press off the bearing from the drive gear, and remove the bearing guard.

Reassembly of the drive gear is in the reverse order to the above. The bearing guard should be fitted with the convex side towards the bearing.

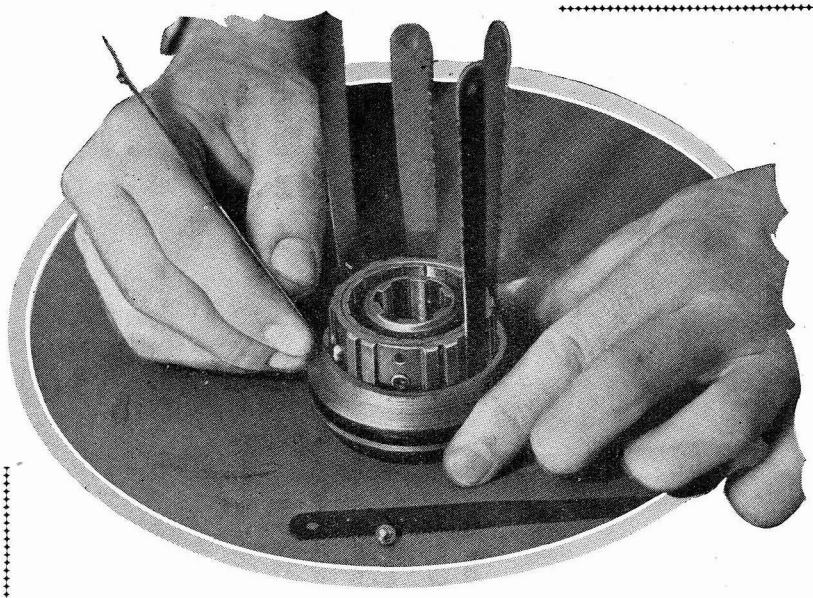


Fig. 57.
The method of reassembling the synchromesh hub assembly in order to keep the locating balls and their springs under control.

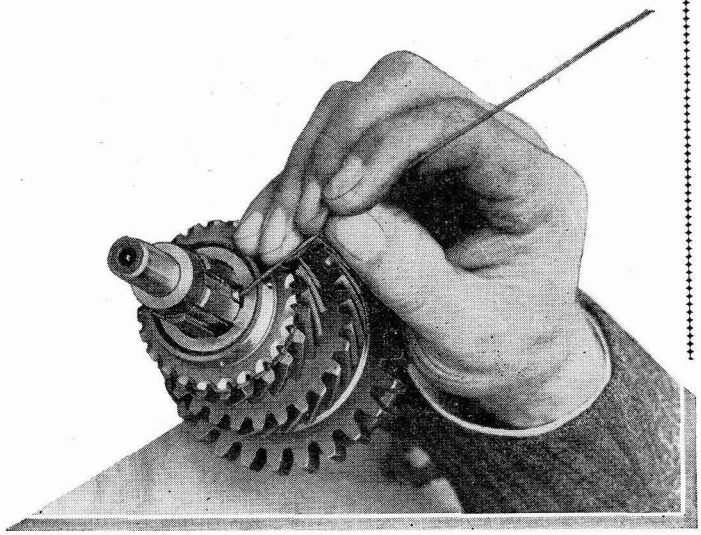


Fig. 58.
Showing the 3rd gear spring-loaded locating plunger.

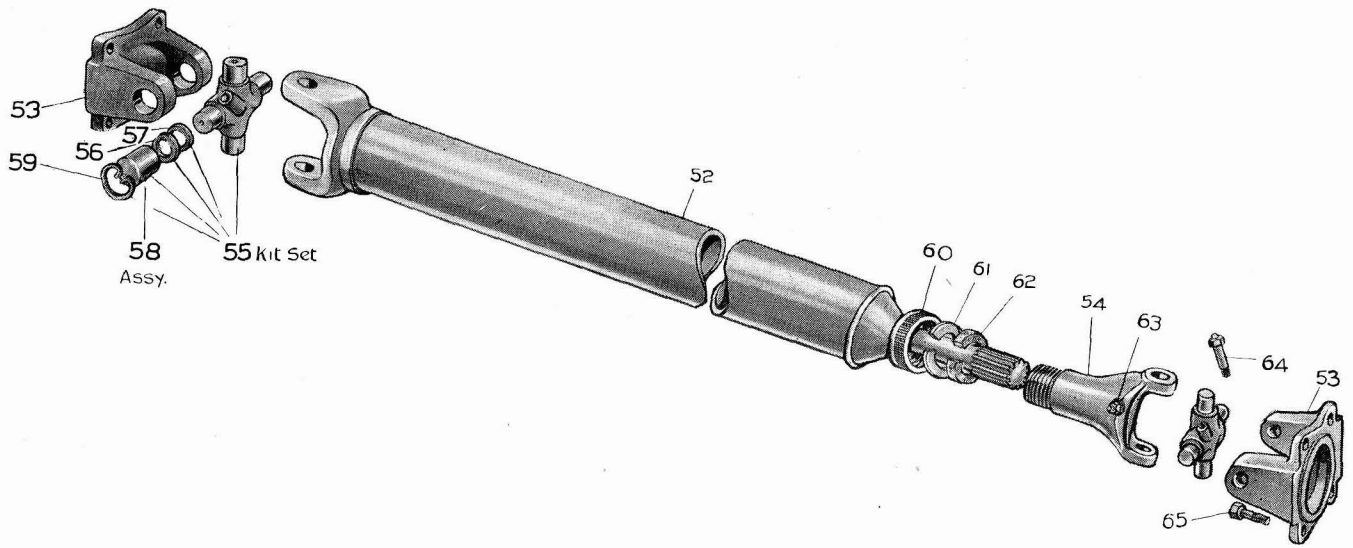


Fig. 59.
The Hardy Spicer propeller shaft, Series KR.1410.

52. Tubular shaft with stub shaft.
53. Flange yoke.
54. Sleeve yoke.
55. Journal and needle bearing set.
56. Gasket for journal.
57. Retainer for gasket.
58. Needle bearing assembly.
59. Snap ring.
60. Dust cap.
61. Steel washer.
62. Cork washer.
63. Lubricating nipple for sleeve yoke.
64. Lubricating nipple for journals.
65. Coupling bolt for propeller shaft.

SECTION G

THE PROPELLER SHAFT

General Description.

GENERAL DESCRIPTION

The propeller shaft and universal joints are of the Hardy Spicer type with needle roller bearings.

A single shaft connects the rear axle and the gearbox. To accommodate fore and aft movement of the axle, the shaft is provided with a splined sliding joint at the front end. Each joint consists of a centre spider, four needle roller bearing assemblies, and two yokes.

Section G.1

ATTENTION TO UNIVERSAL JOINTS

The later type propeller shafts have a lubricator fitted to the front and rear spiders, but the earlier types rely on being adequately packed with grease on assembly for their lubrication.

The type having lubricators fitted should be charged fully after overhauling and subsequently given three or four strokes with the grease gun every 500 miles (800 km.). The correct lubricant is Duckham's "Laminoid" soft grease, or Duckham's "Adcol" H.P.G. grease.

If a large amount of grease exudes from the oil seal the joint should be dismantled and new oil seals fitted.

A lubricator is also provided on the sleeve yoke for the lubrication of the splines of the sliding joint. Lubrication in service is with Duckham's "Laminoid" soft grease every 500 miles (800 km.) or with Duckham's "Adcol" H.P.G. grease. After dismantling, and before reassembling, the inside splines of the sleeve yoke should be smeared liberally with grease.

There are, therefore, three lubricators in all on the later type propeller shafts, one on each universal joint and one on the sliding joint.

The early type propeller shafts have only one grease nipple, and this is situated on the sliding joint.

Section G.2

TESTING FOR WEAR

(In Position)

Wear on the thrust faces is ascertained by testing the lift in the joint, either by hand or with the aid of a length of wood, suitably pivoted.

Any circumferential movement of the shaft relative to the flange yokes indicates wear in the needle roller bearings or in the splined shaft.

Section G.3

REMOVAL OF THE PROPELLER SHAFT

Before removing the bolts and nuts securing the propeller shaft universal joint flanges to the gearbox flange and the rear axle flange, carefully mark the flanges to assist in refitting them in their original position. This is important.

Remove the bolts and nuts securing the propeller shaft to the rear axle flange and gently lower the shaft

onto the frame cross-member. Remove the bolts and nuts securing the shaft to the gearbox flange and slide the shaft out towards the front of the car.

Section G.4

DISMANTLING THE PROPELLER SHAFT

Unscrew the dust cap at the rear end of the sliding joint and pull the joint off the splined shaft. Remove the enamel and dirt from the snap rings and bearing races. Remove all the snap rings by pinching their ears together with a pair of thin-nosed pliers and prizing them out with a screwdriver.

If a ring does not slide out of its groove readily, tap the end of the bearing race slightly to relieve the

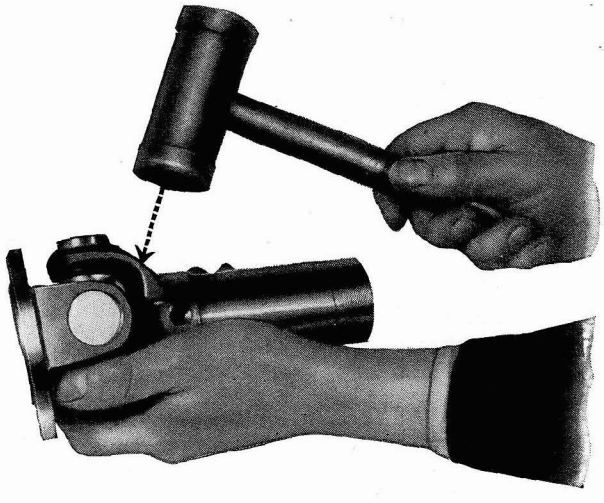


Fig. 60.
Where to apply light blows to the yoke in the first stage of dismantling the universal joint after removing the retaining circlip.

pressure against the ring. Holding the joint in one hand with the splined sleeve yoke on the top, tap the radius of the yoke lightly with a copper hammer. The bearing should begin to emerge ; turn the joint over and finally remove with the fingers. If necessary tap the bearing race from inside with a small diameter bar, taking care not to damage the bearing face ; or grip the needle bearing race in a vice and tap the flange yoke clear.

Be sure to hold the bearing in a vertical position, and when free remove the race from the bottom side to avoid dropping the needle rollers.

Repeat this operation for the opposite bearing.

The splined sleeve yoke can now be removed. Rest the two exposed trunnions on wood or lead blocks to protect their ground surfaces, and tap the top lug of the flange yoke to remove the bearing race.

Turn the yoke over and repeat the operation.

Section G.5

TO EXAMINE AND CHECK FOR WEAR

The parts most likely to show signs of wear after long usage are the bearing races and the spider journals. Should looseness, load markings, or distortion be observed, the affected part must be renewed

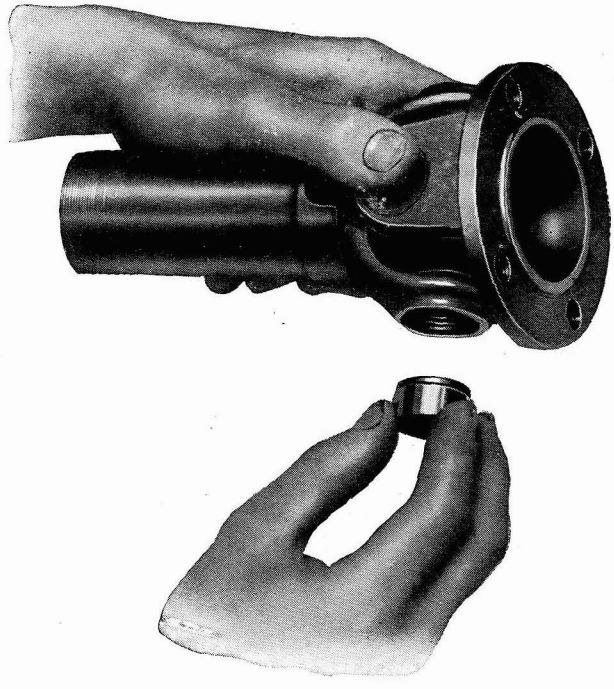


Fig. 61.
Showing the manner of withdrawing the needle bearing after it has been partly withdrawn. When bearings are removed or replaced they should be held vertically to prevent the needle bearings from being displaced.

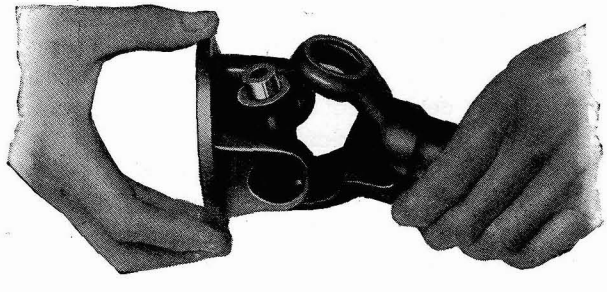


Fig. 62.
When the needle roller bearings have been withdrawn from opposite sides of the spider the joint can be separated as shown.

complete, since no oversized journals or bearing races are provided.

It is essential that the bearing races are a light drive fit in the yoke trunnions. In the event of wear taking place in the yoke cross holes, rendering them oval, the

yokes must be renewed. In case of wear in the cross holes in the fixed yoke, which is part of the tubular shaft assembly, it should normally be replaced by a complete tubular shaft assembly. Only in the case of emergency should any attempt be made to replace this yoke.

Section G.6

REASSEMBLING THE PROPELLER SHAFT

See that all the drilled holes in the journals are thoroughly cleaned out and free from grease. Assemble the needle rollers in the bearing races and

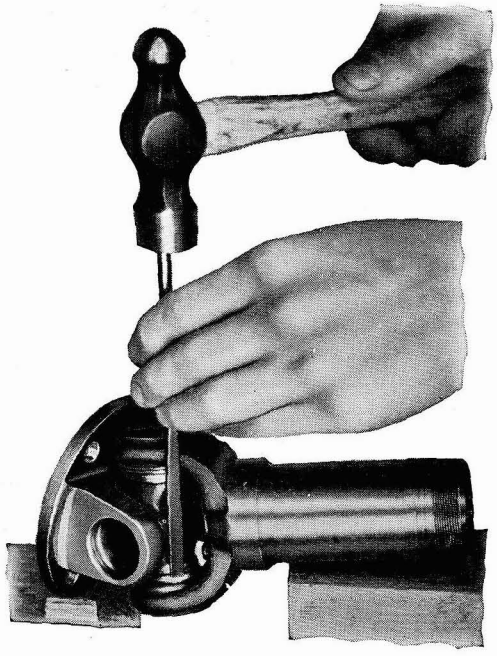


Fig. 63.
When dismantling the universal joint it is permissible to tap out the bearings with a small diameter rod from the inside as shown, provided care is taken not to damage the roller race.

fill with grease. Should difficulty be experienced in retaining the rollers under control, smear the walls of the races with Vaseline petroleum jelly to retain the needle rollers in position while reassembling.

Insert the spider in the flange yoke, ensuring that **the lubricator boss is fitted away from the yoke.** Using a soft-nosed drift, about $\frac{1}{32}$ in. (.8 mm.) smaller in diameter than the hole in the yoke, tap the bearing into position. It is essential that the bearing races are a light drive fit in the yoke trunnions. Repeat this operation for the other three bearings. Replace the circlips and be sure that these are firmly located in their grooves. If the joint appears to bind, tap lightly with a wooden mallet, this will relieve any pressure of the bearings on the end of the journals. Before replacing the sliding joint on the shaft, thread onto the splined shaft the dust cover, the steel washer and the felt washer. When assembling the sliding joint be sure that the trunnions in the sliding and fixed joints are in line. This can be checked by observing that the arrows marked on the splined sleeve yoke and the splined shaft are in line.

It is always advisable to replace the cork gasket and the gasket retainers on the spider journals by means

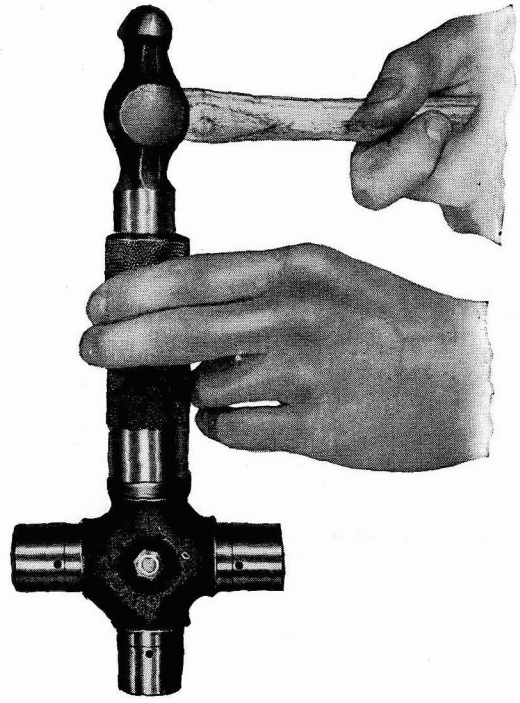


Fig. 64.
When replacing the gasket retainer, use should be made of a hollow drift to tap it into place without damage.

of the tubular drift shown in Fig. 64. The spider journal shoulders should be shellacked prior to fitting the retainers, to ensure a good oil seal.

Section G.7

REPLACEMENT OF THE PROPELLER SHAFT

Wipe the faces of the flanges clean, and pass the rear end of the propeller shaft over the chassis frame cross-member. Ensure that the flange registers engage

correctly and that the joint faces bed down evenly all round. Insert the bolts and see that all nuts are evenly tightened and securely locked and cottered. The sliding joint is always placed at the gearbox end.

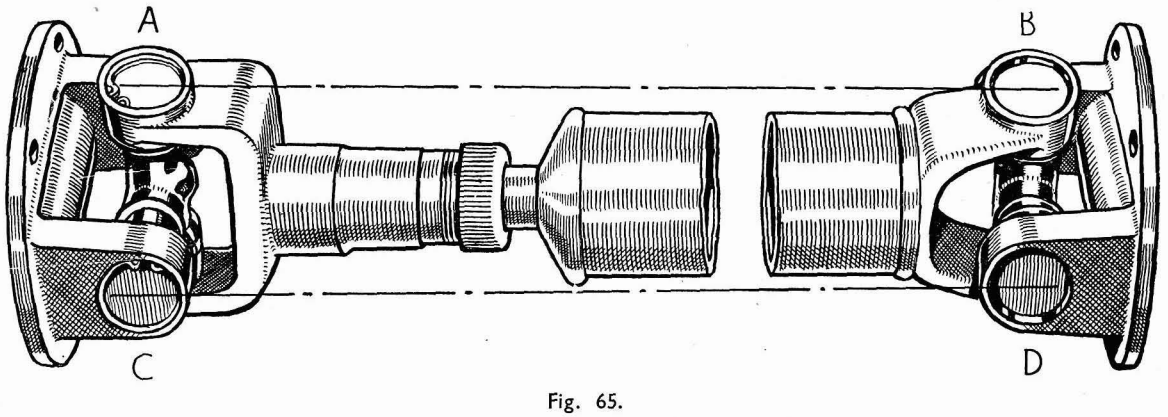


Fig. 65.
The correct method of assembling the universal joints.

When the splined shaft is assembled to the drive shaft it is essential to see that the forked yokes on both shafts have their axes parallel to each other. In other words, the yoke (A) must be in alignment with the yoke (B), and the flange yoke (C) must be in alignment with the flange yoke (D).

SECTION H

THE REAR AXLE

GENERAL DESCRIPTION

The rear axle is driven by a propeller shaft from the gearbox. It is of the three-quarter floating type, in which the drive shafts transmit only the driving torque and do not carry any load.

The rear hub bearings are mounted on extensions of the rear axle casing. The wheel hub flanges complete with driving shaft can therefore readily be withdrawn.

Each brake-drum is secured to its hub by two countersunk retaining screws only, thus allowing the drum to be withdrawn readily when they are removed. The brake gear is of the normal two-shoe type, operating hydraulically from the brake pedal and also mechanically by a hand lever operating the same rear brake-shoes. The operating cylinders for the brakes are mounted horizontally on the brake plates and act directly on to the brake-shoes. Suspension is by means of semi-elliptic leaf springs.

LUBRICATION

Hubs

Remove the wheel disc and give one stroke of the grease gun to the exposed grease nipple on the end of the hub every 6,000 miles (10,000 km.). Use Duckham's " Adcol " H.B.B. grease.

Differential assembly

Oil is introduced through a combined filler and level plug situated on the rear of the axle casing.

Inspect the oil level every 1,000 miles (1,600 km.), and replenish if necessary with N.O.L. " E.P." Transmission Oil 140.

After the first 500 miles (800 km.), and subsequently every 6,000 miles (10,000 km.), drain off the old oil and refill with fresh oil. The capacity of the rear axle is 1 pint (.6 litre).

Section H.1

REMOVAL OF THE REAR HUB

Jack up the axle and, having placed chocks on each side of the wheel remaining in contact with the ground, remove the wheel. Unscrew the two countersunk screws from the brake-drum and, with the hand brake released, ease off the drum.

If it does not come off readily, the hub can be released from its joint to the bearing housing by screwing the two brake-drum screws into the two tapped holes in the hub flange, and screwing them up a turn at a time alternately so that they function as extractors.

Withdraw the driving shaft.

Tap back the tabs of the locking washer for the bearing locknut and remove the bearing locknut, using the special spanner, Part No. 36120.

Note.—The near-side and off-side hub nuts have left- and right-hand threads respectively.

Withdraw the bearing housing complete with bearing and oil seal, using special extractor, Part No. 19431.

Section H.2

REMOVAL AND REPLACEMENT OF BRAKE PLATE ASSEMBLY

Remove the wheel, brake-drum, driving shaft, and hub, as detailed in Section H.1.

Disconnect the hydraulic brake pipe from the back of the wheel cylinder by removing the set bolt securing the banjo union (take care of the two copper jointing washers).

Disconnect the hand brake cable from the lever trunnion by undoing the adjusting nut.

Withdraw the cable through its tube at the side of the propeller shaft tunnel, and release it from its clip underneath the chassis cross-member.

Remove the four bolts and nuts securing the brake plate to the axle tube flange.

The brake plate can now be withdrawn complete with the brake assemblies.

Replacement is the reversal of the above operation.

Note.—As the hydraulic brake system has been " opened " the brakes must be bled in accordance with the instructions given in Section L.13.

The copper washers and the faces of the banjo union and bolt must be made perfectly clean to ensure a fluid-tight joint when they are refitted.

Finally adjust the hand brake as detailed in Section L.18.

Section H.3

REPLACEMENT OF THE REAR HUB

Check the " Gaco " oil seal for damage or wear, and renew if necessary.

Attention should be given to the following points when fitting this type of oil seal :—

1. The surface on which the bore of the oil seal works must be dead smooth. The seal works on the bearing spacer and only the finest emery cloth should be used where necessary to secure the desired finish. All traces of abrasive compound must carefully be removed after this operation.
2. Before fitting, the oil seal should be liberally coated all over with the normal rear axle lubricant.
3. The oil seal should be fitted so that when assembled to the car the internal spring of the oil seal faces outwards, i.e. towards the hub bearing.

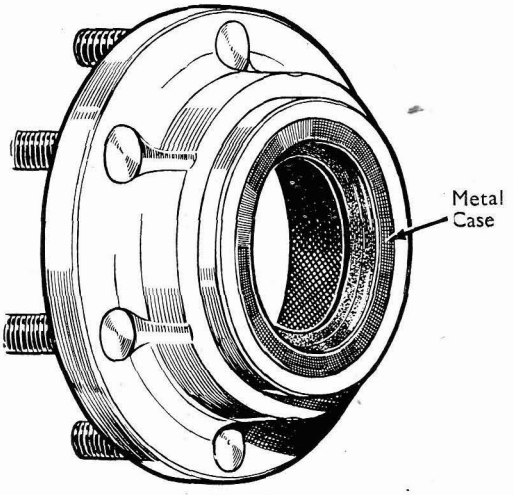


Fig. 66.
Care must be taken to fit the oil seals the correct way round, as illustrated above.

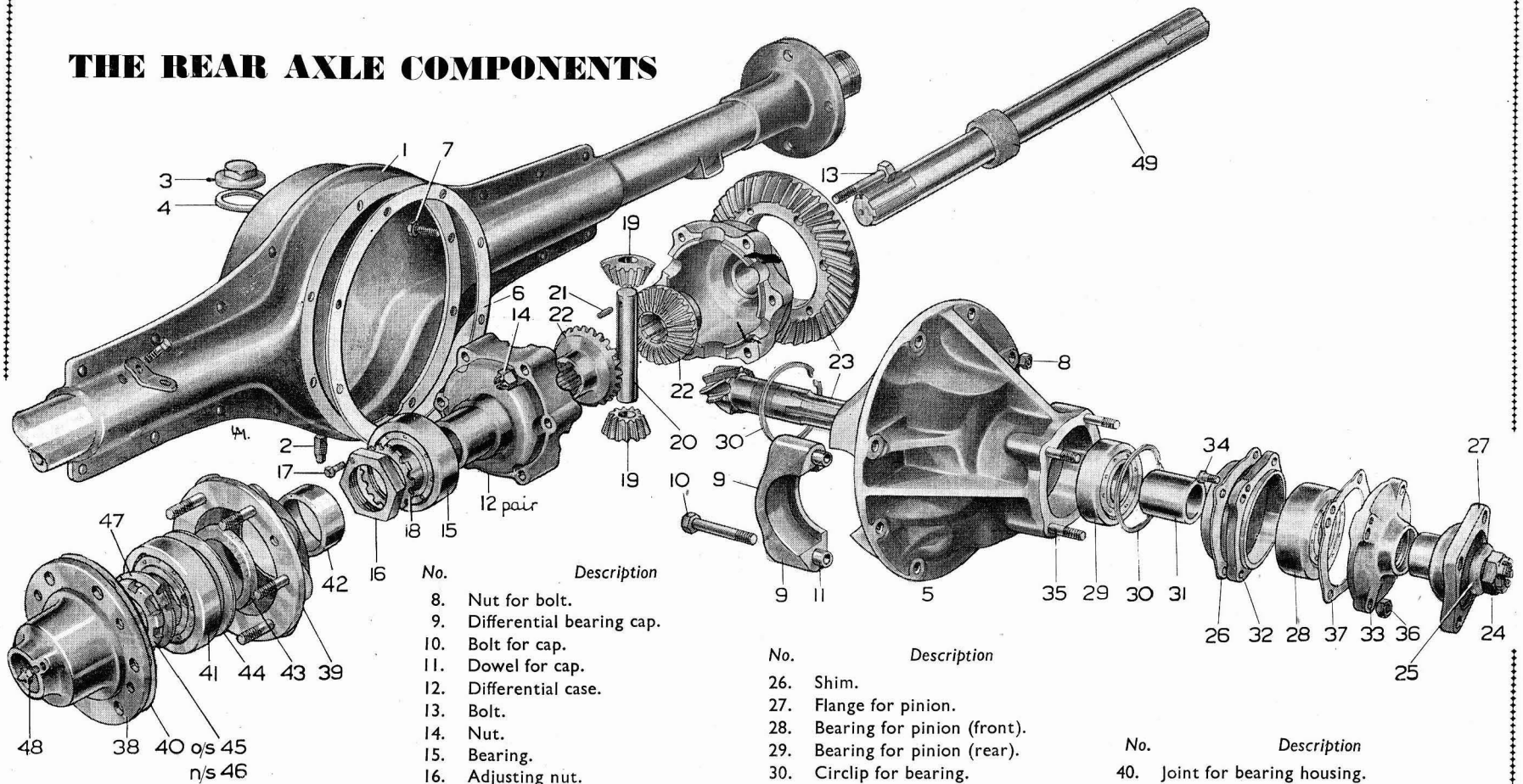
Replace the hub bearing housing complete with bearing and oil seal. The bearing is a tight sliding fit on the axle housing, so it must be gently tapped into position by making use of a piece of tube large enough in diameter to slide over the end of the axle housing.

Place the lock washer and nut in position and tighten the nut (special spanner, Part No. 36120).

Note.—The near-side and off-side hub nuts are threaded left- and right-hand respectively.

Position the nut so that a tab of the locking washer is opposite a slot in the nut, and tap the tab into the recess.

THE REAR AXLE COMPONENTS



No.	Description
1.	Axle housing.
2.	Drain plug.
3.	Filler plug.
4.	Washer for filler plug.
5.	Differential carrier.
6.	Joint gasket.
7.	Bolt.

No.	Description
8.	Nut for bolt.
9.	Differential bearing cap.
10.	Bolt for cap.
11.	Dowel for cap.
12.	Differential case.
13.	Bolt.
14.	Nut.
15.	Bearing.
16.	Adjusting nut.
17.	Lock screw.
18.	Lock washer.
19.	Pinion.
20.	Pin for pinion.
21.	Dowel for pin.
22.	Gear.
23.	Crown wheel and pinion.
24.	Nut for pinion.
25.	Washer.

No.	Description
26.	Shim.
27.	Flange for pinion.
28.	Bearing for pinion (front).
29.	Bearing for pinion (rear).
30.	Circlip for bearing.
31.	Distance piece.
32.	Housing for pinion bearing.
33.	Cap for housing.
34.	Screw for cap.
35.	Stud for cap.
36.	Nut for stud.
37.	Packing for housing.
38.	Rear hub.
39.	Bearing housing.

No.	Description
40.	Joint for bearing housing.
41.	Bearing.
42.	Spacer for bearing.
43.	Oil seal (Gaco).
44.	Washer for oil seal.
45.	Locknut for bearing (off-side).
46.	Locknut for bearing (near-side).
47.	Lock washer for nut.
48.	Lubricating nipple.
49.	Axle drive shaft.

H

Replace the driving shaft, ensuring that the gasket between the hub flange and the bearing housing is in good condition, and that the clearance holes in the flange line up with the two tapped holes in the bearing housing.

Replace the brake-drum and secure it with the two countersunk screws.

Replace the wheel and wheel disc.

Section H.4

REMOVAL AND REPLACEMENT OF DIFFERENTIAL ASSEMBLY

Drain the oil from the axle casing by removing the drain plug.

Remove both driving shafts as detailed in Section H.1.

Disconnect the propeller shaft from the axle drive flange, having marked the two flanges so that they may be reassembled in their original position.

Undo the eight nuts securing the differential carrier to the axle casing, and withdraw the assembly.

Note.—It may be necessary to rotate the pinion flange so that the crown wheel adjusting nut lock screws will clear the axle casing.

Replacement is a reversal of the above operation, but attention should be given to the following points :—

1. Check that the eight differential carrier securing bolts are tight in the axle casing.
2. Ensure that the joint faces are clean and free from burrs.
3. Fit a new gasket when reassembling.

Section H.5

DISMANTLING THE DIFFERENTIAL ASSEMBLY

Hold the unit securely in a vice. To avoid damaging the differential carrier use clamps made of lead or copper.

Remove the lock screws from both the differential adjusting nuts, and unscrew the nuts half a turn. Remove the two differential bearing caps, which are held by four bolts—two to each cap.

Note.—These caps are machined with the carrier and it is most important that they should be fitted in their correct positions when reassembling. They are marked to show the correct assembly, and any difficulty arising from loss or exchange will be avoided if the caps are replaced and bolted into position immediately the crown wheel is removed.

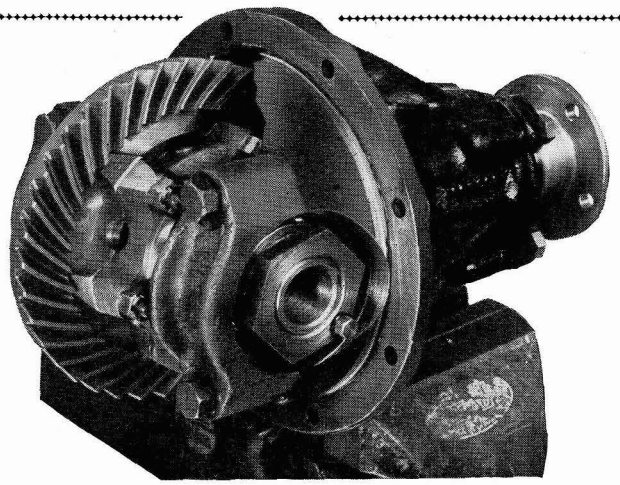


Fig. 67.
The differential assembly may be held, by the housing, in a vice if the jaws are adequately protected.

Remove the crown wheel assembly from its carrier.

Remove the four nuts securing the pinion assembly to the carrier. The pinion assembly can now be withdrawn by lightly tapping with a hide mallet the gear end of the pinion shaft. The outer ring of the roller race will remain in the carrier and can be removed by taking out one of the circlips—the one nearest the

crown wheel assembly is the most convenient—and tapping out the roller ring.

Section H.6

DISMANTLING THE CROWN WHEEL ASSEMBLY

Remove the cotter pins and undo the six differential case bolts and nuts.

Tap the bolts through the differential case with a suitable brass drift, and withdraw the crown wheel.

Part the case, noting that both halves are marked with corresponding numbers so that they may be replaced in their original position.

This exposes the differential gears and pinions.

Remove the gears and pinions, taking care of the dowel retaining the pinion pin to the differential case.

Remove the two adjusting nuts and locking washers. Press off the bearings from their respective halves of the cage.

Section H.7

DISMANTLING THE PINION ASSEMBLY

Remove the cotter pin and nut securing the pinion flange to the pinion shaft.

Withdraw the flange, using a suitable extractor or press.

Remove the two countersunk screws securing the housing cap to the bearing housing, and withdraw the cap. Press the housing complete with bearing off the shaft. Lift out the front half of the split outer race, together with the inner race (only the rear half of the outer race is a tight fit in the housing). Press out the outer half race from the housing. Remove the bearing distance piece and press the roller bearing inner race off the pinion shaft.

Section H.8

EXAMINATION OF PARTS FOR WEAR

Each part must be in a serviceable condition and must be examined before assembly. To carry out this examination correctly the parts must be perfectly clean, and it is important that they should be kept clean as the assembly proceeds.

1. *Crown wheel bearings :* These bearings are of the single row ball journal thrust type. They must spin freely without signs of harshness, or excessive play between the inner and outer races. If there is any doubt about their condition they must be renewed.
2. *Pinion shaft bearings :* The bearing nearest the pinion gear is a single roller bearing, and that by the driving flange a double row double purpose ball bearing, with split outer race. These should be renewed if they do not roll freely and smoothly.
3. *Crown wheel and pinion :* These are lapped in pairs, and are marked with corresponding numbers—the pinion on its end face, and the crown wheel on its back face.

   It is essential that the crown wheels and pinions be stored and used in pairs, otherwise satisfactory results cannot be obtained.
4. If the inner races of the roller bearings are loose on the pinion shaft as the result of wear on the shaft, brought about by the race revolving independently on the shaft, a new pinion, together with a crown wheel, must be used. If the original bearing is loose on the replacement shaft a new bearing must be fitted.
5. Fractures in the teeth, hollows or roughness on the surfaces of the teeth, will render both the crown wheel and pinion unserviceable. Replace them with a new pair.
6. *Carrier :* The outer race of the roller bearing must be a light drive fit in the bore machined in the carrier. Should a new replacement bearing fail to remove any excessive looseness, a new carrier must be fitted.

   Similarly, when the differential bearing caps are held tightly by their bolts, the crown wheel bearings must be a light drive fit in the bores machined for them in the carrier. Any looseness of bearings should be dealt with as above.
7. *Differential gears : Pinions and pinion pins :* The function of these parts is such that rather more latitude in wear is permissible as compared with the crown wheel and pinion. But if there is any doubt about the condition of any part it should be renewed. After examining all parts and replacing any that are not serviceable, the axle should be reassembled as in the the following Sections.

Section H.9

ASSEMBLING THE CROWN WHEEL ASSEMBLY

Fit the crown wheel to its correct half of the differential case. Place the differential gears in the case. Fit the pinions on to their pin, and place

the pinion pin with the retaining dowel in engagement with the dowel hole of the case.

Place the two halves of the case together.

Note.—Both halves are marked with corresponding numbers, and these numbers must be in line when the halves are placed together.

Fit the six differential case bolts and nuts, and tighten up.

Insert an axle shaft, securely held in a vice, into one of the differential gears and check that the pinions and gears will turn freely by revolving the complete case assembly. Should it not do so, strip and examine for the cause. If correct, secure the differential case bolts with split pins.

Press the crown wheel bearings on to the spigots of the differential case.

Note.—Both bearings must be fitted with the thrust side inwards, i.e. facing the crown wheel.

The crown wheel must now be tested for truth.

Place the two bearings on " Vee " blocks, and check the crown wheel for true running axially and diametrically with the aid of a clock gauge. The maximum permissible error is .003 in. (.08 mm.). Should the wheel fail to run true within this limit, renew the case and re-check.

Section H.10

ASSEMBLING THE PINION ASSEMBLY

Press the inner race of the roller bearing on to the pinion shaft, ensuring that the race is right home against the shoulder of the pinion gear. Place the distance piece on the shaft.

Press the double row ball bearing into its housing (only the rear half of the split outer race is a tight fit in the housing). Assemble the cap to its housing—ensure that the cork gasket is in good condition—and secure with the two countersunk screws. Press the bearing housing assembly on to the pinion shaft.

Press the pinion flange on to the shaft and replace the washer and nut, tighten up and secure with the cotter pin.

Section H.11

ASSEMBLING THE CROWN WHEEL ASSEMBLY TO THE CARRIER

Place the crown wheel assembly in position, and replace the bearing caps. (The caps are marked with corresponding numbers to show correct position for assembly.)

Replace the four bolts and partially tighten them in order to place light pressure on the bearings.

Assemble the locking washers and adjusting nuts and steadily pull the bearings into position, keeping the nuts an equal distance from the ends of the differential case, until the outer races of the bearings are against the shoulders of the housing. Tighten fully the bearing cap bolts.

Replace the adjusting nut lock screws when the gears have been correctly meshed.

Note.—These lock screws must protrude through the nuts and engage with the slots provided in the locking washers.

Section H.12

ASSEMBLING THE PINION ASSEMBLY TO THE CARRIER

Press the outer ring of the roller bearing into the carrier, and replace the inner circlip.

Tap the pinion assembly into the carrier with a sufficient number of shims (approximately .012 in. or .30 mm.) to allow the inner faces of the teeth of both the pinion and the crown wheel to be flush. Replace the four spring washers and nuts, and tighten up.

The method of adjusting the gears is explained in Section H.13.

Section H.13

GEAR MESHING

The differential case adjusting nuts should be tightened until all side-play has been eliminated, but without " nipping " the bearings. When finally adjusted the crown wheel assembly should spin quite freely on its bearings without any signs of tightness. Any further adjustment to gain the correct amount of backlash will be made by slackening off one nut a given amount, and at the same time tightening the other a similar amount, assisting the assembly to move in the bearings by giving the caps a smart blow from a copper hammer if necessary.

The crown wheel assembly should be set to give a backlash of not less than .008 in. (.2 mm.) and not more than .010 in. (.25 mm.). This point should always be checked by a dial gauge (see Fig. 68).

Using a suitable cranking handle (see Fig. 69), the crown wheel assembly should be turned in both directions, and the position of the drive pinion altered by moving it in and out of the casing until the quietest running position of the gears is obtained. If it is found necessary to adjust the pinion inwards to obtain quiet running, it will be necessary to re-position the crown wheel assembly to increase the backlash within the correct limits, and vice versa, if it is found that the

quietest running position is obtained by bringing the drive pinion assembly out.

The final adjustment is now made by taking a marking of the teeth, using powdered red lead mixed with engine oil. Approximately a dozen crown wheel teeth should be lightly coated, and the crown wheel assembly again turned in both directions.

Reference to Page 80 will show the correct marking required when the assembly is tested without load on the bench, and how the various types of error are indicated.

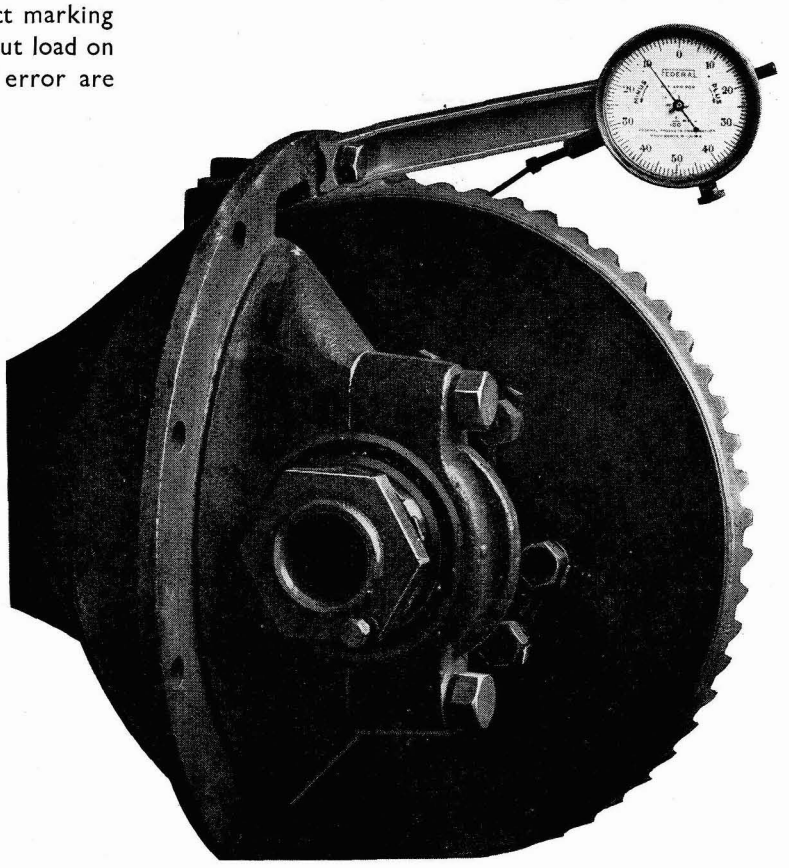


Fig. 68.
To check the backlash accurately a clock gauge should be employed mounted on the differential casing in such a way that its indicator spindle is at right angles to the tooth face.

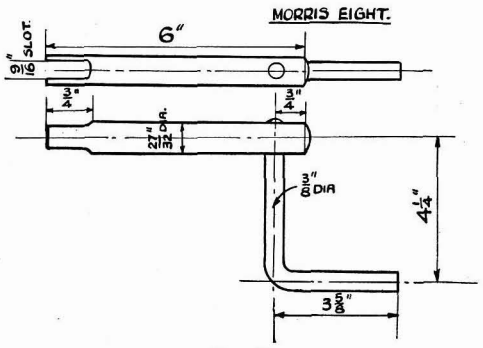


Fig. 69.
The crank handle recommended for turning the crown wheel assembly.

Remove the rear hub as detailed in Section H.1.

Remove the brake plate assemblies as detailed in Section H.2.

Disconnect the propeller shaft from the rear axle driving flange. (It is advisable to mark both the propeller shaft flange and the driving flange to enable the shaft to be replaced in its original position.)

Section H.14

REMOVAL AND REPLACEMENT OF REAR AXLE

Most normal maintenance repairs can be carried out with the rear axle in position in the vehicle, but if its removal from the vehicle is required, proceed as follows :—

Drain the oil by removing the square-headed drain screw.

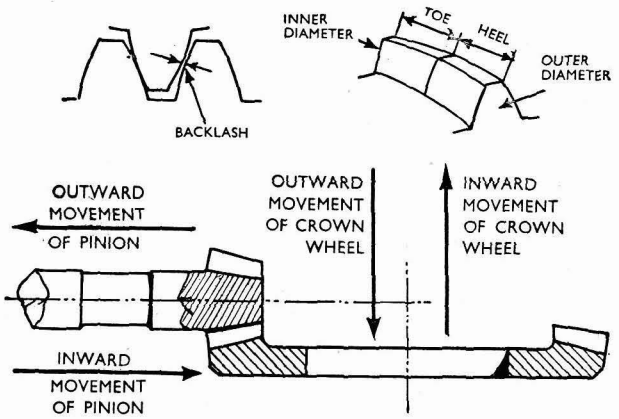
Lift the rear of the car with a hoist and remove the wheels.

Release the rubber brake hose from its bracket on the off-side of the chassis by disconnecting the feed pipe from its union with the flexible pipe and then unscrewing the locknut retaining the flexible hose to the bracket.

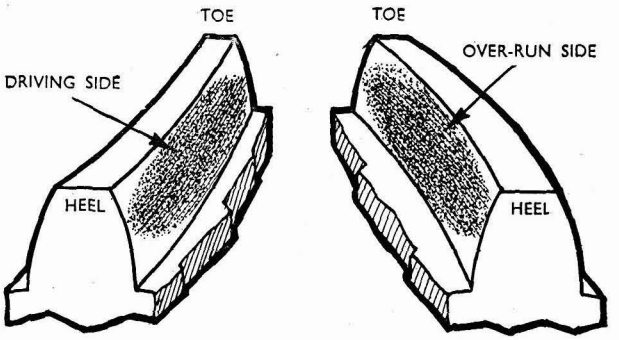
Remove the " U " bolt nuts, and withdraw the " U " bolts and rubber buffers.

Lift the axle housing from the spring centre bolts and remove it to the near-side, until the off-side of the housing is clear of the inside of the spring. The axle housing can now be manoeuvred out between the springs.

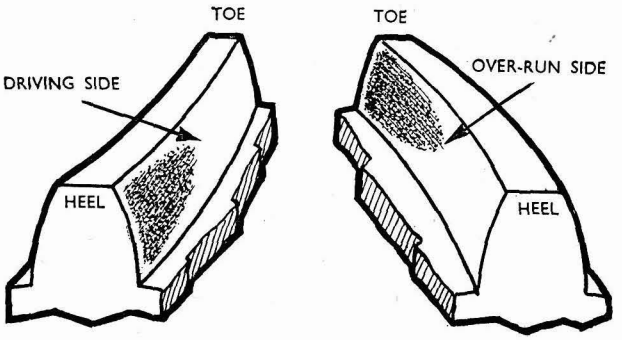
CROWN WHEEL TOOTH MARKINGS



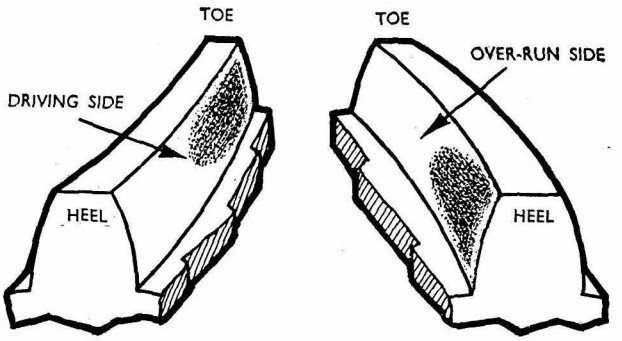
THE NOMENCLATURE USED IN CONNECTION WITH THE GEARS IS HERE CLEARLY SHOWN. OPERATORS SHOULD BE FAMILIAR WITH THE CORRECT MOVEMENTS OF THE GEARS IN PARTICULAR



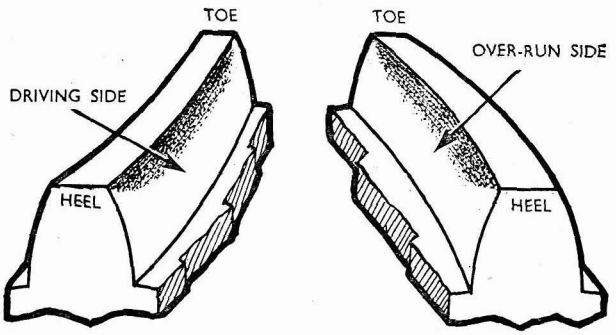
CORRECT GEAR TOOTH MARKINGS WHICH GIVE QUIET OPERATION AND MAXIMUM LIFE. NOTE THAT THESE MARKINGS ARE GIVEN WHEN THE CROWN WHEEL IS ROTATED



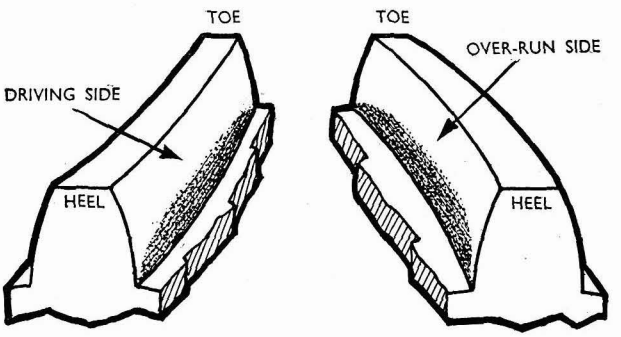
DRIVE TAKING PLACE AT HEEL AND TOE AS SHOWN BY THE ABOVE MARKINGS IS INCORRECT. RECTIFY BY MOVING CROWN WHEEL INWARDS AND PINION OUTWARDS TO MAINTAIN CORRECT BACKLASH



DRIVE TAKING PLACE AT TOE AND HEEL AS SHOWN BY THE ABOVE MARKINGS IS INCORRECT. RECTIFY BY MOVING CROWN WHEEL OUTWARDS AND PINION INWARDS TO MAINTAIN CORRECT BACKLASH



HEAVY CONTACT AT NOSE OF TEETH INDICATES THAT PINION IS TOO FAR OUT OF MESH. MOVE INWARDS TOWARDS CROWN WHEEL AND MOVE CROWN WHEEL OUTWARDS TO MAINTAIN BACKLASH IF NECESSARY



HEAVY CONTACT AT ROOT OF TEETH INDICATES THAT PINION IS TOO FAR IN MESH. MOVE OUTWARDS AWAY FROM CROWN WHEEL AND MOVE CROWN WHEEL INWARDS TO MAINTAIN BACKLASH IF NECESSARY

NOTE :—These markings are **only produced when the pinion is rotated from the crown wheel** as in Fig. 69, and **not** when the drive is applied from the pinion drive flange. A different set of markings is produced in the latter case and care must therefore be taken of this point when interpreting from the markings.

SECTION I

THE FRONT AXLE

GENERAL DESCRIPTION

The steering knuckle swivel pins are locked in the front axle beam by cotters at their centre. Each steering knuckle is fitted with two radial type bearings for the hub, two bushes for the swivel pin, and a bronze washer to take the thrust. There is also an oil-retaining felt at the top of the swivel pin and a dust-excluding plug at the bottom.

The steering and track rod arms are secured to bosses in the stub axle by a keyed taper and nut attachment.

Felt oil seals prevent the grease escaping from the hub, and dirt from entering.

LUBRICATION

The hub bearings should receive one stroke with the grease gun every 6,000 miles (10,000 km.), using Duckham's " Adcol " H.B.B. grease.

There are two nipples to each steering knuckle. Apply the grease gun to each nipple until the grease exudes from the bush faces.

Note.—This operation is more effectively carried out when the axle is jacked so that the wheels are clear of the ground.

Every 500 miles (800 km.) apply the grease gun to each nipple of the track rod and steering draglink until the grease exudes from the ball ends. Use Duckham's " Laminoid " soft grease or H.P.G. grease.

MAINTENANCE

The following parts must be checked for tightness during periodical maintenance :—

Road spring " U " clips to axle beam.

The drop arm securing nut.

All road wheel nuts.

Check for play in the draglink and if necessary take up the excessive clearance by the following method :—

Withdraw the cotter pins from each end of the draglink, and remove the slotted end plugs.

Remove and check the springs and ball cups.

Replace any part that is broken or worn.

Refit the springs and cups and screw up the end plugs until they are tight, then slacken them back a quarter of a turn and replace the cotter pins in the nearest slot.

Check for play in the track rod end sockets. These sockets are not adjustable, and should any looseness be found the complete assembly must be changed.

Toe-in

The front wheel must be set with $\frac{1}{8}$ in. (3.2 mm.) toe-in.

The ends of the track rod are machined with right- and left-hand threads, and adjustment is effected by rotating the track rod in the required direction, after loosening the locknuts. (See Section I.6).

Section I.1

REMOVAL AND REPLACEMENT OF THE HUB

Jack up the front axle and remove the road wheel.

Remove the two countersunk screws securing the brake-drum to the hub, and remove the brake-drum.

Remove the cotter pin and unscrew the castellated locknut from the end of the stub axle. **Note that the nut on the near-side axle has a left-hand thread.**

Using an extractor (special tool, Part No. 19431), withdraw the hub complete with its two bearings and oil seals.

Examine the felt oil retainer, and if damaged it should be renewed.

Replace in the reverse order, after the original grease has been cleaned from the hub and the hub repacked with new grease. Check the inner and outer bearings carefully for wear when the grease has been removed.

Make sure that the inner race of the larger bearing is in proper engagement with the distance piece on the stub axle on replacement.

Section I.2

REMOVAL AND REPLACEMENT OF THE BRAKE PLATE ASSEMBLY

Remove the hub complete with bearings and oil seals, as detailed in Section I.1.

Remove the four bolts and nuts securing the brake plate to the flange of the stub axle. The brake plate assembly, complete with the brake-shoes, can now be withdrawn. As the brake plate still has the flexible brake fluid hose attached to it, it should be firmly secured to the top of the front spring, taking care that the flexible pipe is not damaged and the brake-shoe linings are not damaged by grease from the springs.

Should it be necessary to remove the flexible hose, this is done by first disconnecting the feed pipe from its union with the flexible pipe, and then unscrewing the locknut retaining the flexible hose to the chassis frame.

Replace in the reverse order to dismantling, taking care that the ends of the flexible brake hose are free from dirt and damage.

Note.—After the flexible pipe has been replaced, it will be necessary to bleed the brake system before taking the vehicle on the road, as described in Section L.13.

Section I.3

REMOVAL AND REPLACEMENT OF STEERING KNUCKLE

Remove the hub complete with bearings and oil retainers, as in Section I.1.

Remove the brake plate as detailed in Section I.2.

Remove the oil-retaining felt and its washer and the securing bolt from the top of the swivel pin.

Disconnect the track rod ball end from its attachment to the track rod arm, and in the case of the off-side steering knuckle it is necessary to remove also the draglink rear end from its attachment to the steering arm.

Remove the cotter securing the swivel pin in the eye of the axle. After slackening the nut on the cotter it is advisable to give the nut a sharp tap with a hammer, as this will loosen the cotter in the axle. Finally remove the nut and punch out the cotter.

To remove each swivel pin, support the axle beam firmly and as close as possible to the pin itself. Drive the pin downwards with a suitable punch. Should difficulty be experienced in driving out the pin in this manner, use the special extractor (Part No. 55418).

Note.—Swivel pins are parallel and the thrust washers are fitted on the underside of the axle beam.

To reassemble, reverse the foregoing operation, and in cases where the flexible brake hose has been removed, bleed the brakes.

A new dust excluder cap should be fitted to the lower end of the steering knuckle in the recess provided.

Section I.4

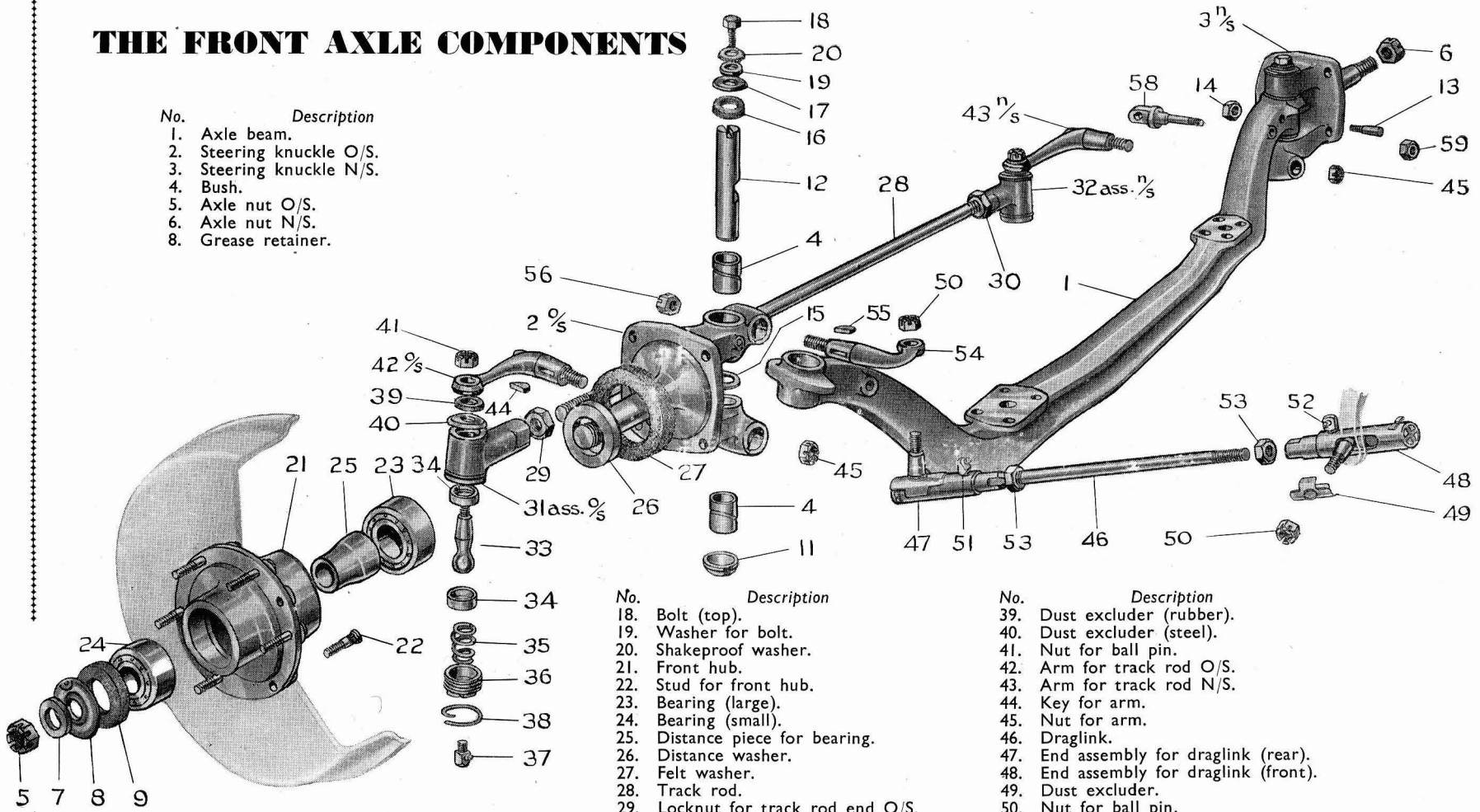
REMOVAL AND REPLACEMENT OF THE FRONT AXLE

Raise the front of the car by hoist and remove the road wheels.

Placing a suitable support under the axle beam, disconnect each Lockheed hose assembly from its attachment to the chassis by first unscrewing the small union nut on the feed pipe and then unscrewing the large nut retaining the brake hose assembly junction union to the chassis frame.

Detach the steering draglink from the steering arm by removing the split pin from the ball pin retaining nut and slackening off the nut. (Do not remove it.) Tap the circumference of the steering drop arm eye

THE FRONT AXLE COMPONENTS



No.	Description
1.	Axle beam.
2.	Steering knuckle O/S.
3.	Steering knuckle N/S.
4.	Bush.
5.	Axle nut O/S.
6.	Axle nut N/S.
8.	Grease retainer.

No.	Description
9.	Felt (grease retainer).
11.	Plug.
12.	Swivel pin.
13.	Cotter.
14.	Nut for cotter.
15.	Thrust washer.
16.	Felt washer.
17.	Retainer for felt washer.

↑ On early models only

No.	Description
18.	Bolt (top).
19.	Washer for bolt.
20.	Shakeproof washer.
21.	Front hub.
22.	Stud for front hub.
23.	Bearing (large).
24.	Bearing (small).
25.	Distance piece for bearing.
26.	Distance washer.
27.	Felt washer.
28.	Track rod.
29.	Locknut for track rod end O/S.
30.	Locknut for track rod end N/S.
31.	End assembly for track rod O/S.
32.	End assembly for track rod N/S.
33.	Ball pin.
34.	Ball seat.
35.	Spring for ball pin.
36.	Plug for ball pin.
37.	Greaser (in plug).
38.	Locking ring.

No.	Description
39.	Dust excluder (rubber).
40.	Dust excluder (steel).
41.	Nut for ball pin.
42.	Arm for track rod O/S.
43.	Arm for track rod N/S.
44.	Key for arm.
45.	Nut for arm.
46.	Draglink.
47.	End assembly for draglink (rear).
48.	End assembly for draglink (front).
49.	Dust excluder.
50.	Nut for ball pin.
51.	Lubricating nipple.
52.	Lubricating nipple.
53.	Locknut for ends.
54.	Steering arm.
55.	Key for steering arm.
56.	Nut for steering arm.
58.	Shock absorber eyebolt.
59.	Nut for eyebolt.

sharply, and the ball pin should drop from its taper seating. If the ball pin is stubborn, support the steering arm with a block of wood, and tap downwards on the end of the pin and the nut to drive the taper pin from its seating. The securing nut may now be removed and the draglink ball pin withdrawn from the arm.

Disconnect the shock absorber links by unscrewing the securing nuts from the axle beam and driving the fixing bolts to the rear.

Note.—It is not necessary to remove the shock absorber body from the chassis.

Slacken off the locknuts on the spring " U " bolts, and then unscrew both the nuts and the locknuts together.

Raise the car from the axle beam, which may be lifted clear and removed for further dismantling.

To replace the front axle the procedure for dismantling should be reversed.

Note.—The front spring 3° castor plates are fitted with the thick end to the front.

IMPORTANT.—The brakes require bleeding after reassembly, before the vehicle is taken on the road. (See Section L.13).

Section I.5

REMOVAL AND REPLACEMENT OF STEERING KNUCKLE BUSHES

Remove the swivel pins as detailed in Section I.3.

Drive out the original bushes, using a punch of suitable size or the special extractor, Part No. 55418.

Press in the new bushes, until the end of each bush is flush with the internal faces of the steering knuckle.

When in position the bushes must be reamed in line with the special spiral-fluted reamer, Part No. 39009.

The swivel pins must be a push fit in their bushes.

Section I.6

CHECKING AND SETTING WHEEL ALIGNMENT (Toe-in)

The correct alignment for the front wheels is with $\frac{1}{8}$ in. (3.2 mm.) toe-in.

Check the tyre pressures.

Turn the front wheels to the straight ahead position.

Position the trammel pointers to the wheel centre height.

Place the trammel at the rear of the front wheels and adjust it longitudinally so that both pointers register against the outside rim of each wheel. Mark the position of the pointers on both wheels with chalk, withdraw the trammel and then push the car forward half a wheel revolution.

Place the trammel in front of the wheels, so that one point registers with the chalk mark on one of the wheels. For the alignment to be correct, the other pointer should stand an $\frac{1}{8}$ in. (3.2 mm.) away from the mark on the other wheel.

Should it not do so, adjust the track by slackening the locknut of both the track rod ball ends, and turn the track rod in the required direction until the correct toe-in of $\frac{1}{8}$ in. (3.2 mm.) is obtained. (The track rod is made with right- and left-hand threads to enable this operation to be carried out without the removal of the ball ends.) When making adjustments remember that they are doubled, that is to say adjustment of the rim $\frac{1}{16}$ in. (1.6 mm.) in one direction makes a similar increase of the opposite portion of the rim in the other direction, making an alignment adjustment of $\frac{1}{8}$ in. (3.2 mm.).

Important.—Do not omit to retighten the locknuts and to ensure that the top surfaces of the ball joints are in the same plane. Should they not be so, cross binding and steering stiffness will be present.

Note.—The track rod is fitted underneath the track rod arms with the left-hand thread on the nearside and the grease nipples to the front of the car.

SECTION J

THE STEERING GEAR

GENERAL DESCRIPTION

The steering gear is of the Bishop cam and lever type with a ratio of 11 to 1. The cam portion takes the form of a worm on the end of the steering mast running in ball bearings. The rocker-shaft is mounted in the steering gearbox housing, and a lever integral with the shaft carries a conical peg which is in engagement with the cam. The peg does not contact the bottom of the cam groove, and adjustment for wear is effected by adjusting the depth of the engagement. This is done on current design by means of a set screw, in the side plate, bearing on a hardened block in the rocker-shaft. On earlier models the adjustment was carried out by the removal or addition of shims between the side cover plate and the steering gearbox.

All the working parts are immersed in oil.

A felt bush fitted in the top of the steering column outer tube serves as a third steady bearing for the steering mast. The steering drop arm is attached to the rocker-shaft by a tapered spline and retaining nut on the later models, but on the earlier types a drop arm with a split boss and pinch bolt, fitting on to parallel splines, was employed.

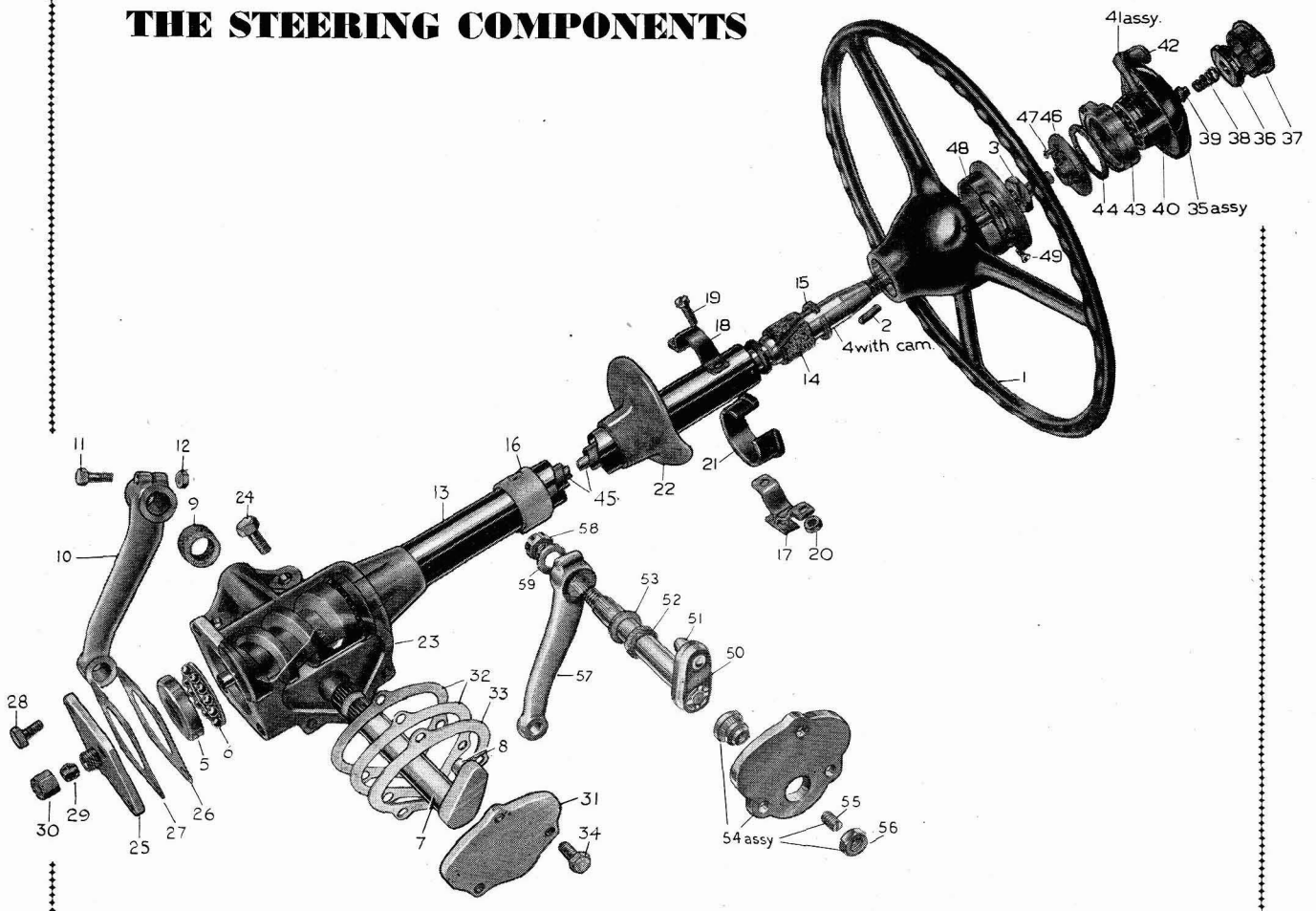
Connection to the axle steering lever is by means of a draglink with ball and socket type joints.

MAINTENANCE

A spring cover is provided on the steering column, which should be moved aside every 500 miles (800 km.) and oil introduced into the opening exposed until the gearbox is filled. Use N.O.L. "E.P." Transmission Oil 140. Grease must not be used under any circumstances.

Check that the steering drop arm and the ball ends are tight and held securely by their nuts, and also that the bolts securing the steering box to the frame are tight.

THE STEERING COMPONENTS



No.	Description
1.	Steering wheel.
2.	Key for steering wheel.
3.	Nut for steering wheel.
4.	Mast, with cam.
5.	Ball cup for cam.
6.	Ball cage with balls.
7.	Rocker-shaft with peg.
8.	Peg.
9.	Felt washer.
10.	Drop arm (parallel splines).
11.	Clamp bolt for drop arm.
12.	Nut for clamp bolt.
13.	Column tube.
14.	Felt bush (top end).
15.	Retaining ring for felt bush.
16.	Clip for oil filler.
17.	Bracket (column to facia).
18.	Clamp for bracket.
19.	Bolt for clamp.
20.	Nut for clamp bolt.
21.	Packing for clamp.
22.	Ferrule (rubber).

No.	Description
23.	Steering box.
24.	Bolt (steering box to frame).
25.	Bottom end cover.
26.	Shim for bottom end cover, .0024 in. (.06 mm.).
26.	Shim for bottom end cover, .005 in. (.13 mm.).
26.	Shim for bottom end cover, .010 in. (.25 mm.).
27.	Joint for bottom end.
28.	Bolt for end cover.
29.	Olive.
30.	Nut for olive.
31.	Side cover.
32.	Side cover shim, .0024 in. (.06 mm.).
32.	Side cover shim, .005 in. (.13 mm.).
32.	Side cover shim, .010 in. (.25 mm.).
33.	Joint for side cover.
34.	Bolt for side cover.
35.	Top cover assembly.
36.	Button (horn push).
37.	Retainer for button.

No.	Description
38.	Spring for button.
39.	Spacer for spring.
40.	Base assembly (indicator switch).
41.	Lever assembly (indicator switch).
42.	Lever knob for indicator switch.
43.	Striker ring.
44.	Felt for striker ring.
45.	Stator tube.
46.	Clamp plate for stator tube.
47.	Bolt for clamp plate.
48.	Locating ring (with screw).
49.	Locating ring screw.
50.	Rocker-shaft with peg.
51.	Peg for rocker-shaft.
52.	Cork washer.
53.	Retainer for cork washer.
54.	Side cover assembly.
55.	Adjusting screw for rocker-shaft.
56.	Locknut for adjusting screw.
57.	Drop arm (taper spline).
58.	Rocker-shaft slotted nut.
59.	Washer for rocker-shaft (plain).

Section J.1

REMOVAL AND REPLACEMENT OF STEERING WHEEL

Disconnect the positive battery terminal.

Separate from the snap connectors, coupling them to the harness cable, the four trafficator and horn wires which lead from the centre of the steering box bottom end cover. Unsolder and remove the four end caps from the wires.

Withdraw the rubber sheathing from the cable, and slacken off the brass hexagon nut on the steering gearbox end plate. Carefully ease the bottom end of the stator tube upwards through the nut and olive nipple. When released, the stator tube and trafficator switch assembly can be pulled upwards into the body of the car two or three inches (5 to 7 cm.).

Note.—A suitable container should be placed to catch the steering gear oil, which is free to fall from the gearbox through the olive locknut.

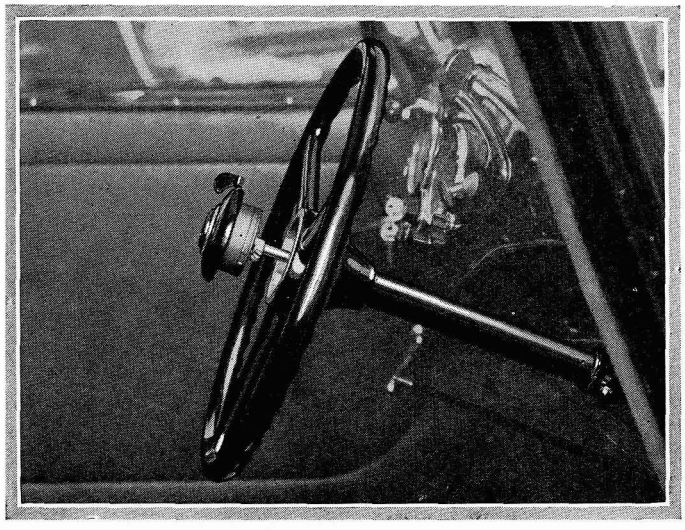


Fig. 70.
This clearly shows the position of the combined horn and trafficator switch clamp screw. On later models with spring wheel the trafficator switch is attached to a flange on the stator tube by three countersunk screws.

Slacken the cheese-headed clamp screw locating the base plate of the combined horn push and trafficator assembly to the stator tube. The switch assembly complete with its harness cable may now be withdrawn from the column.

Push the stator tube back into the steering mast, and through the olive nipple and brass hexagon nut at the base of the steering column, and remove the steering wheel retaining nut, using a $\frac{7}{8}$ in. box spanner. The steering wheel may now be withdrawn with the aid of the special tool used for steering knuckle pin extraction (Part No. 55418) with its special attachment (Part No. 56052) (see Fig. 71).

Reassembly is a reversal of the above procedure, but after the steering wheel has been replaced on the mast the trafficator trip locating ring should be reset before the switch assembly is replaced on the stator tube. To do this, set the front road wheels to the straight-ahead position, release the lock screw, whose head protrudes through the side of the bowl of the wheel, and rotate the trip locating ring until the knock-off cam is positioned at the bottom of the wheel (the 6 o'clock position). Tighten the lock screw.

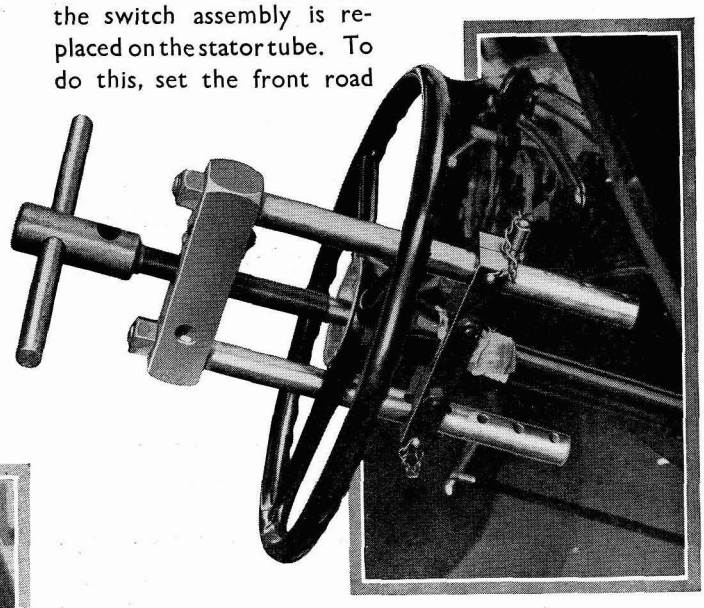


Fig. 71.
The steering wheel is removed by the aid of the steering knuckle pin extractor, Part No. 55418, and attachment, Part No. 56052.

The trafficator and horn wires are now threaded into the stator tube, which is again pushed up two or three inches into the car. Replace the switch assembly and tighten the clamp screw with the trafficator switch operating lever pointing to the top of the steering wheel, and the yoke of the striker ring over the knock-off cam of the trip locating ring. The stator tube and switch assembly is then pushed home. Care must be exercised to see that sufficient clearance is given to prevent the base plate of the switch assembly fouling the steering wheel.

The brass hexagon olive nut is now tightened on its sleeve, over the olive on the lower end of the stator tube.

Note.—During this operation an assistant should hold the switch assembly to prevent its being turned from the correct position.

Replace the rubber tubing, resolder the terminals to the four wires, and reconnect the snap connectors. Replace the battery lead.

Section J.2

REMOVAL AND REPLACEMENT OF STEERING COLUMN BUSH

Remove the steering wheel as detailed in Section J.1.

Pull out the old felt bush.

Apply graphite to the side of the felt which makes contact with the steering mast before attempting to assemble it.

Fit the new felt by inserting a corner between the mast and the outer tube. The remainder of the felt can then be inserted by the aid of a screwdriver and carefully pushed into the annular space.

Refit the steering wheel.

Section J.3

REMOVAL AND REPLACEMENT OF THE DROP ARM

Taper spline type

Remove the split pin, slotted nut and flat washer securing the steering drop arm to the rocker-shaft.

Pull the drop arm off the splines, using an extractor (special tool, Part No. 56347).

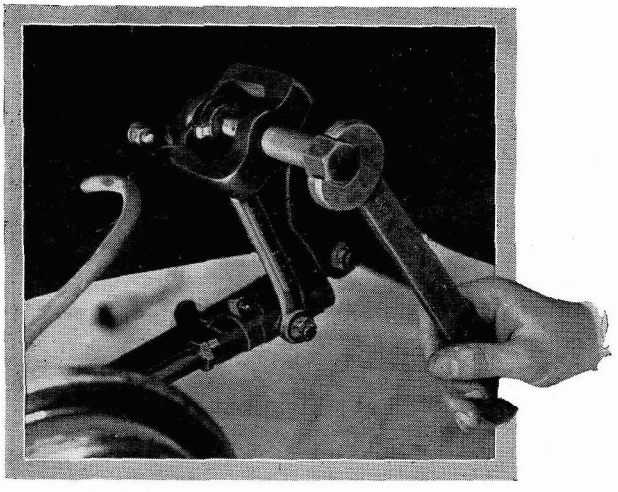


Fig. 72.
To remove the drop arm a special extractor should be employed.

Parallel spline type

Remove the nut, shakeproof washer and clamp bolt from the split end of the drop arm.

Withdraw the drop arm from the steering gearbox shaft, using a suitable extractor.

Replacement is the reversal of the above procedure.

Important. When replacing the drop arm on the rocker-shaft, it is essential that it is fitted to the correct spline. The end of the rocker-shaft and the face of the drop arm boss are marked for this purpose.

Section J.4

TAKING UP BACKLASH WITH THE STEERING GEAR IN POSITION

Turn the steering wheel until the road wheels are in the straight-ahead position. **This is important.**

Disconnect the draglink from the drop arm.

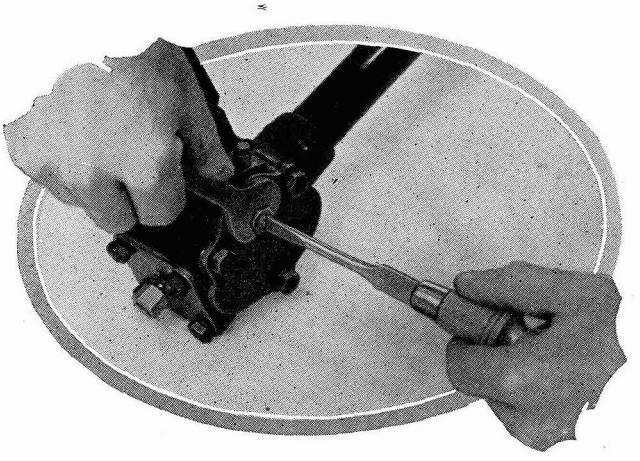


Fig. 73.
The method of adjustment for the steering gearbox on the current models by means of a hardened screw bearing on the end of the rocker-shaft is here shown.

Slacken the locknut, and screw up the rocker-shaft adjusting screw until all play is taken up when the drop arm is in the central position.

Note.—This screw must only be finger-tight.

In the case of earlier models without an adjusting screw, the side plate must be removed and the brass shims removed one at a time until the backlash between the cam and the rocker is just taken up.

Test for slackness by holding the lower end of the drop arm with the forefinger and thumb, and exerting light pressure alternately in both directions while the steering wheel is maintained in the straight-ahead position, when no backlash should be discernible.

It will be noted, however, that when the wheel is moved from lock to lock, the amount of slackness is not the same in all positions, there being no slackness in the centre, but an increasing amount towards the extreme lock positions. If slackness appears at **all** positions of the drop arm, further adjustment must be made. Test again in the same manner. When the correct adjustment has been made, a " high spot "

will be noticed as the steering wheel is moved past the central position, and at this " high spot " no backlash can be felt on the drop arm. When this " high spot " can be felt as a very slight drag on the steering wheel the gear is correctly adjusted and the locknut must be tightened up.

Note.—It is important that the rocker-shaft adjusting screw is not allowed to turn while the locknut is being tightened if the adjustment is to remain at its correct setting.

Replace the draglink on the end of the drop arm.

Section J.5

REMOVAL AND REPLACEMENT OF STEERING GEARBOX

Disconnect the battery by removing the positive cable lug from its terminal post after slackening the $\frac{1}{4}$ in. pinch bolt.

Drain the radiator by means of the drain tap located at the near-side of the radiator bottom tank. If " Bluecol " or other anti-freeze mixture is being used it should be drained into a suitable clean container and carefully preserved for re-use.

Detach the radiator mask by removing the two countersunk-headed metal threaded screws, nuts and spring washers locating the radiator core to the mask. *Undo the ten* $\frac{3}{16}$ *in. set screws with spring washers and* plain steel washers locating the radiator mask to the front wing valances.

Undo the $\frac{5}{16}$ in. locknuts and nuts with plain steel washers from the two radiator foundation studs which pass through the front chassis cross-member. Release the clips on the top and bottom water hoses and separate the hoses from their connections. Remove the radiator core.

Remove the steering wheel as in Section J.1.

Release the bracket locating the steering column to the glove tray by undoing the two $\frac{3}{16}$ in. fixing bolts and nuts equipped with spring washers.

Remove the accelerator Bowden wire control bracket from the steering column by undoing the $\frac{3}{16}$ in. clamp bolt. Remove the accelerator pedal and bracket assembly by removing the two $\frac{3}{16}$ in nuts and spring washers on the pedal bracket locating " U " bolt.

Raise the off-side front wheel clear of the ground and remove the road wheel. Withdraw the drop arm as in Section J.3.

Remove the electric horn by undoing the $\frac{5}{16}$ in. fixing bolt nut and spring washer.

Remove the steering gearbox side cover by undoing the three $\frac{1}{4}$ in. bolts with spring washers, catching the oil in a suitable container. Do not lose the shims on the older type box having this method of adjustment. Extract the rocker-shaft.

Undo the two $\frac{5}{16}$ in. bolts and nuts with spring washers locating the steering gearbox to the front dumb iron.

The steering gearbox and column assembly is now pushed towards the interior of the car until the steering gearbox is clear of the Lockheed brake pipe, when the assembly may be lowered between the chassis side member and the engine.

The assembly is then extracted from under the front of the car.

Reassembly of the steering gear to the chassis is the reverse of the above procedure, but care must be taken when refitting the drop arm to ensure that the mark on the rocker-shaft comes directly in line with the mark on the drop arm.

If the rubber draught excluder is removed from the column, remember to replace it before the steering gearbox assembly is refitted to the chassis.

Section J.6

DISMANTLING THE STEERING GEAR

Withdraw the drop arm as in Section J.3.

Remove the side cover and drain off the oil.

Withdraw the rocker-shaft.

Remove the bottom end cover.

It is necessary to remove the steering wheel locking key from the top of the mast before the mast is pushed

Fig. 74.
Showing the rocker-shaft partly withdrawn.

from its position, as it fouls the felt bush at the top of the column.

Extract the steering mast with cam by pushing downwards. The lower ball cup will thus be forced out of the steering box, and the steering mast with the cam can be removed complete with the ball cup and the two ball cages.

Section J.7

EXAMINING PARTS FOR WEAR

Thoroughly clean the steering gearbox, and examine the rocker-shaft housing for wear. Examine the rocker-shaft on its shank for wear and renew if badly worn. Check the splines, if they are twisted the rocker-shaft must be renewed. At the end of the rocker-shaft arm is a conical peg, which must be free from flats and shoulders. The peg is replaceable and if worn should be tapped out of the lever and a new one fitted.

Examine the cam for excessive wear in the grooves, and also the ball tracks machined at each end of the cam for any signs of pitting. If the cam is defective for either of these reasons, the cam and steering mast must be renewed.

Examine the ball cups for pitting in the ball tracks, and if necessary, renew them.

When the steering mast and cam is reassembled in the steering gearbox housing, and the ball cages and races have been replaced and the end cap refitted and tightened, should there be any end float of the mast, shims must be removed from beneath the end plate to eliminate it in the case of the original type of box with shim adjustment. After fully tightening the bolts the column must be free to rotate, but should possess no end float.

Any side play at the top of the steering mast may be eliminated by fitting a new felt bush.

Section J.8

REASSEMBLING THE STEERING GEAR

See that all parts are clean and dry.

See that the inner ball cup is in position at the top of the steering gearbox, and that the top ball cage is on the steering mast against the cam. It is important that the ball cage is fitted the correct way round, which is with the concave side of the cage towards the cam.

Insert the steering mast and cam into position against the ball cage and cup.

Note.—The position of the anti-vibration rubber ring on the mast must be such that it is above the level of the oil filler hole in the outer column.

Insert the other ball cage and cup in the bottom of the box, ensuring that this ball cage is also fitted in the above manner.

Replace the shims, paper joint, end cover, spring washers and bolts.

Hold the steering box in a vice so that the column is horizontal, fit the steering wheel temporarily and test for end float. Remove shims if necessary to eliminate any end float that may be present, but ensure that the column is free to rotate after finally tightening the end plate bolts.

Fit the steering gearbox assembly into the chassis as in Section J.5.

Insert the rocker-shaft complete with peg. Replace the side cover and rocker adjusting nut assembly.

Fit the drop arm temporarily without the nut, by lightly tapping it on to the tapered splines of the rocker-shaft. The steering gear may now be adjusted by means of the thrust screw, or shims, as already detailed under Section J.4.

Remove the steering wheel and refit the felt bush at the top of the column as detailed in Section J.2.

If the shaft is excessively slack the felt bush should be renewed.

Replace the steering wheel, refit the trafficator and horn push assembly, and adjust the trafficator trip, as in Section J.1.

Refill the steering gearbox with oil, introduced through the hole provided in the steering column.

Fit the rocker-shaft nut to the end of the rocker-shaft, and seeing that it is in its correct position, tighten the nut.

Section J.9

STEERING IRREGULARITIES

When checking over the steering or greasing, always jack up the front axle.

Examine for loose spring clips and eliminate all side play in the spring shackles at each end of the front and rear springs.

Check for wear.

Check for alignment.

SECTION K

THE HYDRAULIC DAMPERS

GENERAL DESCRIPTION

The hydraulic dampers are of the Armstrong double-acting self-regulating hydraulic vertical cylinder type and all the working parts are submerged in oil.

MAINTENANCE

The maintenance of the hydraulic dampers in position on the vehicle is confined to a periodical examination of the anchorage to the chassis, the fixing bolts being tightened up as required.

For replenishing the fluid at every 10,000 miles (16,000 km.) the dampers **must be removed from the chassis.**

Should wear have taken place in the rubber bearings the link assembly should be renewed. This operation may be carried out with the damper in position.

To prevent leaks it is essential to ensure that the six cheese-headed screws securing the cover-plate to the body of the damper are kept fully tightened.

No adjustment of the dampers is required or provided for ; any attempt to dismantle the piston assembly will seriously affect the operation and performance.

Section K.1

TESTING A HYDRAULIC DAMPER

If there is any doubt that the road springs are adequately damped, the conditions of the springs and the tyre pressures should also be considered, as these have an appreciable bearing on the results obtained.

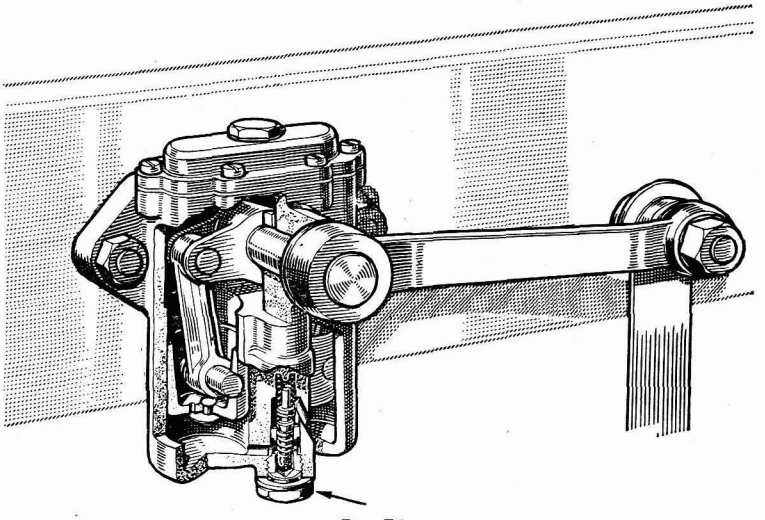


Fig. 75.

The Armstrong double-acting hydraulic shock absorber.

K THE HYDRAULIC DAMPERS

If the hydraulic dampers do not appear to function satisfactorily, an indication of their resistance can be obtained by carrying out the following check :—

Remove the dampers from the chassis.

Place them in a vice (holding them by the fixing lugs to avoid distortion of the cylinder body).

Move the lever arm up and down through its complete stroke. A moderate resistance throughout the full stroke should be felt ; if, however, the resistance is erratic and free movement in the lever arm is noted, lack of fluid is indicated.

If the addition of fluid (added to the level given in Section K.2) gives no improvement, a new damper should be fitted.

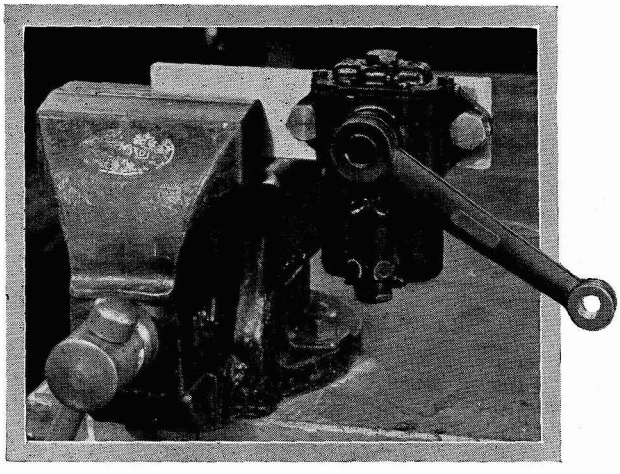


Fig. 76.
When holding the hydraulic dampers in a vice, do so by the fixing lugs as shown and *not* by the body.

Too much resistance, i.e. when it is not possible to move the lever arm slowly by hand, indicates a broken internal part or a seized piston ; in such cases the damper should be changed.

Section K.2

TOPPING UP WITH FLUID

Remove the damper from the chassis. **This is important in order to avoid the possibility of dirt finding its way into the damper.**

Before removing the filler plug (located on the top of the damper) carefully clean the exterior of the damper, especially in the vicinity of the filler plug. This is most important, as it is vital that no dirt or foreign matter should enter the operating chamber.

Use only " Armstrong " super shock absorber oil, which is the correct fluid.

When fluid has been added the lever arm should be worked throughout its full stroke to expel any air that might be present in the operating chamber before the filler plug is replaced.

The interior of the body should be filled with fluid to within $\frac{3}{8}$ in. (9.5 mm.) from the top of the cover. Any shortage of fluid beneath the pistons is instantly automatically made good through the recuperating valve.

Fig. 77.
When testing the hydraulic dampers it is essential to move the lever arms through their full travel.

Section K.3

REPLACEMENT OF THE DAMPER

When handling dampers that have been removed from the chassis for any purpose, it is important to keep the assemblies upright as far as possible, otherwise air may enter the operating chamber, resulting in free movement.

Note.—Before fitting the link to the attachment on the axle, it is advisable to work the lever arm a few times through its full range of movement to expel any air which has found its way into the operating chamber.

SECTION L

THE BRAKING SYSTEM

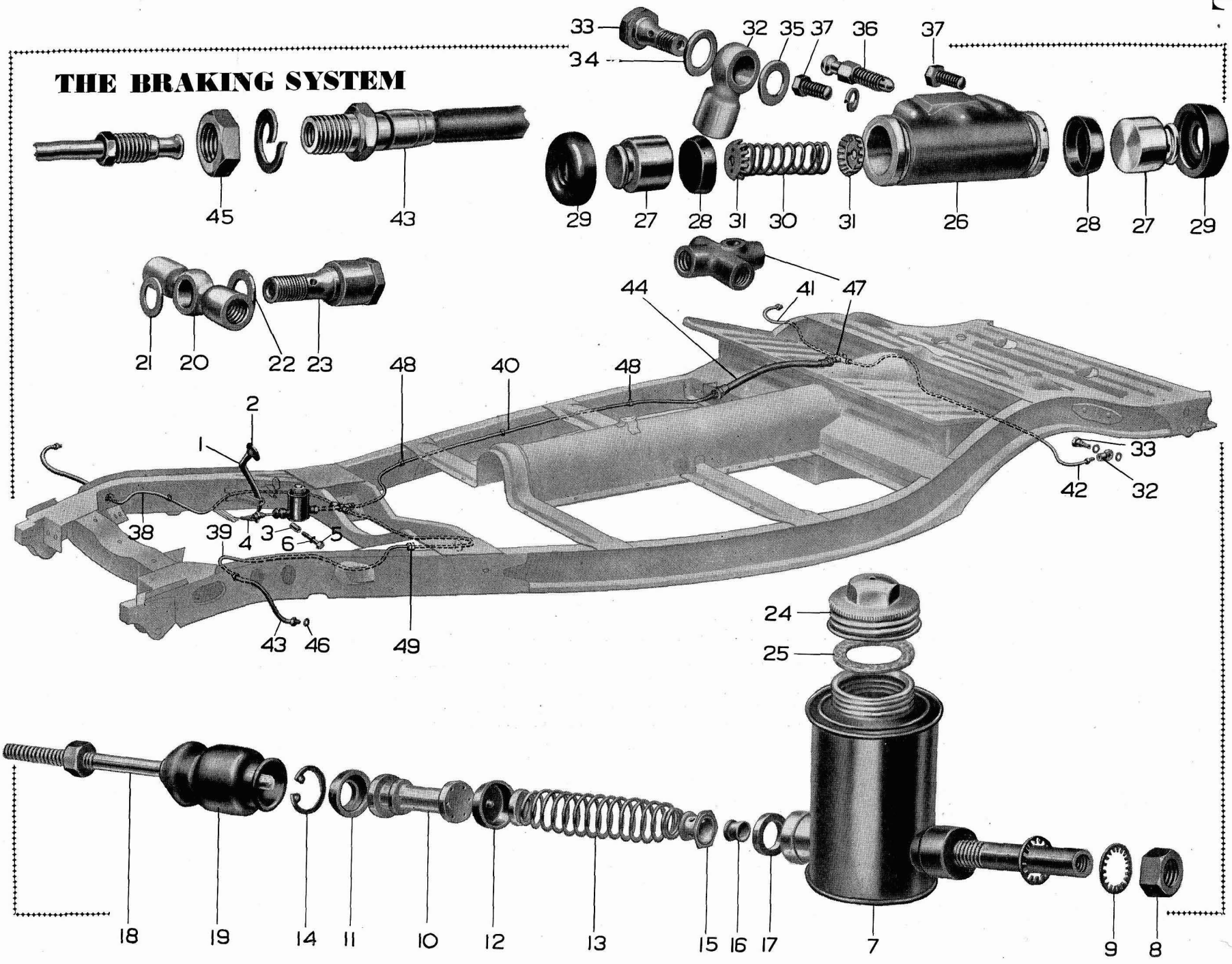
GENERAL DESCRIPTION

The Lockheed hydraulic brake operating equipment comprises a combined fluid supply tank and master cylinder, in which the hydraulic pressure is generated ; wheel cylinders which operate the brake-shoes ; and pipe lines, consisting of steel or copper tubes, flexible hoses and unions, which are interposed between the master cylinder and wheel cylinders to convey the hydraulic pressure.

MAINTENANCE

1. Periodically examine the fluid level in the combined master cylinder and supply tank. This should remain constant for a long period at the correct level of approximately $\frac{1}{2}$—1 in. (10—20 mm.) below the filler cap. The necessity for frequent topping up is an indication of over filling or a leak in the system, which should at once be traced and rectified.

THE BRAKING SYSTEM



KEY TO THE HYDRAULIC BRAKE COMPONENTS

No.	Description
1.	Brake pedal.
2.	Pad for brake pedal.
3.	Bush.
4.	Pull-off spring.
5.	Bolt to frame brace.
6.	Shakeproof washer.
7.	Barrel and supply tank assembly.
8.	Head nut.
9.	Shakeproof washer.
10.	Piston.
11.	Secondary cup.
12.	Cup.
13.	Return spring and retainer.
14.	Circlip.
15.	Valve body.
16.	Cup (valve body).
17.	Washer (valve body).
18.	Push-rod assembly.
19.	Boot (rubber).
20.	Outlet connection (two-way).
21.	Washer for outlet connection (small).
22.	Washer for outlet connection (large).
23.	Bolt for outlet connection.
24.	Filler cap assembly.
25.	Washer for filler cap.
26.	Wheel cylinder (only).
27.	Piston.
28.	Cup.
29.	Boot.
30.	Spring.
31.	Crown spring.
32.	Inlet connection (rear cylinder).
33.	Bolt for inlet connection.
34.	Washer for inlet connection (large).
35.	Washer for inlet connection (small).
36.	Bleeder screw.
37.	Fixing screw for cylinder.
38.	Pipe (master cylinder to O/S front).
39.	Pipe (master cylinder to N/S front).
40.	Pipe (master cylinder to rear hose).
41.	Pipe (three-way connection to O/S rear).
42.	Pipe (three-way connection to N/S rear).
43.	Hose assembly (front).
44.	Hose assembly (rear).
45.	Union nut for hose assembly.
46.	Washer for union nut.
47.	Three-way connection.
48.	Clip (pipe to side member).
49.	Ferrule (through cross-member).

2. Adjust the brake-shoes to compensate for wear of the linings. The need is shown by the pedal going down almost to the floorboards before solid resistance is felt. For foot brake adjustments see Section L.12.

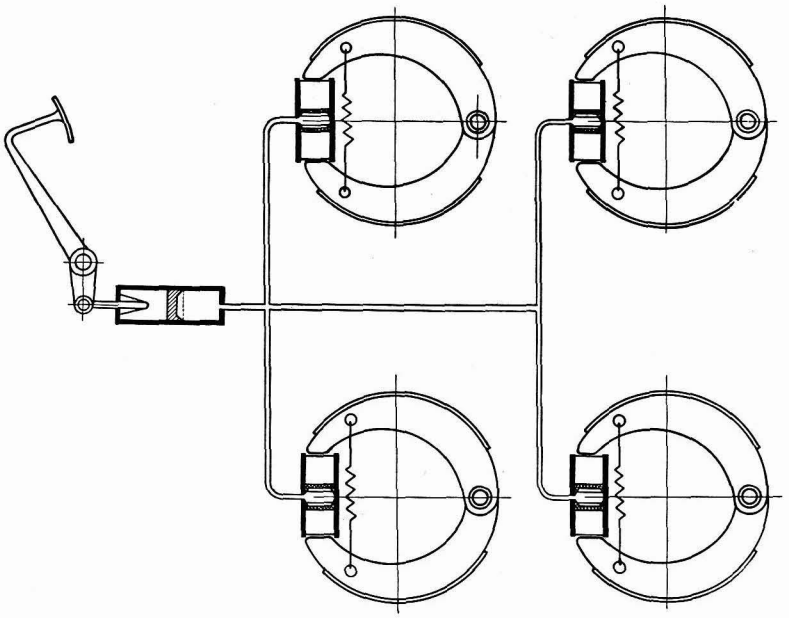


Fig. 78.
Shows the layout of the hydraulic braking system in diagrammatic form. It will be noted that the pressure generated by the master piston operated by the brake pedal is applied at similar pressure to all four brake-shoe cylinders.

THE MASTER CYLINDER

The master cylinder is mounted on the off-side of the chassis behind the foot brake pedal.

Within the cylinder is a piston, backed by a rubber cup, normally held in the "off" position by a piston return spring. Immediately in front of the cup, when it is in the "off" position, is a compensating orifice connecting the cylinder with the fluid supply. This port allows free compensation for any expansion or contraction of the fluid, thus ensuring that the system is constantly filled ; it also serves as a release for additional fluid drawn into the system during brake applications. Pressure is applied to the piston by means of the push-rod attached to the brake pedal. The push-rod is adjustable and should have a slight clearance when the system is at rest to allow the piston to return fully against its stop. Without this clearance the main cup will cover the by-pass port, causing pressure to build up within the system, resulting in binding brakes on all wheels controlled by the master cylinder. The reduced skirt of the piston forms an annular space which is filled with fluid from the supply tank via the feed hole. Leakage of fluid from the open end of the cylinder is prevented by the secondary cup fitted to the flange end of the piston. On releasing the brake pedal after application the piston is returned quickly to its stop by the return spring, thereby creating a vacuum in the cylinder ; this vacuum causes the main cup to collapse and pass fluid through the small holes in the piston head from the annular space formed by the piston skirt. This additional fluid finds its way back to the reserve supply under the action of the brake return springs, when the system finally comes to rest, through the outlet valve and compensating orifice. If the compensating orifice is covered by the piston cup when the system is at rest, pressure will build up as a result of brake application. The combination inlet and outlet check valve in the head of the cylinder is provided to allow the passage of fluid under pressure from the master piston into the pipe lines, and control its return into the cylinder, so that a small pressure of approximately 8 lb. per square inch (.56 kg./cm.^{2}) is maintained in the pipe lines to ensure that the cups of the wheel cylinders are kept expanded ; it also prevents fluid pumped out from the cylinder "when bleeding" from returning to the cylinder, thus ensuring a fresh charge being delivered at each stroke of the pedal. The open end of the cylinder is sealed by a rubber boot.

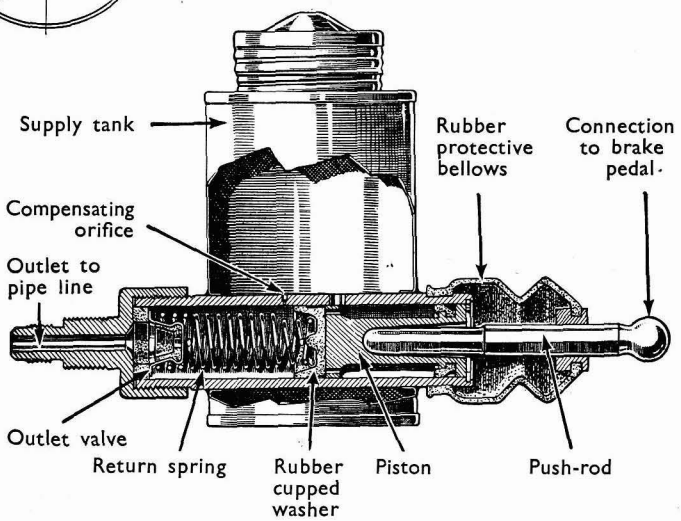


Fig. 79.
The combined master cylinder and fluid supply tank fitted to the hydraulic brake system of the Morris Eight sectioned to show its construction.

Section L.1

ADJUSTMENT OF THE BRAKE PEDAL

The correct amount of free movement between the master cylinder push-rod and piston is set during the erection of the vehicle, and should never need alteration.

In the event of the adjustment having been disturbed, adjust the effective length of the rod connecting the cylinder to the pedal until the pedal pad can be depressed approximately $\frac{1}{2}$ in. (13 mm.) before the piston begins to move. The clearance can be felt if the pedal is depressed by hand.

Note.—Before making any alteration it is important to ensure that neither the floorboard nor the floor carpet obstruct the pedal and that the piston has not stuck in the cylinder bore. In either case a false impression will be given, even though the adjustment is correct.

Section L.2

REMOVAL OF THE MASTER CYLINDER

Remove the rear brake supply pipe, and the off-side and the near-side front brake supply pipes from the master cylinder outlet connection, catching any fluid discharged in a clean receptacle.

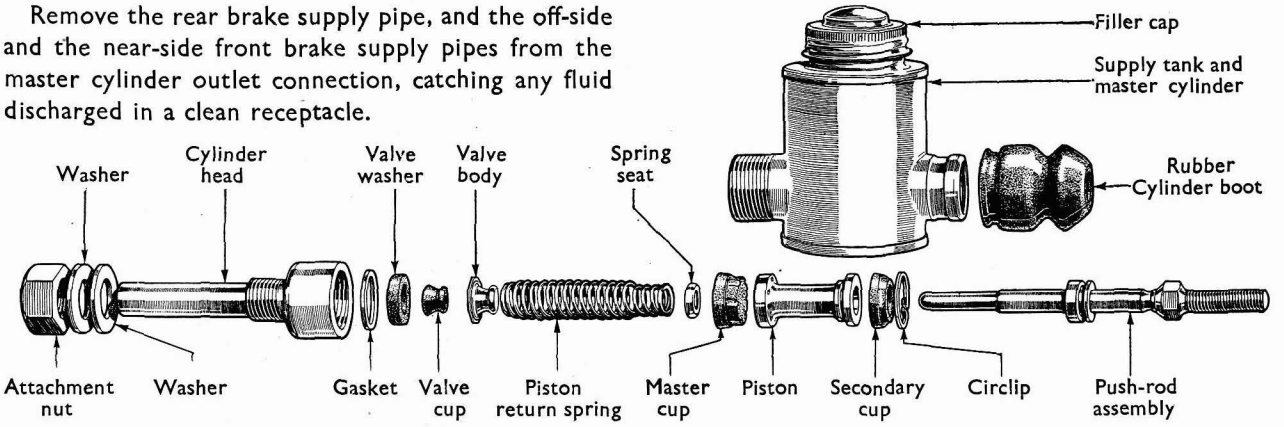


Fig. 80.
The component parts of the master cylinder and supply tank unit.

Remove the master cylinder two-way connection securing bolt, and the two copper washers from the connection.

Remove the brake pedal pull-off spring.

Slacken and remove the brake pedal push-rod locknut.

Unscrew and withdraw the brake and clutch pedal fulcrum pins until the brake pedal is free. Unscrew the push-rod adjuster from the brake pedal and withdraw it from the master cylinder.

Insert a $\frac{5}{8}$ in. box spanner into the chassis cross-member and remove the nut and shakeproof washer securing the master cylinder to the chassis frame.

Note.—A shakeproof washer is fitted on each side of the cross-member.

Section L.3

DISMANTLING THE MASTER CYLINDER

Remove the push-rod assembly and rubber boot.

Push the piston down the cylinder bore and remove the circlip. Remove the remaining internal parts, i.e. the piston, the piston master cup, return spring, valve cup assembly, and valve seating washer.

To remove the secondary cup from the piston, carefully stretch it over the end flange, using the fingers only.

Section L.4

ASSEMBLING THE MASTER CYLINDER

Clean all parts thoroughly, using Lockheed hydraulic brake fluid for all rubber components. All traces of petrol, paraffin or trichlorethylene used for cleaning the metal parts must be removed before assembly.

Examine all the rubber parts for damage or distortion. It is usually advisable to renew the rubbers when rebuilding the cylinder.

Dip all the internal parts in brake fluid and assemble them wet.

Stretch the secondary cup over the end flange of the piston with the lip of the cup pointing towards the opposite end of the piston. When the cup is in its groove, work round gently with the fingers to make sure it is correctly seated.

Fit the valve washer, valve cup and body on to the return spring and insert the spring valve first into the cylinder. See that the spring retainer is in position.

Insert the master cup, lip first, taking care not to damage or turn back the lip, and press it down on to the spring retainer.

Insert the piston, taking care not to damage or turn back the lip of the secondary cup.

Push the piston down the bore slightly, and insert the circlip in the groove in the cylinder bore.

Test the master cylinder by filling the tank and by pushing the piston down the bore and allowing it to return ; after one or two applications fluid should flow from the outlet.

Section L.5

REPLACING THE MASTER CYLINDER

Replacement of the master cylinder is carried out in the reverse order to that given in Section L.2, with the following additions :—

Adjust the foot pedal as in Section L.1.

Connect the fluid pipes and bleed the system as in Section L.13.

Check the system for leaks with the brakes fully applied. Renew the copper washers on the two-way outlet connection if necessary.

Section L.6

FRONT AND REAR WHEEL CYLINDERS

The front and rear wheel cylinders are mounted to the brake plate, inside the brake-drum and between the ends of the brake-shoes.

The opposed pistons act directly on to the tips of the brake-shoes. Each piston is backed by a rubber cup, within which is a crown spring expander. These are held in position by the coil spring which also keeps the rubber cups in contact with the piston head. The ends of the cylinder are sealed by a rubber boot against the entry of dirt and water, which may find its way into the brake-drums. The bleeder screw is located at the topmost position of the cylinder assembly, and through this any air in the system can be expelled during the bleeding operation.

The wheel cylinders are of the non-adjustable button piston type.

Section L.7

REMOVAL OF WHEEL CYLINDER

Jack up the vehicle, remove the wheel and brake-drum.

Remove the flexible hose as detailed in Section L.14.

Turn the brake-shoe adjusting nuts until the brake-shoes are fully extended.

Remove the two set screws securing the wheel cylinder to the brake plate and withdraw the cylinder assembly.

Section L.8

DISMANTLING THE WHEEL CYLINDER

Remove the rubber boots.

Withdraw the pistons, rubber cups with crown springs, and the spring.

Section L.9

ASSEMBLING THE WHEEL CYLINDER

Clean all parts thoroughly, using only Lockheed hydraulic brake fluid for the rubber components. All traces of petrol, paraffin or trichlorethylene used for cleaning the metal parts must be completely removed before assembly.

Examine the rubber cups for damage, wear, or distortion.

Dip all parts in brake fluid and assemble wet.

Insert one piston, flat face first.

Insert one rubber cup, flat face first, from the opposite end of the cylinder. Insert the spring complete with its crown springs.

Insert the second cup, lip first, taking care not to turn back or damage the lip of the cup.

Insert the second piston, flat face first, and press down on to the rubber cup.

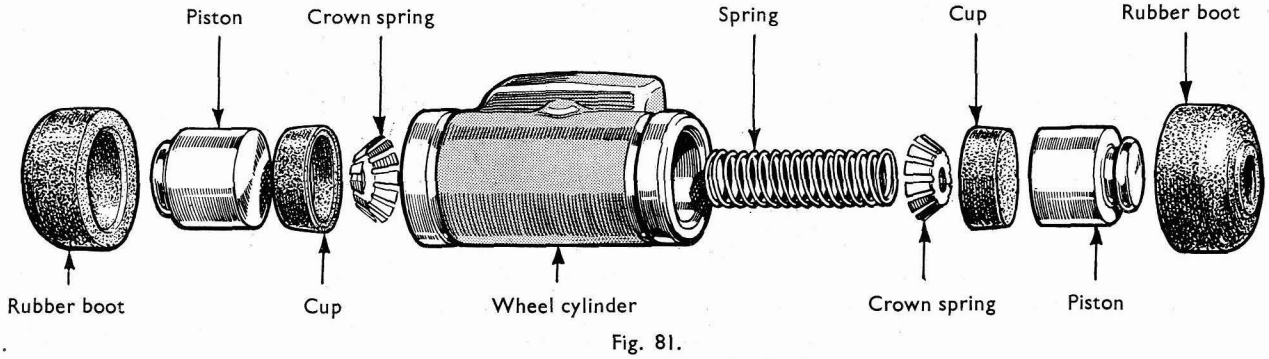


Fig. 81.
The component parts of the wheel cylinders.

Fit the rubber boots into the groove on the end of each piston and then over the end of the cylinder.

Section L.10

REPLACEMENT OF WHEEL CYLINDER

The wheel and brake-drum should be removed when fitting the wheel cylinder.

With the brake-shoes fully extended by means of the adjustment snail cams, fit the wheel cylinder between the shoe-tips and secure in position with the two set screws and spring washers from the outside of the brake plate.

Turn the brake-shoe adjuster to the fully released position.

Refit the flexible hose, or in the case of the rear wheel cylinder, the banjo bolt, using new copper washers to ensure a pressure-tight joint.

Replace the brake-drum.

Adjust the brake-shoes as detailed in Section L.12.

Check the system for leaks with the brakes fully *applied.*

Refit the road wheel.

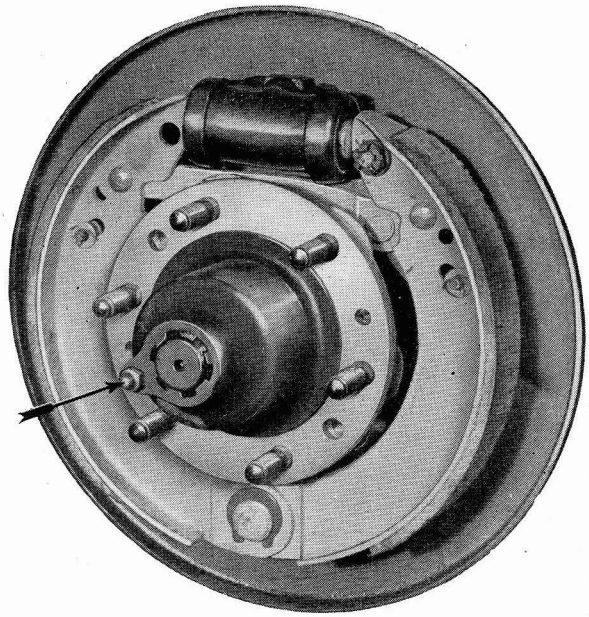


Fig. 82.
The brake assembly.

Section L.11

THE BRAKE ASSEMBLY

The brake-shoes are mounted on a single anchor pin, and a split cotter secures each shoe on its steady pin against a steady pad on the back plate. The brake-shoes are of the normal, fixed type, pivoted at the anchorage end. Incorporated in the rear wheel brakes are the hand brake operating levers, which are operated by cable from the central hand brake lever. The shoe expanding lever, to which the cable is attached, is pivoted close to the tip of the trailing shoe and hangs down behind it. A little below the pivot point and loosely riveted to the lever, there is a cross-strut which bears against the leading shoe. On applying a pull to the lever, the cross-strut forces the leading shoe to contact with the brake-drum. At this point the pivot pin between the lever and the cross-strut becomes the fulcrum and causes the lever to force the trailing shoe into contact with the brake-drum also.

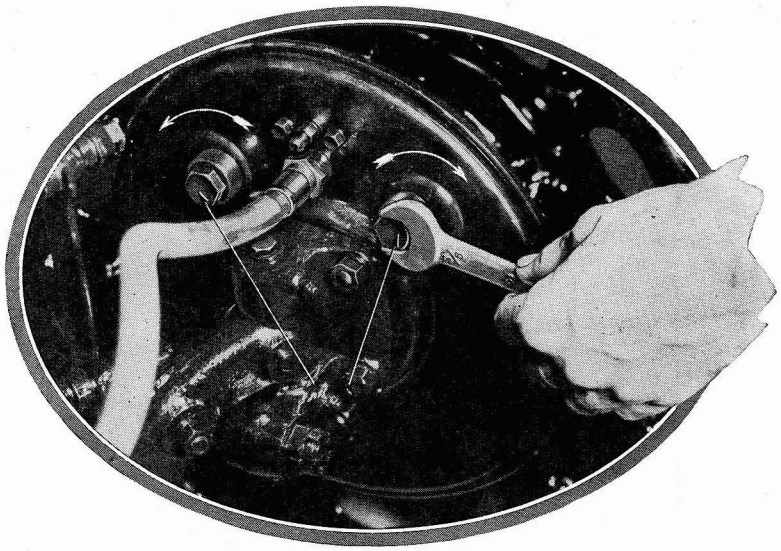


Fig. 83.
Showing the method of adjusting the brake-shoes by applying a spanner to the hexagon head of the adjusting snail cams and rotating them slightly in a direction away from the axle.

Section L.12

FOOT BRAKE ADJUSTMENT

When lining wear has reached a point where the pedal travels to within 1 in. (25 mm.) of the floor-boards before the brakes come into action, it is necessary to adjust the brake-shoes. This is carried out individually at each brake-shoe, as each shoe has a separate adjuster. Proceed as follows :—

Jack up the car until the wheel is clear of the ground. **When adjusting the rear wheel brakes, the hand brake must be in the " off " position.**

Adjust each shoe separately by means of the hexagon adjusters (indicated by arrows in Fig. 83). Rotate the adjuster away from the centre of the wheel, as indicated by the arrows, until the brake-shoe prevents the wheel from turning.

Now turn the adjuster back the slightest possible amount which will allow the wheel to revolve freely.

Note.—In the case of the rear brakes, a slight resistance will be felt from the differential mechanism when turning the wheel by hand, which must be taken into account.

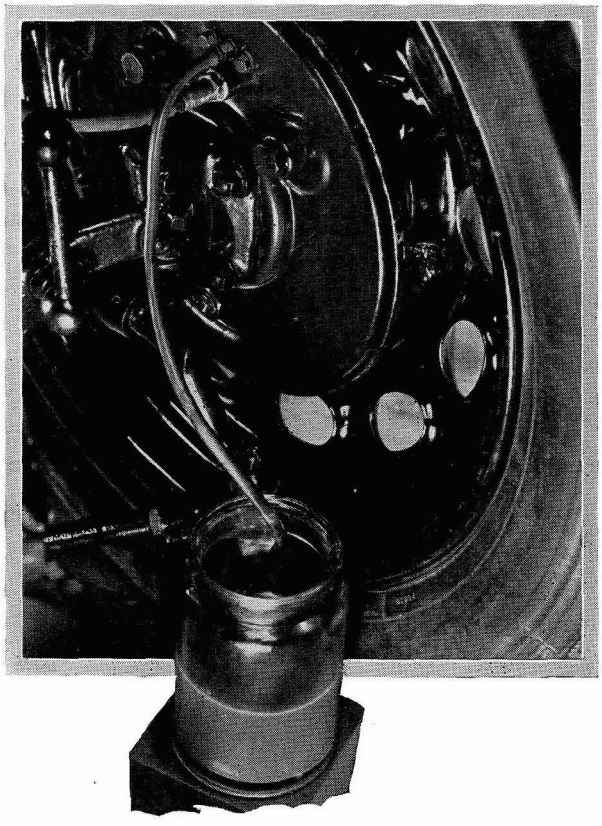


Fig. 84.
The most convenient method of bleeding the brakes.

Repeat this operation with the other adjuster, and this particular brake will be correctly adjusted.

Repeat the above procedure on all the wheels.

Section L.13

TO BLEED THE SYSTEM
(Expel Air)

Bleeding the system is not a routine maintenance job, and should only be necessary when some portion of the hydraulic equipment has been disconnected or the fluid drained off.

Fill the supply tank with Lockheed hydraulic brake fluid and keep it at least half full throughout the operation, otherwise air will be drawn into the system, necessitating a fresh start.

Attach the bleeder tube to the brake cylinder bleeder screw and allow the free end to be submerged in a small quantity of fluid in a clean glass jar.

Open the bleeder screw one full turn.

Depress the brake pedal quickly, and allow it to return without assistance. Repeat this pumping action with a slight pause before each depression of the pedal.

Watch the flow of fluid into the glass jar, and when bubbles of air cease to appear, hold the pedal firmly against the floorboards while the bleeder screw is securely tightened.

Repeat the operation on all the wheel cylinders.

Note.—Clean fluid bled from the system must be allowed to stand some time until it is clear of air bubbles before using it again. Dirty fluid should be discarded.

Section L.14

REMOVAL OF FLEXIBLE HOSE

Do not attempt to release the flexible hose by turning either end with a spanner. It should be removed as follows :—

Unscrew the metal pipe line union nut "A" (Fig. 85) from its connection to the hose.

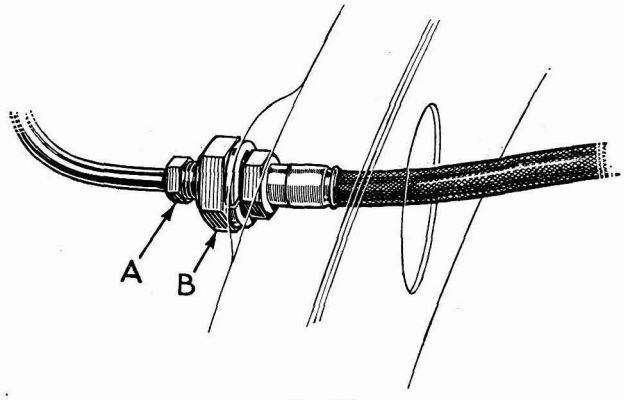


Fig. 85.
When removing the flexible hose it is important not to twist it by applying a spanner to its end unions. The metal supply pipe union should first be released and then the attachment nut for the flexible hose. This will enable it to be withdrawn from its support bracket.

Remove the locknut securing the flexible hose union to the bracket or chassis frame.

Unscrew the hose from the opposite end.

Replacement is carried out by a reversal of the above procedure.

Section L.15

REMOVAL AND REPLACEMENT OF BRAKE-SHOES

Remove the wheel and brake-drum.

Front brakes

Unhook the brake-shoe pull-off spring from the brake-shoes.

Withdraw the circlip from its groove in the shoe anchor pin.

Remove the cotter pin and flat washer from the brake-shoe steady pin of each shoe.

The shoes may now be removed, care being taken not to displace or lose the flat washers remaining on the steady pins and the Thackeray spring washer remaining on the anchor pin.

To refit the brake-shoes, reverse the above sequence of operations, but ensure that the washers are correctly positioned.

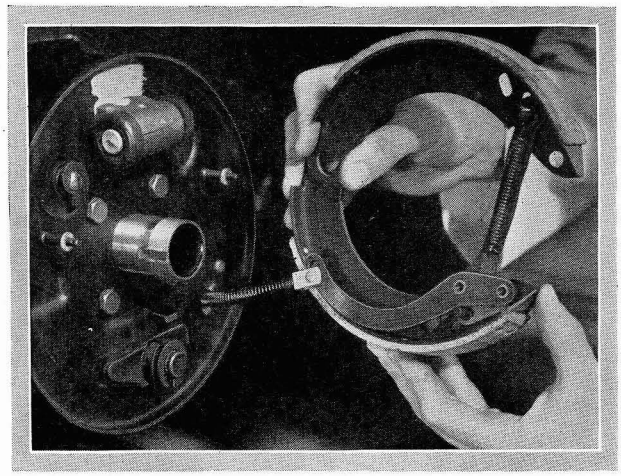


Fig. 86.
Removal of the brake-shoes from the brake plate is easily accomplished after the retaining washers and circlip have been removed.

Rear brakes

Remove the rear hub and bearing housing assembly, as in Section H.1.

Withdraw the circlip from its groove in the shoe anchor pin. Remove the cotter pin and flat washer from the brake-shoe steady pin of each shoe.

The shoes are now free to be withdrawn from the back plate and pivoted clear of the hand brake operating cable yoke. Care should be taken not to displace and lose the flat washers remaining on the steady pins and the Thackeray spring washer remaining on the anchor pin.

Removal of the brake-shoe pull-off spring from its anchor plates will separate the shoes.

To refit the shoes reverse the above sequence of operations, but ensure that the washers are correctly positioned.

Adjust the brakes as in Section L.12.

Section L.16

RELINING THE BRAKE-SHOES

Owing to the need for the brake linings to be finished so that they are perfectly concentric with the brake-drums, in order to obtain the best results, relining of the brake-shoes is not satisfactory without special precautions.

If replacement of the brake-shoes and linings is necessary on account of excessive wear or other cause, it is most important that the material used for the lining is as specified by Morris Motors Ltd. Any variations from this will give an unequal and unsatisfactory braking performance.

After riveting the new brake linings to the brake-shoes it is essential that any high spots should be removed before replacement on the back plate assembly.

When new shoes and linings are fitted it must be appreciated that considerable adjustment has to be made to both hand and foot brake mechanism, and it will become necessary to return both hand and foot adjusters to their " off " position before attempting to refit the brake-drums over the new linings.

IMPORTANT

Do not use any substitute for Lockheed hydraulic brake fluid, as a substitute will seriously affect the working of the system.

Do not allow grease, paint, oil or brake fluid to come in contact with the brake linings.

Do not clean the rubber parts with a fluid that is not Lockheed hydraulic brake fluid. All traces of petrol, paraffin, etc., used for cleaning metal parts must be removed before reassembly.

Do not reline the brake-shoes with different types of linings, as this is bound to cause unequal braking.

Do not allow the fluid in the master cylinder and supply tank assembly to fall below the half-full mark, the correct level is **half an inch (10 mm.) below the filler neck** with the brakes in the " off " position.

Section L.17

FAULT FINDING ON HYDRAULIC BRAKES

Pedal travel excessive (requires pumping)

(*a*) Brake-shoes require adjusting.
(*b*) Leak at one or more joints.
(*c*) Master cylinder cup worn.

Pedal feels springy

(*a*) System requires bleeding.
(*b*) Linings not " bedded-in."
(*c*) Brake-drums weak.
(*d*) Master cylinder fixing loose.
(*e*) Master cylinder cup worn.

Brakes inefficient

(*a*) Shoes not correctly adjusted.
(*b*) Linings not " bedded-in."
(*c*) Linings greasy.
(*d*) Linings poor quality.
(*e*) Drums badly scored.
(*f*) Linings badly worn.

Brakes drag

(*a*) Shoes incorrectly adjusted.
(*b*) Shoe springs weak or broken.
(*c*) Pedal spring weak or broken.
(*d*) Hand brake mechanism seized.
(*e*) Shoes seized on anchor pin.
(*f*) Wheel cylinder piston seized.
(*g*) Locked pipe line.
(*h*) Filler cap vent hole choked.

Brakes remain on

(*a*) Shoes over-adjusted.
(*b*) Hand brake over-adjusted.
(*c*) No free movement on pedal.
(*d*) Compensator port in master cylinder covered by swollen rubber cup, or incorrect adjustment of push-rod.
(*e*) Swollen wheel cylinder cups.
(*f*) Choked flexible hose.

Unbalanced braking

(*a*) Greasy linings.
(*b*) Distorted drums.
(*c*) Front spring broken or loose at its anchorage.
(*d*) Tyres unevenly inflated.
(*e*) Brake plate loose on the axle.
(*f*) Worn steering connections.
(*g*) Worn spring shackles.
(*h*) Different types or grades of lining fitted.

Brakes grab

(*a*) Shoes require adjusting.
(*b*) Drums distorted.
(*c*) Greasy linings.
(*d*) Broken or loose road spring.
(*e*) Scored drums.

Section L.18

THE HAND BRAKE

The hand brake is of the central type with the conventional ratchet and pawl locking device. It operates on the rear wheels only, by means of cables carried in protective casing. These casings are anchored at their rear ends to the brake plates ; in their centres with clips to the chassis frame cross-member ; and at their front ends, in the trunnion of the hand brake assembly.

Passing through the brake plate into the rear brake-drum, the yoke end of each cable engages in the end of the brake-shoe actuating lever. A return spring is located between the yoke and the anchorage of the cable to the brake plate, to return the shoes to the " off " position.

The forward ends of the cables are provided with the orthodox spring-loaded adjusting nuts.

Section L.19

HAND BRAKE ADJUSTMENT

Should the hand brake lack power, or the lever show signs of reaching the end of its travel on the ratchet before the brake-shoes come into operation, readjustment is necessary.

Raise the rear of the car until both wheels are clear of the ground.

Set the hand brake lever to the " off " position, and see that the two wheels rotate quite freely.

Note.—A slight resistance will be felt on the differential mechanism when turning the wheels by hand.

Apply the hand brake until the pawl engages with the fifth notch on the ratchet, and adjust until it is just possible to rotate the wheel by hand under heavy pressure. It is important that the road wheels offer **equal resistance** in order to get full braking power.

Return the lever to the " off " position and check that both wheels are perfectly free. If they are not, remove the brake-drums of the brake that tends to bind, and check that the shoes move freely on their fulcrum and steady pins. Remove any stiffness present, readjust and check.

SECTION M

ELECTRICAL EQUIPMENT

SPECIFICATION OF EQUIPMENT

	Model	*Service No.*
Dynamo	C45YV	228269
Starter	M35G	250405
Ignition Switch ...	PLC6	34040A
Control Box ...	RF95	37081A
Battery	STXW9E	
Distributor ...	DKYH4A	40056B
Ignition Coil ...	6Q6	45016A
Sparking Plug ...	Champion L.10	

BULBS

	Volts	*Watts*	*Lucas No.*
Headlamps, Main (Home)	6	24	106
Headlamps, Main (Export)	6	24/24	168
Headlamps, Pilot (Home and Export)	6	3	200
Stop Tail-lamp	6	3	200
Ignition Warning Light	2.5	0.5	970
Panel Lamp	6	3	990
Trafficators	6	3	255

Section M.1

BATTERY

Note.—Never add tap water to a battery and do not use a naked light when examining the condition of the battery.

Every 1,000 miles (1,600 km.) or more often in hot weather, take out the filler plugs from the top of the battery. Check the level of the electrolyte in each cell and, if necessary, add distilled water to bring the electrolyte level with the top of the separators. A hydrometer will be found useful for topping-up as it prevents the distilled water from being spilled on the top of the battery. If any of the water is spilled, wipe it away and ensure that the top of the battery is clean and dry. Remove any dirt from the holes in the vent plugs with a piece of wire before replacing them.

Clean any corrosion from the battery terminals and smear them with petroleum jelly. Examine the connections to the terminals and make sure that the terminals are secure.

It is advisable to check the state of charge of the battery occasionally by measuring the specific gravity

of the electrolyte in each of the cells by means of a hydrometer.

The specific gravity of the electrolyte in a cell in serviceable condition will rise during a charging period, and fall during discharging.

The specific gravity readings and their respective indications are :—

1.280—1.300	Battery fully charged.
About 1.210	Battery about half discharged.
Below 1.150	Battery fully discharged.

These figures are given assuming an electrolyte temperature of 60° F. (15° C.). If the electrolyte temperature exceeds this, .002 must be added to the hydrometer readings for each 5° F. (2.8° C.) rise to give the true specific gravity at 60° F. (15° C.). Similarly, .002 must be subtracted from the hydrometer readings for every 5° F. (2.8° C.) below 60° F. (15° C.).

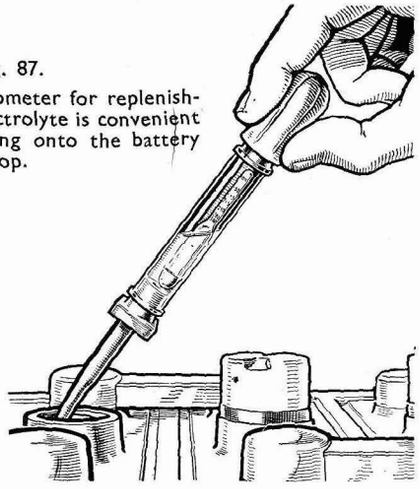


Fig. 87.
The use of a hydrometer for replenishing the battery electrolyte is convenient and prevents spilling onto the battery top.

The readings for all cells should be approximately the same. If one cell gives a reading very different from the rest, it may be that acid has been spilled or has leaked from this particular cell, or there may be a short circuit between the plates. In this case the battery should be returned to a Lucas Service Agent for examination.

When taking specific gravity readings, examine the condition of the electrolyte in the hydrometer. It should be fairly clear. If it is very dirty it is possible that the plates are in a bad condition and the battery should be examined by a Lucas Service Depot or Agent for overhaul.

Never leave the battery in a discharged condition for any length of time. Place it on charge till it is fully charged. A short refreshing charge to prevent any tendency for the plates to become permanently sulphated should be given every fortnight. Arrange this with the owner.

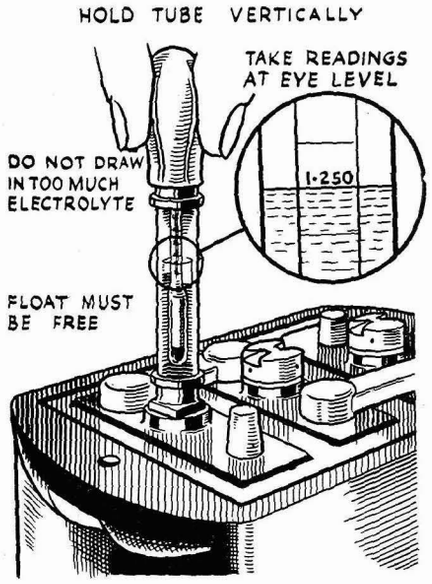


Fig. 88.
When checking the specific gravity of the electrolyte in the cells it is essential to hold the hydrometer vertically and take the readings with the eye level with the surface of the electrolyte in the hydrometer.

Section M.2

DYNAMO

The dynamo is of the compensated voltage control type and its output is automatically controlled by the regulator unit which is housed with the cut-out in the control box.

After about every 12,000 miles' (20,000 km.) running, unscrew the lubricator at the end of the dynamo, lift out the felt pad with its spring and half-fill the lubricator with Duckham's "Laminoid" grease. Replace the spring and felt pad and screw the lubricator into position again.

Inspect the dynamo driving belt and adjust it if necessary by swinging the dynamo on its mounting to take up any excess slackness. The dynamo is mounted on three bolts, the two lower ones forming the pivot for belt adjustment, and the upper one setting the adjustment in conjunction with a slotted link. When adjusting the belt, first slacken the lower pivot bolts, then slacken the upper adjusting bolt, and reset the dynamo to give the required belt tension. Retighten all three bolts. Care should be taken to avoid over-tightening the belt and to see that the dynamo is properly aligned, otherwise undue strain will be thrown on the dynamo bearings.

The dynamo requires no other attention during normal operation.

DYNAMO SERVICING

Brush gear and commutator

When the car is undergoing a general overhaul, say after 50,000 miles (80,500 km.) the brush gear and commutator should be examined in the following sequence :—

(*a*) Remove dynamo cover band.

(*b*) 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 rag. Clean the inside of the holder also.

(*c*) If the brushes are worn so that they do not make good contact on the commutator, or if the brush flexible has become exposed on the running face of the brush, take out the screw securing the eyelet on the end of the brush flexibles, hold back the springs and remove the brushes. Fit the new brushes into their holders and secure the eyelets on the ends of the brush leads in the original positions. The brushes are pre-formed and do not require bedding.

(*d*) Next examine the commutator. It should have a bright burnished appearance and be free from oil or dirt. If it is dirty, clean it with a rag moistened in petrol. If, however, the commutator is in a very bad condition the dynamo must be dismantled and the commutator reconditioned as follows :—

(i) Remove the dynamo from engine by disconnecting the positive cable from the battery ; removing the $\frac{1}{4}$ in. dynamo belt tension adjusting bolt, and its plain steel washer ; slackening the two $\frac{1}{4}$ in. bolts, nuts and spring washers, securing the dynamo to its cradle ; releasing the belt from the fan pulley. Now remove the dynamo terminal cover and disconnect the two leads, and finally remove the two dynamo securing bolts and lift the dynamo from its cradle.

Note.—The dynamo terminals are of different sizes to ensure correct replacement of the leads.

(ii) Lift the brushes from their holders.

(iii) Unscrew the two through-bolts.

(iv) Remove the armature complete with the driving end bracket from the dynamo yoke. Clean the commutator with very fine glass paper, and afterwards very carefully undercut the mica insulation between the segments to a depth of $\frac{1}{32}$ in. (.8 mm.) with a hacksaw blade ground down to the same thickness as the mica.

Reassembly is a reversal of the dismantling procedure outlined above.

Section M.3

THE CONTROL BOX

This unit contains the cutout, voltage regulator and two fuses. The regulator controls the dynamo output in accordance with the load on the battery and its state of charge. When the battery is discharged, the dynamo gives a high output so that the battery receives a quick recharge which brings it back to its normal state in the minimum possible time.

On the other hand, if the battery is fully charged, the dynamo is arranged to give only a trickle charge which is sufficient to keep it in good condition without any possibility of causing damage to the battery by overcharging.

The regulator also causes the dynamo to give a controlled boosting charge immediately after starting up, which quickly restores to the battery the considerable energy taken from it when starting. After about thirty minutes' running, the output of the dynamo falls to the steady rate necessary to suit the particular state of charge of the battery.

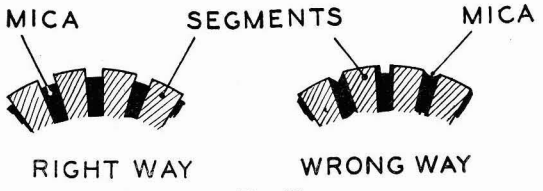


Fig. 89.

The right and wrong methods of undercutting the mica between the commutator segments.

The cut-out is an automatic switch for connecting and disconnecting the battery from the dynamo. This is necessary because the battery would otherwise discharge through the dynamo when the engine is stopped or running at a low speed, and thus lose its charge.

Regulator adjustment

The regulator is carefully set before leaving the Works to suit the normal requirements of the equipment fitted as standard and, in general, it should not be necessary to alter it. If, however, the battery does not keep in a charged condition, or, if the dynamo

output does not fall when the battery is fully charged, it may be advisable to check the setting and if necessary to readjust it.

It is important, before altering the regulator setting when the battery is in a low state of charge, to check that its condition is not due to a battery defect or to the dynamo belt slipping.

Note.—It is particularly important that only a first-grade moving coil voltmeter be used for checking the regulator setting. If this is not available no attempt at setting may be made, and the unit must be returned to a Lucas Service Depot or Agent for attention.

How to check and adjust setting

The regulator setting can be checked without removing the cover of the control box.

Withdraw the cables from the terminals marked "A" and "A1" at the control box and join them together. Connect the negative lead of a moving coil voltmeter (0—10 volt full scale reading) to the "D" terminal on the dynamo and connect the other

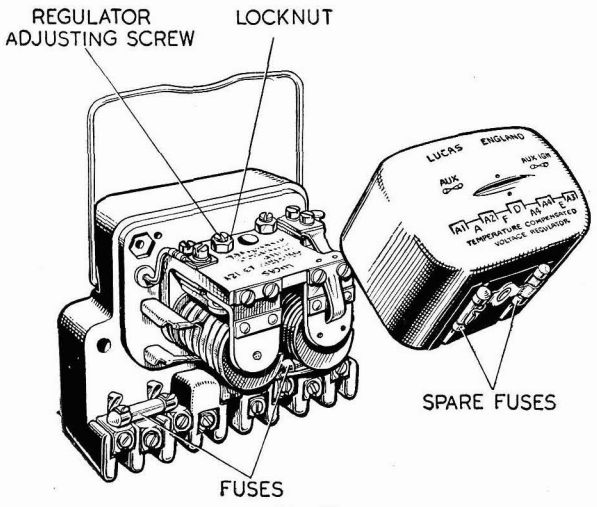


Fig. 90.

The control box, consisting of the cut-out, regulator and fuses, with the cover removed to show the regulator and cut-out coils. On earlier models the fuses are fitted under the cover.

lead from the meter to a convenient chassis earth.

Slowly increase the speed of the engine until the voltmeter needle "flicks" and then steadies; this should occur at a voltmeter reading between the limits given in the "Test Data" below for the appropriate temperature of the regulator.

TEST DATA

	Regulator setting		*Regulator setting*
10° C. (50° F.)	7.9—8.3	30° C. (86° F.)	7.7—8.1
20° C. (68° F.)	7.8—8.2	40° C. (104° F.)	7.6—8.0

If the voltage at which the reading becomes steady occurs outside these limits, the regulator must be adjusted.

Shut off the engine, remove the control box cover, release the locknut holding the adjusting screw, and turn the screw in a clockwise direction to raise the setting, or in an anti-clockwise direction to lower the setting. Turn the adjustment screw a fraction of a turn and then tighten the locknut.

When adjusting, do not run the engine up to more than half throttle, as the dynamo will build up to a high voltage while it is on open circuit, if run at a high speed, so giving a false voltmeter reading.

Section M.4

FUSES

The fuses are accessible without removing the cover.

Fuse marked "AUX"

This fuse protects the accessories which are connected so that they operate irrespective of whether the ignition switch is "on" or "off."

Fuse marked "AUX IGN"

This fuse protects the accessories which are connected so that they operate only when the ignition is switched on.

Units protected

The units which are protected by each fuse can readily be identified by referring to the wiring diagrams on pages 110 and 111.

Blown fuses

A blown fuse is indicated by the failure of all the units protected by it, and is confirmed by examination of the fuse, which can easily be withdrawn from the spring clips in which it fits. If it has blown, the fused state of the wire will be visible inside the glass tube. Before replacing a blown fuse, inspect the wiring of the units that have failed for evidence of a short circuit or other faults which may have caused the fuse to blow, and remedy the cause of the trouble. This is essential or the fuse is liable to blow again on replacement.

Section M.5

STARTER

When starting, observe the following points :—

1. See that the controls are properly set.
2. Operate the starter switch firmly and release it as soon as the engine fires.

3. Do not operate the starter when the engine is running. If the engine will not fire at once, allow it to come to rest before operating the switch again.
4. Do not run the battery down by keeping the starter on when the engine will not start.

The starter requires no attention during normal operation.

SERVICING

When the car is undergoing a general overhaul, say after 50,000 miles (80,500 km.) the commutator and brush gear should be examined. To do this it is advisable to remove the starter from the engine as follows :—

(*a*) Disconnect the earthing cable (positive) from the battery terminal to avoid any danger of causing short circuit.

(*b*) Unscrew the bolt clamping the cable to the starter commutator end bracket.

(*c*) Remove the starter from the engine by disconnecting the positive terminal from the battery ; disconnecting the starter cable from the starter motor ; removing the two $\frac{5}{16}$ in. bolts with spring washers securing the starter motor to the flywheel housing, and withdrawing the starter motor.

Replacement is a reversal of the above procedure.

Commutator

Inspect the commutator by removing the cover band. If it is blackened or dirty, clean it with a rag moistened with petrol. If, however, the commutator

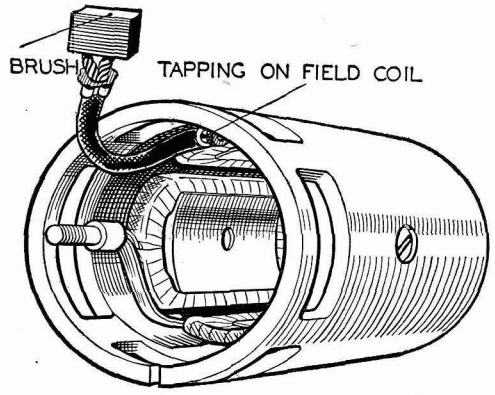


Fig. 91.
Illustrates the position of the tapping on the field coil to which one of the starter brushes is connected.

is in a very bad condition, the starter must be dismantled and the commutator cleaned as follows :—

(*a*) Hold back the brush springs and take out the brushes from their holders.

(*b*) Unscrew and withdraw the two through-bolts.

(*c*) Remove the armature complete with drive from the starter yoke.

Clean the commutator with very fine glass paper.

Note.—The mica on the starter commutator must not be undercut.

Brush gear

Next examine the brushes, check that they 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. Clean the inside of the holder also. If the brushes are worn so that they do not make good contact on the

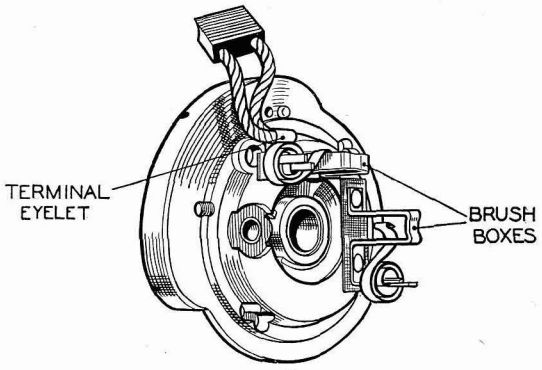


Fig. 92.
The position of the terminal eyelet to which one of the starter brushes is connected.

commutator, or if the brush flexible has become exposed on the running face, they must be replaced. To do this, remove the commutator end bracket from the starter yoke as follows :—

(*a*) Take out the four screws securing the adapter plate to the commutator end bracket and remove the plate.

(*b*) Unscrew the nut on the commutator end bracket now exposed to view which secures the field coil lead.

(*c*) Remove the commutator end bracket.

One of the brushes is connected to a terminal eyelet on the brush box, and the other one is connected to a tapping on the field coils.

The flexible connectors must be removed by unsoldering them from their attachment, and the connectors of the new brushes secured in place by soldering. The brushes are pre-formed so that bedding to the commutator is unnecessary.

Starter drive

In the event of the starter pinion becoming jammed in mesh with the flywheel, it can usually be freed by

applying a spanner to the armature extension at the commutator end and turning it. This is accessible by taking off the protecting cap which is secured by two screws.

If any difficulty is experienced through the starter not meshing correctly with the flywheel, it is probable that the presence of dirt on the starter drive is preventing the free movement of the pinion on its sleeve, in which case the sleeve and pinion should be washed with paraffin. Alternatively the drive may have been damaged owing to misuse, in which case it should be replaced.

Dismantling

If it is found that parts of the drive are worn or damaged they must be replaced in the following manner :—

(*a*) Remove the cotter pin from the nut at the end of the shaft.

(*b*) Hold the squared end of the starter shaft at the commutator end by means of a spanner, and unscrew the squared shaft nut.

(*c*) Lift off the main spring and the screwed sleeve with the pinion.

(*d*) Remove the restraining spring and sleeve on which the restraining spring fits.

Note.—If the screwed sleeve is worn or damaged it is essential that it is replaced by a new one together with a new pinion.

Reassembly is a reversal of the dismantling procedure outlined above.

Section M.6

LAMPS

Headlamps

The headlamps are provided with an electrically operated "dip and switch" device. With this arrangement the near-side reflector is arranged to dip to the left and at the same time the main bulb in the off-side lamp is switched off.

Cars intended for countries abroad are fitted with double filament bulbs in both headlamps, thus providing either a main driving light or a dipped beam light for use when meeting oncoming traffic. The headlamps also incorporate pilot lights.

Removing lamp front

Remove the screw at the bottom of the lamp and withdraw the lamp front by pulling it forward from the bottom. The main and pilot bulbs are then accessible for bulb replacement. When replacing the front, locate the top of the rim first, then press it on at the bottom and secure it by means of the fixing screw.

Focusing

Alternative positions are provided for the main bulb in its holder. Each position should be tried for the best light projection.

Setting

The lamps should be set so that the main driving beams are straight ahead and parallel with the road surface and with each other. Alignment of the lamps is carried out by removing the front rim as described above, and then by slackening the three reflector bracket securing screws, moving the reflector to the required position, and finally tightening up the securing screws.

Stop-tail lamp

To gain access to the bulbs slacken the securing screw and swing open the hinged cover.

Replacement of bulbs

Lucas Genuine Spare Bulbs are sold by any reputable garage and are specially designed and tested to ensure that the filament is in the correct position to give the best results with Lucas lamps. To assist in identification, Lucas bulbs are marked on the metal cap with a number. When fitting a replacement see that it is of the same number as the original bulb.

It is advisable to replace bulbs after long service before they actually burn out, as the filament may sag and cause a reduction in the performance of the lamp.

Replacement bulbs

	Lucas No.	*Volts*	*Watts*
Headlamps, Main (Home)	106	6	24
Headlamps, Main (Export)	168	6	24/24
Headlamps, Pilot ...	200	6	3
Stop Tail-lamp	200	6	3
Ignition Warning Light	970	2.5	0.5
Panel Lights	990	6	3

Cleaning lamps

Care must be taken when handling reflectors to prevent them from becoming finger-marked. A transparent and colourless protective covering enables any finger-marks to be removed by polishing with a chamois leather or a very soft dry cloth, if they do become marked. **Do not use metal polish on reflectors.**

Chromium-plated surfaces should be washed with plenty of water, and when the dirt is completely removed they may be polished with a chamois leather or soft dry cloth. **Do not use metal polishes on chromium plating.**

Section M.7

TRAFFICATORS

In order to raise the arm of the trafficators for the replacement of a bulb or for lubricating, switch on the trafficator, support the arm in a horizontal position, and move the switch to the " off " position.

Trafficator lubrication—every 6,000 miles (10,000 km.)

Apply, by means of a small brush or other suitable article, a drop of thin machine oil, such as sewing machine oil, to the catch pin between the arm and the operating mechanism. Use only the slightest trace as any excess may affect the operating mechanism.

Also withdraw the screw on the underside of the arm and slide off the arm cover. Place the connecting wire to the bulb on one side and apply two or three drops of thin machine oil to the lubricating pad at the top of the arm. To replace the arm cover, slide it on in an upward direction so that the side plates engage with the slots on the underside of the spindle bearing, and secure it in position with the fixing screw.

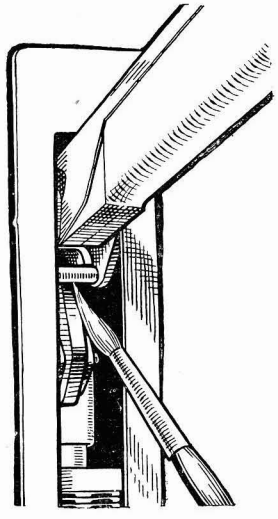


Fig. 93.

(Left). The trafficator arm catch pin should be lubricated with a slight amount of oil applied by a small brush.

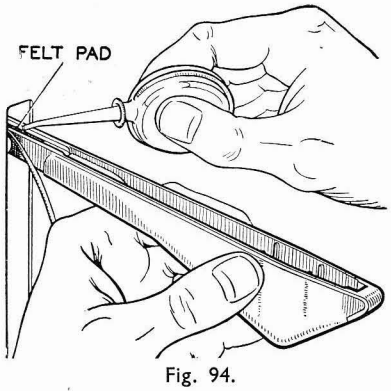


Fig. 94.

The trafficator arm hinge is lubricated from a felt pad which must be kept charged with oil. Oil should be applied with an oilcan as shown.

Replacement of bulb

Withdraw the screw on the underside of the arm and slide off the arm cover ; the burnt-out bulb may then be removed and replaced. The arm cover is replaced as indicated above.

The replacement bulb is a Lucas No. 255, 6-volt, 3-watt, festoon type.

Section M.8

ELECTRIC HORN

All horns before being passed out of the Works are adjusted to give their best performance and will give a long period of service without any attention ; no subsequent adjustment is required.

Section M.9

WINDSCREEN WIPERS

The switch is combined with the operating knob on the driver's side. To start, push in the knob and turn it to disengage from the parking stop. Release the knob and then rotate it until the driving dogs are felt to engage. This will automatically operate the switch and the wiper will start working. To switch off, push in the knob and turn it until the arm lies on the scuttle.

No adjustment or lubrication of the motor is necessary as the gears are packed with lubricant before leaving the Works.

The wiper arm hinge joints should be lubricated with thin oil at intervals of 6,000 miles (10,000 km.) and the joints of the operating links, at the back of the instrument panel, should be lubricated with engine oil at similar intervals. The ball joint of the drive shaft should be smeared with Duckham's " Laminoid."

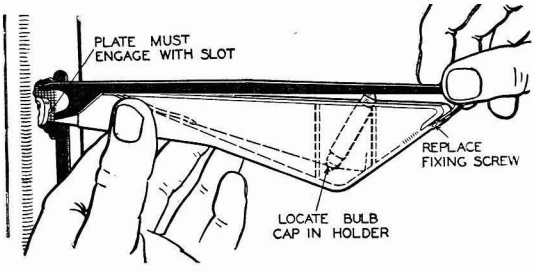


Fig. 95.

The correct procedure for removing the metal cover-plate of the trafficator arms is to unscrew the fixing screw from the tip of the plate and slide it outwards so that its slotted inner end is withdrawn from the bearing spindle.

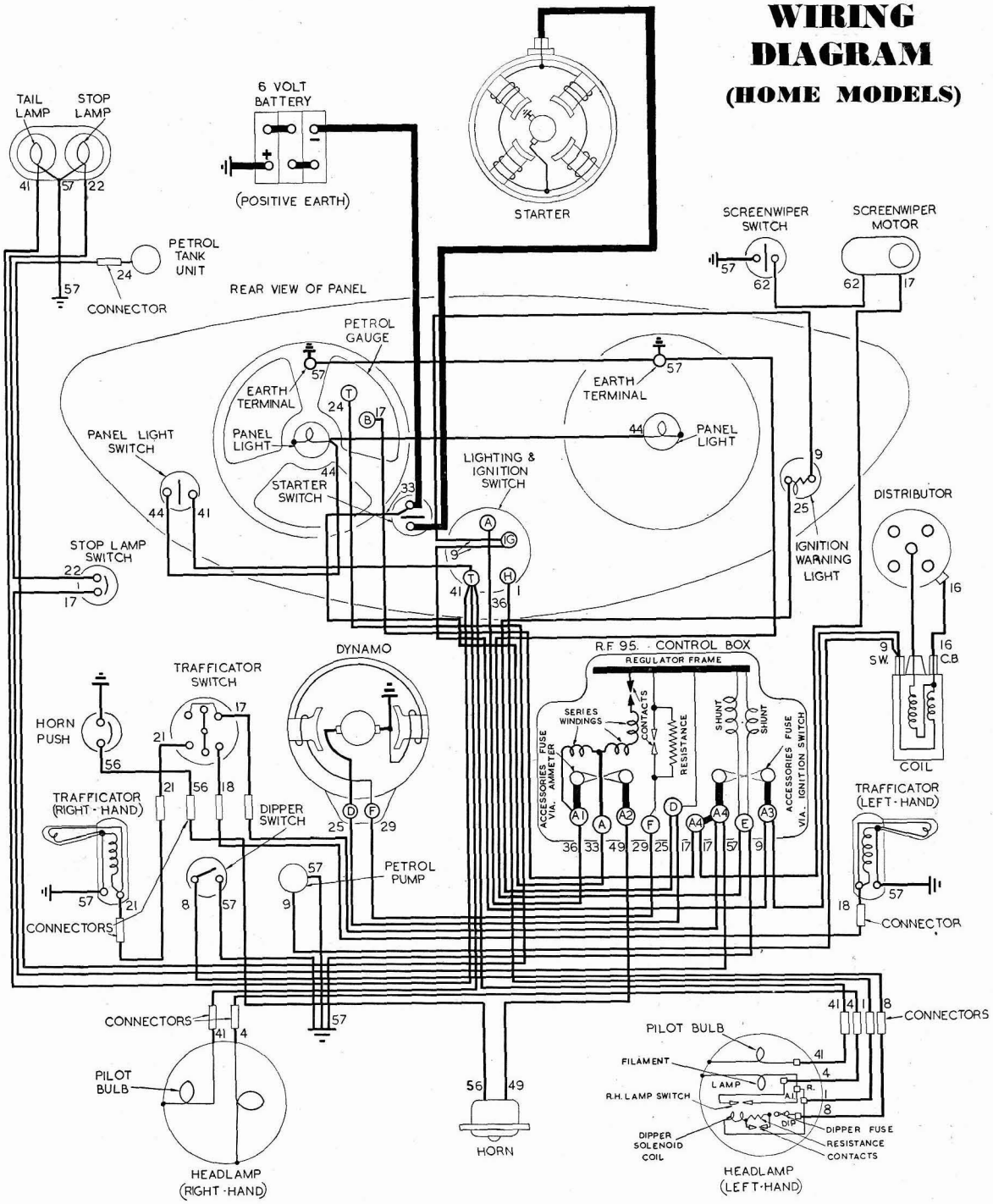
Replacement of arm and blade assembly

To remove the arm and blade assembly, slacken the fixing nut and tap sharply to release the collet which clamps the arm onto the spindle. Then remove the complete assembly. When fitting the replacement arm and blade, slacken the securing nut and push the arm fixing bush over the end of the spindle as far as it will go and secure it by tightening the nut.

Replacement of blade

Take out the rubber bush securing the blade to the arm and remove the blade. Insert the tongue of the replacement blade through the slot in the arm and secure it by fitting the rubber bush through the hole in the tongue.

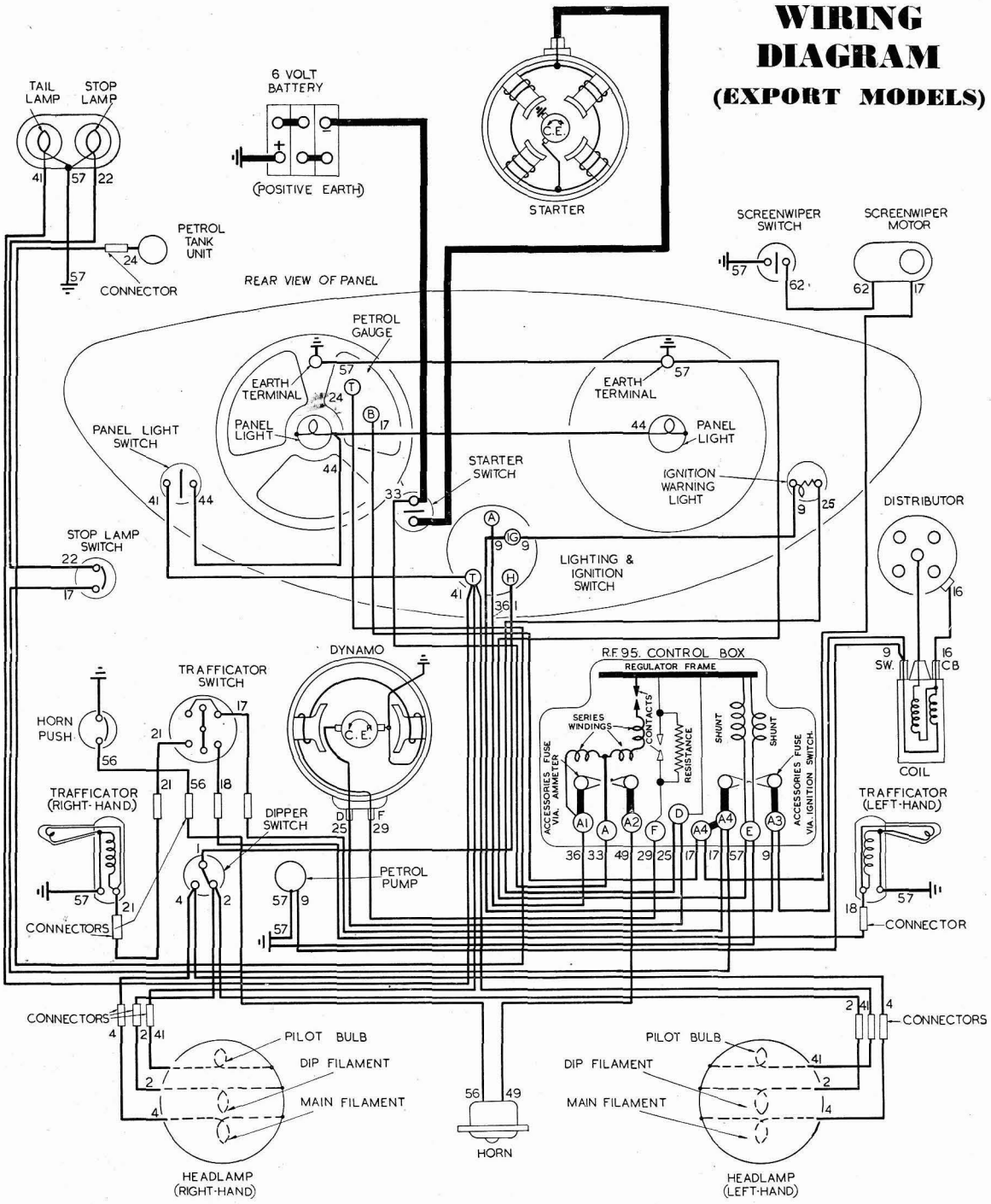
WIRING DIAGRAM (HOME MODELS)



KEY TO CABLE COLOURS

1 BLUE	14 WHITE with PURPLE	27 YELLOW with BLUE	40 BROWN with BLACK	53 PURPLE with WHITE
2 BLUE with RED	15 WHITE with BROWN	28 YELLOW with WHITE	41 RED	54 PURPLE with GREEN
3 BLUE with YELLOW	16 WHITE with BLACK	29 YELLOW with GREEN	42 RED with YELLOW	55 PURPLE with BROWN
4 BLUE with WHITE	17 GREEN	30 YELLOW with PURPLE	43 RED with BLUE	56 PURPLE with BLACK
5 BLUE with GREEN	18 GREEN with RED	31 YELLOW with BROWN	44 RED with WHITE	57 BLACK
6 BLUE with PURPLE	19 GREEN with YELLOW	32 YELLOW with BLACK	45 RED with GREEN	58 BLACK with RED
7 BLUE with BROWN	20 GREEN with BLUE	33 BROWN	46 RED with PURPLE	59 BLACK with YELLOW
8 BLUE with BLACK	21 GREEN with WHITE	34 BROWN with RED	47 RED with BROWN	60 BLACK with BLUE
9 WHITE	22 GREEN with PURPLE	35 BROWN with YELLOW	48 RED with BLACK	61 BLACK with WHITE
10 WHITE with RED	23 GREEN with BROWN	36 BROWN with BLUE	49 PURPLE	62 BLACK with GREEN
11 WHITE with YELLOW	24 GREEN with BLACK	37 BROWN with WHITE	50 PURPLE with RED	63 BLACK with PURPLE
12 WHITE with BLUE	25 YELLOW	38 BROWN with GREEN	51 PURPLE with YELLOW	64 BLACK with BROWN
13 WHITE with GREEN	26 YELLOW with RED	39 BROWN with PURPLE	52 PURPLE with BLUE	

WIRING DIAGRAM
(EXPORT MODELS)



KEY TO CABLE COLOURS

1 BLUE	14 WHITE with PURPLE	27 YELLOW with BLUE	40 BROWN with BLACK	53 PURPLE with WHITE
2 BLUE with RED	15 WHITE with BROWN	28 YELLOW with WHITE	41 RED	54 PURPLE with GREEN
3 BLUE with YELLOW	16 WHITE with BLACK	29 YELLOW with GREEN	42 RED with YELLOW	55 PURPLE with BROWN
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12 WHITE with BLUE	25 YELLOW	38 BROWN with GREEN	51 PURPLE with YELLOW	64 BLACK with BROWN
13 WHITE with GREEN	26 YELLOW with RED	39 BROWN with PURPLE	52 PURPLE with BLUE	

Section M.10

LOCATION AND REMEDY OF FAULTS

Although every precaution is taken to eliminate possible causes of trouble, failure may occasionally develop through lack of attention to the equipment, or damage to the wiring. The following is a recommended systematic examination to locate and remedy the causes of some of the more usual faults.

The sources of trouble are by no means always obvious, and in some cases a considerable amount of deduction from the symptoms is needed.

For instance, the engine might not respond to the starter switch ; a hasty inference would be that the starter motor is at fault. However, as the motor is dependent on the battery, it may be that the battery is exhausted. This, in turn, may be due to the dynamo failing to charge the battery, and the final cause of the trouble may be, perhaps, a loose connection in some part of the charging circuit.

If, after carrying out an examination, the cause of the trouble is not found, the equipment should be sent to the nearest Lucas Service Depot or Agent.

CHARGING CIRCUIT

1. *Battery in low state of charge*
   - (*a*) This state will be shown by lack of power when starting, poor light from the lamps, and hydrometer readings below 1.200, which may be due to the dynamo either not charging or giving a low or intermittent output. The ignition warning light will not go out if the dynamo fails to charge, or it will flicker on and off if the output is intermittent.
   - (*b*) Examine the charging and field circuit wiring, tightening any loose connections or replacing any broken cables. Pay particular attention to the battery connections.
   - (*c*) Examine the dynamo driving belt ; take up any undue slackness by swinging the dynamo outwards on its mounting after slackening the attachment bolts.
   - (*d*) Check the regulator setting and adjust if necessary.
   - (*e*) If, after carrying out the above, the trouble is still not cured, have the equipment examined by a Lucas Service Depot or Agent.

2. *Battery overcharged*
   - (*a*) This will be indicated by burnt-out bulbs, very frequent need for topping-up the battery, and high hydrometer readings.
   - (*b*) Check the regulator setting and adjust if necessary.

3. *Starter operates but does not crank engine*

   This fault will occur if the pinion of the starter drive is not allowed to move along the screwed sleeve into engagement with the flywheel, due to dirt having collected on the screwed sleeve (the starter will be heard revolving at high speed). Clean the sleeve carefully with paraffin.

4. *Starter pinion will not disengage from flywheel when engine is running*

   Stop the engine and see if the starter pinion is jammed in mesh with the flywheel, releasing it if necessary by rotation of the squared end of the starter shaft. If the pinion persists in sticking in mesh, have the equipment examined at a service depot. Serious damage may result to the starter if it is driven by the flywheel.

STARTER MOTOR

1. *Starter motor lacks power or fails to turn engine*
   - (*a*) See if the engine can be turned over by hand. If not, the cause of the stiffness of the engine must be located and remedied.
   - (*b*) If the engine can be turned by hand, first check that the trouble is not due to a discharged battery.
   - (*c*) Examine the connections to the battery, starter and starter switch, making sure that they are tight and that the cables connecting these units are not damaged.
   - (*d*) It is also possible that the starter pinion may have jammed in mesh with the flywheel, although this is not a common occurrence. To disengage the pinion, rotate the squared end of the starter shaft by means of a spanner after removing the protecting cover.

LIGHTING CIRCUITS

1. *Lamps give insufficient illumination*
   - (*a*) Test the state of charge of the battery, recharging it if necessary from an independent electrical supply.
   - (*b*) Check the setting of the lamps.
   - (*c*) If the bulbs are discoloured as the result of long service, they should be replaced.

2. *Lamps light when switched on but gradually fade out*

   As paragraph 1 (*a*).

3. *Brilliance varies with speed of car*
   - (*a*) As paragraph 1 (*a*).
   - (*b*) Examine the battery connections, making sure that they are tight, and replace any faulty cables.

SECTION N

THE ROAD SPRINGS

GENERAL DESCRIPTION

The suspension is by four semi-elliptic leaf springs. The front springs are secured above the axle and the rear springs below the rear axle by " U " bolts (two for each spring).

The front eye of the front springs is anchored on a fixed bracket attached to the chassis frame by a hardened steel shackle bolt and is fitted with a bronze bush and side thrust washers. Lubrication of the shackle bolt is by a grease nipple and passages drilled in the bolt.

The rear springs are also anchored by their front eye, but are fitted with a rubber bush of the flexing type equipped with fibre side washers. No lubrication is therefore required.

Both the front and rear springs are attached at their rear ends to swinging shackles fitted with flexible rubber bushes.

The bushes employed at the front end of the rear springs consist of two steel tubes (inner and outer) between which rubber is introduced so that it is under considerable compression. This bush, while offering great resistance to the load carried, allows freedom for the inner tube to rotate, relative to the outer tube, over a certain arc, providing a satisfactory bearing which requires no lubricant since all relative movement is accommodated by flexing of the rubber.

The action of the springs is damped by use of hydraulic dampers of the piston type. (See Section K.)

MAINTENANCE

Only the front end of the front spring requires lubrication attention to its shackle bolt. All other shackle bolts are mounted in rubber bushes and must therefore **not** be lubricated under any circumstances.

Clean off periodically any dirt, etc., from the springs, and brush them with penetrating oil, taking care that none finds its way onto the rubber bushes.

Ensure that the spring clip nuts are tight, and that there is no side movement of the spring leaves within the clips.

Section N.1

REMOVAL AND REPLACEMENT OF FRONT SPRING

Raise the front of the car with a hoist attached to the front bumper brackets and place a suitable support under the axle beam.

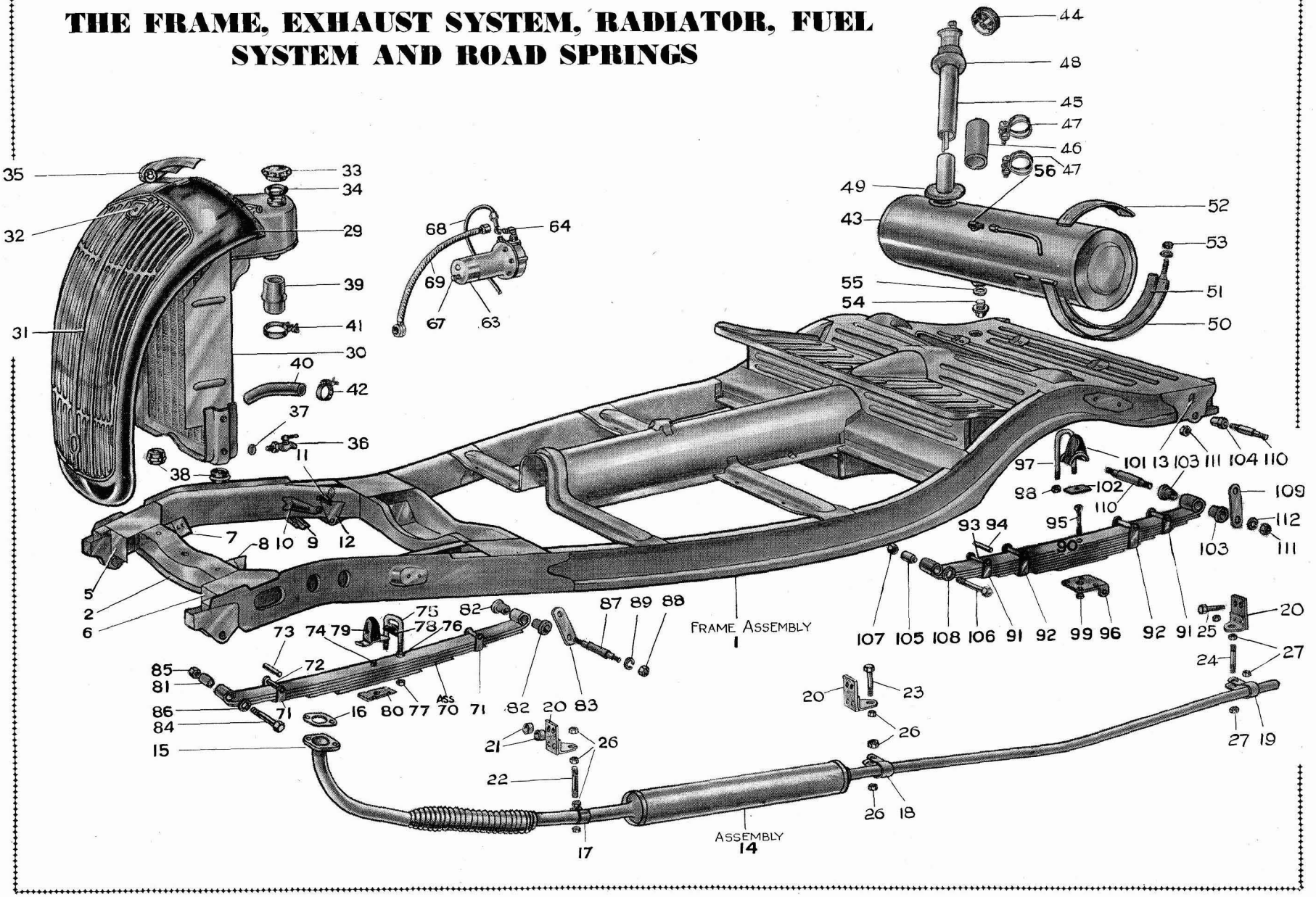
Remove the " U " bolts securing the spring to the axle beam.

Remove the shackle bolt nuts, shackle plates, shackle bolts and rear end rubber bushes.

The spring is now free to be withdrawn.

Replacement of the spring is the reversal of the above operation.

THE FRAME, EXHAUST SYSTEM, RADIATOR, FUEL SYSTEM AND ROAD SPRINGS



KEY TO THE FRAME ASSEMBLY

No.	Description
1.	Frame assembly.
2.	Frame cross-member assembly (front).
5.	Bracket for wing valance (front) O/S.
6.	Bracket for wing valance (front) N/S.
7.	Bracket (engine mounting, front) O/S.
8.	Bracket (engine mounting, front) N/S.
9.	Bracket for pedal return springs.
10.	Support bracket for clutch and brake pedals.
11.	Bracket for pedal stop.
12.	Bracket for front spring (rear) O/S.
13.	Bracket for rear spring (rear outer) N/S.
14.	Exhaust pipe and silencer assembly.
15.	Flange for front exhaust pipe.
16.	Gasket for flange.
17.	Clip for front exhaust pipe.
18.	Clip (centre).
19.	Clip (rear).
20.	Clip support and insulator.
21.	Distance piece (front insulator to frame).
22.	Stud (to front clip insulator).
23.	Bolt (to centre clip insulator).
24.	Stud (to rear clip insulator).
25.	Bolt (rear insulator to cross-member).
26.	Nut for front stud and centre bolt.
27.	Nut for rear stud.
29.	Radiator case assembly.
30.	Radiator core.
31.	Grille assembly.
32.	Motif plate for badge.
33.	Cap for radiator.
34.	Rubber ring for cap.
35.	Mascot.
36.	Drain tap for radiator.
37.	Washer for tap.
38.	Packing block.
39.	Hose connection (top).
40.	Hose connection (bottom).
41.	Clip for hose (top).
42.	Clip for hose (bottom).
43.	Petrol tank.
44.	Cap for petrol tank.
45.	Filler for petrol tank.
46.	Hose (filler to tank).
47.	Clip for hose.
48.	Grommet for filler (in body).
49.	Grommet for filler (in floor).
50.	Strap for tank.
51.	Packing for strap (bottom).
52.	Packing for strap (top).
53.	Nut for strap.
54.	Drain plug for petrol tap.
55.	Washer for drain plug.
56.	Right-angle union.
63.	Petrol pump assembly.
64.	Union elbow.
67.	Insulated terminal.
68.	Pipe (tank to pump).
69.	Pipe (pump to carburetter).
70.	Front spring assembly.
71.	Clip assembly.
72.	Bolt and nut for clip.
73.	Distance piece.
74.	Dowel pin and nut.
75.	Clip (to axle).
76.	Nut for clip.
77.	Locknut for clip.
78.	Pad for clip.
79.	Buffer.
80.	Castor plate.
81.	Bush (front eye).
82.	Bush for rear eye (rubber).
83.	Shackle plate (front spring).
84.	Shackle bolt (front).
85.	Nut for shackle bolt.
86.	Washer for shackle bolt.
87.	Shackle pin (rear).
88.	Nut for shackle pin.
89.	Washer for shackle pin.
90.	Rear spring assembly.
91.	Clip assembly (small).
92.	Clip assembly (large).
93.	Bolt and nut for clip.
94.	Distance piece.
95.	Dowel pin and nut.
96.	Shock absorber plate N/S.
97.	Clip to axle.
98.	Nut for clip.
99.	Locknut for clip.
101.	Buffer.
102.	Packing.
103.	Bush (spring eye, rear) (rubber).
104.	Bush (in frame) (rubber).
105.	Bush (Silentbloc).
106.	Shackle bolt (front).
107.	Nut for shackle bolt.
108.	Washer for shackle bolt (fibre).
109.	Shackle plate (rear spring).
110.	Shackle pin (rear).
111.	Nut for shackle pin.
112.	Spring washer.

Note.—The springs are not symmetrical, and the eye of the front spring which is nearest to the centre bolt must be fitted to the front shackle, that is to say, the short half of the spring must be fitted forward of the axle.

The front spring 3° castor plate is fitted with the thick end towards the front of the car.

The rubber shackle bushes fitted to the rear end of the spring should be coated with powdered graphite before assembly. It is essential that the shackle bolts should not be tightened up until the weight of the car is resting on the springs, otherwise an undue deflection will be given to the rubbers in one direction which will lead to their early failure.

Section N.2

REMOVAL AND REPLACEMENT OF REAR SPRING

Raise the rear of the car by using a hoist attached to the rear bumper brackets.

Disconnect the hydraulic damper link from its plate beneath the spring.

Support the axle casing adequately.

Remove the " U " bolts securing the spring to the axle casing, noting the position of the rubber and steel packing plates.

Remove the shackle bolt nuts, shackle plate, shackle bolts and rear end rubber bushes. The spring is now free for removal.

Replacement is a reversal of the above operation.

Note.—It is important that the flexing rubber bushes at the front and rear ends of the springs are not given an initial deflection. It is therefore essential not to tighten any of the shackle pin nuts until the weight of the car is on the springs. By this method the springs are made to take up their correct positions for normal operating conditions. If this is not done the bushes will be submitted to excessive stress leading to their early failure. Do not omit to replace the fibre washers at each side of the front bush.

The rubber shackle bushes fitted to the rear end of the spring should be coated with powdered graphite before assembly.

Section N.3

DISMANTLING THE SPRINGS

Remove the nuts, bolts and distance pieces from the spring clips.

Remove the spring centre bolt, thus releasing the spring leaves.

In the case of the rear spring, removal of the centre bolt also releases the hydraulic damper plate.

Examination.—Clean each leaf thoroughly, and examine for cracks or fractures.

Check the centre bolt for straightness or wear (this bolt forms the location of the spring on its axle pad).

It is advisable, even when no leaves are broken, to fit replacement springs when the originals have lost their camber due to settling.

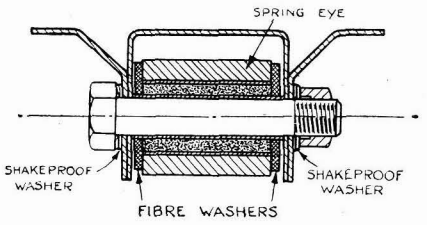


Fig. 96.

Showing the location of the rubber bushes and fibre washers for the front spring eyes of the rear springs.

If the front spring front end bush is worn it should be pressed out and a new bush, bolt, and side thrust washers fitted.

The flexing rubber bushes at the front end of the rear spring are secured in the spring eyes by frictional grip. The bore in the eye of the spring is slightly smaller than the outside diameter of the bush ; thus, when the bush is pressed in, the eye opens slightly and grips the bush firmly.

If the bush requires replacing it may be pressed out and a new one fitted, care being taken to see that the bush extends an equal amount beyond each side of the eye when assembled.

If the rear end rubber shackle bushes are worn they should be renewed. The shackle plates and pins should also be examined for wear, and if necessary new ones should be fitted.

Section N.4

REASSEMBLING THE SPRINGS

Cover each spring leaf liberally with a graphited grease.

Place the leaves together in their correct order, locating them with the centre bolt.

Important.—When fitting new leaves it is necessary that they are of the correct length and thickness, and have the same curvature as the remaining leaves. The dowel head of the centre bolt is fitted on the underside of the front spring and on the top side in the case of the rear spring.

Replace the spring clips and make sure they are fully tightened so that there is no side movement of the leaves within the clips.

SECTION 0

THE TYRES

Section 0.1

GENERAL

Tyre pressures

It is of the utmost importance that the tyres be carefully maintained at the following recommended pressures :—

Front : 24 lb. per sq. in. (1.7 kg./cm.^{2}).

Rear : 27 lb. per sq. in. (1.9 kg./cm.^{2}).

When the car is fully laden, or when it is driven hard, the tyres should be given an extra 2 lb. pressure (.14 kg./cm.^{2}).

Care of the tyres

Valve caps, in addition to preventing dirt from entering the valve, form a secondary air seal and should always be fitted. It is advisable to change the valve interiors every twelve months.

Tyre wear

Even tyre wear is promoted by changing the positions of the tyres on the car at intervals of about 2,000 miles.

Attention should be paid to the following points, with a view to obtaining the maximum mileage from the tyre equipment of the vehicle :—

Test the pressures of the tyres daily by means of a suitable gauge, and restore any air lost. It is not sufficient to make a visual examination of the tyre for correct inflation. Inflate the spare wheel to the correct rear wheel pressure at the same time.

Should any tyre appear to lose an appreciable amount of air between short intervals, have it removed and checked for air leaks.

Regularly remove and examine both covers and tubes. Keep the tread free from grit and stones, and arrange for any repairs to be carried out. Clean the wheel rims and keep them free from rust.

Paint the wheels if required, and replace the tyres and tubes.

Keep the brakes and clutch adjusted correctly and in good order. Fierceness or uneven action in either of these units has a destructive effect on the tyres.

Misalignment is a very costly error. Suspect it if rapid wear of the front tyres is noticed, and have the fault corrected at once. See Section 1.6 for instructions on front wheel alignment.

Keep oil and grease off the tyres. Should the tyres get oily, petrol should be applied sparingly and wiped off at once.

Note.—Inextensible wires are incorporated in the edges of wired type tyres. Do not, therefore, attempt to stretch the edges of the tyre cover over the rim edge.

Force is entirely unnecessary and detrimental, as it tends to damage the wire edges and serves no useful purpose. Fitting or removing is quite easy if the wire edges are carefully adjusted into the rim base ; if it is found to be difficult the operation is not being performed correctly.

Section 0.2

TYRE REMOVAL

Remove all valve parts and push both edges into the base of the rim at a point diametrically opposite the valve, then lever the cover edge near the valve over the rim of the wheel (see illustration), using two levers placed about 6 inches apart. Remove the tube carefully, do not pull on the valve. Stand the tyre and wheel upright, keeping the bead on the base of the rim. Lever the bead over the rim flange, and at the same time push the wheel away from the cover with the other hand.

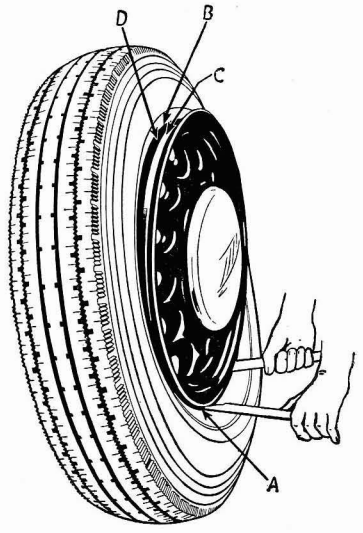


Fig. 97.
Owing to the inextensible wire edges of the tyre, use of the well base of the rim " D " must be made during tyre removal and replacement to avoid damage to the tyre edge.

Section 0.3

THE IMPORTANCE OF BALANCE

In order to obtain good steering it is of importance to ensure that the wheels, with tyres fitted, are in good balance. To assist this, the tyre manufacturers are now marking their tyres with a white spot or spots in the neighbourhood of the bead at the lightest point of the cover ; similarly, they are marking the inner tubes with a group of coloured spots to indicate their heaviest point. When tyres are assembled care must therefore be taken to see that they are assembled with the white spot on the cover coinciding with the coloured spots on the tube, and not opposite to the valve as recommended hitherto.

It must be noted, in addition, that special balancing discs are fitted to the inside of the cover casing in some cases and that these should on no account be removed, as the tyre balance will be upset if this is done. These balance discs are **not** repair patches and do not indicate any fault in the tyre.

Section 0.4

TYRE REPLACEMENT

Note.—Before replacing the tyres, inspect the inside of the cover carefully and remove all dirt. Inspect the wheel rim, which must be clean, free from rust, and undamaged.

Push one edge of the cover over the edge of the rim which is away from the valve hole. It will go over quite easily if the part first fitted is pushed down into the rim base. Slightly inflate the inner tube—do not distend it—and place it in the cover with the valve through the hole in the rim. (Take care that the valve, which is fitted in the side of the tube, is on the correct side of the rim and check that the balance markings on the inner tube and outer cover coincide.)

Fit the second edge of the cover, commencing at the point diametrically opposite the valve, and push the edge down into the base of the rim. Small levers may be used gently to ease the last few inches over the rim edge.

Inflate the tyre, and while doing so, check that the edge of the cover is seating evenly around the rim.

Section 0.5

SYNTHETIC TYRES

Synthetic tyres can be identified by a red medallion on the covers and a red or blue disc on the tubes close to the valve. These tyres are more susceptible to failure from abuse than the natural rubber tyres, and therefore require more careful treatment in service and more regular maintenance if a reasonably good performance is expected. Tyre pressures must be checked regularly.

Avoid travelling at high speeds, this is more detrimental to synthetic tyres than to natural rubber ones. Synthetic tyres generate heat more quickly and have less resistance to cuts and tears, especially when the tyre is hot, and for this reason they require frequent inspection in order that repairs can be made before serious damage is done to the casing.

Special care when fitting synthetic tyres is essential to obtain maximum life and to avoid premature failure.

The following points should be given attention when fitting :—

Dust the inside of the cover evenly with french chalk.

Inflate the tube until it begins to round out, then insert it in the cover.

Apply a frothy solution of soap and water generously around the entire base of the tube, extending upwards between the tyre beads and the tube itself for at least 2 in. (5 cm.) on both sides. Also apply the solution to the bottom and outside of the tyre beads. Do not allow the solution to run into the crown of the tyre. The solution must be strong enough to feel slippery when the fingers are wetted with solution and rubbed together.

Mount the tyres on the rim immediately, and whilst the soap solution is still wet.

Before inflating, be sure that the tyre beads are clear of the well of the rim all the way round.

Inflate slowly until the beads are fully seated.

Remove the valve core to **deflate the tube completely.** Do not disturb the beads of the cover.

Reinflate to the correct working pressure.

This procedure must be followed whenever a tube is fitted.

The object of the double inflation is to permit any stretched portions of the tube to readjust themselves in the cover and relieve any strains in the tube. In an emergency french chalk may be used as a substitute for soap solution, provided it is evenly and generously applied. This practice, however, is not recommended.

Repairing tubes

Punctures or injuries must be vulcanised. Ordinary patches should only be used for emergencies and cannot be relied upon.

SECTION P

LUBRICATION

Correct lubrication of any piece of mechanism is of paramount importance, and in no instance is it of greater importance than in the correct choice of lubricant for a motorcar engine. Automobile engines have different characteristics, such as operating temperatures, oiling systems, size of oilways, clearances and similar technicalities.

As a result of research and exacting tests in the lubrication of motorcar engines, Alexander Duckham & Co. Ltd., in conjunction with the Nuffield Organization Research Department, have developed a new, rapid heat-dispersing stabilised oil called N.O.L. Engine Oil. It is a free-flowing oil at atmospheric temperatures ; it maintains faultless lubrication under peak loading conditions at high temperatures ; it releases more engine power.

This oil, together with the special N.O.L. " E.P." Transmission Oil developed concurrently, is recommended for use on Morris cars.

If the recommended oils are not available we approve the use of the equivalent grades of lubricant indicated subsequently in this section.

The engine is tested on N.O.L. Engine Oil and the sump filled with N.O.L. Engine Oil on leaving the factory. Its continued use is recommended.

The following is a list of the oils recommended :

Reference	*Component*	*Climatic Conditions*	*Recommended Oil*
A	Engine	Temperate and tropical	N.O.L. " Thirty " Engine Oil
		Extreme cold from 32° F. (0° C.) down to 0° F. (—17.8° C.)	N.O.L. " Twenty " Engine Oil
B	Gearbox, Steering Gearbox, Rear Axle	Temperate and tropical down to 20° F. (—6.7° C.)	N.O.L. " E.P." Transmission Oil 140
C	Wheel Hubs	All conditions	Duckham's " Adcol " H.B.B. Grease
D	Steering Connections, King Pins, Propeller Shaft, Shackles, Clevis Pins, Lever Fulcrums, Road Springs	All conditions	Duckham's " Laminoid " Soft or Duckham's " Adcol " H.P.G. Grease
E	Cables and Control Points	All conditions	Duckham's " ZNOL " K.G. 16
F	Oilcan and Carburetter Dashpot	All conditions	N.O.L. " Twenty " Engine Oil

OTHER OIL MANUFACTURERS' EQUIVALENT GRADES

Reference	A		B	C	D	E	F
Component	Engine and Air Cleaner		Gearbox, Rear Axle and Steering Gearbox	Wheel Hubs and Fan Bearings	Chassis, Greasing Nipples, etc.	Cables and Control Points	Oilcan and Carburetter
Climatic Conditions	**Temperate and tropical**	**Extreme cold from 32° F. (0° C.) down to zero Fahr. (—17.8° C.)**	**Temperate and tropical down to 20° F. (—6.7° C.)**	**All conditions**	**All conditions**	**All conditions**	**All conditions**
" ADCOL " (Alexander Duckham & Co. Ltd.)	Duckham's " Adcol " N.P.X.X.	Duckham's " Adcol " N.P.X.	Duckham's " Adcol " X.S. Press 140	Duckham's " Adcol " H.B.B. Grease	Duckham's " Adcol " H P.G. Grease	Duckham's ZNOL K.G.16 Grease	Duckham's " Adcol " N.P.X.
" CASTROL " (C. C. Wakefield & Co. Ltd.)	" Castrol " X.L.	" Castrolite "	" Castrol " Hi-press	" Castrolease " Heavy	" Castrolease " Medium	" Castrolease " Brake Cable Grease	" Castrolite "
" ESSOLUBE " (Anglo-American Oil Co. Ltd.)	" Essolube " 30	" Essolube " 20	" Essoleum " Expee Compound 140	Esso-Grease	Esso-Fluid Grease	Anti-Freeze Grease	" Essolube " 20
" FILTRATE " (Edward Joy & Son Ltd.)	Medium " Filtrate " (regd.)	Zero " Filtrate " (regd.)	E.P. " Filtrate " (regd.)	" Filtrate " (regd.) R.B. Grease	High Pressure Solidified " Filtrate " (regd.) Oil	" Filtrate " (regd.) A.F. Grease	Zero " Filtrate " (regd.)
" MOBILOIL " (Vacuum Oil Co. Ltd.)	Mobiloil " A "	Mobiloil " Arctic "	Mobiloil " E.P."	Mobil Hub Grease	Mobilgrease No. 4	Mobilgrease No. 4	Mobiloil " Arctic "
" MOTORINE " (Price's Lubricants Ltd.)	Price's " Motorine " " M "	Price's " Motorine " " E "	Price's " Motorine " " E.P."	Price's " Belmoline " " C "	Price's " Belmoline " " D "	Price's " Belmoline " " H "	Price's " Motorine " " E "
" SHELL " (Shell Mex & B.P. Ltd.)	Double " Shell "	Single " Shell "	" Shell " Spirax E.P. 140	" Shell " Retinax R.B.	" Shell " Retinax C	" Shell " Retinax C	Single " Shell "
" STERNOL " (Sternol Ltd.)	" Sternol " W.W. 30	" Sternol " W.W. 20	" Sternol " Liquid Ambroleum E.P. 140	" Sternol " R.B. Grease	" Sternol " M.M. Grease	" Sternol " Anti-Freeze Grease	" Sternol " W.W. 20

NOTE :—It is bad practice to mix lubricants, particularly the high-pressure types now in use for rear axles, as they differ considerably in their composition. It is therefore dangerous to replenish the axle with a different make of oil from that in use without first draining off the axle. It is also advisable to carry out a similar procedure in the case of the other components.

SPECIAL CONDITIONS

When conditions are not normal and are outside the temperature ranges indicated in the tables, apply the special recommendations dealing with extreme conditions detailed below.

Extreme cold conditions

Where a car is operated in temperatures which are consistently below zero Fahrenheit (—17.8° C.), the use of an oil of lower viscosity than that recommended for normal use is desirable, and under such conditions the use of N.O.L. " Ten " Engine Oil is recommended.

Equivalent grades of other manufacture are :—

Duckham's " Adcol " N.P.O.
" Castrol " Z.
" Essolube " 10.
" Filtrate " (Regd.) Sub-Zero.
" Mobiloil " Arctic Special.
" Motorine " 10.
Silver " Shell."
" Sternol " W.W. 10.

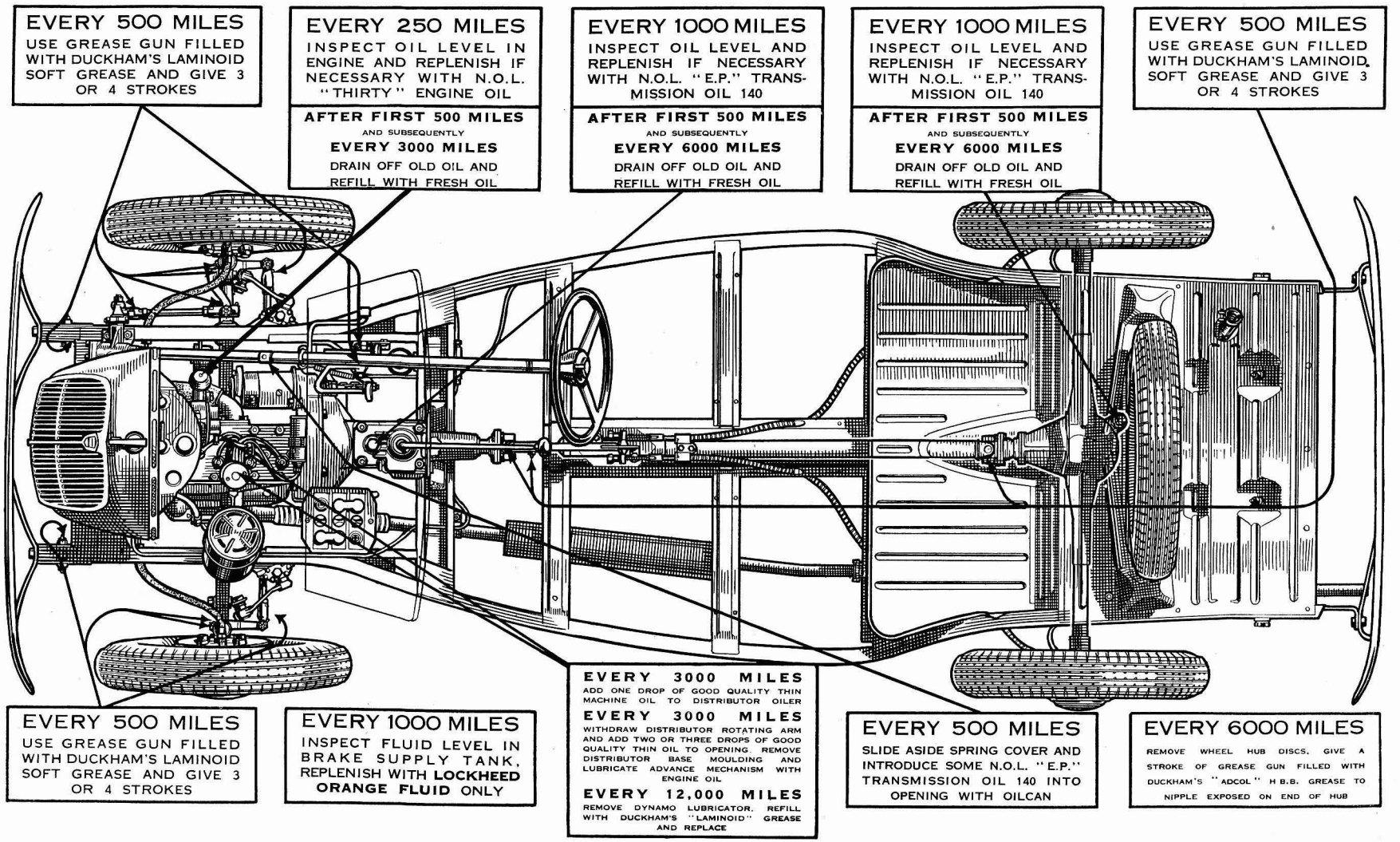
Similar considerations apply in the case of the gearbox, rear axle and steering gearbox, where N.O.L. " E.P." Transmission Oil 80 should be used when temperatures consistently below 20° Fahrenheit (—6.7° C.) are encountered.

Equivalent grades of other manufacture are :—

Duckham's " Adcol " X.S. Press 80.
" Castrol " Hi-Press 80.
" Essoleum " Expee Compound 80.
" Filtrate " (Regd.) 80.
" Mobiloil " G.X.W.
" Shell " E.P. Spirax 80.
" Motorine " E.P. 80.
" Sternol " Liquid Ambroleum E.P. 80.

Special conditions

N.O.L. " Forty " Engine Oil is available for special cases where heavy wear has taken place in an engine, rendering the continued use of a thin oil unsatisfactory.



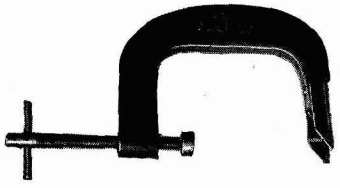
APPROXIMATE METRIC EQUIVALENTS			
250 MILES =	400 KM.	3,000 MILES =	5,000 KM.
500 MILES =	800 KM.	6,000 MILES =	10,000 KM.
1,000 MILES =	1,600 KM.	12,000 MILES =	20,000 KM.

SECTION Q

SPECIAL TOOLS

Every Dealer servicing Morris cars is recommended to maintain the special tools detailed in this list. Damage to parts will be obviated by their use and repairs generally will be greatly facilitated.

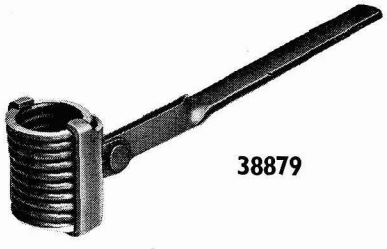
Description	*SE/E Part Numbers*
Extractors	
Valve spring	38378
Detachable foot for above...	65481
Front and rear hub (universal)	19431
Steering knuckle pin (universal)	55418
Steel pegs for the above (universal) ...	55461
Steering wheel extractor attachment (universal)	56052
Drop arm	56347
Reamers	
Steering knuckle bush	39009
Cutters	
Valve seat	65925
Assembly tools	
Clutch plate aligning tool	39371
Clutch dummy gauge plate	38446
Cylinder head distributor aligning gauge	39387
Screwed shackle adjusting thimbles ...	67800
Valve spring clamp	38879
Body tools	
Mono body jack (universal)	67797
Spanners	
Cylinder head nut (universal)	46556
Gudgeon pin clamp screw...	66243
Rear hub nut	36120
Lockheed bleeder screw wrench ...	38992
Tappet	45206
Sump drain plug	38935
Tappet head wrench	38932
Socket for tappet head wrench	38933
Miscellaneous	
Valve grinder (suction)	66893
Feeler blade (.017 in.) (.43 mm.) ...	39336



38378

Tool No. 38378. Valve Spring Extractor—Eight models

It has been found necessary to design a valve spring compressor, specially to suit the Eight model. It will be noted that it is sufficiently robust to prevent fracture in normal usage, and the foot is detachable, making it possible to fit a replacement if the original is damaged.



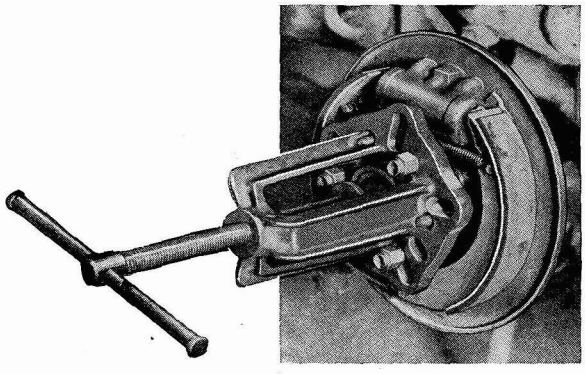
38879

Tool No. 38879. Valve Spring Clamp.

This tool simplifies the replacement of the valve springs.

By compressing the valve spring in a vice the clamp can be passed over it to embrace and retain the spring in a compressed condition.

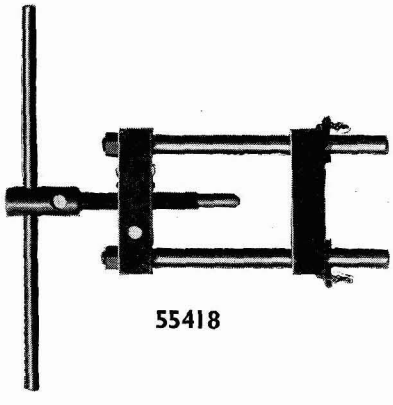
The spring can then easily be inserted in position, leaving the maximum room for the introduction of the cotters which can be manipulated into position on the valve stem by hand.



19431

Tool No. 19431. Front and Rear Hub Extractor —All models

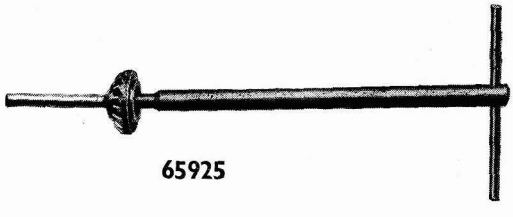
This tool has been designed to suit the front and rear hubs of all models from the early Minor to the present Series range. Consequently every Morris Dealer should have at least one for the use of the Repair Staff.



55418

Tool No. 55418. Steering Knuckle Pin Extractor—All models

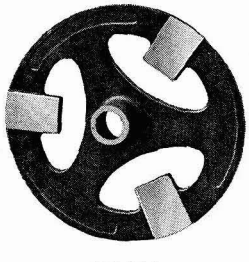
In service the need of a sturdy extractor for removing steering knuckle pins without taking away the front axle from the car has long existed. This particular extractor has been designed to press out even the most obstinate pin without damage. It is also used to replace the knuckle pins, and comes in useful as a portable press. Care should be taken to see that the special thrust pads provided are used, both when removing and replacing a pin.



65925

Tool No. 65925. Valve Re-seating Tool

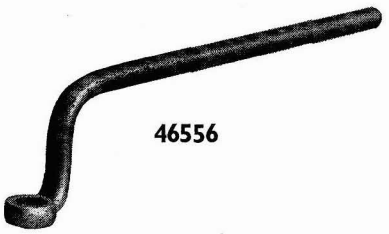
These cutters are made large enough to avoid shrouding or masking of the valves after a seat has been re-cut several times. A valve seat cutter should only be used to skim up a seating, and as little metal as possible should be removed.



38446

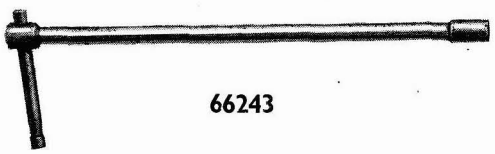
Tool No. 38446. Clutch Dummy Gauge Plate—Morris Eight

This becomes an essential tool when servicing the Borg & Beck clutch, which is fitted as standard to the above model. It ensures that the driven plate is adjusted parallel with the friction face of the flywheel, and that the clutch springs have the correct amount of load. In carrying out this adjustment, the dummy gauge plate takes the place of the clutch driven plate. The pressure plate assembly is added to the flywheel so that each toggle arm comes opposite to the ground surface of the dummy gauge plate. The toggle arm adjusting nuts are then tightened or slackened, until the end of each arm lies dead flush to a straight-edge placed across the ground boss of the gauge plate. This ensures equal throw on each arm, and that the pressure plate lies dead parallel with the flywheel.



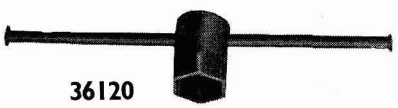
Tool No. 46556. Cylinder Head Nut Spanner

This spanner is specially cranked to clear the sparking plugs when undoing the cylinder head nuts, and becomes a most useful tool for inclusion in every mechanic's kit.



Tool No. 66243. Gudgeon Pin Clamp Screw Spanner

Owing to the restricted space inside the pistons of most engines, an ordinary box spanner is unsuitable for removing or replacing the gudgeon pin clamp screw. The spanners for the various models are shaped specially to suit and are sufficiently long to clear the connecting rod big-end.



Tool No. 36120. Rear Hub Nut Spanner

The necessity of stocking a tool suitable for the rear hub nut will be fully appreciated. The only other alternative, namely a hammer and punch, is to be deprecated, since not only is damage caused, but it is impossible to tighten the nut sufficiently by this means and, therefore, it is unsafe.

Tool No. 38932. Tappet Head Wrench

This tool becomes exceedingly useful when the occasion arises to change the tappet adjusting screws on the Morris Eight model. It will be noted that the socket is detachable from the stem. Consequently the socket is placed on the tappet screw first and the "T"-handled stem connected to it through the valve guide. It is claimed that a set of tappet screws can be replaced in less than ten minutes by the aid of this tool.

Tool No. 66893. Suction Valve Grinder

As valves on current models are not provided with a screwdriver grinding slot, it is necessary to use a rubber suction tool when grinding-in the valves. As it is exceptionally modestly priced, Dealers should purchase in quantities for resale to the Trade and Owners.

SECTION R

THE BODY

Maintenance.

Lubrication.

MAINTENANCE

The following checks should be made periodically :—

Examine the door strikers for wear. (See " Adjustment of the Doors," R.1.)

Examine the door hinge pins for wear. (See " Adjustment of the Doors," R.1.)

Check the screws securing the hinges, locks and handles.

Check the water drain tubes.

LUBRICATION

Lubrication is necessary at the following points :—

Striking plates—coat lightly with grease.

Door hinges—oil at intervals.

Driver's seat—lubricate the moving parts of the frame.

Section R.1

ADJUSTMENT OF THE DOORS

When the door is closed and correctly adjusted it will be a tight fit on the rubber surround. Should it be necessary to adjust it, proceed as follows :—

Slacken the two screws securing the striking plate, and move the plate inwards one serration. Tighten the screws and check. Repeat if required.

Check also that the peg is a correct fit in the socket of the peg plate ; i.e. the peg should fit in the socket for approximately a quarter of its length.

Adjust if necessary by slackening the two screws holding the plate and moving it the required amount. Retighten the screws.

Check each hinge for slackness, and if necessary adjust by slackening off the hinge pin lock washer, tightening up the pin nut as required, and then re-locking with the tab of the lock washer.

Section R.2

CLEANING BODY DRAIN TUBES

A periodical check of the body drain tubes is necessary. The drain tubes and outlets provided are of ample proportions, and if kept clear will cope with all the water they are called upon to deal with under the most severe conditions. If, however, they become choked and the water does not drain away, it will remain behind the panels, producing corrosion. When an outlet becomes choked, the foreign matter in it may set hard ; this can be removed by means of a metal or wooden skewer with a blunt point.

Care must be exercised when carrying out this operation, or the tube may be punctured or forced

back into the interior of the body. A considerable amount of work would then be necessary to restore it to its normal position, or to replace it.

To check the drain tubes, open the sliding roof and carefully pour water into the exposed ends of the tubes. By inspecting the issue of water at their lower ends it will be easy to determine whether the drain tubes are clear or not.

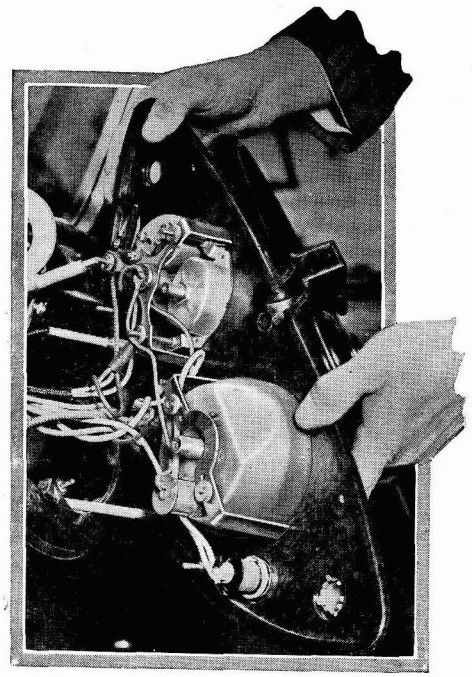


Fig. 98.
Showing the instrument panel removed from the facia.

Section R.3

DISCONNECTING WIRING FOR REMOVAL OF THE BODY

Disconnect both battery terminals and remove the battery fixing bolts and the battery.

Disconnect the wires from the insulated terminal and the body terminal of the petrol pump.

Disconnect the wires to the CB and SW terminals of the coil, and remove the H.T. lead from the centre terminal.

Detach the coil from the scuttle by removing the two $\frac{3}{16}$ in. attachment bolts. Note the battery cable clip on the off-side fixing bolt. Remove the nut and bolt securing the engine earthing cable to the scuttle.

It is not necessary to disconnect the various wires from the cut-out and control box. Remove the box from the scuttle by undoing the two round-headed screws and nuts. Note that a rubber washer is fitted on each screw between the base of the control box and the scuttle.

Remove the black and purple lead from the windscreen wiper motor, noting that it is the wire attached farthest from the scuttle.

Remove the instrument panel by undoing the two screws securing the top to the facia panel and the two hexagon nuts located behind at the bottom. Draw the instrument panel forward and extract the following wires from their respective terminals :—

One yellow wire to ignition warning light.
One black wire to speedometer support frame.
One white wire to centre terminal of switch box, marked IG.
One blue wire to the first or right-hand bottom terminal H.
One black and white wire to the second terminal A.
Three red wires to the third terminal T.
} These connections are all on the switchbox.
The fourth terminal is left blank.
Two black wires to the instrument support frame.
One purple and blue wire to the top petrol gauge terminal T.
One purple and black wire to the bottom petrol gauge terminal +B.

The remaining wires are left in position on the panel. The connections referred to above are when looking at the back of the instrument panel, but reference to the illustration will show the exact position of each wire.

Disconnect the speedometer outer cable from the speedometer head. Disconnect the oil pipe from the oil gauge, and release the pipe from its connection on the cylinder block. Withdraw the pipe from the scuttle.

Release the mixture control from the carburetter by slackening the nut securing the inner cable to the jet operating arm and unscrewing the bolt locating the outer cable steady bracket to the cylinder head.

Disconnect the starter switch operating control from the coupling on the scuttle. Undo the switch securing nut and push the switch assembly forward from the scuttle ; replace the nut on the switch body.

Remove the windscreen wiper control knob by unscrewing its small grub screw. Undo the retaining screw in the centre of the windscreen control operating handle, and withdraw the handle from its spindle. Lift the instrument panel cables and their sheath from the clip securing them to the windscreen wiper assembly.

Disconnect the black " earth " cable from the identification plate fixing bolt.

The harness cable and speedometer cable are now withdrawn from the scuttle towards the engine.

Disconnect the dynamo earth wire from the clip securing the harness cable to the off-side wing valance.

Separate the two trafficator wires from their snap connections, located under the off-side door hinge pillar. Remove the protective cover from the top of the floorboard and withdraw the wires up into the interior of the body.

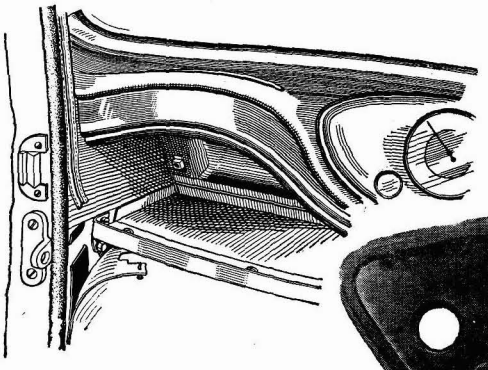


Fig. 99.
(*Above*). This clearly illustrates the position of the glove tray rail fixing screws.

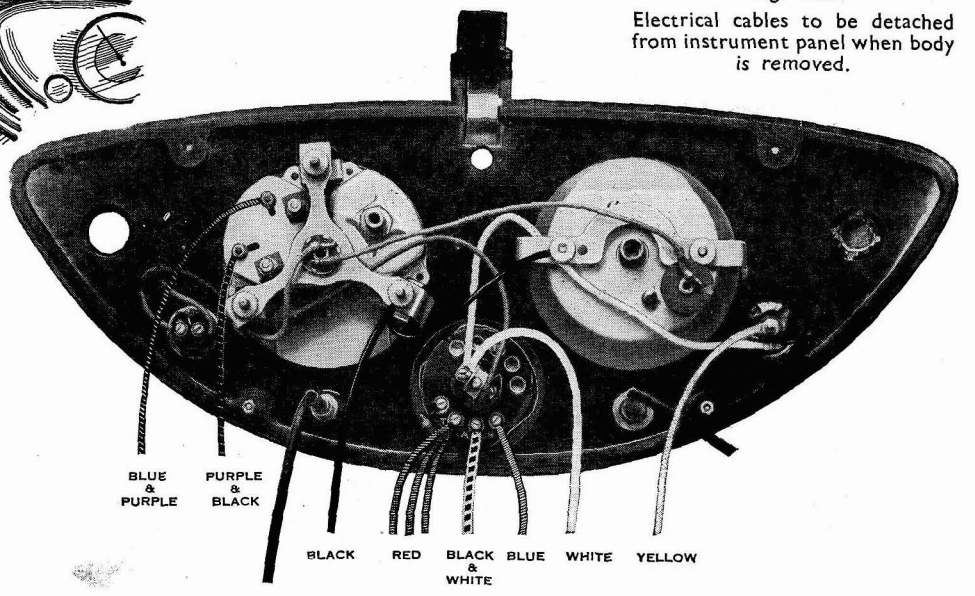


Fig. 100.
Electrical cables to be detached from instrument panel when body is removed.

Disconnect the wires from the tail- and stop-lamp, observing that the red wire is attached to the tail-lamp, the purple to the stop-lamp, and the black to the earth terminal.

Disconnect the off-side and near-side headlamp wires from their multiple snap connections.

Section R.4

REMOVAL OF THE BODY

Remove the wiring as in Section R.3.

Remove the front and rear floor mats by extracting the press pins. Remove the front near-side seat by undoing the four $\frac{3}{16}$ in. bolts and clips locating the seat to the floor of the car, and the off-side seat by releasing the four $\frac{3}{16}$ in. nuts locating the seat to its runners and lifting the seat clear. Remove the rear seat cushion and squab. The latter is located by four round-headed wood screws which are accessible from inside the luggage boot.

Disconnect the petrol pump feed pipe and detach the pump from the scuttle. Without releasing the flexible petrol hose, the pump may now be rested on top of the engine.

Remove the bonnet by unscrewing the four bolts securing it to the hinges.

Release the glove tray front rail from the steering column by removing the two $\frac{3}{16}$ in. nuts, bolts and spring washers from the steady bracket. Remove the raised head fixing screw and nut from the glove tray centre support bracket. Extract the seven bifurcated rivets attaching the glove tray floor to the front rail. Undo the round-headed metal fixing screw and the $\frac{3}{16}$ in. bolt with spring washer locating each end of the rail to the body side. Ease back the trim panel at each side and remove the rail.

Detach the gear lever knob, first slackening the $\frac{1}{4}$ in. locknut, and remove the gearbox rubber cowl.

Remove the near-side and off-side floorboards by unscrewing the four countersunk-headed metal fixing screws, equipped with disc washers. Release the rexine draught excluder from the body side member.

Release the off-side toe-board by removing the countersunk fixing screws and disc washers securing it to the chassis, and detach the foot-operated dip-switch from the board by undoing the two round-headed metal fixing screws.

The near-side toe-board and gearbox shield assembly is detached by removing the countersunk-headed and the single round-headed metal fixing screws and disc washers.

Remove the small metal plate covering the aperture under the steering column at the bottom of the

scuttle by undoing the two countersunk-headed metal fixing screws and disc washers.

Extract the three $\frac{1}{4}$ in. bolts, nuts and spring washers locating the scuttle side panel to the bonnet valance on each side, and the four $\frac{1}{4}$ in. bolts and plain washers securing the rear half of the front wings to the body.

To remove the rear bumper bar, detach the small metal plates covering the rearmost bumper bracket bolt holes. Reference to the accompanying illustration will explain the location of the plates, which are attached by two countersunk-headed self-tapping screws. The bumper brackets are located on each side by two $\frac{3}{8}$ in. bolts and nuts, equipped with spring washers, which should be removed with a suitable box spanner. The bumper is then withdrawn from the rear.

Note.—Keyhole slots provided for removing plate while leaving screws in position.

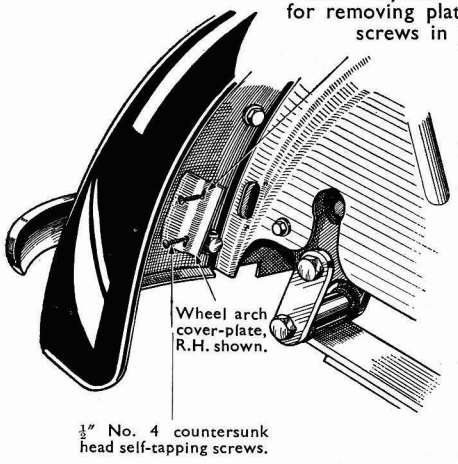


Fig. 101.

(*Above*). The arrows indicate keyhole slotted wheel arch cover-plate and its countersunk-headed attachment screws.

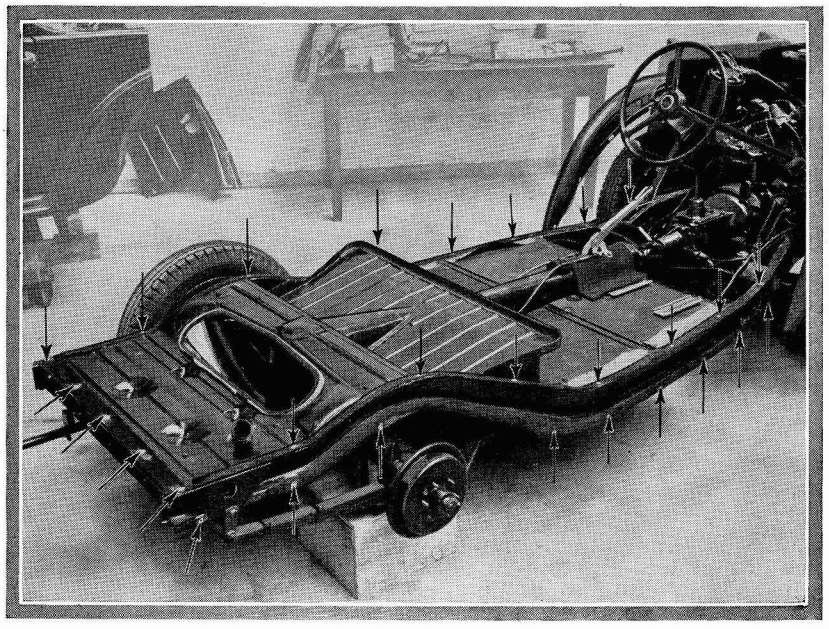


Fig. 102.

(*Right*). The arrows indicate the positions of the various body bolts.

Unscrew the eight countersunk-headed metal screws and dished washers locating the body to the top face of each frame side member, and the three countersunk screws and two $\frac{3}{16}$ in. bolts locating the body to the rear frame cross-member. (See illustrations.)

Remove from each side the $\frac{3}{16}$ in. nuts and bolts passing through the chassis frame side members. These are located under the body sills and rear wheel arches.

Release the petrol tank filler neck by slackening the connecting hose clips inside the luggage boot, and extract the neck from the boot side.

Removal of the rear wings is not essential but it is recommended to avoid damage.

The body is now ready for removal and the rear end should be raised to enable the insertion of a suitable lifting pole over the centre of the rear wheels.

Raise the front end of the body and place a second pole between the body and the chassis just to the front of the hand brake lever.

Four men are required to lift the body clear and carry it backwards from the chassis. (See Fig. 103.)

Reassembly is carried out in the reverse order to that of dismantling, and when the body is replaced make sure that the scuttle side panels go right up to the bonnet valances, and replace and tighten the three nuts and bolts on each side first.

Section R.5

REMOVAL AND REPLACEMENT OF DOOR AND WINDOW HANDLES

Each of the interior door and window handles may be withdrawn from the squared end of its shaft, after removal of the central securing screw. Remove the thrust washer situated between the handle and the trim panel.

The near-side front and rear, and off-side rear, exterior door handles are removed by unscrewing the two screws in the escutcheon plates and pulling the handles outwards.

To remove the off-side front door exterior handle, the two escutcheon plate screws and the anti-thief screw, in the end of the shank beneath the trim panel, must be removed.

To expose this screw, it is necessary to remove the window moulding, the interior handles and the trim panel.

Replacement of the handles is a reversal of the above procedure.

trim fillets and then the clips securing the light to the body.

The door lights in the rear doors of the four-door models are removed as follows :—

Wind the door light to its lowest position.

Remove the door moulding and interior handles and trim pad.

Remove the door light channel and window guide channel.

Fig. 103.
Four men are required to lift the body with suitable poles in the positions illustrated.

Section R.6

REMOVAL AND REPLACEMENT OF DOOR LIGHTS

The front windows are cable operated, and the rear ones quadrant operated.

To remove the front lights, proceed as follows :—

Wind the door light to its lowest position.

Remove the door moulding, interior handle and trim pad.

Remove the door light channel and window guide channel.

Release the door light from the cable by removing the four cheese-headed screws and removing the two plates.

Remove the door light by lifting upwards and forwards.

Replacement is a reversal of the above procedure.

The off-side and near-side rear fixed light of the two-door model is removed after first removing the

Release the window regulator assembly from the inner door panel.

Engage the regulator handle and rotate the quadrant until the lift arm is clear of the light lift channel.

Remove the door light by lifting upwards and forwards.

Replacement is the reversal of the above procedure.

Section R.7

REMOVAL AND REPLACEMENT OF DOOR LOCKS

Wind the door light until it is in the closed position.

Remove both interior and exterior handles of the lock and remove the window regulator handle.

Remove the door moulding and the trim pad. Re-engage the inner door handle.

Remove the window metal guide channel.

Remove the two fixing screws with spring and flat washers on the inside of the door, and the two

countersunk-headed screws on the door edge securing the lock in position.

With the inner handle, turn the door lock to the "open" position.

Push the lock towards the outside panel of the door, and remove the inner handle.

Allow the lock to pass round the outer edge of the door, and remove it from the centre of the panel.

Replace the lock by reversing the above procedure.

Section R.8

REMOVAL AND REPLACEMENT OF THE WINDSCREEN

Open the windscreen fully, and disconnect the winder chain at the windscreen end by removing the cheese-headed fixing screw.

Remove the raised head hinge adjusting screw.

Part the hinges by removing the two $\frac{1}{4}$ in. bolts which secure the halves together.

The windscreen is now free to be withdrawn.

Replacement of the windscreen is a reversal of the above procedure, but care should be taken to fit the screen square with the pillars. This is achieved by using the round-headed screws provided at the hinge. When the screen has been correctly adjusted, the two $\frac{1}{4}$ in. bolts should be tightened.

Section R.9

REMOVAL AND REPLACEMENT OF THE SLIDING HEAD ASSEMBLY

For repair or retrimming, the sliding head assembly, which includes the lock and lifting device, can be removed with little difficulty from the guide channels.

When the roof is opened approximately half way, it will be observed that there are two guides (one at each side of the forward end) located to the sliding portion. Extract the cheese-headed metal thread screws and release the guides from their runners by levering them outwards.

The assembly is now pulled forward and raised at the front end until it is clear of the windscreen panel and may be lifted from the body.

To adjust the effective lift of the sliding head locking device, the rear guide runners may be opened or closed to raise or lower the assembly as required.

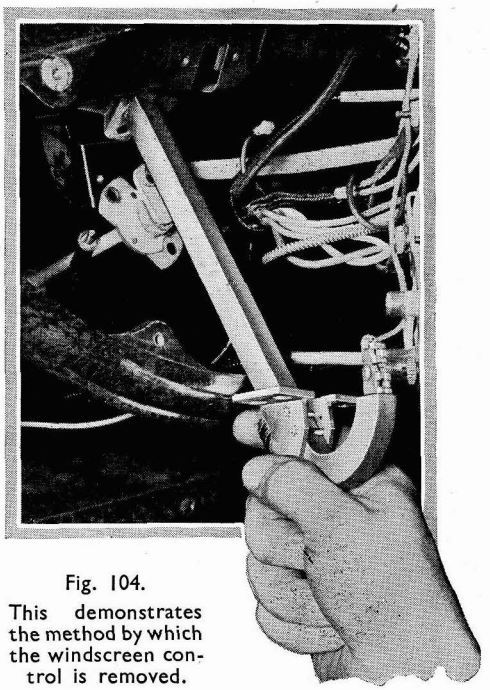


Fig. 104.
This demonstrates the method by which the windscreen control is removed.

The roof trimming is secured by tacks to wooden fillets attached to the metal panel with the exception of the rear end which is fixed in position by suitable adhesive compound.

When replacing the roof assembly locate the centralising rod (which is attached to the rear framework) to the slot in the rear face. Ensure that the rear felt guides enter the runners at both sides and then push the roof backwards, lowering the forward end until it is finally positioned.

The front bolt guides are now located to the runners, and secured by the cheese-headed fixing screws.