Dansk Overseisk Motor Industri A/S
(Service Afdelingen)

The
MORRIS SIX
(Series "MS")
WORKSHOP MANUAL

Issued by
NUFFIELD EXPORTS LIMITED
COWLEY - OXFORD - ENGLAND

61.23

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NUFFIELD EXPORTS LIMITED

Proprietors: MORRIS MOTORS LIMITED

COWLEY - OXFORD - ENGLAND

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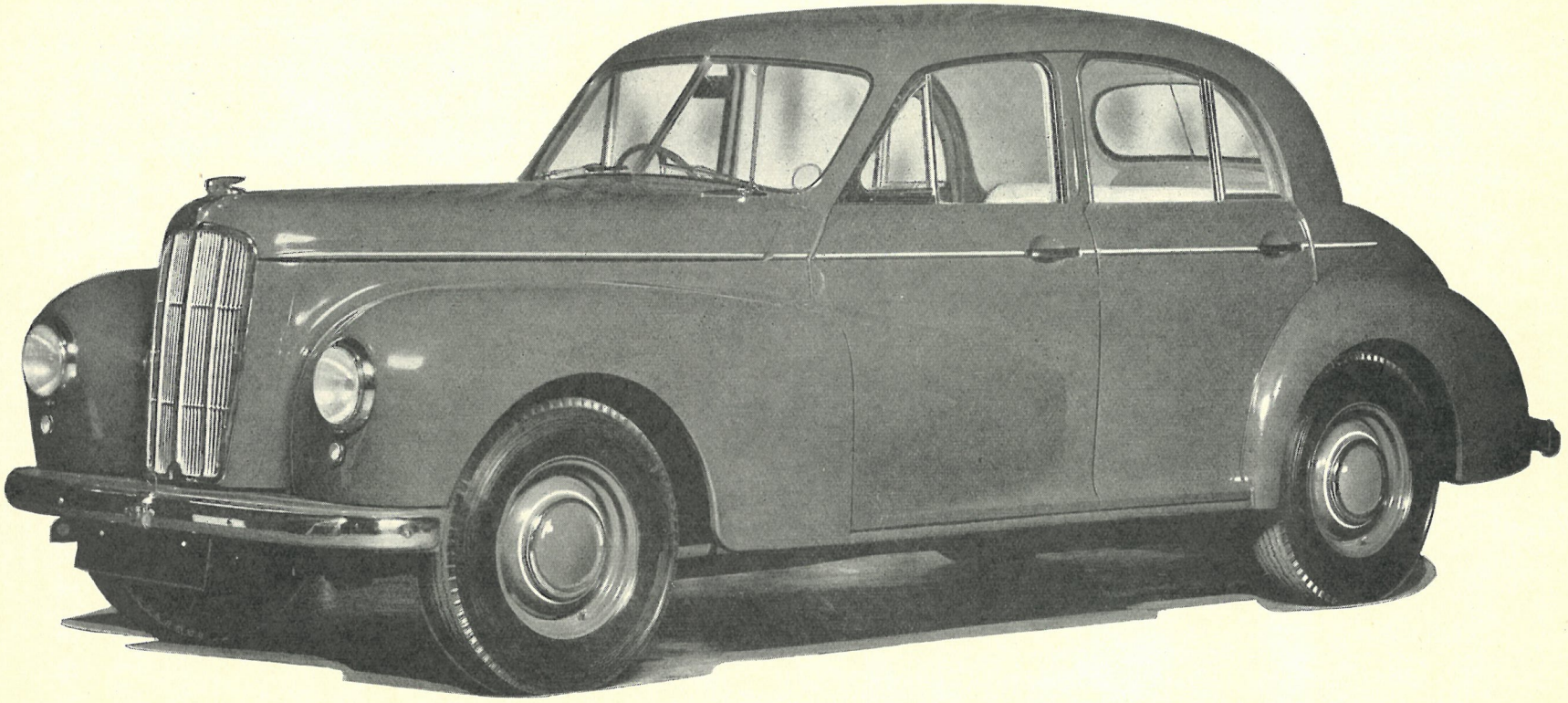
THE MORRIS SIX SALOON (Series "MS")



CONTENTS

	Section
General Data	
General Information	
Maintenance Attention (Free and Periodical)	
Frost Precautions	
Engine	A
Fuel System	B
Ignition Equipment	C
Cooling System	D
Clutch	E
Gearbox	F
Propeller Shaft	G
Rear Axle	H
Rear Road Springs	I
Steering Gear	J
Front Suspension	K
Hydraulic Dampers	L
Braking System	M
Electrical Equipment	N
Tyres	O
Lubrication	P
Special Tools	Q
Body	R
Heater	S
Special Repairs	T

GENERAL DATA

ENGINE TYPE	VC 22 M.
Number of cylinders	Six.
Capacity	2214·8 c.c. (135·1 cu. in.).
B.H.P.	70 at 4,400 r.p.m.
Bore	73·5 mm. (2·894 in.).
Stroke	87 mm. (3·425 in.).
Compression ratio	6·5/6·6 to 1.
System of cooling	Thermo-syphon—impeller assisted.
Radiator hose top	$1\frac{1}{2}$ in. (inside dia.) $\times 6\frac{1}{2}$ in. (38·1 mm. $\times$ 16·5 cm.).
Radiator hose bottom	$1\frac{1}{2}$ in. (inside dia.) $\times 2\frac{7}{8}$ in. (38·1 mm. $\times$ 7·3 cm.).
First oversize bore	+·020 in. (·50 mm.). Actual bore size 74·0 mm. (2·9137 in.).
Second oversize bore (maximum)	+·040 in. (1·0 mm.). Actual bore size 74·5 mm. (2·9337 in.).
Firing order	1–5–3–6–2–4.
Piston type	" Y " alloy wire-wound.
Piston fit	From ·0002 in. (·005 mm.) interference to ·0008 in. (·02 mm.) clearance.
Ring gap	·0085 in.—·0125 in. (·21 mm.—·31 mm.).
Number of compression rings	Two.
Width of compression rings	2 mm. (·079 in.).
Number of oil rings	One.
Width of oil rings	3·97 mm. (·156 in.).
Oil pressure release valve operates	80 lb. per sq. in. (5·6 kg./cm.^{2}).
Filter by-pass valve operates	12–14 lb. per sq. in. (·85 to ·99 kg./cm.^{2}).
Gudgeon pin type	Semi-floating.
Gudgeon pin diameter	·75 in. (19·05 mm.).
Fit in piston	Hot—floating. Cold—push fit.
Fit in connecting rod	Clamped.
Crankpin diameter (standard)	2·0 in. (50·8 mm.).
Crankpin minimum diameter for regrind	1·960 in. (49·78 mm.).
Connecting rod—length between centres	6·406 in. (16·27 cm.).
Connecting rod—type of bearing	Steel-backed, white-metal lined.
Connecting rod—side clearance	·0035 in.—·0065 in. (·09 mm.—·165 mm.).
Connecting rod—diametrical clearance	Normal ·001 in. (·025 mm.). Max. ·003 in. (·075 mm.).
Number of crankshaft bearings	Four.
Type of main bearings	Steel-backed, white-metal lined.
Standard main journal diameter	2·25 in. (57·15 mm.).
Main journals first regrind diameter	2·23 in. (56·64 mm.).
Main journals second regrind diameter (minimum)	2·21 in. (56·13 mm.).
Main bearings—length	Front and intermediate 1·594 in. (40·48 mm.). Rear 2·108 in. (53·54 mm.).
Main bearings—end clearance	·0016 in.—·0048 in. (·04 mm.—·12 mm.).
Main bearing—diametrical clearance	Normal ·001 in. (·025 mm.). Max. ·002 in. (·05 mm.).
Crankshaft—end thrust taken on	Rear main bearing.
Number of camshaft bearings	Four.
Type of camshaft bearings	White-metal lined, steel-backed.
Camshaft—bearing clearance	·0012 in.—·0038 in. (·030 mm.—·096 mm.).
Camshaft—end thrust taken on	Thrust plates on front bearing.
Camshaft—drive (type)	Worm gears and vertical shaft.
Valve timing markings	Flywheel and front camshaft journal.
Exhaust valve throat diameter	1·10 in. (27·94 mm.).
Exhaust valve diameter	Head 1·23 in. (31·24 mm.); Stem ·50 in. (12·7 mm.).
Inlet valve throat diameter	1·22 in. (31 mm.).

GENERAL DATA—*continued*

Inlet valve diameter	Head 1·31 in. (33·27 mm.) ; Stem ·50 in. (12·7 mm.).
Valve seat angle	45°.
Tappet type	Adjustable (screwing into valve stem).
Inlet valve clearance for timing	Timing by timing marks.
Valve lift—inlet	·30 in. (7·62 mm.).
Valve lift—exhaust	·30 in. (7·62 mm.).
Inlet valve opens	8° before T.D.C.
Inlet valve closes	52° after B.D.C.
Exhaust valve opens	52° before B.D.C.
Exhaust valve closes	8° after T.D.C.
Valve spring—shut	38 lb. (17·24 kg.).
Valve spring—open	60 lb. (27·2 kg.).
Inlet valve opens—piston traverse	Piston crown ·021 in. (·53 mm.) below top of block.
Inlet valve working clearance	·015 in. hot (·38 mm.).
Exhaust valve working clearance	·015 in. hot (·38 mm.).
Valve guides	Renewable.

FUEL SYSTEM

Petrol tank level	Recorded by electric gauge on instrument panel.
Fuel delivery	S.U. electric pump.
Carburetter	S.U. horizontal.
Carburetter needle	Standard—AY.

CLUTCH

Type	Borg & Beck 9 in. A.6–G dry plate (22·86 cm.).
Facing	Borg & Beck composite.

GEARBOX

Synchromesh ... ... Second, third, top.

	FIRST SERIES		SECOND SERIES (After Engine No. 2864)					
Ratio	First and Reverse	3·214–1	3·214—1					
	Second	2·087–1	2·25—1					
	Third	1·344–1	1·446—1					
	Top	1·000–1	1·000—1					
Overall gear ratios ...	First and Reverse	13·177	With 10/41 axle	13·177	With 9/41 axle	14·642	With 8/41 axle	16·472
	Second	8·556		9·225		10·248		11·531
	Third	5·510		5·928		6·586		7·410
	Top	4·1		4·1		4·555		5·125

Speedometer gear to pinion ratio ... ... 10/41 axle : 9/17. 9/41 axle : 6/13. 8/41 axle : 7/17.

FRONT AXLE AND STEERING

Camber	Nil to $\frac{3}{4}$° positive.
Castor angle	1° after Chassis No. SMS.790 (+738+745). Previously 3°.
Toe-in	Wheels parallel.
King-pin inclination	9°. With telescopic dampers on front suspension 9$\frac{1}{2}$°.
Track (front)	54 in. (1·372 m.).
Track (rear)	53 in. (1·346 m.).
Turning circle	40 ft. 5 in. (12·3 m.).
Wheelbase	9 ft. 2 in. (2·794 m.).
Tyre size	6·00—15.
Tyre pressures—normal	Front 22 lb. per sq. in. (1·6 kg./cm.^{2}). Rear 24 lb. per sq. in. (1·7 kg./cm.^{2}).
Tyre pressures—fully loaded with five passengers and luggage	Front 24 lb. per sq. in. (1·7 kg./cm.^{2}). Rear 26 lb. per sq. in. (1·8 kg./cm.^{2}).

GENERAL DATA—*continued*

REAR AXLE

Type of axle	Semi-floating.
Type of drive	Hypoid.
Ratio or number of teeth	10/41 (first series), 9/41 (second series), 8/41 (special).
Adjustment	By distance-pieces.

BRAKES

Type	Lockheed hydraulic 10 in. (25·4 cm.) dia.
Type of linings	Ferodo MR.19.
Lining size—front	9·42 in. × 1·72 in. × ·203 in. (23·92 cm. × 4·36 cm. × ·52 cm.).
Lining size—rear	9·42 in. × 1·72 in. × ·203 in. (23·92 cm. × 4·36 cm. × ·52 cm.).
Number and size of rivets	Twelve ·140 in. × ·28 in. (3·5 mm. × 7 mm.) (tubular).

SPRINGS

Type—front	Torsion bar.
Type—rear	Semi-elliptic.
Working load—front	783 lb. (355 kg.).
Working load—rear	679 lb. (308 kg.).
Length—rear (flat)	48 in. (1·22 m.) between eye centres.
Width—rear	1½ in. (38·1 mm.).
Number of leaves—rear	Eight.
Thickness of leaves—rear	¼ in. (6·35 mm.).
Camber—rear	Free : 3·56 in. (9·5 cm.). Working : ¾ in. neg. (1·9 cm.).

HYDRAULIC DAMPERS

Type : Front and rear	Armstrong piston type, Woodhead-Monroe or Girling telescopic type.

ELECTRICAL

Distributor rotation	Anti-clockwise.
Manual advance	None.
Automatic advance	Vacuum and centrifugal governor.
Contact breaker gap	·010 in.—·012 in. (·25 mm.—·30 mm.).
Sparking plug, make and type	Champion L.10 14 mm. ½ in. reach.
Sparking plug gap	·018 in.—·022 in. (·46 mm.—·56 mm.).
Ignition timing—degrees	Crankshaft 5° B.T.D.C. Flywheel ½ in. (12·7 mm.) B.T.D.C.
Charging system	Compensated voltage control.
Battery—make, type and capacity	Lucas G.T.W. 9A, 12-volt 51-amp./hr.
Battery earth circuit	Positive.

CAPACITIES

Sump	10 pints (5·7 litres).
Gearbox	2 pints (1·14 litres).
Rear axle	2½ pints (1·4 litres).
Use Hypoid oil only	
Cooling system	20 pints (11·4 litres).
Petrol	12 gallons (54 litres).

GENERAL DIMENSIONS

Overall length	177 in. (4·5 m.).
Overall width	66 in. (1·68 m.).
Overall height	63⅜ in. (1·61 m.).
Ground clearance	7 in. (17·8 cm.).
Weight	25 cwt. (1270 kg.) (unladen, oil and water, no petrol).

IMPORTANT

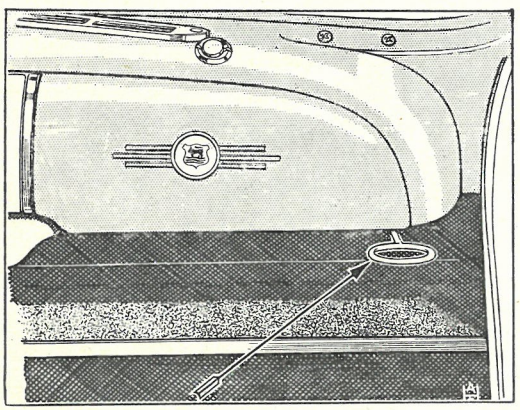
The nut and bolt sizes given in this manual refer only to the size of spanner required to deal with them. Unless otherwise stated all threads used are B.S.F., but the standard Whitworth spanner size is given in accordance with the usual practice, i.e. a ¼ in. spanner is required to undo a bolt which has a $\frac{5}{16}$ in. B.S.F. thread.

GENERAL INFORMATION

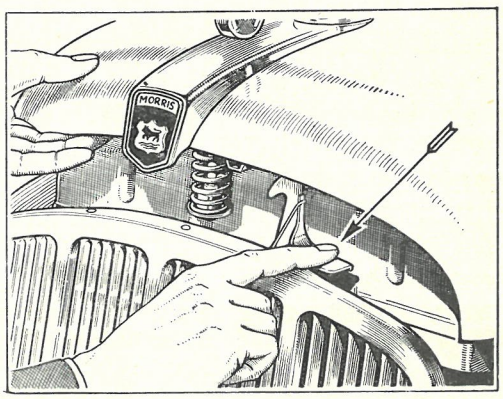
TO OPEN THE BONNET

Release the bonnet catch from inside the car by a gentle pull on the control ring, which is to be found under the facia panel on the extreme right-hand side of the parcel tray.

Depress the lever below the bonnet motif and lift the bonnet lid until the prop can be released from its retaining clip and the end inserted into engagement with the aperture for the lock pin. See that the prop end is right home in the lock pin socket to safeguard against accidental release of the prop by pressure on the bonnet while working or by wind pressure.



Release the bonnet catch by pulling the control ring.

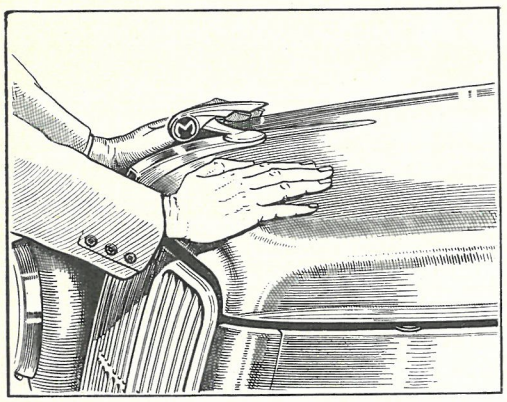


Release the safety catch by pressing on the catch lever extension.

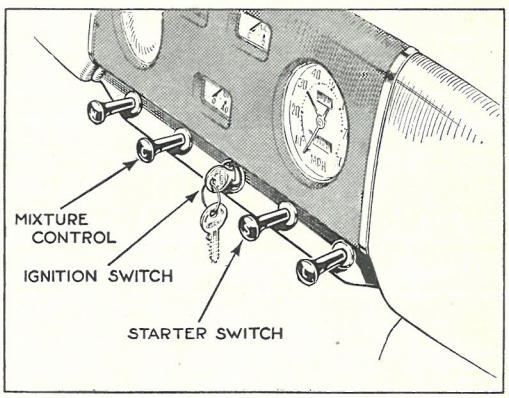
TO CLOSE THE BONNET

Lift the bonnet, insert the prop in its retaining clip, and then lower the bonnet until it engages the safety catch.

Exert downward pressure on the bonnet front to force the lid into the fully closed position.



To engage the bonnet catch, force the bonnet front downwards.



The control panel, showing the location of the mixture control, ignition switch and starter switch.

THE CONTROL PANEL

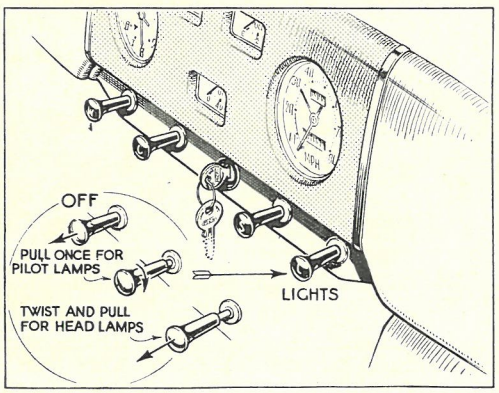
Mixture Control. When starting from cold, rotate the control knob slightly to the right and pull it right out. Immediately the engine has started to run, return the knob half-way and turn it 90° in an anti-clockwise direction to lock it in position. Release and push the knob right in as soon as the warming engine will allow.

Ignition Switch. Turn the key to the right to switch on. Never leave the switch "on" when the engine is not running as this will damage the ignition coil and run down the battery. The ignition key will lock the driver's door and the luggage boot lid.

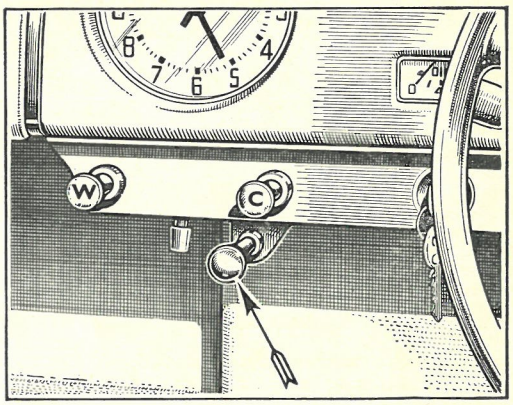
The Starter Switch. Pull the starter knob sharply and return it as soon as the engine fires. Never operate the starter while the engine is running or while the starter motor is still spinning.

The Lamp Switch. Pull the knob outwards to the first stop to put the pilot (side) lamps and tail-lamps on. Twist the knob to the right and pull out again to switch on the headlamps.

The Engine Stop Control. To ensure that the engine ceases to run when the ignition is switched off an engine stop control is fitted to the early models, controlled by the knob under the control panel on the left-hand side. Pulling this knob out completely closes the throttle and stops the engine. The knob must be pushed right in to its stop again after the engine has stopped. Certain modifications on later models have rendered this control unnecessary and it is therefore no longer fitted after Car No. SMS/10215 R.H.D. and SMS/6519 L.H.D.



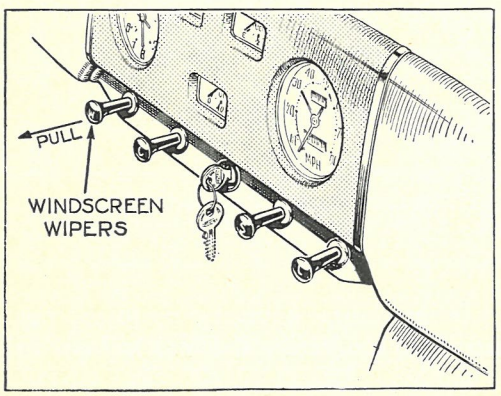
The lamp switch and its operating positions for pilot and headlamps.



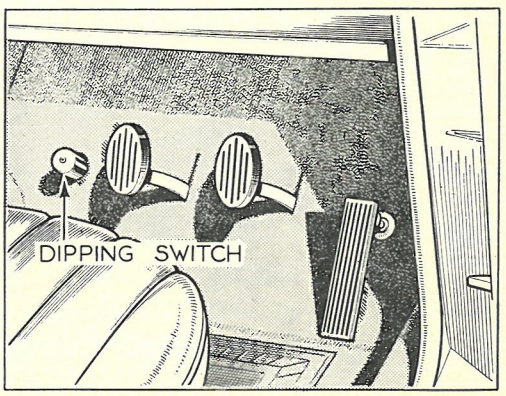
The engine stop control knob on early models for providing definite stopping of the engine.

The Windscreen Wiper Control. Pull outwards the knob on the extreme left of the control panel to operate the windscreen wipers.

The blades cannot be disconnected from the wiper motor and they are parked by switching off when they are at the extremity of their operating arc.



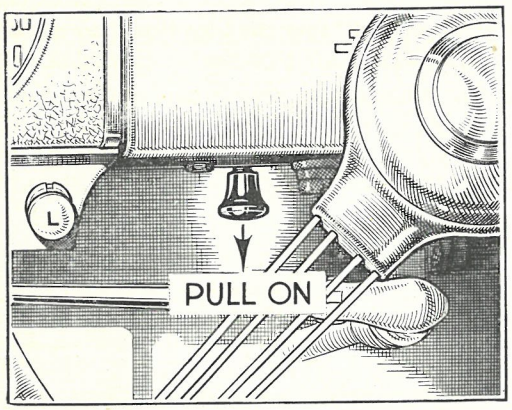
The windscreen wiper switch.



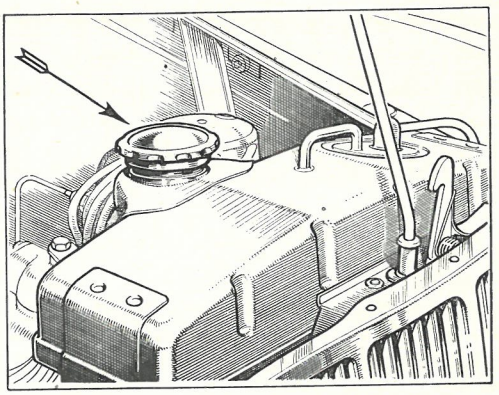
The headlamp dipping switch.

The Headlamp Dipping Switch. The switch controlling the dipping of the headlamps is foot operated and located in the toeboard. It is of the repeating type and switches on the full beams and dipped beam with alternate depressions of the switch.

The Panel Light Switch. This switch is located under the facia panel just to one side of the steering column. It pulls downwards to switch on the panel lights.



The panel light switch.

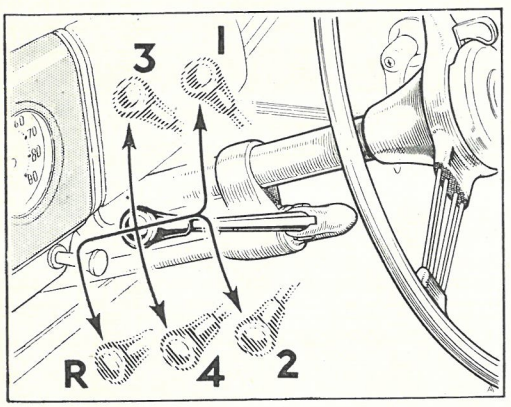


The radiator filler cap.

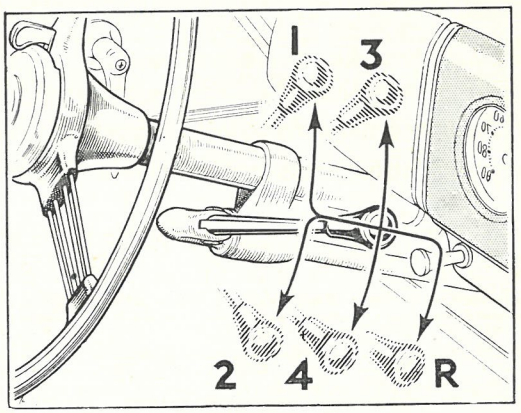
GEAR POSITIONS

The gearbox has four forward speeds, with synchromesh on second, third and top. The gear lever positions are shown in the illustrations below.

To engage reverse gear, pull the gear lever knob outwards and move the gear lever downwards in the neutral position ; and move the lever rearwards.



The gear lever positions on right-hand drive cars.



The gear lever positions on left-hand drive cars.

The normal position of the gear lever is in the neutral position between third and fourth gears as shown in the illustrations. When it is required to engage first or second gears the gear lever must be moved upwards through the gate in neutral position and then forwards or rearwards into the gear position required.

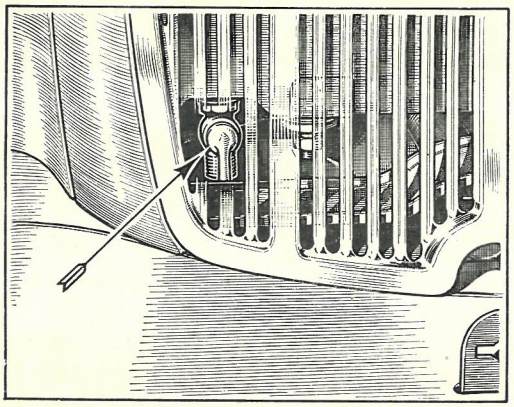
The gear positions are clearly indicated in the illustrations for both right- and left-hand drive models.

FILLING UP THE COOLING SYSTEM

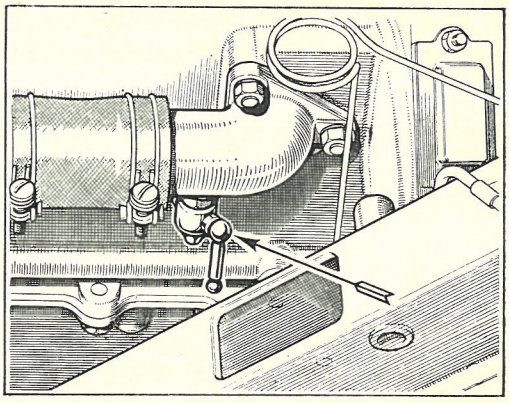
The radiator should be filled to approximately 1 in. below the bottom of the filler neck, and no more, particularly if anti-freeze solution is in use.

DRAINING THE COOLING SYSTEM

Two drain taps are fitted to the cooling system, both of which must be used to drain the system completely, otherwise an appreciable amount of water will be trapped in the cylinder block by the impeller pump, which is mounted high in the circuit.



The radiator drain tap.



The cylinder block drain tap.

The radiator drain tap is fitted in the right-hand side of the bottom tank and reached from under the front bumper while the cylinder block drain tap is fitted to the water inlet elbow at the rear end of the cylinder block on the left-hand side of the engine.

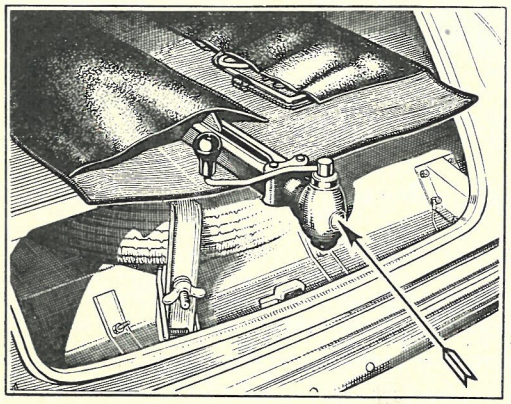
JACKING UP THE CAR

The special jack is housed in clips in the spare wheel compartment.

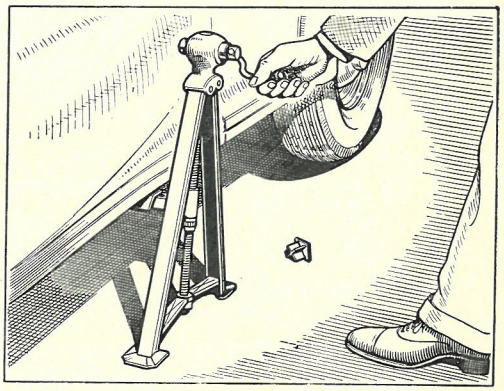
When raising a rear wheel the arm of the jack must engage the special socket bracket fitted beneath the centre body pillar between the two doors. The square hole of the socket is normally closed with a rubber plug to keep out the weather.

Ensure that the jack is leaning slightly inwards when in use, and place blocks of wood on either side of the two wheels remaining on the ground to prevent the car rolling if the hand brake is released.

The jack is operated by the handle provided and lifts both wheels on one side together.



The jack is housed in the spare wheel compartment in the boot.



The special jack in use. Note that it should lean slightly inwards at the commencement of the lift.

THE TOOL KIT

All the tools provided with the car except the jack, starting handle and tyre pump, which are carried in clips, will be found in the tool roll, which is located in the spare wheel compartment below the boot floor and between the petrol filler spout and the body side.

MAINTENANCE ATTENTION

FIRST 500 MILES (800 KM.) FREE SERVICE ATTENTION

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

(*b*) Oil and grease vehicle throughout with appropriate 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 and spring clips.

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

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

PERIODICAL ATTENTION

Every 250 miles (400 km.) : Inspect oil level in engine. Refill if necessary with oil to Ref. A (page P.2).

Every 500 miles (800 km.) : See that wheel nuts are tight.

Attach grease gun filled with grease to Ref. D (page P.2) to the following grease nipple fittings (11 in all) and give pump three or four strokes :—

4 on swivel pin links,
2 on each steering tie-rod,
2 on track-rod,
1 on steering transfer box,
1 on brake and clutch pedal fulcrum pin,
1 on water pump shaft.

See that radiator is full of water. The water level should be $\frac{1}{2}$ in. (12 mm.) below the filler neck and never allowed to sink so low that the cylinder outlet pipe opening is not fully covered.

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

Every 1,000 miles (1600 km.) : Inspect oil level in gearbox and rear axle. Refill if necessary.

Apply grease gun filled with grease to Ref. D (page P.2) to the three nipples on the propeller shaft.

Examine level in Lockheed brake supply tank and replenish with Lockheed Orange fluid (Lockheed No. 5 Overseas) if necessary. The tank should never be allowed to be less than half-full of fluid nor closer than $\frac{1}{2}$ in. (12 mm.) to the bottom of the filler opening.

Top up battery with distilled water.

Add engine oil to Ref. F (page P.2) to carburetter piston dashpot.

Use the oilcan sparingly on the carburetter controls, door hinges, bonnet lock and operating mechanism, hand brake compensating yoke (under car), hand brake balance lever operating fork joint, and seat adjusters.

Every 3,000 miles (5000 km.) : Drain engine and refill with fresh oil. (Page P.2.)

Clean engine oil filter element.

Withdraw rotating arm from distributor and add two drops of engine oil to Ref. F (page P.2) in the aperture. Also lubricate the automatic advance mechanism with engine oil through the hole provided in the contact breaker base plate.

Add a smear of grease to Ref. D (page P.2) to the distributor cam contact breaker pivot and to the face of the cam.

Clean and re-oil the air cleaner. (Overseas.)

Replenish oil level in steering gearbox to level of plug opening. Ref. B (page P.2).

Clean petrol pump contact points.

Check dynamo belt tension.

Every 6,000 miles (10000 km.) : Remove filters from carburetter and petrol pump, clean and replace. (See Section B.)

Clean out filter element housing and fit new filter element.

Clean and re-oil air cleaner. (Home.)

Drain gearbox and rear axle. Refill with fresh oil to Ref. B (page P.2).

Oil trafficators.

Remove front wheel covers and give one stroke of grease gun to hub nipple. Ref. C (page P.2). Later models have a hub cap, which must be removed and refilled with grease for lubrication.

Check contact breaker gap.

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. (·46 mm. to ·56 mm.).

Check valve clearance.

Tighten door-hinge fixing screws.

Tighten spring seat bolts.

Every 12,000 miles (20000 km.) : Remove sump, clean and replace. Refill sump with fresh oil.

Examine fluid level in piston-type front shock dampers and replenish with fluid if necessary. Remove piston type rear shock dampers, clean and replenish if necessary. Check telescopic dampers for functioning and replace if faulty.

Replace sparking plugs with new ones.

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

Check dynamo and starter brushes.

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 Smiths "Bluecol" or Filtrate "Nevafreeze" 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 :—

down to	down to
7° F. (— 14° C.)	0° F. (— 18° C.)
15 per cent. solution	20 per cent. solution
Size 2	Two size 1.A
Quantity 3 pints (1·7 litres)	Quantity 4 pints (2·27 litres)

Where temperatures below 0° F. or — 18° C. are likely to be encountered a mixture of at least 25 per cent. of "Bluecol" must be used to ensure immunity from trouble. Consult your local Dealer on this matter.

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.

PRESERVATIVE ON EXPORT CARS

To remove the hard film preservative from the external plated parts, a cloth dipped in a solution of equal parts of white spirit and petrol should be used. Take care to keep this solvent from anything other than the plated components.

SECTION A

ENGINE

(TYPE VC 22 M)

General Description.

Lubrication System.

Section No. A.1 Draining the engine sump.

Section No. A.2 Removal and replacement of the sump and oil filter.

Section No. A.3 Removal and replacement of the oil pump.

Section No. A.4 Dismantling and reassembling the oil pump.

Section No. A.5 The oil pressure release valve.

Section No. A.6 Removal and replacement of main and big-end bearings.

Section No. A.7 Removal and replacement of carburetter.

Section No. A.8 Removal and replacement of inlet and exhaust manifold.

Section No. A.9 Removal and replacement of cylinder head.

Section No. A.10 Removal and replacement of piston and connecting rod.

Section No. A.11 Dismantling and reassembling piston and connecting rod.

Section No. A.12 Fitting gudgeon pins.

Section No. A.13 Removal and replacement of piston rings.

Section No. A.14 Piston sizes and cylinder bores.

Section No. A.15 Removal and replacement of water pump.

Section No. A.16 Valve clearance adjustment.

Section No. A.17 Removal and replacement of camshaft.

Section No. A.18 Removal and replacement of valves and tappet heads.

Section No. A.19 Removal and replacement of valve guides.

Section No. A.20 Decarbonising.

Section No. A.21 Grinding and testing valves and their seatings.

Section No. A.22 Removal and replacement of engine.

Section No. A.23 Removal and replacement of engine and gearbox unit.

Section No. A.24 Removal and replacement of flywheel (engine out of chassis).

Section No. A.25 Removal and replacement of crankshaft (engine out of chassis).

Section No. A.26 Regrinding of crankshaft.

Section No. A.27 Oil pressure.

Section No. A.28 Locating troubles.

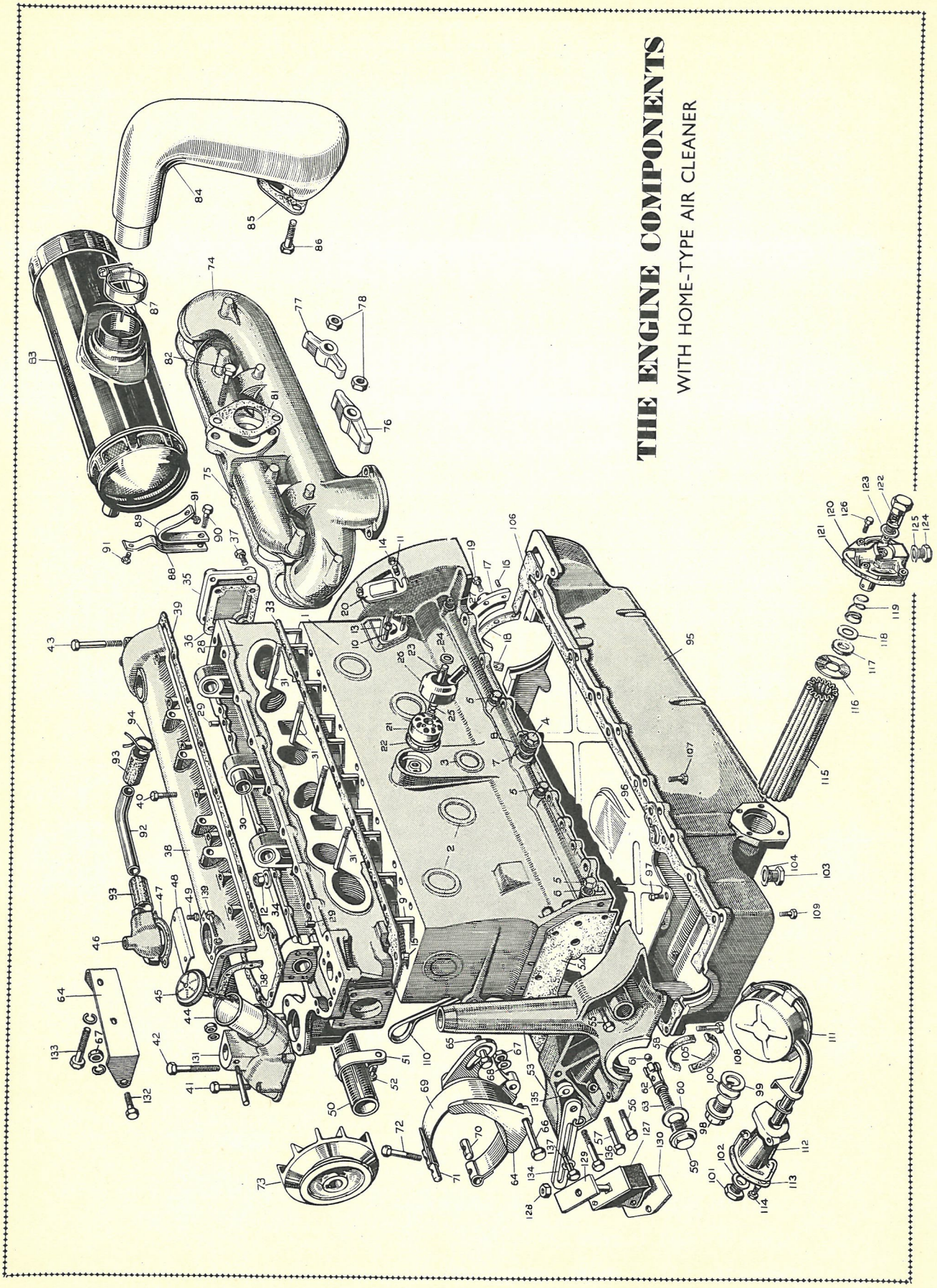
Section No. A.29 Oil leakage down valve stems.

Section No. A.30 Modified cylinder head.

Section No. A.31 Improved engine mounting.

THE ENGINE COMPONENTS

WITH HOME-TYPE AIR CLEANER



KEY TO THE ENGINE COMPONENTS

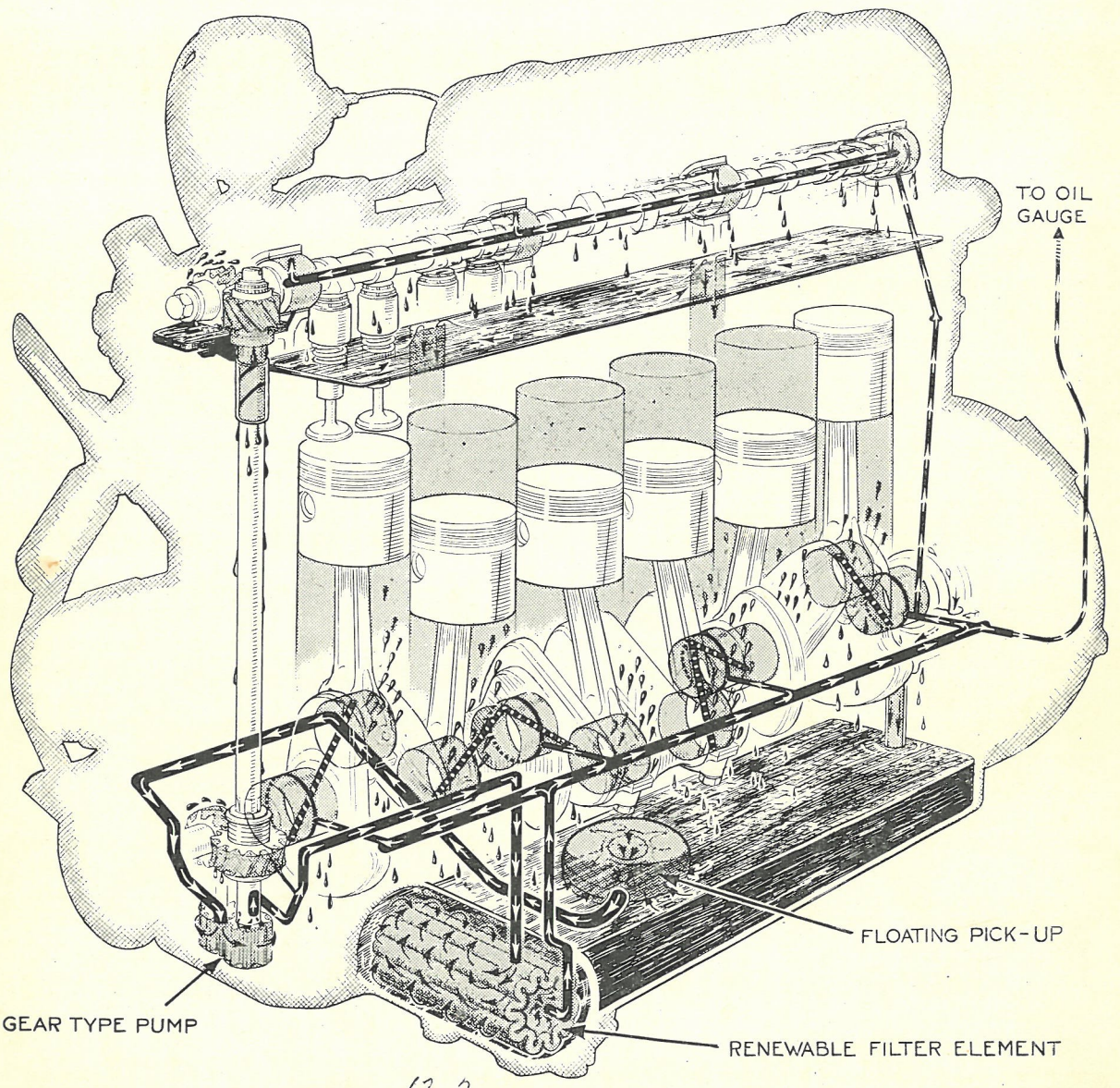
No.	Description
1.	Cylinder block assembly.
2.	Plug—core hole.
3.	Plug—core hole.
4.	Plug—oil gallery—side.
5.	Plug—oil feed hole.
6.	Washer—oil feed hole plug.
7.	Washer—oil gallery plug.
8.	Circlip—oil gallery plug.
9.	Stud—cylinder head.
10.	Stud—water inlet pipe.
11.	Stud—timing cover.
12.	Nut—cylinder head stud.
13.	Nut—water inlet pipe.
14.	Nut—timing cover stud.
15.	Dowel—cylinder head.
16.	Dowel—oil seal cover.
17.	Cover—oil seal.
18.	Joint—oil seal cover.
19.	Bolt—oil seal cover.
20.	Cover—timing.
21.	Body—breather filter.
22.	Gasket—filter body.
23.	Stud—filter body.
24.	Washer—filter body stud.
25.	Spring—breather filter.
26.	Cowl—anti-flame—breather.
27.	Union—oil gauge.
28.	Cylinder head.
29.	Dowel—head cover.
30.	Bearing—camshaft.
31.	Stud—exhaust manifold.
33.	Gasket—cylinder head.
34.	Washer—cylinder head stud.
35.	Cover—rear.
36.	Joint—rear cover.
37.	Bolt—rear cover.
38.	Cover—top.
39.	Joint—top cover.
40.	Bolt—short—top cover.
41.	Bolt—medium—top cover.
42.	Bolt—long—top cover—front.
43.	Bolt—long—top cover—rear.
44.	Sleeve assembly—oil filler.
45.	Cap—oil filler.
46.	Cover—breather filter.
47.	Joint—filter cover.
48.	Baffle plate—filter.
49.	Screw—baffle plate.
50.	Tube—H.T. cable carrier.
51.	Clip—to cylinder head.
52.	Bolt—clip.
53.	Housing and front support.
54.	Joint—to cylinder block.
55.	Bolt—short—cylinder block.
56.	Bolt—medium—cylinder block.
57.	Bolt—long—cylinder block.
58.	Packing—crankshaft—top.
59.	Plug—oil pressure release.
60.	Washer—plug.
61.	Ball—oil release valve.
62.	Guide—ball.
63.	Spring—oil release valve.
64.	Bracket—dynamo.
65.	Bolt—short—bracket.
66.	Bolt—long—bracket.
67.	Nut—bracket bolt.
68.	Washer—bracket bolt.
69.	Strap—dynamo.
70.	Bar—tapped—strap.
71.	Bar—plain—strap.
72.	Pinch-bolt—strap.
73.	Pulley—dynamo.
74.	Manifold—exhaust.
75.	Gasket—manifold.
76.	Clamp—long.
77.	Clamp—short.
78.	Nut—clamp.
81.	Gasket—to manifold.
82.	Bolt—carburetter to manifold.
83.	Air silencer.
84.	Pipe—to carburetter.
85.	Joint—to carburetter.
86.	Bolt—pipe to carburetter.
87.	Clip—air silencer.
88.	Support—air silencer.
89.	Support—air silencer.
90.	Bolt—support to engine.
91.	Bolt—support to silencer.
92.	Breather pipe—cylinder head cover.
93.	Hose—silencer to cover.
94.	Clip—hose.
95.	Sump assembly.
96.	Tray.
97.	Bolt—tray.
98.	Plug—sump drain.
99.	Washer—drain plug.
100.	Circlip—drain plug.
101.	Plug—core hole.
102.	Washer—core hole plug.
103.	Plug—filter drain.
104.	Washer—filter drain plug.
105.	Packing—crankshaft—bottom.
106.	Gasket—to block.
107.	Bolt—to block.
108.	Bolt—long—to front support.
109.	Bolt—short—to front support.
110.	Oil level indicator.
111.	Filter—oil suction.
112.	Bracket—filter.
113.	Joint—bracket.
114.	Bolt—bracket.
115.	Element—oil cleaner.
116.	Plate—element inner cover.
117.	Washer—felt—inner cover-plate.
118.	Washer—steel—cover-plate felt.
119.	Spring—oil cleaner.
120.	Cover—outer—oil cleaner.
121.	Joint—cover.
122.	Valve assembly—balance.
123.	Washer—balance valve.
124.	Plug—cover.
125.	Washer—cover plug.
126.	Bolt—cover to sump.
127.	Mounting rubber—front.
128.	Nut—rubber to engine.
129.	Packing block—front top.
130.	Packing block—front bottom.
131.	Cover—top—front.
132.	Bolt—dynamo to bracket
133.	Bolt—bracket to block.
134.	Link—dynamo.
135.	Distance-piece—link.
136.	Bolt—link.
137.	Bolt—dynamo adjusting.

Note :—On later models the top cover (No. 38) is made in two parts with a joint just behind the distributor drive housing. This provides access to the valve gear without disturbing the distributor and also permits running of the engine with the valve cover removed. In the new construction the oil filler has been moved to the forward end of the engine, adjacent to the distributor.

GENERAL DESCRIPTION

The six-cylinder, overhead-camshaft engine is built in unit construction with a single-plate dry clutch and four-speed synchromesh gearbox.

THE ENGINE LUBRICATION SYSTEM



12,2

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

The thrust is taken by the rear 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 aluminium alloy with a split skirt, and wire-wound. They are fitted with two compression rings and one oil-control ring.

The camshaft is supported in four renewable bearing liners in the cylinder head casting and is driven by a vertical shaft from the crankshaft by spring-loaded split helical gears.

The camshaft bearings are pressure-fed with oil from the hollow centre of the shaft.

The camshaft operates the valves through the medium of tappet heads screwed directly into the valve stem. Adjustment of the valve clearance is made by screwing the tappet head in relation to the valve stem.

Cooling is by thermo-syphon action assisted by an impeller and fan, and is controlled at low temperatures by thermostat.

THE LUBRICATION SYSTEM

The oil supply is carried in the sump below the cylinder block. An oil indicator dipstick is fitted on the right-hand side of the engine and the oil filler is at the rear end of the cylinder head cover on early models and at the forward end on later models. Two marks on the lower end of the dipstick indicate the maximum and minimum oil levels, marked " high " and " low."

The gear-type oil pump is located in the front end of the engine sump, and is driven by helical gears from the crankshaft. The oil is drawn through a

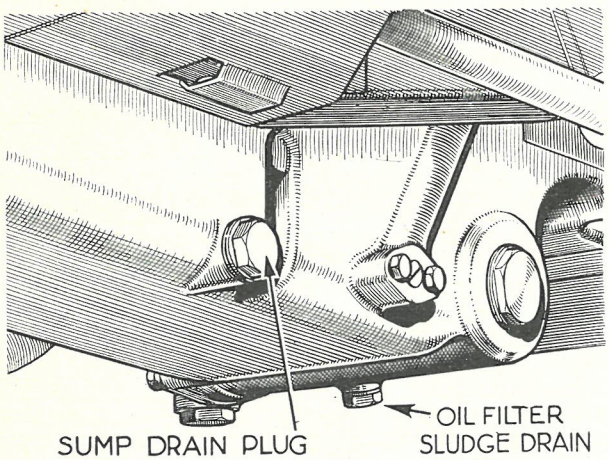


Fig. A.1.

The underside of the engine oil sump, showing the location of the drain plug and the plug for the oil filter sludge drain.

floating filter, and passes to the pump which delivers it to a Tecalemit filter built into the sump. A relief valve is provided in the delivery passage between the pump and the filter to deal with any excessive pressures generated while the oil is cold, the surplus oil being returned to the sump.

From the centre of the filter the cleaned oil passes through the filter end cover, housing the balance valve, and through a drilled passage to the main oil gallery which runs from front to rear of the engine. The balance valve in the filter element cover is provided to ensure, in the event of pressure building up inside the filter, or the filter becoming blocked, that the oil is fed to the main gallery direct. From the main gallery the oil is fed to each crankshaft main bearing and from the rear main bearing a vertical passage delivers the oil to the rear camshaft bearing housing.

The remaining camshaft bearings are lubricated by oil delivered to them from the rear bearing through the centre of the hollow camshaft. Oil escaping from the ducts in the camshaft bearings lubricates the cams and tappets and drains back to the sump through passages provided in the cylinder head and block.

Surplus oil from the big-end bearings splashes onto the cylinder walls and lubricates the pistons and little-ends.

An oil pipe connects the rear end of the main oil gallery with the oil gauge on the instrument panel.

The main pressure release valve is of the non-adjustable ball type and is mounted in the front housing assembly, to the left of the crankshaft pulley. The valve operates when the pressure exceeds 80 lb. per sq. in. (5·6 kg./cm.^{2}).

The upper timing gears are well lubricated by surplus oil from the front camshaft bearing and the lower ones from an oil spray from the pump delivery duct.

Section A.1

DRAINING THE ENGINE SUMP

The sump on new and reconditioned engines must be drained and refilled with new oil after the first 500 miles (800 km.) and then at intervals of every 3,000 miles (5000 km.). The hexagon-headed drain plug is situated on the right-hand side of the sump. The oil should preferably be drained when the engine is hot, in which condition it flows 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 10 pints (5·7 litres) of oil are required to refill it.

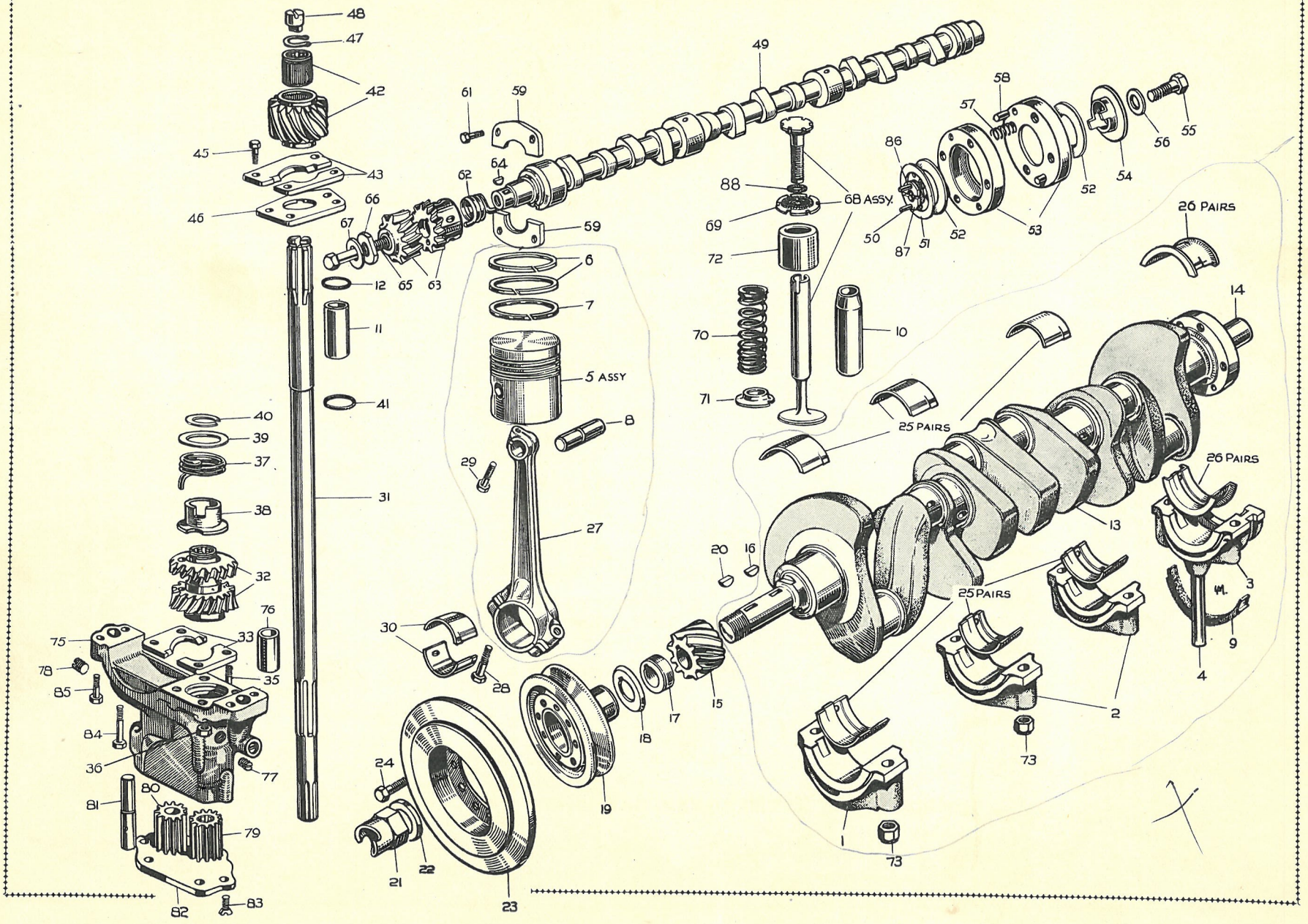
Section A.2

REMOVAL AND REPLACEMENT OF THE SUMP AND OIL FILTER

The sump is located by seventeen $\frac{1}{4}$ in. hexagon-headed bolts and spring washers inserted from the underside of the sump flange, and two $\frac{1}{4}$ in. bolts and nuts with plain washers at the front end. The rear end is secured to the clutch housing and also carries an exhaust pipe bracket. A throttle control bracket is attached to bolts on the left-hand side.

To clean the sump remove the six $\frac{3}{16}$ in. bolts from the tray and remove the tray. Remove the two bolts

OIL PUMP, CAMSHAFT, CRANKSHAFT AND BEARINGS



KEY TO OIL PUMP, CAMSHAFT, CRANKSHAFT AND BEARINGS

No.	Description
1.	Cap—main bearing—front.
2.	Cap—main bearing—inter.
3.	Cap—main bearing—rear.
4.	Drain tube.
5.	Piston assembly.
6.	Ring—compression.
7.	Ring—scraper.
8.	Pin—gudgeon.
9.	Seal—rear bearing cap.
10.	Guide—inlet valve.
10.	Guide—exhaust valve.
11.	Bush—drive shaft.
12.	Ring—distributor oil retaining.
13.	Crankshaft.
14.	Bush.
15.	Gear—crankshaft.
16.	Key—gear.
17.	Distance-piece—gear.
18.	Thrower—crankshaft oil.
19.	Pulley—crankshaft.
20.	Key—pulley.
21.	Dog—starting handle.
22.	Washer—crankshaft.
23.	Inertia member—crankshaft damper.
24.	Bolt—inertia housing.
25.	Bearing—front and inter.—main.
26.	Bearing—rear—main.
27.	Connecting rod and cap.
28.	Bolt—cap.
29.	Pinch-bolt—gudgeon pin.
30.	Bearing—big-end.
31.	Shaft—vertical drive.
32.	Gear—lower—camshaft driving.
33.	Thrust plate—driving gear.
35.	Stud—thrust plate.
36.	Nut—thrust plate stud.
37.	Spring—driving gear torsion.
38.	Centraliser—torsion spring.
39.	Washer—centraliser.
40.	Ring—torsion spring retaining.
41.	Ring—housing oil retaining.
42.	Gear and timing sleeve assembly.
43.	Thrust plate—top.
45.	Bolt—thrust plate.
46.	Plate—drive shaft packing.
47.	Circlip—drive shaft.
48.	Coupling—distributor drive.
49.	Camshaft.
50.	Dowel—camshaft.
51.	Inner plate—damper.
52.	Friction ring—damper.
53.	Damper.
54.	Outer sleeve—damper.
55.	Bolt—damper.
56.	Washer—damper bolt.
57.	Spring—damper.
58.	Dowel—damper.
59.	Thrust plate.
61.	Bolt—thrust plate.
62.	Spring—front damper.
63.	Gear assembly.
64.	Key—gear.
65.	Bolt—camshaft.
66.	Washer—locating—camshaft bolt.
67.	Lock washer—camshaft bolt.
68.	Valve assembly.
69.	Locknut—tappet.
70.	Spring—valve.
71.	Washer—spring locating.
72.	Deflector—spring oil.
73.	Nut—bearing cap stud.
75.	Oil pump body.
76.	Bush.
77.	Plug—oil hole—small.
78.	Plug—oil hole—large.
79.	Gear—driving.
80.	Gear—driven.
81.	Spindle—driven gear.
82.	Cover-plate—oil pump.
83.	Screw—cover-plate.
84.	Dowel bolt—oil pump.
85.	Bolt—oil pump.
86.	Dowel plate—top.
87.	Dowel plate—bottom.
88.	Grommet—valve.

securing the oil pick-up float to the sump and lift out the assembly, noting the paper gasket in the joint.

Remove the sump drain plug. Wash out the sump and oilways with paraffin and clean all deposit from the drain plug. Thoroughly dry the sump and refit the pick-up assembly, tray and drain plug.

Extract the four bolts securing the filter cover to the sump and remove the cover and filter element. Withdraw the filter sludge drain plug and wash out the filter housing. Remove the balance valve from the filter cover and ensure that the plunger is quite free.

If the filter becomes blocked and prevents the passage of oil through it from the outside, the drop of pressure inside the element and consequent build-up of pressure outside and on top of the balance valve will depress the valve plunger and allow oil to by-pass the filter unit. Wash the filter element thoroughly in petrol every 3,000 miles (5000 km.) to remove all trace of impurities. The normal life of a filter element is 6,000 miles (10000 km.), and at the end of this mileage it should be replaced by a new one.

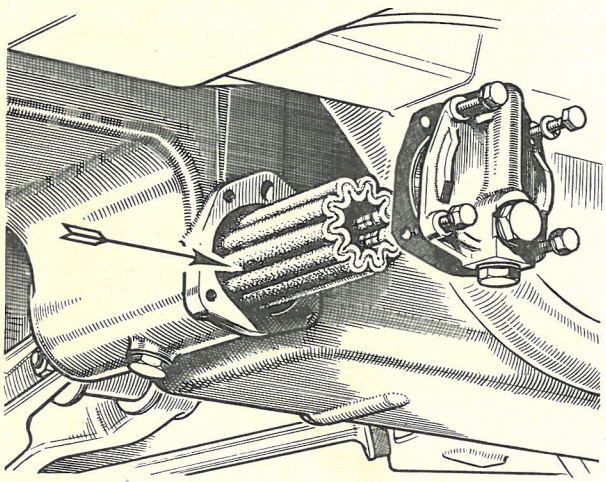


Fig. A.2.
The oil filter with the cover removed and the filter element partly withdrawn.

Fit the filter element and replace the filter cover and gasket, ensuring that the spigot on the underside of the spring-loaded sealing disc engages with the centre of the element. Replace and tighten the cover fixing screws, balance valve, and filter sludge drain plug.

Commencing with engine No. 9534 the aluminium oil filter cover (Part No. 163047) has been replaced by a cast-iron oil filter cover (Part No. 163429).

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 usually 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

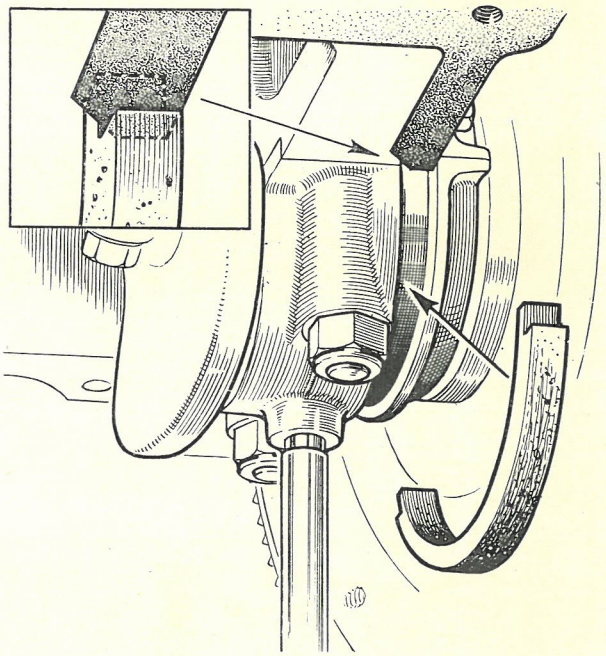


Fig. A.3.
The correct method of fitting the sump gasket and the cork sealing strip for the rear bearing is here clearly shown.

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 fit against the side of the rear main bearing cap (see upper arrow, Fig. A.3).

The cork strip should then be fitted tightly into the recess of the main bearing cap, taking care that the stepped ends fit into the small registers at each side 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 gasket (see upper arrow, Fig. A.3). 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 so.

Tighten evenly the securing bolts into the crankcase flange and the clutch housing, replacing the exhaust and throttle control brackets on their respective bolts.

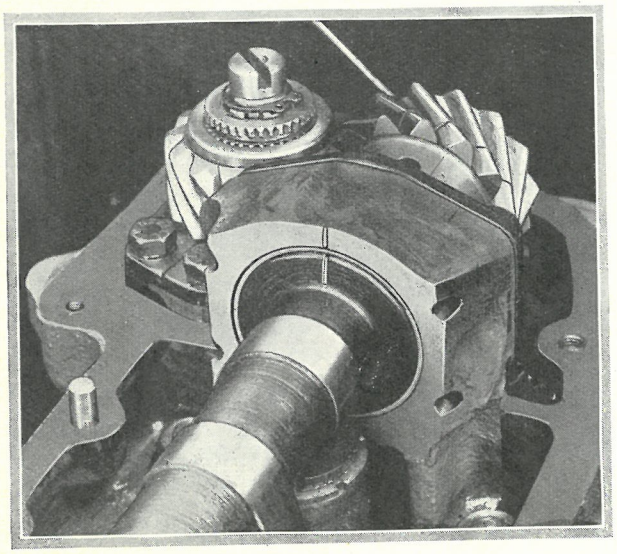


Fig. A.4.
The timing marks on the front camshaft bearing and on the camshaft itself are shown coinciding in this illustration.

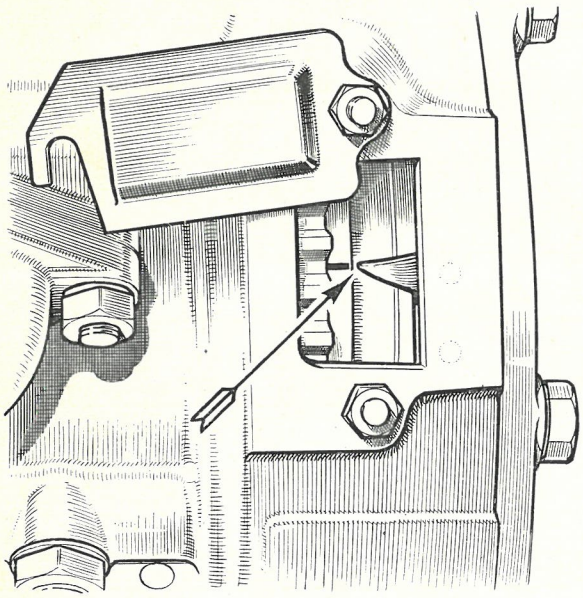


Fig. A.5.
The timing cover on the flywheel housing moved aside to show the timing mark for T.D.C. on the flywheel rim and the indicating pointer.

Section A.3

REMOVAL AND REPLACEMENT OF THE OIL PUMP

Remove the air cleaner hose clips and disconnect the hose. Withdraw the bolts securing the cleaner assembly to the cylinder head cover and carburetter flange, and lift it from the car, taking care not to spill any oil if an Export type oil bath air cleaner is fitted.

Disconnect the vacuum advance control pipe and low-tension lead from the distributor and remove the distributor top.

Remove the bolts securing the cylinder head cover, observing that the two long ones at the front end of the cover are of different length, and lift off the cover, complete with distributor.

Expand the retaining circlip and lift the slotted distributor drive dog from the vertical drive shaft. Turn the engine until the timing mark on the front camshaft bearing journal is in line with the mark on the bearing housing. Number 6 piston is then at T.D.C. (firing position).

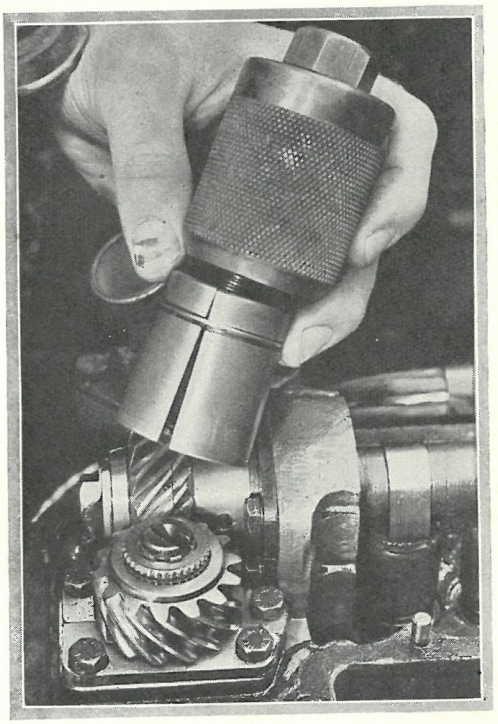


Fig. A.6.
The special extractor (Part No. 68889) needed to withdraw the splined driving and timing sleeve of the upper drive gear.

Use an extractor (Special Tool, Part No. 68889) to withdraw the driving and timing sleeve from the upper driving gear.

Drain and remove the sump as in Sections A.1 and A.2. Withdraw the four bolts securing the oil pump housing to the drive shaft housing, observing that two of them are special dowel bolts. The oil pump and drive shaft assembly is now free to be withdrawn.

Before replacing the pump assembly, carefully clean the metal face of the oil pump and the vertical drive shaft housing.

Check that the timing marks on the camshaft front bearings are still in line and that the pointer below the cover on the left-hand side of the flywheel housing is in line with the mark on the flywheel. Offer up the oil pump assembly and turn the vertical drive shaft until the distributor drive slot at the top end is at an angle of 45° to the camshaft with the rear end of the slot away from the engine (Fig. A.8). This will ensure that the distributor vacuum advance gear will return to its correct position for connection to the inlet manifold.

Press the pump gears into engagement and replace the four housing bolts, making sure that the dowel bolts are fitted to the holes machined for them. **This is important.**

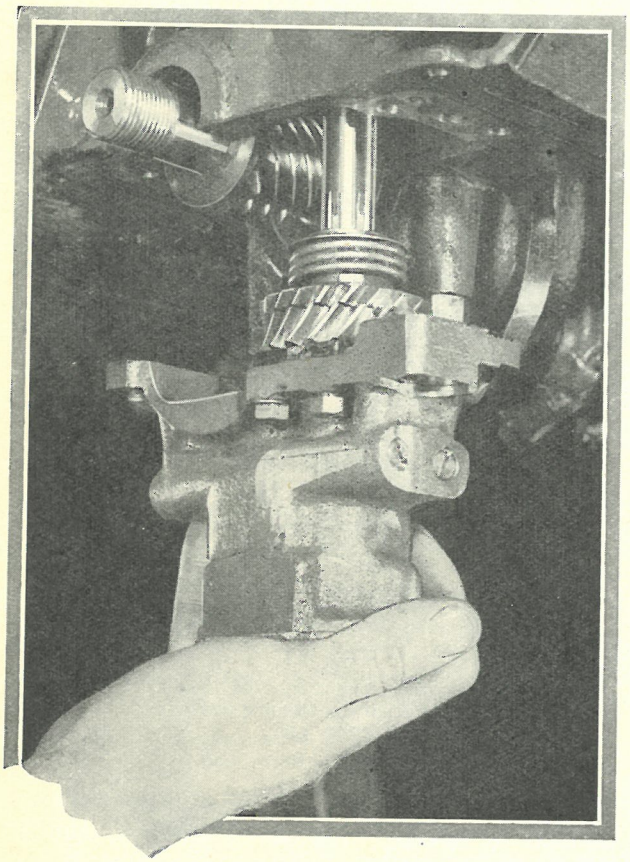


Fig. A.7.
Withdrawing the oil pump assembly from the cylinder block.

Replace the timing sleeve, chamfered end first, on the splined end of the vertical shaft. Note that there are six possible positions. Select the one which brings the outer serrations into exact alignment with those on the inside of the camshaft driving gear and press into engagement.

Replace the distributor drive dog with the narrow side to the rear and secure with the circlip.

Clean the faces of the cylinder head cover and cylinder head, fit a new joint if necessary and replace the cover and distributor. Replace the air cleaner.

Section A.4

DISMANTLING AND REASSEMBLING THE OIL PUMP

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

Withdraw the six screws securing the oil pump cover-plate and remove the plate and idler gear.

Secure the pump body in a vice and remove the nuts securing the drive gear thrust plates to the pump body. Use a brass drift to tap the drive shaft from the oil pump drive gear and remove the two thrust plates as they are released from the pump body.

Withdraw the gear from inside the pump. Note the single white-metal bush in the oil pump body which, if renewed, should be driven into the housing

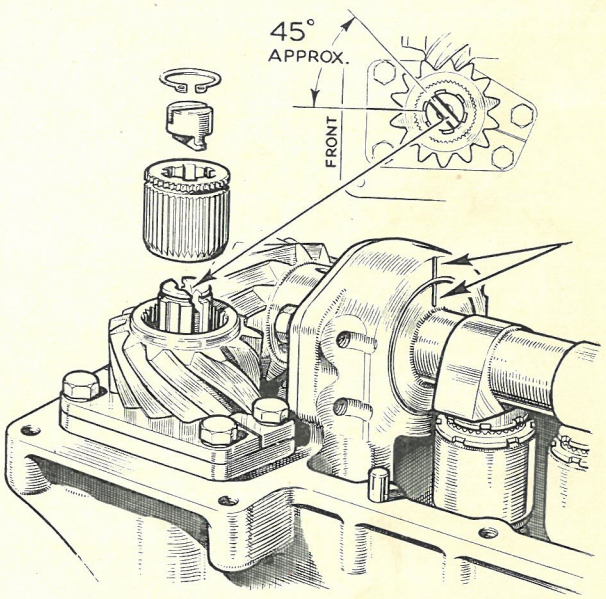


Fig. A.8.
The correct location of the drive slot in the upper end of the vertical shaft, when retiming the engine, can be observed from this illustration.

until the top is level with the lowest edge of the chamfer. The idler gear pin may be driven out from above the oil pump body should it be desired to fit a new one.

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 diametrical clearance between the teeth of the gears and the pump body (see Fig. A.10). This should not be more than ·006 in. (·15 mm.).

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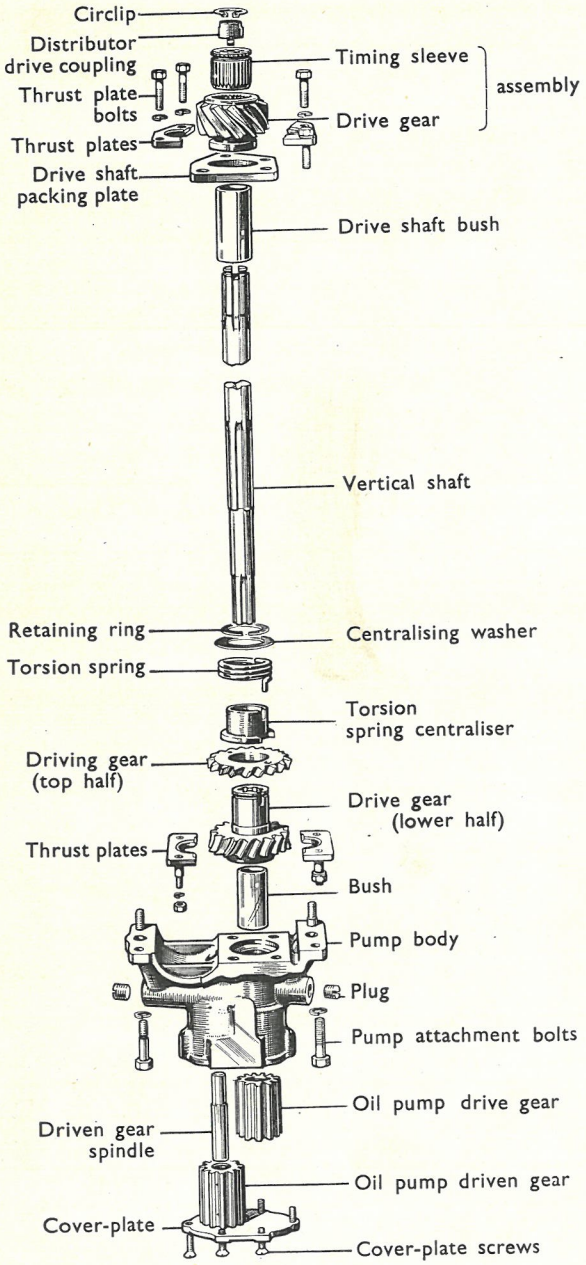


Fig. A.9.
The component parts of the oil pump. Note the two dowel bolts securing the body, which are shown in position on the body.

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. A.11). This should not be more than ·003 in. (·08 mm.).

To dismantle the drive gear, remove the circlip, plain washer, spring, spring centraliser and top half of the driving gear. The bottom half of the gear may then be pressed from the shaft.

When replacing the bottom half of the gear on the shaft it should be pressed on until the lower face of the thrust flange is level with the bottom end of the splines. Reassembly continues by replacing the upper half of the bearing with the flat side towards

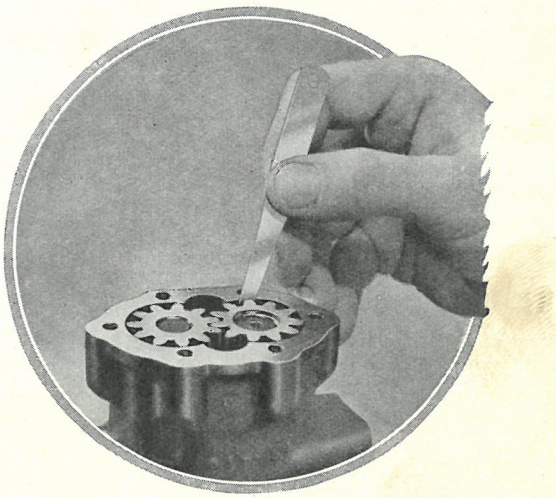


Fig. A.10.
Checking the radial clearance of the gears with a feeler gauge.



Fig. A.11.
The end float on the pump gears can be checked by means of a straight-edge and feelers.

the lower half and rotating it until the two large holes coincide with each other.

Replace the spring centraliser and the spring, engaging the long ends in the gear and the hooked end in the spring centraliser.

Replace the flat washer and circlip.

Ensure that the cover-plate and pump body faces are perfectly clean before reassembling the oil pump.

They form a metal-to-metal joint and no gasket or sealing compound should be used.

Replace the thrust plates, engage the shaft in the pump body and tighten the thrust plate securing nuts. Replace the drive gear with the counter-bored end away from the cover-plate. Ensure that the oil holes in the idler gear are free from obstruction when replacing the gear.

Replace the cover-plate and firmly tighten the securing screws.

Section A.5

THE OIL PRESSURE RELEASE VALVE

A release valve is provided to prevent the generation of excessive oil pressure when starting from cold. It is located on the left-hand side of the crankshaft pulley in the vertical drive housing. The valve

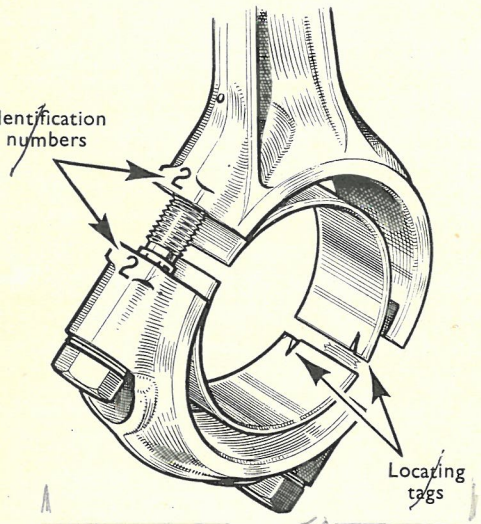


Fig. A.12.
The arrows indicate the position of the tags on the edge of each bearing shell and the identification markings on the connecting rod and cap.

operates when the oil pressure reaches 80 lb. per sq. in. (5·6 kg./cm.^{2}) and allows the oil to return direct to the sump.

The valve assembly is held in position by the release plug and sealed by a copper washer. To dismantle the valve, unscrew the release plug and washer and withdraw the spring, ball and ball guide. Examine the ball to ensure that it is seating properly, and check if the spring has lost its tension. This can be done by measuring the length of the spring, which should not be less than 1·5 in. (38·1 mm.).

The ball seat is a press fit in the drive housing and should be renewed if necessary when a new ball and spring are being fitted.

To prevent a cavitation noise when the engine is cold a modified spring, Part No. 164196, is fitted to the release valve on later models, commencing from engine number 9974. This spring is similar to the original type but is wound left-handed instead of right-handed to prevent distortion when the valve plug is tightened.

Section A.6

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 for both the main and big-end bearings, which are of the shimless type and therefore non-adjustable.

Note.—*Under no circumstances can the connecting rods or caps be filed to take up wear, as this will render the rods useless for future replacement.*

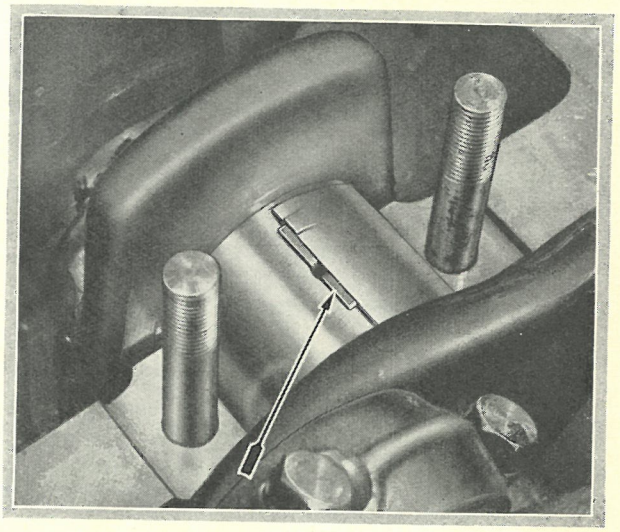


Fig. A.13.
Showing the use of an opened split pin in the main bearing oil hole to rotate the bearing liner into position by rotation of the crankshaft.

Dismantling procedure

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

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 a worn condition, it is advisable to fit a service reground crankshaft, complete with main and big-end bearings, as supplied by the makers under their rapid repair reconditioned parts scheme. (See Section A.26.)

Both the main and big-end bearing liners are located in position in the bearing housing by a small tag on each side of each half liner, and it should be noted that the bearings are fitted so that the tags are on the same joint edge of the bearing housing as shown in Fig. A.12, but on opposite corners and engaging the slots in the connecting rod.

To detach the big-end bearings, remove the $\frac{5}{16}$ in. bolts and spring washers. Remove the connecting rod caps and extract the bearings. Care should be exercised to see that the bearing journals, etc., are thoroughly cleaned before installing them in the bearings. No scraping is required as the bearings are machined to give the correct diametrical clearance of ·001 in. (·025 mm.).

The main bearings should be dealt with one at a time. Remove the $\frac{1}{2}$ in. self-locking nuts and detach the main bearing cap, together with the bottom half bearing liner. The top half of the bearing liner is extracted by rotating it around the crankshaft in the direction of the locating tag, using a split pin, opened at the end and inserted into the crankshaft oil-feed hole as a driver, to facilitate this. The replacement is fitted in a similar manner, by first inserting the plain side of the bearing liner into its housing. Here, again, no scraping is required as the bearing is machined to give the correct diametrical clearance, ·001 in. (·025 mm.).

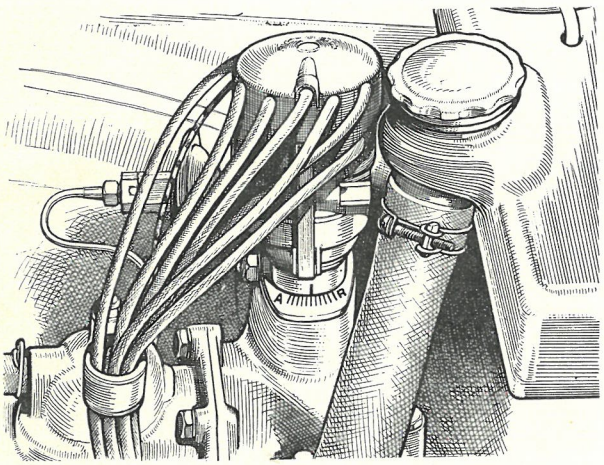


Fig. A.14.

The markings on the cylinder head cover, which give an indication of the contact breaker setting. Observe these before slackening the distributor body clamp bolt.

In the case of a " run " bearing it is always advisable to clean out thoroughly all the oilways in the crankshaft and cylinder block, wash out the engine base and filter with paraffin and remove the pump cover, to ensure that no particles of white metal are left anywhere in the lubricating system.

Note.—*That after Engine No. 8436 the Philidas self-locking nuts fitted to the main bearing cap studs have been superseded by " Aerotight " nuts (Part No. 162612). These can only be used on the earlier models if they are fitted with the later type studs (Part No. 162611).*

Section A.7

REMOVAL AND REPLACEMENT OF CARBURETTER

Release the hose clips on the cylinder head cover fume pipe and disconnect the hose. Withdraw the bolts securing the air cleaner assembly to the cylinder head cover and to the carburetter flange and lift it from the engine. When removing an oil-bath type cleaner care must be taken not to spill any of the oil. The unit should be held and stored in a vertical position.

Disconnect the mixture control inner and outer cable from the carburetter by removing the split pin from the clevis pin on the inner cable and releasing the clip which secures the outer cable.

Pull back the ears of the snap-lock ball joint connecting the throttle control rod to the throttle lever on the carburetter and detach the control rod.

Disconnect the distributor advance vacuum pipe union from the carburetter and the flexible petrol pipe from the petrol pump. Remove the two bolts securing the carburetter to the manifold flange and lift off the carburetter and, on early models, the engine stop control bracket.

Replacement is a reversal of the above procedure, but if the carburetter flange is distorted it should be cleaned off, filed flat and refitted with a new gasket.

Section A.8

REMOVAL AND REPLACEMENT OF INLET AND EXHAUST MANIFOLD

Remove the air cleaner and carburetter as detailed in Section A.7.

Release the exhaust pipe from the manifold by removing the two nuts, spring washers and bolts, observing that a copper-asbestos gasket is fitted between the two flanges.

Remove the manifold and clamps by unscrewing the four nuts and washers securing them to the cylinder block.

Refitting the manifold is a reversal of the above procedure, but before doing so, any excessive carbon must be cleaned from the faces and a new gasket fitted with its perforated metal face outwards, making contact with the face of the manifold.

The ring-type gasket and flange fitted to later models should be retightened after road test and, if new, after 500 miles (800 km.). Cars fitted with this type of gasket may be identified by the two long brass nuts and the gap between the flanges.

Section A.9

REMOVAL AND REPLACEMENT OF CYLINDER HEAD

Drain the water from the cooling system by means of the tap on the right-hand side of the radiator bottom tank, and the tap on the left-hand side of the engine at the rear of the cylinder block. 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 air cleaner and carburetter as in Section A.7.

Remove the inlet and exhaust manifold assembly as in Section A.8.

Disconnect the high-tension leads from the sparking plugs and the high-tension lead and distributor contact-breaker wire from the coil. Extract the securing screws and release the high-tension cable carrier from the cylinder head.

Remove the distributor cover with the high-tension leads and lead carrier attached.

Slacken the clips on the top water hose and remove the hose. Disconnect the by-pass pipe by removing the banjo bolt from the thermostat housing.

Slacken dynamo pivot bolts and belt tension adjuster screw and remove the fan belt. Remove fan blades.

Extract the cylinder head cover bolts and lift off the cover.

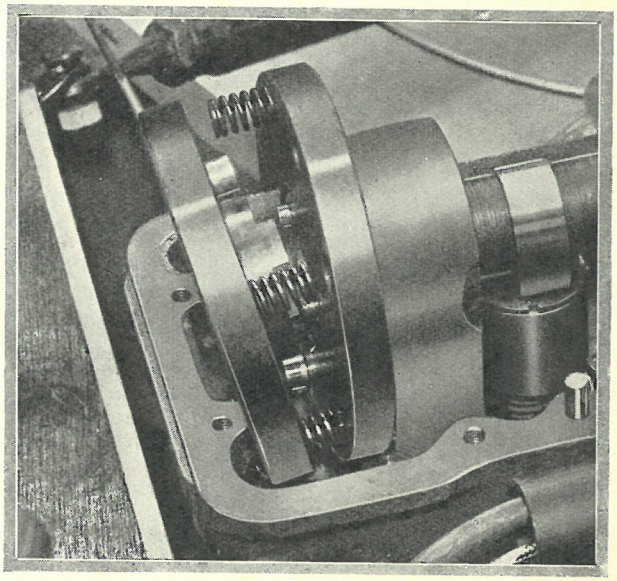


Fig. A.15.
The camshaft damper partly dismantled to show the dowels and springs.

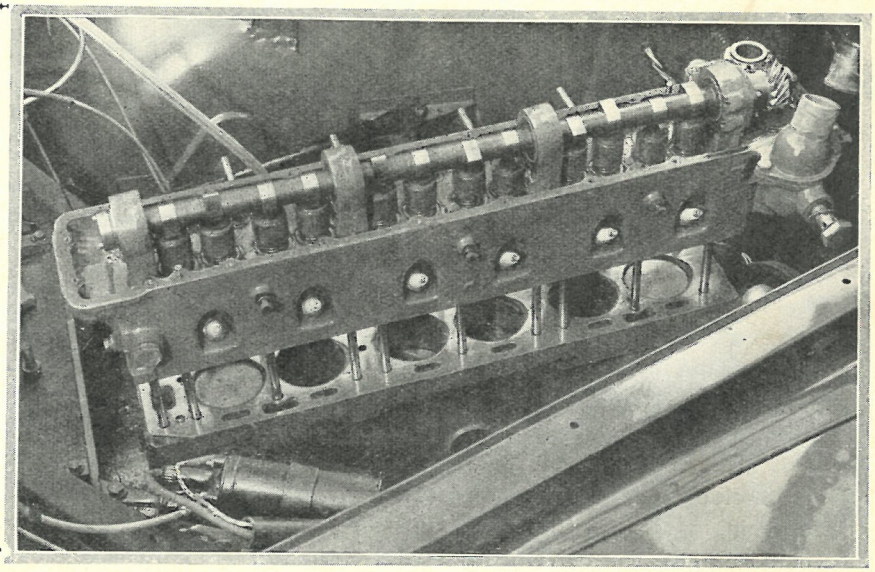


Fig. A.16.
The cylinder head assembly partly withdrawn from the cylinder head studs.

Observe the graduations on the cylinder head cover and the mark on the distributor body, and note the exact position of the distributor in the cover to facilitate replacement (see Fig. A.14). Slacken the distributor clamp bolt in the lug on the side of the cover and remove the distributor.

Rotate the engine until the timing marks on the front camshaft bearing and journal are in line. Remove the cover-plate on the left-hand side of the flywheel housing and observe the position of the timing marks on the flywheel. This is necessary to ensure correct timing when replacing the head.

Disconnect and remove the battery. Tap back the tab of the damper bolt lock washer and remove the bolt and washer. Tap the damper assembly from the camshaft and lift off the outer sleeve and friction ring. Rotate the damper assembly and withdraw the springs one at a time. Rotate the engine until the dowel pins

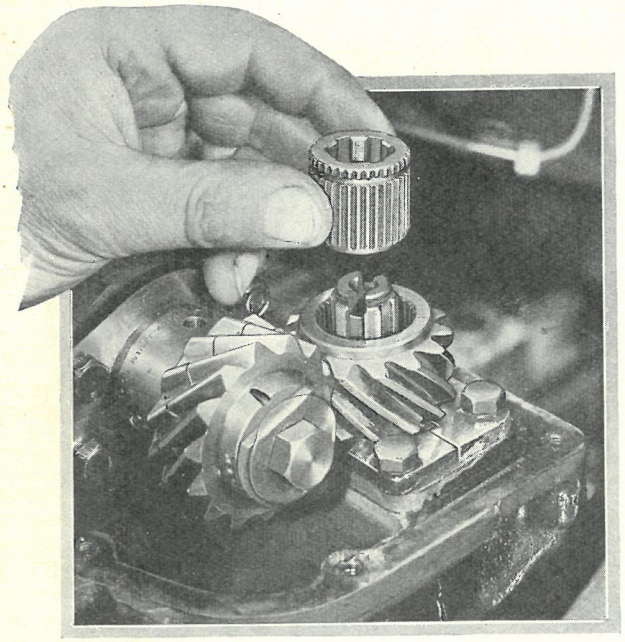


Fig. A.17.
The camshaft driving and timing sleeve must be inserted in the position where it registers exactly with the splines of the helical gear and vertical shaft when the timing marks coincide.

are horizontal and remove the rear half of the damper. Remove the second half of the damper together with the friction ring and inner plate.

After Engine No. 3289 the locating dowels for the outer sleeve and the inner plate are carried in a separate plate and not on the camshaft. This allows the damper to be removed and replaced on the camshaft with greater ease.

Remove the distributor drive circlip and dog and use Special Tool, Part No. 68889, to extract the camshaft timing sleeve from the vertical drive shaft.

The cylinder head may be lifted clear after the retaining nuts and flat washers have been removed (Special Tool, Part No. 68830). They should be

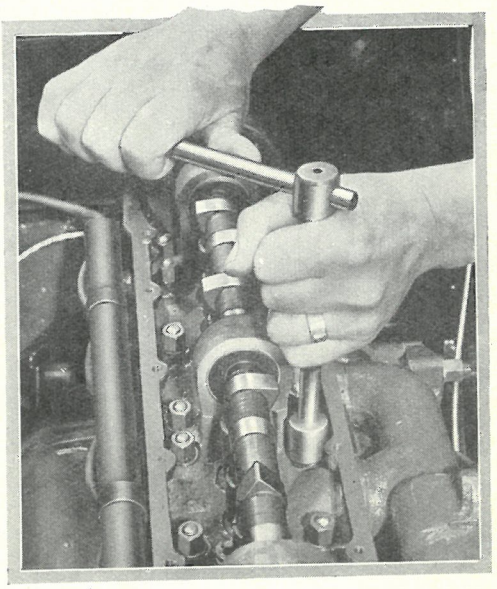


Fig. A.18.
The special spanner (Part No. 68830) in use for tightening the cylinder head stud nuts.

slackened half a turn at a time until they are all quite free. This will avoid any tendency for the head to be distorted.

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

The gasket should be guided over the cylinder head studs evenly with a length of tube, or a box spanner, to avoid damage, and the cylinder head stud nuts tightened half a turn at a time until they are quite tight.

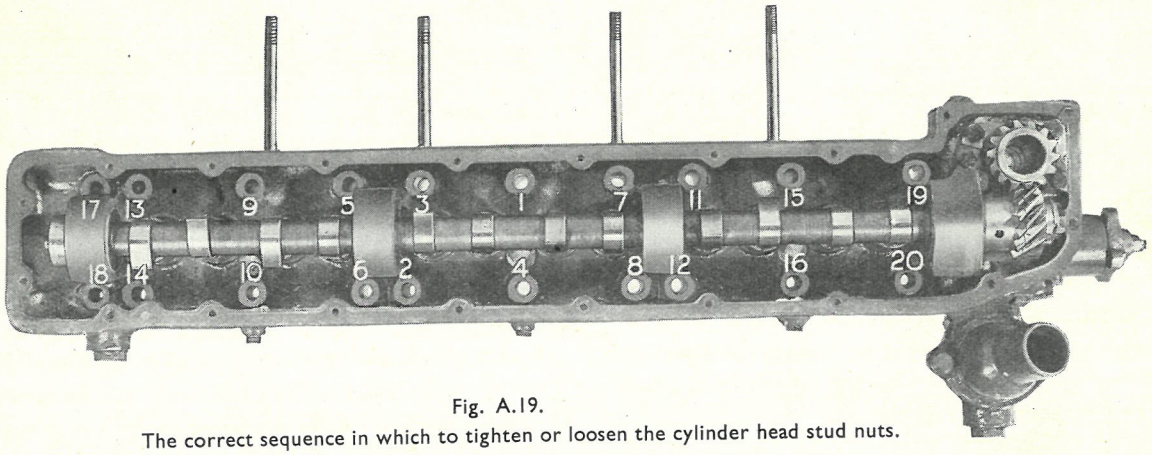


Fig. A.19.
The correct sequence in which to tighten or loosen the cylinder head stud nuts.

To reassemble the damper, first replace the inner plate and friction ring. Position the plate on the camshaft so that the " centre dot " mark is at the top. Replace the two halves of the damper and rotate it to reinsert the springs. Rotate the damper until the markings are in line with that on the inner plate. Replace the outer sleeve and friction ring with its marking in line with the other markings and engage it with the slots in the inner plate. When engaged, rotate the assembly on the camshaft until two of the holes in the outer sleeve are in line with the dowels in the camshaft and then press the sleeve into engagement. Replace the damper retaining bolt and lock washer and firmly tighten. Bend over the lock washer tag and replace the battery.

To reset the timing, the crankshaft should be turned until the pointer below the cover on the left-hand side of the flywheel housing is in line with the mark on the flywheel. Turn the camshaft to bring the timing marks on the front bearing journal into line and replace the timing sleeve, chamfered end first, on the splined end of the vertical shaft. Note that there are six possible positions. Select the one which brings the outer serrations into exact alignment with those on the inside of the camshaft driving gear and press into engagement.

Replace the distributor drive dog with the narrow side to the rear and secure with the circlip.

Clean the faces of the cylinder head and cover, fit a new joint if necessary and replace the cover. Replace the distributor and air cleaner.

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

Run the engine until it attains its normal running temperature, then tighten the cylinder head nuts again in their proper sequence. The maximum torque must not exceed 40 ft./lb. on each stud.

Section A.10

REMOVAL AND REPLACEMENT OF PISTON AND CONNECTING ROD

The pistons and connecting rods can only be withdrawn from the top of the cylinder block, and it is therefore necessary to remove the cylinder head for this operation.

Remove the cylinder head as detailed in Section A.9.

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

Withdraw the big-end bolts and spring washers. Remove the bearing cap, and release the connecting rod from the crankshaft.

The piston and connecting rod can now be withdrawn from the top of the cylinder block, and the bearing cap refitted with the numbered side registering with the corresponding number on the connecting rod.

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

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 split skirt opposite to the thrust side, and the gudgeon pin clamp screw opposite to it on the right-hand side of the engine. The piston crowns are plainly marked to show their forward side.

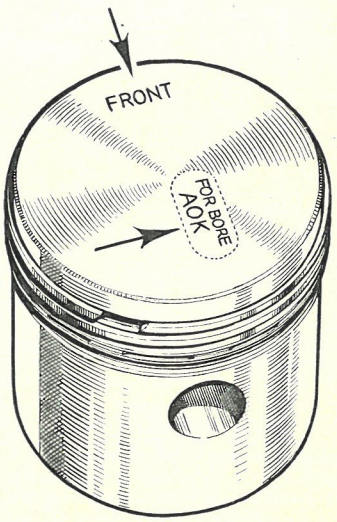


Fig. A.20.
The front of the piston is clearly marked on the crown, which also carries the markings indicating its size.

The big-end bearings should also be refitted in their original positions.

The top and bottom halves of new bearings are, however, interchangeable, each being drilled for cylinder wall lubrication.

Section A.11

DISMANTLING AND REASSEMBLING PISTON AND CONNECTING ROD

The gudgeon pin is rigidly held in the split little-end of the connecting rod by a clamp bolt engaging the central groove of the gudgeon pin.

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 without damage, special holding plugs should be inserted in each end of the gudgeon pin.

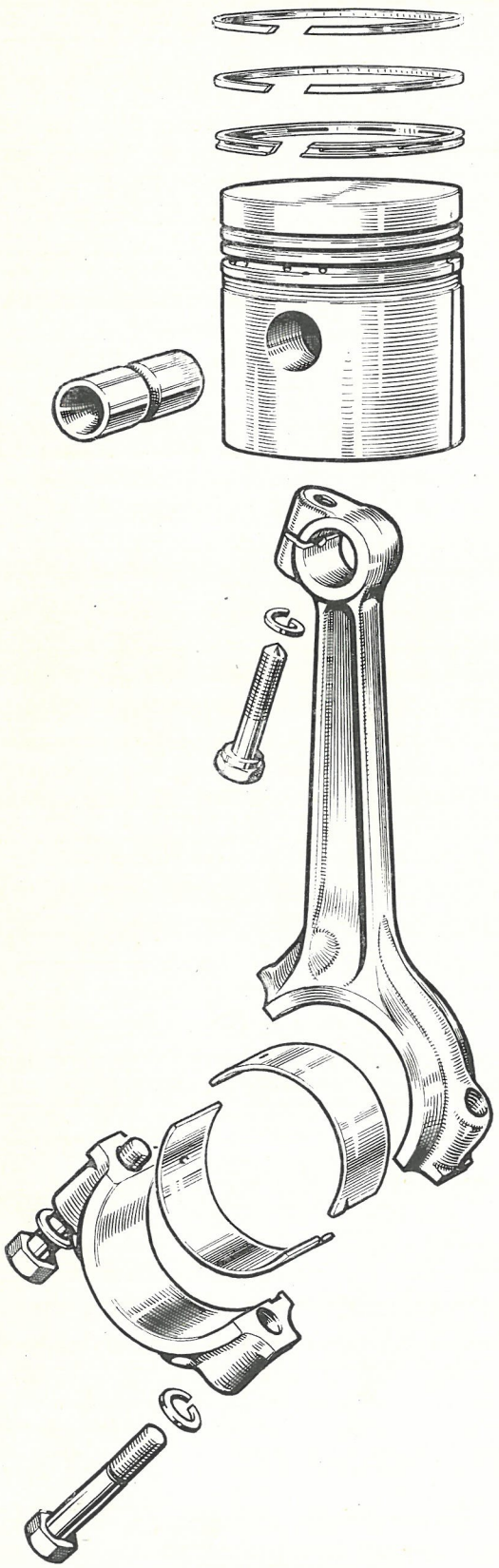


Fig. A.21.
The component parts of the piston and connecting rod assembly.

Unscrew the gudgeon pin clamp screw (Special Tool, Part No. 68832) 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 will tighten firmly onto the spring washer.

Section A.12

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.13

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 ring and 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 side-play between the ring and the groove reduces gas tightness and produces an oil-pumping action leading to excessive oil consumption. There must be no play between

the rings and their grooves but they must nevertheless be free to move without restriction.

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. (2·5 cm.) down the cylinder bore

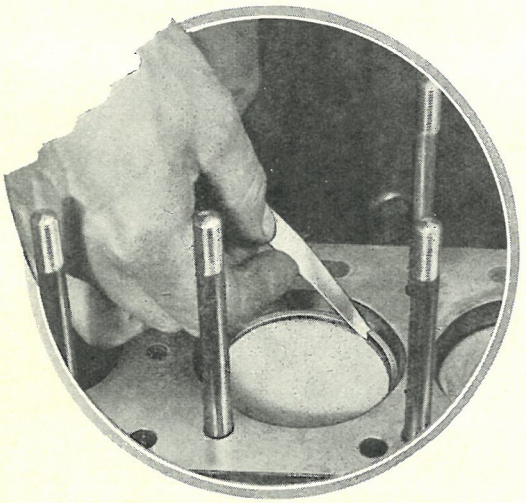


Fig. A.22.
Checking the piston ring gap.

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 ·0085 in. to ·0125 in. (·21 mm. to ·31 mm.).

STD., indicating that the cylinder bore is of standard diameter, i.e. possesses an actual diameter of 2·8937 in. (73·5 mm.).

+·001, indicating that the cylinder bore is oversize to the extent of +·001 in. and thus possesses an actual dimension of 2·8947 in. (73·525 mm.).

+·002, indicating that the cylinder bore is oversize to the extent of +·002 in. and thus possesses an actual dimension of 2·8957 in. (73·55 mm.).

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

Thus those marked +·001 in. should be fitted to bores marked +·001 in. and so on throughout the range covered.

While the cylinder head and pistons are withdrawn, the cylinder bores should be measured for wear. General loss of performance, oiling up, and poor compression indicates that a rebore of the cylinders is necessary and is confirmed by measurement of the bores.

Rebores

Only two ranges of rebore sizes are provided for and cylinders must only be rebored to either of these sizes to ensure the supply of the correct pistons.

To provide the normal machining tolerance, oversize pistons are available which are ·001 in. and ·002 in. (·025 mm. and ·050 mm.) larger in diameter than the standard rebore sizes.

The two standard oversizes for rebores are

	Standard	*1st Oversize*	*2nd Oversize*
Nominal Marking Suitable for Bore Size	Std. 2·8937 in. (73·5 mm.) to 2·89419 in. (73·51 mm.)	+·001 in. (·025 mm.) 2·8947 in. (73·525 mm.) to 2·89519 in. (73·538 mm.)	+·002 in. (·05 mm.) 2·8957 in. (73·55 mm.) to 2·89619 in. (73·563 mm.)
1st Rebore Marking Suitable for Bore Size	+·020 in. (·50 mm.) 2·9137 in. (74·0 mm.) to 2·9142 in. (74·02 mm.)	+·021 in. (·525 mm.) 2·9147 in. (74·033 mm.) to 2·9152 in. (74·046 mm.)	+·022 in. (·55 mm.) 2·9157 in. (74·059 mm.) to 2·9162 in. (74·071 mm.)
2nd Rebore Marking Suitable for Bore Size	+·040 in. (1·0 mm.) 2·9337 in. (74·516 mm.) to 2·9342 in. (74·523 mm.)	+·041 in. (1·025 mm.) 2·9347 in. (74·541 mm.) to 2·9352 in. (74·554 mm.)	+·042 in. (1·05 mm.) 2·9357 in. (74·567 mm.) to 2·9362 in. (74·579 mm.)

Section A.14

PISTON SIZES AND CYLINDER BORES

It is necessary to fit new pistons by selective assembly, and to facilitate this the pistons are marked on their crowns with identification figures which must correspond with those of the cylinders to which they are fitted.

The actual bore dimensions of each cylinder are stamped on the top face of the cylinder block on the front right-hand corner by the appropriate symbol : +·020 in. (·50 mm.) [actual bore 2·9137 in. (74·0 mm.)], +·040 in. (1·0 mm.) [actual bore 2·9337 in. (74·516 mm.)], and oversize pistons are available for the above rebore sizes in the following range : +·020 in., +·021 in., +·022 in., +·040 in., +·041 in., +·042 in.

There are thus nine piston sizes available for replacement purposes as tabulated above.

In addition to being marked for size the pistons are also marked on their crowns to indicate their correct assembly in the bore ; the side marked "Front" should be towards the front of the engine.

Section A.15

REMOVAL AND REPLACEMENT OF WATER PUMP

Drain the water from the cooling system by means of the tap on the right-hand side of the radiator bottom tank and the tap on the left-hand side of the engine at the rear of the cylinder block.

Release the clips on the top and bottom water hoses and remove the hoses.

Remove the locknuts, nuts, flat washers and rubber washers securing the bottom of the radiator to the front member and lift out the radiator.

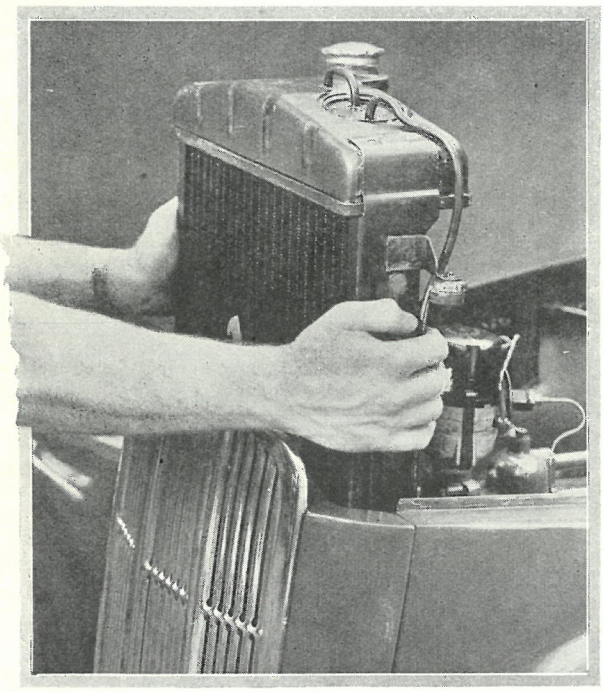


Fig. A.23.
Withdrawing the radiator after releasing its attachment bolts.

Slacken the dynamo belt tension bolt and the bolt on which the dynamo pivots, and remove the fan belt.

Extract the four bolts and spring washers securing the water pump to the cylinder head, and withdraw the pump unit.

When replacing the pump ensure that all traces of the old gasket have been removed from the cylinder head and pump body. Fit a new gasket and replace the water pump by reversing the above procedure.

Section A.16

VALVE CLEARANCE ADJUSTMENT

Release the clips securing the air cleaner breather pipe hose to the cleaner unit and remove the hose.

On Home models also withdraw the bolts securing the air cleaner brackets to the cylinder head cover and the intake pipe to the carburetter, and lift off the cleaner and carburetter pipe as a unit.

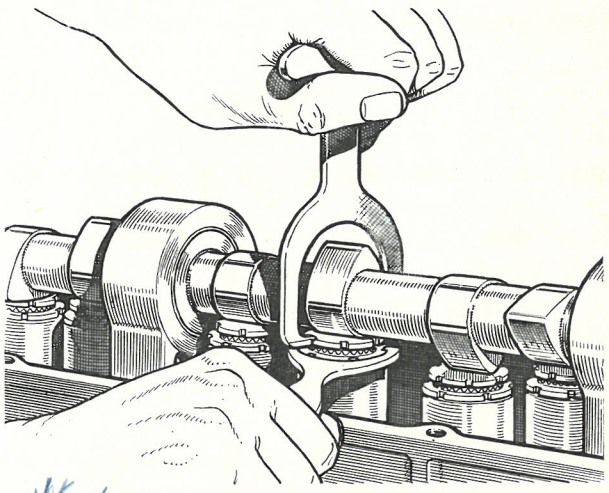


Fig. A.24.
How the valve clearance is adjusted with the help of the special spanners provided. While the "T"-handled spanner straddles the camshaft and engages the tappet head the other spanner engages the spring cap to hold it against rotation. The service spanner (Part No. 68898) is cranked and is designed to engage the tappet head from the side.

Disconnect the suction advance pipe from the union on the distributor. Remove the distributor cover and disconnect the low-tension wire from the distributor base.

Remove the securing bolts from the cylinder head cover and lift off the cover complete with distributor.

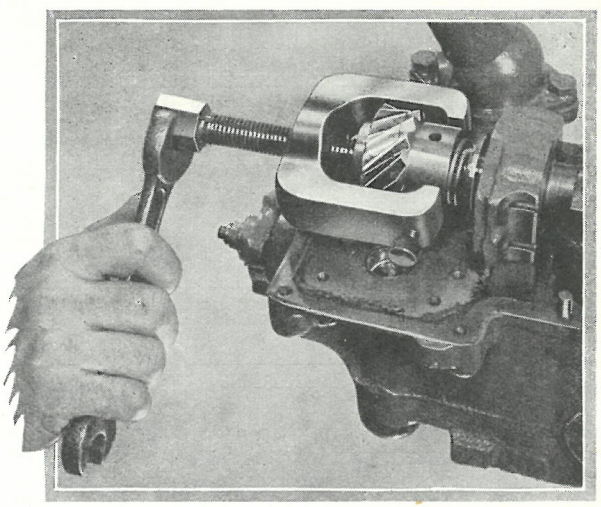


Fig. A.25.
The camshaft helical gear should be withdrawn by means of the special extractor (Part No. 68890) in the manner shown.

The mating faces of the adjustable tappet head and tappet locknut are serrated and as the adjuster is screwed in or out of the valve these serrations will plainly be felt. Each represents an adjustment of ·001 in. (·025 mm.).

Hold the tappet locknut with the straight-handled spanner to prevent the valve from rotating. Straddle the camshaft with the "T"-handled spanner or use the cranked spanner (tappet adjustment set, Special Tool, Part No. 68898) and engage the slots in the head of the adjustable tappet. Screw the tappet into or out of the valve stem in the required direction for adjustment, holding the locknut against rotation by the other spanner. The clearance should be measured between the head of the tappet and the cam while the cam for the valve under adjustment has its peak vertically upwards. Use the starting handle to rotate the engine and position the cams correctly. The correct clearance is ·015 in. (·38 mm.) when the engine is hot. An additional ·001 in. (·025 mm.) must be allowed when the valve setting is made with the engine cold.

The procedure for replacing the cylinder head cover is the reverse of the above. If the gasket has become damaged, a new one should be fitted. When offering up the cover to the cylinder head, turn the distributor rotor arm until the driving tongue at the lower end of the shaft is felt to engage. The tongue is offset to ensure correct positioning of the rotor arm in relation to the vertical shaft.

Section A.17

REMOVAL AND REPLACEMENT OF CAMSHAFT

Remove the cylinder head as in Section A.9.

Detach the vertical shaft drive gear from the cylinder head after unscrewing the four bolts with spring washers which secure the two halves of the split thrust plate and the thrust packing plate.

Remove the four bolts securing the split camshaft end thrust plate to the front journal housing and lift out the top half of the thrust plate.

Attach three valve spring compressing plates (Special Tool, No. 68899) to the cylinder head and depress the valves. The camshaft is then free to be withdrawn forward from the cylinder head. The lower half of the thrust plate is withdrawn after it has passed the front of the cylinder head.

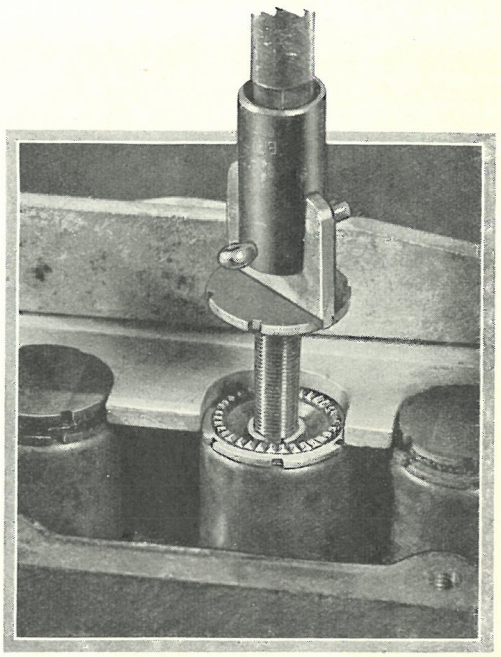


Fig. A.26.
A simple attachment for use with a brace can easily be made to accelerate the removal of the tappet heads from the valves.

Reassembly is a reversal of the above procedure. Remember to refit the lower half of the thrust plate before the camshaft is completely replaced.

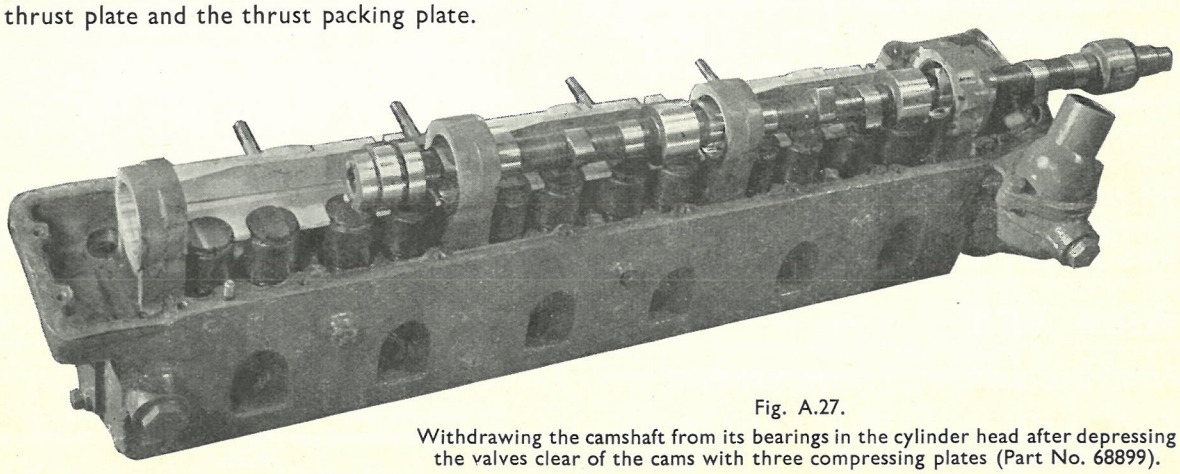


Fig. A.27.
Withdrawing the camshaft from its bearings in the cylinder head after depressing the valves clear of the cams with three compressing plates (Part No. 68899).

To remove the drive gear from the camshaft, extract the gear retaining bolt together with the lock washer and retaining washer and use the extractor (Special Tool, Part No. 68890) to draw the gear from the shaft.

Section A.18

REMOVAL AND REPLACEMENT OF VALVES AND TAPPET HEADS

Remove the cylinder head as in Section A.9.

Remove the camshaft as in Section A.17.

Compress the valve springs (Special Tool, Part No. 68899) and unscrew the tappet head from the valve stem. Release the valve springs and remove the tool. The neoprene rubber sealing grommet, tappet head locknut, oil deflector and valve spring complete with locating washer may now be removed. Withdraw the valve from the valve guide.

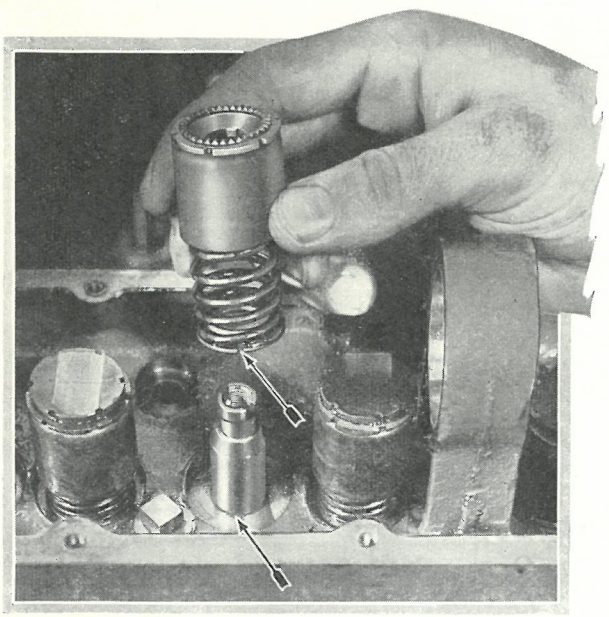


Fig. A.28.

When assembling the valves make sure the slot in the locating washer (upper arrow) engages the peg in the valve spring seat (lower arrow) and that the close-coiled end of the spring is next to the cylinder head.

When replacing the valve spring and locating washer, ensure that the slot in the washer engages the peg in the cylinder head. The spring is fitted with the close coils next to the cylinder head.

Replace the oil deflector and tappet head locknut with the two ears of the locknut engaging the slotted end of the valve stem. Fit a new neoprene rubber grommet over the stem of the tappet head on inlet valves (see Section A.29). Replace the tappet head and compress the springs again (Special Tool, Part No. 68899). Screw in the tappet until it is approximately in its correct position and finally adjust it when the camshaft has been replaced.

Note.—*To prevent excessive oil consumption it is always advisable to fit neoprene rubber grommets to the inlet valve stems as indicated in Section A.29 whether they have been fitted before or not.*

Section A.19

REMOVAL AND REPLACEMENT OF VALVE GUIDES

Remove the valves and tappet heads as detailed in Section A.18.

Invert the cylinder head and support it on wooden blocks. Drive each valve guide downwards with a suitable-sized drift inserted through the combustion space.

The drift should take the form of a hardened steel punch $\frac{11}{16}$ in. (17·46 mm.) in diameter and not less than 6 in. (15 cm.) in length with a locating spigot $\frac{1}{2}$ in. (12·5 mm.) in diameter machined on one end for a length of 1 in. (2·5 cm.) to engage the bore of the guide.

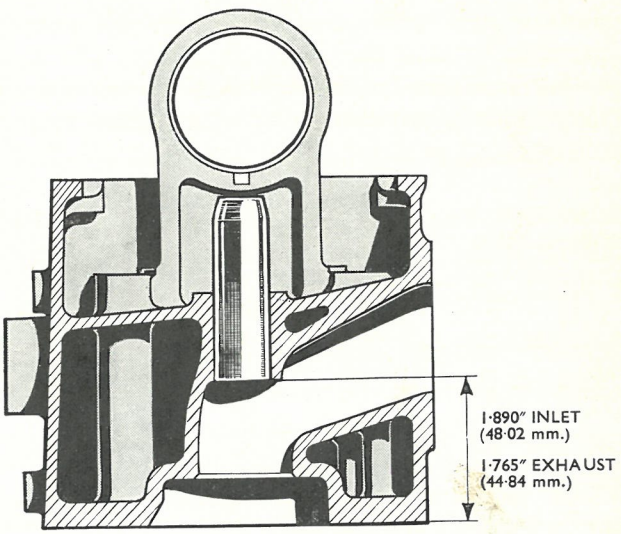


Fig. A.29.

When fitting replacement valve guides it is important that they are correctly located when pressed into position. The inlet valve guides should be 1·890″ (48·02 mm.) from the cylinder head face and the exhaust valve guides should be 1·765″ (44·84 mm.) from the face as indicated.

When fitting new valve guides these should also be driven in from the combustion space side of the cylinder head with chamfered end first. The valve guides are correctly positioned when the lower ends are level with the bosses in the inlet and exhaust ducts.

The exhaust valve guides, which are $\frac{1}{8}$ in. (3·17 mm.) longer than the inlet valve guides and of copper-nickel alloy, are readily distinguished from the cast-iron inlet valve guides.

Section A.20

DECARBONISING

Remove the cylinder head as detailed in Section A.9.

Withdraw the camshaft, valves and tappets as in Sections A.17 and A.18.

Remove the cylinder head gasket and plug the waterways and vertical drive shaft housing with a clean rag.

Where special equipment is not available for decarbonising it will be necessary to scrape the carbon deposit from the piston crowns, cylinder block and cylinder head, using a blunt scraper.

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.

The cylinder head is next given attention. The sparking plugs must be removed, cleaned and adjusted. Clean off the carbon deposit on the valve stems, valve ports and combustion spaces of the cylinder head. Remove all traces of carbon dust with compressed air, or by the vigorous use of a pair of household bellows, and then thoroughly clean in paraffin and dry off.

Fit a new cylinder head gasket when replacing the cylinder head.

Section A.21

GRINDING AND TESTING VALVES AND THEIR SEATINGS

Remove the valve and tappet as in Section A.18.

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.

If valve seats show signs of pitting or unevenness, they should be trued by the use of a suitable grinder or a special cutter. When using a cutter, care must 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 12, 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 similarly numbered to identify the port to which they belong.

The valve face should be smeared lightly with fine or medium grade carborundum paste, and then ground to its seat, using the suction grinder, Part No. 66893. Avoid the use of excessive quantities of grinding paste and see that it remains in the region of the valve seating only. A light coil spring placed under the valve head will assist considerably in the process of grinding. The valve 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, free from blemish, 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 and ports should be cleaned thoroughly with paraffin-soaked rag, dried, and then thoroughly cleaned by compressed air. The valves should be washed in paraffin, and all traces of grinding paste removed.

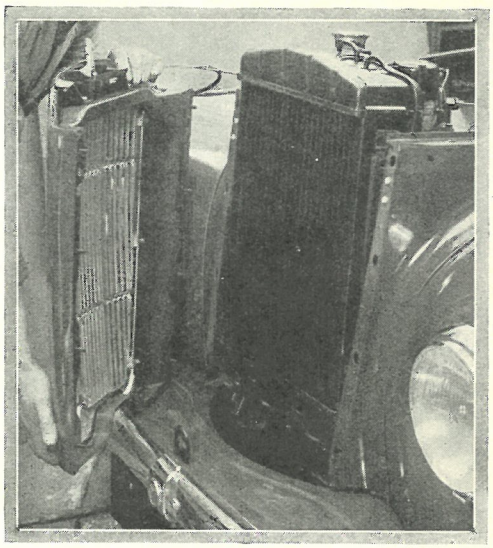


Fig. A.30.
Withdrawing the radiator case.

Section A.22

REMOVAL AND REPLACEMENT OF ENGINE

Unscrew the two nuts on each bonnet hinge and, with the aid of a second operator, lift off the bonnet.

Drain the water from the cooling system, using the drain tap at the base of the radiator on the right-hand side under the grille, and the tap at the rear of the cylinder block on the left-hand side.

Release the clips on the top and bottom radiator hoses and remove the hoses. Remove the nuts, locknuts, flat and rubber washers from the radiator mounting studs in the front cross-member and lift out the radiator core.

Release the bonnet-catch operating cable from the lever attached to the right-hand wing valance.

Remove the eight nuts with spring and flat washers securing the radiator case and grille assembly to the wing valances, but do not undo the two nuts securing each radiator support bracket. The radiator case is now free to be withdrawn.

Disconnect the battery by removing the raised head screw from the positive earth cable and lifting the cable from the terminal post.

Remove carburetter and air cleaner as in Section A.7.

Disconnect the exhaust pipe flange from the manifold, taking care not to damage the copper-asbestos gasket.

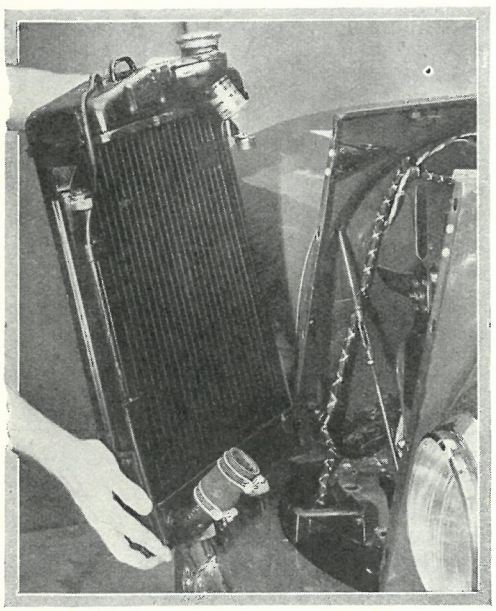


Fig. A.31.
Removing the radiator from the car.

Disconnect the oil gauge pipe from its connection on the left-hand side of the cylinder block. Use a $\frac{3}{16}$ in. spanner to undo the union nut, and a $\frac{1}{4}$ in. spanner to prevent the union turning in the cylinder block and fracturing the pipe.

Pull back the ears of the snap-lock ball joint connecting the throttle pedal rod to the relay lever below the exhaust manifold, and disconnect the rod.

Remove the distributor cover. Disconnect the vacuum advance pipe from the distributor body and the high-tension leads from the sparking plugs and coil. Disconnect the contact breaker wire at the coil and distributor terminal. Withdraw the bolts securing the high-tension lead carrier to the cylinder head and lift the carrier and leads clear of the engine.

Disconnect the dynamo and starter cables.

The dynamo on later models is mounted on a bracket attached to the side of the engine block. Dynamos mounted in this manner must be removed from the engine before the engine can be withdrawn.

Remove the front floor carpet and carpet felt and lift out the gearbox cover-plate after extracting the brass retaining screws and flat washers and releasing the foot-operated dipping switch.

Support the engine with a sling and remove the bolts securing the front mounting rubbers and packing plates to the frame.

Undo the nut securing each mounting to the engine and remove the mountings.

Extract the bolts and spring washers securing the clutch housing to the flywheel housing, noting the position of the exhaust pipe bracket.

Draw the engine forward from the splines and raise the forward end. Extract the bolts securing the crankshaft damper to the pulley and withdraw the damper. The engine may then be raised and carefully manœuvred forward clear of the car.

When replacing the engine in the frame, it will be found helpful if the car is moved forward steadily while in gear, as this will assist in aligning the gearbox drive shaft with the clutch and flywheel.

Ensure that the clutch casing is located on the two dowel pins in the flywheel housing, and replace the mounting rubbers.

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

Section A.23

REMOVAL AND REPLACEMENT OF ENGINE AND GEARBOX UNIT

Removal of the engine and gearbox as a single unit is more easily carried out over a pit. Follow the procedure given in Section A.22 until the sling is placed round the engine.

Disconnect the front end of the propeller shaft and remove the strap which is secured to the top of the engine steady by two $\frac{1}{4}$ in. nuts and bolts.

Disconnect the speedometer drive and extract the split pin and Belville washer from the forward end of the clutch-operating rod.

Withdraw the split pin and clevis pin at the lower end of each gear-operating rod.

Take the weight of the engine and gearbox unit on the sling. Remove the bolts and nuts securing the rear support rubbers to the clutch housing and support member. Withdraw the four long bolts from each side of the gearbox support member and remove the member. Note that the engine earth strip is attached to one of the bolts.

Detach the wires from the reverse lamp switch—they are secured by snap connectors—and release the exhaust pipe from its bracket.

Remove the bolts securing the front mounting rubbers and packing plates to the frame. Undo the nut securing each mounting to the engine and remove the mounting.

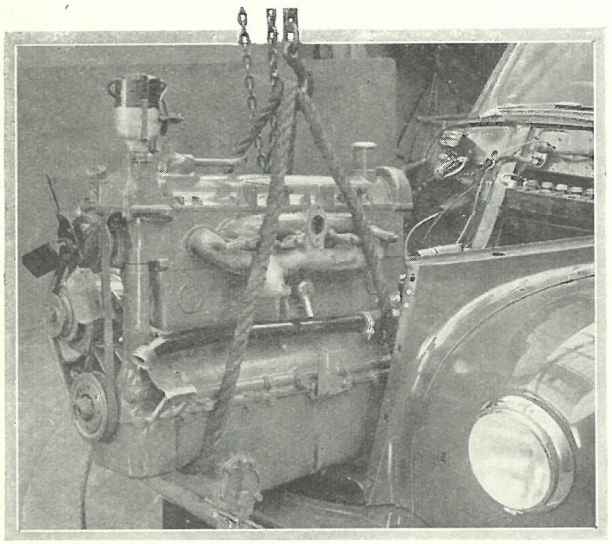


Fig. A.32.
Withdrawing the engine from the car (early model) with the help of a suitable sling.

Raise the front end of the unit and draw it forward. Lift the gearbox drive flange clear of the engine steady bracket and manœuvre the unit forward clear of the car.

The engine and gearbox may be replaced as a complete unit if the above operations are carried out in the reverse order.

Section A.24

REMOVAL AND REPLACEMENT OF FLYWHEEL (Engine out of Car)

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

Remove the clutch as in Section E.2.

Extract the locking wire, and remove the four $\frac{3}{8}$ in. flywheel attachment bolts and the dowel pin retaining plate.

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.

Reassembly is carried out in the reverse order to the above. The locating dowels are offset to prevent incorrect replacement of the flywheel.

Normally the starter ring is serviced as a complete unit with the flywheel. In overseas countries where this is not convenient, arrangements have been made to supply the starter rings separate for fitting to the existing flywheel, but as they have to be shrunk on at the right temperature, special precautions have to be taken, and these are covered by special instructions obtainable on application to the Nuffield Distributor in the country concerned. No attempt should be made to replace the starter ring on a flywheel unless the special instructions are available and carried out. Ring and flywheel **assemblies only** are available for the home market.

Section A.25

REMOVAL AND REPLACEMENT OF CRANKSHAFT (Engine out of Car)

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

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

Slacken the dynamo and remove the fan belt.

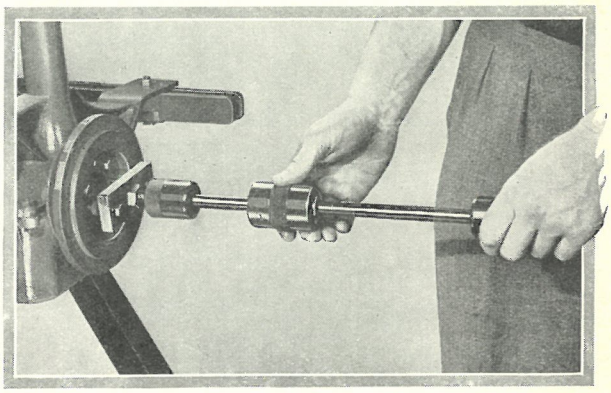


Fig. A.33.
The use of the special impact extractor (Part No. 68823) is here shown in conjunction with the extracting tool (Part No. 68893) used to remove the crankshaft pulley and damper.

Remove the starting handle dog nut and flat washer. Use the special extractor (Part No. 68893) to withdraw the pulley and crankshaft damper from the end of the crankshaft, taking care not to lose the pulley key.

Withdrawal of the pulley and damper is greatly facilitated if the special impact tool (Part No. 68823) is used.

Remove the flywheel as detailed in Section A.24.

Remove the big-end bearing caps and release the connecting rods from the crankshaft.

Unscrew the two Philidas securing nuts from each main bearing, and remove the caps—these are numbered on the right-hand side to ensure replacement on the correct bearings.

Lift the crankshaft out of the bearings.

particularly when the oil is warm and fluid. This will cause a drop in the pressure recorded on the gauge, as compared with that shown when the bearings are in good order.

Note :—*The automatic release valve in the vertical drive shaft housing deals with any excessive oil pressure when the engine and oil are cold.*

Cold running and 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.

Particular attention is called to the recommended change of oil every 3,000 miles (5000 km.). This is a most important factor in attaining long and trouble-free service from the engine.

Section A.28

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.
   6. Faulty starter brushes.

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.
      (*e*) Faulty condenser (substitute a condenser known to be in order).
      (*f*) Faulty coil (substitute a coil known to be in order).
   4. Check the 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 the 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.
   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.
   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. Cylinder head gasket for leaks.
   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 stop control requires adjustment.
3. Throttle controls incorrectly set.
4. Engine stop control wrongly set.
5. Weak mixture or over-rich mixture.
6. 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
5. Faulty high-tension leads. [circuit.
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 mixture weak.
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 worn, causing air leaks.
7. Excessive carbon deposit.

Section A.29

OIL CONSUMPTION

Where excessive oil consumption is suspected the first step to take is to make sure that oil is not finding its way down the valve stem through the keyways for the valve tappet locknut, and thus being sucked into the induction port and consumed.

To prevent the possibility of this happening, later engines (subsequent to No. VC 22M 2944) are fitted with neoprene rubber grommets, Part No. 163431, between the spring cap and the tappet head on the inlet valves which effectively seal both the keyways and the tappet threads and arrest the passage of oil. The location of these grommets is shown on Fig. A.36.

Whenever an engine, on dismantling, is found to be without these grommets it is advisable to fit them when reassembling, and in all cases where the grommets are already fitted it is essential to fit new grommets whenever the valves have been disturbed, since it is impossible to make a satisfactory seal a second time with the same grommet. It is also imperative to use one of the correct neoprene synthetic rubber grommets, as ordinary rubber is useless.

Excessive oil consumption has also been traced to the excessive transfer of oil from the valve chamber to the air cleaner through the breather pipe from the valve chamber filter cover, and in such cases the fitting of a suitable restrictor in the breather pipe effects a considerable improvement.

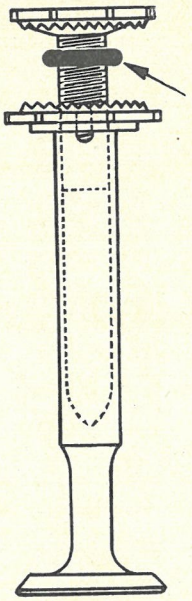


Fig A.36.
The location of the special neoprene rubber grommet to arrest the passage of oil down the valve stem.

A suitable restrictor is indicated in Fig. A.37 and consists of a simple plug with a central passage which is forced into the breather pipe of the valve chamber filter cover.

This plug is a simple turning operation and it can be made from any suitable metal which will withstand forcing into the end of the pipe. It must not, of course, be made from any material affected by oil or or be liable to disintegrate in use.

Section A.30

MODIFIED CYLINDER HEAD

A new cylinder head, Part No. 164606, and gasket, Part No. 164433, are fitted to engines commencing No. 9450. The new head and gasket may be fitted to engines prior to the above change point.

From Engine No. 10041 onwards a new cylinder block has been employed and the latest head and gasket must always be used with this.

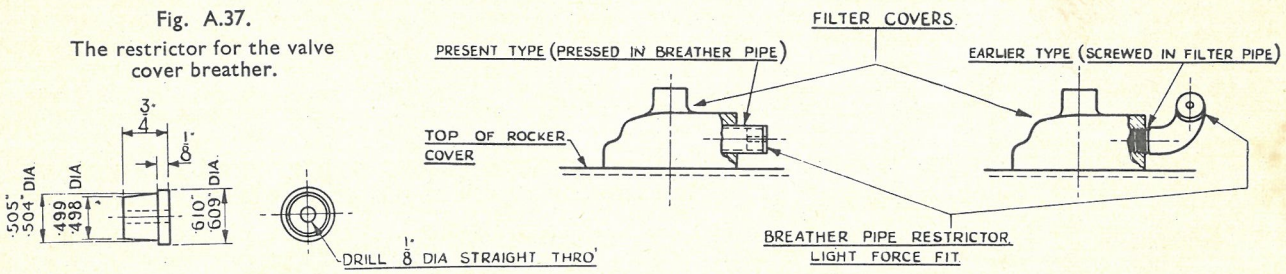
Section A.31

IMPROVED ENGINE MOUNTING

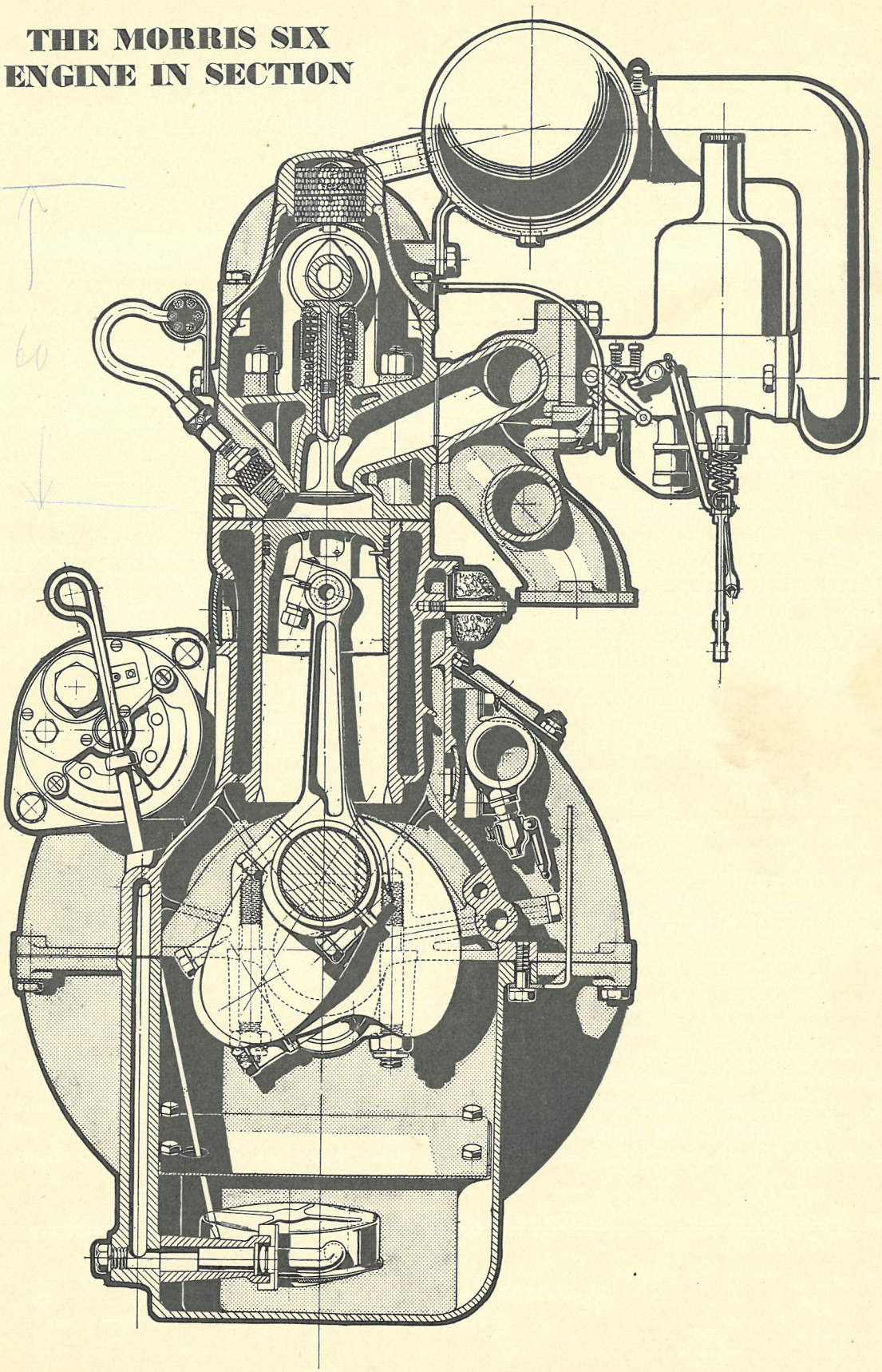
On later models the front and intermediate engine mounting rubbers have been given an increased shore hardness to reduce the liability of clutch judder.

The new rubbers have been given new Part Numbers to avoid confusion. The front rubber is now Part No. 182660 and the intermediate rubber Part No. 182703. When replacing rubbers the new type should be fitted.

Fig. A.37.
The restrictor for the valve cover breather.



THE MORRIS SIX ENGINE IN SECTION



Section A.32

ADDITIONAL SUMP BOLT

In order to counter complaints of oil leakage at the sump joint, in the region of the oil duct between the cylinder block and the filter element in the sump, an additional bolt has been introduced on the left-hand side of the cylinder block which screws into the sump from above.

It is, of course, essential to withdraw this bolt before the sump can be removed and, as it is inserted from above, there is the danger that it may be overlooked and the sump damaged in consequence.

The bolt is situated towards the front of the engine in a small recess on the left-hand side and must be removed completely before dealing with the remaining sump bolts from below. It can be identified readily from the illustration Fig. A.38.

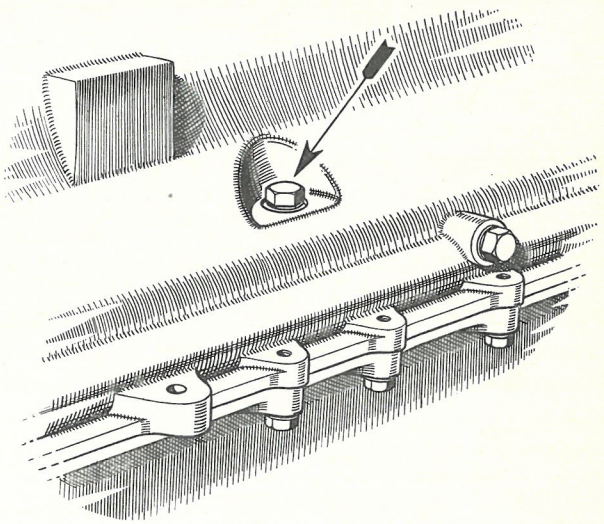


Fig. A.38.
The location of the additional sump bolt which screws downwards into the sump through the cylinder block base.

SECTION B

THE FUEL SYSTEM

Section No. B.1	Removal and replacement of the petrol tank.
Section No. B.2	Construction of the petrol pump.
Section No. B.3	Action of the petrol pump.
Section No. B.4	To dismantle and reassemble the petrol pump.
Section No. B.5	Petrol pump adjustment.
Section No. B.6	Tracing petrol pump troubles.
Section No. B.7	Petrol pump maintenance.
Section No. B.8	The carburetter.
Section No. B.9	Carburetter adjustments.
Section No. B.10	Centring the jet.
Section No. B.11	Sources of carburetter trouble.
Section No. B.12	The air silencer. The air cleaner.
Section No. B.13	The mixture control.

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 $\frac{1}{2}$ 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.

Disconnect the petrol pipe from the tank by undoing the $\frac{5}{16}$ in. union nut.

Release the excluder plate and rubber seal from the spare wheel compartment floor by removing the three $\frac{3}{16}$ in. bolts and nuts with spring and flat washers.

The long bolt also secures the jack clip and a distance tube.

Slacken off the top clip on the hose joining the petrol tank to the filler neck and withdraw the filler neck from the hose.

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

Support the petrol tank and unhook the two straps from the brackets securing them to the spare wheel compartment floor.

The tank may now be lowered from the car.

The tank is replaced by reversing the above procedure, noting that the excluder plate, rubber seal and felt pads are properly in position and that the drain plug is fitted with its washer and fully tightened.

Section B.2

CONSTRUCTION OF THE PETROL PUMP

The petrol pump is an S.U. Type L, 12-volt electric pump. (See Fig. B.1.)

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.

To deal with conditions of high temperature later pumps are fitted with a special vented diaphragm. Such pumps are identified by the serial number prefix "G" and the letter "E" stencilled on the magnet housing.

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.

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

1. Outlet union.
2. Fibre washer (thick orange).
3. Spring clip.
4. Delivery valve disc.
5. Valve cage.
6. Fibre washer.
7. Suction valve disc.
8. Pump body.
9. Diaphragm assembly.
10. Armature guide rollers.
11. Retaining plate.
12. Filter.
13. Fibre washer (thick orange).
14. Filter plug.
15. Steel armature.
16. Push-rod.
17. Magnet iron core.
18. Magnet coil.
19. Rocker hinge pin.
20. Terminal screw.
21. Cover.
22. Cover and terminal nuts.
23. Earth terminal screw.
24. Spring blade.
25. Inner rocker.
26. Outer rocker.
27. Magnet housing.
28. Volute spring.
29. Inlet union.

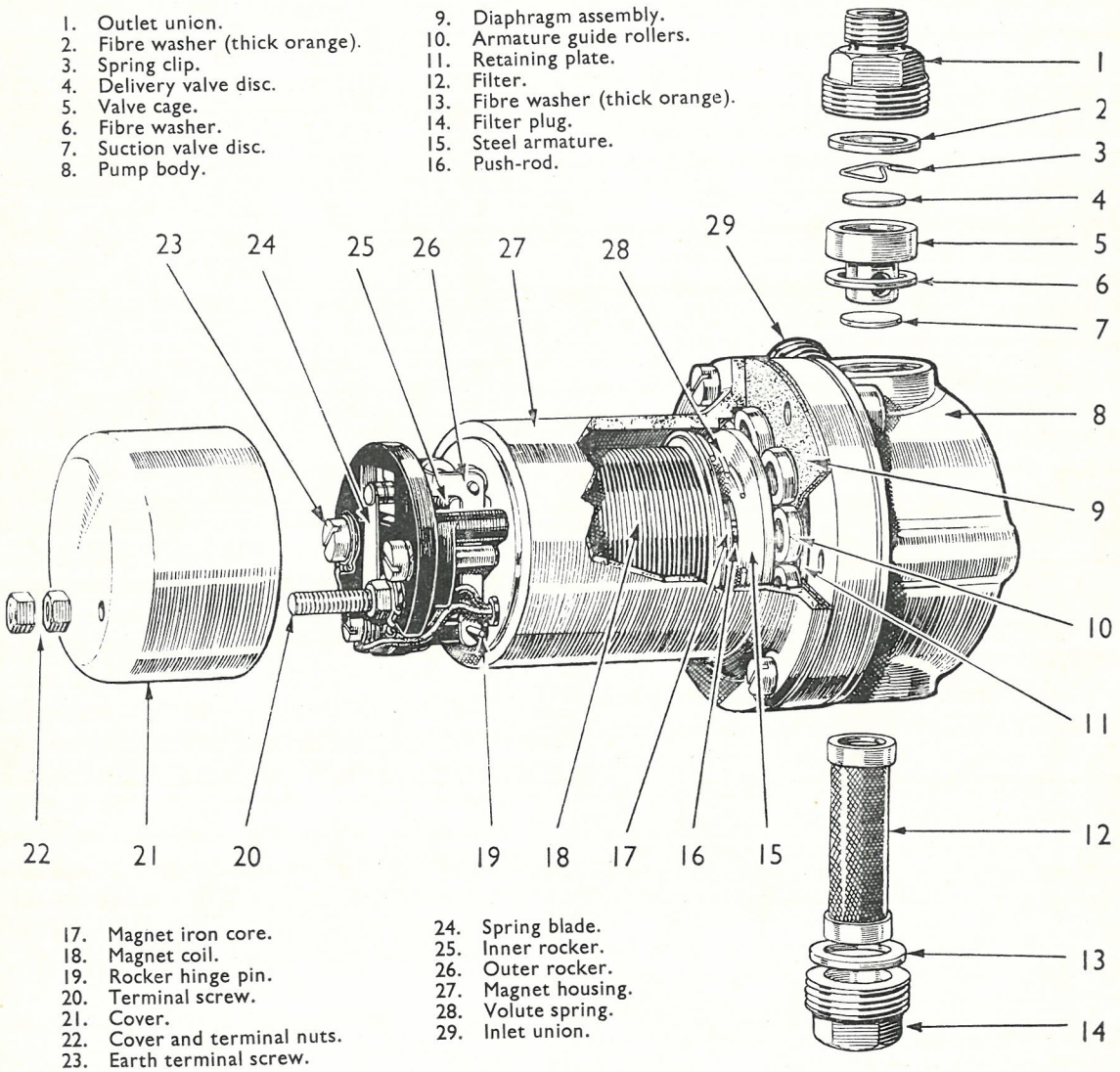


Fig. B.1.
The S.U. petrol pump.

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 farther 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.

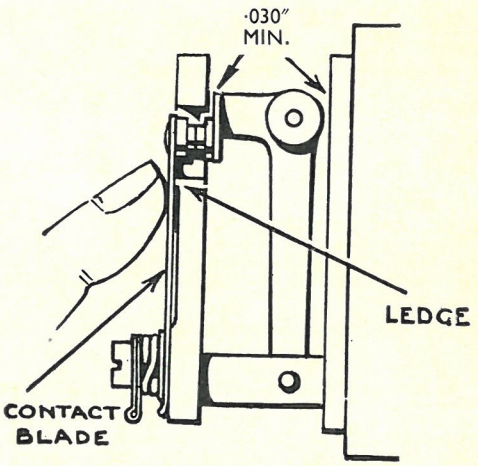


Fig. B.2.
The correct setting for the contact breaker points is clearly indicated in this illustration.

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.

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 must always be replaced bearing directly against the bakelite pedestal, i.e. underneath the tag.

When properly fitted the blade should rest against the ledge on the pedestal while 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 over-hanging portion, and see that you can get a ·030 in. (·76 mm.) feeler between the white rollers and the magnet mounting of the pump (see Fig. B.2). 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.*

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. B.3. 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.

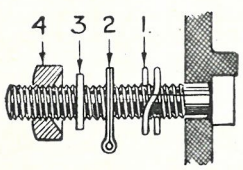


Fig. B.3.

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

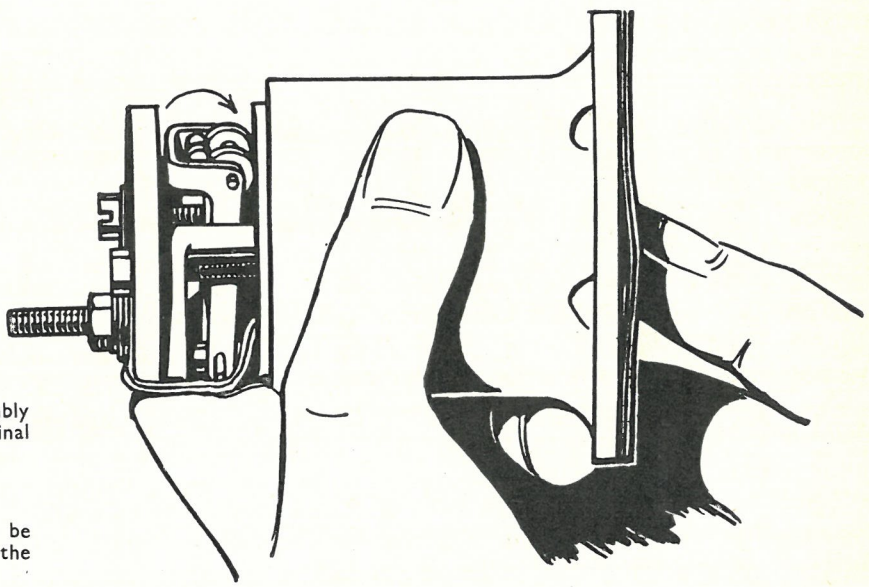


Fig. B.4.

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

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 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 farther 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. B.4). 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 magnet housing in position on the main body, taking care to see that the drain hole in the magnet housing 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 magnet housing 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. B.5). 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. B.6 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

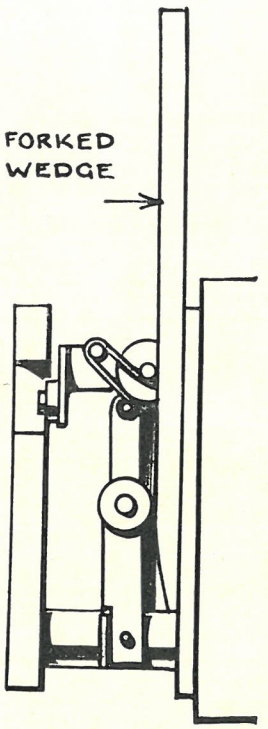


Fig. B.5.
The use of a forked wedge to keep the armature in the correct position for fitting the diaphragm.

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 litre) of fuel per minute should be pumped.

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

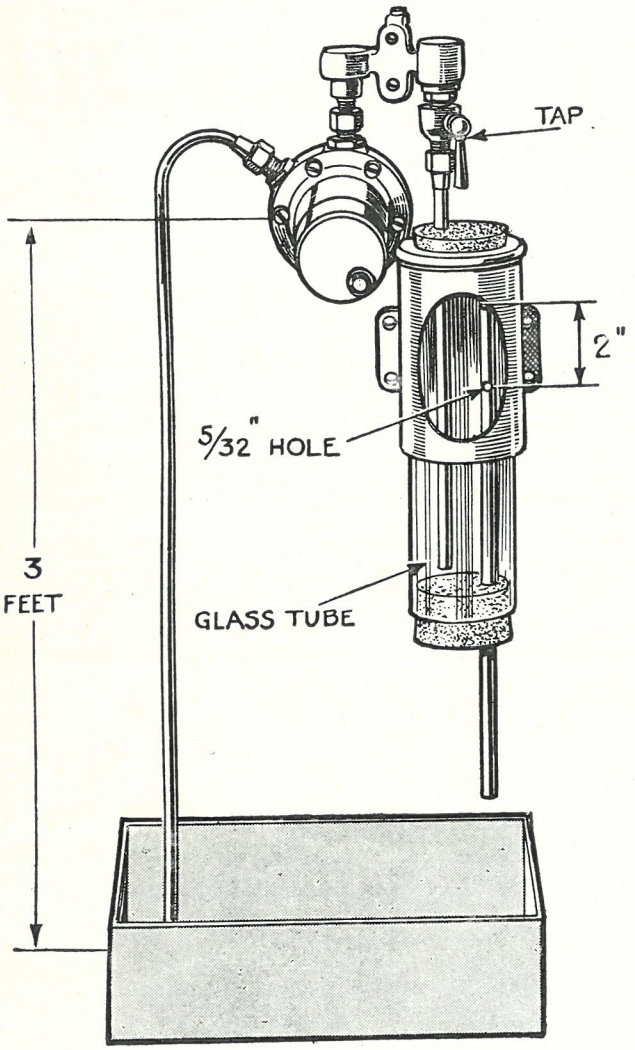


Fig. B.6.

The checking rig. This can usually be constructed from items available locally, but the complete rig is obtainable from the Service Parts Department of Morris Motors Ltd. or your local Distributor.

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 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 B.5.

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

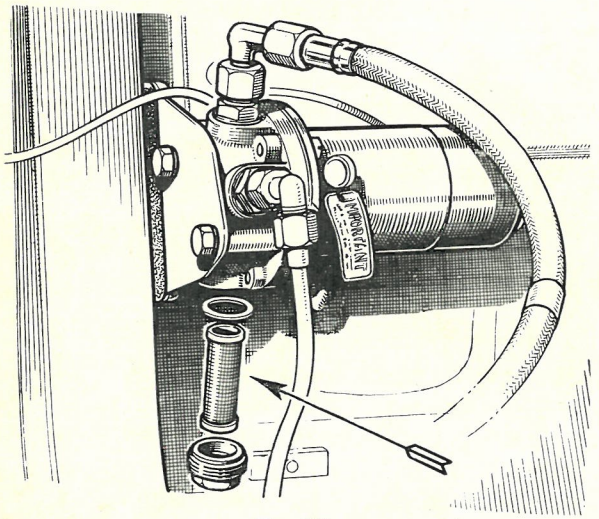


Fig. B.7.
The pump filter should be withdrawn at intervals of approximately 6,000 miles (10000 km.), cleaned and replaced. Make sure the terminal nuts are tight, particularly the one for the earth wire.

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

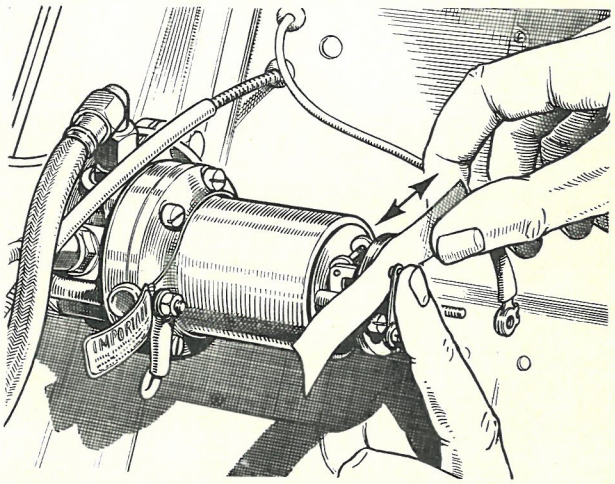


Fig. B.8.
The contact breaker points should be cleaned every 3,000 miles (5000 km.) by drawing a strip of paper between them while holding them lightly together with a finger.

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.

Section B.8

THE CARBURETTER

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

A damper is provided consisting of a plunger and non-return 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 to prevent piston flutter.

Section B.9

CARBURETTER ADJUSTMENTS

The mixture

Run the engine until it attains its normal running temperature.

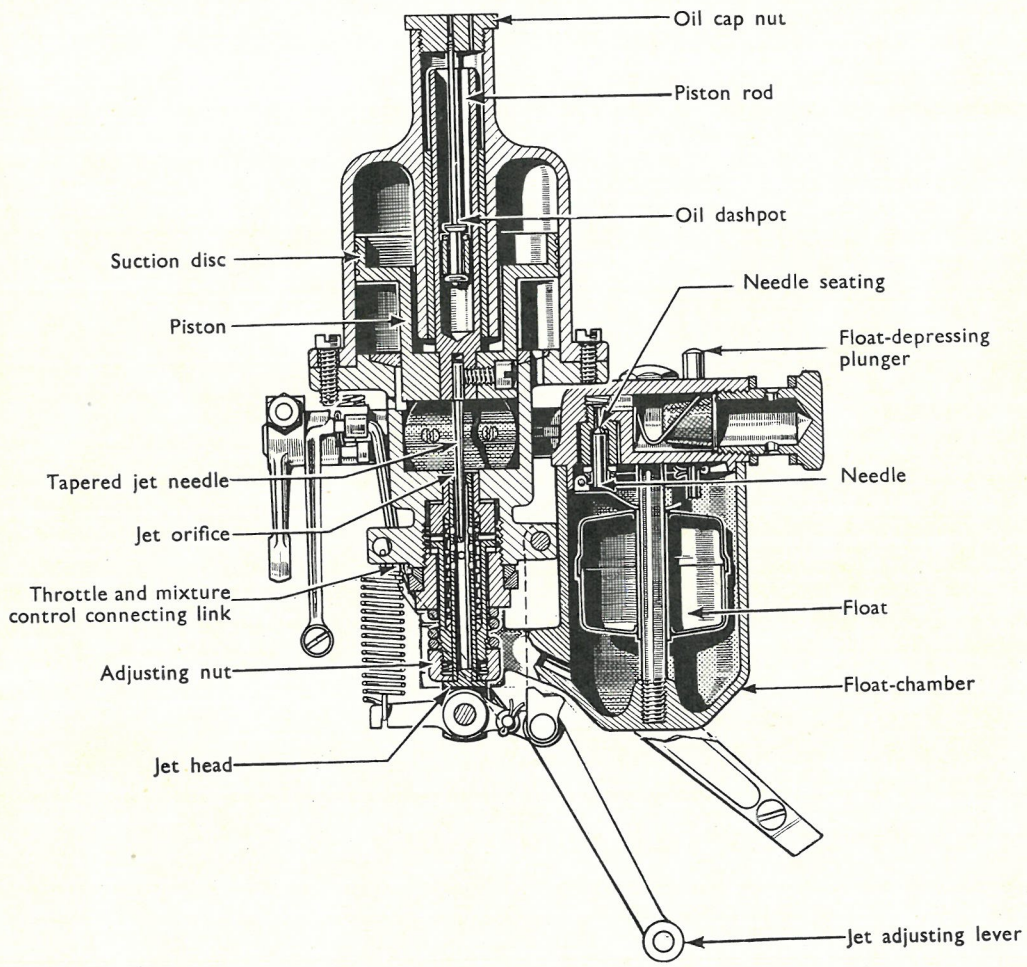


Fig. B.9.
The S.U. carburetter.

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 the road performance is not satisfactory after this adjustment has been made, 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 and return spring 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.**

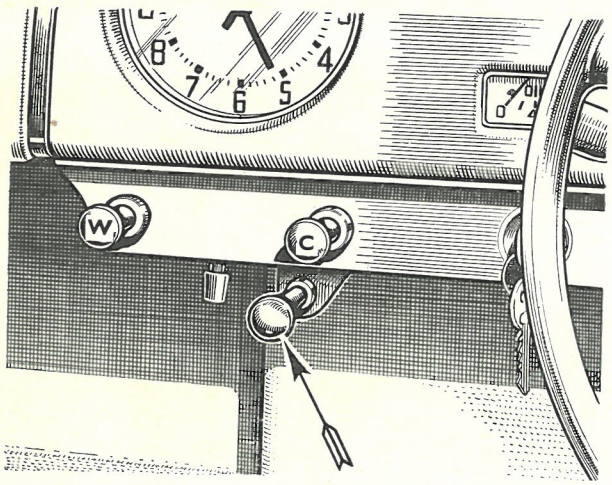


Fig. B.10.
The engine stop control which is provided on some cars to ensure stoppage of the engine by complete closure of the throttle. Pulling out the knob closes the throttle.

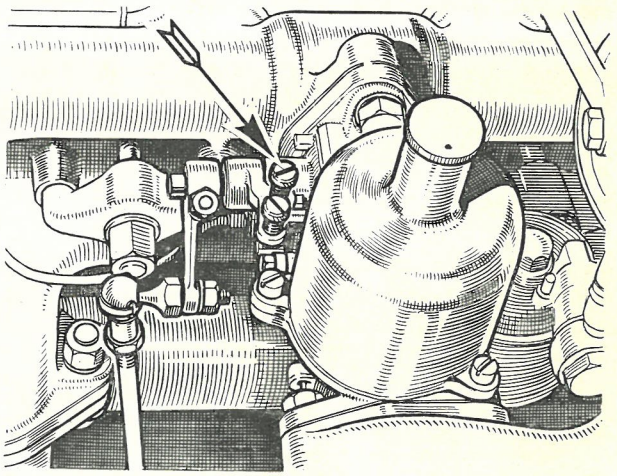


Fig. B.11b.
On later models the slow-running screw is vertically disposed as shown. Screwing it inwards increases the engine speed.

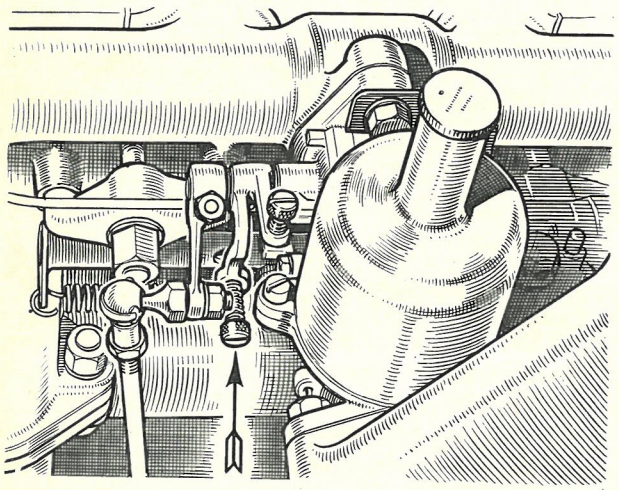


Fig. B.11a.
The slow-running of the carburetter on early models is adjusted by the spring-loaded self-locking screw shown. Screwing it inwards increases the engine idling speed.

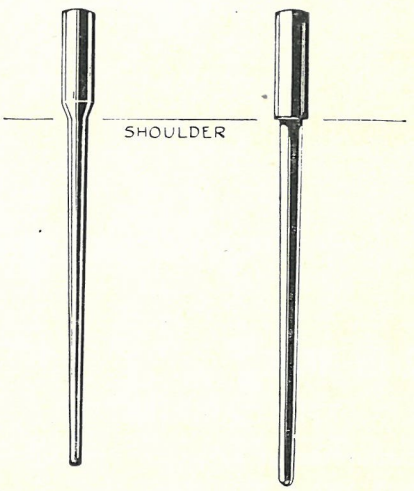


Fig. B.12.
The shoulder of the needle should be flush with the under face of the piston. Two types of shoulder are in use and the correct datum point for each is shown.

When replacing, care should be taken that the key-way at the side of the piston registers with the key in the body and that the return spring is refitted correctly. 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.

This is checked by inserting a $\frac{7}{16}$ in. (11·1 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. B.14) 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.

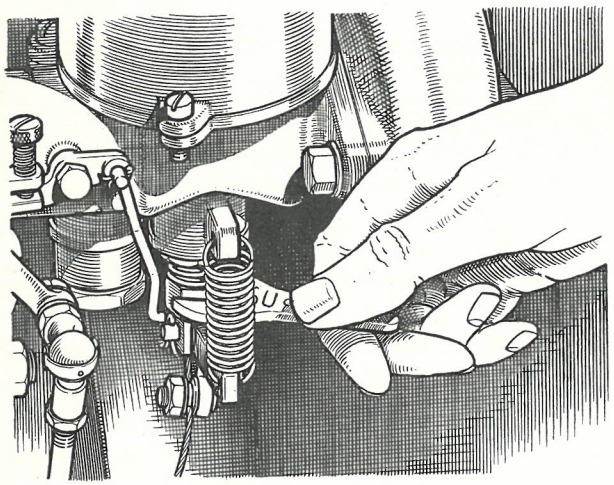


Fig. B.13.

Adjustment of the jet is achieved by turning the jet adjusting nut in the appropriate direction as shown.

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 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.

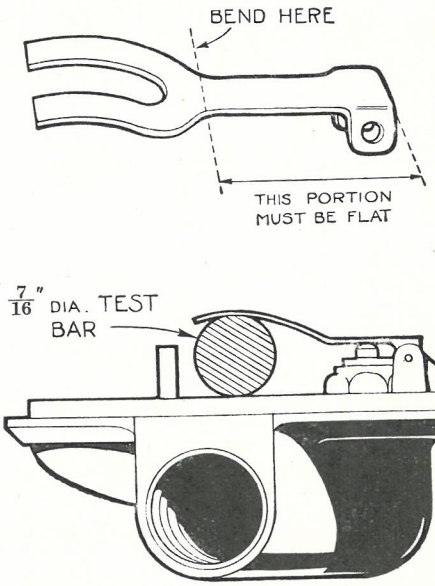


Fig. B.14.

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

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

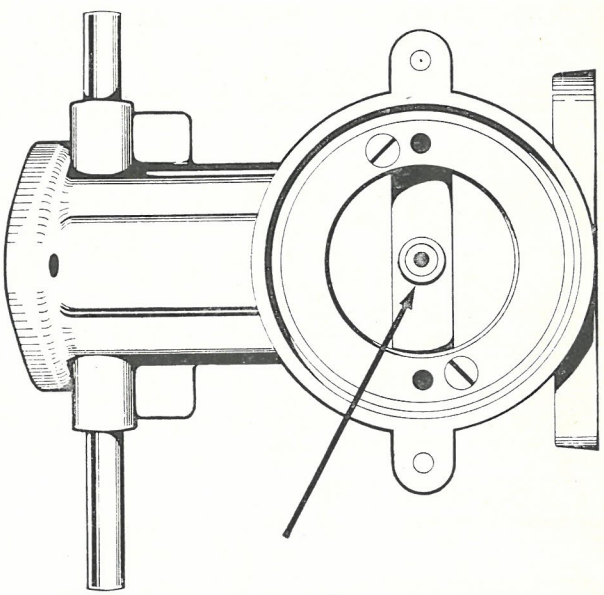


Fig. B.15.

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

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.

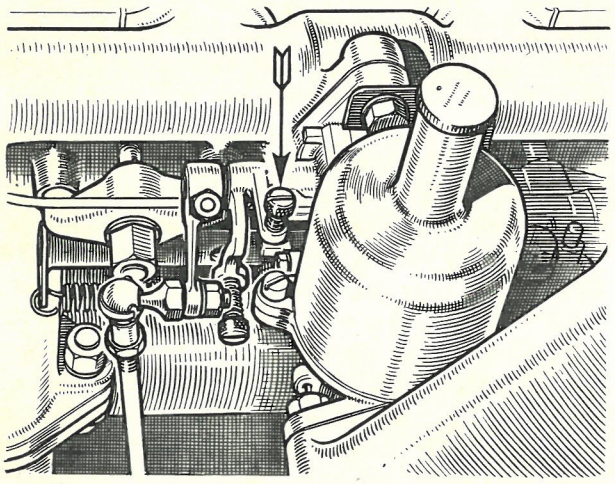


Fig. B.16a.
The screw indicated by the arrow regulates the degree of interconnection between the mixture control and throttle for cold running on the earlier cars with the special stop control.

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 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. On no account should the piston return spring be stretched or its tension altered in an attempt to improve its rate of return.

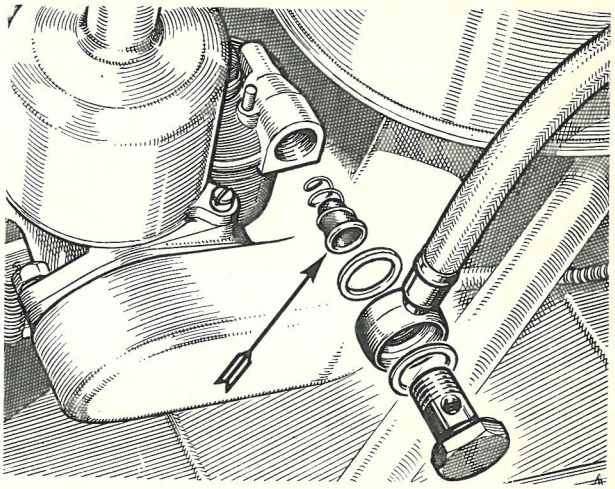


Fig. B.17.
The carburetter filter should be replaced with its opening outwards as indicated. The fibre washers must be replaced either side of the banjo union.

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

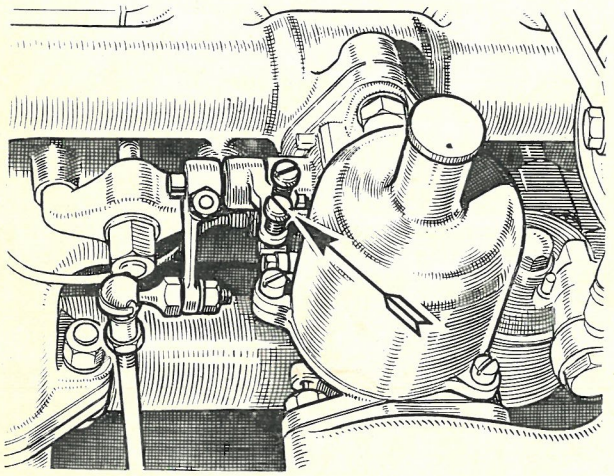


Fig. B.16b.
The adjustment screw for regulating the inter-connection between the mixture and throttle controls on later models.

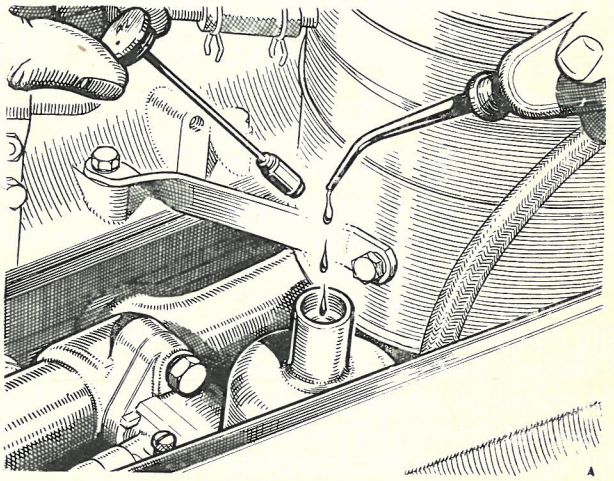


Fig. B.18.
Every 1,000 miles (1600 km.) the carburetter oil cap should be unscrewed and a small quantity of oil to Ref. F (page P.2) poured into the dashpot.

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(Service Afdelingen)

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. (See Section B.10.)

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

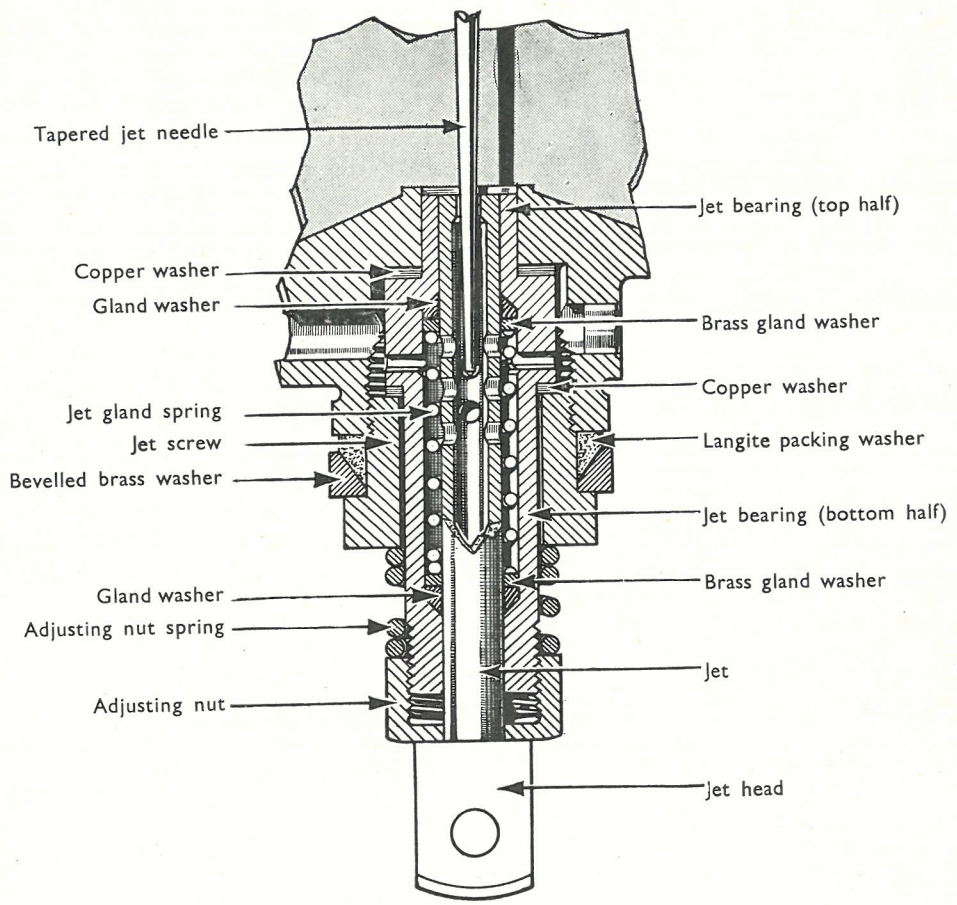
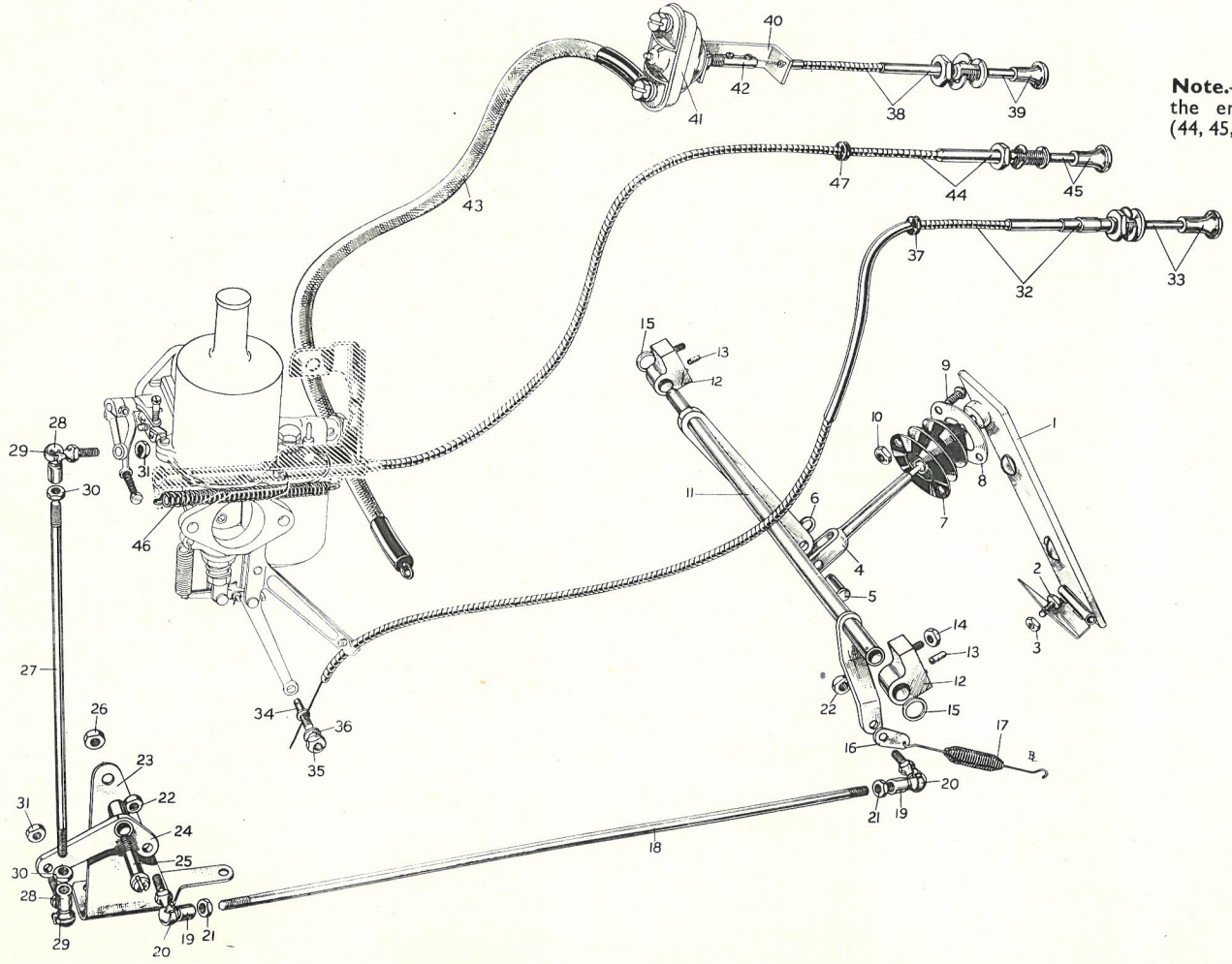


Fig. B.19.
An enlarged view of the jet assembly, showing its component parts.

THE ACCELERATOR, MIXTURE AND STARTER CONTROL COMPONENTS



Note.—On later models the engine stop control (44, 45, 46 and 47) has been eliminated.

KEY TO THE ACCELERATOR, MIXTURE AND STARTER CONTROL COMPONENTS

No.	Description
1.	Pedal—accelerator.
2.	Screw—pedal to toeboard.
3.	Nut—pedal screw.
4.	Connecting link—pedal to lever.
5.	Clevis pin—link to lever.
6.	Washer—clevis pin.
7.	Excluder—pedal draught.
8.	Retainer—excluder.
9.	Screw—retainer to toeboard.
10.	Nut—retainer screw.
11.	Cross-shaft assembly.
12.	Bearing—cross-shaft.
13.	Plug—lubricating felt.
14.	Nut—bearing to toeboard.
15.	Washer—cross-shaft to bearing.
16.	Anchor lug—return spring.
17.	Spring—accelerator return.
18.	Connecting rod—cross-shaft lever to relay.
19.	Ball joint.
20.	Lock clip—ball joint.
21.	Locknut—ball joint.
22.	Nut—connecting rod to levers.
23.	Bracket—on sump.
24.	Lever—relay.
25.	Pivot—relay lever to bracket.
26.	Nut—pivot.
27.	Connecting rod—relay to carburetter.
28.	Ball joint.
29.	Lock clip—ball joint.
30.	Locknut—ball joint.
31.	Nut—rod to levers.
32.	Cable—outer—mixture.
33.	Cable with knob—inner.
34.	Lever pin—carburetter.
35.	Nut—lever pin.
36.	Washer—lever pin.
37.	Grommet—control through dash.
38.	Cable—outer—starter.
39.	Cable with knob—inner.
40.	Bracket—starter switch wire.
41.	Switch (on dash)—starter.
42.	Coupling—switch to control.
43.	Cable—starter to starter switch.
44.	Cable—outer—engine stop.
45.	Cable with knob—inner.
46.	Spring—cable return.
47.	Grommet—through dash.

Note.—On later engines the stop control has been eliminated.

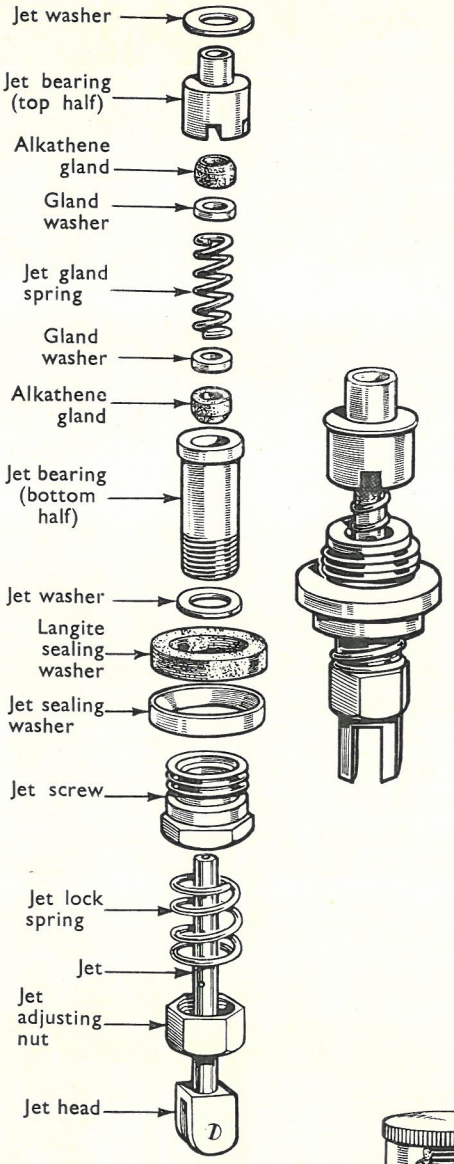


Fig. B.20.
The carburetter suction chamber, suction disc, piston and piston rod, partly sectioned to show the details of the oil dashpot.

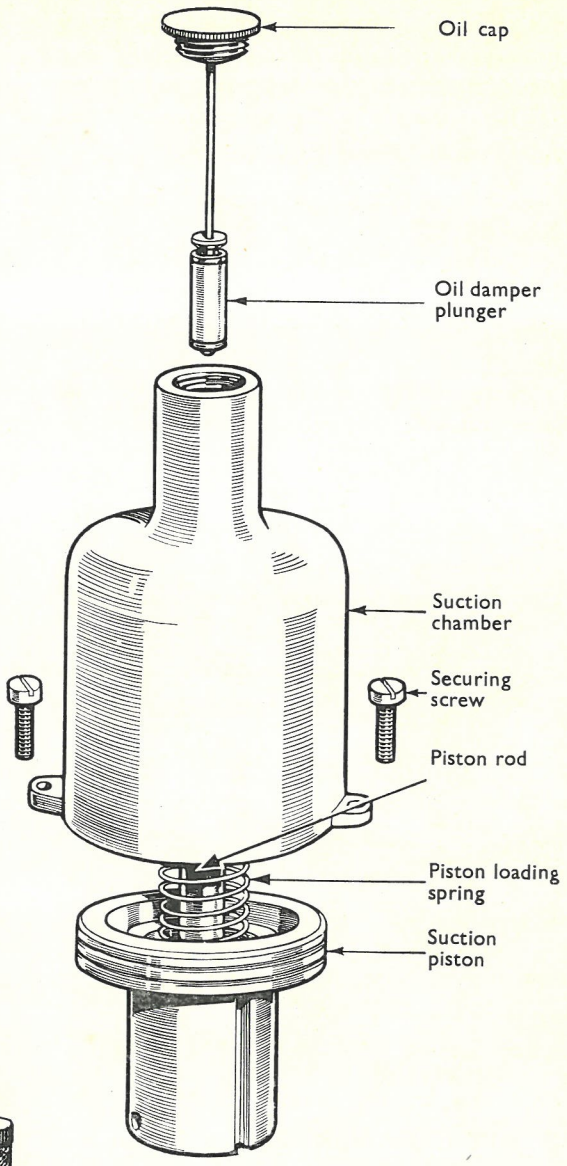
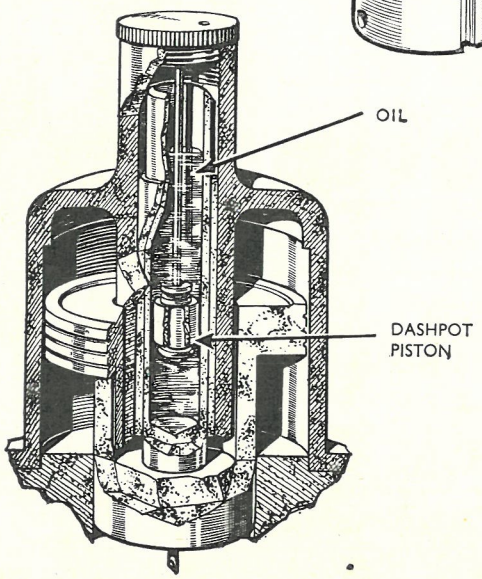


Fig. B.21 (*above*).
The component parts of the S.U. carburetter jet and suction chamber.



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.

Section B.12

THE AIR CLEANER (Home Models)

Cars supplied to the home market are fitted with an air intake silencer.

It is advisable to remove this every 6,000 miles (10000 km.), wash it in petrol and then dry it thoroughly before replacing it.

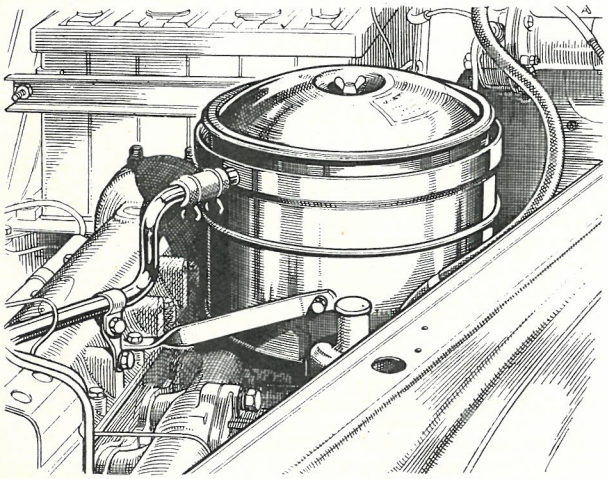


Fig. B.22.
The oil bath air cleaner fitted to models for use overseas.

THE AIR CLEANER (Export Models)

Cars supplied overseas are fitted with oil bath air cleaners of the A.C. type.

Reference to Fig. B.24 shows that the air enters the cleaner through the opening between the shell and the top cover. It then passes downwards through the annular passage between them, strikes the oil shelf, and reverses upwards into the filter element and downwards through the central opening into the air intake.

The majority of the dust and dirt suspended in the ingoing air is precipitated into the oil in the bottom of the cleaner when the air stream reverses above the oil shelf, and settles in the bottom of the oil sump as sludge. Subsequently, a cleaning operation also takes place as the partly cleaned air is drawn upwards through the woven metallic mesh.

The filter element is automatically oiled and washed by oil picked up from the shelf by the incoming air.

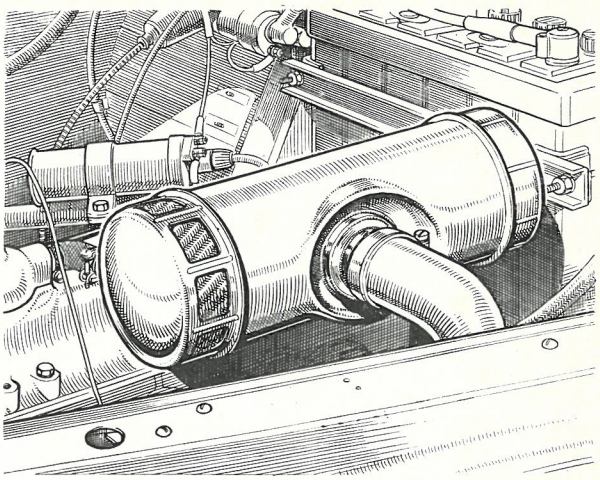


Fig. B.23.
The air silencer fitted to home models.

To inspect for sludge

The air cleaner must be inspected every 1,000 miles (1600 km.) or more often under conditions of dust-laden atmosphere.

Remove the nut retaining the top cover and lift off the cover.

Lift out the filter element assembly.

Examine oil container for sludge. If a depth of $\frac{1}{4}$ in. solid sludge is present, the cleaner must be serviced completely as described below.

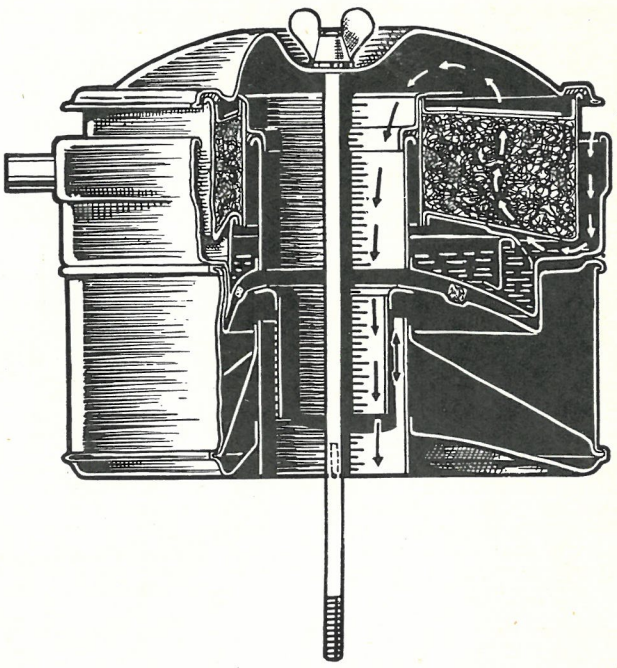
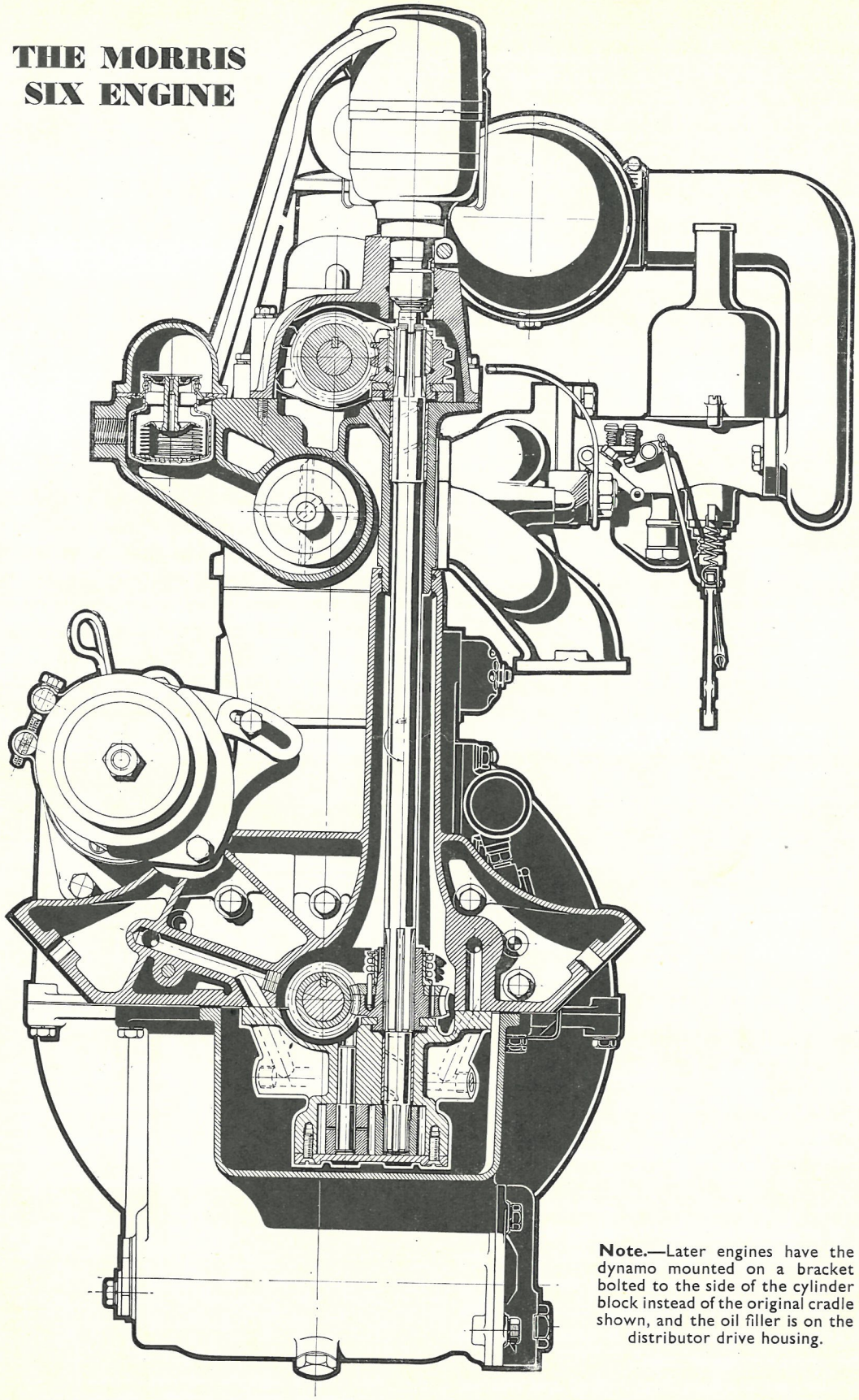


Fig. B.24.
A section through the overseas oil-bath type air cleaner, showing its construction and the path taken by the incoming air.

THE MORRIS SIX ENGINE



Note.—Later engines have the dynamo mounted on a bracket bolted to the side of the cylinder block instead of the original cradle shown, and the oil filler is on the distributor drive housing.

If the accumulation of sludge is slight, top up the oil container with engine oil to the level indicated on the instruction plate fitted just above the shelf.

Replace the element, top cover and nut, after making sure that the cover gasket is clean and in good condition.

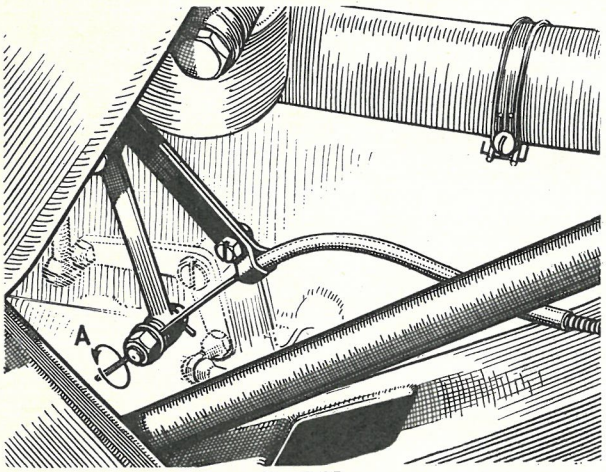


Fig. B.25.

Showing the direction in which bias should be applied to the mixture control cable to ensure that the control knob remains locked when it is turned 90° anti-clockwise.

It is important that the oil level in the cleaner is correct. Too high a level will result in oil being drawn into the combustion spaces, and too low a level will result in failure to keep the element saturated.

Cleaning and re-oiling

The cleaner should be periodically cleaned and filled with new oil every 3,000 miles (5000 km.), or more frequently if inspection for sludge shows this to be necessary.

Wash the filter element thoroughly in a bowl of paraffin, and allow it to drain and dry **thoroughly.**

Lift out the oil container, empty the oil, and scrape out the accumulated sludge. Wash the entire oil container in paraffin and fill to indicated level with engine oil. It is not necessary to re-oil the filter element, as this is done automatically as soon as the engine starts up.

Make sure that the two cork gaskets are in good condition and reassemble cleaner.

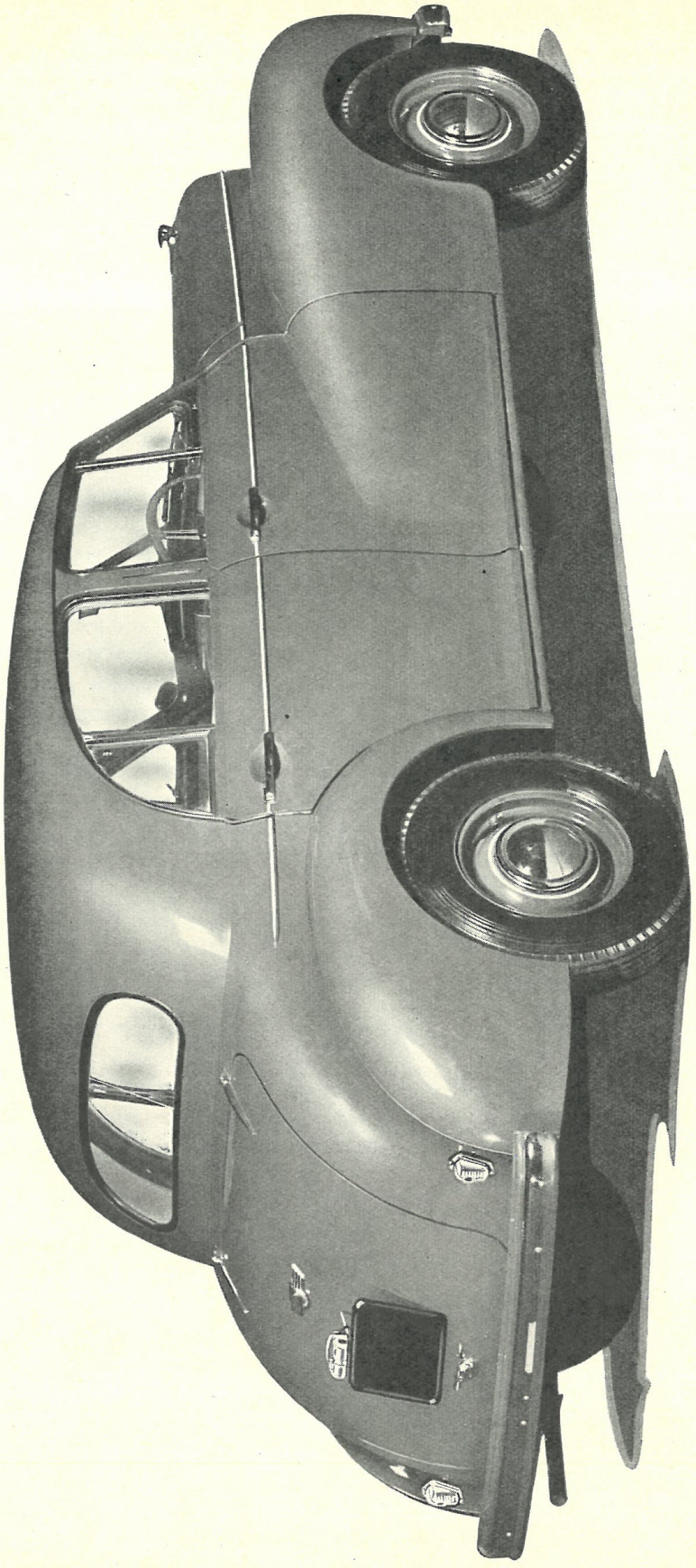
Section B.13

THE MIXTURE CONTROL

It is important that the mixture control cable should allow the jet adjusting lever to return the jet into contact with the jet adjusting nut when the knob on the instrument panel is pushed home.

In order to ensure that the mixture control knob remains locked when pulled out and turned 90° anti-clockwise a slight bias must be applied to the cable by twisting it with the fingers in the direction shown at "A" in Fig. B.25, while its clamp bolt is tightened up.

THE MORRIS SIX SALOON ("Series MS")



SECTION C

THE IGNITION EQUIPMENT

Description and specification of equipment.

Section No. C.1 Testing with sparking plugs in position.

Section No. C.2 Testing low-tension circuit.

Section No. C.3 The high-tension cables.

Section No. C.4 Attention to sparking plugs.

Section No. C.5 The contact breaker.

Section No. C.6 Distributor lubrication.

Section No. C.7 Removal and replacement of distributor.

Section No. C.8 Timing the ignition.

Section No. C.9 Dismantling the distributor.

Section No. C.10 The condenser.

Section No. C.11 Fitting new distributor bearings.

Section No. C.12 Reassembling the distributor.

Section No. C.13 Interference suppressors.

Section No. C.14 Ignition setting.

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 and suction-operated mechanism by means of which the ignition is advanced in proportion to the engine speed and load.

Like the rest of the electrical equipment it is wired on the "positive earth" system, which results in longer sparking plug life.

Distributor type

The distributor is a Lucas Model DVXH6A, Service No. 40157. These identification marks are stamped on the side of the distributor. When ordering replacements, always quote these numbers.

Ignition coil type

The coil is a Lucas Model Q12, Service No. 45039. These identification marks are stamped on the base of the ignition coil. When ordering, always quote these numbers.

Sparking plugs

The standard sparking plugs for the Morris Six (Series MS) are Champion L.10, 14 mm., $\frac{1}{2}$ in. reach.

C THE IGNITION EQUIPMENT

Section C.1

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

Test 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 or insulated-type 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 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. Restart the engine and hold the end of the cable about $\frac{3}{16}$ in. from the cylinder head.

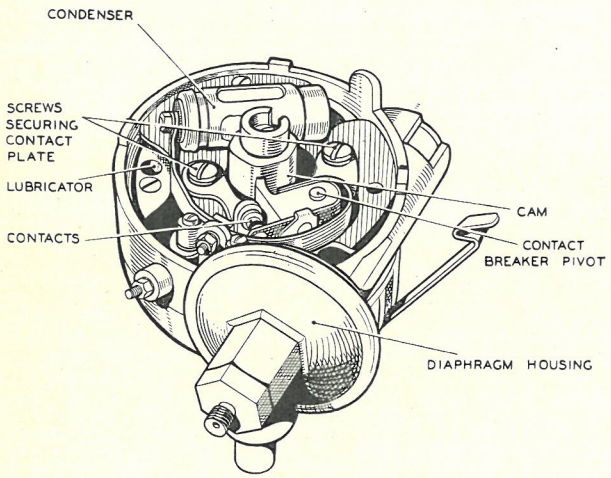


Fig. C.1.
The distributor with the cover and rotor arm removed, showing the contact breaker mechanism.

(*d*) If the sparking is strong and regular, the fault probably lies in the sparking plug. Remove the plug, clean, and adjust the 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 distributor moulded 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. After long service, it may have become tracked, 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 in the places indicated. A replacement distributor cap must be fitted in place of one that has become tracked.

Section C.2

TESTING LOW-TENSION CIRCUIT

Testing in position. Low-tension circuit

(*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 pits, burns, 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 between ·010 in. and ·012 in. (·25 mm. and ·30 mm.). Correct the gap if necessary. (See Section C.5.)

(*c*) Switch on the ignition, turn the engine with the starting handle and observe the ammeter reading, which should rise and fall with the closing and opening of the contacts. If the reading fluctuates in this way, the low-tension circuit is in order.

(*d*) If the ammeter reading remains steady, locate the fault in the low-tension circuit.

(*e*) Another method of testing is to disconnect the cable at the contact breaker 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.

Low-tension circuit—to locate fault

(*a*) Having determined, by testing as previously described, 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.

(*b*) Refer to the wiring diagram (page N.22) and check the circuit with a voltmeter (0—20 volts) as follows :—

Note.—*If the circuit is in order, the reading on the voltmeter should be approximately* 12 *volts.*

(c) *Battery to starter switch.* Connect voltmeter to starter switch terminal and earth. No reading indicates faulty cable or loose connections.

(d) *Starter switch to horn fuse* (brown lead). Connect a voltmeter to horn fuse terminal and earth. No reading indicates faulty cable or loose connections.

(e) *Horn fuse to ammeter* (brown lead). Connect a voltmeter to the ammeter terminal "B" and earth. No reading indicates faulty cable or loose connections.

(f) *Ammeter.* Connect a voltmeter to the ammeter terminal "A" and to earth. No reading indicates a fault in the ammeter, which must be replaced.

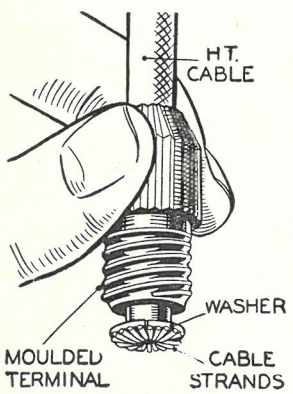


Fig. C.2.
Demonstrates the correct method of fitting the high-tension cable to the moulded terminal nut of the ignition coil.

(g) *Ammeter to control box terminal* "A" (brown with white). Connect a voltmeter to the control box terminal "A" and to earth. No reading indicates a faulty cable or loose connections.

(h) *Control box terminal* "A1." Connect a voltmeter to the control box terminal "A1" and to earth. No reading indicates a fault in the series winding of the control box.

(i) *Control box "A1" to ignition switch* (brown with blue). Connect a voltmeter to the ignition switch terminal and to earth. No reading indicates a faulty cable or loose connections.

(j) *Ignition switch.* Connect a voltmeter to the other ignition switch terminal (white lead) and to earth. No reading indicates a fault in the ignition switch.

(k) *Ignition switch to control box terminal* "A3" (white lead). Connect the voltmeter to the control box terminal "A3" and to earth. No reading indicates a faulty cable or loose connections.

(l) *Control box terminal "A3" to ignition coil terminal "SW"* (white lead). Connect a voltmeter to the ignition coil terminal "SW" and to earth. No reading indicates a faulty cable or loose connections.

(m) *Ignition coil.* Connect a voltmeter to the ignition coil terminal "CB" and earth. No reading indicates a fault in the primary winding of the coil.

(n) *Ignition coil to distributor* (white with black lead). Connect a voltmeter to the distributor low-tension terminal and to earth. No reading indicates a faulty cable or loose connections.

(o) *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 by 7 mm. rubber-covered ignition cable.

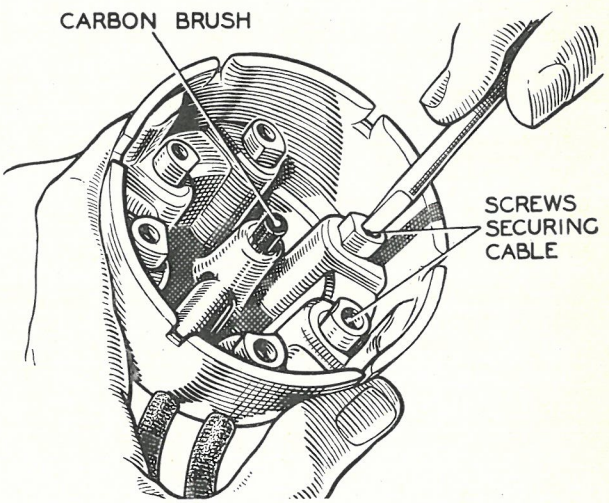


Fig. C.3.
Shows how the high-tension cables are secured to the distributor pick-up segments by means of pointed fixing screws.

(b) To fit the cables to the terminal of the ignition coil, thread the knurled moulded terminal nut over the lead, bare the end of the cable for about $\frac{1}{4}$ in., thread the wire through the brass washer removed from the original cable and bend back the strands over the washer. Finally screw the nut into its terminal.

To make the connections to the terminals in the distributor moulded cap, first remove the cap and slacken the screws on the inside of the moulding till they are clear of the cables. Cut the new cables off to the required length, push them completely home and tighten the securing screws.

(c) The cables from the distributor to the sparking plugs must be connected up in the correct firing order, which is 1, 5, 3, 6, 2, 4.

Section C.4

ATTENTION TO SPARKING PLUGS

It is recommended that the plugs be inspected, cleaned and tested every 3,000 miles (5000 km.).

When sparking plugs are removed from the engine their gaskets should be removed with them and replaced on the plugs, which should be placed in a suitable holder. It is advisable to identify each plug with the number of the cylinder from which it was removed so that any faults revealed on examination can be traced back to the cylinder concerned. The plug stand illustrated in Fig. C.4 is of simple construction, possessing a series of holes to admit the upper ends of the plugs.

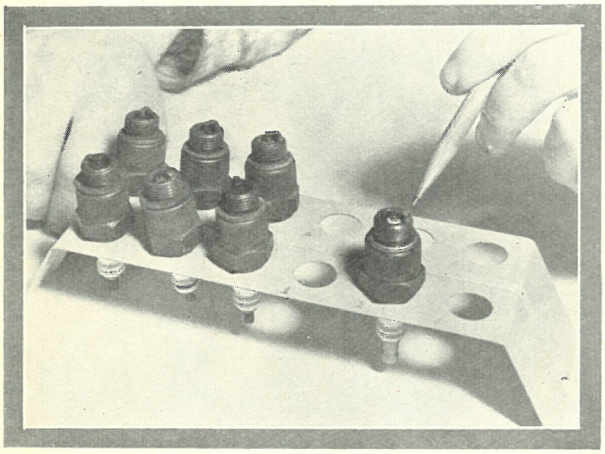


Fig. C.4.
The use of a simple plug stand of the type illustrated is recommended to hold the plugs when they are removed from the engine.

When examining the plugs, place a new plug of the same type beside the others to afford a ready comparison of the relative condition of the used plugs.

Examine for signs of oil fouling. This will be indicated by a wet, shiny, black deposit on the insulator. This is caused by oil pumping due to worn cylinders and pistons, or gummed-up or broken rings. Under such conditions, oil from the cylinder walls is forced up past the rings on the suction stroke of the piston, and is eventually deposited on the plugs.

A permanent remedy for this cannot be effected, the only cure being the fitting of a new piston and rings, or, in extreme cases, a rebore may be necessary.

Next examine the plugs for signs of petrol fouling. This is indicated by a dry, fluffy, black deposit which is usually caused by over-rich carburation, although ignition system defects such as a run-down battery, faulty distributor, coil or condenser defects, or a broken or worn-out cable, may be additional causes. The important thing is for the carburetter setting to be correctly adjusted and the ignition system overhauled as indicated in Sections 3 and 5. If the plugs appear to be suitable for further use, proceed to clean and test them.

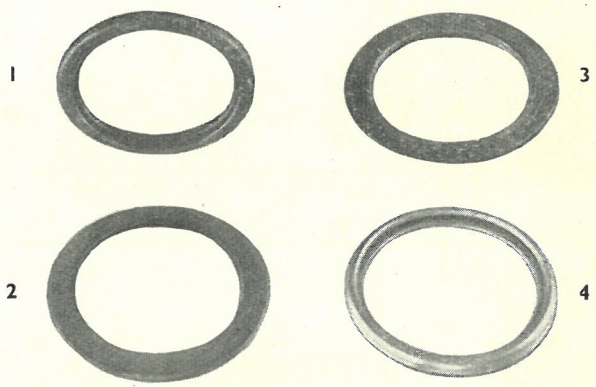


Fig. C.5.
This illustration shows plug gaskets in various conditions —(1) Indicating insufficient tightening down of plug. (2) Over-tightening of plug. (3) Correct degree of tightening. (4) New gasket before use.

First remove the plug gaskets and examine them for condition. Gaskets in different conditions are illustrated in Fig. C.5. The upper left gasket was obviously not properly compressed, owing to the plug not having been tightened down sufficiently. A large proportion of the heat of the plug is normally dissipated to the cylinder head through the copper gasket between the plug and the head. Plugs not screwed down tightly can thus easily become overheated so that they operate out of their proper heat range, thus producing pre-ignition, short plug life and "pinking." On the other hand it is unnecessary and unwise to tighten up the plugs too much. What is required is a reasonably good seal between the plug and the cylinder head.

The lower left-hand gasket clearly indicates that the plug was pulled down too tightly or has been in service too long. Note its distorted condition and the

evidence of blow-by, which is also a cause of plug overheating.

The upper right-hand gasket demonstrates a gasket in good condition, providing an adequate seal and a good path for heat dissipation.

For comparison a new gasket is shown at the lower right-hand corner of Fig. C.5. If gaskets are at all questionable they should be replaced by new ones without hesitation.

If the plugs require cleaning it is preferable to make use of a proper plug cleaner of the type recommended

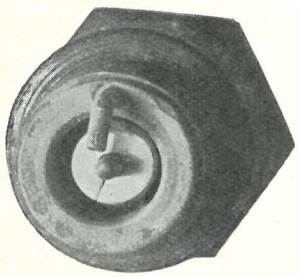


Fig. C.6.
Here is shown a plug with a cracked insulator.

by the plug manufacturers, and the makers' instructions for using the cleaner should carefully be followed out.

Occasionally a blistered insulator or a badly burnt electrode may be noticed when examining the plugs.

If the plug is of the type normally recommended for the engine and it was correctly installed (down tightly on the gasket), this condition may have been brought about by a very lean mixture or an overheated engine. There is, however, a possibility that a plug of another type is required, but as a rule the Champion L.10 plug recommended should be adhered to.

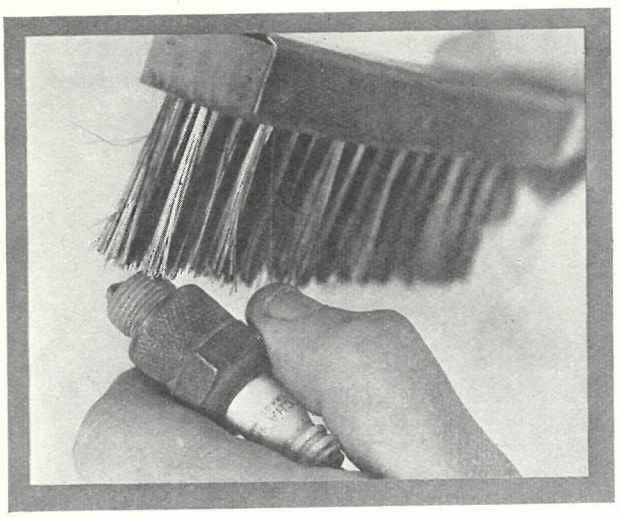


Fig. C.7.
The plug threads should be cleaned with a wire brush to remove deposits on the thread.

After cleaning carefully, examine the plugs for cracked insulators and wear of the insulator nose due to excessive previous cleaning. In such cases the plugs have passed their useful life, and new plugs should be installed.

Examine the insulator for deposits underneath the side electrode which have possibly accumulated and which act as a "hot spot" in service.

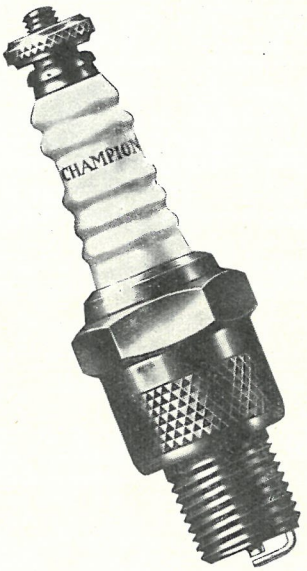


Fig. C.8.
The Champion L.10 14 mm. sparking plug, reach $\frac{1}{2}$ in., which is the standard equipment for the Morris Six.

After cleaning the plugs in the special cleaner, blow all surplus abrasive out of the body recesses, and off the plug threads, by means of an air-blast. Next examine the threads for carbon. Any deposits can be removed and the threads cleaned with a wire brush. A wire buffing wheel may also be utilised, but reasonable care must be used in both methods in order not to injure the electrodes or the tip of the insulator. The thread section of the plug body is often neglected when cleaning the plugs, owing to the fact that it is not generally realised that, like the gaskets, the threads are a means of heat dissipation and that when they are coated with carbon it retards the flow of the heat from the plug, producing overheating. This simple procedure will also ensure absence of binding on the threads on replacement and also avoid the unnecessary use of the plug spanner.

When replacing a plug, always screw it down by hand as far as possible and use the spanner for final tightening only. Whenever possible use a box spanner to avoid possible fracture of the insulator.

Examine the electrodes for correct gap by inserting a feeler ·018 in. to ·022 in. (·46 mm. to ·56 mm.) thick between them. Avoid an incorrect reading in the case of badly pitted electrodes.

Remember that electrode corrosion and the development of oxides at the gap area vitally affects the sparking efficiency. The special cleaner can remove the oxides and deposits from the insulator, but the cleaner stream does not always reach this

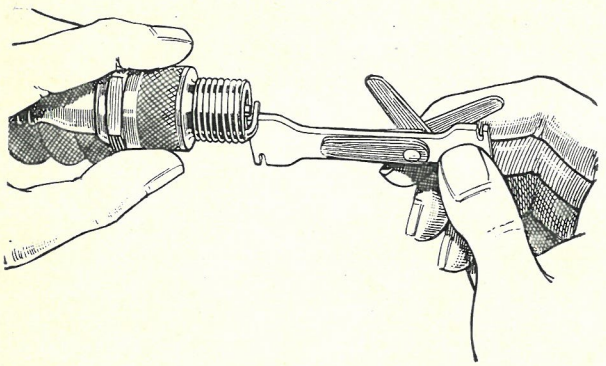


Fig. C.9.
Adjustments to the spark plug gap should be made only by bending the side wire, preferably by using a proper setting tool such as the " Champion " setting tool here illustrated.

area with full effect owing to its location, and cannot necessarily deal with corrosion effectively as this sometimes requires too strong a blast for proper removal.

When plugs appear worthy of further use it is good practice to dress the gap area on both centre and side electrodes with a small file before resetting them to the correct gap. The intense heat, pressure, explosion shock, electrical and chemical action to which the plugs are submitted during miles of service are so intense that the molecular structure of the metal points is eventually affected. Plugs then reach a worn-out condition and resetting the points can no longer serve a good purpose. When points are burnt badly, it is indicative that the plug has worn to such an extent that its further use is undesirable and wasteful.

Before replacing the plug in the engine, test it for correct functioning under air pressure in a plug tester, following out the instructions issued by the makers of the plug tester. Generally speaking, a plug may be considered satisfactory for further service if it sparks continuously under a pressure of 100 lb. per sq. in. (7 kg./cm.^{2}) with the gap between the points set at ·022 in. (·56 mm.). It is essential that the plug points should be reset close to the smaller gap of ·018 in. (·46 mm.) before the plug is refitted to the engine.

While the plug is under pressure in the tester, it should be inspected for leakage by applying oil round the terminal. Leakage is indicated by the production of air bubbles, the intensity of which will serve to indicate the degree of leakage. The leakage gases have a " blow-torch " effect when the engine is running which rapidly raises the temperature of the plug, raising it above its designed heat range, thus producing overheating, pre-ignition, and rapid electrode destruction.

The top half of the insulator is frequently responsible for poor plug performance due to the following faults : splashes ; accumulation of dirt and dust ;

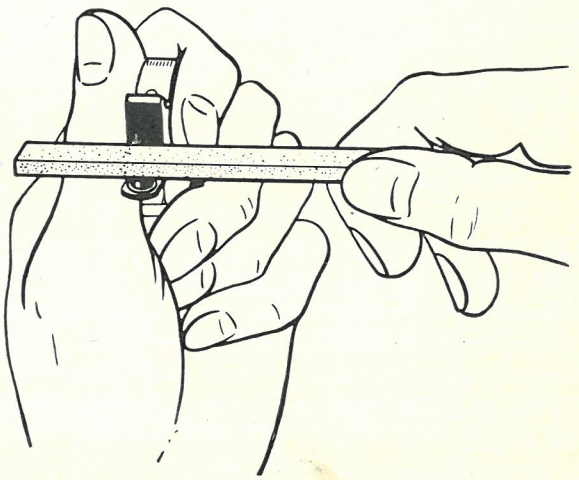


Fig. C.10.
Cleaning the contact breaker points with a stick of carborundum.

cracked insulators, caused by a slipping spanner ; over-tightness of the terminals.

Examine for a cracked insulator at the shoulder and the terminal post and remove any accumulations of dirt and dust.

Section C.5

CONTACT BREAKER MECHANISM

After the first 500 miles (800 km.) and subsequently every 3,000 miles (5000 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 from ·010 in. to ·012 in. (·25 mm. to ·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 thickness.

To adjust the setting, keep the engine in the position which gives maximum opening of the contacts and then slacken the two screws

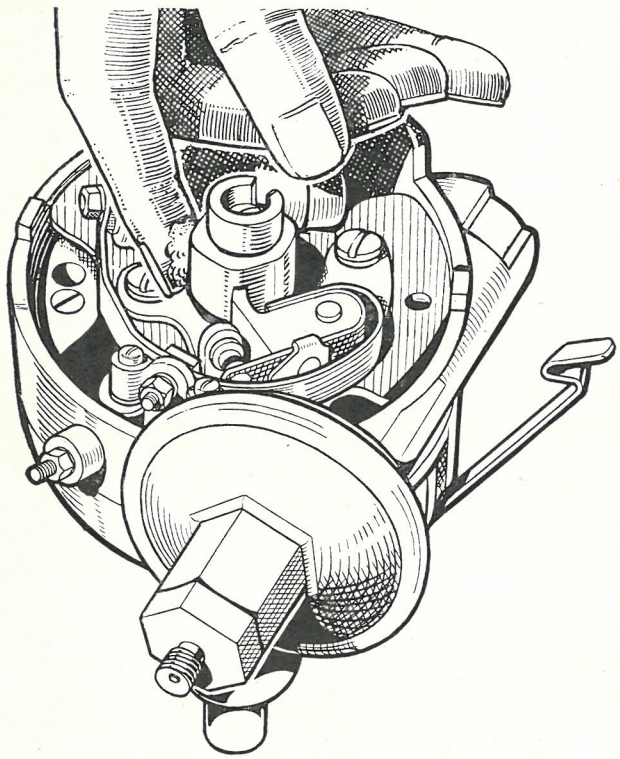


Fig. C.11.
Every 3,000 miles (5000 km.) the cam may be given a slight smear of grease to Ref. D (page P.2).

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, they must be cleaned by polishing them with a fine carborundum stone, and afterwards wiping them with a petrol-moistened cloth. The moving contact can be removed from its mounting in order to assist cleaning. (See Fig. C.10.) Check and adjust the contact breaker setting after cleaning the contacts.

(*c*) Check that the moving arm moves freely on its pivot. If it is sluggish, remove the moving arm and polish the pivot pin with a strip of fine emery cloth. Afterwards apply a spot of clean engine oil or grease to Ref. D (page P.2) to the top of the pivot.

Section C.6

DISTRIBUTOR LUBRICATION

To be carried out after servicing the distributor and at intervals of about 3,000 miles (5000 km.).

(*a*) Give the cam a light smear of grease to Ref. D (page P.2) and apply a slight trace of oil 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 oil to Ref. F (page P.2) through the lubricating passage provided in the spindle to lubricate the cam bearing and distributor shaft. (Do not remove the screw in the top of the spindle as an oilway is provided.) Refit the rotor correctly and push it on the shaft as far as it will go.

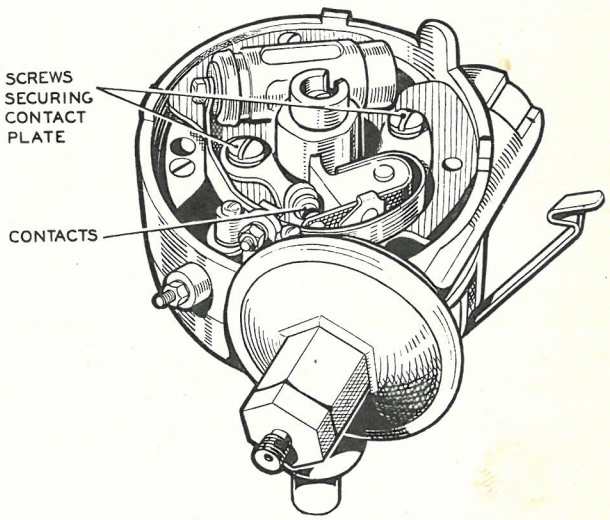


Fig. C.12.
The contact breaker, showing the adjustment screws.

(*c*) Add a few drops of thin oil to Ref. F (page P.2) through the hole in the contact breaker base marked "oil here" in order to lubricate the automatic timing control and drive-shaft bearing. Do not allow any oil to get on or near the contacts.

Section C.7

REMOVAL AND REPLACEMENT OF DISTRIBUTOR

The distributor can be removed and replaced without interfering with the ignition timing, provided the graduations on the cylinder head cover and the mark on the distributor body are observed and the exact position of the distributor body noted.

To facilitate the replacement of the high-tension leads, spring open the clips securing the distributor cover and lift the cover from the body and turn the engine over until the rotor arm is pointing to the segment in the cover for No. 1 cylinder plug lead.

Disconnect the low-tension lead from the 2 B.A. terminal on the distributor body and release the copper pipe from the suction advance union.

Extract the distributor clamp bolt and packing piece and withdraw the distributor from the cylinder head cover.

To replace the distributor, insert it into the cylinder head cover until the driving dog rests on the distributor drive shaft. The rotor arm should then be rotated

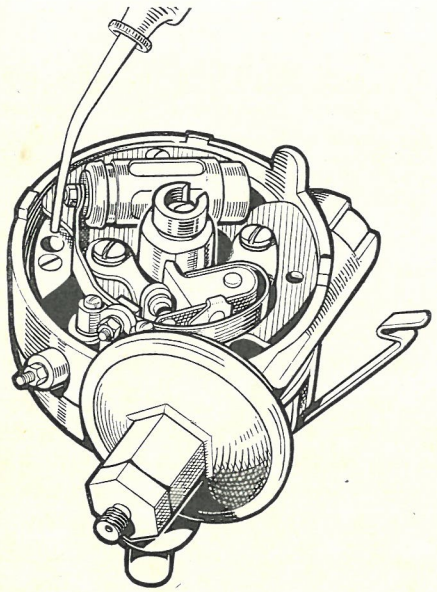


Fig. C.13.

The advance control mechanism is lubricated from the special oil well provided, which is replenished through the aperture shown. Take care no oil finds its way on to the contact points. Oil to Ref. F (page P.2) should be used.

slowly until the driving dog lug engages 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, but care must be taken to ensure that the distributor body is replaced in its original position. Adjustment from this position may be made after a road trial. (See Section C.8.)

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, 5, 3, 6, 2, 4, remembering that the distributor rotation is anti-clockwise.*

Section C.8

IGNITION TIMING

The ignition timing varies according to the condition of the engine and the fuel used and can only be determined by actual road test. Refer to Section C.14 for information concerning later models.

When setting the ignition timing, commence by setting the ignition so that the spark occurs at top dead centre or just before top dead centre. Then gradually increase the amount of advance until the engine just shows signs of "pinking" when given full throttle in top gear on a normal steep incline. This is the correct setting.

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. 6 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 flywheel is in line with the pointer below the cover on the left-hand side of the flywheel housing, the piston is exactly at T.D.C. (See Fig. C.14.)
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. Position the distributor so that the suction advance gear side of the body is facing, and parallel to, the sparking plugs.
5. 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 lug bolt. 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 12-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 5 until the lamp lights, which indicates that the points have just opened.

Or

Get a second operator to watch the ammeter and then turn the distributor body as detailed in paragraph 5, when it will be observed that the small reading recorded on the ammeter when the points are closed "flicks" back to zero immediately the points open.

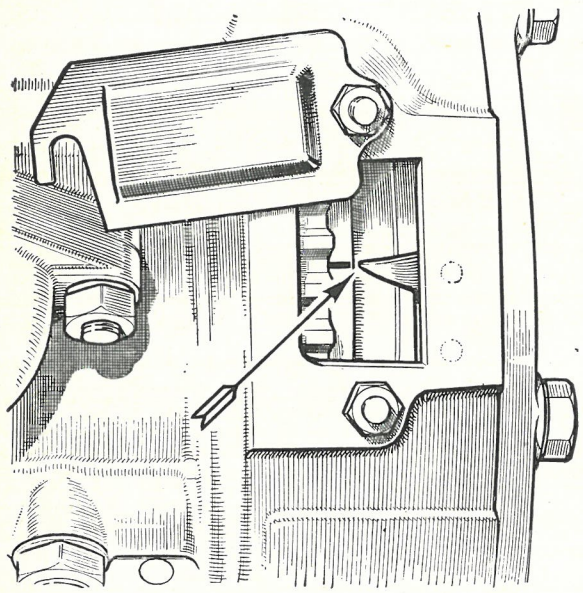


Fig. C.14.
The timing mark on the flywheel rim indicating top dead centre for Nos. 1 and 6 cylinders, and the indicating arrow on the flywheel housing.

Section C.9

DISMANTLING THE DISTRIBUTOR

Before dismantling carefully note the positions in which the various components are fitted so that they can be replaced correctly.

(*a*) Spring back the securing clips and remove the moulded cap.

(*b*) Lift the rotor off the top of the spindle. If it is a tight fit, it should be levered off carefully with a screwdriver.

(*c*) Slacken the nut from the moulded junction block and lift the end of the contact breaker spring off the bolt, and remove the contact breaker lever and insulating washer from the pivot pin. Take out the two screws complete with spring washers and flat steel washers securing the fixed contact plate and remove the plate.

(*d*) Extract the condenser clip retaining screw and lift out the condenser and connecting strip. Remove the square-headed bolt from the moulded junction block.

(*e*) Undo the three screws fitted at the edge of the contact breaker base casting and accessible through apertures cut in the contact breaker platform. The contact breaker base can then be removed from the body of the distributor.

(*f*) Undo the two nuts securing the suction unit to its bracket. Draw the unit off its seating until the fixing studs are clear of the bracket and then rotate the suction unit until the connecting rod is unscrewed from the control barrel.

(*g*) Take out the screw from inside the top of the cam spindle and lift off the cam. The automatic timing control is then accessible. Before dismantling, carefully note the positions in which the various components are fitted in order that they may be replaced correctly.

(*h*) Expand the circlip on the drive shaft dog and remove the flat washer and shims. The shaft may then be pressed from its bearings.

(*j*) The bearings must not be disturbed unless they are worn and need replacing. The bearing bush fitted at the lower end of the shank can be removed by driving it out with a suitable punch, while the ball bearing at the top can be removed by means of a shouldered mandrel locating on the inner journal of the bearing.

Note.—*Should it be required to remove the contact breaker plate from the base casting, remove the jump ring from the underside of the contact breaker base, lift off the star-shaped spring and slide out the plate and bearing sleeve. Disconnect the earth cable from its terminal on the base casting.*

Section C.10

THE CONDENSER

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

When fitting a new condenser make sure that both the clip retaining screw and the condenser terminal nut are securely tightened, and that the connection strip is firmly held by the square-headed bolt in the junction block.

Section C.11

FITTING NEW DISTRIBUTOR BEARINGS

If the bearings have been removed the distributor should be assembled with new bearings fitted. Press the ball bearing into its housing, using a shouldered mandrel which locates on the inner and outer journal of the bearing.

The bearing bush at the lower end of the shank must also be fitted, using a shouldered mandrel.

Before fitting the bearing bush it should be allowed to stand completely immersed in thin engine oil for at least twenty-four hours.

Section C.12

REASSEMBLING THE DISTRIBUTOR

Note.—*Before reassembly, the automatic advance mechanism, distributor shaft, and the portion of the shaft on which the cam fits, must be lubricated with clean engine oil to Ref. F (page P.2).*

(*a*) Refit the shaft in its bearings and replace the shims, flat washer and circlip.

(*b*) Assemble the automatic timing control, taking care that the parts are fitted in their original positions and that the control springs are not stretched. Place the cam on its spindle and tighten the locking screw.

(*c*) Screw the suction unit connecting rod into the control barrel and position the suction unit on its fixing plate so that the two studs fit through the holes provided. Secure with the nuts and spring washers.

(*d*) If the contact breaker plate has been removed from the base casting ensure that the cables are re-connected to the terminal and to the earthing screw in the casting. Replace the contact breaker plate so that the peg in the control barrel engages the hole provided in the plate. Place the star-shaped spring over the bearing sleeve on the underside of the base casting and secure by springing the jump ring into its location.

(e) Place the contact breaker base on the distributor body and secure with the three bolts.

(*f*) Replace the condenser and connecting strip, ensuring that the condenser terminal nut and clip securing screw are fully tightened.

(*g*) **Note.**—*If it becomes necessary to renew the contacts a replacement set comprising fixed and moving contacts must be fitted.*

Position the fixed contact plate on the contact breaker base and secure it by lightly tightening the two screws with spring and flat washers. The eyelet on the end of the cable connected to the earthing screw must be fitted under the head of one of the screws. Place the insulating washer over the contact breaker pivot pin and position the contact breaker lever. Insert the square-headed bolt through the condenser connecting strip and contact breaker spring. Fit the low-tension terminal connection over the bolt and secure in the moulded junction block with the nut and spring washer.

(*h*) Adjust the contact breaker setting to give a maximum opening of ·010 in.—·012 in. (·25 mm.—·30 mm.). (See Section C.5.)

(*j*) Place the rotor arm on the top of the spindle, locating the register correctly, and push it fully home. Replace the distributor moulding and secure with the spring clips.

Section C.13

INTERFERENCE SUPPRESSORS

In order to reduce the interference with television reception to a minimum, later models are fitted with suppressors incorporated in the plug terminals for each high-tension lead.

Section C.14

IGNITION SETTING

To reduce road tests to a minimum the ignition may be timed so that the contacts are just breaking when the timing mark on the flywheel is $\frac{1}{2}$ in. (13) mm. before the pointer on the flywheel housing.

Commencing from engine No. 9540, it is recommended that the timing advance be increased to 1 in. (25·4 mm.) before the mark on the flywheel reaches the pointer on the housing. This is permitted by the lower compression ratio of the later engines.

SECTION D

THE COOLING SYSTEM

Description of the Cooling System.

Section No. D.1 Draining and filling the cooling system.

Section No. D.2 Removal and replacement of the radiator.

Section No. D.3 Fan belt adjustment.

Section No. D.4 Removing the water pump.

Section No. D.5 Dismantling and reassembling the water pump.

GENERAL DESCRIPTION

The cooling system is of the thermo-syphon impeller-assisted type, with thermostatic control. The water is circulated from the base of the radiator by the pump, and after passing round the cylinders and cylinder head it reaches the header tank via the thermostat and top water hose. From the header tank it passes downwards through the cooling ducts to the radiator base tank.

Air is drawn through the radiator by a fan which is mounted on the water pump spindle, and both are driven by a belt from the crankshaft.

Section D.1

DRAINING AND FILLING THE COOLING SYSTEM

Remove the header tank filler cap.

Drain the water from the cooling system by means of the drain tap on the left-hand side of the radiator bottom tank and the tap on the left of the engine at the rear of the cylinder block. The system cannot be fully drained from the radiator tap alone.

If " Bluecol " or any other anti-freeze mixture is used it should be drained into a suitable clean container and kept for future use.

To fill the system, close both the drain taps and fill through the header tank filler orifice until the water is approximately 2 in. (5 cm.) from the top of the filler neck. The capacity of the cooling system is 20 pints (11·4 litres). When possible, rain-water should be used for filling the system.

Avoid over-filling when anti-freeze is in use to prevent unnecessary loss on expansion.

Screw the filler cap firmly into position.

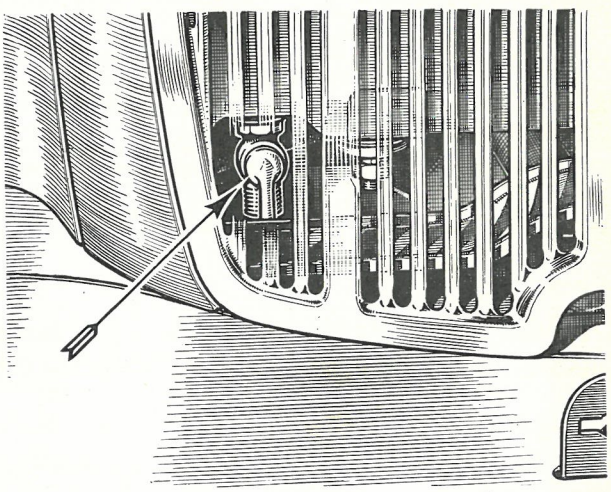


Fig. D.1.
The radiator drain tap is accessible beneath the front bumper. It may be seen through the radiator grille.

Section D.2

REMOVAL AND REPLACEMENT OF THE RADIATOR

Raise the bonnet to the vertical position and secure it in this position with a cord tied to the motif and passing over the roof to the rear bumper before commencing work on the radiator.

Drain the cooling system as detailed in Section D.1.

Release the clips on the top and bottom radiator hoses and remove the hoses. Remove the nuts, locknuts, flat and rubber washers from the radiator mounting studs in the front cross-member and lift out the radiator core.

To remove the radiator case and grille assembly release the bonnet-catch operating cable from the lever attached to the right-hand wing valance.

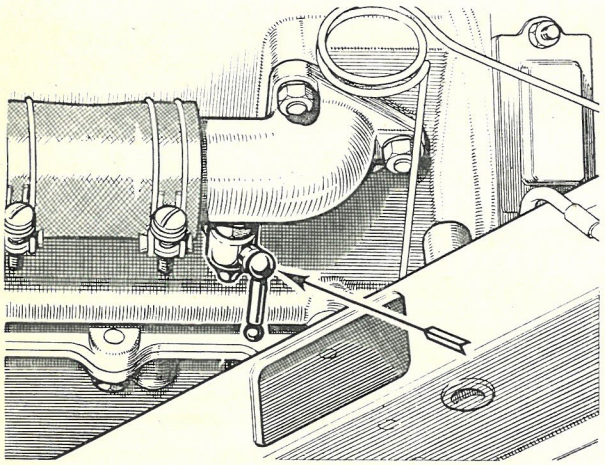


Fig. D.2.
The drain tap for the cylinder block is located in the intake elbow at the rear left-hand side of the engine.

Remove the eight nuts, with spring and flat washers, securing the radiator case and grille assembly to the wing valances, but do not undo the two nuts securing each radiator support bracket.

The radiator case and grille may now be removed.

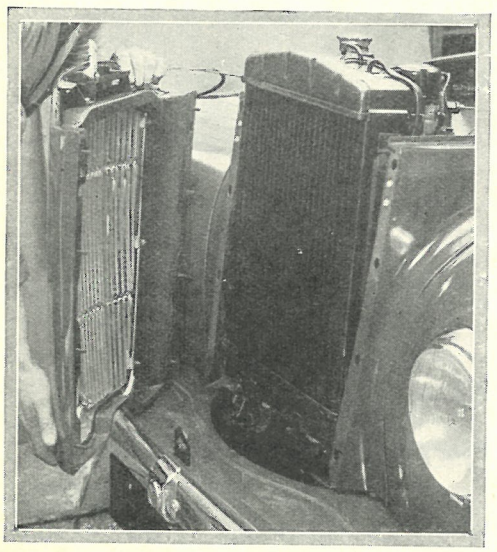


Fig. D.3.
The radiator grille is removed together with the radiator case after releasing the nuts at the back of the wing valance flange.

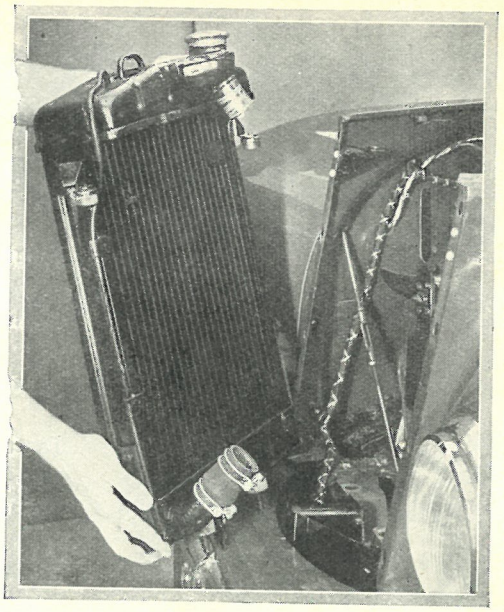


Fig. D.4.
With the grille and radiator case removed there is no difficulty in withdrawing the radiator.

Important.—*Do not invert the radiator or lay it flat, as this will allow any accumulated sediment in the bottom tank to pass into the cooling ducts. Always store the radiator in its normal upright position.*

Replacement of the radiator and grille is a reversal of the above procedure.

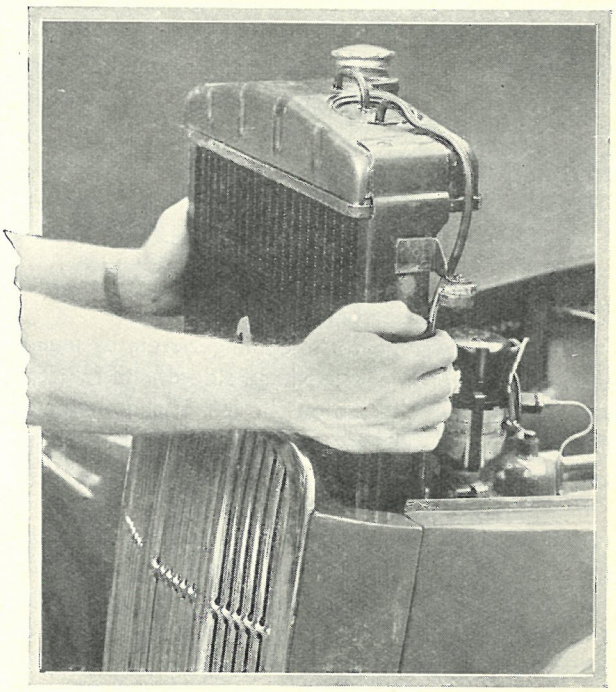


Fig. D.5.
The radiator can be removed, when required, without disturbing the grille and radiator case.

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Section D.3

FAN BELT ADJUSTMENT

The adjustment of the fan and dynamo belt tension on earlier models is effected by slackening off slightly the bolt on which the dynamo pivots, releasing the bolt securing the dynamo slotted link to the cylinder block and pulling the dynamo bodily outwards until the belt tension is sufficient.

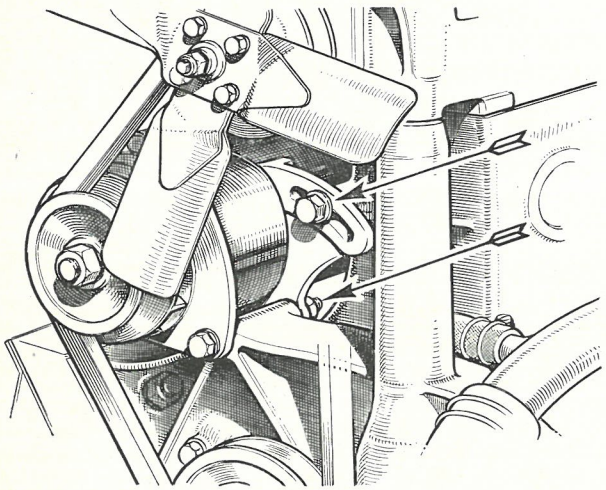


Fig. D.6a.
The two bolts which must be slackened before the dynamo belt tension can be adjusted on the earlier models are indicated by the arrows.

On later models the dynamo is mounted on a bracket by two bolts and located by a third bolt engaging a slotted link. The method of adjustment is similar to the earlier type of mounting.

The correct belt tension is achieved when the belt can be depressed approximately ½ in. (13 mm.) in the middle of its longest run, by light hand pressure.

Tighten up the bolts with the dynamo in this position.

Note.—*Only gentle hand pressure must be exerted on the dynamo or the belt tension will be excessive and cause rapid wear.*

After Engine No. 6955 a modified dynamo pulley is fitted.

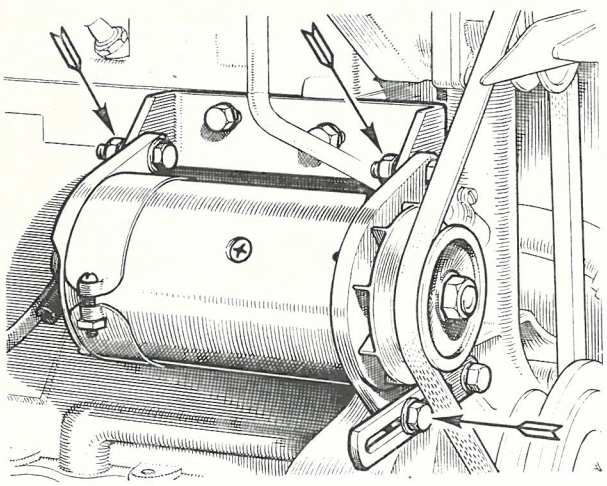


Fig. D.6b.
On later models the dynamo is mounted on a bracket which enables it to swing outwards for belt adjustment, when its three attachment bolts are slackened.

Section D.4

REMOVING THE WATER PUMP

The water pump is attached to the front of the cylinder head by four hexagon-headed bolts and spring washers and may readily be withdrawn complete with fan blades after the radiator core has been removed as detailed in Section D.2 (see Fig. D.5).

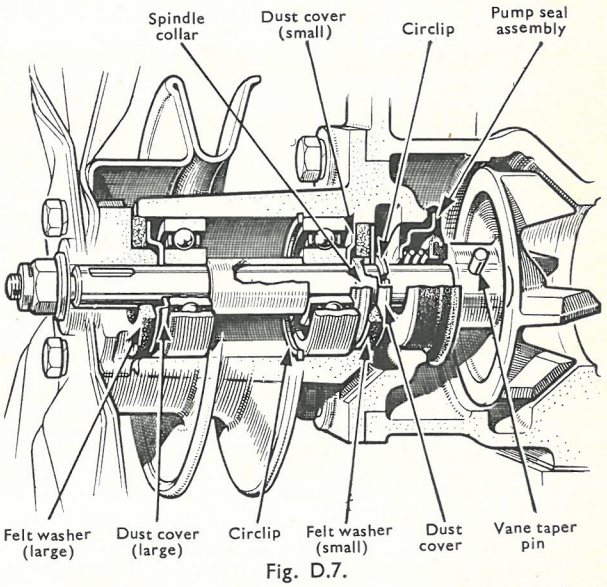


Fig. D.7.
The water pump in section, showing the disposition of its components. Later models have a bronze facing on the sealing face of the pump vane.

If the gasket is damaged as the pump body is withdrawn from the cylinder head, ensure that all traces of it are removed before a new gasket is fitted and the pump replaced.

Full instructions for removing the pump from the cylinder head are to be found in Section A.15.

Section D.5

DISMANTLING AND REASSEMBLING THE WATER PUMP

Remove the pump from the cylinder head as indicated in Section A.15.

Care must be taken to observe the order in which the parts are dismantled.

Unscrew the four $\frac{3}{16}$ in. bolts and spring washers and remove the fan blades from the pulley.

Remove the $\frac{1}{4}$ in. self-locking nut and flat washer and withdraw the pulley and pulley hub from the pump spindle, making use of an extractor. This is important. Take care not to lose the felt washer and dished oil thrower inside the pulley hub.

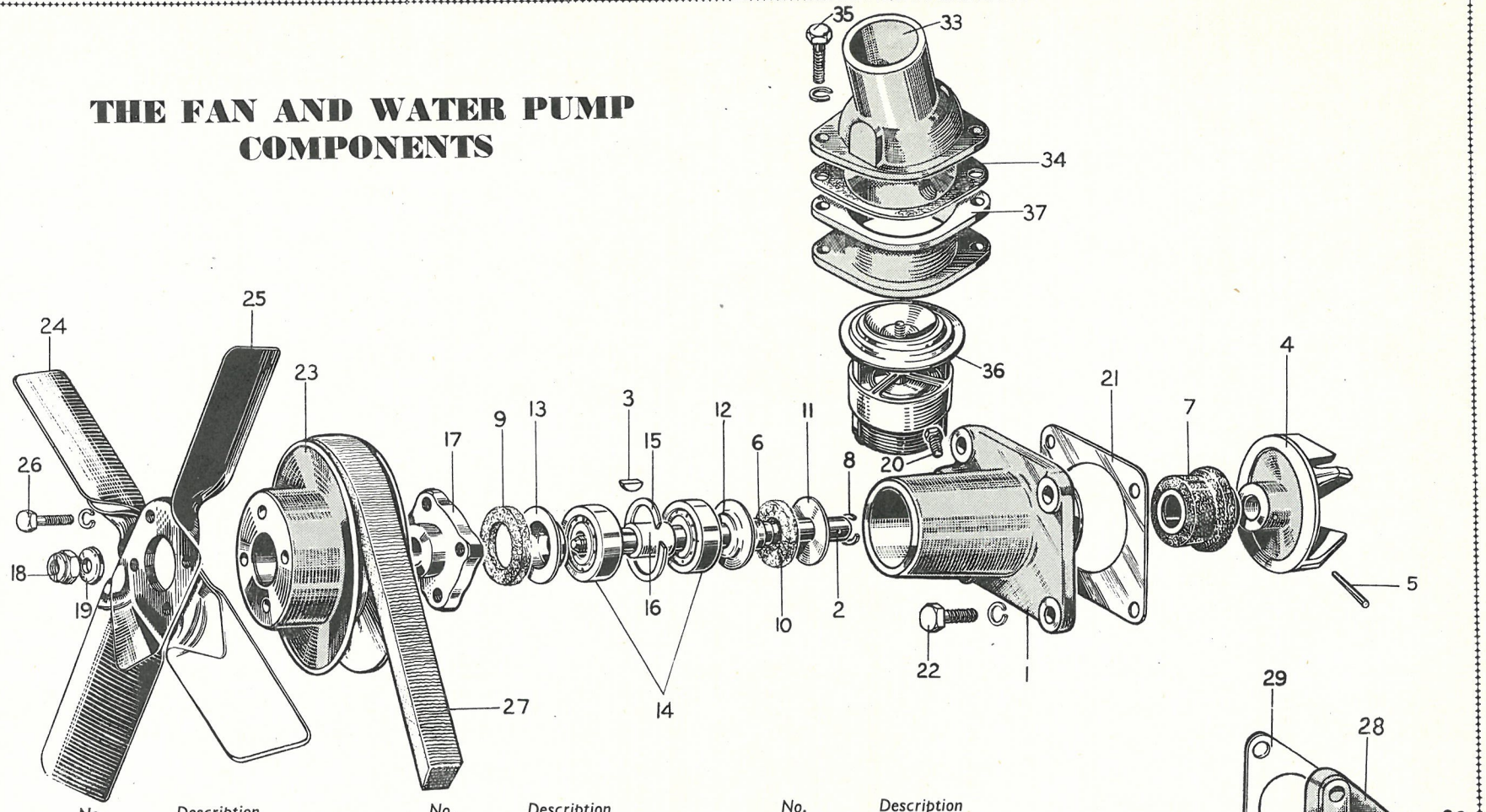
Extract the Woodruffe key and tap out the spindle complete with the impeller, water seal, circlip and plain dust cover. Withdraw the felt washer, collar and dust cover (small) from the rear of the pump body. Tap out the front bearing and distance tube.

The rear bearing is secured by a circlip, which must be removed before the bearing can be extracted from the housing.

Remove the spindle circlip to release the rubber seal. The seal is replaced with the brass cup against the circlip.

The pump is reassembled by carrying out the above instructions in the reverse order. Dust covers must always be fitted the concave side away from the bearing and the largest washer is fitted at the back of the pulley.

THE FAN AND WATER PUMP COMPONENTS



No.	Description
1.	Body—water pump.
2.	Spindle—pump.
3.	Key—spindle.
4.	Vane—pump.
5.	Taper pin—vane.
6.	Collar—spindle.
7.	Seal assembly—pump.
8.	Circlip—spindle.
9.	Felt washer—large.
10.	Felt washer—small.
11.	Dust cover—small—plain.
12.	Dust cover—small—rear.

No.	Description
13.	Dust cover—large—front.
14.	Bearings—spindle.
15.	Circlip—bearing.
16.	Distance tube—bearing.
17.	Hub—fan.
18.	Nut—spindle—self-locking.
19.	Washer—spindle nut.
20.	Greaser.
21.	Joint—pump body.
22.	Bolt—body to block.
23.	Pulley—fan.
24.	Blade—fan.

No.	Description
25.	Blade (offset)—fan.
26.	Bolt—blade.
27.	Belt—fan and dynamo.
28.	Water inlet elbow.
29.	Joint—inlet elbow.
30.	Washer—elbow nut.
31.	Tap—water drain—in elbow.
32.	Washer—drain tap.
33.	Water outlet pipe.
34.	Gasket—outlet pipe.
35.	Bolt—outlet pipe.
36.	Thermostat.
37.	Housing—thermostat.

SECTION E

THE CLUTCH

Description of the Clutch Assembly.

Section No. E.1 Running adjustments.

Section No. E.2 Removal of the clutch.

Section No. E.3 Dismantling the clutch.

Section No. E.4 Assembling the clutch.

Section No. E.5 Adjusting the release levers.

Section No. E.6 Replacement of the clutch.

Section No. E.7 Servicing the clutch.

Section No. E.8 Modification to operating rods.

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 initial assembly. The adjusting nut is locked in place and should never be disturbed unless the clutch is dismantled for the replacement of parts.

The general construction can be followed by reference to Fig. E.1 and the following description :—

The driven plate assembly

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

The release bearing assembly

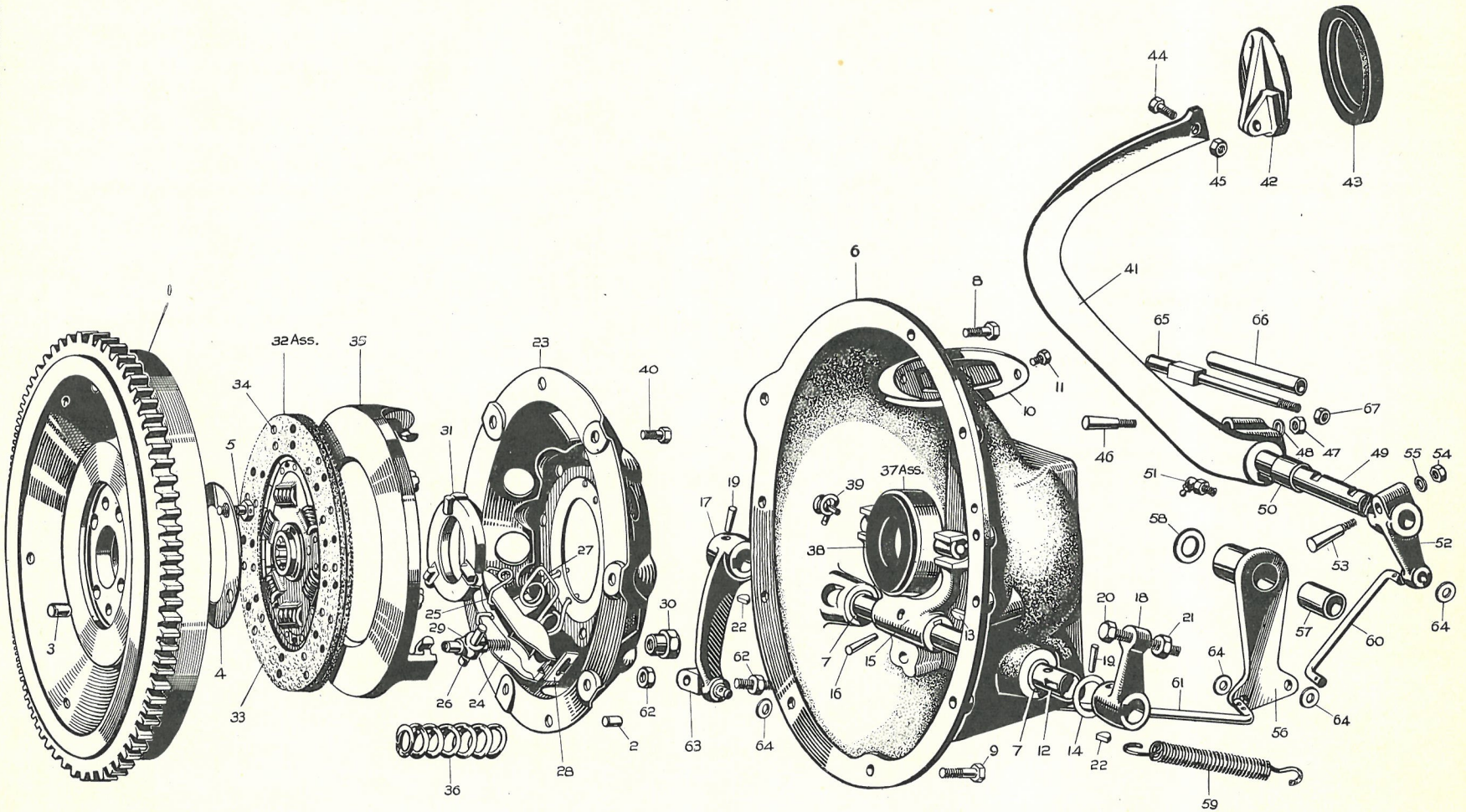
This comprises the graphite release bearing " G " (Fig. E.1) mounted in a cup attached to the throw-out fork, and a release plate " J " is attached to the inner ends of the release levers " L " by means of the retainer springs " K." Release is accomplished by moving the release bearing forward into contact with the release plate and thus applying pressure to the release levers.

Cover assembly

Each release lever is pivoted on a floating pin " P " which remains stationary in the lever and rolls across a short flat portion of the enlarged hole in the eye-bolts " O " (see Figs. E.1 and E.7). The outer ends of the eyebolts extend through holes in the clutch cover and are fitted with adjusting nuts " N " by means of which each lever is located in its correct position. The outer or shorter ends of the release levers engage the pressure plate lugs by means of struts " Q " which provide knife-edge contact between the outer ends of the levers and the pressure plate lugs, eliminating friction at this point. Thus the pressure plate " R " is pulled away from the driven plate " C," compressing the nine thrust coil springs " E " which are assembled between the pressure plate " R " and the clutch cover " D."

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

THE FLYWHEEL AND CLUTCH COMPONENTS



Note.—On later models the clutch adjusting lever (18) and its associated components is no longer fitted.

KEY TO THE FLYWHEEL AND CLUTCH COMPONENTS

No.	Description
1.	Flywheel and starter ring assembly.
2.	Dowel—clutch.
3.	Dowel—crankshaft.
4.	Retaining plate—dowel.
5.	Bolt—to crankshaft.
6.	Housing—clutch.
7.	Bush—shaft bearing.
8.	Bolt—housing to block.
9.	Bolt—housing to block—exhaust bracket.
10.	Cover—housing.
11.	Bolt—cover.
12.	Shaft—clutch fork.
13.	Key—shaft to clutch fork.
14.	Washer—shaft spacing.
15.	Fork—clutch shaft.
16.	Taper pin—fork.
17.	Lever—operating—fork shaft.
18.	Lever—adjusting—fork shaft.
19.	Taper pin—operating lever.
20.	Stop bolt—adjusting lever.
21.	Locknut—stop bolt.
22.	Key—lever.
23.	Cover—clutch.
24.	Lever—clutch release.
25.	Retainer—release lever.
26.	Pin—release lever.
27.	Spring—anti-rattle.
28.	Strut.
29.	Eyebolt.
30.	Nut—eyebolt.
31.	Plate—release lever.
32.	Driven plate assembly.
33.	Lining.
34.	Rivet.
35.	Plate—pressure.
36.	Spring—pressure plate.
37.	Release bearing assembly.
38.	Bearing.
39.	Retainer—bearing.
40.	Bolt—to flywheel.
41.	Clutch pedal.
42.	Pad—clutch pedal.
43.	Rubber—pad—clutch pedal.
44.	Bolt—pad to pedal.
45.	Nut—pad bolt.
46.	Cotter—pedal to shaft.
47.	Nut—cotter.
48.	Washer—cotter.
49.	Shaft—pedal.
50.	Bush—shaft.
51.	Greaser—shaft.
52.	Lever—shaft.
53.	Cotter—lever to shaft.
54.	Nut—cotter.
55.	Washer—cotter.
56.	Lever—relay.
57.	Bush.
58.	Washer—pivot shaft.
59.	Pull-off spring—pedal.
60.	Rod—pedal lever to relay.
61.	Rod—relay to clutch.
62.	Nut—connecting rod.
63.	Trunnion—connecting rod.
64.	Washer—anti-rattle—trunnion
65.	Stop—clutch and brake pedal.
66.	Distance tube—stop.
67.	Nut—stop.

Section E.1

RUNNING ADJUSTMENTS

The only adjustment necessary throughout the life of the driven plate friction facings is to restore the free movement of the clutch pedal periodically. As the driven plate facings wear, the free movement of the clutch pedal will gradually decrease ; when it is reduced to $\frac{1}{2}$ in. (13 mm.), measured at the pedal

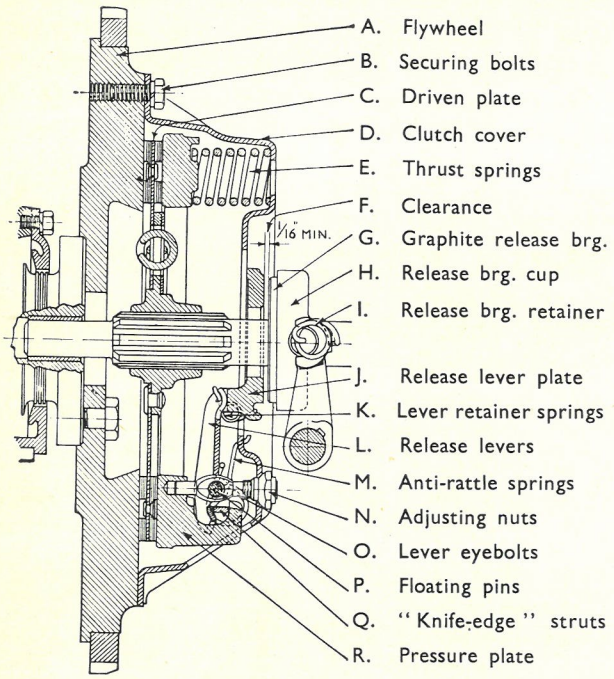


Fig. E.1.
The clutch in section showing the disposition of its components.

pad, adjustment must be made to restore the correct amount of free movement, i.e. $1\frac{3}{8}$ in. (35 mm.). To correct this clearance, proceed as follows :—

There are two points to check on early models.

1. The free movement of the pedal should not be less than $1\frac{3}{8}$ in., that is, the driver's foot should move at least $1\frac{3}{8}$ in. (35 mm.) before the main resistance is felt.
2. The total travel of the clutch. This is measured between the stop screw on the clutch lever and the flywheel casing. This should not be more than $\frac{5}{8}$ in. (16 mm.) with the pedal in the " off " position.

(1) If the free movement is less than $1\frac{3}{8}$ in. (35 mm.), slacken the adjusting and locknuts on the forward end of the clutch operating rod and adjust these as necessary. Do not forget to tighten the locknut when the correct adjustment has been obtained.

(2) If the total travel of the clutch lever is more than $\frac{5}{8}$ in. (16 mm.) slacken off the locknut at the top of the clutch stop lever, and adjust the stop screw as required. Tighten up the locknut and re-check (see Fig. E.4).

Note.—*Over-travel of the release bearing leads to solid coiling of the thrust springs, and this brings undue stress on the internal parts of the clutch and to the graphite release bearing in particular, which will wear extremely rapidly under these conditions.*

On later models the clutch pedal linkage has been modified to render excessive travel impossible if the correct free travel is properly maintained. The stop lever and stop screw are therefore no longer fitted.

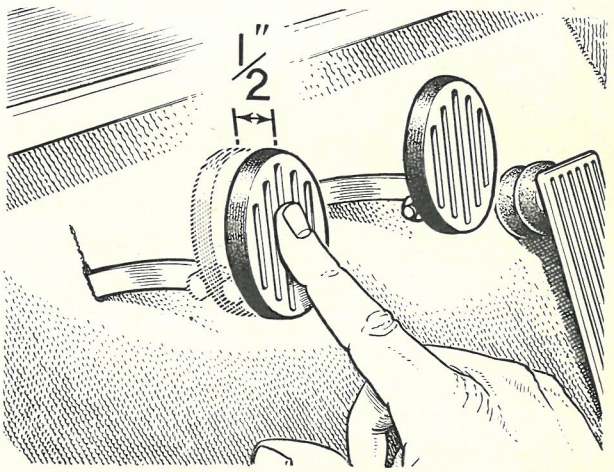


Fig. E.2.
There must be at least $\frac{1}{2}$ in. (13 mm.) of free movement at the clutch pedal and preferably $1\frac{3}{8}$ in. (35 mm.). The pedal travel from the end of the free movement to its stop should be approximately $3\frac{5}{16}$ in. (84 mm.).

Section E.2

REMOVAL OF THE CLUTCH

Remove the gearbox as in Section F.1.

Loosen each of the $\frac{1}{4}$ in. hexagon bolts securing the clutch to the flywheel by slackening them a turn at a time until the spring pressure is released (this should be done carefully to avoid distortion of the clutch cover flange).

The clutch cover can now be disengaged from the flywheel dowels and the whole assembly lifted from the flywheel, all parts except the driven plate remaining assembled to the cover.

Section E.3

DISMANTLING THE CLUTCH

Place the cover on the bed of a press as shown in Fig. E.5, with the pressure plate resting on wood blocks so arranged that the cover is left free to move

downwards. Place a block or bar across the top of the cover, resting on the spring bosses.

Apply pressure to the cover with the spindle of the press and, holding it under compression, remove the three adjusting nuts. The pressure from the press

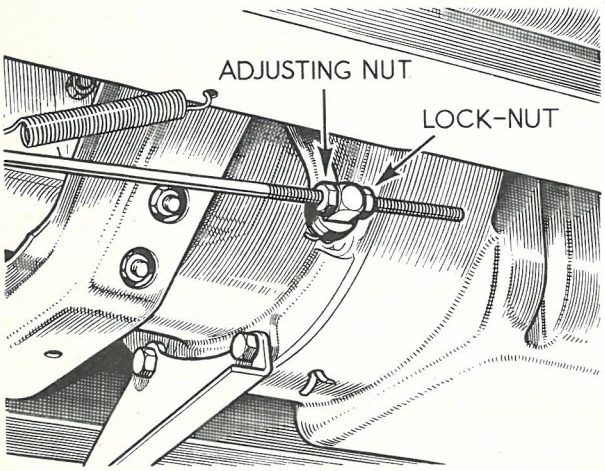


Fig. E.3.
The clutch pedal clearance is adjusted by means of the nuts on the threaded end of the clutch operating rod.

may now be released gradually until the clutch springs are fully extended.

While stripping down the cover-plate assembly, the parts should be marked so that they may be re-assembled in the same relative position to each other, to ensure that the correct balance is maintained.

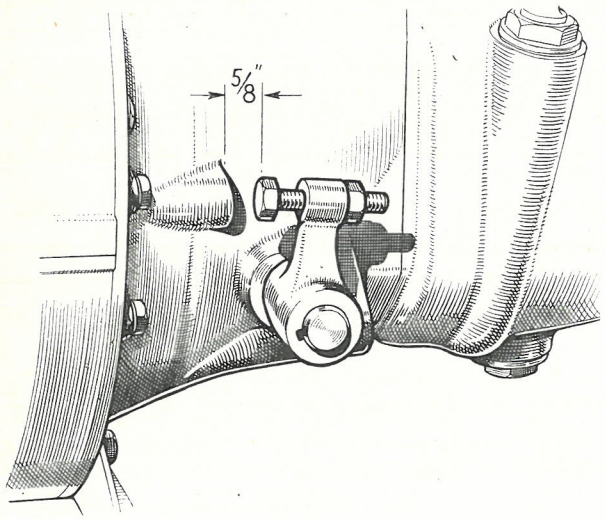


Fig. E.4.
The clutch pedal travel on early models is controlled by the distance between the stop screw and the stop on the clutch housing. The distance between the stops must not exceed $\frac{5}{8}$ in. (16 mm.) when the pedal is in the "off" position, or less than $\frac{3}{8}$ in. (10 mm.) with light hand pressure on the clutch pedal. On later models the operating linkage has been modified to render this stop unnecessary and it is no longer fitted.

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.

The cover can then be lifted off, and all parts will be available for inspection.

To remove the release levers, grasp the lever and eyebolt between the thumb and fingers as shown in Fig. E.7, so that the inner end of the lever and the threaded end of the eyebolt are as near together as possible, keeping the eyebolt pin seated in its socket on the lever. The strut can then be lifted over the ridge on the end of the lever as shown, making it possible to lift the eyebolt off the pressure plate. It is advisable to replace any parts which show signs of wear.

Section E.4

ASSEMBLING THE CLUTCH

Lay the pressure plate on the wood block on the bed of the press and place the springs on it in a vertical position, seating them on their small locating bosses as shown in Fig. E.6. Thoroughly clean all parts and replace any which show appreciable wear.

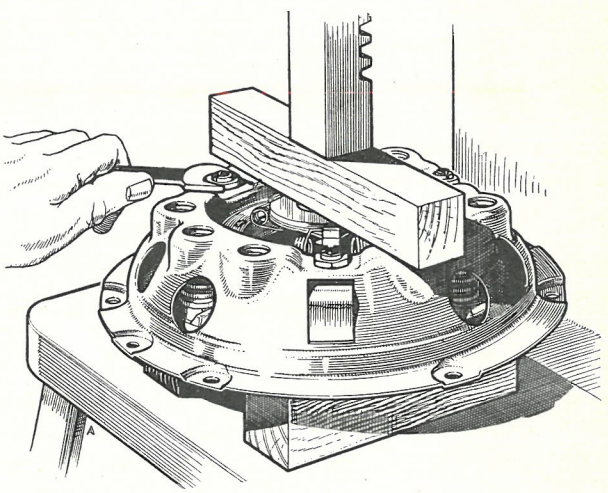


Fig. E.5.
The correct procedure to adopt when dismantling the clutch cover assembly. Note the two wood blocks supporting the pressure plate on the bed of the press. These must not project beyond the pressure plate, to ensure that they do not foul the cover-plate when this is depressed by the press.

Assemble the release levers, eyebolts and eyebolt pins, holding the threaded end of the eyebolt and the inner end of the lever as closely together as possible. With the other hand insert the strut in the slots of the pressure plate lug just sufficiently to allow the plain end of the eyebolt to be inserted in the hole

in the pressure plate. Move the strut upwards into the slots in the pressure plate lugs, over the ridge on the short end of the lever, and drop it into the grooves formed in the lever.

Lay the cover over the parts, taking care that the anti-rattle springs are in position as shown in Fig. E.1, and that the springs are directly under the seats in the cover. Also make sure, if using the original parts, that the eyebolts, eyebolt nuts, pressure plate lugs and cover are fitted in their correct relative positions, as marked when dismantling, to ensure correct balance being maintained.

Place a block of wood across the cover and compress the springs, taking great care to guide the eyebolts and the pressure plate lugs through the correct holes in the cover. Make sure also that the thrust springs remain correctly in their seats.

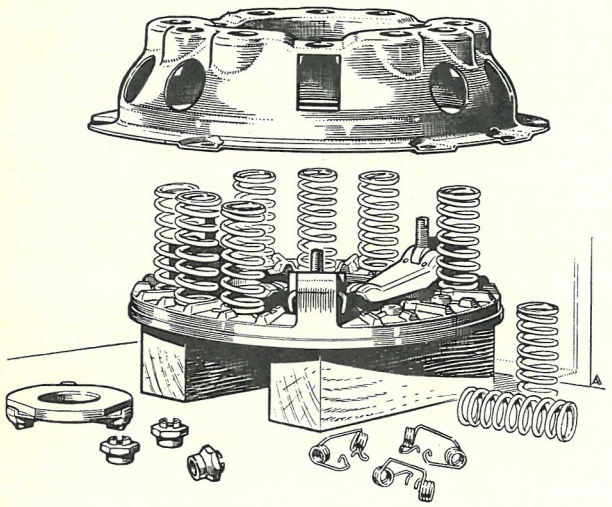


Fig. E.6.

When reassembling the clutch the pressure plate should be supported on the wood blocks used for dismantling and the levers assembled on their shoulder studs. The thrust springs should be placed in position on their seatings, making sure that they remain correctly located when the clutch cover is placed in position. Make sure also that the lever anti-rattle springs are properly located.

Replace the eyebolt nuts onto the eyebolts, and release the pressure compressing the cover assembly.

Note.—*The final setting of the release levers should be made, using the special gauge plate, Part No.* 68887 *(as described in Section E.5).*

The release lever plate "J" (Fig. E.1) should then be assembled to the release levers, taking care that the projecting portions properly engage in the slots in the release lever ends. Finally, the small retaining springs "K" should be fitted as indicated.

Section E.5

ADJUSTING THE RELEASE LEVERS

Satisfactory operation of the clutch is dependent upon accurate adjustment of the release levers, so that the pressure plate face is maintained parallel to the flywheel face. This cannot be accomplished by setting the levers parallel to the face of the release bearings after the clutch has been assembled to the flywheel, because of the variations in the thickness of the driven plate. The only accurate method is to adjust the release levers while the pressure plate

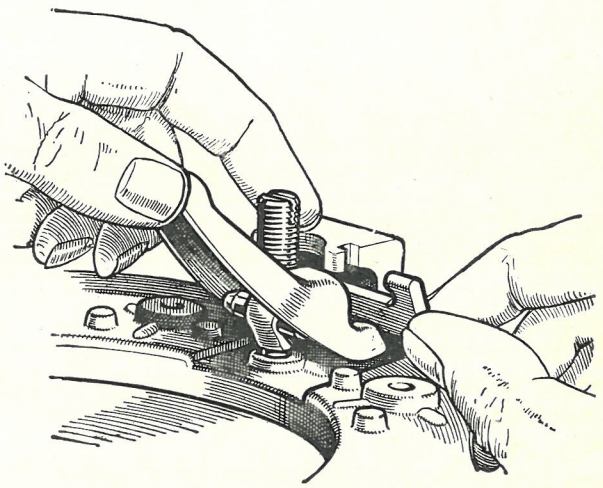


Fig. E.7.

To assemble the levers hold the threaded end of the eyebolt "O" and lever "L" close together as shown and with the other hand insert the struts in the slots of the pressure plate lugs sufficiently to permit the plain end of the eyebolt to be inserted in the hole in the pressure plate "R."

is held parallel to the flywheel by using the Borg & Beck lever adjustment gauge (Special Tool, Part No. 68887) (see Fig. E.8).

Place this gauge in 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 pulling against the spring pressure, otherwise the cover may be distorted. Before the cover is tightened down be sure that the gauge plate is properly centred, and the three flat machined lugs are directly under the levers. The clutch is equipped with a release lever plate attached to the levers which should be removed before the levers are adjusted.

After the cover assembly has been mounted, a short straight-edge should then be laid across the centre boss of the special gauge plate and the bearing surface of one lever, and the nut adjusted until the lever just

makes contact with the straight-edge. The other levers can then be set in turn by the same method. If carefully done, this setting will be within the permissible tolerance of ·005 in. (·12 mm.).

The adjusting nut is then locked in position by punching the protruding flange of the nut into the slot of the eyebolt, thereby definitely locking it in position. When carrying out this operation take care not to upset the adjustments previously made.

After adjustment is completed, loosen the holding screws a turn or two at a time until the spring pressure is released, which will allow the clutch assembly and the gauge plate to be removed.

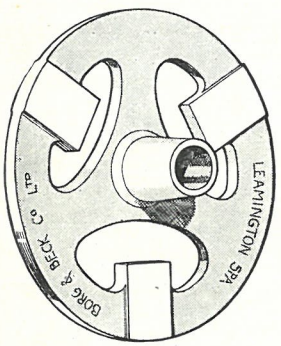


Fig. E.8.
The special Borg & Beck lever-adjusting gauge plate (Part No. 68887) for setting the levers correctly.

Section E.6

REPLACEMENT OF THE CLUTCH

Check the adjustment of the release levers, and if necessary adjust as in Section E.5.

Replace the release lever plate, taking care that the projecting portions properly engage the slots in the release lever ends. Finally the small lever-retaining springs should be fitted as indicated in Fig. E.1.

Assemble the driven plate and clutch assembly to the flywheel, taking care to place the chamfered end of the driven plate hub towards 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. 67833) before tightening the cover holding screws. Tighten the screws fully before removing the dummy clutch shaft.

Note.—*The weight of the gearbox must be supported during its replacement, in order to prevent strain and distortion of the driven plate assembly.*

After the gearbox and floorboards have been assembled the foot pedal should be adjusted until there is approximately 1 in. (25 mm.) free movement at the pedal pad, and the clearance between the stop on the clutch withdrawal lever and the stop on the flywheel housing is not more than $\frac{5}{8}$ in. (16 mm.) with the pedal in the "off" position, or less than $\frac{3}{8}$ in. (10 mm.) with light hand pressure on the clutch pedal.

Section E.7

SERVICING THE CLUTCH

As the clutch facings wear, the pressure plate moves closer to the flywheel face, 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 and the release bearing. 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 into contact with the release lever plate. Some free movement must always be maintained here to prevent

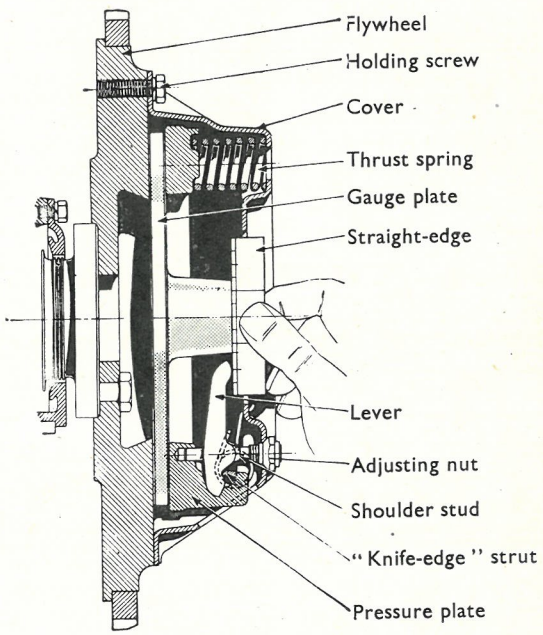


Fig. E.9.
Setting the release levers by means of the special Borg & Beck gauge plate and a short straight-edge.

the clutch pedal riding against the back stop and thus causing the clutch to slip. This essential free movement is restored by adjusting the clutch pedal position.

Excessive pedal movement causes coil binding of the springs and imposes an undue load on the bearing and on the crankshaft, causing excessive and rapid bearing wear. It therefore follows that the required pedal travel is the sum of the two movements :—

1. *The free movement*, or travel necessary to take up the clearance between the release bearing

and the release lever plate, provided to ensure that the clutch is fully engaged when the foot is removed from the pedal.

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

The pedal travel should be limited by the front and back stops of the clutch pedal, to the correct amount indicated. It is essential that these clearances

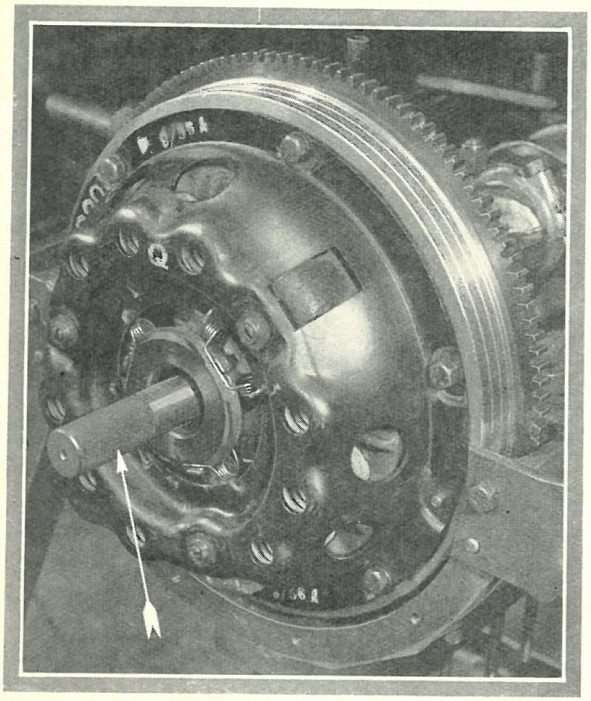


Fig. E.10.
The dummy shaft in use to ensure proper assembly of the clutch assembly and driven plate on the flywheel.

be adhered to, to allow the clutch to be completely freed, and at the same time prevent the possibility of damage to the clutch 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 of the trouble must be ascertained and rectified.

The free pedal movement, measured at the pedal pad, should be 1 in. (25 mm.), and the clearance between the stop on the clutch withdrawal lever and the stop on the flywheel housing should not be more than $\frac{5}{8}$ in. (16 mm.) when the pedal is in the "off" position, or less than $\frac{3}{8}$ in. (10 mm.) with light hand pressure on the clutch pedal (see Fig. E.4).

To obtain a clean release, the release lever plate should move a distance of $\frac{5}{16}$ in. (8 mm.) towards the flywheel.

Spring pressure

A tolerance of not more than 10 to 15 lb. (4·5 to 6·8 kg.) pressure is allowable on the compression load of the operating springs when at their assembled height, and all clutch springs are tested for this before assembly.

The clutch operation springs are not affected by high clutch temperatures, as the pressure plate absorbs heat rapidly, the springs have only line contact, and a draught is continually passing under them when the engine is running.

Tolerances

Wear on the working faces of the driven plate is about ·001 in. (·02 mm.) per 1,000 miles (1600 km.) under normal running conditions. The accuracy of the alignment of the face of the driven plate must be within ·015 in. (·38 mm.).

Driven plates

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

Lubrication of the splines of the driven plate is provided at assembly only, when CS881 graphite grease or zinc-based "Kenol" is used.

It is essential to install a complete driven plate assembly when renewal of the friction surfaces is required. If the facings have worn to such an extent as to warrant replacement, then slight wear will have taken place on 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" of which make contact. As the amount of useful friction for the purpose of taking up the drive is dependent upon the area in actual 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, the polished surface is common, but it must not be confused with the glazed surface which is sometimes encountered

due to conditions to be discussed subsequently. The ideally smooth or polished condition will therefore provide proper surface contact, but a glazed surface entirely alters the frictional value of the facing, and will result in excessive clutch slip. These two conditions might be simply illustrated by 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 dry varnish is interposed between the contact surfaces, and actual contact is made by the varnish.

If 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.

Should oil in small quantities gain access to the clutch and find its way onto 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 facings, 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.

Should increased quantities of oil obtain access to the facing, then one of two conditions, or a combination of these, 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, producing 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" due to the tendency of the face of the 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.

Still greater quantities of oil produce a dark and soaked appearance of the facings, and the result will be further slip, accompanied by fierceness or "juddering."

If the conditions enumerated above 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 cleaned out thoroughly before reassembly. (See also Section A.31.)

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 inserted into their metal cup by heating the metal cup to a cherry red, then forcing the graphite ring into position. 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. (·12 mm.).

In almost every case of rapid wear on the splines of the clutch driven plate, 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 which makes gear changing difficult. In cases of persistent difficulty it is advisable to check the flywheel for truth with a dial indicator. The dial reading should not vary more than ·003 in. (·07 mm.) anywhere on the flywheel face.

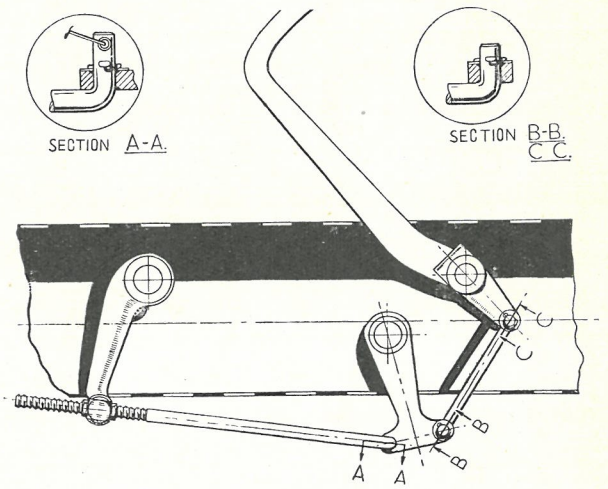


Fig. E.11.

The modifications required to the clutch operating levers to accommodate the larger operating rods.

Section E.8

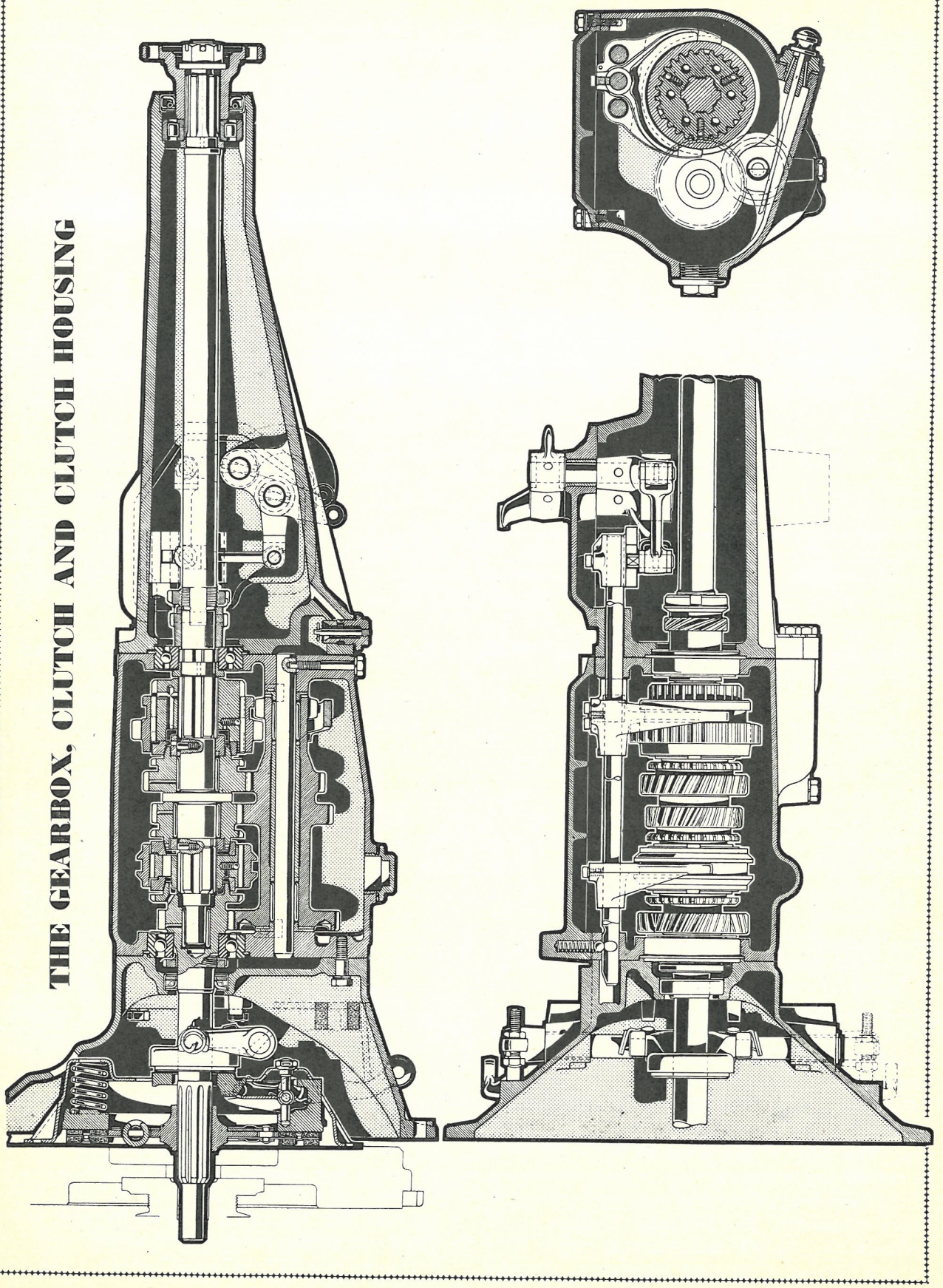
MODIFICATION TO OPERATING RODS

Later models are fitted with $\frac{5}{16}$ in. diameter operating rods in place of the $\frac{1}{4}$ in. diameter rods originally fitted.

The early models can easily be fitted with the later type rods by enlarging the holes in the levers to $\frac{21}{64}$ in. (8·3 mm.) and countersinking the edges for $\frac{1}{16}$ in. (1·5 mm.) at 45°, as indicated in Fig. E.11. A new trunnion (Part No. 139542–Z) must be fitted to the end of the clutch actuating lever to take the larger rod.

The new rods are Parts Nos. 139539–Z and 135848–Z.

THE GEARBOX, CLUTCH AND CLUTCH HOUSING



SECTION F

THE GEARBOX

Description of Gearbox.

Section No. F.1 Removal and replacement of the gearbox.

Section No. F.2 Dismantling and reassembling the gearbox.

Section No. F.3 Dismantling and reassembling the mainshaft assembly.

Section No. F.4 Dismantling and reassembling the drive gear assembly.

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, first and reverse by sliding spur gears.

The gear-change lever on the steering column selects and engages the gears through linkage in the gearbox extension.

Needle roller bearings are provided in the layshaft, second and third speed gears and drive gear spigot. The mainshaft and drive gear run in ball bearings, and a roller bearing is fitted to the gearbox extension tail-end bearing.

A drain valve below the speedometer drive allows oil in the gearbox extension to return to the gearbox.

Two types of gearbox with different ratios for second and third gear reductions have been fitted, but they are structurally the same and similar service instructions apply to both.

Section F.1

REMOVAL AND REPLACEMENT OF THE GEARBOX

This operation is more easily carried out over a pit.

Drain the water from the radiator, using the drain tap on the right-hand side under the grille. Release the clips on the top water hose.

Unscrew the two nuts on each bonnet hinge and, with the aid of a second operator, lift off the bonnet. Alternatively, the bonnet may be secured in the vertical position by a cord attached to the bonnet motif and passing over the roof to the rear bumper.

Disconnect the exhaust pipe flange from the manifold, taking care not to damage the copper-asbestos gasket. Support the engine from lifting tackle with a sling passing beneath the flywheel case.

Remove the rear engine-steady. This is secured by four long bolts passing through the frame on each side, together with two long bolts which secure the hand-brake lever tie bracket on the left-hand side. The steady bracket may be withdrawn, leaving the steady strap and rubber bush in position.

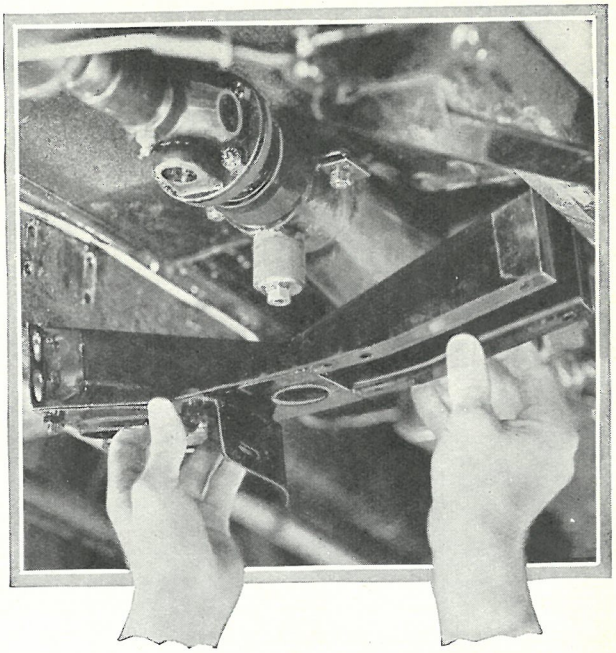


Fig. F.1.
Withdrawing the gearbox rear support member.

Disengage the return spring from the hand-brake lever, and release the lever from its pivot in the tie bracket.

Disconnect the forward end of the propeller shaft at its universal joint flange. Early models have the nuts locked by split pins while later models are fitted with self-locking nuts.

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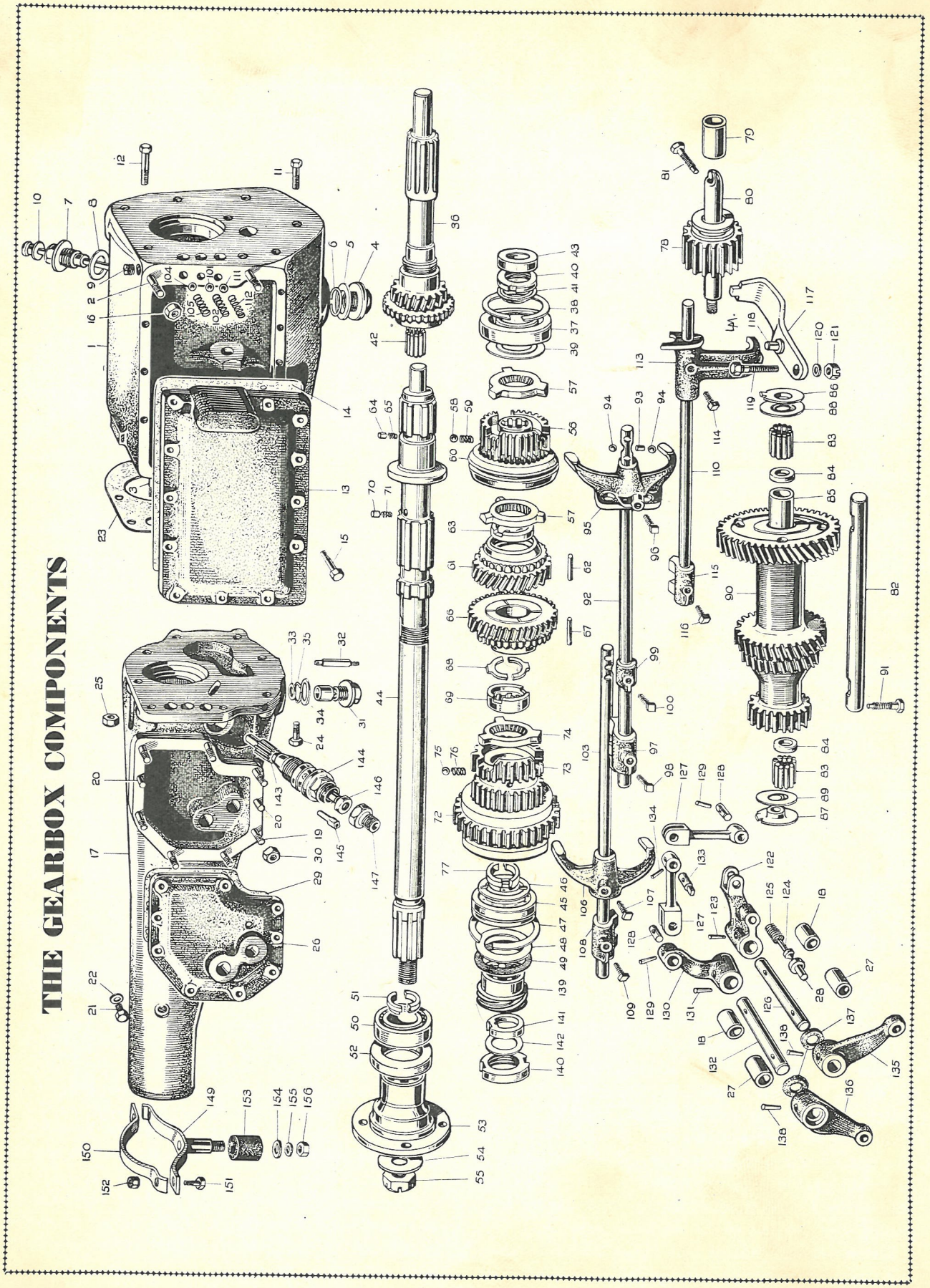
THE GEARBOX COMPONENTS



KEY TO THE GEARBOX COMPONENTS

No.	Description
1.	Gearbox casing.
2.	Stud—side cover.
3.	Stud—extension.
4.	Plug—oil drain.
5.	Washer—drain plug.
6.	Circlip.
7.	Plug—oil filler.
8.	Washer—oil filler plug.
9.	Plug—interlock hole.
10.	Indicator with knob—oil level.
11.	Bolt—short—to clutch housing.
12.	Bolt—long—to clutch housing.
13.	Cover—gearbox side.
14.	Joint—side cover.
15.	Bolt—side cover.
16.	Nut—cover bolt.
17.	Extension casing.
18.	Bush—selector cross-shaft.
19.	Stud—side cover.
20.	Dowel—side cover.
21.	Plug—oiling.
22.	Washer—plug.
23.	Joint—extension to gearbox.
24.	Bolt—extension to gearbox.
25.	Nut—extension stud.
26.	Cover—extension side.
27.	Bush—selector cross-shaft.
28.	Insert—side cover.
29.	Joint—side cover.
30.	Nut—side cover stud.
31.	Body—valve.
32.	Spindle—valve.
33.	Plate—valve.
34.	Washer—valve body.
35.	Circlip—valve body.
36.	Drive gear.
37.	Bearing—drive gear.
38.	Circlip—bearing.
39.	Guard—bearing.
40.	Nut—bearing.
41.	Lock washer—bearing nut.
42.	Rollers—drive gear.
43.	Oil seal—drive gear.
44.	Mainshaft.
45.	Bearing—intermediate.
46.	Guard—bearing.
47.	Circlip—bearing.
48.	Plate—bearing.
49.	Spring plate—bearing.
50.	Bearing—rear.
51.	Collar—bearing.
52.	Oil seal—bearing.
53.	Universal joint flange.
54.	Washer—universal joint flange.
55.	Nut—flange to mainshaft.
56.	Sliding hub—top and third.
57.	Interceptor—top and third.
58.	Ball—sliding hub.
59.	Spring—hub ball.
60.	Striking dog—top and third.
61.	Third speed gear.
62.	Rollers—gear.
63.	Lock plate—gear.
64.	Plunger—gear.
65.	Spring—plunger.
66.	Second speed gear.
67.	Rollers—gear.
68.	Washer—gear.
69.	Lock plate—gear.
70.	Plunger—gear.
71.	Spring—plunger.
72.	First speed gear.
73.	Sliding hub—first speed.
74.	Interceptor—first speed.
75.	Ball—sliding hub.
76.	Spring—sliding hub.
77.	Distance collar—mainshaft.
78.	Reverse gear.
79.	Bush—reverse gear.
80.	Shaft—reverse gear.
81.	Screw—shaft.
82.	Layshaft.
83.	Rollers—layshaft.
84.	Washer—layshaft roller.
85.	Spacer—layshaft.
86.	Bearing plate (large)—layshaft—front.
87.	Bearing plate (small)—layshaft—rear.
88.	Thrust washer (large)—layshaft—front.
89.	Thrust washer (small)—layshaft—rear.
90.	Gear unit—layshaft.
91.	Locating screw—layshaft.
92.	Shifter shaft—top and third.
93.	Interlock pin—shaft.
94.	Ball—interlock.
95.	Striking fork—top and third.
96.	Screw—fork.
97.	Selector—top and third.
98.	Screw—selector.
99.	Stop collar—fork.
100.	Screw—stop collar.
101.	Ball—shaft.
102.	Spring—shaft ball.
103.	Shifter shaft—first and second.
104.	Ball—shaft.
105.	Spring—shaft ball.
106.	Striking fork—first and second.
107.	Screw—fork.
108.	Selector—first and second.
109.	Screw—selector.
110.	Shifter shaft—reverse.
111.	Ball—shaft.
112.	Spring—shaft ball.
113.	Shifter fork—reverse.
114.	Screw—fork.
115.	Selector—reverse.
116.	Screw—selector.
117.	Shifter lever—reverse.
118.	Pin lever.
119.	Swivel bolt—lever.
120.	Washer—swivel bolt.
121.	Nut—swivel bolt.
122.	Selector lever—internal.
123.	Taper pin—lever.
124.	Plunger—lever.
125.	Spring—lever plunger.
126.	Cross-shaft—lever.
127.	Connecting link—lever.
128.	Pin—link.
129.	Taper pin—link.
130.	Shifter lever—internal.
131.	Taper pin—lever.
132.	Cross-shaft—lever.
133.	Pin—selector and shifter lever.
134.	Taper pin—selector and shifter lever.
135.	Selector lever—external.
136.	Shifter lever—external.
137.	Gland washer—shifter and selector lever.
138.	Taper pin—external lever.
139.	Speedometer gear.
140.	Nut—gear.
141.	Lock ring—rear.
142.	Washer—lock ring.
143.	Pinion.
144.	Bearing—pinion.
145.	Sleeve—pinion.
146.	Oil seal—pinion.
147.	Retainer—oil seal.
149.	Strap assembly—bottom—rear engine steady.
150.	Strap—top—rear engine steady.
151.	Bolt—top to bottom strap.
152.	Nut—strap bolt.
153.	Bush—rubber—rear engine steady.
154.	Washer—special—rear engine steady.
155.	Washer—rear engine steady.
156.	Nut—rear engine steady.

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Remove the front floor carpet and carpet felt, and lift out the gearbox cover-plate after extracting the brass retaining screws and flat washers and releasing the foot-operated dipping switch.

Withdraw the split pins, flat washers and anti-rattle washers from the two pins on the selection levers and withdraw the clevis pins. Withdraw the split pin and anti-rattle washer from the adjuster on the forward end of the clutch operating rod.

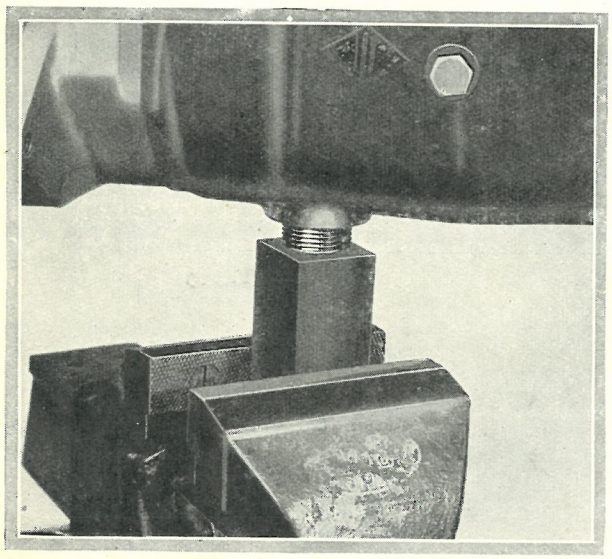


Fig. F.2.
The best method of holding the gearbox while working on it is by the use of a screwed bar engaging the drain plug hole.

Disconnect the speedometer cable, taking care not to lose the felt oil retainer.

Remove the four bolts securing each side of the gearbox support member to the frame and the four nuts, spring and flat washers securing the mounting rubber. Observe the position of the engine earthing strip and remove the gearbox support.

Place a wooden block beneath the propeller shaft to keep it clear of the gearbox drive flange.

Remove the bolts securing the clutch housing to the crankcase, slacken the exhaust pipe clip and swing it clear of the gearbox.

Lower the rear of the engine until the cylinder head cover just touches the dash panel. The gearbox assembly may then be withdrawn to the rear.

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 must be exercised to ensure that the weight of the gearbox is not allowed to hang on the hub of the driven plate and that the driven plate 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 in the clutch housing and the gearbox moved forward into position. Replace the securing bolts and secure the exhaust pipe bracket in its correct position.

Raise the rear of the engine, replace the gearbox support member and continue the assembly in the reverse order to the dismantling procedure.

Section F.2

DISMANTLING AND REASSEMBLING THE GEARBOX

Remove the drain plug and drain off the oil.

When dismantling the gearbox it will be found advantageous to support it in a vice by means of a piece of steel bar approximately $1\frac{1}{2}$ in. (40 mm.) square by 5 in. (120 mm.), this being turned down and threaded at one end (30 mm. $\times$ 2 mm. pitch thread) to enable it to be screwed into the gearbox drain plug hole (see Fig. F.2).

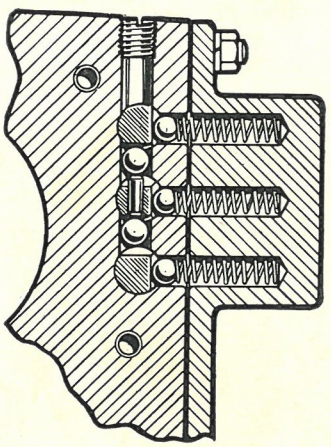


Fig. F.3.
The arrangement of the interlocking balls and plunger for the selector bars is clearly indicated in this illustration.

Remove the gearbox side cover-plate by unscrewing the ten $\frac{3}{16}$ in. bolts and two $\frac{3}{16}$ in. nuts with spring washers. Take care not to lose the three selector balls and springs from the front wall of the gearbox.

Remove the external shifter and selector levers by tapping out the taper pins.

Note.—*The selector lever pin should be removed first, and the selector lever, which is fitted to the front of the shifter lever, withdrawn from the shaft together with its felt washer.*

Withdraw the seven $\frac{3}{16}$ in. stud nuts and spring washers securing the gearbox extension side cover. Remove the cover, noting that it is mounted on two dowel pins and carries two porous bronze bushes for the shafts.

Remove the six $\frac{1}{4}$ in. bolts securing the gearbox extension to the gearbox and slacken the two nuts as far as they will go. Draw the gearbox extension to the rear until the two nuts and washers can be removed. Withdraw the selectors from the shifter

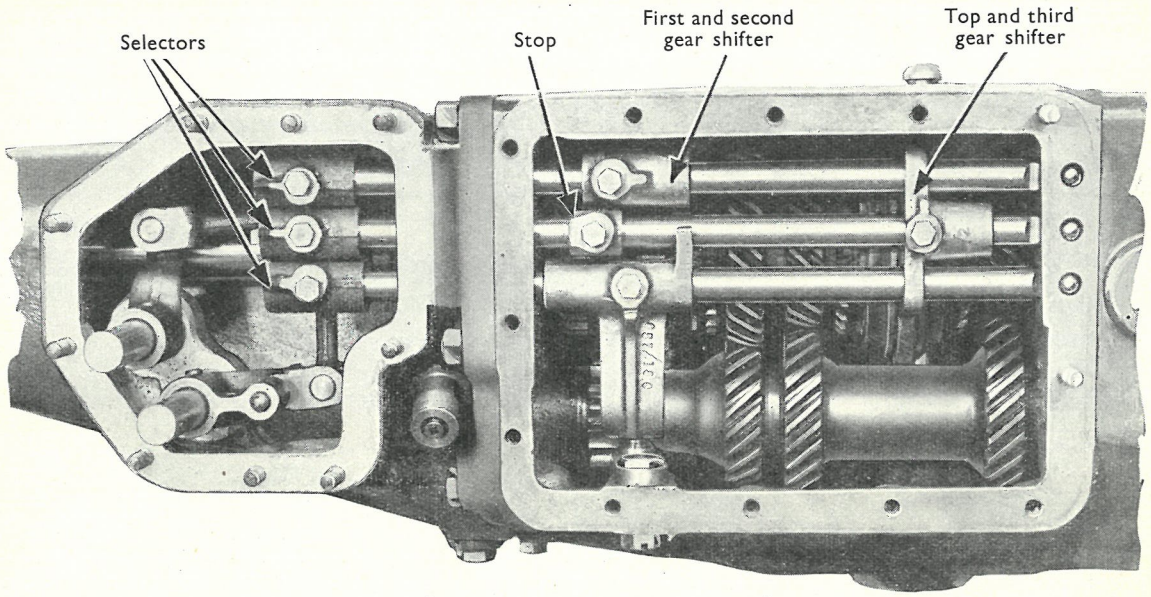


Fig. F.4.
The location of the components of the selector mechanism can be seen clearly from this illustration. The reverse shifter is the one attached to the lower shaft.

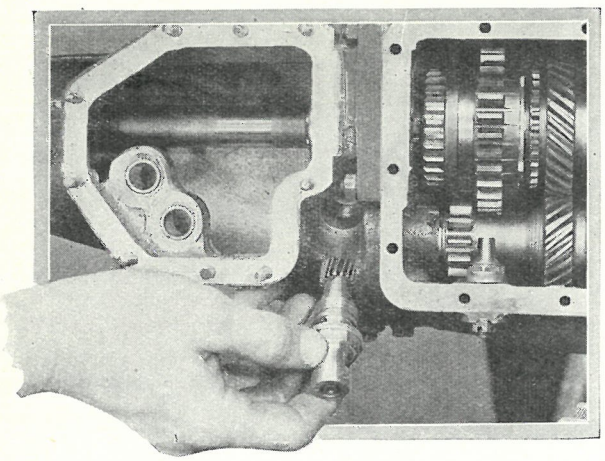


Fig. F.5.
Withdrawing the speedometer drive assembly from its housing in the gearbox extension.

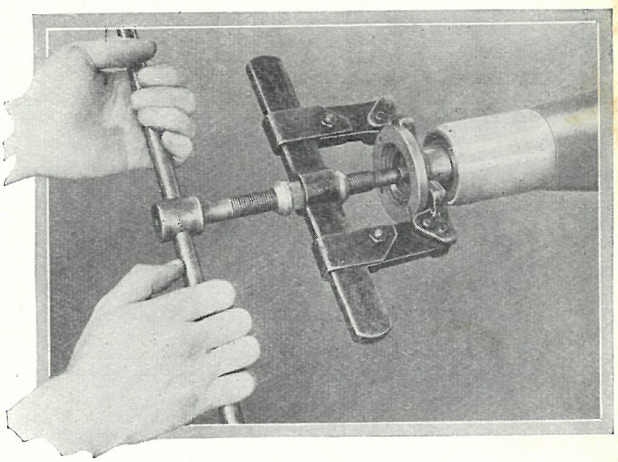


Fig. F.6.
The propeller shaft drive flange requires an extractor to withdraw it from the rear end of the mainshaft.

Extract the locking wire and three hexagon screws locating the selectors to the shifter shafts.

Unscrew the speedometer drive assembly from its housing. Withdraw the split pin and remove the nut and flat washer securing the propeller shaft drive flange to the rear of the gearbox mainshaft. Use a suitable extractor to withdraw the flange.

shafts and remove the gearbox extension. The outer race of the rear end roller bearing and the oil seal will remain in the extension.

Tap the internal race of the roller bearing from the main shaft and remove the split collar. Note that this is fitted with the shoulder forward of the bearing.

Tap back the speedometer gear lock washer and

remove the securing nut, washer, distance-piece and speedometer gear. The distance-piece is not threaded and may readily be withdrawn from the shaft. The geared end of the speedometer drive is fitted away from the gearbox.

Remove the bearing plate and spring plate from the mainshaft bearing. Note that the spring plate is fitted with its concave side next to the bearing.

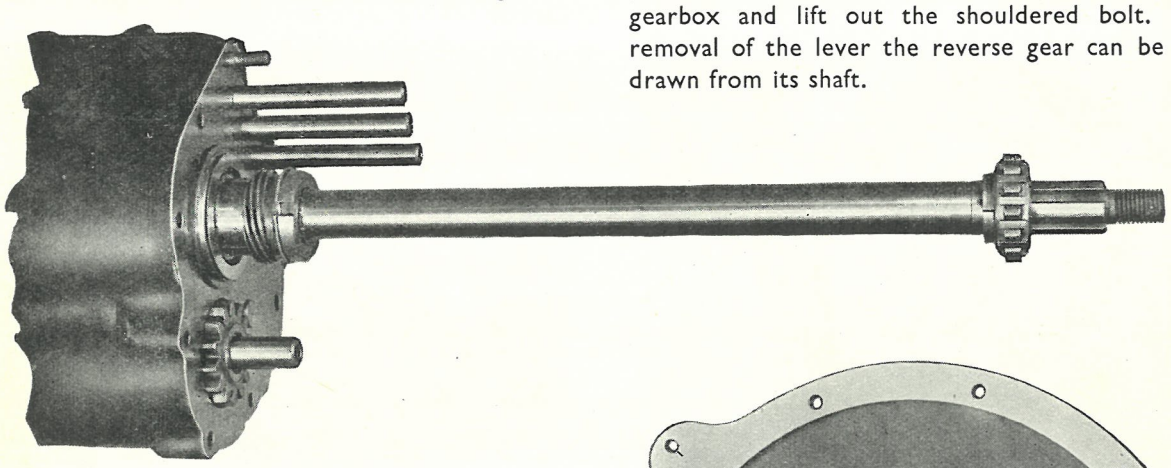


Fig. F.7.
The gearbox extension removed, showing the selector shafts, mainshaft, helical speedometer gear and the rear end of the reverse gear sliding pinion protruding from the rear face of the gearbox.

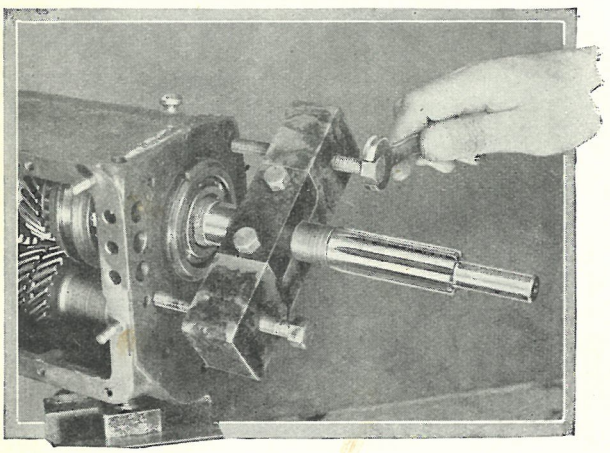


Fig. F.8.
To remove the drive gear and its shaft it is necessary to make use of special extractor (Part No. 68894) as shown.

Remove the clutch thrust pad by extracting the two retaining springs. Remove the seven $\frac{1}{4}$ in. bolts securing the clutch housing to the gearbox. Note that two long bolts are necessary on the right-hand side. Withdraw the clutch housing, complete with clutch shaft and oil seal.

Withdraw the locking wire and four screws securing the gear shifters to the shifter shafts and withdraw the shafts, observing the positions of the shifter forks and stop. The top and third gear shifter forks are fitted with their bosses to the front (see Fig. F.4).

Lift out the shifters and stops and remove the two interlocking balls from the front end of the gearbox, and take care not to lose the interlocking pin from the front end of the centre shifter.

To remove the reverse gear lever, extract the split pin and remove the $\frac{1}{4}$ in. nut from the underside of the gearbox and lift out the shouldered bolt. After removal of the lever the reverse gear can be withdrawn from its shaft.

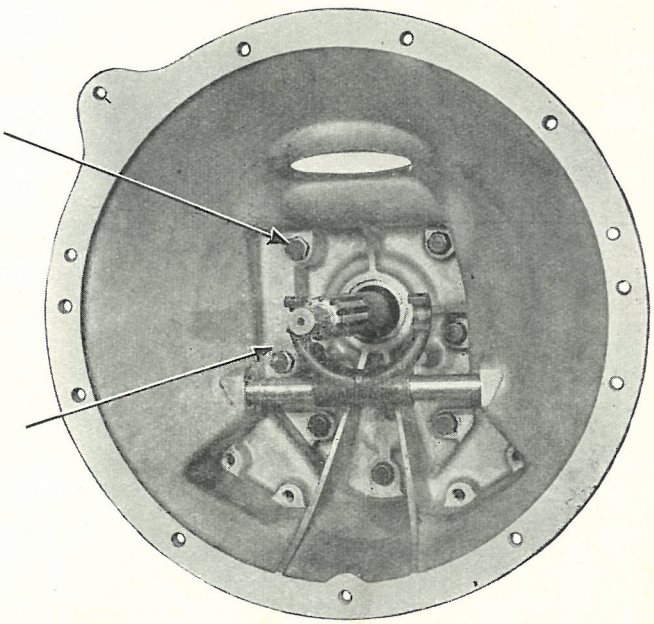


Fig. F.9.
The position of the two long bolts attaching the gearbox to the clutch housing are indicated by the arrows.

Remove the $\frac{1}{4}$ in. layshaft locating bolt from the rear end of the base of the gearbox.

Use a suitable copper or brass drift and tap out the layshaft to the rear, thus allowing the layshaft gear unit to drop to the bottom of the box away from the mainshaft gear.

Use an extractor (Special Tool, Part No. 68894) to remove the drive gear from the gearbox ; this will prevent damage to the bearing guard through tapping out the bearing. Take care not to lose any of the sixteen rollers which are free to fall from the spigot bearing. Remove the drive gear.

Drive the mainshaft to the rear with a suitable brass or copper drift until the rear mainshaft bearing is clear of its housing. Remove the bearing and guard, noting that the guard is fitted with its convex side towards the bearing.

The mainshaft assembly may now be manœuvred from inside the gearbox.

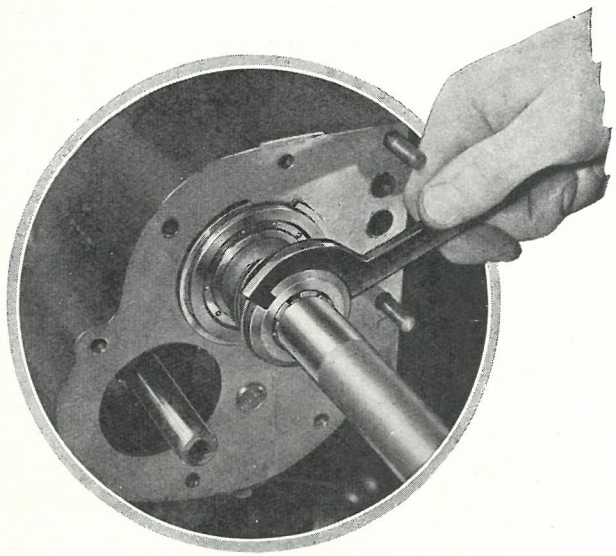


Fig. F.10.
The gearbox mainshaft locknut requires a " C " spanner for loosening and tightening. A special spanner (Part No. 68836) is obtainable from the Service Department.

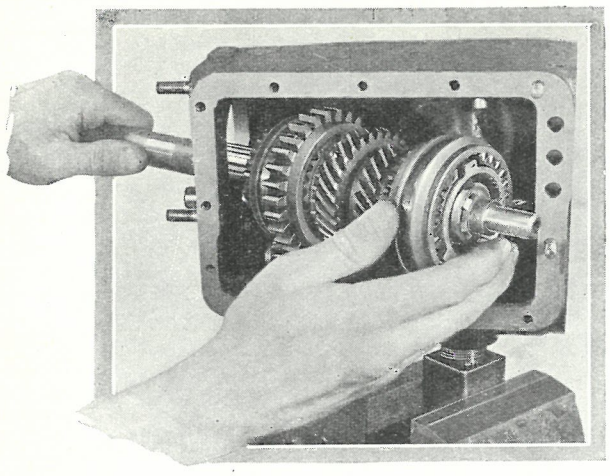


Fig. F.11.
Withdrawing the mainshaft with its gear assembly from the gearbox.

Engage the tags on the layshaft end thrust washers with the grooves in the gearbox and lift out the layshaft. Take care not to lose any of the sixteen rollers which are fitted to each end of the layshaft.

The reverse gear spindle is extracted after removing the $\frac{1}{4}$ in. dowel bolt from the left-hand side of the gearbox.

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 :—

If the two roller washers and the roller spacer have been removed from the layshaft gear unit, ensure that they are correctly replaced before the rollers are inserted.

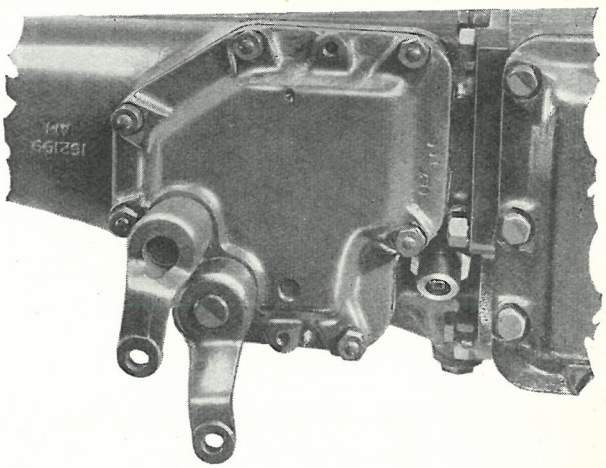


Fig. F.12.
The correct positions of the selector and shifter actuating levers in the cover of the gearbox extension.

Insert the rollers into each end of the layshaft and replace the thrust washers and end plates. To keep the rollers in position until the layshaft is raised from the bottom of the gearbox and the layshaft spindle inserted, it is advisable to insert a piece of $\frac{5}{8}$ in. (15·8 mm.) diameter bar $7\frac{1}{4}$ in. (184 mm.) long into the layshaft before it is placed in the gearbox.

Place the layshaft gear unit and dummy spindle in position in the bottom of the gearbox. The layshaft spindle is not replaced until the mainshaft assembly and drive gear have been installed. The spindle must be inserted chamfered end first from the rear, and care taken to see that the dowel bolt hole in the spindle is lined up to correspond with the bolt hole in the gearbox and that the tags on the thrust washers register with the grooves in the gearbox bearing bosses.

Reassembly continues in the reverse order to the dismantling sequence.

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.

Remove the third gear collar by pressing down the spring-loaded locating plunger and rotating the collar until the splines register with those on the shaft. The third gear may now be withdrawn. Care must be exercised not to lose the plunger and spring, or the thirty-two rollers.

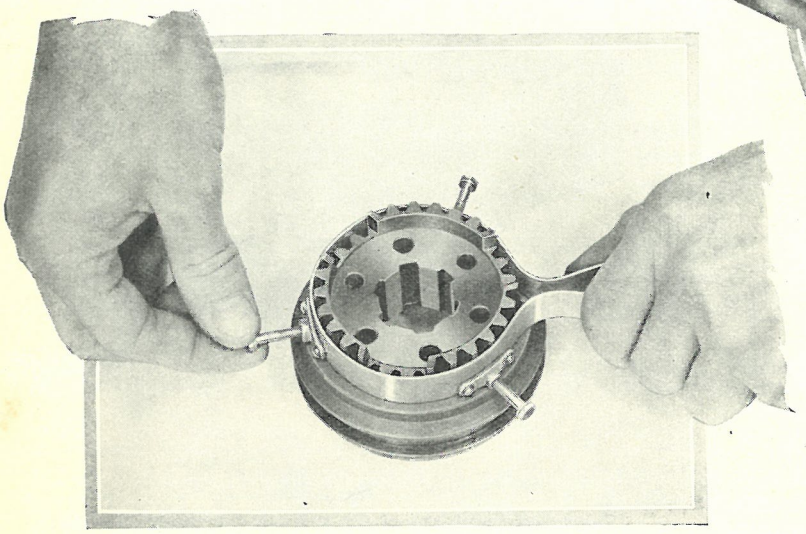


Fig. F.13.
Reassembly of the synchromesh hub is facilitated by the use of this simple tool which keeps the locating balls and springs under control during the refitting process.

In order to remove the first gear hub unit it is necessary to remove the split collar from the mainshaft before sliding the hub to the rear. While doing this, take care not to release the three plungers and springs between the hub and sliding dog.

To remove the second gear synchromesh hub unit, extract the second speed gear collar by pressing down the spring-loaded locating plunger and rotating the collar until the splines register with those on the shaft. Withdraw the plunger and spring and the two halves of the split gear washer. The synchromesh hub may then be withdrawn from the rear of 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 three $\frac{3}{16}$ in. 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 a specially made-up tool (as shown in Fig. F.13) will facilitate the replacement of the balls and springs. When the three balls and springs have been replaced in their housings the hub can be pressed into the

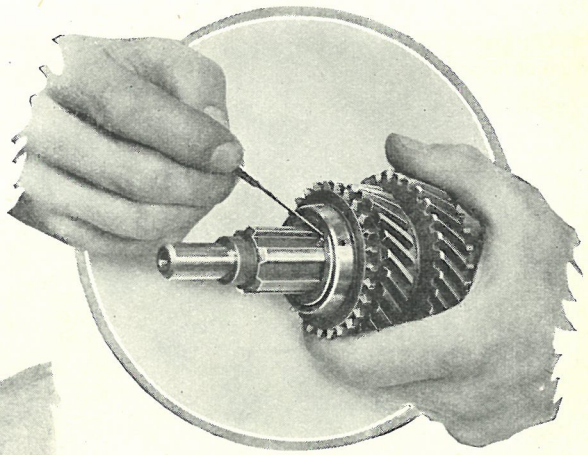


Fig. F.14.
Pressing down the spring-loaded locating plunger to release the third gear collar.

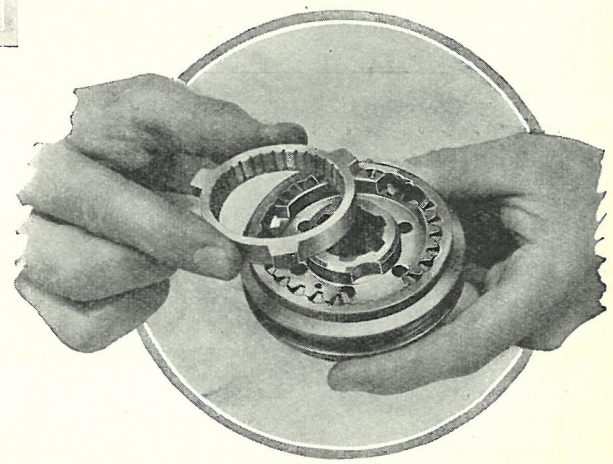


Fig. F.15.
The interceptor ring must be replaced with its three lugs in engagement with the three cut-away portions of the synchromesh hub.

striking dog. **Care must be taken to ensure that the cut-away portions of the hub and the striking dog coincide. The ears of the phosphor-bronze interceptor must engage these slots.**

Reassembly of the mainshaft is a reversal of the dismantling procedure, but the synchromesh hubs must slide freely on the mainshaft splines, and the twenty-eight needle rollers in the second, and thirty-two needle rollers in the third speed gears must be replaced correctly.

When the second-speed gear and rollers have been replaced, the split gear washer must be positioned so that one of its ears is in line with the locking plunger hole. Thread the lock washer along the shaft with its slotted face towards the gear. Engage the splines with the lock washer slots coinciding with the plunger and split gear washer. Depress the plunger and move the lock washer towards the gear, rotating it one spline until it locks in position. The locking washer may be released when the plunger is depressed by the end of a length of wire inserted through the radial holes provided.

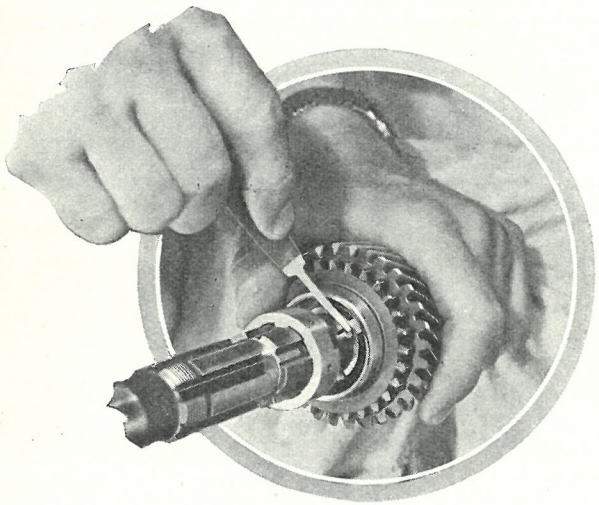


Fig. F.16.
Reassembly of the gears on the mainshaft is accomplished in the manner detailed in Section F.3, the final locking being carried out by depressing the plunger, moving the lock washer towards the gear and rotating it to the extent of one spline.

The split collar securing the first gear hub is replaced on the mainshaft with its shoulder towards the gear.

Replace the third speed gear rollers, plunger spring and plunger before replacing the third gear. The lock-plate must be placed on the mainshaft with the slotted face away from the gear and the slots offset one spline from the plunger. The plunger and spring is then depressed with a length of stiff wire inserted in the hole in the cone provided for this purpose. Alternatively a thinly ground blade can be used and the lock-plate moved into position. Rotate the lock-plate one spline until it is locked in position with the slot above the plunger. This is essential in order to facilitate any future dismantling.

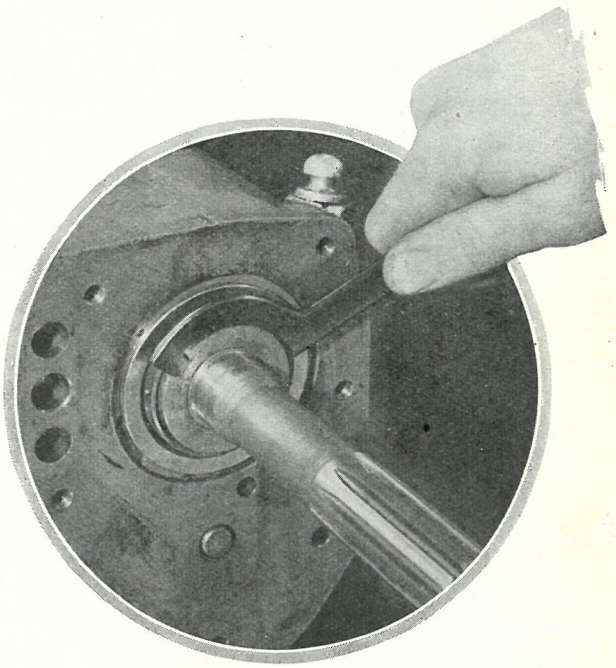


Fig. F.17.
A special "C" spanner (Part No. 68897) is required to deal with the drive gear nut.

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

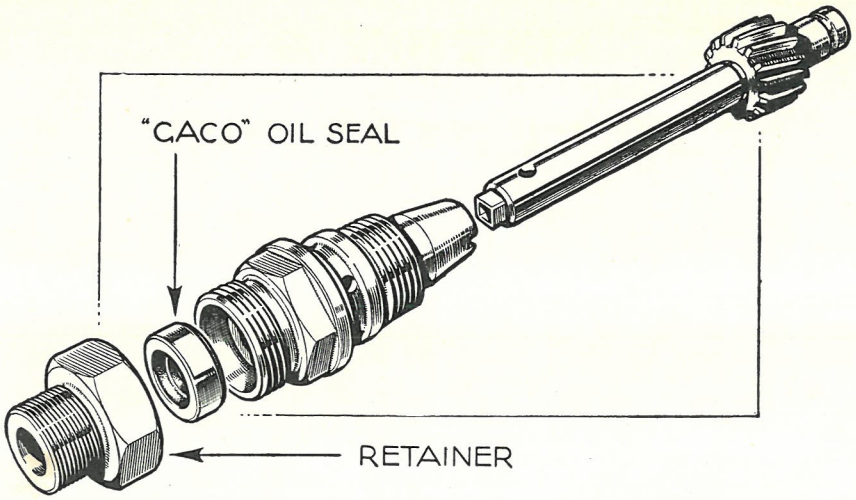


Fig. F.18.
The components of the modified speedometer drive assembly are here shown in their relative positions for assembly. When passing the oil seal over the shaft it is essential to make quite sure that the edge of the oil seal is not damaged in any way or it will be rendered ineffective.

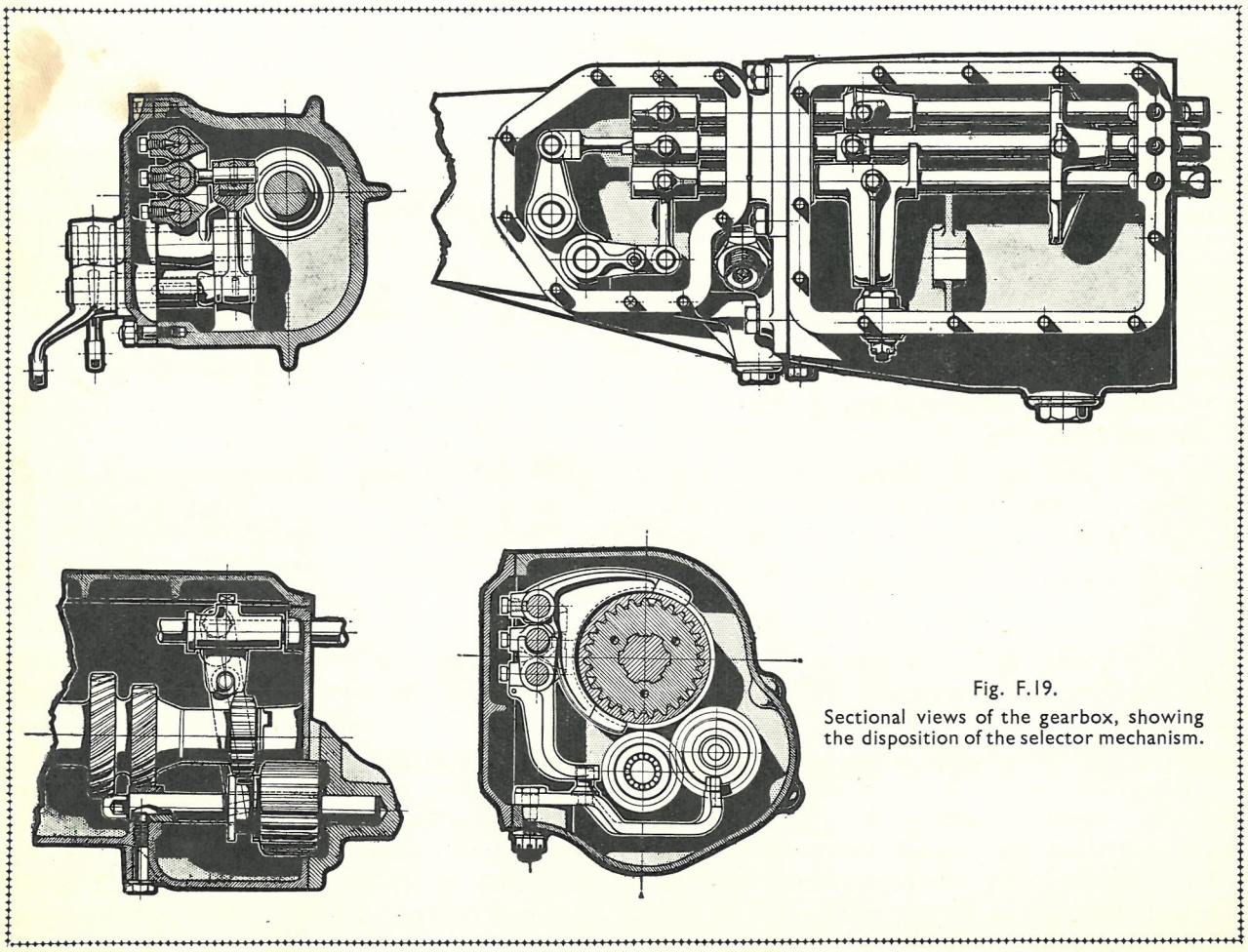


Fig. F.19.
Sectional views of the gearbox, showing the disposition of the selector mechanism.

SECTION G

THE PROPELLER SHAFT

General Description.

Section No. G.1 Attention to universal joints.

Section No. G.2 Testing for wear. (In position.)

Section No. G.3 Removal of the propeller shaft.

Section No. G.4 Dismantling the propeller shaft.

Section No. G.5 To examine and check for wear.

Section No. G.6 Reassembling the propeller shaft.

Section No. G.7 Replacement of the propeller shaft.

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 universal joint consists of a centre spider, four needle roller bearing assemblies, and two yokes.

Section G.1

ATTENTION TO UNIVERSAL JOINTS

The propeller shaft has a lubricator fitted to the front and rear spiders which should be given three or four strokes with the grease gun every 1,000 miles (1600 km.). The correct lubricant is grease to Ref. D (page P.2).

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 grease to Ref. D (page P.2) every 1000 miles (1600 km.). 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 propeller shaft, one on each universal joint and one on the sliding joint. When fitting new grease nipples it is essential to make sure that the thread on the replacement nipple is correct. On early models the thread is $\frac{1}{8}$ in. B.S.P.; on later models it is $\frac{1}{4}$ in. A.N.F.

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 positions. This is important to ensure correct balance.

Remove the bolts and nuts securing the propeller shaft to the gearbox flange and carefully support it while removing the bolts and nuts securing the shaft to the rear axle flange. The shaft can now be removed from the car downwards and rearwards.

On early models the flange bolt nuts are locked by split pins, but later models are fitted with self-locking nuts.

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 dirt and enamel 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 prising 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 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.

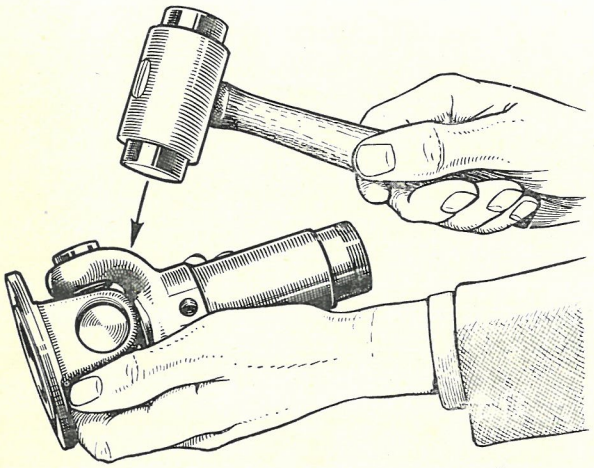


Fig. G.1.
Where to apply light blows to the yoke in the first stage of dismantling the universal joint after removing the retaining circlip.

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

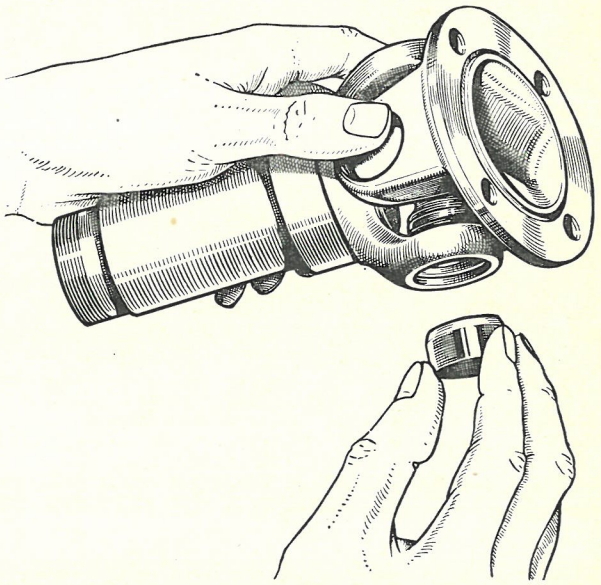


Fig. G.2.
Showing the manner of withdrawing the needle bearing after it has been partly withdrawn. When bearings are removed or replaced they should be held vertically to prevent the needle bearings from being displaced.

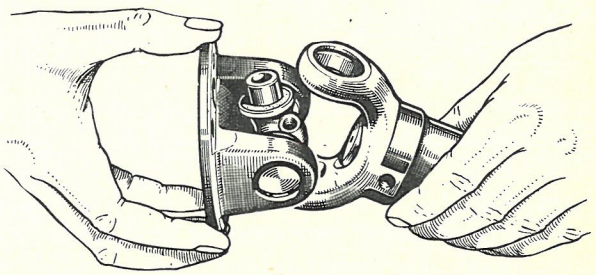


Fig. G.3.
When the needle roller bearings have been withdrawn from opposite sides of the spider the joint can be separated as shown.

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

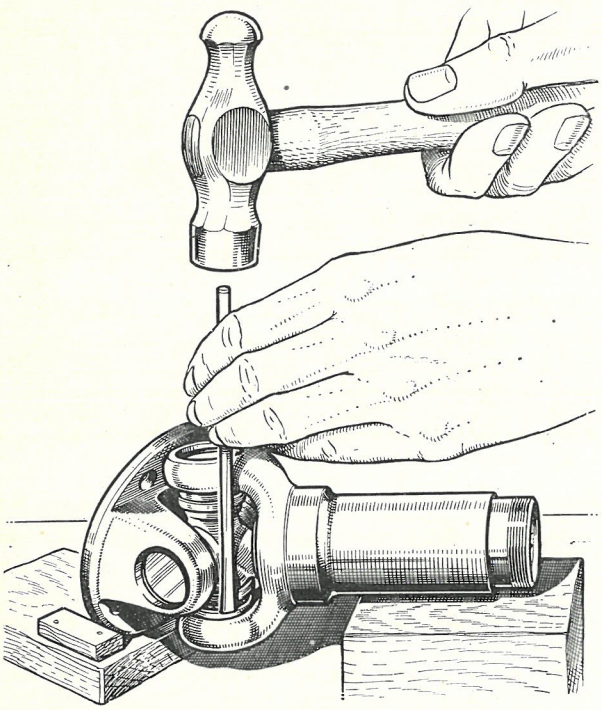


Fig. G.4.
When dismantling the universal joint it is permissible to tap out the bearings with a small diameter rod from the inside as shown, provided care is taken not to damage the roller race.

fill with grease. Should difficulty be experienced in retaining the rollers under control, smear the walls of the races with grease to Ref. D (page P.2) 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

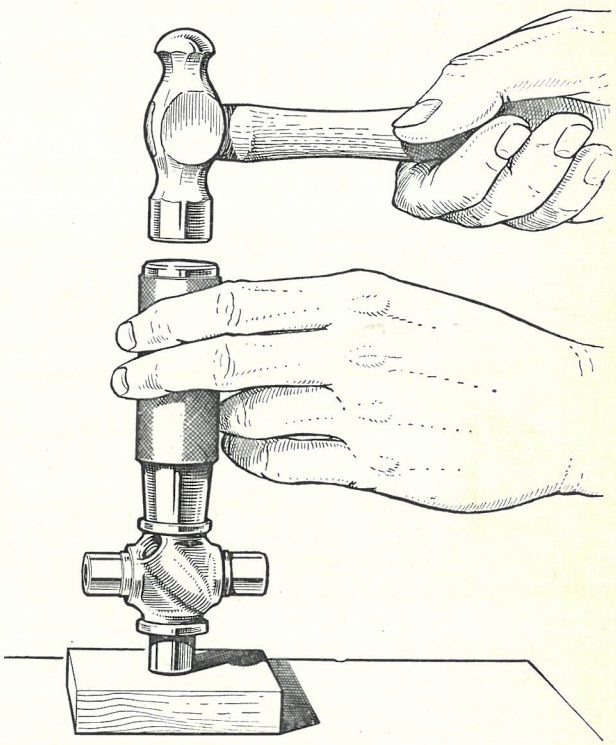


Fig. G.5.
When replacing the gasket retainer, use should be made of a hollow drift to tap it into place without damage.

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, the felt washer, and grease the splines well with grease to Ref. D (page P.2). 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 of the tubular drift shown in Fig. G.5. 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 place the propeller shaft in position on the chassis. Ensure that the flange registers engage correctly and that the joint faces bed down evenly all round, also that the markings made on the flanges on removal coincide. Insert the bolts and see that all nuts are evenly tightened. The sliding joint is always placed at the gearbox end, and it is essential that the axis of each forked yoke is in the same plane or parallel to the other as shown in Fig. G.6.

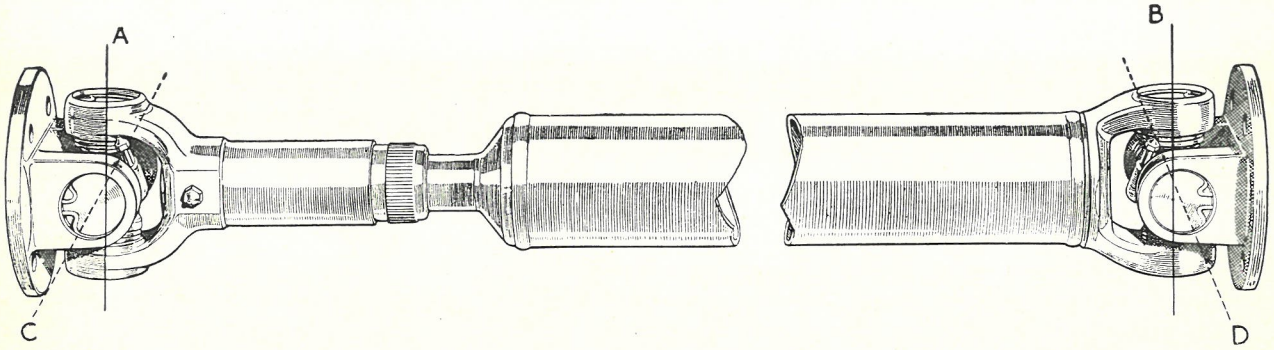


Fig. G.6.
The correct method of assembling the universal joints.

When the splined shaft is assembled to the drive shaft it is essential to see that the axis of each forked yoke is parallel to the other. In other words, the yoke axis (A) must be in alignment with the yoke axis (B), and the flange yoke axis (C) must be in alignment with the flange yoke axis (D).

NOTE

The thread of the grease nipples used on the propeller shaft of early models is $\frac{1}{8}$ in. B.S.P. On later models nipples having a $\frac{1}{4}$ in. A.N.F. thread are fitted. It is therefore essential to ensure that correct nipples are fitted should they be renewed at any time.

SECTION H

THE REAR AXLE

General Description.

Lubrication.

Section No. H.1 Removing and replacing brake-drum and hub.

Section No. H.2 Removal and replacement of brake plate assembly.

Section No. H.3 Removing and replacing a rear axle half-shaft.

Section No. H.4 Removing the rear axle from car.

Section No. H.5 Important points concerning axle attention.

Section No. H.6 Dismantling the axle and removing the differential assembly.

Section No. H.7 Dismantling the differential and crown wheel assembly.

Section No. H.8 Examining parts for wear.

Section No. H.9 To replace a differential cage.

Section No. H.10 Assembling differential and crown wheel.

Section No. H.11 To replace pinion.

Section No. H.12 To fit a new axle casing.

Section No. H.13 To fit a new axle housing cover.

Section No. H.14 To replace a crown wheel and pinion having markings different to the original.

Section No. H.15 Reassembling the axle.

Section No. H.16 Refitting the axle to the car.

Section No. H.17 Reduced axle ratios.

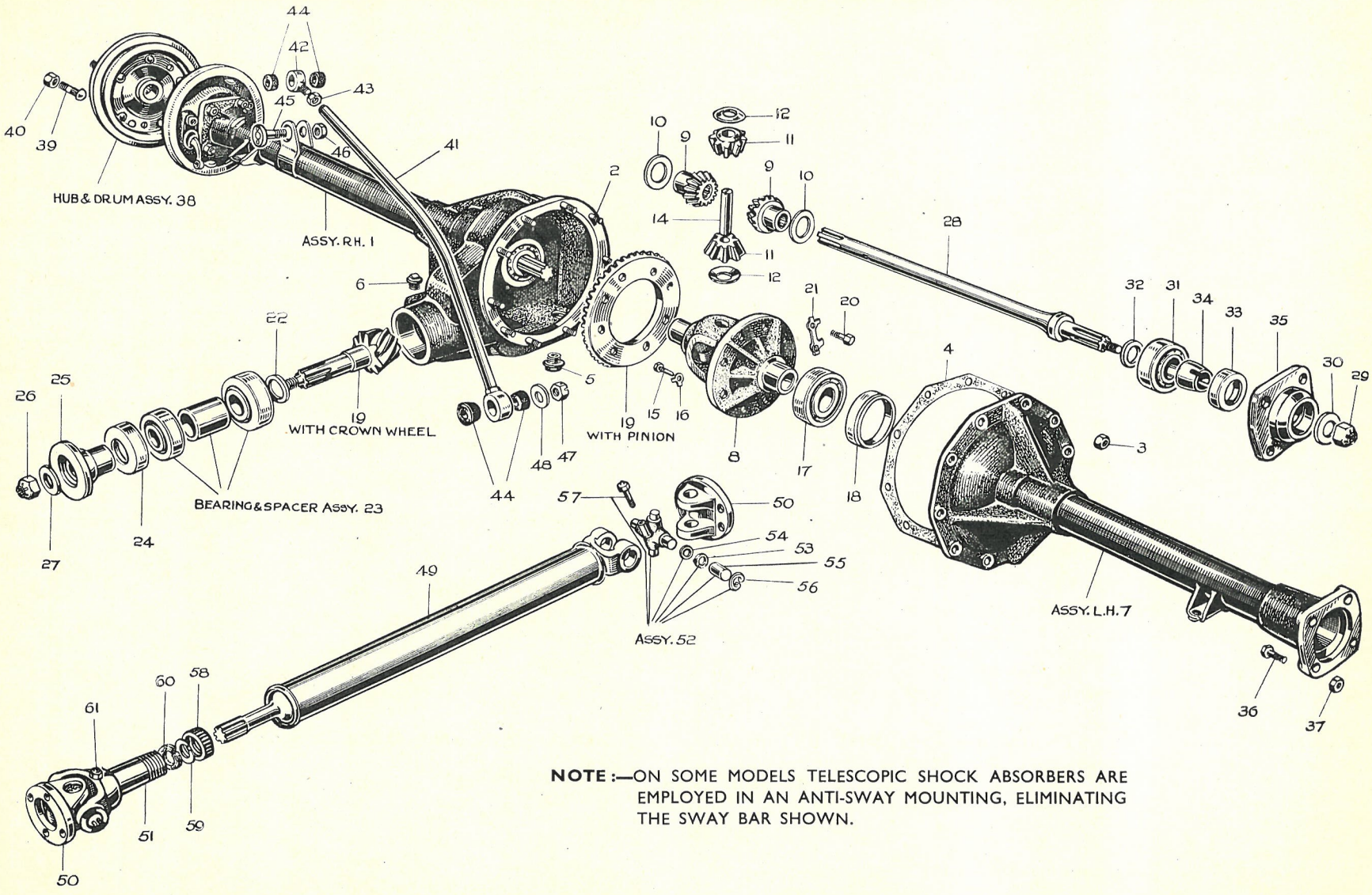
GENERAL DESCRIPTION

The rear axle is of the semi-floating type. It is of unit construction and no repairs or adjustments apart from those connected with the half-shafts and rear wheel bearings, brake-drums and shoe mechanism can be carried out without removing the complete axle unit from the car.

The rear wheel bearing outer races are carried in an extension of the rear axle casing and the inner races bear directly on the axle half-shafts. The wheel hubs are attached to the axle shafts by splines and a tapered split collar.

Contrary to previous Morris practice, the axle half-shafts can only be withdrawn after removing the wheel, wheel hub and brake-drum, brake back plate assembly and the wheel bearing housing.

THE REAR AXLE AND PROPELLER SHAFT COMPONENTS



NOTE:—ON SOME MODELS TELESCOPIC SHOCK ABSORBERS ARE EMPLOYED IN AN ANTI-SWAY MOUNTING, ELIMINATING THE SWAY BAR SHOWN.

KEY TO THE REAR AXLE AND PROPELLER SHAFT COMPONENTS

No.	Description
1.	Axle tube and casing assembly—R.H.
2.	Stud.
3.	Nut—axle cover stud.
4.	Joint—casing to cover.
5.	Plug—axle drain.
6.	Plug—axle filler.
7.	Axle tube and cover assembly—R.H.
8.	Cage—differential.
9.	Gear—differential.
10.	Washer—gear.
11.	Pinion—differential.
12.	Washer—pinion.
14.	Pin—pinion.
15.	Bolt—pinion pin lock.
16.	Tab washer—pin lock bolt.
17.	Bearing—differential.
18.	Distance collar—bearing.
19.	Crown wheel and pinion.
20.	Bolt—crown wheel to cage.
21.	Locking tab—crown wheel bolt.
22.	Distance-piece—pinion rear bearing.
23.	Bearings and spacer assembly.
24.	Oil seal—pinion—front.
25.	Flange—universal joint.
26.	Nut—flange to pinion.
27.	Washer—flange nut.
28.	Axle shaft.
29.	Nut—shaft.
30.	Washer—shaft nut.
31.	Bearing—hub.
32.	Distance washer—hub bearing.
33.	Oil seal—bearing.
34.	Collar—oil seal.
35.	Support—brake plate
36.	Bolt—support.
37.	Nut—support bolt.
38.	Hub and brake-drum.
39.	Wheel stud.
40.	Nut—wheel stud.
41.	Sway bar.
42.	Eye—sway bar.
43.	Locknut—eye.
44.	Bush (rubber)—sway bar.
45.	Pin—eye to axle bracket.
46.	Nut—eye pin.
47.	Nut (slotted)—to frame.
48.	Washer—to frame.
49.	Tubular shaft with stub shaft and ball yoke.
50.	Flange yoke.
51.	Sleeve yoke.
52.	Journal and needle kit set.
53.	Gasket—journal.
54.	Retainer—gasket.
55.	Bearing assembly.
56.	Snap ring.
57.	Lubricator.
58.	Dust cap.
59.	Washer—steel.
60.	Washer—cork.
61.	Greaser.

The brake-drums are of cast iron and permanently attached to the wheel hub flanges by countersunk-headed screws, which must not be disturbed.

Hypoid-type final reduction gears are used and the axle housing is divided close to its centre for assembly purposes, the pinion assembly being mounted in the right-hand half or axle casing.

The bearings of the differential and crown wheel assembly are carried in recesses machined in the axle casing and cover, which are bolted together, and, since no inspection apertures are provided, **all adjustments have to be carried out by pre-measurement in conjunction with special gauges.**

Adjustment of the position of both the crown wheel and the pinion in the axle is effected by distance-pieces, which are selected on initial assembly, and there is no other provision for adjustment. The crown wheel and pinions are only supplied in pairs as heretofore.

The use of Hypoid gears enables a much larger pinion to be used, providing more silent running and a greatly increased life.

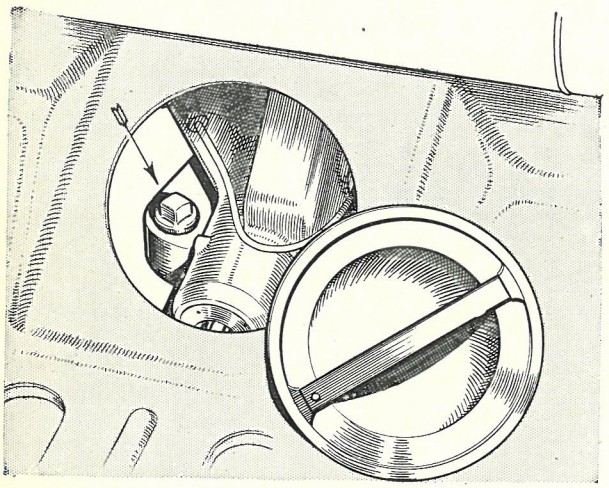


Fig. H.1.
Access to the rear axle oil filler is achieved through the opening in the rear seat pan closed by the circular cover-plate.

The rear brake gear is of the normal two-shoe type operated hydraulically from the brake pedal and also mechanically by hand-operated mechanism actuating the same shoes. The operating cylinder for the shoes is mounted vertically on the brake plates and acts directly on the brake-shoes.

Adjustment is by means of a serrated snail cam with screwdriver operation through holes in the brake-drum disc.

Suspension is by means of semi-elliptic leaf springs with rubber interleaving and rubber mounting. The shackles and the spring anchorage are both fitted with flexing rubber bushes needing no lubrication.

LUBRICATION

Oil is introduced to the axle through a filler plug on the right-hand side of the pinion housing. When replenishing or refilling, the level of the oil should not be raised above the lip of the filling aperture.

It is of the utmost importance that only HYPOID oils of the approved grades and manufacture be employed if satisfactory service is to be obtained from the Hypoid gears.

Inspect the oil level every 1,000 miles (1600 km.) and replenish if necessary to the level of the filler opening with Hypoid oil to Ref. B (page P.2).

After the first 500 miles (800 km.) and subsequently every 6,000 miles (10000 km.) drain off the old oil and refill with new.

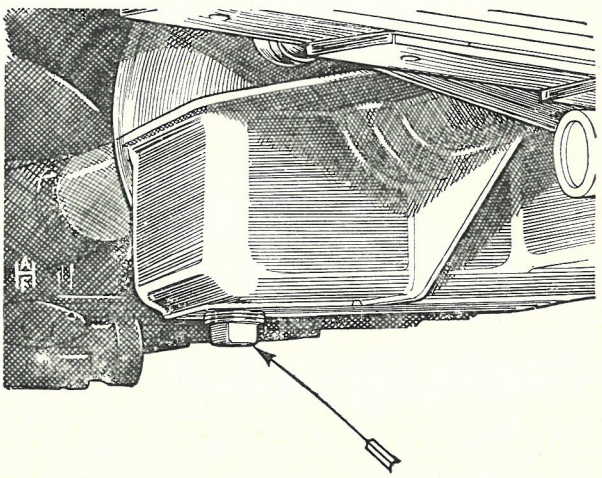


Fig. H.2.
The rear axle drain plug is situated in the base of the axle casing.

The drain plug is underneath the rear end of the axle casing. The capacity of the axle is $2\frac{1}{2}$ pints (1·4 litres).

Lubrication of the rear hub bearings is achieved automatically from the main oil supply and no provision is made for any other attention.

Section H.1

REMOVING AND REPLACING THE BRAKE-DRUM AND HUB

The brake-drums are permanently attached to the wheel hubs by countersunk-headed screws, the inner ends of which are riveted over. **These screws should not be disturbed, and if it is necessary to fit a new drum or hub a complete assembly should be used as the hubs and brake-drums are machined after assembly. On some models the hub and brake-drum are a single casting.**

Jack up the axle so that the wheel to be operated on is clear of the ground, and place chocks on either side of the wheels remaining on the ground. **Release the hand brake fully—THIS IS IMPORTANT.**

Remove the road wheel by prising off the hub cover with the flat on the end of the wheel nut spanner, giving the spanner a sideways motion and **not** a radial one. The spanner end should be inserted in the depressions provided adjacent to the studs holding the cover.

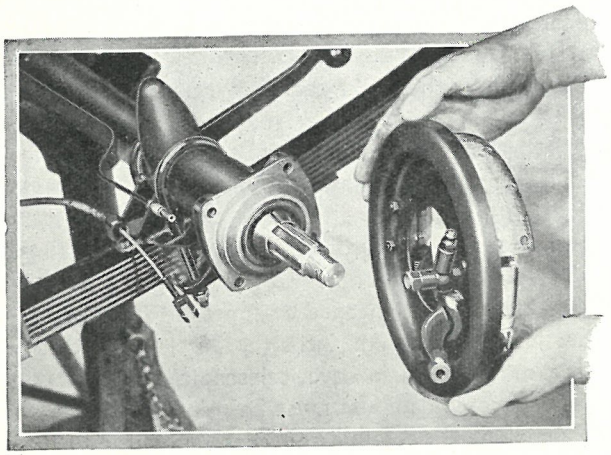


Fig. H.3.
Removing the brake plate assembly from the axle casing flange.

Unscrew the wheel stud nuts and withdraw the wheel.

Remove the split pin from the axle nut and unscrew the nut with a set spanner. The axle half-shafts are threaded right-handed on both sides of the car and are therefore interchangeable.

The wheel hub is locked to the axle half-shaft by means of a tapered split collar in addition to the driving splines. It is therefore to be expected that some resistance will be evident when the extractor is used to free the hub from the taper. (Special Tool, Part No. 68822.)

When replacing the rear hub it is essential to make quite sure that the tapered split collar is right home against the inner race of the wheel bearing before any attempt is made to offer up the hub. It is, in fact, advisable to tap the collar lightly into position with a hide hammer, taking the utmost care not to damage it in any way. It is also essential to see that the parallel portion of the collar engaging the oil seal is absolutely free from blemishes before it is replaced, and that the oil seal is not damaged in any way.

Section H.2

REMOVAL AND REPLACEMENT OF BRAKE PLATE ASSEMBLY

Jack up the axle and remove wheel as in Section H.1. **See that the hand brake is fully released.**

Remove the hub as in Section H.1.

If it is required to remove the brake plate assembly to the bench for attention, the Lockheed pipe should be disconnected, but this is not recommended unless absolutely necessary as it entails bleeding the brakes.

The brake plate assembly is attached to the axle flange by four bolts with the nuts fitted on the inner side of the flange. Removal of the nuts enables the bolts to be withdrawn and the brake plate assembly to be removed.

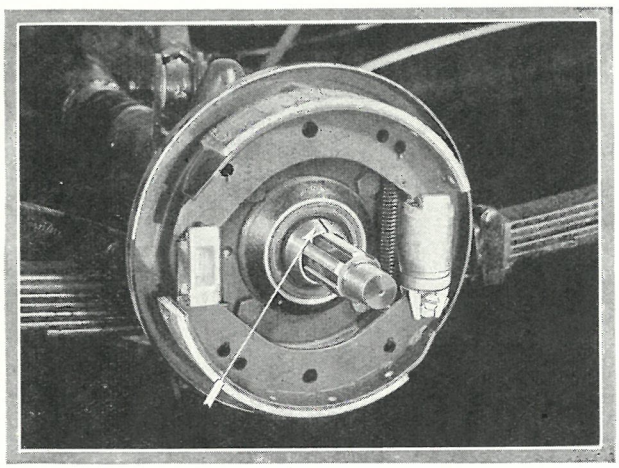


Fig. H.4.
When refitting the rear hubs it is absolutely essential to make sure that the split tapered collar is right home against the ball race and perfectly clean.

Reassembly takes place in the reverse order to dismantling and it is essential to make sure that the retaining nuts are screwed up tight.

Do not forget to bleed the brakes if the pipeline has been disconnected.

Section H.3

REMOVING AND REPLACING A REAR AXLE HALF-SHAFT

Jack up the axle as outlined in Section H.1, or raise the rear of the car with a sling attached to the bumper supports.

See that the hand brake is fully released.

Remove the hub and brake-drum assembly as in Section H.1.

Remove the brake plate and shoe assembly as in Section H.2.

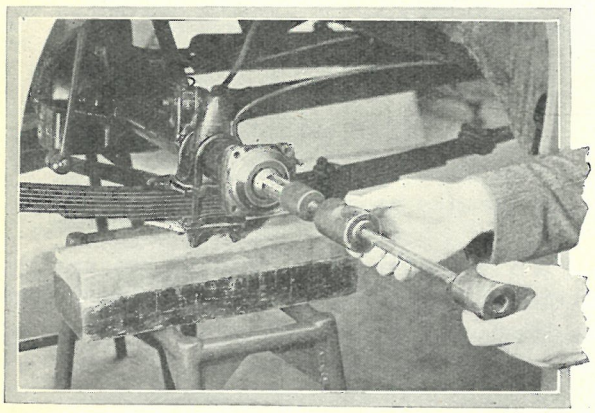


Fig. H.5.
The special impulse extractor (Part No. 68823) in use to withdraw the axle shaft and bearing.

Withdraw the split collar from the axle half-shaft.

Screw one end of the special impulse extractor (Part No. 68823) onto the axle half-shaft and tap the outer end of the extractor with the sliding bob weight, when the shaft, complete with bearing, housing and oil seal, should come away.

The half-shaft can then be pressed out of the bearing.

Reassembling is a reversal of the foregoing.

When replacing an oil seal in the wheel bearing housing see that the sealing edge of the bore is towards the bearing. It should be a good press fit in the axle end cap.

Do not forget to see that the split collar is perfectly clean and free from blemish, particularly on its parallel portion, and pushed well home against the bearing inner race before replacing the wheel hub. It is advisable to tap it lightly into contact with the axle bearing with a hide hammer, taking the utmost care not to damage it in any way in the process.

Section H.4

REMOVING REAR AXLE FROM CAR

Raise rear of car by means of a suitable sling attached to the bumper supports.

Remove the road wheels and release the hand brake.

Disconnect the Lockheed flexible pipe at its junction to the bracket on the underside of the body floor. (See Section M.13.)

Disconnect the brake cable casings from their anchorage to the spring brackets by removing the retaining nut and spring washer.

Disconnect the brake cables by removing the clevis pin attaching the forked yoke to the brake-shoe actuating lever on the brake plate.

Disconnect the anti-sway bar from its attachment to the right-hand side of the axle casing by removing the nut and retaining bolt. Note that the bolt head has two pin spanner holes to hold it against rotation while the nut is tightened or loosened (Special Tool, Part No. 68965). An anti-sway bar is not fitted to later models which have telescopic rear dampers. The telescopic dampers must be released at each end by removing the retaining nut, flat washer, and rubber bushes, before the rear spring shackles are disconnected.

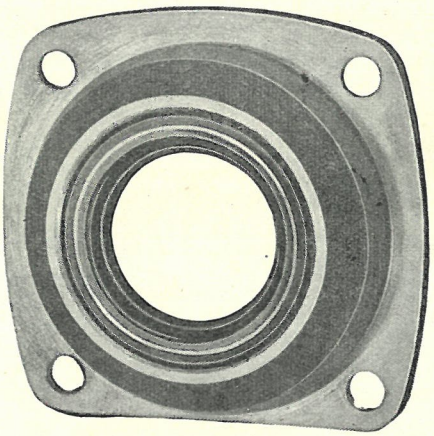


Fig. H.6.
The correct way round for the axle hub oil seal is with its sealing edge facing towards the bearing.

Disconnect the shock absorber arms on early models at their junction to the body by removing the retaining nut and split pin.

Support the rear axle on a suitable stand.

Mark the propeller shaft coupling flanges so that they are replaced in the same relative positions.

Uncouple the propeller shaft at the rear flange by unscrewing the four coupling nuts and bolts. Support the tail end of the propeller shaft through the aperture, below the rear seat, giving access to the rear axle oil filler.

Remove the rear shackle nuts and bolts.

Remove the spring front anchorage bolts after removing the retaining nuts and spring washers.

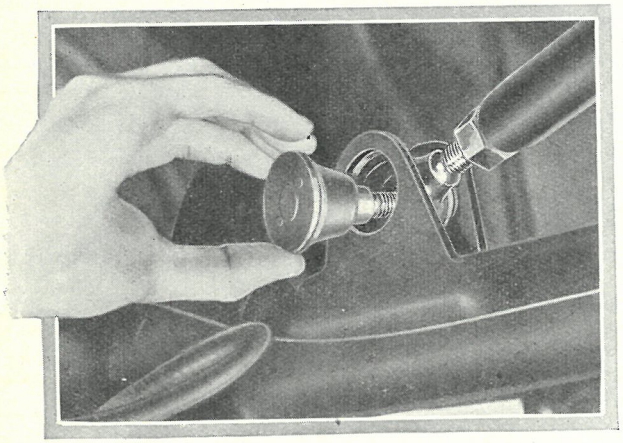


Fig. H.7.
Removing the anchorage bolt for the anti-sway bar from its lugs on the axle casing.

These bolts have pin spanner holes in their heads to permit them to be held against rotation while loosening or tightening up the nuts.

The axle is now free to be withdrawn rearwards from the car on the stand.

you are equipped with the necessary checking gauges and a full range of distance-pieces and spacers from which to select the required new sizes. The fitting of a replacement axle, when possible, is advised.

Dismantling for examination and cleaning is permissible provided care is taken to refit the distance-pieces and spacers in exactly the same locations.

No adjustment is provided in the accepted sense. The crown wheel and pinion are set in their correct relation to each other by means of distance-pieces and spacers selected to provide the correct location of the components on initial assembly. Should the components be dismantled, their relative positions should be carefully observed and each part marked suitably so that it can be reassembled correctly in its original position.

Various components can be replaced by correctly combining the markings on the original components against those on the new parts in the manner detailed in subsequent sections.

It is important that the repairer be quite clear on this point before he undertakes the dismantling of the axle.

Spacers between the outer races of the differential

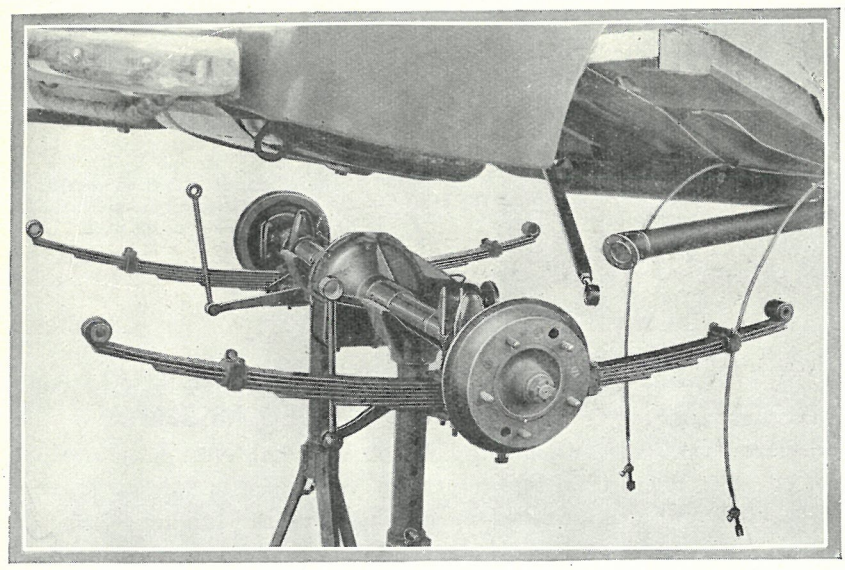


Fig. H.8.
The axle, complete with springs, disconnected from the car and supported on a suitable stand for removal.

Section H.5

IMPORTANT POINTS CONCERNING AXLE ATTENTION

Attention requiring the dismantling of the axle and the replacement of parts is not advised unless this is absolutely necessary and unless

bearings, and faces of the recesses machined in the axle casing and cover, control the position of the crown wheel in relation to the centre line of the pinion.

Adjustment of the pinion position is made by varying the thickness of the pinion washer, and that of the crown wheel by the varying thickness of the differential bearings spacers.

The following operations are possible without the use of special tools :—

(*a*) To replace a crown wheel and pinion with a pair carrying markings which are identical to the originals.

(*b*) To replace a crown wheel bearing alone, since these are of the controlled-width type, provided genuine **Morris** replacements are used.

(*c*) To replace an axle cover which carries markings identical to the originals.

The following replacements are possible by calculations alone :—

(*d*) To replace the differential cage by one carrying a different marking to the original.

(*e*) To replace an axle cover carrying different markings to the original.

The following replacements can be carried out by calculation and the use of special tools :—

(*f*) To replace an axle case carrying different markings to the original.

(*g*) To replace a crown wheel and pinion carrying different markings to the originals.

(*h*) To replace bearings to the pinion shaft.

Operations (*a*), (*b*) and (*c*) merely call for the fitting of the new parts in the positions occupied by the old. The remaining operations entail special precautions and are detailed subsequently.

The axle or half-shafts, rear hub bearings, brake-drums and shoe mechanism can all be dismantled and replaced with the axle in position on the car.

Section H.6

DISMANTLING THE AXLE AND REMOVING THE DIFFERENTIAL ASSEMBLY

Remove the axle from the car as detailed in Section H.4.

To dismantle the axle, first remove the hub and brake-drum assemblies as in Section H.1, and the brake plates as in Section H.2.

Remove the axle half-shafts and bearing housings as detailed in Section H.3.

Remove the series of bolts joining the axle casing and cover together and carefully part them, taking care to see that both halves of the axle are suitably supported to avoid damage to the differential assembly.

The withdrawal of the axle cover from the casing releases the differential and crown wheel assembly, which can now be withdrawn.

Note that spacers are fitted between the differential bearings and the bearing housings and that they are important as they control the position of the differential assembly in the axle.

It is essential that they be replaced in their original locations on assembly, so make a note of the positions from which they are removed.

Note.—*All original spacers are marked o/s and n/s.*

It must also be noted that the axle casing and cover are marked on the surface of one of the outside webs or tubes with one of the following figures :—Zero, 1, 2, 3, 4, 5, 6, all being positive.

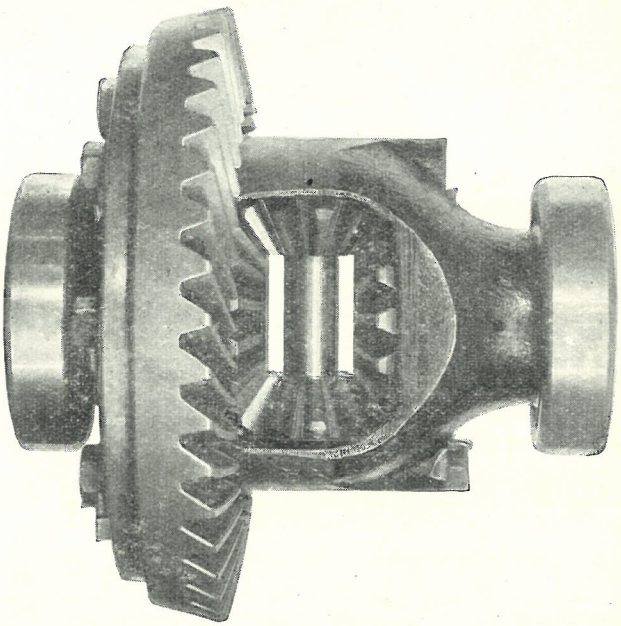


Fig. H.9.

The differential and crown wheel assembly with the ball races in position on the differential cage. The bolt locking the shaft for the differential pinions is clearly seen at the lower right-hand corner of the cage.

Section H.7

DISMANTLING THE DIFFERENTIAL AND CROWN WHEEL ASSEMBLY

When the differential assembly has been removed from the axle casing, as detailed in Section H.6, it is dismantled by bending back the locking washer tab of the bolt locating the differential pinion shaft, withdrawing the bolt and removing the shaft.

The differential pinions can now be removed from the differential cage by swinging them round with their dished thrust plates until they register with the openings in the differential cage, through which they can be removed together with their distance-piece.

The differential cage gears can then be withdrawn from inside the differential through the openings, together with their thrust washers.

The crown wheel is attached to the differential cage by bolts locked by lock plates. Bending back the tabs of the lock plates and removing the bolts releases the crown wheel from the differential cage.

Note.—*The crown wheels are marked on their back faces with one of the following figures* :—+2,+1, *Zero* (*or no marking*), —2, —1.

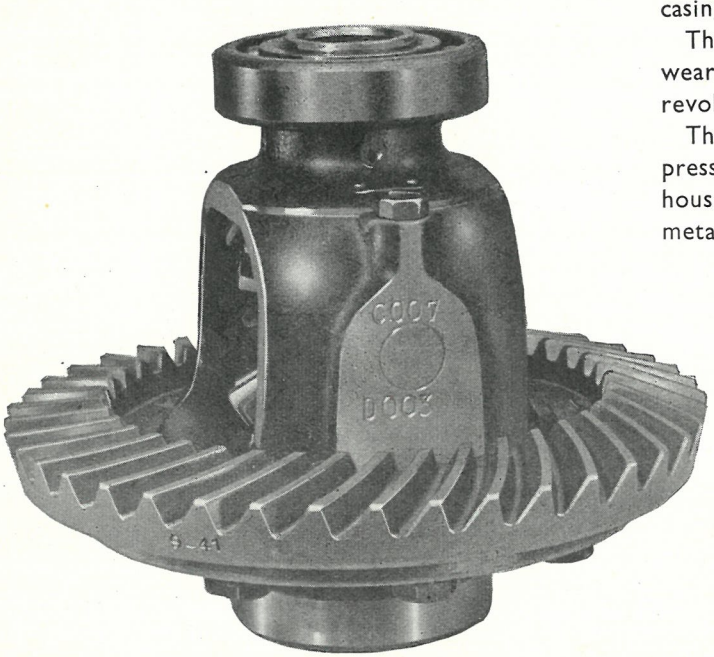


Fig. H.10.
The marking of the differential cage to indicate its assembly dimensions is clearly shown in this illustration, which bears a " C " dimension of ·007 and a " D " dimension of ·003.

Section H.8

EXAMINING PARTS FOR WEAR

Before examination all parts should be cleaned thoroughly.

The crown wheel bearings are of the ball type and should be renewed if necessary. They are controlled dimensionally and must only be replaced by **genuine Morris replacements.** Failure to observe this instruction will only lead to complications later.

The pinion shaft bearings are of the taper roller type and should be renewed, as a set, complete with distance-piece, if they do not run smoothly on their rollers.

The crown wheel and pinion are lapped in pairs.

It is essential, therefore, that crown wheels and pinions be stored and used in pairs as originally supplied, otherwise satisfactory results cannot be obtained.

If the inner races of the roller bearings are loose on the pinion, check with a new set of bearings, and if these are also loose on the pinion shaft it is an indication that the shaft has worn ; a new crown wheel and pinion should be fitted.

Fractures in the teeth, hollows or any roughness on the surface of the teeth will render both crown wheels and pinions unserviceable.

The axle casing or axle cover (or both) should be renewed if new replacement bearings are not a light drive fit in the bores machined in their housings. Any looseness of the bearings should be overcome by renewing the bearing, the axle cover or axle casing.

The cage should be replaced if there is excessive wear in the bores in which the differential gears revolve.

The oil seals should be renewed if they are not a press fit in the pinion housing or wheel bearing housing, or if their central portion is loose in the outer metal casing, or if the spring is fractured or broken.

The differential gears, pinions and pins should be renewed if there is any doubt about their condition, although more latitude in wear is permissible in these parts without detrimental effects than is the case with the crown wheel and pinion.

Section H.9

TO REPLACE A DIFFERENTIAL CAGE

Selecting an axle casing spacer

All differential cages are stamped with two letters—" C " and " D "—together with a figure. The prefix " C " indicates the dimension over the differential bearings, and the dimensional range is from 0 in. to ·012 in. " D " indicates the dimension from the crown wheel back face to the outside face of the right-hand bearing outer race, and the range is from 0 in. to +·006 in.

Differential cages can be interchanged by applying the following procedure :—

Balance the " D " dimensions of the two cages and from the result select differential bearing spacers which will produce the same final location of the crown wheel on assembly.

Example (1) If the " D " dimension of the old cage was ·005 in. and the " D " dimension on the new cage is ·002 in., giving a difference of +·003 in., then this difference must be **added** to the old spacer thickness.
That is to say, if the old spacer is marked ·503 in. the new spacer must be ·506 in. thick.

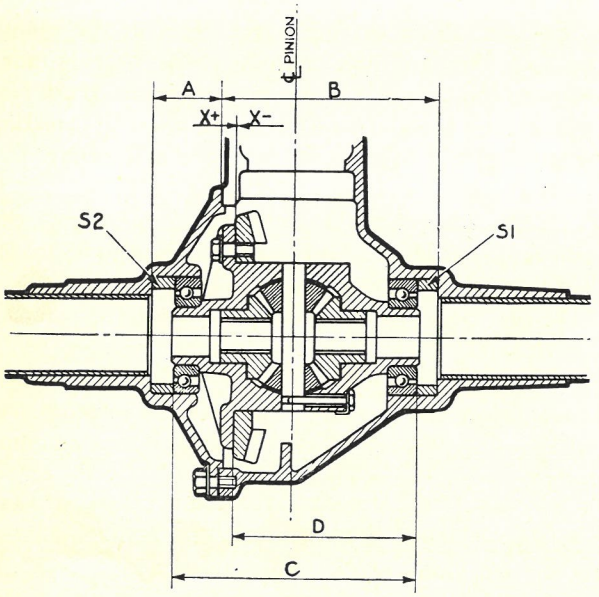


Fig. H.11.
This diagram indicates the significance of the " A," " B," " C," and " D " dimensions.

Example (2) If the " D " dimension of the old cage was ·001 in. and the " D " dimension on the new cage is ·005 in., giving a difference of —·004 in., then this difference must be **subtracted** from the original spacer thickness.
That is to say, if the old spacer was ·509 in. thick, then the new spacer must be ·505 in. thick.

Selecting an axle cover spacer

In this case subtract the " D " dimension from the " C " dimension on both the old and the new differential cages.

If the resultant of the dimensions on the new cage is greater than that on the old cage, the new spacer for the axle cover is less than the old one by the difference and vice versa.

Example (1) Old : " C " ·006 in. — " D " ·005 in.
= ·001 in.
New : " C " ·007 in. — " D " ·002 in.
= ·005 in.
The new resultant of the new cage is the greater by ·004 in., therefore the new spacer should be ·004 in. **less** in thickness than the old one.

Example (2) Old : " C " ·002 in. — " D " ·001 in.
= ·001 in.
New : " C " ·001 in. — " D " ·005 in.
= — ·004 in.
The old resultant is here the greater by ·005 in., therefore the new spacer must be ·005 in. thicker than the old one.

Section H.10

ASSEMBLING DIFFERENTIAL AND CROWN WHEEL

The differential is assembled by first inserting the differential gears inside the differential cage with their thrust washers in position.

Note.—*When new washers are fitted it is necessary to see that they are properly bedded in or it may be difficult to insert the pinions.*

The differential pinions are next inserted through the opening of the cage with their distance-pieces and thrust washers. The pinions are then rotated in the cage until they register with the holes in the cage for the shaft.

The pinion spindle, which should be a light push-fit in the cage, is then inserted, taking care to line up the locking bolt holes.

Note.—*The slot in the shaft can be used as a guide.*

Fit the locking bolt and turn up the tab of its locking washer.

Fit the crown wheel to the differential cage after making sure that the mating surfaces are perfectly clean and the edges free from burrs.

Check the crown wheel for truth by spinning the assembly on a roller fixture with a dial gauge registering against the outer edge of the crown wheel. The maximum permissible error of alignment is ·001 in. (·025 mm.), and if the figure registered is in excess of this the crown wheel should be removed from the differential cage and the flange of the cage checked for truth. If necessary, fit a replacement cage.

Provided the flange is true within the permissible error, clean all parts carefully and reassemble the crown wheel to the cage in a different position to that in which it was first assembled and checked, then re-check. This process should be repeated several times before finally deciding to discard the crown wheel and pinion.

The differential ball races can now be pressed on.

If a new crown wheel or differential cage has been fitted it is essential to measure the " C " dimensions over the outer ball races, and " D " dimensions from the crown wheel back face to the right-hand bearing outer race outside face, and inform the Service Department at Cowley of the change of components, quoting the new dimensions so that the necessary modification can be made to the axle history card for future reference.

Section H.11

TO REPLACE PINION

(*a*) The old pinion in a new axle casing.
(*b*) New pinion and new matched set of bearings and distance-piece in an old casing.
(*c*) New pinion and old bearings and distance-piece in an old casing.

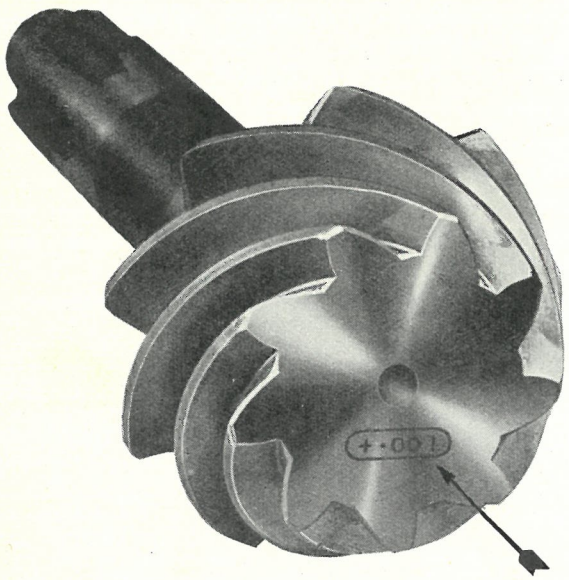


Fig. H.12.
The marking of the pinion to show its dimension for fitting is indicated by the arrow.

(*d*) Old pinion and new matched set of bearings and distance-piece in an old casing.

In all cases the pinion must be set accurately in the axle casing, remembering that the roller races and their distance-pieces are supplied in sets giving the correct amount of pre-load on assembly. They can, therefore, only be replaced as " sets " and not individually.

The pinions may be marked on their heads with one of the following figures :—

A ringed figure +2, +1, Zero (or no marking), —1, —2, and possibly an unringed figure —2, or —1.

The pinion washer controls the position of the pinion in relation to the axis of the crown wheel, and it is fitted between the head of the pinion and its rear bearing.

Adjustment of the pinion position is made by varying the thickness of the pinion washer. These are available in a range of thickness varying by ·001 in. (·025 mm.) and are marked on spares replacements only.

The pinion is fitted to the axle in the following way :—

Fit the pinion bearing outer races in the pinion housing, then assemble the rear pinion bearing inner race to the special dummy pinion spindle (Part No. 68892), and place in position in the housing, inserting it through the cover opening in the axle casing.

Fit the front bearing inner race.*

Fit the spindle nut and tighten it up to give the correct pre-load torsional resistance of 14 to 16 in./lb. (·161 to ·184 m./kg.) to the bearings.

Rotate the spindle eight or ten times to seat the bearings.

Fit the checking fixture (Part No. 68892) in the axle cover opening and make sure that the locating arm makes firm contact with the side of the dummy spindle head. (See Fig. H.17.)

This leaves a gap between the dummy pinion head and the checking anvil of the fixture, and this is the actual thickness of the pinion washer required for a standard pinion or one that has no marking.

Select a washer which will just slide between these faces and fit it behind the pinion head when reassembling.

To assist manufacturing conditions it is occasionally necessary that a pinion be assembled away from the standard position. If this is so the variation is marked on the pinion head in a ring such as (+2), the sign + meaning that the centres are increased by ·002 in. Correction has to be made for this, and when the figure is + (plus) the amount must be **taken from** the washer thickness, and if the figure is — (minus), then the amount has to be **added** to the washer thickness.

Example (*a*) A washer fitting the gap of the dummy pinion with a marking of ·127 must be replaced by a washer having the marking ·129 when refitting a pinion with the marking —2 or —·002.

Example (*b*) A washer fitting the gap of the dummy pinion bearing the marking ·127 must be replaced by a washer marked ·125 when the pinion is marked +2 or +·002 on its head.

* NOTE.—The bearing spacer is omitted, because the correct pre-load can only be obtained with the bearing spacer in position if the universal joint flange is locked up tight. This is due to the calculated compression of the bearing spacer under this locking load.

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A plain or unringed figure may be marked on the pinion head in addition to a ringed figure, but this is only an indication of the variation of the pinion head thickness from standard and is always minus. It has no bearing on the pinion setting.

When the correct spacing washer has been decided upon, the actual pinion assembly can take place, **but the importance of making the measurements correctly must be appreciated, since it is impossible to check the adjustment when the axle is assembled.**

The actual pinion assembly is carried out by threading the selected pinion washer onto the pinion shaft, bevelled side against the pinion, and pressing on the rear roller bearing inner race with its largest diameter against the washer. This sub-assembly is then

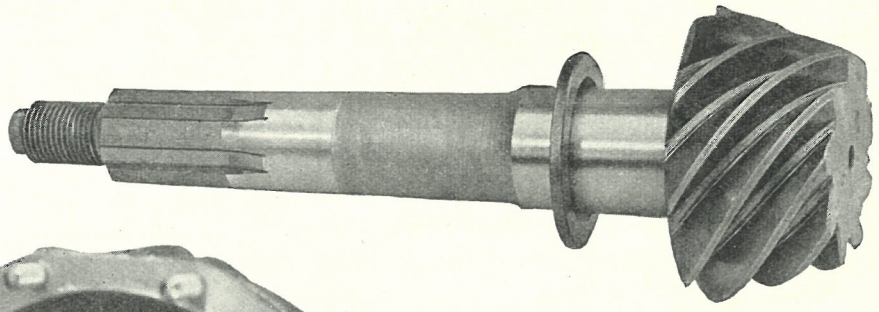

Fig. H.13.
The pinion and pinion spacing washer. Note that the bevelled side of the washer bore should be against the pinion.

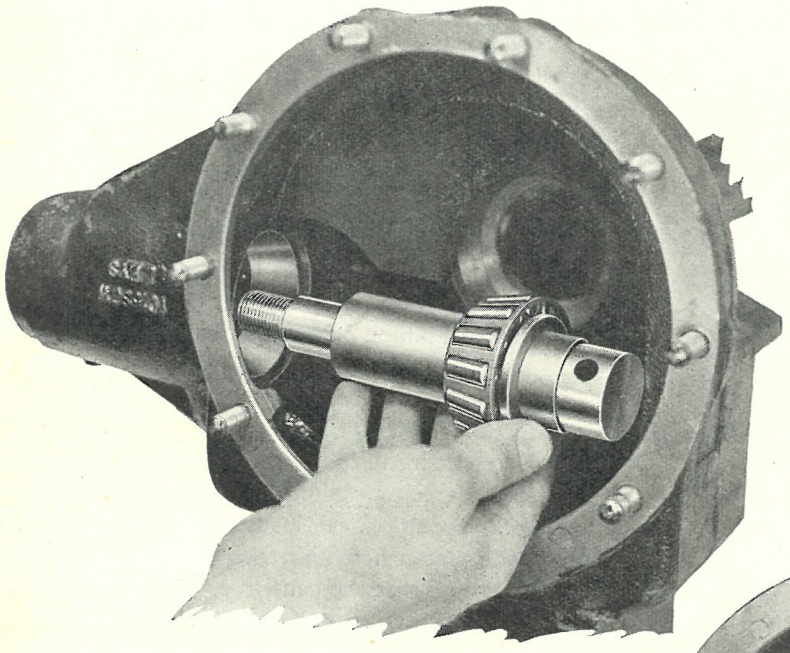

Fig. H.14.
Inserting the special dummy pinion shaft into the axle casing pinion housing.

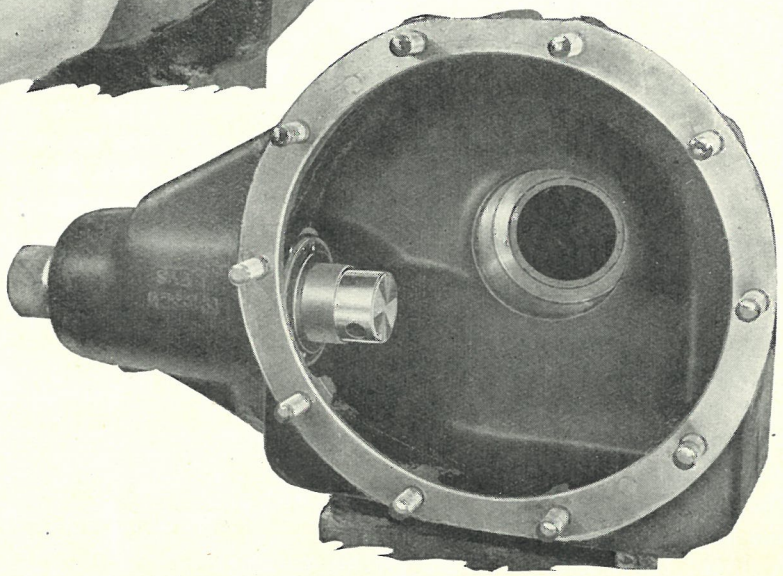

Fig. H.15.
The dummy pinion shaft in position in the housing. The ground head of the dummy shaft forms the datum for establishing the correct thickness for the spacing washer.

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inserted into the casing through the axle cover opening and located in position in the pinion housing of the axle casing.

The distance-piece and forward roller bearing inner race are next passed onto the pinion shaft, with the largest diameter of the inner race facing forward. These components are followed by the pinion flange with its retaining washer and nut. Tighten up the nut firmly.

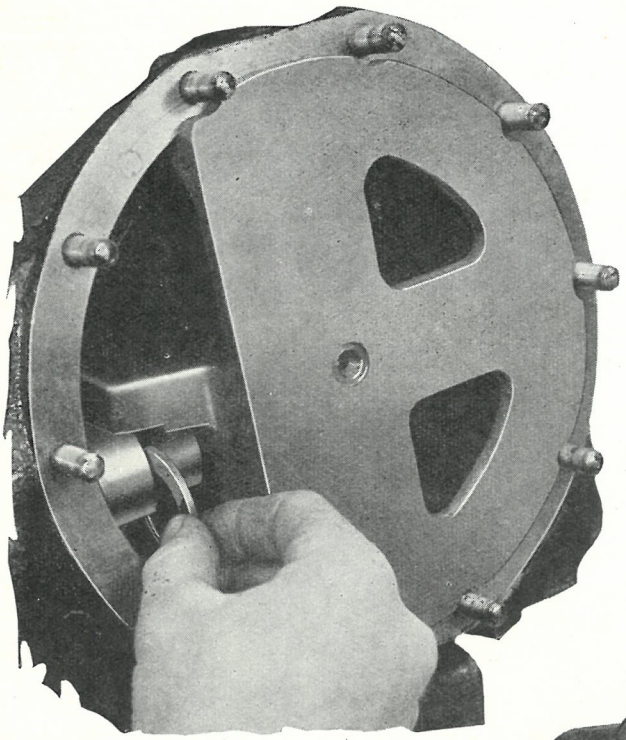


Fig. H.16.

(*Above.*) When the locating tongue of the special checking fixture is in contact with the head of the dummy pinion spindle the space between the head of the spindle and the anvil of the checking fixture determines the thickness of the pinion spacing washer.

Fig. H.17.

(*Right.*) The special checking fixture for determining the correct spacing washer thickness in position in the axle casing. Note that its locating tongue is making contact with the head of the dummy pinion spindle.

Rotate the pinion to ascertain that the correct degree of pre-load is present. The pinion should present the same resistance to rotation as was evident when using the special dummy spindle.

If the pre-load is correct, undo the nut and remove the washer and flange ; fit the oil seal (sharp edge of the bore towards bearing), replace the pinion flange, retaining washer and nut.

Finally tighten up the nut and fit the split pin.

Section H.12

TO FIT A NEW AXLE CASING

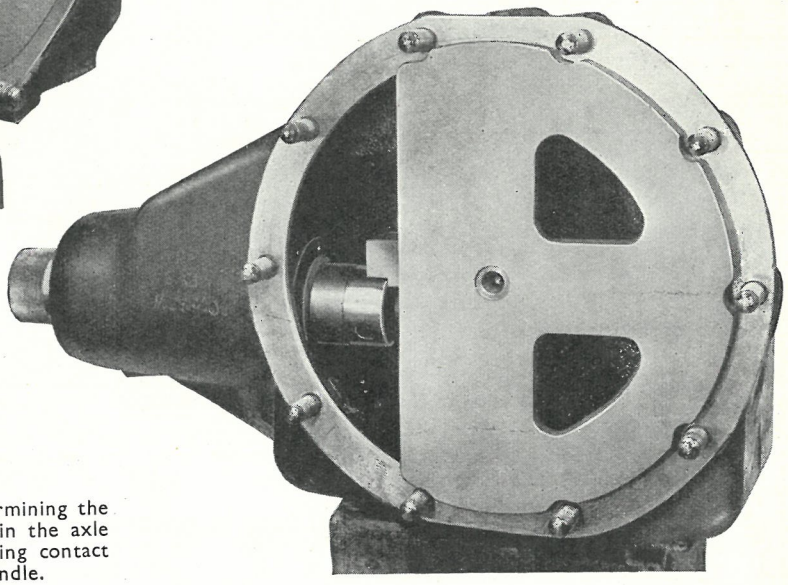
When a new axle case is being fitted it is necessary to refit the pinion as detailed in Section H.11, and select a new distance collar for the differential bearing in the manner here indicated.

Compensation for variations in the depth of the differential bearing bores is made by taking note of the markings on the old and new axle casings. For example :—

If the old casing is +·002 in. and the new one +·004 in., the positive difference ·002 in. is added to the existing differential bearing distance collar. That is to say, if the old distance collar is marked ·505 in., then the required new distance collar is ·507 in.

Similarly, if the old casing is +·005 in. and the new one +·001 in., the resulting difference is negative —·004 in. and must be subtracted from the bearing distance collar, i.e. if the old distance collar is ·509 in., the required new distance collar is ·505 in.

The distance collars are manufactured in steps of ·001 in. and measurements should therefore be made to the nearest thousandth of an inch.



Section H.13

TO FIT A NEW AXLE HOUSING COVER

When a new axle cover is being fitted it is not necessary to make any adjustment to the pinion.

Compensation must, however, be made for variations in the depth of the differential bearing housing

in the same manner as that outlined for the axle casing in Section H.12, and the same calculations for the selection of the required new distance collar for the differential bearings involved.

Section H.14

TO REPLACE A CROWN WHEEL AND PINION HAVING MARKINGS DIFFERENT TO THE ORIGINAL

Note.—The crown wheels and pinions are manufactured in matched pairs and are not replaceable individually but only in pairs. The necessity for replacing either a pinion or crown wheel therefore necessitates the fitting of a new pair of components, and the operations of fitting a new pinion and a new crown wheel are involved.

The crown wheels are marked on their back faces with one of the following markings : +2, +1, Zero (or no marking), —1 and —2.

Read off the marking from the back face of the old crown wheel and note the difference between this and the marking on the new crown wheel.

For example : If the old one is marked —1 (—·001 in.) and the new one +2 (·002 in.), the dimensional difference is +·003 in. To reassemble correctly it is thus necessary to fit a new distance collar in the axle casing which is ·003 in. **thicker** than the old one, and a new one ·003 in. **thinner** than the old one in the axle cover.

Note that the **combined** thicknesses of these distance collars must remain the same.

The setting of the pinion is carried out as indicated in Section H.11.

Section H.15

REASSEMBLING THE AXLE

Provided that no replacement parts are fitted, the assembly of the axle is quite straightforward if proper note is taken of the positions of various distance-pieces, washers and spacers on dismantling, and they are replaced in exactly their original locations.

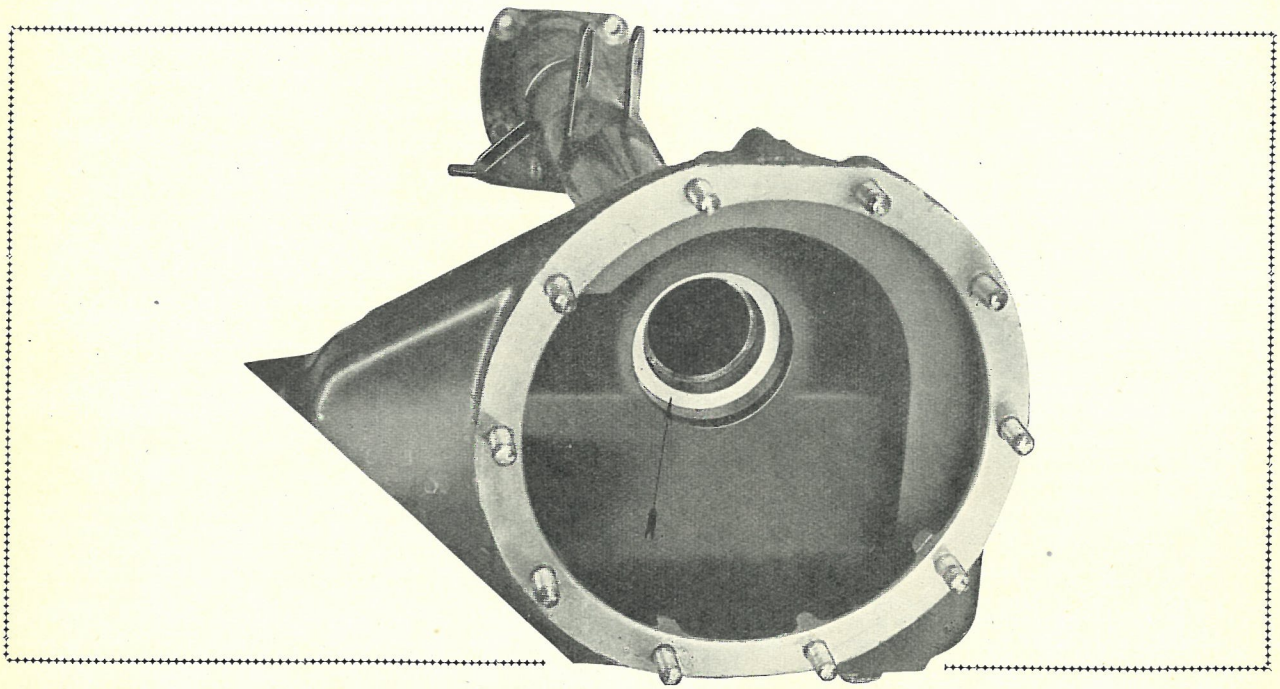


Fig. H.18.
The location of the pinion bearing spacer in the axle casing is indicated by the arrow.

Assembly of the differential and crown wheel is described in detail in Section H.10.

Assembly of the pinion housing is given in detail in Section H.11.

The assembly of the axle cover to the axle casing is carried out with a gasket between their joint surfaces. The calculations made for adjustment provide for the thickness of the gasket, but it is important that a genuine Morris replacement is used. (Thickness of gasket ·005 in. (·125 mm.) when compressed.)

The differential assembly should be assembled in

the axle casing, making sure that its bearing in the axle casing is right home in its housing and that a gasket is in position on the joint surface. The axle cover is then placed in position over the axle casing and carefully pushed home till the joint faces are in contact.

The ten nuts fastening the halves of the axle housing together are then screwed lightly in position and finally tightened up a quarter of a turn at a time in a diagonal sequence to ensure even tightening and absence of distortion.

The brake plates are refitted in the manner described in Section H.2. The axle half-shafts are refitted in the manner described in Section H.3. The hub and brake-drum assemblies are refitted as in Section H.1.

Make sure that the pinion, differential and axle half-shafts are free from undue restriction before replacing the axle in the car.

The shackle bolts and front anchorage bolts should be tightened with the car loaded to its normal running condition resting on the springs to allow the bushes to deflect equally on each side of the neutral position and avoid the overstressing which will occur if the spring bolts are tightened with no load on the springs and the deflection is all in one direction.

Attach the anti-sway bar to the bracket on the axle, on cars so fitted, using a pin spanner (Special Tool No. 68965) on the head to prevent it from turning while the nut is being tightened up.

A rubber bush is fitted at this attachment, and it should be replaced if it shows signs of wear.

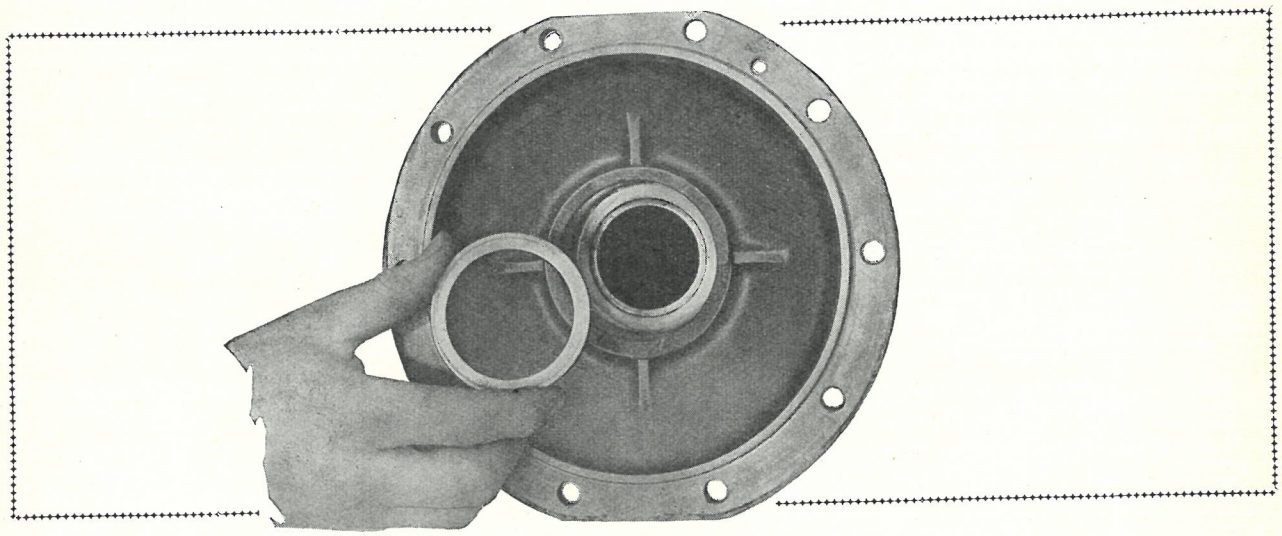


Fig. H.19.
The differential bearing spacer for the axle cover and its recess in the cover.

Section H.16

REFITTING THE AXLE TO THE CAR

The assembled axle is replaced in the car by raising the rear end sufficiently to enable the axle to be wheeled into position, preferably on a suitable stand.

Couple up the front ends of the springs to the brackets, making sure that the two flexing rubber bushes are in each spring eye and not worn. The circular head of the bolt is towards the inside of the car.

Couple the rear ends of the springs to the rear shackles, making sure that the flanged rubber bushes are in good condition before fitting.

Attach the propeller shaft to the axle pinion flange, taking care that it is fitted correctly so that the universal joint forks at either end of the propeller shaft are in line with one another (see Fig. G.6).

If the flanges have been marked on dismantling as indicated in Section H.4, this will present no difficulty.

Refit the shock absorber arms to the anchorage bolts.

On models fitted with telescopic dampers the rubber attachment bushes for the dampers should be checked for wear. Worn bushes should be replaced.

Couple the Lockheed brake flexible pipe to its union at the body bracket.

Attach hand-brake-cable forked yokes to the shoe-actuating levers at the back of the brake plates and attach brake-cable casing stops to the spring brackets.

Bleed the brakes as indicated in Section M.3.

Fit the road wheels and lower the car.

Fit the plated wheel covers.

Section H.17

REDUCED AXLE RATIOS

Commencing with car No. SMS 9537 (home) and SMS 6405 (export) a rear axle with a ratio of 9/41 (4·555) has been fitted instead of the original ratio of 10/41 (4·1).

The reduction of the rear axle ratio naturally affects the speedometer drive in the gearbox.

All cars with the 9/41 ratio are therefore fitted with speedometer drive gears having a ratio of 6/13 and all cars with the 10/41 axle ratio are fitted with speedometer drive gears having a ratio of 9/17.

In cases where the special low ratio axle with the 8/41 pinion and crown wheel is fitted the speedometer drive gears Part Nos. 162566 and 162567 must be used.

The following cars prior to SMS 9537 were also fitted with 9/41 ratio axles.

Home	Export
9534 to 9535	6399
8837	6400
8918	6264
	6323

The following cars subsequent to SMS 9537 were **NOT** fitted with the lower ratio but retain the 10/41 ratio.

Home	Export
9576	6412
9592	6416
9593	6417
9604	
9610	
9611	
9616 to 9622	
9629	
9630	
9656	

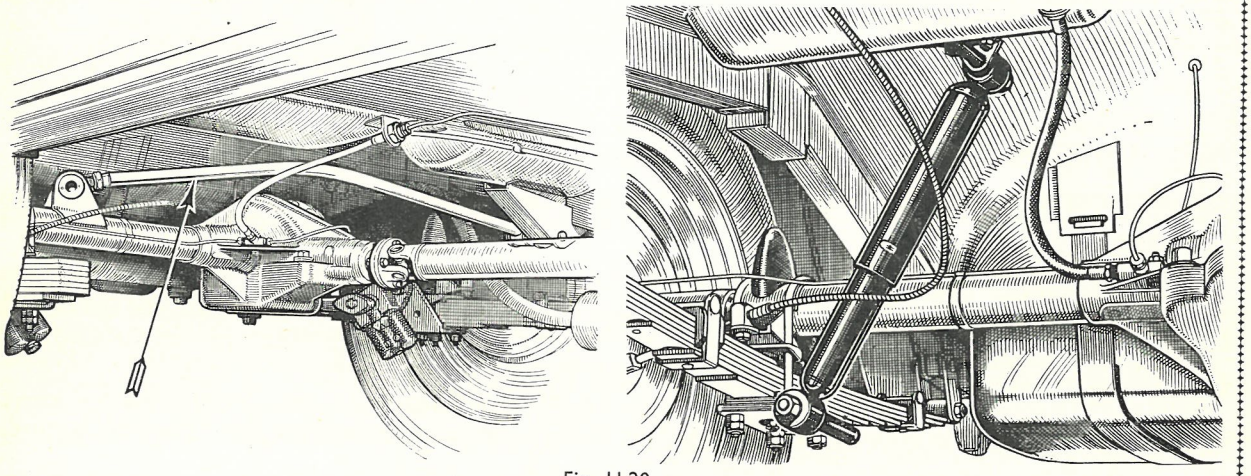


Fig. H.20.

The rear axle is provided with an anti-sway bar mounted in flexing rubber bushes at both ends. Some models are fitted with Woodhead-Monroe shock absorber with anti-sway mountings which eliminate the need for the sway bar.

SECTION I

THE REAR ROAD SPRINGS

General Description.

Section No. I.1 Removal and replacement of the rear springs.

Section No. I.2 Dismantling and reassembling the springs.

Section No. I.3 Maintenance of rear springs.

GENERAL DESCRIPTION

The semi-elliptic leaf springs provided for rear suspension are secured beneath the rear axle by " U " bolts.

The front ends of the springs are anchored in flexing rubber bushes, while the rear ends are mounted in similar bushes in swinging shackles.



Fig. I.1.
When it is desired to raise the rear of the car this is accomplished by attaching lifting tackle to the rear bumper support brackets.

Moulded rubber packing pads are inserted between the leaves and the spring clips, while rubber insertions are also fitted at the ends of the spring leaves. It is essential that no lubricant be used on the spring leaves or shackles.

The spring action is controlled by the use of hydraulic dampers of the piston type (Section L).

Some models have Woodhead-Monroe telescopic dampers for the rear springs.

Section I.1

REMOVAL AND REPLACEMENT OF THE REAR SPRINGS

Raise the rear of the car by means of a suitable sling attached to the bumper brackets and place a support beneath the axle casing.

Slacken off the " U " bolt locknuts and remove the nuts. Raise the " U " bolts until the shock absorbers

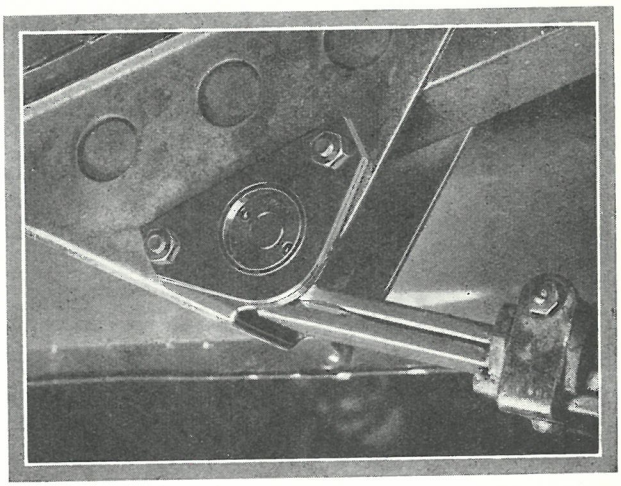
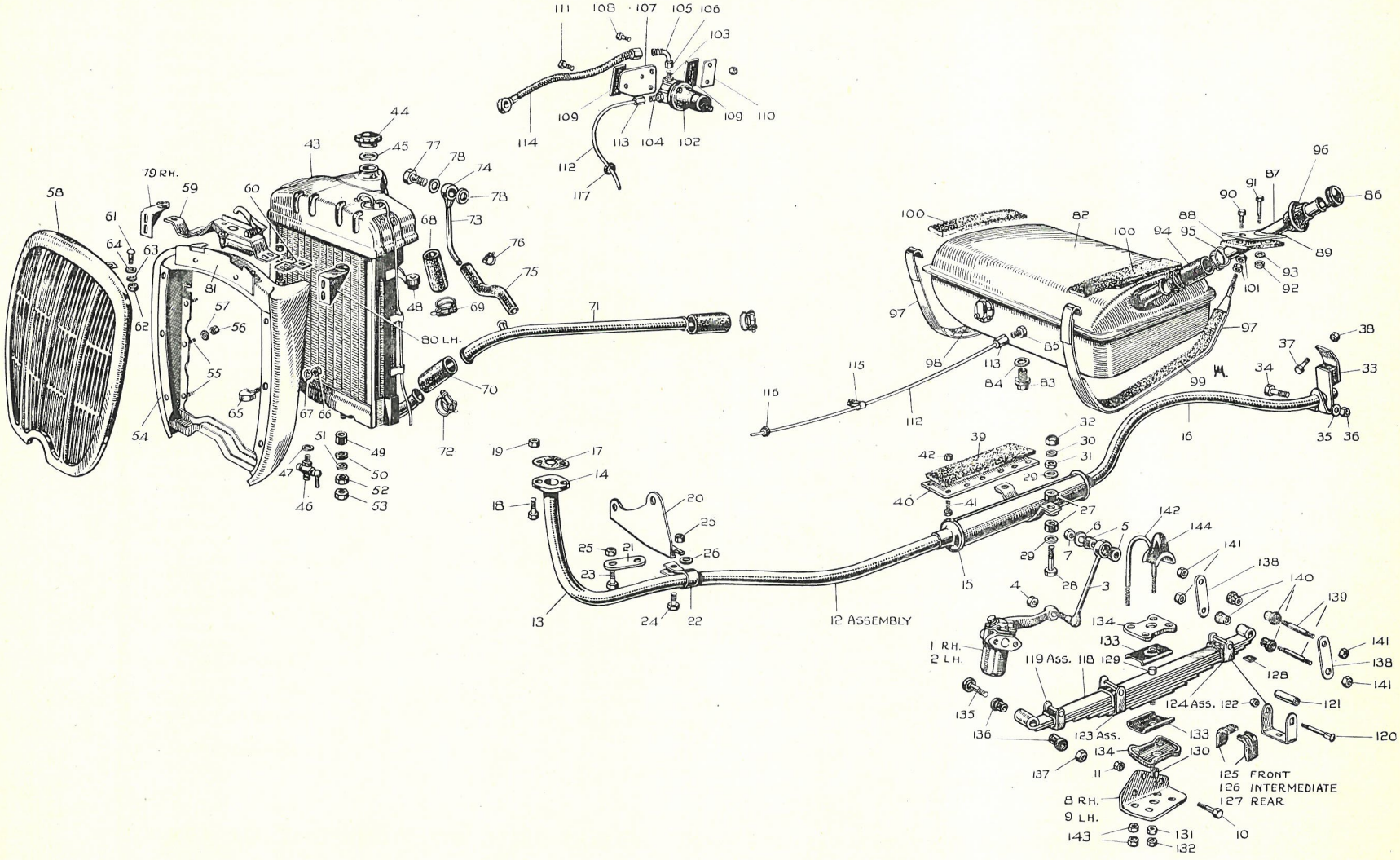


Fig. I.2.
The front anchorage bolt for the rear spring is here indicated. Note the pin spanner holes in its head by which it is held against rotation while the nut is loosened or tightened by Special Tool, Part No. 68965.

RADIATOR, FUEL SYSTEM, EXHAUST SYSTEM AND SPRINGS



KEY TO THE RADIATOR, FUEL SYSTEM, EXHAUST SYSTEM AND SPRINGS COMPONENTS

No.	Description
1.	Shock absorber—rear R.H.
2.	Shock absorber—rear L.H.
3.	Link.
4.	Nut—link to absorber.
5.	Bush—link.
6.	Washer—link.
7.	Nut—link to frame.
8.	Bracket—R.H.
9.	Bracket—L.H.
10.	Bolt—absorber to bracket.
11.	Nut—absorber bolt.
12.	Exhaust assembly.
13.	Pipe—front—with flange.
14.	Flange—front pipe.
15.	Silencer assembly.
16.	Pipe—rear.
17.	Gasket—flange to manifold.
18.	Bolt—front pipe to manifold.
19.	Nut—front pipe to manifold.
20.	Bracket—to clutch housing.
21.	Link—clip to housing bracket.
22.	Clip—front pipe.
23.	Bolt—link to housing bracket.
24.	Bolt—clip to link.
25.	Nut—clip to link bolt.
26.	Washer—clip bolt.
27.	Ferrule—silencer support.
28.	Bolt—silencer strap to floor.
29.	Washer—silencer strap bolt—large.
30.	Washer—silencer strap bolt—small.
31.	Nut—silencer strap bolt.
32.	Locknut—silencer strap bolt.
33.	Support—rear pipe.
34.	Bolt—support to rear pipe.
35.	Washer—support bolt.
36.	Nut—support bolt.
37.	Screw—support to rear floor.
38.	Nut—support bolt.
39.	Insulator—front floor.
40.	Retaining plate—insulator.
41.	Screw—retaining plate to floor.
42.	Nut—screw.
43.	Radiator core.
44.	Cap.
45.	Rubber ring—cap.
46.	Drain tap.
47.	Washer—drain tap.
48.	Rubber block—top mounting.
49.	Rubber block—bottom mounting.
50.	Washer—bottom.
51.	Washer—flat—bottom.
52.	Nut—bottom mounting.
53.	Locknut—bottom mounting.
54.	Case assembly.
55.	Screw—to grille.
56.	Nut—to side panel.
57.	Washer—to side panel.
58.	Grille assembly.
59.	Bracket—R.H.—grille to case—top.
60.	Bracket—L.H.—grille to case—top.
61.	Screw—grille to case—top.
62.	Nut—grille screw.
63.	Washer—grille to case.
64.	Shim—grille to case.
65.	Retainer—grille to case.
66.	Nut—retainer.
67.	Washer—retainer.
68.	Hose—top—radiator.
69.	Clip—top hose.
70.	Hose—bottom—radiator.
71.	Pipe—hose connector.
72.	Clip—bottom hose.
73.	Pipe—by-pass.
74.	Banjo—by-pass pipe.
75.	Hose—by-pass pipe—lower.
76.	Clip—hose.
77.	Bolt—banjo.
78.	Washer—banjo.
79.	Support bracket—R.H.—radiator top.
80.	Support bracket—L.H.—radiator top.
81.	Shield panel—bonnet lock.
82.	Petrol tank.
83.	Plug and strainer.
84.	Washer—plug.
85.	Union—D.E.
86.	Cap—filler.
87.	Extension—filler.
88.	Seal—extension to spare wheel floor.
89.	Plate—seal to spare wheel floor.
90.	Bolt—plate to spare wheel floor—short.
91.	Bolt—plate to spare wheel floor—long.
92.	Nut—plate bolt.
93.	Washer—plate bolt.
94.	Hose—filler extension.
95.	Clip—hose.
96.	Ferrule—filler extension.
97.	Strap—tank securing.
98.	Packing—R.H.—tank strap.
99.	Packing—L.H.—tank strap.
100.	Packing—top—tank strap.
101.	Nut—tank strap.
102.	Pump assembly.
103.	Union—pump to carburetter.
104.	Union—pump to tank pipe.
105.	Elbow—pump union to tank pipe.
106.	Nut—elbow.
107.	Bracket—pump support.
108.	Bolt—bracket to dash.
109.	Mounting rubber—pump to bracket.
110.	Retainer—mounting rubber.
111.	Bolt—pump to bracket.
112.	Pipe—tank to pump.
113.	Union nut.
114.	Pipe (flexible)—pump to carburetter.
115.	Clip—pipe—tank to pump.
116.	Grommet—pipe—tank to pump.
117.	Grommet—pipe through dash.
118.	Rear spring assembly.
119.	Clip assembly—front.
120.	Bolt—leaf clip.
121.	Tube—leaf clip.
122.	Nut—clip bolt.
123.	Clip assembly—intermediate.
124.	Clip assembly—rear.
125.	Rubber—front—leaf clip.
126.	Rubber—intermediate—leaf clip.
127.	Rubber—rear—leaf clip.
128.	End pad—rubber—leaf ends.
129.	Dowel bolt.
130.	Distance-piece—dowel bolt.
131.	Nut—dowel bolt.
132.	Locknut—dowel bolt.
133.	Seating pad.
134.	Locating plate.
135.	Pin—spring—front.
136.	Bush—rubber—front pin.
137.	Nut—front pin.
138.	Shackle plate—spring—rear.
139.	Pin—rear shackle.
140.	Bush—rear shackle pin.
141.	Nut—rear shackle pin.
142.	Clip—anchor.
143.	Nut—anchor clip.
144.	Bumper—rear spring.

and brackets can be pivoted clear of the springs. Remove the plate and rubber pad.

Remove the rear shackle nuts and plates.

Undo the $\frac{5}{16}$ in. nut from the spring front anchorage bolt. The bolt has pin spanner holes in its head to permit it to be held against rotation while loosening or tightening up the nut. (Special Tool, Part No. 68965.)

The spring is now free to be removed.

Replacement of the spring is a reversal of the above procedure, but before replacing the shackle bolts, bushes and plates they must be inspected for wear, and if necessary replaced by new components.

Ensure that the rubber pads are positioned correctly and that the head of the spring centre bolt registers with the spring bracket on the axle case.

The shackle bolts and front anchorage bolts should be tightened while the weight of the car, loaded to its normal running load, is taken by the axle and springs. This allows the bushes to take up their normal working position and prevents the overstressing which takes place if the bolts are tightened while the springs are in the non-loaded position.

The spring must be replaced with two spring clips forward of the axle, and the front anchorage bolt has to be inserted from the inner side of the bracket.

Section I.2

DISMANTLING AND REASSEMBLING THE SPRINGS

Slacken off and remove the three spring clip bolts, distance-pieces, and rubber packings.

Release the locknut and nut from the spring centre bolt and remove the distance-piece and bolt.

The leaves may now be separated, releasing the twelve interleaf rubber pads.

Inspection

Clean each leaf thoroughly, and examine for cracks or breakage. Check the centre bolt for wear or distortion (this bolt forms the location for the spring on its axle pad and should be in good condition).

Important.—*When fitting new leaves it is important that they are of the correct length and thickness, and have the same curvature as the remaining leaves.*

It is advisable, even when no leaves are broken, to fit replacement springs when the originals have lost their camber due to settling.

Reassembling

The springs should be assembled clean, dry and free from any lubricant.

Place the leaves together in their correct order, locating them with the centre bolt and positioning the interleaf rubber packings between the ends of the leaves before the bolt is tightened.

The dowel head of the bolt must be on top of the spring.

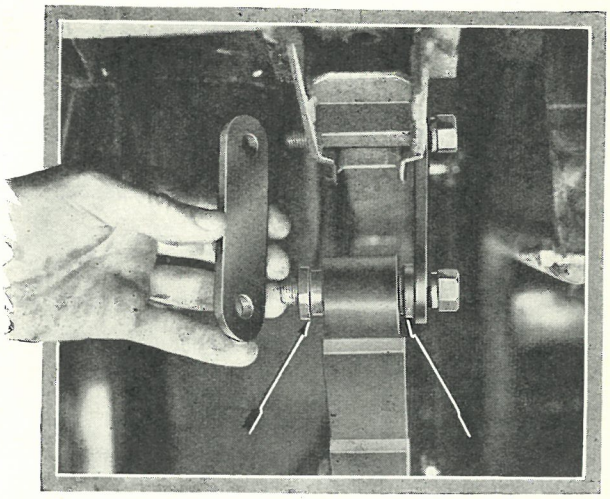


Fig. I.3.
The rear spring shackle assembly, showing the flanged rubber bushes in position.

Fit Nos. 3 and 7 leaves with their clips on the same side of the centre bolt and No. 4 leaf with its clip on the opposite side.

Replace the spring clip rubber packings, clip distance-pieces, and bolts.

Section I.3

MAINTENANCE OF REAR SPRINGS

As the rear springs are mounted in rubber, spraying with oil should be avoided. The only maintenance attention required is an occasional checking of the spring seat bolts to make sure they are quite tight.

Should squeaks develop, the use of a small quantity of Lockheed brake fluid may be used on the bushes, but it must be remembered that they are intended to accommodate the movement of the spring by flexing, without movement between the bush and its anchorage in the shackle or bracket, and the spring eye.

SECTION J

THE STEERING GEAR

General Description.

Maintenance.

Section No. J.1 Removal and replacement of steering wheel.

Section No. J.2 Removal and replacement of steering column bush.

Section No. J.3 Taking up backlash with steering gear in position.

Section No. J.4 Removal and replacement of steering gear.

Section No. J.5 Dismantling the steering gear.

Section No. J.6 Examining parts for wear.

Section No. J.7 Reassembling the steering gear.

Section No. J.8 The transfer box.

Section No. J.9 Checking and setting wheel alignment.

Section No. J.10 Resetting the steering linkage.

Section No. J.11 The Mark III gear change.

GENERAL DESCRIPTION

The steering gear is of the Bishop cam and lever two-pin type, in which the cam portion takes the form of a worm of varying pitch, mounted on the end of the steering mast and running in ball bearings. The rocker-shaft is mounted in the steering gearbox housing in a single renewable plain bearing of considerable length. A lever integral with the shaft carries a conical peg or pegs which engage the cam. As the pegs do not contact the bottom of the cam groove, adjustment for wear can be effected by adjusting the depth of the engagement. This is carried out by the removal or addition of shims between the cover-plate and the steering gearbox. (See Section J.11.)

All 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 double-ended steering drop arm is attached to the rocker-shaft by parallel splines and a retaining nut.

The steering drop arm is connected to a steering transfer box on the opposite side of the car which also carries a double-ended steering arm. The steering arm and drop arm are interconnected by a track-rod and connected to the swivel pin steering levers by tie-rods. Each end of the track-rod and tie-rods is connected by a ball-and-socket type joint.

MAINTENANCE

The filler plug provided on the steering gearbox should be removed every 3,000 miles (5000 km.) and the oil replenished with one of the recommended

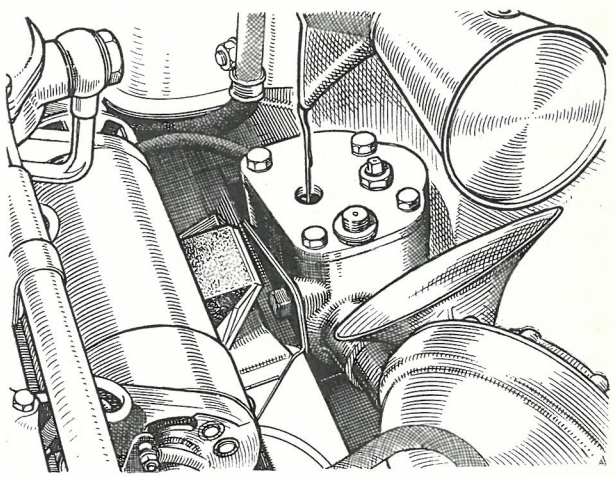
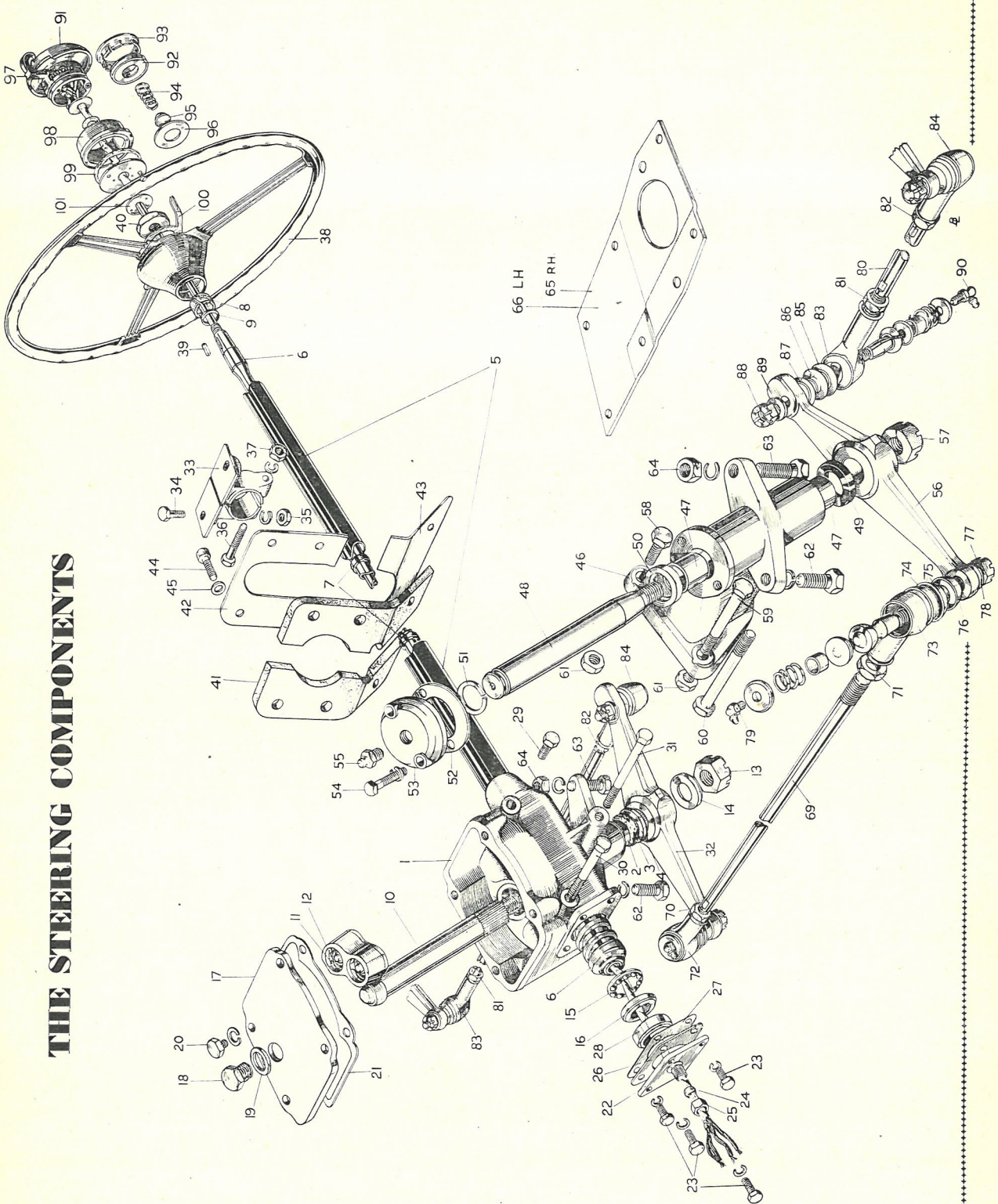


Fig. J.1.
The steering gearbox should be filled with Hypoid oil through the filling plug provided, which also acts as a level regulator.

Hypoid oils, Ref. B (page P.2), to the level of the filler plug opening. Grease must not be used under any circumstances.

THE STEERING COMPONENTS



KEY TO THE STEERING COMPONENTS

No.	Description
1.	Box assembly—steering.
2.	Bush.
3.	Cork washer.
4.	Retaining disc.
5.	Column tube.
6.	Mast with cam.
7.	Rubber ring.
8.	Felt bush—mast.
9.	Circlip—mast.
10.	Rocker-shaft assembly.
11.	Circlip—cam roller.
12.	Washer—cam roller.
13.	Nut—rocker-shaft.
14.	Washer—rocker-shaft.
15.	Ball cage with balls.
16.	Ball cup—for cam.
17.	Cover—box side.
18.	Oil plug.
19.	Washer—plug.
20.	Screw—side cover.
21.	Shim—side cover.
22.	Cover—box bottom end.
23.	Screw—bottom end cover.
24.	Olive—bottom end cover.
25.	Nut—bottom end cover.
26.	Joint—bottom end cover.
27.	Shim—bottom end cover.
28.	Packing disc.
29.	Screw—steering to frame.
30.	Bolt—steering to frame—short.
31.	Bolt—steering to frame—long.
32.	Drop-arm.
33.	Bracket—column support to wireless shelf.
34.	Bolt—bracket.
35.	Nut—bracket bolt.
36.	Bolt—bracket to column.
37.	Nut—bracket bolt.
38.	Wheel—steering.
39.	Key—steering wheel.
40.	Nut—steering wheel.
41.	Seal—column to dash.
42.	Plate—column seal—top.
43.	Plate—column seal—bottom.
44.	Bolt—plate to dash.
45.	Washer—bolt.
46.	Transfer box.
47.	Bush.
48.	Shaft.
49.	Oil seal.
50.	Cup washer.
51.	Circlip.
52.	Shim.
53.	Cap.
54.	Bolt—cap to box.
55.	Greaser.
56.	Lever.
57.	Nut—lever to shaft.
58.	Bolt—box to frame—short.
59.	Bolt—box to frame—medium.
60.	Bolt—box to frame—long.
61.	Nut—box bolt.
62.	Bolt—steering and transfer box lugs to floor—short.
63.	Bolt—steering and transfer box lugs to floor—long.
64.	Nut—box lug bolts.
65.	Tie-plate—R.H.—steering box.
66.	Tie-plate—L.H.—transfer box.
69.	Track-rod.
70.	Nut (R.H.T.).
71.	Nut (L.H.T.).
72.	Ball socket assembly (R.H.T.).
73.	Ball socket assembly (L.H.T.).
74.	Cap—inner—grease retainer.
75.	Cap—outer—grease retainer.
76.	Pressure ring—for cap.
77.	Nut.
78.	Washer.
79.	Greaser.
80.	Tie-rod.
81.	Nut (R.H.T.).
82.	Nut (L.H.T.).
83.	Ball socket assembly (R.H.T.).
84.	Ball socket assembly (L.H.T.).
85.	Cap—inner—grease retainer.
86.	Cap—outer—grease retainer.
87.	Pressure ring—for cap.
88.	Nut.
89.	Washer.
90.	Greaser.
91.	Top cover assembly.
92.	Button—horn push.
93.	Retainer—button.
94.	Spring—button.
95.	Spacer—spring locating.
96.	Contact assembly.
97.	Lever and rotor assembly—indicator switch.
98.	Striker ring—indicator switch.
99.	Felt washer.
100.	Locating ring—trafficator trip.
101.	Bracket and stator tube.

Every 500 miles (800 km.) a grease gun, filled with a grease to Ref. D (page P.2), should be applied to the grease nipple on the transfer box cover-plate and given three or four strokes.

The steering gearbox and transfer box are accessible from above when the bonnet is raised.

Every 500 miles (800 km.) the grease gun should also be applied to the steering tie-rod and track-rod ball joint grease nipples and given three or four strokes.

There are six nipples in all on the steering linkage.

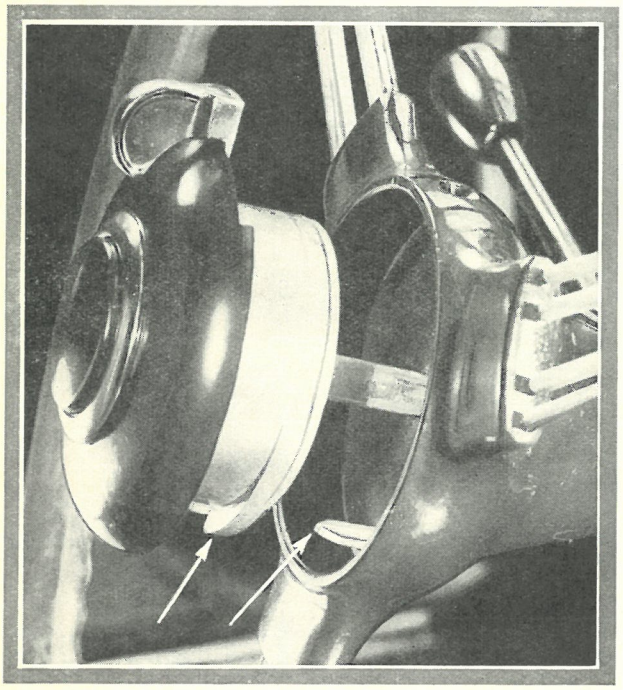


Fig. J.2.
The stator tube assembly partly withdrawn to show the switch striker ring and the trip finger held in position by the steering wheel replacement nut.

Check that the steering arms and ball ends are tight and held securely by their nuts, and also that the bolts securing the steering gearbox and transfer box to the frame are tight.

Section J.1

REMOVAL AND REPLACEMENT OF STEERING WHEEL

Disconnect the negative battery terminal.

Disconnect the four trafficator and horn control wires from the snap connectors coupling them to the harness cable beneath the radiator. Unsolder and remove the end caps from each steering column wire.

Slacken the brass hexagon nut on the steering gearbox end-plate ; the nut is accessible through the floor of the car beneath the steering gearbox. Carefully ease the lower end of the stator tube upwards through the nut and olive nipple, placing a suitable tin beneath the nut to catch the steering gearbox oil which will drain from it as the stator tube is withdrawn.

The trafficator switch assembly and stator tube may be withdrawn from inside the car.

Remove the steering wheel retaining nut, using a $\frac{7}{8}$ in. box spanner, and withdraw the wheel with the universal steering wheel extractor (Special Tool, Part No. 68827).

Reassembly is a reversal of the above procedure, but before the steering wheel locknut is fully tightened the trafficator trip locating ring must be reset. To do this, turn the road wheels to their "straight-ahead" position (the countersunk hole in the steering wheel

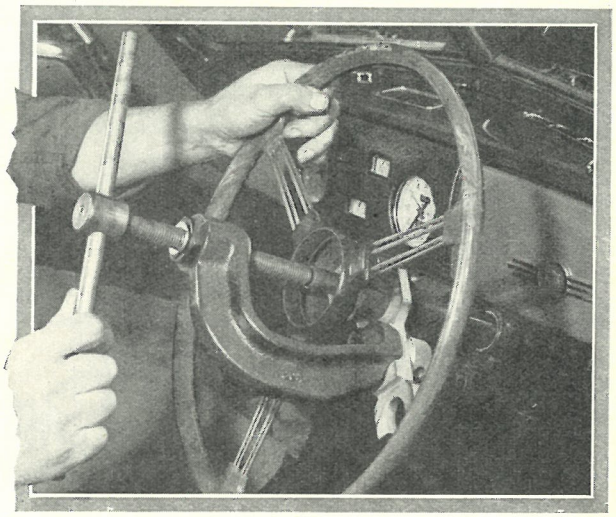


Fig. J.3.
The special extractor (Part No. 68827) in position for removal of the steering wheel.

hub should be at 12 o'clock and the trafficator trip finger to the 6 o'clock position in the steering wheel). Firmly tighten the steering wheel locknut.

Push the trafficator switch assembly and the stator tube into the steering column, engaging the trip finger between the lugs on the striker ring of the switch assembly. Turn the switch until the trafficator lever is in a vertical position. Replace and tighten the olive nipple and locking nut.

Note.—*During this operation an assistant should hold the trafficator switch to prevent it being turned from its correct position.*

Reconnect the horn and trafficator control wires and refill the steering gearbox with Hypoid oil to Ref. B (page P.2).

Section J.2

REMOVAL AND REPLACEMENT OF THE 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 shaft before attempting to assemble it.

Fit the new felt, inserting a corner between the shaft and the outer tube. The remainder of the felt can then be inserted and, with the aid of a screwdriver, carefully positioned in the annular space.

Refit the steering wheel.

Section J.3

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 track-rod and steering tie-rod from the drop arm. Test for slackness by holding one of the ends of the steering drop arm and exerting light pressure alternately in both directions. To eliminate backlash remove the steering gearbox cover-plate and remove the joint shims one at a time until the play is just taken up. Four different thicknesses of shims are available to provide the correct adjustment ; the sizes are : ·002 in. (·50 mm.) ; ·004 in. (1·01 mm.); ·005 in. (1·27 mm.) ; ·010 in. (2·54 mm.).

On some models the location of the rocker shaft is controlled by a hardened thrust screw and locknut ; in these cases adjustment is effected by slackening the locknut and tightening the thrust screw until all play is taken up. Do not forget to retighten the locknut.

It should be noted that as the steering wheel is turned from lock to lock the degree of backlash at the end of the drop-arm is not the same at all steering positions, there being no backlash in the " straight ahead " position and an increasing amount as the full-lock positions are reached.

If slackness is present at ALL positions of the steering, further adjustment must be made until a high-spot is felt as the steering passes the " straight ahead " position. When this high-spot can be felt as a very slight drag on the steering wheel the adjustment is correct.

Note—*In the case of steering boxes fitted with adjustable thrust screws care must be taken not to alter the setting of the thrust screw while the locknut is being tightened up.*

Section J.4

REMOVAL AND REPLACEMENT OF STEERING GEAR

Disconnect and remove the battery.

Drain and remove the radiator core and radiator grille and case assembly as indicated in Section A.22.

Disconnect the dynamo.

Slacken the fan belt tensioner bolt and the bolt on which the dynamo pivots, and remove the fan belt. Remove the dynamo-retaining-strap bolt on early models and lift out the dynamo. On later models remove the three dynamo attachment bolts.

Remove the nut and bolt securing the tie-rod to the wing valance and slacken the bolt at the other end of the tie-rod. Swing the tie-rod towards the engine until it is clear of the steering column. Release the starter cable from the clips securing it to the steering column.

Extract the Phillips screws securing the parcel tray rail and tray liner to the scuttle and side panels. Remove the rivets and flat washers securing the tray liner to the battery box. Remove the parcel and rail.

Slacken the Phillips screw securing the collar on the gear control rod and slide the collar, spring and abutment bracket up the rod.

Remove the bolts and flat washers securing the upper and lower halves of the steering column draught-excluder plate and remove the plate and rubber seal.

Extract the two bolts and spring washers clamping the halves of the gear lever support bracket to the steering column. On later models only one clamping bolt is used and the bracket remains attached to the steering column after removal of the bolt.

Remove the nut, bolt and spring washer clamping the steering column in its support bracket and release each half of the bracket from the facia panel by withdrawing the securing nut and bolt.

Separate the horn and trafficator wires at the snap connectors coupling them to the harness cable below the radiator.

Extract the split pin and remove the steering drop arm retaining nut from the rocker-shaft. Note the alignment of the spline marking on the drop arm and on the end of the shaft, and withdraw the steering drop arm, with an extractor if necessary.

Remove the bolt, and the nut and bolt, securing the steering gearbox to the frame, together with the two long bolts and one short bolt securing it to the longitudinal member.

Raise the lower end of the steering gearbox to a convenient position and unsolder and remove the end caps from the four steering column wires. Place

a suitable tin below the gearbox to catch any oil which may drain from it. Slacken the brass nut on the steering gearbox end-plate and carefully ease the bottom end of the stator tube upwards through the nut and olive nipple. The steering oil will now drain from the gearbox through the olive locknut.

Manœuvre the steering column so that the trafficator switch assembly and stator tube may be withdrawn from the column and taken out of the car through the rear door.

With a punch, mark the exact position of the trafficator trip locating ring in relation to the steering wheel hub and then use a $\frac{7}{8}$ in. box spanner and remove the steering wheel retaining nut. Use the special extractor (Special Tool, Part No. 68827) to withdraw the steering wheel from the column.

The steering column assembly is now free to be withdrawn from the front of the car.

Replacement of the steering column and gearbox assembly is a reversal of the above procedure, though care of the following points should be taken when reassembling.

The steering wheel must be replaced and tightened with the trafficator trip ring reset, and the stator tube and trafficator switch assembly inserted in the column, before the steering gearbox is secured.

The gear control rod collar should be tightened in such a position that the load on the spring below it retains the gear change lever in the gate between the third and fourth gears when the lever is in the neutral position.

Before tightening the stator tube locknut over the olive nipple ensure that the trafficator trip finger is engaged between the lugs on the switch assembly striker ring. Turn the switch until the trafficator lever is in the vertical position and replace and tighten the olive nipple and locking nut.

NOTE.—During this operation an assistant should hold the trafficator switch to prevent it being turned from its correct trip position.

Refill the steering gearbox with oil through the filler plug orifice in the cover-plate. The correct lubricant is Hypoid oil to Ref. B (page P.2).

Section J.5

DISMANTLING THE STEERING GEAR

Remove the steering gear as detailed in Section J.4.

Remove the gearbox cover and shims and withdraw the rocker-shaft.

Remove the bottom end cover and shims.

It is necessary to remove the steering wheel locking key from the top of the mast before the mast is pushed from its position, as it fouls the felt bush at the top of the column.

Extract the steering mast with its cam by pushing it downwards. The distance collar, lower ball cup and ball cage will thus be forced out of the steering box, and the steering mast with the cam can be removed, complete with the upper ball cage. The upper ball cage may be removed by prising it out with a screwdriver blade.

Section J.6

EXAMINING PARTS FOR WEAR

Thoroughly clean the steering gearbox and examine the rocker-shaft housing and bush for wear. Examine the rocker-shaft on its shank for wear ; if it is badly worn it should be renewed and a new bush and oil-retaining felt fitted. Check the splines ; if they are twisted the rocker-shaft must be renewed.

Extract the small circlip from the end of each rocker-shaft peg assembly and lift off the spring packing washer. Press the peg, together with its ball and roller bearings, from the rocker-shaft. Wash the assembly clean and reassemble in a dry condition without the circlip to check for any side play in the bearings. In the unlikely event of it being necessary to renew the peg and bearing assembly, extract the large circlip locating the bearing outer race and press the assembly from the rocker-shaft.

Some models are fitted with a single peg, pressed into the rocker shaft lever, which must be free from flats or shoulders. The peg is replaceable and should be tapped out of the lever, if worn, 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, 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. 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 in the column tube as indicated in Section J.2.

Section J.7

REASSEMBLING THE STEERING GEAR

See that all parts are clean and dry. Check 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 anti-vibration rubber rings should be positioned approximately half-way along the steering mast.*

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 distance collar, shims, paper joint and end cover, and secure in position with the bolts and spring washers.

Hold the steering box in a vice so that the column is horizontal, fit the steering wheel temporarily and test for end float. Remove the shims, if necessary, to eliminate any end float that may be present, but make sure that the column is free to rotate after finally tightening the end plate bolts.

If the rocker-shaft peg bearing assemblies fitted to early models have been dismantled and cleaned, they should be lubricated with Hypoid oil to Ref. B (page P.2) before replacement. Ensure that the spring packing washers are correctly refitted beneath the small circlips and that each large circlip is replaced.

Smear the rocker-shaft with oil and insert the shaft in its housing. Replace the cover and shims and adjust for backlash as detailed in Section J.3.

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 must be renewed.

Replace the steering gear in the frame as detailed in Section J.4.

Refill the steering box with Hypoid oil to Ref. B (page P.2) through the filler plug hole provided in the cover.

Section J.8

THE TRANSFER BOX

The steering transfer box is secured by a bolt, and bolt and nut, from below the frame and by a long and short bolt and nut inserted through the transfer box and longitudinal member. The remaining long securing-bolt is accessible from below the car.

The transfer box may be removed after releasing the steering arm securing-nut and withdrawing the arm from the transfer shaft taper.

After removal of the transfer box assembly, the transfer shaft may be withdrawn after extracting the two cap-retaining bolts and removing the cap and shims.

Great care must be taken to prevent damage when removing the oil seal from the housing, should it become absolutely essential to do so.

Dismantling transfer gearbox

Normally the transfer box will not require dismantling as there is little to go wrong with it.

Its removal is accomplished by extracting the steering lever from its lower end after removing the lever-retaining nut and washer and releasing the two bolts and three screws attaching it to the frame.

Thoroughly clean the steering transfer box and check the shaft in its housing for wear. Fit new bushes if necessary. Examine the Gaco oil seal and renew if it shows any signs of wear.

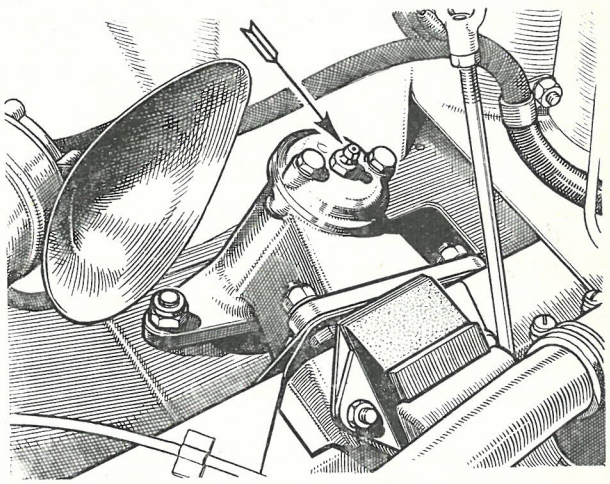


Fig. J.4.
The steering transfer box. The lubricating nipple for the shaft bearing is indicated by the arrow.

Before reassembling the shaft in the steering transfer box ensure that the Gaco oil seal is pressed firmly home with the rubber lip inside the housing.

Place the circlip retainer over the threaded end of the transfer shaft and slide it along until the circlip on the upper end of the shaft is housed in the recessed face of the retainer. Assemble the shaft in its bearings and replace and tighten the cap and shims with the two securing-bolts. Check the shaft for end float or tightness and adjust as necessary by the addition or removal of shims beneath the cap. When correctly adjusted remove the shaft and smear with lubricating oil, replace and finally tighten.

In early models the circlip was fitted against a flat washer. In all cases of this nature the washer **must**

be replaced by one of the recessed retainers (No. 50, page J.2) to ensure safety. **This is imperative.**

Apply the grease gun filled with grease to Ref. D (page P.2) to the transfer box nipple and replenish the oil until it exudes from the small hole in the cap.

Section J.9

CHECKING AND SETTING WHEEL ALIGNMENT

When correctly adjusted the front wheels should be parallel to each other. To carry out any necessary adjustment first inflate the tyres to the standard pressure of 22 lb. per sq. in. (1·6 kg./cm.^{2}).

Where modern wheel alignment equipment is available this will present no difficulty but when this facility is not available the trammel method must be used.

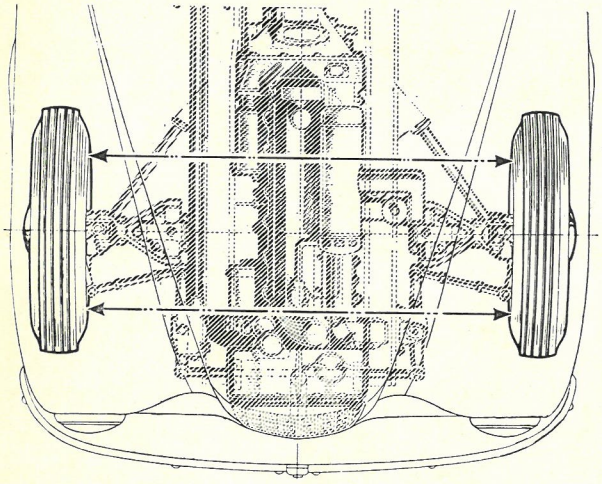


Fig. J.5.
The alignment of the front wheels should be such that they are parallel to each other when in the straight-ahead position.

Turn the wheels to their straight-ahead position and position the pointers of a set of alignment trammels 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 each wheel rim with chalk, withdraw the trammel and push the car forward so that the wheels make exactly half a revolution.

Move the trammel to the front of the wheel, so that one pointer registers with the chalk mark on one of the wheels. For the alignment to be correct, the other pointer should register against the mark on the other wheel.

Should it not do so, adjust the track by slackening the locknut at each end of the track-rod and then rotate the track-rod in the necessary direction with a spanner applied to the flats provided.

NOTE.—All adjustments must be made by the track-rod only. On no account must the tie-rods from the steering boxes to the wheel steering arms be disturbed or this will completely upset the steering setting.

When making adjustments remember that they are doubled because adjustment of the rim in one direction makes a similar increase of the opposite portion of the rim in the other direction.

Important.—*The top surfaces of the ball joints must be in the same plane when the two track-rod locknuts are tightened.*

Section J.10

RESETTING THE STEERING LINKAGE

Should it be found necessary to remove the steering tie-rods and track-rod for overhaul, or repairs due to accident damage, they must be reassembled in the following manner.

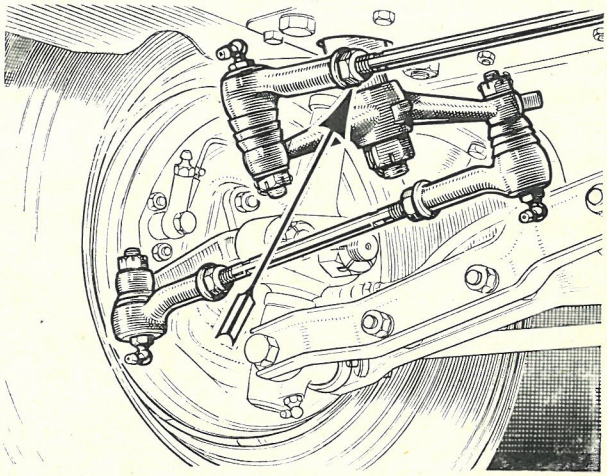


Fig. J.6.
When setting the alignment of the front wheels only the track-rod may be used for the purpose. The track-rod is provided with right- and left-hand threads as in normal practice and is locked in position by locknuts, one of which is shown in this illustration.

Measure the distance between the centres of the steering gearbox rocker-shaft and transfer gear shaft and adjust the track-rod ball joint centres to this dimension. Lock the nuts to secure the surface of each joint in the same plane and refit the track-rod to the drop arm and transfer lever.

Turn the steering gear until the cam is in the half-way or straight-ahead position, when the countersunk hole and keyway in the steering wheel hub should be at the 12 o'clock position.

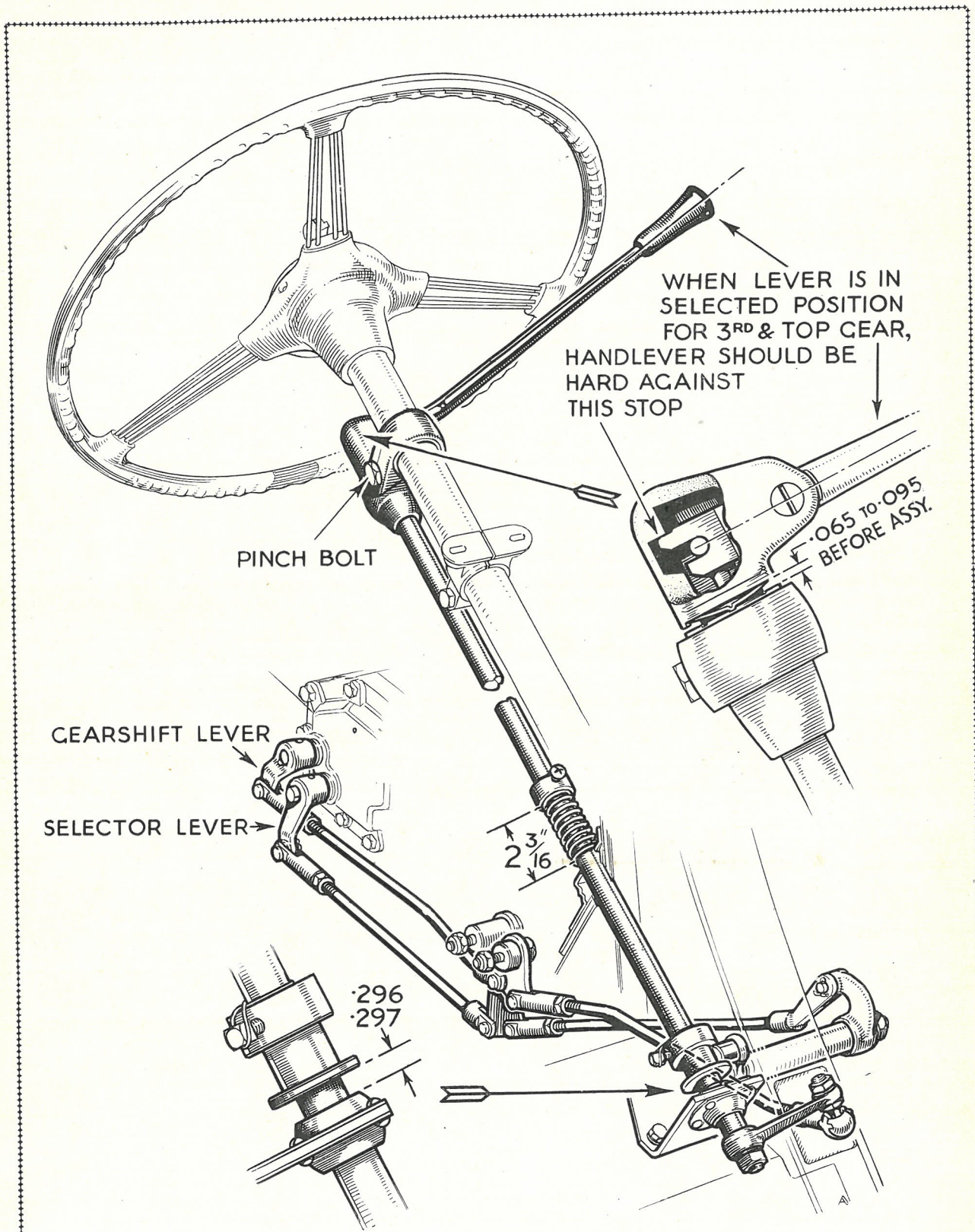


Fig. J.7.
The Mark III gear change mechanism.
(See Section J.11).

Set the road wheels to the straight-ahead position and set each tie-rod to the required length to bring the wheels parallel to each other, ensuring that they are both of exactly equal length, and assemble them to the car.

Check the wheel alignment as detailed in Section J.9 and make any slight corrections necessary by means of the track-rod.

Section J.11

THE MARK III GEAR CHANGE MECHANISM

Later models are fitted with a modified gear change mechanism in which the hand lever pivot bracket is of the external type embracing the end of the lever.

Certain precautions must be taken when fitting the Mark III mechanism to ensure its correct functioning, and the following procedure should be adopted.

1. Assemble the countershaft, operating levers and lower support bracket assembly to the dash reinforcement member, assemble the relay levers to the bracket on the frame.
2. Select "third and top" gear (mid-position) by the selector lever on the gearbox and place the gearbox gearshaft lever in the top gear (rearmost) position.

   Set the power rod to $13\frac{25}{32}$ in. (35 cm.) and the selector rod to $11\frac{3}{16}$ in. (28·4 cm.) and assemble them between the relay levers and the levers on the gearbox. The clevis pin in the selector lever fork must be centralised by using a dummy pin.
3. Check the gap between the gear lever pivot bracket and the support bracket on the column, setting it so that it is between ·065 in. and ·095 in. (1·65 mm. and 2·41 mm.).
4. With the hand lever set in its normal position for selecting third and top gear, pass the control rod through the steering column support bracket and thread the collar for the steady spring onto the bottom end of the rod, followed by the steady spring and steady spring bracket.
5. Pass the end of the rod through the hole in the sealing plate and toeboard and push the "selection boss" into position over the end of the rod until the square-headed retaining screw engages the hole in the rod. Tighten the screw and lock it with lockwire. Thread the control rod through the lower support bracket after engaging the selection boss with the operating pin and assemble the power lever at the end of the control rod.
6. Insert the fibre packing sleeves between the upper support bracket and the steering column. Use a gauge to ensure the correct gap between the selection boss and the lower support bracket (see Fig. J.7) and tighten the bolt pinching the upper support bracket to the steering column.
7. Set the hand lever in the top gear position (the locating washer registering in the central groove) and adjust the collar on the control rod to provide a spring length of $2\frac{3}{16}$ in. (55·6 mm.) to apply the correct tension to the steady spring.
8. With the hand levers and gearbox lever in the positions described above connect the selector and power rods between the relays and the control rod. The clevis pin in the selector lever fork must be centralised by using a dummy pin.

SECTION K

THE FRONT SUSPENSION

General Description.

Maintenance.

Section No. K.1	Removing the torsion bars.
Section No. K.2	Replacing and resetting the torsion bars.
Section No. K.3	Removal and replacement of the swivel pin assembly.
Section No. K.4	Dismantling and examining the swivel pin assembly.
Section No. K.5	Removal and replacement of the lower suspension arm.
Section No. K.6	Removal and replacement of brake-drum and hub.
Section No. K.7	Removal and replacement of brake plate assembly.
Section No. K.8	Torsion bar buffers.
Section No. K.9	Camber adjustments.
Section No. K.10	Castor angle setting.
Section No. K.11	Front Suspension rattle.

GENERAL DESCRIPTION

The independent front suspension comprises torsion bars disposed longitudinally and splined into arms attached to the lower end of each swivel pin. At their upper ends the swivel pins are linked to the hydraulic damper arms.

The grease nipples provided at the swivel pin links are the only points requiring lubrication attention, the inner ends of the lower arms being anchored to the frame members in flexing rubber bushes.

Tie-rods between the rear side of the lower suspension arms and the frame members maintain rigidity of the assembly during acceleration and braking, and abnormally rough road conditions.

The trim of the car is adjustable by means of the torsion bar splines which provide a vernier-type adjustment in conjunction with their anchorage sockets.

MAINTENANCE

Normal maintenance is confined to lubrication of the linkage.

The grease gun should be applied to the nipples at the top and bottom of the steering swivel pins every 500 miles (800 km.). The recommended lubricants are indicated under Ref. D in the table of Recommended Lubricants on page P.2.

Section K.1

REMOVING THE TORSION BARS

Raise the front of the car until the road wheels are clear of the ground.

Remove the hub discs and wheels. Place a jack beneath the outer end of the lower suspension arm and raise it until the hydraulic damper arm at the top of the swivel pin is just clear of the upper rubber rebound pad. Care must be taken to see that the jack is not liable to slip while it is taking the torsion bar load. The use of a special pad is advised.

Slacken the bolts clamping the two halves of the lower arm together and slacken the nut on the inner end of the arm.

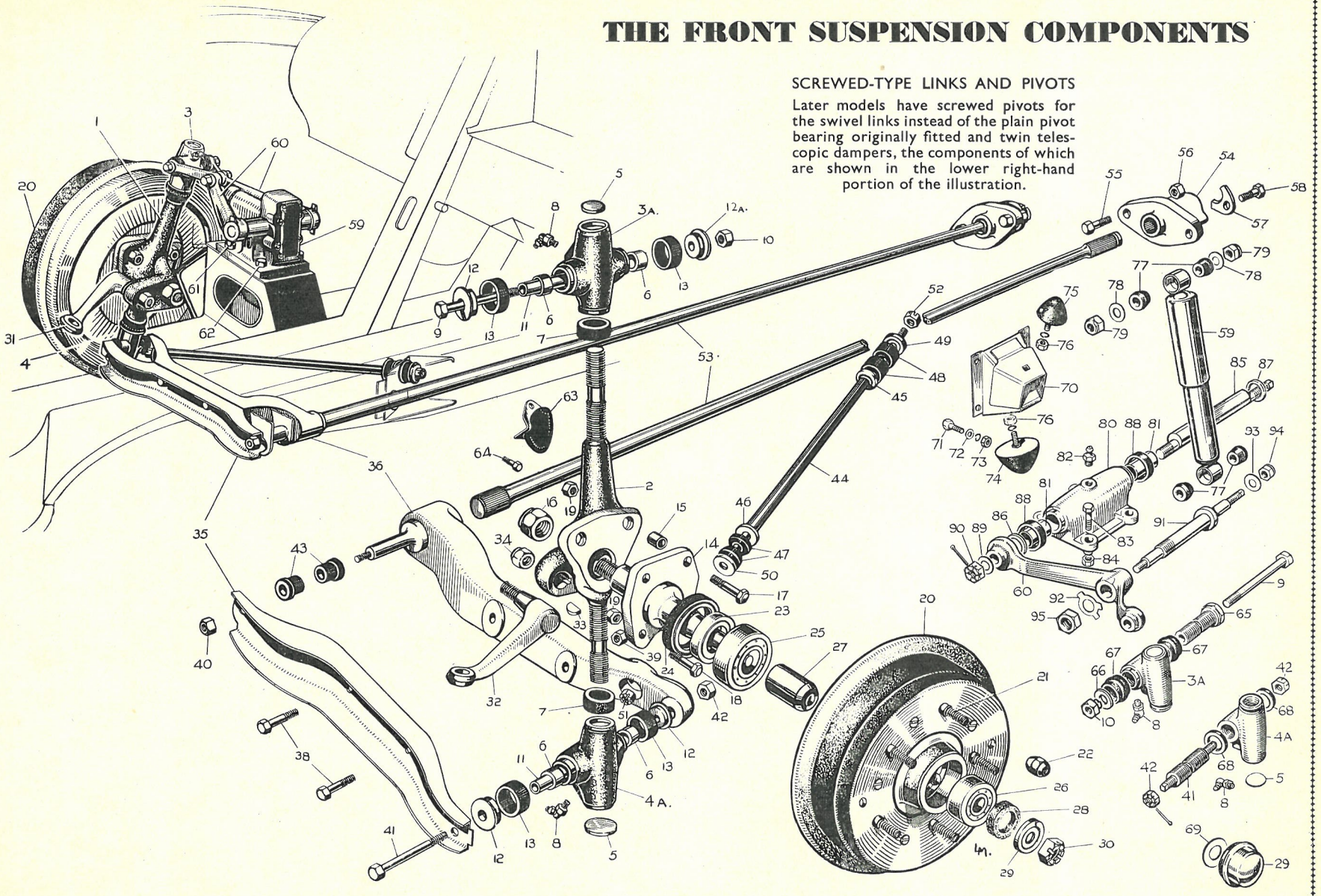
Remove the $\frac{7}{16}$ in. nut and spring washer from the bottom swivel pin link and tap out the bolt.

Lower the jack until the torsion bar is free of its load, and withdraw the $\frac{3}{16}$ in. bolt and spring washer securing the lock plate at the rear of the torsion bar.

THE FRONT SUSPENSION COMPONENTS

SCREWED-TYPE LINKS AND PIVOTS

Later models have screwed pivots for the swivel links instead of the plain pivot bearing originally fitted and twin telescopic dampers, the components of which are shown in the lower right-hand portion of the illustration.



KEY TO THE FRONT SUSPENSION COMPONENTS

No.	Description
1.	Swivel pin—R.H.
2.	Swivel pin—L.H.
3.	Link—top—R.H.—swivel pin.
3A.	Link—top—L.H.—swivel pin.
4.	Link—bottom—R.H.—swivel pin.
4A.	Link—bottom—L.H.—swivel pin.
5.	Plate.
6.	Bush.
7.	Seal—rubber—link.
8.	Greaser—link.
9.	Bolt—damper arms—link to.
10.	Nut—link bolt.
11.	Distance tube—link bolt.
12.	Thrust washer—front.
12A.	Thrust washer—rear.
13.	Dust seal—link bolt.
14.	Stub shaft—L.H.
15.	Dowel—shaft to swivel pin.
16.	Nut—shaft to swivel pin.
17.	Bolt—long—shaft to swivel pin.
18.	Bolt—short—shaft to swivel pin.
19.	Nut—shaft to swivel pin.
20.	Hub and brake-drum.
21.	Wheel stud.
22.	Nut—wheel stud.
23.	Distance washer—hub.
24.	Oil seal—hub.
25.	Bearing—hub—inner.
26.	Bearing—hub—outer.
27.	Spacer—hub bearing.
28.	Felt washer—hub.
29.	Grease retainer—hub.
30.	Nut—L.H.T.—hub to stub shaft.
31.	Steering lever—R.H.
32.	Steering lever—L.H.
33.	Key—lever to swivel pin.
34.	Nut—lever to swivel pin.
35.	Lower arm—front.
36.	Lower arm—rear.
38.	Bolt—to rear arm.
39.	Arm bolt—nut.
40.	Nut—arms to frame.
41.	Bolt—arms to swivel pin link.
42.	Nut—arms to swivel pin link bolt.
43.	Bush—rubber—eye bolt on frame.
44.	Tie-bar.
45.	Washer—cup.
46.	Washer—special.
47.	Bush—rubber—wishbone.
48.	Bush—rubber—frame.
49.	Washer—cup—frame end.
50.	Washer—plain—wishbone end.
51.	Nut—tie-rod—wishbone end.
52.	Nut—tie-rod—frame end.
53.	Torsion bar.
54.	Hub—torsion bar—rear.
55.	Bolt—hub to frame.
56.	Nut—hub to frame.
57.	Retaining plate—bar.
58.	Screw—retaining plate.
59.	Damper assembly—front.
60.	Arms.
61.	Bolt—damper to frame—long.
62.	Bolt—damper to frame—short.
63.	Bump and rebound rubber—on frame.
64.	Bolt—rubber to frame.
65.	Sleeve—top link.
66.	Washer—top link.
67.	Dust seal—top link.
68.	Dust seal—bottom link.
69.	Washer—grease retainer.
70.	Bracket—bump rubber—on frame.
71.	Bolt—bracket to frame.
72.	Washer—bracket bolt.
73.	Nut—bracket bolt.
74.	Bump rubber.
75.	Rebound rubber.
76.	Nut—bump and rebound rubber to bracket.
77.	Bush—shock absorber.
78.	Washer—S/A top pivot.
79.	Nut—S/A top pivot.
80.	Pivot bracket—on frame.
81.	Bush.
82.	Greaser—pivot bracket.
83.	Bolt—bracket to frame.
84.	Nut—bracket bolt.
85.	Shaft—pivot bracket.
86.	Washer—pivot bracket thrust (thin).
87.	Washer—pivot bracket thrust (thick).
88.	Dust seal—pivot bracket.
89.	Washer—pivot shaft.
90.	Nut—S/A arms to pivot shaft.
91.	Pin—S/A bottom pivot.
92.	Tab washer—S/A bottom pivot pin.
93.	Washer—S/A bottom pivot pin.
94.	Locknut—S/A bottom pivot pin.

Remove the two $\frac{3}{8}$ in. nuts, bolts and spring washers securing the torsion bar hub to the frame.

The torsion bar may now be disengaged from the suspension arm and lowered from the car.

Note.—*The hardened surface of the torsion bars must not be damaged in any way, and in particular by marks scribed or punched to indicate the correct spline for replacement. When both torsion bars are removed from the car at the same time they should be labelled to ensure that they are refitted to the side of the car from which they were taken.* **They are not interchangeable.**

Section K.2

REPLACING AND RESETTING THE TORSION BARS

(See Section K.9 for models with twin telescopic dampers at front.)

A torsion bar which has been fitted and used on one side of the car must not be taken for use on the other side. The bars are only interchangeable when new, and become "handed" once they have been in service and must always be used on the same side of the car. Neither are the torsion bars reversible end for end, and, since there are forty-eight splines on the front and fifty-two on the rear, this difference in the number of splines permits a fine vernier adjustment when trimming the suspension.

When rotated one spline the lower suspension arm moves through $7\frac{1}{2}°$, whereas when the rear end torsion bar hubs are rotated one spline they move through approximately 7°. The difference of $\frac{1}{2}°$ is the effective rise or fall of the suspension arm when the torsion bar is rotated one spline. For each spline rotation of the torsion bar the effective vertical movement of the swivel pin is approximately ·1 in. (2·5 mm.).

Reference in Fig. K.1	"A" (Full load)	"B" (Showroom trim)	"C" (Free)
1949 production ...	$1\frac{5}{16}$ in. (33·3 mm.)	$2\frac{5}{16}$ in. (58·7 mm.)	$7\frac{11}{16}$ in. (195 mm.)
Models fitted with telescopic dampers (rear only) ...	$\frac{9}{16}$ in. (14·3 mm.)	$1\frac{9}{16}$ in. (39·7 mm.)	$6\frac{15}{16}$ in. (176 mm.)
Commencing Car No. R.H.D. 2958 plus 2713 and 2799, L.H.D. 5858 plus 5820 and 5837 to 5846	$\frac{9}{16}$ in. (14·3 mm.)	$1\frac{9}{16}$ in. (39·7 mm.)	$8\frac{5}{32}$ in. (207 mm.)
Cars fitted with twin telescopic dampers on front	Nil	$\frac{11}{16}$ in. (17·4 mm.)	$7\frac{3}{4}$ in. (197 mm.)

Support the front of the car and adjust the jack beneath the lower suspension arm until there is a difference between the vertical height of the inner and outer suspension arm swivel bolts equal to dimension "C" in the table.

When a new torsion bar is to be fitted the difference in height must be increased by $\frac{1}{2}$ in. (12·7 mm.) to allow for the small permanent set which takes place when the bar is loaded for the first time.

Note.—*The car must be standing on a level floor and measurements taken from a horizontal flat plate.*

The front end of the torsion bar should be engaged in any position in the arm and the torsion bar hub then replaced on the rear end of the shaft in such a manner that its bolt holes are in exact alignment with those in the frame.

If it is not found possible to do this the torsion bar must be withdrawn from the suspension arm and rear end anchorage hub and then rotated one spline at a time until the position is found which will permit the exact alignment of the holes in the anchorage hub with those in the frame.

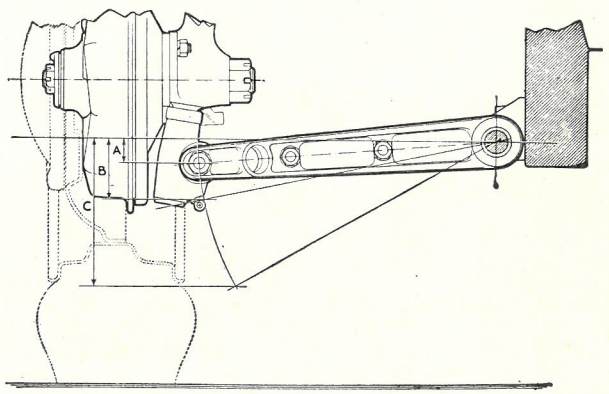


Fig. K.1.

The position of the lower arm of the suspension under various conditions of loading is indicated in this diagrammatic drawing, where "A" is the position under a full load of three passengers and full equipment, "B" is the position with the car unladen and "C" is the assembly position with no load on the torsion bar. For relevant dimensions see table in Section K.2.

When the hub has been bolted in this position and the lock plate replaced, the jack should be raised until the lower swivel pin link registers with the suspension arm. Ensure that the distance tube, dust seals and thrust washers are still clean and in position, and then replace and tighten the bolt.

Tighten the suspension arm clamp bolts and replace the road wheel.

Lower the car onto level ground and measure the difference in level between the suspension arm eyebolt centre and the centre of the bolt connecting the outer end of the arm to the bottom link.

The measurements should be the same on both sides and must be close to the dimensions indicated in Fig. K.1, either " A " or " B," according to the loading conditions.

Section K.3

REMOVAL AND REPLACEMENT OF THE SWIVEL PIN ASSEMBLY

The following instructions are for removing the swivel pin assembly with the brake-drum, hub and brake plate attached. These parts may be removed first, in accordance with the instructions given in Sections K.6 and K.7, and the brake plate left suspended

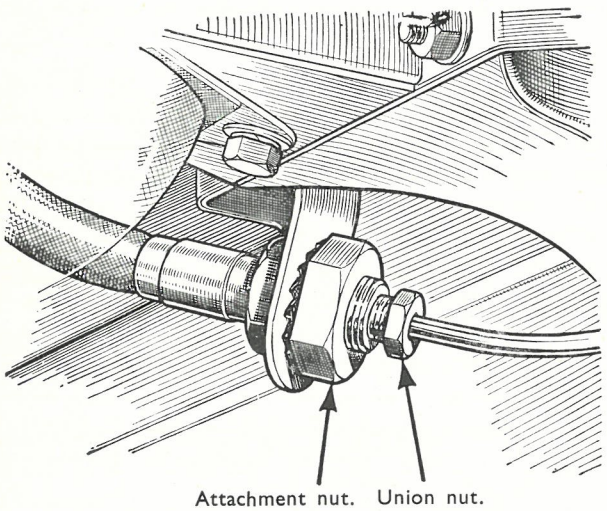


Fig. K.2.

The flexible pipe must be disconnected by unscrewing the union nut and then the attachment nut shown. The hexagon on the end of the flexible pipe itself must not be disturbed.

from the hydraulic damper arm rebound bracket with the flexible hydraulic brake pipe still attached, thus obviating the need to bleed the brakes after reassembly.

Removal

Raise the front of the car and remove the wheel. Place a suitable wooden block beneath the suspension arm and lower the car until the block is just taking the torsion bar load and the upper swivel pin link just clears the rubber rebound pad beneath it.

Unscrew the small union nut securing the hydraulic brake feed pipe to the flexible pipe at the bracket below the wing valance. Detach the flexible pipe by unscrewing the $\frac{1}{2}$ in. hexagon nut, using a $\frac{3}{8}$ in. spanner on the hexagon provided on the hose union, to prevent the flexible hose from turning.

Remove the split pin and slacken off the slotted nut securing the steering tie-rod ball joint to the steering arm. Tap the circumference of the steering arm eye and, placing a support below the steering arm, use a suitable brass drift applied to the ball joint nut to drive the ball pin from its tapered seating.

Slacken off the two $\frac{3}{8}$ in. bolts and nuts clamping the halves of the lower suspension arm together, and slacken the $\frac{7}{16}$ in. nut on the inner end of the arm.

Remove the $\frac{7}{16}$ in. nut and spring washer from the bottom swivel pin link and tap out the bolt.

Collect the distance tube and two thrust washers from the swivel pin link. The two rubber sealing rings will probably stay on the link.

Unscrew the $\frac{7}{16}$ in. nut on the pivot bolt securing the upper swivel pin link to the hydraulic damper arms. Tap the bolt clear of the hydraulic damper arm, using a brass drift to drive it out if necessary and supporting the swivel pin assembly while withdrawing the pin from the hydraulic damper arm, thus leaving the assembly free to be removed for further dismantling.

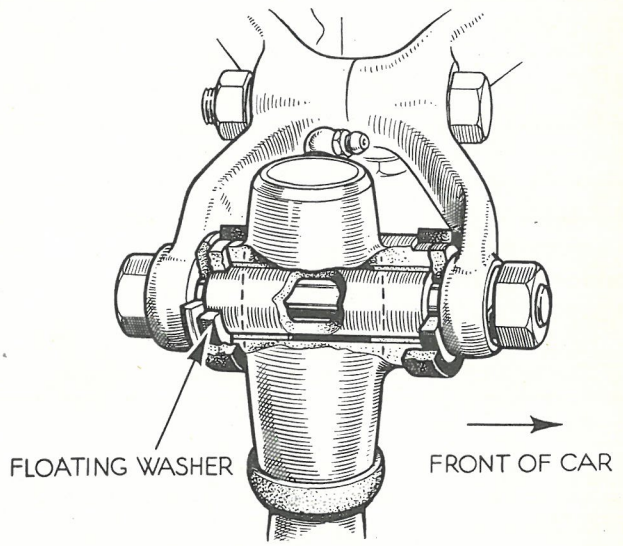


Fig. K.3.

The floating washer, Part No. 136987, introduced to reduce the castor angle on later models with plain pivots, is here clearly shown in position. On current models screwed pivots and links are used as indicated in Section K.11.

Replacement

The swivel pin assembly may be replaced without difficulty by carrying out the removal instructions in the reverse order, provided the following points are given special attention.

1. The swivel pin and links fitted to the left-hand side of the car have left-hand threads at each end, and those fitted to the right-hand side have right-hand threads.
2. The swivel pin links screw onto threads on each end of the swivel pin and the threads are waisted at their centre to avoid fouling the pivot bolts

passing through the links. Before the upper pivot bolt is replaced the link must be correctly positioned on the thread.

Place the pivot in position in the link and screw the link over its maximum travel on the swivel pin thread ; this is about three revolutions. Screw the link back approximately one and a half times to obtain the maximum clearance for the pivot pin in each direction.

If the brake plate has been removed from the swivel pin assembly, the lower link must also be centralised in a similar manner before the brake-drum is replaced and before the swivel pin is fitted to the suspension arm.

3. See Sections K.9 and K.10 if the vehicle is fitted with telescopic front dampers.

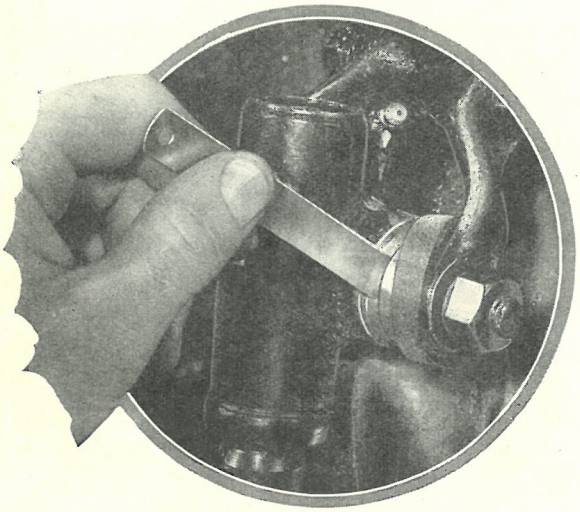


Fig. K.4.

It is essential to give the swivel pin links on pre-screwed pivot models an end float of at least ·005 in. (·12 mm.) to ensure proper functioning. The clearance should be checked with a feeler gauge as shown. (See Section K.11 for details of screwed pivots.)

4. Before the lower steering knuckle link is bolted in position ensure that the distance tube inside it has been replaced and that both thrust washers and rubber seals are fitted correctly.

   On the very early models the thrust washers were flanged, the flange being fitted away from the link. On later models a decreased castor angle has been introduced by machining $\frac{3}{16}$ in. (4·8 mm.) off the long extension of the link, facing towards the front of the car, and adding a floating thrust washer of the same thickness (Part No. 136987) behind the rear end of the link to bring it forward.

5. Insert the distance tube in the upper swivel link and position the floating washer on the rear side of the link. Replace the two thrust washers and rubber seals and engage the link between the damper arms. Make sure that the distance tube, bearing bushes, floating washer and thrust washers are in their correct positions (see Fig. K.3). Replace the bolt and tighten the spring washer and nut.

6. Check clearance between the swivel pin links and thrust washers to ensure that it has not been lost. The clearance, at each end of the swivel pin, should be from ·005 in. to ·011 in. (·12 mm. to ·27 mm.).

Section K.4

DISMANTLING AND EXAMINING THE SWIVEL PIN ASSEMBLY

Remove the swivel pin assembly as detailed in Section K.3 and remove the rubber seals, thrust washers and distance tube from the lower and upper swivel pin link. Unscrew the upper and lower links from the swivel pin ends. **The left-hand swivel pin has a left-hand thread at each end.**

The stub axle is located in position by two hollow dowels between the stub axle flange and swivel pin and is secured by a 1 in. hexagon nut.

Thoroughly clean and dry off all parts and examine them for wear.

Check the swivel pin links for wear across the thrust faces and in the threaded bores. When new, the links should be a free turning fit on the swivel pin, but without slackness. In service a certain amount of slackness is permissible, but when any doubt arises a new swivel link assembly should be fitted. Lubrication of the swivel link assemblies at the intervals recommended will considerably reduce wear on the threads and should be carried out regularly.

Check the top pivot pin and the screwed pivot of later models for wear. If either the link or pin is worn it must be renewed.

The distance tube and two thrust washers fitted to the swivel pin links on models with plain pivots should be examined for wear, particularly the thrust washers, which may have become ridged, and the floating thrust washer. The faces should be flat and parallel. Try the distance tube in the link ; if there is any slackness two new bushes must be fitted and reamed in line, or a new distance tube fitted.

When the swivel pin links, distance tubes and thrust washers are assembled, in the case of links with plain pivots, the total clearance between the links and the thrust washers should be ·005 in. to ·011 in. (·12 mm. to ·27 mm.)

Check that the grease nipples are clear.

If the rubber seals are damaged or worn they should be renewed.

For the correct assembly of the screwed-type links and pivots see Section K.11.

Section K.5

REMOVAL AND REPLACEMENT OF THE LOWER SUSPENSION ARM

Raise the front of the car and remove the wheel. Place a suitable wooden block beneath the suspension arm and lower the car until the block takes the torsion bar load and the upper swivel pin link just clears the rubber rebound pad beneath it.

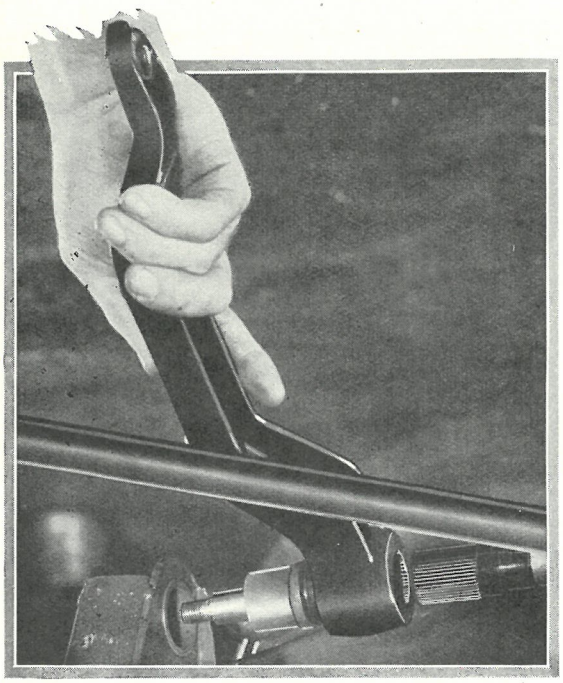


Fig. K.5.
Withdrawing the rear member of the lower suspension arm from its support bracket in the frame.

Slacken off the two $\frac{7}{16}$ in. nuts and two $\frac{3}{8}$ in. nuts and bolts clamping the two halves of the lower suspension arm together.

Remove the $\frac{7}{16}$ in. nut and on models fitted with plain pivots drive out the lower swivel pin pivot bolt. If a split-pinned nut is fitted to each end of the pivot it indicates that a screwed pivot pin is fitted which cannot be withdrawn until the nuts and front half of the suspension arm have been removed, permitting the pin to be unscrewed.

Raise the front of the car until the suspension arm is clear of the wooden block and the torsion bar is unloaded. Remove the two $\frac{3}{8}$ in. nuts and bolts and the remaining $\frac{7}{16}$ in. nut from the arm ; the front half of the arm is then free to be removed.

Remove the split pin, $\frac{3}{8}$ in. slotted nut and flat washer securing the suspension tie-rod to the suspension arm.

Withdraw the $\frac{3}{16}$ in. bolt and spring washer securing the lock plate at the rear of the torsion bar. Remove the two $\frac{3}{8}$ in. nuts, bolts and spring washers securing the torsion bar hub to the frame.

Disengage the torsion bar from its splines and withdraw the rubber bush from the front of the suspension arm support bracket. The rear member of the suspension arm may then be disengaged from the tie-bar and withdrawn from the support bracket. Withdraw the remaining rubber bush.

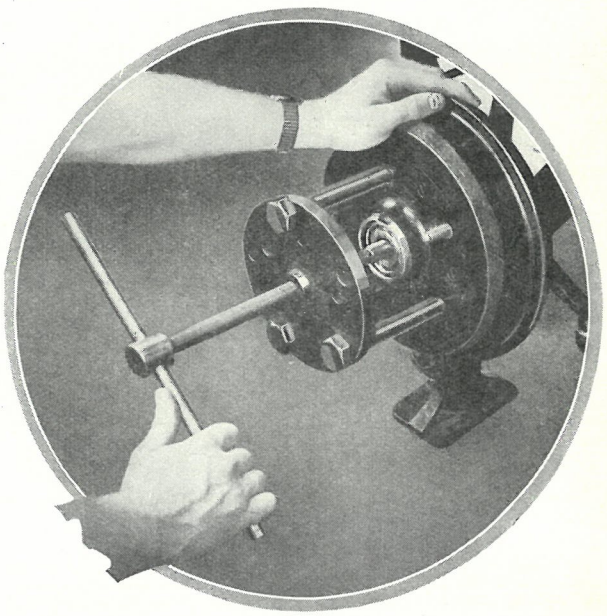


Fig. K.6.
The special extractor (Part No. 68822) in use to withdraw the hub and brake-drum.

Replacement of the suspension arm is a reversal of the above procedure, but if the original eyebolt rubber bushes are worn, new ones must be fitted.

Instructions for resetting the torsion bars are given in Section K.2.

See Section K.10 for method of setting the castor angle on cars with screwed pivot pins.

A jack may be used beneath the suspension arm instead of a wooden block but care must be taken to ensure that it does not slip when under the torsion bar load. A special head is advised.

Section K.6

REMOVAL AND REPLACEMENT OF THE BRAKE-DRUM AND HUB

Prise off the hub cover by inserting the flattened end of the wheel nut spanner in the depressions provided adjacent to the cover holding studs and giving a sideways twist.

Slacken the wheel stud nuts.

Raise the car until the wheel to be operated on is clear of the ground.

Unscrew the stud nuts and remove the wheel.

The brake-drums on some models are attached to the wheel hubs by countersunk-headed screws,

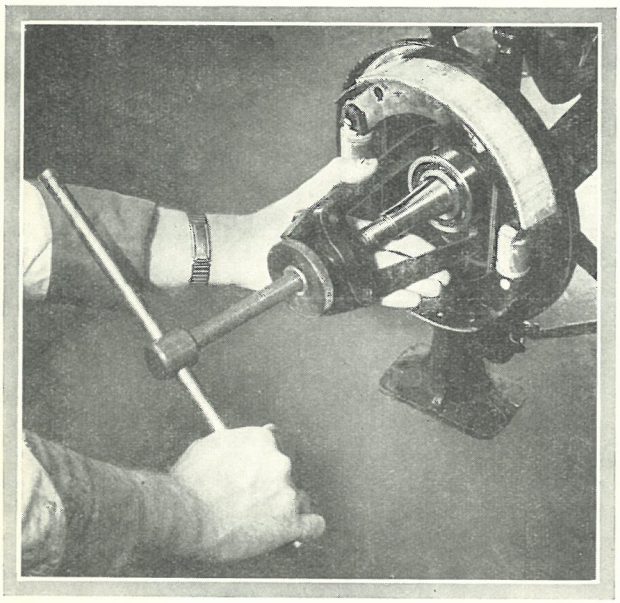


Fig. K.7.
The special extractor (Part No. 68895) in position for extraction of the hub inner bearing.

the inner ends of which are riveted over. These screws must not be disturbed and a complete brake-drum and hub assembly must be used for replacement. Other models have hubs and drums made in one piece. The brake-drum, complete with hub, must be removed to give access to the brake-shoes.

Remove the split pin from the stub axle nut and unscrew the nut, remembering that the axle on the left-hand side of the car has a left-hand thread.

Remove the grease-retaining disc and felt washer.

Note.—*On later models an improved seal is fitted which supersedes the felt washer and retaining disc. It must be prised out of the end of the hub to give access to the hub retaining nut.*

Place the hub extractor (Special Tool, Part No. 68822) in position over the wheel studs and tighten the bolts to retain it in position. Use the central extractor screw to withdraw the brake-drum and hub assembly.

The inner ball race bearing spacer and oil seal will remain on the stub axle and must be withdrawn with the aid of a separate extractor (Special Tool, Part No. 68895). Care must be taken not to damage the oil seal at the rear of the bearing.

Important.—*When the front hub has been removed, the inner bearing, oil seal and hub distance washer* **must** *be removed from the stub axle and replaced in the hub before it is refitted to the stub axle. If the hub is pressed on the shaft without first fitting the bearing and oil seal to it, the inner bearing will re-enter its housing but the oil seal will only be pushed farther from its correct position.*

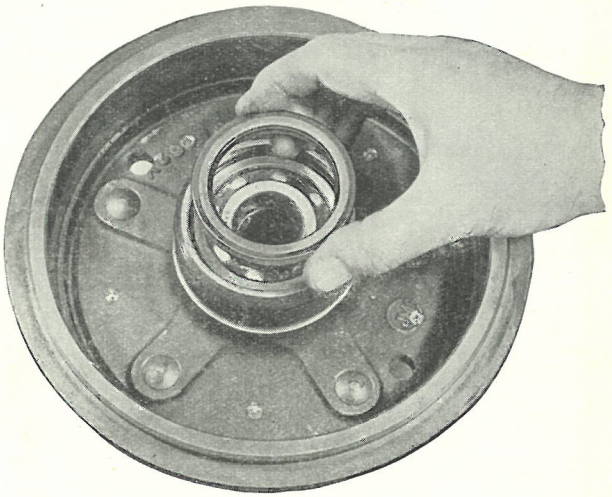


Fig. K.8.
The ball race and oil seal must be fitted to the front hub before it is replaced on the stub axle.

Replacement

If all grease has been cleaned from the hub and the bearings washed for examination, ensure that they are repacked with grease to Ref. C (Page P.2) before the hub is reassembled.

Replace the bearing spacer with the chamfered side towards the small outer bearing and then press the large bearing into position. Replace the oil seal and distance washer. The metal face of the oil seal and the recessed side of the distance washer are fitted away from the bearing.

Replace the hub on the stub axle shaft and, in the case of early models, fit a new felt washer. Refit the grease retainer and replace and tighten the hub nut.

In the case of later models fitted with sealing caps the cap should be repacked with grease to Ref. C

(page P.2) before it is replaced and tapped into position.

Section K.7

REMOVAL AND REPLACEMENT OF THE BRAKE PLATE ASSEMBLY

Remove the brake-drum and hub as detailed in Section K.6.

If it is required to remove the brake plate to the bench for attention then the flexible hydraulic brake hose must be disconnected from its union at the wing valance, but this is not advisable unless absolutely necessary.

If the desired attention can be given without disconnecting the flexible brake pipe, the brake plate assembly can be hung on a suitable portion of the frame to take the load off the flexible pipe.

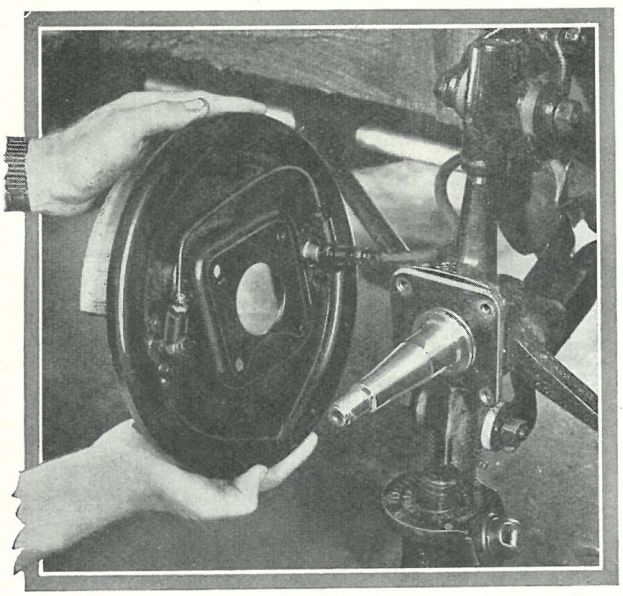


Fig. K.9.
Withdrawing the front brake plate and brake-shoe assembly from the stub axle.

If it is necessary to disconnect the flexible pipe, unscrew the small union nut securing the metal feed pipe to the flexible pipe. This is accessible beneath the wing valance. Use a $\frac{3}{8}$ in. spanner on the hexagon provided on the hose union, to prevent the hose from turning while unscrewing the $\frac{1}{2}$ in. hexagon nut to detach the flexible pipe.

Unscrew the four special-headed $\frac{5}{16}$ in. bolts and nuts securing the brake plate to the stub axle flange and remove the brake plate complete with brake-shoes and wheel cylinders.

Reassembly takes place in the reverse order to dismantling but do not forget to bleed the brakes if the flexible pipe has been disconnected.

Section K.8

TORSION BAR BUFFERS

Under severe road conditions it has been found that the torsion bar sometimes deflects sufficiently to contact the bolt heads for the frame cross-members.

As it is essential that all surface damage to the torsion bars should be avoided, rubber buffers are fitted to the torsion bars, between the bolt locations, as indicated in Fig. K.10.

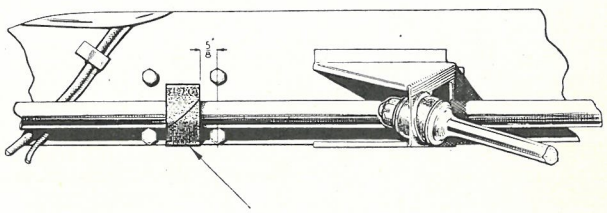


Fig. K.10.
The location of the rubber protecting buffers on the torsion bars.

Section K.9

CAMBER ADJUSTMENTS

On models fitted with twin telescopic dampers at the front a certain amount of adjustment to the camber is possible by means of the eccentric shaft forming the inner mounting for the top wishbone, to accommodate wear and settling.

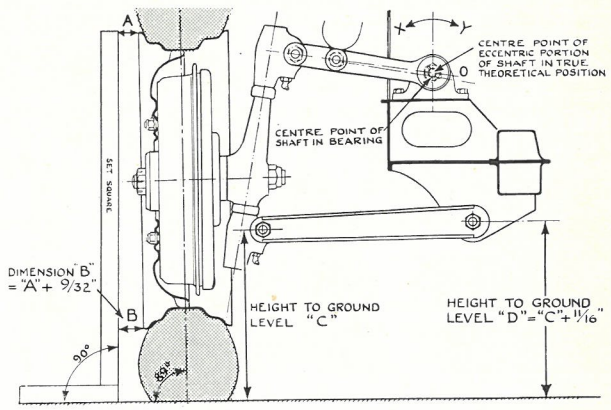


Fig. K.11
The method of checking and adjusting the camber on models equipped with twin telescopic dampers.

To check the camber, position the car on an absolutely level floor complete with full equipment (tools, spare wheel, petrol, water), but without passengers.

Set the wheels in the straight-ahead position and check the dimension "A," Fig. K.1. This should be $\frac{11}{16}$ in. Adjust the load on the car to obtain this condition.

Place a large square alongside the wheel and measure the extent of the camber by taking measurements between the face of the square and the top and bottom of the rim edge ("A" and "B," Fig. K.11). There should be a difference of $\frac{9}{32}$ in. between the two measurements, the lower one being the greater, of course.

If the difference is less than $\frac{7}{32}$ in. or more than $\frac{11}{32}$ in. the camber must be adjusted as follows :—

Loosen both of the slotted nuts on the eccentric shaft for the upper link inner pivot bearing. If the dimension "B" (Fig. K.11) is less than required, turn the shaft, by means of the flats provided, in the direction "X."

If the dimension "B" is greater than required, turn the shaft in the direction "Y."

When the correct dimension is obtained, fully tighten the slotted nuts without disturbing the setting and split-pin them in position.

Section K.10

CASTOR ANGLE SETTING

On cars fitted with screwed pivot pins to the swivel pin links the castor angle may be set within certain limits by adjusting the location of the screwed pivot pin sleeve in the upper link.

It is therefore important to see that the correct castor angle is achieved on assembly.

Adjust the screwed pin of the lower swivel link so as to leave $\frac{3}{16}$ in. of its threaded stem protruding

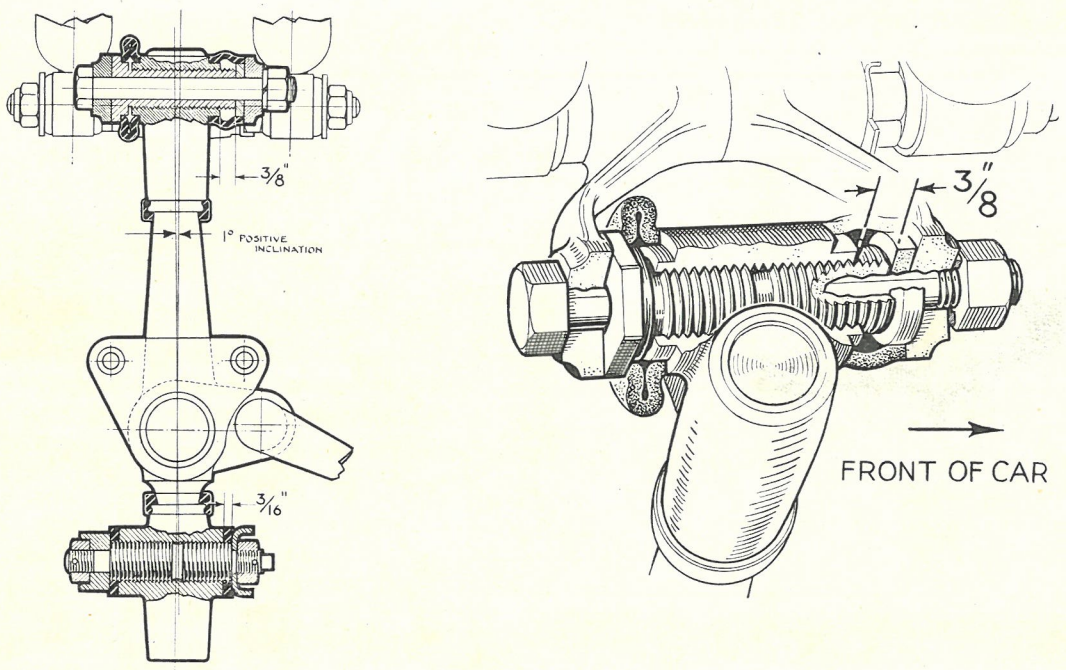


Fig. K.12.
The bottom swivel link pivot sleeve should be positioned so that it protrudes an equal amount ($\frac{3}{16}$ in.) (4·8 mm.) on each side of the link as shown. The upper link screwed sleeve should project $\frac{3}{8}$ in. (9·5 mm.) on the forward face of the upper link as indicated.

at each side of the link. (See Fig. K.12.) Screw the top link pivot sleeve through the rear face of the upper links until $\frac{3}{8}$ in. of its thread extends from the front face (see Fig. K.14), when it is bolted up between the upper suspension arms with the thrust washers in position against the rear face of the forward arm.

This should provide a castor angle of 1° measured with the car with its normal laden weight on the springs.

Section K.11

FRONT SUSPENSION RATTLE

When front suspension rattle is experienced on cars fitted with steering swivel pin links with plain pivot pins, the following action should be taken :—

1. Ensure that all suspension bearings are adequately lubricated through the grease nipples with the grease gun and examine the steering gear assembly for visible oil leaks, since the lubricant in this assembly provides damping and subdues mechanical rattle.

Assuming the lubrication of the suspension system is satisfactory and rattle persists :—

2. Examine the end clearance of the top swivel pin link bearings. If this exceeds ·002 in. the locknut should be released and the adjusting nut screwed up to give this figure. Re-tighten the locknut and lock with the tab washer in the new position. Re-grease the bearing assembly after this operation.

If the rattle still persists :—

3. Check the outer ball connections for play along the axis of the tie-rod. If play in this plane is observed, fit new joints.

Note.—*It should be borne in mind that front suspension rattles are more prevalent in hot weather, due to the reduced lubricant viscosity. Suspension rattle should not be confused with shock absorber noises. Should the complaint be traced to defective shock absorbers refer to the instructions regarding these in Section L.*

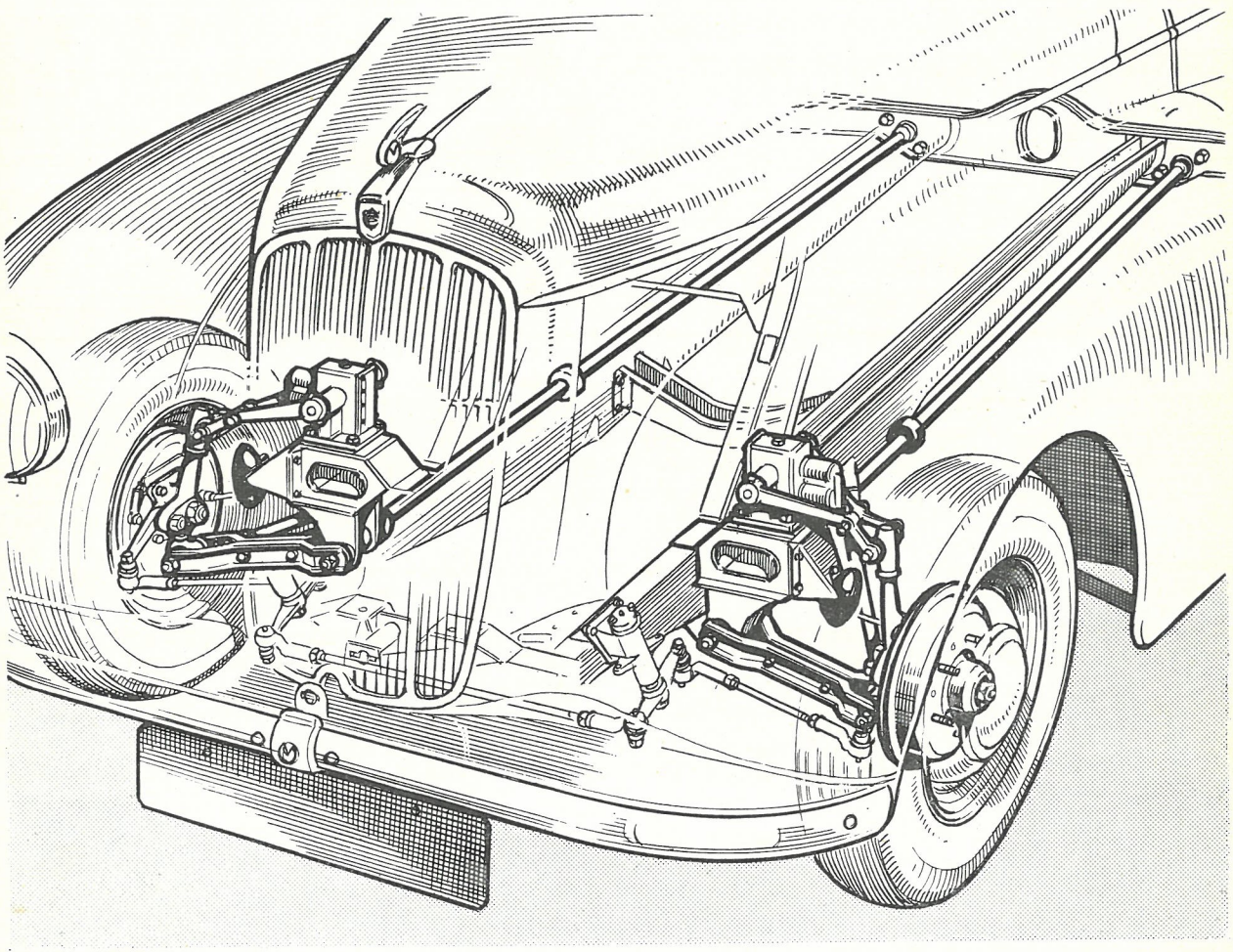


Fig. K.13.
A general view of the front suspension on early models with piston-type dampers showing the disposition of its components.

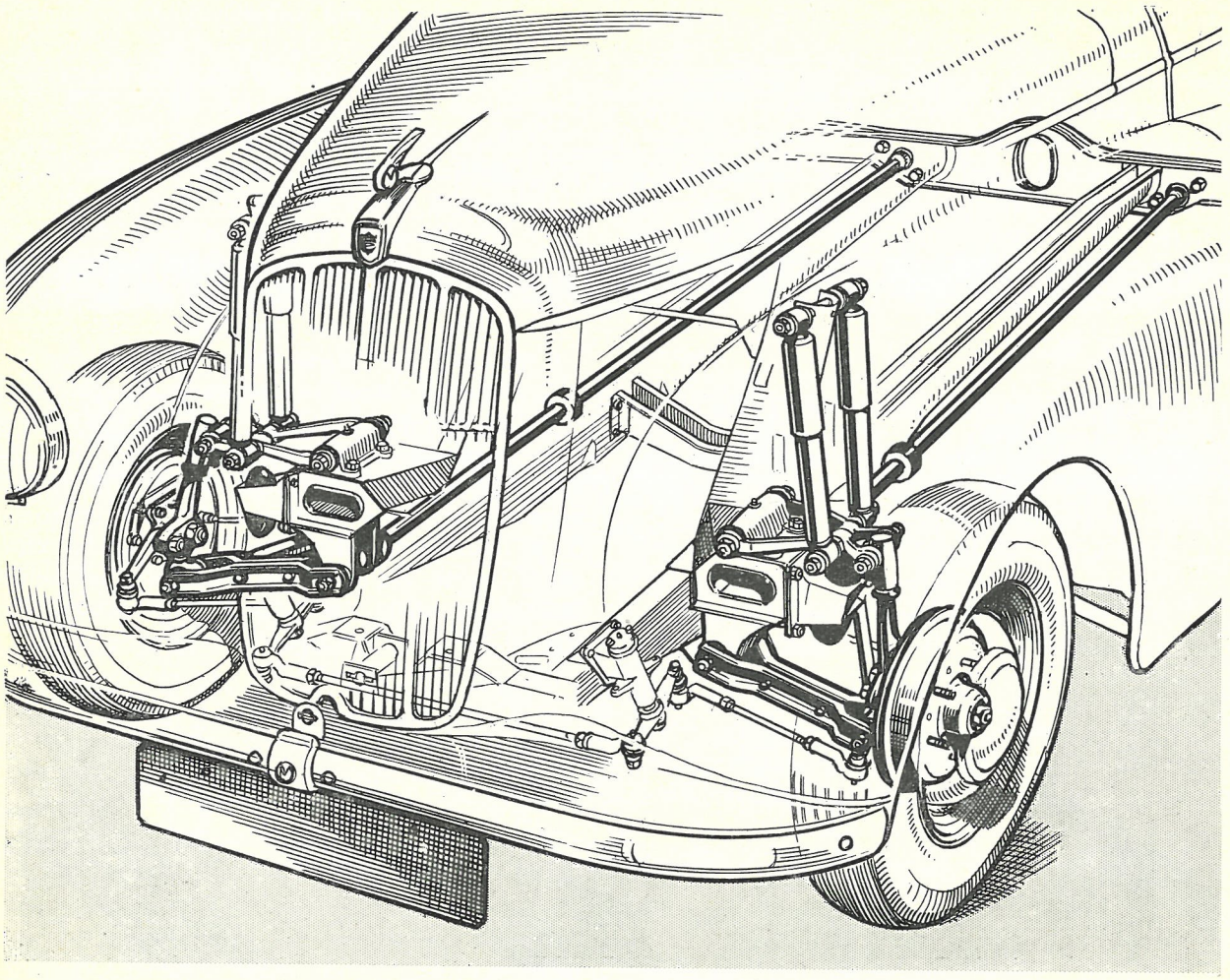


Fig. K.14.
The arrangement of the front suspension on later models fitted with twin telescopic front dampers.

SECTION L

THE HYDRAULIC DAMPERS

General Description.

Maintenance.

Section No. L.1 Removal and replacement of the dampers.

Section No. L.2 Testing hydraulic dampers.

Section No. L.3 Topping up with fluid.

Section No. L.4 Telescopic dampers.

Section No. L.5 Fitting telescopic rear dampers.

GENERAL DESCRIPTION

Hydraulic dampers of the Girling, Armstrong or Woodhead-Monroe double-acting type are fitted to the suspension. All working parts are submerged in oil. The hydraulic dampers are carefully set before dispatch and cannot be adjusted without special equipment. Their design is such that they are capable of giving long service without attention, other than the periodical replenishment of the fluid in the case of the Girling or Armstrong type. The Woodhead-Monroe telescopic type cannot be replenished and defective dampers of this type must be replaced.

MAINTENANCE

The maintenance of the Armstrong rear hydraulic dampers in position on the vehicle is confined to the periodical examination of the anchorage to the chassis and axle, and tightening the fixing bolts up as required. The cheese-headed screws securing the cover-plate must be kept fully tightened to prevent leakage of the fluid. For replenishing the fluid at every 12,000 miles (20000 km.) they must be removed from the chassis and thoroughly cleaned before the filler plug is unscrewed.

The front dampers may be replenished without removal since they are in a protected position, provided they are thoroughly cleaned before the filler plug is removed.

No adjustment of the dampers is required or provided. Any attempt to dismantle them will seriously affect their operation and performance. They should be returned to their respective makers for attention.

In cases where steering instability or flabbiness is evident it is essential to check the front damper arms for absence of free movement as detailed in Section L.2.

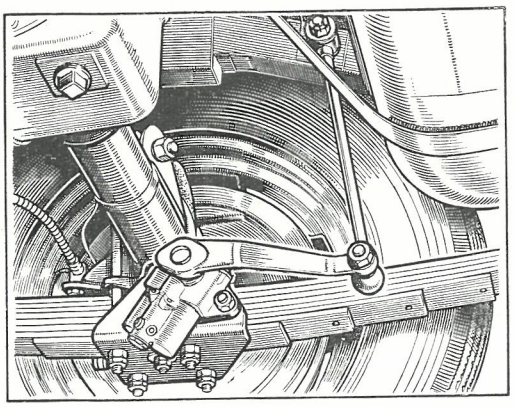


Fig. L.1.
The Armstrong-type rear damper on earlier models, showing its attachment to the spring plate and the anchorage of its link rod to the frame.

Section L.1

REMOVAL AND REPLACEMENT OF THE ARMSTRONG DAMPERS

To withdraw the rear dampers from their anchorage brackets, remove the split pin and the $\frac{3}{8}$ in. nut securing the damper arm link to the frame and extract the rubber bushes. Remove the link from its pivot bolt and the two $\frac{5}{16}$ in. nuts and spring washers securing the damper body to the spring bracket.

To remove the front suspension, raise the front of the car until the road wheels are almost clear of the ground and remove the hub cap and wheel.

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Unscrew the $\frac{7}{16}$ in. nut and bolt securing the swivel pin link between the damper arms. Support the hub and swivel pin assembly and tap the bolt out of the damper arm, using a copper hammer or drift if necessary.

The damper may be withdrawn after removal of the nuts and bolts securing it to the body.

To extract the damper on the steering column side of the car, one of the damper arms must be removed. It should be noted that one arm only is splined to the damper shaft. The other arm, being a push fit, is more easily removed.

Replacement of the dampers is carried out in the reverse order to the removal procedure, but if the rubber bushes on the rear damper links are worn, new ones must be fitted. After replacing and tightening the swivel pin bolt, check the clearance between one of the thrust washers and the swivel pin link. There must be a clearance of ·005 in. (·12 mm.) to ·011 in. (·27 mm.). (See Fig. K.4.)

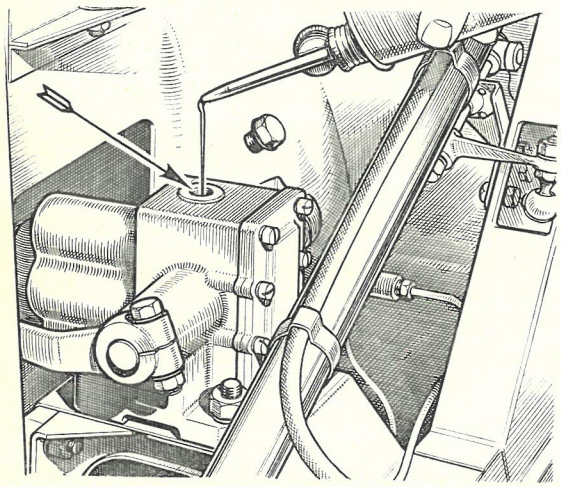


Fig. L.2.
Replenishment of the front piston-type dampers on the earlier models can be effected in position if the exterior is carefully cleaned before removing the filler plug.

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. When the damper arm is in the half-way position the free rotational movement at the end of the arm must not exceed $\frac{1}{16}$ in. (1·6 mm.).

Note.—*Before fitting the link to the attachment on the frame or swivel pin, 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.2

TESTING ARMSTRONG HYDRAULIC DAMPERS

If there is any doubt that the road springs are adequately damped, the condition of the springs and the tyre pressures should also be considered, as these have an appreciable bearing on the results obtained.

To do this, raise the front of the car and support it on suitable blocks, so that the tyres are just clear of the ground, remove the road wheel on the side on which attention is to be given, support the lower suspension member with a suitable jack and take the load, remove the upper link pin and free the damper arm from the link, ensuring that the swivel pin is supported in such a way that it will not fall outwards from the top and thus stretch the Lockheed flexible pipe.

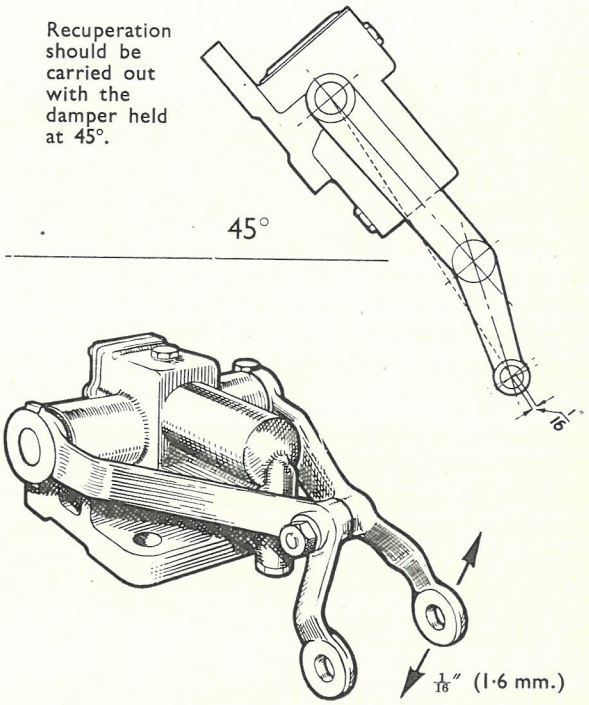


Fig. L.3.
To ensure good steering the hydraulic front dampers must not have more than $\frac{1}{16}$" (1·6 mm.) of free movement at the end of the arm.

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, or free movement in the lever is noted, lack of fluid is indicated or there may be air in front of the pistons.

When the fluid level is correct and all air has been removed from the damper, free rotational movement

at the end of the arm must not exceed $\frac{1}{16}$ in. (1·6 mm.).

If the addition of fluid (added to the level given in Section L.3) gives no improvement, and excessive free movement exists, disconnect the damper from its mounting on the chassis and remove it. (Some difficulty may be experienced with early-type vehicles in removing the damper on the steering side, and withdrawal of the front half of the damper arm will assist in these cases.) Remove the filler plug and ensure that the movement is topped up with fluid to the filler orifice. Now support the damper in a vice at an angle of 45°, cover-plate to the top, and work the damper arm through six to eight complete cycles. This will release air from the compression chambers, ensuring smooth and equal resistance, and render the damper satisfactory, provided, of course, no mechanical fault exists.

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 for a new or reconditioned one.

Important.—*When recuperation has been effected, dampers must be maintained in their upright or normal running position, otherwise air will find its way into the compression chambers again, and render the damper ineffective.*

When recuperation has been effected, paint a strip of yellow paint on the top of the damper, for identification purposes. All units checked at the factory are so marked.

Reassembly and replacement on the car should be effected in the reverse order to dismantling.

Section L.3

TOPPING UP ARMSTRONG DAMPERS WITH FLUID

The front dampers may be replenished in position, providing the tops have been thoroughly cleaned before the filler plug is extracted. The rear dampers must be removed from the chassis to ensure that they are clean and that no dirt from the axle casing or underside of the body falls into the filler orifice.

Before removing the filler plug (located on the top of the damper) carefully clean the whole of the exterior of the damper, especially in the vicinity of the filler plug. **This is most important, as it is absolutely vital that no dirt or foreign matter should enter the operating chamber.**

Use of Armstrong Super Shock Absorber Oil only in the Armstrong dampers is imperative.

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, and in the case of the front dampers they should be held at 45° while recuperation takes place.

The interior of the body should be filled with fluid to the level of the bottom of the filler plug hole.

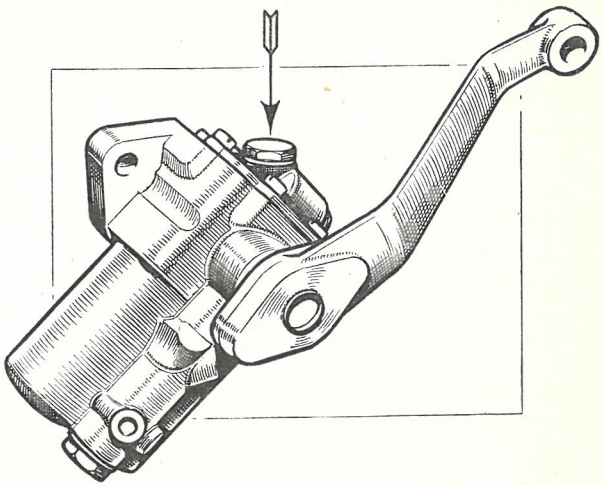


Fig. L.4.
The location of the filler plug on the rear Armstrong piston-type shock absorbers.

Section L.4

TELESCOPIC DAMPERS

Some models are fitted with telescopic dampers. These are non-adjustable and no provision is made for replenishment.

They should be removed every 12,000 miles (20000 km.) and checked for free movement.

In the event of a damper being found defective it must be replaced by a new unit.

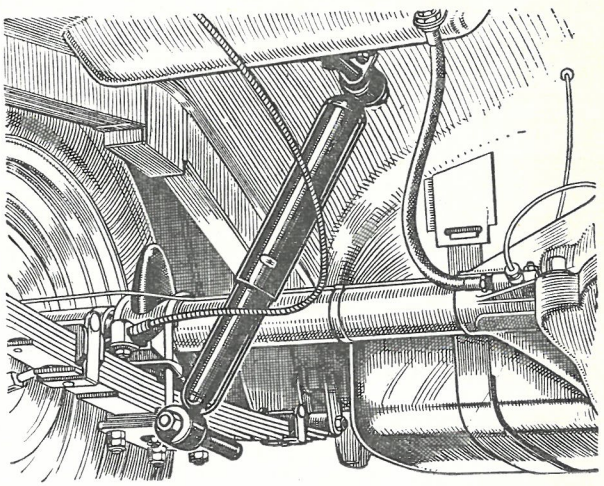


Fig. L.5.
The telescopic damper fitted to some models. Its diagonal mounting eliminates the need for a sway bar.

Fig. L.6.
Some models fitted with Armstrong dampers at the rear make use of a larger type, which are attached to an extension plate on the rear spring bracket in the manner shown. Note the location of the countersunk fixing screw which should not be disturbed normally.

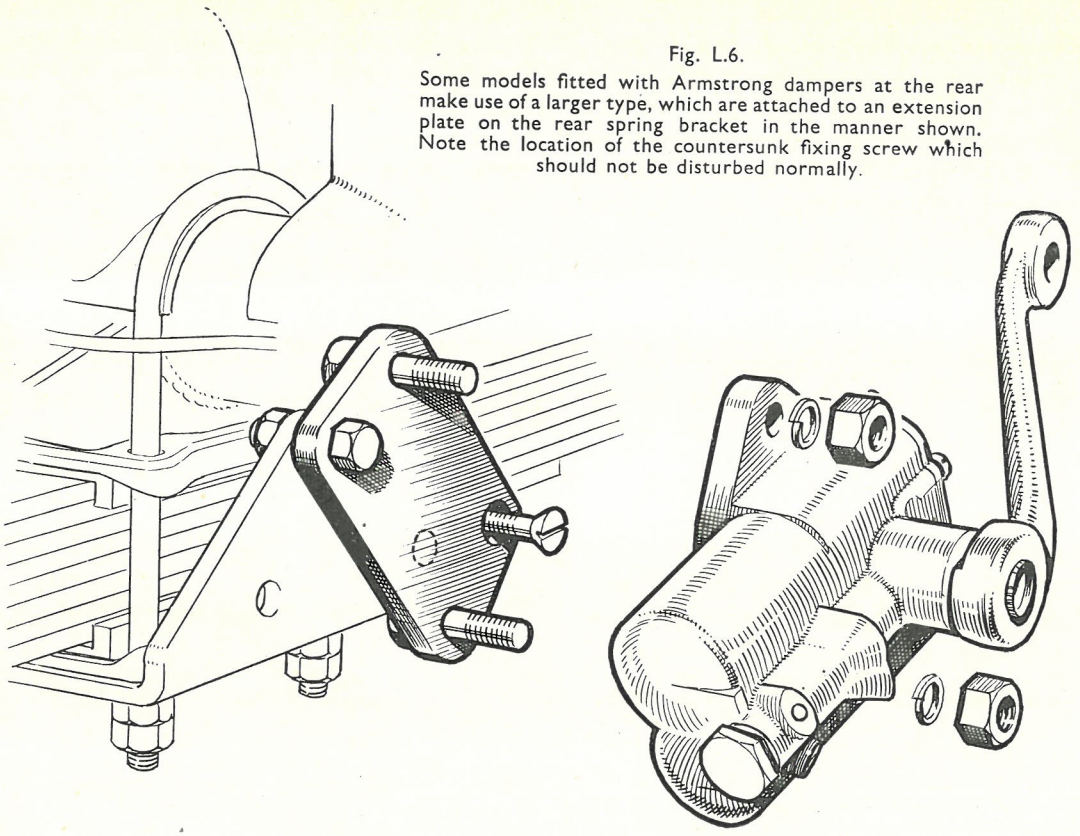
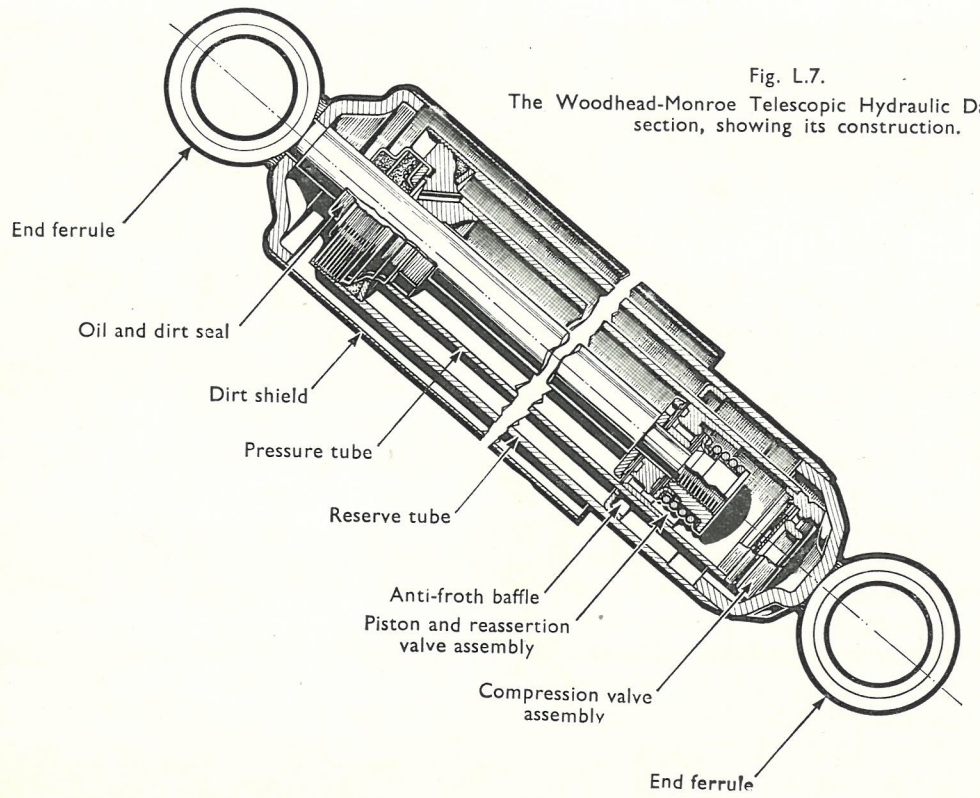


Fig. L.7.
The Woodhead-Monroe Telescopic Hydraulic Damper in section, showing its construction.



Section L.5

FITTING TELESCOPIC REAR DAMPERS

In cases where complaints are received concerning the functioning of the piston rear dampers fitted to the earlier models the telescopic type can be fitted without much difficulty.

In the first place the old type dampers and the anti-sway bar must be removed as the latter is no longer required, the diagonal mounting of the telescopic dampers fulfilling the function of an anti-sway device.

The body shell requires the following additional drilling and reinforcing:—

1. Reinforcement angle brackets must be fitted in the angle between the squab support reinforcement cross-members and the floor of the spare wheel compartment on each side. The Part Number of the reinforcement angle bracket is 137170-Z and they should be welded to the squab support reinforcement and the spare wheel floor with six welds approximately $\frac{3}{4}$ in. (20 mm.) long at each corner and in the centre as indicated in Fig. L.3 so that their centres are $9\frac{7}{16}$ in. (240 mm.) from the centre of the car.
2. Two reinforcement plates for the shock absorber pivot, Part No. 137171-Z must also be welded to the forward face of the seat pan with their centre 1 in. (2·5 cm.) below the top edge of the seat pan and $9\frac{7}{16}$ in. (240 mm. (from the centre of the car. Eight welds approximately $\frac{1}{2}$ in. (13 cm.) long should be made, two at each corner as indicated in Fig. L.3.
3. Slotted holes should be made in the reinforcements and panels as indicated.
4. The shock absorber frame-pivot (Part No. 136971-Z) can now be fitted, using $\frac{5}{16}$ in. B.S.F. hexagon bolts $\frac{3}{4}$ in. (20 mm.) long with nuts and spring washers.
5. New rear spring clamp brackets, Part Nos. 139610 and 139611 must be fitted to the springs. These carry the pivot pin for the lower end of the shock absorber.
6. The telescopic dampers can now be fitted to the pivot pins with $\frac{7}{16}$ in. B.S.F. Philidas self-locking nuts and special bearing retaining washers, Part No. 50014-Z.

Do not forget that the sway bar is no longer required and must be removed complete with its pin and bushes from the frame and axle brackets.

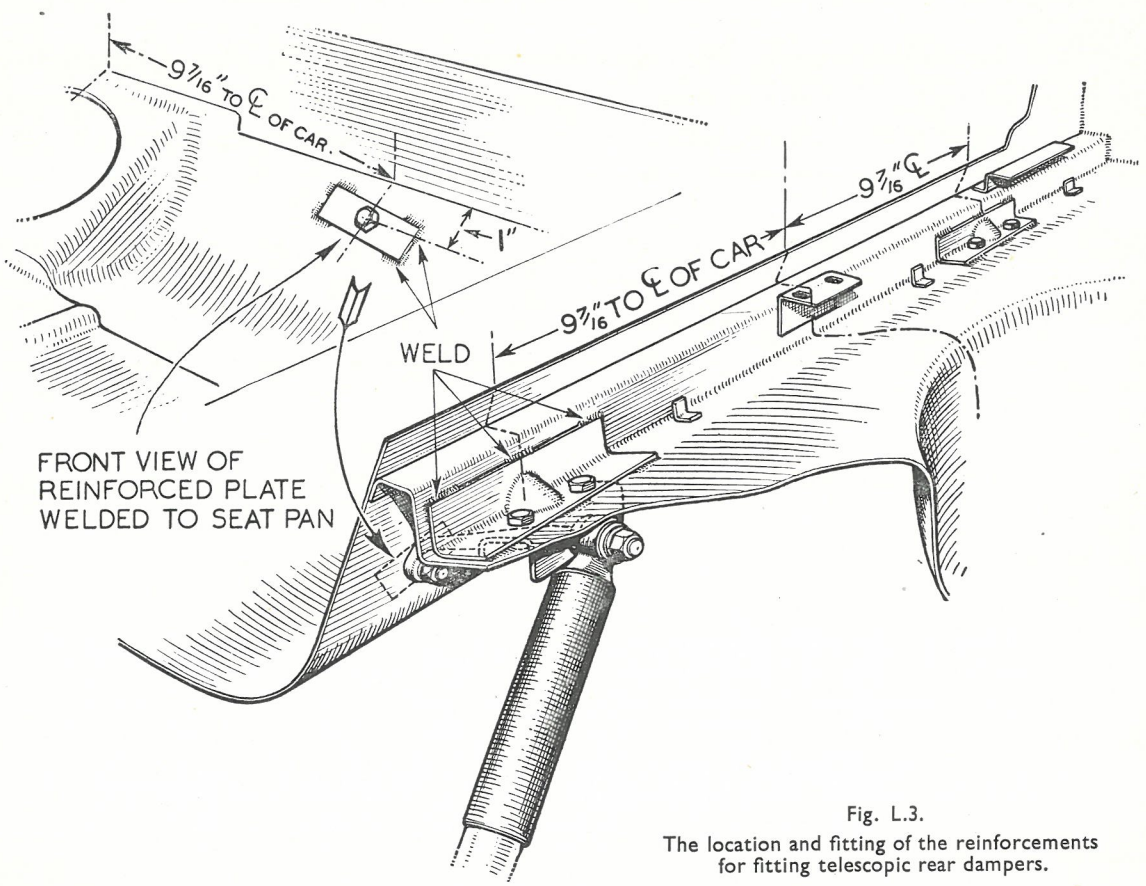


Fig. L.3.
The location and fitting of the reinforcements for fitting telescopic rear dampers.

SECTION M

THE BRAKING SYSTEM

General Description.

Maintenance.

The Master Cylinder.

Section No. M.1 Adjustment of the brake pedal.

Section No. M.2 Brake-shoe adjustments.

Section No. M.3 To bleed the system (expel air).

Section No. M.4 Removal of the master cylinder.

Section No. M.5 Dismantling the master cylinder.

Section No. M.6 Assembling the master cylinder.

Section No. M.7 Replacing the master cylinder.

Section No. M.8 Brake assembly.

Section No. M.9 Removal of the wheel cylinder.

Section No. M.10 Dismantling the wheel cylinder.

Section No. M.11 Assembling the wheel cylinder.

Section No. M.12 Replacement of wheel cylinder.

Section No. M.13 Removal of flexible hose.

Section No. M.14 Removal and replacement of brake-shoes.

Section No. M.15 Relining the brake-shoes.

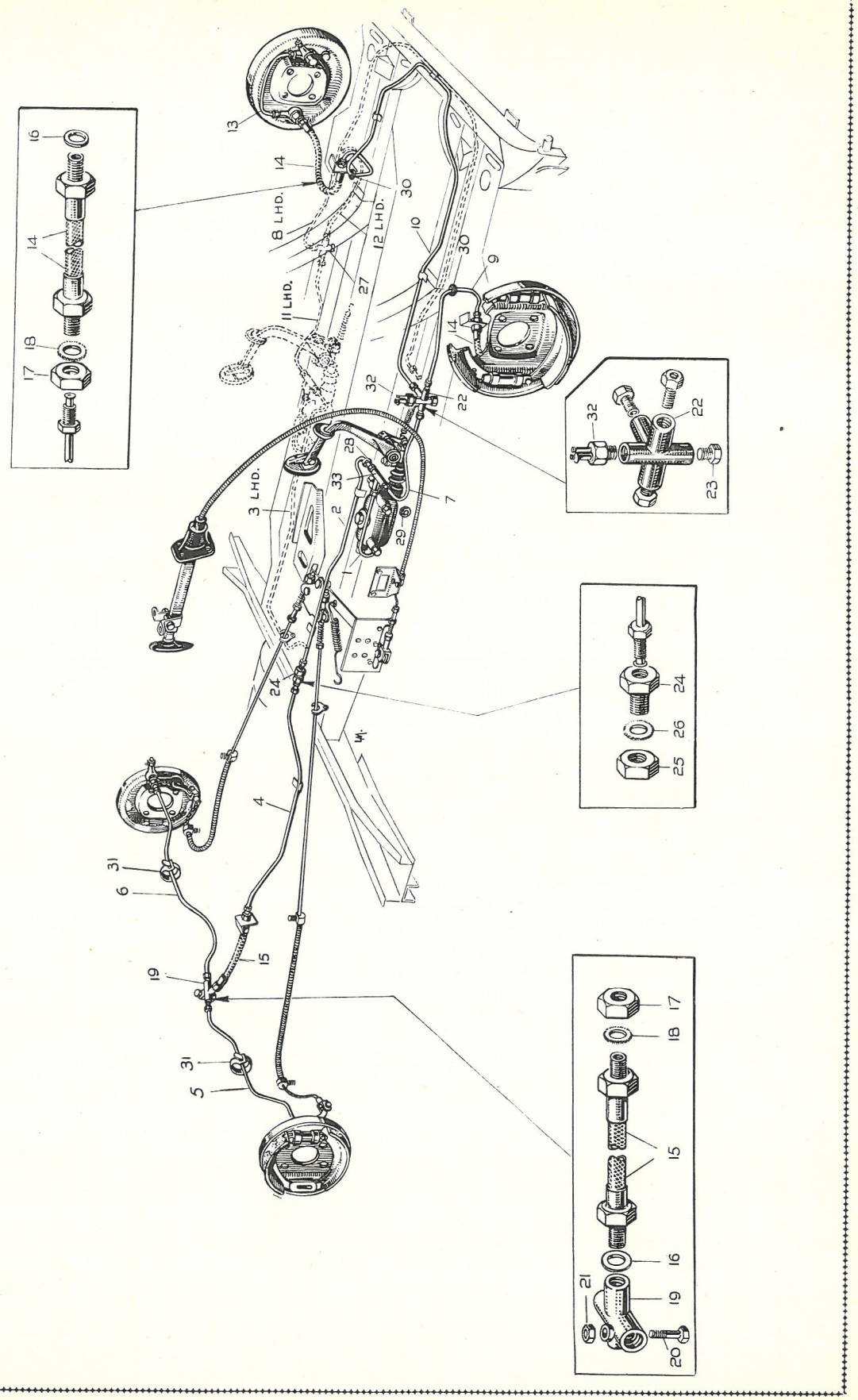
Section No. M.16 Important points.

Section No. M.17 Braking irregularities and their causes.

Section No. M.18 The hand brake.

Section No. M.19 Brake squeaks.

THE BRAKING SYSTEM COMPONENTS



KEY TO THE BRAKING SYSTEM COMPONENTS

No.	Description
1.	Pipe—master cylinder to 3-way connection.
2.	Pipe—3-way connection to cross-member.
3.	Pipe—3-way connection to cross-member (L.H.D.).
4.	Pipe—cross-member to rear hose.
5.	Pipe—3-way rear—to R.H. wheel cylinder.
6.	Pipe—3-way rear—to L.H. wheel cylinder.
7.	Pipe—3-way front—to stop-light switch connection.
8.	Pipe—3-way front—to stop-light switch connection (L.H.D.).
9.	Pipe—stop-light switch connection to R.H. front hose.
10.	Pipe—stop-light switch connection to L.H. front hose.
11.	Pipe—frame 3-way to L.H. front 3-way (L.H.D.).
12.	Pipe—L.H. front 3-way to L.H. front hose (L.H.D.).
13.	Pipe—wheel cylinder bridge—front.
14.	Hose—front.
15.	Hose—rear.
16.	Gasket—hose.
17.	Locknut—hose.
18.	Washer—hose connections.
19.	3-way piece—rear axle.
20.	Bolt—3-way piece.
21.	Nut—3-way piece bolt.
22.	3-way piece—front pipe and stop-light switch adaptor.
23.	Screw—stop-light switch adaptor.
24.	Connection—cross-member.
25.	Locknut—connection.
26.	Washer—connection.
27.	3-way piece—L.H. front (L.H.D.).
28.	Grommet—pipes through frame—small hole.
29.	Grommet—pipes through frame—large hole.
30.	Grommet—pipes through tie-plates.
31.	Strap—pipes to axle.
32.	Switch—stop-light.
33.	3-way piece—master cylinder and pipe.

GENERAL DESCRIPTION

The Lockheed hydraulic brake-operating equipment comprises a combined fluid supply tank and master cylinder in which the hydraulic pressure is generated, and wheel cylinders which operate the brake-shoes.

Steel pipe lines, unions and flexible hoses convey the hydraulic pressure from the master cylinder to each wheel cylinder.

Each brake-shoe on the front wheels has a separate wheel cylinder, thus providing two leading shoes.

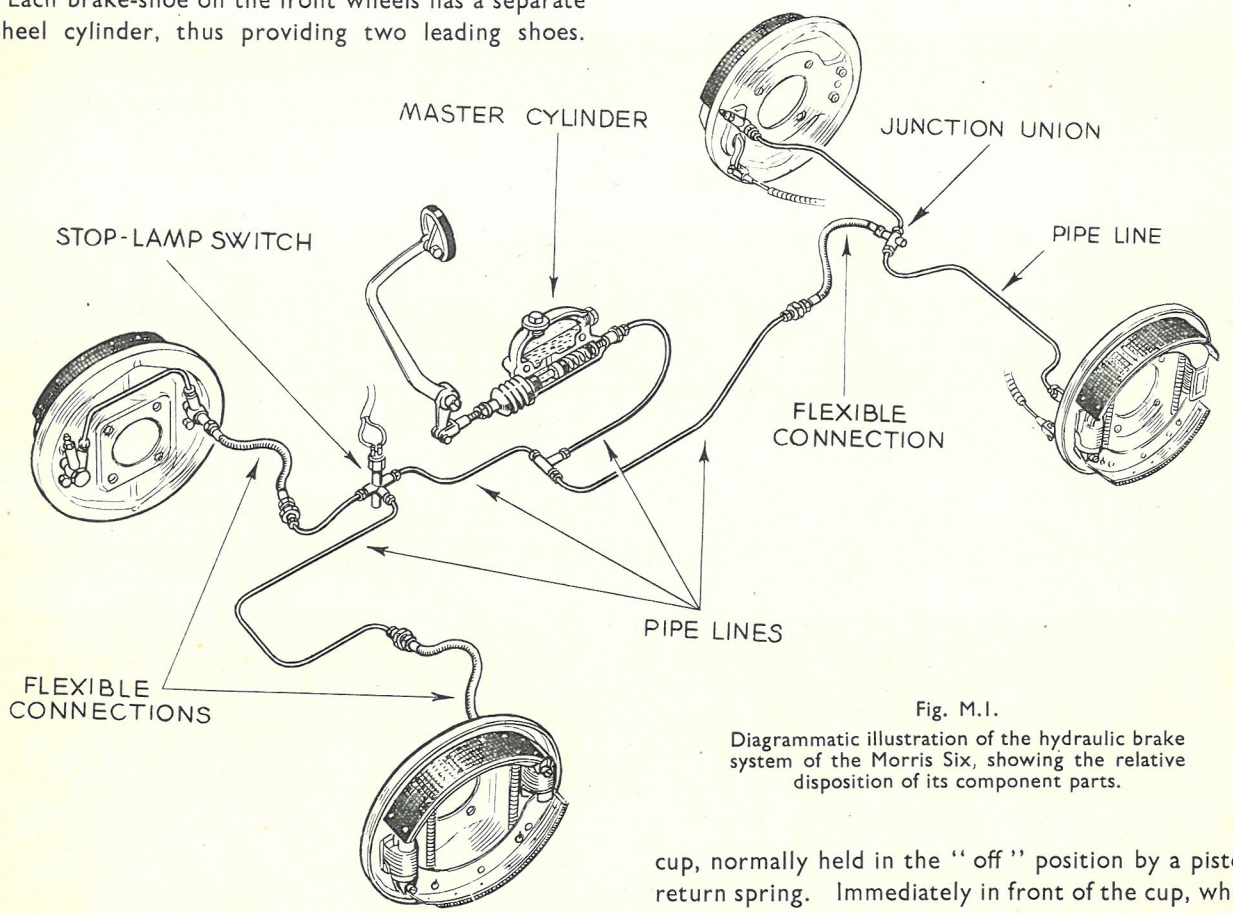


Fig. M.1.
Diagrammatic illustration of the hydraulic brake system of the Morris Six, showing the relative disposition of its component parts.

On the rear wheels a single wheel cylinder, operated both hydraulically and mechanically, floats on the brake plate and operates the two shoes, giving one leading and one trailing shoe in either direction of rotation to provide adequate braking in reverse.

MAINTENANCE

Periodically examine the quantity of brake fluid in the master cylinder. It should not be less than half full or closer than $\frac{1}{2}$ in. (13 mm.) from the bottom of the filler neck. 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.

Adjust the brake-shoes to compensate for wear of the linings. The need for this is shown by the pedal going down almost to the floorboards before solid resistance is felt. For brake-shoe adjustments see Section M.2.

THE MASTER CYLINDER

The master cylinder is mounted on the driver's side of the car underneath the gearbox cover.

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, and produce binding of the brakes on all wheels. 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, thus 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 the 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.

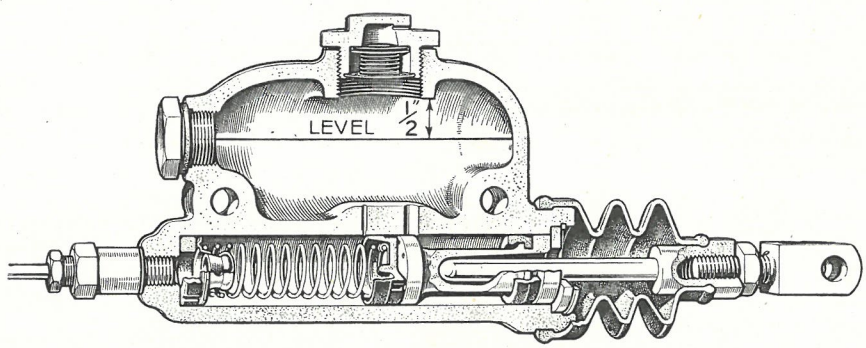


Fig. M.2.
The master cylinder in section, showing its components and construction. The correct level for the hydraulic fluid is also shown clearly.

Section M.1

ADJUSTMENT OF THE BRAKE PEDAL

The correct amount of free movement between the master cylinder push-rod and piston is set during erection of 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 obstructs 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.*

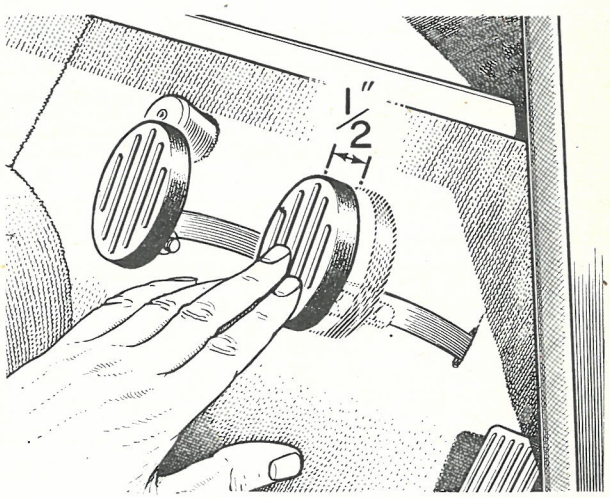


Fig. M.3.
There must be $\frac{1}{2}$ in. (13 mm.) of free movement at the pedal pad before resistance is felt. When this free movement becomes excessive and the pedal can be depressed so that it is close to the floorboard the need for adjustment is evident.

Section M.2

BRAKE-SHOE ADJUSTMENTS

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.

Use the special jack provided in the tool kit to raise one side of the car, placing suitable blocks beneath the wheels remaining in contact with the ground.

The front brakes

Remove the front hub cap and road wheel and rotate the brake-drum until both adjustment screws are visible through the holes provided in the face of

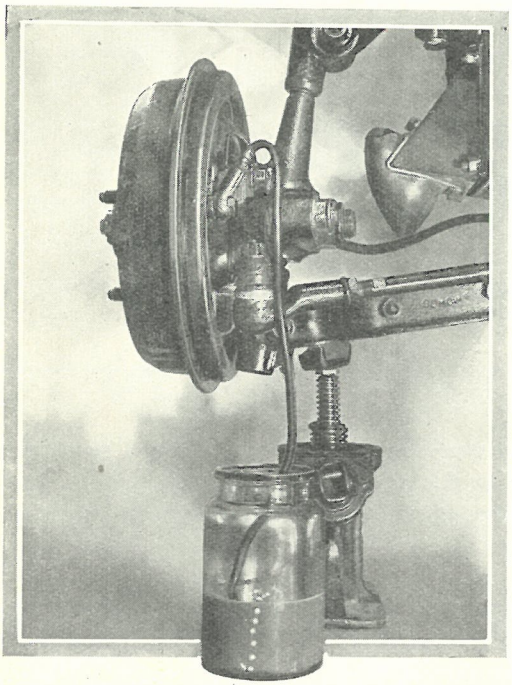


Fig. M.4.
The hydraulic system is bled by means of a bleeding tube attached to the bleeding-screw nipple. The lower end of the tube is submerged in a glass jar so that the formation of bubbles can be observed.

the brake-drum. With a screwdriver turn both screws as far as they will go in a clockwise direction until the drum is locked solid, then turn them anti-clockwise **one** notch only. The brake-drum should then be free to rotate without the shoes rubbing, and the adjustment on this wheel is complete. The brake-shoes on the other front wheel must be adjusted by the same method.

The rear brakes

The procedure is similar to that detailed for the front brakes except that there is only one adjuster, and this controls both shoes.

Section M.3

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 master cylinder with Lockheed hydraulic brake fluid and keep it at least half full throughout the

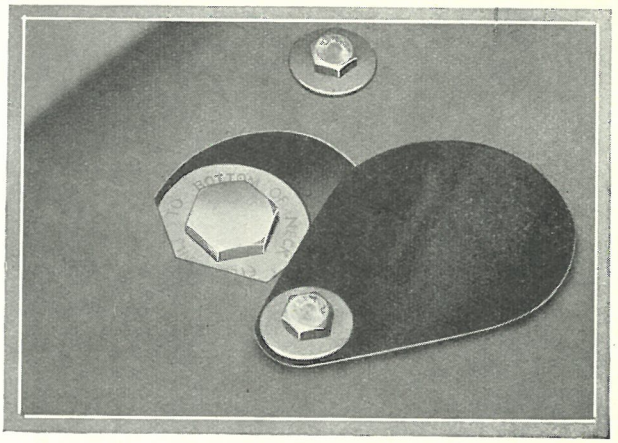


Fig. M.5.
The master cylinder filler is accessible for replenishments through the hinged cover-plate revealed when the carpet in front of the driver's seat is lifted.

operation, otherwise air will be drawn into the system, necessitating a fresh start.

Attach the bleeder tube to the wheel cylinder bleeder screw and allow the free end of its tube to be submerged in a small quantity of fluid in a clean glass jar.

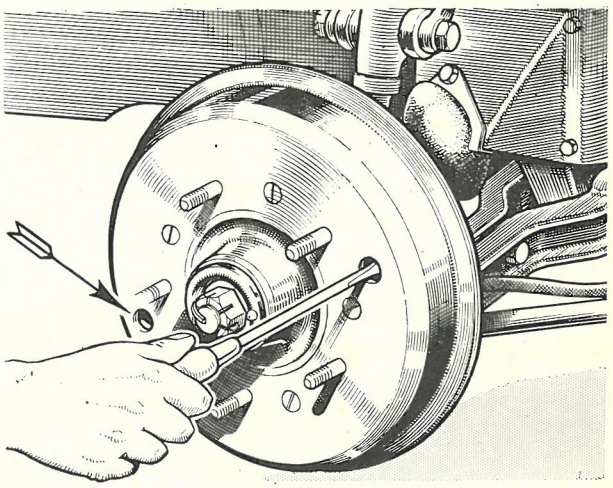


Fig. M.6.
The brake-shoes are adjusted by engaging the adjusting screws with a screwdriver through the holes provided in the brake-drum. The front brakes have separate adjusters for each shoe, the rear brake-shoes only one.

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 air bubbles cease to appear, hold the pedal firmly against the floorboards while the bleeder screw is securely tightened.

Repeat the operation on each wheel.

Note.—*Clean fluid bled from the system must be allowed to stand until it is clear of air bubbles before using it again. Dirty fluid should be discarded.*

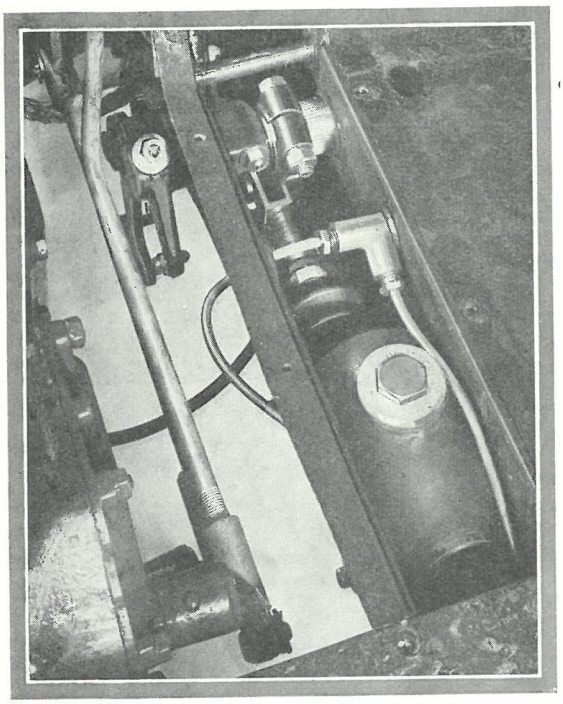


Fig. M.7.

The master cylinder is located in the frame channel under the gearbox cover-plate.

Section M.4

REMOVAL OF THE MASTER CYLINDER

Remove the gearbox cover after extracting the $\frac{3}{16}$ in. brass retaining bolts and flat washers and also releasing the dipper switch, which is secured by two Phillips screws.

Disconnect the $\frac{3}{16}$ in. union nuts from the three-way connection above the master cylinder, removing the front brake feed pipe union first.

Remove the nut from the clutch and brake pedal stop bolt and withdraw the special bolt and distance tube.

Remove the $\frac{5}{16}$ in. nuts and spring washers from the two bolts passing through the master cylinder and securing it to the frame member. Withdraw the bolts, observing that they also secure the hand brake cable abutment bracket.

Disconnect the brake pedal return spring from the frame.

Remove the split pin and anti-rattle washer and disconnect the clutch rod from the pedal lever.

Remove the grease nipple, circlip and flat washer from the clutch pedal shaft.

Undo the cotter pin securing nuts and flat washers and drive out the master cylinder and clutch pedal cotter pins.

Remove the split pin and clevis pin to disconnect the rear end of the gear selector rod from the selector lever, and withdraw the clutch lever shaft towards the gearbox. Lift out the clutch pedal.

Prise the master cylinder lever from the splined brake pedal shaft and remove the brake pedal clamping nut, bolt and spring washer. Press the splined shaft from the brake pedal and remove the pedal. Draw out the shaft assembly from below the car.

The master cylinder, complete with main supply pipe, push-rod, rubber boot and actuating lever, is now removed by lifting it forward and upward.

Section M.5

DISMANTLING THE MASTER CYLINDER

Remove the filler cap and drain the Lockheed hydraulic brake fluid from the master cylinder. Remove the main feed pipe, union and copper washers.

Push the piston down the cylinder bore and remove the retaining circlip.

Remove the remaining internal parts, i.e. the piston, dished washer, 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 M.6

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 facing towards the

opposite end of the piston. When the cup is in its groove, work it round gently with the fingers to make sure it is correctly seated.

Fit the valve washer, valve cup and body onto 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 onto the spring retainer. Fit the dished washer on top of the master cup with its concave side against the cup.

Insert the piston, taking care not to damage or turn back the lip of the secondary cup.

Push the piston down the bore and insert the retaining 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 M.7

REPLACING THE MASTER CYLINDER

The replacement procedure is the reverse of the removal instructions given in Section M.4, with the following additions :—

Replace the main feed pipe in its correct position and fully tighten the union before replacing the master cylinder in its housing.

Ensure that the draught-excluder rubber is in position on the brake pedal and replace the pedal on the splined brake shaft. Raise the pedal arm until it is against the underside of the toeboard, and push the master cylinder control rod into the master cylinder until it is touching the piston. When in this position engage the master cylinder lever with the splined pedal shaft.

Replace and tighten the lever cotter pin and reinsert the brake pedal clamp bolt through the hole provided in the floor above it.

Check the foot pedal movement as detailed in Section M.1.

Connect the fluid pipes and bleed the system as in Section M.3.

Check the system for leaks with the brakes fully applied. Renew the copper washers on the two-way outlet connection if necessary.

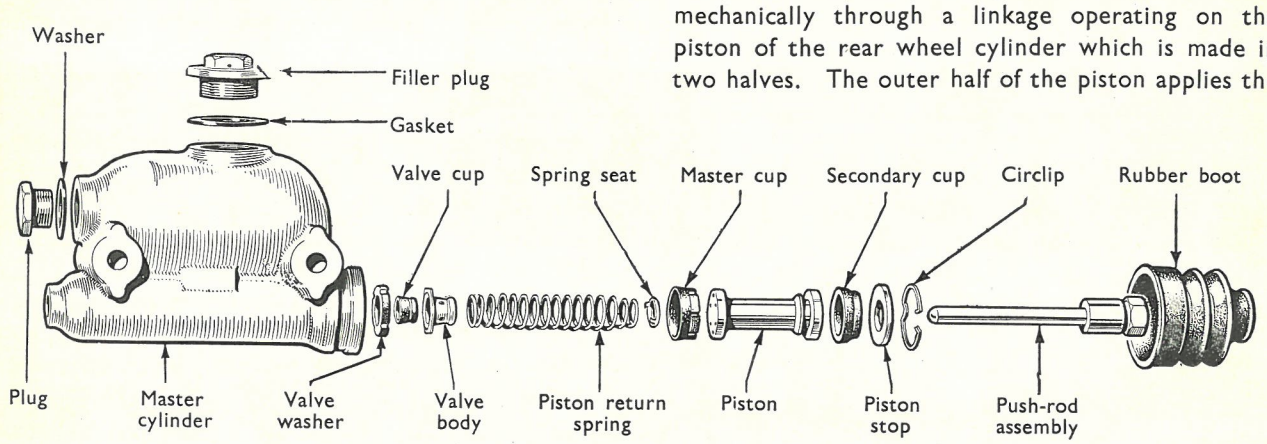


Fig. M.8.
The component parts of the master cylinder.
Later models have a thin dished copper washer between the end of the piston and the master cup which must be fitted with its concave side in contact with the cup and convex side against the piston.

Section M.8

BRAKE ASSEMBLY

Two leading shoes are incorporated in the front wheel braking system and take the greater percentage of the braking load. The rear brakes are of the leading and trailing shoe type, giving the advantage of equal braking action when the brakes are used in reverse.

All the shoes have a floating anchorage, each front wheel shoe utilising the closed end of the other shoe-actuating cylinder as its abutment. The two rear wheel shoes share one common abutment stop.

The hand brake lever operates the rear brakes mechanically through a linkage operating on the piston of the rear wheel cylinder which is made in two halves. The outer half of the piston applies the leading shoes when actuated by a lever pivoted in the cylinder body. The trailing shoe is applied by the movement of the cylinder body, which slides on the brake plate as a result of the reaction of the mechanically operated lever on the pivot.

When operated hydraulically the inner half of the piston is forced outwards, carrying with it the outer half, thus applying the leading shoe, and the trailing shoe is applied by the floating cylinder body as a result of the reaction of the fluid pressure on the body.

Section M.9

REMOVAL OF THE WHEEL CYLINDER

Front cylinders

Raise the front of the car and remove the hub cap and road wheel. Remove the brake-drum and hub assembly as detailed in Section K.6.

Draw the brake-shoes apart until the assembly can be lifted from the wheel cylinders and brake plate.

Release the flexible hose as detailed in Section M.13. Remove the flexible hose union bolt from the wheel cylinder, observing that the copper washers on either side of the banjo union are of different sizes and that the small washer is next to the cylinder.

Remove the two $\frac{1}{4}$ in. nuts and spring washers securing the wheel cylinder to the brake plate and remove the cylinder.

The other cylinder is removed after extracting the $\frac{5}{16}$ in. banjo union bolt and the two bolts securing the cylinder to the brake plate.

Rear cylinders

Raise the rear of the car and remove the hub cap and road wheel. Remove the brake-drum and hub assembly as detailed in Section H.1.

Draw the brake-shoes apart until the assembly can be lifted from the brake plate.

Release the metal feed pipe from the wheel cylinder by undoing the $\frac{3}{16}$ in. union nut. Remove the $\frac{5}{16}$ in. adaptor securing the bleed screw banjo union to the wheel cylinder, observing that the large copper washer is fitted away from the cylinder.

Remove the clevis pin from the hand brake cable yoke and disconnect the cable from the wheel cylinder lever. Remove the rubber boot and withdraw the lower half of the piston from the wheel cylinder. Extract the wheel cylinder from the brake plate.

Section M.10

DISMANTLING THE WHEEL CYLINDER

Rear cylinders

Tap out the hand brake lever pivot pin and withdraw the lever. Withdraw the upper half of the piston, the rubber cup and the bakelite filler.

Front cylinders

Withdraw the piston, the rubber cup and cup filler.

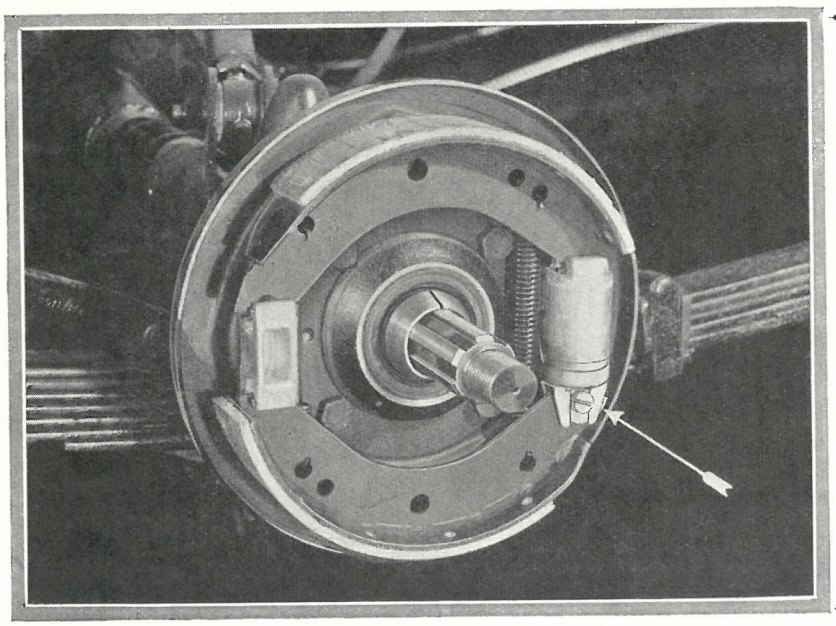


Fig. M.9.
The rear brake is provided with one leading and one trailing shoe, which are adjusted from a single serrated snail-type adjusting cam. The adjustment automatically deals with the hand brake adjustment at the same time.

Section M.11

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.

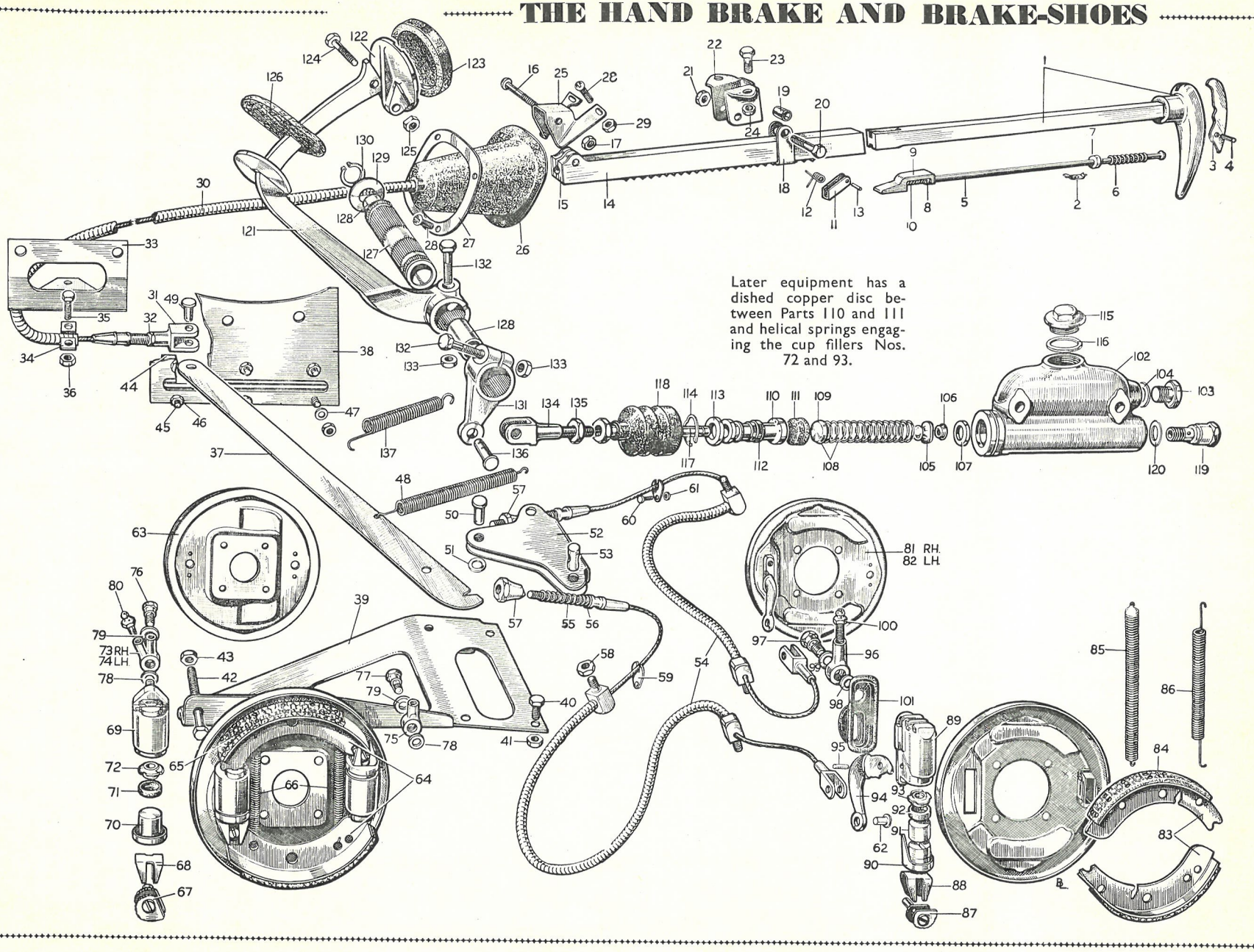
Examine the rubber cups for damage, wear, or distortion. Dip all parts in brake fluid and assemble wet.

Insert the cup filler, shallow side first (this is important) and the rubber cup concave side first.

In the case of later models with a helical return spring, the small end of the spring should engage the spigot in the centre of the cup filler, on which it should be a reasonably tight fit.

Replace the piston, and in the case of the rear cylinders, insert the hand brake lever and its pivot pin.

THE HAND BRAKE AND BRAKE-SHOES



KEY TO THE HAND BRAKE AND BRAKE-SHOE COMPONENTS

No.	Description
1.	Inner sleeve and handle.
2.	Retaining spring—for handle.
3.	Trigger.
4.	Pivot—trigger.
5.	Push-rod—trigger.
6.	Spring—push-rod.
7.	Washer—push-rod.
8.	Nut—push-rod.
9.	Wedge—pawl operating.
10.	Spring—wedge.
11.	Pawl—hand brake.
12.	Spring—pawl.
13.	Rivet—pawl.
14.	Outer sleeve.
15.	Distance-piece—outer sleeve.
16.	Abutment bolt—outer sleeve.
17.	Nut—abutment bolt.
18.	Clip—control support bracket.
19.	Distance-piece—clip.
20.	Bolt—clip.
21.	Nut—clip bolt.
22.	Bracket—hand brake to wireless shelf.
23.	Screw—bracket.
24.	Nut—bracket screw.
25.	Bracket—hand brake to dash.
26.	Seal—rubber—hand brake.
27.	Plate—seal.
28.	Screw—seal and bracket to dash.
29.	Nut—screw.
30.	Cable—front.
31.	Yoke—cable to lever.
32.	Locknut—yoke.
33.	Bracket—front cable abutment.
34.	Clip—abutment bracket.
35.	Bolt—clip.
36.	Nut—clip bolt.
37.	Lever—hand brake.
38.	Bracket—lever steady.
39.	Tie-bracket—hand brake lever.
40.	Screw—tie-bracket to engine steady.
41.	Nut—tie-bracket screw.
42.	Bolt—tie-bracket to engine member.
43.	Nut—tie-bracket bolt.
44.	Wearing pad—fibre—hand brake lever.
45.	Screw—wearing pad to steady.
46.	Nut—wearing pad screw.
47.	Washer—wearing pad screw.
48.	Pull-off spring—hand brake lever.
49.	Clevis pin—lever to front yoke.
50.	Clevis pin—lever to balance link.
51.	Washer—anti-rattle—clevis pins.
52.	Balance link—rear cable.
53.	Trunnion—balance link.
54.	Cable—rear.
55.	Spring—hand brake adjuster.
56.	Washer—plain—adjuster spring.
57.	Adjuster nut—cable.
58.	Nut—cable to floor.
59.	Guide—cable.
60.	Screw—guide to cross-member.
61.	Nut—guide screw.
62.	Clevis pin—cable to brake-drum lever.
63.	Brake plate.
64.	Brake-shoe with liner.
65.	Lining with rivets.
66.	Spring—shoe pull-off.
67.	Adjuster—brake-shoe.
68.	Mask—shoe adjuster.
69.	Body with studs and abutment.
70.	Piston and dust cover.
71.	Cup.
72.	Cup filler.
73.	Banjo connection—forward cylinder—R.H.
74.	Banjo connection—forward cylinder—L.H.
75.	Banjo connection—rear cylinder.
76.	Bolt (forward cylinder)—banjo connection.
77.	Bolt (rear cylinder)—banjo connection.
78.	Gasket—small—banjo bolt.
79.	Gasket—large—banjo bolt.
80.	Bleeder screw.
81.	Brake plate—R.H.
82.	Brake plate—L.H.
83.	Brake-shoe with liner.
84.	Lining with rivets.
85.	Spring—shoe pull-off.
86.	Spring—shoe tension.
87.	Adjuster—brake-shoe.
88.	Mask—shoe adjuster.
89.	Body with abutment strip.
90.	Piston and dust cover.
91.	Piston—hydraulic.
92.	Cup.
93.	Cup filler.
94.	Hand brake lever.
95.	Pivot pin—hand brake lever.
96.	Banjo connection.
97.	Bolt—banjo connection.
98.	Gasket—small—banjo bolt.
99.	Gasket—large—banjo bolt.
100.	Bleeder screw.
101.	Boot—wheel cylinder.
102.	Cylinder and tank.
103.	Plug.
104.	Gasket—plug.
105.	Body—valve.
106.	Cup—valve.
107.	Washer.
108.	Spring and retainer—piston return.
109.	Retainer—return spring.
110.	Piston.
111.	Cup—piston.
112.	Cup—piston secondary.
113.	Washer—piston retainer.
114.	Circlip—retainer washer.
115.	Filler cap.
116.	Gasket—filler cap.
117.	Push-rod—piston.
118.	Boot—rubber.
119.	Adaptor—cylinder.
120.	Gasket—adaptor.
121.	Brake pedal.
122.	Pad—pedal.
123.	Rubber—pad.
124.	Bolt—pad to pedal.
125.	Nut—pad bolt.
126.	Seal—pedal (R.H.D.).
127.	Shaft assembly (R.H.D.).
128.	Bush (R.H.D.).
129.	Washer—shaft.
130.	Circlip—shaft.
131.	Lever—shaft (R.H.D.).
132.	Bolt—pedal and lever to shaft.
133.	Nut—pedal and lever bolt.
134.	Yoke—lever to master cylinder.
135.	Locknut—yoke.
136.	Clevis pin—lever to yoke.
137.	Pull-off spring—pedal.

Section M.12

REPLACEMENT OF WHEEL CYLINDER

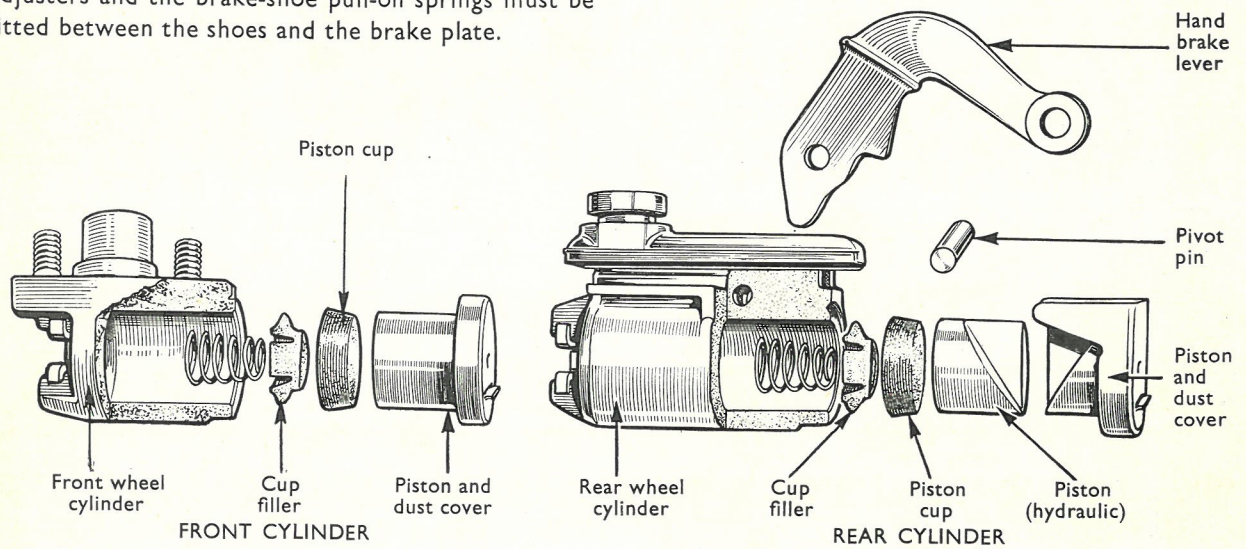
The procedure for replacing the wheel cylinder is a reversal of the sequence of operations given in Section M.9 but attention must be given to the following important points.

Front

The front brake wheel cylinders are interchangeable but the link pipe banjo unions must be fitted to them so that the flexible hose is connected to the rear cylinder and the bleed screw to the forward cylinder. The link pipe must pass above the brake plate.

The brake-shoes are interchangeable but the recessed ends must engage the "Micram" shoe adjusters and the brake-shoe pull-off springs must be fitted between the shoes and the brake plate.

Fig. M.10.
The front and rear wheel cylinder components.



Rear

The wheel cylinder must be fitted on the forward side of the axle casing with the bleed screw vertical.

The brake-shoes are interchangeable but the recessed end of the lower or leading shoe must engage the "Micram" shoe adjuster. The other shoe should also be fitted with its recessed end against the wheel cylinder.

The light brake-shoe pull-off spring must be fitted away from the wheel cylinder, and both springs are fitted between the shoes and the brake plate.

Section M.13

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. M.12) from its connection to the hose.

Remove the locknut "B" securing the flexible hose union to the bracket, holding the hexagon of the flexible pipe with a $\frac{3}{8}$ in. spanner to prevent its rotation, and unscrew the hose from the wheel cylinder.

Great care must be taken not to twist the flexible hose while undoing or tightening the attachment nut.

The union on the master cylinder side also incorporates the stop-lamp switch. Disconnect the two wires from their terminals and with a $\frac{5}{16}$ in. spanner undo the nut to release the switch and the two copper washers fitted either side of the two-way union.

Section M.14

REMOVAL AND REPLACEMENT OF BRAKE-SHOES

Remove the rear brake-drum and hub as detailed in Section H.1. Instructions for removing the front brake-drum and hub are given in Section K.6.

Draw the brake-shoes apart until they can be removed from the brake plate.

Important.—*When replacing the shoes the pull-off springs must be between the shoes and brake plate.*

The brake-shoes are interchangeable but the recessed end must engage the "Micram" shoe-adjuster on the wheel cylinder.

In the case of the rear brakes, the light pull-off spring is fitted away from the wheel cylinder. The recessed end of the upper or trailing shoe is fitted against the end of the wheel cylinder.

Section M.15

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, 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 Limited. 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.

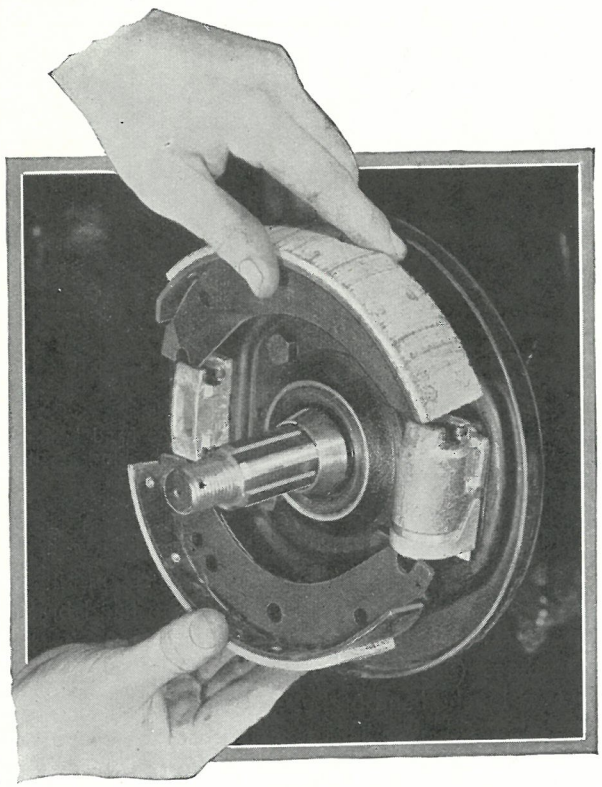


Fig. M.11.
Removing the rear brake-shoes from the brake plate after releasing the return spring.

When new shoes and linings are fitted it must be appreciated that considerable adjustment has to be made to the foot brake mechanism, and it is necessary to return the "Micram" adjusters to their fully anti-clockwise position before attempting to refit the brake-drums over the new linings. The hand brake must also be in the fully released position.

Section M.16

Important points.—Do not use any substitute for Lockheed hydraulic brake fluid, as a substitute will seriously affect the working of the system. The correct fluid for use in the British Isles is Lockheed Orange Fluid, and Lockheed No. 5 Fluid overseas. Where low temperatures consistently below 0° F. (— 18° C.) are encountered overseas, Wagner No. 21 Fluid should be used.

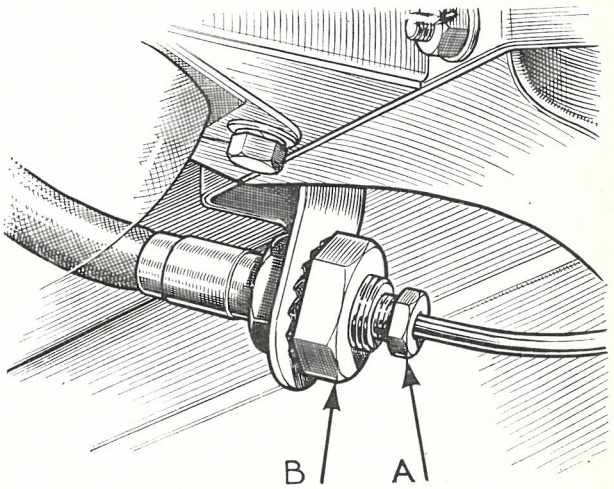


Fig. M.12.
The union nut "A" is the one which must first be unscrewed to release the flexible hose from the pipe line. The hose is then released from its attachment by unscrewing the nut "B."

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. When full the fluid should be $\frac{1}{2}$ in. (13 mm.) below the bottom of the filler neck, with the brakes in the "off" position.

Section M.17

BRAKING IRREGULARITIES AND THEIR CAUSES

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*) Master cylinder fixing loose.
(*d*) Master cylinder cup worn.

Brakes inefficient

(*a*) Shoes not correctly adjusted.
(*b*) Linings not "bedded in."
(*c*) Linings greasy.
(*d*) Linings wrong quality.
(*e*) Drums badly scored.
(*f*) Linings badly worn.
(*g*) Wrongly fitted cup fillers.

Brakes drag

(*a*) Shoes incorrectly adjusted.
(*b*) Shoe springs weak or broken.
(*c*) Pedal spring weak or broken.
(*d*) Hand brake mechanism seized.
(*e*) Wheel cylinder piston seized.
(*f*) Locked pipe line.
(*g*) 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*) Tyres unevenly inflated.
(*d*) Brake plate loose on the axle.
(*e*) Worn steering connections.
(*f*) Worn suspension linkage.
(*g*) 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.
(*f*) Worn suspension linkage.

Section M.18

THE HAND BRAKE

The hand brake is of the pistol-grip type with a thumb-operated ratchet release incorporated in the handle. It is located beneath the facia panel adjacent to the steering column. Pulling out the handle operates the rear wheel shoes only by means of a cable-operated lever.

Brake release is achieved by pulling on the lever to take the load and then pressing on the ratchet release.

The wheel cylinder cables are connected to the lever through a balancer link which ensures even braking without cable-balancing adjustment.

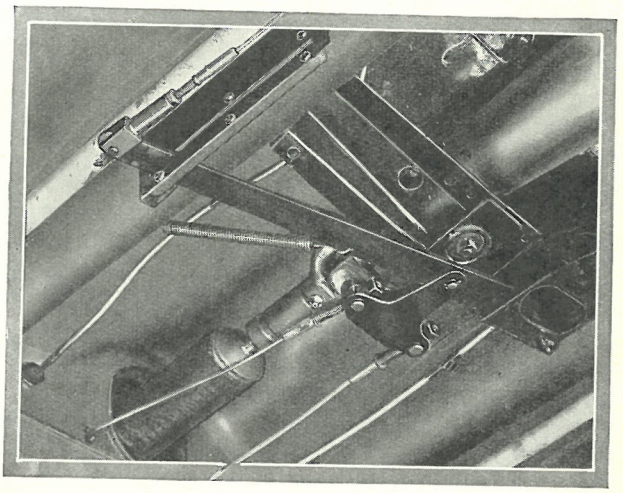


Fig. M.13.
The actuating lever and balancing line of the hand brake operating mechanism, which ensures equal braking at all times.

Sufficient motion is provided on the hand brake pull lever to deal with full wear of the brake linings; there is therefore no need to adjust the hand brake operating mechanism. Correct adjustment of the brake-shoes (Section M.2) is the only maintenance required by the hand brake.

If the wheel cylinder operating cables have been disconnected, they should be readjusted after re-assembly in the following manner.

Return the hand brake pull lever to the fully released position.

Adjust the brake-shoes as in Section M.2.

Remove the split pin and clevis pin retaining the brake cable to each wheel cylinder lever and screw up the cable adjusting nuts by equal amounts until the clevis pins will fall into position without moving the wheel cylinder lever. Replace the split pins.

Section M.19

ATTENTION TO SQUEAKING BRAKES

In cases where excessive brake squeak is encountered, this trouble may be alleviated by drilling a hole in the brake-shoe flange and making a saw-cut connecting it to the inner radius of the flange in the manner indicated in Fig. M.14.

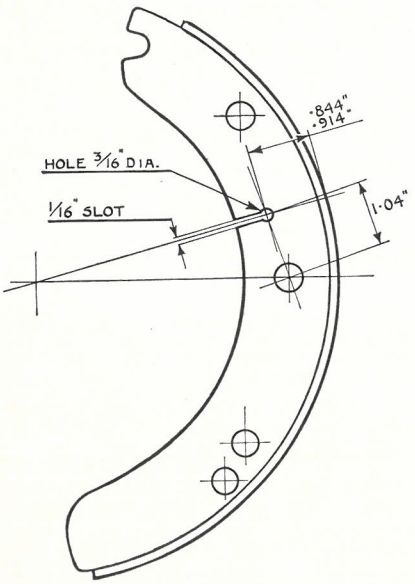


Fig. M.14.
The location of the hole and saw-cut in the brake-shoe flange which relieves brake squeak.

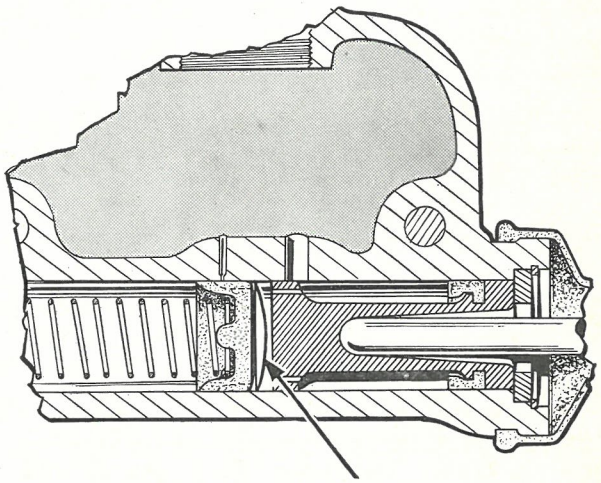


Fig. M.15.
This illustration of the master cylinder in part section clearly shows the correct position of the dished washer with its convex side in contact with the main cup.

SECTION N

ELECTRICAL EQUIPMENT

General Description.

Section No. N.1 The battery.

Section No. N.2 The dynamo.

Section No. N.3 Removal and replacement of dynamo.

Section No. N.4 Dismantling the dynamo.

Section No. N.5 Servicing the dynamo.

Section No. N.6 The starter.

Section No. N.7 Removal and replacement of starter.

Section No. N.8 Servicing the starter.

Section No. N.9 The control box.

Section No. N.10 Windscreen wiper.

Section No. N.11 The Trafficators.

Section No. N.12 The electric horn.

Section No. N.13 Fuses.

Section No. N.14 Replacement bulbs.

Sections Nos. N.15 to N.28 Lamps.

Section No. N.29 Location and remedy of faults.

Section No. N.30 Pilot Lamps.

GENERAL DESCRIPTION

The electrical equipment fitted to the Morris Six (Series "MS") is of the 12-volt type incorporating constant voltage control for the charging circuit. The positive earth system of wiring is employed.

The battery is mounted on the dash under the bonnet and is readily accessible for examination and maintenance attention.

The dynamo is mounted on the right of the cylinder block and driven by endless belt from the engine crankshaft. A rotatable mounting enables the belt tension to be adjusted.

The control box is sealed and should not normally need attention. The fuses are carried in external holders, as are the spare fuses, so that there is no need to remove the control box cover to gain access to them.

The starter motor is mounted on the flywheel housing on the right-hand side of the engine unit and operates on the flywheel through the usual sliding pinion device.

The starter shaft rear bearing is in the flywheel housing, however, and the armature is unsupported at the rear when the starter is removed from the engine.

The headlamps employ the double-filament dipping system. On home models the near-side lamp beam is dipped and the off-side lamp extinguished on operation of the dipping switch. On exported models both lamps are fitted with double-filament bulbs both dipping either to the right or to the left according to the regulations existing in the country concerned.

Section N.1

THE BATTERY
MODEL G.T.W. 9A

ROUTINE MAINTENANCE

In order to keep the battery in good condition, a periodical inspection should be made and the following carried out :—

(i) *Topping up*

About once a month (more often in warmer climates), remove the vent plugs from the top of each of the cells and examine the level of the electrolyte. If necessary, add distilled water to the level of the top of the separators. Do not fill above this level, otherwise the excess electrolyte will be thrown out from the cell. A hydrometer will be found useful for topping up, as it prevents the distilled water from being spilled on the top of the battery.

Note.—*In very cold weather it is essential that the car be used immediately after topping up the battery to ensure that the distilled water is thoroughly mixed with the electrolyte. Neglect of this precaution may result in the distilled water freezing, with consequent damage to the battery.*

When examining the cells, do not hold naked lights near the vent holes, as there is a danger of igniting the gas coming from the plates.

(ii) *Testing the condition of the battery*

Occasionally examine the condition of the battery by taking hydrometer readings. There is no better way of ascertaining the state of charge of the battery. The hydrometer contains a graduated float on which is indicated the specific gravity of the acid in the cell from which the sample is taken.

The specific gravity readings and their indications are as follows :—

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. If the temperature of the electrolyte exceeds this, ·002 must be added to hydrometer readings for each 5° F. rise to give the true specific gravity. Similarly ·002 must be subtracted from hydrometer readings for every 5° F. below 60° F.

The readings for each of the cells should be approximately the same. If one cell gives a reading very different from the rest it may be that the electrolyte has been spilled or has leaked from one of the cells or there may be an internal fault. In this case it is advisable to have the battery examined by a battery specialist. Should the battery be in a low state of charge, it should be recharged by taking the car for a long daytime run or by charging from an external source of D.C. supply at a current rate of 5 amperes until the cells are gassing freely.

After examining the battery, check the vent plugs, making sure that the air passages are clear, and screw the plugs into position. Wipe the top of the battery to remove all dirt and moisture.

STORAGE

If a battery is to be out of use for any length of time, it should first be fully charged and then given a freshening charge about every fortnight.

A battery must never be allowed to remain in a discharged condition, as this will cause the plates to become sulphated.

INITIAL FILLING AND CHARGING

Usually, the battery will have been filled and initially charged. If, however, it should be found necessary to prepare a new battery, supplied dry, proceed as follows :—

(*a*) *Preparation of electrolyte*

The specific gravity of the electrolyte necessary to fill the new battery, and the specific gravity at the end of the charge, are as follows :—

Climate	*S.G. of Filling Acid (corrected to 60° F.)*	*S.G. at End of Charge (corrected to 60° F.)*
Ordinarily below 80° F. (27° C.)	1·350	1·280—1·300
Between 80°—100° F. ...	1·320	1·250—1·270
Over 100° F. (38° C.) ...	1·300	1·220—1·240

The electrolyte is prepared by mixing distilled water and concentrated sulphuric acid 1·835 S.G. The mixing must be carried out in a lead-lined tank or a suitable glass or earthenware vessel. Steel or iron containers must **not** be used. The acid must be added slowly to the water, while the mixture is stirred with a glass rod. **Never add the water to the acid,** as the severity of the resulting chemical reaction may have dangerous consequences.

To produce electrolyte of the correct specific gravity, use the following proportions of acid and distilled water :—

To obtain Specific Gravity (corrected to 60° F.)	*Add 1 part by volume of 1·835 S.G. acid to distilled water by volume as below*
1·350	1·8 parts
1·320	2·2 ,,
1·300	2·5 ,,

Heat is produced by the mixture of acid and water, and it should therefore be allowed to cool before pouring it into the battery, otherwise the plates, separators and moulded container may become damaged.

(*b*) *Filling in and soaking*

The temperature of the filling-in acid, battery and charging room should be above 32° F.

Carefully break the seals in the filling holes and half fill each cell in the battery with dilute sulphuric acid solution of the appropriate specific gravity

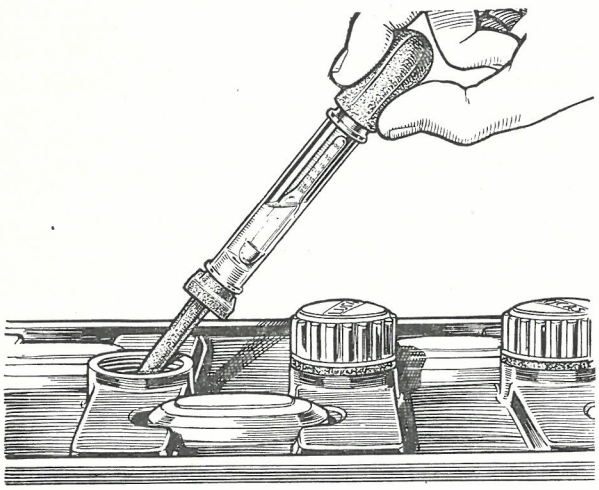


Fig. N.1.
A hydrometer is a convenient instrument for topping up the battery cells without spilling.

(according to temperature), see table in (*a*) above. The quantity of electrolyte required to half fill a two-volt cell is $\frac{1}{2}$ pint (·28 litre).

(*c*) *Duration and rate of initial charge*

Charge at a constant current of 3·5 amps. until the voltage and temperature-corrected specific gravity readings show no increase over five successive hourly readings. This period is dependent upon the length of time the battery has been stored since manufacture, and will be from forty to eighty hours, but usually not more than sixty.

Throughout the charge, the acid must be kept level with the tops of the separators in each cell by the addition of acid solution of the same specific gravity as the original filling-in acid.

If, during charge, the temperature of the acid in any cell of the battery reaches the maximum permissible temperature of 120° F. (49° C.), the charge must be interrupted and the battery temperature allowed to fall at least 10° F. (5·5° C.) before charging is resumed.

At the end of the first charge, i.e. when specific gravity and voltage measurements remain substantially constant, carefully check the specific gravity in each cell to ensure that it lies within the limits specified. If any cell requires adjustment, the electrolyte above the plates must be syphoned off, and replaced either with acid of the strength used for the original filling in, or distilled water, according to whether the specific gravity is too low or too high respectively. After such adjustment, the gassing charge should be continued for one or two hours to ensure adequate mixing of the electrolyte. Re-check, if necessary, repeating the procedure until the desired result is obtained.

Section N.2

THE DYNAMO

Type

The dynamo is a Lucas Model C45PV, Service No. 22434A. These identification marks are stamped on the yoke. When ordering replacements always quote these numbers.

To test on vehicle

(*a*) Make sure that belt slip is not the cause of the trouble. The belt should be capable of being deflected approximately $\frac{1}{2}$ in. (13 mm.) at the centre of its longest run between two pulleys with moderate hand pressure. If the belt is too slack, tightening is effected by slackening the long bolt on which the dynamo pivots, and the bolt securing the slotted adjustment link to the crankcase, and gently pulling the dynamo outwards by hand until the correct tension is obtained. The slotted link bolt must then be tightened, followed by the lower bolt.

(*b*) Check that the dynamo and control box are connected correctly. The dynamo terminal "D" should be connected to the control box terminal "D" and the dynamo terminal "F" connected to control box terminal "F."

(*c*) After switching off all lights and accessories, disconnect the cables from terminals of dynamo marked "D" and "F" respectively.

(*d*) Connect the two terminals with a short length of wire.

(e) Start the engine and set to run at normal idling speed.

(f) Clip the negative lead of a moving coil type voltmeter, calibrated 0—20 volts, to one dynamo terminal and the other lead to a good earthing point on the dynamo yoke.

(g) Gradually increase the engine speed, when the voltmeter reading should rise rapidly and without fluctuation. Do not allow the voltmeter reading to reach 20 volts. Do not race the engine in an attempt to increase the voltage. It is sufficient to run the dynamo up to a speed of 1,000 r.p.m.

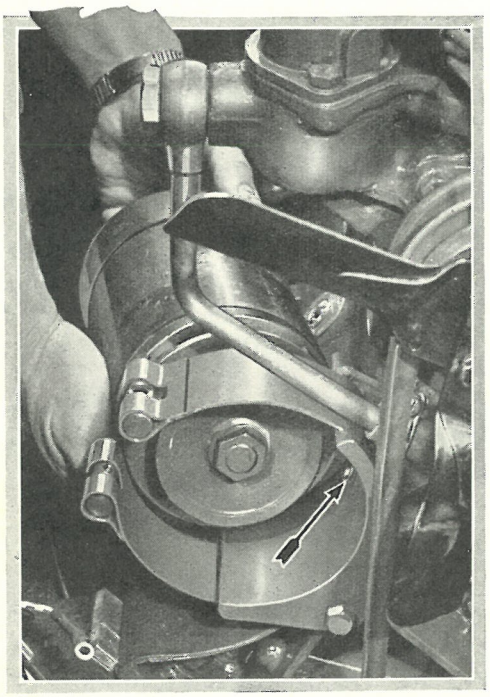


Fig. N.2.

Removing the dynamo from its attachment to the engine on earlier models. When replacing the dynamo the dowel indicated by the arrow must engage the dowel hole in the dynamo yoke to ensure correct fan belt alignment. Later models have a bracket mounting with three attachment bolts which presents no dismantling difficulty.

If there is no reading—check the brush gear.

If the reading is low (approximately 1 volt) the field winding may be faulty.

If the reading is approximately 5 volts, the armature winding may be faulty.

(h) Remove the dynamo cover band and examine the brushes and commutator. Hold back each of the brush springs and move the brush by pulling gently on its flexible connector. If the movement is sluggish, remove the brush from its holder and ease the sides by lightly polishing on a smooth file. Always replace brushes in their original positions. If the brushes are worn so that they no longer bear on the commutator, or if the brush flexible has become exposed on the running face, new brushes must be fitted. If the commutator is blackened or dirty, clean it by holding a petrol-moistened cloth against it while the engine is turned slowly by hand-cranking. Re-test the dynamo ; if there is still no reading on the voltmeter, there is an internal fault and the complete unit should be replaced, if a spare is obtainable.

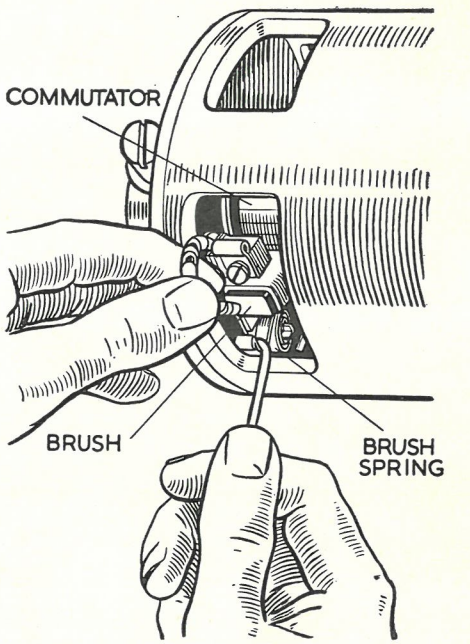


Fig. N.3.

To release the brushes hold back the brush spring with a piece of bent wire as shown.

If the dynamo is in good order, remove the temporary link from between the terminals and restore the original connections, taking care to connect the dynamo terminal "D" to the control box terminal "D" and the dynamo terminal "F" to the control box terminal "F." Remove the lead from the "D" terminal on the control box and connect the voltmeter between this cable and a good earthing point on the vehicle. Run the engine as before. The reading should be the same as that measured directly at the dynamo. No reading on the voltmeter indicates a break in the cable to the dynamo. If the reading is correct test the control box (see Section N.9).

Section N.3

REMOVAL AND REPLACEMENT OF DYNAMO

To remove the dynamo, slacken its two attachment bolts and swing the dynamo towards the engine to give maximum belt slackness. Carefully free the belt from the dynamo pulley.

Disconnect the dynamo leads from the dynamo terminals.

Slacken and remove the strap securing bolt and lift the dynamo from the locating dowel.

Replacement of the dynamo is an exact reversal of this procedure.

Note.—*On later models the dynamo is attached to a bracket bolted to the side of the cylinder block. To enable it to be removed the three attachment bolts between the dynamo and its bracket and the slotted adjustment link must be removed.*

Section N.4

DISMANTLING THE DYNAMO

Take off the dynamo pulley.

Remove the cover band, hold back the brush springs and remove the brushes from their holders.

Unscrew and withdraw the two through bolts from the driving end.

Remove the nut, spring washer and flat washer from the smaller terminal (i.e. field terminal) on the commutator end bracket and remove the bracket from the dynamo yoke.

The driving end bracket, together with the armature, can now be lifted out of the yoke.

Note.—*Take care not to lose the spring and cup from the end of the armature shaft.*

The driving end bracket which, on removal from the yoke, has withdrawn with it the armature and armature shaft ball bearing need not be separated from the shaft unless the bearing is suspected and requires examination ; in which event the armature should be removed from the end bracket by means of a hand press.

Section N.5

SERVICING THE DYNAMO

Brushes

Test if the brushes are sticking. Clean them with petrol and, if necessary, ease the sides by lightly polishing with a smooth file. Replace the brushes in their original positions.

Test the brush spring tension with a spring scale if available. The correct tension is 30—40 oz. (850—1134 gm.). Fit a new spring if the tension is low.

If the brushes are worn so that the flexible is exposed on the running face, new brushes *must* be fitted. Brushes are pre-formed so that bedding to the commutator is unnecessary.

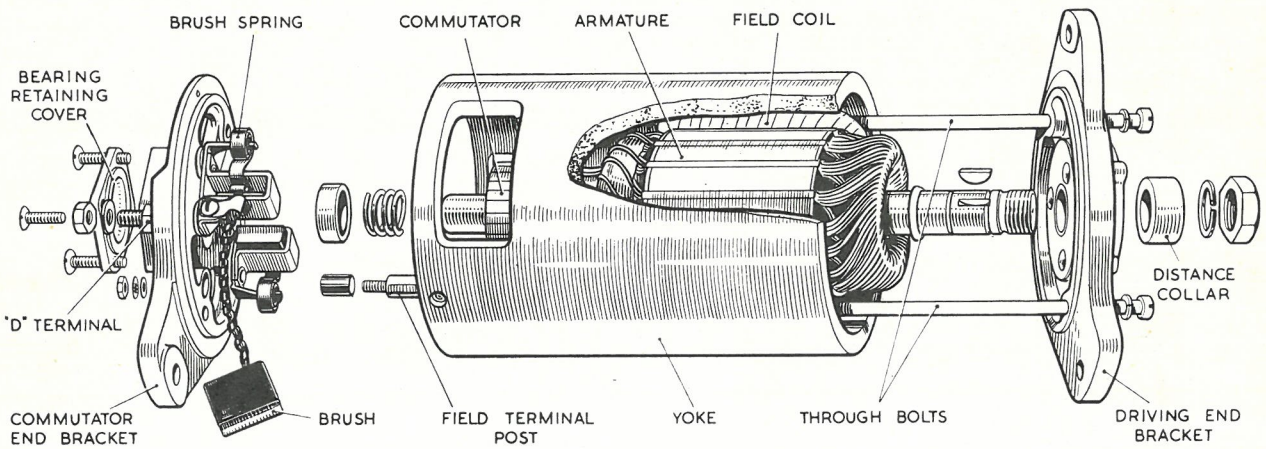


Fig. N.4.
The dynamo components.

Commutator

A commutator in good condition will be smooth and free from pits or burned spots. Clean the commutator with a petrol-moistened cloth. If this is ineffective, carefully polish with a strip of fine glass-paper while rotating the armature. To remedy a badly worn commutator, mount the armature (with or without the drive end bracket) in a lathe, rotate at high speed and take a light cut with a very sharp tool. Do not remove more metal than is necessary. Polish the commutator with very fine glass-paper. Undercut the insulation between the segments to a depth of $\frac{1}{32}$ in. (·8 mm.) with a hack-saw blade ground down to the thickness of the mica.

Field coil

Test the field coils, without removing them from the dynamo yoke, by means of an ohmmeter. The reading on the ohmmeter should be between 6·0 and 6·3 ohms. If this is not available, connect a 12-volt D.C. supply with an ammeter in series between the field terminal and dynamo yoke. The ammeter reading should be approximately 2 amps. If no reading is indicated the field coils are open-circuited and must be replaced. To test for earthed field coils, unsolder the end of the field winding from the earth terminal on the dynamo yoke and, with a test lamp

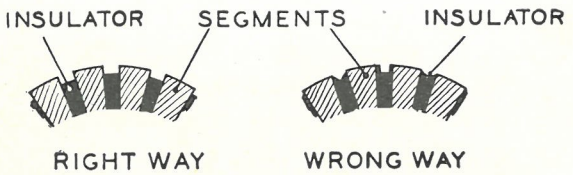


Fig. N.5.
The correct and incorrect methods of undercutting the commutator segments.

connected from supply mains, test across the field terminal and earth. If the lamp lights, the field coils are earthed and must be replaced.

When replacing field coils, carry out the procedure outlined below, using an expander and wheel-operated screwdriver.

(*a*) Remove the insulation piece which is provided to prevent the junction of the field coils from contacting the yoke.
(*b*) Mark the yoke and pole shoes in order that they can be refitted in their original positions.
(*c*) Unscrew the two pole shoe retaining screws by means of the wheel-operated screwdriver.
(*d*) Draw the pole shoes and coils out of the dynamo yoke and lift off the coils.
(*e*) Fit the new field coils over the pole shoes and place them in position inside the yoke. Take care to ensure that the taping of the field coils is not trapped between the pole shoes and the yoke.
(*f*) Locate the pole shoes and field coils by lightly tightening the fixing screw.
(*g*) Insert the pole shoe expander, open it to the fullest extent and tighten the screws.
(*h*) Finally tighten the screws by means of the wheel-operated screwdriver and lock them by caulking.
(*i*) Replace the insulation piece between the field coil connections and the yoke.

Armature

The testing of the armature winding requires the use of a voltage drop test and growler. If these are not available, the armature should be checked by substitution. No attempt should be made to machine the armature core or to true a distorted armature shaft.

Bearings

Bearings which are worn to such an extent that they will allow side movement of the armature shaft must be replaced.

To replace the bearing at the commutator end, proceed as follows :—

(*a*) Remove the four screws securing the square metal plate.
(*b*) Press the bearing out of its housing.
(*c*) Before fitting replacement bearing see that it is clean and pack it with a high-melting-point grease to Ref. D (page P.2).
(*d*) Locate the bearing in the housing and press it home by means of a hand press. Finally refit the square plate by means of the four fixing screws.

The ball bearing at the driving end is replaced as follows :—

(*a*) Knock out the rivets which secure the bearing retaining plate to the end bracket and remove the plate.

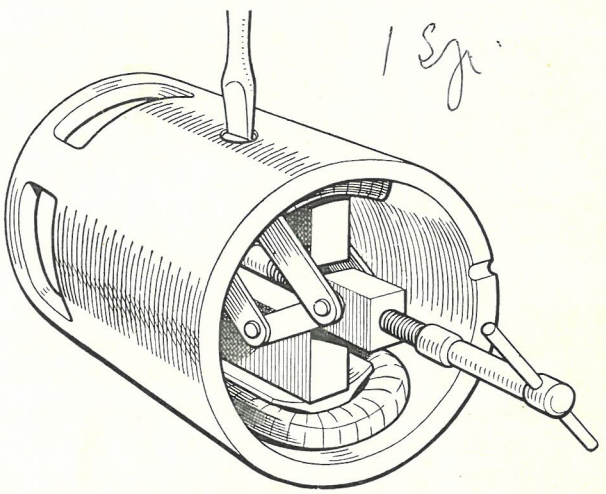


Fig. N.6.
To fit the pole shoes correctly an expander of the type illustrated is required.

(*b*) Press the bearing out of the end bracket and remove the corrugated washer, felt washer and oil-retaining washer.
(*c*) Before fitting the replacement bearing see that it is clean and pack it with a high-melting-point grease.

(*d*) Place the oil-retaining washer, felt washer and corrugated washer in the bearing housing in the end bracket.

(*e*) Locate the bearing in the housing and press it home by means of a hand press.

(*f*) Fit the bearing retaining plate. Insert the new rivets from the inside of the end bracket and open the rivets by means of a punch to secure the plate rigidly in position.

Reassembly

In the main the reassembly of the dynamo is a reversal of the operations described in Section N.4.

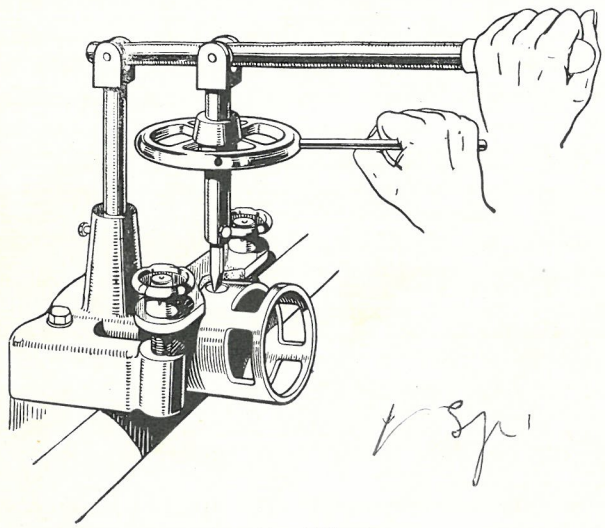


Fig. N.7.
The use of a wheel-operated screwdriver is necessary to remove and replace the pole shoe attachment screws.

Section N.6

THE STARTER

Type

The starter is a Lucas Model M418G, Service No. 25518. These identification marks are stamped on the yoke. When ordering replacements always quote these numbers.

To test on vehicle

Switch on the lamps and operate the starter control. If the lights go dim, but the starter is not heard to operate, an indication is given that current is flowing through the starter windings, but that the starter pinion is meshed permanently with the geared ring on the flywheel. This has probably been caused by the starter being operated while the engine is still running. In this case the starter must be removed from the engine for examination.

Should the lamps retain their full brilliance when the starter switch is operated, check that the switch is functioning. If the switch is in order, examine the connections at the battery, starter switch and starter, and also check the wiring between these units. Continued failure of the starter to operate indicates an internal fault in the starter and the starter must be removed from the engine for examination.

Sluggish or slow action of the starter is usually caused by a poor connection in the wiring which produces a high resistance in the starter circuit. Check as described above.

Damage to the starter drive is indicated if the starter is heard to operate but does not crank the engine.

Section N.7

REMOVAL AND REPLACEMENT OF STARTER

To remove the starter release the starter cable from the starter terminal and unscrew the two bolts attaching the starter flange to the flywheel housing. The starter can then be withdrawn without difficulty.

The rear bearing for the starter shaft is in the flywheel housing and care must be taken to engage the shaft properly with the bearing on replacement.

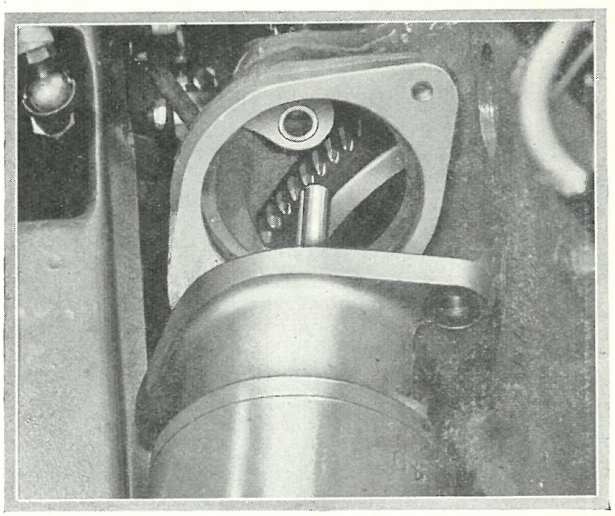


Fig. N.8.
The armature rear end bearing remains in the flywheel housing when the starter is withdrawn.

Section N.8

SERVICING THE STARTER

Examination of commutator and brush gear

Remove the starter cover band "A" (Fig. N.10) and examine the brushes "B" and the commutator

"C." Hold back each of the brush springs "D" and move the brush by pulling gently on its flexible connector. If the movement is sluggish, remove the brush from its holder "E" and ease the sides by lightly polishing on a smooth file. Always replace brushes in their original positions. If the brushes are worn so that they no longer bear on the commutator, or if the brush flexible has become exposed on the running face, they must be replaced.

If the commutator is blackened or dirty, clean it by holding a petrol-moistened cloth against it while the armature is rotated.

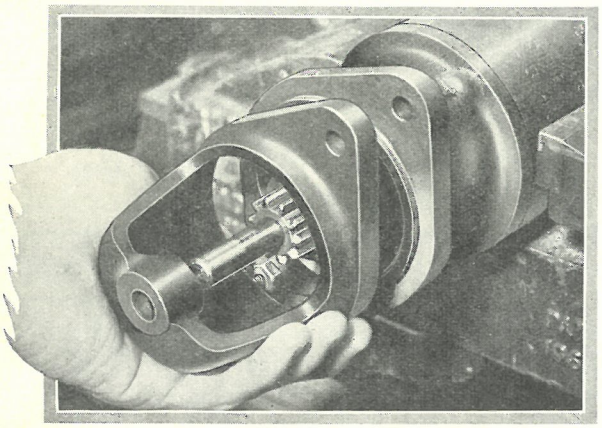


Fig. N.9.
In order to be able to test the starter when it is removed from the engine a slave bearing, Lucas Part No. 251196, must be used.

Before testing the starter motor on the bench a special bearing bracket must be bolted to the starter end bracket to provide a bearing for the rear end of the armature. This special bracket is obtainable from the manufacturer, Joseph Lucas Ltd., under Part No. 251196 (see Fig. N.9).

Secure the body of the starter in a vice and test by connecting it with heavy gauge cables to a battery of the correct voltage. One cable must be connected to the starter terminal and the other held against the starter body or end bracket. Under these light load conditions, the starter should run at a very high speed.

If the operation of the starter is still unsatisfactory, the starter should be dismantled for detailed inspection and testing.

Dismantling

Take off the cover band "B" (Fig. N.13) at the commutator end, hold back the brush springs "C" and take out the brushes "D" from their holders.

Withdraw the jump ring and shims "H" from the armature shaft at the commutator end and remove the armature complete with drive from the commutator end bracket and starter frame.

Remove the terminal nuts "E" and washers "F" from the terminal post "A" at the commutator end bracket and also withdraw the two through bolts. Remove the commutator end bracket and the attachment bracket "M" from the starter yoke.

Brushes

(*a*) Test the brush springs with a spring scale. The correct tension is 30—40 oz. (850—1134 gm.). Fit a new spring if the tension is low.

(*b*) If the brushes are worn so that they no longer bear on the commutator, or if the flexible connector has become exposed on the running face, they must be replaced. Two of the brushes are connected to terminal eyelets "A" (Fig. N.12) attached to the brush boxes "B" on the commutator end bracket, and two brushes (Fig. N.11) are connected to tappings on the field coils.

The flexible connectors must be removed by unsoldering and the connectors of the new brushes

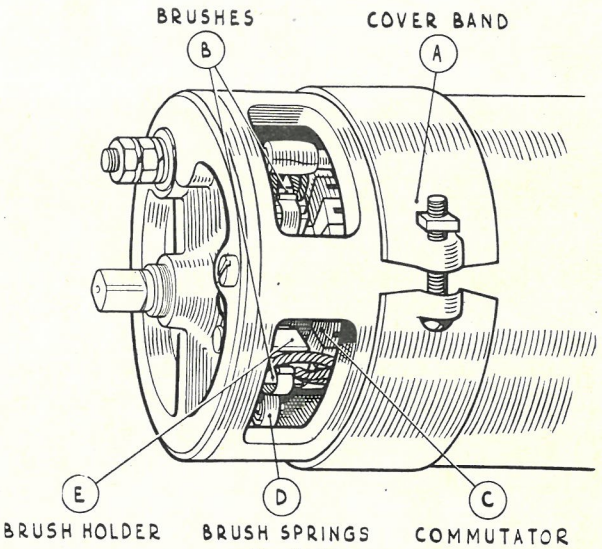


Fig. N.10.
The starter brush gear.

secured in their place by soldering. The brushes are pre-formed so that bedding of their working faces to the commutator is unnecessary.

Drive

(*a*) If the pinion is tight on the screwed sleeve, wash away any dirt with paraffin.

(*b*) If any parts are worn or damaged they must be replaced.

(*c*) Remove the retaining ring "J" (Fig. N.13) and the barrel and pinion assembly can be withdrawn. Take care not to lose the shims which may remain inside the barrel.

(*d*) Withdraw the locating nut "L."

Note.—*Before this nut can be removed it will be necessary to break the caulking between the armature shaft and locating nut.*

(*e*) Remove the friction washer "K" and restraining spring.

(*f*) The sleeve and control nut can now be withdrawn from the armature shaft.

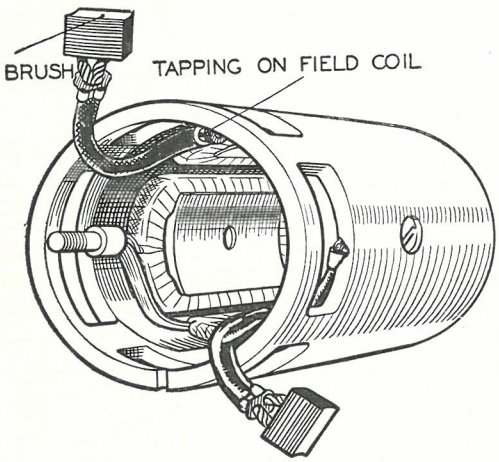


Fig. N.11.
The brush connections for the starter.

(*g*) Remove the sleeve coupling "P" (Fig. N.13) and friction washer "K" and withdraw the rubber coupling.

(*h*) Finally remove the transmission plate "G."

Commutator

A commutator in good condition will be smooth and free from pits and burned spots. Clean the commutator with a petrol-moistened cloth. If this is ineffective, carefully polish with a strip of fine glass-paper, while rotating the armature. To remedy a badly worn commutator, dismantle the starter drive as described on page N.8 and remove the armature from the end bracket. Now mount the armature in a lathe, rotate it at a high speed and take a light cut with a very sharp tool. Do not remove any more metal than is absolutely necessary, and finally polish with very fine glass-paper.

The insulation on the starter commutator **must not be undercut.**

Field coils

The field coils can be tested for an open circuit by connecting a 12-volt battery, having a 12-volt bulb in one of the leads, to the tapping points of the field coils

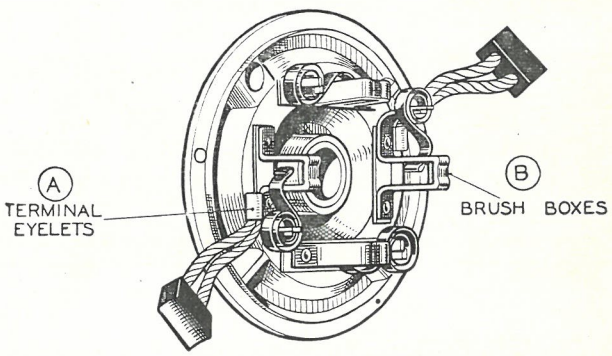


Fig. N.12.
The starter end cover.

to which the brushes are connected. If the lamp does not light, there is an open circuit in the wiring of the field coils.

Lighting of the lamp does not necessarily mean that the field coils are in order, as it is possible that one of them may be earthed to a pole shoe or to the yoke. This may be checked by removing the lead from one of the brush connectors and holding it on

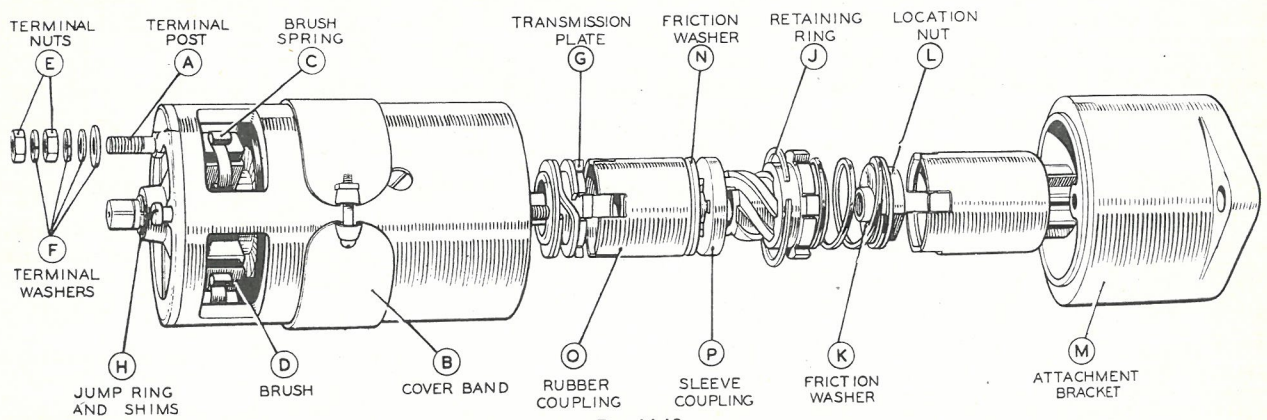


Fig. N.13.
The component parts of the starter.

a clean part of the starter yoke. Should the bulb now light it indicates that the field coils are earthed.

Should the above tests indicate that the fault lies in the field coils, they must be replaced. When replacing field coils carry out the procedure detailed in the Dynamo Section N.5.

Armature

Examination of the armature will in many cases reveal the cause of failure, e.g. conductors lifted from the commutator due to the starter being engaged

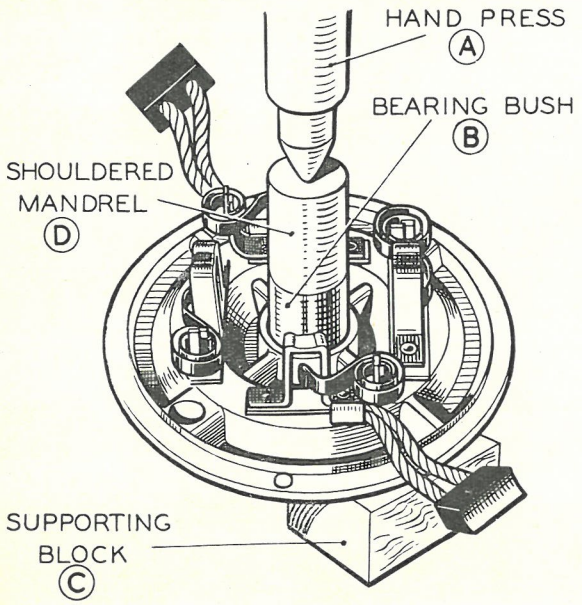


Fig. N.14.
The method of inserting a new bush in the starter end cover.

while the engine is running and causing the armature to be rotated at an excessive speed. A damaged armature must in all cases be replaced—no attempt should be made to machine the armature core or to true a distorted armature shaft.

Bearings (commutator end)

Bearings which are worn to such an extent that they will allow excessive side play of the armature shaft must be replaced. To replace the bearing bush, proceed as follows :—

(*a*) Press the new bearing bush into the end bracket, using a shouldered mandrel of the same diameter as the shaft which is to fit in the bearing.

Note.—*The bearing bush is of the porous phosphor-bronze type and, before fitting, new bushes should be allowed to stand completely immersed for twenty-four hours in thin engine oil in order to fill the pores of the bush with lubricant.*

Reassembly

The reassembly of the starter is a reversal of the operations described in this Section.

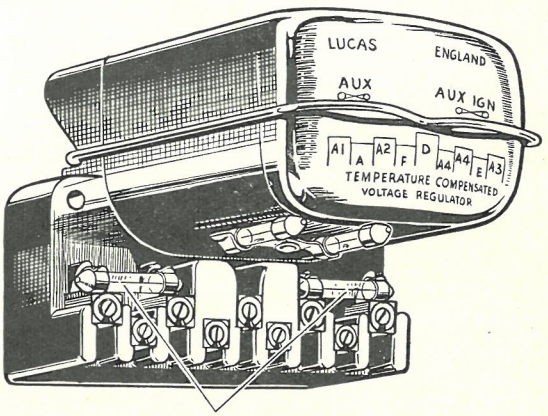
Note.—*When reassembling the starter drive the locating nut must be re-caulked to the armature shaft.*

Section N.9

THE CONTROL BOX

Regulator adjustment

The regulator is carefully set before leaving the Works to suit the normal requirements of the standard equipment, 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



FUSES IN CIRCUITS OF ACCESSORIES

Fig. N.15.
The control box, showing the location of the fuses.

fall when the battery is fully charged, it may be advisable to check the setting and, if necessary, to re-adjust 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.

How to check and adjust electrical setting

The regulator setting can be checked without removing the cover on the control box.

Withdraw the cables from the terminals marked "A" and "A.1" at the control box and join them together. Connect the negative lead of a moving

coil voltmeter (0—20 volts full scale reading) to the "D" terminal in the dynamo and connect the other 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

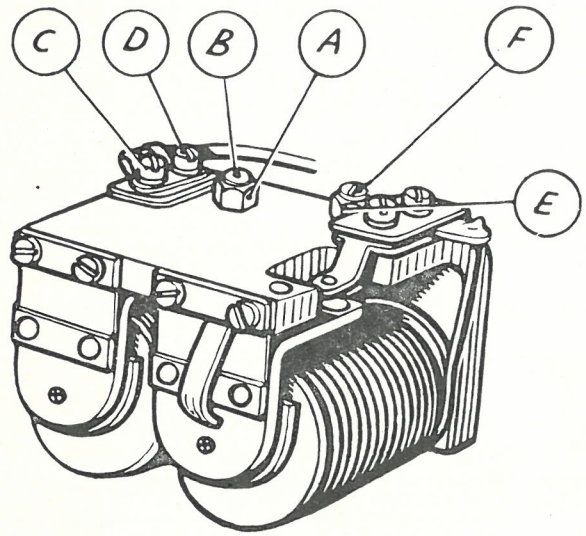


Fig. N.16.
The cut-out and regulator assembly.

given below for the appropriate temperature of the regulator.

Setting at 10° C. (50° F.)	16·1—16·7 volts
,, ,, 20° C. (68° F.)	15·8—16·4 ,,
,, ,, 30° C. (86° F.)	15·6—16·2 ,,
,, ,, 40° C. (104° F.)	15·3—15·9 ,,

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 "A" (Fig. N.16) holding the adjusting screw "B" and turn the screw in a clockwise direction to raise the setting or in an anti-clockwise direction to lower the setting. Turn the adjusting screw a fraction of a turn and then tighten the locknut.

When the dynamo is run at a high speed on open circuit, it builds up a high voltage. When adjusting the regulator, do not run the engine up to more than half throttle or a false voltmeter reading will be obtained.

Mechanical setting

The mechanical setting of the regulator is accurately adjusted before leaving the Works and, provided that the armature carrying the moving contact is not removed, the regulator will not require mechanical adjustment. If, however, the armature has been removed from the regulator for any reason, the contacts will have to be reset. To do this, proceed as follows :—

(i) Slacken the two armature fixing screws "E" (Fig. N.17). Insert a ·018 in. (·46 mm.) feeler gauge between the back of the armature "A" and the regulator frame.

(ii) Press back the armature against the regulator frame and down onto the top of the bobbin core with the gauge in position and lock the armature by tightening the two fixing screws.

(iii) Check the gap between the underside of the arm and the top of the bobbin core. This must be ·012 in. to ·020 in. (·30 mm. to ·51 mm.). If the gap is outside these limits

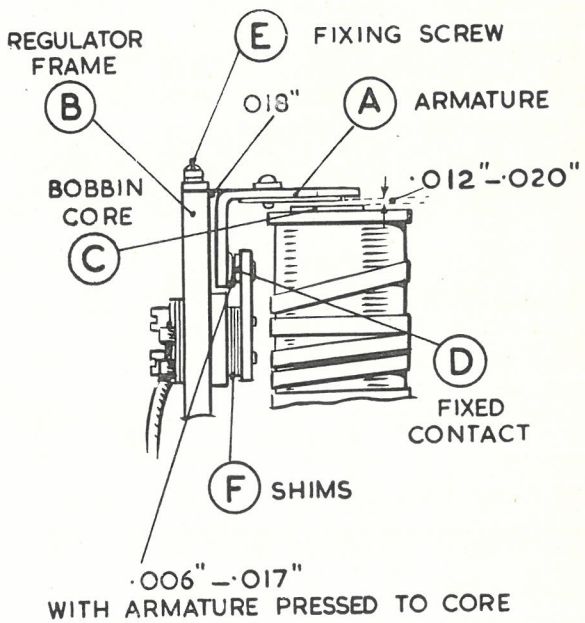


Fig. N.17.
The mechanical adjustment for the regulator.

correct by adding or removing shims "F" (Fig. N.17) at the back of the fixed contact "D."

(iv) Remove the gauge and press the armature down, when the gap between the contacts should be between ·006 in. (·15 mm.) and ·017 in. (·43 mm.).

Cleaning contacts

To render the regulator contacts accessible for cleaning, slacken the screws securing the plate carrying the fixed contact. It will be necessary to slacken the

upper screw " C " (Fig. N.16) a little more than the lower " D," so that the contact plate can be swung outwards. Clean the contacts by means of fine carborundum stone or fine emery-cloth. Carefully wipe away all traces of dirt or other foreign matter. Finally tighten the securing screws.

CUT-OUT

Adjustment

If it is suspected that the cutting-in speed of the dynamo is too high, connect a voltmeter between the terminals marked " D " and " E " at the control box and slowly raise the engine speed. When the voltmeter reading rises to between 12·7 to 13·3 the cut-out contact should close.

If the cut-out has become out of adjustment and operates at a voltage outside these limits it must be reset. To make the adjustment, slacken the locknut " E " (Fig. N.16), turn the adjusting screw " F " a fraction of a turn in a clockwise direction to raise the operating voltage or in an anti-clockwise direction to lower the voltage. Tighten locknut after making the adjustment.

Cleaning

To clean the contacts remove the cover, place a strip of fine glass-paper between the contacts and then, closing the contacts by hand, draw the paper through. This should be done two or three times, with the rough side towards each contact.

Radio suppression

When it is desired to fit suppressors for radio equipment, make sure that this is done only in accordance with recommended practice. Suppressors and capacitors wrongly fitted may cause damage to the electrical equipment.

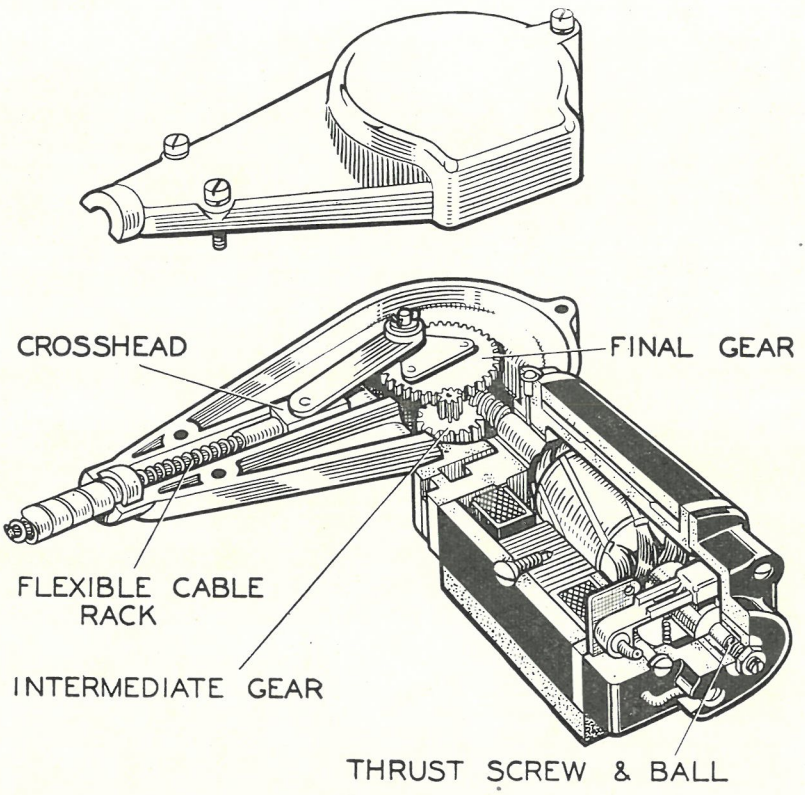


Fig. N.18.
The wiper motor and gearbox.

Section N.10

WINDSCREEN WIPER

Normally the windscreen wiper will not require any servicing apart from the occasional renewal of the rubber blades.

Should any trouble be experienced, first check for loose connections, worn insulation, etc., before dismantling the motor.

1. *To detach the cable rack from the motor and gearbox*

Remove the gearbox cover.

Remove the split pin and washer from the crank pin and final gear wheel.

Lift off the connecting link.

2. *Commutator dirty*

Remove the connecting leads to the terminals, withdraw the three screws securing the cover at the commutator end. Lift off the cover. Clean the commutator with a cloth moistened with petrol and carefully remove any carbon dust from between the commutator segments.

3. *Brush lever stiff or brushes not bearing on commutator*

Check that the brushes bear freely on the commutator. If they are loose, and do not make contact, a replacement tension spring is necessary. The brush levers must be free on their pivots. If they are stiff they should be freed by working them backwards and forwards by hand and by applying a trace of thin machine oil. Packing shims are fitted beneath the legs of the brush levers to ensure that the brushes are central and that there is no possibility of the brush boxes fouling the commutator. If the brushes are considerably worn they must be replaced.

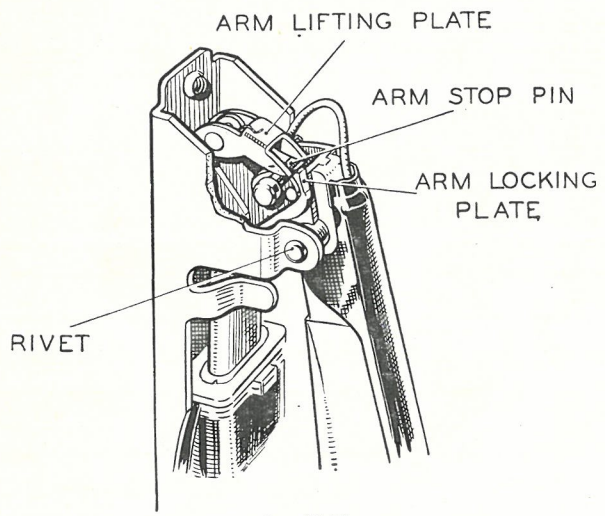


Fig. N.19.
The Trafficator arm hinge mechanism.

4. *Motor operates but does not transmit motion to spindles*

Remove the cover of the gearbox. A push-pull motion should be transmitted to the inner cable of the flexible rack. If the cross-head moves sluggishly between the guides, lightly smear a small amount of medium grade engine oil in the groove formed in the die-cast housing. When overhauling, the gear must be lubricated by lightly packing the gearbox with a grease to Ref. D (Page P.2).

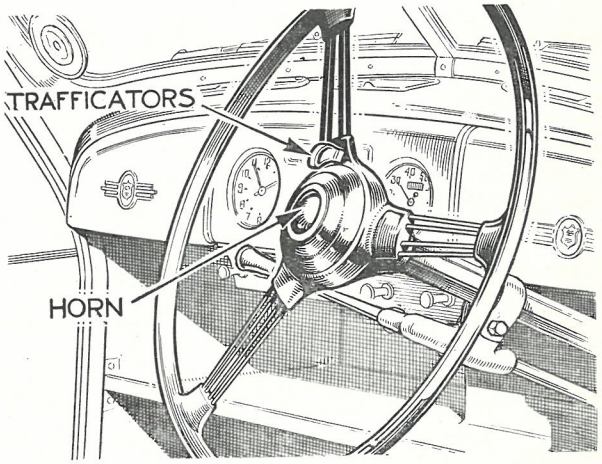


Fig. N.20.
The Trafficator control and horn push.

Section N.11

THE TRAFFICATORS

REPLACEMENT OF TRAFFICATOR ARM

Removing the Trafficator from the car

Withdraw the three Phillips head screws securing the door pillar trim panel.

Unscrew the two $\frac{1}{4}$ in. bolts with spring and flat washers and remove the Trafficator case from the pillar.

Remove the screw securing the Trafficator in the case and disconnect the cable.

Removing the arm

Drill out the rivet securing the arm to the bracket.

Remove the Trafficator arm cover and withdraw the cable and bulb.

Open out the clip securing the cable to the arm of the Trafficator and remove the arm.

Replacement of the arm

Place the new arm in position so that the arm stop pin locates between the arm lifting plate and locking plate (as shown).

Secure it in this position by fitting a new rivet.

Remove the arm cover, replace the cable and bulb and refit the cover.

Finally secure the cable to the arm by means of the clip, taking care to see that the bending over of the clip does not damage the cable or its insulating covering. Also see that when the Trafficator is operated the cable can move in a wide arc.

Section N.12

THE 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 normally required.

If one of the horns fails or becomes uncertain in its action, it does not follow that the horn has broken down. First ascertain that the trouble is not due to a loose or broken connection in the wiring of the horn. If both horns fail or become uncertain in action, the

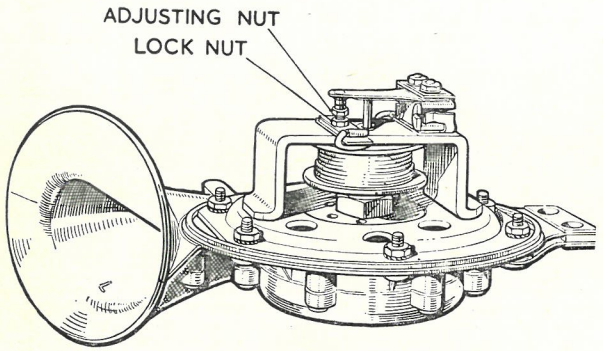


Fig. N.21.
The adjustment on Windtone-type horns for compensating for wear.

trouble is probably due to a blown fuse or discharged battery. If the fuse has blown, examine the wiring for the fault and replace with the spare fuse provided.

It is also possible that the performance of a horn may be upset by the fixing bolt working loose, or by some component near the horn being loose. If after carrying out the above examination the trouble is not rectified, the horn may need adjustment, but this should not be necessary until the horns have been in service for a long period.

Adjustment does not alter the pitch of the note, it merely takes up wear of moving parts. When adjusting the horns, short-circuit the fuse, otherwise it is liable to blow. Again, if the horns do not sound on adjustment, release the push instantly.

When making adjustments to a horn, always disconnect the supply lead of the other horn, taking care to ensure that it does not come into contact with any part of the chassis and so cause a short circuit.

Adjustment

Remove the fixing screw from the top of the horn and take off the cover. Detach the cover securing bracket by springing it out of its location.

Slacken the locknut on the fixed contact and rotate the adjusting nut until the contacts are just separated (indicated by the horn failing to sound). Turn the adjusting nut half a turn in the opposite direction and secure it in this position by tightening the locknut.

Section N.13

FUSES

The fuses are accessible without removing the cover of the control box.

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.

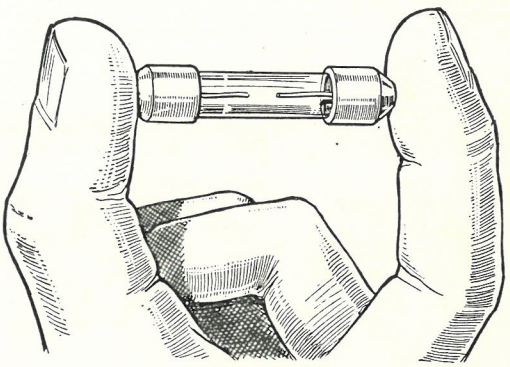


Fig. N.22.
The appearance of a burnt-out fuse.

Units protected

The units which are protected by each fuse can readily be identified by referring to the wiring diagram on page N.22.

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.

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Section N.14

REPLACEMENT BULBS

	Lucas No.	Volts	Watts
Headlamps (Main), Home (L.H.)	300 (dip left)	12	36/36
Headlamps (Main), Home (R.H.)	162	12	36
Headlamps, Export (R.H.D.)	300 (dip left)	12	36/36
Headlamps (Main), commencing Chassis No. 10497 R.H.D., 6561 L.H.D.	354 (dip left)	12	36/36
Headlamps, Export (L.H.D.)	301 (dip right)	12	36/36
Headlamps, Export and Home	360 (dip vertical)	12	36/36
Headlamps, Export (Europe and N. Africa)	Phillips Duple No. 12721	12	35/35
Headlamps (pilot)	989	12	6
Stop tail-lamps (early type)	189	12	6/24
Stop tail-lamps (irreversible type)	361	12	6/18
Number-plate illumination lamp	989	12	6
Boot lamp (when fitted)	207	12	6
Trafficators	256	12	3
Ignition warning light	970	2·5	·5
Panel, side and tail warning lights	987	12	2·4
Roof lamp	207	12	6

Section N.15

THE HEADLAMPS

The headlamps are built into the wings and incorporate pilot bulbs on the early models in addition to the headlamp bulbs.

On later models separate pilot lamps are fitted in the wings immediately below the headlamps.

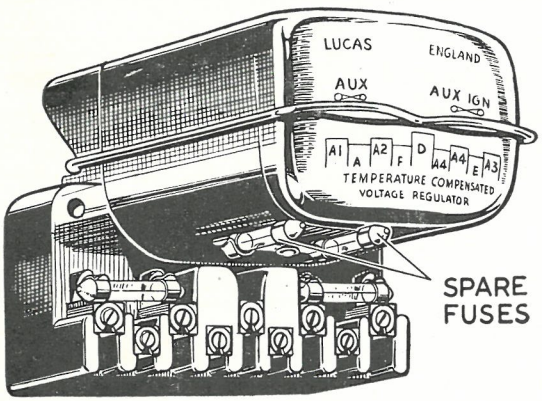


Fig. N.23.
Two spare fuses are carried in clips on the underside of the regulator cover.

The design of the headlamp and its holder is such that the bulb is correctly positioned in relation to the reflector, and no special attention to focusing is required when a replacement bulb is fitted.

In short, the lamps are of the pre-focused type, with replaceable bulbs.

The anti-dazzle device

Home models are equipped with double-filament bulbs in the left-hand headlamp, controlled by the dipping switch.

Operation of the dip switch extinguishes the right-hand lamp and simultaneously deflects the left-hand headlamp beam downwards and to the left to provide good illumination of the left-hand kerb.

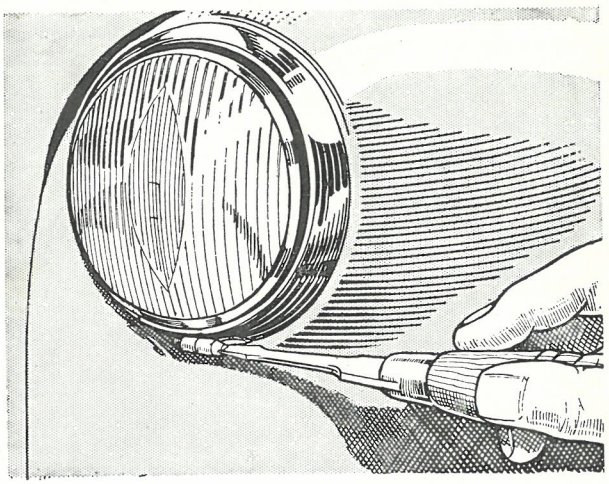


Fig. N.24.
The plated lamp rim is released by unscrewing the contracting screw on the underside.

On some models a double filament bulb is fitted to both lamps and arranged to dip the beams vertically.

On Export models both headlamps are fitted with double-filament main bulbs and pilot bulbs.

Operation of the dip switch extinguishes the main driving beam in each headlamp and brings the dipping beams into action.

Certain countries have lighting regulations to which the foregoing arrangements do not conform and cars exported to such countries have lighting equipment modified to suit the regulations existing in the countries concerned.

Section N.16

THE LIGHT UNITS

The light units consist of a lamp glass, reflector, and a back shell forming the pilot bulb holder. The light unit is located to the front wing by three spring-loaded attachment screws in a domed shield attached to the wing. The back of the lamp is therefore sealed to give complete protection.

A dust- and weather-excluding rubber is fitted in the recess of the rim of the light unit and a plated rim is contracted onto this to complete the weather sealing.

Section N.17

REMOVING THE LIGHT UNITS

To remove the light unit for bulb replacement, unscrew the contracting screw at the bottom of the plated lamp rim and lift the rim away from the dust-excluding rubber.

Remove the dust-excluding rubber, which will reveal the three spring-loaded screws. Press the light unit inwards against the tension of the springs and turn it in an anti-clockwise direction until the heads of the screws can pass through the enlarged ends of the keyhole slots in the lamp rim.

This will enable you to withdraw the light unit sufficiently to give attention to the wiring and bulbs.

Section N.18

REPLACING HEADLAMP BULBS

Withdrawal of the light unit on earlier models gives immediate access to the pilot bulb and its holder at the back of the reflector (see Fig. N.26).

Twist the pilot bulb carrier anti-clockwise and pull it off. The main bulb can now be withdrawn from its

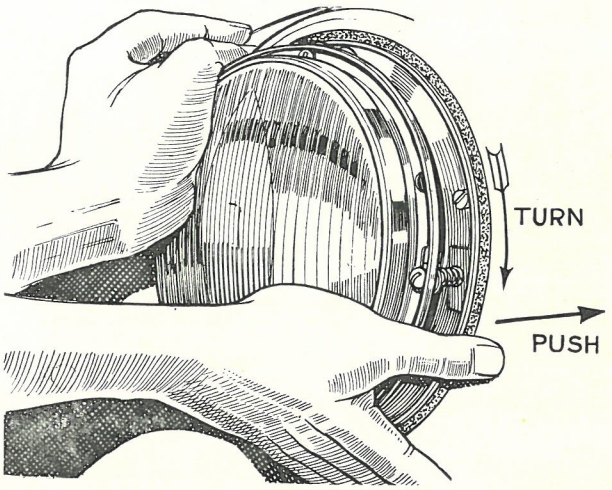


Fig. N.25.

When removing or replacing the light unit it must be pushed towards the wing to compress the springs of the attachment screws. The action of replacing the light unit is here shown. Removal is effected by rotation in the opposite direction.

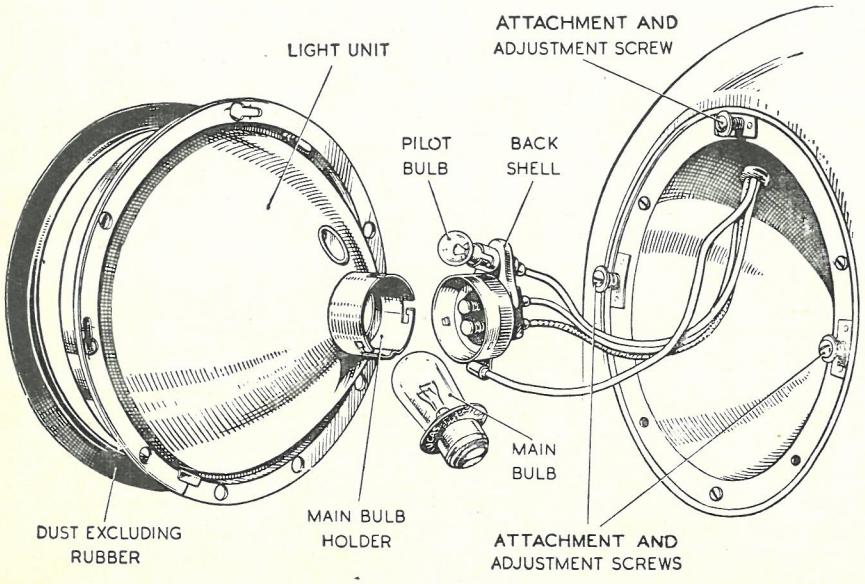


Fig. N.26.

The light unit withdrawn from its housing in the wing, showing the flanged main bulb and the back shell carrying the pilot bulb.

The location of the three spring-loaded attachment screws is also clearly shown.

Later models with separate pilot lamps have no mounting for the pilot bulb on the back shell.

holder complete with its locating flange, which is an integral part of the bulb.

Insert the replacement bulb in the holder, making sure that the slot in the periphery of the bulb flange engages the projection in the holder.

Engage the projections on the pilot bulb carrier with the slots of the holder, press it on and twist it clockwise until it engages with its catch. Later models are fitted with separate pilot lamps (see Section N.30).

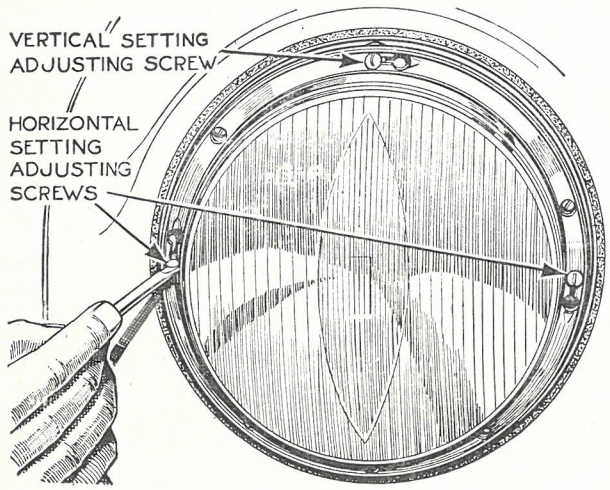


Fig. N.27.
The headlamp beams are set by means of the spring-loaded attachment screws locating the light unit.

Section N.19

REPLACING THE LIGHT UNITS

Position the light unit so that the heads of the adjusting screws coincide with the enlarged ends of the attachment slots. Push the light unit towards the wing to compress the springs and turn the unit to the right as far as it will go, that is, approximately $\frac{1}{2}$ in. (13 mm.).

Replace the dust-excluding rubber on the light rim with its flanged face forward and refit the plated rim.

Section N.20

SETTING THE HEADLAMPS

The lamp should be set so that the main driving beams are parallel with the road surface or in accordance with your local regulations.

If adjustment is required, this is achieved by removing the plated rim and dust-excluding rubber as indicated in Section N.17.

Vertical adjustment can then be made by turning the screws at top of lamp in the necessary direction.

Horizontal adjustment can be effected by using the adjustment screws on each side of the light unit (see Fig. N.27).

Section N.21

CLEANING LAMPS

Care must be taken when handling tail-lamp 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 such as lamp rims 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.**

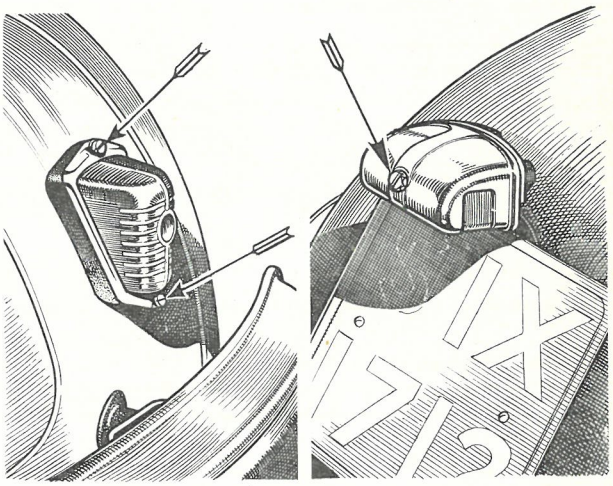


Fig. N.28.
The stop- and tail-lamps. The arrows indicate the cover attachment screws.

Section N.22

THE TAIL-LAMPS AND STOP LIGHTS

The tail-lamps on all models are of the twin bulb type, having a second filament giving a marked increase in brilliance when the brakes are applied.

To obtain access to the bulbs release the two screws fastening the tail-lamp rim in position and withdraw the rim and glass.

The Lucas No. 189, 12-volt, 6/24-watt bulbs are held in bayonet-type holders and are easily withdrawn for replacement.

Note.—*The dual-filament bulbs can naturally be fitted in their bayonet holders in either of two positions. If they are fitted the wrong way round the action of the lamp will be reversed and a bright light will be emitted*

under normal conditions, while a dim light will appear when the stop switch comes into operation.

It is therefore essential to make sure that the bulbs have been fitted the right way round before taking the car on the road. They are marked "top" to facilitate their correct replacement.

Later models are fitted with bulb-holders with off-set bayonet pins in which only the special irreversible bulbs Lucas No. 361 can be used, thus preventing reversal of the filaments.

Section N.23

THE NUMBER-PLATE ILLUMINATION

The number-plate on early models is illuminated by a separate lamp with twin Lucas bulbs No. 989, 12-volt, 6-watt. Later models have a single bulb only.

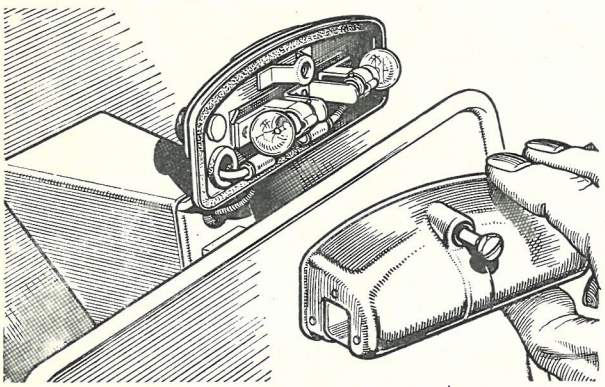


Fig. N.29.
The number-plate lamp on earlier models is provided with two miniature bayonet bulbs. Later models are fitted with a lamp having a single bulb.

The domed cover is removed for bulb replacement by unscrewing the slotted attachment screw. The bulbs are of the miniature bayonet type and are easily removed and replaced.

Section N.24

THE LUGGAGE BOOT LAMP

A lamp is provided in the lid of the luggage boot on some models which automatically switches on when the lid is opened while the car lamps are switched on.

The lamp is fitted with a red plastic cover which provides an additional rear lamp when the lid is open.

The plastic cover is held on by spring clips and is easily withdrawn by pulling it off the lamp body. This gives immediate access to the bulb, which is of the small bayonet type, Lucas No. 207, 12-volt, 6-watt.

The switch for the lamp is of the enclosed spring plunger type and is located adjacent to the boot lid hinge.

Section N.25

THE PANEL LAMPS

The instruments are illuminated by miniature lamps located at the back of the instrument panel.

It is therefore necessary to remove the instrument panel to obtain access to them. The panel is removed by opening the glove box lid and removing the attachment screw passing through the corner ear of the panel. A similar screw attaches the other upper corner of the panel, but in order to obtain access to this it is necessary to remove the cover panel in front of the steering wheel.

This is achieved on earlier models by releasing the steady bracket for the steering column from the facia panel, removing the two attachment screws from the bottom of the cover panel and swinging it forward a sufficient distance to allow the insertion of a hand to undo the upper attachment screw at the back of the cover panel. This releases the panel and gives access to the ear of the instrument panel.

Later models have a spring clip retainer at the top which engages behind the lip of the facia panel to hold

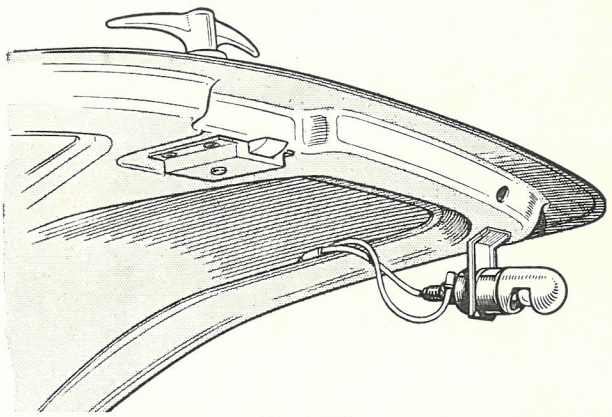


Fig. N.30.
The luggage boot lamp is automatically switched on when the boot lid is opened, provided the lamps are "ON." Later models with "helmet"-type tail-lamps are not fitted with this lamp as they render it unnecessary.

the top edge of the cover, and modified brackets secure the lower edge of the panel, greatly simplifying removal and refitting of the panel.

Remove the corner attachment screw of the instrument panel and the two attachment screws at the bottom edge.

The instrument panel is now free and can be withdrawn to give access to the panel lamps.

Care must be taken when removing and replacing the panel bulbs not to bend or displace the bulb holders as they may touch an adjacent portion of the panel and cause a short circuit.

The panel lamps are Lucas No. 987, 12-volt, 2·4-watt.

Section N.26

THE ROOF LAMP

The glass of the roof lamp is held in position by a wire circlip.

To remove the glass and obtain access to the bulb it is necessary to withdraw the end of the circlip from its location in the lamp rim.

The bulb is a Lucas No. 207, 12-volt, 6-watt bayonet type, and its replacement presents no difficulty.

Section N.27

THE IGNITION WARNING LAMP

Access to the bulb of the ignition warning lamp is obtained by unscrewing the slotted plated rim surrounding the light. Removal of the rim releases the bulb from its spring holder and no difficulty arises

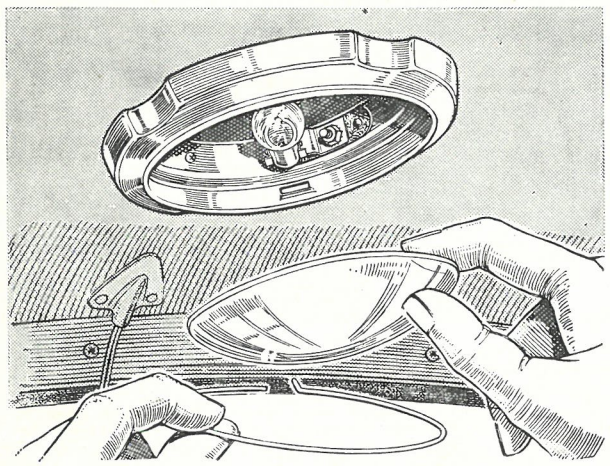


Fig. N.31.
Access to the roof lamp bulb is obtained by removing the wire retaining the glass and withdrawing the glass.

in replacement. On earlier models removal of the plated rim releases the warning lamp from the facia panel and it will drop down behind the panel if it is not held while the rim is removed. Later models have the lamp body held to the facia panel by a locknut and the bulb can be changed without special precaution.

The ignition warning bulb is a Lucas No. 970, 2·5-volt, ·5-watt.

Section N.28

THE LAMP WARNING LIGHT

As the headlamps are completely protected and housed in the wing it is not possible to observe from the driver's seat if the pilot lamps are "on" or not. A green warning light is provided on the instrument panel next to the ignition switch which indicates when the pilot lights are "on."

The bulb is identical to the instrument panel lamps and is fitted at the back of the panel. Access to it is obtained by withdrawing the instrument panel in exactly the same way as for access to the instrument panel lamps.

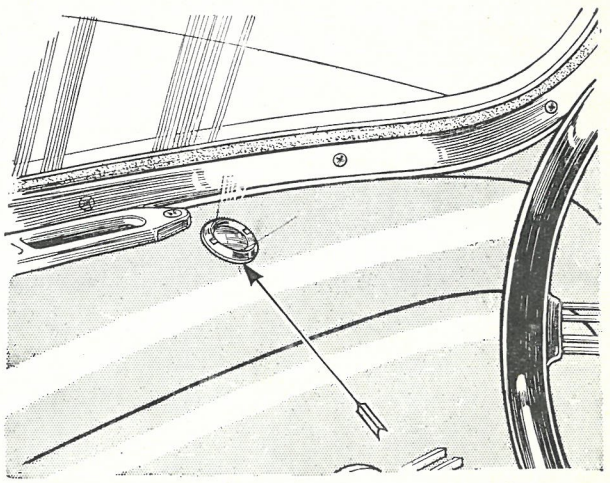


Fig. N.32.
Ignition warning lamp.

Section N.29

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 pages set out the recommended procedure for a systematic examination to locate and remedy the causes of some of the more usual faults encountered.

The sources of trouble are by no means always obvious, and in some cases a considerable amount of deduction from the symptoms is needed before the cause is disclosed.

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 checked by 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. It may be due to the dynamo not charging or giving low or intermittent output. The ignition warning light will not go out if the dynamo fails to charge, or will flicker on and off in the event of intermittent output.
   (*b*) Examine the charging and field circuit wiring, tightening any loose connections or replacing 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. Check the ammeter reading when the car is running steadily with a fully charged battery and no lights or accessories in use; the charge reading should be of the order of only 3—4 amperes.
   If the ammeter reading is in excess of this value, it is advisable to check the regulator setting and adjust if necessary.

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 in 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 by no means a common occurrence. To disengage the pinion, rotate the squared end of the starter shaft by means of a spanner.

2. *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. Remove the starter and clean the sleeve carefully with paraffin.

3. *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.

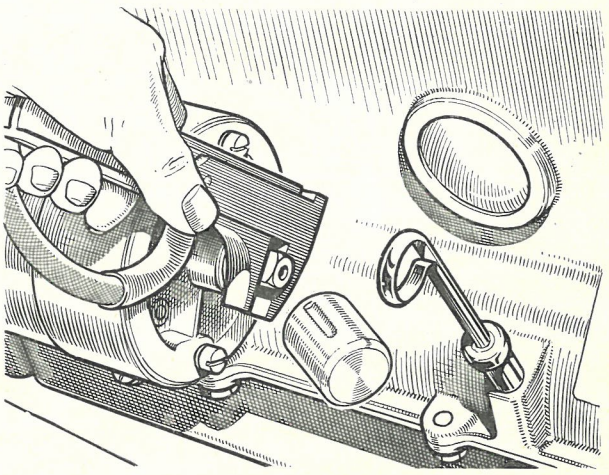


Fig. N.33.
The end of the starter shaft is squared to enable it to be turned with a spanner to release a jammed pinion. The squared end is protected by a cap.

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.30

PILOT LAMPS

Later models are fitted with separate pilot lamps mounted immediately below the headlamps. Access to the bulbs is obtained, without disturbing the headlamps, by folding back the rubber retaining ring with the fingers and extracting the glass and its rim.

The method will be clear from Fig. N.34.

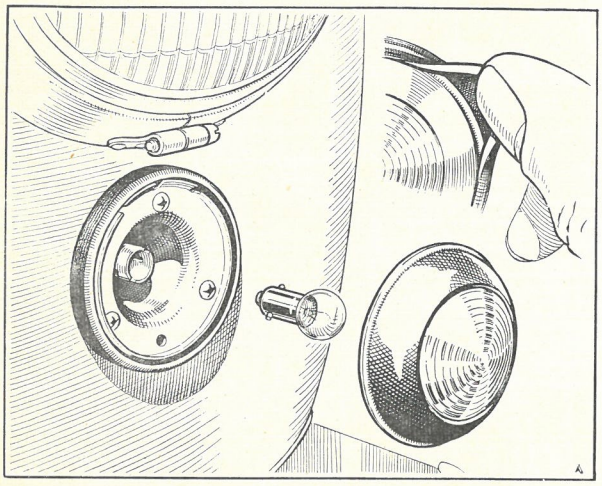


Fig. N.34.
The method of removing the lamp glass and rim from the pilot lamp is here clearly shown.

Section N.31

ALIGNMENT OF WINDSCREEN WIPER DRIVE CABLE

When the battery is fully charged the windscreen wiper blades should make not less than 35 complete cycles per minute on a wet screen.

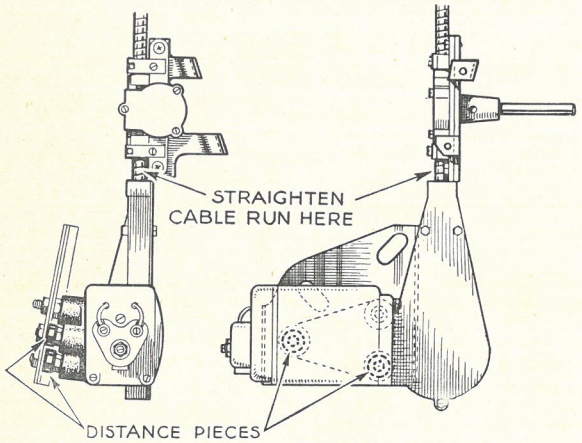


Fig. N.35.
Clearly showing the positions in which the two packing pieces should be fitted to obtain a straight run for the cable.

If necessary, adjustments should be made to reduce any excessive friction on the drive cable, which must have as straight a run as possible between the electric motor and the wheel box.

To eliminate a sharp curve between the motor and its nearest wheel box a $\frac{3}{16}$ in. (4·8 mm.) thick distance-piece $\frac{1}{2}$ in. (13 mm.) in diameter should be added to each of the two bolts indicated in the illustration, between the mounting bracket and the motor.

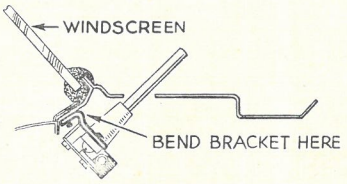


Fig. N.36.
Adjust the wiper blade spindle to the centre of the hole provided in the opening panel by bending the support bracket as indicated.

Ensure that the wiper blade spindles are in the centre of the holes in the windscreen opening panel. If they are not, their location should be corrected by bending the wheel box support brackets where indicated.

Section N.32

HEADLAMP BEAM WARNING LIGHT

Later models are fitted with a headlamp beam warning light in the centre of the motif on the facia panel on the driver's side.

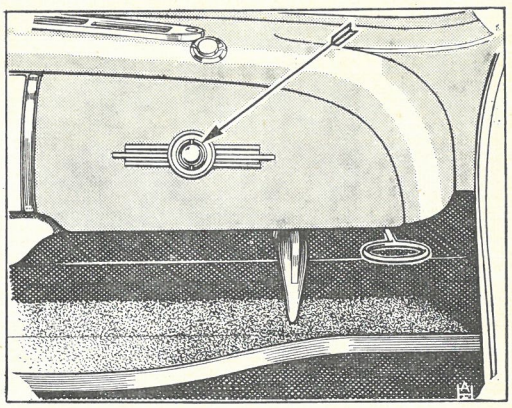


Fig. N.37.
The headlamp beam warning light.

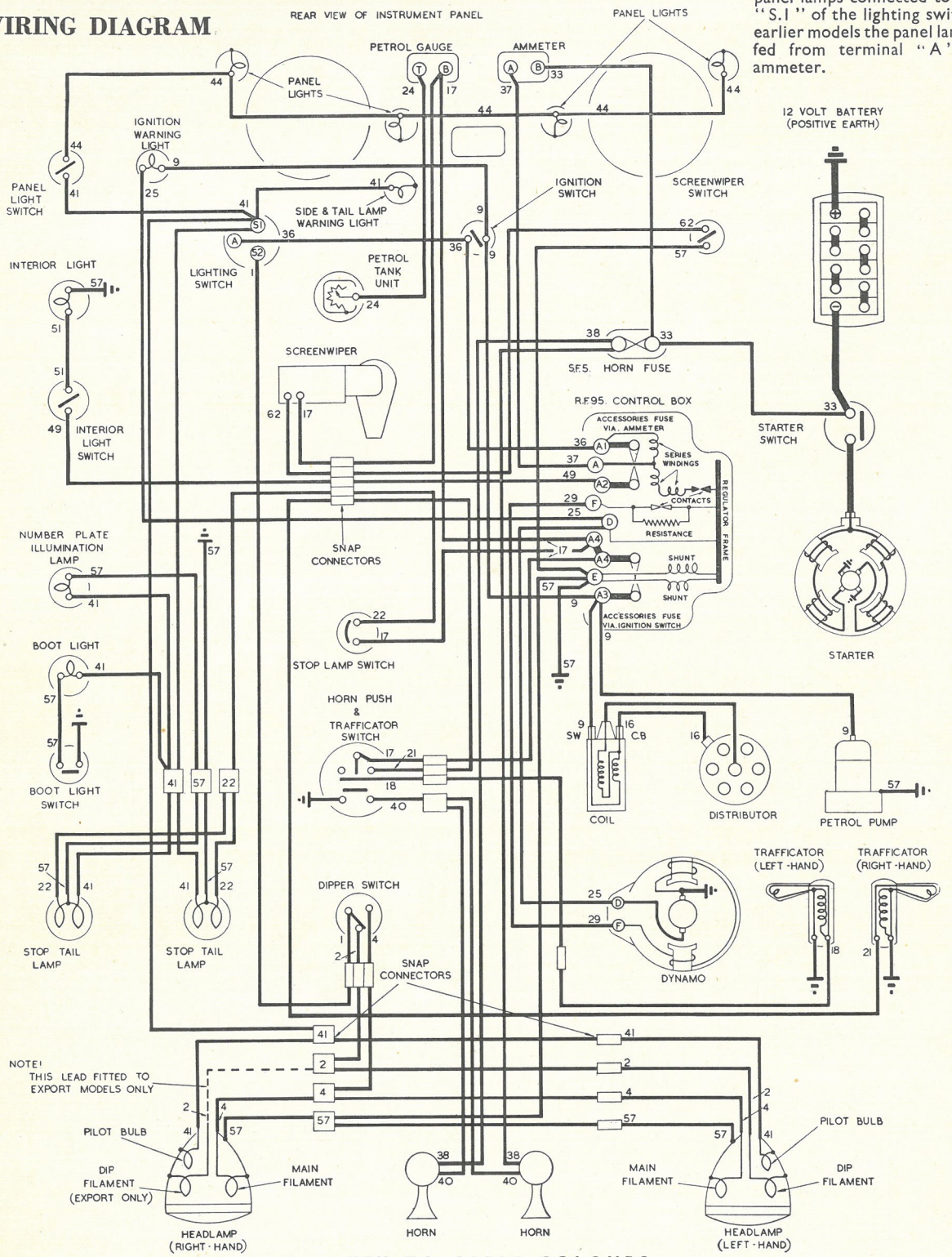
When the headlamp beams are in the normal driving position (horizontal) the light is switched on to warn the driver to use the dip-switch when meeting oncoming traffic.

The warning light is switched off automatically when the headlamp beams are in the dipped position.

ELECTRICAL EQUIPMENT

WIRING DIAGRAM

Note.—This diagram shows the panel lamps connected to terminal "S.1" of the lighting switch. On earlier models the panel lamps were fed from terminal "A" of the ammeter.

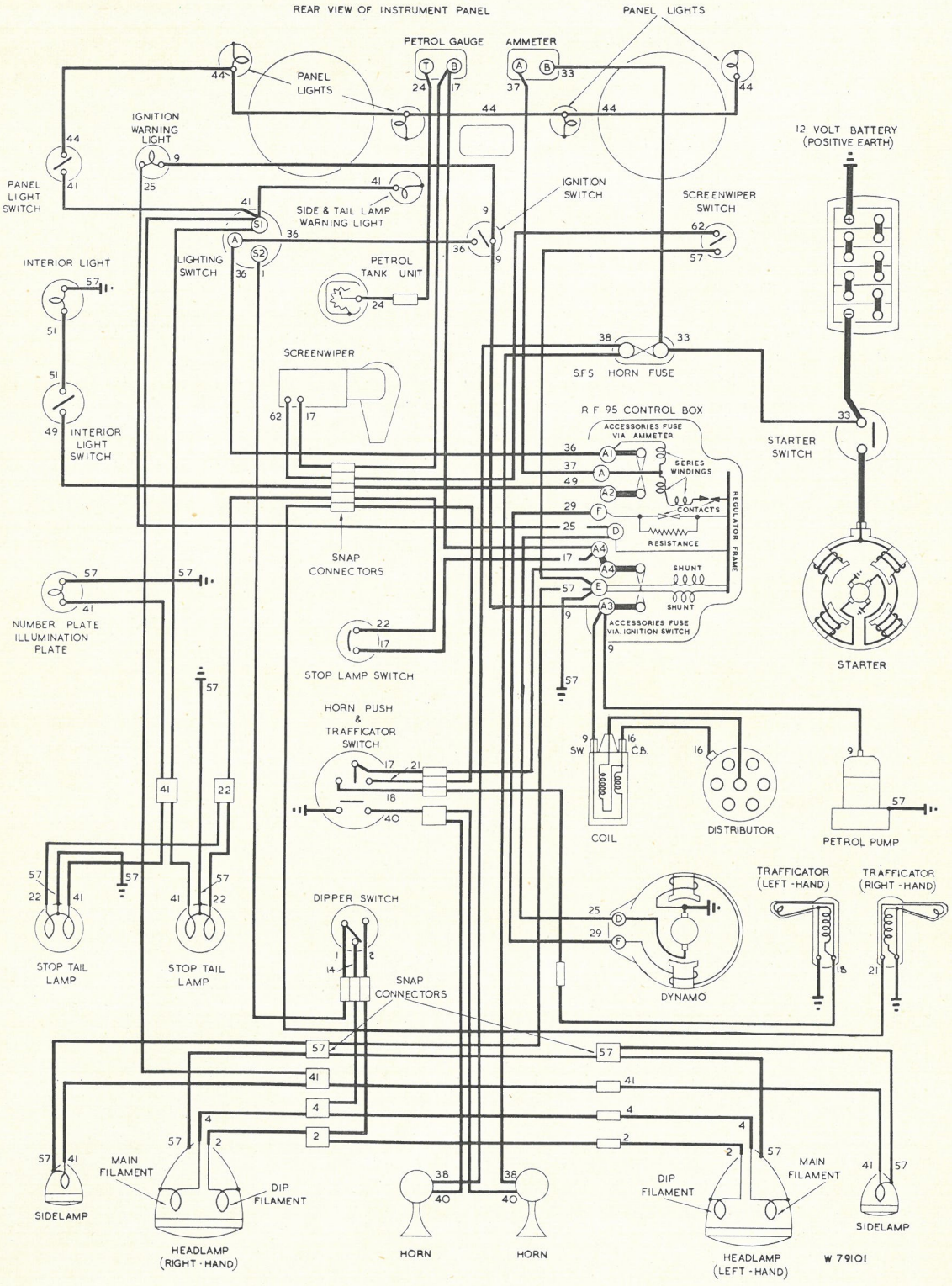


KEY TO CABLE COLOURS

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	

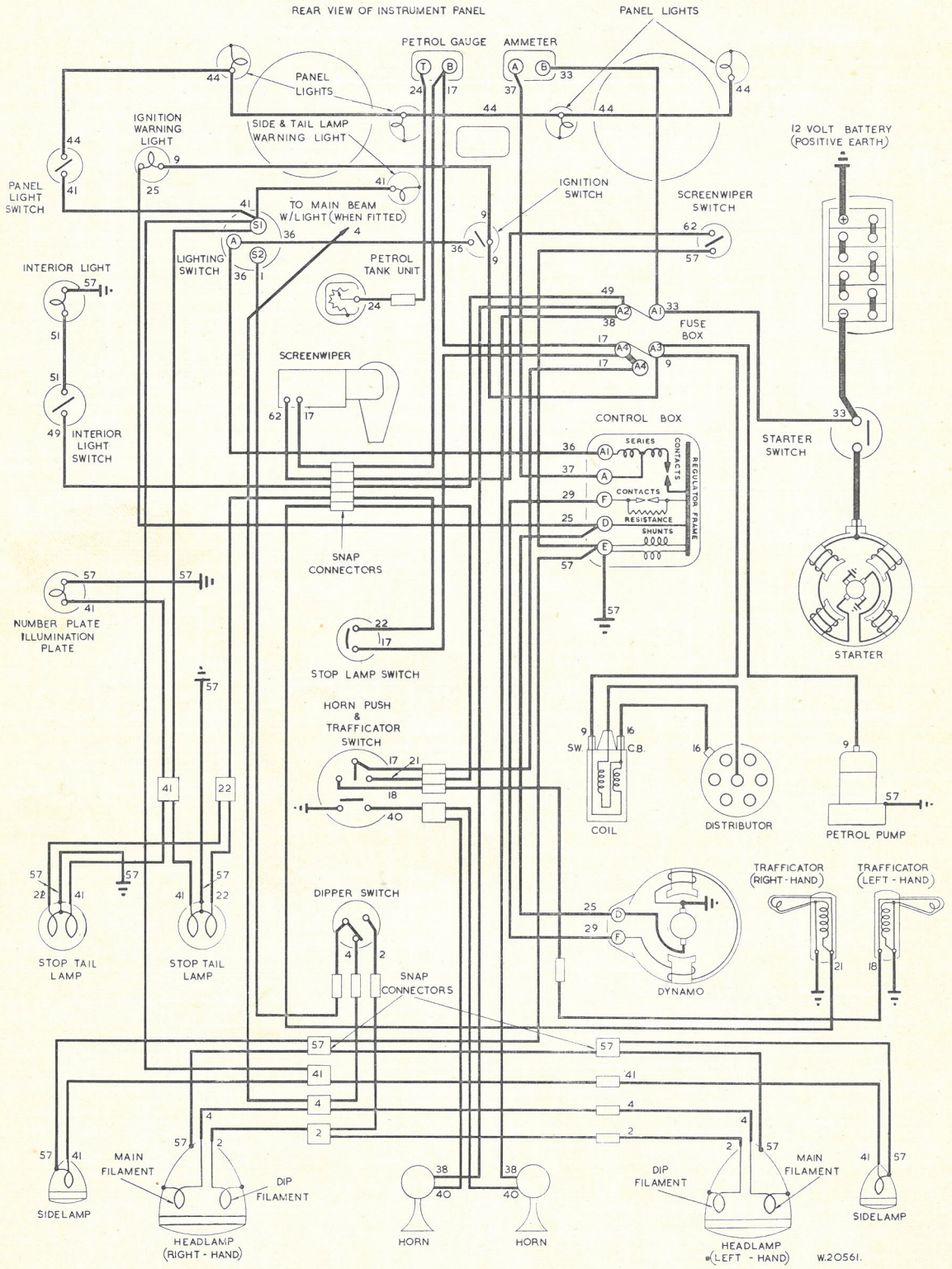
Note.—Models with the improved tail-lamps are not fitted with the boot light indicated at the left of the diagram.

WIRING DIAGRAM FOR CARS WITH SEPARATE PILOT LAMPS



Key to cable colours as on page N.22.

WIRING DIAGRAM FOR CARS WITH SEPARATE CONTROL BOX AND FUSEBOX AND HEADLAMP WARNING LIGHT



Key to cable colours as on page N.22.

SECTION 0

THE WHEELS AND TYRES

Section No. O.1 General.

Section No. O.2 Tyre removal.

Section No. O.3 The importance of balance.

Section No. O.4 Fitting tyres and tubes.

Section 0.1

GENERAL

Tyre pressures

It is of the utmost importance that the tyres be carefully maintained at the following recommended pressures :—

When carrying two passengers :

Front : 22 lb. per sq. in. (1·6 kg./cm.^{2}).

Rear (normal) : 24 lb. per sq. in. (1·7 kg./cm.^{2}).

When carrying five passengers and luggage the front tyres should be inflated to 24 lb. (1·7 kg./cm.^{2}) and the rear tyres should be inflated to 26 lb. per sq. in. (1·8 kg./cm.^{2}).

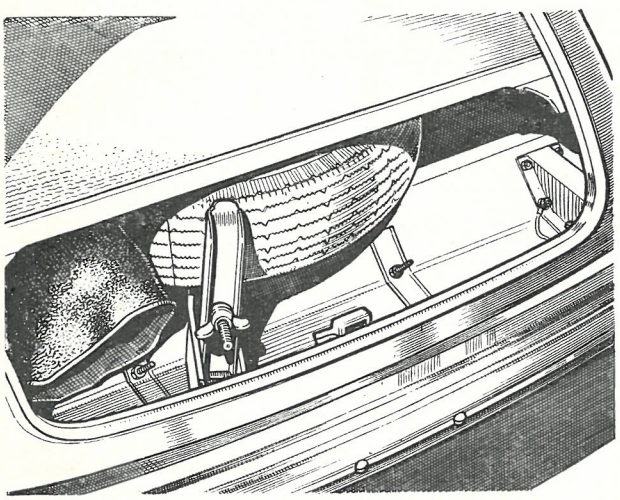


Fig. O.1.
The spare wheel is held in position in its compartment by a clamp plate and wing nut.

Spare wheel

The spare wheel is carried in a separate compartment beneath the trunk lid and is secured in position by a wing nut and clamp plate which must be removed before the wheel can be withdrawn. Keep the tyre inflated to 26 lb. per sq. in. (1·8 kg./cm.^{2}).

The jack

When using the special jack apply the hand brake and remove the rubber plug from the square section tube which is welded to the chassis on either side beneath the centre door pillar. Insert the square arm of the jack and raise the side of the car, placing chocks on each side of the two wheels which are not being raised from the ground.

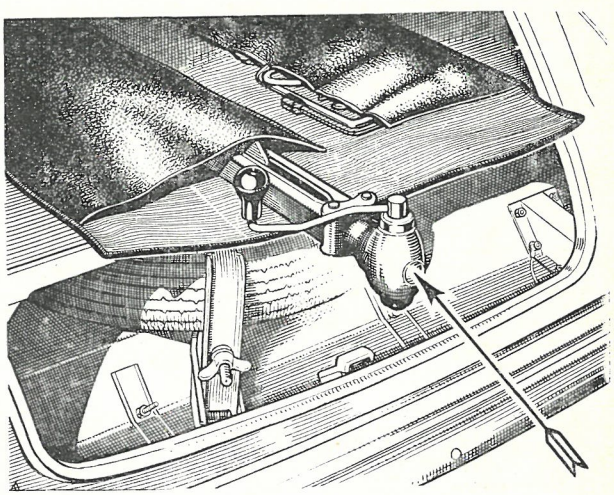


Fig. O.2.
The jack is housed in the tool roll and stowed alongside the spare wheel as shown in Fig. O.1.

Road wheels removal and replacement

Remove the hub cover by inserting the flattened end of the wheel nut spanner in the recess provided, adjacent to the retaining studs, and giving it a sideways twist.

Remove the five nuts securing the road wheels to the hub. The wheel nuts have right-hand threads, i.e. turn clockwise to tighten and anti-clockwise to remove. Lift the road wheel from the studs.

Reverse this procedure when replacing the road wheel and ensure that the wheel stud nuts are tight. **This is important.**

To refit the hub disc, the rim should be placed over two of the buttons on the wheel centre and the outer face given a sharp blow of the fist over the third button.

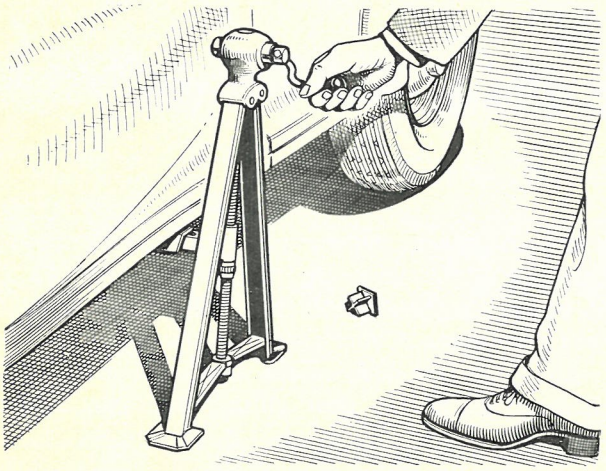


Fig. O.3.
The car is raised for wheel removal by inserting the square arm in the socket provided beneath the centre door pillar.

The valves

Valve caps, in addition to preventing dirt from entering the valve, form a secondary air seal and should always be fitted. The valves may be tested for air-tightness by rotating the wheel until the valve is at the top and inserting its end in an eggcup full of water. If bubbles appear the seating is faulty and should be removed and replaced by a new one. 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 (3200 km.).

Attention should be paid to the following points, with a view to obtaining the maximum mileage from the tyre equipment of the vehicle :—

Test 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.

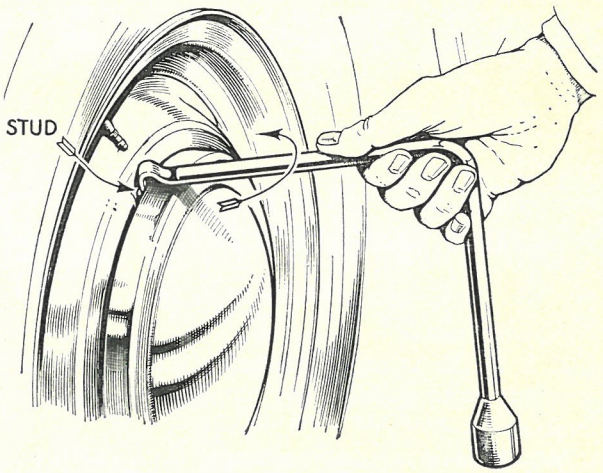


Fig. O.4.
The wheel hub disc is removed by using the flattened end of the wheel nut brace and giving it a sideways motion.

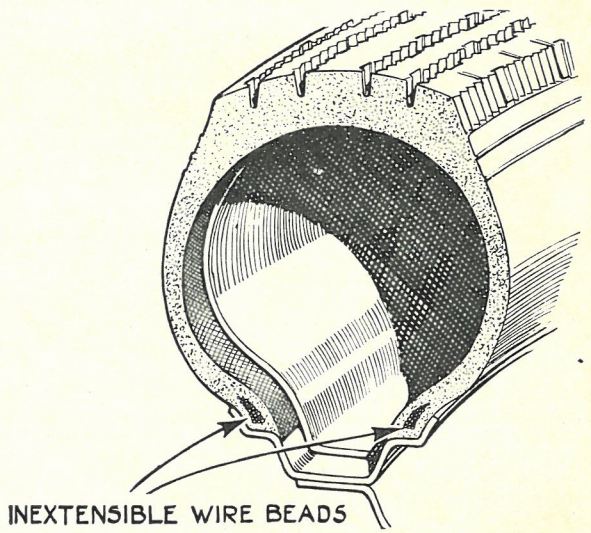


Fig. O.5.
The Dunlop tyres fitted as standard to the Morris Six have wired edges and no attempt must be made to stretch them.

Misalignment is a very costly error. Suspect it if rapid wear of the front tyres is noticed, and correct the fault at once. See Section J for details of 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.

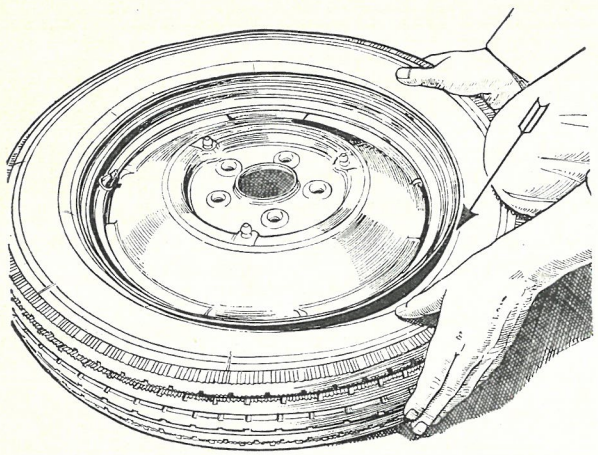


Fig. O.6.
The first step in tyre removal is the pushing of the bead into the well of the rim opposite the tyre valve.

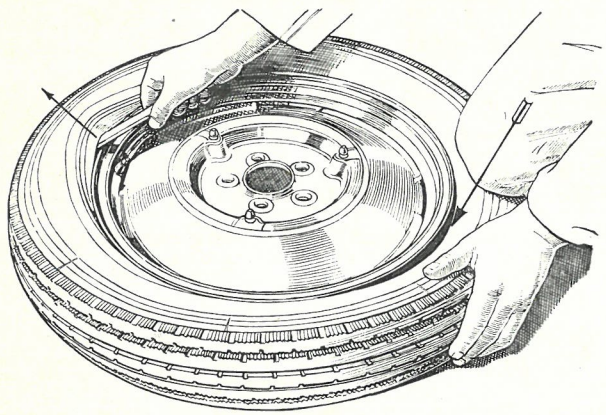


Fig. O.7.
Tyre levers can then be inserted close to the tyre valve and the tyre lifted over the rim without difficulty.

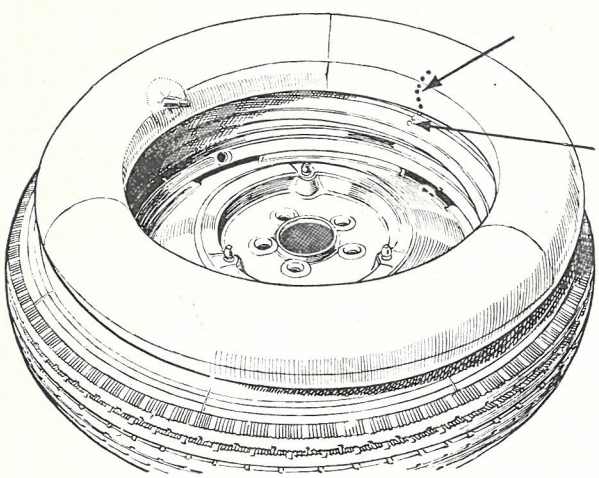


Fig. O.8.
When replacing a cover and tube make sure the balance marks on the tube and cover coincide.

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 to completely deflate the tyre 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 Fig. O.7), using two levers at intervals of 6 in. (15 cm.) 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.

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 spots 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.

The maximum out of balance of the tyre and wheel assembly permissible to ensure good steering is 20 in./oz. (·015 m./kg.). Assemblies which are out of balance beyond this amount should be balanced by means of special rim weights obtainable from Messrs. Dunlop Rubber Co., Part Nos. WBW/1 to 7, which cover a range of weights weighing from $\frac{1}{2}$ oz. to $3\frac{1}{2}$ oz. in steps of $\frac{1}{2}$ oz.

Section 0.4

FITTING TYRES AND TUBES

The following procedure is recommended when fitting tyres and tubes to well-base rims :—

1. Inspect the inside of the cover carefully and remove all dirt. The wheel rim must be clean, free from rust and undamaged.
2. Dust the inside of the cover evenly with french chalk.
3. Inflate the tube until it begins to round out, then insert it in the cover.
4. 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. (5·0 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 the solution and rubbed together.
5. Mount the tyre on the rim immediately, whilst the soap solution is still wet.

   Push one edge of the cover over the edge of the rim. It will go quite easily if the part first put on is fitted on the opposite side of the valve and is pushed right down into the rim base. Move it round so that its balance spots coincide with those of the inner tube when it is inserted with the valve passing 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.)
6. Before inflating, be sure that the tyre beads are clear of the well of the rim all the way round.
7. Inflate slowly until the beads are fully seated.
8. Remove the valve core to **deflate the tube completely.**
9. Re-inflate to the correct working pressure (see page O.1). 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 local strains in the tube.

In an emergency french chalk may be used as a substitute for the 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.

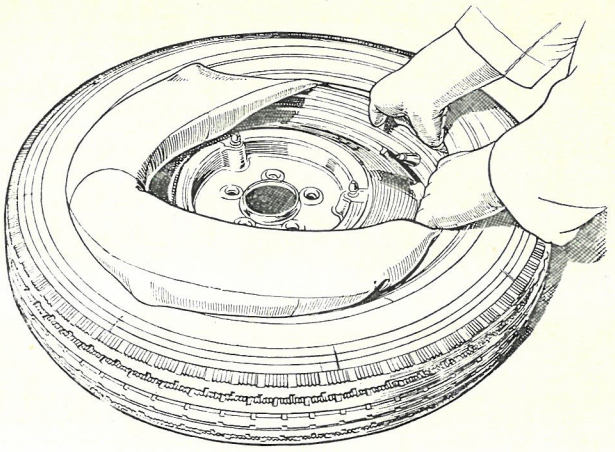


Fig. O.9.
After slight inflation the tube is introduced into the cover, fitting the valve in position first.

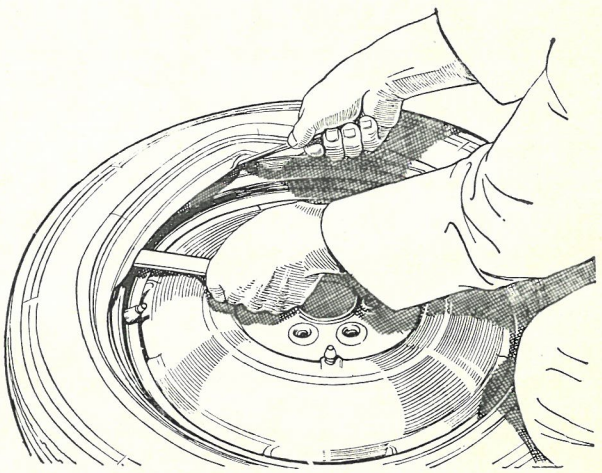


Fig. O.10.
When refitting the cover, start at a point diametrically opposite to the valve and finish at the valve.

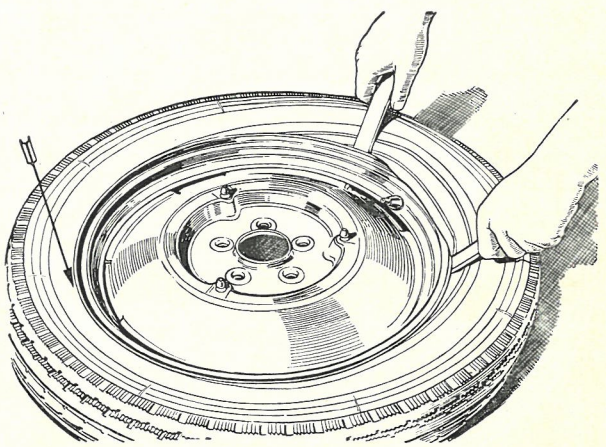


Fig. O.11.
If the portion of the cover first fitted is kept well into the well of the rim no difficulty will be encountered in replacing the last portion of the cover.

SECTION P

LUBRICATION

General information.

Section No. P.1 Engine lubrication.

Section No. P.2 Gearbox lubrication.

Section No. P.3 Rear axle lubrication.

Section No. P.4 Grease gun lubrication.

Section No. P.5 Carburetter lubrication.

Section No. P.6 Steering lubrication.

Section No. P.7 Air cleaner lubrication.

Section No. P.8 Distributor lubrication.

Section No. P.9 Dynamo lubrication.

Section No. P.10 Front wheel bearings.

Section No. P.11 Front suspension bearing.

USE CORRECT LUBRICANTS

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 and the use of the correct oil is therefore essential.

Section P.1

ENGINE LUBRICATION A

New engines should have their oil drained after the first 500 miles (800 km.) and refilled with fresh oil. Subsequently the oil should be changed at intervals of 3,000 miles (5000 km.).

The engine should preferably be drained when warm and the oil is relatively fluid.

When draining the engine sump, the oil filter housing plug should also be removed to release any deposit which may have accumulated.

The oil level should be checked by the dipstick every 250 miles (400 km.) and replenished if necessary. The level should never be allowed to fall below the "low" mark.

The sump capacity is 10 pints (5·7 litres).

Every 12,000 miles (20000 km.) the filter element should be withdrawn from the sump housing and a

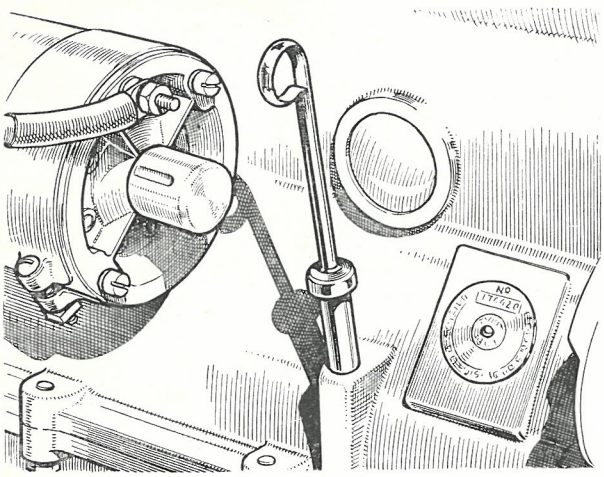


Fig. P.1.
The oil level dipstick for the engine is on the right-hand side of the cylinder block.

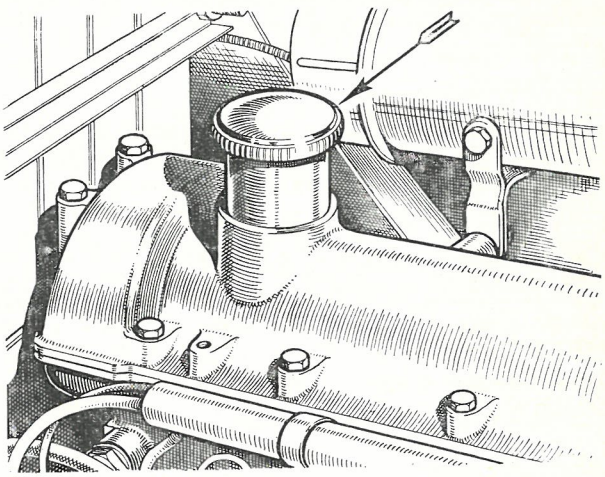


Fig. P.2.
The oil filler for the engine is situated on the rear end of the cylinder head cover on early models. On later models it is at the front end of the engine.

P LUBRICATION

The following is a list of lubricants recommended :

A ENGINE AND OIL BATH AIR CLEANER

Climatic Conditions	**Castrol** *C. C. Wakefield & Co. Ltd.*	**Essolube** *Esso Petroleum Co. Ltd.*	**Mobiloil** *Vacuum Oil Co. Ltd.*	**Shell** *Shell Mex & B.P. Ltd.*	**Energol** *Price's Lubricants Ltd.*	**Filtrate** *Edward Joy & Sons Ltd.*	**Sternol** *Sternol Ltd.*	**Duckham's** *Alexander Duckham & Co. Ltd.*
Tropical and temperate down to 32° F. 0° C.	" Castrol " X.L.	" Essolube " 30	Mobiloil " A "	" Shell " X—100 S.A.E. 30	" Energol " Auto 150	Medium " Filtrate "	" Sternol " W.W. 30	Duckham's N.O.L. " Thirty "
Extreme cold down to 0° F. —18° C.	" Castrolite "	" Essolube " 20	Mobiloil " Arctic "	" Shell " X—100 S.A.E. 20	" Energol " Auto 125	Zero " Filtrate "	" Sternol " W.W. 20	Duckham's N.O.L. " Twenty "
Arctic—consistently below 0° F. —18° C.	" Castrol " Z	" Essolube " 10	Mobiloil " Arctic " Special	" Shell " X—100 S.A.E. 10	" Energol " Auto 80	Sub-Zero " Filtrate "	" Sternol " W.W. 10	Duckham's N.O.L. " Ten "

B REAR AXLE (HYPOID), GEARBOX, STEERING GEAR

Tropical and temperate down to 10° F. —12° C.	" Castrol " Hypoy	" Esso " Expee Compound 90	Mobilube " G.X." 90	" Shell " Spirax E.P. 90	" Energol " Transmission 300 E.P.	Hypoid " Filtrate " 90	" Sternol " Liquid Ambroleum Hypoid 90	Duckham's Hypoid 90
Extreme cold below 10° F. —12° C.	" Castrol " Hypoy 80	" Esso " Expee Compound 80	Mobilube " G.X." 80	" Shell " Spirax E.P. 80	" Energol " Transmission 200 E.P.	Hypoid " Filtrate " 80	" Sternol " Liquid Ambroleum Hypoid 80	Duckham's Hypoid 80

C WHEEL HUBS AND FAN BEARINGS

All temperatures	" Castrolease " Heavy	" Esso " Bearing Grease	Mobilgrease No. 5	" Shell " Retinax H for Hubs Retinax C for Fan	"Energrease" Chassis Pressure No. 2	" Filtrate " R.B. Grease	" Ambroline " R.B. Grease	Duckham's H.B.B. Grease

D STEERING CONNECTIONS, KING-PINS, PROPELLER SHAFT, CLEVIS PINS AND LEVER FULCRUMS

All temperatures	" Castrolease " Medium	" Esso " Chassis Lubricant	Mobilgrease No. 2 or 4	" Shell " Retinax C	"Energrease" Chassis Pressure No. 2	H.P. Solidified " Filtrate "	" Ambroline " M.M. Grease	Duckham's H.P.G. Grease

E CABLES AND VITAL CONTROL JOINTS

All temperatures	" Castrolease " Brake Cable Grease	" Esso " Chassis Lubricant	Mobilgrease No. 2 or 4	" Shell " Retinax C	"Energrease" Chassis Pressure No. 2	" Filtrate " A.F. Grease	" Ambroline " A.F. Grease	Duckham's " Keenol " K.G. 16 Grease

F UTILITY LUBRICANT, S.U. CARBURETTER DASHPOT, OILCAN POINTS, ETC.

All temperatures	" Castrolite "	" Essolube " 20	Mobiloil " Arctic "	" Shell " X—100 S.A.E. 20	" Energol " Auto 125	Zero " Filtrate "	" Sternol " W.W. 20	Duckham's N.O.L. " Twenty "

EXTREME COLD CONDITIONS

Where a car is operated in temperatures which are consistently below 0° F. (—18° C.), the use of an oil of lower viscosity than that recommended for normal use is desirable, and under such conditions the use of engine oil of the grades indicated in the appropriate temperature range is recommended.

Similar considerations apply in the case of the gearbox, rear axle and steering gearbox.

MIXING LUBRICANTS

Note.—It is a 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 other components.

new element fitted. The element is easily withdrawn after the four bolts securing the filter cover to the sump have been removed.

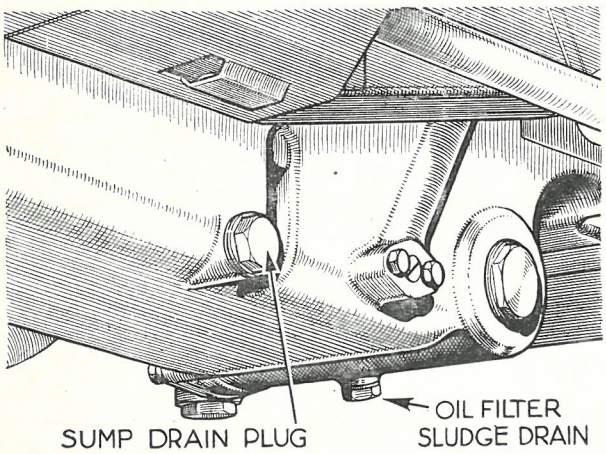


Fig. P.3.
The location of the sump drain plug and the drain plug for the oil filter sludge drain.

The filter element is a Tecalemit F.G.2343, or Fram No. 802, and care must be taken to see that the filter cover is replaced properly, engaging the recessed seating, and that the seating gasket is undamaged. On later models a cast-iron cover is fitted instead of an aluminium cover, to reduce distortion.

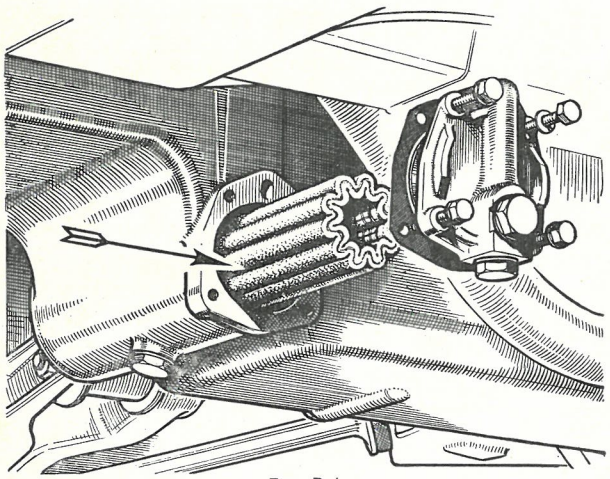


Fig. P.4.
The filter element partly removed from the engine sump.

Section P.2

GEARBOX LUBRICATION **B**

The gearbox oil level should be checked by the dipstick every 1,000 miles (1600 km.) and replenished if necessary.

Access to the dipstick is obtained through the aperture in the left toeboard, closed by a rubber plug and revealed by raising the carpet.

The oil should never be allowed to fall below the "low" mark.

The gearbox should be drained and refilled with fresh oil to Ref. B after the first 500 miles (800 km.)

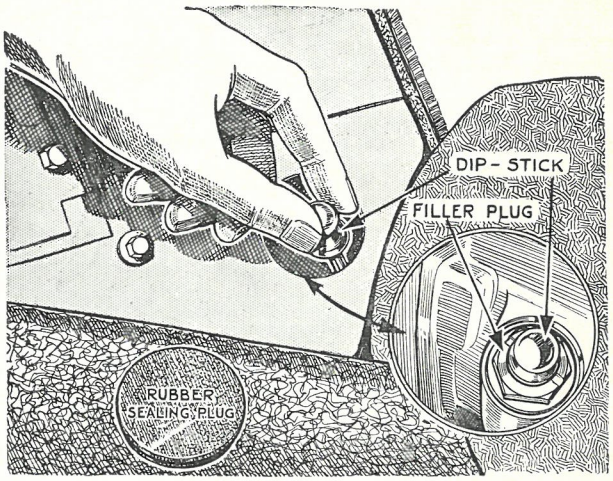


Fig. P.5.
The gearbox oil filler and dipstick are accessible through the aperture in the toeboard.

with a new car and subsequently every 6,000 miles (10000 km.).

A drain plug is provided in the base of the box.

The capacity of the gearbox is 2 pints (1·14 litres).

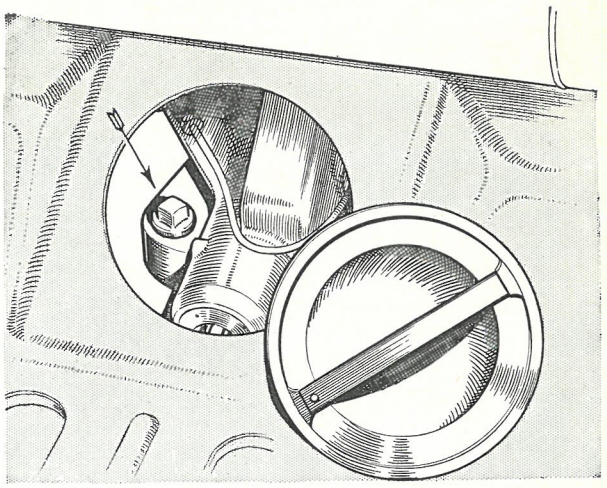


Fig. P.6.
The rear axle oil filler can be reached through the opening in the rear seat pan.

Section P.3

REAR AXLE LUBRICATION **B**

It is important that only Hypoid oils of the approved grades be used in the rear axle if damage to the gears is to be avoided.

The rear axle oil level should be checked every 1,000 miles (1600 km.) and replenished if necessary.

The surface of the oil should be kept level with the bottom thread of the filler plug opening.

Access to the filler plug is obtained through the circular aperture in the rear seat pan closed by a dished cover with spring retainer.

The rear axle should be drained, through the plug provided, after the first 500 miles (800 km.) with a new car and subsequently every 6,000 miles (10000 km.).

The capacity of the axle is $2\frac{1}{2}$ pints (1·4 litres).

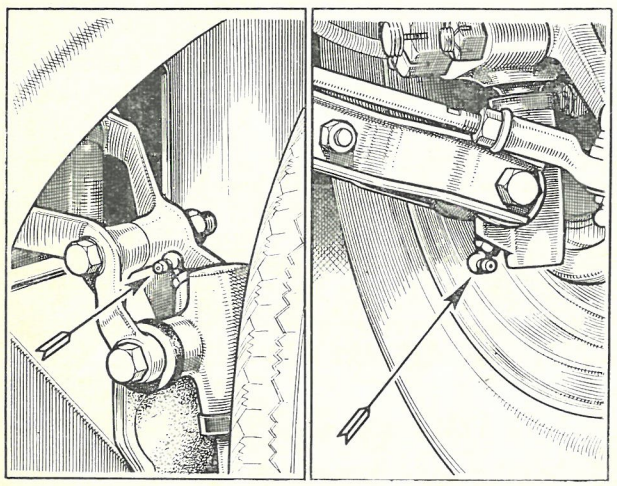


Fig. P.7.
The grease nipples at the top and bottom steering knuckles.

Section P.4

GREASE GUN LUBRICATION POINTS

Extensive use of oil-less bearings has reduced the number of points requiring attention with the grease gun to a minimum.

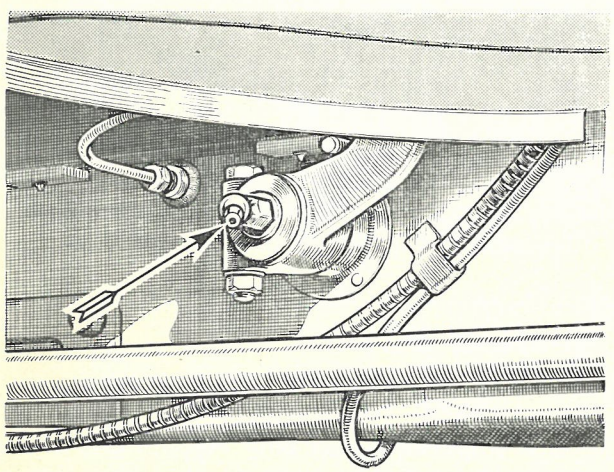


Fig. P.8.
The grease nipple for the foot pedal shaft bushes.

Grease nipples are located at the following points, which should receive attention, at the intervals indicated, with the grease gun filled with grease to Ref. D :—

1. Steering knuckles (four nipples), every 500 miles (800 km.) three or four strokes.
2. Steering tie-rod ball ends (four nipples), every 500 miles (800 km.) three or four strokes.
3. Steering track-rod ball ends (two nipples), every 500 miles (800 km.) three or four strokes.
4. Propeller shaft universal joints (two nipples), every 1,000 miles (1600 km.) three or four strokes.
5. Propeller shaft sliding joint (one nipple), every 1,000 miles (1600 km.) three or four strokes.
6. Foot control pedal shaft (one nipple), every 500 miles (800 km.) three or four strokes.
7. Steering transfer gearbox (one nipple), every 500 miles (800 km.) three or four strokes.

The grease gun should be filled with grease to Ref. C when attending to the following items :—

8. Fan spindle (one nipple), every 500 miles (800 km.) two strokes.
9. Front wheel hubs (two nipples), every 6,000 miles (10000 km.) one stroke. (Later models have a grease-retaining cap which must be prised from the end of the hub and refilled with grease.)

Be sure to use the correct grease for each purpose (see page P.2).

Section P.5

CARBURETTER DASHPOT

Every 1,000 miles (1600 km.) the brass cap of the carburetter suction chamber should be unscrewed and withdrawn sufficiently to enable the dashpot chamber to be replenished with engine oil to Ref. F (page P.2).

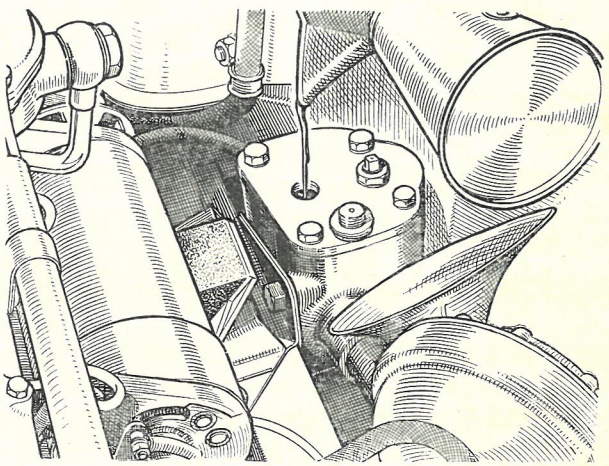


Fig. P.9.
Filling the steering gearbox to the level of the filler plug orifice.

Section P.6

STEERING GEARBOX LUBRICATION

The steering gearbox and filler plug are accessible when the bonnet is lifted.

The oil level should be checked every 3,000 miles (5000 km.) and the oil replenished, if necessary, to the level of the filler plug orifice with one of the oils to Ref. B indicated in the list of approved oils on page P.2.

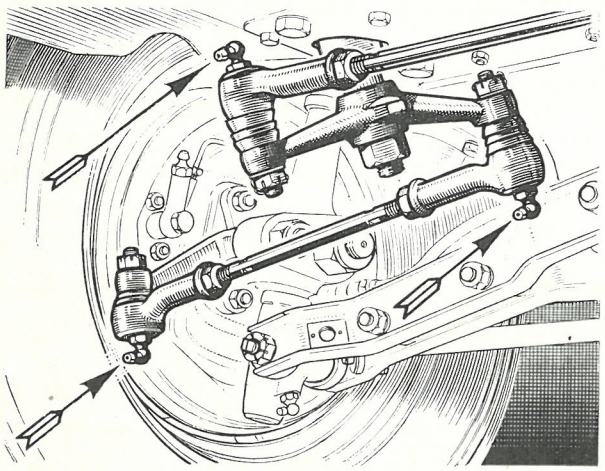


Fig. P.10.
The three greasers on the right-hand side of the steering linkage.

Section P.7

AIR CLEANER LUBRICATION

The air cleaners fitted to the vehicles for Home use are of the oil-wetted mesh type and they require maintenance attention every 6,000 miles (10000 km.), when they should be removed from the engine, washed in petrol, dried and re-oiled by dipping the mesh-loaded end in a shallow dish of engine oil.

Allow the surplus oil taken up by the wire mesh to drain away before refitting the air cleaner to the engine.

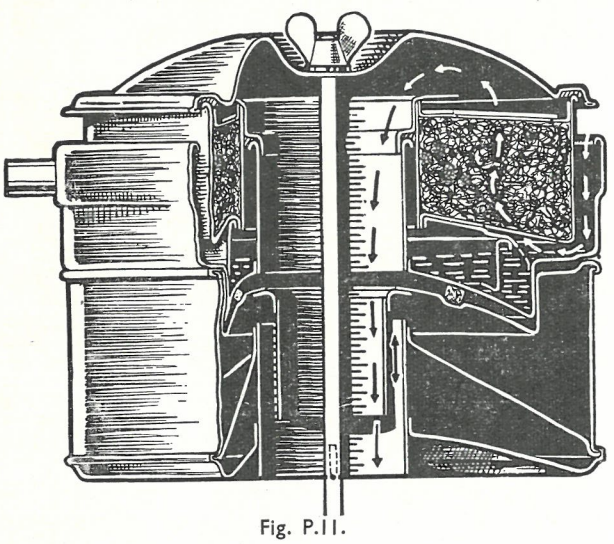


Fig. P.11.
The oil bath air cleaner fitted to Overseas models, showing the path taken by the air and how it impinges on the oil to deposit the heavier particles of dust.

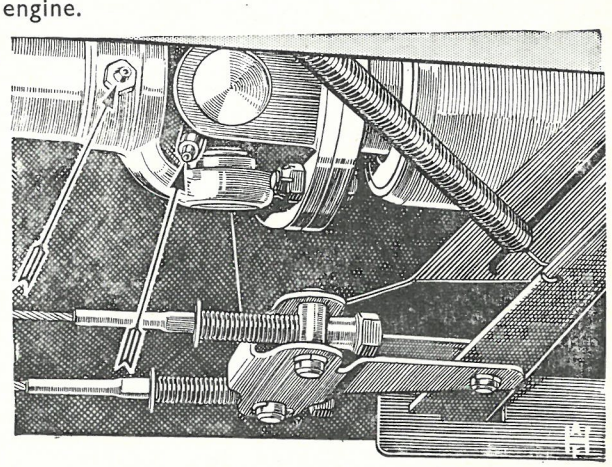


Fig. P.12.
The greasers for the front universal joint and sliding joint of the propeller shaft. The greaser for the rear joint may be reached through the opening in the rear seat pan.

Cars for Export use are fitted with oil bath air cleaners.

Every 3,000 miles (5000 km.) the cover should be removed by unscrewing its central fixing nut. This enables the filtering element to be lifted out and cleaned in paraffin or petrol. Allow the paraffin to drain off thoroughly and dry off the exterior of the filter element.

Examine the oil container in the base of the cleaner for sludge. If this is more than $\frac{1}{4}$ in. (6 mm.) deep, clean out the base and refill it with fresh engine oil to the level indicated on the cleaner.

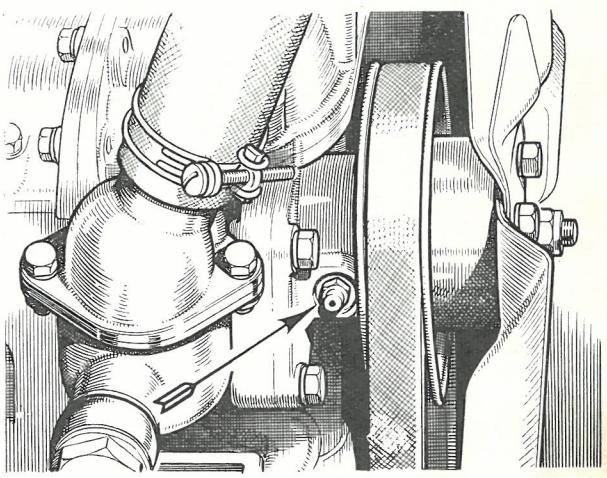


Fig. P.13.
The grease nipple for the fan spindle.

If the accumulation of sludge is only slight it is merely necessary to replenish the oil to bring it to the correct level.

When reassembling the air cleaner make sure that the cork gaskets are in good condition. Fit new ones if necessary.

Section P.8

DISTRIBUTOR LUBRICATION

Every 3,000 miles (5000 km.) the distributor cam and rocker-arm pivot should be given a slight smear of grease to Ref. D (page P.2).

A few drops of thin machine oil should be added to the spindle centre at the same time after removing the rotor arm.

A few drops of thin machine oil should also be added, through the oil hole provided in the distributor base, to replenish the oil well feeding the spindle and advance mechanism.

Section P.9

DYNAMO LUBRICATION

Every 12,000 miles (20000 km.) the dynamo square end cover on earlier models should be unscrewed and the bearing repacked with grease to Ref. D (page P.2).

Later models are fitted with a wick-type lubricator; on these models the lubricator should be unscrewed, the body half-filled with grease to Ref. D (page P.2) every 3,000 miles (5000 km.).

Avoid over-filling the lubricator. Excessive loading of the lubricator is likely to do more harm than good as it is essential to prevent grease from reaching the commutator.

Section P.10

FRONT WHEEL BEARINGS

Every 6,000 miles (10000 km.) the front wheel hub caps should be removed and the grease gun filled with grease to Ref. C should be applied to the nipple on the wheel hub bearing cap and given two strokes only.

Later models are fitted with a sealing cap on the outer end of the hub, which must be removed, repacked with grease and replaced.

The cap is clearly shown in the illustration in Fig. P.18 and the old disc-type grease retainer with grease nipple in Fig. P.17.

The new grease cap is a tight fit in the end of the hub and it should carefully be prised off with a

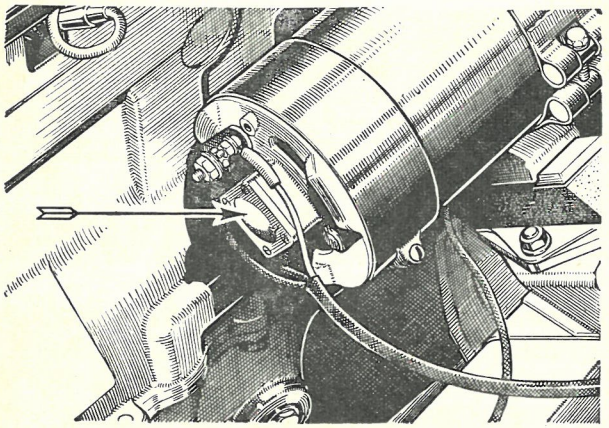
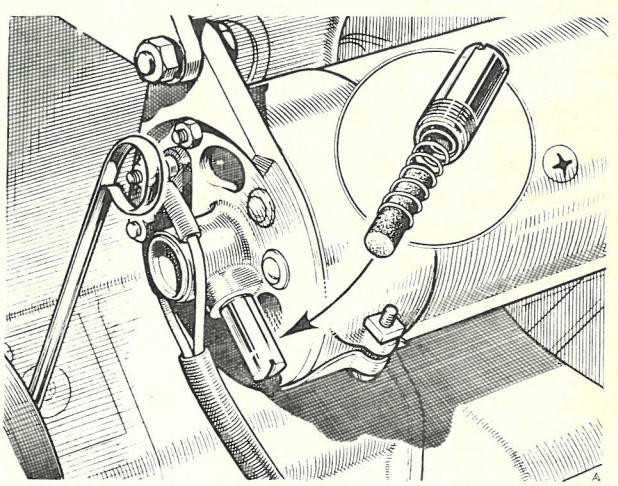


Fig. P.14. (*Above*)
The dynamo bearing end cap on early models must be removed to pack the bearing with grease.

Fig. P.15. (*Below*)
On later models the dynamo is provided with a wick-type lubricator which should be removed and half-filled with grease every 3,000 miles (5000 km.).



suitable lever inserted between the end of the hub and the beading on the cap.

Do not overfill the cap with grease or the excess quantity will be forced past the seal onto the brake drums.

Section P.11

FRONT SUSPENSION BEARING D

On later models fitted with twin telescopic dampers the inner bearing for the upper wishbone is no longer part of the damper system and must be lubricated every 500 miles (800 km.) by applying the grease gun to the nipple on the bearing bracket, giving two to three strokes. Use grease to Ref. D (page P.2).

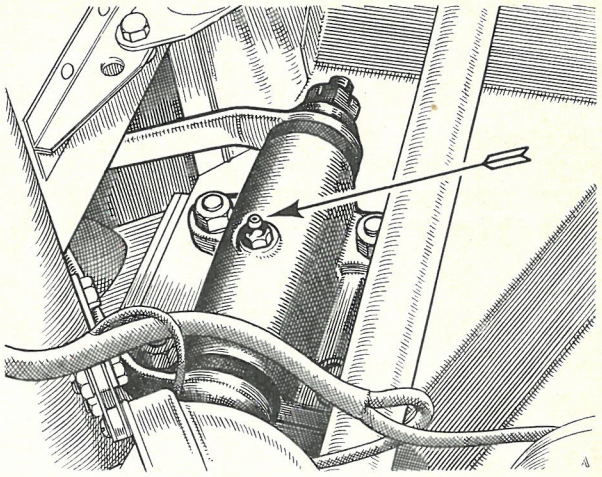


Fig. P.16.
The nipple on the upper wishbone inner bearing.

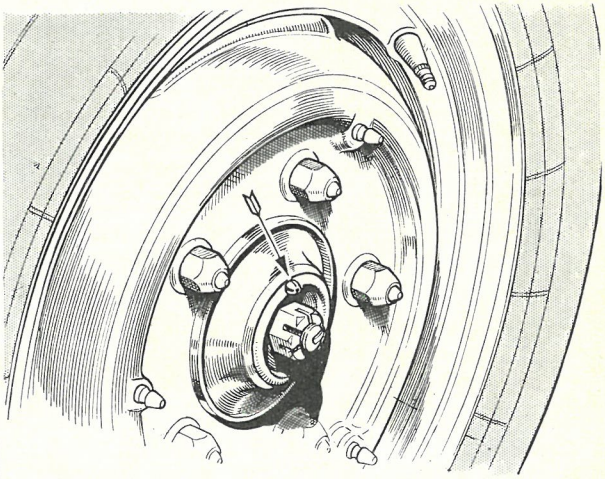


Fig. P.17. (*Right*)
The nipple on the front wheel bearing cap. Later models are fitted with a sealing cap (see Fig. P.17).

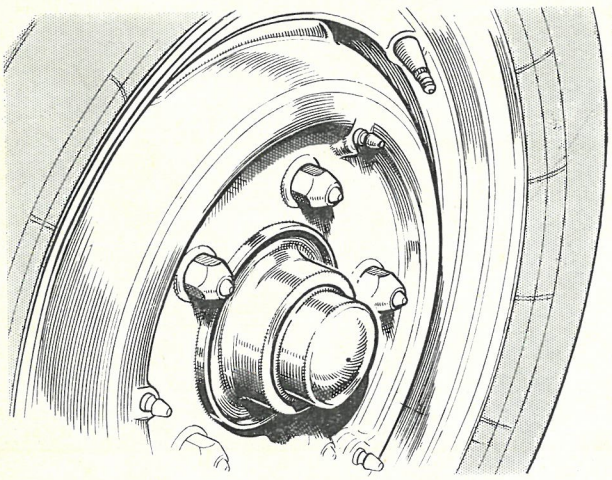


Fig. P.18. (*Left*)
The grease retaining cap on the later models which must be prised off carefully, repacked with grease and replaced, to lubricate the bearings.

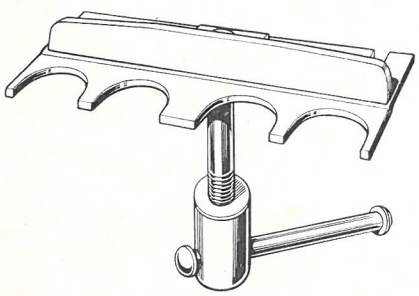
SECTION Q

SPECIAL TOOLS

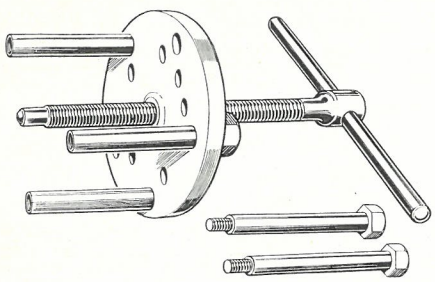
Every Dealer servicing Morris cars is recommended to maintain the special tools detailed in this list, as by their use damage to parts will be obviated and repairs generally will be greatly facilitated.

Description	*Part Numbers*
Extractors	
Valve spring compressor plate (three required)	68899
Front and rear hub...	68822
Axle shaft	68823
Crankshaft pulley (for attachment to 68823)	68893
Gearbox drive gear	68894
Steering wheel	68827
Timing gear sleeve	68889
Camshaft gear	68890
Front hub inner bearing and crankshaft gear	68895
Body Tools	
Mono body jack (universal)	67797
Metal case for above	67798
Assembly Tools	
Clutch plate aligning tool	67833
Clutch dummy gauge plate	68887
Rear axle pinion positioning fixture (with mandrel)	68892
Axle pre-load check tool	68839
Spanners	
Lockheed bleeder screw wrench ...	46746
Cylinder head nut	68830
Gearbox drive gear nut	68897
Gudgeon pin clamp screw...	68832
Tappet adjusting tools	68898
Gearbox mainshaft bearing locknut " C " spanner	68836
Shackle and anti-sway bar bolt pin spanner	68965
Miscellaneous	
Valve grinder (suction)	66893
Feeler blade (·015 in.)	75718

NOTES ON THE USE OF SPECIAL TOOLS



68899



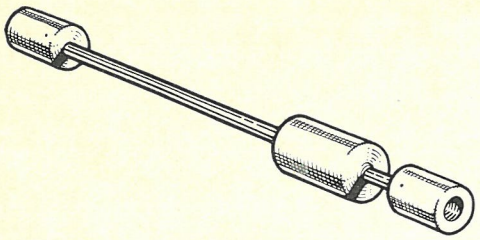
68822

Tool No. 68899. Valve Spring Compressor Plate

The plate is supplied with a special bolt, nut and thrust washer, and fits between the camshaft and the valve spring retainers. As the nut is screwed into the bolt the valve springs are compressed until the camshaft can be withdrawn over the tappet heads. Since each plate compresses four springs, three plates are required when removing the Morris Six camshaft. The plates also fit the Wolseley Four-Fifty and Six-Eighty engines.

Tool No. 68822. Front and Rear Hub Extractor

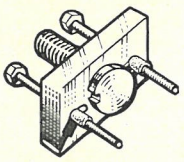
This tool is designed to remove not only the front or rear brake-drum and hub assemblies of the Morris Six, but may be used on the complete range of new Morris and Wolseley models. The three special hub attachment hollow bolts provided will fit any wheel stud size except the Morris Minor, for which two separate shouldered bolts are provided.



68823

Tool No. 68823. Axle Shaft Extractor

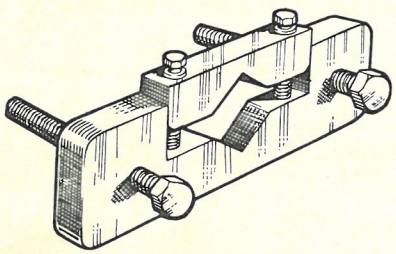
The use of this impulse-type extractor is essential when withdrawing one of the rear axle shafts. It is attached to the threaded end of the axle shaft and withdraws the shaft complete with its bearing, oil seal and brake plate support. This tool may be used on any of the new Morris and Wolseley models and, with a special attachment, may be used to withdraw the crankshaft pulley and timing gears.



68893

Tool No. 68893. Timing Gears and Crankshaft Pulley Attachment

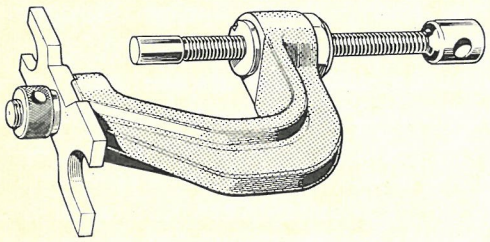
Specially designed to fit the axle shaft extractor, this tool may be used to withdraw the crankshaft pulley and damper without damage to the pulley flange.



68894

Tool No. 68894. Gearbox Drive Gear

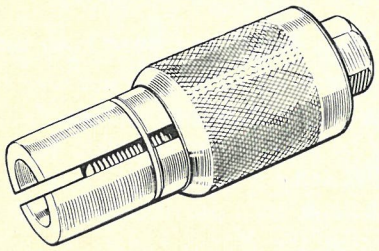
The use of this extractor is essential if the drive gear is to be withdrawn from the gearbox without damage to the bearing guard. The extractor is clamped to the drive gear shaft and withdraws the drive gear and bearing.



68827

Tool No. 68827. Steering Wheel

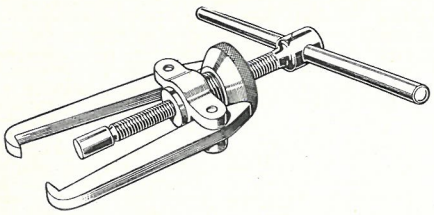
This extractor has been specially designed to remove any Morris, Wolseley or M.G. steering wheel without damage. Dealers who already possess Tool No. 55418 and the attachment (Part No. 56052) will find that this may also be used to withdraw the steering wheel.



68889

Tool No. 68889. Timing Gear Sleeve Extractor

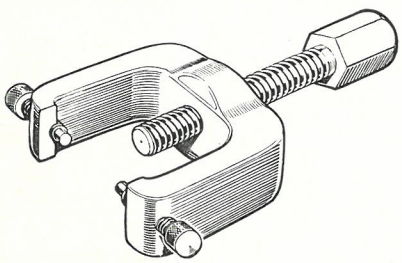
Removal of the timing sleeve from the vertical drive shaft is a difficult operation without the aid of this special tool which will also fit the new Wolseley models.



68895

Tool No. 68895. Front Hub Inner Bearing and Crankshaft Gear Extractor

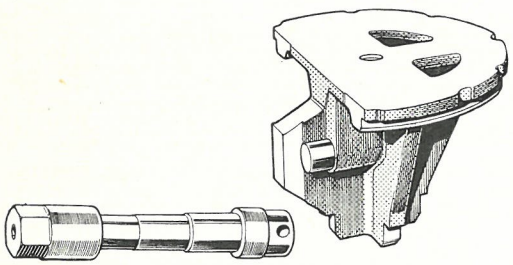
Should the inner bearing remain on the stub axle after removing the front hub and brake-drum assembly from the new Morris and Wolseley range of models, this specially designed extractor must be used to remove the bearing without damage to the oil seal behind it.



68890

Tool No. 68890. Camshaft Gear Extractor

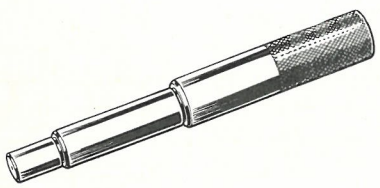
Designed to remove the camshaft gear assembly without damage to the gear teeth. This extractor may also be used on the new range of Wolseley models. The two locating bolts must be screwed into the gear until they become solid and then turn back one revolution. This will ensure that the torsion spring inside the gear is not damaged.



68892

Tool No. 68892. Rear Axle Pinion-positioning Fixture

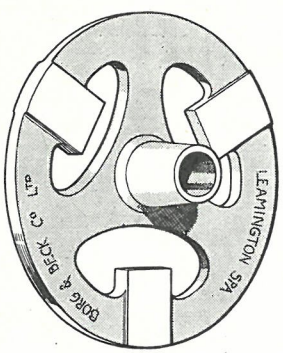
This fixture is designed to enable the correct pinion spacing washer to be selected when fitting a rear axle pinion. Full instructions for its use are given in Section H.11 of this Manual.



67833

Tool No. 67833. Clutch Aligning Tool

When reassembling the single-plate clutch it is essential to use this tool to ensure that the clutch plate is concentric with the spigot bearing in the flywheel centre, otherwise it is impossible to assemble the gearbox to the engine. This tool may also be used to assemble the clutch on all post-war Morris and Wolseley cars with the exception of the Morris Minor.

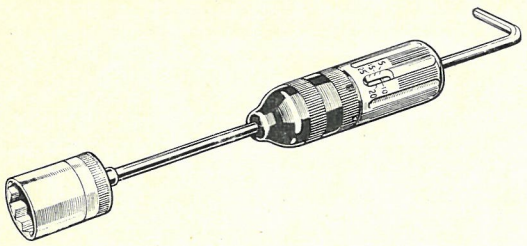


68887

Tool No. 68887. Clutch Dummy Gauge Plate

This tool is essential when adjusting the release levers of the Borg & Beck clutch.

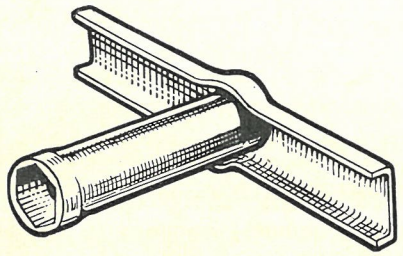
In use the dummy gauge plate takes the place of the clutch driven plate when the cover-plate assembly is attached to the flywheel, and is positioned so that each release lever coincides with the ground surfaces of the plate lugs. The release lever adjusting nuts are then tightened or slackened until the end of each arm lies dead flush with the edge of a straight-edge placed across the ground end face of the gauge plate centre boss. This ensures an equal throw to each release lever and that the pressure plate is exactly parallel to the flywheel face.



68839

Tool No. 68839. Axle Pre-load Check Tool

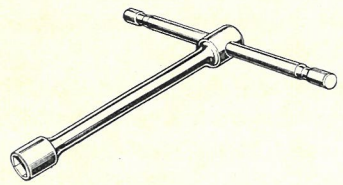
This torque spanner is ideal for measuring the rear axle pinion bearing pre-load. It has a clearly marked indicator, which can be set to read accurately between 5 and 25 in./lb. (·058 to ·288 m./kg.) with the key provided.



46746

Tool No. 46746. Lockheed Bleeder Screw Wrench

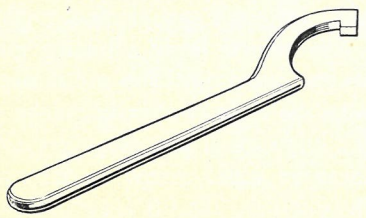
This specially designed tube spanner and integral tommy bar greatly assists the brake-bleeding operation. The bleed tube passes through the hollow centre of the spanner and the spanner remains square on the bleed screw throughout the operation.



68830

Tool No. 68830. Cylinder Head Nut Spanner

A strong spanner with a tommy bar designed to give the recommended maximum torque to the cylinder head stud nuts with normal hand pressure. This tool will fit the complete range of new Morris and Wolseley models.

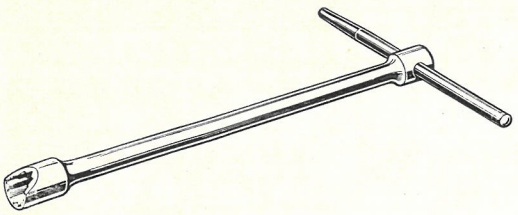


68897

Tool No. 68897. Gearbox Drive Gear Nut Spanner

Designed to fit the Morris Six and Wolseley Six-Eighty models, this spanner will remove the drive gear bearing locknut without damage. A hammer and punch should never be used for the purpose.

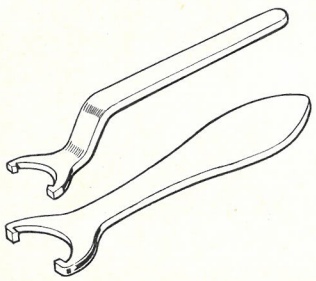
Remember that the drive gear nut has a left-hand thread.



68832

Tool No. 68832. Gudgeon Pin Clamp Screw Spanner

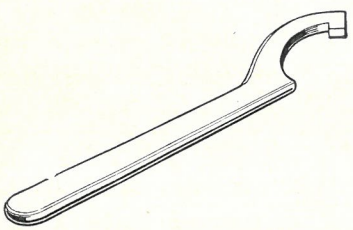
Owing to the restricted space inside the pistons of most engines, an ordinary box spanner is unsuitable for removing or replacing the gudgeon pin clamp screw. This spanner is specially shaped to suit most models of the new Morris and Wolseley ranges, and is long enough to clear the connecting rod big-end.



68898

Tool No. 68898. Tappet Adjusting Tools

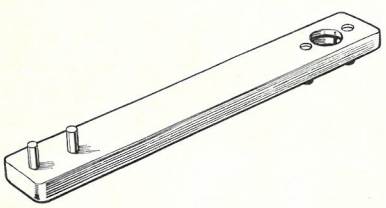
A special set of spanners which will fit the overhead camshaft models of the latest Morris and Wolseley ranges and simplify the adjustment of the tappets. A set of these essential tools should be in the hands of every dealer.



68836

Tool No. 68836. Gearbox Mainshaft Bearing Locknut Spanner

Do not use a hammer and punch to slacken the locknut on the rear end of the mainshaft, but use this tool, which has been specially designed to do the job easily and without damage to the nut.

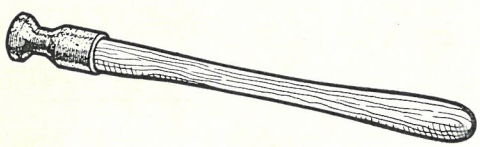


68965

Tool No. 68965. Shackle and Anti-sway Bar Bolt Pin Spanner

This tool is necessary when removing the bolts which secure the anti-sway bar or the rear spring front anchorage and may be used on the latest Morris and Wolseley models.

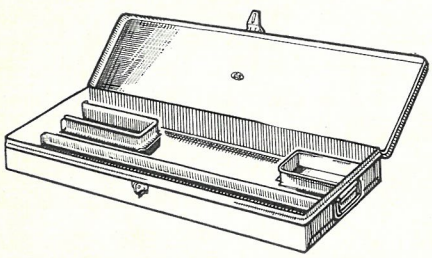
The opposite end of the tool is essential when dismantling the steering rack of the Morris Oxford or Morris Minor.



66893

Tool No. 66893. Suction Valve Grinder

As the valves on the Morris Six 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.

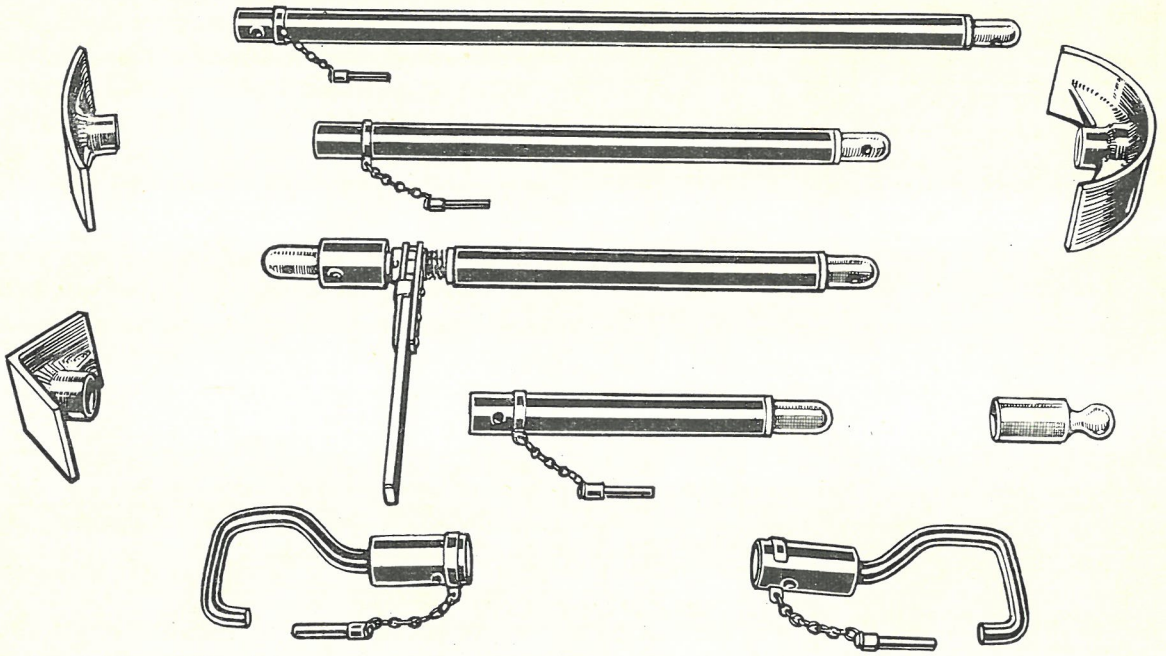


67798

Part No. 67798. Metal Case for Body Jack

This is a special metal container, enabling the Morris Mono Body jack, complete with accessories, to be kept together, thus avoiding damage or parts becoming mislaid.

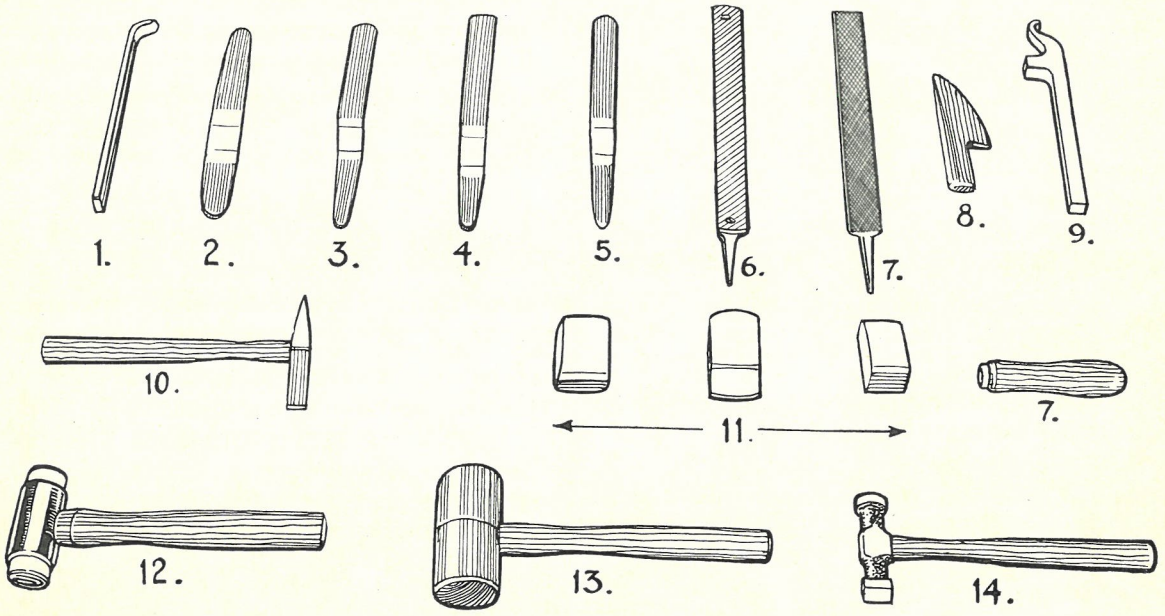
BODY TOOLS



Tool No. 67797. The Morris Mono Body Jack

The jack is a tool which has been designed to deal with repairs to bodies of all-steel construction. It is supplied complete with the various attachments and will be found capable of dealing with all normal requirements.

RECOMMENDED BODY REPAIR TOOLS



1. Dolly wrench.
2. Spoon (smooth).
3. Spoon (medium).
4. Spoon (extra heavy).
5. Spoon (medium smooth).
6. Milling file.
7. File and handle.
8. Soldering paddle.
9. Spot weld wrench (for breaking inaccessible spot welds).
10. Pin hammer.
11. Dolly blocks (specially shaped).
12. Hide mallet.
13. Wooden mallet (used for shrinking).
14. Bumping hammer.

SECTION R

THE BODY

Lubrication.

Section No. R.1 Adjustments.

Section No. R.2 Removal and replacement of the windscreen.

Section No. R.3 Removal and replacement of the rear light.

Section No. R.4 Removal of the door handle.

Section No. R.5 Removal of the door locks.

Section No. R.6 Removal and replacement of the door glass.

Section No. R.7 Removal of front and rear ventilators.

Section No. R.8 Replacement of the rear blind cord.

Section No. R.9 Ventilating window adjustment.

Section No. R.10 The body finish.

Section No. R.11 Air-drying synthetic material.

Section No. R.12 Checking body alignment.

LUBRICATION

An oilcan filled with oil to Ref. F (page P.2) should be used sparingly on the door hinges, front seat rollers and lock, and bonnet lock mechanism every 1,000 miles (1600 km.).

Coat the door and luggage boot striker plates lightly with grease at the same time.

Section R.1

ADJUSTMENTS

The bonnet lock

The spring-loaded striker pin may be adjusted for length after slackening the locknut which secures it to the bracket beneath the bonnet lid.

The pin is correctly positioned when its upper end is approximately level with the top of the locknut. If the pin is too high the bonnet lid will not lock in the fully closed position.

The front seat

The bench-type front seat is supported on two rollers and an adjustable centre guide tube which is secured to brackets on the main floor assembly by a $\frac{5}{16}$ in. bolt at either end. The rear end bracket is slotted to provide adjustment and ensure a 3-point support for the seat.

If the seat can be rocked about the centre guide tube when the fixing bolts are fully tightened, the rear end bolt must be slackened and retightened while both rollers are on their support plates.

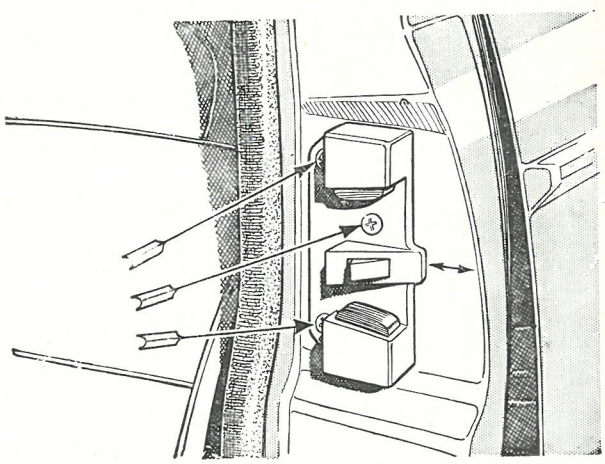


Fig. R.1a.

Releasing the three Phillips screws indicated by the arrows enables the striker plate position to be adjusted to give the best shutting condition.

The doors and trunk lid

When closed and correctly adjusted the doors and trunk lid will be a tight fit on the rubber surround. Should adjustment be necessary, slacken the screws securing the striker plate to the body and move the plate inwards the required amount. Tighten the screws and recheck. Repeat if necessary.

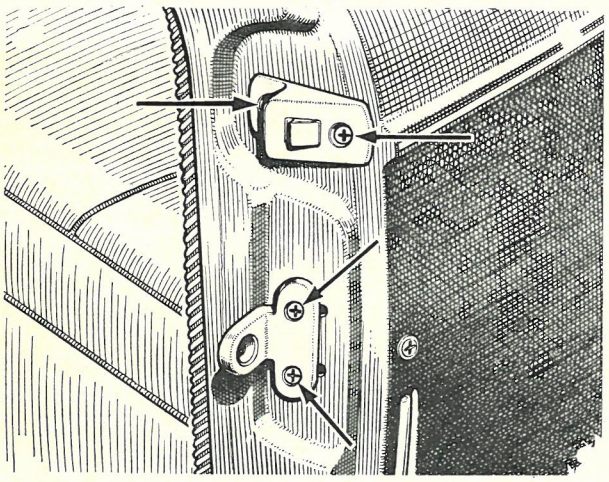


Fig. R.1b.

Later models are fitted with a pin and socket register but the method of adjustment is similar to that employed for the combined slam plate and register.

Section R.2

REMOVAL AND REPLACEMENT OF THE WINDSCREEN

On early models

Remove the windscreen de-mister channels from the top of the facia.

Withdraw the fixing screws and the driving mirror bolt from the screen centre pillar and remove the exterior chromium strip.

Remove the small cover-plates at each end of the centre pillar and remove the pillar.

Unscrew and remove the metal mouldings from the inside of the windscreen.

Press the glass towards the inside of the car and remove the rubber seal.

To replace the screen insert the glass in the rubber seal and press the screen into position from inside the car until the flange of the rubber seal can be persuaded over the exterior chromium finisher.

Insert a length of string between the interior flange of the seal and the glass the whole way round the screen, with the ends of the string protruding about 9 in. (25 cm.) beyond the unsealed edge of the glass.

Note.—*Care must be taken to ensure that sufficient clearance to insert the rubber strip is left between the two windscreen glasses. If necessary small wooden wedges may be used to ensure this.*

Position the interior metal surround with its leather piping and draw the lower end of the string from beneath the seal flange so that the rubber is lifted over

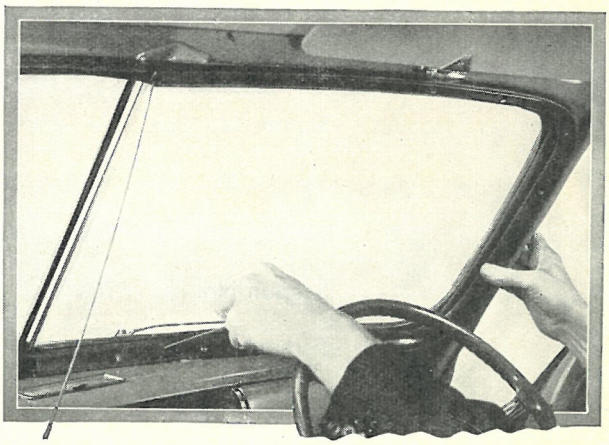


Fig. R.2.

Replacing a windscreen glass, showing the use of a length of string to lift the sealing flange over the surround.

the surround. When the lower end of the screen is correctly positioned insert two of the retaining screws and carry out a similar procedure at the top, continuing until the string is withdrawn completely.

Replace all the metal surround fixing screws, but before tightening them straighten the edge of the rubber, should it be necessary.

Place a strip of $\frac{1}{8}$ in. (3 mm.) square-section Prestik sealer across each end of the channel between the two

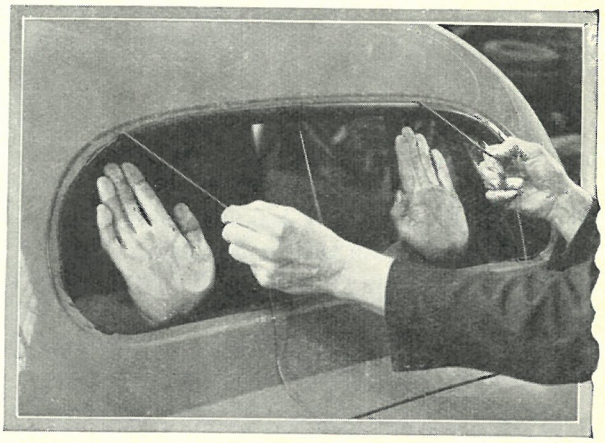


Fig. R.3.

The rear light glass is fitted in a similar manner to the windscreen, with the help of a piece of string to lift the flange of rubber sealing strip into position over the metal edge of the window.

screen glasses and cover the full length of the channel with a strip of $\frac{3}{4}$ in. × $\frac{1}{16}$ in. (19 mm. × 1·6 mm.) Prestik overlapping the chromium finisher at each end.

Replace the centre sealing strip so that the raised portion engages the channel between the screens and then place the metal finisher strip over it and, having made holes in the sealer, insert the securing screws to hold it in position.

Replace the rubber seal outside the screen, place the chromium finisher over it, and get a second operator to assist by tightening the screws from inside while the finisher is held in position.

Refit the two small centre pillar cover-plates and the de-mister channels.

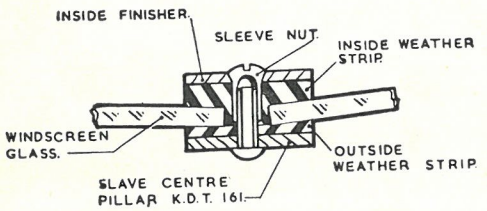


Fig. R.4.

This section through the centre pillar shows the relative positions of the components and the slave strip.

On cars commencing from Car No. R.H.D. 948. L.H.D. from Car No. 5532

Remove the windscreen de-mister discharge nozzles from the top of the facia.

Withdraw the fixing screws and driving mirror bolt from the screen centre pillar and remove the inside centre finisher.

Extract the securing screws and remove the interior screen mouldings and centre cover-plates.

Remove the exterior chromium pillar and small capping plates and prise the outer chromium finisher strip from the rubber seal. Withdraw the rubber strip from between the windscreen glasses and remove the screen-retaining screws from each side pillar.

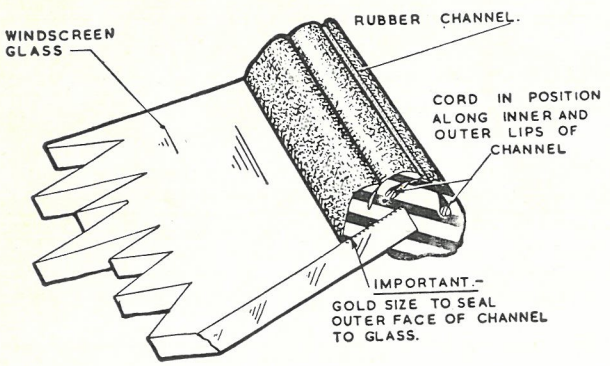


Fig. R.5.

Cords must be inserted in the lips of the rubber channel as shown, after the channel has been fitted to the glass with gold size.

Press each glass towards the inside of the car, commencing at one corner, and carefully ease the sealing rubber from the metal edge of the windscreen housing.

Before attempting to refit the windscreen glasses in the body they must be assembled with the finishers and weather sealing strips into the surrounding rubber channel. For this operation a slave centre pillar is required and should be made up from $1\frac{1}{4}$ in. × $\frac{1}{8}$ in. (32 mm. × 3 mm.) steel strip $13\frac{1}{2}$ in. (343 mm.) long with four holes drilled and tapped 2 B.A. thread at 4 in. (102 mm.) centres, commencing $\frac{3}{4}$ in. (19 mm.) from one end.

Fit the "T"-section interior weather strip, and the outside weather strip, and fit the slave centre pillar.

Fit the inside finisher and secure the assembly with three sleeve nuts through the three lower holes in the inside centre pillar finisher. Do not fully tighten the sleeve nuts (see Fig. R.4).

The glass channel portion of the rubber seal should be brushed with gold size and the seal immediately fitted round the windscreen glasses. Care should be taken to see that the glass is right home in the channel.

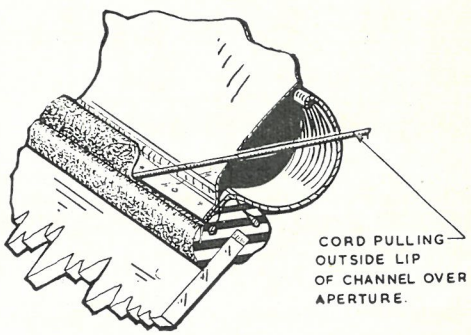


Fig. R.6.

Withdrawing the cord to draw the lip of the channel outside the body panel flange.

To facilitate the assembly of the windscreen to the car body, lengths of cord, each about 11 ft. (3 m.) long, should be threaded round the rubber channel. Insert one cord along the outer lip and the other along the adjacent inner flap, as shown in Fig. R.5. This operation is easily carried out if one end of the cord is threaded through approximately 6 in. (15 cm.) of small diameter tubing—brake pipe is ideal. Radius one end of the tube inside and out and bell-out the opposite end. Allow 6 in. (15 cm.) of the cord to protrude from the plain end of the tube and then press that end of the tube into the channel in which it is desired to lay the cord. Run the tube round the channel, allowing the cord to flow freely through it until it surrounds the screen and the free ends overlap and suspend from the screen. The ends should be long enough to permit

a good pull when the screen is being assembled to the body. Finally apply petroleum jelly to the windscreen rubber channel over the outer lip and outer finisher lip.

In order to obtain a good glass-to-rubber seal it is advisable to fit the windscreen as soon after the application of gold size as possible, approximately within ten minutes.

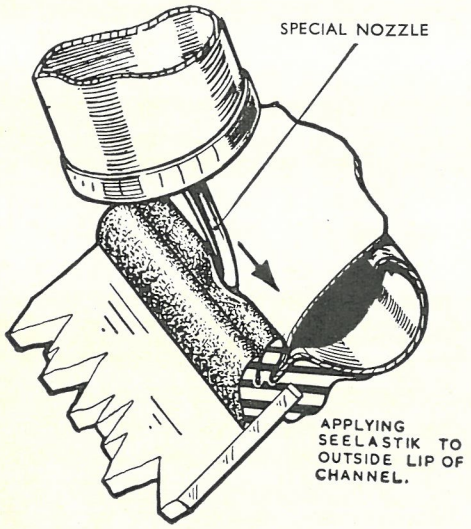


Fig. R.7.
Inserting the " Seelastik " compound between the channel lip and the body panel with the help of a pressure gun and tubular nozzle.

To fit the windscreen to the body, it must be offered to the windscreen aperture from inside the car. With the assembly pressed into position from the inside, the outer cord must be pulled away progressively round the aperture to draw the outside lip of the rubber channel over the flange as shown in Fig. R.6.

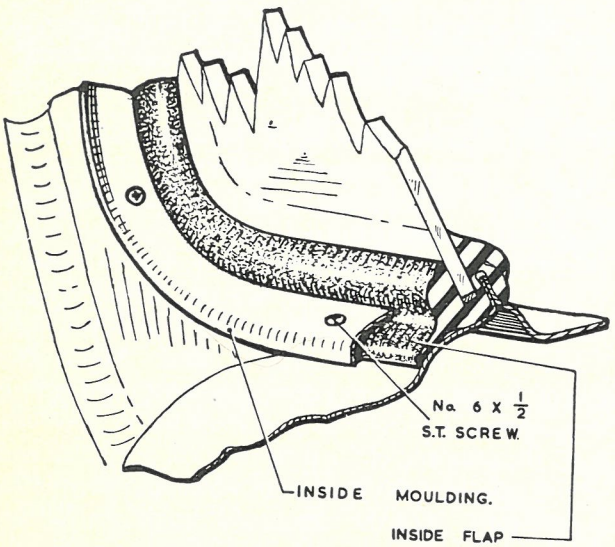


Fig. R.8.
The inside lip of the rubber channel is concealed by a metal moulding strip.

The cord beneath the interior lip should next be drawn out, leaving the lip in the position seen in Fig. R.7. Tap the rubber round the inside edge of the windscreen to ensure complete seating of the assembly.

Remove the slave centre pillar and outside weather strip and place a strip of black Prestik sealer (Part No. 135625) $\frac{3}{4}$ in. (19 mm.) wide × 16 in. (40 cm.) long over the outside surface of the glasses at the centre joint. Replace the weather strip and fit the plated

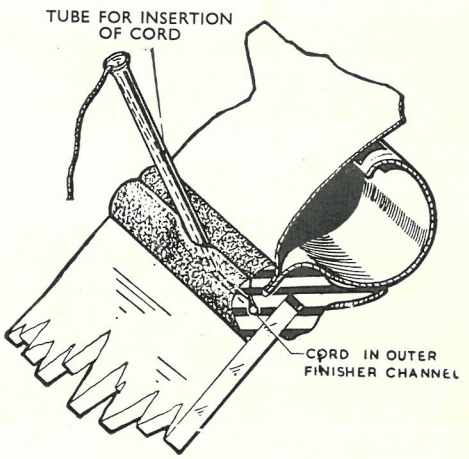


Fig. R.9.
Inserting the cord in the outside lip of the rubber channel prior to fitting the plated finisher.

centre pillar. Secure in position with the three sleeve nuts in the lower holes of the inside centre pillar finisher. Do not tighten the sleeve nuts (see Fig. R.4).

" Seelastik " sealing compound should be injected between the outer lip of the rubber channel and the body flange. The application must be evenly distributed right round the windscreen. To ensure this the outside lip should be firmly pressed down, with the fingers or a wooden roller, to spread the sealing compound under the rubber seal.

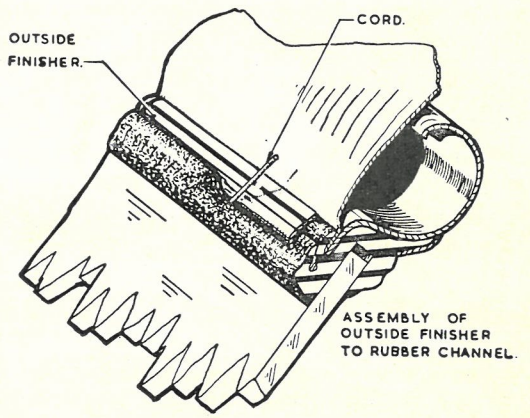


Fig. R.10.
Withdrawing the cord and simultaneously inserting the plated finisher.

Fig. R.7 shows the method of applying "Seelastik" sealing compound between the channel lip and body flange, using an Expandite pressure applicator gun if possible, fitted with a special $\frac{3}{16}$ in. (4·5 mm.) bore brass tube nozzle.

Replace the inside windscreen mouldings and secure in position with the self-tapping screws. The moulding centre cappings are secured in a similar manner (see Fig. R.8).

Insert a length of cord in the outside chromium finisher channel with the help of a feeding tube, commencing the operation at the top of the windscreen centre pillar and continuing round the channel until both free ends of the cord are above the pillar (see Fig. R.9).

Insert the end of one windscreen outside finisher in the channel at the top of the centre pillar and simultaneously draw out the cord and press in the finisher. Repeat the operation to fit the other finisher (see Fig. R.10).

The outside centre cappings should be pressed into the channel beneath each end of the centre pillar and the sleeve nuts finally tightened up, from inside the car, to secure the assembly.

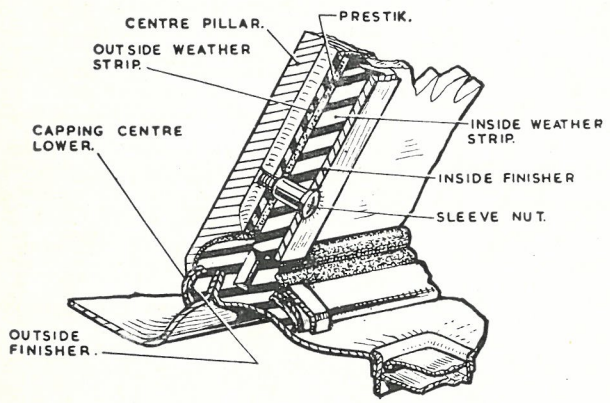


Fig. R.11.
A section through the centre screen pillar showing the final assembly of the components.

Refit the interior mirror bar into the upper hole of the inside centre finisher and trim off any rubber or "Prestik" protruding either side of the plated exterior pillar. Clean all traces of petroleum jelly and gold size from the glass and rubber seal.

The discharge nozzles of the de-misting ducts should now be replaced on the facia panel.

Section R.3

REMOVAL AND REPLACEMENT OF THE REAR LIGHT

Remove the fourteen Phillips screws securing the metal surround to the body.

Push the glass, and rubber seal, towards the inside of the car until it is free.

To replace the glass, brush goldsize into the channel of the rubber seal and fit the seal round the glass with the joint at the centre top. Thread a length of cord along the outer flange of the rubber seal with the ends protruding at the joint.

With the aid of a second operator to apply hand pressure to the inside of the glass, draw the string from the rubber seal so that the flange is lifted over the metal edge of the window opening.

Inject "Seelastik" sealing compound between the outer lip of the rubber channel and the body flange (see Section R.2).

Replace the metal surround.

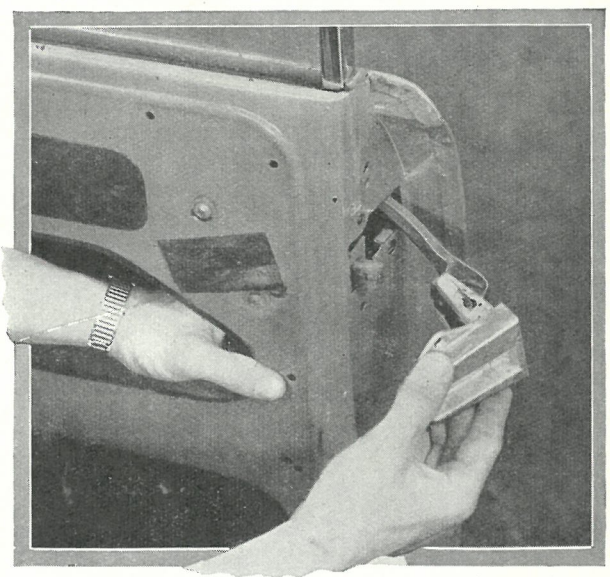


Fig. R.12.
Withdrawing the guide plate with the door handle from the edge of the door.

Section R.4

REMOVAL OF THE DOOR HANDLE

Remove the screws from the window regulator handle, interior door handle and the door pull.

Prise the trim liner panel from the door. It is secured by spring fasteners.

Escutcheon plates are fitted to some models and these must be removed to release the door handle assemblies. The first type are secured by two Phillips screws and the second type by studs with nuts accessible from inside the door.

Remove the centre sealing strip from the door panel and the three screws securing the guide plate to the door edge.

Withdraw the two Phillips screws and two $\frac{1}{4}$ in. bolts with spring and flat washers securing the window channel to the edge of the door.

Wind the windows to the fully closed position and prise the rear end of the window channel towards the inside of the car.

Withdraw the door handle and guide plate assembly from the edge of the door.

Section R.5

REMOVAL OF THE DOOR LOCKS

Front doors

Remove the window regulator handle, interior door handle and the door pull or arm rest.

Prise the trim liner panel from the door, to which it is attached by spring fasteners.

Remove the two large door panel sealing strips.

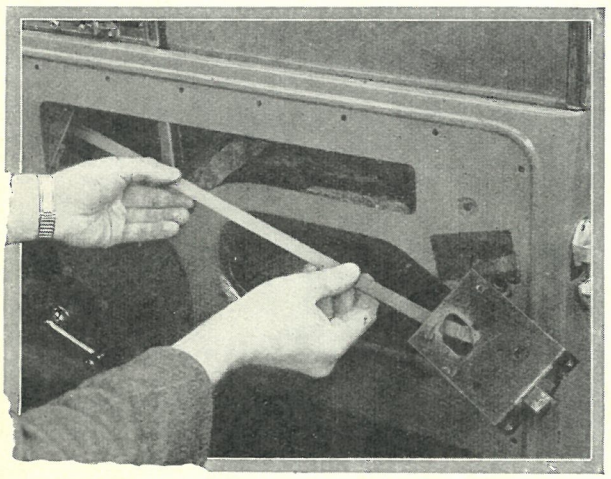


Fig. R.13.
Withdrawing the lock assembly from inside the door panel.

Withdraw the three screws from the door guide plate, the screws securing the door lock and interior door handle plate. Push the door handle plate into the door, depress the lock plunger and push the lock inside the door. The complete lock assembly may be withdrawn through the panel.

Rear doors

The procedure is similar to that for the front doors, but before the lock is released from the door panel the four $\frac{3}{16}$ in. bolts securing the window regulator quadrant to the panel must be removed and the quadrant disengaged from the channel at the bottom of the door glass and lowered to the bottom of the door.

Section R.6

REMOVAL AND REPLACEMENT OF THE DOOR GLASS

Remove the regulator handle, interior door handle and door pull. Prise off the door trim liner panel.

Remove the two Phillips screws and the two $\frac{3}{16}$ in. bolts securing the door glass channel to the rear edge of the door.

Remove the blanking strips below and to the rear of the interior handle. Remove the two $\frac{3}{16}$ in. bolts inserted from inside the door frame, below the ventilator window, securing the door glass frame to the door.

Note.—*A hole is provided beneath the rear edge of the rear doors to permit the use of a tube spanner when removing these bolts. The hole is blanked by a rubber plug.*

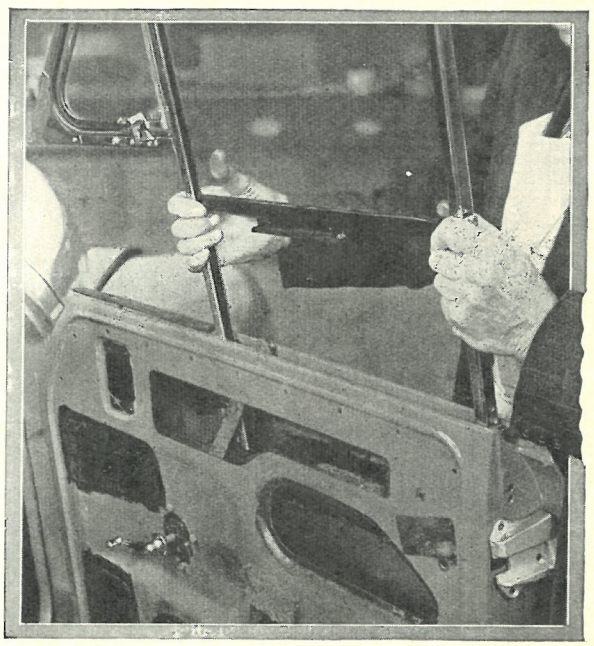


Fig. R.14.
Lifting the door glass complete with its surround from the door.

Remove the $\frac{3}{16}$ in. bolt securing the lower end of the guide channel in the centre of the door panel.

With the glass in the fully opened position, remove the contour strip from the top edge of the door inside the glass.

Wind the window up until it is in the fully closed position and lifts the surround from the door. Continue to wind the glass upward until the quadrant arm is disengaged from the window lift channel.

The door glass and surround assembly may then be lifted from the door.

Note.—*Take care not to lose the rubber packing between the window channel and the door, and the rubber strip beneath the ventilator.*

Replacement.—Place the glass in the frame assembly and engage the lower ends of the guide channel with the door. With the glass at the top of the channel engage the winder quadrant arm with the lift channel at the bottom of the glass.

Lower the glass with the winder handle and the frame assembly will follow the glass into position.

Place the sealer strip and rubber packing in position.

Section R.7

REMOVAL OF FRONT AND REAR VENTILATORS

Remove the two screws securing the top swivel bearing in the window channel and slacken the raised head screw in the chromium channel beneath the bottom swivel.

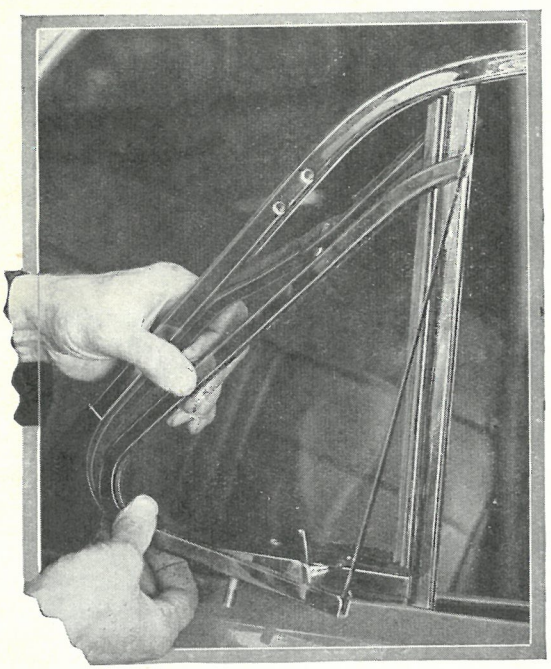


Fig. R.15.
Removing the ventilator from the door window frame.

Note.—*This screw clamps a split bush and can be used to adjust the operation of the ventilator and cause it to remain open in any desired position.*

Open the ventilator. Pull out the sealing rubber from the top corner until the upper bearing is free and the ventilator can be lifted out.

To remove the rear ventilator the door glass frame must be removed as detailed in Section R.6 before the screws securing the ventilator bottom channel can be withdrawn and the glass removed.

Section R.8

REPLACEMENT OF THE REAR BLIND CORD

Should replacement of the nylon cord be necessary, before removing the broken length from the curtain or finger pull it is advisable to observe the type of knot employed as difficulty may be experienced in securing the new nylon cord with a knot which will not slip.

Remove the roof lamp glass retaining ring and glass. Extract the bulb and the three screws securing the lamp to its mounting block and lower the lamp from the roof.

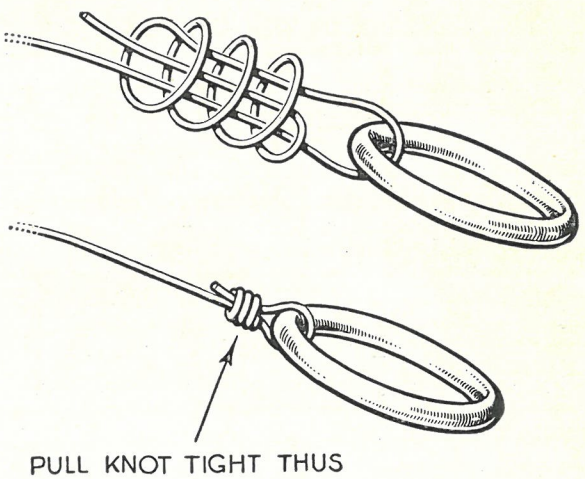


Fig. R.16.
Owing to its nature, nylon requires special precautions when tying. A knot of the type shown should be used to prevent the nylon from becoming detached.

Prise downwards one edge of the centre roof liner panel and thread one end of the new nylon pull through the forward guide. Draw the cord along the top of the liner until it reaches the roof lamp hole. The pull may then be threaded through the rear guide.

Before attaching the cord to the curtain, temporarily secure the front end to the finger pull to prevent the cord being pulled inside the roof. Fasten the cord to the curtain and then pull on the front end, at the same time inserting a hand above the liner panel to place the cord in the channel between the felt strips.

The position of the finger pull must be adjusted correctly before it is finally secured.

Section R.9

VENTILATING WINDOW ADJUSTMENT

The ventilating windows are prevented from closing under the action of wind pressure by the frictional resistance of the hinge bearings.

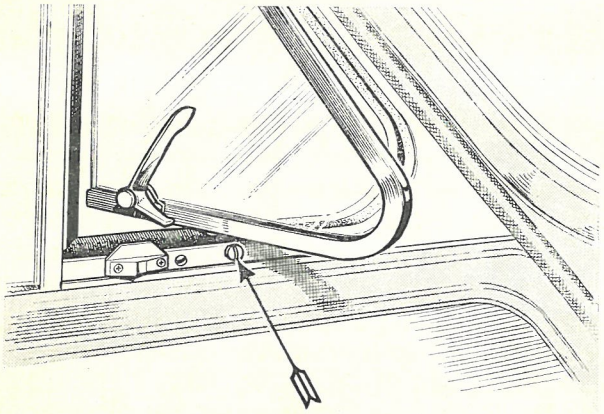


Fig. R.17.
The large Phillips screw which enables the resistance of the ventilating window hinge to be adjusted.

Should they show signs of closing of their own accord under wind pressure, the resistance of the hinge can be increased by means of the large Phillips screw adjacent to the lower hinge.

Avoid over-tightening the screw as this will produce unnecessary strain and wear on the hinge.

Section R.10

THE BODY FINISH

As Morris Six cars are now being finished in synthetic enamel, it is necessary to outline the correct methods of repairing this type of finish.

It must clearly be understood that synthetic enamel differs from cellulose enamel fundamentally in that it hardens by a complicated chemical change, known as polymerisation, as distinct from the process of evaporation of volatile solvents such as takes place with normal paints and cellulose enamel.

The nature of the synthetic enamel surface is such that it renders the use of cellulose enamel for retouching purposes quite unsatisfactory since the two materials will not " knit " together properly.

As a result a special technique has to be adopted when repairing damage to the finish of cars treated with synthetic enamel or Synobel if good results are to be obtained.

Provided the instructions given in the pages of this publication are carried out, no difficulty should be encountered in effecting a good and lasting repair.

There are two ways of dealing with the repair of synthetic enamel. The first is by the use of an air-drying material, and the second is by using a similar enamel to that originally applied to the body with the addition of driers, thus allowing the stoving temperature to be reduced, but the first is generally more convenient and the one recommended for general use.

Synobel is similar in nature to synthetic enamel and requires the same treatment.

Identification

It will be realised that the correct identification of the type of finish on the car to be repaired is of particular importance. **For this reason it is imperative to quote the engine and chassis numbers of the car for which the repair material is required when ordering, as a check.** These are to be found on the plate fixed to the bulkhead under the bonnet. As a guide, the change points for the various current Morris models are given below.

As a help in identifying the type of finish used on each car, symbols have been added to the car type symbols on the identification plates under the bonnets of all cars. In the case of synthetic-finished cars the letters SYN are used ; in the case of Synobel-finished cars the symbol S is used ; and in the case of cars finished in cellulose enamel they are marked with a " C."

Change points

As a general guide the following are the change points for the finishes on current Morris Six cars :—

All Morris Six saloon cars prior to Chassis No. 1986 (R.H.D.) or 5707 (L.H.D.) were finished in cellulose enamel.

Morris Six saloon cars from Chassis No. 1986 (R.H.D.) and from Chassis No. 5707 (L.H.D.) and up to 2318 (R.H.D.) or 5757 (L.H.D.) have been finished either in cellulose or synthetic enamel. Those finished in cellulose are marked under the bonnet with C, and those finished in synthetic enamel are marked with the letters SYN.

All Morris Six saloon cars from Chassis No. 2319 (R.H.D.) and 5758 (L.H.D.) are finished in synthetic enamel up to car No. 4831 (R.H.D.) and 5971 (L.H.D.). Subsequently Morris Six cars have been finished in cellulose or synthetic enamel and identified as indicated above.

Section R.11

AIR-DRYING SYNTHETIC MATERIAL

The damaged portion should be flattened down with 400 grade " Wet or Dry " paper until a smooth surface is obtained, free from defined edges, and then,

if necessary, built up with primer surfacer or stopper before being finally faced down to a perfectly smooth and level surface.

The air-drying enamel is then thinned to the desired consistency, usually a 50 by 50 mixture of enamel and thinners, and is then placed into a suction feed cup which is connected to a spray gun of a similar type to the Devilbiss type " CH," fitted with a No. 90 nozzle and requiring about 25 lb. pressure per sq. in. (1·8 kg./cm.^{2}) for atomisation.

Spray the damaged area in a circular motion, giving a wet coat in the centre and fading away towards the edges.

Allow the spot to dry for about four hours, and then use a fine cutting compound to remove the dry spray around the outer edge of the sprayed area. Obtain the final lustre by polishing the area with liquid polish.

If the damage is extensive, it is often quicker to mask up and spray out the whole panel.

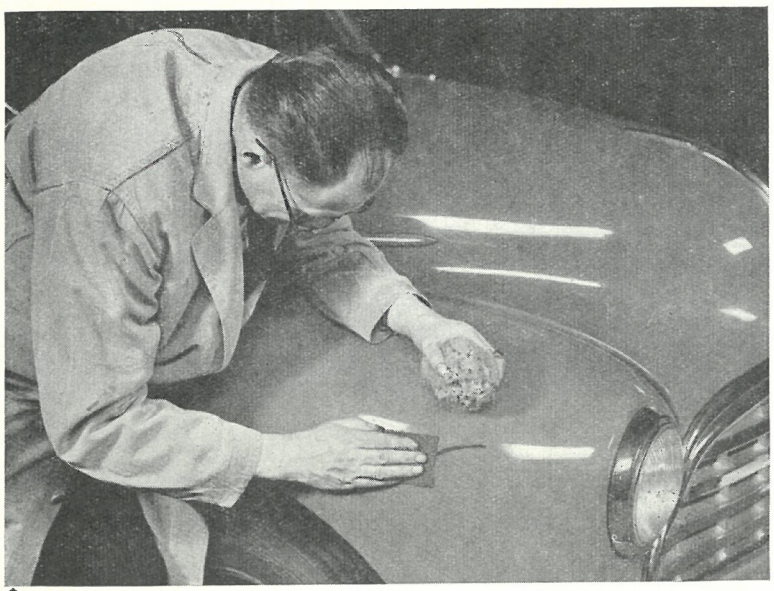


Fig. R.18.
(*Left.*) The damaged area should be carefully flattened down, using "Wet or Dry" paper.

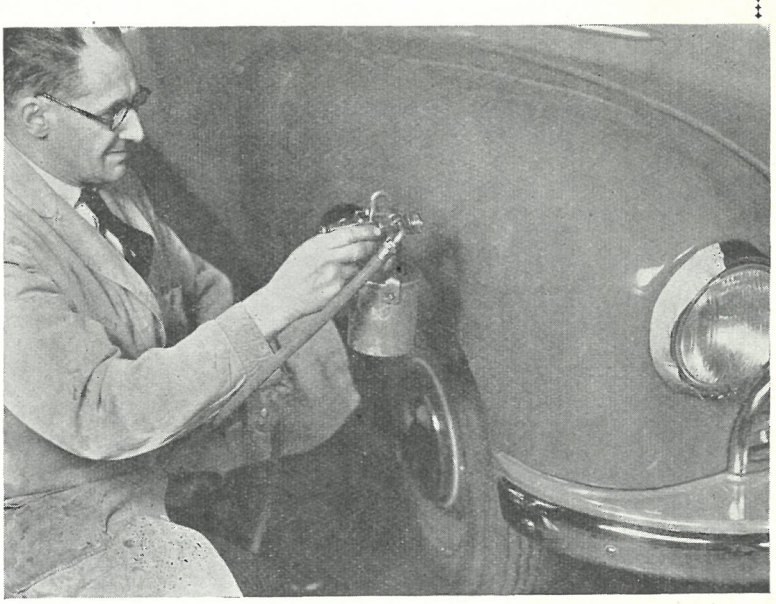


Fig. R.19.
(*Right.*) When properly prepared the repair should be sprayed, using a circular motion to obtain a wet coat in the centre, fading away gradually to the edges.

ENAMELS FOR RETOUCHING

COLOUR	HIGH SOLID FINISHES (Cellulose)			SYNTHETIC OR SYNOBEL FINISHES		
	½ pt.	1 pt.	½ gal.	½ pt.	1 pt.	½ gal.
Black	56400	56401	56456	56408	56409	56460
Romain Green	56402	56403	56457	56410	56411	56461
Platinum Grey	56404	56405	56458	56412	56413	56462
Maroon	56406	56407	56459	56414	56415	56463
Gascoyne Grey	—	—	—	300522	300523	300524
Mist Green	—	—	—	300525	300526	300527
Thames Blue	—	—	—	300528	300529	300530
Stoppers (1 lb.)	56448	—	—	56448	—	—
Thinners	56450	56480	56485	56452	56482	56487

Section R.12

CHECKING BODY ALIGNMENT

A limited number of front end checking fixtures are available on loan at a nominal fee from the Service Department, Morris Motors Ltd., Cowley, but it is recommended that those with the necessary facilities should manufacture their own from the drawing Fig. R.22. Working drawings are also available on request.

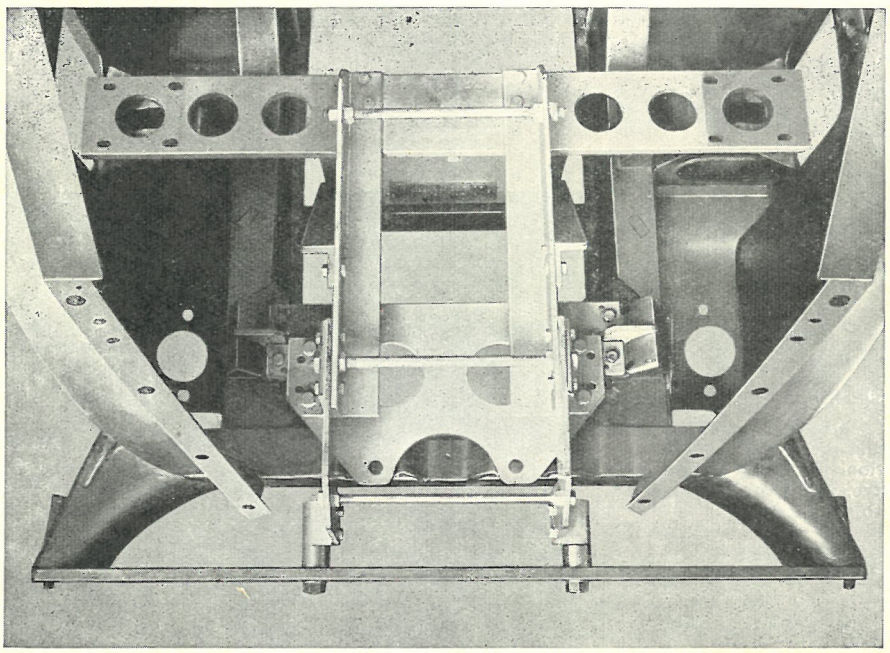


Fig. R.20.
The Morris Six front end checking fixture in position on a car for making a dimensional and alignment check.

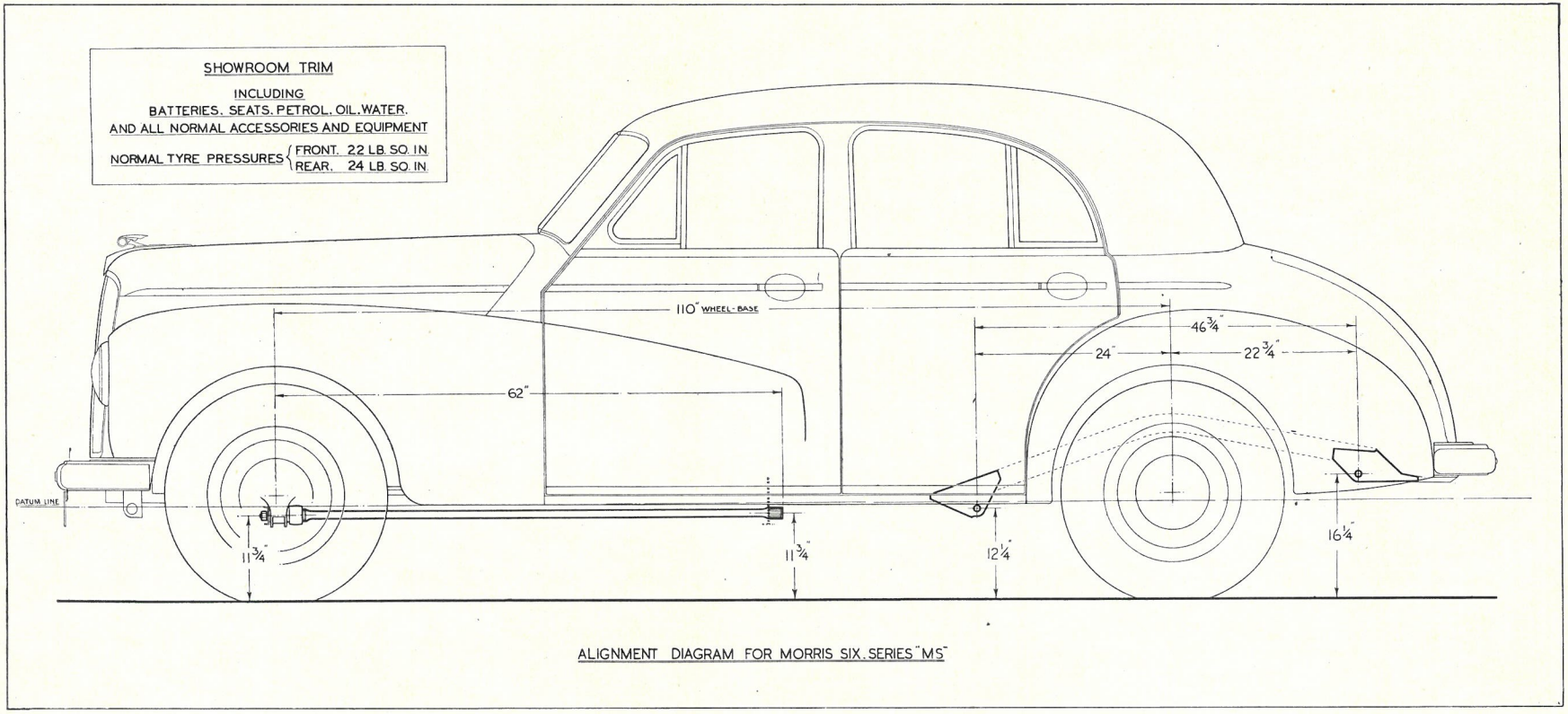
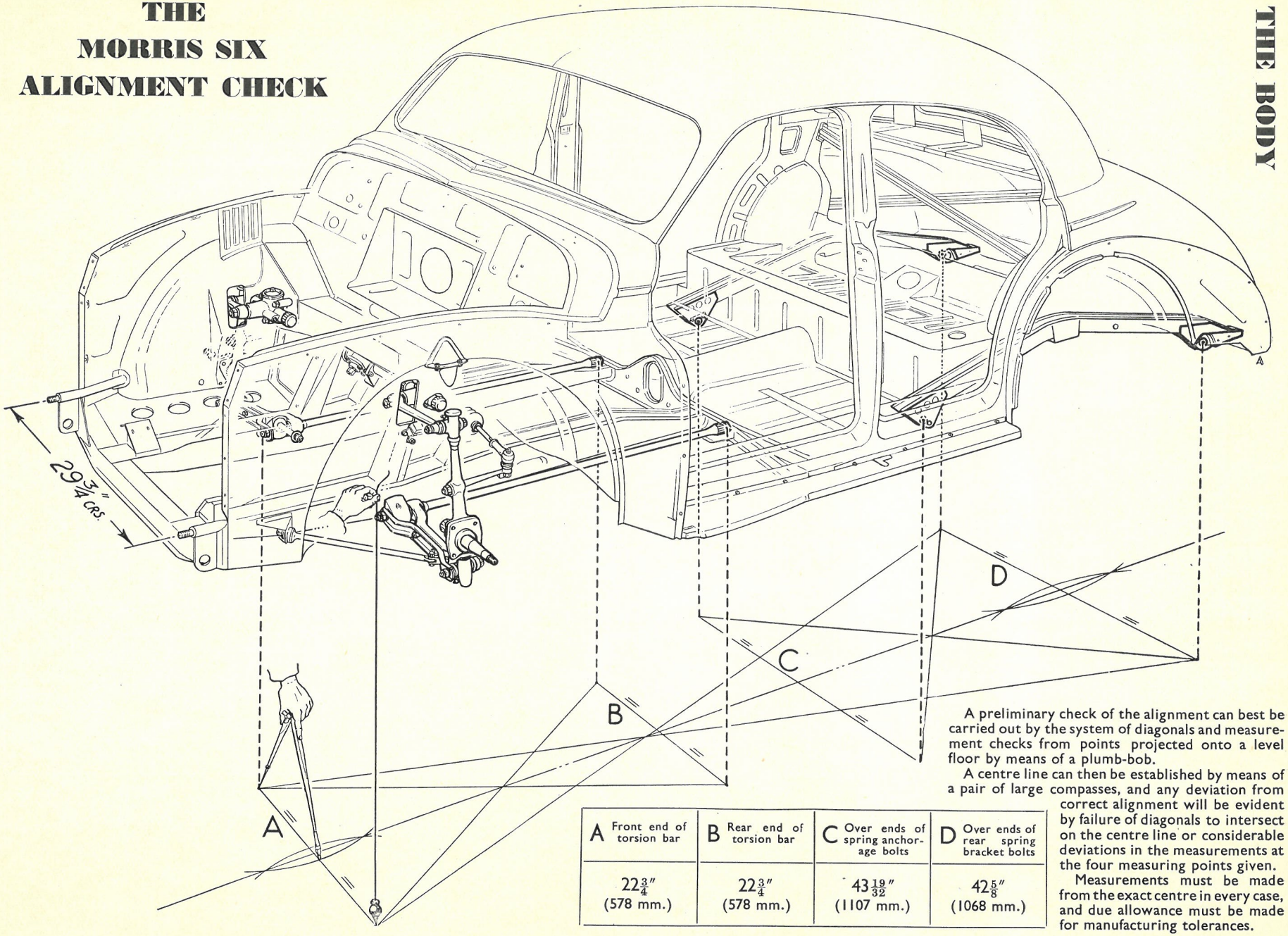


Fig. R.21.

This diagram indicates the main dimensions required for checking the body for distortion in the vertical plane after an accident.

It must be remembered that the important point is the relative positions of the vertical datum points **to each other** and not their actual height from ground level, although these dimensions are given to facilitate checking.

THE MORRIS SIX ALIGNMENT CHECK



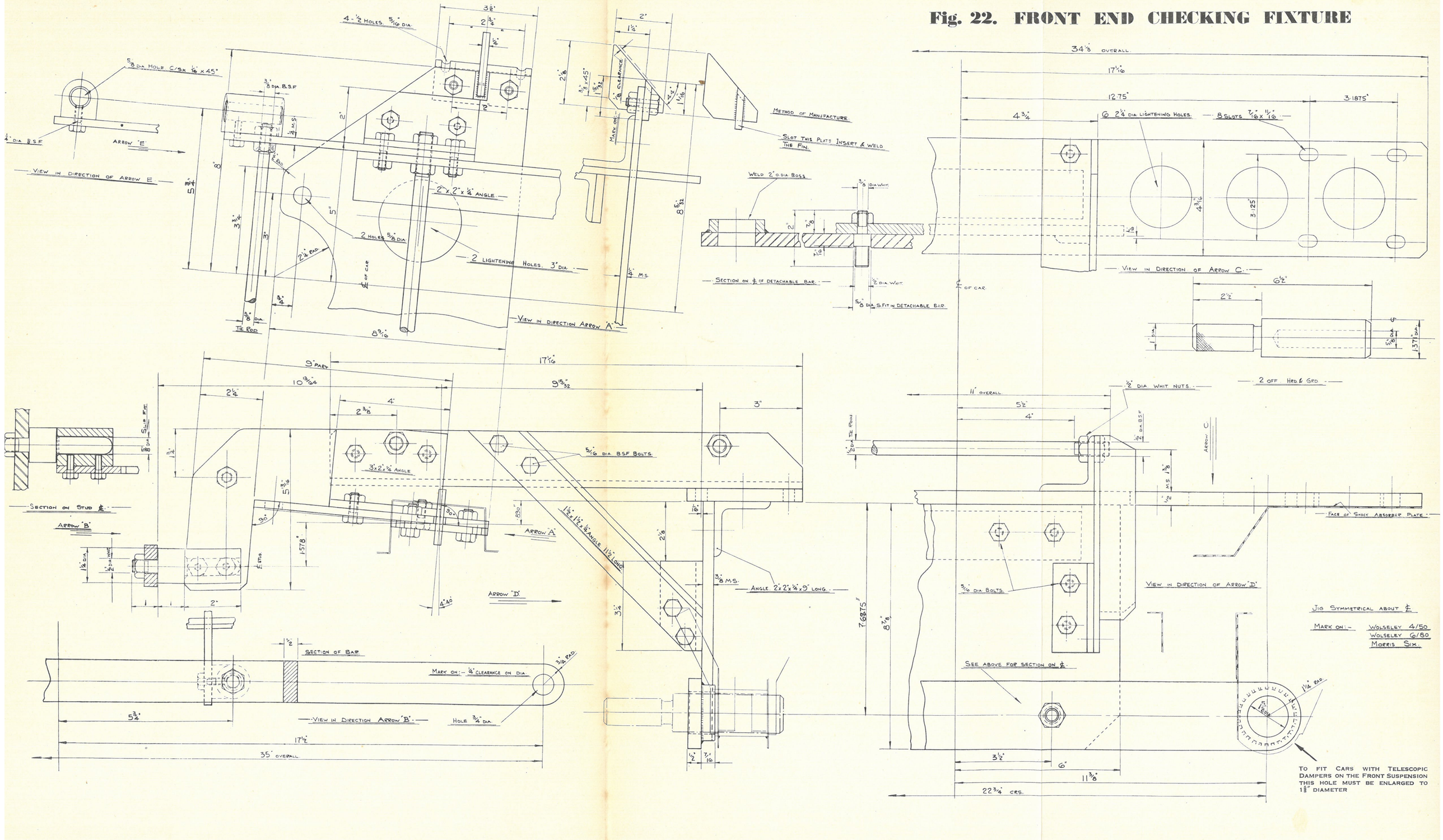
A preliminary check of the alignment can best be carried out by the system of diagonals and measurement checks from points projected onto a level floor by means of a plumb-bob.

A centre line can then be established by means of a pair of large compasses, and any deviation from correct alignment will be evident by failure of diagonals to intersect on the centre line or considerable deviations in the measurements at the four measuring points given.

Measurements must be made from the exact centre in every case, and due allowance must be made for manufacturing tolerances.

A Front end of torsion bar	B Rear end of torsion bar	C Over ends of spring anchorage bolts	D Over ends of rear spring bracket bolts
22 3/4" (578 mm.)	22 3/4" (578 mm.)	43 19/32" (1107 mm.)	42 5/8" (1068 mm.)

Fig. 22. FRONT END CHECKING FIXTURE



Dansk Oversøisk Motor Industri A/S
(Service Afdelingen)

SECTION S

THE HEATER

SMALL (133951.Y) AND LARGE (136056.Y)

Section No. S.1 Operation of the heater.

Section No. S.2 Installation.

Section No. S.3 The electrical connections.

Section S.1

OPERATION OF THE HEATER

The Smiths Car Heater De-froster and De-mister operates on the recirculation principle, that is, air from the car interior is drawn through the heater radiator by an axial flow fan and driven out through the heater grille.

The axial flow fan also drives air through the port at the top of the heater through special ducts built into the car, and this air supply is used for windscreen de-misting purposes.

The car heater derives its heat supply from the engine cooling system, to which it is connected by circulation pipes. The water control tap, situated at the front of the engine cylinder head, is intended for seasonal operation. During the winter months the tap is turned to the open position, allowing the hot water to pass through the car heater radiator, thus heating the air circulated by the heater fan. At the same time a constant stream of warm air is being blown through the de-mister feed ducts and so on to the windscreen, keeping this clear of mist and reducing ice formation under severe conditions.

The electric motor driving the heater fan is controlled by means of a rheostat mounted beneath the instrument panel. When in the fully anti-clockwise position the motor is " off." The first clockwise turn of the knob switches on the motor to full speed, so that it gives the greatest heat output and the maximum flow of warm air to the windscreen. Further movement of the rheostat knob in the clockwise direction progressively reduces the motor speed and the heat output from the unit, as well as reducing the intensity and pitch of the fan note. When the electric motor is turned off, hot water will still be circulating through the heater, but little heat is actually being circulated into the car interior, except by radiation.

During the summer season, when no heating is required, the water control tap should be turned to the " off " position. The car heater can then be used, if desired, to recirculate the air in the car interior, although there is little advantage in doing this. (The air will be unheated since no water is being circulated through the heater radiator.)

Section S.2

INSTALLATION

First check that the correct heater support bracket is available. Part No. 133496.Y is required for right-hand-drive cars, and Part No. 133497.Y for left-hand-drive vehicles.

Note the position of the two oval-shaped holes blanked with rubber plugs below the battery box in the dash panel. Remove the appropriate plug and insert grommet 135429.Z in position. The right-hand hole should be used for left-hand-drive cars and the left-hand hole for right-hand-drive cars.

First mount the car heater unit 136056.Y on the support bracket, allowing the radiator pipes to pass through the large oval hole in the bracket, and securely bolt the heater to the bracket, using the nuts and washers provided on the heater mounting pillars. Fit the two connection hoses to the heater pipes and fasten them with two hose clips, Part No.97428.Z, in the position indicated in Fig. S.1.

Drain the cooling system and remove the hexagon banjo bolt from the front of the engine cylinder head.

Release the clips on the lower end of the by-pass pipe and remove the pipe and banjo union. Secure the control cock 135708.Z with the original banjo bolt and two new fibre washers 133422.Z.

Fit the new by-pass pipe 135951.Z with rubber connection 135645.Z and tighten the clips securing the bottom hose 135933.Z. Remove the plug from

the rear of the cylinder head and insert the lower hose connector 133962.Z.

Firmly tighten the connector onto the fibre washer 133422.Z.

Remove the two appropriate cylinder head cover bolts on the right-hand side of the engine and, after fitting the front end rubber connection 135645.Z and two hose clips, use the bolts to secure the front connecting pipe 135650.Y to the cover.

Connect the heater inlet hose 133417.Z to the connector 133962.Z and connect the upper hose to the front water pipe 135650.Y.

In making the connection to the heater, the hoses should be pushed through the grommet 135429.Z and fed on to the pipes. The bracket and heater assembly and do not require any other fixing. The twin hose adaptor is then pressed into the rectangular port on the heater front, and the two flexible hoses from the windscreen nozzles attached after cutting a suitable aperture in the parcel tray floor.

The rheostat bracket 132091.Z should now be fitted beneath the instrument panel to the right-hand side of the steering bracket (left-hand side in the case of left-hand-drive cars), using the 2 B.A. $\times \frac{1}{2}$ in. hexagon bolts, nuts and shakeproof washers provided. The rheostat 138233.Z is then inserted in the bracket and secured by tightening up the chromium-plated screwed ring.

Make a final check to ensure that all connections, hose clips, etc., are firmly tightened up. Refill the

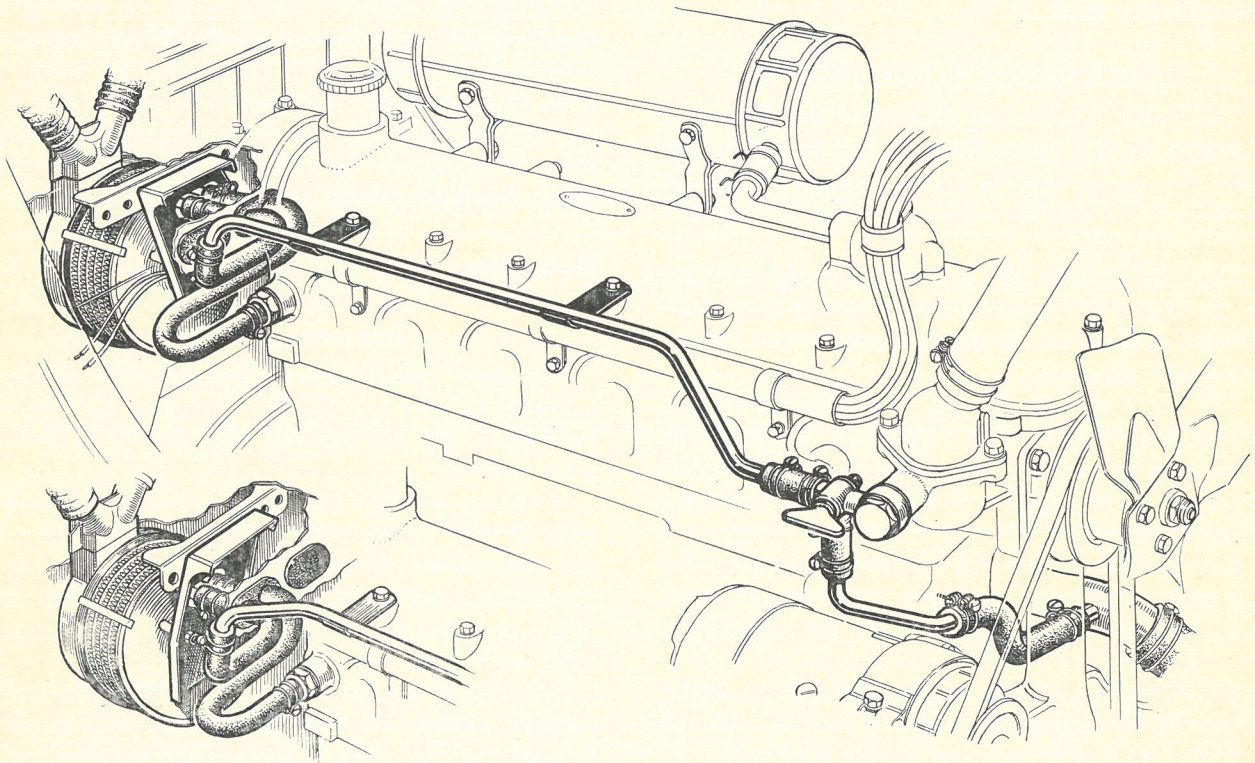


Fig. S.1.
The layout of the heater installation, clearly showing the method of fitting and the difference in location of the heater unit on right-hand-drive (top) and left-hand-drive (bottom) cars.

should then be fitted in position on the angle bracket beneath the battery shelf, fixing it by means of the two $\frac{5}{16}$ in. B.S.F. $\times \frac{3}{4}$ in. hexagon bolts, hexagon nuts and shakeproof washers provided (Part Nos. FB.105/6D, FN.105/K and 435/F). Secure the hoses by means of the two remaining clips 97428.Z.

The two lengths of flexible connector tube 136055.Z for the de-misting device should now be attached to the underside of the screen nozzles behind the instrument panel and shelf. These are a tight fit

cooling system, start the engine and allow it to tick over—the water connections at the back of the heater should be warm to the touch within a few minutes of starting up. This can be taken as evidence that water is circulating properly through the heater.

In certain circumstances an air lock may form in the heater radiator, and this will be evident by failure of the heater pipes to become warm after the engine has been started up a few minutes. In this event, the hose clip securing the joint between the control cock

and the front pipe 135650.Y should be loosened, and the hose pulled off the control cock, whilst the engine is still ticking over. Turn the control cock to the " off " position to prevent the pump sucking air, and a full flow of water should come from the copper connection pipe immediately. Replace the hose on the pipe and secure it with the hose clip. The air lock should now have been eliminated.

Section S.3

THE ELECTRICAL CONNECTIONS

The electrical connections are made in the following manner :—

One of the terminals of the rheostat should be connected by a suitable length of wiring to the ignition switch terminal to which are also connected the various auxiliary circuits and the actual ignition supply terminal A.3 of the control box (white lead). The other terminal of the rheostat should be connected to one lead of the heater motor, while the other lead of the heater motor should be earthed to the frame of the car at a suitable point (the heater support bracket, for instance).

In this way the heater is wired through the ignition switch so that when the ignition is " off " the motor will not operate regardless of the position of the rheostat switch. When the ignition is switched on the heater motor can be started and controlled by clockwise rotation of the rheostat knob as previously indicated.

WARNING

AS THERE IS NO PROVISION FOR DRAINING THE HEATER RADIATOR IT IS ESSENTIAL TO USE ANTI-FREEZE IN THE COOLING SYSTEM IN SEVERE WEATHER AND WHEN FROST IS EXPECTED.

THE WISE COURSE IS ALWAYS TO USE ANTI-FREEZE IN THE COOLING SYSTEM WHEN A HEATER IS FITTED.

Section S.4

THE 3½-KILOWATT HEATING AND VENTILATING SYSTEM

The 3½-kilowatt heating and ventilating system introduced on later Morris Six cars provides a much wider control over the temperature of the interior air and its condition than the previous heaters.

It can, however, only be fitted to cars equipped to receive the 3½-kilowatt installation and it is not possible to fit this equipment to cars prior to

SMS/10887 on right-hand drive models

SMS/6720 on left-hand drive models.

The 3½-kilowatt heater equipment is supplied as a complete kit under Morris Motors Service Part No. 300883.

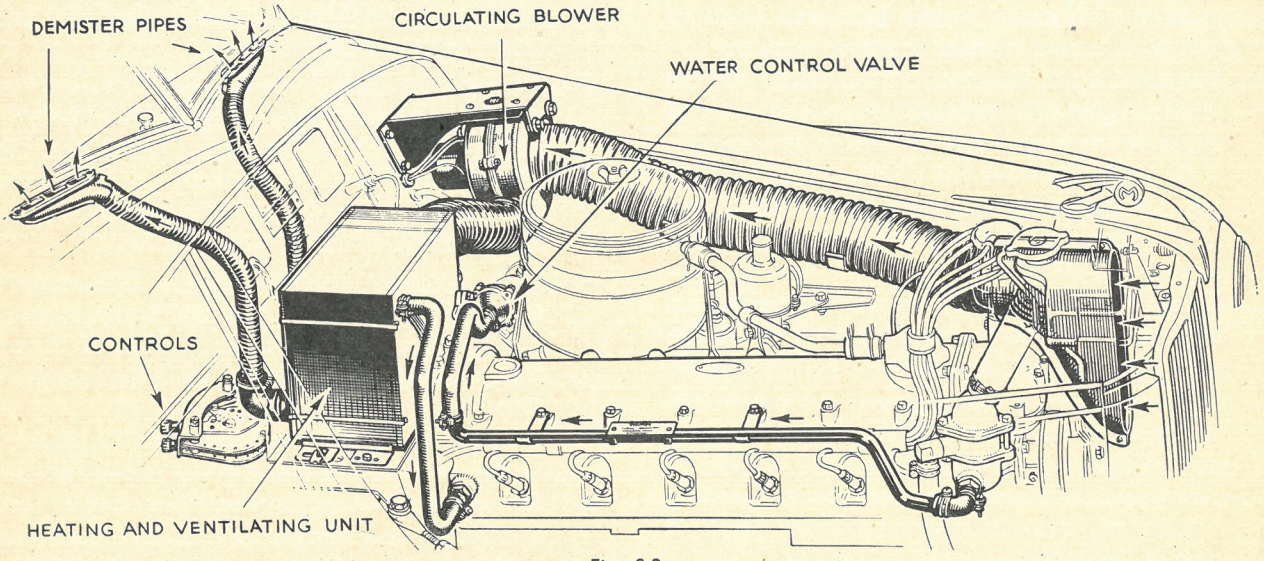


Fig. S.2.

The general assembly of the 3½-kilowatt heating and ventilating system for the Morris Six, showing the disposition of the components.

This unit provides heating and ventilation for the interior of the vehicle with provision for demisting and defrosting the windscreen.

The heating and ventilating system incorporates a circulating blower in the fresh-air duct and valves, controlled from a two-lever quadrant control unit located on the centre of the parcel tray, which provides control over the heat supply and air circulation.

The circulating blower is a centrifugal-type unit of high capacity and delivers a supply of fresh air to the heating and ventilating unit, which consist of four main assemblies—

(*a*) The radiator unit.

(*b*) The air-box, containing the distribution valves.

(*c*) The outer casing.

(*d*) The water regulating valve.

The radiator unit is of the tube-and-fin type and rectangular in shape, with the water connection pipes extended to pass through the outer casing.

FITTING THE HEATER UNIT

To fit the 3½-kilowatt car heater and ventilating unit the following sequence of operations should be followed :—

1. Fit the cold air intake pipe (Part No. 182631), securing it to the radiator top with two ¼ in. B.S.F. hexagon bolts, nuts and spring washers, and to the bottom bracket with a ¼ in. B.S.F. hexagon (pointed) screw and spring washer.
2. Fit the blower mounting bracket (Part No. 182653) to the dash (holes are already drilled) by four ¼ in. B.S.F. hexagon bolts, nuts and spring washers. The blower assembly (Part No. 182654) may now be fixed to the bracket by four ½ in. self-tapping screws.
3. Remove the blanking plate with seal from the heater platform and in place fit the rubber seal (Part No. 182647) and deflector (Part No. 183394) with the vane blanking plate forward.
4. Remove the rear blanking plate. Before fitting the cover-plate and seal (Part No. 182656/7) the cover-plate may be used as a template to cut two 2 in. diameter identical holes in the mill-board facia tray for the demister tube connections.
5. Place the heater unit assembly (Part No. 182711) on the forward edge of the heater platform.
6. Assemble the demister control cable (short) (Part No. 182856) and ventilator control cable (long) (Part No. 182855) to the connections on

the heater control quadrant (Part No. 182744). Drill clear the two cable holes in the bulkhead and fit the cable grommets (Part No. 86663).

7. Fit the heater control cables through the grommets from the inside of the car, leaving the heater control quadrant free inside the car, with both control levers in the fully open position. Pulling each cable taut in turn, connect to heater unit control valve levers, which should also be in the fully open position. Now operate the control levers to ensure that the controls are working freely.
8. By using the fixing plate (Part No. 182746) as a template, drill four holes in the centre of the facia tray angle horizontal member on the underside. The control quadrant may now be secured to the fixing plate forward holes by means of the quadrant bolts and to the facia tray angle by two 2 B.A. screws, nuts and plain washers.
9. From the inside of the car fit the elbows for the demister pipes (Part No. 183245) onto the outlet pipes of the heater unit projecting through the 2 in. holes. Remove and modify the centre facia panel millboard blanking cover to allow the fitting of the heater to the demister connecting tubes (Part No. 183759).
10. Place the heater unit cover-plate in position with rubber seal to the bulkhead, ensuring that the six speed nuts correspond with the holes in the bulkhead. Check the alignment of the heater unit on the platform and fit the four self-tapping screws and speed nuts loosely. Now secure the cover-plate and heater unit with six self-tapping screws from behind the sound deadening blanket to the platform.
11. Utilising the two holes already drilled to the left of the rheostat bracket, fit the heater switch bracket (Part No. 183561) and the heater switch (Part No. 138439) with two 2 B.A. bolts, nuts and spring washers.
12. **Electrical Connections.**

Blower assembly. The leads should be connected in the following manner :—

(*a*) One lead must be fitted with an eyelet terminal in lieu of the existing snap terminal and then secured to the petrol pump earthing bolt on the bulkhead.

(*b*) The remaining lead should be passed alongside the petrol pump feed cable through the grommet (Part No. 5497) which replaces the existing grommet in the bulkhead.

Heater switch.—The heater leads (Part No. 138528) may now be connected to the switch with the long lead (green/brown) to the L/H terminal. This lead should be fed behind the facia panel and joined to the blower unit lead with a single snap connector. From the harness cable connectors situated behind the R/H facia panel remove the green cables from the multiple connector and disconnect the green/red cables from the single connector. The green/red cable should then be fitted to the multiple connector in lieu of the green cable. Using a double common snap connector, join the two green leads together and then connect them with the short green lead from the heater switch.

13. Fit two duct clips (Part No. 182710) to the top of the L/H valance (holes already drilled) by ¼ in. B.S.F. bolts, nuts and spring washers. Fit the ducts (Part No. 182661/2) between the air intake and the blower assembly, and between the blower assembly and the heater unit.
14. Drain the water from the cooling system, remove the blanking plugs from the thermostat housing and the rear of the cylinder head, and fit the water pipe connections and their fibre washers (Part No. 182642).

Fit the water pipe assembly (Part No. 182644) to the valve cover studs, by the clips provided, and connect this to the thermostat outlet pipe connector with the rubber elbow (Part No. 182641) and two hose clips (Part No. 97428). Connect the rear end of the water pipe to the heater unit water control valve with the rubber water inlet hose (Part No. 182639), using two hose clips (Part No. 97428).

Fit the water outlet hose (Part No. 182640) to the water pipe connector at the rear of the cylinder head and to the outlet pipe of the heater unit. Use two hose clips (Part No. 97428) to make the joints secure.

Finally refill the radiator, with the heater controls set in the "Hot" position to ensure complete filling of the system.

WARNING

THE INSTRUCTION PLATE ASSEMBLY (PART No. 182904) MUST BE FITTED IN A PROMINENT POSITION ON THE WATER PIPE ASSEMBLY, PREFERABLY ON THE RUN ATTACHED TO THE VALVE COVER.

AS THERE IS NO PROVISION FOR DRAINING THE HEATER RADIATOR IT IS ESSENTIAL TO USE ANTI-FREEZE IN THE COOLING SYSTEM.

CONTROL

The heating and ventilating system is controlled from two levers in a quadrant in the centre of the parcel tray.

The upper or ventilating air lever controls the amount of heat introduced into the ventilating air.

The lower or demister lever controls the quantity and proportion of air fed to the windscreen demisting and defrosting ducts and the car interior.

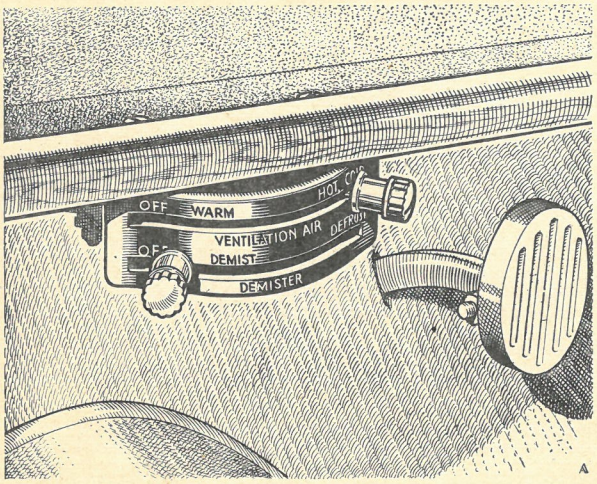


Fig. S.3.
The controls for the 3½-kilowatt heating and ventilating system.

The air circulation is controlled by the circulating blower, which is operated by a pull-push switch at the extreme left of the switch panel.

It will be obvious that this arrangement provides a wide measure of control and care must be exercised in order to obtain the required results.

The more frequently required positions for the controls are indicated below for guidance, but it must be realised that air will be forced into the car and onto the windscreen by the ramming effect due to the motion of the car through the air and that this effect is proportional to the car speed. At low car speeds the circulating blower should therefore be switched on to give adequate circulation.

No ventilation

When it is required to cut off the air supply altogether, the ventilation lever and the demister lever are *both* placed in the extreme left in the "Off" position.

Warm weather

When no heating is required, place the ventilation lever in the "Cold" position and the demister lever in the "Demist" position.

Alternative control setting. When especially good ventilation is required at head level rather than at foot level, place the ventilation lever in the "Cold" position and the demister lever in the "Defrost" position.

Moderately cold weather

When heating is required, place the ventilation lever between the "Warm" and "Hot" positions according to the degree of heating required, and place the demister lever in the "Demist" position for demisting or in the "Defrost" position for removal of frost from the screen.

Emergency condition of severe frosting of windscreen

When the maximum heat supply to the screen is required, place the ventilation lever between the "Cold" and "Hot" positions and place the demister lever in the "Defrost" position.

SECTION T

SPECIAL REPAIRS AND MODIFICATIONS

Section No. T.1 Fitting new silencer to original pipes.

Section No. T.2 Fitting new front pipe to existing silencer.

Section No. T.3 Fitting new tail pipe to existing silencer.

Section No. T.4 Improved exhaust silencer mounting.

Section No. T.5 Hydraulic stop-light switches.

Section T.1

FITTING NEW SILENCER TO ORIGINAL PIPES

The old silencer should be cut away from the front pipe with a hacksaw at a point $2\frac{3}{16}$ in. (55 mm.) from the front edge of the silencer body and from the tail pipe at a point $2\frac{3}{16}$ in. (55 mm.) from the rear edge of the silencer body.

An additional 3 in. (76 mm.) should now be cut from the end of the front pipe and inserted into the front end of the replacement silencer to a depth of $\frac{7}{8}$ in. (22 mm.) and welded in position. The special sleeve (Part No. 136053–Z) should then be inserted into the rear end of the replacement silencer to a depth of $\frac{3}{8}$ in. (10 mm.) and tack-welded in this position.

The special sleeve (Part No. 96305–Z) should be pushed onto the tail pipe and the special sleeve (Part No. 136052–Z) pushed onto the front pipe.

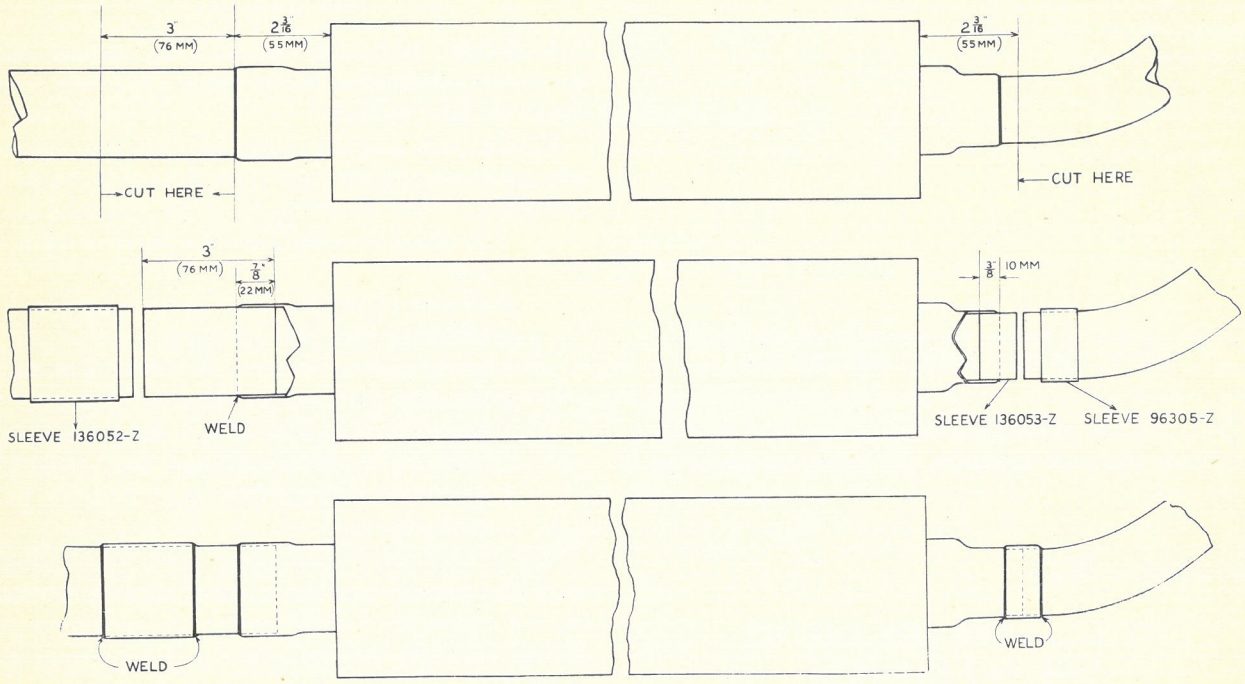


Fig. T.1.
The sequence of operations when fitting a replacement silencer.

The replacement silencer can now be placed in position and sleeve 96305–Z pushed forward into engagement with the rear end of the silencer, followed by sleeve 136052–Z which is in turn pushed into

engagement with the short length of pipe welded to the front end of the silencer so that it overlaps for $\frac{1}{2}$ in. (13 mm.).

The silencer is then welded in position by welding the two sleeves 136052–Z and 96305–Z to the silencer and pipes.

Section T.2

FITTING NEW FRONT PIPE TO EXISTING SILENCER

Cut off the front pipe at a point $4\frac{3}{16}$ in. (106 mm.) forward of the front edge of the silencer body.

Slide sleeve (Part No. 136052–Z) onto the new front pipe and fit pipe in position.

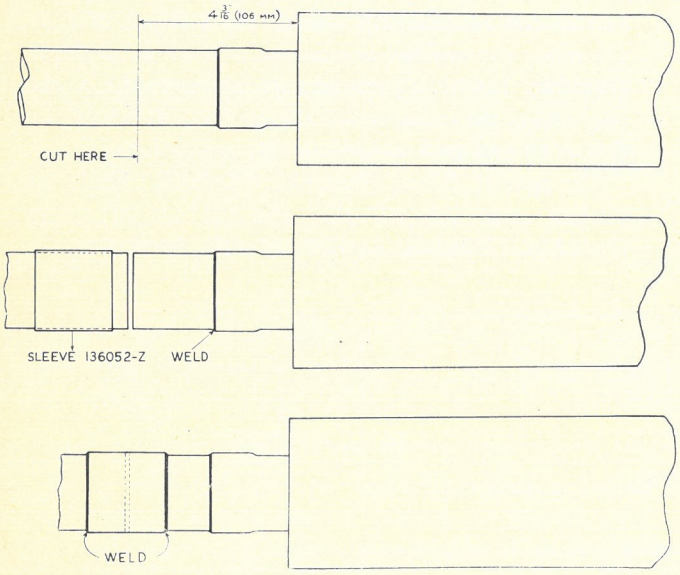


Fig. T.2.
The method of parting the silencer from the front exhaust pipe when fitting a new front pipe.

Slide the sleeve over the joint so that it is centralised over the joint and weld the sleeve all round at both ends.

Section T.3

FITTING NEW TAIL PIPE TO EXISTING SILENCER

Cut off the tail pipe at a point $1\frac{9}{16}$ in. (40 mm.) from the rear of the rear edge of the silencer body. This will just cut off the weld between the silencer and the existing tail pipe and release the latter. Withdraw the short length of the old tail pipe left in the end of the silencer.

Fit the new tail pipe and insert its end into the silencer to a depth of $\frac{9}{16}$ in. (14 mm.), and weld in position all round.

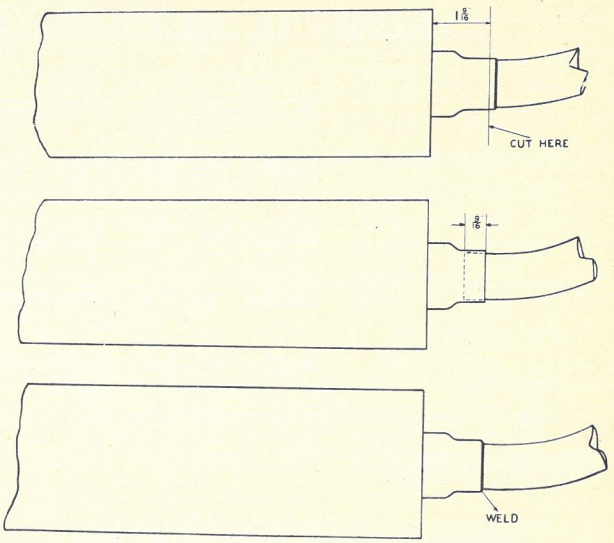


Fig. T.3.
The method of separating the tail pipe from the silencer when fitting a new tail pipe.

Section T.4

IMPROVED EXHAUST SILENCER MOUNTING

A modified method of mounting the silencer, using balata straps instead of rubber bushes, has been introduced on later models.

Where cars require attention to the original silencer mounting the new type mounting should be introduced. The following parts are required :—

- 4 Washers Part No. 278-AT-4 ($\frac{5}{16}$ in. × $1\frac{1}{2}$ in. × $\frac{1}{8}$ in.).
- 4 Washers Part No. 64401 (countersunk).
- 6 Washers Part No. 129185.Z.
- 6 Spring washers Part No. SW. 104-2 ($\frac{1}{4}$ in. dia.).
- 6 Hexagon nuts Part No. FN.104-2 ($\frac{1}{4}$ in. B.S.F.).
- 4 Screws Part No. 620-E-2 ($\frac{1}{4}$ in. B.S.F. csk. H.D.).
- 2 Support insulators to Part No. 180915.Z.
- 2 Bolts Part No. FB.104/6 ($\frac{1}{4}$ in. B.S.F. × $\frac{3}{4}$ in. hexagon head).

First release the silencer from the original attachment and remove the two silencer support brackets welded to the floor, drill four $\frac{9}{32}$ in. diameter holes in the locations indicated in Fig. T.4, remove the reinforcing washers on each end of the silencer supporting strap and tack-weld one of the Part No. 278-AT-4 washers on each side (top and bottom face) of the strap.

Fit the support insulators to the support strap centres, using bolts FB.104/6 with washers 129185-2 under their heads as shown.

Section T.4

IMPROVED EXHAUST SILENCER MOUNTING

A modified method of mounting the silencer, using balata straps instead of rubber bushes, has been introduced on later models.

Where cars require attention to the original silencer mounting the new type mounting should be introduced. The following parts are required :—

- 4 Washers, Part No. 278–AT–4 ($\frac{5}{16}$ in. × $1\frac{1}{2}$ in. × $\frac{1}{8}$ in.).
- 4 Washers, Part No. 64401 (countersunk).
- 6 Washers, Part No. 129185–Z.
- 6 Spring washers, Part No. SW.104–2 ($\frac{1}{4}$ in. dia.).
- 6 Hexagon nuts, Part No. FN.104–2 ($\frac{1}{4}$ in. B.S.F.).
- 4 Screws, Part No. 620–E–2 ($\frac{1}{4}$ in. B.S.F. csk. H.D.).
- 2 Support insulators to Part No. 180915–Z.
- 2 Bolts, Part No. FB.104/6 ($\frac{1}{4}$ in. B.S.F. × $\frac{3}{4}$ in. hexagon head).

First release the silencer from the original attachment and remove the two silencer support brackets welded to the floor, drill four $\frac{9}{32}$ in. diameter holes in the locations indicated in Fig. T.4, remove the reinforcing washers on each end of the silencer supporting strap and tack-weld one of the Part No. 278–AT–4 washers on each side (top and bottom face) of the strap.

Fit the support insulators to the support strap centres, using bolts FB.104/6 with washers 129185–Z under their heads as shown.

Section T.5

HYDRAULIC STOP-LIGHT SWITCHES

In cases where trouble has been experienced due to failure of the stop-light switch the modified type, Part No. 138425, should be fitted.

When changing over the switches, do so as quickly as possible to obviate loss of brake fluid and then bleed the brake system as detailed in Section M.3.

When reconnecting the stop-light wires cut off the terminal tags and bare the cable ends for connection to the terminals of the new switch.

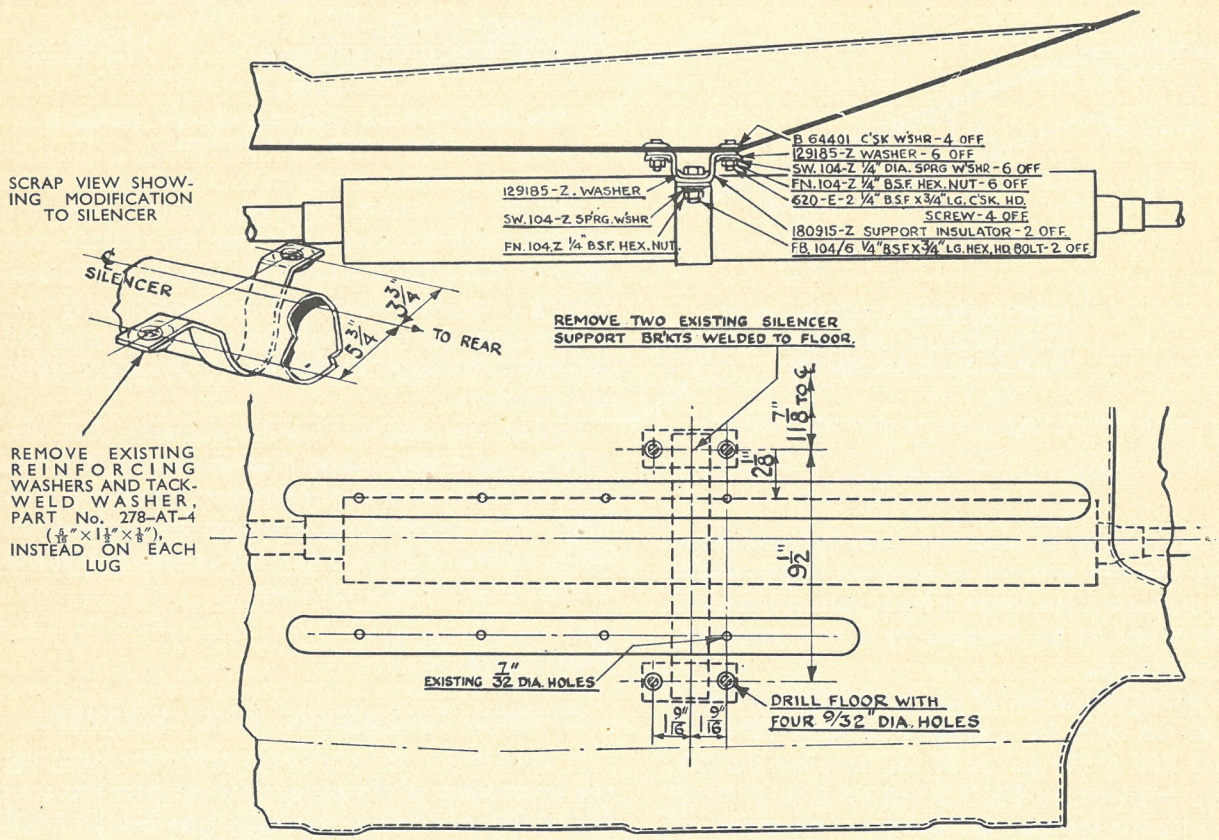


Fig. T.4.
The modifications required for the flexible exhaust silencer mounting are clearly shown in this illustration.

Section T.6

REINFORCING REAR LONGITUDINAL MEMBER AT SWAY-BAR

When severe usage has caused the sway-bar anchorage to pull away from the rear longitudinal member it is necessary to repair and reinforce the member at the sway-bar anchorage as here indicated.

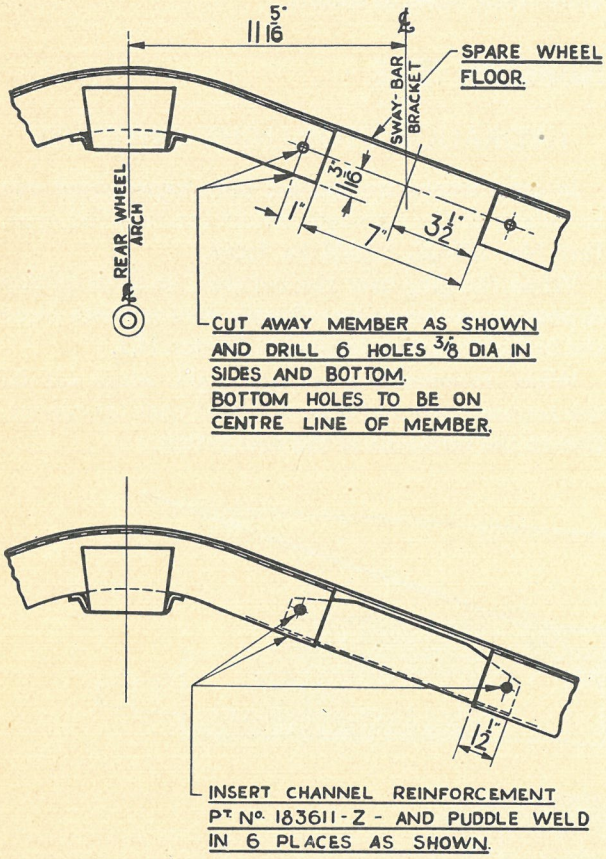


Fig. T.5.

The portion of the longitudinal member which should be cut away is shown together with the correct location of the channel reinforcement.

In the majority of cases the sway-bar anchorage bracket assembly will not be seriously damaged and can be used again, but where it has sustained extensive damage it should be replaced by a new assembly, Part No. 137045.

The damaged portion of the longitudinal member must be cut away for a distance of $3\frac{1}{2}$ in. (89 mm.) on each side of the centre of the sway-bar bracket position as shown in Fig. T.5, and six $\frac{3}{8}$ in. (9 mm.) holes drilled in the sides and bottom of the member, on the centre line in each case.

The special channel reinforcement member, Part No. 183611, is now inserted inside the longitudinal member, taking care that it is centralised in the cut-away portion. The channel reinforcement is then gas-welded in position on the longitudinal member through the six $\frac{3}{8}$ in. holes which have been introduced for this purpose.

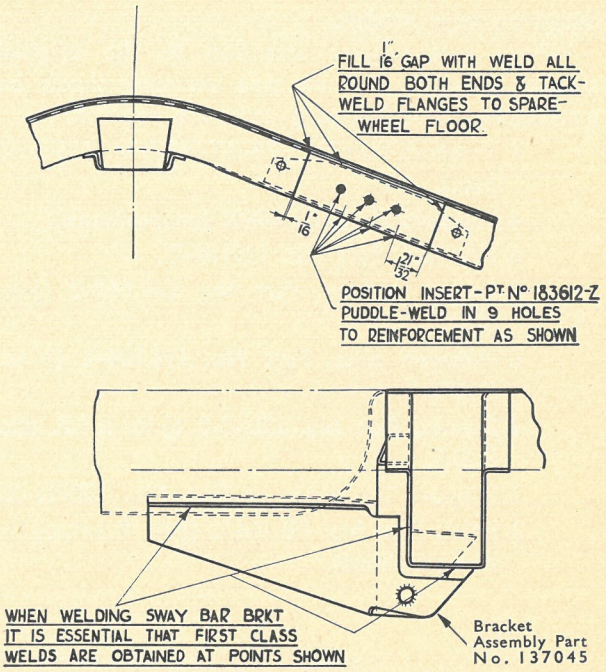


Fig. T.6.

The assembly of the insert and sway-bar bracket is clearly shown in this illustration.

Position the insert, Part No. 183612, over the channel reinforcing member, Part No. 183611, and gas-weld it in position through the nine holes provided, leaving $\frac{1}{16}$ in. gap at both ends as indicated in Fig. T.6. Fill the $\frac{1}{16}$ in. gap with weld right round both ends and tack-weld the flange to the floor of the spare wheel compartment.

Replace the sway-bar bracket assembly, Part No. 137045, and carefully weld it to the insert, Part No. 183612, and to the floor of the spare wheel compartment. It is essential that first-class welds should be made, otherwise there is still the possibility that the bracket assembly will pull away.

Section T.7

FITTING TELESCOPIC REAR DAMPERS

In cases where complaints are received concerning the functioning of the piston rear dampers fitted to the earlier models the telescopic type can be fitted without much difficulty.

In the first place the old type dampers and the anti-

sway bar must be removed as the latter is no longer required, the diagonal mounting of the telescopic dampers fulfilling the function of an anti-sway device.

The body shell requires the following additional drilling and reinforcing :—

1. Reinforcement angle brackets must be fitted in the angle between the squab support reinforcement cross-members and the floor of the spare wheel compartment on each side. The Part Number of the reinforcement angle bracket is 137170–Z and they should be welded to the squab support reinforcement and the spare wheel floor with six welds approximately $\frac{3}{4}$ in. (20 mm.) long at each corner, and in the centre as indicated in Fig. T.7, so that their centres are $9\frac{7}{16}$ in. (240 mm.) from the centre of the car.
2. Two reinforcement plates for the shock absorber pivot, Part No. 137171–Z, must also be welded to the forward face of the seat pan with their centre 1 in. (25 mm.) below the top edge of the seat pan and $9\frac{7}{16}$ in. (240 mm. (from the centre of the car. Eight welds approximately $\frac{1}{2}$ in. (13 mm.) long should be made, two at each corner as indicated in Fig. T.7.
3. Slotted holes should be made in the reinforcements and panels as indicated.
4. The shock absorber frame-pivot, Part No. 136971–Z, can now be fitted, using $\frac{5}{16}$ in. B.S.F. hexagon bolts $\frac{3}{4}$ in. (20 mm.) long, with nuts and spring washers.
5. New rear spring clamp brackets, Part Nos. 182948 and 182949, must be fitted to the springs. These carry the pivot pin for the lower end of the shock absorber.
6. The telescopic dampers can now be fitted to the pivot pins with $\frac{7}{16}$ in. B.S.F. Philidas self-locking nuts and special bearing retaining washers, Part No. 50014–Z.

   Do not forget that the sway-bar is no longer required and must be removed complete with its pin and bushes from the frame and axle brackets.

Section T.8

RE-LOCATION OF REAR TELESCOPIC DAMPERS

In order to permit the use of standard dampers in addition to the dampers specified for the Morris Six the lower anchorage to the axle has been re-located

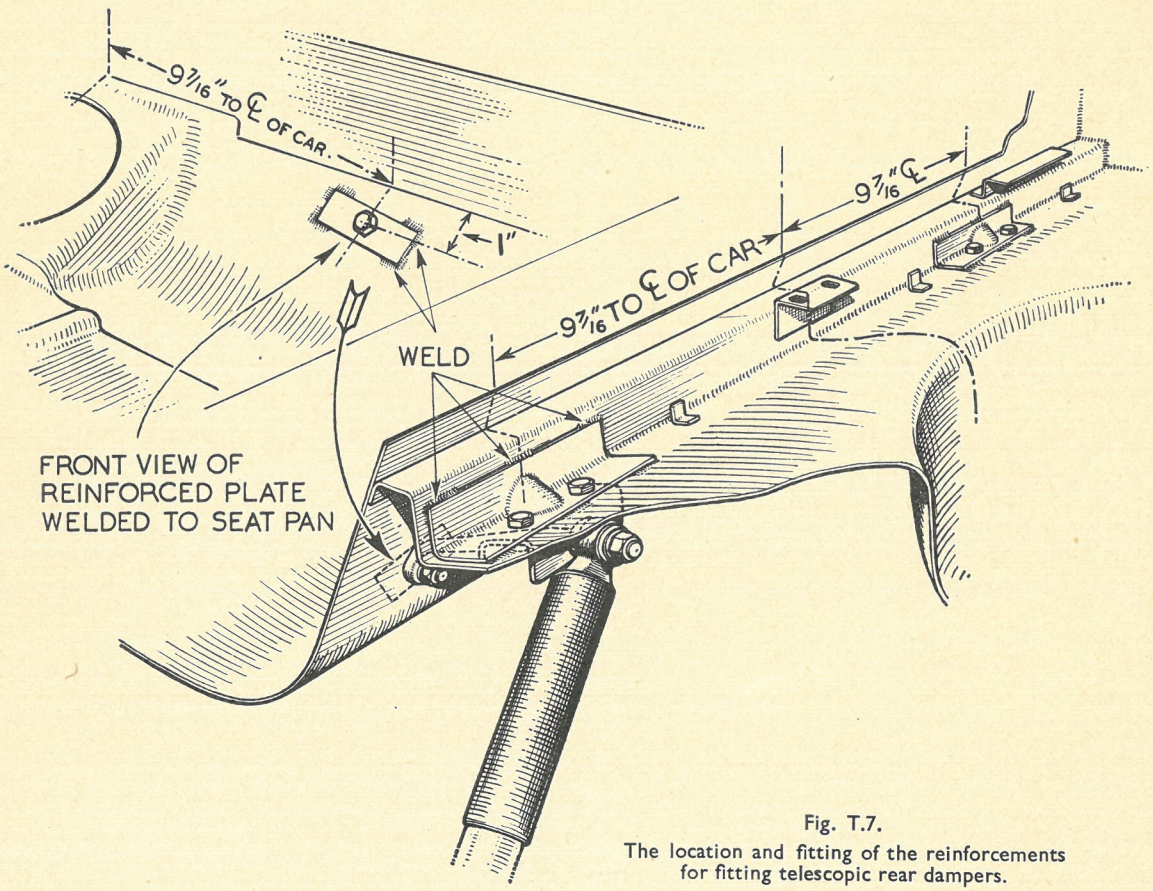
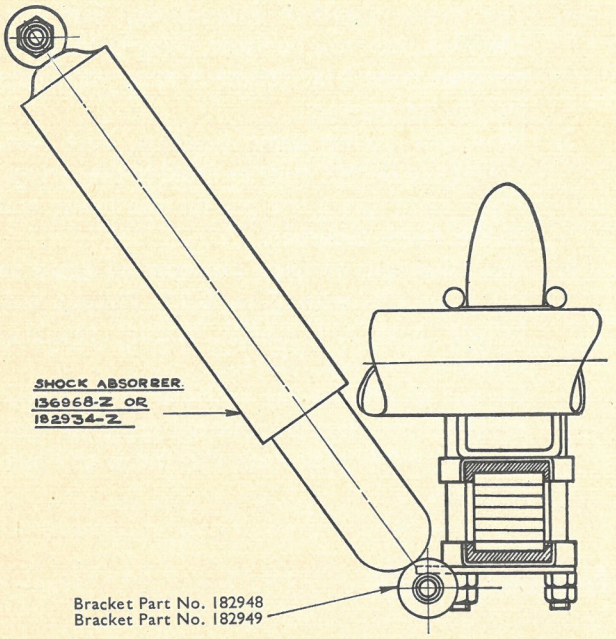


Fig. T.7.
The location and fitting of the reinforcements for fitting telescopic rear dampers.



to give the greatest possible clearance under full-bump conditions.

The telescopic dampers of the new standard length are approximately $\frac{5}{16}$ in. (8 mm.) longer in the fully closed position than the original type, and the new spring clamp bracket enables both types of damper to be used.

Where rough operating conditions exist and there is evidence that the dampers are bottoming under full-bump conditions with the original brackets, the new brackets, Part Nos. 182948 and 182949 should be fitted to provide the wider range of movement.

Fig. T.8.
The re-location of the rear telescopic dampers.

KEY TO RECOMMENDED LUBRICANTS

A — ENGINE AND OIL BATH AIR CLEANER

Climatic Conditions	**Castrol** *C. C. Wakefield & Co. Ltd.*	**Essolube** *Esso Petroleum Co. Ltd.*	**Mobiloil** *Vacuum Oil Co. Ltd.*	**Shell** *Shell Mex & B.P. Ltd.*	**Energol** *Price's Lubricants Ltd.*	**Filtrate** *Edward Joy & Sons Ltd.*	**Sternol** *Sternol Ltd.*	**Duckham's** *Alexander Duckham & Co. Ltd.*
Tropical and temperate down to 32° F. 0° C.	" Castrol " X.L.	" Essolube " 30	Mobiloil " A "	" Shell " X—100 S.A.E. 30	" Energol " Auto 150	Medium " Filtrate "	" Sternol " W.W. 30	Duckham's N.O.L. " Thirty "
Extreme cold down to 0° F. —18° C.	" Castrolite "	" Essolube " 20	Mobiloil " Arctic "	" Shell " X—100 S.A.E. 20	" Energol " Auto 125	Zero " Filtrate "	" Sternol " W.W. 20	Duckham's N.O.L. " Twenty "
Arctic—consistently below 0° F. —18° C.	" Castrol " Z	" Essolube " 10	Mobiloil " Arctic " Special	" Shell " X—100 S.A.E. 10	" Energol " Auto 80	Sub-Zero " Filtrate "	" Sternol " W.W. 10	Duckham's N.O.L. " Ten "

B — REAR AXLE (HYPOID), GEARBOX, STEERING GEAR

Tropical and temperate down to 10° F. —12° C.	" Castrol " Hypoy	" Esso " Expee Compound 90	Mobilube " G.X." 90	" Shell " Spirax E.P. 90	" Energol " Transmission 300 E.P.	Hypoid " Filtrate " 90	" Sternol " Liquid Ambroleum Hypoid 90	Duckham's Hypoid 90
Extreme cold below 10° F. —12° C.	" Castrol " Hypoy 80	" Esso " Expee Compound 80	Mobilube " G.X." 80	" Shell " Spirax E.P. 80	" Energol " Transmission 200 E.P.	Hypoid " Filtrate " 80	" Sternol " Liquid Ambroleum Hypoid 80	Duckham's Hypoid 80

C — WHEEL HUBS AND FAN BEARINGS

All temperatures	" Castrolease " Heavy	" Esso " Bearing Grease	Mobilgrease No. 5	" Shell " Retinax H for Hubs Retinax C for Fan	"Energrease" Chassis Pressure No. 2	" Filtrate " R.B. Grease	" Ambroline " R.B. Grease	Duckham's H.B.B. Grease

D — STEERING CONNECTIONS, KING-PINS, PROPELLER SHAFT, CLEVIS PINS AND LEVER FULCRUMS

All temperatures	" Castrolease " Medium	" Esso " Chassis Lubricant	Mobilgrease No. 2 or 4	" Shell " Retinax C	"Energrease" Chassis Pressure No. 2	H.P. Solidified " Filtrate "	" Ambroline " M.M. Grease	Duckham's H.P.G. Grease

E — CABLES AND VITAL CONTROL JOINTS

All temperatures	" Castrolease " Brake Cable Grease	" Esso " Chassis Lubricant	Mobilgrease No. 2 or 4	" Shell " Retinax C	"Energrease" Chassis Pressure No. 2	" Filtrate " A.F. Grease	" Ambroline " A.F. Grease	Duckham's " Keenol " K.G. 16 Grease

F — UTILITY LUBRICANT, S.U. CARBURETTER DASHPOT, OILCAN POINTS, ETC.

All temperatures	" Castrolite "	" Essolube " 20	Mobiloil " Arctic "	" Shell " X—100 S.A.E. 20	" Energol " Auto 125	Zero " Filtrate "	" Sternol " W.W. 20	Duckham's N.O.L. " Twenty "

EVERY 1,000 MILES (1600 Km.). Use oilcan on all control joints, door locks, hinges.

SPECIAL NOTE. Only Hypoid oils must be used in the rear axle.

THE MORRIS SIX (Series "MS")
LUBRICATION CHART

B

EVERY 12,000 MILES
(20000 Km.)
REMOVE STEERING GEARBOX FILLER AND REPLENISH TO LEVEL OF OPENING WITH RECOMMENDED OIL TO REF. B.

EVERY 12,000 MILES
(20,000 Km.)
CLEAN SHOCK ABSORBERS THOROUGHLY. EXAMINE FLUID LEVEL AND REPLENISH IF NECESSARY

EVERY 6,000 MILES
(10000 Km.)
FIT NEW OIL FILTER ELEMENT

EVERY 3,000 MILES
(5000 Km.)
CLEAN AND REFILL AIR CLEANER WITH ENGINE OIL TO REF. A.

A

D

EVERY 500 MILES
(800 Km.)
GIVE 3 OR 4 STROKES OF GREASE GUN TO REF. D.

EVERY 500 MILES
(800 Km.)
GIVE 3 OR 4 STROKES OF GREASE GUN TO REF. D

C

EVERY 6,000 MILES
(10000 Km.)
EARLY MODELS—2 STROKES OF GREASE GUN TO REF. C. LATER MODELS—REMOVE CAP, REFILL WITH GREASE AND REPLACE

EVERY 6,000 MILES
(10000 Km.)
EARLY MODELS—2 STROKES OF GREASE GUN TO REF. C. LATER MODELS—REMOVE CAP, REFILL WITH GREASE AND REPLACE

A

EVERY 250 MILES
(400 Km.)
INSPECT OIL LEVEL IN ENGINE BY DIPSTICK AND REPLENISH IF NECESSARY WITH RECOMMENDED ENGINE OIL TO REF. A

AFTER FIRST 500 MILES (800 Km.)
AND SUBSEQUENTLY
EVERY 3,000 MILES (5000 Km.)
DRAIN OFF OLD OIL AND REFILL WITH FRESH OIL TO REF. A.

F

EVERY 1,000 MILES
(1600 Km.)
REMOVE BRASS CAP FROM TOP OF CARBURETTER SUCTION CHAMBER, ADD A TEASPOONFUL OF ENGINE OIL TO REF. F.

B

EVERY 1,000 MILES
(1600 Km.)
INSPECT OIL LEVEL IN GEARBOX BY DIPSTICK AND REPLENISH IF NECESSARY WITH RECOMMENDED HYPOID OIL TO REF. B.

AFTER FIRST 500 MILES (800 Km.)
AND SUBSEQUENTLY
EVERY 6,000 MILES (10000 Km.)
DRAIN OFF OLD OIL AND REFILL WITH FRESH OIL TO REF. B.

F

EVERY 3,000 MILES
(5000 Km.)
WITHDRAW DISTRIBUTOR COVER AND ADD A FEW DROPS OF THIN OIL TO REF. F THROUGH OIL HOLE IN CONTACT BREAKER PLATFORM FOR THE OIL RESERVOIR. LATER MODELS ARE FITTED WITH A DYNAMO WITH A LUBRICATOR WHICH MUST BE UNSCREWED EVERY 3,000 MILES AND HALF-FILLED WITH GREASE TO REF. D.

B

EVERY 1,000 MILES
(1600 Km.)
INSPECT OIL LEVEL IN AXLE THROUGH FILLER AND REPLENISH IF NECESSARY WITH RECOMMENDED HYPOID OIL TO REF. B.

AFTER FIRST 500 MILES (800 Km.)
AND SUBSEQUENTLY
EVERY 6,000 MILES (10000 Km.)
DRAIN OFF OLD OIL AND REFILL WITH FRESH OIL TO REF. B.

EVERY 1,000 MILES
(1,600 Km.)
INSPECT FLUID LEVEL IN BRAKE MASTER CYLINDER, REPLENISH WITH LOCKHEED ORANGE FLUID

(LOCKHEED No. 5 OVERSEAS)

EVERY 12,000 MILES
(20000 Km.)
REMOVE REAR HYDRAULIC DAMPERS. CAREFULLY CLEAN EXTERIOR OF PISTON TYPE, THEN INSPECT FLUID LEVEL. REPLENISH WITH CORRECT FLUID. IN THE CASE OF TELESCOPIC DAMPERS, REMOVE, CHECK ACTION, AND RENEW IF DEFECTIVE.

D

EVERY 1,000 MILES
(1600 Km.)
GIVE 3 OR 4 STROKES OF GREASE GUN TO REF. D.

NOTE:—IN EXTREME CONDITIONS OF COLD USE THE LIGHTER LUBRICANTS INDICATED FOR "EXTREME COLD" CONDITIONS. ON LATER MODELS WITH TWIN TELESCOPIC DAMPERS AT THE FRONT ADDITIONAL GREASE NIPPLES ARE TO BE FOUND ON THE INNER BEARINGS FOR THE UPPER SUSPENSION ARMS WHICH REQUIRE ATTENTION WITH THE GREASE GUN EVERY 500 MILES (800 Km.).

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