SUPPLEMENTARY INFORMATION

FOR

4·2 LITRE "E" TYPE AND 2+2 CARS

(SERIES 2)

This Supplement covers the variations between the 4·2 Litre "E" Type, 2+2 cars and the 3·8 Litre versions of the "E" Type. Insert the Supplement at the end of the 3·8 Litre "E" Type Service Manual, Publication No. E.123.

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SECTION A

GENERAL INFORMATION

The Routine Maintenance Service periods have been increased to 3,000 mile (5,000 km.) stages as follows:—

1,000 MILES (1,600 KM.)

FREE SERVICE

1. Road test and check for oil, petrol, hydraulic fluid or coolant leaks.
2. Check torque loading of cylinder head nuts.
3. Check oil or fluid levels and top up as necessary:—
   (a) Brake reservoirs,
   (b) Clutch reservoir (if fitted),
   (c) Power steering reservoir (if fitted),
   (d) Top up carburetter hydraulic dampers and check carburation,
   (e) Battery,
   (f) Screen washer bottle,
   (g) Radiator header tank (add anti-freeze when necessary),
   (h) Manual gearbox,
   (i) Final drive unit.
4. Drain and refill
   (a) Engine sump,
   (b) Automatic transmission unit (if fitted).
5. Adjust front band on automatic transmission unit (if fitted).
6. Check driving belts for correct tension.
7. Clean and adjust contact-breaker points.
8. Check all brake pipe unions, petrol pipe unions, and hoses for leakage.
9. Check tightness of all front and rear suspension bolts and nuts.
10. Check tightness of nuts on all steering connections including column universal joints.
11. Check tightness of road wheel nuts and wheel alignment.
12. Check tyres for damage and adjust pressures.
13. Check operation of all lights and systems.
14. Check door locks and bonnet release control.
15. Lubricate all grease nipples (excluding wheel bearings).

3,000 MILES (5,000 KM.)
CHECK SERVICE

Repeat these servicing items at the under-mentioned subsequent periods:—

9,000 miles (15,000 Km.)
15,000 miles (25,000 Km.)
21,000 miles (35,000 Km.)
27,000 miles (45,000 Km.)
33,000 miles (55,000 Km.)
39,000 miles (65,000 Km.)
45,000 miles (75,000 Km.)
51,000 miles (85,000 Km.)
57,000 miles (95,000 Km.)
63,000 miles (105,000 Km.)
69,000 miles (115,000 Km.)

1. Check oil or fluid levels and top up as necessary:—
   (a) Engine sump,
   (b) Brake reservoirs,
   (c) Clutch reservoir (if fitted),
   (d) Power steering reservoir (if fitted),
   (e) Top up carburetter hydraulic dampers and check carburation,
   (f) Battery,
   (g) Screen washer bottle,
   (h) Radiator header tank (add anti-freeze when necessary),
   (i) Manual gearbox,
   (j) Final drive unit.
2. Check driving belts for correct tension.
3. Examine brake pads for wear and check operation of brake stop lights.
4. Examine tyres for damage and adjust pressures.
5. Check tightness of road wheel nuts.

6,000 MILES (10,000 KM.)
MINOR SERVICE

Repeat these servicing items at the under-mentioned subsequent periods:—

18,000 miles (30,000 Km.)
30,000 miles (50,000 Km.)
42,000 miles (70,000 Km.)
54,000 miles (90,000 Km.)
66,000 miles (110,000 Km.)

1. Check oil or fluid levels and top up as necessary:—
   (a) Brake reservoirs,
   (b) Clutch reservoir (if fitted),
   (c) Power steering reservoir (if fitted),
   (d) Top up carburetter dampers,
   (e) Battery and check connections,
   (f) Screen washer bottle,
   (g) Radiator header tank (add anti-freeze when necessary),
   (h) Manual gearbox or automatic transmission unit,
   (i) Final drive unit.
2. Drain and refill:—
   (a) Engine sump. Fit new oil filter element and seal.
3. Check driving belts for correct tension.
4. Check brake pads for wear and advise wear-rate to owner.
5. Check tyres for damage and tread depth. If uneven wear evident, check wheel alignment. Adjust pressures.
6. Check tightness of road wheel nuts.
7. Check headlamp alignment and functioning of mandatory lights including stop lights.
8. Lubricate all grease nipples, excluding wheel bearings.

12,000 MILES (20,000 KM.)
MAJOR SERVICE

Repeat these servicing items at the under-mentioned subsequent periods:—

24,000 miles (40,000 Km.)
48,000 miles (80,000 Km.)
60,000 miles (100,000 Km.)

1. Check oil or fluid levels and top up as necessary:—
   (a) Brake reservoirs,
   (b) Clutch reservoir (if fitted),
   (c) Power steering reservoir (if fitted),
   (d) Top up carburetter hydraulic dampers,
   (e) Battery and check connections,
   (f) Screen washer bottle,
   (g) Radiator header tank (add anti-freeze when necessary),
   (h) Automatic transmission,
   (i) Final drive unit.
2. Drain and refill:—
   (a) Engine sump. Fit new oil filter element and seal,
   (b) Manual gearbox. Clean overdrive filter (if fitted),
   (c) Final drive unit (if 'Powr-Lok' differential fitted. Use only special limited slip oil).
3. Renew sparking plugs.
4. Renew air cleaner element and fuel line filter element.
5. Clean and adjust contact breaker points. Check operation of centrifugal advance mechanism. Lubricate distributor.
6. Check driving belts for wear and tension.
7. Adjust top timing chain if required.
8. Lubricate all grease nipples including front and rear wheel bearings.
9. Check all suspension and exhaust mountings for security.
10. Check all steering connections, ball joints etc., for security and wear.
11. Check brake pads for degree of wear and advise wear-rate to owner.
12. Check functioning of all mandatory lights including stop lights and alignment of headlamps.
13. Check tyres for damage and tread depth. If uneven wear evident, check wheel alignment. Adjust pressures.
14. Oil can lubrication of door locks, bonnet hinges and locks, boot hinges and lock, seat slides, fuel filler flap hinges, control linkages.
15. Detect and report any oil, petrol, water, hydraulic fluid leakage and damaged hoses or other damaged parts.

36,000 MILES (60,000 KM.)
MAJOR SERVICE

Repeat these servicing items at the under-mentioned subsequent period:—

72,000 miles (120,000 Km.)

1. Check oil or fluid levels and top up as necessary:—
   (a) Clutch reservoir (if fitted),
   (b) Power steering reservoir (if fitted),
   (c) Top up carburetter hydraulic dampers,
   (d) Battery and check connections,
   (e) Screen washer bottle,
   (f) Radiator header tank (add anti-freeze when necessary),
   (g) Automatic transmission,
   (h) Final drive unit.
2. Drain and refill:—
   (a) Engine sump. Fit new oil filter element and seal,
   (b) Manual gearbox. Clean overdrive filter (if fitted),
   (c) Braking system. Retract wheel cylinder pistons to expell all old fluid,
   (d) Final drive unit (if 'Powr-Lok' differential fitted. Use only special limited slip oil).
3. Renew sparking plugs.
4. Renew air cleaner element and fuel line filter element.
5. Clean and adjust contact breaker points. Check operation of centrifugal advance mechanism. Lubricate distributor.
6. Check driving belts for wear and tension.
7. Adjust top timing chain if required.
8. Lubricate all grease nipples including front and rear wheel bearings.
9. Check all suspension and exhaust mounting for security.
10. Check all steering connections, ball joints etc., for security and wear.
11. Check brake pads for degree of wear and advise wear-rate to owner.
12. Check functioning of all mandatory lights including stop lights and alignment of headlamps.
13. Check tyres for damage and tread depth. If uneven wear evident, check wheel alignment. Adjust pressures.
14. Oil can lubrication of door locks, bonnet hinges and lock, boot hinges, and lock, seat slides, fuel filler flap hinges, control linkages.
15. Detect and report any oil, petrol, water, hydraulic fluid leakage and damaged hoses or other damaged parts.

RECOMMENDED LUBRICANTS

Component	MOBIL	CASTROL	SHELL	ESSO	B.P.	DUCKHAM	REGENT Caltex/Texaco
Engine	Mobil Super or Mobil Special	Castrol GTX	Shell Super Oil	Esso Extra Motor Oil 10W/30 Esso Extra Motor Oil 20W/40	Super Visco-Static 10W/40	Q20–50 or Q5500	Havoline 20W/40 or 10W/30
Upper cylinder lubrication	Mobil Upperlube	Castrollo	Shell U.C.L. or Donax U.	Esso U.C.L.	U.C.L.	Adcoid Liquid	Regent U.C.L.
Distributor oil can points Oil can lubrication	Mobiloil A	Castrol GTX	Shell Super Oil	Esso Extra Motor Oil 20W/40	Energol SAE 30	Q20–50	Havoline 30
Gearbox Final Drive Unit (not 'Powr-Lok')	Mobilube GX 90	Castrol Hypoy	Spirax 90 EP	Esso Gear Oil GP 90/140	Gear Oil SAE 90 EP	Hypoid 90	Multigear Lubricant EP.90
Front wheel bearings Rear wheel bearings Distributor cam Final drive half-shafts Steering tie-rods Wheel swivels Door hinges Steering housing	Mobil grease MP	Castrolease LM	Retinax A	Esso Multi-purpose Grease H	Energrease L.2	LB 10	Marfak All Purpose
Automatic transmission unit Power steering system	Mobilfluid 200	Castrol T.Q.	Shell Donax T6	Esso Automatic Transmission Fluid	Automatic Transmission Fluid Type A	Nolmatic	Texamatic Fluid

SECTION B

ENGINE

DATA

Camshaft

Permissible end float	·004″ to ·006″ (·10 to ·15 mm.)

Connecting Rod

Big end—Diameter clearance	·0015″ to ·0033″ (·037 to ·083 mm.)

Crankshaft Main Bearings

Journal diameter	2·750″ to 2·7505″ (69·85 to 69·86 mm.)
Journal length	
—Front	$1\frac{9}{16}$″ (39·06 mm.)
—Centre	$1\frac{3}{8}$″ + ·001″ — ·0005″ (34·37 mm. + ·025 mm. — ·0125 mm.)
—Rear	$1\frac{11}{16}$″ (42·86 mm.)
—Intermediate	$11\frac{7}{32}$″ ± ·002″ (30·96 mm. ± ·05 mm.)

Cylinder Block

Bore size for fitting liners	3·761″ to 3·762″ (94·03 to 94·05 mm.)
Outside diameter of liner	3·765″ to 3·766″ (94·13 to 94·15 mm.)
Interference fit	·003″ to ·005″ (·08 to ·13 mm.)
Overall length of liner	6·959″ to 6·979″ (17·39 to 17·45 cm.)
Outside diameter of lead-in	3·758″ to 3·760″ (93·95 to 94·00 mm.)
Size of bore honed after assembly—cylinder block—Nominal	92·07 mm. (3·625″)

Gudgeon Pin

Length	3·00″ (75 mm.)

ENGINE

Piston and Piston Rings

Gudgeon pin bore	·8571″ to ·8753″ (2·188 to 2·1883 mm.)
Piston rings—Width Compression	·0770″ to ·0780″ (1·97 to 2·00 mm.)
Oil Control	Self expanding (Maxiflex)
Piston rings—Thickness	·151″ to ·158″ (3·775 to 3·95 mm.)
Piston rings—Gap when fitted to cylinder bore	
Oil Control	·015″ to ·033″ (·38 to ·82 mm.)

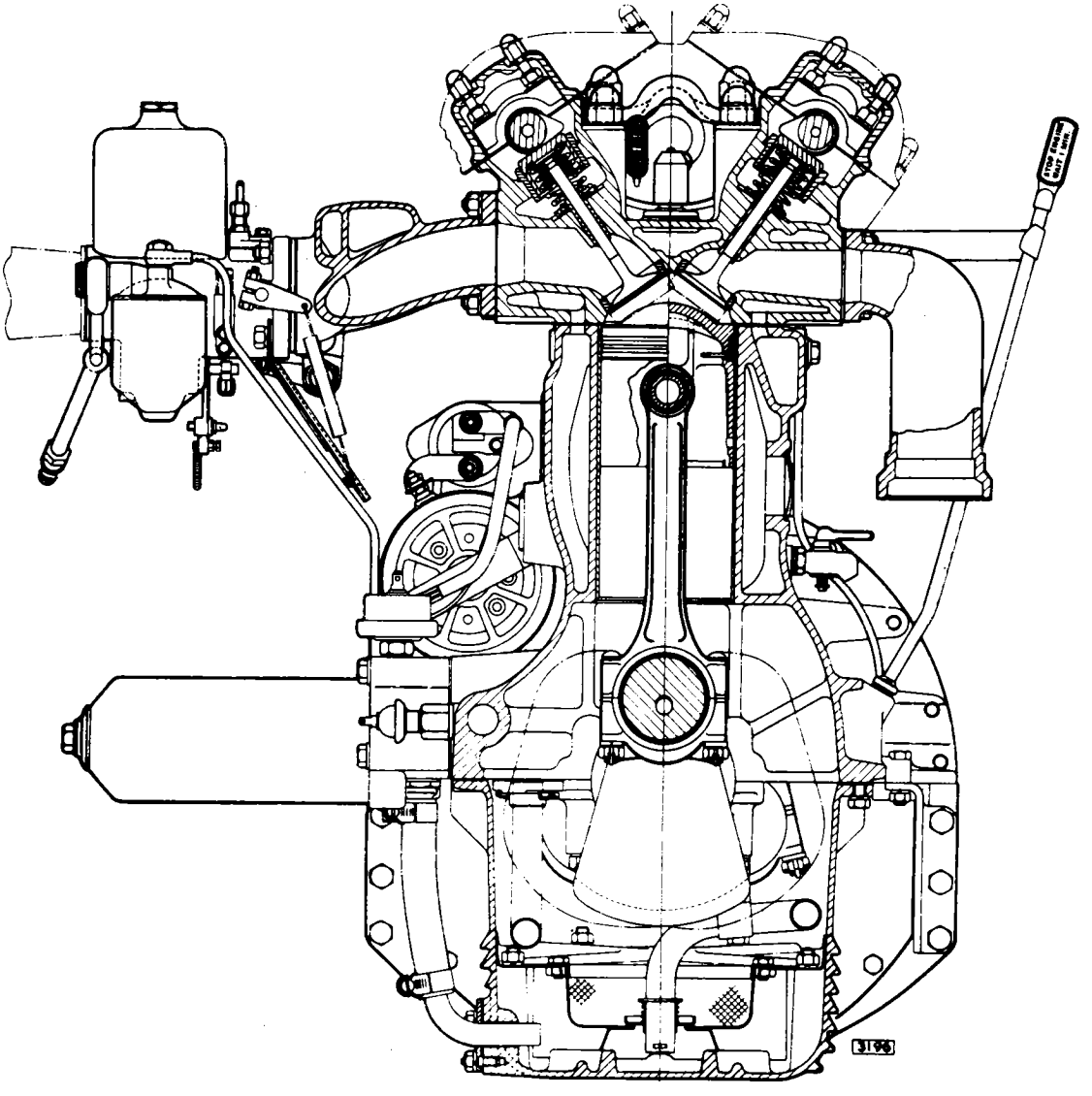


Fig. 1. *Cross sectional view of the engine.*

ENGINE REMOVAL AND REFITTING

REMOVAL

Remove the bonnet.

Disconnect the battery.

Drain the cooling system and cylinder block; conserve the coolant if antifreeze is in use.

Slacken the clip on the breather pipe; unscrew the two wing nuts and withdraw the top of the air cleaner.

Disconnect the petrol feed pipe from under the centre carburetter.

Slacken the clamps and remove the water hoses from the cylinder head and radiator to the header tank. Slacken the two clamps and withdraw the water pump hose. Remove the heater hoses from the inlet manifold.

Disconnect the brake vacuum hose from the inlet manifold.

Pull off the two Lucar connectors from the fan thermostat control in the header tank.

Remove the two bolts securing the header tank mounting bracket to the front cross member. Remove the two nuts and two bolts securing the header tank straps to the radiator and fan cowl. Withdraw the header tank complete with mounting bracket and straps.

Disconnect the throttle linkage at the rear carburetter.

Disconnect:—

The two coil leads.

The water temperature transmitter.

The battery cable and solenoid switch cable from the starter.

The output cables from the alternator.

The engine earth strap from the left hand side member.

Withdraw the oil filter canister; catch the escaping oil in a drip tray.

Remove the crankshaft pulley, damper and drive belt. Mark the pulley and damper to facilitate re-fitting. Remove the ignition timing pointer from the sump.

Remove the revolution counter generator complete with cables.

Remove the four nuts and washers securing each exhaust downpipe from the manifold. Unclip the pipes at the silencers and withdraw the downpipes. Collect the sealing rings between the pipes and the manifold.

On standard transmission cars, proceed as follows:—

Remove the seats. Remove the knob and locknut from the gear lever. Remove two hexagon headed setscrews and two chromium-plated nuts and detach the radio/ash tray console panel from the gearbox tunnel. If a radio is fitted, disconnect the electrical cables from the control head to enable the panel to be completely removed.

On 2+2 cars, raise the central arm-rest; lift out the bottom panel; withdraw five self-tapping screws and remove the central arm-rest. Lift off the trimmed cover panel from the gearbox tunnel.

On all other cars, withdraw two pan-headed screws and two seat belt attachments before lifting off the trimmed cover. Withdraw the self-tapping screws and remove the gearbox cover.

Disconnect the reverse lamp cables from the switch on the gearbox top cover.

Disconnect the speedometer drive cable from the gearbox.

Remove the clutch slave operating cylinder from the clutch cover.

Disconnect the propeller shaft.

On automatic transmission cars, proceed as follows:—

Withdraw the transmission dipstick and unscrew the dipstick tube from the transmission oil pan.

Place the selector lever in L and, from underneath the car, unscrew the nut securing the selector cable adjustable ball joint to the transmission lever. Release the nut securing the outer cable clamp to the abutment bracket.

Remove the speedometer drive cable from the transmission extension housing.

Disconnect the transmission oil cooler pipes from the right hand side of the radiator block and from the transmission unit. Withdraw the clips and remove the pipes.

Disconnect the kickdown cable at the rear of the cylinder head.

Remove the central arm-rest and lift off the trimmed cover panel from the gearbox tunnel. Withdraw the drive screws securing the cover plate on the transmission tunnel. Disconnect the propeller shaft.

For all models, proceed as follows:—

Remove the nuts securing the torsion bar reaction tie plate on each side and tap the bolts back flush with the face of the tie plate. With the aid of a helper, place a lever between the head of the bolt just released and the torsion bar. Exert pressure on the bolt head to release the tension on the upper bolt. Remove the nut and tap the upper bolt back flush with the face of the tie plate. Withdraw the bolts securing the tie plate on each side to the body underframe channels through the side members. Tap the tie plate off the four bolts.

Note: Failure to relieve the tension on the upper bolts when tapping them back to the tie plate will result in stripping the threads. If this occurs, new bolts must be fitted and the torsion bars re-set.

Support the engine by means of two individual lifting tackles using the hooks provided on the cylinder head. Insert a trolley jack under the transmission (or gearbox) and support the transmission.

Remove the self-locking nut and washer from the engine stabiliser.

Remove the bolts securing the rear engine mounting plate. Remove the bolts from the front engine mountings.

Raise the engine on the lifting tackles and, keeping the combined engine and transmission assembly level, move forwards ensuring that the water pump pulley clears the sub-frame top cross member. Carefully raise the front of the engine and withdraw forwards and upwards.

REFITTING

Refitting is the reverse of the removal procedure. After the unit is in place, it is important that the engine stabiliser is adjusted and that the clutch slave cylinder is mounted correctly.

On automatic transmission 2+2 cars, the kickdown cable must be adjusted and the manual linkage connected in accordance with the instructions given in Section FF.

THE CYLINDER BLOCK

OVERHAUL

Reboring is normally recommended when the bore wear exceeds ·006″ (·15 mm). Reboring beyond the limit of ·030″ (·76 mm) is not recommended and, when the bores will not clean out at ·030″ (·76 mm), liners and standard size pistons should be fitted.

The worn liners must be pressed out from below utilising the stepped block illustrated.

PISTONS AND GUDGEON PINS

Piston Grades

Grade Identification Letter	To suit cylinder bore size
F	3·6250″ to 3·6253″ (92·075 to 92·0826 mm.)
G	3·6254″ to 3·6257″ (92·0852 to 92·0928 mm.)
H	3·6258″ to 3·6261″ (92·0953 to 92·1029 mm.)
J	3·6262″ to 3·6265″ (92·1055 to 92·1131 mm.)
K	3·6266″ to 3·6269″ (92·1156 to 92·1123 mm.)

Oversize Pistons

Oversize pistons are available in the following sizes: +·010″ (·25 mm.) ±·020″ (·51 mm.) +·030″ (·76 mm.).

There are no selective grades in oversize pistons as grading is necessary purely for factory production methods.

Tapered Periphery Rings

All engine units are fitted with tapered periphery piston rings and these must be fitted the correct way up.

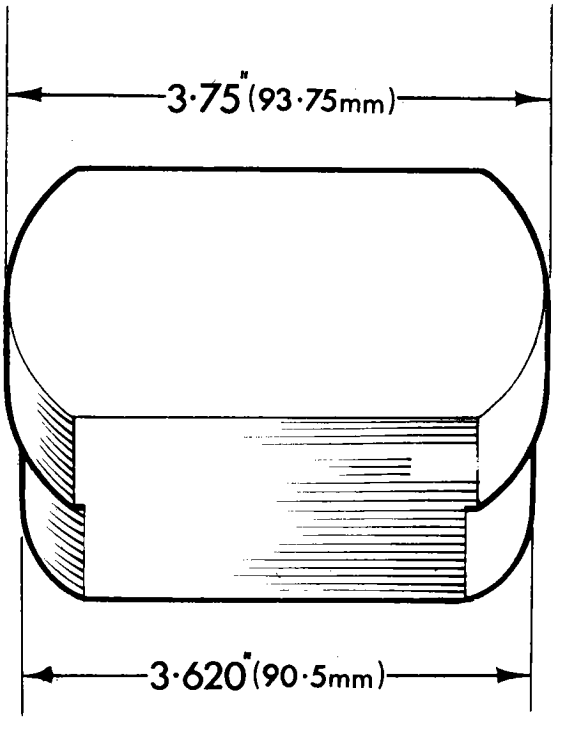


Fig. 2. *Stepped block for cylinder liner removal.*

The narrowest part of the ring must be fitted uppermost; to assist in identifying the narrowest face a letter "T" or "Top" is marked on the side of the ring to be fitted uppermost.

The oil control ring consists of two steel rails with a spacer between. These rails are held together on assembly with an adhesive. The expander, which is fitted inside the oil control ring, should be assembled with the ends of the expander ring (internal ring) butted together. If the internal ring is fitted to the piston groove with the ends overlapping, the outer ring assembly cannot be seated properly.

Pistons

Skirt clearance (measured at bottom of skirt at 90 to gudgeon pin pin axis)	·0007″ to ·0013″ (·018 to ·03 mm.)

Ring gap—when fitted to bore

Top compression	·015″ to ·020″ (·38 to ·51 mm.)
Lower compression	·010″ to ·015″ (·254 to ·38 mm.)
Scraper	·015″ to ·045″ (·38 to 1·143 mm.)
Side clearance in groove	·001″ to ·003″ (·02 to ·07 mm.)

Gudgeon Pins

Grades	(Red) ·8753″ to ·8754″ (22·23 to 22·24 mm.) (Green) ·8752″ to ·8753″ (22·22 to 22·23 mm.)
Clearance in piston	·0001″ to ·0003″ (·0025 to ·0076 mm.)

Cargraph Treatment—Piston Rings

The chromium plated ring (top compression) is Cargraph treated on the outside diameter to assist in bedding in the chromium surface. This coating is coloured Red for identification purposes and **should not be removed.** Excess oil or grease may be removed with clean paraffin but **rings should not be soaked in any degreasing agent.**

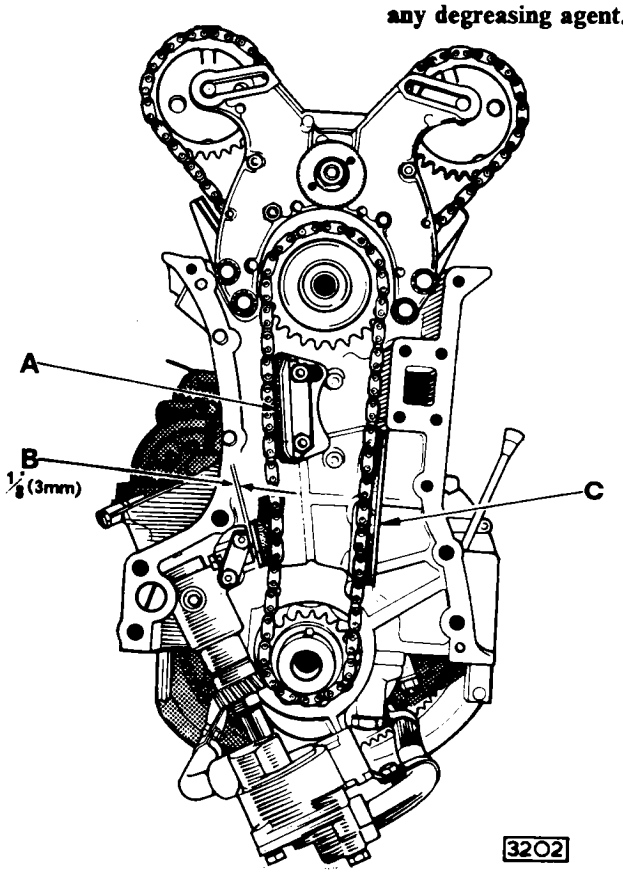


Fig. 3. *The timing gear arrangement.*

When fitting a new lower timing chain, set the intermediate damper (A) in light contact with the chain when there is a ⅛" (3 mm) gap between the rubber slipper and the tensioner body. In the case of a worn chain, the gap (B) may have to be increased to avoid fouling between the chain and the cylinder block. Set the lower damper (C) in light contact with the chain.

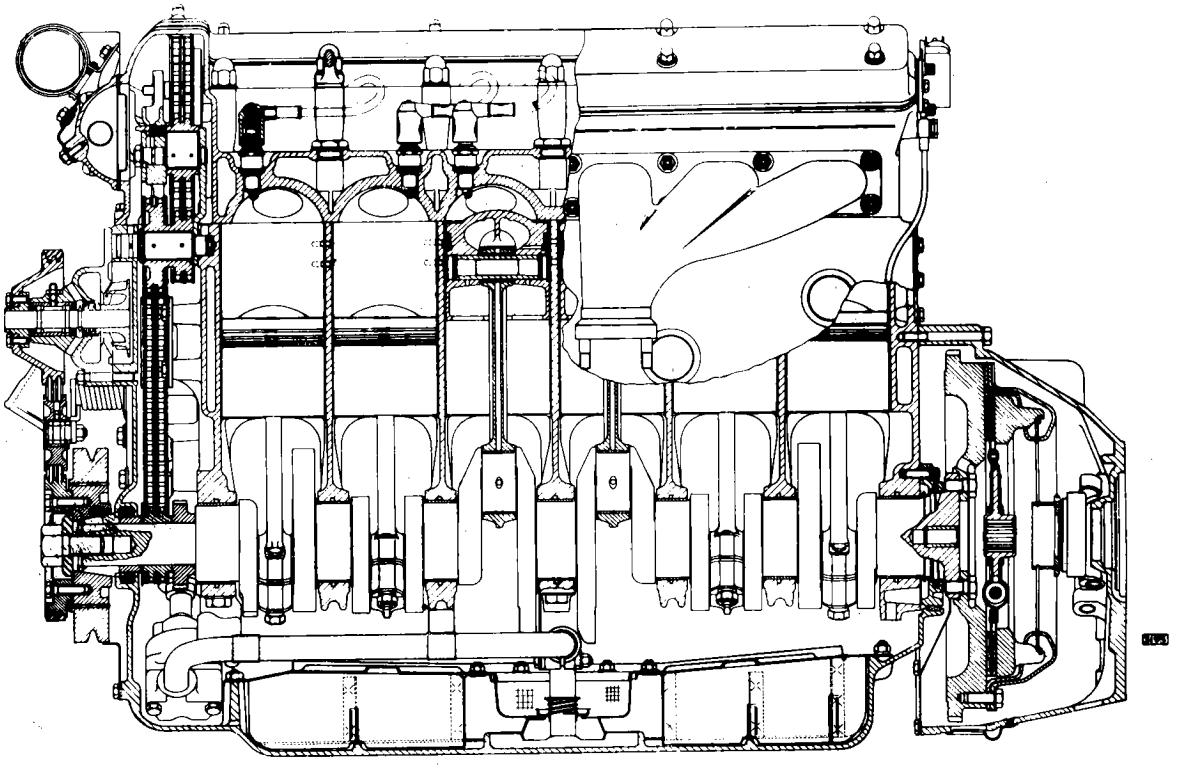


Fig. 4. *Longitudinal section of the engine.*

OIL SUMP

REMOVAL

Drain the sump; disconnect the oil return pipe and remove the crankshaft damper.

Remove the self-locking nut and washer from the top of the engine stabiliser. Screw down the lower flanged washer to the limit of the stud thread.

Sling the engine from the rear lifting loop and raise the engine approximately 1″ (25·4 mm.).

Remove the sump securing screws, lower the front end and withdraw forward.

REFITTING

Refitting is the reverse of the removal procedure but care must be taken to ensure that the rear oil seal is positioned correctly. Adjust the engine stabiliser after refitting.

Check for oil leakage after refilling the sump and running the engine.

VALVE GUIDES

Valve guides have circlips fitted to ensure positive location in the cylinder head. These valve guides are chamfered at the upper ends and have the outside diameter reduced at the lower end to provide a "lead-in" when fitting.

Oil seals are also fitted to the inlet valve guide—a second groove being machined in the guide above the circlip groove to seat the oil seal.

Checking Valve Guides

Examine the guides for evidence of wear in the bore. The clearance between the valve stem and the guide when new is ·001″–·004″ (·025–·10 mm).

If it is found necessary to renew worn valve guides, they must be fitted in accordance with the following instructions and only genuine factory replacement parts used.

Valve Guide—Replacement

Heat the cylinder head by immersing in boiling water for 30 minutes. With a piloted drift, drive out the old valve guide from the combustion chamber end.

Note: If carbon deposits around the valve guide in the combustion chamber are quite heavy, they should be cleaned off thoroughly before attempting to drive out the old valve guide.

Valve guides when fitted during engine assembly are to the following dimensions and may be fitted in mixed form.

(1) ·501″ to ·502″ (12·70 to 12·725 mm.)
(2) ·503″ to ·504″ (12·776 to 12·801 mm.)

The valve guide (2) will be identified by the machining of one circular groove on the shank of the guide: valve guide (1) will **not** have the groove.

When removing worn guides, care must be taken to identify each individual guide to its particular bore in the cylinder head.

Replacement guides are available in the following sizes and will have identification grooves machined in the shank as noted:—

1st oversize (one groove)	·503″ to ·504″ (12·776 to 12·801 mm.)
2nd oversize (two grooves)	·506″ to ·507″ (12·852 to 12·877 mm.)
3rd oversize (three grooves)	·511″ to ·512″ (12·979 to 13·005 mm.)

Valve guides with one groove should only be fitted as replacements for those originally fitted without a groove: the bore in the cylinder head will not require reaming before fitting.

Guides with two grooves should be used as replacements for those with one groove and guides with three grooves for those with two. Cylinder head bores should be reamed to the following dimensions:—

Valve Guide	Ream to Size
2nd oversize (two grooves)	.505″ $^{+.0005″}_{-.0002″}$ (12.83 mm. $^{+.012}_{-.005}$ mm.)
3rd oversize (three grooves)	.510″ $^{+.0005″}_{-.0002″}$ (12.95 mm. $^{+.012}_{-.005}$ mm.)

Coat the valves with graphite grease and fit the circlips. Reheat the cylinder head. With a piloted drift, drive in the valve guide from the top until the circlip registers in the groove machined in the guide bore of the cylinder head. Visually check that the circlip has seated correctly.

SECTION C

CARBURETTERS AND FUEL SYSTEM

CARBURETTERS

Removal

Drain the cooling system.

Disconnect the battery.

Slacken the hose clip securing the water hose from the inlet manifold to the header tank. Remove the hose.

Disconnect the two electrical connections from the thermostat fan control in the header tank.

Remove the throttle return springs.

Unclip hose connection to breather pipe.

Remove the two butterfly nuts at the carburetter trumpets and remove the air cleaner elbow.

Remove the carburetter trumpet from the carburetters having removed the six nuts and spring washers together with the three gaskets.

Disconnect the throttle linkage at the rear carburetter.

Remove the three banjo union bolts and six fibre washers from the float chambers.

Ensure that the three float chamber filters are not mislaid.

Disconnect the mixture control outer and inner cables.

Remove the suction pipe from the front carburetter.

Disconnect the brown/black cable from the oil pressure switch.

Slacken the clips and disconnect the heater pipes at the water manifold and below the inlet manifold.

On 2+2 cars fitted with automatic transmission, disconnect the kickdown cable at the rear of the cylinder head.

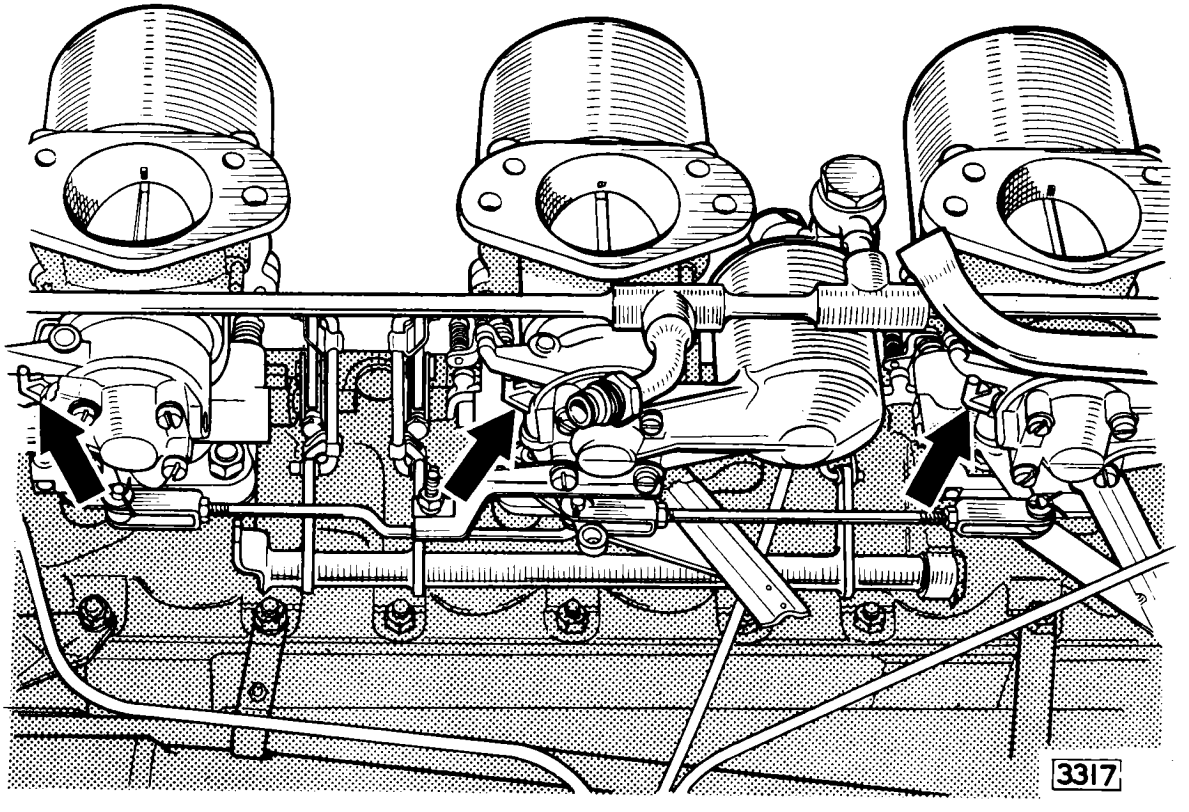


Fig. 1. *Refitting the mixture control rods with the jet levers against the stops.*

CARBURETTERS AND FUEL SYSTEM

Remove the inlet manifold complete with the carburetters and linkage.

Remove the four nuts and spring washers, together with the return spring bracket from each carburetter. Remove all three carburetters together.

If necessary, remove the mixture control linkage from each carburetter by removing the split pins and withdrawing the clevis pins.

Refitting

Refitting is the reverse of the removal procedure except that new gaskets should be fitted to the inlet manifold, to either side of the heat insulating gasket and also to the carburetter trumpet flanges.

Adjust the kickdown cable as detailed on page FFY.s.24.

CARBURETTER TUNING

The method of tuning carburetters is identical with that given for 3·8 litre "E" Type cars, however, the idling speed on standard transmission cars should be 700 r.p.m. in order to eliminate any chatter from the constant mesh gears in the all-synchromesh gearbox.

On automatic transmission 2+2 cars, the idling speed should be 500 r.p.m.

The fuel feed line filter incorporates a renewable fibre filter element. This element should not be cleaned but must be renewed every 12,000 miles. When renewing, the two sealing washers should also be replaced.

If sediment build-up is excessive, the element should be renewed more frequently than stated above.

THE FUEL SYSTEM

THE PETROL PUMP

Description (Fig. 2)

The pump consists of three main assemblies, the main body casting (A); the diaphragm armature and magnet assembly (M) contained within the housing; and the contact breaker assembly housed within the end cap (T2). A non-return valve assembly (C) is affixed to the end cover moulding to assist in the circulation of air through the contact breaker chamber.

The main fuel inlet (B) provides access to an inlet air bottle (I) while access to the main pumping chamber (N) is provided by an inlet valve assembly. This assembly consists of a Melinex valve disc (F) permanently assembled within a pressed-steel cage, held in position by a valve cover (E1).

The outlet from the pumping chamber is provided by an identical valve assembly which operates in the reverse direction. Both inlet and outlet valve assemblies together with the filters are held in position by a clamp plate (H). The valve assemblies may be removed by detaching the clamp plate (H) after removing the self-tapping screws. A filter (E) is provided on the delivery side of the inlet valve assembly. The delivery chamber (O) is bounded by a flexible plastic spring loaded diaphragm (L) contained by the vented cover (P). Sealing of the diaphragm (L) is provided by the rubber sealing ring (L.2).

The magnetic unit consists of an iron coil housing, an iron core (Q), an iron armature (A1) provided with a central spindle (P1) which is permanently united with the diaphragm assembly (L1), a magnet coil (R) and a contact breaker assembly consisting of parts (P2), (U1), (U), (T1) and (V). Between the coil housing and the armature are located eleven spherically edged rollers (S). These rollers locate the armature (A1) centrally within the coil housing and permit freedom of movement in a longitudinal direction.

The contact breaker consists of a bakelite pedestal moulding (T) carrying two rockers (U) and (U1) which are both hinged to the moulding at one end by the rocker spindle (Z). These rockers are interconnected at their top ends by means of two small springs arranged to give a throw-over action. A trunnion (P2) is carried by the inner rocker and the armature spindle (P1) is screwed into this trunnion. The outer rocker (U) is fitted with two tungsten points which contact with corresponding tungsten points which form part of the

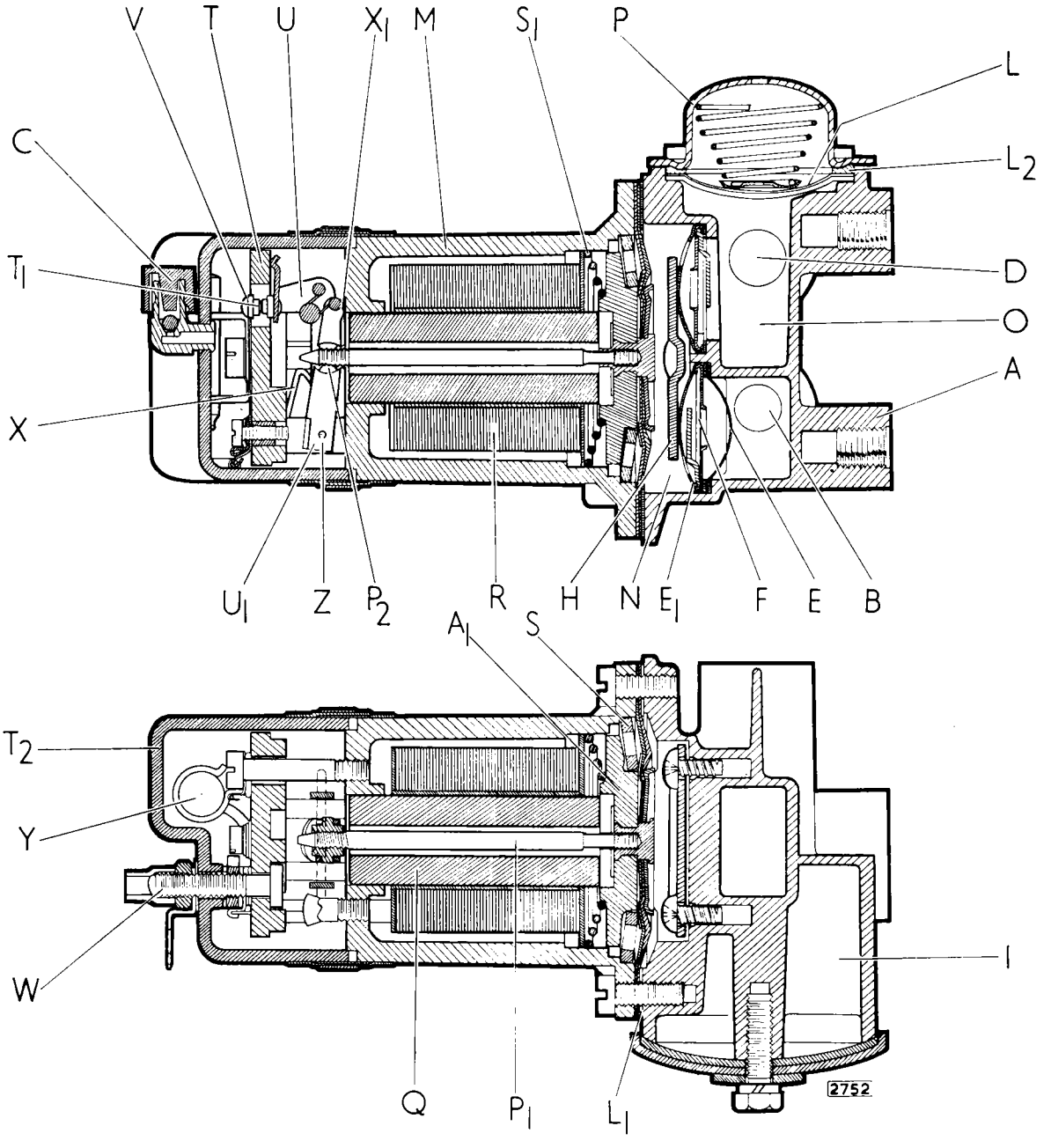


Fig. 2. *The Petrol Pump.*

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

spring blade (V) connected with one end of the coil. The other end of the coil is connected to a terminal (W) while a short length of flexible wire (X) connecting the outer rocker to one of the screws holding the pedestal moulding onto the coil housing provides an earth return to the body of the pump. It is important that the body of the pump be effectively earthed to the body of the vehicle by means of the earthing terminal provided on the flange of the coil housing.

OPERATION

When the pump is at rest the outer rocker (U) lies in the outer position and the tungsten points are in contact. Current passes from Lucar connector (W) through the coil and back to the blade (V), through the points and to earth, thus energising the coil and attracting the armature (A1). The armature, together with the diaphragm assembly, then retracts thereby sucking petrol through the inlet valve into the pumping chamber (N). When the armature has travelled nearly to the end of its stroke, the throw-over mechanism operates and the outer rocker moves rapidly backwards, thus separating the points and breaking the circuit.

The spring (S1) then reasserts itself forcing the armature and diaphragm away from the coil housing. This action forces petrol through the delivery valve at a rate determined by the requirements of the engine. As the armature nears the end of its stroke the throw-over mechanism again operates, the tungsten points remake contact and the cycle of operations is repeated.

The spring blade (V) rests against the small projection moulding (T) and it should be set so that, when the points are in contact, it is deflected away from the moulding. The gap at the points should be approximately ·030″ (·75 mm.) when the rocker (U) is manually deflected until it contacts the end face of the coil housing.

REMOVAL

Remove both inlet and outlet pipes from the side of the pump by withdrawing the banjo bolt and washers. Disconnect the electrical feed cable to the pump by unscrewing the knurled knob on the end of the pump. Remove the two self-locking nuts attaching the pump to the bracket and withdraw the two washers from each stud. The pump can now be withdrawn from the bracket leaving the two rubber grommets in position. The rubber grommets in the brackets should be examined for deterioration and replaced if necessary, otherwise excessive petrol pump noise may result.

REFITTING

Refitting is the reverse of the removal procedure.

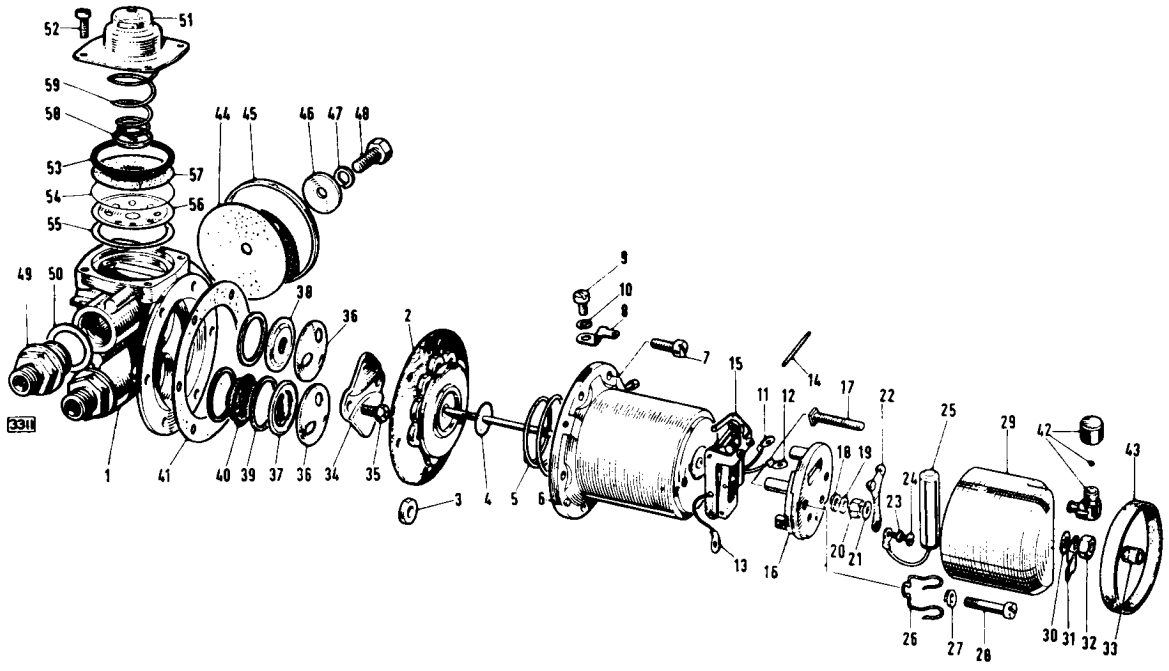


Fig. 3. *Exploded view of the petrol pump.*

1. Pump body.
2. Diaphragm and spindle assembly.
3. Roller—armature centralising.
4. Washer—impact.
5. Spring—armature.
6. Housing—coil.
7. Screw—securing housing—2 B.A.
8. Connector—earth.
9. Screw—4 B.A.
10. Spring washer.
11. Terminal tag.
12. Terminal tag.
13. Earth tag.
14. Rocker pivot pin.
15. Rocker mechanism.
16. Pedestal.
17. Terminal stud.
18. Spring washer.
19. Lead washer.
20. Terminal nut.
21. Washer.
22. Contact blade.
23. Washer.
24. Screw.
25. Condenser.
26. Clip.
27. Spring washer.
28. Screw.
29. End cover.
30. Shakeproof washer.
31. Lucas connector.
32. Nut.
33. Insulating sleeve.
34. Clamp plate.
35. Screw.
36. Valve cap.
37. Inlet valve.
38. Outlet valve.
39. Sealing washer.
40. Filter.
41. Gasket.
42. Vent valve.
43. Sealing band.
44. Joint.
45. Inlet air bottle cover.
46. Dished washer.
47. Spring washer.
48. Screw.
49. Outlet connection.
50. Fibre washer.
51. Cover.
52. Screw.
53. 'O' ring.
54. Diaphragm barrier.
55. Sealing washer.
56. Diaphragm plate.
57. Diaphragm.
58. Spring end cap.
59. Diaphragm spring.

DISMANTLING (Fig. 3).

Contact Breaker

Remove the insulated sleeve (33), terminal nut (32), and connector (31), together with its shakeproof washer (30). Remove the tape seal (if fitted) and take off the end-cover.

Unscrew the 5 B.A. screw (24) which holds the contact blade (22) to the pedestal (16) and remove the condenser (25) from its clip. This will allow the washer (23), terminal tag (11), and the contact blade to be removed.

Coil housing and diaphragm

Unscrew the coil housing securing screws (7), using a thick-bladed screwdriver to avoid damaging the screw heads.

Remove the earthing screw (9).

The coil housing (6) may now be removed from the body (1). Next remove the diaphragm and spindle assembly (2) by taking hold of the diaphragm and unscrewing it anti-clockwise until the armature spring (5) pushes the diaphragm away from the coil housing. It is advisable to hold the housing over the bench so that the 11 brass rollers (3) will not fall on the floor. The diaphragm and its spindle are serviced as a unit and should not be separated.

Pedestal and rocker

Remove the end-cover seal washer (21), unscrew the terminal nut (20), and remove the lead washer (19). This will have flattened on the terminal tag and thread and is best cut away with cutting pliers or a knife. Unscrew the two 2 B.A. screws (28), holding the pedestal to the coil housing, remove the earth terminal tag (13) together with the condenser clip (26). Tip the pedestal and withdraw the terminal stud (17) from the terminal tag (12). The pedestal (16) may now be removed with the rocker mechanism (15) attached.

Push out the hardened steel pin (14) which holds the rocker mechanism to the pedestal and separate the two.

Body and valves

Unscrew the two Phillips screws (35) securing the valve clamp plate (34), remove the valve caps (36), valves (37) and (38), sealing washers (39) and filter (40).

Note: Dismantling of the delivery flow-smoothing device should only be undertaken if the operation of it is faulty, and if the necessary equipment for pressure-testing after assembly is available. On this understanding proceed as follows:

Remove the four 4 B.A. screws (52) securing the delivery flow-smoothing device vented cover (51), remove the cover, the diaphragm spring (59), rubber 'O' ring (53), spring cap (58), diaphragm (57), barrier (54), diaphragm plate (56) and sealing washer (55).

Remove the single 2 B.A. screw (48), securing the inlet air bottle cover (45). Remove the cover and gasket (44).

Unscrew the inlet and outlet connections.

INSPECTION

If gum formation has occurred in the fuel used in the pump, the parts in contact with the fuel will have become coated with a substance similar to varnish. This has a strong stale smell and may attack the neoprene diaphragm. Brass and steel parts so affected can be cleaned by being boiled in a 20 per cent. solution of caustic soda, dipped in a strong nitric acid solution and finally washed in boiling water. Light alloy parts must be well soaked in methylated spirits and then cleaned.

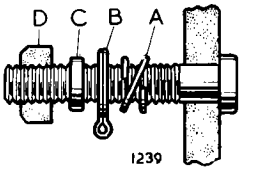


Fig. 4. *The terminal arrangement.*

A—*Double coil spring washer.*

B—*Cable tag.*

C—*Lead washer.*

D—*Countersunk nut.*

Clean the pump and inspect for cracks, damaged joint faces and threads.

Examine the plastic valve assemblies for kinks or damage to the valve plates. They can best be checked by blowing and sucking with the mouth.

Check that the narrow tongue on the valve cage, which is bent over to retain the valve and to prevent it being forced out of position, has not been distorted but allows a valve lift of approximately $\frac{1}{16}$ in. (1·6 mm.).

Examine the delivery flow-smoothing device diaphragm, barrier, plate, spring, and spring cap for damage. If in doubt, renew the diaphragm.

Examine the inlet air bottle cover for damage. Examine the valve recesses in the body for damage and corrosion; if it is impossible to remove the corrosion, or if the recess is pitted, the body must be discarded.

Clean the filter with a brush and examine for fractures, renew if necessary.

Examine the coil lead tag for security and the lead insulation for damage.

Examine the contact breaker points for signs of burning and pitting; if this is evident, the rocker assembly and spring blade must be renewed.

Examine the pedestal for cracks or other damage, in particular to the narrow ridge on the edge of the rectangular hole on which the contact blade rests.

Examine the non-return vent valve in the end-cover for damage, ensure that the small ball valve is free to move.

Examine the diaphragm for signs of deterioration.

Renew the following parts: all fibre and cork washers, gaskets, and 'O' section sealing rings, rollers showing signs of wear on periphery, damaged bolts, and unions.

ASSEMBLY

Pedestal and rocker

Note: The steel pin which secures the rocker mechanism to the pedestal is specially hardened and must not be replaced by other than a genuine S.U. part.

Invert the pedestal and fit the rocker assembly to it by pushing the steel pin (14, Fig. 3) through the small holes in the rockers and pedestal struts. Then position the centre toggle so that, with the inner rocker spindle in tension against the rear of the contact point, the centre toggle spring is above the spindle on which the white rollers run. This positioning is important to obtain the correct "throw over" action; it is also essential that the rockers are perfectly free to swing on the pivot pin and that the arms are not binding on the legs of the pedestal.

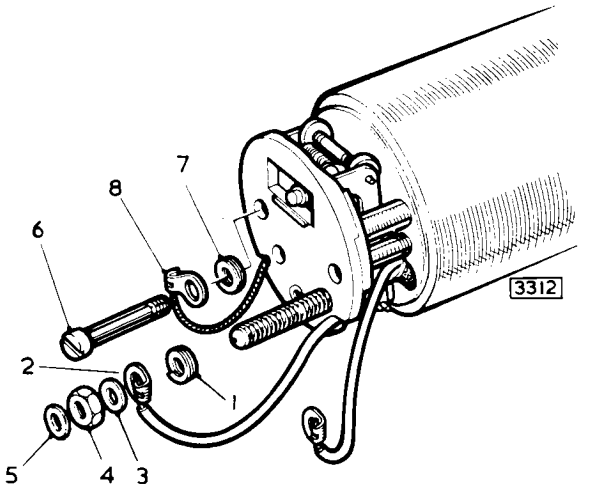


Fig. 5. *Attaching the pedestal to the coil housing.*

If necessary the rockers can be squared up with a pair of thin-nosed pliers.

Assemble the square-headed 2 B.A. terminal stud to the pedestal, the back of which is recessed to take the square head.

Assemble the 2 B.A. spring washer (1) (Fig. 5), and put the terminal stud through the 2 B.A. terminal tag (2), then fit the lead washer (3) and the coned nut (4) with its coned face to the lead washer. (This makes better contact than an ordinary flat washer and nut).

Tighten the 2 B.A. nut and finally add the end-cover seal washer (5).

Assemble the pedestal to the coil housing by fitting the two 2 B.A. pedestal screws (6), ensuring that the spring washer (7) on the left-hand screw (9 o'clock position) is between the pedestal and the earthing tag (8). When a condenser is fitted, its wire clip base is placed under the earthing tag and the spring washer is not required.

Tighten the screws, taking care to prevent the earthing tag (8) from turning, as this will strain or break the earthing flex. Do not tighten the screws or the pedestal will crack.

Do not fit the contact blade at this stage.

Diaphragm assembly

Place the armature spring into the coil housing with its larger diameter towards the coil (5, Fig. 3).

Before fitting the diaphragm make sure that the impact washer is fitted to the armature. (This is a small neoprene washer that fits in the armature recess). Do not use jointing compound or dope on the diaphragm.

Fit the diaphragm by inserting the spindle in the hole in the coil and screwing it into the threaded trunnion in the centre of the rocker assembly.

Screw in the diaphragm until the rocker will not "throw over"; this must not be confused with jamming the armature on the coil housing internal steps.

Fit the 11 brass centralizing rollers (3, Fig. 3) by turning back the diaphragm edge and dropping the rollers into the coil recess. The pump should be held in the left hand, rocker end downwards, to prevent the rollers from falling out.

Fit the contact blade and adjust the finger settings as described in "Contact gap setting", then carefully remove the contact blade.

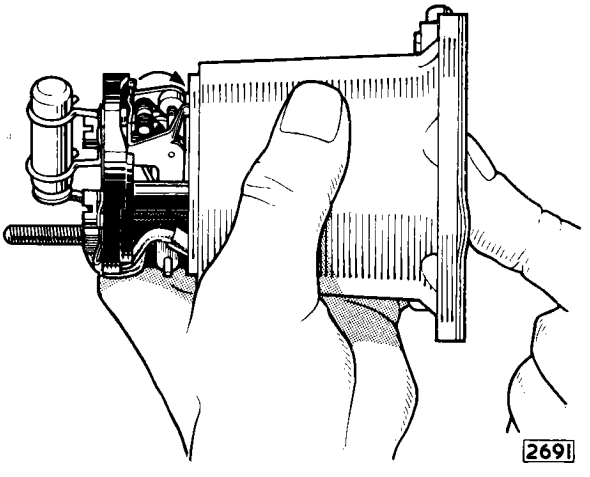


Fig. 6. *Setting the diaphragm.*

Holding the coil housing assembly in the left hand in an approximately horizontal position (see Fig. 6), push the diaphragm spindle in with the thumb of the right hand, pushing firmly but steadily. Unscrew the diaphragm, pressing and releasing with the thumb of the right hand until the rocker just "throws over". Now turn the diaphragm back (unscrew) to the nearest hole and again 4 holes (two-thirds of a complete turn). The diaphragm is now correctly set.

Press the centre of the armature and fit the retaining fork at the back of the rocker assembly. This is done to prevent the rollers from falling out when the coil housing is placed on the bench prior to fitting the body, and is not intended to stretch the diaphragm before tightening the body screws.

Body components

The valve assemblies are retained internally in the body by a clamp plate secured with self-tapping screws (35, Fig. 3). The inlet valve recess in the body is deeper than the outlet recess to allow for the filter and extra washer. Another feature of these pumps is the incorporation of an air bottle on the inlet and a flow-smoothing device on the delivery side.

The inlet air bottle is a chamber in the body casting blanked off by a simple cover and joint washer held by a single screw. The delivery flow-smoothing device is formed by a perforated metal plate which is in contact with a plastic barrier backed by a rubber diaphragm, all held in position by a spring and end-cap retained by a vented cover. This assembly seals the delivery chamber in the body.

Screw in the inlet and outlet connections with their sealing rings. Assemble the outlet valve components into the outless recess in the following order, first a joint washer, then the valve, tongue side downwards, then the valve cap.

Assemble the inlet valve into the inlet recess as follows: first a joint washer, then the filter, dome side downwards, then another joint washer, followed by the valve assembly, tongue side upwards, then the valve cap.

Take care that both valve assemblies nest down into their respective recesses, place the clamp plate on top, and tighten down firmly to the body with the two screws.

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

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

Contact gap setting

Check that when the outer rocker is pressed onto the coil housing, the contact blade rests on the narrow rib or ridge which projects slightly above the main face of the pedestal. If it does not, slacken the contact blade attachment screw, swing the blade clear of the pedestal, and bend it downwards a sufficient amount so that when repositioned it rests against the rib lightly, over-tensioning of the blade will restrict the travel of the rocker mechanism.

Correct positioning gives a gap of ·035″ ±·005″ (·9±·13 mm.) between the pedestal and tip of spring blade (Fig. 7).

Check the gap between rocker finger and coil housing with a feeler gauge, bending the stop finger, if necessary, to obtain a gap of ·070±·005 in. (1·8±·13 mm.).

End-cover

Tuck all spare cable into position so that it cannot foul the rocker mechanism. Ensure that the end-cover seal washer is in position on the terminal stud, fit the bakelite end-cover and lock washer, secure with the brass nut, fit the terminal tag or connector, and the insulated sleeve.

The pump is now ready for test.

After test, replace the rubber sealing band over the end cover gap and seal with adhesive tape.

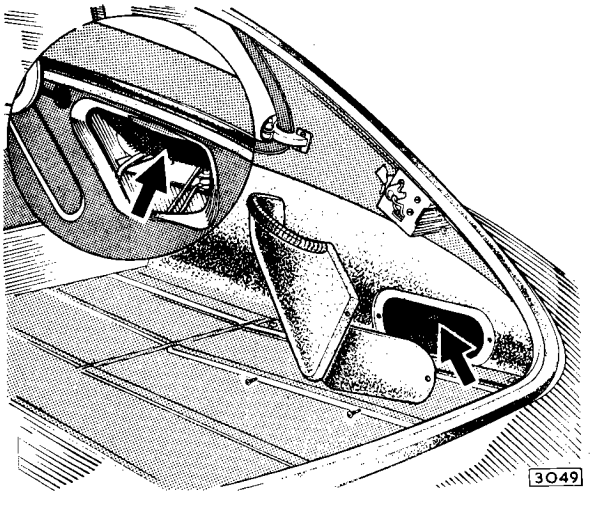


Fig. 8. *The location of the petrol pump.*
(Fixed head coupe).
Inset shows location in open 2-seater model.

release the assembly tool. The pump should be pressure-tested after disturbance of the flow-smoothing device.

Body attachment

Fit the joint washer to the body, aligning the screw holes.

Offer up the coil housing to the body, ensuring correct seating between them.

Line up the six securing screw holes, making sure that the cast lugs on the coil housing are at the bottom, insert the six 2 B.A. screws finger-tight. Fit the earthing screw with its Lucar connector.

Remove the roller retaining fork before tightening the body securing screws, making sure that the rollers retain their position; a displaced roller will cut the diaphragm. It is not necessary to stretch the diaphragm before tightening the securing screws.

Tighten the securing screws in sequence as they appear diametrically opposite each other.

Contact blade (Fig. 7)

Fit the contact blade and coil lead to the pedestal with the 5 B.A. washer and screw. The condenser should be fitted with the tag placed under the coil lead tag.

Adjust the contact blade so that the points are a little above the points on the rocker when closed, also that when the contact points make or break, one pair of points completely covers the other. As the contact blade is provided with a slot for the attachment screw, some degree of adjustment is possible.

Tighten the contact blade attachment screw when the correct setting is obtained.

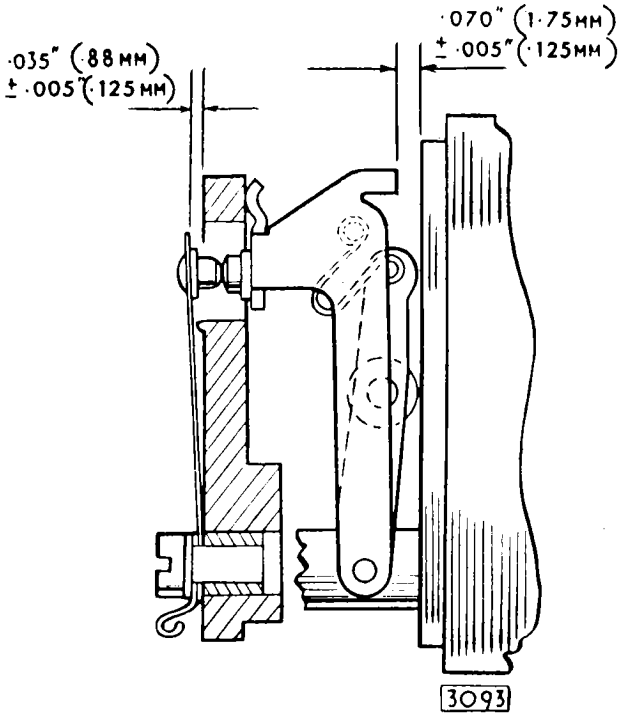


Fig. 7. *Rocker and contact clearances.*

SECTION D

COOLING SYSTEM

'E' Type series 2 have a sealed cooling system with a vertical flow radiator and an expansion tank.

The thermostat is retained in a revised housing.

The radiator top tank incorporates a plain (non-pressure) cap, the pressure cap being fitted to the expansion tank mounted on the bulkhead.

PRESSURE CAP RATING

With Standard Equipment .. .. 7 lb.
With Air-Conditioning System .. 13 lb.

Instructions for filling or checking the coolant level in the system differ from those stated for earlier cars fitted with the cross flow radiator, as follows:—

Filling Up

Remove the radiator and expansion tank filler caps.

Fill the radiator to the bottom of the filler neck. Replace the filler cap and tighten down fully.

Top up the expansion tank to the half-way mark, refit the cap and tighten down fully.

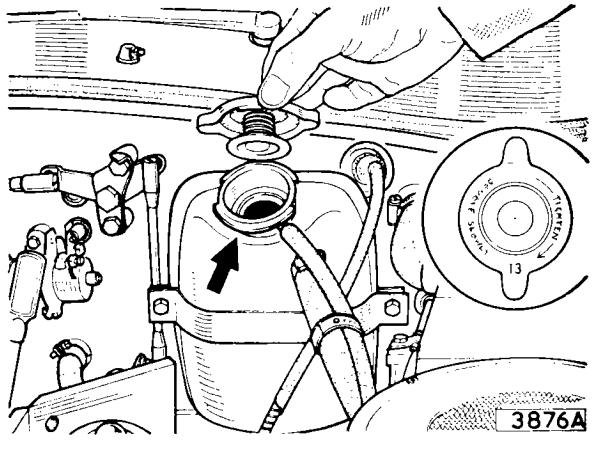


Fig. 1. The expansion tank and pressure cap. (Inset shows the pressure cap fitted to cars with Air-Conditioning Equipment).

Note: Care must be taken to ensure that the radiator and the expansion tank filler caps are not reversed.

Checking the Coolant Level

IMPORTANT: The coolant level must be checked at the expansion tank and NOT at the radiator top tank.

Check when the system is COLD.

Remove the pressure cap and top up to the half-way mark in the tank.

Replace the pressure cap and tighten down fully.

Refilling the Cooling System—Important

When refilling the cooling system following complete drainage, place the heater temperature control in the "Hot" position to allow the heater circuit to be filled with coolant. Re-check the level after running the engine for a short period.

THE RADIATOR

Removal

Release the filler cap, open the drain tap and drain the cooling system. Conserve the coolant if anti-freeze is in use.

Disconnect the multi-pin socket from the left-hand side of the bonnet.

Remove two bolts, self-locking nuts and washers securing the bonnet linkage to the sub-frame.

Withdraw two hexagon-headed pivot pins and washers securing the bonnet pivot to the sub-frame front lower cross tube, and remove the bonnet assembly.

Release the hose clips and disconnect the top and bottom hoses from the radiator.

Disconnect the oil cooler pipes (2 + 2 automatic transmission cars only) and blank off the unions to prevent loss of oil.

Remove six setscrews securing the cowl to the matrix side brackets. Disconnect the fan thermostat switch cables at the cable junction.

Release the radiator duct panel from the bottom of the matrix by removing two setscrews.

Remove the two bottom fixing nuts and rubber mounting washers.

Lift out the radiator matrix and collect the rubber washers fitted between the bottom tank and the mounting brackets.

NOTE : If air-conditioning equipment is fitted to the car, the condenser unit should be left in position after removal of the two setscrews securing the side support brackets to the matrix.

DO NOT DISTURB THE HOSE CONNECTIONS AT THE CONDENSER UNIT. IT IS DANGEROUS FOR AN UNQUALIFIED PERSON TO ATTEMPT TO DISCONNECT OR REMOVE ANY PART OF THE AIR-CONDITIONING SYSTEM.

Care must be taken when removing the radiator matrix that the fins of the condenser are not damaged.

Refitting

Refitting is the reverse of the removal procedure.

THERMOSTAT

The thermostat differs from that stated on Page D. 8. in respect of the mounting only.

Removal

Drain sufficient coolant from the system to allow the level to fall below the thermostat.

Disconnect the three hoses from the thermostat housing.

Remove three nuts and washers and detach the housing to gain access to the thermostat.

Refitting

Refitting is the reverse of the removal procedure.

Renew all gaskets.

To avoid distortion of the flange faces do not over-tighten the nuts.

RADIATOR COWL

Removal

Disconnect the cables from the twin fan motors.

Remove six setscrews securing the cowl to the radiator and remove the cowl complete with fan motors and mounting brackets.

Refitting

Refitting is the reverse of the removal procedure.

FAN MOTORS

Remove the fan cowl as detailed above.

Remove three nuts and setscrews securing each fan mounting bracket to the cowl and detach the bracket assembly.

Remove four nuts and washers securing each motor and detach the motor units from the brackets.

WATER PUMP

The water pump and mounting remain basically the same as detailed in the 3.8 'E' Type Service Manual with the exception of the pump body and the impeller (See Fig. No. 3) which have been redesigned to give a higher flow rate of coolant.

It is important to note when fitting the impeller to the spindle that the dimension shown in Fig. 2 is obtained when measured with a feeler gauge.

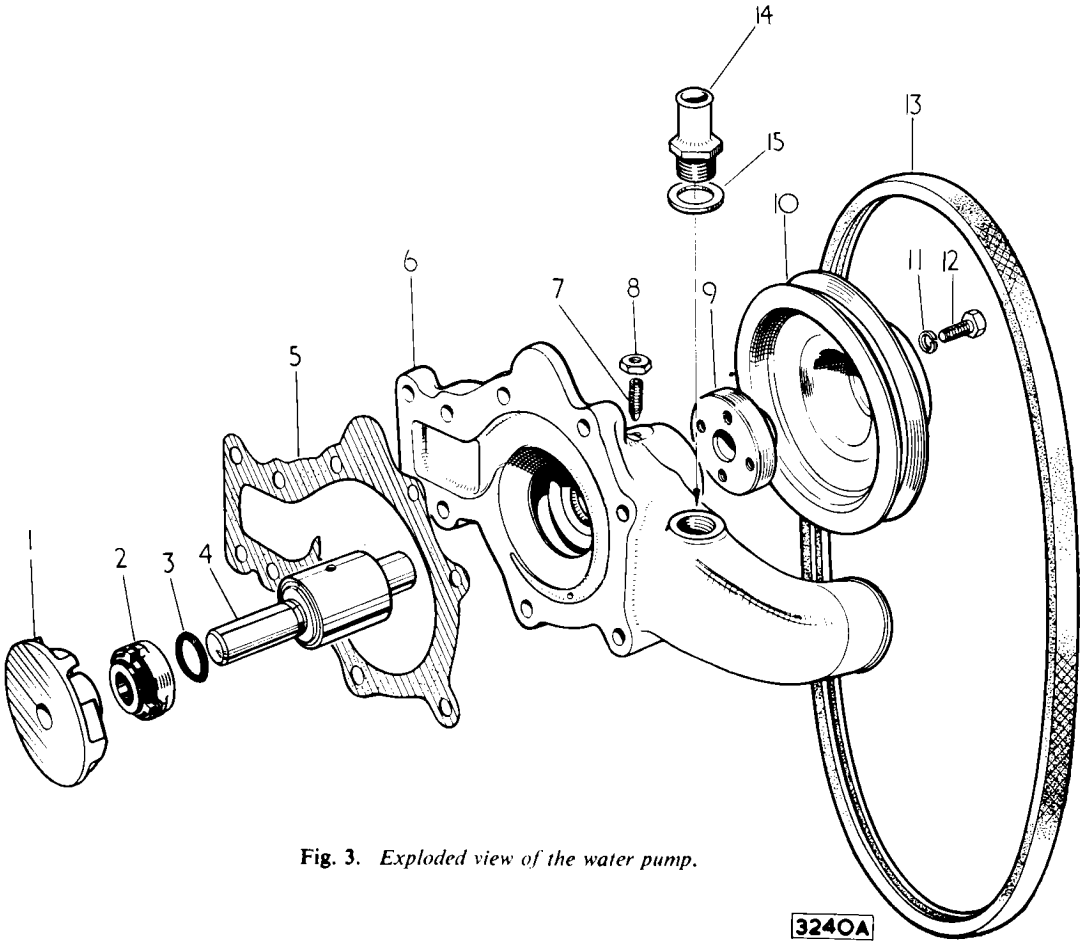


Fig. 3. *Exploded view of the water pump.*

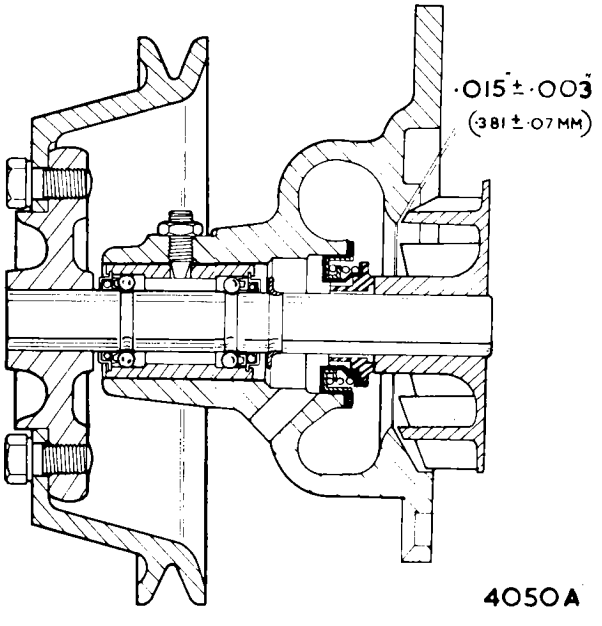


Fig. 2. *Sectioned view of water pump.*

1. Impeller.
2. Seal.
3. Thrower.
4. Spindle and bearing assembly.
5. Gasket.
6. Pump body.
7. Allen-headed lockscrew.
8. Locknut.
9. Pulley carrier.
10. Pulley.
11. Spring washer.
12. Setscrew.
13. Drive belt.
14. Adaptor for heater return pipe.
15. Copper washer.

SECTION E

CLUTCH

DESCRIPTION

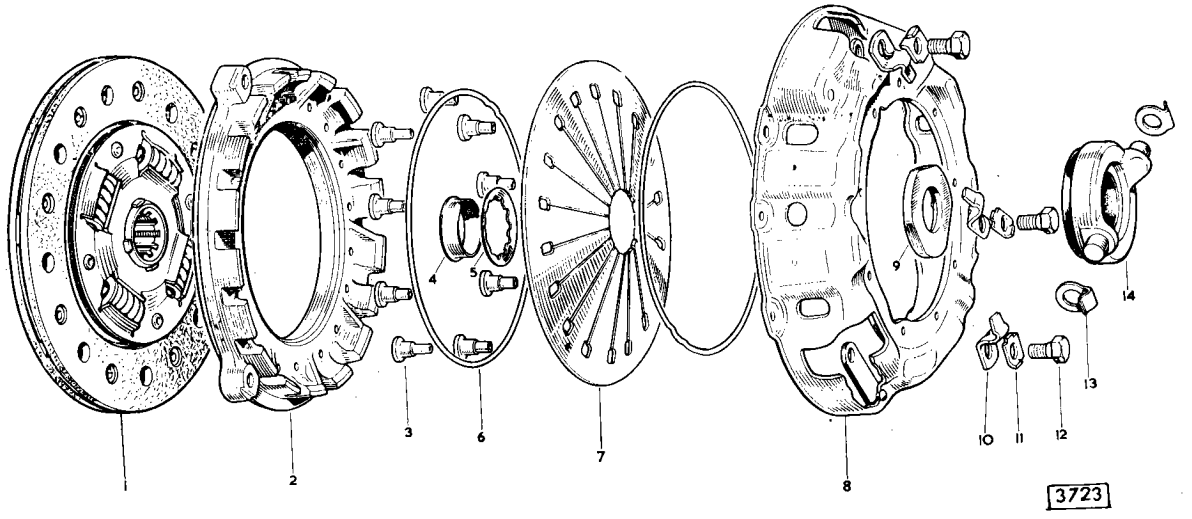
A Borg and Beck diaphragm spring clutch is fitted to all cars equipped with manual transmission.

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

DATA

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

THE CLUTCH UNIT



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

Fig. 1. *Exploded view of the diaphragm spring clutch.*

SERVICING

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

GENERAL INSTRUCTIONS

To enable the balance of the assembly to be preserved after dismantling, there are corresponding paint marks on the cover plate and driving plate. In addition, there are corresponding reference numbers stamped in the flanges of the cover and driving plate.

When reassembling ensure that the markings coincide, and that, when refitting the clutch to the flywheel, the letter "B" stamped adjacent to one of the dowel holes coincides with the "B" stamped on the edge of the flywheel.

The clutch is balanced in conjunction with the flywheel by means of loose balance pieces which are fitted under the appropriate securing bolt. Each balance piece must be refitted in its original position, the number stamped on the balance weight corresponding to the number stamped on the cover plate. There are three balance weights stamped 1, 2 and 3, the weight stamped 3 being the heaviest.

If it is necessary to fit a replacement unit, clutch units supplied as spares have no reference numbers and therefore must be balanced with the flywheel. The balance weight number should be stamped on the cover adjacent to the weight position. The letter 'B' should be stamped on the cover opposite the 'B' on the flywheel.

If the graphite release bearing ring is badly worn it should be replaced by a complete bearing assembly.

CLUTCH REMOVAL

In order to remove the clutch, the engine and gearbox must first be removed (see Page B.Y.s.4).

Remove gearbox and clutch housing from engine.

Remove the bolts securing the clutch to the flywheel and withdraw the clutch assembly.

Retain any balance weight fitted.

DISMANTLING

Removing Release Plate

The centrally mounted release plate is held in position by a small centre sleeve which passes through the diaphragm spring and belleville washer into the release plate.

To free the plate, collapse the centre sleeve with a hammer and chisel. To avoid any possible damage whilst carrying out this operation, support the release plate in the locating boss of the special tool which should be held firmly in a vice.

Separating the Pressure Plate from Cover Pressing

Knock back the locking tabs and remove the three setscrews securing the pressure plate to the straps

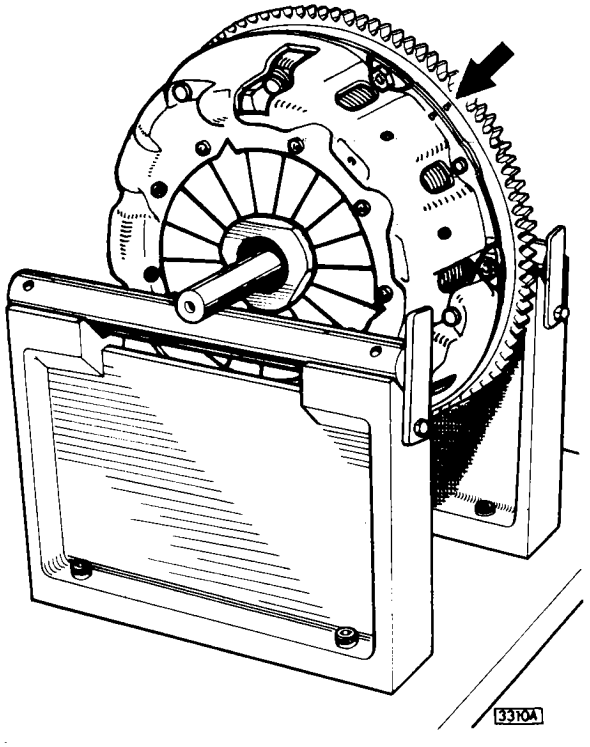


Fig. 2. *Clutch and flywheel balancing.*

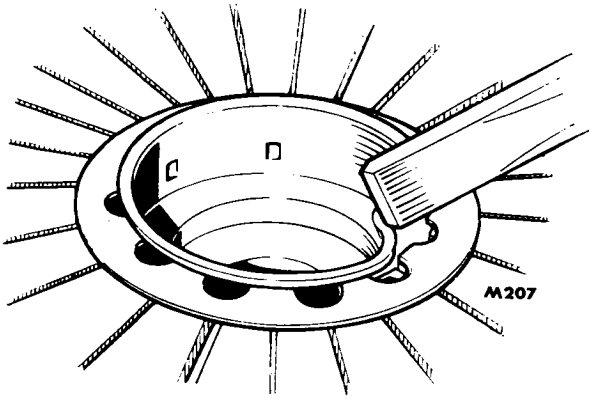


Fig. 3. *Collapsing the centre sleeve with a hammer and chisel.*

riveted to the cover pressing. These straps within the cover pressing must NOT be detached as this is an assembly reduced to its minimum as a spare part.

Dismantling the Cover Assembly

Remove the rivets securing the diaphragm spring and fulcrum rings by machining the shank of the rivets using a spot face cutter.

IT IS ESSENTIAL that the thickness of the cover is not reduced in excess of ·005" (·127 mm.) at any point. The remaining portions of the rivets may be removed with a standard pin punch.

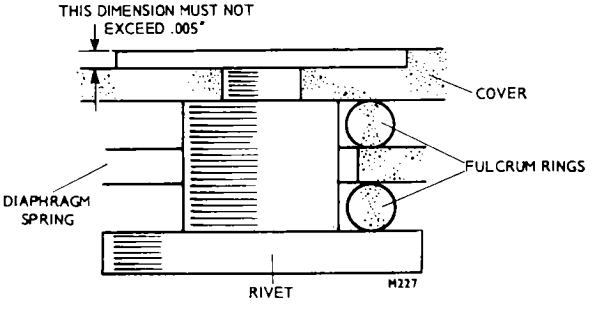


Fig. 4. *Do not reduce the thickness of the cover pressing in excess of ·005" (·127 m.m.).*

REBUILDING

The Cover Assembly

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

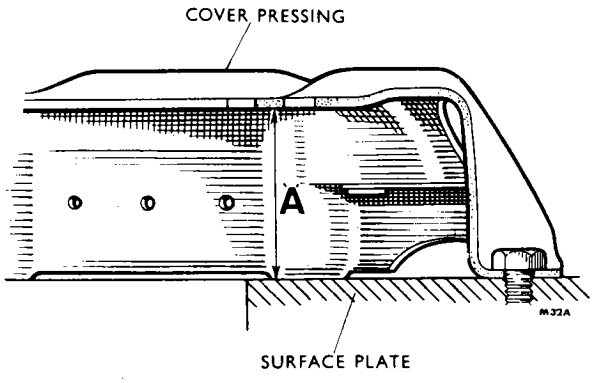
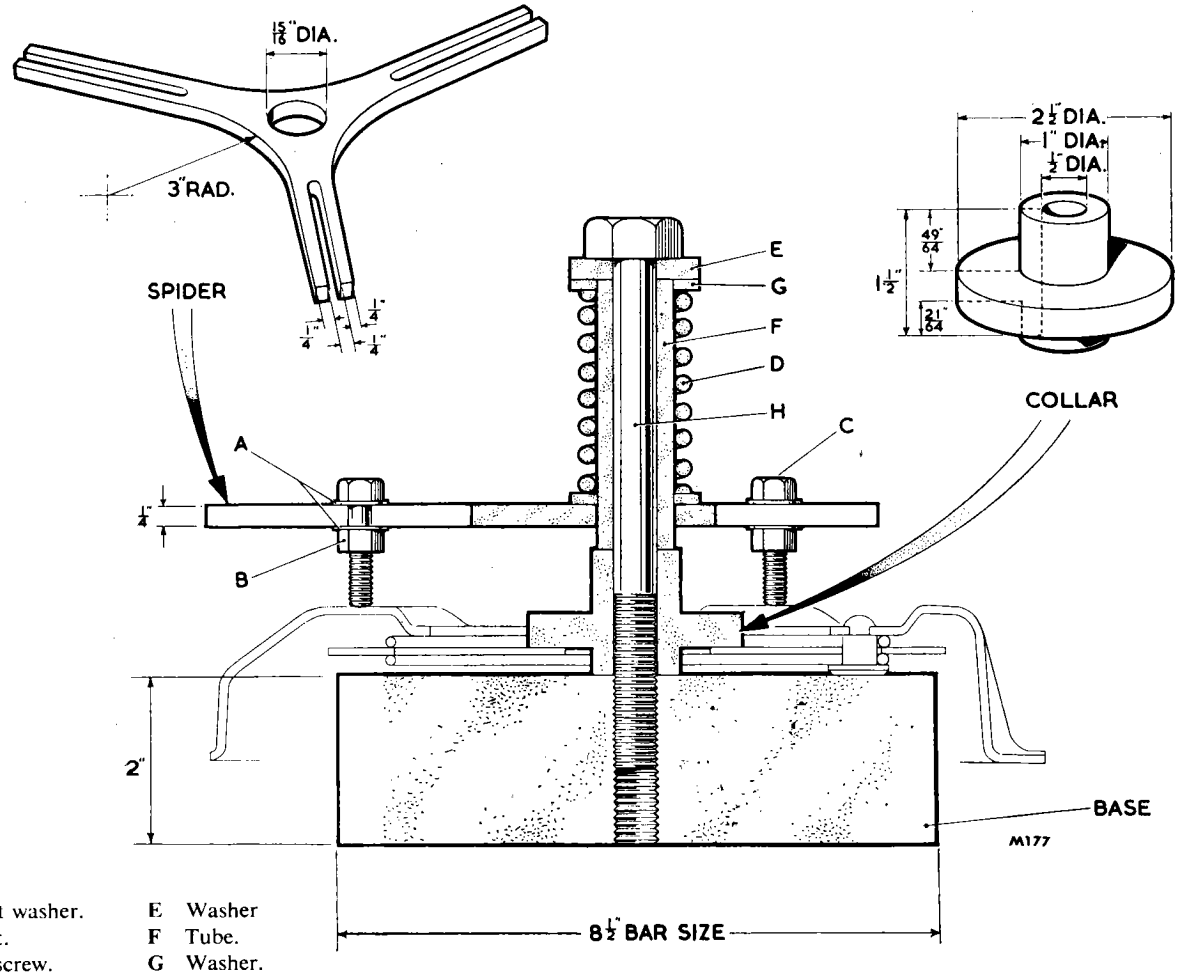


Fig. 5. *The measurement "A" must not vary by more than ·007" (·2 mm.).*

To achieve a satisfactory result when riveting the diaphragm spring into the cover pressing, a special tool must be fabricated to the specifications given in **Fig. 6.**

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

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



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

Fig. 6. *Dimension of special tool for compressing the diaphragm spring when riveting the spring to cover pressing.*

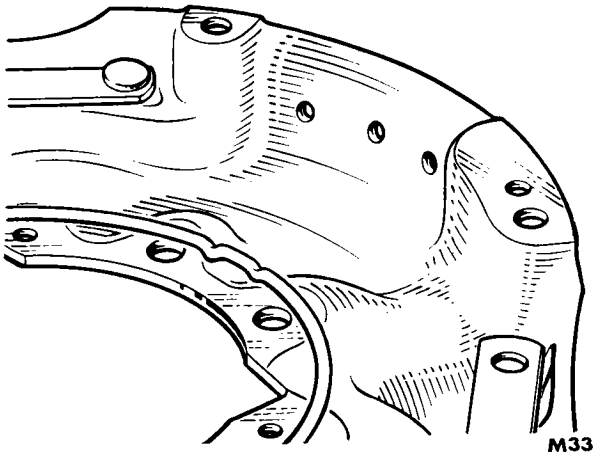


Fig. 7. *Assembly of cover pressing and fulcrum ring.*

Place the base of the special tool on to the rivet heads. Invert the clutch and base plate.

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

Rivet securely with a hand punch.

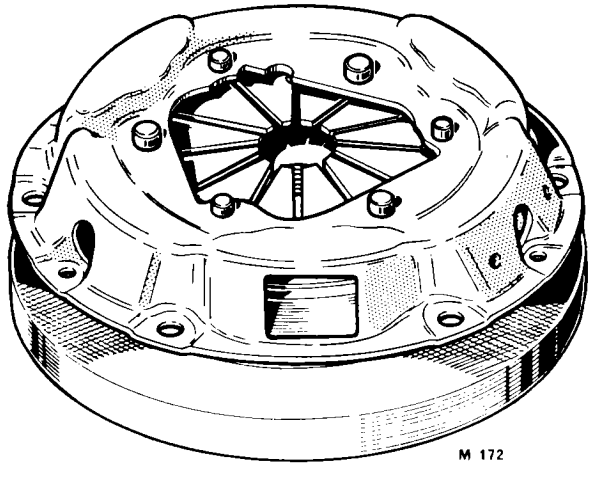


Fig. 8. *Clutch and base plate inverted.*

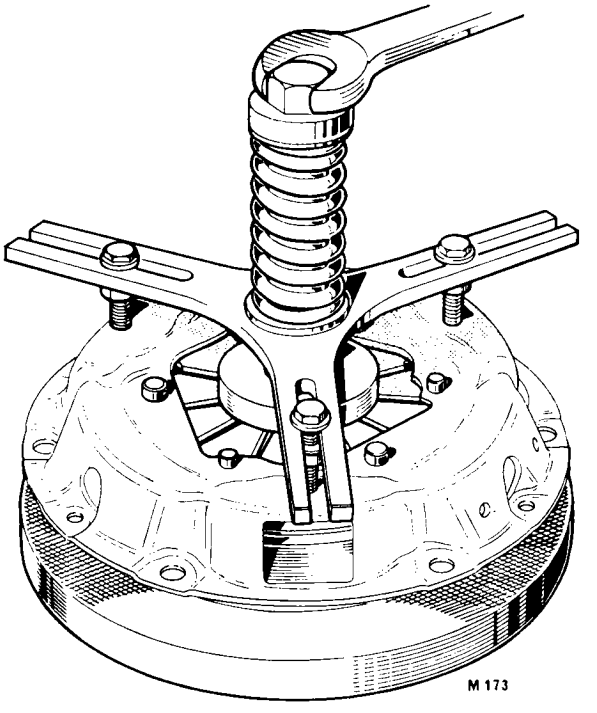


Fig. 9. *Tighten down the large nut so that the diaphragm spring is compressed flat.*

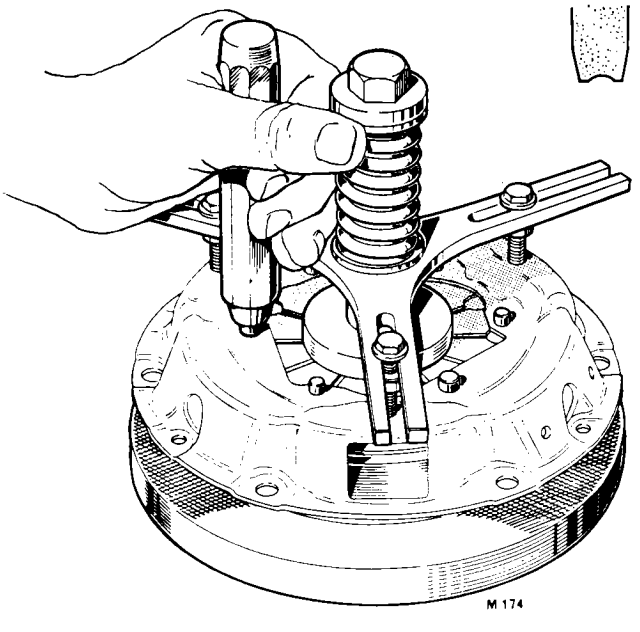
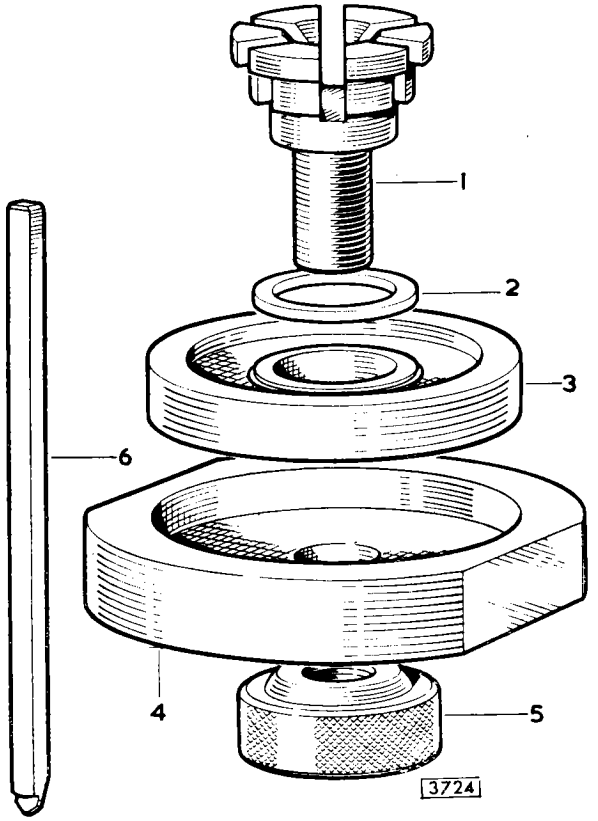


Fig. 10 *Riveting with a hand punch.*

Assembling the Pressure Plate to Cover Pressing

Before assembling the pressure plate to the cover pressing, examine the plate for any signs of wear. Should it have been damaged or have excessive scoring, it is strongly recommended that a new plate is fitted. If, however, renewal of the pressure plate is not possible, grinding of the original unit may be undertaken by a competent machinist, bearing in mind that incorrect grinding of the plate may seriously affect the operation of the clutch. IN NO CIRCUMSTANCES MUST THE PRESSURE PLATE BE GROUND TO A THICKNESS OF LESS THAN 1·070" (27.178 mm.)



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

Fig. 11. *Special Tool (SSC805).*

Position the pressure plate inside the cover assembly so that the lugs on the plate engage the slots in the cover pressing. Insert the three setscrews through the straps which are riveted to the cover pressing and lock with the tab washers.

Fitting a New Release Plate

A special tool (Part No. SSC.805) is available from Automotive Products Ltd., Service and Spares Division, Banbury, England, for completion of this operation. Ensure that all parts of the clutch and special tool are clean.

Grip the base of the tool in a vice and place the locating boss into the counterbore of the base plate. Place the release plate, face downwards, into the counterbore of the locating boss.

Apply a little high melting point grease to the tips of the diaphragm spring fingers and position the clutch, pressure plate friction face upwards, on to the release plate.

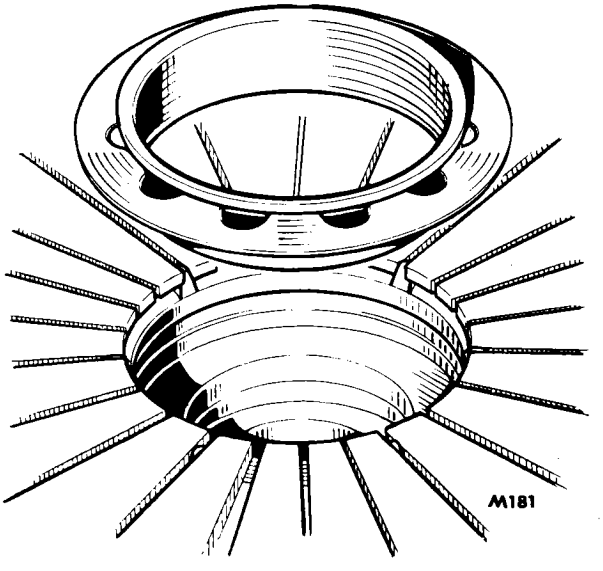


Fig. 12. *Fitting the sleeve and belleville washer.*

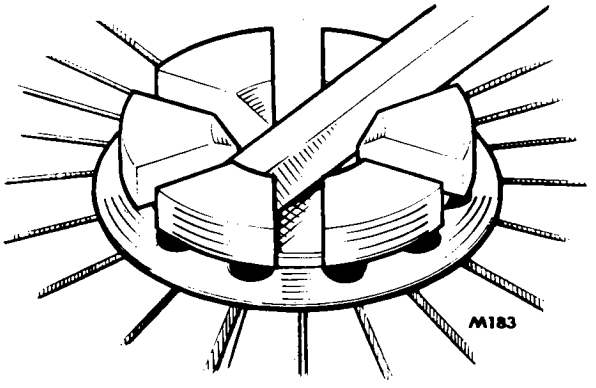


Fig. 13. *Staking the sleeve to the release plate.*

Place the belleville washer, concave surface towards the spring, on to the centre of the diaphragm spring and then push the centre sleeve through the spring into the release plate.

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

REFITTING

Place the driven plate on the flywheel, taking care that the larger part of the splined hub faces the gear-

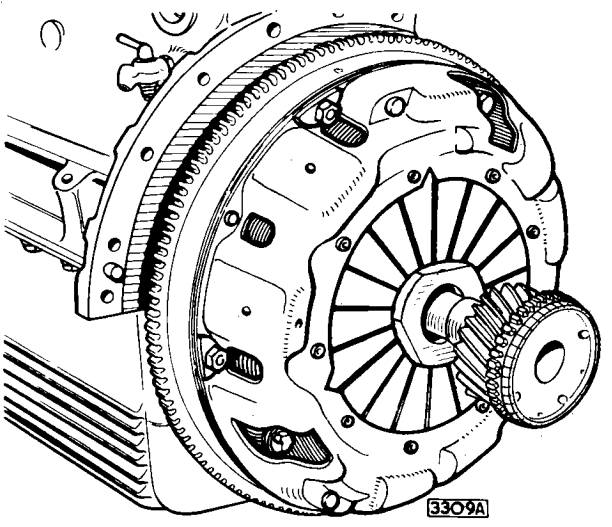


Fig. 14. *Centralising the driven plate on the flywheel by means of a dummy plate.*

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

CONDITION OF CLUTCH FACINGS

The possibility of further use of the friction facings of the clutch is sometimes raised, because they have a polished appearance after considerable service. It is natural to assume that a rough surface will give higher frictional value against slipping, but this not correct. Since the introduction of non-metallic facings of the moulded asbestos type, in service a polished surface is a common experience, but it must not be confused with a glazed surface which is sometimes encountered due to the conditions discussed below.

The ideal smooth or polished condition will provide a normal contact, but a glazed surface may be due to a film or a condition introduced, which entirely alters the frictional value of the facings. These two conditions might be simply illustrated by the comparison between a polished wood and a varnished surface. In the former the contact is still made by the original material whereas, in the latter instance, a film of dried varnish is interposed between the contact surfaces.

The following notes are issued with a view to giving useful information on this subject:—

(a) After the clutch has been in use for some little time under perfect conditions (that is, with the clutch facings working on true and polished or ground surfaces of correct material, without the presence of oil, and with only that amount of slip which the clutch provides for under normal conditions) then the surface of the facings assumes a high polish, through which the grain of the material can be clearly seen. This polished facing is of mid-brown colour and is then in a perfect condition.

(b) Should oil in small quantities gain access to the clutch in such a manner as to come into contact with the facings, it will burn off due to the heat generated by slip which occurs under normal starting conditions. The burning off of the small amount of lubricant has the effect of gradually darkening the facings, but provided the polish on the facings remains such that the grain of the material can be clearly distinguished, it has very little effect on clutch performance.

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

  (i) The oil may burn off and leave on the surface a carbon deposit which assumes a high glaze and causes slip. This is a very definite, though very thin deposit, and in general it hides the grain of the material.

  (ii) The oil may partially burn and leave a resinous deposit on the facings, which frequently produces a fierce clutch, and may also cause a "spinning" clutch due to tendency of the facings to adhere to the flywheel or pressure plate face.

  (iii) There may be a combination of (i) and (ii) conditions which is likely to produce a judder during clutch engagement.

(d) Still greater quantities of oil produces a black soaked appearance to the facings, and the effect may be slip, fierceness, or judder in engagement, etc., according to the conditions. If the conditions under (c) or (d) are experienced, the clutch driven plate should be replaced by one fitted with new facings, the cause of the presence of oil removed and the clutch and flywheel face thoroughly cleaned.

FAULT FINDING

SYMPTOM	CAUSE	REMEDY
Drag or Spin	(a) Oil or grease on the driven plate facings.	Fit new facings or replace plate.
	(b) Misalignment between the engine and splined clutch shaft.	Check over and correct the alignment.
	(c) Air in clutch system.	"Bleed" system. Check all unions and pipes.
	(d) Bad external leak between the clutch master cylinder and the slave cylinder.	Renew pipe and unions.
	(e) Warped or damaged pressure plate or clutch cover.	Renew defective part.
	(f) Driven plate hub binding on splined shaft.	Clean up splines and lubricate with small quantity of high melting point grease.
	(g) Distorted driven plate due to the weight of the gearbox being allowed to hang on clutch plate during assembly.	Fit new driven plate assembly using a jack to take overhanging weight of the gearbox.
	(h) Broken facings of driven plate.	Fit new facings, or replace plate.
	(i) Dirt or foreign matter in the clutch.	Dismantle clutch from flywheel and clean the unit; see that all working parts are free. **Caution:** Never use petrol or paraffin for cleaning out clutch.
Fierceness or Snatch	(a) Oil or grease on driven plate facings.	Fit new facings and ensure isolation of clutch from possible ingress of oil or grease.
	(b) Misalignment.	Check over and correct alignment.
	(c) Worn out driven plate facings.	Fit new facings or replace plate.
Slip	(a) Oil or grease on driven plate facings.	Fit new facings and eliminate cause.
	(b) Seized piston in clutch slave cylinder.	Renew parts as necessary.
	(c) Master cylinder piston sticking.	Free off piston.
Judder	(a) Oil, grease or foreign matter on driven plate facings.	Fit new facings or driven plate.
	(b) Misalignment.	Check over and correct alignment.
	(c) Bent splined shaft or buckled driven plate.	Fit new shaft or driven plate assembly.

FAULT FINDING *(continued)*

SYMPTOM	CAUSE	REMEDY
Rattle	(a) Damaged driven plate. (b) Excessive backlash in transmission. (c) Wear in transmission bearings. (d) Bent or worn splined shaft. (e) Release bearing loose on throw out fork.	Fit new parts as necessary.
Tick or Knock	Hub splines worn due to misalignment.	Check and correct alignment then fit new driven plate.
Fracture of Driven Plate	(a) Misalignment distorts the plate and causes it to break or tear round the hub or at segment necks.	Check and correct alignment and fit new driven plate.
	(b) If the gearbox during assembly be allowed to hang with the shaft in the hub, the driven plate may be distorted, leading to drag, metal fatigue and breakage.	Fit new driven plate assembly and ensure satisfactory re-assembly.
Abnormal Facing Wear	Usually produced by over-loading and by excessive clutch slip when starting.	In the hands of the operator.

SECTION F
GEARBOX

DESCRIPTION

The gearbox is of the four speed type with baulk-ring synchromesh on all forward gears. With the exception of reverse, the detents for the gears are incorporated in the synchro assemblies, the three synchro balls engaging with grooves in the operating sleeve. The detent for reverse gear is a spring loaded ball which engages on a groove in the selector rod.

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

The gears are pressure fed at approximately 5 lb. per sq. in. (0·35 kg/cm.²) from a pump driven from the rear of the mainshaft.

DATA

Identification number	**Open 2 seater and F.H. Coupe 2+2**		**KE 101 onwards KJS 101 onwards**
	Ratios		
1st gear	2.933:1	3rd gear	1.389:1
2nd gear	1.905:1	4th gear	1.000:1
	Reverse	3.378:1	

1st gear—end float on mainshaft ·005″ to ·007″ (·13—·18 mm.)

2nd gear—end float on mainshaft ·005″ to ·008″ (·13—·20 mm.)

3rd gear—end float on mainshaft ·005″ to ·008″ (·13—·20 mm.)

Countershaft gear unit end float ·004″ to ·006″ (·10—·15 mm.)

RECOMMENDED LUBRICANTS

Mobilube GX 90	Castrol Hypoy	Spirax 90 E.P.	Esso Gear Oil GP 90/140	Gear Oil SAE 90 E.P.	Hypoid 90	Multigear Lubricant EP90

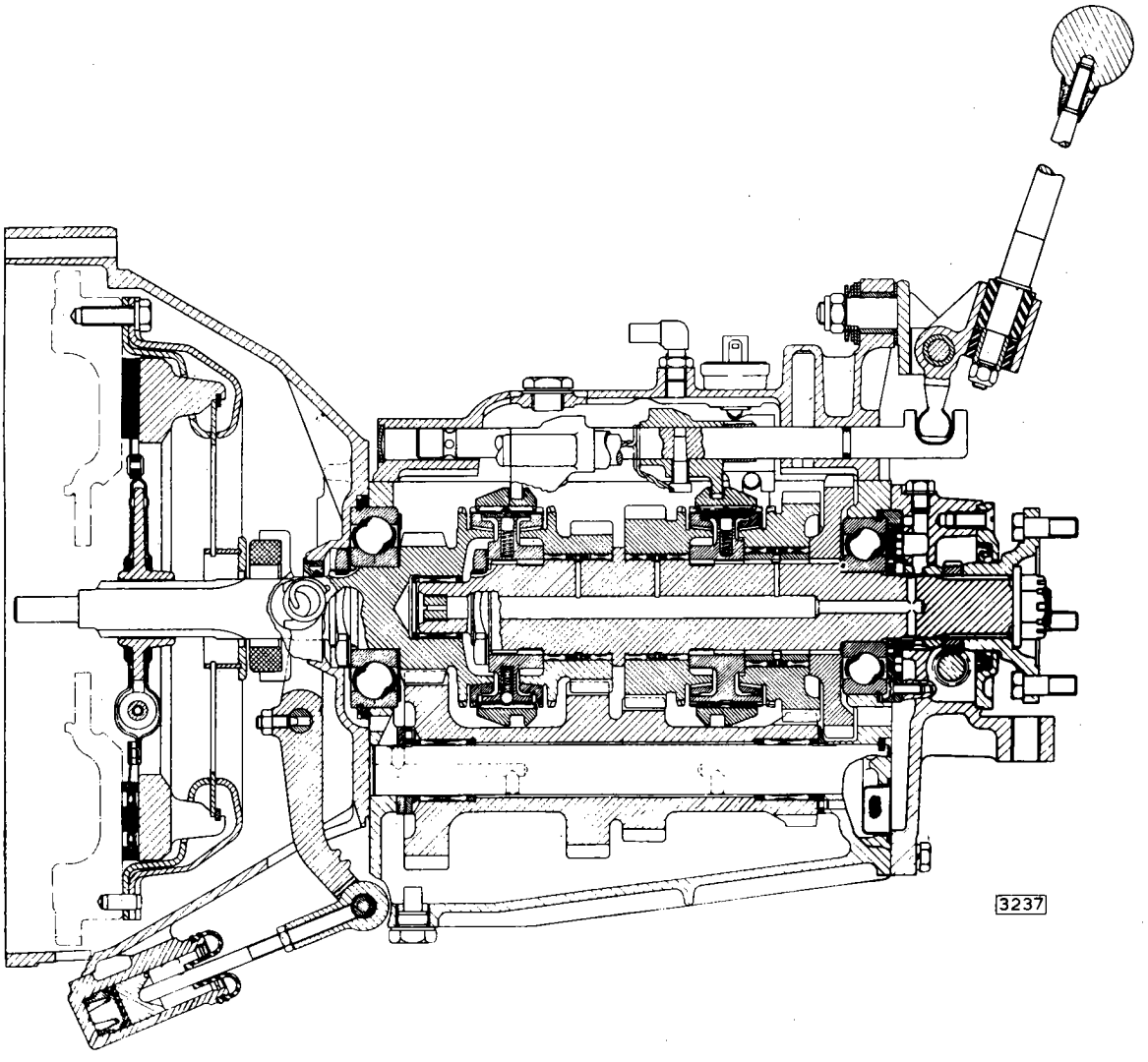


Fig. 1. *Longitudinal section of clutch and gearbox.*

GEARBOX DISMANTLING

REMOVAL OF CLUTCH HOUSING

Detach the springs and remove the carbon thrust bearing.

Unscrew the two nuts and remove the clutch slave cylinder.

Remove the allen screw, push out the fulcrum pin and detach the clutch fork.

Tap back the locking tabs and break the locking wire and remove the eight setscrews.

Detach the clutch housing.

REMOVAL OF TOP COVER

Place the gear lever in neutral.

Remove the eight setscrews and two nuts and lift off the lid.

REMOVAL OF REAR EXTENSION

Engage first and reverse gears to lock the unit.

Remove the split pin and unscrew the flange nut.

Withdraw the flange.

Remove the four setscrews and detach the rear cover.

Remove the speedometer pinion and bush assembly after unscrewing the retaining bolt.

Withdraw the speedometer driving gear from the mainshaft.

Remove the seven setscrews and withdraw the extension.

Collect the distance piece and oil pump driving pin.

REMOVAL OF OIL PUMP

From the inside face of the rear extension break the staking and remove the three countersunk screws securing the oil pump gear housing. Withdraw the housing by entering two of the securing screws into the tapped holes in the housing; screw in the two screws evenly until the housing is free.

Mark the gears with marking ink so that they can be replaced the same way up in the housing.

REMOVAL OF COUNTERSHAFT

Remove the fibre plug from the front end of the countershaft.

Drive out the countershaft from the front of the casing.

Important:

Ensure that the rear washer (pegged to casing) drops down in a clockwise direction looking from the rear to avoid trapping the washer with the reverse gear when driving the mainshaft forward (see Fig. 2). This is effected by rocking the gearbox casing and moving the reverse lever backwards and forwards, or by pushing the washer down with a piece of wire bent at right angles.

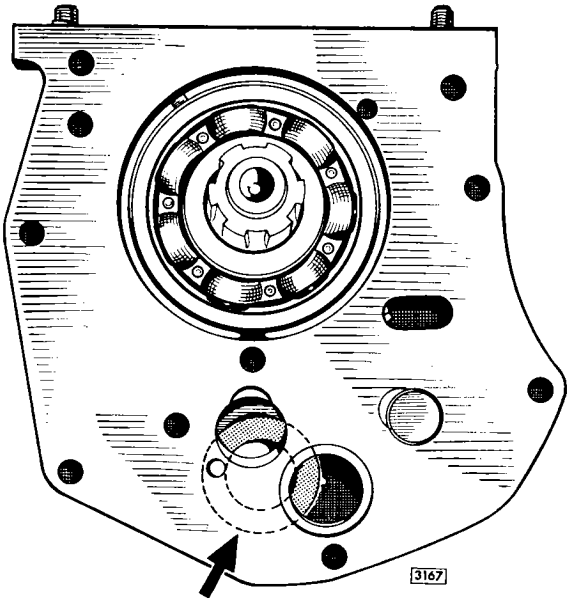


Fig. 2. *Ensure that the rear washer (indicated by arrow) drops down in a clockwise direction.*

REMOVAL OF CONSTANT PINION SHAFT

Rotate the constant pinion shaft until the cutaway portions of the driving gear are facing the top and bottom of the casing otherwise the gear will foul the countershaft.

With the aid of two levers ease the constant pinion shaft and front bearing assembly forward until it can be withdrawn (see Fig. 3).

DISMANTLING THE CONSTANT PINION SHAFT

Remove the roller bearing from inside the constant pinion shaft. On early cars, a spacer was also fitted along with the needle roller bearing.

Tap back the tab washer and remove the large nut, tab washer and oil thrower.

Tap the shaft sharply against a metal plate to dislodge the bearing.

REMOVAL OF MAINSHAFT

Rotate the mainshaft until one of the cutaway portions in 3rd/Top synchro hub is in line with the countershaft (see Fig. 4), otherwise the hub will foul the constant gear or the countershaft.

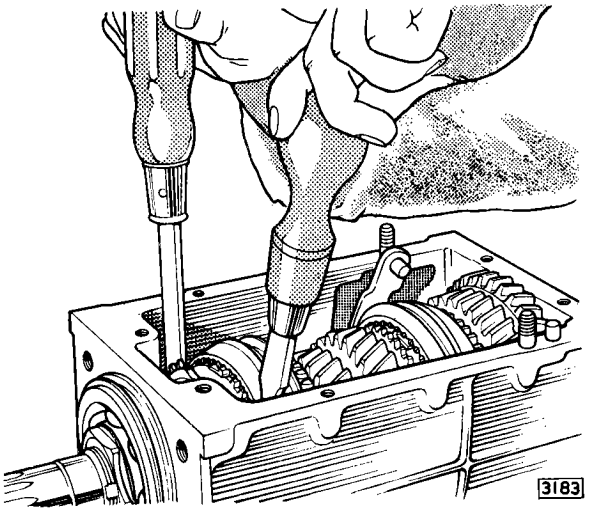


Fig. 3. *With the aid of two levers ease the constant pinion shaft forward.*

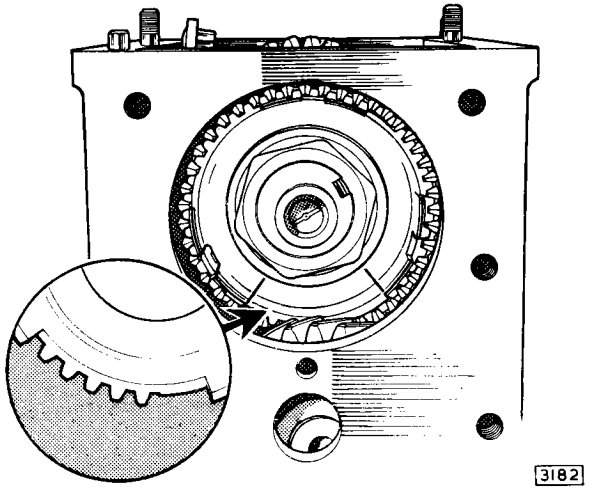


Fig. 4. *Rotate the mainshaft until one of the cutaway portions in 3rd/Top synchro hub is in line with the countershaft.*

Tap or press the mainshaft through the rear bearing ensuring that the reverse gear is kept tight against the first gear (see Fig. 5).

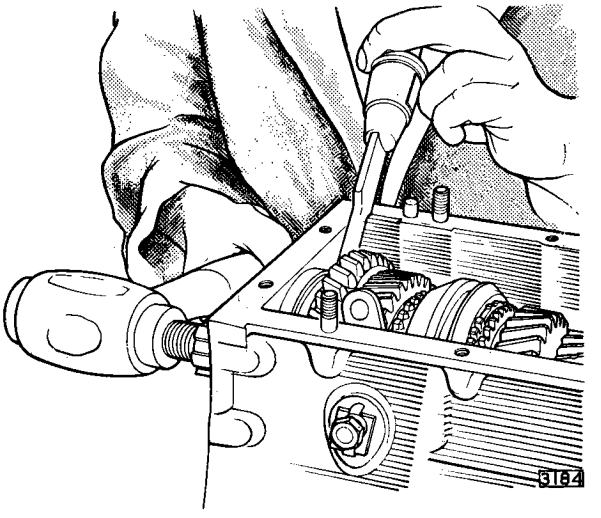


Fig. 5. *Tapping the mainshaft through the rear bearing.*

Remove the rear bearing from the casing and fit a hose clip to the mainshaft to prevent the reverse gear from sliding off (see Fig. 6).

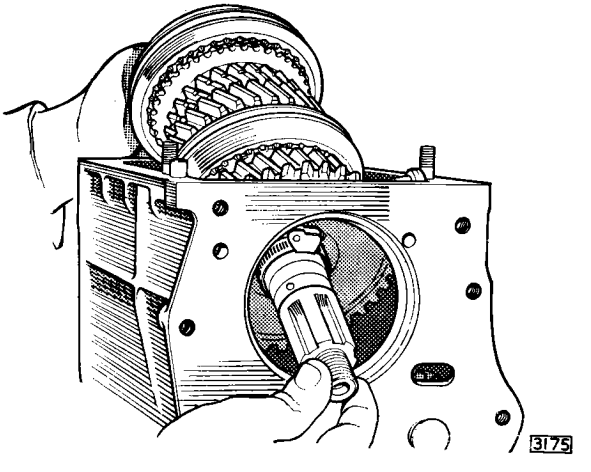


Fig. 6. *Removal of the mainshaft. Note the hose clip fitted to the mainshaft to retain the reverse gear.*

Slacken the reverse lever bolt until the lever can be moved to the rear.

Lift out the mainshaft forward and upward.

Lift out the countershaft gear unit and collect the needle bearings and retaining rings.

Withdraw the reverse idler shaft and lift out the gear.

DISMANTLING THE MAINSHAFT

Note: The needle rollers are graded on diameter and must be kept in sets for their respective positions.

Remove the hose clip.

Withdraw the reverse gear from the mainshaft.

Withdraw the 1st gear and collect the 120 needle rollers, spacer and sleeve.

Withdraw the 1st/2nd synchro assembly and collect the two loose synchro-rings.

Withdraw the 2nd speed gear and collect the 106 needle rollers leaving the spacer on the mainshaft.

Tap back the tab washer and remove the large nut retaining the 3rd/Top synchro assembly to the mainshaft.

Withdraw the 3rd/Top synchro assembly from the mainshaft and collect the two loose synchro-rings.

Withdraw the 3rd speed gear and collect the 106 needle rollers and spacer.

DISMANTLING THE SYNCHRO ASSEMBLY

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

DISMANTLING TOP COVER

Unscrew the self-locking nut and remove the double coil spring, washer, flat washer and fibre washer securing the gear lever to the top cover.

Withdraw the gear lever and collect the remaining fibre washer.

Remove the locking wire and unscrew the selector rod retaining screws.

Withdraw the 3rd/Top selector rods and collect the selector, spacing tube and interlock ball. Note the loose interlock pin at the front end of the 1st/2nd selector rod.

Withdraw the reverse selector rod and collect the reverse fork, stop spring and detent plunger.

Withdraw the 1st/2nd selector rod and collect the fork and short spacer tube.

GEARBOX RE-ASSEMBLING

ASSEMBLING THE SYNCHRO ASSEMBLIES

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

Note: Although the 3rd/Top and 1st/2nd synchro hubs are similar in appearance they are not identical and to distinguish them a groove is machined on the edge of the 3rd/Top synchro hub (see Fig. 7).

Assemble the synchro hub to the operating sleeve with;

(i) The wide boss of the hub on the opposite side to the wide chamfer end of the sleeve (see Fig. 8).

(ii) The three ball and springs in line with the teeth having three detent grooves (see Fig. 10).

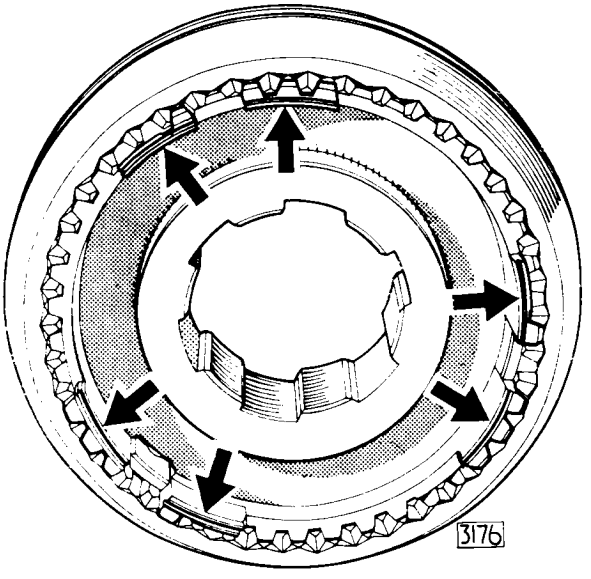


Fig. 7. *Identification grooves—3rd/Top, synchro assembly.*

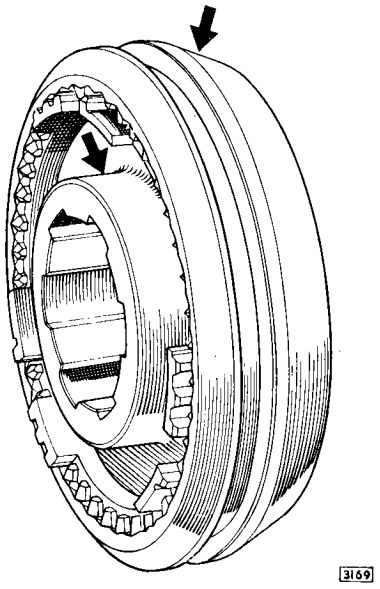


Fig. 8. *Assembly of synchro hub.*

Pack up the synchro hub so that holes for the ball and springs are exactly level with the top of the operating sleeve (see Fig. 11).

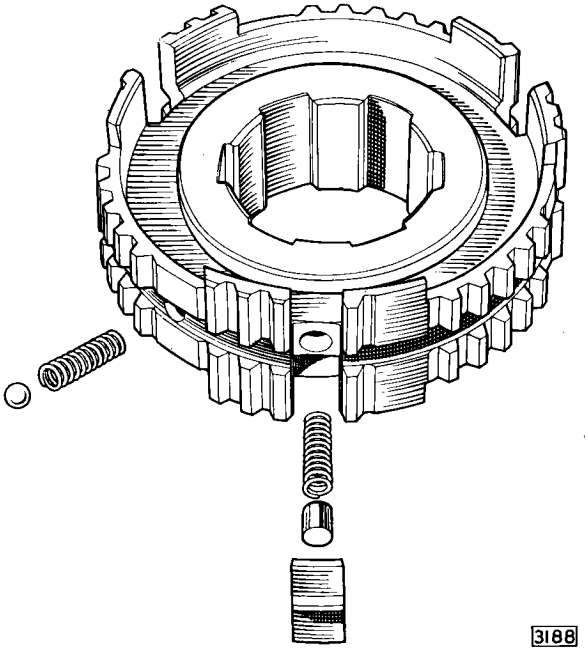


Fig. 9. *Showing the relative positions of the detent ball, plunger and thrust member.*

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

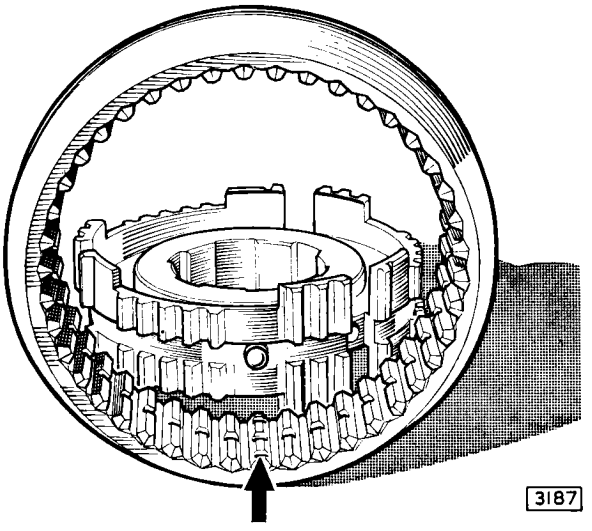


Fig. 10. *Fitting the synchro hub in the sleeve.*

Compress the springs with a large hose clip or a piston ring clamp as shown in Fig. 12 and carefully lift off the synchro assembly from the packing piece.

Depress the hub slightly and push down the thrust members with a screwdriver until they engage the neutral groove in the operating sleeve (see Fig. 13).

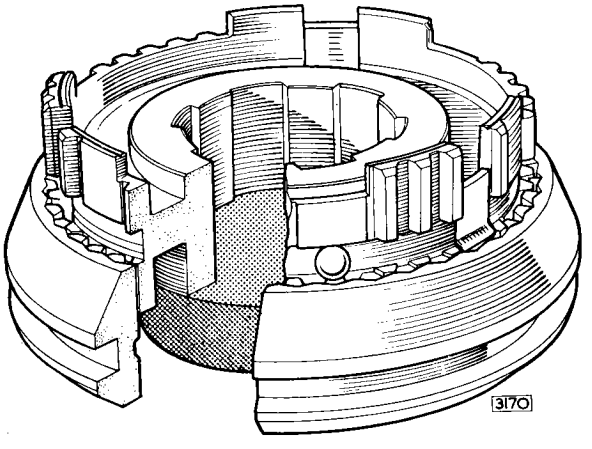


Fig. 11. *Fitting the springs, plungers and thrust members.*

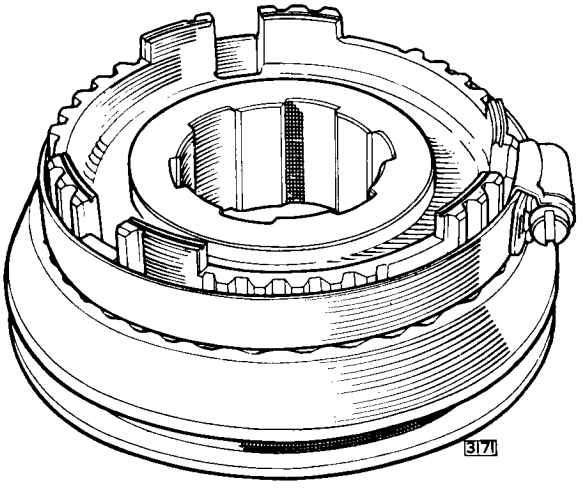


Fig. 12. *Compressing the springs.*

Finally tap the hub down until the balls can be heard and felt to engage the neutral groove (see Fig. 14).

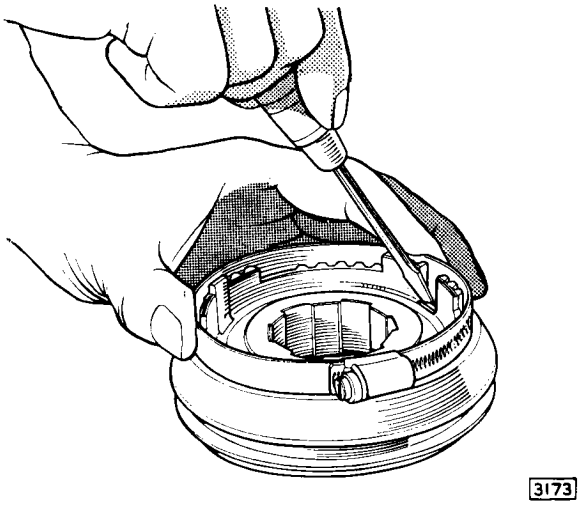


Fig. 13. *Pushing down the thrust members.*

ASSEMBLING THE CLUSTER GEAR

Fit one retaining ring in the front end of the cluster gear. Locate the 29 needle roller bearings with grease and fit the inner thrust washer ensuring that the peg on the washer locates in a groove machined on the face of the cluster gear.

Fit a retaining ring, 29 needle roller bearings and a second retaining ring to the rear end of the cluster gear.

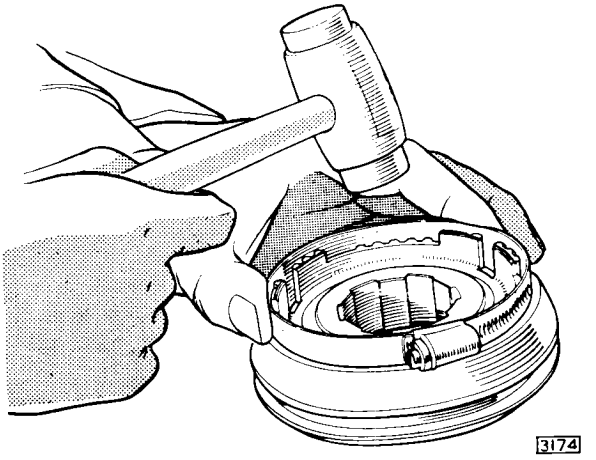


Fig. 14. *Tapping the hub into position.*

CHECKING THE CLUSTER GEAR END FLOAT

Fit the reverse idler gear, lever and idler shaft.

Fit the pegged rear washer to its boss on the casing with grease.

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

Part Number	Thickness
C.1862/3	·152″ (3·86 mm.)
C.1862	·156″ (3·96 mm.)
C.1862/1	·159″ (4·04 mm.)
C.1862/2	·162″ (4·11 mm.)
C.1862/4	·164″ (4·17 mm.)

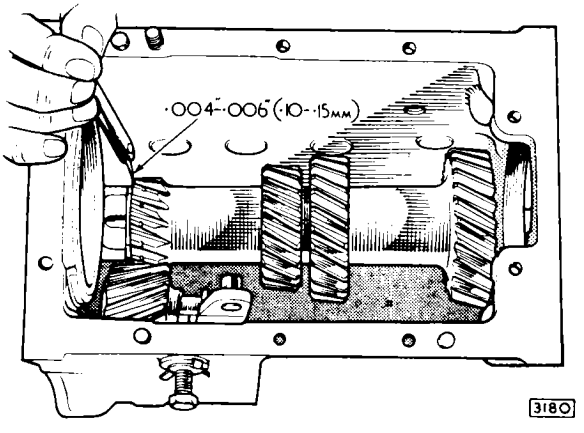


Fig. 15. *Checking the clearance between the rear thrust washer and the countershaft cluster gear.*

ASSEMBLING THE CONSTANT PINION SHAFT

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

ASSEMBLING THE MAINSHAFT

The re-assembly of the mainshaft is the reverse of the dismantling instructions but the following instructions should be noted.

(i) The end float of the gears on the mainshaft is given in "Data" at the beginning of this section and if found to be excessive the end float can only be restored by the fitting of new parts.

(ii) The needle rollers which support the gears on the mainshaft are graded on diameter and rollers of one grade only must be used for an individual gear. The grades are identified by /1, /2, and /3 after the part number.

(iii) The "E" Type constant pinion, countershaft and 3rd speed gear have a groove machined around the periphery of the gear, see Fig. 16. This is to distinguish the "E" Type gears from those fitted to the same type of gearbox on other models which have different ratios.

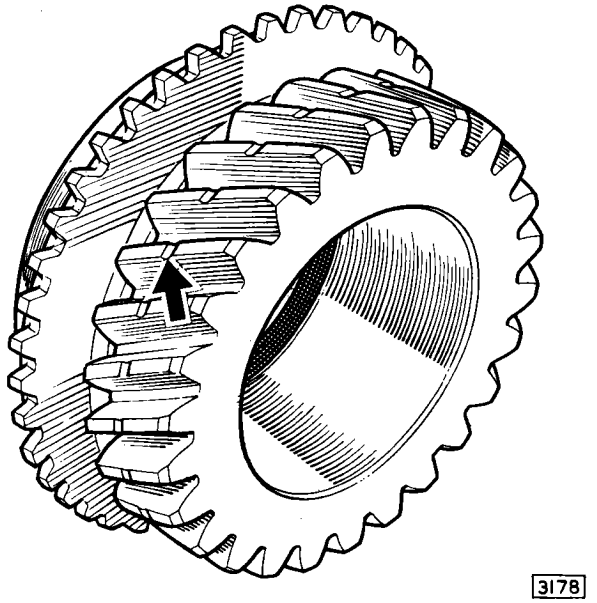


Fig. 16. *Showing the groove which identifies the 'E' type gears.*

(iv) Fit a hose clip to prevent the reverse gear from sliding off when assembling the mainshaft to the casing.

ASSEMBLING THE GEARS TO THE CASING

Withdraw the dummy shaft from the cluster gear and, at the same time, substitute a thin rod keeping both the dummy shaft and the rod in contact until the dummy shaft is clear of the casing. The thin rod allows the cluster gear to be lowered sufficiently in the casing for insertion of the mainshaft.

Fit a new paper gasket to the front face of the casing.

Enter the mainshaft through the top of the casing and pass the rear of shaft through the bearing hole.

Enter the constant pinion shaft at the front of the casing with the cutaway portions of the tooth driving member at the top and bottom.

Tap the constant pinion shaft into position and enter the front end of the mainshaft into the spigot bearing of the constant pinion shaft.

Hold the constant pinion shaft in position and with a hollow drift tap the rear bearing into position.

Withdraw the thin rod from the front bore of the cluster gear approximately half way and lever the cluster gear upwards, rotating the mainshaft and constant pinion shaft gently until the cluster gear meshes. Carefully insert the countershaft from the rear and withdraw the rod. Fit the key locating the countershaft in the casing.

REFITTING REAR EXTENSION

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

Fit a new paper gasket to the rear face of the casing.

Fit the distance piece and driving pin to the oil pump in the rear extension.

Offer up the rear extension and secure with the seven screws.

Fit the speedometer driving gear to the mainshaft.

Fit the speedometer driven gear and bush with the hole in the bush in line with the hole in the casing and secure with the retaining bolt.

Fit a new gasket to the rear cover face.

Fit a new oil seal to the rear cover with the lip facing forward.

Fit the rear cover to the extension noting that the setscrew holes are offset.

Fit the four bolts to the companion flange, slide on the flange and secure with flat washer with split pin.

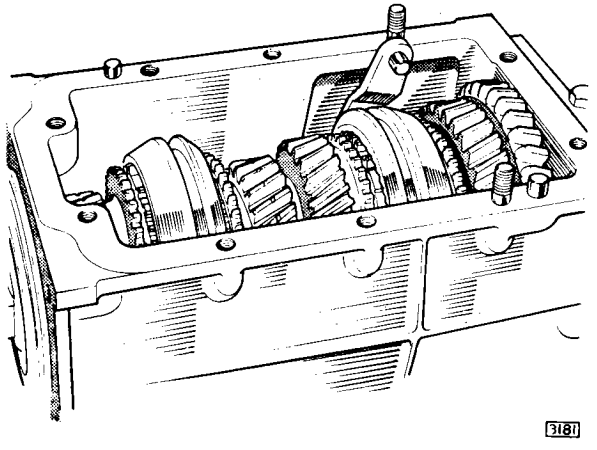


Fig. 17. *Re-assembled gearbox prior to refitting of top cover.*

RE-ASSEMBLING THE TOP COVER

(see Fig. 20).

Re-assembly of the top cover is the reverse of the dismantling instructions. When assembling the selector rods do not omit to fit the interlock balls and pin.

Renew the "O" rings on the selector rods.

To adjust the reverse plunger fit the plunger and spring.

Fit the ball and spring and start the screw and locknut; press the plunger inwards as far as possible and tighten the screw to lock the plunger.

Slowly slacken the screw until the plunger is released and the ball engages with the circular groove in the plunger. Hold the screw and tighten the locknut.

FITTING THE TOP COVER

Fit a new paper gasket.

Ensure that the gearbox and the top cover are in the neutral position.

Ensure that the reverse idler gear is out of mesh with the reverse gear on the mainshaft by pushing the lever rearwards.

Engage the selector forks with the grooves in the synchro assemblies.

Secure the top cover with the nuts and bolts noting that they are of different lengths.

REFITTING THE CLUTCH HOUSING

Refitting the clutch housing is the reverse of the removal procedure.

Fit a new oil seal to the clutch housing with the lip of the seal facing the gearbox. The oil seal has a metal flange and should be pressed in fully.

The two clutch housing securing bolts adjacent to the clutch fork trunnions are secured with locking wire; the remainder are secured with tab washers.

Note: After refitting the gearbox, run the car in top gear as soon as possible to attain the necessary mainshaft speed to prime the oil pump.

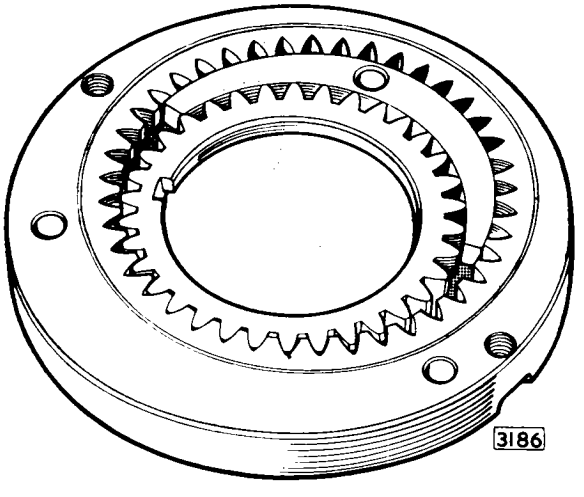


Fig. 18. *The oil pump.*

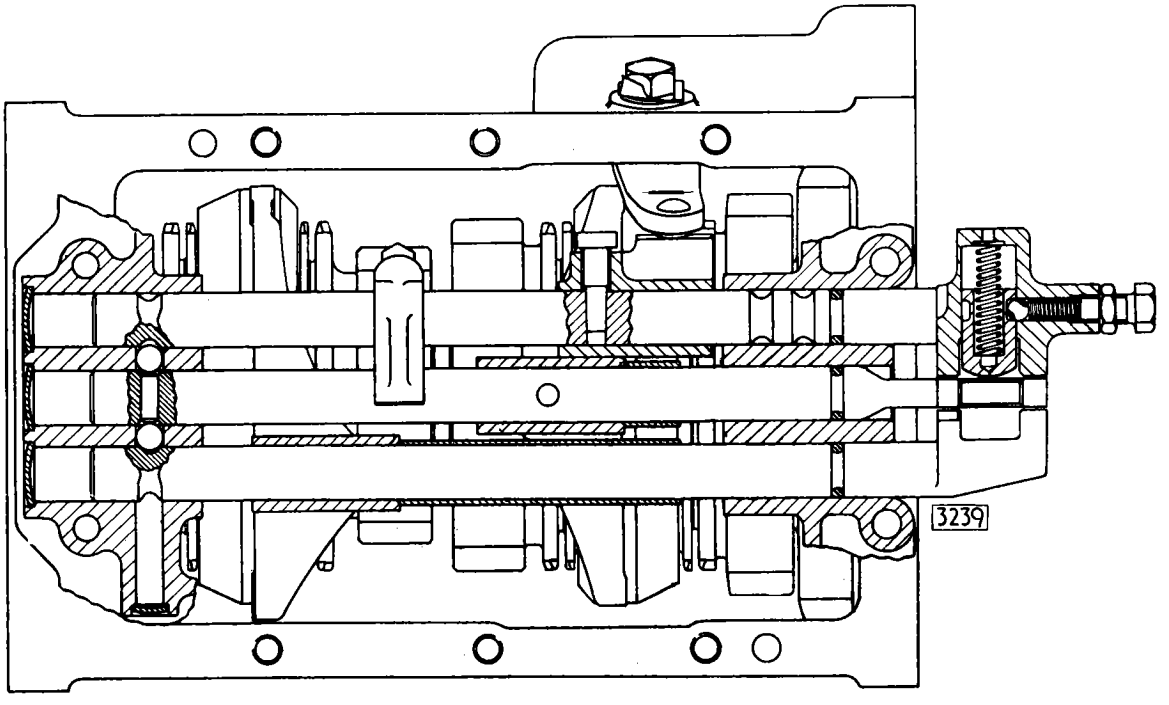


Fig. 19. *Plan view of gearbox showing selector arrangement.*

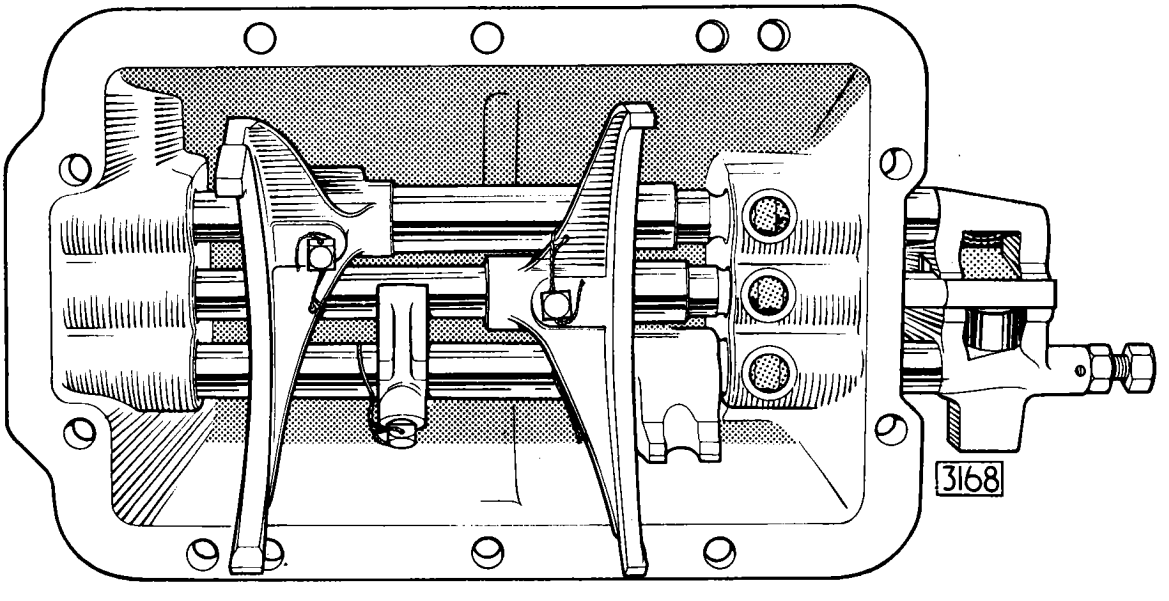


Fig. 20. *View of the underside of the top cover.*

SECTION FF

AUTOMATIC TRANSMISSION

GENERAL DATA

Maximum ratio of torque converter	2·00:1
1st Gear reduction	2·40:1
2nd Gear reduction	1·46:1
3rd Gear reduction	1·00:1
Reverse Gear reduction	2·00:1

AUTOMATIC SHIFT SPEEDS

2·88:1 Final Drive

Selector Position	Throttle Position	Upshifts 1 – 2	Upshifts 2 – 3	Downshifts 3 – 2	Downshifts 3 – 1	Downshifts 2 – 1
				M.P.H.		
	Minimum	7 – 9	12 – 15	8 – 14	—	4 – 8
D1	Full	38 – 44	66 – 71	23 – 37	—	—
	Kickdown	52 – 56	81 – 89	73 – 81	20 – 24	20 – 24
	Minimum	—	12 – 15	8 – 14	—	—
D2	Full	—	66 – 71	23 – 37	—	—
	Kickdown	—	81 – 89	73 – 81	—	—
L	Zero	—	—	60	—	12 – 20
				K.P.H.		
	Minimum	11 – 14	19 – 24	13 – 23	—	6 – 13
D1	Full	61 – 71	106 – 114	37 – 60	—	—
	Kickdown	83 – 90	130 – 143	118 – 130	32 – 39	32 – 39
	Minimum	—	19 – 24	13 – 23	—	—
D2	Full	—	106 – 114	37 – 60	—	—
	Kickdown	—	130 – 143	118 – 130	—	—
L	Zero	—	—	96	—	19 – 32

AUTOMATIC SHIFT SPEEDS *(Continued)*

185×15 SP 41 HR Tyres – 3·31:1 Final Drive

Selector Position	Throttle Position	Upshifts 1 – 2	Upshifts 2 – 3	Downshifts 3 – 2	Downshifts 3 – 1	Downshifts 2 – 1
				M.P.H.		
	Minimum	6 – 8	11 – 13	7 – 13	—	3 – 7
D1	Full	33 – 40	58 – 62	19 – 33	—	—
	Kickdown	45 – 49	70 – 78	63 – 71	17 – 21	17 – 21
	Minimum	—	11 – 13	7 – 13	—	—
D2	Full	—	58 – 62	19 – 33	—	—
	Kickdown	—	70 – 78	63 – 71	—	—
L	Zero	—	—	60	—	10 – 18
				K.P.H.		
	Minimum	9 – 13	18 – 21	11 – 21	—	5 – 11
D1	Full	53 – 64	93 – 100	31 – 53	—	—
	Kickdown	73 – 80	113 – 126	101 – 114	28 – 34	28 – 34
	Minimum	—	18 – 21	11 – 21	—	—
D2	Full	—	93 – 100	31 – 53	—	—
	Kickdown	—	113 – 126	101 – 114	—	—
L	Zero	—	—	96	—	16 – 29

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

TIGHTENING TORQUE FIGURES

	lb. ft.	kgm.
Front pump to transmission case bolts	17 – 22	2·35 – 3·04
Front servo to transmission case bolts	30 – 35	4·15 – 4·70
Rear servo to transmission case bolts	40 – 45	5·53 – 6·22
Centre support to transmission case bolts	20 – 25	2·76 – 3·46
Upper valve body to lower valve body bolts	4 – 6	0·55 – 0·83
Control valve body to transmission case bolts	8 – 10	1·11 – 1·38
Pressure regulator assembly to transmission case bolts	17 – 22	2·35 – 3·04
Extension assembly to transmission case bolts	28 – 33	3·87 – 4·56
Oil pan to transmission case bolts	10 – 13	1·38 – 1·80
Case assembly—gauge hole plug	10 – 15	1·38 – 2·07
Oil pan drain plug	25 – 30	3·46 – 4·15
Rear band adjusting screw lock nut	35 – 40	4·70 – 5·53
Front band adjusting screw lock nut	20 – 25	2·76 – 3·46
Detent lever attaching nut	35 – 40	4·70 – 5·53
Companion flange nut	90 – 120	12·44 – 16·58
Bearing retainer to extension housing bolts	28 – 33	3·87 – 4·56

	lb. in.	kgm.
Front pump cover attaching screws	25 – 35	0·29 – 0·40
Rear pump cover attaching screws ¼" (6·30 mm.)	50 – 60	0·58 – 0·69
Rear pump attaching screws Nos. 10–24	20 – 30	0·24 – 0·35
Governor inspection cover attaching screws	50 – 60	0·58 – 0·69
Governor valve body to counterweight screws	50 – 60	0·58 – 0·69
Governor valve body cover screws	20 – 30	0·24 – 0·35
Pressure regulator cover attaching screws	20 – 30	0·24 – 0·35
Control valve body screws	20 – 30	0·24 – 0·35
Control valve body plug	10 – 14	0·11 – 0·16
Control valve lower body plug	7 – 15	0·08 – 0·17

SPECIAL SERVICE TOOLS

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

Description

Mainshaft end play gauge (CB.W.33).

Rear clutch spring compressor (C.B.W. 37A used with W.G.37).

Hydraulic pressure test gauge equipment (C.B.W. 1A used with adaptor C.B.W.1A-5A).

Spring beam torque wrench (used in conjunction with the following adaptor) (C.B.W.547A-50).

Rear band adjusting adaptor (C.B.W.547A-50-2).

Torque screwdriver (used in conjunction with the following adaptor) (C.B.W.548).

Front band adjusting adaptor (C.B.W.548-2).

Front band setting gauge (C.B.W.34).

Circlip pliers (used with "J" points) (7066).

Bench cradle (C.W.G.35).

Rear clutch piston assembly sleeve (C.W.G.41).

Front clutch piston assembly sleeve (C.W.G.42).

Rear pump discharge tube remover (C.W.G.45).

AUTOMATIC TRANSMISSION

DESCRIPTION AND OPERATION

The Model 8 automatic transmission incorporates a fluid torque converter in place of the usual flywheel and clutch. The converter is coupled to a hydraulically operated planetary gearbox which provides three forward ratios and reverse. All forward ratios are automatically engaged in accordance with accelerator position and car speed.

Overriding control by the driver is available upon demand for engine braking by manual selection of "L".

TORQUE CONVERTER

The feature of using a hydraulic converter in conjunction with a three-speed automatic gearbox provides a means of obtaining a smooth application of engine power to the driving wheels and additional engine torque multiplication to the 1st and 2nd gears of the gearbox.

The converter also provides extreme low-speed flexibility when the gearbox is in 3rd gear and, due to the ability of multiplying engine torque, it provides good acceleration from very low road speed without having to resort to a down-shift in the gearbox.

Torque multiplication from the converter is infinitely variable between the ratios of 2:1 and 1:1. The speed range, during which the torque multiplication can be achieved, is also variable, depending upon the accelerator position.

The hydraulic torque converter for use in conjunction with the automatic gearbox has a mean fluid circuit diameter of 11" (27·9 cm.).

It is of the single-phase, three-element type, comprising an impeller connected to the engine crankshaft, a turbine connected to the input shaft of the gearbox, and a stator mounted on a sprag-type one-way clutch supported on a fixed hub projecting from the gearbox case.

THE GEAR SET

The planetary gear set consists of two sun gears, two sets of pinions, a pinion carrier, and a ring gear. Helical, involute tooth forms are used throughout. Power enters the gear set via the sun gears. In all forward gears power enters through the forward sun gear; in reverse, power enters through the reverse sun gear. Power leaves the gear set by the ring gear. The pinions are used to transmit power from the sun gears to the ring gear. In reverse a single set of pinions is used, which causes the ring gear to rotate in the opposite direction to the sun gear. In forward gears a double set of pinions is used to cause the ring gear to rotate in the same direction as the sun gear. The carrier locates the pinions in their correct positions relative to the sun gears and the ring gear (and also forms a reaction member for certain conditions). The various mechanical ratios of the gear set are obtained by the engagement of hydraulically operated multi-disc clutches and brake bands.

CLUTCHES

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

BANDS

Brake bands, operated by hydraulic servos, hold elements of the gear set stationary to effect an output speed and a torque increase. In Lockup the rear band holds the planet carrier stationary and provides the 1st gear ratio of 2·40:1 and, in reverse, a ratio of 2·00:1. The front band holds the reverse sun gear stationary to provide the 2nd gear ratio of 1·46:1.

ONE-WAY CLUTCH

In D1, a one-way clutch is used in place of the rear band to prevent anti-clockwise rotation of the planet carrier, thus providing the 1st gear ratio of 2·40:1. This one-way clutch, allowing the gear set to freewheel in 1st gear, provides smooth ratio changes from 1st to 2nd, and vice-versa.

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

MECHANICAL POWER FLOW

First Gear (Lockup selected)

The front clutch is applied, connecting the converter to the forward sun gear. The rear band is applied, holding the planet carrier stationary, the gear set providing the reduction of 2·40:1. The reverse sun gear rotates freely in the opposite direction to the forward sun gear.

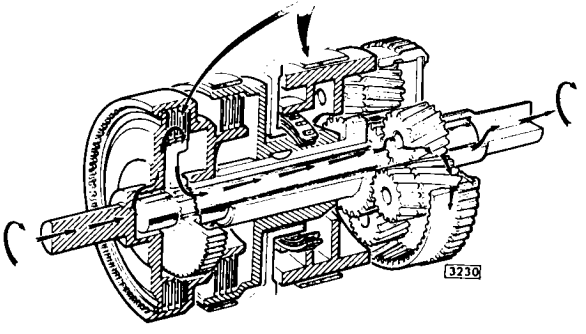


Fig. 1. *Mechanical power flow—1st gear (L) selected.*

First Gear (Drive 1 selected)

The front clutch is applied, connecting the converter to the forward sun gear. The one-way clutch is in operation, preventing the planet carrier from rotating anti-clockwise; the gear set provides the reduction of 2·40:1. When the vehicle is coasting the one-way clutch over-runs and the gear set freewheels.

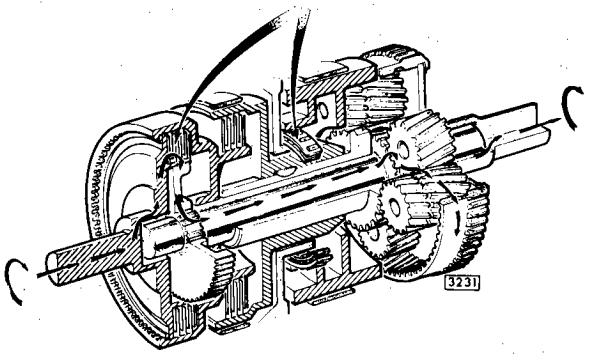


Fig. 2. *Mechanical power flow—1st gear (D) selected.*

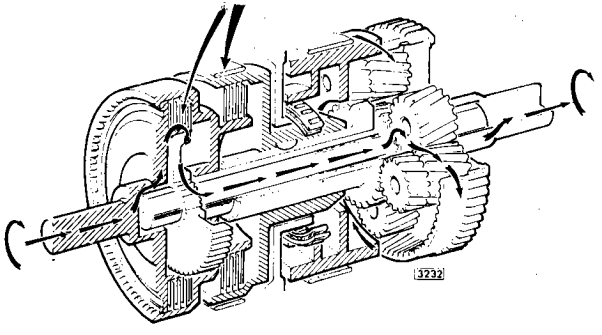


Fig. 3. *Mechanical power flow—2nd gear (L or D2) selected.*

Second Gear (Lockup or Drive 2 selected)

Again the front clutch is applied, connecting the converter to the forward sun gear. The front band is applied, holding the reverse sun gear stationary; the gear set provides the reduction of 1·46:1.

Third Gear

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

Neutral and Park

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

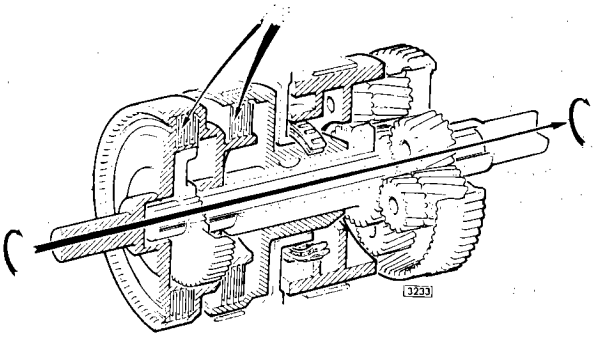


Fig. 4. *Mechanical power flow—3rd gear (D) selected.*

Reverse Gear

The rear clutch is applied, connecting the converter to the reverse sun gear. The rear band is applied, holding the planet carrier stationary, the gear set providing the reduction of 2·00:1 in the reverse direction.

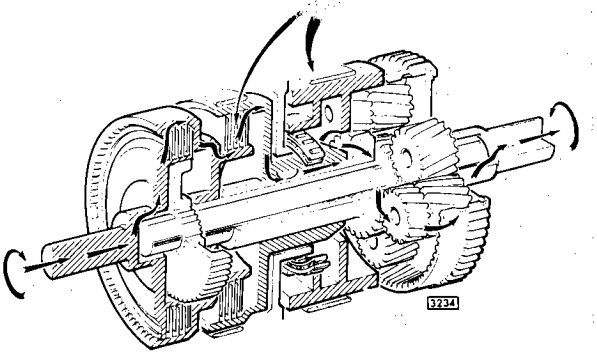


Fig. 5. *Mechanical power flow—Reverse (R) selected.*

THE HYDRAULIC SYSTEM

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

The Front Pump

The front pump, driven by the converter impeller,

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

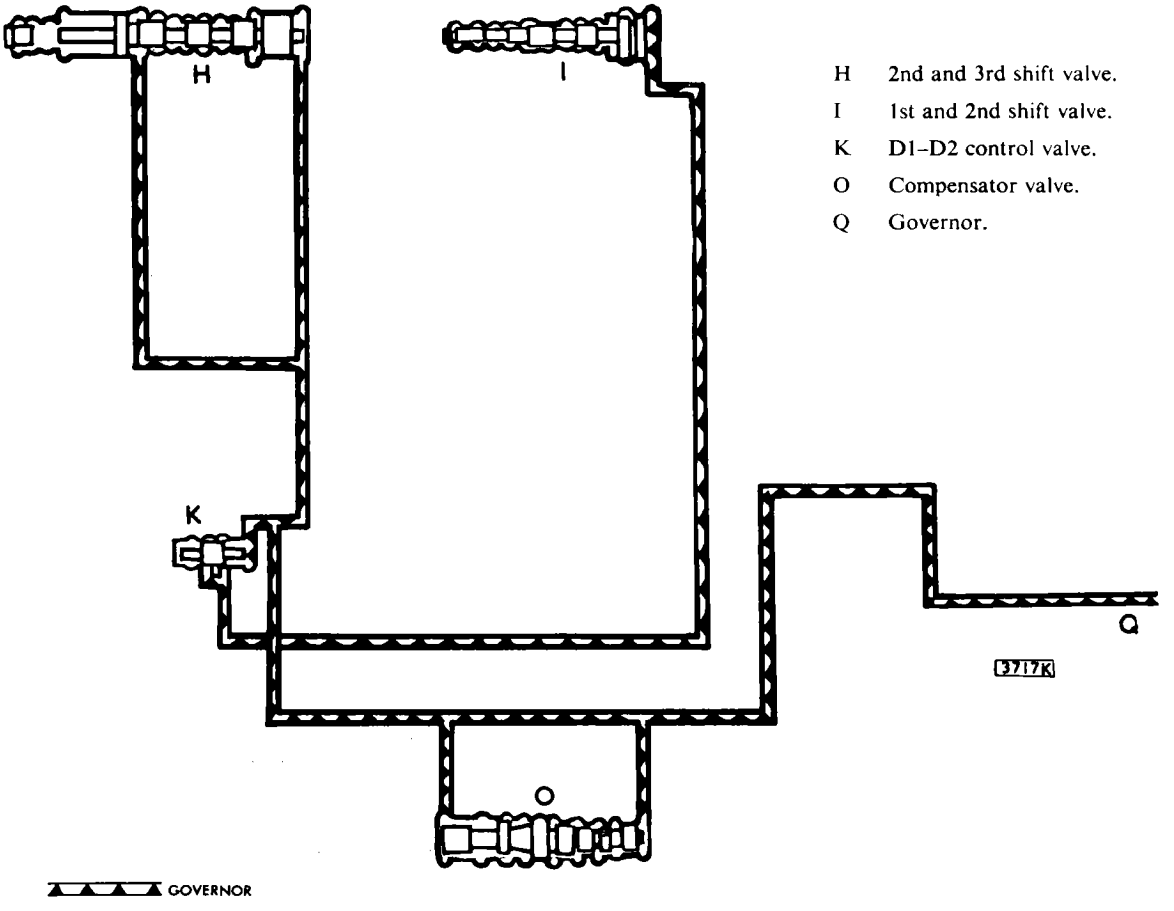


Fig. 6. *Governor circuit.*

The Rear Pump

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

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

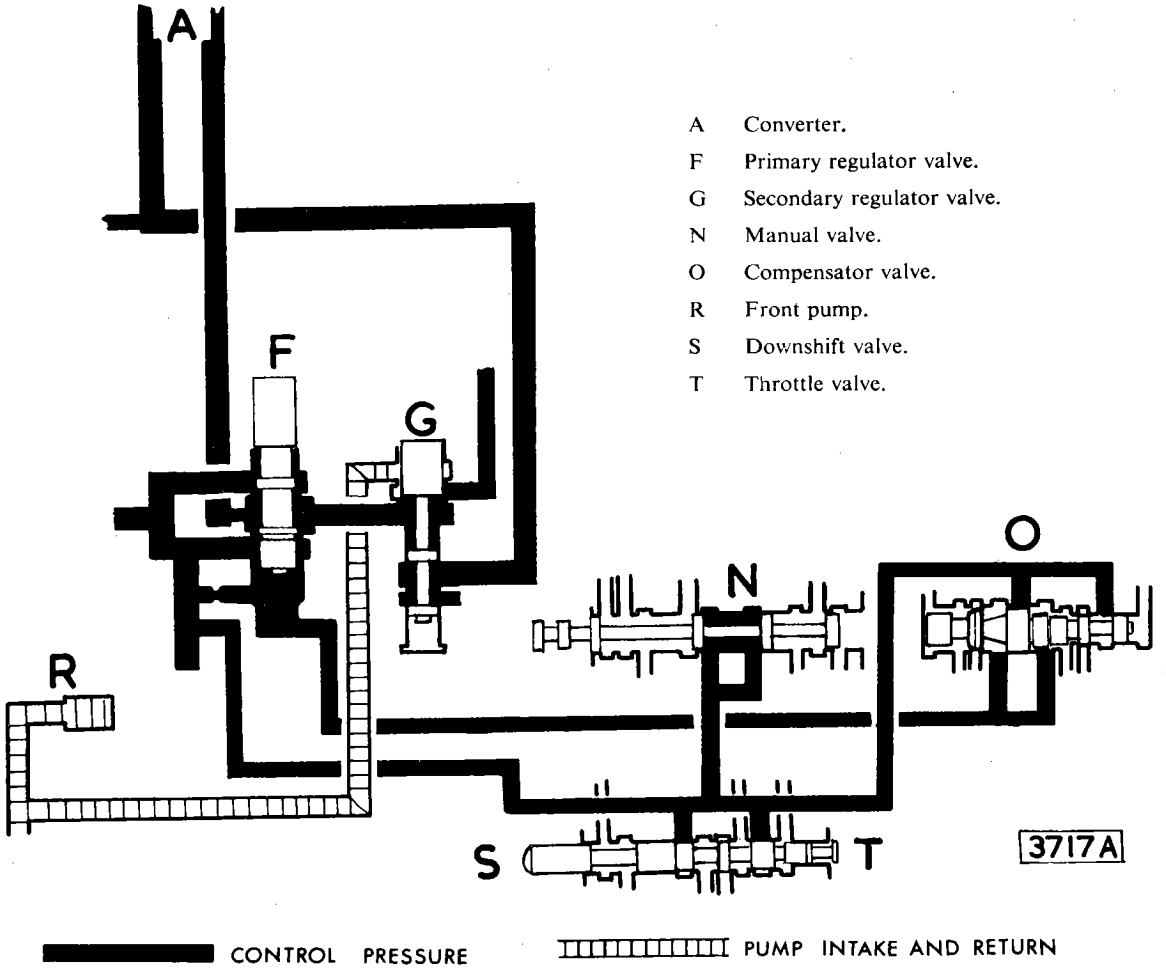
The Governor

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

As rotational speed increases the governor weight moves outward to rest on a stop in the governor body, and can move no further. When this occurs, a spring located between the counter weight and the valve

becomes effective. The constant force of this spring then combines with the centrifugal force of the governor valve and the total force is opposed by governor pressure. This combination renders governor pressure less sensitive to output shaft speed variations.

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



A Converter.
F Primary regulator valve.
G Secondary regulator valve.
N Manual valve.
O Compensator valve.
R Front pump.
S Downshift valve.
T Throttle valve.

Fig. 7. *Hydraulic circuit—neutral.*

THE CONTROL SYSTEM

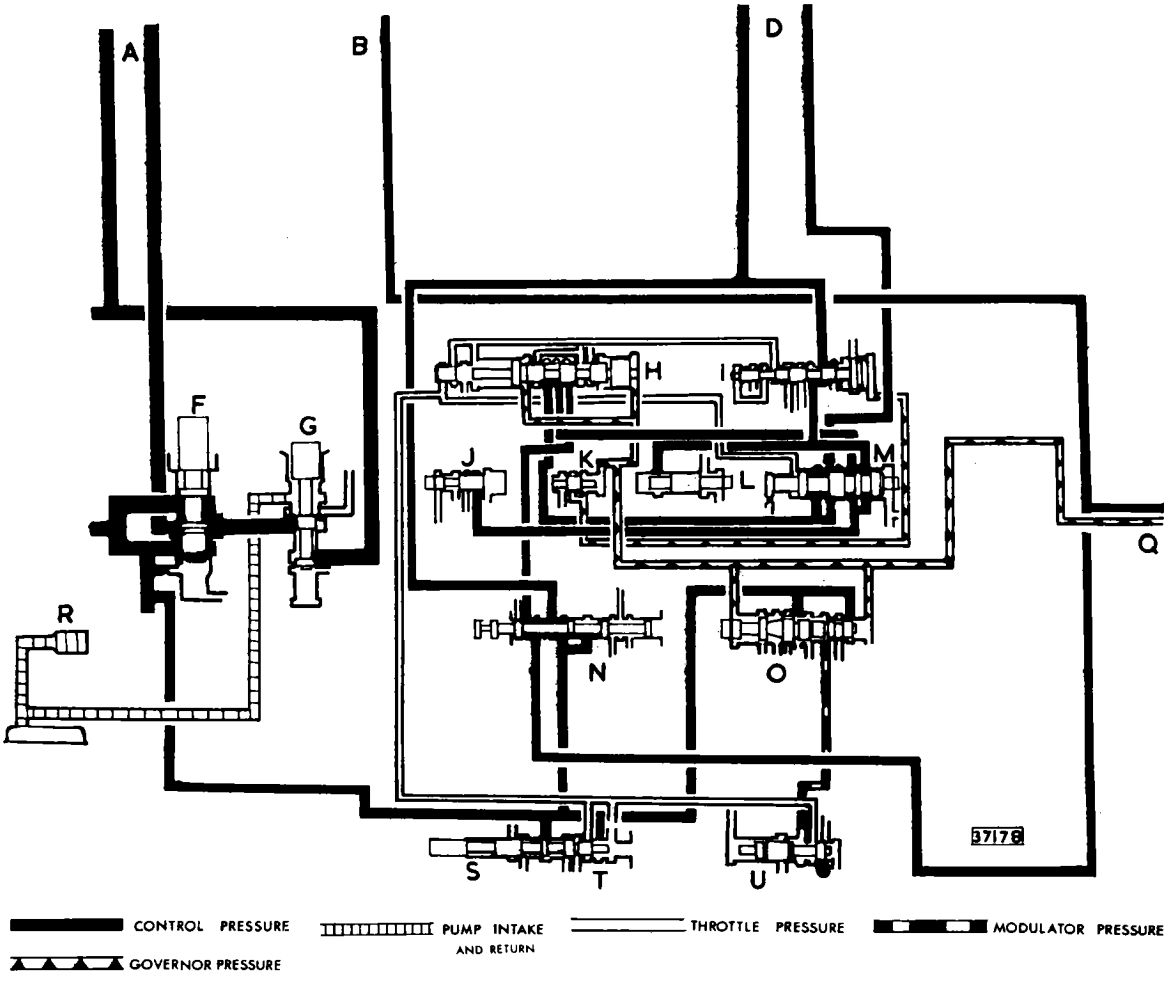
Neutral—Engine Running (see Fig. 7)

When the selector is moved to the neutral position, the manual control valve is positioned so that control pressure cannot pass through the manual valve to the clutches or servos; therefore, the clutches and servos cannot apply. There is no transmission of power through the transmission in the neutral position.

The pressure regulation system, however, is functioning. With the engine running, the front pump is driven and fluid is picked up from the pan by the front pump inlet. Fluid, circulated by the front pump is directed to the control pressure regulator. The primary regulator valve will maintain correct control pressure by expelling the excess fluid to feed the secondary regulator valve. The secondary regulator valve maintains correct pressure for converter feed and lubrication, then forces the excess fluid back to the pump inlet.

Control pressure is directed to the manual control valve, where it is blocked by two lands on the valve. Control pressure is also directed to the throttle valve and the downshift valve and, with the valve closed

(accelerator at idle position) it is blocked by lands on the valves. Control pressure to the compensator valve is regulated by that valve, and compensating pressure is directed to the primary regulator valve.



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

Fig. 8. *Hydraulic circuit—1st gear (D1 range).*

First Gear, D1 Range (see Fig. 8)

When the selector lever is placed in the D1 position, with the car standing still, and the engine running, the manual control valve is moved to admit control pressure to apply the front clutch.

Control pressure is also directed to the governor, but with the car standing still, the control pressure is blocked at the governor valve.

Control pressure from the manual valve is directed through another passage to the apply side of the front servo and the 1–2 shift valve.

From the 1–2 shift valve pressure then passes to the servo orifice control valve and the front servo release valve where it is blocked.

Control pressure is then directed from the servo orifice control valve via the 2–3 shift valve and again through the control valve to the release side of the front servo.

Pressure is also present at the transition valve where it is blocked.

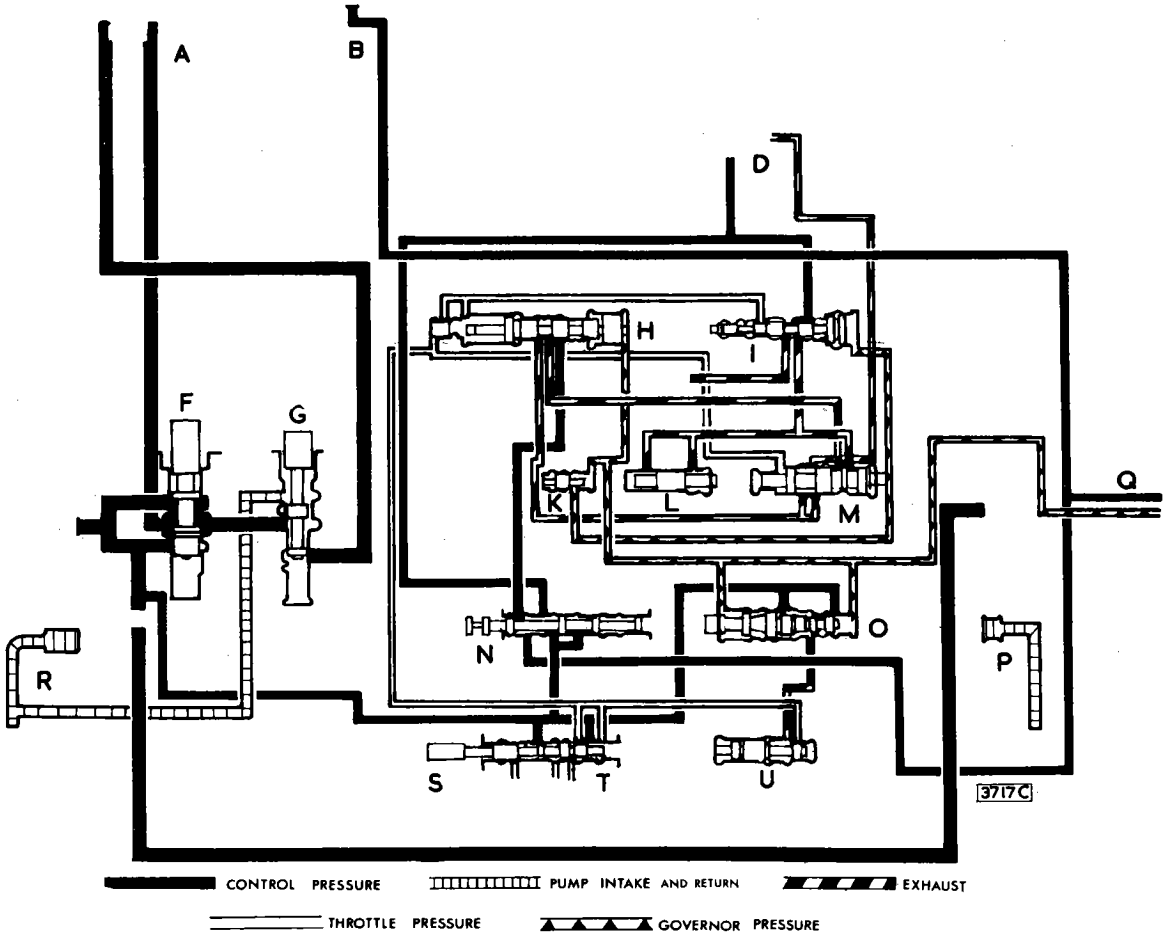
With pressure on both sides of the front servo piston, the servo is held in a released position. The

one-way clutch takes the reaction torque on the rear drum, thus eliminating need for rear servo action.

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

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

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



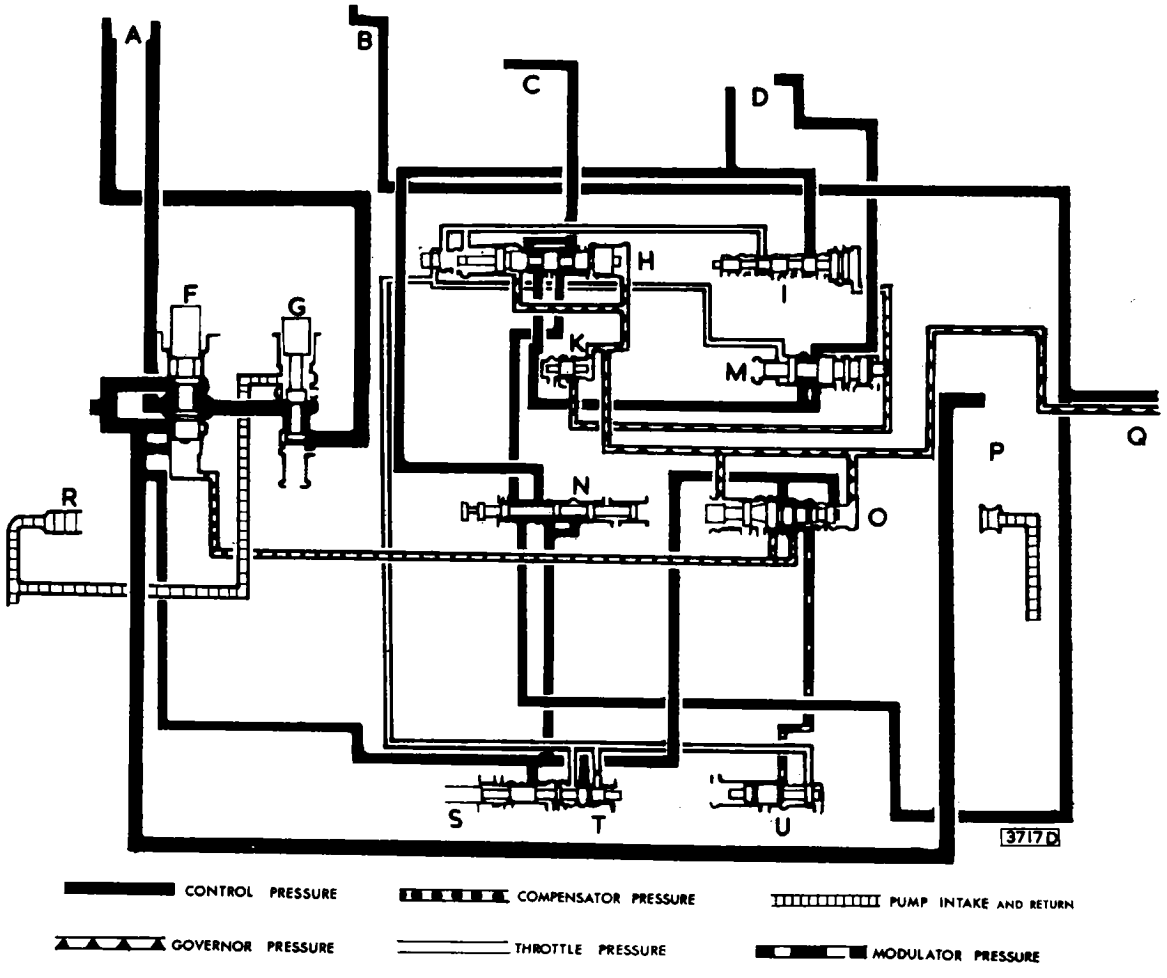
A	Converter	I	1st and 2nd shift valve.	P	Rear pump.
B	Front clutch.	K	D1–D2 control valve.	Q	Governor.
D	Front servo.	L	Front servo orifice valve.	R	Front pump.
F	Primary regulator valve.	M	Servo orifice control valve.	S	Downshift valve.
G	Secondary regulator valve.	O	Compensator valve.	T	Throttle valve.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

Fig. 9. *Hydraulic circuit—2nd gear (D1 range).*

Second Gear, D1 Range (Fig. 9)

As the car speed increases, the governor pressure builds up until it can overcome the opposite force of the 1–2 shift valve spring and reduced throttle pressure on the end of the valve and so moves the valve. When the 1–2 shift valve moves, control pressure at the valve is shut off and the front servo release pressure is

exhausted, first slowly through a restricting orifice and then fast through the front servo release orifice valve. This leaves the front clutch and the front band applied.



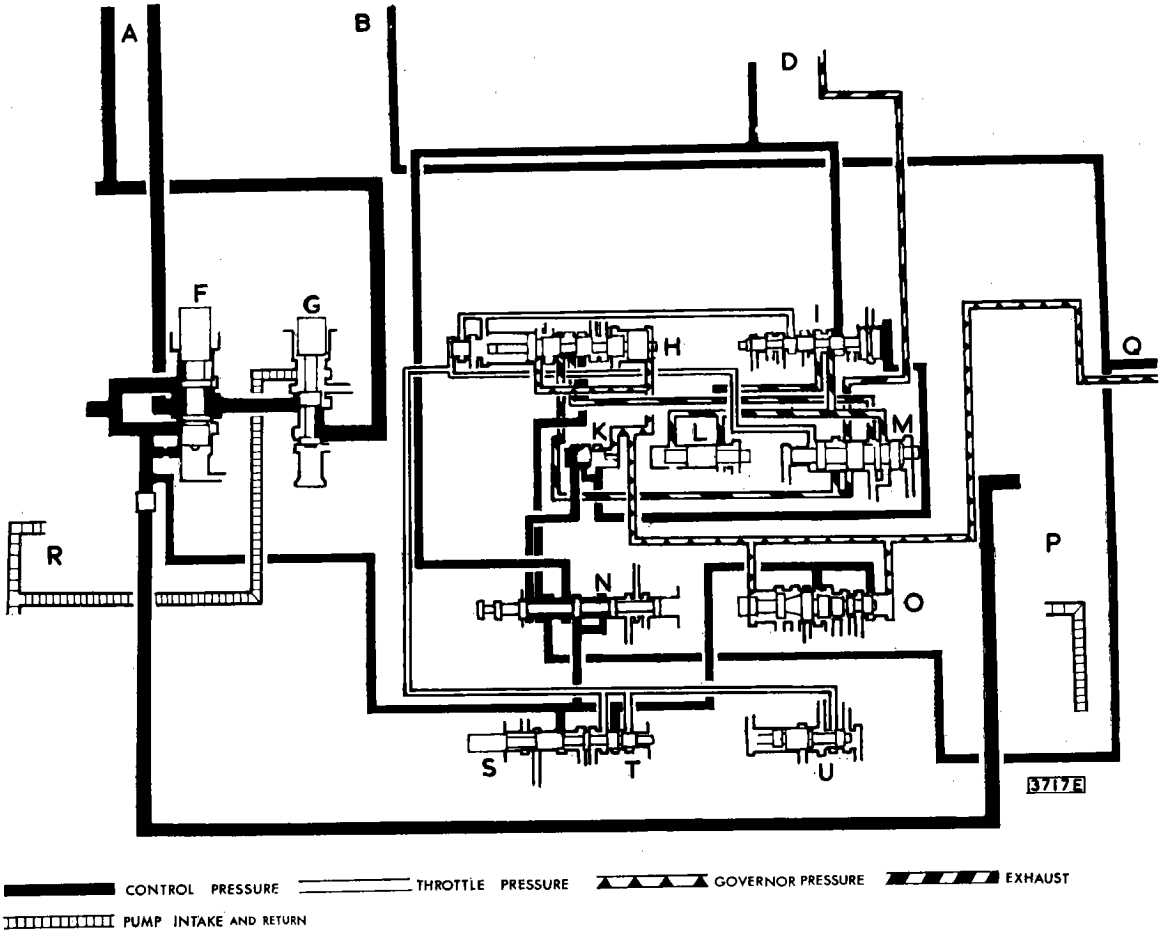
A	Converter.	H	2nd and 3rd shift valve.	P	Rear pump.
B	Front clutch.	I	1st and 2nd shift valve.	Q	Governor
C	Rear clutch.	K	D1–D2 control valve.	R	Front pump.
D	Front servo.	M	Servo orifice control valve.	S	Downshift valve.
F	Primary regulator valve.	N	Manual valve.	T	Throttle valve.
G	Secondary regulator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

Fig. 10. *Hydraulic circuit—3rd gear (D1 or D2 range).*

Third Gear, D1 or D2 Range (Fig. 10)

As the car speed continues to increase, the governor pressure also increases until it overcomes the 2–3 shift valve spring and the reduced throttle pressure on the end of the 2–3 shift valve, thus causing the valve to move. When the valve moves, control pressure is admitted to the rear clutch and through the annulus of the servo orifice control valve to the release side of the front servo, thus applying the rear clutch and placing the front servo in the released position. This leaves the front clutch and the rear clutch applied.

As the governor pressure continues to increase, it acts against modulator pressure at the compensator valve to increase compensator pressure and decrease control pressure through the movement of the valve in the primary regulator.



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

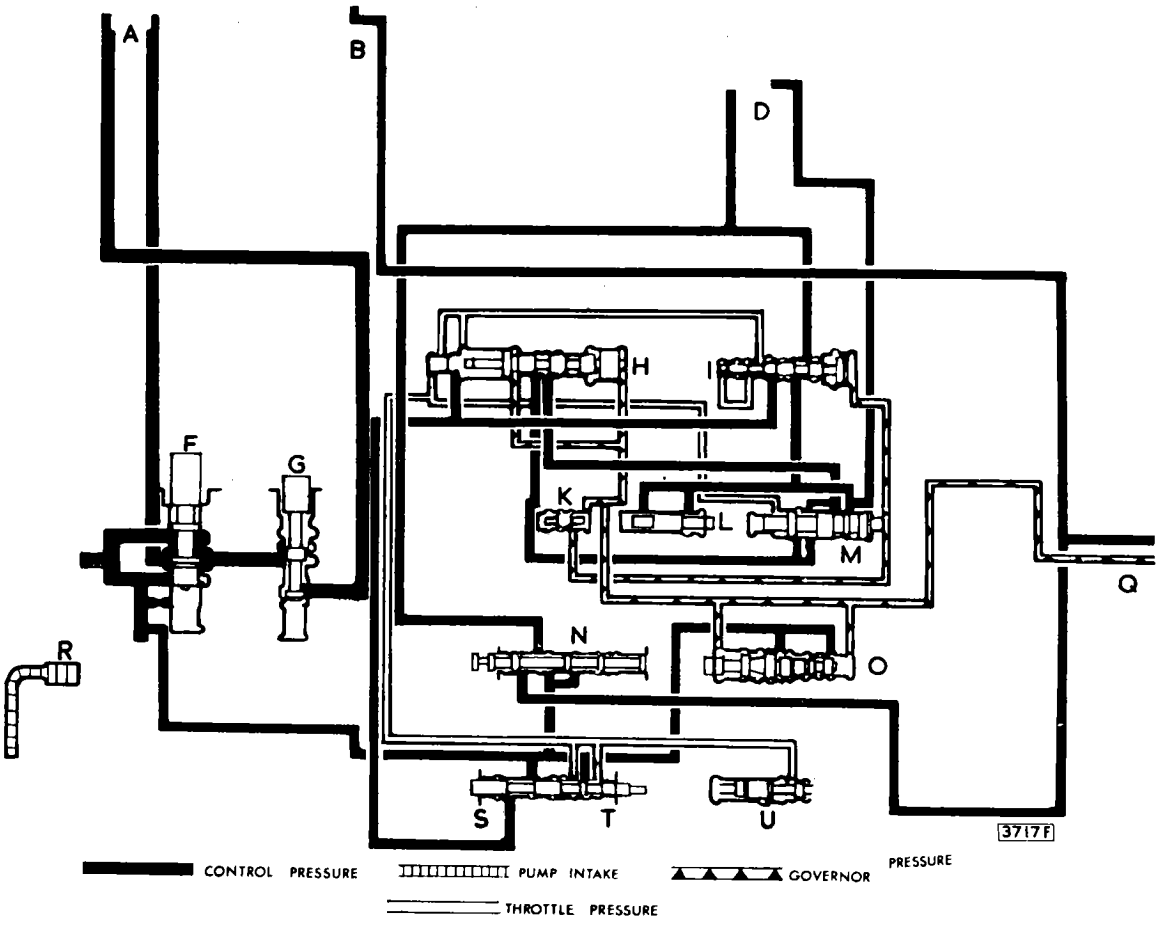
Fig. 11. *Hydraulic circuit—2nd gear (D2 range).*

Second Gear, D2 Range (Fig. 11)

When the selector lever is placed in the D2 (drive) position, with the car standing still and the engine running, control pressure passes through the manual valve to the D1 and D2 control valve, overcomes any governor pressure acting on this valve and passes through the valve to the governor pressure area of the 1–2 shift valve, thus positioning it in the 2nd gear position.

Pressure is exhausted from the release side of the front servo, which results in the front clutch and front band being applied.

All upshifts from 2nd gear ratio direct will be similar to the description of 3rd gear D1 range.



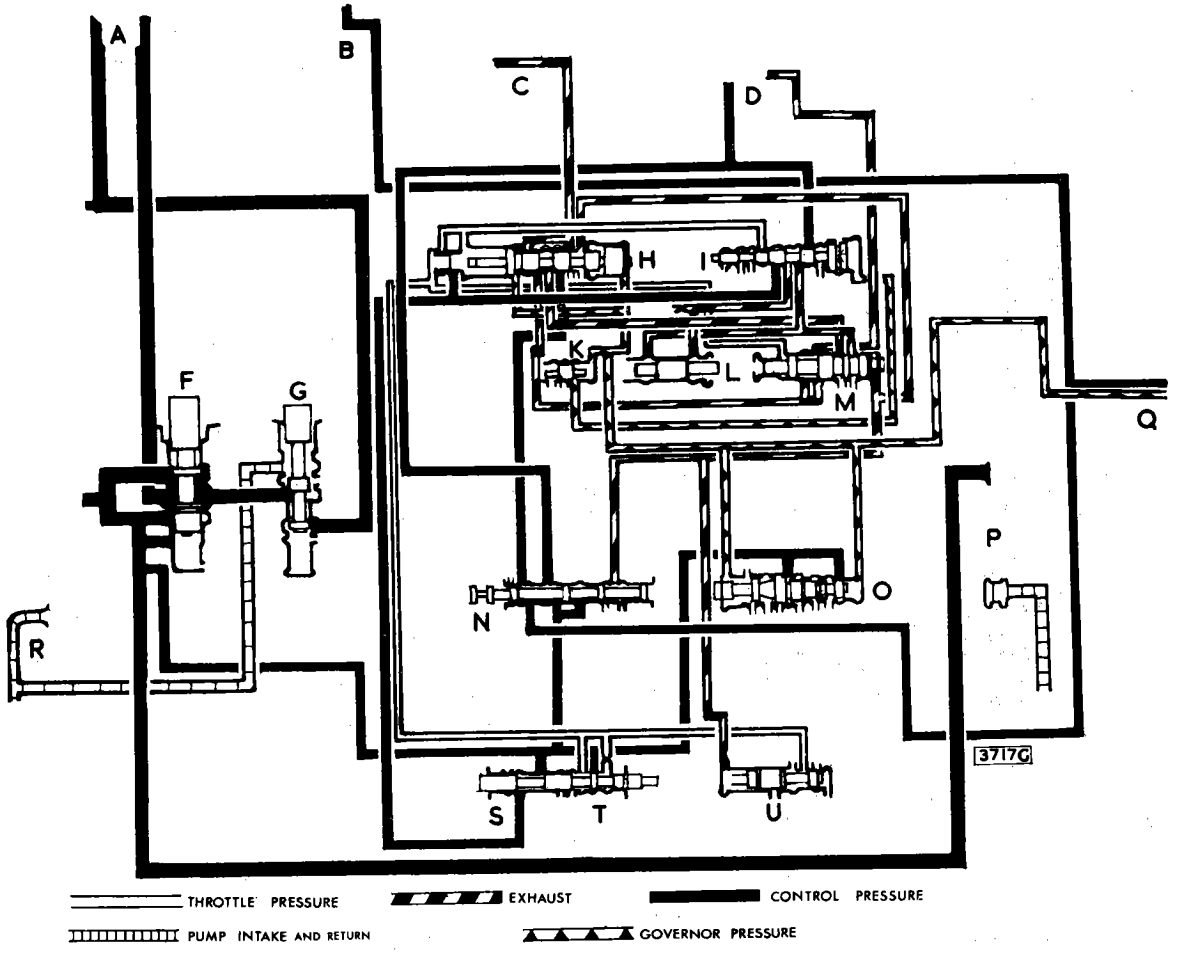
A	Converter.	I	1st and 2nd shift valve.	Q	Governor.
B	Front clutch.	K	D1–D2 control valve.	R	Front pump.
D	Front servo.	L	Front servo orifice valve.	S	Downshift valve.
F	Primary regulator valve.	M	Servo orifice control valve.	T	Throttle valve.
G	Secondary regulator valve.	N	Manual valve.	U	Throttle modulator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

Fig. 12. *Hydraulic circuit—2–1 kickdown (D1 range).*

2–1 Kickdown, D1 Range (Fig. 12)

At car speeds up to approximately 20 m.p.h. (32 k.p.h.), after the transmission has shifted from 1st to 2nd or 3rd gear, the transmission can be downshifted to 1st gear by depressing the accelerator pedal beyond the wide open throttle position.

Movement of the accelerator to kickdown position causes the throttle cable to move the downshift valve to allow control pressure to pass through the downshift valve to another land on the 1–2 shift valve. The combination of control pressure and the 1–2 shift valve spring is sufficient to overcome governor pressure and return the valve to the 1st gear position. In this position, control pressure is admitted to the release side of the front servo. This places the front servo in the released position, leaving the front clutch applied and the one-way clutch holding the rear drum.



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

Fig. 13. *Hydraulic circuit—3–2 kickdown (D1 or D2 range).*

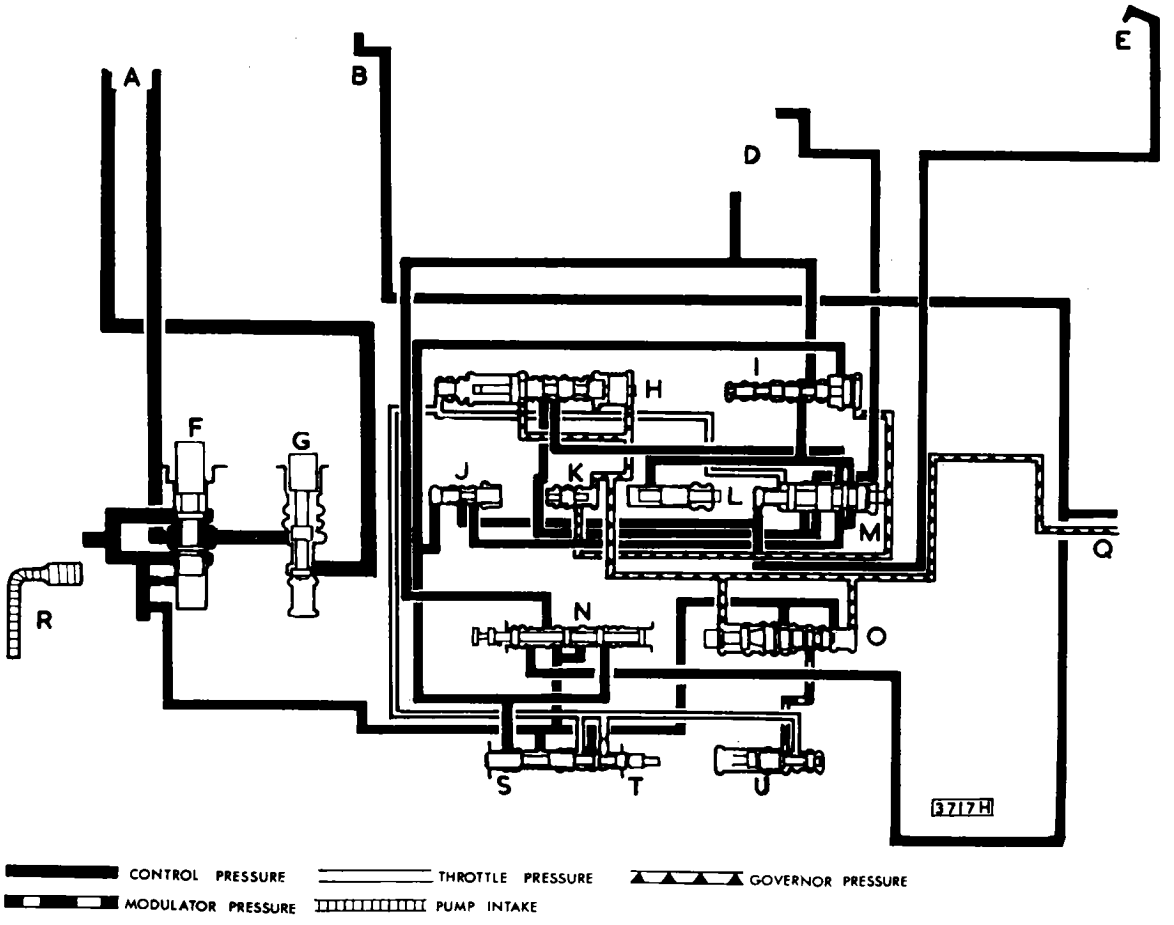
3–2 Kickdown, D1 or D2 Range (Fig. 13)

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

Movement of the accelerator causes the throttle cable to move the downshift valve to allow control pressure to pass through the downshift valve to the spring end of the 2–3 shift valve. The combination of control pressure at the end on the 2–3 shift valve and 2–3 shift valve springs is sufficient to overcome governor pressure to move the valve. When the valve is in 2nd gear position, control pressure to the rear clutch and through the servo orifice control valve to the release side of the front servo is shut off. The rear clutch circuit exhausts through the exhaust port of the manual control valve, whereas the front servo release circuit exhausts through the 1–2 shift valve, orifice and front servo release orifice valve. This leaves the front clutch and front band applied.

If the accelerator is left in the kickdown position, governor pressure will increase as the car speed increases until the governor pressure is greater than the combined pressures on the 2–3 shift valve, and the transmission will again upshift to 3rd gear.

At speeds above approximately 66 m.p.h. (106 k.p.h.) the governor pressure is so great that the combined pressures on the 2–3 shift valve cannot overcome the governor pressure; therefore, there is no kickdown.



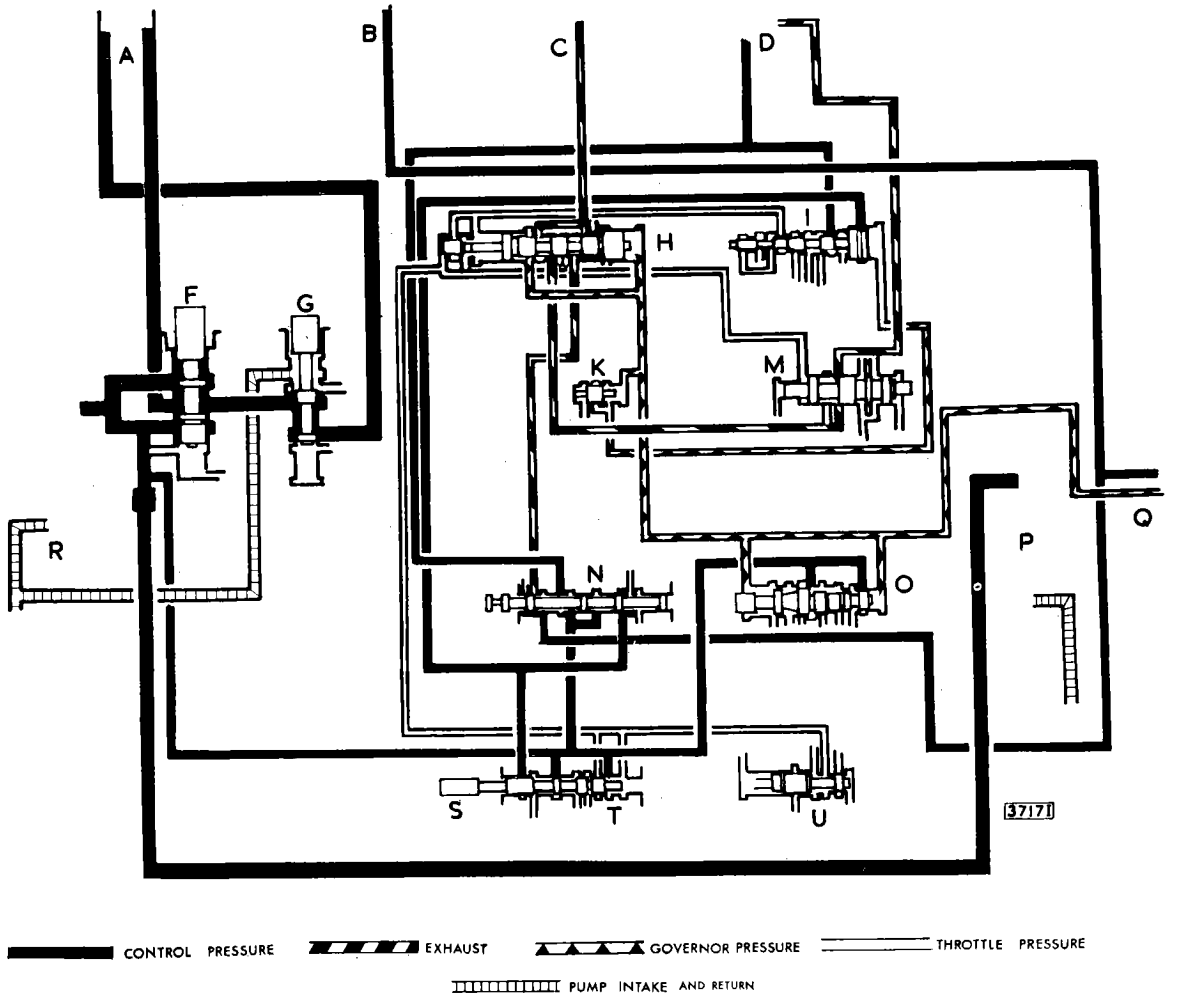
A	Converter.	I	1st and 2nd shift valve.	Q	Governor.
B	Front clutch.	J	Transition valve.	R	Front pump.
D	Front servo.	K	D1–D2 control valve.	S	Downshift valve.
E	Rear servo.	L	Front servo orifice valve.	T	Throttle valve.
F	Primary regulator valve.	M	Servo control valve.	U	Throttle modulator valve.
G	Secondary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

Fig. 14. *Hydraulic circuit—Lockup (1st gear).*

Lockup—First Gear (Fig. 14)

When the selector lever is placed in the Lockup position, the manual control valve is moved to admit through one port, control pressure to the governor feed and to apply the front clutch. Another port supplies both sides of the front servo which is held in the released position and also to the rear servo to apply the rear band through the servo orifice control and transition valves. A third port supplies pressure to move the transition valve and to an additional land on the 1–2 shift valve.

In this position, there is no automatic upshift to a higher gear ratio, since the combination of control pressure on the 1–2 shift valve and the 1–2 shift valve spring is greater than governor pressure acting against the valve, so that the valve cannot move. The combination of control pressure on the 2–3 shift valve and the 2–3 valve spring is also greater than the governor pressure acting against the valve so that the 2–3 shift valve cannot move.

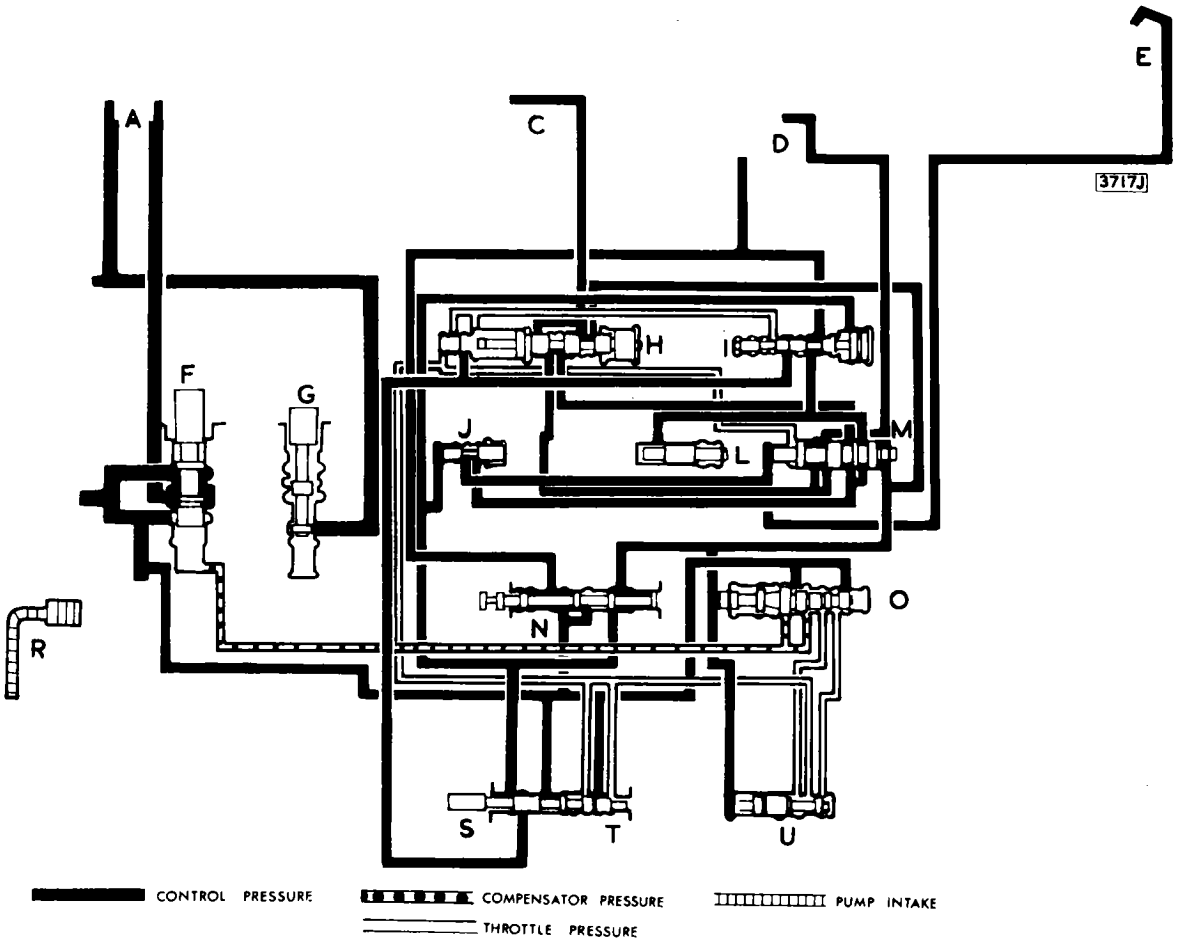


A	Converter.	H	2nd and 3rd shift valve.	P	Rear pump.
B	Front clutch.	I	1st and 2nd shift valve.	Q	Governor.
C	Rear clutch.	K	D1–D2 control valve.	R	Front pump.
D	Front servo.	M	Servo orifice control valve.	S	Downshift valve.
F	Primary regulator valve.	N	Manual valve.	T	Throttle valve.
G	Secondary regulator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

Fig. 15. *Hydraulic circuit—Lockup (2nd gear).*

Lockup—Second Gear

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



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

Fig. 16. *Hydraulic circuit—reverse gear.*

Reverse (Fig. 16)

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

Control pressure is also directed to the modulator valve to move the valve so when the throttle valve is opened by depressing the accelerator, the throttle pressure passes through the modulator valve to two lands on the compensator valve to reduce compensating pressure, thus increasing control pressure.

High control pressure is desired in reverse, since the reaction forces increase appreciably and higher pressure is required to hold the rear drum.

MAINTENANCE

It is most IMPORTANT that the following maintenance instructions are closely followed and absolute cleanliness is maintained when topping-up or filling the transmission.

It is **vitally important** when checking the fluid level that no dirt or foreign matter enters the transmission, otherwise trouble will almost certainly arise. Before removing the transmission dipstick, the surrounding area must be cleaned off to prevent dirt from entering the dipstick aperture. When filling the transmission with fluid ensure that the fluid container and funnel are perfectly clean.

In countries where ambient temperatures are unusually high, dust and/or mud must not be allowed to decrease the effective areas of the stoneguards in the converter housing or the slots in the transmission case. Also any foreign matter on the oil pan must be removed as it would act as a temperature insulator.

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

Check Transmission Fluid Level

The transmission filler tube is located on the right-hand side of the engine under the bonnet just forward of the bulkhead. Check the fluid level every 3,000 miles (5,000 km.).

Before checking the fluid level, the car should be on level ground and the transmission should be at the normal operating temperature.

Set the handbrake firmly and select P position.

The engine should be at normal idle.

When the engine is running, remove the dipstick, wipe clean and replace in the filler tube in its correct position.

Withdraw immediately and check.

If necessary, add fluid to bring the level to the FULL mark on the dipstick. The difference between FULL and LOW marks on the stick represents approximately 1½ pints (2 U.S. pints or 0·75 litres).

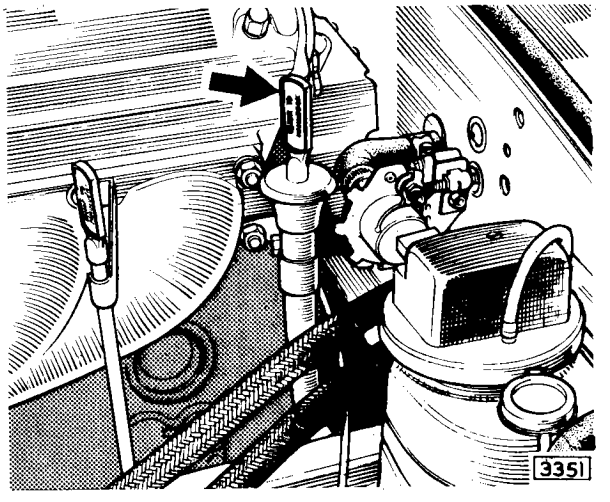


Fig. 17. *Automatic transmission dipstick.*

Be careful not to overfill.

If fluid is checked with transmission cold, a false reading will be obtained and filling to the FULL mark will cause it to be overfilled.

If it is found necessary to add fluid frequently, it will be an indication that there is a leakage in the transmission and it should be investigated immediately to prevent damage to transmission.

Total fluid capacity (including cooler) 16 Imperial pints from dry (19 U.S. pints, 9 litres).

RECOMMENDED AUTOMATIC TRANSMISSION FLUIDS

Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent Caltex/Texaco
Mobilfluid 200	Castrol T.Q.	Shell Donax T.6	Esso Automatic Transmission Fluid	Automatic Transmission Fluid, Type A	Nolmatic	Teaxamatic Fluid

If these recommended lubricants are not available, only a transmission fluid conforming to the following specification should be used:—

Automatic Transmission Fluid, Type "A" or Type "A" Suffix "A" (AQ–ATF)

ROAD TEST AND FAULT DIAGNOSIS

TESTING THE CAR

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

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

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

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

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

With the transmission at normal running temperature, select "D1". Release the brakes and accelerate with minimum throttle opening. Check for 1–2 and 2–3 shifts.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

At idle or slightly above idle speed in neutral, a gear whine indicates dragging front clutch plates. A tendency for the car to creep in neutral is a further

indication of dragging front clutch plates. Check carefully, to avoid confusing this with front pump or engine noises.

PRESSURE TESTS

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

Note: Figures given in table are normal for transmission temperatures from 150° to 185°F. only (65·5°C. to 85°C.).

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

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

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

FAULT DIAGNOSIS

Converter

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

Inability to start on steep gradients combined with poor acceleration from rest indicates that the converter stator one-way clutch is slipping. This condition permits the stator to rotate in an opposite direction to the turbine and torque multiplication cannot occur. Check the stall speed, and if it is more than 600 r.p.m. below normal the converter assembly must be renewed.

Below standard acceleration in 3rd gear above 30 m.p.h. (48 k.p.h.), combined with a substantially reduced maximum speed, indicates that the stator one-way clutch has locked in the engaged condition. The stator will not rotate with the turbine and impeller, therefore the fluid flywheel phase of the converter performance cannot occur. This condition will also be indicated by excessive overheating of the transmission, although the stall speed will remain normal. The converter assembly must be replaced.

Stall speed higher than normal indicates that the converter is not receiving its required fluid supply or that slip is occurring in the clutches of the automatic gearbox.

Note: When checking stall speeds ensure that the transmission is at normal operating temperature. Do not stall for longer than 10 seconds, or the transmission will overheat.

The torque converters are sealed by welding and serviced by replacement only.

The stoneguards in the converter housing must be unobstructed.

Stall Speed Test

This test provides a rapid check on the correct functioning of the converter as well as the gearbox.

The stall speed is the maximum speed at which the engine can drive the torque impeller while the turbine is held stationary. As the stall speed is dependent both on engine and torque converter characteristics, it will vary with the condition of the engine as well as with the condition of the transmission. It will be necessary, therefore, to determine the condition of the engine in order to correctly interpret a low stall speed.

To obtain the stall speed, allow the engine and the transmission to attain normal working temperature, set the handbrake, chock the wheels and apply the footbrake. Select "L" or "R" and fully depress the accelerator. Note the reading on the revolution indicator.

Note: To avoid overheating, the period of stall test must not exceed 10 seconds.

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

Clutch and Band Checks

To determine if a clutch or band has failed, without removing a transmission, check as detailed below.

Refer to the chart on page FF.s.5, showing the clutches and bands applied in each gear position.

Apply the handbrake and start the engine.

Engage each gear ratio and determine if drive is obtained through the component to be checked. If a clutch or band functions in one selector position it is reasonable to assume that the element in question is normal and that trouble lies elsewhere. If the clutch or band is tried in two positions and no drive is obtained in either position, it can be assumed that the element is faulty.

Air Pressure Checks

Air pressure may be used to test various transmission components in the car on the bench. Care should be exercised when air pressure checks are being made to prevent oil blowing on the clothing or into the eyes.

Knowledge of various circuits should be acquired referring to Figs. 6 to 16. It is necessary to remove the valve body to complete these checks.

Apply air pressure to the front clutch passage. A definite thump will indicate engagement. A similar sound should be heard when the rear clutch circuit is tested.

If clutch engagement noise is indefinite it is almost certainly due to damaged piston rings.

Servo action may be watched as air is applied to apply circuits of each servo.

It can be assumed, that if air pressure checks indicate that clutches and servos are being applied normally with air pressure, then the trouble lies in the hydraulic system.

A. *Front servo apply.*
B. *Front clutch.*
C. *Rear servo.*
D. *Rear clutch.*
E. *Governor feed.*

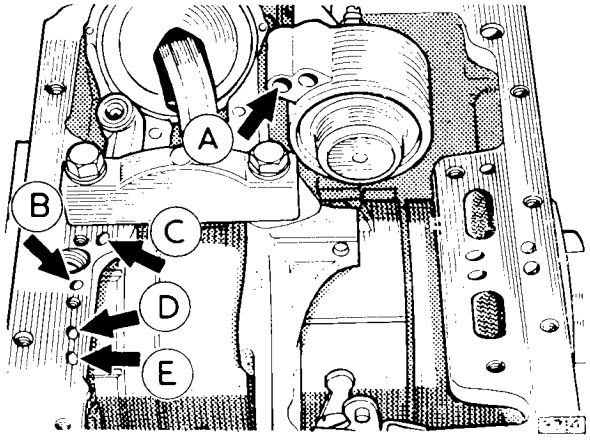


Fig. 18. *Showing pressure passages with valve body removed.*

FAULT DIAGNOSIS

	In Car	On Bench
ENGAGEMENT		
Harsh	B. D. c. d.	2, 4
Delayed	A, C, D, E, F, a, c, d	b
None	A, C, a, c, d	b, 9, 10, 11, 13
No forward	A, C, a, c, d	B, 1, 4, 7
No reverse	A, C, F, a, c, j, k, h	b, 2, 3, 6
Jumps in forward	C, D, E, F	4, 7, 8
Jumps in reverse	C, D, E	2
No neutral	C, c	2
UPSHIFTS		
No. 1–2	C, E, a, c, d, f, g, h, j	b, 5, 17
No. 2–3	C, a, c, d, f, g, h, k, l	b, 3, 17
Shift points too high	B, C, c, d, f, g, h, j, k, l	b
Shift points too low	B, c, f, g, h, l	B
UPSHIFT QUALITY		
1–2 slips or runs up	A, B, C, E, a, c, d, f, g, k	b, 1, 5
2–3 slips or runs up	C, a, c, d, f, g, h, k, l	b, 3, 5
1–2 harsh	B, C, E, c, d, f, g, h	1, 7, 8
2–3 harsh	B, C, E, s, d, f	4
1–2 Ties up or grabs	F, c	4, 7, 8
2–3 Ties up or grabs	E, F, C	4
DOWNSHIFTS		
No. 2–1	B, C, c, h, j	7
No. 3–2	B, c, h, k	4
Shift points too high	B, C, c, f, h, j, k, l	b
Shift points too low	B, C, c, f, h, j, k, l	b
DOWNSHIFT QUALITY		
2–1 Slides		7
3–2 Slides	B, C, E, a, c, d, f, g	b, 3, 5
2–1 Harsh		b, 1, 7
3–2 Harsh	B, E, c, d, f, g, 5	3, 4, 5
REVERSE		
Slips or chatters	A, B, F, d, c, g	b, 2, 3, 6

FAULT DIAGNOSIS *(continued)*

	In Car	On Bench
LINE PRESSURE		
Low idle pressure	A, C, D, a, c, d	b, 11
High idle pressure	B, c, d, e, f, g	
Low stall pressure	A, B, a, c, d, f, g, h	b, 11
High stall pressure	B, c, d, f, g	
STALL SPEED		
Too low (200 r.p.m. or more)		13
Too high (200 r.p.m. or more)	A, B, C, F, a, c, d, f	b, 1, 3, 6, 7, 9, 13
OTHERS		
No push starts	A, C, E, F, c	12
Transmission overheats	E, F, e	1, 2, 3, 4, 5, 6, 13, 18
Poor acceleration		13
Noisy in neutral	m	2, 4
Noisy in park	m	14
Noisy in all gears	m	2, 4, 14, 16
Noisy during coast (30–20 m.p.h.)		16, 19
Park brake does not hold	C, 15	15

KEY TO THE FAULT DIAGNOSIS CHART

1. **Preliminary Checks in Car**
   - A. Low fluid level.
   - B. Throttle cable incorrectly assembled or adjusted.
   - C. Manual linkage incorrectly assembled or adjusted.
   - D. Engine idle speed.
   - E. Front band adjustment.
   - F. Rear band adjustment.

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

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

SERVICE ADJUSTMENTS

THROTTLE/KICKDOWN CABLE ADJUSTMENT

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

Preliminary Testing

Test the car on a flat road.

With the selector in the D1 or D2 position and at a minimum throttle opening, the 2–3 upshift should occur at 1,100–1,200 r.p.m.

A "run-up" of 200–400 r.p.m. at the change point indicates LOW pressure.

At full throttle opening, a jerky 2–3 upshift or a sharp 2–1 downshift (in D1 when stopping the car) indicates HIGH pressure.

Install a pressure gauge, 0–200 lb./sq. in. (0–14 kg./sq. cm.) in the line pressure point at the left hand rear face of the transmission unit. Start the engine and allow to reach normal operating temperature.

Select D1 or D2, apply the handbrake firmly and increase the idling speed to exactly 1,250 r.p.m.

The pressure gauge reading should be 72·5±2·5 lb./sq. in. (5·097±·175 kg/cm. sq.).

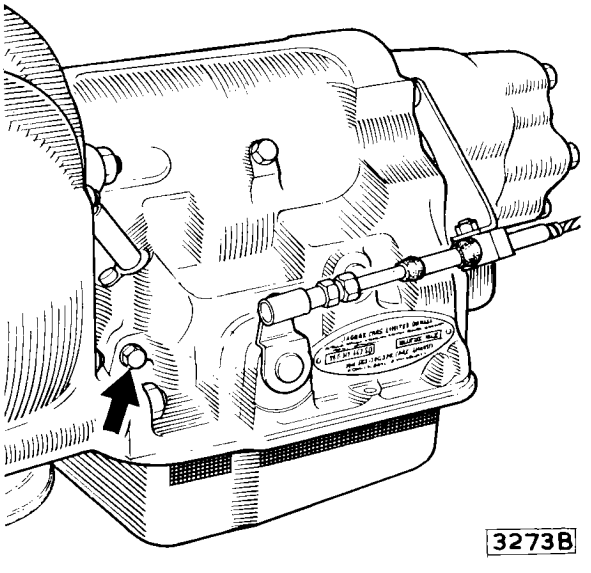


Fig. 19. *The transmission pressure take-off point.*

Adjustment

If road and pressure tests indicate that the throttle/kickdown cable setting is incorrect, adjustment is made at the fork end (see Fig. 20).

Release the fork end locknut, remove the split pin and fork end clevis pin.

To LOWER the pressure, turn the fork end clockwise: to RAISE the pressure, turn anti-clockwise.

Note: One full turn will alter the setting by 9 lb./sq. in. (·63 kg./sq. cm.).

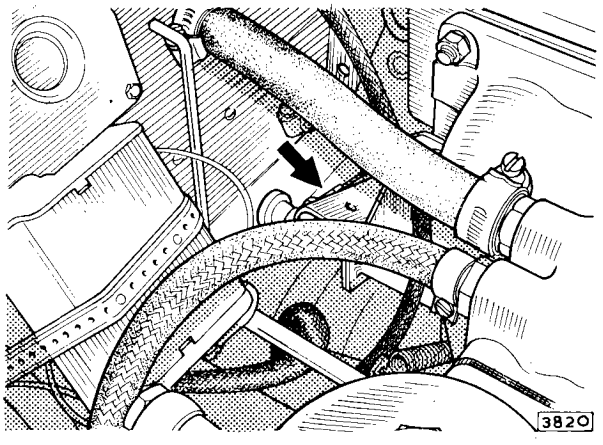


Fig. 20. *The kickdown cable adjustment.*

Slight adjustment only should be necessary; excessive adjustment will result in loss of "kickdown" or an increase in shift speeds.

Refit the fork end joint pin and split pin and tighten the locknut.

Restart the engine and check the pressure at 1,250 r.p.m.

Check that the carburetter butterfly valves are closed at idling speed after adjustment is completed.

If, after repeated attempts to stabilize the change points, the pressure still fluctuates, the throttle/kickdown inner cable may be binding or kinked and the cable should be replaced.

Throttle/Kickdown Cable Renewal

Disconnect the cable at the fork end.

Remove the cable retaining clip after withdrawing the setscrew.

Lift the carpets and the underfelts from the gearbox tunnel on the left-hand side.

Remove six drive screws and detach the aperture cover plate now exposed.

Remove the Allen-headed screw and washer retaining the outer cable.

Withdraw the outer cable and locate the spring clip securing the inner cable to the control rod operating the kickdown cam in the transmission unit.

Spring the clip open with a small screw driver and withdraw the inner cable.

Refitting is the reverse of the removal procedure.

Adjust the length of the operating cable to $3\frac{5}{16}$" (84·1 mm.) between the centre line of the clevis and the end of the outer cable.

Check that the carburetter butterfly valves are closed before commencing adjustments described under the previous heading.

MANUAL LINKAGE ADJUSTMENT

(See Fig. 23)

Remove the transmission tunnel finisher assembly and the carpet at the side of the transmission cover. Remove the rubberised felt and withdraw the set-screws securing the cover plate at the left-hand side of the transmission cover.

Loosen the linkage cable locknut and remove the cable from the transmission lever. Push the transmission lever fully forward to the Lockup detent. Place the gear selector lever in the Lockup position.

Adjust the cable end to fit freely on to the transmission lever. Temporarily re-attach the cable to the lever. Move the gear selector lever through the various positions checking that gating at positions L, D1, R and P does not interfere with the transmission lever setting at the detent positions. The transmission lever must locate the transmission detents positively. Once correct adjustment is established, be sure the linkage cable is secured to the transmission lever and the locknut is tightened.

REMOVAL OF OIL PAN

Prior to front band adjustment or a check of internal parts, the gearbox fluid must be drained and the oil pan removed. When this is done an inspection should be made. A few wear particles in the dregs of the fluid in the pan are normal. An excess of wear particles whether ferrous or non-ferrous, or pieces of band lining material, would indicate that further checking should be done. A new gasket should be used when refitting the pan and the 14 attaching screws torqued to 10–15 lb. ft. (1·38–2·07 kgm.). Always use fresh fluid when refilling.

FRONT BAND ADJUSTMENT

(See Fig. 21)

The front band should be adjusted after the first 1,000 miles (1,600 km.) of operation and at 21,000 mile (35,000 km.) intervals thereafter.

Drain the oil by removing the oil filler connection and remove the oil pan. Loosen the adjusting screw locknut on the servo, apply lever and check that the screws turn freely in the lever. Install a $\frac{1}{4}$" (6·4 mm.) thick gauge block between the servo piston pin and the servo adjusting screw, then tighten the adjusting screw with a suitable torque wrench or adjusting tool until 10 lb. ins. (0·12 kgm.) is reached. Retighten the adjusting screw locknut to 20–25 lb. ft. (2·76–3·46 kgm.). Remove the $\frac{1}{4}$" (6·3 mm.) spacer.

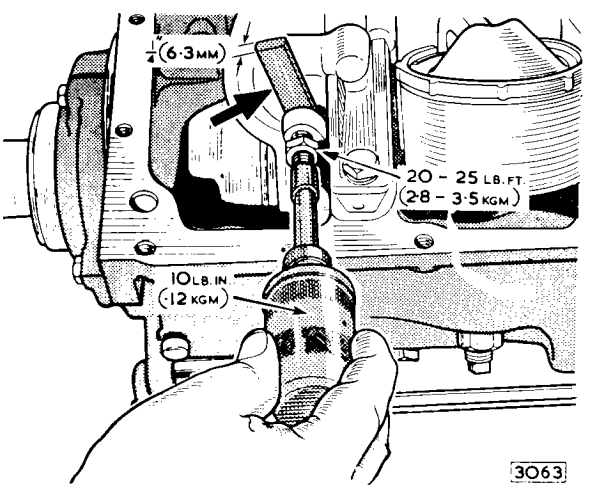


Fig. 21. *Front band adjustment.*

REAR BAND ADJUSTMENT

The rear band adjustment at the first 1,000 miles (1,600 km.) and at 21,000 miles (35·000 km.) intervals thereafter is made externally. To make the adjustment, first loosen and back off the adjusting screw locknut three or four turns and then make sure that the adjusting screw works freely in the threads in the case. Turn the adjusting screw in with a torque wrench or special tool for this purpose to 10 lb. ft. (1·382 kgm.) torque reading. Back the adjusting screw off 1½ turns exactly, then retighten the locknut to 35–40 lb. ft. (4·84–5·53 kgm.). The adjusting screw is on the right-hand side of the casing and an access hole is provided in the transmission cowl.

GOVERNOR

The governor can be inspected without removal of the oil pan. Remove the inspection cover and gasket. This will expose the governor, but the output shaft may have to be turned to position the governor head at the opening. First check for freedom of the valve by pushing and pulling on the governor weight. If removal of the governor body is desired, take out the two screws which retain it, being careful that they are not dropped inside the extension housing After removal of the body, dismantle it completely and clean all parts. When reassembling the governor, torque the governor body plate screws to 20–30 lb. in. (0·24–0·36 kgm.). When replacing the governor body on to the transmission, torque the screws which retain it to 50–60 lb. in. (0·60–0·72 kgm.). Replace the governor inspection cover, using a new gasket and torque its retaining screws to 50–60 lb. in. (0·60–0·72 kgm.).

It should be noted that if any of the four governor screws mentioned above are loose, the governor will not function correctly.

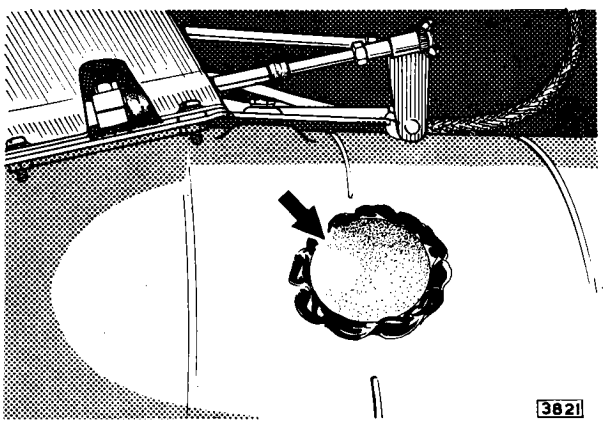


Fig. 22. *Rear band adjustment access point.*

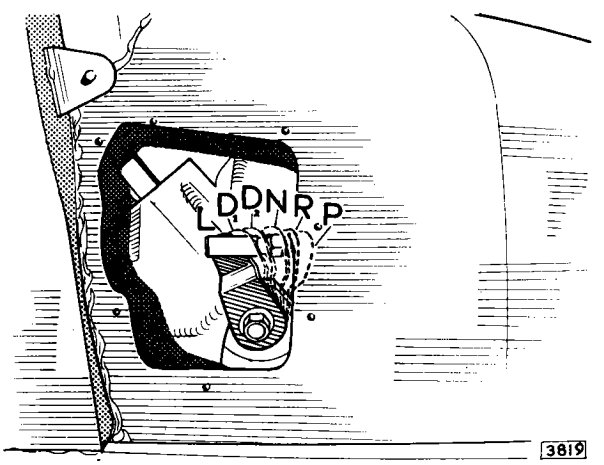


Fig. 23. *Manual selector linkage adjustment.*

TRANSMISSION UNIT

REMOVAL AND REFITTING

To remove the transmission unit, it is necessary to withdraw the engine and transmission as a complete unit from the car before separating the transmission.

Removal

Disconnect the battery.

Remove the bonnet.

Drain the cooling system and cylinder block. Conserve the coolant if antifreeze is in use.

Slacken the clip on the breather pipe; unscrew the two wing nuts and withdraw the top of the air cleaner.

Disconnect the petrol feed pipe under the centre carburetter.

Slacken the clamps and remove the water hoses from the cylinder head and radiator to the header tank.

Remove the transmission oil cooler pipes from the radiator block.

Remove the heater hoses from the inlet manifold.

Disconnect the brake vacuum pipe.

Pull off the two Lucar connectors from the fan control thermostat in the header tank.

Remove the two bolts securing the header tank mounting bracket to the front cross member. Remove two nuts and two bolts securing the header tank straps to the radiator and fan cowl. Remove the header tank complete with bracket and straps.

Disconnect the throttle linkage at the rear carburetter and the kickdown cable at the rear of the cylinder head.

Disconnect:—

The two coil leads.

The water temperature transmitter cable.

The battery cable and solenoid switch cable from the starter motor.

The oil pressure cable at the top of the oil filter body.

The main harness connector and the Lucar connector for the 3AW warning light control from the alternator.

The engine earth strap from the left-hand side member.

Withdraw the bolt securing the oil filter canister and remove the canister complete with filter. Catch the escaping oil in a drip pan.

Remove the crankshaft pulley; damper and drive belt. Remove the ignition timing pointer from the sump. Mark the pulley and damper to facilitate refitting.

Slacken the two clamps of the water pump hose and withdraw the hose.

Remove the revolution counter generator complete with cables.

Remove the four nuts and washers securing each exhaust downpipe to the manifold. Unclip the pipes at the silencers and withdraw the downpipes. Collect the sealing rings between the downpipes and the manifold.

Withdraw the transmission dipstick and unscrew the dipstick tube from the oil pan.

Place the selector lever in L and withdraw the nut securing the selector cable adjustable ball joint to the transmission lever. Release the nut securing the outer cable clamp to the abutment bracket.

Remove the two lower nuts securing the torsion bar reaction tie plate on each side and tap the bolts back flush with the face of the tie plate. With the aid of a helper, place a lever between the head of the bolt just released and the torsion bar. Exert pressure on the bolt head to relieve the tension on the upper bolt. Remove the nut and tap the upper bolt back flush with the face of the tie plate. Tap the tie plate off the four bolts.

Note: Failure to relieve the tension on the upper bolts when tapping them back against the face of the tie plate will result in stripping the threads. If this occurs, new bolts must be fitted and the torsion bars re-set.

Disconnect the speedometer cable from the rear extension of the transmission unit.

Support the engine by means of two individual lifting tackles using the hooks on the cylinder head. Insert a trolley jack under the transmission and support the unit.

Remove the self-locking nut and stepped washer from the engine stabiliser.

Remove the bolts securing the rear mounting plate. Disconnect the propeller shaft at the front universal joint.

Remove the bolts from the front engine mountings.

Raise the engine on the lifting tackles and, keeping the unit level, move forwards ensuring that the converter housing clears the torsion bar anchor brackets and that the water pump pulley clears the sub-frame top cross member. Carefully raise the front of the engine and withdraw the complete unit forwards and upwards.

Refitting

Reverse the removal procedure to refit the transmission and engine. IT IS IMPORTANT that the engine stabiliser is adjusted properly and that the kickdown linkage is set correctly when refitting.

TRANSMISSION UNIT

Removal

Disconnect the kickdown linkage at the operating shaft. Drain the oil from the transmission unit. Remove the bolts securing the transmission to the converter housing and withdraw the unit.

TORQUE CONVERTER AND FLYWHEEL

Removal

Withdraw the cover from the front of the converter housing. Remove the starter motor and withdraw the setscrews securing the converter housing to the engine.

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

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

TRANSMISSION
DISMANTLING AND ASSEMBLY

TRANSMISSION—DISMANTLING

Dismantling should not begin until the transmission exterior and work area have been thoroughly cleaned.

Place the transmission (bottom side up) on a suitable stand or holding fixture.

Remove the oil pan bolts, oil pan and gasket. Remove the oil screen retaining clip, lift off the oil screen from the regulator; lift and remove the screen from the rear pump suction tube. (See Fig. 24).

Use a screwdriver to prise the compensator tube from the valve body and regulator assemblies (Fig. 25).

The control pressure tube should be prised from the valve body, then removed from the regulator (Fig. 26).

Remove the rear pump suction tube by pulling and twisting it at the same time.

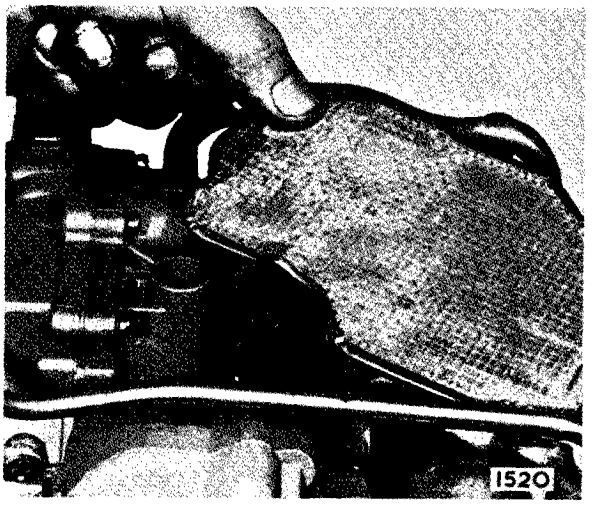


Fig. 24. *Removing the screen from the rear suction tube.*

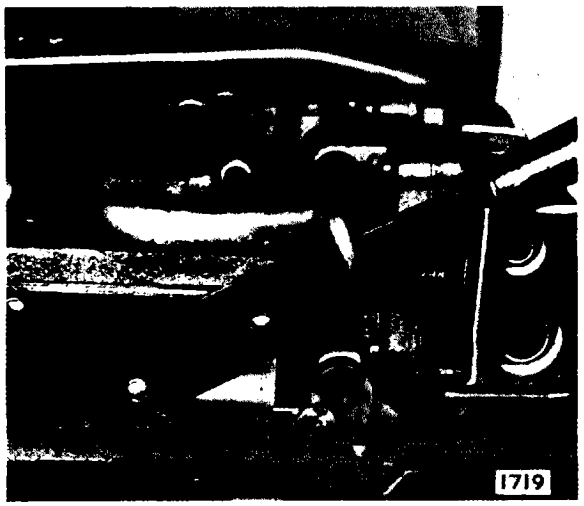


Fig. 25. *Removing the compensator tube.*

Carefully remove the pressure regulator spring retainer. Maintain pressure on the retainer to prevent distortion of the retainer, and sudden release of the springs (Fig. 27).

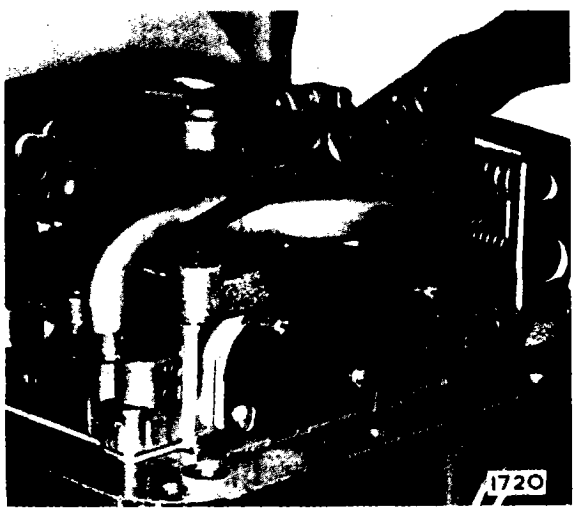


Fig. 26. *Removing the line pressure tube.*

Remove springs and spring pilots, but do not remove the regulator valves at this time. The valves will be protected as long as they remain in the regulator body.

Remove the two regulator attaching capscrews and lockwashers, then lift the regulator assembly from the transmission case (Fig. 28).

Loosen the front and rear servo adjusting screw locknuts and adjusting screws. This will aid in dismantling and later, in assembling, the transmission.

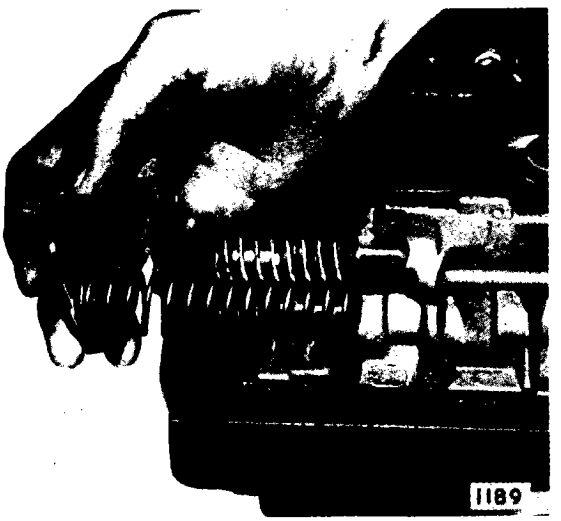


Fig. 27. *Removing the pressure spring retainer.*

Remove the three valve body attaching capscrews and lockwashers (Fig. 29).

Loosen the front servo to case capscrew and lockwasher approximately $\frac{5}{16}$" (7·94 mm.) (Fig. 30).

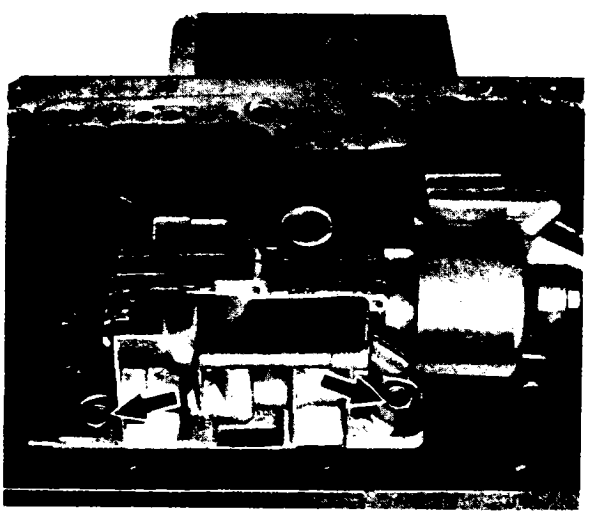


Fig. 28. *The regulator retaining screws.*

Place the manual selector lever in park or reverse position. Lift the valve body until the throttle control rod will clear the manual detent lever, then remove the hook from the throttle cam using the index finger or a screwdriver.

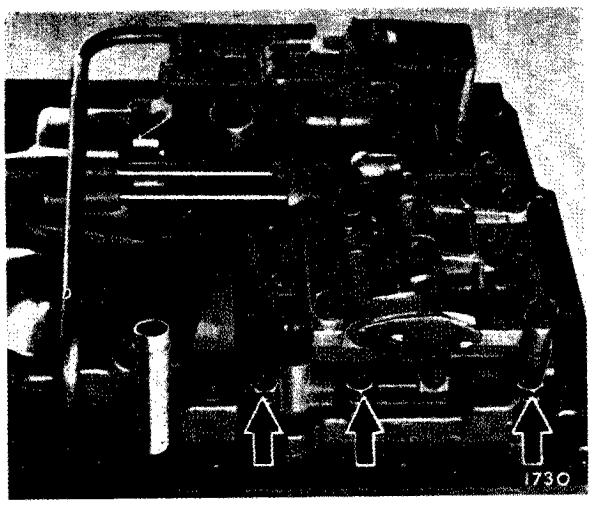


Fig. 29. *The valve body attaching screws.*

Lift the valve body and servo until the valve body will clear the linkage and slide it off the servo apply and release tubes (Fig. 31).

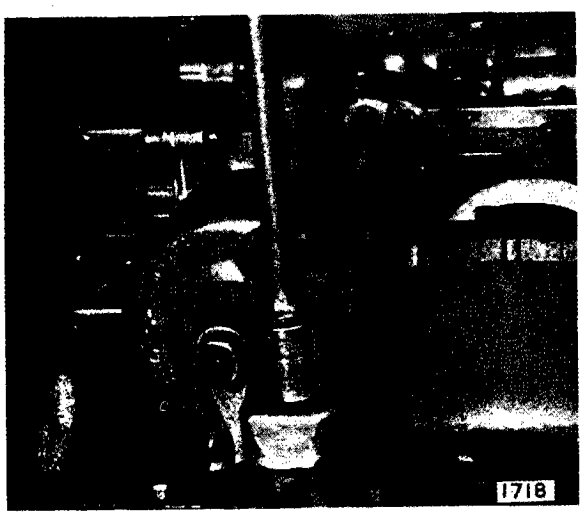


Fig. 30. *Slackening the front servo screws.*

Remove the front servo apply and release tubes (Fig. 32).

Remove the front servo bolt and lift the servo from the transmission, catching the servo strut with the index and middle finger of the left hand (Fig. 33).

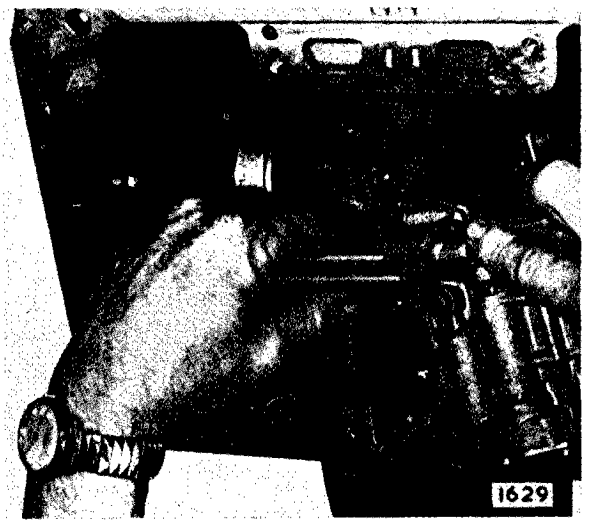


Fig. 31. *Lifting the valve body to clear the front servo.*

Remove the two rear servo attaching capscrews and lockwashers, then lift the rear servo assembly from the transmission (Fig. 34).

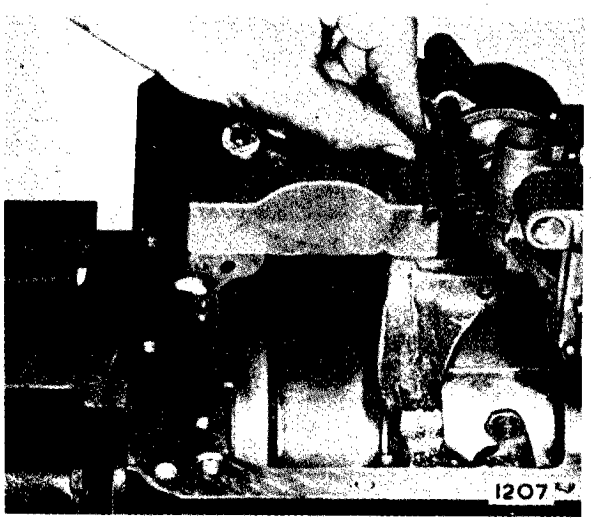


Fig. 32. *Withdrawing the apply and release tubes.*

Remove the rear band apply and anchor struts.

Remove the rear pump outlet tube, using special extractor tool Part No. CWG.45 (Fig. 35).

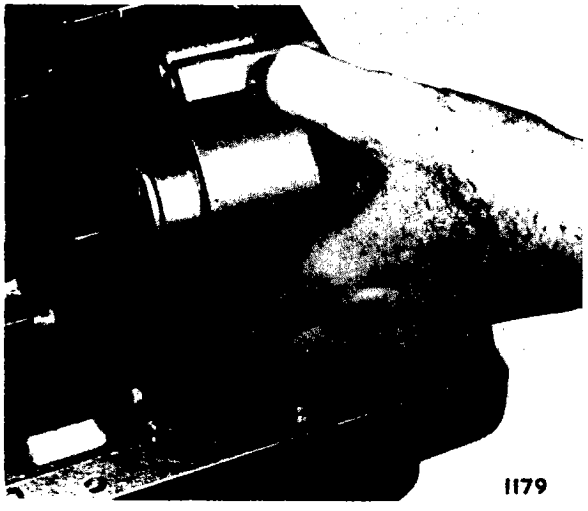


Fig. 33. *Removing the front servo.*

Check the end play at this time. Should the end play need correcting it will be done during assembly of the transmission (see Fig. 36). Place an indicator against the end of the input shaft. Prise between the front of the case and the front clutch to move clutch assemblies to their extreme rearward position. Set the indicator to "O". Prise between the planet carrier and the internal gear with a screwdriver to move the clutches to their extreme forward position. Read the end play on the indicator. The allowable limits are 0·008″–0·044″ (0·2–1·1 mm.). It is preferable to have approximately 0·020″ (0·5 mm.). Should correction be necessary, remove the output shaft, extension housing and companion flange as an assembly so that the selective washer can be changed.

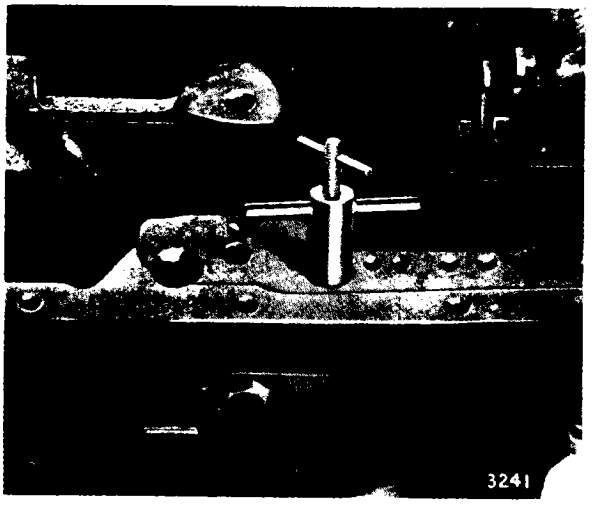


Fig. 35. *Removing the rear pump outlet tube (Extractor Tool Part No. CWG45).*

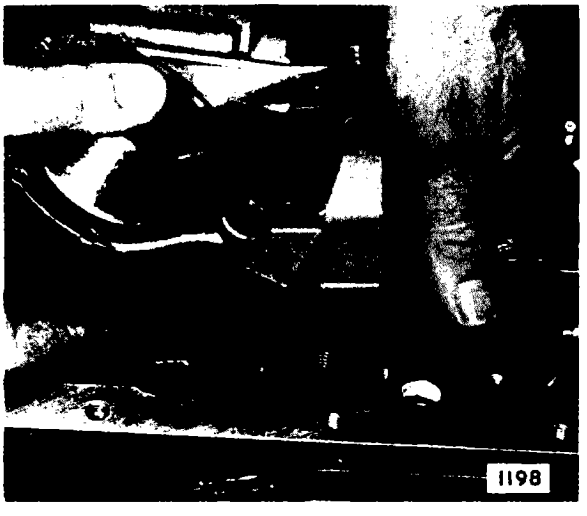


Fig. 34. *Removing the rear servo.*

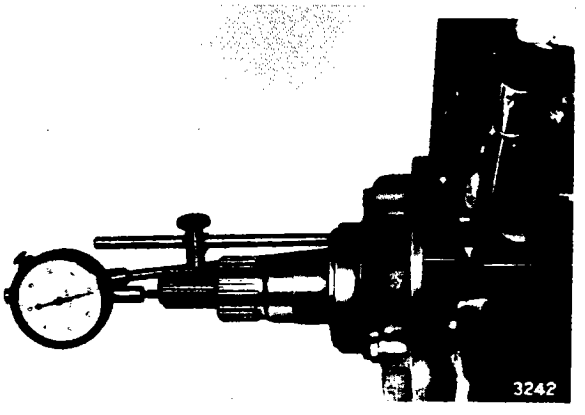


Fig. 36. *Checking end play.*

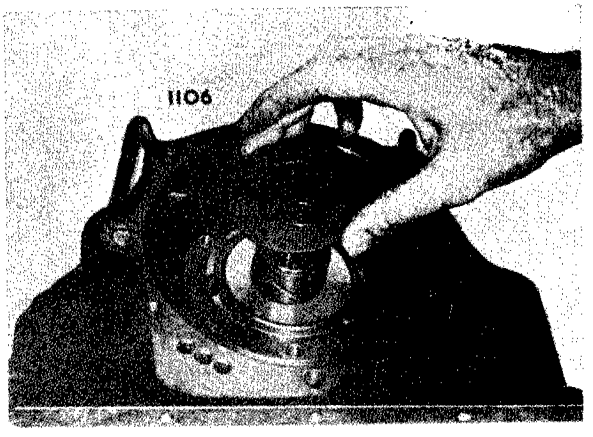


Fig. 37. *Removing the selective thrust washer.*

Selective thrust washers are available in the following thicknesses:

0·061″–0·063″	0·074″–0·076″	0·092″–0·094″
(1·53–1·58 mm.)	(1·85–1·90 mm.)	(2·3–2·35 mm.)
0·067″–0·069″	0·081″–0·083″	0·105″–0·107″
(1·68–1·73 mm.)	(2·03–2·08 mm.)	(2·63–2·68 mm.)

Place the shift selector in park position to hold the output shaft, then remove the companion flange nut, lockwasher, flat washer and flange.

Remove the bearing retainer capscrews, the bearing retainer and the bearing retainer gasket.

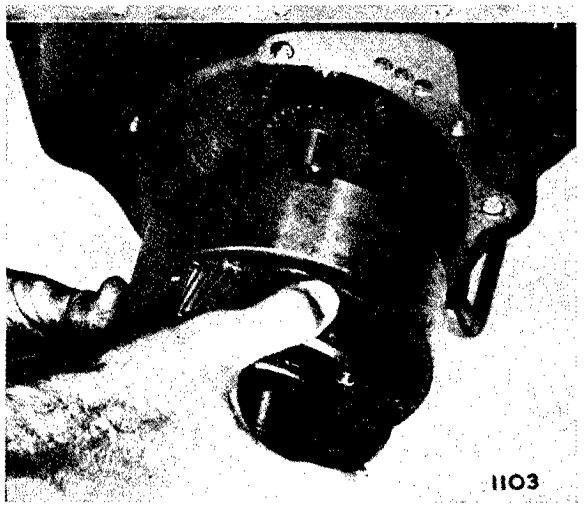


Fig. 38. *Removing the planet carrier.*

Slide the speedometer drive gear off the output shaft.

Remove the governor inspection cover and gasket.

Remove the five extension housing capscrews and remove the output shaft and extension housing assembly.

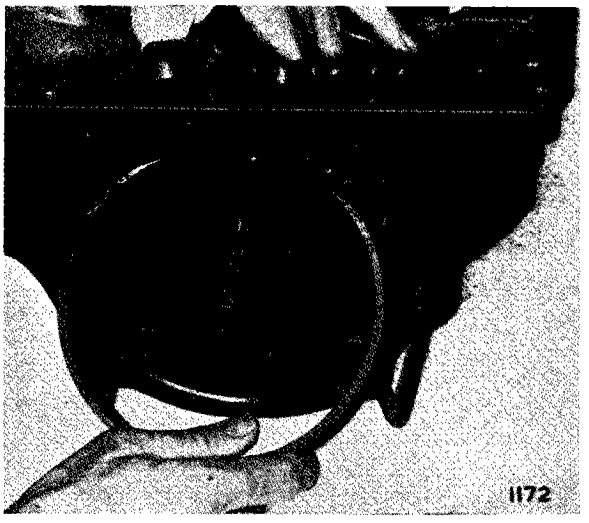


Fig. 39. *Removing the rear band.*

Remove the two hook type seal rings from the rear of the primary sun gear shaft.

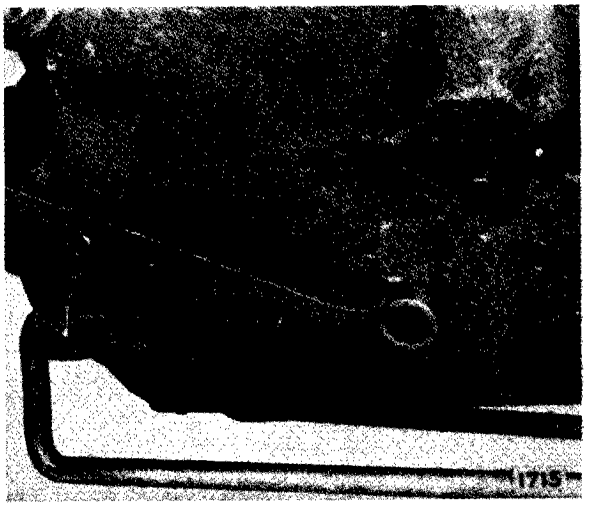


Fig. 40. *Removing one of the centre support bolts.*

Remove the selective thrust washer from the rear of the planet carrier (Fig. 37).

Pull the planet carrier from the transmission (Fig. 38).

Fig. 41. *Removing the clutch assemblies.*

Pull the rear band through the rear opening of the transmission. Hold the two ends of the band together with the left hand while pulling rearward through the rear of the case with the right hand (Fig. 39).

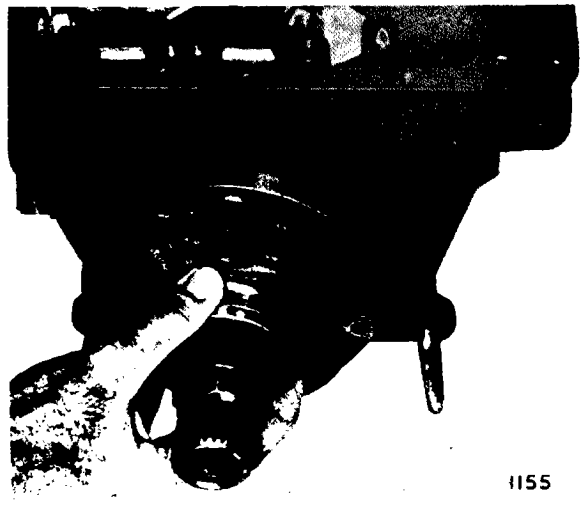


Fig. 42. *Removing the front pump.*

Remove the two centre support bolts; one from each side of the case (Fig. 40).

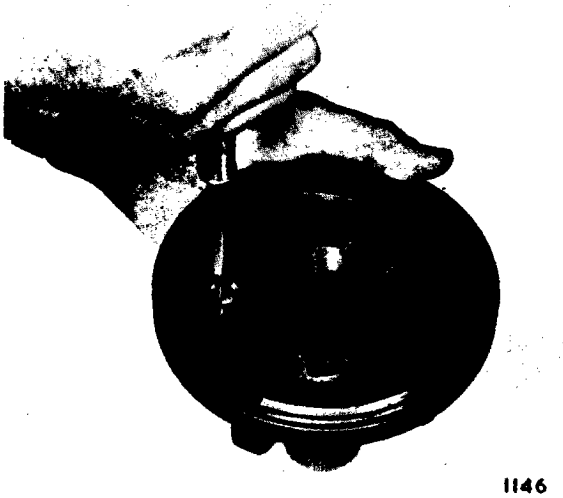


Fig. 43. *Removing the attaching setscrew.*

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

Remove the front and rear clutch assemblies, placing them in a suitable stand for dismantling (Fig. 41). (The planet carrier can be used as a stand for dismantling and assembling the clutches).

Remove the front band (up and out of the case).

Remove the front pump oil seal. Use a seal puller or punch.

Remove the four front pump attaching capscrews and lift off the front pump (Fig. 42).

Remove the front pump oil seal ring from the case.

Front Pump—Dismantling

Remove the stator support attaching screw and remove the stator support (Fig. 43). Mark the top of the internal and external gears with marking ink or a crayon. Lift the gears from the pump body.

Inspect the pump body, the internal and external tooth gears, and stator supports for scores, scratches and excessive wear.

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

Front Pump—Assembling

Drive a new seal into the pump body until it bottoms.

Lubricate all pump parts with transmission fluid before assembly. Install the internal and external gears in the pump body with marks previously made in the upward position. Insert the stator support on the pump body and install the retaining screw. Torque the screw to 25–35 lb. in. (0·29–0·40 kgm.). Check the gears for free movement.

Manual Linkage—Dismantling

Pull the retainer clip from the forward end of the linkage rod (Fig. 44). Disconnect the rod from the manual valve detent lever. Release the detent ball and spring by rocking the manual valve lever to the extreme of its travel. The ball will be released with considerable force, but can be caught in a shop towel or even in the hands. Remove the manual lever locknut, the manual detent lever, and then pull the manual control lever from the transmission. Prise the manual lever oil seal from the transmission case with a screwdriver.

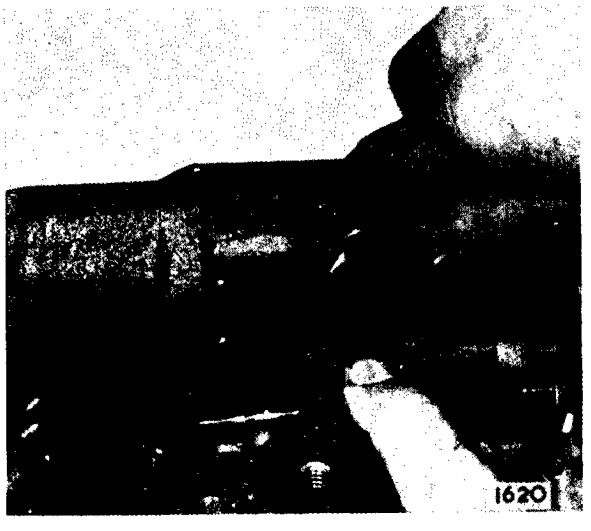


Fig. 44. *Removing the retainer clip from the linkage rod.*

Manual Linkage—Assembling

Install a new manual lever oil seal. Assemble the manual control lever through the transmission case boss. Place the manual valve detent lever and locknut on the manual control lever shaft. Rock the manual valve lever to its extreme travel, then install the detent spring. Place the ball in position on the spring, then using the lubrication ball and spring (Fig. 45), rock the manual valve lever back over the ball and spring. Connect the linkage rod and insert the retainer spring clip.

Fig. 45. *Releasing the detent ball.*

Park Linkage—Dismantling

Pull the retainer clip from the rear of the parking brake linkage rod. Disconnect the linkage rod from the torsion lever. Remove the retainer spring from the torsion lever pin and slide the washer with the torsion lever off the pin. Tap the toggle lever rearward to loosen the pin retainer (Fig. 46), then pull the retainer using snap ring pliers (Fig. 47). The toggle lever pin and toggle lever can now be removed. A magnet may be used to pull the parking pawl anchor pin from the transmission case. The parking pawl is now free to be removed.

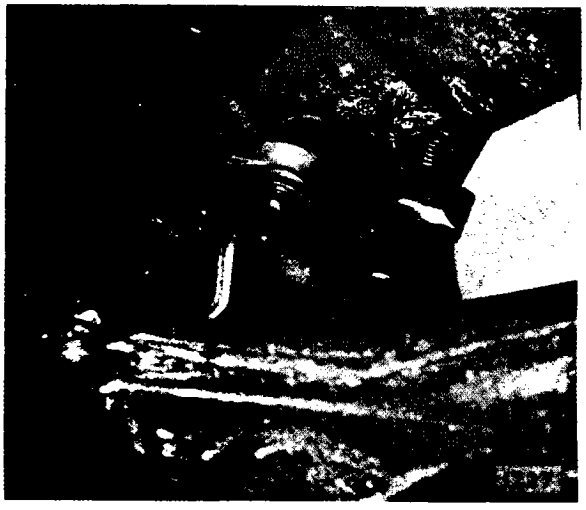


Fig. 46. *Tapping the toggle lever rearwards.*

Parking Linkage—Assembling

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

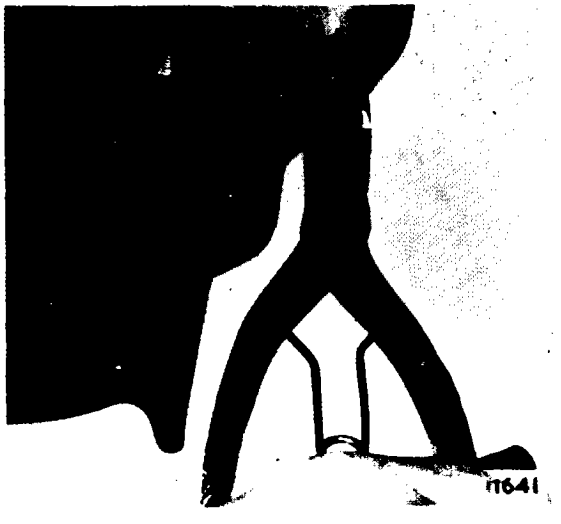


Fig. 47. *Removing the toggle lever pin retainer.*

Clutches—Dismantling

Place the clutch pack in a suitable stand. The planet carrier will work very well for this purpose.

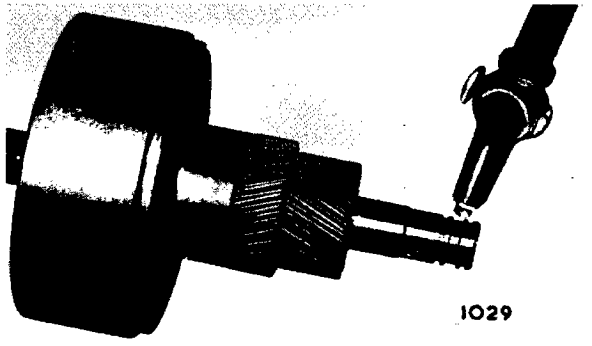
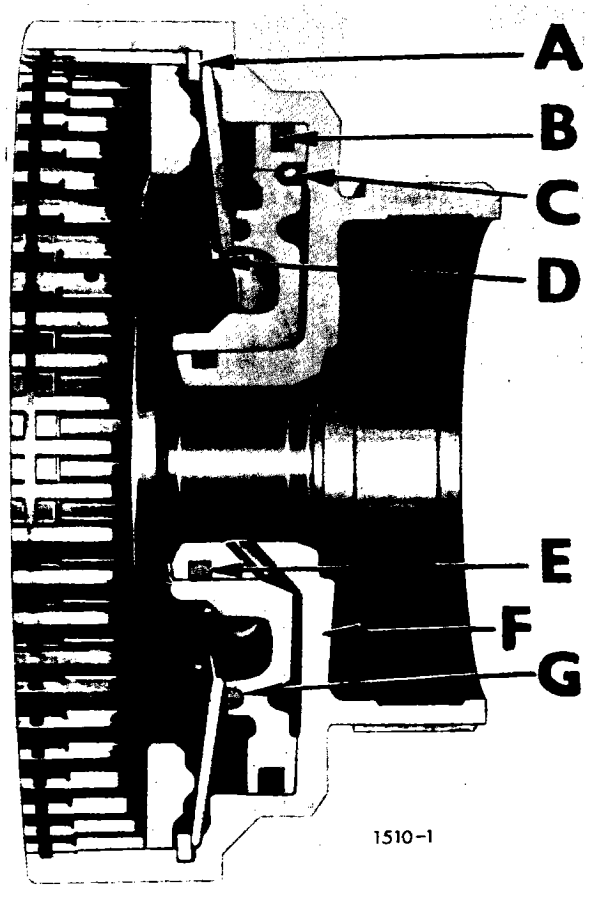


Fig. 48. *Applying compressed air to the clutch feed hole.*



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

Fig. 49. *Sectioned view of the clutch front drum.*

Lift the complete front clutch assembly from the rear clutch and forward sun gear.

Remove the snap ring and lift the input shaft from the clutch cylinder. (The clutch hub thrust washer may stick to the input shaft).

Lift the clutch hub and thrust washer from the clutch assembly.

Lift the front clutch plates and the pressure plate from the assembly.

Remove the clutch return spring snap ring and then the return spring. It is not necessary to compress the spring to remove the snap ring.

Compressed air applied to the clutch feed hole in the clutch hub will force the piston from the clutch cylinder (Fig. 48).

Remove the rubber seal rings from the clutch hub and clutch piston.

Remove the two front clutch sealing rings from the forward sun gear shaft (Fig. 50).

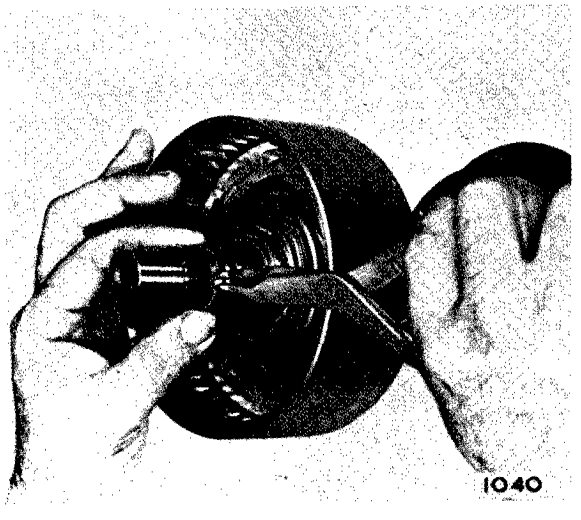


Fig. 50. *Removing the two front clutch sealing rings.*

Remove the thrust washer and thrust plate from the shoulder of the rear clutch hub.

Lift the rear clutch assembly up and off the forward sun gear shaft.

Remove the rear clutch ring.

Remove the clutch pressure plate and the clutch plates.

Use the service tool to compress the clutch return spring, then remove the spring retainer snap ring. Release the spring, but do not permit the spring retainer to catch in the snap ring groove as the spring is being released (Fig. 51).

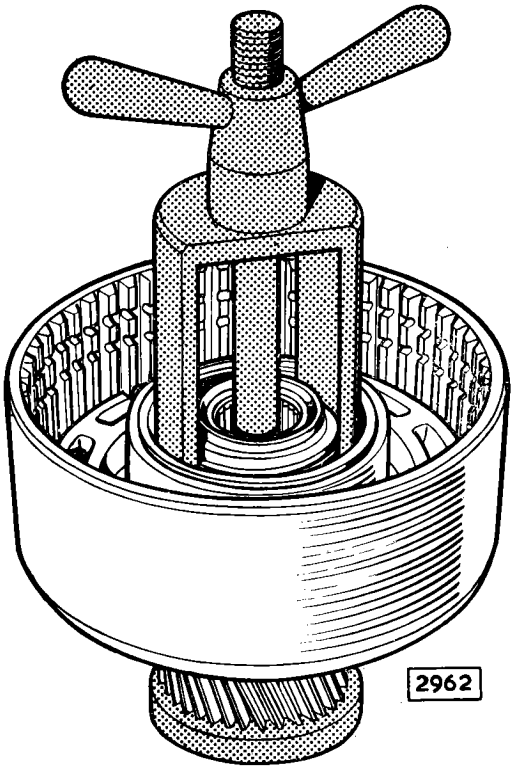


Fig. 51. *Dismantling the clutch using the special tool (Part No.* CBW37A).

Replace the forward sun gear shaft in the clutch hub, being careful not to break the cast iron sealing rings. The clutch piston can now be removed from the clutch cylinder by blowing compressed air through the rear clutch passage of the forward sun gear.

Remove the forward sun gear from the clutch cylinder and remove the two rear clutch sealing rings from their grooves in the shaft.

Remove the rubber seal rings from the clutch hub and the clutch piston.

Inspection of Clutches

Inspect all parts for burrs, scratches, cracks and wear. Check all the front clutch plates and the rear clutch friction plates for flatness. Check the rear

clutch steel plates for proper cone. Lay plates on a flat surface when checking for flatness and cone. Cone should be 0·010″ to 0·020″ (0·25 to 0·5 mm.). Replace friction plates when wear has progressed so that the grooves are no longer visible. Replace all warped plates. Replace complete set of steel or friction plates in any clutch. Do not replace individual plates (Fig. 52).

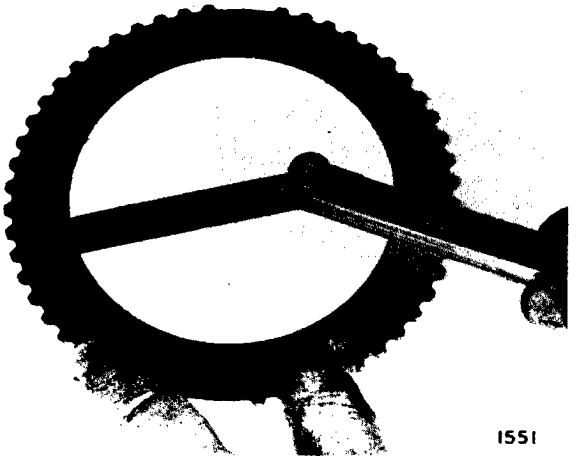


Fig. 52. *Checking a clutch plate.*

Inspect the band surfaces of the drum for wear. If only slightly scored the drum may be refaced. Renew if excessive.

Inspect the clutch bushing and the needle bearing for wear and brinelling and for scores. The cast iron sealing rings are normally replaced. If the transmission is being rebuilt and has had little service, the rings may be re-used if they have not worn excessively and are not scratched or distorted.

Inspect the forward sun gear for broken or worn teeth. Inspect all journals and thrust surfaces for scores. Inspect all fluid passages for obstruction or leakage. Inspect the front clutch lubrication valve for freedom (Fig. 53).

Clutches—Assembling

Place the planet carrier on the assembly bench.

Place the forward sun gear in the carrier. Be sure the thrust washer is on the shaft (Fig. 54).

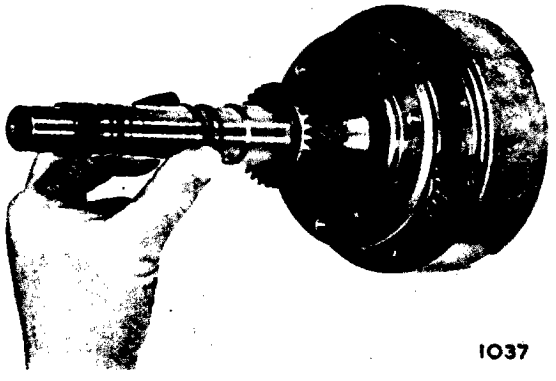


Fig. 54. *Placing the forward sun gear on the carrier.*

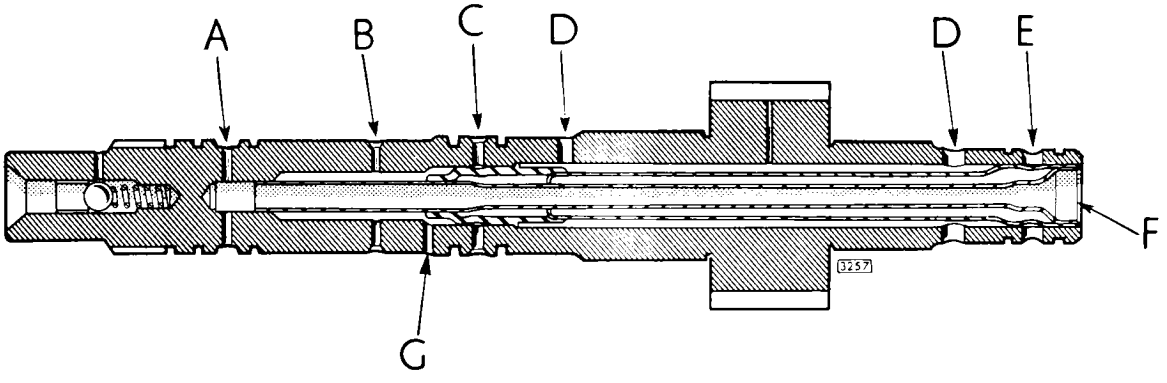


Fig. 53. *Longitudinal section of the forward sun gear showing oil ways.*
A, F—Front clutch: C, E—Rear clutch: B, D, G—lubrication.

Assemble the rubber "O" ring in its groove on the rear clutch hub (Fig. 55).

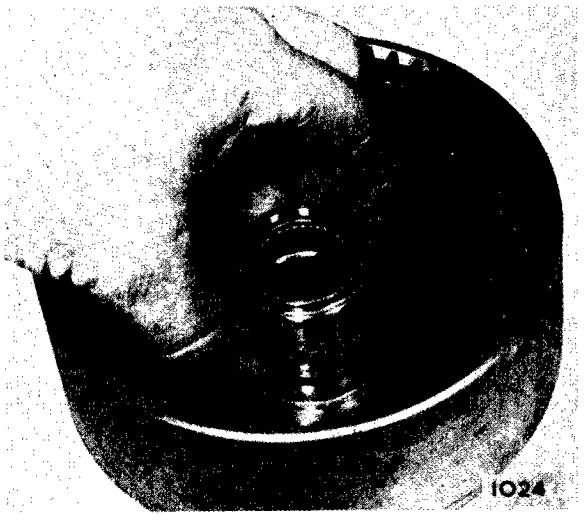


Fig. 55. *Fitting the "O" ring on the rear clutch hub.*

Assemble the square section rubber seal ring in its groove on the rear clutch piston (Fig. 56).

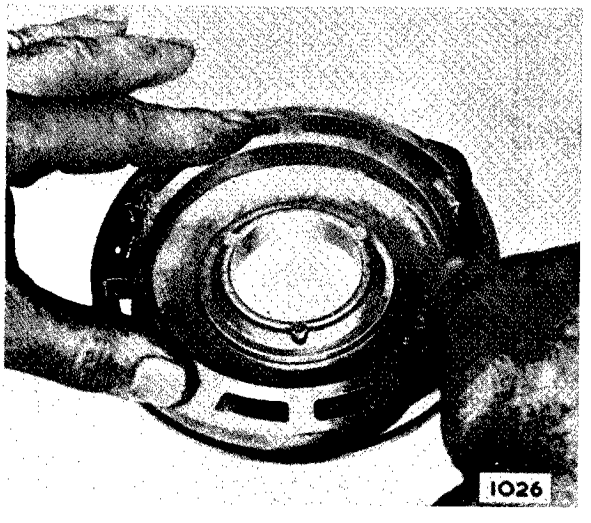


Fig. 56. *Fitting the rear clutch piston sealing ring.*

Assemble the clutch piston in the rear clutch cylinder using Tool Part No. CWG.41 to force it into position. Be sure to lubricate the seal rings so that they will assemble easier.

Place the rear clutch return spring and spring retainer in position on the clutch piston. The rear clutch spring fixture is then used to compress the spring, then the snap ring is assembled in its groove in the clutch.

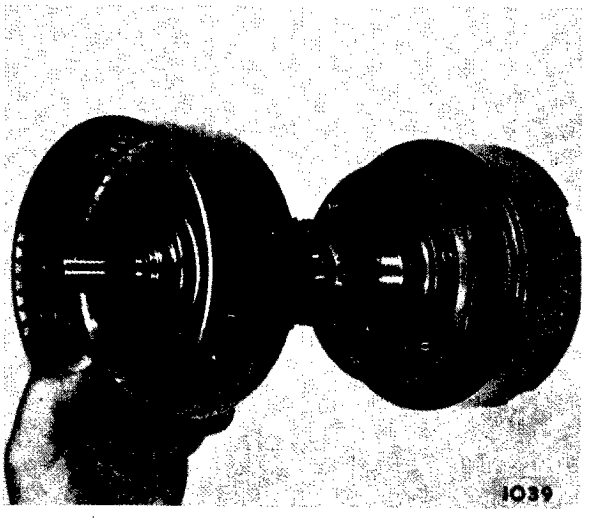


Fig. 57. *Fitting rear clutch over primary sun gear ring.*

Install the rear clutch cast iron sealing rings in their grooves on the forward sun gear. Be sure that the rings are free in their grooves. Centre each ring in its groove, so that ends do not overlap edges of groove.

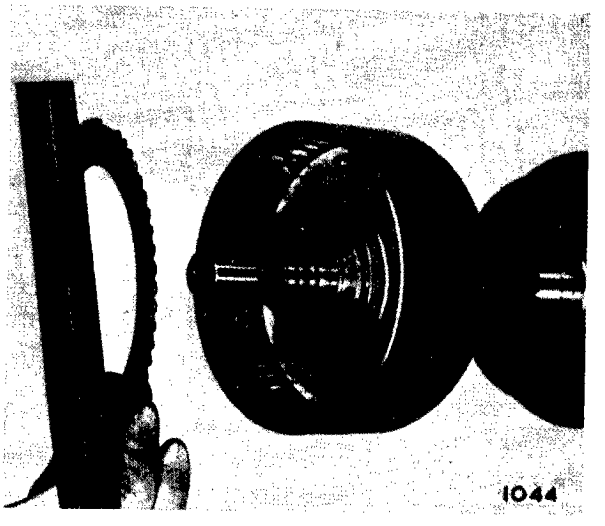


Fig. 58. *Fitting a rear clutch steel plate.*

Place the rear clutch piston and cylinder assembly over the forward sun gear and gently slide it down over the sealing rings (Fig. 57).

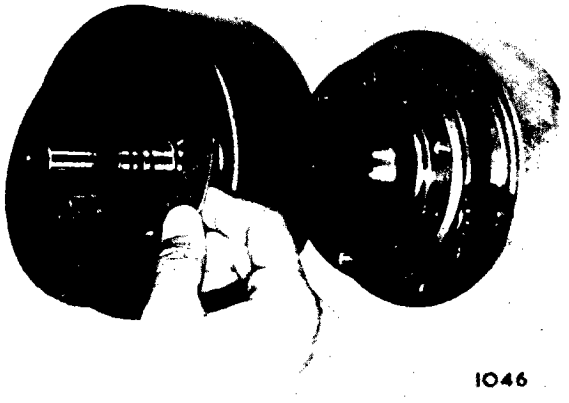


Fig. 59. *Fitting a rear clutch friction plate.*

Install a rear clutch steel plate with its concave face up or forward facing in the transmission. Note that these plates are identified by missing teeth on the O.D. and are not interchangeable with front clutch steel plates (Fig. 58).

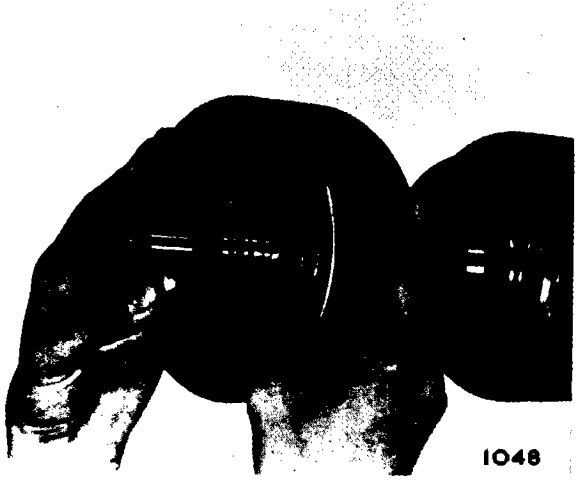


Fig. 60. *Fitting the snap ring.*

Install a rear clutch friction plate, then alternating with first a steel and then a friction plate, complete the clutch pack (Fig. 59).

Install the rear clutch pressure plate.

Install the rear clutch snap ring. This ring has one tanged end (Fig. 60).

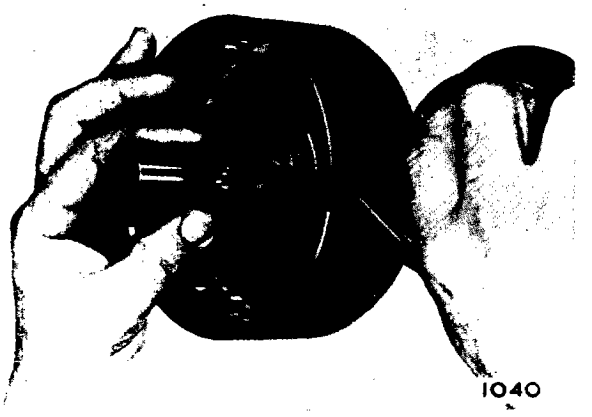


Fig. 61. *Fitting the sealing rings.*

Install the front clutch cast iron sealing rings in their grooves on the forward sun gear. Centre each ring in its groove so that ends do not overlap edges of the groove (Fig. 61).

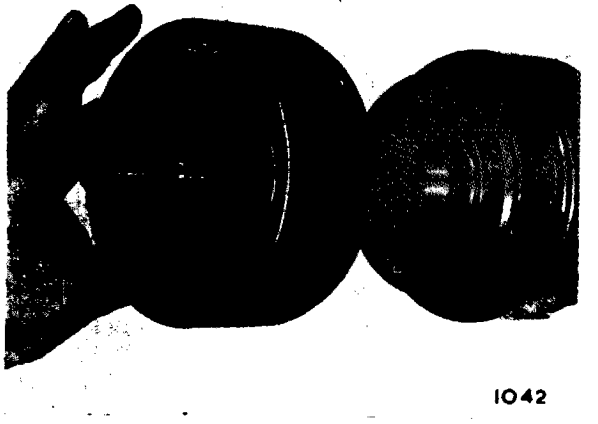


Fig. 62. *Fitting the front thrust plate.*

Install the front clutch cylinder thrust plate (Fig. 62). Be sure flats on the washer match flats on shaft.

Install the front clutch cylinder thrust washer (Fig. 63).

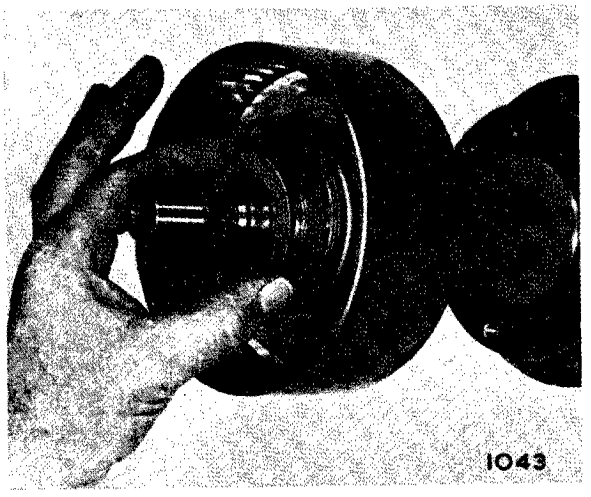


Fig. 63. *Fitting the front clutch cylinder-thrust washer.*

Assemble the front clutch hub "O" ring into its groove in the clutch hub.

Assemble the front clutch piston square section rubber sealing ring in the groove of the clutch piston.

Install the clutch piston into the clutch cylinder after thoroughly lubricating the parts. Press the piston into position using Tool Part No. WG.42.

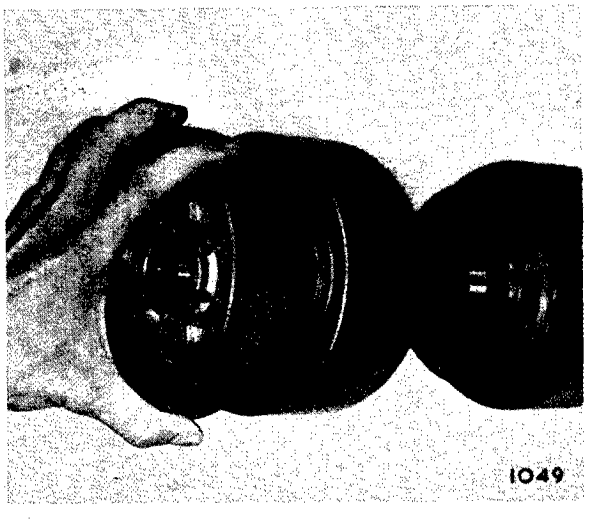


Fig. 64. *Assembling the front clutch.*

Install the front clutch belleville spring and snap ring. This snap ring is thicker than the other two clutch snap rings and has two tanged ends instead of one.

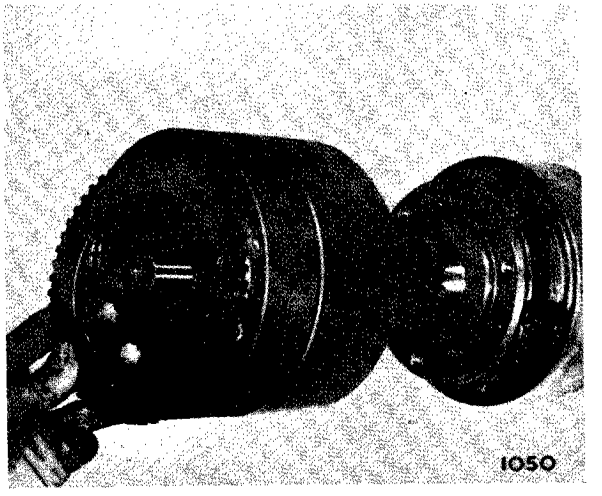


Fig. 65. *Fitting the front pressure plate.*

Assemble the front clutch assembly over the forward sun gear shaft and into the rear clutch, being careful not to distort or break the cast iron sealing rings. Use a short oscillating movement to engage splines of the rear clutch friction plates (Fig. 64).

Install the front clutch pressure plate (Fig. 65).

Install the front clutch hub, followed by front clutch hub thrust washer (Fig. 66).

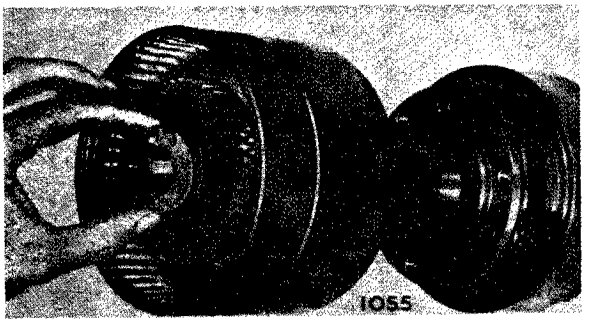


Fig. 66. *Fitting the front clutch hub thrust washer.*

Install a front clutch friction plate over the splines of the hub (Fig. 67). Next, install a front clutch outer plate, meshing splines in the cylinder, alternating as above, complete assembly of plates (Fig. 68).

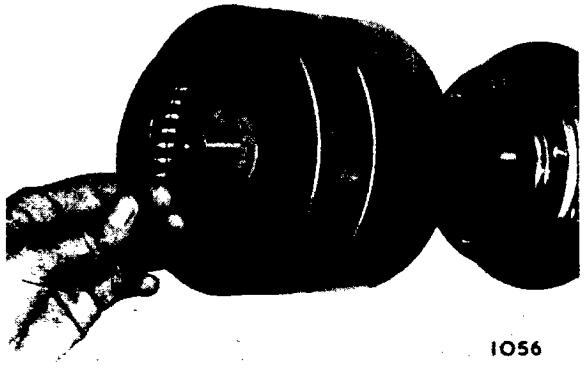


Fig. 67. *Fitting a front friction plate.*

Assemble the input shaft to the front clutch cylinder.

Assemble the snap ring that holds the input shaft in place (Fig. 69).

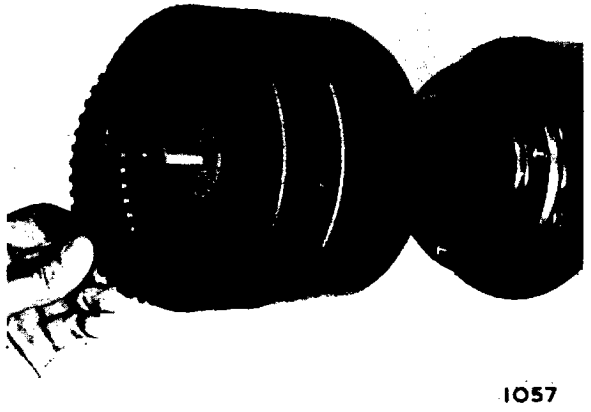


Fig. 68. *Fitting a front clutch outer plate.*

Place the thrust washer on the input shaft and the clutch assemblies are complete (Fig. 70).

Centre Support

The centre support is serviced as an assembly. Therefore, there is no dismantling or assembly procedure.

Inspect the support for burrs or distortion, the race bearing surface for scores or scratches.

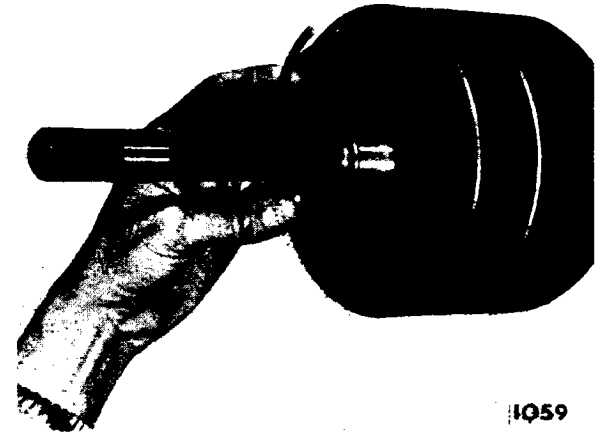


Fig. 69. *Fitting the snap ring.*

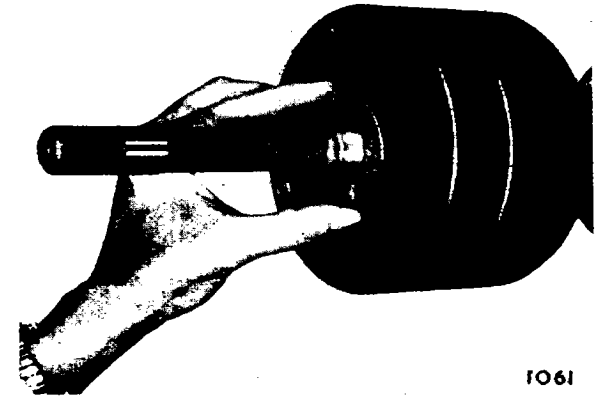


Fig. 70. *Placing the thrust washer in position.*

Pinion Carrier Assembly

The pinion carrier is serviced as an assembly. Therefore there is no dismantling or assembly procedure.

Inspect the band surface and the inner and outer bushing for scores. Rotate pinions on their shafts to check for freedom of movement and for worn or broken teeth. Use a feeler gauge to check pinion end play. End play should be 0·010″ to 0·020″ (·23 to ·5 mm.). Inspect pinion shafts for tightness to the planet carrier.

Sprag Clutch

A sprag-type one-way clutch assembly is incorporated in the planet carrier assembly and is held in place by a snap ring.

When installing the sprag clutch, the flange side of the sprag cage is located down into the outer race of the planet carrier assembly with the copper tension springs towards the centre support.

After the planet carrier and sprag assembly are installed in the case, the planet carrier will freewheel when turned counterclockwise and lock when turned clockwise (from the rear).

Output Shaft

Remove the extension housing and bearing from the output shaft by lifting the housing and tapping the shaft with a heavy plastic hammer.

Remove the bearing spacer washer.

Slide the oil collector and tubes from the shaft.

Remove the four sealing rings.

Remove the governor snap ring, governor and governor drive ball from the output shaft.

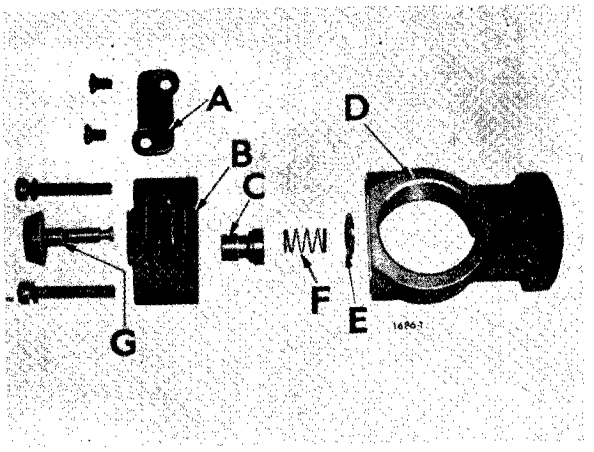
Lift the rear pump from the shaft and remove the rear pump drive key.

The snap ring may be removed and the output shaft removed from the ring gear; however, this is not necessary unless replacing one of these parts.

Inspect the output shaft thrust surfaces and journals for scores and the internal gear for broken teeth. Check the ring grooves, splines and gear teeth for burrs, wear or damage. The output shaft is a two-piece assembly and is serviced separately. Inspect the distributor and sleeve mating surfaces for excessive wear and for burrs, scores or leakage.

Governor

Remove the governor body cover plate attaching screws and remove the plate (Fig. 71). Remove the governor body attaching screws, then remove the body from the counter weight. Slide the spring retainer from the stem of governor weight and remove the spring. Remove the valve and weight from the governor body.



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

Fig. 71. *Exploded view of the governor.*

Inspect the governor weight, valve and bore for scores. Minor scores may be removed with crocus cloth. Replace the governor valve, weight or body if deeply scored. Check for free movement of the weight and valve in the bore. Inspect all fluid passages in the governor body and counterweight for obstruction. All fluid passages must be clean. Inspect the mating surfaces of the governor body and counterweight for burrs and distortion. Check governor spring retainer washer for burrs. The mating surfaces must be smooth and flat.

Re-install governor body cover plate, torqueing screws to 20–30 lb. in. (0.24 to 0.35 kgm.).

Install the governor valve in the bore of the body. Install the weight in the governor valve. Compress the spring and slide the retainer onto the stem of the weight and release the spring tension. Install the governor body on the counterweight.

Note: Make sure the fluid passages in the body and counterweight are aligned.

Torque the governor body attaching screws to 50–60 lb. in. (0·58 to 0·69 kgm.).

Rear Pump

Withdraw the five $\frac{1}{4}$" (6·4 mm.) screws, also the No. 10 U.N.C. screw and remove the cover. Mark the top face of the gears with marking ink or a crayon to assure correct re-installation of gears upon assembly (Fig. 72). Remove the drive and driven gears from the pump body.

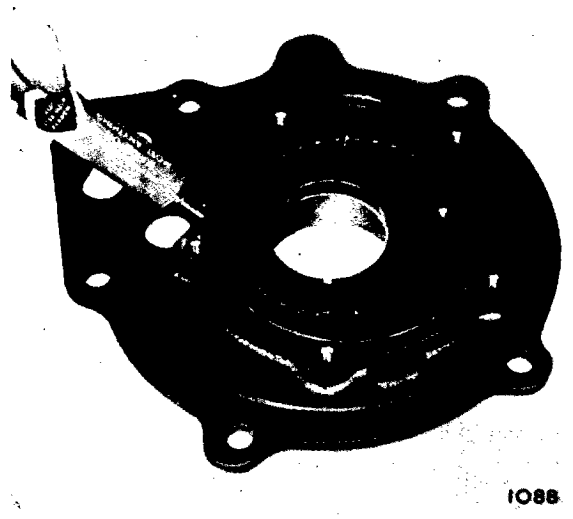


Fig. 72. *Marking the top face of the gears.*

Inspect the gear pockets and crescent of the pump body for scores or pitting. Inspect the bushing and drive and driven gear bearing surfaces for scores. Check all fluid passages for obstructions and clean if necessary. Inspect the mating surfaces, gear teeth, pump body and cover for burrs. If any pump parts are defective beyond minor burrs or scores, which cannot be removed with a crocus cloth, replace complete pump as a unit.

Lubricate parts with transmission fluid and replace both gears with the marks facing upward. Install the pump cover, attaching screws and lock-washers. Tighten the $\frac{1}{4}$" (6·4 mm.) screws to 50–60 lb. in. (0·58 to 0·69 kgm.) torque and the number 10 screw to 20–30 lb. in. (0·24 to 0·35 kgm.) torque (Fig. 73).

Check the pump for free movement of the gears.

Fig. 73. *Replacing the gears.*

Output Shaft and Rear Pump—Assembling

Install the rear pump drive key in the output shaft.

Install rear pump assembly over the shaft.

Install the governor drive ball into the recess in the output shaft, using a spot of petrolatum to hold in place.

Install governor assembly, with plate on the governor body down (facing pump assembly). Install snap ring to lock governor in place (Fig. 74).

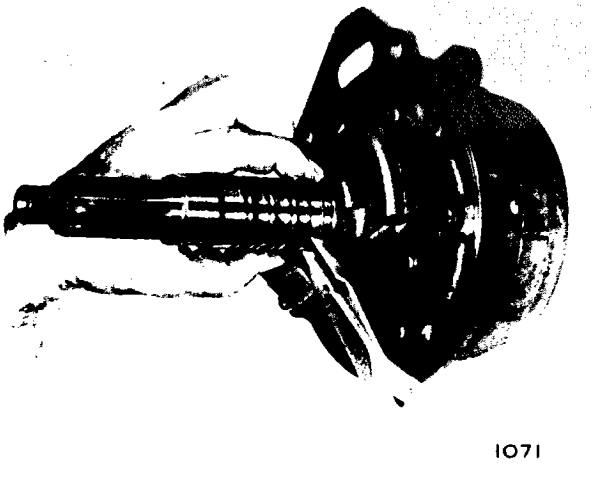


Fig. 74. *Fitting the snap ring.*

Install the four output shaft sealing rings, making sure they are free in their grooves (Fig. 75).

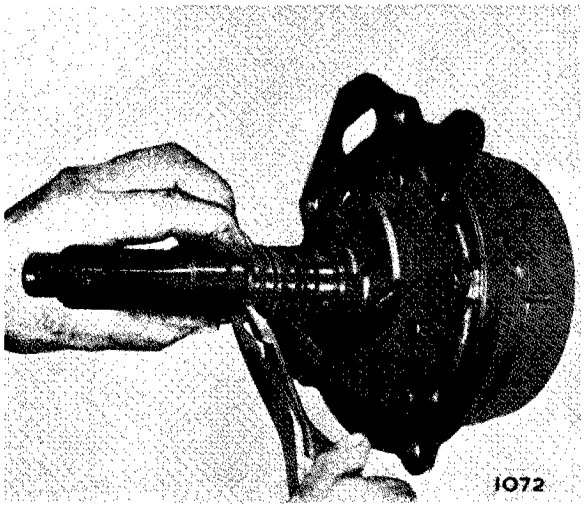


Fig. 75. *Fitting the output shaft sealing ring.*

Install oil collector sleeve and tube assembly. Compress each ring with the fingers and carefully slide the sleeve over them (Fig. 76).

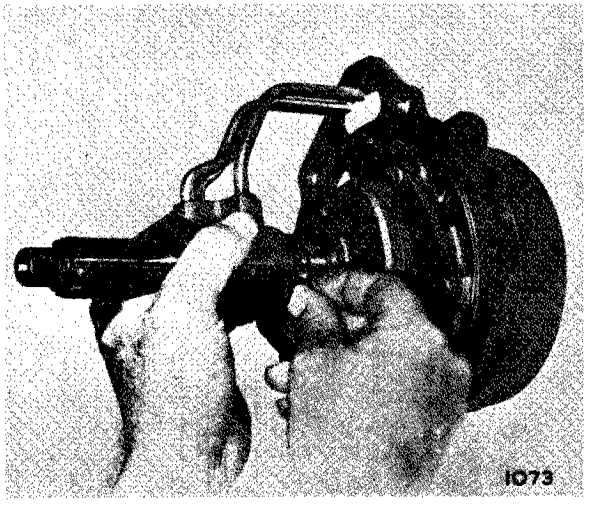


Fig. 76. *Installation of the oil collector sleeve and tube.*

Assemble the bearing spacer washer against the shoulder on the output shaft (Fig. 77).

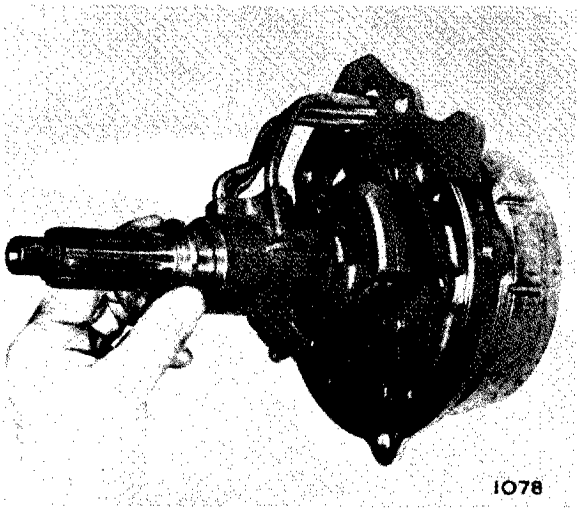


Fig. 77. *Fitting the bearing spacer washer.*

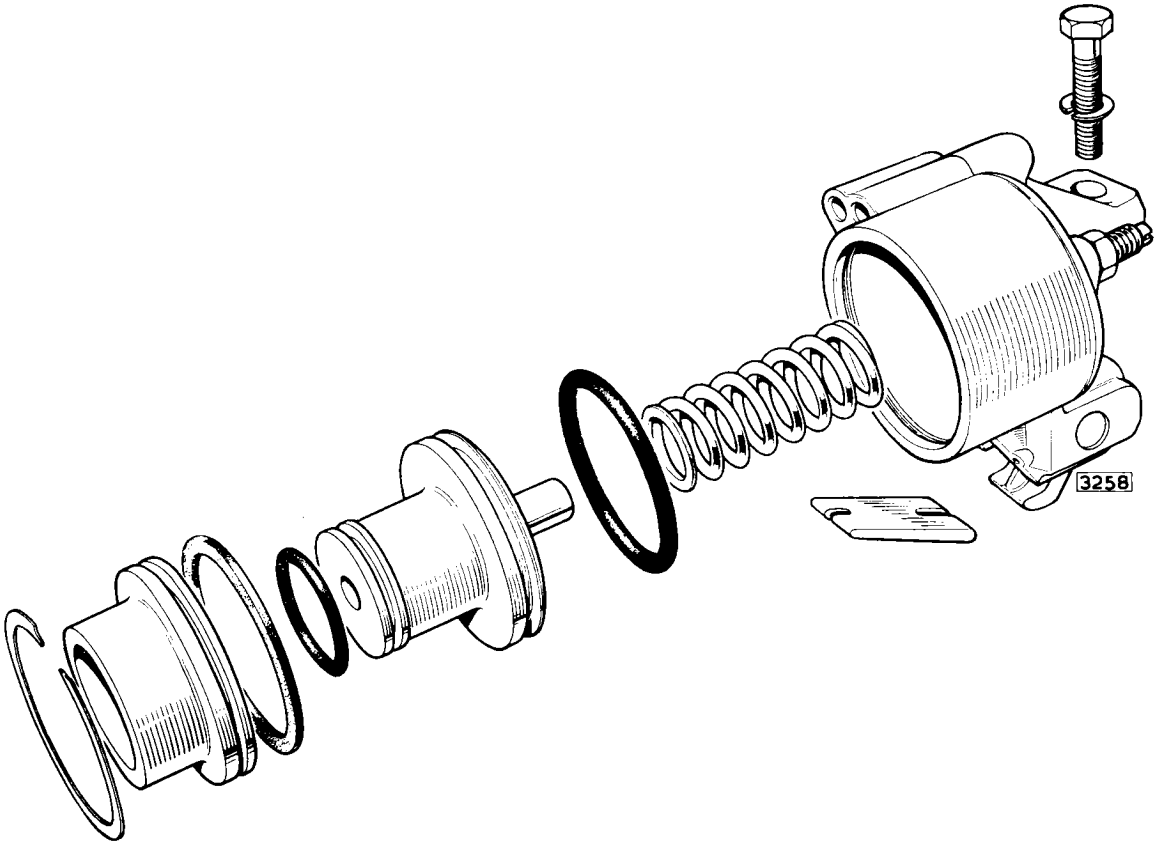


Fig. 78. *Exploded view of the front servo.*

Front Servo—Dismantling

Use a small screwdriver to remove the snap ring.

Pull the sleeve and piston from the servo body.

Remove the piston from the servo sleeve.

Remove all sealing rings.

If the servo lever needs attention, it may be removed by first driving the roll pin from the servo and then removing the pivot pin and lever. Use a $\frac{1}{8}$" (3.1 mm.) drift punch to remove the roll pin.

Inspect the servo parts for cracks, scratches and wear. Check the adjusting screw for freedom in the lever. Check the lever for freedom of movement.

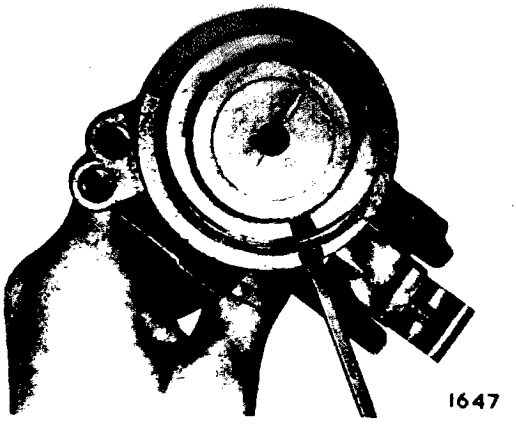


Fig. 79. *Removing the snap ring.*

Front Servo—Assembling

Assemble the servo lever, pivot pin and the roll pin.

Assemble the sealing rings on the sleeve and piston.

Assemble the piston to the sleeve, place the spring in the piston, and assemble the sleeve, piston and spring into the housing.

Replace the snap ring.

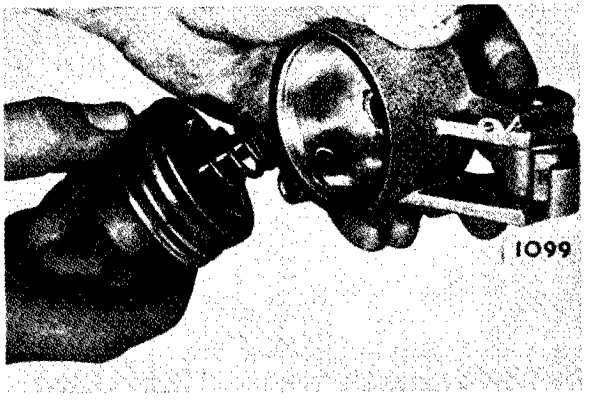


Fig. 80. *Assembling the front servo.*

Rear Servo—Dismantling

Remove the actuating lever roll pin with a $\frac{1}{8}$" (3·1 mm.) drift punch.

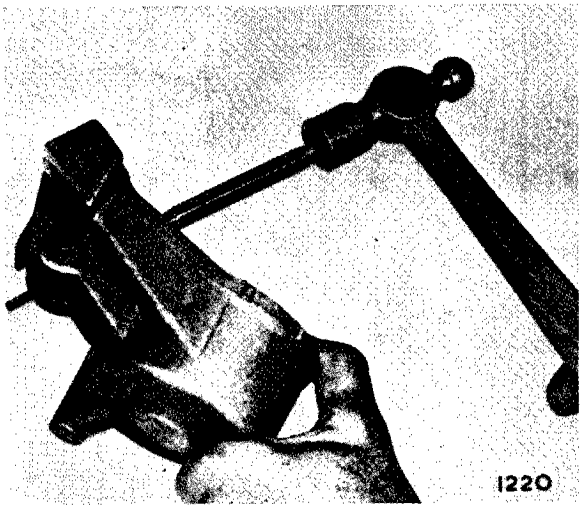


Fig. 81. *Removing the rear servo roll pin.*

Remove the lever and shaft.

Depress the spring retainer while removing the snap ring.

Remove the servo release spring, piston and rubber "O" ring.

Inspect the servo body for cracks, burrs and obstructed passages and the piston bore and stem for scores. Inspect the actuating lever and shaft for wear and brinnelling.

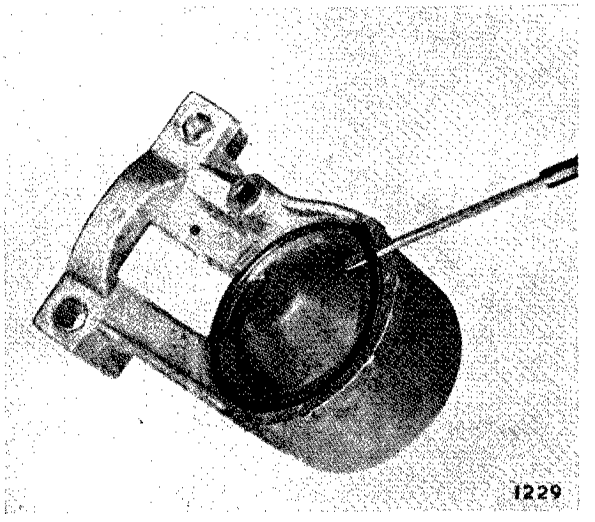


Fig. 82. *Removing the rear servo snap ring.*

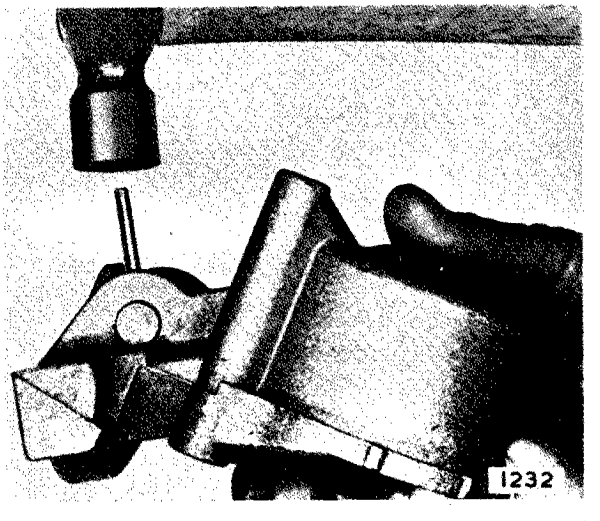


Fig. 83. *Replacing the roll pin.*

Rear Servo—Assembling

Lubricate all parts of the servo with transmission fluid before starting assembly.

Install a new "O" ring and then install piston in the servo body.

Install the release spring, retainer and snap ring.

Replace the servo lever, shaft and roll pin.

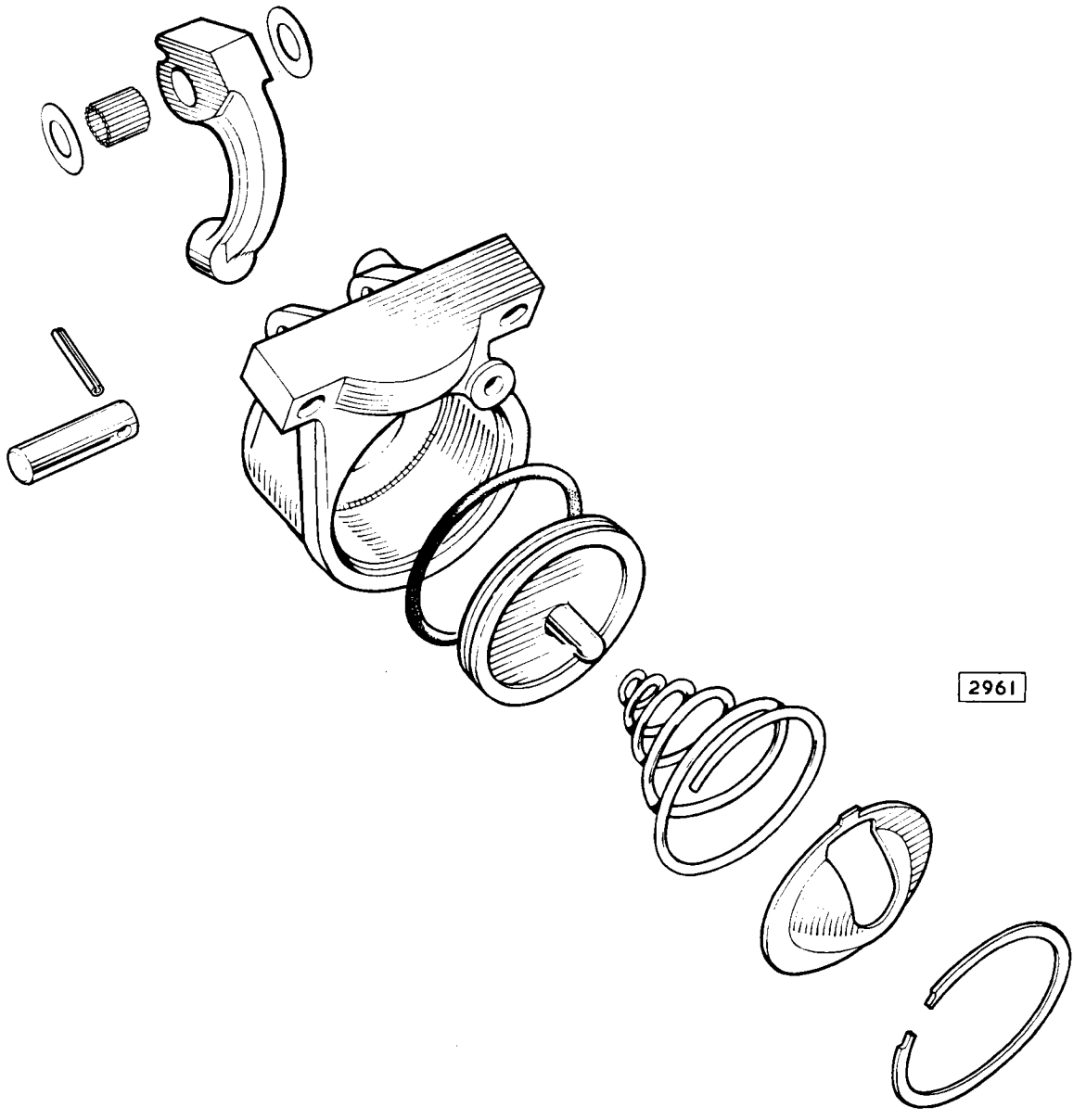


Fig. 84. *Exploded view of the rear servo.*

Pressure Regulator

Remove the valves from the regulator body. Remove the regulator body cover attaching screws and remove the cover. Remove the separator plate from the regulator body.

Wash all parts thoroughly in cleaning solvent and dry with compressed air. Inspect the regulator body and cover mating surfaces for burrs. Check all fluid passages for obstructions. Inspect the control pressure and converter pressure valves and bores for burrs and scores. Remove all burrs carefully with crocus cloth. Check free movement of the valves in their respective bores. The valves should fall freely into the bores when both the valve and bore are dry. Inspect the valve springs for distortion.

When assembling, be careful to avoid damaging the parts. Replace the separator plate and then the cover on the regulator body. Install and torque the attaching screws to 20–30 lb. in. (0·24–0·35 kgm.).

Insert the valves in the pressure regulator body.

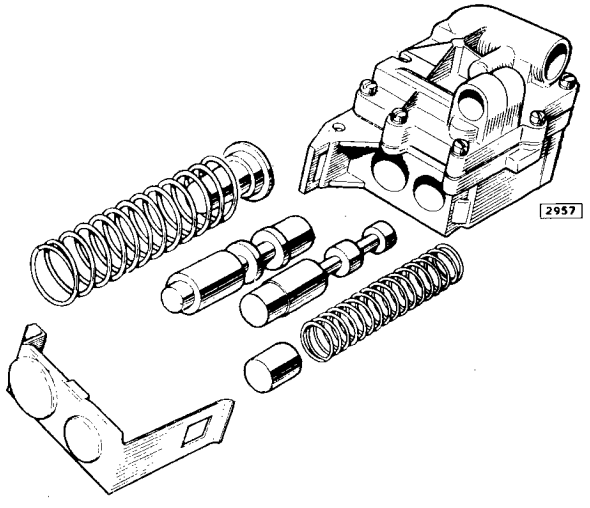


Fig. 85. *Regulator assembly. Valves, springs and retainer shown exploded.*

Valve Body—Dismantling

During dismantling of the control valve assembly, avoid damage to the valve parts and keep the parts clean. Place the valve parts and the assembly on a clean surface while performing the dismantling operation.

Remove the manual valve from the upper valve body.

Remove the four cap screws that retain the valve bodies.

Remove the cover and separator plates from the valve bodies. The body plate is attached to the lower valve body by a cheese head screw and to the upper valve body by a cheese head and a flat head screw. The separator plate and the lower valve body cover are held together by two cheese head screws.

Remove the front upper valve body plate retained by two screws. Remove the compensator valve plug, sleeve, springs and valve. Remove the modulator valve and spring assembly. The outer spring is retained to the modulator valve by a stamped retainer. The spring may be removed by tilting and pressing outward on the retainer.

Remove the downshift valve and spring.

Remove the rear upper valve body plate and throttle return spring retained by three screws to the body. Then remove the compensator cut back valve and the throttle valve.

Remove the four screws that retain the end body to the lower body. Remove the 2–3 shift valve inner and outer springs and the 2–3 shift valve. Remove the orifice control valve and spring and the transition valve spring and valve. Remove the orifice control valve plug and the 2–3 shift valve plug from end body. The end body plate should be removed for cleaning the end body.

Remove the four cheese head screws that retain the lower valve body side plate. Remove the 2–3 governor plug, the D1 and D2 control valve spring and valve.

The rear pump check valve, spring and sleeve generally should not be removed. The sleeve may be removed with snap ring pliers, if necessary.

Remove the end plate from the lower valve body cover. Then remove the 1–2 shift valve and spring and the front servo release orifice valve and spring.

Note: When removing all plates, be sure to hold the plates until screws are removed and release slowly as they are spring loaded.

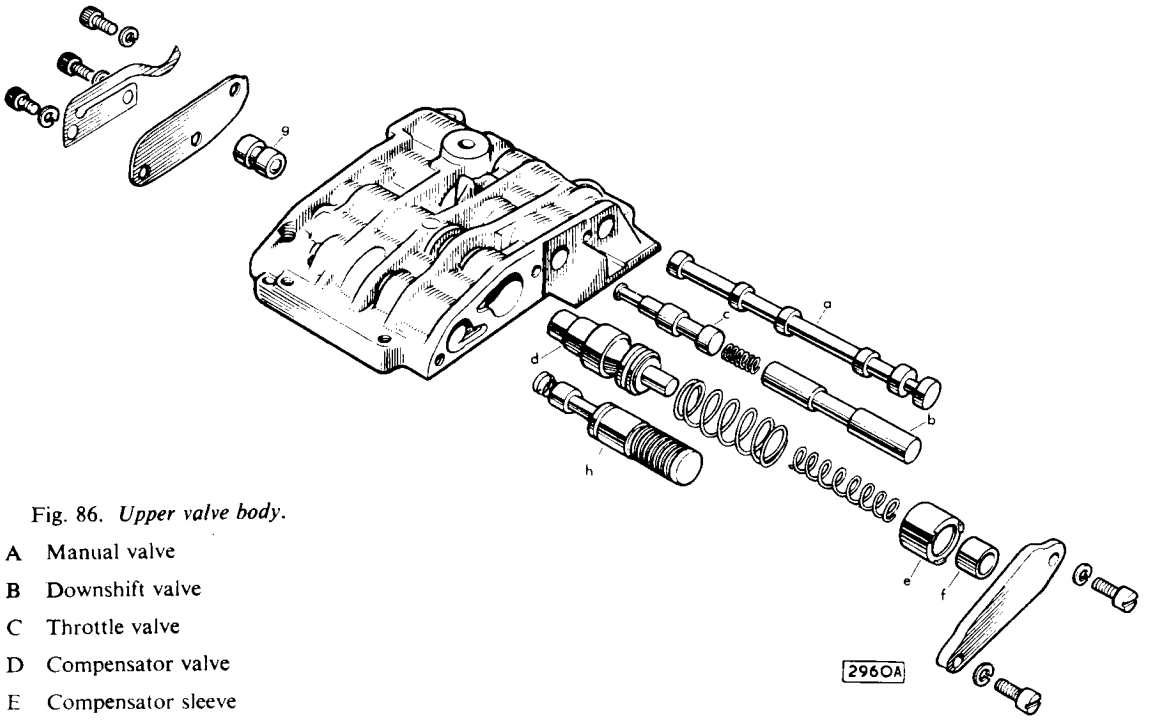


Fig. 86. *Upper valve body.*

A Manual valve
B Downshift valve
C Throttle valve
D Compensator valve
E Compensator sleeve
F Compensator sleeve plug
G Compensator cut-back plug
H Throttle modulator valve

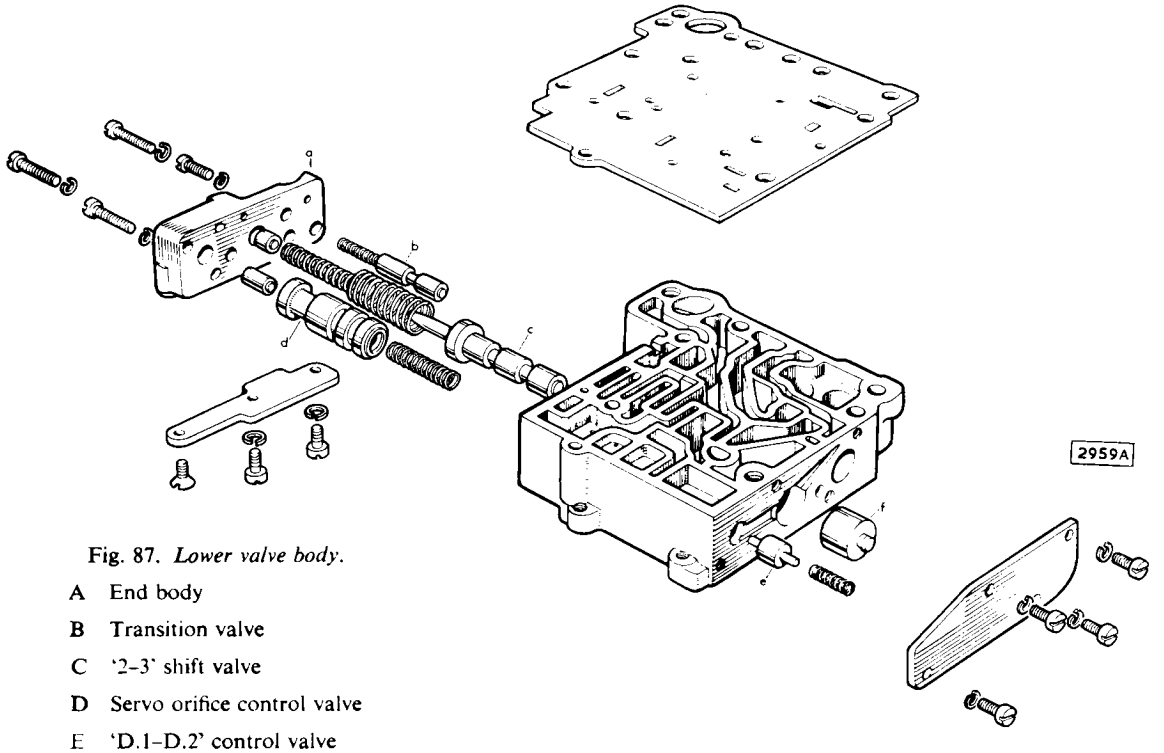


Fig. 87. *Lower valve body.*

A End body
B Transition valve
C '2–3' shift valve
D Servo orifice control valve
E 'D.1–D.2' control valve
F '2–3' governor plug

Inspection

Clean all parts thoroughly in a cleaning solvent, then dry them with compressed air. Inspect all fluid passages for obstructions. Inspect the check valve for free movement. Inspect all mating surfaces for burrs and distortion. Inspect all plugs and valves for burrs and scores.

Note: Crocus cloth can be used to polish the valves and plugs if care is taken to avoid rounding the sharp edges.

Valve Body—Assembling

When assembling the control valve bodies, always use the following procedure:

Install the valve body plate on the upper valve body (retained by one cheese head and one flat head screw). Do not tighten the screws. If the rear pump check valve sleeve, valve and spring were removed from the lower valve body, install them, carefully staking the sleeve in the bore with the smooth end against the valve.

Place the upper body on the lower body and install the cheese head screw, but do not tighten the screw.

Place the lower valve body separator plate and cover on the lower valve body and install the two head screws, leaving them loose.

Install the four cap screws and lockwashers; torque the four screws to 72 lb. in. (·84 kgm.), then tighten the cheese head screws and flat head screw to 20–30 lb. in. (0·23–0·35 kgm.).

Try all valves dry in their respective bores, rotating them to make sure that they are free before final assembly in the valve body. If any sticking or binding occurs, the valve bodies will have to be separated and each surface lapped on crocus cloth, using a surface plate or a glass plate, to ensure against low or high spots or a warped condition.

Note: Lubricate all valves and plugs with automatic transmission fluid before final assembly in their respective bores.

Install the 1–2 shift valve spring and valve in the lower valve body cover. Install the front servo release orifice valve spring and valve and the cover end plate with two cheese head screws.

Install the range control valve and spring, the governor plug, and then install the side plate with four cheese head screws.

Install the orifice control valve spring and valve, the 2–3 shift valve, the 2–3 shift valve inner and outer springs, the transition valve, and spring in the lower valve body.

Replace the end body plate using one flat head and two cheese head screws and torque to 20–30 lb. in. (0·23–0·35 kgm.). Install the orifice control valve plug and the 2–3 shift valve plug in the lower valve body. Install the end body to the lower valve body, guiding the 2–3 shift valve inner spring into the 2–3 shift valve plug. Three long and one short special cheese head screws are used to retain the end body.

Note: Make sure the inner spring is piloted on the 2–3 shift valve plug.

Install the modulator valve and spring assembly. Install the compensator valve, compensator inner and outer springs, compensator plug and sleeve (be sure end of sleeve with the three protrusions is toward the plate and the smooth end to the spring in the upper valve body). Assemble the plate which is retained by two cheese headed screws.

Install the compensator cut-back valve in the rear end of the upper body. Install the rear plate so that the edge of the plate fits into the band of the throttle valve and install one screw to hold the rear plate in place. Install the throttle return spring and install the two remaining cheese headed screws.

Install the manual valve. Torque on all cheese headed screws should be 20–30 lb. in. (0·23 to 0·35 kgm.)

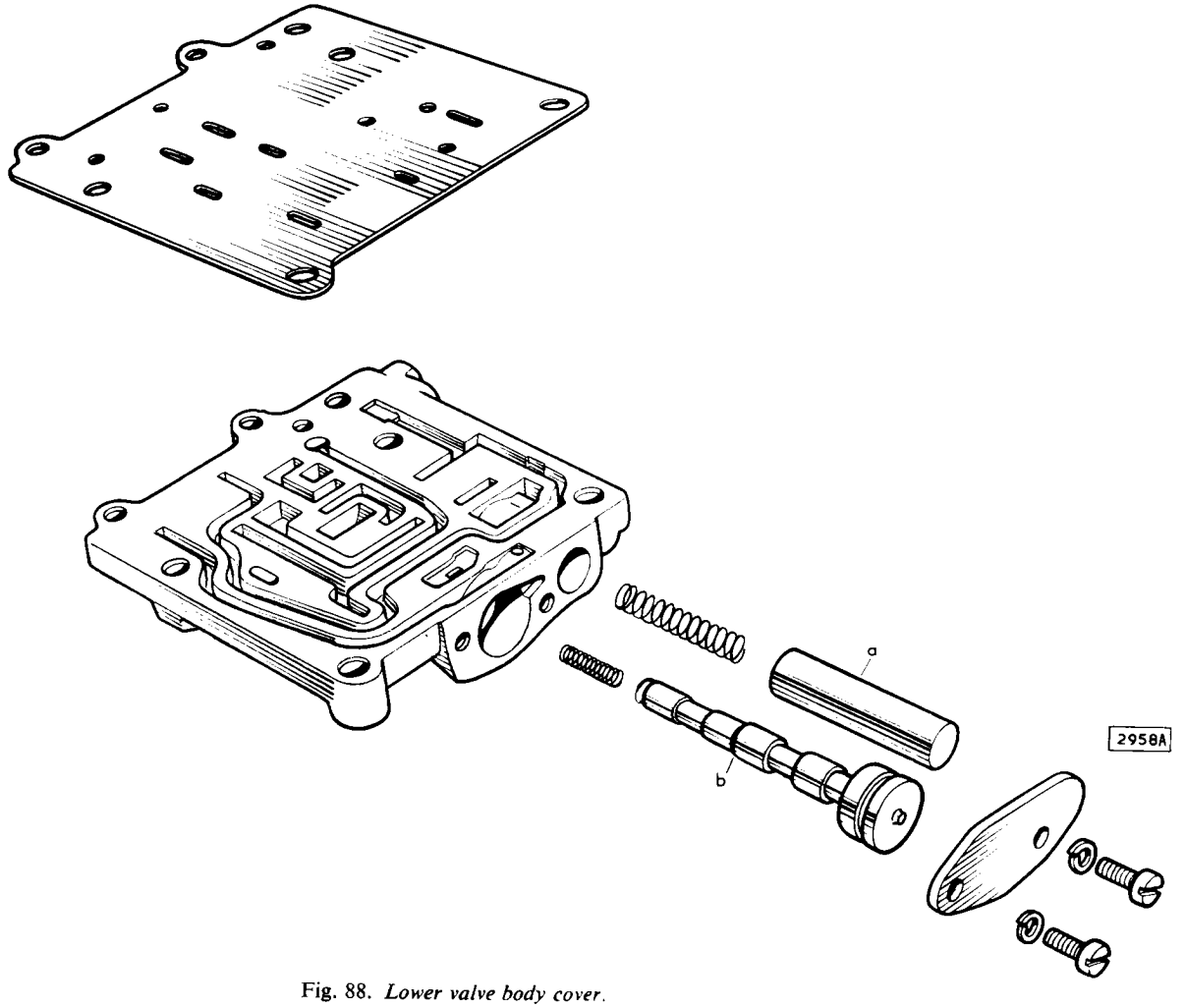


Fig. 88. *Lower valve body cover.*

A Front servo release orifice valve

B '1–2' shift valve

TRANSMISSION ASSEMBLING

Lubricate all parts as they are assembled, with the same fluid used for filling the transmission. Petrolatum can be used sparingly to hold gaskets or thrust washers in position during assembly.

Wash the transmission case and dry with compressed air.

Install a new front pump to case gasket, then install the front pump. Torque the four attaching cap screws to 17–22 lb. ft. (2·35 to 3·04 kgm.).

Install the front band through the bottom of the case, positioning the band so that the anchor end is aligned with the anchor in the case.

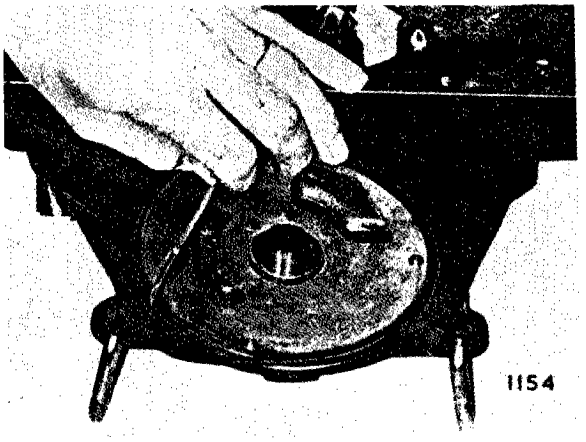


Fig. 89. *Fitting a new front pump gasket.*

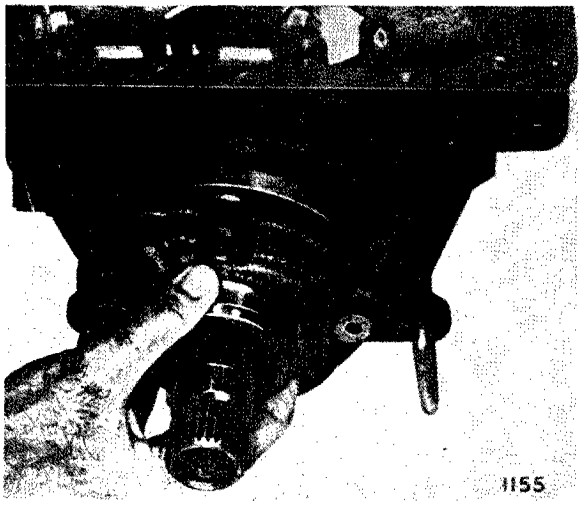


Fig. 90. *Installing the front pump.*

Install the front clutch, rear clutch and forward sun gear assembly in the case. Handle the clutch assemblies in a manner that will prevent the clutches being pulled apart.

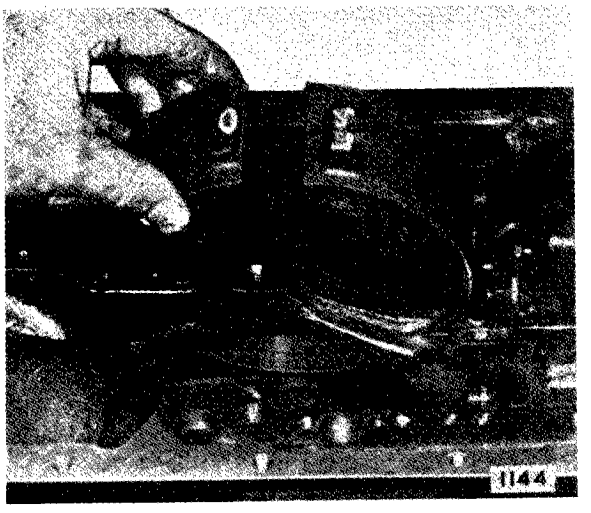


Fig. 91. *Installing the front band.*

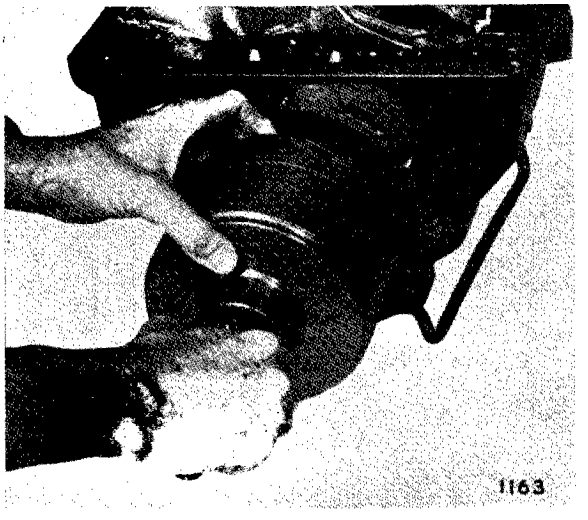


Fig. 92. *Installing the front clutch.*

Install the centre support in the transmission case with the three positioning holes aligned with the holes in the case.

Install the centre support cap screws with the rolled edge of each lockwasher towards the case. Torque to 20–25 lb. ft. (2·76 to 3·46 kgm.).

Install the rear band through the rear of the case. Be sure that the end with the depression or dimple is placed toward the adjusting screw.

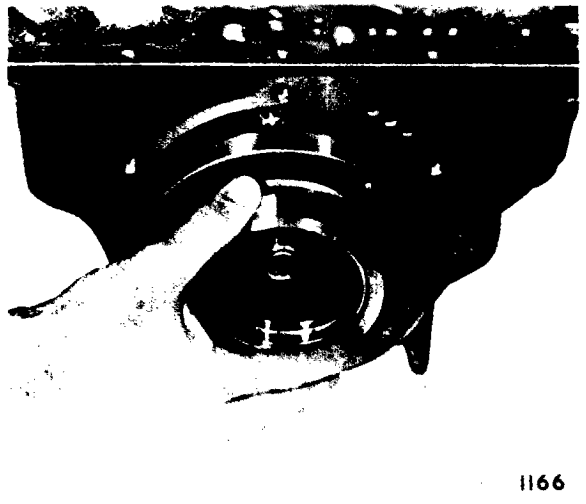


Fig. 93. *Installing the centre support.*

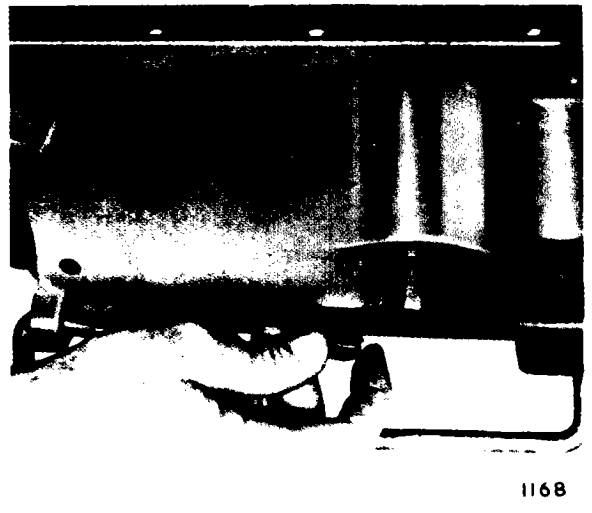


Fig. 94. *Fitting the centre support cap screws.*

Use petrolatum sparingly to hold the forward sun gear thrust plate and needle bearing in the planet carrier, while the carrier is assembled over the sun gear.

Install the hook type seal rings on the rear of the forward sun gear. Check the rings for free movement in their grooves.

Choose a selective washer to give the correct end play (end play determined during dismantling is used to determine the need for a different thrust washer).

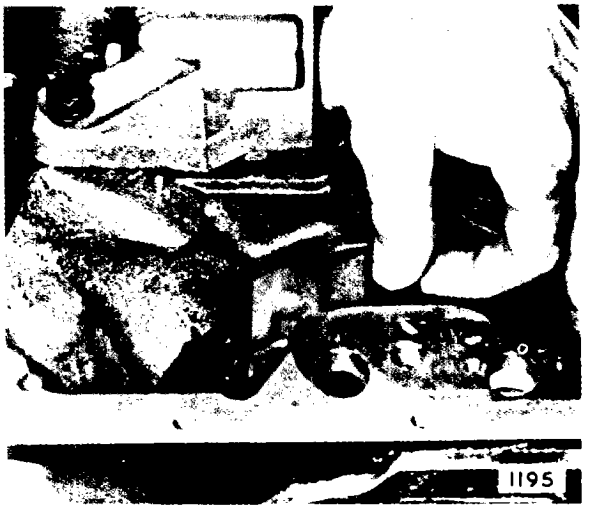


Fig. 95. *Fitting the rear band.*

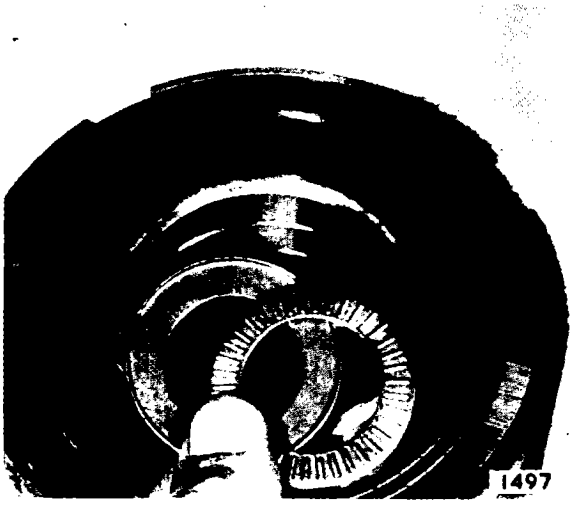


Fig. 96. *Fitting the thrust plate and needle bearing.*

Install washer on the rear of the planet carrier.

Use petrolatum to hold the rear pump to case gasket to rear of the case.

Install the ring gear and output shaft assembly. Align the three oil tubes as the assembly is fitted and tap them in position.

Place the rear pump to extension housing gasket in position, then assemble the extension housing. Torque the five extension housing cap screws to 28–33 lb. ft. (3·87 to 4·56 kgm.).

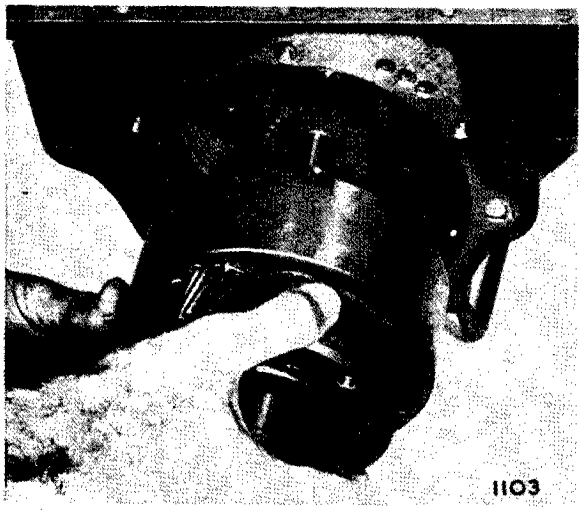


Fig. 97. *Assembling the carrier over the sun gear.*

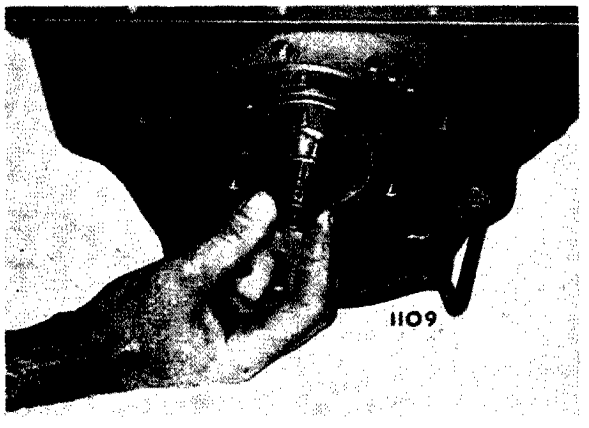


Fig. 98. *Fitting the sealing rings.*

Install the bearing snap ring, and then tap the ball bearing into position in the extension housing and on the output shaft (be sure spacer washer is on shaft ahead of bearing).

Slide the speedometer drive gear on the output shaft.

Install rear seal in bearing retainer. Assemble the bearing retainer in its gasket.

Install the companion flange, flat washer, lock-washer and nut. Torque the nut to 90–120 lb. ft. (12·44–16·58 kgm.).

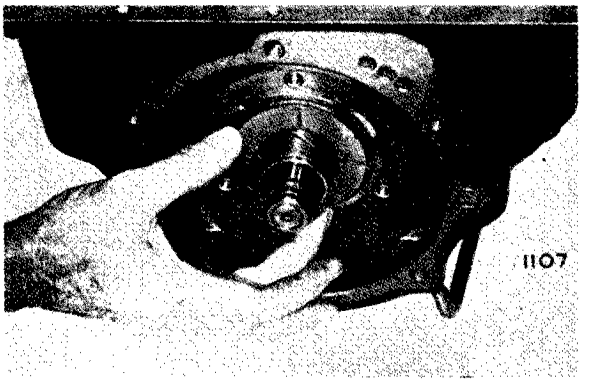


Fig. 99. *Fitting the washer on the rear of planet carrier.*

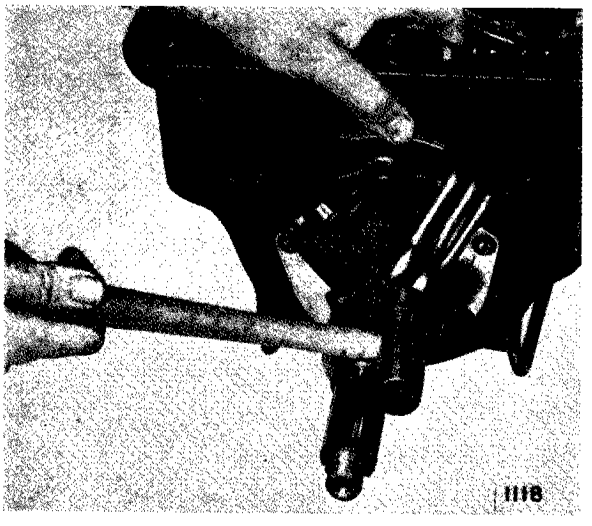


Fig. 100. *Tapping the output shaft assembly into position.*

Front Servo Installation

Rotate the front band into position so that the anchor end is positioned over the anchor pin in the case.

Position the servo strut with the slotted end aligned with the servo actuating lever, and hold it in position with the middle and index fingers of the left hand.

Engage the end of the band with the small end of the strut then position the servo over the dowel pin.

Install the attaching cap screw but do not screw it in more than two or three threads at this time.

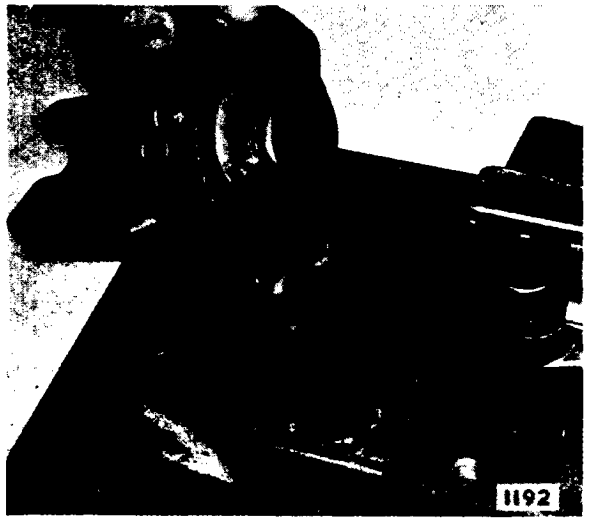


Fig. 101. *Installing the front servo.*

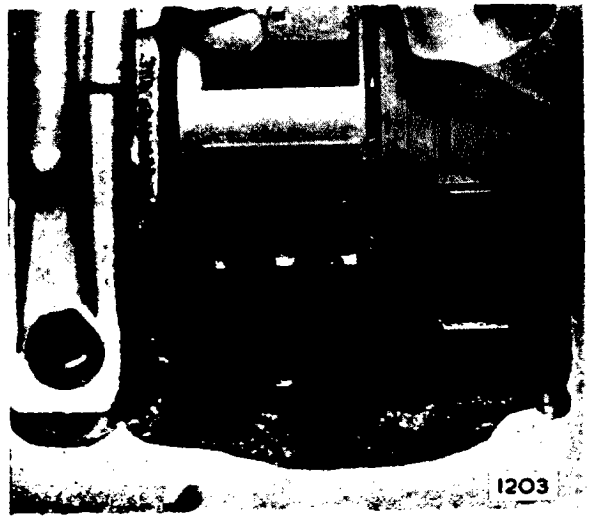


Fig. 102. *Engaging the servo anchor strut.*

Rear Servo Installation

Position the servo anchor strut over the adjusting screw, then rotate the rear band to engage this strut. Place the servo actuating lever strut with the notched end to the band and lift the other end with index finger or screwdriver, while locking the servo lever over the strut.

Install the long pointed bolt in the forward servo hole so that it will engage the centre support.

The other shorter bolt is used in the rear position.

Torque the bolts to 40–50 lb. ft. (5·53–6·91 kgm.).

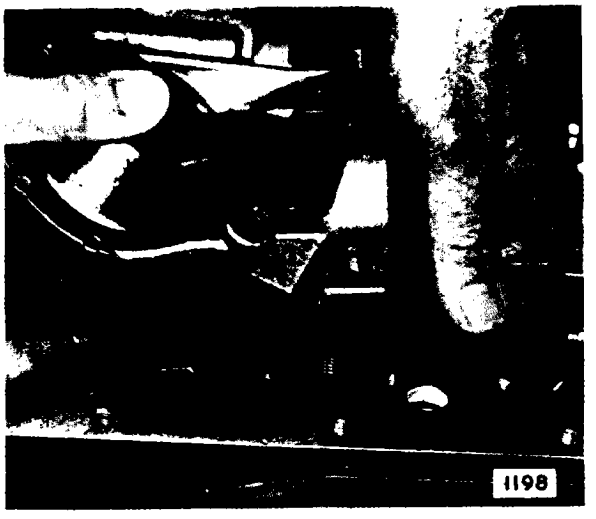


Fig. 103. *Fitting the rear servo.*

Valve Body Installation

Place the manual selector in park or reverse position. Carefully align the valve body with the servo tubes and gently slide the valve body further onto the tubes.

The front servo must be pulled up off the dowel to allow easy assembly. Be careful at this point—the servo apply strut may become disengaged from the servo. Before seating the valve body on the case, install the nipple end of the throttle cable, into the throttle cam.

Next, align the manual valve with the inside lever pin and the valve body will then drop into position. Torque the three valve body attaching cap screws to 8–10 lb. in. (0·09–0·12 kgm.).

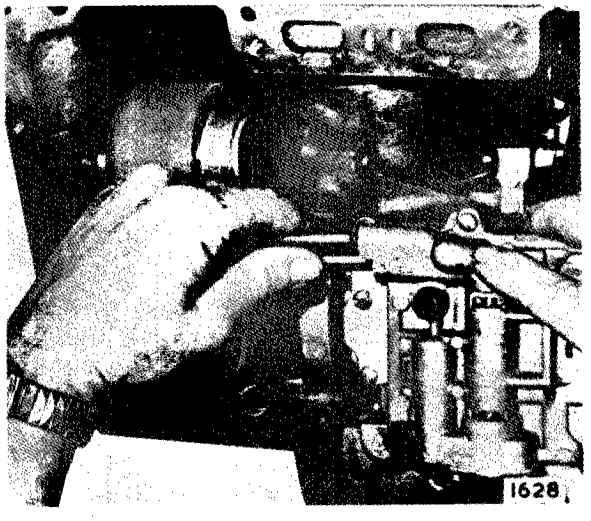


Fig. 104. *Fitting the servo tubes.*

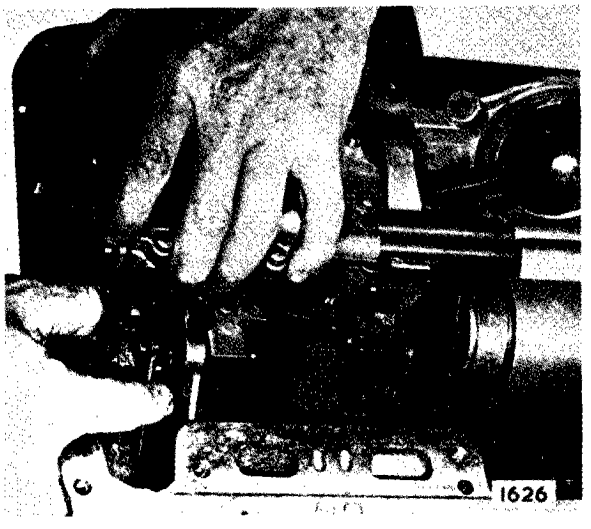


Fig. 105. *Positioning the valve body.*

Torque the front servo attaching cap screw to 30–35 lb. ft. (4·15–4·84 kgm.) and adjust the front servo.

Replace the control pressure tube, by first assembling the long straight end into the regulator, then rocking the tube downward into the control valve body. If too much resistance is encountered, it will help to loosen the control body attaching cap screws until the tube can be assembled.

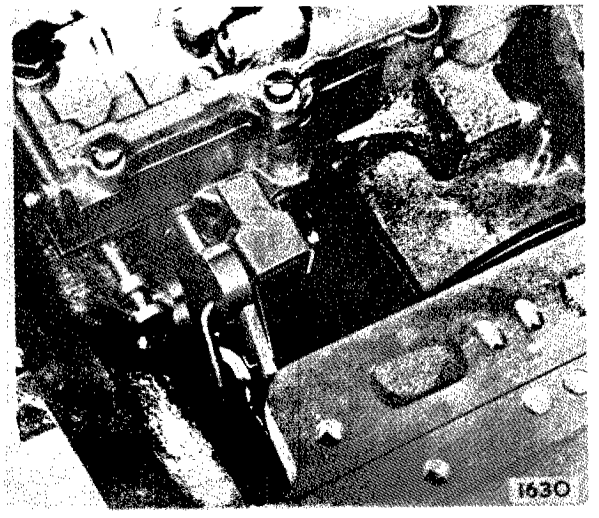


Fig. 106. *The valve body in position.*

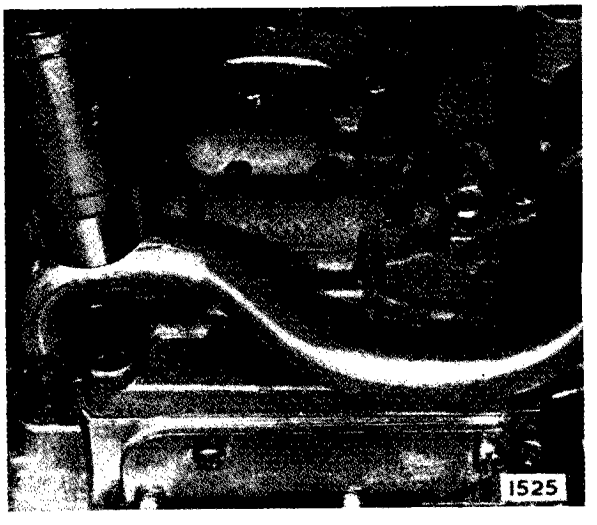


Fig. 107. *Replacing the control pressure tube.*

Pressure Regulator Installation

Assemble the regulator, with the valves in position in their bores, to the case with the attaching cap screws.

Torque cap screws to 17–22 lb. ft. (2·35–3·04 kgm.). Install both springs and guides, then install the spring retainer.

Install the front servo apply and release tubes in the servo.

Install the rear pump inlet and outlet tubes, using new "O" rings.

Replace the compensator tube by aligning one end with the pressure regulator and the other end with the control valve body and then tap it into position.

Assemble the long end of the lubrication tube into the rear pump, then rock the other end into position and tap it into the pressure regulator assembly.

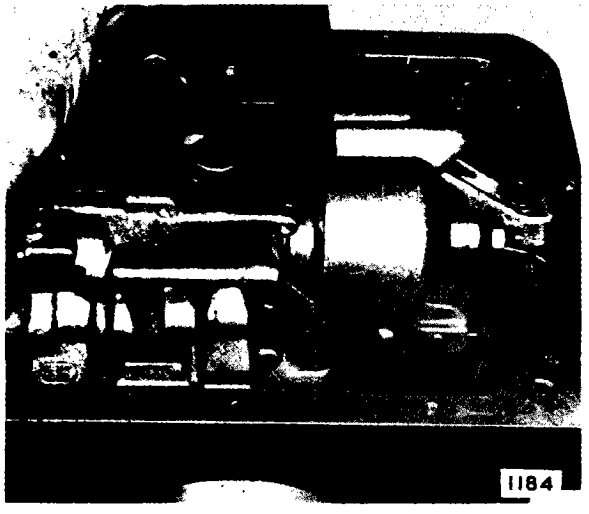


Fig. 108. *The pressure regulator installed.*

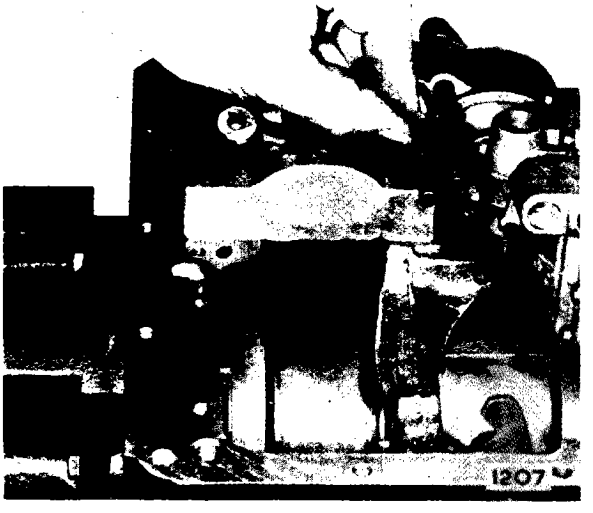


Fig. 110. *Fitting the apply and release tubes.*

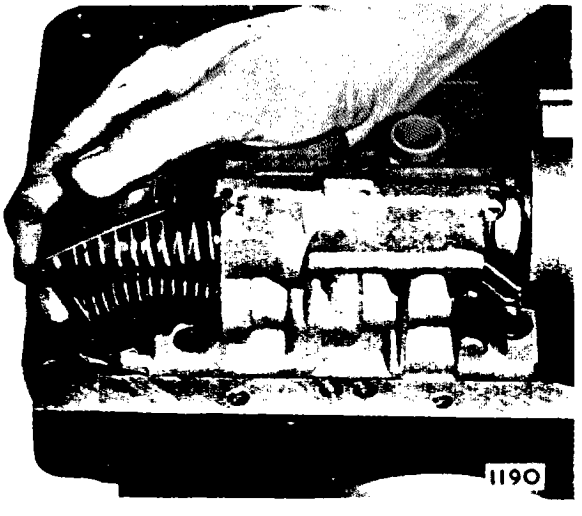


Fig. 109. *Fitting the pressure regulator springs.*

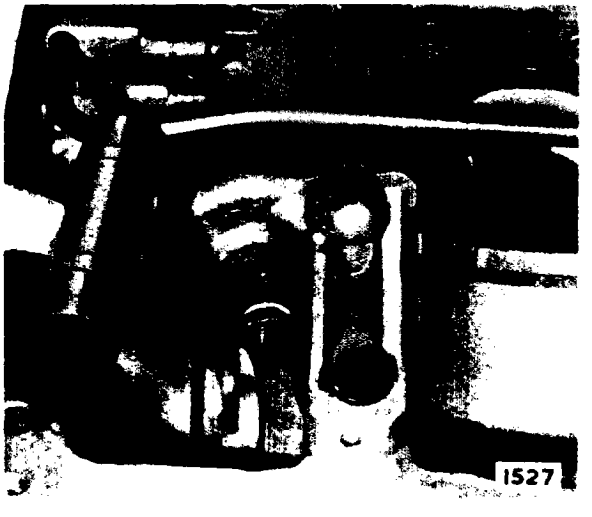


Fig. 111. *Fitting the lubrication tube.*

Replace the front band lubrication tube. Be sure the tube is aligned so that the open end will direct oil onto the front drum surface at the front band gap. Tube should point at approximately the centre of the gap.

Assemble the oil screen assembly onto the rear pump inlet tube and then rock into position over the front pump inlet on the pressure regulator assembly. Hook the screen retainer under the lubrication tube, lay across screen, and snap onto compensator tube.

Install the oil pan gasket, the oil pan and torque the 14 cap screws to 10–20 lb. ft. (1·38–2·76 kgm.).

Adjust the rear band.

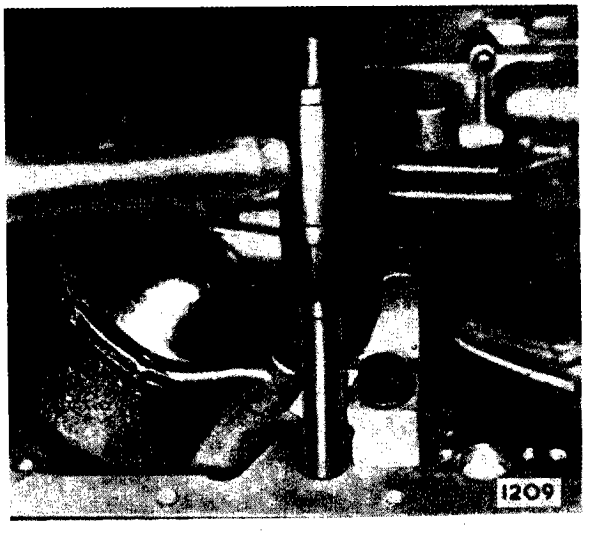


Fig. 113. *Fitting the rear pump inlet tube.*

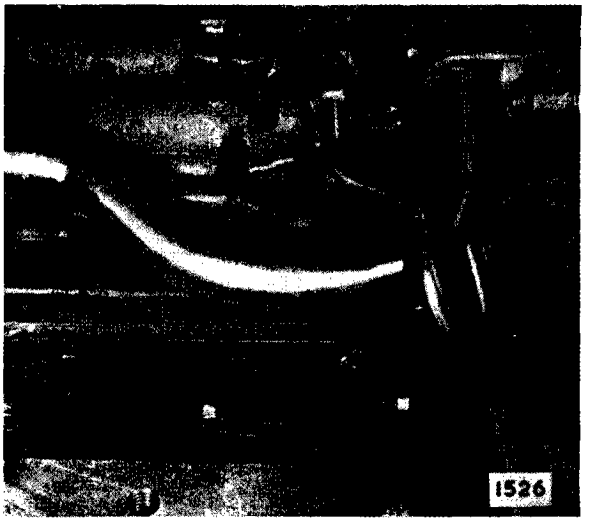


Fig. 112. *Replacing the compensator tube.*

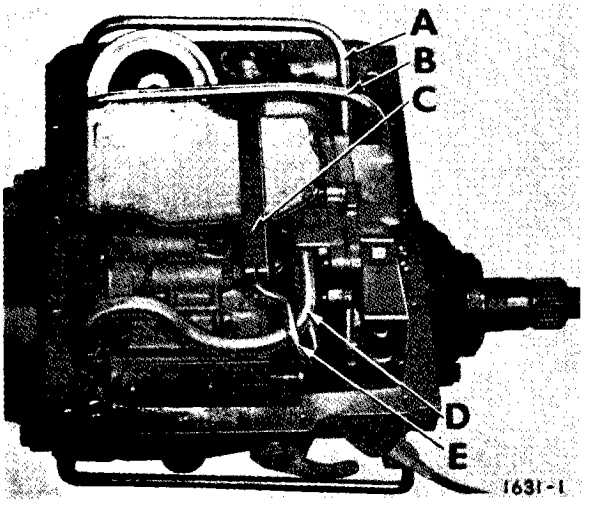


Fig. 114. *View of the Model 8 transmission inverted.*

CONVERTER AND CONVERTER HOUSING

When installing the converter housing, the maximum allowable runout should not exceed 0·010″ (0·25 mm.) for bore or face indicator readings relative to crankshaft centre line; however, it is preferable to have less than 0·006″ (0·015 mm.) reading for both.

When installing the transmission to the converter housing and converter assembly, be certain that the converter lugs are properly aligned with the front pump drive gear, so that the parts will not be damaged by forcing impeller hub drive tangs against the pump drive gear lugs.

1. Converter housing.
2. Stud.
3. Stoneguard assembly.
4. Cover (bottom).
5. Cover (front).
6. Right hand support bracket.
7. Left hand support bracket.
8. Drive plate assembly.
9. Dowel.
10. Setscrew.
11. Plate.
12. Setscrew.
13. Tab washer.
14. Support bracket.
15. Coil spring.
16. Retainer.
17. Spring seat (rubber).
18. Pin assembly.
19. Oil outlet pipe.
20. Flexible hose.
21. Flexible hose.
22. Clip.
23. Bracket.
24. Clip.
25. Oil return pipe.
26. Bracket.
27. Clamp.
28. Clip.
29. Transmission dipstick assembly.
30. Tube assembly.
31. Clip.
32. Strut.

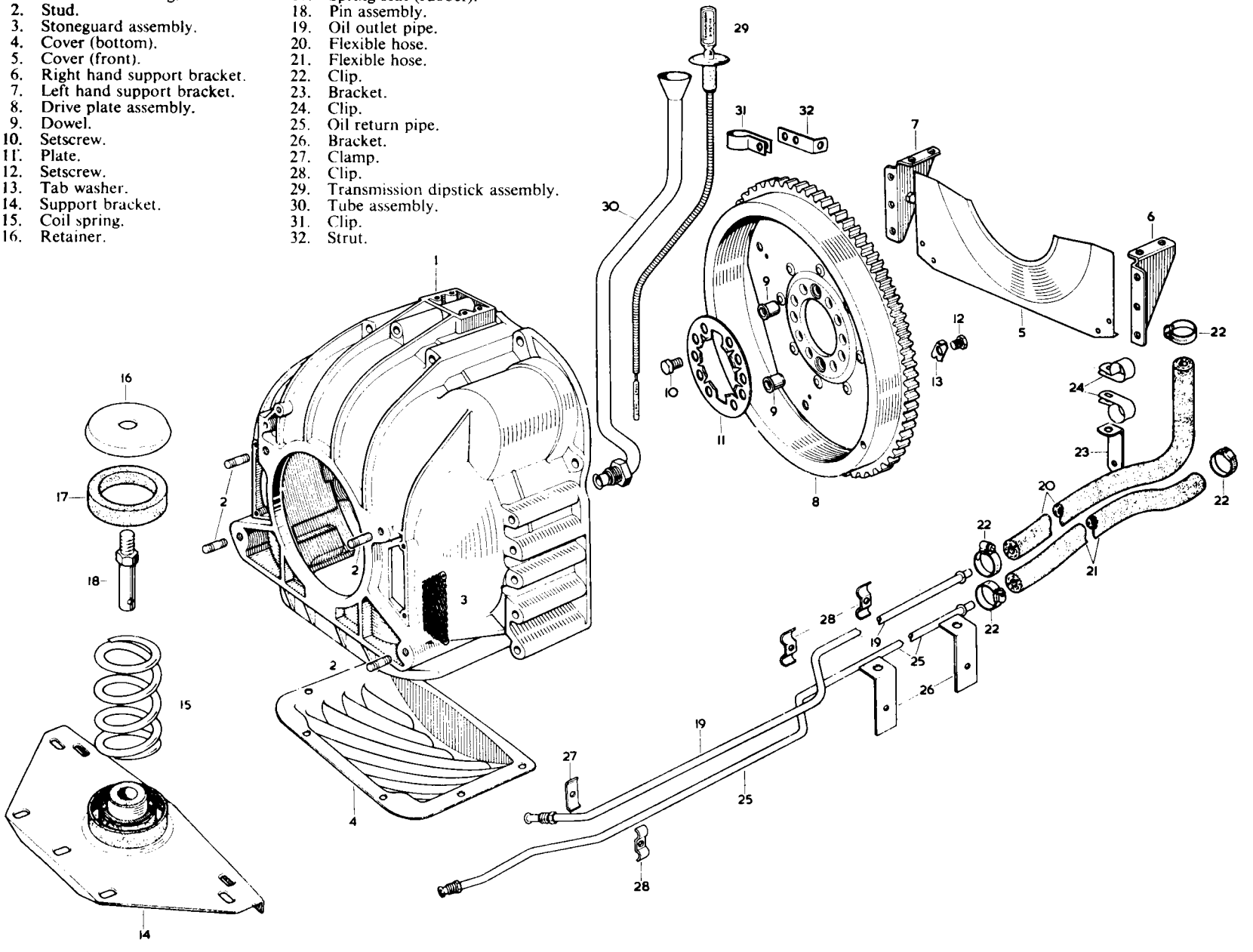


Fig. 115. *Converter housing, transmission mounting, etc.*

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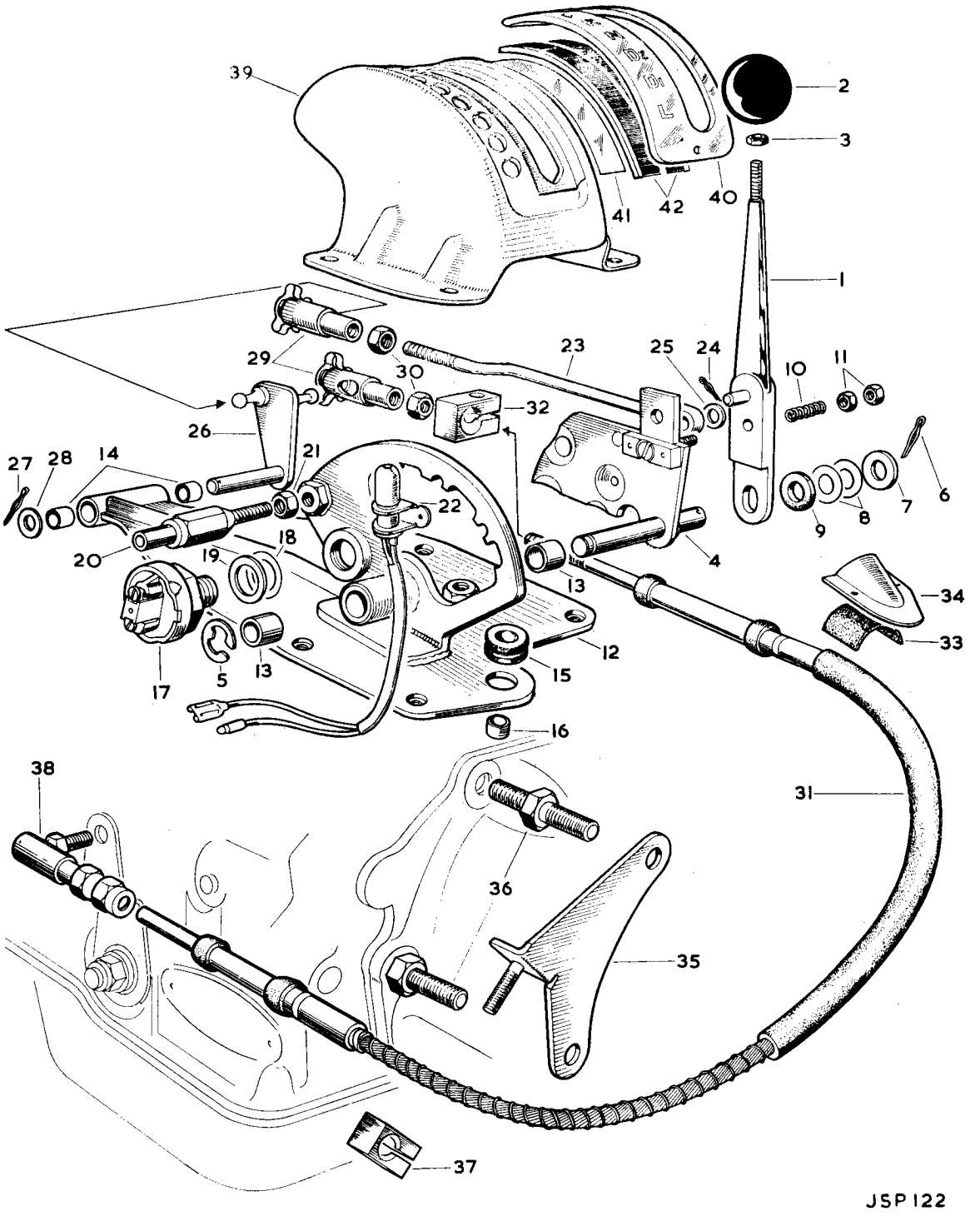


Fig. 116. *The transmission controls.*

1. Selector lever assembly.
2. Knob.
3. Nut.
4. Cam plate assembly.
5. Circlip.
6. Split pin.
7. Washer.
8. Shim.
9. Washer (rubber).
10. Spring.
11. Nut.
12. Mounting plate and selector gate assembly.
13. Bush.
14. Bush.
15. Grommet.
16. Distance tube.
17. Reverse lamp switch.
18. Shim.
19. Shim.
20. Starter cut-out switch.
21. Nut.
22. Lamp assembly.
23. Operating rod assembly.
24. Split pin.
25. Washer.
26. Transfer lever assembly.
27. Split pin.
28. Washer.
29. Ball joint.
30. Nut.
31. Gear control cable assembly.
32. Clamp.
33. Pad.
34. Plate.
35. Abutment bracket.
36. Stud.
37. Clamp.
38. Adjustable ball joint.
39. Cover assembly.
40. Indicator plate.
41. Light filter.
42. Seal.

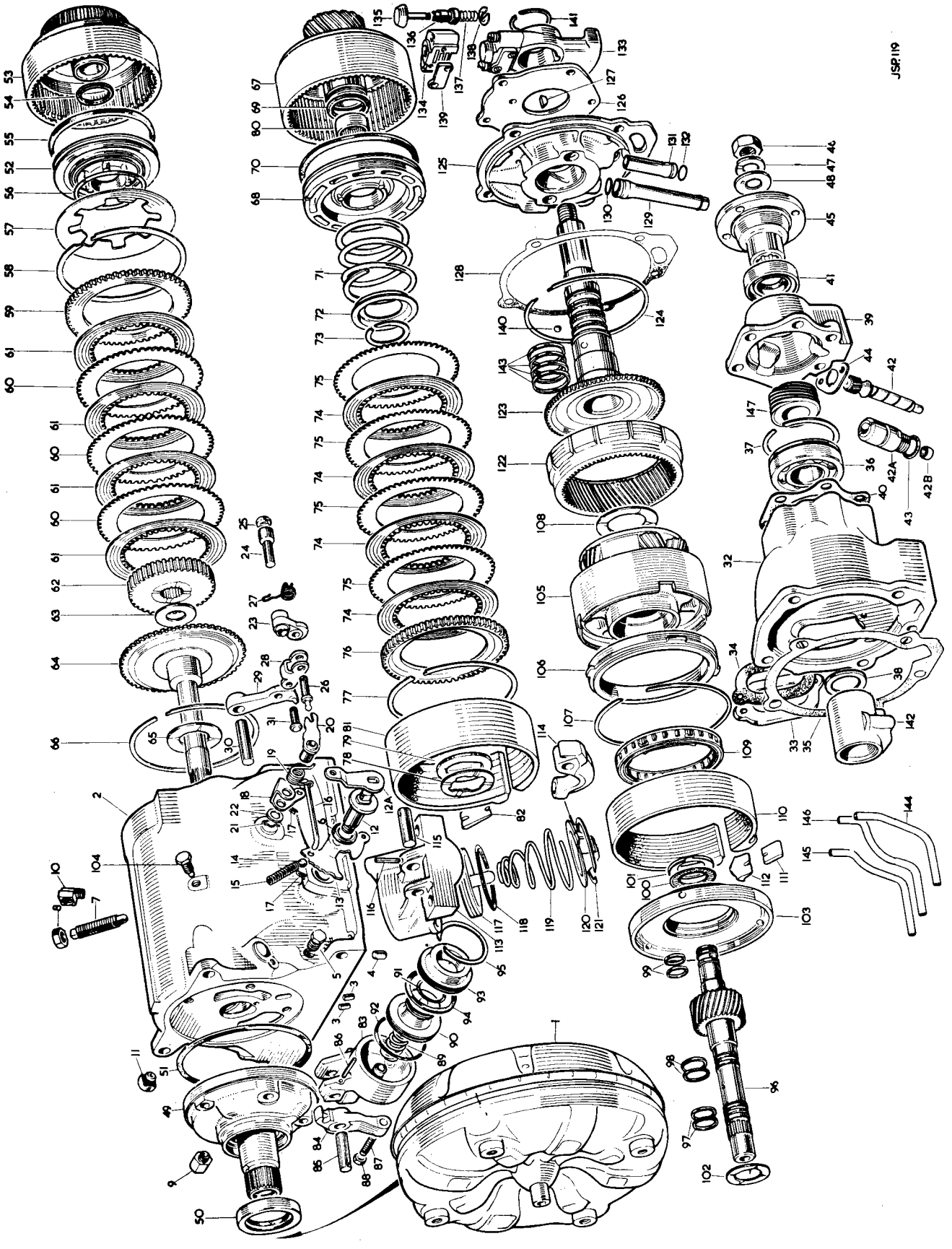


Fig. 117. *Exploded view of the transmission unit.*

1. Converter assembly.
2. Transmission case assembly.
3. Plug.
4. Dowel.
5. Plug.
6. Oil seal.
7. Screw.
8. Nut.
9. Union.
10. Union.
11. Breather assembly.
12. Manual control shaft assembly.
12A. Selector lever.
13. Lever assembly.
14. ¼" ball.
15. Spring.
16. Link.
17. Clip.
18. Torsion lever.
19. Spring.
20. Forked lever.
21. Clip.
22. Washer.
23. Toggle lever.
24. Toggle pin.
25. Plug.
26. Ball pin.
27. Spring.
28. Link.
29. Pawl.
30. Pivot pin.
31. Pin.
32. Extension case assembly.
33. Cover plate.
34. Gasket.
35. Gasket.
36. Bearing.
37. Snap ring.
38. Spacing washer.
39. Speedometer housing.
40. Gasket.
41. Oil seal assembly.
42. Speedometer driven gear.
42A. Bearing.
42B. Oil seal.
43. "O" ring.
44. Plate.
45. Flange.
46. Nut.
47. Lockwasher.
48. Washer.
49. Front pump assembly.
50. Oil seal assembly.
51. Sealing ring.
52. Piston assembly.
53. Cylinder.
54. Sealing ring (inner).
55. Sealing ring (outer).
56. Split ring.
57. Spring.
58. Snap ring.
59. Pressure plate.
60. Clutch plate (drive).
61. Clutch plate (friction).
62. Hub.
63. Thrust washer (fibre).
64. Input shaft assembly.
65. Thrust washer.
66. Snap ring.
67. Front drum assembly.
68. Piston assembly.
69. Sealing ring (inner).
70. Sealing ring (outer).
71. Spring.
72. Seat.
73. Snap ring.
74. Clutch plate (friction).
75. Clutch plate (drive).
76. Pressure plate.
77. Snap ring.
78. Thrust washer (bronze).
79. Thrust washer (steel).
80. Needle bearing.
81. Brake band.
82. Strut (servo).
83. Body.
84. Lever.
85. Pivot pin.
86. Roll pin.
87. Screw.
88. Nut.
89. Return spring.
90. Piston assembly.
91. "O" ring (small).
92. "O" ring (large).
93. Piston sleeve.
94. Sealing ring.
95. Snap ring.
96. Forward sun gear assembly.
97. Sealing ring.
98. Sealing ring.
99. Sealing ring.
100. Thrust bearing.
101. Race.
102. Thrust washer (bronze).
103. Centre support assembly.
104. Screw.
105. Planetary gears and rear drum assembly.
106. Outer race.
107. Snap ring.
108. Thrust washer.
109. One way clutch assembly.
110. Brake band for rear drum.
111. Strut (servo).
112. Anchor strut.
113. Body assembly.
114. Lever.
115. Shaft.
116. Roll pin.
117. Piston.
118. "O" ring.
119. Return spring.
120. Plate.
121. Snap ring.
122. Ring gear.
123. Mainshaft assembly.
124. Snap ring.
125. Rear pump assembly.
126. Plate.
127. Key.
128. Gasket.
129. Oil inlet tube.
130. "O" ring.
131. Oil outlet tube.
132. "O" ring.
133. Governor assembly.
134. Governor body.
135. Governor weight.
136. Governor valve.
137. Spring.
138. Retainer.
139. Cover plate.
140. ¼" ball.
141. Snap ring.
142. Oil collector sleeve.
143. Piston ring.
144. Oil collector tube (front).
145. Oil collector tube (intermediate).
146. Oil collector tube (rear).
147. Speedometer drive gear.

SECTION H

REAR AXLE

The rear axle (final drive unit) remains identical to that stated in the 3·8 "E" Type Service Manual with the exception of the following details:—

Axle Ratios

U.S.A., CANADA (Manual transmission only)	3·54:1
All other countries (Manual transmission only)	3·07:1
Automatic Transmission (2+2 only, U.S.A. and CANADA)	3·31:1
Automatic Transmission (2+2 only, all other countries)	2·88:1

HALF SHAFT UNIVERSAL JOINTS

Grease nipples (see the 3·8 "E" Type Service Manual—Page H8—Early cars) were reintroduced from the commencement of production of Series 2 cars.

Access to the nipples of the outer joints is gained by removing the plastic sealing plugs from the joint covers. The universal joints should be greased every 6,000 miles (10.000 km.).

SECTION I

STEERING

GENERAL DESCRIPTION

The upper and lower steering columns and the mountings are of the collapsible type designed to comply with the U.S.A. Federal Safety Regulations.

The collapse points are retained by nylon plugs which will shear on impact, allowing the steering wheel and columns (upper and lower) to move forward.

NO ATTEMPT must be made to repair the units if damaged due to accident.

NEW replacement items MUST be fitted.

UPPER STEERING COLUMN

Description

The upper steering column (inner) is composed of two separate sliding shafts retained to a fixed length by nylon plugs, the outer column being pierced in a lattice form.

The inner shaft assembly is supported in the outer column by two pre-lubricated taper roller bearings.

A gaiter covers the pierced portion of the outer column to seal against the ingress of dirt.

Removal

Disconnect the battery.

Withdraw the self-tapping screws and remove the under-scuttle casing above the steering column.

Disconnect the cables contained in the direction indicator switch harness.

Note the location of the connections for reference when refitting.

Withdraw the ignition key, remove the ring nut and detach the ignition switch from the mounting bracket on the steering column.

Note : If the car is fitted with air-conditioning equipment the switch will be mounted on a bracket attached to the evaporator unit and need not be removed.

Release three grub screws in the steering wheel hub and remove the steering wheel motif.

Remove the locknut, hexagon nut and flat washer and withdraw the steering wheel from the splines on the inner column.

Disconnect the cables from the steering column lock (if fitted). Note the location of the cables for reference when refitting.

Remove the nut, lockwasher and pinch bolt securing the upper universal joint to the lower steering column.

Remove two nuts and lockwashers securing the upper column lower mounting bracket to the underside of the scuttle.

Remove two bolts, nuts, lockwashers and distance pieces securing the upper mounting bracket to the support bracket on the body.

Withdraw the upper column from the splines on the lower column.

Note : If the steering column has not been damaged by impact, i.e., if the nylon plugs in the inner column or the top mounting bracket have not sheared, excessive force must NOT be used to separate the upper universal joint from the lower column.

Refitting

Refitting is the reverse of the removal procedure.

Set the road wheels in the straight ahead position and check that the bolt holes in the lugs of the upper column universal joint register correctly with the groove machined in the lower column splines. Tighten the pinch bolt to a torque of 16-18 lb. ft. (2.2-2.5 kgm).

IMPORTANT

Excessive force as noted under 'Removal' must not be used when reassembling the universal joint to the column.

UNDER NO CIRCUMSTANCES should a mallet or similar tool be used when engaging the splines in the joint and column.

If the splines will not engage freely, inspect for damage or burrs and remove with a fine file.

NO ATTEMPT must be made to repair any nylon plugs which have sheared due to impact.

Dismantling

Dismantling is confined to removing the steering column adjuster locknut, the splined shaft and the direction indicator switch as detailed on page I.8.

LOWER STEERING COLUMN

Description

The lower steering column comprises two sliding shafts retained to a fixed length by nylon plugs.

STEERING

Removal

Remove the upper steering column as detailed previously.

Remove the nut, lockwasher and bolt securing the column to the lower universal joint and withdraw the column rearwards through the grommet.

Note : If the steering column has not been damaged by impact, i.e., if the nylon plugs in the column have not sheared, excessive force must NOT be used to separate the column and the lower universal joint.

Refitting

Refitting is the reverse of the removal procedure.

Check that the bolt holes in the universal joint register correctly with the groove machined in the column splines. Tighten the pinch bolt to a torque of 16 - 18 lb. ft. (2.2 - 2.5 kgm).

IMPORTANT

Excessive force as noted under 'Removal' must not be used when reassembling the universal joint to the column. **UNDER NO CIRCUMSTANCES** should a mallet or similar tool be used when engaging the splines in the joint or the column.

If the splines will not engage freely, inspect for damage or burrs and carefully remove with a fine file. NO ATTEMPT must be made to repair any nylon plugs which have sheared due to impact.

STEERING HOUSING

The rack and pinion assembly is identical to that shown in Fig. 3—page 15 of the 3·8 "E" Type Service Manual with the exception of the rack pre-load components.

The belleville washer and disc are replaced by a spring and retaining cap.

The method of adjustment and the rack and float figure remain as stated on page 17.

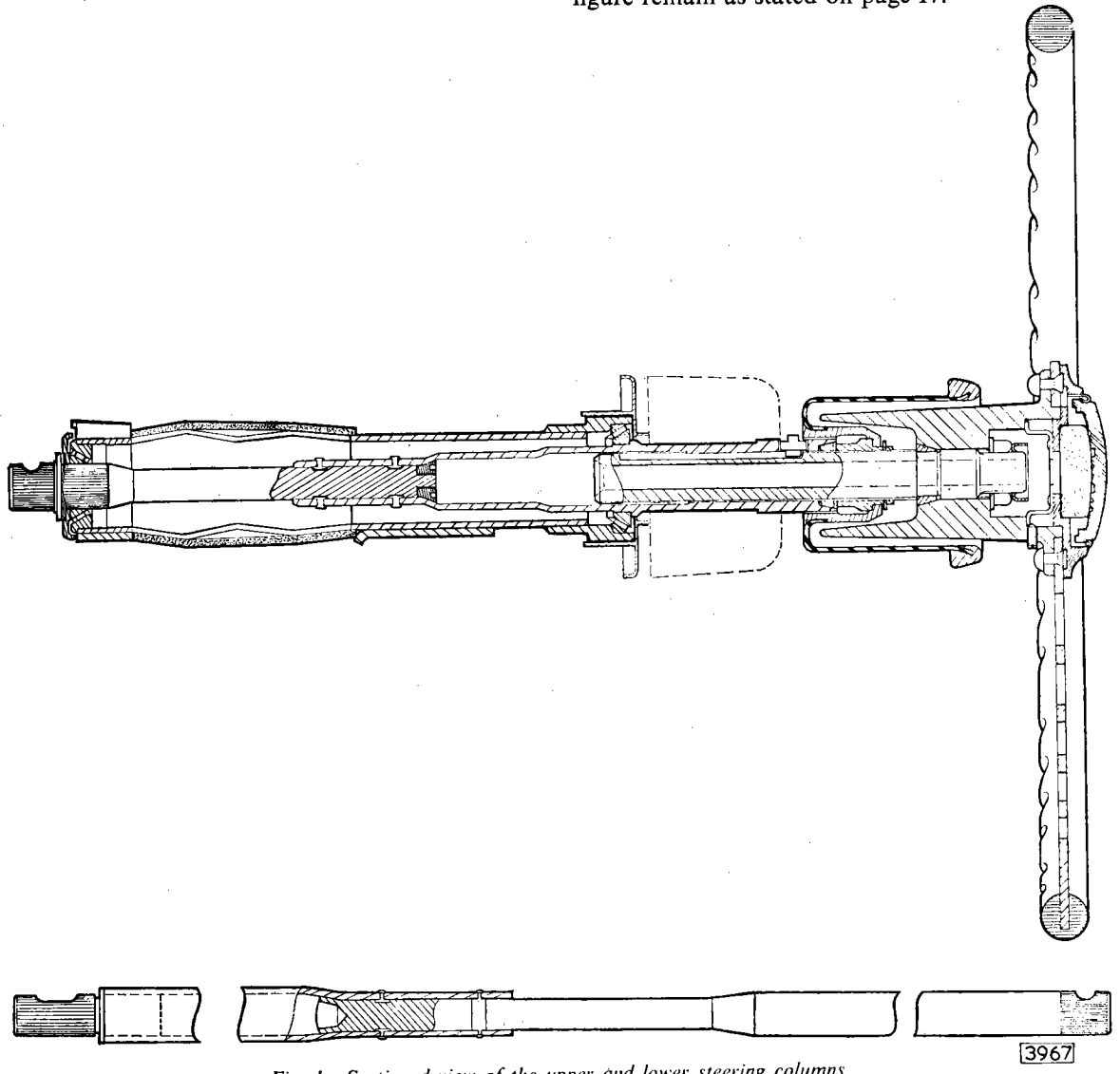


Fig. 1. Sectioned view of the upper and lower steering columns showing the nylon plugs.

SECTION II

STEERING

(Power assisted)

DESCRIPTION

The power-assisted steering system, available as optional equipment, consists of three main components; the rack and pinion steering unit, the pump, and the reservoir interconnected by flexible hoses.

The pump is mounted on the left-hand side of the engine, the reservoir being attached to brackets secured to the left-hand sub-frame.

A shield protects the reservoir on left-hand drive cars from the exhaust manifold heat.

The upper and lower columns remain the same in detail as stated in Section I, page IY.s.1.

DATA

Steering Gear

Make	Adwest Engineering Co. Ltd.
Type	Rack and Pinion
Number of turns—lock to lock	
Turning circle	

Oil Pump

Make	Hobourn Eaton
Location	Left-front of engine
Operating Pressure	1,000 lb./sq. in. (70·3 kg./cm.^{2})

Front Wheel Alignment $\frac{1}{16}$—$\frac{1}{8}$" (1·6–3·2 mm.) toe-in

OPERATION

STEERING GEAR

Oil is supplied from the reservoir via the output side of the pump to the steering unit (pressure hose) and is then returned from the steering unit to the reservoir (return hose).

A continuous flow of oil is pumped through the system whilst the engine is running but pressure builds up only when the steering wheel is turned.

The steering gear is basically a normal rack and pinion manual steering with a torsion bar controlled rotary value embodied in the input shaft and a hydraulic cylinder.

The piston in the hydraulic cylinder is connected to the rack.

Steering lock stops are incorporated in the gear unit.

THE VALVE UNIT

This is a rotary type control valve. The valve rotor, which is also the input shaft to the steering gear, has three grooves machined in it.

These grooves lie between three grooves in the valve sleeve when no load is applied to the steering wheel, the rotor being centred in the sleeve by a torsion bar.

When steering effort is applied at the wheel, this is transmitted via the torsion bar to the rotor. The torsion bar is, however, slender and the manual effort causes it to twist, thus allowing the rotor to rotate in the sleeve.

The relative movement of the grooves in the rotor to the grooves in the sleeve allows hydraulic pressure from the pump to operate on either side of the piston thus assisting the movement of the rack.

THE PRESSURE PUMP

The pressure pump is a roller type, belt driven unit. The relief valve is set to operate between 950 and 1,000 lb./sq. in. (66·8–70·3 kg./cm.^{2}). The flow control valve is set at 2·2 Imp. galls. per min. (10 litres/min.) (21 U.S. pints per min.).

No servicing or adjustment is possible with the pump. Replacement units can be obtained on an exchange basis from:—

THE SPARES DIVISION,

JAGUAR CARS LTD.,

COVENTRY,

ENGLAND.

SERVICING

Checking The Reservoir Oil Level

The oil reservoir is mounted on the right-hand side of the engine. It is important that absolute cleanliness is observed when replenishing with oil as any foreign matter that enters may affect the hydraulic system.

Remove the filler cap, check the oil level and top up if necessary with the recommended grade of fluid. The correct level of the oil is just above the filter element.

Rack and Pinion Housing

The rack and pinion housing is attached to the front suspension crossbeam.

A grease nipple, located in the rack adjuster pad for the lubrication of the rack and pinion assembly, is accessible from underneath the front of the car from the driver's side.

Lubricate sparingly with the recommended grade of lubricant. Do not over-lubricate the housing to the extent where the bellows at the end of the housing become distended. Over-lubricating may also block the air transfer pipe.

Check that the clips at the ends of the bellows are fully tightened, otherwise the grease will escape from the housing.

Steering Tie-Rods

Lubricate the ball joints of the two steering tie-rods with the recommended lubricant. When carrying out this operation, examine the rubber seals at the bottom of the ball housing to see if they have become displaced or split. In this event they should be repositioned or replaced as any dirt or water that enters the joint will cause premature wear.

Do not over-lubricate the ball joints to the extent where grease escapes from the rubber seal.

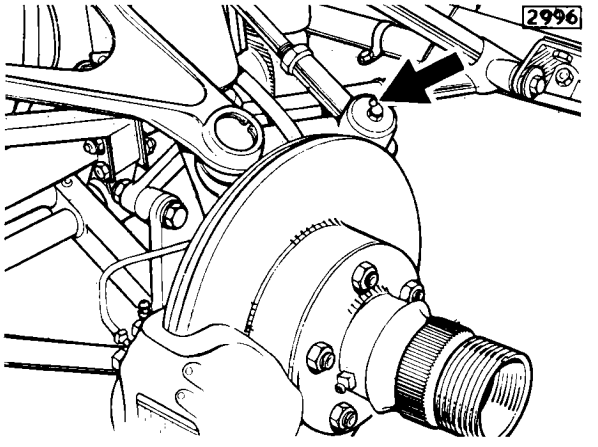


Fig. 1.

Front Wheel Alignment

Check the front wheel alignment as detailed on page IIY.s.9. if uneven wear is evident on the tyres.

CHECKING AND ADJUSTMENT ON CAR

The following adjustments can be carried out on the car; all others which may develop require the removal of the unit from the chassis.

RACK RATTLE

This is usually apparent when travelling on rough surfaces.

Adjust as follows:—

(1) Release the locknut retaining the rack pad adjusting screw.

(2) Screw the rack adjusting screw until a firm resistance is felt, and back off $\frac{1}{16}$th of a turn ($22\frac{1}{2}°$) maximum.

Firmly grip the ball pin arm protruding from the pinion end of the steering gear and by moving it towards the rack back-up pad, a spring resistance should be felt.

The total amount of play at the rack pad should not exceed ·010" (·254 mm.). Check by removing the grease nipple and inserting a dial indicator through the rack pad and rack adjusting screw until the stem contacts the back of the rack. By pulling the rack against the spring the total amount of end play can be measured.

If the spring resistance is negligible, remove the

rack pad screw and check that the spring is not broken.

The clearance should be the minimum that will allow smooth operation of the steering unit with no binding at any point throughout the full travel.

STEERING VEERING TO RIGHT OR LEFT

If the car steers to the right or left when being driven in the straight ahead position, or if unequal efforts are required to turn the steering to the right or left, carry out the following preliminary tests before proceeding further:—

Check the tyre pressures and tyre wear and change the front tyres from one side to the other. If the pull changes direction, then the trouble lies with one or both of the front tyres.

If the pull remains unchanged, check the steering geometry.

If no improvement is apparent, the fault must be in the trimming of the valve in the steering unit.

Fit a 100 lb. per sq. in. (7 kg./cm.^{2}) pressure gauge in the return line, start engine and allow to idle. Note the pressure gauge reading which should be 40 lb. per sq. in. (2·8 kg./cm.^{2}) approximately.

Turn the steering to the left and right by a small equal amount. The pressure should increase by an equal amount irrespective of the direction the steering is turned.

If the pressure is not balanced as indicated by a slight fall in pressure on one side before rising, the valve and the pinion assembly must be replaced.

If, on starting the engine, the steering kicks to one side, replace valve and pinion assembly as detailed on page IIY.s.6, under "Dismantling and Re-assembling".

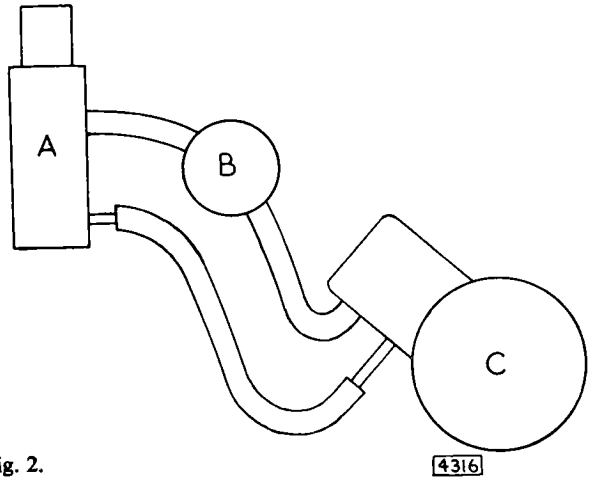


Fig. 2. 4316

The pinion assembly can be removed without detaching the rack housing assembly from the car, if necessary.

Back off the rack adjuster pad fully before removing the pinion housing and readjust to give ·010" (·254 mm.) end play as detailed under "Rack Rattle" after refitting.

Note the position of the pinch bolt slot in the input shaft before removing, and ensure that the slot is in the same position after refitting. Allow for the spiral in the pinion when reassembling.

BALL PIN KNOCK

Ball pin knock, evident when turning to left or right, is due to wear in the inner ball assembly.

This will only be apparent after long periods of service, and on no account must any adjustment be attempted to reduce wear which may have developed.

A new ball pin/track rod assembly must, in ALL cases, be fitted.

The new assembly will be supplied less the outer ball pin and bellows which must be ordered separately if required.

The ball pin/track rod assembly can be removed with the rack *in situ* as follows:—

Disconnect the track rod on the side to be removed, from the steering arm.

Remove the bellows retaining clip from the rack housing. Fold the bellows back until the inner ball joint is exposed.

Knock back the ears of the tab washer which locks the inner ball joint assembly to the rack shaft, remove the ball joint and track rod as a unit and collect the spring.

Check the length of the track rod between the inner and outer ball pin centres.

Release the outer ball joint locknut, remove the joint and nut and withdraw the bellows after releasing the clip.

Check the outer ball joint and replace if necessary. Re-assemble to the track rod and adjust the length between the ball pin centres to the figure as noted on removal. This should be 8·75" (22·2 cm.). IT IS IMPORTANT that both track rods are of equal length.

Refit the inner ball joint and spring to the rack shaft and tighten fully. Secure with new tabwasher.

Apply a generous coating of the recommended grade of grease to the inner ball housing and refit the bellows and tighten the clips.

Reconnect the track rod to the steering arm and check the front wheel alignment as detailed on page IIY.s.9,

CHECKING THE HYDRAULIC SYSTEM

A number of faults in the steering system can be caused by inefficiencies in the hydraulic circuit, see page IIY.s.10 for "Fault Finding" chart. The following checks can be carried out without removing any components from the car. Before starting any of this work the fluid should be checked for correct level and for lack of froth.

Pump Blow Off Pressures

Fit a pressure gauge into the return line, start the engine and run at idling speed.

Turn the steering to full lock and continue to increase the steering wheel effort until the pressure ceases to increase. The peak pressure should lie between 950 and 1,000 lb./sq. in. (66·8–70·3 kg./cm.^{2}) and should not increase with engine r.p.m.

If however, the pressure is below 950 lb./sq. in. (66·8 kg./cm.^{2}) at tickover but rises to the correct figure with increased engine speed, then the trouble is caused either by a faulty relief valve in the pump or by excessive internal leakage in the steering gear.

Fit a pressure gauge into the pressure line with an "ON–OFF" tap in series with the gauge and the steering unit.

Start the engine, open the tap and turn the steering to full lock. Check the pressure reading on the gauge. This should read 1,000 lb./sq. in. (70·3 kg./cm.^{2}).

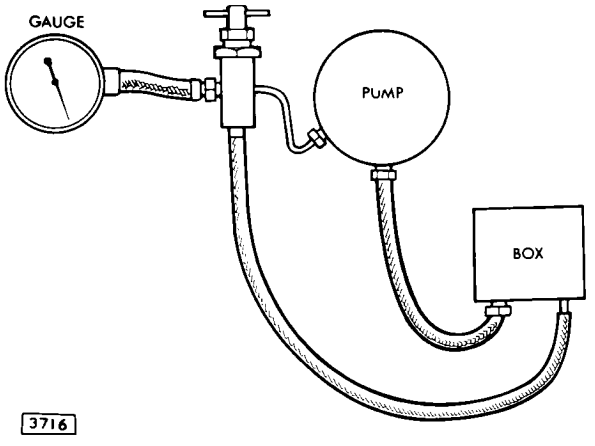


Fig. 3.

If the pressure does not rise to this figure **close the tap for a maximum of 5 seconds** and note the gauge reading. This should be 1,000 lb./sq. in. (70·3 kg./cm.^{2}) —relief valve pressure.

If this reading is obtained, the leaks are confined to the steering unit which should be removed and overhauled. If the reading is not obtained the fault lies in the pump.

Faulty pumps cannot be serviced. New replacement units can be obtained on an exchange basis from:—

The Spares Division,
Jaguar Cars Ltd.,
Coventry,
England.

STEERING GEAR

Removal

Remove the bonnet as detailed in Section N—page NY.s.3.

Remove the radiator as detailed in Section C—page DY.s.1.

Turn the steering wheel until the Allen screw in the lower column universal joint is accessible, insert an Allen key and remove the screw.

Disconnect the hoses from the steering unit and catch the oil which will drain away. Blank off the connections and unions to prevent the ingress of dirt.

Remove the nuts and washers and disconnect the track rod ball joints from the steering levers using a suitable extractor.

Remove the bolts, nuts and washers securing the steering gear unit to the frame assembly as detailed under "Steering Housing—Removal", on page I.6 and withdraw the unit.

Note: If the steering column has not been damaged by impact, i.e. if the nylon plugs in the column have not sheared, excessive force must NOT be used to separate the pinion shaft and the lower universal joint.

Dismantling

Thoroughly clean the outside of the unit before attempting to dismantle.

Remove the sub-assemblies or components as follows:—

(a) Remove the external pipes.

(b) Remove the wire clips retaining the bellows to the steering unit and fold back the bellows to expose the ball joints.

(c) Knock back the tab washer securing the inner ball pin to the rack shaft.
Remove the inner ball pin and track rod as a unit. DO NOT dismantle the ball pin assembly.
Collect the thrust spring and spacer.

(d) Release the locknut retaining the rack adjusting pad screw, remove screw, spring and pad.

(e) Mark the location of the pinion housing in relation to the rack housing. Remove three nylon locking nuts retaining valve body assembly to the rack housing. Withdraw the assembly and discard the joint. Note the location of the pinch bolt slot before withdrawing the housing.

(f) The unit is now separated into its two major components, that is, valve and pinion assembly and the rack and tube assembly.
Depending on the fault, either of these or both can be dismantled and the faulty component replaced.

Do not disturb the outer ball joints unless these are to be removed for replacement. If the ball joints are removed for any purpose, check the total length of the tie rods before releasing the locknut.

Tie rods must be re-assembled to an equal length of 8·75″ (22·2 cm.).

EXAMINATION OF COMPONENTS

Valve and Pinion/Housing Assembly

The valve and pinion/housing assembly will be available for Service Replacement purposes as a complete unit only, with the exception of the top seal and the associated back-up seal, the housing gasket and the pipe union seats.

With the assembly removed from the rack tube, carry out the following checks:—

With a soft mallet drift out the valve and pinion assembly from the housing.

Examine the teflon rings. These should be a loose fit in their grooves and the outer diameter should be free from cuts, scratches or similar blemishes.

Ensure that there is no relative movement at the trim pin between the valve sleeve and the shaft.

Check that there is no wear in the torsion bar assembly pins by ensuring that there is no free movement between the input and output pinion shafts.

Examine the housing bore for signs of wear, particularly on the rubbing surfaces of the teflon rings.

Examine the needle roller bearings for damage or wear.

If, during the above checks, any fault is found, the complete assembly must be replaced as a unit.

Replacing the Top Seal

Drift out the shaft assembly as detailed above.

Remove the circlip and extract the top and back-up seals.

Replace with the new seals contained in the seal kit and refit the circlip.

Refit the shaft assembly and reassemble the housing to the rack tube with a new gasket.

Renewing the Pipe Union Seats

If worn or damaged, the pipe union seats can be renewed by tapping a suitable thread in the internal bore of the seat and inserting a setscrew with an attached nut and plain washer.

Tighten down the nut against the housing base and withdraw the seat.

Fit new seat by inserting in the housing and tapping home square with a soft drift.

Rack and Rack Housing

The following items will be available as replacement parts:—

1. Rack
2. Rack Housing
3. "Clevite" Bearing
4. Seal (contained in Seal Kit).

Replacement rack housings will be complete with end cap, seals, "Clevite" bearing and needle bearing.

] Remove the valve and pinion housing as detailed previously.

Mark the location of the end cap in relation to the rack tubing.

Unscrew the ring nut retaining the end cap to the rack tube and withdraw the cap.

Remove the union from the rack tube and push out the centre seal housing from the pinion housing end of the tube.

Check the condition of the piston and ring and if worn or scratched renew complete.

Remove the outer circlip and withdraw the piston. Note any shims which may be fitted between the inner circlip and the piston.

Remove the "O" ring from the shaft and replace with the new part contained in the Seal Kit. Refit the piston and secure with circlips.

Check that end float between piston and circlip does not exceed ·010". If this condition exists reduce end float by adding a shim.

IMPORTANT: Check that the piston rotates freely between the circlips on completion.

Remove the "O" rings and seal from the centre seal housing and discard. Replace with new parts contained in the Seal Kit.

Insert the housing into the tube with the lips of the seal facing towards the centre.

Line up the hole in the housing with the hole in the tube and secure with the union.

Insert the rack in the rack housing. Extreme care must be taken to ensure that the oil seal in the housing is not damaged by the rack teeth.

Remove the "O" ring and oil seal from the end cap. Check the condition of the "Clevite" bearing and replace if worn or damaged with a new bearing. A mandrell machined to the internal diameter of the bearing should be used when refitting to prevent the bearing collapsing.

Renew the oil seal and "O" ring and refit the end cap. Line up the location marks made during removal and secure with the ring nut. Care must be taken to ensure that the end cap does not turn when tightening the ring nut. Any movement will place the mounting brackets out of phase with each other.

Refit the rack adjuster pad, spring, adjuster screw and locknut, but do not attempt to carry out any rack adjustment at this stage.

Final Assembly

Place a new seal joint over the three studs in the rack housing.

Refit the pinion housing, noting the position as marked on removal.

Check that the pinch bolt slot is in the same relative location as noted on removal when engaging the pinion with the rack teeth.

Allow for the spiral in the pinion assembly when reassembling. Fit the self-locking nuts and tighten down evenly.

Refit the inner ball joints and track rods as an assembly as detailed on page IIY.s.4 under "Ball Pin Knock". If the inner ball joint is to be replaced due to wear, a new unit complete with track rod must be obtained. **ADJUSTMENT OF THE JOINT IS NOT PERMISSIBLE.**

Refit the outer ball joints if removed; adjust the length of each track rod to 8·75"(22·2 cm.) between the ball joint centres. IT IS IMPORTANT that the track rods are of equal length.

Adjust the rack back-up pad as detailed on page IIY.s.3.

Refit the grease nipple and the external pipes.

Coat both rack ball housings with 2 oz. (56·7 grammes) of the recommended grade of grease, fit the bellows and secure with the clips to the track rod and steering housing.

Apply a grease gun to the nipple in the back-up adjuster pad and inject 1 oz. (28·35 grammes) of the recommended lubricant.

Do not lubricate the housing to the extent where the bellows become distended. Over-lubrication may also block the air transfer pipe.

Refitting

Refitting is the reverse of the removal procedure.

Reconnect the high and low pressure hoses, care being taken to ensure that the connections are perfectly clean.

Refit the lower and upper steering columns as detailed on page IIY.s.8.

Refill the reservoir to the full mark of the dipstick with the recommended grade of Automatic Transmission Fluid.

Bleed the system as follows:—

(a) With the engine running, turn the steering from lock to lock a few times to expel any air which may be present, indicated when all lumpiness has disappeared.

(b) Check the fluid level in the reservoir and top up if necessary with the recommended grade of fluid. The correct level is just above the filter element.

STEERING COLUMN

The upper and lower steering columns and mountings are of the collapsible type designed to comply with U.S.A. Federal Safety Regulations.

The collapse points are retained by nylon plugs which will shear on impact, allowing the steering wheel and columns (upper and lower) to move forward.

NO ATTEMPT must be made to repair the units if damaged due to accident. NEW replacement items MUST be fitted.

UPPER STEERING COLUMN

Description

The upper steering column (inner) is composed of two separate sliding shafts retained to a fixed length by nylon plugs, the outer column being pierced in a lattice form.

The inner shaft assembly is supported in the outer column by two pre-lubricated taper roller bearings.

A gaiter covers the pierced portion of the outer column to seal against the ingress of dirt.

Removal

Disconnect the battery.

Withdraw the self-tapping screws and remove the under-scuttle casing above the steering column.

Disconnect the cables contained in the direction indicator switch harness.

Note the location of the connections for reference when refitting.

Withdraw the ignition key, remove the ring nut and detach the ignition lock from the mounting bracket on the steering column.

Note: If the car is fitted with air-conditioning equipment, the switch will be mounted on a bracket attached to the evaporator unit and need not be removed.

If the car is fitted with a steering column lock, removal of the lock will not be possible, and it will be necessary to disconnect the attached cables at the snap connectors.

Release three grub screws in the steering wheel hub and remove the steering wheel motif.

Remove the locknut, hexagon nut and flat washer, and withdraw the steering wheel from the splines on the inner column.

Remove the nut, lockwasher and pinch securing bolt the upper universal joint to the lower steering column.

Remove two nuts and lockwashers securing the upper column lower mounting bracket to the underside of the scuttle.

Remove two bolts, nuts, lockwashers and distance pieces securing the upper mounting bracket to the support bracket on the body.

Withdraw the upper column from the splines on the lower column.

Note: If the steering column has not been damaged by impact, i.e. if the nylon plugs in the inner column or the top mounting bracket have not sheared, excessive force must NOT be used to separate the upper universal joint from the lower column.

Refitting

Refitting is the reverse of the removal procedure.

Set the road wheels in the straight ahead position and check that the bolt holes in the lugs of the upper column universal joint register correctly with the groove machined in the lower column splines. Tighten the pinch bolt to a torque of 16–18 lb. ft. (2·2–2·5 kgm.).

IMPORTANT

Excessive force as noted under "Removal" must not be used when reassembling the universal joint to the column.

UNDER NO CIRCUMSTANCES should a mallet or similar tool be used when engaging the splines in the joint and column.

If the splines will not engage freely, inspect for damage or burrs and remove with a fine file.

NO ATTEMPT must be made to repair any nylon plugs which have sheared due to impact.

Dismantling

Dismantling is confined to removing the steering column adjuster locknut, the splined shaft and the direction indicator switch as detailed on page IIY.s.8.

LOWER STEERING COLUMN

Description

The lower steering column comprises two sliding shafts retained to a fixed length by nylon plugs.

Removal

Remove the upper steering column as detailed

previously.

Remove the nut, lockwasher and bolt securing the column to the lower universal joint and withdraw the column rearwards through the grommet.

Note: If the steering column has not been damaged by impact, i.e. if the nylon plugs in the column have not sheared, excessive force must NOT be used to separate the column and the lower universal joint.

Refitting

Refitting is the reverse of the removal procedure.

Check that the bolt holes in the universal joint register correctly with the groove machined in the column splines. Tighten the pinch bolt to a torque of 16–18 lb. ft. (2·2–2·5 kgm.).

IMPORTANT

Excessive force as noted under "Removal" must not be used when reassembling the universal joint to the column. UNDER NO CIRCUMSTANCES should a mallet or similar tool be used when engaging the splines in the joint or the column.

If the splines will not engage freely, inspect for damage or burrs and carefully remove with a fine file. NO ATTEMPT must be made to repair any nylon plugs which have sheared due to impact.

FRONT WHEEL ALIGNMENT

It is ESSENTIAL that the following instructions are carried out when checking the front wheel alignment, otherwise steering irregularities may result.

Important

Inflate all tyres to the recommended pressures.

Each wheel must be adjusted individually by means of the tie-rods to give half the total toe-in of $\frac{1}{16}$" to $\frac{1}{8}$" (1·6 to 3·2 mm.).

Procedure

Set the front wheels in the straight ahead position.

Centralise the steering by removing the grease nipple from the rack adjuster pad and inserting the centralising tool (Jaguar Part No. 12297).

Check the alignment of the front wheels by using light beam equipment or an approved tract setting gauge.

If adjustment is required, slacken the locknuts at the outer end of each tie-rod, release the outer clips securing the rack housing bellows to avoid distortion after turning the tie-rods.

Turn the tie-rods by an equal amount in the necessary direction until the alignment is correct. Tighten the locknut and re-check.

Ensure that the bellows are not twisted and tighten the clips.

REMOVE THE CENTRALISING TOOL and refit the grease nipple to the rack adjuster pad.

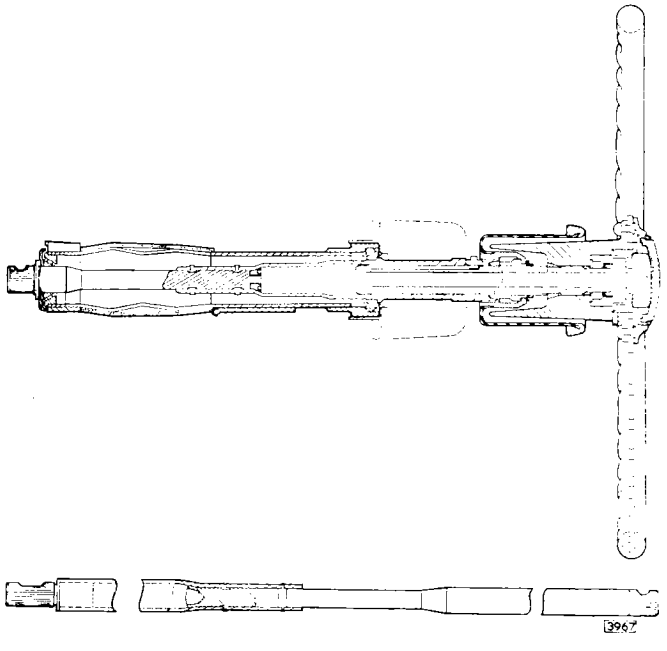


Fig. 4.

FAULT FINDING CHART

FAULT	POSSIBLE CAUSE	REMEDY
External oil leaks from Rack and Pinion unit.	Damage or wear to seals or incorrect tightening of unions or bolts.	It is most important that source of the leak is traced before any attempt is made to rectify. Once the leak is located, tighten the unions or bolts or replace the seals as necessary.
Leak at reservoir.	Cover gasket damaged. Hose connection loose.	Renew gasket. Tighten hoses.
Leak at pump shaft.	Worn or damaged seals on shaft.	Replace pump.
Steering veering to right or left.	Unbalanced tyre pressures or faulty tyres. Steering gear out of trim.	Check as detailed on Page IIY.s.4.
Heavy steering when driving.	Low tyre pressures. Tightness or stiffness in column and/or steering and suspension joints.	Inflate tyres. Grease or replace components.
Heavy steering when parking.	Loose pump belt (nearly always accompanied by a squealing noise). Insufficient pressure from pump due to defective pump valve or restricted hoses. Insufficient pressure due to high leaks in steering gear.	Check pump belt, replace if necessary. Remove restriction or check pump pressure as detailed on Page IIY.s.5. Replace pump if faulty. Confirm high internal leaks. If proven, remove the rack unit from the car and replace seals.
Steering effort too light.	Worn torsion dowel pins or torsion bar broken.	Remove valve housing and fit new unit.
Poor straight running.	Incorrect tyre pressures. Incorrect toe-in.	Inflate. Check and reset as necessary.
Noise from pump.	Belt loose, indicated by squealing during parking manoeurvres. Other pump noises are due to wear or damage.	Check belt and replace as necessary. Replace pump.
Rattle when travelling on rough roads.	Wear between rack and pinion assembly. Wear at ball joints at the ends of the rack. Wear in the rack housing bush.	Adjust rack pad adjuster screw as detailed on Page IIY.s.3. Renew ball joint and track rod as an assembly. Remove the rack and renew the bush.

SECTION J

FRONT SUSPENSION

The front suspension remains basically the same as that detailed in Section J—3·8 "E" Type Service Manual with the exception of the removal of the wheel hubs when steel spoked wheels are fitted and the torsion bar settings.

The routine maintenance periods are increased from those stated previously.

Wheel Swivels

Lubricate the nipples (four per car) fitted to the top and bottom of the wheel swivels.

A bleed hole is provided in each ball joint; The hole being covered by a nylon washer which lifts under pressure and indicates when sufficient lubricant has been applied.

The nipples are accessible from underneath the car.

Wheel Bearings

Removal of the wheel bearings will expose a grease nipple in the wheel hubs.

Lubricate sparingly with the recommended grade of lubricant. If excess grease is pumped into the bearing the grease will exude into the bore of the hubs (Wire wheels) or through a small hole drilled centrally in the hub end cap (Pressed steel wheels).

TORSION BAR SETTING

Check that the car is full of petrol, oil and water and that the tyre pressures are correct.

Place the car on a perfectly level surface, with the wheels in the straight ahead position.

Check the measurement from the centre line of the inner fulcrum of each lower wishbone assembly to the ground. This should be 9″ (22·86 cm.) minimum.

If any adjustment is required this should be carried out in accordance with the instructions given in Section J—Page J.15 of the 3·8 "E" Type Service Manual.

The correct dimensions for the hole centres for setting links are as follows:—

Without air-conditioning equipment

4·2 "E" Type—Open Sports	17 25/32″ (45·16 cm.) L.H.D.
4·2 "E" Type—F.H.C.	17 25/32″ (45·16 cm.) L.H.D.
4·2 "E" Type—Open Sports	17 31/32″ (45·6 cm.) R.H.D.
4·2 "E" Type—F.H.C.	17 31/32″ (45·6 cm.) R.H.D.
4·2 "E" Type—2+2	18 1/8″ (46·06 cm.) L.H.D./R.H.D.

With air-conditioning equipment

4.2 "E" Type—Open Sports	17 31/32″ (45·6 cm.) L.H.D./R.H.D.
4·2 "E" Type—F.H.C.	17 31/32″ (45·6 cm.) L.H.D./R.H.D.
4·2 "E" Type—2+2	18 3/16″ (46·5 cm.) L.H.D./R.H.D.

This method ensures that the headlamps centres are maintained at the correct height from the ground level necessary to conform to U.S.A. Federal Regulations which is 24″ (60·9 cm.).

FRONT HUBS (Pressed Steel Wheels)

If the car is fitted with pressed steel wheels, available as optional equipment, the hub nut and split pin retaining the hub to the stub axle is accessible after prising off the end cap.

Further removal, dismantling, bearing end float and refitting details remain as stated on Page J.13 of the 3·8 "E" Service Manual.

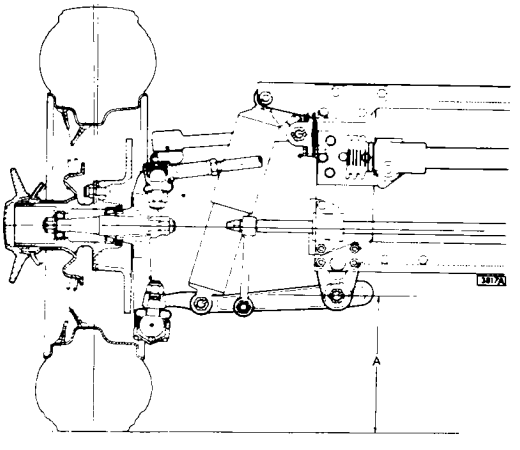


Fig. 1. *The dimension for checking the front suspension riding height.*
A—9″ (22.8 cm.)

SECTION L

BRAKES

DATA

Caliper type	Girling bridge type with quick change pads
Brake disc diameter—front	11″ (27·9 cm.)
—rear	10″ (25·4 cm.)
Master cylinder bore diameter	$\frac{7}{8}$″ (22·23 mm.)
Master cylinder stroke	1·30″ (3·3 cm.)
Servo unit type	Lockheed Dual—line
Main friction pad material	Mintex M.59
Handbrake friction pad material	Mintex M.34

Key to Figs. 1

1. Fluid at feed pressure
2. Fluid at master cylinder delivery pressure
3. Fluid at system delivery pressure
4. Vacuum
5. Air at atmospheric pressure

A Slave cylinder primary chamber
B Outlet port—front brakes
C Inlet port for secondary piston
D Outlet port—rear brakes
E Vacuum
F Air pressure
G Diaphragm
H Filter
I Air control spool
J To rear brakes
K To front brakes
L Dual slave cylinder
M Servo unit
N Master cylinder
O Brake reservoirs
P To manifold
Q To reservac
R Reaction valve
S Atmospheric pressure

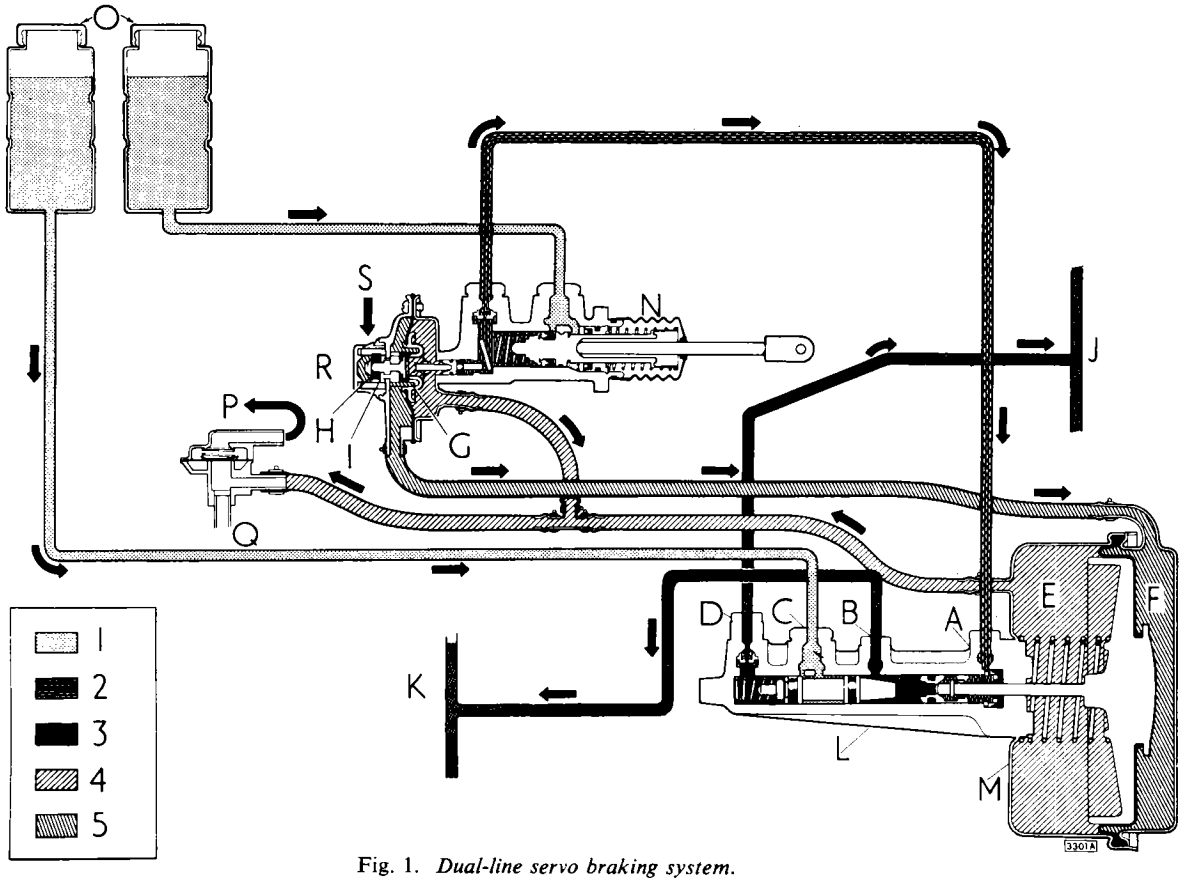


Fig. 1. *Dual-line servo braking system.*

DESCRIPTION

The dual-line servo braking system consists of an integral vacuum booster with tandem slave cylinder, a master cylinder combined with a booster reaction valve and two fluid reservoirs.

The master cylinder is of conventional design consisting of a single cast iron cylinder housing a steel, black oxided piston sealed by a single hydraulic cup. This piston is deeply skirted to engage the operating push rod. The smaller intermediate piston, housed in its own bore in the nose of the master cylinder, is actuated by hydraulic pressure generated within the main chamber.

Mounted on the end of the master cylinder, the reaction valve consists of a pair of flow control valves which sequence the flow of air to the booster. Both control valves are operated by the intermediate piston in the master cylinder. A flat plate, interposed between the two master cylinder pistons, enables the intermediate piston to function mechanically in the event of an hydraulic failure.

The booster portion of the integral booste slave cylinder assembly consists of a pressed tank which houses a moulded phenolic resin I and a rubber rolling diaphragm. A push rod, secured to the piston, extends through the forward face of the tank into the slave cylinder. This push rod provides the principal motive force for the tandem pistons.

On the forward face of the boost tank is mounted the tandem slave cylinder which consists of a single cast iron cylinder housing two pistons in tandem, each piston having its own inlet and outlet port. Either piston will, in the event of a failure, operate independently.

OPERATION (Fig. 1)

When the system is at rest, both sides of the boost system are continuously exhausted by the engine manifold depression.

As the brake pedal is depressed, the master cylinder

piston moves along the cylinder building up pressure and forcing fluid out to the primary chamber of the slave cylinder (A). Simultaneously, the intermediate piston, in the end of the master cylinder, closes the diaphragm valve (G) in the reaction valve and, in so doing, isolates the vacuum (E) from the air pressure side (F) of the boost system.

Further progress of the intermediate piston along its bore will crack the air control spool (I) in the reaction valve thus admitting air at atmospheric pressure to the rear of the boost cylinder piston. The air enters the system through a small cylindrical filter (H) on the reaction valve.

The pressure imbalance, created by the admission of air to the pressure side of the boost system, will push the boost piston down the cylinder transmitting a linear force, through the push rod, to the primary piston of the slave cylinder.

Forward motion of the primary piston, supplemented by the output of the master cylinder, transmits hydraulic pressure to the secondary piston (C) and fluid under pressure flows simultaneously from the two output ports (B and D), to the front and rear brakes.

SAFETY FACTORS

In the event of a fluid line failure in the pipe linking the master cylinder to the slave cylinder or the pipe linking the master cylinder to the fluid supply tanks, the reaction valve will be actuated mechanically by the master cylinder piston providing the booster pressure to the front and rear brakes.

A failure in the fluid line coupling the slave cylinder to the rear brakes will result in the slave cylinder secondary piston travelling to its fullest extent, down the bore. This has the effect of isolating the rear brake line from the rest of the system and permitting normal fluid pressure to build up in the front brake line.

If a fault exists in the front brake line, the slave cylinder piston will travel along the bore until it contacts the other piston and the two pistons will then travel along the bore together to apply the rear brakes.

In the case of leaks in either the air or vacuum pipes both front and rear brakes may still be applied by the displacement of fluid at master cylinder pressure.

REMOTE SERVO AND SLAVE CYLINDER

Removal

Remove the trim on the floor recess panel on the left-hand side of the car. This will disclose the three nuts securing the remote servo to the bulkhead. Withdraw the three nuts.

Drain the fluid from the system.

Disconnect the four brake pipe unions and the two flexible hoses.

Remove the battery and carrier bracket for the battery tray.

Withdraw the bolt securing the slave cylinder to the mounting bracket on the outer side member. Remove the servo together with the slave cylinder.

Refitting

Refitting the servo is the reverse of the removal procedure. Bleed the system after replenishing with fresh fluid.

MASTER CYLINDER AND REACTION VALVE

Removal

Drain the fluid from the system. Disconnect the two hydraulic pipes from the master cylinder. Disconnect the vacuum hose from the reaction valve.

Remove the clevis pin, which is retained by a split pin, securing the brake pedal to the master cylinder push rod from inside the car. In the case of right-hand drive cars, remove the top of the air cleaner and reaction valve prior to removing the two nuts securing the master cylinder to the mounting.

On left-hand drive cars the master cylinder and reaction valve can be removed as a complete unit.

Refitting

Refitting is the reverse of the removal procedure. Bleed the system after replenishing with fresh fluid.

SERVICING THE UNIT

General

Prior to dismantling either the remote servo or the master cylinder reaction valve assembly, it is advisable to obtain repair kits containing all the necessary rubber parts required during overhaul. Three separate repair kits are available as follows:—

(a) Remote servo repair kit.

(b) Reaction valve repair kit.

(c) Master cylinder repair kit.

When either of the units have been dismantled the component parts should be washed in denatured alcohol (industrial methylated spirits). Parts that have been washed should be thoroughly dried using a clean lint-free cloth or pressure line and then laid out on clean paper to prevent dirt being assembled into the servo or master cylinder and reaction valve assembly.

Examine all metal parts for damage, with particular reference to those listed below and make renewals where necessary:—

(a) the reaction valve piston and bore.

(b) the master cylinder piston and bore.

(c) the servo slave cylinder pistons and bore.

(d) the servo push rod stem.

If any of the vacuum hose connections have become loose in service these must be rectified prior to reassembly.

The vacuum non-return valve is a sealed unit and, if faulty, it must be replaced by a new assembly.

THE REMOTE SERVO (Fig. 2)

Dismantling

Support the servo slave cylinder in the jaws of a vice, shell uppermost, with specially formed wooden blocks placed either side of the cylinder and against the jaws of the vice.

Fit the cover removal tool (Churchill Tool No. J.31) to the end cover and secure it by fitting the three nuts.

Turn the end cover in an anti-clockwise direction until the indents in the servo shell line-up with the small radii around the periphery of the end cover. Remove the end cover from the servo.

Remove the diaphragm (11) from its groove in the diaphragm support (10) and, with the servo removed from the jaws of the vice, apply a gentle pressure to the diaphragm support and shake out the key (12).

The diaphragm support (10) and diaphragm support return spring (8) can then be removed.

Bend down the tabs on the locking plate (16) and remove the locking plate, abutment plate (17) and servo shell (14) from the slave cylinder by unscrewing and removing three screws (15).

Extract the seal (19) and bearing (18) from the mouth of the slave cylinder bore which will permit the removal of the push rod (9) together with the slave cylinder piston assembly.

The push rod may be separated from the piston by sliding back the spring steel clip (6) around the piston and removing the pin (5). It is not necessary to remove the cup (21) from the piston as a new piston together with a cup are contained in the repair kit.

Unscrew and remove the fluid inlet connection (3) and extract the piston stop pin (30) from the base of the inlet fluid port. To facilitate this operation, apply gentle pressure to the secondary piston (4).

Tap the open end of the slave cylinder body with a hide or rubber hammer to remove the secondary piston together with the piston return spring (28) from the bore.

The rubber seal (25) located in the groove adjacent to the heel of the piston may be removed but it is advisable to first remove the spring retainer (26) from the piston head extension before attempting to remove the seal (25) and piston washer (24). Removal of the plastic spring retainer (26) is sometimes difficult but, as a new one is provided in the repair kit, this part should be replaced.

To remove the trap valve assembly, unscrew and remove the adaptor (1) from the fluid outlet port. If it is necessary to remove the shim-like clip from the body of the trap valve (29) ensure that this part is not distorted in any way.

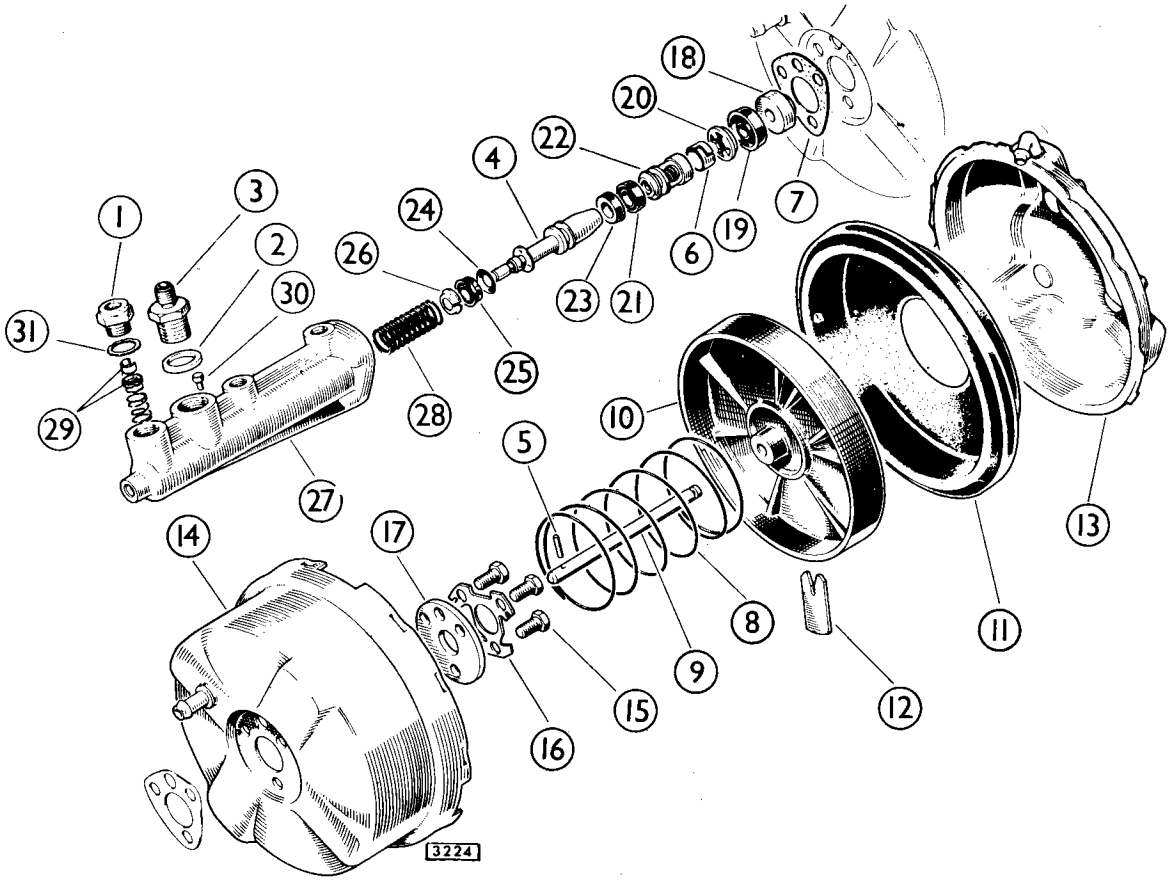


Fig. 2. *Exploded view of the remote servo.*

1. Outlet connection.
2. Gasket.
3. Inlet connection.
4. Piston.
5. Pin.
6. Retaining clip.
7. Gasket.
8. Spring.
9. Push rod.
10. Diaphragm support.
11. Diaphragm.
12. Key.
13. Cover.
14. Vacuum cylinder shell.
15. Screw.
16. Locking plate.
17. Abutment plate.
18. Bearing.
19. Seal.
20. Spacer.
21. Cup.
22. Piston.
23. Cup.
24. Piston washer.
25. Seal.
26. Retainer.
27. Slave cylinder body.
28. Spring.
29. Trap valve.
30. Stop pin.
31. Gasket.

Assembling

Assemble the trap valve (29) complete with spring and clip into the outlet port and secure it by fitting the fluid outlet adaptor (1) together with the copper gasket (31).

Prior to further assembly, lightly coat the four rubber seals to be replaced in the slave cylinder bore with Lockheed Disc Brake Lubricant.

Locate the piston washer (24) over the piston head extension, convex face towards the piston flange and, using the fingers only, assemble the two rubber seals (23 and 25) onto the piston so that their concave faces oppose each other.

Press the spring retainer (26) onto the piston head extension with both seals in position.

Fit the piston return spring (28) to the secondary piston and assemble into the slave cylinder bore, spring leading.

Press the piston assembly down the cylinder bore, using a short length of brass bar, until the drilled piston flange passes the piston stop pin hole.

Insert the piston stop pin (30) into the fluid inlet port and secure it by fitting the inlet adaptor (3) complete with the copper gasket (2). Place the push rod (9) in the primary piston and, with the aid of a small screwdriver, compress the small spring within the piston to enable the pin (5) to be inserted. Prior to fitting the pin retainer (6), it is important to establish that the small coil spring is loaded between the heel of the piston and the pin. Ensure that the pin does not pass through the coils of the spring.

Fit the spring retainer by sliding it into position along the piston ensuring that no corners are left standing proud after assembly.

Using fingers only, fit a new cup (21) into the groove on the piston so that its lip (concave face) faces towards the piston head and assemble the piston into the slave cylinder bore.

Insert the spacer (20), gland seal (19) and plastic bearing (18) into the slave cylinder counterbore leaving the bearing projecting slightly from the mouth of the bore.

Place the gasket (7) in position on the end face of the slave cylinder, using the plastic bearing as a location spigot and fit the vacuum shell (14), abutment plate (17) and locking plate (16).

Insert the three securing screws (15) and tighten down to a torque of 150/170 lb./ins. (1·7–1·9 kg/m.).

Bend the tabs on the locking plate against the flats on the three screws.

Locate the diaphragm support return spring (8) centrally inside the vacuum shell, fit the diaphragm support (10) to the push rod and secure it by dropping the key (12) into the slot provided in the diaphragm support.

Stretch the rubber diaphragm (11) into position on the diaphragm support ensuring that the bead around its inside diameter fits snugly into the groove in the diaphragm support.

If the surface of the rubber diaphragm appears wavy or crinkled this indicates that it is not correctly seated. To ease assembly, smear the outside edges of the diaphragm liberally with Lockheed disc brake lubricant.

Fit the end cover using Churchill Tool No. J.31.

Note: As it is possible to fit the end cover in three different positions, ensure that the end cover hose connections line up with the slave cylinder inlet and outlet ports when assembly is complete.

1. Diaphragm.
2. Screw.
3. Shakeproof washer.
4. Gasket.
5. Bolt.
6. Outlet adaptor.
6A. Copper gasket.
7. Trap valve body.
8. Washer.
9. Banjo.
10. Copper gasket.
11. Body.
12. Bearing.
13. Secondary cup.
14. Seal.
15. Piston.

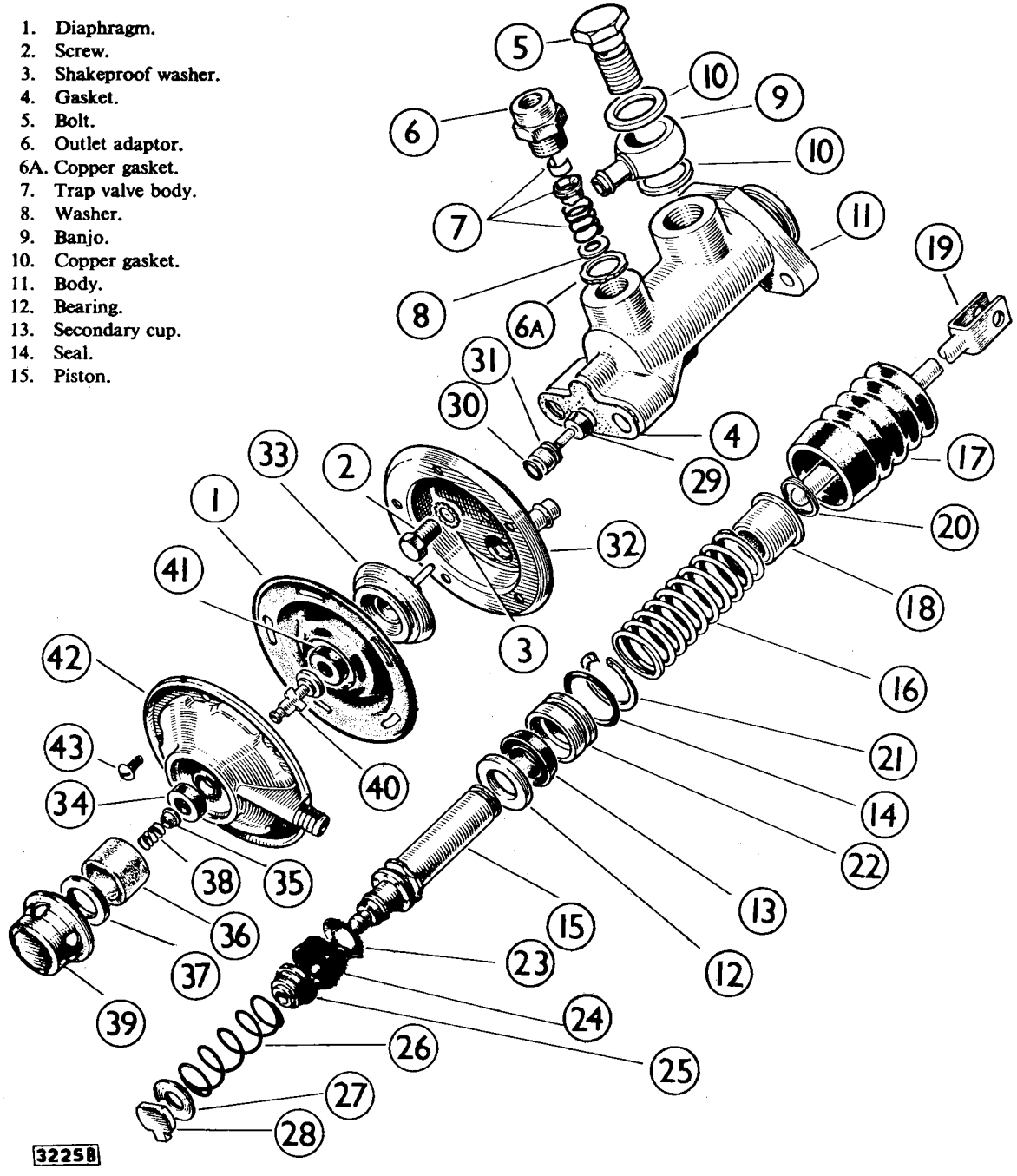


Fig. 3. *Exploded view of the master cylinder and reaetion valve.*

16. Return spring.
17. Rubber boot.
18. Spring retainer.
19. Push rod.
20. Spirolox circlip.
21. Circlip.
22. Bearing.
23. Piston washer.
24. Main cup.
25. Retainer.
26. Spring.
27. Retainer.
28. Lever.
29. Seal.
30. Seal.
31. Piston.
32. Valve housing.
33. Diaphragm support.
34. Valve rubber.
35. Valve cap.
36. Filter.
37. Sorbo washer.
38. Spring.
39. Filter cover.
40. Valve stem.
41. Valve rubber.
42. Valve cover.
43. Screw.

MASTER CYLINDER AND REACTION VALVE

Dismantling (Fig. 3)

Unscrew and remove the fluid outlet adaptor (6) and extract the trap valve assembly (7) from the outlet port.

Remove the rubber boot (17) from the mouth of the cylinder bore, compress the piston return spring (16) and unwind the spirolox circlip (20) from the heel of the piston. The spring retainer (18) and piston return spring (16) can at this stage be removed.

Press the piston (15) down the bore and, with the aid of special circlip pliers (Tool number 7066) extract the circlip (21) from the mouth of the cylinder bore. Care should be taken during this operation not to damage the finely machined cylinder piston.

The piston assembly, complete with nylon bearings and rubber seals, can be withdrawn from the cylinder bore.

Remove the plastic bearing (22), complete with "O" ring (14), secondary cup (13) and rectangular section plastic bearing (12) from the piston by sliding the assembly along the finely machined portion.

Due to the plastic spring retainer (25) being an interference fit onto the piston head extension, this part is likely to become damaged during dismantling. In view of this a new spring retainer is contained in the appropriate repair kit. To remove the spring retainer, hold the piston on a bench, piston head downwards, applying a downwards force to the back face of the spring retainer with a slim open-ended spanner. The piston return spring (26), pressed steel retainer (27) and lever (28) may, at this stage, be withdrawn from the cylinder bore.

Remove the filter cover (39) and collect the filter (36) sorbo washer (37) and spring (38).

Unscrew and remove the five screws securing the valve cover (42), remove the valve cover assembly from the valve housing (32) which can be dismantled further by prising off the snap-on clip securing the valve rubber (34).

The valve stem (40) complete with the other valve rubber (41) can now be withdrawn from the valve housing and the valve rubber removed from the valve stem flange. The reaction valve diaphragm (1) can now be separated from the diaphragm support (33) and, by unscrewing the two hexagon-headed screws (2), the valve housing can be separated from the master cylinder body.

Removal of the valve piston (31) assembly can be effected by inserting a small blunt instrument into the master cylinder fluid outlet port and easing the valve piston assembly along its bore until it can be removed by hand.

Important: No attempt should be made to withdraw the valve piston assembly along its bore by using pliers.

Assembling

Prior to assembly liberally coat all rubber seals and plastic bearings, with the exception of the two valve rubbers, with Lockheed disc brake lubricant.

Holding the master cylinder body at an angle of approximately 25° to the horizontal, insert the lever (28), tab foremost, into the cylinder bore ensuring that, when it reaches the bottom of the bore, the tab on the lever drops into the recessed portion provided.

Place the piston washer (23) on the piston head, convex face towards the piston flange, together with a new main cup (24) and press the plastic spring retainer (25) onto the piston head extension.

Drop the pressed steel spring retainer (27) into the bottom of the bore following up with the piston return spring (26). When these two parts have been assembled it is advisable to recheck the position of the lever.

Press the piston assembly into the cylinder bore and locate the rectangular section plastic bearing (12), secondary cup (13) and bearing (22) together with seal (14) into the mouth of the cylinder bore.

Press the assembly down the bore to its fullest extent and with the aid of the special circlip pliers (Tool number 7006 with "K" points) fit the circlip to retain the internal parts.

Locate the other piston return spring (16) over the heel of the piston together with the pressed steel spring retainer (18), slide the spring retainer down the finely machined portion of the piston against the load of the spring and fit the spirolox circlip (20) into the groove ground around the heel of the piston.

Using the fingers only, stretch a new valve seal (29) and "O" ring into position on the valve piston and insert the assembly into the valve box.

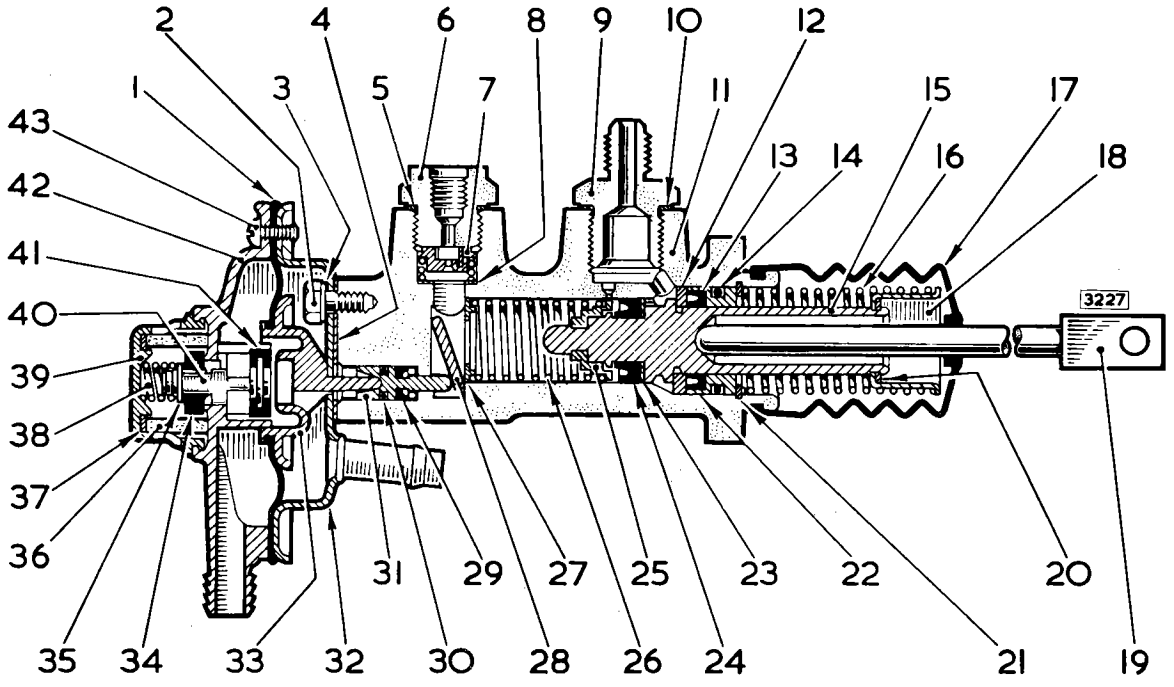


Fig. 4. *Sectioned view of the master cylinder and reaction valve.*

1. Diaphragm.
2. Screw.
3. Shakeproof washer.
4. Gasket.
5. Gasket.
6. Outlet adaptor.
7. Trap valve body.
8. Washer.
9. Inlet adaptor.
10. Copper gasket.
11. Body.
12. Bearing.
13. Secondary cup.
14. Seal.
15. Piston.
16. Return spring.
17. Rubber boot.
18. Spring retainer.
19. Push rod.
20. Spirolox circlip.
21. Circlip.
22. Bearing.
23. Piston washer.
24. Main cup.
25. Retainer.
26. Spring.
27. Retainer.
28. Lever.
29. Seal.
30. Seal.
31. Piston.
32. Valve housing.
33. Diaphragm support.
34. Valve rubber.
35. Valve cap.
36. Filter.
37. Sorbo washer.
38. Spring.
39. Filter cover.
40. Valve stem.
41. Valve rubber.
42. Valve cover.
43. Screw.

Secure the valve housing to the master cylinder body by fitting the two hexagon headed screws (2) complete with spring washers and tighten each screw to a torque of 160/180 lb./ins. (1·8–2 kg/m.). A new gasket should be fitted between the valve housing and the master cylinder body.

Stretch the reaction valve diaphragm onto the diaphragm support through the hole in the valve housing so that it engages the depression in the valve piston.

Using the fingers only, stretch the valve rubber, which is formed with the groove around its inside diameter, onto the valve stem flange, insert the valve stem through the hole in the valve cover and secure it by placing the other valve rubber over the valve stem and fitting the snap-on clip.

The valve cover assembly can now be placed into position on the valve housing ensuring that all the holes line up and that the hose connections are in line with each other at the bottom of the unit. Secure the valve cover assembly by fitting the five self-tapping screws.

Hold the master cylinder in an upright position (valve uppermost) and place the air filter together with the rubber washer in position upon the valve cover with the small spring on the snap-on valve stem clip.

Carefully locate the air filter cover over the air filter and press it firmly home.

If the trap valve assembly has been dismantled; insert the small clip into the trap valve body ensuring that it does not become distorted and locate the spring on the reduced diameter of the trap valve body.

Assemble the trap valve complete (spring innermost) into the master cylinder fluid outlet port.

Place a copper gasket under the head of the fluid outlet adaptor and screw the adaptor into the fluid outlet port. If the fluid inlet adaptor has been removed, this must be replaced in the same manner using a copper gasket under the head.

The master cylinder push rod and convoluted rubber boot can best be fitted during the installation of the assembly.

FRICTION PADS

Renewal

Friction pads should be renewed if it is found, on visual examination through the caliper apertures, that they have worn down to an approximate thickness of $\frac{1}{8}$" (3·2 mm.).

Withdraw the hairpin clips and extract the pad retaining pins. On front brakes, remove the anti-chatter clips from around the retaining pins and pad backing plates. Withdraw the pads.

To enable new pads to be inserted it will be necessary to lever the pistons back down the cylinder bores. It is advisable to half empty the brake fluid reservoirs otherwise forcing the pistons back will eject fluid from the reservoirs with possible resultant paint damage.

Insert new pads. Line up the holes in the backing plates and caliper bodies. Fit the retaining pins and hairpin clips: fit the anti-chatter clips to front pads. Ensure that the pads are free to move on the pins to allow for brake application and automatic adjustment.

Top up the reservoirs to the correct level and apply the brake several times until the pedal feels "solid".

FRONT CALIPERS

Removal

Jack up the car and remove the front wheel(s).

Disconnect the caliper fluid feed pipe from the union and seal the pipe and union.

Remove the locking wire, withdraw the mounting bolts and lockwashers and detach the caliper.

Locate the caliper in position and secure with the mounting bolts and lockwashers. Lockwire the bolts after fully tightening.

Reconnect the caliper feed pipe to the union and bleed the braking system as detailed on page L10.

REAR CALIPERS

Removal

The rear suspension unit must be removed in order to withdraw the rear calipers.

Proceed as described in Section K "Rear Suspension" and support the suspension unit under its centre.

Disconnect the handbrake compensator linkage from the handbrake operating levers. Discard the split pins and withdraw the clevis pins.

Lift the locking tabs and remove the pivot bolts together with the retraction plate.

Remove the friction pad carriers from the caliper bridges by moving them rearwards round the discs and withdrawing from the rear of the rear suspension assembly.

Remove the hydraulic feed pipe at the caliper and plug the hole to prevent the entry of dirt.

Remove the friction pads from the caliper as described previously.

Remove the front hydraulic damper and road spring unit (as described in Section K "Rear Suspension")

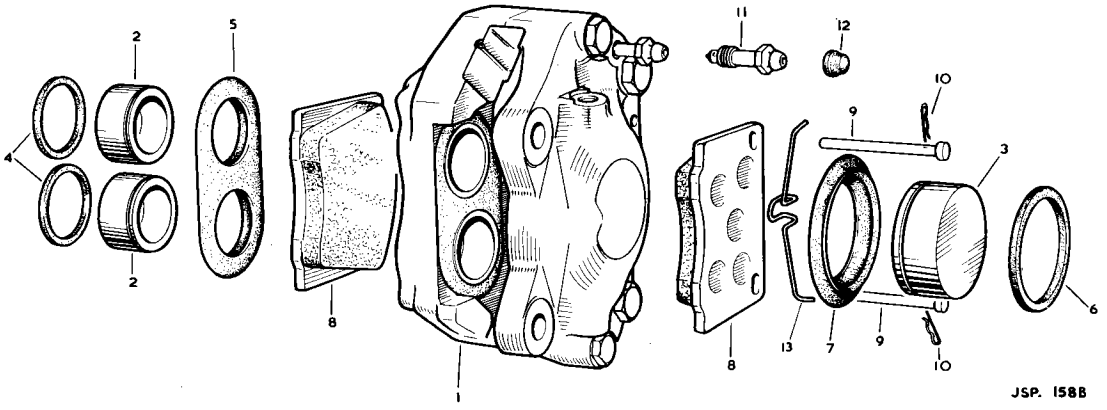


Fig. 5. *Exploded view of front caliper.*

1. Caliper body
2. Outer piston
3. Inner piston
4. Seal
5. Dust seal
6. Seal
7. Dust seal
8. Friction pad
9. Retaining pin
10. Clip
11. Brake bleed nipple
12. Dust cap
13. Anti-chatter clip

and remove the four self-locking nuts from the half-shaft inner universal joint.

Withdraw the joint from the bolts and allow the hub carrier to move outwards—support the carrier in this position.

The caliper can now be removed from the aperture at the front of the cross-member.

Refitting

Refitting is the reverse of the removal procedure.

Fit the fluid supply pipe and the bridge pipe. Bleed the braking system.

THE FRONT BRAKE DISCS

Removal

Jack up the car and remove the road wheel. Disconnect the flexible hydraulic pipe from the frame connection and plug the connector to prevent ingress of dirt and loss of fluid.

Discard the locking wire and remove the two caliper mounting bolts. Remove the caliper.

Remove the hub (as described in Section J "Front Suspension").

THE REAR BRAKE DISCS

Removal

Remove the rear suspension unit (as described in Section K "Rear Suspension").

Invert the suspension and remove the two hydraulic damper and road spring units (as described in Section K "Rear Suspension").

Remove the four steel type self-locking nuts securing the halfshaft inner universal joint and brake disc to the axle output shaft flange.

Withdraw the halfshaft from the bolts noting the number of camber shins between the universal joint and the brake disc.

Knock back the tabs and unscrew the two pivot bolts securing the hand brake pad carriers to the caliper. Remove the pivot bolts and the retraction plate.

Withdraw the handbrake pad carriers from the aperture at the rear of the cross members.

Knock back the tabs at the caliper mounting bolts.

Remove the keeper plate on the caliper and using a hooked implement, withdraw both brake pads.

Disconnect the brake fluid feed pipe at the caliper.

Unscrew the mounting bolts through the access holes in the brake disc. Remove the bolts.

Withdraw the caliper through the aperture at the front of the cross member.

Tap the halfshaft universal joint and brake disc securing bolts back as far as possible.

Lift the lower wishbone, hub carrier and halfshaft assembly upwards until the brake disc can be withdrawn from the mounting bolts.

Refitting

Refitting the brake discs is the reverse of the removal procedure. The securing bolts must be knocked back against the drive shaft flange when the new disc has been fitted.

Refit the rear suspension (as described in Section K "Rear Suspension").

Bleed the brakes.

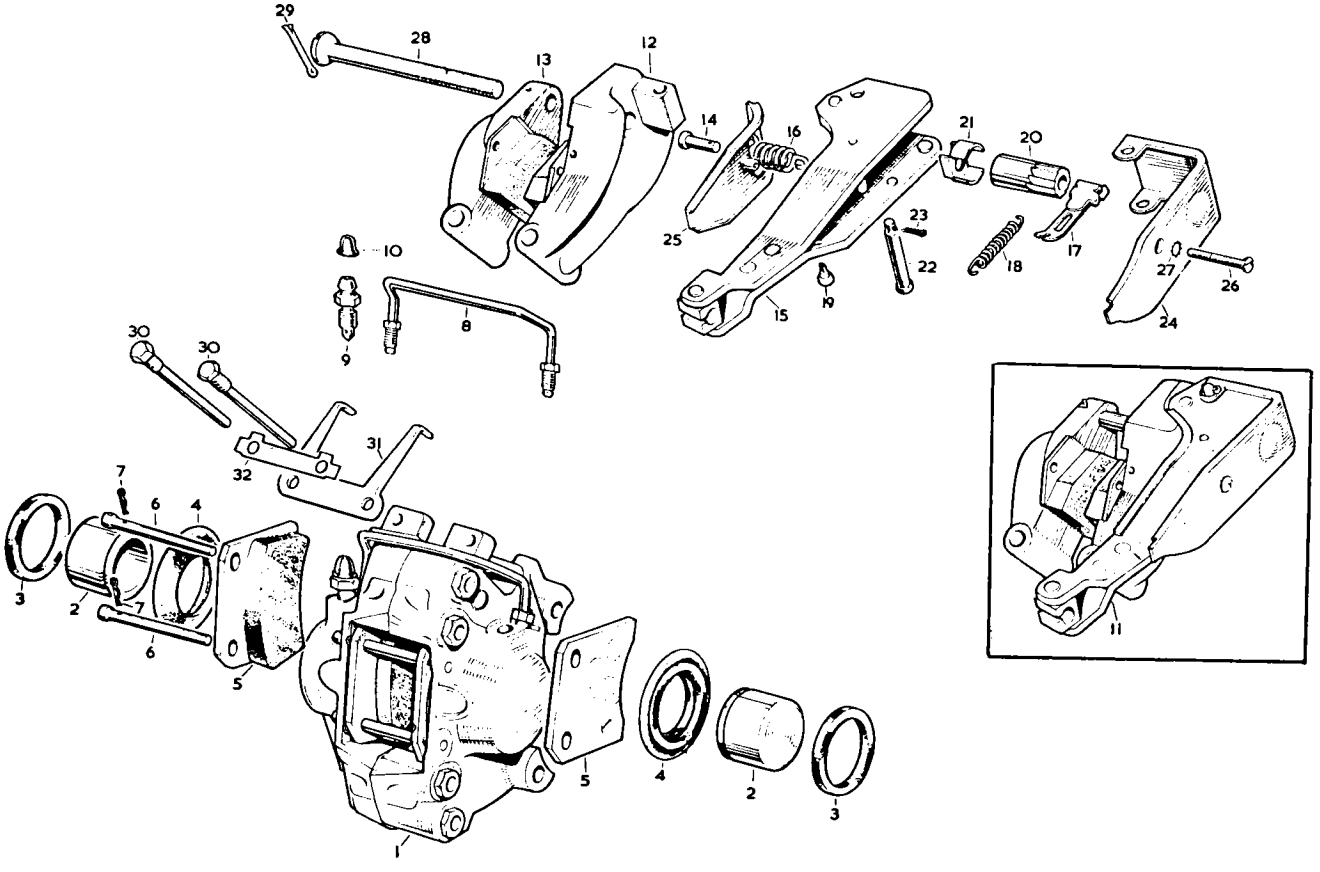


Fig. 6. *Exploded view of the rear brake caliper*

JSP159A

1 Rear caliper assembly (R.H.)
2 Piston
3 Seal
4 Dust seal
5 Friction pad
6 Pin
7 Clip
8 Bridge pipe
9 Bleed screw
10 Dust cap
11 Handbrake mechanism assembly
12 Pad carrier assembly (R.H. outer)
13 Pad carrier assembly (R.H. inner)
14 Anchor pin
15 Operating lever
16 Return spring
17 Pawl assembly
18 Tension spring
19 Anchor pin
20 Adjusting nut
21 Friction spring
22 Hinge pin
23 Split pin
24 Protection cover
25 Protection cover
26 Bolt
27 Washer
28 Bolt
29 Split pin
30 Bolt
31 Retraction plate
32 Tab washer

THE BRAKE/CLUTCH PEDAL BOX ASSEMBLY

Removal (L.H. Drive)

Remove the servo vacuum pipe and clips.

Drain the brake and clutch fluid reservoirs.

Remove fluid inlet pipes from the clutch and brake master cylinders. Plug the holes.

Remove the brake fluid warning light wires.

Remove the brake and clutch reservoirs.

Remove the fluid outlet pipes from the brake and clutch master cylinders. Plug all holes.

Remove the brake and clutch pedal pads from inside the car.

Remove the dash casing in accordance with the instructions contained in Section N (Body and Exhaust). The nuts securing the pedal box assembly to the bulkhead are now exposed and can be removed together with two distance pieces and the brake pedal stop plate. Note that there are six self-locking nuts and one plain nut with a shakeproof washer. The plain nut is located on the bottom centre stud.

Remove the brake/clutch pedal box assembly by turning it through approximately 90° to allow the pedals to pass through the hole in the bulkhead.

Removal (R.H. Drive)

Remove the air cleaner elbow and the carburetter trumpets.

Remove the servo vacuum pipe and clips.

Drain the brake and clutch fluid reservoirs.

Remove the fluid inlet pipes from the clutch and brake master cylinders. Plug the holes.

Slacken the rear carburetter float chamber banjo nut and bend the petrol feed pipe towards the float chamber.

Remove the brake fluid warning light wires.

Remove the brake and clutch reservoirs.

Remove the fluid outlet pipes from the brake and clutch master cylinders. Plug all holes.

Remove the five screws securing the reaction valve assembly to the valve housing and withdraw the complete assembly. The valve housing can be removed by unscrewing the two setscrews, together with the shakeproof washers, which secure the housing to the body of the master cylinder.

Remove the throttle bell crank bracket.

Remove the brake and clutch pedal pads from inside the car.

Remove the dash casing in accordance with the instructions contained in Section N (Body and Exhaust). The nuts securing the pedal box assembly to the bulkhead are now exposed and can be removed together with two distance pieces and the brake pedal stop plate. Note that there are six self-locking nuts and one plain nut with a shakeproof washer. The plain nut is located on the bottom centre stud.

Remove the brake/clutch pedal box assembly by turning it through approximately 90° to allow the pedals to pass through the hole in the bulkhead.

Refitting

Refitting is the reverse of the removal procedure.

When refitting the securing nuts inside the car ensure that the plain nut and the shakeproof washer are fitted on the short stud in the bottom centre position.

Ensure that the brake fluid warning light wires are fitted with one feed wire (red and green) and one earth wire (black) to each reservoir cap.

When tightening the banjo union nut ensure that the petrol feed pipe is clear of the rear float chamber.

Bleed the brake and clutch hydraulic systems.

SECTION M

WHEELS AND TYRES

DESCRIPTION

Pressed spoke or wire spoke wheels, the latter in spray painted form, are available as alternative standard equipment.

Chromium plated wire spoke wheels are fitted as Special Equipment only.

Dunlop 185VR15 SP. SPORT tubed tyres are fitted as standard equipment, whitewall tyres being available to special order only.

Whitewall tyres only will be fitted to cars sold in U.S.A. or CANADA.

These tyres will have the "MAXIMUM LOADING" and "MAXIMUM PRESSURE" information moulded on the wall of the tyre, necessary to conform to U.S.A. FEDERAL REGULATIONS.

This information, together with Seating Capacity, Seating Distribution and Recommended Tyre Size data is also quoted on a panel attached to the inside of the glove box lid.

Type—standard equipment	Pressed spoke
	Wire spoke—spray painted
—special equipment	Wire spoke—chromium plated
Fixing—Pressed spoke	Five studs and nuts
—Wire spoke	Centre lock, knock-on hub cap
Rim Section—Pressed spoke	6 JK
—Wire spoke	5 K

Tyres

Make	Dunlop
Type	185VR15 SP. SPORT

IMPORTANT

It is particularly important that tyres of different makes or types, or, those having different tread patterns, should not be mixed on individual cars as this may adversely affect the handling and steering characteristics.

A car should not, of course, be driven on bald tyres, or on tyres which have only part of the tread showing.

Driving with badly worn tyres on wet roads also greatly increases the risk of "aquaplaning" with consequent loss of steering and braking.

The importance of having tyres that are in good condition of the correct type cannot be overstressed. The Dunlop 185VR15 SP. SPORT tyres fitted as original equipment are specially produced to suit the performance of the car, and a change of make or tyre should not be made unless an assurance is given by the tyre manufacturer concerned that the alternative type is suitable for the car under maximum performance conditions.

INFLATION PRESSURES

PRESSURES SHOULD BE CHECKED WHEN THE TYRES ARE COLD, SUCH AS STANDING OVERNIGHT AND NOT WHEN THEY HAVE ATTAINED THEIR NORMAL RUNNING TEMPERATURES.

Dunlop SP Sport 185VR15	Front	Rear
For speeds up to 125 m.p.h. (200 k.p.h.)	32 lb/sq. in. (2.25 kg/cm²)	32 lb/sq. in. (2.25 kg/cm²)
For speeds up to maximum	40 lb/sq. in. (2.81 kg/cm²)	40 lb/sq. in. (2.81 kg/cm²)

Tyres for Winter Use

(When snow conditions make the use of special tyres necessary).

Dunlop Weathermaster SP. 44.185x15

(For use on rear wheels to replace SP. Sports tyres)

Maximum permitted speed 100 m.p.h. (160 k.p.h.)	32 lb/sq, in. (2.25 kg/cm²)

TYRES

General Information

The Dunlop tyres specified have been specially designed for the high speeds possible with this car.

When replacing worn or damaged tyres and tubes it is essential that tyres with exactly the same characteristics are fitted.

Due to the high speed performance capabilities of the car, it is important that no attempt is made to

repair damaged or punctured tyres.

All tyres which are suspect in any way should be submitted to the tyre manufacturer for their examination and report. The importance of maintaining all tyres in perfect condition cannot be too highly stressed.

IMPORTANT

The use of standard inner tubes with Weathermaster tyres is NOT permissible.

Special tubes are available and are identified by the size and lettering "Weathermaster Only".

These special tubes should NOT be used with standard tyres.

WIRE SPOKE WHEELS

Description

Dunlop cross-spoked wheels are fitted as optional equipment.

Cross spoking refers to the spoke pattern, where the spokes radiate from the well of the wheel rim to the nose or outer edge of the hub shell, and from the rim to the flanged or inner end of the shell.

Dismantling, reassembling, and adjustment details remain the same as that detailed in the 3.8 'E' Type Service Manual Section M.

Warning

Chromium plated wire wheels are protected by a clear lacquer which, under normal circumstances, should never be removed. Should removal become necessary, due to dismantling the wheel, however, the best results can be obtained by using British Domolac L10–12 Cellulose Thinners.

UNDER NO CIRCUMSTANCES SHOULD A WIRE SPOKED WHEEL BE FITTED TO THE CAR IN AN UN-LACQUERED CONDITION.

To re-lacquer, the wheels should be treated with "NECOL" which is an I.C.I. clear cellulose air-drying lacquer. This will obviate rust stains originating at the unprotected threaded portion of the spokes.

SECTION N

BODY AND EXHAUST

SIDE FACIA PANEL

Removal

Disconnect the battery.

Remove the screen rail facia.

Withdraw all warning light and panel illumination bulb holders. Note the location for reference when refitting.

Remove the chrome ring nut and withdraw the dipper switch from the panel.

Disconnect the speedometer drive cable from the instrument head.

Withdraw the plastic retaining clip and seperate the plug and socket connection attached to the tachometer cables.

Disconnect the brake fluid warning light cables.

Disconnect the control cable from the heater air outlet ducts after releasing the locking screw securing the inner cable to the air duct operating spindle.

Remove the locknut securing the outer cable to the air duct bracket. Withdraw the cable and collect the loose adaptor.

Remove the two thumbscrews and lower the centre instrument panel.

Release two setscrews securing the two heater inner control cables to the control levers and withdraw the cables.

Withdraw two slotted screws and one setscrew, nut, and washer securing the side facia panel to the centre panel support bracket and two nuts and washers securing the panel to the support bracket at the base of the screen pillar and remove the panel.

Refitting

Refitting is the reverse of the removal procedure.

Reconect the heater and air outlet control cables ensuring that the full movement of the levers is maintained.

Reconnect the warning and panel light illumination bulb holders as noted on removal.

GLOVE BOX

Removal

Disconnect the battery.

Remove the screen rail facia.

Withdraw two screws and nuts and detach the grab handle from the mounting brackets.

Withdraw the choke warning light bulb holder from the socket at the rear of the glove box panel.

Release the locking screw and disconnect the choke operating cable from the lever (cars equipped with Exhaust Emission Control only).

Lower the centre instrument panel.

Remove the securing setscrews, nuts and washers as detailed for the side facia panel and detach the glove box.

Refitting

Refitting is the reverse of the removal procedure.

Check when reconnecting the choke control cable that the full movement of the lever is maintained when the choke is operated.

SCREEN RAIL FACIA

Removal

Disconnect the battery and lower the centre instrument panel.

Remove two nuts, lock and plain washers securing the facia to the centre panel supports.

Remove two drive screws securing the facia to the demister panel (2+2 cars only).

Remove two nuts, lock and plain washers securing the facia to the body side panels at the base of the screen pillars.

Detach the flexible demister conduit pipes from the demister nozzles.

Disconnect the two cables from the map light.

Remove the facia complete with demister nozzles.

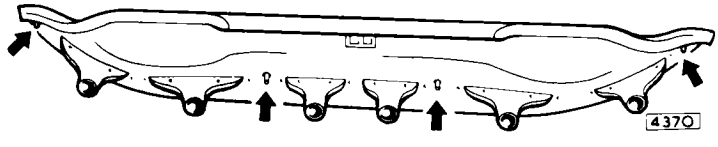


Fig. 1. *Screen rail facia.*

Refitting

Refitting is the reverse of the removal procedure.

Utilizing the elongated holes in the mounting brackets adjust the forward edge of the facia to the screen rail.

DEMISTER PANEL (2+2 cars only)

Removal

Remove the screen rail facia as detailed previously.

Remove four setscrews, nuts and lockwashers securing the panel support brackets to the instrument panel support brackets.

Detach the conduits from the four demister nozzles.

Remove the panel complete with the demister nozzles.

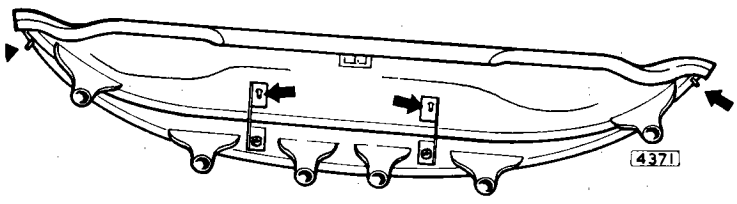


Fig. 2. *Demister panel (2+2 cars).*

Refitting

Refitting is the reverse of the removal procedure.

Utilising the elongated holes in the centre brackets adjust the forward edge of the panel to the screen.

FRONT BUMPER

Removal

The front bumper is comprised of three components, right and left hand outer sections and a centre section.

Sections are detachable after removing the bumper as a complete assembly.

Remove the four setscrews, lock and plain washers securing the outer sections to the bonnet. The setscrews are accessible through cut-out portions in the underside of the sections.

Dismantle the bumper after removing the two setscrews, lock and plain washers securing the outer sections to the centre and the two setscrews securing the over-riders.

Remove the motif, if required, after withdrawing two drive screws, spring clip, and the backing plate.

Refitting

Reassembly and refitting is the reverse of the removal procedure.

Renew the beading between the bumper sections and the over-riders if worn or damaged.

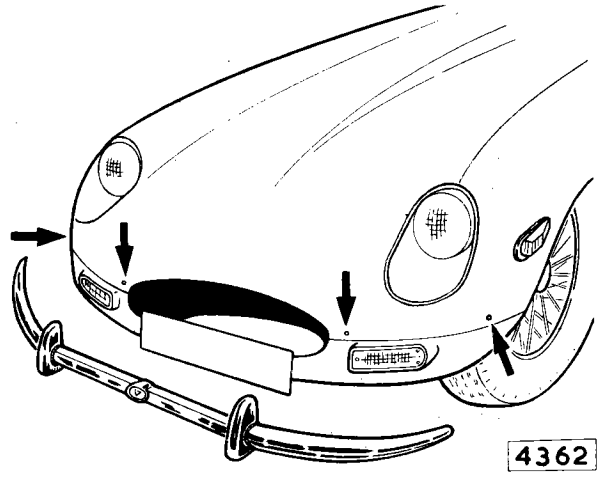


Fig. 3. *Front bumper removal The arrows indicate the mounting points.*

REAR BUMPER

Removal

The rear bumper is comprised of three components, right and left hand and centre sections.

Sections are detachable after removal of the bumper as an assembly.

Remove the two setscrews, lock and plain washers and two nuts securing the bumper outer sections to the body; the setscrews are located within the wheel arch.

Release the two setscrews located above the rear lamps. Withdraw the two setscrews securing the reverse lamp carrier brackets and remove the bumper assembly.

Dismantle the bumper after removing the two setscrews, lock and plain washers securing the outer sections to the centre and the two setscrews securing the over-riders.

Refitting

Refitting is the reverse of the removal procedure.

Renew the beading between the bumper sections and the over-riders if worn or damaged.

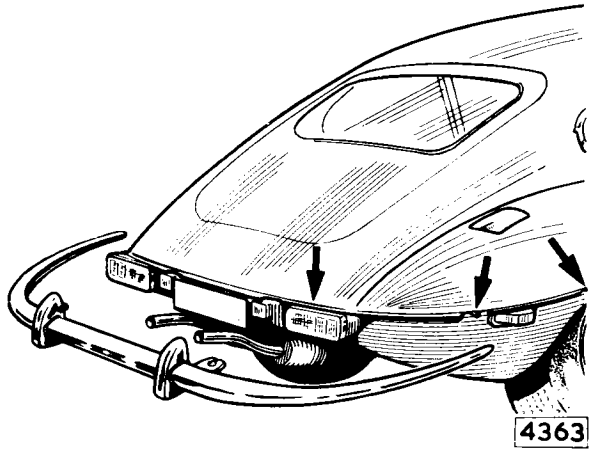


Fig. 4 *Rear bumper removal. The arrows indicate the mounting points.*

BONNET

The removal and refitting procedure remains identical to that stated in the 3·8 "E" Type Service Manual—Page N8—with the addition of the following:—

Withdraw the split pin, washer and clevis pin and detach the front number plate tie-rod fork end from the chassis front cross tube.

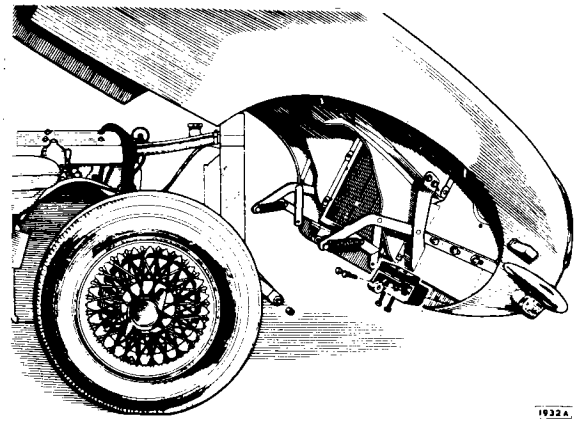


Fig. 5. *Bonnet hinge mounting points.*

WINDOW REGULATOR

The window regulator remains the same basically as that detailed on Page N21 of the 3·8 "E" Type Service Manual with the exception of the method of securing the regulator handle.

This is now secured to the control unit by a central fixing screw and not by a pin. Removal of this screw will permit the handle to be withdrawn.

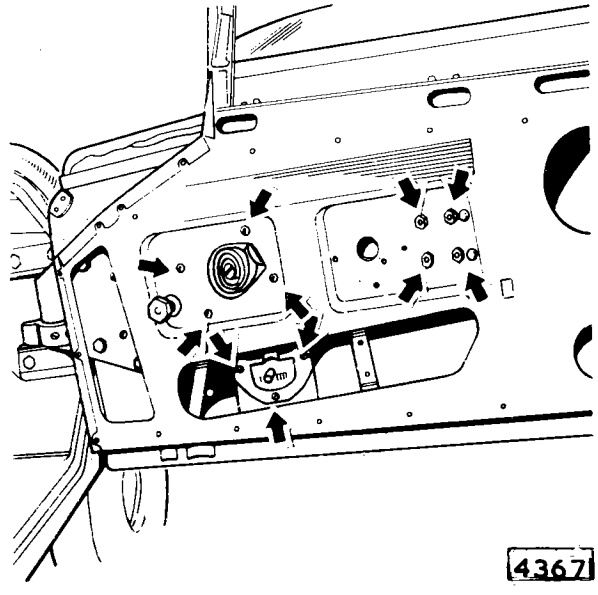


Fig. 6. *Location of the screws and nuts securing the window regulator to the door panel.*

DOOR LOCK MECHANISM

Door locks fitted to the "E" Type Series 2 cars incorporate an anti-burst feature, while the remote control units have recessed handles.

The removal, refitting and adjusting details remain the same as those quoted in the "E" Type Service Manual with the exception of the following details:—

The recessed handle is secured to the remote control unit by a central fixing screw and not by a pin.

Removal of the screw will permit the handle to be withdrawn.

The remote control unit is not supplied in the locked position as was the previous model and no provision is made for the insertion of a pin when refitting (see Page N23 under "Locating the Remote Control Unit").

Any adjustment necessary when reconnecting the link can be made by utilising the elongated holes in the control unit mounting plate.

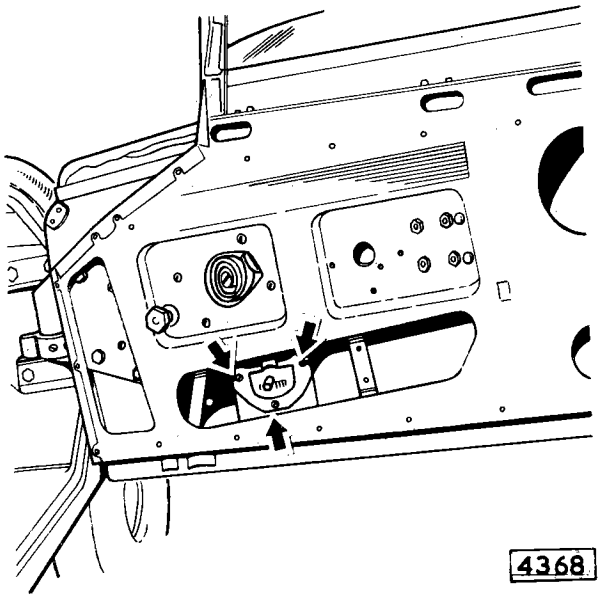


Fig. 7. *Location of the screws securing the door lock control.*

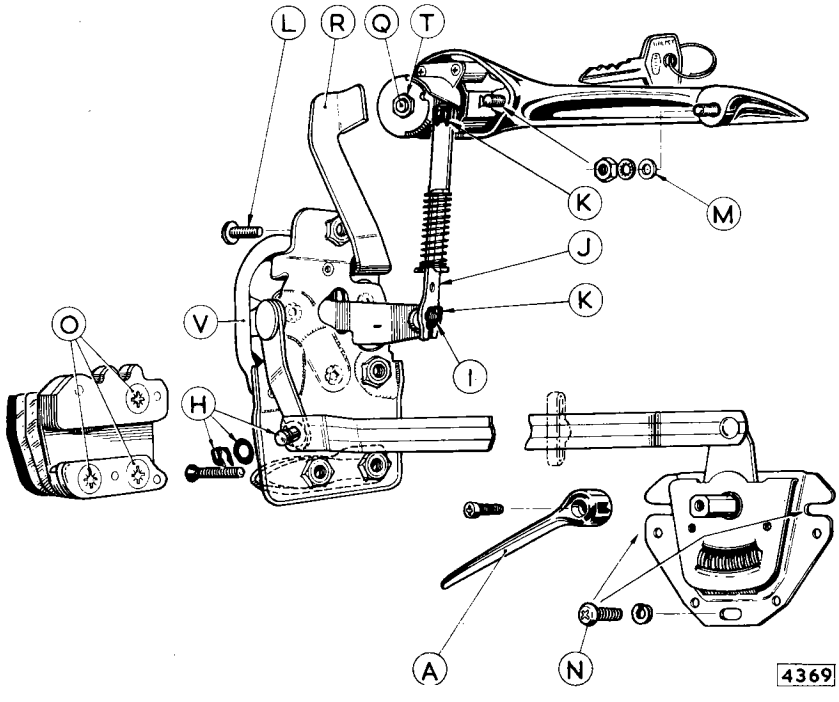


Fig. 8. *Exploded view of the door lock mechanism.*

A Interior handle.
H Lever pin, wave washer and clip.
I Spring clip.
J Adjustable link.
K Dowel.
L Latch fixing screw.
M Exterior handle fixings.
N Remote control fixing screw.
O Striker fixing screws.
Q Striker.
R Striker lever.
T. Locknut.

SECTION O

HEATING AND WINDSCREEN WASHING EQUIPMENT

HEATER

The heater unit remains the same as that stated in the 3·8 "E" Type Service Manual with the exception of the following items:—

1. Heater air controls.
2. Heater temperature controls.
3. Heater fan switch.
4. Air distributor controls.

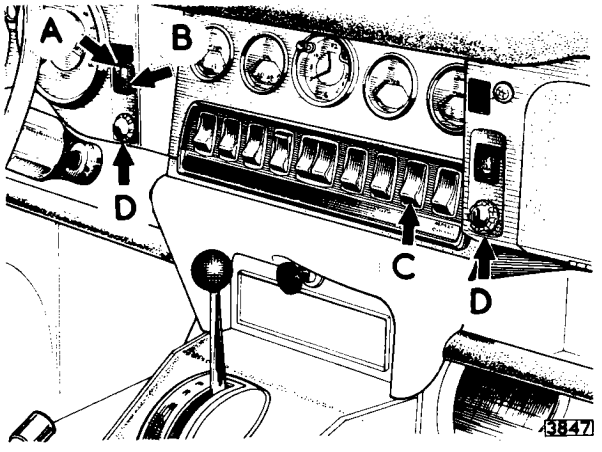


Fig. 1. *Heating and ventilating controls.*

A Heater air controls.
B Heater temperature controls.
C Heater fan switch.
D Heater outlet controls.

The outlets situated under the duct behind the facia panel, are fitted with finger operated direction controls.

Fully rotating the right-hand knob clockwise and the left-hand knob anti-clockwise will cut off all air to the interior of the car and direct the supply to the ducts at the base of the windscreen. Reverse rotation of the knobs will re-direct air progressively from the windscreen to the car interior.

VENT CONTROL CABLES

Removal

Withdraw the parcel tray on each side of the dash by removing four drive screws and four thumb screws.

Release the locknuts securing the outer cables to the vent bracket. Disconnect the cables and collect the loose adaptor. Unscrew the cable from the centre finisher and withdraw the assemblies. A thin spanner will be required to remove the outer casing from the finisher.

Refitting

Reverse the removal procedure to refit the cables.

AIR/TEMPERATURE CONTROLS

Removal

Remove the screen rail facia as detailed in Section N Page NY.s.1.

Withdraw two small screws and detach the knobs from the levers.

Release the locking screws and disconnect the control cables.

Remove the self locking nut and withdraw the lever pivot pin. Note the plain washer located between the levers.

Refitting

Refitting is the reverse of the removal procedure. Check that full movement of the levers is maintained when connecting the cables.

WINDSCREEN WASHER

Description

The Lucas 5SJ windscreen washer replaces the unit detailed in the 3·8 Service Manual.

The Lucas 5SJ screen jet is an electrically operated unit comprising a small permanent—magnet motor driving a centrifugal pump through a 3-piece Oldham type coupling. The water container is moulded in high density polythene.

DATA

Minimum water delivery pressure ..	4·5 lb./sq. in. (0·32 kg./sq. cm.).
Minimum water delivery per second ..	3·5 c.c.
Container capacity	2¼ pints (1·1 litres).
Usable quantity of water	2 pints (1 litre).
Diameter of nozzle orifice	0·25″–0.28″ (6·3–7 mm.).
Nominal voltage of unit	12
Maximum current consumption ..	2 amps.
Resistance between commutator segments	2·8–3·1 ohms.

Filling Up

The correct water level is up to the bottom of the container neck. Do not overfill or unnecessary splashing may result. Always replace the filler cover correctly after filling up. It is not possible to empty the container with the pump. Refilling is necessary when the water level has fallen below the level of the pump.

Keep the pump filter clean and the container free from sediment.

Cold Weather

The water container can be given a safe degree of protection down to —28°F. (—33°C.) by the use of proprietary antifreeze solutions such as marketed by Trico or Holts. Instructions regarding the use of the solvent will be found on the container.

Denatured alcohol (methylated spirits) must NOT be used. The use of this chemical will discolour the paintwork.

SERVICING

Testing in Position

(*a*) *Testing with a voltmeter*:-

Connect a suitable direct current voltmeter to the motor terminals observing the polarity as indicated on the moulding housing. Operate the switch. If a low or zero voltage is indicated, the No. 6 fuse. switch and external connections should be checked and corrected as necessary.

If the voltmeter gives a reverse reading, the connections to the motor must be transposed.

If supply voltage is registered at the motor terminals but the unit fails to function, an open-circuit winding or faulty brush gear can be suspected. Dismantle the motor as described under the heading "Dismantling".

(*b*) *Checking the external nozzles and tubes*:—

If the motor operates but little or no water is delivered to the screen, the external tubes and nozzles may be blocked.

Remove the external plastic tube from the short connector on the container and, after checking that the connector tube is clear, operate the washer switch. If a jet of water is ejected. check the external tubes and nozzles for damage or blockage.

If no water is ejected, proceed as detailed under "Dismantling".

(*c*) *Testing with an ammeter*:—

Connect a suitable direct current ammeter in series with the motor and operate the switch. If the motor does not operate but the current reading exceeds that given in "Data", remove the motor and check that the pump impeller shaft turns freely.

If the shaft is difficult to turn, the water pump unit must be replaced. If the shaft turns freely, the fault lies in the motor which must be dismantled and its component parts inspected.

Dismantling

Disconnect the external tube and the electrical connections and remove the cover from the container. Remove the self-tapping screw which secures the motor to the cover and pull away the motor unit. Take care not to lose the loose intermediate coupling which connects the armature coupling to the pump spindle coupling.

Remove the armature coupling from the armature shaft as follows:—

Hold the armature shaft firmly with a pair of snipe-nosed pliers and, using a second pair of pliers, draw off the armature coupling.

Remove the two self-tapping screws from the bearing plate. The bearing plate and rubber gasket can now be removed. Remove the two terminal screws. The terminal nuts and brushes can now be removed and the armature withdrawn. Take care not to lose the bearing washer which fits loosely on the armature shaft.

The pole assembly should not normally be disturbed. If, however, its removal is necessary, make a careful note of its position relative to the motor housing. The narrower pole piece is adjacent to the terminal locations. Also the position of the pole clamping member should be observed. When fitted correctly, it locates on both pole pieces but, if fitted incorrectly, pressure is applied to one pole piece only.

Bench-Testing

If the motor has been overheated, or if any part of the motor housing is damaged, a replacement motor unit must be fitted.

Armature:—

If the armature is damaged or if the windings are loose or badly discoloured, a replacement armature must be fitted.

The commutator must be cleaned with a fluffless cloth moistened in petrol, or, if necessary, polished with a strip of very fine glass paper.

The resistance of the armature winding should be checked with an ohmmeter. This resistance should be in accordance with that given in "Data".

Brushes:—

If the carbon is less than $\frac{1}{16}$" (1·59 mm.) long, a new brush must be fitted. Check that the brushes bear firmly against the commutator.

Re-assembling

Re-assembling of the unit is the reverse of the dismantling procedure. However, the following points should be noted:—

Make sure the bearing recess in the motor is filled with Rocol Molypad molybdenised grease. Remove excessive grease from the face of the bearing boss.

Check that the pole piece assembly does not rock and that the pole pieces are firmly located in the circular spigot. Ensure that the pole piece assembly and clamping member are the right way round.

Before replacing the motor unit on the cover, ensure that the armature coupling is pushed fully home and that the intermediate coupling is in place.

Performance Testing

Equipment required:—

D.C. supply of appropriate voltage.

D.C. voltmeter, first grade, moving coil 0–3 amp.

D.C. ammeter.

0–15 lb. sq. in. (0–1 kg. sq. cm.) pressure gauge.

Pushbutton with normally open contacts.

Two-jet nozzle.

On-off tap.

100 c.c. capacity measure.

4 ft. 6 in. (1·37 m.) length of plastic tubing.

Connect up the equipment as shown in Fig. 1. The water level in the container must be 4" (101·6 mm.) above the base of the pump assembly. The pressure gauge and nozzle must be 18" (45·72 cm.) above the water level.

Open the tap. Depress the button for approximately five seconds and check the voltmeter reading which should be the same as the supply voltage. On releasing the switch, close the tap to ensure that the plastic tubing remains charged with water. Empty the measuring cylinder.

Open the tap and operate the push switch for precisely ten seconds after which period release the switch and close the tap.

During the ten-second test, the current and pressure values should be in accordance with those given in Data and at least 35 c.c. of water should have been delivered.

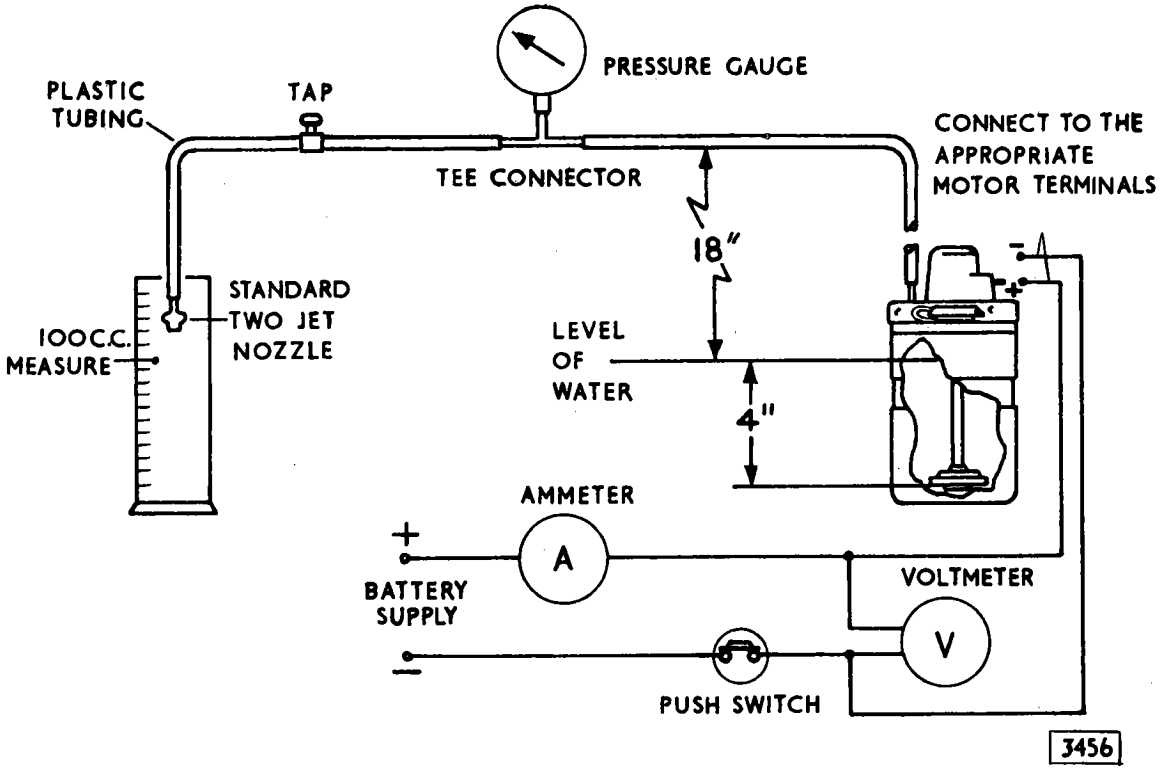


Fig. 1. *Performance testing the windscreen washing equipment.*

SECTION P

ELECTRICAL AND INSTRUMENTS

BATTERY

LUCAS CA11/7

Description

The Lucas Model C.A. battery, as listed above, is a new type fitted with an air lock device (Aqualok) which simplifies the topping up procedure. This device consists of a one-piece vent cover and six sliding tubes, perforated to act as air valves and fitted one to each cell aperture.

The tubes are automatically raised when the vent cover is removed and depressed when the cover is refitted.

Air or added water is admitted to the cell venting chamber (via the tube perforations) only while the tubes are in the depressed position.

No provision is provided in the battery top cover for the insertion of the prong of a heavy discharge tester.

DATA

Battery type	CA11/7
Voltage	12
Number of plates per cell	11
Capacity at 10-hour rate	53
Capacity at 20-hour rate	60

Maintenance

Wipe away any foreign matter or moisture from the top of the battery and ensure that the connections and fixings are clean and tight.

Check the electrolyte level weekly. In extreme cold conditions the battery should be topped up immediately prior to driving the car so that the electrolyte mixing can occur to prevent freezing of the added water.

Topping up the battery should be carried out with the car on a reasonably level surface.

Remove the vent cover. If the acid level is below the bottom of the tubes pour distilled water into the trough until all the tubes are filled.

Replace the vent cover. The electrolyte level is now correct.

DO NOT, under any circumstances, top up the battery by using the normal type of battery filler which incorporates a plunger valve in the filler neck.

The use of this type of filler will depress the sliding tubes and allow the battery to be overfilled.

Important: The vent cover must be kept in position at all times except when topping up.

Distilled water should always be used for topping-up. In an emergency, however, clean soft rain water collected in an earthernware container may be used.

Note: Never use a naked light when examining a battery as the mixture of oxygen and hydrogen given off by the battery when on charge and to a lesser extent when standing idle, can be dangerously explosive.

Clean off any corrosion from the battery cable terminals and coat with vaseline before re-connecting.

Removal

Unscrew the two wing nuts retaining the battery strap; remove the fixing rods and strap. Disconnect terminals and lift out the battery from the tray.

WARNING: Rubber sealing plugs are not incorporated in the manifold filler cover.
When removing the battery it is ESSENTIAL that extreme care is taken to ensure that it is NOT tipped to any degree.
Failure to ensure this will result in acid spillage which may cause severe acid burning to the operator and to the car.

Refitting

Refitting is the reverse of the removal procedure.

Before refitting the cable connectors, clean the terminals and coat with petroleum jelly.

Persistent low state of charge

First consider the conditions under which the battery is used. If the battery is subjected to long periods of discharge without suitable opportunities for recharging, a low state of charge can be expected. A fault in the alternator or control unit, or neglect of the battery during a period of low or zero mileage may also be responsible for the trouble.

Manifold Vent Cover

See that the ventilating holes in the cover are clear.

Level of Electrolyte

The surface of the electrolyte should be just level with the tops of the separator guards. If necessary, top up with distilled water as detailed on page PY.s.1. Any loss of acid from spilling or spraying (as opposed to the normal loss of **water** by evaporation) should be made good by dilute acid of the same specific gravity as that already in the cell.

Cleanliness

See that the top of the battery is free from dirt or moisture which might provide a discharge path. Ensure that the battery connections are clean and tight.

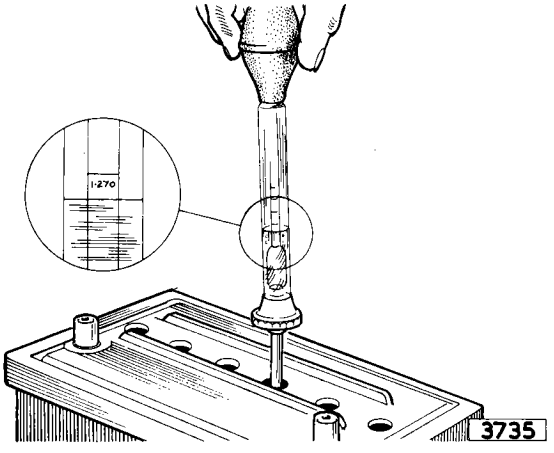


Fig. 1. *Method of topping up the Lucas C.A. battery.*

Hydrometer Tests

Measure the specific gravity of the acid in each cell in turn with a hydrometer. To avoid misleading readings, do not take hydrometer reading immediately after topping-up.

The reading given by each cell should be approximately the same.

If one cell differs appreciably from the others, an internal fault in the cell is indicated.

The appearance of the electrolyte drawn into the hydrometer when taking a reading gives useful indication of the state of the plates. If the electrolyte is very dirty, or contains small particles in suspension, it is possible that the plates are in a bad condition.

The specific gravity of the electrolyte varies with the temperature, therefore, for convenience in comparing specific gravities, this is always corrected to 60°F (16°C) which is adopted as a reference temperature.

The method of correction is as follows:—

For every 5°F (2.8°C) below 60°F (16°C) deduct 0.002 from the observed reading to obtain the true specific gravity at 60°F (16°C).

For every 5°F (2.8°C) above 60°F (16°C) add 0.002 to the observed reading to obtain the true specific gravity at 60°F (16°C).

The temperature must be that indicated by a thermometer actually immersed in the electrolyte and not in the air temperature.

Compare the specific gravity of the electrolyte with the values given in the table and so ascertain the state of charge of the battery.

If the battery is in a discharged state, it should be recharged, either on the vehicle by a period of daytime running or on the bench from an external supply, as described under "Recharging from an External Supply".

All Service procedure concerning the following items remains as detailed on pages P8–P9 of the 3.8 'E' Type Service Manual.

(1) Recharging from an external supply

(2) Preparing new unfilled, uncharged batteries for Service

(3) Preparing new "Dry-charged" batteries for Service.

DISTRIBUTOR

(NOT U.S.A. AND CANADA)

A waterproof cover is incorporated in the distributor assembly, located between the distributor cap and body. This cover is detachable after removing the distributor cap and disconnecting the cable from the contact breaker spring post.

DATA

Ignition Distributor Type	22D6
8 to 1 Compression Ratio	41060A
9 to 1 Compression Ratio	41060A
Cam dwell angle	34°±3°
Contact breaker gap	0·014″–0·016″ (0·36—0·41 mm.)
Contact breaker spring tension (Measured at free contact)	18—24 ozs. (512—682 gms.)

IGNITION TIMING

8 to 1 Compression Ratio	9° BTDC
9 to 1 Compression Ratio	10° BTDC

IGNITION DISTRIBUTOR TEST DATA

			VACUUM TIMING ADVANCE TESTS The distributor must be run immediately below the speed at which the centrifugal advance begins to function to obviate the possibility of an incorrect reading being registered.				CENTRIFUGAL TIMING ADVANCE TESTS Mount distributor in centrifugal advance test rig and set to spark at zero degrees at 100 r.p.m.				
Distributor Type	Lucas Service Number	Lucas Vacuum Unit Number	Vacuum in inches of mercury and advance in degrees Inches	Degrees	No advance in timing below-ins. of mercury	Lucas Advance Springs Number	Acelerate to-RPM and note advance in degrees RPM	Degrees	Decelerate to-RPM and note advance in degrees RPM	Degrees	No advance in timing below-RPM
22 D6	41060A	54415894	20 13 9 7½ 6	7—9 6—8½ 2½—5½ 0—3 0—½	4½	55415562	2,300	8½—10½	1800 1250 800 650 525	8½—10½ 6½—8½ 5—7 2—4 0—1½	300
Auto advance weights Lucas number 54413073. One inch of mercury = 0·0345 kg/cm²											

FUSE UNITS

Fuse No.	CIRCUITS	Amps
1	Headlamps—Main Beam	35
2	Headlamps—Dip Beam	35
3	Horns	50
4	Traffic Hazard Warning System	35
5	Side, Panel, Tail and Number Plate (not Germany) Lamps	35
6	Horn Relay, Washer, Radiator Fan Motor and Stop Lamps	35
7	Flashers, Heater, Wiper, Choke, Fuel, Water and Oil Gauges	35
8	Headlamp Flasher, Interior Lamps and Cigar Lighter	35
In line	Heated Backlight (when fitted)	15
In line	Radio, Optional Extras	5

THE ALTERNATOR

MODEL 11AC (43 AMP)

DESCRIPTION

The Lucas 11 AC alternator is a lightweight machine designed to give increased output at all engine speeds.

Basically the unit consists of a stationary output winding with built in rectification and a rotating field winding, energised from the battery through a pair of slip rings.

The stator consists of a 24 slot, 3 phase star connected winding on a ring shaped lamination pad housed between the slip ring end cover and the drive end bracket.

The rotor is of 8-pole construction and carries a field winding connected to two face type slip rings. It is supported by a ball bearing in the drive end bracket and a needle roller bearing in the slip ring end cover (see Fig. 2).

The brushgear for the field system is mounted on the slip ring end cover. Two carbon brushes, one positive and one negative, bear against a pair of concentric brass slip rings carried on a moulded disc attached to the end of the rotor. The positive brush is always associated with the inner slip ring. There are also six silicon diodes carried on the slip ring end cover, these being connected in a three phase bridge circuit to provide rectification of the generated alternating current output (see Fig. 2). The diodes are cooled by air flow through the alternator induced by a 6" (15·24 cm.) ventilating fan at the drive end.

The alternator is matched to an output control unit, Model 4TR, which is described on page PY.s.11.

This unit controls the alternator field current and hence the alternator terminal voltage.

A cut-out is not included in the control unit as the diodes in the alternator prevent reverse currents from flowing through the stator when the machine is stationary or is generating less than the battery voltage.

No separate current-limiting device is incorporated; the inherent self-regulating properties of the alternator effectively limit the output current to a safe value.

A Lucas 3AW warning light control unit is incorporated in the circuit.

The output control unit and the alternator field windings are isolated from the battery when the engine is stationary by a Lucas 6RA relay incorporated in the circuit.

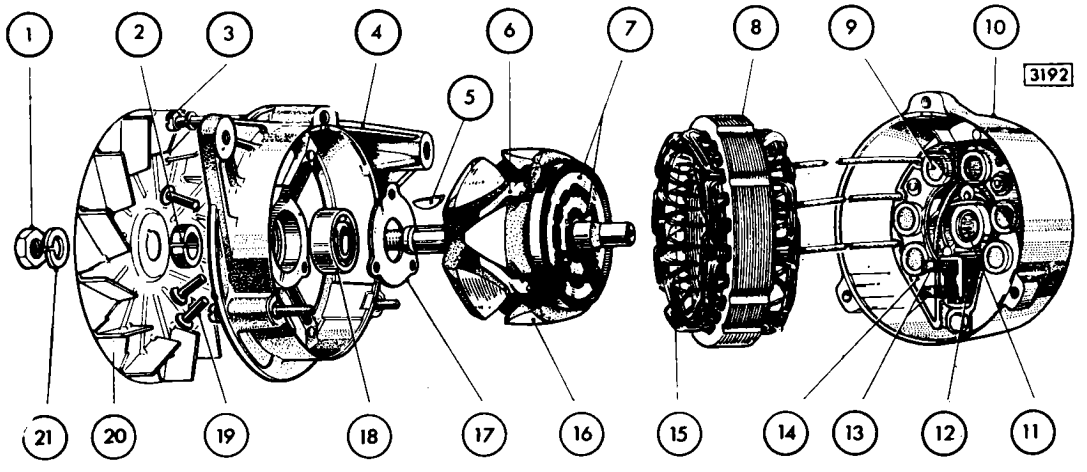


Fig. 2. *Exploded view of the Lucas 11 AC alternator.*

1. Shaft nut.
2. Bearing collar.
3. Through fixing bolts (3).
4. Drive end bracket.
5. Key.
6. Rotor (field) winding.
7. Slip rings.
8. Stator laminations.
9. Silicon diodes (6).
10. Slip ring end bracket.
11. Needle roller bearing.
12. Brush box moulding.
13. Brushes.
14. Diode heat sink.
15. Stator windings.
16. Rotor.
17. Bearing retaining plate.
18. Ball bearing.
19. Bearing retaining plate rivets.
20. Fan.
21. Spring washer.

PERFORMANCE DATA

Nominal voltage	12 volts
Nominal d.c. output (hot) in amperes	43 amperes
Stator phases	3
Phase connections	Star
Resistance/phase at 68°F (20°C) ± 5%	0.107 ohms
Resistance of rotor winding in ohms at 68°F (20°C)	3.8 ± 5%

REMOVAL

Disconnect the cables from the terminals on the slip ring end cover. Note the colour and location of the cables with Lucar termination for reference when refitting.

Remove the drive belt by pushing the spring loaded jockey pulley inwards and lifting the belt over the alternator pulley.

Remove the two bolts securing the alternator to the mounting bracket and adjuster link. Withdraw the alternator.

REFITTING

Refitting is the reverse of the removal procedure.

When replacing the alternator belt, hold the spring loaded jockey pulley in towards the block and only release when the belt is sitting securely in the "vee" tracks.

SERVICE PRECAUTIONS

Important

4·2 "E" Type cars are equipped with transistors in the control box unit and diode rectifiers in the alternator.

The car electrical system must NOT be checked with an ohmmeter incorporating a hand driven generator until these components have been isolated.

REVERSED battery connections will damage the diode rectifiers.

Battery polarity must be checked before connections are made to ensure that the connections for the car battery are NEGATIVE earth. This is most important when using a slave battery to start the engine.

NEVER earth the brown/green cable if it is disconnected at the alternator. If this cable is earthed, with the ignition switched ON, the control unit and wiring may be damaged.

NEVER earth the alternator main output cable or terminal. Earthing at this point will damage the alternator or circuit.

NEVER run the alternator on open circuit with the field windings energised, that is with the main lead disconnected, otherwise the rectifier diodes are likely to be damaged due to peak inverse voltages.

WARNING: When using electric welding equipment for car accident repair it is advisable to carry out the following precautions.

1. Disconnect the battery.
2. Disconnect the main output and AL cables at the alternator.
3. Disconnect all cables at the 4TR control unit.

SERVICING

Testing the Alternator in position

In the event of a fault developing in the charging circuit check by the following procedure to locate the cause of the trouble.

1. Disconnect the battery.
2. Disconnect the cable (brown) from the alternator output terminal and connect a good quality moving-coil ammeter between the disconnected cable and the output terminal.

3. Detach the terminal connector block from the base of the control unit and connect the black and brown/green cables together by means of a short length of cable with two Lucar terminals attached. This operation connects the alternator field winding across the battery terminals and by-passes the output control unit (Fig. 3).

4. Reconnect the battery earth lead. Switch on the ignition and start the engine. Slowly increase the engine speed until the alternator is running at approximately 4,000 r.p.m. (2,000 engine r.p.m.). Check the reading on the ammeter which should be approximately 40 amperes with the machine at ambient temperature.

   A low current reading will indicate either a faulty alternator or poor circuit wiring connections.

   If, after checking the latter, in particular the earth connections, a low reading persists on repeating the test refer to paragraph (5).

   In the case of a zero reading, switch on the ignition and check that the battery voltage is being applied to the rotor windings by connecting a voltmeter between the two cable ends normally attached to the alternator field terminals. No reading on this test indicates a fault in the field isolating relay or the wiring associated with this circuit. Check each item in turn and rectify as necessary.

5. If a low output has resulted from the test described in paragraph (4) and the circuit wiring is in order; measure the resistance of the rotor coil field by means of an ohmmeter connected between the field terminal blades with the external wiring disconnected.

   The resistance must approximate 3·8 ohms.

When a ohmmeter is not available connect a 12 volt DC supply between the field terminals with an ammeter in series. The ammeter reading should be approximately 3·2 amperes Fig. 4.

A zero reading on the ammeter, or an infinity reading on the ohmmeter indicates an open circuit in the field system, that is, the brush gear slip rings or winding. Conversely, if the current reading is much above, or the ohmmeter is much below, the values given then it is an indication of a short circuit in the rotor winding in which case the rotor slip ring assembly must be changed.

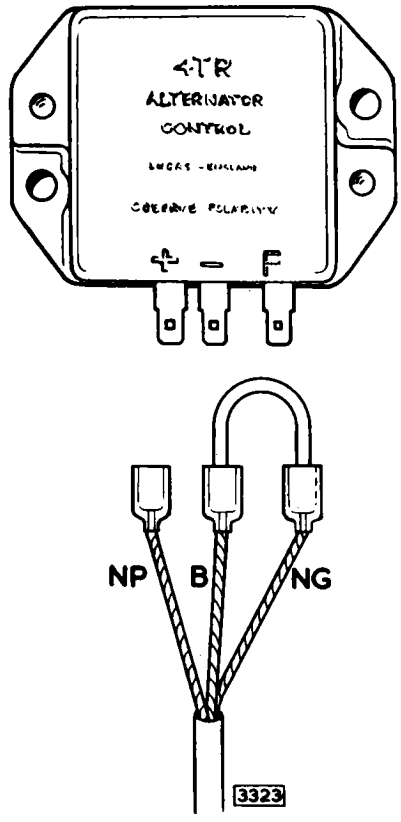


Fig. 3. *Detach the terminal connectors from the base of the control unit.*

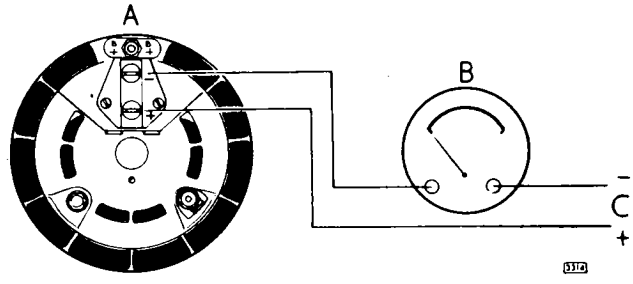


Fig. 4. *Testing the alternator with an ammeter.*
A—*Alternator.* B—*Ammeter.* C—*Battery.*

DISMANTLING THE ALTERNATOR (Fig. 2).

Disconnect the battery and remove the alternator as detailed on page PY.s.6.

Remove the shaft nut (1) and spring washer (21). Withdraw the pulley and fan (20).

Remove bolts (3) noting that the nuts are staked to the through bolts and that the staking must be removed before the nuts are unscrewed. If the threads of the nuts or bolts are damaged, new bolts must be fitted when reassembling.

Mark the drive end bracket (4), lamination pack (8) and slip ring end bracket (10) so that they may be reassembled in correct angular relation to each other. Care must be taken not to damage the lamination pack when marking.

Withdraw the drive end bracket (4) and rotor (16) from the stator (8). The drive end bracket and rotor need not be separated unless the bearing requires examination or the rotor is to replaced.

In the latter case the rotor should be removed from the drive end bracket by means of a hand press having first removed the shaft key (5) and bearing collar (2).

Remove the terminal nuts, washers and insulating pieces brush box screws and the 2 B.A., hexagon headed setscrew. Withdraw the stator and diode heat sink assemblies from the slip ring end cover.

Close up the retaining tongue at the root of each field terminal blade and withdraw the brush spring together with the terminal assemblies from the moulded brushbox.

REASSEMBLY

Reassembly of the alternator is the reverse of the dismantling procedure. Care must be taken to align the drive end bracket, lamination pack, slip ring and bracket correctly.

Tighten the three through bolts evenly to a maximum torque of 45 to 50 lb./ins. (0·518 to 0·576 kgm.). Restake the nuts after tightening.

Tighten the brush box fixing screws to a maximum torque of 10 lb./ins. (0·115 kgm.).

IMPORTANT

It is important to ensure that a .045″ (1.28 mm.) gap exists between the non-pivotal end of the heat sinks (see Fig. 15) when reassembling the alternator.

INSPECTION OF BRUSHGEAR (EARLY MODELS)

a maxi-

Measure brush length. A new brush is $\frac{5}{8}$″ (15·88 mm.) long; a fully worn brush is $\frac{5}{32}$″ (3·97 mm.) and must be replaced at, or approaching, this length. The new brush is supplied complete with brush spring and Lucar terminal blade and has merely to be pushed in until the tongue registers. To ensure that the terminal is properly retained, carefully lever up the retaining tongue with a fine screwdriver blade, so that the tongue makes an angle of 30° with the terminal blade.

The normal brush spring pressures are 4–5 oz. (113 to 142 gms.) with the spring compressed to $\frac{25}{32}$″ (19·84 mm.) in length and $7\frac{1}{2}$ to $8\frac{1}{2}$ oz. (212 to 242 gms.) with the spring compressed to $\frac{13}{32}$″ (10·31 mm.) in length. These pressures should be measured if the necessary equipment is available.

Check that the brushes move freely in their holders. If at all sluggish, clean the brush sides with a petrol moistened cloth or, if this fails to effect a cure, lightly polish the brush sides on a smooth file. Remove all traces of brush dust before re-housing the brushes in their holders.

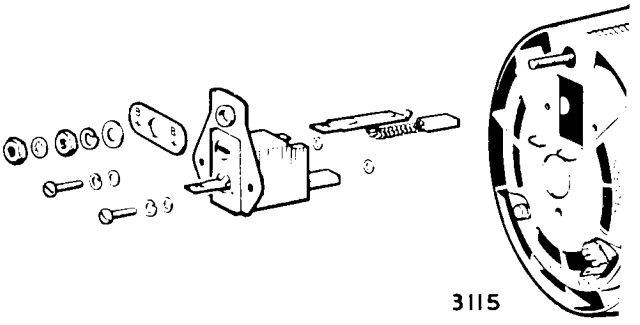


Fig. 5. *Showing the brush removal (early cars).*

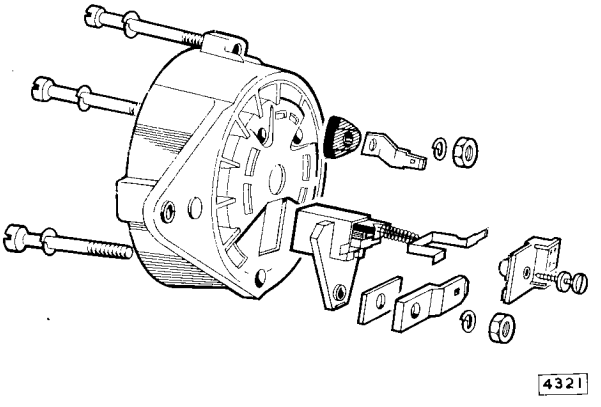


Fig. 6. *Showing the brush removal (later cars).*

INSPECTION OF BRUSHGEAR (LATER MODELS)

Later model alternators will have side entry cables. The characteristics of the alternator remain the same as the previous model (side entry cables) with the exception of the method of inspection and the fixing of the brush gear as detailed below:—

The brush length when new is $\frac{5}{8}$″ (15.9 mm.). The serviceability of the brushes may be gauged by measuring the amount by which they protrude beyond the brushbox moulding when in the free position. For a brush to remain serviceable this should exceed 0.2″ (5 mm.).

Renew the brush assemblies if the brushes are worn to or below this length.

The new brush is supplied complete with brush spring and 'Lucar' terminal blade and is retained in position by a plate secured with a single fixing screw.

Check the brush spring pressure by using a push type spring gauge. Push each spring back against its spring until the brush face is flush with the housing.

The gauge should then register 8–16 oz. (227–454 grammes). Replace a brush assembly which gives a reading appreciably outside these limits where this is not due to the brush movement being impeded for any reason.

INSPECTION OF SLIP RINGS

The surfaces of all slip rings should be smooth and uncontaminated by oil or other foreign matter. Clean the surfaces using a petrol moistened cloth, or if there is any evidence of burning, very fine glasspaper. On no account must emery cloth or similar abrasives be used. No attempt should be made to machine the slip rings, as any eccentricity in the machining may adversely affect the high-speed performance of the alternator. The small current carried by the rotor winding together with the unbroken surface of the slip rings mean that the likelihood of scored or pitted slip rings is almost negligible.

ROTOR

Test the rotor winding by connecting an ohmmeter (Fig. 7) or 12 volt D.C. (Fig. 8) supply between the slip rings. The readings of resistance or current should be as given on page PY.s.6.

Test for defective insulation between each of the slip rings and one of the rotor poles using a mains low-wattage test lamp for the purpose. If the lamp lights, the coil is earthing therefore a replacement rotor/slip ring assembly must be fitted.

No attempt should be made to machine the rotor poles or to true a distorted shaft.

STATOR

Unsolder the three stator cables from the heat sink assembly, taking care not to overheat the diodes—(see 4h page 6). Check the continuity of the stator windings by first connecting any two of the three stator cables in series with a test lamp of not less than 36 watts and a 12-volt battery as shown in Fig. 10. Repeat the test, replacing one of the two cables by the third cable. Failure of the test lamp to light on either occasion means that part of the stator winding is open-circuit and a replacement stator must be fitted.

Test for defective insulation between stator coils and lamination pack with a mains test lamp. Connect the test probes between any one of the three cable ends and the lamination pack. If the lamp lights, the stator coils are earthing and a replacement stator must be fitted.

Before re-soldering the stator cable ends to the diode pins check the diodes.

DIODES

Each diode can be checked by connecting it in series with a 1·5 watt test bulb (Lucas No. 280)

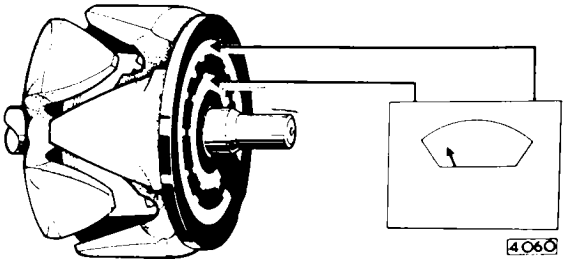


Fig. 7. *Measuring the rotor winding resistance with an ohmmeter.*

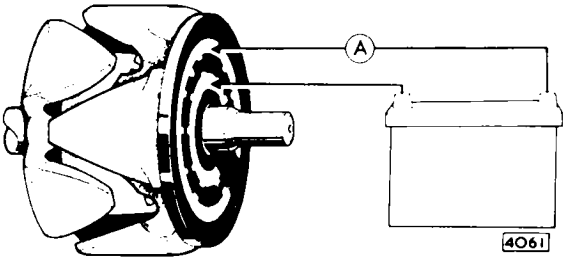


Fig. 8. *Measuring the rotor winding resistance with an ammeter and battery.*

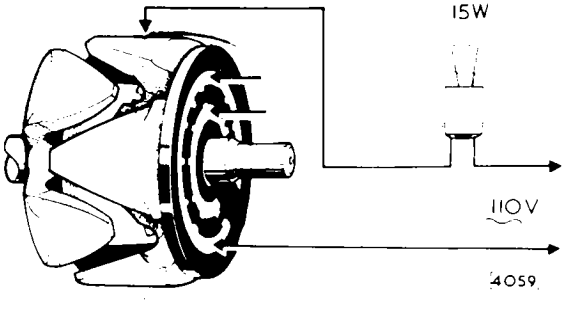


Fig. 9. *Insulation test of rotor winding.*

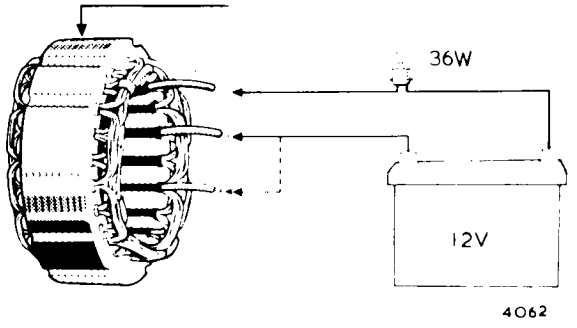


Fig. 10. *Stator winding continuity test.*

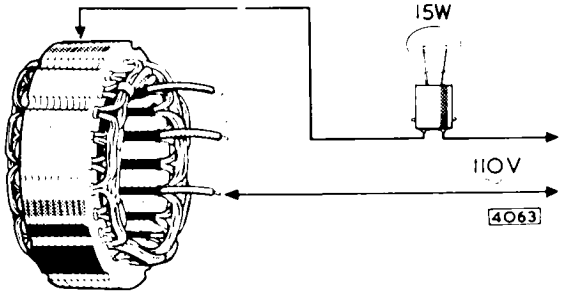


Fig. 11. *Stator winding insulation test.*

across a 12 volt D.C. supply and then reversing the connections.

Current should flow and the bulb light in one direction only. If the bulb lights up in both tests or does not light up in either then the diode is defective and the appropriate heat sink assembly must be replaced.

The above procedure is adequate for service purposes. Any accurate measurement of diode resistance requires factory equipment. Since the forward resistance of a diode varies with the voltage applied, no realistic readings can be obtained with battery-powered ohmmeters.

If a battery—ohmmeter is used, a good diode will yield "Infinity" on one direction and some indefinite, but much lower, reading in the other.

WARNING:

Ohmmeters of the type incorporating a hand-driven generator must never be used for checking diodes.

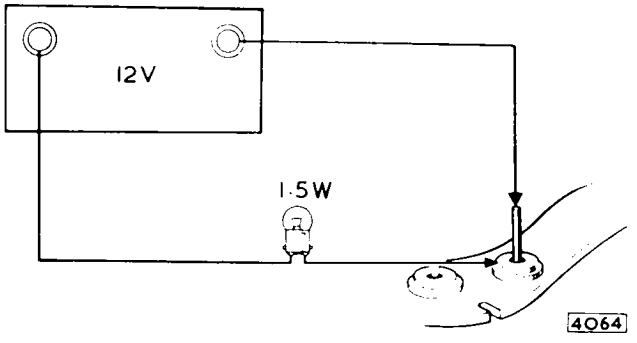


Fig. 12. *Method of testing diodes.*

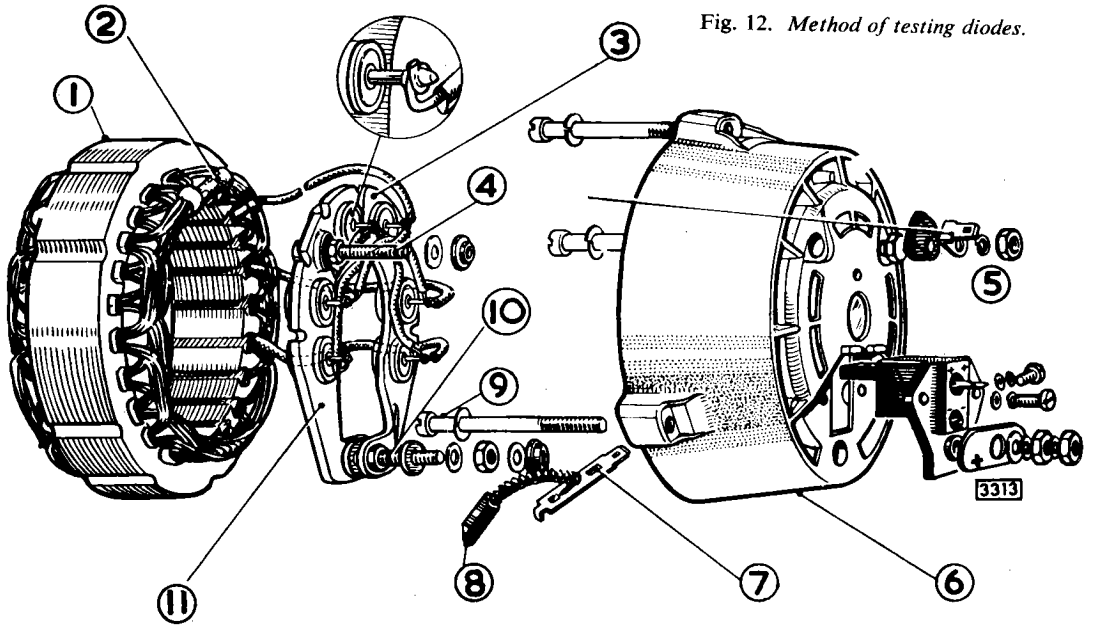


Fig. 13. *Exploded view of the slip ring end cover.*

1. Stator.
2. Star point.
3. Negative heat sink anode base diodes (black).
4. Warning light terminal 'AL'.
5. Field terminal (2)
6. Slip ring end cover.
7. Terminal blade retaining tongue.
8. Rotor slip ring brush (2).
9. "Through" bolts (3).
10. Output terminal (+).
11. Positive heat sink and cathode base diode (red).

ALTERNATOR DIODE HEAT SINK REPLACEMENT

The alternator heat sink assembly consists of two mutually insulated portions, one of positive and the other of negative polarity. The diodes are not individually replaceable but, for service purposes, are supplied already pressed into the appropriate heat sink portion. The positive carries three cathode base diodes marked black.

When soldering the interconnections, M grade 45–55 tin-lead solder should be used.

Great care must be taken to avoid overheating the diodes or bending the diode pins. The diode pins should be lightly gripped with a pair of suitable long-nosed pliers, acting as a thermal shunt and the operation of soldering carried out as quickly as possible.

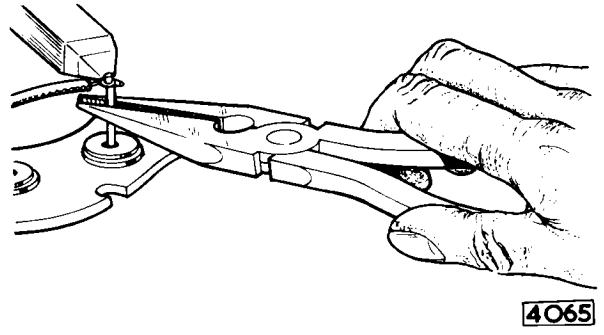


Fig. 14. *Use of thermal shunt when soldering diode connections*

After soldering to ensure adequate clearance of the rotor, the connections must be neatly arranged around the heat sinks and tacked down with "MMM" EC 1022 adhesive where indicated in Fig. 15. The stator connections must pass through the appropriate notches at the edge of the heat sink.

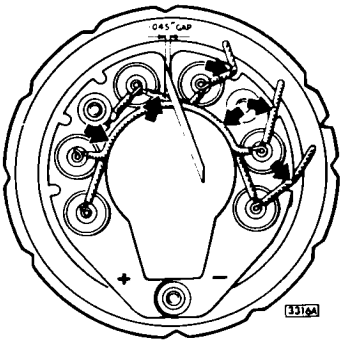


Fig. 15. *Showing the silicon diodes and connection in the slip ring end cover.*
The feeler gauge inserted between the diode carriers.

BEARINGS

Bearings which are worn to the extent that they allow excessive side movement of the rotor shaft must be renewed. The needle roller bearing in the slip ring end cover is supplied complete with the end cover.

To renew the drive end ball bearing following the withdrawal of the rotor shaft from the drive-end bracket, proceed as follows:—

(a) File away the roll-over on each of the three bearing retaining plate rivets and punch out the rivets.

(b) Press the bearing out of the bracket.

(c) Locate the bearing in the housing and press it home. Refit the bearing retaining plate using new rivets.

Note: Before fitting the replacement bearing see that it is clean and, if necessary, pack it with high-melting point grease such as Shell Alvania No. 3 or an equivalent lubricant.

ALTERNATOR OUTPUT CONTROL UNIT MODEL 4 TR.

GENERAL

Model 4 TR is an electronic control unit. In effect its action is similar to that of the vibrating contact type of voltage control unit but switching is achieved by transistors instead of vibrating contacts. A Zener diode provides the voltage reference in place of the voltage coil and tension spring system. No cut-out is required since the diodes incorporated in the alternator prevent reverse currents flowing. No current regulator is required as the inherent self-regulating properties of the alternator effectively limit the output current to a safe value.

The control unit and the alternator field windings are isolated from the battery, when the engine is stationary, by a special double-pole ignition switch.

On cars fitted with a steering column lock, the field windings are isolated by means of a relay replacing the ignition switch control.

Care must be taken at all times to ensure that the battery, alternator and control unit are correctly connected. Reversed connections will damage the semi conductor devices employed in the alternator and control unit.

OPERATION

When the ignition is switched on, the control unit is connected to the battery through the field isolating switch or relay. By virtue of the connection through

R1 (see Fig. 16), the base circuit of the power transistor T2 is conducted so that, by normal transistor action, current also flows in the collector-emitter portion of T2 which thus acts as a closed switch to complete the field circuit and battery voltage is applied to the field winding.

As the alternator rotor speed increases, the rising voltage generated across the stator winding is applied to the potential divider consisting of R3, R2 and R4. According to the position of the tapping point on R2, a proportion of this potential is applied to the Zener diode (ZD). The latter is a device which opposes the passage of current through itself until a certain voltage is reached above which it conducts comparatively freely.

The Zener diode can thus be considered as a voltage-conscious switch which closes when the voltage across it reaches its "breakdown" voltage (about 10 volts) and, since this is a known proportion of the alternator output voltage as determined by the position of the tapping point on R2, the breakdown point therefore reflects the value of the output voltage.

Thus at "breakdown" voltage the Zener diode conducts and current flows in the base-emitter circuit of the driver transistor T1. Also, by transistor action, current will flow in the collector-emitter portion of T1 so that some of the current which previously passed through R1 and the base circuit of T2 is diverted through T1. Thus the base current of T2 is reduced and, as a result, so also is the alternator field excitation. Consequently, the alternator output voltage will tend to fall and this, in turn, will tend to reduce the base current in T1, allowing increased field current to flow in T2. By this means, the field current is continuously varied to keep the output voltage substantially constant at the value determined by the setting of R2.

To prevent overheating of T2, due to power dissipation, this transistor is operated only either in the fully-on or fully-off condition. This is achieved by the incorporation of the positive feed-back circuit consisting of R5 and C2. As the field current in transistor T2 starts to fall, the voltage at F rises and current flows through resistor R5 and capacitor C2 thus adding to the Zener diode current in the base circuit of transistor T1. This has the effect of increasing the current through T1 and decreasing, still further, the current through T2 so that the circuit quickly reaches the condition where T1 is fully-on and T2 fully-off. As C2 charges, the feed-back current falls to a degree at which the combination of Zener diode current and feed-back current in the base circuit of T1 is no longer sufficient to keep T1 fully-on. Current then begins to flow again in the base circuit of T2. The voltage at F now commences to fall, reducing the feed-back current eventually to zero. As T2 becomes yet more conductive and the voltage at F falls further, current in the feed-back circuit reverses in direction thus reducing, still further, the base current in T1.

This effect is cumulative and the circuit reverts to the condition where T1 is fully-off and T2 is fully-on.

The above condition is only momentary since C2 quickly charges to the opposite polarity when feed-back current is reduced and current again flows in

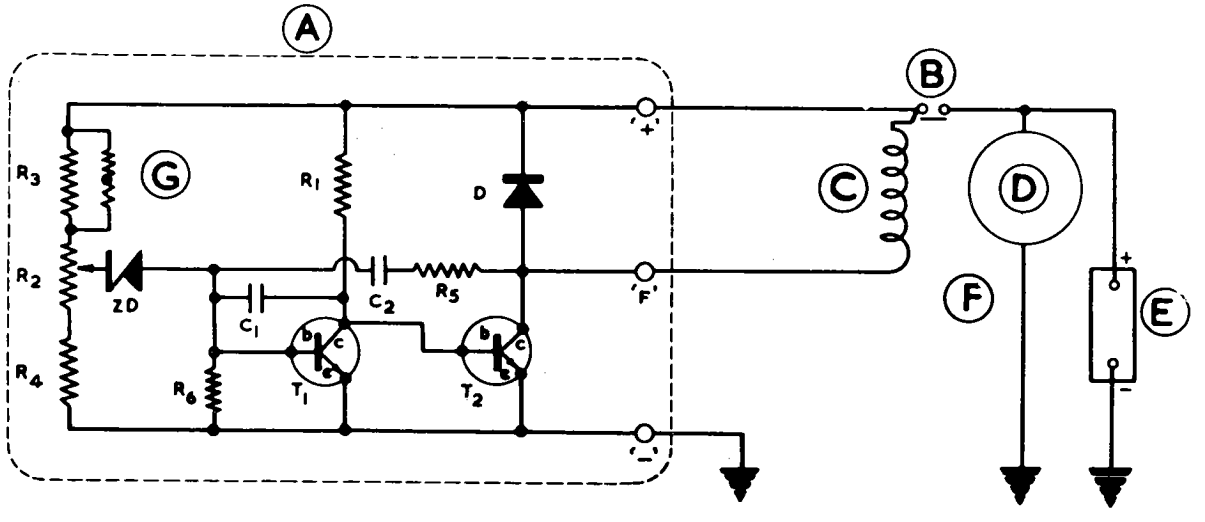


Fig. 16. *4TR Control Unit Circuit Diagram.*

A—Control unit.
B—Field isolating device.
C—Rotor field winding.
D—Alternator.
E—12-volt battery.
F—Stator winding (rectified) output.
G—Thermistor.

3190

the base circuit of T1. The circuit thus oscillates, switching the voltage across the alternator field winding rapidly on and off.

Transistor T2 is protected from the high induced voltage surge, which results from the collapse of the field current, by the surge quench diode D connected across the field windings. This diode also provides a measure of field current smoothing since current continues to flow in the diode after the excitation voltage is removed from the field.

The elimination of radio interference is achieved by connecting condenser C1 between the base and collector terminals of T1 to provide negative feedback. At high temperatures, a small leakage current may flow through the Zener diode even though the latter is in the nominally non-conductive state. Resistor R6 provides a path for this leakage current which otherwise would flow through T1 base circuit and adversely affect the regulator action.

A thermistor is connected in parallel with resistor R3. The thermistor is a device whose resistance increases as the temperature falls and vice verse. Any alteration in its ohmic value will modify the voltage distribution across the potential divider and thus affect the voltage value at which the Zener diode begins to conduct, so matching the changes which take place in battery terminal voltage as the temperature rises.

CHECKING AND ADJUSTING THE CONTROL UNITS

Important:

Voltage checking and setting procedure may be carried out only if the alternator and associated wiring circuits have been tested and found satisfactory in conjunction with a well-charged battery, (i.e., charging current not exceeding 10 amperes).

VOLTAGE CHECKING

Run the alternator at charging speed for eight minutes. This operation applies when bench testing or testing on the car.

Leave the existing connections to the alternator and control unit undisturbed. Connect a high quality voltmeter between control unit terminals positive and negative. If available, use a voltmeter of the suppressed-zero type, reading 12 to 15 volts.

Switch on an electrical load of approximately 2 amperes (e.g., side and tail lighting).

Start the engine and run the alternator at 3,000 r.p.m. (1,500 engine r.p.m.).

The voltmeter should now show a reading of 13·9 to 14·3 volts at 68° to 78° F. (20° to 26° C.) ambient temperature. If not, but providing the reading obtained has risen to some degree above battery terminal voltage before finally reaching a steady value, the unit can be adjusted to control at the correct voltage (see Adjusting).

If, however, the voltmeter reading remains unchanged, at battery terminal voltage, or, conversely, increases in an uncontrolled manner, then the control unit is faulty and, as its component parts are not serviced individually a replacement unit must be fitted.

ADJUSTING

Stop the engine and withdraw the control unit mounting screws.

Invert the unit and chip away the sealing compound which conceals the potentiometer adjuster (see Fig. 7).

Check that the voltmeter is still firmly connected between terminals +ve and —ve. Start the engine and, while running the alternator at 3,000 r.p.m., turn the potentiometer adjuster slot (clockwise to increase the setting or anti-clockwise to decrease it) until the required setting is obtained.

Use care in making this adjustment as a small amount of adjuster movement causes an appreciable difference in the voltage reading.

Recheck the setting by first stopping the engine then again running the alternator at 3,000 r.p.m.

Remount the control unit and disconnect the voltmeter.

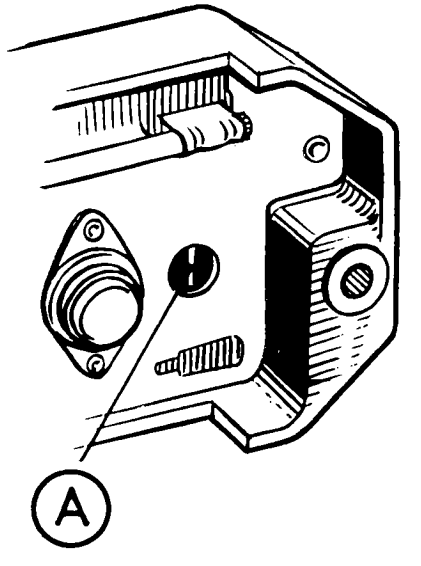


Fig. 17 *4 TR Alternator Control.*
A *Potentiometer adjuster.*

WARNING LIGHT CONTROL UNIT
Model 3AW

DESCRIPTION

The Model 3AW warning light unit is a device connected to the centre point of one of the pairs of diodes in the alternator and operates in conjunction with the ignition warning light to give indication that the alternator is charging.

The unit is mounted on the bulkhead adjacent to the control box and is similar in appearance to the flasher unit but has different internal components consisting of an electrolytic (polarised) capacitor; a resistor and a silicone diode mounted on an insulated base with three "Lucar" terminals.

The unit is sealed, therefore servicing and adjustment is not possible. Faulty units must be replaced. Due to external similarity of the 3AW warning light unit and the flasher unit, a distinctive green label is attached to the aluminium case of the 3AW unit.

Checking Check by substitution after ensuring that the remainder of the charging circuit (including the drive belt) is functioning satisfactorily.

Warning. A faulty diode in the alternator or an intermittent or open-circuit in the alternator to battery circuit can cause excessive voltages to be applied to the warning light unit.

To prevent possible damage to a replacement unit, it is important to first check the voltage between the alternator "AL" terminal and earth. Run the engine at 1,500 r.p.m. when the voltage should be 7–7·5 volts measured on a good quality moving-coil voltmeter. If a higher voltage is registered, check that all charging circuit connections are clean and tight; then, if necessary, check the alternator rectifier diodes before fitting a replacement 3AW unit.

TRAFFIC HAZARD WARNING DEVICE (OPTIONAL EQUIPMENT)

Description

The system operates in conjunction with the four flashing (turn) indicator lamps fitted to the car. The operation of the dash panel switch will cause the four turn indicator lamps to flash simultaneously.

A red warning lamp is incorporated in the circuit to indicate that the hazard warning system is in operation.

A 35 amp. in-line fuse incorporated in the sub-panel circuit.

The flasher unit is located and is similar in appearance to the one used for the flashing turn indicators but has a differenti internal circuit. A correct replacement unit must be fitted in the even of failure.

The pilot lamp bulb is accessible after removing the bulb holder from the rear of the panel.

Failure of one or more of the bulbs due to an accident or other cause will not prevent the system operating on the remaining lamps.

THE STARTER MOTOR

DESCRIPTION

The purpose of the pre-engaged, or positive engagement, starting motor is to prevent premature pinion ejection.

Except on occasions of tooth to tooth abutment, for which special provision is made, the starter motor is connected to the battery only after the pinion has been meshed with the flywheel ring gear, through the medium of an electro-magnetically operated linkage mechanism.

After the engine has started, the current is automatically switched off before the pinion is retracted. On reaching the out of mesh position, the spinning armature is brought rapidly to rest by a braking device. This device takes the form of a pair of moulded shoes driven by a cross peg in the armature shaft and spring loaded (and centrifuged) against a steel ring insert in the commutator end bracket. Thus, with the supply switched off and the armature subjected to a braking force, the possibility is minimised of damaged teeth resulting from attempts being made to re-engage a rotating pinion.

A bridge-shaped bracket is secured to the front end of the machine by the through bolts. This bracket carries the main battery input and solenoid winding

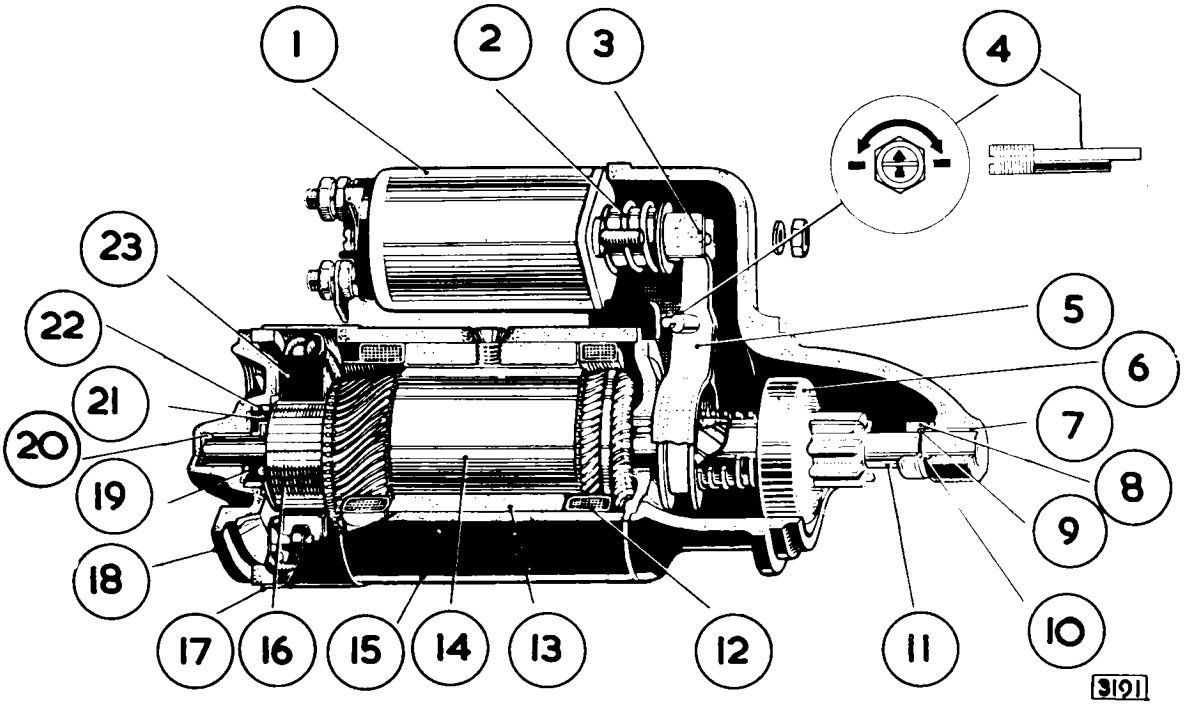


Fig. 18. *The Pre-engaged Starter Motor Model M45G.*

1. Actuating solenoid.
2. Return spring.
3. Clevis pin.
4. Eccentric pivot pin.
5. Engaging lever.
6. Roller clutch.
7. Porous bronze bush.
8. Thrust collar.
9. Jump ring.
10. Thrust washer.
11. Armature shaft extension.
12. Field coils.
13. Pole shoe.
14. Armature.
15. Yoke.
16. Commutator.
17. Band cover.
18. C.E. bracket.
19. Thrust washer.
20. Porous bronze bush.
21. Brake shoes and cross peg.
22. Brake ring.
23. Brushes.

terminals, short extension cables being connected between these and the corresponding solenoid terminals.

TOOTH TO TOOTH ABUTMENT

The electro-magnetically actuated linkage mechanism consists essentially of a pivoted engaging lever having two hardened steel pegs (or trunnion blocks) which locate with and control the drive through the medium of a groove in an operating bush. This bush is carried, together with the clutch and pinion assembly, on an internally splined outboard driving sleeve, the whole mechanism being housed in a cut-away flange mounting snout-shaped end bracket. This operating bush is spring loaded against a jump ring in the driving sleeve by an engagement spring located between the bush and the clutch outer cover. The system return or drive demeshing spring is located round the solenoid plunger.

On the occurrence of tooth to tooth abutment (between the ends of the starter pinion teeth and those of the flywheel ring gear), the pegs or trunnion blocks at the "lower" end of the engaging lever can move forward by causing the operating bush to compress the engagement spring, thus allowing the "upper" end of the lever to move sufficiently rearwards to close the starter switch contacts. The armature then rotates and the pinion slips into mesh with the flywheel ring gear under pressure of the compressed engagement spring.

THE "LOST MOTION" (SWITCH-OFF) DEVICE

As it is desirable that the starter switch contacts shall not close until the pinion has meshed with the flywheel ring gear therefore it is important that these same contacts should always re-open before the pinion has been retracted or can be opened in the event of a starter pinion remaining for some reason enmeshed with the flywheel ring gear. To ensure this, a measure of "lost motion" is designed into some part of the engagement mechanism, its effect being to allow the starter switch or solenoid contacts (which are always spring-loaded to the open position) to open before pinion retraction begins.

Several methods of obtaining "lost motion" have been adopted, but each depends upon the yielding of a weaker spring to the stronger system return (drive demeshing or dis-engagement) spring of the solenoid plunger.

This initial yielding results in the switch contacts being fully-opened within the first $\frac{1}{8}$" (3·18 mm.) of plunger return travel; this action being followed by normal drive retraction.

Solenoid model 10S has a weaker (lost motion) spring located inside the solenoid plunger. Here, enclosed at the outer end by a retaining cup, it forms a plunger within a plunger and it is spring loaded against the tip of the engaging lever inside the plunger clevis link.

THE ROLLER CLUTCH

Torque developed by the starting motor armature must be transmitted to the pinion and flywheel through an over-running or free-wheeling device which will prevent the armature from being rotated at an excessively high speed in the event of the engaged position being held after the engine has started. The roller clutch performs this function.

The operating principle of the roller clutch is the wedging of several plain cylindrical rollers between converging surfaces. The convergent form is obtained by matching cam tracks, to a perfectly circular bore. The rollers, of which there are three, are spring loaded and, according to the direction of drive, are either free or wedge-locked between the driving and driven members. The clutches are sealed in a rolled over steel outer cover and cannot be dismantled for subsequent reassembly.

THE STARTER SOLENOID

The starter solenoid is an electro-magnetic actuator mounted pick-a-back fashion on the yoke of the pre-engaged starter motor. It contains a soft iron plunger (linked to the engaging lever), the starter switch contacts and a coil consisting of a heavy gauge pull-in or series winding and a lighter-gauge hold-on or shunt winding.

Initially, both windings are energised in parallel when the starter device is operated but the pull-in winding is shorted out by the starter switch contacts at the instant of closure—its purpose having been effected.

Magnetically, the windings are mutually assisting.

Like the roller clutch assembly, the starter solenoid is sealed in a rolled-over steel outer case or body and cannot be dismantled for subsequent reassembly.

STARTER MOTOR PERFORMANCE DATA

Model	M45G Pre-engaged
Lock Torque	22·6 lb./ft. (3·13 kg./m.) with 465 amperes at 7·6 terminal volts
Torque at 1,000 r.p.m.	9·6 lb./ft. (1·33 kg./m.) with 240 amperes at 9·7 terminal volts
Light running current	70 amperes at 5,800 to 6,500 r.p.m.

SOLENOID SWITCH DATA

Model	10 S
Closing Coil Resistance (measured between terminal STA with copper link removed and Lucar terminal)	0·36 to 0·42 ohms
Hold on Coil Resistance (measured between Lucar terminal and solenoid outer case)	1·49 to 1·71 ohms

REMOVAL

DISCONNECT THE BATTERY EARTH LEAD.

Disconnect and remove the transmitter unit from the top of the oil filter.

Disconnect the battery cable and solenoid switch cable from the starter motor.

Remove the distributor clamping plate retaining screw and withdraw the distributor.

Remove the two setscrews and lock washers securing the motor to the housing, gently bend away the carburetter drain pipes and remove the starter motor through the chassis frame.

The two setscrews are accessible from beneath the car or through an access panel in the right-hand side of the gearbox tunnel. Remove the front carpet to expose the panel.

Refitting

Refitting is the reverse of the removal procedure.

Care must be taken when refitting the two setscrews, which have a fine thread, that they are not cross-threaded.

Insert the distributor and rotate the rotor until the drive dog engages correctly and secure with the clamping plate setscrew.

Note: If the clamping plate has been removed from the distributor or its position altered, the engine must be re-timed as detailed in Section B.

SERVICING

Checking the Brusngear and Commutator

Remove the starter motor from the engine.

Release the screw and remove the metal band cover.

Check that the brushes move freely in the brush boxes by holding back the spring and pulling gently on the flexible connection. If a brush is inclined to stick, remove it from its holder and clean its sides with a petrol moistened cloth. Replace the brushes in their original position in order to retain "bedding". Brushes which will not "bed" properly or have worn to $\frac{5}{16}$" (7·94 mm.) in length must be renewed. See page PY.s.20 for renewal procedure.

Check the tension of the brush springs with a spring balance. The correct tension should be 52 ozs. (1·47 kg.) on a new brush.

Replace each existing brush in turn with a new brush to enable the tension of the brush springs to be tested accurately.

Check that the commutator is clean and free from oil or dirt. If necessary clean with a petrol moistened cloth or, if this is ineffective, rotate the armature and polish the commutator with fine glass paper. DO NOT use emery cloth. Blow out all abrasive dust with a dry air blast.

A badly worn commutator can be reskimmed by first rough turning, followed by diamond finishing. DO NOT undercut the insulation. Commutators must not be skimmed below a diameter of $1\frac{17}{32}$" (38·89 mm.). Renew the armature if below this limit.

SERVICING

Testing in position

Check that the battery is fully charged and that the terminals are clean and tight. Recharge if necessary.

Switch on the lamps together with the ignition and operate the starter control. If the lights go dim and the starter does not crank the engine this indicates that the current is flowing through the starter motor windings but the armature is not rotating for some reason. The fault is due possibly to high resistance in the brush gear or an open circuit in the armature or field coils. Remove the starter motor for examination.

If the lights retain their full brilliance when the starter switch is operated check the starter motor and the solenoid unit for continuity.

If the supply voltage is found to be applied to the starter motor when the switch is operated the unit must be removed from the engine for examination.

Sluggish or slow action of the starter motor is usually due to a loose connection causing a high resistance in the motor circuit. Check as described above.

If the motor is heard to operate, but does not crank the engine, indication is given of damage to the drive.

BENCH TESTING

Remove the starter motor from the engine

Disconnect the battery. Disconnect and remove the starter motor from the engine (see page PY.s.18 for the removal procedure).

Measuring the light running current

With the starter motor securely clamped in a vice and using a 12-volt battery, check the light running current and compare with the value given on page P.X.s.15. If there appears to be excessive sparking at the commutator, check that the brushes are clean and free to move in their boxes and that the spring pressure is correct.

Measuring lock torque and lock current

Carry out a torque test and compare with the values given on page PY.s.17. If a constant voltage supply is used, it is important to adjust this to be 7·6 volts at the starter terminal when testing.

FAULT DIAGNOSIS

An indication of the nature of the fault, or faults, may be deduced from the results of the no-load and lock torque tests.

Symptom	Probable Fault
1. Speed, torque and current consumption correct.	Assume motor to be in normal operating condition.
2. Speed, torque and current consumption low.	High resistance in brush gear, e.g., faulty connections, dirty or burned commutator causing poor brush contact.
3. Speed and torque low, current consumption high.	Tight or worn bearings, bent shaft, insufficient end play, armature fouling a pole shoe, or cracked spigot on drive end bracket. Short circuited armature, earthed armature or field coils.
4. Speed and current consumption high, torque low.	Short circuited windings in field coils.
5. Armature does not rotate, high current consumption.	Open circuited armature, field coils or solenoid unit. If the commutator is badly burned, there may be poor contact between brushes and commutator.
6. Armature does not rotate, high current consumption.	Earthed field winding or short circuit solenoid unit. Armature physically prevented from rotating.
7. Excessive brush movement causing arcing at commutator.	Low brush spring tension or out-of-round commutator. "Thrown" or high segment on commutator.
8. Excessive arcing at the commutator.	Defective armature windings, sticking brushes or dirty commutator.
9. Excessive noise when engaged.	Pinion does not engage fully before solenoid main contacts are closed. Check pinion movement as detailed under Setting Pinion Movement.
10. Pinion engaged but starter motor not rotating.	Pinion movement excessive. Solenoid main contacts not closing. Check pinion movement as detailed under Setting Pinion Movement.

DISMANTLING

Disconnect the copper link between the lower solenoid terminal and the starting motor yoke.

Remove the two solenoid unit securing nuts. Detach the extension cables and withdraw the solenoid from the drive end bracket casting, carefully disengaging the solenoid plunger from the starter drive engagement lever.

Remove the cover band and lift the brushes from their holders.

Unscrew and withdraw the two through bolts from the commutator end bracket. The commutator end bracket and yoke can now be removed from the intermediate and drive end brackets.

Extract the rubber seal from the drive end bracket.

Slacken the nut securing the eccentric pin on which the starter drive engagement lever pivots. Unscrew and withdraw the pin.

Separate the drive end bracket from the armature and intermediate bracket assembly.

Remove the thrust washer from the end of the armature shaft extension using a mild steel tube of suitable bore. Prise the jump ring from its groove and slide the drive assembly and intermediate bracket from the shaft.

To dismantle the drive further prise off the jump ring retaining the operating bush and engagement spring.

BENCH INSPECTION

After dismantling the motor, examine individual items.

Replacement of brushes

The flexible connectors are soldered to terminal tags; two are connected to brush boxes and two are connected to free ends of the field coils. Unsolder these flexible connectors and solder the connectors of the new brush set in their place.

The brushes are pre-formed so that "bedding" to the commutator is unnecessary. Check that the new brushes can move freely in their boxes.

Commutator

A commutator in good condition will be burnished and free from pits or burned spots. Clean the commutator with a petrol moistened cloth. Should this be ineffective, spin the armature and polish the commutator with fine glass paper; remove all abrasive dust with a dry air blast. If the commutator is badly worn, mount the armature between centres in a lathe, rotate at high speed and take a light cut with a very sharp tool. Do not remove more metal than is necessary. Finally polish with very fine glass paper. The INSULATORS between the commutator segments MUST NOT BE UNDERCUT: Commutators must not be skimmed below a diameter of $1\frac{17}{32}$" (38·89 mm.).

Armature

Lifted conductors

If the armature conductors are found to be lifted from the commutator risers, overspeeding is indicated. In this event, check that the clutch assembly is operating correctly.

Fouling of armature core against the pole faces

This indicates worn bearings or a distorted shaft. A damaged armature must in all cases be replaced and no attempt should be made to machine the armature core or to true a distorted armature shaft.

Insulation test

To check armature insulation, use a 110 volt a.c., test lamp. The test lamp must not light when connected between any commutator segment and the armature shaft.

If a short circuit is suspected, check the armature on a "growler". Overheating can cause blobs of solder to short circuit the commutator segments.

If the cause of an armature fault cannot be located or remedied, fit a replacement armature.

Field Coils

Continuity Test

Connect a 12-volt test lamp and battery between the terminal on the yoke and each individual brush (with the armature removed from the yoke). Ensure that both brushes and their flexible connectors are clear of the yoke. If the lamp does not light, an open circuit in the field coils is indicated.

Replace the defective coils.

Insulation test

Connect a 110-volt a.c., test lamp between the terminal post and a clean part of the yoke. The test lamp lighting indicates that the field coils are earthed to the yoke and must be replaced.

When carrying out this test, check also the insulated pair of brush boxes on the commutator end bracket.

Clean off all traces of brush deposit before testing. Connect the 110-volt test lamp between each insulated brush box and the bracket.

If the lamp lights this indicates faulty insulation and the end bracket must be replaced.

Replacing the field coils

Unscrew the four pole-shoe retaining screws, using a wheel operated screwdriver. Remove the insulation piece which is fitted to prevent the inter-coil connectors from connecting with the yoke.

Draw the pole-shoes and coils out of the yoke and lift off the coils. Fit the new field coils over the pole-shoes and place them in position inside the yoke. Ensure that the taping of the field coils is not trapped between the mating surfaces of the pole-shoes and the yoke.

Locate the pole-shoes and field coils by lightly tightening the retaining screws. Replace the insulation piece between the field coil connections and the yoke.

Finally, tighten the screws by means of the wheel operated screwdriver while the pole pieces are held in position by a pole shoe expander or a mandrel of suitable size.

Bearings and Bearing Replacement

The commutator and drive end brackets are each fitted with a porous bronze bush and the intermediate bracket is fitted with an indented bronze bearing.

Replace bearings which are worn to such an extent that they will allow excessive side play of the armature shaft.

The bushes in the intermediate and drive end brackets can be pressed out whilst that in the commutator bracket is best removed by inserting a $\frac{9}{16}$" (14·29 mm.) tap squarely into the bearing and withdrawing the bush with the tap.

Before fitting a new porous bronze bearing bush, immerse it for 24 hours in clean engine oil (SAE 30 to 40). In cases of extreme urgency, this period may be shortened by heating the oil to 100° C. for 2 hours and then **allowing the oil to cool before removing the bush.** Fit new bushes by using a shouldered, highly polished mandrel approximately 0·0005" (·013 mm.) greater in diameter than the shaft which is to fit in the bearing. **Porous bronze bushes must not be reamed out after fitting,** as the porosity of the bush will be impaired.

After fitting a new intermediate bearing bush, lubricate the bearing surface with Rocol "Molypad" molybdenised non-creep, or similar, oil.

CHECKING THE ROLLER CLUTCH DRIVE

A roller clutch drive assembly in good condition will:—

(i) Provide instantaneous take-up of the drive in the one direction.

(ii) Rotate easily and smoothly in the other.

(iii) Be free to move round or along the shaft splines without roughness or tendency to bind.

Similarly, the operating bush must be free to slide smoothly along the driving sleeve when the engagement spring is compressed. Trunnion blocks must pivot freely on the pegs of the engaging lever. All moving parts should be smeared liberally with Shell Retinax "A" grease or an equivalent alternative.

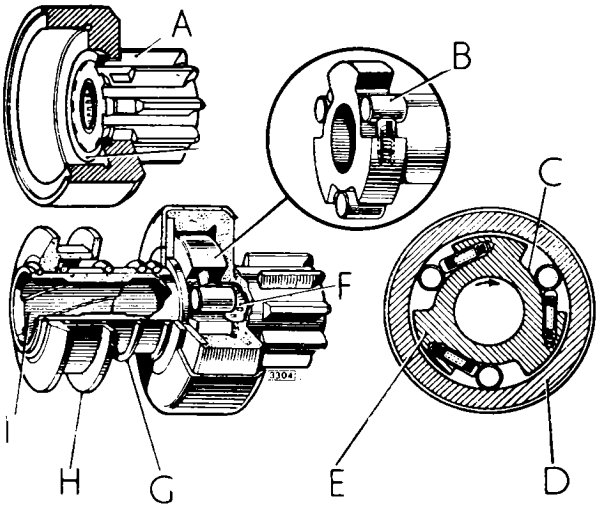


Fig. 19. *The roller clutch drive components.*

A—*Alternative contruction (pinion pressed and clear-ringed into driven member).*

B—*Spring loaded rollers.*

C—*Cam tracks.*

D—*Driven member (with pinion).*

E—*Driving member.*

F—*Bush.*

G—*Engagement spring.*

H—*Operating bush.*

I—*Driving sleeve.*

REASSEMBLY

After cleaning all parts, reassembly of the starting motor is a reversal of the dismantling procedure given on page PY.s.20 but the following special points should be noted:—

(i) The following parts should be tightened to the maximum torques indicated:—

Nuts on solenoid copper terminals	20 lb./in. (0·23 kgm.)
Solenoid fixing bolts ..	4·5 lb./ft. (0·62 kgm.)
Starting motor through bolts	8·0 lb./ft. (0·83 kgm.)

(ii) When refitting the C.E. bracket see that the moulded brake shoes seat squarely and then turn them so that the ends of the cross peg in the armature shaft engage correctly with the slots in the shoes.

Setting Pinion Movement (Fig. 10)

Connect the solenoid Lucar terminal to a 6-volt supply. DO NOT use a 12-volt battery otherwise the armature will turn.

Connect the other side of the supply to the motor casing (this throws the drive assembly forward into the engage position).

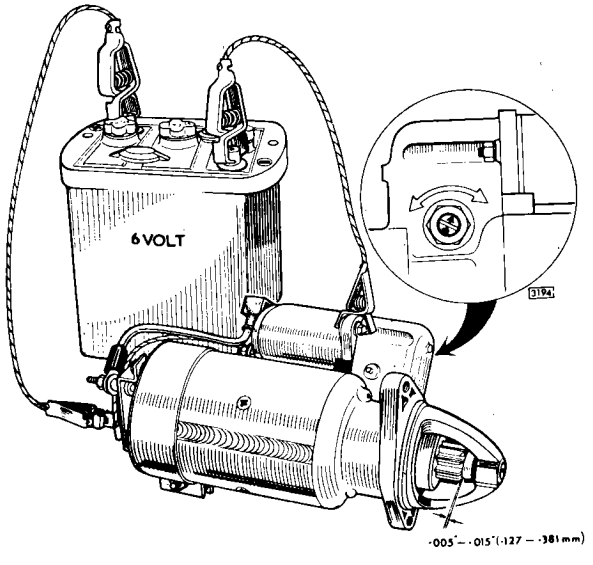


Fig. 20. *Setting pinion movement.*

Measure the distance between the pinion and the thrust washer on the armature shaft extension. Make this measurement with the pinion pressed lightly towards the armature.

For correct setting the dimension should be 0·005" to 0·015" (0·13 to 0·38 mm.).

Disconnect the battery.

Adjust the setting by slackening the eccentric pivot pin securing nut and turning the pin until the correct setting is obtained.

Note: The head of the arrow stamped on the end of the eccentric pivot pin should be set only between the ends of the arrows cast in the drive end bracket.

Turning the screw to the left (anti-clockwise) will increase the gap between the pinion and the thrust washer, turning to the right (clockwise) will decrease the gap.

Reconnect the battery and recheck the setting.

After setting tighten the securing nut to retain the pin position.

CHECKING OPENING AND CLOSING OF STARTER SWITCH CONTACTS

The following checks assume that pinion travel has been correctly set.

Remove the copper link connecting solenoid terminal STA with the starting motor terminal.

Connect, through a switch, a supply of 10 volts d.c., to the series winding, that is, connecting between the solenoid Lucar terminal and large terminal STA. DO NOT CLOSE THE SWITCH AT THIS STAGE.

Connect a separately energised test lamp circuit across the solenoid main terminals.

Insert a stop in the drive end bracket to restrict the pinion travel to that of the out of mesh clearance, normally a nominal $\frac{1}{8}$" (3·17 mm.). An open-ended spanner or spanners of appropriate size and thickness can often be utilised for this purpose, its jaws embracing the armature shaft extension.

Energise the shunt winding with a 10-volt d.c., supply and then close the switch in the series winding circuit.

The solenoid contacts should close fully and remain closed, as indicated by the test lamp being switched on and emitting a steady light.

Switch off and remove the stop.

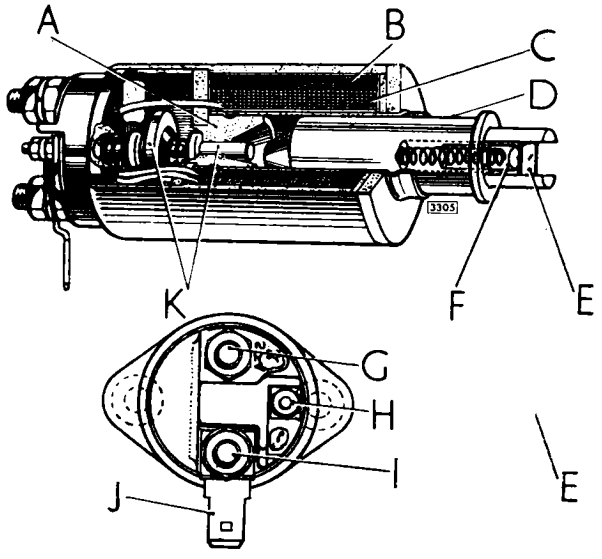


Fig. 11. *Checking the opening and closing of the starter switch contacts.*

A—*Core.*

B—*Shunt winding.*

C—*Series winding.*

D—*Plunger.*

E—*Clevis pin.*

F—"*Lost motion*" *device.*

G—*Starter terminal.*

H—*Solenoid terminal.*

I—*Battery terminal.*

J—*Accessories terminal.*

K—*Spindle and moving contact assembly.*

Switch on again and hold the pinion assembly in the fully engaged position.

Switch off and observe the test lamp.

The solenoid contacts should open, as indicated by the test lamp being switched off.

WINDSCREEN WIPER

(LUCAS MODEL 15W)

DESCRIPTION

The windscreen wiper assembly consists of a two-speed motor coupled by connecting rods to three wiper arm spindle bearings (Open Sports and F.H.C.) or two spindles (2+2).

Windshield wiper motor model 15W is designed to operate a link-type wiper installation. The motor is self-switching to the OFF (or park) position. A two-pole permanent magnet field is provided by two ceramic magnets which form part of the yoke assembly. Inside the motor gearbox a worm gear on the armature shaft drives a shaft-and-gear assembly comprising a moulded gearwheel assembled to a location-plate-and-shaft. Power from the motor is transmitted through the gearwheel, location-plate-and-shaft to, finally, a rotary link which serves as a coupling between the motor and the links which operate the wiper arm spindles.

Associated with the terminal assembly is a two-stage plunger operated limit switch. The plunger is actuated by a cam on the underside of the moulded gearwheel inside the gearbox. When the manually-operated control switch is moved to OFF (or park) the motor continues to operate under the automatic control of the limit switch. As the wiper blades near the parked position the first-stage contacts open and the motor is switched off but continues to rotate under its own momentum. The second-stage contacts, to which are connected the positive and negative brushes, then close and regenerative braking of the armature takes place to maintain consistent parking of the blades.

Two-speed operation is provided by a third (stepped) brush incorporated in the brushgear assembly. When the main control switch is moved to the high speed position, the positive feed to the normal brush is transferred to the third brush, and a higher-than-normal wiping speed is obtained. (The higher speed should not be used in heavy snow or on a partially wet windshield).

The blades and arms fitted to the two models are of different lengths and are individually cranked for Right-hand and Left-hand drive cars.

Note: The wiper blades are manufactured with special anti-smear properties. Renew only with genuine Jaguar replacement parts.

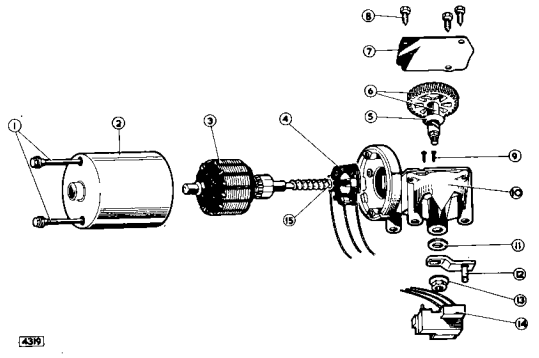


Fig. 22. *Exploded view of the 15W windscreen wiper motor.*

1—*Yoke fixing bolts.*
2—*Yoke assembly comprising two permanent-magnet poles and retaining clips and armature bearing bush.*
3—*Armature.*
4—*Brushgear, comprising insulating plate and brushboxes, brushes, springs and fixing bolts.*
5—*'Dished' washer.*
6—*Shaft and gear.*
7—*Gearbox cover.*
8—*Cover fixing screws.*
9—*Limit switch fixing screws.*
10—*Gearbox.*
11—*Flat washer.*
12—*Rotary link.*
13—*Link fixing nut.*
14—*Limit switch assembly.*
15—*Nylon thrust cap.*

MAINTENANCE

All bearings are adequately lubricated during manufacture and require no maintenance.

Oil, tar spots or similar deposits should be removed from the windshield with methylated spirits (denatured alcohol). Silicone or wax polishes must not be used for this purpose.

Efficient wiping is dependent upon keeping wiper blades in good condition. Worn or perished blades are easily removed for replacement.

DATA

MOTOR

(i) Typical light running current (i.e. with the rotary link disconnected from the transmission) after 60 seconds from cold:	1.5 amp. (normal speed)
	2.0 amp. (high speed)

4.2 'E' Type RHD	10½" (R.H. crank)	12"
LHD	10½" (L.H. crank)	12"

SERVICING

Note: Since the motor is of permanent magnet design, the direction of rotation of the armature depends on the polarity of the supply of its terminals. If it is necessary to run the motor while it is removed from the vehicle, the negative supply cable must be connected to motor terminal number 1 and the positive supply cable to terminal number 5 for normal speed or terminal number 3 for high speed (see Fig. 23).

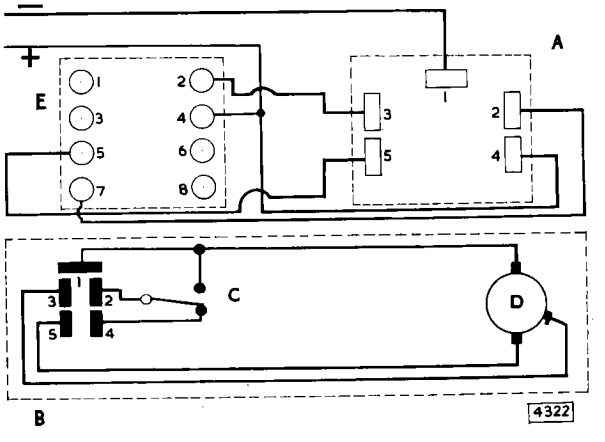


Fig. 23. *15W Wiper wiring diagram.*

A—*Moulded terminal connector on cable harness.*
B—*Terminal connector on wiper motor.*
C—*Limit switch.*
D—*Armature.*
E—*152 SA switch.*
Switch internal connections.

OFF	NORMAL SPEED	HIGH SPEED
(5–7)	(4–5)	(2–4)

Systematic Check of Faulty Wiping Equipment

Unsatisfactory operation (if the supply voltage to the motor is adequate) may be caused by a fault that is mechanical or electrical in origin. Before resorting to dismantling, consideration should be given to the nature of the fault.

The symptoms and remedial procedure associated with the more common causes of wiper failure (or poor performance) are described in (i) and (ii) below.

(i) **Frictional Wiper Blades**

Excessive friction between apparently satisfactory wiper blades and the windshield may result in a marked reduction in wiping speed when the blades are operating on a windshield that is only partially wet. A further symptom is that the blades become noisy at each end of the wiping arc. When possible, the blades should be temporarily replaced with a pair known to be in good condition. If this rectifies the fault, fit new blades.

(ii) **Low Wiping Speed or Irregular Movement of the Blades**

To determine whether a low wiping speed is due to excessive mechanical loading or to poor motor performance, the rotary link must first be disconnected from the transmission linkage and the light running current and speed of the motor can then be checked under no load conditions.

Measuring Light Running Current and Speed

Connect a first-grade moving coil ammeter in series with the motor supply cable and measure the current consumption. Also check the operating speed by timing the speed of rotation of the rotary link or moulded gearwheel. The current consumption and speed are given in Data.

If the motor does not run, or current consumption and speed are not as stated, an internal fault in the motor is indicated and a replacement unit should be fitted or the motor removed for detailed examination.

If current consumption and speed are correct, check for proper functioning of the transmission linkage and wiper arm spindles.

Removal

4.2 litre Open Sports and F.H.C.

Disconnect the battery.

Remove the two thumbscrews and lower the instrument panel.

Remove two drive screws and detach the hazard warning unit carrier plate. Disconnect the drive link from the ball joint on the centre wheelbox.

Remove the P.V.C. cable strap from the body of the windscreen wiper motor and disconnect the cables by withdrawing the cable plug from the socket.

Mark the position of the throttle fulcrum lever bracket relative to the bulkhead, remove two setscrews, and detach the bracket. It is not necessary to disconnect the throttle control pads.

Remove four setscrews securing the motor mounting plate to the bulkhead and withdraw the motor with the attached drive link.

4.2 litre 2+2

Disconnect the battery.

Remove the top facia panel as detailed in Body and Exhaust System—Section N, page NY.s.1.

Disconnect the motor drive link from the ball joint on the L/H wheel box.

Remove the cable strap and plug as detailed above.

Remove the setscrews securing the mounting plate to the bulkhead and withdraw the motor.

Dismantling

Remove the gearbox cover.

The rotary link may be fitted to the gearwheel shaft in one of two positions (180° apart) depending on the parking requirement of the windshield installation. To ensure that the original parking position is maintained, the position of the rotary link in relation to the zero mark on the gearwheel location plate must be noted before removing the link.

Important: The moulded gearwheel inside the gearbox must be prevented from moving while the rotary link fixing nut is slackened (or, on reassembly, tightened). This is most easily achieved by securing the rotary link in a vice while the nut is turned.

Remove the fixing nut and withdraw the rotary link and flat washer.

Remove the shaft-and-gear from the gearbox, taking care not to lose the dished washer fitted beneath the gearwheel. It is not normally necessary to dismantle the shaft-and-gear assembly since this is serviced only in an assembled condition. However, should it become necessary to assemble the moulded gearwheel

to the location-plate-and-shaft, it is essential to fit the gear wheel in the correct one of the two alternative positions to maintain the original parking position of the wiper blades. The gearwheel is correctly fitted to the location-plate-and-shaft when the 'zero' mark on the location plate is positioned furthest away from the gearwheel cam.

Unscrew and remove the two fixing bolts from the motor yoke and carefully remove the yoke assembly and armature. While removed, the yoke must be kept well clear of swarf, etc., which may otherwise be attracted to the pole pieces.

Undo the two sets of fixing screws and remove from the gearbox the brushgear and the terminal and switch unit assemblies, linked together by the connecting cables.

Bench Inspection

After dismantling, examine individual items.

(i) **Brush replacement**

The original specified length of the brushes is sufficient to last the life of the motor. If, due to accidental damage to the brushes, or faulty commutator action, it becomes necessary to renew the brushes, the complete brushgear service-assembly must be fitted. The brushgear assembly must be renewed if the main (diametrically-opposed) brushes are worn to $\frac{3}{16}$ in. (4.8 mm.), or if the narrow section of the third brush is worn to the full width of the brush. Check that the brushes move freely in the boxes.

(ii) **Check Brush Springs**

The design of the brushgear does not allow for easy removal of the brush springs. This is due to the fact that, similar to the brushes, the springs are expected to last the life of the motor and should not normally require renewing. In the unlikely event of the spring pressure failing to meet the specified requirements, the complete brushgear service-assembly must be renewed in a similar manner to that necessary for servicing the brushes.

Note the location of the cables before unsoldering for reference when refitting.

To check the spring pressure on the end face of the brush with a push-type spring gauge push until the bottom of the brush is level with the bottom of the slot in the brush box, when the spring pressure reading should be 5–7 oz.f. (140–200 gf).

(iii) **Testing and Servicing the Armature**

Use armature testing equipment to check the armature windings for open and short circuits. Test the insulation by using a mains test lamp (Fig. 24). Lighting of the lamp indicates faulty insulation.

If the commutator is worn, it can be lightly skimmed while the armature is mounted in a lathe.

Afterwards, clear the inter-segment spaces of copper swarf.

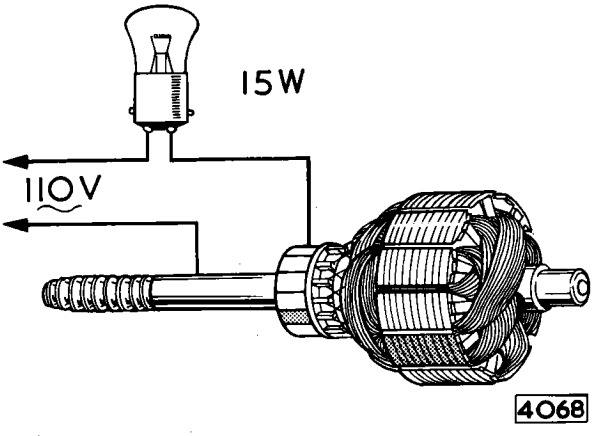


Fig. 24. *Armature insulation test.*

(iv) **Inspection of Moulded Gear**

Examine the gearwheel, especially the teeth, for signs of wear or damage. If the gearwheel needs renewing, a shaft-and-gear service replacement assembly will have to be fitted.

Re-assembly

Reassembly is the reverse of the dismantling procedure.

A liberal quantity of Ragosine Listate grease is necessary for lubrication of the gearwheel teeth, the gearwheel cam and the worm gear on the armature shaft. The total quantity of grease must not be less than 15 cc.

Apply Shell Turbo 41 oil to the bearing bushes, armature shaft bearing surfaces (sparingly), gearwheel shaft, and the felt-oiler washer in the yoke bearing (thoroughly soak).

Reassembly of Yoke

Before refitting the armature to the yoke, inspect the inside of the yoke and ensure that the thrust disc and the felt-oiler washer are in place in the yoke bearing.

The correct method of assembly is with the thrust disc flat against the end face of the bearing, followed by the felt-oiler washer which must have a hole in the centre to allow the captive ball bearing in the end of the armature shaft to contact the thrust disc.

If the felt-oiler is renewed, check that the replacement is provided with the necessary hole and, if not, make a $\frac{1}{8}$" (3 mm.) diameter hole in the centre of the felt. (A felt-oiler without a hole could result in the armature end-float becoming excessive in service due to the ball bearing wearing away the felt after the end-float adjustment has been made). Soak the felt-oiler in Shell Turbo 41 oil.

The yoke fixing bolts should be tightened to a torque of 12–16lb in. (0.138–0.184 kg.m.). If a service replacement armature is being fitted, it is advisable to first slacken the armature end-float thrust screw before tightening the yoke fixing bolts. Afterwards, reset the thrust screw.

Armature End-Float Adjustment

Armature end-float is 0.002–0.008" (0.05–0.2 mm.).

To obtain a satisfactory end-float adjustment with the motor and gearbox completely assembled, position the unit with the thrust screw uppermost, tighten the thrust screw until abutment takes place and then slacken it off one quarter turn and secure it in this position by tightening the locknut.

WINDSCREEN WIPER SPINDLE HOUSINGS

2+2 Models

Removal

Disconnect the battery. Remove both windscreen wiper arms.

Lower the instrument panel and remove the screen rail facia assembly. Disconnect the motor link rod from the ball joint on the left-hand spindle lever.

Unscrew the large nuts securing the housings to the scuttle and remove the distance pieces and rubber seal washers. Withdraw the twin spindle and carrier plate assembly through the scuttle panel and complete the removal through the left-hand aperture in the bulkhead inner panel.

Housings are replaceable only as a complete assembly comprising both housings and carrier plate.

Open Sports and F.H.C. Models

Removal (Right or Left Hand Housing)

Disconnect the battery.

Withdraw the wiper arm from the spindle housing to be removed. Unscrew the large nut securing the housing to the scuttle and remove the distance piece and rubber seal washer.

Lower the instrument panel after removing the two retaining screws in the top corners. Remove the four nuts and washers retaining the screen rail facia assembly. Two are accessible from the centre aperture and one each at the outer edges below the screen rail.

Disconnect the ball joint from the spindle lever.

From inside the car remove two nuts and washers securing the housing bracket to the base plate and withdraw the housing.

Removal (Central Housing)

Disconnect the battery. Remove all wiper arms from the spindles.

Lower the instrument panel, remove the screen rail facia and outer housings as detailed previously.

Remove the large nut, distance piece and rubber seal washer from the central housing. Withdraw the housing and carrier plate assembly through the scuttle panel and complete the removal through the left-hand aperture in the bulkhead inner panel.

WIPER MOTOR LINKAGE SETTING (2+2 cars)

It is essential that the wiper motor primary linkage (motor to wheelbox) is adjusted as detailed below if the link length is altered from the original dimension or, if a new link is fitted. Failure to carry out these instructions will result in a knock when the wiper arms are operating.

R.H.D. Cars

Disconnect the primary link (motor to wheelbox) from the ball joint on the wheelbox spindle.

Manually operate the non-adjustable link, connecting the two wiper spindles, to the extreme left position.

Adjust the ball joint socket on the link until it fits on the ball whilst maintaining the position of the lever to the left.

Disconnect the socket and turn to the **right (clockwise) four complete** turns, i.e. shorten the length of the rod between the socket and the motor.

Refit the socket on the ball and secure with the locknut.

L.H.D. Cars

Proceed as for R.H.D. cars, but for the following exceptions.

Manually operate the non-adjustable link to the extreme right and after adjustment turn the ball socket four complete turns to the left (anti-clockwise) to increase the length of the rod.

THE INSTRUMENTS

ELECTRIC CLOCK

Description

The electric clock, fitted in the centre of the instrument panel, is a fully transistorised instrument powered by a mercury cell housed in a plastic holder attached to the back of the clock.

Frontal adjustment is provided by means of a small knurled knob for setting the hands and a slotted screw for time-keeping regulation.

To reset the hands, pull out the knurled knob, rotate and release.

To regulate the time-keeping, turn the slotted screw with a small screwdriver towards the positive (+) sign if gaining, and towards the minus (—) sign if losing.

Moving the indicator scale through one division will alter the time-keeping by five minutes per week.

The action of resetting the hands automatically restarts the movement.

The window of the clock is a plastic moulding, and should only be cleaned with a cloth or chamois leather slightly dampened with water. Oil, petrol or other fluids associated with cleaning, are harmful and must not be used.

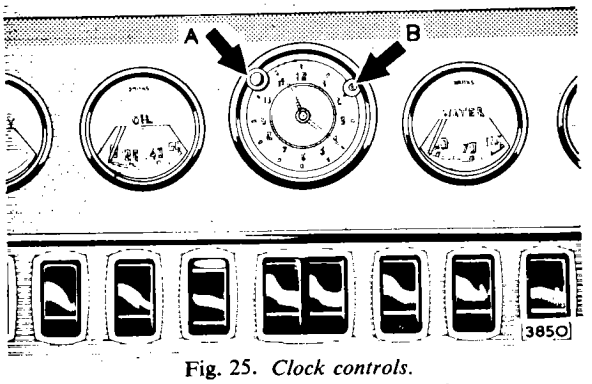


Fig. 25. *Clock controls.*
A — Handsetting. B — Time regulator.

MAINTENANCE

The mercury cell life is in the region of 18 months, throughout which it ensures a steady and continuous voltage to the clock.

Renew the cell at this period to maintain perfect time-keeping.

Battery Replacement

Remove the instrument panel retaining screws and lower the panel.

Lever the battery out of the holder and discard.

Press the new battery into the holder.

Refit the panel.

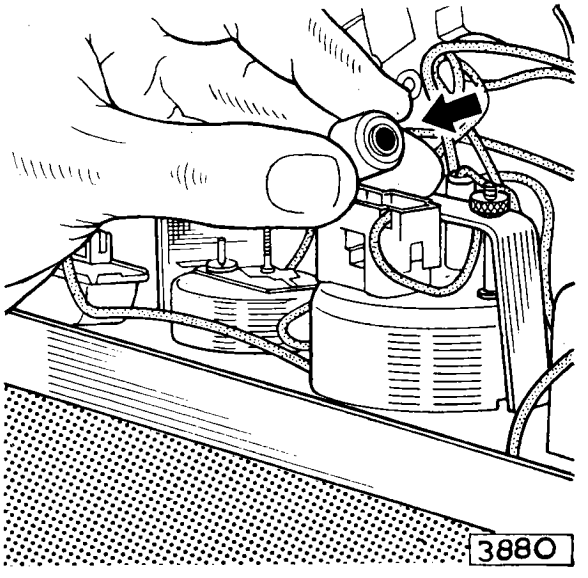


Fig. 26. *Renewing the electric clock battery.*

Clock—Removal

Lower the instrument panel.

Withdraw the illumination bulb holder from the back of the clock.

Remove the two nuts and the clamp strap from the back of the clock.

Withdraw the clock, complete with the battery holder, from the instrument panel.

Refitting

Refitting is the reverse of the removal procedure.

THE REVOLUTION COUNTER (TACHOMETER)

Description

The revolution counter is an impulse tachometer instrument incorporating transistors and a printed

circuit, the pulse lead (coloured WHITE) being wired in circuit with the S/W terminal on the ignition coil and the ignition switch.

Mechanical drive cables or an engine-driven generator are not required with this type of instrument.

The performance of this instrument is not affected by the distributor contact setting, by corrosion of the sparking plug points, or by differences in the gap settings.

Connection to the back of the instrument is by means of a locked plug and socket, the contacts being offset to prevent incorrect coupling.

Removal

Disconnect the battery.

Remove the screen rail facia assembly as detailed on Page NY.s.1 to gain access to the instrument.

Remove the two knurled nuts, earth lead and instrument retaining pieces.

Withdraw the tachometer from the facia panel and remove the illumination bulb holders.

Disconnect the plug and socket as follows:—

Pinch together the prongs of the plastic retaining clip and withdraw from the plug and socket assembly (Fig. 27).

Detach the plug from the socket and complete the removal of the instrument.

IMPORTANT

Do not detach the green and white cables connected to the plug and the instrument.

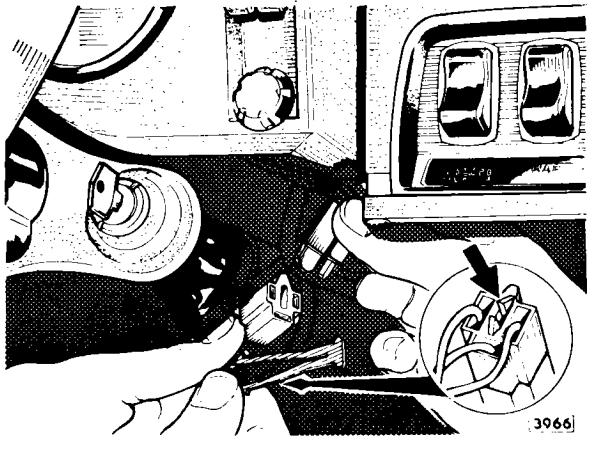


Fig. 27. *The tachometer plug and socket assembly. (Inset shows the clip in its fitted position).*

Refitting

Refitting is the reverse of the removal procedure.

Reconnect the plug and socket assembly and lock with the retaining clip.

THE INSTRUMENT PANEL

The instrument panel differs from that fitted to all previous cars in respect of the following items:—

(1) Rocker Switches—Replacing tumbler switches.
(2) Battery Indicator—Replacing Ammeter.
(3) Panel Light Dimming Resistance—Replacing resistance previously attached to the panel light switch.
(4) The combined Ignition/starter switch which is now mounted on a separate sub-panel. These switches were previously two separate items mounted in the instrument panel.
(5) The Cigar Lighter—Now located in the console below the instrument panel, was previously part of the instrument panel assembly.

THE SWITCHES

The rocker switches are mounted in a sub-panel which is attached to the instrument panel by four self-tapping screws.

Individual switches may be removed without detaching the sub-panel cluster as follows:—

Removal

Disconnect the battery.

Lower the instrument panel.

Remove the cables from the switch, noting location for reference when refitting.

Press in the two locking tabs located at the bottom and the top faces of the switch body and push the switch through the aperture.

Refitting

Press the switch into the panel aperture until the nylon locking tabs register.

Reconnect the cables as noted on removal.

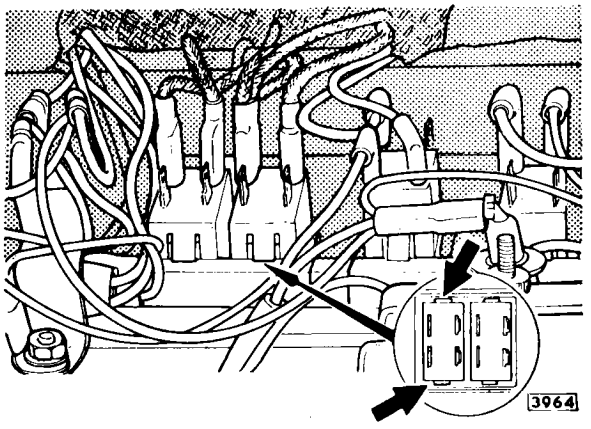


Fig. 28. *Instrument panel rocker switch removal (Inset shows arrowed the nylon locking tabs).*

THE IGNITION/STARTER SWITCH

A Lucas 47SA combined ignition/starter switch replaces the separate switches previously used.

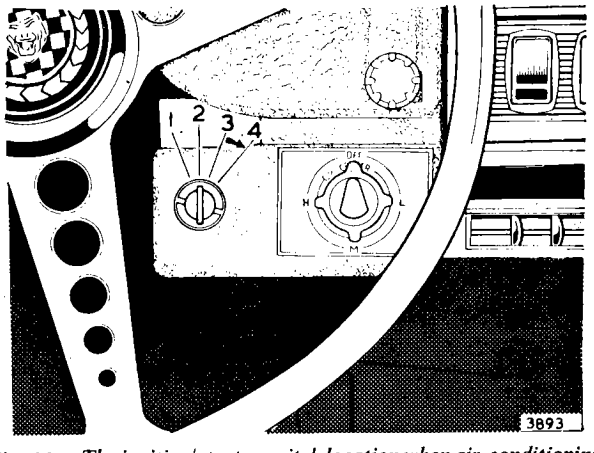


Fig. 29. *The ignition/starter switch location when air-conditioning system is fitted.*
1 — Auxiliaries. 2 — Ignition "OFF"
3 — Ignition "ON". 4 — Starter.

The switch is mounted on a bracket attached to the steering column (if Air-conditioning equipment is installed the bracket is attached to the evaporator unit).

In conjunction with the 47SA ignition/starter switch a Lucas 6RA relay is included in the alternator circuit. This functions as a field isolating relay, the relay coil being energised by operation of the ignition switch.

Removal

Remove the locking ring and withdraw the switch through the bracket with the brass locknut and wave washer.

Disconnect the cables and remove the switch. Note the location of the cables for reference when refitting.

The lock barrel can be withdrawn by inserting a thin rod through a hole in the body of the switch and depressing the plunger in the lock. Insert the key and turn to the 'OFF' position to gain access to the plunger.

Refitting

Refitting is the reverse of the removal procedure.

When refitting a new lock barrel, check that the number on the face of the barrel and the key is the same as that on the barrel removed. This will be identical to the door locks.

Insert the key in the lock and turn the switch to the 'OFF' position before inserting the barrel.

PANEL LIGHT DIMMING RESISTOR

The resistor unit is comprised of a wire resistance attached to two 'Lucar' cable contact blades mounted on an insulating carrier plate.

The plate is secured to two studs on the back face of the instrument panel by means of distances peices, nuts and lockwashers.

Excessive force should not be used when connecting the cable terminals to the blades.

This may force the blade retaining tongues through the insulating plate and allow the resistor to make contact with the metal face of the panel, resulting in a short circuit in the side light feed line.

BATTERY INDICATOR

This instrument is a voltmeter with a specially calibrated dial which indicates the condition of the battery. It does not register the charging rate of the alternator.

The position of the needle with a charged battery will be within the area marked 'Normal'.

Removal

Disconnect the battery and lower the instrument panel.

Disconnect the cables, noting the location for reference when refitting.

Detach the illumination bulb holder.

Remove two nuts and clamp strap and withdraw the instrument forward through the panel.

Refitting

Refitting is the reverse of the removal procedure.

Check the condition of the battery by means of the panel shown below

RED (Off Charge)		NORMAL			RED (On Charge)
BATTERY CHARGE EXTREMELY LOW	BATTERY CHARGE LOW	WELL CHARGED BATTERY	CHARGING VOLTAGE LOW	CHARGING VOLTAGE SATISFACTORY	CHARGING VOLTAGE TOO HIGH
If with the ignition and electrical equipment e.g. headlamps etc., switched on, but with the engine not running the indicator settles in this section—your battery requires attention.		Ideally the indicator should settle in this section when the ignition and electrical equipment e.g. headlamps etc., are switched on and the engine is not running.	This condition may be indicated when the headlights and other equipment are in use.	The indicator should point to this section when the engine is running above idle.	If the indicator continues to point to this section after 10 minutes running either your voltage regulator requires adjustment or some other fault has developed.

IMPORTANT All readings on the indicator should be ignored when the engine is idling, since readings may vary at very slow engine speeds due solely to operation of the voltage regulator.

OFF CHARGE
This means more energy is being used from your battery than is being replaced by the alternator on your car. This condition is satisfactory provided it does not persist for long periods, when the engine is running above idle or at speed. If the indicator remains in the section, it may mean that you have a broken or slipping fan belt, a faulty alternator, a badly adjusted voltage regulator or some other fault.

ON CHARGE
This means your battery is having more energy put into it than is being taken out of it. In the ordinary way this condition predominates and your battery is continuously being recharged by the alternator whenever the engine is running above idle. If however the engine is continually running slowly as may be the case in traffic—or when, in winter, lights and cold starting make extra demands on the battery—you may find the rate of discharge exceeds the rate of charge—that is to say the battery is running down, as will be indicated on your Battery Condition Indicator and you may need an extra charge if "battery charge low or extremely low" is indicated by the instrument.

LAMPS

HEADLAMP

Sealed beam units are fitted to all cars with the exception of certain European Countries which retain the pre-focus bulb (see Bulb Data Chart).

The beam setting and unit replacement instructions differ from those stated on Page P.24 as follows:—

Beam Setting

If beam setting adjustment is required, prise off the headlamp rim (retained by spring clips). Switch on the headlamps and check that they are on Main beam.

The setting of the beams is controlled by two screws A' and 'B' on Fig. 30.

The top screw 'A' is for vertical adjustment, i.e. to raise or lower the beam; turn the screw anti-clockwise to lower the beam or clockwise to raise the beam.

The side screw 'B' is for horizontal adjustment, i.e. to turn the beam to right or left. To move the beam to the right, turn the screw clockwise. To move the beam to the left, turn the screw anticlockwise.

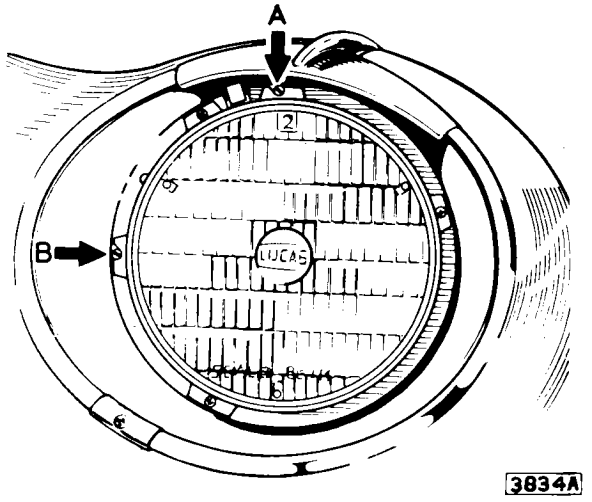


Fig. 30. *Adjustment of the screw 'A' will alter the headlamp beams in the vertical plane; adjustment of the screw 'B' will alter the headlamp beams in the horizontal plane.*

Sealed Beam Unit — Replacement

Prise off the headlamp rim (retained by spring clips).

Remove the three cross-headed screws and detach the retaining ring.

Note: Do not disturb the two beam setting screws.

Withdraw the sealed beam unit and unplug the adaptor.

Replace the sealed beam unit with one of the correct type (see 'Lamp Bulbs').

On cars fitted with bulb light units, proceed as directed above until the unit is removed. Release the bulb retaining clips and withdraw the bulb. Replace with a bulb of the correct type (see 'Lamp Bulbs').

When reassembling, note the groove in the bulb plate which must register with the raised portion on the bulb retainer.

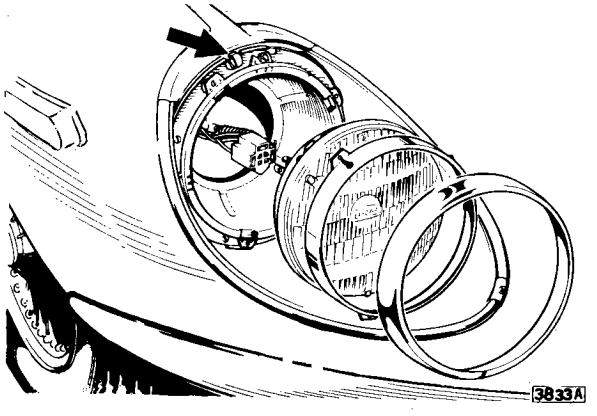


Fig. 31. *Headlamp sealed beam unit removal. The arrow indicates one of the spring clips retaining the rim.*

SIDE LAMP BULB—REPLACEMENT

Remove three screws and detach the lens. Remove the bulb by pressing inwards and rotating outwards. Check the condition of the lens seal when refitting.

On cars for certain European countries the side lamp bulb is mounted in the headlight unit and is accessible after removing the light unit as detailed under 'Headlamps'.

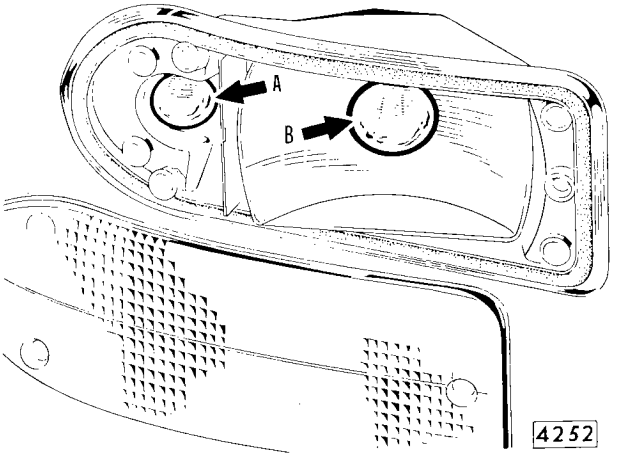


Fig. 32. *A—Side lamp bulb.*
B—Flasher bulb.

FRONT FLASHER BULB—REPLACEMENT

Proceed as detailed for 'Side Lamp Bulb'.

REAR/BRAKE LIGHT BULB—REPLACEMENT

Remove the four screws and detach the glass. The rear/braking light bulb is the lower one of the two exposed and is removed by pressing inwards and rotating anti-clockwise. When refitting a replacement bulb note that the pins are offset.

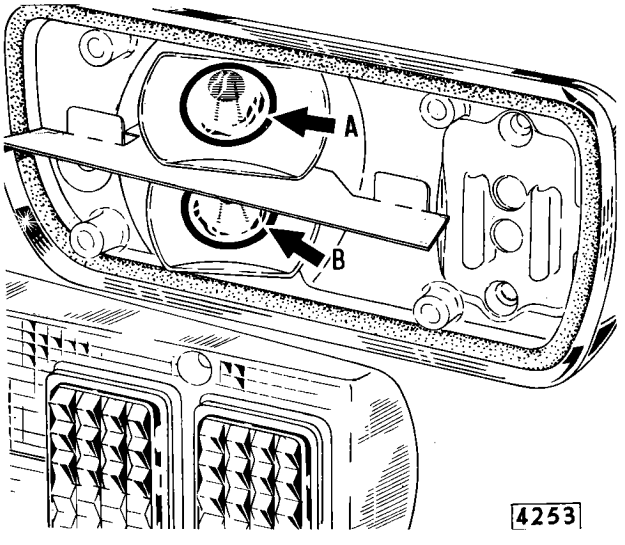


Fig. 33. *A—Rear flasher bulb.*
B—Rear/Brake bulb.

REAR FLASHER BULB—REPLACEMENT

Proceed as detailed for 'Rear/Brake Light Bulb —Replacement.' The flasher bulb is the top one of the two exposed.

INTERIOR LIGHT BULB—REPLACEMENT (2+2).

Release the spring side clip and withdraw the retaining tongue on the glass cover from the slot in the lamp base. Remove the faulty bulb and replace with one of the correct value.

When refitting ensure that the retaining tongue is inserted in the slot in the base before locking into position.

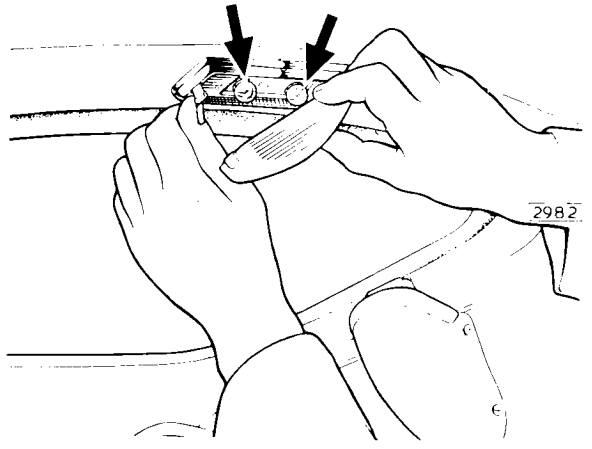


Fig. 34. *Interior lamp bulb removal (2+2).*

INTERIOR/LUGGAGE LIGHT BULB—REPLACEMENT (Open 2 seater)

Proceed as detailed in the 3.8 'E' type Service Manual—page P.26.

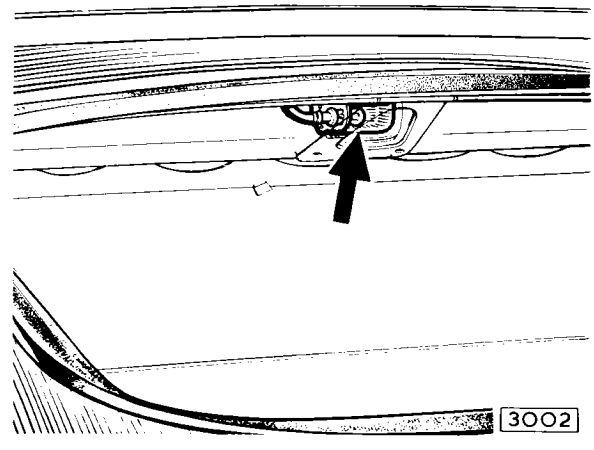


Fig. 35. *Interior lamp bulb removal (open 2 seater).*

NUMBER PLATE LAMP BULB—REPLACEMENT

Remove two screws and detach the glass and rim. Replace the faulty bulb with one of the correct value. Check the condition of the seal before refitting.

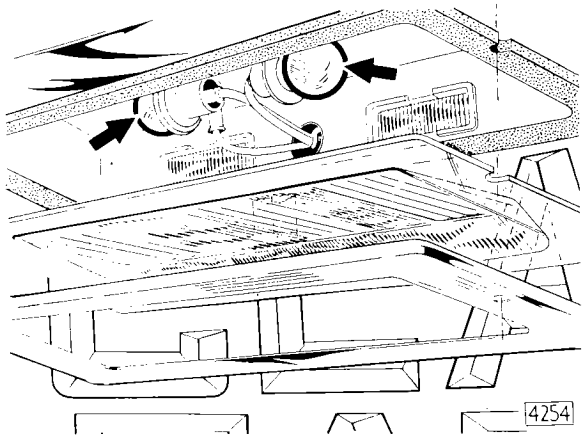


Fig. 36. *Number plate lamp bulb removal.*

REVERSE LAMP BULB—REPLACEMENT

Remove the two retaining screws and detach the lamp glass. Lift the upper contact and withdraw the bulb. Check the condition of the lens seal before refitting.

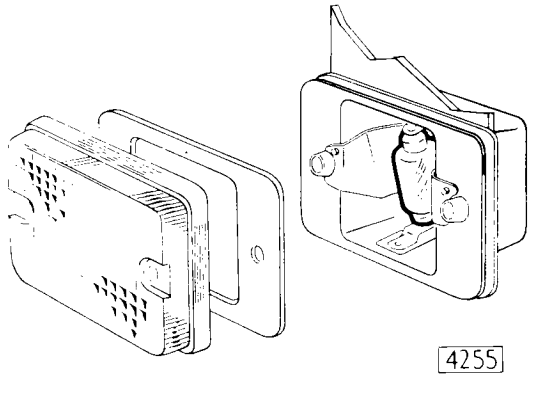


Fig. 37. *Reverse lamp bulb removal.*

TRAFFIC HAZARD INDICATOR BULB—REPLACEMENT

Remove the chrome bezel and unscrew the bulb from the holder.

HEATED BACK LIGHT INDICATOR BULB—REPLACEMENT

Proceed as detailed under 'Traffic Hazard Indicator Bulb'.

AUTOMATIC TRANSMISSION INDICATOR BULB—REPLACEMENT

Remove the drive screws, detach the arm rest and transmission unit cover.

Unscrew the gear control knob. Withdraw two screws and remove the gear indicator cover. Replace the bulb with one of the same value (24 volts).

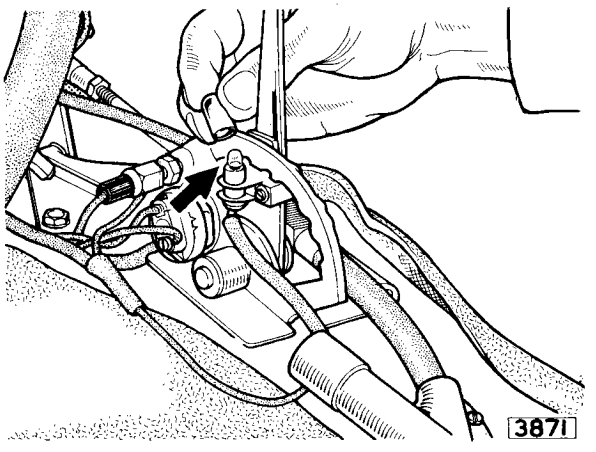


Fig. 38. *Automatic transmission indicator bulb removal.*

HORNS—MODEL 9H

DESCRIPTION

The horns are mounted on brackets attached to the sub-frame lower cross-member.

The horns are now mounted on brackets attached to the sub-frame lower cross-member.

The horn circuit operates through a Lucas 6RA relay, the contacts C1 and C2 closing when the relay coil is energised by depressing the horn switch button located in the direction (turn) indicator switch lever.

Maintenance

In the event of the horns failing to sound or performance becoming uncertain, check before making adjustments that the fault is not due to external causes.

Check as follows and rectify as necessary:

(i) Battery condition.

(ii) Loose or broken connections in the horn circuit.

(iii) Loose fixing bolts. It is important to keep the horn mountings tight and to maintain rigid the mounting of any unit fitted near the horns.

(iv) Faulty relay. Check by substitution after verifying that current is available at terminal C2 (cable colour—brown/purple) and terminal W1 (cable colour—Green).

(v) Check that fuse No. 3 (50 amperes) and fuse No. 6 (35 amperes) have not blown.

Note: Horns will not operate unless the ignition is switched on.

Adjustment

As the horns cannot conveniently be adjusted in position, remove and mount securely on a test fixture.

A small serrated adjusting screw located adjacent to the horn terminal is provided to take up wear of moving parts in the horn. Turning this screw does not alter the pitch of the horn note.

Connect a moving coil ammeter in series with the horn supply feed. The ammeter should be protected from overload by connecting on ON-OFF switch in parallel with its terminals.

Keep this switch ON except when taking readings, that is when the horn is sounding.

Turn the screw clockwise until the horn operates within the specified limits of 6.5-7.0 amperes.

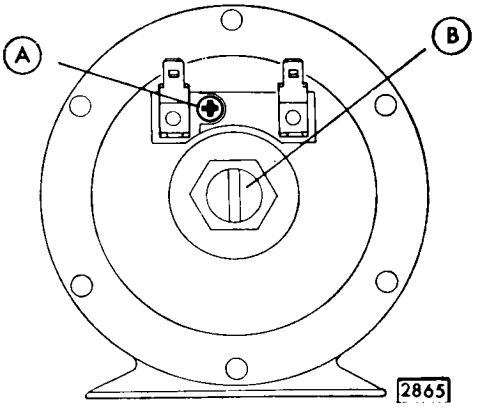


Fig. 39. *The Lucas 9H horn.*
A — Contact breaker adjustment screw.
B — Slotted centre core (Do not disturb).

Service Replacements

When fitting replacement horns it is essential that the following procedure be carried out:—

(i) Refit the lockwashers in their correct positions, one at each side of the mounting bracket centre fixing.

(ii) Ensure, after positioning the horn, that the $\frac{3}{16}$" centre fxing bolt is secure but not over-tightened. Over-tightening of this bolt will damage the horn.

(iii) Ensure that, when a centre fixing bolt or washers other than the originals are used, the bolt is not screwed into the horn to a depth greater than $\frac{11}{16}$" (17.5 mm).

Muted Horns (Holland only)

These horns are muted to comply with the Dutch Traffic Regulations and incorporate a rubber plug inserted in the trumpet.

Horn Relay—Checking

If the horn relay is suspected, check for fault by substitution or by the following method:—

(i) Check that fuses No. 3 and No. 6 have not blown. Replace if necessary.

(ii) Check with a test lamp that current is present at the relay terminal W1 (Green) and C2 (Brown/Purple). Switch on the ignition before checking terminal W1.

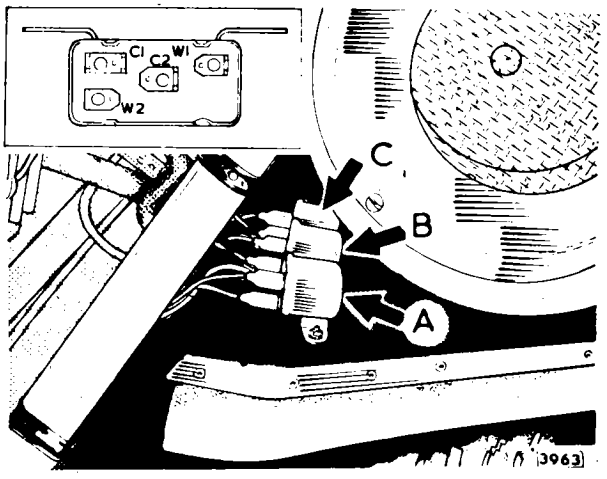


Fig. 40. *Location of horn and alternator relays.*
A — Horn relay.
B — Alternator/Ignition relay.
C — Air conditioning equipment relay (when fitted).
(Inset shows the connections).

(iii) Remove the cable from terminal W2 (Purple/Black) and earth the terminal to a clean part of the frame. The relay coils should now operate and close the contacts.

Reconnect cable.

(iv) Remove cable from terminal C2 (Brown/Purple). Check for continuity by means of an earthed test lamp. Check with the horn button depressed and the ignition 'ON'. Replace the relay if faulty.

RADIATOR COOLING FANS

Twin electrically motor driven cooling fans are fitted, automatic operation being controlled by a thermostat switch mounted in the radiator header tank.

A Lucas 6RA relay is incorporated in the circuit to prevent over-loading the thermostat switch contacts.

When air-conditioning is fitted a second relay is also included to over-ride the thermostat switch when the car is stationary and the air-conditioning system is working.

THERMOSTAT

Checking

Check by substitution or by the following test procedure:—

Drain off sufficient water from the radiator and remove the switch from the header tank.

Wire the switch in series with a 12 volt battery and a 1.5 watt bulb and suspend in water with a thermometer.

Heat the water and note the temperature at which the contacts close and the bulb lights up. Cool the water and note the temperature at which the contacts open. Replace if faulty.

Renew the joint between the tank and the thermostat switch if damaged.

TEST DATA

Closing temperature	..75°C±2°C
Opening differential	..3°–5°

FAN MOTOR

Checking

Disconnect the cables and check the fan motors by connecting to a 12 volt battery.

Remove for inspection if faulty.

Inspection

Withdraw the two through bolts, and detach the end cover. Expand the retaining spring and lift off the two brush carriers as an assembly.

Note: The brushes are loose in the carriers and care must be taken that they are not misplaced when removed.

Examine the commutator and clean with a petrol moistened cloth or fine glass paper if dirty or scored.

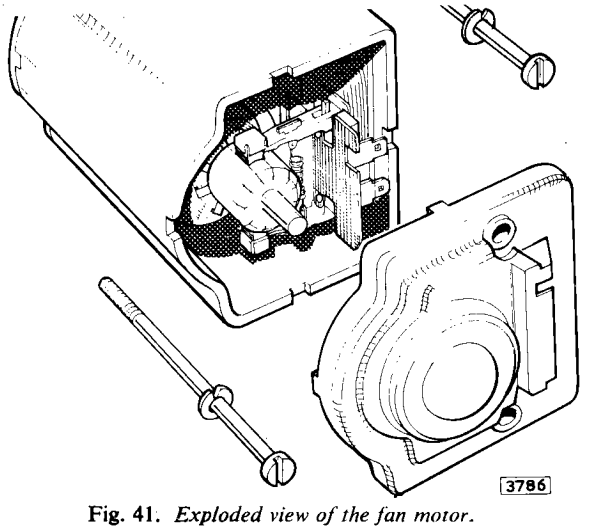


Fig. 41. *Exploded view of the fan motor.*

FAN RELAY

Checking

Check that fuse No. 6 has not blown. Replace if necessary.

Check that the current is present at terminal C2 (Green) with the ignition 'ON'.

Earth the terminal W1 (Black/red), switch on the ignition and check by means of an earthed test lamp that current is available at terminal C1 (Black/green).

If air-conditioning system is fitted, check the over-riding relay as detailed under 'Horn relay'. Ignore reference to horn button.

Refer to the wiring diagram when checking.

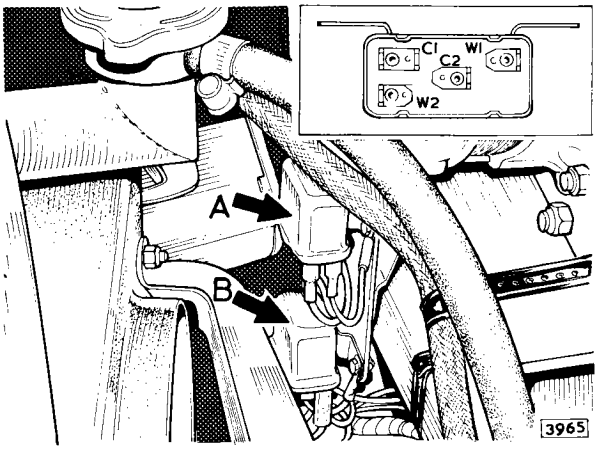


Fig. 42. *The radiator fan relays.*
A—Fan relay.
B—Over-riding relay.

STEERING COLUMN LOCKS

Description

Steering column locks, if fitted, replace the normal Starter/Ignition Switch.

The lock, mounted on a bracket attached to the steering column, has five operative positions as follows:—

(1) Lock, (2) Park, (3) Accessories, (4) Ignition, (5) Start.

During the assembly of the switch/lock to the column, the hexagon portions of the lock securing bolts which are of the necked type, are sheared when fully tightened and cannot subsequently be removed, thus preventing unauthorised removal of the lock.

IMPORTANT

The steering column lock is brought into action when the key is turned to the 'LOCK' position and then removed.

IMMEDIATELY THIS IS DONE IT BECOMES IMPOSSIBLE TO STEER THE CAR.

It is, therefore, important to remember that if the ignition is switched off whilst the car is in motion the key should not be turned past the 'PARK' position. The ignition key should NEVER be removed from the lock whilst the car is moving.

OPERATION

(1) Lock

This is a locked stop position. The key can be removed leaving the steering locked by engagement of the lock bolt with the register in the inner steering column.

(2) Park

This is the normal stop position. The key can be removed leaving the car capable of being steered with the ignition "OFF".

(3) Accessories

This position will allow the operation of accessories such as Radio and Electric Window Lift control (when either is fitted) with the ignition 'OFF'.

The key cannot be removed.

(4) ON

This is the normal starting position. On release, the key will automatically return to the ignition 'ON' position.

IMPORTANT

Re-engagement of the starter (cranking) motor will not be possible until the key is returned to the 'Park' position. This is a safety device introduced to prevent damage to the starter drive through accidental engagement when the engine is running.

SERVICING

No servicing is possible with the exception of the switch carrier contact plate which can be replaced if faulty as follows:—

(1) Disconnect the cables at the connectors.
(2) Remove two hexagon headed screws and plain washers and withdraw the contact plate with attached harness.
(3) Refit by reversing the removal procedure.

Note: The contact plate is indexed and cannot be fitted incorrectly.

Two Lucas 6RA relays are incorporated in the circuits controlled by the ignition switch to prevent overloading of the switch contacts.

Both units are located under the screen rail facia.

Operation of the individual relays should be checked when testing for a fault in the ignition/starter switch circuits.

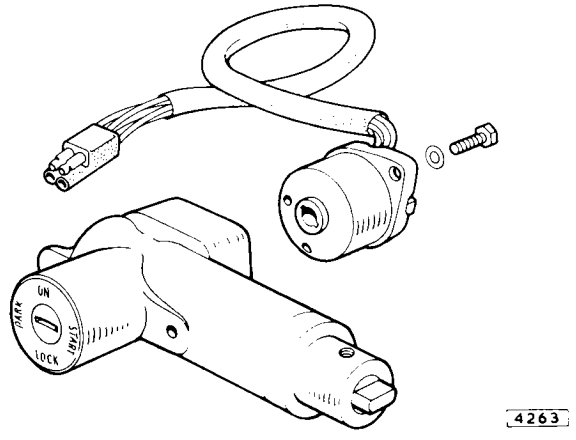
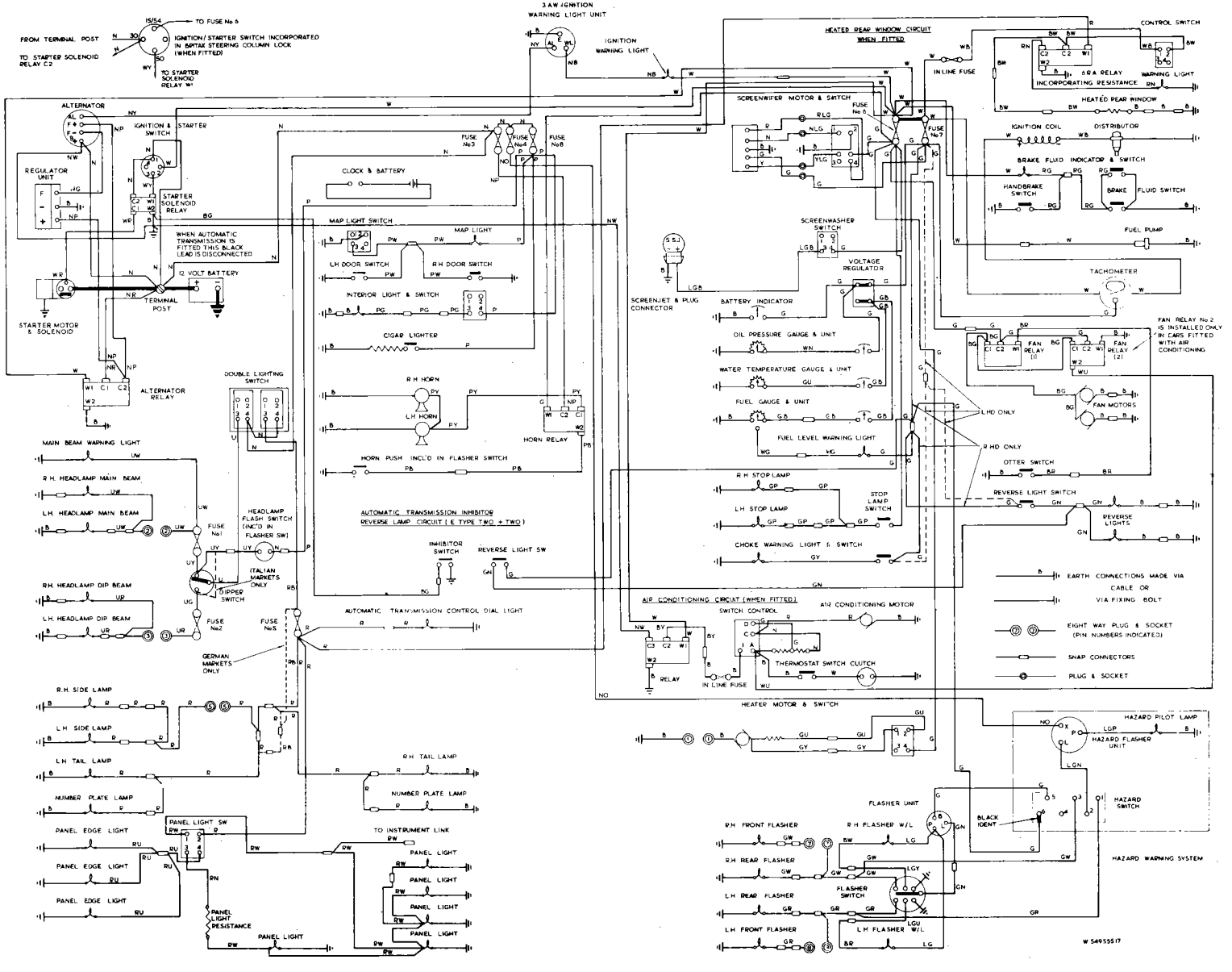


Fig. 43. *The steering column lock dismantled.*
(The lock is shown removed from the column for clarity).



CABLE COLOUR CODE

B	BLACK
U	BLUE
N	BROWN
G	GREEN
K	PINK
P	PURPLE
R	RED
S	SLATE
W	WHITE
Y	YELLOW
D	DARK
L	LIGHT
M	MEDIUM

SECTION Q

EXHAUST EMISSION CONTROL

To meet U.S.A. Federal and Canadian engine emission requirements, the Jaguar 4·2 Litre engine has been modified in relation to carburation, induction system and ignition as follows.

The Duplex Manifolding System employs the metering system of the carburetters to feed fuel mixture to the combustion chambers through two manifolds. Two throttles are employed—the primary being in its normal position in the carburetter and the secondary located in the water-jacketed secondary throttle housing. The linkage between the two throttles is so arranged that on part throttle opening (employed during most city driving and cruising) the secondary throttle remains closed, routing the mixture through the primary mixture pipe and returning it to the inlet manifold downstream of the secondary throttles.

This circuit ensures complete homogeneity of fuel mixture resulting in a constant air/fuel ratio being distributed to the cylinders so that an overall leaner mixture can be employed. It also avoids the deposition of wet fuel in the inlet manifold which is a major cause of engine emissions.

After approximately 25° of primary throttle opening, the secondary throttle comes into operation until, at full throttle, both butterflies are fully opened and the mixture passes straight through both manifolds so that maximum power is maintained.

A modified distributor with redesigned power curve is fitted in conjunction with this system, the ignition timing being 5° B.T.D.C. static (10° B.T.D.C. at 1,000 r.p.m.).

ROUTINE MAINTENANCE

Owing to the critical emission limits which must be maintained throughout the lifetime of the engine, it is imperative that the following routine maintenance instructions are carried out conscientiously at the recommended mileage intervals.

Failure to comply with these recommendations may result in engine emissions falling outside U.S.A. Federal or Canadian limitations.

1,000 MILES FREE SERVICE

After the car has completed 1,000 miles from delivery, the following checks relating to Engine Emission Control should be carried out together with other Free Service details as shown in the Service Maintenance Voucher Booklet.

Engine Oil

Change the engine oil.

Distributor Contact Breaker Gap

Adjust contact breaker points to ·014"-·016" gap as detailed in the Service Manual. Verify correct dwell angle—see Diagnosis Chart.

Distributor Lubrication

Lubricate the distributor as detailed in the Service Manual.

Sparking Plugs

Clean the sparking plugs and adjust the gap to ·025".

Engine Idle Speed

Allow the engine to warm up to normal operating temperature. **Adjust the idle speed by turning each adjuster screw an equal amount** to give slow running speed of 750 r.p.m. on standard transmission cars; 650 r.p.m. on cars with automatic transmission with the selector lever in the neutral position.

Check the synchronisation of the carburetters by using a balance meter.

Fast Idle Speed

Ensure that the choke control cam on the rear carburetter is in the "fully off" position.

Release the locknut and turn the fast idle abutment screw until the gap between the cam and the screw is ·067". Tighten the locknut and re-check the gap.

Carburetter Hydraulic Piston Damper

Unscrew and withdraw the hydraulic piston damper from the piston cover.

Top up the hollow guide rod of the piston with Zenith Lube Pack, or, if this is not available, use SAE 20 engine oil, to within $\frac{1}{4}$" of the top of the rod. Replace the damper securely.

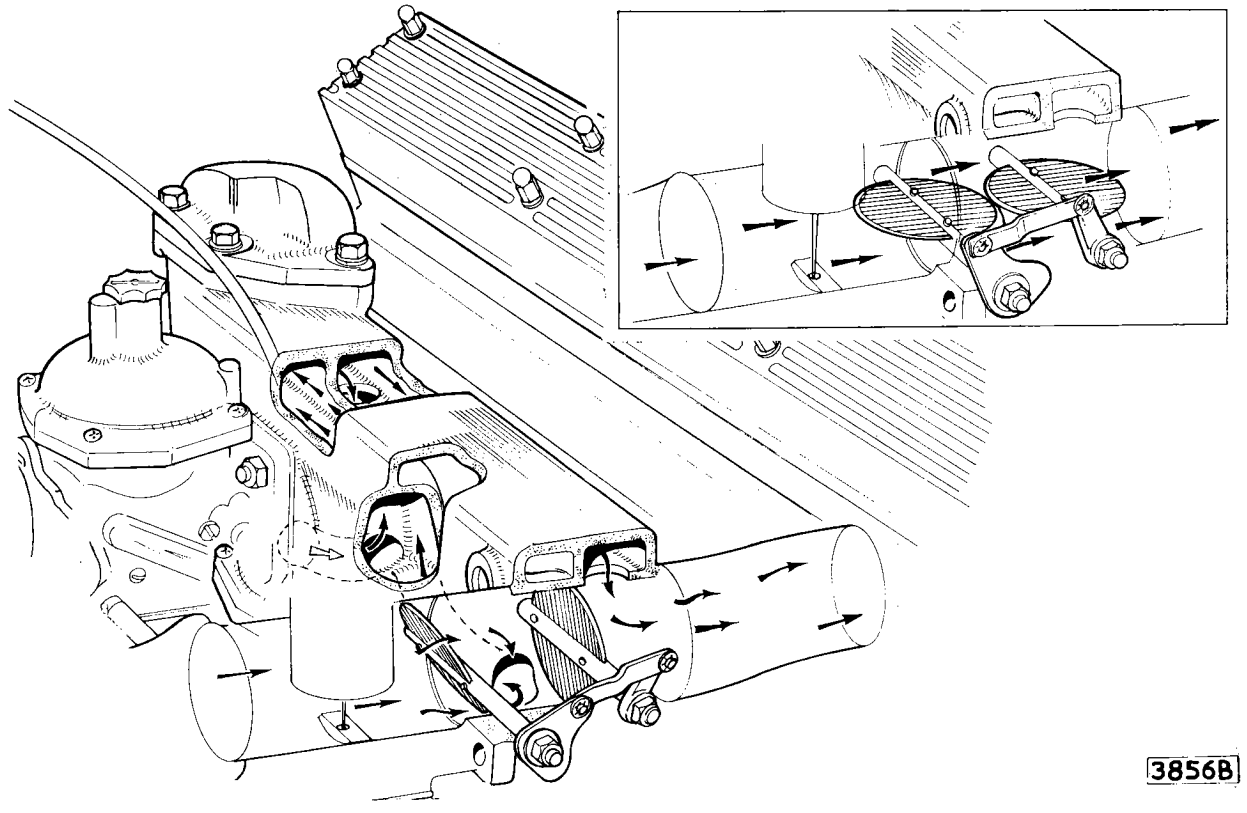


Fig. 1. *Schematic layout of the carburetters and linkage showing the direction of the gas flow.*

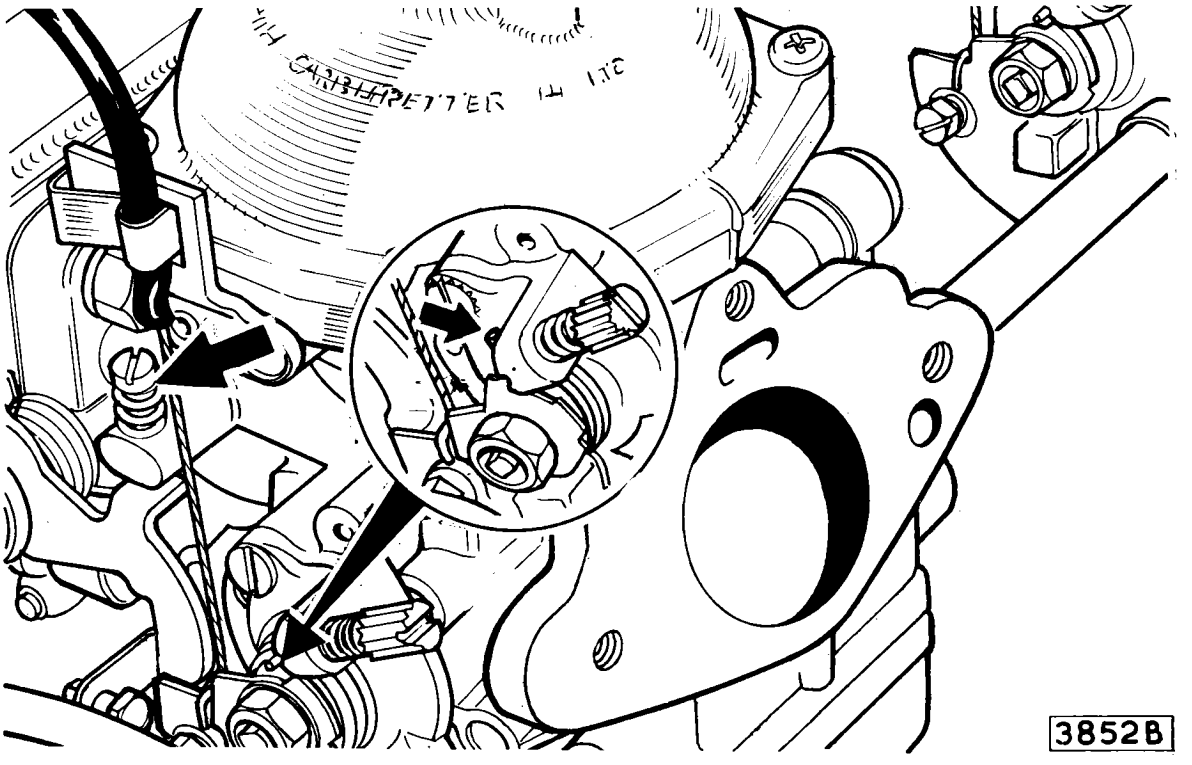


Fig. 2. *Slow running adjustment screw.*

Ignition Timing

As the ignition timing of an emission controlled engine is critical, the greatest possible care must be taken to ensure that the correct figure is obtained.

Adjust the distributor vernier scale to the central position. With the engine running at exactly 1,000 r.p.m. check the timing with a stroboscope and adjust by means of the vernier control on the distributor to 10° B.T.D.C.

The timing scale is located on the rim of the crankshaft damper.

To check the distributor advance characteristics at higher r.p.m., refer to Distributor Test Data on page QY.s.5.

Cylinder Head Nuts

Check the torque of the cylinder head nuts (Torque 696 lbs. ins.) tightening in sequence as detailed in the Service Manual.

Inlet Manifolds

Check the tightness of all inlet manifold system securing nuts.

Tighten the carburetter mounting nuts.

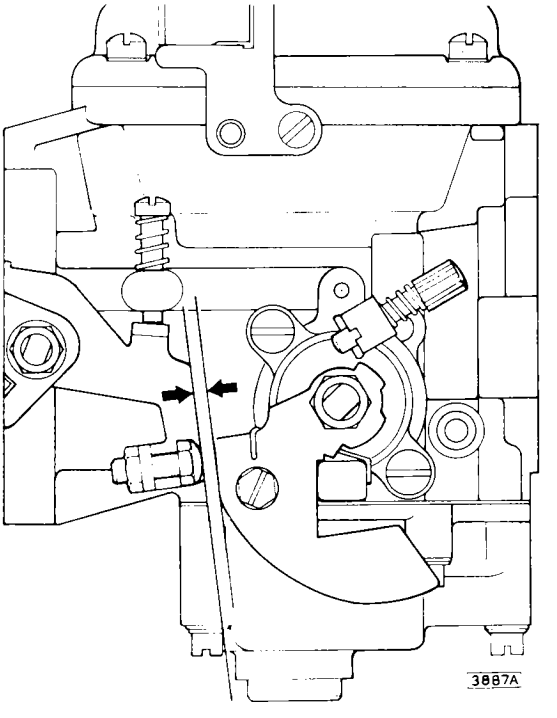


Fig. 3. *Fast idle adjustment. Gap between screw and cam should be ·067".*

It is important to ensure that no air leaks exist at any of these joints otherwise the mixture will be weakened to a point where idling will be effected.

Idle "Trim" Screw

Screw in the idle "trim" screw to obtain the optimum quality of idling.

EVERY 3,000 MILES

Engine Oil

Change the engine oil.

Low speed city driving in hot dusty territory or in very cold weather may produce conditions conducive to oil dilution and sludge formation. In these conditions the engine oil and the filter should be changed every 1,000 miles.

Distributor Contact Breaker Gap

Clean points and adjust the contact breaker gap as detailed in the Service Manual.

Adjust the gap to ·014"-·016". Verify correct dwell angle—see Diagnosis Chart.

Ignition Timing

Check ignition timing as detailed in the 1,000 miles Free Service.

Distributor Lubrication

Lubricate the distributor as detailed in the Service Manual.

Sparking Plugs

Clean and adjust and test the spark plugs. Check on an oscilloscope and renew any doubtful plugs. Set the gap between the side wire and the centre electrode to ·025".

NOTE: Misfiring of a plug will cause incomplete combustion of the mixture and raise the engine emission levels above the specified limits.

Engine Idle Speed

Adjust the engine idle speed as detailed in the 1,000 miles Free Service.

Fast Idle Speed

Adjust the fast idle speed as detailed in the 1,000 miles Free Service.

Carburetter Hydraulic Damper

Top up the hydraulic piston damper as detailed in the 1,000 miles Free Service.

EVERY 12,000 MILES

Fit Emission Pack Part No. 11549 (coloured Yellow) to the carburetters. See page QY.s.11 for details.

Air Filter

Renew the air filter element as detailed in the Service Manual. If the car is operating in dusty territory inspect at 6,000 miles and renew if necessary.

Crankcase Breather

Disconnect the breather pipe from the front of the engine and the air filter. Remove the pipe. Remove the nuts securing the breather and withdraw the flame trap. Wash the flame trap and pipe in gasoline and refit. Renew the gaskets located on each side of the flame trap. Examine all hoses, renew if necessary. Check that all clamps are tight allowing no air leakage.

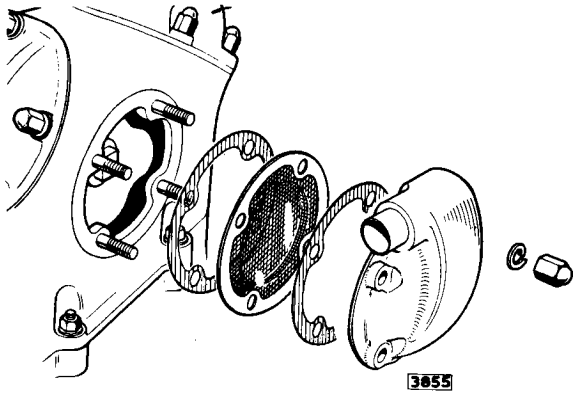


Fig. 4. *The crankcase breather.*

Inlet Manifolds

Check tightness of all secondary throttle housing and inlet manifold securing nuts. Check tightness of nuts securing primary mixture pipe to secondary throttle housing.

It is important to ensure that no leaks exist at any of these joints.

Exhaust System

Check the exhaust system for leaks. Renew any parts showing signs of deterioration.

Spark Plugs

Renew the spark plugs with the recommended grade.

Cylinder Head

Check the torque of the cylinder head securing nuts (696 lb. ins.) and check the cylinder head gasket for leaks.

Fuel Line Filter

At the recommended interval, or more frequently if sediment build-up is evident, slacken the locknut, swing the retaining clip to one side and remove the glass bowl, sealing washers and filter.

Wash the glass bowl in gasoline. Fit a new filter element with new sealing washers and re-assemble.

Distributor Contact Breaker Gap

Clean points and adjust contact breaker gap as detailed in the Service Manual. Adjust the gap to ·014"-·016". Verify correct dwell angle—see Diagnosis Chart.

Ignition Timing

Check ignition timing as detailed in the 1,000 mile Free Service.

EVERY 24,000 MILES

Carburetters

Remove lead seal and fit Red Emission Pack Part No. 11791 to carburetters. See pages QY.s.12 to QY.s.13. Fit new lead seal after completion.

Valve Clearances

Check the valve clearances as detailed in the Service Manual. Clearances (cold)—inlet ·004"; exhaust ·006"

Valve Timing

Check valve timing as detailed in the Service Manual.

Contact Breaker Points

Renew contact breaker points as detailed in the Service Manual. Adjust points gap to ·014"-·016". Check ignition timing as detailed in the 1,000 Miles Free Service. Verify correct dwell angle—see Diagnosis Chart.

Compression Pressures

Compression pressures must be checked with all spark plugs removed, carburetter throttles wide open and the engine at normal running temperature.

Disconnect the black/white low tension lead from the coil before operating the ignition/starter switch to check pressures. All cylinders should be even and approximately 150 p.s.i.

If one or more cylinders show low compression, a full investigation into engine condition must be made on an Electronic Engine Tester such as a Sun 1020. See diagnosis chart.

DISTRIBUTOR TEST DATA

CENTRIFUGAL TIMING ADVANCE

With a stroboscopic timing light, check the advance characteristics of the distributor at the following r.p.m.

R.P.M.	DEGREES
1200	13—17
1600	22—26
2900	29—33
4400	37—41

THE STROMBERG 175 CD2SE EMISSION CARBURETTER

DESCRIPTION

The STROMBERGE 175 CD2SE carburetter is a development of the constant depression carburetter which operates on the principle of varying the effective areas of choke and jet orifice in accordance with the degree of throttle opening, engine speed and engine load. A number of special features have been introduced to meet the needs of engine emission control.

Fuel passes into the float chamber via a needle valve where flow is controlled by the needle valve and twin floats mounted on a common arm. Fuel in the jet orifice is controlled at the same level as that in the float chamber by means of cross drillings in the jet assembly.

Clearance around the piston in its vertical bore permits air to "leak" into the mixing chamber and thus lower the depression. A drilling is taken from the atmospherically vented region beneath the diaphragm to meet a further drilling that breaks into the mixing chamber downstream of the piston. An adjusting screw with a conical tip is inserted into the drilling and is adjusted by the manufacturer to bring each carburetter to a common "leak" datum and sealed with a plug **which must not be disturbed in any circumstance.**

COLD STARTING

Pulling out the choke control on the instrument panel operates a lever at the side of each carburetter which rotates a disc in the starting device in which a series of holes of different diameters are drilled. In the fully rich position all these holes will be in communication with the starting circuit and will provide the richest mixture. Gasoline is drawn from the float-chamber via a vertical drilling adjacent to the central jet, through the starting device and into the throttle body between the piston and the throttle disc. Simultaneously the cam on the choke lever will open the throttle disc beyond the normal idle position to ensure a faster idle speed and prevent stalling.

As the choke is gradually pushed to the "OFF" position, fewer and smaller holes will limit the gasoline feed from the float chamber thereby progressively weakening the mixture to a point where the choke is fully home and the mixture strength is governed by the Factory setting of the main jet and the idling speed determined by the setting of the throttle stop screw.

NOTE: DO NOT DEPRESS THE ACCELERATOR PEDAL WHEN STARTING FROM COLD.

A control in each carburetter enables the choke to be varied for summer and winter operation, and takes the form of a spring loaded plunger operating against the cam. To check the setting, note the position of the stop cross-pin. If lying in the horizontal slot in the casting the choke is set for winter operation. To adjust for summer running depress the spring loaded pin and turn through 90°. Release and check that the cross-pin is at right angles to the slot.

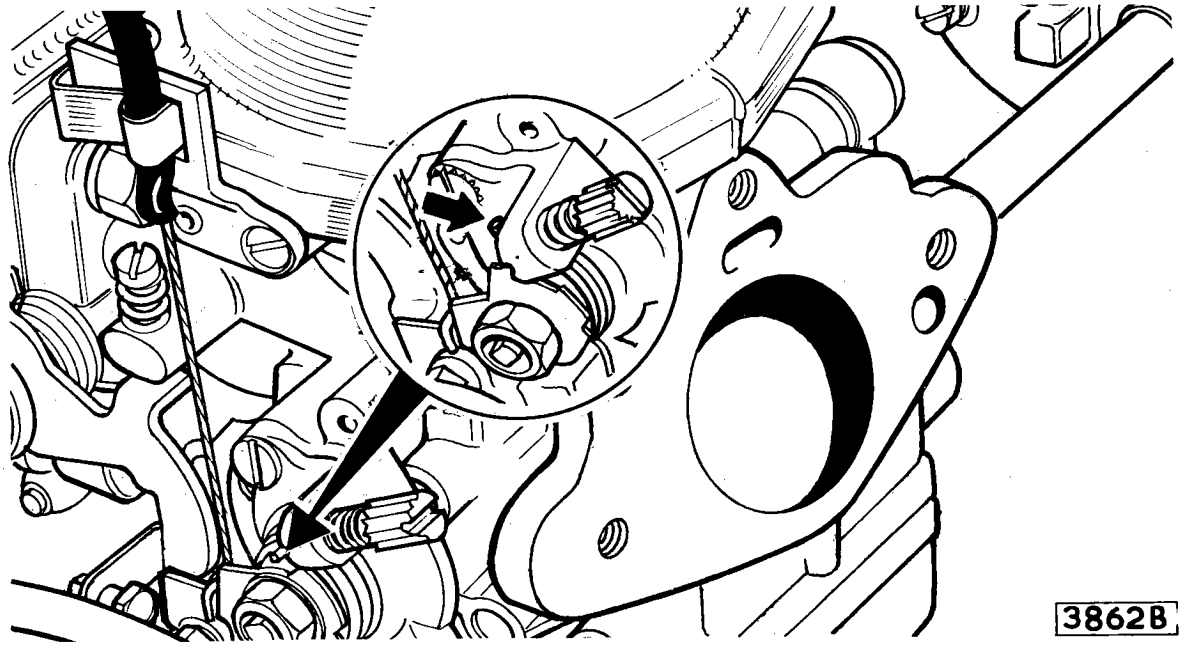


Fig. 5. *The choke limiting spindle in the Winter setting (inset shows the Summer setting).*

IDLING

There is no separate circuit for idling. The fuel is provided by the jet orifice (the amount being controlled by jet/needle relationship established during manufacture) and the speed of idle by adjustment of the throttle stop screw which limits the closure of the throttle when the accelerator pedal is released.

To cater for variations in engine "stiffness" when manufactured, an idle "trim screw" is provided. Engine stiffness dictates idling air consumption and a new and very stiff engine will require more air than one which has become "free". The trim screw may be adjusted to provide a slightly leaner mixture for any engine found to be extremely stiff on production engine test. When fully seated, the maximum enrichment is achieved and emission figures will be within requirements, the engine having freed to a value equivalent to the datum at which the original trim screw setting was carried out.

Finger pressure only should be used when tightening the trim screw, care being taken not to over-tighten.

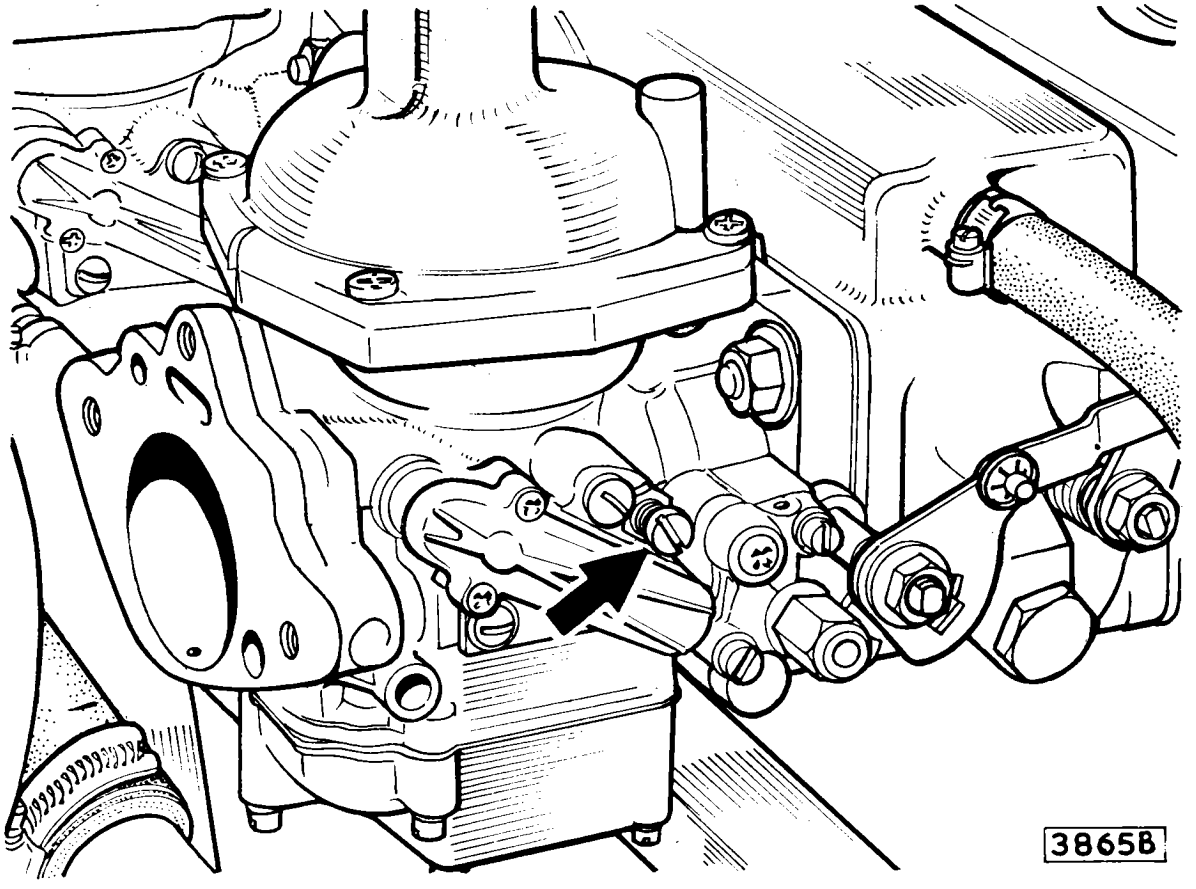


Fig. 6. *The idle trim screw.*

JET/NEEDLE RELATIONSHIP

The jet/needle relationship not only governs the correct idle mixture but also the correct mixture strength throughout the range. During development, it was found desirable to have the needle central in the jet. This not being practicable to achieve the needle has been biased permanently on one side of the jet to rub lightly against the jet orifice.

The needle profile has been evolved to compensate for the known air leak (consistency being obtained by manufacturer's setting of the "leak adjuster screw") and therefore a constant fuel/air ratio is maintained. All carburetters therefore, produce a consistent flow from the given needle profile.

To meet emission control requirements, carburetters must be kept within very narrow "flow bands". Exhaustive testing on Jaguar engines decided the optimum jet position in the orifice and, therefore, all carburetters have the jets pressed into position to a predetermined depth thereby eliminating any possible maladjustment in service. Every unit is flow tested by the carburetter manufacturer ensuring that all carburetters are supplied within the desired limits.

On throttle opening, the piston rises withdrawing the tapered jet metering needle, held in its base, from the jet orifice so that the fuel flow is increased proportionate to the greater air flow.

The metering needle is variable along its length and has been machined to very close limits.

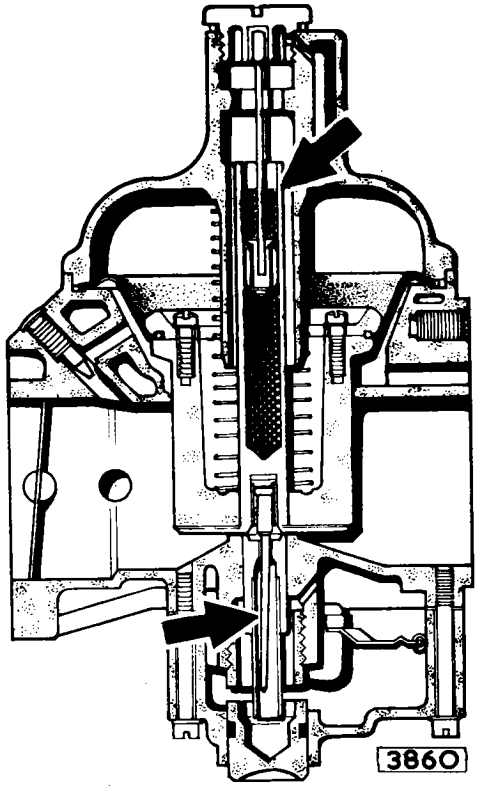


Fig. 7. *Cut-away view showing the Jet/Needle relationship.*

As the needle profile has been developed from exhaustive testing, it is vitally important, to maintain correct results in regard to engine emission control, that only the recommended needle is used.

For correct identification the needle is stamped with the figure B1E on the shank.

Variations in mixture strength caused by heat transfer to the carburetter castings are significant in the context of the extraordinary precision demanded by emission requirements. A temperature compensator is incorporated to cater for this condition.

An air flow channel permits air passing through the carburetter to by-pass the bridge section. A bimetallic blade regulated the movement of a tapered plug which adjusts the quantity of air by-passed to the mixing chamber. Two screws attach the temperature compensator assembly to the body and two seals are provided to ensure that no leakage can occur at the joint with the body.

The assmbly is preset, and unless necessary due to the tapered plug sticking, should not be readjusted in service. If malfunctioning of the compensator is suspected and the tapered plug moves freely when tested carefully by hand with the engine hot or cold, the compensator assembly must be changed for a new unit.

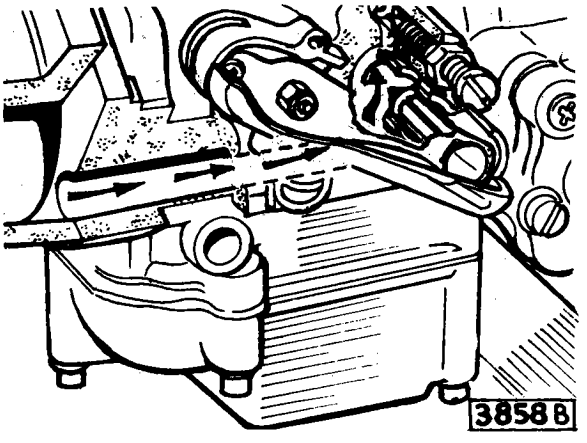


Fig. 8. *Cut-away view of the temperature compensator.*

THROTTLE BY-PASS

During periods of engine over-run, high emissions will occur if the fuel/air mixture in the combustion chambers is not of sufficient strength, when diluted by exhaust gas, to support combustion. To overcome this problem, a device is fitted to the carburetters which consists of a by-pass formed in the carburetter around the primary throttle under the control of a vacuum operated valve. The vacuum signal to the valve is via an internal drilling in each carburetter. The flow of this circuit is determined by the size of the ports, the valve always lifting to full travel. As the throttle remains on its stop, the primary induction circuit only is in use ensuring that even mixture is fed through the primary system to all six combustion chambers. This valve is pre-set and provided it is free from air leaks, requires no adjustment. It is possible however, that small particles of foreign matter may lodge under the valve seating causing leakage and consequent high idling speed. In these circumstances the valve cover should be removed and the valve and seating cleaned.

Manifold depression acting on the valve diaphragm will cause the valve to open when the value is reached that will overcome the valve spring tension.

This allows fuel to feed from the mixing chamber to the downstream side of the primary throttle enriching the gases in the combustion chamber to a combustible level.

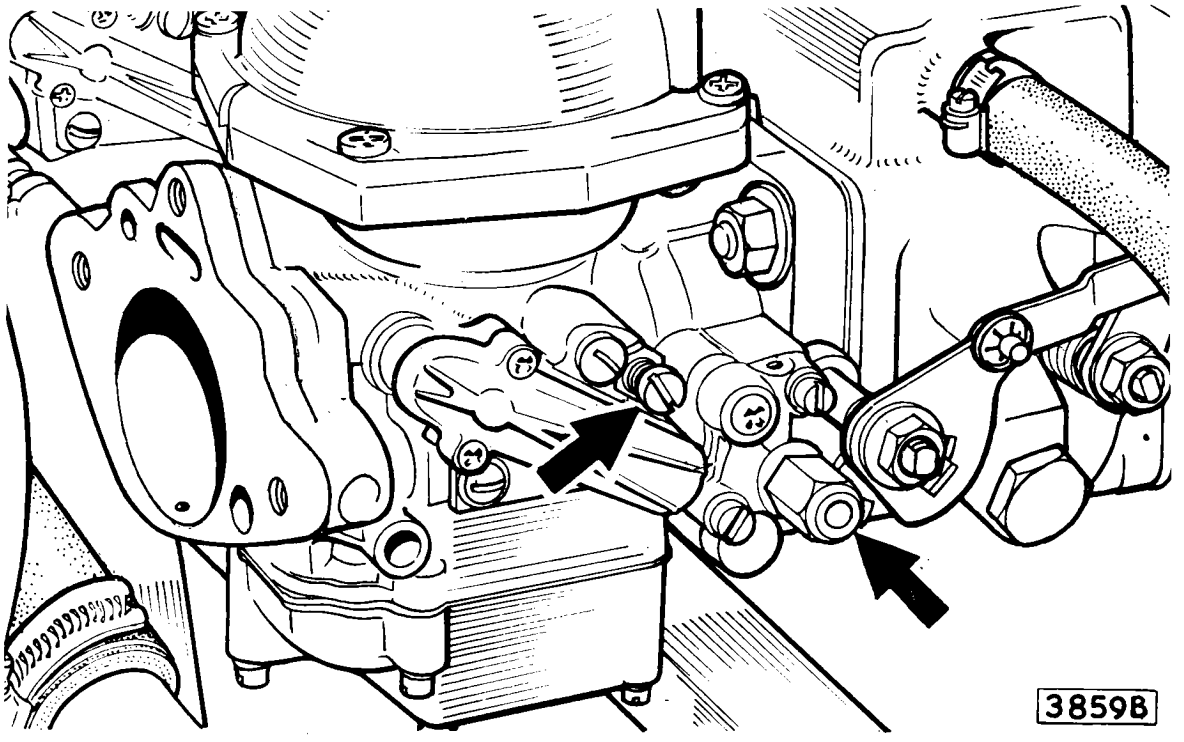
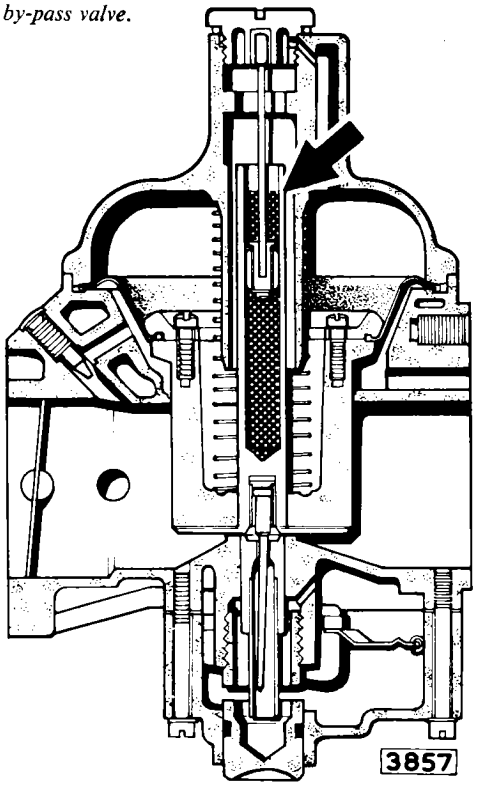


Fig. 9. *The throttle by-pass valve.*



0. *The hydraulic damper. Sectioned view showing the oil level in the piston guide.*

HYDRAULIC DAMPER

At any point in the throttle range, a temporary enrichment is required when the throttle is suddenly opened. A hydraulic damper is arranged inside the hollow guide rod of the piston to provide this.

The guide rod itself is filled with "Zenith Lube Pack" or SAE 20 engine oil to within $\frac{1}{4}$" of the end of the rod.

When the throttle is suddenly opened the immediate upward motion of the piston is resisted by the damper. For this brief period a temporary increase in the depression over the jet orifice is achieved and the mixture is enriched. Downward movement of the piston is assisted by a coil spring.

RECOMMENDED SERVICE PROGRAMME

It is necessary to maintain the carburetters at peak efficiency to control engine emission, therefore the following service recommendations should be carried out.

EXHAUST EMISSION CONTROL

1. Hydraulic damper.
2. "O" ring.
3. Cover.
4. Diaphragm securing ring.
5. Piston return spring.
6. Needle securing screw.
7. Butterfly.
8. Bush.
9. Pick-up lever.
10. Floating lever.
11. Washer.
12. Shakeproof washer.
13. Nut.
14. Diaphragm.
15. Idle trim screw.
16. Gasket.
17. By-pass valve.
18. Gasket.
19. Spring.
20. Cover.
21. Seal.
22. Seal.
23. Gasket.
24. Temperature compensator housing.
25. Tapered plug.
26. Bi-metallic blade.
27. Plastic cover.
28. Jet assembly.
29. Float assembly.
30. Float chamber.
31. Pivot pin.
32. "O" ring.
33. Needle valve.
34. Special washer.
35. Choke assembly.
36. Needle.
37. Spring.
38. Throttle stop screw.
39. Throttle spindle assembly.
40. Piston.
41. Diaphragm.

Inset—Lead seal.

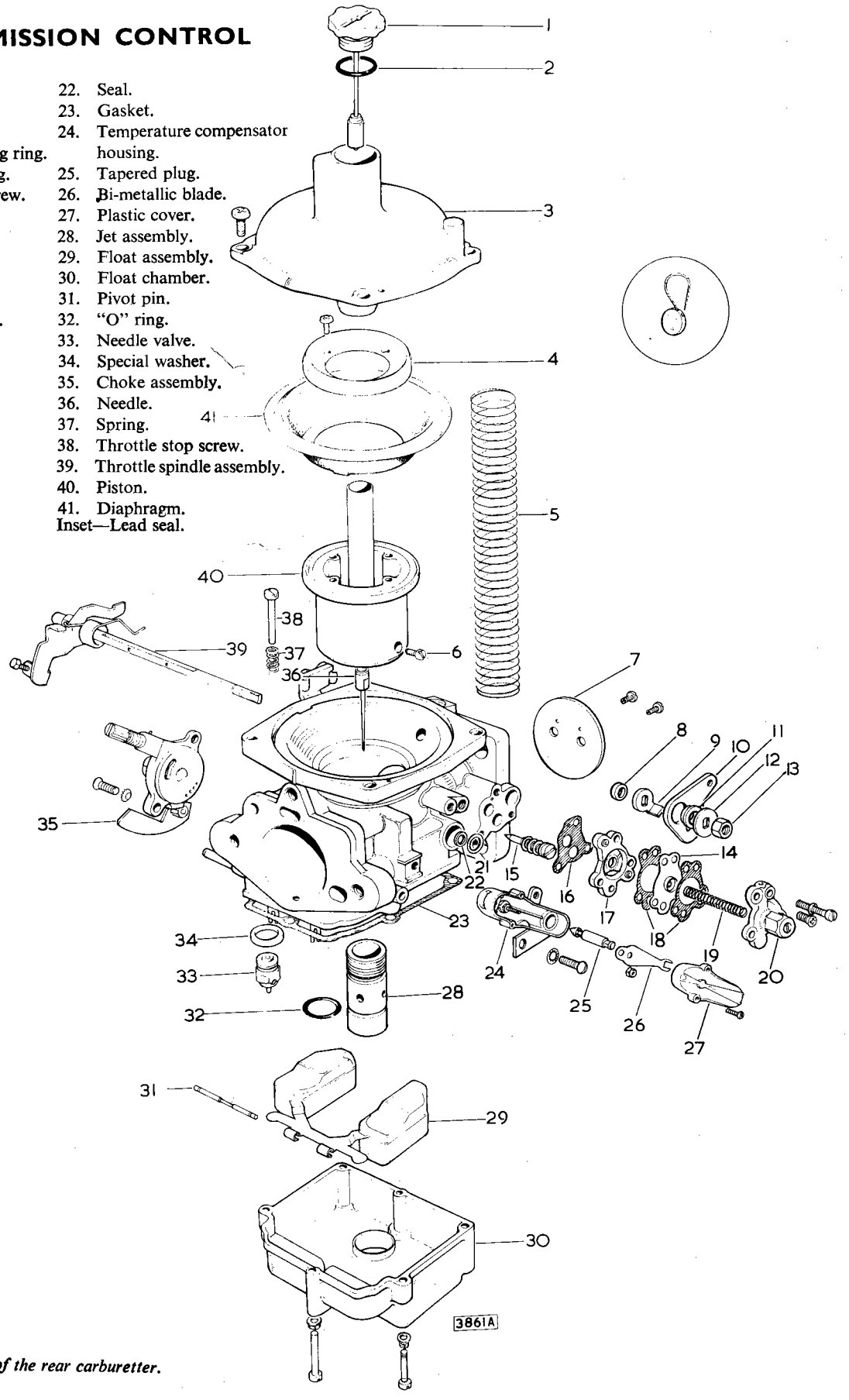


Fig. 11. *Exploded view of the rear carburetter.*

12,000 Miles Service

For this service period, one Yellow Emission Pack (Part No. 11549) is required for the two carburetters. This pack contains 2 float-chamber gaskets, 2 "O" rings for the float-chamber plugs and 2 needle valve washers.

Additionally, 4 manifold/carburetter gaskets and 2 spacers will be required.

Remove the carburetters as follows:

Remove three setscrews securing the air trumpet to each carburetter and withdraw the engine breather pipe from the air box. Lift off the air cleaner. Thin gaskets are fitted between each trumpet and carburetter and these should be carefully placed to one side for use when refitting.

Remove the gasoline pipes from the float-chambers.

Remove the nut, lock washer and plain washer, securing the linkage from the primary to the secondary throttles, at the primary spindles of the rear carburetter.

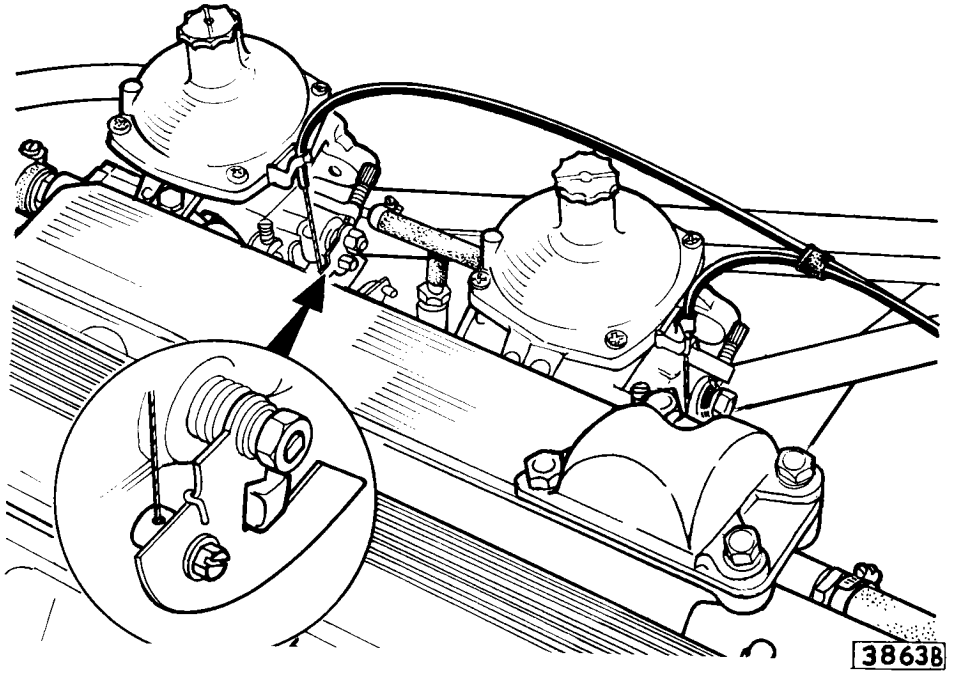


Fig. 12. *The choke cable connections.*

Detach the link. Replace the washers and nuts on the spindle for safe-keeping.

Repeat the operation for the front carburetter.

Release the bolts securing the inner cables to the choke levers and withdraw the outer casings from the clips at the sides of the carburetters.

Remove four nuts, spring washers and plain washers securing each carburetter to the studs on the primary inlet manifold. Disconnect the central link between the throttle slave shaft and the carburetter spindles. Withdraw both carburetters as an assembly.

Separate the units by slackening the clamps on the throttle spindles.

It is important to dismantle and assemble each carburetter individually to avoid the possibility of similar parts being interchanged between carburetters.

Unscrew the float-chamber fixing screws and withdraw the float-chambers vertically away from the body to clear the float mechanism. Remove the float-chamber gaskets.

Unclip the float pivot pin.

Note the fitted position of the float assembly. The flat portion of the float must be uppermost when refitted, with the carburetter in an inverted position.

Unscrew the hexagon-bodied needle valve from the float-chamber body.

Remove the "O" ring from the centre plug and wash all metal parts in cleansing solvent.

Re-assemble the carburetters as follows:

Refit the needle valve with the new washer to the float-chamber body and screw home tightly. Replace the float assembly, after inspecting for distortion or damage.

To ensure correct float level, measure the float height as follows.

Invert the carburetter so that the float tag closes the needle valve. Measure from the face of the carburetter body (with the gasket removed) to the top of each float.

The correct height should be 16·5 ± ·5 mm.

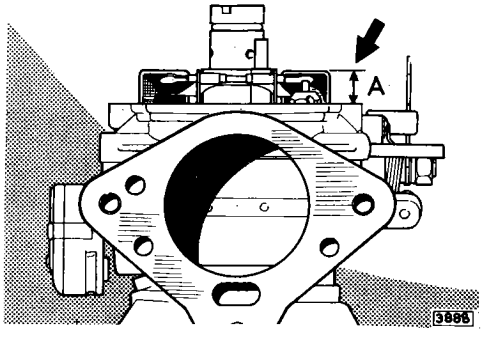


Fig. 13. *Checking the float height. Dimension A should be* 16·5 ± ·5 mm.

Fit a new "O" ring to the centre plug.

With the new gasket in position refit the float chamber and tighten the securing screws from the centre outwards.

Refit the carburetters to the manifold with the new gaskets and spacers. Reconnect the carburetter linkage. Reconnect the gasoline pipes and top up the hydraulic piston damper of each carburetter with "Zenith Lube Pack" or SAE 20 engine oil to within ¼" of the top of the centre rod.

Leaving the clamping bolts on the throttle spindles loose, unscrew the throttle stop screws to permit the primary throttles in each carburetter to close completely. Screw in the stop screws to the point where the ends of the screws are just contacting the casting. Rotate each screw 1½ turns to open the throttles an equal amount and to provide a basis from which the final idling speed can be set.

Ensure that the fast idle screw is clear of the choke cam otherwise incorrect synchronising will result.

Check that both choke cams are in contact with the stops. With the instrument panel choke control pushed home fully, reconnect the choke cables to the cams.

Check that both cams operate simultaneously.

Start the engine and warm up to the normal operating temperature.

Check the synchronising of the throttles with a balance meter, and tighten the clamping bolts on the throttle spindles. Set the throttle stop screws to give the correct idling speed as stated in "Routine Maintenance". Turn each screw by an equal amount.

Adjust the fast idle as detailed on page QY.s.6.

If care is exercised in setting each throttle opening to the same extent, no difficulty should be encountered in obtaining satisfactory idling and smooth acceleration.

Refit the vacuum pipe to the by-pass valve.

Refit the air cleaner and the engine breather pipe.

NOTE: The idling quality and acceleration depend to a large extent upon general engine condition and it is therefore essential to check the engine on an Electronic Engine Tester such as the Sun 1020 or other make of similar capacity. See Diagnosis Chart for test procedure.

24,000 Miles Service

This is a more comprehensive service for which one **RED Emission Pack,** Part No. 11791 will be required for each carburetter. This Pack contains 2 float-chamber gaskets, 2 "O" rings, 2 needle valves and washers, 4 throttle spindle seals, 4 temperature compensator seals, 2 by-pass body gaskets, 2 piston diaphragms, and 2 hydraulic damper seals.

Additionally, the following will also be required 4 secondary throttle housing/carburetter gaskets and spacers, 1 secondary throttle housing/manifold gasket. 1 primary mixture pipe/secondary throttle housing gasket.

IMPORTANT: Dismantle and assemble each carburetter individually to avoid the possibility of interchanging similar parts between carburetters.

Remove the carburetters as detailed under the 12,000 miles service.

Drain sufficient water from the cooling system to allow the level of coolant to fall below the throttle housing.

Disconnect the water pipes from the housing.

Remove four nuts and washers securing the primary mixture pipe to the secondary throttle housing.

Release the four nuts securing the secondary throttle housing to the inlet manifold; these are located behind the manifold.

Disconnect the clamping bolt securing the front throttle slave shaft to the rear throttle slave shaft.

If automatic transmission is fitted, disconnect the link between the automatic transmission throttle control shaft and the front throttle slave shaft.

Withdraw the secondary throttle housing together with the front throttle slave shaft.

For each carburetter, carry out the instructions detailed under 12,000 miles Service.

In addition to this service however, fit the new needle valve assemblies with new washers.

Remove the damper assembly from the top cover and break the wire seal.

Unscrew the four cover fixing screws and carefully lift off the cover. Remove the piston return spring and lift out the piston assembly.

Drain off the oil from the damper reservoir (centre of guide rod). Slacken the metering needle clamping screw and withdraw the needle from the piston.

Place the needle carefully to one side to avoid damage.

Remove the four screws attaching the diaphragm retaining ring to the top of the piston.

Lift off the ring and diaphragm.

Fit the new diaphragm into the top of the piston ensuring that the locating tag is recessed into the aperture provided. Secure in position with the retaining ring and the four screws.

Check the spring action of the needle in its housing at the top of the shank. Fit the needle into the base of the piston lining up the flat portion with the locking screw. Using a straight edge placed lightly against the small shoulder on the needle, (not the casing) press the assembly into the piston until the straight edge aligns the shoulder of the needle with the flat surface of the piston. Lightly tighten the locking screw, taking care not to collapse the needle housing. Shoulder alignment of the needle is critical and great care must be taken during this operation. Correctly fitted, the needle will be baised towards the throttle and the shoulder of the needle will be exactly flush with the piston face.

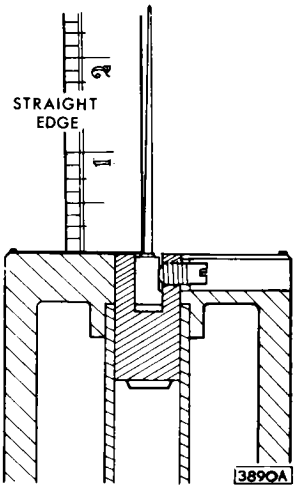


Fig. 14. *Positioning the needle in the piston.*

Carefully enter the piston and diaphragm assembly into the main body, guiding the needle into the jet with a finger in the air intake. Locate the outer tag of the diaphragm into the recess at the top of the body. Check the assembly by looking down the piston to ascertain that the two depression transfer holes are towards and in line with the throttle spindle and that the needle is biased towards the throttle.

Replace the piston spring, hold the piston against the spring with a finger through the air intake and fit the cover. This method will prevent the piston from moving out of position. The cover must be fitted with the damper ventilation boss towards the air intake.

Replace the four cover screws and tighten down evenly.

Check the movement of the piston; freedom of movement over the full travel is essential and when released from the uppermost position, the piston should fall with a sharp click onto the bridge of the carburetter.

Top up the piston damper, fit new seal and refit the damper assembly.

Remove the two screws securing the temperature compensator unit to the body and withdraw the assembly. Take out the inner seal from the carburetter body and remove the outer seal from the valve. Renew both seals and refit the assembly to the carburetter body.

Tighten the two screws evenly.

Remove the two screws and detach the compensator cover. Check for free movement of the valve by lifting the plug from its seat. On releasing, the valve should return freely.

Do not strain the bi-metal strip, or attempt to alter the adjustment. It is permissible to ensure that there is consistent radial clearance around the valve to allow for thermal expansion. If the valve is sticking, remove the securing nut and screw. Lightly clean the bore and the plug with a gasoline moistened cloth. Refit the bi-metal strip and re-tension by tightening the nut until the valve is just seated. DO NOT TIGHTEN BEYOND THIS POINT.

Unscrew the three setscrews securing the by-pass valve body and lift the assembly from its seat. Prise out the throttle spindle seal and renew before replacing the by-pass body with a new gasket. Renew the throttle spindle seal on the other side of the carburetter spindle. Repeat this operation on the rear carburetter.

Refit the secondary throttle housing and mixture pipe with new gaskets. Refit the water pipes to the secondary throttle housing and top up the coolant to the correct level.

Refit the carburetters to the secondary throttle housing with new gaskets and spacers. Fit new wire and seal to the dashpot. Re-connect the throttle spindles controls and set the carburetters as detailed in the 12,000 Miles Service.

Check the engine performance on an Electronic Engine Tester such as the Sun 1020 or other make of similar capacity. See Diagnosis Chart for test procedure.

CARBURETTER FAULT FINDING

Service complaints can generally be broken down into three main categories:—

(a) Erratic or poor idling.
(b) Hesitation or flat spot.
(c) Heavy fuel consumption.

Under these headings, possible causes are put forward together with suggestions.

Erratic or Poor Idling

(1) Incorrect fuel level caused by maladjustment of the floats and/or worn or dirty needle valves. Check the float level. Wash the needle valve in clean gasoline, replace the valve if worn.
(2) Piston sticking. Check for free movement of the spring loaded metering valve needle. Clean the piston rod and guide. Lubricate the rod and guide with a few drops of light oil.
(3) Metering needle incorrectly fitted. Check that the shoulder of the needle is flush with the face of the piston and that the needle is biased towards the throttle. Check the needle identification and ascertain that the correct needle is fitted. Check that the needle housing has not been distorted by over-tightening of the securing screw.
(4) Partially or fully obstructed diaphragm ventilation holes. Check that the air cleaner element and casing are correctly fitted and that the air trumpet/carburetter gaskets are not causing obstruction.
(5) Diaphragm incorrectly fitted or damaged. Check the location with the depression chamber cover removed. The two depression holes at the base of the piston should be in line with and towards the throttle spindle. Replace the diaphragm if damaged. When replacing the depression chamber cover, the damper ventilation boss must be towards the air intake.
(6) Throttles not synchronised. Reset correctly using a balance meter.
(7) Temperature compensator not working properly. With the engine and the carburetters cold, remove the cover from the temperature compensator assembly. The tapered valve should be seated in this instance. Check the operation by carefully lifting of the valve off its seat. When released, the valve should return freely. If damage prevents the mechanical operation functioning correctly, renew the compensator unit.
(8) If high mileage has been covered, inspect the throttle spindles and end seals for wear. Check the spindles for fractures: renew if suspect.

Hesitation or Flat Spot

Possible causes are as enumerated for "Erratic or Poor Idling" but with the addition of the following:

(1) Damper inoperative. Check the oil level and top up with light engine oil.
(2) Piston return spring omitted.

Heavy Fuel Consumption

Points covered under the two previous headings may contribute to heavy fuel consumption. Additionally, check that there is no fuel leakage from the float-chambers or centre plug "O" ring. Replace as necessary.

SPECIAL PARTS

In an endeavour to maintain engine emission within the legislated limits, the following parts must not be changed in service.

ITEMS THAT MUST NOT BE CHANGED

(a) The jet assembly.
(b) The piston.
(c) The depression chamber cover.
(d) The **position** of the metering needle.

If any of the above items require changing, the sub-assemblies or the complete carburetter(s) must be renewed. In the case of the metering needle it is quite permissible to replace the needle providing the procedure outlined previously is carefully followed.

EQUIPMENT

The recommended equipment for servicing should include at least the following:

Ignition Analyser oscilloscope	Cam Angle Dwell Meter
Ohmeter	Ignition Timing Light
Voltmeter	Engine Exhaust Combustion Analyser
Tachometer	
Vacuum Gauge	Cylinder Leak Tester
Carburetter Balance Meter	Distributor Advance Tester

It is important that test equipment has regular maintenance and calibration.

The following equipment covers most of the requirements for engine testing and tuning of vehicles fitted with exhaust emission control devices.

Equipment made by other suppliers may also be adequate.

Equipment	Type/Model	Manufacturer
Oscilloscope engine tuning set and exhaust gas analyser	1020 or 720	Sun Electric Corp

ENGINE SPEED	TEST	COMPONENT CONDITION	READ/OBSERVE	CORRECT READINGS	CHECK SEQUENCE—FAULT LOCATION
START	Cranking voltage	Battery; Starting system	Voltmeter	10·2 volts minimum at the battery	Battery—Starter Motor—Connection/Cables—Alternator
(CRANKING)	Cranking Coil output	Coil; Ign. Primary circuit	Scope Trace	16 kv. max. 14 kv. min.	Ignition coil—Battery—Condenser—Resistance in distributor wiring and/or points—Ignition switch
	Cranking vacuum	Engine	Vacuum Gauge	16-18 in. hg. even pulse	Hoses and connections—Valve tappet clearance—Servo—Inlet manifold system leaks—Valves or seats—Piston rings
IDLING	Idle Speed	Carburetter idle setting	Tachometer	750 r.p.m. (Standard trans.) 650 r.p.m. (Automatic trans.)	Carburetter adjustment—Hoses and connections—Servo—Carburetter mechanical condition—Engine condition
	Dwell	Distributor/drive; Points	Dwell Meter; Scope	33°–37°	Breaker points—Distributor and drive mechanical condition
	Initial Timing	Spark Timing Setting	Timing light	5° B.T.D.C. (Static) 10° B.T.D.C. (1,000 r.p.m.)	Distributor adjustment
	Fuel Mixture	Carburetter float level and needle position	Exhaust Gas Analyser	2–4% c.o. at idle when hot	Carburetter float level and needle position—Hoses and connections—Manifold system leaks—Servo—Spark plugs—Ignition timing
	Manifold Vacuum	Engine Idle Efficiency	Vacuum Gauge	16 to 18 in. hg.	Hoses and connections—Inlet manifold system leaks—Valves or seats—Piston rings
CRUISE (1,000 r.p.m.)	Dwell Variation	Distributor mechanical	Dwell Meter	Variation of 3° maximum	Distributor and drive mechanical condition
	Coil Polarity	Ignition circuit polarity	Scope Trace	Pattern inverted	Ignition circuit connections—Ignition coil—Battery or charging system polarity reversed
	Cam Lobe Accuracy	Distributor Cam	Scope Trace	2° max. Variation	Distributor cam defective
	Secondary Circuit	Plugs; Leads; Cap; Rotor	Scope Trace	Standard pattern	Spark plugs and leads—Breaker points—Distributor cap towers—Hoses and connections—Servo—Coil
	Coil and Condenser Condition	Coil Windings; Condenser	Scope Trace	Lack of oscillation in Intermediate Section	Ignition coil—Condenser
	Breaker Point Condition	Points Closing/Opening/Bounce	Scope Trace	Unusual Dwell Section	Breaker points—Condenser
	Spark Plug Firing Voltage	Fuel Mixture; Compression; Plug/Rotor Gaps	Scope Trace	Abnormal Spark Plug Firing Voltage Voltage at Rotor Caps—4 kv. max.	Spark plugs and leads—Breaker points—Ignition timing—Distributor cap and rotor—Carburetter float level or needle position—Hoses and connections—Servo
	Engine/Cylinder Balance/ Power Drop	Cylinder compression	Tachometer/Cylinder Leak Tester (150 r.p.m. scale)	Max. variation/cylinder 40 r.p.m. Complete cut 170 r.p.m.	Valve tappet clearance—Valves and seats—Piston rings
ACCELERATE	Spark Plugs Under Load	Spark Plugs	Scope Trace	Abnormal Scope Firing Lines under Load 10 kv./plug maximum	Spark plugs and leads—Carburetter float level or needle position—Hoses and connections—Servo
TURNPIKE (2,500 r.p.m.)	Timing Advance	Distributor Mech.	Timing light advance Meter	5° B.T.D.C. (Static) 10° B.T.D.C. (1,000 r.p.m.)	Distributor mechanical condition, centrifugal weights and springs
	Maximum Coil Output	Coil; Condenser; Ign. Primary	Scope Trace	Standard pattern minimum reserve $\frac{1}{8}$ more than requirement	Ignition coil/condenser—H.T. circuit insulation—Charging circuit—Battery
	Secondary Circuit Insulation	H.T. Cables, Cap, Rotor	Scope Trace	Standard pattern	H.T. leads—Distributor cap and rotor—Coil tower
	Charging Voltage	Alternator—Alternator control unit	Voltmeter	14·5 volts steady reading	Alternator—Alternator control unit
	Exhaust Restriction	Exhaust system	Vacuum Gauge	No variation in reading at constant speed for 10 sec.	Exhaust system